



# Pipelines Expertise



Equinox Engineering Ltd is a world class provider of EPCM services to the global oil and gas marketplace. Founded in 1997, Equinox has successfully executed over 7,000 significant projects in Canada and around the world. We have a worldwide presence with offices in Calgary (Canada), Houston (USA), Pittsburg (USA), Brisbane (Australia) and Pune (India) with projects executed in fourteen countries and three continents.

## Pipelines Expertise

Equinox has industry leading expertise in engineering design and installation of pipelines and pipeline facilities. Our services include scoping, routing and conceptual design, Front End Engineering Design (FEED), Detail Design through to construction management and operations support for gas, oil and liquids, water, steam and refined product pipelines.

Our highly skilled, technical team provides expertise in pipeline routing, mechanical design, hydraulic analysis, stress analysis, hydrate control, material selection, civil and earthworks design, crossing designs (HDD), as well as environmental and regulatory compliance.

Our terrain experience includes prairie, foothills, forest, mountains, wetlands, muskeg, rainforest as well as remote, desert climates. Our construction experience ranges from severe, winter weather environments to challenging wet,



**Gathering Lines**



**Thermal Lines**



**Distribution Lines**

# Pipeline Categories

Equinox has extensive knowledge and expertise in all phases of pipeline system design, material selection and construction. Our experience includes the design and installation of 1000's of kilometers of pipe ranging from 3" to 36" diameter. This includes all types of terrain ranging from hard rock to farmland to forest to muskeg.

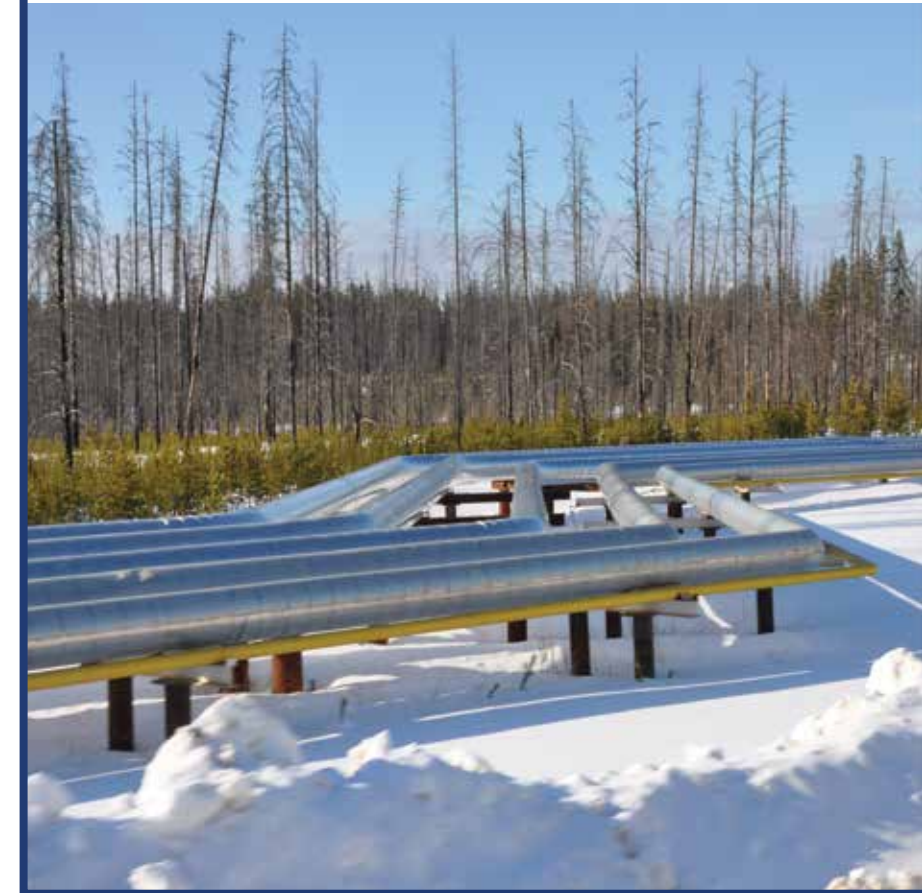


## OIL & LIQUIDS

Equinox designs and installs varying diameters of liquids pipelines for crude oil, condensate, ethane, natural gas liquids, diluted bitumen (dilbit) and diluent. We also provide expertise for facilities such as pump stations, terminals, tank farms, blending facilities and truck / rail / barge loading facilities.

