WHITEFISH WORK PLAN

Environmental Assessment

Bruce A Units 3 & 4 Restart
Follow-up Program

August 2003

Bruce Power

WHITEFISH WORKPLAN
ENVIRONMENTAL ASSESSMENT
BRUCE A UNITS 3 & 4 RESTART
FOLLOW-UP PROGRAM

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BRUCE UNITS 3 & 4 RESTART
ENVIRONMENTAL ASSESSMENT FOLLOW UP PROGRAM

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1.0 INTRODUCTION

This document outlines the workplan for the Bruce A Restart EA follow-up monitoring for whitefish in Lake Huron and completes the overall EA Follow-up Program presented in *"Work Plans, Environmental Assessment, Bruce A Units 3 & 4 Restart Follow-up Program"*, published by Bruce Power in April 2003. The current workplan should be read in conjunction with the above referenced document, which provides the following information:

- The Canadian Nuclear Safety Commission's (CNSC's) decision on the environmental assessment (EA) conducted for the Bruce A Restart;
- The CNSC's requirement for a Follow-up Program, involvement of First Nations, public and stakeholders in developing the program, and inclusion of elements related to lake whitefish and the related fishery;
- The purpose and overall scope for the EA Follow-up Program;
- The First Nations, public and stakeholder involvement in the process of developing the EA Follow-up Program; and,
- Common workplan activities, including quality assurance and quality control, health and safety planning, and project management activities.

On March 5, 2003 a workshop was held to facilitate stakeholder consultation on the overall Bruce A Restart EA Follow-up Program. At this workshop it was decided that a second workshop would be held specifically to discuss follow-up monitoring for whitefish in Lake Huron.

At the second workshop (held March 12, 2003), the goals, objectives and methods for follow-up monitoring related specifically to Lake Huron whitefish were discussed. Workshop attendees agreed that the details of follow-up monitoring to verify the effects of Bruce A operations on local or lake-wide populations of whitefish would be developed by an *ad hoc* Technical Working Group (TWG). Representatives of the agencies/organizations attending the second workshop, and/or with a scientific or regulatory responsibility for the whitefish fishery in Lake Huron, were invited to participate in the TWG.

A terms of reference (TOR) was jointly developed for the TWG by the CNSC, Bruce Power and the Saugeen Ojibway (the Chippewas of Nawash and Chippewas of Saugeen First Nations, collectively). The TOR outlined the TWG's goals and objectives, as well as the steps and methods for their implementation (refer to Appendix A). The TOR also outlined deliverables, completion dates, and the participants for the TWG. The involvement of the TWG is described in more detail in the following Section.

2.0 INVOLVEMENT OF THE TECHNICAL WORKING GROUP

The TWG met on April 29 and 30, 2003 to develop a workplan specifically for EA follow-up monitoring of whitefish in Lake Huron. Participants of the TWG are listed in Appendix B. Notes of the meeting were subsequently circulated to workshop participants for comment. The current document details the workplan developed.

Five components of the overall EA Follow-up Program, as they relate to whitefish, were discussed by the TWG. These are outlined in Table 1 below. Whitefish workplan details are presented in the following Section.

Table 1. Follow-up Program Elements Discussed by the TWG and Resulting Whitefish Specific Work Plan Component Developed

Element Number in Overall EA Follow-up Program	Description	Whitefish Workplan Component and Section in this Document
2.2	Water Temperature – Occurrence and extent of thermal plume	Thermal Effects on Local Spawning Habitat (Section 3.3)
3.3	Aquatic Biota - Impingement	Impingement (Section 3.4)
3.4	Aquatic Biota - Entrainment	Entrainment (Section 3.5)
3.5	Aquatic Habitat and Biota - Reproductive success of whitefish and effects of the thermal plume (related to Element 2.2 above)	Thermal Effects on Local Spawning Habitat (Section 3.3)
7.1	Aboriginals - Entrainment, impingement and reproductive success of whitefish as it relates to the First Nations Fishery in Lake Huron	Thresholds for Decision Making (Section 3.1) and Population Discrimination Study (Section 3.2)

A draft version of the whitefish workplan was circulated to the TWG for review, and comments were incorporated into the workplan as appropriate. Summary comments received on the draft have been presented in Appendix C.

The next meeting of the TWG is scheduled for September 2004, following one year of follow-up monitoring.

3.0 AQUATIC ENVIRONMENT – WHITEFISH MONITORING

EA follow-up monitoring for whitefish consists of activities that will be conducted in the year following the restart of Bruce A Units 3 and 4. Restart is assumed to occur prior to the end of Summer 2003 (optimistically, the end of September is the earliest that both units would be operational). These activities include defining thresholds for decision making, and developing study programs for the assessment of thermal plume effects on spawning habitat and discrimination of whitefish populations in the waters adjacent to Bruce Power. Physical sampling activities include impingement and entrainment monitoring of whitefish at the Bruce A facility.

Once the above activities are complete, requirements for additional monitoring will be evaluated in the context of the availability of whitefish population models and the establishment of specific thresholds that constitute biological effect (i.e. adverse effects on the population). The workplan and evaluation of additional monitoring requirements will consider both round and lake whitefish and the relevance of the monitoring programs in the context of the whitefish fishery.

An annual follow-up monitoring report will be prepared and submitted to the CNSC. The report will then be made available to the public. Comments received on the monitoring report will be considered in monitoring conducted the proceeding year.

3.1 Thresholds for Decision Making

EA follow-up for whitefish will include definition of thresholds that correspond to effects on Lake Huron whitefish populations.

At present, little is known about the population structure of lake and round whitefish in Lake Huron. Acknowledging that a measured environmental effect may vary depending on the population scenarios (e.g. a local population may be more susceptible to effects than a regional or basin-wide population), the TWG decided that a better understanding of the population structure should be obtained. The TWG agreed that specific thresholds establishing what constitutes a biological effect in the context of population structure and size should be developed to fully understand the potential effect of Bruce A operations on whitefish and the whitefish fishery in Lake Huron. Establishing these thresholds will allow the level of effect to be quantified, and will aid in making decisions regarding mitigation measures and/or future monitoring.

Consequently, thresholds establishing biological effect levels will be developed once initial population models are available. Initial population models for both lake and round whitefish are being developed by the University of Guelph and the Saugeen Ojibway, and are expected to be available in early summer 2004. These models will provide the probabilities for various population hypotheses (i.e. that whitefish in the vicinity of the Bruce A site are part of a local,

regional, basin-wide or lake-wide population). Initial population models will be developed using existing information, including existing gross harvest data, catch per unit effort statistics, individual samples (sub-samples of the commercial catch) and some non-commercial assessment fishing. While the initial population models will establish preliminary probabilities associated with each of the hypothesized population scenarios (local, regional, basin-wide and lake-wide), it is acknowledged that these models will be iterative based on continued availability of input data. As such, the confidence in the probability of a population hypotheses will increase as additional data are made available to the models. An update on the development of initial population models will be presented in the 2004 EA follow-up monitoring report.

Based on the initial population models, thresholds establishing what is considered to constitute biological effect in the context of each of the population hypotheses will be defined. The TWG and selected expert advisors will meet before the end of September 2004 to discuss these thresholds. While this information will not be available for comparison against EA follow-up monitoring being conducted in 2003/2004, it will form the basis against which planned or potential future long-term monitoring will be developed and implemented. The future and on-going monitoring plans, where required, will be developed incorporating statistical methods including definition of the decision rules and acceptable decision error rates (e.g. Type I, Type II). The status of establishing thresholds for biological effect will also be discussed in the 2004 EA follow-up monitoring report.

