POLLUTION PREVENTION & GOOD HOUSEKEEPING PROGRAM HANDBOOK

Ottawa County

Where You Belong®

2019

Prepared by

Macatawa Area Coordinating Council

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Cover Photos

Top: Grassed swale and culverts at Hagar Park, MACC

Middle: Catch basin inlet, MACC

Bottom: Lighthouse at channel from Lake Macatawa to Lake Michigan, MACC

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SECTION 1: The Importance of Pollution Prevention and Good Housekeeping

1.1 Introduction

Stormwater runoff occurs when rain and snowmelt flows over land and does not soak into the ground. Runoff is part of the natural water cycle. However, human activity in urban areas impacts the natural water cycle by increasing runoff and reducing infiltration. Runoff in urban areas tends to pick up trash, chemicals, sediment, and other pollutants and deliver them directly to local drains, rivers and lakes untreated. This can lead to poor water quality and impair uses, such as recreation and fish habitat.

Many municipal activities have the potential to impact surface water. Some activities, such as construction site management, vehicle washing and street maintenance can negatively impact water quality. Other activities, such as street sweeping, storm drain cleaning and employee training, can help improve water quality. Negative impacts can be reduced through the use of best management practices to protect water quality. A municipal pollution prevention and good housekeeping program can help control and reduce stormwater pollution while addressing local land and water restoration goals and objectives.

1.2 Purpose and Scope

This guidebook was developed by the Macatawa Area Coordinating Council in coordination with the Ottawa County Water Resources Commissioner (OWRC), on behalf of Ottawa County, and other members of the Macatawa Watershed Stormwater Committee to document the pollution prevention and good housekeeping (PPGH) program in order to maintain compliance with the State of Michigan's NPDES permit for discharge of stormwater to surface waters of the state from a municipal separate storm sewer system (Part 31 of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended). The guidebook provides detailed information about Ottawa County urbanized areas facilities, stormwater controls, operation and maintenance procedures, best management practices, and other required program components that must be followed in order to maintain compliance with the MS4 permit.

1.3 Users of the Guidebook

This guidebook is intended to be used and maintained at all facilities owned and operated by Ottawa County that fall within the jurisdiction of the MS4 permit. Users will include facility managers and employees that are engaged in pollution prevention and good housekeeping activities that are described in the guidebook.

1.4 Organization of the Guidebook

The guidebook is divided into the following sections:

Section 1: The Importance of Pollution Prevention and Good Housekeeping

> This section provides a general overview of the purpose and use of the guidebook. Included is information about the Lower Grand River and Macatawa Watersheds, regulatory program requirements and a list of definitions and acronyms.

Section 2: Municipal Facility and Structural Stormwater Control Inventory

This section contains detailed information about facilities owned by Ottawa County. Included is a list of property locations and contact information, information about activities that occur at each property that have the potential to pollute rain water, and the types and quantities of stormwater controls that are located on Ottawa County property and right of ways. Much of this information is summarized in table with maps as appropriate

Section 3: Facility-specific Stormwater Management

Section 3 provides detailed information about how stormwater is being managed at individual properties. Included is a procedure for prioritizing facilities according to their potential to discharge pollutants to stormwater. Best management practices are described for activities that are occurring at high priority facilities. This section also outlines procedures for completing regular inspections of stormwater control devices implemented at high priority facilities and comprehensive inspections of high priority facilities.

Section 4: Structural Stormwater Control Operation and Maintenance Activities

Section 4 provides procedures for inspecting and maintaining catch basins owned by Ottawa County that are located in the urbanized areas of the County as well as a procedure for inspecting and maintaining all other stormwater control devices that are not otherwise addressed at high priority facilities.

Section 5: Municipal Operations and Maintenance Activities

This section provides an assessment of operation and maintenance activities that are performed by Ottawa County and the potential pollutants associated with those activities. Also included is a procedure for conducting street sweeping.

Section 6: Additional Program Components

The final section of the handbook provides information on other program components that are required by the MS4 permit. Included is information related to vegetation management, contractor oversight and an employee training program.

1.5 Watershed Information

Ottawa County contains portions of two major watersheds that fall within the regulated MS4 area: the Lower Grand River Watershed and the Macatawa Watershed (Fig. 1), both of which contain water bodies that are subject to Total Maximum Daily Loads (TMDLs) for various pollutants.

The Lower Grand River Watershed covers 2,909 square miles, 18% of which is in Ottawa County, and the landuse (2006) is 51% agriculture, 24% forest/open land, 13% wetland/open water, and 12% urban, (LGROW 2011). The Lower Grand River, which flows through Ottawa County, is the largest major subwatershed, encompassing 42% of the watershed. Overall, the Lower Grand River Watershed has lost 42% of its historic wetlands.

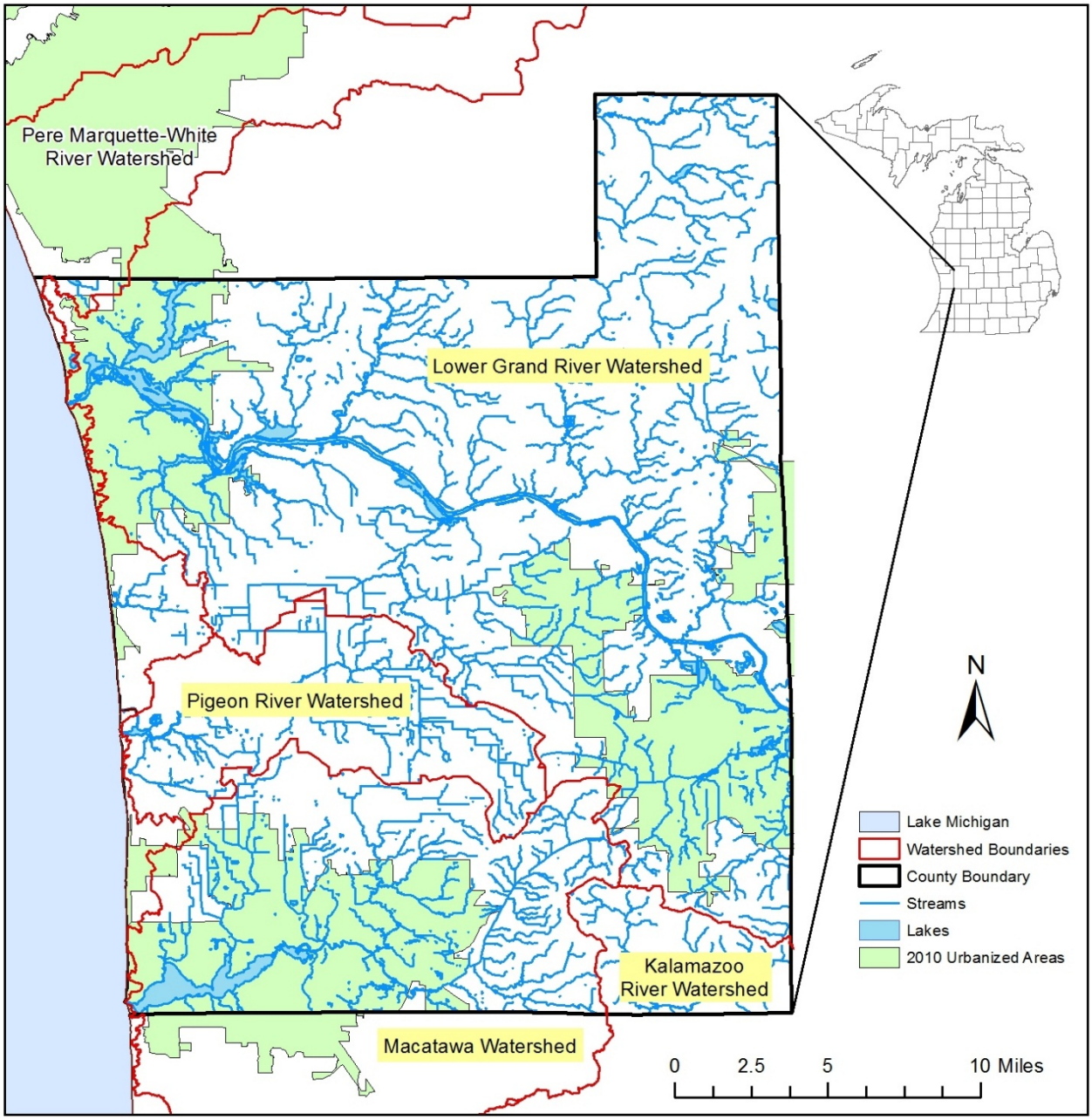

Figure 1. Ottawa County Watershed Map

Numerous tributaries in the watershed are listed on the state of Michigan integrated report for not attaining water quality standards for various uses. In Ottawa County, Bass River is listed as impaired for the designated uses of warm water fishery and other indigenous aquatic life due to erosion/sedimentation. A TMDL for sediment was approved for Bass River in 2005 (Wuycheck 2005a). Increased urbanization and residential development in the Bass River Watershed resulted in an altered hydrology (rapid runoff rates to streams) and increase in nonpoint source pollution runoff. Additionally, riparian vegetation losses have further contributed to stream instability and erosion/sedimentation. The NPDES stormwater point source waste load allocation is 65% of the total suspended solid (TSS) annual load estimated target. The TSS goal for stormwater point sources is 80 mg/L during wet-weather runoff events. Also in Ottawa County, Sand Creek is a trout stream and is listed as impaired for the designated

use of cold water fishery due to excessive sedimentation and flashy stream flows. This is attributed to increased development and the associated increased runoff that is realized with impervious surfaces. A TMDL for sediment was approved for Sand Creek in 2005 (Wuycheck 2005b). The NPDES stormwater point source waste load allocation is 68% of the TSS annual load estimated target. The TSS goal for stormwater point sources is 80 mg/L during wet-weather runoff events. Overall, only a very small portion of the MS4 regulated area falls within these two TMDL watersheds (Fig. 2).

The Macatawa Watershed covers 175 square miles, 63% of which is in Ottawa County, and the landuse (2009) is 46% agriculture, 33% urban and 21% natural/forested and water/wetland (MACC 2012). The watershed has lost over 85% of its wetlands and 75% of its forestland to agriculture and urbanization. From 1978 to 2009, urban land increased from 15% of the watershed area to 33% (MACC 2012). With this increase in urbanization came an increase in impervious surfaces, with most of the urbanized subwatersheds having more than 20% impervious surface cover (Fongers 2009). An increase in impervious surfaces resulted in dramatic increases in the volume of stormwater runoff (89% on average from 1978 to 2005), which has resulted in a flashy stream system that is plagued by erosion and sediment laden flows during many rain or snowmelt events. Most peak flows have increased by more than 100% and runoff volumes in most subwatersheds have increased by over 75% since 1978 (Fongers 2009).

This history of landuse changes in the Macatawa Watershed has led to most of the tributaries being listed as impaired and not supporting water quality for a variety of uses, most commonly warm water fishery and other aquatic wildlife due to sedimentation and phosphorus. A phosphorus total maximum daily load (TMDL) was approved for Lake Macatawa in 2000 (Walterhouse 1999). The majority of the phosphorus load in Lake Macatawa, 90%, was determined to be from nonpoint sources. Since the TMDL was developed prior to the issuance of the Phase II program, discharges from MS4s are part of the nonpoint source load allocation. The *Nonpoint Source Phosphorus Reduction Plan for the Macatawa Watershed* was developed and approved in 2000. Numerous efforts were made to reduce nonpoint sources of phosphorus throughout the watershed, but by 2008, water quality monitoring showed little improvement. The TMDL was renewed at that time and a process was started to update the plan. The *Macatawa Watershed Management Plan* was updated in 2012 and provides best management practice recommendations for reducing sediment and phosphorus loads from priority areas in the watershed, including recommendations for urban areas.

1.6 Regulatory Requirements

The federal Clean Water Act (CWA), as amended in 1987, is the principal legislation for establishing requirements for the control of stormwater pollutants. Enforcement of the CWA and other federal laws has generated numerous federal, state and local requirements and programs that deal directly or indirectly in controlling stormwater discharges. In the following sections, various programs are discussed in relation to the control of pollutants from municipal stormwater systems.

Federal NPDES Program

In 1972, provisions of the federal Water Pollution control Act, also known as the Clean Water Act (CWA) was amended so that discharge of pollutants to waters of the United States from any point source is effectively prohibited unless the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. The 1987 amendments to the CWA added Section 402(p) that established a framework for regulating municipal, industrial and construction stormwater discharges under the NPDES program. In 1990, the EPA published final Phase I regulations that established

application requirements for stormwater permits for municipal separate storm sewer systems (MS4s) serving populations over 100,000 and certain industrial facilities, including construction sites greater than 5 acres. In 1999, the EPA published final Phase II regulations for communities with an MS4 serving populations less than 100,000 and operators of construction sites 1 to 5 acres in size.

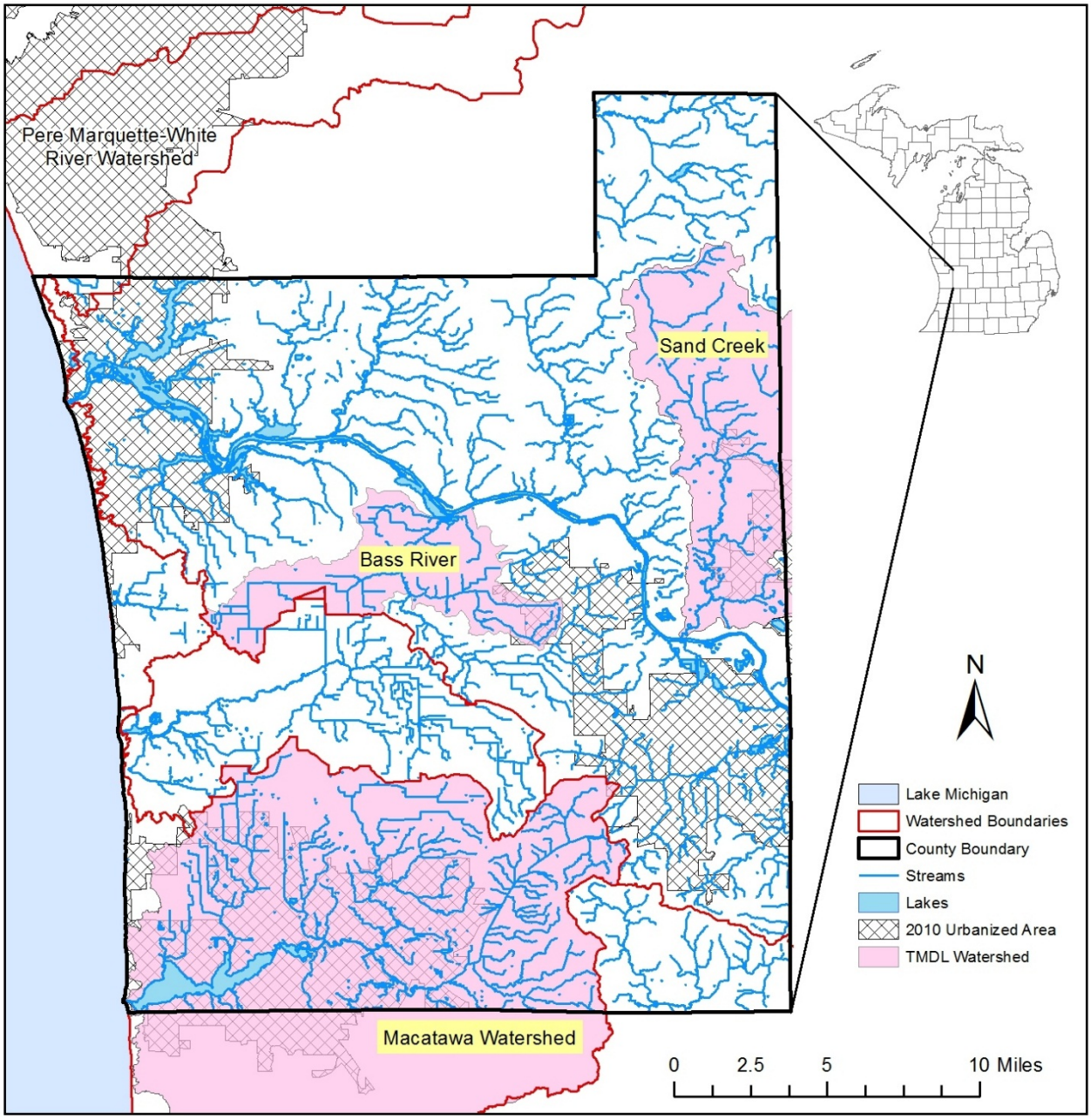

Figure 2. Ottawa County Watersheds with TMDLs

Municipal NPDES Stormwater Programs

In Michigan, municipalities were given the option to apply for a jurisdictional permit or a watershed permit and work together with other MS4s within a watershed to meet Phase II requirements. The watershed approach uses the local watershed management plan as a basis for guiding water quality protection activities. MS4 communities whose jurisdictions spanned multiple watersheds were allowed to select which watershed to work with. The six communities that have jurisdictional boundaries within the Macatawa Watershed all elected to work collectively under a watershed permit with the assistance of the Macatawa Area Coordinating Council. Ottawa County entities, including the Road Commission, have still participated in some aspects of the Phase II program in the Lower Grand Watershed, most notably public education.

On April 1, 2016, all Macatawa Watershed permittees reapplied for MS4 permit coverage under the new individual permit required by the State of Michigan as of 2013. As part of the new permit, phase II communities are required to develop and implement a Stormwater Management Plan with the following six minimum control measures:

Public Participation/Involvement Program – Provide opportunities for citizens within the jurisdiction to review the Stormwater Management Plan and participate in the implementation and periodic review of the plan.

Public Education Program – Distribute education materials and perform outreach to inform citizens about stormwater issues and actions they can take to help prevent stormwater pollution.

Illicit Discharge Elimination Program – Develop and implement a plan to detect and eliminate illicit discharges and connections to the storm drain system, including illegal dumping.

Construction Stormwater Runoff Control Program – Develop, implement and enforce an erosion and sediment control program for construction activities that disturb one or more acres of land.

Post-Construction Stormwater Runoff Program – Develop, implement and enforce a program to address discharge of stormwater runoff from new and redeveloped areas to minimize water quality impacts and maintain or restore stable stream hydrology.

Pollution Prevention and Good Housekeeping Program – Develop and implement a program to prevent or reduce pollutant runoff from municipal facilities and operations. This is the purpose of this guidebook.

In addition to the six measures listed above, the Stormwater Management Plan must identify measureable goals for each for each control measure. The goals will be used by the MS4 and the MDEQ to gauge compliance and evaluate effectiveness of individual best management practices or of the stormwater management program as a whole. Phase II communities must also monitor their efforts and prepare periodic progress reports demonstrating that they are implementing their minimum control measures and are in compliance with the permit requirements.

1.7 Definitions and Acronyms

The following is a list of terms and acronyms that are commonly used throughout the guidebook.

BMP – best management practice. Methods or techniques that are used to achieve an objective. In the context of this guidebook, a BMP is any physical structure or behavioral activity that prevents or minimizes the potential for pollution to enter stormwater.

CWA – Clean Water Act. Passed in 1972, it is the primary federal law in the United States governing water pollution. The act specifically addresses point and nonpoint source pollution, wastewater treatment and wetland protection.

EPA – Environmental Protection Agency. A federal agency that was established to consolidate federal research, monitoring, standard-setting and enforcement activities to ensure environmental protection. The EPA is in charge of enforcing the Clean Water Act including authorizing states to implement the Stormwater NPDES permitting program.

NPDES – National Pollutant Discharge Elimination System. NPDES is the national program for administering and regulating Sections 307, 318, 402, and 405 of the Clean Water Act. In Michigan, the Michigan Department of Environmental Quality issues permits for stormwater discharges associated with Phase II and Phase I communities.

MACC – Macatawa Area Coordinating Council. The MACC is a designated inter-municipality study committee, also known as a metropolitan planning organization, which is the local decision-making body responsible for carrying out the metropolitan transportation planning process. The mission of the MACC is "to encourage cooperation among neighboring units of government on area wide issues."

MDEQ – Michigan Department of Environmental Quality. The Michigan Department of Environmental Quality promotes wise management of Michigan's air, land, and water resources to support a sustainable environment, healthy communities, and vibrant economy. MDEQ is the regulatory agency that, among other things, administers the NPDES program in Michigan and oversees MS4 permitting.

MS4 – Municipal Separate Storm Sewer System. An MS4 is a conveyance or system of conveyances that is owned by a public entity that discharges to waters of the state and is designed to collect and convey stormwater. It is not a combines sewer nor part of a publically owned sewage treatment facility.

OC – Ottawa County

OCWRC – Ottawa County Water Resources Commissioner

Phase I Community – Medium to large cities or counties that own or operate a MS4 with a population of 100,000 or more. Phase I of the NPDES permit program was initiated in 1990.

Phase II Community – Small communities who own or operate a MS4 in an urbanized area with a population less than 100,000. Phase II of the NPDES permit program was initiated in 1999.

TMDL – Total Maximum Daily Load. A TMDL is a document that describes the process used to determine how much pollutant a lake or stream can assimilate and meet water quality standards. TMDLs are developed by the MDEQ and must be approved by the EPA.

1.8 References and Resources

Fongers, D. 2009. Macatawa Watershed Hydrologic Study. Hydrologic Studies Unit. Land and Water Management Division. Michigan Department of Environmental Quality.

Lower Grand River Organizations of Watersheds (LGROW). 2011. Lower Grand River Watershed Management Plan.

Macatawa Area Coordinating Council (MACC). 2012. Macatawa Watershed Management Plan.

Walterhouse, M. 1999. Total Maximum Daily Load (TMDL) for Phosphorus in Lake Macatawa. Great Lakes and Environmental Assessment Section, Surface Water Quality Division, Michigan Department of Environmental Quality.

Wuycheck, J. 2005a. Total Maximum Daily Load for Biota for the Bass River, Ottawa County. Surface Water Assessment Section, Water Bureau, Michigan Department of Environmental Quality.

Wuycheck, J. 2005b. Total Maximum Daily Load for Biota for the Sand Creek Watershed, Ottawa County/Kent County. Surface Water Assessment Section, Water Bureau, Michigan Department of Environmental Quality.

SECTION 2: Municipal Facility and Structural Stormwater Control Inventory

2.1 Introduction

One key component of the PPGH Program is a comprehensive inventory of the facilities and stormwater controls that are owned or operated by the MS4. Maps of all Ottawa County facilities and stormwater controls are located both in individual department offices (Parks and Recreation and Facilities Maintenance) and in the OCWRC's office at the Fillmore Street Complex (12220 Fillmore St, West Olive, MI 49464). Facilities and stormwater controls are also mapped in an online mapping program that is maintained by the Ottawa County GIS Department. The MACC will maintain a master database of facilities and stormwater controls that are found in the following sections. The inventory, both the online mapping system and the MACC's master database, will be updated within 30 days of the addition, removal or transfer of ownership of any facility or stormwater control. OCWRC staff will make updates to the online mapping system and notify the MACC to update their database.

2.2 Ottawa County Parks and Recreation

The Ottawa County Parks and Recreation (OCPR) Commission owns and operates 38 parks and open spaces throughout Ottawa County. The parks offer a variety of outdoor recreational experiences including hiking, kayaking/canoeing, hunting, winter sports, fishing, biking, horseback riding, and more. The OCPR offers programs and experiences throughout the year, including volunteer work days, outdoor educational experiences and facilitated outdoor recreation.

2.2.1 Facility Inventory and Descriptions

Staff at the MACC completed facility assessments for all OCPR properties during the summer of 2014. The assessment included interviews with OCPR staff and site inspections of most facilities within the urbanized areas of the county. The MACC used a checklist of activities as the basis for the OCPR staff interviews and site inspections (Appendix A). As appropriate, MACC staff viewed maps, site plans and as-builts in order to develop an accurate inventory of stormwater controls at each facility. MACC staff also reviewed existing related OCPR documents to evaluate existing pollution prevention and good housekeeping practices. The assessment results were input into a database created and maintained by the MACC. Table 1 contains a complete list of all facilities and properties owned and operated by the Ottawa County Parks and Recreation (OCPR). Maps of facilities located within the regulated MS4 area are shown in Figures 3-5. Table 2 provides a list of the activities that are occurring at each facility that have the potential to generate pollution.

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Table 1. Ottawa County Parks and Recreation Properties

Facility Name	Facility Type	Legal Description	Address	City	Zip	Contact Person	Contact Information	Sub Watershed (12 digit)	Latitude	Longitude
LAKE MICHIGAN COASTAL GREENWAY										
*Historic Ottawa Beach**	Park	Sec 33, T5N, R16W, Park Twp	2278 Ottawa Beach Rd	Holland	49424	Eric Frifeldt	EFrifeldt@miottawa.org	Lake Macatawa Direct Drainage	42.774692	-86.200970
*Kirk Park**	Park	Sec 33, T7N, R16W, Grand Haven Twp	9791 Lakeshore Dr	West Olive	49460			Lake Michigan Direct Drainage	42.946183	-86.213711
*North Beach Park**	Park	Sec 18, T8N, R18 W, Spring Lake Twp	18775 North Shore Dr	Ferrysburg	49409			Lake Michigan Direct Drainage	43.082082	-86.253286
*North Ottawa Dunes**	Park	Sec 6, 7 & 18, T7N, R16W, Spring Lake Twp	18201 North Shore Dr	Ferrysburg	49409			Spring Lake, Grand River & Lake Michigan Direct Drainage	43.095284	-86.254734
Olive Shores	Park	Sec 9, T6N, R16W, Port Sheldon Twp	8555 Olive Shores Ave	West Olive	49460			Lake Michigan Direct Drainage	42.922875	-86.213151
Ottawa Beach Marina*	Marina	Sec 33, T5N, R16W, Park Twp	2330 Ottawa Beach Rd	Holland	49424			Lake Macatawa Direct Drainage	42.773133	-86.203491
*Ottawa Sands**	Park	Sec 17 & 18, T8N, R16W, Spring Lake Twp	18153 North Shore Dr	Ferrysburg	49456			Grand River Direct/Lake Michigan Direct	43.078708	-86.241964
*Rosy Mound Natural Area**	Park	Sec 4 & 5, T6N, R16W, Grand Haven Twp	13925 Lakeshore Dr	Grand Haven	49417			Pottawattomie Bayou/Lake Michigan Direct Drainage	43.019785	-86.222623
*Tunnel Park**	Park	Sec 21, T5N, R16W, Park Twp	66 Lakeshore Dr	Holland	49424			Lake Michigan Direct Drainage	42.798183	-86.207451
GRAND RIVER GREENWAY										
Bend Area	Open Space	Sec 2, T6N, R13W, Georgetown Twp Sec 35, T7N, R13W, Tallmadge Twp	9500 12th Ave	Jenison	49428	Collin Zackrison	czackrison@miottawa.org	Grand River Direct Drainage	42.941647	-85.812818
Bur Oak Landing	Open Space	Sec 6, T7N, R14W, Polkton Twp	13580 90th Ave	Coopersville	49404	Anne Engvall	aengvall@miottawa.org	Grand River Direct Drainage	43.015309	-86.012573
Connor Bayou	Park	Sec 33, T8N, R15W, Crockery Twp	12945 North Cedar Dr	Grand Haven	49417			Grand River Direct Drainage	43.035230	-86.109889
Crockery Creek Natural Area	Park	Sec 22/26/27/34, T8N, R15W, Crockery Twp	11071 Wren Dr	Nunica	49448			Crockery Creek	43.052104	-86.069978
Deer Creek Park	Park	Sec 11, T7N, R 14W, Polkton Twp	13426 60th Ave	Coopersville	49404			Grand Rive Direct Drainage	43.011448	-85.932563
Eastmanville Bayou	Open Space	Sec 9/10, T7N, R14W, Polkton Twp	13507 68th Ave	Allendale	49401			Grand River Direct Drainage	43.013896	-85.958398
Eastmanville Farm	Park	Sec 4/5/9, T7N, R14W, Polkton Twp	7851 Leonard St	Coopersville	49404			Grand River Direct Drainage	43.018728	-85.983289
Grand River Open Space	Open Space	Sec 29/32, T7N, R13W, Tallmadge Twp	10851 Linden Dr	Allendale	49401			Grand River Direct Drainage	42.961813	-85.873329
Grand River Park	Park	Sec 4, T6N, R13W, Georgetown Twp Sec 33, T7N, R13W, Tallmadge Twp	9473 28th Ave	Jenison	49428	Collin Zackrison	czackrison@miottawa.org	Grand River Direct Drainage	42.941836	-85.857965
Grand Ravines	Park	Sec 32, T7N, R13W, Tallmadge Twp Sec5, T6N, R13W, Georgetown Twp	North: 9920 42nd Ave South: 3991 Fillmore St	Jenison	49428	Anne Engvall	aengvall@miottawa.org	Grand River Direct Drainage	42.944852	-85.881311
Jubb Bayou	Open Space	Sec 35/36, T8N, R15W, Crockery Twp	10340 Oriole Dr	Nunica	49448			Grand River Direct Drainage	43.034038	-86.044830
Kuits Bayou	Open Space	Sec 12/13, T7N, R14W, Polkton Twp Sec 7, T7N, R13W, Tallmadge Twp	4575 Warner Dr	Allendale	49401			Grand River Direct Drainage	43.002284	-85.904668
Ripps Bayou	Open Space	Sec 11/12, T7N, R14W, Polkton Twp	13426 60th Ave	Coopersville	49401			Grand River Direct Drainage	43.004795	-85.925010
Riverside Park	Park	Sec 1, T7N, R15W, Robinson Twp	10317 North Cedar Dr	Grand Haven	49417			Grand River Direct Drainage	43.027521	-86.040411

** located in an urbanized area*

Facility Name	Facility Type	Legal Description	Address	City	Zip	Contact Person	Contact Information	Sub Watershed (12 digit)	Latitude	Longitude
PIGEON RIVER GREENWAY										
Hemlock Crossing	Park	Sec 12/13, T6N, R16W, Port Sheldon Twp	8115 West Olive Rd	West Olive	49460	Leif VanHorssen	lvanhorssen@miottawa.org	Pigeon Creek	42.915521	-86.151610
Pigeon Creek Park and Forest	Park and Open Space	Sec 4/9, T6N, R15W, Olive Twp	12524 Stanton St	West Olive	49460			Pigeon Creek	42.932520	-86.094801
Pine Bend	Park	Sec 14, T6N, R16W, Port Sheldon Twp	15400 Polk St	West Olive	49460			Pigeon Creek	42.913152	-86.165944
MACATAWA RIVER GREENWAY										
*Adams Street Landing**	Park	Sec 25/26, T5N, R15W, Holland Twp	10363 Adams St	Holland	49424	Leif VanHorssen	lvanhorssen@miottawa.org	Macatawa River Direct Drainage	42.783758	-86.037609
Hawthorn Pond Natural Area	Park	Sec 36, T5N, R15W, Holland Twp	9876 Black River Ct	Holland	49424			Lower Macatawa River	42.779525	-86.025905
*Paw Paw Park**	Park	Sec 23, T5N, R15W, Holland Twp	1230 Paw Paw Dr	Holland	49424			Macatawa River Direct Drainage	42.799489	-86.054539
Upper Macatawa Natural Area	Park	Sec 16/20/21/28/29, T5N, R14W, Zeeland Twp	East: 76th St West: 84th St	Zeeland	49464			Upper Macatawa River	42.803311	-85.980310
GENERAL PARKS, OPEN SPACE AND TRAILS										
Grose Park	Park		22200 24th Ave	Cassanovia	49318	Anne Engvall	aengvall@miottawa.org	North Branch Crockery Creek	43.174863	-85.847101
*Hagar Park**	Park	Sec 9/16, T6N, R13W, Georgetown Twp	8134 28th Ave	Jenison	49428	Collin Zackrison	czackrison@miottawa.org	Grand River Direct Drainage	42.918992	-85.850069
Hiawatha Forest	Open Space	Sec 33 & 34, T7N, R16W, Grand Haven Twp	16777 Fillmore St	West Olive	49461	Leif VanHorssen	lvanhorssen@miottawa.org	Little Pigeon Creek	42.947043	-86.195629
Johnson Street Forest	Open Space	Sec 4, T7N, R15W, Robinson Twp	12255 Johnson St	Grand Haven	49417	Anne Engvall	aengvall@miottawa.org	Grand River Direct Drainage	43.017262	-86.098038
Port Sheldon Natural Area	Open Space	Sec 26 & 27, T6N, R16W, Port Sheldon Twp	6260 160th Ave	West Olive	49461	Leif VanHorssen	lvanhorssen@miottawa.org	Pigeon River	42.876084	-86.178647
Riley Trails	Park	Sec 15, T5N, R16W, Park Twp	16300 Riley St	Holland	49424			Lake Macatawa Direct Drainage	42.822156	-86.186543
Robinson Forest	Open Space	Sec 2, T7N, R15W, Robinson Twp	13995 104th Ave	Grand Haven	49417	Anne Engvall	aengvall@miottawa.org	Grand River Direct Drainage	43.021426	-86.050580
*Spring Grove Park**	Park	Sec 10, T5N, R13W, Jamestown Twp	1800 Greenly St	Grandville	49418	Collin Zackrison	czackrison@miottawa.org	East Branch Rush Creek	42.832830	-85.826178
Van Buren Street Dunes	Open Space	N ½, Sec 33, T6N, R16W, Port Sheldon Twp	16780 Van Buren St	West Olive	49460	Leif VanHorssen	lvanhorssen@miottawa.org	Pigeon River	42.867875	-86.197873
Musketawa Trail	Trail	10 miles in Wright and Chester Townships	Trailheads: 15295 8th Ave 19610 Main St	Marne Conklin	49435 49403	Anne Engvall	aengvall@miottawa.org	Headwaters Sand Creek and Rio Grande Creek-Crockery Creek	43.047517 43.126264	-85.808579 -85.881569
Parks Operation Center	Administrative, Storage and Maintenance	Sec 34, T7N, R16W, Grand Haven Twp	16777 Fillmore St	West Olive	49460	Jason Boerger, Bob Reichel	jboerger@miottawa.org breichel@miottawa.org	Little Pigeon Creek	42.943556	-86.201347

** located in an urbanized area*

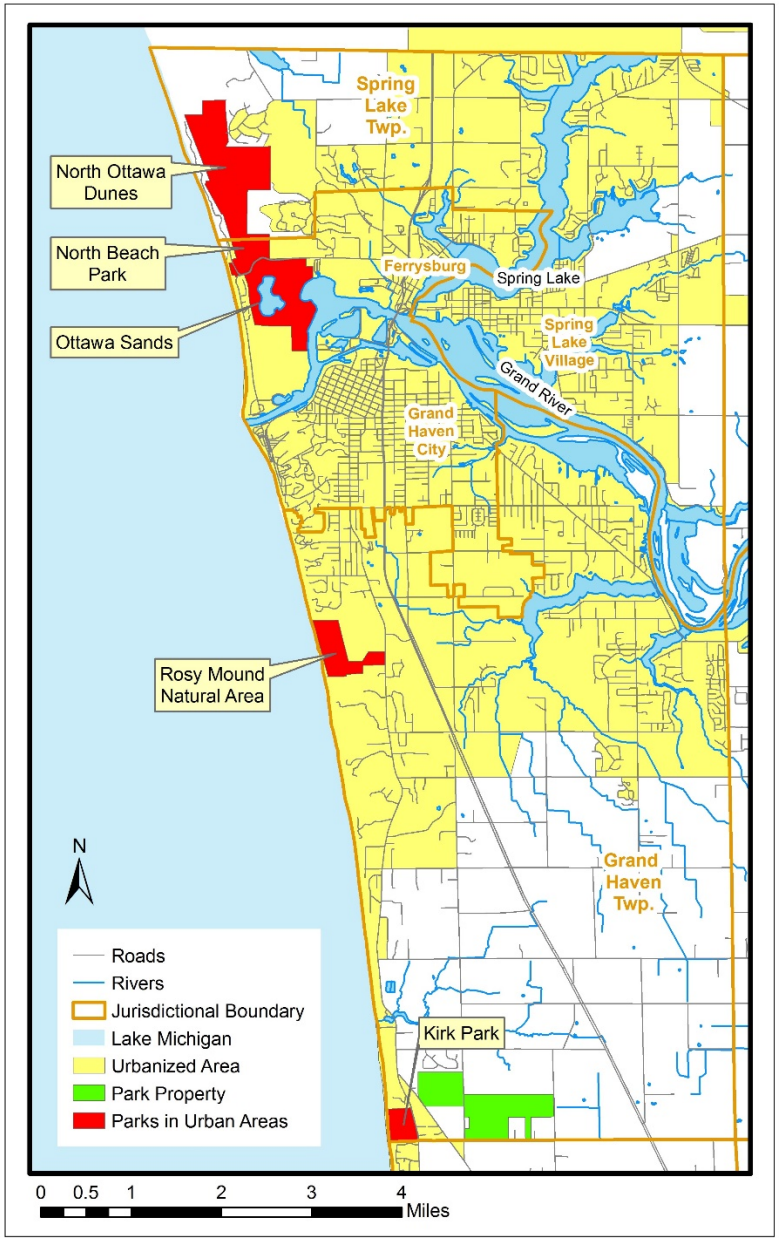

Figure 3. OCPR Properties in the Muskegon Urbanized Area

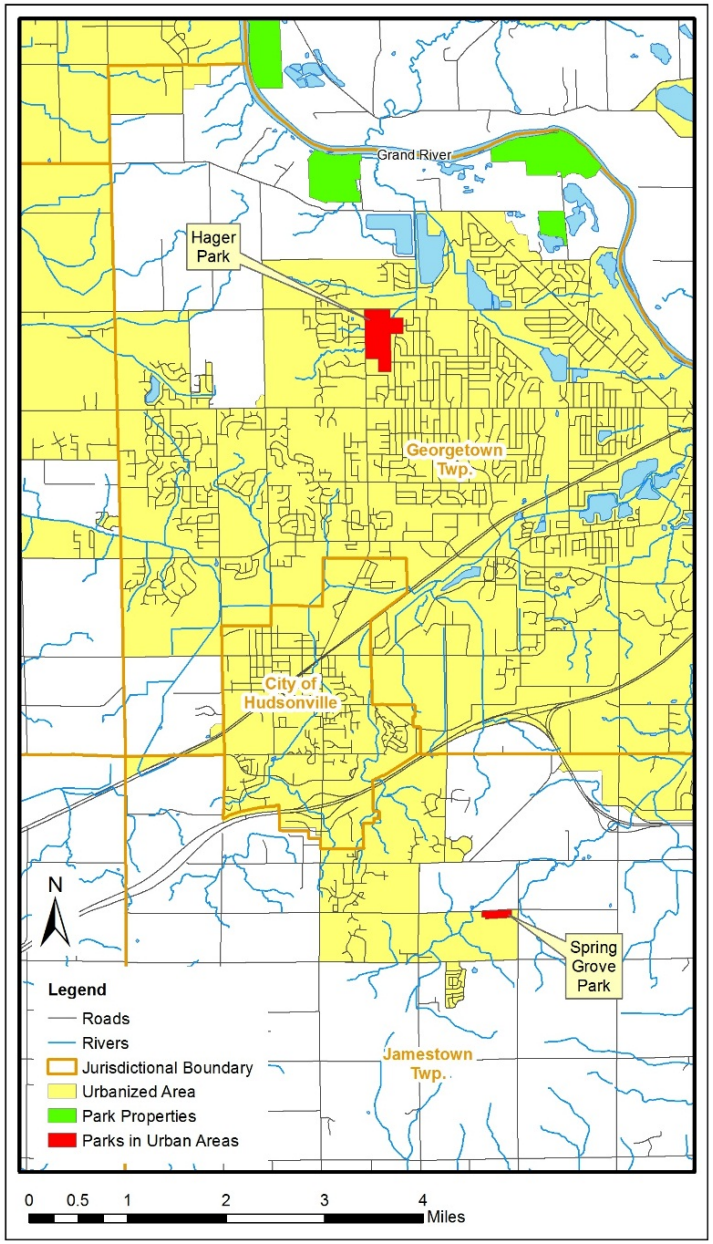

Figure 4. OCPR Properties in the Grand Rapids Urbanized Area

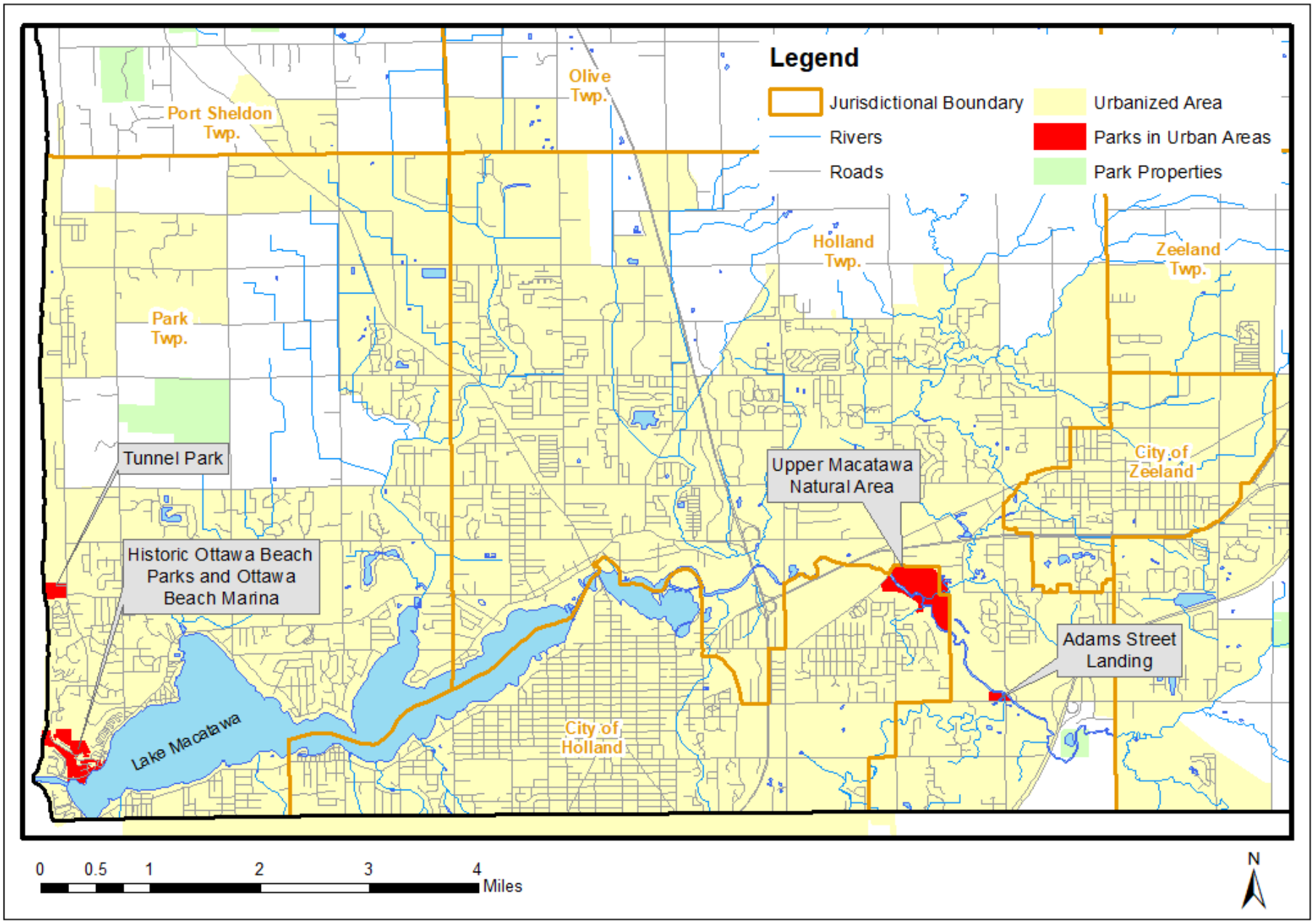

Figure 5. OCPR Properties in the Holland Urbanized Area

Table 2. Pollutant Generating Activities at OCPR Facilities

Facility Name	Stormwater Control Inspection and Maintenance	Building Washing	Onsite Septic System	Vault Toilets	Vehicle and Equipment Storage	Vehicle Maintenance	Vehicle Washing	Vehicle Fueling/ Fuel Storage	Hazardous Materials Storage	Materials Storage	Salt Storage	Parking Lot/ Sidewalk Salting	Parking Lot/ Sidewalk Cleaning	Onsite Snow Storage	Outside Dumpster	Lawn Maintenance[1]	Weed or Invasive Species Control	Pet Waste Control
*Historic Ottawa Beach**	✓												✓	✓	✓	✓	✓	✓
*Kirk Park**	✓	✓	✓		✓ In/out	✓ Outside	✓ Outside					✓	✓	✓	✓	✓	✓	
*North Beach Park**	✓	✓	✓										✓	✓		✓	✓	✓
*North Ottawa Dunes**	✓				✓ In/out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Olive Shores	✓	✓	✓										✓	✓	✓	✓	✓	✓
*Ottawa Beach Marina**	✓				✓								✓		✓		✓	✓
*Ottawa Sands**			✓														✓	
*Rosy Mound Natural Area**	✓		✓								✓	✓	✓	✓	✓	✓	✓	✓
*Tunnel Park**	✓	✓	✓										✓	✓	✓	✓	✓	✓
Bend Area														✓		✓	✓	✓
Bur Oak Landing														✓		✓	✓	✓
Connor Bayou		✓			✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓ Fertilizer	✓	✓
Crockery Creek Natural Area		✓			✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Deer Creek Park		✓			✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Eastmanville Bayou	✓	✓			✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Eastmanville Farm	✓	✓		✓	✓ In/Out	✓ In/Out	✓ Outside		✓ pesticides				✓	✓	✓	✓	✓	✓
Grand River Open Space													✓	✓		✓	✓	✓
Grand River Park	✓		✓		✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Grand Ravines	✓	✓				✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Jubb Bayou		✓											✓	✓		✓	✓	✓
Kuits Bayou														✓		✓	✓	✓
Ripps Bayou														✓		✓	✓	✓
Riverside Park		✓			✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
Hemlock Crossing	✓	✓	✓										✓	✓	✓	✓	✓	✓

Facility Name	Stormwater Control Inspection and Maintenance	Building Washing	Onsite Septic System	Vault Toilets	Vehicle and Equipment Storage	Vehicle Maintenance	Vehicle Washing	Vehicle Fueling/ Fuel Storage	Hazardous Materials Storage	Materials Storage	Salt Storage	Parking Lot/ Sidewalk Salting	Parking Lot/ Sidewalk Cleaning	Onsite Snow Storage	Outside Dumpster	Lawn Maintenance[1]	Weed or Invasive Species Control	Pet Waste Control
Pigeon Creek Park and Forest		✓	✓										✓	✓	✓	✓	✓	✓
Pine Bend	✓													✓		✓ Fertilizer	✓	✓
*Adams Street Landing**														✓		✓	✓	✓
Hawthorn Pond Natural Area	**None?**													✓		✓	✓	✓
*Paw Paw Park**	✓			✓									✓	✓	✓	✓	✓	✓
Upper Macatawa Natural Area	✓			✓									✓	✓		✓	✓	✓
Grose Park	✓	✓	✓		✓ In/Out	✓ Outside	✓ Outside						✓	✓	✓	✓	✓	✓
*Hagar Park**	✓		✓		✓ In/Out	✓ Inside	✓ Outside	✓	✓				✓	✓	✓	✓ Contractor	✓	✓
Hiawatha Forest														✓		✓	✓	✓
Johnson Street Forest													✓	✓		✓	✓	✓
Port Sheldon Natural Area													✓	✓		✓	✓	✓
Riley Trails	✓			✓?									✓	✓		✓	✓	✓
Robinson Forest													✓	✓		✓	✓	✓
*Spring Grove Park**	✓	✓	✓							✓			✓	✓	✓	✓ Fertilizer	✓	✓
Van Buren Street Dunes														✓			✓	✓
Musketawa Trail				✓									✓	✓		✓	✓	✓
Parks Operation Center			✓		✓ Outside			✓	✓					✓	✓	✓		

[1] May include mowing, pesticide use, fertilizer application, and/or irrigation

2.2.2 Structural Stormwater Control Inventory

Table 3 contains a list and quantity of all stormwater structural controls owned and operated by the OCPR. The number in parentheses indicates the amount in urbanized areas. Table 4 provides more detail about the stormwater management systems in place at each county park.

