# ROBERTS BANK TERMINAL 2
# TECHNICAL DATA REPORT
## Terrestrial Wildlife and Vegetation
## Barn Owl Habitat Suitability, Habitat Use, Site Occupancy and Collision Study

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**Technical Report/Technical Data Report Disclaimer**

The Canadian Environmental Assessment Agency determined the scope of the proposed Roberts Bank Terminal 2 Project (RBT2 or the Project) and the scope of the assessment in the Final Environmental Impact Statement Guidelines (EISG) issued January 7, 2014. The scope of the Project includes the project components and physical activities to be considered in the environmental assessment. The scope of the assessment includes the factors to be considered and the scope of those factors. The Environmental Impact Statement (EIS) has been prepared in accordance with the scope of the Project and the scope of the assessment specified in the EISG. For each component of the natural or human environment considered in the EIS, the geographic scope of the assessment depends on the extent of potential effects.

At the time supporting technical studies were initiated in 2011, with the objective of ensuring adequate information would be available to inform the environmental assessment of the Project, neither the scope of the Project nor the scope of the assessment had been determined.

Therefore, the scope of supporting studies may include physical activities that are not included in the scope of the Project as determined by the Agency. Similarly, the scope of supporting studies may also include spatial areas that are not expected to be affected by the Project.

This out-of-scope information is included in the Technical Report (TR)/Technical Data Report (TDR) for each study, but may not be considered in the assessment of potential effects of the Project unless relevant for understanding the context of those effects or to assessing potential cumulative effects.

## EXECUTIVE SUMMARY

The Barn Owl Habitat Suitability, Habitat Use, Site Occupancy and Collisions Study (the Study) was conducted as part of an environmental program for the proposed Roberts Bank Terminal 2 Project (Project or RBT2), and focused on collecting information to develop an understanding of existing conditions in the study area. The Project, part of Port Metro Vancouver's Container Capacity Improvement Program, is a proposed new three-berth marine container terminal located at Roberts Bank in Delta B.C.

Barn owl (*Tyto alba*) was selected as a focal raptor species for Project-related field studies because it is known to occur within the terrestrial study area, could potentially be affected by Project-related disturbances, and is listed as Threatened by the Committee on the Status of Endangered Wildlife in Canada, Special Concern under the *Species at Risk Act,* and Blue-listed by the province. These ratings indicate that barn owl has characteristics that make it particularly sensitive to human activities or natural events.

Desktop and field studies were undertaken to understand whether barn owls were likely to use habitats adjacent to the road and rail alignments associated with Roberts Bank terminals. Specific studies included habitat suitability assessments, roadside and rail use field surveys, and nest and roost site occupancy surveys. Carcass searches were also conducted to determine the number and spatial distribution of barn owls killed by collisions with vehicles and trains.

The spatial scope of the Study includes terrestrial areas at Roberts Bank. The Study was planned and completed prior to the Project scope being finalised, and the overall objective of this study was to ensure that adequate information is available to inform a future effects assessment for the Project. Although the Project scope includes less than 1 ha of area above the high-water mark on British Columbia Railway Company (BCR) owned lands, the spatial scope for the Study was much larger.

The roadside and rail-side habitat use and habitat suitability study areas consisted of a 500 m-wide buffer on both sides of the British Columbia Railway (BCR) right-of-way (i.e., ~1 km wide corridor) from the east end of the Roberts Bank causeway to the 72$^{nd}$ Street crossing in Delta. The study area for the collision surveys consisted of approximately 10 m on both sides of Deltaport Way and the BCR right-of-way for 10 km from the east end of the Roberts Bank causeway east to the 64$^{th}$ Street crossing. The study area for the nest and roost site occupancy study was approximately 1 km on either side of the BCR right-of-way (i.e., ~2 km wide corridor), from the east end of the Roberts Bank causeway to where the railway right-of-way crosses Highway 99.

The habitat suitability assessment determined that 40% of the study area provided moderate to high-suitability barn owl foraging habitat. The roadside and rail habitat surveys confirmed that barn owls use roadside and rail habitats within the study area, which is consistent with the habitat suitability assessment, current knowledge on landscape requirements for barn owl foraging, and with Townsend's vole (*Microtus townsendii)* habitat suitability mapping.

Barn owl and great horned owl (*Bubo virginianus*) were the only owl species observed during the roadside and rail habitat field surveys. Use of the study area by barn owls was documented most frequently in two general areas: (1) between the east end of the Roberts Bank causeway and 41B Street, and; (2) between Arthur Drive and 64$^{th}$ Street near moderate-quality (i.e., grassy verges) and high-quality (i.e., grass-dominated, abandoned fields) foraging habitat. Barn owl crossings were most frequently observed near Arthur Drive, which is adjacent to high-quality and moderate-quality foraging habitat. The majority of active nest and roost sites were also found in this area.

Eighteen active barn owl nest and roost sites were identified within the study area during the 2013 breeding season (April to August). Of the 18 occupied sites, nine were used for breeding, seven were occupied but breeding was not confirmed, and two were identified as roost sites only. Of the nine nest sites where breeding activity was documented (i.e., evidence of egg laying, incubation, or young), seven were physically checked for visual and auditory cues to determine the number of fledglings. The average number of young fledged per active nest was 2.7.

Six barn owl carcasses were detected within the study area from December 2012 to April 2013, equating to an estimated 13 mortalities within the study area when corrections are applied to account for searcher efficiency and scavenger removal biases. Carcasses were found adjacent to moderate-quality (i.e., verges, hayfield) and low-quality (i.e., broadleaf herbaceous) foraging habitat. Three of the six carcasses were found within 250 m of each other, despite only 4% of all barn owl observations (excluding crossings) being documented in the vicinity. The cause of death was presumed to be vehicular for two carcasses, train-related for one carcass, and not determined for the remaining three carcasses.

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# 1.0 INTRODUCTION

This section provides an overview of the study, including project background, study overview, and study components and major objectives.

## 1.1 PROJECT BACKGROUND

The Roberts Bank Terminal 2 Project (RBT2 or the Project) is a proposed new three-berth marine terminal at Roberts Bank in Delta, B.C. that could provide 2.4 million TEUs (twenty-foot equivalent unit containers) of additional container capacity annually. The project is part of Port Metro Vancouver's Container Capacity Improvement Program, a long-term strategy to meet anticipated growth in demand for container capacity to 2030.

Port Metro Vancouver has retained Hemmera to undertake environmental studies to inform a future effects assessment for the Project. This technical data report describes the results of the Barn Owl (*Tyto alba*) Habitat Suitability, Habitat Use, Site Occupancy and Collision Study (the Study).

## 1.2 BARN OWL STUDY OVERVIEW

The spatial scope of the Study includes terrestrial areas at Roberts Bank. The Study was planned and completed prior to the Project scope being finalised, and the overall objective of this study was to ensure that adequate information is available to inform a future effects assessment for the Project. Although the Project scope includes less than 1 ha of area above the high-water mark on British Columbia Railway Company (BCR) owned lands, the spatial scope for the Study was much larger.

A review of available information and state of knowledge for barn owl was undertaken to identify key data gaps and areas of uncertainty within the general Project area. Study components, major objectives and a brief overview are provided in **Table 1**.

**Table 1 Barn Owl Study Components and Major Objectives**

| Component | Major Objective | Brief Overview |
|---|---|---|
| 1) Habitat suitability assessment | Understand barn owl habitat suitability in and around the existing road and rail right-of-way corridor in the study area. | A habitat suitability assessment was conducted to assess whether barn owls were likely to use habitats adjacent to the road and rail alignment. |
| 2) Roadside and rail habitat use | Understand barn owl habitat use in and around the existing road and rail right-of-way corridor in the study area. | As barn owls are vulnerable to vehicle collisions, modified crepuscular (i.e., dawn and dusk) roadside surveys were conducted to understand barn owl use of open habitat near the existing road and rail right-of-way corridors. |

| Component | Major Objective | Brief Overview |
|---|---|---|
| 3) Collision surveys | Estimate the number and spatial distribution of barn owls killed or injured by collisions with vehicles and trains within the study area. | Carcass search surveys were conducted to estimate the numbers, demographics (if possible) and spatial distribution of barn owls affected by road and rail collisions in the study area. |
| 4) Barn owl nest and roost site occupancy | Estimate the number and spatial distribution of active nest and roost sites within the study area. | Nest and roost site occupancy surveys were conducted to monitor and estimate the number of active nest and roost sites, and to discern whether there are any patterns between road-side foraging areas and active barn owl sites. |

The habitat suitability assessment was supported by other Project-related environmental studies, in particular the Small Mammals Habitat Inventory Study (Hemmera 2014*a*) and the Terrestrial Ecosystem Mapping (TEM) Study (Hemmera 2014*b*).

## 2.0 REVIEW OF AVAILABLE LITERATURE AND DATA

Barn owls are Blue-listed by the B.C. Conservation Data Centre (CDC), Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and of Special Concern in Schedule 1 of the federal *Species at Risk Act* (*SARA*). Species of Special Concern have characteristics that make them particularly sensitive to human activities or natural events (Environment Canada 2012), but are not currently considered to be Endangered or Threatened. Threatened species are likely to become Endangered if nothing is done to reverse the factors leading to their extirpation or extinction.

Barn owls are at the northernmost extent of their North American range in B.C. Their presence in the Lower Mainland is limited to agricultural areas such as in southwest Delta, where some of the highest barn owl densities in Canada occur (Campbell et al. 1990). Barn owls generally forage over open fields, grasslands and agricultural areas where they prey almost exclusively on small mammals, particularly Townsend's vole (*Microtus townsendii*) (BC CDC 2013).

A variety of man-made and natural structures, including wooden barns, concrete silos, bridges, nest boxes, hollow tree cavities, river banks, and abandoned hawk nests are used by barn owls as nest and roost sites (Marti et al. 1979, Campbell et al. 1990, Andrusiak 1994). The most common nest sites are wooden platforms high in old wooden barns (BC CDC 2013).

Barn owls are threatened by the ongoing loss of foraging, nesting and roosting habitats in the Lower Mainland through urban and industrial development of agricultural lands, and the decay and demolition of old wooden barns and outbuildings.

Barn owls often hunt from perches such as fence posts, but also spend a great deal of time flight-hunting in low ($\leq$4m) quartering flights over suitable habitat (Taylor 1994). They frequently hunt along roadside verges, where their low, slow flight makes them particularly vulnerable to vehicle-induced collision mortality (COSEWIC 2010), particularly along major roads (Andrusiak 1994, Ramsden 2003, Preston and Powers 2006). In the United Kingdom, 50% of barn owl mortalities were attributed to road traffic, and barn owls were the most frequently recovered raptor or owl species (Ramsden 2003).

Between 1987 and 2005, Preston and Powers (2006) recorded vehicle-related mortality of 10 owl species in the Lower Mainland and Central Fraser Valley. Barn owl was the most frequently collected species (57%; n = 952). In Delta alone, barn owl accounted for more than 80% of owls collected. Andrusiak (1994) reviewed B.C. Ministry of Environment taxidermy permit records from 1983 to 1992 and reported that 63% (n = 341) of barn owl carcasses collected in the Lower Mainland were a result of vehicle collisions. These studies highlight the vulnerability of barn owls to vehicle collisions.

Barn owl road mortality appears to be the greatest during the winter months (December to April) in the Lower Mainland (Andrusiak 1994, Preston and Powers 2006). Other studies have reported a higher incidence of immature barn owl road mortalities in the fall, when fledglings are dispersing, relative to mortality of adult birds (Massemin et al. 1998, Boves and Belthoff 2012).

