

The Value of Routing Studies for New Natural Gas Pipelines

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When natural gas pipeline owners announce their preferred route for a new pipeline, permitting bodies and other stakeholders inevitably ask, “Why here?” By conducting a methodical routing study that produces data-driven and experience-tested route alternatives, owners obtain supporting data and documentation they can use to formulate a response and help obtain buy-in.



In an uncomplicated world, the criteria for selecting the route for a new natural gas pipeline would be simple. Pipeline companies would choose the route that requires the shortest distance of pipeline and can be constructed for the least possible cost.

The real world is complicated, however, and such routes are increasingly difficult to find. Environmental and geological considerations, landowner reluctance, permitting issues, and a host of other factors add complexity to route selection decisions.

A formal routing study, performed early in the project life cycle, brings clarity to the search for the optimal route and can be helpful in obtaining stakeholder buy-in before design and construction begin.

These studies serve other purposes as well. First, these studies help forestall claims of routing bias by communicating the process used to select a route and creating opportunities for landowners, public officials and other interested parties to

provide early input on options. This feedback can be helpful when securing approval from state permitting agencies, which may require a public participation process and an analysis comparing the preferred route with one or more alternatives.

Routing studies also provide the supporting data needed to obtain rights-of-way and easements, gain property access, purchase options on land acquisition, or defend condemnations. Project engineers responsible for preliminary engineering and design value them because they set project boundaries, which help define the scope of their work. These studies can also help identify environmental constraints, conservation issues and other fatal flaws in prospective routes before considerable time and money have been invested. Routing studies accomplish all these things for a fraction of the total engineering budget, which is in turn a fraction of the total construction cost.

The Routing Study Life Cycle

Even among industry professionals and subject matter experts, opinions on route recommendations will often differ.

A routing study identifies the key criteria needed to make recommendations and provides data to support them. A typical life cycle for a routing study includes these steps:

1. Define the study area. The shortest distance between two points is a straight line. To identify the study area, therefore, route planners begin by reviewing the two points the new pipeline will connect, recognizing that any proposed routes should divert as little as possible from the center point between them. Routes that impact towns, conservation areas, large bodies of water and other significant topographic, social or political constraints are identified as areas to be avoided at this early stage.

2. Collect data from desktop sources and the field. The routing team typically begins its data collection efforts by searching federal, state and local geographic information system (GIS) data sources and reviewing existing aerial photography. These sources can identify state and federal properties that should be avoided, as well as conservation easements, wetlands, land parcel boundary lines and other data that can be layered over route alternatives.

Maps developed from this data tend to have a large scale, 1:10,000 or more. While helpful in identifying properties that should be avoided, accuracy at this high level can be suspect. Boundaries, for example, will need to be verified later using land surveys.

The routing team may next take to the air to obtain current aerial photography of the study area. Light Detection and Ranging (lidar) technology may be used to collect information on elevations and topography. Boots-on-the-ground cultural surveys may be needed later, during the detailed design and permitting phase, to identify known or suspected sensitive archeological areas within a study area.

To learn about new economic development plans being considered, data collection continues in meetings with town planners and development groups located within the study area. A review of zoning and new parcel data may indicate plans for new residential, commercial or industrial development.

3. Review siting board requirements. Prior to developing specific route alternatives, the routing team confirms the requirements of the siting board responsible for approving the proposed route. For example, the number of route alternatives varies by state and study area, with most states requiring an owner to designate a preferred route and at least one alternative. Most also require the final report to detail

the factors that led to selecting the preferred route. Some states also dictate the amount of overlap that can exist between alternatives. In Ohio, for example, alternatives can have no more than 20% of the route in common without requiring an additional waiver from the siting board.

4. Develop route alternatives. Building from the data collected, the routing study team next pinpoints a network of route segments. Complete routes are then pieced together from these segments, providing the study team with multiple combinations of alternatives to consider.

5. Conduct a windshield survey. When selecting a pipeline route, the devil is most often in the details. Closer inspections of individual routes are necessary to identify cultural and environmental issues and survey conflicts. Many are discovered when the study team drives the route alternatives to perform a windshield study, which allows the team to view routes from publicly accessible roadways and confirm there are no substantive development changes or signs of impending development, such as cleared trees or construction equipment. Windshield surveys also provide a more complete understanding of the terrain, social environment, ecological conditions and other features that might complicate pipeline installation.

6. Modify route alternatives. Using these findings, the team develops route alternatives that acknowledge constraints and minimize the pipeline's impact. For example, routes that align with a boundary line or the edge of a farm field are often chosen to minimize impairment of landowners' use of their property. Similarly, routes that run parallel to existing rail lines, highways and other infrastructure often pose fewer obstacles than those with no existing easements or rights-of-way.