Table 3. OCPR Stormwater Structural Control Quantities

Type	Quantity
Catch Basins	16 (10)
Bioretention	2 (0)
Wetland detention	2 (0)
Detention ponds	6 (2))
Infiltration/leaching basin	11 (8)
Isolated sumps	3

Table 4. Stormwater Runoff Controls at OCPR Facilities

Property	CB[1]	Comments
Lake Michigan Coastal Greenway		
North Ottawa Dunes	X	Paved parking in Coast Guard Park, leaching basin on north end
North Beach Park and Rosy Mound Natural Area		Paved parking, surface runoff
Kirk Park	X	Paved parking, surface runoff to infiltration areas and leaching system
Olive Shores	X	Paved parking, leaching system in center of lot
Tunnel Park	X	Paved parking, surface runoff and leaching system
Historic Ottawa Beach	X	Black Lake Boardwalk west has detention system, Black Lake Boardwalk east is surface runoff into infiltration swale.
Ottawa Beach Marina	X	Leaching basins, paved parking, some runoff to basins, some to lake
Grand River Greenway		
Connor Bayou		Paved parking, surface runoff
Crockery Creek Natural Area		Gravel roadside parking only
Riverside Park, Grand River Park		Paved parking, surface runoff
Jubb Bayou, Bur Oak Landing, Eastmanville Farm, Deer Creek Park, Grand River Open Space, Bend Area Open Space		Gravel parking, surface runoff
Eastmanville Bayou	X	Paved parking, bio-detention area on south side of lot
Ripps Bayou, Kruits Bayou		No facilities
Grand Ravines	X	Gravel parking, bio-retention system.
Pigeon River Greenway		
Hemlock Crossing/Pine Bend		Paved parking, surface runoff to infiltration swales
Pine Bend	X	Paved parking, leaching system with bio-retention overflow
Pigeon River Open Space		No facilities
Pigeon Creek Park and Forest		Gravel parking, surface runoff
Macatwa River Greenway		
Paw Paw Park		Paved parking, surface runoff to new wetland areas
Adams Street Landing		Gravel parking, surface runoff
Upper Macatawa Conservation Area		
84th St. Access		Gravel parking, surface runoff to culvert outlet to ditch
76th St. Access	X	Gravel parking, surface runoff to basins in grass areas
General Parks, Open Space and Trails		
Grose Park	X	Paved parking with leaching system; grass parking with surface runoff to infiltration area
Robinson Forest, Johnson Street Forest, Hiawatha Forest, Van Buren Street Dunes		Gravel roadside parking only
Hager Park	X	Paved parking, surface runoff and pipe directed to grass swales
Port Sheldon Natural Area, Riley Trails		Gravel parking, surface runoff
Spring Grove Park		Paved parking , surface runoff to roadside ditch

[1] CB = catch basin

2.3 Ottawa County Facilities Maintenance

The Ottawa County Facilities Maintenance (OCFM) Department is responsible for assuring County compliance with all federal, state and local building codes and regulations. A sophisticated energy management system monitors and controls all County-owned facilities. This system allows the department to control the environment and trouble shoot equipment failures remotely from their office in the Fillmore Street Complex.

2.3.1 Facility Inventory and Descriptions

Staff at the MACC completed facility assessments for all OCFM properties during the summer of 2014. The assessment included interviews with OCFM staff and site inspections of all facilities in the urbanized areas. The MACC used a checklist of activities as the basis for the OCFM staff interviews and site inspections (Appendix A). As appropriate, MACC staff viewed maps, site plans and as-builts in order to develop an accurate inventory of stormwater controls at each facility. MACC staff also reviewed existing related OCFM documents to evaluate existing pollution prevention and good housekeeping practices. The assessment results were input into a database created and maintained by the MACC. Table 5 contains a complete list of all facilities and properties owned and operated by Ottawa County Facilities Maintenance (OCFM). Maps of facilities located within the regulated MS4 area are shown in Figures 6-8. Table 6 provides a list of the activities that are occurring at each facility that have the potential to generate pollution.

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Table 5. Ottawa County Properties Maintained by Ottawa County Facilities Maintenance

Facility Name	Facility Type	Legal Description	Address	City	ZIP	Contact Person	Phone Number	Sub Watershed (12 digit)	Latitude	Longitude
Hudsonville District Court and Department of Public Health*	Administration, Police	Sec 21, T6N, R13W, Georgetown Twp	3100 Port Sheldon Rd	Hudsonville	49426	Ottawa County Facilities Manager, Fillmore Street Complex	616-738-4873	Rush Creek	42.886947	-85.858865
Community Mental Health Grand Haven-Fulton*	Administration	Sec 21, T8N, R16W, City of Grand Haven	1111 Fulton St	Grand Haven	49417			Grand River Direct Drainage	43.063252	-86.215111
Grand Haven District Court*	Administration	Sec 20, T8N, R16W, City of Grand Haven	414 Washington Ave	Grand Haven	49417			Grand River Direct Drainage	43.062368	-86.227272
Holland District Court*	Administration	Sec 29, T5N, R 15W, City of Holland	85 West 8th St	Holland	49423			Lower Macatawa Macatawa River	42.790443	-86.110912
James Street Complex: Holland A-Building*	Administration	Sec 16, T5N, R15W, Holland Twp	12265 James St	Holland	49424			Lower Macatawa #40 Drain	42.812768	-86.085241
James Street Complex: Holland B-Building*	Administration	Sec 16, T5N, R15W, Holland Twp	12263 James St	Holland	49424			Lower Macatawa #40 Drain	42.814270	-86.085218
James Street Complex: Holland C-Building*	Administration	Sec 16, T5N, R15W, Holland Twp	12251 James St	Holland	49424			Lower Macatawa #40 Drain	42.812794	-86.083778
James Street Complex: Holland DHS*	Administration	Sec 16, T5N, R15W, Holland Twp	12185 James St	Holland	49424			Lower Macatawa #40 Drain	42.813879	-86.082556
Fillmore Jail	Administration, Police	Sec 4, T6N, R15W, Olive Twp	12130 Fillmore St	West Olive	49460			Headwaters Pigeon River	42.939991	-86.087453
Fillmore Administration Building	Administration	Sec 4, T6N, R15W, Olive Twp	12220 Fillmore St	West Olive	49460			Headwaters Pigeon River	42.940239	-86.088082

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Figure 6. OCFM Properties in the Muskegon Urbanized Area

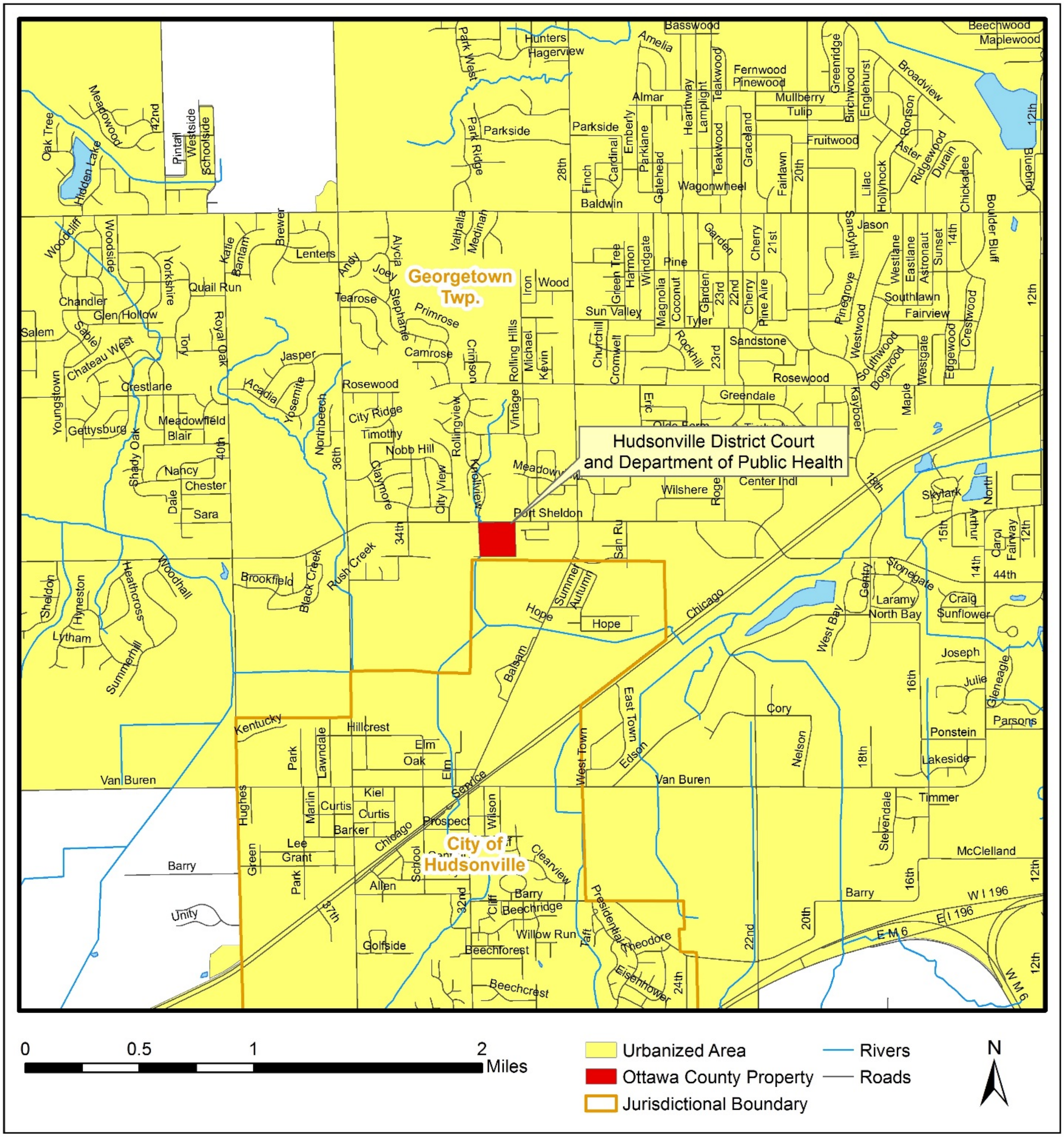

Figure 7. OCFM Properties in the Grand Rapids Urbanized Area

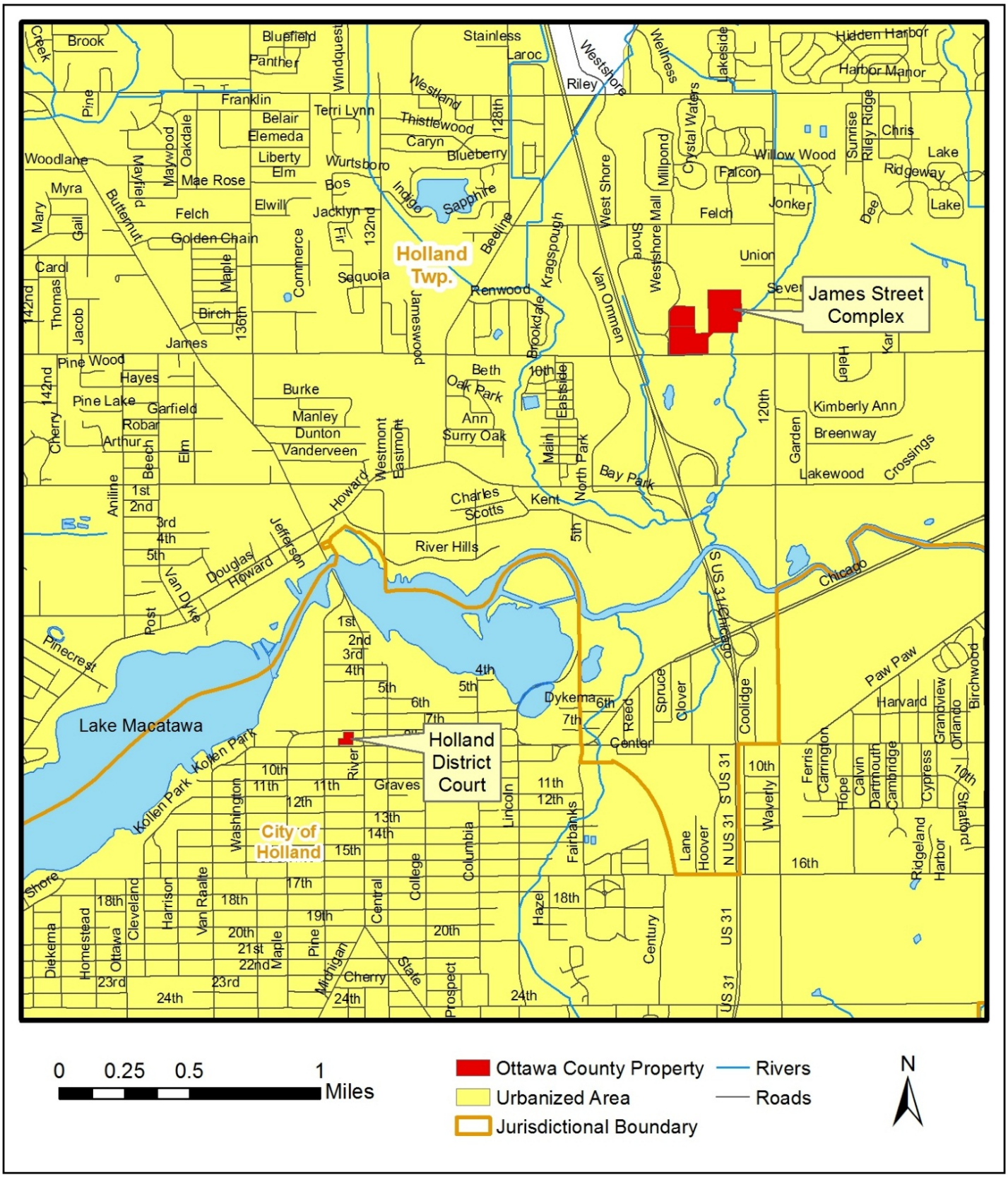

Figure 8. OCFM Properties in the Holland Urbanized Area

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Table 6. Pollutant Generating Activities at Properties Maintained by OCFM

Activity	Hudsonville District Court and Department of Public Health*	Community Mental Health - Grand Haven*	Grand Haven District Court*	Holland District Court*	James Street Complex	Fillmore Street Complex
Stormwater Control Inspection and Maintenance	✓	✓	✓	✓	✓	✓
Culvert and Discharge Point Inspection and Maintenance	✓	✓	✓	✓	✓	
Building Washing (every 5-7 years)			✓		✓	
Vehicle and Equipment Storage	✓ inside and outside (police vehicles)	✓ outside	✓ inside	✓ inside	✓ inside and outside	✓ inside and outside
Vehicle Maintenance						✓ inside
Vehicle Washing						✓ outside
Hazardous Materials Storage					✓	✓
Salt Storage						✓
Parking Lot/ Sidewalk Salting	✓	✓	✓	✓ minimal	✓	✓
Salt vehicle washing			✓		✓	✓
Parking Lot/ Sidewalk Cleaning	✓	✓	✓	✓ done by City of Holland	✓	✓
Onsite Snow Storage	✓	✓	✓	✓	✓	✓
Outside Dumpster	✓	✓	✓	✓	✓	✓
Lawn Maintenance[1]	✓	✓	✓	✓	✓	✓

[1] May include mowing, pesticide use, fertilizer application, and/or irrigation

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2.3.2 Structural Stormwater Control Inventory

Table 7 contains a list and quantity of all stormwater structural controls owned and operated by the OCFM. The number in parentheses indicates the amount in urbanized areas.

Table 7. OCFM Stormwater Structural Controls

Type	Quantity
Catch Basins	58 (48)
Leach Basins[1]	1 (1)
Trench Drain[2]	1 (1)
Yard Drain[2]	4 (4)
Underground detention[2]	1 (1)
Retention pond[3]	1 (0)
Detention pond[4]	1 (1)
Isolated sumps	3 (3)

[1] Located at the Holland District Court
[2] Located at the Grand Haven District Court
[3] Located at the Fillmore Street Complex
[4] Located at the James Street Complex

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SECTION 3: Facility-specific Stormwater Management

3.1 Ottawa County Parks and Recreation

3.1.1 Facility Assessment

Staff at the MACC completed facility assessments for all OCPR properties during the summer of 2014. The assessment included interviews with OCPR staff and site inspections of most facilities within the urbanized areas of the county. The MACC used a checklist of activities as the basis for the OCPR staff interviews and site inspections (Appendix A). As appropriate, MACC staff viewed maps, site plans and as-builts in order to develop an accurate inventory of stormwater controls at each facility. MACC staff also reviewed existing related OCPR documents to evaluate existing pollution prevention and good housekeeping practices. The assessment results were input into a database created and maintained by the MACC. The OCPR will notify the MACC of any changes to their facilities that impact stormwater, including the construction of new facilities, addition or removal of stormwater controls, demolition of old facilities, and transfer of ownership, so that MACC staff can complete a new assessment and update the database. The new assessment and/or database update will be completed within 30 days, weather permitting, of the completion of any major facility changes as listed above.

3.1.2 Prioritized Facility List

MACC staff used information gathered during the assessment procedure to assign priority levels to each facility based on having high, medium or low potential to discharge pollutants to surface waters of the state (Table 8). The same priority criteria was applied to all Ottawa County owned facilities. The list of prioritized OCPR facilities is provided in Table 9. Only one OCPR property was determined to be high priority. A fact sheet with more information about Hagar Park is in Figure 9. Properties maintained by OCFM are discussed in section 3.2.

Table 8. Criteria Used to Assign Pollutant Discharge Potential Priorities to Ottawa County Facilities

Priority Level	Location	Stormwater management	Facility type	Material storage
High*	In an urbanized area	Connect to waters of the state	Fleet Maintenance and Storage Yard	Bulk chemical on site
Medium	In an urbanized area	Connect to waters of the state	Any other except open space	Small quantities of chemicals on site
Low	In an urbanized area	Infiltration or maintained on site	Any other including open space	No chemicals of any quantity on site

* A site is considered high priority if it meets the facility type *or* the material storage criteria

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Table 9. OCPR Prioritized Facility List

Facility Name	Location	Stormwater Management	Facility Type	Material Storage	Priority
Hagar Park	Urbanized	Connected to waters of the state	Park	Hazardous, bulk fuel	HIGH
Historic Ottawa Beach	Urbanized	Connected to waters of the state	Park	None	MEDIUM
Kirk Park	Urbanized	Connected to waters of the state	Park	None	MEDIUM
Paw Paw Park	Urbanized	Connected to waters of the state	Park	None	MEDIUM
Ottawa Beach Marina	Urbanized	Connected to waters of the state	Marina	None	MEDIUM
North Beach Park	Urbanized	Infiltration	Park	None	LOW
North Ottawa Dunes	Urbanized	Infiltration	Park	None	LOW
Rosy Mound Natural Area	Urbanized	Infiltration	Park	Salt	LOW
Adams Street Landing	Urbanized	Infiltration	Park	None	LOW
Tunnel Park	Urbanized	Infiltration	Park	None	LOW
Spring Grove Park	Urbanized	Infiltration	Park	None	LOW
Ottawa Sands	Urbanized	Infiltration	Park	None	LOW
Olive Shores	Non-urbanized	Infiltration	Park	None	NONE
Bend Area	Non-urbanized	Infiltration	Open Space	None	NONE
Bur Oak Landing	Non-urbanized	Infiltration	Open Space	None	NONE
Connor Bayou	Non-urbanized	Infiltration	Park	None	NONE
Crockery Creek Natural Area	Non-urbanized	Infiltration	Park	None	NONE
Deer Creek Park	Non-urbanized	Infiltration	Park	None	NONE
Eastmanville Bayou	Non-urbanized	Infiltration	Open Space	None	NONE
Eastmanville Farm	Non-urbanized	Infiltration	Park	Pesticides	NONE
Grand River Open Space	Non-urbanized	Infiltration	Open Space	None	NONE
Grand River Park	Non-urbanized	Infiltration	Park	None	NONE
Grand River Ravines	Non-urbanized	Infiltration	Park	None	NONE
Jubb Bayou	Non-urbanized	Infiltration	Open Space	None	NONE
Kuits Bayou	Non-urbanized	Infiltration	Open Space	None	NONE
Ripps Bayou	Non-urbanized	Infiltration	Open Space	None	NONE

Facility Name	Location	Stormwater Management	Facility Type	Material Storage	Priority
Riverside Park	Non-urbanized	Infiltration	Park	None	NONE
Hemlock Crossing	Non-urbanized	Infiltration	Park	None	NONE
Pigeon Creek Park and Forest	Non-urbanized	Infiltration	Park and Open Space	None	NONE
Pine Bend	Non-urbanized	Infiltration	Park	None	NONE
Upper Macatawa Natural Area	Non-urbanized	Connected to waters of the state	Park	None	NONE
Grose Park	Non-urbanized	Infiltration	Park	None	NONE
Hiawatha Forest	Non-urbanized	Infiltration	Open Space	None	NONE
Johnson Street Forest	Non-urbanized	Infiltration	Open Space	None	NONE
Port Sheldon Natural Area	Non-urbanized	Infiltration	Open Space	None	NONE
Riley Trails	Non-urbanized	Infiltration	Park	None	NONE
Robinson Forest	Non-urbanized	Infiltration	Open Space	None	NONE
Van Buren Street Dunes	Non-urbanized	Infiltration	Open Space	None	NONE
Musketawa Trail	Non-urbanized	Infiltration	Park	None	NONE
Parks Operation Center	Non-urbanized	Infiltration	Equipment Storage and Maintenance	None	NONE

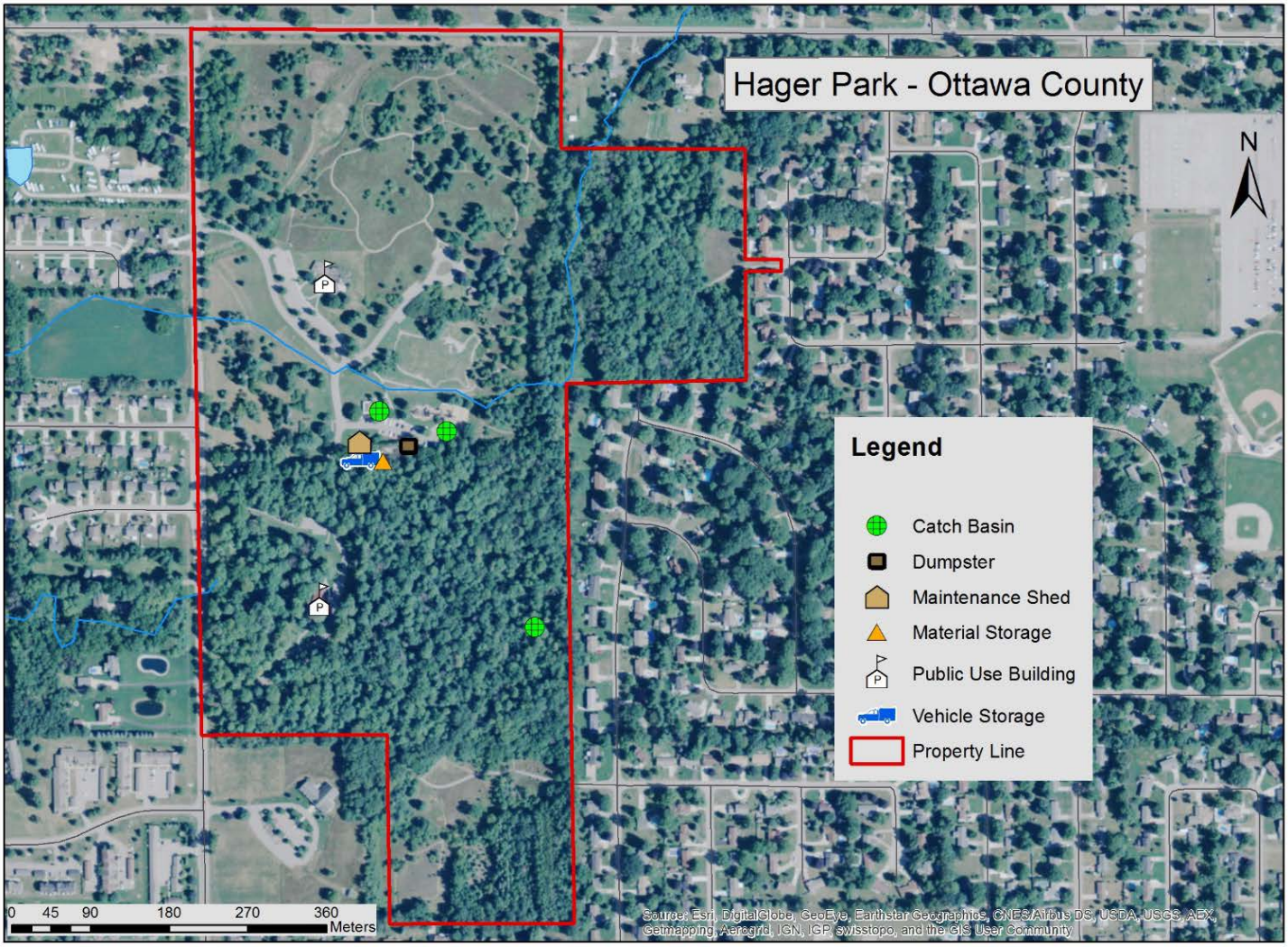

Figure 9: Hagar Park Site Plan (8134 28th Avenue, Jenison MI 49428)

Property Type: Park

Structural Stormwater Controls: Catch basins, open grassed channels

Lawn Care: Contractor used for lawn care/ landscaping

Winter Maintenance: Salting performed, salt vehicle washing, snow storage behind maintenance building

Vehicle Maintenance: Off site, performed by contractor

Oil water separator: None

Hazardous Materials Storage: See Table 11

Miscellaneous Storage: empty barrels

Other Information:

- No floor drains in garage where vehicles are stored
- Septic system on site – pumped annually
- Building roof drains outlet into turf areas

3.1.3 Best Management Practices

Best management practices (BMPs) are physical structures that are installed or actions that are taken to prevent or reduce the potential for stormwater pollution when undertaking certain activities. Table 10 provides a list of activities that require BMPs and where in this document a summary of recommended BMPs can be found. Section 3.3 provides BMPs that are being and will be followed for activities that are occurring at high priority OCPR facilities. These same BMPs will be implemented at medium and low priority facilities for the applicable activities.

Table 10. Activities that Could Generate Stormwater Pollution at Hagar Park

ACTIVITY	BMP Summary Sheet (page #)
Septic System Maintenance	47
Vehicle and equipment storage inside/outside	48
Vehicle and equipment maintenance - inside	49
Vehicle and equipment washing - outside	50
Vehicle fueling station	51
Fuel Storage	52
Bulk chemical/hazardous materials storage[1]	53
Parking lot/sidewalk salting	54
Parking lot/sidewalk cleaning	55
Snow storage	56
Outside dumpster storage	57
Lawn maintenance	58
Pet Waste Control	59
Building Washing[2]	60
Materials Storage[2]	61
Salt Storage[2]	62

[1] See Table 11 for list of significant materials

[2] Does not occur at Hagar Park but does at medium or low priority facilities

Table 11. Significant Materials Stored at Hagar Park

Material	Quantity	Location	Storage and Handling	Potential to Discharge
Diesel fuel	200 gallons	In maintenance yard on cement pad	Secondary containment, spill response and prevention	Low – spills during transfer, leaks
Motor oil	10 gallons	In maintenance building		Low
Used motor oil	15-30 gallons	In cabinet on cement pad		Low
Gasoline	30 gallons	Fireproof cabinet in maintenance building		Low – spills during transfer
Antifreeze	4 gallons	In maintenance building		Low
Wood sealer	40 gallons	In maintenance building		Low – spills during use
Paint	20 gallons	In maintenance building		Low
Cleaning supplies	50 gallons	In maintenance building		Low
Herbicide	6-8 gallons	Metal storage cabinet in maintenance building		Low – spills during use or improper application methods
Road salt	500 pounds	On pallet in maintenance building		Low
Top soil	8 yards	In maintenance yard, 300 yards north of storm drain	Protect from stormwater runoff, sweep up any spillage during handling	Low – stormwater runoff if not kept contained
Wood chips	30 yards	In maintenance yard, 300 yards north of storm drain		

3.2 Ottawa County Facilities Maintenance

3.2.1 Facility Assessment

Staff at the MACC completed facility assessments for all OCFM properties during the summer of 2014. The assessment included interviews with OCFM staff and site inspections of all facilities in the urbanized areas. The MACC used a checklist of activities as the basis for the OCFM staff interviews and site inspections (Appendix A). As appropriate, MACC staff viewed maps, site plans and as-builts in order to develop an accurate inventory of stormwater controls at each facility. MACC staff also reviewed existing related OCFM documents to evaluate existing pollution prevention and good housekeeping practices. The assessment results were input into a database created and maintained by the MACC. The OCFM will notify the MACC of any changes to their facilities that impact stormwater, including the construction of new facilities, addition or removal of stormwater controls, demolition of old facilities, and transfer of ownership, so that MACC staff can complete a new assessment and update the database. The new assessment and/or database update will be completed within 30 days of the completion of any major facility changes as listed above.

3.2.2 Prioritized Facility List

MACC staff used information gathered during the assessment procedure to assign priority levels to each facility based on having high, medium or low potential to discharge pollutants to surface waters of the state (Table 8). The list of prioritized OCFM facilities is provided in Table 12. The table is followed by a series of fact sheets that provide addition information about the activities and stormwater controls present at high, medium and low priority facilities. One facility is located in a non-urbanized area and further information is not included.

Table 12. OCFM Prioritized Facility List

Facility Name	Location	Stormwater Management	Facility Type	Material Storage	Priority
James Street Complex	Urbanized area	Connected to waters of the state	Administrative, Vehicle Storage	Salt	HIGH
Hudsonville District Court and Department of Public Health	Urbanized area	Connected to waters of the state	Administrative, Vehicle Storage	None	MEDIUM
Grand Haven District Court	Urbanized area	Connected to waters of the state (via City of Grand Haven)	Administrative, Vehicle Storage	None	MEDIUM
Holland District Court	Urbanized area	Connected to waters of the state (via City of Holland)	Administrative, Vehicle Storage	None	MEDIUM
Community Mental Health Grand Haven	Urbanized area	Connected to waters of the state (via City of Grand Haven)	Administrative, Vehicle Storage	None	LOW
Fillmore Administration Building	Non-urbanized area	Maintained on site	Administrative, Vehicle Storage	Hazardous materials and bulk materials, salt storage	N/A

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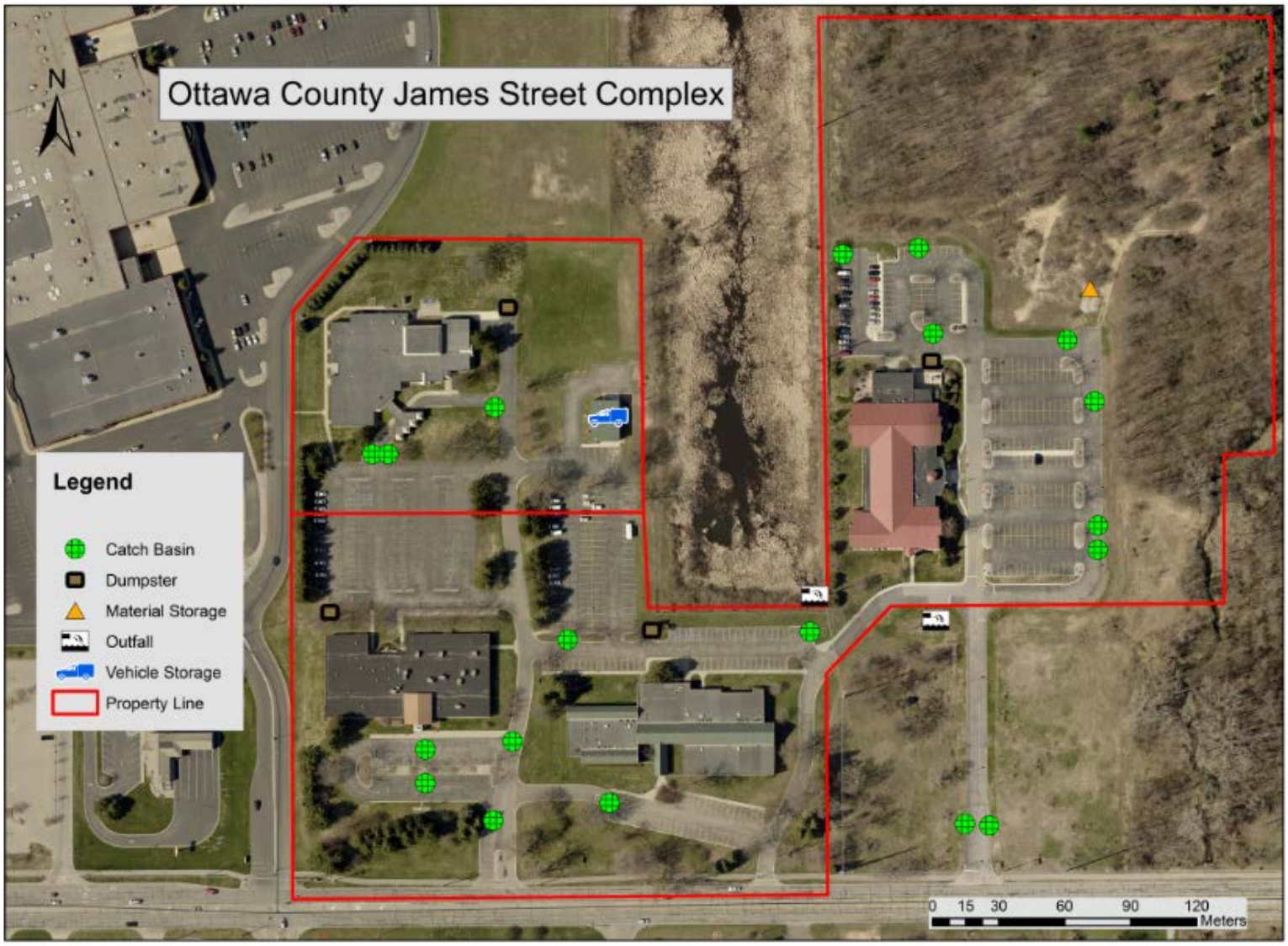

Figure 10. James Street Complex Site Plan (12265 James Street, Holland MI 49424)

****HIGH PRIOIRTY FACILITY*****

Property Type: Administration building, Vehicle storage, Equipment storage

Structural Stormwater Controls: Catch basins

Lawn Care: Contractor used for lawn care/ landscaping

Winter Maintenance: Salt use, salt vehicle washing, snow storage behind maintenance building

Material Storage: Salt storage

Other Information:

- Floor drains in maintenance building connected to sanitary
- Roof drains for all buildings are connected to storm sewer (excludes maintenance building)
- Litter control program

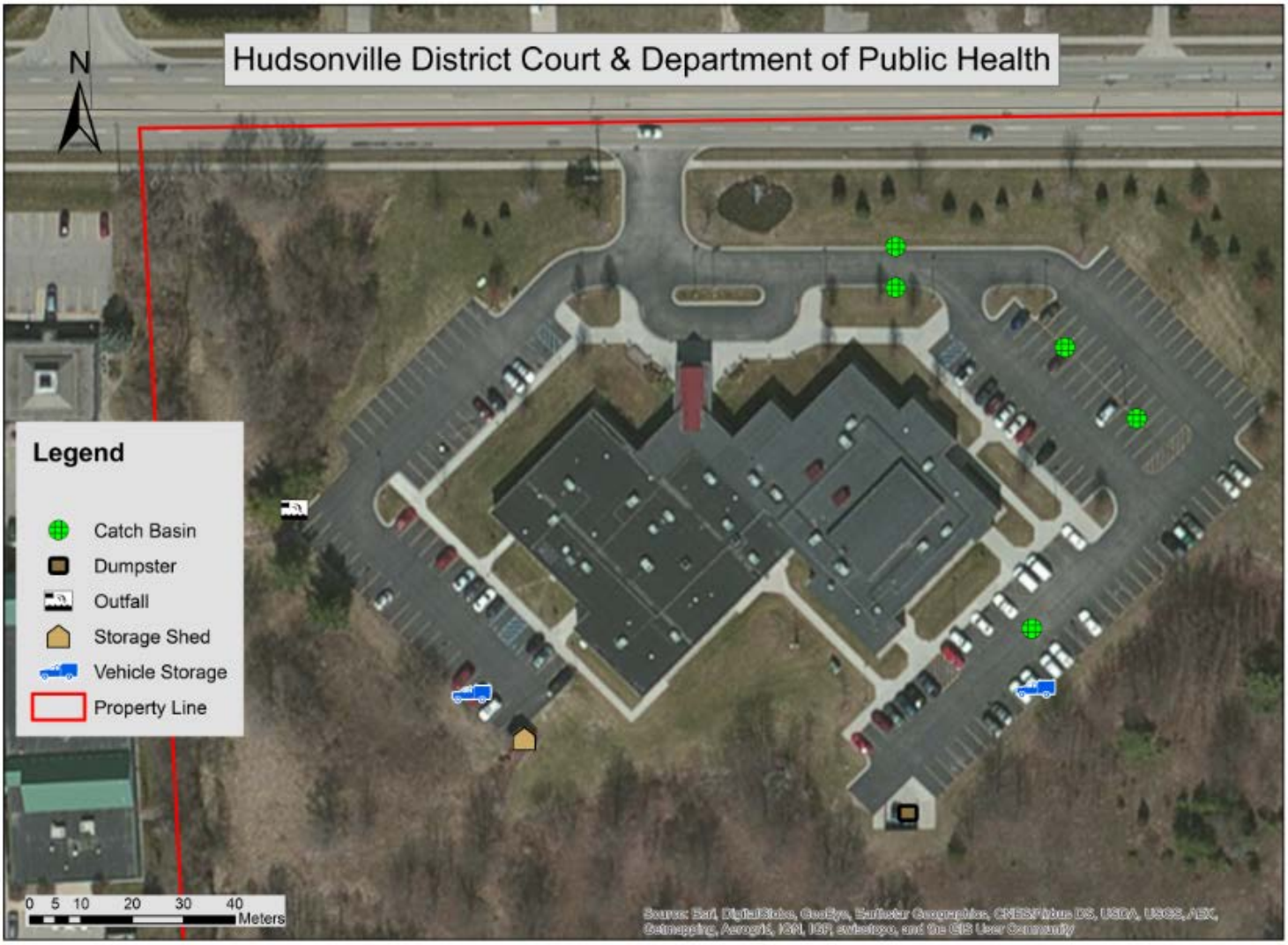

Figure 11. Hudsonville District Court and Department of Public Health Site Plan (3100 Port Sheldon Road, Hudsonville MI 49426)

****MEDIUM PRIORITY FACILITY****

Property Type: Police department, Department of public health

Structural Stormwater Controls: Catch basins

Lawn Care: Contractor used for lawn care/landscaping

Winter Maintenance: Salt use

Hazardous Materials Storage: None

Miscellaneous Storage: Storage shed for equipment, small quantities of vehicle fluids

Other Information:

- For west parking lot, surface runoff collects at westernmost corner of parking lot and flows to creek
- County owns soccer fields south of the building
- All drains on east side of the property discharge to outfall

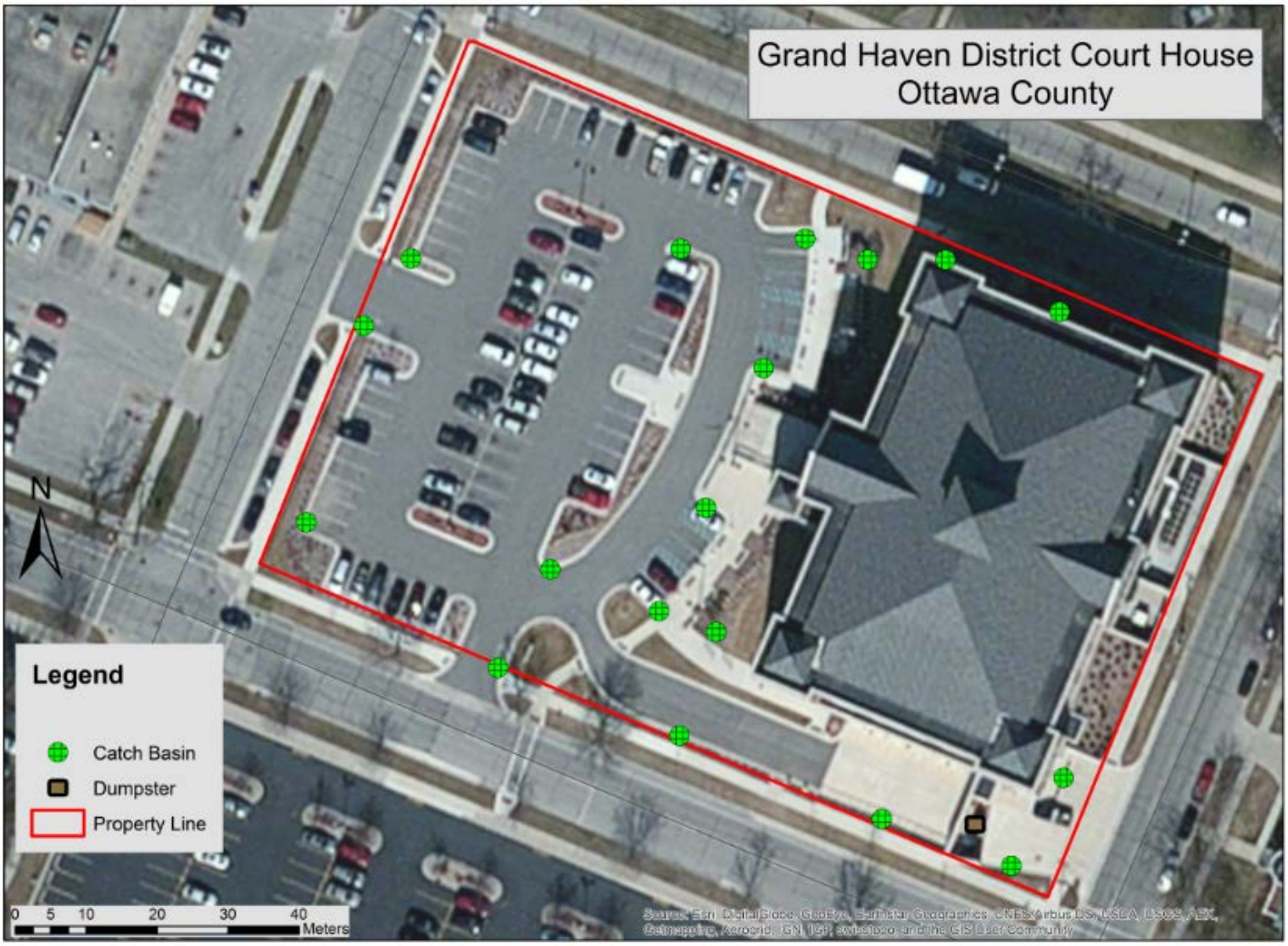

Figure 12. Grand Haven District Court Site Plan (414 Washington Avenue, Grand Haven MI 49417)

*****MEDIUM PRIORITY FACILITY*****

Property Type: Courthouse

Structural Stormwater Controls: Catch basins

Lawn Care: Contractor used for lawn care/landscaping

Winter Maintenance: Salt use

Hazardous Materials Storage: None

Miscellaneous Storage: None

Other Information: Dumpster located near catch basin

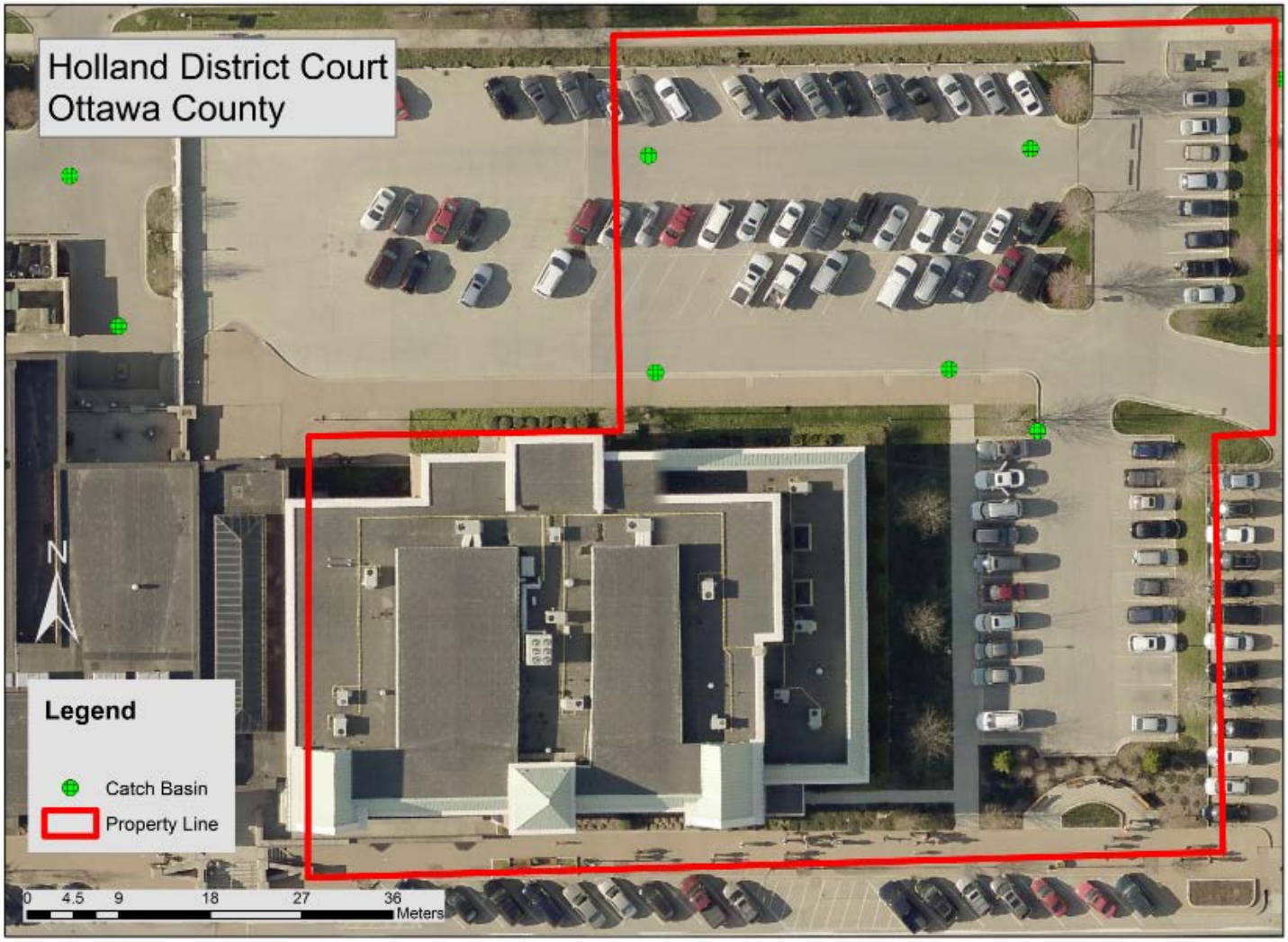

Figure 13: Holland District Court Site Plan (85 West 8th Street, Holland MI 49423)

****MEDIUM PRIORITY FACILITY****

Property Type: Courthouse

Structural Stormwater Controls: Catch basins

Lawn Care: Contractor used for lawn care/landscaping

Winter Maintenance: Salt use

Vehicle Maintenance: Off site

Oil water separator: None

Hazardous Materials Storage: None

Miscellaneous Storage: None

Figure 14: Grand Haven Community Mental Health Site Plan (111 Fulton Street, Grand Haven, 49417)

****LOW PRIORITY FACILITY****

Property Type: Community mental health

Structural Stormwater Controls: None/sheet-flow to street storm drain system

Lawn Care: Contractor used for lawn care/landscaping

Winter Maintenance: Salt use

Hazardous Materials Storage: None

Miscellaneous Storage: None

3.2.3 Best Management Practices at Properties Maintained by OCFM

Best management practices (BMPs) are physical structures that are installed or actions that are taken to prevent or reduce the potential for stormwater pollution when undertaking certain activities. Section 3.3 provides BMPs that are being and will be followed for activities that are occurring at high priority OCFM facilities. These same BMPs will be implemented at medium and low priority facilities for the applicable activities. The only significant material stored at the James Street Complex is rock salt in 50 pound bags. There is low potential for discharge to stormwater when applying salt to sidewalks and parking lots.

