



**Plains Midstream Canada ULC
NPS 20 Rainbow Pipeline Failure
Licence No. 5592, Line No. 1
April 28, 2011**

ERCB Investigation Report

February 26, 2013

ENERGY RESOURCES CONSERVATION BOARD

ERCB Investigation Report: Plains Midstream Canada ULC, NPS 20 Rainbow Pipeline Failure,
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Executive Summary

On April 29, at approximately 10:00 a.m., Plains Midstream Canada ULC (Plains) confirmed a pipeline failure and a release of sweet crude oil into a muskeg / stagnant water area. The pipeline was shut in and isolated on confirmation of the release. The 508 millimetre pipeline, known as the NPS 20 Rainbow Pipeline, failed as a result of a crack associated with a weld-on Type B sleeve used for corrosion repair. The failure resulted in an estimated 4500 cubic metres of crude oil being spilled on and off the pipeline right-of-way at the location referenced in this report as Mile Post (MP) 188.

Due to the significant environmental effect of the release, a multiple government agency response lead by the Energy Resources Conservation Board (ERCB) was required. Along with provincial and federal regulatory agencies, local authorities, First Nations, and Northern Sunrise County also attended the site and assisted with response efforts. There was an ERCB press release and the incident received international media attention.

To resolve concerns regarding the integrity of the rest of the Rainbow Pipeline, the ERCB required Plains to conduct several integrity digs to inspect the types of sleeves that were the subject of the failure at MP 188. The ERCB also required a third-party engineering analysis of Plains's leak detection management system. The analysis was to make recommendations on how to enhance the current leak detection system and alarm protocol and response practices. The ERCB allowed Plains to resume pipeline operations on August 26, 2011, after reviewing and accepting the engineering analysis report. After conducting an in-depth analysis of the incident, the ERCB has made the following determinations:

- Plains failed to fully assess the history of the pipeline, failed to identify the risks posed by the application of Type B sleeves used for corrosion repair, and did not have measures in place to monitor and inspect the repairs.
- Plains failed to have adequate practices in place for backfill placement and compaction for excavated pipeline sections where Type B sleeve repairs were present and for unique soils conditions such as muskeg. The ERCB concluded that inadequate backfill and compaction likely contributed to stresses on the circumferential fillet weld that failed.
- The excessive size of the release resulted from failure to have proper leak detection alarm response procedures in place, lack of operator training, and lack of supervisory oversight and involvement in decisions to restart the pipeline after a leak detection shutdown.

1 Incident Description

On April 29, 2011, at 9:56 a.m., Plains Midstream Canada ULC (Plains) contacted the Energy Resources Conservation Board (ERCB) St. Albert Field Centre (SAFC) to report a pipeline failure and the release of sweet, sales-grade crude oil from the nominal pipe size (NPS) 20 Rainbow Pipeline licensed to and operated by Plains. The failure site, located at Legal Subdivision 1, Section 1, Township 86, Range 13, West of the 5th Meridian (the site), is about 12 kilometres (km) southeast of the Woodland Cree Reserve and about 90 km east-northeast of the city of Peace River (see Appendix A). The site is also referenced as mile post (MP) 188 along the pipeline corridor in several Plains communications. Upon being notified of the release, the SAFC deployed an inspector to the failure site and called the ERCB's Emergency Response Group.

Plains's supervisory control and data acquisition (SCADA)¹ system indicated abnormal operating conditions on the pipeline starting at about 6:35 p.m. (SCADA)² on April 28, 2011, until about 3:00 a.m. (SCADA) on April 29. This included several pipeline monitoring and leak detection alarms. At 2:50 a.m. (SCADA), Plains shut the pipeline down. At about 3:00 a.m. (SCADA), phone calls were made by Plains's control centre operator to its operations supervisor and control centre supervisor indicating that the pipeline had been shut down due to continued pressure concerns and pipeline monitoring and leak detection alarms.

In its initial report to the ERCB, Plains estimated the spill volume to be about 1000 cubic metres (m³)³. By 5:30 p.m. on April 30, 2011, Plains increased the estimated spill volume to about 4500 m³ and communicated this revised estimate to the ERCB at about 7:30 p.m. on April 30, 2011.

There were no permanent residences or public facilities within 12 km of the failure site. The release occurred in a mixed forested and muskeg area with no actively flowing creeks or streams. One registered trapline was affected as a result of the release.

1.1 Pipeline History and Monitoring

The Rainbow NPS 20 pipeline is composed of carbon steel pipe externally coated with plicoflex primer and polyvinyl chloride butyl tape outer wrap. The pipe was designed to API 5L X52 standards⁴ and manufactured by Stelco using a submerged arc welding process. The Rainbow pipeline was originally licensed in 1967 for crude oil containing up to 8 moles per kilomole hydrogen sulphide (H₂S), and Plains purchased it from Imperial Oil Ltd. in 2008. Ninety-five Type B repair sleeves were installed in the 1980s. In 1990, following an incident investigation involving a Type B sleeve fillet weld failure on a pipeline that it regulated, the National Energy Board (NEB) directed pipeline licensees under its jurisdiction to inspect/re-inspect circumferential fillet welds associated with these sleeves. As the Rainbow NPS 20

* This report is accompanied by numerous supporting documents. These documents are available from the webpage for this investigation report on the ERCB website, ercb.ca. For ease of reference, each document has been given a number, which is provided in a footnote when the document is cited (e.g., DOC01, DOC02, etc.).

¹ SCADA are computer controlled systems that monitor and control industrial processes.

² SCADA time is 1 hour earlier than Mountain Standard Time. All references to SCADA time will have "(SCADA)" after the time reference.

³ To convert cubic metres to barrels, multiply by 6.2899.

⁴ American Petroleum Institute 5L Specification for Line Pipe, Grade X52.

pipeline was not under NEB jurisdiction at that time, the license would not have been subject to this requirement. As discussed in more detail in section 3.1.4 of this report, both third-party consultants engaged by Plains in connection with the incident have assumed that the licensee “prudently” conducted those inspections in response to the NEB requirements.⁵ However, the ERCB was not able to ascertain whether those inspections did, in fact, occur.

According to Plains, after purchasing the Rainbow pipeline, Plains conducted corrosion inspections and investigations involving excavations based on in-line inspection tool results. These excavations were conducted through 2011.⁶

Plains had in place an integrity management program and an asset integrity management plan.⁷

Plains uses SCADA systems technology on all of its pipeline systems. This allows for continuous electronic monitoring and control of pipeline systems from dedicated computer consoles located in the control centre. The Plains control centre (which is staffed at all times) monitors the Rainbow pipeline system 24 hours per day, 365 days per year. The SCADA system and its associated leak detection software continuously monitor pipeline flow and operating conditions.

1.2 Response and Control

On April 29, 2011, at about 7:30 a.m., Plains dispatched a helicopter to find the potential failure site. Once the failure site was located, Plains initiated its emergency response plan for a Level-1 emergency.⁸ Plains then activated its corporate emergency response centre in Calgary and mobilized an incident command post to the failure site and, as indicated above, reported the release to the SAFC and Alberta Environment (AENV)⁹ at 9:56 a.m. on April 29, 2011. Plains also contacted Sustainable Resource Development (SRD) at approximately 11:15a.m. on April 29.

As a result of the incident and subsequent pipeline shutdown, producers’ shipments into the Rainbow Pipeline north of the Nipisi Terminal ceased. Prior to the incident, typical average daily shipments totalled about 28 195 m³/day (177 344 barrels/day) based on a 15-month average. The daily shipments south of the Nipisi Terminal were reduced to 15 226 m³/day due to the pipeline failure.

Based on initial reported release volumes, the fact that the pipeline had been shut in, and its significant distance from the public and flowing water, the SAFC initially classified this incident as an Alert, using the ERCB Assessment Matrix for Classifying Incidents. The SAFC chose to maintain the Alert classification until more information was gathered from the failure site. On April 29, 2011, at about 7:00 p.m., an ERCB inspector was on site and

⁵ Det Norske Veritas, July 27, 2011, *NPS 20 Rainbow Pipeline Reinstatement Case Support* (DNV Report No. 1), page 16 (DOC01); National Energy Board Report, June 1986, *In the Matter of an Accident on 19 February 1985 near Camrose, Alberta, on the Pipeline System of Interprovincial Pipeline Line Limited* (NEB Report) (DOC02).

⁶ Plains Midstream Canada, July 8, 2011, *Response to Investigation Report MP 188*, page 3 (Plains Response) (DOC03); DNV Report No. 1, page 16 (DOC01).

⁷ Plains Midstream Canada, July 8, 2011, *Response to Investigation Report MP 188*, Appendix 40 (DOC03).

⁸ The Assessment Matrix for Classifying Incidents in ERCB *Directive 071*, Appendix 4, is used to determine the emergency response level.

