Mine Closure 2022 - M Tibbett, AB Fourie & G Boggs (eds)

doi:10.36487/ACG_repo/2215_61

Achieving landscape-scale social and ecological recovery for successful mine closure

N Tashe *EcoTASH Limited, Canada*

L Hantler *Peace River Coal Ltd, Canada*

Abstract

Mines operate in biodiverse and culturally diverse regions of the globe. Mine restoration through design and construction of landforms and establishment of vegetation may result in a different landscape that can impede the capacity to return the social and ecology back to pre-mine conditions. There is a need to meet social and ecological restoration standards by defining impacts and providing mine owners with actions to implement during the life-of-mine to return to pre-mine condition. Ecologically based restoration standards aim to:

1. *Avoid or reduce the area of disturbance particularly rare or sensitive ecosystems where feasible.*
2. *Minimise disturbance by prioritising mine activities in already disturbed landscapes wherever possible.*
3. *Reduce the recovery timeline to the extent possible by implementing progressive reclamation beginning with safe, stable and non-polluting landforms; and when long-term impacts are unavoidable.*
4. *Conducting offsetting which can be in the form of monetary programs that support large-scale recovery efforts, protection of critical habitat or offsite recovery of legacy mines and other adjacent degraded landscapes in order to move towards ecological and social net gain.*

To illustrate, we present restoration examples from Peace River Coal's Trend-Roman Mine near Tumbler Ridge, British Columbia, Canada. The history of mine activities will highlight the following examples of:

1. *Where key areas were avoided.*
2. *Where mine expansion can use existing disturbance to protect social and ecological values.*
3. *Shortening the recovery timeline by restoring the land building blocks.*
4. *Measures to show net gain through land offsetting and understanding the role of indigenous communities and stakeholder needs for re-establishing the social and ecological use on landforms.*

Keywords: *restoration, coal, caribou, water quality, principles, offsetting, indigenous*

1 Introduction

AngloAmerican plc (AA) in line with the International Council on Mining and Metals (ICMM) mining principles has developed a Closure Technical Standard (Grant & Botha 2019) to form a single guidance document to support a closure standard that has the aim of implementing restoration/reclamation at its mine properties and associated exploration properties. In line with these principles the goal for mine development is avoiding impacts where feasible and/or using existing disturbance; when avoidance is not possible to minimise or mitigate impacts; and when impacts occur applying ecologically based offsets to address the significant residual negative impacts.

The key ecological principles discussed in this paper address a mine restoration case study to highlight the restoration mitigation hierarchy applied for mining and what has been successful and what has led to challenges and adjustments in the restoration (reclamation) plan and how to maintain the key principles being applied as a path forward.

The case study is for the Peace River Coal's (PRC) Trend-Roman Mine, a subsidiary of AA located near Tumbler Ridge, British Columbia, Canada. The mine has evolved from a greenfield exploration development in 2003 to an operating mine that went through a major mine expansion in 2012 and since January 2015 has been in care and maintenance.

2 Methodology

Eight principles provide a framework for ecological restoration at PRC. These principles are adapted from the International Standards (Gann et al. 2019), other relevant leading documents, scientific literature, and practitioner experience. The eight principles guiding ecological restoration are to:

1. Engage stakeholders throughout the life-of-mine.
2. Draw on many types of knowledge.
3. Be informed by reference ecosystems, while considering environmental change.
4. Support ecosystem recovery processes.
5. Assess against clear goals and objectives, using measurable indicators.
6. Seek the highest level of recovery attainable.
7. Gain cumulative values when applied at large-scales.
8. Be part of a continuum of restorative activities.

2.1 Case study: Peace River Coal Trend-Roman Mine

Peace River Coal's Trend-Roman metallurgical coal mine is located approximately 25 km south of the town of Tumbler Ridge in northeast British Columbia and approximately 700 km NE of Vancouver, British Columbia, Canada (Figure 1). The property is located in the Peace River Regional District found in the Inner Foothills of the Canadian Rocky Mountains.