Table 13. Activities that Could Generate Stormwater Pollution at the James Street Complex

ACTIVITY	BMP Summary Sheet (page #)
Vehicle and equipment storage inside/outside	48
Parking lot/sidewalk salting	54
Parking lot/sidewalk cleaning	55
Snow storage	56
Outside dumpster storage	57
Lawn maintenance	58
Building Washing	60
Materials Storage	61
Salt Storage	62

3.3 Best Management Practice Summary Sheets

The following pages provide summaries of the recommended BMPs that will be followed for each activity that is, or could be, occurring at each property as listed in Tables 10 and 13. The same BMPs will implemented at all county properties regardless of priority or location in an urbanized area for all applicable activities.

Septic System Maintenance

BMP Description:

- Septic systems should be inspected once every three years by a professional. Systems with electrical or mechanical components should be inspected more frequently.
- Pump tank as necessary per inspection recommendations (generally every 3-5 years)
- Maintain a record of inspections and pump outs
- Inspect all indoor components and fixtures for water leaks and repair as necessary
- As much as possible, use high-efficiency toilets and faucet aerators to conserve water
- Post notices in restroom facilities to discourage improper disposal of items into the septic system
- Plant grasses or septic friendly mixes over drainfields and avoid trees and shrubs
- Do not drive or park vehicles over the drainfield
- Keep roof drains, sump drains, parking lot/sidewalk runoff, or other excess rainwater away from drainfields

Measurable Goals:

Inspect all septic systems at least once every 3 years

Educational signage installed at 100% of facilities with septic systems to encourage proper disposal of items that should not go into septic systems

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Reference: EPA. 2002. A Homeowner's Guide to Septic Systems. Available at: http://www.nesc.wvu.edu/pdf/ww/septic/epa_septic_guide.pdf

Vehicle and Equipment Storage

BMP Description:

- Floor drains must not be connected to storm sewers.
- All floors should be constructed of cement or other impervious materials to prevent contaminants from leaching into the soils or groundwater.
- Equipment wash areas should discharge into a sanitary sewer line. Depending on the amount of oil, grease and other pollutants, pre-treatment of wastewater may be needed before it enters the sanitary sewer.
- Spill kits should be available and clearly marked to respond quickly to any automotive fluid leaks for both inside and outside vehicle storage.
- Vehicles parked outside for extended periods of time or overnight should be parked away from storm drains.
- If equipment is to be stored outside, all fluids should be drained first. Store idle equipment containing fluids under cover.

Measurable Goals:

A minimum of one well-marked spill kit available in every garage

100% of vehicles and equipment stored outside kept a minimum of 100 feet from any storm drain

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Comprehensive inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Vehicle and Equipment Maintenance

BMP Description:

- Whenever feasible, move maintenance and repair activities indoors.
- Avoid hosing down work areas, but if work areas are washed, collect the water and direct to sanitary sewer.
- Post signs to indicate storm drains and sinks are not to receive hazardous wastes.
- Designate a special area, with no connections to the storm drain, to drain motor fluids.
- Collect leaking or dripping fluids in drip pans or containers, and drain all fluids immediately.
- Promptly transfer used fluids to proper waste or recycling drums.
- Keep equipment clean, don't allow excess grease and oil buildup.
- If temporary work is being done outside, use a tarp, ground cloth, or drip pans to capture all spills and drips, and dispose of properly.
- Regularly inspect vehicles and equipment for leaks and repair immediately.
- Spill kits should be available and clearly marked to respond quickly to any fluid leaks for both inside and outside maintenance activities.

Measurable Goals:

100% of all maintenance activities conducted inside and use of tarp for any maintenance that must be conducted outside

A minimum of one well-marked spill kit available in every garage

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Comprehensive facility inspections every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Vehicle and Fleet Maintenance*, Stormwater Coalition of Monroe County, NY*

Vehicle and Equipment Washing

BMP Description:

- Wash waste water must not be allowed to enter storm drains.
- Consider washing vehicles and equipment inside the building if washing must occur on-site.
- If washing must be done outside, it should be done over a gravel or grassed area with cold water and no soap. Alternatively, wash outside on a covered, paved surface that collects wash waste water and directs it to the sanitary sewer.
- Design wash areas to properly collect and dispose of wash waste water when engine cleaning is conducted and when chemical additives, solvents or degreasers are used.
- Use biodegradable, phosphate-free detergents for washing vehicles if needed.
- Discharge all wash waste water to a sanitary sewer, holding tank or a process treatment system after consulting with the local sewer authority to find out if pretreatment is required.

Measurable Goals:

100% of vehicles washed inside or at a commercial facility

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Vehicle Fueling Station

BMP Description:

- Inspect tank foundations, connections, coatings, tank walls, and piping systems. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Visually inspect new tank or container installations for loose fittings, poor welds and improper or poorly fitted gaskets.
- Check for leaks or spills when transferring fuel from tanker truck into storage system and when fueling vehicles.
- Above-ground tanks should be tested periodically for integrity by a qualified professional.
- Dry cleanup methods should be employed when cleaning up fuel-dispensing areas. Spill kits should be readily available and clearly labeled.
- Fuel dispensing areas should be covered, and the cover's minimum dimensions must be equal to or greater than the area within the grade break or the fuel dispensing area.
- Barriers should be in place to prevent vehicles from damaging pumps and other fuel station structures.
- Fueling stations should be located away from storm drains.

Measurable Goals:

A minimum of one well-marked spill kit available at fueling station

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Fuel Storage

BMP Description[1]:

- Follow standard tank filling practices when filling tanks to prevent spills and overfills
- Each storage tank should have impermeable, adequately sized secondary containment to contain spills (also allows leaks to be detected more easily)
- Use a manually controlled sump pump to collect main water that may collect in the secondary containment area
- Regular monitor storage areas to checks for leaks and ensure proper working condition of the system. Ensure that corrosion control measures are in place.
- Properly decommission storage tanks that are no longer in use
- Locate storage tanks at safe distances from surface water, storm or sanitary sewers and drinking water wells
- Conduct periodic cleanup of the containment area to remove any dirt and other contaminant buildup

Measurable Goals:

Secondary containment for all fuel storage tanks

A minimum of one well-marked spill kit available near fuel storage areas

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

[1] *Under certain storage capacities, Part 112 rules apply. This BMP is not intended to take the place of or meet the standards of Part 112 rules.*

Reference: EPA. 2001. Source Water Protections Practices Bulletin: Managing Above Ground Storage Tanks to Prevent Contamination of Drinking Water.

Hazardous Materials Storage

BMP Description:

- Ensure sufficient aisle space to provide access for inspections and to improve the ease of material transport.
- Store materials away from high-traffic areas to reduce the likelihood of accidents that might cause spills or damage to drums, bags or containers.
- Stack containers in accordance with the manufacturers' directions to avoid damaging the container or the product itself.
- Store containers on pallets or equivalent structures. This facilitates inspection for leaks and prevents the containers from coming into contact with wet floors, which can cause corrosion. This consideration also reduces the incidence of damage by pests (insects, rodents, etc.).
- Liquid materials should be stored with secondary containment to contain any leaks or spills.
- Delegate the responsibility for management of hazardous materials to personnel trained and experienced in hazardous substance management.
- Have a spill response and prevention plan including readily available and well-marked spill kits.

Measurable Goals:

A minimum of one well-marked spill kit available near hazardous material storage area
100% of liquid materials stored with secondary containment
Monthly inspections of storage areas at high priority facilities

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on EPA Hazardous Materials Storage website:
http://water.epa.gov/polwaste/npdes/swbmp/Hazardous-Materials-Storage.cfm

Parking Lot and Sidewalk Salt[1] Application

BMP Description:

- Calibrate spreaders to ensure proper application rates.
- Consider environmental impacts and practical melting temperature when determining which material and how much to apply.
- Consider alternative products to spread on sidewalks and parking lots that have less environmental impact.
- Only apply the amount of deicer needed to get the job done.
- As much as possible, remove snow prior to applying deicers. The less snow, the less deicer needed.
- Remember that sand provides traction and does not melt ice. If sand must be used, then institute regular sweeping to prevent sand from entering storm drains.
- Consider anti-icing products in key areas that receive high-foot traffic to avoid slip and fall injuries.

Measurable Goals:

Track amount of salt used with a goal of reducing salt use or incorporating alternative deicers or anti-icing products

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

See *Winter Parking Lot and Sidewalk Maintenance Manual* in Appendix B for more information.

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

[1] Salt includes sand-salt mixtures and other alternative deicers.

Parking Lot Sweeping and Sidewalk Cleaning

BMP Description:

- A regular sweeping schedule should be maintained.
- Parking lot sweeping is only to be performed during dry weather if possible.
- Wet cleaning or flushing of the lot is to be avoided where possible. If wet cleaning is necessary, collect debris and direct wash waste water to the sanitary sewer.
- Sweepers are to be operated at manufacturer directed optimal speed level to increase effectiveness.
- Vacuum or regenerative air sweepers should be used in high sediment and trash areas.
- Accurate logs of the sweeping frequency and the amount of waste collected are to be kept.
- Dispose of sweeping debris and dirt at a landfill.
- Do not store swept material near a storm drain inlet.
- Debris storage is to be kept to a minimum during the wet season. Piles will be contained by a berm or covered.

Measurable Goals:

Annual sweeping of parking lots/sidewalks at high priority facilities

Track number of acres of parking lots cleaned and volume of material collected with a goal of reducing the volume over time

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Street Sweeping and Cleaning*, Stormwater Coalition of Monroe County, NY*

Snow Storage and Removal

BMP Description:

- Snow disposal sites must be located at least 50 feet from private water supply wells, 75 feet from non-community water supply wells, 200 feet from municipal water supply wells, and not be located in a wellhead protection area.
- Do not dispose of snow within a drinking water source water protection area.
- Avoid snow storage and disposal on erodible sites or where there are steep slopes.
- Avoid disposal sites with high risk for human exposure (parks, playgrounds, etc.).
- Avoid disposal sites near areas of fractured bedrock. Choose sites with adequate soil depth between the surface and groundwater to act as a filter. Fine-grained loamy soils with high organic matter will filter and retain contaminants better than sandy soils.
- Avoid disposal in a landfill.
- Avoid disposal in wetland and floodplains.
- The best disposal sites are those that drain to a detention pond or infiltration area that capture pollutants and keep them from entering surface water.

Measurable Goals:

Amount (volume or percent of total managed) of snow stored in detention/infiltration areas

100% of snow stored in areas that allow infiltration or treatment of meltwater

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on MDEQ Snow Disposal Guidance: https://www.michigan.gov/documents/deq/wrd-waterwords-20140208_446950_7.pdf

Dumpster Storage and Maintenance

BMP Description:

- All outdoor dumpsters will be stored on an impervious surface.
- All outdoor dumpsters will have a cover that is closed when they are not being loaded or unloaded.
- All outdoor dumpsters will be inspected during the six-month comprehensive site inspection to check for structural damage. Leaky dumpsters will be repaired or replaced.
- Dumpster areas will be inspected regularly as part of a facility litter control program to ensure that debris is disposed of properly and not allowed to enter surface water.
- Minimize the disposal of liquids in dumpsters.

Measurable Goals:

Monthly inspections of dumpsters at high priority facilities

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Lawn Care and Landscape Maintenance

BMP Description:

- Use phosphorus-free fertilizer in all cases except when starting a new lawn from seed, patching/repairing a lawn with seed or when a soil test has shown there is a need
- The area of lawn will be measured prior to applying fertilizer to ensure that the proper amount is applied
- Maintain at least a 3-foot buffer of no fertilizer application when applying adjacent to surface water or stormwater controls
- Grass should be cut no shorter than three inches to encourage root growth
- All grass clippings and fertilizer will be swept or blown off impervious surfaces back onto lawns to prevent runoff into storm drains
- When irrigating, follow a schedule to maximize efficiency and prevent excess water from running off
- When selecting landscape plants, choose species that are appropriate for the site conditions. Use of native species is encouraged to minimize the need for fertilizing and irrigation.
- Any pesticide application will be completed by an employee or contractor that is certified by the State of Michigan as a pesticide applicator in the applicable category

Measurable Goals:

100% of fertilizer used is phosphorus free unless necessary for the above listed reasons
Maintain a 3-foot buffer of no fertilize application adjacent to surface water and stormwater controls
100% of pesticide applications completed by certified individuals

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on Macatawa Watershed Project's Lawn Care Seal of Approval criteria

Pet Waste Collection

BMP Description:

- Assess municipal parks and open space areas to determine locations with excessive amounts of pet waste.
- Prioritize problem areas based upon quantity of pet waste and proximity to waterbodies.
- Install pet waste signs or bag stations as necessary.

Measurable Goals:

Signs and bag stations installed at all parks where dogs are allowed

Timeline/Implementation Schedule:

Employee training once every 5 years and within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Pet Waste Collection*, Stormwater Coalition of Monroe County, NY*

Building Washing (Powerwashing)

BMP Description:

- Use dry spot cleaning methods when possible and properly dispose of any pre-cleaning debris
- Block or protect storm drains from waste water runoff
- Minimize water usage with regulating nozzles or high pressure delivery systems
- If necessary, use only non-toxic cleaning solutions
- Contain and collect waste water and dispose of in the sanitary sewer (with permission) or allow to infiltrate into vegetated areas. If necessary, use an absorbent pad to reduce/remove any oil or other hydrocarbons
- Clean up any residue or solids left after disposal to keep materials out of stormwater runoff

Measurable Goals:

100% of waste water is kept out of storm drains

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Plaza and Sidewalk Cleaning*, Stormwater Coalition of Monroe County, NY*

Outdoor Materials Storage

BMP Description:

- Consider building a covered area with a paved floor for storing materials to prevent contact with stormwater runoff. This practice can be used for significant materials that could contaminate stormwater runoff.
- If small quantities of materials are stored outdoors, consider placing a temporary plastic film or sheeting over the material to protect it from stormwater runoff.
- New storage areas should be paved and include a drainage system to collect the stormwater runoff. The paved area should be sloped to avoid pooling and curbed to contain any contaminated runoff. Avoid the use of catch basins in the interior of the paved area since catch basins could fill with material and clog. The drain from the paved area can be connected to the sanitary sewer if allowed by the local public works department. If this is not possible, then the runoff may need treatment to remove pollutants.
- For unpaved storage areas, determine whether or not rainfall infiltrates into the soil through visual observations during rainfall events. If stormwater passes into the soil, no further work is needed provided there is no concern for groundwater contamination. If runoff is observed, construct a berm around the storage area to collect and divert the excess runoff either to the sanitary sewer or for treatment.
- On paved surfaces, sweep any spilled or escaped materials back into the storage area. Do not hose down an area with water.
- Maintain an Emergency Spill Response and Cleanup Plan

Measurable Goals:

Monthly inspection of storage area

100% of spills or trackout are cleaned up and kept out of storm drains and other structural controls

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Reference: State of Oregon Department of Environmental Quality. 1997. *Recommended Best Management Practices for Stormwater Discharges.*

Salt[1] Storage

BMP Description[2]:

- Salt should be stored inside and in dry conditions or covered with waterproof tarps.
- Salt should be stored on impervious surfaces to reduce seepage into groundwater.
- Salt piles should be located at least 50 feet from any open water body or wetland and located outside the 100-year floodplain.
- For indoor storage, minimize trackout of vehicles and sweep up any materials deposited outside of building and exposed to stormwater as soon as possible.

Measurable Goals:

A minimum of one well-marked spill kit available near salt storage areas100% of spills and trackout are cleaned up and kept out of storm drains

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Comprehensive facility inspection once every 6 months at high priority facilities

Specific Components and Notes:

See MDEQ *Salt and Brine Storage Guidance* in Appendix C for more information.

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

[1] Includes salt, salt-sand mixtures and other alternative deicers in solid form

[2] Some of these recommended practices, as well as additional requirements, may need to be met in order to comply with Part 5 rules if the salt storage facility meets certain criteria.

3.4 Inspection and Maintenance of Stormwater Control Devices

Routine monthly inspections of stormwater control devices will occur at the high priority facilities (Hagar Park and the James Street Complex). Inspections will be completed by trained OCPR and OCFM staff using the **Monthly Facility Stormwater Control Inspection Form** (Appendix D). During these inspections, the inspector shall review the following areas:

- Stormwater management and control devices including outfalls and detention ponds
- Parking lot maintenance and cleanliness
- Catch basin sumps and grates
- Dumpster area cleanliness
- Salt storage containment

Specific observations will be recorded on the inspection form and upon completion, the form will be reviewed with the individual Facility Supervisor for any areas that need attention. If any pollutants are found being discharged into the stormwater controls, corrective action will be taken within two (2) business days to remove and cleanup all pollutants. Any other issues will be addressed within thirty (30) days. All corrective actions taken will be recorded on the inspection form. Each facility will maintain copies of their inspection forms onsite. Copies of completed inspection forms will also be provided to the Ottawa County Water Resource Commissioner's (OCWRC's) Office at least annually.

Stormwater controls will be inspected at low and medium priority facilities in urbanized areas annually or after significant rain events. The same inspection procedure, inspection form and corrective action schedule will be used for all inspections at all facilities.

Any new stormwater structural controls that fall under Ottawa County's responsibility will be incorporated into the inspection and maintenance schedule within 30 days of construction or addition.

3.5 Comprehensive Site Inspection

Comprehensive site inspections will be performed at high priority facilities in the spring and fall of each year. Comprehensive site inspections will be performed at medium priority facilities every other year and at low priority facilities at least once every 5 years. The inspections will be conducted by trained OCPR and OCFM staff using the **Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection Form** (Appendix E). During these inspections, the following areas will be reviewed as applicable:

- Facility operation
- Fluids management
- Leak and spill prevention and control
- Battery storage
- Tire storage
- Fueling areas
- Absorbent materials storage and disposal
- Salt storage
- Miscellaneous material storage
- Facility stormwater runoff

After the inspection is complete, the form will be reviewed with the Facility Supervisor for any areas that need attention. When there are areas of concern, the Facility Supervisor will notify their respective Department Supervisor and the Office of the Water Resources Commissioner to review current processes and procedures to address areas of concern with a goal of having a safe, clean and efficient operation. Any concerns that have a high potential to discharge pollutants into the storm drain system will be addressed in two (2) business days. All other concerns, including employee training, will be addressed within sixty (60) days. A copy of the inspection form will be kept at each facility and provided to the OCWRC's Office upon completion of the inspection. All corrective actions taken will be documented and copies provided to the OCWRC's office at least annually.

SECTION 4: Structural Stormwater Control Operation and Maintenance Activities

4.1 Catch Basin Inspection and Maintenance

Catch basin inspections will be prioritized following the criteria outlined in Table 14. Catch basins under the authority of Ottawa County are summarized in Table 15. Catch basins are owned by the applicable Drain District and Michigan Drain Code gives the OCWRC's office the authority to maintain these catch basins. An easement is granted to the OCWRC on behalf of Drain District to allow for maintenance. A general permit is obtained from the Ottawa County Road Commission (OCRC) that allows the OCWRC to perform catch basin and other typical drain maintenance within the road right of way. Separate permits are obtained for major projects. The OCRWC's office notifies the OCRC office when maintenance will take place.

Table 14. Criteria Used to Prioritize Catch Basin Inspections

System Type	High Priority	Low Priority
Chapter 20 Drains (road systems)	Primary road	Subdivision road
County Drains	Drains that discharge directly to waters of the State (no detention) and Drains located in industrial or commercial land use areas or in known problem areas	Drains located in residential areas that have detention

Table 15. Ottawa County Catch Basin Summary

Location	Quantity
Allendale Charter Township	456
Blendon Township	41
City of Ferrysburg	16
Georgetown Township	2,485
Grand Haven Charter Township	501
Holland Charter Township	1,493
City of Hudsonville	86
Jamestown Charter Township	271
Park Township	706
Spring Lake Township	115
Tallmadge Township	66
Zeeland Charter Township	138
Zeeland City	1
TOTAL	**6,375**

High priority catch basins will be inspected once every 7 years. All others will be inspected once every 14 years (Table 16). Catch basins will be inspected by OCWRC staff or by a trained contracted inspector and

documented on the **Catch Basin Inspection Form** (Appendix F). Inspections will be completed between late spring and fall of each year. Catch basins that are 50% or more full of sediment will be scheduled for cleaning within one year. If other maintenance needs exist such as a blocked inlet or sink hole with infiltration into the structure, it will be addressed within 30 to 90 days depending on the type and severity of the problem. Additional inspections will be scheduled based on citizen complaints.

All inspections of catch basins will be recorded, reported and evaluated on an annual basis. After the initial 5-year cycle of inspections are completed, the County will determine whether or not to prioritize inspections in the future. Conditions observed at the time of inspection will be used to determine how to prioritize future inspections. Citizen complaints will also be considered when evaluating catch basin and inspection priority. Any newly constructed catch basins and will be incorporated into the regular inspection schedule within 30 days of construction.

Additional inspections of catch basins will be completed as necessitated by dry weather screening conducted as part of the Illicit Discharge Elimination Program (IDEP). Points of discharge are inspected a minimum of once per permit cycle. If an illicit discharge of excessive sediment or other material is observed during dry weather screenings, upstream catch basins will be examined to determine the source of the discharge. This investigation will be completed by OCWRC staff or a trained contractor/intern and will be done at the same time as the dry weather screening. Once the source is determined, corrective action will be taken following procedures outlined in the IDEP Plan. A copy of the Dry Weather Screening and Catch Basin Inspection Form will be kept on file at the OCWRC office.

Additional inspections of catch basins will also be completed as necessitated by detention basin inspections (See Section 4.2). Detention basins will be inspected every 5 years. If excess sediment has accumulated in the basin, then the catch basins associated with that basin will be inspected to determine the source of the sediment so that it can be addressed and eliminated.

Once the catch basins have been inspected and marked for cleaning, OCWRC staff will schedule cleaning with the contractor. Catch basin cleaning is always completed by a contractor who is required to show proof of delivery to the landfill for disposal. All catch basin cleaning activities will comply with procedures outlined in the Michigan DEQ guidance document (Appendix G).

Citizens are invited to call the main OCWRC office or submit requests or questions via e-mail thru the OWCRC's website (http://www.miottawa.org/Departments/Drain/) related to drain/catch basin issues. When a complaint is received, an **Inspection Request Form** is generated and forwarded to the appropriate OCWRC staff for response the same day or next business day if received after hours. If the complaint is regarding an OCWRC-related drain/catch basin, OCWRC staff will investigate the complaint within two (2) business days. If staff determines further action is warranted, corrective action will then be taken within 30 to 90 days depending on the type and severity of the problem.

If the complaint is related to private construction activity, enforcement action will be taken by the OCWRC Soil Erosion staff. The Soil Erosion staff will contact the contractor and/or developer within two (2) business days to take immediate action to get the site in compliance. If immediate action is not taken by the contactor or developer, a violation letter, cease and desist order and/or citation will be issued. Continued follow up by staff will take place throughout the construction of the development until all areas are stabilized.

Table 16. Catch Basin Inspection Schedule

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Total per Location
Allendale Charter Twp	34	34	34	35	35	35	46	35	35	35	35	35	35	46	463
Blendon Twp	22	23					5							5	50
City of Ferrysburg						15									15
Georgetown Charter Twp	253	254	254	232	233	233	233	253	254	254	233	233	233	233	2624
Grand Haven Charter Twp	69	69	69	69	69	69	124							124	538
Holland Charter Twp	111	111	252	253	253	111	111	111	111	252	253	253	112	112	1648
City of Hudsonville	42	43													85
Jamestown Charter Twp								110	110	55					275
Park Twp	110	110					117	110	110		55	55	110	117	777
Spring Lake Twp				55	55	24							24		134
Tallmadge Charter Twp						17				48			17		65
Zeeland Charter Twp						64					57	57	64		178
Zeeland City													1		1
Total per Year	641	644	609	644	645	568	636	619	620	644	633	633	596	637	

Red numbers in the table indicated high priority basins within the given geographic location.

4.2 Other Stormwater Controls

A list of non-catch basin stormwater structural controls that are not associated with facilities is shown below. The dams are inspected annually by OCWRC staff using the **Stormwater Structural Control Inspection Form** (Appendix D) assessing the overall function, condition and need for maintenance. Copies of the inspection forms will be kept in the appropriate drain file at the OCWRC office.

BLENDON TOWNSHIP

1. Berens Dam – Section 35

GEORGETOWN CHARTER TOWNSHIP

1. Port Sheldon Street Dam – Section 19
2. Rosewood Industrial Ponds – Section 22

JAMESTOWN CHARTER TOWNSHIP

1. Buttermilk Creek Dam – Section 5
2. DeWeerd Dam - Section 4

PARK TOWNSHIP

1. Ottogan Intercounty Dam – Located in Allegan County

ZEELAND CHARTER TOWNSHIP

1. Steenwyk Dam – Section 11
2. Timmer Dam – Section 12

Detention basins under the jurisdiction of the OCWRC will be inspected every 5 years. A listing of all detention basins by location are shown in Table 17. Easements are provide by each drain district to the OCWRC's office to conduct inspections and maintenance activities on detention ponds. All inspections of detention basins will be recorded, reported and evaluated on an annual basis. After the initial 5-year cycle of inspections are completed, the County will determine whether or not to prioritize inspections in the future. Conditions observed at the time of inspection will be used to determine how to prioritize future inspections. Citizen complaints will also be considered when evaluating detention basin inspection priority. Any newly constructed detention basis will be incorporated into the regular inspection schedule within 30 days of construction.

Table 17. Ottawa County Detention Basin Inventory

Location	Number of Basins	Location	Number of Basins
Allendale Charter Twp	29	Jamestown Charter Twp	10
Blendon Twp	3	Park Twp	17
City of Ferrysburg	2	Spring Lake Twp	6
Georgetown Charter Twp	40	Tallmadge Charter Twp	4
Grand Haven Charter Twp	13	Zeeland Charter Twp	5
Holland Charter Twp	44	Zeeland City	1
City of Hudsonville	6		

When sediment in a stormwater structural control reaches 50% of capacity it will be scheduled for maintenance. When dewatering of detention basins, a filter bag will be used on the pump outlet to filter small sized particles and discharge water to a location downstream of the basin utilizing the appropriate soil erosion measures. The material removed from the detention basins will be spread on site or transported to a location approved by the OCWRC. If the pond is in an area of known contaminants, the material will be transported to and disposed of at an approved landfill.

Stormwater structural controls will also be inspected annually at low and medium priority facilities by trained OCPR or OCFM staff, as applicable, using the **Facility Stormwater Structural Control Inspection Form** (Appendix D). Copies will be kept in the respective department offices and copies will be provided to the OCWRC's office at least once a year. Any immediate maintenance needs that threaten surface water quality will be addressed within two (2) business days. Other concerns will be addressed within sixty (60) days. All corrective actions will be documented on the inspection forms.

Ottawa County requires that all construction of new county-owned facilities or new stormwater controls designed for water volume control will be designed, installed and maintained in accordance with the county's post construction runoff control performance standards and long-term operation and maintenance requirements.

SECTION 5: Municipal Operations and Maintenance Activities

5.1 Assessment

All Ottawa County owned facilities were assessed by the MACC in consultation with OCPR and OCFM staff, to determine which operation and maintenance activities are occurring at facilities and within right of ways. The following activities were assessed:

- Plaza, sidewalk and parking lot maintenance and cleaning
- Landscape maintenance
- Drainage system operation and maintenance
- Cold weather operations

A summary of the operation and maintenance activities and associated potential pollutants is found is Table 18. The assessment will be revised within 30 days of any significant changes to operation and maintenance activities or to the best management practices that are implemented.

5.2 Impervious Surface Sweeping

The Ottawa County Parks and Recreation Department inspects parking lots on a regular basis and schedules sweeping as needed to remove sand at lakeshore parks and clean up soil that may result from construction activities. This material is all swept back into the landscape and not collected and disposed. Leaves may be blown or swept off paved surfaces back into the landscape but are not collected and disposed. Linear paved trails are blown off on a weekly basis to remove gravel, leaves and sticks from the paved surface. These materials are blown into the adjacent landscaped area and not collected for disposal. The Parks Department does not own or operate a street sweeper and does not contract any sweeping to a street sweeper.

Ottawa County Facilities staff sweep or blow debris out of other county-owned parking lots twice a year in May and September. The Grand Haven Courthouse is given higher priority due to high usage in the summer and is cleaned more frequently. All waste is collected and disposed of at a landfill.

5.3 Best Management Practices

Best management practices to reduce stormwater pollution for each identified operation and maintenance activities are found in the pages following Table 18. Some BMPs are found in Section 3.3 and are noted as applicable in Table 18.

Table 18. Potential Pollutants Typically Associated with Municipal Operation and Maintenance Activities

		Potential Pollutants									
Field Programs	**Activities**	**Sediment**	**Nutrients**	**Trash**	**Metals**	**Bacteria**	**Oil & Grease**	**Organics**	**Pesticide**	**Oxygen demanding substances**	**BMP Summary Sheet (Page #)**
Plaza, Sidewalk and Parking Lot Maintenance and Cleaning	Sweeping and Cleaning	X	X	X	X	X	X	X	X	X	74
	Surface Cleaning	X	X			X	X			X	55, 60
	Graffiti Cleaning	X	X		X			X			75
	Sidewalk/Parking Lot Repair	X		X							76, 77
	Controlling Litter	X		X		X	X			X	78
Landscape Maintenance	Mowing, Trimming, Planting	X	X	X		X			X	X	58
	Fertilizer and Pesticide Management	X	X						X		58
	Managing Landscape Wastes	X	X	X					X	X	58
	Erosion Control	X	X								79
Drainage System Operation and Maintenance	Inspection and Cleaning of Stormwater Conveyance Structures	X	X	X		X		X		X	80
	Controlling Illicit Connections and Discharges	X	X	X	X	X	X	X	X	X	See Illicit Discharge Elimination Program Plan
	Controlling Illegal Dumping	X	X	X	X	X	X	X	X	X	81
	Maintenance of Inlet and Outlet Structures	X		X	X		X			X	82
Cold Weather Operations (at facilities only)	Plowing	X	X	X	X		X	X		X	83
	Sand application	X	X								84
	Salt application		X								85
	Use of deicing agents		X								54
	Snow removal and storage	X	X	X	X		X	X		X	56

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Street Sweeping and Cleaning

Category of Municipal Operation: Roads, Streets, and Highways Operation and Maintenance

BMP Description:

- Maintain a consistent sweeping schedule.
- Street cleaning is only to be performed during dry weather if possible.
- Wet cleaning or flushing of the street is to be avoided where possible.
- When possible, sweeping frequency will be increased based on factors such as traffic volume, land use field observations of sediment and trash accumulation, proximity to water course.
- Sweepers are to be operated at manufacturer requested optimal speed level to increase effectiveness.
- Vacuum or regenerative air sweepers will be used in the high sediment and trash areas.
- Accurate logs of the number of curb-miles swept and the amount of waste collected are to be kept.
- Dispose of sweeping debris and dirt at a landfill.
- Do not store swept material along the side of the street or near a storm drain inlet.
- Debris storage is to be kept to a minimum during the wet season. Piles will be contained by a berm or covered.

Measurable Goals:

Reduction in the quantity (tons or cubic yards) of debris cleaned from streets, sidewalks and parking lots.

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Impervious surfaces sweeping schedule (see previous section)

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Street Sweeping and Cleaning*, Stormwater Coalition of Monroe County, NY*

Graffiti Removal

Category of Municipal Operation: Plaza, Sidewalk and Parking Lot Maintenance and Cleaning

BMP Description:

- Graffiti removal activities are to be scheduled during dry weather.
- When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal.
- Nearby storm inlets are to be protected prior to removing graffiti. Runoff from sand blasting and high pressure washing should be directed into a landscaped or dirt area. If such an area is not available filter runoff through an appropriate filtering device (e.g. filter fabric) to keep sand, particles and debris out of storm sewers.
- When power washing using cleaning compounds, nearby storm inlets are to be plugged and water is to be vacuumed/pumped to the sanitary sewer.
- Waterless and nontoxic chemical cleaning methods (e.g. gels or spray compounds) should be used when possible.

Measurable Goals:

Number of projects that utilize storm drain covers (goal = 100% of all completed within the urbanized area)

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Graffiti Removal*, Stormwater Coalition of Monroe County, NY*

Sidewalk and Parking Lot Maintenance

Category of Municipal Operation: Roads, Streets, and Highways Operation and Maintenance

BMP Description:

- Prevent concrete, steel, wood, metal parts, tools and other work materials from entering storm drains or waterbodies.
- If present near the job site, cover storm drains prior to commencing repair activities to prevent accidental discharges
- Thoroughly clean up the job site when repair work is completed and properly dispose of any waste materials
- If surface cleaning (page 47 and 52), painting and paint removal (page 64), and graffiti removal (page 62) are performed, implement the appropriate procedures as outlined in those BMPs

Measurable Goals:

Use of storm drain covers

Recycling/proper disposal of waste materials

Timeline/Implementation Schedule:

Employee training

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Bridge Repair and Maintenance*, Stormwater Coalition of Monroe County, NY*

Painting and Paint Removal

Category of Municipal Operation: Roads, Streets, and Highways Operation and Maintenance

BMP Description:

- Paint and materials are to be transported to and from job sites in containers with secure lids and tied down to the vehicle.
- Do not transfer or load paint near storm drain inlets or waterways.
- Spray equipment is to be tested and inspected prior to starting to paint. Tighten all hoses and connections and do not overfill paint container.
- Nearby storm drain inlets are to be plugged prior to starting painting in areas where there is a significant risk of a spill reaching the drain. Remove plugs when the job is complete.
- Storm drain inlets are to be covered prior to sand blasting.
- If a bridge crosses a waterway, work should be performed on a maintenance traveler, platform or over suspended netting or tarps to capture paint, rust, paint removing agents, or other materials to prevent discharge of materials to surface waters. If sanding, use a sander with a vacuum filter bag.
- Capture all cleanup water and dispose of properly.
- Properly disposed of unused paint at a County Resource Recovery Center.

Measurable Goals:

Number of projects that utilize storm drain covers (goal = 100% of all completed within the urbanized area)

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on P2 BMP Summary Sheet – Painting and Paint Removal*, Stormwater Coalition of Monroe County, NY*

Litter Control

Category of Municipal Operations: Plaza, Sidewalk and Parking Lot Maintenance and Cleaning

BMP Description:

- Source reduction
  - Place outdoor litter containers in visible areas and empty frequently to prevent overflow. Containers should have lids.
  - Promote recycling programs
  - Develop an educational message to garner employee support
- Litter removal
  - Includes regular street and parking lot sweeping, catch basin cleaning and general property cleanup
  - Leaf collection program

Measurable Goals:

Annual sweeping of parking lots and sidewalks (see Appendix H)
Monthly property inspections to pick up general trash
Reduction in the amount of litter collected

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on BMP: Litter Control*, Springville City Corporation Public Works Department, Springville UT*

Erosion Control

Category of Municipal Operations: Landscape Maintenance

BMP Description:

- Preserve and protect existing vegetation on site
- Implement vegetative and soil protection practices in areas where soil is exposed
    - Establish permanent vegetative cover as soon as possible by seeding, seeding and mulching or sodding. Establish temporary vegetative cover until permanent cover can be established.
    - Secure mulch, erosion control blankets or other physical measures to protect exposed soil until permanent measures can be established.
- Use structural stormwater controls to reduce the amount or velocity of water flowing across erosive surfaces or divert water away from these areas.
- Inspect and maintain all erosion control measures to ensure proper function

Measurable Goals:

Severe erosion issues addressed within thirty-six hours of discovery; all other erosion issues addressed within 60 days

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires Annual inspection and maintenance as needed

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on BMP: Erosion Control*, Springville City Corporation Public Works Department, Springville UT*

Stormwater Conveyance Structures

Category of Municipal Operations: Drainage System Operation and Maintenance

BMP Description:

- Check surface over the pipe system for settlement or lost cover
- Inspect structural condition of outlet and inlets including headwalls and aprons for cracks, separation or collapsed ends
- Look for scouring or undermining, including evidence of animal burrows
- Look for scour at inlets and outlets due to heavy volumes and flows and assess need for erosion control measures
- Check for obstructions due to excessive vegetation, particularly trees or other woody vegetation
- Check pipe structure for collapse or deformation
- Check for corrosion on metal pipe, particularly at the inlet
- Look for deposition of sediment and other debris and remove as necessary

Measurable Goals:

Annual inspections

All repairs and maintenance completed within 60 days of discovery

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on Stormwater System Inspection and Maintenance Manual, *Georgia Department of Transportation, 2015.*

Controlling Illegal Dumping

Category of Municipal Operations: Drainage System Operation and Maintenance

BMP Description:

- Develop and implement public awareness program to prevent illegal dumping and encourage reporting
- Train staff to recognize and report incidents
- Establish system to track incidents that will identify:
  - Dumping hot spots
  - Types and quantities of waste
  - Patterns of occurrence (time of day, season, etc.)
  - Method of dumping
  - Responsible parties

Measurable Goals:

Decrease number of illegal dumping reports
Develop public awareness program by September 2017
Develop tracking system by September 2017

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on BMP: Illegal Dumping Controls*, Springville City Corporation Public Works Department, Springville UT*

Inlet and Outlet Structure Maintenance

Category of Municipal Operations: Drainage System Operation and Maintenance

BMP Description:

- Inspect riser/standpipe cover for trash and debris and remove as needed
- Inspect inlet, outlet pipes and emergency spillways for trash or debris that may be blocking
- Remove accumulated sediment at inlets, outlets, forebays, and emergency spillways
- Inspect pipes for structural integrity
- Inspect rip rap and replace as necessary
- Check for erosion around inlets, outlets and other features and install stabilization measures as necessary

Measurable Goals:

All repairs and maintenance completed within 60 days

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Monthly inspections of all stormwater controls

Specific Components and Notes:

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Based on Best Management Practices for Maintenance of Private Stormwater Facilities, *City of Cedar Rapids, Iowa Public Works Department, 2014.*

Plowing

Category of Municipal Operations: Cold Weather Operations

BMP Description:

- Plow prior to an application of chemical in order to minimize product dilution.
- Coordinate plowing activities to eliminate windrows at intersections and prevent removal of another operator's deicing material.
- Remove snow from roads as quickly as possible to reduce compaction.
- Avoid pushing snow over the bridge rails and onto roads or water beneath.
- Pay attention to wind conditions. If shoulder blading isn't critical, then delay until wind speeds are lower.
- Reduced speed minimizes the risk of a snow cloud. Lift the blade and wing if a snow cloud forms; do not slow down or brake.

Measurable Goals:

Develop annual winter maintenance plan

Conduct annual route preparation and planning

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

See *Michigan Winter Maintenance Manual* (Appendix H) for more information

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Reference: *Michigan Winter Maintenance Manual: Promoting Safe Roads and Clean Water*. 2013. See Appendix H.

Sand Application

Category of Municipal Operations: Cold Weather Operations

BMP Description:

- Sweep up excess sand after each event.
- Apply sand in extreme cold weather, when salt is ineffective.
- Avoid salt/sand mixes because they reduce each other's effectiveness. Determine if you need melting or temporary traction and choose the proper tool.
- Employ sand only for short-term traction needs. It has no melting capability.
- In limited situations such as a freezing rain event, a 25 to 50% sand/salt mix can be effective in increasing friction.[1]

Measurable Goals:

Track and reduce the amount of sand used

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

See *Michigan Winter Maintenance Manual* (Appendix H) for more information

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Reference: *Michigan Winter Maintenance Manual: Promoting Safe Roads and Clean Water*. 2013. See Appendix H.

[1] *Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators*, Second Revision, published by the Minnesota Local Road Research Board, 2012. http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf

Road Salt Application

Category of Municipal Operations: Cold Weather Operations

BMP Description:

- Calibrate salt spreaders to ensure proper application.
- Only apply the amount of salt needed to get the job done.
- Follow the proper application guidelines.
- Consider temperature when determining volume of salt to apply.
- Cleanup 'trackout' after a storm event around the storage area.
- Contain wash water from trucks used for salting and sanding in a holding tank for disposal or discharge into sanitary sewers.
- Explore alternative compounds to spread on the roads that have the same effect but are better for surrounding area.
- Store salt properly under cover to make sure salt is not leaving the storage area and draining to a storm drain or water body.
- Place salt piles in areas not subject to flooding.
- Use diversion berms to minimize water runoff from storage areas.

Measurable Goals:

- Salt storage structures are inspected annually and necessary repairs have been scheduled or completed within 60 days
- All deicing materials are stored under cover.
- Application components aren tested, calibrated, and maintained at regular intervals.

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires

Specific Components and Notes:

See *Michigan Winter Maintenance Manual* (Appendix H) for more information

Responsible Party for this BMP

Indicate who specifically is responsible for the implementation and monitoring of this BMP. This should be the individual who is actively involved with the BMP.

