



Autodesk Topobase Wastewater Technical Overview

Autodesk® Topobase™

Autodesk® Topobase™ software brings engineering design data and geospatial data together in a centralized database environment, so that organizations can share and use spatial information more easily. By integrating previously disparate islands of CAD and GIS data into a common, centralized framework, Topobase enables organizations to improve the efficiency of business processes and reduce the redundancy of information. Organizations no longer have to “throw data over the wall” between departments and re-create data due to incompatible formats. With Topobase, data is available, accurate, and synchronized across the organization.

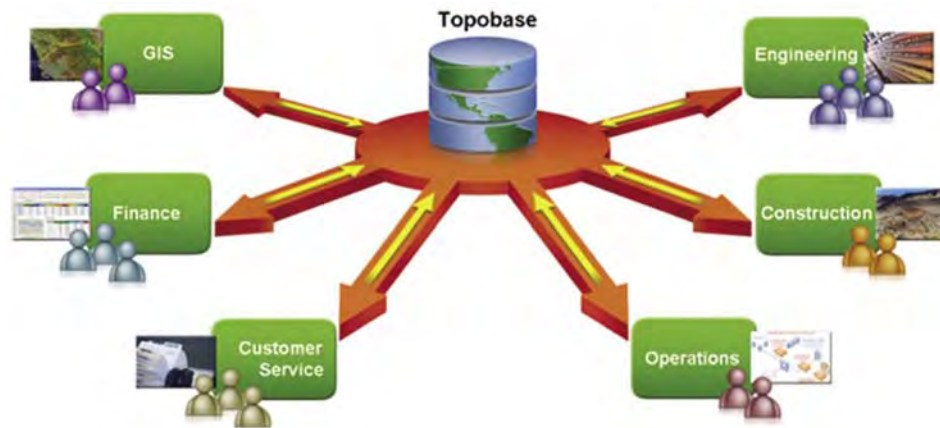


Figure 1: Autodesk Topobase is an infrastructure design and management solution that provides integrated, organization-wide access to spatial information for engineering, GIS, operations, and business processes.

The Benefits of Topobase

Using Autodesk Topobase, organizations gain a comprehensive view of infrastructure assets, which helps to improve decision making by geospatially enabling all asset management processes. Organizations enhance efficiency and data quality by using the same applications to create and manage spatial information across departments. When all departments in an organization can use the same set of business rules to access and analyze data, the organization reduces manual and duplicate data entry and minimizes data conversion processes. Topobase also streamlines data editing and creation, while making those processes more efficient with rule-based design and process automation. Perhaps most importantly, Topobase enables organizations to securely share spatial information with employees—such as field staff and business decision makers—as well as with customers who have traditionally lacked access to this kind of information.

The Topobase Architecture

Topobase is architected to store spatial data in a central database and to integrate with other business systems. Topobase is built on AutoCAD® Map 3D and Autodesk MapGuide® Enterprise software applications. AutoCAD Map 3D is a leading platform for creating and editing spatial data. It combines the familiarity of AutoCAD® software-based design applications with GIS functionality.

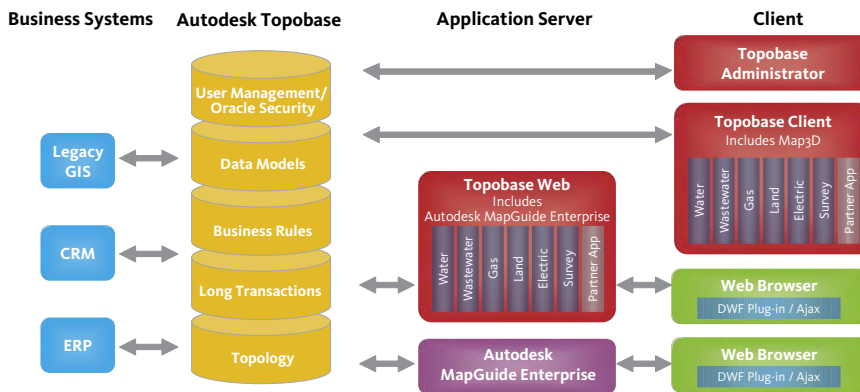


Figure 2: The Autodesk Topobase architecture delivers data integration, sharing, creation, and management capabilities along with superior database performance.

Autodesk MapGuide Enterprise allows organizations to publish map and design information internally or over the web. Using industry-standard development tools, organizations can create online applications that blend spatial and alphanumeric information from business systems on user-friendly maps. This makes sharing valuable infrastructure data with non-CAD and GIS users seamless and cost-effective.

Topobase uses Oracle® Spatial, the world's leading spatial database, to store spatial data. Based on open standards, Oracle Spatial provides vendor-neutral GIS capabilities, which allows organizations to use preferred applications to carry out geospatial analysis. Topobase leverages Oracle Spatial's native GIS capabilities for storing spatial data and performing spatial tasks, and includes the renowned and proven Oracle database management and tuning features that help to ensure superior database performance over time. Organizations can use standard IT tools along with SQL to access information in Topobase for reporting, or to integrate with business and IT systems (such as CRM and ERP) or legacy GIS systems from other vendors.

Extending the value and capabilities of AutoCAD Map 3D, Autodesk MapGuide Enterprise, and Oracle Spatial, each Topobase implementation includes a set of standard components:

- Topobase™ Client—A desktop application that streamlines design within a familiar interface and automatically stores asset data in Oracle Spatial.
- Topobase™ Web—A web application that uses Autodesk MapGuide Enterprise to share asset information over the web.
- Topobase™ Administrator—An application that enables organizations to change or extend data structures in Oracle Spatial, create business rules, design user forms and reports, and regulate access to the Oracle Spatial database.
- Industry-specific applications—Modules designed for managing specific types of infrastructure, such as electric, water, gas, wastewater, sewer, and land assets.

These components, a powerful architecture, and advanced technical features make Topobase the ideal infrastructure asset-management solution for organizations that manage dynamic infrastructure networks. For more detailed information on how to create, edit, share, and manage data using Topobase Client, Topobase Web, and Topobase Administrator, please see the Autodesk Topobase White Paper.

An Overview of Topobase Wastewater

An industry-specific application within Topobase, Topobase™ Wastewater software delivers best-of-breed CAD and GIS functionality using an Oracle enterprise database that has been specifically tailored for use by the wastewater utilities industry. This allows wastewater utilities to use CAD tools to design and manage wastewater treatment networks and infrastructure. In the process, wastewater utilities create rich information that contains attribute data associated with their assets—such as pumps, drains, and septic tanks. Engineering design information is then GIS-ready, incorporating a dynamic utility model that enables on-the-fly topology and analysis abilities, such as network traces. Wastewater utilities are then able to maintain their infrastructure data in the Topobase enterprise solution built on an Oracle database, which can be accessed across the organization and used by business teams in ongoing network and asset management.

Topobase Wastewater comes with a wastewater-specific data model that contains the most commonly requested and used wastewater-specific data schemas, object relationships and associations, business rules, and workflows found in the wastewater industry today—and each area is user-definable or customizable to fit specific needs. For example, the data model on the database contains industry-specific business rules to help protect the integrity of spatial information—thereby increasing the quality of data. Topobase Wastewater workflows are designed to be comprehensive and streamline common activities related to creating and maintaining wastewater treatment networks. In fact, many users can rely on the extensive library of workflows to perform their daily tasks—without needing to understand the entire data model. And if needed, Topobase Wastewater allows users to customize or add new attributes, relationships, and feature classes to support the management of specific wastewater treatment networks and assets.

With Topobase Wastewater display-model-style templates, executives, customer service agents, field crews, and other employees can view the utility's spatial data to carry out their work functions. These preconfigured layer styles allow users to focus on and work with whatever subset of the enterprise database they require to complete job-related tasks efficiently. For example, a network engineer might want to have access to network data to view underground information or as-built infrastructure and network conditions for design work, whereas an operations manager might want to view assets color-coded according to maintenance schedules.

Along with infrastructure asset data management tools, Topobase Wastewater offers features that allow departmental domain experts to accelerate workflows and increase the integrity of infrastructure data using advanced CAD and GIS functions.

Throughout the rest of this white paper, we will explore the basic components of Autodesk Topobase Wastewater: elevation management, workflows and business rules, the database model, and display models.

A Closer Look: The Technical Features of Topobase Wastewater

Autodesk Topobase Wastewater delivers the advanced spatial data creation, sharing, and management capabilities that wastewater utilities require to document, maintain, and present their wastewater network information. The Topobase Wastewater application contains comprehensive elevation management, workflows and business rules, robust wastewater-specific data models, and customizable display-model-style templates for graphic data representation. Combined, these features support optimal database performance, facilitate efficient design and data management, and enhance the integrity of network data.

Autodesk Topobase Wastewater enables wastewater treatment networks and utilities to:

- Gain a more complete view of all network infrastructure and assets.
- Make vital asset information accessible across the organization.
- Reduce data redundancy and duplicate systems while improving data quality, by enforcing business rules and using workflows to meet data quality standards.
- Minimize time-consuming data conversion processes when moving data between departments and job functions.
- Maintain engineering design accuracy throughout the project lifecycle from conceptual design to as-built stages.
- Share information internally and externally more securely, easily, and cost-effectively.

