Adelaide Wind Power Project, Raptor Monitoring 2021

FINAL REPORT

February 25, 2022
File: 160961067

Prepared for:

Suncor Adelaide Wind Limited Partnership
150 6th Avenue SW
Calgary, AB T2P 3E3

Prepared by:

Stantec Consulting Ltd.
100-300 Hagey Boulevard
Waterloo, ON N2L 0A4

This document entitled Adelaide Wind Power Project, Raptor Monitoring 2021 was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Suncor Energy Inc. (the “Client”). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Laura Marshall 2022.02.25 14:56:51 -05'00'

Prepared by _____
(signature)

Laura Marshall, B.E.S.
Terrestrial Ecologist

Melissa Straus Digitally signed by Melissa Straus Date: 2022.02.25 15:18:36 -05'00'

Reviewed by _____
(signature)

Melissa Straus, M.Sc.
Terrestrial Ecologist

Andrew Taylor Digitally signed by Andrew Taylor Date: 2022.02.25 15:07:58 -05'00'

Reviewed by _____
(signature)

Andrew Taylor, B.Sc.
Senior Ecologist

Table of Contents

LIST OF TABLES

LIST OF APPENDICES

Abbreviations

EC	Environment Canada
ERMP	Enhanced Raptor Monitoring Plan
ESA	Endangered Species Act
MECP	Ministry of Environment, Conservation and Parks
MNRF	Ministry of Natural Resources and Forestry
NDMNRF	Ministry of Northern Development, Mines, Natural Resources and Forestry
REA	Renewable Energy Approval
SARO	Species at Risk in Ontario
Stantec	Stantec Consulting Ltd.
UTM	Universal Transverse Mercator

1.0 INTRODUCTION

1.1 BACKGROUND

Suncor Adelaide Wind Limited Partnership (Suncor) is operating the 18 turbine Adelaide Wind Power Project (the "Project") north of Strathroy, Ontario, in Middlesex County, Municipality of Adelaide Metcalfe (**Figure 1, Appendix A**). Post-construction mortality monitoring, in accordance with the Project's Environmental Effects Monitoring Plan, took place from 2015 through 2017.

Results of the annual monitoring programs exceeded provincial raptor thresholds set out in Condition I5 (3) of the Renewable Energy Approval (REA) in 2015-2017. This exceedance triggered Condition I8 in 2015 and I10 in 2016, which included:

- Two years of subsequent scoped mortality and cause and effect monitoring for raptors (undertaken in 2016 and 2017).
- Following the scoped monitoring, implementation of mitigation for the life of the facility (collision risk abatement implemented in 2018).
- Effectiveness monitoring at individual turbines for three years, following implementation of mitigation (2018).
- Increased reporting frequency to identify potential threshold exceedance (implemented in 2017).
- Additional behavioural studies (implemented in 2017).

A mitigation plan was created in 2016 and updated in 2018 (Stantec 2018) to detail mitigation measures and guide the additional monitoring programs.

Through consultation with the Ministry of the Environment, Conservation and Parks (MECP) and Ministry of Natural Resources and Forestry (MNRF, now Ministry of Northern Development, Mines, Natural Resources, and Forestry; NDMNRF) in 2019, an Enhanced Raptor Monitoring Plan (ERMP; **Appendix B**) was developed and agreed upon. The intent of this ERMP was to build upon the conclusions of the 2016 through 2018 monitoring, with the goal of providing insight into where and when operation mitigation may be effective for raptors.

The Enhanced Raptor Monitoring Plan was to be implemented for two years (2019 and 2020), the results of which were to inform an operational mitigation strategy for the Project. As the results did not identify a clear-cut operational mitigation strategy for the Project, a third year of raptor monitoring was undertaken in 2021 to obtain additional information to further inform a proposed mitigation strategy.

Six (6) years of mortality monitoring activities have been conducted at the Adelaide facility. From 2015-2017, twice weekly monitoring was conducted at a 10-turbine subset under the prescribed REA monitoring program. From 2018-2020, monthly (2018 and part of 2019) or weekly (part of 2019 and throughout 2020) effectiveness monitoring for raptor mortalities at all 18 turbines was undertaken. The

REA and effectiveness monitoring used of specific correction factor trials (e.g., searcher efficiency, scavenger rates, and percent area searched) of 1.0. Raptor mortalities from 2015-2020 are shown in **Table A**.

Table A: Background Raptor Mortalities at Adelaide Wind Power Project (2015-2020)

Year	Total Number of Raptor Mortalities	Calculated Mortality Rate (raptors/turbine/ year)	Exceedance of Provincial Threshold?	Type of Monitoring Program	Species (#)
2015	5	0.46	Yes	REA	Red-tailed Hawk (2) Turkey Vulture (2) Osprey (1)
2016	4	0.80	Yes	REA	Red-tailed Hawk (2) Turkey Vulture (2)
2017	6	0.24	Yes	REA	Red-tailed Hawk (1) Turkey Vulture (4) Osprey (1)
2018	1	0 (1 incidental find)	No	Effectiveness monitoring for raptors (monthly)	Red-tailed Hawk
2019	1	0.06	No	Effectiveness monitoring for raptors (monthly then weekly)	Red-tailed Hawk
2020	3	0.17	No	Effectiveness monitoring for raptors (weekly)	Red-tailed Hawk (2) Turkey Vulture (1)

Operational mitigation measures implemented from 2018-2020 consisted of collision risk abatement measures. Based on the required 3-years of effectiveness monitoring undertaken in accordance with REA Condition I12(5) these abatement measures may have contributed to the lack of exceedance of the provincial threshold of 0.2 raptors/turbine/year in 2018, 2019, or 2020. Other factors, such as changes in spatial and behaviour of territorial breeding Red-tailed Hawks (discussed in more detail below) may be contributing to the lack of threshold exceedance observed in 2018-2020.

1.2 PURPOSE

The ERMP monitoring and this report are intended to meet the requirements of the REA triggered by the exceedance of the raptor mortality provincial threshold at the Project recorded in 2015 through 2017 as well as inform adaptive mitigation measures, as required.

This report provides details on the results of the third year of monitoring under the ERMP with analysis of risk to raptors under various conditions (e.g., weather conditions, time of year, time of day, etc.).

2.0 EXISTING OPERATIONAL MITIGATION

2.1 OPERATIONAL MITIGATION

Currently in Ontario, there is no guidance or established protocols on implementation of operational mitigation for raptors. This is likely due, in part, to a lack of empirical evidence that risk of raptor mortality is elevated during specific conditions (e.g., weather or seasonal; Allison et al. 2017). For this reason and as discussed with the MECP and MNRF after submission of the 2018 ERMP monitoring report, operational mitigation was not undertaken at the Adelaide facility in 2019-2021 but instead efforts were directed to collision risk abatement and enhanced monitoring, discussed below.

2.2 COLLISION RISK ABATEMENT

As both Turkey Vultures (Kirk and Mossman 2020), and to a lesser extent Red-tailed Hawks (Preston and Beane 2020), forage on carrion, an increase in carrion in the environment may lead to an increased risk of turbine collision. To address this risk, Suncor contacted a subset of Project landowners to discuss management of their dead livestock to reduce attraction of vultures and other raptors.

2.3 ADAPTIVE MANAGEMENT

An adaptive management approach to mitigation, consisting of a plan subject to adjustment or refinement during ongoing monitoring, is in place at the Adelaide facility. If strong trends become evident during the monitoring program, Suncor will contact the NDMNRF and MECP immediately to discuss potential mitigation options. Based on those discussions, if appropriate, mitigation may be implemented mid-year depending on the observed trend and seasonality. Furthermore, if evident trends are identified and/or successful mitigation techniques are identified by the NDMNRF and MECP through other facilities, these results will be used to inform appropriate operational mitigation measures for the Project.

3.0 METHODS

The ERMP (**Appendix B**) was intended to build upon the analysis and conclusions of mortality and behavioural trends from previous years, with the goal of providing insight into where, when and how operation mitigation would be effective for raptors. 2021 was the third year the enhanced raptor monitoring program was implemented.

The 2021 monitoring program included:

- Mortality monitoring at all turbines, once weekly from the beginning of May to the end of November
- Breeding and territorial monitoring
  - One driving survey end of April (e.g., before leaf out) to document nests within the Raptor Study Area (**Figure 1, Appendix A**)
  - Five behavioural surveys early-May – mid-June at identified nests
- Fall migration monitoring, ten surveys late-August – late-October at identified nests

3.1 MORTALITY MONITORING

Raptor mortality monitoring was conducted at all 18 turbines, comprised of approximately 10-minute surveys, targeted to be focused on large-bodied birds (i.e., raptors), which is consistent with the non-subset searches conducted 2015-2017. Searches were conducted within 50 m of turbines and involved walking in concentric circles. Each vegetation class within the 50 m radius were searched and each turbine was searched weekly from May 6 – November 24, 2021, where weather, safety, and site-specific conditions allowed.

Weather parameters (temperature, wind speed and precipitation) were recorded on each day surveys were conducted. If a carcass was discovered, the following information was recorded:

- Searcher identification
- Species
- Turbine number
- Date and time the carcass was found
- Sex (if possible to determine)
- Universal Transverse Mercator (UTM) coordinates
- State of decomposition

- Estimated days since death
- Injury sustained (if applicable)
- Distance and direction from the nearest turbine
- Substrate upon which the carcass was found
- Visibility class

Carcasses found in the field were photographed and then moved outside of the 50-metre search area to avoid double-counting.

Survey dates, times and weather conditions are provided below in **Table C1, Appendix C**.

3.2 BREEDING TERRITORIAL MONITORING

3.2.1 Nest Search

To determine potential nesting raptor locations, a search within 1 kilometer (km) of each turbine located within the Project (i.e., Raptor Study Area, **Figure 1, Appendix A**) was conducted. The survey took place on April 20, 2021 and included driving municipal and access roads in the Study Area looking for bulky stick nests for Red-tailed Hawks and evidence of Turkey Vulture use of barns and abandoned buildings. Active Red-tailed Hawk nests from previous years were also examined for signs of reuse.

3.2.2 Behavioural Surveys

Five surveys of identified nests were completed between May 3 and June 3, 2021, to assess territory size, observe interactions between raptors, and to monitor nest activity through the breeding season. Each survey consisted of two hours at various times of day at each nest.

Details recorded during each survey included:

- Survey date and time
- Weather conditions
- Field personnel
- Species and age (if determined)
- Flight paths (including height)
- Raptor behaviour (soaring, flapping, gliding, hovering, or perched, including duration) and associated habitat

Incidental observations of raptor species were also recorded, including details on location, species, number of individuals, behaviour and flight height.

Individual flight paths were mapped in the field and consolidated using ArcGIS Online where flight paths overlapped in direction, location, and proximity to nearby turbines and natural features.

Survey dates, times and weather conditions are provided below in **Table C2, Appendix C.**

3.3 FALL MIGRATION BEHAVIOURAL MONITORING

The focus of the fall migration monitoring was on the known active territories, mapping how migrant individuals move through or around these territories and examining interactions between resident and migrants, with specific emphasis on recording high-risk behaviour (i.e., flying within 50 m of a turbine). Ten surveys were conducted between August 24 and October 27, 2021, at nesting territories associated with identified nests.

Data recorded was identical to that of the summer behavioural surveys outlined above, including:

- Survey date and time
- Weather conditions
- Field personnel
- Species and age (if determined)
- Flight paths (including height)
- Raptor behaviour (soaring, flapping, gliding, hovering, or perched, including duration) and associated habitat

Incidental observations of raptor species were also recorded, including details on location, species, number of individuals, behaviour and flight height.

Survey dates, times and weather conditions are provided below in **Table C2, Appendix C.**

4.0 RESULTS

4.1 MORTALITY MONITORING

No raptor mortalities were recovered during the 2021 mortality monitoring surveys conducted by Stantec. **Table C3, Appendix C** provides a comparison of raptor mortalities recovered by year throughout the various monitoring programs (2015-2021).

Nine incidental mortalities were recovered during the mortality monitoring program in 2021, which included three birds (Horned Lark, Bobolink and Mourning Dove) and six bats (three Silver-haired Bats, one Hoary Bat, one Big Brown Bat and one Eastern Red Bat), as summarized in **Table C4, Appendix C**. A notification was made to the MECP regarding the Bobolink (threatened) mortality observed on May 18, 2021.

4.2 BREEDING TERRITORIAL MONITORING

4.2.1 Nest Search

Two new stick nests were identified within the Raptor Study Area during the nest survey conducted on April 20, 2021. Nests were located near turbines 20 and 27. The two Red-tailed Hawk nests previously observed at Turbines 8 and 12 in 2020 were also examined for evidence of reuse on April 20, 2021. No raptor activity was observed at either nest. Both were assessed as inactive during a short follow-up survey on May 3, 2021. Active Red-tailed Hawk nests identified in 2021 are shown on **Figure 3.1** and **Figure 3.2, Appendix A**. For comparison purposes, a summary of nest locations by year is provided in **Table C5** (**Appendix C**).

Candidate nesting habitat for Turkey Vultures occurs throughout the Project with numerous barns documented, although confirmation of nesting was not possible due to a lack of access to these private structures.

4.2.2 Behavioural Surveys

Observed behaviours of Red-tailed Hawks and Turkey Vultures during the breeding season is summarized in **Tables C6** and **C7**, respectively (**Appendix C**), with flight paths of each raptor shown on **Figure 2.1, Figure 2.2, Figure 3.1** and **Figure 3.2, Appendix A**.

4.2.2.1 Red-tailed Hawks

Red-tailed Hawks were observed visiting their nests (likely incubating eggs and/or brooding young) at Turbine 27 on three out of the five survey dates (May 3, May 12 and May 27, 2021) and at the nest at Turbine 20 on two of the five survey dates (May 3 and June 3, 2021).

Red-tailed Hawks were observed on four of the five behavioural surveys at Turbine 27 (all dates except June 3) and on four of the five survey dates at Turbine 20 (all dates except May 12). Observed Red-tailed Hawk activity consisted of a combination of the following behaviours:

- visits to and remaining on the nest
- perching in nearby features (hedgerow, dead trees)
- vocalization both on and in close proximity to the nest
- courtship behaviour (e.g., observed on May 27 in the area of Turbine 20)
- successful foraging (e.g., a snake was captured by one of the adults at Turbine 27 on May 21)
- soaring behaviour (likely associated with foraging or patrolling)
- defensive behaviour (e.g., defending territory from a nearby Turkey Vulture at Turbine 27 on May 27)

These behaviours are expected to be characteristic of resident birds associated with the nesting territories.

Perching locations (RTHA P1 - RTHA P11) were only utilized once during behavioural surveys (**Figure 3.1** and **Figure 3.2, Appendix A**). Identified flight paths (RTHA F1, RTHA F2 and RTHA F4-F10; **Figure 3.1** and **Figure 3.2, Appendix A**) used by Red-tailed Hawks during the breeding territorial mapping were used by between 1 (RTHA F5 and F10) and 5 (RTHA F9) individuals, as shown on **Figure 11** (**Appendix A**).

Interactions between territorial birds and raptors were observed on several occasions during surveys in 2021. An adult Red-tailed Hawk was observed being harassed by Northern Cardinals along the edge of the woodlot at Turbine 20 on June 3 (RTHA F10**; Figure 3.1, Appendix A**). Red-winged Blackbirds also displayed territorial/agitated behaviour towards another adult Red-tailed Hawk on the same survey date at Turbine 27. In this case, the chased Red-tailed Hawk stopped to perch (RTHA P11; **Figure 3.2, Appendix A**) and after continuing to be harassed the called a few times and then flew north over the woodlot (RTHA F9, **Figure 3.1, Appendix A**).

On May 27 the adult Red-tailed Hawk at Turbine 27 appeared to defend its territory as the Turkey Vulture soared within proximity to the nest location (see RTHA F2; **Figure 3.2, Appendix A**) by diving at the Turkey Vulture.

Avoidance behaviour was documented at Turbine 20 in 2021. On May 21, a pair of Red-tailed Hawks were observed flying between 60 and 200 metres high in the vicinity of Turbine 20. The pair appeared to avoid the turbine by circling and veering away from the rotating blades (RTHA F7, **Figure 3.1, Appendix A**).

No high-risk behaviour (i.e., flying within 50 m of a turbine) was documented by Red-tailed Hawks during the breeding behavioural surveys.

4.2.2.2 Turkey Vultures

Interactions between Turkey Vultures and other birds was restricted to being chased by a Red-tailed Hawk, as described above in **Section 4.2.2.1**.

Avoidance behaviour was observed twice on May 27 at Turbine 20 (see TUVU F14 and TUVU F15; **Figure 2.1, Appendix A**). Both individuals appeared to adjust their behaviour to avoid proximity to the turbine. In particular, the Turkey Vulture that used flight path TUVU F15 appeared to fly at a low altitude under the turbine and increased altitude when it had flown clear of the blade sweep.

