Monitoring and Follow Up of Sandhill Crane: Adaptive Management of Project Mitigation for South Fraser Perimeter Road, B.C.

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1.0 INTRODUCTION

The B.C. Ministry of Transportation (MoT) is building a new 40 km-long highway in the Lower Mainland, south of Vancouver (**Figure 1**). The South Fraser Perimeter Road (SFPR) is designed to alleviate traffic congestion and safety issues, particularly from long-distance (faster moving) regional traffic utilising existing local roads to move between Delta and Highway 1 in Surrey. The corridor for the SFPR has diverse range of both ecological values and built infrastructure; southwest Delta has some of the most productive agricultural land in Canada, a significant area of bog wetland (>2000 ha), and along with adjacent Surrey has highly developed industrial land (including port and railway infrastructure) and residential housing. Advancing the Project requires reconciling potential effects on this range of values.

The SFPR was proposed to be advanced by the MoT as a public private partnership (P3), sometimes called a design, build, finance and operate (DBFO) delivery model. Project delivery would see provincial (B.C.) and federal governments partnering with private industry to design, build, finance and operate the project. This approach to delivery of the project provides efficiencies by tapping into the knowledge and expertise of private sector companies that specialise in activities such as road design, construction, operation and maintenance. At the same time, for some projects, the objectives of P3 developments and the requirements of environmental assessment processes do not align well. In the case of SFPR, the environmental assessment (EA) process was based on a reference (or preliminary) concept and undertaken before the final design was complete. While this approach provides flexibility and opportunities for innovation in the final design, it can be perceived as causing uncertainty with respect to effectively managing potential project-related effects during EA processes.

In the case of the SFPR project, the P3 model of project delivery was one factor that introduced some challenges to the harmonized *B.C Environmental Assessment Act* (BCEAA) and *Canadian Environmental Assessment Act* (CEAA) EA review that was conducted in 2007 and 2008. While some potential effects were able to be avoided in the reference concept, a lack of detailed design information in some areas, including mitigation concepts, resulted in uncertainty regarding the effectiveness of mitigation. This was

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particularly the case for vegetation and wildlife values associated with agricultural land in southwest Delta. In order to obtain EA approvals an innovative approach to reducing uncertainty and providing regulators with the confidence that no significant residual impacts would result from the Project was developed.

2.0 ENVIRONMENTAL ASSESSMENT REVIEW

While the MoT assessment of impacts concluded that there were non-significant impacts on sandhill crane and other species and ecosystem components in south-west Delta, during the EA process this assertion was not supported by reviewing agencies (regulators) due to concerns regarding a lack of certainty in effects and mitigation; including the use of 'unproven' mitigation approaches. Such concerns led to delays in the EA process and the overall project schedule. To address this concern, MoT worked with reviewing agencies to develop a monitoring program that would focus on assessing the effectiveness of the MoT's mitigation measures. The *South Fraser Perimeter Road Vegetation and Wildlife Mitigation Monitoring Plan*, which is based on the principles of adaptive management, provides for:

- Confirmation of the MoT impact assessment predictions, based on the collection of more baseline data and monitoring of the effectiveness of mitigation; and
- A continual improvement / feedback process for determining if predicted impacts are being adequately mitigated or if additional mitigation is required.

These two objectives are the key to the power of this post-approval monitoring and follow-up tool. Firstly it was designed to provide the MoT and regulators with good scientific data to reduce the uncertainty surrounding predictions of impacts. Secondly it provided a process within which these data could be used to inform decisions on the application of mitigation to address any confirmed impacts. The Mitigation Monitoring Plan was developed by the MoT, but with input and sign-off from regulatory agencies. Currently it involves these groups in implementation and assessment of ongoing monitoring and mitigation needs.

The Mitigation and Monitoring Plan facilitated project approval by providing a mechanism that ensured the effective application of mitigation, especially in light of uncertainties surrounding final project design associated with P3 delivery. Further, it offered considerable value to the MoT in giving flexibility for detailed design and in deferring the costs of mitigation until monitoring confirmed it was needed to address actual impacts; rather than assuming the need based on predictions. In conjunction with this, it provided regulators with confidence that project related effects would (and could) be addressed, and that potentially significant adverse impacts would be avoided. It is based on adaptive management theory (see Holling 1978, Stankey *et al* 2005, and others) and practice in EA (see Beanlands and Duinker 1983,

and others) with processes that plan, act, check, review and adjust in a long-term continuous improvement cycle (**Figure 2**) that is inclusive and collaborative.

