

INVESTIGATION BY THE DAVID SUZUKI FOUNDATION INTO ISSUES OF POTENTIAL ENVIRONMENTAL CONCERN RELATED TO OIL AND GAS DEVELOPMENT IN THE MONTNEY SHALE PLAY IN NORTHEASTERN BRITISH COLUMBIA, AUGUST 14 - 28, 2015

Prepared by John Werring
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EXECUTIVE SUMMARY

In late August 2015 the David Suzuki Foundation undertook a field investigation in the Montney basin in northeastern BC to look for potential environmental impacts related to oil and gas exploration and development in the region. This report is a summary of our discoveries.

There were three key findings:

1. In relation to a previously reported incident where Foundation field staff found hydrocarbons that may have been related to oil and gas activities leaking into a creek (Alexander Creek) near Wonowon BC in 2014, and reported those concerns to the BC Oil and Gas Commission (BCOGC), evidence gathered during this 2015 field trip suggested that this matter has not been adequately resolved despite the fact that the BCOGC had issued an order to a permittee to conduct a detailed site investigation and undertake remedial measures to delineate and correct the problem. Further, efforts made by the Foundation to obtain information from the Commission related to the ordered investigation, its findings and any proposed remedial works were rebuffed;
2. It would appear that many inactive well and processing facility (like gas plants and compressor stations) sites in the region are not being restored in accordance the BCOGC's Certificate of Restoration Process. The CoR process is designed to ensure land used for oil and gas development is restored to a safe and productive condition when an oil and gas site is no longer productive. In order to obtain a CoR the impacted lands must be returned to a state, as near as is reasonable, to the surface condition which existed before the oil and gas activity was commenced. Our findings show that very few of the inactive sites we visited, including entire gas plants, were being restored despite being inactive for over a decade in some cases; and,
3. Evidence was gathered that suggested that some large, man-made, oil and gas process water holding ponds are leaking their contents into the environment in an un-controlled fashion. Concerns are expressed that this leaking water may be toxic and may be impacting the local environment by killing plants, damaging soils and potentially adversely affecting aquatic life and wildlife that drink it. There is also the possibility that local groundwater may be adversely impacted. It is recommended that further investigation be undertaken by the BCOGC to determine if these ponds are leaking and, if so, how extensive those leaks may be.

This report is being submitted to the BC Oil and Gas Commission in the hopes that our findings will be considered and, where warranted, steps taken to address and resolve these issues.

During the two-week period of August 14 to 28, 2015, the David Suzuki Foundation undertook several different reconnaissance-level field investigations in the Montney basin oil and gas play near Fort St. John to examine potential environmental impacts associated with oil and gas development in the region.

The field surveys were led by John Werring, M.Sc., R.P. Bio, Senior Science and Policy Adviser with the David Suzuki Foundation.

Werring is a member in good standing of the College of Applied Biology of B.C. and the Association of Professional Biologists of B.C. He has over 20 years of experience conducting field investigations and undertaking aquatic sampling programs.

We focused primarily on three areas of potential concern.

1) In September 2014, the Foundation investigated and reported on an issue related to hydrocarbon contamination of surface waters from adjacent oil and gas development activities in a watercourse known as Alexander Creek, near Wonowon, B.C. We prepared a report¹ on this matter and submitted it to the B.C. Oil and Gas Commission in October 2014. We revisited the site on August 15 and 23 to check on whether the issues causing the previously observed hydrocarbon contamination had been resolved.

2) As a matter of interest, and following discussions the Foundation had with a senior B.C. Oil and Gas Commission employee² in September 2014 concerning the level and status of well site restoration in the region (we were told companies operating in the area were not achieving targets or expectations with respect to well abandonment and restoration set by the BCOGC), we decided to investigate the status of site restoration at several well sites that, according to information supplied by the Oil and Gas Commission, had been designated as “abandoned” or “suspended”; and;

3) At the request of members of the Blueberry River First Nation, we accompanied band members to several locations where oil and gas development was taking place within their traditional territory and where they had observed and identified concerns related to oil and gas development and what they perceived to be environmental pollution that had been reported to the B.C. Oil and Gas Commission and where they (BRFN) felt these concerns were not being properly or adequately addressed. We were shown these sites and asked to comment on our observations at these locations.

¹ Werring, J. and N. West. October 2014. Investigation into potential contamination of surface waters associated with adjacent oil and gas development in the Wonowon, B.C. area September 23-25, 2014. Prepared by the David Suzuki Foundation and submitted to the B.C. Oil and Gas Commission for consideration and disposition.

² Kevin Parsonage Supervisor, Field Engineering and Technical Investigations – B.C. Oil and Gas Commission, Fort St. John

Following is a summary of our findings:

HYDROCARBON CONTAMINATION IN ALEXANDER CREEK NEAR WONOWON, B.C.

On September 23, 2014, members of a David Suzuki Foundation field team observed what appeared to be hydrocarbon contamination in Alexander Creek, near Wonowon, B.C. The contamination was initially observed from a bridge crossing the creek (GPS Coordinates: 56.67202 N/121.85576 W). The site of the observed hydrocarbon contamination was in an area of active oil and gas development undertaken by Progress Energy. Immediately upstream from the site was an old, abandoned oil well.

Following a fairly detailed inspection and investigation during which we took water-quality measurements and samples, we determined that both the sediments and surface waters in this stream were being contaminated with petroleum hydrocarbons from an unknown source. We detailed findings of this investigation in a written report submitted to the B.C. Oil and Gas Commission for disposition and action. In that report, the Foundation suggested that, based on our findings, it would be prudent to, at the very least, have a site assessment and characterization program carried out to assess the degree of hydrocarbon contamination of soils and groundwater in this area and potential risk to the environment; and, if necessary, a remediation program should be designed and implemented.