## THERMAL PIPELINES

Equinox is an industry leader in high temperature, above-ground steam and oil emulsion pipelines for SAGD and CSS heavy oil projects. We are experts in the specialized design requirements for high temperature (350°C) pipelines including mechanical design, material specification, hydraulic analysis, stress analysis, expansion loops combined with civil requirements of severe winter and deep muskeg environments.



## NATURAL GAS

Equinox has designed and installed 1000's of kilometers of natural gas pipelines, including sweet and sour, low and high pressure, single and multiphase gathering lines as well as transmission lines. This includes significant experience with unconventional gas gathering and transportation and multi-well pad design and gathering.

## WATER

Equinox has designed hundreds of kilometers of fresh and brackish source water gathering systems utilized for steam generation for thermal projects, as well as for hydraulic fracturing in unconventional reservoirs. We also specialize in produced water gathering systems or flow-back water pipelines (including sour water, oily water, brackish and saline) as well as water treatment, disposal or recycling. Our experience also includes fresh river water intake systems, salt cavern wash and injection facilities including brine ponds.



## ACID GAS

Equinox has extensive experience with high H<sub>2</sub>S rates and CO<sub>2</sub> rates and the unique design and material and regulatory requirements for acid gas pipelines, acid gas compression and acid gas disposal facilities. We have executed numerous severe service pipelines (with up to 99% acid gas composition) and provide safe, fit-for-purpose designs.

## INTEGRITY PROGRAMS

Equinox develops integrity programs compliant to the latest applicable codes and standards on behalf of its clients. Our team is experienced in the coordination and execution of pipeline integrity digs, intelligent pigging runs, data collection and engineering assessments. We also are experienced in the full execution of pipeline repair programs on behalf of our clients including regulatory compliance, lands and environmental scope.



# Pipeline Capabilities

Equinox provides process, mechanical, stress, horizontal directional drilling, geotechnical, and cathodic protection engineering expertise for all pipeline requirements. We deliver complete EPCM services with specialization in route selection, geomatics, mechanical design, hydraulic analysis, material selection and stress analysis. Our instrumentation team also provides expertise in communication, control systems, SCADA, leak detection and metering.



## ROUTE SELECTION

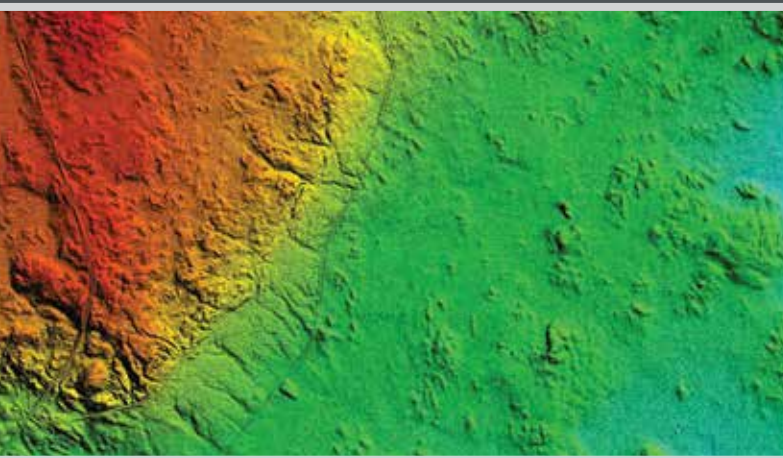
Equinox provides Route Planning expertise leveraging our knowledge of regulatory requirements as well as pipeline design, construction and operations. We advise and provide numerous services such as:

- Land, Environmental and Regulatory Compliance
- Field Route Scouting
- ROW Constructability Reviews
- Crossing Method Recommendations
- Temporary Work Space and Log Decks
- ROW Access Planning ROW

## HYDRAULIC ANALYSIS

The Equinox design team specializes in hydraulic analysis and is proficient in selecting the appropriate hydraulic approach based on project priorities. Analysis includes:

- Flow regimes and erosion velocities
- Condensate drop out and sweeping
- Hydrate and temperature gradient analysis
- Pigging frequency recommendations
- Slug volume estimation



## GEOMATICS

Designing, developing and operating systems for collecting and analyzing spatial information regarding a proposed project site/route is an Equinox corporate specialty. Applications include:

- Geographic Information Systems (GIS)
- Global Positioning Systems (GPS)
- Digital Mapping, Digital Terrain Models & LiDAR
- Geodetic Based Pipeline Alignment Sheets

## MATERIAL SELECTION

Equinox's mechanical design team is adept at choosing the appropriate material for the intended design purpose. In addition to conventional carbon steels, below are some of the alternate materials that Equinox has experience with:

- HDPE Pipe
- Coreliner
- Flexpipe
- Fiberglass
- HDPE Tight Liners
- Fiberspar
- Flexsteel
- Stainless Steel



## MECHANICAL DESIGN

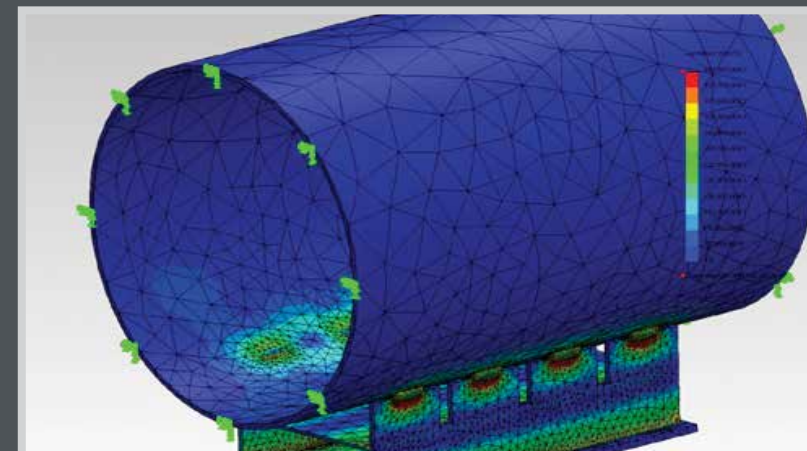
Equinox's mechanical design team provides expertise in pipeline design, pipeline studies and planning. This includes:

- Horizontal Directional Drilling Design
- Stick built and modular fabricated pig barrel design
- Wall thickness, Crack propagation, puncture resistance and fracture studies
- ROW cold and induction bend planning
- Weld Procedures
- Hydrotest section planning

## STRESS ANALYSIS

Equinox's design team understands the importance of accurately estimating modeling both buried and aboveground pipeline stress caused by thermal expansion/contraction and operating conditions. Our stress design capabilities for aboveground and buried pipelines include:

- Pipeline anchoring & flexibility design
- Thermal induced stress analysis and interference design
- Valve closure transient & slugging analysis



# Selected Projects



## SOUTH PEACE PIPELINE

### Sour Gas Pipeline

The South Peace Pipeline is a 92 km x 20" sour gas pipeline in northern British Columbia, Canada. The scope includes thirteen Line Block Valve stations, ESD valves, smart pigging facilities, complete SCADA design, receipt point water analyzers and H2S & CO2 measurement.

