Oil Sands Bird Contact Monitoring Plan for 2012

2011 Plan* Modified by:

Colleen Cassady St. Clair and Sarina Loots
Department of Biological Sciences
Research on Avian Protection Project
University of Alberta
Edmonton, AB T6G 2R3

Prepared for:

Shell Canada Energy Ltd., Calgary, AB
Canadian Natural Resources Limited, Calgary, AB
Imperial Oil, Calgary, AB
Suncor Energy Inc., Calgary, AB
Syncrude Canada Ltd., Fort McMurray, AB
Alberta Environment and Water, Edmonton AB
Alberta Sustainable Resource Development, Edmonton AB
Research on Avian Protection Project, University of Alberta, Edmonton, AB

*This plan provides an updated protocol for
Oil Sands Bird Contact Monitoring Plan for 2011

Prepared by:

Robert A. Ronconi
Department of Biology
Acadia University
Wolfville, NS B4P 2R6

Last Modified
6 April 2011

Table of Contents

1. Monitoring Plan Development: Overview and Outlook

This proposed monitoring program is the result of collaborative effort between oil sands mining industry members and academia, and is based on scientifically rigorous methodology, while recognizing current operational constraints. This monitoring plan incorporates feedback provided by government agencies including Alberta Environment and Water, Alberta Sustainable Resource Development, and Environment Canada.

On January 18, 2012, representatives from Imperial Oil, Shell Albian Sands, Canadian Natural Resources Ltd, Syncrude, Suncor, Total, Alberta Environment and Water, and Alberta Sustainable Resource Development met to discuss progress made in 2011 on standardized bird monitoring in the oil sands region of Alberta. Field data collection for 2011 by operators was based on the *Oil Sands Bird Contact Monitoring Plan for 2011* prepared by Robert A Ronconi. The *Regional Bird Monitoring Plan Annual Report* by Dr. Colleen Cassady St Clair of the University of Alberta on the first year of field data was presented to industry operators. This meeting highlighted several improvements that can be made to the *Oil Sands Bird Contact Monitoring Plan for 2011*. These are included in this updated Monitoring Plan for 2012.

In order to explain how much of the variation in the 2011 data was due to specific 2011 conditions, the majority of the Monitoring Plan is kept the same in 2012; with the exception of some noted improvements for data clarification.

Noted changes to Monitoring Plan: Suggest clear times to monitor birds and the number of observers needed.

Noted Changes to the Monitoring Form (Appendix III *Avian Monitoring Program – Form 1: Pond Inventory*

1. Aerial scan: flight direction to be recorded instead of azimuth for flying birds
2. Bird Contact: Explicit question added for establishing the nature of bird contact with pond surface
3. Wind measurement: Beaufort scale for wind data collection

Outlook of monitoring plan progress:

- **Short-term (1-year)**
  - Implementation of visual observation techniques at all sites and ponds
    - Accomplished with monitoring plan implementation in 2011
  - Development of standardized training program

        - Some training offered in Fort McMurray by Hatfield Consultants
        - Further standardization of training is planned for 2012
        - As the oil sands mine operators move toward electronic data recording devices, tablet form techniques will be incorporated in training
            - Current operators who have adopted tablets include Shell, Imperial Oil, and Canadian Natural
    - Analysis of first year's data by independent, third-party
        - Colleen Cassady St Clair et al. at University of Alberta analysed and reported on 2011 data in the report *Regional Bird Monitoring 2011 Annual Report*
        - Final Report distributed on March 14, 2012
    - Preliminary testing of automated instrument-based monitoring techniques
        - MSc student Sarina Loots is analysing and preparing results of camera-based monitoring of 2011 for peer-review publication
- **Medium-term (1-3 years)**
    - Refinement of training program and observer monitoring including adjustments to survey frequency, timing, and, if necessary, protocols
        - Electronic data recording/entry devices (tablets) by bird observers of all operators
    - Research and development of automated instrument-based monitoring techniques
        - Camera-based monitoring by the U of A will continue in 2011
        - **Research by the U of A on radar-based monitoring and calibration of differences in detection of birds of various radar systems in use in oil sands region will begin in spring 2012**
            - **Testing of radar systems at oil sands industry sites will ideally take place in cooperation between each operator and U of A Research on Avian Protection Project (RAPP)**
    - Implementation of automated instrument-based monitoring techniques
- **Long-term (after 3 years)**
    - Industry-wide implementation of combined observer and instrument-based monitoring program which minimizes operational costs and maximizes the quality and quantity of long-term monitoring data.
    - Open-access data storage.
    - Automated seasonal and annual analysis providing descriptive statistics of bird contacts and mortalities.

2. Purpose

This monitoring program provides systematic and industry-wide monitoring of bird contacts and mortalities at liquid storage facilities at oil sands mining operations.

Desired aspects of effective monitoring plan include:

1. An operational program that will provide relevant long-term data.
2. Program should be consistent, comprehensive, and rigorous.
3. The program will be refined over time to optimize cost effectiveness.
4. Current and future monitoring will support the development and implementation of automated instrument-based systems to further optimize the costs and benefits of monitoring in future.
5. The monitoring program will be scalable to the size and risk of the ponds at each facility.
6. Monitoring plan should merge
    a. the operational constraints of mining sites
    b. sampling relevant to bird biology
7. Protocols are primarily intended to measure bird contacts and mortalities, but measures of bird activity are needed to provide relative measures of risk.
8. First priority is to standardize existing monitoring in order to be able to compare data across ponds, sites, seasons, and years.
9. Results from the monitoring plan will ultimately provide site-specific guidance on bird deterrent strategies.
10. Competency and training are key elements of the program.

3. Objectives

Overall Goal:

To provide a robust and systematic monitoring program that documents bird interactions with liquid storage facilities at oil sands mining facilities. This program will ultimately provide site-specific guidance on bird deterrent strategies aimed at reducing bird contacts and mortalities.

Monitoring Program Objectives:

1. Provide an estimate of bird contacts and mortalities on ponds containing process-affected waters.
2. Provide an estimate of bird contacts on ponds containing fresh water.
3. Develop a standardized monitoring program for all oil sands mine operations to provide comparable data across ponds, sites, seasons, and years.
4. Identify species at risk that have been affected through contact on ponds containing process-affected waters.

5. Provide direction on adaptive management[1] for long-term monitoring and bird deterrent programs.

4. Context for the Monitoring Plan

4.1 Background

Interactions between water birds, including ducks, geese, shorebirds, waders, and others, and process-affected tailings ponds has been a long standing issue in the oil sands mining industry of northeastern Alberta. Open water tailings ponds present potential resting, roosting, foraging, and nesting sites for birds (Gully 1980, Ronconi 2006), particularly during spring when tailings ponds may be the only open water before natural water bodies have thawed (Gully 1980, Boag and Lewin 1980, Ronconi 2006), and during both spring and autumn migrations when volumes of birds passing through this area are at their highest (Shick and Ambrock 1974, Hennan and Munson 1979).

Oil sands operations are required to operate facilities in a manner that minimizes the possibility of birds coming into contact with harmful or hazardous substances.

· Section 5.1 (1) of the Migratory Birds Convention Act, 1994, *"No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area"*.

· Section 155 of the Alberta Environmental Protection and Enhancement Act, 2010, *"A person who keeps, stores or transports a hazardous substance or pesticide shall do so in a manner that ensures that the hazardous substance or pesticide does not directly or indirectly come into contact with or contaminate any animals, plants, food or drink"*.

Oil sands operations have a requirement to take reasonable measures to prevent birds from coming in contact with oil sands process-affected water. This process-affected water includes tailings and recycle water used for the processing of bitumen extraction, storm water, emergency dump ponds and any other water that may contain harmful or hazardous substances[2]. Tailings water contains trace amounts of various compounds, however, it is the residual bitumen that poses the greatest immediate harm to birds through direct contact and potential ingestion.