The BCOGC acknowledged our findings, and in an email communication³ advised that:

".... The Commission collected water samples from Alexander Creek on September 26th and followed up with further soil sampling on October 24th under the supervision of Dr. Akbar Khan P.Eng. in the vicinity of the locations where your samples were taken. The results of laboratory analysis of the water samples did not find VPH, BTEX, EPH10-19, and EPH19-32 to be present in detectable concentration. All parameters sampled were in compliance with the aquatic life and drinking water standards under the Contaminated Sites Regulation and also met the provincial ambient water quality criteria.

The results of laboratory analysis of the soil samples adjacent to the creek found detectable concentrations of petroleum hydrocarbon that were compliant with the applicable legal standards of the Contaminated Sites Regulation.

*"The source is suspected to be a legacy oil well that was in production from 1962 to 1964 located a short distance from the creek just upstream of the bridge. In November 2013 a Commission inspector observed the site had an area that was barren of vegetation and was ditched in a manner that could direct runoff into the creek. As a result of that inspection, the permit holder (who acquired the site in 2011) initiated an environmental investigation this year that is ongoing. **The Commission has issued an order to the permit holder to ensure the thorough investigation of the site including the characterization and delineation of any potential impacts to Alexander Creek and to ensure remedial activities occur in a timely manner.** Thank you for making us aware of your concerns at this location." (Emphasis ours.)*

³Email dated November 6, 2014, from Devin Scheck, Director, Environmental Management & Reclamation, BCOGC

We revisited the site where we had documented hydrocarbons leaking into Alexander Creek on August 15, 2015, and observed what we again believed to be hydrocarbons leaking into the creek at the same location and, from our observations, in the same amounts or in even greater quantities. The presence of these hydrocarbons was documented in photographs (see photos 1-4). As in our previous site investigation, we also poked and prodded the surface sheen with a stick to see if it would break up, but it did not. There was some separation of the sheen upon prodding but it rapidly coalesced. This was an indication that the sheen was likely related to ongoing hydrocarbon contamination. We also could smell the distinct odour of hydrocarbons while manipulating the water's surface and on the stick used to prod the sheen.

We asked the Oil and Gas Commission⁴ on September 16, 2015, about the status of the above-mentioned order to thoroughly investigate the site to characterize and delineate the extent of site-related impacts to Alexander Creek and related remedial works that have been undertaken, if any. We asked to see copies of any relevant reports/findings.

The Commission⁵ subsequently advised us that it had indeed issued an order regarding investigation and remediation of the site in question in September 2014 and that works on the site had been undertaken.

We were advised that since that time approximately 1,900 m³ of soil from that site had been taken to a secure landfill and the petroleum hydrocarbon impacts had been delineated. Delineation of sodium and chloride impacts has also been completed for the area between the site and the creek. In addition, further evaluation of the site was ongoing to ensure that risks to human health and the environment were being appropriately addressed. We were also advised that groundwater samples taken from five monitoring wells at the site in October 2014 met the **"applicable groundwater standards for petroleum hydrocarbons"**. (Emphasis ours.)

This information strongly suggests that there was a problem with some kind of environmental contamination associated with the well in question (contaminated soil was removed, hydrocarbons were detected in groundwater, unspecified impacts related to sodium and chloride were mentioned). But in relation to our request to see the relevant site investigation reports we were told that the Commission would not share that material with us.

We have since been advised⁶ that "finalized reports from the permit holder detailing the results of site investigation and remediation over the past year at the suspect site are expected to be submitted to the Commission by the end of the year. Once received, the reports **may** be available from the Commission through FOIPPA request." (Emphasis ours.)

⁴ Email to Devin Sheck, Director, Environmental Management & Reclamation, BCOGC dated September 16, 2015.

⁵ Email from Devin Sheck, Director, Environmental Management & Reclamation, BCOGC dated September 18, 2015.

⁶ Email from Devin Sheck, Director, Environmental Management & Reclamation, BCOGC dated September 30, 2015.

ABANDONED AND SUSPENDED WELL SITE AND OIL AND GAS PROCESSING FACILITY (I.E., BATTERY, GAS PLANT, COMPRESSOR STATION) SITE RESTORATION

According to the B.C. Oil and Gas Commission, when an oil and gas site — which includes well sites, facilities and pipelines — is no longer productive, the operator is required to reclaim the site and is not allowed to cease payment on surface land tenures until a Certificate of Restoration (CoR) has been issued.

The BCOGC claims that the CoR process is the mechanism to ensure land used for oil and gas development is restored to a safe and productive condition.

To obtain a CoR, the affected lands must be returned to a state as near as is reasonable to the surface condition that existed before the oil and gas activity commenced.

Site restoration requirements under the B.C. Oil and Gas Activities Act

According to the Environmental Protection and Management Regulations (EMPR), which are promulgated under the B.C. Oil and Gas Activities Act and pursuant to Section 19 (1) of the EMPR: A person who carried out an oil and gas activity on an operating area and who no longer intends to do so must, as soon as practicable, restore the operating area by:

- De-compacting any soils compacted by the oil and gas activity;
- Redistributing any retrievable surface soils that were removed from the operating area during construction so that the soil structure is restored, to the extent practicable, to its condition before the oil and gas activity begun;
- If the natural surface drainage pattern was altered by the oil and gas activity, restoring, to the extent practicable, the drainage pattern to its condition before the alteration;
- Re-vegetating any exposed soil on the operating area using seed or vegetative propagules of an ecologically suitable species that;
 - o Promote the restoration of the wildlife habitat that existed on the area before the oil and gas activity begun; and
 - o Stabilize the soil if it is highly susceptible to erosion;
- Removing any structure that was constructed to cross a stream, wetland or lake and ensuring that the site of the structure is in a stable condition;
- Stabilizing any cut slopes or fill slopes in well sites and facility areas; and
- Re-contouring bladed areas or excavations in pipeline corridors and seismic lines.

Exemption to the rules

That said, Section 21 EMPR (Division 3), also states that:

“The commission may exempt a person or a class of persons from one or more of the requirements of Divisions 1 and 2 of this Part if satisfied that, in the circumstances, it is not reasonably practicable for the person to comply with the requirement.”