Road-related mortality in the Lower Mainland is expected to increase as road networks and traffic volumes increase. Infrastructure such as roads and railways also fragments the owls' foraging habitat (Jaeger et al. 2005, Boves and Belthoff 2012).

# 3.0 METHODS

Descriptions of the spatial and temporal scopes of the Barn Owl Study, plus methods are provided below.

## 3.1 STUDY AREAS

Different study area boundaries were used for the four barn owl studies. The study area for the barn owl habitat use study and the habitat suitability study was 500 m from the centreline of the British Columbia Railway Company (BCR) right-of-way for 10 km, from the east end of the Roberts Bank causeway to 72nd Street (**Appendix A: Figure 1**). This area was selected to understand the potential for collision effects on barn owl foraging around their nesting and roosting locations.

The study area for the collision study was approximately 10 m on either side of Deltaport Way and the existing BCR right-of-way from the east end of the Roberts Bank causeway east to 64th Street. The study focussed on Deltaport Way, and not the feeder routes (e.g., Arthur Drive), as it was assumed that Deltaport Way is the main entry or exit route from the existing Roberts Bank terminals and carries the greatest volume of traffic (**Appendix A: Figure 2**).

The study area for the barn owl nest and roost site occupancy study was approximately 1 km on either side of the existing BCR right-of-way, from the east end of the Roberts Bank causeway east to where the BCR right-of-way crosses Highway 99. A 1 km buffer was used, since barn owls forage/hunt within a 1 km radius from their nest during the breeding season (average home range of 3 $km^2$; Taylor 1994) and are considered likely to use suitable habitats along the road and BCR rights-of-way **Appendix A: Figure 3**).

## 3.2 TEMPORAL SCOPE

Barn owls are most active during the breeding season (typically April to August), when they forage and return to their nest sites multiple times each evening to feed their chicks.

Surveys to document habitat use near the existing road and BCR rights-of-way were conducted from July to September, 2012, and from April to mid-July, 2013 during the crepuscular period (i.e., dawn and dusk). Nest and roost site monitoring was conducted during the day between April and August, 2013. To include the period when fledgling dispersal occurs, the collision component of the Study was conducted from December, 2012 to April, 2013 during daylight hours.

## 3.3 STUDY METHODS

### 3.3.1 Habitat Suitability Assessment

To assess whether barn owls are likely to use habitats adjacent to the road and rail alignment, a habitat suitability assessment was conducted. The assessment quantified the theoretical suitability of a habitat or ecosystem unit, in its current condition, to provide the life history requisites for barn owl (RISC 1999). The

life requisite rated for barn owl was 'living', which is satisfied by the presence of suitable foraging areas (mostly habitats suitable for Townsend's vole) close to roosting and nesting habitats. Because there is a large amount of information available concerning barn owl nest/roost availability and occupancy from the yearly monitoring conducted for the South Fraser Perimeter Road (SFPR) (Ministry of Transportation 2008), habitat suitability modeling focussed on foraging habitat in the study area.

A suitability rating is a value assigned to a habitat to describe its potential to support a given species by providing necessary life requisites during specific seasons of use (RISC 1999). Habitat ratings are assigned to each ecosystem unit (from TEM), and then projected onto the landscape where they are mapped using geographic information system (GIS) software. Habitat assessments quantify the presence of potential habitat; however, they do not provide a measure of the potential use of the habitat by a species or the species' abundance. Models can be verified by field surveys of species presence.

The ability to assign habitat suitability ratings depends on the state of the knowledge of a particular species' habitat requirements. For barn owl, an intermediate knowledge of foraging habitat requirements is available, which warrants a four-class rating scheme (RISC 1999).

Habitat suitability assessment methods were based on provincial RISC rating standards (RISC 1999). A barn owl species account was developed as there are no available standardised provincial ratings. The account included information on:

- Species name and conservation status;
- Geographic distribution;
- Ecology and key habitat requirements;
- Habitat use life requisites;
- Seasons of habitat use;
- Habitat use and ecosystem attributes; and
- Ratings assumptions.

Ratings for each TEM polygon were developed using a combination of TEM and species-specific life history requisite data obtained from the species account. The final habitat ratings values (i.e., high, moderate, low, nil) were projected onto the landscape and mapped using GIS software to create the foraging habitat suitability map (**Appendix A: Figure 4**).

#### *3.3.1.1 Barn Owl Foraging Habitat Suitability*

Barn owls require landscapes that provide adequate foraging habitat for primary prey (i.e., voles and mice), and suitable nesting and roosting sites such as barns and other accessible buildings with elevated platforms (Environment Canada 2012). Primary barn owl foraging habitats include old or abandoned agricultural fields, lightly grazed pastures, grass hayfields, salt marshes, and wet meadows (BC CDC 2013).

Townsend's vole, which is known to occur in salt and freshwater marshes, moist meadows (sometimes dry grass), wetlands, and riparian areas along streams, is the primary prey of barn owls in the Lower Mainland (Campbell et al. 1987). In B.C., voles are primarily associated with moist fields and sedge meadows of the alluvial areas of the Fraser River delta and Vancouver Island (Nagorsen 2005) with old field and grassland set-asides among the most productive habitats (M. Merkens *pers. comm.* 2008; Hindmarch 2010). Townsend's voles are common in grassland and upper intertidal habitats within the study area (Hemmera 2014*a*).

Barn owls are year-round residents in B.C.; therefore, their living habitat requisites remain the same throughout the entire year. **Table 2** outlines how the owls' life requisites relate to specific ecosystem attributes collected as part of the TEM conducted (Hemmera 2014*b*).

**Table 2 Terrestrial Ecosystem Mapping (TEM) Relationships for Life Requisites for Barn Owl**

| Life Requisite | TEM Attribute |
|---|---|
| Living Habitat (LI) - foraging | **Site:** land cover classification, structural stage<br>**Vegetation:** crop cover, vegetation type |

Methods used for the TEM followed a modified provincial standard due to extensive agricultural activity in the study area. Ecosystems were defined and delineated based on crop cover and vegetation type, with modifiers for frequency of disturbance, and were designed to support wildlife habitat suitability modeling (Hemmera 2014*b*).

Hindmarch et al. (2012) categorised grass cover into five categories based on the intensity of use (i.e., mowing), a factor that is linked to vole densities (Tattersall et al. 2000, Butet and Leroux 2001, Aschwanden et al. 2007):

1) Permanent grasslands;
2) Grassland set-asides (areas of grass that are not disturbed for up to four years);
3) Pastures (areas of grass that are lightly grazed);
4) Hayfields (areas of hay where the crop that is mowed up to four times per year); and
5) Grassy verges along road and field edges (mowed four to six times per year).

### 3.3.2 Roadside and Rail Habitat Use Surveys

Because barn owls are most vulnerable to vehicle collisions when they are active at night, modified crepuscular) (i.e., dawn and dusk) roadside surveys (RISC 2001) were conducted. Barn owls use open habitats and are conspicuous during roadside surveys conducted just before sunset or just before sunrise (RISC 2001). In the vicinity of the Gulf Yard (**Appendix A: Figure 1**), encounter transects were conducted along Deltaport Way, from the east end of the Roberts Bank causeway to Highway 17, and along the gravel access road on the south side of the rail right-of-way from the BCR office at 27B Avenue east to 64$^{th}$ Street. Each transect was driven at least once during each survey, with the starting point varied among surveys.

The Fisher Yard consists of a single rail track within the 30 m-wide rail right-of-way, does not have an access road, but overlaps with the SFPR alignment **(Appendix A: Figure 1)**. Road access along the SFPR in the vicinity of the Fisher Yard was granted by the provincial Ministry of Transportation and Infrastructure (MoTI), and encounter transects were conducted from Highway 17 to 72$^{nd}$ Street. The following transects were used:

1) Deltaport Way – West to East;
2) Deltaport Way – East to West;
3) BCR Road – West to East;
4) BCR Road – East to West;
5) SFPR to 72$^{nd}$ Street; and
6) 72$^{nd}$ Street to SFPR.

The number of barn owls observed along each transect was recorded, and the locations were recorded using a handheld global positioning system (GPS) unit. Other data collected included:

- Observer(s) name;
- GPS identifier;
- Basic weather data;
- Survey route and direction travelled (i.e., Deltaport Way – West to East), and start and end time for each transect route;
- Speed travelled (km/hr) along the transect route;
- Distance travelled along transect route (km); and
- Incidental observations of other wildlife species within the study area.

If barn owls were observed the following information was recorded:

- General behaviour (e.g., hunting, flying over, perched);
- Number of owls;
- Age of each owl (if possible); and
- If barn owls were observed crossing the road or rail rights-of-way, the following information was recorded:
  - Time of crossing;
  - Flight direction;
  - Activity on road or railway at time of crossing (e.g., truck traffic, no traffic, railcars present (stationary/moving)), no railcars);
  - Approach behaviour to vehicles (rail or road); and
  - Estimated crossing height relative to road or rail.

Field equipment included binoculars, GPS, and smartphones for data entry.

Eight surveys were conducted between July and September, 2012 (~32.5 person-hours), and 16 surveys were conducted between April and mid-July, 2013 (~41.0 person-hours) (**Table 3**). Surveys were typically two to three hours in length, and conducted weekly by one biologist. During the 2012 surveys, the start time alternated each week, with one week starting approximately two hours after sunset, and the next week starting just before or after midnight (**Table 3**). Results from the 2012 survey indicated that a greater number of barn owl observations were made during the later survey periods (i.e., just before or after midnight), which was taken into consideration during the 2013 surveys (**Table 3**).

**Table 3** below summarises survey dates, duration, and person hours. Biologists were rotated each survey to minimise observer bias.

**Table 3 Survey Effort for Roadside Barn Owl Surveys - 2012 and 2013**

| Date | Sunset | Start time | End time | Approximate Person Hours |
|---|---|---|---|---|
| July 4, 2012* | 20:18 | 22:15 | 01:10 | 6 |
| July 13, 2012* | 20:14 | 00:45 | 03:31 | 5.5 |
| July 18, 2012* | 20:09 | 22:35 | 01:43 | 6.5 |
| July 26, 2012 | 20:00 | 00:45 | 03:54 | 3 |
| August 2, 2012 | 19:50 | 23:08 | 01:49 | 3 |
| August 14, 2012 | 19:30 | 21:31 | 00:21 | 3 |
| August 23, 2012 | 19:12 | 23:50 | 02:53 | 3 |
| September 11, 2012 | 18:33 | 00:20 | 02:58 | 2.5 |
| | | | **Total 2012** | **32.5** |

| Date | Sunset | Start time | End time | Approximate Person Hours |
|---|---|---|---|---|
| April 3, 2013** | 19:49 | 21:29 | 23:48 | 6.75 |
| April 11, 2013 | sunrise 06:28 | 04:06 | 06:23 | 2.25 |
| April 18, 2013 | 20:10 | 22:28 | 00:28 | 2 |
| April 26, 2013 | sunrise 05:59 | 03:33 | 05:46 | 2.25 |
| May 3, 2013 | 20:33 | 22:45 | 00:38 | 2 |
| May 7, 2013 | 20:39 | 23:31 | 02:28 | 3 |
| May 20, 2013 | 20:56 | 23:30 | 01:25 | 2 |
| May 21, 2013 | 20:58 | 23:53 | 02:24 | 2.5 |
| June 2, 2013 | 21:11 | 23:10 | 12:53 | 1.75 |
| June 9, 2013 | 21:17 | 21:41 | 00:13 | 2 |
| June 12, 2013 | 21:19 | 01:10 | 02:52 | 1.5 |
| June 27, 2013 | 21:22 | 21:53 | 00:28 | 2.5 |
| July 1, 2013 | 21:21 | 01:05 | 03:00 | 2 |
| July 5, 2013 | 21:20 | 00:30 | 03:05 | 2.5 |
| July 10, 2013 | 21:17 | 21:56 | 00:30 | 2.5 |
| July 18, 2013 | 21:10 | 00:00 | 03:30 | 3.5 |
| | | | **Total 2013** | **41.0** |

**Note:** * Higher person hours in early July 2012 surveys were because two biologists conducted surveys
** April 3, 2013 survey was training for the 2013 season, and was conducted by three biologists

Weather conditions during all surveys days were appropriate for conducting roadside surveys (i.e., little to no rain, and no fog), with the exception of brief fog patches on April 11 and May 22, 2013, and a brief period of heavy rain during the April 18, 2013 survey.

