

**San Diego Stormwater Copermittees
Data and Information Management Workgroup**

Recommended MS4 Digitization Standards

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Section I. Summary of Recommendations

This document provides guidance and recommended standards to Copermittees who are developing or updating their MS4 data layers. These recommendations are intended to promote consistency among jurisdictions in the development of coverages that consider future stormwater management and existing management requirements. This consistency is crucial both to the development of watershed maps and in improving our ability to manage stormwater on a watershed basis.

The recommended standards presented here were developed with three primary endpoints in mind: Permit compliance, future management/modeling, and asset management. Digitization standards recommended by the Data and Information Management Workgroup generally include the use of attributes normally associated with existing asset management needs. This category of use requires the most comprehensive set of attributes and can therefore be readily applied to a variety of stormwater management efforts, including modeling.

As appropriate, recommended point features and drain lines coverages include descriptions, category(s) of use, relative importance, and suggested field types. Recommended accuracy standards are also provided to further facilitate the development of a county-wide MS4 coverage.

Section II. Objectives of the MS4 Digitization Standards Subgroup

In June 2002, the Data and Information Management Workgroup formed a Subgroup to develop recommended standards for municipal separate storm sewer system (MS4) geographic information system (GIS) coverages. The primary goal of the MS4 Digitization Standards Subgroup is to promote consistency between the various Copermittee MS4 coverages, thus facilitating the development of a county-wide MS4 coverage, which will, in turn, improve our ability to manage stormwater on a watershed basis.

The specific objectives of the Subgroup were to develop recommended standards for MS4 digitization, which consider three categories of use:

- a. The requirements of Order No. 2001-01¹ (Permit);
- b. Future management needs, including modeling; and
- c. Asset Management requirements.

Copermittee requirements under the Permit include the development of MS4 maps on both a jurisdictional (Permit Attachment E) and watershed basis (Permit section J.2.a). While the Permit only *recommends* the use of a GIS, its application is crucial to achieve consistency at all scales.

As Copermittees expend resources to develop their MS4 maps, consideration should be given to the potential use of their MS4 data layers. MS4 layers created solely to satisfy minimum Permit requirements may be limited in their use to stormwater managers. Therefore, the Subgroup considered future stormwater management needs, including modeling, and asset management requirements while developing standards.

Recommended standards are based on the consensus of the MS4 Digitization Standards Subgroup and the Data and Information Management Workgroup, and do not necessarily characterize the opinion of individual participants or the organizations they represent. They are intended to provide guidance and to promote consistency among Copermittee MS4 GIS coverages. Consistency is crucial to the development of watershed maps and to ease the transition to watershed-based stormwater management.

¹ Order No. 2001-01, NPDES No. CAS0108758, Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District.

Section III. Description of Existing MS4 Digitization Efforts

To characterize the status of the various MS4 data layers within San Diego County, on behalf of the Data and Information Management Workgroup, Paul Hardwick, SANDAG, and Karl Von Schlieder, City of Carlsbad, contacted the Copermittees in April 2002. Each Copermittee responded to the following survey questions:

- Do you have your storm water collection, conveyance, and discharge system mapped?
- What kind of hardcopy maps exist - one overall map, by subdivision, etc.? How many? Do the scales vary?
- Are all the features of the map identified as to feature type, size, length, width, etc.?
- Is there a digital copy of the map? If so, are the stormwater features coded as to feature type, size, length, width, etc.?
- In what format is the digital copy? ArcInfo, shape files, CAD, etc. What is the coordinate system used for the file?
- What is the original scale of the data, i.e. what was the original mapping scale of the study?
- What is the size of the smallest and largest feature mapped in the digital file?
- What is the area of coverage for the map/file? i.e. Entire jurisdiction, developed areas, newer developments, etc.
- Is the stormwater map/file up-to-date? What is the effective date?
- Is there metadata available for the map/file? If no metadata, are you planning on creating metadata in the near future?
- If a consultant was used to generate all or part of the map/file, who are they?
- If the stormwater facility map (MS4) is not in a GIS format, what steps are the City willing to take towards developing a GIS version, compatible with the other jurisdictions in the URMP watershed?
- What uses beyond the compliance with this permit is your city planning for this data?

