



# Autodesk Topobase Gas 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.

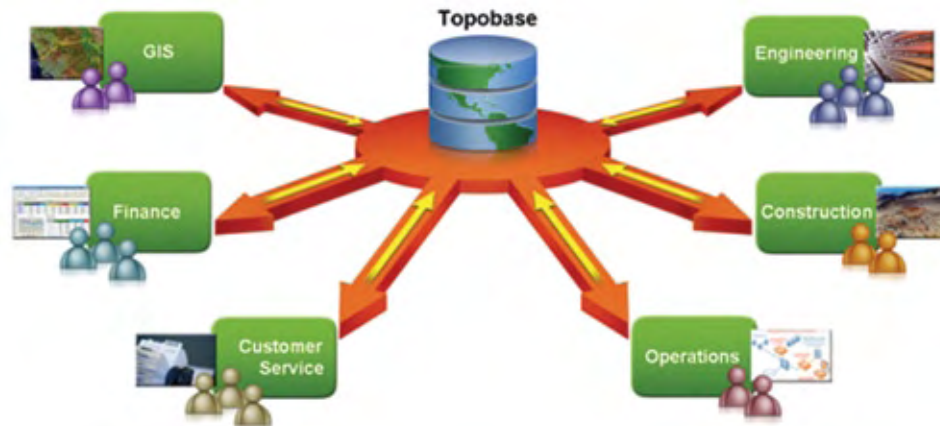


Figure 1: Autodesk Topobase is an infrastructure design and management solution that provides integrated, organization-wide access to spatial information for engineering, GIS, operations, and business processes.

### The Benefits of Topobase

Using Topobase, organizations gain a comprehensive view of infrastructure assets, which helps 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, 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.

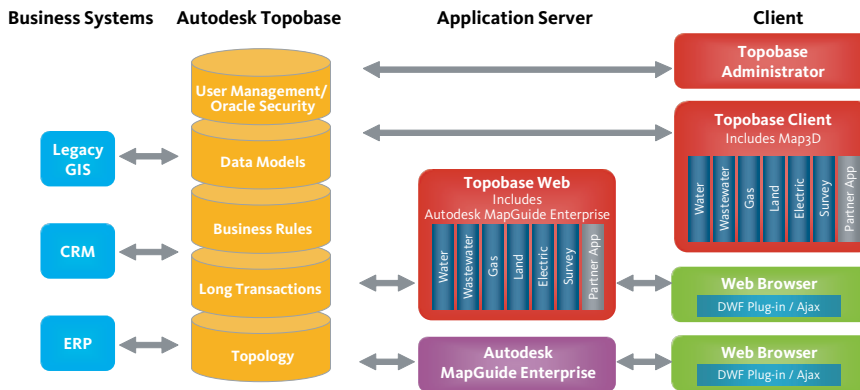


Figure 2: The Autodesk Topobase architecture delivers data integration, sharing, creation, and management capabilities along with superior database performance.

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 allow organizations to use preferred applications to carry out geospatial analysis. It leverages Oracle Spatial's native GIS capabilities for storing spatial data and performing spatial tasks, and it includes the renowned and proven Oracle database management and tuning features that help 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 database.
- 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 database, 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 applications, please see the Autodesk Topobase White Paper.

## An Overview of Autodesk Topobase Gas

An industry-specific application within Topobase, Autodesk® Topobase™ Gas software delivers best-of-breed CAD and GIS functionality, using an Oracle® enterprise database that has been specifically tailored for use by the gas utilities industry. This allows gas utilities to use CAD tools to design and manage gas utility distribution networks and infrastructure. In the process, gas utilities create rich information that contains attribute data associated with their assets—such as pumps, meters, and valves. Engineering design information is GIS-ready, incorporating a dynamic utility model that enables on-the-fly topology and analysis, such as network traces. Gas utilities are then able to maintain their infrastructure data in the Topobase Gas 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 Gas comes with a gas-specific data model that contains the most commonly requested and used gas-specific data schemas, object relationships and associations, business rules, and workflows found in the gas industry today. Furthermore, each element of the model is user-definable and customizable to fit extended or specific requirements. For example, the data model on the database contains industry-specific business rules to help protect the integrity of spatial information, thereby improving the quality of data. Topobase Gas workflows are designed to be comprehensive and streamline common activities related to creating and maintaining gas utility 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.

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

Along with infrastructure asset data management tools, Topobase Gas 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 Gas: workflows and business rules, the database model, and display models.

## A Closer Look: The Technical Features of Topobase Gas

Autodesk Topobase Gas delivers the advanced spatial data creation, sharing, and management capabilities gas utilities require to document, maintain, and present their gas network information. The Topobase Gas application contains comprehensive workflows and business rules, robust gas-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.

### Workflows and Business Rules

One of the most important features of Topobase Gas is that it lets users establish a comprehensive set of workflows—to streamline business processes based on the gas utility's current way of doing business. These workflows help

Topobase Gas enables gas utilities and networks 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.