No high-risk behaviour (i.e., flying within 50 m of a turbine) was documented by Turkey Vultures during the breeding behavioural surveys.

4.3 FALL MIGRATION MONITORING

Observed behaviours of Red-tailed Hawks and Turkey Vultures during the fall migration period is summarized in **Table C8** and **Table C9**, respectively (**Appendix C**), with flight paths of each raptor shown on **Figure 2.1, Figure 2.2, Figure 3.1** and **Figure 3.2, Appendix A**.

4.3.1 Red-tailed Hawks

Red-tailed Hawk observations remained relatively consistent during the fall migration monitoring between early September and late October, 2021. Between 1 and 3 individuals were observed on five of the ten total monitoring dates, and seven individuals were observed on the October 18 survey date. Perching behaviour was documented by one of the seven birds on October 18 with the remaining six birds observed in flight during the survey. Perching behaviour was also observed by one of the three Red-tailed Hawks observed on October 5. Red-tailed Hawks were observed on both warm (≥15˚C) and cool days (1-14˚C) when winds were moderate (Beaufort Scale 2; 6-11 km/h) or high (Beaufort Scale 3-4; 12-28 km/h). Wind direction was variable with the largest number of birds observed under high westerly winds (**Table C8, Appendix C**).

Flight path number RTHA F1 experienced the most activity during fall migration (5 Red-tailed Hawks) followed by flight path RTHA F13 with three uses (**Figure 11, Appendix A**). Considering time of day, Red-tailed Hawk observations were made throughout the day, with an afternoon peak between 12:45 pm and 5:15 pm (**Figure 9, Appendix A**).

Generally Red-tailed Hawks avoided flying within close proximity to operational turbines during surveys in 2021. At Turbine 20, individuals tended to fly above blade height and circled over the woodlot north of Turbine 20 as well as gliding over fields east of Turbine 20, likely in search of prey (see **Figure 3.1, Appendix A**). Red-tailed Hawks at Turbine 27 were also almost exclusively observed flying above or perched on the edge of the woodlot north of the Turbine (see **Figure 3.2, Appendix A**).

One instance of an intraspecific interaction was documented during the fall surveys, with an adult Red-tailed Hawk chasing a juvenile Red-tailed Hawk away from its territory at Turbine 20 on October 18, 2021.

No Red-tailed Hawk high-risk behaviour was observed during fall migration surveys in 2021.

4.3.2 Turkey Vultures

Turkey Vulture observations were highest through September – October, ranging from 3 on October 27 to 132 on September 8, 2021 (**Table C9, Appendix C**). Temperatures were generally warm in September (except for September 24) and variable in October with predominantly medium wind speeds (i.e., 2 on the Beaufort scale) except for higher wind speeds on September 24 and October 18 (3-4 on the Beaufort Scale; **Table C9, Appendix C**).

Flight path number TUVU F37 experienced the most activity with 80 uses by Turkey Vultures, followed by TUVU F34 (77 uses) and TUVU F15 (68 uses; **Figure 12, Appendix A**). Considering time of day, most Turkey Vulture observations were made between late-morning and early afternoon (**Figure 10, Appendix A**).

High-risk Turkey Vulture behaviour was observed on September 2 at Turbine 20, demonstrated by flying within the blade sweep at blade height (see flight paths TUVU F9, F26 and F29; **Figure 2.1, Appendix A**).

Avoidance behaviour during fall migration was documented on September 8 at Turbine 27 and September 24 and 28 (both at Turbine 20), 2021. On all three dates, Turkey Vultures appeared to soar at a higher altitude once they were clear of the blade sweep (see flight paths TUVU F17, F21 and F33; **Figure 2.1** and **Figure 2.2, Appendix A**).

4.3.3 Other Raptors

The ERMP focused on Red-tailed Hawk and Turkey Vulture, as they were the predominant species observed during mortality monitoring at the time of writing (August 2019). However, observations of other species of raptors within the Study Area were recorded in 2021. Species include Bald Eagle, Northern Harrier, Broad-winged Hawk and Cooper's Hawk. A summary of these incidental observations is provided in **Table C10, Appendix C.**

A total of 10 Bald Eagle observations, 4 Northern Harrier observations, 20 Broad-winged Hawk observations and 2 Cooper's Hawk observations were made across the Project. Bald Eagle flight path observations are shown on **Figures 4.1** and **4.2** (**Appendix A**) and the flight paths of three other species are shown on **Figure 5.1** and **Figure 5.2, Appendix A.**

4.4 HAWK WATCH DATA

Data from the Hawk Migration Association of North America's Raptor Migration Database (Hawk Count 2021) was obtained to compare to observations within the Project. The Holiday Beach Hawk Watch station was selected for comparison, as it is the closest Ontario station that is "downstream" (i.e., to the south) of the Project during fall migration. The Holiday Beach Hawk Watch station is approximately 150

km southwest of the Project. It is expected that raptors passing through the Project during fall migration would subsequently pass-through Holiday Beach a day or two later.

Daily numbers of Red-tailed Hawk and Turkey Vultures at Holiday Beach in 2021 between September 1 and November 30 are provided in **Table C11** and **Table C12, Appendix C**, respectively. Red highlighting (add by Stantec) indicated the timing of peak migration of each species based on results of the fall migration monitoring conducted at the Project. As timing of migration can be dependent on weather conditions and is variable from year to year, the long-term migration data was also obtained for Holiday Beach, which is shown on **Figure 7** and **Figure 8, Appendix A.**

5.0 DISCUSSION

5.1 MORTALITY MONITORING

Results of the multi-year mortality monitoring program at the Project has recorded twenty raptor mortalities (including incidental finds) between 2015 and 2021, as shown in **Figure 6, Appendix A**. Red-tailed Hawks and Turkey Vultures (90%; 18 of 20) comprise most of the raptor mortalities at the Project, which is consistent with results across Ontario. Red-tailed Hawk comprises 5.3% and Turkey Vulture 6.1% of all wind facility bird mortalities in Ontario (BSC et al. 2018). The mortality of Red-tailed Hawks and Turkey Vultures in Ontario can likely be attributed to, at least in part, the abundance of these species in the province. The remaining two raptor mortalities at the Project between 2015 and 2021 were Osprey (10%; 2 of 20), unexpected due to a lack of habitat in the Project Area. It is expected that both individuals were in transit through the area when they collided with the turbines.

When comparing mortality rates throughout the seven (7) years of monitoring, mortality rates exceeded the provincial threshold of 0.2 raptors/turbine/year from 2015-2017. Operational mitigation measures implemented from 2018-2021 consisted of collision risk abatement measures which along with changes in spatial and behaviour of territorial breeding Red-tailed Hawks (discussed below) may be contributing to the lack of threshold exceedance observed in 2018-2021.

5.2 BREEDING TERRITORIAL MONITORING

5.2.1 Evidence of Active Territories

Two Red-tailed Hawk nest locations were identified within the Study Area at turbines 20 and 27, within the western portion of the Project, as shown on **Figure 3.1** and **Figure 3.2, Appendix A.** Both nests had adult birds on their nests during the nest survey on April 20 and again on May 3, likely incubating eggs. As with previous years, nests became obscured by foliage after the May 3 visit and therefore subsequent surveys cannot confirm nest occupancy unless a bird visits or leaves the vicinity of the nest. Activity at the Turbine 27 nest was documented up until May 27 whereas at Turbine 20 documented nest activity continued until the last breeding survey date on June 3.

Territorial defense was observed at Turbine 27 on May 27 when an adult Red-tailed Hawk appeared to chase a Turkey Vulture that was flying in proximity to the nest. Additionally, during the fall migration period, an adult Red-tailed Hawk appeared to chase a juvenile Red-tailed Hawk away from its territory at Turbine 20 on October 18, 2021. Although Red-tailed Hawks defend territories more aggressively during the breeding season, intra- and interspecific aggression does occur outside the breeding season and during migration (Preston and Beane 2020). It is also possible that this juvenile was a fledgeling from the Turbine 20 nest and although it is typical for young to remain with parents for up to 10 weeks after fledging (Preston and Beane 2020), approximately the end of September, it is possible this fledgeling was getting some encouragement to leave the home territory from a parent bird.

No other territorial disputes were observed in 2021.

5.2.2 Wind Turbine Collision Risk

The risk of turbine collision may be affected by many factors, including behaviour, flight path, abundance, landscape, morphology, weather, vision, and whether the individual is a resident or breeding bird (Marques et al. 2014). Raptors, in particular Red-tailed Hawks, may be more susceptible to collisions when compared with other birds, potentially attributable to their foraging and flight behaviour (Hoover and Morrison 2005). However, Garvin et al. (2010) found some signs of turbine avoidance, where resident Red-tailed Hawks and Turkey Vultures changed flight height or direction within 100 m of a turbine. This suggests that resident birds may experience a lower risk of wind turbine collision, as they are familiar with the landscape and avoid the turbines (Drewitt and Landston 2008).

The results of the behavioral monitoring in 2021 and previous years support this conclusion, as specific avoidance behaviour was documented during the summer monitoring for Red-tailed Hawks and Turkey Vultures, associated with an observed change in flight direction and/or altitude on May 21 (Red-tailed Hawks, Turbine 20, RTHA F7) and May 27 (Turbine 20, TUVU F14 and TUVUF15) as shown in **Figures 2.1, 2.2, 3.1** and **3.2, Appendix A.**

During previous years of cause and effect monitoring at the Adelaide Wind Power Project, raptor mortality was higher in proximity to an active Red-tailed Hawk nest; five mortalities recorded over the 6 years in proximity to a single active nest It was hypothesized that increased mortality associated with active territories may be attributable to interactions between resident Red-tailed Hawks and raptors passing through their territory. Such interactions may result in distracted flight and increase risk of collision. During such interaction, the migratory birds, unfamiliar with the territory, may be at higher risk of turbine collision.

Results of the 2021 behavioural surveys documented one interaction between a resident Red-tailed Hawk and a Turkey Vulture at Turbine 27 which was consistent with similar behaviour recorded during previous cause and effect monitoring at the Project, although no mortalities were documented in 2021. Additionally, one other incident of territoriality was documented on October 18, 2021, between an adult and juvenile Red-tailed Hawk outside of the breeding season as discussed in **Section 5.2.1**.

Although Red-tailed Hawks defend territories more aggressively during the breeding season, intra- and interspecific aggression does occur outside the breeding season and during migration (Preston and Beane 2020). It is also possible that this juvenile was a fledgeling from the Turbine 20 nest and although it is typical for young to remain with parents for up to 10 weeks after fledging (Preston and Beane 2020), approximately the end of September, it is possible this fledgeling was getting some encouragement to leave the home territory from a parent bird.

5.3 FALL MIGRATION MONITORING

5.3.1 Fall Migration Patterns

Red-tailed Hawk observations remained relatively consistent (1-7 birds) during the fall migration monitoring between end of August and late October. The 2021 Holiday Beach Hawk Watch data

(**Table C11, Appendix C**) is consistent with the long-term trend (**Figure 7, Appendix A**), showing peak Red-tailed Hawk migration in mid-October through mid-November.

The fall migration monitoring surveys observed daily counts of Turkey Vultures that were generally consistent through September and October with the highest count on September 8 at 132 birds combined between Turbines 20 and 27. Only one observation of three Turkey Vultures was made during the last survey on October 27, consistent with Holiday Beach Hawk Watch data (**Table C12, Appendix C**), which shows peak migration of Turkey Vultures in mid-October, dropping off later in the month and into November (**Figure 8, Appendix A**).

Both Red-tailed Hawks (**Figure 9, Appendix A**) and Turkey Vultures (**Figure 10, Appendix A**) had an observed trend of higher flight activity during mid-day. This result agrees with the literature which finds raptor flight activity, in particular migratory flights, to be concentrated mid-day when temperatures are higher and thermals, which support raptors flight, are well developed (Newton 2007).

It is known that weather can affect raptor migration activity, in particular wind direction. At hawk watch stations in southern Ontario, increased fall migration activity typically occurs during prevailing winds from the north or northwest (Hawk Count 2020). Winds blowing in the same direction of the raptor's migration decreases flight effort. As discussed above, temperature can also affect raptor migration, with warmer days providing strong thermals to help lift the raptors.

Results of the 2021 fall migration monitoring identified five days with prevailing winds from the north (including winds that were north-northwest, north-northeast, northwest and due north), September 2, September 28, October 5, October 15 and October 27 (**Table C12, Appendix C**). However, Red-tailed Hawk activity was highest on October 18, which had a westerly wind direction.

Turkey Vulture activity was observed throughout the fall migration period with the highest observed total on September 8, which had a west-northwest prevailing wind. Overall, there was no strong correlations between weather conditions and raptor activity observed at the Project.

5.3.2 Wind Turbine Collision Risk

There were several documented observations of avoidance behavior by both Red-tailed Hawks and Turkey Vultures during behaviour surveys conducted during fall migration. Generally, flight paths shown on **Figures 2.1, 2.2** and **Figures 3.1** and **3.2** (**Appendix A**) tended to steer well clear of turbines. However, three recorded behaviours during fall 2021 documented more evident turbine avoidance behavior, with a close approach, followed by a change in direction and/or height (Turkey Vultures on flight paths TUVU F33, F21 and F17; see **Figures 2.1 and 2.2, Appendix A**).

Red-tailed Hawk migration appeared to peak around mid October with 7 birds observed on October 18 and decreased by the last survey on October 27. Long-term data from the Holiday Beach Hawk Watch station where Red-tailed Hawks are observed in large numbers peaking between late October and mid November

Trends in Turkey Vulture migration appeared to peak from early September to early October, decreasing towards the end of October. This was inconsistent with the Holiday Beach Hawk watch station data that shows mid October as peak migration period for Turkey Vultures.

Raptor mortality in previous monitoring years has not been strongly correlated with fall migration. Only five of the 20 raptor mortalities recovered from the Project have been found during the fall migration period. Furthermore, there has been no observed correlation between mortality, and observations of peak raptor migration events through the Project.

Results of the 2021 fall migration monitoring showed limited evidence of correlation between weather conditions and raptor activity.

6.0 CONCLUSION AND RECOMMENDATIONS

The goal of the ERMP was to provide insight into where, when and how mitigation could be effective for raptors.

Over the course of the mortality monitoring program, an apparent trend of increased raptor mortality in proximity to active nests was observed. As hypothesised in **Section 5.2.2** above, increased mortality could be the result of distracted flight during territorial interactions between the resident pair and other raptors. However, this appears to be associated with a single breeding pair in the vicinity of Turbines 8 and 12, near which five mortalities were recorded between 2016 and 2020. That specific nest was found to be inactive in 2021, a year when no mortalities were observed. Furthermore, the same concentration of mortalities has not been made at other active Red-tailed Hawk nests. It is possible the localized increase in collision risk was associated with a particularly aggressive nesting pair; a risk which is no longer present since the nest is no longer active.

The ERMP has not identified trends in raptor mortality during the fall migration period. Only five of the 20 raptor mortalities identified at the project between 2015 and 2021 have occurred during fall migration. Of the five mortalities observed during fall migration, there is not an apparent correlation with peak migration activity, or weather conditions expected to push greater numbers of raptors through the Study Area.

With regards to time of year, data from the Holiday Beach Hawk Watch station provides insight into when raptor activity is expected to be elevated in the Study Area, specifically in October to mid-November and during conditions with prevailing winds from the north or northwest. However, results of the Project's post-construction monitoring program completed to-date (2015 to 2021) have not found elevated raptor mortality during this period.

Currently, in Ontario, there is no guidance or established protocols on implementation of operational mitigation for raptors. This is likely due, in part, to a lack of empirical evidence that risk of raptor mortality is elevated during specific conditions (e.g., weather or seasonal; Allison et al. 2017). This conclusion is supported by the results of the monitoring programs conducted at the Project, where no trends between raptor mortality risk, weather or season has been established. Through the years of monitoring, a single potential risk factor (the Red-tailed Nest in proximity to Turbines 8 and 12) was identified, which may have contributed to the higher raptor mortality observed earlier in the monitoring program. However, monitoring in 2021 found that risk factor to no longer be present.

Furthermore, there may not be a need to implement operation mitigation for raptors, given the low overall numbers of mortalities in general. This is supported at the Adelaide facility, as no raptor mortalities were identified at the Project in 2021, with low raptor mortality observed (average 1.25 raptors / year) that did not exceed provincial thresholds of 0.2 raptors/turbine/year (0 in 2018 and 2021, 0.06 in 2019 and 0.17 raptors/turbine/year in 2020) over the 4 years of raptor cause and effect and effectiveness monitoring. The results suggest the current risk of the Project to raptors is relatively low and that implemented mitigation (collision risk abatement) as well as loss of the highly aggressive pair of Red-tailed Hawks in the vicinity of turbine 12 may be contributing to this reduction.