The Commission is responsible for overseeing restoration and issuing CoRs and ensuring restoration activities are completed in the public interest with regard to environmental, economic and social effects.

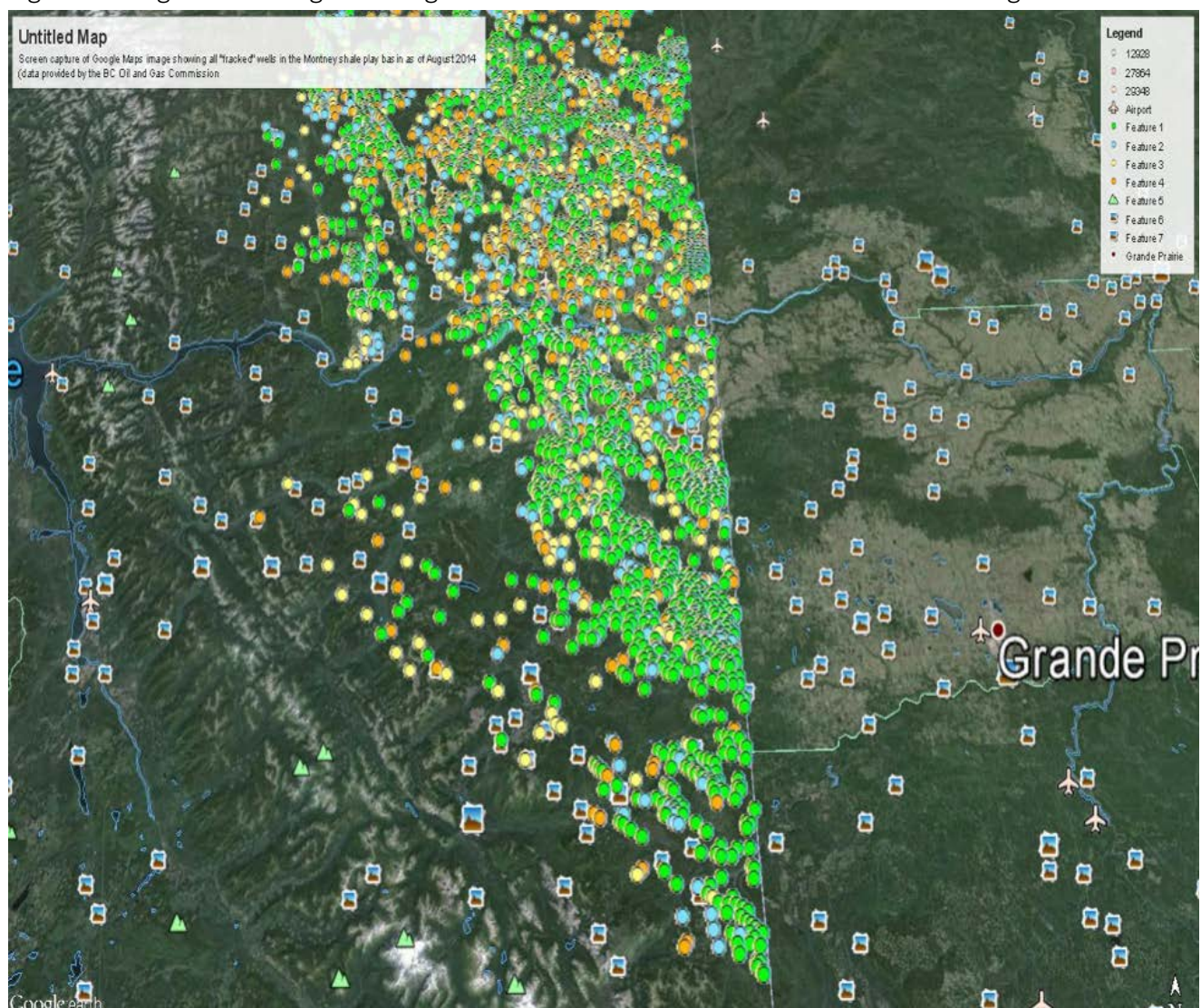
So, how are they doing?

In 2014, the David Suzuki Foundation obtained a data file from the B.C. Oil and Gas Commission that identifies all the oil and gas wells in B.C. that had been fracked up until August of that year. The database shows the location of all active, suspended and abandoned wells and supporting processing facilities that service(d) those wells throughout the region.

The data include: The well/facility identifier number; the name of the company that operates the facility; the name of the field that is being tapped into; the kind of well (oil or gas); the date the well was drilled/facility opened; the date of completion and whether the well is declared as active, suspended or abandoned along with the date of that declaration.

The complete file was transferred to, and plotted on, Google Earth (see Figure 1).

Figure 1. Google Earth Image showing “All Fracked Wells” in Northeastern B.C. as of August 2014



On Figure 1, green dots represent all active wells and processing facilities. Yellow dots represent suspended wells. Abandoned wells are brown.

An **abandoned well** is one that is supposed to be permanently closed off where no viable hydrocarbons are discovered, or where a well is depleted and no longer capable of producing profitably.

A **suspended well** is one that was previously completed and/or producing, but is no longer producing or injecting.

As of November 2014, there were 6,978 abandoned wells in B.C. and 2,945 suspended wells.

We randomly chose two geographical areas with clusters of abandoned and suspended wells to inspect. One was located in the Lower Cache – Red Creek area about 40 kilometres WNW of Fort St. John. The other was located in the vicinity of Peejay, about 65 kilometres northeast of Fort St. John. We visited the Lower Cache area on August 20, 2015, and the area around Peejay on August 23, 2015.

We looked at approximately 35 separate well sites or sites holding ancillary facilities like gas plants or compressor stations (Table 1).