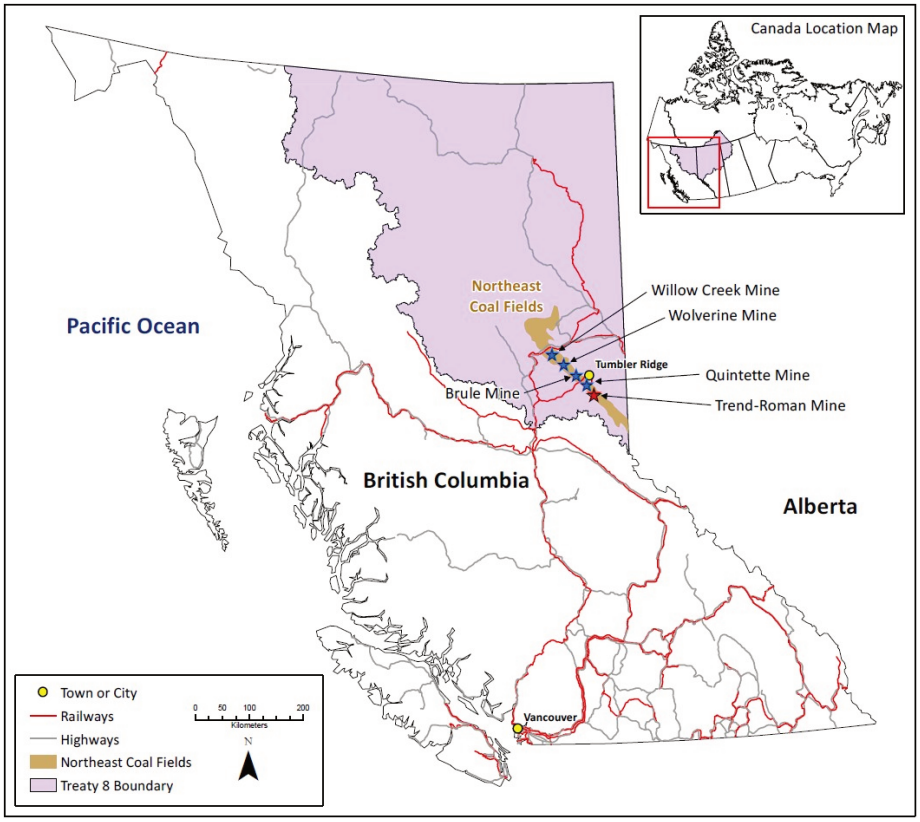

Figure 1 Location map of the Trend-Roman Mine, British Columbia, Canada

The Trend Mine consists of a coal lease and associated coal licenses on the flank of Quintette and Roman Mountain in the Rocky Mountain foothills which began mining in 2005 (Figure 2). As of October 2011, PRC manages the assets as part of AA's Coal business unit based in Brisbane, Australia. The mine permit allows for an annual mine rate maximum of 525 tph and annualised feed of over 3.5 Mt run-of-mine (ROM) coal (Peace River Coal Inc. [PRC] 2007; Lortie 2014) and has an estimated life-of-mine of 16 years (PRC 2022). As part of the mine development of pits and waste rock dumps there is a coal processing plant, workshops, demonstration active water treatment facility at the mine site and roads that lead to the rail load out. In 2015 the mine went into care and maintenance. The mine water discharges to three creeks, Babcock, Gordon Creeks for the mine site and Flatbed Creek for the rail load out that then all discharge to the Murray River. These waterways support fish rearing habitat (PRC 2007). The Trend-Roman Mine falls within critical winter and summer habitat for the Woodland Caribou (*Rangifer tarandus caribou*); specifically, the Central Mountain Quintette herd (Stantec 2012).