The TWG also established a plan to provide input to the iterative population models over the duration of the population discrimination work (refer to Section 3.2 below). The population discrimination study will contribute a substantial amount of data to these models. Additional efforts will include the collection of tissue samples during the population discrimination study and impingement monitoring. These tissues will be stored for use in potential future genetics studies.

3.2 Population Discrimination

EA follow-up monitoring for whitefish will include development and initiation of a study parallel to and integrated with an existing research project to discriminate between local, regional, basin-wide and/or lake-wide populations of whitefish in the Main Basin of Lake Huron[1]. The implementation of Bruce Power's study will be conducted as part of Bruce Power's ongoing environmental monitoring program.

[1] Reference is made to the existing research project being conducted by the following partners: Saugeen Ojibway and Chippewa Ottawa Resource Authority; the Ontario Ministry of Natural Resources; the Ontario Commercial Fisheries' Association; and, the US Fish & Wildlife Service, Michigan Department of Natural Resources.

3.2.1 Scope of Work

An outline of a mark/recapture study to be developed as part of the EA follow-up was completed by the TWG. The study will provide additional data to assist in discerning the type of population(s) represented in the Main Basin of Lake Huron and input to the iterative process of developing population models for whitefish (refer to Section 3.1). The study will be complimentary to the existing research project referenced above.

The study to be implemented by Bruce Power will be initiated in Fall 2004, with the tagging and recapture conducted over a period of three years. It is anticipated that some level of recapture effort will also continue until 2010.

The mark/recapture study will incorporate tagging of 1000 lake whitefish and 500 round whitefish at each of the following sites:

- Two sites adjacent to Bruce Power; and,
- One reference site in the southern Main Basin[2].

While the sample sizes detailed above were not specifically selected through statistical power analysis, *post hoc* analysis will be conducted as part of the study. It is estimated that 10-15% recapture success on 1000 marked lake whitefish will adequately test the homing tendencies of whitefish adjacent to the Bruce A site. A threshold defining recapture success that will test for a local population of round whitefish will be established as part of the study. The study will identify the statistical methods, power and precision used to evaluate results, and rationale for setting these parameters will be presented.

The two sites adjacent to Bruce Power will include the areas around Loscombe Bank and off Gunn Point as they are considered to be suitable habitat for spawning whitefish[3]. Selection of the reference sites and implementation of the study plan will be done in cooperation with participating partners in the lake-wide research project to maximize consistency of methodologies and the value of data collected. The preferred approach is to conduct scientific or experimental fishing through the commercial fishing fleet and to make maximum use of the knowledge and experience of the fisherman.

[2]Reference data will also be obtained from the Fishing Islands, a site included as part of the existing project to be conducted by the partnership noted previously.

[3] Loscombe Bank and Gunn Point were identified as potential whitefish spawning sites based on the presence of ripe females and/or suitable substrate (Holmes, Pers. Comm. 2003). While there may be other areas that may also be spawning sites, this study will also provide data to test the hypothesis that the identified substrate is suitable for spawning and that spawning occurs at these locations.

A strategy to target whitefish during capture/recapture will be developed for those areas not heavily fished commercially. The targeted effort will be similar across all study sites to allow for specific comparison of capture data. Additional protocol, including strategies for targeting round whitefish and establishing a plan for recovery of tagged whitefish through impingement monitoring, will also be developed.

Nets (e.g. gillnets and/or trapnets) will be used for the capture/recapture. Detailed capture/recapture methodologies will be identified under the lake-wide research project. A fish finder will be used to delineate spawning aggregations as validation for net sampling. Captured whitefish will be marked with floy tags, and scale and tissue samples of both round and lake whitefish will be collected and archived during the process of mark/recapture efforts. Tissues will be stored for use in potential genetic population discrimination studies.

In the case of round whitefish, it was agreed that if a local population was deemed to exist then the effect of Bruce A operations on this species would be re-evaluated and follow-up monitoring specific to this species would be considered. If it is established that round whitefish are not part of a local population then no further evaluation of this species will be conducted beyond what is outlined in this workplan.

3.2.2 EA Follow-up Monitoring Deliverables, Schedule and Endpoint

The EA follow-up monitoring endpoint is represented by the development and initiation of the study to discern between whitefish populations in the waters adjacent to Bruce Power. An update on the status of the study, including the details for its implementation and the statistical methods to be applied to interpretation of results, will be presented in the 2004 EA follow-up monitoring report.

3.3 Thermal Effects on Local Spawning Habitat

EA follow-up monitoring will consist of the development and initiation of a study to monitor the effect of the Bruce A thermal plume on confirmed whitefish spawning habitat. The implementation of the study will be conducted as part of Bruce Power's ongoing environmental monitoring program (i.e. beyond the Bruce A Restart EA Follow-up Monitoring Program).

3.3.1 EA Effects Assessment and Predictions

The EA studies considered the effect of thermal plumes associated with the restart of Bruce A. Thermal plumes may alter the thermal environment of nearshore areas of Lake Huron in the Site,

Local and Regional Study Areas[4] around the Bruce A discharge channel. Such changes in thermal environment may effect spawning, embryo development, and larval growth and maturation of whitefish utilizing habitat in the areas affected by the thermal plume. Temperature changes are assumed to be most pronounced in shallow areas and sinking plumes may occur and affect thermal regimes at the substrate in some deeper areas. The EA predicted that sinking plumes are typically of short duration (e.g. hours to days) and occur primarily in February or March. The EA predicted that episodic thermal pulses in winter (i.e. thermal plumes) could exceed optimal temperature ranges for egg development, however, exceedence of optimal spawning temperature ranges under baseline conditions (i.e. natural environment events) were also predicted. The EA predicted that the area affected by the thermal plume is likely exposed in limited duration and frequency, is likely to be a small fraction of the available regional spawning habitat, and is not likely to adversely affect whitefish populations.[5]

3.3.2 Scope of Work

An outline of the study to be developed as part of the EA follow-up was completed by the TWG. The design of the study incorporates a stepped approach. The study will include determining the study areas and sampling locations for each study step, and establishing the specific thresholds that trigger the decision to proceed to subsequent steps. An outline of these steps is as follows:

- Step 1: Spawning condition surveys. Females collected from paired gillnets and trapnets will be evaluated for ripeness. Data collected will include catch per unit effort, total number of females collected, and number and percent of ripe females by species (round and lake whitefish);

- Step 2: If spawning condition females are found in sufficient number (i.e. based on decision criteria established as part of the study design), then embryo surveys will be conducted to assess whether ripe females deposited their eggs at spawning banks in the vicinity of the Bruce A Site (e.g. Loscombe Bank and Gunn Point). These surveys will be conducted through use of suction samplers deployed from the surface and utilizing a fine mesh filter apparatus to separate embryos from the water column. Embryo surveys will be conducted on a statistically designed grid; and,

- Step 3: If embryos are present in sufficient number within the study area (i.e. based on the decision criteria established as part of the study design) then temperature monitoring along the substrate of spawning areas will be conducted. This component of the study

[4] Aquatic habitat Study Areas are defined in the EA Study Report for the Bruce A Units 3 and 4 Restart. Thermal changes are most pronounced in the Site and Local Study Areas, with diminished effect in the Regional Study Area.
[5] The EA studies assumed that a regional population of whitefish was most likely.

will entail installation of temperature monitors on the substrate where embryos are found, and at control stations where similar environmental conditions occur (i.e. Gunn Point). The monitors will record the temperature at specified time intervals (e.g. hourly, daily, weekly, etc) over a certain time period to determine the duration and frequency of changes in temperature above ambient. Specific details of this study component will be developed if and when the program is implemented. At this point it will also be necessary to establish thresholds for biological effect. If necessary, additional study components to identify the specific biological effect of thermal change on developing whitefish embryos and larvae will be identified and developed.

