Support Document for Standard for Digital Stormwater System Data Exchange

July 19, 2010

The *Standard for Digital Stormwater System Data Exchange* provides a recommended set of specifications for exchange of digital stormwater data. The standard includes four parts:

1. Feature representation
2. Feature definitions and domains
3. Spatial coordinate system requirement
4. Documentation (metadata)

This support document provides information not contained in the standard. It includes specifications for feature and attribute formats, definitions, and links to websites that illustrate examples for features and attributes contained in the standard.

CONTENTS

1. INTRODUCTION

A stormwater system conveys stormwater runoff through a sequence of pipes, channels, and treatment devices. It includes structural devices, such as manholes or sumps. Typically it discharges to surface water or point of infiltration.

Stormwater systems can be represented on maps. These maps may illustrate the location of features such as pipes and ponds, the location of structures such as manholes, direction of stormwater flowing within the system, and so on.

Stormwater system maps have many potential uses, including but not limited to aiding in emergency response, water quality management, fulfilling permit requirements, flood preparedness, and disease vector control. The Phase 2 Municipal Separate Storm Sewer System (MS4) permit requires permittees to map portions of their stormwater system (http://www.pca.state.mn.us/publications/wq-strm4-51.pdf).

Spatial data exchange between entities can be problematic. Stormwater systems that cross multiple jurisdictions generally behave as a single hydrologic system. However, the spatial data for stormwater systems created by different entities often do not link to each other (lack connectivity). Many spatial datasets also lack directionality (do not show dominant direction of flow). For example, scenario A in Figure 1 illustrates a stormwater system consisting of pipes and a lake. The pipes are not connected and flow within the system is not illustrated. In scenario B the system is connected and the map illustrates flow. Other challenges when mapping between entities include use of different coordinate systems and attribute lists. A stormwater standard facilitates data exchange by providing guidelines for stormwater data.

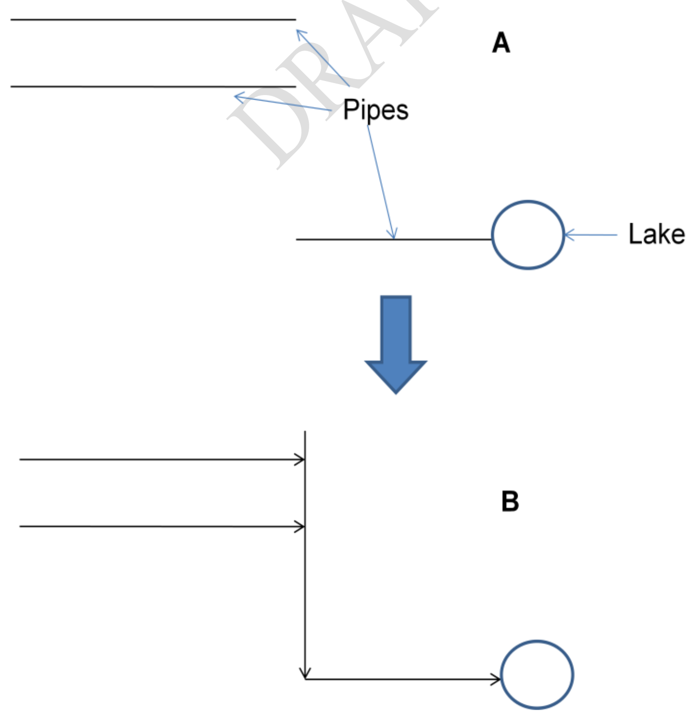

Figure 1: Schematic illustrating some difficulties in connecting stormwater system maps. In scenario A, the pipes are not connected and they lack directionality. In scenario B, direction is included and a connecting pipe has been added.

1.a. Objective

The purpose of this Standard for Digital Stormwater System Data Exchange (the Standard) is to create a framework for geospatial information for stormwater systems that allows data transfer and linkage of mapped data developed by different entities. Ultimately, consistent application of the Standard will result in a datasets for stormwater systems that are connected across different entities. The Standard specifies the names and definitions for stormwater system components that can be geospatially depicted as feature types with attributes.

1.b. Scope and Applicability

Any entity conducting mapping of stormwater can use the Standard to facilitate data exchange. Stormwater system datasets can contain a broad range of features to support potential uses such as stormwater system inspections and maintenance, emergency response, water quality management, vector control, project scoping and design (e.g., road expansions), permit compliance, and drainage permit requests. Many entities have chosen to map more than just locations of stormwater structures. The usefullness of these mapped data could be increased if the data were developed in a consistent manner from one entity to another. The Standard thus presents a recommended structure to facilitate collecting and compiling information about a stormwater system.

The Standard does not specify the features and attributes that an entity should or must map. Many features or attributes are not mapped by entities or may exist in other data layers. For example, lakes and streams already exist as separate statewide data layers.

The Standard does not imply how entities should store data internally. However, entities may want to consider how internal data are structured so that they can be exported to the Standard easily, and so others' data can be easily imported or linked for internal use.

2. DEVELOPMENT PROCESS

In early 2008, a survey was sent to all regulated MS4s. The survey included several questions intended to identify what MS4s are currently mapping and what tools they are using. Of the 235 MS4s, 119 responded. Appendix A provides survey results.

Following an initial meeting with the Governor's Council on Geographic Information Standards Committee, which is now the MnGeo Standards Committee (Standards Committee), a multidisciplinary team representing public and private entities formed to draft a Standard (see Appendix B for a list of people who contributed to development of the Standard). The group, called the Stormwater Standard Workgroup (SSW), met twice in spring of 2008 to discuss development of the Standard. The SSW met three times during the summer and fall of 2008 to complete a draft Standard. The SSW met with the Standards Committee in January of 2009 to discuss progress and formatting of the standard, and the document was formatted to comply with Standards Committee guidelines. The SSW met in February 2009 to finalize a draft for review by a broad range of stakeholders potentially interested in stormwater mapping and exchange of stormwater system information. After a one month review period, the SSW met to discuss the comments. Appendix C provides a summary of the comments received and SSW responses.

The comments were substantial enough to warrant a meeting with stakeholders. This occurred in July 2009. After some modifications, the Standard was presented as a poster at the MN GIS/LIS Consortium annual conference and at the Minnesota Water Resources Annual Conference, both in October 2009. A panel discussion was also held at the MN GIS/LIS conference.

Following these conferences, it was decided to label the Standard as "provisional". The Standard was presented to the Standards Committee in April 2010 and was further revised based on committee feedback. The next step is for the Standards Committee to make the Standard available on its website (http://www.mngeo.state.mn.us/committee/standards/index.html) for wide public review, testing and comment.

3. IMPLEMENTATION and MAINTENANCE

The Standard will be maintained by the Standards Committee. It is recommended that the SSW review the standard annually. If necessary, the SSW will work with the Standards Committee to update the Standard. During the time when the standard is "provisional", the primary focus will be on promoting the Standard through outreach and testing the Standard through pilot studies.

3.a. Outreach

The Standard and this support document will be posted on the Standards Committee website (http://www.mngeo.state.mn.us/committee/standards/index.html). Additional materials will be posted at http://www.pca.state.mn.us/water/stormwater/stormwater-ms4.html, including

1. a PowerPoint presentation that can be used to explain the Standard to potential users and other interested parties;
2. fact sheets, developed as needed;
3. examples and case studies; and
4. various other documents, such as similar standards developed in other states.

3.b. Testing the Standard

An important part of the implementation strategy is determining if and how the Standard is being applied. The SSW will annually distribute surveys to determine if and how the Standard is being implemented. Following each survey, the SSW will determine what actions, if any, are needed to increase implementation of the Standard.

The SSW will track communications with MS4s that are applying the standard. Information gained from these communications will be used to determine what modifications, if any, are needed for the Standard.

The SSW will pursue pilot studies, including funding opportunities, to test the Standard and develop mechanisms or tools to exchange data among entities that map stormwater systems. The purpose of this is to facilitate transfer of data without requiring large expenditures of resources from those entities that transfer data. These pilot studies will also inform the SSW about modifications for the Standard.

4. PARTS of the STANDARD

The Standard is divided into four sections:

- Feature Representation – a description of how features and attributes of those features are represented
- Feature Descriptions and Domains – a recommended format for features and attributes
- Coordinate System Requirement
- Documentation (Metadata)

These are discussed below.

4.a. Feature Representation

The standard specifies the names and definitions for stormwater system components that can be geospatially depicted as feature types with attributes.

4.a.i. Schematic Representation of Standard

Features are depicted as lines and points. One reason for this is that the Standard is primarily intended to demonstrate flow within a stormwater system. This is most easily portrayed with a simple line and point approach. Another reason for this simple approach is that it is easier for an entity to convert polygons to points than points to polygons. Section 4.a.v. discusses the issue of polygons.

