POLLUTION PREVENTION & GOOD HOUSEKEEPING PROGRAM HANDBOOK

Holland
MICHIGAN

2016

Prepared by

Macatawa Area Coordina ng Council

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Cover Photos

Top: Lake Macatawa, © Marge Beaver - Photography Plus, 1571 Goody Rd., Muskegon Michigan 49441, 231-798-2395

Middle: storm drain stencil in the Macatawa Watershed, Macatawa Area Coordinati g Council

Bo om: A view from Yacht Basin Marian on Lake Macatawa, Macatawa Area Coordinati g Council

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SECTION 1: The Importance of Pollution Prevention and Good Housekeeping

1.1 Introduction

Storm water 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 storm water 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 City of Holland (COH) and other members of the Macatawa Watershed Storm Water Committee. The partners worked together 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 storm water to surface waters of the state from a municipal separate storm sewer system (MS4 permit) (Part 31 of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended). The guidebook provides detailed information about the COH's facilities, storm water 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 the COH 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 Macatawa Watershed, regulatory program requirements and a list of definitions and acronyms.

Section 2: Municipal Facility and Structural Storm Water Control Inventory

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

Section 3: Facility-specific Storm Water Management

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

Section 4: Structural Storm Water Control Operation and Maintenance Activities

Section 4 provides procedures for inspecting and maintaining catch basins throughout the City of Holland as well as a procedure for inspecting and maintaining all other storm water 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 occur within the City of Holland 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

The City of Holland is located entirely within the Macatawa Watershed (Fig 1). The Macatawa Watershed covers 175 square miles, 63% of which is in Ottawa County. The landuse (2009) is 46% agriculture, 33% urban and 21% natural/forested and water/wetland (MACC 2012). The area 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 storm water runoff (89% on average from 1978 to 2005), which 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).

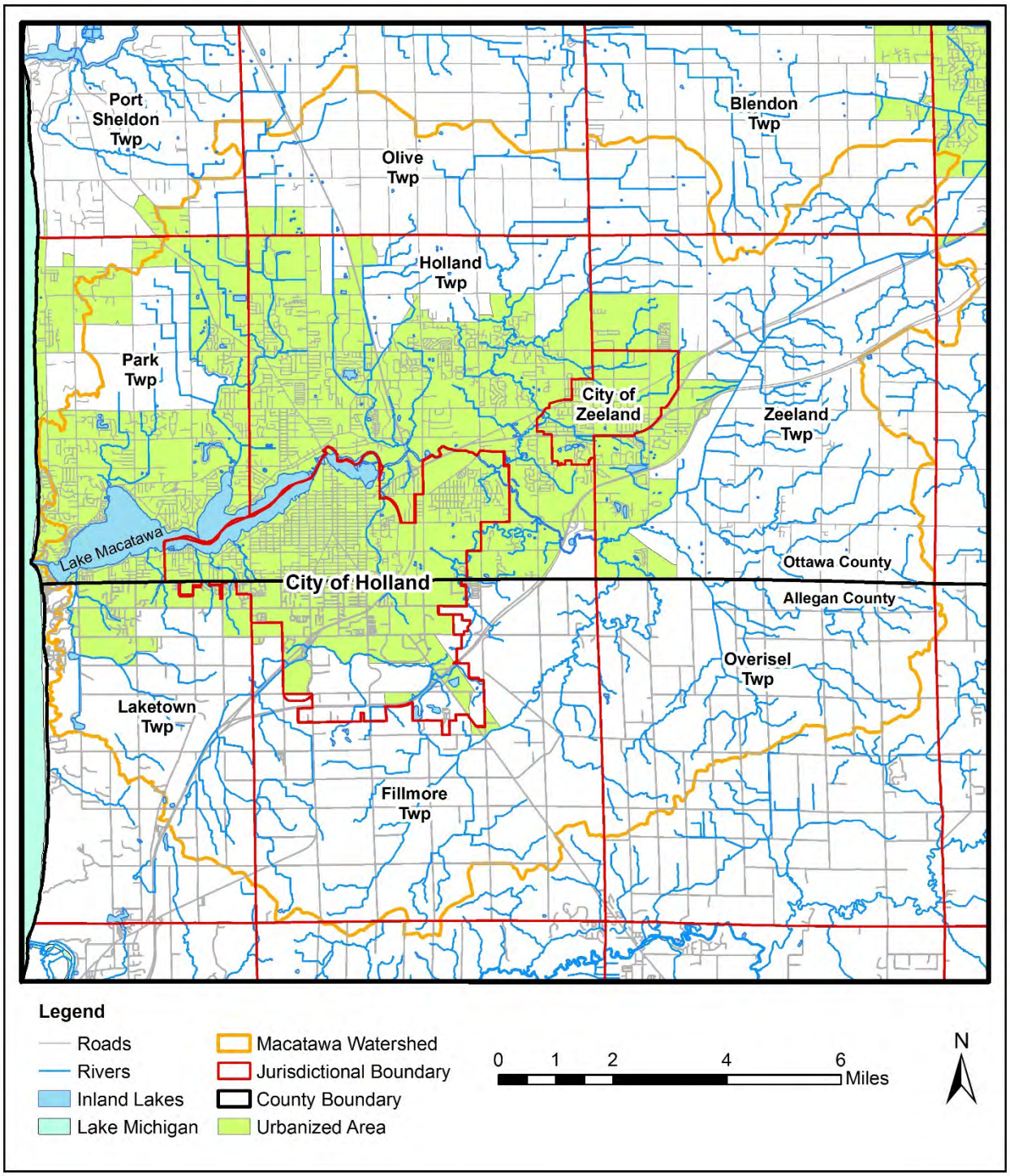

Figure 1. City of Holland Location in the Macatawa Watershed

Lake Macatawa and most of the tributaries are considered to be impaired and not meeting water quality standards to support aquatic habitat. This is caused by too much sediment (soil) and phosphorus in the water. The state approved a phosphorus total maximum daily load (TMDL) for Lake Macatawa in 2000 (Walterhouse 1999). The TMDL set a limit for the amount of phosphorus that Lake Macatawa can receive every year and still support aquatic habitat. The TMDL divided the amount of annual phosphorus inputs

between point and nonpoint sources. Point sources are direct inputs, usually delivered in a pipe, while nonpoint sources are spread throughout the land and delivered in storm water runoff. The majority of the phosphorus inputs into Lake Macatawa, about 90%, are from nonpoint sources. The TMDL was developed prior to the start of the Phase II program and treats discharges from MS4s as nonpoint source inputs. However, the MS4 permit regulates storm water discharges to waters of the state as point sources of pollution. The *Nonpoint Source Phosphorus Reduction Plan for the Macatawa Watershed* was developed and approved in 2000. Many efforts were made to reduce nonpoint sources of phosphorus to Lake Macatawa, but by 2008, water quality monitoring showed little improvement. The TMDL was renewed and a process was started to update the plan. The *Macatawa Watershed Management Plan* was approved 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 primary legislation for establishing requirements for the control of storm water pollutants. Enforcement of the CWA and other federal laws has generated numerous of federal, state and local requirements and programs that deal directly or indirectly in controlling storm water discharges. In the following sections, various programs are discussed in relation to the control of pollutants from municipal storm water systems.

Federal NPDES Program

In 1972, provisions of the federal Water Pollution Control Act, also known as the Clean Water Act (CWA), were 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 storm water discharges under the NPDES program. In 1990, the EPA published final Phase I regulations that established application requirements for storm water 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.

Municipal NPDES Storm Water 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 with multiple watersheds within their jurisdictions were allowed to select which watershed to work with. The six communities with jurisdictional boundaries in the Macatawa Watershed chose to work collaboratively under a watershed permit. The Macatawa Area Coordinating Council provides oversight and coordination of permit activities and assists with maintaining permit compliance.

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 Storm Water Management Plan with the following six minimum control measures:

Public Participation/Involvement Program – Provide opportunities for citizens within the jurisdiction to review the Storm Water 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 storm water issues and actions they can take to help prevent storm water 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 Storm Water 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 Storm Water Runoff Program – Develop, implement and enforce a program to address discharge of storm water 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 Storm Water Management Plan must identify measureable goals for each for each control measure. The goals will be used by the MS4 community and the MDEQ to gauge compliance and evaluate effectiveness of individual best management practices or of the storm water 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 storm water.

COH – City of Holland

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 storm water 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 storm water. It is not a combines sewer nor part of a publically owned sewage treatment facility.

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 Storm Water Control Inventory

2.1 Introduction

One key component of the PPGH Program is a comprehensive inventory of the facilities and storm water controls that are owned or operated by the City of Holland. Maps of the all City-owned facilities and associated storm water controls are located at the Transportation Services Office (333 Wyngarden Way, Holland MI 49423). The MACC will maintain a master database of facilities and storm water controls that are described in the following sections. The inventory, both map files and the MACC database, will be updated within 30 days of the addition, removal or transfer of ownership of any facility or storm water control.

2.2 Facility Inventory and Descriptions

Table 1 contains a complete list of all facilities and properties owned and operated by the City of Holland. A map of all City-owned facilities located within the regulated MS4 area are shown in Figure 2. Table 2 provides a list of the activities that are occurring at each facility that have the potential to generate pollution. The process to assess facilities that generated Table 2 is described in Section 3.1.

In addition to the activities listed in Table 2, Windmill Island Gardens, a City of Holland Park, also seasonally hosts livestock. Four horses and other livestock (chickens and peacocks) are housed at Windmill Island during the summer months. There is also a greenhouse on Windmill Island and a farm field that is plowed annually for the planting of tulip bulbs. These activities, including manure management and agricultural cultivation, could potentially generate storm water pollution.

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Table 1. City of Holland Facility Inventory

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
PRIMARY FACILITIES						
City Hall	270 River Ave	City Manager	616-355-1310	Pine District	42.787284	-86.109569
Herrick District Library – Main Branch	300 River Ave	Library Director	616-355-3100	Pine District	42.786180	-86.109762
Herrick District Library – North Branch	155 Riley St (Holland Charter Twp)	Library Director	616-738-4360	Pine Creek	42.827256	-86.114789
Transportation Services	333 Wyngarden Way	Transportation Services Director	616-928-2400	Maplewood District	42.759884	-86.092373
POLICE AND FIRE						
Holland Police Department	89 W 8th St	Chief of Police	616- 355-1100	Pine District	42.790656	-86.111480
Kollen Park Fire Station	279 Kollen Park Dr	Fire Chief	616-355-1025	Pine District	42.786871	-86.122377
Waverly Fire Station	761 South Waverly Rd			Maplewood District	42.769034	-86.076737
SECONDARY FACILITIES						
Holland Museum and Armory	31 W 10th St	Holland Historical Trust	616-796-3329	Pine District	42.788644	-86.108708
Cappon House	228 W 9th St			Pine District	42.789006	-86.117548
Settlers House	190 W 9th St			Pine District	42.789116	-86.115991
Ottawa Storage Site	681 Homestead Ave	Transportation Services Director	616-928-2400	Wildwood District	42.771593	-86.128074
Padnos Transportation Center (Property owned by city)	171 Lincoln Ave	Macatawa Area Express	616-355-1010	Columbia District	42.791056	-86.096852
West Michigan Regional Airport (Property owned by city)	1601 Lincoln Ave 1581 Washington Ave 1695 Washington Ave	Tulip City Air Service, West Michigan Airport Authority Manager	Tulip City Air: 616-392-7831 Authority: 616-368-3023	Tulip District	42.744952 42.743550 42.742021	-86.092708 -86.106699 -86.120474
PARKS AND CEMETERIES						
Civic Center	150 W 8th St	Civic Center Manager	616-355-1130	Pine District	42.789857	-86.114147
Bouws Pool	365 Fairbanks Ave	Parks and Recreation Director, Parks Supervisor	616-928-2450	Maplewood District	42.783767	-86.090834
Centennial Park	264 Central Ave			Pine District	42.787549	-86.108094
City Greenhouse	496 Central Ave			Pine District	42.779195	-86.107452
DeGraaf Nature Center	598 Graafschap Rd 600 Graafschap Rd			Azalea District	42.774949 42.775311	-86.137726 -86.139486
Hallacy Park	60 E 6th St			Central District	42.792025	-86.104568

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
PARKS AND CEMETERIES, CON'T						
Heinz Waterfront Walkway	519 W 16th St	Parks and Recreation Director, Parks Supervisor	616-928-2450	Direct to Lake Macatawa	42.783298	-86.130983
Holland Heights Park	870 E 10th St			No. 24/Holland Heights District	42.788345	-86.070179
Holland Heights School Park	856 E 12th				42.784978	-86.070792
Joseph Moran Park / Tennis Courts	163 W 22nd St			Pine District	42.777930	-86.113281
Kollen Park	226 Van Raalte Ave 238 Van Raalte Ave 250 Van Raalte Ave 346 Kollen Park Dr 297 W 11th St			Pine District	42.788580 42.788316 42.787985 42.784548 42.787631	-86.120780 -86.122443 -86.120984 -86.124761 -86.120973
Lakeview City Park	609 Blackbass Ave 624 Bay Ave			Midway District	42.774081	-86.161105
Maplewood Youth Complex	52 E 35th St			Lela District	42.764145	-86.103991
Matt Urban Sports Complex	266 E 32nd St			Maplewood District	42.766046	-86.094674
Parks Warehouse	429 E 24th St			Maplewood District	42.777745	-86.087833
Paw Paw Park	1100 Paw Paw Dr			PawPaw District	42.799770	-86.060779
Pine Ave Forestry Yard	85 Pine Ave			Pine District	42.794362	-86.111313
Pocket Park	148 East 28th St			Pine District	42.772001	-86.100353
	711 Michigan Ave			Wildwood District	42.770736	-86.114994
	230 W 28th St			Wildwood District	42.771577	-86.117488
Prospect Park	565 Prospect Ave			Maplewood District	42.776737	-86.100574
Riverview Park / Window on the Waterfront	95 College Ave			Columbia District	42.793912	-86.103154
Rosa Parks Green	471 College Ave			Pine District	42.779886	-86.103209
Soccer Field/ Tennis Courts (Lakeview School Park)	780 Lugers Rd			East End District	42.767905	-86.149116
Smallenburg / Skate Park	325 Fairbanks Ave			Maplewood District	42.784613	-86.091458
Tulip beds	11 E 22nd St			Pine District	42.777859	-86.106849
	704 State St			Maplewood District	42.771009	-86.099898
Van Bragt Park	44 Pine Ave			Direct drainage to Lake Macatawa	42.798828	-86.111433
Van Raalte Farm	1076 E 16th St			Tulip District	42.779663	-86.062494
Washington School Green	265 Maple Ave			Pine District	42.787515	-86.114282

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
PARKS AND CEMETERIES, CON'T						
Windmill Island	1 Lincoln Ave 2 Lincoln Ave 71 Lincoln Ave 111 Lincoln Ave	Parks and Recreation Director, Parks Supervisor	616-928-2450	Direct drainage to Macatawa River	42.797796	-86.093564
Window on the Waterfront	47 Central Ave			Direct drainage to Lake Macatawa	42.795524	-86.105983
	21 River Ave				42.797021	-86.108688
	41 River Ave				42.798068	-86.109535
	61 E 6th St				42.792684	-86.104937
Graafschap Cemetery	708 Graafschap Rd 751 Graafschap Rd 640 W 32nd St 681 W 32nd St			Azalea District	42.769401	-86.137075
Pilgrim Home Cemetery	364 E 16th St 391 E 16th St			Maplewood District	42.781447	-86.089742
HOLLAND PUBLIC SCHOOLS						
Holland High School	600 Van Raalte Ave			Wildwood District	42.774106	-86.121869
Holland High Sports Fields	615, 623, & 635 Van Raalte Ave				42.773342	-86.118584
West	500 W 24th St			Lela District	42.774789	-86.132245
Holland Middle	373 E 24th St			Maplewood District	42.777163	-86.090528
Jefferson	282 W 30th St			Wildwood District	42.769525	-86.119431
Holland Heights	856 E 12th St			No. 24/Holland Heights District	42.786277	-86.070746
Holland Language Academy	461 Van Raalte Ave			Wildwood District	42.779747	-86.119611
Holland Language Academy Parking Lot	288 W 19th St				42.779955	-86.120665
Maintenance and Transportation Center	870 South Waverly Rd			Maplewood District	42.766762	-86.078777
Former Holland Early College (closed)	45 E 25th St			Pine District	42.775351	-86.105320
Maplewood	925 Central Ave			Lela District	42.763716	-86.106283
Vacant Parcel (Harrington School)	1623 W 32nd St (Park Twp)			Virginia Intercounty Drain	42.768314	-86.175923

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
PARKING LOTS						
Parking Deck	111 E 7th St (7E = Upper, 7F = lower)	Transportation Services Director	616-928-2400	College District	42.791427	-86.102269
Parking Deck	65 W 9th St (Lot 9A)			Pine District	42.789564	-86.109933
Padnos Transportation Center Parking Lot	261 E 8th St			Maplewood District	42.790781	-86.095836
Library staff parking lot	316 River Ave			Pine District	42.785517	-86.109284
City-owned parking lots	53 E 9th St (Lot 9D)	Transportation Services Director	616-928-2400	College District	42.789673	-86.105017
	512 & 518 W 16th St			Wildwood District	42.782593	-86.130766
	165 W 8th St (Civic Center North)			Pine District	42.790657	-86.113117
	214 Central Ave (Lot 9B)				42.789634	-86.107883
	221 S River Ave (Lot 9F)				42.788589	-86.109239
	49 W 10th Street (Lot 10A)				42.788726	-86.109716
	49 W 8th St & 50 W 7th St (Lot 7C)				42.790577	-86.109668
					42.790911	-86.109615
	20 E 9th St (Lot 9H)			Central District	42.789124	-86.106325
	23 E 9th St (Lot 9C)				42.789647	-86.106080
	27 E 7th St (Lot 7B)				42.791682	-86.106214
	32 W 7th St (Lot 7D)				42.790924	-86.108442
	40 E 7th St (Lot 7E)				42.790960	-86.105596
OPEN SPACE						
Vacant land and wetlands Window on the Waterfront / Windmill Island	201 E 5th St	Parks and Recreation Director, Parks Supervisor	616-928-2450	Direct drainage to Lake Macatawa	42.793258	-86.098434
	206 E 4th St				42.793573	-86.098787
	134 Lincoln Ave				42.793045	-86.098028
	158 Lincoln Ave				42.796802	-86.099798
	3 Central Ave				42.797300	-86.102230
	80 Columbia Ave				42.797334	-86.101285
Marshy Area/Wetlands	97 N River Ave			Direct drainage to Lake Macatawa	42.793674	-86.108744
Walking Path	672 Midway Ave			Midway District	42.771993	-86.163000
Street end to Lake Macatawa	550 West End Dr			Direct drainage to Lake Macatawa	42.776015	-86.162981

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
OPEN SPACE, CON'T						
Wooded parcel	263 E 16th St	Parks and Recreation Director, Parks Supervisor	616-928-2450	Maplewood District	42.783367	-86.095334
Wooded parcel	428 NB US-31				42.766313	-86.087520
Wooded parcel	285 W 36th St			Lela District	42.764230	-86.120618
Vacant parcels – retention ponds	232 W 48th St	Transportation Services Director	616-928-2400	Tulip District	42.753982	-86.117936
	244 E 16th St			Maplewood District	42.782759	-86.096260
	401 Lincoln Ave				42.782496	-86.096982
	405 Lincoln Ave				42.782318	-86.096969
VACANT LOTS						
Vacant lot – power lines	1110 Washington Ave	Transportation Services Director	616-928-2400	Lela District	42.758735	-86.121394
Vacant parcels - drainage easement	536 W 40th St			Azalea District	42.761169	-86.131317
	795 Maple Ave			Lela District	42.767583	-86.115268
	799 South Shore Dr			Direct drainage to Lake Macatawa	42.778147	-86.142680
Vacant parcel-9th St transition	280 E 8th St			Columbia District	42.790027	-86.094568
Vacant parcel – triangle island	175 W 29th St			Pine District	42.771354	-86.114794
	238 Kollen Park Dr				42.789557	-86.118336
	Pine Ave north				42.776592	-86.111737
	Pine Ave south				42.776275	-86.111897
	229 W 8th St				42.790400	-86.117481
Vacant parcel – home sank demo	165 W 10th St			Pine District	42.788574	-86.115008
Vacant parcel – waterfront	255 Kollen Park Dr			Direct drainage to Lake Macatawa	42.789883	-86.119826
Vacant (Washington School)	265 Maple Ave			Pine District	42.787490	-86.114274
ROW	431 W 23rd St			Wildwood District	42.777051	-86.127000
ROW	425 W 22nd St				42.777717	-86.127013
ROW	424 W 20th St				42.778953	-86.127048
ROW	675 Midway Ave			Midway District	42.771785	-86.162272
Agriculture	1476 Lincoln Ave			Tulip Intercounty Drain	42.747693	-86.097679

Facility Name	Address	Contact Person	Phone Number	Storm Sewer District	Latitude	Longitude
VACANT LOTS, CON'T						
Vacant parcels – Greenspace	1400 Lincoln Ave	Transportation Services Director	616-928-2400	Tulip District	42.749792	-86.097691
	196 E 16th St			Maplewood District	42.782835	-86.098469
	162 W 23rd St			Pine District	42.776412	-86.114550
	5349 143rd Ave			Tulip Intercounty Drain	42.731149	-86.069750
	345 Kollen Park Dr			Direct drainage to Lake Macatawa	42.784692	-86.123958
	376 Kollen Park Dr			Wildwood District	42.783372	-86.124231
	377 Kollen Park Dr				42.783383	-86.123816
	163 W 8th St			Pine District	42.790561	-86.114793

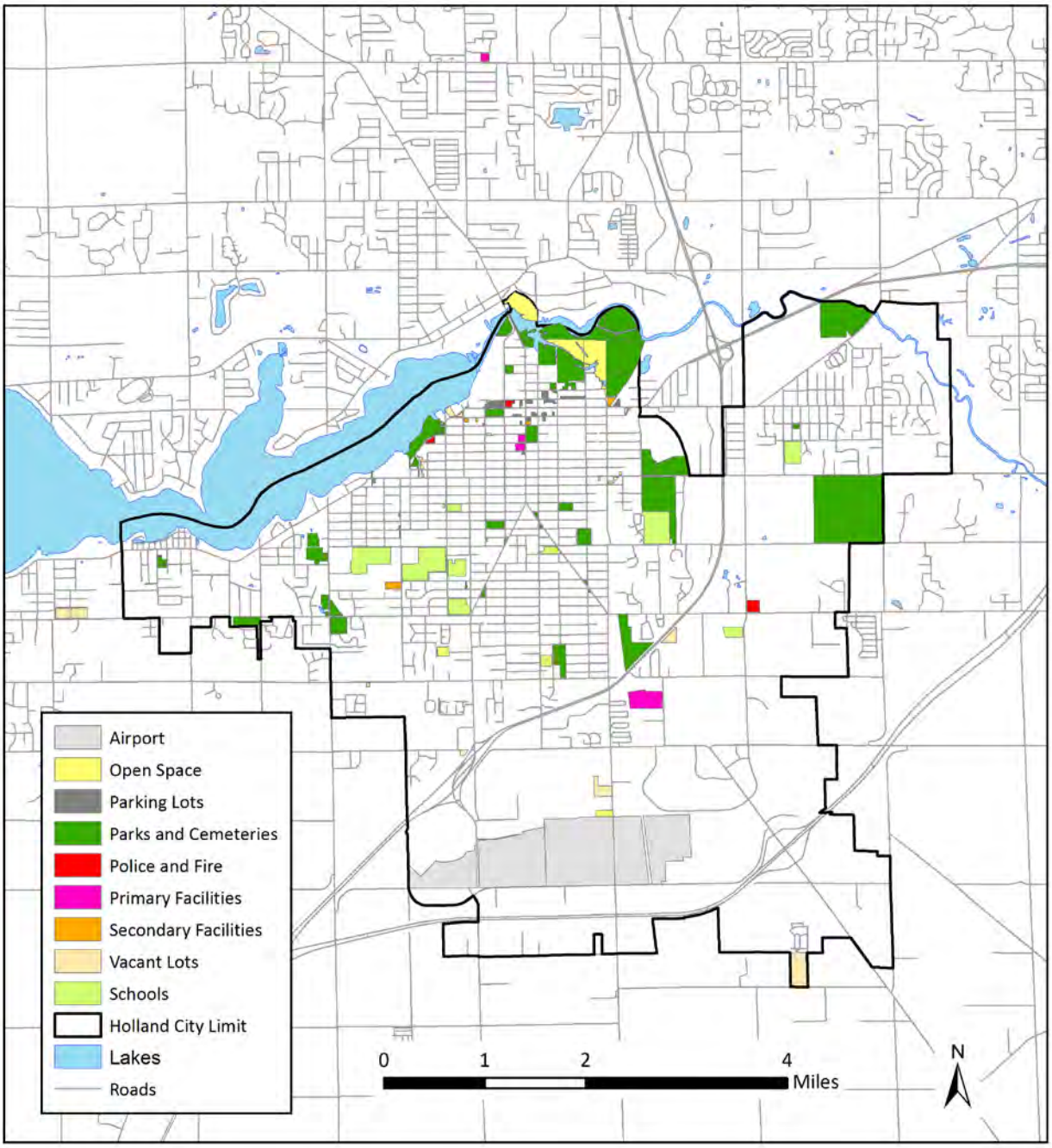

Figure 2. City of Holland Properties

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Table 2: Pollutant Generating Activities that Occur at COH Facilities

Facility Name	Storm water control maintenance	Building washing	Parking lot and sidewalk cleaning	Lawn Care	Garbage Dumpsters	Hazardous Materials Storage	Fuel Storage	Bulk Materials Storage[1]	Parking lot and sidewalk salting	Vehicle and Equipment Storage	Snow Storage
City Hall	X		X	X					X	X - OUTSIDE	X
Transportation Services	X	X	X	X/C	X	X		X	X + WASHING	X + REPAIRS	X
Herrick District Library – Main Branch	X	X	X	X/C	X				X		X
Herrick District Library – North Branch	X	X	X	X/C	X				X		X
Holland Police Department	X	X	X	X/C	X		X		X	X + REPAIRS	X
Kollen Park Fire Station	X	X	X	X/C	X	X			X	X + REPAIRS	X
Waverly Fire Station	X		X	X	X				X	X + REPAIRS	X
Holland Museum and Armory[2]											
Cappon House[2]	X			X/C					X		
Settlers House[2]			X	X					X		X
Ottawa Storage Site	X							X			
Padnos Transportation Center	X	X	X	X/C					X		X
West Michigan Regional Airport[3]	X		X	X	X	X	X	X	X	X	X
PARKS AND CEMETERIES											
Civic Center	X	X	X	X/C	X				X		X
City Greenhouse			X	X/C		X – fertilizer			X	X	X
Parks Warehouse	X	X	X	X/C	X	X	X	X	X	X	X
Bouws Pool						X – chlorine					
Centennial Park	X		X	X/C					X		X
DeGraaf Nature Center			X	X/C	X				X		X
Hallacy Park			X						X		X
Holland Heights Park	X		X	X/C					X		X
Holland Heights School Park[4]	X			X							
Joseph Moran Park / Tennis Courts	X	X	X	X					X		X
Kollen Park / Heinz Waterfront Walkway	X	X	X	X/C	X				X		X
Lakeview City Park	X		X	X/C					X		X
Maplewood Youth Complex	X	X	X	X/C	X				X		X
Matt Urban Sports Complex	X	X	X	X	X			X – temporary	X		X
Neighborhood Pocket Park/Water Tower Park			X								X
Paw Paw Park[5]	X										
Pine Ave Forestry Yard			X					X			X
Prospect Park	X		X	X							X
Riverview Park / Window on the Waterfront	X		X						X		X
Rosa Parks Green	X		X	X					X		X
Smallenburg / Skate Park	X		X	X					X		X
Soccer Field/ Tennis Courts (Lakeview School Park)	X		X	X							X
Van Bragt Park	X		X	X					X		X
Van Raalte Farm	X	X	X	X	X				X		X
Washington School Green			X	X					X		

Facility Name	Storm water control maintenance	Building washing	Parking lot and sidewalk cleaning	Lawn Care	Garbage Dumpsters	Hazardous Materials Storage	Fuel Storage	Bulk Materials Storage[1]	Parking lot and sidewalk salting	Vehicle and Equipment Storage	Snow Storage
Windmill Island	X	X	X	X	X				X + WASHING	X In & out	X
Graafschap Cemetery			X	X					X	X	X
Pilgrim Home Cemetery	X		X	X				X – compost	X		X
MISCELLANEOUS											
Parking Decks	X		X	X					X		X – upper
Parking Lots	X (most)		X	X (most)	X (2)				X		Hauled to Windmill Island
Open spaces	X (some)		X (some)	X (some)					X (some)		X
Vacant Lots	X (some)		X (some)	X (some)					X (some)		X
HOLLAND PUBLIC SCHOOLS											
Holland High School	X		X	X/C	X				X		X
Holland High Sports Fields	X		X	X/C					X		X
West	?		X	X/C	X				X		X
Holland Middle	X		X	X/C	X				X		X
Jefferson	X		X	X/C	X				X		X
Holland Heights	X		X	X/C	X				X		X
Holland Language Academy School	X		X	X/C	X				X		X
Holland Language Academy Parking Lot	X		X						X		X
Maintenance and Transportation Center	X		X	X/C	X	X	X	X	X + WASHING	X + REPAIRS	X
Former Holland Early College (closed)	X		X	X/C	X				X		X
Maplewood	X		X	X/C	X				X		X
Vacant (Harrington School)				X/C							

[1] Includes salt

[2] Land is owned by City of Holland, operation is shared with Holland Historical Trust (non-profit organization)

[3] Land is owned by City of Holland, facility is operated by West Michigan Airport Authority (Tulip City Air Services, LLC) and is subject to industrial NPDES permit regulations

[4] Land is owned by Holland Public Schools, park is operated and maintained by the City of Holland Parks & Recreation

[5] Land is owned by City of Holland and leased to Ottawa County Parks who maintains the site. Ottawa County is also subject to Storm Water regulations as a Phase II MS4.

2.3 Structural Storm Water Control Inventory

Table 3 contains a list and quantity of all storm water structural controls owned and operated by the COH. These numbers represent best estimates based on the information available at the time this document was developed. The inventory was collected through site visits and reviewing COH GIS information. The MACC will continue to work with the COH to refine this inventory in a GIS database so that it is an accurate inventory of the storm water controls owned and maintained by the COH. Any new storm water controls that are discovered or constructed will be input into the GIS database within thirty (30) days of construction or discovery.

Table 3. COH Storm Water Controls

Type	Parks Quantity	HPS Quantity	Other Quantity	Total
Catch Basins	67	170	135 (facilities) 5,739 City ROW	372 (facilities) 6,111 total
Detention Ponds	1			1
Retention Ponds		2		2
Vegetated swales			2	2
Bioretention (rain gardens)	3	1		4
Permeable pavement		5 pk lots		5

SECTION 3: Facility-specific Storm water Management

3.1 Facility Assessment

Staff at the MACC completed facility assessments for all COH properties during the summer of 2014. The assessment included interviews with COH staff and site inspections of most facilities. The MACC used a checklist of activities as the basis for the COH 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 storm water controls at each facility. MACC staff also reviewed existing related COH documents, such as Storm Water Pollution Prevention Plans, to evaluate existing procedures and good housekeeping practices. The assessment results were input into a database created and maintained by the MACC. Hard copies of all field notes were scanned and saved on the MACC server along with photographs taken during site inspections. The City will notify the MACC of any changes to their facilities that impact storm water, including the construction of new facilities, addition or removal of storm water 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 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 4). Criteria used to assign priority levels included the method of on-site storm water management, the facility type and what kind and quality of hazardous materials are stored at the facility. Additional considerations were made for certain facilities where non-typical activities, such as livestock housing, occur. The list of prioritized facilities is provided in Table 5.