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 Gas 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, when the “set pressure zone” rule is turned on, Topobase Gas will automatically detect the pressure zone that a digitized feature belongs to, by spatially checking its location against existing pressure zone areas.

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. For example, when running the damage creation workflow, the workflow asks the user to select the point on the pipe that is damaged and validates that the selected point is on a gas pipe. Once the damage point is validated, it is automatically associated with the gas pipe it was created against. This allows any work order created using the damage point to also have the affected pipe information available to it.

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

Workflow Type	Description
Acquisition	Create network points, pipes, house connectors, sites, facilities, pressure zones, and more.
Analysis	Find connected pipes and trace the network from a designated start and stop point.
Cable Acquisition	Create control cables and points.
Report	Generate and print predefined and customized reports and export the report into ASCII, Crystal Reports, and HTML files.

Within each workflow type, Topobase Gas contains the following specific workflows:

#### Acquisition workflows

- Network point creation—create any of the network point types.
- Network pipe creation—create network pipes with or without casing, anode protection, or fitting points at start and end points.
- Network pipe with fitting point creation—create network pipes with start or end. If the pipes are not connected to a network point, a fitting is created.
- House connection creation—connect the house connector to the main pipe with a generated straight pipe or a created pipe.
- Site or facility creation—create a site and connect to a network point or create a facility structure with geometry.
- Facility creation—create and name a new structure or add facilities to an existing structure.

#### Topobase Gas business rules and workflows allow gas 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.

- Damage creation—place a damage point feature on a pipe.
- Pressure zone creation—create pressure zones that subdivide the gas network into sections of similar pressure.
- Protection creation—add casing or anode protection to a pipe.
- Administrative information creation—acquire administration information such as contacts, locations, supply zones, pressure zones, meter zones, or manufacturers.

#### 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 pipes workflow, with the added benefit of using attribute-dependent stop conditions.
- Stop condition editor—define stop conditions.
- Find non-split points on pipe—find all point features on a pipe which are not split.

#### Cable acquisition workflows

- Control cable creation—create a control cable.
- Control point creation—create control-cable points, and use the same workflow to optionally connect them to a site or to digitize control cabinets.

#### Report workflows

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

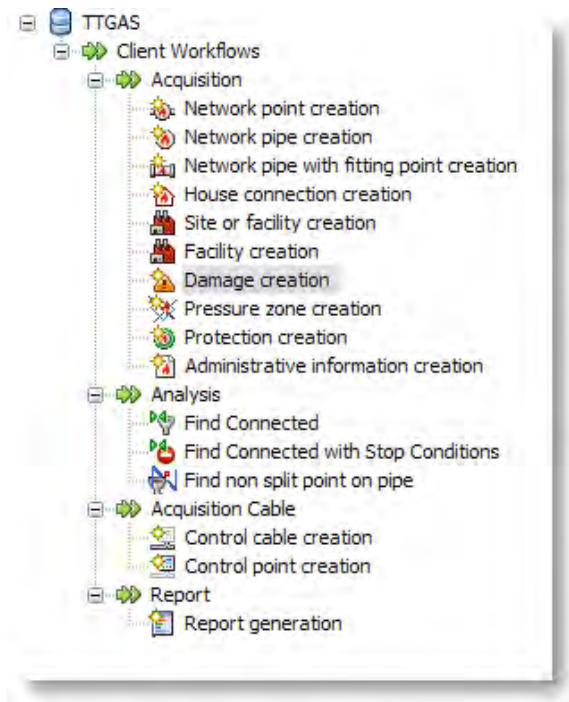
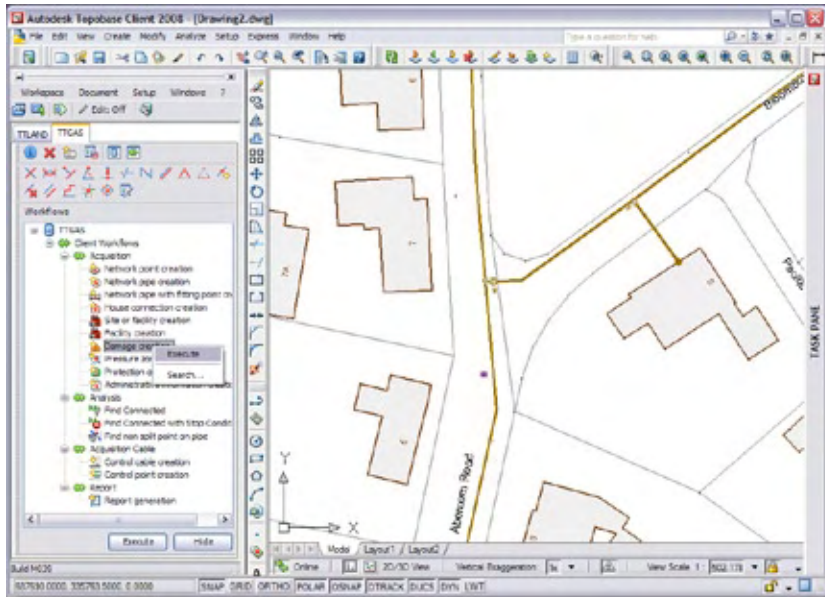


Figure 3: Workflows within Topbase Gas.