The threshold established for a number of spawning condition females that trigger embryo sampling will be based on the output of population models (refer to Section 3.1), and will make use of principles in population biology (i.e. assumptions regarding the minimum number of reproductive animals necessary to maintain a local, regional, basin-wide or lake-wide population). Quantitative criteria will be developed to confirm the presence/absence of embryos (Step 2), and the temperature threshold for which additional studies would be considered (Step 3).

Steps 1 and 2 will be initiated in the Fall of 2004 and conducted over a period of three years (conducted in parallel with the population discrimination study described in Section 3.2). The schedule and duration for conducting temperature monitoring along the substrate of spawning areas (Step 3) will be developed if and when this step is implemented. A process to evaluate the effect of temperature change on whitefish embryo and larvae development will be established if temperature changes above the determined threshold are observed. Study design will also identify the statistical methods, power and precision used to evaluate results. Rationale for setting these parameters will be presented.

The decision process establishing the results that trigger proceeding to the next step is further summarized in Table 2 below.

Table 2. Decision Tree for Conducting Embryo Surveys and Program to Measure Temperature at Substrate

Implement Spawning Surveys (Step 1)	Results of Spawning Condition Surveys	Implement Embryo Surveys at Spawning Banks (Step 2)	Results of Embryo Surveys	Implement Measurement of Temperature at Substrate (Step 3)
Yes	Ripe females present in sufficient number	Yes	Embryos Present in sufficient number	Yes
Yes	Ripe females present in sufficient number	Yes	Embryos Not Present in sufficient number	No
Yes	Ripe females not present in sufficient number	No	N/A	No

Spatial extent of spawning condition and embryo surveys will be established through a number of different factors, including existing models of the area affected by the thermal plume, suitable habitat in which spawning condition females and embryos may be found[6], accessibility of the areas to sampling equipment, and the thresholds developed to trigger decisions between steps.

3.3.3 EA Follow-up Monitoring Deliverables, Schedule and Endpoint

The EA follow-up monitoring endpoint is represented by the development and initiation of a long-term monitoring program to assess the effect of thermal change on whitefish spawning habitat. An update on the status of study design and initiation will be provided in the 2004 EA follow-up monitoring report.

3.4 Impingement

EA follow-up monitoring for impingement of whitefish will initiate after the restart of Bruce A Units 3 and 4 and will assess the annual level of impingement from the associated increase in intake current velocities. Whitefish impingement data will be evaluated against records from historical operations, as characterized in the EA technical studies.

3.4.1 EA Effects Assessment and Predictions

The potential effect on whitefish populations caused by impingement on Condenser Cooling Water (CCW) intake screens was assessed in the EA technical studies. The EA predicted that although increased current velocities at the intake will likely increase the number of whitefish impinged over lay-up conditions, impingement is expected to be equal to or lower than historical operational rates, with no likely significant adverse effects on whitefish populations. Historically, the average annual impingement rate of coregonids (whitefish and ciscoe) was estimated to be equivalent to 100 adults per annum at Bruce A[7] (Balesic and Dunstall, 1992).

3.4.2 Scope of Work

Both round and lake whitefish will be evaluated as part of impingement monitoring. The specific objectives for this workplan include:

- Document the annual level of impingement of whitefish following the restart of Bruce A Units 3 and 4;

[6] The study areas for embryo surveys will include suitable substrates around Loscombe Bank and off Gunn Point as these areas are considered suitable habitat for spawning.
[7] Based on the period of 1979 to 1989.

- Compare annual (mean) levels of impingement to historical records and lay-up conditions;
- Qualitatively evaluate whether follow-up monitoring data supports the EA prediction that impingement will be similar to or lower than historical levels; and,
- Discuss the limitations of the assessment (i.e. the comparison of the data against historical records), evaluate the requirement for future monitoring and recommend improvements to design and data evaluation (e.g. to increase statistical rigour and facilitate effective comparison of data against the biological effect thresholds).

3.4.3 Sampling and Assessment

Sampling methodology will be consistent with impingement monitoring undertaken for the EA studies and as described for the overall EA Follow-up Program. Sampling schedule, techniques, assessment and deliverables specific to the follow-up monitoring for impingement of whitefish are presented below.

Sampling will be conducted for one year following the restart of Units 3 and 4 at the frequency outlined in Table 3.

Table 3. Schedule of Whitefish Impingement Monitoring Events for EA Follow-up Program

2003		2004	
Aug - Sept[8]	Oct - Dec	Jan - Apr	May - Jul
Bi-weekly	Weekly	Monthly	Bi-weekly
5 events	12 events	4 events	5 events

Bi-weekly sampling (one event conducted every two weeks) will occur during summer months when nearshore areas are suitable for inshore foraging. Sampling frequency will increase to one event per week during October to December 2003 to coincide with spawning season and the potential occurrence of adults in the vicinity of the Bruce A Site. Sampling will be conducted one event per month during January through April 2004 when nearshore zones are relatively hostile to most species due to weather induced turbulence and ice-scour. Sampling will be conducted either Tuesdays, Wednesdays or Thursdays with the day of the week selected randomly. The day prior to each sampling event, Bruce A operations staff will be contacted, informed of the sampling

[8] The date of initiation of sampling (and the number of sampling events) corresponds to and may be revised based on the date of restart.

schedule and asked to shut down the automatic screen wash cycle that washes the screens every 12 hours. Immediately prior to impingement sampling, a screen wash operator will be requested to manually run the wash, allowing an estimate of impingement over a 24 hour period. Based on the above schedule, a total of 26 post-restart sampling events will occur.

Impinged whitefish will be identified by species, number, weight, and length, and representative specimens will be photographed. Life phase (juvenile or adult) will be visually assessed and recorded for each identified specimen. Sex and life stage will also be identified via dissection for a subset of the sample. Total annual impingement by species (round and lake whitefish), and total annual impingement by life phase will be calculated. These data will be provided both as total weight and as total number of organisms (based on a combination of direct observation and calculation of average weight to number). Temporal trends in impingement and percent distribution of species and life-stages will be assessed. This information will be related to life history patterns and the occurrence of important environmental and/or operational events. The results of EA follow-up monitoring for impingement of whitefish will be compared against historical annual rates of impingement and qualitatively[9] interpreted to evaluate the relative level of effect, requirement for additional mitigation measures, and recommendations for future monitoring. Limitations of the assessment due to variability in historical sampling design and data will also be discussed.

Scale and Tissue Sampling

As part of the EA follow-up monitoring, scale and tissue samples will be collected from impinged whitefish and archived for use in potential future genetic population discrimination studies. Preliminary arrangements have been made for a biologist representing the Saugeen Ojibway to collect these data. Frequency and schedule for data collection will be arranged prior to initiation of field sampling.

Whitefish Intake Channel Residence-Time Study

The EA follow-up monitoring for impingement will include development of a study to evaluate the length of time whitefish spend in the CCW intake channel and forebay prior to being impinged. The study design will include the introduction of a known number of marked fish into the intake channel and forebay, and monitoring to assess the rate at which marked fish are impinged. The study design will consider the use of marked live and marked deceased fish to evaluate the role of other causes of mortality on impingement levels, and whether fish residing in

[9] Evaluation against historical records is considered qualitative due to the variation between current monitoring methods (i.e. fish identification conducted by qualified fisheries' biologists) versus historical monitoring methods (impinged fish identified to family or group by operations personnel) and the potential occurrence of episodic pulses of impingement.

the intake channel have the ability to avoid impingement. The study is expected to have a duration of up to one year. Specific scope and schedule for this study will be established prior to its implementation. Implementation will occur in parallel with the population discrimination study and will be conducted as part of a long-term monitoring program for Bruce A (i.e. beyond the Bruce A Restart EA Follow-up Monitoring Program).