Table 4. Primary Criteria Used to Assign Pollutant Discharge Potential Priorities to COH Facilities

Priority Level	Storm water management	Facility type	Hazardous Material storage
High*	Connect to waters of the state	Fleet Maintenance and Storage Yard	Bulk chemical on site
Medium	Connect to waters of the state	Any other except open space	Small quantities of chemicals on site
Low	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

Additional criteria were used to distinguish between medium and low priority for facilities that are connected to waters of the state that are other uses and do not store chemicals on site. For parks, medium priority includes those that receive high use and have large parking lots. For other facilities, the activities that occur onsite were considered in terms of their potential to produce pollution.

Table 5. COH Prioritized Facility List

Facility Name	Storm Water Management	Facility Type	Hazardous Material Storage	Priority
Transportation Services	Connected to WOTS*	Fleet Storage and Maintenance	Yes	**HIGH**
West Michigan Regional Airport	Connected to WOTS	Airport	Yes	**HIGH**
Kollen Park Fire Station	Connected to WOTS	Fire Station	Yes – small qty	**MEDIUM**
Waverly Fire Station	Connected to WOTS	Fire Station	Yes – small qty	**MEDIUM**
Holland Police Department	Connected to WOTS	Police Station	Yes - fuel	**MEDIUM**
Ottawa Storage Site	Connected to WOTS	Materials storage	No	**MEDIUM**
Padnos Transportation Center	Connected to WOTS	Bus and train station	No	**MEDIUM**
Parking Deck	Connected to WOTS	Parking Lot	No	**MEDIUM**
Parking Lots	Connected to WOTS (most)	Parking Lot	No	**MEDIUM**
Holland Museum and Armory	Connected to WOTS	Museum	No	**LOW**
Cappon House	Connected to WOTS	Museum	No	**LOW**
Settlers House	Maintained on site	Museum	No	**LOW**
City Hall	Connected to WOTS	Administration	No	**LOW**
Herrick District Library – Main Branch	Connected to WOTS	Library	No	**LOW**
Herrick District Library – North Branch	Connected to WOTS	Library	No	**LOW**
Open spaces	Maintained on site (most)	Open space	No	**LOW**
Vacant Lots	Maintained on site (most)	Vacant lot	No	**LOW**
PARKS AND RECREATION				
Parks Warehouse	Connected to WOTS	Fleet Storage and Maintenance	Yes	**HIGH**
Civic Center	Connected to WOTS	Community	No	**MEDIUM**
Maplewood Youth Complex	Connected to WOTS	Park	No	**MEDIUM**
Matt Urban Sports Complex	Connected to WOTS	Park	No	**MEDIUM**
Smallenburg / Skate Park	Connected to WOTS	Park	No	**MEDIUM**
Windmill Island	Connected to WOTS	Park	No	**MEDIUM**
Pine Ave Forestry Yard	Maintained on site	Material Storage	No	**LOW**
City Greenhouse	Maintained on site	Greenhouse	No	**LOW**
Bouws Pool	Connected to WOTS	Pool	No	**LOW**
Graafschap Cemetery	Maintained on site	Cemetery	No	**LOW**
Pilgrim Home Cemetery	Maintained on site	Cemetery	No	**LOW**

*WOTS = waters of the state

Facility Name	Storm Water Management	Facility Type	Hazardous Material Storage	Priority
PARKS AND RECREATION, CON'T				
Centennial Park	Connected to WOTS	Park	No	**LOW**
DeGraaf Nature Center	Maintained on site	Nature Center	No	**LOW**
Hallacy Park	Maintained on site	Park	No	**LOW**
Holland Heights Park	Connected to WOTS	Park	No	**LOW**
Holland Heights School Park	Connected to WOTS	Park	No	**LOW**
Joseph Moran Park / Tennis Courts	Connected to WOTS	Park	No	**LOW**
Kollen Park / Heinz Waterfront Walkway	Connected to WOTS	Park	No	**LOW**
Lakeview City Park	Maintained on site	Park	No	**LOW**
Neighborhood Pocket Park/Water Tower Park	Maintained on site	Park	No	**LOW**
Paw Paw Park	Maintained on site	Park	No	**LOW**
Prospect Park	Connected to WOTS	Park	No	**LOW**
Riverview Park / Window on the Waterfront	Connected to WOTS	Park	No	**LOW**
Rosa Parks Green	Connected to WOTS	Park	No	**LOW**
Soccer Field/ Tennis Courts (Lakeview School Park)	Connected to WOTS	Park	No	**LOW**
Van Bragt Park	Connected to WOTS	Park	No	**LOW**
Van Raalte Farm	Connected to WOTS	Park	No	**LOW**
Washington School Green	Connected to WOTS	School	No	**MEDIUM**
HOLLAND PUBLIC SCHOOLS				
Maintenance and Transportation Center	Connected to WOTS	Fleet Storage and Maintenance	Yes	**HIGH**
Holland High School	Connected to WOTS	School	No	**MEDIUM**
Holland High Sports Fields	Connected to WOTS	School	No	**MEDIUM**
West	Connected to WOTS	School	No	**MEDIUM**
Holland Middle	Connected to WOTS	School	No	**MEDIUM**
Jefferson	Connected to WOTS	School	No	**MEDIUM**
Holland Heights	Connected to WOTS	School	No	**MEDIUM**
Holland Language Academy School	Connected to WOTS	School	No	**MEDIUM**
Holland Language Academy Parking Lot	Connected to WOTS	School	No	**MEDIUM**
Former Holland Early College (closed)	Connected to WOTS	School	No	**MEDIUM**
Maplewood	Connected to WOTS	School	No	**MEDIUM**

*WOTS = waters of the state

Facility Name	Storm Water Management	Facility Type	Hazardous Material Storage	Priority
HOLLAND PUBLIC SCHOOLS, CON'T				
Vacant (Harrington School)	Connected to WOTS	Vacant	No	**LOW**

*WOTS = waters of the state

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*WOTS = waters of the state

Based on the prioritization criteria, four (4) properties were classified as high priority: Transportation Services, the Parks Warehouse, the Holland Public Schools Maintenance and Transportation Center, and the West Michigan Regional Airport. The **Transportation Services** property has 5 catch basins that collect storm water and discharge into a wetland. There is a point of discharge on the west side of the property into an open ditch that runs along the railroad tracks and discharges into the Maplewood Creek that empties into the Macatawa River. The **Parks Warehouse** property has 4 catch basins that collect storm water and direct it into a retention pond that connects to the City storm sewer system in the Maplewood District that discharges into the Macatawa River via Maple Creek. The **Holland Public Schools Maintenance and Transportation Center** does not have any catch basins on the property. Storm water runs off the property in sheet flow to adjacent open drains on both the north and south side of the property. These drains are part of the Maplewood District and flow into Maple Creek which eventually discharges into the Macatawa River. The **West Michigan Regional Airport** is subject to industrial storm water permits under the National Pollutant Discharge Elimination Program and is currently following a Storm Water Pollution Prevention Plan (SWPPP) that was updated in 2012 (Appendix B). There are two (2) detention ponds and numerous open ditches on the site that direct storm water to five points of discharge, all of which empty into tributaries of or the main channel of the North Branch of the Macatawa River (Tulip Intercounty Drain). See Property Fact Sheets starting on the following page for more information about each of these properties. A site plan for the West Michigan Regional Airport is included in their SWPPP (Appendix B, Section 3.3).

Figure 3. Holland Transportation Services Site Plan

Property Type: Vehicle storage and maintenance, salt storage

Structural Stormwater Controls: curb and gutter in parking lot, catch basins collect storm water runoff and discharge into a wetland detention area east of the parking lot; there is an open drain along the railroad tracks on the west side of the property that collects runoff from the non-catch basin drained portion of the property

Roof Drains: water is collected in pipe system that runs inside building and outlets into wetland detention area

Lawn Care: by contractor

Winter Maintenance: parking lot/sidewalk plowing and salting for employee access, snow stored on site

Salt storage: rock salt in covered building; deicing fluid has secondary containment

Vehicle Maintenance: vehicle washing occurs inside (wash bay); small engine repair occurs inside; service also provided to police, fire and MAXX Transit Authority; oil water separator in building; collect and recycle used oil and antifreeze

Vehicle storage: inside and outside (temporary)

Other Information:

- Wash bay in building is used to decant water from vactor spoils; solids stored on site (street sweeper waste taken to an approved landfill)
- Dumpster is covered and located on an impervious surface

Property Type: Vehicle storage, material storage

Structural Stormwater Controls: curb and gutter in parking lot, catch basins collect runoff and discharge into detention pond that outlets into City storm sewer in road

Roof Drains: roof drains collect water and discharge into the storm sewer system that outlets to detention pond

Lawn Care: performed by staff; fertilization, if needed, done by contractor

Winter Maintenance: snow maintained onsite

Salt storage: small quantities for use on site

Vehicle Maintenance: all vehicles are stored inside; vehicle washing occurs in wash bay (connected to sanitary sewer); all other maintenance done by Holland Transportation Services; oil/water separator cleaned annually

Miscellaneous Storage: 300 gallon diesel fuel storage tank (outside)

Other Information: Parking lot cleaning and maintenance done by Street Department (Transportation Services)

Figure 4. Parks Warehouse Site Plan

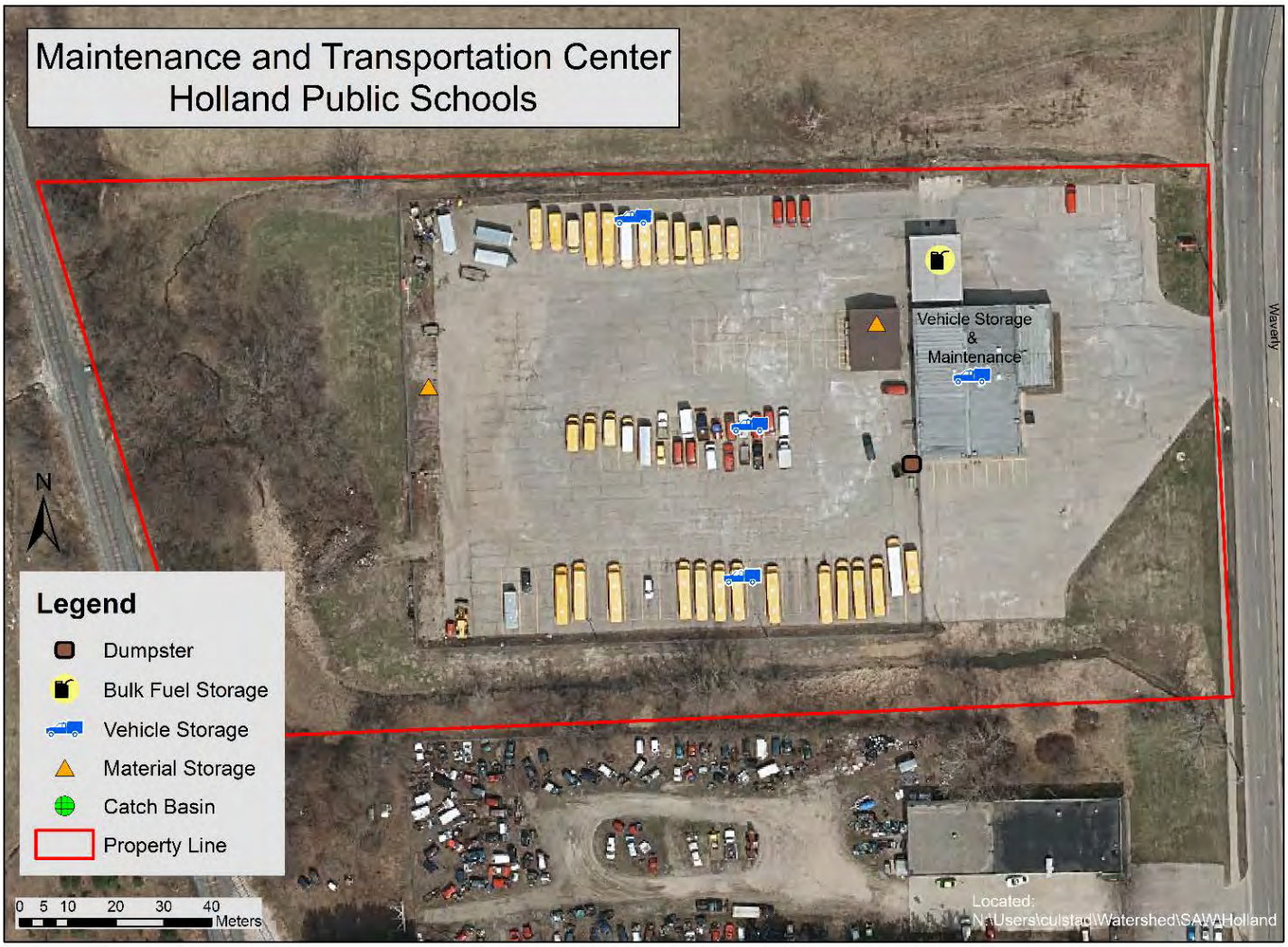

Figure 5. Maintenance and Transportation Center Site Plan

Property Type: Vehicle storage and maintenance

Structural Stormwater Controls: none; all runoff is sheet flow to the open drains on the north and south sides of the property

Winter Maintenance: snow maintained onsite

Salt storage: small quantities for use on site

Vehicle Maintenance: vehicles are stored inside and outside; vehicle washing occurs in wash bay (connected to sanitary sewer); oil/water separator from floor drain, cleaned every 6 months; all mechanical repairs are done off site at commercial facilities

Fuel Storage: fueling station onsite for HPS vehicles, also used by City of Holland Police and Maxx buses; other bulk fluid storage (antifreeze) is inside with secondary containment

Other Information: Property is subject to Industrial Storm Water permitting and operates under an approved Storm Water Pollution Prevention Plan

3.3 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 storm water pollution when undertaking certain activities. The next section of the guidebook provides BMPs that are being and will be followed for activities that are occurring at high priority COH facilities. These same BMPs are implemented at medium and low priority facilities for the applicable activities. In addition, Windmill Island maintains livestock during the summer months and has a field of tulips that is actively planted and harvested annually. All applicable Generally Accepted Agricultural Management Practices will be followed regarding care of the animals, management of manure and nutrients, and control of soil erosion from agricultural production.

Table 6. Activities that Could Generate Storm Water Pollution at High Priority COH Facilities

	FACILITY				
ACTIVITY	**Transportation Services**	**Parks Warehouse**	**HPS Maintenance & Transportation Center**	**West Michigan Regional Airport[1]**	**BMP Summary Sheet (page #)**
Vehicle storage	X	X	X	X	31
Equipment storage	X	X	X	X	31
Vehicle and equipment maintenance	X		X	X	32
Vehicle and equipment washing				X	33
Materials storage	X	X	X	X	34
Bulk chemical/hazardous materials storage[2]	X	X	X	X	35
Fueling Station		X	X	X	36
Fuel Storage		X	X	X	37
Salt storage	X				38
Parking lot/sidewalk salting	X	X	X	X	39
Salt vehicle washing	X		X		40
Parking lot/sidewalk cleaning	X	X	X	X	41
Building washing	X	X		X	42
Snow storage	X	X	X	X	43
Outside dumpster storage	X	X	X	X	44
Lawn Care	X	X	X	X	45
Pet Waste Control	At some low and medium park properties				46

[1] See Appendix B for additional good housekeeping practices conducted at the airport as part of their SWPPP

[2] See Table 7 for list of significant materials

Table 7. Significant Materials Stored at High Priority COH Facilities

Material	Location	Quantity	Handling and storage requirements	Potential to discharge at facility
TRANSPORTATION SERVICES				
Salt	Covered Storage Building	Up to 1,500 Ton		Low
Boost Salt Additive	Enclosed Building	Up to 12,000 gal	Dyke Containment	Low
Gravel	Outside Bin	20 yds		Low
Millings	Outside Gravel Lot	Varies- Up to 100 yds		Low
Sweepings	Asphalt Pad	Up to 40 yds	Temp. Storage	Low
Decanted – Drains Debris	Asphalt Pad	Up to 50 yds	Temp. Storage	Low
Oil Drums	Inside	12-55 gal	All oil products stored inside vehicle maintenance garage. All drains inside building go to oil separator then into sanitary sewer system for treatment.	None
Degreaser	Inside	50 gal		None
Anti-Freeze	Inside	400 gal		None
Hydraulic Oil	Inside	275 gal		None
Waste Oil	Inside	Up to 800 gal		None
Oil Bulk Tank	Inside	675 gal		None
Windshield Washer	Inside	3-55 gal		None
RV Anti-Freeze	Inside	1-55 gal		None
PARKS WARESHOUSE				
Diesel fuel	Elevated storage tank outside warehouse	300 gal	Secondary containment, spill prevention and response	Medium – spills during transfer, leaks
Grease	Inside storage building	30 gal	Stored inside, secondary containment	None
Pesticides (liquid)	Inside cabinet in warehouse	20 gal	Stored in original containers, well labeled, secondary containment, stored away from other chemicals	None, low when in use
Pesticides (solid)		30 lbs		
Fertilizer	Dry storage building	1000 lbs		
Turface	Dry Storage building	4 tons (in 50 lb bags)	Stored inside in dry area, sweep up and reuse spilled material	None
Athletic field marker	Dry storage building	1 ton (in 50 lb bags)	Stored inside in dry area, sweep up and properly dispose of spilled material	None, low when in use
Fill/top soil	W of cemetery	1,500 yds	Prevent/sweep up trackout, protect from water and wind erosion	Low
Clean red sand	W of cemetery	150 yds		Low
Organic compost	W of cemetery	3,000 yds		Low
HPS MAINTENANCE AND TRANSPORTATION CENTER				
Diesel fuel	Underground storage tank at fueling station	12,000 gal	Tank corrosion protection, venting system, spill prevention and response	Medium – spills during transfer
Gasoline		12,000 gal		
Antifreeze	Inside	50 gal	Secondary containment, spill prevention and response	Low

Vehicle and Equipment Storage

BMP Description:

- All floor drains that discharge to storm sewers should be sealed/plugged. New floor drains should discharge to a sanitary sewer.
- 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 garage100% 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 as appropriate.
- 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:

Outdoor Materials Storage

BMP Description:

- Consider building a covered area with a paved floor for storing materials to prevent contact with storm water runoff. This practice can be used for significant materials that could contaminate storm water runoff.
- If small quantities of materials are stored outdoors, consider placing a temporary plastic film or sheeting over the material to protect it from storm water runoff.
- New storage areas should be paved and include a drainage system to collect the storm water 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 storm water 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 Storm Water Discharges.*

Hazardous Materials Storage

BMP Description: (EPA)

- 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

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
- Regularly 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.

Salt[1] and Brine Storage

BMP Description[2]: (DEQ & Winter Manual)

- 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.
- All shipping and loading/unloading activities should occur inside the storage building.
- Minimize and cleanup any track out from storage buildings or from outdoor loading/unloading areas.
- Liquid brine must be stored in double-walled tanks or a single-walled tank with secondary containment. Secondary containment must be large enough to contain the entire volume of the tank if spilled.

Measurable Goals:

A minimum of one well-marked spill kit available near salt/brine storage areas
100% of spills and trackout are cleaned up and kept out of storm drains Secondary containment for all brine storage

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 *Michigan Winter Maintenance Manual* (Appendix C) and *Salt and Brine Storage Guidelines* (Appendix D) 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 or brine storage facility meets certain criteria.

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 *Minnesota Winter Parking Lot and Sidewalk Maintenance Manual* (Appendix E) 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.

Salt Vehicle Washing

BMP Description:

- Wash areas must be located on an impervious pad that is slope or curbed to contain wash water for proper disposal.
- Wash waste water can be disposed of in one of 2 ways:
    - Obtain permission from the Clean Water Plant to discharge into the sanitary system
    - Discharge into a holding tank for proper disposal at an approved facility

Measurable Goals:

100% capture and proper disposal of salt vehicle wash water

Timeline/Implementation Schedule:

Employee training once every 5 years of 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: MDEQ *Salt and Brine Storage Guidelines* (Appendix D)

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*

Building Washing (Powerwashing)

BMP Description: (Sacramento)

- 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 storm water 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*

Snow Storage and Removal

BMP Description: (DEQ)

- 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 storm water 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 storm water 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 in all city parks

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*

3.4 Inspection and Maintenance of Storm Water Control Devices

The City of Holland performs monthly inspections of storm water control devices at high priority facilities. The inspection consists of looking inside catch basin covers, checking all culvert tiles and visual inspections of all other storm water controls onsite. Inspections are conducted by either trained consultants or trained employees at each facility. Each facility will be responsible for conducting their own inspections (or using the City's consultant) and submitting documentation to the Transportation Services Director for tracking of inspections and maintenance for compliance with the MS4 permit. Inspections are documented electronically on the **Facility Storm Water Management and Control Device Inspection Form** (Appendix F) and shared with the Transportation Services Director via Dropbox. The City keeps all records on file in the Transportation Services office. Any critical maintenance needs are reported immediately to the individual Facility Supervisor and corrective action is taken within thirty-six (36) hours. Any other maintenance needs are addressed within sixty (60) days or within a reasonable timeframe based on the maintenance need. All maintenance performed and corrective action taken are documented in writing (or digital format) and kept on file in the Transportation Services office as well as documented in the City's GIS system. Inspection and maintenance reports are reviewed annually to determine if the frequency of inspections or maintenance should be adjusted.

3.5 Comprehensive Site Inspection

Comprehensive site inspections of all high priority facilities are conducted in the spring and fall of each year. Inspections are completed by either trained consultants or trained employees at each facility The inspection includes a review of general facility operations, fluids management, leak and spill prevention, oil and antifreeze management, tire storage, rags and absorbent materials, and salt and materials storage. Inspections are documented on the **Storm Water Comprehensive Site Inspection Form** (Appendix G) and shared with the Transportation Services Director via Dropbox. Any maintenance needs or corrective actions are described on the inspection form and the Facility Supervisor is notified within 24 hours. Corrective action is taken to address critical issues within thirty-six (36) hours. Other issues, including those related to staff training, are addressed within sixty (60) days or within a reasonable timeframe based on the maintenance need. All maintenance performed, improvements made, additional BMPs implemented, and other corrective action taken are documented in writing (or digital format) and stored in the Transportation Services office.

SECTION 4: Structural Storm Water Control Operation and Maintenance Activities

4.1 Catch Basin Inspection and Maintenance

Procedures for catch basin inspection and maintenance were developed in 2014 as part of a *Stormwater System Maintenance Plan* (Appendix H). Catch basin inspections will not be prioritized and all catch basins will be inspected on a regular basis. Corrective maintenance will take place within 60 days and any emergency repairs will be addressed within 36 hours. The City's GIS system serves as a means to record inspections, schedule and perform maintenance and generate summary reports. All catch basin cleaning activities will follow the guidelines outlined in the *Catch Basin Cleaning Activities Guidance Document* provided by the MDEQ (included in Appendix H).

4.2 Other Storm water Controls

Storm water controls at medium and low priority facilities and in City right or ways (excluding catch basins) are inspected following the procedures outlined in the *Stormwater System Maintenance Plan* (Appendix H). In addition, storm water controls at all medium and low priority facilities will be inspected twice a year, in the spring and fall, by trained consultants or trained City staff following the mothly inspection procedure outlined in Section 3.4. Corrective action will be taken within thirty-six (36) hours of notification to address any immediate maintenance needs. Other maintenance needs will be addressed within sixty (60) days of the inspection. All maintenance needs and corrective action taken will be documented in the City's GIS system. Documentation of inspections and maintenance needs are reviewed annually to determine if the frequency of inspections should be adjusted.

The City of Holland requires that all construction of new city-owned facilities or new storm water 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 COH owned facilities, including public roads, were assessed by the Transportation Services Director to determine which operation and maintenance activities are occurring at facilities and within right of ways. The following activities were assessed:

- Road, parking lot and sidewalk maintenance
- Bridge maintenance
- Right-of-way maintenance
- Unpaved road maintenance
- Cold weather operations
- Vehicle washing and maintenance

A summary of the operation and maintenance activities and associated potential pollutants is found in Table 8. City staff will annually review the effectiveness of BMPs that are implemented and make any necessary adjustments to goals and/or add or remove BMPs as appropriate. 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 Street Sweeping

Procedures to prioritize street sweeping including sweeping methods and dewatering, storage and disposal of waste material are found in the *Stormwater System Maintenance Plan* (Appendix H, page 17). High, medium and low priority streets are defined as follows:

High priority (average of at least twice a month): high traffic zones, heavy commercial and industrial districts, shopping malls, high density residential areas, plazas, area that consistently generate high volume of trash, debris and other storm water pollutants

Medium priority (average of at least once a month): medium traffic zones, warehouse districts and medium commercial and industrial districts

Low priority (as necessary, but at least twice before the start of the rainy season): light traffic zones, residential zones and light commercial districts

On an annual basis, staff that conduct street sweeping will be asked to evaluate the effectiveness of this prioritization. They will evaluate whether the types of roads assigned to each priority class are appropriate or if adjustments should be made. They will also evaluate the frequencies assigned to each priority class. Most of the evaluation will be qualitative based on observations, but the quantities of materials swept will also be considered. If low volumes of materials are discovered, then frequency may be decreased or the priority class may be reduced. If high volumes of materials are discovered, then frequencies may be increased or the priority level elevated. Citizen complaints regarding accumulation of trash and debris will also be taken into account when adjusting priority levels.

5.3 Best Management Practices

Best management practices that are or will be followed for operations and maintenance activities that are listed in Table 8 are provided in the pages following Table 8.

Table 8. 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 #)**
Roads, Streets, and Highways Operation and Maintenance	Sweeping and Cleaning	X	X	X	X	X	X	X	X	X	53
	Street Repair, Maintenance, and Striping/Painting	X		X	X		X	X			54, 55
	Bridge and Structure Maintenance	X		X	X		X	X			56
	Unpaved Road Maintenance	X	X	X			X	X		X	57
Plaza, Sidewalk, and Parking Lot Maintenance and Cleaning	Surface Cleaning	X	X			X	X			X	42
	Graffiti Cleaning	X	X		X			X			58
	Sidewalk Repair	X		X							See Bridge, 56
	Controlling Litter	X		X		X	X			X	59
Pools and Water Features Maintenance	Fountain and Pool draining			X		X	X	X			60
	Lake and Lagoon Maintenance	X	X	X		X			X	X	61
Landscape Maintenance	Mowing, Trimming, Planting	X	X	X		X			X	X	45
	Fertilizer & Pesticide Management	X	X						X		45
	Managing Landscape Wastes	X	X	X					X	X	45
	Erosion Control	X	X								62
Drainage System Operation and Maintenance	Inspection and Cleaning of Stormwater Conveyance Structures	X	X	X		X		X		X	63
	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	64
	Maintenance of Inlet and Outlet Structures	X		X	X		X			X	65
Waste Handling and Disposal	Controlling Litter			X	X	X		X		X	59
	Controlling Illegal Dumping	X		X		X	X		X	X	64
Cold Weather Operations	Plowing	X	X	X	X		X	X		X	66
	Sand application	X	X								67
	Salt application		X								68
	Use of deicing agents		X								39
	Snow removal and storage	X	X	X	X		X	X		X	43

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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
Street 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*

Roadway Patching, Resurfacing and Surface Sealing

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

BMP Description:

- Patching, resurfacing and sealing are to be scheduled for dry weather.
- Material stockpiles are to be kept away from streets, gutter areas, storm drain inlets or waterways. Piles are to be bermed or covered during wet weather to prevent runoff.
- Preheating, transfer or loading of hot bituminous material is to be done away from drainage systems or waterways.
- Where applicable, nearby storm drains are to be covered before applying seal coat, slurry seal etc.
- Covers are to be left in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from storm drain inlets when the job is complete.
- Excess material is to be prevented from entering streets or storm inlets.
- There shall be a designated area for cleanup and proper disposal of excess material.
- To avoid runoff, only as much water as is necessary will be used for dust control.

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 of 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 – Roadway Patching, Resurfacing and Surface Sealing*, 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*

Bridge Repair and 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.
- Thoroughly clean up the job site when repair work is completed.
- If surface cleaning, painting and paint removal, and graffiti removal are performed, implement the appropriate procedures as outlined in those BMPs.

Measurable Goals:

Keep 100% of all maintenance wastes out of surface water and 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 – Bridge Repair and Maintenance*, Stormwater Coalition of Monroe County, NY*

Unpaved Roads and Trails

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

BMP Description:

- Stabilize exposed soil areas to prevent soil from eroding during rain events. This is particularly important on steep slopes.
- Roadside areas with exposed soils should be vegetated with a mulch or binder that will hold the soils in place while the vegetation is establishing. Native vegetation should be used if possible.
- If vegetation cannot be established immediately, apply temporary erosion control mats/blankets, straw or gravel as appropriate.
- In roadside areas where sediment is already eroded and mobilized temporary controls should be installed. These may include: silt fences, fabric dikes, hay bales staked in place, or any other appropriate measure.

Measurable Goals:

Erosion control measures in place on all unpaved roads within the urbanized area with a goal of keeping 100% of sediment out of storm drains and surface waters

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 – Unpaved Roads and Trails*, 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*

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*

Fountain and Pool Maintenance

Category of Municipal Operations: Pools and Water Features Maintenance

BMP Description:

- Use chlorine or other alternatives to control algae, not copper-based algaecides.
- Drain water from fountains and pools to a sanitary sewer or water can be dechlorinated and recycled/reused by draining it gradually onto a landscaped area. Water is tested to ensure no chlorine present.
- Maintain an 'air gap' between the discharge line and the sewer line to prevent backflow to the sanitary sewer.
- Provide drip pans beneath drain pipe connections to prevent leaks.
- Never clean a filter in the street or near a storm drain.
- Rinse cartridge filters onto a dirt area and spade filter residue into soil.
- If there is not a proper dirt area for discharge, filter backwater to the sanitary sewer if permitted.

Measurable Goals:

100% of drained water discharged to sanitary sewer or dechlorinated
Emergency maintenance issues addressed within thirty-six (36) hours of discovery

Timeline/Implementation Schedule:

Employee training once every 5 years of 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 – Fountain and Pool Maintenance*, Stormwater Coalition of Monroe County, NY*

Lakes, Ponds and Lagoon Maintenance

Category of Municipal Operations: Pools and Water Features Maintenance

BMP Description:

- Reduce fertilizer use around the water body.
- Discourage the public from feeding the wildlife to control bacteria.
- Consider introducing fish that eat algae.
- Educate the public on algae and relay that certain types of algae are beneficial to the water.
- Control erosion in many ways such as maintaining vegetative cover on banks, provide riprap along banks so minimize erosion potential, and confine excavated materials away from lakes and keep covered.
- Conduct inspections to detect illegal dumping in or near a lake.
- Pickup landscape waste in and around lakes where feasible.
- Provide and maintain trash cans near recreational water bodies for the public, and increase trash collection during peak visitation.

Measurable Goals:

Signage installed at 100% of ponds to discourage feeding of wildlife
Severe erosion issues corrected within thirty-six (36) hours of discovery; all other maintenance addressed within 60 days

Timeline/Implementation Schedule:

Employee training once every 5 years or within 1 year for new hires
Monthly inspections of all storm water control devices

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 –Lakes, Ponds and Lagoon Maintenance*, Stormwater Coalition of Monroe County, NY*

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 storm water 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*

Storm Water 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 Storm Water 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 of within 1 year for new hires
Monthly inspections of all storm water 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 Storm Water 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 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:

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

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 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:

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

[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 are 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 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:

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

SECTION 6: Additional Program Components

6.1 Managing Vegetated Properties

Most of the vegetation management carried out on COH property pertaining to lawn care and landscape maintenance is through private contractors. If pesticide application is determined to be necessary, the COH will require proof that the contractor 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 COH staff, including Holland Public School employees, that may apply pesticides during vegetation management on properties or in right of ways will be certified by the State of Michigan as a pesticide applicator in the applicable category. COH 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

The COH may occasionally hire contractors to complete routine operation and maintenance (O&M) procedures that are described in this handbook. Any contractors that are hired to perform O&M activities must be required to follow all pollution prevention and good housekeeping practices described. Language will be included in any bid packets and contracts to this effect. Contracts will also include language that allows designated COH 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 COH properties or right of ways.