⁹ Now Alberta Environment and Sustainable Resource Development.

conducted an aerial inspection of the failure site. Due to reported impacts on wildlife and standing water (which included three abandoned beaver ponds), the SAFC upgraded the incident to a Level-1 emergency.

Access to the failure site proved to be very challenging for responders due to wet muskeg and thick forests. Access required brushing and clearing along overgrown cut-lines, as well as the use of about 2200 rig mats to stabilize the access route for equipment, personnel, and staging and control points. The initial release occurred on a hill side. The oil flowed about 800 m down the pipeline right-of-way and pooled in a low-lying area containing abandoned beaver ponds. This resulted in the containment and recovery of the spilled fluids. The release footprint encompassed an area of about 8.3 hectares (appendix A).

As indicated above, at about 3 a.m. (SCADA), Plains initiated a controlled pipeline shutdown. This included remote electric shutdown of the block valve at MP 109 by the control centre operator and manual shutdown (helicopter access) of the block valves at MP 167 and MP 212. Once the failure site was accessible, Plains installed Stopples®¹⁰ upstream and downstream of the failure site to further isolate the leak. The Stopples® were installed and pressure tested by about 5 p.m. on May 3, 2011. Because the source was controlled and the release was contained, at 6:00 p.m. on May 3, 2011, the ERCB, in consultation with Plains, AENV, and SRD, downgraded the incident to an Alert.

Plains replaced the failed section of pipe with pretested pipe of similar wall thickness and grade. They then sent the removed section to Acuren Group Inc. (Acuren) for independent third-party metallurgical analysis. Acuren subsequently provided a report in connection with the incident.¹¹

1.3 Regulatory Response

The following regulatory agencies were notified and engaged as a result of the pipeline failure and release: the ERCB, AENV, Environment Canada, SRD (Fairview Fish and Wildlife Office). By May 6, 2011, a total of 25 officials from AENV, Occupational Health and Safety, Alberta Health and Wellness, the ERCB, and First Nations and Inuit Health had toured or were continually present at the failure site.

In addition to the ERCB's on-site incident response, a team of ERCB technical personnel located in the ERCB's head office in Calgary reviewed and assessed evidence related to Plains's procedures and the cause(s) of the failure. A third-party engineering review that analyzed the cause of the failure was completed by Acuren, and a review of Plains's leak detection and response procedures was also completed by Det Norske Veritas. As a result of the reviews and assessments, a number of requirements and recommendations (detailed later in this report) were made by the ERCB and accepted by Plains.

After the failure, several meetings were held between Plains and ERCB staff, and the ERCB made numerous requests to Plains for information to demonstrate that the pipeline could be

¹⁰ T.D. Williamson Inc. (TDW) Stopples® plugging machines serve as temporary block valves installed anywhere in a piping system. They are used to isolate a pipeline section for repair or addition without interruption of service. The Stopples® plugging machine consists of three major sections: a hydraulic cylinder or jackscrew, a plugging head housing, and a plugging head.

¹¹ Acuren Group Inc., May 19, 2011, *Examination of Rainbow Pipeline Failure* (Acuren Report) (DOC04).

safely returned to operation and operated within regulatory requirements. On May 13, 2011, Plains informed the ERCB that a small crack was found near a Type B weld-on sleeve while conducting an inspection approximately 25 km downstream from the MP 188 failure point. On May 17, 2011, the ERCB directed Plains to conduct two excavation programs (five sites per program) to inspect Type B weld-on sleeves and report the results to the ERCB. ERCB inspectors witnessed these excavations in June 2011. The inspection results showed that ten Type B weld-on sleeves had cracks, which were repaired when identified.

On June 3, 2011, the ERCB directed Plains to retain the services of a duly qualified consultant to conduct a comprehensive engineering assessment that would provide engineering evidence supporting whether or not the pipeline could be safely restarted. In response to that request, Plains engaged Det Norske Veritas (DNV). DNV submitted a final report to the ERCB on July 27, 2011 (DNV report). DNV recommended that all Type B weld-on sleeves be excavated and examined for cracks by the end of the year 2012.¹² The ERCB has reviewed and accepted the DNV report.

The ERCB maintained a daily presence at the site and at integrity dig¹³ locations along the pipeline corridor until August 2, 2011, at which time AENV took over as the lead agency to focus on cleanup and remediation. At that time, the ERCB redirected its on-site supervision and surveillance to focus on supervision of the integrity digs.¹⁴ By letters dated August 16 and August 26, 2011, the ERCB conditionally approved resumption of the pipeline. To ensure pipeline integrity and minimal risk to the public and environment, the ERCB imposed the following conditions in a letter to Plains dated August 16, 2011.

- Plains must implement weekly aerial pipeline monitoring of the pipeline with aircraft pilots who have been fully trained in the identification of potential geotechnical hazards. All pilots engaged by Plains must be fully trained prior to startup. Surveillance will continue until otherwise directed by the ERCB.
- Plains must ensure that all new procedures, roles and responsibilities, and lessons learned from the NPS 20 failure have been integrated into corporate procedural and operational documents and that all affected personnel have been trained in the new procedures.
- Plains Senior management must successfully communicate to all Plains staff that the organization will fully support a console operator's decision to shut down a pipeline.
- All five priority sites (Inspection Plan A) and the five additional sites (Inspection Plan B), excavated as per the ERCB's direction on May 17, 2011, must be completed to the stage of being ready for backfilling.
- Plains must implement the Community Consultation Plan submitted to the ERCB on May 12, 2011, and fulfill all commitments made by Plains in that plan to hold stakeholder meetings prior to restarting the pipeline. These meetings must include information on the work conducted to date, the cause of the failure and Plains's plans for reducing the likelihood of another failure and improving incident response should a failure occur.
- Subject to ERCB approval, the interim maximum operating pressure of the pipeline will

¹² DNV Report No. 1, page xv (DOC01).

¹³ Integrity digs refer to each specific site where pipe was exposed and inspected.

¹⁴ Refer to *Petroleum Industry Incident Support Plan*, December 2011, http://www.aema.alberta.ca/se_upstream_petroleum_incident_support_plan.cfm.

be limited to the maximum pressure experienced within 30 days prior to the failure. Plains must submit the pressure profile records used to determine this value to the ERCB prior to the resumption of pipeline operation.

- The ERCB requires a signed statement from Plains confirming that all of the above conditions have been met and proposing a date for pipeline start-up.

1.4 Recovery

In connection with its incident response and clean up efforts, Plains reported to have hired 26 contracting companies and 8 equipment suppliers. Up to 200 personnel were on site at various times throughout the initial response effort, with a peak personnel count of nearly 300 on May 6, 2011.

On May 3, 2011, after consultation with ERCB technical staff, the field inspection staff at the site authorized Plains to resume pipeline operations. This authorization was based on repairs completed by Plains to date and documentation indicating the failure was caused by an isolated event. However, on May 4, 2011, in consideration of additional information not available to field inspection staff, ERCB senior management rescinded this authorization because of concerns about inadequate evidence that the pipeline could safely resume operations. In order for Plains to restart the pipeline, the ERCB required Plains to meet certain conditions, which are summarized in the Regulatory Response section of this report.

On August 26, 2011, the ERCB granted approval to Plains to restart the pipeline. Plains resumed pipeline operations on August 30, 2011.

Plains has completed on-site cleanup operations and is now in the reclamation phase of the remediation process. Of the fluids released from the pipeline, 49 per cent were recovered in free fluids, with the remaining spill material recovered in oil-contaminated soils, vegetation, and other organic materials. Remediation operations included surface contouring of the failure site and, in spring 2012, initiation of a re-vegetation program using local seedlings and salvaged, noncontaminated vegetation and organic cover that were stockpiled for this purpose.

In spring 2012, Plains also initiated a surface and groundwater inspection and monitoring program to monitor the release footprint and identify any settlement, vegetation, or weed contamination issues.

1.5 Wildlife Impacts, Protection, and Monitoring

Plains initiated a wildlife protection and monitoring plan on May 3, 2011. The plan was reviewed and accepted by SRD and AENV on May 4, 2011. The plan included installation of a perimeter fence with amphibian meshing along the bottom. The fence was installed around the entire release footprint. Plains contracted Eco Web to conduct the wildlife protection and monitoring plan. Eco Web installed various wildlife deterrents on site, including eagle kites, scarecrow effigies, streamers, bird calls, and bear-scare cannons to keep bears and ungulates from entering the area. Eco Web ran a 24-hour operation to ensure that fencing was continually repaired and wildlife deterrents remained in good working order.