Figure 2 provides a simple schematic of a stormwater system. The system consists of point and line features that are connected and illustrates the dominant direction of flow in the system. Point A could be a drop inlet where water first enters the system. Water flows from point to point through pipes or channels. The points could be non-treatment devices such as a manhole at point B, treatment devices such as a hydrodynamic device at D, or a constructed pond such as at point C. Since the pond at point C is represented as a point rather than a polygon, artificial paths are needed to represent connectivity and flow through the system. The artificial paths are shown as dashed lines in Figure 2. Ultimately the stormwater system ends at point E, which could be a lake, wetland, or point of infiltration. If the receiving water was a river or stream the end of the system would be represented as a line feature (E), as shown in Figure 3. The stormwater system could also discharge to a pipe owned by another entity, in which case there would be no point E or line E.

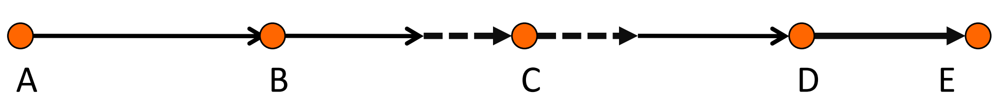

Figure 2: Schematic representation of a stormwater system that ends at a lake, wetland, or point of infiltration (point E).

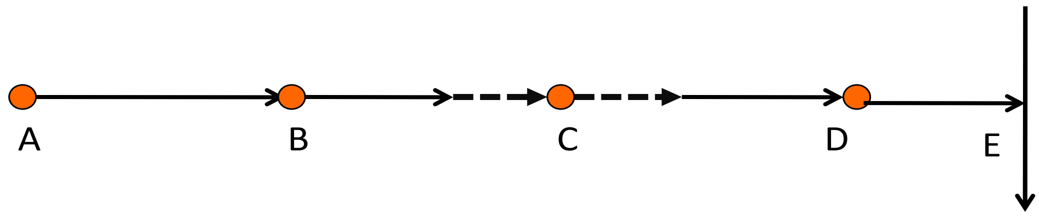

Figure 3: Schematic representation of a stormwater system that ends at a line feature, such as a river or stream (point E).

4.a.ii. Inlets, Outlets, and Outfalls

Figures 2 and 3 illustrate the physical features of a stormwater system. The figures do not illustrate functionality. For example, the figures do not indicate whether a device treats water or whether a feature acts as an inlet or outlet. However, understanding functionality is important for most entities that currently map their systems.

Many of the functional aspects of a stormwater system are considered as attributes in the Standard. However, the Standard does not address inlets, outlets, and outfalls. These are important functions in a stormwater system.

Inlets and outlets can easily be identified in a connected system that includes all features in the system. For example, in Figure 2, the pipe connecting features A and B has an outlet at B, while the feature at B has an inlet at the same location. Different mapping entities will map this point as an inlet or an outlet, depending on their approach. Thus, the Standard avoids defining these. The mapping entity can add an attribute or describe this in the metadata.

Outfalls have a specific meaning for entities regulated under NPDES permits. An outfall is the point at which water leaves a stormwater system and enters a lake, stream, wetland, or another regulated entity. In Figures 2 and 3, the pipe outlet at E is an outfall if E is a lake, stream, or wetland. It would also be an outfall if the discharge was to another pipe owned by a different regulated entity. Outfalls could be associated with pipes or stormwater devices depending on how the mapping entity addressed them. It was therefore decided to not include outfalls in the Standard.

4.a.iii. Separation of Feature Types

Closed pipes and open channels are described as **line features** in this standard. Line features will be represented as a single line (two-dimenstional). Line features digitized as a single line, and associated annotation, will be exported as a single data layer or feature class dataset separate from other types of features. Line features will be broken into segments where needed to assign appropriate attribute values. Line features must be encoded in the direction of predominant flow starting at the upstream point and ending with the downstream point.[1] Line features must have a terminus.

[1] In most cases, data will already be digitized in the direction of predominant flow.

A connector is an artificial line feature (a feature that does not exist in reality) that connects other features (e.g., a line illustrating the flow through lakes, ponds and wetlands). Connector features will be exported as a single data layer or feature class dataset separate from other types of features or cartographic elements. Connectors will be represented as single lines and must be encoded in the direction of predominant flow starting at the upstream point and ending with the downstream point. Connectors will be represented as a line feature snapped to the endpoint of line or point features. These features may be symbolized as desired for cartographic production.

Other features are represented as points. These consist of surface water features that are either constructed (e.g., manholes, treatment devices, etc.) or natural (e.g. lakes, wetlands, etc.).

4.a.iv. Separation of Additional Cartographic Elements

Additional cartographic flourishes, such as arrows or flared end sections as sometimes found in CAD drawing files should be maintained in a separate data layer or symbology layer.

4.a.v. Existing drainage datasets

Entities may use existing associated drainage datasets and avoid duplicating these features in their stormwater system GIS. Examples of other datasets include Minnesota Department of Natural Resources 24K Streams (http://deli.dnr.state.mn.us/metadata.html?id=L260000072102) and National Hydrography Dataset (http://nhd.usgs.gov/index.html). Including explicit connections between the stormwater system and other associated hydrography datasets should be encouraged, whenever possible. Entities should ensure that their stormwater system GIS features are coincident with the associated dataset and they should document the relationship between these datasets in their metadata.

4.b. Features and Attributes

This section provides an overview of the features and attributes in the Standard. Additional recommended descriptions are included, as well as definitions and examples.

4.b.i. Feature Descriptions and Domains

This section provides specifications for each feature-attribute combination. Each combination can be considered a field. Included are the following:

- Description – definition of the attribute (note that some definitions are specific and differ from more general attribute definitions in Section 4.b.ii).
- Name – the field name provided for a given attribute
- Data type – Number, Character, Boolean, etc.
- Length – maximum field length
- Domain – a numeric range or list of permissible text entries

The Standard only provides information on Data type and Domain for each attribute. The following summary provides greater detail. These are preferred options. If these values are not used, alternative types should be documented in the metadata.

FEATURE TYPE: **Line**

FEATURE: **Pipe**

DEFINITION: A closed manmade conveyance device used to transport stormwater from location to location.

ATTRIBUTES:

- ID
    - Description: unique identifier
    - Name: PIPE_ID
    - Data Type: CHARACTER
    - Length: 6
    - Domain: N/A
- Shape
    - Description: predominant cross-sectional configuration of a pipe
    - Name: PIPE_SHP
    - Data Type: CHARACTER
    - Length: 20
    - Domain: round, arch, box, elliptical, tunnel, other, unknown
- Material
    - Description: substance or substances comprising a closed pipe
    - Name: PIPE_MAT
    - Data Type: CHARACTER
    - Length: 30
    - Domain: concrete, plastic-PVC, plastic-polypropylene, steel, aluminum, Other, Unknown
- Height
    - Description: pipe height in inches
    - Name: PIPE_HT
    - Data Type: NUMBER
    - Length: 3
    - Domain: >0, NULL
- Width
    - Description: pipe width in inches
    - Name: PIPE_WID
    - Data Type: NUMBER
    - Length: 3
    - Domain: >0, NULL
- Length
    - Description: pipe length in feet
    - Name: PIPE_LGTH
    - Data Type: NUMBER
    - Length: 5
    - Domain: >0, NULL

- Horizontal Position Accuracy
  - Description: accuracy of pipe location measurement in meters
  - Name: PIPE_ACRCY
  - Data Type: CHARACTER
  - Length: 20
  - Domain: < 0.5 meter, 0.5-1.9 m, 2-4.9 m, 5-9.9 m, > 10 m, other, unknown
- Ownership Type
  - Description: type of entity owning pipe
  - Name: PIPE_OWTYP
  - Data Type: CHARACTER
  - Length: 50
  - Domain: city, state, county, watershed district, other, unknown
- Ownership Name
  - Description: name of entity owning pipe
  - Name: PIPE_OWNAM
  - Data Type: CHARACTER
  - Length: 50
  - Domain: N/A
- Maintenance Authority Type
  - Description: type of entity responsible for maintaining pipe
  - Name: PIPE_MAINT
  - Data Type: CHARACTER
  - Length: 50
  - Domain: city, state, county, watershed district, other, unknown
- Maintenance Authority Name
  - Description: name of entity responsible for maintaining pipe
  - Name: PIPE_MAINN
  - Data Type: CHARACTER
  - Length: 50
  - Domain: N/A

FEATURE: **Channel**
DEFINITION: An open conveyance that transports water from location to location.
ATTRIBUTES:

- ID
  - Description: unique identifier
  - Name: CHAN_ID
  - Data Type: CHARACTER
  - Length: 6
  - Domain: N/A
- Type
  - Description: type of open channel
  - Name: CHAN_TYPE
  - Data Type: CHARACTER
  - Length: 20
  - Domain: ditch, swale, stream, lined channel, other, unknown