TABLE 1. Abandoned and suspended well sites visited in the Peace Region August 22 and 23, 2015

SITE ID NUMBER	COMPANY	STATUS	DATE COMPLETED	STATUS DATE	SITE RESTORED
02-08-086-21 w6m	Huron Resources	Suspended	Unknown	20/06/2015	N
11-08-086-21 w6m	Huron Resources	Suspended	11/12/1976	5/25/1992	N
A13-05-086-21 w6m	Arc Resources	Suspended			N
09-36-085-22 w6	Canadian Natural	Abandoned	01/11/1977	08/14/2002	Y
10-05-086-21 w6m	Canadian Natural	Unknown			N
A04-06-086-21 w6m	Arc Resources	Suspended	21/12/2009	3/01/2012	N
02-01-086-22 w6m	Arc Resources	Suspended	30/05/2011	3/01/2012	N
15-1-86-22 w6m	Canadian Natural	Abandoned	08/12/2007	1/26/2012	N
10-12-086-22 w6m	Canadian Natural	Suspended	30/07/1979	11/04/2009	N
16-12-86-22 w6m	Shell	Unknown			N
8-13-86-22	Canadian Natural	Suspended		10/15/2009	N
6-13-86-21 w6m	Canadian Natural	Suspended	12/16/2008	8/17/2009	N
11-18-86-21 w6m	Canadian Natural	Suspended	01/07/2008	8/19/2009	N
1-18-86-21	Canadian Natural	Suspended	03/22/2008	7/28/2011	N
d-88-A/94-A-15	Canadian Natural	Suspended	11/03/1965	10/01/2000	N

SITE ID NUMBER	COMPANY	STATUS	DATE COMPLETED	STATUS DATE	SITE RESTORED
a-058-H/94-A-15	Canadian Natural	Abandoned	07/14/1967	11/02/2010	N
d-66-H/94-A-15	Canadian Natural	Suspended	10/06/1964	6/1/1975	N
d-68-H/94-A-15	Canadian Natural	Suspended	10/06/1964	6/1/1975	N
d-76-H/94-A-15	Canadian Natural	Abandoned	07/26/1964	09/09/2010	N
d-77-H/94-A-15	Canadian Natural	Suspended	12/18/1985	01/01/1989	N
d-87-H/94-A-15	Canadian Natural	Abandoned	08/27/1964	11/18/2003	N
d-86-H/94-A-15	Canadian Natural	Suspended	07/23/1964	02/01/2007	N
d-85-H/94-A-15	Canadian Natural	Suspended	02/17/1964	02/01/1996	N
d-55-H/94-A-15	Canadian Natural	Suspended	04/16/1968	03/01/1985	N
b-63-H/94-A-15	Canadian Natural	Suspended	01/18/1970	04/01/2008	N
d-53-H/94-A-15	Canadian Natural	Suspended	09/16/1964	07/23/2009	N
d-54-H/94-A-15	Canadian Natural	Abandoned	04/12/1968	09/17/2003	N
b-42-H/94-A-15	Canadian Natural	Abandoned	03/01/1968	03/19/2006	Y
d-22-H/94-A-15	Canadian Natural	Suspended	04/19/1968	04/01/2008	N
b-50-E/94-A-15	Canadian Natural	Abandoned	11/14/1967	11/03/2010	N
d-39-E/94-A-16	Canadian Natural	Abandoned	10/25/1993	09/02/2010	N
d-48-E/94-A-16	Canadian Natural	Suspended	02/28/1967	07/01/1975	N
b-59-E/94-A-16	Canadian Natural	Suspended	12/07/1969	05/01/2005	N
d-69-E/94-A-16	Canadian Natural	Suspended	02/07/1962	07/01/2007	N
b-37-E/94-A-16	Canadian Natural	Abandoned	06/08/1965	03/07/1983	N

Note: Well sites with abandoned or suspended status indicated in red are sites where hydrogen sulfide gas could be smelled, or detected with personal gas monitors (concentration range 0-3 ppm), leaking into the atmosphere. Perceived leaks detected at sites d-39-E/94-A-16 and d-59-E/94-A-16 may actually be associated with a nearby compressor station that was also leaking gas.

Of the 35 sites visited, 11 were classified by the BCOGC as abandoned. The rest were designated as suspended.

Only two of the 11 abandoned wells (18 per cent) met the criteria outlined in section 19 EPMR that would qualify them as fully restored following abandonment (Lower Cache 09-36-085-22 w6; and, Peejay b-42-H/94-A-15; See photos 5 and 6). In all, fewer than six per cent (two of 35) of the inactive well sites we visited could be classified as having been restored.

The two fully restored, abandoned wells were first drilled in the 1960s and are more than 50 years old.

Every one of the other sites, including **all** of the suspended sites, still had surface infrastructure left in place, ranging from remnants of the wellhead (Peejay d-54-H/94-A-15; See Photo 7) to closed and locked-down but complete gas plants and compressor stations (facility site number 15-1-86-22 w6m - Lower Cache; see photo 8). On many of the sites, the soil was still compacted and very little to no vegetation regrowth was observed. All had buildings, pump jacks or above-ground pipeline connections still in place (see photos 9 through 12).

The oldest abandoned well in the Lower Cache area was so designated in 2002 (13 years ago). The average length of time wells in this area have been designated as suspended is seven years.

The oldest abandoned well in the Peejay area was so designated in 1983 (32 years ago). The average length of time wells in this area have been designated as suspended is 19.6 years.

Most of the suspended wells in the Lower Cache area were designated as “completed” within the past 10 years.

Most of the suspended wells in the Peejay area were designated as “completed” in the 1960s (around 40 to 50 years ago).

The oldest suspended well in the Lower Cache area was so designated in 1992 (23 years ago). The average length of time that wells in this area have been designated as suspended is seven years.

The oldest suspended well in the Peejay area was so designated in 1975 (40 years ago). The average length of time that wells in this area have been designated as suspended is 19.6 years.

One gas plant site (Red Creek Gas Facility - 15-1-86-22 w6m) is classified by the BCOGC as abandoned, yet the entire plant still stands (see photo 8). It was closed in 2007, given the status of abandoned in 2012 and three years later in 2015, not a single piece of infrastructure has been removed. Upon inspection it is clear that this facility is not operating.