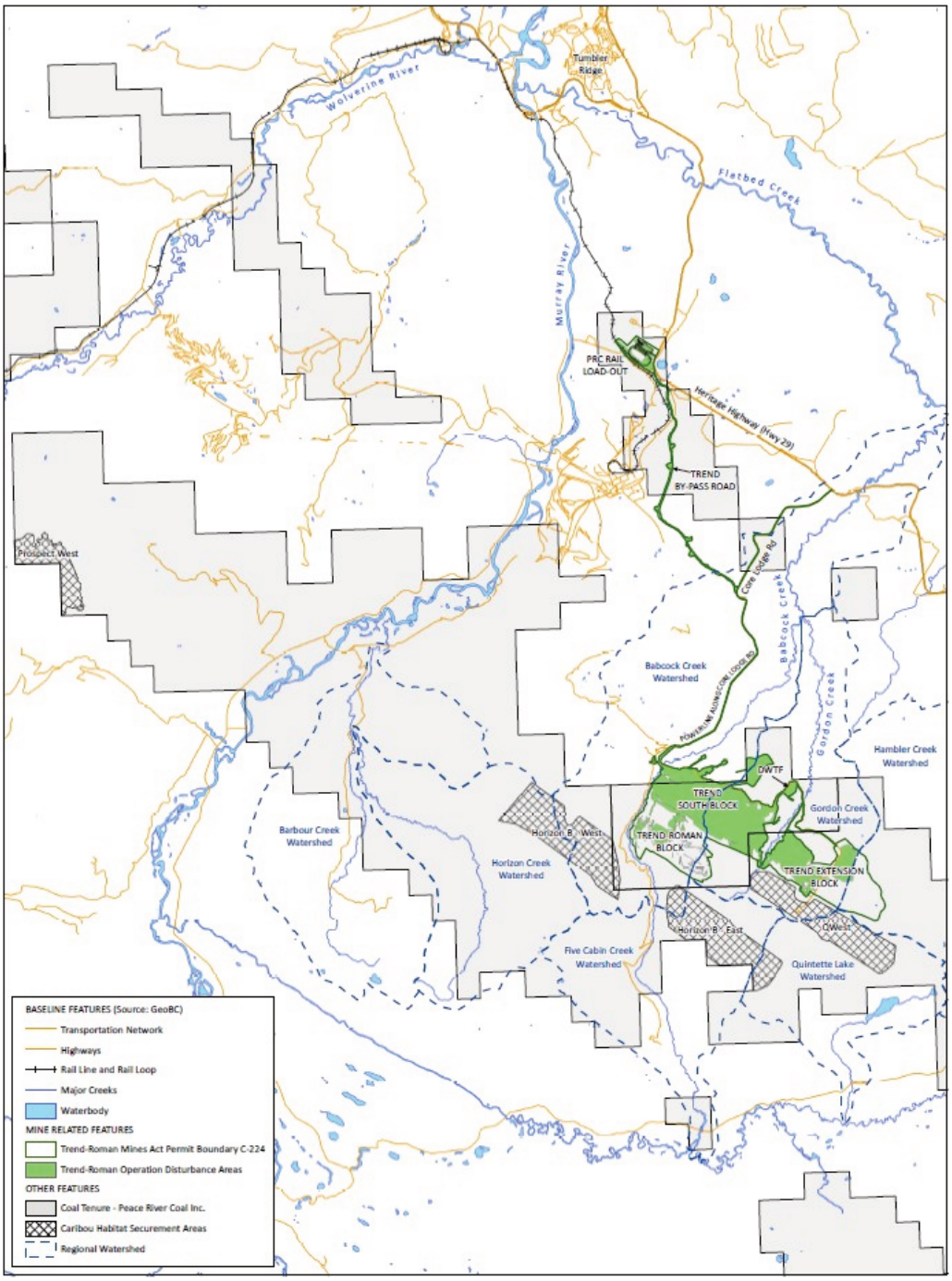

Figure 2 Regional map of the Trend-Roman Mine

The Trend-Roman Mine is within the First Nation's Treaty 8 Territory. As part of the regulatory process of the environmental assessment (PRC 2010) and permit application (PRC 2012a) as a major mine under the *Mines Act*, PRC completed First Nations and public consultation as well as extensive environmental studies. The permit review process was coordinated through the regional multi-agency northeast (NE) Mine Development Review Committee, a committee of government agencies and First Nations who guided the Terms of Reference and consultation process. As part of the consultation process PRC agreed to a third-party review (TPR) process and was one of the first mines in NE BC to choose this consultation process. The TPR process was designed to allow the local First Nations to understand and ask questions directly to the mine operator that they could not receive from government. PRC could then receive certainty on the application being submitted and the outcome of TPR assisted the regulatory decision on the Roman Pit Expansion of the Trend-Roman Mine (Figure 3).

Figure 3 Trend-Roman Mine pit in 2014

2.2 Key ecological and social issues

The coal resources in the Trend Mine area are part of the Peace River Coalfield (Figure 1). This region is rich in high quality metallurgical steelmaking coal and supports a number of coal mines in the region. Other industrial development in the region includes oil and gas development, with a number of gas wells that operate near the mine. On the rolling mountain tops there are also a number of wind energy projects and one of the largest hydroelectric projects in Canada, Site C is being constructed on the Peace River. Logging has been a large part of the area's history as well. This area is subject to pine beetle kill and since the early 1990s, the beetle has attacked 50% of the total volume of commercial lodgepole pine (*Pinus contorta*) in British Columbia (NRCAN 2022). In 2004 the pine beetle reached the Peace River region and as a result large cut blocks to salvage the dead standing timber and forest fires have opened up the regional landscape (Duthie-Holt et al. 2007). This region also contains landform and landscape values and is recognised as a United Nations Educational, Scientific and Cultural Organization (UNESCO) Global Geopark for its geological and palaeontology heritage.

Within the Peace River region Woodland Caribou populations have historically been declining (Festa-Bianchet et al. 2011), primarily because of unsustainable predation. Predation on mostly the caribou calves has increased as a result of habitat alterations that have changed movement of caribou and more open

areas and fragmented habitat changing the predator-prey dynamic (Seip & Jones 2011). Reversing habitat-caused declines takes decades as the landscape slowly reverts to a more natural age distribution that is suitable for caribou (Serrouya et al. 2011). The caribou in BC are currently listed as threatened under the federal Species at Risk Act (Species at Risk Public Registry 2021).

In 2011, the impasse between the BC Government and West Moberly First Nations over mine permitting and the consultation and preservation of caribou resulted in the BC Court of Appeal deciding in favour of the First Nations (BCCA 2011). At this time the Roman mine expansion was in the permit application phase, and it focused the social and ecological process for restoration planning and engagement (PRC 2012b).

In June 2021, the Blueberry First Nation which is part of Treaty 8 won a landmark case in the Supreme Court of Canada. The BC Government says it will not be appealing a landmark court case that found unchecked industrial development in northeastern BC violates Treaty Rights. The decision confirmed that approval of new energy projects in the Peace River region infringed on Treaty Rights (Kurjata 2021). Going forward this landmark case will likely result in further enforcement of progressive reclamation and managing water quality to reduce cumulative effects on the regional landscape.

2.3 Closure and reclamation planning

The Trend-Roman Closure and Reclamation Plan (CRP) was approved by government and First Nations in 2013 (PRC 2012a). This plan had to balance a number of ecological issues. When working through the four-part hierarchy of avoid, mitigate, progressively reclaim and offset, a number of tasks were undertaken to determine that process (Stantec 2012). Approximately 463 ha of undisturbed winter core habitat and 470 ha of undisturbed summer core habitat for caribou would be lost with mine development (Stantec 2012). The eight ecological restoration principles were reviewed in the context of what was undertaken during reclamation planning to allow comparison of the principles relative to the closure and reclamation design and plan that would limit long-term environmental impacts from mine development. Table 1 summarises some of the key design aspects adopted for the CRP relative to the ecological restoration principles.

