

# Planning Process for Reforesting Temporary Roads in the Southern Portion of the Stuart Nechako Resource District

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## Introduction

Forest road construction in the BC Interior has been significantly increased by accelerated harvesting in response to pine beetle mortality. With a forest stand component close to 80% pine, the southern portion of the Stuart Nechako Resource District (SSNRD, the old Vanderhoof Forest District) was amongst the highest pine beetle, salvage harvest and road building impacted districts. The Vanderhoof Forest District is a part of the Prince George Timber Supply Area (PGTSA). The Annual Allowable Cut (AAC) in the TSA has increased steadily since 2002 with an initial pre-beetle harvest level of 9,363,661 m<sup>3</sup>, increasing to 12,244,000 m<sup>3</sup> in 2002, 14,944,000 m<sup>3</sup> in 2004 with a reduction in 2011 to 12,500,000 m<sup>3</sup> as salvage opportunities started to wane (<https://www.for.gov.bc.ca/hts/tsa/tsa24/index.htm>). Projected mid-term harvest levels are between 4 to 6 million m<sup>3</sup> in the PGTSA (<https://www.for.gov.bc.ca/hts/tsa/tsa24/tsr4/24ts10pdp.pdf>). The potential drop in AAC within the Vanderhoof portion of the Prince George TSA is expected to be significantly greater than the rest of the TSA due to its higher proportion of pine. In the SSNRD, accelerated rates of harvest in the period from 2002-2017, removed an estimated 75% of the projected long term timber supply. Road density in the operable landbase is currently estimated at 0.67km/km<sup>2</sup>.

In response to the projected reductions in future harvest, the SSNRD initiated a five year planning and implementation process to identify access management and reforestation opportunities on roads defined as Temporary in the Forest Planning and Practices Regulation (FPPR). Earlier work by Chapman and Thompson (2015) demonstrated the effectiveness of low cost soil rehabilitation methods to produce a commercial crop of trees on severely disturbed soils. Establishing a commercial crop will reduce the risk of degradation of drainage structures, reduce the risk of road related slope failures, as well as a reducing the need to monitor the state of unused roads. Successful rehabilitation would also reduce ongoing use of deactivated roads by motorized recreationists

Current Industry practice is to designate all constructed haul roads as Permanent, contrary to the intention of the FPPR. This implies a long term commitment to road maintenance, access management, and a substantial removal of land from the productive landbase (NAR). Under the FPPR up to 7% of the gross cutblock area is allowed for permanent access which is not considered part of the productive landbase and has no silvicultural obligations.

The target audience for this extension note is resource professionals, managers and decision makers who are looking for new opportunities to address future timber supply deficits, and the long term difficulties associated with managing dormant roads. This note provides managers and practitioners with a multi-year planning concept to support a road rehabilitation program, along with preliminary implementation results.

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An important first step in the development of a road rehabilitation program is the identification of temporary roads as defined in the Forest Planning and Practices Regulation (FPPR). In this project we used an automated GIS algorithm developed by Chapman and Thompson (in preparation). An automated GIS based approach to the classification of roads is of value as it can be applied to broad landscapes.

## **Methods**

This project is being implemented in three phases:

Phase 1 (completed March 31, 2017). In phase one, preliminary identification of areas of interest, and contact with stakeholders was completed. The sequence of steps in this phase was as follows:

1. Acquired classified road database in GIS format for the entire District, and corrected duplicated roads by GIS processing.
2. District staff reviewed road layer product to identify potential areas of interest.
3. Consultant conducted a more detailed review, solicited stakeholder input, and identified final project areas.
4. Consultant manually corrected outstanding data errors within identified project areas.

Phase two (commencing in the 2017 field season). Phase two will focus on field activities including:

- Reconnaissance to assess current road conditions, including natural ingress, compaction, and access;
- Prescription writing for roads that can be rehabilitated. Prescriptions would include not only silviculture objectives but also hydrological, erosion control, fisheries and other objectives such as deciduous or shrub regeneration, the need for, and type of site preparation, fertilization and management of other values;
- Preparation of sowing requests for planting in 2019; and
- Where appropriate, site preparation may be completed.