Another gas-processing facility, a compressor station (Mink compressor station near Peejay - d-88-A/94-A-15; see photo 13), has been closed and classified as suspended since the year 2000, yet virtually all of the plant’s infrastructure remains in place. In fact, there was a coffee pot sitting on a heating pad in the first aid shack that was set to “auto on”. Although empty, it was warm when we were on-site at around 10 a.m. on the day we visited the site. In addition, there were intermittent and strong odours of gases (both methane and H₂S) that would waft through the air every 10 to 15 seconds.

LEAKING FRACK WATER PONDS?

West Gundy Road compressor station (A-58-H)

On August 25 and 26, 2015, David Suzuki Foundation field investigations staff teamed up with members of the Blueberry River First Nation (BRFN), which holds land claims over much of the area north of Fort St. John that is experiencing intense oil and gas exploration and development. The BRFN have for over a century hunted and gathered food on the surrounding land. They have an intimate knowledge of the area and are well aware of the changes occurring across the region.

Members of the BRFN have apparently witnessed what they believe to be discharges or leaks from several oil and gas facility structures, including pipelines. They claim to have reported their concerns to the BCOGC. However, they feel that some of their concerns are not being adequately addressed. They asked if we could accompany them to some sites that are of specific concern to them.

On August 25, 2015, we attended the site of a Progress Energy compressor station facility near KM 16 on the Gundy Creek Road, north of Wonowon.

The site held a huge holding area (pond) situated upslope of the road for what appeared to be wastewater (possibly frack water) from oil and gas activities (photo 14). It included a downstream overflow pond that appeared to be designed to capture runoff and seepage water from the much larger pond upstream and channel that overflow water through culverts under the road (Gundy Creek Road) and on downslope. Pumps and piping in the upstream pond suggested that water deposited in this pond was, at times, pumped out and carried away through an adjacent pipeline that paralleled the facility to an unknown destination.

At one corner of the site (at approximately KM 16.100 Gundy Road) members of the Blueberry First Nation had, in the past few months, allegedly witnessed a substantial flow of dirty, foul-smelling water running off the site, down ditches and across the road. They had no idea where it was coming from but assumed it to be a leak from the compressor station site.

On the date of our visit (August 25), the BRFN commented that the “leak” they had witnessed appeared to have been brought under control (in other words, it was not flowing as copiously as they had seen months earlier) but that there was still some form of discharge taking place at the same location, and they directed us to it (photo 15).

The discharge was an orange-coloured liquid with a strong chemical smell that also smelled very much like manure from a hog farm (actually, much worse than that).

We took photos of the discharge and collected samples of the flowing seep water in clean, clear glass Mason jars for later analysis for the presence of volatile organic compounds.

We also saw evidence (spoor — tracks and scat) that moose and bear had visited the seep, most likely for drinking water.

We also walked the site to try to determine where this discharge was coming from as it appeared to emanate from the hillside, just downslope of the process water holding pond, much like a natural spring or seep. But the smell associated with this discharge made it clear it was not ordinary groundwater.

While it was difficult to ascertain the source of the seepage, we observed the following during our investigation:

- There was water in the main pond at top of the slope at the time we explored the area. The pond was far from full but it was visible from outside the fence surrounding the property. There was a water truck on the main pad near the compressor station and the driver appeared to be off-loading some sort of liquid into the facility;
- The water in the pond at the time appeared to be the same colour and had the same odour as the seepage water we had observed downstream;
- On the west side of the pond, seepage was occurring at the base of the retaining dam built to contain the water in the process water holding pond (photo 16);
- It appeared that this seepage was a regular occurrence as steps had been taken to lay down some sort of mat or matting to prevent or minimize erosion from flowing water;
- The seepage water in the ditch outside the retaining dam flowed in the same general direction as the area where the downstream seep was occurring; and,
- The seepage water in the ditch outside the retaining dam disappeared into the ground before it reached the downstream containment pond that was designed to capture seepage and surface runoff water from upstream.

One logical conclusion from these observations is that the main pond was leaking, allowing contaminated water from inside the pond to escape, possibly through holes or through poorly sealed seams in the geomembrane used to line the ponds.

RESULTS OF WATER SAMPLING FOR VOLATILE ORGANIC COMPOUNDS

As mentioned above, we took water samples (X2) from the seep emanating from the slope on the uphill side of Gundy Road (photo 15).

The water in both samples had a distinct yellowy-orange colour and strong odour. It was a combination of an acrid chemical smell and a strong smell similar to hog manure.

The water samples were taken in new, clean 500 ml Mason jars. Water from the locations being sampled was used to rinse the jars three times before the final sample was taken. The jars were immersed into the water and were filled halfway with the captured water and then immediately capped with aluminum foil, which we sealed tightly to the jar mouth with elastic bands.

The purpose of sampling in this way was to leave head space in the jar that could later be tested for the presence of volatile organic compounds (VOCs) using a hand-held VOC detector (RAE MiniRAE 3000 Handheld PID Monitor). This is referred to as “static headspace analysis” and is an accepted method of field analysis for VOC contamination⁷.

On returning to our hotel approximately two hours later, we left the samples to stand for three hours at room temperature and then tested for volatile organic compounds. Tap water from the hotel was used as a control.

The results are shown in Table 2.

⁷ Environmental applications for PIDs: http://rae.nl/files/markten/AP-214_Environmental_Applications.pdf

TABLE 2. Concentration of volatile organic compounds (in ppm) in the head space above water samples taken from a road-side seep at Progress Energy compressor station site at KM 16 on Gundy Road on August 25, 2015

SAMPLE ID	CONCENTRATION OF VOC'S (PPM) IN HEAD SPACE
Sample 1 (taken where seep emanated from the ground)	21.6
Sample 2 (taken from seep approximately 20 metres downstream from sample 1)	9.7
Control sample (hotel tap water)	0.0

These results suggest that the seep water was contaminated with a significant concentration of VOCs. According to the U.S. Geological Survey⁸, concentrations of volatile organic compounds in natural groundwater and drinking water supply wells, where they are found to occur, are typically less than one microgram per litre (one part per billion). Yet concentrations of VOCs measured in the seep water were orders of magnitude higher (on the order of parts per million). Concentrations of VOCs in the control sample (tap water) were zero ppm.