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

Figure 4: Workflows help to streamline the collection of asset information according to an organization’s standards.

#### Example Workflow: Network Pipe Creation

Let’s take a closer look at a typical Topobase Gas workflow: network pipe creation. Using this workflow, the user creates a network pipe with or without casing or anode protection. A business rule allows consistency of the pipe-attribute feature class and the related line-geometry feature class. For example, if a vertex of the new pipe lies exactly on an existing network point feature, the pipe will automatically be soft split. If the user creates a pipe with a start or end that is not connected to a network point, a fitting is automatically created.

To create a network pipe:

1. Start the workflow explorer and specify Network Pipe Creation workflow.
2. Specify a reference record to automatically apply predefined values for attributes without having to enter them manually.
3. Under “choose protection,” select whether to create casing, anode, or both when creating the pipe.
4. Create the protection features, using polygons for casings and points for anodes.
5. Specify whether to create terrain points.
6. Exit from the workflow when finished.
7. When geometry creation is finished, the feature-class form is displayed so the user can add attribute data.

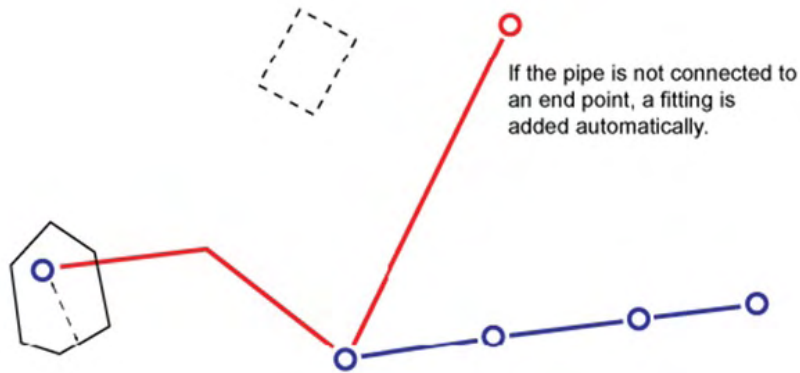


Figure 5: Illustration of network pipe creation workflow.

### Topobase Gas Data Model

Topobase Gas comes preconfigured with an Oracle data model that is designed to capture the exact data needed by the gas utilities industry. It is configured to manage attribute information appropriate to assets common in the industry, such as pipes, filters, meters, valves, and pumps. 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 relationships between features. This means, for example, that every pipe has an appropriate connection or fitting.

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

The Topobase Gas data model is comprised of 11 types of elements and associated functions. Each of these is referred to as a “topic.” The primary topic areas are:

- Administration: Manage contacts, customers, locations, manufacturers, and item models.
- Control Cable: Maintain data on control cables.
- Dimension: Create user-defined markups and label measurements.
- Facility: Maintain simple data structure for facility management to maintain equipment such as chairs and tables.
- Miscellaneous: Store information about maintenance work, physical markers, and the terrain surface.
- Pipe: Use the basic feature class form of the gas pipe to view and edit feature attributes.
- Point: Store utility points of the gas 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 gas network protection in anode, anode test-station (point), or casing (polygon) form.
- 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 Gas to generate on-the-fly analysis, such as network traces using complex stop conditions, and to perform hard and soft splits of network assets.

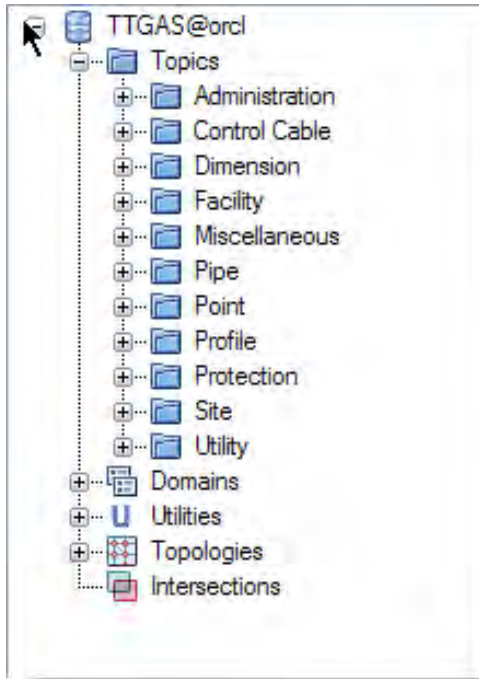


Figure 6: Gas data model supports the streamlined management of pipes, filters, meters, valves, pumps, and other features specific to gas utility networks.