Table 1 Closure and reclamation design relative to restoration principles

Ecological restoration principles	Design of the CRP
Engage stakeholders throughout the life-of-mine	• A third-party review of the Trend-Roman Mine environmental assessment was undertaken in 2013 by the participating Treaty 8 First Nations that was incorporated into the final CRP. Measures included protection for mountain goats from helicopters, and predator access control to limit elk/moose and wolf movement into caribou habitat. • During the environmental assessment members of the public were invited to address concerns. One change was the Emperor's marathon run hosted by the community held initially on Roman mountain was moved to run over Mount Babcock due to mine development and to reduce stress on caribou. The CRP also stressed the need to control recreational snowmobile use at the reclaimed mine which would help to reduce stress on caribou in winter.
Draw on many types of knowledge	• Detailed baseline studies conducted since 2003 inform the comparison of achieving land use objective of wildlife habitat. • Traditional plants were incorporated into the replanting design. • Mine engineering incorporated phasing of mine development and reclamation to allow for caribou movement including

Ecological restoration principles	Design of the CRP
	landforms with 'ramps'. Select water management structures were built to allow for wildlife crossings.
Be informed by reference ecosystems, while considering environmental change	• Learnings from reclamation at other mines including which seed mixes and plant mixes had the best survivorship were incorporated into the plan. • Predicted ecosystems were defined so that the appropriate reference ecosystem to measure restoration success could be measured including which wildlife could be supported on the landscape.
Support ecosystem recovery processes	• Water treatment options such as active and passive systems to test and treat mine contact water. • Testing revegetation prescriptions to improve success and reduce the timeline for re-establishment of ecosystems on the landscape.
Assess against clear goals and objectives, using measurable indicators	• The approved CRP has clear goals and objectives of stable and non-polluting landforms that supported caribou habitat and at lower elevations forestry. • The measurable indicators for success have not been fully defined for all criteria.
Seek the highest level of recovery attainable	• Key challenge for ecosystem restoration was high alpine recovery which is slow and not well understood. Lichen is the key food for caribou in winter and is one of the most important and challenging ecosystems to restore and is the slowest to recover on the landscape. • Much of the recovery focused on controlling predator access to high elevation caribou habitat which could be implemented faster than lichen recovery. This temporary and permanent loss of habitat resulted in the need for offsetting.
Gain cumulative values when applied at large-scales	• Cumulative issues that have to be viewed at a larger scale are caribou and water quality. • PRC committed to regional support of maternal caribou penning and predator management. • PRC participates with other mines, Indigenous communities and government to work together to manage water quality to protect fish bearing waters in the Murray River Watershed that the mine falls within.
Be part of a continuum of restorative activities	• PRC committed to progressive reclamation and due to being in care and maintenance much of the progressive reclamation committed to is on hold. • PRC is in review of water management improvements on the mine to limit water quality exceedances from the mine.

3 Results

With the implementation of the Trend-Roman Mine CRP commitments met include: avoiding ecologically sensitive areas where feasible, minimise disturbance by prioritising mine activities in already disturbed

landscapes wherever possible and implementing effective offsetting for caribou habitat loss. However, due to being in care and maintenance the commitments to reduce the recovery timeline to the extent possible by implementing progressive reclamation beginning with safe, stable and non-polluting landforms has been limited. Intuitively while a mine is in care and maintenance then there may be fewer hindrances for progressive reclamation as there is no ongoing mining and there is the ability to divert mine machinery to support reclamation, however, staff limitations, and not being able to confirm what areas would be able to be reclaimed if the mine plan changed during restart were some of the main reasons for delaying progressive reclamation. During the care and maintenance phase there was some mine machinery that was used to reclaim some of the exploration disturbance that was adjacent to the mine. Table 2 summarises some of the outcomes of implementing the CRP relative to the ecological restoration principles.

Table 2 Outcomes of the Closure and Reclamation Plan relative to ecological restoration principles

Ecological restoration principles	Outcomes of the CRP
Engage stakeholders throughout the life-of-mine	• Research on lichen restoration in alpine and subalpine elevations to restore winter caribou habitat restoration was initiated (Stantec 2011). Research has stalled when mine went into care and maintenance. • Native plant collection program with training for Indigenous communities was implemented, however it was put on hold while the mine went into care and maintenance. • Engagement with First Nations has focused on the reclamation of exploration properties.
Draw on many types of knowledge	• The TPR process provided an opportunity to engage Treaty 8 First Nations with technical specialists and created opportunities in the area of reclamation and regional monitoring for caribou management that addressed the Peace Northern Caribou Plan, and on water quality management.
Be informed by reference ecosystems, while considering environmental change	• Detailed pre-disturbance ecological data was available as well as other historical data and information from adjacent undisturbed landscapes. The importance now is to manage the data, so it is available when final restoration is occurring. • Climate change models have not yet been applied. This mine is located in four biogeoclimatic zones from alpine tundra to boreal forest. • Storm events are being monitored, and the water quality model has been updated for projected climate change along with additional water management infrastructure which has been constructed since the CRP was approved.
Support ecosystem recovery processes	• The reclamation of exploration disturbance undertaken on the adjacent leases of the mine were monitored to allow for understanding of what reclamation has been successful as the research trials at the mine have been limited while in care and maintenance. • Areas of natural regeneration (e.g. under powerlines and along roadsides) have been monitored for reclamation success, including flora and fauna studies.