A total of 222.9 km were travelled along the transect routes during the 2012 surveys, and 457.3 km were travelled during the 2013 surveys (**Table 4**). The average speed during surveys was 23.1±8.1 km/hr in 2012 and 17.2±3.4 km/hr in 2013. A breakdown of the distance within each of the six transects is provided in **Table 4** below.

**Table 4 Kilometers Travelled in each Transect in the Study Area – 2012 and 2013**

| Transect Route | Distance Travelled (km) | | |
|---|---|---|---|
| | 2012 | 2013 | Total for Both Years |
| 1. Deltaport Way – West to East | 52.7 | 81.9 | 134.6 |
| 2. Deltaport Way – East to West | 47.5 | 71.7 | 119.2 |
| 3. BCR Road - West to East | 36.1 | 88.0 | 124.1 |
| 4. BCR Road - East to West | 42.2 | 93.4 | 135.6 |
| 5. SFPR to 72nd Street | 24.7 | 61.4 | 86.1 |
| 6. 72nd Street to SFPR | 19.7 | 60.9 | 80.6 |
| **Total** | **222.9** | **457.3** | **680.2** |

The total distance travelled along the SFPR alignment in 2012 was less than other transects due to access restrictions (e.g., permission not obtained, construction activities) on July 4, August 23, and September 11, 2012. The SFPR transects were surveyed more evenly during the 2013 survey period (**Table 5**).

**Table 5 Number of Times Survey Routes were Driven – 2012 and 2013**

| | Survey Route Transects | | | | | |
|---|---|---|---|---|---|---|
| **Year Survey Route Driven** | **BCR Road – East to West** | **BCR Road – West to East** | **Deltaport Way – East to West** | **Deltaport Way – West to East** | **SFPR – East to West** | **SFPR – West to East** |
| 2012 | 7 | 6 | 8 | 10 | 5 | 6 |
| 2013 | 15 | 14 | 13 | 15 | 14 | 14 |

### 3.3.3 Collision Surveys

Carcass search surveys, which were conducted from December 5, 2012 to April 1, 2013, were conducted to estimate the numbers, demographics where possible, and spatial distribution of barn owls affected by road and rail collisions in the study area. A permit to implement the carcass searches under the provincial *Wildlife Act* was obtained, and was on hand during all field activities. The study was based on methods developed for a 2012 to 2013 study of the effects of overhead transmission wires and vehicular traffic on birds (Hemmera 2014*c*), which were largely based on methods used by Burger and Cassidy (1995) and Cassidy et al. (1998) and OMNR (2011). Modifications included shortening the interval between surveys from seven to ten days to four days, and modifying aspects of scavenger removal and searcher efficiency trials.

On November 29, 2012, prior to initiating the carcass survey program, the study area (**Appendix A: Figure 2**) was searched for existing carcasses and bird remains to ensure that carcasses found during the study were associated with mortalities occurring during the study period. The November 29 survey was conducted following the same protocol as standardised surveys (see below), except that any barn owl carcasses detected were not collected or moved, because the permit under the *Wildlife Act* for possessing barn owls was not issued until December 5, 2013.

Every four days, systematic carcass searches were conducted within 10 m of Deltaport Way and the BCR rights-of-way. Barn owls that collide with vehicles do not appear to be thrown farther than ~20m from the site of the collision (A. Ballevona, Hemmera Biologist, pers. obs.), likely due to the carcasses being large and relatively heavy; therefore, the search area was considered large enough to locate any carcasses present.

General road traffic and container trucks access the Roberts Bank terminals along Deltaport Way from Highway 17. The Deltaport container terminal is served by between three and five container trains each day, and five loaded coal trains are handled each day at Westshore coal terminal. In order to assess the number of barn owl collisions related to the Roberts Bank terminals road and rail traffic, two biologists conducted walking surveys along Deltaport Way and the BCR rights-of-way.

To avoid potential health and safety concerns associated with working in an active area, survey routes were predetermined and not randomised. Two biologists would start at the west end of the survey area (Section 1, see **Appendix A: Figure 2**) and walk east searching for barn owl carcasses. One biologist surveyed the rail right-of-way from the BCR access road, while the other surveyed the north side of Deltaport Way. The biologist surveying the road would cross Deltaport Way before Highway 17 (end of Section 3), turn around and survey the south side of Deltaport Way heading west towards the starting point in Section 1 and allowing the biologist to always be walking against the flow of traffic. The biologist surveying the BCR right-of-way would walk east to 64$^{th}$ Street where a vehicle was parked, and drive back to the west end of the study area to survey (walk) the north side of the BCR right-of-way from the south side of Deltaport Way, beginning at the original starting point in Section 1. This biologist was then picked up along Deltaport Way, just before Highway 17 by the other biologist at the end of the survey.

For each carcass detected, the following information was recorded:

- Date and time of detection;
- Species (where possible);
- Age (where possible);
- Sex (where possible);
- Specific location (via GPS unit);
- Distance to road or rail;
- General condition of bird;
- Possible scavenge condition;
- Details of any detectable injuries;
- Cause of mortality based on location and injuries (i.e., vehicular kill, train kill, predator kill, or other); and
- Estimated number of days since death.

Weather information was also collected at the start and end of each survey.

Unless left in place as part of a removal trial, carcasses were removed after each survey to avoid double-counting. Recovered carcasses were placed in a labelled Ziploc bag with date, time, species and sex/age if possible, and unique ID number, and stored in an on-site freezer.

#### *3.3.3.1 Searcher Efficiency and Scavenger Removal Trials*

Scavenger removal and searcher efficiency trials were conducted concurrently with carcass surveys to adjust mortality estimates for carcasses that were removed by scavengers prior to being located and for carcases missed by surveyors. Carcasses used in the scavenger trials were obtained from this study and Lower Mainland wildlife rescue organisations including the Orphaned Wildlife Rehabilitation Society, Delta, B.C., and the Wildlife Rescue Association, Burnaby, B.C. These facilities are permitted to handle and hold barn owls under the *Wildlife Act*. In order to receive carcasses from these organisations, confirmation of the disposition was required for *Wildlife Act* reporting purposes; therefore, a database was maintained of all received carcasses.

To determine correction factors to adjust mortality estimates for missed and removed carcasses, one scavenger removal trial (January 28, 2013) and four searcher efficiency trials (January 12, 20 and February 5, 21, 2013) were conducted over the course of the four-month study. Each trial consisted of placing three intact barn owl carcasses within the study area in randomly selected locations. The carcasses were placed during the morning of a survey and their locations marked using GPS.

In the scavenger removal trial, marked carcasses were monitored for scavenger removal. The marked carcasses were photographed and their locations recorded using a map and GPS unit. Carcasses were checked daily for five days following placement, and then every other day over an eight day period. For carcasses still in their original locations during a check, the biologist photographed and recorded the condition of the carcass, noting any signs of scavenging or decomposition. If the bird was not in its original location, the biologist searched a 30 m radius from its original placement point. If the bird was relocated, its new location was recorded and its condition documented. The last documented location of all carcasses was checked each subsequent day of the trial. Carcasses were marked in a manner that allowed for easy identification (e.g., body parts were tagged and numbered) should the biologists conducting standard carcass surveys find part or all of a trial bird, allowing carcasses to be entered back into ongoing trials or for scavenger removal estimates to be corrected after trials ended.

In the searcher efficiency trials, carcasses were marked with non-toxic fluorescent clear-coat paint only visible under ultraviolet light. After the searcher efficiency carcass survey was over, searchers were informed of the trial and provided with an ultraviolet light to determine the number of marked carcasses collected. Carcasses not found during the survey were collected. The searcher efficiency trials were conducted blind, meaning that searchers were unaware of the trial to test their efficiency.

#### *3.3.3.2 Mortality Estimates – Collision Surveys*

Total barn owl mortalities were adjusted to account for searcher efficiency and scavenger removal estimates using OMNR (2011) as guidance:

**Scavenger Correction Factor**

The proportions of placed carcasses that remained after each search interval were pooled to calculate the overall scavenger correction (Sc) factor:

$$S_c = \frac{n_{visit1} + n_{visit1} + n_{visit3}}{n_{visit0} + n_{visit1} + n_{visit2}}$$

Where:

$S_c$ is the proportion of carcasses not removed by scavengers over the search period;

$n_{visit0}$ is the total number of carcasses placed; and

$n_{visit1}$ – $n_{visit3}$… are the numbers of carcasses remaining on visits 1 through 3 (corresponding days 4, 9 and 13 of scavenger removal trial).

**Searcher Efficiency**

Searcher efficiency ($S_e$) was calculated for each searcher as follows:

$$S_e = \frac{n_{found}}{N_{placed} - n_{scavenged}}$$

Where:

$n_{found}$ is the total number of carcasses found;

$n_{placed}$ is the numbers of carcasses placed; and

$n_{scavenged}$ is the numbers of carcasses scavenged.

**Minimum Estimated Mortalities**

The minimum estimated mortalities (C) was calculated as follows:

$$C = \frac{c}{(Se\ x\ Sc)}$$

Where:

**C** is the corrected number of barn owl mortalities;

**c** is the number of barn owl carcasses found;

**$S_e$** is the proportion of carcasses expected to be found by searchers (overall searcher efficiency); and

**$S_c$** is the proportion of carcasses not removed by scavengers over the search period.

### 3.3.4 Nest and Roost Site Monitoring

Surveys for nest and roost occupancy followed previously established methodologies (Andrusiak 1994, Hindmarch 2010). Potential barn owl nest and roost sites were identified using data from previous years, which included sites monitored as part of the long-term mitigation monitoring plan for SFPR since 2007, historical data, and a reconnaissance of the study area by the project biologists. Surveys focused on searching for nest and roost sites (i.e., barns and other structures with beams and rafters that could support roosts / nests with easy ingress and egress). Initial surveys to check previously identified and potential nest and roost locations were conducted in early April, 2013, which is the beginning of the core breeding season which typical runs until August, but may extend longer depending on food availability and weather (pers. comm, S. Hindmarch). Identified nest sites were monitored monthly during the core breeding season. Nest boxes were either physically checked or, if the structure was in poor condition or the nest box or platform could not be accessed, were visually checked. Observations lasting 10 to 15 minutes were conducted at dusk to determine if females were likely to be incubating, nestlings were present, or any barn owls were roosting inside the structure. Barn owl vocalizations are a key factor in determining owl presence, since females screech during the incubation and nesting period, and chicks beg loudly. To minimise disturbance, nest inspections were conducted after dusk.

For each nest and roost site, the following information was recorded:

- Status (active/inactive);
- Breeding activity;
- The number of eggs (where possible);
- The number of fledglings (where possible); and
- The number of adults roosting inside the structure.

## 3.4 DATA MANAGEMENT

Data were collected electronically using smartphones and wirelessly downloaded into an information management system that has integrated backup, disk and network redundancy, and intrusion prevention measures. Data from hardcopy field forms were then imported directly into an MS Access database developed specifically for the Study. The database information was cross-referenced with photographs and GPS coordinates as a quality assurance/quality control (QA/QC) measure. Non-conformities were identified and corrected during the QA/QC process to ensure a robust dataset.