Let's take a closer look at the individual components of the gas 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 meter areas, pressure zones, protection zones, and supply zones. Captured data includes geometry, area, creation date, name, narrative, and user flag. The Administration topic includes the following feature classes:

- 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 gas assets.
- Model feature classes—collects several types or models of a particular item (such as a meter, valve, or pump), to simplify data acquisition and data entry into the database.
- Meter area—groups gas utility items into defined meter areas.
- Pressure zone—groups gas utility items into defined pressure zones.
- Supply zone—groups gas utility items into defined supply zones.

#### Hard and soft split functionality

Hard split—splits the original record into two new records and geometries. For example, when splitting a pipe using a hard split, two pipe records are created, each with its own geometric representation.

Soft split—keeps the original attribute record and only splits the geometry into two. For example, when splitting a pipe using a soft split, the original pipe record remains but it is now represented by two geometries.

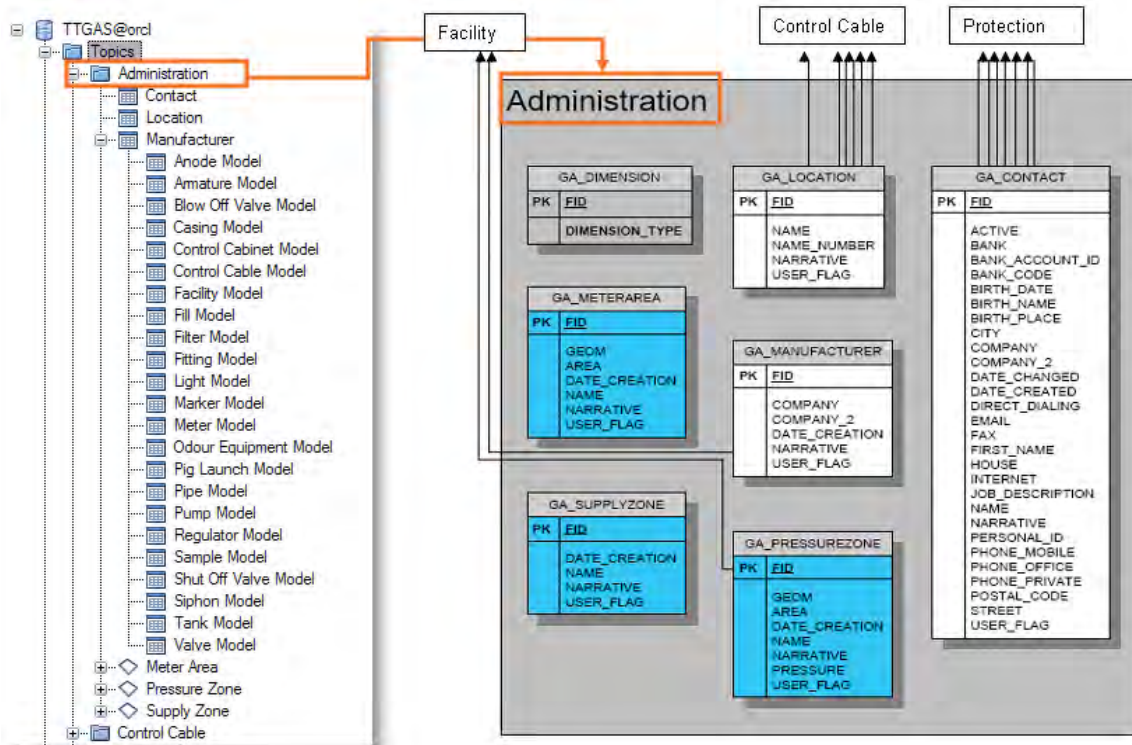


Figure 7: Topbase Gas Administration topic.

### Control Cable

The Control Cable topic contains information about wires, cables, and electronic system controls that are deployed throughout the gas utility network. The Control Cable topic is where information such as sensory control and data acquisition (SCADA) on the cable point, control cabinet, and cable is stored. It includes the following feature classes:

- Control cabinet—a cabinet for the cable where electrical nodes are located.
- Control cable—a cable used to transmit electricity or information to system controls.
- Control cable point—a cable point that represents an electrical node.

