

Building a Geodatabase for Spill Response & Stormwater Impacts at PDX

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Background/Purpose

- Potential for spills and accidental release of material
- Common materials spilled/released: vehicle fluids, jet fuel, and sewage
- Tenants, airlines, construction contractors, and ground service companies
- The Port is responsible for:
 - ensuring agency notification
 - oversight
 - containment of spills/releases that may impact waterways and outfalls

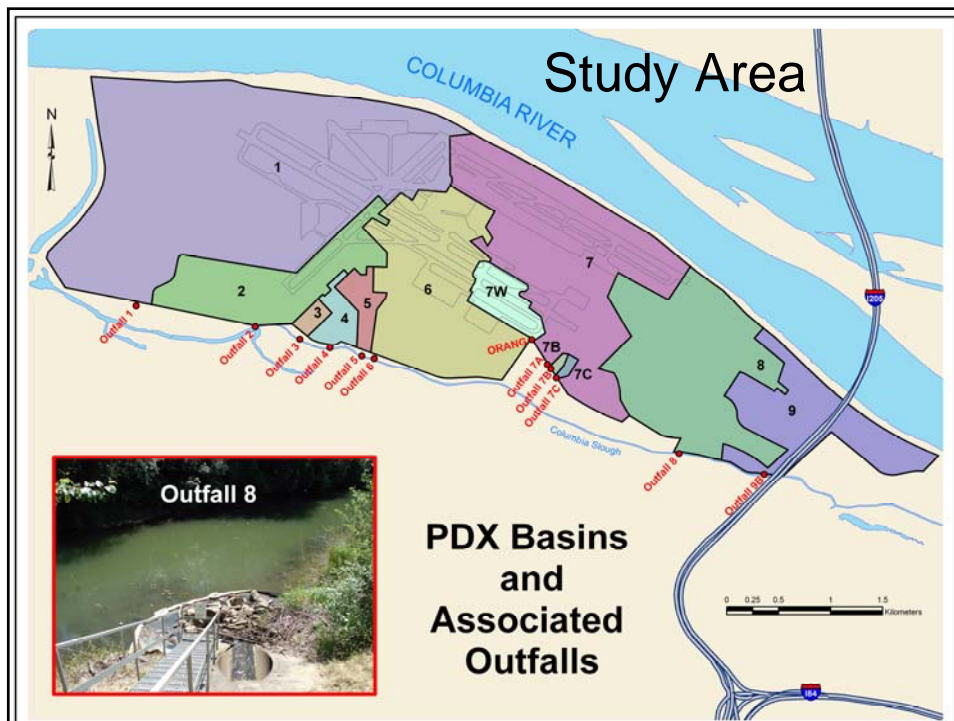


Problem Statement

- Currently spill incidences are recorded in a Word Document format
- Documents are not related to stormwater analysis or visual monitoring data
- No spill trends or analysis is being preformed

Objectives

- Build a Relational Database where:
 - Spill reports are related spatially to PDX infrastructure & stormwater data
- Create topology
- Identify relationships
- Build a storm sewer network
- Identify areas that have high risk for spills