# 4.0 RESULTS

This section presents the main findings of the studies and incidental observations.

## 4.1 HABITAT SUITABILITY – FORAGING HABITAT

Over 84% of the study area consisted of agricultural fields (Hemmera 2014*b*). Using the TEM data (Hemmera 2014*b*), and taking into consideration the graminoid categories of grass described in **Section 3.3.1.1**, 39% of the study area provides moderate- to high-suitability foraging habitat for barn owls (**Table 6** and **Appendix A: Figure 4**). Low-suitability foraging habitat comprised 43% of the study area, and 18% was rated as having no (nil) value (**Table 6** and **Appendix A: Figure 4**).

**Table 6 Amount of Foraging Habitat within the Study Area for Barn Owl, by Habitat Suitability Rating**

| Foraging Habitat Quality | Area (ha) |
|---|---|
| **High** | 206.1 (19.8%) |
| **Moderate** | 201.6 (19.4%) |
| **Low** | 444.7 (42.8%) |
| **Nil** | 186.5 (18%) |
| **Total** | **1,038.9** |

High-suitability foraging habitat polygons in the study area are typically unused farm fields (0 to 3 years since disturbance, see **Appendix B: Photo 1**), old fields (deliberate set-asides), and fallow fields (fields in a state of temporary inactivity). Set-aside fields are deliberately left unworked to provide wildlife habitat (funded by the Delta Farm and Wildlife Trust).

Hay fields (**Appendix B: Photo 2**), grazed fields, forage crops (graminoid crops planted for livestock forage), and grassy verges (strips of land between road and rail rights-of-way that are usually managed) were rated as providing moderate suitability for foraging.

Broadleaf herbaceous crops (**Appendix B: Photo 3**) such as beans, corn and legumes, which may have frequent turnover, comprised almost 40% of the study area and were rated as having low quality for barn owl foraging. Hedgerows (37.7 ha, 3.6%) were also rated low for foraging habitat (**Appendix B: Photo 4**). Although hedgerows can provide high quality habitat for small mammals, barn owls do not generally forage within hedgerows. Nonetheless, the hedgerows are assumed to increase the suitability of barn owl foraging habitat in immediately adjacent polygons.

Nil-rated polygons (186.5 ha, 18%) included non-vegetated polygons and developments.

### 4.2 ROADSIDE AND RAIL HABITAT USE SURVEYS

Barn owl and great horned owl (*Bubo virginianus*) were the only owl species observed during the habitat use surveys. Occurrences of barn owls were documented during all eight of the 2012 surveys, and on 13 of the 16 surveys conducted in 2013. All owl observations in the study area are shown in **Appendix A: Figure 5**.

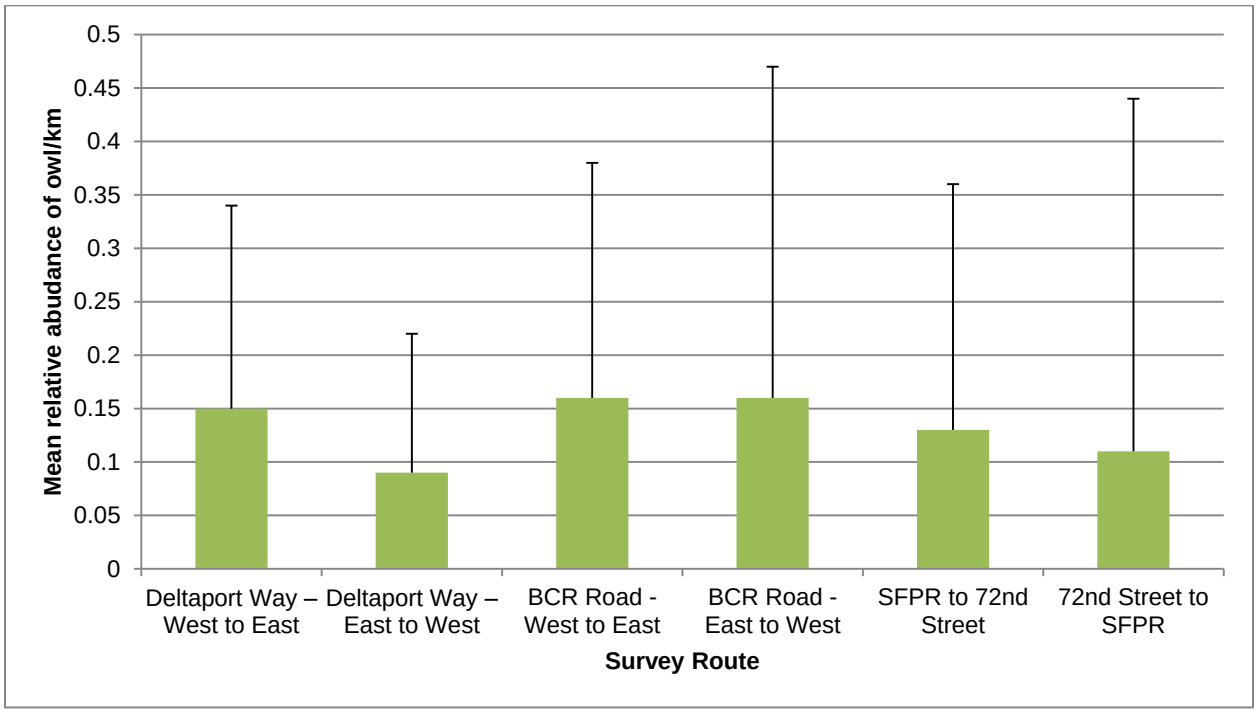
A total of 101 barn owl observations (including crossings) were made during the 2012 and 2013 surveys (**Table 7**), while observations per transect route ranged from 10 to 23. In general, more owl observations were made in the western and central sections of the study area (Deltaport Way and BCR Road) than the eastern section (SFPR to 72nd Street) (**Appendix A: Figures 5** and **7**). The number of barn owl observations made during west to east surveys was similar to that made during east to west surveys, except on Deltaport Way, where considerably fewer owls were observed on the westbound surveys than on the eastbound surveys.

**Table 7 Total Owl Observations (Includes Crossings) for each Transect Route Surveyed in the Study Area, Delta, BC - 2012 and 2013**

| Species | Deltaport Way – W to E | Deltaport Way – E to W | BCR Road – W to E | BCR Road - E to W | SFPR to 72nd Street | 72nd Street to SFPR | Total |
|---|---|---|---|---|---|---|---|
| Barn owl | 19 | 12 | 22 | 23 | 15 | 10 | 101 |
| Great horned owl | 2 | 1 | 4 | 2 | 0 | 2 | 11 |
| **Total** | **21** | **13** | **26** | **25** | **15** | **12** | **122** |

The mean number of barn owls observed on a survey transect route ranged from 0.09 $\pm$ 0.13 owls/km (mean ± standard deviation) to 0.16 ± 0.22 owls/km (**Figure 4.2-1**). As with the total number of owls observed, the mean number of owl observations was slightly higher in the western and central sections of the study area than the eastern section; however, a high variability in the number of owls was observed (**Figure 4.2-1**). This variability, along with the large difference between the mean number of owls observed during eastbound versus westbound surveys on Deltaport Way, makes it difficult to draw meaningful conclusions regarding differences in barn owl abundance among the three alignment sections surveyed.

**Figure 4.2-1 Mean Relative Abundance (+ SD) of Barn Owls/km at each Survey Route - 2012 and 2013**




### 4.2.1 Crossing Locations

Approximately 30% (30/101) of barn owl observations during the roadside surveys were of owls crossing the road and or rail rights-of-way (**Appendix A: Figure 6**). Barn owls were observed crossing a road or rail right-of-way during 70% (17/24) of surveys. The greatest number of crossings was documented during surveys that started just before or after midnight. All crossing observations involved only a single barn owl, with the exception of crossings observed at waypoints number 205 and 217 during the 2012 survey, where two barn owls were observed crossing together. **Appendix A: Figures 7** to **9** are insets of **Figure 6** and illustrate crossing direction (i.e., cardinal direction). A summary of the crossing data is presented in **Table 8**, which indicates whether barn owls crossed a road, rail right-of-way, or both. No great horned owls were observed crossing the road or rail rights-of-way during the study.

**Table 8 Barn Owl Crossings in the Study Area - 2012 and 2013**

| Date | Crossing ID No. [1] | Crossing Time | Heading | Crossed Deltaport Way or Rail | Height Above Road or Rail (m) | Activity at Time of Crossing | Approach Behavior[3] |
|---|---|---|---|---|---|---|---|
| Jul. 13, 2012 | 88 | 01:47 | Northwest | Rail | 5 | Trains moving | No change |
| Jul. 26, 2012 | 191 | 00:30 | South | Deltaport Way | 4 | Moderate vehicle traffic | No change |
| | 195 | 01:34 | South | Deltaport Way and Rail | 4 | Light vehicle traffic | No change |
| | 197 | 01:55 | South | Deltaport Way and Rail | 5 | Light vehicle traffic | No change |
| Aug. 2, 2012 | 165 | 01:31 | North | Deltaport Way | 1 | No traffic | No change |
| Aug. 14, 2012 | 166 | 21:40 | South | Deltaport Way | 10 | Trains present and stationary | No change |
| | 167 | 23:09 | North | SFPR | 10 | No traffic | No change |
| Aug. 23, 2012 | 205 | 00:29 | South | Rail | 4 | No trains | No change |
| Sep. 11, 2012 | 209 | 00:20 | North | Deltaport Way and Rail | 4 | Light vehicle traffic | No change |
| | 210 | 01:00 | West | Deltaport Way and Highway 17 | 3 | Light vehicle traffic | No change |
| | 217 | 02:10 | North | Deltaport Way and Rail | 2 | No traffic | No change |
| | 218 | 02:22 | South | Rail | 6 | No trains | No change |
| | 221 | 0:2:54 | South and North | Deltaport Way | 4 | Light vehicle traffic | No change |
| Apr. 3, 2013 | 1785 | 22:58 | West | SFPR and Rail | 1 | No traffic/no trains | No change |
| Apr. 11, 2013 | 354 | 04:17 | North | Deltaport Way | 4 | No traffic | Gradual change |
| April 26, 2013 | n/a[2] | 03:49 | South | Deltaport Way and Rail | 5 | No traffic/no trains | No change |
| May 22, 2013 | 1792 | 12:17 | East | SFPR | 5 | No traffic | Gradual change |
| | 1796a | 02:13 | South | Deltaport Way and Rail | 5 | No traffic/no trains | Gradual change |

| Date | Crossing ID No. [1] | Crossing Time | Heading | Crossed Deltaport Way or Rail | Height Above Road or Rail (m) | Activity at Time of Crossing | Approach Behavior[3] |
|---|---|---|---|---|---|---|---|
| Jun. 2, 2013 | 5 | 00:35 | West | SFPR and Rail | 4 | No traffic/no trains | Gradual change |
| | 7 | 00:42 | West | SFPR | 2 | No traffic | No change |
| | 8 | 00:45 | East | SFPR and Rail | 7 | No traffic/no trains | No change |
| Jun. 9, 2013 | 1796b | 22:12 | South | Rail | 10 | No trains | No change |
| Jun. 12, 2013 | 362 | 01:17 | South | Deltaport Way and Rail | 1 | Light vehicle traffic | No change |
| | 363 | 02:48 | South | SFPR and Rail | 2 | No traffic/no trains | No change |
| Jun. 27, 2013 | 16 | 22:47 | South | Rail | 5 | No trains | No change |
| | 18 | 22:51 | South | Deltaport Way | 5 | No traffic | No change |
| Jul. 1, 2013 | 366 | 01:55 | South | Rail | 3 | No trains | No change |
| Jul. 5, 2013 | 368 | 00:46 | South | Deltaport Way and Rail | 4 | Moderate vehicle traffic | No change |
| | 372 | 02:03 | North | Deltaport Way and Rail | 2 | No traffic/no trains | No change |
| Jul. 18, 2013 | 380 | 02:12 | Northwest | Deltaport Way and Rail | 2 | Train traffic | Gradual change |

**Note:** [1] 'Crossing number' refers to waypoint number, and does not imply a numerical value to each crossing.
[2] Waypoint was not marked.
[3] Approach behaviour was recorded in the field as: abrupt change (quick change flight pattern); gradual change (slow change in flight pattern); or no change (maintain height - no reaction to flight pattern).