Without further analysis it is difficult to determine exactly what kinds of chemicals or gases were present in these samples but it is clear that the samples were contaminated by some sort of chemical that exuded high levels of volatile organic compounds. We believe that this contamination may be arising as a consequence of oil and gas process water leaking from the on-site containment pond.

East Gundy Road compressor station

The following day (August 26, 2015), we visited a second Progress Energy compressor station site on East Gundy Road (East Gundy compressor station d-4-H/94-B-16 W6M). Here too, members of the BRFN had, in the past, observed “coloured, smelly water” emanating from the compressor station site, pooling on the road surface, running off the road surface onto the shoulder and on the downslope side of the road and entering ditches and being discharged further downslope through culverts. As with the site on the West Gundy, there was a large pond on site that appeared to be used to store process water (photo 17).

We also witnessed such a pooling of water on the road surface and a discharge taking place (see photos 18 through 21). Interestingly, ditch water adjacent to the road just a few hundred metres uphill away from the compressor site was an entirely different colour, more clay-green (photo 22).

We also saw evidence of what appeared to be rilling (narrow, shallow channels on hillslopes that are eroded into unprotected soil by water runoff) on the downslope side of the road from road-surface water runoff (photo 23).

⁸ Zogorski, J.S., Carter, J.M., Ivahnenko, Tamara, Lapham, W.W., Moran, M.J., Rowe, B.L., Squillace, P.J., and Toccalino, P.L., 2006, The quality of our Nation's waters—Volatile organic compounds in the Nation's ground water and drinking-water supply wells: U.S. Geological Survey Circular 1292, 101 p

An observation worth noting is that there were signs of runoff (i.e., rilling on the downslope, fill side of the road) from the road surface running adjacent to the process water pond. Where this runoff occurred, the vegetation on the fill slope was either dead, dying or appeared unhealthy (e.g., stunted growth, brown coloration. See photo 24). Further along the road the vegetation appeared much healthier (more vibrant growth and green; photo 25). This suggests that road runoff from the area adjacent to the process water pond may be contaminated with compounds that are adversely affecting vegetation growth.

RESULTS OF WATER SAMPLING FOR VOLATILE ORGANIC COMPOUNDS

We took water samples from four locations: 1) water ponded on the road surface at the compressor station site (photo 18); 2) water flowing in a ditch on the upslope side of road flowing downhill, away from compressor station (photo 20); 3) water discharging from a culvert — on the downslope side of East Gundy Road — approximately 80 metres downslope of the compressor station site (photo 21); and 4) water taken from a ditch on the upslope side of the road, uphill and away from the compressor station site (photo 22) .

As with the water emanating from the seep at the compressor station site we visited a day earlier (see above reference to site at KM 16 on Gundy Road), the water in all samples taken at or downslope of the compressor site (ponded road water, ditch water and culvert water) had a distinctly yellowy-orange colour.

There was no noticeable odour associated with the coloured water ponded on the road surface but there was a strong odour (chemical/manure smell) associated with water flowing in the ditch and exiting the culvert. The same smell could be detected when standing beside the partially filled process water pond at the compressor station site, and it was similar to the odour exuded by the seep water observed at the other compressor station site on West Gundy Road (discussed above).

The water in the control sample was visibly different than the water at or downstream of the control site. It was greyish-green, possibly as a result of suspended clay particles. (Note: this water was likely the result of heavy rainfall the day before.) There was no apparent odour in the control sample.

All water samples were taken in new, clean 500 ml Mason jars. Water from the locations being sampled was used to rinse the jars three times before the final samples were taken. The jars were immersed into the water and were filled halfway with the captured water and then immediately capped with aluminum foil, which we sealed tightly to the jar mouth with elastic bands.

The samples were then left to stand for around six hours at room temperature and then tested for volatile organic compounds.

The results are shown in Table 3.

TABLE 3. Concentration of volatile organic compounds (in ppm) in the head space above water samples taken from water ponded on the road surface; water flowing in the ditch away from the process water collection pond; a water sample taken at downslope exit from a culvert on the road located approximately 100 metres downslope of the compressor site; and from a control location — ponded water lying in the ditch) at Progress Energy’s East Gundy compressor station d-4-H/94-B-16 W6M on East Gundy Road on August 26, 2015

SAMPLE ID	CONCENTRATION OF VOC’S (PPM) IN HEAD SPACE
Sample 1 (Orange-coloured water ponded on the road surface immediately adjacent to compressor station)	0.0
Sample 2 (Taken from ditch on upslope side of road — water was flowing downhill, away from compressor station)	2.6
Sample 3 (Taken from discharge from culvert 80 m downslope of compressor station site)	3.4
Sample 4 (Control sample — ditch water taken from ditch on upslope side of road uphill, away from compressor station site)	0.0

These results suggest that the water emanating from the compressor site (the water in the ditch downstream of this location was actually flowing) may be contaminated process water and may be an indication that the process water pond at this location is leaking into the environment.

Sharing information:

With regard to sharing information with citizens who report incidents of potential contamination associated with oil and gas exploration and development in B.C., the B.C. Oil and Gas Commission needs to be much more transparent. After reporting what we believed to be a potential environmental issue (hydrocarbons leaking into surface water in a creek), we were pressed by the Commission to share any data we had to support our observations, which we did willingly. These observations apparently triggered a Commission investigation and subsequent order to a permit holder (Progress Energy) to conduct a detailed site investigation and prepare a site-remediation plan⁹. The results of the site investigation and the proposed site-remediation plan were to be submitted to the Commission by December 31, 2014.