AUID

Description: identifier for streams, rivers, ditches, and other types of open channels
Name: CHAN_AUID
Data Type: CHARACTER
Length: 12
Domain: N/A

Height or Mean Depth

Description: channel height or depth in inches
Name: CHAN_HT
Data Type: NUMBER
Length: 3
Domain: >0, NULL

Width

Description: channel width in inches
Name: CHAN_WID
Data Type: NUMBER
Length: 3
Domain: >0, NULL

Length

Description: channel length in feet
Name: CHAN_LGTH
Data Type: NUMBER
Length: 5
Domain: >0, NULL

Channel Shape

Description: The cross-sectional shape of a channel or ditch.
Name: CHAN-SHAPE
Data Type: CHARACTER
Length: 20
Domain: triangular, trapezoidal, segmental, other, unknown

Horizontal Position Accuracy

Description: accuracy of channel location measurement in meters
Name: CHAN_ACRCY
Data Type: CHARACTER
Length: 20
Domain: < 0.5 meter, 0.5-1.9 m, 2-4.9 m, 5-9.9 m, > 10 m, other, unknown

Ownership Type

Description: type of entity owning the open channel
Name: CHAN_OWTYP
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Ownership Name

Description: name of entity owning the channel
Name: CHAN_OWNAM

Data Type: CHARACTER
Length: 50
Domain: N/A

Maintenance Authority Type

Description: type of entity responsible for maintaining the open channel
Name: CHAN_MAINT
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Maintenance Authority Name

Description: name of entity responsible for maintaining open channel
Name: CHAN_MAINN
Data Type: CHARACTER
Length: 50
Domain: N/A

FEATURE: **Artificial Path**

DEFINITION: An artificial feature that connects other features. Connectors are often used to illustrate flow through lakes, ponds and wetlands. Typically line connectors have a horizontal flow component but not a significant vertical flow component. Connectors have directionality and are digitized in the direction of physical flow starting at the upstream point and ending with the downstream point.

ATTRIBUTES:

ID

Description: unique identifier
Name: ART_ID
Data Type: CHARACTER
Length: 6
Domain: N/A

Comment

Description: information regarding the connector
Name: ART_COMNT
Data Type: CHARACTER
Length: 256
Domain: N/A

FEATURE TYPE: **Point**

FEATURE: **Constructed Basin**

DEFINITION: A feature constructed for detention, retention or infiltration of stormwater[2]. Constructed ponds and wetlands have a small horizontal flow component. Ponds can have a significant vertical flow component if constructed for temporary storage.

ATTRIBUTES:

[2] Wetlands may be constructed for other purposes, such as wildlife management.

ID

- Description: unique identifier
- Name: BASN_ID
- Data Type: CHARACTER
- Length: 6
- Domain: N/A

Type

- Description: type of constructed basin
- Name: BASN_TYPE
- Data Type: CHARACTER
- Length: 20
- Domain: wet pond, dry pond, constructed wetland, rain garden, infiltration trench, infiltration basin, other, unknown

Area

- Description: the surface area, in acres, of a constructed basin. For basins that hold water, it is the area when the basin holds water at the design depth.
- Name: BASN_AREA
- Data Type: NUMBER
- Length: 10
- Domain: >0, NULL

Mean Design Depth

- Description: average depth, in feet, of constructed basin, as designed. This does not apply to infiltration basins.
- Name: BASN_DEPTH
- Data Type: NUMBER
- Length: 8
- Domain: >0, NULL

Contributing Drainage Area

- Description: land surface area, in acres, that drains to a constructed basin.
- Name: BASN_CAREA
- Data Type: NUMBER
- Length: 10
- Domain: >0, NULL

Infiltration Rate

- Description: average rate of water infiltration, in inches per hour, through the bottom of the constructed basin
- Name: DEVC_INFIL
- Data Type: NUMBER
- Length: 10
- Domain: >0, NULL

Treatment

- Description: indication of whether the constructed basin treats water
- Name: DEVC_TRTMT
- Data type: BOOLEAN
- Length: 3
- Domain: YES, NO

Horizontal Position Accuracy
- Description: accuracy of location measurement in meters
- Name: BASN_ACRCY
- Data Type: CHARACTER
- Length: 20
- Domain: < 0.5 meter, 0.5-1.9 m, 2-4.9 m, 5-9.9 m, > 10 m, other, unknown

Ownership Type
- Description: type of entity owning constructed basin
- Name: BASN_OWTYP
- Data Type: CHARACTER
- Length: 50
- Domain: city, state, county, watershed district, other, unknown

Ownership Name
- Description: name of entity owning constructed basin
- Name: BASN_OWNAM
- Data Type: CHARACTER
- Length: 50
- Domain: N/A

Maintenance Authority Type
- Description: type of entity responsible maintaining constructed basin
- Name: BASN_MAINT
- Data Type: CHARACTER
- Length: 50
- Domain: city, state, county, watershed district, other, unknown

Maintenance Authority Name
- Description: name of entity responsible for maintaining constructed basin
- Name: BASN_MAINN
- Data Type: CHARACTER
- Length: 50
- Domain: N/A

FEATURE: **Stormwater Device**

DEFINITION: A constructed stormwater device.

ATTRIBUTES:

ID
- Description: unique identifier
- Name: DEVC_ID
- Data Type: CHARACTER
- Length: 6
- Domain: N/A

Type
- Description: type of stormwater device
- Name: DEVC_TYPE
- Data Type: CHARACTER
- Length: 20

Domain: grit chamber, sump, trap manhole, skimmer, swirl separator, filter, settling device, filtering device, oil and grease separator, stormwater inlet trap, leaky well, seepage pipe, other

Length

Description: length of stormwater device in inches
Name: DEVC_LGTH
Data Type: NUMBER
Length: 5
Domain: >0, NULL

Width

Description: width of stormwater device in inches
Name: DEVC_WID
Data Type: NUMBER
Length: 3
Domain: >0, NULL

Height

Description: height of stormwater device in inches
Name: DEVC_HT
Data Type: NUMBER
Length: 3
Domain: >0, NULL

Invert Elevation of Outlet

Description: the elevation of the bottom of an inside wall at the outlet for the device
Name: DEVC_IELEV
Data Type: NUMBER
Length: 6
Domain: >0, NULL

Treatment

Description: indication of whether the stormwater device treats water
Name: DEVC_TRTMT
Data type: BOOLEAN
Length: 3
Domain: YES, NO

Bottom Elevation of Device

Description:
Name: DEVC_BELEV
Data Type: NUMBER
Length: 6
Domain: >0, NULL

Contributing Drainage Area

Description: overall surface area, in acres, draining to a stormwater device
Name: DEVC_AREA
Data Type: NUMBER
Length: 6
Domain: >0, NULL

Holds Water

Description: a determination of whether the stormwater device holds water for more than 10 days
Name: DEVC_WAT
Data Type: CHARACTER
Length: 10
Domain: wet, dry, unknown

Infiltration Rate

Description: average rate of water infiltration, in inches per hour, through the bottom of the stormwater device
Name: DEVC_INFIL
Data Type: NUMBER
Length: 10
Domain: >0, NULL

Horizontal Position Accuracy

Description: accuracy of location measurement in meters
Name: DEVC_ACRCY
Data Type: CHARACTER
Length: 20
Domain: < 0.5 meter, 0.5-1.9 m, 2-4.9 m, 5-9.9 m, > 10 m, other, unknown

Ownership Type

Description: type of entity owning stormwater device
Name: DEVC_OWTYP
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Ownership Name

Description: name of entity owning stormwater device
Name: DEVC_OWNAM
Data Type: CHARACTER
Length: 50
Domain: N/A

Maintenance Authority Type

Description: type of entity responsible for maintaining stormwater device
Name: DEVC_MAINT
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Maintenance Authority Name

Description: name of entity responsible for maintaining stormwater device
Name: DEVC_MAINN
Data Type: CHARACTER
Length: 50
Domain: N/A

FEATURE: **Natural Surface Water Feature**

DEFINITION: a natural feature that temporarily or permanently stores and/or conveys water. This feature includes natural waters that have been modified but not those that have been constructed.