6.3 Employee Training

The MACC provides training opportunities to the COH and other MS4 communities within the Macatawa Watershed. In class training will be offered at least once during each permit cycle, and all employees will be required to attend the training. Additional in-class training sessions will be scheduled as needed. Online modules will be made available for special interest topics, such as lawn care or rain garden maintenance, and annual refresher courses, and employees will be encouraged to participate in these as applicable. A comprehensive online training will also be available for any new employees that are hired after the in-class training has been completed during that permit cycle. New hires will be required to complete the online training within one year of their start date, or attend an in-class training if one is offered.

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APPENDIX A

CHECKLIST OF MUNICIPAL ACTIVITIES

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City of Holland

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

Municipal Operations Storm Water 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 Storm Water Assessment

FACILITY/BUILDING NAME

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 Storm Water Assessment

FACILITY/BUILDING NAME

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 Storm Water Assessment

FACILITY/BUILDING NAME

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																					

APPENDIX B

WEST MICHIGAN REGIONAL AIRPORT STORM WATER POLLUTION PREVENTION PLAN

Storm Water Pollution Prevention Plan (SWPPP)

And

Spill Prevention, Control & Countermeasure Plan (SPCC)

For

Tulip City Air Service, Inc.

At

West Michigan Regional Airport
Holland, Michigan

Updated
December 31, 2012

Prepared by:

DRIESENGA & ASSOCIATES, INC.

Engineering · Surveying · Testing

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continued

GENERAL FACILITY INFORMATION

West Michigan Regional Airport

1581 S. Washington Avenue
Holland, Michigan 49423

Owned by:
City of Holland
270 S. River Avenue
Holland, Michigan 49423

Operated by:
Tulip City Air Service, Inc.
Mr. Ronald Ludema, President
1581 S. Washington Avenue
Holland, MI 49423

Ph: 616-392-7831
Fax: 616-392-8280

Permit Information

General Permit No.:	MIS219000
Designated Name:	Tulip City Airport - Holland
Certificate of Coverage No.:	MIS210458
Effective Date of Coverage:	April 1, 2002
Standard Industrial Classification (SIC) Code:	4581
Certified Storm Water Operator:	Mick J. Osborne
Certification Number:	I-00955
Number of Storm Water Outfalls:	5
Receiving Waters:	North Branch Macatawa River Also known as Tulip Intercounty Drain

Emergency Contacts:
Ronald Ludema
Home: 616-335-9487
Cell: 616-218-7394

Mick Osborne
Home: 616-399-2094
Cell: 616-218-4281

SPCC PLAN REQUIREMENTS CROSS REFERENCE

Regulation	Requirement Description	Plan Section
112.3(d)	Professional Engineer Certification	8.2
112.4(a)	Spill Reporting Requirements	7.5
112.5(b)	Five Year Plan Review	Prefix
112.7	Management Approval of Plan	8.1
112.7(a)(2)	Equivalent Environmental Protection	5.3
112.7(a)(3)	Facility Description & Diagram	3.0
112.7(a)(3)(vi)	Contact Information	Appendix D
112.7(b)	Discharge Predictions	4.1
112.7(c)	Containment & Diversionary Structures	5.1, 5.2
112.7(e)	Inspections, Tests & Records	5.1.2 & 7.4
112.7(f)	Personnel Training	7.1
112.7(g)	Security	5.2.6
112.7(h)	Tank Truck Loading and Unloading	5.1.3, 5.2.4, & Appendix N
112.8(b)	Facility Drainage	5.2.4
112.8(c)	Bulk Storage Containers	5.1, 5.2
112.8(d)	Facility Transfer Operations	5.1, 5.2

DOCUMENT REVISION HISTORY

In accordance with 40 CFR 112.5(b), a review and evaluation of this SPCC Plan is conducted at least once every five years. The owner or operator is to amend the SPCC Plan within six months of the review to include more effective prevention and control technology if the technology has been field-proven at the time of the review and will significantly reduce the likelihood of a discharge from the facility. Amendments must be implemented as soon as possible, but not later than six months following preparation of any amendment. Technical amendments require recertification by a licensed engineer. These reviews and revisions are recorded below:

Initial Plan Date: 02/21/06

Review Date: 04/24/07 By (signature): _____
Plan amended as a result? Yes X No___
If Yes, Amendment Date: 10/15/07
Amendment Description: Added deicing controls, integrated SPCC into SWPPP
P.E. Recertification Required? Yes X No___

Review Date: 09/17/2012 By (signature): _____
Plan amended as a result? Yes X No___
If Yes, Amendment Date: 12/31/2012
Amendment Description: Updated Facility Map for Geurink Blvd Construction, updated significant material inventory to include evaluation of potential for exposure, added TMDL requirements, updated comprehensive inspection, annual report, and other requirements per April 1, 2012 general permit.
P.E. Recertification Required? Yes X No___

Review Date: _____ By (signature): _____
Plan amended as a result? Yes___ No___
If Yes, Amendment Date: _____
Amendment Description: _____
_____
P.E. Recertification Required? Yes___ No___

Review Date: _____ By (signature): _____
Plan amended as a result? Yes___ No___
If Yes, Amendment Date: _____
Amendment Description: _____
_____
P.E. Recertification Required? Yes___ No___

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1.0 OVERVIEW

1.1 INTRODUCTION

This Storm Water Pollution Prevention Plan (SWPPP) & Spill Prevention, Control, and Countermeasure (SPCC) Plan covers the operations of Tulip City Air Service, Inc., which operates at West Michigan Regional Airport. It has been developed as required under Part I.B of Michigan's National Pollutant Discharge Elimination System (NPDES) general permit for storm water discharges and in accordance with good engineering practices, as well as under 40 CFR Part 112. This SWPPP/SPCC describes this facility and its operations, identifies potential sources of storm water pollution at the facility, recommends appropriate best management practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff, and provides for periodic review of this SWPPP/SPCC.

This SWPPP/SPCC becomes effective as of February 21, 2006.

A copy of the General Permit and this facility's Certificate of Coverage are contained in Appendix A.

1.2 OBJECTIVES

The Storm Water Pollution Prevention Plan (SWPPP) for Tulip City Air Service, Inc. was developed with the following mission in mind:

"To maximize the control of all significant materials and to reduce the level of these materials as to prevent storm water runoff from contacting any contaminants before being discharged into any receiving waters."

The objectives of this SWPPP are:

- To identify potential sources of pollution at West Michigan Regional Airport.
- To describe best management practices (BMPs) which are to be used by Tulip City Air Service, Inc.
- To provide other elements such as, but not limited to, a facility inspection program, site compliance evaluation program, record keeping and reporting program that will help Tulip City Air Service, Inc. comply with the terms and conditions of their storm water discharge permit, and fulfill the mission stated above.

2.0 STORM WATER POLLUTION PREVENTION TEAM

The storm water pollution prevention team is responsible for developing, implementing, maintaining, and revising this SWPPP/SPCC. The members of the team are familiar with the management and operations of West Michigan Regional Airport.

The member(s) of the team and their primary responsibilities are as follows:

Ronald Ludema, President	Corporate approval and implementation of SWPPP
Mick Osborne, Line Operations Manager	Employee Training, Record Keeping, Preparing and Submitting Reports, Conducting Inspections, Maintaining Structural Controls, Emergency Preparedness
Steve Timmer, Shift Supervisor	Conducting Inspections, Maintaining Structural Controls, Emergency Preparedness

Certificates for the Certified Stormwater Operators at this facility are contained in Appendix B.

Operations carried out by other tenants at West Michigan Regional Airport are not covered by this SWPPP/SPCC.

3.0 FACILITY DESCRIPTION

3.1 AIRPORT OVERVIEW

West Michigan Regional Airport is located on 507 acres in Sections 7 & 8, Town 4 North, Range 15 West, in the City of Holland. It is owned by the City, and is a public use airport serving the needs of a wide variety of general aviation aircraft. Tulip City Air Service, Inc. is the fixed base operator at the facility, providing aviation services to the corporate, charter, and pleasure aircraft that utilize the airport. Some of the services offered include fueling, maintenance, charter sales, flight instruction, and storage of aircraft.

There are several corporate aircraft hangars, along with multi-unit T-hangars available for smaller aircraft. The airport also includes a parking lot, small terminal and office building, ramp, fueling terminal, and maintenance building. The single runway is 6262' long and crosses over a tunnel which carries traffic on South Washington Avenue. Taxiways provide access to the runway from the hangars and ramp. The Airport operates 16 hours per day, 7 days a week, and employs a staff of about 35 people.

3.2 DRAINAGE PATTERNS AND INFRASTRUCTURE

West Michigan Regional Airport is drained via a system of storm sewers and drainage ditches which traverse the site. The site lies south of the North Branch of the Macatawa River (also known as Tulip Intercounty Drain), and a single tributary of this channel crosses the site from south to north. This unnamed tributary collects the stormwater runoff from all of the airport's outfalls and carries it to the North Branch of Macatawa River, ultimately to Lake Macatawa.

The site is divided into eight drainage areas, which are shown on Exhibit A. Areas A, F, G, and H are natural or agricultural areas where no airport activities take place. In these areas there is no known presence of significant materials, and therefore no potential for these significant materials to enter the stormwater runoff. Area B includes the west end of the runway and taxiway, as well as the Washington Avenue tunnel which crosses under the runway. Runoff from this area is conveyed to the detention basin on the south side of the runway. Pumps are utilized to drain the tunnel into this detention basin. Area C includes the parking lot, and the ramp, as well as the hangars owned by Hangar 3 Leasing, Inc., Tulip City Air Service, Inc., Gentex, Inc., and Westshore Aviation, Inc. Area D includes the T-hangars owned by Tulip City Air Service, Inc., the ADB Industries Hangar, and the paved areas around those hangars. Area E includes most of the runway and taxiways, as well as the grassy median between the runway and the taxiway.

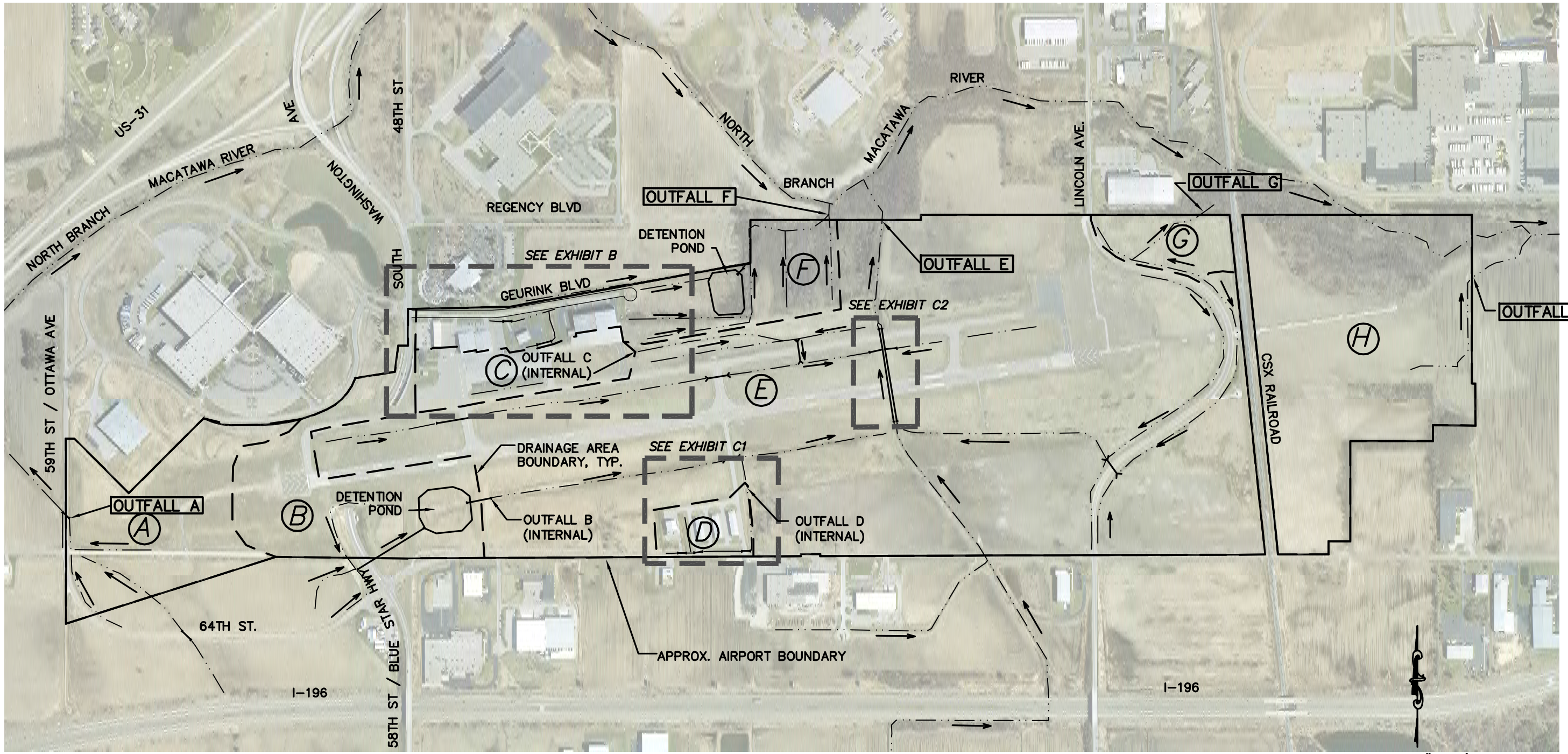
The site has a total area of about 506.7 acres. Buildings occupy approximately 3.2 acres (0.6%). An additional 43.4 acres (8.6%) of the site is paved with parking lots, ramp, taxiways, and runway. Pervious areas such as grass, wooded land, or fields account for the remaining 460.1 acres (90.8%) of the site.

3.3 SITE MAPS

Exhibit A presents a site map of the entire property occupied by West Michigan Regional Airport with locations of buildings, runway, taxiways, and other permanent structures. Exhibits B & C show the facilities in more detail. The following features are noted:

- property boundaries
- buildings and other permanent structures
- storage or disposal areas for significant materials
- storm water discharge outfalls
- location of storm water inlets contributing to each outfall
- outlines of drainage areas contributing to each outfall
- location of NPDES permitted discharges other than storm water
- structural runoff controls and storm water treatment facilities
- areas of vegetation
- areas of exposed and/or erodible soils
- impervious surfaces (roof tops, asphalt, concrete)
- names and locations of receiving waters
- areas of known or suspected impacts on surface waters as designated under Part 201 of the Natural Resources and Environmental Protection Act of 1994, Public Act 451 (formerly Act 307). Locations are noted as *Incident A, B,* etc.
- locations where the following activities are exposed to storm water:
  - fixed fueling operations
  - vehicle and equipment maintenance and/or cleaning areas
  - loading/unloading areas
  - waste storage or disposal areas
  - liquid storage tanks
  - equipment operating areas
  - storage areas
  - deicing operations

EXHIBIT "A"



SCALE: 1"=800'

LEGEND

DRAINAGE AREA — (A)

DIRECTION OF FLOW

STREAM CENTERLINE

DRAINAGE BOUNDARY

EXTERNAL OUTFALL (RUNOFF LEAVES SITE) — OUTFALL E

INTERNAL OUTFALL (RUNOFF STILL ON-SITE) — OUTFALL B (INTERNAL)

APPROXIMATE AREAS

SITE AREA = 506.7 ACRES

BUILDING COVERAGE = 3.2 ACRES (0.6%)

EX. PAVEMENT COVERAGE = 43.4 ACRES (8.6%)
(DOES NOT INCLUDE PUBLIC ROADWAYS)

TOTAL = 9.2%

NOTE: THIS IS FOR ILLUSTRATIVE PURPOSES ONLY AND IS NOT A BOUNDARY SURVEY.

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FOR *TULIP CITY AIR SERVICE*

IN SECTIONS 7, 8 & 9, T4N, R15W

DATE	12-31-2012	DRAWN BY	JMT
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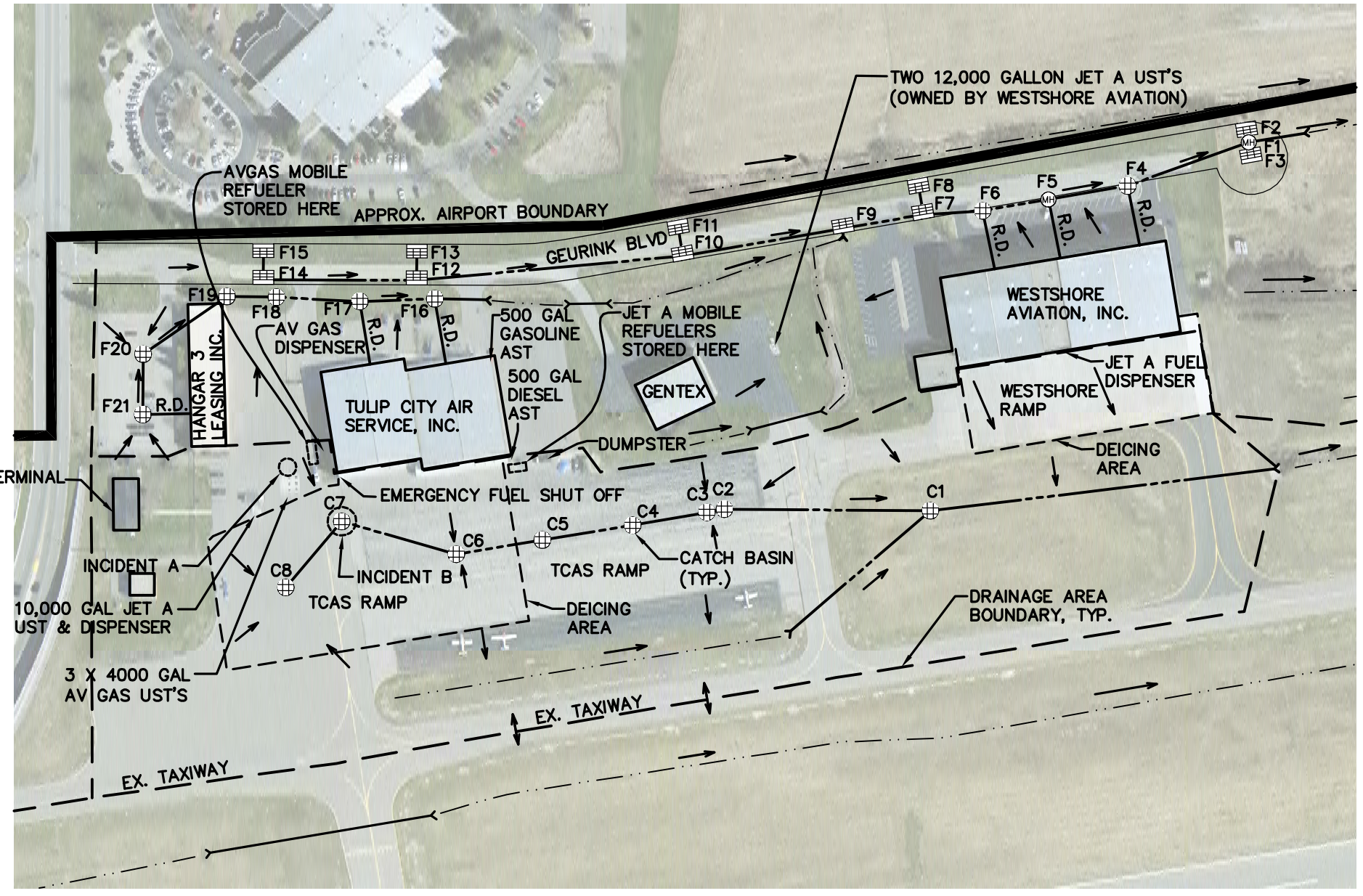
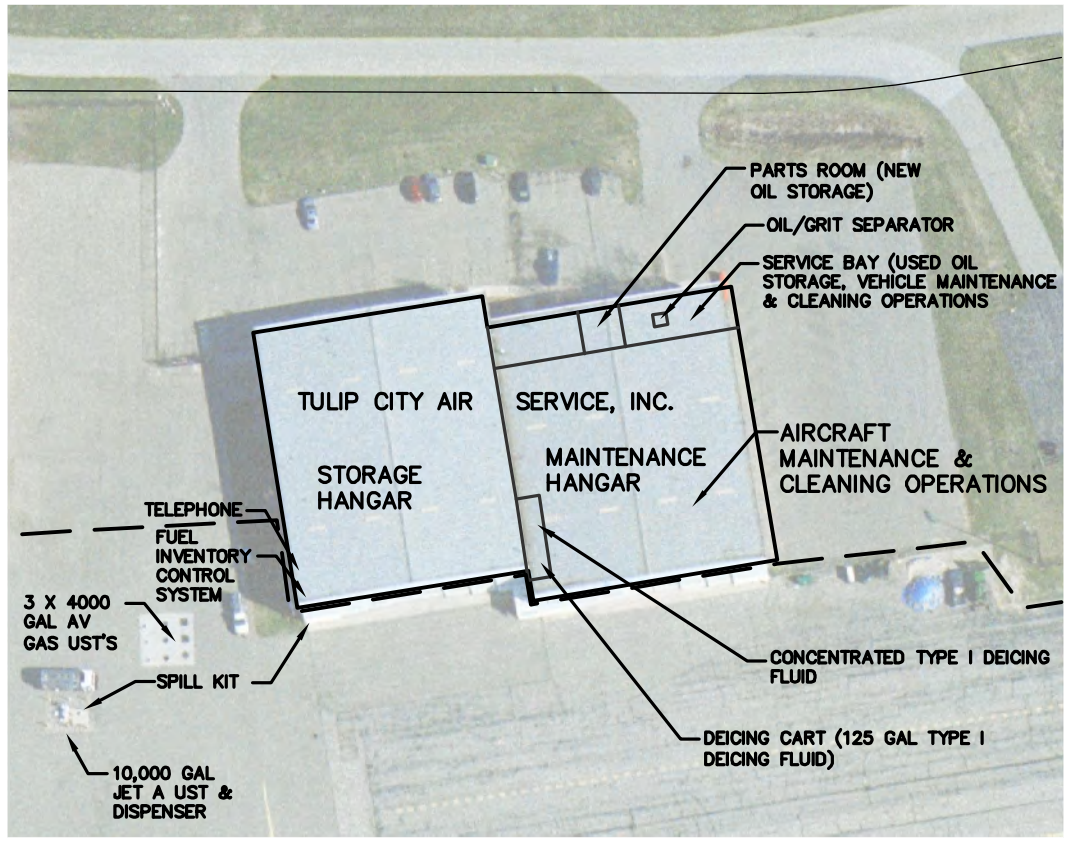
EXHIBIT "B"





TCAS HANGAR INTERIOR DETAIL

DETAIL SCALE: 1"=100'

LEGEND

DIRECTION OF FLOW

STREAM/DITCH

STORM SEWER

DRAINAGE BOUNDARY

ROOF DRAIN PIPE R.D.

SCALE: 1"=200'

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FOR TULIP CITY AIR SERVICE

IN SECTIONS 7, 8 & 9, T4N, R15W

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EXHIBIT "C1"

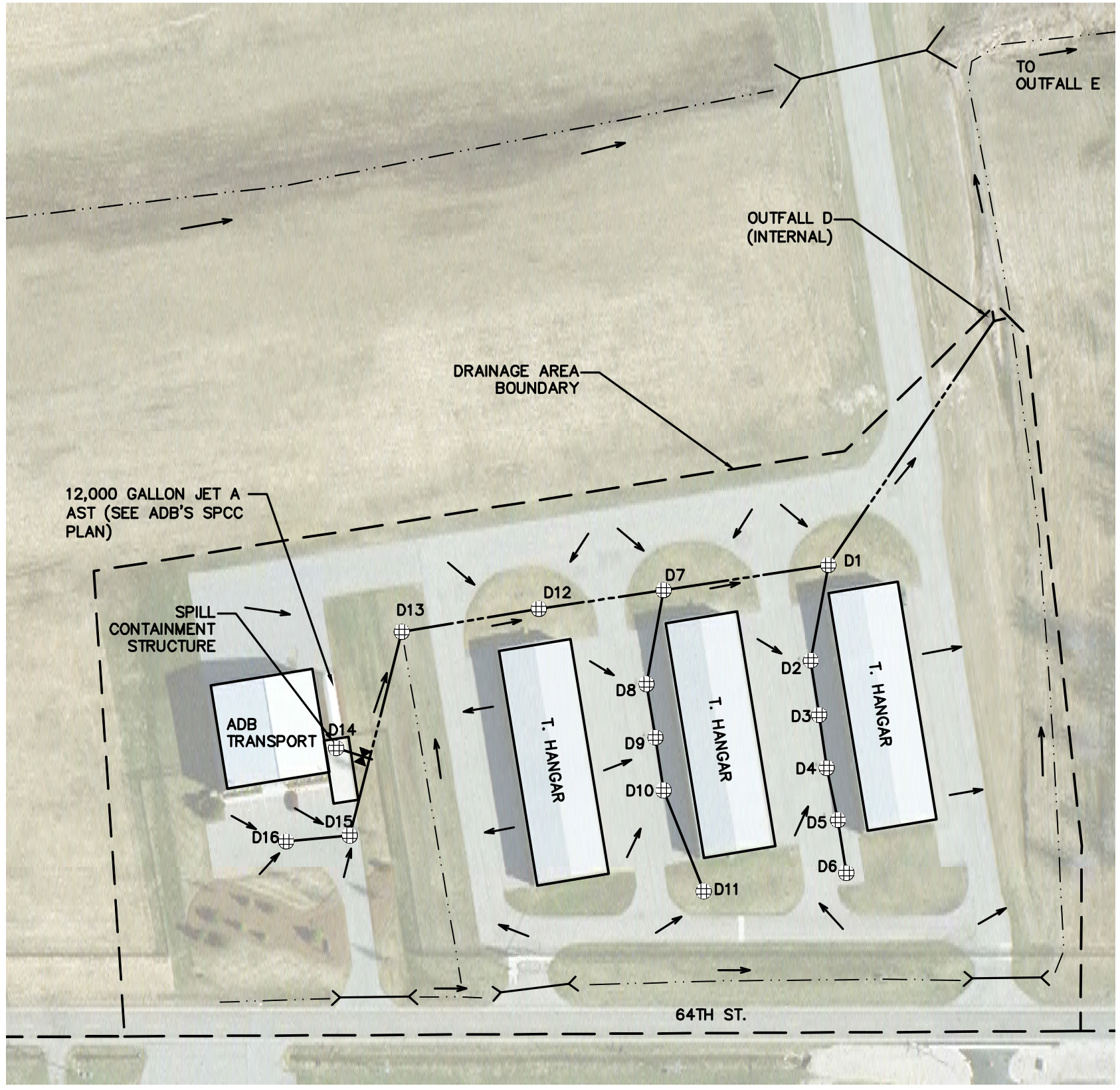
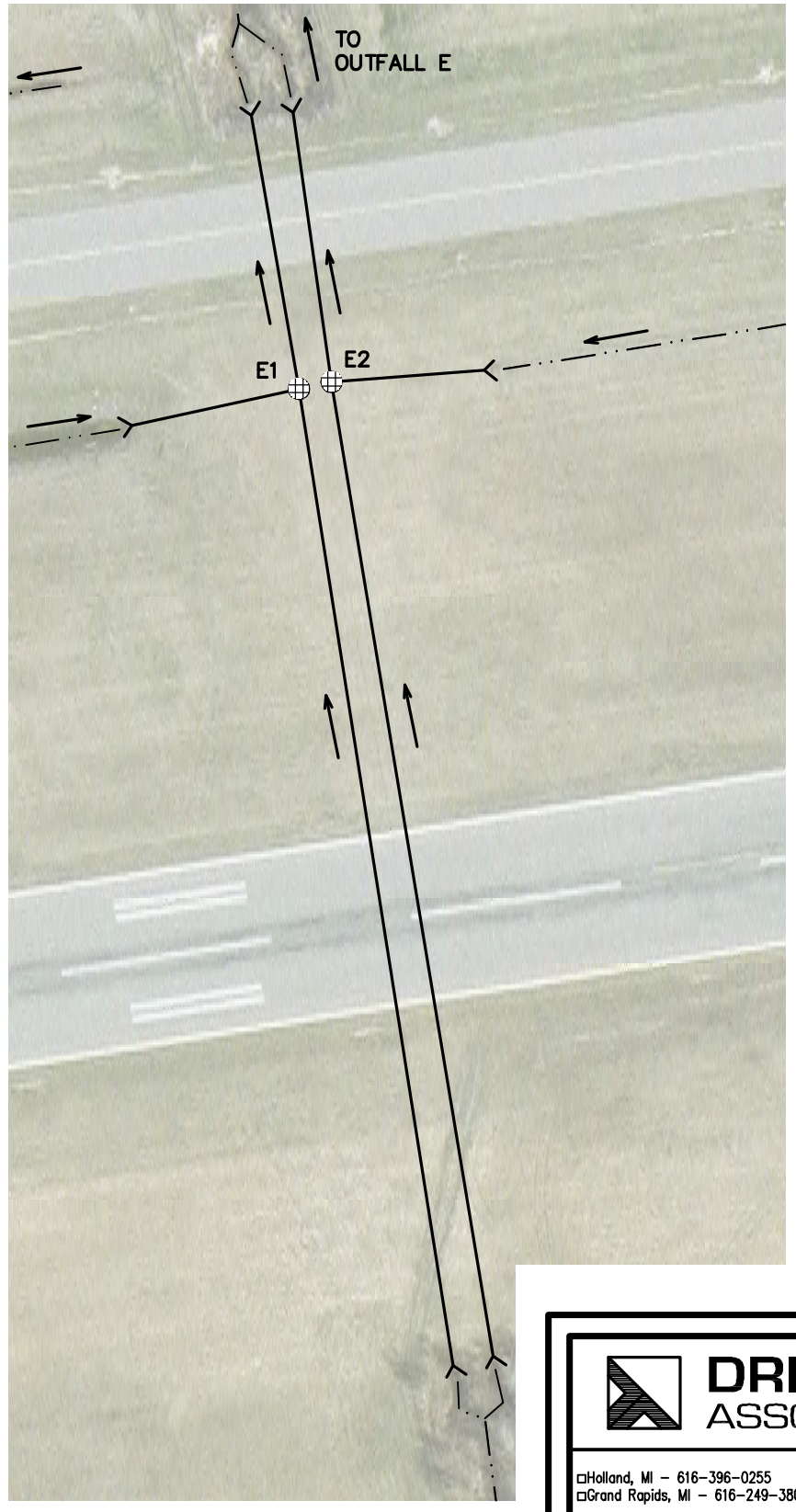


EXHIBIT "C2"



SCALE: 1"=100'

LEGEND

DIRECTION OF FLOW

STREAM/DITCH

STORM SEWER

DRAINAGE BOUNDARY

NOTE: THIS IS FOR ILLUSTRATIVE PURPOSES ONLY AND IS NOT A BOUNDARY SURVEY.