This report represents the conclusion of the monitoring commitments in the ERMP. Given the results of the 4 years of cause-and-effect monitoring, further mortality and behaviour monitoring are not recommended. It is Stantec's professional opinion that further monitoring and operational mitigation are not warranted, but that Suncor has decided to repeat the ERMP in 2022. Ongoing abetment measures, including landowner education on management of dead livestock have been implemented. It is recommended that this abatement measure be continued for the life of the Project.

7.0 REFERENCES

Allison, T.D. J. F. Cochrane, E. Lonsdorf, and C. Sanders-Reed. 2017. A Review of Options for Mitigating Take of Golden Eagles at Wind Energy Facilities. Journal of Raptor Research, 51(3):319-333.

Bird Studies Canada (BSC), Canadian Wind Energy Association, Environment and Climate Change Canada and Ontario Ministry of Natural Resources and Forestry. 2018. Wind Energy Bird and Bat Monitoring Database Summary of the Findings from Post-construction Monitoring Reports.

Drewitt, A.L. and R.H.W. Langston. 2008. Collision effects of wind-power generators and other obstacles on birds. Ann. N. Y. Acad. Sci., 1134: 233–266.

Hawk Count. 2020. Hawk Migration Association of North America's Raptor Migration Database. https://www.hawkcount.org/siteinfo.php?rsite=100

Garvin, J. C. C. S. Jennelle, D. Drake, and S.M. Grodsky. 2011. Response of raptors to a windfarm. Journal of Applied Ecology. 48: 199-209.

Hoover. S.L., and M.L. Morrison. 2005. Behavior of red-tailed hawks in a wind turbine development. Journal of Wildlife Management: 69: 150–159.

Kirk, D. A. and M. J. Mossman (2020). Turkey Vulture (Cathartes aura), version 1.0. In The Birds of the World (A. F. Poole and F. B. Gill, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA.

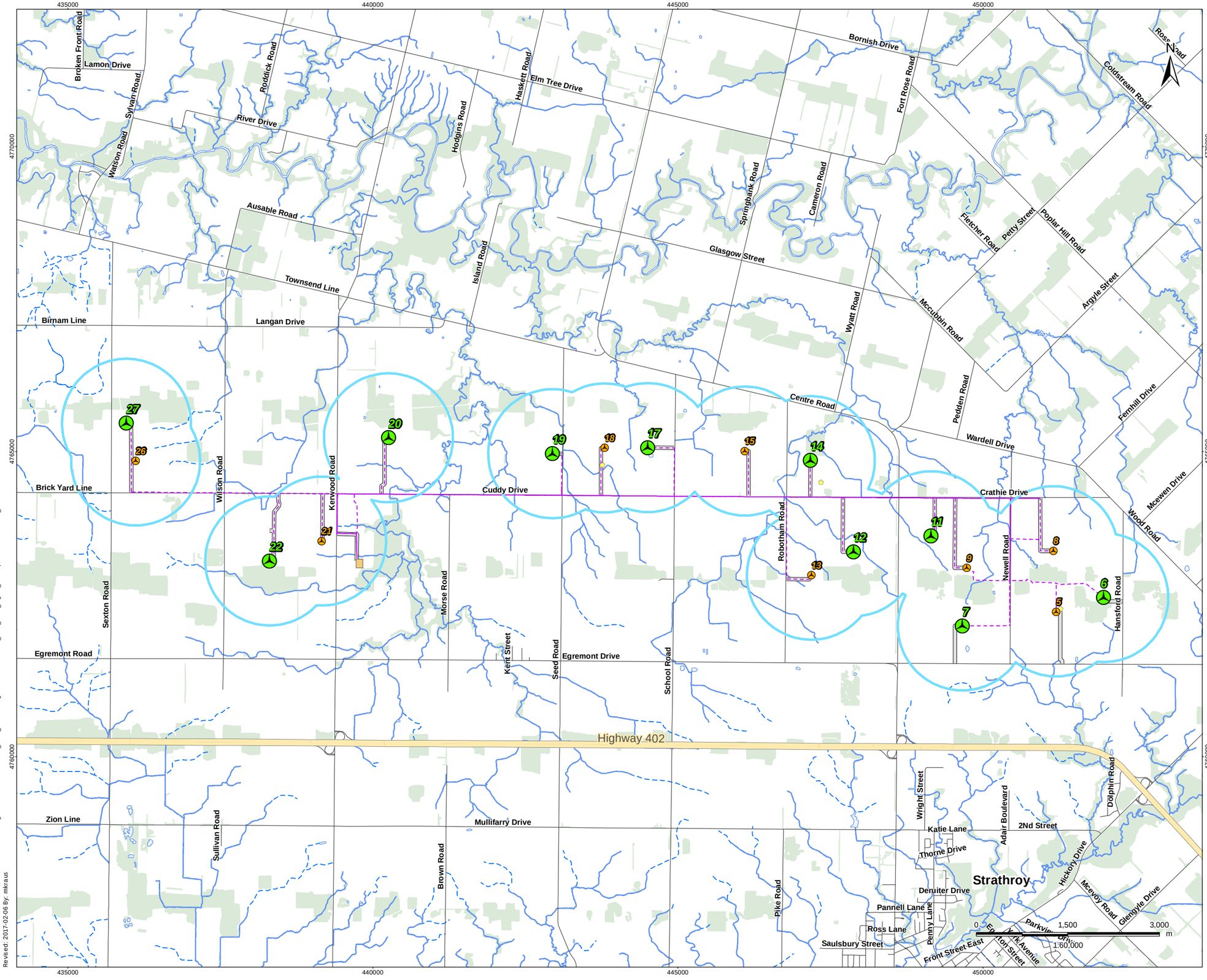
Marques, A.T., H. Batalha, S. Rodrigues, H. Costa, M.J.R.Pereira, C. Fonseca, M. Mascarenhas, and J. Bernaardino. 2014. Understanding Bird Collisions at Wind Farms: An Updated Review on the Causes and Possible Mitigation Strategies. Biological Conservation 179:40-52.

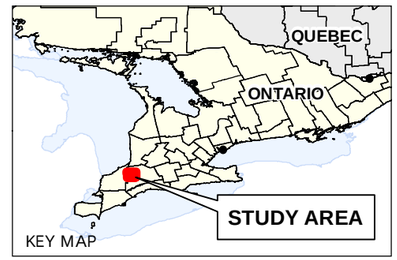
Newton, I. 2007. The Migration Ecology of Birds. Academic Press. pp 163-192.

Preston, C. R. and R. D. Beane (2020). Red-tailed Hawk (Buteo jamaicensis), version 2.0. In The Birds of North America (A. F. Poole, Editor). Cornell Lab of Ornithology, Ithaca, NY, USA.

Stantec Consulting Ltd. (Stantec) 2018. Adelaide Wind Power Project – Mitigation Plan for Raptors.

APPENDIX A
Figures





Legend

- Raptor Study Area

Project Components

- MET Tower
- Turbine Location
- Turbine Subset
- Access Road
- Collector Line
- Substation Constructible Area

Existing Features

- Expressway / Highway
- Road
- Watercourse
- Constructed Drain
- Waterbody

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.

February 2017
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

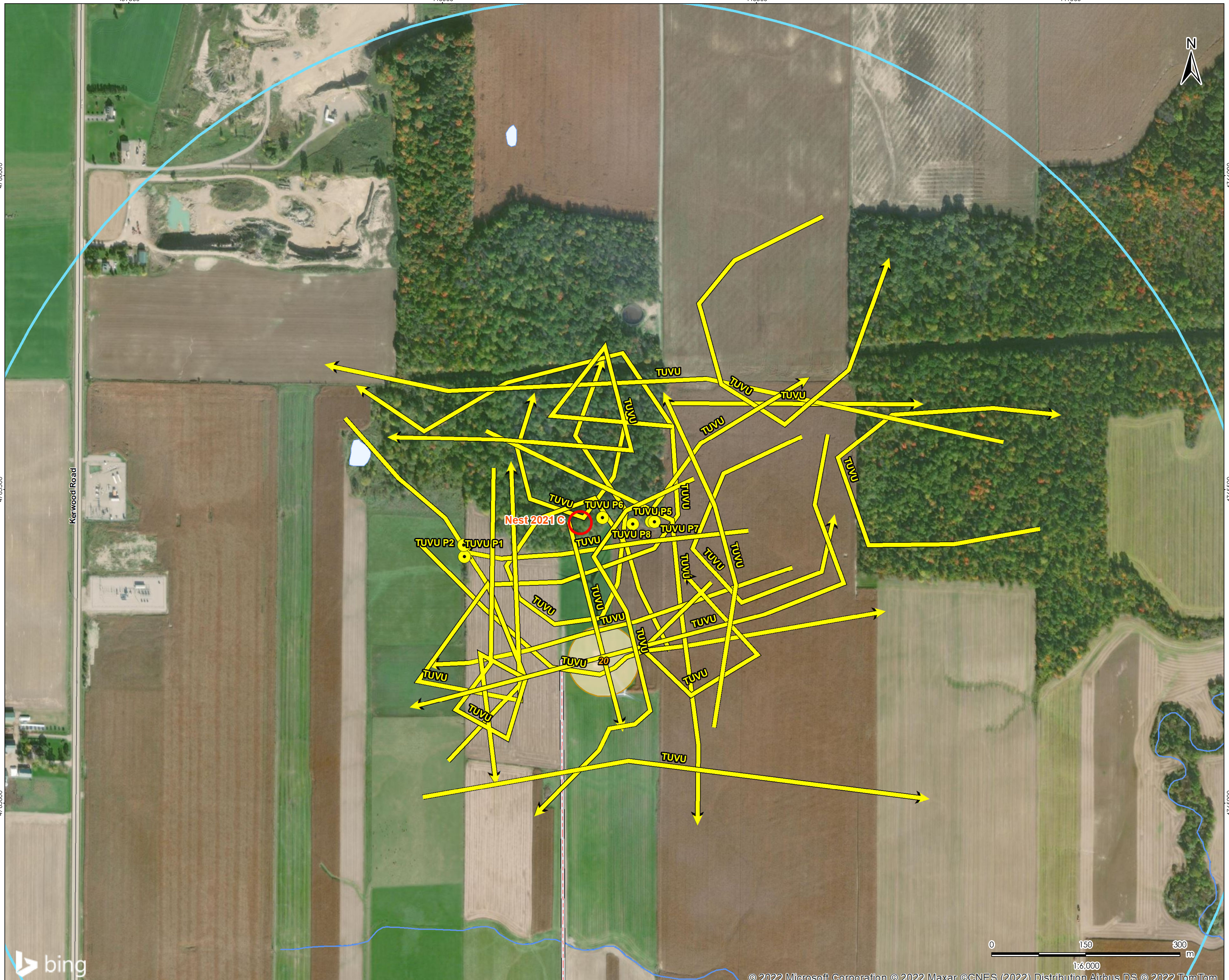
Figure No.

1

Title

Raptor Study Area

\\ Cd122p-f02\01609\active\160960710\drawing\MXD\Terrestrial\Post_Con_Monitoring\2016\160961067_Post_Con_Fig2a_T12RaptorNestBehavior_20170206.mxd
Revised: 2017-02-06 By: mkraus



V:\01609\active\60960710\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig02_TurkeyVulture_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey

Stantec

Legend

- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Road
- Watercourse
- Constructed Drain
- Waterbody

Perch Location

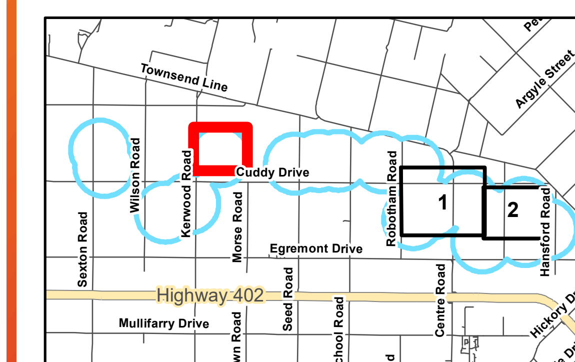
- Turkey Vulture (TUVU)

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Turkey Vulture (TUVU)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

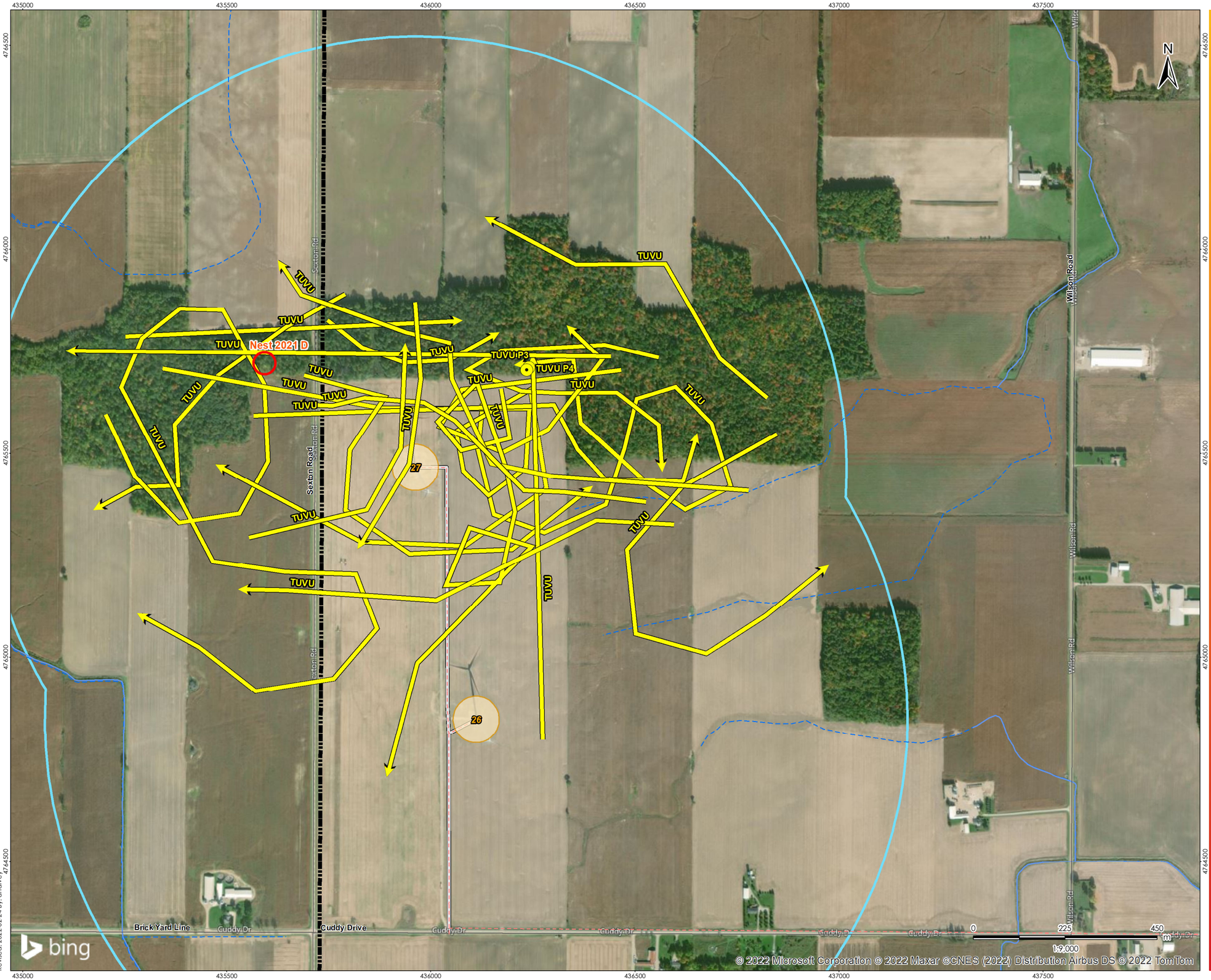
February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

Figure No.
2.1

Title
Turkey Vulture Flight Paths 2021



Stantec

Legend

- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Collector Line
- Road
- Watercourse
- Constructed Drain

Perch Location

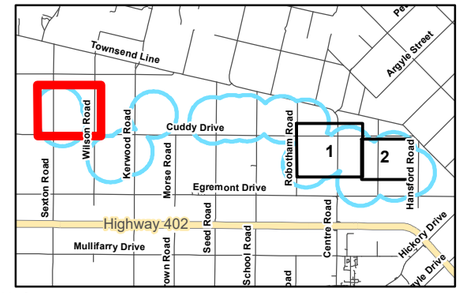
- Turkey Vulture (TUVU)

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Turkey Vulture (TUVU)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