The results of this survey, which are presented in Table 1, illustrate that many strategies have been utilized in the development of jurisdictional MS4 maps. Some Copermittees have contracted with consulting companies, while others have completed the digitization and global positioning system (GPS) process internally. Survey results also showed that only four cities (Carlsbad, Chula Vista, Escondido, and San Diego) have a complete GIS map of their MS4; however, the coverages for the City of San Diego must be updated in order to include new development that has occurred within the last 12 years. MS4 maps for the remaining Copermittees are in various stages of development, ranging from finished CAD drawings to hardcopy maps.

Table 1. Status of Copermitttee MS4 Digitization Efforts

Agency	Is the MS4 Mapped?	Type of Hardcopy Map? Do Scales vary?	Are all features mapped and coded?	Is there a digital copy of the map? Are all the features coded?	In what format is the digital data, and what is the coordinate system?	What is the original scale of the data?	What is the size of the smallest and largest feature mapped?
Carlsbad	Yes	Multiple sheets	Yes	Yes. Yes	Arclnfo coverages		
Chula Vista	In progress (50%)	Improvement plans	Yes	Yes. Yes	ESRI geodatabase	Varies 40' to 100'	
Coronado	Yes, except open culverts	One map	Yes	Yes. No	Shapefiles. State Plane NAD83	1"=400', other parts GPS	1' to 2000 square foot pump station
Del Mar	Yes	One sheet plotted	Yes	Yes. Update in progress	AutoCAD; NAD83	Varies 40' to 100'	inlets, swales
El Cajon	Yes	One sheet	No	No	N/A		18" and up
Encinitas	Yes	Multiple sheets	Yes	In progress (75%)	Arclnfo coverages. State Plane NAD83	1" = 100'	6" to 84" pipes pump station
Escondido	Yes	Single and multiple	Yes	Yes. Yes	Arclnfo coverages. State Plane NAD83	1"=200' and 1'=20' or 40'	1' to 1,700'
Imperial Beach	Yes	Scales vary	No	No	N/A	1"=400'	N/A
Lemon Grove	Yes	Multiple sheets	Yes	No (Contractor may have CAD files)	CAD	Varies	18" and up
La Mesa	Yes (Being updated)	Multiple sheets	In progress	In progress (80%)	Arclnfo coverages. State Plane NAD83	Varies 40' to 100'	
National City	Yes	One map	Yes	Yes	Shapefiles	1"=200'	10'. 120'
Oceanside	Yes	Multiple sheets	Yes	Yes. Yes	CAD	1" = 200'	
Poway	Yes	5 sheets; 1"=500'	Yes	Yes. Yes	Hydra (exportable to dxf)	1" = 20'	18" and up
San Marcos	Yes	5 sheets; 1"=500'	No	No	N/A	Varies 40' to 100'	
City of San Diego	Yes	Multiple sheets; 1"=100' scale	Most are coded	Yes. Yes	ARclnfo coverages and shapefiles. NAD83		
Santee	Yes	One sheet	Yes	Yes. No	CAD	1" = 1000'	
Solana Beach	Yes (Inlets only)	Four sheets	No	Yes. No	AutoCAD		
Vista	Yes	No	Yes	Yes	DWG	N/A	ge 42"
County of San Diego	Yes	Multiple sheets at various scales	Yes, in a database	In progress	Arclnfo coverages. State Plane NAD83	Varies	18" and up
San Diego Unified Port District	Yes (95%, except Imperial Beach)	Multiple sheets	Yes	Yes. Some features coded.	CAD. State Plane NAD83	1" = 100'	Pipe size

