

PIPELINE INTEGRITY ANALYSIS

ACQUIRE
ANALYZE
ANSWER



High-density lidar data provides an effective solution for measuring above-ground pipe declination and movement over time.

Why NV5 Geospatial?

NV5 Geospatial (NV5G) has a measurement and analysis solution that enables pipeline operators to evaluate and monitor the structural integrity of their networks. Remotely sensed data and analyses provide value and insight that can help to pinpoint current and potential future problem areas, so managers can effectively plan mitigation efforts and maintain safety.

Above-ground pipeline supports are subject to settlement and heave due to the yearly freeze and thaw cycle as well as water movements and other terrain failures. These movements can threaten the integrity of sensitive infrastructure. Pipelines are engineered with a tolerance for movement, however alignment and declination must be routinely inspected along the line in order to find areas of stress that are exceeding established tolerances.

NV5G's solution utilizes high-density aerial lidar to map the pipelines and supports in detail. Precise pipeline elevation values at support structures are extracted from the point cloud and recorded in a geodatabase. This database is then analyzed to find areas of stress. NV5G can integrate this analysis with existing asset information or utilize the newly collected data to create an updated inventory. Repeat surveys can be added to the geodatabase to monitor changes at specific structures over time, providing integrity managers a powerful planning tool.

ACQUIRE

- Airborne Lidar
- Topo-Bathy Lidar
- Ground Mobile Lidar
- Large Format Cameras
- Oblique Cameras
- Thermal Infrared Imaging
- Hyperspectral Imaging

ANALYZE

- Spatial Rectification
- 3D Asset Model
- Asset Inventory
- Engineering Design
- Topographic Maps
- Planimetric Maps
- Orthophotos
- Full Feature Classification
- 3D and 4D Models
- Enterprise GIS
- Geospatial Cloud Solution

ANSWER

- Regulatory Compliance
- Vegetation Analysis
- Environmental Monitoring
- Land Use and Permitting
- Infrastructure Management
- Hazard Detection
- Disaster Preparedness

Classified above-ground features in the high-density lidar point cloud

Orthoimagery of pipeline section

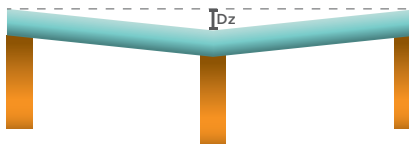
Pipeline Integrity Analysis

- Analyze the point cloud directly rather than using raster or vector derivatives
- Pipelines and support structures are uniquely coded in the point cloud using automated classification routines
- Extract pipeline elevation values at support locations to perform structural integrity analysis
- Because pipelines follow terrain, it is necessary to examine the change from support to support, rather than compare to a fixed elevation
- Analysis compares elevation changes along pipeline sections comprising three support structures
- The observed elevations at the first and third supports are used to calculate an expected elevation at the middle support. This expected value is then compared to the observed value and the difference recorded as a Dz value.
- The analysis then slide down the pipeline so that each support has an expected, observed, and Dz value recorded

Expected Pipeline Elevation Profile

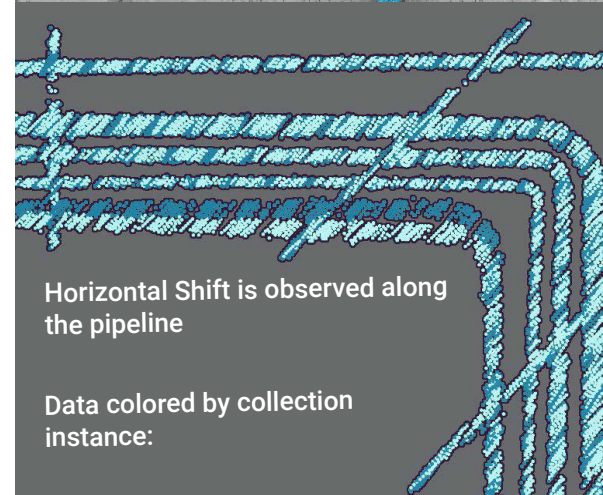
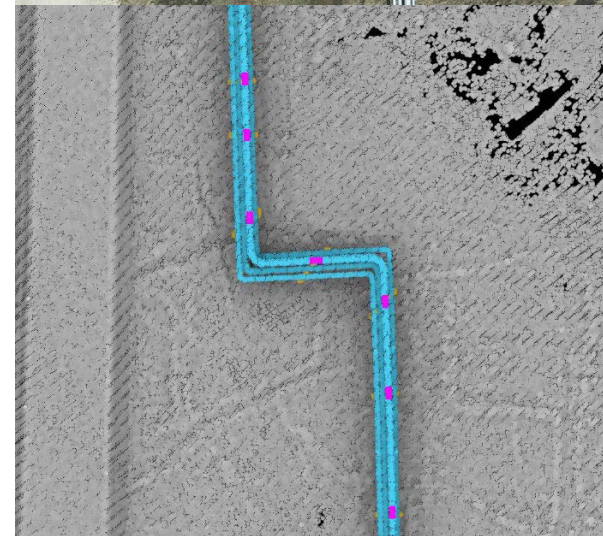


Calculated Pipeline Elevation



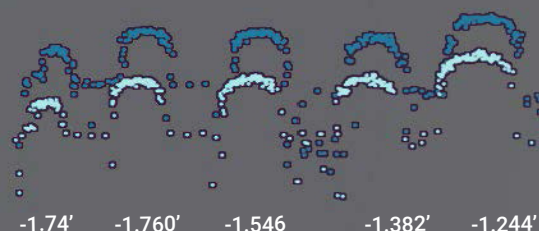
Change Detection

- Changes are observed over two or more distinct data collections, year to year is a typical array
- Newly measured elevation and changes from the previous year are recorded to the pipeline geodatabase
- Elevation values at the structure locations can identify full structural heaving or sagging in pipeline corridor, or individual pipes on individual structures
- Horizontal shifts of pipelines on the support structures are also observed, and recorded for monitoring
- Some pipelines are not anchored in order to accommodate slide on their supports to prevent stress



Horizontal Shift is observed along the pipeline

Data colored by collection instance:



-1.74' -1.760' -1.546 -1.382' -1.244'

Vertical Shift observed in the pipelines. The structure sank from one year to the next