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4.0 POTENTIAL SOURCES OF POLLUTANTS

4.1 INVENTORY OF SIGNIFICANT MATERIALS

Table 1 provides a comprehensive list of significant materials present at West Michigan Regional Airport. Location and container volume for the material, exposure method (ways in which the material has reasonable potential to become exposed to storm water), and inlets and outfalls through which the material may be discharged are identified. Any relevant documentation for these materials is contained in Appendix C.

Table 1. Inventory of Significant Materials

Significant Material	Container & Volume	Location	Exposure Method	Inlet(s)	Outfall(s)
Jet A Fuel	10,000 gal UST	TCAS Ramp	Pipe leak, spill during fuel transfer	C7, C8	C, E
Jet A Fuel	5,000 gal mobile refueler	TCAS Ramp	Tank leak, spill during fuel transfer	C2-C8	C, E
100LL Aviation Gas	4,000 gal UST (three total)	TCAS Ramp	Pipe leak, spill during fuel transfer	C7	C, E
100LL Aviation Gas	750 gal mobile refueler	TCAS Ramp	Tank leak, spill during fuel transfer	C2-C8	C, E
Diesel Fuel	500 gal portable tank	TCAS Ramp	Tank leak, spill during fuel transfer	C5	C, E
Gasoline	500 gal portable tank	TCAS Parking Lot	Tank leak, spill during fuel transfer	F16	F
Gasoline	100 gal truck mounted tank	TCAS Ramp, Parking Lot	Tank leak, spill during fuel transfer	C2-C8, F16-F17	C, E, F
Oils & Lubricants	Various small containers	Maintenance Hangar	Leak from parked aircraft	C2-C8	C, E
Hydraulic Fluid	Various small containers	Maintenance Hangar	Leak from parked aircraft	C2-C8	C, E
Ethylene Glycol Monomethyl Ether	20 gal drum	Maintenance Hangar	Leak from parked aircraft, spill during transfer to aircraft	C2-C8	C, E
Mineral Spirits	Various small containers	Maintenance Hangar	Maintenance activities conducted outdoors	C2-C8	C, E
Propylene Glycol Type I	230 gal bulk storage cont.	Maintenance Hangar	De-icing operations; improper vacuum clean-up	C2-C8	C, E
Propylene Glycol Type IV	230 gal bulk storage cont.	Maintenance Hanger	Anti-icing operations; improper vacuum clean-up	C2-C8	C, E
De-icing pellets	Bulk dry container	Maintenance Hangar	De-icing runway; use very limited	Open Ditch	B, E
Detergents & Cleaning Agents	Various small containers	Maintenance Hangar	Maintenance or cleaning activities conducted outdoors	C2-C8	C, E
Floor Coatings	Various small containers	Maintenance Hangar	None	N/A	N/A
Adhesives & Sealants	Various small containers	Maintenance Hangar	None	N/A	N/A
Aerosol Paints	Various small containers	Maintenance Hangar	None	N/A	N/A
General Refuse	Dumpster	TCAS Ramp	Loading & unloading, poor containment or housekeeping	C5	C, E

4.2 DESCRIPTION OF INDUSTRIAL ACTIVITIES AND STORAGE AREAS

Table 2 provides a description of industrial activities and storage areas that have reasonable potential for contribution of significant materials to storm water runoff. A description of the significant materials associated with those activities and areas, and an evaluation of the reasonable potential for contribution of those materials is also provided.

Table 2. Description of Industrial Activities and Significant Material Storage Areas

Activity/Storage Area	Significant Materials	Exposure Method	Evaluation of Potential	Inlet(s)	Outfall(s)
Loading, unloading, and other material handling operations					
UST Dispensers	Jet A Fuel, Av Gas	Spill during fuel transfer	High	C7-C8	C, E
Ramp Area (Mobile Refuelers)	Jet A Fuel, Av Gas, Diesel Fuel, Gasoline, Ethylene Glycol Monomethyl Ether	Spill during fuel transfer	High	C2-C8	C, E
Diesel AST	Diesel fuel	Spill during fuel transfer	High	C5	C, E
Gasoline AST	Gasoline	Spill during fuel transfer	High	F16	F
Outdoor storage including secondary containment structures					
UST Dispensers	Jet A Fuel, Av Gas	Pipe or valve leak	Med	C7-C8	C, E
Ramp Area (Mobile Refuelers)	Jet A Fuel, Av Gas, Gasoline, Ethylene Glycol Monomethyl Ether	Tank leak	Med	C2-C8	C, E
Diesel AST	Diesel fuel	Tank leak	Med	C5	C, E
Gasoline AST	Gasoline	Tank leak	Med	F16	F
Ramp – Aircraft Storage	Hydraulic Fluid, Oils & Lubricants	Leak from parked aircraft	Low	C2-C8	C, E
Outdoor manufacturing or processing activities					
None					
Significant dust or particulate generating processes					
None					
Discharge from vents, stacks, and air emission controls					
None					
On-site waste disposal practices					
Dumpster Area	General Refuse	Spillage during loading or unloading, poor containment or housekeeping practices	High	C5	C, E
Maintenance and cleaning of vehicles, machines, and equipment					
Aircraft and vehicle maintenance	Mineral spirits, detergents & cleaning agents, coolant	Maintenance activities conducted outdoors	Low	C2-C8	C, E
Aircraft washing	Detergents, wash water	Washing activities conducted outdoors	Low	C2-C8	C, E
Areas of exposed and/or erodible soils					
None					
Sites of Environmental Contamination listed under Part 201					
None					
Areas of significant material residues					
None					
Areas where animals congregate (wild or domestic) and deposit wastes					
None					
Other areas where storm water may contact significant materials					
De-icing Aircraft	Propylene Glycol, Type I and Type IV	De-icing operations; improper vacuum clean-up	High	C2-C8	C, E
De-icing Runway	Urea de-icing pellets	De-icing runway; use is very limited	Low (very limited use)	Open Ditch	B, E

4.3 LIST OF PAST SPILLS AND LEAKS

Material spills are documented below with the date of the incident, volume of materials, the exact location of each release, and the actions taken to clean up the materials and/or prevent exposure of the materials to storm water runoff. Locations are noted on the site map in Section 3.3.

Incident A – August 16, 1990
Description: Contaminated soils were found while removing two underground storage tanks (80 octane aviation fuel), immediately north of and adjacent to the present 100 LL Av Gas tanks which replaced them.
Corrective Action Taken: Contaminated soils were removed for proper disposal. Soil and groundwater samples were taken to ensure mitigation was completed to the extent necessary.
Plan for Preventing Recurrence: Any future underground storage tanks will be designed and installed in accordance with all applicable Federal and State UST regulations, and this SWPPP/SPCC as applicable, to minimize potential for leakage and corrosion which could lead to soil contamination. Fuel Inventories will be checked daily to ensure underground storage tanks are not leaking.

Incident B – June 14, 1995
Description: A spill of 100LL Av Gas occurred due to overfilling. An estimated 75 gallons of fuel was spilled and entered the ramp's storm sewer system at Catchbasin 6.
Corrective Action Taken: Absorbent material was placed on the pavement, a temporary plug was placed in the storm sewer near the outfall, and approximately 1400 gallons of contaminated stormwater was pumped from the storm sewer and removed for proper disposal. A floating boom was placed to absorb any remaining contaminants.
Plan for Preventing Recurrence: Emergency shut-offs were installed on pumps, and training procedures & policies were implemented to ensure fuel transfer is performed only by properly trained personnel.

4.4 TMDL REQUIREMENTS

The Total Maximum Daily Load (TMDL) is the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

This facility discharges storm water to the North Branch of the Macatawa River, which is a tributary of Lake Macatawa. There is an established TMDL on Lake Macatawa for total phosphorus, requiring that this facility assess controls for discharge of phosphorus.

The only significant material used at this facility which has the reasonable potential to cause discharge of phosphorus in storm water is urea-based de-icing pellets. To minimize this discharge, the following controls have been implemented in this SWPPP:

- The use of urea de-icing pellets for runway deicing operations will be very limited, and only when safety considerations require it.
- Runway drainage is via fully vegetated grassy swales and ditches, which provide the ability to filter and remove nutrients from runoff prior to discharge, thereby minimizing to the greatest extent practicable the discharge of phosphorus from the facility.
- The use of urea de-icing pellets is gradually being phased out at this facility and once existing supplies have been exhausted, the use of urea de-icing pellets is proposed to be eliminated in favor of alternative methods.

These controls are effective and adequate for meeting the requirements of the TMDL. No additional controls are necessary.

4.5 SUMMARY OF SAMPLING DATA

No sampling data is available for this facility.

5.0 BEST MANAGEMENT PRACTICES

Storm water management controls, or best management practices (BMPs), will be implemented to reduce the amount of pollutants in storm water discharged from West Michigan Regional Airport.

5.1 NON-STRUCTURAL CONTROLS

Non-structural controls are practices that are specifically intended to reduce the amount of pollution getting into surface waters. These are generally implemented to address the problem at the source. They do not require any structural changes to the facility. The following Non-Structural Controls have been selected for implementation:

5.1.1 Good Housekeeping Practices

Good housekeeping practices are designed to maintain a clean and orderly work environment. This will reduce the potential for significant materials to come contact with storm water.

The follow practices are included in our good housekeeping routine.

Housekeeping Task	Frequency
• Hangar floors will be cleaned. Floor scrubbers will be drained into the oil/debris separator.	Daily
• Sump pails and drip pans will be checked and emptied into the appropriate waste storage containers for proper disposal.	Daily
• Storage areas and containers will be kept in a clean and orderly manner at all times.	Continuously
• Significant materials shall not be stored outside.	Continuously
• Dumpster area will be kept in a clean and orderly manner at all times.	Continuously
• Maintenance vehicles and fueling trucks will be cleaned once per month. This will be done in the maintenance hangar only. If outdoor washing is absolutely necessary, a phosphate-free detergent must be used.	Monthly
• Pumps, valves, hoses and other equipment will be cleaned once per month. This will ensure proper operation and make it easier to detect leaks.	Monthly
• Aircraft will be washed in the maintenance hangar only. If outdoor washing is absolutely necessary, a phosphate-free detergent must be used.	As Needed

5.1.2 Preventive Maintenance

Preventive Maintenance involves the inspection, testing, and cleaning of facility equipment and operational systems. This practice will help to uncover conditions which might lead to a release of materials.

The following tasks will be included in the preventive maintenance program.

Preventive Maintenance Task	Frequency
• Truck mounted storage tanks will be visually inspected for signs of leaks or excessive wear.	Daily
• Overfill shut-off valves will be tested to ensure proper operation.	Daily
• Quality samples of fuel will be taken.	Daily
• Fuel inventory will be checked to verify that a leak has not occurred in an underground storage tank.	Daily
• Above ground storage tanks, pumps, and hoses will be visually inspected for signs of leaks or excessive wear.	Daily
• Stored aircraft will be visually inspected for signs of leaks.	Weekly
• Storage containers will be visually inspected for signs of leaks or deterioration.	Weekly
• Deadman switches and emergency shut-off controls will be tested to ensure proper operation in an emergency.	Monthly
• Catchbasin sumps will be cleaned of oil, sediment, and debris.	6 Months
• Oil/Debris Separators will be cleaned of oil, sediment, and debris.	6 Months
• Pumps will be lubricated to maintain proper operation and avoid excessive wear which may lead to leaks.	6 Months

5.1.3 Spill Prevention and Response Procedures

This SWPPP specifies material handling procedures and storage requirements for significant materials. Equipment and procedures necessary for cleaning up spills and preventing the spilled materials from being discharged have also been identified.

The following procedures have been developed for spill prevention and response for our facility.

Spill Prevention

- Off-loading of fuel delivered to West Michigan Regional Airport must be supervised by a trained representative of the fuel purchaser (e.g., Tulip City Air Service, Inc.). See Appendix N for Bulk Delivery Procedures.
- Fuel transfer to refueling trucks must be performed by personnel properly trained in this SWPPP, spill prevention, and spill containment.
- Outside handling or transfer of significant materials will be minimized to the extent practical during rain events.

Spill Response

- Copies of the Emergency Spill Response Plan contained in Appendix D of this SWPPP shall be posted at all locations where significant materials are stored, and in all refueling trucks.
- All refueling trucks must carry a supply of dry absorbent material and pads in case of a spill during fuel transfer to the truck or to aircraft.
- Spill kits will be kept readily available outside at the Jet A dispenser as well as in the aircraft storage hangar near the fuel control system for use in case of a spill.

5.1.4 Other Non-Structural Controls

The following non-structural controls which can not be classified in the previous categories, are used at the facility.

- Aircraft de-icing operations will be completed in a heated hangar when at all possible, to prevent the discharge of deicing fluid into storm sewers. If outdoor de-icing is necessary, it will be done while utilizing the structural controls detailed in Section 5.2.
- Runway de-icing operations using urea de-icing pellets will be minimized, and only as required for safety. Ultimately, the use of urea de-icing pellets will be phased out in favor of alternative non-urea based methods.
- Maintenance, painting, oil changing, and washing of aircraft will not be done outside. These activities will only occur inside hangars which have floor drains connected to the sanitary sewer system.
- Fuel sump samples will be returned to the tank if not contaminated. Contaminated samples must be placed in approved containers for proper disposal.
- Third-party contractors or vendors will be required to demonstrate that any materials brought on-site do not contain chemicals on Michigan's Register of Critical Materials. They will also be notified of the Spill Prevention and Response Procedures contained in this SWPPP.

5.2 STRUCTURAL CONTROLS

Structural control measures will be necessary to control any pollutants that have the potential to be present in the storm water after the non-structural controls have been implemented.

5.2.1 Significant Materials with Potential Presence in Stormwater Runoff

Of those materials listed in Section 4.1, the following materials require the implementation of structural controls since the potential for these materials to contaminate stormwater runoff exists, even after full implementation of non-structural controls.

- Jet A Fuel
- 100LL Avgas
- Diesel Fuel
- 87 Octane Unleaded Gasoline
- Oils/Lubricants: Aeroshell 15w50 & w80, Phillips XC & XCII, Phillips Type M, Power Lube, Rust Preventative MIL-C-16173D, Turbo Oil 2380
- Hydraulic Fluid
- Ethylene Glycol Monomethyl Ether (ice inhibiting fuel additive)
- Propylene Glycol Type I and Type IV (aircraft de-icing fluids)
- Urea de-icing pellets (runway de-icing)
- General Refuse

5.2.2 Preventive Structures

The following preventive measures have been selected for use at West Michigan Regional Airport.

- Refueler trucks will have safety locks in place on their sumps.
- Fuel transfer pumps shall have deadman switches which will prevent the unsupervised transfer of fuel.
- An emergency shut off switch shall be available near the fuel storage and pumping facilities to shut down fuel transfer pumps if a spill occurs.
- Sump pails and drip pans will be kept clean and readily available in the hangars and near the ramp.
- A sign shall be in place on the ramp notifying pilots of proper procedures for fuel sump disposal.
- Signs or labels must be in place on all storage containers for significant/hazardous materials. These materials must be stored in approved containers only.
- Overfill protection valves will be used on all underground storage tanks and on fueling trucks.
- Cathodic protection and/or coatings suitable for local soil conditions will be provided for buried metallic tanks and piping.
- A self-contained parts washer will be maintained in the maintenance hangar for solvent cleaning. Used solvent and sludge will be removed for proper disposal off-site on a monthly basis.

- A telephone will be available near the spill kits and fuel control system for use in case of a spill.

5.2.3 Diversion Structures

The following areas are to be protected through the use of diversion structures.

- All pumps and fuel transfer equipment shall be covered to prevent contact with stormwater.
- Dumpster shall have a lid, which is kept closed except when loading or unloading refuse.

5.2.4 Containment Structures

Containment structures are utilized in the following areas.

- All hangar floor drain systems shall have an oil/debris separator in place.
- Sump pails and drip pans shall be readily available for maintenance or if a leak occurs. Maintenance to repair a leak shall be performed as soon as possible.
- Hoods shall be installed in all catchbasins to trap oils and other floatables which may enter storm sewers.
- Impermeable catchbasin covers shall be put in place at Catchbasins 6 & 7 during the transfer of fuel from the bulk delivery truck to the on-site storage tanks. See Appendix N for Bulk Delivery Procedures. Resulting containment volume is 12,467 gallons, sufficient for volume of largest compartment on bulk delivery vehicle of 8000 gallons:

Containment area	= 10,000 SFT
Containment depth	= 6 in = 0.50 ft
Containment volume	= 1/3 x b x h
	= 1/3 x 10,000 sft x 0.50 ft = 1667 cft = 12,467 gal

- Sorbent materials shall be readily available for use in the event of a spill to contain and remove spilled fuel from the pavement.
- During deicing operations outside of hangars, impermeable covers will be placed over catchbasins which are downgradient from the operation. A hand-operated mobile vacuum system will then be used to remove deicing waste from the pavement, for proper disposal and treatment.

5.2.5 Sedimentation Control Structures

There are certain areas at the facility that are prone to soil erosion. These areas need to be protected, and the soil kept out of the storm water discharge.

- Riprap shall be placed on the banks and bottom of the ditch at all storm sewer outlets.

- Ditch banks shall be adequately vegetated. Bare spots shall be restored with erosion control blanket and an appropriate grass seed mixture.
- Ditches shall be kept reasonably free of debris or blockages which could force water to cut a new path.

5.2.6 Security Related Structures

Proper security of the facility is critical to minimizing the threat of a discharge. Therefore, the following measures will be implemented.

- The fuel dispensers will be fully fenced to prevent unauthorized access or vandalism.
- All valves and piping which permit outward flow of stored oil products will have locks or other adequate security measures to ensure they remain in a closed position when in non-operating or non-standby status.
- The starter control on each oil pump will have a lock to keep it in the “off” position and will be placed at a location accessible only to authorized personnel when the pump is in a non-operating or non-standby status.
- All fuel transfer connections will be capped or blank-flanged when not in service.
- Sufficient lighting will be provided in all fuel transfer and storage areas to allow proper operation during hours of darkness, to assist in the discovery of discharges during hours of darkness, and to minimize the threat of discharges through acts of vandalism.

5.3 EQUIVALENT ENVIRONMENTAL PROTECTION

In lieu of strict compliance with SPCC requirements under 40 CFR 112, the following uses of "equivalent environmental protection" are utilized at this facility:

- 112.8 (c)(6) Integrity Testing of Bulk Storage Containers. Visual inspection plus a non-destructive integrity test is required for above ground bulk storage tanks. However, for well designed, smaller (less than 30,000 gallons) shop-built containers, such as those utilized at this facility for gasoline and diesel fuel storage, equivalent environmental protection is provided by the visual inspection plus elevation of the tank in a manner that allows (1) all sides of the tank including the bottom to be visually inspected and (2) isolates the tank from contact with the ground, thereby minimizing the corrosion potential. Non-destructive integrity testing of these tanks is deemed impractical in this case, and is therefore not utilized in this SPCC plan.

6.0 NON-STORM WATER DISCHARGES

The permit requires that all discharge locations be evaluated for the presence of non-storm water discharges. Any unauthorized storm water discharges must be eliminated, or covered under another National Pollutant Discharge Elimination System (NPDES) permit. Certification that there are no unauthorized discharges must be submitted to the appropriate district supervisor. The following is a list of non-storm water discharges authorized under the general permit.

> Fire fighting activities, fire hydrant flushing, potable water sources including waterline flushing, irrigation drainage, lawn watering, uncontaminated ground water, foundation or footing drains, building washdown where no detergents were used, air conditioning condensate, dust control spraying.

The following table summarizes the evaluation results.

Date	Outfall	Method	Evaluator	Observations	Date Corrected

CERTIFICATION OF EVALUATION OF NON-STORM WATER DISCHARGES

I certify under penalty of law that the storm water drainage system in this SWPPP has been tested or evaluated for the presence of non-storm water discharges either by me, or under my direction and supervision. To the best of my knowledge and belief, the information submitted is true, accurate, and complete. And at the time this plan was completed no unauthorized discharges were present. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

_____ _____
(Signature) (Date)

_____ _____
(Printed Name) (Title)

7.0 COMPLIANCE AND DOCUMENTATION REQUIREMENTS

The permit requires that records of all preventive maintenance inspections, the quarterly comprehensive site inspections, records of employee training sessions, and the annual report be retained at West Michigan Regional Airport for at least three years.

These records must be made available, upon request, to a representative of the Michigan Department of Environmental Quality (MDEQ). In the case of facilities which discharge storm water to a municipal separate storm sewer system, the records must also be made available to the operator of the municipal system.

7.1 EMPLOYEE TRAINING

All employees of Tulip City Air Service, Inc. who may come in contact with any significant materials, or whose responsibilities involve use, moving, or storing of any significant materials at the facility will be trained by a Certified Industrial Stormwater Operator at least once per year. A record of those training sessions and attendees is located in Appendix E. Training sessions will cover the following information, at a minimum:

- Proper operation and maintenance of equipment.
- Discharge procedure protocols.
- Applicable pollution control laws, rules, and regulations.
- General facility operations.
- The contents of this SWPPP/SPCC Plan.
- Descriptions of past discharges, failures, and malfunctions.
- Any recently developed measures.

In addition to the annual training sessions, training will be provided to all employees in the future if any of these conditions arise:

- New materials, equipment, or controls (structural or non-structural) are implemented at West Michigan Regional Airport in the future.
- New policies or requirements are put in place for any significant materials on site.
- The Certified Operator or responsible Corporate Officer believes it is beneficial to conduct a refresher course on the SWPPP.

Records of these sessions are also filed in Appendix E.

7.2 COMPLIANCE BY AIRPORT TENANTS

All commercial tenants of West Michigan Regional Airport who may come in contact with any significant materials, or who use, move or store any significant materials at their own facilities will be required to develop their own SWPPP if coverage is required, or they may enter into a written agreement with Tulip City Air Service, Inc., to be participants in this

SWPPP. In the latter case, they will be provided a copy of this SWPPP and must employ their own Certified Industrial Stormwater Operator to ensure compliance at their facilities.

Currently, the commercial tenants at West Michigan Regional Airport are as follows:

- Tiara Yachts, Inc.
- Westshore Aviation, Inc.
- Hangar 3 Leasing, Inc.
- Brown Transport, Inc. A separate Spill Prevention Control and Countermeasure (SPCC) Plan was prepared for the Brown Transport Facility by Holland Engineering, Inc., dated February 2003. This SPCC is contained in Appendix F.

7.3 COMPLIANCE BY BASED AIRCRAFT OWNERS

Tulip City Air Service, Inc. will notify all based aircraft owners of their obligations under this SWPPP on an annual basis. This notice will include the following statements:

- Maintenance, painting, oil changing, and washing of aircraft shall not be done outside. These activities shall only occur inside hangars which have floor drains connected to the sanitary sewer system.
- Pails or drip pans shall be used to collect oil or any other fluid for proper disposal. Under no circumstances shall oil, mineral spirits, fuel, or other chemicals be put into a floor drain, catchbasin, or ditch.
- Fuel sump samples must be returned to the tank if not contaminated, with care taken to avoid spillage. Contaminated samples must be placed in approved containers for proper disposal.
- Stored aircraft shall be checked periodically for signs of leaks.
- If a spill occurs Tulip City Air Service, Inc. shall be notified immediately so that appropriate spill response procedures can be implemented.

7.4 INSPECTION REPORTS

Inspection reports are contained in the appendices, as indicated in the table below. West Michigan Regional Airport will implement an inspection and record keeping schedule as follows:

Inspection	Frequency	Appendix
Good Housekeeping Inspection	Weekly	G
Preventive Maintenance Inspection	Monthly	H
Non-Storm Water Discharge Inspection	Quarterly	I
Comprehensive Facility Inspection	Quarterly	J

7.5 SIGNIFICANT SPILL REPORTS

Any spills of significant materials which occur at West Michigan Regional Airport must be documented on a Significant Spill Report form. These reports are filed in Appendix K.

If a single discharge of more than 1,000 gallons of oil occurs, or if a discharge of more than 42 gallons of oil occurs twice in any 12 month period, the following information must be submitted to the Regional Administrator within 60 days:

- Name of the facility;
- Your name;
- Location of the facility;
- Maximum storage or handling capacity of the facility and normal daily throughput;
- Corrective action and countermeasures you have taken, including a description of equipment repairs and replacements;
- An adequate description of the facility, including maps, flow diagrams, and topographical maps, as necessary;
- The cause of such discharge, including a failure analysis of the system or subsystem in which the failure occurred;
- Additional preventive measures you have taken or contemplated to minimize the possibility of recurrence;
- Such other information as the Regional Adminstrator may reasonably require pertinent to the Plan or discharge.

7.6 ANNUAL REPORT

The permit requires that Tulip City Air Service, Inc. prepare an annual report. This report should include summaries of spill incidents and resulting actions taken, employee training which took place, and inspections completed. The report should also detail changes to the facility or its use of significant materials, changes or improvements to control measures, and a review of the SWPPP's effectiveness. The annual report is to be retained on site, and a copy is to be submitted to MDEQ on or before January 10 of each year. Copies of these reports are filed in Appendix L.

7.7 AMENDMENT OF THIS SWPPP

If West Michigan Regional Airport expands, experiences significant increases in services or traffic, or if any changes occur in the use, handling, or storage practices for any significant materials resulting in the potential for increased impact on storm water discharges from the facility, the SWPPP will be amended appropriately.

The SWPPP will also be amended if it is determined by MDEQ to be ineffective in controlling exposure of storm water runoff to contaminants at the facility.

The amendment will describe the circumstances which make the amendment necessary (i.e. a significant increase in deicing activities or construction of a new hangar), the additional controls being implemented at the facility to handle this change, and the resulting revisions to the SWPPP.

8.0 CERTIFICATION OF THE SWPPP/SPCC

8.1 OPERATOR'S CERTIFICATION

I certify under penalty of law that this SWPPP/SPCC has been developed in accordance with good engineering practices. To the best of my knowledge and belief, the information submitted is true, accurate, and complete. In addition, at the time this plan was completed no unauthorized discharges were present. I also pledge that Tulip City Air Service, Inc. will commit the necessary resources to implement this plan. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment for knowing violations.

_____	_____
(Signature of Certified Operator)	(Certification Number)
_____	_____
(Printed Name)	(Date)
_____	_____
(Signature of Corporate Officer)	(Title)
_____	_____
(Printed Name)	(Date)

Retain a copy of this certification with the SWPPP and submit a copy with the original signatures to the MDEQ office in your area.

8.2 ENGINEER'S CERTIFICATION

I hereby certify that I am familiar with the requirements of Title 40 Part 112 of the Code of Federal Regulations (40 CFR Part 112); that I have visited and examined the facility; that this plan has been prepared in accordance with good engineering practices, including consideration of applicable industry standards, and with the requirements of 40 CFR Part 112; that procedures for required inspections and testing have been established; and that the plan is adequate for the facility.

Engineer: John M. Tenpas, P.E.

Signature: _____

Date: _____

State of Licensure: Michigan

License #: 48168

Seal:

8.3 SUBSTANTIAL HARM CERTIFICATION

40 CFR 112 Appendix C, Attachment C-II
Certification of the Applicability of the Substantial Harm Criteria

Facility Name: Tulip City Air Service, Inc.
Facility Address: 1581 S. Washington Avenue, Holland, MI 49423

1. Does the facility transfer oil over water to or from vessels and does the facility have a total oil storage capacity greater than or equal to 42,000 gallons? Yes____ No__X__

2. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and does the facility lack secondary containment that is sufficiently large to contain the capacity of the largest aboveground oil storage tank plus sufficient freeboard to allow for precipitation within any aboveground oil storage tank area? Yes____ No__X__

3. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility could cause injury to fish and wildlife and sensitive environments? For further description of fish and wildlife and sensitive environments, see Appendices I, II, and III to DOC/NOAA's "Guidance for Facility and Vessel Response Plans: Fish and Wildlife and Sensitive Environments" (see Appendix E to this part, section 10, for availability) and the applicable Area Contingency Plan. Yes____ No__X__

4. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and is the facility located at a distance (as calculated using the appropriate formula in Attachment C-III to this appendix or a comparable formula[1]) such that a discharge from the facility would shut down a public drinking water intake[2]? Yes____ No__X__

5. Does the facility have a total oil storage capacity greater than or equal to 1 million gallons and has the facility experienced a reportable oil spill in an amount greater than or equal to 10,000 gallons within the last 5 years? Yes____ No__X__

Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document, and that based on my inquiry of those individuals responsible for obtaining this information, I believe that the submitted information is true, accurate, and complete.

_____
Signature

_____
Name (please type or print)

_____
Title

_____
Date

1. If a comparable formula is used documentation of the reliability and analytical soundness of the comparable formula must be attached to this form.
2. For the purposes of 40 CFR part 112, public drinking water intakes are analogous to public water systems as described at 40 CFR 143.2(c).

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IN CASE OF FUEL SPILL

1. SHUT DOWN any power sources (fuel trucks, tugs, etc).
2. LOCATE and CORRECT source of leak.
3. CONTAIN spill using spill kits located near Jet A dispenser, or in south-west corner of TCAS hangar, or on fuel truck.
4. CONTACT Tulip City Air Service Personnel:

Mick Osborne	616-399-2094 (home) 616-218-4281 (cell)
Ron Ludema	616-335-9487 (home) 616-218-7394 (cell)

5. CONTACT emergency response personnel, if necessary.
6. CONTACT an environmental cleanup contractor, if necessary:

Egeler Industrial Service, Inc.	1-800-722-6745
K&D Grand Rapids, Inc.	1-616-784-8900
Liquid Industrial Waste Service, Inc.	1-616-396-5994
Valley City Environmental Services	1-616-235-1500

EMERGENCY CONTACT NUMBERS

Local Emergency Response: **911**

MDEQ Pollution Emergency Alerting System (PEAS): **800-292-4706**
National Response Center (US Coast Guard, NRC): **800-424-8802**

Airport Address:	1581 South Washington Ave Holland, MI 49423
Airport Phone #:	616-392-7831

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EMPLOYEE TRAINING SESSION

Topic:_____

Date of Session: _____ Time: _____

Trainer : _____ _____
(printed) (Signature)

Attendees (print name):	Signature:
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Discussion / Material Covered: _____

_____

_____

_____

_____

_____

_____

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GOOD HOUSEKEEPING INSPECTION (WEEKLY)

Date: _____ Time: _____

Inspected by (print name): _____

Signature: _____

Areas Inspected	Observations	Actions Taken
Parking areas		
Ramp		
Fuel Pumps		
Dumpsters		
Hangars		
Storm water outfall		

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PREVENTIVE MAINTENANCE INSPECTION (MONTHLY)

Date: _____ Time: _____

Inspected by (print name): _____

Signature: _____

Areas Inspected	Observations	Actions Taken

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NON-STORM WATER DISCHARGE INSPECTION (QUARTERLY)

Date of Inspection: _____ Time: _____

Inspected by (print name): _____

Signature: _____

Description of type of inspection (check those that apply):
visual observation dye tests smoke tests TV line survey
analysis of accurate schematics sampling/monitoring

Location: _____

Observations/Results: _____

_____

_____

_____

_____

_____

Are there any apparent non-storm water discharges? yes no

If yes, answer the following questions:

Is the discharge authorized under this Facility's permit? yes no

Is the discharge authorized under another National Pollutant Discharge Elimination System (NPDES) permit? yes no

Are any structural changes necessary to eliminate the discharge? yes no

Describe necessary changes:_____

_____

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COMPREHENSIVE FACILITY INSPECTION (QUARTERLY)

Date: _____ Time: _____

Inspected by (print name): _____

Signature: _____

Areas Inspected	Observations	Actions Taken
storm water outfalls		
property boundaries		
storage areas		
dumpsters		
waste storage areas		
equipment		
valves		

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SIGNIFICANT SPILL REPORT

Name of Facility: _____

Date of Spill: _____

Discovered by Whom: _____

Location of Spill: _____

Material Type & Volume: _____

_____

Cause of Spill: _____

_____

_____

_____

Corrective Action Taken: _____

_____

_____

_____

_____

_____

Agencies/Persons Contacted: _____

_____

_____

_____

_____
Signature

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BULK DELIVERY PROCEDURES

The following procedures have been established for delivery of bulk fuel to West Michigan Regional Airport:

1. Delivery driver shall not proceed with delivery without supervision from a representative of Tulip City Air Service (the "operator").