Table 1 (cont.'d). Status of Copermitttee MS4 Digitization Efforts

Agency	What is the area of coverage (entire city, developed areas, etc.)?	Is the map up to date? What is the effective date?	Is there metadata? If No, will there be in the future?	If a consultant was used to generate the map, who was it?	If not in GIS format, is the city willing to create a GIS version compatible with other watershed members?	To what other uses, besides this permit, is your city planning to use this data?
Carlsbad	Entire city	In progress. 06/01/02	No. Yes	Rick Engineering	N/A	
Chula Vista	Entire city	In progress. 06/01/02	No. Yes	N/A	N/A	Master Plan; GASB34; Maintenance & operations
Coronado	Entire city & Navy Base	In progress. 2002	No. Yes	N/A	N/A	Asset management
Del Mar	Entire city	July '00; Update in progress	No. Yes	PBS&J	TBD	Maintenance & operations; Asset accounting
El Cajon	Entire City	Yes. 2002	No	N/A	Yes	Asset management
Encinitas	Entire city	In progress. 2002	No. Yes	N/A	N/A	Asset management
Escondido	Entire city	Yes. 2002	Yes	SAIC	N/A	Asset management
Imperial Beach	Entire city	1992 (95%)	No.	Grant pending	Yes	Asset management
Lemon Grove	Entire city	No. 1970	No	ASL Engineers	Work with SANDAG	Asset management
La Mesa	Entire city	In progress. 5/2002	No. Yes	Dudek & Associates	N/A	Maintenance & operations; Asset accounting
National City	Entire city	Yes. 03/02	No.	PBS&J	N/A	
Oceanside	Entire city	Yes. 2002	No	N/A	Planning on taking CAD files to a geodatabase in Sept.	Asset management
Poway	Entire city	No. 2001	Yes - partial.	Dudek & Associates	TBD	Maintenance & operations; Asset accounting
San Marcos	Entire city (out-of-date)	No. 1987	No.	N/A	Not known - need more info	Maintenance & operations; Asset accounting
City of San Diego	Entire city	12 years old	Yes	Street Div maintains the data	TBD	Maintenance & operations; Asset accounting
Santee	Developed Areas	2/1/90	No. No	BSI Consulting	Yes. CAD files will be converted to GIS (12-18 months).	Maintenance & operations; Asset accounting
Solana Beach	Entire city	Yes. 2001	No. No.	N/A	Yes	Maintenance & operations; Asset accounting; Locate pollution sources
Vista	Entire city	1998	No.	Rick Engineering	Yes.	Maintenance & operations; Asset accounting
County of San Diego	Unincorporated Area	2002	No. Yes	Earth Tech	Yes. Current contract	Maintenance & operations; Asset accounting
San Diego Unified Port District	District, except IB	1999	No. Yes	Brown&Caldwell	Yes. Current contract to take CAD to Arc Coverages	Environmental Modeling

Section IV. Description of the Standards Development Process

To facilitate initial discussion, the Cities of Carlsbad, Chula Vista, and Escondido each presented an overview of the digitization process for their respective jurisdiction. The GIS layers for each jurisdiction contained both an inlet/node coverage as well as a channel/main coverage. Upon initial review, the coverages from Carlsbad, Chula Vista, and Escondido appeared to have many similar data fields, which could provide a foundation for developing recommended standards.

Metadata was obtained for the MS4 data layers from the Cities of Carlsbad, Chula Vista, Escondido, and San Diego. MS4 Digitization Standards Subgroup participants compared these coverages and identified the common attributes using an Access database. Subsequently, the Subgroup prioritized the attributes based on the following three categories of use:

- a. The requirements of the Permit;
- b. Future management needs, including modeling; and
- c. Asset Management requirements.

This prioritization included an identification of the appropriate category(s) of use, their relative importance, and the field type for each attribute. Recommended standards for both point features and drain line coverages, which were finalized by the Data and Information Management Workgroup, are presented in Section V.

Section V. Recommended MS4 Digitization Standards

Copermittees may store and access their MS4 data in many ways. While a GIS can be used to manage all of the data elements described below, only a subset are required to create a GIS coverage. Therefore, Copermittees may elect to manage this subset of data in a GIS, while linking to the other attributes in a related data management system.

This section provides the MS4 digitization standards recommended by the Workgroup, including descriptions of the attributes to minimize inconsistencies caused by differing terminology. Matrices (Tables 2 and 3) are provided to characterize the specific category(s) of use (Permit compliance, Modeling, and/or Asset Management) for each attribute and their associated level of importance. The information and recommendations captured in these tables are divided into general attributes (those relevant to Point Features *and* Drain Lines coverages) and specific attributes (those relevant to Point Features *or* Drain Lines coverages).

To ensure thorough and expandable MS4 coverages, the Workgroup recommends including all attributes outlined for the Asset Management category in the Point Features (Table 2 and Section V.A) and Drain Lines (Table 3 and Section V.B) coverages. Additionally, recommended standards for accuracy, which relate to many of the attributes defined below, are presented in Section VI.

A. Point Features

This section provides an explanation for the attributes associated with MS4 point features. Such point features are also called access points, inlets, outfalls, storm drain structures, and nodes. To supplement the following text, the attributes, their associated category of use, their level of importance, and the recommended field type are presented in Table 2.