Phase 3 (commencing in the 2018). Complete additional site preparation as needed.

Reforestation/planting activities would be completed 2 years following the sowing request. All sites will be given an opening number, entered into RESULTS government database and tracked over time.

### **Phase 1: GIS Processing**

A GIS process was developed to eliminate duplicated roads. Temporary roads overlying permanent roads were clipped using a 5 meter buffer around all permanent roads. Temporary roads overlying each other were eliminated by: isolating roads by source, then merging all line segments into one multi-part line for each source, and finally exploding back into individual lines. As a result of this process attribute

details for individual road segments are lost, and roads were only identified as permanent or temporary by source. For the intended purpose, this provided sufficient information.

### **Phase 1: Identification of Areas of Interest**

Chapman and Thompson (in preparation) developed an automated, GIS based method of classifying roads as permanent or temporary, following the definitions in the FPPR. This method was applied to the entire SSNRD and a modelled road layer product was created from roads documented in the Consolidated Roads Database (CRDB, updated 2014). The CRDB is a comprehensive summary of all roads in the landscape compiled from analysis of multiple sources: As Built Roads, RESULTS, DRA, TRIM and FTEN. The district took the modelling product, which was a road map layer identifying individual roads as being either temporary or permanent, and completed a preliminary clean-up of data. Some cleanup of the modelling results was required to eliminate obvious classification errors and duplicates as the five road data sources used were not completely consistent with each other.

The initial road classification was in part based upon the use of the road to access current rotation wood fibre opportunity. Roads within 400 meters of a harvest opportunity were initially classed as permanent, subject to other constraints programmed in the model such as major stream crossings, reserves, or restrictive management areas. If there was no opportunity within 400 meters, the road was designated as temporary and a candidate for rehabilitation. Opportunity was defined as a minimum 12.5 cm DBH, with 100 m<sup>3</sup> volume in a 10 ha area, free of other constraints.

Following clean-up of the automated road classification product, maps were assessed for areas containing the highest density of temporary roads, the least amount of future fibre opportunity and the highest proportion of free growing stands to non-free growing stands in order to avoid conflict with ongoing stand tending requirements.

## **Results and Discussion**

Mapping of classified roads over the entire District facilitated a preliminary review to identify potential treatment areas.

### **Total Road Construction in the SSNRD**

Following the definitions in the FPPR, a total of 14,542 km of Temporary road, and 33,659 km of Permanent road were identified. These estimated road lengths may underestimate total current road length because at the time this project started the roads database has not been updated since it was assembled in 2014. From an unbiased sample of widths measured on eight orthophotos distributed throughout the Interior, Chapman and Thompson (in preparation) found average widths of 9.6 meters for permanent, and 8.1 meters for temporary roads. This implies road occupancy of 117,790 ha, temporary, and 323,126 ha. permanent roads.

**Quality of Data**

Road classification from the computer algorithm was accurate within the range of error quantified by Chapman and Thompson (in preparation), average 17%, ranging from 8 – 25%. An initial finding was a large number of duplicated roads and missing roads. This required some additional GIS processing, and manual updating of the algorithm results. Duplicated roads are an artifact of how the CRDB was assembled, in particular the conversion of RESULTS polygons to lines, and duplicated FTEN roads. Road permits are frequently re-issued, and it appears that old permits for the same road are not deleted from the database. The algorithm used to classify roads was able to filter some, but not all duplicate roads. The follow up GIS process applied by the District was successful in filter a large proportion, but not all, duplicate roads.

In processing the algorithm output using GIS it was assumed that permanent roads were accurately identified, and no analysis was made for duplicates. At this stage, no manual orthophoto review was conducted. These approximations were necessary given the short time frame for completing the project. Assuming permanent roads to be correctly mapped was reasonable given the objectives of this project, however in its current state, the algorithm occasionally misclassifies permanent roads as temporary.