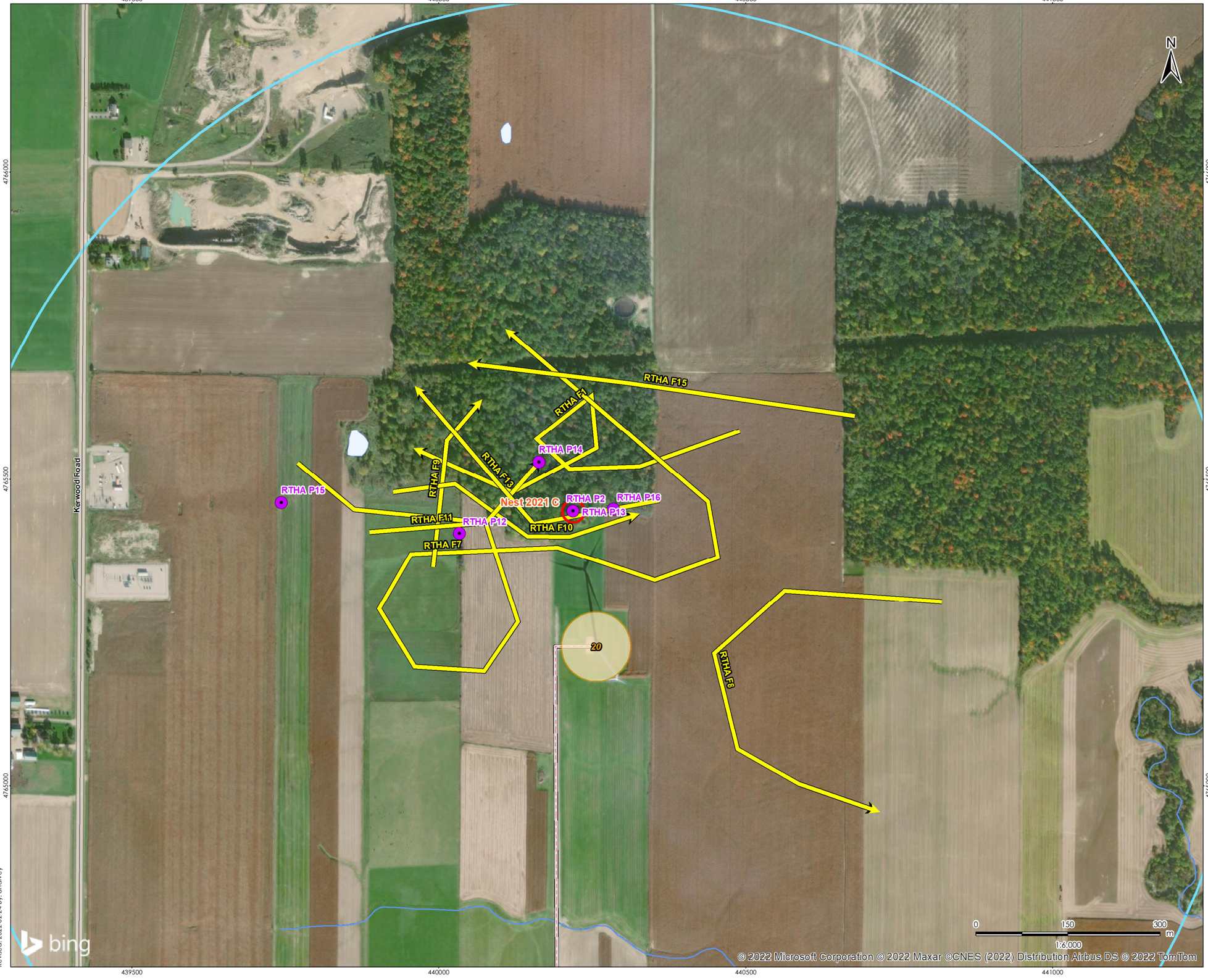
Figure No.

2.2

Title

Turkey Vulture Flight Paths 2021

V:\01697\active\160961067\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig02_TurkeyVulture_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey



V:\01609\active\609607\10\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig03_Red_Tailed_Hawk_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey

Stantec

Legend

- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Road
- Watercourse
- Constructed Drain
- Waterbody

Perch Location

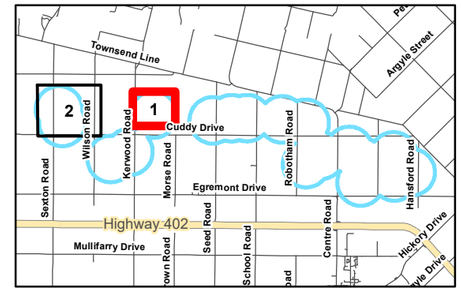
- Red-tailed Hawk (RTHA)

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Red-tailed Hawk (RTHA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

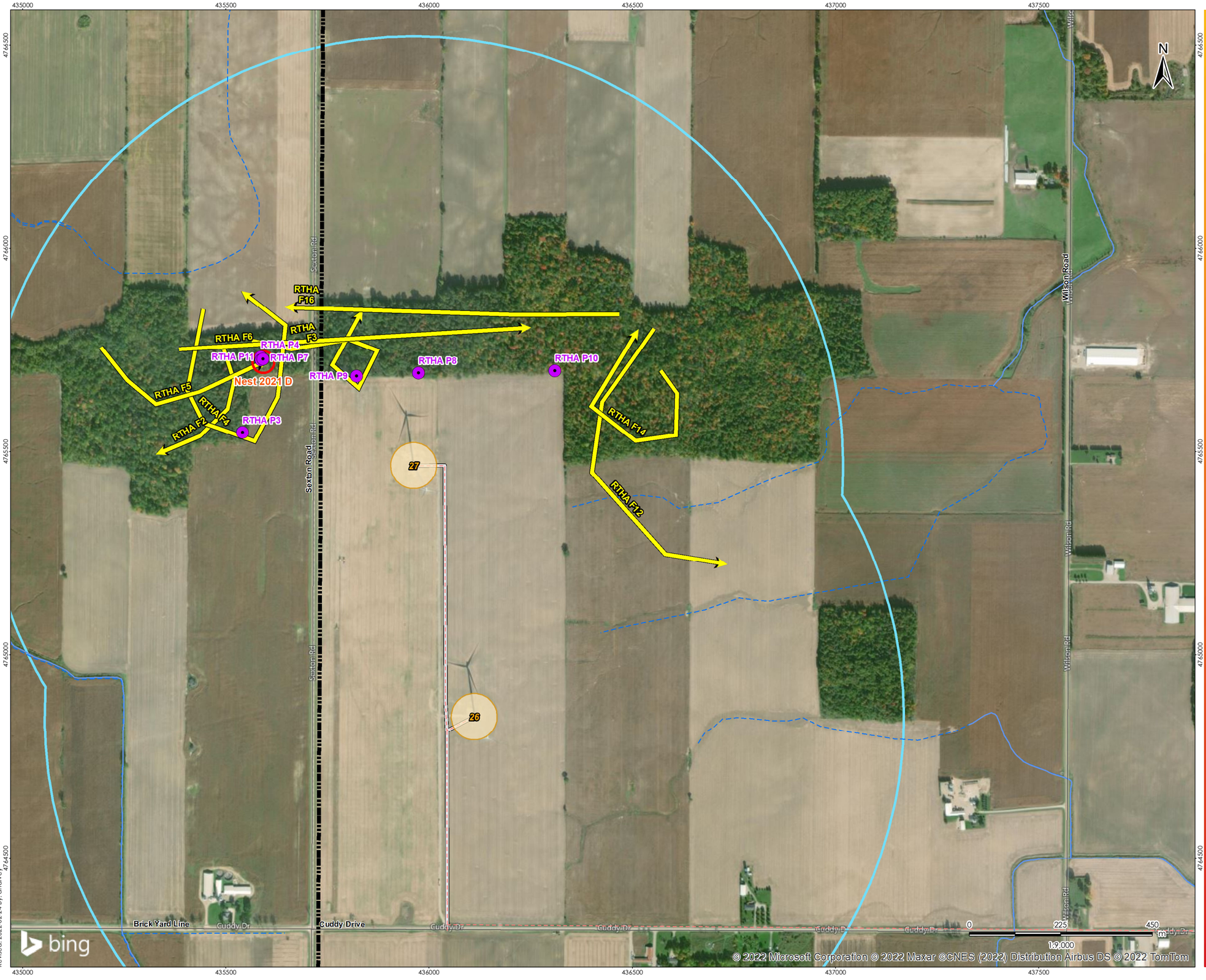
Suncor Energy
Adelaide Wind Project

Figure No.

3.1

Title

Red-tailed Hawk Flight Paths 2021



V:\01609\active\609607\10\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig03_Red_Tailed_Hawk_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey

Stantec

Legend

- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Collector Line
- Road
- Watercourse
- Constructed Drain

Perch Location

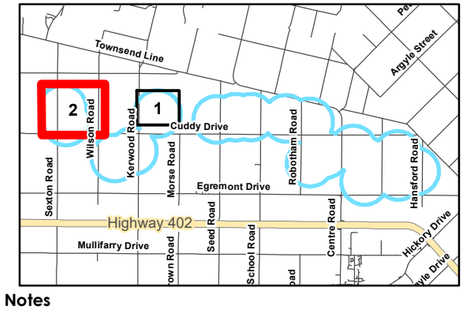
- Red-tailed Hawk (RTHA)

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Red-tailed Hawk (RTHA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

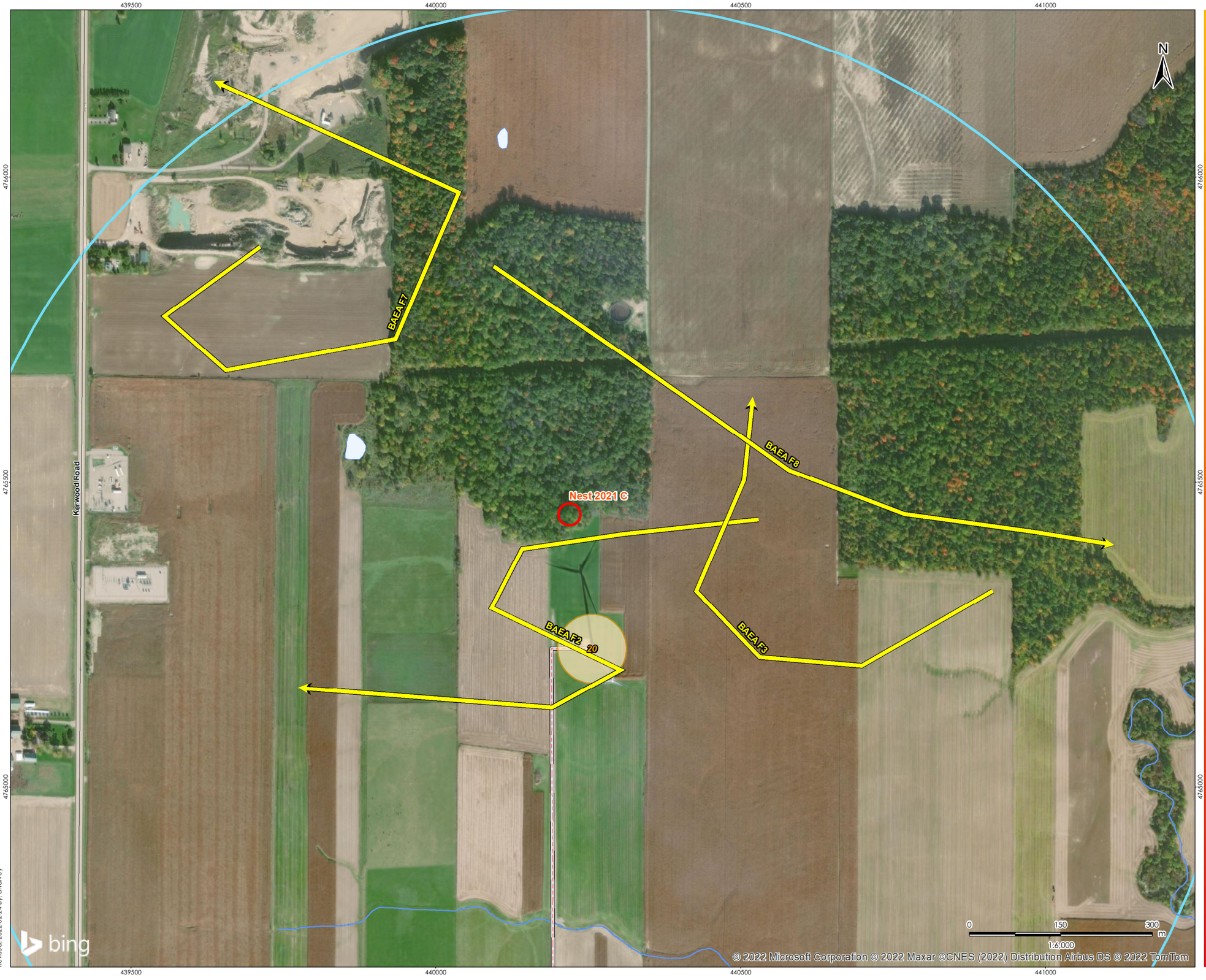
February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

Figure No.
3.2

Title
Red-tailed Hawk Flight Paths 2021



Stantec

Legend

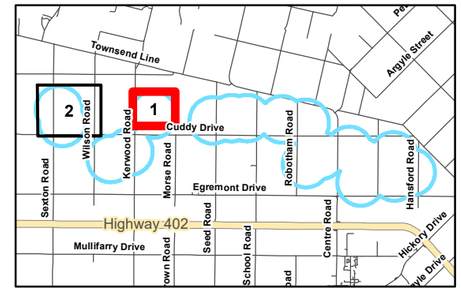
- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Road
- Watercourse
- Constructed Drain
- Waterbody

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Bald Eagle (BAEA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

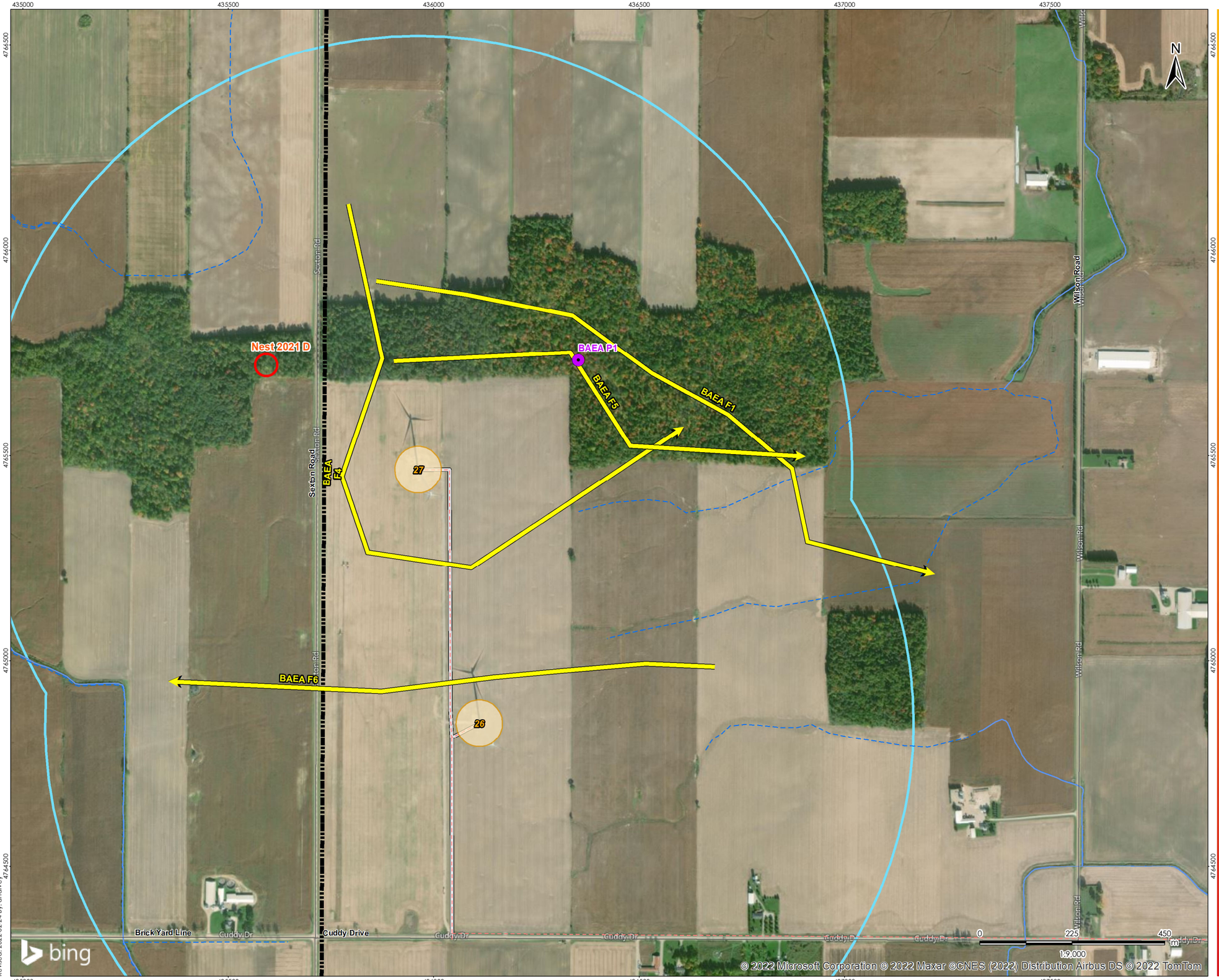
Figure No.