ATTRIBUTES:

- ID
  - Description: unique identifier
  - Name: WATR_ID
  - Data Type: CHARACTER
  - Length: 6
  - Domain: N/A
- Type
  - Description: type of water feature
  - Name: WATR_TYPE
  - Data Type: CHARACTER
  - Length: 20
  - Domain: lake, stream, wetland, other, unknown
- DNR Lake ID
  - Description: 8-digit identifier for each lake
  - Name: WATR_DNRID
  - Data Type: CHARACTER
  - Length: 10
  - Domain: N/A
- PWI Number
  - Description: a unique ID for public waters that have been mapped under Statute 103G.201
  - Name: WATR_PWI
  - Data Type: CHARACTER
  - Length: 8
  - Domain: N/A
- Height or Mean Depth
  - Description: depth, in feet, of surface water feature
  - Name: WATR_DEPTH
  - Data Type: NUMBER
  - Length: 3
  - Domain: >0, NULL
- Width
  - Description: width, in feet, of surface water feature
  - Name: WATR_WIDTH
  - Data Type: NUMBER
  - Length: 3
  - Domain: >0, NULL
- Length
  - Description: length, in feet, of surface water feature
  - Name: WATR_LGTH
  - Data Type: NUMBER
  - Length: 5

Domain: >0, NULL

Horizontal position accuracy

Description: accuracy of location measurement in meters
Name: WATR_ACRCY
Data Type: CHARACTER
Length: 20
Domain: < 0.5 meter, 0.5-1.9 m, 2-4.9 m, 5-9.9 m, > 10 m, other, unknown

Ownership Type

Description: type of entity owning surface water feature
Name: WATR_OWTYP
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Ownership Name

Description: name of entity owning surface water feature
Name: WATR_OWNAM
Data Type: CHARACTER
Length: 50
Domain: N/A

Maintenance Authority Type

Description: type of entity responsible for maintaining surface water feature
Name: WATR_MAINT
Data Type: CHARACTER
Length: 50
Domain: city, state, county, watershed district, other, unknown

Maintenance Authority Name

Description: name of entity responsible for maintaining surface water feature
Name: WATR_MAINN
Data Type: CHARACTER
Length: 50
Domain: N/A

4.b.ii. Definitions for feature attributes

Apron: a structure constructed to dissipate energy delivered at a stormwater discharge point. Aprons may be constructed of rock (e.g.,iprap), asphalt, concrete, or other material.

Area: the overall surface area of a feature. An example is an area of 10 acres for a pond. For constructed basins that hold water, the area is based on the basin holding water at the design depth. For natural water features, the area may be based on different water depths or elevations and this should be described in the metadata.

AUID: Assessment Unit ID, a water body identifier that is the eight digit sub basin code and the three digit reach number. The AUID constitutes a unique identifier for open channel reaches. Not all open channels have AUIDs.

Bottom Elevation: the elevation, relative to sea level, of the bottom of a structural pollution control device.

Catch Basin: an inlet to the storm drain system that typically includes a grate or curb inlet where stormwater enters the catch basin. Catch basins are often associated with structural pollution control devices, such as a sump, that treat stormwater.

Catch Basin Insert: Inserts for catch basins are designed to remove oil and grease, trash, and sediments. Examples include filter fabrics and a system of trays with media filters.

Cistern: Cisterns are large storage devices that are often built below ground for storing captured stormwater and can be integrated with more sophisticated pumping devices. For example, some cisterns collect stormwater that is subsequently used for non-potable plumbing, such as flushing of toilets, or irrigation applications.

Channel Shape: Channels have three basic shapes. They are triangular, trapezoidal and segmented.

Constructed Wetland: A constructed wetland is a man-made basin that contains water, a substrate (soil, gravel, rock, organic materials, etc.), plants (vascular and non-vascular), and organisms similar to those usually found in natural wetlands. The number of plants and the biodiversity of a constructed wetland are greater than that of wet retention pond. Constructed wetlands usually use a relatively impermeable subsurface layer to prevent water from seeping into the ground.

Contributing Drainage Area: the overall land surface area draining to a device or basin, in acres. An example is 300 acres draining to a wet pond. The calculation is made at the point where water leaves the device or basin. The area is typically taken between two devices or basins so that overlapping areas are eliminated. The term most often applies to devices or basins designed for treating stormwater.

Ditch: an open constructed channel used to carry a substance from location to location

DNR Lake ID: A unique 8-digit identifier for each lake polygon. The value of this field is the DNR Division of Water lake identification number if one has been assigned. Otherwise, the Lake id is a unique sequential number.

Drop Inlet: A sediment filter or an excavated impounding area around a storm drain drop inlet or curb inlet.

Dry Pond (detention basin): a constructed pond that temporarily fills with water during a storm and retains it for up to 48 to 72 hours, but is dry most of the time. Detention ponds have a surface outlet that allows for discharge of water, versus an infiltration basin that is primarily designed to infiltrate water but may also have an outlet.

Filter Strip (vegetated buffer): Vegetated filter strips are vegetated surfaces used to reduce stormwater velocity from nearby less pervious surfaces. They also filter out pollutants from stormwater and allow infiltration into underlying soil.

Filtering Device: a proprietary storm water device designed to remove sediment from stormwater.

Flow Direction: The direction of flow within a line feature.

Green Roofs: Green roofs are vegetated and reduce surface runoff from the rooftop by absorbing stormwater and slowing stormwater flow rates.

Grit Chamber: A tank in which the flow of stormwater is slowed, allowing heavy solid materials such as pebbles and sand to sink to the bottom.

Height: The maximum height of a feature, measured from inside faces. An example is a pipe that has a 20 inch height (inside diameter of 20 inches).

Holds Water: An attribute used to identify structures or structural pollution control devices that hold water for more than 10 days. This information is used to assess the likelihood for mosquito breeding. Values are yes (holds water for more than 10 days) or no (does not hold water for more than 10 days).

Horizontal Position Accuracy: the degree of closeness of a measured or calculated quantity to its actual (true) value

ID: A unique numerical identifier given to a feature. An example is a dry pond located at the intersection of 1^{st} Street and 1^{st} Avenue and given a unique ID of 1001.

Infiltration Basin (includes trenches, dry wells): A rock-filled trench with no outlet. Typically stormwater first passes through a swale or other stormwater management application before reaching the trench. The stormwater filters through the soil.

Infiltration Rate: The rate at which water leaves an infiltration device and enters the surrounding soil or vadose zone.

Invert Elevation of Outlet: the elevation, relative to sea level, of the bottom of an inside wall at the wall outlet.

Lake: an enclosed basin filled or partly filled with water that is large enough to produce a wave-swept shore.

Leaky Well - a vertical perforated pipe with a lid at the ground surface and an open bottom.

Length: The overall length of a feature, measured between connecting points or a connecting point. An example is a ditch that is 2000 feet in length and connected by two ponds.

Lift Station - A structure in a sewer system which collects and lifts stormwater to a higher elevation.

Maintenance Name: the individual, organization, or agency responsible for maintaining a feature. Examples include the City of St. Paul, Capitol Region Watershed District, and the Minnesota Department of Transportation. Entities may differ for ownership and maintenance responsibility.

Maintenance Type: the type of individual, organization, or agency responsible for maintaining a feature. Examples include state, city and watershed district.

Manhole: The top opening to an underground utility vault used to house an access point for making connections or performing maintenance on underground stormwater system features.

Material: The substance or substances comprising a closed pipe.

Mean Depth: The average depth of a channel or natural surface water feature. Mean depth will vary with time due to weather, as a feature infills with sediment, or after sediment is removed from the feature.

Mean Design Depth: The average original depth for a constructed pond. The design depth will vary from the current mean depth when a constructed feature is partially filled with sediment.

Media Filter: Filters that stormwater passes through for removal of solids. Filters can be made out of sand, peat, foam, crushed glass, or textile.

Oil and Grease Separator:

Ownership Name: Entity that owns a feature. Examples include the City of St. Paul, Capitol Region Watershed District, and the Minnesota Department of Transportation. Entities may differ for ownership and maintenance responsibility.

Ownership Type: The type of individual, organization, or agency that owns a feature. Examples include state, city and watershed district.

Permeable Pavement: Pavement composed of a permeable pavement material, which allows infiltration into the subsoil. There may also be an underlying stone reservoir that temporarily stores the surface runoff before it infiltrates into the subsoil.

Pond: a constructed body of water designed to retain or detain stormwater.

PWI Number: A unique ID for public waters that have been mapped under Statute 103G.201

Rain Barrel: A storage tank that captures stormwater runoff. Rain barrels are typically adapted from existing barrels, sit above ground, and have a storage capacity of approximately 50-80 gallons.

Rain Garden: a planted depression that is designed to absorb rainwater runoff from impervious urban areas like roofs, driveways, walkways, and compacted lawn areas. Typically runoff collected in a rain garden infiltrates the surrounding soil within 48 hours.

Riparian Buffers: Restricted land use within a certain distance from wetlands or water sources, which protects sensitive environmental resources, such as streams. These setbacks are also called resource protection areas.

Seepage Pipe - a pipe with pervious walls that allows stormwater to percolate into the surrounding soil.

Settling Device: a proprietary treatment device designed to allow solids in stormwater to settle.