**Table 1 Summary of Duplicate Temporary Roads**

Source	Number of Roads		Length			
	Original	Modified	Original (km)	Modified (km)	Duplicated (km)	Duplicated (%)
Results	54,341	24,949	5,524	4,610	914	17%
FTEN	5,555	8,709	3,303	1,173	2,130	64%
DRA	50,342	34,618	12,854	7,345	5,509	43%
TRIM	2,175	1,781	242	226	17	7%
ABR	6,150	5,165	1,613	1,188	425	26%
<b>TOTAL</b>	<b>118,563</b>	<b>75,222</b>	<b>23,536</b>	<b>14,542</b>	<b>8,994</b>	<b>38%</b>

Table 1 summarizes the length and proportion of duplicated temporary roads. No analysis of duplicated permanent roads was completed. Considering all data sources, duplicated roads comprised 38% (8,994 km) of temporary road length. This amount is much greater than the 0 – 3.3% found by Chapman and Thompson (in preparation) on eight map tiles distributed throughout the Interior. Among road sources, FTEN roads had the highest proportion of duplicates, 64%. This is consistent with Chapman and Thompson who found duplicated road percentages were higher where FTEN roads are more commonly constructed, as is the case on the Coast.

The number of missing roads varied considerably throughout the District. A fundamental reason for missing roads is that the CRDB was last updated in 2014. As a result, 2-3 years of road building and harvesting may be missing in recently developed areas. An orthophoto review of eight 4,000 ha map tiles distributed throughout the Interior found an average of 1.2% of total roads in the CRDB were duplicated, and on average 4.2% (range: 0 – 13%) were missing (Chapman and Thompson, in preparation). The orthophoto review of one map tile in SSNRD found 13% missing roads, the largest among all Interior Districts.