4.1

Title

Bald Eagle Flight Paths 2021

V:\01609\active\609607\10\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig04_Bald_Eagle_Hawk_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey



V:\01609\active\609607\0\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig04_Bald_Eagle_Hawk_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dhavey

Stantec

Legend

- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Collector Line
- Road
- Watercourse
- Constructed Drain

Perch Location

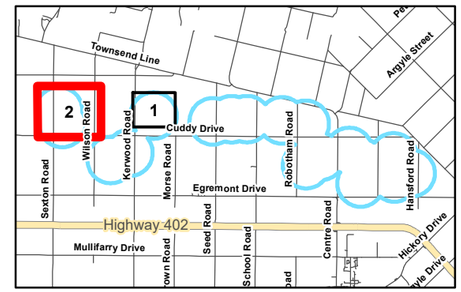
- Bald Eagle (BAEA)

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Bald Eagle (BAEA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

Figure No.

4.2

Title

Bald Eagle Flight Paths 2021

439500 440000 440500 441000

4766000 4765500 4765000

N

Kerwood Road

NOHA F4

NOHA F3

Nest 2021 C

COHA F1

20

COHA F2

NOHA F1

bing

© 2022 Microsoft Corporation © 2022 Maxar ©CNES (2022) Distribution Airbus DS © 2022 TomTom

0 150 300 m

1:6,000

V:\01609\active\609607\10\ drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig05_BWHA_COHA_NorthernHarrier_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey

Stantec

Legend

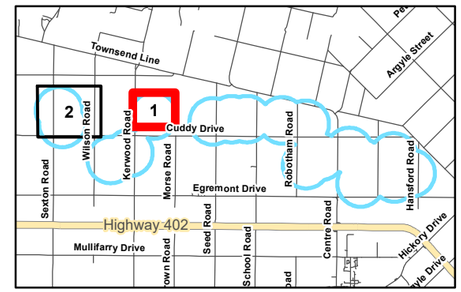
- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Road
- Watercourse
- Constructed Drain
- Waterbody

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Cooper's Hawk (COHA)
- Northern Harrier (NOHA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

Figure No.

5.1

Title

Broad-winged Hawk, Cooper's Hawk, and Northern Harrier Flight Paths 2021

V:\01609\active\609607\0\drawing\MXD\Terrestrial\Post_Con_Monitoring\2021\160961067_Fig05_BWHA_COHA_NorthernHarrier_Mapbook_2021_20220126.mxd
Revised: 2022-02-24 By: dharvey

Stantec

Legend

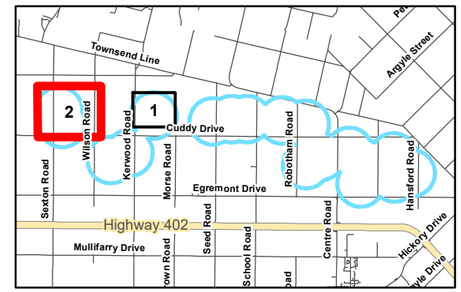
- Project Boundary
- Raptor Study Area
- Turbine Location
- Access Road
- Collector Line
- Road
- Watercourse
- Constructed Drain

Nest Locations

- Red-tailed Hawk Nest-Active (RTHA)

Flight Paths (2021)

- Broad-winged Hawk (BWHA)
- Northern Harrier (NOHA)



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base features produced under license with the Ontario Ministry of Natural Resources © Queen's Printer for Ontario, 2013.
3. Orthographic Imagery provided by Suncore, 2011. Imagery taken in Spring 2010.

February 2022
160961067

Client/Project

Suncor Energy
Adelaide Wind Project

Figure No.

5.2

Title

Broad-winged Hawk, Cooper's Hawk, and Northern Harrier Flight Paths 2021

Figure 6: Raptor Mortalities by Year, Adelaide Wind Power Project

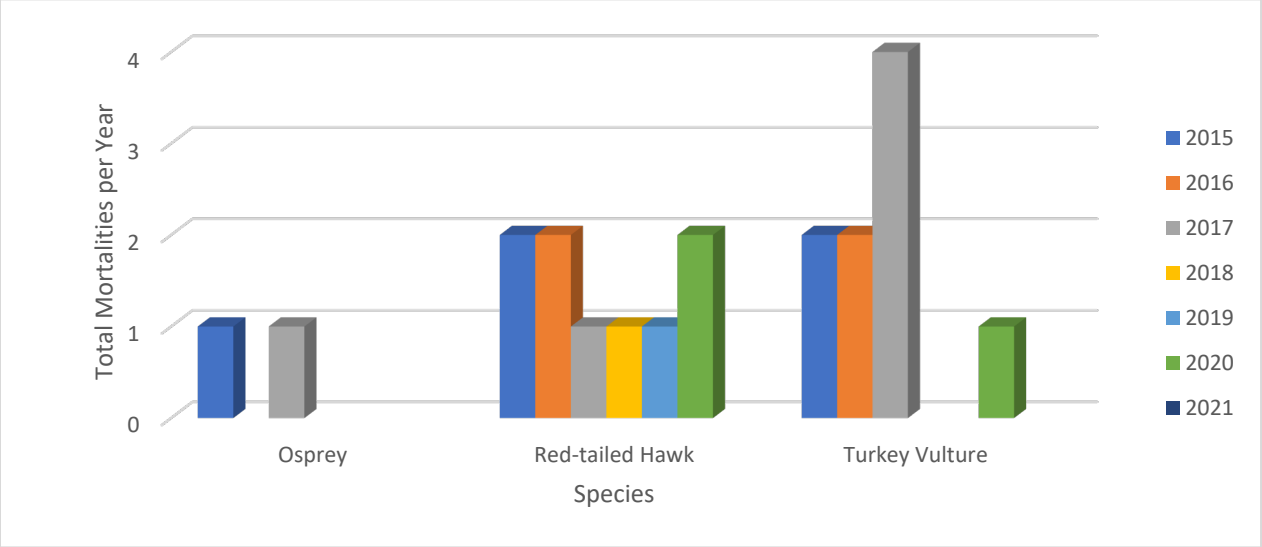


Figure 7: Summary of Red-tailed Hawk migration timing using long-term data from the Holiday Beach Hawk Watch station (1974-2021). Source: Hawk Count 2021

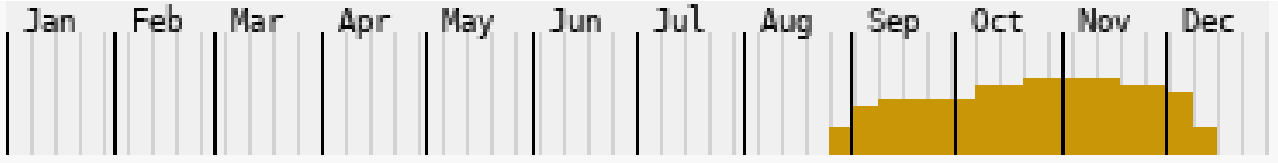


Figure 8: Summary of Turkey Vulture migration timing using long-term data from the Holiday Beach Hawk Watch station (1974-2021). Source: Hawk Count 2021

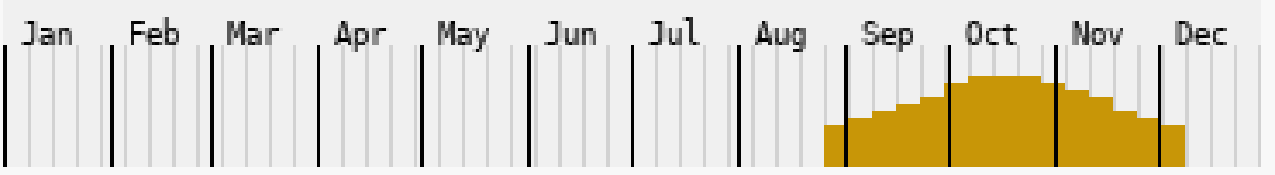


Figure 9: Summary of Red-tailed Hawk Observation by Time of Day, Breeding Territory and Fall Migration, 2021

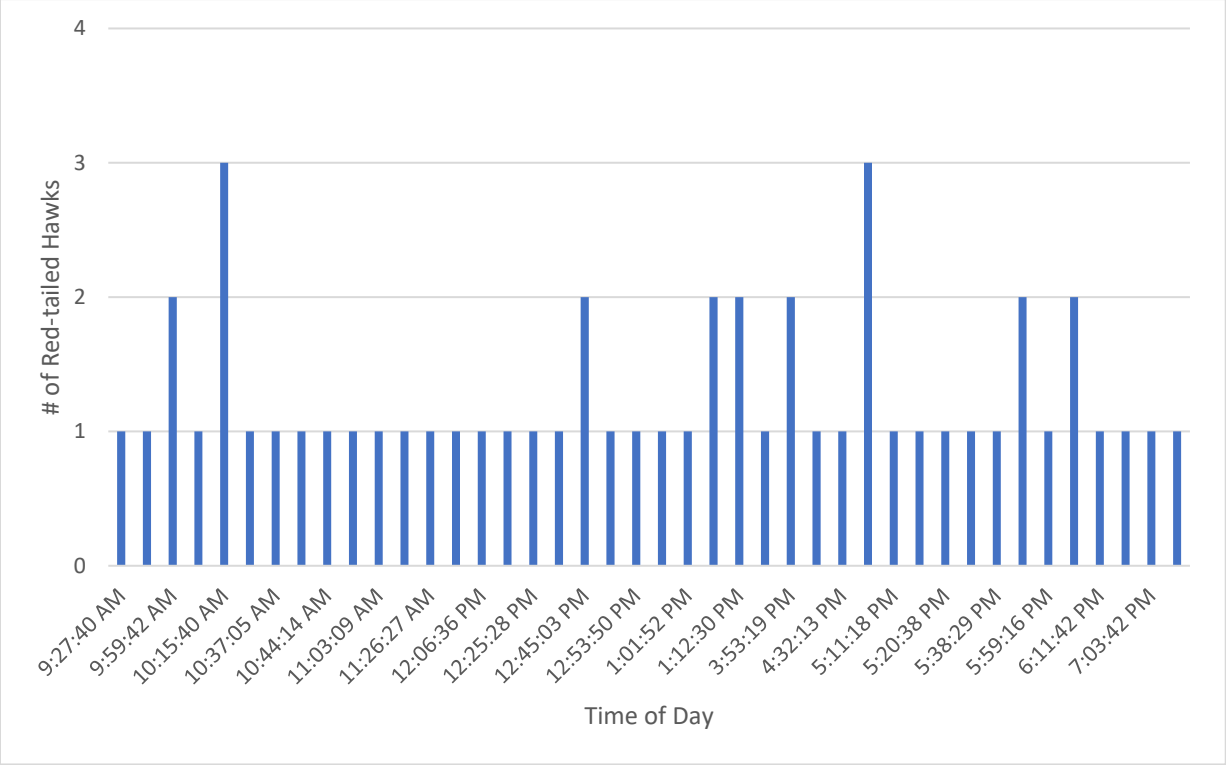


Figure 10: Summary of Turkey Vulture Observation by Time of Day, Breeding Territory and Fall Migration, 2021

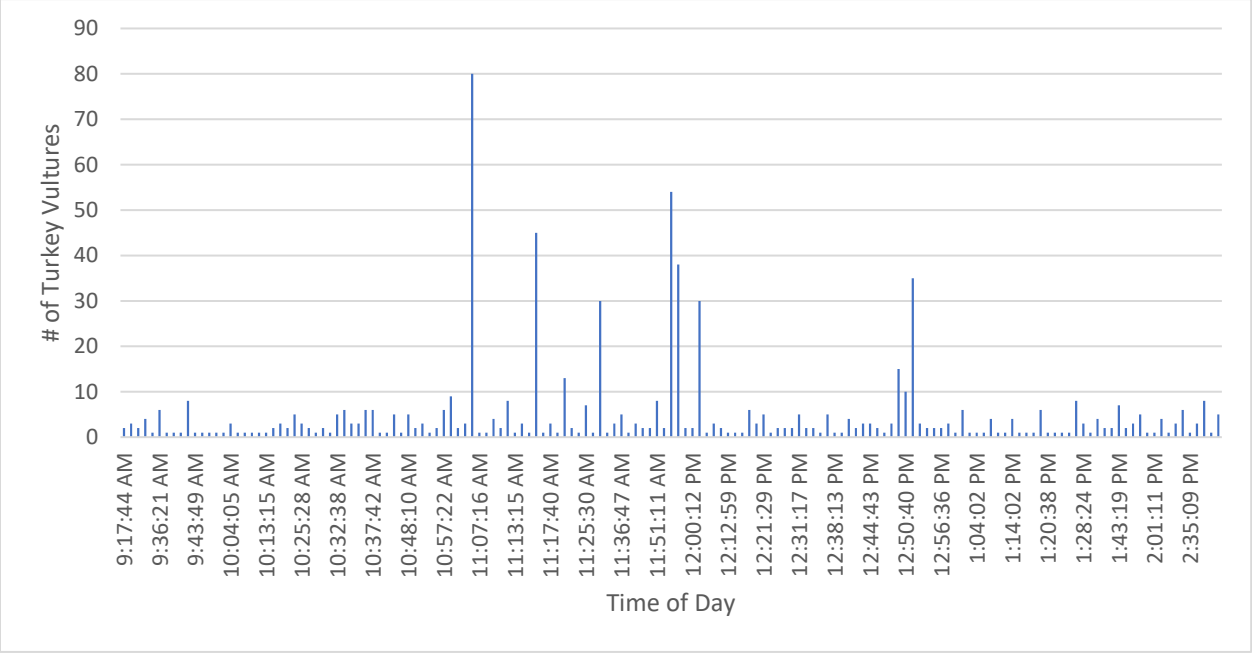


Figure 11: Red-tailed Hawk Observations by Flight Path, Breeding Territory and Fall Migration, 2021

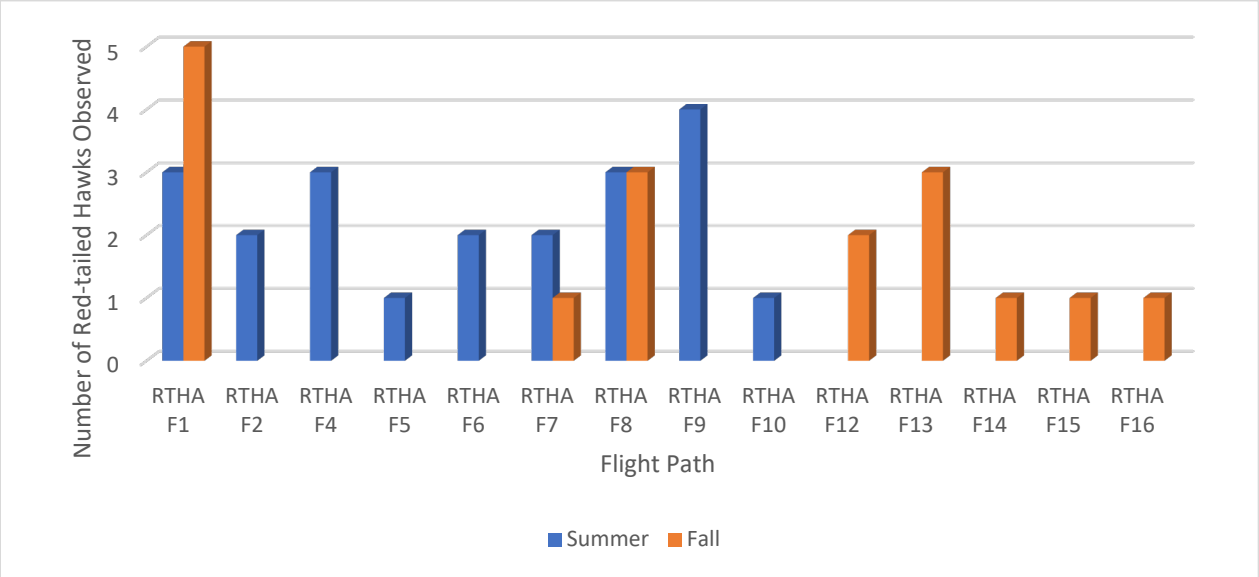
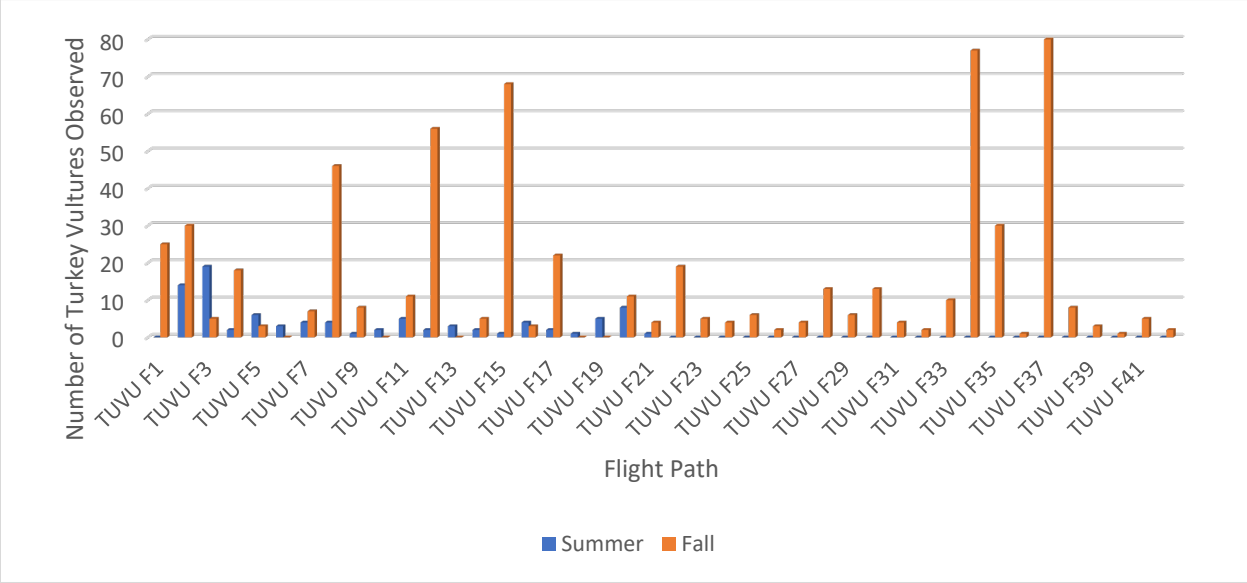