Elevation Management

Topobase Wastewater provides elevation management to help ensure consistent values for the heights of related covers, manholes, and sections. The accurate recording of heights and slopes is critically important for wastewater networks to validate the relation between wastewater feature elevations and measured depths. For example, the bottom elevation plus the depth of a manhole should result in the cover height. Height is measured by a terrain elevation or a height above sea level. Depth is usually measured with a meter rule.

The wastewater data model provides both a simple and a detailed approach to elevation management. Users can store the network by simply connecting manholes, use intermediate points for a more detailed model, and refine the network according to internal workflow. For example, a surveyor measures the covers above ground, and then the wastewater specialist measures and correlates the wastewater network underground with exact coordinates and heights.

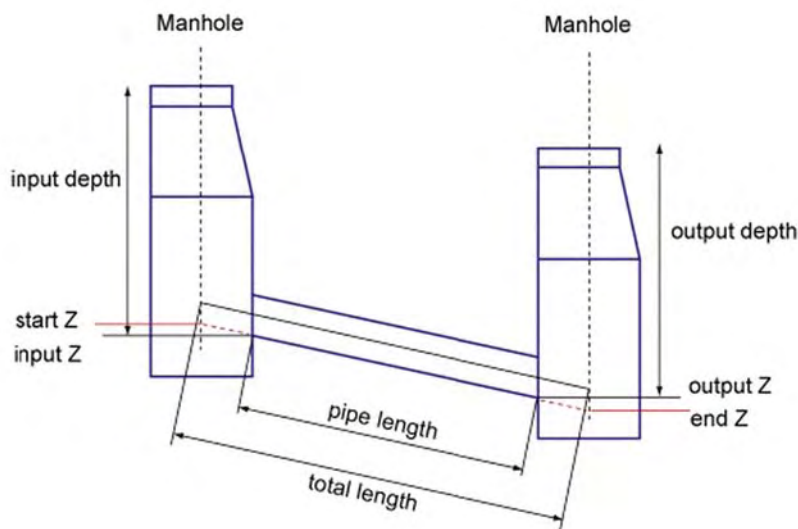


Figure 3: The Compute Section Elevation feature rule calculates consistent elevation values.

Workflows and Business Rules

One of the most important features of Topobase Wastewater is that users have the ability to establish a comprehensive set of workflows, to streamline business processes based on the wastewater utility's current way of doing business. These workflows help guide users through common tasks and govern the way information is entered into the database. Workflows—and related business rules that are working behind the scenes—also prevent designers from leaving out required elements, choosing incorrect materials, or including incorrect material sizes, thereby reducing errors during design and data updates.

Workflows within the Topobase Wastewater consist of a sequence of procedures or steps that the user is required to follow while performing a routine task. Business rules are actions executed automatically when a change is made to the database. For example, the compute elevation section rule provides consistent elevation values, so that flow direction is continuous and section slopes are greater than zero. Topobase workflows support both pressure and gravity based systems. Business rules automatically correct data according to predefined algorithms and perform complex consistency and dependency checks. Once business rules are established, dialogs within the Topobase Client include only valid elements for the designer to select, streamlining the process and increasing accuracy.

Topobase business rules and workflows allow wastewater utilities to:

- Improve productivity, quality of data, and efficiency by combining multiple steps into a single workflow.
- Check, validate, and maintain data quality at all points within the organization across all levels of users.

For example, in the process of removing a section, the workflow prompts the user to examine the section to be removed, while the business rule automatically checks for connected manholes, covers, and other related entities and prompts the user about whether or not to delete them as well. Organizations can also define common sets of materials and data standards—and both can be linked to a workflow, such as adding a new manhole to the network or replacing an old section.

Workflows and business rules help users save time by combining several steps into one, automatically checking for errors, and helping ensure that all relevant information is entered into the database. Users can easily create custom workflows, or use one of three types of workflows provided by Topobase Wastewater.

Workflow Type	Description
Acquisition	Create network points, pipes, house connections, fire hydrants, structures, facilities, and more.
Analysis	Trace the network from a designated start and stop point.
Report	Generate and print predefined and customized reports and export the report into ASCII, Crystal Reports, and HTML files.

Within each area, Autodesk Topobase Wastewater contains the following workflows:

Acquisition workflows

- Manhole creation—create standard and complex manholes and associate manholes with covers.
- Network point creation—create a wastewater point.
- Section creation—create sections of a wastewater network.
- Section remove—delete a section from the database, including all related network points.
- House connector remove—remove a house connector.
- Sub drain area creation—create a sub-drain area or add a higher level drain area.
- Site creation—create a site and relate it to a network point.
- Administrative information creation—create administration areas, such as washing areas with contacts, locations, and manufacturers.
- Create protection—add casing or anode protection to a pipe.

Analysis workflows

- Find connected—support network tracing by selecting one or more start features and optional stop features. The network tracing begins from the start location and stops when all stop features have been reached.
- Find connected with stop conditions—provide the same tracing functionality as the “find connected” workflow, with the added benefit of using attribute-dependent stop conditions.
- Find non split point on section—find point objects on a pipe where the pipe is not split on that point, or find point objects that are not connected to the network.
- Topology checker—locate errors in a network topology.

Report workflows

- Report generation—print predefined and user-defined reports.

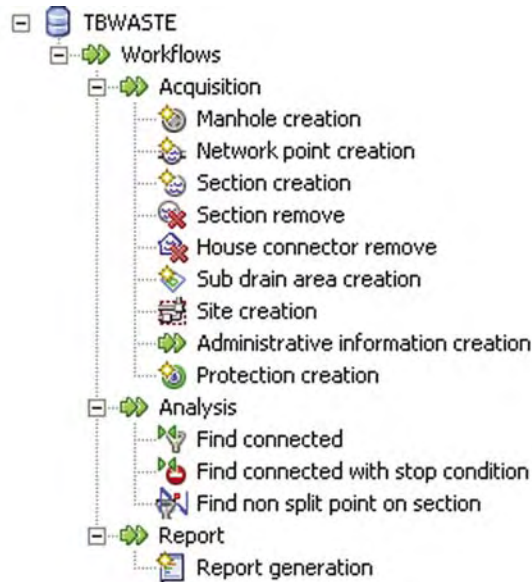


Figure 4: Workflows within Topbase Wastewater.

Waste Water Options
Specify the options for the Waste Water application module.

General | Elevation Computation Priority

Define the value which has to be computed automatically and the priority used for the computation.

- Section Output Depth
- Cover Start Z
- Cover End Z
- Manhole Start Bottom Elevation
- Manhole End Bottom Elevation
- Manhole Start Depth
- Manhole End Depth
- Section Input Z
- Section Output Z
- Section Input Depth
- Section Start Z
- Section End Z
- Section Total Slope
- Section Total Length
- Section Pipe Slope
- Section Pipe Length
- Section Fall Height
- Section Input Step

Figure 5: Business rules help ensure that asset information is maintained according to an organization's standards.

Example Workflow: Manhole Creation

Let's take a closer look at a typical Topobase Wastewater workflow: manhole creation. Using the workflow for digitizing a manhole, the user creates a standard or complex manhole and an associated cover. A business rule prompts him to designate a cover. He can select "none" if no cover is associated with the manhole, "digitize" to create a new cover, or "connect" to select and connect an existing cover to the manhole. The manhole creation workflow includes the following steps:

1. Start the workflow explorer and specify "manhole creation" workflow.
2. Specify a reference record to automatically apply predefined values for attributes without having to enter them manually.
3. Choose the type of manhole cover: "none," "digitize" to create a cover, or "connect" to select an existing cover.
4. Specify whether to add additional details to the manhole.
5. Follow prompts to create the manhole.
6. Complete "digitize" operation to create manhole.
7. Exit from the workflow when finished digitizing the manhole.