3.4.4 EA Follow-up Monitoring Deliverables, Schedule and Endpoint

EA follow-up monitoring will be conducted for one year following restart as described previously. The results of the impingement monitoring, as well as a summary of tissue sampling activities, will be provided in the 2004 EA follow-up monitoring report. The report will also present an update on the progress toward initial population modelling, development of specific thresholds for biological effect, and the design of the residence-time study. Requirements for future impingement monitoring will be evaluated. Any recommendations for future impingement monitoring will consider scheduling, evaluation of statistical performance relative to biological effect thresholds (i.e. the identification of the statistical criteria to test whether results of monitoring are biologically different than the thresholds for effect), and improvements in methodology.

The 2004 EA follow-up monitoring report will be submitted after completion of the impingement monitoring. Acceptance of this report by the CNSC represents the endpoint for EA follow-up monitoring for impingement of whitefish.

3.5 Entrainment

EA follow-up monitoring for entrainment of whitefish will initiate after the restart of Bruce A Units 3 and 4 and will assess the annual level of entrainment from the associated increase in intake current velocities. Whitefish entrainment data will be evaluated against records from historical operations, as characterized in the EA technical studies.

3.5.1 EA Effects Assessment and Predictions

The potential effect on whitefish populations caused by entrainment in the CCW system was assessed in the EA technical studies. Potential overall effects associated with entrainment include removal of organisms from the natural population (i.e. they remain in the intake channel and forebay indefinitely), and thermal or mechanical effects from passage through the cooling system. The EA predicted that sensitive life stages are only present for short durations throughout the year, that the habitat in the vicinity of the Bruce A Site makes up a small fraction of regionally available whitefish spawning habitat, and subsequently, that the number of organisms available for entrainment is relatively low. As such, the EA predicted that although increased current

velocities at the intake structure and in the intake channel will likely increase the number of whitefish entrained over lay-up conditions, whitefish entrainment will be similar to or lower than historical operational rates, with no likely significant adverse effects on a hypothesized regional whitefish population.

3.5.2 Scope of Work

Both round and lake whitefish will be evaluated as part of entrainment monitoring. The specific objectives for this workplan include:

- Document the annual level of entrainment of whitefish following the restart of Bruce A Units 3 and 4;
- Compare annual (mean) levels of entrainment to historical records and lay-up conditions;
- Qualitatively evaluate whether the follow-up data supports the EA prediction that entrainment will be similar to or lower than historical levels; and,
- Discuss the limitations of the assessment (i.e. the comparison of the data against historical entrainment records), evaluate the requirement for future monitoring and recommend improvements to design and data evaluation (e.g. to increase statistical rigour and facilitate effective comparison of data against biological effect thresholds).

3.5.3 Sampling and Assessment

Sampling methodology will generally be consistent with entrainment monitoring undertaken for the EA studies and as described for the overall EA Follow-up Program. Sampling schedule, techniques, assessment and deliverables specific to follow-up monitoring for entrainment of whitefish are described below.

Sampling will be conducted for one year following the restart of Units 3 and 4 at the frequency outlined in Table 4.

Table 4. Schedule of Whitefish Entrainment Monitoring Events for EA Follow-up Program

2003		2004
Aug[10]	Nov - mid-Dec	Mar - July
Bi-weekly	Weekly	Weekly
1 event	6 events	22 events

[10] The date of initiation of sampling (and the number of sampling events) corresponds to and may be revised based on the date of restart.

Weekly sampling is designed to correspond with those periods when embryos are deposited (November through December 2003) and larvae are emerging (March through July 2004). Bi-weekly sampling (one event conducted every two weeks) will occur in August 2003 to sample late emergence and/or unexpected occurrence of larvae. No entrainment sampling will be conducted in September through October 2003, or January through February 2004. As much as possible, temporal variation in sampling schedules will be similar to those used during the EA and/or historical entrainment monitoring. Sample days will be selected randomly from within the week designated for sampling to facilitate extrapolation to an annual rate of entrainment. Based on the above schedule, a total of 29 post-restart sampling events will occur.

All captured specimens of entrained whitefish will be identified to species and life stage (typically larvae or embryos) and representative specimens will be photographed. Total length and egg diameter will be measured to the nearest 0.1 mm and each larval specimen will be categorized as recently dead or long dead based on the criteria identified for the overall EA Follow-up Program. Based on the sampling frequency outlined above, total annual entrainment by species (round and lake whitefish), and total annual entrainment by life phase will be estimated. These data will be provided as total number of organisms. Temporal trends in entrainment, and distribution by species and life-stages will be assessed. This information will be related to life history patterns and the occurrence of important environmental and/or operational events. Data will be extrapolated to daily and weekly entrainment rates of recently dead and long dead larvae and embryos of each species. Extrapolations of number of entrained embryos and larvae to theoretical number of adults will be made[11]. The results of EA follow-up monitoring for entrainment of whitefish will be compared against historical benchmarks and qualitatively interpreted to evaluate the relative level of effect. The limitations of the data analysis will be discussed, incorporating information about sampling variability between current and historical programs, and CCW entrainment survivability. Requirement for additional mitigation measures, and recommendations for future monitoring, including modifications to sampling design to improve the evaluation of effect will be presented.

This component of the workplan will also incorporate a review of pertinent literature outlining optimal pump sampling technique. Subsequently, minor modifications to the physical pump sampling technique outlined for the overall EA Follow-up Program may be implemented.

Expert Review and Advice

As part of the whitefish workplan, requirements for future entrainment monitoring will be evaluated. This evaluation will include reviewing information on estimation of conditional

[11] Extrapolation to number of adults will be made using general assumptions about reproductive success and survivability based on available literature. This information will limited by the availability of pertinent field studies on reproductive success and survival for whitefish.

mortality rate and source sampling in the context of population modelling and entrainment sampling. Expert review and advice will be solicited to facilitate the integration of these considerations into future monitoring design, including measuring variables such as (i) how many eggs/larvae are susceptible to entrainment (i.e. how many are available from the natural water column in the vicinity of the intake structure), (ii) how many eggs and/or larvae enter the intake forebay alive, and (iii) how may live eggs and/or larvae pass through the CCW. Expert review will be sought following collection of one year of post-restart entrainment data and will be incorporated into the evaluation of requirements and recommendations for future monitoring presented in the 2004 annual follow-up monitoring report.

3.5.4 EA Follow-up Monitoring Deliverables, Schedule and Endpoint

EA follow-up monitoring will be conducted for one year following restart as described previously. The results of entrainment monitoring, as well as an update on the progress toward initial population model estimates and development of thresholds that constitute a biological effect, will be provided in the 2004 EA follow-up monitoring report. Requirements for future entrainment monitoring will be evaluated. Any recommendations for future entrainment monitoring will consider scheduling, evaluation of statistical performance relative to biological effect thresholds (i.e. the identification of the statistical criteria to test whether results of monitoring are biologically different than the thresholds for effect) and improvements in methodology.

The 2004 EA follow-up monitoring report will be submitted after completion of the entrainment monitoring. Acceptance of this report by the CNSC represents the endpoint for EA follow-up monitoring of whitefish entrainment.