Name:

Department:

Phone:

E-mail:

Reference: *Michigan Winter Maintenance Manual: Promoting Safe Roads and Clean Water*. 2013. See Appendix H.

SECTION 6: Additional Program Components

6.1 Managing Vegetated Properties

Most of the vegetation management carried out on Ottawa County property pertaining to lawn care and landscape maintenance is through private contractors. If pesticide application is determined to be necessary, Ottawa County will require proof that the contractor and/or its employees are certified by the State of Michigan as a pesticide applicator in the appropriate category. As much as possible, contractors will use integrated pest management techniques and to minimize the use of pesticides to protect the environment and avoid potential surface or groundwater contamination.

Any Ottawa County staff that may apply pesticides during vegetation management or invasive species control on properties or in right of ways will be certified by the State of Michigan as a pesticide applicator in the applicable category. Ottawa County staff will be trained in the use of integrated pest management in order to consider all potential solutions before applying pesticides.

6.2 Contractor Requirements and Oversight

Ottawa County may hire contractors to complete routine operation and maintenance (O&M) procedures that are described in this handbook, such as catch basin cleaning. Any contractors that are hired to perform O&M activities must be required to follow all pollution prevention and good housekeeping practices described here. Language will be included in any bid packets and contracts to this effect. Contracts will also include language that allows designated Ottawa County staff to perform inspections to ensure that all PPGH practices are being followed. A copy of the handbook will be made available to all contractors performing O&M at Ottawa County properties or right of ways.

6.3 Employee Training

The MACC provides training opportunities to Ottawa County and other MS4 communities within the Macatawa Watershed. In class training will be scheduled for staff responsible for PPGH activities within one (1) year of adopting this manual. Online training modules are being developed to cover PPGH required activities, and staff responsible for PPGH activities will be required to complete the modules once during each permit cycle. Any new staff will be required to complete the online training modules within one year of their date of hire. In-class training sessions will be available and scheduled as needed. Additional online modules will be created for special interest topics, such as lawn care or rain garden maintenance. Employees will be encouraged to participate in these as applicable.

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APPENDIX A

FACILITY ASSESSMENT CHECKLIST

Municipal Operations Stormwater Assessment

FACILITY/BUILDING NAME

Activity																						
Stormwater Drainage and Conveyance System																						
Not applicable																						
Dredging																						
Inspections of system components (how often)																						
Record keeping and frequency tracking																						
Maintenance, repair, cleanout of system components																						
Maintenance of open drain ditches																						
Dumping of vactor spoils																						
Winter Maintenance																						
Snow stored on site																						
Snow removed off site - where?																						
Snow is stored away from wells																						
Snow is stored out of wetlands/floodplains																						
Snowmelt is directed to structual control																						
Parking Lot/Sidewalk Salting Performed																						
Salt Storage On-site																						
Alternative Materials Used (ie.sand)																						
Salt Vehicle Washing																						
Sensitive or Priority Waterbody Considerations																						
Spreaders Calibrated and Maintained																						

Municipal Operations Stormwater Assessment

Activity																					
Municipal Building Maintenance																					
Contractor Used for Maintenance																					
Bulk Fuel Storage																					
Other bulk fluid storage (list)																					
Hazardous Materials Storage																					
Spill Prevention and Response																					
Flourescent Light Recycling																					
Paper/Plastic Recycling																					
Roof Drainage Systems																					
Building Washing Performed																					
Sidewalk Cleaning (powerwashing)																					
On Site Septic System systems																					
Septic Inspections and Record Keeping																					
Dumpsters covered																					
Dumpsters have secondary containment																					
Contractor used for lawn care/landscaping																					
Lawn mowing																					
Lawn/landscape watering																					
Lawn/landscape fertilizing																					
Pesticide application																					
Lawn equipment and chemical stoarge onsite																					
Staff have been trained re. Stormwater mgmt Principles																					
Sump pumps connected to storm sewer																					

Municipal Operations Stormwater Assessment

Activity																					
Vehicle Equipment Maintenance																					
Not applicable																					
Vehicle storage (indoor or outdoor)																					
Vehicle washing done outside																					
Vehicle washing done at commercial facility																					
Maintenance done outside																					
Maintenance done inside																					
Maintenance done at commercial garage																					
Vechicle fluid bluk storage (list)																					
Recycling oil and antifreeze																					
Spill prevention and response plan																					
Wastewater disposal and treatment from wash water																					
Oil water separator on site																					
Staff have been trained re. stormwater mgmt principles																					
Impervious Surfaces Maintenance																					
Not applicable																					
Sidewalks and parking lots cleaned (sweeping)																					
Dumping of Sweeper Waste																					
Repairs done by staff																					
Repairs done by contractors																					

Municipal Operations Stormwater Assessment

Activity																						
Streambank and Hydrologic Habitat Maint.																						
Not applicable																						
Stream bed dredging																						
Creek bottom sediment removal																						
Removal of woody debris																						
Bank reshaping																						
Cleaning culverts and outfalls																						
Priority setting for streambank stabilization projects																						
Use of alternative "soft" engineering approaches																						
Inventory of ponds																						
Pond maintenance program																						
Buffer strips																						
Parks & Open Space Maintenance																						
Not applicable																						
Maintenance Contractor Used																						
Fertilizer Application																						
Pesticide Application																						
Fertilizer and Pesticide Usage Records																						
Integrated Pest Management Use																						
Lawn mowing																						
Lawn equipment and chemical storage onsite																						
Lawn/landscape watering																						
Erosion Control Practices																						
Pet Waste Present																						
Pet Waste Education																						
Recycling																						
Litter Control																						
Dumpsters covered																						
Dumpsters secondary containment																						
Hazardous Materials Storage																						
Staff have been trained re. Stormwater mgmt Principles																						

INVENTORY OF MUNICIPAL PROPERTIES

Common Name of Property: _____

Property Location: _____

Person(s) completing this form: _____ **Date:** _____

Property type (check one)

☐Administration building	☐Animal control building	☐Airport	☐Bus station/terminal
☐Cemetery	☐Composting facility	☐Equipment storage/maintenance	
☐Fire station	☐fuel farm	☐Hazardous waste disposal	
☐Landfill	☐Library	☐Material storage yard	
☐Park/open space	☐Pesticide Storage	☐Police station	☐Public parking lot
☐Public School	☐Public works yard	☐ Recycling facility	☐Salt storage
☐Solid waste handling facility	☐Vehicle storage/maintenance	☐Other: _____	

Does storm water from this property enter the MS4 owned conveyance or Waters of the State?

☐ YES ☐ NO, stormwater goes to the sanitary sewer
☐ NO, there is no runoff ☐ DON'T KNOW

If NO, then go to next Municipal Property. If YES or DON'T KNOW, then continue with this form.

Structural Stormwater Controls at this Facility

Control Measure or BMP	**Qty.**	**Inspection Frequency**	**Maintenance Schedule**	**BMP operation & maintenance program**
☐ vegetated swales				
☐ infiltration facility (e.g. seepage pond, drywell)				
☐ detention pond or sedimentation facility				
☐ bioretention facility (e.g. raingarden)				
☐ storm water devices (swirl separation or other proprietary device)				
☐ curb, gutter, catch basins, storm sewers				
☐ filter				
☐ grit separator				
☐ oil/water separators				
☐ isolated sump				
☐ vegetated buffer strips				
☐ porous pavement				
☐ underground storage tanks				
☐ any other controls _____				

Is there a map available of the stormwater structural controls? ☐**YES** ☐**NO**

Municipal Operations at the Property: complete attached

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APPENDIX B

WINTER PARKING LOT AND SIDEWALK MAINTENANCE MANUAL

Winter Parking Lot and Sidewalk Maintenance Manual

Winter Parking Lot and Sidewalk Maintenance Manual

Reducing Environmental Impacts of Chloride

Written by:

Minnesota Pollution Control Agency

Fortin Consulting, Inc. serving the environment

Minnesota Department of Transportation

CTAP Circuit Training and Assistance Program

University of Minnesota

minnetonka

Certified Snow Pros & Landscapers

GGP General Growth Properties, Inc.

Envirotech

LTAP

Scott

Prepare

For winter operations

Take Action

To keep parking lots clear

Winter
Parking Lot and Sidewalk
Maintenance Manual

Evaluate

The effectiveness of your actions

Application Rates

For reduced environmental impacts

08/24/06
Revised:
June 2008

Resources

And biblography

Winter
Parking Lot and Sidewalk Maintenance Manual

June 2006

Revised June 2008

Produced by:

Minnesota Pollution Control Agency

FORTIN CONSULTING, INC. serving the environment

CTAP Circuit Training and Assistance Program

minnetonka

UNIVERSITY OF MINNESOTA

MINNESOTA DEPARTMENT OF TRANSPORTATION

LTAP MINNESOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

ENVIROTECH SERVICES, INC.

Cadwell Lawn Care & Landscaping Saving Our Customers And The Environment

GGP General Growth Properties, Inc.

Scott Celebrating 150 Years

Acknowledgments

This manual is dedicated to helping Minnesotans protect the environment. Whether you are the plow driver, the building manager or the traveling public, you have an important role to play in protecting our environment.

The *Winter Parking Lot and Sidewalk Maintenance Manual* is based on the *Minnesota Snow and Ice Control Field Handbook for Snowplow Operators* produced by the Minnesota LTAP Center and on the training materials for the MPCA parking lot winter maintenance training class. Thanks to the following sponsors and participants for their valuable input in the production of this document.

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Table of Contents

List of Tables and Figures

Purpose of this Manual

The purpose of this manual is to deliver practical advice to those who manage parking lots and sidewalks. This manual will help you make better, proactive, cost-effective choices in winter parking lot and sidewalk management. It will give you knowledge to become a leader in your industry by operating more efficiently and reducing environmental impacts.

A blanket approach will not work for the range of conditions Minnesota experiences; different strategies are needed for different regions and different conditions. We encourage you to continue to test, document, and refine the practices from this manual.

Throughout the manual you will find environmental tips shown with a fish symbol. These tips will help you reduce environmental impacts from snow and ice control operations.

Throughout the manual you will find cost-saving tips shown with a dollar symbol.

Background Information

Good Business Choices

Customer service is the key to success. You can use Best Management Practices (BMP's) to keep parking lots and sidewalks safe and also reduce environmental impacts. By taking time to educate your customers on the proper methods of snow removal and ice control (and the value to them), you can create a good and long standing-relationship with them.

Your customers want reliable service. Providing a well-planned and executed winter maintenance program will leave a positive impact on your customer. By using the latest technologies, you will be more reliable. By providing a higher level of service, you are likely to reduce slip and fall exposures.

Your customers want someone educated on parking lot maintenance. You are educating yourself on best practices for winter maintenance, with this handbook.

If you use the right amount of material at the right time, you will save time and money.

Certification in snow and ice control is a good reflection on you and your organization.

Your customers and the public want safe parking lots and sidewalks. By understanding the materials, weather and application rates, you will have a head start on controlling icy, slippery parking lots and sidewalks.

Your customers want clean and neat parking lots and sidewalks. By using less material and increased winter sweeping, pedestrians will track less material into buildings, and there will be less damage to flooring. Proper snow storage makes debris removal in the spring easier. Covered storage of deicers looks better, will reduce loss of material and will protect water. By preventing vehicle leaks, cleaning up spills and using lower application rates, you will keep parking lots and sidewalks neat.

Your customers want affordable snow and ice control. By using more sophisticated chemicals, you might need a bigger budget up-front. Initially you may have to charge more for using liquids. However, these costs are likely recovered by reduced sweeping, reduced floor and rug maintenance, reduced parking lot striping and reduced snow and ice maintenance time. Companies are willing to pay to keep the dirt out.

Your customers want to protect our lakes and rivers. Educate your customers on the importance of responsible deicing applications.

The best way to protect our lakes is to use less material. It is difficult to recover salt or sand once applied.

Water and Environmental Impacts

- Only 2.5 percent of all of the water on this planet is freshwater (not saltwater). Of that, less than 1 percent is available to us. The majority of our freshwater is frozen in the glaciers.

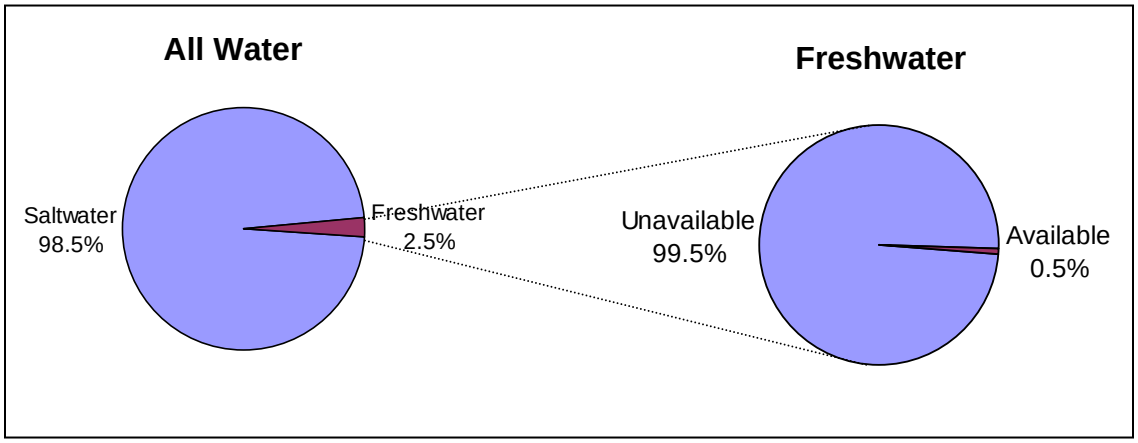

Figure 1. Available Water

- Water is recycled over long periods of time. We have a limited supply of water on this planet. Water is reused, recycled and dispersed as illustrated below from MnDNR "Healthy Rivers a Water Course" CD-Rom.

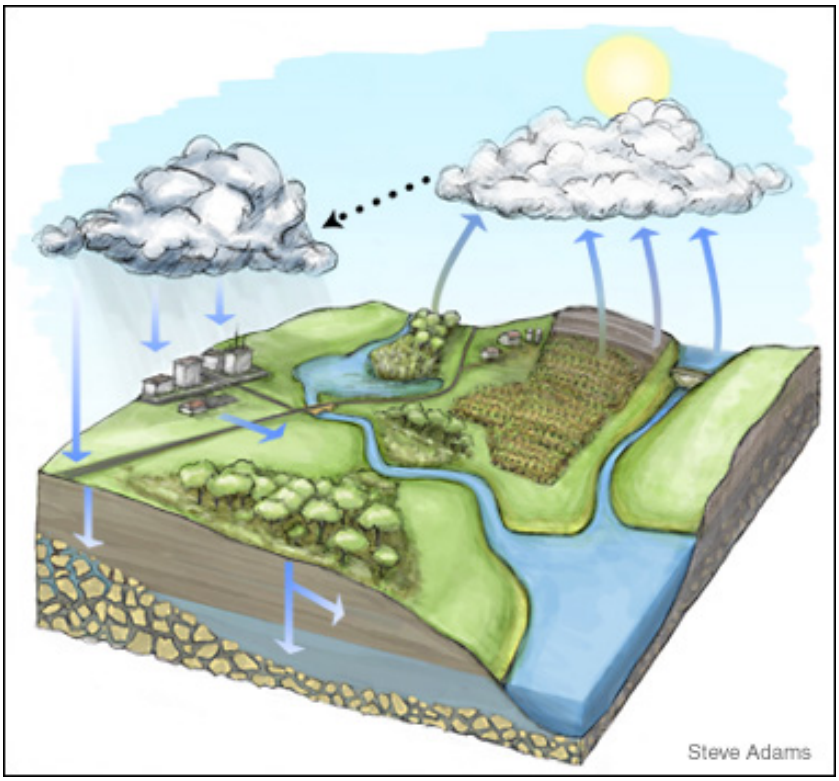

Figure 2. The Water Cycle

- Forty percent of Minnesota's tested lakes and rivers are polluted enough to be put on the federal list of impaired waters. For a list of impaired waters, including those impaired by chlorides, see www.pca.state.mn.us/water/tmdl/index.html
- A lot of salt is used in winter maintenance. The average salt use in the Twin Cities Metropolitan area is 350,000 tons per year (Sander et al. 2007).

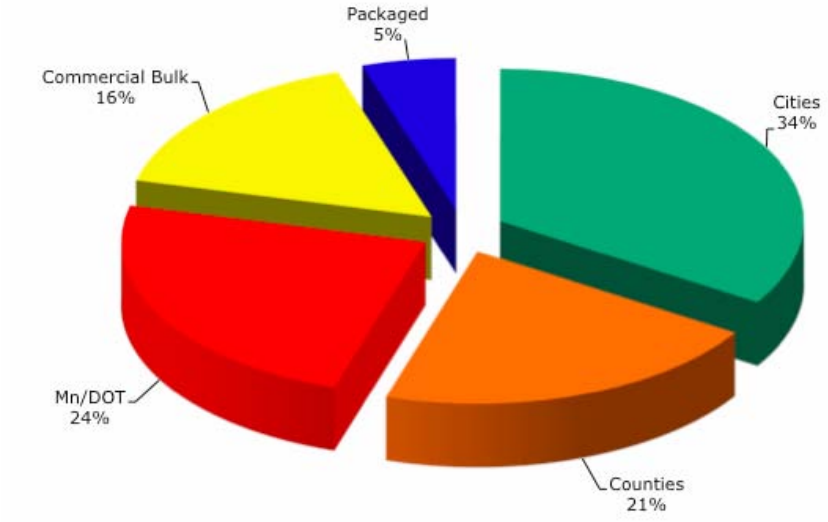

Figure 3. The Distribution of road salt use in the Twin Cities Metropolitan area.

- Our lakes are becoming more saline with increase road salt use.
- Salts dissolve and move downhill with the water to the nearest lake, river or pond. They do not settle out; they stay in our water cycle virtually forever.
- The concentration of chloride is increasing in our surface and groundwater. Salt water is heavier than freshwater and sinks to the bottom of the lakes. Eventually causing chemical stratification of the lake and loss of lake turn over.

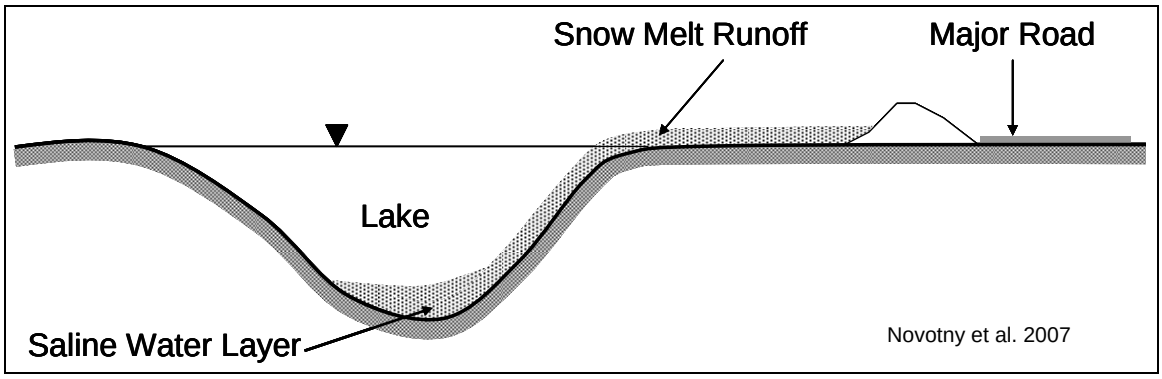

Figure 4. Schematic of a saline water intrusion into a lake

Reduced salt use equals reduced salt in lakes and streams.

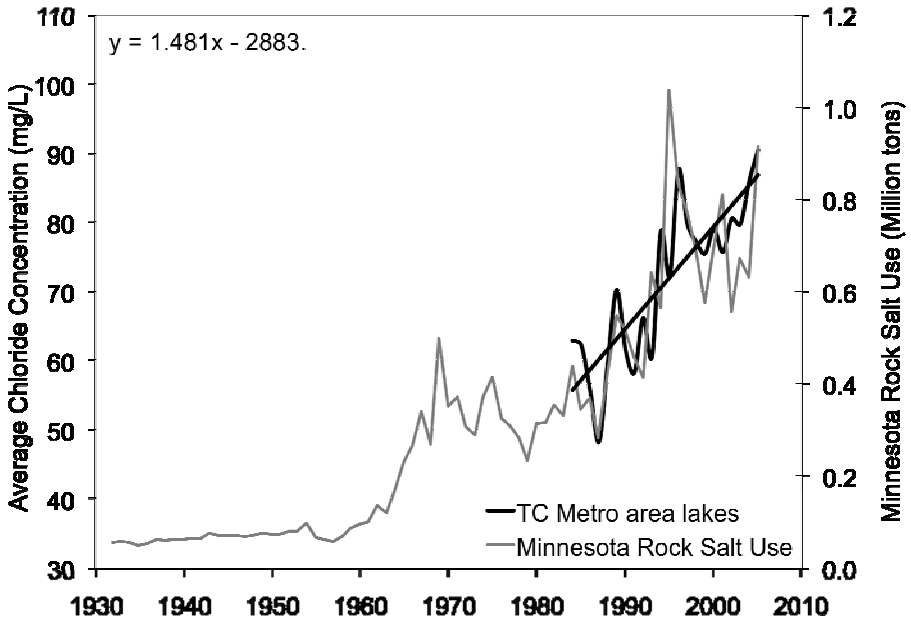

Figure 5. Lake chloride concentrations and rock salt use

Comparison of lake chloride concentrations in 39 Twin Cities lakes and rock salt purchases by the state of Minnesota.
(Novotny et al. 2007).

- Winter sand leaves parking lots and moves downhill with water to the nearest lake, pond or river. They fill in the bottoms of our lakes and rivers, accelerating the aging process of the water body and disrupting the food chain.
- In 2004-2005, the MPCA measured chloride concentrations in Minnesota's ground water. The results show that Minnesota's urban areas have the highest occurrence of chlorides (25-150 mg/L). (MPCA Minnesota's Ground Water Condition: A Statewide View 2007).
- To remove salt from water reverse osmosis is required. This is not practical for our lakes, rivers, groundwater and wetlands. Therefore prevention is important.

1 ton of rock salt ($50) causes greater than $1,450 in corrosion damage to bridges. (Sohanghpurwala 2008)

Fathead Minnows will die if exposed to chloride concentrations of 443 mg/l for more than 30 days
(http://duluthstreams.org/understanding/impact_salt_2.html)

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Prepare for Winter Operations

Policies

Start now! Develop a maintenance policy with your customer. A little planning and communication up-front can help you do a better job.

- To see example policies www.mnltap.umn.edu/ctap.
- Schedule training for you, your crew and customer. Check the MPCA website to find out about upcoming training opportunities: www.pca.state.mn.us/programs/roadsalt.html .
- Discuss the maintenance policy with your crew.
- Address customer expectations, the hours and use of the building, priority access points and environmental concerns in your policy.
- Inform your customers of any changes to your snow and ice maintenance program, and why you are making them.
- Include site monitoring in the policy.
- Plan for year round sweeping.
- Document any closed building entrances during the winter. If this is agreeable, it would reduce the amount of chemicals and maintenance time.
- Reduce your risk by having a solid written winter maintenance policy and training program that utilizes best management practices.

Our waters are threatened by policies which are based on fees for material use. This encourages overuse of materials.

Reduce your liability. Establish a maintenance policy with the customer and follow it.

Storage

Storage areas often cause groundwater or surface water contamination.

Snow Piles

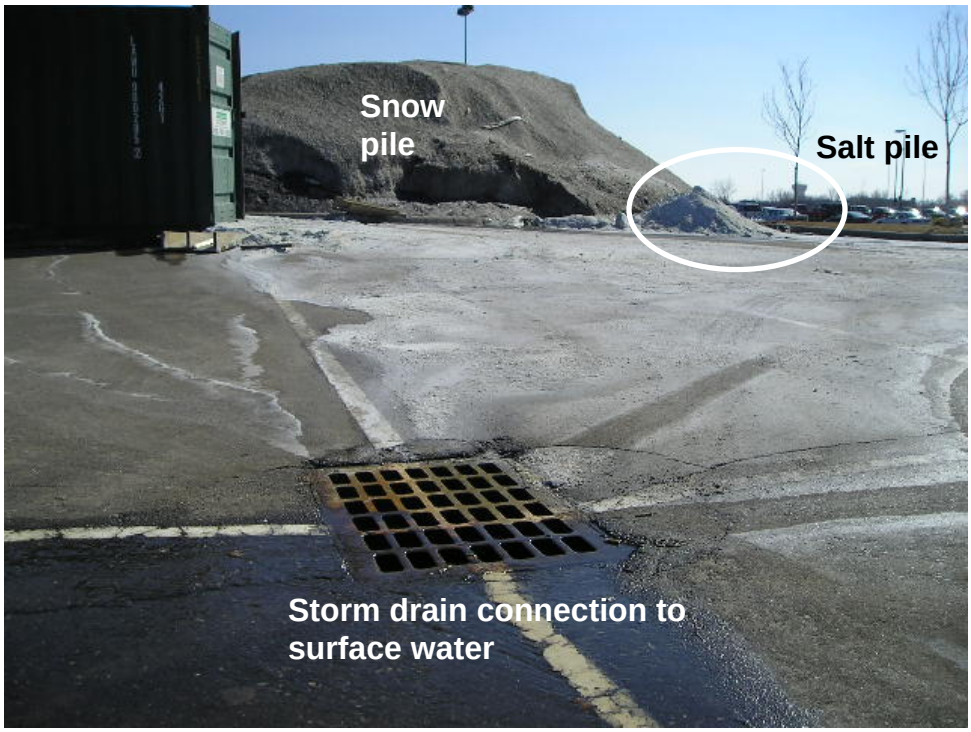
- Store in an area where you can recover the solids after the snow melts.
- Locate snow down-slope from salt and sand storage. Prevent snow melt from flowing through salt or sand storage area.
- Avoid pushing snow into lakes, ponds, wetlands, rivers or other natural areas. This will increase the amount of solids that can be recovered after the melt.
- Windrows of snow can be used to guide motorists in parking when they cannot see the parking lines.

Salt Piles

- Store salt where it is protected from rain, snow and melt water.
- Store on an impervious surface.
- Cover all piles, ideally indoors.

Improper storage of salts can lead to groundwater contamination.

- Sweep loading areas back into the pile to reduce leaching.
- Contoured pads (bowl-like) for pretreated salts, reduces runoff from the pile.
- Store away from lakes, rivers, ditches, storm drains and wetland edges.



A common mistake is storing a snow pile uphill of a salt pile.

Figure 6. Incorrect Salt Storage: uncovered and placed in path of melting snow pile

Salt storage areas are often a source of groundwater contamination. To reduce risk, have a covered storage area on an impervious pad. Take measures to keep salt or salt brine from leaving storage area.

Salt Bags

- Store away from rain or snow.
- Dispose of bags properly.
- Seal open bags.

Liquids

- Understand the freezing point of your liquid. This will determine if it can be stored outdoors or if it must be stored indoors. Salt brine (NaCl) should be stored indoors.
- Storage tanks for liquids are regulated by the MPCA.
- Tanks should be double-walled or have secondary containment.
- Label the tank documenting its contents.
- Before installing tanks, check on local visual screening ordinances.
- Some above-ground storage tanks are exempt from regulations:
    - Those with a capacity of 500 gallons or less.
    - Those with a capacity of 1100 gallons or less and not located within 500 feet of Class 2 surface water (Class 2 surface water includes all

Minnesota waters that are or may be used for fishing, fish culture, bathing, or any other recreational purpose and where it may be necessary to protect water or plant life as well as the public health, safety, or welfare).

- For more information on storage tanks see www.pca.state.mn.us/cleanup/ast.html, Minnesota Rules Chapter 7151

Sand piles

- Winter sand is typically mixed with some deicer to prevent freeze-up of the pile. Therefore, sand pile storage should be the same as salt pile storage.
- Do not use leftover winter sand for other uses. Save it under cover for the next season.

Prevent groundwater contamination. Do not locate storage areas near wells. Limestone regions with fissures and sinkhole are very prone to groundwater contamination as are sandy soils.

Weather

Knowing existing and potential weather conditions is very important for a successful snow and ice control operation. Monitor the weather closely so that you are prepared to act early in storm situations. Check the National Weather Service (website http://www.noaa.gov) local TV station, or website weather. A Road Weather Information System (RWIS) is available on the Internet at www.rwis.dot.state.mn.us. RWIS provides information like pavement temperature from various locations around the state.

Pavement Temperature

You must know the pavement temperature to determine the proper amount and type of material to apply. Most weather stations report air temperature measured at a height of 30 feet above ground, which can differ from pavement temperatures. There is not a direct correlation between air temperature and pavement temperature.

Figure 7. Temperature Sensor

Pavement temperatures differ from sunny to shaded areas and concrete to asphalt surfaces. Similar surfaces constructed over different base materials hold temperatures differently. Seasonal differences also occur. The same air temperature in November and January will often show very different pavement temperatures.

Why guess. You can purchase hand-held temperature sensors from auto part stores for about $100. They are designed to measure engine temperature. Make Sure the one you buy has the appropriate temperature range and accuracy for cold weather work.

Be still and point pavement sensor at the ground to get a reading. Mirror-mounted temperature sensors are also available; they are less likely to be lost or stolen but do cost more and are generally not available at an auto parts store. A small investment in equipment will improve your performance.

Getting prepared for winter

- Calculate the area of your parking lots, service roads and sidewalks.
- Identify snow storage areas.
- Understand the properties of various deicers, and then select the type(s) to use.
- Estimate the amount of material you will need using the application rate charts. Order based on your estimate.
- Understand the environmental problems caused by snow, salt and sand storage. Determine where and how you can best store each item.
- Train your crew on proper application rates.
- Mark islands, fire hydrants and other landmarks obscured by snow.
- Note existing conditions of curbs and other items that might be damaged by winter maintenance.
- Note or mark all catch basins and manholes that may cause a hazard to the plow and the operator.

Knowing the pavement temperature will allow you to apply the proper amount of material for each situation.

Drainage

Take time to inspect drainage ways and, remove obstructions to prepare for the spring melt. Never open frozen storm drains with high doses of salt. This is toxic to aquatic life in the receiving waters. Use other methods such as heat to open drains. Look for ways to capture any solids before they enter the storm drain system. Make sure your parking lot does not drain through your salt storage area.

Storm drains lead to the nearest lake, river, pond or wetland. They do not go to a treatment plant.

Calibration

Calibration is an essential procedure to measure the amount of material applied. No matter how sophisticated or simple your operations, always calibrate each piece of equipment yearly. The trend is to use less material. Purchase equipment that has the capability to deliver low application rates. You can calibrate any type of equipment. Just find a way to determine how many pounds of material per minute is landing on the pavement or sidewalk over a measured area or distance, and for differing speeds.

All good programs are based on calibration of equipment.

If you cannot or choose not to calibrate your equipment, you will need to calculate the size of the parking lot, the surface temperatures and the material you are using. The application rate chart and these three

parameters will tell you how many pounds of deicer to apply. Without calibration, it will be up to you to find a way to evenly distribute the recommended amount across your parking lot.

- Because spreaders vary, calibrate each truck.
- Calibrate separately for every type of material you use.
- If you don't have different settings, you can change your application rate by adjusting the gate opening and truck speed.
- Place the calibration results, for each setting, in your truck.
- For specific calibration directions, contact the manufacturer.

Calibration tells you how much material will be applied at each setting or at each speed.

Calibration will allow you to more accurately use your deicers.

Simple Calibration for Conveyor and Auger Spreaders

If your equipment has different settings, you will need to calibrate for each setting. Make sure the auger plate is in place while calibrating. It generally takes three people to calibrate equipment: one to run the truck, one to catch the material and one to count the auger revolutions. Repeat the calibration for different materials.

Best bet: Contact manufacturer for calibration instructions.

Step 1: Calculate discharge rate

- Mark the auger or conveyor shaft so you can tell when a revolution has been made.
- Determine how many pounds are discharged per auger/conveyor shaft revolution. Capture in a bucket or tarp the amount of material that comes out for one revolution and weigh it. For more reliable results, do this three times and average the results.
- Count the number of revolutions per minute.
- Lbs/revolution X number of revolutions/minute = discharge rate in lbs/minute.

Example: *5 lbs of dry salt was the average amount dropping in 1 revolution. 10 revolutions occurred in one minute. The discharge rate is 50 lbs/minute. We tested setting #1 using dry rock salt (NaCl). We were discharging 50 pounds/minute and at 15 mph the application rate is 200 lbs/mile.*

Step 2: Calculate application rate:

Speed	Time to drive 1 mile	Discharge rate Per setting*	Application rate (discharge x time)	Type of material
5 MPH	12 minutes			
10 MPH	6 minutes			
15 MPH	4 minutes			
20 MPH	3 minutes			
Example: 15 MPH	Example: 4 minutes	Example: 50 lbs from setting #1	Example: 200 lbs/mile	Example: Dry salt (NaCl)

Table 8. Calibration Chart for Auger Spreader

*This number is always the same for each setting

Simple Calibration for Gravity Flow Equipment

Gravity flow equipment is very difficult to calibrate and likewise very difficult to deliver products in a consistent manner. Look for ways to upgrade your equipment. This calibration procedure can also be adapted for use on sidewalk equipment.

Step 1: Calculate discharge rate

- Mark out a 10-foot stretch of road/parking lot.
- Sweep it clean of sand or any other material.
- Drive the truck and start applying material prior to the marked area. When you cross the start point, make sure your speed stays at the desired speed and remains consistent for the 10-foot stretch. Continue spreading material a short distance beyond your marked area.
- Record your vehicle speed.
- Measure the width the material is spread or bounces, in feet.
- Sweep up and weigh the material that is within your marked 10-foot stretch.
- Record the lever position/setting for the gate/chute. If there are no numbers for the positions, make your own permanent marks and numbers on the equipment to identify the positions.
- To improve accuracy, repeat this procedure two more times and calculate the average weight of material applied.

Step 2: Repeat step 1 for different speeds, settings and materials

Step 3: Create an application rate chart to keep in your truck

- Using the information gathered, make an application rate chart to indicate how much material is applied at each setting and speed.
- If you use more than one type of material, repeat the test for each material.
- Place the completed calibration chart in each truck. You can use it to compare to the recommended application rates.

Calculate application rate:

Vehicle: _____ Material:_____ Date:_____

		A	**B**	**C**	**D**	**E**
Speed	Lever position or gate setting	Lbs. Material recovered in 10 feet	Spread width in feet	Coverage area in sq/ft (**B x 10**)	Application rate in lbs/1000 ft^2 (**1000/C x A**)	Application rate in lbs/lane mile (12' width) (**D x 63.4**)
5 MPH						
10 MPH						
15 MPH						
20 MPH						
Example 20 MPH	*Setting 2 Half-closed*	*0.4 lbs*	*13 feet*	*130*	*3.1 lbs/1000 sq. feet*	*196 lbs/mile*

Table 9. Example Calibration Chart for Gravity Flow Equipment

Example:

- *Using sand, driving 20 mph, spreader position half closed.*
- *0.4 lbs of sand was recovered in the 10-foot length, spread out to a 13-foot width (the width the sand bounced to).*
- *Coverage area = 13 feet wide by 10 feet long or 130 square feet.*
- *Since the application rate tables are all in 1000 sq ft units, you can compare this test to the recommended application rate tables.*
- *To determine how much would be spread in 1000 square feet, divide 1000 by the coverage area and multiply by the lbs. of material recovered 1000/130 x 0.4 = 3.1.*
- *The application rate delivered is 3.1 pounds per 1000 square feet. If you want to convert it to lbs. per 12 foot lane mile, multiply by 63.4.*

Desirable Equipment Features

- Ability to calibrate
- Ability to deliver low application rates
- Control switch in cab

Some fish species are affected by concentrations of less than 1000 ppm sodium chloride, about 1 to 1.5 tablespoons of salt in 5 gallons of water.

Apply wisely. We will never have a chance to recover the chemicals applied.

Calibration Chart

Calibration Chart for Gravity Flow Equipment						
Vehicle or spreader number:					Date:	
Material Type:				Calibrated by:		
		A	**B**	**C**	**D**	**E**
Speed	Lever position or gate setting	Lbs. Material recovered in 10 feet	Spread width in feet	Square feet covered with material (**B x 10**)	Application rate in lbs/1000 ft^2 (**1000/C x A**)	Application rate in lbs/lane mile (12' width) (**D x 63.4**)

Table 10. Blank Calibration Chart for Gravity Flow Equipment

How Salt Works

- Salt is a deicer, it will melt snow and ice.
- Sand is an abrasive; it does not melt snow and ice.
- Abrasives provide traction on top of packed snow or ice.
- Abrasives and deicers do not work well mixed together.
- Salt lowers the freezing point of water from 32 ºF to a colder temperature.
- Salt must be in solution (brine) to work, it won't do anything until it begins to dissolve.
- Salt brine (NaCl) is most effective at a 23.3% solution.
- The melting power is reduced as more snow falls or melts and the brine becomes less than 23.3%.
- The melting power is reduced as more salt is applied making a stronger ("hotter") mix and the brine becomes more than 23.3%.
- A deicer (salt) will work until the freeze point of the brine equals the pavement temperature. At this point the salt will stop melting and you may experience refreeze if pavement temperatures are dropping.

One application rate will not fit all storms; how long an application lasts depends on:

- Pavement temperature
- Application rate
- Precipitation
- Beginning concentration of the brine

Speed of Melting

Will the road salt you apply have time to work or is it time to switch to a different deicer? This chart will aid you in making that decision.

Pavement Temp. ºF	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs of ice	5 min.
25	14.4 lbs of ice	10 min.
20	8.6 lbs of ice	20 min.
15	6.3 lbs of ice	1 hour
10	4.9 lbs of ice	Dry salt is ineffective and will blow away before it melts anything
5	4.1 lbs of ice	
0	3.7 lbs of ice	
-6	3.2 lbs of ice	

Table 11. Speed of Melting

Don't use road salt below 15º F . You are wasting money and time.

Selection and Use of Materials

Factors to consider

- Environmental impacts
- Practical melting temperature
- Testing
- Cost and availability

Human drinking water cannot exceed 250 mg/l chloride

Environmental Impacts

Deicers are not environmentally safe no matter what the bag says. Do not buy a product based on this claim.

Chlorides:

- Are less effective if applied in concentrations that are too high. The correct concentration is crucial, just like anti-freeze in your car.
- Are corrosive to steel unless they have a corrosion inhibitor added.
- Have corrosion inhibitors and anti-caking agents that are often toxic substances.
- Damage plants through direct toxicity or by interfering with water uptake.
- Change the soil structure.
- Are often the least expensive and most available deicer.
- Are not removed by holding ponds or rain gardens.
- Can be removed by water by reverse osmosis, a very slow and expensive process

About 1 teaspoon of salt can pollute 5 gallons of water forever. This applies to all chlorides.

Acetates:

- Are non-chloride compounds. They have different melting characteristics than chlorides.
- Are an organic substance.
- When added to water, compete with aquatic life for oxygen.
- Contribute nutrients which promote algal blooms in lakes and ponds.
- Cause problems in our waters but tend to be less persistent than the problems introduced by chlorides.
- Are usually safer for vegetation.
- Have less corrosion potential and are often used at airports or in areas with expensive infrastructure such as bridges.
- Have the potential to be treated by holding ponds.

Acetates can have a high biological oxygen demand (BOD), and can contribute to oxygen depletion in soil and water. Use carefully.

Plant-based additives:

- Often corn, beet, molasses or other organic additives are added to salts to improve performance. Increased performance allows for lower application rates.
- These additives do not contribute chlorides to the water but contribute nutrients (fertilizer) to the water. The impact they have is to increase aquatic plant and algae growth. They also use oxygen as they decompose.
- The impacts are serious but not as long-lasting as chlorides.

One lb. of phosphorus encourages growth of up to 500 lbs of algae. Phosphorus is in plant-based products.

Vegetation:

- Deicers can be very damaging to both soil and vegetation.
- Our efforts should be to keep salt off of vegetation: Drive slower when applying deicers, turn down spinner speed to reduce spread pattern, use drop spreaders on sidewalks, store snow piles on hard surfaces, and reduce application rates.
- One source of information about salt-tolerant plants is the MnDOT plant selector tool ***http://plantselector.dot.state.mn.us.***

Figure 12. "Witches Broom" Branching from Salt Spray

Salt spray damages budding and branching of trees.

Salt changes the soil structure. It reduces its permeability and reduces the nutrients in the soil available for the plant uptake.

Practical Melting Temperature

Be careful when reading the melting temperature on bags of deicers. They often list the eutectic temperature, which is the lowest possible melting temperature. At this temperature it would take a very long time to melt ice. Instead, use the lowest practical melting temperatures in the chart below or ask your supplier for the practical melting temperature and the time it takes to melt ice at that temperature. Remember, use pavement temperature, not air temperature.

Chemical	Lowest Practical Melting Temp.	Eutectic Temp.	Optimal Concen-tration
NaCl (Sodium Chloride) —Delivered as solid rock salt, also can be made into a brine. The basis of most deicing materials. Very corrosive. Inexpensive. Very available. Rarely has a corrosion inhibitor added.	15º F	-6º F	23%
$MgCl_2$ (Magnesium Chloride)—Delivered as a liquid. Often used to wet NaCl crystals to increase adherence to surface and reduce melting points. Corrosive. Higher cost. Often has a corrosion inhibitor added.	-10º F	-28º F	27 to 30%
$CaCl_2$ (Calcium Chloride)—Delivered as flakes, pellets, or liquid. Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost. Often has a corrosion inhibitor added.	-20º F	-60º F	30%
CMA (Calcium Magnesium Acetate)—Delivered as a powder, crystals, pellets, or liquid. Liquid CMA is used mainly on automated bridge deicing systems. Non-corrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibiter. Alternative for areas where chloride use must be limited. Often higher cost.	20º F	-18º F	32%
KAc (Potassium Acetate)—Delivered as a liquid. Often used on automated bridge deicing systems and airports. Use for anti-icing, deicing, and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.	-15º F	-76º F	50%
Blends— Both chlorides and acetates exist in blends. Talk to your supplier and determine the lowest practical melting temperature, the optimal concentration and the basic components in the blend. Most blends are centered on rock salt since it is cheap.			
Winter Sand/Abrasives—Winter sand has some salt mixed in it to keep it from freezing. Abrasives should be used for cold temperatures when deicers are not effective. They provide temporary traction but only work when they are on top of the ice.	Never melts—provides traction only		

Table 13. Lowest Practical Melting Temperature

Testing

The best way to reduce impacts, save money and maintain customer satisfaction is to:

- Know what is in your product.
- Know how and when to use it.
- Use the minimum amount needed to get the job done.
- Seek out products that allow for smaller application rates.

Take time to test your materials to ensure that they perform as expected. Do not rely solely on the bag or on the manufacturer's literature. There are no labeling requirements so manufacturers can choose to label products in their own way. Labeling can be confusing; some list the eutectic temperature while others list the lowest practical melting temperature. The list of ingredients may or may not be included. Often the percentage of each ingredient is not included. Research your product, understand the practical melting temperature and get a list of the ingredients.

An area of special concern is the transition to liquids. Anti-icing liquids if over applied can become slimy or slippery. Test your application rates and your spray pattern so you can become confident in preventing the bonding of ice without creating a slimy or slippery situation.

For pre-treating stockpiles, add liquids conservatively. The dry material can only hold so much liquid before leaching occurs. Keep a close eye on your storage area to make sure it can contain the wet salt pile. Test your liquid application rates and your storage facility on a small stockpile before doing this on a large scale.

Cost and Availability

Sodium Chloride (Road Salt) is typically the cheapest and easiest to find of the deicers. Because of this it is widely used and overused. Sodium Chloride is only effective at pavement temperatures above 15 degrees. Because it doesn't work well at colder temperatures it is often over applied in attempts to get it to work better. At temperatures lower than 15 degrees switch to a different deicer.

Non-chloride deicers are more difficult to find and often cost more. If you are concerned about the long term effects of chlorides on our lakes and rivers, take time to find a source for alternate products and give them a try. As the demand for non-chloride deicers increases, the cost will drop and the products will be easier to find. All deicers have environmental impacts but the impacts of chloride based deicers are very long term.

Salt and sand mixes are commonly used to stretch the salt budget. This is an ineffective practice. Salt and sand work against each other. To save money use deicers when you need to melt and sand when you need temporary traction. Mixing them decreases the effectiveness of both products and increases the cost.

If you use a 50/50 salt/sand mix, you're generally either half right or half wrong. Using a salt/sand mix leads to over application of both materials.

Sidewalk Tips

Always remove snow prior to applying deicers. If you plow first, the chances of refreeze diminish and slush build-up is minimized.

- Sidewalks are often the most over-salted of all areas in winter maintenance.
- Sidewalks are the area of highest tracking into the building. Extra salt and sand contribute to slippery entryways inside the building.
- Use drop spreaders, not rotary spreaders, for sidewalks. If you are using a rotary spreader, adjust the opening to limit dispersion of deicers to the sidewalk or install shields to restrict the spread pattern. This minimizes your application rate and protects the vegetation.
- Many slip and fall incidents occur within ten feet of the curb lines. Adjust practices to include proactive measures like anti-icing.
- If you are not responsible for sidewalk maintenance, consider providing this information to the building occupants to educate them on these best practices for winter maintenance.
- Look for opportunities to close extra entrances during the winter to reduce the need to use chemicals on all sidewalks and steps.
- Focus on aggressive mechanical removal of snow. The less snow, the less deicer required. This will lend to a safer walking surface.
- Deicers can harm heated sidewalks.
- Products such as heated or textured mats, placed on sidewalks or steps, may work for small problem areas. Test these, as you would, any new product or deicer.

Salt only needs to melt 1/16 inch to prevent the bond between the pavement and the ice. Save money by applying salt before the ice bonds so you don't need to melt through it.