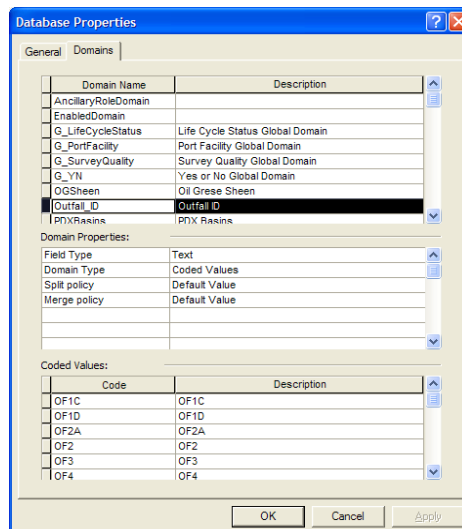
Methods

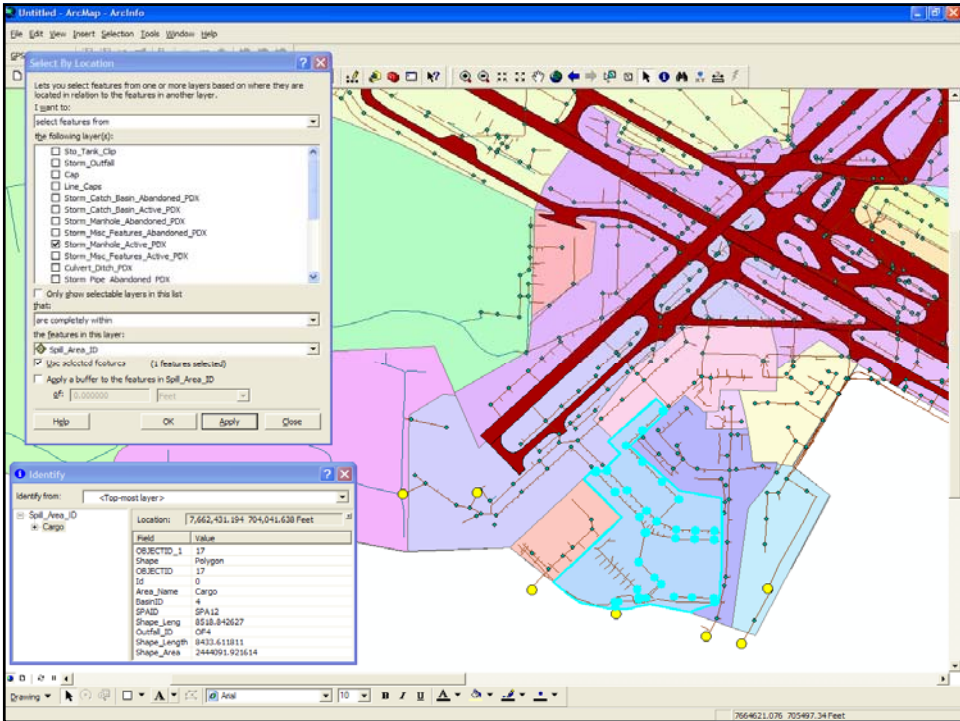
- Domains
- Primary Keys
- Data Creation
- Simplification
- Normalization
- Topology Rules
- Relationships
- Geometric Network



Domains

- The type of attribute domain and range of permissible coded values were assigned to our domains





Selected Features

FACILITY	FLOW_ELEV	MH_TYPE	OWNER	REV_DATE	RIM_ELEV	STRUCT_ID	SURV_QUAL	SYSTM_TYPE	TRC_ID	Outfall_ID	Basin
PDX	0	MANHOLE	POP	05/14/2007	0	0	FO	STORM	UNKNOWN	OF4	4
PDX	0	MANHOLE	POP	05/14/2007	0	0	FO	STORM	UNKNOWN	OF4	4
PDX	0	MANHOLE	POP	05/14/2007	0	0	FO	STORM	UNKNOWN	OF4	4
PDX	0	MANHOLE	POP	05/14/2007	0	0	FO	STORM	UNKNOWN	OF4	4
PDX	0	MANHOLE	POP	06/30/2004	0	1933	RD	DEICE DILUTE	CD PDX 2000 0522 00 0041 0	OF4	4
PDX	0	MANHOLE	POP	01/11/2006	20.41	1711	SU	STORM	CD PDX 1996 0530 00 0002 0	OF4	4
PDX	7.75	MANHOLE	POP	07/17/2001	20.71	1754	SU	GRAVITY	CD PDX 1996 0530 00 0002 0	OF4	4
PDX	0	MANHOLE	POP	01/11/2006	19.64	1797	SU	STORM	CD PDX 1996 0530 00 0002 0	OF4	4
PDX	8.85	MANHOLE	POP	07/17/2001	20.91	1810	SU	GRAVITY	UNKNOWN	OF4	4
PDX	9.06	MANHOLE	POP	07/17/2001	20.21	1812	SU	GRAVITY	TD PDX 1996 1006 00 0004 0	OF4	4
PDX	9.26	MANHOLE	POP	07/17/2001	15.86	1846	SU	GRAVITY	TD PDX 1996 1006 00 0004 0	OF4	4
PDX	0	MANHOLE	POP	01/11/2006	17.35	8323	SU	STORM	CD PDX 1990 0506 00 0021 0	OF4	4
PDX	0	MANHOLE	POP	01/04/2006	17.4	8324	SU	STORM	TD PDX 2000 1012 00 0005 0	OF4	4
PDX	0	MANHOLE	POP	01/04/2006	17.45	8325	SU	STORM	TD PDX 2000 1012 00 0005 0	OF4	4
PDX	0	MANHOLE	POP	01/04/2006	17.31	8326	SU	STORM	TD PDX 2000 1012 00 0005 0	OF4	4
PDX	0	MANHOLE	POP	01/04/2006	17.27	8327	SU	STORM	TD PDX 2000 1012 00 0005 0	OF4	4
PDX	0	MANHOLE	POP	01/11/2006	17.33	8328	SU	STORM	CD PDX 1990 0506 00 0021 0	OF4	4
PDX	7.5	GRADED	POP	07/17/2001	0	1907	SU	GRAVITY	CD PDX 1989 0503 00 0020 0	OF4	4
PDX	0	MANHOLE	POP	01/04/2006	18.72	1923	SU	STORM	CD PDX 1989 0505 00 0012 0	OF4	4
PDX	7.2	MANHOLE	POP	07/17/2001	21.15	1933	SU	GRAVITY	CD PDX 1989 0503 00 0020 0	OF4	4
PDX	0	MANHOLE	POP	07/17/2001	20.15	1936	SU	GRAVITY	CD PDX 1990 0506 00 0022 0	OF4	4
PDX	9.91	MANHOLE	POP	01/04/2006	17.41	1970	SU	STORM	CD PDX 1989 0505 00 0014 0	OF4	4

Primary Keys

- Includes outfalls, drainage basins, and spill areas.
- Relationship class determines which fields are denoted as primary or foreign keys.