During cleanup operations, all personnel attending the site were directed by AENV and SRD to count and report all affected wildlife. As of July 6, 2011, the release affected 11 beavers, 4 bears, 28 ducks, 50 small birds (shoreline and songbirds), 3 mice, and 10 frogs. All found

or captured wildlife were handed over to Alberta Fish and Wildlife for evaluation. The wildlife mortality count as reported to the ERCB by Plains on November 1, 2012, was 11 beavers, 11 frogs, 79 birds, 6 mice, 1 vole, and 1 toad. The above count was for the deceased wildlife encountered during clean up activities. No determination of the cause of death was made for any of the wildlife.

1.6 Environmental Monitoring

1.6.1 Air Monitoring

Throughout the incident, Plains and Alberta Environment (AENV) conducted air monitoring which was under the direction and supervision of AENV.

As a result of odours identified, on Friday, April 29, 2011, the Lubicon Lake, First Nation Little Buffalo School, which is located approximately 12 km from the site, was voluntarily closed by the school administration as a precautionary measure. The school remained closed the following Monday as a result of further odour complaints. Plains deployed an air monitoring unit (AMU) to the school, which was operating by 11:00 a.m. on Monday, May 3, 2011. No hydrocarbon readings were recorded by the AMU at the school. On May 4, 2011, the AENV Mobile Air Monitoring Laboratory (MAML) was deployed and arrived at the school to measure for volatile hydrocarbons at and in the vicinity of the school. MAML data indicated that there was no evidence of risk resulting from airborne contaminants. Consequently, the unit was demobilized and removed from the area on or about May 14, 2011 (see Appendix B).

On April 30, 2011, Plains initiated an air monitoring program that used three AMUs owned and operated by Trojan Safety Ltd. The first AMU was located at MP 188, close to the failure site on April 30, 2011. The second AMU was positioned in the community of Little Buffalo (school) on May 3, 2011, in response to odour concerns. The third AMU was located in the community of Marten Lake (school) on May 8, 2011, at the request of the Woodland Cree First Nation.

The AMUs used to monitor air quality in connection with this incident were capable of monitoring hydrogen sulphide, total hydrocarbons, sulphur dioxide, and meteorology (wind speed, direction, temperature, etc.). The three AMUs were operational continually for the duration of the incident and while aggressive cleanup operations were in progress. All monitoring results were submitted to AENV on a daily basis. Results of AMU monitoring did not reveal any AAAQO exceedances (see Appendix C).

1.6.2 Water Monitoring

Water monitoring following the incident was under the direction and supervision of AENV.

To verify effective containment efforts, Plains initiated a water monitoring program that considered three sampling/testing criteria:

- 1) Surface water sampling and testing: Sampling locations were selected in areas representative of surface water flow characteristics. Eight sample locations were chosen. Sample analysis indicated that containment was secure and contaminated water was not migrating off-site.
- 2) Groundwater well installation, sampling, and testing: A total of 14 groundwater wells were installed at 3 depth intervals. At the time that failure site monitoring criteria were

released, no groundwater samples had been collected, as groundwater conditions had not reached hydrologic equilibrium due to seasonal run-off and inclement weather conditions. Visual monitoring of groundwater wells did not indicate any oil migration or contamination.

- 3) Sand-point (screen-point) samplers and testing: A total of seven sand-point samplers were installed at the organic surface/mineral soil layer interface in areas where contamination migration could pose a challenge. The test results did not suggest contamination migration.

1.6.3 Soil and Vegetation Monitoring and Waste Management

Soil and vegetation monitoring following the incident were under the direction and supervision of AENV and SRD. Activities related to temporary waste management and disposal were directed by the ERCB.

All affected vegetation and soils were collected and temporarily stockpiled on site. To permit temporary storage of waste resulting from the clean up efforts, the ERCB granted a temporary waste management approval to Plains to facilitate management of oil-impacted materials both on and off site. Where materials were stockpiled, Plains installed appropriate linings and prepared trenches to mitigate further contamination. Plains also constructed a temporary waste management facility on site to assist with washing settling tanks for oil skimming operations and decontaminating personnel and equipment.

At the time failure site monitoring criteria were released by AENV, workers were actively engaged in on-site cleanup operations. Because of this, AENV did not require Plains to implement a formal soils monitoring plan. A closure sampling plan will be submitted by Plains to the appropriate regulatory authorities once the main cleanup phase of the response has been completed. Plains reported that as of July 6, 2011, vegetation monitored outside the release footprint did not show signs of stress due to soil or water contamination.

1.7 Communications

For a number of reasons, the ERCB found Plains's communication regarding the incident to be substandard and deficient. Plains demonstrated a lack of commitment to consult with stakeholders beyond the initial notification that an incident had occurred. Prior to May 9, 2011, Plains did not provide any proactive communications updates to stakeholders beyond those requested or required by the ERCB. While there was a "website" with incident information, it was the US Plains All American site and was not sufficient or easily accessible for local stakeholders. Although the incident occurred on April 28, 2011, Plains did not submit a community consultation plan to the ERCB until May 10, 2011.¹⁵ Prior to the submission of the consultation plan, the ERCB directed Plains to proactively release information to affected parties. Unless requested or required by ERCB communications staff or complaints or concerns from affected stakeholders, Plains failed to provide any form of proactive, transparent, and timely information about the incident and its subsequent response efforts.

¹⁵ The ERCB approved the communication plan as submitted by Plains on May 12, 2011 (DOC05).

The Plains staff located at the site and in its Calgary office had difficulty understanding the communications requirements and responding appropriately. Plains did not engage or provide a public information officer or equivalent designated staff person responsible for stakeholder communications within the incident command structure, and this deficiency was evident in its substandard communications efforts.

To compensate for this significant deficiency, ERCB staff and the other Government of Alberta responders expended an inordinate level of effort, time, and resources to ensure that open, accurate, and transparent communications were established and maintained in the early days after the incident. In fact, prior to Plains's first proactive communication about the incident on May 9, 2011, the ERCB and Government of Alberta communications staff issued a number daily bulletins providing current information about the spill and the progress in clean-up and response activities. Plains did not proactively communicate with stakeholders, and ERCB staff had to prompt Plains on several occasions during the response to do so.

2 Pipeline Failure Root Cause Analysis

Cause analysis addresses what happened, how the event occurred, and why conditions leading up to the event existed. Root causes are defined as

- specific underlying causes that can be reasonably identified,
- those over which responsible parties (licensees) have control, and
- those for which effective mitigation measures can be established.

The ERCB considered two aspects of the Rainbow pipeline failure in its assessment of root causes:

- 1) the failure of the pipeline and
- 2) the large quantity of crude oil released as a result of the pipe failure.

2.1 Pipeline Failure Root Cause

The ERCB determined that Plains failed to fully assess the history of the pipeline, failed to

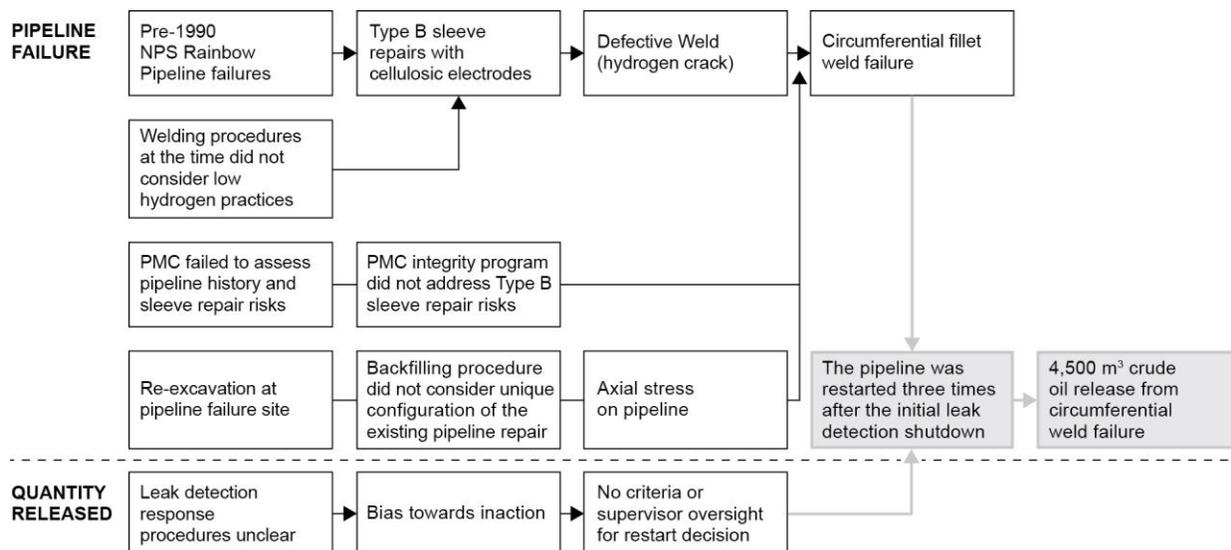


Figure 1. NPS 20 Rainbow Pipeline Failure Root Cause Analysis, 2011

identify the risks posed by the application of Type B sleeves used for corrosion repair (referring to the NEB notification of cracking associated with Type B repair sleeves), and did not have measures in place to monitor and inspect the repairs. Had diligent inspection measures been in place for the sleeve repairs, the condition of the repair could have been assessed when the section of pipeline was excavated one year prior to the failure with the possibility that the defective weld may have been identified and repaired at that time.