Traffic flow was minimal during surveys and no container trucks were observed on Deltaport Way. The largest pulse of vehicle traffic (eastbound and westbound) was on Deltaport Way, typically between midnight and 1 am, when shift change at the terminal occurred. Train traffic was variable during the survey period and among transects routes during the same survey day.

The maximum crossing height of barn owl recorded was 10 m above the BCR right-of-way and the SFPR, although observability is likely limited above this height. The lowest crossing height was 1 m over Deltaport Way with no traffic present (**Table 8**). Gradual changes in approach behaviour (i.e., gradual climb) were noted on several occasions during the 2013 surveys (**Table 8**), but only during one instance was traffic (i.e., a train) present, and in this instance the train flushed the barn owl. Most of the time, no changes in flight approach behaviour were documented when barn owls crossed either the road or rail rights-of-way when vehicular or train traffic was present.

The greatest concentration of crossings (27%) was observed within approximately 500 m of Arthur Drive, which is adjacent to high-suitability (grass-dominated, abandoned fields) and moderate-suitability (grassy verges) foraging habitat (**Appendix A: Figure 8**).

### 4.3 COLLISION SURVEYS

#### 4.3.1 Carcass Searches

Six barn owl carcasses were recovered from the study area during the survey period (**Table 9, Appendix A: Figure 10**). Of these carcasses, 67% (4/6) were found along Deltaport Way (**Appendix A: Figure 10**). All carcasses were found within 10 m of the rail or road that was being searched.

**Table 9 Barn Owl Carcasses Salvaged within the Study Area between December 5, 2012 and April 2, 2013**

| Date Collected | ID #[1] | Age | Sex | Location - Road / Rail | Comments on Location Detected |
|---|---|---|---|---|---|
| Dec. 5, 2012 | 170 | Unknown | Female | Rail | Between rail tracks |
| Dec. 13, 2012 | 225 | Unknown | Unknown | Road | In grass beside road |
| Jan. 8, 2013 | 332 | Unknown | Unknown | Road | In grass beside road |
| Jan. 16, 2013 | 228 | Unknown | Unknown | Road | Shoulder of road |
| Feb. 5, 2013 | 231 | Unknown | Unknown | Rail | On railroad tie |
| Feb. 9, 2013 | 338 | Unknown | Unknown | Road | On road |

**Note:** [1] 'ID #' refers to a waypoint number shown on Figure 10, and does not imply a numerical value to each carcass.

Cause of death was presumed to be vehicular for two carcasses (ID# 225 and 338), and train-related for one carcass (ID#170) based on the locations where carcasses were found (**Table 9** and **Appendix A: Figure 10**). Cause of death was unknown for the remaining three carcasses, as only portions (i.e., wings or feathers) were found. However, for the purpose of this study and calculating fatality estimates, any carcass found within the search area was assumed to have been killed by a road or rail collision.

Dead barn owls were distributed across the survey route (**Appendix A: Figure 10**); however, 50% (3/6) were found within 250 m of each other between the 46a Street overpass and Arthur Drive (**Appendix A: Figure 10**). Two carcasses were found along Deltaport Way within 1 m perpendicular distance from the road edge (ID#228 on the north side of Deltaport Way, and ID#332 on the south side of Deltaport Way) while the third carcass (ID#170) was found between the rail tracks just south of carcass ID#228 (**Appendix A: Figure 10**).

Habitats in the immediate vicinity of carcasses #170, 228 and 332 were rated as having low- to moderate-suitability foraging habitat (**Appendix A: Figure 10**). During the survey period, only 4% (3/73) of all barn

owl observations (excluding crossings) were made in the vicinity of the cluster of three carcasses, and only 7% (2/30) of barn owl crossings were observed in this general area (**Appendix A: Figure 6**).

### 4.3.2 Mortality Estimates

#### *4.3.2.1 Searcher Efficiency*

Three out of four of the searchers tested detected all (3/3) planted carcasses while one searcher did not detect any carcasses. Searcher efficiency ($S_e$), calculated as the proportion of carcasses expected to be found by searchers (i.e., overall searcher efficiency), was 0.75 (9/12).

#### *4.3.2.2 Scavenger Removal (Carcass Removal)*

Of the three carcasses used in the scavenger trial, one (carcass BO17) was removed by day 2 of the trial, and another (carcass BO33) was removed by day 3. The third carcass was not scavenged, and remained in place for the 13-day duration of the trial. The scavenger correction factor ($S_c$) was calculated to be 0.60, and was applied to the overall carcass data.

#### *4.3.2.3 Corrected Mortality Estimates*

Based on corrections to account for searcher efficiency and scavenger removal biases, an estimated 13 barn owls were killed within the 25.3 ha study area during the survey period. This estimate should be treated with caution; however, given the inherent limited nature of searcher efficiency, results of the carcass removal trials, and low sample size.

### 4.4 NEST AND ROOST SITE MONITORING

Eighteen occupied active barn owl nest and roost sites were identified within the study area during the 2013 breeding season. Two changes in the availability of nest and roost sites occurred since 2012. One barn consistently occupied in previous years was sealed up. Although a nest box was installed on the outside of this barn, there was no evidence of use by barn owls during the monitoring period. Another old barn formerly used as a roost site was demolished in late 2012. The occupancy status of one barn in the study area could not be determined because the owner denied access.

Of the 18 occupied sites, nine had evidence of breeding, seven were occupied but breeding was not confirmed, and two were identified as roost sites only. For the nine nest sites with evidence of breeding, seven were physically checked or assessed with visual and auditory cues to determine the number of fledglings. In 2013, the mean number of fledglings per nest attempt was 2.7 ± 0.9 (n = 7).

The majority of active nest and roost sites were found in the two western segments of the study area, between the east end of the Roberts Bank causeway and 64$^{th}$ Street (**Appendix A: Figure 3**). A map of known nest and roost sites has not been included in this report, as this information is considered

confidential by collaborating researchers and landowners, and because public access could lead to disturbance.

### 4.5 INCIDENTAL OBSERVATIONS

Great horned owls were observed in the study area during the roadside surveys in July, 2012 and in June and July, 2013 (**Table 7**, **Appendix A: Figure 5**). In all but two instances, when two individuals were seen flying parallel to the SFPR on July 18, 2013, great horned owls were observed perching. No observations of road or rail crossings were noted. Great horned owls breed throughout B.C., and are not considered to be at-risk (BC CDC 2013).

Other carcasses detected during the collision surveys included, American kestrel (*Falco sparverius*), mallard (*Anas platyrhynchos*), an unknown duck (*Anas* spp.), and the wing of a great blue heron (*Ardea herodias*). These carcasses were not salvaged, as the *Wildlife Act* collection permit only allowed salvage of barn owl carcasses.

# 5.0 DISCUSSION

A discussion of the major results arising from the barn owl studies and data gaps are provided below.

## 5.1 KEY FINDINGS

### 5.1.1 Habitat Suitability Assessment

Approximately 40% of the study area provided moderate- to high-quality foraging habitat for barn owls. Low-suitability foraging habitat comprised 43% of the study area while 18% was rated as offering nil-quality (**Table 6**; **Appendix A: Figure 4**). As expected, habitat quality is consistent with habitat suitability mapping conducted for Townsend's vole (Hemmera 2014*a*); the more suitable the habitat is for voles, the more suitable it is for the barn owls that prey on them.

### 5.1.2 Roadside and Rail Habitat Use Survey

Barn owl use of roadside and rail-side habitats within the study area was confirmed. The level of use corresponded with habitat suitability ratings (**Table 6**, **Appendix A: Figures 6 and 7; Appendix A: Figure 4**) and was consistent with the current knowledge on landscape requirements for barn owl foraging.

Barn owls were observed on 21 of 24 surveys, and were most often observed perched and/or hunting (i.e., flying parallel to the road/rail rights-of-way) in two general areas: between the east end of the Roberts Bank causeway and 41B Street, and between Arthur Drive and 64$^{th}$ Street near moderate-quality (i.e., grassy verges) and high-quality foraging habitat (i.e., grass-dominated, abandoned fields). Road and rail crossings were recorded less frequently than observations of perched or hunting barn owls; however, crossings were generally distributed proportionally across the study area, with the greatest concentration near Arthur Drive adjacent to high- and moderate-quality foraging habitat. The large barn on the southwest corner of Arthur Drive is an established nesting and roosting site that attracts barn owls.

Traffic volumes during the surveys were typically low, with a few occasions of moderate personal vehicle traffic during the evening shift change at the terminal. Container trucks were never observed on the road during the surveys, and train activity varied from survey to survey. Of the few times a gradual change in barn owl flight approach behaviour was noted, only once was it associated with a moving vehicle (i.e., moving train) at the time of crossing. The observed barn owl crossing height was less than 5 m on average, which is consistent with Taylor (1994); however, owls crossing at heights above 10 m may not have been observed because vision above this height was limited.

### 5.1.3 Carcass Searches

Six barn owl carcasses were detected within the study area, equating to an estimated 13 barn owl mortalities during the four-month survey period when corrections for searcher efficiency and scavenger removal biases are applied. This estimate is a very coarse one; however, as the correction factors for searcher efficiency and scavenger removal are based on very limited data.

The carcass search study area focussed on Deltaport Way and the BCR right-of-way from the east end of the Roberts Bank causeway to approximately 64$^{th}$ Street. This study area was small for two reasons: the existing rail right-of-way east of 64$^{th}$ Street could not be safely surveyed because there is no access road and surveyors would not have a safe location to stand if a train passed; and the SFPR segment from 64$^{th}$ to 72$^{nd}$ streets was under construction and not open to vehicles at the time the surveys were conducted. The barn owl carcass estimate was not extrapolated to include the road and rail rights-of-way beyond 64$^{th}$ Street.

Barn owl carcasses were found next to moderate-quality and low-quality foraging habitats. Three of the six carcasses were found within 250 m of each other; however, only 4% (3/73) of all barn owl observations (excluding crossings) and 7% (2/30) of barn owl road and rail crossings were documented in the vicinity of the three carcasses. The reasons for this discrepancy are unclear.

Carcasses were only detected during December to early February (**Table 9**) and no carcasses were detected during the last eight weeks of surveys, although there was no change in survey effort. This result is consistent with previous studies that reported the greatest barn owl mortality from December through April (Andrusiak 1994, Preston and Powers 2006).

### 5.1.4 Nest and Roost site Monitoring

Eighteen barn owl nest/roost sites were identified within the study area. Breeding was documented at nine nests and the number of fledged chicks was documented at seven of these. At the seven sites, the average number of fledglings was 2.7 ± 0.9, which was identical to the 2013 average for the entire Lower Mainland, which included data from an additional 14 nest sites (S. Hindmarch, Center for Wildlife Ecology SFU, unpublished data).