Add Field ? X

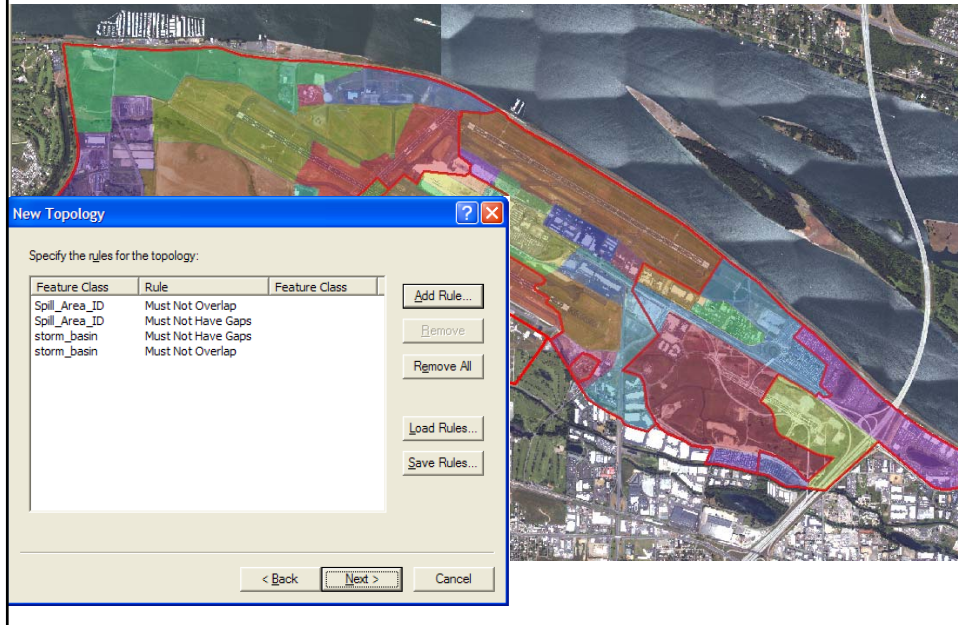
Name:

Type:

Field Properties

Alias	
Allow NULL Values	Yes
Default Value	
Domain	
Length	50

Data Creation

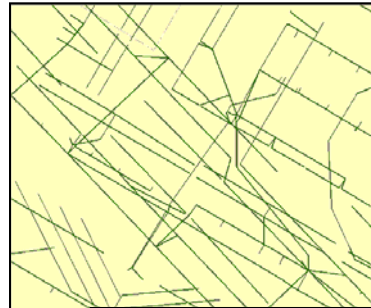


Simplification (Normalization?)



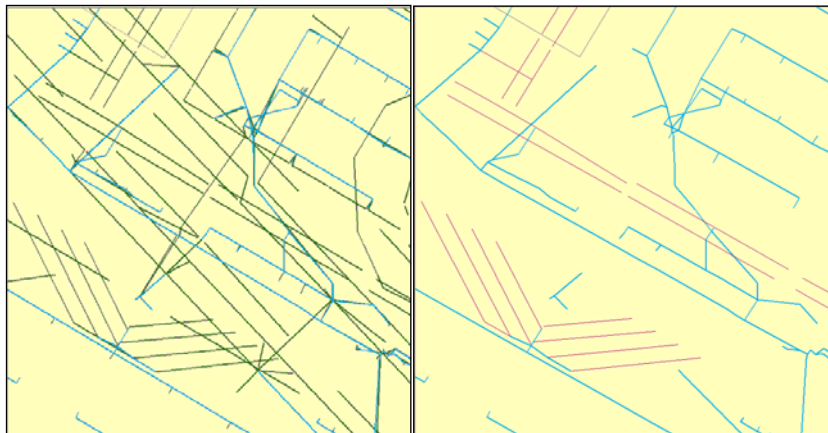
Simplification

- First Split Features by their attributes.
 - PDX Features
 - Abandoned vs. Active
- Then into Separate Feature datasets & Feature classes
 - Excluded_Storm_System
 - Subdrains
 - Trench Drain
 - Caps

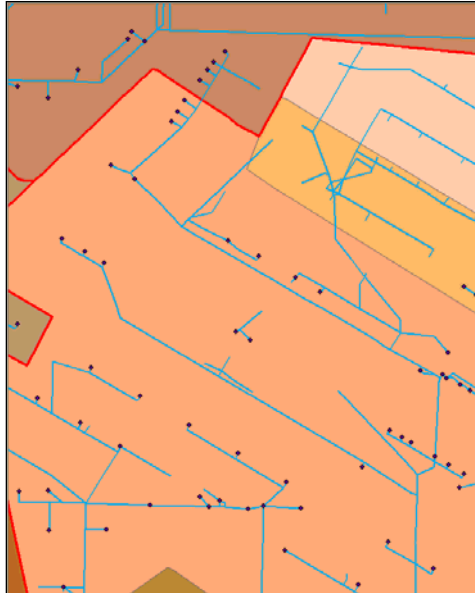


Name	Type
Attributes_maintained_by_Env_Af...	Excel File
Export_Output.dbf	dBASE Table
storm_basin.shp	Shapefile
storm_basin0.bmp	Raster Dataset
storm_catch_basin.shp	Shapefile
storm_catch_basin0.bmp	Raster Dataset
storm_manhole.shp	Shapefile
storm_misc_feature0.bmp	Raster Dataset
storm_misc_feature.shp	Shapefile
storm_outfall.shp	Shapefile
storm_pipe.shp	Shapefile
storm_pipe0.bmp	Raster Dataset