The ERCB determined that Plains failed to have adequate practices in place for backfill placement and compaction for excavated pipeline sections where Type B sleeve repairs were present and for unique soils conditions such as muskeg. The ERCB viewed that inadequate backfill and compaction likely contributed to stresses on the circumferential fillet weld that failed.

2.2 Large Spill Volume Root Cause

The ERCB concluded that the root causes of the operator error that resulted in the large release were:

- failure to have proper leak detection alarm response procedures in place,
- lack of operator training, and
- lack of supervisory oversight and involvement in decisions to restart the pipeline after a leak detection shutdown.

The ERCB determined that these factors are the result of failures of Plains's management to fulfill their responsibilities.

3 Investigation Findings

ERCB reviewed staff incident reports, incident reports filed by Plains, and detailed reports prepared at the direction of the ERCB by experts contracted by Plains. The following summarizes key findings regarding two aspects of the event: the pipeline failure and the large release of crude oil.

3.1 Observations on Pipeline Failure

3.1.1 Plains

The initial engineering assessment report from Plains found that the most likely cause of the failure was the combination of three factors:¹⁶

- 1) The presence of a stress riser¹⁷ in the form of an increase in relative pipe stiffness from the carrier pipe to carrier pipe with a full encirclement repair sleeve,
- 2) Differential settlement due possibly to inadequate compaction following the re-excavation of over 20 metres of pipeline straddling the location of the stress riser, and
- 3) Excessive stress on the bottom chord of the pipeline likely resulting from soil settlement.

¹⁶ Plains Midstream, May 8, 2011, *Approval To Re-Start NPS 20 Rainbow Pipeline*, Appendix A – Engineering Assessment (Engineering Assessment) (DOC06).

¹⁷ A stress riser is a location in an object where stress is concentrated.

3.1.2 Acuren

The Acuren report stated that the longitudinal stress responsible for the fracture was the result of an unsupported sag in the pipe at the failure location. Acuren indicated the sag in the pipe developed over the life of pipe or when the Type B sleeve was installed in 1980. Acuren had no information on how much pipe was exposed or what support was placed under the pipe during the Type B sleeve installation. The Acuren report stated that the same Type B sleeve had been previously exposed at this failure location for inspection in 1989/1990. (According to Acuren, all sleeves in this system were examined for toe cracks at this time.) Acuren had no information on how much pipe was inspected that may have contributed to the amount of sagging. The Acuren report stated that the failed section of pipe was exposed for the third time in 2010. Acuren indicated that about 7 m of pipe was uncovered. Acuren also stated that inadequate compaction of the soil under the pipe during backfilling could have contributed to the degree of the pipe sag and longitudinal stress.

The Acuren report further identified that the steel carrier pipe had a high carbon equivalent of 0.53 per cent and that increasing the hardenability of the steel could make it susceptible to cracking.¹⁸ At the time of pipe manufacturing, CSA standard API 5LX did not require a carbon equivalent to be specified. Over time, CSA standard Z245.1 has lowered the maximum carbon equivalent to 0.40 per cent.

3.1.3 Det Norske Veritas

Analysis carried out for Plains found that the pipeline failure was the result of high axial-aligned stress¹⁹ that caused an existing crack in the circumferential fillet weld to fail. Det Norske Veritas (DNV) reported that they could not conclusively locate the source of the high axial-aligned stress and that the stress could not have been caused solely by internal pressure or lack of support due to inadequate backfill compaction following excavation of this section of the pipeline in April 2010.²⁰ While the DNV report could not determine the source of the axial stresses that caused the failure, Plains noted the following on excavating the failed section of pipeline:

“Subsequent to the above-referenced failure the ruptured pipe was exposed by way of excavation and upon removal of the overburden the elevation of the pipe at the failure location sprung upward to the now unrestrained position.”²¹

The DNV report also stated that the welding procedure involved cellulosic electrodes. Cellulosic electrodes generate large volumes of hydrogen in comparison to other electrodes. These electrodes were used in the past to weld Type B repair sleeves to the carrier pipe. The DNV report stated that this procedure produced hardened microstructure susceptible to hydrogen cracking. It was DNV’s opinion that the pre-existing crack was a hydrogen-assisted crack that can occur after a pipe cools, the result of hydrogen trapped in the weld pool. DNV concluded that the hydrogen crack formed after the circumferential fillet weld cooled.²²

¹⁸ Acuren Report, page 41 (DOC04).

¹⁹ DNV Report No. 1, pages 103–105 (DOC01).

²⁰ DNV Report No. 1, page 80 (DOC01).

²¹ Engineering Assessment (DOC06).

²² DNV Report No. 1, page 34 (DOC01).

In April 2010, Plains exposed the section of the pipe that included the previously installed Type B sleeve repair for the purposes of inspecting for corrosion. This was the third time this segment of pipe had been excavated. Although once again the excavation exposed the type B sleeve repair, Plains did not inspect it.²³

3.1.4 ERCB Findings

Plains advised the ERCB that both the sleeve installation and the 1990 repair sleeve re-inspection occurred prior to its acquisition of the pipeline in 2008 (see section 1.1). However, Plains was not able to produce these installation and inspection records from its files.²⁴ As such, the ERCB was unable to verify or confirm Plains's assertion that the repair sleeves were inspected in 1990. Further, Plains was unable to provide evidence that it reviewed information on the sleeve repairs or included sleeve repair risk mitigation and monitoring in its integrity program.

The ERCB concluded that Plains failed to obtain or review pipeline records and evaluate integrity risks when it acquired the pipeline in 2008, at least with respect to historical repairs on the pipeline.²⁵ Had it assessed the records with respect to the sleeve repairs, the ERCB believes Plains could have identified and properly mitigated the risks associated with Type B sleeve fillet repair welds.²⁶

The CSA Z183 oil pipeline standards at the time the repairs were made allowed the use of both low-hydrogen and controlled-cooling practices for circumferential fillet welds. They also noted that special procedures may be necessary for northern areas and that it is advisable, when welding on large diameter pipelines, to stop the liquid flow to obtain an acceptable weld.²⁷

In addition, the ERCB is of the view that in light of the NEB report on Type B sleeve fillet weld failures, Plains ought to have known that there were risks associated such types of welds. Even if Plains did not have any records in relation to the historical repairs of the pipeline, it ought to have taken appropriate care to determine if there was a potential for such risks as part of an integrity management program for the older pipeline. This should have resulted in identification of the risks and created the opportunity for Plains to be proactive in inspecting the repair sleeve welds any time Plains excavated the pipe.

The ERCB concluded that, while Plains incorporated industry standard backfilling measures into its integrity program, Plains failed to address backfill compaction and other factors when complex soil conditions are encountered.²⁸ Based on the evidence, the ERCB concludes that a lack of compaction during the 2010 excavation could have been a key contributing factor in stresses that gave rise to the failure.

²³ DNV Report No. 1, pages 98, 99, and 103 (DOC01).

²⁴ Plains Midstream Canada, February 24, 2012, *Response to ERCB February 11, 2012, Information Request* (DOC07).

²⁵ Ibid.

²⁶ EUB Bulletin 2006-27, July 20, 2006, *Directive 041: Adoption of CSA Z662-03, Annex N, as Mandatory*.

²⁷ CSA Z183-1977, Clause 9.16, Oil Pipeline Transportation Systems; CSA Z183-M82, Clause 9.16., Oil Pipeline Systems; and CSA Z183-M86, Clause 10.16.2.2, Oil Pipeline Systems.

²⁸ DNV Report No. 1, page 60 (DOC01).