The focus of this monitoring program is on birds. Specific monitoring of other wildlife such as ungulates, bears and coyotes is not addressed within this program. All operators will continue to fulfill the conditions of existing licenses and permits, including those contained within the Wildlife Research and Collection licenses issued by Alberta Sustainable Resource Development (see *Appendix I* for summary of reporting

[1] "adaptive management" is defined below in Section 4.4
[2] Nomenclature of facilities varies amongst operations

requirements related to avian monitoring). This monitoring program documents the monitoring that will be undertaken by each operating company with active ponds. This does not preclude other operational and maintenance activities done as part of the regular bird deterrent programs for each company. The monitoring of bird contacts and mortalities will provide guidance for adaptive management of bird deterrent programs with a goal to minimize overall bird contact and mortality rates.

The monitoring program is not designed to detect or document other possible causes of avian injury and mortality, unrelated to oil sands tailings ponds and process-affected ponds, which may occur in other areas of mining facilities or in adjacent forested areas.

4.2 General Principles of an Effective Monitoring Plan

The process of designing a monitoring plan will ideally lead from the identification of a problem, through to the development of objectives and key questions, a rigorous sampling design, and analysis that observes trends with some estimate of probabilities (Yoccoz et al. 2001, McComb et al. 2010). Thus far, the problem and key questions have been identified (see *Objectives* above) and the next step is to develop a rigorous sampling design. Aspects of an effective sampling design include (Elzinga et al. 2001, McComb et al. 2010):

1. Adequate sample sizes (i.e. number of ponds or survey stations per pond)
2. Appropriate levels of sampling effort (replication and stratification of sampling)
3. Information on detection and identification accuracy.

Some aspects, such as adequate sample size and effort, may only become known once preliminary data are collected and analyzed whereby estimates of variance can be used to predict the sample size needed to achieve desired levels of statistical power in trend detection. As data become available, there may be good reasons to modify some aspects of the sampling effort (i.e. lowering or increasing sampling frequency where necessary) to maximize the efficiency of monitoring resources (section *4.4 Adaptive Management*). Other aspects, such as detection and identification accuracy, may require experimental testing in the field. This will be accomplished with the outlined protocols below.

4.3 Operational Constraints

Oil sands mining facilities are large industrial sites that pose many challenges and constraints not typically encountered when monitoring wildlife in other contexts. It is important to recognize these constraints and how they will impact the implementation of monitoring activities related to bird contacts and mortalities. Most of the constraints are related to human health and safety concerns which will not be compromised. However, **where possible, operators will work to overcome other operational constraints that negatively impact the quality of the data collected under the monitoring plan**. Major constraints include:

- Safety concerns related to hearing damage from deterrents, additional dangers posed by night time work, and unstable terrain around some portions of ponds.

    - *Impacts on monitoring:* These constraints make it almost impossible to be near tailings ponds at night and limit walking and/or driving near the pond perimeter due to drowning risks, etc.
    - *Possible actions to remove constraints:*
        - Most shoreline searches for bird mortalities (5.2) will be conducted by boats traveling near shorelines.
        - Identification of safe survey stations (5.1.1)
        - Installation and operation of automated instrument-based monitoring (section 7)
- Shift start/end times are dictated by company-wide safety protocols that require all individuals at mining sites to check in/out at designated times of the day. These protocols differ among sites. In 2011, detection rates increased slightly in the late morning period, alleviating operational constraints involved in dawn and dusk observations (St. Clair et al. 2012).
- For standardization and operational simplification, we recommend that each operator aim to do one observation per observation site between sunrise and 6 hours after sunrise. Alternatively, operators could sample throughout the daylight hours provided they (a) alternated the order of visits at sites to avoid the potential for systematic biases between sites and times, (b) continued to record the timing of observations, and (c) adjusted schedules to ensure that sampling times within seasons was similar across sites (St. Clair et al. 2012).
- Operators could census pond with one, two or more individuals according to their own operational contexts. As for variation in the timing of observations, variation in the number of observers within lease sites must be recorded and spread equally among observation times and sites so that the potential for unintended confounds between methods and results can be measured and avoided.
    - *Impacts on monitoring:* The timing of shifts may impact the timing of monitoring when start/end times overlap with critical dawn monitoring periods.
    - *Possible actions to remove constraints:*
        - Operators will make efforts to implement early morning surveys during peak spring migration (15 April to 20 May) in 2012
        - Operators will start with a different pond each day and do their rotation from that pond onward, to avoid systematic confounds between time and site.
        - Obtain blanket permits to avoid signing in every 4 hours.
        - Installation and operation of automated instrument-based monitoring (section 7)

4.4 Adaptive Management Strategy

A well designed monitoring program can be an important tool in an adaptive management strategy towards the use of resources (Walters 1986, Yoccoz et al. 2001). Adaptive management *"is a process to find better ways of meeting natural resource management goals by treating management as a hypothesis*" (p. 11 McComb et al. 2010). In the context of the oil sands, this bird monitoring program should test hypotheses of

alternative management scenarios at tailings ponds and other process-affected waters. Monitoring data are then used to continuously assess the state of the system for the purpose of making periodic decisions on changes in management actions (Yuccoz et al. 2001). Thus, operators can employ adaptive management principles in the design and adjustment of both monitoring and deterrence protocols (Table 4.1).

In the long-term, an adaptive management approach will work towards more effective deterrence strategies and more efficient monitoring activities with the goals of:

1) Increasing the efficiency and reducing the cost of monitoring
2) Minimize impacts of oil sands process-affected water on birds

The overall success of an adaptive management strategy can be tracked by the long-term monitoring of bird contact and mortality trends related to tailings ponds.

Table 4.1 Examples of adaptive management scenarios based on potential outcomes of monitoring.

Monitoring variable measured	**Potential outcomes**	**Potential adaptive management scenario**
# of bird contacts (including and specified by contact with pond surface, contact with pond vegetation, or contact with pond shore) by time of day	a) 10a.m. counts are consistently 50% less than dawn counts b) no linear relationship between mid-day and early morning counts	a) Develop correction factor for 10a.m. counts to estimate bird activities at dawn b) No correction factor – monitoring must occur during time of day when contacts are most likely to occur
# of bird contacts by survey station	a) contact rates do not differ among survey stations on the same pond b) contact rates differ among survey stations on the same pond	a) Reduce the number of survey stations required for large ponds. b) Implement area or zone-based monitoring and deterrence on large ponds.
# of bird contacts by season	a) 52% of contacts occur during spring migration (May) and 45% of contacts occur during fall migration (Aug/Sept)	a) Reduce frequency of monitoring (i.e. mortality searches) during non-migratory periods.
Proportion of	a) Proportion of birds landing	a) Identify ponds that pose greatest

birds landing (relative to flyovers)	differs among ponds b) Proportion of birds landing does not differ among ponds	risk and increase deterrent effort. Reduce or eliminate deterrents from ponds that pose no risk. b) Maintain or increase level of deterrent effort across all sites
Mortality search	a) Numbers of dead birds decreases with pond distance from Athabasca river b) Numbers of dead birds increases with pond size.	a) Increase deterrent effort for ponds closest to the river. b) Increase deterrent effort on larger ponds.