2. No smoking is allowed in the vicinity!

3. The operator shall verify that the fuel storage tank has sufficient capacity for the intended delivery.

4. Wheel chocks shall be placed, or a vehicle brake interlock system shall be engaged, to ensure vehicle does not move or depart until after complete disconnection of transfer hoses and/or piping.

5. The hose, gaskets, seals, and other unloading equipment on the delivery truck shall be inspected to verify all are in good condition.

6. Impervious catchbasin mats shall be placed over the two catchbasins immediately to the south and east of the storage tanks.

7. Drip pans shall be placed under the hose connections.

8. Off-loading of fuel may commence only under complete supervision of both driver and operator.

9. If a spill occurs, immediately cease off-loading of fuel and follow the EMERGENCY SPILL RESPONSE PLAN.

10. After completion of off-loading, driver shall completely disconnect the hoses and inspect the delivery vehicle's drains, outlets, and hoses for signs of leaks.

11. The operator shall inspect the off-loading area for spills, and provided none are found, shall remove the catchbasin mats.

12. Wheel chocks shall be removed, or brake interlock shall be disengaged for departure.

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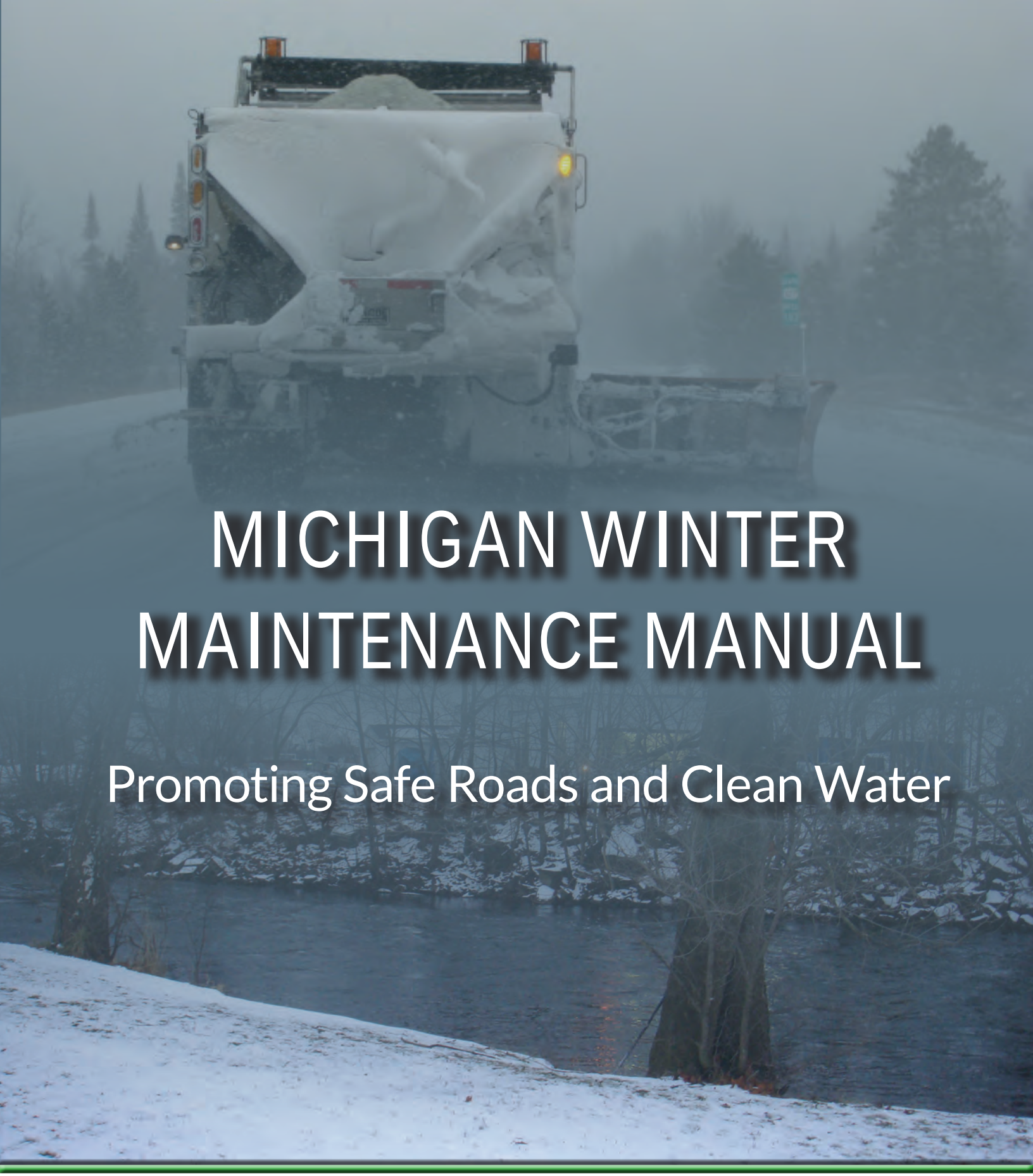
APPENDIX C

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.

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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.

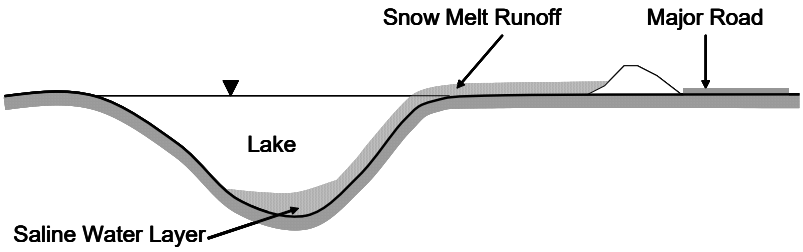

Figure 3: Lake Stratification Due to Saltwater Runoff

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.

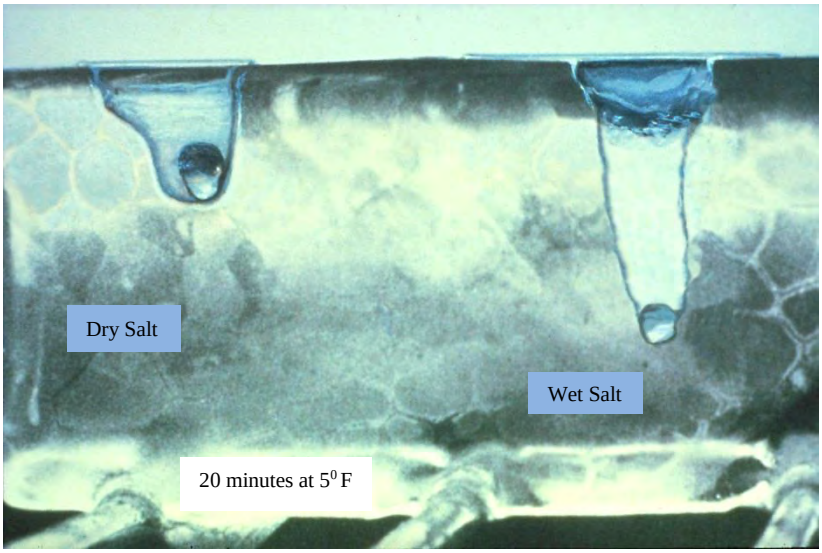
Removing ice that has already bonded to the pavement can be difficult, and removing it mechanically causes wear on equipment and roads. Enough ice must be melted to weaken the bond between the ice and pavement in order to make physical removal

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.

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.

Salt that is bounced off the roadway or is spread outside the travel lanes is money down the drain.

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.

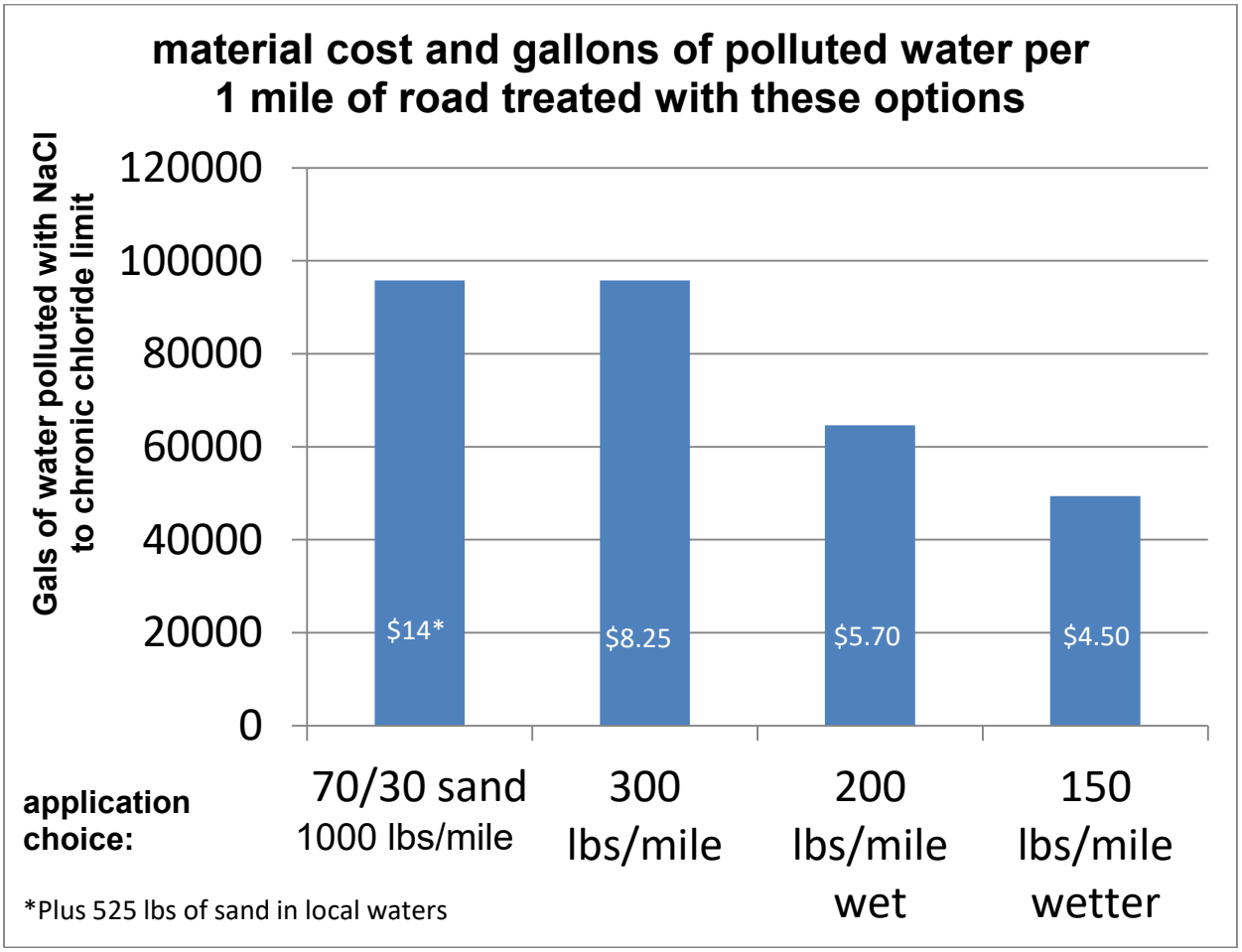


Figure 7: Material Cost and Gallons of Water Polluted

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.

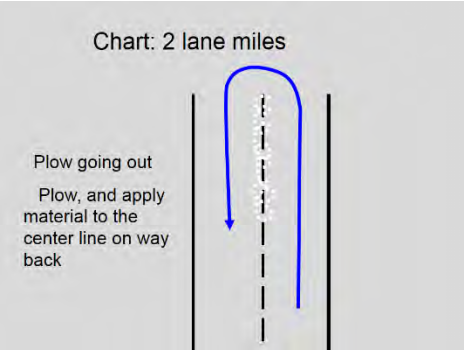


Figure 9: Suggested Plow and Apply Pattern for Deicing

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 <u>below</u> 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.

<u>After the Event</u>

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.

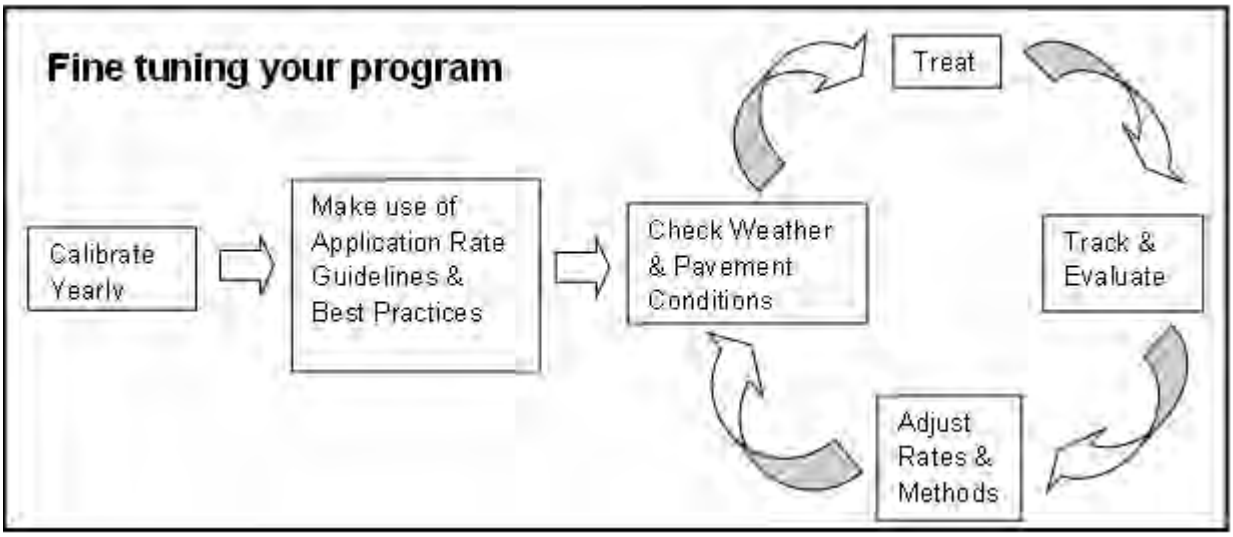


Figure 11: Maintaining a Progressive Winter Maintenance Operation

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.

Bibliography

Dean, W., Anderson, R., Bradbury, J.P., and Anderson, D. "A 1500-year record of climatic and environmental change in Elk Lake, Minnesota." Journal of Paleolimnology 2002 (27), pp. 287-299.

Dindorf, Carolyn and Fortin, Connie. "The Real Cost of Road Salt Use for Winter Maintenance in the Twin Cities Metropolitan Area of Minnesota." Draft report created for the Minnesota Pollution Control Agency. January 21, 2013.

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. March 2011 (Vol. 1223), pp. 58-68.

Gallivan, Frank et al. "Greenhouse Gas Mitigation Measures for Transportation, Construction, Maintenance, and Operations Activities." ICF International. August 2010.

"Global positioning system (GPS) technology can assist in tracking and reducing costs." Inside, (online) p 10. http://www.iowadot.gov/inside/inside_december_2011.pdf.

MDOT Operations Field Services Division. "Salt Bounce and Scatter Study." Final Report, November 2012.

Minnesota Department of Transportation (Mn/DOT), undated. MnDOT 2010-2011 Annual Winter Maintenance Report- At a Glance. http://www.dot.state.mn.us/maintenance/docs/MnDOT%20Winter%20at%20a%20Glance_1.26.12_WEB.pdf . Accessed on 6/21/12.

Minnesota Snow and Ice Control: Field Handbook for Snowplow Operators, Second Revision, published by the Minnesota Local Road Research Board, 2012.

Mullaney, J.R., Lorenz, D.L., Arntson, A.D. "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) p. 41.

Murray, D M and Brenner, R. "Economic Analysis of the Environmental Impact of Highway Deicing Salts." Transportation Research Board Report. 1977. No. HS-024 782.

"Storm Water Management Fact Sheet: Minimizing Effects from Highway Deicing." US Environmental Protection Agency, Office of Water, Washington, D.C. (EPA 832-F-99-016). September 1999.

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.

Vitaliano, Donald F. 1992. “An Economic Assessment of the Social Costs of Highway Salting and the Efficiency of Substituting a New Deicing Material.” Journal of Policy Analysis and Management. 1992 (11-3) pp. 397-418.

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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APPENDIX D

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

- ☐ Surface waters (include name of river, lake, drain involved) _____ Distance from spill location to surface water, in feet_____
- ☐ 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 E

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

CTAP Circuit Training and Assistance Program

University of Minnesota

General Growth Properties, Inc.

ENVIROTECH

LTAP

Scott

Winter Parking Lot and Sidewalk Maintenance Manual

Third Revision

June 2015

Published by:

Minnesota Pollution Control Agency
www.pca.state.mn.us/programs/roadsalt.html

Acknowledgments

This manual is dedicated to helping Minnesotans protect the environment. The plow driver, the building manager, or the traveling public, all have an important role to play in protecting the 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 Local Technical Assistance Program Center, and on the training materials for the Minnesota Pollution Control Agency's (MPCA) *Winter Maintenance of Parking Lots and Sidewalks* training class. Thanks to the following sponsors and participants for their valuable input in the production of this document.

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Mississippi Watershed Management Organization – 2010 revision

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For information on Winter Maintenance training for parking lots and sidewalks, and Winter Maintenance for Roads training:

Fortin Consulting Inc. 763-478-3606. connie@fortinconsulting.com and www.fortinconsulting.com.

MPCA Smart Salting Training: Level 1 (formerly the MPCA Level 1 Certification: Snow and Ice Control Best Practices) Minnesota Pollution Control Agency.

www.pca.state.mn.us/programs/roadsalt.html.

- Training schedule
- List of those certified
- Printable version of the training manuals
- Video of small site winter maintenance
- Other technical information on winter maintenance

Table of Contents

List of Figures

Purpose of this Manual

The purpose of this manual is to deliver practical advice to those managing parking lots and sidewalks. This manual will help to make proactive, cost-effective, environmentally conscious choices in winter parking lot and sidewalk management. This knowledge will provide the opportunity to become a leader in the industry by operating more efficiently and reducing environmental impacts.

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

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

*Throughout the manual **cost-saving tips** will be shown with a dollar symbol.*

Background Information

Good Business Choices

Customer service is the key to success. Best Management Practices (BMP) keep parking lots and sidewalks safe and also reduce environmental impacts. Educating customers on the proper methods of snow removal and ice control (and of the value of this approach) can create a good and long-standing relationship.

Customers want reliable service. Providing a well-planned and well-executed winter maintenance program will have a positive impact. Using the latest technologies will increase the abilty to provide reliable service.

Customers want to hire educated winter maintenance professionals. This maunal will provide the necessary information to increase staff knowledge on the best practices for winter maintenance.

Using the right amount of material at the right time, will save time and money.

Certification in Smart Salting is a good reflection on the professional and the organization.

Customers and the public want safe parking lots and sidewalks. Understanding the materials, weather and application rates, provide a head start on controlling icy, slippery parking lots, and sidewalks.

Clean and neat parking lots and sidewalks are important to the public. 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 will reduce loss of material, protect water, and is more aesthetic. Using BMPs and lower application rates will keep parking lots and sidewalks looking neat.

Customers also want affordable snow and ice control. The use of sophisticated chemicals and equipment may require a larger budget up-front; however, these costs can be balanced by reduced on-going costs. Reducing the need for sweeping, floor and rug maintenance, parking lot striping, and snow and ice maintenance time will allow for cost savings.

Minnesotan's value water resources and the protection of lakes, streams, and wetlands is important. Educating customers how sustainable winter maintenance protects water resources is necessary.

Using less material is an effective approach to protecting our water resources. It is difficult to recover salt or sand once applied.

Water and Environmental Impacts

- Only 2.5% of all of the water on this planet is freshwater (not saltwater). Of that, less than 1% is available for use. The majority of the freshwater is frozen in the glaciers (*Freshwater Crisis* n.d.).

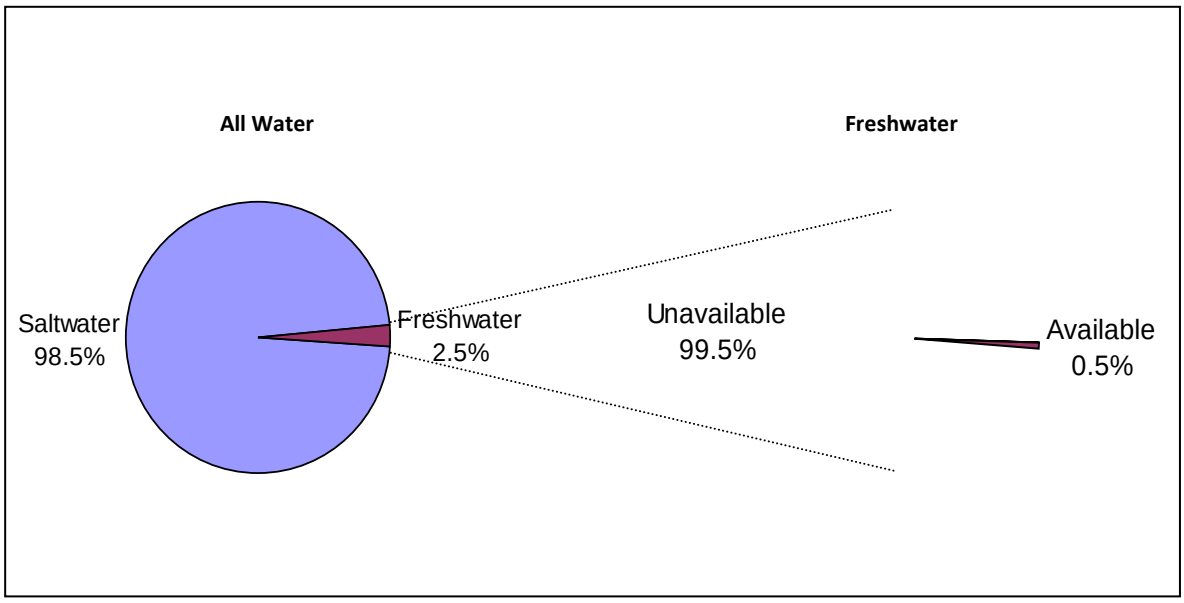
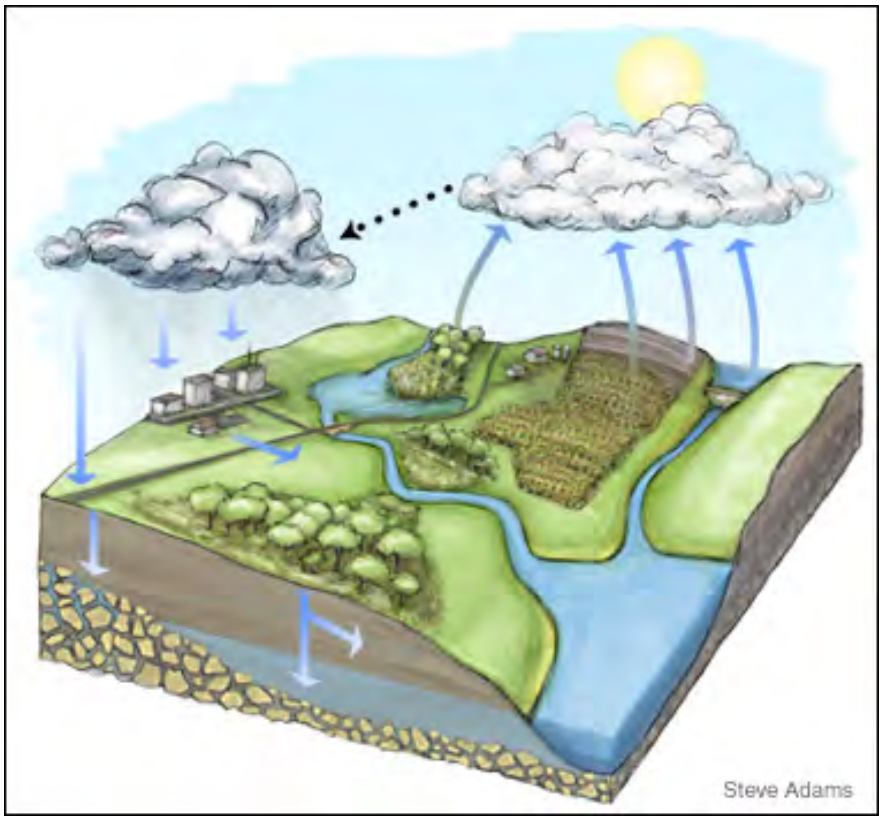


Figure 1: Available water (*Freshwater Crisis* n.d.)

- Water is recycled over long periods of time. There is a limited supply of water on this planet. Water is reused, recycled and dispersed as illustrated below from the Minnesota Department of Natural Resources (DNR), "Healthy Rivers: a Water Course" (Healthy Rivers 2004).

Figure 2: The water cycle



Chloride concentrations are increasing in many surface waters and groundwater across Minnesota.

- In the Twin Cities Metropolitan Area (TCMA), of surface water bodies tested, 39 are on the *draft* 2014 impaired waters list for chloride exceedances and 38 more are found to be at high risk as of July 2015. (MPCA 2015). Salts (chloride) dissolve in water and move with the water to nearby lakes, streams, and wetlands and also infiltrate into groundwater.
- Chloride is virtually a permanent pollutant that does not degrade and cannot be removed from surface waters. Once in the water, it continues to accumulate in the environment over time.
- Salt water is heavier than freshwater and may sink to the bottom of lakes. This may cause chemical stratification of the lake and loss of or changes in lake turn over (Stefan et al. 2008).

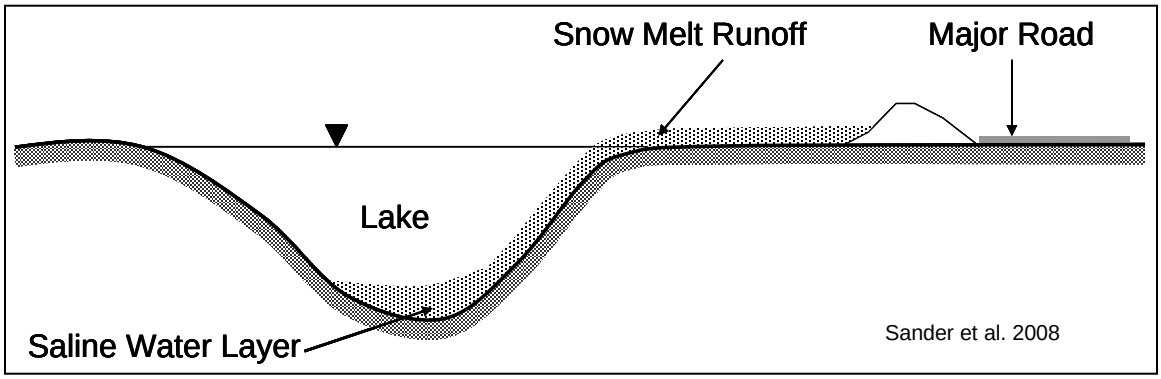


Figure 3: Schematic of a saline water intrusion into a lake

- Thirty percent of the 270 shallow aquifer monitoring wells tested in the TCMA exceeded the state chloride standard. (MPCA 2013).
- About 75% of Minnesotans rely on groundwater for drinking water. The MPCA has found 30% of the shallow monitoring wells, often found in urban areas, have exceeded the state standard for salt levels. As water moves from shallow to deeper aquifers, the salt contamination could penetrate sources of drinking water (MPCA 2013).
- The average salt use in the TCMA based on purchasing records is 349,000 tons per year (Sander et al. 2007).

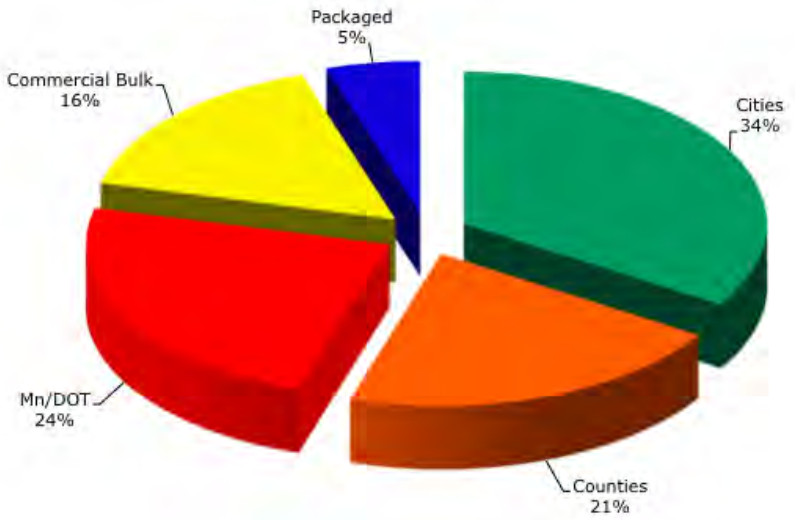


Figure 4: The distribution of road salt use in the Twin Cities metropolitan area
Figure adapted from Sander et al., 2007.

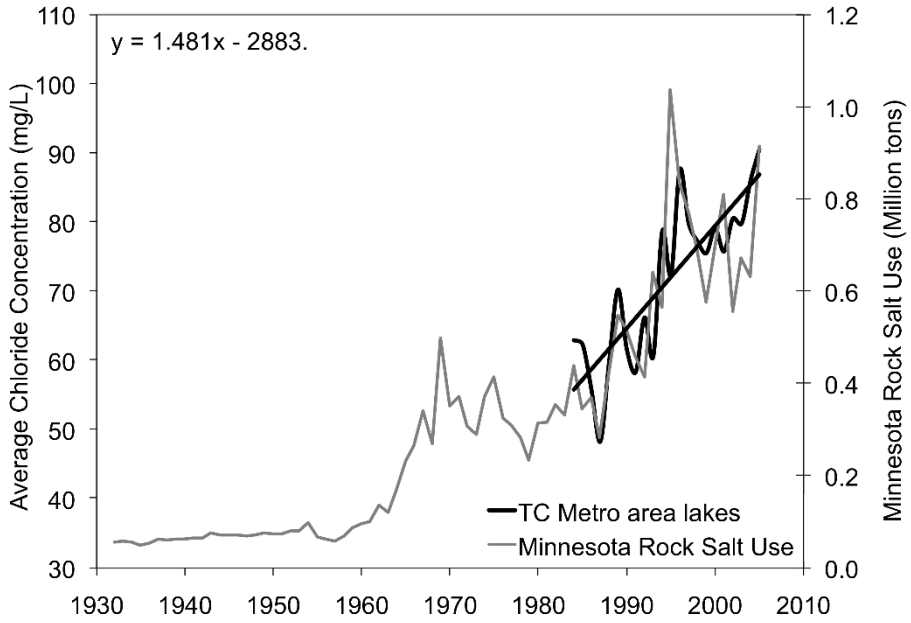


Figure 5: Comparison of lake chloride concentrations in 39 Twin Cities' area lakes and rock salt purchases by the State of Minnesota. (Sander et al. 2007).

Deicers can be very damaging to both soil and vegetation. Efforts to keep salt off vegetation are needed: 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 Plant Selector from Minnesota Department of Transportation.

Salt spray damages budding and branching of trees.

Figure 6: "Witch's broom" branching from salt spray

Impacts of Materials

Abrasives and deicers cause problems to infrastructure, drainage, water, vegetation, and soils when used in large quantities.