Parking Lot Tips

- It is hard to walk and push shopping carts through salt and sand accumulations in parking lots. Sand is ineffective once it is on the pavement. Sweep it up to prevent a slippery situation.
- Handicap parking spots are often over salted and over sanded. They should get the same amount of salt or sand as other areas.
- Sand/salt mix isn't advised however it may help in freezing rain situations.
- Always plow before applying chemical.
- You may be able to use a lower rate in high traffic areas. Traffic tends to help mix and melt.
- Store snow downhill from any salt storage areas. Avoid water running through salt storage.

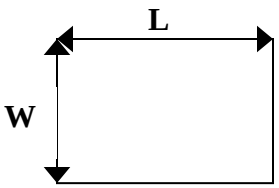
Sand fills in lake bottoms, accelerating the aging process of lakes. Lakes get shallower as they age, some eventually becoming wetlands.

Calculating Parking Lot or Sidewalk Area

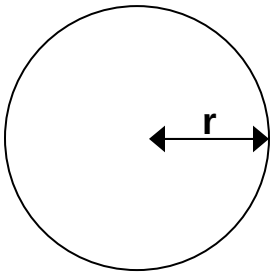
The amount of deicer needed is based on the size of the parking lot. Here are simple ways to calculate the area of your parking lot.

- Ask the property owner for a scaled map of the facility so you can calculate areas.
- Ask the property owner for the size of the area they want you to treat.
- Go out and measure the parking lot.

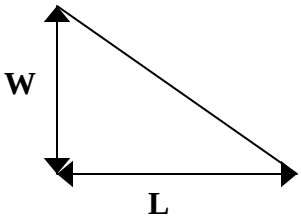
The area or square feet of a square or rectangle is
Length (L) X Width (W)



The area or square feet of a circle is **π r^2**
Or **3.14 x (r x r)** where **r** is half of the distance across the circle.



The area or square feet of a right triangle is
Length (L) X Width (W) divided by 2



Measuring your area along with knowing the pavement temperature will allow you to use the application rate charts. This will help you reduce the amount of chemicals you apply.

Surfaces such as pervious asphalt, pervious concrete and pervious pavers do not experience refreeze. All melted snow and ice travel to the storage layer below the surface. Salt is generally not needed on these surfaces and sand should be avoided.

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Take Action to Keep Parking Lots Clear

Snow Removal Basics

It is best to apply sand or deicers after the storm. Materials applied during the storm are wasted.

All application rates are based on thoroughly plowed surfaces.

- Plow first before applying deicers to avoid dilution of the salt.
- Place deicers in high traffic areas as you plow. Leave other areas until plowing is complete.
- Limit use of salt and sand during the storm; use only to reduce bonding.
- Do not use salt to burn off snow.
- Use application rate chart.
- Understand the melting properties of your deicers. Do not use them unless you understand how they work.
- Plan and look for ways to anti-ice or use wetted materials.
- Check conditions and formulate the best strategy for those conditions.
- Don't apply dry salt (sodium chloride) below 15º F pavement temperature. It will not melt fast enough to help and it will blow off the surface onto nearby vegetation.

About 1 tsp of salt will pollute 5 gallons of water…forever! (Federal Chloride standard is 230 mg/l).

- Below 15º F, use a salt wetted with magnesium or calcium chloride or other low temperature deicers. For extreme cold, skip melting and use sand.
- Turn off auger when stopped, even briefly.
- Clean up spills.
- Track material use and effectiveness with an in-cab deicing data form.
- Use only what is needed based on proper application rates for the conditions. Put extra back in salt pile.
- Never plow or blow snow into bodies of water, wetlands, traffic or into streets.
- Remove snow from surfaces as quickly as possible to reduce compaction. Plow during off-peak hours or prior to the facility opening to increase efficiency and reduce conflicts with vehicles and pedestrians.
- Minimize back-up maneuvers to reduce chance of accidents.

Because it uses less materials, mechanical snow and ice removal is the best strategy for protecting our water.

Loading/hauling

- Don't overfill the vehicle: material will spill out as you drive around corners.
- Fill in side gaps in tailgates or equipment with spill shields where materials can escape and spill out.
- Large snow piles may need to be loaded out and removed to another site. Schedule this work when the mall or facility is closed to minimize conflicts with vehicles and pedestrians.

Deicing/Anti-Icing Information

Anti-icing

Anti-icing is the most cost-effective and environmentally safe practice in winter maintenance. You should be heading in this direction.

Anti-icing—a proactive approach—should be first in a series of strategies for each winter storm. By applying a small and strategic amount of liquid or pre-wet deicer before a storm, you can prevent snow and ice from bonding to the pavement.

Anti-icing is like preparing a frying pan. If you add a small amount of a liquid before cooking, the food will not bond to the pan. This reduces the amount of soap needed; scrubbing and time spent trying to clean the pan.

Anti-icing requires about ¼ the material and 1/10 the overall cost of deicing. It can increase safety at the lowest cost, and is effective and cost-efficient when correctly used and approached with realistic expectations.

Anti-icing prevents formation of ice from frost. It can be effective for up to several days depending on the weather conditions.

Anti-icing is quick. You can treat your parking lot in a matter of minutes. It is an excellent strategy for saving time. Charging by the hour is not a desired practice when you move into anti-icing.

Get started in anti-icing

The basic equipment you will need includes: Pavement temperature sensor, storage tank, spray truck system, transfer pump, hoses and fittings.

Guidelines for anti-icing

- Liquids are the more efficient than solids and may be applied days in advance of an event.
- It is better to use less than more. Over-application can cause slippery conditions.
- Anti-icing is often effective for heavy frosts.
- Liquids are dispersed by the traffic. If you spray the traffic lanes, liquid will migrate with the tires to the parking areas.
- Some users advise against spraying the service road in front of buildings and instead spray traffic lanes and back service roads to allow the traffic to spread the liquids near the building where foot traffic is higher. This can reduce tracking into the building and over-application in a high-traffic area.
- For service roads on hills, some users recommend applying to only the top half of the hill, relying on traffic to carry it down the hill, to avoid a slippery situation at the bottom of the hill.

- Anti-icing works best when combined with accurate surface weather information.
- Early application is particularly important for frost or light freezing drizzle.
- Pretreated or prewet materials are not as efficient as liquids for anti-icing; you need more material and they don't track as well. They will work if applied at very low application rates immediately before the snow event.
- See the Anti-Icing Application Rate Chart in this manual.

Stream nozzles prevent slippery conditions better than fan spray.

Anti-icing requires less material, and less material means less water pollution.

What to do

- Apply with stream nozzles to maintain dry areas between sprayed areas to reduce slipperiness. Stream nozzles work the best for anti-icing.
- If using fan nozzles apply extra light to reduce chance of causing a slimy/slippery situation.
- Try anti-icing in a low traffic area until you feel confident about its properties.
- Read some of anti-icing guidelines in the reference section of this manual.

What not to do

- Don't re-apply if there is still residue. The residue can remain many days after application if precipitation or traffic wear-off does not dilute the initial application.
- Don't apply $MgCl_2$ or $CaCl_2$ to a warm surface (above 35º F pavement temp.). It can become slippery.
- Do not apply liquids before predicted rain or significant freezing rain. They will wash away.
- Don't apply too much or the surface may become slippery.
- Less is better. Always follow application recommendations.

Too little $MgCl_2$ is safer than too much.

Using less salt doesn't have to reduce safety, but it does protect our lakes, streams and groundwater.

Equipment

- Anti-icing unit, i.e., transport vehicle with tank.
- Stream nozzles, minimum 8 holes, 8-inch spacing, bar height 12 to 14 inches from surface, 30 to 35 psi at the bar. These can be purchased or constructed.
- Solid stream. Fan spray is more apt to make slippery conditions.
- A hand held pump sprayer or backpack sprayer can be used for sidewalks. Remember to leave a pattern of wet and dry to reduce the chance of creating slippery conditions.

- There are many ways to retrofit your pick-up truck or ATV with a tank and boom and/or hose reel with sprayer.
- A shutoff switch in the cab is recommended.

Prewetting and Pretreating salt and sand

Prewetting and pretreating both mean getting dry material wet. Salt only melts snow and ice when it is in solution (dissolved). Dry salt does nothing until it is dissolved. Liquids applied to dry salt jump-start the melting process and penetrate ice and snow pack faster. Wet materials stick to the pavement and are less likely to end up in the nearby vegetation.

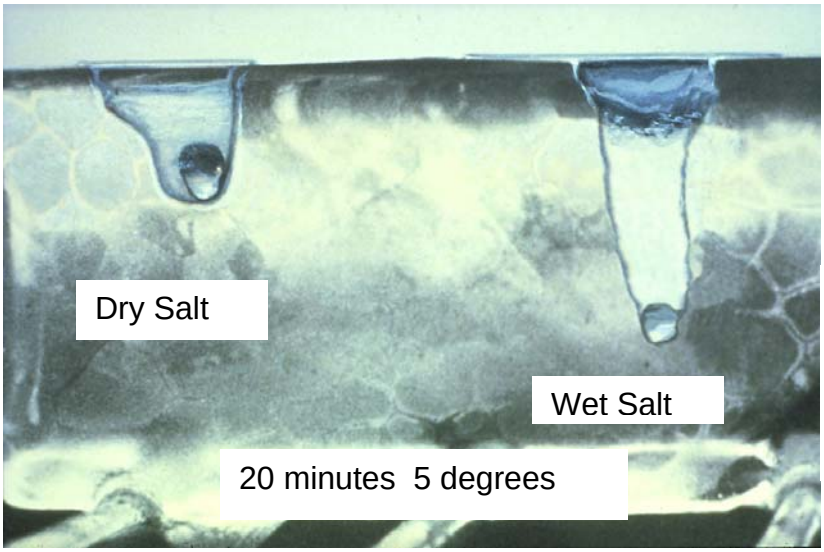

Photo courtesy of Wisconsin DOT transportation bulletin #22

Figure 14. Dry Salt vs. Wet Salt

- There are many types of liquid deicers.
- Brine is a common liquid deicer made from water and rock salt (NaCl).
- Prewetting (truck treatment) is the process of adding liquid to solids as they come off the truck onto the parking lot.
- Pretreating (stockpile treatment) is the process of adding liquid to solids in the stockpile.
- If you add sodium chloride (NaCl) liquid (brine) to dry salt, it will work faster.
- If you use magnesium chloride ($MgCl_2$) or calcium chloride ($CaCl_2$) liquid to dry salt, it will work faster and at lower temperatures.
- Prewetting or pretreating a sand stockpile is an alternative to adding dry salt to keep it flowing.
- Wet material sticks to the surface. Less is wasted by bounce and scatter.

Guidelines for pretreating stockpiles

Pretreating is mixing a liquid deicer into the stockpile of salt or sand. Salt brine, calcium or magnesium chloride or acetates may be used as pretreating agents.

Treated Stockpile Application

- You can apply pretreated salt with a pickup truck, a dump truck, a drop or rotary spreader or almost any type of equipment used for dry salt.
- No equipment changes are required.
- Remember to turn down the application rate; you will need 1/3 less material than dry salt.

Cover salt and salt/sand piles and place them on an impervious pad to limit runoff and infiltration of chlorides.

Treated salt stockpile

- Spray the salt stockpile with a liquid deicing chemical. Salt may be purchased pretreated or mixed on site by you or the vendor.
- When treating the stockpile, apply at 6 to 8 gallons/ton. For $MgCl_2$, rates greater than 6 gallons/ton tend to leach out.
- Because leach risk at a stockpile is increased, proper storage is even more important.
- Be careful not add too much liquid. Follow guidelines.

Covering your stockpile protects the salt from wind, rain and snow and reduces waste.

Treated sand stockpile

- Spray the sand stockpile with a liquid deicing chemical.
- Apply to stockpile at 4 to 6 gallons of salt brine/ton sand.
- Because leach risk at a stockpile is increased, proper storage is even more important.

Generally you can use 1/3 less material if you prewet or pretreat and it works faster than dry salt!

Guidelines for prewetting

Prewetting is adding a liquid to the salt as it comes off of the truck. This can happen either at the spinner or through a soaker pipe in the auger box. While prewetting requires some equipment changes, it provides flexibility to switch the chemical makeup depending on conditions. Salt brine, calcium or magnesium chloride, or acetates may be used as prewetting agents.

Tips

- Remember to turn down the application rate; you will need 1/3 less than dry salt.
- Requires tanks and hoses on your truck.
- Best if you can turn on/off the liquid from inside the cab.
- Best if you can regulate the flow of liquids to be synchronized with the flow of solids so you are getting the proper mix.
- The optimal application rate is 8 to 14 gallons/ton for salt brine, 6-8 gallons/ton for $MgCl_2$.

- Prewetting with a chemical other than salt brine can reduce the application rate even further.
- Below 15º F, salt brine is less effective than other liquids and has the potential of freezing hoses and valves. Verify it is mixed at 23.3% to reduce freezing risk.
- Prewetting is most practical with a dump truck. Use of a pickup truck may be limited due to material weight.
- Think twice before mixing chemicals to form "hotter" brine. This is where problems often occur.

Use cautiously. Many deicers contain trace metals including cyanide, arsenic, lead, and mercury.

Two common overuses of salt are applying to already wet surfaces and not giving the material enough time to work, but adding more on top of existing salt.

Deicing/Traction

Deicing is a reactive operation where a deicer is applied to the top of an accumulation of snow, ice, or frost that has already bonded to the pavement surface and can no longer be physically removed. Deicing costs more than anti-icing in materials, time, equipment, and environmental damage. Deicing is the "traditional" approach to winter maintenance.

The goal is not to melt everything. The goal is to penetrate through the ice and snow and break the bond so the pavement can be plowed.

Deicing

Removing ice that has already bonded to the pavement is difficult. Removing it mechanically can damage equipment and surfaces. Generally, enough ice must be melted chemically to break the bond between the ice and the pavement. This requires larger amounts of chemical, making deicing much less efficient than anti-icing.

Use the application rate table to help you with deicing. Using recommended rates will help you with these common problems:

- Over-salting. Most over-salting can be prevented by using calibrated spreaders and good judgment in selecting application rates based on pavement temperatures.
- Trying to melt everything. Don't try to melt all the snow or ice on the surface with salt. This is an overuse of materials. Apply just enough to loosen the bond between the surface and the ice so it can be plowed off.

Using abrasives

Use winter sand and other abrasives when temperatures are too cold for deicing chemicals to be effective. But be aware that sand does not melt anything. It provides temporary traction, and only when it is on top. As a result, avoid sand use as much as possible. When sand is in contact with the pavement, sweep it up. It is no longer useful to you and can only harm the environment. Sand on dry pavement can cause skidding.

Advantages of sand (abrasives)

- Short-term traction: Abrasives can be helpful in areas of slow moving traffic, such as intersections.
- Useful in very cold temperatures when chemicals will not work.

Disadvantages of sand

- Sand is not cheap when you consider handling, clean-up, and disposal costs.
- Sand will be tracked into your lots or buildings. Sweep this up as often as possible and dispose of it properly.
- Used sand is contaminated with various pollutants such as oil, grease, metal and rubber and should not be used for clean fill unless screened, should not be used for sandboxes or beaches, and should not be dumped in wetlands, fields or any natural area.
- Once sand is driven over many times, the particles are much finer and can cause air quality concerns.
- Cannot be used over pervious asphalt, pervious concrete, or pervious pavers.

Sweeping

Sweep the sand from the parking lot areas midwinter as well as in the spring. Trailer-type power sweepers are available that can be hauled behind a pickup truck. Smaller power brooms or sweepers may be used on sidewalks. Workers should wear a dust mask to avoid inhalation of the fine dust particles.

- Used sand is contaminated with pollutants such as oil, grease, metal and rubber.
- Sweepings often can be brought to a landfill. Inform landfill operator in advance.
- Keep children from playing on the sweeping piles.
- Sweepings may be reused by some industries.
- Before reusing sweepings, trash, leaves and other debris should be removed from them. This is often accomplished by screening. When screening sweepings for reuse, use a small mesh for the final screening to ensure that all of the larger debris has been removed. (A 3/4-inch mesh will screen out much of the debris.) Dispose of trash and debris removed from the sweepings by recycling it (*e.g.,* aluminum cans), composting it (*e.g.,* leaves) or sending it to a sanitary landfill.

For more information on sweeping refer to the MPCA website: www.pca.state.mn.us.

Sweep up sand frequently, after each event if possible. Sand that washes into a stream or lake increases water turbidity, clogs fish gills, inhibits plant growth, and may kill small aquatic organisms due to smothering.

Sand clogs storm sewers, ponds, ditches and is expensive to clean up.

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Evaluate the effectiveness of your actions

After the Storm

When snow and ice control operations have ended after the storm, evaluate what was done, what worked, and what could be changed to improve operations.

- Have an after-the-storm discussion with the maintenance crew.
- Have an after-the-storm discussion with the property manager.
- Consider the environmental impacts caused by your deicer/abrasive use.
- Based on all aspects of the storm fighting experience, look for ways to improve your practices.
- Accurately record your material use at each site.
- Clean and check all equipment.
- At the end of the season, clean and maintain the truck, tanks, brine-making systems, and pumps according to manufacturer specifications.
- Do not use deicers at the end of the season just to use them up. Save them for next year. Place all piles on an impervious pad and cover them. This includes salt and salt/sand mixes.

Save extra salt at the end of the season. Do not apply just to get rid of it.

Winter abrasives are an air pollution concern. They get crushed by tires and the tiny dust can become airborne. Sweep up after the storm.

Documenting and charting

Good documentation leads to reduced use of materials, more effective snow and ice control, reduced environmental impacts, and cost savings.

- Unless you document and chart, you can't measure what you are doing.
- Track your material use. Learn to record what and how much you apply at each site, each time you visit. Be prepared to analyze and make adjustments to your process based on what you learn.
- Use forms like those shown in the appendix of this manual to record and track your work and observations.

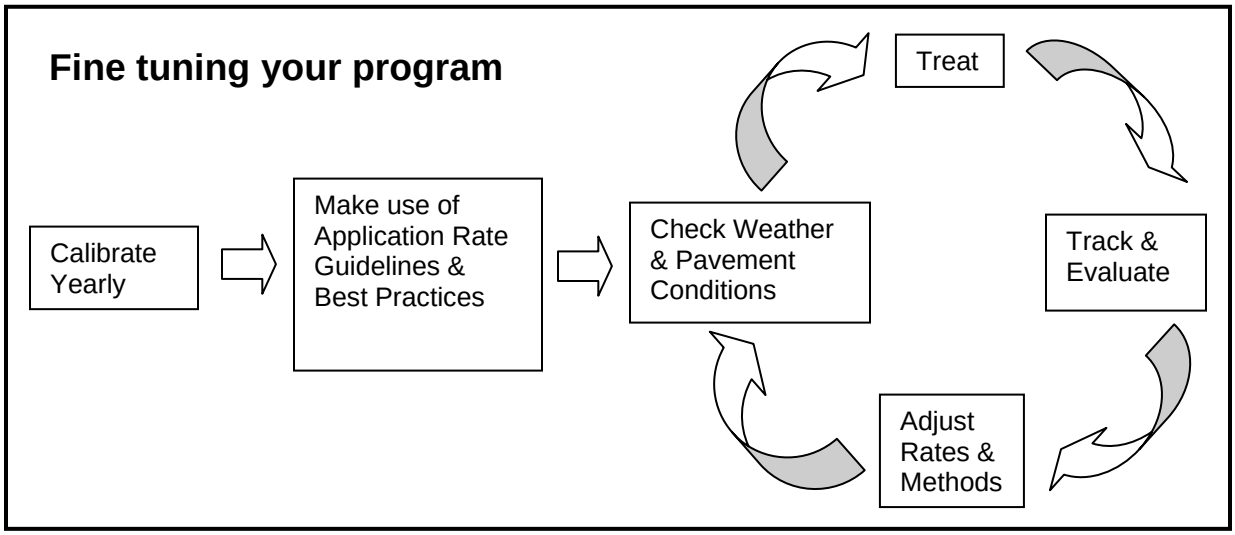

Figure 15. Fine Tuning Your Program

You can't manage what you don't measure.

Following Best Practices and documenting your actions will help prove you are doing the best job possible and may reduce your liability.

Documentation Form For Anti-Icing

Anti-icing Data Form				
Location: Date:				
Air Temp.	Pavement Temp.	RH	Dew	Sky
Reason for applying: Location: Chemical: Application Time: Application Amount: Observation (1st day): Observation (After event): Observation (Before next application): Name:				

Table 16. Documentation Form for Anti-Icing

RH- relative humidity
Dew- dew point
Sky- sunny to cloudy

Documentation Form for Deicing

Deicing Data Form			
Operator:			
Location:			
Event Began:	Date	Time	
Event ended:	Date	Time	
Event type:	snow	rain	both
Total precipitation:			
Pavement temp.:		Air temp.:	
Dew point:			
Temperature Trend:			
Material used:			
Amount used:			
Application rate:			
Observations:			

Table 17. Documentation Form for Deicing

Application Rates for Reduced Environmental Impacts

Effective application rates are based on many factors, including type and rate of precipitation, air and pavement temperature, forecast and temperature trend, humidity, dew point, type of surface and subsurface material and sun exposure. The application rate tables used in this book have been taken from the Mn Snow & Ice Control Field Handbook, Manual 2005-1. These application rates are not perfect but are to be used as a stepping stone to improve your performance. Develop your own application rates using the guidelines included in this handbook as a starting point. Modify your practices incrementally over time to fit your needs. Make it a goal to reduce application rates and keep surfaces safe.

Anti-Icing Application Rate Guidelines **These are a starting point only. Adjust based on your experience.**			
Condition	**Gallons/1000 sq. ft.**		**Other Products**
	$MgCl_2$	**Salt Brine(NaCl)**	
1. Regularly scheduled applications	0.1 - 0.2	0.25 – 0.3	Follow manufacturers' recommendations
2. Prior to frost or black ice event	0.1 - 0.2	0.25 – 0.3	
3. Prior to light or moderate snow	0.1 - 0.2	0.2 – 0.4	
CAUTION: Too high an application rate may result in slippery conditions or tracking.			

Table 18. Anti-Icing Application Rates

***How to use the anti-icing rate table above*:**

1. Determine your parking lot or sidewalk area in square feet.
2. Calculate size factor: Divide that area by 1000 (chart is based on a 1000 square foot area).
3. Find the application rate: Choose your condition in the first column of the table and follow sideways, stopping at the anti-icing chemical you are using.
4. Determine how many gallons you need: Multiply the application rate by your size factor.

Tip: To convert from gallons to ounces: multiply result from #4 by 128.

One 50 lb. bag of salt can contaminate over 10,000 gallons of water.

Deicing Application Rate Guidelines for Parking Lots and Sidewalks

These rates are based on road application guidelines (Mn Snow & Ice Control Field Handbook, Manual 2005-1). Develop your own application rates by adjusting your current rates incrementally downward toward these guidelines. Where temperature categories overlap, select the rate most applicable to your situation.

Pavement Temp. (ºF) and Trend (↑↓)	Weather Condition	Maintenance Actions	Application Rate in lbs/per 1000 square foot area			
			Salt Prewetted/ Pretreated With Salt Brine	Salt Prewetted/ Pretreated With Other Blends	Dry Salt	Winter Sand (abrasives)
>30º↑	Snow	Plow, treat intersections only	0.75	0.5	0.75	not recommended
	Frz. Rain	Apply chemical	1.25	1.0	1.5	not recommended
30º↓	Snow	Plow & apply chemical	1.25	1.0	1.5	not recommended
	Frz. Rain	Apply chemical	1.5	1.25	1.75.	not recommended
25 - 30º ↑	Snow	Plow & apply chemical	1.25	1.0	1.5	not recommended
	Frz. Rain	Apply chemical	1.5	1.25	1.75	not recommended
25 - 30º ↓	Snow	Plow & apply chemical	1.25	1.0	1.5	not recommended
	Frz. Rain	Apply chemical	1.75	1.5	2.25	3.25
20 - 25º ↑	Snow or Frz. Rain	Plow & apply chemical	1.75	1.5	2.25	3.25 for frz. rain
20 - 25º ↓	Snow	Plow & apply chemical	2.0	2.0	2.75	not recommended
	Frz. Rain	Apply chemical	2.5	2.0	3.0	3.25
15º to 20º↑	Snow	Plow & apply chemical	2.0	2.0	2.75	not recommended
	Frz. Rain	Apply chemical	2.5	2.0	3.0	3.25
15º to 20º↓	Snow or Frz. Rain	Plow & apply chemical	2.5	2.0	3.0	3.25 for frz. rain
0 to 15º ↑ ↓	Snow	Plow, treat with blends, sand hazardous areas	not recommended	3.0	not recommended	5.0 spot treat as needed
< 0º	Snow	Plow, treat with blends, sand hazardous areas	not recommended	4.5	not recommended	5.0 spot treat as needed

Table 19. Application Rates for Deicing

Instructions for using application rate table if you calibrate your spreaders

1. Using Deicing Application Rate Guidelines for Parking Lots and Sidewalks. Select the row with the appropriate pavement temperature, temperature trend, and weather conditions.➔
2. Select the column that has the type of material you are using.🡻
3. Find the box where the row and columns intersect to find the application rate. ➔🡻
4. Compare those values to the calibration chart for your truck.*
5. Dial the correct setting for the rate calculated.

*If your spreader is calibrated in lbs/lane mile refer to Table 21 for conversion to lbs/1000 square feet.

Example:

1. Temperature: 22ºF and falling. It has finished snowing. Parking Lot: 54,000 sq. ft. ➔
2. Deicer: salt pretreated with salt brine. 🡻
3. Find the 20 – 25º ↓ box. Follow it to the right under the column labeled "Salt Prewetted/pretreated with salt brine." Read the rate in the box.

The box where the column and row intersect shows a rate of 2.0 /1000 square feet. ➔🡻

4. Refer to the calibration chart in your vehicle and set the spreader to the setting that most closely matches the 2.0 lbs/1000 square feet.

How much material will be applied in this example?

a. Calculate parking lot size factor: Divide parking lot size (54,000 sq. ft.) by 1,000 sq. ft. 54,000/1,000 = 54 The size factor is 54.

c. Use the size factor multiplied by the rate from step 3 above to find the amount of material to use for the 54,000 square foot lot.
Multiply 2.0 by 54 = 108.

The application amount for the entire lot is 108 lbs. prewetted/pretreated salt brine.

Instructions for using application rate table if you DO NOT calibrate your spreaders

Follow steps 1 – 3 above and the following instructions:

4. Calculate parking lot size factor: Divide parking lot size by 1,000 square feet.
5. Use the size factor (step 4) multiplied by the application rate (from step 3) to find the amount of material to use. Spread this amount evenly over your parking lot.

 ***Once chlorides enter the ground or surface water, they never go away.***

Results

The first winter maintenance training and certification workshops were held in 2005. After holding several classes, it was determined that a training manual was needed. The Winter Parking Lot and Sidewalk Maintenance Manual was written in 2006 and the training classes using the manual started in the winter of 2006-2007. In order to evaluate the effectiveness of the training, three class exercises were created. These exercises show potential rate reductions, potential change in practices and evaluate the training program. The results from the in class exercises were compiled at the end of the 2007-2008 winter season and are shown below.

Potential Changes

In 2007-2008, 345 people attended 14 Winter Parking Lot and Sidewalk Maintenance Workshops and filled out the forms used to evaluate the course. The summary of all the exercises is given below.

Rate Reduction:

- **95%** of attendees found that they need to either reduce the amount of material that they use, or not use that material at all.
- **96%** of attendees who used rock salt found that they need to reduce their application rates.
- **24%** of all attendees used sand or salt/sand mix. They found that they are using the wrong material.
- **62%** Average potential reduction in salt application rates
- **20% - 89%** Range of potential reduction

Best Management Practices (BMP):

Attendees were given a survey about their BMP practices. Out of 19 recommended practices listed:

- Before training: **31%** of BMPs were already being used
- After training: **76%** BMPs will be used in the future (as stated by participants)

Evaluation:

- Recommend class to colleagues? **93% yes**
- Was this class useful to you? **87% yes**
- Do you think you will be able to reduce the environmental impacts of the winter maintenance activities as a result of attending this class? **79% yes**

Comments from those attending class:

"*It's about time people got concerned about our water. Thanks for your work"*
"Real world examples by people using these methods brings integrity to the presentation"
"Awesome job! I can see the wheels turning in people's heads"
"Spread the word fast. This information is too important"!
"I am very surprised to learn so much about a subject that I thought I knew. "

Actual Changes

Following the winter season, follow up interviews were conducted to learn more about the winter maintenance changes made since training. The individuals interviewed had attended the training and volunteered to be part of our follow up research on the effectiveness of the training class. Several examples of these interviews are included below.

School District of Superior Wisconsin
Michael Soderlund - Maintenance Worker

Michael Soderlund attended the Parking Lot Training in October, 2007. After the training, many new successful changes were implemented. Overall, the District of Superior reduced their total use of deicers. One of the biggest steps forward was the production of their own brine. Michael said that everything is currently working well and there is no marked reduction in quality. Many District of Superior workers were initially hesitant about the new practices, but after a few tries they realized that the new methods work just as well or even better. The material application rates were greatly reduced, especially in the middle school and high school. The actual reduction rates are given below.

Rates:

2006-2007
The district used 294 bags of ice melt (50 lb bags)
The total was $2,320.48.

2007-2008
The district used 196 bags of ice melt.
The total was $1,552.32

Reduction in ice melt use: 33.3%
Reduction in cost: 33.1%

University of Minnesota Twin Cities campus
Jim Weber - U of M Facilities Management

Over the past few years, the U of M recognized the need to become much more environmentally conscious with winter maintenance, storm water management and the campus environment. They made many changes in their snow removal program; two key areas were employee training and calibration of equipment. By increasing awareness of proper application rates, they were able to significantly decrease the amount of de icing chemical we used. They started an aggressive anti-icing program with Liquid Magnesium Chloride for their sidewalks and salt brine for the streets and loading docks. Pre-storm applications were extremely successful in reducing the bond of snow and ice to walks as well as giving them more response time on the front end of snow events. They focused on mechanical removal of snow as their first line of defense and they have changed the main deicer for walks from a blended material to straight Magnesium Chloride. They dramatically reduced the sand in their sidewalk and street program which has saved them time and money in spring clean up and long term savings are expected in storm sewer maintenance. Small amounts of sand are still used as pattern indicators for their sidewalk trucks and for use during extreme cold weather. The numbers speak for themselves:

Material # 1 – Rock Salt
1997 - 2005 average: 775 tons of salt
2006 - 2008 average: 462 tons of salt

Net Average Reduction: 313 tons
% Reduction: 41%
Material Cost: $48.53/ton
Amount Saved: $15,193 average per year (2006 – 2008)

Material #2 – Ice Melt (Magnesium Chloride - MgCl2)
1997 - 2005 average: 131 tons
2006 - 2008 average: 64 tons

Net Average Reduction: 67 tons
% Reduction: 51%
Material Cost: $410/ton
Amount Saved: $27,470 average per year (2006 – 2008)

Material #3 – Sand
1997 - 2005 average: 1965 tons
2006 - 2008 average: 18 tons

Net Average Reduction: 1947 tons
% Reduction: 99%
Material Cost: $8.30/ton
Amount Saved: $16,160 average per year (2006 – 2008)

Net-Work Services Company
Bob Rush – Director of Operations

NSC is a national facility management company that services commercial properties in 22 states. NSC's responsibility is to manage all building services which include hiring and managing winter maintenance contractors. While working in his prior role as Regional Manager for Minnesota and North Dakota, Bob Rush required all of his Minnesota winter maintenance contractors to be trained and certified on the best practices. As Director of Operations he has implemented a regional training program based on the Minnesota program. This allowed NSC to expand the training based on the best practices to all winter maintenance contractors in cold weather states. Bob has taken many steps to reduce the impacts of winter maintenance and to improve the safety of his operations

Bob required all Suppliers in the seven county Metro area to switch to a standardized treated salt for parking areas. He helped calibrate all truck mounted spreading equipment to insure they were not over applying the deicer.

Bob required all Twin City Metro and Duluth area suppliers to switch to a mag/hex for sidewalks. This standardized the deicer which helped the suppliers determine the correct application rates per sq. ft. based on temperature and location of the sidewalk.

He requested that all Twin City Metro suppliers attend the MPCA snow training program. He rewarded the suppliers that were able to show their certifications.

NSC held regional training sessions with all contractors, reviewed best practice for snow removal, and discussed the proper techniques and timing for deicer application.

He expanded the material that was developed by the MPCA and trained his Regional Managers that covered 14 States on best practices, impact on the environment and the need for continual training. They in turn introduced the training material in the larger markets like Salt Lake City, Denver, Omaha, Boise and others.

Bob requires preseason re-training of large suppliers to refresh them on the best practices.

They eliminated sand use in Minneapolis and Denver and continue to educate the maintenance contractors on the impact that sand has on the environment.

Net-Work Services reduced deicer use on parking lots by 15-20% in the first year of the program and on sidewalks by 20-25%. They hope to see additional reductions in the amounts of wasted material by continuing to help the teams understand the use of technology and best practices. Bob developed a working group to continue to research better practices and material with the goal of reducing deicer use and our impact on the environment.

Cadwell Lawn and Landscaping
Charles Cadwell – Owner

After attending the Parking Lot Training in 2005, Charles Cadwell's company examined their procedures for applying salt and deicing chemicals at Ridgedale Center and found some areas that were candidates for improvement. Practices in previous years included using salt rather carelessly and applying it to attempt to keep snow from accumulating during a storm. As such, it was quite common to apply twelve to fourteen tons of salt during a given storm. Since training, they examined their practices and have taken the following measures to reduce usage of salt products:

They reduced the speed setting on our auger to slow the feed rate of salt to the wheel. At the same time, we maintained the speed of the wheel and that made for better dispersion of the salt (more even dispersion of salt and greater coverage in a given load).

They inspected the truck tailgate because in previous years, they had a problem with spillage that resulted in "piles" of salt being dropped at random during turns or when hitting potholes or speed bumps. They found gaps between the tailgate sander and the truck bed that they filled with weather stripping. That forced all salt to be fed through the auger and baffle so that the spillage was eliminated. That further increased the coverage per given load that was achieved.

Based on the lectures provided in training, they no longer apply salt chemical during a storm. Salt is applied after the snow has been mechanically removed. The one exception to this is where some material might be needed to permit traffic safety at stop signs or on slopes and then it is used very sparingly after plowing the areas and then applying the chemical to facilitate traction. (That has occurred twice during this current year, to date.)

Average salt usage for a given snow event is now five to six tons. That is based on the number of loader buckets put in the truck where one bucket is considered to be one ton (Ridgedale does not have a scale). That form of measurement is standard for what we did in previous years and from one contractor to another.

They were able to further reduce salt applications the winter of 2007 -2008 by educating the customer on the mechanical removal being the major step and only when that is complete, applying salt to the pavement. They did use some salt during snowfalls that were extended to maintain traffic traction and safety, however the mall was very receptive to only using salt when absolutely necessary.

They were also able to maintain good performance in terms of the number of slip-and-fall incidents that occurred due to ice or snow. That supported our premises of using mechanical removal - then salt application as a process.

Resources and Bibliography

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Dow Chemical www.dow.com.

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University of New Hampshire Technology Transfer Center. *Manual of Practice.* www.t2.unh.edu/pubs/manofpractice_1.pdf.

Additional Resources

Training and technical assistance

- Winter Maintenance Voluntary Certification Program.
- Minnesota Pollution Control Agency www.pca.state.mn.us/programs/roadsalt.html.
- The Circuit Training and Assistance Program (CTAP), a joint program of Mn/DOT and the Minnesota Local Technical Assistance Program (LTAP), brings training to cities, counties and townships 651-282-2160 or www.mnltap.umn.edu/ctap.
- Mn/DOT Winter Maintenance Coordinator: 651-366-3586.
- Winter Parking lot training, Winter road training & Power of winter maintenance professionals to protect our water presentations. Fortin Consulting Inc. 763-478-3606. fci@fortinconsulting.com www.fortinconsulting.com.
- Storage tank regulation questions – MPCA Customer Assistance Center 651-297-2274 or 800-646-6247.

Other Web resources

- Minnesota Snow and Ice Control Field Handbook for Snowplow Operators. August 2005. www.lrrb.org.
- RWIS – Road Weather and Information System. www.rwis.dot.state.mn.us is an Internet weather service provided by Mn/DOT. It gets its information from sensors embedded in the state highways.
- The Minnesota Stormwater Manual. November 2005. http://www.pca.state.mn.us/water/stormwater/stormwater-manual.html.
- Iowa Department of Transportation. *Anti-icing Equipment Manual* (with drawings for shop-made equipment). www.dot.iowa.gov/maintenance/internetpages/chemicals/ManualAntiicingEquipment.pdf.
- Minimizing De-icing Salt Damage to Trees http://www.extension.umn.edu:80/distribution/naturalresources/DD1413.html.
- Minnesota Department of Transportation. *Guide to Field-Testing Deicing and Anti-Icing Chemicals.* www.dot.state.mn.us/maint/research/chemical/chem_evaluation_guide.pdf.
- MPCA fact sheet “Managing Street Sweepings” (Fact Sheet #4.54 September 1997) available at www.pca.state.mn.us.
- Plant selector tool. Allows you to select plants for many conditions including high salt areas. Minnesota Department of Transportation. http://plantselector.dot.state.mn.us.
- Protecting Water Quality in Urban Areas — A Manual, Chapter 7 – Pollution Prevention, http://www.pca.state.mn.us/water/pubs/sw-bmpmanual.html. pages 7.27-1 – 7.27-2 street sweeping and the reuse of sweepings
- Assessment of Stormwater Best Management Practices http://wrc.umn.edu/outreach/stormwater/bmpassessment/assessmentmanual/index.html , Chapter 7 – Source Reduction, pages 17 and 21-24 street sweeping and its effectiveness.

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- Pacific Northwest Snowfighters. www.wsdot.wa.gov/partners/pns/default.htm.
- Salt Institute. *Practical Guide for Storing and Handling Deicing Salt.* www.saltinstitute.org/snowfighting.
- Salt Institute. *Calibration Instructions* (with downloadable Excel worksheet) www.saltinstitute.org/snowfighting/6-calib.html.
- Lake Superior Duluth Streams. "How much salt is a problem" http://duluthstreams.org/understanding/impact_salt_2.html].
- Salt Institute. Snow and Ice List Serve: www.sicop.net.
- Transportation Association of Canada. Syntheses of Best Practices-Road Salt Management:

  www.tac-atc.ca/english/informationservices/readingroom.cfm#syntheses.

Material Conversions

SAND			SALT	
Yards	Tons		Yards	Tons
1	1.4		1	1.1
2	2.8		2	2.2
3	4.2		3	3.2
4	5.6		4	4.3
5	7.0		5	5.4
6	8.4		6	6.5
7	9.8		7	7.6
8	11.2		8	8.6
9	12.6		9	9.7
10	14.0		10	10.8
11	15.4		11	11.9
12	16.8		12	13.0
13	18.2		13	14.0
14	19.6		14	15.1
15	21.0		15	16.2
16	22.4		16	17.3
17	23.8		17	18.4
18	25.2		18	19.4
19	26.6		19	20.5
20	28.0		20	21.6

Table 20. Material Conversions

The following formulas and the above quick reference table will help you convert between tons and cubic yards. Weights will vary depending upon moisture content.

1. To convert tons of clean sand to cubic yards: # tons divided by 1.4 = cubic yards
2. To convert cubic yards of clean sand to tons: # cubic yards multiplied by 1.4 = tons
3. To convert tons of winter sand to cubic yards: # tons divided by 1.37 = cubic yards
4. To convert cubic yards of winter sand to tons: # cubic yards multiplied by 1.37 = tons
5. To convert tons of straight salt to cubic yards: # tons divided by 1.08 = cubic yards
6. To convert cubic yards of straight salt to tons: # cubic yards multiplied by 1.08 = tons

Use these tables to convert application rates between pounds per lane mile and pounds per 1000 square feet.

lbs/ lane mile*	lbs/1000 square feet
25	0.4
50	0.8
75	1.2
100	1.6
125	2.0
150	2.4
175	2.8
200	3.2
225	3.5
250	3.9
275	4.3
300	4.7
350	5.5

lbs/1000 square feet	lbs/ lane mile*
0.5	32
0.75	48
1	63
1.25	79
1.5	95
1.75	111
2	127
2.25	143
2.5	159
2.75	174
3	190
3.25	206
5	317

*12 foot lane width

Table 21. Application Rate Conversion Charts

Common Conversions

- 1 lane mile (12' x5280 ft.) = 63360 square feet
- Average size parking spot: 9 x 20 feet or 10 x 20 feet = 180 – 200 square feet
- Driving isles (2-way) = About 25 feet wide
- 1 acre = 43,560 square feet
- 1 ton = 2000 lbs.
- 1 cup of salt (NaCl) = 0.6 lbs.
- Salt (NaCl) weighs 72 – 84 lbs/ft^3 depending upon moisture and granule size
- 1 gallon = 128 ounces
- 1 cubic yard of salt = 1.1 ton
- 1 cubic yard of sand = 1.4 tons
- 1 cubic yard = 27 cubic feet
- 1 square yard = 9 square feet

Definitions

°C – degrees Celsius
°F – degrees Fahrenheit
brine – liquid deicer made from water and rock salt (NaCl)
lbs. – pounds
LTAP – Local Technical Assistance Program
mg/l – milligrams per liter
Mn/DOT or MnDOT – Minnesota Department of Transportation
MPCA – Minnesota Pollution Control Agency
mph – miles per hour
ppm – parts per million
psi – pounds per square inch
sq. ft. – square feet

APPENDIX C

SALT AND BRINE STORAGE GUIDANCE

Michigan Department of Environmental Quality

SALT AND BRINE STORAGE GUIDANCE

FOR ROAD AGENCY MAINTENANCE AND OTHER FACILITIES

Jennifer M. Granholm, Governor ✹ Steven E. Chester, Director
www.michigan.gov/deq

I. INTRODUCTION

There have been documented groundwater quality problems caused by improper salt storage and handling. Most of these problems involve the contamination of drinking water wells.

Salt includes:

- ✓ Sodium chloride (often called rock salt),
- ✓ Potassium chloride,
- ✓ Calcium chloride,
- ✓ Magnesium chloride, and
- ✓ Any solutions or mixtures containing 1% or more of these compounds in either solid or liquid form.

This guidance is to offer the more than 400 Michigan road agency facilities, and other facilities with large amounts of salt or brine, suggested methods for preventing pollution incidents and achieving compliance with the following water protection regulations:

- Effective August 31, 2001, the Part 5 Rules, Spillage of Oil and Polluting Material, promulgated pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451) (R 324.2001 through R 324.2009).
- Effective August 26, 1999, Part 22 Rules, Groundwater Quality, promulgated pursuant to Part 31 of Act 451 (R 324.2201 through R 324.2240).
- Part 31, Water Resources Protection, of Act 451 of 1994, as amended
  - Effective June 15, 2004, Section 3111b of Part 31 was amended to include additional release reporting requirements to 911 (or the local primary public safety answering point if 911 service is not available) and also a written follow-up report to the local health department if a facility is subject to Part 5 Rules release reporting. Public Act 142 of 2004
  - Effective June 15, 2004, Section 3115 of Part 31 was amended regarding penalties for not reporting a release if required or having an illegal discharge. Public Act 143 of 2004.

These regulations and additional resources can be obtained from the Internet at www.michigan.gov/deq and select "Water," then select "Emergency Response for Releases to Water" for the Part 5 Rules information and select "Groundwater Discharge" for the Part 22 Rules information. To request printed copies of the rules, call 517-373-2730 or write to the Water Bureau, Michigan Department of Environmental Quality (DEQ), PO Box 30241, Lansing, Michigan, 48909.

The following salt storage facilities are required to meet the Part 5 Rule requirements:

a. **Any location that has 5 tons or more (threshold management quantity – TMQ) of salt in solid form. This includes salt and sand mixtures or other mixtures that contain 1% or more of salt (hereafter referred to as sand-salt).**

b. **Any location that has 1,000 gallons or more (TMQ) of salt in liquid form. This includes brine that has 1% or more concentration of salt (i.e. 10,000 milligrams per liter chloride).**

This guidance does not cover all the requirements for the following:

- ⌦ Brine located at brine storage facilities overseen by DEQ Office of Geological Survey (OGS). These are exempted from the Part 5 Rules by R 324.2001(f) and (g), and by R 324.2003 because they are part of a facility regulated under Part 615, Supervisor of Wells, of Act 451.
- ⌦ Oil, gasoline, and/or other polluting materials such as ethylene glycol used for deicing aircraft which have requirements under the Part 5 Rules and other state or federal regulations. If you have any questions with regard to storage of these materials, please see the "Pollution Incident Prevention Plan (PIPP) and Part 5 Rules Informational Packet" and contact the Water Bureau District Office in your area or see Appendix B. Also see the Waste and Hazardous Materials Division antifreeze guidance.

The purpose of the Part 5 Rules is to prohibit injurious discharges to the waters of the state and the primary requirements include:

- Surveillance requirements in R 324.2004 so the facility inspects the areas for releases or potential problems
- Storage and use area requirements in R 324.2005(4) for solids to contain the salt or precipitation exposed to the salt
- Secondary containment requirements in R 324.2005(2) for brine stored outdoors to contain the salt or precipitation exposed to the salt
- Pollution Incident Prevention Plan (PIPP) requirements in R 324.2006 to identify procedures needed to properly contain the salt and other polluting materials onsite, identify the procedures to address releases, and inventory salt storage, etc. (see Appendix C for checklist of required information)
- Release reporting requirements in R 324.2007, and R 324.2002, and Section 3111b of Part 31 (see Section VIII)

For the purposes of this guidance the following words and their usage are defined as follows:

"impervious" –- incapable of being passed through or penetrated.

"compatible" –- capable of being mixed with, or coming in contact with another substance without reacting chemically or otherwise resulting in deterioration.

"must" –- indicates a particular action is required to meet compliance with the regulations.