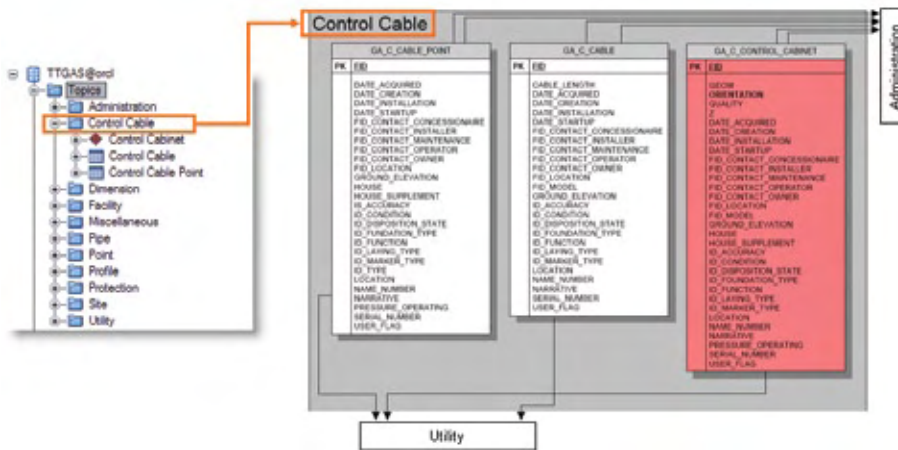


Figure 8: Topbase Gas Control Cable topic.

## Dimension

The Dimension topic enables the users who are constructing and editing the gas 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 9: Topbase Gas Administrator view of Dimension topic.

## Facility

The Facility topic contains a simple data structure for facility management to maintain equipment, such as chairs and tables. A gas structure can be a building with rooms that contain equipment such as desks and chairs.

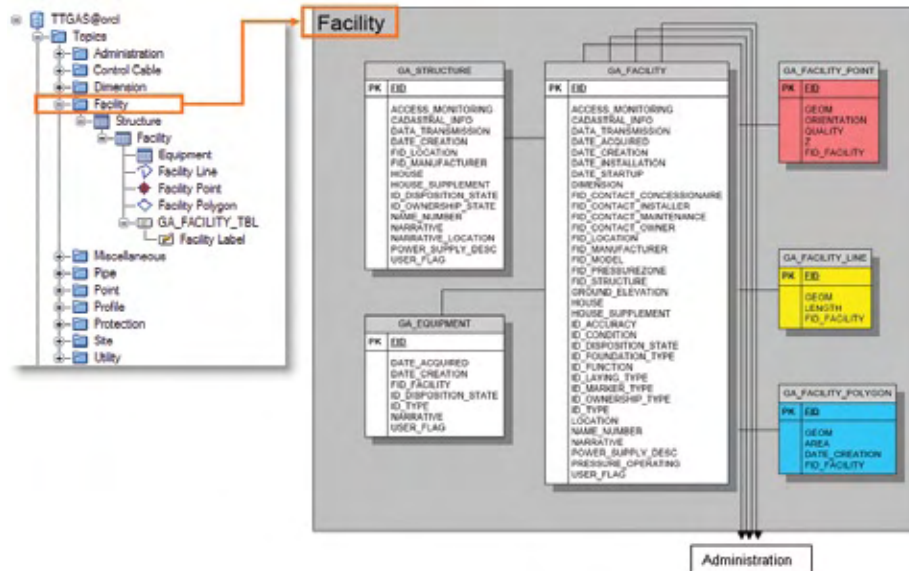


Figure 10: Topbase Gas Facility topic.

## Miscellaneous

The Miscellaneous topic stores information about maintenance work, physical markers, and terrain points. It contains three feature classes:

- 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 gas.

- Owner—names the entity which has ownership in a fixed asset or pipeline.
- Terrain point—stores height points to describe the terrain surface.

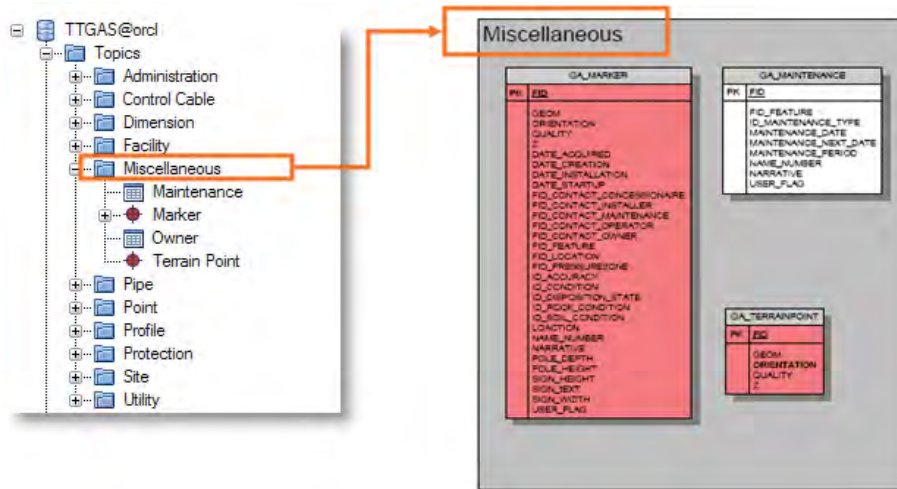


Figure 11: Topbase Gas Miscellaneous topic.

### Pipe

The Pipe topic contains basic information on the one gas-line feature: pipes. Use this topic area to view and edit feature attributes and view related pipe data. The Pipe topic contains the following elements:

- Damage—indicates locations where damage has occurred related to a pipe.
- Pipe—the only standard line feature of a gas utility model.