The Mitigation Monitoring Plan considers a number of valued ecosystem components (i.e., sandhill crane, barn owl, breeding birds, red-legged frog, Pacific water shrew, red-listed (at-risk) plant communities, and air quality and hydrology in the nearby Burns Bog). For each, a work plan was written that achieved the overall objectives of the Mitigation Monitoring Program by outlining the existing conditions and likely project-related impacts along with:

- Ecological assumptions;
- Core indicators for assessing the effectiveness of mitigation;
- Study methodology; and
- Data interpretation and reporting protocols.

The work conducted on the sandhill crane work plan has been selected as a case study to highlight the innovation and cost-effectiveness of this approach to providing environmental protection and enhancement, the applicability to transportation projects and the lessons learned to date on the SFPR project.

3.0 SANDHILL CRANE

3.1 BACKGROUND

Sandhill cranes (*Grus canadensis*) are blue-listed (i.e., of special concern) in B.C.; the Lower Mainland population is estimated at 30-35 birds. In fall these sandhill cranes congregate to forage in agricultural fields in the Crescent Slough area, using nearby Burns Bog for roosting (**Figure 1**). They are later joined by cranes nesting further north on the Pacific Flyway, and peak numbers are around 50 birds. During fall cranes make daily morning and afternoon flights between Burns Bog roost locations and agricultural fields for foraging near Crescent Slough. Forage from these agricultural fields appears to be important to cranes, as many spend over a month prior to initiating/continuing their southward migration. The SFPR will utilise some of these agricultural fields; as such there is potential for impacts by direct (habitat loss) and indirect (noise and visual) disturbances displacing them from foraging habitat. This might negatively impact breeding Lower Mainland cranes, as well as staging cranes migrating along the Pacific Flyway. Approximately 10.5 ha of these agricultural fields are required for the SFPR. There were uncertainties expressed with respect to the MoT impact assessment and mitigation efficacy, and for this reason the Mitigation Monitoring Plan was developed.

The purpose of monitoring for sandhill crane is to develop a more detailed understanding of existing use of the agricultural fields by sandhill crane, to support the development and adaptive management of

mitigation measures required to address potential project related effects. In particular, monitoring activities are focused on understanding crane use, behaviours, preferences and selection of foraging fields. Information obtained will then be used to adapt and/or develop recommendations for implementation of monitoring and mitigation in subsequent years. Sandhill crane monitoring associated with the SFPR has been underway for four seasons. Initially it involved only crane observations in fields, though guided by the Mitigation Monitoring Plan agreed to between the regulators and the MoT, it now includes behavioural observations, field/cover crop assessments and satellite tracking of cranes (**Figure 3**).

3.2 MONITORING RESULTS

The MoT monitoring results indicate that the selection and use of agricultural fields by sandhill cranes were influenced by multiple factors; but repeatedly and through a number of data types and analyses cover crops of young and seeded barley emerged as the most important factor. Based on data from the preference and utilisation indices (**Figure 4**) and behavioural observations (**Figure 5**), seeded and young barley is the preferred cover crop, selected for by staging sandhill cranes over others. Of the 34 cover types tested, nine were preferred (preferred covers only shown on **Figure 4**). Of the preferred cover types the ones with most availability and utilisation (time spent on that crop) were seeded and young barley. From behavioural observations, the cumulative time spent on crop types also showed the importance of seeded and young barley to cranes. The continued provision of these cover types during construction and operation of the SFPR is expected to provide resources such that cranes will seek unaffected fields with suitable foraging attributes in the Crescent Slough staging/foraging area when parts of the currently preferred fields are developed by the SFPR.

The importance of the Crescent Slough staging/foraging area likely lies in the provision of multiple fields of this cover type in close proximity, which sequentially reach optimal conditions for cranes; as well as nearby grass fields providing access to invertebrates, and fields providing grit to facilitate digestion of plant material (**Figure 6** – note the prevalence of orange and pea-green hatched fields in close proximity to each other (pink box) in the west of the study area). Field management in this area is conducted by five different landowners, each with a slightly different schedule for harvest of summer cash crops and the planting of winter cover crops in the fall. The slight variability in dates of barley planting in this area creates a mosaic of nearby fields with slightly different stages of barley germination, at least one of which will likely satisfy crane requirements. Cranes range across the Crescent Slough staging/foraging area in the fall, selectively choosing the field or fields with optimal barley characteristics on that day.