"should" –- indicates that the particular action is a recommendation.

"publicly owned sanitary sewer system" –- is a term used to describe a municipal sewer system, which is also called a POTW (publicly operated treatment works) and WWTP (wastewater treatment plant).

II. SOLID SALT AND SAND-SALT STORAGE

Possible ways to eliminate the requirement for sand-salt mixture storage and containment provisions would be:

- Use alternative deicing products and clean sand whenever possible to eliminate salt contaminated runoff.
- Store the sand and salt separately and batch-mixed it on an as needed basis, if the amount of salt on-site is below 5 tons.

If solid salt and sand-salt are on-site and meet threshold management quantities of 5 tons or more, the following provides requirements and guidelines for proper storage at salt loading and unloading sites.

A. All solid salt and sand-salt at the site must be stored in an enclosed building, or covered with waterproof tarps, when the facility's total salt storage exceeds the threshold management quantity. This practice will help prevent the generation of salt contaminated runoff and the need for runoff collection and disposal. Storage on impervious surfaces such as asphalt or coated concrete that provide 1 x 10-7 centimeters per second permeability or less should also be utilized to eliminate salt contaminants from seeping to groundwater. If tarps are used, it will be necessary to ensure they are providing the necessary salt protection.

   The rules do not require a specific type of structure to be built. For more guidance on constructing salt storage units or calculating space needed for storage, see the salt storage publications from the Salt Institute. At the www.saltinstitute.org website, select "About the Salt Institute" "Publications and Audio-visual materials" and scroll down to "Winter Maintenance". The Salt Storage Handbook contains tables showing how much space different height piles will cover and also provides exposure surface areas to use in calculating how many tarps would be needed for covering salt piles. Road agencies may also contact the Michigan Department of Transportation at 517-322-3319 for information.

B. All solid salt and sand-salt must be stored at least 50 feet from the shore or bank of any lake or stream or any designated wetland.

C. Any salt and sand-salt containment structures located within a 100-year floodplain as defined by the federal flood disaster protection act of 1973, 42 U.S.C. 4001 et seq., must be designed and constructed to remain effective during a 100-year flood. Some floodplain information is on the Internet through the Federal Emergency Management Agency at www.fema.gov. Floodplain information may be available through watershed groups, and Soil and Water Conservation District. Or contact the DEQ Land and Water Management Division, Water Management Section at 517-373-1170.

D. Storage and handling of solid salt awaiting transfer at regional distribution sites, and sand-salt not stored within an enclosed structure, must be designed to contain the salt to prevent run-on, runoff, seepage, or leakage to public sewers or to surface water or groundwater. The salt containment should include storage on an impervious pad and a waterproof tarp covering at all times prior to use. The pad must be sloped to direct salt contaminated runoff to an appropriate collection area, and in a manner that prevents the runoff from reaching the soil or surface waters. The curbing must also direct runoff to an appropriate collection area (see sections VI and VII).

III. BRINE STORAGE

Brine storage facilities must meet all of the following conditions.

A. All aboveground brine storage tanks must have secondary containment (e.g. spill containment dikes, double walled tanks, etc). The dike must be lined with or constructed of an impervious material. Soils, other than clay, are not impervious. If a concrete or asphalt liner is used, it must be free of cracks and covered with a compatible waterproof coating. Please refer to Appendix A of this document for liner and lagoon design recommendations.

B. The containment area must have an enclosed storage area so as to be able to contain a volumetric capacity of at least 100% of the largest tank's capacity or at least 10% of the total volume of tanks within the containment area, whichever is larger. The containment area must be constructed so that no volume of brine can escape through drains, sewer systems, or otherwise directly or indirectly into any sewer without prior written approval by the wastewater treatment plant operator or to the surface waters or groundwater of the state.

C. Consider how to provide squirt protection in case aboveground tanks holding liquids are punctured or ruptured. Use engineering calculations to calculate the potential distance a material can squirt, or a general rule of thumb for determining squirt distance for containers is to measure the tallest height of the containers and use that measurement as the minimum distance between the stored containers and the edge of the containment area.

D. Tanks set on ring foundations should be tested each year to insure that there is no leaking inside the ring.

E. All accessory pipes, hoses, valves, and pumps must also be located within the diked area. Top loading and unloading piping is recommended.

F. The containment area should be designed so it is accessible at all times and so there will be easy removal of storm water and spillage by a non-automatic sump, if required.

G. Spilled brine should be pumped and transferred to another tank or tank truck for use or disposal (see Section VI). The PIPP must include provisions for the capture and removal of spilled brine as prescribed by R 324.2006 of Part 5. The PIPP should also include steps to promptly collect and transfer brine from any disabled or damaged tanker on the road.

H. If the brine is from an oil or gas well, then there are additional requirements including annual testing and the facility must obtain a General Permit 2215-00-5 Application of Oil Field Brines for Ice and Dust Control and Soil and Road Stabilization from the Water Bureau. The brine must meet the requirements in R 324.705 of the administrative rules promulgated under Part 615, Supervisor of Wells, of Act 451. Contact Ray Vugrinovich at 517-241-1532 for more information.

   In order to be used for ice or dust control, the brine and well must be approved by the Office of Geological Services (OGS) and meet the following criteria:

   - Calcium: 20,000 milligrams per liter or more;
   - Total Benzene, Ethylbenzene, Toluene, Xylene: 1,000 micrograms per liter or less.

   The PIPP should include the facility's management procedures and maximum brine application rates (1,500 gallons per lane mile of road or 1,250 gallons per acre of land, provided runoff does not occur) contained in General Permit 2215-00-5 Application of Oil Field Brines for Ice and Dust Control and Soil and Road Stabilization.

IV. TRUCK LOADING/UNLOADING AREAS

A responsible observer should be present at all times when salt and brine is being loaded and unloaded. All truck loading and unloading areas must be maintained by one of the following options:

A. Loading areas must be constructed on an impervious pad and should be covered or enclosed within the storage structure to prevent the generation of salt contaminated runoff.

B. Loading areas must be surrounded by curbing or graded to direct salt contaminated runoff to an appropriate collection area (as described under Storm Water Collection and Disposal in section VI), and the drainage ways should be scraped clean of all salt and sand-salt mixture after trucks are loaded and dispatched. The collected salt or sand-salt should be used or returned to the proper storage area.

V. TRUCK WASH AREAS AND GARAGE FLOOR DRAINS

All truck wash areas must be located on an impervious pad. The pad must be sloped or curbed to contain the wastewater and direct it to a collection area for recycling or proper disposal. The wastewater from all garage floor drains and truck wash areas, which is not collected and recycled, must be disposed of by one of the following options.

A. Facility must obtain prior approval from the wastewater treatment facility operator before any discharge of the wastewater to a publicly owned sanitary sewer system. This should be a written approval.

B. The facility can discharge the wastewater into a holding tank which is subsequently pumped and hauled for proper disposal. It is usually taken to a wastewater treatment facility with prior approval from the treatment facility operator, a disposal well, or other disposal company. Recommendations for holding tank design and installation may be obtained from Water Bureau District staff.

1. If a company is hired to haul the liquid waste, then they must be a permitted and registered waste transporter in accordance with Part 121, Liquid Industrial Wastes, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, as amended, and Act 138 of 1998, Hazardous Material Transportation Act. The facility must have a site identification number before shipping. Check the Waste Data System (WDS) to see if an existing number is assigned for the site and other information on file, and either use the online MiTAPS system at www.michigan.gov/mitaps or submit the form EQP5150 if need to update information or apply for a new number. Waste manifests must accompany the shipment and the facility must meet manifest recordkeeping requirements. Submit manifest copy to DEQ Waste & Hazardous Materials Division by the 10th of month following shipment. Get signed copy back from the disposal company and keep that copy at least 3 years from the date of shipment. If the transporter is using a consolidated manifest, they must provide the facility with a receipt that has the following:
   - Transporter's company name,
   - Driver's signature,
   - Date of pickup,
   - Type and quantity of waste removed,
   - Consolidated manifest number, and the
   - Designated facility information.

2. If a governmental agency owns and operates the hauling vehicle, they are exempt from the permit and registration transporter requirements but must still meet manifesting and other liquid industrial waste generator requirements. See above for site identification number and manifesting requirements. Confirm with the insurance company that there is coverage for environmental cleanup in case of an accident.
   - If the governmental agency is hauling 55 gallons or less themselves, they are not required to use a manifest if the following conditions are met:

     • A record of the source and quantity of waste and where the waste is being transported is kept with the waste shipment.

     • The designated facility acknowledges receipt of the waste by signing the record and they keep a copy of the record.

     • Keep a copy of the shipment records for at least three years.

     • The designated facility and the generator must manage the waste according to the liquid industrial waste regulations.

C. The facility is not allowed to discharge to the environment unless the wastewater discharge to the groundwater or to surface water has the required individual permit, or meets one of the exemptions or conditions for a specifically authorized discharge under Part 22, Groundwater Quality Rules, of Part 31, (see R 323.2210 (v), R 323.2215, or R 323.2218). General permits or exemptions can be considered for wash water or snow melt only when it does not contain additives or other contaminants. Floor drains, in garages where automotive repair and maintenance occurs, are not allowed and are not eligible for an exemption. Discuss the operations with the local Water Bureau district office.

VI. SALT CONTAMINATED STORM WATER MANAGEMENT

Salt contaminated storm water (hereafter referred to as brine) from the loading and unloading areas and salt and sand-salt storage areas can be managed in accordance with one of the following options. Storm water in contact with salt resulting in a chloride concentration of 10,000 mg/l or greater must be collected for use or proper disposal.

A. The preferred option is to collect and use the brine as a road dust control agent or pre-wetting ice control agent. Meet the industry and/or MDOT recommendations regarding usage concentration and application rates for using brine or for pre-wetting sand or roads. It is recommended that if brine is used as a dust control agent, it is used only as make-up water on commercial products. This is the preferred management option.

   1. A groundwater discharge permit may not be required per R 323.2210(b) if application is done according to “normally accepted or regulated practices.” These practices must not cause nuisance conditions or erosion, or becomes injurious, and it does not cause runoff to, ponding on, or flooding of adjacent property.

   2. Storm water in contact with salt resulting in a chloride concentration of 250 mg/l or greater, or sodium concentration of 120 mg/l or greater, is subject to Part 31 groundwater discharge authorization. Discuss requirements with the local Water Bureau district office.

B. Discharge the brine into a holding tank for later disposal off-site. Holding tank guidance is being developed. Contact the Environmental Assistance Center at 800-662-9278 for availability or discuss your holding tank design and installation questions with the Water Bureau district office.

   When being disposed of, the brine must be pumped and hauled by a permitted and registered liquid industrial waste transporter or by using the governmental agency's vehicle. See Section V.B for site identification and shipping requirements. If the brine is not reused, it should be hauled for disposal to an Environmental Protection Agency (EPA) and DEQ approved Class I Underground Injection Control (UIC) disposal well or to a facility capable of treating it. As of August 2005, there are two commercial disposal wells that accept brine from salt piles in Michigan:

   - Liquid Management Inc, Bay City 517-684-3742 (Bay County)
   - Northeastern Exploration, Johannesburg 800-792-8168 or 989-786-4346 (Otsego County)

C. Collect the brine in a lined lagoon for later disposal off-site. When being disposed of, it must be pumped and hauled either by a permitted and registered liquid industrial waste transporter or by using the governmental agency's vehicle (see section V. B.). If not reused, it should be hauled for disposal to an EPA and DEQ approved Class I UIC disposal well (see above) or to a facility capable of treating it.

   1. The lagoon must be lined with an impervious, compatible material which is capable of withstanding changing weather conditions without significant deterioration and/or loss of integrity. Please refer to Appendix A of this document for liner and lagoon design recommendations.
   2. The lagoon must be accessible at all times of the year.
   3. An appropriate test for lagoon leak detection should be performed annually.
   4. The lagoon must have adequate storage capacity. Storage capacity should be determined by considering the frequency that the lagoon will be pumped and the maximum amount of rainfall or snow melt possible during that time. The lagoon must maintain at least one foot of freeboard above the lagoon water level at all times. The lagoon liner must be saturated at all times with at least a one foot water/wastewater level to avoid UV rays degrading installed plastic liners (and stored liners awaiting installation) and desiccation cracking of clay liners.

D. The DEQ does not recommend that brine be discharged directly to a municipal sanitary sewer due to potential impacts to surface water and groundwater quality. However, where options for reuse or approved brine disposal wells are unavailable, it may be an option depending on the amount of brine, the rate of discharge to the wastewater treatment plant, and the discharge location.

   Prior to discharge to a municipal sanitary sewer, approval must be obtained from the wastewater treatment plant (WWTP) personnel and an evaluation must be made by DEQ to determine whether water quality standards will be met. The DEQ evaluation will be made at time of reissuance of the WWTP's discharge permit if the WWTP identifies the potential discharge (including flow and concentration of salt) in their permit application. If the DEQ evaluation shows water quality standards will be met, then the WWTP can approve the discharge into their sanitary sewer.

VII. UNCONTAMINATED STORM WATER MANAGEMENT

The best management option is to eliminate all salt contaminated runoff and thus eliminate the required collection and disposal of salt contaminated wastewater. Enclosed salt storage and a valved piping system is a practical method to eliminate storm water from entering the brine collection system.

The site operator will need to determine if the storm water is contaminated with salt or other pollutants or uncontaminated. To be excluded from the Part 5 rules, the salt concentration must be below 1% concentration. The PIPP must include how you will manage the storm water as discussed below:

Uncontaminated storm water collected in the containment area may be handled by either:

A. Applying the storm water to the soil surface outside the containment area without a groundwater discharge permit per R 323.2210(d) if the water does not contain salt contaminated storm water or other leaks or spills and is inspected to ensure compliance with other discharge standards of the Part 22 Rules. For storm water exposed to salt, the discharge of sodium concentration must be below 120 ppm and chloride concentration below 250 ppm; otherwise the discharge is regulated by R 323.2222. If storm water is directly discharged to surface water, it must also meet Part 4 Rules on Water Quality Standards. Discuss these limits or discharge permit requirements with the Water Bureau District Office.

   The discharge cannot be, or become, injurious, and cannot cause runoff to, ponding on, or flooding of adjacent property. It also cannot cause erosion or cause nuisance conditions. When doing a visual inspection before discharging, consider odor, color of any discharges, turbidity, floatable solids, deposits or stains. See the EPA Storm Water Management Fact Sheet *"Visual Inspection."*

B. Discharging the storm water directly to a municipal sanitary sewer with prior approval of the treatment facility operator. Approval should be in writing. Be aware not all sewer systems accept storm water.

VIII. REPORTING POTENTIAL INCIDENTS OF CONTAMINATION

A. The facility needs to meet the following **reporting requirements if a release occurs and it meets or exceeds the threshold reporting quantities of 50 pounds of salt or 50 gallons of brine**. If salt-sand is spilled, calculate the amount of mixture that would contain 50 pounds of salt. This calculation should be done before a release occurs and included in your PIPP

1. Call to report releases:

- **PEAS at 800-292-4706** or from out of state call 517-373-7660, and
- **911** (or the primary public safety answering point per Section 3111b of Part 31)

2. Submit written report within 10 days after the release to:

- DEQ Water Bureau District Supervisor that oversees the area where the release occurred (Note. See Appendix B for the mailing address which is the same as for the staff contacts. This program was transferred to the Water Bureau, so the report no longer is submitted to the Waste Management Division as noted in the rule.)
- Local health department, environmental health section (per Section 3111b of Part 31)

A facility may use the form EQP 3465 "Spill or Release Report" attached in Appendix D or available on the Internet, or submit a written report containing the information identified in Rule 7(2). Include:

a. Cause of the release
b. Date and time of discovery of the release
c. Response measures that have been done, and the schedule for completion of other measures to be taken, or both
d. Measures taken to prevent recurrence of similar releases

3. Report releases if required under other regulations.

When preparing a PIPP, it is recommended you identify potential scenarios that would require additional release reporting and include those in the plan. For example, a local wastewater treatment plant may require a report if a release went into a drain that goes into their system. Check with the sewer authority for local reporting requirements. Another example where additional release reporting requirements may apply is if there was an accident with a salt truck and in addition to the salt release, there was fuel or other fluids from the vehicles released in reportable amounts or a salt truck hit a fuel storage tank resulting in a release of fuel.

If you are required to submit a written release report to a DEQ Division (for example a permit may require reporting of releases) and are subject to the Part 5 Rule reporting requirements, and if the other required report contains the information listed, it is not necessary to also submit a separate report to the Water Bureau for meeting the Part 5 release reporting requirement. Releases that go into a public wastewater treatment plant (WWTP) and meet Part 5 Rule conditions are reportable to the Water Bureau.

B. The road agency or other responsible party may be required to conduct a hydrogeological investigation if DEQ staff deems that a spill or other discharge to the ground warrants an investigation. The investigation may need to determine one or more of the following factors:

1. Groundwater flow direction.
2. Groundwater flow rate.
3. Horizontal and vertical extent of contamination.
4. Potential adverse effects on the human and natural environment from the discharge.
5. Alternative remedial actions to consider.
6. Other factors deemed necessary by DEQ staff.

APPENDIX A — LAGOON DESIGN RECOMMENDATIONS

Treatment and storage lagoons for wastewater regulated under Part 31 of Act 451 and the Part 22 Groundwater Quality Rules must be designed to prevent, to the maximum extent possible, discharges to the groundwater. The following criteria are acceptable to the Water Bureau, Department of Environmental Quality (DEQ), as guidance for treatment and storage lagoon design along with the Part 22 Guidesheet IV "Wastewater Treatment and Storage Lagoons" which has more information about liners and the quality assurance program. This guide sheet can be found at www.michigan.gov/deq and select "Water" "Groundwater Discharge" and under Permits heading select "Groundwater Permit Application Forms & Technical Information." Note that the quality assurance report is now submitted to the Water Bureau District Office instead of the Waste Management Division as stated on page 5 of the guide sheet.

A composite liner is a system that consists of both of the following components:

1) An upper component that consists of a flexible membrane liner which is installed in direct and uniform contact with the lower compacted soil component. The flexible membrane liner shall have nominal thickness not less than 40 mils (0.040 inch) polyvinyl chloride or 60 mils (0.060 inch) thick high-density polyethylene in accordance with R 323.2237(3).
2) A lower component that consists of any of the following soil layers:
   (a) A compacted soil clay liner that meets the requirements of R 323.2237(2)(b).
   (b) A geocomposite clay liner that meets the requirements of R 323.2237(2)(c).
   (c) A natural soil clay barrier that meets the requirements of R 323.2237(2)(a).
   (d) An alternative soil layer that is approved pursuant to the provisions of the Part 22 Rules.

Alternate composite designs will be considered by the Water Bureau District staff and approved, if the alternative design provides the same or greater environmental protection.

Prior to initiating lagoon construction, the following must be approved in writing by the appropriate DEQ Water Bureau District Office:

- Preliminary soil study verifying that an adequate volume of clay exists on site or can be brought which meets the soil criteria for the clay portion of the composite liner
- Engineering plans for lagoon construction
- Construction Quality Assurance Plan

Recertification of liner construction must be done after sludge removal, or any maintenance or other activity which can potentially jeopardize the liner integrity.

APPENDIX B — DEQ WATER BUREAU DISTRICT OFFICE CONTACTS

DISTRICT OFFICE LOCATION	SERVING THE FOLLOWING COUNTIES		STAFF CONTACT MAILING ADDRESS	PHONE/ Email
Bay City (Saginaw Bay)	Arenac Bay Clare Gladwin Huron Iosco	Isabella Midland Ogemaw Saginaw Sanilac Tuscola	Gene Suuppi DEQ Water Bureau 503 N Euclid Ste 8 Bay City MI 48706-2965	989-686-8025 ext 8262 mailto:suuppig@michigan.gov
Cadillac	Antrim Benzie Grand Traverse Kalkaska Lake Leelanau	Manistee Mason Missaukee Osceola Wexford	Brian Myers DEQ Water Bureau 120 West Chapin St Cadillac MI 49601 OR	231-775-3960 ext 6263 mailto:myersbf@michigan.gov
Gaylord Field Office	Alcona Alpena Charlevoix Cheboygan Crawford Emmet	Montmorency Oscoda Otsego Presque Isle Roscommon	Rick Shoemaker DEQ Water Bureau 2100 West M-32 Gaylord, MI 49735	989-705-3424 mailto:shoemakr@michigan.gov
Grand Rapids	Barry Ionia Kent Mecosta Montcalm	Muskegon Newaygo Oceana Ottawa	Keith Zahn DEQ Water Bureau 350 Ottawa Ave NW Grand Rapids MI 49503	616-356-0244 mailto:zahnk@michigan.gov
Jackson	Hillsdale Jackson Lenawee	Monroe Washtenaw	Greg Merricle DEQ Water Bureau 301 E. Louis Glick Hwy Jackson MI 49201-1556	517-780-7841 mailto:merriclg@michigan.gov
Kalamazoo	Allegan Berrien Branch Calhoun	Cass Kalamazoo St. Joseph Van Buren	Steve Norton Greg Danneffel DEQ Water Bureau 7953 Adobe Rd Kalamazoo MI 49009	269-567-3573 269-567-3575 mailto:nortonsc@michigan.gov mailto:danneffg@michigan.gov
Lansing (previously Shiawassee)	Clinton Eaton Genesee Gratiot	Ingham Lapeer Livingston Shiawassee	Craig Lapham Chris Babcock DEQ Water Bureau PO Box 30242 Lansing MI 48909	517-335-6113 517-373-2230 mailto:laphamc@michigan.gov mailto:babcockch@michigan.gov
Southeast Michigan	Macomb Oakland St. Clair Wayne		Tracy Kecskemeti DEQ Water Bureau 27700 Donald Court Warren MI 48092-2793	586-753-3777 mailto:kecskemt@michigan.gov
Upper Peninsula Gwinn (previously Marquette)	Alger Baraga Chippewa Delta Dickinson Gogebic Houghton Iron	Keweenaw Luce Mackinac Marquette Menominee Ontonagon Schoolcraft	Randy Conroy DEQ Water Bureau 420 Fifth St Gwinn MI 49841	906-346-8527 mailto:conroyr@michigan.gov

You may also contact Bob Babcock, Water Bureau, at 517-373-8566 or email mailto:babcockr@michigan.gov.

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APPENDIX C — PIPP COMPLETENESS REVIEW CHECKLIST

This checklist is provided to help identify that the minimum requirements included in Rule 323.2006 that must be addressed in the PIPP along with a few recommended items to include. Include components that are specific to the facility's pollution prevention methods and emergency response. It is not required to provide the information in the order presented. This checklist does not address all the requirements that may be needed to be included if preparing an Integrated Contingency Plan (ICP) as that will vary with the other planning regulation requirements.

IN THE PLAN?			**I: Facility identification information Rule 6(1)(a)**
Yes	**No**	**N/A**	**Identify the following information about the facility:**
☐	☐		1. Facility name
☐	☐		2. Facility owner
☐	☐		3. Mailing address
☐	☐		4. Street address (if different from mailing address)
☐	☐		5. Facility telephone number
☐	☐		6. 24-Hour emergency telephone number(s)
☐	☐		7. Designated spill prevention and control coordinator. It is recommended to also have an alternate contact.
☐	☐	☐	8. Name of person(s) responsible for on-site spill prevention and control (if different from coordinator). It is recommended to also identify an alternate contact.
☐	☐		9. Procedures that will be used to notify individuals within the facility. It is recommended you include how the following will be alerted of an emergency at the facility:
☐	☐		a. Spill prevention and control coordinator
☐	☐		b. Person(s) responsible for on-site spill prevention and control if different from coordinator, and
☐	☐		c. Other people in the facility about the emergency
☐	☐		10. Map showing facility relative to the surrounding area, include thoroughfares.

			II: Notification Procedures to Entities Outside of Facility Rule 6(1)(b)
Yes	**No**	**N/A**	**Identify the reporting procedures that will be used to notify entities off-site. At a minimum, include notification to the following:**
			1. Michigan Department of Environmental Quality
☐	☐		a. PEAS Hotline 800-292-4706 (or 517-373-7660 if calling from out-of-state)
☐	☐	☐	b. District office during business hours (recommended)
☐	☐		2. U.S. Coast Guard - National Response Center 800-424-8802
☐	☐		3. 911 or if that service not available, then contact your community's primary public safety answering point
☐	☐		4. Local emergency planning committee (may be covered by calling 911)
☐	☐		5. Local fire department (may be covered by calling 911)
☐	☐		6. Local law enforcement agency (e.g. police, sheriff's department, state police) (may be covered by calling 911)
☐	☐	☐	7. Municipal wastewater treatment plant if facility served by that plant
☐	☐	☐	8. Spill clean-up contractor, or consulting firm, or both
☐	☐	☐	9. Other local, state, and/or federal agencies or entities that you may be required to report releases under other regulations (required if preparing an ICP that has additional reporting requirements)

			III: Spill Control and Cleanup Procedures Rule 6(1)(c)
Yes	**No**	**N/A**	**Identify information about how the facility will control spills and conduct cleanups of releases:**
			1. Inventory and location of spill control and clean-up equipment (type and quantity)
☐	☐		a. Equipment available on-site
☐	☐	☐	b. Equipment available off-site
☐	☐		2. Procedures for response and cleanup
☐	☐		3. Procedures for characterization and disposal of recovered materials

			IV: Polluting Material Inventory Rule 6(1)(d)
Yes	**No**	**N/A**	**Include information about polluting materials typically on-site in quantities exceeding TMQs during the preceding 12 months:**
			1. Polluting Material(s) by:
☐	☐		a. Chemical Name(s), and
☐	☐		b. Product Name (e.g. Trade Name(s)), and
☐	☐		c. Chemical Abstracts Service (CAS) number
☐	☐		2. Location where the Material Safety Data Sheets (MSDS) are kept for these polluting materials

IN THE PLAN? **V: Site Plan Rule 6(1)(e)**

Yes	No	N/A	**Include information about polluting materials typically on-site in quantities exceeding TMQs during the preceding 12 months:**
☐	☐	☐	1. Aboveground and underground storage tanks
☐	☐	☐	2. Floor drains (know where these floor drains lead to)
☐	☐	☐	3. Loading and unloading areas, docks
☐	☐	☐	4. Sumps (sump pumps)
☐	☐	☐	5. On-site water supply
☐	☐	☐	6. Containment structures for solid polluting materials
☐	☐	☐	7. Secondary containment structures for liquid polluting materials
☐	☐	☐	7. Other storage and use areas of polluting materials that do not exceed TMQs (recommended)
☐	☐	☐	8. Other relevant site structures

VI: Outdoor Secondary Containment for Liquid Polluting Materials Rule 6(1)(f)

Yes	No	N/A	**Include information about outdoor secondary containment structures on-site used for liquid polluting materials exceeding TMQs:**
☐	☐	☐	1. Location(s)
☐	☐	☐	2. Design and construction data including:
☐	☐	☐	a. Dimensions
☐	☐	☐	b. Construction materials (and types of coatings) used
☐	☐	☐	c. Holding capacity
☐	☐	☐	d. Amount of polluting material stored in that structure
☐	☐	☐	3. How spilled polluting materials will be captured and removed
☐	☐	☐	4. Provisions for physical security of secondary containment structure, such as:
☐	☐	☐	a. Signage
☐	☐	☐	b. Gates & Fences
☐	☐	☐	c. Barriers
☐	☐	☐	d. Other
☐	☐	☐	5. Precipitation management (rain or storm water and snow accumulation) procedures
☐	☐	☐	a. Characterization of collected precipitation
☐	☐	☐	b. Disposal procedures
☐	☐	☐	c. Copies of permits or exemptions authorizing discharge (i.e. from DEQ, local wastewater treatment plant)
☐	☐	☐	6. Inspections and maintenance procedures

VII: Other Control Mechanisms and Facility Security Rule 6(1)(g) & (h)

Yes	No	N/A	**Include the following information if it has not already been addressed in the plan:**
☐	☐	☐	1. Other control mechanisms at facility to prohibit or control releases
☐	☐	☐	2. Provisions for general facility physical security

VIII: Plan Preparation, Submittal, and Update Requirements Rule 6(2)–(5)

Yes	No	N/A	**Complete PIPP or ICP, review and update as necessary, and submit notifications:**
☐	☐		1. PIPP, or update, was completed by August 31, 2003 or when facilities meet threshold management quantities
☐	☐		2. Plan is kept at the facility and available for inspection
☐	☐		3. Notification that PIPP or ICP has been prepared and certification of compliance with Part 5 rules sent to Water Bureau district office within 30 days of completing the PIPP or ICP
☐	☐		4. Notification sent to LEPC that plan is completed and available upon request
☐	☐		5. Notification sent to local health department that the plan is completed and available upon request
☐	☐	☐	6. Copy of plan submitted to a requesting agency within 30 days after receiving the request
☐	☐		7. Plan is evaluated every three years and after any release requiring implementation of the plan
☐	☐	☐	8. Plan is updated if any facility personnel, processes, or procedures that were included in the plan occur, or other changes are necessary to maintain compliance with rules
☐	☐	☐	9. Recertification and re-notification of updates are sent to Water Bureau district office, LEPC, and local health department
☐	☐	☐	10. Plan is modified within 30 days of receipt, or other DEQ provided response timeframe, of the DEQ's request to modify the plan if found to be incomplete or inadequate; submit re-notification and recertification

APPENDIX D — SPILL OR RELEASE REPORT

Report Form EQP3465 begins on the next page. This form is optional to use when reporting releases. It can be used by a facility to organize information they need to report when they call in a release and can also be used to submit the written follow-up report for reportable releases under the Part 5 rules.

Facilities may choose to enter basic information such as facility name etc. onto the form, and then enter the spill/release specific information if the need arises.

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

SPILL OR RELEASE REPORT

NOTE: Some regulations require a specific form to use and procedures to follow when reporting a release. Those forms and procedures **MUST** be used and followed if reporting under those regulations. This report form is to aid persons reporting releases under regulations that do not require a specific form. This report form is not required to be used. **To report a release, some regulations require a facility to call the PEAS Hotline at 800-292-4706, or DEQ District Office that oversees the county where it occurred, and other regulating agencies and provide the following information. A follow-up written report may be required. Keep a copy of this report as documentation that the release was reported. If you prefer to submit this report electronically by FAX or e-mail, contact the regulating agency for the correct telephone number or e-mail address.** See the DEQ website on Spill/Release Reporting for more reporting information. Click here for a Microsoft Word version of this report.

Please print or type all information.

NAME AND TITLE OF PERSON SUBMITTING WRITTEN REPORT

TELEPHONE NUMBER (provide area code)

NAME OF BUSINESS

STREET ADDRESS

CITY | **STATE** | **ZIP CODE**

BUSINESS TELEPHONE NUMBER (provide area code)

RELEASE LOCATION (provide address if different than business, if known, and give directions to the spill location. Include nearest highway, town, road intersection, etc.)

SITE IDENTIFICATION NUMBER AND OTHER IDENTIFYING NUMBERS (if applicable)

COUNTY | **TOWNSHIP** | **TIER/RANGE/SECTION (if known)**

RELEASE DATA. Complete all applicable categories. Check all the boxes that apply to the release. Provide the best available information regarding the release and its impacts. Attach additional pages if necessary.

DATE & TIME OF RELEASE (if known)
____/____/____
_____am/pm

DATE & TIME OF DISCOVERY
____/____/____
_____am/pm

DURATION OF RELEASE (if known)
_____ days
_____ hours
_____ minutes

TYPE OF INCIDENT
- ☐ Explosion
- ☐ Fire
- ☐ Leaking container
- ☐ Loading/unloading release
- ☐ Pipe/valve leak or rupture
- ☐ Vehicle accident
- ☐ Other _____

MATERIAL RELEASED (Chemical or trade name)
☐ CHECK HERE IF ADDITIONAL MATERIALS LISTED ON ATTACHED PAGE.

CAS NUMBER or HAZARDOUS WASTE CODE

ESTIMATED QUANTITY RELEASED (indicate unit e.g. lbs, gals, cu ft or yds)

PHYSICAL STATE RELEASED (indicate if solid, liquid, or gas)

FACTORS CONTRIBUTING TO RELEASE
- ☐ Equipment failure
- ☐ Operator error
- ☐ Faulty process design
- ☐ Training deficiencies
- ☐ Unusual weather conditions
- ☐ Other _____

SOURCE OF LOSS
- ☐ Container
- ☐ Railroad car
- ☐ Pipeline
- ☐ Ship
- ☐ Tank
- ☐ Tanker
- ☐ Truck
- ☐ Other _____

TYPE OF MATERIAL RELEASED
- ☐ Agricultural: manure, pesticide, fertilizer
- ☐ Chemicals
- ☐ Flammable or combustible liquid
- ☐ Hazardous waste
- ☐ Liquid industrial waste
- ☐ Oil/petroleum products or waste
- ☐ Salt
- ☐ Sewage
- ☐ Other_____
- ☐ Unknown

MATERIAL LISTED ON or DEFINED BY
- ☐ CAA Section 112(r) list (40 CFR Part 68)
- ☐ CERCLA Table 302.4 (40 CFR Part 302)
- ☐ EPCRA Extremely Hazardous Substance (40 CFR Part 355)
- ☐ Michigan Critical Materials Register or permit
- ☐ NREPA Part 31, Part 5 Rules polluting material
- ☐ NREPA Part 111 or RCRA hazardous waste
- ☐ NREPA Part 121 liquid industrial waste
- ☐ Other list _____
- ☐ Unknown

IMMEDIATE ACTIONS TAKEN
- ☐ Containment
- ☐ Dilution
- ☐ Evacuation
- ☐ Hazard removal
- ☐ Neutralization
- ☐ System shut down
- ☐ Diversion of release to treatment
- ☐ Decontamination of persons or equipment
- ☐ Monitoring
- ☐ Other _____

RELEASE REACHED

Distance from spill location to surface water, in feet_____

- ☐ Surface waters (include name of river, lake, drain involved) _____
- ☐ Drain connected to sanitary sewer (include name of wastewater treatment plant and/or street drain, if known) _____
- ☐ Drain connected to storm sewer (include name of drain or water body it discharges into, if known) _____
- ☐ Groundwater (indicate if it is a known or suspected drinking water source and include name of aquifer, if known) _____
- ☐ Soils (include type e.g. clay, sand, loam, etc.) _____
- ☐ Ambient Air
- ☐ Spill contained on impervious surface

THIS IS A MASTER COPY. PLEASE MAKE COPIES AS NEEDED.

EXTENT OF INJURIES, IF ANY	WAS ANYONE HOSPITALIZED?	TOTAL NUMBER OF INJURIES TREATED ON-SITE:
	☐ Yes NUMBER HOSPITALIZED:____ ☐ No	

DESCRIBE THE INCIDENT, THE TYPE OF EQUIPMENT INVOLVED IN THE RELEASE, HOW THE VOLUME OF LOSS WAS DETERMINED, ALONG WITH ANY RESULTING ENVIRONMENTAL DAMAGE CAUSED BY THE RELEASE. IDENTIFY WHO IMMEDIATELY RESPONDED TO THE INCIDENT (own employees or contractor — include cleanup company name, contact person, and telephone number). ALSO IDENTIFY WHO DID FURTHER CLEANUP ACTIVITIES, IF PERFORMED OR KNOWN WHEN REPORT SUBMITTED

☐ **CHECK HERE IF DESCRIPTION OR ADDITIONAL COMMENTS ARE INCLUDED ON ATTACHED PAGE**

ESTIMATED QUANTITY OF ANY RECOVERED MATERIALS AND A DESCRIPTION OF HOW THOSE MATERIALS WERE MANAGED (include disposal method if applicable)

☐ **CHECK HERE IF DESCRIPTION OR ADDITIONAL COMMENTS ARE INCLUDED ON ATTACHED PAGE**

ASSESSMENT OF ACTUAL OR POTENTIAL HAZARDS TO HUMAN HEALTH (include known acute or immediate and chronic or delayed effects, and where appropriate, advice regarding medical attention necessary for exposed individuals.)

☐ **CHECK HERE IF DESCRIPTION OR ADDITIONAL COMMENTS ARE INCLUDED ON ATTACHED PAGE**

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY NOTIFIED:

INITIAL CONTACT BY: ☐ Telephone ☐ Fax ☐ Email ☐ Other

DATE/TIME INITIAL CONTACT:_____

☐ PEAS: 800-292-4706 Log Number Assigned _____

☐ DEQ District or Field Office

- ☐ Baraga
- ☐ Bay City
- ☐ Cadillac
- ☐ Crystal Falls
- ☐ Detroit
- ☐ Gaylord
- ☐ Grand Rapids
- ☐ Gwinn
- ☐ Jackson
- ☐ Kalamazoo
- ☐ Lansing
- ☐ Newberry
- ☐ Warren
- ☐ Wyoming

DEQ Office locations are subject to change

Divisions or Offices Contacted:

- ☐ Air Quality
- ☐ Land & Water Management
- ☐ Office Geological Survey
- ☐ Remediation and Redevelopment
- ☐ Waste and Hazardous Materials
- ☐ Water Bureau

NAME AND TITLE OF PERSON MAKING INITIAL REPORT:

_____

DEQ STAFF CONTACTED & PHONE NUMBER:

_____

_____

OTHER ENTITIES NOTIFIED:

	Date:	Time:
☐ National Response Center (NRC): 800-424-8802	_____	_____
☐ US Coast Guard Office: ☐ Detroit ☐ Grand Haven ☐ Sault Ste. Marie	_____	_____
☐ US Department of Transportation	_____	_____
☐ US Environmental Protection Agency	_____	_____
☐ 911 (or primary public safety answering point)	_____	_____
☐ Local Fire Department	_____	_____
☐ Local Police and/or State Police	_____	_____
☐ Local Emergency Planning Committee	_____	_____
☐ State Emergency Response Commission via MI SARA Title III Program	_____	_____
☐ Wastewater Treatment Plant Authority	_____	_____
☐ Hazmat Team	_____	_____
☐ Local Health Department	_____	_____
☐ Department of Labor & Economic Growth MIOSHA	_____	_____
☐ Department of Labor & Economic Growth Fire Safety	_____	_____
☐ Michigan Department of Agriculture: 800-405-0101		
☐ Other _____		

PERSON CONTACTED & PHONE NUMBER:

_____

_____

DATE WRITTEN REPORT SUBMITTED	SIGNATURE OF PERSON SUBMITTING WRITTEN REPORT

THIS IS A MASTER COPY. PLEASE MAKE COPIES AS NEEDED.

Any questions about salt and brine storage requirements should be directed to the Water Bureau District Office or call the Environmental Assistance Center at 800-662-9278 for referral.

This Salt and Brine Storage Guidance for Road Agency Maintenance and Other Facilities was revised August 2007 by the Water Bureau and Environmental Science and Services Division. Regulations are subject to change. Reliance on information from this document is not usable as a defense in any enforcement action or litigation. Refer to the regulations and discuss questions about requirements with the regulating agency.

APPENDIX D

MONTHLY FACILITY STORM WATER CONTROL INSPECTION FORMS

Ottawa County

Monthly Facility Storm Water Control Inspection Form

Facility Name: **HAGAR PARK** Date: _____

Person completing form (printed name): _____

Control devices present. Check off every device that was inspected.

___ curb and gutter

___ catch basins (3)

___ vegetated swales

___ storm water discharge to Hagar Creek

___ Other (list)

_____

_____

Checklist:

☐ YES ☐ NO Are structural storm water control devices accessible?

☐ YES ☐ NO Are structural storm water control devices free of debris, oil and grease, and other pollutants?

☐ YES ☐ NO Are vegetated controls free of any bare soil, erosion or gullies?

☐ YES ☐ NO Are vegetated controls free of noxious weeds?

☐ YES ☐ NO Are inlet/outlet pipes and/or devices clear and undamaged?

☐ YES ☐ NO Are storm water management devices maintained and functioning properly?

For every NO that is checked above, explain why below:

_____

_____

_____

_____

Is ***any*** maintenance needed? ☐ YES ☐ NO If yes, document on the back of this form.

Provide copy to Parks Supervisor to schedule any necessary maintenance. Attach facility map with additional notes if appropriate.

_____ _____

Inspector's Signature Title

Ottawa County

Monthly Facility Storm Water Control Inspection Form

Storm Water Maintenance Needs for <u>Hagar Park</u>

Describe maintenance needed: ____

____

____

Date resolved: ________________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: __________________________ Comments: _______________________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ________________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: __________________________ Comments: _______________________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ________________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: __________________________ Comments: _______________________________________

____

Ottawa County

Monthly Facility Storm Water Control Inspection Form

Facility Name: **JAMES STREET COMPLEX** Date: _____

Person completing form (printed name): _____

Control devices present. Check off each that are inspected.

___ curb and gutter

___ catch basins (20)

___ isolated sump (3)

___ detention pond

___ Other (list)

_____

_____

Checklist:

☐ YES ☐ NO Are structural stormwater control devices accessible?

☐ YES ☐ NO Are structural stormwater control devices free of debris, oil and grease, and other pollutants?

☐ YES ☐ NO Are vegetated controls free of any bare soil, erosion or gullies?

☐ YES ☐ NO Are vegetated controls free of noxious weeds?

☐ YES ☐ NO Are inlet/outlet pipes and/or devices clear and undamaged?

☐ YES ☐ NO Are storm water management devices maintained and functioning properly?

For every **NO** that is checked above, explain why below:

_____

_____

_____

_____

_____

Is ***any*** maintenance needed? ☐ YES ☐ NO If yes, document on the back of this form.

Provide copy to Maintenance Supervisor to schedule any necessary maintenance. Attach facility map with additional notes if appropriate.

_____ _____

Inspector's Signature Title

Ottawa County

Monthly Facility Storm Water Control Inspection Form

Storm Water Maintenance Needs for James Street Complex

Describe maintenance needed: ____

____

____

Date resolved: ______________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ________________________ Comments: ____________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ______________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ________________________ Comments: ____________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ______________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ________________________ Comments: ____________________________

____

Ottawa County

Facility Storm Water Structural Control Inspection Form

Medium and Low priority facilities

Facility Name: _____ Date: _____

Person completing form (printed name): _____

Control devices present. Select all that apply and indicate quantity on the line in front of the device.

___ curb and gutter

___ catch basins

___ infiltration facility

___ bioretention facility (e.g. rain garden)

___ detention ponds

___ Storm water discharge points

___ Other (list)

_____

_____

Checklist:

☐ YES ☐ NO Are structural storm water control devices accessible?

☐ YES ☐ NO Are structural storm water control devices free of debris, oil and grease, and other pollutants?

☐ YES ☐ NO Are vegetated controls free of any bare soil, erosion or gullies?

☐ YES ☐ NO Are vegetated controls free of noxious weeds?

☐ YES ☐ NO Are inlet/outlet pipes and/or devices clear and undamaged?

☐ YES ☐ NO Are storm water management devices maintained and functioning properly?

For every NO that is checked above, explain why below:

_____

_____

_____

_____

Is ***any*** maintenance needed? ☐ YES ☐ NO If yes, document on the back of this form.

Provide copy to Street Department Supervisor to schedule any necessary maintenance. Attach facility map with additional notes and/or photos if appropriate.

_____ _____

Inspector's Signature Title

Ottawa County

Facility Storm Water Structural Control Inspection Form

Medium and Low priority facilities

Storm Water Maintenance Needs for ______________________________ (facility name)

Describe maintenance needed: ____

____

____

Date resolved: ____________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ______________________ Comments: _________________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ____________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ______________________ Comments: _________________________________

____

Describe maintenance needed: ____

____

____

Date resolved: ____________________ By whom: ☐ Facility staff ☐ Street Department

Is follow up necessary prior to next monthly inspection? ☐ YES ☐ NO If yes, document below:

Date of follow up: ______________________ Comments: _________________________________

____

Ottawa County Water Resources Commissioner

Storm Water Structural Control Inspection Form

Inspector: _____Date: _____

Drain/Storm Water Control Name: _____

Checklist:

☐ YES ☐ NO Are structural storm water control devices accessible?

☐ YES ☐ NO Are structural storm water control devices free of debris and other pollutants?

☐ YES ☐ NO Are vegetated controls free of any bare soil, erosion, gullies or animal burrows?

☐ YES ☐ NO Are vegetated controls free of noxious weeds?

☐ YES ☐ NO Are inlet/outlet pipes and/or devices clear and undamaged?

☐ YES ☐ NO Are storm water management devices maintained and functioning properly?

For every NO that is checked above, explain why below:

_____

_____

_____

_____

Is ***any*** maintenance needed? ☐ YES ☐ NO If yes, explain below

_____

_____

_____

_____

_____ _____

Inspector's Signature Title

NOTE: When maintenance is required, provide a copy of this form to the Drain Clerk to create an entry (Inspection Report) in the maintenance database to initiate the required work and follow up inspection.

APPENDIX E

STORM WATER COMPREHENSIVE SITE INSPECTION FORMS

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

This checklist shall be completed at least once every 6 months at facilities that were determined to have a high potential for pollutant runoff.