4.0 REFERENCES

Balesic, H. and T.G. Dunstall. 1992. *Ecology and biology of fish species in the vicinity of Bruce GS "B", 1979 to 1989*. Ont. Hydro. Res. Div. Report No. 92-350-K

Holmes, J. 2003. Email "*EA Follow-up Comments*" sent to Sara Lancaster of Golder Associates from John Holmes, July 10, 2003.

APPENDIX A

TERMS OF REFERENCE FOR TECHNICAL WORKING GROUP WHITEFISH MONITORING (APRIL 2003)

Follow-up Program – Bruce A Restart EA
Whitefish Monitoring

TERMS OF REFERENCE FOR TECHNICAL WORKING GROUP
(April 2003)

1.0 INTRODUCTION

The Bruce A Restart EA Follow-up Program involves monitoring to test the prediction of no likely significant adverse effects on round and lake whitefish in Lake Huron from the thermal plume and the water intake process associated with Bruce A operations. The goals, objectives and methods for monitoring related to potential effects on whitefish in the vicinity of Bruce A were extensively discussed at two Workshops on the Bruce A Restart EA Follow-up Program on March 5 and 12, 2003. Staff of the Canadian Nuclear Safety Commission (CNSC) agreed with the unanimous conclusion of the Workshops that the workplan related to follow-up monitoring of the effect of Bruce A operations on local or lake-wide populations of whitefish should be developed by an *ad hoc* Technical Working Group. The focus of the Technical Working Group will be to develop the components of the workplan for the following elements[1]:

Element Number	Description
2.2	Water Temperature – Occurrence and extent of thermal plume as it effects whitefish habitat
3.3	Aquatic Biota - Impingement of whitefish
3.4	Aquatic Biota - Entrainment of whitefish
3.5	Aquatic Habitat and Biota - Reproductive success of whitefish from the thermal plume (this element is related to Element 2.2)
7.1	Aboriginals - Entrainment, impingement and reproductive success of whitefish as it relates to the First Nations Fishery in Lake Huron

These Terms of Reference have been developed by the CNSC, Bruce Power and the Saugeen Ojibway (Chippewas of Nawash First Nation and Saugeen First Nation, collectively), taking comments from other participants at the Workshops (including federal and provincial agencies, the Sauguingue Métis Council, the Ontario Commercial Fisheries Association and other workshop participants) into consideration.

[1] As discussed at the March 5, 2003 workshop, workplans for some of the above elements (2.2, 3.3, and 3.4) have also been prepared to verify the predictions made in the EA regarding other VECs. These components of the workplans have already been finalized and the elements in the above table will be considered by the Technical Working Group only as they apply to Lake Huron whitefish.

2.0 GOALS AND OBJECTIVES

The Technical Working Group is responsible for developing a monitoring workplan which meets the requirements of the Follow-up Program for the Bruce A Restart EA as outlined in the CNSC October 2002 *Screening Report*, and the CNSC January 6, 2003 *Record of Proceedings, Including Reasons for Decision*, taking into account the general framework of Bruce Power's March 2003 Proposed Follow-up Program. Specifically, the Technical Working Group is responsible for:

1. Developing a scientifically defensible program to test the predictions made in the EA with respect to effects on Lake Huron whitefish from Bruce A operations;

2. Ensuring that the monitoring program in the vicinity of Bruce A is integrated, to the extent practicable and relevant, with research on whitefish already completed as part of the WINGS project and other whitefish research projects currently proposed in Lake Huron; and,

3. Recommending mechanisms to monitor, review and comment on follow-up monitoring results and decision analysis, and processes for dealing with recommendations and/or conclusions of the follow-up workplan.

3.0 STEPS AND METHODS

To implement the above goals, the Technical Working Group will undertake the following tasks:

1. Develop and agree upon the scientific method(s) to be employed in follow-up workplan design in terms of Lake Huron whitefish monitoring, and for establishing specific thresholds or criteria for decision making. The follow-up workplans should recognize the operating timeframe for the Bruce A reactors and the need for "measures of success" for specific program elements;
2. Review, and to the extent practicable and relevant, align the follow-up workplan with the WINGS recommendations; and,
3. Recommend specific elements and activities/schedules in the Bruce A Restart EA follow-up workplan to address hypotheses that will test the EA prediction of no likely significant adverse effects of Bruce A operations on round and lake whitefish in Lake Huron. These elements should define thresholds or criteria for future decision making, establish mechanisms to monitor, review and comment on follow-up monitoring results and decision analysis, and develop processes for dealing with recommendations and/or conclusions of the follow-up workplan.

The recommended Follow-up Program workplan should acknowledge and take into account, the importance of the fishery to First Nations (Element 7.1 - Aboriginals). The workplan should be used to verify the EA prediction of unlikely effects on the Aboriginal commercial and traditional fishery of Lake Huron.

4.0 PROPOSED MEMBERSHIP FOR THE TECHNICAL WORKING GROUP

The Technical Working Group will be scientific in focus and will comprise technical representatives from the organizations with a direct interest or responsibility in the potential effects of Bruce A on the Lake Huron whitefish. Every reasonable effort will be made by the CNSC staff, Bruce Power and the Saugeen Ojibway to ensure the participation of the identified organizations. The Technical Working Group will be chaired by CNSC staff. To facilitate implementation of a scientifically defensible workplan design and a quantitative basis for decision making thresholds, a statistician will participate as part of the Technical Working Group. Golder Associates Ltd. will provide the secretarial and organizational support for the Technical Working Group.

The following provides a listing of the organizations invited to provide Technical Representatives to participate in the Technical Working Group.

- Canadian Nuclear Safety Commission
- Bruce Power
- Saugeen Ojibway
- Fisheries and Oceans Canada
- Environment Canada
- Indian and Northern Affairs Canada
- Ontario Ministry of Natural Resources
- Ontario Ministry of Environment
- Members of The WINGS Core Group
    - Dr. John Holmes
    - Dr. David Noakes
    - Dr. Steve Crawford
    - Ontario Power Generation (Don Wismer)
    - Bruce Power (Jason Verburg)
- Kettle & Stoney Point First Nation
- Ontario Commercial Fisheries Association
- Sauguingue Métis Council
- Technical and Administrative Support
    - Statistician
    - Golder Associates Ltd.

Reasonable technical and administrative support costs will be paid by Bruce Power. Support costs for attending the two-day working session by Dr. John Holmes and Dr. David Noakes will also be provided by Bruce Power, as required. It is expected that other representatives will be responsible for their own costs related to participation on the Technical Working Group.

5.0 TIMELINES

The Technical Working Group will complete its activities in a timely manner, recognizing the need to implement follow-up monitoring once both Bruce A units are operational.

To meet this schedule, the following milestones are established for the Technical Working Group's activities and the resulting follow-up monitoring:

TASK	DELIVERABLE	COMPLETION DATE
Two Day Working Session to prepare draft follow-up workplan by: • Agreeing on the scientific methodology • Reviewing the WINGS recommendations • Integrating WINGS and other proposed research where practicable and relevant (Technical Working Group responsibility)	Draft Plan for Bruce A Restart EA follow-up workplan for whitefish monitoring including: • The scientific methods to be employed for the follow-up monitoring • Thresholds for decision making • Mechanisms to monitor, review and comment on follow-up monitoring results and decision analysis • Processes for dealing with recommendations and/or conclusions of the follow-up workplan	End April 2003
Review draft and finalize follow-up workplan (Technical Working Group responsibility)	Final Bruce A Restart EA follow-up workplan for whitefish monitoring	June 2003
Implement final Bruce A Restart EA follow-up workplan (Bruce Power responsibility)	Annual monitoring reports including decision analysis	Monitoring to commence Fall 2003
Accept results of program and report to public (CNSC responsibility)	Make annual monitoring reports available to the public	As determined by the CNSC

APPENDIX B

PARTICIPANTS OF THE TECHNICAL WORKING GROUP

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Steve Mihok (Chair)	Canadian Nuclear Safety Commission
Steve Munger	Canadian Nuclear Safety Commission
Steve Crawford	Chippewas of Nawash First Nation / WINGS
Councillor Paul Jones	Chippewas of Nawash First Nation
Tania Morais	Chippewas of Saugeen First Nation
Jim McLay	Saugingue Métis Council
John Holmes	Fisheries and Oceans Canada / WINGS
Lisa Fowler	Fisheries and Oceans Canada
Lloyd Mohr	Ontario Ministry of Natural Resources
Kevin Reid	Ontario Commercial Fisheries' Association
Don Wismer	Ontario Power Generation / WINGS
Ron Stager	SENES Consultants Limited
Bob Stepaniak	Bruce Power Inc.
Jason Verburg	Bruce Power Inc.
Terry Brown	Bruce Power Inc.
Dan McArthur	Bruce Power Inc.
Duncan Moffett	Golder Associates Ltd.
Sara Lancaster	Golder Associates Ltd.