1. **Unique Local Identification Number.** A unique number assigned to each node by the jurisdiction. Because jurisdictions may have similar numbering formats, a separate regional numbering scheme should be applied by the person or organization merging the jurisdiction-specific point coverages. This will ensure that identifiers remain unique, while preserving internal data tracking.
2. **Jurisdiction.** The name of the jurisdiction with direct access to the source data for the given node.
3. **Atlas Sheet Number.** The field atlas sheet number.
4. **Drawing Number.** The number of the original Public Works drawing, or improvement plan, on which a given node can be found.
5. **Source of Data.** The original source of data for the given node. This field may include the following common data sources: Master plan, Storm Drain Atlas, Global Positioning System (GPS) data, improvement plan, and generated by the digitization process. To supplement this information, links to scanned images of the original maps, drawings, or plans may also be included.
6. **Date of Data.** The date that the data was collected. This field may also be used to represent the level of confidence in the data and to ensure that updates to the coverage include the most recent data available.

Table 2. Recommended attributes associated with a MS4 Point (or node) coverage.

Point Features					
Attribute		Importance by Category of Use			Field Type
		Permit	Modeling	Asset Management*	Text / Numeric / Integer
General Attributes					
1	Unique Local ID Number	Highly Recommended	Highly Recommended	Highly Recommended	Integer / Text
2	Jurisdiction	Highly Recommended	Highly Recommended	Highly Recommended	Text
3	Atlas Sheet Number		Highly Recommended	Optional	Text
4	Drawing Number		Highly Recommended	Highly Recommended	Text
5	Source of Data		Optional	Highly Recommended	Text
6	Date of Data		Optional	Highly Recommended	Date
7	Responsible Party	Optional		Highly Recommended	Text
8	Installation Date			Highly Recommended	Date
9	Inspection Date			Optional	Date
10	Maintenance Date			Optional	Date
11	Coordinate X	Highly Recommended	Highly Recommended	Highly Recommended	Numeric
12	Coordinate Y	Highly Recommended	Highly Recommended	Highly Recommended	Numeric
13	Street Location		Optional	Optional	Text
14	Type	Optional	Highly Recommended	Highly Recommended	Text
15	Notes		Optional	Optional	Text
16	Capacity		Highly Recommended	Optional	Numeric
17	Geometry of Node		Highly Recommended	Optional	Text
Specific Attributes					
18	Invert Center		Highly Recommended	H.R.	Numeric
19	Number of Inlets		Highly Recommended	Optional	Integer
20	Structure Operations		Highly Recommended	Highly Recommended	Text
21	Needs Cleaning/Repair		Optional	Optional	Text
22	Accessibility			Optional	Text
23	Paint/Stencil	Optional		Optional	Text

Key:

* = The Data and Information Management Workgroup recommends including all attributes in the Asset Management category for the Point Features coverage.

7. **Responsible Party.** The current agency, jurisdiction, or department responsible for management of the storm drain structure. This field may include the following data sources: Copermittee name, Caltrans, the Navy, Private, Other, and Unknown.
8. **Installation Date.** The installation date for the given node.
9. **Inspection Date.** The date of the most recent inspection for a given node.
10. **Maintenance Date.** The date of the most recent maintenance for a given node.
11. **Coordinate X.** The easting coordinate of the center of the node. This location is likely identical to the access point to the node and any variation may be described in the notes field.
12. **Coordinate Y.** The northing coordinate of the center of the node. This location is likely identical to the access point to the node and any variation may be described in the notes field.
13. **Street Location.** A unique identification number representing the street segment nearest to the node.
14. **Type.** The type of structure at a given node. Following are some structure types, which may be used to populate this field: manhole, box culvert, catch basin, curb outlet, curb inlet, headwall, pump station, wingwall, or unknown.
15. **Notes.** This field provides details for the given node within a coverage.
16. **Capacity.** The maximum capacity (storage capacity, pumping capacity, etc.) for the given storm drain structure. The capacity is usually presented as a rate.
17. **Geometry of Node.** This attribute captures the size of the node, such as a diameter of a manhole or an area of a catchment opening. Specifically, this field includes length, width, and/or height, depending on the structure type.
18. **Invert Center.** The elevation of the bottom of the center of the box. The accuracy of the elevation is largely dependent on the source of data. Specifically, data derived from a survey-quality GPS will be much more accurate than elevation data derived from Public Works drawings.
19. **Number of Inlets.** The number of inlets contributing to a storm drain structure or node.
20. **Structure Operations.** This field describes management activities that may cause changes to the performance of the storm drain structure (i.e. opening of flood gates).
21. **Needs Cleaning / Repair.** This attribute identifies whether a given node needs cleaning or repair.
22. **Accessibility.** This field provides a description of the immediate surroundings, ease of access to the storm drain structure, and may include links to digital photographs.
23. **Paint / Stencil.** This attribute identifies whether a node has been stenciled or painted.