Abrasives: Winter Sand

- Runs off parking lots with water to the nearest storm drain entering lakes, wetlands, streams, and rivers.
- Fills in surface water bodies, accelerating the aging process.
- Covers habitat and disrupts the food chain.
- Irritates the gills of fish.
- Clogs and disrupts the flow of water in storm drain systems.

Deicers are not "environmentally safe," regardless of what the bag says.

Chlorides commonly used for deicing are Sodium Chloride (road salt), Magnesium Chloride, Calcium Chloride, and Potassium Chloride.

- Road salt is the least expensive and most widely used deicer.
- Salt is corrosive to steel.
- Some have corrosion inhibitors and anti-caking agents added that are often toxic.
- Frequently damage plants through contact or by interfering with soil properties.
- Salt can cause soil to lose its ability to retain water, leading to soil erosion.
- Excess salt can make soil more alkaline and compact, and less permeable, making it more difficult to store nutrients that plants need to grow.
- Cannot be removed by stormwater ponds or rain gardens.
- Cannot be removed from the lakes, wetlands and rivers.
- Are persistent pollutants and will not break down over time.

About one teaspoon of salt can pollute five gallons of water. This applies to all chloride containing deicers.

Acetates:

- Are non-chloride compounds.
- Are an organic substance.
- When added to water, compete with aquatic life for oxygen.
- Contribute nutrients which promote algal blooms in lakes and ponds.
- Most of the problems they cause in the water are relatively short term, but severe.
- Are usually safer for vegetation.
- Are less corrosive than salts.
- Have the potential to be treated by stormwater BMPs.

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

Plant-based additives (beet, corn, molasses):

- These additives do not contribute chloride to water but contribute nutrients (fertilizer).
- Cause an increase aquatic plant and algae growth.
- Use up oxygen in the lake or water body as they decompose.
- Serious impacts but not as long-lasting as chloride.

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

Twin Cities Metropolitan Area Chloride (TCMA) Management Plan

There are two primary sources of chloride to Minnesota water resources: 1) salt applied to roads, parking lots, and sidewalks for deicing; and 2) water softener brine discharges to municipal wastewater treatment plants (MPCA 2015). To address chloride impacts to Minnesota water resources, the MPCA worked with local stakeholders to develop a Chloride Management Plan designed specifically to minimize chloride use across the seven counties of the metropolitan area. This plan is intended to be useful for all winter maintenance practices. The plan can be located on the MPCA's website: http://www.pca.state.mn.us/programs/roadsalt.html

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 (Axler n.d.)

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Prepare for Winter Operations

Policies/Plans

Start now—develop a maintenance policy or plan that guides winter operations. A little planning and communication up-front can help achieve better results throughout the season.

- Develop a maintenance policy or plan.
- Review the maintenance policy with the crew.
- Inform customers of the maintenance policy.
- In the plan:
    - list the key actions to take during a winter event
    - list the order of these actions
    - address the level of service
        - consider customer expectations, the hours and use of the building, priority access points and environmental concerns in the policy
    - spell out any additional strategies such as routes, chemicals, application rate ranges etc.
- Follow the plan.
- Document actions.
- Review and update the maintenance policy each year.

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

Reduce liability. Establish a maintenance policy and follow it.

Training

Reduce risk by having a solid written winter maintenance policy and training program that utilizes best management practices. Schedule training for supervisors, staff, and customers.

The MPCA has three Smart Salting training classes available:

1. Level 1 Winter maintenance of roads
2. Level 1 Winter maintenance of parking lots/sidewalks
3. Level 2 winter maintenance training for supervisory staff

Check the MPCA website to find out about upcoming training opportunities.
www.pca.state.mn.us/programs/roadsalt.html

Storage

Snow Piles:

- Store in an area where the solids can be recovered after the snow melts.
- Locate snow piles down-slope from salt and sand storage to prevent snow melt from flowing through salt or sand storage areas.
- Avoid pushing snow into lakes, ponds, wetlands, rivers, or other natural areas.

Salt and Salt/Sand Piles:

Improper storage of salts can lead to groundwater contamination.

- Storage areas often cause groundwater or surface water contamination. These problems can be easily tracked back to the source. Do not skimp on proper storage. When locating new storage for liquid or granular products investigate local visual screening ordinances.
- Indoor storage is recommended.
- Store on an impervious (water proof) surface.
- Floor should be sloped away from the door.
- Sweep loading areas back into the pile.
- Store away from lakes, rivers, ditches, storm drains, and wetland edges.

Figure 7: 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.

A common mistake is storing a salt pile downhill from a snow pile.

Salt Bags:

- Protect from rain or snow.
- Dispose of bags properly.
- Seal all open bags.

Liquids:

- Know the freezing point of the liquid. This will determine if it can be stored outdoors. Salt brine (NaCl) will freeze at -6° F.
- Tanks should be double-walled or have secondary containment. Secondary containment is like creating a bath tub around the tank so if the tank leaks, the "tub" captures the spill.
- Label the tank documenting its contents.
- For more information on storage tanks see www.pca.state.mn.us/cleanup/ast.html

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.
- Store leftover winter sand for next year. Do not use it for other purposes.

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

Weather

Know existing and potential weather conditions for a successful snow and ice control operation. Monitor the weather closely to prepare to act early in storm situations. Check the National Weather Service http://www.noaa.gov, local TV stations, or website weather. A Road Weather Information System (RWIS) is available for free on-line at www.rwis.dot.state.mn.us. The RWIS provides real time pavement temperatures and other information from locations around the state.

Pavement Temperature

Pavement and air temperature are different. Know the pavement temperature to determine the proper amount and type of material to apply. Weather stations report air temperature which is measured at least 6 ft. in the air. The air temperature is not helpful when trying to determine what to apply to surfaces on the ground.

Air temperature measurements are generally the same in a given area, but pavement temperatures in the same general location can vary greatly. Pavement temperatures are influenced by exposure to sun, pavement type, and subsurface materials.

Figure 8: Hand-held temperature sensor

The same air temperature in November and January will often accompany very different pavement temperatures.

The hand-held temperature sensors can be purchased from auto part stores for less than $100. Some temperature sensors only accurately monitor in the warm temperature range, confirm the one purchased measures in the cold temperature range. 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. RoadWatch by Commercial Vehicle Group, Inc. is one example of this type of sensor. A small investment in equipment will improve performance.

Knowing the pavement temperature allows the application of the proper amount of material for each situation.

Getting prepared for winter

- Calculate the area of the parking lots, service roads, and sidewalks.
- Understand the environmental problems caused by snow, salt, and sand storage. Determine where and how to best store each item.
- Understand the properties of various deicers, and then select the type(s) to use.
- Train the crew on proper application rates.
- Mark islands, fire hydrants, and other landmarks that could be obscured by snow.
- Note existing conditions of curbs and other items that might be damaged by winter maintenance activities.
- Note or mark all catch basins, manholes, sidewalk segments that may cause a hazard to the plow and the operator.

Drainage

Inspect storm drains in the fall. Remove obstructions such as leaves, sticks, and trash to prepare for the spring melt. Because storm drains lead to lakes, rivers, ponds, and wetlands, never use salt to open frozen storm drains. Salt used to thaw frozen drains harms aquatic life. Use non-chemical methods such as heat to open drains.

Poor drainage on the maintenance surfaces will result in icy surfaces and will increase the risk of safety problems. These areas cause the application of salt on non-snow event days in the winter. To remedy this, inventory the site and note drainage problems. Make a checklist so the professional or client can fix these drainage problems in the summer.

Examples of drainage problems:

- Roof that drips on the steps
- Downspout discharging on sidewalk
- Sidewalk segments sloped into a V
- Potholes or low spots in parking lots

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

Equipment

The trend in winter maintenance is to use less material to accomplish the same results. Following this trend will reduce environmental impacts and save money. Below are listed a few tips, but there are many other innovations in the equipment area that can help to reduce application rates.

- Purchase a pavement sensor (Figure 8)
- Buy equipment that can deliver very low rates of granular products.
- Outfit larger trucks with ground speed controls so that the application rate changes automatically as the speed changes.
- Modify existing equipment so that it can discharge the application rates described in the "Application Rates" section. Older equipment often applies more salt than recommended.
- Outfit sidewalk spreaders with shields to better direct the spread pattern.
- Invest in equipment that can deliver liquid deicers.
- Obtain a tank for liquid storage or find a near-by source of liquids to fill up trucks.

Calibration

Calibration is an essential procedure to understand how much material will be discharged at a given setting. No matter how sophisticated or simple the operation, calibrate each piece of equipment in the fall of the year.

Simple Calibration for Salt Spreaders

If the equipment has different settings, it must be calibrated for each setting and for each product, as they all flow differently. It generally takes a team of two or three people to calibrate equipment efficiently.

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

Ground Speed Controlled Spreaders

Ground speed controlled spreaders are run by a computer in the cab and are tied to the speedometer and an auger or conveyor sensor in the rear of the truck. The application rate is set and the computer regulates the amount of salt discharged (regardless of the speed traveled) consistently. Most equipment used for winter maintenance of roads have ground speed controls. These are more effective and efficient systems than the manually controlled systems.

The equipment vendor will have specific calibration instructions for the operation based the type and brand of equipment. Contact them; it is in their best interest to provide instructions to calibrate and correct product use. This is the basic principle behind calibrating a ground speed controlled spreader:

- The speedometer input (sensor) lets the controller know how fast or slow the truck is traveling.
- The auger or conveyor input (sensor) tells the controller how fast or slow the auger is turning.
- To calibrate a ground oriented controller, input the pounds discharged per revolution.
- Once the computer knows the pounds/ revolution, it will calculate the necessary auger speed needed to hit the target application rates at the speed the truck is traveling.

Best bet: Contact manufacturer for calibration instructions.

Calibration allows accurate deicer use.

Manual Controlled Spreaders

Manual controlled spreaders fall into two categories. Those that have an auger or conveyor and those that are gravity fed. They operate by selecting a setting that changes the size of the discharge opening and/or the auger or conveyor speed. More or less salt may be discharged depending on the speed of application. Most parking lot and sidewalk spreaders fit into one of these two categories.

All good programs are based on calibration of equipment.

The basic principle behind calibrating an auger/conveyor spreader is to choose a setting, run the spreader for a timed interval, and weigh the discharge. Record the discharge and repeat for all settings. In the end, there will be data that tells the operator how much material will be delivered at each setting. With this information, the operator can choose the proper setting. Without this information, they have no guidance on which setting to use. Calibration is different for gravity fed spreaders. There is more detail on this in a few pages.

Apply wisely. The chemicals applied cannot be recovered.

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.

Auger or conveyor systems

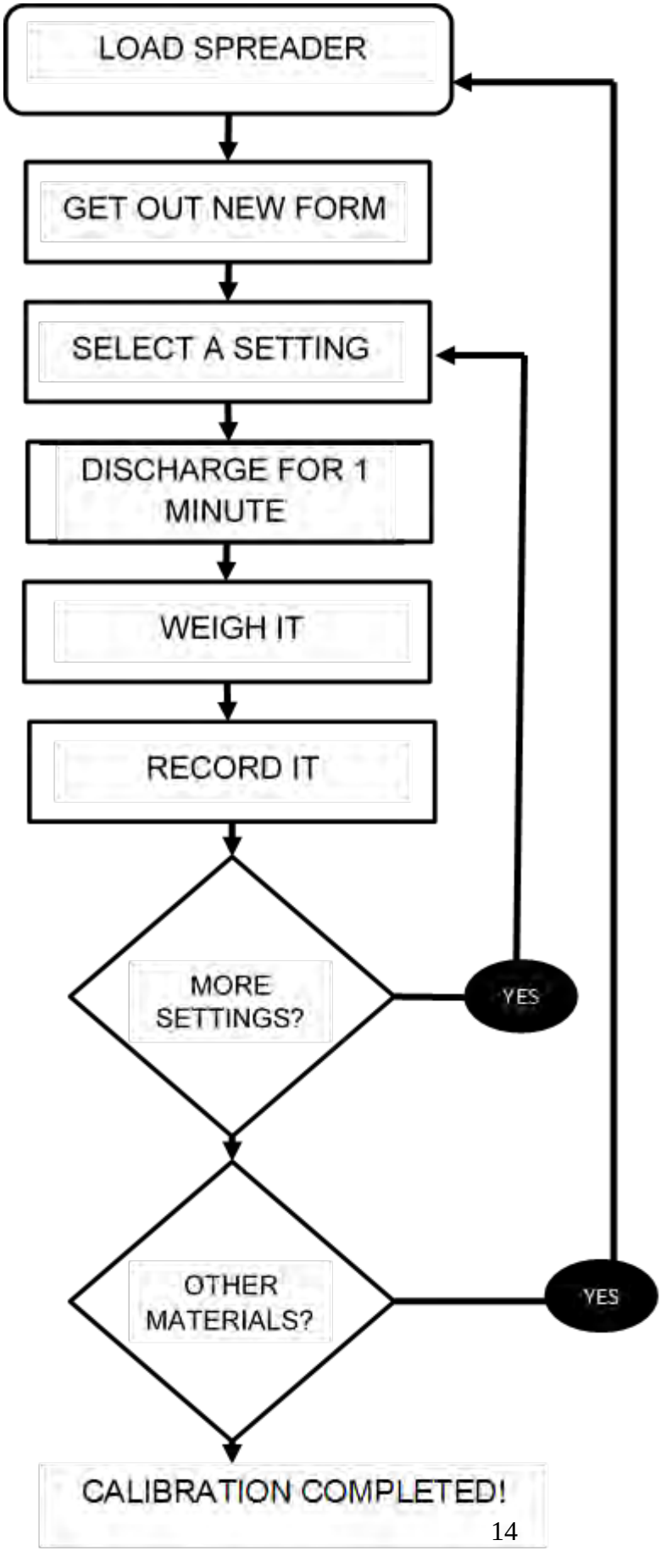


Figure 9: Steps for calibrating an auger or conveyor system

Example: Step #1, blank calibration form

See the References and Resources section for a full size form to copy for calibration. This is how the empty form looks.(Keep a stack of these on a clipboard when ready to begin the calibration.)

CALIBRATION CHART FOR AUGER OR CONVEYOR SYSTEMS

DATE _____ SPREADER # _____ MATERIAL _____

SETTING	POUNDS PER MINUTE	5 MPH (x12)	10 MPH (x6)	15 MPH (x4)	20 MPH (x3)
1					
2					
3					

Figure 10: Blank calibration form

Example: Step #2, calibration form filled out during calibration

Fill in the header information and column 2, the discharge weight per setting.

CALIBRATION CHART FOR AUGER OR CONVEYOR SYSTEMS

DATE 8-Aug-15 SPREADER # A4219 MATERIAL Rock Salt

SETTING	POUNDS PER MINUTE	5 MPH (x12)	10 MPH (x6)	15 MPH (x4)	20 MPH (x3)
1	10				
2	22				
3	34				

Figure 11: Example calibration form with discharge and header information filled out

Example: Step #3, calibration form ready to put in truck for road application

Back in the shop, do the calculations to fill in the rest of the blanks. Multiply the weight in column 2 with the multiplier in the top row. This provides the pounds per mile that needed to fill in the table.

CALIBRATION CHART FOR AUGER OR CONVEYOR SYSTEMS

DATE 8-Aug-15 **SPREADER #** A4219 **MATERIAL** Rock Salt

SETTING	POUNDS PER MINUTE	5 MPH (x12)	10 MPH (x6)	15 MPH (x4)	20 MPH (x3)
1	10	* 120	60	40	30
		**			
2	22	264	132	88	66
3	34	408	204	136	102

***** top half of each row = lbs/lane mile. To get this number, multiply lbs/min by the factor shown for each speed.

****** bottom half of each row = lbs/1000 sq.ft. To find this, divide the number in the top half by 63.

Figure 12: Example calibration form with pounds per lane mile filled out

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

Example: Step #4, calibration form ready to zip tie to hand spreader or put in truck for parking lot application.

Divide by 63 to convert pounds per lane mile to pounds per 1,000 square feet. This is very useful for parking lot and sidewalk applications.

CALIBRATION CHART FOR AUGER OR CONVEYOR SYSTEMS

DATE 8-Aug-15 SPREADER # A4219 MATERIAL Rock Salt

SETTING	POUNDS PER MINUTE	5 MPH (x12)	10 MPH (x6)	15 MPH (x4)	20 MPH (x3)
1	10	*120	60	40	30
		**1.9	1.0	0.6	0.5
2	22	264	132	88	66
		4.2	2.1	1.4	1.0
3	34	408	204	136	102
		6.5	3.2	2.2	1.6

* top half of each row = lbs/lane mile. To get this number, multiply lbs/min by the factor shown for each speed.

** bottom half of each row = lbs/1000 sq.ft. To find this, divide the number in the top half by 63.

Figure 13: Example calibration form with pounds per 1000 sq. ft. filled out

Gravity Flow Equipment

This is applicable for equipment that does not have a motorized delivery system such as an auger. This type of equipment might be a pickup mounted spreader, gator mounted spreader or a hand push spreader. Gravity flow equipment is typically controlled by gate opening and speed of application.

Step 1: Calculate discharge rate

- Mark out a 10-foot stretch of pavement. (By increasing the size of the test area i.e., the longer the test area, the more accurate the results will be).
- Sweep it clean of sand or any other material.
- Using a constant speed, apply one pass of material to the test area.
- Measure the width the material is spread or bounces, in feet.
- Sweep up and weigh the material that is within the marked 10-foot stretch.
- Record the lever position/setting for the gate/chute. If there are no numbers for the positions, make permanent marks on the equipment to identify the positions.
- To improve accuracy, repeat this two more times and calculate the average weight of material applied.
- Record results in columns A, B, C, and D (Figure 14).

Step 2: Repeat step #1 for various settings.

Step 3: Fill out chart.

- Fill out columns E, F, and G (Figure 14).
- If using more than one type of material, repeat the test for each material.
- Place the completed calibration chart with the equipment.

Shortcuts:

- Put down a tarp over the application area; this makes it quicker to recover and weigh material.
- After the first pass, put a bag around spreader to catch discharge material. The first pass is needed to determine the spread width.

Calculate application rate:

Equipment: _____ Material: _____ Date: _____

A	B	C	D	E	F	G
Speed	Lever position or gate setting	Pounds spread in 10 feet*	Spread width in feet	Coverage area in sq. ft. (**D x 10**)*	Application rate in lbs./1000 ft^2 (**1000/E x C**)	Application rate in lbs./lane mile (12' width) (**F x 63.4**)
.....EXAMPLE.....						
20 MPH	*Half-closed*	*0.4 lbs.*	*13 feet*	*130 sq. ft.*	*3.1 lbs. per 1000 sq. ft.*	*196 lbs./mile*

* If changing the test strip length, adjust the title in column C and the multiplier in column E.

Figure 14: Example calibration chart for gravity flow equipment

What if calibration is not a practice?

Even without calibrating the equipment, the amount of material to use can be determined but will take more time to calculate. Know the material, the size of the area to be treated, and the pavement temperature, then consult the application rate chart (application rate section) and do the math. Without calibration, the way to evenly distribute the recommended amount across the maintenance area must be determined by the professional. This approach may work well for treating sidewalks using the "chicken feed" method. For example:

- 20°F degrees pavement temperature and rising
- Using dry salt
- Sidewalk is 2,000 square feet
- Table recommends 2.25 lbs. per 1,000 square feet (for this situation)
- Measure about 4.5 lbs. of salt
- Figure out a way to spread it evenly over the 2,000 sq. ft. surface

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

Calibration Charts

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**)

Figure 15: Blank calibration chart for gravity flow equipment

CALIBRATION CHART FOR AUGER OR CONVEYOR SYSTEMS

DATE _____ **SPREADER #** _____ **MATERIAL** _____

SETTING	POUNDS PER MINUTE	Quantity / Area	5 MPH (x12)	10 MPH (x6)	15 MPH (x4)	20 MPH (x3)
1		lbs/lane mile				
		lbs/1000 sq.ft.				
2		lbs/lane mile				
		lbs/1000 sq.ft.				
3		lbs/lane mile				
		lbs/1000 sq.ft.				
4		lbs/lane mile				
		lbs/1000 sq.ft.				
5		lbs/lane mile				
		lbs/1000 sq.ft.				
6		lbs/lane mile				
		lbs/1000 sq.ft.				

Figure 16: Blank calibration chart for augured or conveyed manual controlled spreaders

Materials

All products have pros and cons. No one material is suitable for every condition. It is best to have a variety to choose from to select the one that works the best, with the least amount applied, in a specific situation. Understand the melting properties of the deicers; do not use the product without understanding how it works.

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

- Know what is in the product.
- Know the product's practical melting range.
- Use it only when it will be effective.
- Use the minimum amount needed to get the job done.
- Seek out products that allow for smaller application rates.

Abrasives:

- Sand is an abrasive; it does not melt snow and ice.
- Abrasives provide traction on top of packed snow or ice.
- Abrasives and deicers typically work better alone, rather than together.
- A small amount of salt must be mixed in the sand to keep it from freezing in the pile (less than 10%).

Salts:

- Sodium Chloride, Magnesium Chloride, Potassium Chloride and Calcium Chloride are all considered "salts."
- Salt is a deicer; it will melt snow and ice.
- Salt lowers the freezing point of water from 32° F to a colder temperature.
- Salt must be dissolved to work; therefore, liquids act faster than solids.
- Salts have different melting characteristics, depending on the selection.
- Road salt (NaCl) is a granular product and is mined from the earth.
- Magnesium Chloride ($MgCl_2$) and Calcium Chloride ($CaCl_2$) can naturally occur as liquids.
- $MgCl_2$ and $CaCl_2$ are hygroscopic, drawing moisture from the air to the pavement.
- Salt brine (NaCl) is commonly used at a 23.3% concentration as this has the lowest freezing point and can be stored and handled down to -6°F.

Acetates:

- Acetates are chemically manufactured, not mined from the earth.
- Acetates are more expensive than chloride salts.
- Acetates are less corrosive than salts.
- They have a wide melting range, depending on the selection.
- They are not better or worse than chloride salts, they are different.

Plant-based additives

Corn, beet, molasses, or other organic additives are added to salt or salt brine to change its performance, though how they function as an ice melting agent is not well understood. Clear Roads (2015), a national resource consortium of state agencies, is studying this issue.

- Often have very low ice melt capacity.
- May be used to reduce corrosion.
- Are sticky and may help dry material stay on the surface longer.

Speed of Melting

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

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

Figure 17: Speed of melting

$ Do not use dry road salt below 15º F. This wastes money and time.

Practical Melting Temperature

Use care when reading the melting temperature on bags of deicers. The package often lists 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 the supplier for the practical melting temperature and the time it takes to melt ice at that temperature. It should be noted that there is not a standard measure for determining the lowest practical melting temperature. Across the literature there are a range of values. In the References and Resources section there are lists of several websites to learn more about the lowest practical melting temperature.

Chemical	Lowest Practical Melting Temp.	Eutectic Temp.	Optimal Concen-tration
NaCl (Sodium Chloride) —Delivered as rock salt, can be made into a brine. The basis of many bagged blends. Corrosive. Inexpensive. Very available. Most commonly us used without a corrosion inhibitor added, but corrosion inhibited products are available.	15º F	-6º F	23%
$MgCl_2$ (Magnesium Chloride)—Delivered primarily as a liquid, other forms available. Used for anti-icing, pre-wetting and stockpile treatments. Corrosive. Higher cost. Often has a corrosion inhibitor added. Often added to salt brine.	-10º F	-28º F	27 to 30%
$CaCl_2$ (Calcium Chloride)—Delivered as flakes, pellets, or liquid. Corrosive. Most effective ice melter at very cold temperatures. Sometimes used incorrectly to open storm drains. Higher cost. Often has a corrosion inhibitor added. Often added to salt brine.	-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 to steel, biodegradable. Alternative for areas where chloride use must be limited. 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. Non-corrosive to steel but corrosive to galvanized, 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 the 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. Abrasives should be used for cold temperatures when deicers are not effective. Want to minimize salt % in sand.	Never melts—provides traction only		

Figure 18: Lowest practical melting temperature

Testing

When ordering a liquid product in bulk, test it. If it is NaCl brine it should be 23.3%. If it is another liquid, use the vendor recommended density and test to confirm. Hydrometers are the tools for testing the density of liquids. They are inexpensive and look similar to a thermometer.

Research the product, understand the practical melting temperature, and know the list of ingredients. Take time to test the materials to ensure that they perform as expected. Product 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. Do not rely solely on the bag or on the manufacturer's literature. There are no labeling requirements; manufacturers can choose to label products in their own way.

Cost and Availability

Of the deicers, NaCl is typically the cheapest and easiest to find. Because of this, it is widely used and overused. Sodium chloride is only effective at pavement temperatures above 15^{o}F. Because it doesn't work well at colder temperatures, it is often over-applied in attempts to increase its effectiveness. At temperatures lower than 15^{o}F degrees, switch to a different deicer.

Non-chloride deicers are more difficult to find and often cost more. Take the time to source and try non-chloride products if there are concerns from the professionals or customers about the long-term effects of chlorides on the lakes and rivers. All deicers have environmental impacts but the impacts of chlorides 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 melting is needed and sand for temporary traction to buy time at temperatures too low for deicers to be effective. Pre-wetted sand has shown to be effective in keeping sand in place longer on icy surfaces.

$ Using 50/50 salt/sand mix is generally 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. Plow, blow, or sweep first; the chances of refreeze diminish and slush build-up is minimized.

- Sidewalks are the most over-salted areas in winter maintenance.
- Use drop spreaders, not rotary spreaders. If using a rotary spreader, install shields to restrict the spread pattern. This minimizes the application rate and protects the vegetation.
- Many slip and fall incidents occur within 10 ft. of the curb lines. Adjust practices to include proactive measures like anti-icing.
- If the professional is not responsible for sidewalk maintenance, consider providing this information to the responsible party.
- Focus on aggressive mechanical removal of snow. The less snow, the less deicer required. This will lend itself to a safer surface.
- Deicers can harm heated sidewalks.
- Abrasives can harm permeable pavers or permeable concrete.

$ 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 to the surface it doesn't need to melt through the ice.

Building Entrances

Steps are often the most over-salted area in all of winter maintenance. This overabundance of deicer causes damage to floors inside the building as salt and/or sand is tracked in. It causes problems outside of the building with deterioration of concrete and metal structures. Over applying deicer costs more money than necessary, pollutes the water, and does not provide any additional safety. The right amount of deicer and proper mechanical removal of snow and ice will yield better results.

A free short video for small site winter maintenance is available at:

www.pca.state.mn.us/programs/roadsalt.html. It is designed for those that do winter maintenance of small sites such as stairs, curb cuts, and handicap ramps. The video is a visual instruction tool useful for those who apply granular deicer to small areas outside building entrances. It recommends:

- Do site assessments, document drainage problems, and fix them in the summer (e.g., roof that drips on steps, downspout that drains to sidewalk).
- Always remove snow prior to applying deicers. The less snow, the less deicer required for a safer walking surface.
- Use the proper tool for snow and ice removal:
    - Push shovel (no sides) for pushing snow.
    - Scoop shovel (sides) for lifting snow.
    - Broom or blower for light fluffy snow.
    - Ice scraper for use under ice and compaction.
    - Ice chisel for breaking open compaction, or under ice and compaction.
- Use hand-held spreaders to disperse deicers. Spreaders:
    - Provide more even distribution.
    - Reduce amount needed.
    - Reduce tracking into buildings.
    - Save money with reduced salt application.
    - Save infrastructure: less salt, less corrosion.
- Look for opportunities to close extra building entrances during the winter. High maintenance, non-essential entrances are perfect candidates.

To determine the amount of deicer needed for steps, stairs, and small sites:

- Refer to the application rate chart.
- For those who do maintenance as a small part of their job, it is unlikely they will ever use an application rate chart. Here are some guidelines to get them closer to the proper rates. The goal should be:
    - Even spread pattern with granules no farther than 3 in. apart
    - Even spread pattern with no granules touching each other
    - No piles of deicer
    - No deicer on dry pavement
    - No deicer in vegetation

$ Handheld spreaders and shakers, not scoops, should be used to apply deicer to steps and building entrances. This will save at least 50% of the salt normally used per winter without reducing the level of safety.

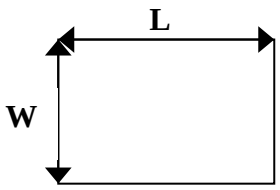
Parking Lot Tips

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

- 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 generally isn't advised; however, it may help in freezing rain situations.
- Always plow before applying materials.
- It may be possible 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.

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 the parking lot.

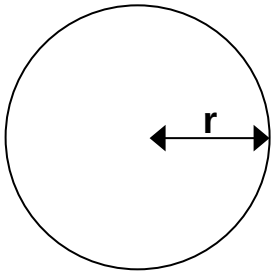


Ask the property owner for a scaled map of the facility to calculate areas.

Ask the property owner for the size of the area to be treated.

Measure the parking lot.

Use an internet mapping tool to calculate areas.



The area, or square feet, of a square or rectangle is:

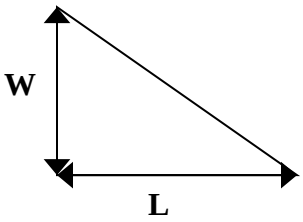
Length (L) X Width (W)

The area, or square feet, of a circle is:

πr^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 the area, along with knowing the pavement temperature, will allow the use of the application rate charts. This will help to reduce the amount of chemicals applied.

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Take Action to Keep Surfaces Clear

Winter Maintenance Basics

- Anti-ice before the storm.
- Remove snow from surfaces as quickly as possible to reduce compaction.
- Plow before applying deicers to avoid dilution of the salt.
- Minimize deicer use during the storm.
- Never plow or blow snow into bodies of water, wetlands, traffic or into streets.
- Minimize back-up maneuvers to reduce chance of accidents.
- 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 to determine how much salt to use.
- Don't apply dry salt (sodium chloride) below 15º F pavement temperature. It will not melt fast enough to help.
- Below 15° F, use a wetted salt.
- For extreme cold, skip melting and use sand.
- Clean up spills.
- Accurately record the material used at each site.
- Pay attention to its effectiveness and record observations.
- Use only what is needed based on proper application rates for the conditions.
- Put extra back in salt pile or return extra bags.

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

Loading/hauling

- Don't overfill the truck or spreader: material will spill out as it is driven or pushed. This is a common practice and wastes salt.
- Large snow piles may need to be hauled to another site.
- Schedule this work when the mall or facility is closed to minimize conflicts with vehicles and pedestrians.
- Clean up loading area, sweep extra back into the pile.

Deicing/Anti-Icing Information

Anti-icing

Anti-icing is the most cost-effective and environmentally safe practice in winter maintenance. This is the direction to pursue.

Anti-icing is a proactive approach. It should be first in a series of strategies for each winter storm. Applying a small and strategic amount of liquid on the pavement before a storm will prevent snow and ice from bonding to the pavement. This buys time for the clean-up efforts.

Anti-icing is like frying eggs: grease the pan and the eggs come out easily with no mess to clean up. Like greasing the frying pan, the purpose of anti-icing is to keep snow from sticking to the pavement. Anti-icing provides safer pavement during the event and faster clean up after the event.

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 frost. It can be effective for up to several days depending on the weather conditions.

$ ***Anti-icing is quick. It is possible to treat a 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 changing to anti-icing.***

Get started in anti-icing

The basic equipment needed includes: pavement temperature sensor, storage tank, spray truck system, transfer pump, hoses, and fittings.

What to do

- Calibrate.
- Use application rates suggested in the Rate section of this manual.
- 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. This makes a dry surface wet and users will have less friction until it dries.
- Try anti-icing in a low traffic area to build confidence about its properties.
- Read some of anti-icing guidelines in the reference section of this manual.

Stream nozzles prevent slippery conditions better than fan spray.

Test the application rates and spray pattern to become confident in preventing the bonding of ice without creating a slimy or slippery situation.