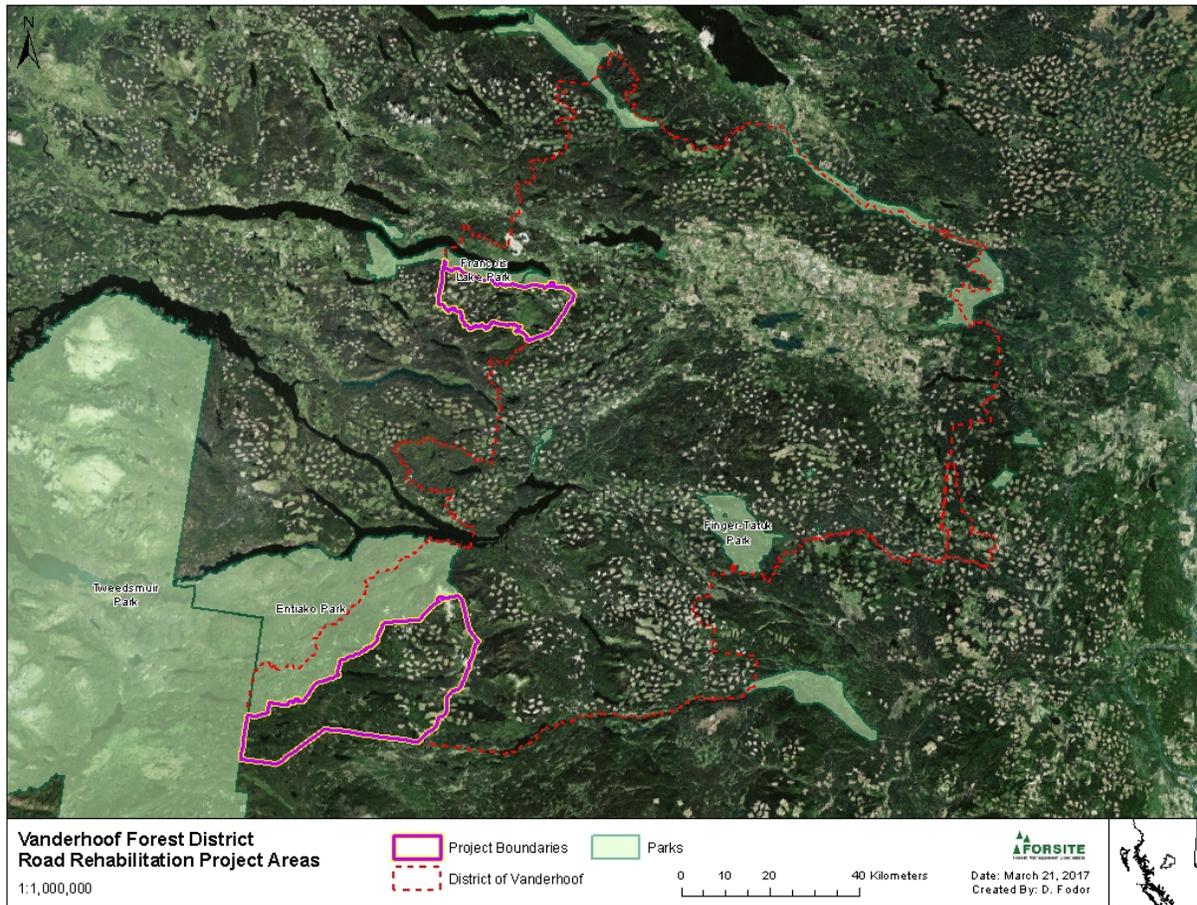


Figure 1 Overview of SSNRD (old Vanderhoof District) showing road rehabilitation project areas outlined in magenta

### Preliminary Review

This initial assessment identified 8 distinct areas totalling about 200,000 ha. The total temporary road length for the 8 areas varied between each of the data sources from 7 km in total length to over 900 km. It was evident that although the classified roads layer provided a start to the process, further remote sensing and ground work will be required to determine a more accurate length of temporary roads.

As a Phase 1 deliverable, the initial assessment and area identification was used by a local consultant to initiate discussions with stakeholders, licensees and First Nations to refine the areas selected for future on-ground assessment work. Through their discussions, the consultant was able to narrow the focus for area selection down to four locations. Two areas were consistent with the original sites chosen by the District, and two areas were newly identified through licensee and stakeholder discussion (Figure 1).

One new area in the southwest portion of the District showed very few modelled roads, which was inaccurate, and also contained caribou winter range which elevated the priority of the area for further assessment. Another area south of Francois Lake was also selected as a result of discussions with the licensee operating in this area. In this second priority area, significant recent-past wildfire impacts also reduced the likelihood of any further fibre opportunities, thereby increasing the priority for assessment and potential road rehabilitation.

The roaded area within these four locations was evaluated further to develop a refined road classification for suitability of rehabilitation. The consultant performed an initial assessment of these roads which included consideration for future harvest opportunities (planned or potential), silvicultural obligations (stands yet to meet free growing), and additional constraints including access for recreational opportunities and private lands. Using this information along with an orthophoto review, in-block roads, spurs, and general access roads that had no future opportunities or ongoing obligations were identified as potential candidates for rehabilitation. This in-depth review was completed for the four identified areas and a list of candidate roads for rehabilitation were mapped and sent to Licensees operating within each specific area for comment and feedback. For the purpose of the orthophoto review the same basic criteria used by the GIS algorithm were used (distance to opportunity and constraints).

Figures 2 and 3 show the initial road classification and reclassification after review in one selected project area (Southeast of Entiako Park). These figures show typical results from the current implementation of the classification algorithm. Some sections of road initially classed as permanent were reclassified as temporary, and vice versa, based on a logical review of the road network. There were several missing roads that were digitized from the orthophoto. The results of this review step are consistent with (Chapman and Thompson, in preparation) who found misclassification rates of 8 – 25% of total road length following a detailed review of eight, 4,000 ha. Interior map tiles. Despite the misclassification errors, the algorithm product provides a good initial identification of the permanent and temporary road network.