Figure 12: Turkey Vulture Observations by Flight Path, Breeding Territory and Fall Migration, 2021



APPENDIX B
Enhanced Raptor Monitoring Plan

Stantec Consulting Ltd.
1-70 Southgate Drive, Guelph ON N1G 4P5

August 28, 2019
File: 160961067

Attention: John McGlynn, Senior Environmental Officer
Ontario Ministry of the Environment, Conservation and Parks
Southwest Region, London District Office
733 Exeter Road, London, Ontario

Dear Mr. McGlynn,

Reference: Adelaide Wind Power Project
Monitoring Plan for Raptors

Stantec Consulting Ltd. has been retained by Suncor Energy Inc. to conduct the ongoing post-construction monitoring of the Adelaide Wind Power Project. The Environmental Effects Monitoring Plan (EEMP) monitoring was completed in 2015 through 2017, with continued, ongoing post-construction raptor monitoring to address the raptor threshold exceedance.

On July 25, 2019, Suncor provided the Ontario Ministry of Environment, Conservation and Parks (MECP) with Stantec's proposed Enhanced Raptor Monitoring Plan. Comments from MECP and the Ministry of Natural Resources and Forestry (MNRF) were received August 26, 2019. The purpose of this letter is to respond to MECP and MNRF comments and to provide a revised Enhanced Raptor Monitoring Plan that addresses those comments.

1. *It has not been demonstrated that the proposed plan was developed by a qualified professional. Please identify the person(s) responsible for the development of the plan.*

The proposed plan was developed by Andrew Taylor from Stantec. Andrew has over 10 years of post-construction monitoring experience of wind power facilities, including studies specific to raptors mortality and behavioral impacts. Andrew's CV is attached.

2. *The intent of the additional monitoring option (i.e. option 2) is to provide more focused monitoring that would allow for an enhanced understanding of possible causes and/or trends related to the mortality occurring at the turbines to inform appropriate and effective mitigative actions.*

    a. *As such, please outline and include rationale as to how the proposed methodology would enhance or improve upon previous post-construction monitoring (i.e. mortality monitoring and scoped cause and effect monitoring).*

Based on the post-construction monitoring completed to-date (2015 through 2018) the following conclusions have been drawn, regarding trends in raptor mortality:

- In two years of monitoring (2016 and 2017), there appeared to be a potential correlation between the location of active raptor nests and the location of raptor mortality.

- Most raptor mortality has occurred during the breeding and fall migration; with variability from year to year.

- Otherwise, there has been a lack of identifiable trends in raptor mortality that would inform mitigatable conditions (e.g. timing or weather).

The Enhanced Raptor Monitoring Plan is intended to build upon these conclusions, with the goal of providing insight into where and when operation mitigation would be effective for raptors. Monitoring is proposed for May through November with an emphasis during the breeding and fall migration seasons, which corresponds to the timing of observed mortality during previous years of monitoring at this facility. Rational for each component of the Enhanced Raptor Monitoring Plan is provided below.

MORTALITY MONITORING

- The ongoing mortality monitoring is intended to provide additional information on mortality trends, beyond what has been collected from the previous years of studies.

- In addition, having mortality data in the same year of behavior studies is required to allow for a correlation between potentially high-risk behaviors and observed mortalities.

- Monitoring will be revised to occur at all 18 turbines on a weekly basis instead of only a subset, to allow a more comprehensive assessment of spatial mortality across the Project.

- We continue to propose once a week monitoring, as the monitoring is typically for larger-bodied raptors with high carcass persistence. The monitoring does not include searches for small-bodied birds or bats (which have shorter carcass persistence). As such, we believe the twice weekly monitoring typically of the full EEMP programs is not necessary to meet the goals of the enhanced raptor monitoring plan.

BEHAVIORAL STUDIES

Territorial Monitoring

- The territorial monitoring will be used to confirm the location of active nests and/or territories, which will allow:
    - An assessment of correlation between mortality data and proximity of active territories.
    - Conduct fall migration monitoring in proximity to active territories (see more details below).
- Territorial monitoring will look for interactions between territorial birds during the breeding season, with a focus on looking for potential high-risk behavior.

- In the event of a raptor mortality in proximity to an active territory, territorial monitoring may provide insight into whether the mortality was of the resident territorial pair, or an individual moving through the territory (i.e. determine if both individuals of the resident pair are still present).

- The initial spring, leave-off survey, will be used to determine the location of active nest in each year of monitoring. Rational for the additional five surveys, spread across the breeding season, is to confirm the territory remains active, provide additional survey effort to observe raptor interactions and to assess if observed mortalities are of the breeding pair.

Fall Migration Monitoring

- Resident birds typically remain on territory year-round and will interact with migratory raptors that pass through their territory.
- The Project site is not situated along a shoreline or major landscape formation (e.g. escarpment), as such, raptor migration is not expected to be concentrated in a particular area or along a specific feature.
- Focus of the fall migration monitoring will be on the active territories, mapping how migrant individuals move through or around active territories and examining interactions between resident and migration, with specific emphasis on recording high-risk behavior.
- Furthermore, the fall migration monitoring will be used to assess the hypotheses that there would not be distinct migration paths through the Project site, or if there are features that concentration movement (e.g. Ausable River valley to the north) are present and should be considered in a mitigation strategy.
- Survey effort has been increased to 10 surveys, spread throughout the fall migration period (i.e. late August through early November). This level of effort and survey period is based on consultation and advice from subject experts at Canadian Wildlife Services on other wind power projects in southern Ontario (e.g. Wolfe Island and Port Alma wind farms).

    b. Please describe and provide a rational as to how the enhanced monitoring intends to inform the development of an operational mitigation plan at the facility (i.e. what improved results will it yield to inform mitigative actions for raptors). See comments for consideration in red text in the original email below.

The goal of the Enhanced Raptor Monitoring Plan is to provide insight into where and when operation mitigation would be effective for raptors. Specific parameters that will be assessed using the Enhanced Raptor Monitoring Plan data including:

- Location
    - Results to-date suggest proximity to active nests may be a factor in raptor mortality and should be considered in a mitigation strategy.
    - Results of the fall migration monitoring will be assessed to determine if other spatial considerations (i.e. areas of concentrated raptor movement) should be used in developing a mitigation strategy.
- Time of year

  - The mortality monitoring results to-date have been somewhat variable on time of year (concentrated in the breeding season in some years and in the fall migration season in other years).
  - The addition of behavioral studies may help to refine when raptor activity is highest in the studies area, or when potentially high-risk behaviors are most frequent.

- Time of day
  - The monitoring completed to-date does not provide any insight into what time of day raptors may be a highest risk of mortality.
  - The additional behavior studies may help to determine what times of day raptor activity if highest or when high-risk behaviors are most frequent.

- Weather Conditions
  - It is difficult to correlate mortality monitoring results with weather conditions, as it is unknown exactly when a collision took place or the weather at the time.
  - However, through the additional behavioral monitoring, weather conditions can be recorded in real-time, when high-risk behaviors are identified.

PROPOSED WORK PLAN (REVISED)

The proposed Enhanced Raptor Monitoring Plan, which has been revised to address MECP and MNRF comments, is provided below. A reporting section has also been added to discuss how data will be analyzed to inform an operational mitigation strategy.

1. Mortality Monitoring
   - Weekly mortality monitoring
     - monitoring at all 18 turbines
     - weekly monitoring for raptors from the beginning of May to the end of November
     - Approx. 10 minute searches at each turbine (as the target are large-bodied, highly visible birds)
   - Correction factor trials:
     - searcher efficiency will be assumed to be 1.0 for large-bodied raptors, consistent with previous years of monitoring.
     - scavenger trials will be assumed to be 1.0 for large-bodied raptors, consistent with previous years of monitoring.
     - as previously requested by MNRF on this Project, raptor carcass, if available, will be set out to confirm if any removal of raptor carcasses is occurring.
     - percent area searched
2. Breeding territorial monitoring:
   - Initial April survey to identify and map location of active raptor nests within 1km of turbines.
   - Five additional surveys:
     - Identification of territory size around nests.

- Observation interactions between territorial raptors.
- Assume 2 hours of observations at each nest during each survey event.

3. Fall migration monitoring
    - 10 surveys from late August through early November.
    - Mapping migration flight paths in proximity to active territories and landscape features.
    - Observations of interactions between territorial raptors and migrant raptors.

4. Reporting
    - An annual report will be prepared summarizing the results, with a comparison to previous year's results at the Project.
    - The results will be compared to publicly available data from other sources (i.e. Hawk Watch) to assess trends in migration activity.
    - The results of behavioral studies (breeding and fall migration monitoring) will be compared to mortality data, to assess potential correlation between observed high-risk behavior and observed mortality.
    - Where possible, a determination of resident vs. migration will be made for observed raptor mortality.
    - Trends in observed high-risk behavior will be assessed against time of year, time of day and weather conditions.
    - The annual reports will provide conclusions on if and what trends in raptor mortality risk were identified, with recommendations for an operational mitigation strategy and/or additional study requirements.

Thank you for your attention to this letter and the ongoing consultation with Suncor and Stantec on this file. Should MECP or MNRF have additional comments or questions regarding the study design rational or the revised work plan above, please do not hesitate to contact the undersigned.

Regards,

Stantec Consulting Ltd.

Andrew Taylor
Senior Ecologist
Phone: 519 780 8122
Fax: 519 836 2493
andrew.taylor@stantec.com

Attachment: Andrew Taylor CV

c. Mark Kozak, Suncor Energy Inc.

tw:\active\60961067\reports\2019 raptor plan\let_61067_adelaide_raptor_plan_08272019.docx

Andrew Taylor B.Sc.

Senior Ecologist

Andrew is a knowledgeable terrestrial ecologist and project manager. He has successfully managed a wide range of projects, including natural heritage assessments (NHA), environmental impact statements, constraint analyses, environmental implementation reports and natural heritage components of Environmental Assessments. These projects involve the implementation of natural heritage policies of the Renewable Energy Approval, Ontario Provincial Policy Statement, Greenbelt Plan and municipal policy documents. He is familiar with various Acts and their application to projects, including the Migratory Birds Convention Act, Endangered Species Act, Species at Risk Act and others.

Andrew is knowledgeable about the biology and life history of Ontario birds and bats. He also has strong technical skills at identification of vascular plants, breeding amphibians (calling frogs and toads), breeding salamanders (adult and egg studies), reptiles, butterflies and dragonflies.

Andrew has been involved in field studies, providing technical advice and/or reporting on over 30 wind energy projects in Ontario. Through these projects he has extensive experience conducting surveys for the diversity, abundance and behavior of breeding, migrating, staging and wintering birds. Andrew has experience analyzing the results of field surveys to assess potential impacts of local and migratory populations of birds. He has conducted pre-construction bat surveys on a number of projects in Ontario; including identification of candidate roost and hibernacula features and has experience surveying for bats using acoustic detectors to determine presence and species. Andrew has extensive experience with post-construction monitoring at wind energy projects, having coordinated studies at ten facilities in Ontario. These studies have assessed the direct impact of mortality on bird and bat populations and the indirect impacts of avoidance on birds.

He has extensive experience with policies, field studies and permitting requirements pertaining to species at risk. He is skilled at assessing wildlife habitat, applying Ecological Land Classification (ELC) and delineating wetland boundaries. Andrew is experienced at analyzing natural heritage features for the presence of Significant Woodlands or Significant Wildlife Habitat using applicable provincial guidance documents.

Andrew has provided terrestrial ecology expertise in a wide range of sectors, including urban lands, energy (including renewable energy), recreational development, infrastructure and aggregate extraction. He has appeared as an expert witness in front of Boards and Tribunals including the Environmental Review Tribunal.

EDUCATION

B.Sc. (Hons), University of Guelph / Environmental Toxicology, Guelph, Ontario, 2001

CERTIFICATIONS & TRAINING

Certificate #032, Ontario Ministry of Natural Resources / Butternut Health Assessor, Hamilton, Ontario, 2009

Certificate, Ontario Ministry of Natural Resources / Ecological Land Classification System for Southern Ontario, Turkey Point, Ontario, 2006

PROJECT EXPERIENCE

Renewable Energy

Renewable Energy Approval (REA) Natural Heritage Assessments (NHA) and Environmental Impact Studies (EIS), Multiple Projects, Various Sites, Ontario (Terrestrial Ecologist)

NHAs and EISs were prepared in accordance with O. Reg. 359/09 under the Environmental Protection Act with guidance obtained from the Draft Natural Heritage Assessment Guide for Renewable Energy Projects (MNR, 2010). NHAs included records review and site investigation, including but not limited to vascular plant surveys, Ecological Land Classification and wildlife surveys for avian species, amphibians, reptiles, mammals and invertebrates.