The maintenance of such characteristics on nearby and unaffected fields during construction and operation of the SFPR project is considered to provide conditions for continued sandhill crane use in the

fall. In the event of any SFPR-related impacts, this work has shown how to develop mitigation to restore (or enhance) these characteristics to minimise impacts. It has also shown that cranes are not wholly dependent on this area; satellite data indicate they range widely across the lower Fraser Valley (**Figure 7**). This suggests that while mitigation in the event of an impact would be most easily applied in the Crescent Slough staging/foraging area, other nearby areas already have appropriate characteristics, that could in cooperation with landowners be developed for more optimal crane foraging conditions.

3.3 INTERPRETATION FOR SFPR MANAGEMENT

The crane use and field selection results have provided the MoT with more evidence that SFPR-related residual impacts are non-significant, and that management of fields (mitigation) for sandhill crane fall staging requirements is possible. In this respect the Mitigation Monitoring Plan:

1. Continues to indicate that impacts are low and no specific mitigation is needed at this time;
2. Shows they type of mitigation that would be successful (and that it is practical); and
3. Provides information for broader sandhill crane habitat enhancement in the Lower Mainland.

While the SFPR will directly and indirectly remove sandhill crane habitat, there are not likely to be significant residual impacts on cranes if a large number of proximally located fields with appropriate timing of the cash crop harvest and barley planting are maintained. Maintenance of such conditions in the unaffected parts of the area is the key to avoiding impacts; or to providing mitigation within or outside the area if there are any SFPR impacts that need to be addressed. Such mitigation / enhancement measures would require cooperation and collaboration between landowners and the MoT to plant winter cover crops (specifically barley) on adjacent fields spread over a number of days such that over the course of the 20 to 30 days of fall staging for sandhill cranes fields gradually reach optimal conditions for sandhill crane (germinating shoots ~ 5-7 cm length. It also shows that hedgerows proposed to be planted adjacent to the SFPR to mitigate for visual sensory disturbance on cranes might still be useful, but regulators desires for noise walls to mitigate for noise impacts are likely not needed. Cranes already use areas close to existing highways in the study area as long as a food resource is available.

Mitigations to enhance field characteristics for sandhill cranes could also be usefully applied by others to other areas, and point out the impacts of land conversion to non-preferred crops (berries). In this respect the MoT Mitigation Monitoring Plan has provided information for broader sandhill crane conservation needs; showing that areas with many berry crops (cranberries and blueberries) such as occur in parts of the study area not used heavily by cranes (royal-blue coloured fields in **Figure 6**) are less valuable. That fields in the study area and beyond in other parts of the lower Fraser Valley are rapidly being converted

from the fields with summer cash crops and winter cover crops preferred by cranes to cranberry and blueberry fields is likely already impacting sandhill cranes. Such information is considered by the MoT to be valuable in providing wider management for the species.

4.0 SUMMARY

A key commitment associated with EA approvals for the SFPR was the development and implementation of long-term monitoring and follow up program to address concerns raised by regulators regarding the effectiveness of non-standard mitigation, level of impacts and a preliminary reference design. The Mitigation Monitoring Plan was an innovative approach to resolving the difficulties in the EA process and provides an effective tool for transportation proponents; particularly those involved in design build projects (P3) and regulators. For this project it was a valuable commitment that allowed the project to gain environmental certifications, and such approaches have applicability to other transportation infrastructure facing similar issues.

The value of the Mitigation Monitoring Plan lies in the provision of a process that achieves multiple goals around the central aim of giving more certainty for proponent and regulator decision making. In particular it:

- Increases baseline conditions knowledge (for better impact assessment prediction);
- Identifies the need for mitigation;
- Is collaborative, allowing all involved to input to the program;
- Reports on mitigation efficacy;
- Defers (or removes) mitigation costs until their need is confirmed; and
- Provides a process for continual improvement of impact management.