As a part of their contract, the consultant developed funding proposals for delivery of reconnaissance works within the identified areas and submitted them to the appropriate agencies for consideration to fund year 2 activities. The Forest Enhancement Society (FES) is seen to be a prospective partner in the project through funding it has received from the Forest Carbon Initiative (FCI). These funds are intended to go towards projects that either store more carbon than current forest management or reduce carbon emissions. The carbon balance will be a consideration in project delivery if these funds are accessed.

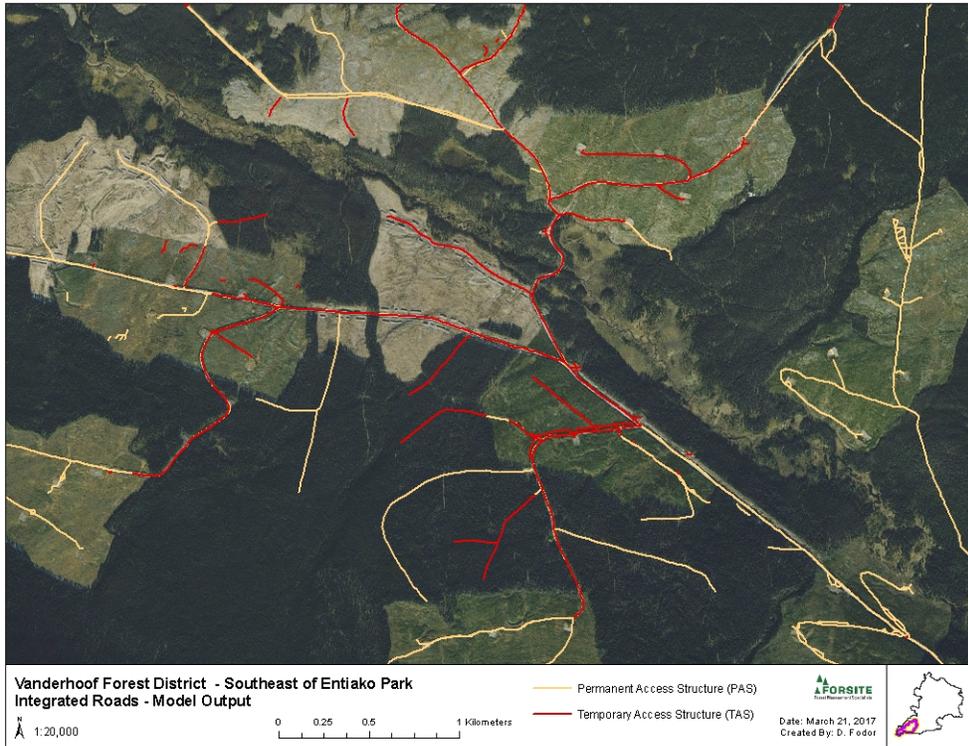
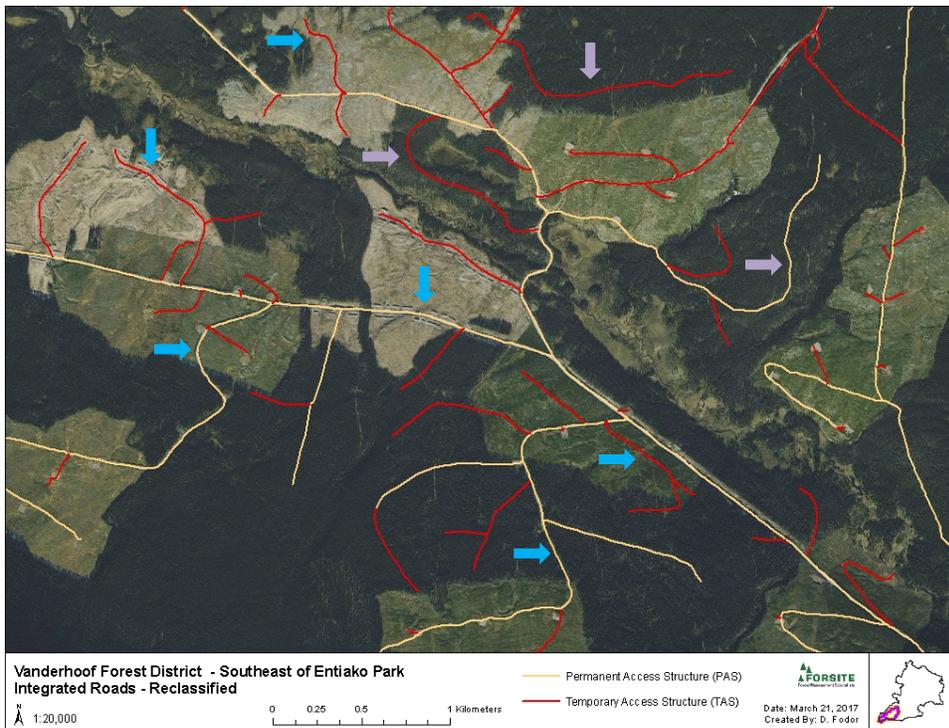