3.2 Observations on the Release Volume Resulting from the Pipeline Failure

The Rainbow pipeline failure resulted in the release of 4450 m³ (28 000 barrels) of crude oil. This volume represents between six and nine hours of continuous pumping, similar rates to those observed on the system prior to the event.²⁹

3.2.1 Plains

Plains reported that abnormal operating conditions began at 6:32 p.m. (SCADA) on April 28, 2011.³⁰ Plains reported five leak detection alarms between 6:35 p.m. (SCADA) and the first pipeline shutdown at 7:22 p.m. (SCADA) on April 28, 2011. From about 7:22 p.m. (SCADA), the pipeline was shut down and restarted three times before final shutdown at 2:50 a.m. (SCADA) April 29, 2011.³¹ The times indicated in Plains's incident description coincided with the times identified by Plains pressure and leak monitoring system data.³²

Plains reported that its SCADA system worked as designed; however, the pipeline was restarted three times throughout the incident before being completely shut down.³³ Plains attributed this to operator error.³⁴

3.2.2 DNV

At the ERCB's request, DNV conducted an independent evaluation of Plains's leak detection and response procedures. DNV's evaluation findings include the following:³⁵

- Procedures were not updated consistent with Plains's organizational structure. This suggests Plains's management failed to ensure that critical procedures relating to pipeline leak and failure detection and response were current, appropriate, and reviewed on a regular basis.
- Plains's alarm response protocol lacked clarity around
 - the importance of leak detection,
 - using available information to evaluate potential leak situations,
 - required actions to respond to warnings or alarms,
 - decision criteria to restart the pipeline following a shutdown
 - monitoring instructions following pipeline restart,
 - leak diagnosis and response with a "potential bias towards inaction" (procedures in place at the time of the event only initiated leak diagnosis response one hour after a potential imbalance was initially detected),³⁶ and

²⁹ Plains Response, Appendix 17 (DOC03).

³⁰ Plains Response, page 3 (DOC03).

³¹ Plains Response, Appendix 4 (DOC03).

³² Plains Response, Appendices 4, 8, 9, 10, 11, 12,13, 14,15, 16, and 17 (DOC03).

³³ Plains Response, page 3 (DOC03).

³⁴ Ibid.

³⁵ Det Norske Veritas, November 2011, *Bow Tie Analysis and Point-by-Point Comparison of Old and New Rainbow NPS 20 Pipeline Leak Detection and Alarm Response Procedures* (DNV Report No. 2) (DOC08).

³⁶ DNV Report No. 2, Table 1, page 14 (DOC08).

- roles and responsibilities, including no documented procedures outlining supervisory approval to shut down and restart the pipeline.

3.2.3 ERCB Findings

The ERCB has concluded that the volume of the release was much greater than it should have been under the circumstances. The actions of Plains's control centre staff appear to have contributed to a much larger release than may have otherwise been the case.

Specifically, the ERCB has concluded that Plains's failure to completely shut down the pipeline at the time of the initial indication of a potential leak, its subsequent failure to properly investigate the cause of the alarm, and its subsequent repeated restart of pumping resulted in a much larger crude oil release than if proper response actions had been taken at the first indication of a potential pipeline failure. However, it bears noting that when the ERCB attempted to interview the Plains employee who was in charge of the control centre at the time of the incident, Plains told the ERCB that the employee was no longer employed by them. As such, ERCB staff were unable to interview the control centre operator in connection with the incident. This significantly hindered the ERCB's ability to obtain a first-hand and direct account of the specific sequence of events, the standard processes and procedures, and potential deficiencies in the control centre operator's response to the alarms. As a result, the ERCB was forced to rely on documented reports, logs, and evidence.

The ERCB has concluded that failure of Plains's management to have and maintain proper alarm response and leak and failure detection and response procedures, lack of operator training, and lack of supervisory oversight were all critical factors that contributed to the operator errors that resulted in continued pipeline operation and releases of crude oil after information was available that should have resulted in a pipeline shutdown. Overall, the actions of Plains appeared to demonstrate a practice of placing higher priority on continued operation of the pipeline over any potential impacts related to a pipeline leak.

4 Other Investigation Findings

Following incident notification, communication challenges arose between ERCB and Plains personnel and between Plains and its stakeholders. Due to the remote nature of the failure site and the deficiencies in Plains's communications procedures as outlined in section 1.7, accurate and timely reports from Plains's on-site and Calgary-based personnel were difficult to obtain. As result, significant ERCB and Government of Alberta resources were expended to ensure the accurate, timely release of information in the days following the incident.

Overall, Plains appeared to have a total lack of appreciation of the affects a spill of this magnitude has beyond its own on-site operational response. Plains's pattern of having to be continually prodded and pushed into proactively sharing information with stakeholders was both concerning and disappointing to the ERCB. Given Plains has significant experience and expertise operating pipelines in both Canada and the United States, the ERCB found its communications preparedness and response to be unacceptable and substandard.

4.1 Noncompliance with ERCB Requirements

4.1.1 Directive 066: Requirements and Procedures for Pipelines, Pipeline Regulations, and CSA Z662 – 07 Oil and Gas Pipeline Systems

In light of the ERCB's findings, the ERCB has determined that Plains failed to comply with a number of regulatory requirements in relation to the incident. Accordingly, three high risk enforcement actions (HREA) were issued against Plains on February 26, 2013, in accordance with *Directive 019: Compliance Assurance*.

4.1.1.1 HREA for Inadequate Backfill and Compaction Procedures

The reports completed subsequent to the incident contain information that indicate that increased axial/longitudinal stresses exerted at the failed pipeline section, as a result of insufficient pipeline support, was a contributing factor leading to the pipeline failure.

The ERCB noted the following excerpts contained in the Acuren and DNV reports and Plains's engineering assessment:

- "Differential settlement due possibly to inadequate compaction...",³⁷
- "...lack of support due to inadequate backfill compaction of the backfill...",³⁸
- "The longitudinal stress responsible for the fracture would have been the result of an unsupported sag in the pipe at the location of failure,"³⁹ and
- "...upon removal of the overburden the elevation of the pipe at the failure location sprung upward to the now unrestrained position."⁴⁰

The ERCB noted that Plains had also previously excavated and exposed this same section of pipe in 2010 to investigate pipeline corrosion.

Further, the DNV report identified that backfill procedures only met standard industry practices for flat ground away from watercourses and that there was no evidence of use of compaction practices and procedures for more complex soil conditions.⁴¹

Based upon this information and the ERCB's own findings, the ERCB has concluded that backfill and compaction procedures following the excavation in 2010 were not completed in such a manner as to prevent excessive subsidence or erosion of the backfill and support material, and Plains had contravened the following:

- section 9(2) of the *Pipeline Regulations*,
- clause 6.2.7.4 of Canadian Standards Association (CSA) Z662 *Oil and Gas Pipeline Systems* (CSA Z662), and

³⁷ Engineering Assessment, page 3 (DOC06).

³⁸ DNV Report No. 1, page 80 (DOC01).

³⁹ Acuren Report, page 41 (DOC04).

⁴⁰ Engineering Assessment, page 2 (DOC06).

⁴¹ DNV Report No.1, Section 9.3, Sub-task 1: Summary, page 60 (DOC01).

- *Directive 066: Requirements and Procedures for Pipelines (Directive 066)*, Appendix 1, Operational Deficiencies, Construction, Section 25, “Backfill procedures are unsatisfactory.”

In its letters dated August 16 and 29, 2011, the ERCB required Plains to revise its backfill and compaction procedures. Plains subsequently made the revisions as required by the ERCB, and the ERCB accepted Plains’s revised backfilling procedure entitled “Pipeline Integrity Dig Backfill Procedure” in a letter e-mailed September 9, 2011.

In reference to the above exchange of correspondence, via e-mail to the ERCB dated August 26, 2011, Plains stated that once the ERCB accepts its enhanced backfilling procedures, Plains will “...turn it into a Standard Operating Procedure/Practice (SOP) and it will be referenced in Plains’s Ground Disturbance Procedure and Excavation and Trenching SOP.”

No further consequences are being applied by the ERCB with respect to the HREA associated with this incident’s noncompliant event; however, the ERCB has directed Plains to confirm and demonstrate to the ERCB within 30 days of the issuance of the enforcement action letter, that the enhanced backfill procedure is incorporated into a SOP and is further referenced in the Ground Disturbance Procedure and Excavation and Trenching SOP.

4.1.1.2 HREA for Inadequate Operations and Maintenance Procedures

Engineering assessments conducted by DNV and Acuren indicate that the section of pipe at which the failure occurred was excavated in or around 1980 for the original installation of a Type B sleeve repair. This same section of pipe was re-excavated for inspection in or around 1990. The DNV report further indicated that the 1990 inspection was assumed to have been conducted in response to requirements enacted by the National Energy Board (NEB)⁴² in response to a pipeline failure under the NEB’s jurisdiction that involved a Type B sleeve fillet weld.⁴³

Although the pipeline was not under NEB jurisdiction, DNV assumed the previous operator of the pipeline complied with this requirement and excavated and inspected the sleeves. DNV also noted that Plains did not have the results of those inspections.⁴⁴

Plains acquired the pipeline in 2008. In subsequent investigations for pipe corrosion in 2010, Plains re-excavated the pipeline section at the incident location. Notwithstanding it exposed the pipeline section for the purposes of inspecting for corrosion, Plains did not inspect the Type B sleeve repair at that time despite historical information being available in relation to the potential risks associated with Type B sleeve fillet welds.

