

9.0 SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS

9.1 CONTEXT FOR DETERMINATION OF SIGNIFICANCE

The *CEAA* requires an assessment of the significance of the environmental effects that are likely to occur as a result of the project, having taken into account the implementation of the proposed mitigation measures. Such effects are called “residual effects”. All residual effects (adverse and positive) identified in earlier chapters have been advanced to this chapter for an assessment of significance.

In this chapter, residual adverse effects from the PNGS B Project are assessed for significance using the following broad criteria:

- **Magnitude** The size or degree of the effect compared against baseline conditions or thresholds.
- **Geographic Extent** The area over or throughout which the effects will be measurable.
- **Duration** The time period over which the effect will last.
- **Frequency or Probability** The rate of recurrence of the effect (or conditions causing the effect).
- **Reversibility** The degree to which the effect can be or will be reversed (typically measured by the time it will take to restore the environmental attribute or resource).
- **Physical Human Health** The degree to which the physical aspects of human health may be affected
- **Psycho-social Human Health** The degree to which psychological or social behaviour of the public may be affected
- **Ecological Importance** The importance of the environmental attribute or resource to ecosystem health and function.
- **Societal Value** The value of the environmental attribute or resource to society.

Tables 9.1-1 and 9.1-2 outline the specific measurement parameters used for the assessment of each of the biophysical environmental components and socioeconomic effects, respectively. Where possible, measurement values were selected to reflect criteria, guidelines or other published standards. In cases where published measurement values were not available, they were established using the professional judgment of the EA study team to reflect actual measurements of environmental impact. In general, the measurement ranges represent a typical ranking of low, medium or high (or variations).

**TABLE 9.1-1
GENERAL CRITERIA FOR DETERMINATION OF
SIGNIFICANCE OF RESIDUAL EFFECTS ON VECs (BIOPHYSICAL
ENVIRONMENT)**

Effects Criteria	Effects Level Definition		
	Low	Moderate	High
Magnitude of Effect	Effect exceeds baseline conditions; however, is less than reference criteria or guideline values.	Effect will likely exceed reference criteria or guideline values but has limited effect on VEC or pathway to VEC.	Effect will likely exceed reference criteria or guideline values and may cause an effect on VEC or pathway to VECs.
Spatial (Geographic) Extent of Effect	Site	Local	Regional
	Effect limited to Site Study Area or immediate surroundings.	Effect limited to Local Study Area.	Effect extends into the Regional Study Area.
Duration / Timing (of effect)	Short Term	Medium Term	Long Term
	Effect is limited to short-term events.	Effect is limited to operational and/or decommissioning project phases.	Effect extends beyond the decommissioning phase.
Frequency (or Probability) (of conditions causing effect)	Rarely	Occasionally	Often
	Conditions or phenomena causing the effect are unlikely to occur.	Conditions or phenomena causing the effect may occur on one or more occasions over the project life.	Conditions or phenomena causing the effect may occur at regular and frequent intervals.
Reversibility	Reversible	Moderately Reversible	Not Reversible
	Effect ceases once source/stressor is removed.	Effect persists for some time after source/stressor is removed.	Effect is not readily reversible.
Effect on Physical Human Health	Low	Moderate	High
	Effect exceeds baseline conditions; however, is less than reference criteria or guideline values.	Effect will likely exceed reference criteria or guideline values but has limited effect on human health or pathway to human health.	Effect will likely exceed reference criteria or guideline values and may cause an effect on human health or pathway to human health.
Effect on Psycho-Social Human Health	Low	Moderate	High
	Effect is not generally noticeable to the public.	Effect is somewhat noticeable, but not generally of concern to the public.	Effect is noticeable, and of concern to the public.
Ecological Importance (of VEC)	Limited Value	Moderate Value	High Value
	The VEC being affected is common and abundant within the Local Study Area.	The VEC being affected is less common and of limited abundance within the Local Study Area.	The VEC being affected is recognized as being a threatened or a rare or endangered species.
Societal Value (of VEC)	Limited Value	Moderate Value	High Value
	The VEC being affected is of limited value to people in the study area.	The VEC being affected is of moderate value to people in the study area.	The VEC being affected is of high value to people in the study area.