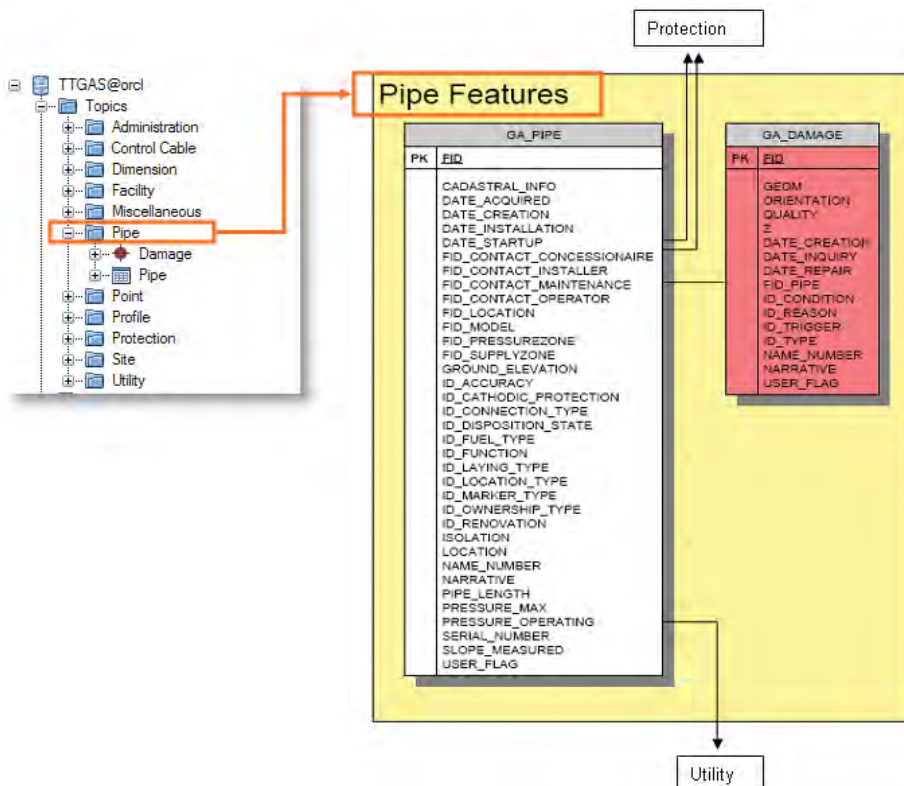


Figure 12: Topbase Gas Pipe topic.

## Point

The Point topic contains information about the point assets in the gas utility 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:

- Armature—an assembly that connects pipes.
- Blow-off valve—a device used to blow pressure off the pipeline.
- Fill—a location where gas is controlled and discharged to users.
- Filter—used upstream of pressure regulators to protect the regulator from particles that may be in the gas stream.
- Fitting—a device used to connect, cap, or plug a pipe carrying gas.
- House connector—the last point of a gas network, usually on or inside a building that represents the connection between the network and the customer.
- Light—a gas light fixture that uses gas as its energy source and contains a flame to illuminate an area.
- Meter—a device installed in a line to measure gas flow-rate or consumption.
- Odor equipment—equipment in the control station allowing the addition of an odorant—a chemical with an extraordinary intensive and characteristic warning smell—to the gas.
- Pig launch—a temporary point to insert a pigging device, generally used during construction or maintenance.
- Pump—a mechanical device that moves gas through a network.
- Regulator—a device that automatically reduces the pressure on the downstream side of the valve to a preset magnitude.
- Reservoir—a body of gas that supplies gas to a gas distribution system.
- Sample—point locations where one or more gas samples are collected from a gas utility or system.
- Shut-off valve—a device designed to shut off gas flow upon flame failure, pilot outage, control impulse, overpressure, or underpressure without manual effort.
- Source—the point from which gas is supplied for processing and distribution.
- Tank—an above- or below-grade receptacle or chamber used for holding odorant chemicals on a temporary basis prior to transfer or use.
- Valve—a fitting or device used for controlling the flow of gas through a line.