*Councillor Brian Monague of Chippewas of Kettle and Stony Point also accepted his invitation to participate but was unable to attend the meeting.
**Environment Canada has indicated their intent to participate as a member of the Technical Working Group, but was not in attendance at the April 29-30 meeting.

APPENDIX C

TECHNICAL WORKING GROUP
COMMENTS ON THE DRAFT WHITEFISH WORKPLAN

Table C-1. Comments Provided by the Technical Working Group[1]

Reference in the Draft Whitefish Workplan	TWG Member	Comment	Disposition
Section 3.4.3 - paragraph 3	RS	I don't know what "with little to no temporal variation over a 24 hour period" means. Should the phrase be dropped?	'Little to no temporal variation' was removed from the text and the sampling schedule to be implemented as part of impingement monitoring (sampling over a 24 hour period on either Tuesdays, Wednesdays or Thursdays with the day of the week selected randomly) was included in Section 3.4.3.
Section 3.0 - paragraph 2	RS	"adverse effects on the population" might be tied in or related to the First Nations fisheries concern. I was under the impression that it was the lake-wide First Nations fishery that was of concern. The population discrimination work was needed because the same number of fish impinged from a local population may have different effects on the lake-wide fishery than the same number of fish impinged from a lake-wide population.	The following sentence has been added to Section 3.0. "The workplan and evaluation of additional monitoring requirements will consider both round and lake whitefish and the relevance of the monitoring programs in the context of the whitefish fishery."
Section 3.1 - paragraph 4	RS	Input over the period "2004 through to 2010" is discusse[d] but the rest of the document describes work in 2003 (potentially) or three years starting in 2004. It is not clear what the other work would include (I suspect that ongoing monitoring will provide the later information for the population studies).	Input to the iterative population models will be provided during the period for which the population discrimination study results are available. The population discrimination study to be implemented by Bruce Power will be initiated in Fall 2004, with the tagging and recapture conducted over a period of three years. It is anticipated that some level of recapture effort will also continue until 2010. The text of both Sections 3.1 and 3.2.1 have been revised to reflect this schedule.
Section 3.2.2 - paragraph 1	RS	[It was suggested that reference to "in the Main Basin of Lake Huron" be removed]. This is the first time Main Basin is introduced and the Plan C (no USFW funding) would not be able to characterize the entire Main Basin.	The Main Basin is referenced in the first paragraph of Section 3.2.1. No change to the text was made. Note that it has now been confirmed that Plan B will be implemented (and thus reference to Plan A or C as they were originally presented are no longer valid).

[1] Note: Some additional minor editorial (grammar, etc) were also provided by various reviewers but have not been presented in this table.

Section 3.3.2 - Table 3	RS	It might be useful to add a column with "Step 1, Step 2, Step 3" in the table to match text. Also the order in Table 3 would be reversed (e.g. Step 1 at the top).	Step numbers have been labeled in the table as they are reflected in the text. Note that this is now Table 2 in the final Whitefish Workplan.
Section 3.4.1 - paragraph 1	RS	Isn't it the increase in current at the intake structure not the increase in current in the forebay that affects the impingement rate (the intake forebay current will affect residence time in the forebay not the eventual impingement)?	The text of the Whitefish Workplan has been revised to be consistent throughout the document, making reference to increase in flow at the intake, and the associated increase in flows in the CCW intake channel and forebay.
Section 3.4.1 - paragraph 1	RS	Would it be useful to use "historical operational rates" rather than "historical rates" to clarify that EA predictions are against historical rates (this might be useful throughout the report).	The Whitefish Workplan has been revised to reflect “historical operational rates”.
Section 3.4.3 - paragraph 6	RS	I understood that the collection efficacy study had to do with the flow sampler for entrainment rather than the impingement of adult fish. Relative to impingement I think a term such as "Forebay Residence Time Study" would be more applicable.	The title of the study has been changed to “Whitefish Intake Channel Residence-Time Study”
Section 3.4.3 - paragraph 6	RS	I must admit that I did not understand the importance of the study of how quickly a fish in the forebay becomes impinged since it was discussed that once an adult enters the forebay it is biologically dead and will eventually end up impinged. I guess there is some interest on how long this takes (the residence time) since this would be useful in the implementation [and] the frequency of the sampling events. The longer the residence time the more the impingement is "averaged out" and the less frequently impingement sampling is required to get the same precision.	Acknowledged.
Section 3.4.4 - paragraph 1	RS	Shouldn't "present an update on the progress toward initial population model estimates" be in Section 3.2 where populations are discussed?	Reference to presenting an update on progress toward initial population modeling was also presented in Section 3.1 which discusses thresholds for decision making and population modeling.
Section 3 (General)	JH	Is there a formal process in place for commenting on the 2004 EA follow-up monitoring report?	The annual follow-up monitoring report will be prepared and submitted to the CNSC. The report will then be made available to the public. Comments received on the monitoring report will be considered in monitoring conducted the proceeding year. This information has been provided in the last paragraph of Section 3.0 of the Whitefish Workplan.

Section 3.1	JH	An explicit discussion of statistical and ecological effects (the two are not necessarily the same) will be needed at some point and a clear statement of which type of effect we are trying [to] detect will be needed. In the best case scenario, these discussions will occur long before monitoring begins.	The statistical and ecological effects thresholds are to be discussed during the next meeting of the TWG (scheduled for September 2004). A sentence reflecting the time of the meeting has been added to Section 2.0 of the Whitefish Workplan.
Section 3.2.1 - Table 2	JH	Plan C, if it has to be initiated, will begin in the fall of 2003 (i.e., 3 months from now). Is current planning for the field work sufficiently advanced to accommodate this new work if needed?	As Plan B represents the scope of the study to be implemented by Bruce Power (based on the level of funding provided by the US Fish and Wildlife Restoration Program for the existing proposal), reference to Plan C are no longer valid. Subsequently, Table 2 has been removed from the Whitefish Workplan.
Section 3.2.1	JH	Loscombe Bank and Gunn Point were identified as potential lake whitefish spawning sites based on the presence of ripe females and suitable substrate (Loscombe Bank, Dec 2001) and CPUE data (Gunn Point, Nov 2000), respectively. The evidence supporting these identifications is weak. There are other areas that may also be spawning sites, at least based on substrate type, and that also may be at risk of warming because they located north of Bruce A along the shoreline (e.g., Scougall and Welsh Banks) but were not considered in the EA because they were beyond the bounds of a designated impact area with limited spatial scope. There is a high probability that round whitefish spawned at depths of 3- to 7 m in relatively open littoral areas around Douglas Point prior to the commissioning of the Bruce B NGS. Don Wismer estimated that a potential 234 ha of spawning habitat was available at depths of 3-7 m between Scott Point to the north and McRae Point to the south. This habitat estimate is based on knowledge of round whitefish spawning substrate preferences and the summing of the total bottom coverage of patches with >50% boulder-cobble and pebble-gravel composition from bottom substrate maps. Wismer strongly suspected that potential spawning habitat was available beyond the area adjacent to Douglas Point, especially to the north where preferred substrates and depths are known to be present. Essentially the proposed workplan is a test of the hypothesis that there is suitable substrate and that spawning occurs when substrate is suitable.	A footnote was added to Section 3.2.1 of the Whitefish Workplan indicating that Loscombe Bank and Gunn Point were identified as potential spawning sites for whitefish based on the presence of ripe females and/or suitable substrate.