Ecological restoration principles	Outcomes of the CRP
Assess against clear goals and objectives, using measurable indicators	• Goals and objectives set for the mine may need to be adjusted over time. The key objectives were the protection and re-establishment of habitat for key wildlife species including caribou. A low productivity commercial forest objective was also proposed for the high elevation forest within the mine footprint and the low elevation forest at the rail load out and along the Trend Bypass Road. Since the CRP approval additional protection measures for caribou habitat has expanded to lower elevation forested areas and not just critical core winter habitat in the alpine.
Seek the highest level of recovery attainable	• The mine design is to backfill pits where feasible to allow for restoration of the landscape. Currently pits do remain open and not yet fully backfilled while the mine is in care and maintenance.
Gain cumulative values when applied at large-scales	• Cumulative effects for caribou and water quality remain concerns and new measures are being implemented. • Since the approved CRP further protection measures and increases to the requirements for caribou habitat offsetting have been defined and moratorium areas were established an Order under Section 7 of the Environment and Land Use Act to prevent new authorisations with regard to Section 12 of the Coal Act (MFLNRORD 2019). • Water quality guidelines in the Murray River watershed were outlined in the Ambient Water Quality Guidelines for Selenium Technical Report Update (MENV 2014).
Be part of a continuum of restorative activities	• Progressive reclamation was incorporated; however, it has been stalled by the mine being in care and maintenance. • Since the plan was approved a change in waste rock dump construction from bottom up to top dump has limited the ability for progressive reclamation. Future mine planning will re-evaluate the dump designs further to limit selenium leachate where feasible.

The overall plan to date was successful in implementing avoidance measures with limiting expansion to the Babcock, Gordon and Flatbed Watersheds and avoiding two adjacent water sheds of Five Cabin Creek and Hambler Watersheds to limit water quality impacts.

The minimising activities at the mine site by using existing roads where feasible such as the Talisman Road which had been built to support oil and gas and logging. The exploration activities also limited new road development by using logging roads and limiting water crossings where feasible.

Reducing the timeline of recovery has had limited success that the mine site as large-scale restoration/reclamation has not been undertaken while the mine was operating and now in care and maintenance. Research trials on revegetation are needed to confirm the most successful species (Stantec 2011). Learning can be gained from areas that have naturally revegetated and on the reclamation that has taken place on AA's adjacent exploration properties and benchmarking relative to other mines in the area that have been reclaimed over the last decade.

Studies that were undertaken to determine water quality recovery at the mine since the mine went into care and maintenance are which showed a reduction in nitrate levels reduced over time. The demonstration water treatment facility has successfully reduced selenium levels but only captures a fraction of the water that is

discharged from the mine. Plans are underway to further investigate a semi-passive water treatment system to treat additional mine water and to improve capture of non-contact water and divert it from the mine, along with increasing the amount of water that is treated each year.

Offsetting was undertaken as part of the mine approval. A $2.566 million (CAD) offset was paid to the Government of British Columbia's Peace Northern Caribou Plan in Vancouver, BC and represented the largest funding contribution made by a mining company for caribou mitigation measures under the Peace Northern Caribou Plan (Powell 2013). In addition, AA set aside a total of 2,009 ha of tenure to support caribou habitat securement and offset the loss of critical caribou habitat where proposed mine development has taken place. Effective offsetting has to include like for like habitat to truly be effective and to limit road development and other uses in the area (Virah-Sawmy et al. 2014). As the caribou securement areas are on mine tenure land no mine exploration or mining is planned and the habitat is mostly within critical winter and summer habitat which is not ideal areas for logging.

Since 2014, PRC has monitored collared caribou's use of the mine site and caribou securement areas. The Quintette herd, as of October 2021, has an increasing trend measured from 2015 to 2021 compared to the historic decreasing trend measured from 2003 to 2014 (Figure 4). Current estimates assume 120 head in the Quintette herd (81–228) based on estimates generated from collared caribou (BC FLNRORD 2021) and as recent as June 2022, two caribou were observed on the mine site. Figure 5 outlines the location of caribou in 2021 based on telemetry data relative to both the mine site and habitat securement areas.