Since the SFPR project achieved its EA approvals, implementation of the Mitigation Monitoring Plan has shown the power of this tool in achieving the desired outcomes. Monitoring of baseline conditions conducted by the MoT on sandhill crane continues to confirm the EA predictions that there are not likely to be significant long-term impacts from the SFPR on this species. The information gathered is also being used to guide the development of mitigation, and is currently showing that additional mitigation beyond that already committed to by the MoT (hedgerows) is not needed. For example, there is no evidence yet to suggest the need for costly and spatially greedy noise walls.

Further, and of relevance to conservation management, is that adaptive management in general, and the SPFR Mitigation Monitoring Plan in particular, is a long-term and inclusive approach that provides benefit to the MoT in managing the effects of its project, and to regulators in ensuring that appropriate

management for the project is being conducted. The information gained can also be used for wider benefit in managing the same resources for sandhill cranes in other areas.

The applicability to transportation and cost-effectiveness of this adaptive management approach to environmental management is that it provides for the staged development of mitigation and the application of mitigation that is known to be required. Such an approach provides an alternative to the more traditional and conservative approach of applying additional (costly and potentially unnecessary) mitigation without confirming the need for this mitigation. As such, the adaptive management approach being used for the SFPR is particularly relevant to use on other transportation developments, especially those being advanced through a design, build, finance and operate (DBFO or P3) model, where detailed project related information (design and environmental) may not available during the environmental assessment process. In such situations this approach can provide regulators with the certainty that appropriate management will be conducted, easing the way for project approvals in light of suspected uncertainties around impact assessment and or mitigation efficacy.