Section 3.3.2 - paragraph 4	JH	Temperature thresholds for triggering additional studies. I strongly suggest you use Steve Griffiths work to develop temperature triggers: Griffiths, J.S. 1979. *Potential effects of unstable thermal discharges on incubation of lake whitefish eggs*. Ont. Hydro Res. Div. Rep. 79-521-K. Griffiths, J.S. 1980. *Potential effects of unstable thermal discharges on incubation of round whitefish eggs*. Ont. Hydro Res. Div. Rep. 80-140-K.	Acknowledged.
Section 3.4 (General)	JH	Impingement. Ideally, in order to evaluate the significance and population risk from impingement we need to know (1) population structure (local, regional, lake-wide), (2) what life stage and how many are impinged, and (3) what life stage(s) and how many were available in the lake for impingement. The studies in the workplan will provide data relevant to 1 and 2. How do we interpret this? Furthermore, experience at other GS in the Great Lakes demonstrates that whitefish impingement is episodic (at least in the literature that I reviewed for WINGS). This means that we can expect large confidence intervals around annual impingement estimates, both historical and recent. If there is substantial overlap in these confidence intervals, how will the "qualitative" comparison of historical and recent data be interpreted? I presume the intent is to compare some measure of central tendency (mean, median or mode). If there is a difference and the confidence intervals overlap substantially I don't think anything can be concluded except that the number from the most recent data is not the same as before. We cannot determine if it is higher or lower because we will not know how much of the variability in these numbers is biological (what we really need to know) and how much is experimental (related to sampling).	Acknowledged. Applicable text in Section 3.4.2 was revised to indicate that limitations of the assessment will be discussed and that a mean value will be used in comparing annual rates of impingement to historical rates.
Section 3.4.2 / 3.4.3	JH	Impinged fish should also be sexed. This will require opening the body cavity, which would be necessary for evaluating life stage. Furthermore, observers should watch out for jacks in the fall (precocious males).	Determination of sex will be completed for a sub-set of the sample collected during impingement monitoring. Section 3.4.3 has been revised to reflect this.
Section 3.4.2 - paragraph 1	JH	How will the historical benchmarks for whitefish impingement be established? Also, this implies more than a "qualitative" comparison.	The evaluation will compare mean annual rate of impingement. The applicable text of Section 3.4.2 was revised by adding 'mean' in brackets in the second bullet.

Section 3.4.3 - paragraph 3	JH	"Sampling will be conducted using a systematically stratified schedule, with events occurring during the period of Tuesday to Thursday with little to no temporal variation over a 24 hour period." Three questions: (1) What is a systematically stratified schedule? (2) What are the strata? (3) What does "…little to no temporal variation over a 24 hour period" mean? It seems to me that we discuss[ed] randomly choosing the day of the week (Tues, Wed or Thurs) on which sampling would occur before sampling began and then repeatedly sampling on that day for all sampling events. I suggest that time be used to stratify the sampling day. On[e] strategy is to divide the day into 8 hr blocks and then randomly choose which block to sample the week before the event. In the absence of randomization, extrapolation to an annual number will not be valid.	The sentence and paragraph in Section 3.4.3 was revised to reflect more specific sampling times and details. Based on comments from other reviewers sampling will be conducted on either a Tuesday, Wednesday or Thursday, with the day of the week chosen randomly to allow for extrapolation to an annual estimate. Samples will represent 24 hours of impingement (based on the timing of turning off the screen wash and collecting the sample).
Section 3.5 (General)	JH	Entrainment. Comparison of recent and historical data. The issue of variability in the data and interpretation of the comparison arises in this context as with the impingement data. I know of only studies, with restricted temporal scope (< 2 years total), that provide historical data on entrainment at Bruce A. Confidence intervals will be large and contain biological and sampling variability. How do we interpret the result of the comparison? To effectively assess the effect(s) of entrainment we need to know (1) population structure (local, regional, lake-wide), (2) how many eggs/larvae enter the intake forebay alive, (3) how many eggs/larvae are available in the lake near the intake, and (4) the survival of eggs/larvae that pass through the CCW (recent EPRI work suggests the assumption of 100% mortality may be incorrect).	The Whitefish Workplan indicates that limitations of the evaluation will be discussed, and that modifications to sample design or future monitoring will be considered (refer to Section 3.5.2). This comment will be considered when evaluating requirements for future entrainment monitoring and any recommendations for improved methodology.
Section 3.5.3	JH	Are criteria available for identifying eggs and larvae of different fish species commonly entrained and do you have them? Also, the intent is to extrapolate from sampling to produce an annual estimate of entrainment. This usually requires some sort of random or stratified random sampling design. I did not see such details in the workplan. Furthermore, the extrapolation will be from a small sample, say 30 m^3 to a very large sample, say 3×10^6 m^3, so expect large variability in your annual estimates.	The identification of eggs and larvae will be based on available literature and working manuals. The entrainment sampling methodology has been revised to incorporate random selection of sampling dates, parallel to impingement monitoring. This is now reflected in the text of Section 3.5.3.

Section 3.5.3	JH	There are very few field studies of reproductive success and survival of lake whitefish and none for round whitefish.	This information is acknowledged in a footnote in Section 3.5.3.
Section 3.5.4	JH	"Any recommendations for future entrainment monitoring … evaluation of statistical performance relative to biological effect thresholds….."]… I do not understand the last part of this statement.	Any recommendations for future entrainment monitoring will identify the statistical analyses that will be used to test whether the results of monitoring are different than the thresholds. Minor modifications have been made to clarify this sentence.
Section 3.1	DW	Will the Lake Huron whitefish population model that is being developed be useful for defining endpoints and thresholds (e.g. survival, growth, reproduction) as well as probabilities for various stock spatial types? The values for thresholds will vary depending upon life table-matrix model parameter values (fecundity, density dependence, juvenile mortality and duration of juvenile stage, adult mortality, spawning period duration, survival at different ages, recovery times from a stress versus generation time). These could vary by stock location and would vary by species (round versus lake whitefish). The threshold definitions need to linked to a population dynamics model. Example: Brown, et al 2003. *Predicting the effects of endocrine disrupting chemicals on fish populations.* Human and Ecological Risk Assessment 9(3):761-788. Shuter et al 1985. *An application of ecological modelling: Impact of thermal effluent on a smallmouth bass population.* TAFS 114(5):631-651.	The population models are to be developed by University of Guelph and The Saugeen Ojibway (also members of the TWG). Comments provided on the draft Whitefish Workplan will be appended to the final Whitefish Workplan and available to the TWG for discussion at the next meeting (scheduled for September 2004) to discuss thresholds for ecological effect. No change has been made to the text of the Whitefish Workplan.
Section 3.2	DW	How will we define a "local" population? What "a priori" criteria?	A threshold for recapture that would test for a local population which will be established as part of the study. This is reflected in Section 3.2.1. Hypotheses for different populations will also be based on the assumptions used in developing the initial and iterative population models.