Data obtained were used to identify and evaluate significant natural heritage features including wetlands, woodlands, valleylands and significant wildlife habitat. Outside the REA process, field surveys and habitat assessments were completed for species protected under the provincial Endangered Species Act. Andrew coordinated and conducted field studies, habitat assessments for species at risk, authored technical reports and engaged in public consultation for the following:
• Grand Renewable Energy Park (Haldimand County, 69 turbines & solar, total 253.1 MW)
• Port Dover and Nanticoke Wind Project (Norfolk and Haldimand Counties, 58 turbines)
• Ostrander Wind Energy Park (Prince Edward County, 9 turbines)
• Mica Bay (Algoma District, 12 turbines)
• Amherst Island (Lennox and Addington County, 37 turbines)
• Fairview Wind Farm (Simcoe County, 4 turbines)
• Whittington Wind Farm (Dufferin County, 3 turbines)
• Springwood Wind Farm (Wellington County, 4 turbines)
• Brooke-Alvinston Wind Farm (Lambton County, 4 turbines)
• Bow Lake (Algoma District, 36 turbines)
• Niagara Region Wind Farm (Niagara Region, 80 turbines)
• Adelaide Wind Power Project (Middlesex County; 28 turbines)
• Cedar Point Wind Power Project (Lambton County, 72 turbines)
• Grand Valley 3 (Dufferin County, 15 turbines)

Environmental Screening Report / Environmental Review Report, Multiple Projects, Various Sites, Ontario (Terrestrial Ecologist)
Environmental Screening Reports/Environmental Review Reports were prepared for various wind energy projects in compliance with the Ministry of the Environment's Guide to Environmental Assessment Requirements for Electricity Projects and the Canadian Environmental Assessment Act (CEAA). Andrew's involvement included pre-construction study design, coordinating and conducting monitoring for avian and other wildlife species, including targeted surveys for species at risk. Avian studies included breeding grassland and forest birds, wintering raptors and migratory surveys for waterfowl, raptors, passerines and shorebirds. Andrew conducted and coordinated acoustic bat surveys including data collection, species identification, data analysis and reporting, and co-authoring technical reports as part of the following projects in Ontario:
• Wolfe Island Wind Project (Wolfe Island, 86 turbines)
• Port Alma Wind Power Project (Municipality of Chatham-Kent, 44 turbines)
• Plateau Wind Project (Municipality of Grey Highlands & Melancthon Township, 18 turbines)
• Gosfield Comber Wind Energy Project (Essex County, 149 turbines)
• Kingsbridge II Wind Project (Huron County, 69 turbines)
• Chatham Wind Power Project (Municipality of Chatham-Kent, 44 turbines)
• Melancthon Wind Plant, Phases I & II (Melancthon and Amaranth Townships, 177 turbines)

Post-construction Monitoring Programs, Multiple Projects, Various Sites, Ontario (Terrestrial Ecologist)
Post-construction monitoring of renewable energy projects is performed to assess the direct impacts to birds and bats and indirect impacts to breeding, migrating and wintering wildlife. The purpose of post-construction monitoring programs is to verify predictions of the pre-construction assessment and, if necessary, implement appropriate measures to mitigate adverse effects. Andrew has coordinated and conducted monitoring field studies including assessment of disturbance to grassland, forest and wetland breeding birds, staging waterfowl and shorebirds, tundra swans and wintering raptors and co-authored or authored the post-construction monitoring reports for the following projects in Ontario:
• Wolfe Island Wind Project (Wolfe Island, 86 turbines)
• Melancthon Wind Plant, Phase I & II (Melancthon & Amaranth Townships, 177 turbines)
• Kingsbridge I Wind Plant (Huron County, 22 turbines)
• Port Alma Wind Power Project (Municipality of Chatham-Kent, 44 turbines)
• Gosfield Comber Wind Energy Project (Essex County, 149 turbines)
• Grand Valley Wind Farm (Dufferin County, 9 turbines)
• Enbridge Underwood and Cruickshank Wind Farms (Bruce County, 115 turbines)
• Gesner Wind Energy Project (Municipality of Chatham-Kent, 5 turbines)
• Port Dover and Nanticoke Wind Project (Counties of Norfolk and Haldimand, 58 turbines)

Oil & Gas

Energy East Pipeline, Various Sites, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on impact assessment of wildlife habitat and species at risk for project spanning across Ontario through four ecoregions. Consultation with Ontario Ministry of Natural Resources regarding species at risk including, but not limited to, Woodland Caribou.

** denotes projects completed with other firms*

Andrew Taylor B.Sc.

Senior Ecologist

Genesis Pipeline Extension Project, Sarnia, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on impact assessment of wildlife habitat and species at risk.

Hamilton to Milton Natural Gas Pipeline, Halton, Ontario (Terrestrial Ecologist)
Terrestrial surveys included vegetation community assessments and floral inventory, with emphasis on species at risk.

Parkway West Compressor Station, Halton, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on impact assessment of wildlife habitat and species at risk.

Bickford to Dawn Pipeline Project, Chatham, Ontario (Terrestrial Ecologist)
Terrestrial surveys included vegetation community assessments, floral inventory and species at risk habitat assessments. Study design and development in conjunction with local Ontario Ministry of Natural Resources district for Eastern Foxsnake, including a SAR 17b permit application.

Brantford Take-off to Kirkwall Valve Site Pipeline Project, Hamilton, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on impact assessment of wildlife habitat and species at risk.

Dow Moore, Corunna and Seckerton Pipeline Project, Lambton County, Ontario (Terrestrial Ecologist)
Species at risk habitat assessment and inventory. Study design and development in conjunction with local Ontario Ministry of Natural Resources district for several species protected under the Endangered Species Act.

Electrical Power Distribution

Bruce to Milton Transmission Reinforcement Project, Multiple Sites, Ontario (Terrestrial Ecologist)
Terrestrial surveys related for species at risk protected under the provincial Endangered Species Act (2007).

Coote's Paradise Transmission Reinforcement Project, Hamilton, Ontario (Terrestrial Ecologist)
Terrestrial surveys included vegetation community assessments, floral inventory, with emphasis on species at risk.

Clarington Transformer Station, Durham, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on wildlife habitat and species at risk impact assessment.

Midtown Electricity Infrastructure Renewal Project, Toronto, Ontario (Terrestrial Ecologist)
Senior ecologist coordinating species at risk inventories and permitting requirements.

Huycke Island Electrical Distribution Submarine Cable Replacement, Trent Hills, Ontario (Terrestrial Ecologist)
Senior ecologist and advisory role on impact assessment of wildlife habitat and species at risk.

Bruce Creek x Sarnia Scott TS B3N Line Protection Project, Sarnia, Ontario (Terrestrial Ecologist)
Senior ecologist and technical advisory on species at risk and implementation of Species at Risk Act permit.

Stratford Distribution Station, Stratford, Ontario (Terrestrial Ecologist)
Coordination of tree management plan and species at risk assessment.

Transportation Planning

City of Toronto Fort York Pedestrian Footbridge, Toronto, Ontario (Terrestrial Ecologist)
Coordinated Natural Sciences component of project including assessment of potential impacts, with an emphasis on species at risk.

** denotes projects completed with other firms*

Andrew Taylor B.Sc.

Senior Ecologist

Natural Science Reports Related to MTO Highway Improvement Works, Various Sites, Ontario (Terrestrial Ecologist)
Produced numerous Natural Sciences reports related to highway improvement works. Where required, Fisheries Act authorization was obtained and Fish Habitat Compensation Plans were developed. Potential impacts to terrestrial vegetation, wetlands and wildlife were described for the following studies:
• Highway 3 (Essex County): Preliminary Design Study
• Highway 40 (Municipality of Chatham-Kent): Detail Design Study
• Highway 11 (Town of Bracebridge): Preliminary Design
• Highway 24 (Cambridge): Detailed Design
• Highway 8 (Perth County): Detailed Design
• Highway 401 (Kitchener): Post-construction Compliance Monitoring
• Highway 401 (Essex County, near Comber): Post-construction Compliance Monitoring
• Highway 26 (County of Grey): Post-construction Compliance Monitoring
• Highway 17 (Sudbury): Preliminary Design Study
• Highway 9 (Municipality of South Bruce): Post-construction Compliance Monitoring

Research

Rice Lake Plains Joint Initiative*, Northumberland County, Ontario (Ecologist)
Tallgrass prairie research program. Identification and detailed cataloging of remnant tallgrass prairie sites, landowner liaison and education, development of tallgrass prairie management plans, reporting of findings.

Alderville First Nations Black Oak Savannah*, Alderville, Ontario (Ecologist)
Tallgrass prairie and black oak savannah research program. Technical reporting. Vegetation monitoring, tallgrass prairie reconstruction, wildlife monitoring, Species at Risk reintroduction.

Aggregate Services

Proposed Bromberg Pit, Ayr, Ontario (Terrestrial Ecologist)
Natural environment field inventories with emphasis on Species at Risk (SAR).

Neubauer Pit, Town of Puslinch, Ontario (Terrestrial Ecologist)
Natural environment field inventories with emphasis on Species at Risk (SAR).

Dufferin Aggregates Acton Quarry Extension, Acton, Ontario (Terrestrial Ecologist)
The extension of the existing Acton Quarry is proposed to meet the need for additional close-to-market aggregate resources of high quality Amabel Dolostone. Andrew has conducted extensive ecological field surveys and habitat assessments for breeding birds, amphibians and mammals with specific emphasis on Species at Risk (SAR).

St. Marys Cement Flamborough Quarry License Environmental Impact Study and Level 2 Natural Environment Technical Report (Ecologist)
Identification and impact assessment of natural heritage features, compensation and management plan for Species at Risk (Butternut), water balance to maintain provincially significant wetland, salamander habitat and migration study, assessment of provincially significant woodland and significant wildlife habitat, environmental impacts of transportation.

Natural Sciences & Heritage Resources

Crates Marina, Keswick, Ontario (Project Manager / Ecologist)
Environmental policies, approvals and desgin. Identification of natural heritage features and sensitive species.

Kortright East Development, Guelph, Ontario (Project Manager / Ecologist)
Envrionmental Implementation Report. Vegetation buffers, wildlife corridor, tree conservation plan, planning and design of invasive species removal, design of compliance and performance monitoring program.

Southeast Sutton Development Area Plan, Sutton, Ontario (Project Manager / Ecologist)
Environmental policies, approval and design. Identification of natural heritage features and constraints for Development Area Plan. Plan of Subdivision forest buffers, mitigation of impacts to forest resources, sensitive vegetation and Species at Risk. Participation in Ontario Muncipal Board discussions.

** denotes projects completed with other firms*

Andrew Taylor B.Sc.

Senior Ecologist

Fourteen Mile Creek Development, Oakville, Ontario (Ecologist)
Natural Heritage Monitoring Program Director - directed monitoring program of vegetation communities, change in species composition, avian wildlife, aquatic Species at Risk, benthic invertebrate communities, hydrogeology, geomorphology and erosion.

Activa Waterloo East, Waterloo, Ontario (Ecologist)
Terrestrial and Aquatic Monitoring Program - monitoring of vegetation communties, changes in species composition and disturbance levels were undertaken, interpreted and reported. Directed monitoring of benthic invertebrate communities.

Sports, Recreation & Leisure
Sunnidale Park Master Plan, Barrie, Ontario (Ecologist)
Identification and delineation of ecological management units. Design of management plans for ecological units, wetland and forest habitat rehabilitation. Technical reporting.

** denotes projects completed with other firms*

APPENDIX C
Tables

Table C1: Mortality Monitoring Dates, Times and Weather Conditions

		Weather					
Date	**Time**	**Temp**	**Wind (Beaufort Scale)**	**Wind Direction**	**Cloud**	**PPT/PPT last 24 hours**	**Surveyor(s)**
May 6 2021	09:15 - 16:45	10	2	N	10	None/None	Laura Williams
May 13 2021	08:06 - 13:30	8	3	NW	0	None/None	Laura Williams
May 18 2021	08:58 - 15:00	14	3	W	0	None/None	Kayla Ellis
May 27 2021	09:00 - 15:00	10	3	N	10	None/Rain	Kayla Ellis
June 3 2021	08:20 - 13:30	17	0	-	100	Light Rain/Rain	Laura Williams
June 11 2021	09:15 - 14:15	24	3	NE	5	None/None	Laura Williams
June 19 2021	09:45 - 15:20	22	2	SW	50	Rain/Thunderstorms	Melissa Straus
June 23 2021	08:15 - 14:00	10	1	E	10	None/None	Melissa Straus
June 30 2021	08:00 - 13:30	22	1	W	100	Light Rain/Rain	Jordan Brooks
July 7 2021	08:00 - 14:25	19	1	NW	100	None/Thunderstorms	Melissa Straus
July 15 2021	07:40 - 11:50	22	2	S	70	None/Rain	Jordan Brooks
July 22 2021	08:00 - 11:40	14	1	NW	50	None/None	Jordan Brooks
July 28 2021	07:33 - 12:30	21	1	E	100	None/Rain	Laura Williams
August 6 2021	07:35 - 12:40	20	3	S	25	None/None	Laura Williams
August 11 2021	07:27 - 12:20	26	3	SSW	90	None/Thunderstorms	Laura Williams
August 19 2021	07:30 - 12:25	21	2	W	70	None/Rain	Laura Williams
August 24 2021	08:30 - 12:30	19	1	SE	10	None/None	Jordan Brooks
September 1 2021	10:30 - 15:30	20	3	NE	25	None/None	Melissa Straus
September 10 2021	08:06 - 12:35	14	0	-	75	Rain/Rain	Laura Williams
September 13 2021	07:40 - 12:00	14	0	-	100	Rain/Rain	Laura Williams
September 23 2021	10:39 - 16:40	13	3	W	100	Light Rain/Rain	Mitch Ellah
September 28 2021	07:35 - 12:20	13	2	N	10	None/None	Laura Williams
October 5 2021	07:34 - 12:05	20	2	ENE	100	None/Rain	Laura Williams
October 13 2021	07:31 - 12:10	18	1	SW	100	None/Rain	Laura Williams
October 19 2021	08:05 - 12:30	7	1	W	0	None/None	Laura Williams
October 28 2021	07:48 - 12:15	7	2	E	30	None/None	Laura Williams
November 8 2021	10:45 - 18:30	18	2 to 3	SSW	-	None	Melissa Straus
November 12 2021	09:59 - 14:38	8	3	NE	0	None/Rain	Kayla Ellis
November 18 2021	09:48 - 13:56	5	4	W	100	None/Rain	Kayla Ellis
November 24 2021	09:47 - 14:41	5	4	N	75	None/None	Kayla Ellis

Table C2: Behaviour Survey Dates, Times, and Weather Conditions

Date	Survey Type	Time	Weather					Surveyors
			Temp	Wind Direction	Wind (Beaufort Scale)	Cloud	PPT / PPT last 24 hours	
4/20/2021	Driving Survey	9:30-16:00	2	W	3	75	None/light rain	Mitch Ellah
5/3/2021	Nest Survey (at Turbines 20 and 27)	10:30-14:45	14	SE	3	100	Rain showers/ Rain	Mitch Ellah
5/12/2021	Nest Survey (at Turbines 20 and 27)	9:50-14:00	10	NW	2	0	None/None	Mitch Ellah
5/21/2021	Nest Survey (at Turbines 20 and 27)	9:20-13:30	24	SW	4	5	None/None	Mitch Ellah
5/27/2021	Nest Survey (at Turbines 20 and 27)	9:10-13:35	10	NW	3	5	None/ Rain showers 1-3 mm	Mitch Ellah
6/3/2021	Nest Survey (at Turbines 20 and 27)	8:30-12:40	16	W	1	95	None/ Heavy Rain 10-15 mm	Mitch Ellah
8/24/2021	Fall Migration (at Turbines 20 and 27)	8:30-12:50	23	SW	2	0	None/None	Mitch Ellah
9/2/2021	Fall Migration (at Turbines 20 and 27)	9:40-13:45	19	NNW	2	0	None/None	Melissa Straus
9/8/2021	Fall Migration (at Turbines 20 and 27)	9:00-13:10	18	WNW	2	0	None/ Heavy Rain	Mitch Ellah
9/13/2021	Fall Migration (at Turbines 20 and 27)	8:00-12:35	15	ENE	2	100	Short, light rain/ Storms and heavy ra	Mitch Ellah
9/24/2021	Fall Migration (at Turbines 20 and 27)	9:00-13:15	12	SW	3	90	None/ Rain	Mitch Ellah
9/28/2021	Fall Migration (at Turbines 20 and 27)	9:28-12:59	17	N	2	5	None/None	Kayla Ellis
10/5/2021	Fall Migration (at Turbines 20 and 27)	11:16-15:25	19	NNE	2	90	None/Rain	Kayla Ellis
10/15/2021	Fall Migration (at Turbines 20 and 27)	8:00-12:10	15	NW	1	100	None, then light rain at end of survey/	Mitch Ellah
10/18/2021	Fall Migration (at Turbines 20 and 27)	11:14-15:25	13	W	4	35	None/Rain	Kayla Ellis
10/27/2021	Fall Migration (at Turbines 20 and 27)	10:11-14:20	10	NNW	2	100	None/None	Mitch Ellah

Table C3: Raptor Mortalities Documented to Date at the Adelaide Wind Power Project (2015-2021)

Year	Date	Turbine #	Species
2015	June 18	27	Turkey Vulture
			Turkey Vulture
	June 21	9	Osprey
	June 22	6	Red-tailed Hawk
		11	Red-tailed Hawk
2016	May 2	12	Red-tailed Hawk
	Sept 19	11	Red-tailed Hawk
	Sept 26	20	Turkey Vulture
		22	Turkey Vulture
2017	May 1	12	Red-tailed Hawk
		27	Osprey
	May 2	15	Turkey Vulture
	Aug 10	5	Turkey Vulture
	Sept 27	14	Turkey Vulture
	Oct 27	21	Turkey Vulture
2018	Aug 21	22	Red-tailed Hawk
2019	June 25	9	Red-tailed Hawk
2020	May 5	8	Red-tailed Hawk
	May 20	18	Turkey Vulture
	Aug 13	7	Red-tailed Hawk
2021	-	-	-

Table C4: Incidental Recovered Mortalities (2021)

Date	Turbine	Species
6/5/2021	21	Horned Lark
6/5/2021	22	Silver-haired Bat
6/5/2021	26	Silver-haired Bat
18/5/2021	8	Bobolink
22/7/2021	6	Big Brown Bat
19/8/2021	6	Hoary Bat
24/8/2021	22	Eastern Red Bat
5/10/2021	18	Mourning Dove
19/10/2021	6	Silver-haired Bat

Table C5: Red-tailed Hawk Nests Monitored at the Adelaide Wind Power Project (2016-2021)