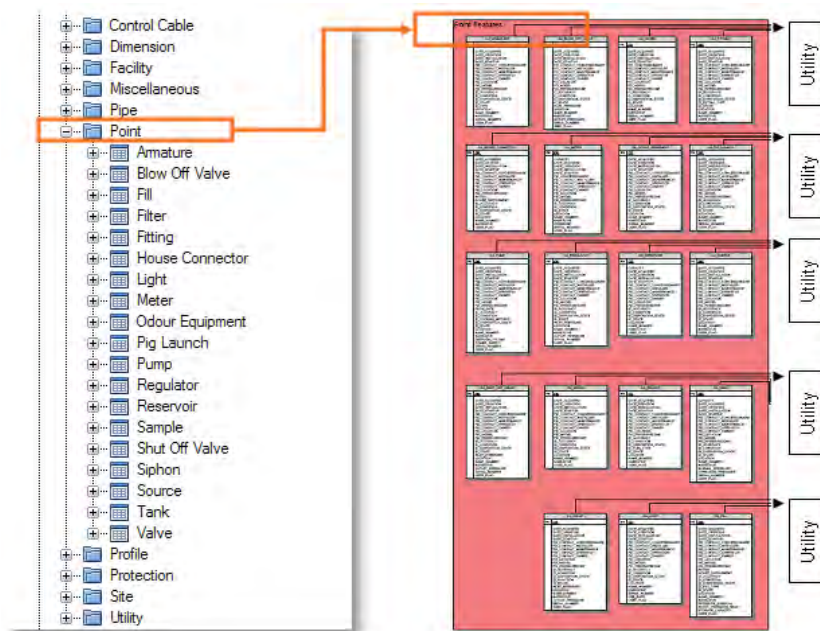


Figure 13: Topobase Gas Point topic.

## Profile

The Profile topic stores the profile geometry that is created using the profile manager.

Users can generate a profile view of the gas network section by either selecting it on the screen, or by using the results of a network trace analysis.

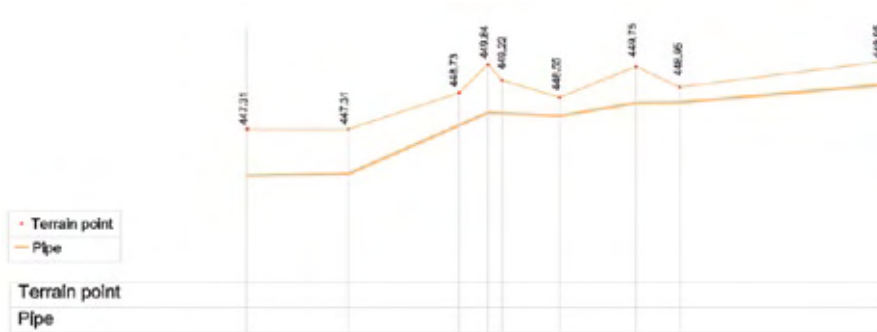


Figure 14: Topobase Gas Profile example.

## Protection

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

- Anode—a method for protecting a pipe that involves installing sacrificial material (usually magnesium or zinc) adjacent to a gas 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 station—a central location where anodes are tested for performance in gas network.
- Casing—a method of protecting a pipe segment by surrounding it with a larger diameter pipe.

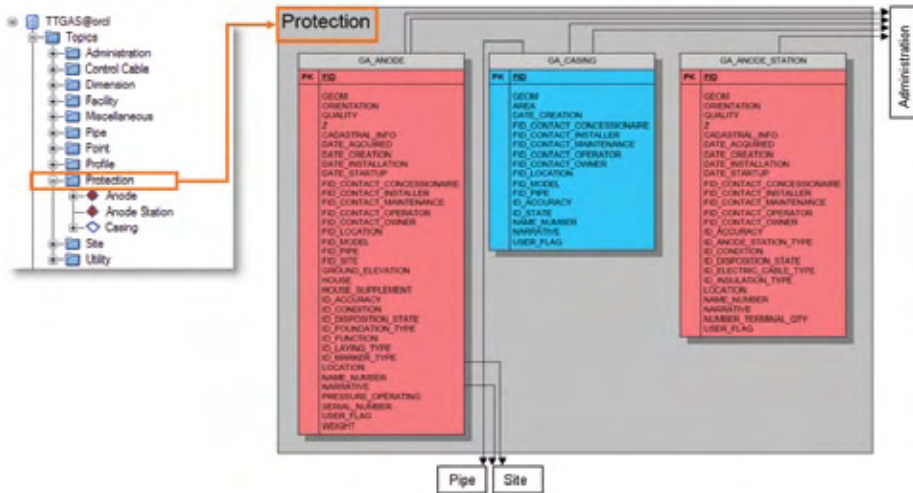


Figure 15: Topbase Gas Protection topic.

### Site

The Site topic contains point, line, and polygon geometry that can be used to relate gas network features together. For example, a site such as a pump station can be used to group several point features (e.g., 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 gas 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.