Figure 2 Portion of the Entiako project area showing Permanent and Temporary roads as classified by the GIS algorithm



*Figure 3 Same area as Figure 2 showing roads re-classified after orthophoto review. Blue arrows show some examples of roads that were reclassified after review. Purple arrows show roads that were missing from the GIS algorithm.*

### **Stakeholder Response**

Response varied by licensee and stakeholder, in part a result of the short timeframe of the first phase of this project. Where possible, in-person meetings were scheduled to introduce project objectives, gather initial impressions, and establish expectations of licensees and stakeholders. Where in-person meetings were not available, conference calls were scheduled that utilized the consultants webmap service developed for the project which stored the data presented in the meetings used to facilitate discussions.

At this stage of the project, feedback sought from forest licensees was focused on:

- The scope and approach of the project, including their initial thoughts and concerns;
- Description of their current practices regarding road rehabilitation and deactivation;
- Planned development activities in order to identify areas not suitable for rehabilitation;
- Silviculture requirements in the short-term (10 to 15 years) to identify areas with short-term needs but may be suitable candidates in the future; and
- Identification of key areas or roads that would be ideal for this project in order to focus efforts.

Most licensees were in support of the concept of road rehabilitation in the District, however time available for an in-depth review of candidate roads was not available. Three licensees were able to respond with feedback specific to the candidate roads identified, providing higher level input and feedback, and a suggestion for a more in-depth review of candidate roads when specific areas were planned for recce and prescriptions. As a result, two of the identified areas were removed from consideration, and the two newly identified areas (South of Francois Lake and Southeast of Entiako Park) were brought forward as the first two areas slated for recce and treatment prescriptions in subsequent phases of the project.

### **Conclusions**

1. Despite minor flaws in the CRDB data, the classified roads layer from the GIS algorithm provided a useful framework to initiate large scale rehabilitation planning. Having a snapshot of the entire road network in the District, including in-block roads, was a good starting point.
2. Mapped and classified roads also facilitated engagement with stakeholders.
3. Some manual work was required to correct errors and update missing roads in the CRDB. In implementing future projects of this type, manual clean-up of the database should be anticipated.
4. Incremental improvements in the computer algorithm used to initially classify roads would reduce errors requiring correction manually.
5. Discussions and involvement of licensees were invaluable to identifying candidate roads, as these are the primary users of the land base and have detailed knowledge of the areas in review.

Communication at the onset of a project will increase the efficiency of data reviews and road classification procedures.

6. In the course of this work, numerous roads were identified that at the time of construction would provide no access for a future timber harvesting opportunity. Several clear examples are shown in Figure 3. To avoid a future backlog, road rehabilitation should be planned in advance of road construction and harvesting. This requires accurate identification of temporary roads that will not be needed for a future harvest opportunity, or other access. These roads should be treated as part of the NAR and put in commercial production.

## **Literature Cited**

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