The ERCB’s review of Plains’s asset integrity management plan indicated it did not include relevant information identifying risks associated with Type B sleeve fillet welds. Given that Plains ought to have known of these risks, this further demonstrates to the ERCB that Plains lacked a risk assessment procedure that comprehensively anticipates, identifies, and then subsequently responds to potential pipeline risks, reflecting a failure in its pipeline integrity management system.

⁴² NEB Report (DOC02).

⁴³ DNV Report No. 1, page 16 (DOC01).

⁴⁴ DNV Report No. 1, Section 4.7.1, page 33 (DOC01).

As a result, Plains was found to be in contravention of the following:

- sections 1.2(1) and 9(2) of the *Pipeline Regulations*,
- clauses 10.14.1, and N.10.1 of *CSA Z662*,
- section A-5.2(1) of *Directive 077: Pipelines – Requirements and Reference Tools (Directive 077)*, and
- *Directive 066*, Appendix 1, Operational Deficiencies, Operations Review, s.48(b), “No operations and maintenance procedures manual, or not followed.”

The ERCB has determined that Plains lacked or did not follow a risk assessment procedure designed to fully anticipate, identify, and respond to potential pipeline risks. Further, Plains did not appear to have used and included historical pipeline information in any risk assessment procedure.

The ERCB directed Plains to develop and implement, within 60 days of issuance of the enforcement action letter, a risk assessment procedure that is capable of identifying and considering all pertinent information (both present and historical) about the risks associated with operating pipelines of this type. Plains is to also demonstrate to the ERCB’s satisfaction that its risk assessment procedures can proactively and comprehensively anticipate, identify and adequately respond to real and potential risks to pipeline integrity, and must also provide evidence that its pipeline integrity risk assessment procedure has been communicated to all applicable staff and is incorporated into, and forms an integral component of its Asset Integrity Management Plan.

4.1.1.3 HREA for Inadequate Leak Detection and Response

Engineering assessments conducted by DNV identified a number of deficiencies associated with Plains’s leak detection and alarm response procedures, in relation to which DNV made a number of near- and long-term recommendations for improvement.⁴⁵ Most notable were Plains’s failure to completely shut down the pipeline at the time of the initial leak indication, its failure to properly investigate the cause of the alarm, and its subsequent repeated restart of pumping before investigating and ascertaining the cause of the initial alarm. As per DNV recommendations, Plains has subsequently implemented enhancements to both leak detection and pipeline restart procedures.⁴⁶

Based on the above, the ERCB determined that the Plains’s leak detection and response procedures at the time of the incident were deficient. Further, the ERCB found that the inadequate leak detection and response procedures, and the actions of Plains’s staff in responding to the incident, directly contributed to the large volume of crude oil released as a result of the incident.

⁴⁵ DNV Report No. 1, Task 7, Section 10.6, Conclusions and Recommendations, page 73 (DOC01).

⁴⁶ DNV Report No. 2, Executive Summary, page iii (DOC08).

Subsequently, the ERCB found that Plains was in contravention of the following:

- sections 9(2) and 9(4) of the *Pipeline Regulations*,
- clauses 10.2.2, 10.3.6.5, E.5 of *CSA Z662*, and
- *Directive 066*, Appendix 1, Operational Deficiencies, Operations Review, s.57, “Leak detection unsatisfactory.”

The ERCB concurred with DNV’s findings with respect to the deficiencies identified in Plains’s leak detection and alarm response procedures in relation to the incident. However, the ERCB also acknowledged the subsequent improvements made by Plains to its leak detection and pipeline restart procedures as identified by DNV. For this reason, the ERCB did not issue any further consequences with respect to this noncompliant event.

4.1.2 Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry (Directive 071)

Also, as part of the ERCB’s incident investigation, ERCB Emergency Planning and Assessment Section (EPA) staff conducted an audit of Plains’s Western District emergency response plan (ERP) in December 2011. The audit results determined that Plains had failed to meet the requirements of *Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry (Directive 071)*.

Enforcement action in accordance with *Directive 019* was issued to Plains on February 27, 2012.

The noncompliance events that were identified and the required actions to achieve compliance in accordance with *Directive 019* are outlined below.

4.1.2.1 High Risk Noncompliance Events

Failure to test the sour operation, high vapour pressure (HVP) pipeline, or cavern storage facility ERP through tabletop and major exercises.

Pursuant to section 14.10 of *Directive 071*, the licensee must test its ERPs through the following types of planned exercises to promote emergency response preparedness:

- tabletop or communications exercise, held annually for each area ERP, except in a year when a major exercise is held, and
- major exercise, held once every three years for each area ERP.

In its letter dated February 10, 2012, the ERCB requested Plains to provide a copy of the post-exercise report for the latest major exercise held where the core portion of the Western District ERP was tested. Plains did not submit the required information, stating that the Rainbow Pipeline incident that occurred in 2011 will be credited as completion of a major exercise. The ERCB does not accept response to incidents as a fulfillment of the requirements in section 14.10

The ERCB directs Plains to conduct a major ERP exercise by March 31, 2013, to demonstrate its capacity to address the findings identified in section 4.1.2

4.1.2.2 Low Risk Noncompliance Events

In its letter to Plains dated February 27, 2012, the ERCB cited Plains with a low risk noncompliance on the following basis.

- 1) Failure to have a process for recording the information for the activities in section 14.11 of *Directive 071*.

Pursuant to section 14.11 of *Directive 071*, the licensee must have a process for recording the following:

- Incident Records: Information gathered during and following an incident provide documentation to be used for assessment and analytical purposes.
- Training, Meetings, and Exercise Records: Within 60 days of an exercise, a report of the results must be kept, which includes:
 - type of exercise held,
 - scope and objectives,
 - persons involved,
 - outcome (i.e., whether objectives were achieved),
 - lessons learned, and
 - an action plan, including timelines.

Although Plains stated that the post-incident debriefing is pending the ERCB incident investigation, Plains failed to submit documentation showing that a post-incident debriefing was conducted following the pipeline failure in April 2011.

As per ERCB requirements a tabletop exercise is required annually. The tabletop post exercise reports submitted to the ERCB did not include sufficient detail to comply with the requirements of section 14.11 of *Directive 071*; outcomes of the exercise, lessons learned, and action plans were not reflected in the report.

- 2) Failure to include information specified in section 2.1 in the corporate-level ERP.

Pursuant to section 2.1 of *Directive 071*, the licensee's ERP must at least include a communications plan that addresses communication with the response team, support services, and government.

The core portion of the Western District ERP does not include a communication plan, specifically communication procedures and a list of service providers hired to assist with managing the incident.

The Appendix 6 "REVISION HISTORY" page of Plains's January 16, 2012, response contains no indication that the Western District ERP was updated to include this communication plan.

On April 18, 2012, the EPA group accepted the Plains action plan to prevent similar noncompliance in the future and issued an audit completion letter to Plains. Included in the audit completion letter is acknowledgement that Plains did submit sufficient information to demonstrate that their tabletop exercise reports comply with requirements of *Directive 071*.

5 Additional ERCB-Directed Actions

- 1) The ERCB directs Plains to engage a third party to conduct a communications audit that focuses on the company's ability to manage communications during a crisis or incident.

The communications audit must assess:

- crisis and incident response communications plans (including research, analysis, and evaluation and reporting),
- individual roles and responsibilities,
- media relations policies and procedures and resources, and
- executive responsibility to communicate effectively with all affected stakeholders.

Results of the communications audit, with Plains's action plan to implement any recommendations for improvement, are to be provided to the ERCB no later than April 30, 2013. The ERCB may direct Plains to take additional action with respect to Plains's communications policies and procedures upon final review of the audit.

6 ERCB Follow-up

The ERCB Communications Group will follow up with Plains on directed action item no. 1 in section 5 above to ensure that these directed actions have been addressed within the time frame specified.

On the basis of consulting engineering advice, Plains has committed to excavating all welded pipeline sleeves and inspecting them for cracks, with repairs conducted as necessary, by December 31, 2012.⁴⁷ Plains must submit evidence to the ERCB confirming that all sleeve inspections and repairs have been completed no later than March 15, 2013.

By letter dated August 16, 2011, the ERCB directed Plains to conduct weekly aerial monitoring of the pipeline. Plains has been monitoring and will continue to monitor all remaining Type B sleeves on the pipeline during its weekly aerial patrols to identify potential geotechnical hazards until otherwise directed by the ERCB.

The ERCB will follow up with Plains to ensure that all directed actions specified in section 4.1.1 in this report have been addressed within the time frame specified.

The ERCB will also increase the audits and inspections of Plains's pipeline operations to ensure ongoing compliance with ERCB requirements, and may perform further reviews and evaluations of Plains's safety and loss management systems.