Simplification



Final Results of Simplification



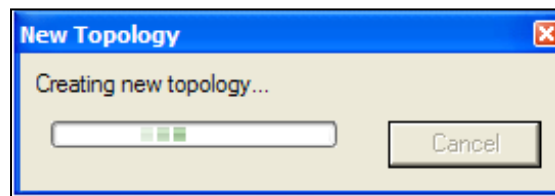
Storm System

Name	Type
<input checked="" type="checkbox"/> Culvert_Ditch	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Catch_Basin_Active	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Manhole_Active	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Misc_Features_Active	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Outfall	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Pipe_Active	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_System_Topology	File Geodatabase Topology

Excluded Storm System

Name	Type
<input checked="" type="checkbox"/> Cap	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Line_Caps	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Catch_Basin_Abandoned	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Manhole_Abandoned	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Misc_Features_Abandoned	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Storm_Pipe_Abandoned	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Sub_Drain	File Geodatabase Feature Class
<input checked="" type="checkbox"/> Trench_Drains	File Geodatabase Feature Class

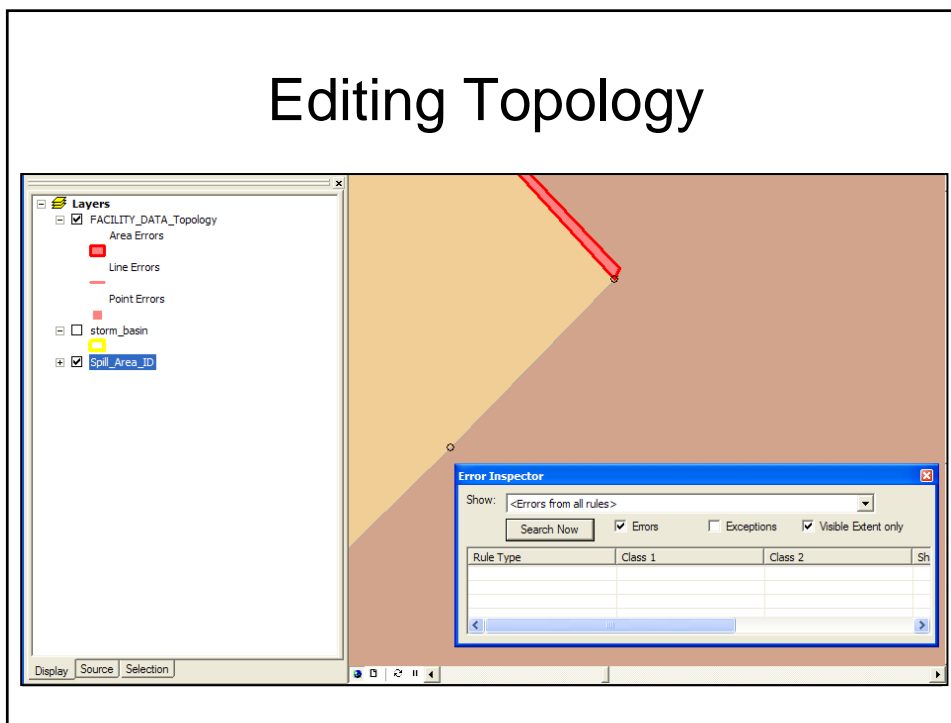
Topology

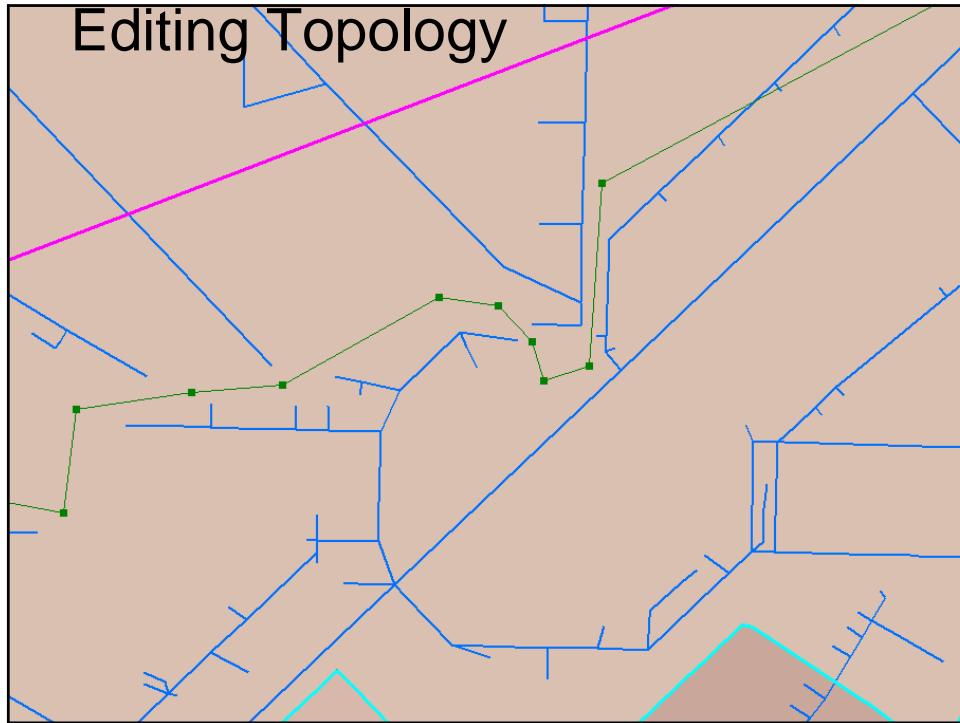


Topology Rules

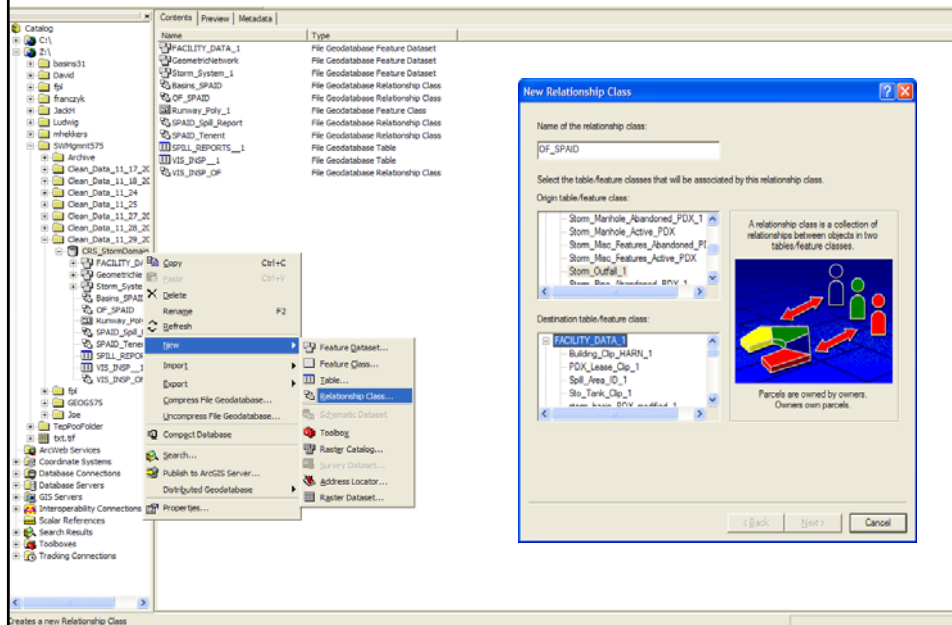
Rule	Number of Errors
CB Must be Covered by Stormpipe Line	501
OF Must be Covered by Stormpipe Line	2
Misc Must be Covered by Stormpipe Line	233
MH Must be Covered by Stormpipe Line	197
Stormpipe Must Not Self Overlap	10
Stormpipe Must Not Self Intersect	11
Culverts Must Not Overlap Stormpipe	18
Must Not Be Greater Than Cluster Tolerance 5ft	1191
Total Errors	2163

Editing Topology

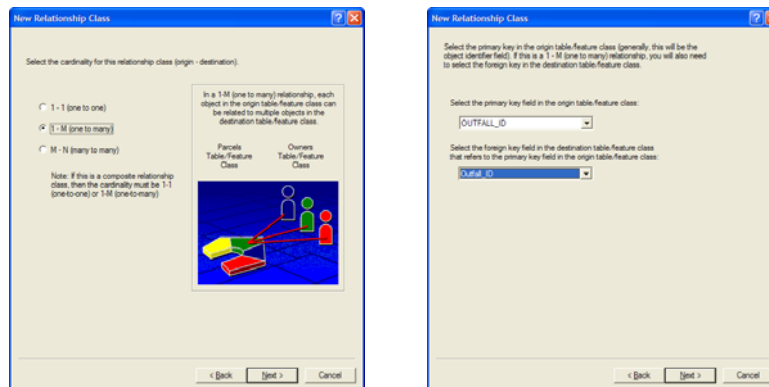




Assigning Relationship Class



Relationship Class Defined



- Our primary key field is assigned to Outfall_ID and is defined by a one-to-many relationship (1 – M)

Relationship Types

The screenshot shows a tree view on the left with various data layers. A red arrow points from the 'SPAID_Tenant' layer in the tree to the 'Relationship Class Properties' dialog box. The dialog box has two tabs: 'General' and 'Rules'. The 'General' tab is active and displays the following information:

- Name: SPAID_Tenant
- Type: Simple
- Cardinality: 1 - M
- Notification: None (no messages propagated)

Below this, there are two sections for relationship classes:

- Origin Table/Feature Class:**
 - Name: Spill_Area_ID
 - Primary Key: SPAID
 - Foreign Key: SPAID
- Destination Table/Feature Class:**
 - Name: PDX_Lease

At the bottom, there is a 'Labels' section:

- Forward: PDX_Lease_Clip_1
- Backward: Spill_Area_ID_1

Buttons for 'OK', 'Cancel', and 'Apply' are visible at the bottom right of the dialog box.

The screenshot shows the 'Identify' dialog box with 'StormOutfall' selected in the 'Identify from' dropdown. The left pane shows a tree view of features, with 'SPILL_REPORTS_1' selected. The right pane shows a table of attribute values for the selected feature:

Field	Value
OBJECTID_1	37
Shape	Polygon
OBJECTID	37
Id	0
Area_Name	B8_Employee_Parking
BasinID	8
SPAID	SPA38
Shape_Leng	3944.38363711
Outfall_ID	OF8
Shape_Length	3939.74334384703
Shape_Area	698126.87595073

A green box highlights a feature on the map, and a red arrow points from the 'Example' text to this feature. The 'Identified 1 feature' status is shown at the bottom left of the dialog box.

Geometric Network



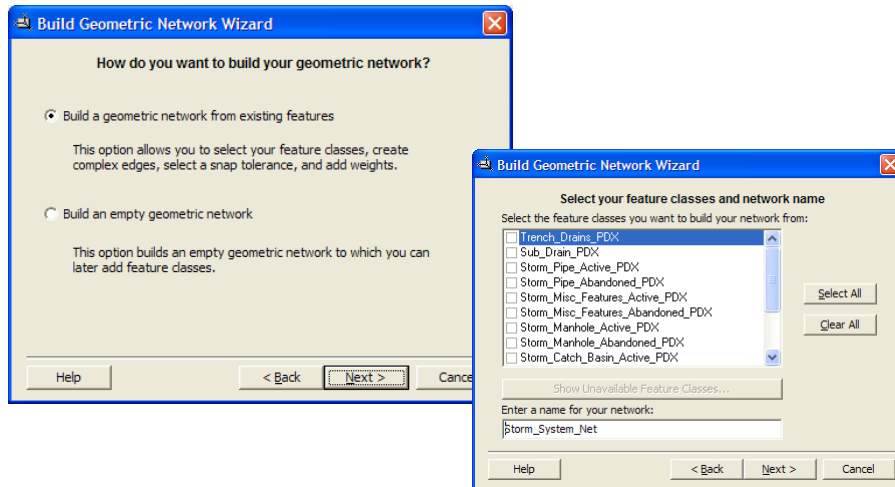
Geometric Network Cont....

- Comprised of edges and junctions creating a linear network.
- Connectivity is based in their geometric coincidence (topology).
- Connectivity is stored in a logical network.

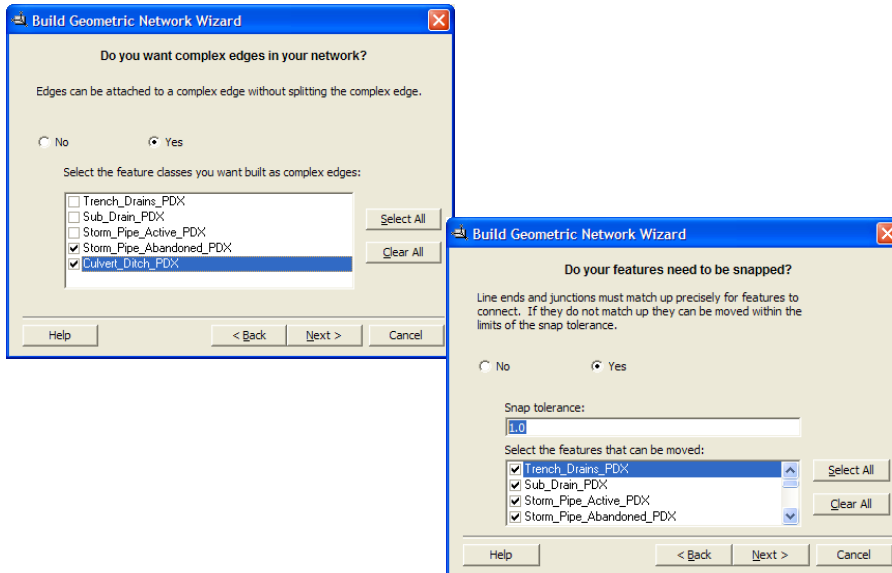


•Hidden tables that store edges, junctions, The connectivity between them. Also stores the weights necessary for traversing the Network.