Section 3.3.2 - Step 2	DW	Lascombe Bank and Gunn Point are potential spawning areas - there is no proof yet. Embryo surveys will be conducted...statistically designed grid and probabilistic decision criteria will be developed to confirm presence/absence....	Surveys will only be conducted if spawning condition females are found in sufficient numbers. Minor modifications have been made to Section 3.3.2 - Step 2 to clarify.
Section 3.3.2 - Step 3	DW	What is sufficient number of embryos given the (low) probability of capture? Should be decided before the surveys are done. There has been similar work done for lake trout on Lake Ontario and Lake Opeongo. There may be lessons learned on equipment and sampling design that could be used here to avoid repeating others mistakes. Fitzsimmons (1996) concerns with egg trap or tray collections even on a small spawning reef, also use of netting to find spawning locations. Egg/embryo collection in large lakes problematic (Gunn et al 1996). [Cited in Flavelle, L.S. et al. 2002. *Integration of acoustic telemetry and GIS to identify potential spwaning areas for lake trout.* Hydrobiologia 483:137-146]	Quantitative criteria will be developed to trigger proceeding steps prior to implementation. Minor edits have been made throughout Section 3.3.2. to clarify.
Section 3.3.2	DW	What is the schedule for spawning condition/embryo surveys?	Spawning condition and embryo surveys will be conducted parallel to the population discrimination study implemented by Bruce Power. Section 3.3.2 has been revised to include this information.
Section 3.4.2	DW	Impingement - The first two objectives require representative sampling and calculation of a statistic of variability (standard error). The 3rd objective is a comparison that should be statistical otherwise it will not be confirmatory only exploratory. The sampling program may be sufficient to test for incremental change in impingement from baseline values but it will not be sufficient to get a reliable estimate of annual impingement. Scientific literature guidance indicates a 30% sampling fraction (~100 days) are needed to generate reliable estimates of annual impingement. The sampling fraction here (n=26d) is less than 10%. All this means is that the estimates of annual impingement will have very large confidence intervals around them so the actual values could be anywhere within a large range. That may not matter if the range is small, it will depend upon the threshold for effect.	Impingement values will not be compared to effect thresholds until these have been determined based on population models (following the September 2004 meeting). For the first year following restart the TWG agreed to conduct a qualitative analysis, acknowledging that this analysis may not be amenable to statistical analysis. Future monitoring will consider additional information that can be collected to improve statistical comparison of data against biological effect thresholds (i.e. once population models are available).

Section 3.4.3 - paragraph 3	DW	Impingement - the sampling would be more representative if the actual sample day within the stratum (TWR) was selected randomly. What does "with little to no temporal variation over a 24hour period" mean? Add a few more sentences to explain.	'Little to no temporal variation' was removed from the text and the impingement sampling schedule to be implemented as part of the study (sampling over a 24 hour period on either Tuesdays, Wednesdays or Thursdays with the day of the week selected randomly) was subsequently described.
Section 3.5.3 paragraph 3	DW	Entrainment - random pick of sample days will allow extrapolation up to annual.	The entrainment sampling methodology has been revised to incorporate random sampling parallel to impingement monitoring.
Appendix A	DW	The thresholds for decision making are not expected [by the] end of April 2003 any more (September 2004?). If the purpose of this Appendix is to display the original TOR then it should have the date of the original TOR or else it should be updated to the current schedule.	The date of the original TOR is now reflected on the Appendix A cover page.
General	DW	The mechanisms to monitor, review and comment and process for dealing with recommendations are happening and may be sprinkled throughout the work plan but have not been explicitly listed together anywhere that I can remember. That might be helpful.	Section 2.0 summarizes the review of the draft Whitefish Workplan and indicates that the next meeting of the TWG will be in September 2004.
General		The minimum viable population size from conservation biology genetics I was trying to remember at the meeting is Ne=500 (Franklin, Soule 1980), others have recently said it should be Ne= 5000 (Lande 1995). The Ne is the number of individuals needed in a population to allow long-term persistence, minimize loss of fitness brought about by accumulation of deleterious mutation and retain genetic diversity. The actual census population size is higher, usually several fold. So a minimum population size for a local round whitefish population should be more than 5000 fish.	Acknowledged.
Section 3.0 - paragraph 1	SC	Is this date [of July 2003 for the anticipated restart of Bruce A] realistic?	The date in Section 3.0 has been revised to reflect the anticipated restart of Bruce A in late Summer 2003.
Section 3.1 - paragraph 2	SC	["Preliminary experimental or scientific fishing" in the context of developing the initial population models] should read "non-commercial assessment fishing".	The text has been revised to read "non-commercial assessment fishing".
Section 3.2 - paragraph 1	SC	[Does the long-term monitoring program in which the population discrimination study will be implemented include] just Bruce A? or A & B?	The text of the Whitefish Workplan has been revised to refer to "Bruce Power's ongoing environmental monitoring program" (i.e. the program is not specific to Bruce A).

Section 3.2.1 - paragraph 1	SC	[Reference to First Nations in the partnership for the existing proposal to the US Fish and Wildlife Restoration Program include the] Saugeen Ojibway & Chippewa Ottawa Resource Authority. Also, US Fish & Wildlife Service, Michigan Department of Natural Resources [is a partner in this study].	The text of the Whitefish Workplan specifically notes these partners (refer to footnotes in Section 3.2).
Section 3.2.1 - paragraph 1		[In reference to the sentence: "The specific design of the study will be contingent on the acceptance and level of funding provided to an existing proposal presented to the US Fish and Wildlife Restoration Program"] - This result is already known - see Lloyd Mohr (OMNR).	Acknowledged. Reference to Plan A and C have been removed from the text of the Whitefish Workplan, as Plan B (partial funding from the US Fish and Wildlife Restoration Program for the existing proposal) will be implemented.
Section 3.3.2 - last paragraph	SC	I don't understand what this ['conducting temperature monitoring at substrate] means.	Conducting temperature monitoring at substrate refers to Step 3 in the Thermal Effects on Local Spawning Habitat component of the Whitefish Workplan (refer to Section 3.3.2). "Step 3" has been added to this sentence in brackets to clarify.
Section 3.4.1 - paragraph 1	SC	Over what time period? [Reference is made to the average annual impingement rate of coregonids (whitefish and ciscoe) estimated to be equivalent to 100 adults per annum at Bruce A]. Reference needed here.	This estimate is based on the period of 1979 to 1989 as reported by Balesic and Dunstall, 1992. A footnote was added to Section 3.4.1 to reflect this information.
Section 3.5.1 - paragraph 1	SC	[The EA predicted…, no likely significant adverse effects] ..on a hypothesized regional whitefish population.	The applicable text in Section 3.5.1 has been revised to reflect "a hypothesized regional whitefish population".
Section 3.5.3 - paragraph 3	SC	What about diurnal effects? If these were not appropriately sampled during the EA or historical monitoring, then the protocol must be changed to account for diurnal effects.	The first year of monitoring will compare the mean annual rate of entrainment to historical levels, with quantitative evaluation of daily and weekly estimates. Based on the nature of the entrainment sample, various blocks of time over the day will be sampled.
Section 3.5.4	SC	Expert Review is a significant component of the whitefish workplan and requires a subsection of its own [which should also include:] - rationale (why the need) - method of review - deliverable - effect of review on future workplans	Acknowledged. The discussion of expert review has been moved to Section 3.5.3 under a sub-heading of its own.