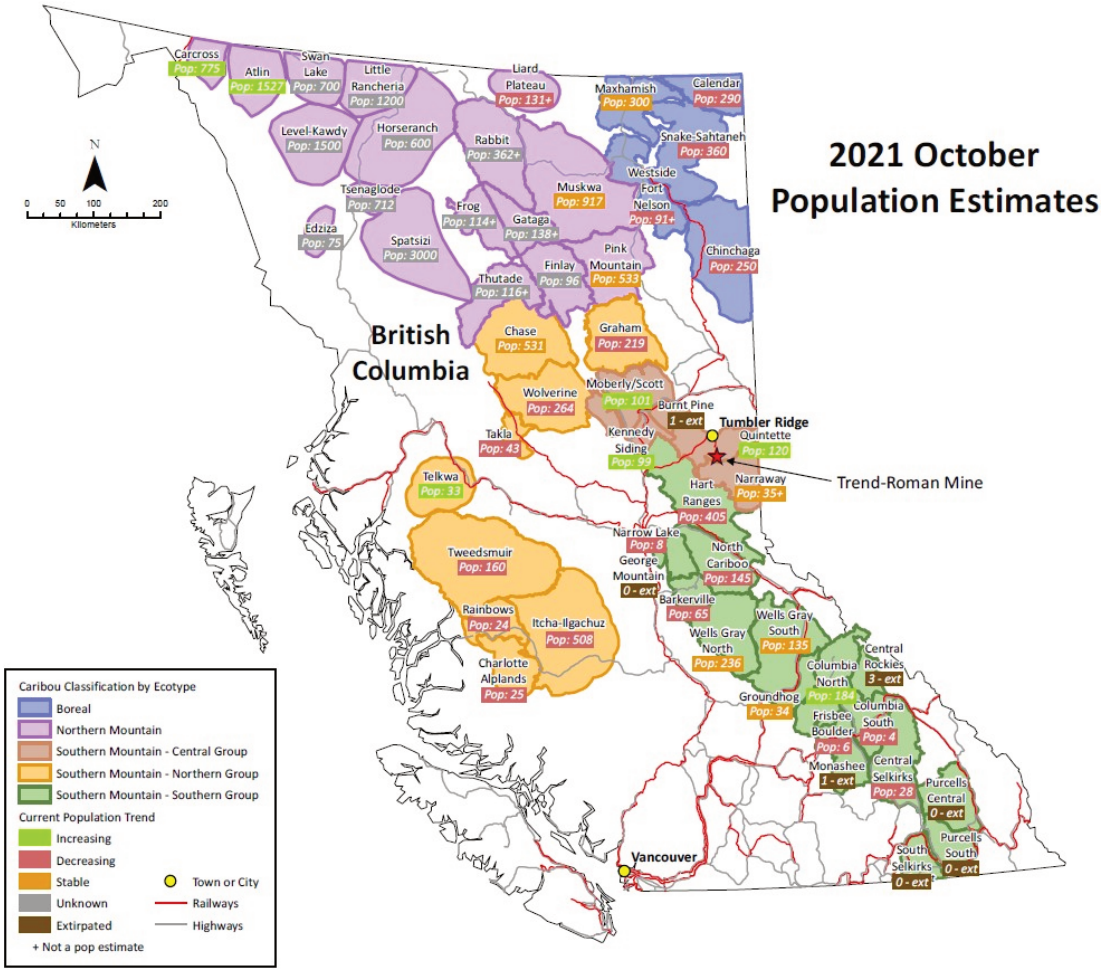

Figure 4 2021 Quintette Caribou herd increasing population trend

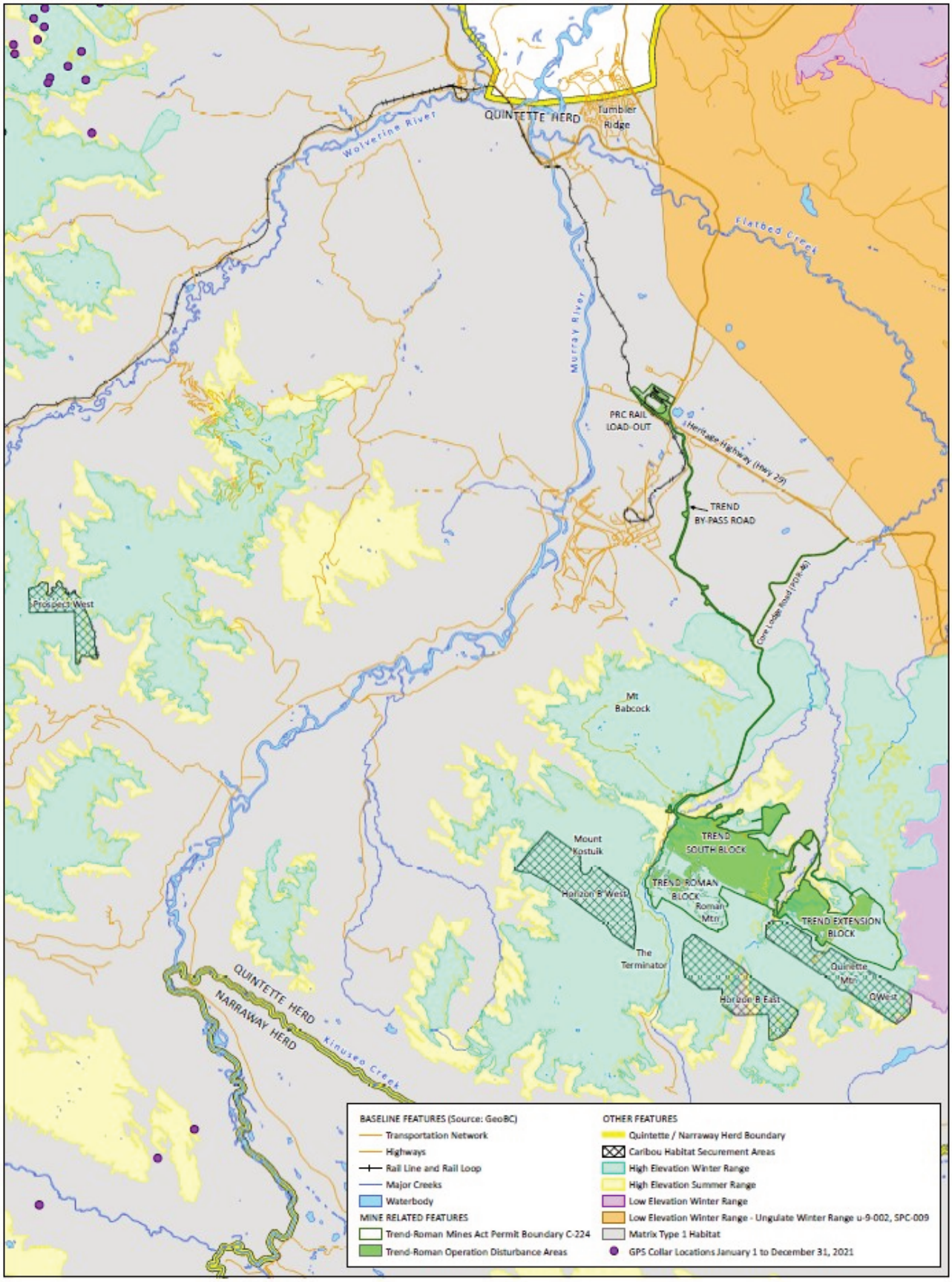

Figure 5 2021 Quintette herd female collared caribou locations relative to Trend-Roman Mine and the habitat securement areas

4 Conclusion

Following key ecological principles during restoration provides the process that Trend-Roman Mine utilised to develop and begin implementing the CRP. Through consultation closure planning prioritised the key social and ecological issues of the local caribou population, Indigenous rights to the land and the need to maintain water quality. These social and ecological issues remain today and as knowledge improves the need for continual review and adjustments to the CRP is needed. The key ecological issues have a broader context with respect to cumulative effects to water quality, fish health and caribou populations. Viewing restoration planning with a larger regional context helps to fully understand cumulative effects especially in regions of multiple industrial activities. One of the critical steps for successful restoration is understanding what can be reclaimed to pre-mining conditions and clearly defining the permanent or long-term losses to define appropriate offsetting and monitoring the effectiveness. The key is to avoid disturbance where possible effects of critical watersheds or habitat, and then to mitigate effects through progressive and timely reclamation that has been vetted by research and community.

Trend-Roman Mine did adjust the mine design to limit effects to watersheds where feasible, and planned for progressive reclamation however, their adjustments to waste rock management and going into an unforeseen care and maintenance has delayed the progress of reclamation with limited staff and a possible future mine redesign when the mine reopens. The offsetting of caribou has shown to be effective since its implementation has shown to reverse the decline of the threatened caribou population in the area. The recent court ruling in Treaty 8 territory on the detrimental cumulative effects will result in