What not to do

- Do not re-apply if there is still residue. It can remain many days after application.
- Do not apply $MgCl_2$ or $CaCl_2$ to a warm surface (above 35º F pavement temperature). It can become “greasy” as it pulls moisture to the pavement. These liquids do not always become greasy, but there is a higher potential in warmer temperatures and higher humidity.
- Do not over apply $MgCl_2$ or $CaCl_2$.
- Do not apply liquids before a rain storm. They will wash away.

Too little $CaCl_2$ or $MgCl_2$ is safer than too much.

Anti-icing Tips

- Liquids are 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 because it makes a dry surface wet.
- Anti-icing is often effective for heavy frosts.
- Liquids are dispersed by the traffic. Spray the traffic lanes and the 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-ice when weather forecasts indicate a need. Do not anti-ice on a regular schedule, e.g., every Friday.
- Early application is particularly important for frost or light freezing drizzle.
- Pretreated or pre-wet materials are not as efficient as liquids for anti-icing. These require more material overall than with liquids. The pre-wet granular materials don't stay in place as well as the liquids. Pre-wet granular solids can work if applied at very low application rates immediately before the snow event.

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

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

Equipment

- Anti-icing unit, e.g., transport vehicle with tank.
- For larger trucks: Stream nozzles (minimum eight 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 a pick-up truck or ATV with a tank and one of the following boom, spray bar, or hose reel with sprayer.
- A shutoff switch in the cab is recommended.

Deicing

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.

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 (Figure 24) to help with deicing. Using recommended rates will help with these common problems:

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.

- 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 on the surface with salt. This is an overuse of materials. Apply just enough to loosen the bond between the pavement surface and the snowpack so it can be plowed off.

Pre-wetting and Pretreating Salt and Sand

Pre-wetting 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.

When integrating the liquids, decrease the application rate of the granular product. This is a common mistake made by new users of liquids.

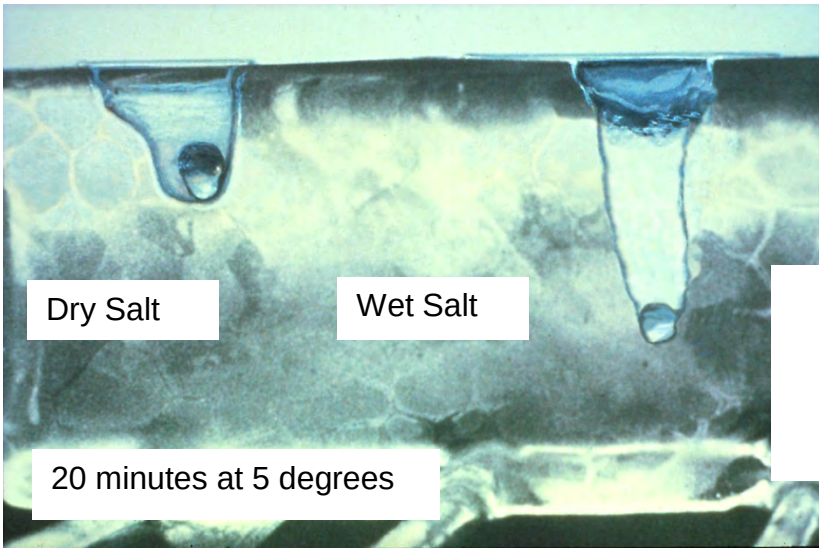

Photo courtesy of Wisconsin DOT transportation bulletin #22

Figure 19: Dry salt vs. wet salt

- There are many types of liquid deicers.
- Salt brine is a common liquid deicer made from water and rock salt (NaCl).
- Brines can contain other ingredients besides water and rock salt.
- Pre-wetting (truck treatment) is the process of adding liquid to solids as they are applied to the pavement.
- Pretreating is the process of adding liquid to solids in the stockpile.
- Adding brine to dry salt, the combination will work faster than dry salt.
- Use magnesium chloride ($MgCl_2$) or calcium chloride ($CaCl_2$) liquid with dry salt, it will work faster and at lower temperatures.
- Wet material bounces less.

Generally it is possible to use 1/3 less material when using a pre-wet or pretreat, and it works faster than dry salt!

Guidelines for Pretreating Stockpiles

Pretreating is mixing a liquid deicer into the stockpile of salt or sand. It can be purchased as a product already mixed and ready to use or can be created. To create a pre-treated stockpile, add liquids conservatively. The dry material can only hold so much liquid before leaching occurs. Watch the storage area to make sure it can contain the wet salt pile. Test mixing skills and observe the amount of leaching on a small stockpile before doing this on a large scale.

Treating the salt stockpile:

- Spray and mix the salt stockpile with a liquid deicing chemical (not brine).
- When treating the stockpile, apply at 6 to 8 gallons/ton, less is better.
- Because leach risk at a stockpile is increased, proper storage is critical.
- To minimize problems, mix up pre-wet materials per storm event not per season.

Treated Stockpile Application:

- Pretreated salt can be applied 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; it requires 1/3 less material than dry salt.

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

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

Guidelines for Pre-wetting

Pre-wetting is combining liquid from a tank to dry material from the hopper at the point of discharge. The most common set up is on a truck but it can be configured for smaller equipment. The liquid and granular usually come together at the spinner or auger.

While pre-wetting requires some equipment changes, it provides flexibility to switch the amount and type of liquid.

Tips:

- Turn down the application rate; 1/3 less material than dry salt is needed.
- Add tanks and hoses on the truck.
- Turn on/off the liquid from inside the cab.
- Synchronize the flow of liquids with the flow of solids to achieve the proper mix.
- A common application rate is 8 -14 gallons/ton for salt brine, 6-8 gallons/ton for $MgCl_2$.
- The higher the liquid to granular ratio, the faster it works. Some go up to 60 gallons per ton.
- Pre-wetting with a chemical other than salt brine can improve cold weather performance.
- Pre-wetting is most practical with a dump truck. Use of a pickup truck may be limited due to the weight of the material.
- 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 1) applying to already wet surfaces, and 2) not giving the material enough time to work and adding more salt on top of the first application of salt.

Traction

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 of snow and ice. When sand is in contact with the pavement, sweep it up. It is no longer useful 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 considering handling, clean-up, and disposal costs.
- Sand will be tracked into 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. It 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 the trash, leaves and other debris should be removed. 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.

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Evaluate the effectiveness of 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 deicer/abrasive use.
- Based on all aspects of the storm fighting experience, look for ways to improve practices.
- 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.
- If there is no place for year round storage, contact the city, they may be willing to purchase it, take it, or store it. Everyone benefits from good storage and less salt in our water.

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

Documenting and charting

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

- Without documention and charts, there is no measurement of performance.
- Track the material use. Learn to record what and how much is applied at each site, from each visit. Be prepared to analyze and make adjustments to the process based on what is learned.
- Use forms like those shown (Figure 21 and Figure 22) to record and track the work and observations.

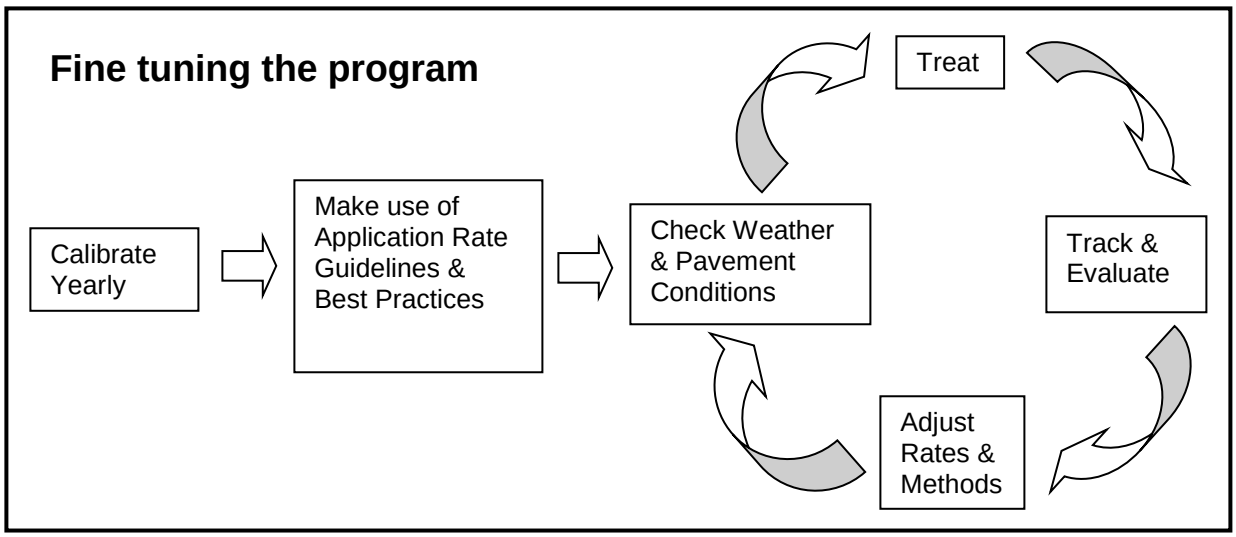

Figure 20: Fine-tuning the program

There is no management of what is not measured.

Following Best Practices and documenting actions will help prove the professional is doing the best job possible and may reduce 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:

Figure 21: 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:			

Figure 22: 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 Minnesota Snow and Ice Control Field Handbook for Snowplow Operators, Second Revision (LRRB 2012). They were converted from gallons or pounds per lane mile to gallons or pounds per 1000 square feet.

These application rates are not perfect but are to be used as goal to work toward. Develop specific application rate tables to standardize performance. Track application rates measure and improve performance. Modify the practices incrementally over time to fit the needs. Make it a goal to reduce application rates and keep surfaces safe.

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

- Pavement temperature
- Application rate
- Precipitation
- Type of material applied
- Salt lost to plowing or traffic blowing it off of the surface

Anti-Icing Application Rate Guidelines

These are a starting point only. Adjust based on experience.

Condition	Gallons/1000 sq. ft.		Other Products
	$CaCl_2$ or $MgCl_2$	Salt Brine(NaCl)	
1. Regularly scheduled applications	0.2 - 0.4	0.3 – 0.6	Follow manufacturers' recommendations
2. Prior to frost or black ice event	0.2 - 0.4	0.3 – 0.6	
3. Prior to light or moderate snow	0.2 - 0.4	0.3– 0.8	
CAUTION: Too high an application rate may result in slippery conditions or tracking.			

Figure 23: Anti-icing application rates

How to use the anti-icing rate table above:

1. Determine the parking lot or sidewalk area in square feet.
2. Divide the area by 1,000 (chart is based on a 1,000 square foot area).
3. Find the application rate: Choose the condition in the first column of the table and follow sideways, stopping at the anti-icing chemical being used.
4. Determine how many gallons needed: Multiply the application rate by the answer in #2.

Example: The parking lot is 20,000 square feet. The chart tells how much to apply for 1,000 square feet. The plan is to apply brine prior to light or moderate snow. Do a calculation to see how much brine is needed:

1. Divide the parking lot size by the chart size (20,000/1,000 = **20**).
2. Application rate from chart **is between 0.3 to 0.8** gallons.
3. Then multiply 20 x 0.5 = about 10 gallons are needed.

Tip: To convert from gallons to ounces: multiply the result 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 (LRRB 2012).

Develop specific application rates by adjusting the current rates incrementally downward toward the guidelines. Where temperature categories overlap, select the rate most applicable to the present situation.

Pavement Temp. (ºF) and Trend (↑↓)	Weather Condition	Maintenance Actions	Application Rate in lbs./per 1000 square foot area			
			Salt Pre-wetted/ Pretreated With Salt Brine	Salt Pre-wetted/ 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

Figure 24: Application rates for deicing

All application rates are based on thoroughly cleared surfaces.

Instructions for using application rate table for calibrated spreaders

1. Using Deicing Application Rate Guidelines for Parking Lots and Sidewalks. Select the row (è) with the appropriate pavement temperature, temperature trend, and weather conditions.
2. Select the column (ê) that has the type of material used.
3. Find the box where the row (è) and columns (ê) intersect to find the application rate.
4. Compare those values to the calibration chart for the spreader.*
5. Select the correct spreader setting for the rate calculated.

Example:

1. Parking lot is 54,000 sq. ft.
2. Temperature: 22ºF and falling. It has finished snowing. (è)
3. Using salt pretreated with salt brine. (ê)
4. Find the 20 – 25º ↓ box. Follow it to the right to the column labeled "Salt Pre-wetted/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. (è ê)
5. Refer to the calibration chart in the vehicle and set the spreader to the setting that most closely matches the 2.0 lbs. /1000 square feet.
6. The mixture is ready to apply.

Instructions for using application rate table for spreaders that are NOT calibrated

Using the example above:

1. Calculate size factor: Divide the parking lot size (54,000 sq. ft.) by 1,000 sq. ft. 54,000/1,000 = 54. The size factor is 54.
2. Find application rate (2.0).
3. Multiply application rate by size factor 2 x 54 = 108.
4. The amount needed for the entire lot is 108 lbs. pre-wetted/pretreated salt brine.
5. Because the spreader is not calibrated, the setting is unknown.
6. Although the calibration setting is not known, this establishes the amount of salt to use and increases efficiency.
7. Determine the best method to spread the 108 pounds evenly across the 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 discovered the need to either reduce the amount of material that used, or to not use that material at all.
- **96%** of attendees who used rock salt found that a need to reduce the application rates.
- **24%** of all attendees used sand or salt/sand mix. It was discovered to be 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 the use of BMPs. Out of the recommended BMPs:

- 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 (UMN) - Twin Cities campus

Jim Weber - U of M Facilities Management

Over the past few years, the UMN recognized the need to become much more environmentally conscious with winter maintenance and storm water management. 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 deicing chemical 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

Percent 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

Percent 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: 1,947 tons
Percent Reduction: 99%
Material Cost: $8.30/ton
Amount Saved: $16,160 average per year (2006 – 2008)

Net-Work Services Company (NSC)

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

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

They eliminated sand use in Minneapolis and Denver and continue to educate the maintenance contractors on the impact that sand has on the environment. In the first year of the program, NCS reduced deicer use by 15-20% in parking lots and by 20-25% on sidewalks. They hope to see additional reductions in the amount 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.

Joe's Lawn and Snow

Joe Mather - Owner

Joe's Lawn and Snow is a small company located in the Twin Cities area. Joe attended the certification class in the winter of 2013-2014 and sent four employees. The changes were implemented for the last half of the season. They normally would have expected to use 20 tons of salt and only used 9 tons.

Prior to attending the class, they relied on application rates listed on the deicers and their best judgment to determine how much material to apply and did not calibrate their equipment. They learned a lot in the class and implemented many practices in their first year. Practices implemented included:

* Purchased new spreader
* Calibrated equipment
* Made a "bowl" to catch any excess salt at spinner and reuse this
* Made modifications to spreader to get more even spread and prevent salt piles
* Reduced application rates
* Tested application rates and results and kept refining
* Purchased hand-held and truck mounted temperature sensors
* Use temperature to help determine rates and materials
* Identify drainage patterns and appropriate snow storage areas prior to winter
* Use sediment traps to contain solids in runoff and they clean out manholes
* Experimented with anti-icing using liquids and will continue to experiment

They were not able to reliably calibrate and adjust their old spreader so they purchased a new one. He plans to add mud flaps with pockets to prevent salt from going all over the truck and catch extra salt which they will reuse. They tested areas in parking lots to determine the best application rates. Before winter, they mark the edges of their parking lots with blue poles and used a different color to indicate where snow should be stacked. They have a covered salt storage area on one of their properties. It is a 20 x 30' concrete walls and "tarp-type" top. It has a subfloor and a capture drain. It was a $20,000 investment. They had this prior to training. They do spring and fall sweeping.

They reduced their application rates by about ½ and then adjusted them up based on results as needed. With the changes made, they were able to reduce their salt usage by about 50% without reducing their results.

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 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 12 to 14 tons of salt during a given storm. Since training, they examined their practices and have taken 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, they 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 spillage was eliminated. That further increased the coverage per given load that was achieved.

Based on the information provided in training, they no longer apply salt or other chemicals 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 provide traction and permit traffic safety at stop signs or on slopes. In these situations, the materials are applied only sparingly after plowing is done.

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 they 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 is it reasonable to apply salt to the pavement. The mall was very receptive to only using salt when absolutely necessary. Supporting this approach, 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 the approach of using mechanical removal and then salt application as a standard process.

References and Resources

References

Axler, R. *(n.d.) How Much Salt is a Problem?* Lake Superior Duluth Streams. http://www.lakesuperiorstreams.org/understanding/impact_salt_2.html

Clear Roads Research Study: Field Evaluation of Organic Materials for Winter Snow and Ice Control. (2015). TRB Annual Meeting Paper 15-4555.

http://docs.trb.org/prp/15-4555.pdf

Freshwater Crisis. (n.d.) *National Geographic*. http://environment.nationalgeographic.com/environment/freshwater/freshwater-crisis/

Healthy Rivers: a Water Course. (2004). [Multimedia CD]. St. Paul MN: Minnesota Department of Natural Resources. http://www.dnr.state.mn.us/publications/cdroms/index.html.

Healthy Rivers: a Water Course (n.d.) [online interactive learning tool]. http://files.dnr.state.mn.us/assistance/backyard/healthyrivers/course/100/101_00.html

LRRB. (2012). Minnesota snow and ice control: Field handbook for snowplow operators. Minnesota Local Road Research Board, St. Paul, MN. http://www.mnltap.umn.edu/publications/handbooks/documents/snowice.pdf

MPCA. 2013. The condition of Minnesota's groundwater, 2007-2011. Minnesota Pollution Control Agency, St. Paul, MN. http://www.pca.state.mn.us/index.php/view-document.html?gid=19743

MPCA. 2015. Twin Cities Metropolitan Area Chloride Management Plan. Minnesota Pollution Control Agency,St. Paul, MN. http://www.pca.state.mn.us/index.php/view-document.html?gid=22754

MPCA. 2015. Twin Cities Metropolitan Area Chloride Total Maximum Daily Load. Minnesota Pollution Control Agency, St. Paul, MN. http://www.pca.state.mn.us/index.php/view-document.html?gid=22754

Parking Lot and Sidewalk Maintenance for Reduced Environmental Impacts (2005-2006). Fortin Consulting, Inc. Funded by a Minnesota Pollution Control P2 grant.

Sander, A., E. Novotny, O. Mohseni, H.G. Stefan, (2007) Inventory of Road Salt Uses in the Minneapolis/St. Paul Metropolitan Area. University of Minnesota St. Anthony Falls Laboratory Engineering, Environmental and Geophysical Fluid Dynamics. Report No. 503. Prepared for Minnesota Department of Transportation. https://conservancy.umn.edu/bitstream/handle/11299/115332/pr503.pdf?sequence=1

Stefan, H., Novotny, E., Sander, A., and Mohseni, O. 2008. Study of Environmental Effects of Deicing Salt on Water Quality in the Twin Cities Metropolitan Area, Minnesota. Minnesota Department of Transportation. Report No. MN/RC 2008-42. http://www.lrrb.org/media/reports/200842.pdf

Sohanghpurwala, A. A. (2008, February 5). *Cost of Winter Maintenance on Infrastructure*. [Power Point Presentation]. Brooklyn Center, MN: Seventh Annual Road Salt Symposium.

Additional Resources

Training and technical assistance

Anti-icing Equipment: Recommendations and Modifications. Iowa Department of Transportation. Includes drawings for shop-made equipment. http://www.iowadot.gov/maintenance/pdf/manualantiicingequipment.pdf

AASHTO Snow and Ice Pooled Fund Cooperative. Snow and Ice List Serve: http://sicop.transportation.org/Pages/SnowandIceList-Serve.aspx.

Amsler Sr., D. E. (2004). "Are You Using the Right Amount of Ice Control Chemical?" Salt & Highway Deicing, Vol. 40, No. 2.

Approved product list. (2014-2015). Minnesota Department of Transportation, St. Paul, MN. http://www.dot.state.mn.us/maintenance/pdf/approved-products-winter-chemicals.pdf

Axler, R. *(n.d.) How Much Salt is a Problem?* Lake Superior Duluth Streams. http://www.lakesuperiorstreams.org/understanding/impact_salt_2.html

Blackburn, R.; Amsler, D; & Bauer, K. (2003, July). Guidelines for Snow and Ice Control. [Power Point]. Presented at 10th AASHTO/TRB Maintenance Management Conference, Duluth MN.

Blackburn, R., Bauer, K., Amsler, D. E., Boselly, S. E., McElroy, A. D. (2004). Snow and ice control: Guidelines for materials and methods. National Cooperative Highway Research Program Report 526. Transportation Board: Washington, D.C. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_526.pdf.

Calibration Procedures Manual. (2000-2001) Circuit Training and Assistance Program (CTAP).

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. www.mnltap.umn.edu/ctap.

Correlating Lab Testing and Field Performance for De-icing and Anti-icing Chemicals. [Final report]. (2010, August 31). Western Transportation Institute for Wisconsin Department of Transportation and Clear Roads.

Determining the toxicity of de-icing materials. (2013). Clear Roads Fact Sheet. http://clearroads.org/wp-content/uploads/dlm_uploads/11-02_12-30-13-Final-Fact-Sheet.pdf

Guide to Field-Testing Deicing and Anti-Icing Chemicals. Minnesota Department of Transportation. http://www.dot.state.mn.us/products/snow_ice/index.html

Highway Deicing: Comparing Salt and Calcium Magnesium Acetate. (1991). *Special Report 235*, p. 11. Washington, D.C.: Transportation Research Board, National Research Council.

Johnson, G.R. & Sucoff, E. (2015).*Minimizing De-icing Salt Damage to Trees*. University of Minnesota Extension. http://www.extension.umn.edu/garden/yard-garden/trees-shrubs/minimizing-de-icing-salt-injury-to-trees/

Katz, D.B. (2015). *Road maps to liquids.* [Snow and Ice Maintenance Association website publication]. http://www.sima.org/news2/2015/04/16/road-map-to-liquids.

Managing Street Sweepings. (1997, September). Minnesota Pollution Control Fact Sheet w-sw4-54. http://www.pca.state.mn.us/index.php/view-document.html?gid=13934.

Manual of practice for an effective anti-icing program: A guide for highway winter maintenance personnel. (1996). Washington, D.C.: Federal Highway Administration. http://www.fhwa.dot.gov/publications/research/safety/95202/index.cfm

Minnesota Snow and Ice Control Field Handbook for Snowplow Operators. (2012, October). http://www.lrrb.org/media/reports/200501REV.pdf.

Minnesota's Stormwater Manual. (2005, November). Minnesota Pollution Control Agency. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/minnesotas-stormwater-manual.html.

National Weather Service http://www.noaa.gov/

Nixon, W.A. (2004, January). "Snow-How." Snow & Ice Manager. Primedia Business Magazines and Media. http://grounds-mag.com/snow_ice/2004_january_snow/.

Pacific Northwest Snowfighters. http://pnsassociation.org/.

Parker, J. Liquids, How to get Started. (2006). [Power Point]. Presented at the Snow and Ice Management Association's Snow and Ice Symposium.

Plant selector tool. [Interactive program on-line]. Minnesota Department of Transportation. Allows you to select plants for many conditions including high salt areas. http://www.dot.state.mn.us/roadsides/plantselector/index.html

Practical Guide for Storing and Handling Deicing Salt. (2006). Alexandria, VA: Salt Institute.

http://landscapemanagement.net/wp-content/uploads/2014/05/The-Salt-Storage-Handbook.pdf

Protecting Water Quality in Urban, Chapter 7 – Pollution Prevention. (2000, March 1). Minnesota Pollution Control Agency. Information on street sweeping and re-use of sweepings. http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/stormwater-management/stormwater-best-management-practices-manual.html.

RWIS – Road Weather and Information System. www.rwis.dot.state.mn.us [Internet-based weather service]. MN/DOT. Information comes from sensors embedded in state highways.

Salt Institute. *Calibration Instructions* [with downloadable Excel worksheet]. http://www.saltinstitute.org/wp-content/uploads/2013/06/Summer-Vol-46-No-3.pdf

Snow & Ice Control 2014. Cornell Local Roads Program: New York LTAP Center. http://www.clrp.cornell.edu/workshops/manuals/snow_and_ice_control.pdf.

Snow and Ice Management Association (SIMA). www.sima.org.

Transportation Association of Canada. Syntheses of Best Practices-Road Salt Management:

http://tac-atc.ca/en/bookstore-and-resources/free-resources-and-tools/syntheses-practice

Twin Cities Metro Area Chloride Management Plan. [Power Point]. (2013, February 7).

http://freshwater.org/wp-content/uploads/2013/02/Brooke-Asleson1_Road-Salt-Symposium_02-07-13-.pdf

Winter Chemical Catalog. (n.d.) Minnesota Department of Transportation, St. Paul, MN. http://www.dot.state.mn.us/maintenance/pdf/research/winterchemcatalog.pdf

Winter Maintenance training for parking lots and sidewalks. Also Winter Maintenance for Roads training. Fortin Consulting Inc. 763-478-3606. connie@fortinconsulting.com and www.fortinconsulting.com.

Winter Maintenance Voluntary Certification Program. Minnesota Pollution Control Agency. www.pca.state.mn.us/programs/roadsalt.html.

Winter Operations. (2010). [Website]. University of New Hampshire Technology Transfer Center. http://www.t2.unh.edu/winter-operations.

Websites: more information on deicers

Alternatives to Sodium Chloride. [Website]. Bard Center for environmental Policy. http://www.roadsaltsmart.com/alternatives-to-sodium-chloride/

Break the Ice: Comparison of Ice Melting Chemicals. (2006). Peters Chemical Company. http://www.peterschemical.com/break-the-ice-comparison-of-ice-melting-chemicals/

Fischel, M. *Evaluation of Selected Deicers Based on a Review of the Literature*. Report No. CDOT-DTD-R-2001-15 Final Report. (2001, October 31). The SeaCrest Group for the Colorado Department of Transportation Research Branch. https://www.codot.gov/programs/research/pdfs/2001/deicers.pdf

Greenawalt, L. (2006, July 1). *Clean Melt: A Scientific Primer on Deicers*. Clean Link website. http://www.cleanlink.com/sm/article/Ice-Melt-A-Scientific-Primer-On-Deicers--4896

Holt, M. (2013, November 22). *When it comes to Deicing, Not all Salt is Created Equal.* Cornell University Cooperative Extension website. http://blogs.cornell.edu/ccecattall/2013/11/22/when-it-comes-to-deicing-not-all-salt-is-created-equal/

Ice Melting 101: The Truth about Melting Ice and Snow. (2015). [Brochure]. Dri-Now Products website. http://www.climaterx.com/ice-melt-101/

Winter Maintenance: Choosing a Deicer. (n.d.) [brochure, on-line] Nine Mile Creek Watershed District. http://www.ninemilecreek.org/Education/PDFs/Buying%20a%20Deicer_NMCWD.pdf

Appendix

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

Figure 25 Material Conversions

The following formulas and the above quick reference table will help to 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

Figure 26. 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 – 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 F

FACILITY STORM WATER MANAGEMENT AND CONTROL DEVICE INSPECTIONS FORMS

City of Holland – Holland Public Schools

Facility Storm Water Management and Control Device Inspection Form

To be completely at least monthly.

Facility Name: **Maintenance and Transportation Center** Date: _____

Person completing form (printed name): _____

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

___ oil/water separator

___ open drains

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

_____ _____

Inspector's Signature Title

City of Holland – Holland Public Schools

Facility Storm Water Management and Control Device Inspection Form

Storm Water Maintenance Needs for <u>Maintenance and Transportation Center</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: ____________________________________

____

City of Holland

Facility Storm Water Management and Control Device Inspection Form

To be completely at least monthly.

Facility Name: **Parks Warehouse** 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

___ retention pond

___ Catch basins

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

_____ _____

Inspector's Signature Title

City of Holland

Facility Storm Water Management and Control Device Inspection Form

Storm Water Maintenance Needs for Parks Warehouse

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: _______________________________________

____

City of Holland

Facility Storm Water Management and Control Device Inspection Form

To be completely at least monthly.

Facility Name: **Transportation Services** 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

___ oil/water separator

___ Other (list)

___ wetland retention

_____

_____

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

_____ _____

Inspector's Signature Title

City of Holland

Facility Storm Water Management and Control Device Inspection Form

Storm Water Maintenance Needs for <u>Transportation Services</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: ____________________________________

____

City of Holland

Facility Storm Water Management and Control Device Inspection Form

Medium and Low priority facilities ♦ To be completed every six months

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	Storm water discharge points
catch basins	Other (list)
infiltration facility	_____
bioretention facility (e.g. rain garden)	_____
detention ponds	_____

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

City of Holland

Facility Storm Water Management and Control Device Inspection Form

Medium and Low priority facilities ♦ To be completed every six months

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:

APPENDIX G

STORM WATER COMPREHENSIVE SITE INSPECTION FORMS

Storm Water Comprehensive Site Inspection

With Fuel Station

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 FACILITY:	
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?				

Storm Water Comprehensive Site Inspection

With Fuel Station

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?				

Storm Water Comprehensive Site Inspection

With Fuel Station

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?				

Storm Water Comprehensive Site Inspection

With Fuel Station

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?				

Storm Water Comprehensive Site Inspection

With Fuel Station

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?				

Storm Water Comprehensive Site Inspection

With Fuel Station

Salt Storage				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are salt piles stored in a salt storage building or under a roof?				
Are salt spills at a facility cleaned up promptly?				
Does stormwater drain away from the salt pile?				
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 Facility Manager or person in charge of storm water program. A copy will be provided to the Environmental Coordiantor.

Inspector's Signature

Date

Storm Water Comprehensive Site Inspection

Without Fuel Station

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 FACILITY:	
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?				

Storm Water Comprehensive Site Inspection

Without Fuel Station

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?				

Storm Water Comprehensive Site Inspection

Without Fuel Station

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?				

Storm Water Comprehensive Site Inspection

Without Fuel Station

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?				

Storm Water Comprehensive Site Inspection

Without Fuel Station

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?				
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?				
Salt Storage				
	Yes	**No**	**N/A**	**Notes/Maintanence Needs**
Are salt piles stored in a salt storage building or under a roof?				
Are salt spills at a facility cleaned up promptly?				
Does stormwater drain away from the salt pile?				
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?				

Storm Water Comprehensive Site Inspection

Without Fuel Station

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 Facility Manager or person in charge of storm water program. A copy will be provided to the Environmental Coordiantor.

Inspector's Signature

Date

APPENDIX H

STORMWATER SYSTEM MAINTENANCE PLAN

City of Holland

Stormwater System Maintenance Plan

PREPARED FOR:
CITY OF HOLLAND TRANSPORTATION SERVICES
HOLLAND, MICHIGAN

JUNE 30, 2014

PREPARED BY
FISHBECK, THOMPSON, CARR & HUBER, INC.

PROJECT NO. G110673MP5

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LIST OF ABBREVIATIONS/ACRONYMS

City	City of Holland, Michigan
GIS	Geographic Information System
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System

Maintenance Plan Elements

- **Purpose**
- **Type of Maintenance**
- **Frequency and Timing**
- **Performance**
- **Reporting/Record Keeping**
- **Evaluation**
- **Training**
- **Solid Waste Handling**

Purpose

The City of Holland (City) believes it is in the best interest of the residents for the City to assume the responsibility of inspecting and maintaining its public storm water system. Reasonable inspection and maintenance is necessary for the protection of property, vehicle and pedestrian safety, water quality protection, and to comply with the requirements of the City's MS4 NPDES permit.

This plan is a guide for City staff and residents of the community. The City may deviate from this plan if they feel it is in the best interest of the City while considering unusual circumstances or emergency conditions.