The pipeline route runs through agricultural and forested terrain, as well as wetlands and deep muskeg requiring extensive buoyancy control. In addition, several sections run through regions of rocky, hilly terrain. The route includes four (4) major river crossings, three (3) major Horizontal Directional Drills (HDD), twenty-five additional watercourse crossings, two (2) rail crossings and a highway crossing of the Hart Highway.



## SOUTH MONTNEY

### Sour Gas Gathering System

This program included design and construction of several sour gas trunklines and lateral pipelines installed to connect 25 unconventional multiwell pad locations to a central gas processing plant in northern British Columbia, Canada.

The project includes 70 km of 16" sour gas gathering trunklines (sized for a capacity of 360 MMscfd), 46 km of 4" lined produced water gathering, and 60 km of fuel gas supply lines. Gathering Lines (laterals) include 10" sour gas, 3" water and 3" fuel gas. In total, the project consists of over 425 km of pipelines installed, with ten major river / creek crossings, Horizontal Directional Drills (HDD), ESD stations, smart pigging facilities and complete SCADA.

Notable features include multiple lines in common trench construction. Logistical challenges included working in remote, northern muskeg regions with severe winter weather construction environments.

## PRIMROSE PIPELINES

### Above Ground Thermal Pipelines

The program consists of the installation of over 40 kilometers of above ground pipelines to support existing heavy oil developments in northern Alberta. The pipelines provide steam distribution and emulsion gathering from numerous Cyclical Steam Stimulation (CSS) wellpads to three Central Processing Facilities.

Steam pipeline diameters are typically 24" (grade 550) for trunklines and operate at a design temperature of over 300°C. Emulsion pipelines diameters are typically 24" for trunklines and operate at design temperatures over 200°C.



## STANLEY TO KIUNGA

### Condensate Pipelines & Terminal

The 40 km x 6" pipeline transports 5,800 bpd of condensate from the Stanley Gas Plant to the Kiunga Terminal routed through dense, jungle terrain in an active seismic (earthquake) zone.

The Kiunga Terminal includes a 75,000 bbl floating roof condensate storage tank with two centrifugal condensate loading pumps and a connecting 2 km x 12" condensate pipeline that delivers up to 88,000 bpd from the terminal to the Fly River Barge Loading Facility.



## RESTHAVEN

### Sour Gas Pipeline

The Restaven Sour Gas Pipeline is 12" in diameter and 28 km in length located in the foothills of Alberta, Canada. The pipeline scope included two major Horizontal Directional Drills, an intermediate riser site as well as smart pig launching and receiving facilities. The pipeline connects a producers' condensate recovery plant to existing gas processing infrastructure.

The pipeline route crosses challenging terrain which required additional attention to the constructability, pipeline hydraulics and stress aspects of the design.





## Pipeline Facilities Gas

- Compression
- Pigging Facilities
- Line Block Valves
- Slug Catchers

Equinox capabilities include the design and installation of gas pipeline field facilities such as pigging facilities, slug catchers, ESD stations, Line Block Valves, risers, meter stations as well as delivery and receipt point analyzers.

Our extensive gas compression experience includes centrifugal, reciprocating, rotary screw and vane type compressors, with gas turbine, natural gas engine, steam turbine and electric drivers.



## Pipeline Facilities Liquids

- Pump Stations
- Terminals
- Batching, Blending
- Truck / Rail Loading
- Tank Farms
- Measurements

Equinox specializes in liquids pipeline facilities design and construction for crude oil, condensate, diluted bitumen, ethane, LPG and refined products.

Our technical team provides complete design and construction solutions for pump stations, terminals, storage facilities and tank farms, batching and blending facilities, measurement and metering as well as truck loading, rail loading and barge loading operations.





Equinox delivers focused and experienced

## **Premium Teams**

customized with the best

## **Technical Expertise**

to align with

## **Client Culture**

to ensure repeatable and

## **Successful Projects**



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