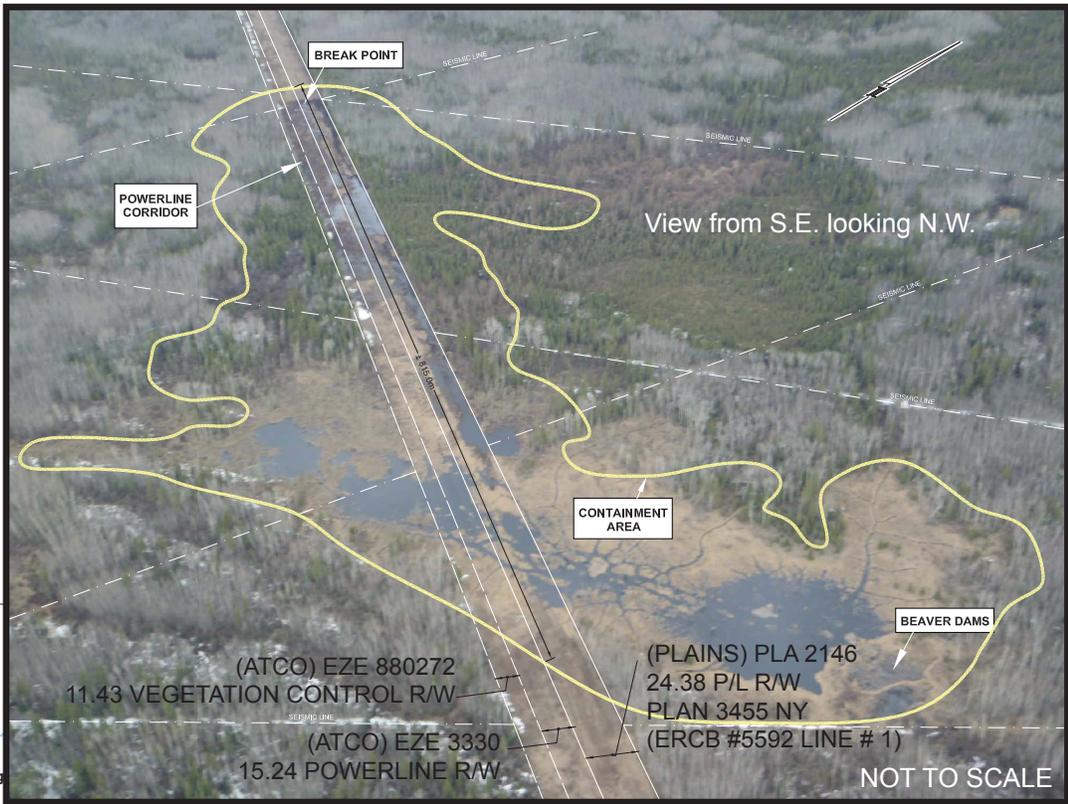
As noted in section 4.1.2.1, Plains must conduct a major ERP exercise under *Directive 071*. This exercise will be witnessed and evaluated by ERCB staff to ensure Plains addresses the emergency response-related noncompliance findings as identified to the ERCB's satisfaction.

⁴⁷ DNV Report No. 1, page 82 (DOC01).

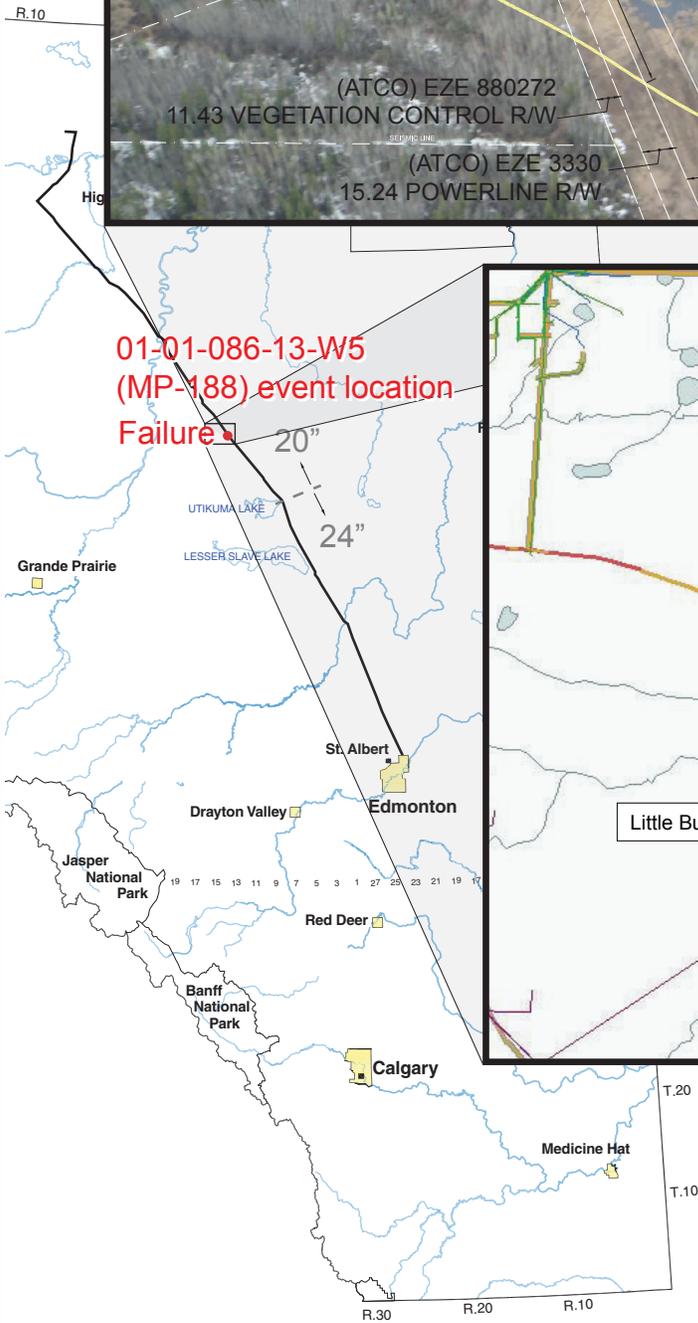
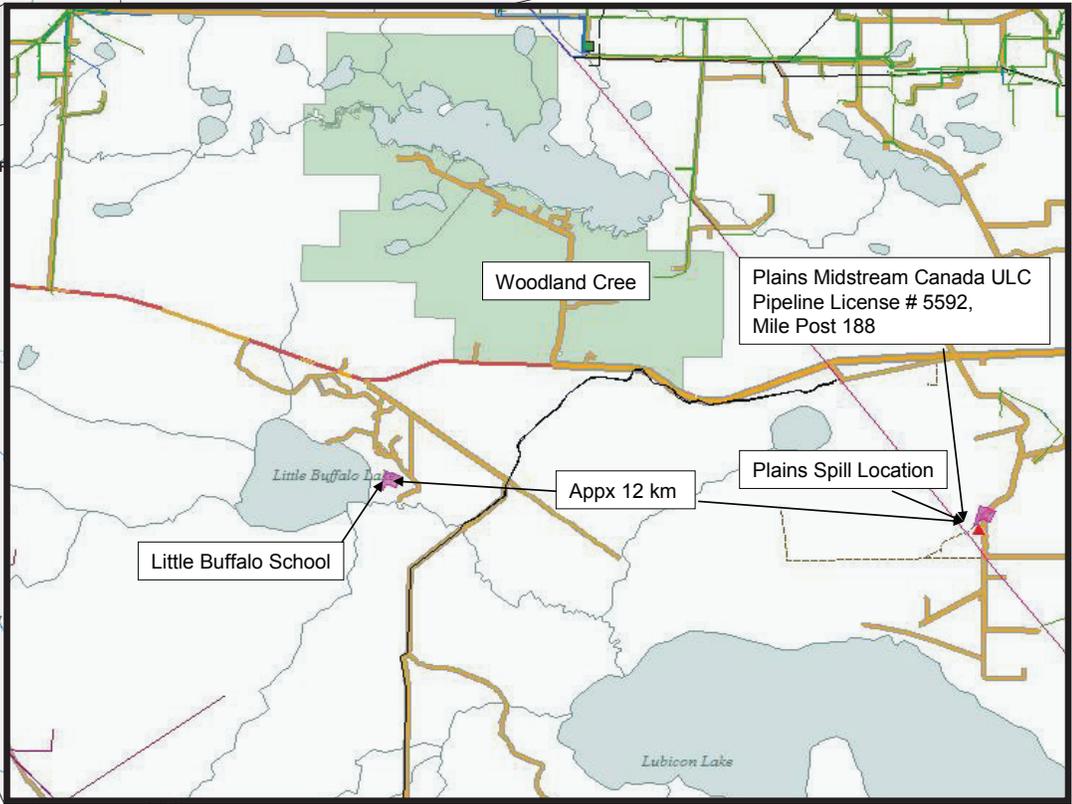
The ERCB will continue to meet with Plains until the ERCB is satisfied that Plains has met its compliance commitments and operating procedure improvements, and the ongoing integrity of the pipeline is verified and maintained.