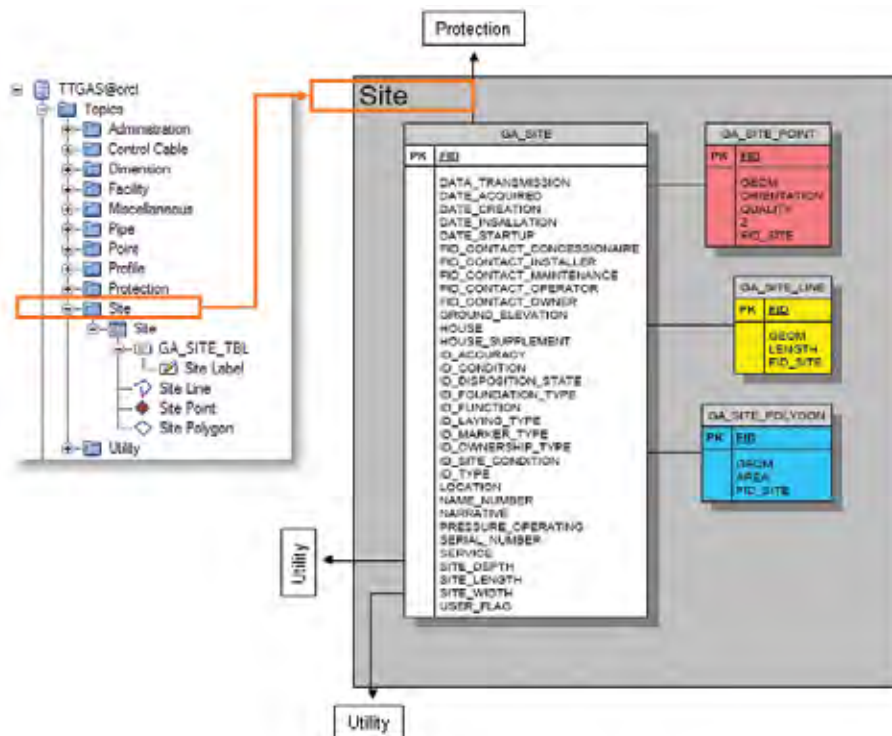


Figure 16: Topbase Gas Site topic.

## Utility

The Utility topic houses basic network topology components related to the point and line feature classes, and allows Topobase Gas users to generate on-the-fly analysis, such as network traces using complex stop conditions. Topobase Gas 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

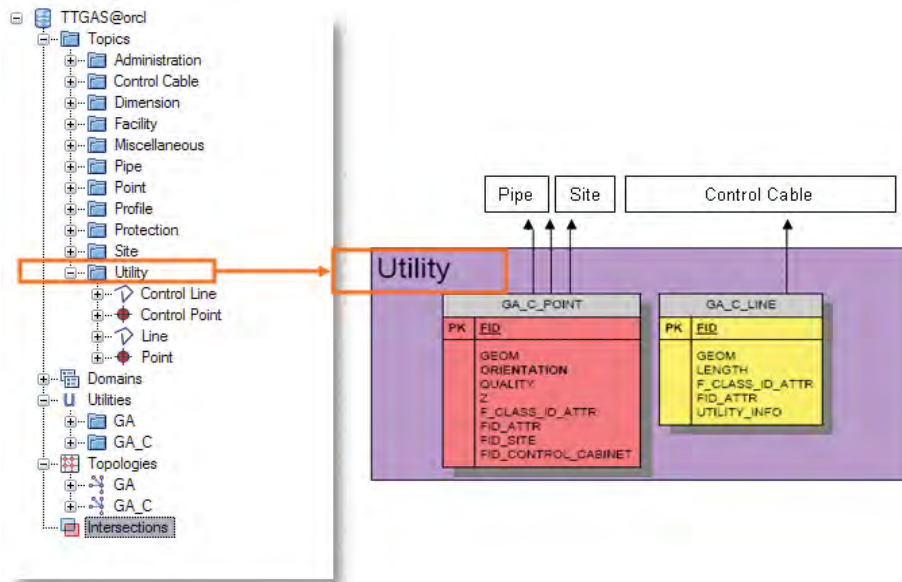


Figure 17: Topobase Gas Utility topic.

## Display Style Templates

With Topobase Gas 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 allow users to view relevant information using the scale, symbols, and formatting most relevant to their jobs, allowing them to complete job-related tasks efficiently. For example, gas utility network designers want to know where the existing sections are below the street, but maintenance and operation personnel might be interested in viewing the same data represented according to physical state, throughput, and damage sites.

Figure 18: Display style templates show different graphic representations, depending on the job function.



Figure 18: Display style templates show different graphic representations, depending on the job function.

## Conclusion: Autodesk Topobase Gas Delivers Results

Infrastructure design and management impacts the success and accuracy of gas networks and utilities. For too long, gas utilities have conducted design, as-built, and management processes using disparate applications that generate data in proprietary formats and store data in independent, siloed databases. This lack of integrated asset management has resulted in duplicate work, increased risk of errors, limited visibility into assets as a whole, and a myriad of time-consuming workarounds such as data conversions. Autodesk Topobase Gas software gives gas utilities the architecture, gas-specific components, and technology features they need to overcome these challenges.

By providing centralized access to spatial data and enhanced processes, Autodesk Topobase Gas improves the way workers complete vital tasks throughout gas utility 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 gas-related data is easily—and accurately—shared among departments.

With Topobase Gas, organizations are able to:

- Gain a big-picture view of gas 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 Gas by visiting [www.autodesk.com/topobase](http://www.autodesk.com/topobase) today.

## Appendix

Gas data model—See next page