When we asked for copies of these two reports in September 2015, we were told we could not see them. We were also told that our investigation and results had nothing to do with the issuance of this order¹⁰; that unrelated, prior observations made by a Commission investigator were what led to an order being issued. But this is clearly not the case. (See attached copy of General Order 2014-017.) The General Order states that the order was issued because Commission staff had collected soil sediment samples from Alexander Creek and determined them to be contaminated with hydrocarbons. (This was in direct follow-up to our reported concerns.)

⁹ General Order 2014 – 17 issued to Progress Energy Canada Ltd. in respect to site d-009-K/094-A-12

¹⁰ Email from Devin Sheck, Director, Environmental Management & Reclamation, BCOGC dated October 5th, 2015.

We believe that in this case the Commission has been deliberately vague about the details of what has transpired and is apparently still transpiring in this matter and they have been somewhat obstructionist and evasive in sharing information. This kind of conduct on the part of the Commission is not conducive to establishing rapport with the public and makes it seem like the Commission is more interested in shielding the industry from public scrutiny than it is in acting as a regulator and protector of the environment.

Abandoned, inactive and legacy well sites and facilities

Our field investigation found that fewer than six per cent of the inactive (abandoned and/or suspended) well sites we visited could be considered restored. Many of these wells have been inactive for more than a decade and many still had all their surface infrastructure on-site. This included entire mothballed gas plants and compressor stations.

The B.C. Oil and Gas Commission is responsible for overseeing restoration of inactive well sites and facilities and ensuring restoration activities are completed in the public interest with regard to environmental, economic and social effects. Laws are in place to ensure that these activities take place.

The Canadian Association of Petroleum Producers claims that their industry:

“Manages wells safely through all stages — exploration, development, operation, abandonment and reclamation”

and that,

“Well abandonment includes removal of surface equipment, cutting off the well below the surface, plugging and capping it.”

(See: <http://www.capp.ca/responsible-development/land/abandonment-and-reclamation>)

From what we have seen this is not happening.

There is a distinct possibility that because of lax laws and enforcement, if the permit holders fail to clean up their wells and facilities, the costs of the cleanup could potentially fall on taxpayers. Those costs could be enormous, especially considering the proposed massively increased pace of drilling and construction of pipelines and gas-processing and -handling facilities.

In 2012, the auditor-general of Saskatchewan estimated the average cost of cleanup for an “orphaned well”¹¹ to be around \$70,000 (estimate based on cost of cleanup of 10 orphan wells; see: https://auditor.sk.ca/pub/publications/public_reports/2012/Volume_2/2012v2_31_CleanupWells.pdf).

¹¹ In the upstream oil and gas industry, an orphan is a well, pipeline, facility or associated site that has been investigated and confirmed as not having any legally responsible or financially able party to deal with its abandonment and reclamation.

As of November 2014, there were an estimated 10,000 inactive well sites in British Columbia (6,978 abandoned wells and 2,945 suspended wells). We can't say how many can be considered orphans. But at a cleanup cost of \$70,000 per well, the potential liability to B.C. taxpayers could be as high as \$700 million if these wells and facilities are not properly restored. That cost could grow to a completely unmanageable number if the industry grows unchecked as it has in Alberta. In that province there are estimated to be 170,000 inactive wells,¹² leaving taxpayers with a potential liability of around \$12 billion!

Man-made process water ponds and possible environmental leaks

Our observations and results obtained during field investigations into two separate process water holding ponds at Progress Energy compressor station sites in the Gundy strongly suggest that these ponds, although lined with geotextile to prevent seepage of contaminated water into the ground, may be leaking.

Further investigation is needed to determine if they are leaking and, if so, how extensive those leaks may be. (Based on our observations, they could be substantial.)

Process water (also known as produced water) can be highly toxic¹³. Leaks from produced water holding facilities can kill plants and damage soil to the extent that future plant growth in the area of leaks is inhibited. (Anecdotal evidence suggests this may be happening at one of the two sites we investigated.) It can also adversely affect aquatic life and wildlife that drink it. Large releases of produced water from leaking impoundments may also soak deep into the ground and impair drinking water sources.

If these ponds are leaking then proper risk assessments need to be undertaken to consider the hazard posed, the chemicals involved and the toxicity of leaking fluids. An assessment also needs to be undertaken to determine the likelihood of an event or exposure to humans or other animals that could cause harm.

¹² <http://globalnews.ca/news/2301432/map-shows-nearly-every-corner-of-alberta-littered-with-inactive-oil-and-gas-wells/>

¹³ Veil, et. al. 2004. A White Paper Describing Produced Water from Production of Crude Oil, Natural Gas, and Coal Bed Methane. Prepared by: Argonne National Laboratory. Prepared for: U.S. Department of Energy National Energy Technology Laboratory. 79 pages

APPENDIX OF PHOTOS



Photo 1. Hydrocarbon sheen in creek water at the bridge crossing on Alexander Creek; August 15, 2015.



Photo 2. Hydrocarbon sheen on the surface of Alexander Creek; August 15, 2015



Photo 3. More hydrocarbon sheen at Alexander Creek bridge site; August 15, 2015



Photo 4. Surface of Alexander Creek at bridge; August 15, 2015



Photo 5. One of only two fully abandoned and restored sites observed in the northeastern B.C. oil patch. This is well site 09-36-085-22 w6 in the Lower Cache area. According to B.C. O&GC data It was completed in 1977 and declared abandoned in 2002.



Photo 6. Abandoned well site in the Peejay region. This is well site b-42-H/94-A-15. It was completed in 1968 and declared abandoned in 2006.



Photo 7. Abandoned well site in the Peejay area (Peejay d-54-H/94-A-15) showing above-surface piping remaining in place.



Photo 8. A complete, abandoned gas plant in the Lower Cache area (facility site number 15-1-86-22 w6m). This site was declared abandoned in 2012.



Photo 9. This is well site A13-05-086-21 w6m located in the Lower Cache area approximately 70 km NW of Fort St. John. It could not be determined if this site was abandoned or suspended.