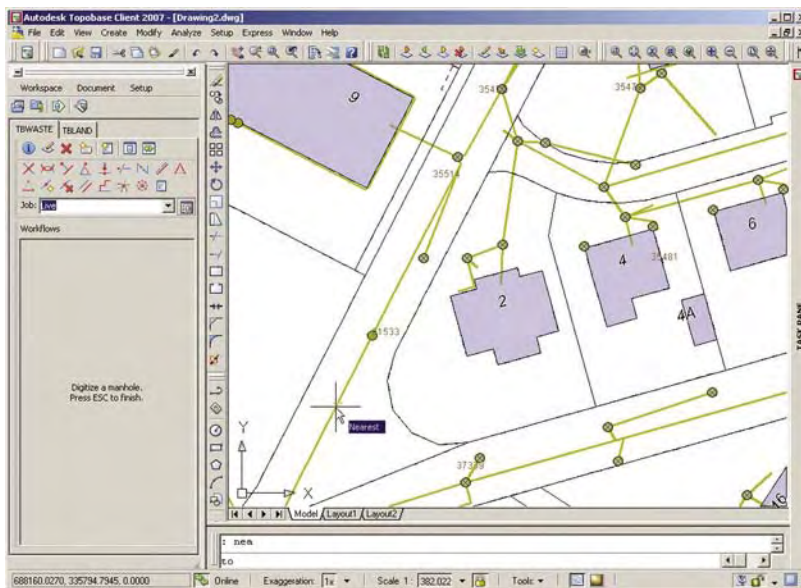
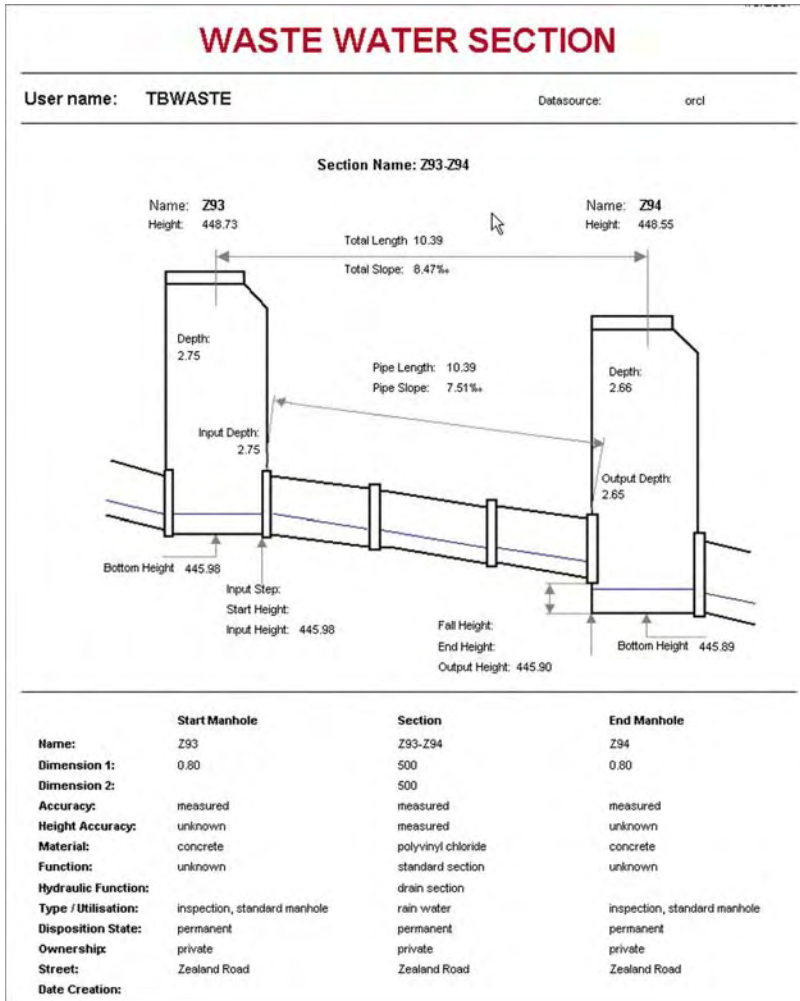


Figure 6: Illustration of manhole creation workflow.

Example Workflow: Report Generation

Let's look at another typical workflow: report generation. Using this workflow, a user can quickly and easily generate reports from a list of predefined report templates. These reports include:

- Data model description—displays a complete list of all topics and features in the wastewater database.
- Data creation statistics—displays creation dates and lengths of lines.
- Error statistics—displays errors in the network.
- Network statistics—displays line and point information, lists other features, and provides a count.
- Manhole statistics—displays manhole information.
- Section—displays a schematic diagram of a section.
- Section statistic—displays section information.



The built-in wastewater-specific data model allows you to reduce deployment time and realize better ROI with wastewater-specific database schemas, workflows, and business rules.

Figure 7: The report generation workflow helps create standard reports.

Topobase Wastewater Data Model

Topobase Wastewater comes preconfigured with an Oracle data model that is designed to capture the exact data needed by the wastewater industry. It is configured to manage attribute information appropriate to assets common in the industry, such as manholes, tanks, valves, pumps, and drains. Additionally, the data model is designed to capture all the underlying attributes relevant to each feature, such as size, dimension, age, condition, pressure, and connection. The data model also maintains the relations between features. This means, for example, that every manhole generally has a specific cover associated with it.

The wastewater data model can be further customized with the Topobase Administrator to meet the exact data requirements of individual wastewater networks. And because the wastewater data model is preconfigured based on the most common needs of the wastewater industry, these customizations are typically completed rapidly—helping organizations realize the return on their Topobase investment sooner.

The Topobase Wastewater data model is comprised of 10 types of elements and associated functions. Each of these is referred to as a “topic.” The 10 primary topic areas are:

- Administration: Manage contacts, customers, locations, manufacturers, and item models.
- Dimension: Create user-defined markups and label measurements.
- Drain area: Store information about a drain area or region of land where water flows into a specified body of water, such as a river, lake, sea, ocean, or sewer pipe.
- Miscellaneous: Store information about filtration beds, maintenance work, and physical markers.
- Point: Store utility points of the wastewater data model in separate attribute feature classes, one for each point type. These point features, which contain all associated attribute information, are used in conjunction with the point geometries for analysis.
- Profile: Store profile geometry that is created and managed using the profile manager.
- Protection: Display and manage wastewater network protection in one of three types: anode (point), anode test station (point), or casing (polygon).
- Section: Store information on sections, the only standard line feature of a wastewater utility model. A section can be a wastewater channel or pipe between network points.
- Site: Store one master feature class or attribute with related line, point, and polygon feature classes. Sites are not part of the network topology, but are a useful means to group various features of the utility network to make them reachable—such as storing a house number and location.
- Utility: Store geometry related to the point and pipe feature classes. Allows Topobase to generate on-the-fly analysis, such as network traces using complex stop conditions, and perform hard and soft splits of network assets.

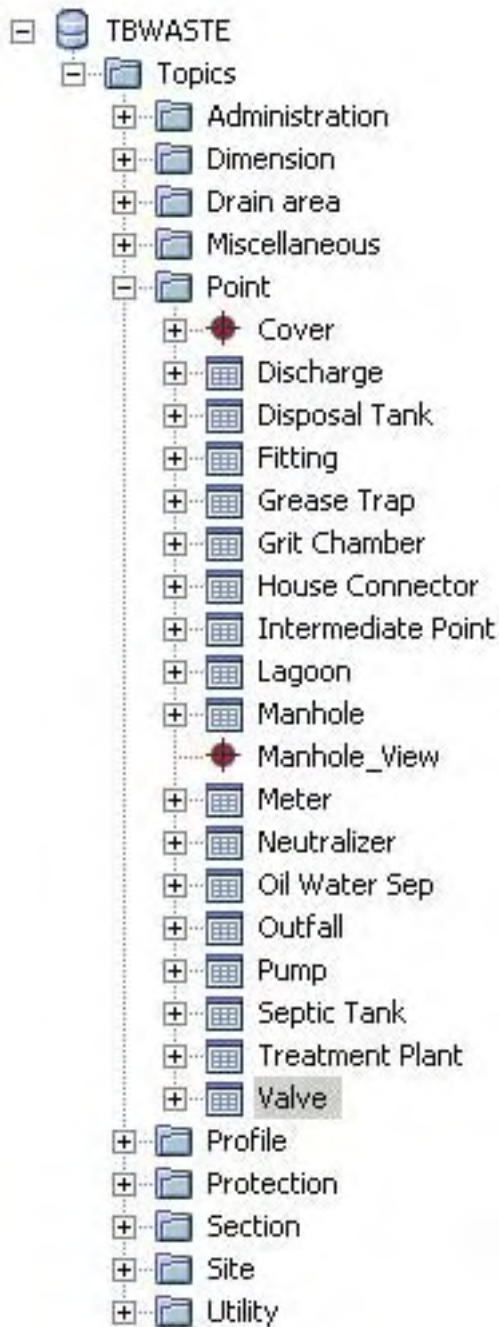


Figure 8: Wastewater data model supports the streamlined management of drain areas, sections, and other features specific to wastewater networks.

Let's take a closer look at the individual components of the wastewater data model.

Administration

The Administration topic contains attribute feature classes that manage information about contacts, customers, dimensions, locations, manufacturers, and item numbers related to network assets. In addition, the Administration topic includes feature classes for the creation of washing areas, administration areas, and protection zones. Captured data includes geometry, area, creation date, name, narrative, and user flag. The Administration topic includes the following feature classes:

- Administration area—represents areas of jurisdiction or responsibility as approved by a federal, state, or local utility regulatory authority.

- Contact—captures relevant contact information, such as company name, contact person, address, and email address.
- Location—stores location of an item, such as neighborhood or district.
- Manufacturer—captures manufacturers for all wastewater assets.
- Protection area—describes a visually grouped protection zone.
- Washing area—defines an area for washing sections.
- Wastewater model feature classes—collects several types or models of a particular item (such as cover, manhole, meter, valve, or pump) to simplify data acquisition and data entry into the database.