future changes to mines in the area with improvements to water quality and caribou protection through habitat restoration. Climate change will also begin factoring into restoration designs of water management features to address larger storm events and possible changes in revegetation prescriptions to adapt to shifts in elevation of ecosystems.

Acknowledgement

The Society of Ecological Restoration and partners are in the midst of publishing the International Principles and Standards for the Ecological Restoration and Recovery of Mine Sites. This manual inspired this talk and many thanks to Renee Young and the team for their support. Thanks to Darren Mawhinney, Trend-Roman Mine Manager, David Lortie, Manager, Coal Resources at Anglo American, Michael Patterson and Carl Grant who have supported reclamation at Trend-Roman Mine.

References

British Columbia Court of Appeal 2011, *West Moberly First Nations v. British Columbia, Ministry of Energy, Mines and Petroleum Resources [2011] B.C.J. No. 942,* https://landuse.alberta.ca/Forms%20and%20Applications/RFR_ACFN%20Reply%20to%20Crown%20Submission%202%20-%20Tab25%20Moberly_2014-08_PUBLIC.pdf

British Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) 2019, *Government implements interim moratorium to protect caribou*, Office of the Premier press release, https://news.gov.bc.ca/releases/2019PREM0076001284#:~:text=The%20 moratorium%20on%20new%20resource,Draft%20Caribou%20Recovery%20Partnership%20Agreement

British Ministry of Forests, Lands, Natural Resource Operations and Rural Development (BC FLNRORD) 2021, *Population Estimates for Caribou Herds of British Columbia, October 2021*, https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/wildlife-wildlife-habitat/caribou/bc_caribou_herds_population_estimates.pdf

British Columbia Ministry of Environment 2014, *Ambient Water Quality Guidelines for Selenium Technical Report Update,* Water Protection and Sustainability Branch Environmental Sustainability and Strategic Policy, Division British Columbia Ministry of Environment, https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/bc_moe_se_wqg.pdf