Year	Nearest Turbine	Reuse Details
2021	27	New nest in 2021
	20	New nest in 2021
2020	8	Same woodlot but farther east than 2018 nest
	12	Reuse of 2019 T12 Nest
2019	12	New nest, rebuilt close to 2016/2017 nest site
	17	New nest in 2019
	27	Use not confirmed in 2019.
2018	8	New nest in 2018
	11	New nest in 2018
	12	New nest, same woodlot as 2017, moved westward. 2017 nest blew down. Determined to be likely active but use not confirmed in 2018.
2017	12	Reuse of 2016
2016	12	First year of nest studies

Table C6: Red-tailed Hawk Observations, Breeding Territorial Surveys 2021

Nest Location	Flight Path	Date	Observed Behavior	Observed Flight Pattern(s) (if recorded)
Turbine 27	RTHA P2	May 3 2021	Perched	Perched
	RTHA P3		Perched. On nest.	Perched
	RTHA F2		Flapping, Gliding	Flapping, Gliding
	RTHA P4	May 12 2021	Adult RTHA visited nest	Perched to/from flight
	RTHA F4		Three RTHA soaring high. One came close to nest.	Thermal Soaring, Flapping
	RTHA F5		Visited the nest	Perched to/from flight
	RTHA P5	May 21 2021	Successfully captured a large snake along woodlot edge/meadow and brought snake up to dead standing tree to eat.	Perched to/from flight
	RTHA P6		Soaring in local area, stopped in for a quick perch then soaring again.	Perched to/from flight
	RTHA F6		Staying close to woodlot. A single RTHA came from the west and let out a call over the nest. Soon there were two RTHA flying, gliding and soaring in local area. Did not approach turbine.	Gliding, Thermal Soaring
	RTHA P7	May 27 2021	Perched in dead standing tree	Perched to/from flight
	RTHA P8		Soaring in area, then visited nest, proceeded by more soaring	Gliding, Thermal Soaring
	RTHA F2		Soaring over woodland then visited nest, proceeded by more soaring, appeared to defend air space above nest by diving at a TUVU also soaring in area.	Thermal Soaring
Turbine 20	RTHA P1	May 3 2021	On nest for duration of two hour survey. Observed tending to nest or eggs.	Perched
	RTHA F1		30-50 m height, did not approach turbine	Flapping, Thermal Soaring
	RTHA F1	May 21 2021	Thermal Soaring, Flapping	Thermal Soaring, Flapping
	RTHAF7		A pair, soaring together from 60 - 200 m high, appeared to avoid close proximity to turbine.	Thermal Soaring
	RTHA P9	May 27 2021	Perched in dead standing tree on fence row and appears to be hunting in adjacent pasture field.	Perched to/from flight
	RTHA F8		Thermal Soaring	Thermal Soaring
	RTHA F9		Two RTHA observed flying low over pasture field and up into woodlot. Proceeded by one returning and perching in dead standing tree on pasture field fence row.	Flapping
	RTHA F9		From perch and flying west then north around back side of woodlot	Flapping
	RTHA F8		Appear to be displaying courting or pair behaviour. Pair observed chasing and intimidating one another very high and away from turbine. The birds were initiating aerial maneuvers by swooping at one another and flying in tandem.	Thermal Soaring, Gliding
	RTHA P10	June 3 2021	Visited nest	Perched to/from flight
	RTHA P11		Flew in from the north and along south edge of woodlot. Was being harassed by RWBL, then landed in a tree.	Perched to/from flight
	RTHA F9		RTHA arrived from the west and was harassed by RWBL. RTHA let out a few calls and flew north over woodlot.	Flapping
	RTHA F10		Adult RTHA being harassed by cardinals along woodlot edge. RTHA then visited nest.	Flapping
	RTHA F1		Flapping, Thermal Soaring	Flapping, Thermal Soaring

[1] – Flight path # corresponds to flight paths on **Figures 3.1 and 3.2, Appendix A**

[2] –RTHA= Red-tailed Hawk; TUVU= Turkey Vulture; RWBL=Red-winged Blackbird

Table C7: Turkey Vulture Observations, Breeding Territorial Surveys 2021

Survey Location	Flight Path	Date	Observed Behavior	Observed Flight Pattern(s)
Turbine 27	TUVU F3	May 3 2021	Gliding	Gliding
	TUVU F3		Gliding	Gliding
	TUVU F3		Thermal Soaring	Thermal Soaring
	TUVU F4	May 12 2021	Gliding and soaring over woodland and over field	Gliding, Thermal Soaring
	TUVU F5		20-60 m	Thermal Soaring, Flapping
	TUVU F3		Thermal Soaring	Thermal Soaring
	TUVU F6		Gliding	Gliding
	TUVU F7		Thermal Soaring	Thermal Soaring
	TUVU F3	May 21 2021	Stayed over woodland	Thermal Soaring
	TUVU F10		Gliding and soaring over field, east of the turbine, and higher than the turbine, did not soar over the turbine.	Thermal Soaring, Gliding
	TUVU F11		Stay over woodlot mostly	Thermal Soaring, Gliding
	TUVU F5	May 27 2021	Thermal Soaring	Thermal Soaring
	TUVU F13		Gliding, Thermal Soaring	Gliding, Thermal Soaring
	TUVU F13		Soaring over crop and woodland, avoiding proximity to turbine	Gliding, Thermal Soaring
	TUVU F3		Gliding, Thermal Soaring	Gliding, Thermal Soaring
	TUVU F7		Thermal Soaring	Thermal Soaring
	TUVU F3	June 3 2021	Gliding over woodlot	Gliding
	TUVU F19		Thermal Soaring	Thermal Soaring
Turbine 20	TUVU F2	May 3 2021	Soaring 40-120 m Did not come close to turbine.	Thermal Soaring, Flapping
	TUVU F2		Soaring 40 - 80 m, did not approach turbine.	Thermal Soaring
	TUVU F8	May 12 2021	Gliding	Gliding
	TUVU F9		Flying near turbine at low altitude, 3-20 m.	Flapping, Thermal Soaring
	TUVU F8		Gliding	Gliding
	TUVU P1	May 21 2021	Perched on dead standing tree in hedge row.	Perched
	TUVU F12		Soaring over woodland coming from the east and out of sight to the east	Thermal Soaring
	TUVU F2		Thermal Soaring	Thermal Soaring
	TUVU F14	May 27 2021	Soaring from 40-80 m over woodlot and field, appeared to avoid proximity to turbine.	Thermal Soaring
	TUVU F15		Flapping and soaring at low altitude under and close to turbine, increased altitude to 60 - 80 m once further away from turbine and proceeded to soar above woodlot.	Flapping, Thermal Soaring
	TUVU F16		Gliding, Thermal Soaring	Gliding, Thermal Soaring
	TUVU F17		Gliding around and past turbine	Gliding
	TUVU F8		Gliding	Gliding
	TUVU F18		Flew low and under the turbine and west in adjacent fields	Flapping
	TUVU P2	June 3 2021	Perched in dead standing tree along pasture fence row.	Perched
	TUVU F20		Thermal Soaring, Flapping	Thermal Soaring, Flapping
	TUVU F20		Soaring in area	Thermal Soaring
	TUVU F16		Flapping, Gliding	Flapping, Gliding
	TUVU F20		Flapping, Thermal Soaring	Flapping, Thermal Soaring
	TUVU F21		Flight along woodlot edge and perched in dead standing tree on pasture field fence row.	Flapping

[1] – Flight path # corresponds to flight paths on **Figures 2.1 and 2.2**, **Appendix A**

[2] – Wind is measured using the Beaufort Scale (1 = low, 2 = medium, 3-4 = high)

[3] – Temperature is measured in degrees Celsius (cold = ≤ 0°C, cool = 1°C - 14°C, warm = ≥ 15°C)

Table C8: Red-tailed Hawk Observations, Fall Migration 2021

Date	Total Observed	Nearest Turbine	Flight Path Observed	Flight Height	Wind	Temp
September 2 2021	3	20	RTHA F1	20	NNW, medium	Warm
September 8 2021	1	20	RTHA F7	70	WNW, medium	Warm
September 24 2021	2	27	RTHA F12	60	SW, high	Cool
		20	RTHA F13	50		
October 5 2021	3	20	RTHA P12		NNE, medium	Warm
		20	RTHA F1	70		
		20	RTHA F8	20		
October 18 2021	7	20	RTHA P13		W, high	Cool
		20	RTHA F1	30		
		20	RTHA F13	15		
		20	RTHA F8	50		
		27	RTHA F14	20		
		27	RTHA F16	20		
October 27 2021	3	20	RTHA F10	30	NNW, medium	Cool
		20	RTHA F13	60		
		20	RTHA F15	40		

[1] – Flight path # corresponds to flight paths on **Figures 3.1 and 3.2**, **Appendix A**

[2] – Wind is measured using the Beaufort Scale (1 = low, 2 = medium, 3-4 = high)

[3] – Temperature is measured in degrees Celsius (cold = ≤ 0°C, cool = 1°C - 14°C, warm = ≥ 15°C)

Table C9: Turkey Vulture Observations, Fall Migration 2021

Date	Total Observed	Nearest Turbine	Flight Path Observed	Flight Height (m)	Wind	Temp
August 24 2021	7	T20	TUVU F2	60	SW, medium	Warm
		T20	TUVU F2	50		
		T20	TUVU F20	30		
		T20	TUVU F2	100		
		T27	TUVU F22	60		
		T27	TUVU F23	100		
		T27	TUVU F5	80		
September 2 2021	118	T20	TUVU F12	45	NNW, medium	Warm
		T20	TUVU F9	30		
		T20	TUVU F9	50		
		T20	TUVU F9	45		
		T20	TUVU F26	60		
		T20	TUVU F27	30		
		T20	TUVU F28	15		
		T20	TUVU F17	80		
		T20	TUVU F8	80		
		T20	TUVU F29	60		
		T20	TUVU F2	30		
		T20	TUVU F30	20		
		T20	TUVU F12	60		
		T20	TUVU F20	10		
		T20	TUVU F12	70		
		T20	TUVU F20	50		
		T20	TUVU F2	40		
		T20	TUVU F30	30		
		T20	TUVU F12	30		
		T20	TUVU F16	15		
		T20	TUVU F2	30		
		T20	TUVU F2	40		
		T20	TUVU F12	40		
		T27	TUVU F11	50		
		T27	TUVU F3	40		
		T26	TUVU F24	20		
		T27	TUVU F1	20		
		T26	TUVU F24	30		
		T27	TUVU F22	25		
		T27	TUVU F25	20		
		T27	TUVU F22	30		
		T27	TUVU F11	80		
		T27	TUVU F22	30		
		T27	TUVU F22	25		
		T27	TUVU F11	30		
		T27	TUVU F22	30		
		T27	TUVU P3	20		
		T27	TUVU P4	20		
September 8 2021	132	T20	TUVU F20	100	WNW, medium	Warm
		T20	TUVU F21	80		
		T20	TUVU F34	30		
		T20	TUVU F28	40		
		T20	TUVU F34	90		
		T20	TUVU F35	160		
		T20	TUVU F30	20		
		T20	TUVU F12	50		
		T27	TUVU F31	90		
		T27	TUVU F32	40		
		T27	TUVU F33	100		
		T27	TUVU F33	15		
		T27	TUVU F33	30		
		T27	TUVU F22	60		
		T27	TUVU F22	50		
September 13 2021	107	T20	TUVU F36	5	ENE, medium	Warm
		T20	TUVU F37	80		
		T20	TUVU F17	40		
		T20	TUVU F2	60		
		T20	TUVU F8	70		
		T20	TUVU F14	60		
		T27	TUVU F32	60		
		T20	TUVU P5	25		
		T20	TUVU P6	25		

Date	Total Observed	Nearest Turbine	Flight Path Observed	Flight Height (m)	Wind	Temp
September 24 2021	17	T20	TUVU F21	20	SW, high	Cool
		T20	TUVU F2	50		
		T20	TUVU F16	70		
		T20	TUVU F2	50		
		T27	TUVU F1	80		
		T27	TUVU F38	60		
		T27	TUVU F23	15		
		T27	TUVU F11	70		
		T27	TUVU F38	60		
September 28 2021	117	T20	TUVU F30	80	N, medium	Warm
		T20	TUVU F12	60		
		T20	TUVU F2	50		
		T20	TUVU F17	60		
		T20	TUVU F30	60		
		T20	TUVU F29	60		
		T20	TUVU F28	60		
		T20	TUVU F29	30		
		T27	TUVU F11	40		
		T27	TUVU F38	40		
		T27	TUVU F1	40		
		T27	TUVU F39	60		
		T27	TUVU F4	40		
		T27	TUVU F39	60		
		T27	TUVU F3	40		
		T27	TUVU F1	40		
		T27	TUVU F40	30		
		T27	TUVU F1	40		
		T27	TUVU F4	40		
		T27	TUVU F39	80		
October 5 2021	96	T20	TUVU F15	80	NNE, medium	Warm
		T20	TUVU F15	70		
		T20	TUVU F29	70		
		T20	TUVU F17	50		
		T20	TUVU F41	30		
		T20	TUVU F34	40		
		T27	TUVU F1	40		
		T27	TUVU F4	50		
		T27	TUVU F25	70		
October 15 2021	12	T20	TUVU P7	20	NW, medium	Warm
		T20	TUVU P8	20		
October 18 2021	22	T20	TUVU F8	30	W, high	Cool
		T20	TUVU F42	25		
		T20	TUVU F28	30		
		T27	TUVU F7	40		
		T27	TUVU F4	30		
		T27	TUVU F1	20		
		T27	TUVU F23	20		
October 27 2021	3	T20	TUVU F28	60	NNW, medium	Cool

[1] – Flight path # corresponds to flight paths on **Figures 2.1 and 2.2, Appendix A**

[2] – Wind is measured using the Beaufort Scale (1 = low, 2 = medium, 3-4 = high)

[3] – Temperature is measured in degrees Celsius (cold = ≤ 0°C, cool = 1°C - 14°C, warm = ≥ 15°C)

Table C10: Other Raptor Observations, 2021

Date	Species	Flight Path Observed	Number Observed	Nearest Turbine	Wind	Temp
September 13, 2021	NOHA	NOHA F1	1	T20	ENE, medium	Warm
September 24, 2021	BAEA	BAEA F2	1	T20	SW, high	Cool
	BAEA	BAEA F3	1	T20		
	COHA	COHA F1	1	T20		
	BAEA	BAEA F1	1	T27		
	BWHA	BWHA F1	20	T26		
September 28, 2021	COHA	COHA F2	1	T20	N, medium	Warm
	BAEA	BAEA F4	1	T27		
October 15, 2021	NOHA	NOHA F3	1	T20	NW, medium	Warm
	NOHA	NOHA F2	1	T26		
	BAEA	BAEA F5	1	T27		
	BAEA	BAEA P1	1	T27		
October 27, 2021	BAEA	BAEA F7	2	T20	NNW, medium	Cool
	BAEA	BAEA F7	3	T20		
	BAEA	BAEA F8	1	T20		
	NOHA	NOHA F4	1	T20		
	BAEA	BAEA F6	1	T26		

[1] – Flight path # corresponds to flight paths on **Figures 4.1, 4.2, 5.1 and 5.2 Appendix A**

[2] – Wind is measured using the Beaufort Scale (1 = low, 2 = medium, 3-4 = high)

[3] – Temperature is measured in degrees Celsius (cold = ≤ 0°C, cool = 1°C - 14°C, warm = ≥ 15°C)

4 -- NOHA=Northern Harrier; BAEA= Bald Eagle; COHA=Cooper's Hawk; BWHA=Broad-winged Hawk

Table C11: Summary of Red-tailed Hawk observations from Holiday Beach, fall migration 2021 (Hawk Count 2021)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Sept	14	4				1		1	3	3	1		2		4	7	4	26	2	2				3	1			36	11	10	N/A
Oct	10	2			9		3	2	8	2	1	2	8	6		23	95	134	47	119	16	162	29	26		323	38	283		6	52
Nov	158	101	95	167	102	78	34	17	45	222	44	8	5		27	93	1	56	86	10	1	59	58	23		24	6	1	18	24	N/A

Source: Hawk Count 2021

Table C12: Summary of Turkey Vulture from Holiday Beach, fall migration 2021 (Hawk Count 2021)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Sept	16	18		4		11		5	1	1	7	10	1	2	4	15	5	84	20		1			20	43	101	78	1709	1696	1025	N/A
Oct	917	117		35	236	389	454	607	486	180	65	1072	1952	1203		1832	3823	4500	10685	3361	570	3129	2665	1050		18567	822	1284		97	396
Nov	888	301	542	406	222	247	255	51	13	297	42	12	7		2	49		13	2	3		26	12	7		1			3	2	N/A

Source: Hawk Count 2021