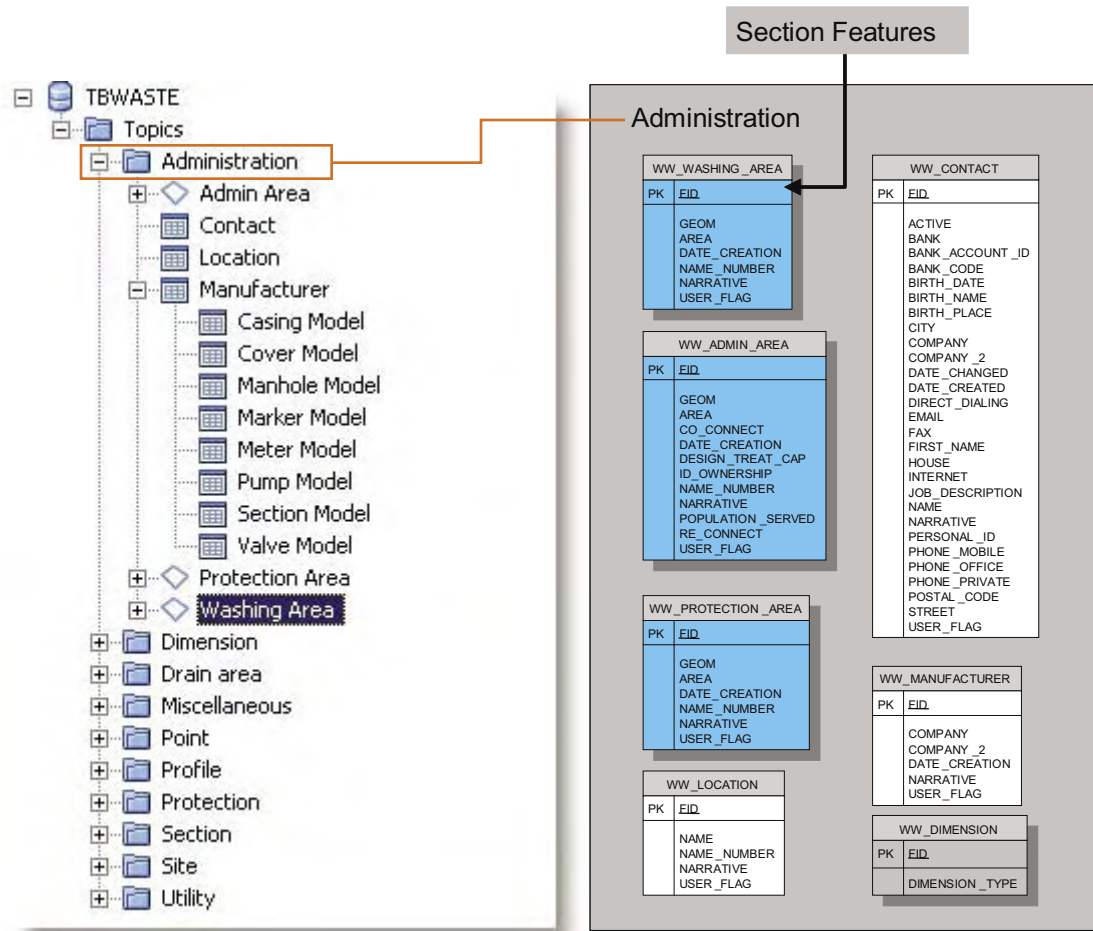


Figure 9: Topbase Wastewater Administration topic.

Dimension

The Dimension topic enables users constructing and editing the wastewater network to store transient data on asset dimensions. Use it to create user-defined markups and label measurements, such as the option to measure and label the distance between two sections.

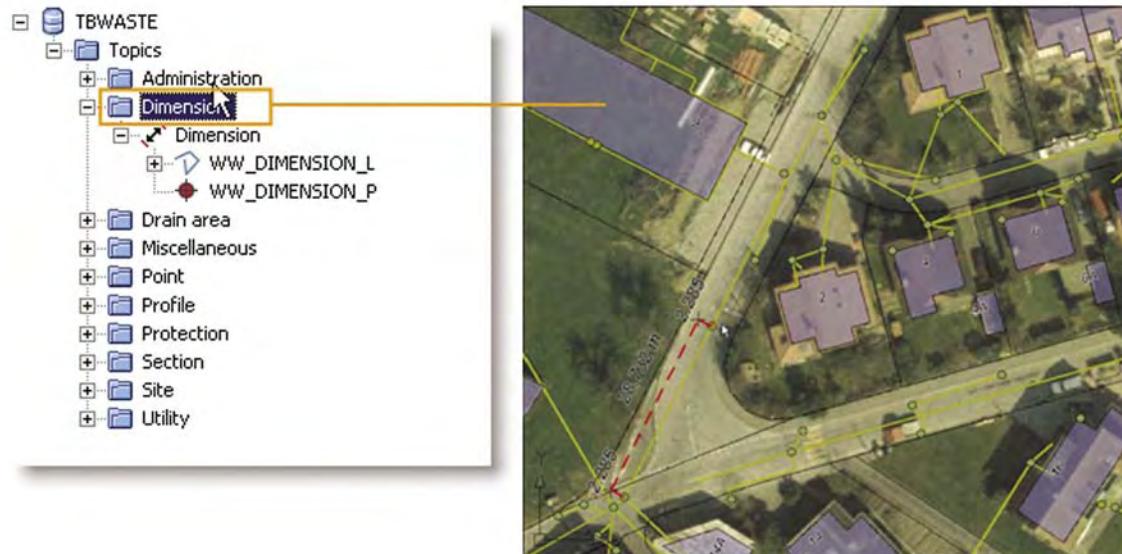


Figure 10: Topobase Wastewater Administrator view of Dimension topic.

Drain Area

The Drain Area topic contains information about the drain and sub-drain areas served by the wastewater system or utility. A drain area is where water flows into a specified body of water, such as a river, lake, sea, ocean, or sewer pipe. In the case of a wastewater system, drain areas are commonly referred to as basins or catchments.

In the wastewater data model, drain areas are used to group smaller sub-drain areas, commonly referred to as sub-basins or sub-catchments used for flow computations. Each sub-drain area can belong to one drain area. Sub-drain areas are characterized by soil type, slope, and inflow values for residential, industrial, and commercial sources.

The Drain Area topic includes the following feature classes:

- Drain area—a grouping of smaller sub-drain areas.
- Sub drain area—an area where water flows, characterized by soil type, slope, and inflow values for residential, industrial, and commercial sources.

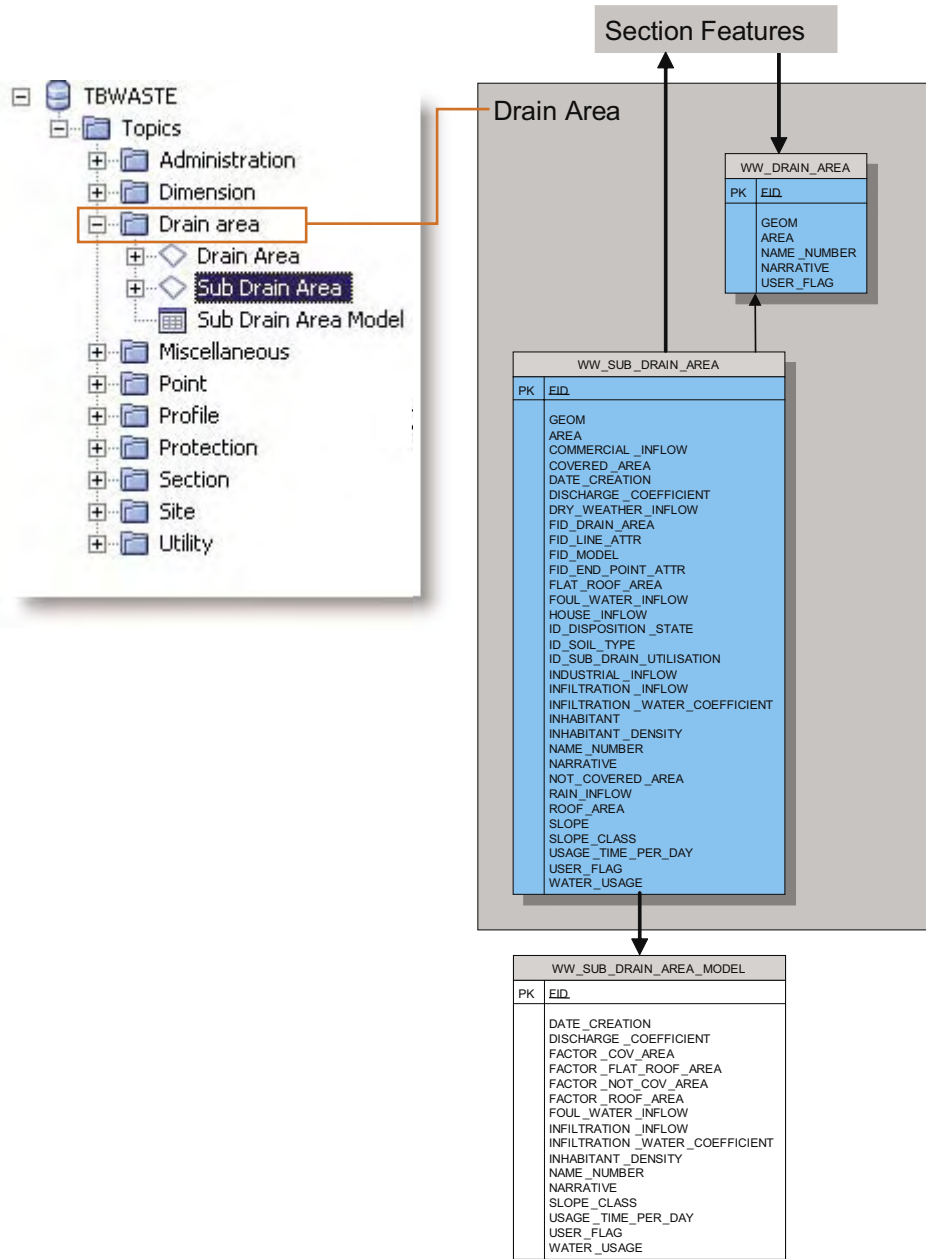


Figure 11: Topobase Wastewater Drain Area topic.