Shape: the predominant cross-sectional configuration of a pipe.

Skimmer: a device used to take up or remove floating matter from the surface of a liquid, including stormwater.

Stream - an open non-constructed channel used to carry a substance from location to location. Streams may be modified (e.g. straightened, etc.)

Stormwater Inlet Trap: a device designed to capture sediment in stormwater before it enters the storm sewer system.

Sump: a pit, cistern, cesspool, etc. for draining, collecting, or storing stormwater runoff.

Swale: A shallow troughlike depression that carries stormwater. Swales are often vegetated and typically have both vertical and horizontal flow components. Vegetated swales are often referred to as bio-swales, enhanced swales, or water quality swales and can be classified as wet swales, dry swales, and grassed channels. A *dry swale* (bio-swale) incorporates additional elements with the vegetated swale design. A *wet swale* is capable of temporarily retaining stormwater runoff, but, unlike the dry swale, lacks an underdrain system. The wet swale is marshlike and relies on and supports wetland vegetation.

Swirl Separator: A mechanical device used to remove solids from liquids. Water enters a cylinder from the top and is rotated (or swirls) about a vertical axis. Solids are discharged or pumped out of the outlet located at the bottom of the device. Liquid is sent spiraling back up the middle of the vessel prior to discharge.

Trap Manhole:

Treatment: Any constructed basin or stormwater device designed to remove pollutants from stormwater.

Tree Box: Tree boxes are usually located in urban areas. Runoff is directed to the treebox, where it can be filtered by the soil and vegetation. Some tree boxes may drain to a channel below, which conveys stormwater to the selected collection system.

Type: a number of things having common traits or characteristics that distinguish them as a group or class. For example, wet ponds and dry ponds are two types of constructed basin.

Wetland – An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands can be naturally occurring or constructed.

Wet Pond (retention basin): A constructed pond designed to have a permanent pool of water.

Width: The maximum width of a feature, measured from inside faces. An example is a pipe that is 20 inches in width (20 inch inside diameter).

4.b.iv. Websites for Features and Attributes

This section provides links to websites that help explain or illustrate some attributes for features included in the Standard. There may be many more suitable websites than the ones provided here – these are intended to introduce the reader to the attributes. Inclusion of a website is not an endorsement of any commercial product or service.

Apron

http://www.portlandonline.com/BES/index.cfm?a=168335&c=33006

http://www.smwg.org/presentations/Puget%20Sound%20Workshop/Case%20Study11-Head%20of%20Thea%20Foss.pdf

Catch Basin

http://www.stormwatercenter.net/Pollution_Prevention_Factsheets/CatchBasins.htm

Catch Basin Insert

http://www.fhwa.dot.gov/environment/ultraurb/3fs13.htm

http://www.stormwatercenter.net/Pollution_Prevention_Factsheets/CatchBasins.htm

Cistern

http://en.wikipedia.org/wiki/Cistern

http://www.rain-barrel.net/rainwater-cistern.html

Constructed Wetland

http://en.wikipedia.org/wiki/Constructed_wetland http://www.extension.umn.edu/distribution/naturalresources/DD7671.html

Ditch

http://en.wikipedia.org/wiki/Ditch

http://www.extension.umn.edu/distribution/naturalresources/DD6978.html

http://www.tpub.com/content/armyengineer/EN5465A/EN5465A0068.htm

Drop Inlet

http://www.google.com/imgres?imgurl=http://www.roanokecountyva.gov/NR/rdonlyres/8AF714A5-097F-46A3-AE96-7FF3497DD1C4/0/WetPond.JPG&imgrefurl=http://www.roanokecountyva.gov/Departments/Engineering/1Stormwater/4StormNetwork.htm&h=420&w=560&sz=91&tbnid=k3zo2JIAncMJ::&tbnh=100&tbnw=133&prev=/images%3Fq%3Dwet%2Bpond%2Bpictures&usg=__Mr89m16Woj-Mc8hP35YhoyVkKAo=&sa=X&oi=image_result&resnum=1&ct=image&cd=1

Dry Pond

http://www.google.com/imgres?imgurl=http://www.roanokecountyva.gov/NR/rdonlyres/8AF714A5-097F-46A3-AE96-7FF3497DD1C4/0/WetPond.JPG&imgrefurl=http://www.roanokecountyva.gov/Departments/Engineering/1Stormwater/4StormNetwork.htm&h=420&w=560&sz=91&tbnid=k3zo2JIAncMJ::&tbnh=100&tbnw=133&prev=/images%3Fq%3Dwet%2Bpond%2Bpictures&usg=__Mr89m16Woj-Mc8hP35YhoyVkKAo=&sa=X&oi=image_result&resnum=1&ct=image&cd=1

http://www.pneac.org/stormwater/pg-stormwater-detention.cfm

Filter Strip

http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Filtering%20Practice/Grassed%20Filter%20Strip.htm

http://www.duluthstreams.org/stormwater/toolkit/filterstrips.html

Filtering Device

http://rpitt.eng.ua.edu/Publications/StormwaterTreatability/Filtration%20Woelkers%20et%20al%20Stromcon%2006.pdf

http://www.lowimpactdevelopment.org/ffxcty/2-3_filtrationdevice_draft.pdf

Green Roofs

http://www.greenroofs.com/

http://en.wikipedia.org/wiki/Green_roof

Grit Chamber

(http://www.google.com/imgres?imgurl=http://www.esemag.com/0904/victoria1.jpg&imgrefurl=http://www.esemag.com/0904/victoria.html&h=209&w=300&sz=20&tbnid=V-IhcDPXWQ8J::&tbnh=81&tbnw=116&prev=/images%3Fq%3Dgrit%2Bchamber%2Bstormwater%2Bpicture&hl=en&usg=__z5ZkLpth3rRoLGiO5QyDjpoiZkk=&sa=X&oi=image_result&resnum=2&ct=image&cd=1)

http://www.minneapolisparks.org/documents/caring/WQ_Annual_2001/3%20Grit%20Chamber%20Monitoring.pdf

Infiltration Basin

http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Basin.htm

http://www.cabmphandbooks.com/Documents/Development/TC-11.pdf

Infiltration Trench

http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Trench.htm

http://www.stormwatercenter.net/Manual_Builder/Performance%20Criteria/Infiltration.htm

Leaky Well

http://www.thewaterchannel.tv/index.php?option=com_hwdvideoshare&task=viewvideo&Itemid=53&video_id=298

http://rainwaterharvesting.wordpress.com/2008/03/15/leaky-wells-oz-way-to-recharge-groundwater/

Lift Station

http://www.google.com/imgres?imgurl=http://www.gashplumbing.com/Images/Lex.%2520Armory%2520lift%2520station%2520rehab%2520001.jpg&imgrefurl=http://www.gashplumbing.com/commliftstation.aspx&h=336&w=448&sz=39&tbnid=lbnGcRZgiVrN8M:&tbnh=95&tbnw=127&prev=/images%3Fq%3Dlift%2Bstations&usg=__PchFZEaZJ43eDLTiIJiQ6igFuP8=&ei=MkYUS7fPL4-BnQeHs9zBAw&sa=X&oi=image_result&resnum=6&ct=image&ved=0CBsQ9QEwBQ

http://www.google.com/imgres?imgurl=http://www.pumpsinc.net/wp2/lift_station.JPG&imgrefurl=http://www.pumpsinc.net/Lift%2520Stations.html&h=270&w=258&sz=12&tbnid=ovcjZ0OJ2p0ZhM:&tbnh=113&tbnw=108&prev=/images%3Fq%3Dlift%2Bstations&usg=__vvJvd3Ot_iioQAQ1OCp0endVflk=&ei=MkYUS7fPL4-

BnQeHs9zBAw&sa=X&oi=image_result&resnum=8&ct=image&ved=0CB8Q9QEwBw

Manhole

http://en.wikipedia.org/wiki/Manhole

http://karachiites.files.wordpress.com/2009/05/manhole.jpg

http://www.fotosearch.com/photos-images/manhole.html

Media Filter

http://en.wikipedia.org/wiki/Media_filter

Oil and Grease Separator

http://danewaters.com/pdf/manual/Appendix_1/OilandGreaseSeparator.pdf

http://www.seas.ucla.edu/stenstro/r/r8

http://www.georgiastormwater.com/vol2/3-3-6.pdf

Permeable Pavement

http://en.wikipedia.org/wiki/Permeable_paving

http://www.toolbase.org/Technology-Inventory/Sitework/permeable-pavement

Pipe Outfall

http://cleanwater.ucsc.edu/scihill_map_pages/InfrastructureII.html

http://portal.environment.wa.gov.au/pls/portal/docs/PAGE/ADMIN_SRT/REPORT_CARDS/SECTION1_DRAINAGE_OUTFALLS_PROOF_1.PDF