INSPECTOR'S NAME:	DATE:
NAME & ADDRESS OF STORMWATER FACILITY: **HAGAR PARK**	
GENERAL OBSERVATIONS (IS WATER FLOWING?):	
WEATHER:	

Facility Operation				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are vehicles parked indoors or under a roof when not in use?				
Are operations such as vehicle washing, vehicle maintenance, draining of fluids, storage of fluids and waste performed under a roof or inside?				
Are vehicles washed regularly to remove contamination and prevent it from polluting stormwater?				
Is wash water treated in an oil-water separator prior to discharge?				
Is process water diverted to a trench drain system to collect contaminated run-off inside work areas?				
Is process water from the trench drain system treated in an oil-water separator prior to discharge?				
Are solids cleaned out of the oil-water separator and trench drain system regularly?				
When working outdoors, is contaminated process water and sediment collected to prevent it from mingling with and contaminating stormwater?				
Are drains inside the facility connected to a sanitary sewer?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Fluids Management				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are fluids in tanks or drums stored with an appropriate amount of secondary containment?				
Are drum-top pads used for leaks and spills that occur during transfer of fluids?				
Are fluids drained over a drip pan or pad?				
Are funnels or pumps used when transferring fluids?				
Are drip pans placed under leaks?				
Are containers maintained in good condition, closed, covered and away from equipment that can cause them to tip over?				
Are containers stored inside or under a roof?				
Are containers inspected regularly?				
Are all containers labeled in a manner that describes the contents adequately?				
Are absorbent pads used on drum tops to catch spills?				
Is a closed-loop parts washer system used (contains solvent)?				
Is the parts-washer lid kept closed when not in use?				
Is a contract in place with a parts washer service company to change out spent solvent?				
Has the possibility of using an aqueous-based parts washer been explored?				
Are fluids stored in appropriate containers and/or storage cabinets?				
Are storage areas kept clean and well organized?				
Are storage areas labeled clearly?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Leak and Spill Prevention and Control				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are vehicles inspected daily for leaks?				
Is spill control equipment and absorbents readily available? (Spill kits clearly labeled)				
Are emergency phone numbers posted in the area?				
Are material safety data sheets (MSDS's) readily available?				
Are spills cleaned up immediately?				
Are employees trained annually on spill prevention?				
Oil Management				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is oil changed indoors over concrete, sloped to a drain or curbed surface?				
Is oil changed over a drip pan or pad?				
Are funnels or pumps used when transferring oil?				
Are drip pans placed immediately under any oil leak?				
Is waste oil stored indoors when possible and with secondary containment?				
Are waste oil containers in good condition, closed, labeled and inspected regularly?				
Is anything else mixed with waste oil?				
Is waste oil recycled?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Antifreeze				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is antifreeze changed indoors over concrete that is sloped to drain or curbed surface?				
Is antifreeze drained over a drip pan or pad?				
Are funnels or pumps used when transferring antifreeze?				
Are drip pans placed immediately under any leak?				
Is waste antifreeze stored indoors when possible with secondary containment?				
Are containers kept in good condition, closed, labeled and inspected regularly?				
Is antifreeze mixed with any other wastes?				
Is waste antifreeze recycled?				
Lead-Acid Batteries				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are lead-acid batteries stored indoors over a curbed impermeable surface?				
Are intact batteries stored on an acid resistant rack or tub?				
Are cracked or leaking batteries stored in closed leak-proof and labeled containers?				
Is the date each battery was placed into storage recorded?				
Are batteries stacked more than 5 high?				
Are batteries inspected regularly for leaks?				
Are acid neutralizing agents, such as baking soda, available in case of leaks?				
Are batteries recycled?				
Are batteries stored longer than 6 months before recycling?				
Are lead cable ends left on the batteries to be recycled?				

Tires				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are tires stored indoors?				
If tires are stored outdoors, is the tire pile covered?				
Are tires recycled frequently to keep the number of tires stored on site low?				
Fueling Areas				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is fueling performed under a canopy?				
Are spill cleanup materials available at the fueling area?				
Is the fueling handle lock disconnected so the person fueling must attend the fueling process?				
Are breakaway valves used on fueling hoses?				
Is fueling area stormwater runoff treated in an oil-water separator?				
Are all fuel deliveries monitored?				
Is the fueling automatic stop inspected regularly to ensure proper function?				
Rags, Oil-Absorbing Pads, Towels and Clothing				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are oil rags and absorbent pads stored in appropriate containers and disposed of properly?				
Are reusable oily materials such as towels and clothing maintained through a commercial laundering service or an in-house washing machine that discharges to a sanitary system through and oil-water separator?				

Miscellaneous Storage Piles				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are piles of spoils, asphalt, street cuts, etc. stored at the facility under a roof or cover?				
Are spills of miscellaneous debris on facility grounds cleaned up promptly?				
Facility Stormwater Runoff				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is uncontaminated stormwater prevented from mixing with process areas?				
Are stormwater controls free of debris, in good condition and functioning properly? *Attach completed Stormwater Control Inspection Checklist.*				

Comments/Action Items:

Submit completed report to Parks Supervisor or person in charge of municipal stormwater program.

Inspector's Signature

Date

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

This checklist shall be completed at least once every 6 months at facilities that were determined to have a high potential for pollutant runoff.

INSPECTOR'S NAME:	DATE:
NAME & ADDRESS OF STORMWATER FACILITY: **JAMES STREET COMPLEX**	
GENERAL OBSERVATIONS (IS WATER FLOWING?):	
WEATHER:	

Facility Operation				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are vehicles parked indoors or under a roof when not in use?				
Are operations such as vehicle washing, vehicle maintenance, draining of fluids, storage of fluids and waste performed under a roof or inside?				
Are vehicles washed regularly to remove contamination and prevent it from polluting stormwater?				
Is wash water treated in an oil-water separator prior to discharge?				
Is process water diverted to a trench drain system to collect contaminated run-off inside work areas?				
Is process water from the trench drain system treated in an oil-water separator prior to discharge?				
Are solids cleaned out of the oil-water separator and trench drain system regularly?				
When working outdoors, is contaminated process water and sediment collected to prevent it from mingling with and contaminating stormwater?				
Are drains inside the facility connected to a sanitary sewer?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Fluids Management				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are fluids in tanks or drums stored with an appropriate amount of secondary containment?				
Are drum-top pads used for leaks and spills that occur during transfer of fluids?				
Are fluids drained over a drip pan or pad?				
Are funnels or pumps used when transferring fluids?				
Are drip pans placed under leaks?				
Are containers maintained in good condition, closed, covered and away from equipment that can cause them to tip over?				
Are containers stored inside or under a roof?				
Are containers inspected regularly?				
Are all containers labeled in a manner that describes the contents adequately?				
Are absorbent pads used on drum tops to catch spills?				
Is a closed-loop parts washer system used (contains solvent)?				
Is the parts-washer lid kept closed when not in use?				
Is a contract in place with a parts washer service company to change out spent solvent?				
Has the possibility of using an aqueous-based parts washer been explored?				
Are fluids stored in appropriate containers and/or storage cabinets?				
Are storage areas kept clean and well organized?				
Are storage areas labeled clearly?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Leak and Spill Prevention and Control				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are vehicles inspected daily for leaks?				
Is spill control equipment and absorbents readily available? (Spill kits clearly labeled)				
Are emergency phone numbers posted in the area?				
Are material safety data sheets (MSDS's) readily available?				
Are spills cleaned up immediately?				
Are employees trained annually on spill prevention?				
Oil Management				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is oil changed indoors over concrete, sloped to a drain or curbed surface?				
Is oil changed over a drip pan or pad?				
Are funnels or pumps used when transferring oil?				
Are drip pans placed immediately under any oil leak?				
Is waste oil stored indoors when possible and with secondary containment?				
Are waste oil containers in good condition, closed, labeled and inspected regularly?				
Is anything else mixed with waste oil?				
Is waste oil recycled?				

Stormwater Pollution Prevention Good Housekeeping Comprehensive Site Inspection

Antifreeze				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is antifreeze changed indoors over concrete that is sloped to drain or curbed surface?				
Is antifreeze drained over a drip pan or pad?				
Are funnels or pumps used when transferring antifreeze?				
Are drip pans placed immediately under any leak?				
Is waste antifreeze stored indoors when possible with secondary containment?				
Are containers kept in good condition, closed, labeled and inspected regularly?				
Is antifreeze mixed with any other wastes?				
Is waste antifreeze recycled?				
Lead-Acid Batteries				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are lead-acid batteries stored indoors over a curbed impermeable surface?				
Are intact batteries stored on an acid resistant rack or tub?				
Are cracked or leaking batteries stored in closed leak-proof and labeled containers?				
Is the date each battery was placed into storage recorded?				
Are batteries stacked more than 5 high?				
Are batteries inspected regularly for leaks?				
Are acid neutralizing agents, such as baking soda, available in case of leaks?				
Are batteries recycled?				
Are batteries stored longer than 6 months before recycling?				
Are lead cable ends left on the batteries to be recycled?				

Tires				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are tires stored indoors?				
If tires are stored outdoors, is the tire pile covered?				
Are tires recycled frequently to keep the number of tires stored on site low?				
Fueling Areas				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is fueling performed under a canopy?				
Are spill cleanup materials available at the fueling area?				
Is the fueling handle lock disconnected so the person fueling must attend the fueling process?				
Are breakaway valves used on fueling hoses?				
Is fueling area stormwater runoff treated in an oil-water separator?				
Are all fuel deliveries monitored?				
Is the fueling automatic stop inspected regularly to ensure proper function?				
Rags, Oil-Absorbing Pads, Towels and Clothing				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are oil rags and absorbent pads stored in appropriate containers and disposed of properly?				
Are reusable oily materials such as towels and clothing maintained through a commercial laundering service or an in-house washing machine that discharges to a sanitary system through and oil-water separator?				

Miscellaneous Storage Piles				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are piles of spoils, asphalt, street cuts, etc. stored at the facility under a roof or cover?				
Are spills of miscellaneous debris on facility grounds cleaned up promptly?				
Facility Stormwater Runoff				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Is uncontaminated stormwater prevented from mixing with process areas?				
Are stormwater controls free of debris, in good condition and functioning properly? *Attach completed Stormwater Control Inspection Checklist.*				

Comments/Action Items:

Submit completed report to Maintenance Supervisor or person in charge of municipal stormwater program.

Inspector's Signature

Date

APPENDIX F

CATCH BASIN INSPECTION FORM

OTTAWA COUNTY WATER RESOURCES COMMISSIONER CATCH BASIN INSPECTION FORM

INSPECTOR _____ DATE _____

TOWNSHIP _____ SECTION _____

NAME OF DRAIN_____ # OF CB INSEPCTED _____

At each CB, look for debris and sediment blocking the inlet and remove if found. Look for sediment and trash in sump. If sump is more than 50% full, note below and schedule for cleaning. Look for damage or cracks to frame, grate, basin walls, etc., note below and schedule for repair.

MAINTENANCE NEEDS

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

OTTAWA COUNTY WATER RESOURCES COMMISSIONER CATCH BASIN INSPECTION FORM

MAINTENANCE NEEDS CONTINUED

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

OTTAWA COUNTY WATER RESOURCES COMMISSIONER CATCH BASIN INSPECTION FORM

INSPECTOR _____ DATE _____

TOWNSHIP _____ SECTION _____

NAME OF DRAIN_____ # OF CB INSEPCTED _____

At each CB, look for debris and sediment blocking the inlet and remove if found. Look for sediment and trash in sump. If sump is more than 50% full, note below and schedule for cleaning. Look for damage or cracks to frame, grate, basin walls, etc., note below and schedule for repair.

MAINTENANCE NEEDS

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

OTTAWA COUNTY WATER RESOURCES COMMISSIONER CATCH BASIN INSPECTION FORM

MAINTENANCE NEEDS CONTINUED

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

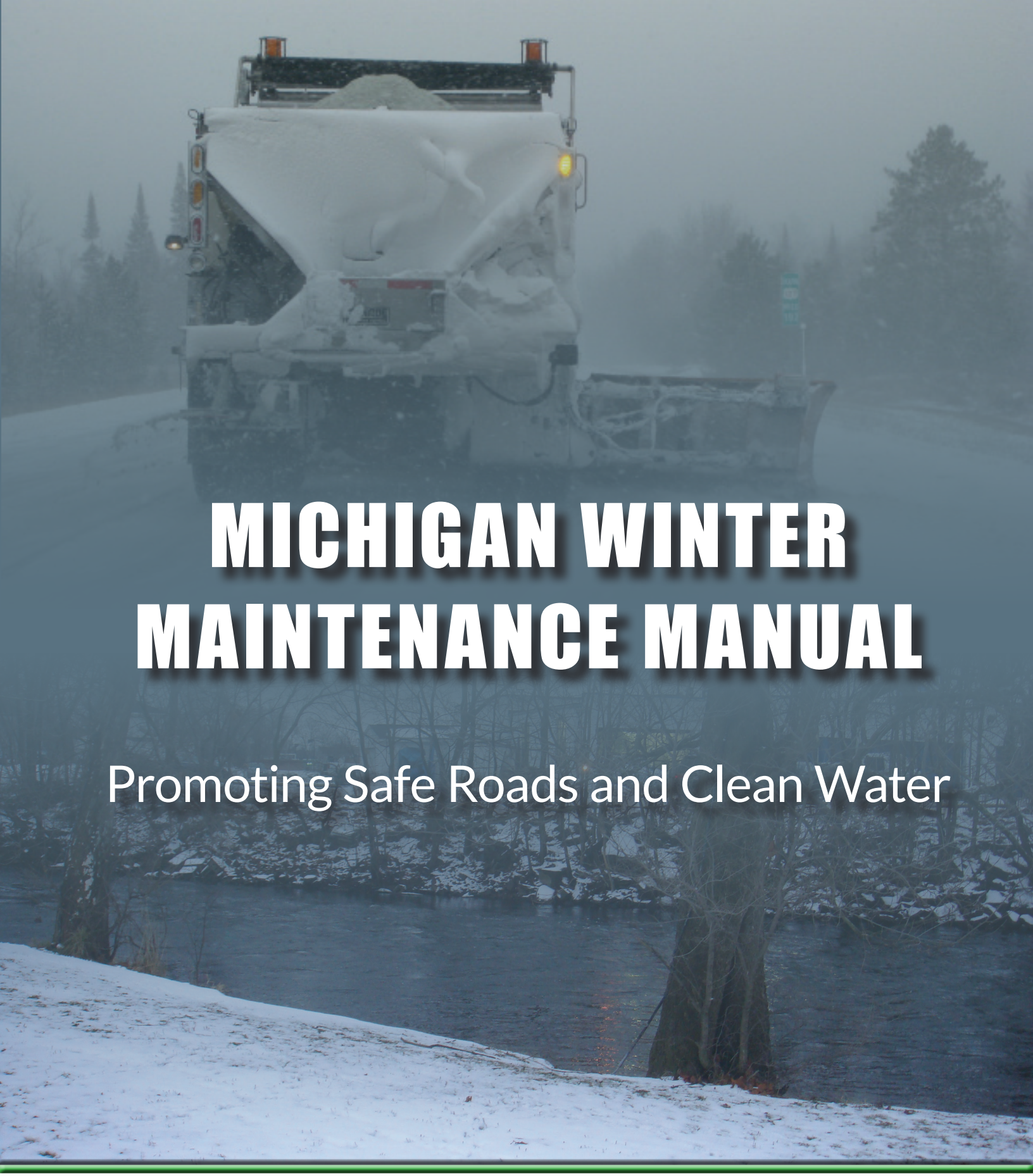
CB Location: _____

Type of maintenance: _____

Date maintenance completed: _____

APPENDIX G

MICHIGAN WINTER MAINTENANCE MANUAL



MICHIGAN WINTER MAINTENANCE MANUAL

Promoting Safe Roads and Clean Water

Applying knowledge to improve water quality
Great Lakes Regional Water Program
A Partnership of USDA NIFA & Land Grant Colleges and Universities

MICHIGAN STATE UNIVERSITY | Extension

Acknowledgments

This manual is dedicated to the protection of Michigan's natural resources and the winter maintenance professionals who have the opportunity to protect them. *Michigan Winter Maintenance Manual – Promoting Safe Roads and Clean Water* is based on the *Minnesota Snow and Ice Control Field Handbook for Snowplow Operators, Second Revision* published by the Minnesota Local Road Research Board in 2012.

Thank you to the following sponsors and participants for their valuable input in the production of this document. Final interpretation is the responsibility of the authors.

Project Funding
Great Lakes Regional Water Program This material is based upon work supported by the USDA-NIFA under award No. 2012-48691-20334

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Publication Date
2013

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Purpose of this Manual

The purpose of this manual is to help winter maintenance professionals achieve their goals of providing safe roads through sustainable winter maintenance practices and policies. As a maintenance professional involved in your organization's winter maintenance program, your daily actions are critical components of its success.

Not only are you tasked with providing continued public safety on roads, parking lots and sidewalks during winter storm events, but the choices you make can greatly affect the ability of your organization to provide these services in a cost-effective manner. The actions you take can also make the difference between adding to or reducing the amount of salt, sand and other pollutants presently entering drains, creeks, streams and lakes throughout Michigan.

The over-application of deicing materials can have a detrimental effect on surface water, groundwater and drinking water quality. Studies have also shown that the over-application of deicing materials can contribute to habitat degradation in our local creeks**,** streams, and lakes and in vegetated areas near roadways. This has a negative effect on fish and other wildlife living in these areas. The use of deicing materials is being increasingly regulated, and discharge limits are being applied under federal and state storm water regulations.

This manual is designed to provide you with Best Management Practices (BMPs) and other information that can assist you and your organization in making sound decisions around your winter maintenance duties. The goal of this manual is help you establish procedures that will maintain the desired level of service while reducing the amount of deicing materials that are being applied. It will also help your organization comply with strict federal and state storm water regulations.

We hope that reading this manual will increase your knowledge of the equipment, materials and application processes that are used in winter maintenance operations. Reviewing this manual in your organization can provide an opportunity for further discussion between you, your coworkers, supervisors and managers on how to improve efficiency, while reducing the use of de-icing materials and increasing protection of the environment.

Throughout the manual you will find environmental tips shown with a fish symbol. These tips will help you reduce environmental impacts.

Throughout the manual you will find cost-saving tips shown with a dollar symbol. These tips will allow you to maximize your efficiency and save money.

Michigan Roads: Where Economics and Environment Meet

The business of winter maintenance rests in the very capable hands of people like you.

As the industry evolves, it is important for you to stay current in your knowledge and understanding of the issues that drive winter maintenance. We are beginning to understand the serious corrosion and environmental harm caused by the deicing materials used in winter maintenance. With the advent of better equiment and alternative deicers, we have great opportunity for cost savings as well for a lessening of the environmental impacts of winter maintenance.

By following the BMPs discussed in this manual, you can both meet the needs of your customers and protect the freshwater systems that surround your roads.

The use of more sophisticated deicing materials and equipment with more flexibility may have higher cost assosiated with them up-front. These costs can be recovered, however, by reducing your salt usage and minimizing the need for some of your post-winter maintenace activities such as curb sweeping and catchbasin cleaning. These chemicals and equipment can also help improve your level of service.

By demonstrating a strong return on investment (ROI), you will increase public support for your efforts. By taking time to educate the public on your winter maintenance policy and methods, you can foster a positive and cooperative relationship with them.

In order to help public agencies be careful stewards of taxpayer dollars, the Clear Roads pooled study created an interactive tool kit that helps agencies calculate the cost/benefit ratio of selected winter maintenance technologies. This tool kit can be found on the Clear Roads website at www.clearroads.org.

There are other costs associated with the use of deicing materials that commonly are not included in most organizations' ROI assessment. These uncounted costs include repairing damage to infrastructure. Using less salt on the roadways can save all taxpayers money by reducing the corrosion of maintenance equipment, personal vehicles and bridges, and by limiting the degradation of road surfaces.

Estimates of damage to infrastructure, automobiles, vegetation, human health and the environment from deicing materials range from $803 to $3300 per ton of road salt used, according to several research reports (see figure 1 and citations below).

The True Cost of Road Salt: It Really Adds Up!

Item	Cost
Material (salt) $55/ton[1]	$55/ton
Labor and Equipment to apply salt[2]	$100/ton
Damage from use of salt[3]	$800 - $3300/ton
Total cost:	$955 - $3455/ton

Figure 1: Estimates of Costs for Using Road Salt

Sources: MDOT (2013), Vitaliano (1977) and Murray et. al (1992) as cited in a draft, "The Real Cost of Road Salt Use for Winter Maintenance in the Twin Cities Metropolitan Area of Minnesota," prepared for the Minnesota Pollution Control Agency by Carolyn Dindorf and Connie Fortin, January 21, 2013.

Figure 2: Great Lakes Drainage Area

In addition to having safe roads and reducing the immediate and long-term winter maintenance costs, your customers are also interested in protecting Michigan's lakes and rivers. As "The Great Lakes State," Michigan has an abundance of water bodies, with the Great Lakes and approximately 11,000 inland lakes, as well as streams and wetlands. These should be preserved as the valuable and irreplaceable natural resources that they are.

Lake Michigan and the other Great Lakes represent 20 percent of the world's fresh surface water. The Great Lakes, along with the rivers, channels, and lesser lakes feeding or draining them, constitute the largest surface freshwater system on Earth!

Michigan residents rely on this freshwater for personal, agricultural and business uses. Tourism is important to the state of Michigan as it is one of our leading industries. Our fresh, clean lakes and rivers attract many visitors to the state and contribute to our quality of life in many ways.

Unfortunately, chloride from road salt is entering the environment and threatening the health of Michigan's fresh water ecosystems. Salts, such as those used in winter maintenance activities, dissolve and move downhill with water (snow melt or rain) to the nearest lake, river or pond. Chloride does not settle out or disappear. Chloride stays in our water cycle virtually forever. It only takes about 1 teaspoon of rock salt to contaminate 5 gallons of water to the federal chronic chloride standard of 230mg/l.[1]

There is an overall trend of higher chloride concentrations in water bodies located in the southern region of Michigan. The highest concentrations are around the larger cities and most heavily-traveled roadways.[2] The United States Environmental Protection Agency documented 29 incidences of Michigan groundwater contamination from salt or salt/sand[3] in addition to effects on surface waters.

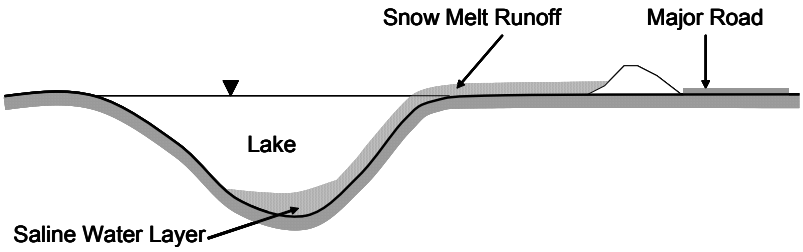

Figure 3: Lake Stratification Due to Saltwater Runoff

In addition to causing aquatic toxicity, salt water is heavier than freshwater and sinks to the bottom of lakes. This can eventually cause stratification of the lake and loss of lake turnover.[4]

A recent study on the negative impacts from road salt runoff concluded that "reduction in usage appears to be the only effective road-salt-runoff management strategy."[5] You, as a winter maintenance professional, are uniquely positioned to safeguard the freshwater resources of Michigan by using less salt. The information in this manual provides many suggestions on how to accomplish this.

Preparing for Winter

All winter maintenance organizations should have a written winter maintenance plan. This plan, if followed, will help protect you legally. It will also help you run a smooth and well-thought-out winter maintenance operation. Each year, in advance of winter, take time to review and update your maintenance procedures. A little planning up-front can help you do an excellent job in keeping the roads safe and decrease the required application of salt throughout the season.

Winter Maintenance Plan

- Develop a winter maintenance plan, and be prepared to follow it.
- Share the plan with all involved staff.
- Define levels of service for all of your snow routes. Your level of service may be based on average daily traffic, environmental concerns, safety, mobility, economics, and other factors.
- Communicate the relevant portions of your winter maintenance plan to your customers so they understand their role and what to expect. See Appendix A for examples of how to reach out to your customers with information on winter maintenance activities.

Route Preparation and Planning

These activities can be done by operators and supervisors, as appropriate, during the fall to lay the groundwork for efficient winter operations.

- Inspect and clear ditches, culverts, and other water channels.
- Remove potential snow traps, such as tall grasses along the road that will catch and deposit snow on the road.
- Assign routes to operators; better performance is achieved when operators have an assigned route throughout the season.
- Drive all routes prior to winter to identify critical or problem areas.
- Understand the target level of service for various areas of a route.
- Inventory all the areas prone to drifting and develop a plan to manage them. Consider installing snow fences.
- Explain the best ways to manage blowing and drifting snow with new operators.

Snow Fences

National research has found that it is 100 times more expensive to plow snow than to trap it with a snow fence.[6] A snow fence can be permanent or seasonal, living or structural. Using vegetation as a snow fence takes long-term vision, as it can take five to ten years before the plantings are of sufficient size to create the desired effect. The economic benefits of using snow fences in winter maintenance operations include savings from: reduced overtime, less need for contract equipment and services, reduced operating expenses, and reduced sand or chemical usage for ice control. See Appendix D for more resources on snow fencing.

Storage and Handling Systems

Proper storage and handling of deicers is a primary way to reduce groundwater contamination from salt. Stored salt needs to be covered, as do sand piles which contains more than 1% of salt. This applies to all piles greater than 5 tons. The DEQ has produced a document to guide the proper storage and handling of road salt. See Appendix D.

The best method to store granular salt and sand/salt mix is in a covered, water-tight building with doors. Having a salt shed with doors greatly improves protection from the elements. The salt and salt/sand mix needs to be stored on an impervious pad such as asphalt. If your impervious pad is constructed out of concrete it should have a sealer applied to it. The surrounding outdoor pad should be sloped and curbed to direct runoff water into a collection area.

Currently, the outdoor storage requirements in Michigan indicate that liquid storage should be in double-walled tanks or that secondary containment should be around single-wall tanks. Secondary containment should be such that if the tank leaks, all of the contents of the tank can be contained and recovered on site. This applies to all liquid deicers over 1000 gallons under the present Part 5 rules. These requirements may change during the Part 5 stakeholder process, so check the DEQ website for the most current information.

The feasibility of outdoor liquid storage is limited based on the eutectic temperature of the liquid product. The eutectic temperature is the freeze point of a liquid at the optimal concentration. Figure 12 lists the eutectic temperature for some of the common liquids.

Key points for salt storage and handling:

- Ensure salt storage is at least 50 feet from the waters of the state (natural wetlands, ponds, lakes, rivers).
- Provide indoor storage for salt and sand that has an impervious floor.
- Use double-wall tanks or secondary containment for liquid deicers.
- Handle salt shipments and loading operations indoors.
- Sweep pad, for outdoor loading, after receiving shipments and after loading.

Storage requirements under Part 5 rules are under review. Check with MDEQ for the most current requirements.

Snow Disposal Sites

Suitable sites for snow disposal should be established prior to the winter season. The optimal sites are those where the debris can be easily recovered in the spring. Snow should not be plowed directly into ponds, rain gardens, lakes, rivers, or wetlands. DEQ draft guidance recommends that snow storage be at least 75 feet from non-community

water supply, 50 feet from private water supply and 200 feet from community water supply wells. This recommendation may change, so keep informed of all local regulations, policies, and guidelines for Michigan water quality protection. See Appendix F for a reference to this draft document.

Calibration

Before the beginning of each snow fighting season, salt trucks must be calibrated to measure the amount of material applied at various settings. The salt discharge should fall within your agency's guidelines. If the automatic controller is not applying the material at the correct application rate per your agency's guidelines, it must be adjusted. The calibration should be rechecked if there are any mechanical adjustments or changes throughout the remainder of the winter season.

By calibrating your equipment, you can be sure your application rates will be accurate and you will know how much product is actually being applied to the roadway. This alone can result in salt cost savings, by avoiding unintentional over-salting. Calibration should be done for all equipment that dispenses liquid or granular material. All granular materials (salt, prewet salt, sand, etc.) flow differently, so calibrate for each material.

With manual-controlled systems, the operator must have a copy of the calibration worksheet in the cab of the truck. This allows the driver to cross-reference the desired material application rate with the speed of travel, and then choose the setting that gives the desired result. A calibration worksheet example is in Appendix C along with other calibration resources.

Key points for calibration

- Calibrate all new equipment prior to use.
- Calibrate all equipment at least once a year or if the truck has had any major service.
- Calibrate for each type or blend of granular material.
- Calibrate liquid application systems, both anti-icing and prewet systems.
- Follow the manufacturer's guidelines for calibration, and contact the manufacturer for training if necessary.
- Put the auger plate in place during calibration for dump trucks. Calibration won't be accurate if the material is gravity-flowing during the calibration process.
- Place a calibration worksheet in each truck and a copy in the shop for those with manual-control spreaders.

Calibration saves you salt and money.

Investment in Equipment

Investing in equipment that can make your organization's winter maintenance more efficient is money that is repaid quickly. Investment in controllers, liquids and blades are areas that that often give a good return on investment. Top performing organizations integrate new practices and equipment to increase their efficiency. The

Clear Roads online cost benefit analysis toolkit can help provide insight into new practices, equipment and operations. See Appendix D for this resource.

Plow early and often to reduce hard pack.

- Mechanical Removal

  Mechanical removal (blading or plowing) is the most effective strategy to remove snow, from a cost and efficiency standpoint. The Clear Roads Pooled Funds Study has an evaluation of plow prototypes. You can find this in Appendix D, under blades and plows.

  - One trend in the industry is towards segmented blades. These offer more flexibility for blading on uneven surfaces, less vibration for the operator, and will wear more evenly and scrape better. Clear Roads has produced some research on cutting edges. This is in Appendix D, under blades and plows.
  - Underbody blades are very common in Michigan; they allow more down pressure and are helpful at removing compaction. The more snow you remove mechanically, the less salt you will need to keep roads safe.
  - The use of wing-plows for winter operations in Michigan has increased over the past few years. Using wing-plows can make a winter operations program more effective by providing a more effective means of mechanical removal. With a wing-plow, operators can clear an entire lane plus a few feet of the shoulder in one pass, a job that usually takes two passes or two trucks working together.
  - In Michigan and other snow-belt states, the tow plow has been tested and proven to be an effective method of snow removal.
  - Brooms can be very efficient at removing light snow. These are common tools at airports and for sidewalks.

Electronic closed loop controls are easier to operate and are a potential money saver!

- Controllers

  The ability to control the application rate of deicers is vital. By improving the accuracy of your controllers, you will be able to achieve a more efficient operation automatic controllers and manual controllers. All agencies should work toward replacing manual controllers with electronic closed-loop controllers.

  Automatic controllers self-adjust the flow of salt to match the target application rate regardless of the truck speed. When the snowplow speeds up or slows down, the controller automatically speeds up or slows down the salt delivery rate so that desired application rate is maintained.

  Manual controllers are not as accurate as automatic controllers. Manual controllers do not self-adjust to meet a target application rate. Application rates are difficult to hold constant with manual controllers because the speed of the truck is often changing. Although accuracy is low, calibration is essential so your organization can attempt to follow application guidelines. Without calibration, you cannot attempt to deliver a specific amount of salt per lane mile.

With manually-controlled systems the operator must have a calibration worksheet in the truck. An example of a calibration worksheet is located in Appendix C along with other calibration resources.

The calibration of the controllers should be completed annually, at a minimum. Calibration should also be completed anytime major truck repairs are done, or if the operator notices that it is not working properly. It is also important to remember that the gate opening must be set and marked during calibration.

Weather Data

Basic, up-to-date weather information is critical for winter maintenance planning and effective response during an event. The means to acquire this information should be in place prior to the start of winter. Information that should be gathered before an event, and tracked throughout, includes:

- Start of precipitation and expected event length
- Type of precipitation expected
- Total precipitation expected/event intensity
- Wind conditions (speed, gusts, directions)
- Temperature trend (rising or falling during the event)
- Pavement temperature trend (rising or falling during the event)
- Dew point

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Pavement Temperatures should guide your application rates.

Weather information can and should come from a variety of sources, and there are many from which to choose. Many services provide weather forecasts, condition trends but fewer provide pavement temperatures.

The dew point describes the temperature below which water will condense into liquid water at the same rate at which it evaporates. Condensed water is called dew. The dew point is the critical ingredient in predicting the formation of frost on roads. When the pavement temperature falls below the dew point, if that pavement temperature is equal or below freezing, then frost will form. By monitoring the dew point and other weather factors, you can predict frost and be out in front of it. Wind speed and absolute humidity are the other variables which play a role in how quickly the frost forms and how thick the layer will be.

Dew point can be obtained from commercial weather services or the Michigan RWIS system. MDOT's RWIS system started in 2010, and now includes more than 50 stations around the state. The system is made up of a network of sensors, to measure air and road surface temperatures, barometric pressure, wind, salt concentrations on the road surface, frost depth and dew point. You can access MDOT's RWIS system by visiting http://mdotnetpublic.state.mi.us/drive/. Figure 4 is a sample of the information you can get from their RWIS stations.

Pavement Temperatures

Keep in mind that most weather services measure temperature and other conditions in the air, above the ground, which means that the reported conditions can differ substantially from pavement temperatures. It is extremely important to use the pavement temperature, not air temperature, to determine what material(s) to use and the appropriate application rate of your chemicals.

Air Temperature: 61°F
Maximum Daily Temperature: 76°F
Minimum Daily Temperature: 42°F
Relative Humidity: 70.7%
Average Wind Speed: ENE 5 MPH
Maximum Gust Speed: ENE 11 MPH
Barometric Pressure: 29.27"
Precipitation: No Precipitation
Precipitation over the last 24 hours: 0"
Dew Point: 52°F
Visibility: 10 miles

Figure 4: RWIS example (I-75 @ South of M-48 overpass)

Pavement temperature can be measured several different ways. One way is by hand-held temperature sensor guns that can be purchased at any automotive store for under $100. Truck-mounted systems are another alternative. Truck-mounted systems are better than hand-held sensors in that they display in the cab a continuous reading of the air and pavement temperatures. Truck-mounted systems may be incorporated into your spreader controller or can be purchased independently of your controller.

There are many influences on pavement temperature. For example, you will notice changes in pavement temperature first on bridge decks and ramps; pavement temperatures will also be lower in shady areas. The pavement's color and texture, and the type of material in the layer underneath the pavement, all influence its temperature as well. You cannot substitute air temperature for pavement temperature; you must know the pavement temperature before making a decision on application rates. **All of your application rate charts should be based on current and trending pavement temperature.**

Automatic Vehicle Location (AVL) and Maintenance Decision Support Systems (MDSS)

Many organizations are now using computer technology in the form of AVL systems and/or MDSS to further improve the efficiency of their winter maintenance responses.

Use salt carefully! 1 teaspoon of salt pollutes 5 gallons of water.

- Automatic Vehicle Location system

With an AVL system you can see where the snow plow vehicles are deployed in near real time during a winter event. This is typically done through a web portal. Vehicles are depicted on the map via icons indicating the type of actions underway, when and where a vehicle is actively spreading material, or when and where the plow blade is down and pushing snow. Users may hover a cursor over an individual vehicle icon and get a pop-up box describing the vehicle and what it is doing.

Iowa Department of Transportation reported that equipping their trucks with Automatic Vehicle Location (AVL) provided a return on investment of $6.40 for every $1.00 expended.[7]

Both AVL and MDSS have shown good results in reducing salt used.

- Maintenance Decision Support Systems (MDSS)

MDSS combines advanced weather prediction service, advanced road condition prediction and your agency's winter maintenance practices for anti-icing and de-icing to generate road treatment recommendations on a route-by-route basis. The goal of MDSS is to suggest more effective use of maintenance resources and increase safety, reliability and mobility on roadways.

The MDSS system allows crews to input real-time conditions, including road and ambient temperature, type of material being used and the application rate. After compiling the information provided by the crews, along with weather reports, the system will then provide suggested treatments based on the information and models. The system may tell the operator to re-treat the road at a later time, apply different products at different rates, or simply to continue current procedures. The suggested treatment can then be followed or the operator can override the system.

MDSS systems have a scenario selector that can be used as a training tool. For more information on MDSS, see Appendix D. There is a report, "Analysis of Maintenance Decision Support System (MDSS) Benefits & Costs," which summarizes the experiences of several states using MDSS.

Anti-icing before the Event

Anti-icing is the process of putting down a liquid deicer before a winter event. It can be a cost-effective strategy that optimizes, and therefore reduces, chemical usage. It is a proactive approach that should be considered first in a series of strategies for managing most winter events. By applying a liquid deicer before an event, you can prevent snow and ice from bonding to the pavement, or even prevent frost from forming on the roadway altogether.

Anti-icing is not always the answer, but when it is, it can buy you time for physical removal that is easier and more cost-effective. To determine when it is appropriate to anti-ice, see an example of an anti-icing decision chart in Appendix B.

Anti-icing procedures look different from other winter maintenance activities and may cause concern with the general public. Educate your customers about anti-icing techniques and their value ahead of its use.

Selection and Storage of Anti-Icing Products

- Liquids are the most effective anti-icing agents.
- At temperatures below 15°F, it may be more cost effective to use a chemical other than sodium chloride brine (see Appendix B for anti-icing cost model).
- Hygroscopic liquids bring the moisture from the air to the pavement surface (similar to dust control on gravel roads). They give added benefit on cold winter pavement because of this property but they can be troublesome at warm (over 28°F pavement temp) or in humid conditions. The most commonly used hygroscopic products are $CaCl_2$ or $MgCl_2$.
- When using hygroscopic products, it is critical to not over-apply.

Guidelines for Anti-icing Product Application

These are only guidelines and not exact recommendations. Generally it is better to under-apply rather than over-apply anti-icing materials. So start low and increase rates, instead of starting high and decreasing rates. Forms such as those shown in Appendix B of this manual are useful to record and track your work and observations, so you can refine your use and understanding of anti-icing products.

Condition	**Gallons per lane mile**		
	$CaCl_2$ or $MgCl_2$	**Brine**	**Brine Blends**
Regularly scheduled application	15-25	20-40	Ask manufacturer
Prior to frost or black ice	15-25	20-40	Ask manufacturer
Prior to light or moderate snow	15-25	20-50	Ask manufacturer

Figure 5: Anti-icing Application Rates

Key points for Anti-icing

- Apply liquids at half the rate (not half the concentration) for the first application of the season, or after a prolonged dry spell. On dry roads, liquids tend to mix with oil from vehicles and cause slippery conditions if over-applied.
- Consider spot-applications on hills, bridge decks, curves and intersections if predicted conditions warrant and you are just beginning an anti-icing program. Continue to expand anti-icing until you treat most of the areas that you de-ice.
- Utilize anti-icing for light freezing drizzle and light frost events; it can be very effective.

- Apply your anti-icing agent during low traffic times and during regular work hours; this saves product and reduces staff costs.
- Avoid anti-icing under blowing conditions, in areas prone to drifting or anywhere else you would not use salt.
- Avoid applying before a predicted heavy rain.
- Apply liquid anti-icers 24-48 hours in advance of an event. The closer to the event start time the better. Tire action and wind wear away material.
- Remember that re-application isn't always necessary. The residual effect of anti-icing applications can remain for up to five days if precipitation or traffic wear-off does not dilute the material.
- Apply liquids with stream nozzles to maintain bare pavement between application areas.
- Use a spray skirt when anti-icing. This helps significantly in directing product to the roadway where it is needed. Adding a simple spray skirt behind the truck's spray bar significantly increases the amount of product reaching the roadway.[8]

Look at anti-icing's costs and benefits and evaluate how it can best serve you. Anti-icing can provide significant cost, safety, and environmental benefits. Appendix B contains anti-icing resources and a link to a Cost Benefit Analysis Tool that can help you understand how anti-icing can provide a return on your investment in equipment.

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Liquid deicers are faster acting and stay in place better.

During the Event

During a winter precipitation event there is very little extra time. Preparation in advance of an event is the key to success. Integrating best management practices (BMPs) into your operations can help provide safety, appropriate levels of service, and protect Michigan's natural resources. Good documentation is one of the BMP's that helps move your organization ahead. Make sure this is integrated into your winter operations. Appendix E has example charts that you can use for recording your activities.

Effective Use of Plows/Underbody Blades

Plowing or blading is the best approach to snow removal. It can be the most cost-effective approach when all the factors (cost of chemicals, damage to public roadways and infrastructure, etc.) are considered. Physical removal of snow should always be done prior to the application of deicing materials.

Key Points for Plowing/Blading

- Blade prior to an application of chemical in order to minimize product dilution.
- Coordinate blading activities to eliminate windrows at intersections and prevent removal of another operator's deicing material.
- Remove snow from roads as quickly as possible to reduce compaction.
- Avoid pushing snow over the bridge rails and onto roads or water beneath.
- Pay attention to wind conditions. If shoulder blading isn't critical, then delay until wind speeds are lower.
- Reduced speed minimizes the risk of a snow cloud. Lift the blade and wing if a snow cloud forms; do not slow down or brake.

Loading and Hauling Salt

A substantial amount of salt can be spilled, and potentially wasted, during the loading and hauling process. Some easy steps can be taken to ensure that this purchased material ends up only where it is needed, on the roadway.

Key Points for Loading and Hauling

- Load inside the salt shed.
- Sweep outdoor loading areas frequently.
- Fill but do not overfill trucks. One city that uses very little salt inserts a cement base in the truck bed to provide extra weight, thus requiring less material to be loaded.
- Tarp your loads when transporting material.
- Install spill shields to plug up gaps in truck bed.
- Install sander plates to prevent free-fall of salt or sand.

Using Abrasives

Use winter sand and other abrasives when temperatures are too cold for deicing chemicals to be effective, or when immediate traction is needed after a freezing rain event. Be aware that sand does not melt anything. It only provides temporary traction, and only when it is on top of snow or ice. Sand will clog sewers, ditches, and streams. As a result, avoid sand use as much as possible.

Our lakes are turning into wetlands as they fill in and become shallower. Unrecovered winter sand accelerates this process.

A salt/sand mix is generally not recommended as salt reduces the effectiveness of sand, and sand reduces the effectiveness of salt.

Key points for Abrasives

- Sweep up excess sand after each event.
- Apply sand in extreme cold weather, when salt is ineffective.
- Avoid salt/sand mixes. Determine if you need melting or temporary traction and choose the proper tool.
- Employ sand only for short-term traction needs. It has no melting capability.
- Note that, in limited situations such as a freezing rain event, a 25 to 50% sand/salt mix has been documented as effective in increasing friction.[9]

Material Application

Deicing is a reactive operation in which a chemical is applied to the top of snow, ice or frost already on the roadway. Forms such as those shown in the Appendix F of this manual are useful to record and track your deicing work.

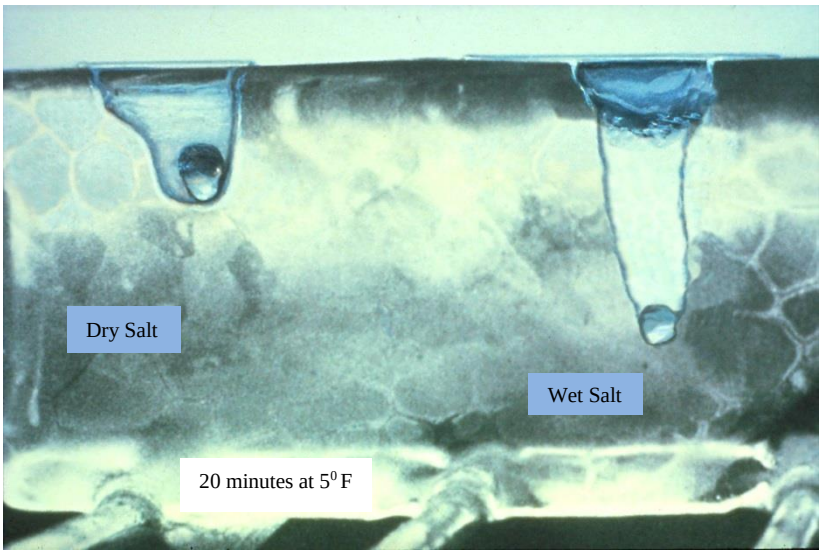
Removing ice that has already bonded to the pavement can be difficult, and removing it mechanically causes wear on equipment and roads. Enough ice must be melted to weaken the bond between the ice and pavement in order to make physical removal

possible. Breaking the bond after it is formed requires more chemical than preventing the bond from forming in the first place.

Integrating science into winter maintenance allows us to use an appropriate amount of product for deicing. Most application rates can be reduced by the best maintenance practices already discussed, such as proper calibration and using closed-loop spreaders. But there are two major handicaps to the effectiveness of a salt application during an event: the precipitation which dilutes it, and the next blade pass which can remove it before it has had a chance to work.

Slower truck speed and prewetting or pretreating salt are best practices for reducing salt waste and lowering the necessary application rates. Applying dry material is a common but ineffective practice. Research and results in the field show that prewetted or pretreated material stays on the road surface better, and is therefore more effective. Another way to reduce salt use is to minimize applications during the storm event. This helps keep blading activities from removing the deicing salt.

Dry salt is slow to dissolve. Adding liquids not only keeps more of the salt on the roadway, it also helps to increase the speed of melting as it jump-starts this process. The greater the liquid to granular ratio, the better control you have over your product during application, and the faster its performance once it is down. The photograph below illustrates the melting speed of prewetted salt versus dry.



Liquids allow you to use less product overall.

Figure 6: Melting Comparison of Dry Salt vs. Prewet Salt
Photo courtesy of the Wisconsin Department of Transportation bulletin #22

How to reduce application rates

1. Speed of application. MDOT recently proved that reducing the speed of application from 35 mph to 25 mph can prevent up to 40% of the salt discharged from being wasted.[10] The speed of trucks during application of granular material should be 25 mph or less, or the lowest safe speed under the conditions.

2. Vary application rates. Use the higher rate listed for the first pass, and reduce on any subsequent passes. Adjust rates as needed if you know you will be able to only make one pass.

$

Salt that is bounced off the roadway or is spread outside the travel lanes is money down the drain.

3. Spread pattern. The most effective spread pattern is a windrow of salt on the centerline or highpoint in the roadway. Set spreaders lower to the ground or use a chute to reduce bounce and scatter. See Appendix D for instructions on how to build a chute or how to set-up a grid to run a test and get your own bounce and scatter data.

4. Pretreated or prewetted salt. Wet salt remains on the road longer (less bounce and scatter) than dry salt and works faster too. With pretreated salt the liquid to granular ratio is about 4 to 6 gallons per ton. In prewetting operations, the ratio of liquid to granular can vary greatly. It starts at about 8 gallons per ton, upwards to over 100 gallon/ton (slurry). Some organizations have nearly abandoned granular products altogether and are applying straight liquids.

5. Application rate. Make sure your organization has an application rate chart that is based on pavement temperatures. Continually work to refine your chart and lower your application rates.