Miscellaneous

The Miscellaneous topic stores information about filtration beds, maintenance work, physical markers, and sludge beds. It contains four feature classes:

- Filtration bed—stores information about filtration beds, the below-grade system consisting of perforated piping installed in sand, gravel beds, or trenches. Filtration beds are designed to permit the uniform distribution and absorption of effluent from a septic tank or aerobic unit into the soil.
- Maintenance—captures data on general maintenance activities.
- Marker—contains data on signs or concrete monuments installed either directly above or immediately adjacent to underground lines, bends, or fittings to indicate the presence of wastewater.
- Sludge bed—stores information on an area used for spreading and drying waste sludge.

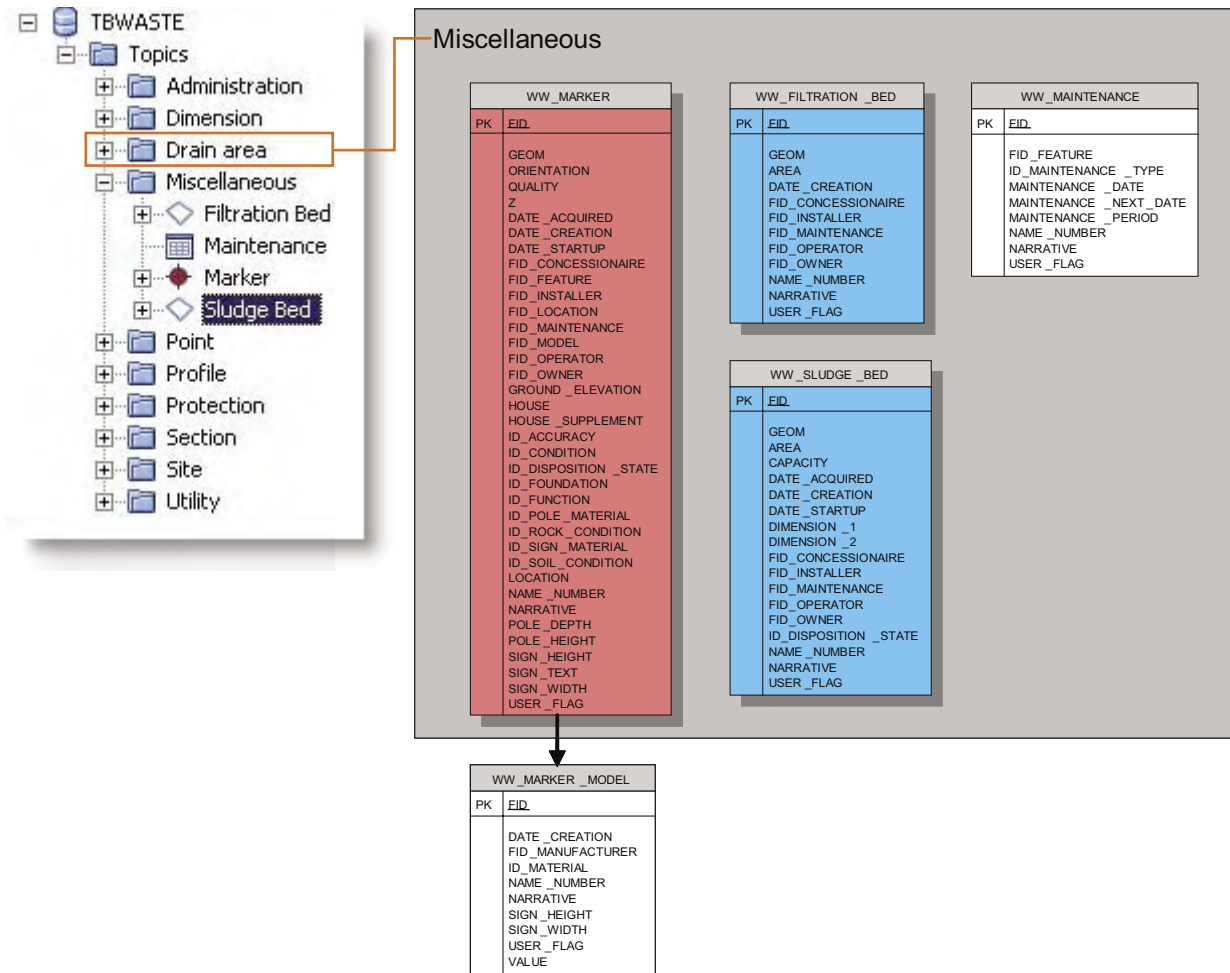


Figure 12: Topobase Wastewater Miscellaneous topic.

Point

The Point topic contains information about the point assets in the wastewater network. All the features that can be represented geometrically and symbolized as point features have been grouped under the Point topic. These point features contain associated attribute information that is used in conjunction with point geometries for analysis, and stored in separate attribute feature classes—one for each point type—as follows:

- Cover—the lid or cover for such items as manholes and grease traps. The following wastewater point features can be associated with a cover: discharge, disposal tank, grease trap, grit chamber, manhole, neutralizer, oil/water separator, outfall, and septic tank.
- Discharge—a location where wastewater pipes directly discharge effluent.
- Disposal tank—an above-grade or below-grade receptacle or chamber for holding wastewater on a temporary basis prior to transfer or use.
- Fitting—an item used to connect, cap, plug, or otherwise alter a pipe carrying wastewater.
- Grease trap—a specialized tank that separates grease from water, collects the grease for removal, and allows the water to exit.
- Grit chamber—a device designed to remove sand, gravel, or other heavy solids that have subsiding velocities or specific gravities substantially greater than those of the organic solids in the wastewater system.
- House connection—the last point of a wastewater network usually on or inside a building that represents the connection between the network and the customer.
- Intermediate point—a section of the wastewater network without hydraulic meaning, usually located at the points where a pipe meets the manhole structure.
- Lagoon—a shallow, man-made pool or pond for the purpose of providing treatment of domestic wastewater.
- Manhole—a physical access point to the wastewater network.
- Meter—a device installed in a line for measuring the quantity or rate of wastewater flowing to a facility or through a section of pipe.
- Neutralizer—a receptacle or chamber where chemicals react with reactant materials, making the liquid waste passing through it chemically neutral.
- Oil/water separator—a device or structure placed in the wastewater stream to separate water from oil products.
- Outfall—an outlet of a river, drain, or sewer where it discharges into the sea or a lake.
- Pump—a mechanical device that moves wastewater through a network.
- Septic tank—typically a below-grade receptacle or chamber in which solid organic waste is decomposed and purified by anaerobic bacteria that are present in the tank.
- Treatment plant—a plant containing equipment used to treat or remove unwanted constituents from wastewater.
- Valve—a fitting or device used for controlling flow through a wastewater line.