5. Monitoring Protocols

This section describes protocols for the systematic monitoring of bird activities, abundance and mortalities at tailings ponds. Several monitoring approaches are needed to meet the objectives of the program and to quantify key parameters of interest. The key parameters of interest are 1) bird contact with process affected water, or landing, rates, 2) bird mortalities, and 3) identification of sensitive/at risk species. The following three protocols should be implemented in order to quantify these parameters:

5.1 Pond Inventories
5.2 Mortality Searches
5.3 Incidental Observations and Reports

Table 5.1 – Overview of bird monitoring plan. *Numbers in brackets refer to subsection protocols below. PA = process-affected; FW = fresh water*

Activity	**Period**	**Actions and frequency of surveys**
Set up	1-15 April	a) Selection of survey stations and recording of deterrent placement (5.1.1) b) All PA ponds visited every 3 days until tailings ponds are > 25% thawed or first birds are detected on ponds (5.1.2), whichever occurs first
Spring Pond Inventories	16 April to July 6	a) One observation per day (5.1.2) at all survey stations at PA ponds b) Twice weekly observations (5.1.2) at one FW pond
Fall Pond Inventories	25 July to 31 October	a) One observation per day (5.1.2) at all survey stations at PA ponds

		b) Twice weekly observations (5.1.2) at one FW pond
Mortality Searches	16 April to 31 October	a) Twice weekly searches of all PA pond shorelines and surface waters (5.2)
Incidental Observations	Year round	a) Reporting of all incidental bird observations and mortalities associated with PA ponds at oil sands facilities (5.3)

Each of these protocols include specific data recording requirements (below). However, it should be noted that with the first two protocols, **it is imperative that observers also document monitoring activity on days when no birds are recorded (i.e. "zero" data).** Recording of no bird landings or no mortalities is essential to analysis of factors affecting avian risk and mortality at tailings ponds.

All datasheets are provided in Appendix I.

5.1 Pond Inventories

Purpose: Pond inventories document annual variability in bird contacts and landing rates on process-affected waters. The same protocol should also be used on fresh water ponds at oil sands mining facilities.

- Provide a minimum estimate of known contacts.
- Estimate the total number of bird contacts based on landings/hr.
- Determine the species groups, environmental conditions (weather, timing of spring thaw, etc.), and periods (time of day and time of year) when birds are most likely to fly over and land on ponds.
- Separate documentation of birds that do not land but fly over ponds, as an index of relative bird abundance during migratory periods. Monitoring the natural annual variation in migratory activity is essential as a basis against which bird mortalities can be compared. Use of migration data generated by radar systems, already installed at certain mines, may serve as a useful proxy but will need validation with visual surveys.

5.1.1 Survey station placement and pond characteristics

Ponds at oil sands mining facilities are dynamic and some may change in size, shape and location from year to year. This will affect the placement of Pond Inventory observation points (hereafter referred to as *survey stations*). Appropriate survey stations for each pond will be identified prior to the onset of spring migration (between 1-15 April).

Prior to the onset of spring migration, for each pond at oil sands mining facilities operators will record:

- GPS location of each survey station
- GPS location of each deterrent device and date of deployment
- GIS layer of pond characteristics including:

- area of surface water
- location of tailings deposition area
- location of booms or other bitumen containment devices
- other relevant attributes

At each survey station:

- Mark stations with a permanent post/flag that is easy to locate. Flag will help in wind measurement on Beauford Scale.
- Give a unique name or ID code
- Establish additional permanent markers, where necessary, to assist with distance estimation:
  - Barrels or large flags places 500 m along the shoreline
  - Floats in the centre of the pond at 500 m intervals from the observer

Table 5.2 - Survey station locations. *Number of survey stations should be proportional to pond size and risk.* *For this second year of systematic monitoring the number of survey stations based on pond size will emulate 2011 criteria as follows:*

Pond Size	**# of stations**	**Criteria for station locations**
< 1.5 km^2	1	Best location for viewing entire surface area
1.5 km^2 - 5 km^2	2	Placed on opposite ends of the pond (e.g., north and south ends)
5 km^2 - 10 km^2	3	Divide the perimeter into thirds and place one station in each ensuring they are at least 2 km apart
> 10 km^2	4	Divide the perimeter into quarters and place one station in each ensuring they are at least 2 km apart

Position notes:

- Identify safety constraints (e.g., heavy equipment traffic, surface stability), but limit concessions for operational convenience.
- Ideally observers will be able to drive vehicles to stations so that vehicles can be used as a wind break during observations.
- Put stations as close to shore as safely possible
  a. Where possible within 10 m of water; avoid station points with large amounts of shore between observers and liquid pond surface
  b. Elevation may permit stations to be further
  c. Survey stations should not be further than 50 m from water's edge as this will impede ability to see birds

- Aim for a peninsula when possible to increase viewing area (see example; Fig. 5.1)
- Maximize the height of observation locations from pond surface and measure it.
- If the observed area does not cover the entire pond, maximize the distance between survey stations.
- Establish similar survey stations on one fresh water pond per operator (if applicable).
- See example below

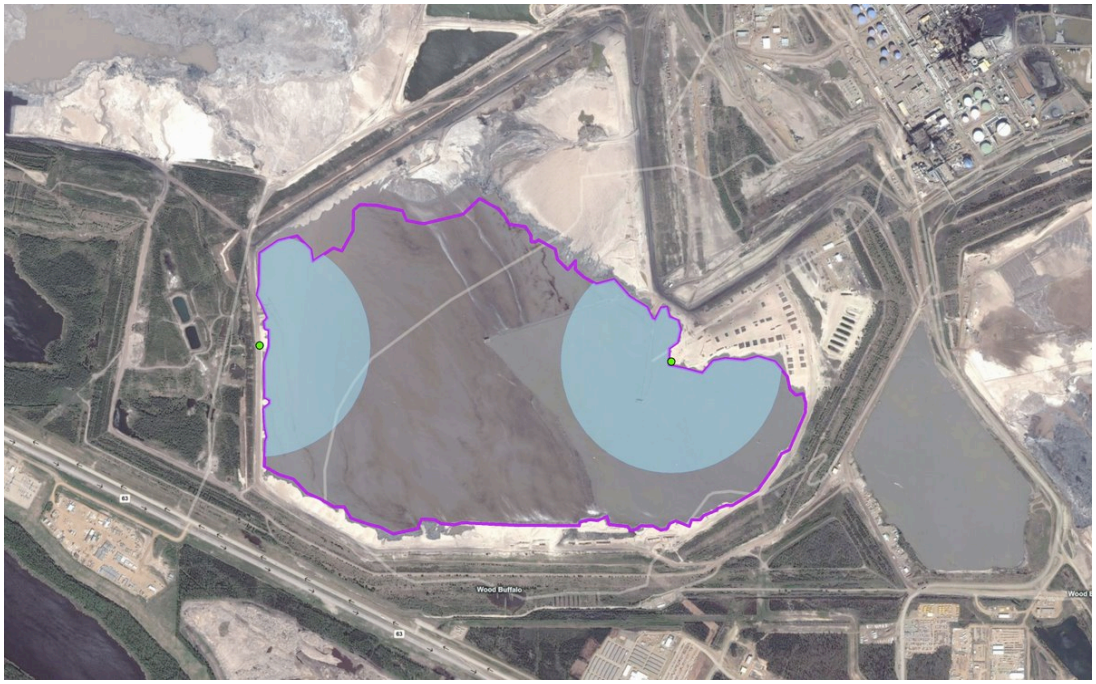

Figure 5.1. Example of survey station positioning at Suncor pond 2/3. Pond surface area is approximately 2.7 km^2 and circles illustrate 500m radius from survey station.

5.1.2 Bird Observations

Staffing:

1. Surveys may be conducted in teams of one, two, or more individuals.
    a. Ideally, one or more people will observe birds and another individual will record their observations. A single observer can manage this protocol provided (a) recording time does not reduce observation time, (b) recording equipment does not compromise effective use of observation equipment, and (c) variation in the number of observers is spread equally among times of the day, days in the season, and observation sites. Operators must record the number of individuals participating in each observation session. Single observers may find it easier to record their observations by voice and enter the data subsequently, in which case it will be necessary to overcome automatic time stamps on tablets as data entry platforms.
    b. Ensure all observers are familiar with monitoring forms prior to observations starting, to streamline recording process.

2. When necessary, companies should have separate teams dedicated to a) monitoring and b) maintenance and bird hazing. This will limit the disruption to monitoring and increase the efficiency of completing monitoring close to sunrise and sunset times.

Survey frequency:

1. All survey stations at process-affected (PA) ponds will be monitored ONCE daily.
2. A selected fresh water (FW) pond will be monitored twice weekly.
3. Survey effort, when possible, should be increased during annual or daily events (e.g., late thaw, storms) that are likely to promote landing of migratory birds (Ronconi 2006).