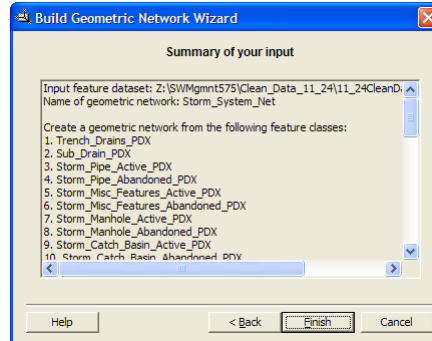
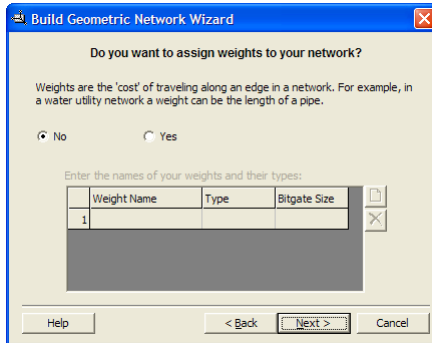
Creating the Network



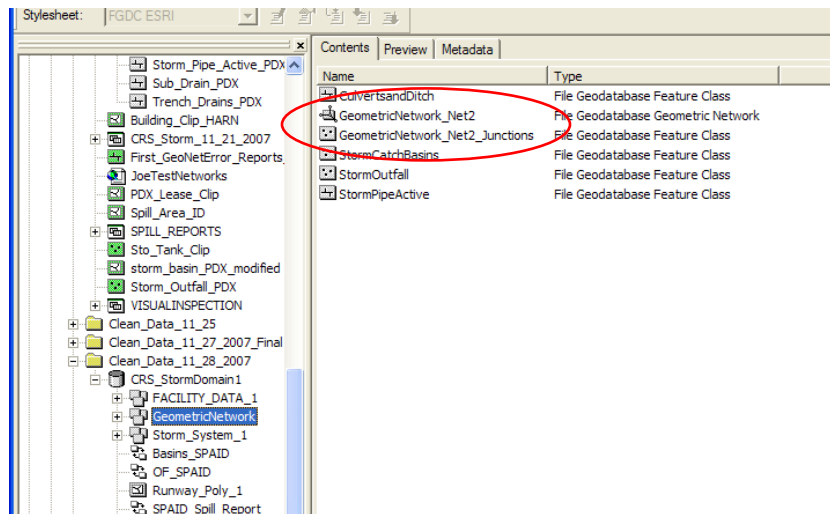
Creating the network Cont..



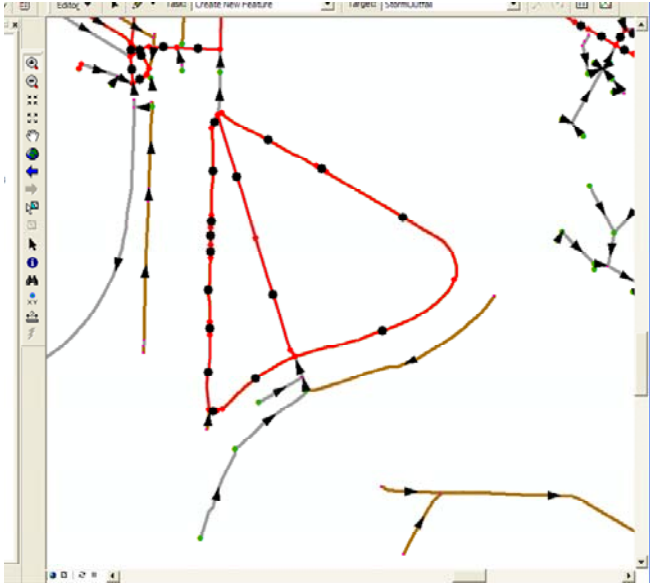
Creating the network Cont..