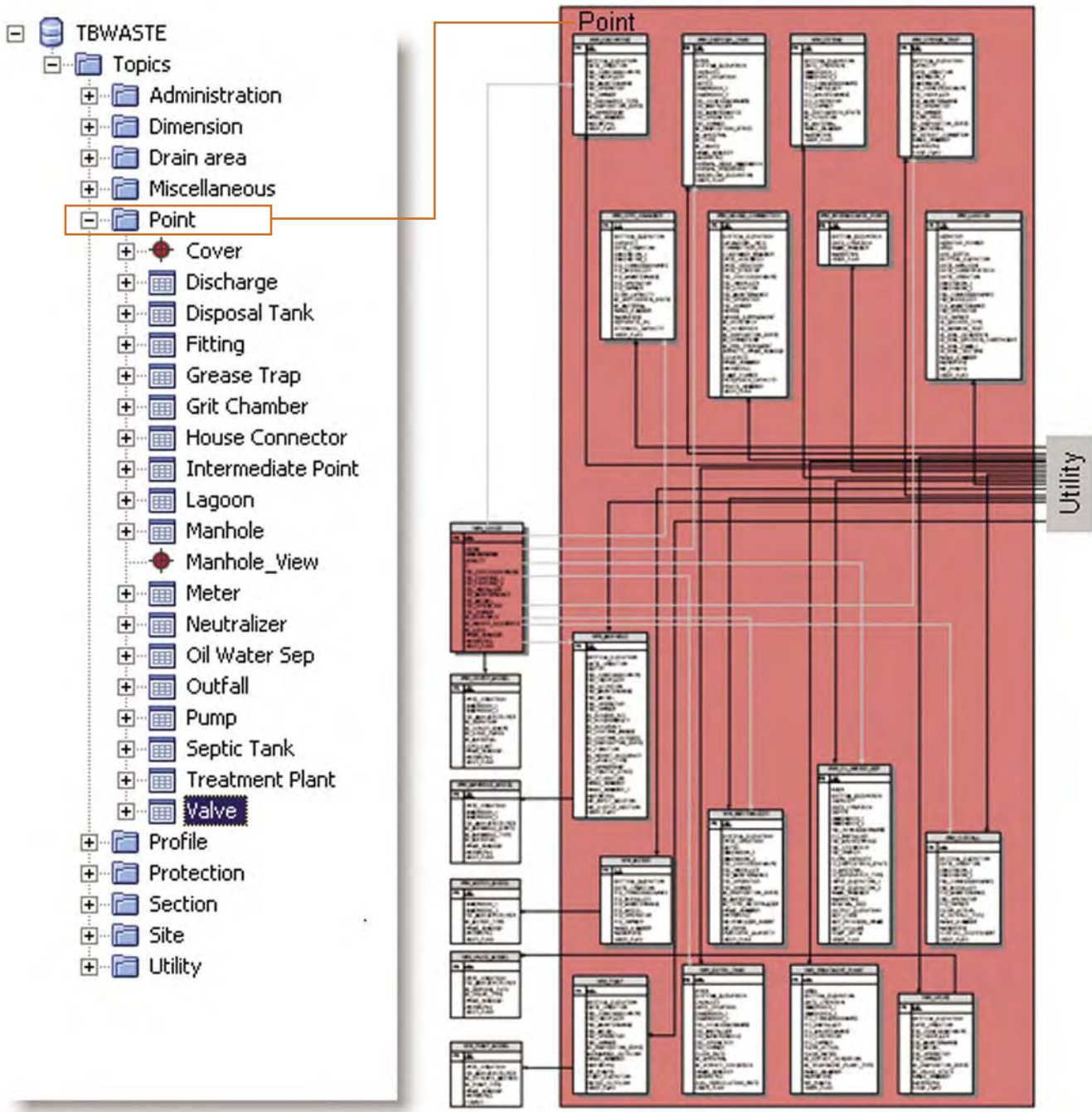


Figure 13: Topobase Wastewater Point topic.

Profile

The Profile topic stores the profile geometry that is created using the profile manager. Users can generate a profile view of the sections and associated manholes by either selecting them on the screen or by using the results of a network trace analysis.

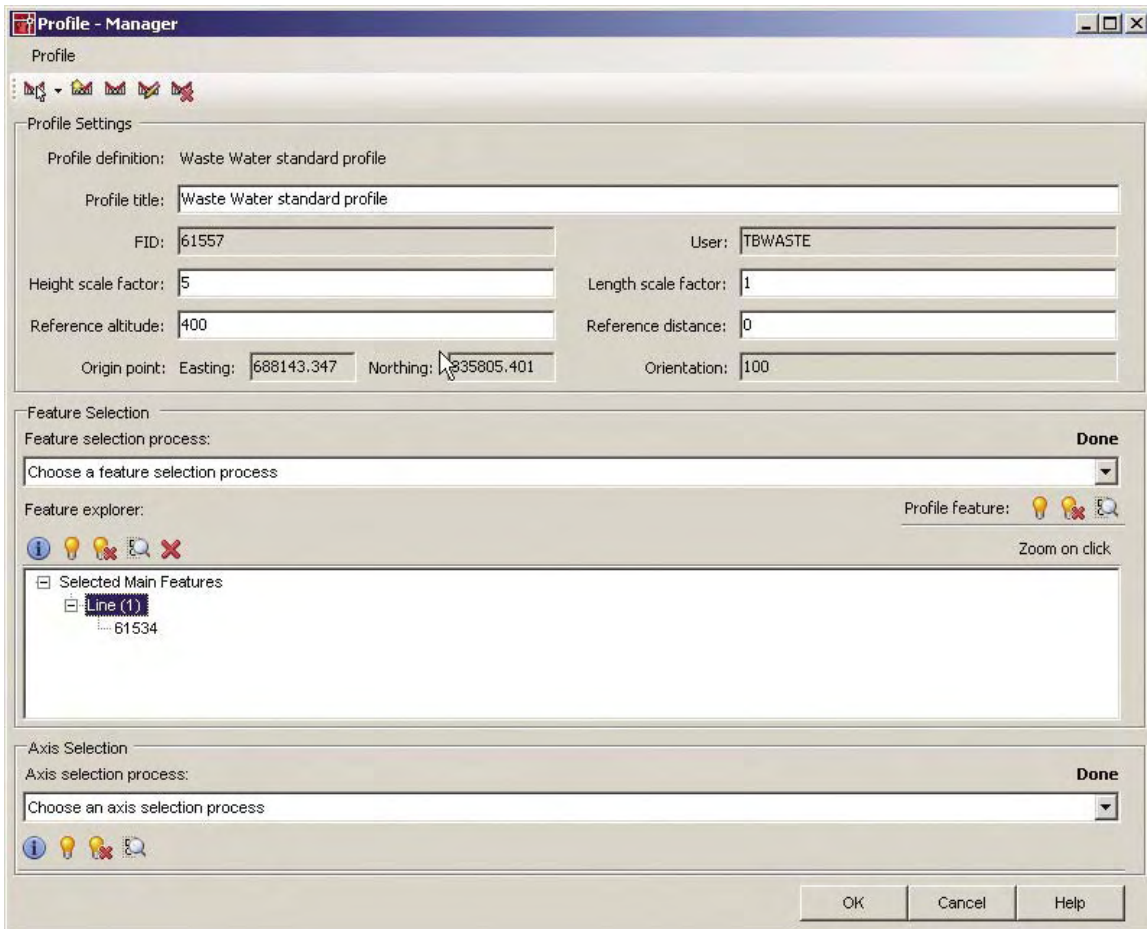


Figure 14: Topobase Wastewater Profile manager helps generate a standard profile view.

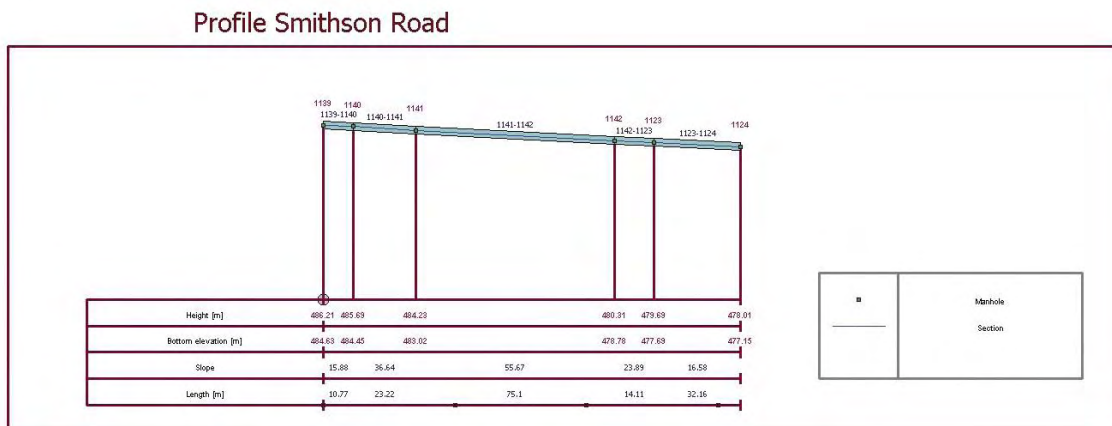


Figure 15: Example Profile result.

Protection

The Protection topic contains information about applications used to extend the life of wastewater pipes. Three types of protection are provided: anode protection, anode test station, and pipe casing.

- Anode—a method for protecting a pipe that involves installing sacrificial material (usually magnesium or zinc) adjacent to a sewer pipe and connecting it to the pipe with insulated copper wire to minimize the effect of external corrosion on existing ductile and cast-iron pipelines.
- Anode test station—a central location where anodes are tested for performance in wastewater systems.
- Casing—a method of protecting a pipe segment by surrounding it with a larger diameter pipe.