Pond – see wet pond or dry pond

Rain Barrel

http://www.uri.edu/ce/healthylandscapes/rainbsources.html

http://www.epa.gov/Region3/p2/what-is-rainbarrel.pdf

Rain Garden

http://www.cityofmadison.com/engineering/stormwater/raingardens/

http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2008/06/17/HOCM1182C5.DTL

http://watercenter.unl.edu/archives/RainGardens2009.asp

Riparian Buffer

http://en.wikipedia.org/wiki/Riparian_buffer

http://www.bae.ncsu.edu/programs/extension/wqg/sri/riparian5.pdf

Seepage Pit or Pipe

http://www.stormwaterpa.org/assets/media/BMP_manual/chapter_6/Chapter_6-4-6.pdf

Settling Device

http://on.dot.wi.gov/wisdotresearch/database/briefs/00-03hydrodynamicdevice-b.pdf

http://on.dot.wi.gov/wisdotresearch/database/reports/00-03hydrodynamicdevice-f.pdf

Skimmer

http://www.stormwaterauthority.org/assets/142PLGISB.pdf

Stormwater Inlet Trap

http://www.pca.state.mn.us/publications/wq-strm2-28.pdf

Sump

http://en.wikipedia.org/wiki/Sump

Swales

http://www.google.com/imgres?imgurl=http://nemo.uconn.edu/tools/stormwater/Images/By-River-Swale.jpg&imgrefurl=http://nemo.uconn.edu/tools/stormwater/swales.htm&h=300&w=400&sz=36&tbnid=Gs8gZCiUO_AJ::&tbnh=93&tbnw=124&prev=/images%3Fq%3Dstormwater%2Bswales%2Bpictures&usg=__SMZJA5v3SfTa7xSLgwOi5BcsO2w=&sa=X&oi=image_result&resnum=2&ct=image&cd=1

http://www.google.com/imgres?imgurl=http://www.duluthstreams.org/stormwater/toolkit/images/checkDams.jpg&imgrefurl=http://www.duluthstreams.org/stormwater/toolkit/swales.html&h=280&w=360&sz=23&tbnid=tHxnnsSqDSoJ::&tbnh=94&tbnw=121&prev=/images%3Fq%3Dstormwater%2Bswales%2Bpictures&usg=__QzcBEQOu5ynx0Q9tOaj5FtULcfk=&sa=X&oi=image_result&resnum=4&ct=image&cd=1

Swirl Separator

http://www.google.com/imgres?imgurl=http://www.praqua.com/images/BTCswirlseparatorworking.jpg&imgrefurl=http://www.praqua.com/filtration.cfm&h=113&w=150&sz=6&tbnid=oDQRiMcJlxgJ::&tbnh=72&tbnw=96&prev=/images%3Fq%3Dswirl%2Bseparator%2Bpictures&usg=__yhgiHqhyRwDNOXnTSsC8NTN4X6s=&sa=X&oi=image_result&resnum=3&ct=image&cd=1

http://www.google.com/imgres?imgurl=http://www.enkoi.com/images/categories/C49.jpg&imgrefurl=http://www.enkoi.com/subcat48.html&h=225&w=300&sz=9&tbnid=sMCpL_pfp04J::&tbnh=87&tbnw=116&prev=/images%3Fq%3Dswirl%2Bseparato

r%2Bpictures&usg=__Fs1xeHsEc9Go6D0jTcZx602DW28=&sa=X&oi=image_result&resnum=4&ct=image&cd=1

Trap Manhole

http://eng.lacity.org/techdocs/stdplans/s-100/s139-0.pdf

Tree Box

http://www.lid-stormwater.net/treeboxfilter_home.htm

Wet Pond

http://www.google.com/imgres?imgurl=http://www.roanokecountyva.gov/NR/rdonlyres/8AF714A5-097F-46A3-AE96-7FF3497DD1C4/0/WetPond.JPG&imgrefurl=http://www.roanokecountyva.gov/Departments/Engineering/1Stormwater/4StormNetwork.htm&h=420&w=560&sz=91&tbnid=k3zo2JIAncMJ::&tbnh=100&tbnw=133&prev=/images%3Fq%3Dwet%2Bpond%2Bpictures&usg=__Mr89m16Woj-Mc8hP35YhoyVkKAo=&sa=X&oi=image_result&resnum=1&ct=image&cd=1

http://www.google.com/imgres?imgurl=http://www.fairfaxcounty.gov/dpwes/images/environmental/wetpond.jpg&imgrefurl=http://www.fairfaxcounty.gov/dpwes/environmental/swm_pond_pics.htm&h=324&w=432&sz=41&tbnid=UgHZtntP3cQJ::&tbnh=95&tbnw=126&prev=/images%3Fq%3Dwet%2Bpond%2Bpictures&usg=__fs8RQI5wa5g69LtQOdYAjuZx2fo=&sa=X&oi=image_result&resnum=2&ct=image&cd=1

4.c. Spatial Coordinate System

Digital data for stormwater systems is to be provided inUniversal Transverse Mercator (UTM) Zone 15N, extended to cover the entire land surface of the State of Minnesota, in the NAD83 datum and horizontal units of meters (http://spatialreference.org/ref/epsg/26915/).

4.d. Documentation (Metadata)

Stormwater system data transfer files must be accompanied by clear documentation in the form of a metadata record that complies with the Minnesota Geographic Metadata Guidelines (http://www.mngeo.state.mn.us/chouse/meta.html) or the Federal Geographic Data Committee metadata standard (http://www.fgdc.gov/metadata). The metadata record should include information about data accuracy, data collection methods and attribute values. See the support document for specific information.

5. GENERAL DEFINITIONS

Attribute - a defined characteristic of a feature. Examples are the length of a pipe or drainage area of a pond.

Entity – an organization, agency, etc. that maps one or more features of its stormwater system.

Feature type - definition and description of a set (class of real world phenomena) into which similar features are classified. A feature type can be a point, a line, or a polygon. Polygons are represented as points in this Standard.

Feature - real-world spatial phenomenon about which data is collected, maintained, and disseminated. Features are geospatial objects that are graphically delineated in a spatial database. Examples include pipes and ponds.

Geospatial information (data) - data with implicit or explicit reference to a location relative to the earth.

Municipal Separate Storm Sewer System - a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

1. Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under state law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management Agency under section 208 of the Clean Water Act (33 U.S.C. § 1288) that discharges to waters of the United States;
2. Designed or used for collecting or conveying storm water;
3. Which is not a combined sewer; and
4. Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR § 122.2.

NPDES – National Pollutant Discharge Elimination System, which is a permit program established by the federal government that controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Outfall - the point where a Municipal Separate Storm Sewer System discharges from a pipe, ditch, or other discrete conveyance to receiving waters, or to other Municipal Separate Storm Sewer Systems. It does not include diffuse runoff or conveyances which connect segments of the same stream or water systems.

Receiving water – A river, lake, stream or other body of water into which wastewater or treated effluent is discharged.

Standard - that which is established as a model by authority, custom, or general consent.

Stormwater System- a system that conveys, stores, or treats stormwater, such as pipes, channels, pollution control devices, wetlands, etc.

Value - a specific quality or quantity assigned to an attribute for a specific feature. Examples are the units of height for a pipe or units of area for a pond.

Appendix A – Results from Survey of Regulated MS4s

Do you represent a:		**Number**	**Percent**
	Designated MS4	38	31.7
	Mandatory city	61	50.8
	Township	6	5.0
	County	7	5.8
	Watershed district	4	3.3
	Nontraditional	2	1.7
	Phase 1	1	0.8
	More than one of the above	1	0.8
Does your organization own or maintain storm sewers?			
	Yes	114	93.3
	No	6	5.0
Are the storm sewers mapped?			
	Yes	110	96.5
	No	4	3.5
What format are your maps in?			
	CADD - Microstation	6	5.3
	AutoCADD	49	43.0
	Other	8	7.0
	GIS - Shapefile	44	38.6
	GIS - Geodatabase	33	28.9
	GIS - 3rd party database	7	6.1
	Other	9	7.9
	Don't know	6	5.3
What features do you map?			
	Pipes (24" and over)	99	86.8
	Pipes (under 24")	97	85.1
	Ponds, streams, lakes, wetlands	82	71.9
	Outfalls	96	84.2
	Structural pollution control devices	72	63.2
	Constructed ponds and	77	67.5

	wetlands		
	Other surface waters	45	39.5
	Catch basins	96	84.2
	Storm sewer inlets	91	79.8
How often do you update your mapping system?			
	Monthly	4	3.5
	Quarterly	3	2.6
	Annually	37	32.5
	When needed	67	58.8
Are your maps publicly available?			
	Yes	43	37.7
	No	71	59.6
In what form are your maps?			
	Paper maps available at city hall	37	86.0
	Noninteractive web-based	12	27.9
	Interactive web-based	2	4.7
Does your mapping interface with other applications?			
	Yes	48	42.1
	No	63	55.3
	No answer	3	2.6