Note: This frequency is the required effort in 2012, set at one observation per station per day in order to standardize effort and results between operators. An adaptive management approach (section 4.4) suggests that this frequency may increase or decrease over time as required. Over time, successful implementation of instrument-based monitoring (section 7) may reduce the need for daily human observations.

Survey timing:

Landings of birds at and on process-affected ponds have have been assumed to occur most often at dawn and dusk (Yonge et al. 1981, Ronconi unpubl. data). In 2011, emphasis was placed on these periods. The 2011 data showed maximum counts in the late morning, and in order to achieve more consistency among operators, observations should be made within 6 hours of sunrise. Automated monitoring of ponds with cameras may be used to supplement observations by people (see section 7).

1. Within the constraints of daily shifts, ponds will be monitored as close as possible to local sunrise times (Table 5.3).
2. Total survey time (Table 5.4) indicate that all operators should be able to complete surveys within a 6 hours of sunrise. Several operational and logistical factors will influence the duration of time needed to complete observation protocols. Whenever possible, delays owing to operational factors (e.g., securing a permit) should be anticipated and overcome with alternative arrangements (e.g., a pass). Delays caused by necessary interspersion of sites to avoid site-time confounds should be anticipated and accommodated.
    a. Companies with many ponds (CNRL, Suncor and Syncrude) will require 2 or more monitoring teams operating independently to achieve this.
    b. Afternoon shift periods should be reserved for mortality searches (section 5.2)
3. Alternate the time of day when ponds are surveyed.
    a. The order with which ponds are surveyed should vary among days.
    b. Operators should set up survey routes that maximize the efficiency of surveys (minimize driving).
4. Order of pond/station surveys within morning periods:
    a. If routes are established, the order of the route should be reversed on alternate days. This ensures that the same ponds are not surveyed at the same time each day.

b. Where possible, the order of surveys should also be randomized within routes.

Table 5.3 – Sunrise and sunset times for Fort McMurray, AB. *Times have been adjusted for daylight savings time.*

	Rise	Set	daylight hours
1-Apr	6:55	20:05	13:10
15-Apr	6:18	20:34	14:16
1-May	5:39	21:08	15:29
15-May	5:09	21:36	16:27
1-Jun	4:43	22:05	17:22
15-Jun	4:33	22:19	17:46
1-Jul	4:38	22:20	17:42
15-Jul	4:55	22:07	17:12
1-Aug	5:25	21:37	16:12
15-Aug	5:53	21:05	15:12
1-Sep	6:28	20:22	13:54
15-Sep	6:56	19:44	12:48
1-Oct	7:29	19:01	11:32
15-Oct	7:58	18:24	10:26
1-Nov	8:35	17:43	9:08

Survey Methodology:

Protocols have been adapted from Yonge et al. (1981) and Ronconi and St. Clair (2006). Distance sampling methodology for point counts (Buckland et al. 2001) will be used to quantify inter-observer variability and measure the distances of effective detection for birds landing on the water (see section 9 for details). The same protocol and datasheets will be used at all survey stations at both process-affected and fresh water ponds. Surveys will only differ in duration based on pond size. Complete survey protocol will take a total of 10 minutes **only** at small ponds (<1.5 km^2) and **30 minutes at survey stations on large ponds**.

Table 5.4 – Estimated total survey time required to conduct daily observations of all ponds containing process affect waters. *Number of survey stations is based on Table 5.1 above. Survey time is based on 10 minute and 30 minute protocols for small ponds and survey stations at large ponds, respectively. Operators will need to estimate driving times between sites and schedule surveys accordingly.*

	Number of Ponds			Number of Survey stations		Survey time (minutes)		Total time (hrs)	Index of per area effort
Operator (mine)	Small ponds	Large ponds	Surface area (total km^2)	Small ponds	Large ponds	Small ponds	Large ponds		ratio of total survey time to total surface area
Albian (MRM)	5	1	4.7	5	2	50	60	1.8	0.39
Albian (JPM)	4	2	6.8	4	4	40	120	2.7	0.39
CNRL	13	1	10.9	13	4	130	120	4.2	0.38
Imperial	1	1	9.3	1	3	10	90	1.7	0.18
Suncor	11	6	25.6	11	14	110	420	8.8	0.34
Syncrude	3	7	36.3	3	18	30	540	9.5	0.26

Notes: *Syncrude* sites Aurora and Mildred Lake operate under the same EPEA approval (here shown

together as just *Syncrude*), but per request by Alberta Environment and Water, the data from the two sites will be separated in 2012. *Imperial* ponds include one tailings pond and one compensation pond for monitoring in 2011; more ponds will be included when mine is fully operational in 2012.

Protocols – see accompanying Form-1 for recording observations

1. Observe pond during arrival to site; count the birds that flush as you arrive and before you get out of the truck. Record these as a row in the datasheet but indicate F (flushed) on the scan type
    a. If using an electronic data recording device, save "bird observation forms" for flushed birds after recording instead of immediately submitting so modifications can be made e.g. if birds initially flushed and then land later in the same observation period, their landing (and type of contact) can be included in their original observation form if it is saved rather than instantly submitted. Submit these forms at the end of each observation period.
2. Park at pull out (permanent flag or stake marking survey station)
    a. Set up spotting scope on tripod and any other equipment (see section 6.0)
    b. Fill out datasheet (circling correct answers where applicable)
        i. If using an electronic data entry device, the following information is held in the "site characteristics" form (each bird observation is linked automatically to its corresponding "site characteristics" form by a concatenation of "Pond name"+"Date"+"Time of day"). "Site characteristics" form will upload through 3G network to a spreadsheet accessible only to the operator and the U of A Research on Avian Protection Project.
        ii. Pond name or survey station ID
        iii. Date and Observers
        iv. Precipitation: none, fog, rain, snow, hail
        v. Wind Measure (Beauford Scale): indicate # 0-12
        Ensure all observers have access to Beauford scale reference chart at observation site
        vi. Cloud cover: 0-25% 25-75% 75-100%
        vii. Cloud ceiling: <200m 200-700m >700m
        viii. Visibility: clear <100m <500m <1km
        ix. % Bitumen coverage: none 1-25 25-50 50-75 >75

x. Data on barometric pressure, temperature, wind speed and direction will be recorded from local weather stations and can be added to the database afterwards.
xi. Note start time on datasheet.

3. Surface and shoreline scan
    a. Scan the water surface and adjacent shorelines. Having one observer scanning the shoreline with a spotting scope, another observer scanning the shore and the air for birds, and a third observer recording the data as dictated by the first two observers may be an efficient and effective approach.
        i. If using an electronic data recording device, fill out a "bird observation" form for each bird or bird group (each "bird observation" form is linked automatically to its corresponding "site characteristics" form by a concatenation of "Pond name"+"Date"+"Time of day"). "Bird observation" form will upload through 3G network to a spreadsheet accessible only to the operator and the U of A Research on Avian Protection Project.
        ii. Identify birds with as much detail as possible. E.g. If a shorebird is further than 300m away, and cannot be identified beyond sandpiper, indicate "unknown sandpiper" in the species column. If it can be identified as Lesser Yellowlegs, indicate LEYE in the species column.
        iii. All observers must ensure consistent adherence to the standardized four letter bird codes. Those using electronic data recording devices can have this conversion made automatically from more familiar names (e.g., "Lesser Yellowlegs" to "LEYE")
    b. Estimate distance (in meters) and direction (degrees relative to North) for each bird or bird group observed on the water or shoreline.
        i. Use range finders and compass to estimate distance and direction
        ii. Range finders will likely not work on individual birds, therefore use range finders measure distance to nearest solid object (shoreline, markers, or floating deterrent platform), then estimate distance to the nearest 50m
    c. Record each bird or bird group as a new entry in the datasheet.
4. Aerial scan

    This protocol is intended to provide an index of bird activity at each pond rather than a region-wide count of the total number of birds flying over. Therefore, flocks may be counted at multiple sites. NB: While one observer is scanning the surface and shoreline of the pond, a second observer can be conducting aerial scans using binoculars.
    a. Scan the sky by eye for approaching birds
        i. Face south during spring migration
        ii. Face north during autumn migration
        iii. Scan all directions during other times of the year.
    b. Record all birds or bird groups seen flying overhead
        i. Species/guild

ii. Flight direction
    1. If a bird group arrived and/or departed pond area at clear bearings, record the azimuths with a compass
    2. If a bird group was clearly migrating north or south, indicate this in flight details
    3. If a bird was merely circling, hunting, or flying sporadically, indicate this in flight details
iii. Altitude <200m 200-700m >700m
iv. Flight over water: yes/no
v. Bird numbers: landing and flyover
vi. Landing location: distance and direction\
    1. If a bird landed, note whether it made contact with the pond surface, pond shore, or pond vegetation.
vii. Visible floating bitumen: yes/no (Record whether bird is close to floating bitumen or not).