The majority of active sites was found in the two western segments of the study area, between the east end of the Roberts Bank causeway and 64$^{th}$ Street, which was also the area where barn owls were most frequently observed hunting (perched or flying) or crossing the road and/or rail rights-of-way.

## 5.2 DATA GAPS AND LIMITATIONS

The TEM completed for the study area mapped over 84% as agricultural fields. Because crops are changing on a regular basis, the TEM is only accurate for the current harvest year (Hemmera 2014*b*). Any changes in the TEM would affect the habitat ratings presented in this report.

Roadside and rail habitat surveys were unsuccessful in observing barn owls and container trucks on the road together because barn owl activity begins to decline as sunrise approaches, and surveys were completed prior to the time when container trucks begin to arrive at the terminal.

The sex of only one of six of the barn owl carcasses was determined; therefore, no comparison of mortalities between sexes was possible. The age of the carcasses was also not determined; therefore, no analysis of juvenile versus adult mortalities could be completed.

Since barn owls are strictly nocturnal and quite elusive, it is possible that some nest and roost sites were overlooked. In addition, one property suspected to contain barn owl nest or roost sites could not be surveyed due to property access restrictions.

Despite these limitations, the overall objective of this study of ensuring that adequate information is available to inform a future effects assessment for the Project has been achieved.

# 6.0 CLOSURE

Major authors and reviewers of this technical data report are listed below, along with their signatures.

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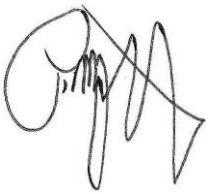

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# 8.0 STATEMENT OF LIMITATIONS

This report was prepared by Hemmera, based on fieldwork conducted by Hemmera Envirochem Inc. ("Hemmera"), for the sole benefit and exclusive use of Port Metro Vancouver. The material in it reflects Hemmera's best judgment in light of the information available to it at the time of preparing this Report. Any use that a third party makes of this Report, or any reliance on or decision made based on it, is the responsibility of such third parties. Hemmera accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this Report.

Hemmera has performed the work as described above and made the findings and conclusions set out in this Report in a manner consistent with the level of care and skill normally exercised by members of the environmental science profession practicing under similar conditions at the time the work was performed.

This Report represents a reasonable review of the information available to Hemmera within the established Scope, work schedule and budgetary constraints. The conclusions and recommendations contained in this Report are based upon applicable legislation existing at the time the Report was drafted. Any changes in the legislation may alter the conclusions and/or recommendations contained in the Report. Regulatory implications discussed in this Report were based on the applicable legislation existing at the time this Report was written.

In preparing this Report, Hemmera has relied in good faith on information provided by others as noted in this Report, and has assumed that the information provided by those individuals is both factual and accurate. Hemmera accepts no responsibility for any deficiency, misstatement or inaccuracy in this Report resulting from the information provided by those individuals.