Appendix B – Participants in Development of the Exchange Standard for Digital Stormwater System Data

Molly Churchich – Ramsey County
Brad Digre – Short Elliott Hendrickson Inc.
Adam Freihoefer – Metropolitan Council
Hart Gilchrist – Bonestroo
Steve Kloiber – Minnesota Department of Natural Resources
Paul Leegard – Minnesota Pollution Control Agency
Joe Lewis – Houston Engineering
Barb Loida – Minnesota Department of Transportation
Carrie Mack – Ramsey-Washington Watershed District
John Mackiewicz – WSB and Associates
Susanne Maeder – Minnesota Geospatial Information Office
Thomas Martin – Minnesota Department of Transportation
Jason Menard – United States Geological Survey
Beth Neuendorf – Minnesota Department of Transportation
Mark Olsen – Minnesota Pollution Control Agency
Jane Onorati – Minnesota Pollution Control Agency
Bonnie Peterson – Minnesota Department of Transportation
Nancy Read – Metropolitan Mosquito Control District
Lisa Saylor – Minnesota Department of Transportation
John Studtmann – City of Minneapolis
Kellie Thom – Minnesota Department of Transportation
Mike Trojan – Minnesota Pollution Control Agency

Appendix C – Summary of comments received from March, 2009 public review

John Mackiewicz - WSB

1. Line 87-89: I like the option to use alternate options here. Smaller Cities may not have metadata but data should be relatively self explanatory (CB, MH, etc)
   RESPONSE: Noted
2. Line 128: Most GIS based databases do not support the storage of lines and annotation in the same feature class.
   RESPONSE: Replaced annotation with attributes.
3. The standard should be a standalone document and not require a support document
   RESPONSE: The support document is not intended as a required accompaniment. Because the standard adheres to the Governor Council's format for state standards, it was necessary to remove a considerable amount of information from the original draft of the standard. This information may be useful to people who want to use the standard. At this point, the support document requires considerable editing. Much of the duplicity between the standard and the support document will be eliminated.
4. Data formats are not discussed in the document
   RESPONSE: The standard does not imply specific formats that should be followed. The support document will contain information on this subject. We will include some examples.
5. Line 155-180: City's normally store ponds and wetlands as poly's. If these features are converted to points the data sets will not contain the connectivity it appears you are trying to build.
   RESPONSE: The standard was designed with a minimum common denominator in mind. We understand many of the features in the standard are commonly mapped as polygons. The workgroup feels it is easier to go from polygons to points than from points to polygons. The standard does not preclude data from be stored as polygons by the mapping entity. There is an issue with connectivity. The standard includes an artificial path feature designed to connect points and lines. The question of how these connecting features are added and who adds them has not been resolved. The workgroup has discussed the possibility of seeking funding for mapping entities to convert data.
6. Line 244-266: City's normally store natural surface features as poly's. If these features are converted to points the data sets will not contain the connectivity it appears you are trying to build.
   RESPONSE: See response above.
7. Line 244-266: Some of these features seem better represented as lines or polygons
   RESPONSE: Streams will be removed from this feature and added as a new feature class.
8. Lines 182-242: This is the area where there is quite a bit of difference with how Cities store data. Some of features such as rain gardens are better suited as polygon features. Others are typically mapped with other storm sewer point data. Some attributes only apply for a few types. Others should be applied to line features (inlet elevation of outlet).
   RESPONSE: Acknowledged. Please see comment 5.
9. Line 273-278: Clear documentation is desirable as suggested but many cities do not have this available at this point.
   RESPONSE: Noted.
10. Many City governments maintain a storm sewer database that is much more detailed than the proposed standard. While it is understood that there is a need for the standard to be generalized to some extent, the proposed standard is not consistent with data models in use by the majority of City governments in Minnesota. As stated above there will always be the need for some generalization but in this case the differences in the data model is

significant enough that the difficulty associated with migrating the database to the proposed format will be overly time and resource consuming to the point where Cities will not participate in utilizing any part of the standard at all for data exchange.
RESPONSE: The workgroup would like to better understand the difficulties in using the standard. We are scheduling an open meeting to discuss the standard with MS4s in July. In the interim, we would appreciate any insight you can provide into the difficulty of using the standard. T he survey of MS4s conducted in spring of 2008 did not identify significant roadblocks, but perhaps the survey was not detailed enough for that purpose.

11. In addition to this it should be noted that many Cities have already invested large amounts of resources into developing maps, desktop applications, web applications, mobile applications, and asset management systems on established data models such as ArcHydro which could be expanded and applied for this purpose. The effort to export these resources to the proposed format will be excessive. These currently available applications leverage existing data models adding value to City’s existing map products. In addition to this any free toolsets released by ESRI in the future would require extensive modification to function with non standard data models such as the one proposed. If ArcHydro or another nationally recognized standard were to be expanded to meet the requirements of the SDSSDE it would aid Cities greatly.
RESPONSE: See comments above. The work group is interested in learning more about linkage with other models, including ArcHydro. We are requesting information from Dr. David Maidment, Univ. of Texas at Austin regarding compatibility and linkage issues. If you have additional information or insight for the work group, we would be appreciative. Please keep in mind the workgroup acknowledges and has identified some of these issues. This is one reason the standard is being developed as a provisional standard, so that we can have time to determine what roadblocks there are to using the standard and as appropriate, pursuing resources necessary to overcome those roadblocks.

Scott Anderson – City of Bloomington

1. It should remain very clear that the Standard is voluntary. The Standard as drafted is likely not consistent with the current data structures of the many varieties of entities that maintain stormwater data. Cost implications for incorporation of this Standard have not been addressed.
RESPONSE: Noted. The workgroup has discussed cost implications and realizes this is a concern.
2. The multidisciplinary team was heavily represented by MnDOT and the MPCA. Only one municipality was included and no medium or small MS4s were a part of the team. MS4s have a mapping requirement as part of the NPDES MS4 permit. The Standard should not conflict with this requirement. Additionally, the Standard as written is not appropriate to be incorporated into future permits without further discussion and input.
RESPONSE: The MPCA is not considering making the standard an NPDES requirement. Any attempt to create a standard as part of a regulatory requirement would include an extensive stakeholder process. Although MS4s were asked to participate when the work group was formed, it seems appropriate to ask again now that the standard is in draft form. We are holding an open meeting to discuss the standard with MS4s in July and will extend the invitation at that time.
3. The Standard will still likely not result in a stormwater system that is connected across different entities. As these entities have varying resources and standards for actual data collection, the data itself will be the limiting factor to connections across entities, not the standards for exchange.
RESPONSE: The work group acknowledges that there is variability across MS4s. The standard is intended to provide a simple way for data exchange to occur. We don’t

envision that all features and attributes will be mapped uniformly by each mapping entity. We hope that whatever data is available can be transferred using the standard.

4. The document states that the Standard does not imply how entities should store data, but that entities should consider how data is structured to fit the Standard easily. This implies that data should be stored to fit the standard or that entities should have secondary data that fits this Standard.
   RESPONSE: We did not intend to imply that data should be stored to fit the standard, although the workgroup hopes that mapping entities will consider this as they store data.
5. It is reasonable to identify a standard coordinate system and data format for data exchange between entities. However, standards for spatial representation and related attributes are going to be specific to each entity. Most entities map and collect data other than just stormwater systems and may have very specific geometries necessary to integrate these components within the larger system. Attributes for this data will also be specific based on the entity's responsibilities, maintenance practices, and needs.
   RESPONSE: The workgroup acknowledges that local needs vary. At a certain level there is uniformity between different mapping entities. For example, pipes are always mapped as lines. It is these common features that are of most interest for the standard.
6. Has the Stormwater Mapping Committee audited various entities to see what information currently exists to see how it may already fit this standard? A review of existing data may identify more appropriate standards or may show that a formal standard is not needed.
   RESPONSE: The workgroup feels that understanding stormwater connectivity is important for a number of reasons that are presented in the standard. A standard seemed the best way to improve our understanding of connectivity. A survey of MS4s was conducted in 2008 to determine how stormwater features are currently mapped. Results of that survey are available and the workgroup will attempt to get those posted on the web within the next few months.