5.2 Mortality Searches

Purpose: Census for bird carcasses should be conducted to assess mortalities associated with each process-affected pond at oil sands mining sites.

- Provide a minimum estimate of known mortalities associated with ponds.
- Use estimates from known search effort (i.e. birds/km shoreline) to extrapolate mortality estimates for total pond area (where portions of ponds are not searched).
- Determine seasonal and annual rates in bird mortalities and assess environmental factors and pond characteristics that may be contributing to mortalities.
- Identify species/guilds most frequently killed in tailings ponds.

All bird mortalities are to be documented and reported to Alberta Sustainable Resource Development (ASRD) immediately as required in the individual terms and conditions of company permits issued by ASRD. To ensure that all mortalities are documented, recovered, and reported, specific searches of the shoreline for each pond should be conducted twice per week. Depending on the size of the pond, these searches may be conducted on foot, in a vehicle, or on a boat. Regardless of the method used, it is important that both surfaces and shorelines of ponds be checked for the presence of bird mortalities.

Survey frequency and timing:

- Monitoring of all pond surfaces and immediate shoreline twice per week. Sampling from shore or by boat as appropriate to ensure adequate coverage of the pond and documentation and collection of all mortalities.
- Surveys can occur at any time of the day but preferably in the middle of the day so as not to divert effort away from dawn Pond Inventories (5.1).
- Survey effort and timing should be increased during annual or daily events (e.g., late thaw, storms) that are likely to promote landing of migratory birds (Ronconi 2006).
    - Conduct mortality searches as soon as possible following storms (typically within 2 days).

- Reporting of all fatalities by species and condition (e.g. bitumen oiling) to Alberta Sustainable Resource Development (birds must also be preserved and stored).
- Documentation of bird location on the pond or shore.

Survey Methodology – see accompanying Form 2 for recording observations

1. Bird mortalities will be monitored by a combination of (ordered by priority):
    a. Shoreline and surface water searches by boat.
        i. Effort reported by search time and % surface/perimeter searched
    b. Perimeter walks around small ponds where boats are not available.
        i. Effort reported by search time and % perimeter searched
    c. Perimeter search by vehicle (only when boats and walking is not possible).
        i. Effort reported by search time and % perimeter searched
2. When dead birds or live oiled birds are found, the following information should be recorded:
    a. Fill out datasheet (circling correct answers where applicable)
        i. Pond name
        ii. Guild or species (enter separate record for each group or species)
        iii. # of birds per group of same species
        iv. Bird status: dead or live
        v. % oiled
        vi. Describe location found: habitat, vegetated, dyke wall, island, sandy beach
        vii. UTM/GPS coordinates
        viii. Provide a unique ID (DD-MMM-YYYY-001)
3. All dead birds are to be collected: bagged, tagged with unique ID and stored frozen until collected by ASRD
    a. Each operator will be responsible for developing collection and storage protocols that include documentation in Form 2.

5.3 Incidental Observations and Reports

Due to the scale of oil sands mining facilities, it is difficult for systematic monitoring to occur everywhere that birds may be encountered. Each facility has hundreds of workers who are asked to report all wildlife sightings, incidence, and recoveries of wildlife to the appropriate operator Environment Department staff. "Incidence" is defined (as per Alberta Environment and Water) as observations of birds where harm or danger to a bird has occurred or had the potential to occur. This would therefore include all opportunistic observations of birds on process-affected ponds as well as relevant wildlife observations in other areas of oil sands mining facilities. All reported avian incidences should be followed up for documentation to record pertinent data and collect carcasses of dead birds.

Purpose: Provide a record of all opportunistic observations of bird incidences made at oil sands PA ponds.

- Provide an inventory of other bird incidence not recorded during systematic surveys.

Protocol:

1. No standardized search protocol is required.
   Note: Operators adopting electronic data recording devices in 2012 will have the option of recording incidental observations of all wildlife on a very simple form.
   The Incidental Observation Form contains Date, Time, GPS location (no GPS required; tablet form will acquire GPS coordinates upon prompt by user) and species details in the form of apha-entry whereby number, state, and species identification can be recorded.
   - The Incidental Observation Form will upload through 3G network to a spreadsheet that is initially accessible only to the operator and the U of A Research on Avian Protection Project. Following discussion with regulators and operators, some or all of the data may subsequently appear on public sites.
2. Workers should report all avian incidences at oil sands PA ponds to the operator Environment Department.
3. Operator Environment Department staff should document incidents using the standardized reporting form provided by Alberta Environment and Water for wildlife sightings and incidences (for submission in the annual conservation and reclamation report).
4. All dead birds should be documented and collected as per protocols in section 5.2.

6. Identification and Monitoring of Species At Risk

Objective 4 (above) aims to identify species at risk (SAR) that are affected through contact on ponds containing process-affected waters. Most SAR are, by definition, rare. Therefore, monitoring programs designed to detect rare species must take into consideration the fact that occurrences (e.g. contacts, mortalities) will be less frequent and more difficult to detect.

The protocols above are not designed explicitly to detect rare species. Instead, this section provides guidance on the identification of SAR most likely to a) occur in the oil sands region, and b) come in contact with ponds. The monitoring program must be able to recognize/identify those species and the observer training (section 8) must reflect this. However, if specific species of conservation concern are identified as requiring detailed species-specific monitoring plans, guidance should be provided by Environment Canada, Alberta Environment and Water, and Alberta Sustainable Resource Development.

6.1 Federally listed species

Table 6.1 provides a list of nine bird species which are listed under the Species At Risk Act and may occur in the oil sands region as either migrants which typically pass through the area or seasonal breeding residents. None are year-round residents.

- Observers should be trained to identify 4 wetland associated species by sight and sound.

Only four species are wetland associated species which may potentially come in contact with tailings pond:

- **Whooping cranes** are the most critically endangered of these species. They have the potential to land in vegetated areas surrounding tailings ponds (R. Ronconi observed closely related Sandhill Cranes around tailings ponds in 2003).
    - Record date, time, location (GPS), and number of all Whooping Cranes heard or seen.
    - Immediately report to ASRD any Whooping Cranes observed landed anywhere at mining facilities.
- All observations (sight or sound) of **Rusty Blackbird, Yellow Rail** and **Red Knot** should be recorded even if outside of systematic monitoring.
    - Record date, time, location, and number of birds heard or seen

Table 6.1 Avian species at risk which are listed under the federal Species At Risk Act (SARA) and may occur in the oil sands region. *Shaded cells indicate wetland associated species. EN = Endangered, TH = Threatened; SC = Special Concern. Provincial status from the General Status of Alberta Wild Species 2010 (unpubl. report).*

Species	SARA Status	Provincial Status	Occurrence in Oil Sands
Whooping Crane	EN	At Risk	Migrant
Canada Warbler	TH	Sensitive	Breeding resident
Olive-Sided Flycatcher	TH	May Be At Risk	Breeding resident
Common Nighthawk	TH	Sensitive	Breeding resident
Peregrine Falcon	TH*	At Risk	Migrant
Rusty Blackbird	SC	Sensitive	Breeding resident
Yellow Rail	SC	Undetermined	Breeding resident
Short-eared Owl	SC	May Be At Risk	Breeding resident
Red Knot	SC	May Be At Risk	Migrant

*subspecies *anatum*

6.2 Provincially listed species

Table 6.2 provides a list of 35 bird species which occur in the oil sands region and have been identified provincially as "sensitive" (General Status of Alberta Wild Species 2010; unpubl. report). 16 of these species are typically associated with wetlands, marshes, or water, and may potentially come in contact with ponds containing process-affected water.