6. Deicers. Not all deicers perform the same under the same conditions. By choosing the combination of liquid and granular deicers that is least toxic and that works the best at your pavement temperature, you can reduce your application rate and costs, as well as your environmental impact. Figure 7 compares four different applications, using different materials (from salt/sand to a higher ratio of salt/liquid), and all would potentially achieve satisfactory results.

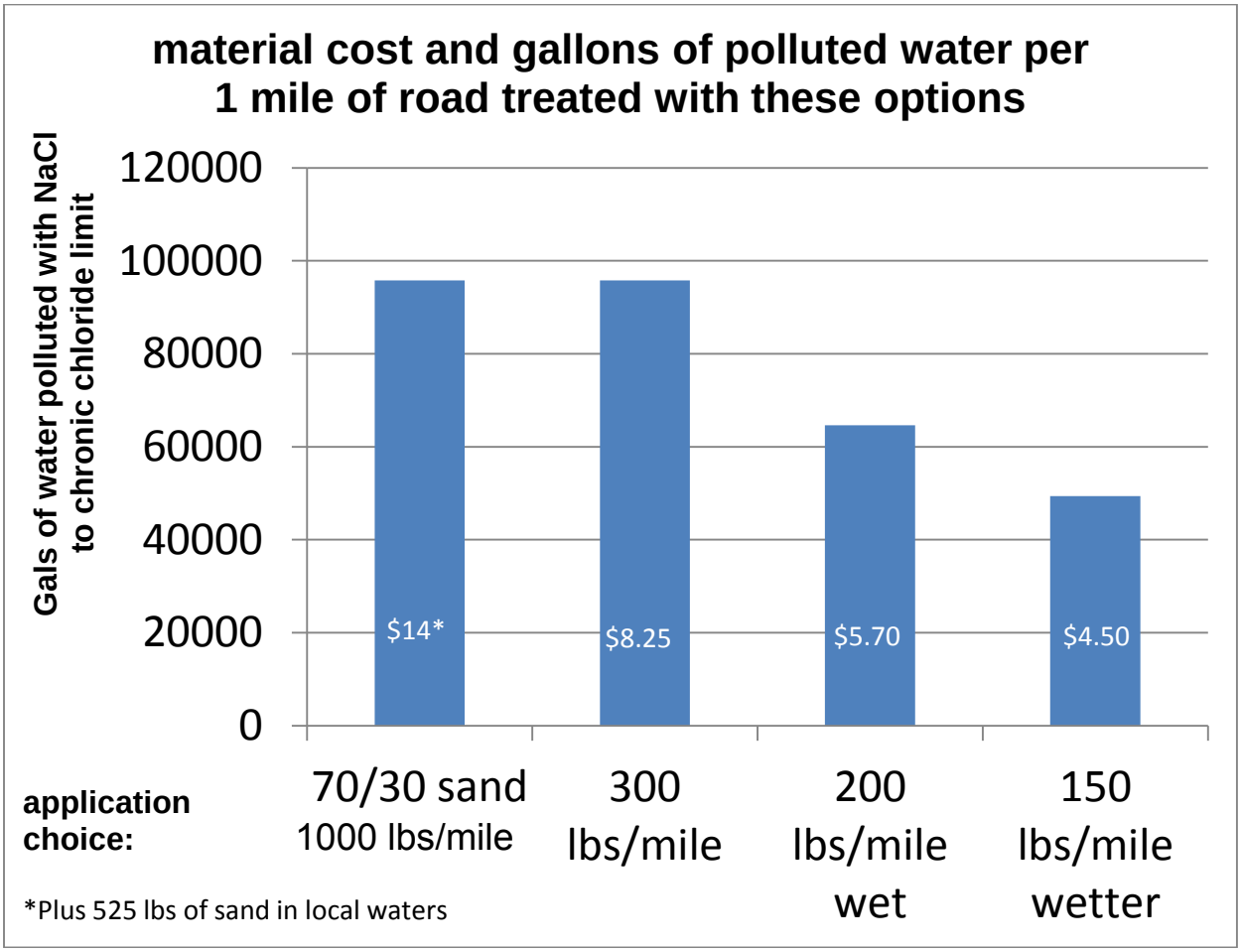


Figure 7: Material Cost and Gallons of Water Polluted

The purchase cost based on $55 ton salt, $16 ton sand and $0.20 gallon brine. Per federal chronic chloride standards of 230 mg/l, 1 pound of salt pollutes 320 gallons of water, 1 gallon of brine pollutes 728 gallons of water. Wet = 10 gal/ton and Wetter = 15 gal/ton

There are many ways to accomplish a safe winter road. We can see from this chart that material selection is a key factor in providing the opportunity to reduce application rates while maintaining effectiveness. By looking at all the factors--performance, cost, and environmental damage--winter maintenance professionals can make the most informed decisions on how to maintain their level of service. See Appendix F for the new Clear Roads Fact Sheet on the Toxicity of Deicers to run your own calculations.

Selecting a Deicer

When selecting a deicer, be careful when looking at the melting temperature on marketing materials. The eutectic temperature is often cited, which is the lowest possible temperature at which a solution remains liquid. At this temperature it would take a very long time for the product or solution to melt ice. Instead, you need to know a product's practical melting temperature range.

Sodium chloride (NaCl, or road salt) is the most widely used of the deicers. It is effective at pavement temperatures above 15°F. Because it doesn't work well at colder temperatures, it is often over-applied in attempts to get it to work better. See the chart below for the melting capacity of NaCl at various temperatures. Ask your vendor for a similar chart for the products you buy or are considering buying.

By adding liquid to granular salt, you can speed up melting and use less salt.

Pounds of Ice Melted Per Pound of Salt

Pavement Temp (F)	One Pound of Salt (NaCl) melts	Melt Times
30	46.3 lbs. of ice	5 min.
25	14.4 lbs. of ice	10 min.
20	8.6 lbs. of ice	20 min.
15	6.3 lbs. of ice	1 hour
10	4.9 lbs. of ice	Dry salt is ineffective and will blow away before it melts any significant amount of ice.
5	4.1 lbs. of ice	
0	3.7 lbs. of ice	
-6	3.2 lbs. of ice	

Avoid using dry rock salt at pavement temperatures below 15° F.

Figure 8: Ice Melting Capacity of Sodium Chloride at Various Pavement Temperatures

- For a chart showing practical temperature ranges for other deicers, see Figure 12.
- For more information on the toxicity of deicers see "Determining the toxicity of deicing materials," a Clear Roads research project, in Appendix F.
- Melting all the snow or ice on the road is not necessary. This is an overuse of materials. Apply just enough to loosen the bond between the road and the ice/compacted snow so it can be effectively bladed off.
- Use pavement temperatures and trends to help you to apply the right product application rate at the right time. Generally use less chemical when temperatures are warm or rising, and more when they are cold or falling.
- Avoid straight salt when temperatures below 15°F; use other deicers such as $CaCl_2$ and $MgCl_2$ to obtain better melting at lower temperatures. If you do not have a good alternative available, use sand for traction until pavement temperatures warm.

Spread Patterns

The spread pattern in Figure 9 is a visual representation of the application method on which the application table is based. That is, you blade only (no chemical application) going out, and blade and apply in a windrow to the centerline on the return trip.

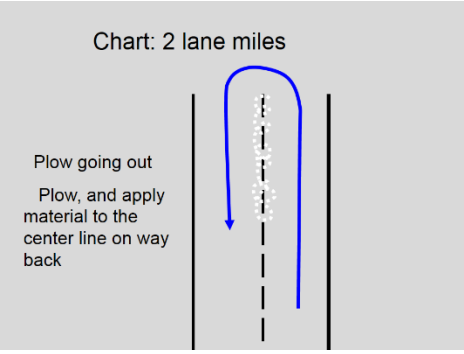


Figure 9: Suggested Plow and Apply Pattern for Deicing

One of the biggest challenges with salt is to keep it on the road long enough for it to work. Narrow your spread pattern to apply salt to the crown of the road. As the salt melts it will migrate across the drive lanes. By driving slowly and applying salt to the center line in a windrow or tight spread pattern you will waste less salt. This applies to all roads, but is essential on high speed roads.

There are various devices and modifications to your spreader that you can make to help you create a tighter spread pattern. Chutes that direct the salt from the spreader to the pavement are one good example. Other examples include skirts below and around the spreader, holes in the spreader, zero velocity spreaders and or simply turning your spreader off.

Strive for an even spread pattern at low application rates. Equipment that was designed to deliver large amounts of sand likely will have trouble delivering a steady spread pattern with a low rate of salt. If this is the case, you will need to retrofit or change your equipment to make it able to deliver an even spread pattern at a low rate. When you purchase new equipment, make sure it can deliver a very low application rate (100 pounds/mile) with an even spread pattern.

Deicing Application Rate Guidelines

Every organization should have an application rate chart that is based on pavement temperatures. This allows you to standardize your operations. The chart below is an example of an application rate chart developed for Minnesota. This chart was developed by a team of city, county and state winter maintenance experts. The rates were chosen with the goal of defining sufficient rates to clear and hold the roads after an event, assuming all of the best practices were done before and during the event.

No chart will be perfect. Make your own chart and keep improving it. See if you can continue to lower the rates as you become more efficient in your winter maintenance practices.

Deicing Application Rate Guidelines

24 feet of pavement (typical two-lane road)

These rates are not fixed values, but rather the low end of a range to be selected and adjusted by an agency, according to its local conditions and experience.

Lbs/two-lane road						
Pavement Temperature (F) and Trend	Weather Conditions	Maintenance Actions	Salt Prewetted/Pretreated with Salt Brine	Salt Prewetted/Pretreated with Other Blends	Dry Salt, least effective*	Winter Sand (Abrasives)
>30 F ↓	Snow	Plow, treat intersections only	**80 (40/lane mile)**	**70**	**100***	Not recommended
	Freezing Rain	Apply product	**80-160**	**70-140**	**100-200***	Not recommended
30 F ↓	Snow	Plow & apply product	**80-160**	**70-140**	**100-200***	Not recommended
	Freezing Rain	Apply product	**150-200**	**130-180**	**180-240***	Not recommended
25-30 F ↑	Snow	Plow & apply product	**120-160**	**100-140**	**150-200***	Not recommended
	Freezing Rain	Apply product	**150-200**	**130-180**	**180-240***	Not recommended
25-30 F ↓	Snow	Plow & apply product	**120-160**	**100-140**	**150-200***	Not recommended
	Freezing rain	Apply product	**160-240**	**140-210**	**200-300***	Not recommended
20-25 F ↑	Snow or freezing rain	Plow & apply product	**160-240**	**140-210**	**200-300***	Not recommended
20-25 F ↓	Snow	Plow & apply product	**200-280**	**175-250**	**250-350***	Not recommended
	Freezing Rain	Apply product	**240-320**	**210-280**	**300-400***	**400**
15-20 F ↑	Snow	Plow & apply product	**200-280**	**175-250**	**250-350***	Not recommended
	Freezing Rain	Apply product	**240-320**	**210-280**	**300-400***	**400**
15-20 F ↓	Snow or freezing rain	Plow & apply product	**240-320**	**210-280**	**300-400***	500 for freezing rain
0-15 F ↓↑	Snow	Plow, treat with blends, sand	Not recommended	**300-400**	Not recommended	500-750 spot treat as needed
<0	Snow	Plow, treat with blends, sand	Not recommended	**300-400**	Not recommended	500-750 spot treat as needed

To calculate for 1 lane, divide application rate numbers in half

Use lower end of application rate range when using super-saturated mixes

Source: Chart: Minnesota Snow and Ice Control Field Handbook for Snowplow Operators (2012).

Figure 10: Application Rate Chart for Deicing

Dilution: the cause of refreeze

An ice control product will work until dilution causes the freeze point of the remaining brine on the roadway to equal the current pavement temperature. At this point, the material will stop melting and you may experience re-freeze if the pavement temperature is dropping. This process is called the dilution of solution.

How long a treatment will last depends on five factors: pavement temperature, application rate, precipitation, beginning concentration, and chemical type. These factors explain why one application rate will not fit all winter events.

Pretreated Stockpiles

Pretreating is mixing a liquid deicer into the stockpile of salt or sand. The liquid used is not brine but a deicer that is hygroscopic and contains a corrosion inhibitor, and may also have stickiness to it. Often a dye is added to help identify the treated pile. You can apply pretreated salt without any equipment changes. Pretreated salt is more effective than dry salt and can allow you to lower your application rate.

- Purchase the pretreated salt from a vendor or mix it on site. If you choose to mix your own be accurate in your measurements.
    - Start out with dry salt. See the salt moisture worksheet in the materials testing section.
    - Treat the stockpile with a liquid deicing chemical (not brine) at 4-6 gallons/ton. Be consistent and check rates.
    - Mix up enough for one storm, not the entire season.
- Store pretreated stockpiles indoors on an impervious pad, consistent with Rule 5 requirements. See Appendix F to locate this information from the DEQ.
- Be aware that pretreated stockpiles have a higher risk of leaching. If you have containment limitations with your storage area, mix up just enough for one event rather than enough for the season. This will limit the leaching risk.

Treated salt piles need proper storage due to a greater risk of leaching

Prewetting Method for Deicing

Prewetting is the addition of a liquid to granular material by means of an on-board truck system. Liquid and granular are combined most often at the spreader, but sometimes in the auger. Wet salt has several advantages; it bounces less and melts ice faster. Prewetting requires some equipment changes, but this practice provides the flexibility to switch chemicals or liquid/granular ratio depending on conditions. Just as with pretreated salt, you can reduce your application rates by using prewetted salt.

- Include salt brine, calcium chloride, magnesium chloride, brine blends, acetates and others among the options you consider for prewetting.
- Check your liquid concentration before using. Figure 12 lists many of the optimal concentrations.
- Start with application ratios of 8-14 gallons/ton; this is the typical starting place for most organizations.[11]
- Super-saturated or slurry mixes activate even more quickly.

- Be sure to properly size the dry volume capacity in the hopper versus liquid holding capacities when purchasing on-board prewetting systems. It is vital that the total truck weight capacity is considered, as liquids add considerable weight to the overall load.

Direct Liquid Application for Deicing

Straight liquids are most commonly used for anti-icing, pretreating salt piles and prewetting on board the truck. However, it is becoming more common, especially in warmer winter conditions, to de-ice with straight liquid product. This is an advanced winter maintenance activity. Called "direct liquid application," or DLA, this deicing technique is more difficult and should only be attempted by those very familiar with the use of liquid deicers in other areas of winter maintenance. It is possible to create a more slippery surface if straight liquids are used improperly for deicing.

- Attempt liquid-only deicing only after you have mastered the anti-icing and prewetting uses of liquids, and have the proper equipment for the liquid deicing operation.
- Having sufficient pressure on the streamer nozzles, so that the liquid penetrates the snow or ice and spreads out below the snow and ice, is the key to effective deicing with liquids.
- Spraying a liquid deicer on top of compacted snow or ice can increase the slipperiness of the surface.

After the Event

Learn from each storm. Each event provides an opportunity to evaluate what was done, how well it worked and what could be changed to improve operations. Information exchange is the best way to speed up positive changes in winter maintenance. At the end of each event, post or discuss the results of your operation so the entire crew can be informed. When the entire crew is informed and included, change happens faster. Examples of what to track and discuss include: driver statistics such as route length, the type materials used, the amount of material used, and the recovery time. Other things to consider might be the liquid to granular ratio, the type of plow blade, new road surface or other new equipment and/or procedures being tested.

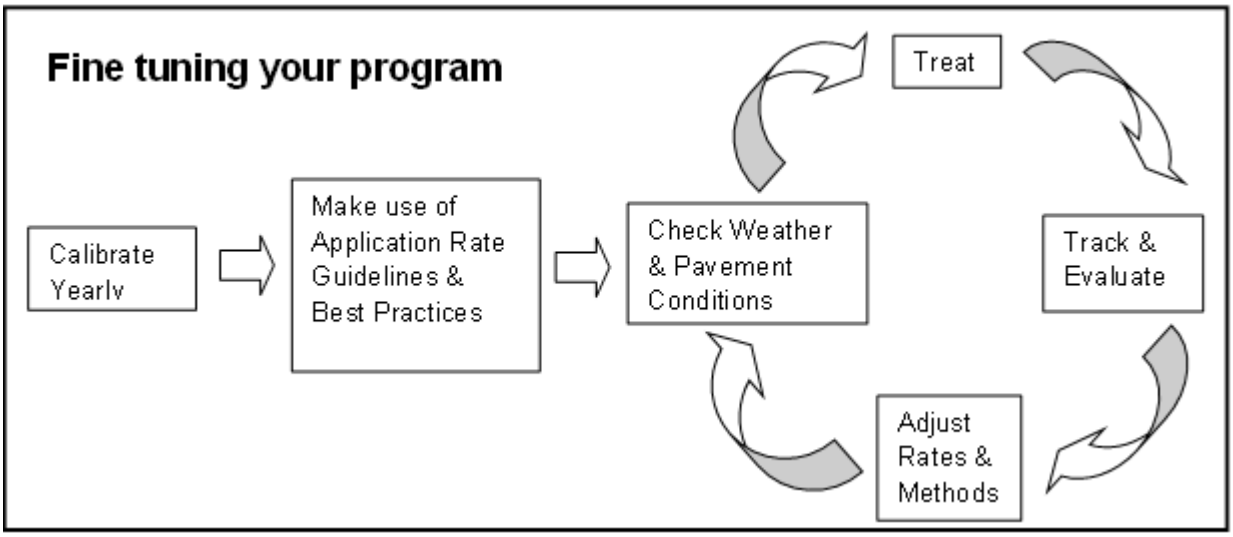


Figure 11: Maintaining a Progressive Winter Maintenance Operation

Key points for after the event

- Use forms such as those shown in the Appendix E of this manual to record and track your material use.
- Report any hazards such as low hanging branches and raised utilities.
- Ensure that all unused granular salt and salt/sand mixtures are stored properly.
- Refine your procedures and material use based on the “end of storm” meeting, and observations from operators.
- Wash vehicles after ensuring they are as empty as possible.
- Direct the wash water to collection/reuse areas or the sanitary sewer system. Do not direct wash water to septic systems or storm drains. Michigan’s DEQ Water Resources Division provides a guidance document on truck washing at municipally owned truck stations. See Appendix D, under salt storage and handling.

Key points for after the season

- Ensure that all unused granular salt and salt/sand mixtures are stored properly and records are kept of the amount of each product remaining.
- Clean and maintain truck tanks, brine making systems and pumps according to manufacturer specifications.

Materials and Quality Control

Practical and Eutectic Temperatures of Deicers

Multiple products can be used in a snow and ice control program. This chart helps you choose the correct product and apply it under the correct conditions. For further guidance on blending chemicals, see the MNDOT Anti-icing Guide, in Appendix B.

Chemical	Lowest Practical Melting Temp.	Eutectic Temp.	Optimal Concen-tration
NaCl (Sodium Chloride) —Delivered as solid rock salt, also can be made into a brine. The basis of most deicing materials. Very corrosive. Inexpensive. Very available. Rarely has a corrosion inhibitor added.	15º F	-6º F	23%
$MgCl_2$ (Magnesium Chloride)—Delivered as a liquid. Often used to wet NaCl crystals to increase adherence to surface and reduce melting points. Corrosive. Higher cost. Often has a corrosion inhibitor added.	-10º F	-28º F	27 to 30%
$CaCl_2$ (Calcium Chloride)—Delivered as flakes, pellets, or liquid. Powerful deicer but extremely corrosive. Sometimes used incorrectly to open storm drains. Higher cost. Often has a corrosion inhibitor added.	-20º F	-60º F	30%
CMA (Calcium Magnesium Acetate)—Delivered as a powder, crystals, pellets, or liquid. Liquid CMA is used mainly on automated bridge deicing systems. Non-corrosive, biodegradable. Sometimes added to sodium chloride as a corrosion inhibiter. Alternative for areas where chloride use must be limited. Often higher cost.	20º F	-18º F	32%
KAC (Potassium Acetate)—Delivered as a liquid. Often used on automated bridge deicing systems and airports. Use for anti-icing, deicing, and prewetting. Non-corrosive, biodegradable. Alternative for areas where chloride use must be limited. Higher cost.	-15º F	-76º F	50%
Blends— Both chlorides and acetates exist in blends. Talk to your supplier and determine the lowest practical melting temperature, the optimal concentration and the basic components in the blend. Most blends are centered on rock salt since it is cheap.			
Winter Sand/Abrasives—Winter sand has salt mixed in it to keep it from freezing. Sand should be used for cold temperatures when deicers are not effective. They provide temporary traction but only work when they are on top of the ice.	Never melts—provides traction only		

Figure 12: Practical and Eutectic Temperatures of Deicers

Material Conversions

The following quick reference table will help you convert between tons and cubic yards. Weight will vary depending on moisture content and density. This chart is based on a density of 80lbs/cubic foot.[12]

Sand		Salt	
Yards	Tons	Yards	Tons
1	1.4	1	1.1
2	2.8	2	2.2
3	4.2	3	3.2
4	5.6	4	4.3
5	7	5	5.4
6	8.4	6	6.5
7	9.8	7	7.6
8	11.2	8	8.6
9	12.6	9	9.7
10	14	10	10.8
11	15.4	11	11.9
12	16.8	12	13
13	18.2	13	14
14	19.6	14	15.1
15	21	15	16.2
16	22.4	16	17.3
17	23.8	17	18.4
18	25.2	18	19.4
19	26.6	19	20.5
20	28	20	21.6

Figure 13: Material Conversions
Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators, Second Revision, published by the Minnesota Local Road Research Board, 2012.

Materials Testing

It is important to understand how deicing chemicals will react on the roadway. Clear Roads developed a guide for testing the effectiveness of chemicals. See Appendix E.

Also test your materials to ensure that they are delivered as ordered and will perform as needed. Refer to your contract or Material Safety Data Sheet (MSDS) for optimal specific gravity and test for that. Michigan's state bid standard for moisture in road salt is 1.5%.

Testing solid salt

Having a standard for the moisture content in your salt prevents having to pay for water weight, and helps reduce the amount of leaching potential should you decide to pretreat the salt. Salt with excessively high moisture content is also more likely to freeze in storage and become difficult to work with.

- Watch the load being dumped and observe if it appears wet.
- Schedule deliveries for days when it is not raining, if delivery will occur outside.
- Test for moisture content. Typically you want a moisture content of less than or equal to 1.5% (check your agency's specification).

How to measure the moisture content of rock salt:

1. Supplies needed:
    - Calibrated scale (triple beam or digital) accurate to 0.1 grams
    - Microwave
    - Sample of the salt (about 1 cup), that is a good representation of the pile
    - Worksheet for recording weight measurements

2. What to do:
    - Place empty container on scale, zero out scale to account for your container.
    - Weigh sample before cooking and record weight on worksheet.
    - Cook sample on low heat (high power may be too hot and make the salt pop, compromising the weight of your sample).
    - Measure cooked/dry weight, record on worksheet.
    - Perform moisture calculations on the worksheet.
    - Save worksheet.

Salt Moisture Worksheet

Date: Company:

P.O. #: Ticket #:

A. Weight of wet salt

B. Weight of dry salt

C. Weight loss (A-B)

Moisture Calculations:

C÷A X 100 = _____ %moisture ***

Tested by:

Remarks:

***Typically you want a moisture content of less than or equal to 1.5% (check your agency's specification).

Testing sand

- Conduct a visual inspection of the material to make sure it is clean.
- Note that each agency has its own specifications based on available materials.

Testing liquids

- Take a 2 cup sample before unloading the tanker truck, use a clean container.
- Make sure you have the correct hydrometer for your material.
- Measure the specific gravity of the liquid using a hydrometer or salimeter.
- Record the results. Salt brine should have a salimeter reading of 85%, or a hydrometer reading of 1.176, which equates to 23.3% salt in the brine.
- Accept the load if the specific gravity is within specifications; if it doesn't meet specifications, don't unload, and notify the responsible supervisor.
- Keep a labeled, dated and sealed sample.

Glossary of Terms

Anti-Icing: The prevention of ice or frost formation upon a surface. Used typically to mean the application of liquid chemicals to prevent the formation of frost or the bonding of snow or ice to pavement.

AVL: Computer-based automatic vehicle location system; a GPS-based system which allows users to view vehicle location and other operational data through a computer portal.

BMPs: best management practices

Black Ice: Popular term for a very thin coating of clear ice which forms on a pavement or bridge deck surface.

Brine: Liquid deicer made of rock salt and water combination, 23% rock salt.

Brine Blends: Any solution for lowering the freezing point of water, with sodium chloride brine as the predominant component.

°C – degrees Celsius

$CaCl_2$: calcium chloride

Calibration: Measurement of the material discharged at each setting of a spreader.

Chloride: The most common ingredient in deicers.

Clear Roads: Clear Roads refers to the pooled funded project for winter maintenance research of which Michigan is a member. www.clearroads.org

De-icing: Defined as removal of existing, snow ice, frost, etc., from a surface. It includes both mechanical (blading or scraping) and chemical (application of salt or other ice melting chemicals) methods. De-icing after snow, ice or frost has already bonded to the pavement surface.

DEQ: Michigan's Department of Environmental Quality. Also referred to as MDEQ.

Dew Point: The atmospheric temperature (varying according to pressure and humidity) below which water droplets begin to condense and dew can form.

DLA: Direct liquid application. The use of straight liquids for deicing purposes.

DOT: Department of Transportation

Eutectic Temperature: Lowest freeze point attainable for a given solution or mixture. At the eutectic temperature, ice and saltwater and solid salt exist in equilibrium. For brine, the eutectic temperature -6°F.

°F – degrees Fahrenheit

Hydrometer: Measures the density of many liquids.

Hygroscopic: Nature of a substance, tending to absorb moisture from the air.

KAC: potassium acetate

DEQ: Michigan Department of Environmental Quality. Tasked with providing guidance and enforcement of the NREPA's Water Resources section, including Part 5 rules. Sometimes referred to as "MDEQ".

Lane mile (LM): An area considered to be 12 foot by 5, 280 feet or an area 63, 360 square feet.

lbs. – pounds

LOS (Level of Service): The LOS describes the desired end-of-storm condition and acceptable interim conditions.

MDSS: Maintenance Decision Support System

Melting capacity: Ice melting capacity is the weight of ice melted per pound of deicer at a given temperature. It can be expressed as the total amount of ice melt that can be achieved or it can be expressed as the amount of ice melt that will occur in a given period of time (e.g. 1 hour, 4 hours, etc.).

mg/l – milligrams per liter

mph – miles per hour

MSDS: Material Safety Data Sheet; content and safety information on chemical products.

$MgCl_2$: magnesium chloride

NaCl: sodium chloride

Non-community Water Supply: A water system that provides water for drinking or potable purposes to 25 or more persons at least 60 days per year or has 15 or more service connections. Michigan is home to nearly 10,000 non community water supply systems, which includes schools, restaurants, motels, campgrounds, and churches.

NREPA: Natural Resources and Environmental Protection Act, 1994 Public Act 451. Regulates facilities of environmental contamination in Michigan. Section 31 deals with Water Resources.

ppm – parts per million

Practical Temperature: Sometimes referred to as the effective temperature; the lowest temperature at which a chemical solution/product is useful for lowering the freezing point of water.

Prewetting: Action by which a solid material is wetted with a liquid via an on-board system either at the spinner or in the auger.

Pretreating: Action by which a solid material is wetted in the stockpile. It can either be delivered already pretreated by the supplier, treated with an overhead showering system, pubmilled, or wetted with a hose and loader, then rolling material to mix.

psi – pounds per square inch

ROI: return on investment

Part 5 Rules: Administrative rules promulgated pursuant to Part 31, Water Resources Portection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451) MCL 324.3101 et seq and revised in 2009. The rules address release prevention planning, secondary containment, surveillance and release reporting requirements.

RWIS: Road weather information system; computer-based system of obtaining weather and surface data from remotely-located, permanent sensors.

Salimeter: Instrument that measures the density of salt brine. Also sometimes called a salinometer.

sq. ft. – square feet

Practical Temperature: Range of pavement temperatures within which a chemical will effectively melt ice.

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Winter Parking Lot and Sidewalk Maintenance Manual: Environmental Impacts of Chloride. 2008 revision. Fortin Consulting Inc. with Minnesota Department of Transportation, Minnesota Pollution Control Agency and CTAP (Circuit Training and Assistance Program).

APPENDIX A: Policy and Education Examples

Level of Service Designations by MDOT.
http://www.michigan.gov/mdot/0,4616,7-151-9620_11057-225137--,00.html

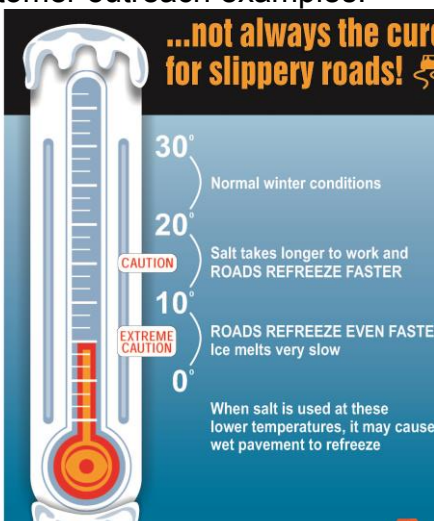
Michigan Winter Maintenance for Michigan Roads Program.
http://miwintermaintenance.weebly.com/

How Salt Works: New Hampshire Best Management Practices.
http://des.nh.gov/organization/divisions/water/wmb/was/salt-reduction-initiative/documents/bmp-salt-works.pdf

Minnesota Winter Maintenance Training and Manuals.
www.pca.state.mn.us/programs/roadsalt.html

Colorado DOT webpage for customer outreach.
http://www.coloradodot.info/travel/winter-driving/faqs.html

MDOT customer outreach examples:



See first link of this Appendix to find this document on-line.

APPENDIX B: Anti-icing Information

Anti-icing cost model
www.dot.state.mn.us/maintenance/training.html

Iowa Department of Transportation. *Anti-icing Equipment Manual* (with drawings for shop-made equipment). 1999.
www.dot.iowa.gov/maintenance/internetpages/chemicals/ManualAntiicingEquipment.pdf

Minnesota DOT *Anti-icing Guide*. 2010.
www.dot.state.mn.us/maintenance/docs/training/antiicingguide8Full.pdf

Anti-icing in winter maintenance operations: examination of research and survey of state practice
www.lrrb.org/media/report/TRS0902.pdf

Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Winter Maintenance Personnel. 1996.
http://www.fhwa.dot.gov/reports/mopeap/mop0296a.htm#I17

Example Documentation Form For Anti-Icing

Anti-icing Route Data Form				
Truck Station: Date:				
Air Temperature	Pavement Temperature	Relative Humidity	Dew Point	Sky

Reason for applying:

Route:

Chemical:

Application Time:

Application Amount:

Observation (1st day):

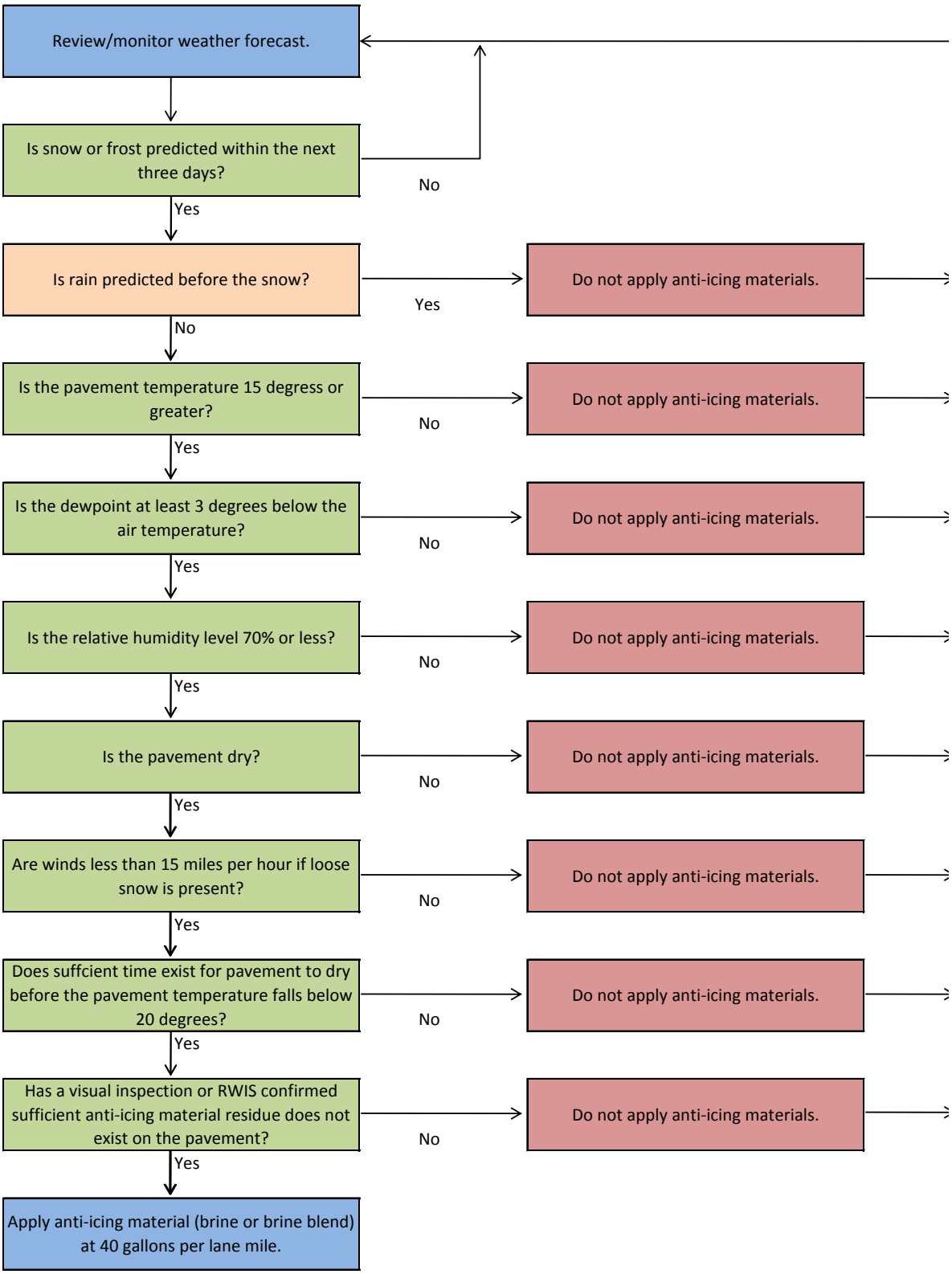
Observation (After event):

Observation (Before next application):

Name:

Source: Minnesota Snow and Ice Control: Field Handbook for Snowplow, Second Revision. Published by the Minnesota Local Road Research Board, 2012.

Anti-Icing Application Decision Flowchart



This is one example of an anti-icing flow chart. You should review this, change as appropriate to fit your organization, and put into place a customized decision tree for your organization.

Source: Anti-icing Decision Flowchart provided by Mark DeVries, McHenry County, Illinois.

APPENDIX C: Calibration information

Calibration Resources

Link to calibration of salt truck
http://michigan.gov/documents/mdot/mdot_ma_2009-02_calibration_of_salt_trucks_349377_7.pdf

MDOT Dickey John ICS 2000 calibration Manual
http://www.dickey-john.com/_media/pw_mac_ICS2000_calibration_and_programming_manual.pdf

MDOT Control Point Calibration Manual
http://www.dickey-john.com/_media/1-1489_1.pdf

Old MDOT Salt Calibration Instructions
http://inside.michigan.gov/sites/mdot/highways/ops/maintenance/mmm/Documents/Salt_Calibration_Instructions.pdf

Clear Roads has links to manufacturers' calibration instructions and a comprehensive calibration guide. Clear Roads: Research for Winter Highway Maintenance.
http://clearroads.org/researchprojects/05-02calibration.html

For liquid calibrations, see page 30 of the Minnesota DOT Anti-icing Guide (2010) at
http://www.dot.state.mn.us/maintenance/docs/Training/Anti%20Icing%20Guide%208%20Full.pdf

Road Salt Education Program, Minnesota Pollution Control Agency. Four types of calibration links, bottom of the page.
http://www.pca.state.mn.us/index.php/about-mpca/mpca-events-and-training/road-salt-education-program.html

Calibration Worksheet

Agency:	
Location:	
Truck No.:	Spreader No.:
Date:	By:
Gate Opening:	Pounds per Revolution:

Control **Setting**	Auger or Chain Sprocket Revolutions per Minute	Discharge Rate per Revolution	Discharge Rate per Minute	15 MPH X 4.00	20 MPH X 3.00	25 MPH X 2.14	30 MPH X 2.00	35 MPH X 1.71
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Sample Cab Card: courtesy of Michigan DOT

APPENDIX D: Equipment and Weather Resources

- **Blades and Plows**

The Clear Roads Institute has published a study of plow prototypes. 2011.
http://www.clearroads.org/downloads/Multiple-Blade-Snowplow-Project-Final%20Report_1-6-11.pdf

The Clear Roads Institute has published a study of carbide blade durability with comparisons. 2001.
www.clearroads.org/research-projects/07-01 carbideinsert.html

- **Equipment modification for low application rates**

For those unable to deliver an even spread pattern with a 9-inch auger at low application rates, one suggestion is exchanging the 9 inch diameter auger for either a 6 inch auger or a 9 inch "special" auger with larger core and smaller flighting; these "special" augers deliver about 2/3 less material per revolution.

- **Chute**

How to build a chute:

Minnesota Department of Transportation, Office of Maintenance-Training.
www.dot.state.mn.us/maintenance/training.html and

LLRB: Local Operational Research Assistance Program. Maintenance Decision Support System.
http://www.mnltap.umn.edu/about/programs/opera/fact/documents/washingtoncad.pdf

- **MDSS, AVL**

Pooled Fund Study Maintenance Decision Support System Website.
http://www.meridian-enviro.com/mdss/pfs/

Analysis of Maintenance Decision Support System (MDSS) Benefits & Costs, Study SD2006-10, Final Report. Prepared by Western Transportation Institute and Iteris, Inc., May 2009.
http://www.meridian-enviro.com/mdss/pfs/files/WTI-4W1408_Final_Report.pdf

- **Snow fence resources**

Illinois Department of Transportation. Snow fence information.
www.dot.il.gov/blr/1002.pdf

Minnesota Department of Transportation. Living Snow Fences. Snow fence and road design information to prevent blowing snow.

http://www.dot.state.mn.us/environment/livingsnowfence/index.html

Iowa Department of Transportation. Systems Operation Bureau-Office of Maintenance.
http://www.iowadot.gov/maintenance/snowfence.html

- **General Assessment of New Equipment/Resources**

Clear Roads cost benefit analysis toolkit. This provides instruction on how to do return on investment (ROI) calculations for new equipment and new techniques.
http://clearroads.org/research-projects/08-02costbenefitanalysis.html

Western Transporation Institute. Periodic bulletins with information on new equipment and new techniques.
http://www.westerntransportationinstitute.org/publications

Grid for bounce and scatter evaluation
www.sustainablesaltingsolutions.com/material_application_gr.html

- **Salt Storage and Handling**

Michigan Department of Environmental Quality. Salt is considered to be a polluting material under Part 5 Rules—Spillage of Oil and Polluting Materials, of Part 31 of NREPA—Water Resources Protection.
http://www.michigan.gov/documents/deq/deq-ess-p2tas-commercialsaltguidance_267027_7.pdf

Michigan DEQ Water Resources guidance document on vehicle washing.
http://www.michigan.gov/documents/deq/dnre-oppca-faq-vehiclemaintenance_341557_7.pdf

Indiana DOT Invests in Improved Salt Storage, Salt Institute Newsletter, First Quarter 2010.
http://www.bv.transports.gouv.qc.ca/per/0974374/09_2010/01_vol_47_no_1_2010.pdf

- **Weather Information**

Michigan Department of Transportation. Weather and road camera for specific Michigan highway locations. Provides air temperatures only.
http://mdotnetpublic.state.mi.us/drive/

APPENDIX E: De-icing Information

Example Loader Ticket: Daily Salt/Sand Issued

Operator	Shift	Date
Loader No.	Capacity of Bucket	

Stockpile	Truck #	Yards Sand	Yards Salt	Stockpile	Truck #	Yards Sand	Yards Salt
TOTALS							

Example Daily Salt/Sand Use Ticket

Operator	Shift	Date
Truck No.	Capacity	
Weather		

Stockpile	Route	Yards Sand	Yards Salt	Yards Used	Yards Returned	Liquid Gallons
TOTALS						

Clear Roads: Research for Winter Highway Maintenance. Testing the effectiveness of chemicals.
http://clearroads.org/
Click on research projects, completed projects.

MDEQ FAQ Deicers from Agricultural By-Products. Link to report is on the bottom of this page, under Miscellaneous.
http://www.michigan.gov/deq/0,1607,7-135-3307_36106-167850--,00.html

"Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts." The National Cooperative Highway Research Program. This is a comprehensive report.
http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=883

Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators, Second Revision. Minnesota Local Road Research Board. 2012.
http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf

Summary of an evaluation program of de-icing options by the New Hampshire DOT Research Board.
http://www.nh.gov/dot/org/projectdevelopment/materials/research/projects/documents/13733q_poster.pdf

Salt Bounce and Scatter Link
http://michigan.gov/documents/mdot/Final_ReportNov2012_404228_7.pdf

APPENDIX F: Environmental Information

MDEQ. Salt and Brine Storage Guidance for Road Agency Maintenance and Other Facilities.
http://www.michigan.gov/documents/deq/deq-ess-p2tas-bulksaltbrineguidance_267024_7.pdf

MDEQ, Rule 5 Guidance Documents.
http://www.michigan.gov/deq/0,4561,7-135-3313_23420-109985--,00.html

MDEQ guidance on how to develop a Pollution Incident Protection Plan (PIPP).
http://www.michigan.gov/documents/deq/deq-ess-p2tas-Part5PIPPchecklist_267025_7.pdf

Michigan's Storm Water Pollution Prevention Initiative (SWPPI). The SWPPI is a subset of the Watershed Management Plan and is typically due 2.5 years after the certificate of coverage is issued to the applicant. The following link details the SWPPI requirements as stated in the permit.
http://rougeriver.com/stormwater/permit.html

Proof's in: salt management protects the environment. Richard L. Hanneman. Salt Institute Newsletter. Third Quarter 2010
http://www.saltinstitute.org/content/download/12660/79607

Determining the toxicity of deicing materials. Research project funded by Clear Roads. (2012-ongoing).
http://www.clearroads.org/research-projects/11-02toxicity-of-deicing-materials.html

To learn more about Part 31 of NREPA, refer to the guidance document found line at
www.michigan.gov/deq
Select the "Get Involved Programs for Citizens" browser button on the left side of the webpage.

Environmental Fact Sheet, New Hampshire Department of Environmental Services, 2011. Includes information on best management practices.
http://des.nh.gov/organization/commissioner/pip/factsheets/wmb/documents/wmb-4.pdf

Information on the water quality of Michigan's inland lakes. Fuller, L.M., and Taricska, C.K., 2012, Water-quality characteristics of Michigan's inland lakes, 2001–10: U.S. Geological Survey Scientific Investigations Report 2011–5233.
http://pubs.usgs.gov/sir/2011/5233/

Water Quality and Pollution Control in Michigan. 2012
2012 Sections 303(d), 305(b), AND 314. MI/DEQ/WRD-12/001
http://www.michigan.gov/documents/deq/wrd-swas-draft-2012IR_370366_7.pdf

End Notes

[1] *Winter Parking Lot and Sidewalk Maintenance Manual: Environmental Impacts of Chloride*. 2008 revision. Fortin Consulting Inc. with Minnesota Department of Transportation, Minnesota Pollution Control Agency and CTAP (Circuit Training and Assistance Program).
[2] Mullaney, J.R., Lorenz, D.L., Arntson, A.D., 2009, Chloride in groundwater and surface water in areas underlain by the glacial aquifer system, northern United States: U.S. Geological Survey Scientific Investigations Report 2009–5086, 41 p.
[3] US EPA National Water Summary, 1986. Secondary maximum contaminant levels, (subpart B of Part 141, national interim primary drinking water regulations). US Code of Federal Regulations, Title 40, Parts 100-149, revised July 1, 1986, pp. 587-590.
[4] Dean, W., Anderson, R., Bradbury, J.P., and Anderson, D., 2002, A 1500-year record of climatic and environmental change in Elk Lake, Minnesota: Journal of Paleolimnology 27, 287-299.
[5] Findlay, Stuart E.G. and Kelly, Victoria R. Emerging Indirect and Long-term Effects of Road Salt on Ecosystems. Annals of the New York Academy of Sciences, Vol. 1223, pp. 58-68, March 2011.
[6] *Snow Fence Guide*. Strategic Highway Research Program (SHRP), 1991. SHRP - National Research Council, Washington, D.C., SHRP-W/FR-91-106.
[7] "Global positioning system (GPS) technology can assist in tracking and reducing costs." Inside, p 10. http://www.iowadot.gov/inside/inside_december_2011.pdf.
[8] Bruce Erickson, Oregon DOT Fleet Services Manager (Nov. 17, 2009) citied in *Greenhouse Gas Mitigation Measures for Transportation, Construction, Maintenance, and Operations Activities*, requested by Gallivan, Frank et al. ICF International. August 2010.
[9] *Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators, Second Revision,* published by the Minnesota Local Road Research Board, 2012. http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf
[10] Salt Bounce and Scatter Study. Final Report, November 2012. MDOT Operations Field Services Division. http://www.michigan.gov/documents/mdot/Final_ReportNov2012_404228_7.pdf
[11] *Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators, Second Revision.*
[12] Salt Institute. The Salt Institute references a dry density of 72 lbs./ft3 for the ASTM D632 Specification; however, there is a variability of density from mid 70s to 84 lbs./ft^3 for natural halite/salt. http://www.saltinstitute.org/About-salt/Physical-properties

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