# APPENDIX A
## Figures

**Figure 1 Barn Owl Study Area – Habitat Use and Habitat Suitability Study Area**

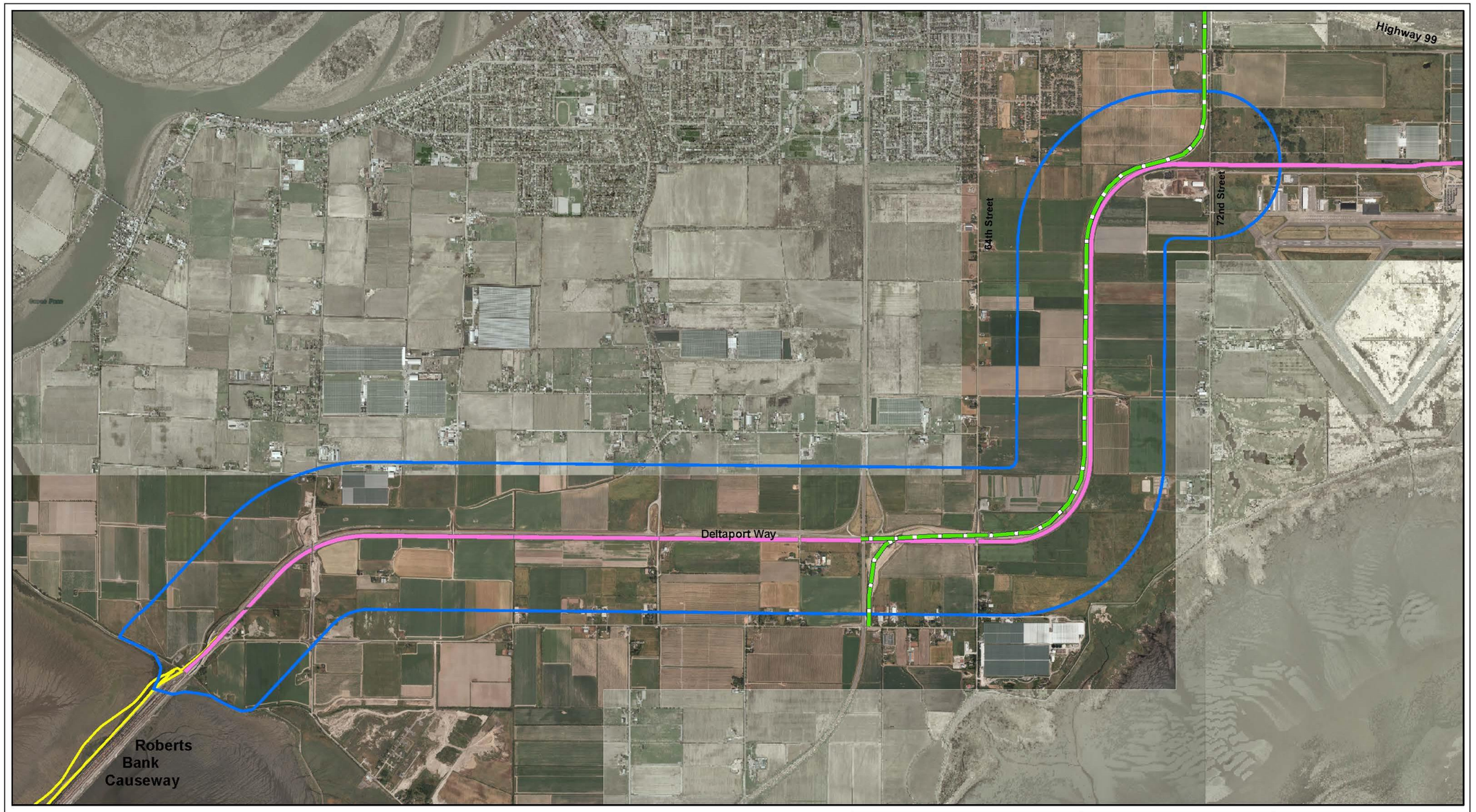


**Figure 2 Barn Owl Study Area – Collision Surveys**

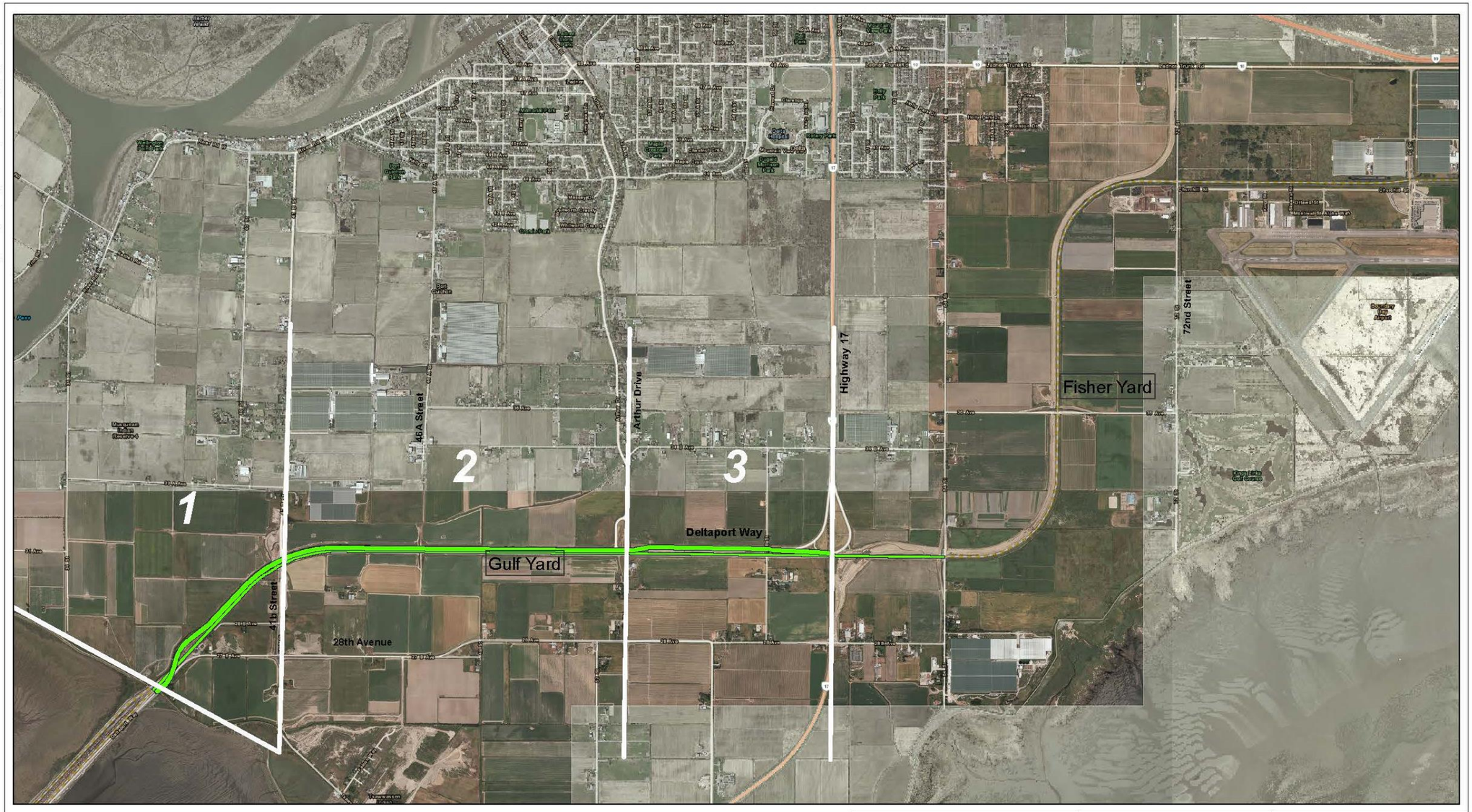


**Figure 3 Barn Owl Nest and Roost Site Study Area including Number of Active Sites**

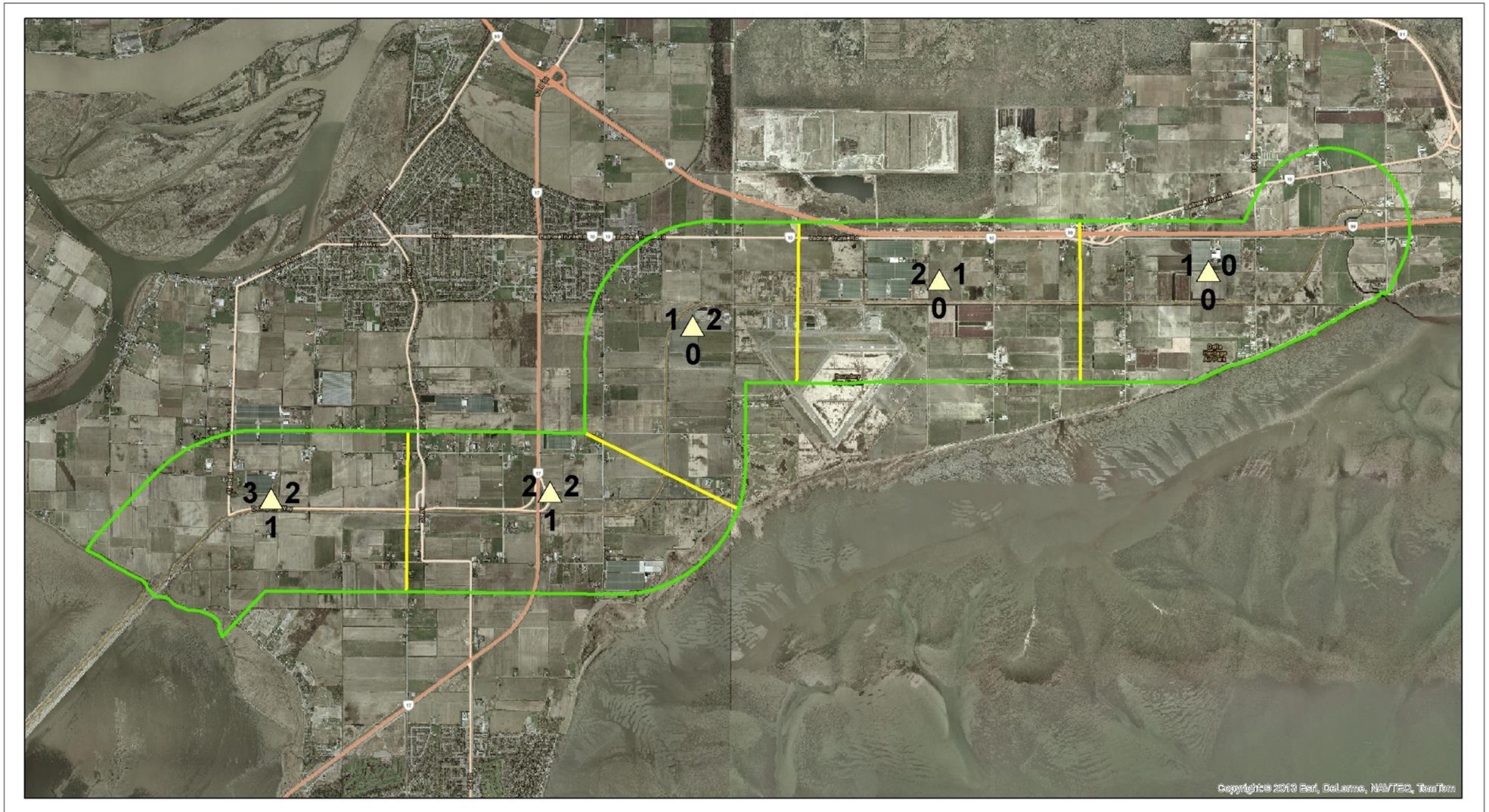


**Figure 4 Habitat Suitability Ratings – Foraging Habitat**

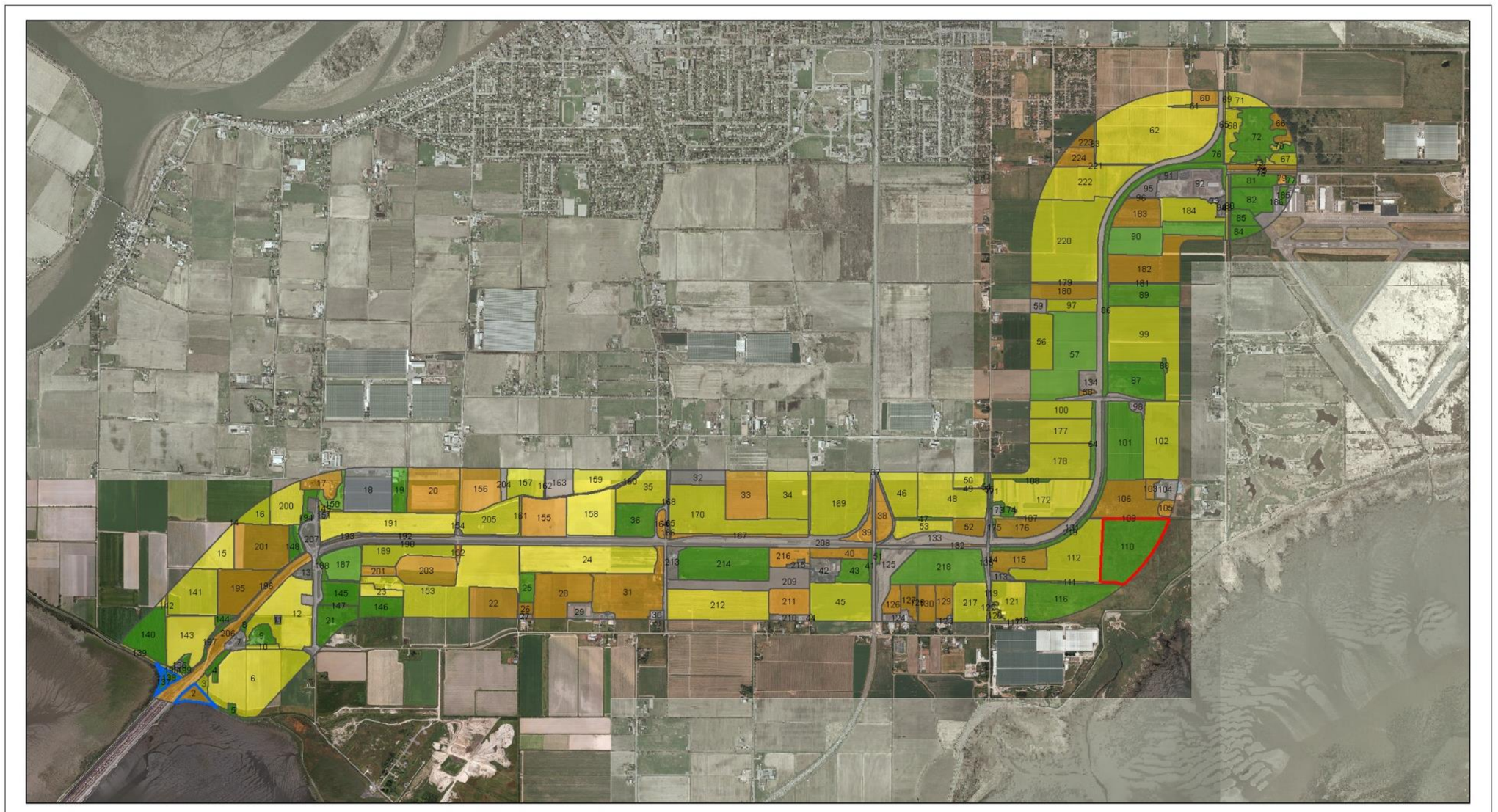


**Figure 5 Owl Observations in the Study Area – 2012 and 2013**

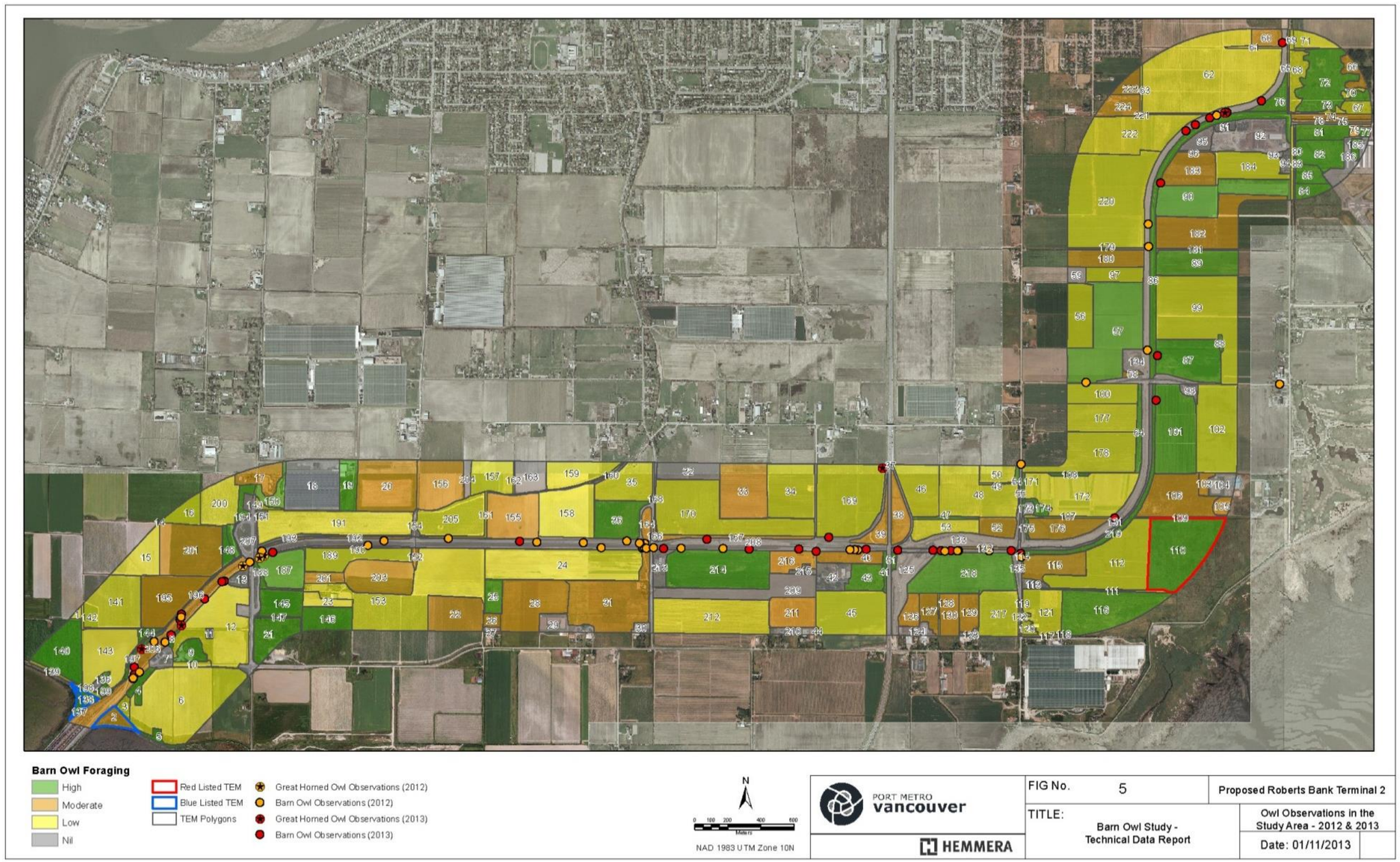


**Figure 6 Barn Owl Crossing Observations in the Study Area – 2012 and 2013**

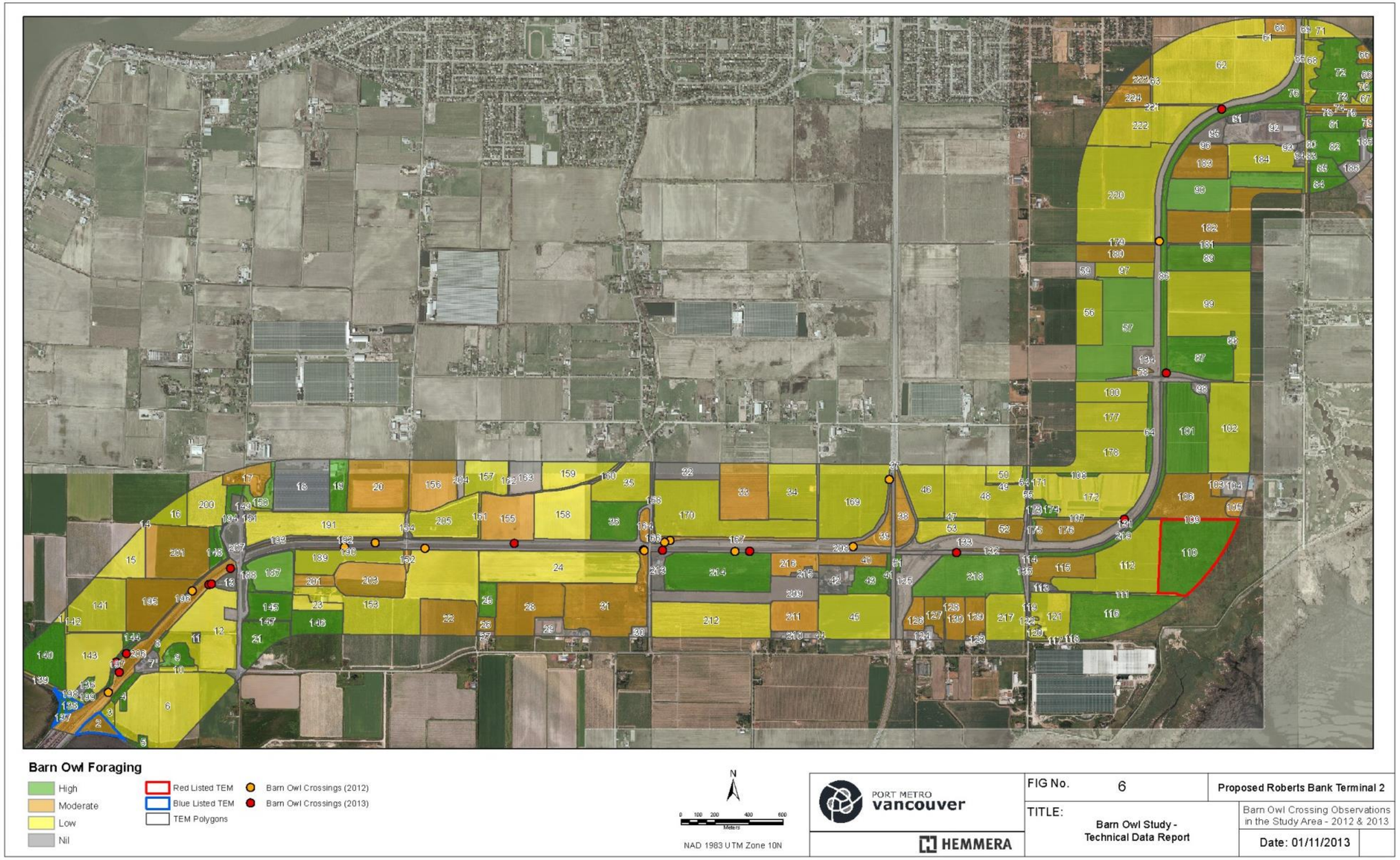


**Figure 7 Barn Owl Crossing Observations Study Area West – 2012 and 2013**

**Figure 8 Barn Owl Crossing Observations Study Area Central – 2012 and 2013**

**Figure 9 Barn Owl Crossing Observations Study Area East – 2012 and 2013**

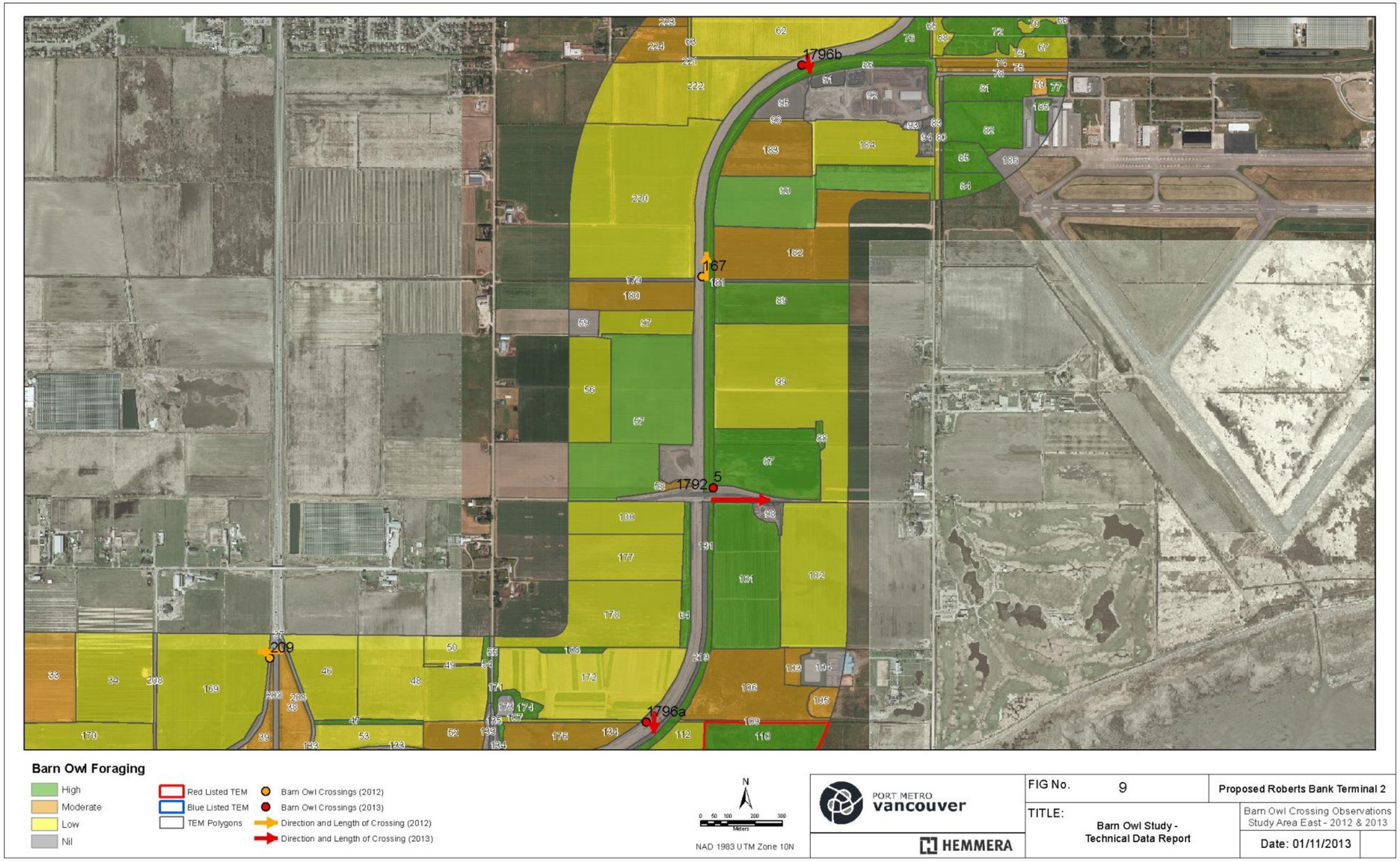