- Observers should be trained to identify all 16 species by sight.

Table 6.2 Avian species listed provincially as "sensitive" under the General Status of Alberta Wild Species 2010 (unpubl. report). *Shaded cells indicate those species which may come in contact with ponds containing process-affected water. List includes only those species that occur in the oil sands region of north-eastern Alberta. The list omits those species already identified in Table 6.1.*

Habitat	Family	Scientific Name	Common name
Wetland, marsh, or water associated species			

	Ducks	*Anas acuta*	Northern Pintail
		Anas crecca	Green-winged Teal
		Aythya affinis	Lesser Scaup
		Melanitta fusca	White-winged Scoter
	Grebes	*Aechmophorus occidentalis*	Western Grebe
		Podiceps auritus	Horned Grebe
		Podilymbus podiceps	Pied-billed Grebe
	Terns	*Chlidonias niger*	Black Tern
		Hydroprogne caspia	Caspian Tern
	Herons	*Ardea herodias*	Great Blue Heron
		Botaurus lentiginosus	American Bittern
	Raptors / Birds of Prey	*Circus cyaneus*	Northern Harrier
		Pandion haliaetus	Osprey
	Cranes	*Grus canadensis*	Sandhill Crane
	Rails	*Porzana carolina*	Sora
	Pelicans	*Pelecanus erythrorhynchos*	American White Pelican
Forest or field associated species			
	Sandpipers	*Bartramia longicauda*	Upland Sandpiper
	Raptors / Birds of Prey	*Accipiter gentilis*	Northern Goshawk
		Aquila chrysaetos	Golden Eagle
		Haliaeetus leucocephalus	Bald Eagle
		Strix nebulosa	Great Gray Owl
		Strix varia	Barred Owl
	Woodpeckers	*Dryocopus pileatus*	Pileated Woodpecker
		Picoides arcticus	Black-backed Woodpecker
	Swallows	*Hirundo rustica*	Barn Swallow
		Progne subis	Purple Martin
	Warblers	*Dendroica castanea*	Bay-breasted Warbler
		Dendroica tigrina	Cape May Warbler
		Dendroica virens	Black-throated Green Warbler
		Geothlypis trichas	Common Yellowthroat
	Flycatchers	*Contopus sordidulus*	Western Wood-Pewee
		Empidonax minimus	Least Flycatcher
		Sayornis phoebe	Eastern Phoebe
	Orioles	*Icterus galbula*	Baltimore Oriole
	Tanagers	*Piranga ludoviciana*	Western Tanager

7. Implementation of Instrument-based Monitoring

Rationale: Current operational constraints make it nearly impossible to conduct pond inventories (5.1) near dawn and dusk periods during the spring migration. These are periods when birds are most active and landing probabilities at ponds are likely to be greatest (Yonge et al. 1981, Ronconi & St. Clair 2006, Ronconi unpubl. data). Long-distance migratory flights in this region peak at night (Blokpoel 1973; Berthold 1993) and typically end in the early morning (Richardson & Gunn 1971) when birds are most likely to land. Therefore, there is an important need to invest in and test instrument-based monitoring techniques that can monitor bird activities 24 hours per day, especially during early morning periods.

Pilot study (2011):
Due to operational constraints limiting dawn and dusk surveys during spring migration, two oil sands operators, Shell Albian Sands Jackpine and Imperial Oil agreed to participate in pilot studies using high-definition (HD) cameras to monitor bird activities during these critical periods.

- Study was lead by Colleen St. Clair (U of A), with Sarina Loots (MSc Student with U of A)
- Cameras were installed at process-affected ponds and compensation ponds at mining sites in 2011.
- Camera observations were compared to observation-based count methods by the U of A research team working at freshwater or compensation ponds

Pilot study (2012):
Currently, each of the oil sands mine operators uses a different type and / or configuration of radar with which to monitor bird activity in the vicinity of its lease site. Because of large and unmeasured variation in both hardware and software, it is impossible to use these data to compare migratory pressure across the region. This comparison was among the objectives for the Research on Avian Protection Project ordered by the court and it is necessary for any meaningful comparison of deterrent efficacy. To rectify this problem, a radar calibration tool will be developed in the 2012 season and migratory pressure throughout the region will be assessed with a single radar unit.

a. A mobile, independent, X-band radar will be moved to various sites in the oil sands region throughout spring and fall migration to monitor bird abundance. When possible, radar detections will be compared to observation-based and camera-based detections.
    i. After identifying participating operators, U of A researchers will schedule each operator into a rotation for access to areas near process-affected water ponds, where radar can capture bird movement around the ponds.
        1. Currently, U of A researchers have access to Shell Albian Sands Jackpine and Imperial Oil sites for this radar study.

b. The radar will operate and record radar feed using *radR*, which is an open-source software program developed by Phil Taylor and John Bruztowski (Acadia University) for the purpose of monitoring migrating birds with radar.
c. For a portion of each visit and as weather and operational conditions allow, migratory pressure will be measured simultaneously with radar, human observers, and automated cameras. Subsequent comparisons will provide measures of both sensitivity (i.e., false negatives) and specificity (i.e., false positives).
d. These data will be used to assess both challenges and opportunities for use of existing radar systems in the oil sands region as a means of monitoring migratory pressure through the region within and among sites and seasons. The single-season study is expected to support a methods-oriented publication in a peer-reviewed journal.

8. Training and Monitoring Tools

Competency and training are key elements of this monitoring program. To ensure that data are comparable across teams, sites, operators, and years, all bird monitoring teams must receive standardized training in:

1. Bird identification
2. Use of equipment, including electronic data recording devices
3. Use of protocols
4. Use/interpretation of monitoring forms

In 2011 standardized training modules were developed by Hatfield Consultants (Fort McMurray, AB) under the guidance of Joshua Martin (Suncor) and other oil sands operators. All operators were expecting that the training courses and modules will evolve over time to meet the changing needs of the monitoring program.

Standardized training planning for 2012 is ongoing as of February 3, 2012.

Suggested methods of training to be developed over time include:

1. Classroom-based training
2. Computer modules
3. Field-based training
4. On-site visits to insure proper implementation of protocols (see section 10)
5. Combination of
    i. comprehensive training for new staff
    ii. refresher courses for annual re-certification

8.1 Minimum training standards

Bird identification

Observers should be able to identify birds at risk of contact with process-affected waters.

Identification of the following guilds by **sight**:

- Waterfowl: swans, geese, and ducks ("dabblers" and "divers")
- Shorebirds: plovers and sandpipers
- Waders: herons and cranes
- Gulls and terns
- Other water birds: coots, grebes, loons, cormorants, pelicans

Species level identification

- All 9 federally listed Species at Risk (Table 6.1) by **sight and sound**
- 10 provincially listed "sensitive" species (shaded cells in Table 6.2) by **sight**
- Extensive group training and practice identifying birds using the drop down menus on electronic data recording devices and available bird identification books and electronic resources (iBird Pro on tablets)

Use of Equipment

Training on the proper use of the following

- Binoculars, spotting scope, and range finders
- Compass
- GPS
- Field guides
- Hand-held data recording devices
- Cameras/ video equipment for out-of-observation confirmation of species at risk

Use of Protocols

Training should cover bird observations protocols (5.1.2), with particular focus on overcoming challenges of observations beside process-affected ponds. Necessary training includes

1. Search/scanning techniques with scope/binoculars
2. Estimation of flock size, flight direction, and altitude
3. Use of datasheets
4. Use of hand-held data recording devices

Field-based, rather than classroom-based training will be essential to learn the protocols for Pond Inventories (5.1.2). Options for field-based training include:

1) Pre-season training - If the training course takes place in Fort McMurray, this could involve a couple hours down by the river to practice using binoculars, range finders and compass. Range finders will not work on individual birds on the water, so there should be some training to use range finders on river banks or other large objects and then estimation of distances to other smaller objects. This could be done as a group so that individuals can practice together and compare estimates.