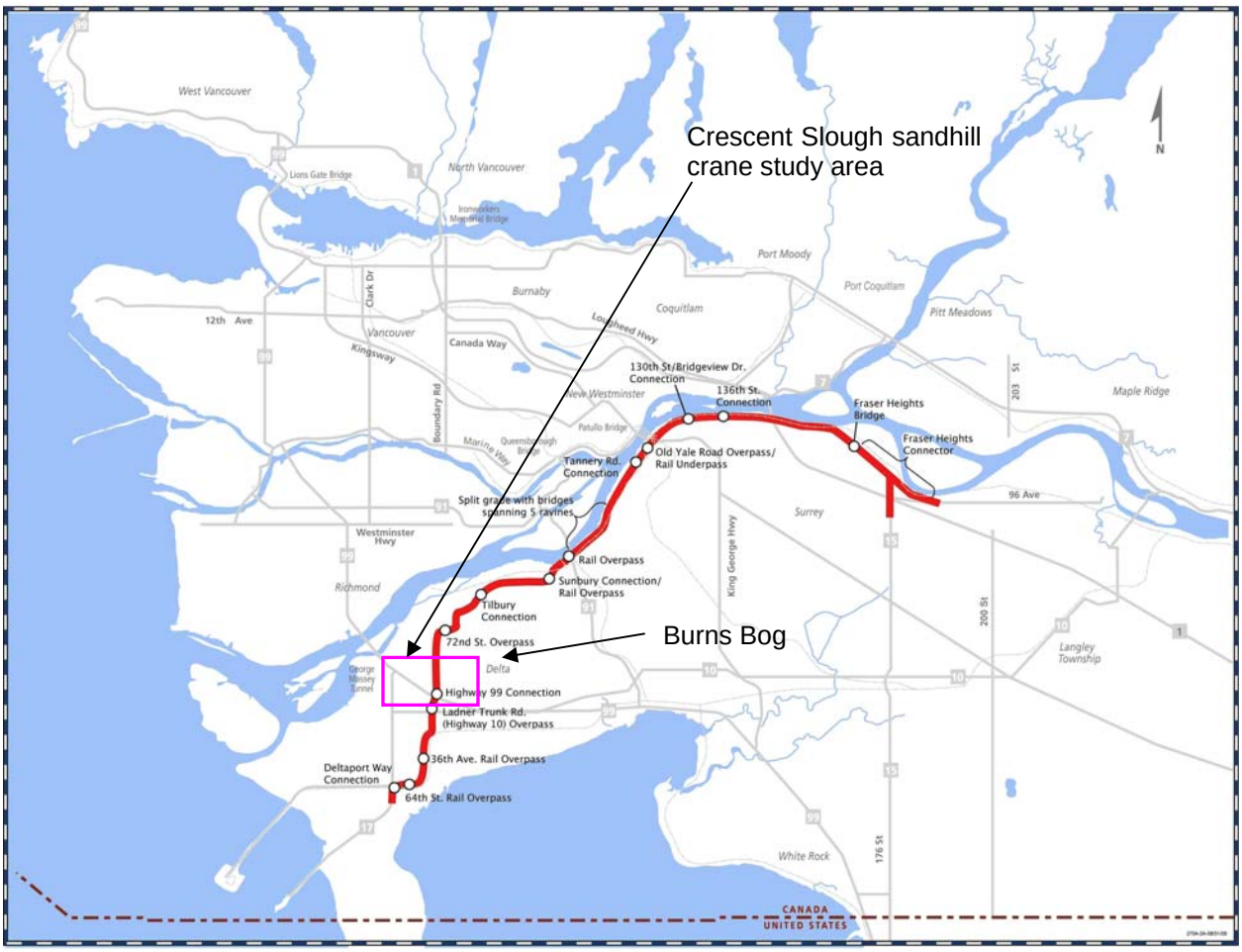


Figure 1: **South Fraser Perimeter Road and the lower Fraser Valley (Lower Mainland).**

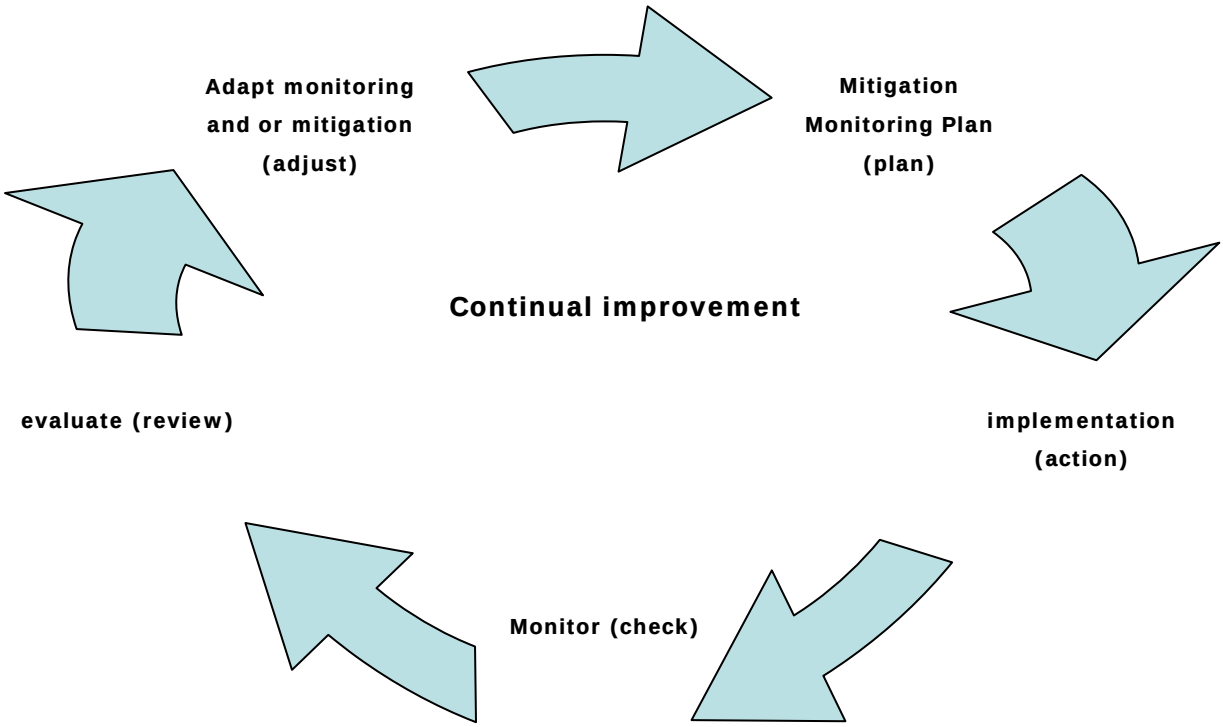


Figure 2. **Continual Improvement Cycle used as the basis for the SFPR Mitigation Monitoring Plan**

Figures 3: **Sandhill crane monitoring activities; behavioural observations (L) and satellite transmitter fitting (R). Note: satellite transmitter aerial.**