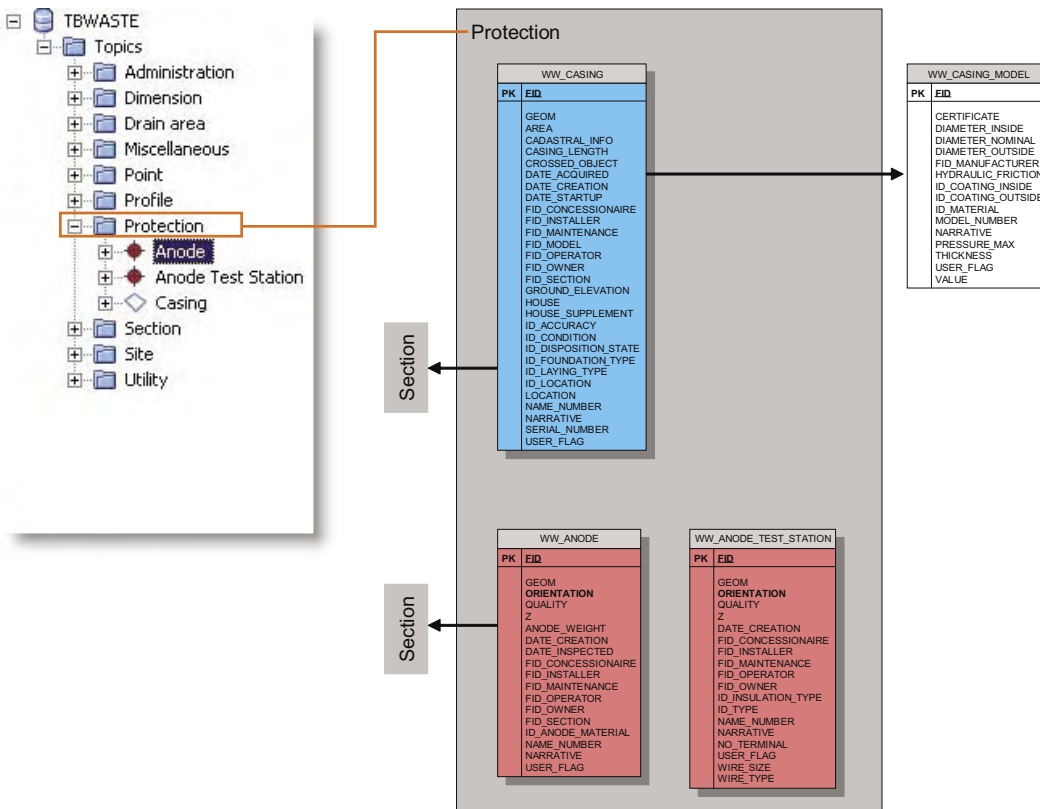


Figure 16: Topobase Wastewater Protection topic.

Section

The Section topic contains information on a section of the network—typically a wastewater channel or pipe between network points. Sections are the only standard line feature of a wastewater utility model. The Section topic contains four tabs:

- General—provides information about the object, such as name or creation date.
- Details—displays feature attributes of the section item. Link buttons provide access to common workflows and functions.
- Related Tables—provides direct access to the following related tables using link buttons: line, label, anode, casing, sub-drain area, and maintenance.
- Table—displays the table of feature classes.

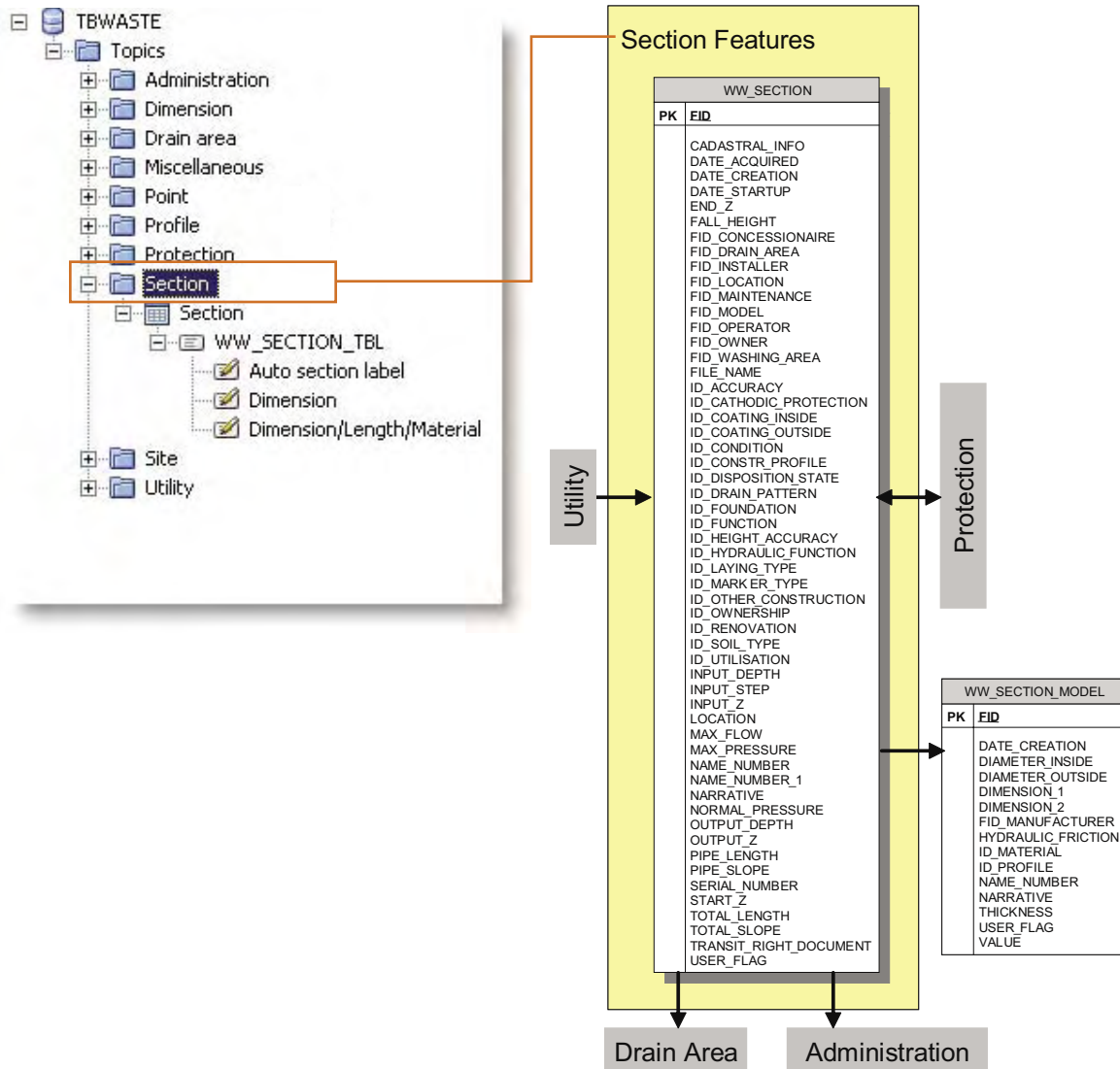


Figure 17: Topbase Wastewater Section topic.

Site

The Site topic contains point, line, and polygon geometry that can be used to associate wastewater features with each other. For example, a site such as a pump station can be used to group several point features (like pumps and valves) into one object that can be more easily distinguished in a map window. Representing the location or site of a group of wastewater network assets such as valves or meters, the Site topic contains:

- Site—site used to enclose assemblies and make them reachable.
- Site line—line objects for site.
- Site point—point objects for site.
- Site polygon—polygon objects for site.