2) During season training and calibration – If Hatfield (or other consultant group) is administering the pre-season training, they should also include some in-season training at mining sites. This could also be accomplished with site visits by Research Team or other qualified individuals (see section 10). This could include consultant representative to spend a day with each bird monitoring team to assure:

- suitable placement of survey stations
- competency in guild identification and flock size estimation
- proper use of protocols and datasheets
- accuracy in data recording (i.e. distance and angle measurements)
- consistency among monitoring teams and operators

Mid-season training and calibration was not done in 2011, except for one tailings facility at Shell Albian Sands Jackpine, and the Kearl Compensation pond of Imperial Oil, where U of A researchers could be applied as quality control.

This standardized calibration by external observers is planned for 2012 to be conducted by trained individuals at all operator sites, on a rotational basis throughout spring migration. In addition to providing a measure of inter-observer variation, these visits will provide opportunities for ongoing training in bird identification by everyone involved.

8.2 Training tools

The following is a list of tools that could be developed to facilitate training and in-the-field implementation of protocols

- Computer-based modules for training and refresher
- Field ID reference card for quick identification of guilds and Species At Risk
- Field guide of birds in northeastern Alberta which identify
  - Distinguishing migratory and resident breeding species
  - Identify birds most likely to land on process-affected water ponds
  - Identify relevant species at risk
- Field books for monitoring and identification of oiled birds. Beached bird survey programs in the USA and Canada have already developed books with photographs and measurements of oiled birds to assist with identification in the field. Some of these may be adapted for use in the oil sands region. Examples are available from the COASST program in Washington State (http://depts.washington.edu/coasst/what/vision.html) and the Bird Studies Canada program in Atlantic Canada (http://www.bsc-eoc.org/volunteer/acbeachbird/).

9. Data compilation, storage, and analysis

9.1 Data compilation and submission

In 2011, a standardized database (Microsoft Access) was developed for all operators to use. Each company established a process and resources/personnel to ensure complete data entry that complies with submission schedule.

This process will be streamlined in 2012 with the adoption of electronic data entry devices. The submitted electronic observation forms are instantly transmitted through the 3G network to a Google Spreadsheet accessible to the applicable operator and the U of A research team lab.

Submission schedule for 2012

1. Bird mortalities:
   - reported immediately to Alberta Sustainable Resource Development (ASRD)
2. Raw data:
   - Operators using electronic data entry devices and will not have to manually submit these spreadsheets because U of A will have access to them online.
   - In the light of unforeseen electronic data issues, database files will be submitted to Dr. St. Clair (U of A) within 5 working days of the end of each month
3. Pond characteristics
   - Digital maps of the ponds including tailings discharge points, booms to contain floating bitumen, location of all deterrent systems and the Pond Inventory sampling points for used in monitoring program
   - Submitted once per year to U of A, on or before April 15th (after initial setup).
4. Annual analysis and summary
   - Industry wide submission of Annual Bird Monitoring Report.
   - Submitted once per year to AENV, on or before February 15th.
   - The detailed contents of annual reporting will be developed between operators and regulators (ASRD and AEW). Suggested elements of annual report include:
     - Be prepared by the independent 3rd party data manager or designate
     - Provide an analysis and comparison of data at the pond level, site level and the regional level.
     - Provide estimates of total mortality and incidents.
     - Contain a spatial component, showing where deterrents, survey points etc. are located at each pond.
     - Identify ponds in need of greater deterrent effort and provide recommendations for increasing deterrent effort.
     - Provide an update on changes to the monitoring program, as per the adaptive management approach.
     - Be submitted digitally and in hardcopy.

NOTE: See *Appendix I* for summary of report on avian monitoring related to this monitoring plan and other licensing requirements

9.2 Data storage

Short-term

- During 2012, Dr. St. Clair will store all data provided by operators for the purpose of detailed descriptive analyses (see section 8.3)

Long-term

- Raw data and analyzed summary reports should be house somewhere in perpetuity.
- Suggested endpoint is a perennially and publicly-available (open-access), data-storage system.
    - One possible system is OSRIN (http://www.osrin.ualberta.ca/)
    - Another possible system is University of Alberta's ERA system.
        - Library-type system for electronic files that will be maintained in perpetuity.
        - Searchable archive, but there is no one maintaining it or querying it, so all datasets would need to have explicit metadata so they can stand alone.
        - Products of research and summary reports can also be archived here.

9.3 Data analysis

Consolidated data from all operators will be used to generate relative measures of bird activity, landings, and mortality among temporal (e.g., time of day, season, year), operational (e.g., observers, pond functions) and spatial variables (pond size and location). The 2011 annual report of the standardized monitoring program provides a starting point for these analyses, but refinements are expected in the coming years.

Data analysis and reporting should be conducted by a third party in the future. In the short-term, analyses are being conducted by researchers associated with Dr. C. C. St. Clair (U of A) and others associated with the court-ordered Research on Avian Protection Project. Ongoing collaboration and discussion will occur with Alberta Environment and Industry. Oil sands operators have agreed to provide resources to support this analysis. Initial analyses will include estimates of bird contacts and mortalities on PA and freshwater ponds. The data will also be made publicly available so that current and future researchers can expand analyses. The following list identifies some potential applications of the data.

1. Correction for declining detections over distance (i.e., Distance Sampling) could make it possible to estimate bird density on large ponds where it is not possible to observe the entire pond surface (comparable to Buckland et al. 2001).

Additionally, these analyses could identify differences among sites and observers in detection distances and reveal appropriate standards for detection radii.

2. The use of Generalized Linear Models would make it possible to compare landing (5.1) and mortality (5.2) rates among ponds or sections of ponds (either could be the unit of analysis) to identify the temporal, spatial, and operational correlates of bird contacts. Potential factors in such an analysis include:
    a. Pond size, shape, type and purpose
    b. Deterrent types, densities and deployment methods
    c. Distance from Athabasca River and other water bodies
    d. Pond isolation (distance from facilities and other ponds)
    e. Latitude (north-south)
    f. Time of day (relative to sunrise/sunset
    g. Season (spring, summer, fall)
3. Geographical Information Systems spatial analyses can be used to map locations and identify clusters of bird mortalities separately for systematic searches (5.2) and incidental reports (5.3). This may identify problem areas in need of greater deterrents and monitoring efforts.
4. Other analyses may explore the techniques developed by others for extrapolating the total number of oiled birds represented by oiled bird reports. A rich literature is emerging for both monitoring the presence of oiled birds on beaches and extrapolating this information to populations (e.g., Camphuysen and Heubeck 2001; Wiese and Ryan 2003; Wiese and Robertson 2004; O'Hara and Morgan 2006). These techniques could be adapted for use in the oil sands region to provide more accurate estimates of the total number of bird oilings that occur.

10. Auditing and QA/QC

The success of this monitoring program is dependent on systematic and comparable data collected across sites and years. This requires consistency in data collection among operators and staff. Some ways to ensure quality of monitoring methodology and standards across operators include:

1. Initial on-the-ground training by consultants with expertise and bird identification, observation, and the monitoring protocols
2. Rotation of visits by a qualified third party[3], which may include:
    a. Accompanying bird monitoring staff
    b. Providing in-the-field training of bird identification and use of protocols
    c. Conducting independent counts to validate data collected by monitoring staff
3. Site visits by Alberta Environment and Water and/or ASRD staff.