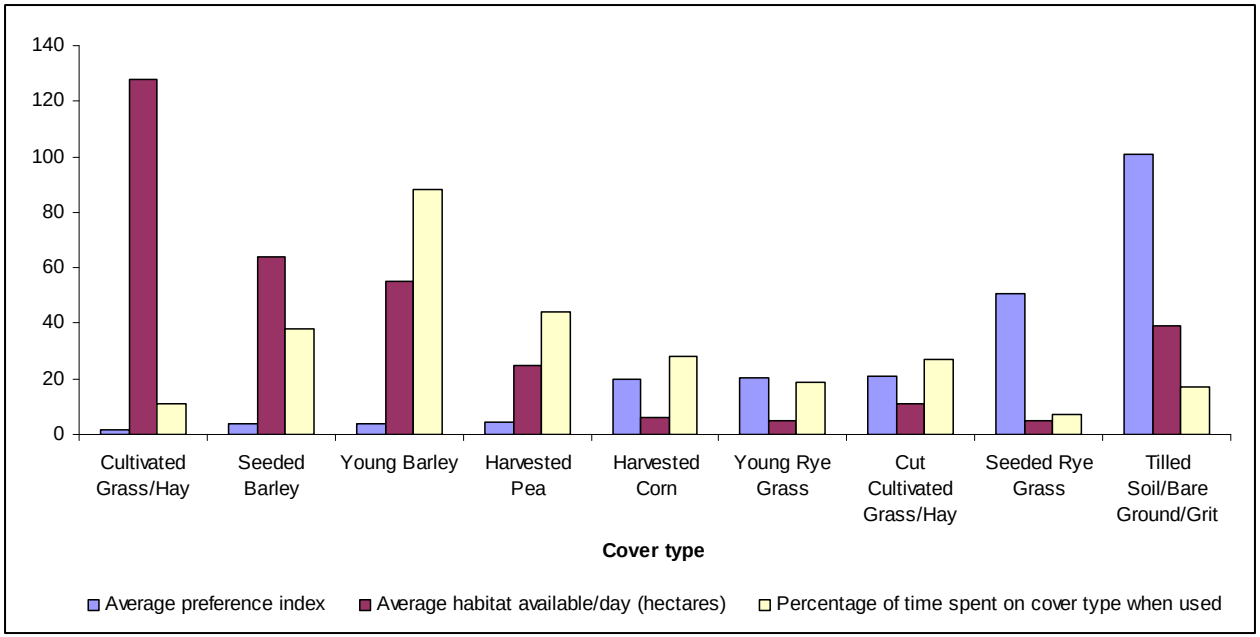


Figure 4: **Average preference index (blue), average availability (red), utilization and (tan) for each of the preferred cover types. Note; high preference (blue) often occurs for crops that have limited availability (red) – giving lower utilisation (e.g., rye). The importance of seeded and young barley and harvested pea is shown by high utilisation and high availability.**