Mike Kasel – City of Rosemount

1. After reviewing the draft Stormwater System Data Exchange Document our main concern is that the proposed standard is not consistent with data models in use by the City of Rosemount. While there will undoubtedly be differences between any data standard and production databases, the time involved in exporting our data to the proposed standard is anticipated to be so costly that it is unlikely we would support the standard at all in its current format. It is unclear why this standard has chosen to ignore existing widely accepted standard data models such as ArcHydro and those in use by commercial asset management systems. Also, I find the lack of City representation on the panel troublesome.
   RESPONSE: The workgroup would like to better understand the difficulties in using the standard. We are scheduling an open meeting to discuss the standard with MS4s in July. In the interim, we would appreciate any insight you can provide into the difficulty of using the standard. The survey of MS4s conducted in spring of 2008 did not identify significant roadblocks, but perhaps the survey was not detailed enough for that purpose. The work group is also interested in learning more about linkage with other models, including ArcHydro. We are requesting information from Dr. David Maidment, Univ. of Texas at Austin regarding compatibility and linkage issues. If you have additional information or insight for the work group, we would be appreciative. Please keep in mind the workgroup acknowledges and has identified some of these issues. This is one reason the standard is being developed as a provisional standard, so that we can have time to determine what roadblocks there are to using the standard and as appropriate, pursuing resources necessary to overcome those roadblocks.

Nat Kale – Minnehaha Creek Watershed District

1. Generally the format appears acceptable. Without directly applying a standard it is difficult to determine what the various issues with the format might be, so a preliminary phase of use and testing before the standard is finalized is critical.
   RESPONSE: It is the intention of the workgroup to adopt this as a provisional standard. During the time when the standard is provisional, the workgroup will attempt to gain feedback and insight on how the standard can be modified.
2. On initial review, it appears that all of the necessary categories for water conveyance and treatment/detention are present. The sole change that MCWD would like to see before this standard enters preliminary use would be to specify units for those feature attributes that are measurements (pipe diameters, for instance).
   RESPONSE: Noted. This will be discussed by the workgroup.
3. Two of the primary benefits of a standard are to automate the integration of external data into an internal system, and to reduce human error. The latter would be greatly improved by specifying a unit directly in the standard. The former is impossible to fully achieve in a system where vital information is embedded in metadata instead of generally understood and enforced.
   RESPONSE: Noted
4. MCWD understands that various organizations may use a variety of units to measure attributes (such as inches or centimeters for pipe diameters); however, this standard is a standard for exchange, and does not impose any requirements on any organization to alter their internal method of storing or analyzing data, so imposing such a requirement is appropriate.
   RESPONSE: Noted.

Barb Huberty - Rochester

1. As I thought about all of this last night and this morning, in the context of practical applications, I wondered whether this standard may be trying to do too much. I may be short-sighted, but I feel the most probable use of It would be for MS4s to show connectivity between their systems – e.g. to track illicit discharges or identify ownership and maintenance responsibilities. If that is the case, then it seems like this standard should only address those conveyance elements that would be needed to show the linkages between MS4s – specifically conveyance connections and flow directions. Adding anything more just makes this effort messy.
   RESPONSE: This has been extensively discussed by the workgroup. Some members favored the simpler approach you advocate. Because the standard provides recommendations, it was ultimately decided that having a comprehensive standard would not detract from the more fundamental mapping features, such as pipes and structures. Please note that if a mapping entity wishes to exchange information with another entity, they can choose those features they want to exchange (i.e. it is not necessary to exchange information for all features in the standard).
2. If you think that one objective is to have watershed-wide compatible data for water quality modeling purposes (akin to our nondegradation modeling or perhaps for TMDL work), then this standard may not go far enough to note and define all the BMPs and the attributes that should be considered to complete modeling. There is no framework for adding new BMPs as they become more common place (for instance, green roofs or pervious pavement).

RESPONSE: The workgroup discussed this and acknowledges that the standard is not all inclusive. Having the standard as a provisional standard should allow us to determine if it is sufficiently flexible to incorporate additional information as it becomes available.

3. Maybe all that should be tackled as a first step is consistency in the conveyance nomenclature. For the most part, it is the LGU that builds the GIS datasets for MS4s. Therefore, I think there needs to be more discussion about the water quality aspects of GIS mapping and modeling systems among the local MS4 GIS staff, permit managers, and their consultants who have already done nondegradation modeling to further refine the need for having standards applicable to non-conveyance features.
   RESPONSE: This makes sense. There are entities that cross multiple MS4s, such as watershed districts, that should weigh in on the need for standards.
4. Lines 39-40: I hope this won't create a situation where we have to rename our features/attributes or rebuild our system.
   RESPONSE: It will not.
5. Line 53: I don't know if rules is a term in GIS standards, but is sure is different from "rules" that are promulgated from statute. Should a different term be used?
   RESPONSE: The term 'rules' will be dropped.
6. Line 66: Aren't open pipes considered channels? I don't think these were discussed in the support document.
   RESPONSE: The feature was changed to open channels.
7. Line 105-106: So if you don't have consistency in using the values in the standard, then how is the merging of datasets accomplished efficiently? It seems like this standard should address the minimum features and attributes necessary to enable "communication" of data sets between jurisdictions to understand system connectivity and flow linkages. Anything else is superfluous to the objective of the standard and the sole responsibility of the MS4.
   RESPONSE: We recognize that there may be consistency issues at this time. If the metadata contains sufficient explanations, we hope to eventually establish values.
8. Line 112: Does Closed mean limited points of input (closed system), or physically closed (cylindrical) pipe?
   RESPONSE: Physically closed.
9. Line 127: Consider clarifying between slope distance length and horizontal distance length – may be little different in most cases, but at least clarify the correct value to be used here.
   RESPONSE: Noted.
10. Line 134: Include Contact Fields (Phone, Email, etc)?
    RESPONSE: We recommend this information be included in the metadata.
11. Line 165: Artificial Flow – perhaps General Flow, or Connectors better describe these features, as it is not artificial, but just a simplified representation of the flow.
    RESPONSE: The term was changed to Artificial Path
12. Line 176: Consider keeping like features together constructed and natural, they are still ponds or wetlands, with like attributes – use a field to distinguish:
    RESPONSE: The workgroup felt that features were best defined as being constructed or natural, particularly since most natural features already exist as coverages (e.g. NHD). The feature was changed to Constructed Basins.
13. Line 226: Clarify between Invert and Bottom, see appendix for comments
    RESPONSE: Noted. The bottom is the bottom of the device, relative to mean sea level.
14. Line 270: Stream should be considered polyline feature, I would think
    RESPONSE: Agreed.
15. Line 282: Compliance is a legal, regulatory term that infers existence of a promulgated law, statute, rule, or permit. Since this document applies to a permit requirement in the

MS4 permit (mapping), perhaps referring to compliance takes on an unintended meaning. Perhaps conformity or consistency would be a better term.
RESPONSE: Compliance is a term consistently used in Minnesota standards. We agree the term is misleading, but we must maintain consistency with the format for standards.

Steve Kloiber - DNR

1. Line 51: Point of information: What is the difference between a closed and open pipe? Later on the standard seems to group open channels and open pipes (Line 120). Are the terms “open pipe” and “closed pipe” meaningful?
   RESPONSE: The terms closed and open are removed
2. Line 72-73: Additional cartographic flourishes, such as arrows or flared end sections, as sometimes found in CAD drawing files, should be maintained in a separate data layer or symbology layer.
   RESPONSE: Change made.
3. Line 82: Including explicit connections between the stormwater system and other associated hydrography datasets should be encouraged, whenever possible.
   RESPONSE: Change made.
4. Line 93 – 266: There are some issues with the feature attribute definitions that may lead to some confusion. I strongly suggest that the following formatting change be considered. For each attribute, you should list the field name (I think there is a 10 character limit for shapefiles), a full field description, the data type (e.g. boolean, character, integer, floating point, etc.), field length, precision (for numbers), and the domain (e.g. a numeric range or a list of permissible text entries). See the following example.

Closed Pipe Attributes

Field Description: Cross-sectional shape of the pipe
Field Name: PIPE_SHP
Data Type: CHARACTER
Field Length: 10
Precision: N/A
Domain: round, arch, box, elliptical, tunnel, other, unknown
Field Description: Pipe height in units of inches
Field Name: HEIGHT
Data Type: Integer
Field Length: 3
Precision: N/A
Domain: 1 – 240, NULL
Field Description: Pipe length in units of feet
Field Name: LENGTH
Data Type: FLOATING POINT
Field Length: 10
Precision: 2
Domain: >0, NULL

RESPONSE: These recommendations were incorporated into the Support document.

5. Line 93 – 266: For numeric fields, the required units should be specified. For example, all pipe height data should be converted to inches. Only one set of units should be allowed in a data exchange standard. This will reduce confusion and error for those aggregating the data.
   RESPONSE: Consistency has been improved. Some length features may be in feet.
6. Line 93 – 266: Maybe we should add an attribute for closed pipes to indicate whether a pipe is a force main (pressurized) or gravity flow system.

RESPONSE: After further discussion, this change was not made.