Type of Maintenance

Routine Maintenance – Repetitive maintenance activities performed on a regular schedule (i.e. catchbasin cleaning), or addressing impairments as the need arises (i.e. removing trash and debris).

Inspection – A formal review of system components and function performed in conjunction with routine maintenance, or in response to a service request or emergency condition.

Corrective Maintenance – Performed in response to an identified deficiency found through inspection.

Emergency Maintenance – A failure or condition that presents an immediate threat to public health and safety.

Deficiency – A failure or other damage requiring repair.

Frequency and Timing

Routine maintenance work will be completed on a designated schedule as specified for each stormwater system component and summarized in ***Table 1***.

Inspection will be performed on a designated schedule as specified for each stormwater system component (see ***Table 1***), or in response to a service request, in which case inspection will be completed within three (3) business days.

Corrective maintenance work will be addressed within sixty (60) days of Work Order.

Emergency work will be addressed within thirty-six (36) hours of notification.

Performance

The City will use its own employees, equipment and/or private contractors to complete the inspections and maintenance. Inspection and maintenance will typically be conducted during a regular eight (8) hour work day when weather conditions permit. Extended workdays and shift changes may be necessary for emergency conditions to provide maximum efficiency.

Service requests will be taken by the City during normal business hours and after working hours by those designated as emergency contacts. Problems requiring immediate attention will be handled on a priority basis as determined by the City.

Reporting/Record Keeping

The City has developed a comprehensive stormwater system map with priority areas identified for maintenance, which is available on the City's GIS. The map shows City-owned storm sewer, outfalls, drainage structures, open drains and culverts, stormwater facilities and pump stations. This map used in conjunction with the City's GIS and this maintenance plan provide the City with the ability to adequately perform and record inspections, schedule and perform maintenance activities and generate valuable reports.

The City will document all of its inspection, maintenance, service request and emergency responses. All findings, determinations and courses of action will be properly entered into the City's GIS. The City will also document circumstances that limit its ability to comply with this policy. At a minimum, the records will show by date which stormwater system components have been inspected and maintained. The City will also develop a list of stormwater system components that are not functioning as intended. Any unusual flows, spills or illegal dumping incidents observed during inspection (particularly dry weather flows) and the follow-up actions/referrals will also be documented.

These records shall be kept in accordance with the City's record retention policy.

Evaluation

The City will review the records annually to critique the effectiveness of storm drain operation and maintenance activities. Modifications to stormwater system operation and maintenance activities shall be identified as necessary. Opportunities for structural retrofit and design changes to be included in planning and design phases of Capital Improvement Projects will also be identified.

Training

The City will provide a minimum of eight (8) hours of training for stormwater operation and maintenance personnel at least once a year with emphasis on:

- Health and safety
- Regulations and liability
- Proper equipment and maintenance technique
- Consistent and accurate record-keeping
- Controlling stormwater pollution through stormwater system operation and maintenance.

Dewatering and Solid Waste Handling

Dewatering operations are practices that manage the discharge of pollutants when non-stormwater and accumulated precipitation must be removed from a work location.

Solid waste is generally defined as non-soluble material that is discarded in a solid or semi-solid form. This includes garbage, refuse, sludge and other discarded domestic materials, as well as waste from industrial, commercial, agricultural and mining operations.

The City and its Contractors will follow proper dewatering and solid waste handling procedures in accordance with "Catch Basin Cleaning Activities Guidance Document" (Michigan Department of Environmental Quality, 10/4/07) included in ***Appendix 1***.

Table 1 – Schedule of Routine Maintenance Work

Stormwater System Component	Month of the Year											
	J	F	M	A	M	J	J	A	S	O	N	D
Storm Sewer				X	X	X	X	X	X	X	X	
Drainage Structure				X	X	X	X	X	X	X	X	
Stormwater Pump Station			X					X				
Stormwater Facility				X	m	m	m	m	m	X		
Open Channel												X
Channel Stability Measure												X
Culvert												X
Street Sweeping			X	X	X	X	X	X	X	X	X	
Porous Pavement	s	s	s	X						X	s	s
Landscaping				w	X	w	w	w	X	w		

X = scheduled inspection and maintenance (by priority area)
m = mow as necessary
s = snow removal as necessary
w = weed as necessary

Stormwater System

- **Definition**
- **Measures**
- **Procedures**
- **Frequency and Timing**
- **Standard Inspection Items and Corrective Action**

Storm Sewer

Definition
An underground system of pipes built to collect and convey excess stormwater in times of heavy rain.

Measures
Routine inspection and cleaning.

Procedures
Visual inspection of storm sewer inlets and outlets. Manual removal of sediments, trash and debris for minor clogs.

Frequency and Timing
Routine inspection and cleaning will primarily take place from mid-April to mid-November, resulting in 100% of the City's outfalls and discharge points being inspected once per NPDES permit cycle.

Standard Inspection Items and Corrective Action

Compromised Sewer Pipe
The sewer pipe has deteriorated, been damaged, or separated at the joints. Inspect pipe at drainage structures for signs of deterioration, clogging, or damage. Sink holes above the pipe are good indicators of either a pipe section failure or poor joint seal. If evidence of a problem exists but the cause cannot be identified, videotaping of the drain pipe may be required. Maintenance repairs may include:
1. Re-grout or seal cracks, holes, or separated joints.
2. Replace damaged sections of pipe.

Clogged Sewer Pipe
Sediment or debris is obstructing flow through the storm sewer. Compare the water flow through drainage structures upstream and downstream of the clogged sewer pipe. Higher water levels in an upstream drainage structure could also be a sign of a clogged sewer pipe.

A vactor truck, high pressure jet or roto-rooter is typically required to remove sediment or debris from a storm sewer system. Videotaping of the pipe may be required to identify the location of the obstruction or if the structural integrity of the pipe has been compromised (see compromised sewer pipe).

Erosion at Pipe Inlet
When open channel flow enters an enclosed drain via a daylighted pipe, erosion at the inlet may occur. Stabilize the area using the following measures:
1. Install riprap placed over geotextile fabric around and beneath pipe.
2. Install a flared end section.

Erosion at Outlet
When an enclosed drain enters open drain, erosion at the outlet may occur. Stabilize the outfall using the following measures:
1. Install riprap placed over geotextile fabric around and beneath pipe.
2. Install riprap on opposite bank if needed to prevent erosion.
3. Grade and/or berm at the top of bank above outfall to prevent gully erosion at the outlet.

Clogged Pipe Inlet
Sediment, trash, or debris is obstructing flow through the drain inlet and may cause localized flooding or ponding. Minor inlet clogs are those that can generally be removed manually. Major clogs may require the use of additional equipment.

Clogged Outlet
Sediment, trash or debris is obstructing flow out of the storm sewer and may cause localized flooding or ponding. Minor outlet clogs can generally be removed manually.

Drainage Structure

Definition
Open-grated inlets into the storm sewer system also referred to as catch basins.

Measures
Routine inspection and cleaning.

Procedures
Visual inspection. Measurement of the amount of sediment in the sump. Catchbasin cleaning.

Frequency and Timing
Routine inspection and cleaning will primarily take place from mid-April to mid-November, resulting in 100% of the City's drainage structures being inspected once per NPDES permit cycle.

Standard Inspection Items and Corrective Action

Compromised Drainage Structure
The drainage structure or casting has been damaged as evident by signs of cracking, settling, or chipping. Casting may be missing. Joints may have separated or been improperly sealed often resulting in excessive sediment buildup within the structure and/or sinkholes adjacent to the drainage structure. Maintenance repairs may include:
1. Re-grout or seal cracks, holes, or separated joints.
2. Replace damaged castings or drainage structure sections.

Sediment Sump Full
The purpose of a sediment sump is to trap, collect and store sediment, as well as provide a location to remove accumulated sediment. When sediment or debris has filled up the sediment sump in the drainage structure, the sediment needs to be removed to restore the particle settling capability of the sump. A full sediment sump can be detected by measuring the amount of sediment in a drainage structure. A vactor truck is typically required to remove sediment or debris from a drainage structure.

Clogged Inlet
Sediment, trash, or debris is obstructing flow through the drain inlet and may cause localized flooding or ponding. Minor inlet clogs are those that can generally be removed manually. Major clogs may require the use of additional equipment.

Stormwater Pump Station

Definition
An enclosure consisting of a wet well, pump(s), chamber and electrical system for the purpose of pumping stormwater to a higher elevation through a force main when gravity flow is not practical.

Measures
Routine inspection, service, calibration of instrumentation and cleaning.

Procedures
Visual inspection, and service completed for all equipment and housing in accordance with pump station operation and maintenance manual.

Frequency and Timing
In accordance with the Operation and Maintenance Plan for the pump station. Bi-annual inspections will be scheduled at the end of winter before spring rainy season, and end of summer during the dry season.

Stormwater Facility

Definition
Stormwater facilities, also referred to as detention or retention basins, collect, temporarily store and treat surface runoff from a developed site. Stormwater management facilities include structural and non-structural practices intended to manage the volume, rate, and quality of stormwater runoff.

Measures
Routine inspection and mowing.

Procedures
Visual inspection of facility, inlet, outlet, and overflow structures. Mow vegetation.

Frequency and Timing
Inspect a minimum of twice a year in the spring and in the fall. Mow annually in the fall to prevent establishment of woody vegetation. For manicured facility, mow as needed throughout the growing season.

Standard Inspection Items and Corrective Action

Stormwater facility inspections will assess vegetation, erosion, flow channelization, bank stability, inlet/outlet conditions, embankment and sediment/debris accumulation.

Sediment Forebay Full
The purpose of a sediment forebay is to trap, collect and store sediment, as well as provide a location to remove accumulated sediment. When sediment or debris has filled up the sediment forebay in the stormwater facility, the sediment needs to be removed to restore the particle settling capability of the sump. An excavator is typically required to remove sediment or debris from a sediment forebay.

Erosion at Pipe Inlet
When open channel flow enters an enclosed section of pipe, erosion at the inlet may occur. Stabilize the area using the following measures:
1. Install riprap placed over geotextile fabric around and beneath pipe.
2. Install a flared end section.

Erosion at Outlet
When an enclosed section of pipe enters an open drain, erosion at the outlet may occur. Stabilize the outfall using the following measures:
1. Install riprap placed over geotextile fabric around and beneath pipe.
2. Install riprap on opposite bank if needed to prevent erosion.
3. Grade and/or berm at the top of bank above outfall to prevent gully erosion at the outlet.

Clogged Pipe Inlet
Sediment, trash, or debris is obstructing flow through the drain inlet and may cause localized flooding or ponding. Minor inlet clogs are those that can generally be removed manually. Major clogs may require the use of additional equipment.

Clogged Outlet
Sediment, trash or debris is obstructing flow out of the storm sewer and may cause localized flooding or ponding. Minor inlet clogs are those that can generally be removed manually. Major clogs may require the use of additional equipment.

Compromised Outlet Control Structure
The outlet control structure or casting has been damaged as evident by signs of cracking, settling, or chipping. Casting may be missing. Joints may have separated or been improperly sealed often resulting in excessive sediment buildup within the structure and/or sinkholes adjacent to the drainage structure. Stone filter around a perforated stand pipe may be clogged. Maintenance repairs may include:
1. Re-grout or seal cracks, holes, or separated joints.
2. Replace damaged castings or drainage structure sections.
3. Replace and/or rejuvenate stone and filter fabric.

Emergency Overflow Spillway
Inspect the emergency overflow spillway for evidence of erosion and/or structural integrity. If damage is found, the damage is typically repaired by replacement of riprap or concrete; or re-grading, seeding and installing mulch blanket on the embankment.

Embankment
Inspect the embankment for evidence of erosion and/or tunneling or borrowing by wildlife. If damage is found, the repair damage by re-grading, seeding and installing mulch blanket on the slope, and removing the animals.

Vegetation
Inspect vegetated areas for unwanted growth and invasive species. If present, remove unwanted growth/invasive species. Maintain vegetative cover at a minimum of 85 percent, otherwise seed and mulch bare areas. Mow and/or trim vegetation as necessary to sustain the system.

Safety and Access Features
Inspect fences, locks, and signs for vandalism and graffiti. If vandalism has occurred, report the incident to Public Safety, repair fences and gates, and replace broken locks. If present, remove graffiti or replace signs. If vandalism becomes a reoccurring problem, an action plan will be developed in cooperation with Public Safety. Inspect the entire fence line for potential problem areas, and make minor adjustments to the gate periodically to ensure the fence and gate remains in good working order. Inspect access roads for pot holes. If present, repair pot holes to ensure a safe access road.

Open Channel

Definition
Open-channel flow, a branch of hydraulics, is a type of liquid flow within a conduit with a free surface, known as a channel. The other type of flow within a conduit is pipe flow. These two types of flow are similar in many ways, but differ in one important respect: the free surface.

Measures
Routine inspection and spraying.

Procedures
Inspection: Visual inspection by walking open channels. Identify problem areas with photographs and GPS coordinates for mapping. Tape or rod for measuring approximate dimensions of work areas.

Spraying: Applicator must be certified and follow manufacturer's instructions. Obtain all appropriate permits.

Frequency and Timing
Annually in the spring or in the fall.

Standard Inspection Items and Corrective Action

Lack of Vegetation on Side Slope
If there is no vegetation on the channel side slope, erosion of the side slope may occur. Lack of vegetation may be caused by lack of sunlight to the side slope if the channel is in a heavily wooded area. Selectively cut the tree canopy to allow sunlight to the channel side slope prior to installing topsoil, seed and mulch blanket.

Rill or Gulley Erosion on Side Slope
Rill erosion is a form of overland erosion where stormwater runoff concentrates in rivulets, causing small grooves along the slope develop. Individual rills range in depth and width up to several inches and reflect a tremendous loss of soil. Gully erosion will develop if rilling is not corrected immediately. The depth of erosion defines the difference between rills and gullies, with gullies being much deeper and wider than rills. Gullies can form wherever the topography or paved surfaces concentrate water into an area that cannot handle the flow.

Rill Erosion: Install a permanent vegetated buffer strip along the top of the drain bank: re-grade, seed and install mulch blanket on the slope.

Gully Erosion: Install a permanent vegetative buffer strip along the top of the drain bank, re-grade the bank and install an armored rock rip rap spillway, a pipe drop spillway, or a reinforced vegetative spillway in the location of the gully.

Erosion at Toe of slope and/or slope failure
Erosion at the toe of slope occurs from high flows, stream meandering, or from debris which has redirected the flow of water against the bank. Slope failure can occur when there are changes in the water table in the slope; an increased height of the slope due to stream bed degradation, bank

or toe erosion; when a stream bank is too steep; and when loads are added to the top of the streambank such as adding spoil.

Erosion of toe of slope: Once any debris has been removed, install tree revetments, or bioengineering techniques, as recommended by an engineer. Soil bioengineering measures slow the water velocity near the slope face and help to reinforce the surface soils. Riprap armoring may be needed in critical or high velocity areas.

Slope failure: Re-grade and re-seed the bank. Depending on the severity of the slope failure, bioengineering may be used along with the bank re-grading to further stabilize the bank. Underdrain may be necessary if slope failure is due to a groundwater seep with a large amount of pore water pressure that cannot be stabilized using vegetation or riprap.

Headcutting of Channel Bottom

The channel bottom is eroding (headcutting) as indicated by a waterfall or sudden drop in bottom elevation. Install a grade control structure, or series of grade controls such as check dams or rock riffle sections, across the channel bottom as recommended by an engineer.

Erosion at Storm Sewer Outlet

An enclosed storm sewer outletting to an open channel has eroded the channel bank at the discharge point. Recess pipe outlet into the bank or add fill provide a uniform bank and to prevent the pipe from protruding. Install riprap around and beneath the pipe over geotextile fabric. Where possible, direct flow downstream. Install riprap on the opposite bank if needed to prevent erosion. Construct a small berm at the top of bank above the outfall to prevent gully erosion at the trench. Stabilize all disturbed areas with seed and mulch blanket.

Excessive Vegetation in Channel

Vegetation in the channel bottom limits flow capacity and poses a threat to channel and bank stability by diverting flow. If possible, maintain the vegetation on south and west drain banks. Chemical applicators, heavy equipment, light machinery, and hand tools, may be needed. Cut vegetation within a few inches of the ground surface, leave root zone intact and do not grade area. Stump treatments may be applied to prevent re-sprouting. Remove cut vegetation and dispose in the City's recycling facility. If a tree must be cut from within the channel, cut it during low flow conditions.

Excessive Sediment Deposition

When sediment has accumulated so that the drain is not providing adequate drainage, remove excess sediment from the channel bottom. When practical, clear north and east banks to maintain shading of the stream. Install downstream sediment control measures such as sediment sumps and check dams or sheet piling prior to commencing earth change activities. When practical, begin sediment removal downstream and work upstream. Seed, apply mulch when necessary, or otherwise stabilize disturbed drain banks daily and stabilize disturbed areas, either temporarily or permanently, within 5 days. Truck spoils offsite and dispose of appropriately per solid waste handling requirements.

Debris or Log Jam

Debris is deadfall and other objects such as shopping carts, tires, appliances, and mattresses that have accumulated in the open channel. Debris removal is important to prevent flooding, reduce safety hazards and prevent bottom scour and channel bank erosion.

A log jam is an accumulation of large woody debris such as logs more than four inches in diameter and over six feet long that can span an entire channel. Log jams alter flow hydraulics, which control characteristics of erosion and sediment deposition. Log jams also cause shifts in stream flow. They often redirect flow into former channels or cause the creation of new channels. Chain saws and heavy equipment may be needed for debris and log jam removal. Remove debris minimizing channel bottom and bank disturbance. Use “clean and open” method where feasible.

Channel Stability Measure

Definition
Hard armoring used to stabilize an erodible channel.

Measures
Routine inspection of riprap, concrete lining, sheeting, dam, etc.

Procedures
Visual inspection. Identify problem areas with GPS coordinates for mapping. Tape or rod for measuring approximate dimensions of work areas.

Frequency and Timing
Inspect structures after large rain events. Inspect other structures annually in conjunction with open channel inspection.

Standard Inspection Items and Corrective Action

Displaced Rip Rap
Riprap may become displaced by high flow velocities, vandalism or other disturbances, exposing geotextile fabric and increasing the risk of erosion. If riprap has been displaced and the geotextile fabric is damaged during high flow conditions, remove riprap, repair geotextile fabric and replace riprap with appropriate size. If riprap has been displaced by vandalism, riprap may need to be grouted. If riprap has been displaced by gravity, side slopes may need to be graded flatter or angular rock or broken concrete used in lieu of rounded field stone.

Scour Around Rip Rap
Erosion may occur around riprap if high flow conditions occur, if the riprap is not the appropriate size for the design flows, or if the riprapped area does not cover enough of the flow area. If riprap has been displaced and the geotextile fabric is damaged during high flow conditions, remove riprap, regrade eroded bank, repair geotextile fabric and replace riprap with appropriate size. Expand area as needed (upward, downward - toe, longitudinally). Bioengineering measures such as facsines and brush mattresses can be used to aid in the longitudinal transition to a vegetated bank.

Scour Around Concrete Lining
Erosion may occur around concrete lining if flows find their way under or behind the concrete. Regrade eroded bank, place geotextile fabric and riprap with appropriate size. Expand area as needed (upward, downward - toe, longitudinally). Do not replace damaged concrete channel lining with more concrete.

Scour Around Sheeting
Erosion may occur around sheeting if high flow conditions occur, or concentrated surface runoff causes rill or gulley erosion behind the sheeting. Regrade eroded bank, place geotextile fabric and riprap with appropriate size. Expand area as needed (upward, downward - toe, longitudinally).

Failed Sheeting

Sheet pile walls can fail if earth and/or water pressure causes the sheets to disjoint from one another and to move from their vertical position. Failed sheeting may require an underdrain. Repair work will require heavy equipment and should be completed by a contractor.

Culvert

Definition
A relatively short enclosure to carry a stream or open drain under a road, railroad, driveway or other use.

Measures
Routine inspection.

Procedures
Visual inspection.

Frequency and Timing
Inspect critical structures after large rain events. Inspect other structures annually in conjunction with open channel inspection.

Standard Inspection Items and Corrective Action

Compromised Culvert or Culvert End Treatment
The culvert or end treatment has been compromised. Joints may have separated or been improperly sealed often resulting in excessive sediment buildup within the culvert and/or sinkholes adjacent to the culvert. The culvert material may have deteriorated (in the case of a metal pipe). The culvert end treatment may have broken off and fallen into the stream/drain/ditch. Maintenance repairs may include:
1. Re-grout or seal cracks, holes, or separated joints.
2. Replace damaged end sections.
3. Replace culvert.

Clogged Inlet or Outlet
Sediment, trash, or debris is obstructing flow through the culvert inlet or outlet and may cause localized flooding or ponding. Inlet or outlet clogs may need to be removed mechanically.

Street Sweeping

Definition
The act of mechanically cleaning streets and gutters by sweeping, vacuuming, spray washing or some combination thereof, usually performed in an urban area.

Measures
Routine street cleaning.

Procedures
Sweep streets and maintain street sweeper. Identify and designate streets, roads, and public parking lot sweeping within jurisdiction by the following three categories: high, medium or low priority.

- High Priority: High traffic zones, heavy commercial and industrial districts, shopping malls, high density residential dwellings, plazas, and areas that consistently generate high volumes of trash, debris and other stormwater pollutants
- Medium Priority: Medium traffic zones, warehouse districts, and medium commercial and industrial districts
- Low Priority: Light traffic zones, residential zones and light commercial districts.

Frequency and Timing
Sweep streets/roads/public parking lots as follows:

- *High Priority*: average of at least twice per month
- *Medium Priority*: average of at least once per month
- *Low Priority*: as necessary, but at least twice before the onset of the rainy season.

Standard Inspection Items and Corrective Action

Operate all sweepers according to the manufacturer's recommended procedures. Normally centerlines are swept after gutter lines are cleaned. Operate sweepers at manufacturer requested optimal speed levels to increase effectiveness. Maintain cleaning equipment in good working condition and purchase replacement equipment as needed. Publicize street sweeping schedule. Regularly inspect vehicles and equipment for leaks, and repair immediately. Make sure brushes and water spray hoses are functional before leaving the shop. Fill the water tank daily or as needed.

Porous Pavement

Definition
Bituminous or concrete pavement or paving bricks constructed with aggregate and little to no fines that allow stormwater to infiltrate through the pore space between aggregates and thereby reduce the volume of stormwater runoff generated by the paved surface.

Measures
Routine inspection and cleaning.

Procedures
Visual inspection. Check water levels in monitor wells or cleanouts (if any), vacuum sweep pavement. Remove snow.

Frequency and Timing
Inspect and vacuum sweep twice a year in the spring and in the fall after leaves are down. Inspect and clean underdrain cleanouts at the same time. Snow removal as necessary throughout the winter season.

Standard Inspection Items and Corrective Action

Sediment or Organic Matter Sealing Voids in Pavement
Accumulation of fine sediments and organic matter (pollen, leaf detritus) in the void spaces of the porous pavement can cause clogging and a reduction in the permeability. The surface material can usually be effectively removed by sweeping and vacuuming with a Vactor truck. If the pavement surface has become significantly clogged such that routine vacuum sweeping does not restore permeability, then wash the porous pavement with clean, low pressure water, followed by immediate vacuuming.

Snow Removal
Winter maintenance for porous pavement may be necessary. Do not apply abrasives such as sand or cinders on or adjacent to the porous pavement. Snow plowing is necessary for significant snow accumulation. Perform snow plowing carefully (i.e. by setting the blade slightly higher than usual, about an inch). Standard road salt is acceptable for use as a deicer on porous pavement, although more environmentally-benign deicers are preferable. Follow supplier recommendations when applying deicers to pavement.

Raveling of Pavement Surface
Damaged areas, or potholes, less than 50 square feet, can be patched with porous or standard asphalt. Patch larger areas with an approved porous asphalt. Never seal coat the porous pavement surface.

Underdrain not Functioning

An underdrain is a perforated pipe placed in the bottom stone layer of the porous pavement section. The purpose of the underdrain is to remove extra water in the stone layer below the porous pavement if infiltration into the soil below is hindered. Checking the water level in a monitor well or cleanout will indicate if a drainage problem exists. To clean a clogged underdrain, flush pipe through inlets leading to the subsurface bed.

Landscaping

Definition
Improving the aesthetic appearance of a piece of land by changing its contours, adding ornamental features, or planting trees and shrubs.

Measures
Routine inspection and maintenance of rain gardens and planter boxes within street rights-of-way.

Procedures
Visual inspection, check water level in monitor wells (if any), weeding, watering.

Frequency and Timing
Inspect a minimum of twice a year in the late spring and early fall. Weed monthly or as needed. Water plants and trees every week as needed during first growing season.

Standard Inspection Items and Corrective Action

Weeds
A weed is an undesirable plant that is growing where it is not wanted. If weeds exist in the landscaping, they may hinder the growth of the desirable plants. Weeds and debris (including garbage or trash) should be removed from the landscaped areas by hand.

Watering
Water is vital for plant survival. Water plants during the first growing season to help ensure their establishment.

Pruning
Pruning is cutting off part of the plant to produce a desired growth response. Pruning helps to keep plants at a desired size and removes all dead, diseased, broken and injured parts. Use pruning shears to prune woody plants by hand as needed. Plants can be pruned during any season of the year for the removal of dead, diseased, broken, or injured parts.

Damaged Edging or Landscape Structures
High velocity water flow, or other unforeseen factors, may damage landscape edging or structures. Replace the edging or landscape structures by hand with the same type of material that was damaged.

Holes and Displaced Plants
The velocity of water flow into a rain garden or planter box area may cause scour holes or plants to be uprooted. Animals may also burrow and dig up plants. Other unforeseen factors may also cause destruction to the planting area. Re-grade the area around the hole, and use the surrounding soil to fill in the hole. Re-plant uprooted plants or replace in-kind.

Underdrain not Functioning

An underdrain is a perforated pipe placed in a bottom stone layer of the raingarden or planter box. The purpose of the underdrain is to remove extra water in the soil mix if infiltration into the soil below is hindered. Checking the water level in a monitor well or cleanout will indicate if a drainage problem exists. To clean a clogged underdrain, flush pipe through inlets leading to the subsurface bed.

Appendix 1

Catch Basin Cleaning Activities Guidance Document

Catch Basin Cleaning

Catch Basin Cleaning Activities Guidance Document

Catch Basin Cleaning Activities

Catch basins are included in storm sewer system designs in order to remove solids such as gravel, sand, oils, and organic material carried by storm water. Catch basins also contain elevated concentrations of metals (attached to the solids) from street runoff or drainage from industrial, commercial and residential properties. In order to maintain the storm sewer systems effectiveness, catch basins must be periodically cleaned out. The Department of Environmental Quality (DEQ) Water Bureau (WB) and Waste and Hazardous Materials Division (WHMD) oversee environmental regulations pertaining to this activity. The Michigan Occupational Safety and Health Administration (MIOSHA) within the Department of Labor and Economic Growth oversee confined space entry and other worker health and safety standards.

In the past, the waste generated from the catch basin cleaning activities was typically discharged back into the storm sewer system. This type of discharge is unauthorized per Part 31, Water Resources Protection (Part 31) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) and is therefore illegal. The combined solid and liquid waste stream (solid/liquid waste) from cleaning storm sewers systems is legally defined as “liquid industrial waste” pursuant to Part 121, Liquid Industrial Wastes (Part 121) of NREPA.

The following are options recommended to properly deal with the waste stream generated from catch basin cleaning activities:

1. Have the waste transported to drying beds to separate the solid/liquid waste. This is usually performed at a publicly owned treatment plant or at a privately owned permitted facility where the liquid portion of the waste stream is separated from the solids and treated.

2. Request permission from the local wastewater treatment plant operator to discharge the combined solid/liquid waste into the sanitary system. Most treatment plants will require pre-treatment prior to the discharge. All applicable local ordinance provisions must be followed.

3. When conducting catch basin maintenance activities where the above options are not available, the following method can be used as long as there are no discharges to surface waters during dry weather conditions.

- Conduct visual inspection to ensure the water in the sump has not been contaminated. If necessary, collect a grab sample of the water and look for signs of contamination such as visible sheen, discoloration, obvious odor, etc. See the EPA Visual Inspection guidance for more tips. If there is any doubt of the quality of the water, it should be collected into the Vactor truck and treated as waste under Part 121 or Part 115 Solid Waste Management (Part 115) of NREPA.

- Using a sump pump, or any other pumping mechanism, remove the majority of water in the sump of the basin without disturbing the solid material below. Do not use pumps connected to the Vactor truck's holding tank.

- The clear water may then be directly discharged to one of the following:
  - Sanitary system (with prior approval from local sewer authority)
  - Curb and gutter
  - Back into the storm sewer system as long as it is contained within the system during dry weather condition to ensure no discharge into surface water
  - Applied to the ground adjacent to the catch basin (evenly distributed at a maximum rate of 250 gallons/acre/year)

- The remaining liquid/solid in the sump should be collected with a Vactor truck and disposed of off-site in accordance with Parts 115 or 121.

The entity whose catch basin is being cleaned is responsible for meeting the generator requirements under Part 121. See the Liquid Industrial Waste Generator guidance for more information.

The entity transporting the solid/liquid waste must meet the applicable transporter requirements. A local, state, or federal government may use its own vehicle to service catch basins or other parts of the sewer system without being a permitted and registered transporter under the provisions of the Hazardous Materials Transportation Act, 1998 PA 138, as amended (HMTA).

If the local government contracts with a private company to transport the liquids generated from cleaning the catch basins or other parts of the sewer system, that entity must be registered and permitted as a uniform liquid industrial waste transporter under the provisions of HMTA.

The transporter must notify the WHMD about their activity and obtain a site identification number. Follow the instructions and links to the form EQP5150 and online paying option posted at www.deq.state.mi.us/wdspi. There is a fee.

A uniform hazardous waste manifest must accompany the load, or a consolidated manifest may be used per Operational Memo 121-3, when the liquid waste is transported over public roadways by the local government or by a contract transporter. Keep the records at least three years from shipment. The waste transporting portion of the vehicle and/or containers used to

transport the waste must be kept closed except when adding or removing the waste, and the exteriors must be kept free of the liquid waste and residue.

The facility accepting the solid/liquid waste must meet operating requirements:

- They must notify the WHMD that they are operating a liquid industrial waste designated facility, obtain a site identification number, and meet operating requirements under Part 121. This includes practices to prevent unauthorized discharge of the waste, sign manifests, and keep required records. If waste containers are used, they must be kept closed and protected from the weather, fire, physical damage and vandals.

- The discharge of the liquids into the treatment plant that is permitted by the WB must meet the wastewater treatment plant requirements. Any other discharge of the liquids would require a separate DEQ discharge permit.

- The resulting solid waste must be managed under Part 115 requirements. Dispose of the solid waste in a licensed landfill. Contact the landfill authority for their specific disposal requirements, including any tests they require to document the solids are not hazardous or liquid waste. Do not use the solids as fill on local government or private property, or for any other use, unless it meets the conditions of being an inert material according to the solid waste rules R299.4114 through R299.4118. See the Waste Characterization Guidance for information how to determine if the waste is hazardous or not.

Street sweeping activities are also subject to the above solid waste requirements. Street sweeping involves the use of specialized equipment to remove litter, loose gravel, soil, pet waste, vehicle debris and pollutants, dust, de-icing chemicals, and industrial debris from road surfaces. See the BMPs for Street Sweeping and Parking Lot and Street Cleaning.

Follow-up Answers Can be Found as Follows:	
Topic	**Contact:**
Using the solids as fill or other use under Part 115	Duane Roskoskey at 517-335-4712
Part 121 transportation requirements and HMTA	WHMD District Office
Managing waste under Part 31, or general questions regarding this guidance	Mark Fife at 517-241-8993
Confined space entry requirements	MIOSHA Consultation, Education and Training Division at 517-322-1809