Photo 10. This is well site d-39-E/94-A-16 in the Peejay region. It was completed in 1993 and declared abandoned in 2010. There is still infrastructure on-site (surface pipes) and the site has not been replanted.



Photo 11. This is well site 16-12-86-22 w6m in the Lower Cache. We stumbled on this site by accident so we do not have information on its status but it is clearly abandoned. However, two well casings are evident.



Photo 12. This is well site Peejay d-86-H/94-A-15. It was completed in 1964 and designated as "suspended" in 2007. The old pumpjack remains on site.



Photo 13. The Mink compressor station near Peejay (d-88-A/94-A-15) has been closed and classified as “suspended” since the year 2000. A coffee maker in the first aider’s shack remains plugged in and set on “Auto Brew”. The pot was empty but hot when we visited the site. Hydrogen sulphide gas was wafting through the air at this site.



Photo 14. Large (approximately one hectare) process water holding pond at a Progress Energy compressor station site (a-58-h) at KM 16 on the West Gundy road approximately 90 km NW of Fort St. John.



Photo 15. Seep water leaking out of the upslope shoulder of the road at KM 16 on West Gundy Road, downslope of a large process water holding pond.



Photo 16. Seepage occurring at the base of the retaining dam built to contain the water in the process water holding pond at km 16 on the West Gundy Road.



Photo 17. Process water holding pond at East Gundy compressor station site d-4-H/94-B-16 W. Note the reddish colour of the water and the dried sediments on the geotextile liner at the water's edge.



Photo 18. Tea coloured water on road surface immediately adjacent to process water holding pond at East Gundy compressor station site d-4-H/94-B-16 W.



Photo 19. Orange-coloured water seeping out of base of berm on southeast corner of process water holding pond at East Gundy compressor station site d-4-H/94-B-16 W.



Photo 20. Water from seep depicted in photo 19 flowing down road ditch line to culvert.



Photo 21. Ditch water in photo 20 exiting culvert on downslope side of road.



Photo 22. Natural colouration of water in ditch alongside road, uphill, away from East Gundy compressor station site d-4-H/94-B-16 W. This is after a rainfall that occurred the day before.



Photo 23. Rilling observed in fill slope on downhill side of the road immediately adjacent to East Gundy compressor station site d-4-H/94-B-16 W. Note the dead vegetation.



Photo 24. Picture of fill slope of road immediately adjacent to East Gundy compressor station site d-4-H/94-B-16 W. Note signs of rilling and how sparse and brown vegetation is at this location.



Photo 25. Picture of fill slope on downhill side of road approximately 100 metres east of East Gundy compressor station site d-4-H/94-B-16 W. Note absence of rilling and how more abundant and lush (green and tall) vegetation is at this location.

GENERAL ORDER 2014-017
Section 49 Oil and Gas Activities Act

Issued to:

Progress Energy Canada Ltd.
Bow Valley 2
1200, 205-5th Ave SW
Calgary, Alberta, T2P 2V7

Attention: Mr. Steve Dunk, Manager Regulatory and Stakeholder Affairs, Operations

Order:

Pursuant to section 49(1)(b) of the *Oil and Gas Activities Act* (the Act), I, Dean Zimmer, order that Progress Energy Canada Ltd. (Progress) must :

1. Conduct an investigation of well site d-009-K/094-A-12 (the well site) to characterize, and delineate the extent of contamination within soil and groundwater resulting from oil and gas activities at the site including , characterization and delineation of residual contamination within soil, sediment, and surface water of Alexander Creek adjacent to and downstream of the well site. The results of this investigation shall be submitted to the Oil and Gas Commission (Commission) at C&E@bcogc.ca by December 31, 2014.
2. Provide a remediation plan to the Commission for review detailing how Progress will remediate the impacted area. Submit this plan electronically to the Commission at C&E@bcogc.ca by December 31, 2014.
3. Excavate and remove from the site by January 30, 2015 all contaminated soil that exceeds upper cap limits described in Protocol 11 for contaminated sites.
4. By January 30, 2015 implement measures to prevent any precipitation or run-off that contacts the well site from entering Alexander Creek. Accumulated precipitation shall be collected from the site and must be discharged in accordance with the *Environmental Management Act*.

Conditions:

- A. This order shall remain in effect until amended or terminated in whole or in part by the Commission.

Reasons:

I make this Order for the following reasons:

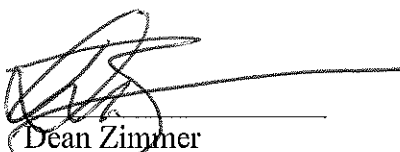
- i. Progress is the permit holder for well site d-009-K/094-A-12.
- ii. Well site d-009-K/094-A-12 was drilled in 1962 and ceased production for oil in 1964 and was abandoned in 1973
- iii. On October 24, 2014 Commission staff collected a water sample from Alexander Creek, downstream from the well site and soil sediment samples were collected from the bed of Alexander Creek just west of the well site. These samples were analyzed and hydrocarbons were detected.
- iv. I am of the opinion that hydrocarbons originating from the site have migrated offsite and been detected in and adjacent to Alexander Creek.

Review and Appeal

Progress Energy Canada Ltd. may request a review of this order under section 70 of the Act by submitting a request for review to ogc.determinationreviews@bcogc.ca

Progress Energy Canada Ltd. may appeal this Order to the Oil and Gas Tribunals under section 72 of the Act. The process for appeals may be found at www.ogat.gov.bc.ca and a notice of appeal may be sent to the Oil and Gas Appeals Tribunal at:

Oil and Gas Appeals Tribunal
PO Box 9425 Stn Prov Govt
Victoria, BC, V8W 9V1



Dean Zimmer
Director, Compliance and Enforcement
Oil and Gas Commission

DATED AT Fort St. John, in the Province of British Columbia, this 5th day of November, 2014

Attachment: Ministry of Environment Protocol 11 for Contaminated Sites