Duthie-Holt, M, Burleigh, J, Cleaver, M & Strome, T 2007, *Peace Forest District Mountain Pine Beetle Comprehensive Strategy 2007,* Prepared for: BC Forest Service, Peace Forest District, https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/forest-health/fh-strategies/peace_forest_district_mountain_pine_beetle_strategy.pdf

Festa-Bianchet, M, Ray, JC, Boutin, S, Côté, SD & Gunn, A 2011, 'Conservation of caribou (Rangifer tarandus) in Canada: an uncertain future', *Canadian Journal of Zoology*, vol. 89, no. 5, https://doi.org/10.1139/z11-025

Gann, G, McDonald, BW, Aronson, J, Nelson, CR, Jonson, J, Hallett, JG … Dixon, KW 2019, *International Principles and Standards for the Practice of Ecological Restoration*, 2nd edn, https://doi.org/10.1111/rec.13035

Grant, C & Botha, R 2019, *Mine Closure Toolbox*, version 3, Anglo-American, https://www.angloamerican.com/~/media/Files/A/Anglo-American-Group/PLC/sustainability/mine-closure-toolbox-version-3-2019.pdf

Kurjata, A 2021, 'BC won't appeal landmark First Nation court victory; BC Supreme Court found approval of energy projects in Treaty 8 territory is 'death by a thousand cuts', *CBC News,* https://www.cbc.ca/news/canada/british-columbia/treaty-8-province-appeal-1.6121474

Lortie, D 2014, *Coal Assessment Report: Roman Property Peace River District*, BC Geological Survey Coal Assessment Report 954, https://cmscontent.nrs.gov.bc.ca/geoscience/coal/COALReports/0954.pdf

Natural Resources Canada (NRCAN) 2022, *Mountain pine beetle*, NRCAN, Vancouver, https://www.nrcan.gc.ca/forests/fire-insects-disturbances/top-insects/13397

Peace River Coal Inc. (PRC) 2007, *Project Description Roman Mountain Project,* prepared for BC Environmental Assessment Office, pursuant to BC Environmental Assessment Act, https://projects.eao.gov.bc.ca/api/public/document/5886932bde49fe015163a0ba/download/Roman%20Coal%20Mine%20Project%20Description%20dated%20Aug%2023_07%20from%20Peace%20River%20Coal%20Inc..pdf

Peace River Coal Inc. 2010, *Roman Coal Mine Project Environmental Assessment Report*, Peace River Coal, Vancouver, https://projects.eao.gov.bc.ca/p/58851142aaecd9001b81d310/documents?currentPage=4

Peace River Coal Inc. 2012a, *Trend-Roman Mine Joint Mines Act and Environmental Management Act Permit Amendment Application*. submitted to the Technical Advisory Group for Major Mines Permit Applications, Vancouver.

Peace River Coal Inc. (PRC) 2012b, *Cumulative effects re-analysis memorandum to BC Environmental Assessment Office*. PRC, Vancouver, https://projects.eao.gov.bc.ca/api/public/document/588693eede49fe015163a23f/download/Roman%20Mine%20Cumulative%20Effects%20Assessment%3A%20Reanalysis%20with%20Quintette%20Mine%20Restart.pdf

Peace River Coal Inc. (PRC) 2022, *Trend-Roman Mine Five Year Mine Plan and Reclamation Plan for 2022 to 2027*, submitted to the BC Ministry of Mines and Low Carbon Innovation.

Powell, K 2013, 'Anglo American contributes $2.5 million to Caribou Mitigation', *Canadian Mining & Energy*, https://www.miningandenergy.ca/mininginsider/article/anglo_american_contributes_2.5_million_to_caribou_mitigation/

Seip, D & Jones, E 2011, *Population Status of Threatened Caribou Herds in the Central Rockies Ecoregion of British Columbia*, https://www.researchgate.net/publication/265159816_Population_Status_of_Threatened_Caribou_Herds_in_the_Central_Rockies_Ecoregion_of_British_Columbia_2011

Serrouya, R, McLellan, BN, Boutin, S, Seip, DR & Nielsen, SE 2011, 'Developing a population target for an overabundant ungulate for ecosystem restoration', *Journal of Applied Ecology*, vol. 48, no. 4, pp. 935–942.

Species at Risk Public Registry 2021, *Species List*, Species at Risk Public Registry, Government of Canada, http://www.sararegistry.gc.ca/species/default_e.cfm

Stantec Consulting Ltd. (Stantec) 2011, *High Elevation Vegetation Transplant Plan for Reclamation of Core Caribou Habitat*, draft report prepared for Peace River Coal Inc., Vancouver.

Stantec Consulting Ltd. (Stantec) 2012, *Caribou Mitigation and Monitoring Plan,* prepared for Peace River Coal Inc, Stantec, Burnaby.

Virah-Sawmy, M, Ebling, J & Taplina, R 2014, 'Mining and biodiversity offsets: A transparent and science-based approach to measure 'no-net-loss'', *Journal of Environmental Management Review,* vol. 143, pp. 61–70, www.sciencedirect.com/science/article/pii/S0301479714002138