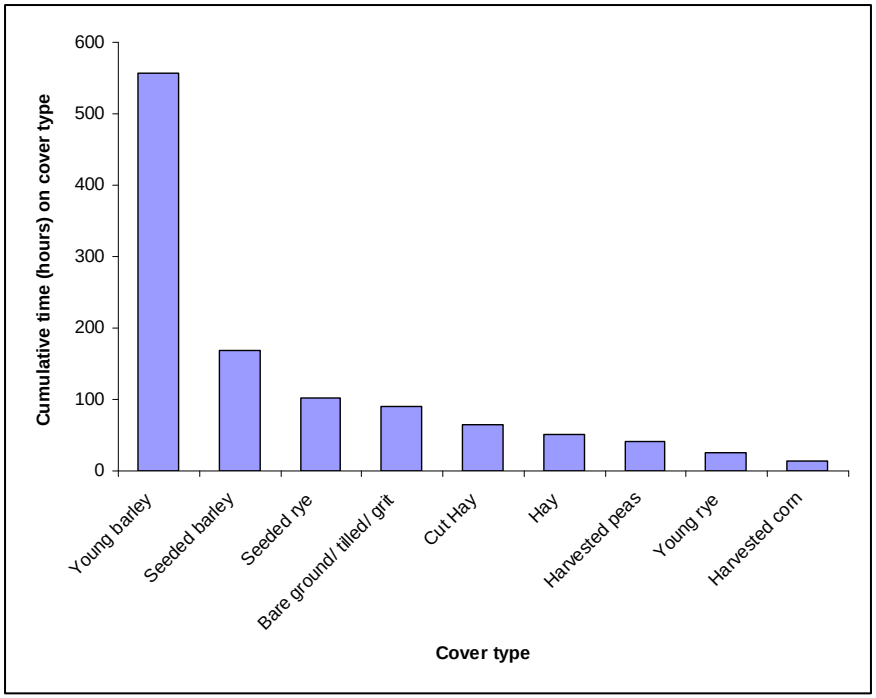
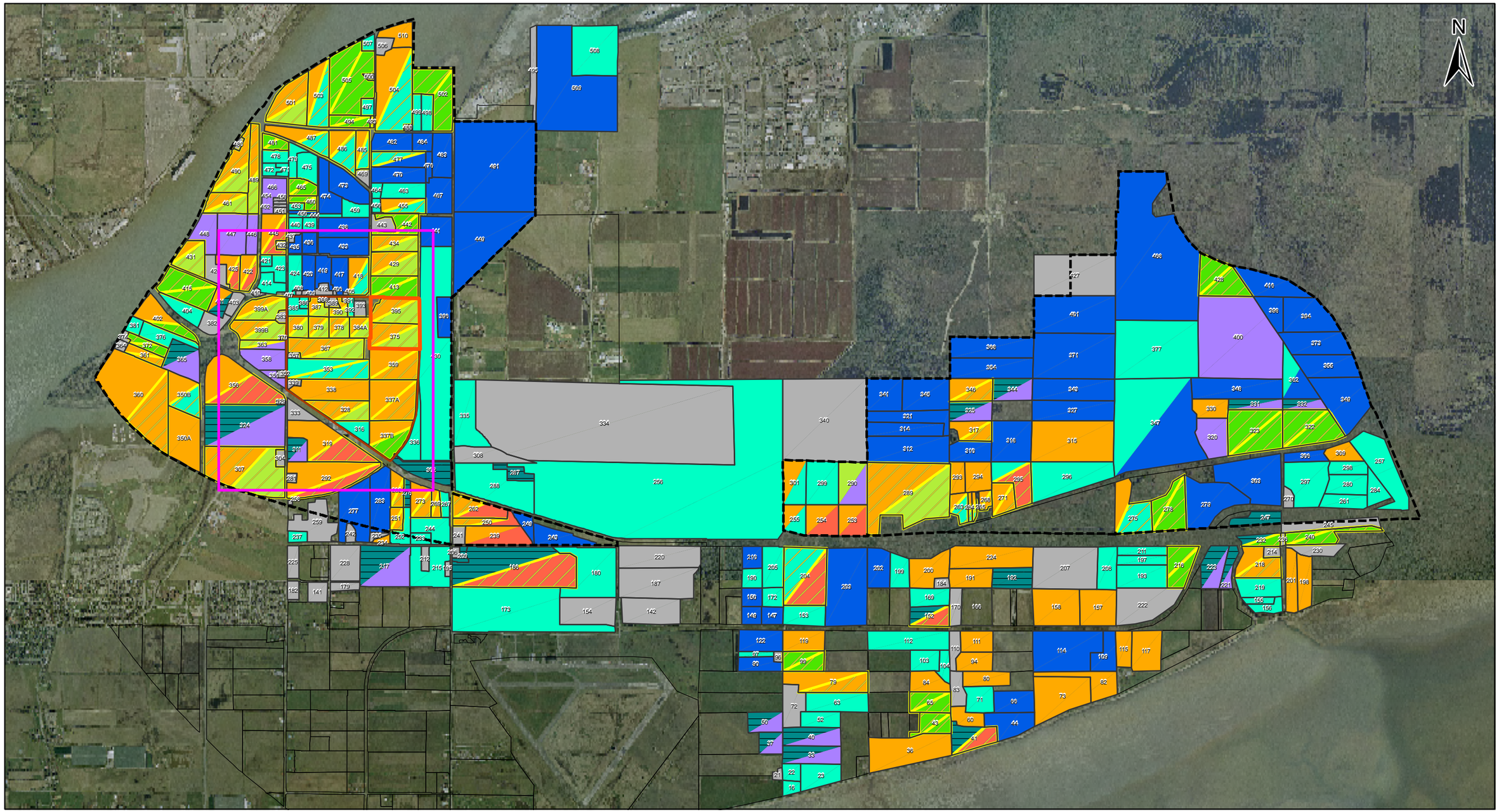


