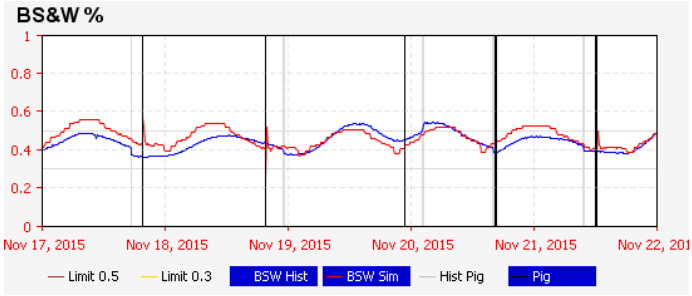
STREAM
systems in motion

Pipeline Quality Management Model

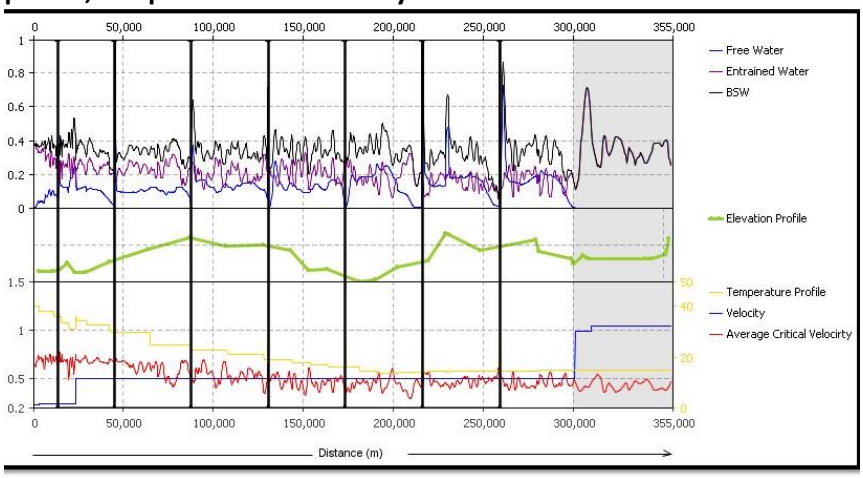
Case Study

- Single Pipeline or Pipeline Network with tank farms
- Pipeline Quality Simulation
- Scalable Infrastructure
- Batch Auto Scheduling
- Custom Business Rules
- Fittable Physical Functions
- Geospacial Aspects
- Sensitivity and Optimization Analysis
- Reliability and Maintenance
- Capital Projects Scoping
- Feasibility Assessments
- Quality Forecasting
- Operational Savings

Simulated BS&W compared to historical



Entrained and Free water through the main pipeline vs elevation profile, temperature and velocity.



The Challenge

The client had a challenge to maintain the delivery batch quality within the given specification because of varying flow rates and quality at upstream direct injection and side stream injection locations. Some parts of the system were in laminar flow regime, some in transition and others in turbulent flow. The variation upstream resulted in several off spec batches downstream with severe financial penalty. Pigging had improved the delivery quality at the risk of line integrity, but the client still experienced unexpected off spec batches.

The client wanted a model to experiment with different operational options, e.g. pigging frequency, flow rate changes, tank farm management to forecast the near future batch quality based on actual and scheduled injection and to evaluate potential system change like targeted tank farm mitigation strategies.

During initial discovery meetings, technical experts openly disclosed their scepticism about modelling and the ability to represent physical behaviours in a simulation model based on fitted functions and statistics rather the fully fledged hydraulics. They had experienced difficulties to model the situation with a commercial engineering tool that turned out to be too rigid and not having enough tune factors.

Business Objectives

Client needed a tool to:

- Understand the water behavior in the pipeline system as a function of pipeline dynamics, events, operational procedures and

system configuration

- Manage water levels at < 0.5%
- Forecast water levels @ delivery points
- Identify short term and mid term levers to support the water management. .

Consideration of the following asset variables:	Consideration of the following behaviours and dynamic variables:
• Pipelines • Tanks • Variable Pig injection • Instrumentation & SCADA historian input • Feeders / Deliveries • Flow rates per injection point and blending • Batch Quality • Input based on historical or statistical parameters	• Water behaviour (slippage, drop out, re-entrainment) • Quality dispersion through the pipeline • Reflection of flow regime • Reflection of elevation profile • Pigging impact on quality through the pipeline • Quantity and throughput at delivery points over time and on avg. • Reflection of physical properties (temperature, density, viscosity, pressure)

Solution

Stream's approach was to focus on water behaviour in the pipeline by selecting key known individual physical behaviours, representing them through fitted functions and using statistics to fine tune.

The challenges addressed in the initial phase included:

- Varying pig type and frequency impacting oil and water dispersion through the pipeline
- Varying flow regimes influenced by upstream production assets and tank farm injections.
- Variability in injection batch quality
- Tank Farm Operations
- Trim Blending
- Quality prediction based actual data + scheduled injections
- Analysis of historical periods
- Instrumentation error adjustment outside typical 5% range
- Seasonality

Future scope is planned to be expanded to include additional variables such as:

- Other quality parameters
- Multi-commodities
- Reliability
- planned and unplanned pipeline shutdowns
- Trim Blending
- Financial Pre-feasibility Assessment

Results

As a result of Stream's simulation modeling, the client was able to replicate past quality incidents and has now a tool to predict and mitigate the impact of short term operational incidents. In addition this tool will support future capex options reducing the currently required pigging frequency, increasing the lifetime of critical pipeline components.

At this stage we do not yet have quantitative impact.

An engineer of a reputed engineering consulting firm confirmed the model behaves as he would expect confirming the validity of the underlying fitted functions.