B. Drain Lines

This section provides an explanation of the attributes associated with MS4 drain line features. These features include channels and underground pipes and may also be referred to as storm drain conveyances or mains. Copermittees may elect to have separate coverages for the channels and underground pipes in their jurisdiction. All of the attributes described below are relevant for a complete conveyance system coverage; however, certain data fields may not be necessary in both a channel and underground pipe coverage. Attributes, their associated category of use, their level of importance, and the recommended field type are also provided in Table 3.

1. **Unique Local Identification Number.** A unique number assigned to each Drain Line by the jurisdiction. Because jurisdictions may have similar numbering formats, a separate regional numbering scheme should be applied by the person or organization merging the jurisdiction-specific Drain Line coverages. This will ensure that identifiers remain unique, while preserving internal data tracking.
2. **Jurisdiction.** The name of the jurisdiction with direct access to the source data for the given drain line.
3. **Atlas Sheet Number.** The field atlas sheet number.
4. **Drawing Number.** The number of the original Public Works drawing, or improvement plan, on which a given storm drain line can be found.
5. **Source of Data.** The original source of data for the given drain line. This field may include the following common data sources: Master plan, Storm Drain Atlas, GPS data, improvement plan, and generated by the digitization process. To supplement this information, links to scanned images of the original maps, drawings, or plans may also be included.
6. **Date of Data.** The date that the data was collected. This field may also be used to represent the level of confidence in the data and to ensure that updates to the coverage include the most recent data available.
7. **Responsible Party.** The agency, jurisdiction, or department responsible for management of the storm drain line or channel. This field may include the following data sources: Copermittee name, Caltrans, the Navy, Private, Other, and Unknown.
8. **Installation Date.** The installation date for the drain line. The value for this field can be estimated from the original Public Works drawing.
9. **Inspection Date.** The date of most recent inspection for a given drain line.
10. **Maintenance Date.** The date of most recent maintenance for a given drain line.
11. **Starting Point.** The X,Y (easting, northing) coordinates of the beginning node of a given drain line. This node may also be called the “from” node or the node associated with the upstream end of the given drain line.

Table 3. Recommended attributes associated with a MS4 Drain Line coverage.

Drain Lines					
Attribute	Importance by Category of Use			Field Type	
	Permit	Modeling	Asset Management*	Text / Numeric / Integer	
General Attributes					
1	Unique Local ID Number	Highly Recommended	Highly Recommended	Highly Recommended	Integer / Text
2	Jurisdiction	Highly Recommended	Highly Recommended	Highly Recommended	Text
3	Atlas Sheet Number		Highly Recommended	Optional	Text
4	Drawing Number		Highly Recommended	Optional	Text
5	Source of Data		Optional	Highly Recommended	Text
6	Date of Data		Optional	Highly Recommended	Date
7	Responsible Party	Optional		Optional	Text
8	Installation Date		Highly Recommended	Highly Recommended	Date
9	Inspection Date			Highly Recommended	Date
10	Maintenance Date			Highly Recommended	Date
11	Starting Point (X,Y)	Highly Recommended	Highly Recommended	Highly Recommended	Numeric
12	Ending Point (X,Y)	Highly Recommended	Highly Recommended	Highly Recommended	Numeric
13	Street Location		Optional	Optional	Text
14	Type	Highly Recommended	Highly Recommended	Highly Recommended	Text
15	Notes		Optional	Optional	Text
16	Capacity		Highly Recommended	Optional	Numeric
17	Drain Line Geometry		Highly Recommended	Highly Recommended	Text
a	Cross-Section Shape		Highly Recommended	Highly Recommended	Text
i	Height		Highly Recommended	Highly Recommended	Numeric
ii	Width		Highly Recommended	Highly Recommended	Numeric
iii	Other Geometric Features		Optional	Optional	Text
b	Length		Highly Recommended	Highly Recommended	Numeric
Specific Attributes					
18	Measured Length		Highly Recommended	Highly Recommended	Numeric
19	Invert In		Highly Recommended	Highly Recommended	Numeric
20	Invert Out		Highly Recommended	Highly Recommended	Numeric
21	Slope		Highly Recommended	Highly Recommended	Percent
22	Composition/Material		Highly Recommended	Highly Recommended	Text
23	Roughness Coefficient		Highly Recommended	Optional	Numeric
24	Upstream Access ID		Highly Recommended	Optional	Text
25	Downstream Access ID		Highly Recommended	Optional	Text
26	Cross Streets			Optional	Text

Key:

* = The Data and Information Management Workgroup recommends including all attributes in the Asset Management category for the Drain Lines coverage.