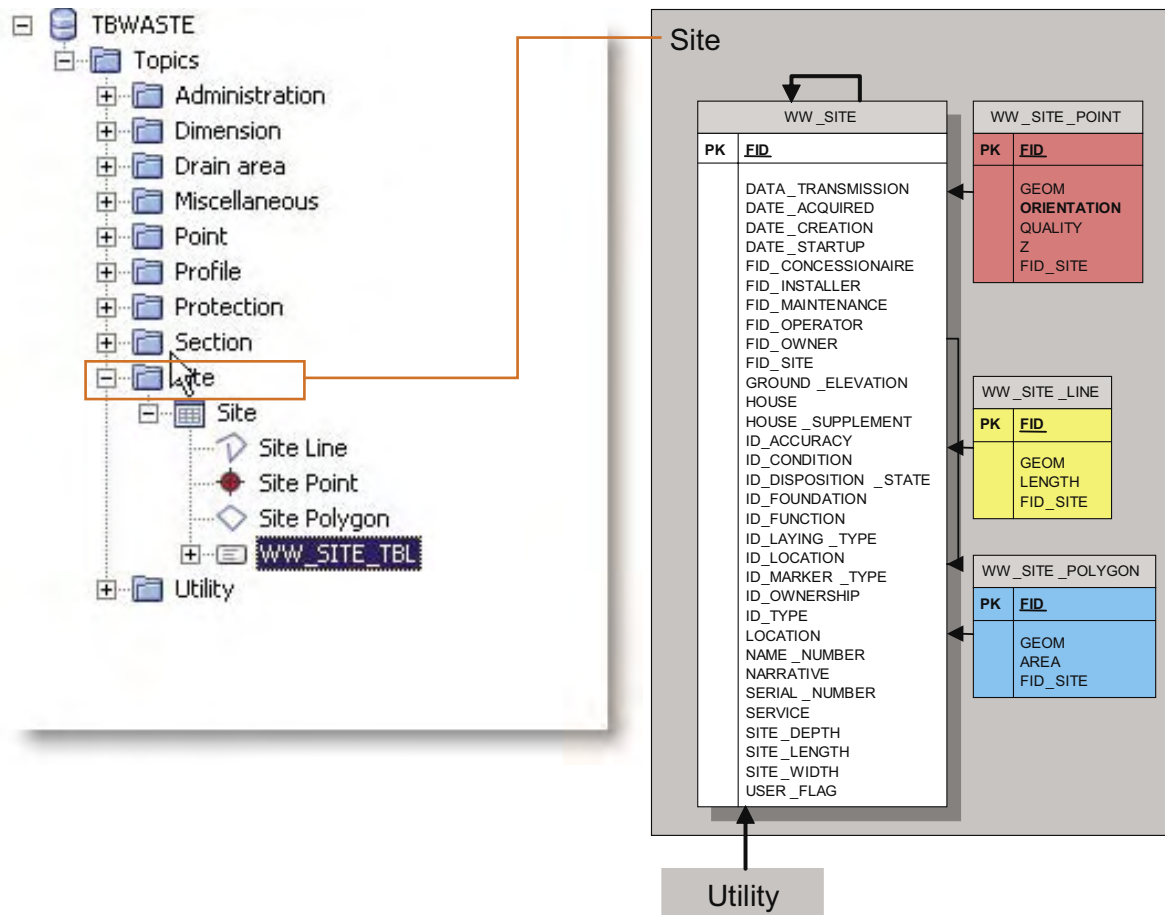


Figure 18: Topobase Wastewater Site topic.

Utility

The Utility topic houses basic network topology components related to the point and line feature classes, and allows Topobase users to generate on-the-fly analysis such as network traces using complex stop conditions. Topobase uses system-generated tables to maintain a utility network model that references the point and linear features to make up a network topology. The Utility topic includes:

- Point—geometrically represents point features that constitute the utility model.
- Line—geometrically represents linear features that constitute the utility model.

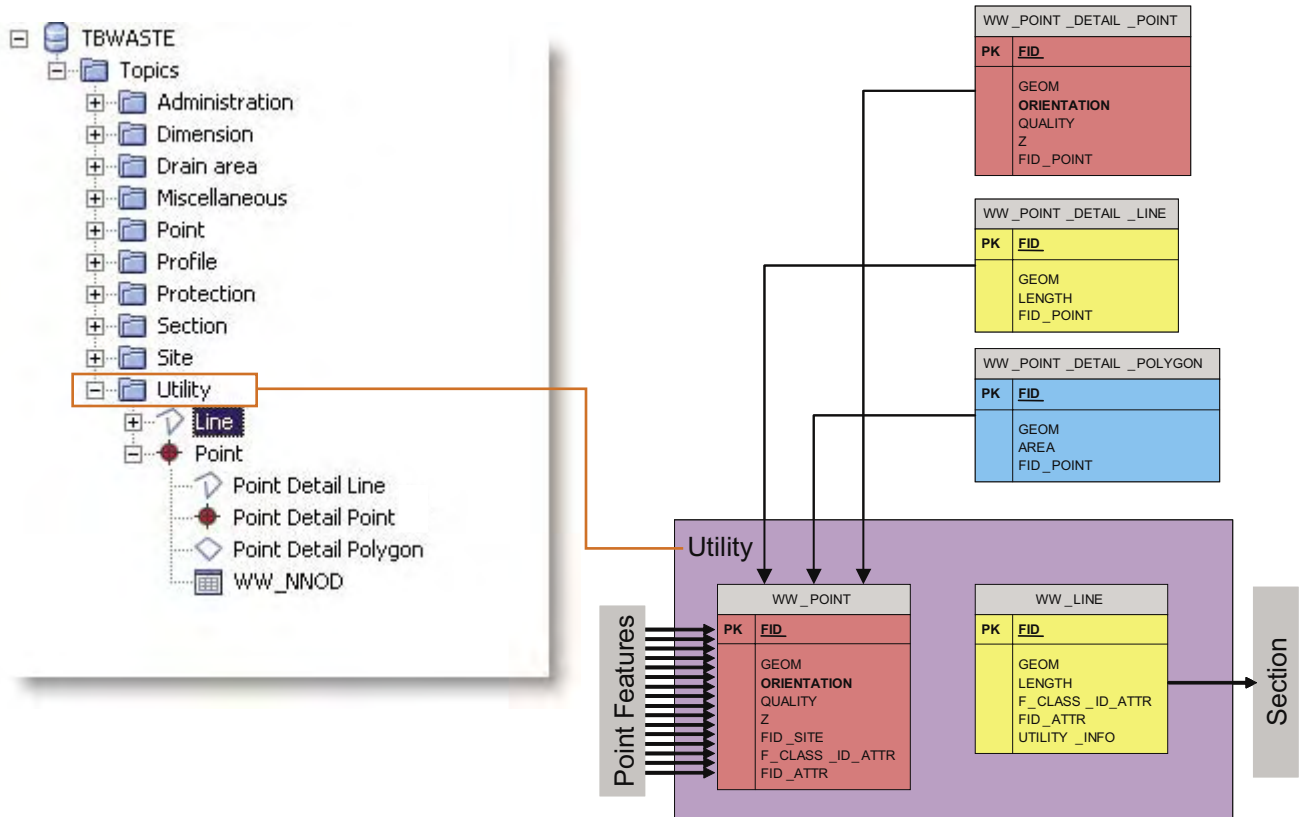


Figure 19: Topobase Wastewater Utility topic.

Display Style Templates

With Topobase Wastewater preconfigured layer styles, many different users or groups of users—such as executives, customer service agents, or field crews—can access and view the facility data they need, in a customized view designed to meet their unique work functions. These style templates let users view relevant information using the scale, symbols, and formatting most relevant to their jobs, allowing them to complete job-related tasks efficiently. For example, wastewater network designers want to know where the existing sections are below the street, but maintenance and operations personnel might be interested in viewing the same data represented according to physical state, throughput, and damage sites.

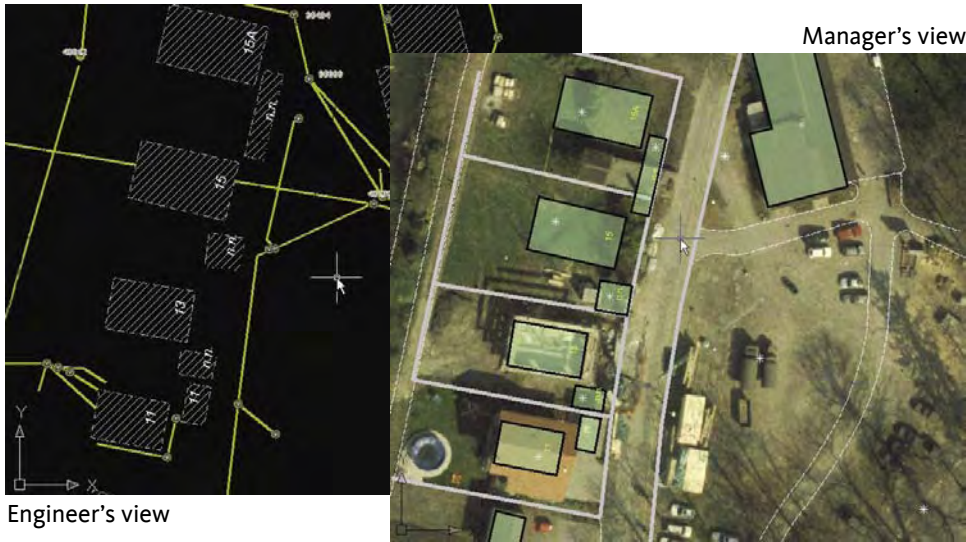


Figure 20: Display style templates show different graphic representations, depending on the job function.

Conclusion: Autodesk Topobase Wastewater Delivers Results

Infrastructure design and management affects the success and accuracy of wastewater networks and utilities. For too long, wastewater utilities have conducted processes using disparate applications that generate data in proprietary formats and store data in independent, siloed databases. The result? Duplicate work, increased risk of errors, limited visibility into assets as a whole, and a myriad of time-consuming workarounds, such as data conversions. Now, Autodesk Topobase Wastewater gives wastewater utilities the architecture, wastewater-specific components, and technology features they need to overcome these challenges.

By providing centralized access to spatial data and enhanced processes, Autodesk Topobase Waste Water improves the way workers complete vital tasks throughout waste water organizations. Employees in every department can save time, boost productivity, and work more independently. Predefined data models, workflows, and business rules help speed processes within the organization and help ensure that waste-water-related data is easily—and accurately—shared among departments.

With Topobase Wastewater, organizations:

- Gain a big-picture view of wastewater network and related assets.
- Streamline common processes and tasks using automated workflows.
- Improve data quality and accuracy using embedded business rules.
- Minimize data conversions.
- Share asset data more seamlessly.
- Implement quickly and cost-effectively.

Find out more about the benefits of Autodesk Topobase Wastewater by visiting www.autodesk.com/topobase today.

Appendix

Wastewater data model—See next page