Figure 5: **Cumulative time spent on cover types by sandhill cranes during fall 2008. Cranes spent more time on young and seeded barley than all other cover types.**



Legend

- StudyArea
- Overall Trapping Area
- Primary Trapping Area
- Berries Present
- Field Boundaries and Numbers

Field Divider

- Left Side, Early Season
- Right Side, Late Season

- Preferred Cover

Cover Type

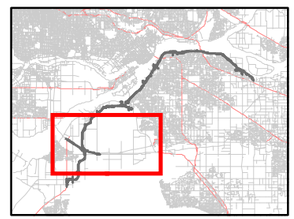
- Berries
- Cash Crop
- Cultivated Grass
- Early Winter Cover Crop
- Late Winter Cover Crop
- Winter Cover Crop
- Developed
- Unknown
- Other

Notes: Base imagery from openmaps.gov.bc.ca

Figure 6

Land cover types within and outside the sandhill crane study area during fall 2008, Delta, BC. Changes in cover during the season due to harvesting are indicated by the diagonal line bisecting fields.

500 250 0 500 1,000 1,500 2,000
Meters



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February, 2009

a)

b)

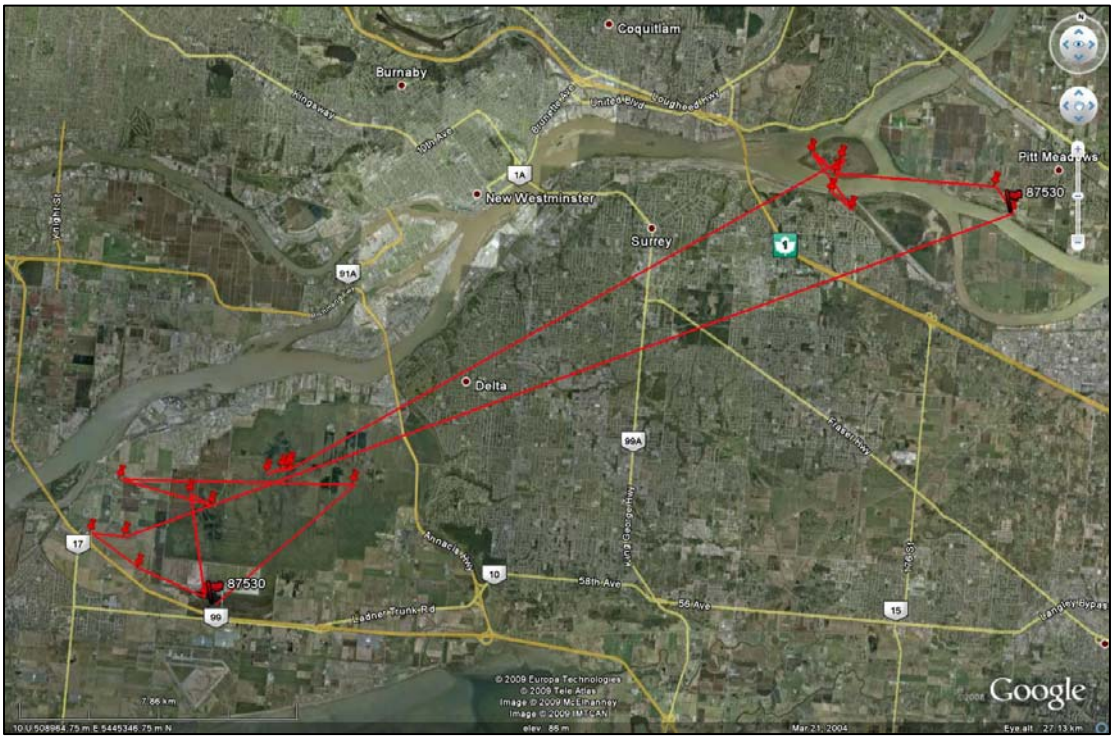

Figure 7: **Sandhill crane movement / distribution as shown by satellite telemetry data. Note high sandhill crane use in the Burns Bog roost site (a centre) and around Crescent Slough and agricultural fields (a and b left), but with use of areas beyond these at Annacis Island (a top), south of Ladner Trunk Road (a bottom) and Douglas Island and Pitt Meadows Airport (b top). Note, maps are dissimilar scales, but the core study area shown in a) is at the left side of b).**