On February 26, 2013, the ERCB issued Bulletin 2013-08 to address the issue of cellulosic welding consumables and hydrogen-induced cracking on fillet welds, branch connection welds, and direct deposition welds.

Appendix A: Plains Incident Map



01-01-086-13-W5
(MP-188) event location
Failure



Plains Incident Map

Photo provided by Plains Midstream Canada ULC.

Appendix B: Government of Alberta Information Bulletin – May 5, 2011

Building a better Alberta



May 5, 2011

Cleanup ongoing of pipeline leak northeast of Peace River

Edmonton... The Alberta government continues to work with Energy Resources Conservation Board (ERCB), Plains Midstream Canada, and other appropriate agencies during cleanup efforts following a crude oil pipeline leak about 100 km northeast of Peace River on April 29.

The following highlights the activities underway as of May 5.

Spill overview

- The release is contained
- 28,000 barrels of light sweet crude oil has been spilled
- Oil is contained in pipeline right of way and is 300 metres from the nearest flowing water
- Air quality monitoring has detected no hydrocarbon levels above Alberta's ambient air quality standards
- The company has implemented a wildlife protection plan
- The pipeline has been excavated and examined by company and regulatory officials
- The company has completed repairs and has applied to reopen the line. No approval will be granted until the ERCB is assured the line is safe.

Spill containment/clean-up

- Alberta Environment and Energy Resources Conservation Board worked with the company and contractor to develop an action plan for clean up and remediation of the impacted area. Clean up activities began shortly after the spill was noticed and remediation activities are ongoing.
- Approximately 300 response personnel are on the scene working on containment, oil recovery, line repair and site remediation.
- Skimmers are collecting oil from open water in the pond. Soil cleanup preparations are underway. There has been no migration of oil from the effected area, which is fenced off.
- Clean up crews are currently recovering 15m³ per hour from the pond during daylight hours, and slightly less at night due to the product becoming thicker with lower temperatures. Additional skimmers are expected soon.
- Contaminated soil is being removed and being taken to an approved waste disposal facility.
- To date, 551 m³ of product has been removed from the site (of the original 4,500 m³ estimated to have spilled).
- Water samples have been taken from the beaver pond and downstream to determine the water quality. To date no evidence of migration has occurred.
- Alberta Environment will continue to work with the Energy Resources Conservation Board and Plains Midstream Canada to ensure the clean up is conducted as quickly as possible.

Response to air quality/ health concerns raised by local residents:

- Two air monitoring stations have been set up: one at the site of the incident and one at the school. Both stations have been monitoring air emissions since May 3.
- May 4th, Alberta Health Services sent an Environmental Health Officer to the community to conduct monitoring.
- AHS has reviewed all air monitoring data conducted for this area thus far - including ambient air quality and indoor air quality at the school - and all results are well below the maximum acceptable concentration guidelines set by Health Canada.
- The Mobile Air Monitoring Lab has been deployed by Alberta Environment and is on site to measure for Volatile Organic Compounds around the school.
- Based on the current data, there is no evidence that the air quality poses risk of long term health impact, at this time.
- Alberta Environment, ERCB and AHS will continue to review the air monitoring data. AHS will advise on all health-related aspects of the oil spill response, and exposure to related air quality concerns over time.

Results of the monitoring in school:

- The air quality parameters tested in the school were carbon monoxide and carbon dioxide.
- The highest carbon monoxide level detected in the inside the school was found to be 0.2 parts per million. Acceptable short-term exposure ranges (ASTER) for carbon monoxide in residential indoor air are 11 parts per million or less, based on an eight-hour average concentration.(Health Canada's Exposure Guidelines for Residential Indoor Air Quality).
- Carbon dioxide levels inside the school were in the range of 400 – 550 parts per million. The acceptable long-term exposure range (ASTER) for carbon dioxide in residential indoor air is 3500 parts per million or less.(Health Canada's Exposure Guidelines for Residential Indoor Air Quality).
- The findings demonstrate that the carbon monoxide and carbon dioxide levels inside the school are well below the acceptable indoor air quality guidelines for these parameters.

Results of the monitoring at spill site:

- An ambient air quality monitoring station located at the site of the Plains-Midstream oil spill, detected benzene at a concentration of 1.0 part per billion. This is the only site where benzene was detected.
- Acceptable concentrations of benzene in ambient air, as outlined in the Alberta Ambient Air Quality Objectives and Guidelines (December 2010) is 30 parts per billion, based on a 1-hour average.
- This result shows that the concentration of benzene detected in the ambient air near the oil spill site was significantly lower than acceptable levels.

Where residents can go for more information:

- Residents experiencing symptoms can call HealthLink (1-866-408-5465) to discuss concerns, and receive advice on personal protection measures/symptom management.

Information on Little Buffalo school closure:

- Alberta Education continues to work with Northland School Division and other provincial ministries including Health and Wellness and Environment to ensure the health of the students.
- We will also work with Northland to see that students return to school as quickly as possible. In the meantime, alternative arrangements will be made for Little Buffalo students to continue their education
- For more information, residents can contact Donna Barrett, Superintendent of Schools, Northland School Division. Donna.Barrett@northland61.ab.ca Office: (780) 624-2060 Toll Free: 1-800-362-1360

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Appendix C: Government of Alberta Information Bulletin – May 7, 2011

May 7, 2011

Cleanup ongoing of pipeline leak northeast of Peace River

Edmonton... The Alberta government continues to work with Energy Resources Conservation Board (ERCB), Plains Midstream Canada, and other appropriate agencies during cleanup efforts following a crude oil pipeline leak about 100 km northeast of Peace River on April 29.

The following highlights the activities underway as of May 7. Please note, this will be the final daily update, unless the situation changes.

Current status

- The spill is contained.
- Government has been working with the company and its environmental specialists to generate an appropriate clean-up and remediation plan. That plan is now being implemented.
- Significant work is occurring, 24-hours a day. There are currently more than 300 people working to clean up the site.

Product recovered

- To date, 1076 m³ of product (6671 barrels, or 24 per cent) has been recovered, of the original 4,500 m³ (or 28,000 barrels) estimated to have spilled.
- Oil on the ground is being recovered using vacuum trucks. Twelve skimmers are now deployed on the main pond area – additional skimmers will arrive on site next week.
- Work continues on removal and collection of impacted woody debris from around the beaver pond.
- Contaminated soil is being removed and transported to an approved waste disposal facility.

Air

- Continuous sampling onsite is being conducted by Alberta Environment's Mobile Air Monitoring Laboratory and has not identified any Ambient Air Quality Objective exceedances.
- Canister sampling is currently underway to test for volatile organic compounds both at the spill site and the school.
- Monitoring will continue to operate over the weekend; additional air monitoring will be conducted inside Little Buffalo school on May 9.
- The two stationary air monitoring stations (one at the spill site and one at the school) will continue over the next several weeks to ensure air quality guidelines are not exceeded. An assessment will be completed to see if additional stations should be deployed.
- Alberta Environment, ERCB and Alberta Health Services will continue to review the air monitoring data.

Water

- Samples have been taken from the beaver pond and downstream to determine the water quality and potential impacts. Water samples are being taken downstream of the incident to ensure no offsite impact to water bodies.

- Results from May 2 sampling indicate there are some exceedances of hydrocarbons downstream from the wetlands, as expected during an event of this nature.
- Water sampling will continue including adding monitoring for polycyclic aromatic hydrocarbons, metals and potentially other contaminants of concern.

Pipeline

- ERCB continues to monitor operations on site. While the investigation is currently underway, initial examination does not indicate a systemic pipeline issue in this instance.
- The ERCB has received a request from Plains Midstream Canada to resume operations following the successful repair of the pipeline. The ERCB is reviewing the request from a public safety and technical perspective and will grant approval when it is satisfied the pipeline can operate safely.
- ERCB staff are checking historical data to find more information on the largest crude oil spills in Alberta history. Early reports which placed a Bow River Pipeline release as having leaked 6,500 m³ in 1975 were inaccurate; the company was incorrectly identified in an information data search by ERCB staff which proved to be inaccurately generated in the days after the incident.
- The ERCB is regenerating a search of computer and paper records through its 70-year history to place the Plains Midstream leak of April 29 in the correct historical context and will set the record straight as soon as the information is complete, verified and confirmed.

Site visit

Alberta Environment Minister Rob Renner, Solicitor General and Public Security Minister and MLA for Peace River Frank Oberle, and Pearl Calahasen, MLA Lesser Slave Lake, today toured the site of the spill by air and ground to get a first-hand look at clean-up efforts. The group was briefed about the pipeline failure, and examined the newly repaired pipeline on site.

Photos and footage of the site tour, as well as audio and video of Minister Renner's comments following his visit are available online at XXXXinsert link

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