[3] This could be conducted by Dr. St. Clair's research team and/or other independent consultants.

    a. Ensure that the protocols defined here are being applied and that they are consistent in all programs for all oil sands mine operations.
4. Institution of ongoing and active evaluation by government of the deterrence and monitoring programs implemented by the industry.

Analyses of incident and similar reports provided to the government by operators can identify some inconsistencies in practice among operators, but should not replace periodic on-the-ground inspections. These inspections need not have a purely regulatory nature. Indeed, a collaborative approach between government and operators could guide the industry towards sustainable and adaptive management of avian populations in the mineable oil sands region.

Literature Cited

Berthold, P. (1993) *Bird Migration: A General Survey*. Oxford University Press, Oxford, UK.

Blokpoel, H. (1973) *Bird Migration Forecasts for Military Air Operations*. Occasional Paper No. 16. Canadian Wildlife Service, Ottawa, Canada.

Boag, D.A. and Lewin, V. (1980) Effectiveness of three waterfowl deterrents on natural and polluted ponds. *Journal of Wildlife Management* 44: 145-154.

Buckland S.T., Anderson D.R., Burnham K.P., Laake J.L., Borchers D.L., Thomas L. (2001) Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford

Camphuysen, C.J. and Heubeck, M. (2001) Marine oil pollution and beached bird surveys: the development of a sensitive monitoring instrument. *Environmental Pollution* 112: 443–461.

Elzinga, C.L., D.W. Salzer, J.W. Willoughby, and J.P. Gibbs (2001) Monitoring Plant and Animal Populations. Blackwell Science, Inc., Oxford, England. 660 pp.

Gulley, J.R. (1980) *Factors influencing the efficacy of human effigies in deterring waterfowl from polluted ponds*. Unpublished master's thesis, University of Alberta, Edmonton, Canada.

Hennan, E.G. and Munson, B. (1979) Species Distribution and Habitat Relationships of Waterfowl in Northeastern Alberta. AOSERP Report No. 81 for Alberta Oil Sands Environmental Research Program. Canadian Wildlife Service, Edmonton, AB, Canada.

McComb, B., B. Zuckerberg, D. Vesely, and C. Jordan (2010) Monitoring Animal Populations and Their Habitats: a Practitioner's Guide. CRC Press, Boca Raton, FL. 277 pp.

O'Hara, P.D. and Morgan, K.H. (2006) Do low rates of oiled carcass recovery in beached bird surveys indicate low rates of ship-source oil spills? *Marine Ornithology* 34: 133–140.

Richardson, W.J. and W.W.H. Gunn (1971) Radar observations of bird movements in east-central Alberta. *Studies of Bird Hazards to Aircraft* (ed. V.E.F. Solman), pp. 35–68. Report No. 14. Canadian Wildlife Service, Ottawa, Canada.

Ronconi, R.A. & St. Clair, C.C. (2006) Efficacy of radar-activated on-demand systems for deterring waterfowl from oil sands tailings ponds. *Journal of Applied Ecology* 43: 111-119.

Ronconi, R. A. (2006) Predicting bird oiling events at oil sans tailings ponds and assessing the importance of alternate water bodies for waterfowl: a preliminary assessment. *Canadian Field-Naturalist* 120: 1-9.

St Clair, C.C., Habib, T., Ball, J., Loots, S (2012) DRAFT *Regional Bird Monitoring Plan 2011 Annual Report*. Prepared for Alberta Environment and Water and mineable oil sands operators. Presented at regional bird monitoring meeting on January 18, 2012.

Shick, C. D. and D. R. Ambrock (1974) Waterfowl investigations in the Athabasca tar sands area. Canadian Wildlife Service.

Walters, C.J. (1986) Adaptive Management of Renewable Resources. MacMillan Publishing Company, Vancouver, BC. 374 pp.

Wiese, F. and Ryan, P. (2003) The extent of chronic marine oil pollution in southeastern Newfoundland waters assessed through beached bird surveys 1984–1999. *Marine Pollution Bulletin* 46: 1090–1101.

Wiese, F.K. and Robertson, G.J. (2004) Assessing seabird mortality from chronic oil discharges at sea. *Journal of Wildlife Management* 68: 627-638.

Yoccoz N.G., Nichols J.D. and Boulinier T. (2001) Monitoring of biological diversity in space and time. Trends in Ecology and Evolution 16: 446–453.

Yonge, K. S., M. L., Christiansen, H. P. Samoil, J. A. Smith, and T. Van Meer (1981) Syncrude bird surveillance program: A methodology for assessing bird activity and bird losses associated with the tailings pond. Prepared for Syncrude Canada, Ltd. Edmonton.

Yonge, K. S. and M. L. Christiansen (1979) A review of bird migration patterns and techniques for monitoring migration. Syncrude Canada, Ltd. Professional Paper 1981-2.

APPENDIX

Appendix I – Summary of reporting requirements

*Table A-1. Summary of reporting requirements related to bird monitoring outlined in this document and relating to pre-existing requirements and approval conditions. *ASRD Research and Collection Permits. **Section 9.1 of this document.*

By Whom	To Whom	What	When	Why
Individual Operators	ASRD	Mortality (species-at-risk only)	Immediately	License requirement*
Individual Operators	ASRD	injured wildlife	Immediately	License requirement*
Individual Operators	ASRD	all observations, including mortality	Monthly	License requirement*
Individual Operators	ASRD	Mortality data	Annually	License requirement*
Individual Operators	AEW	Incidents & Mortality data	Annually - April 15	EPEA approval condition
Individual Operators	Database manager (U of A)	Digital maps of ponds and deterrents	Annually - April 15	As per Bird Contact Monitoring Plan**
Individual Operators	Database manager (U of A)	database files	Monthly	As per Bird Contact Monitoring Plan**
Industry representative	AEW	Annual analysis and summary report	Annually - February 15	As per Bird Contact Monitoring Plan**

Appendix II - Equipment List

Each simultaneous crew will require the following equipment.

Pond Inventory

- Bird identification tools, e.g. field guides (see section 8.2)
- Binoculars (10x magnification)
- Range finder (may be integrated with binoculars)
- Tripod with ball head
- Spotting scope, at least 40 x power, higher is desirable
- Clip board with datasheets (as backup to electronic data collection device)
- Digital camera (to photo document where necessary)
- Compass (unless part of another device)
- One or more devices that can:

    - Record position with GPS
    - Provide date and time stamp
    - Provide a counter and timer
- Miscellaneous additional equipment such as portable waterproof casings for cameras, extra batteries or battery banks, extra memory cards for cameras

Mortality Search

- Boats, where necessary
- Binoculars
- Range finder
- Clip board with datasheets (as backup to electronic data collection device)
- Digital camera (to photo document where necessary)
- Gloves, bags, and labels for collection of dead birds
- Miscellaneous additional equipment such as portable waterproof casings for cameras, extra batteries or battery banks, extra memory cards for cameras

Instrument-based monitoring:

The following is a list of potential instrument-based equipment that will be tested in the field this summer. Dr. St. Clair's research group is working towards a comprehensive list

- Several Low-end HD Video cameras with zoom capacity (test at least two models); one video camera is needed per monitoring station (up to four of these for very large ponds; up to several dozen for operators with many large ponds)
- One higher end HD digital video camera to travel with each crew
- One boat-mountable HD digital video camera
- One high resolution automatic camera (to support spot counts)
- Software, apps, and data plans will also be needed for each electronic data storage unit
- Cameras will each require at least 3 high capacity digital cards
- All operators are encouraged to use radar to generate activity counts; a low cost, open source option is being developed.
- Height extensions if topography and pond size require them to achieve an effective vantage for observation

Appendix III - Datasheet List

Datasheets that accompany survey protocols are attached separately. These include the following:

- Avian Monitoring Program – Form 1: Pond Inventory
- Avian Monitoring Program – Form 2: Mortality Search
- Alberta Environment form for reporting "Avian Incidence"