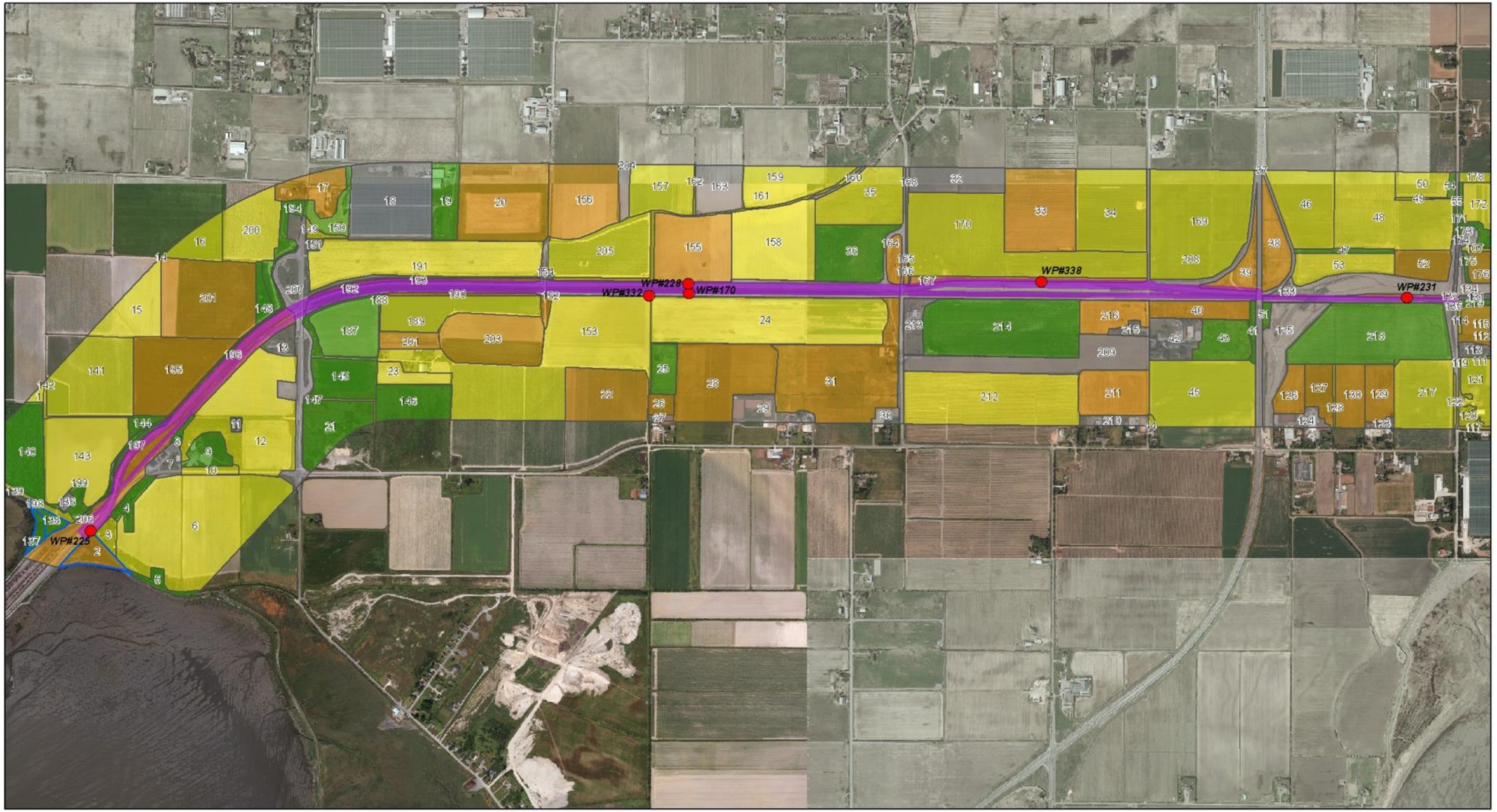


**Figure 10 Barn Owl Carcass Locations – December 2012 to April 2013**



# APPENDIX B
## Photographs

## PHOTOGRAPHIC REPRESENTATION

Photographic representative of some fields rated as high (abandoned field), moderate (hay field), and low (broadleaf herbaceous crop and hedgerow) are presented below. Additional photos can be found in Appendix C of Terrestrial Wildlife and Vegetation – Terrestrial Ecosystem Mapping (Hemmera 2014*b*).

Photo 1: Unused Farm Field – high suitability foraging habitat.

Photo 2: Hay Field – moderate suitability foraging habitat.

Photo 3: Broadleaf Herbaceous Crops – low suitability foraging habitat.

Photo 4: Hedgerow – low suitability foraging habitat.