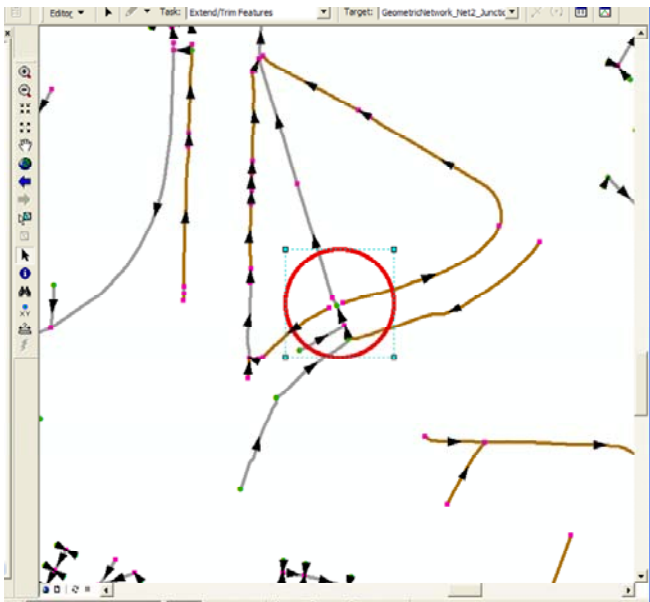
Finished Network

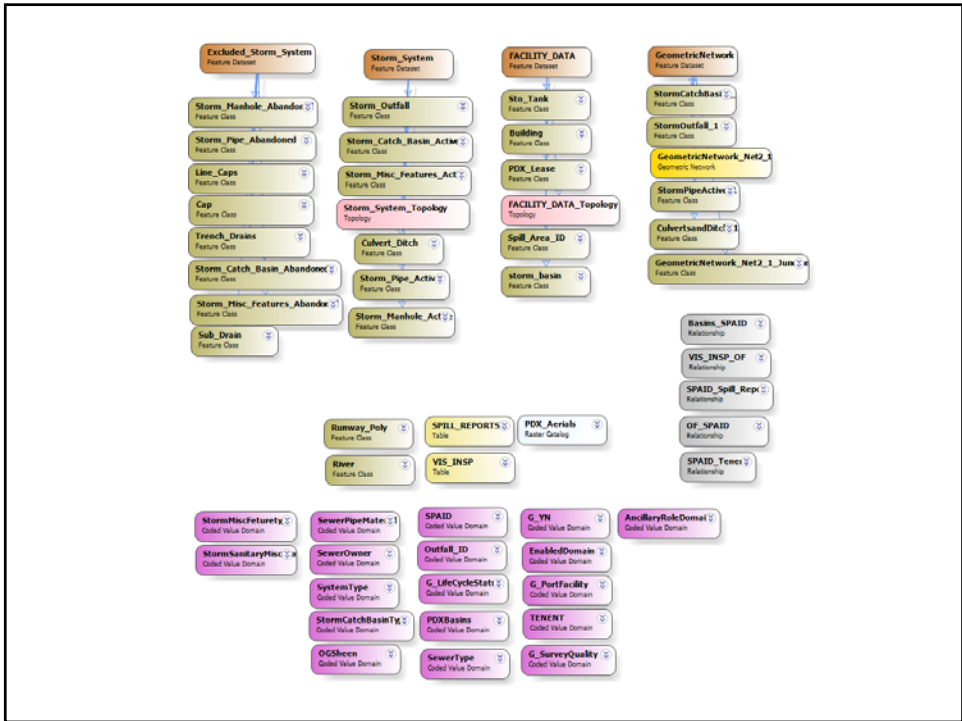


Problem Areas



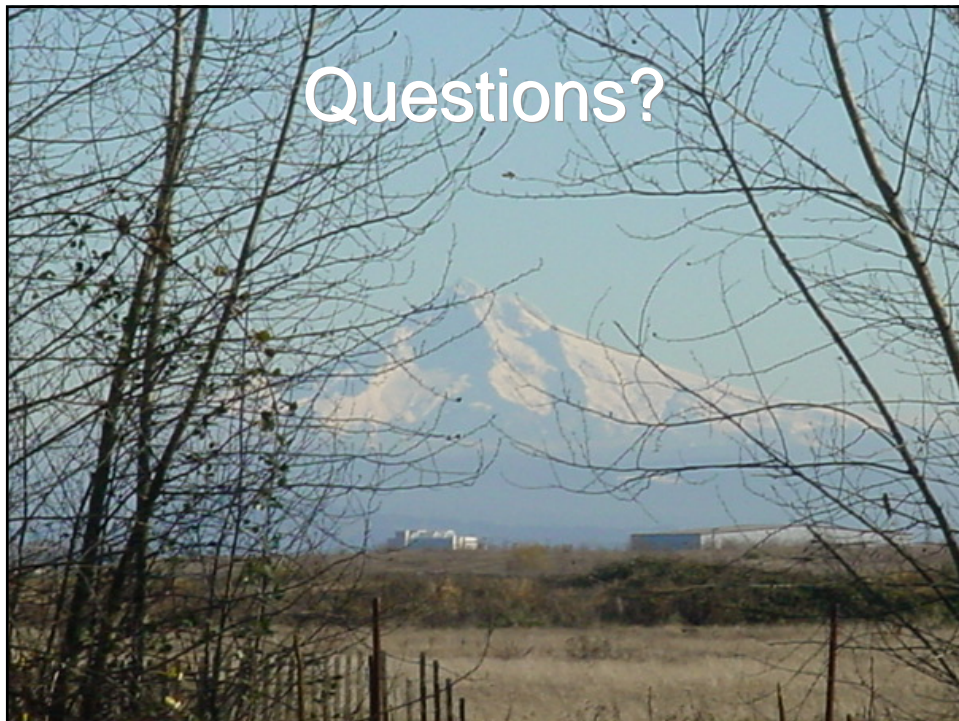
Solution





Limitations

- Data Quality
 - Field survey existing storm sewer network
- Geometric Network excluded auxiliary functions (e.g. shut off valves or catch basins)
- Unable to determine tenants that have higher spill rate with the data that is currently in the database.



References

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- Portland International Spill Response Procedures Draft, Port of Portland. October 2007.
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