Depending on the nature of the parallel corridor, some changes to the pipeline design may be required. For example, pipeline depth of cover may need to be increased when paralleling a railroad. When running adjacent to high-voltage electric transmission lines, alternating current (AC) mitigation must be considered. At this stage, route planners also look for opportunities to co-locate within or directly adjacent to these existing corridors. Collocation can be difficult because the pipeline company will be required to obtain an easement on top of an existing easement. Another common technique involves adjacent paralleling (or abutting) a new pipeline easement to an existing utility corridor. This approach is frequently more palatable for landowners.

7. Score each route. Each potential route is evaluated by a series of criteria, not all of which are weighted equally. For example, a route that passes within 25 feet of a residence carries a greater weight than one going through a field. Using algorithms to normalize the data, planners can make apples-to-apples comparisons of alternatives. A z-score method is frequently used to identify trends within the evaluation criteria, which include:

- **Social and political concerns** — Planners review land use as well as the number of residences and land parcels impacted. The presence of commercial/ industrial developments, schools, churches and other institutions is considered. Conflicts can arise when landowner interests compete with those of the pipeline company. For example, a landowner may prefer a pipeline to be located near wetlands on a property rather than an agricultural field, resulting in higher permitting and construction costs. The routing study factors all these issues into its scoring.
- **Controlled-use properties** — Planners also look at any constraints that could impede a route. These can include the presence of federal, state and tribal property; cemeteries; and archeological and historic sites, among others. States might prohibit the use of a horizontal directional drilling (HDD) method for pipeline installation beneath sensitive archeological areas, or the U.S. Army Corps of Engineers might restrict HDD under a levee. When such sites cannot be avoided, it might be necessary to excavate and move sensitive materials to a protected area, affecting the project cost, or to reroute around the sensitive area.
- **Environmental concerns** — Pipelines that impact wetlands and streams require various state and U.S. Army Corps of Engineers permits. The habitats of threatened and endangered species also must be protected. For some sensitive species, restrictions limit when their habitat can be disturbed, which can lead to additional construction costs. If these habitats are harmed, it may be necessary to pay into a mitigation bank for bats and other species. Conservation areas, forests, dunes and other environmental features may require similar protections.
- **Geologic and physical environment features** — Some geologic features, including karst, permafrost and muskeg, are notoriously difficult to construct pipelines through. Planners also prefer to avoid mountainous landscapes and locations with shallow or hard rock that may require ripping, blasting or other costly construction methods.

- **Cost** — Routes with the least-cost path (i.e., creating the least impact) are obviously preferred. However, the routes that can be constructed for the lowest cost are not always the shortest, depending on the constraints that lie in their path. “Cost” is not simply a financial consideration. In many cases, the goal is to identify routes with the least social, environmental and economic impacts. Owners often choose to invest more funds to produce a less disruptive result.

8. Identify the preferred and alternative routes.

The study ends with an analysis of the best-scoring routes. By weighting criteria and normalizing data, planners gain greater confidence that routes with lower scores have fewer overall impacts than higher scoring routes. Scoring also enables planners to whittle down the number of alternatives to a manageable number that can be studied in greater detail.

After scoring is complete, planners typically rank the alternatives for review by a larger group, including the owner, the engineering and construction teams, community engagement staff, and permitting and right-of-way professionals, among others. In some cases, there may be factors outside of the scoring process — perhaps a conversation with a land agent or the results of a public hearing — that provide rationales for eliminating some routes and deeming others more favorable.

Final recommendations are based on scoring in combination with the planner’s professional judgment and experience, client insights, and public feedback.

Transition to Detailed Design and Engineering

In a best-case scenario, members of the engineering team have played a consulting role in the routing study from its inception. The relationships forged between engineers and other interested parties early in the project can pay dividends in route selection and beyond. Once a route is approved, planners can complete a smooth handoff to the survey and engineering team. The planners then assume a consulting role as the project moves forward.

The corridors developed in the routing study help define the parameters for the field survey. Typically, a Google Earth KMZ file or shapefile, created using the route’s expected center line, can be used by field personnel to define the regions for environmental, civil, geotechnical, cultural and other necessary surveys.

For a relatively low investment and effort, a routing study sets a pipeline project on a course that positions it for success. It enables early, structured community engagement

that can produce actionable feedback on alignment selection. Overlaying physical environmental data with interested-party preferences early in the project life cycle typically yields more favorable routing solutions.

These studies can minimize surprises and costly reroutes. They help project teams navigate increasingly complex permitting, easement and right-of-way processes. They provide the engineering team a significant head start on detailed design. They are, in short, a valuable first step toward a successful pipeline project.

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