12. **Ending Point.** The X,Y (easting, northing) coordinates of the ending node of a given drain line. This node may also be called the “to” node or the node associated with the downstream end of the given drain line.
13. **Street Location.** A unique identification number representing the street segment nearest to the drain line.
14. **Type.** The type of structure for the given drain line. This field may be populated with the following common types of drain lines: pipe, drainage channel, and brow ditch.
15. **Notes.** This field provides details for the given drain line within a coverage.
16. **Capacity.** The maximum capacity for the given drain line. The capacity is usually presented as a rate.
17. **Drain Line Geometry.** This field describes the overall geometry of the drain line.
 - (a) ***Cross-Section Shape.*** This attribute represents the shape of the drain line cross-section. Specifically, this field may be populated with the following common drain line shapes: rectangular, semicircle, trapezoid, circular pipe, and unknown. In addition to a description of the shape, this field may contain the following additional features:
 - i. ***Height.*** The height of a given drain line in inches. This field may be used if the drain line is not a round pipe, such as elliptical-shaped, metal pipe. For a channel, this field may represent the mean channel depth.
 - ii. ***Width.*** The width of a given drain line in inches. This attribute represents the drain line diameter if the feature is a round pipe.
 - iii. ***Other Geometric Features.*** This field may be used to represent the dimensions of additional geometric features (in inches) not captured in the height and width fields.
 - (b) ***Length.*** The estimated drain line length, in feet, as calculated during the digitization process.
18. **Measured Length.** The actual length of the given drain line based on field measurements or accurate drawings.
19. **Invert In.** The elevation of the bottom of the upstream end of the pipe. The accuracy of the elevation is largely dependent on the source of data. Specifically, data derived from a survey-quality GPS will be much more accurate than elevation data derived from Public Works drawings.
20. **Invert Out.** The elevation of the bottom of the downstream end of the pipe. The accuracy of the elevation is largely dependent on the source of data. Specifically, data derived from a survey-quality GPS will be much more accurate than elevation data derived from Public Works drawings.

21. **Slope.** The slope (percent) of the given drain line. For a channel, this field captures the shallowest, or least, slope of the line.
22. **Composition / Material.** The type of material of which a given drain line is composed. Suggested materials that may be used to populate this field include: corrugated metal, reinforced concrete, asbestos cement, polyvinyl chloride, concrete, vitrified clay, soil type (i.e. Soil Conservation Service Hydrologic Soil Group), rip-rap, and asphalt-lined, corrugated, metal.
23. **Roughness Coefficient.** This value is used to represent flow resistance for hydraulic computations of flow in drain lines.
24. **Upstream Access ID.** Identification number of the node for the beginning point of drain line.
25. **Downstream Access ID.** Identification number of the node for the ending point of the drain line.
26. **Cross Streets.** The name of the closest cross street to the given drain line.

Section VI. Recommended Accuracy Standards

The accuracy standards presented in this section, though minimal, are intended to assist Copermittees in aggregating their MS4 data sets across jurisdictional boundaries. It should be noted that the required level of accuracy is directly related to the intended use of the MS4 coverages. For example, the level of accuracy needed for an illustrative map is much lower than that for a hydrologic model of a watershed or subwatershed.

A. Coordinate System

The recommended coordinate system standards are:

- State Plane, Zone VI for projection;
- North American Datum 1983 (NAD 83) for datum;
- Global Reference System (GRS) 1980 for spheroid;
- North American Vertical Datum 1988; and
- U.S. feet for the data units.

B. Data Collection

Ideally, data should only be digitized off of maps with no less than a 1:2,400 scale; however, a finer scale is preferable. Data obtained with a GPS should be collected in the above coordinate system. Additionally, if data is being collected in decimal degrees, a minimum precision of 5 to 6 decimal places is recommended.

C. Attribute Units

All attributes describing MS4 pipes and structures should be recorded in English Units (i.e. inches, feet, square feet, cubic inches, etc.).

D. GIS Format

A majority of GIS users in the region utilize some form of Environmental Systems Research Institute, Inc. (ESRI) GIS software. It is highly recommended that Copermittees store their geographic data in a GIS system that is compatible and easily exchangeable with ESRI-supported data formats.