TABLE 9.1-2
CRITERIA FOR DETERMINATION OF SIGNIFICANCE OF RESIDUAL EFFECTS
ON SOCIO-ECONOMIC CONDITIONS

Effects Criteria	Effects Level Definition		
	Low	Moderate	High
Magnitude of Effect	Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Effect is clearly evident; however there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Effect is clearly evident and there is an anticipated adverse change in the economic base, social structure, community stability or the character of local communities.
Spatial (Geographic) Extent of Effect	Effect is likely to be noticeable to some individuals and/or neighbourhoods within the Local Study Area and/or will likely affect a limited number of community features (e.g., community facilities, businesses, schools, etc.).	Effect is likely to be widespread across the Local Study Area and/or affect a number of community features (e.g., community facilities, businesses, schools, etc.).	Effect is likely to be widespread across the Local and Regional Study Areas, including noticeable effects on community features outside the Local Study Area.
Duration / Timing (of effect)	Short Term Effect is only likely to be evident during the site preparation and refurbishment phase.	Medium Term Effect is likely to be evident during site preparation and refurbishment and the continued operations phase.	Long Term Effect extends beyond the continued operations phase.
Frequency (or Probability) (of conditions causing effect)	Rarely Conditions or phenomena causing the effect occur infrequently; or are effectively one-time events during the project phase in which they occur.	Occasionally Conditions or phenomena causing the effect occur at regular although infrequent intervals during the project phase in which they occur.	Often Conditions or phenomena causing the effect occur at regular and frequent intervals, or are ongoing conditions during the project phase in which they occur.
Reversibility	Reversible Adverse effects are manageable ¹ and reversible during the project phase within which they occur. Positive effects are evident only during the project phase in which they occur.	Moderately Reversible Adverse effects are manageable ¹ but may not be reversible during the project phase within which they occur. Positive effects are evident beyond the project phase within which they occur, but are not likely to be permanent.	Not Reversible Adverse effects are not readily manageable ¹ or reversible. Positive effects extend beyond the project phase within in which they occur and are likely to be permanent.
Effect on Physical Human Health	Low Effect exceeds baseline conditions; however, is less than reference criteria or guideline values.	Moderate Effect will likely exceed reference criteria or guideline values but has limited effect on human health or pathway to human health.	High Effect will likely exceed reference criteria or guideline values and may cause an effect on human health or pathway to human health.

Note: ¹. Manageable means that mitigation measures can be developed and applied, if required.

TABLE 9.1-2 (Cont'd)
CRITERIA FOR DETERMINATION OF SIGNIFICANCE OF RESIDUAL EFFECTS
ON SOCIO-ECONOMIC CONDITIONS

Effects Criteria	Effects Level Definition		
	Low	Moderate	High
Effect on Psycho-social Human Health	A small proportion of people in the Local and Regional Study Areas are likely to experience a change in their sense of health, safety and well-being. Few residents are likely to change their behaviours as a result of changed attitudes.	Changes in people's sense of health, safety and well-being and changes in people's attitudes are likely to be widespread across the Local and Regional Study Areas; however, only a few residents are likely to change their behaviours as a result of changed attitudes.	Changes in people's sense of health, safety and well-being and changes in people's behaviours are likely to be widespread across the Local and Regional Study Areas.
Societal Value (of VEC)	Limited Value	Moderate Value	High Value
	The VEC plays a limited and indirect role in maintaining the economic base, social structure, community stability, the character of local communities or people's sense of health, safety and well-being.	The VEC plays an important yet indirect role in maintaining the economic base, social structure, community stability, the character of local communities or people's sense of health, safety and well-being.	The VEC plays a highly important and direct role in maintaining the economic base, social structure, community stability, the character of local communities or people's sense of health, safety and well-being.

9.2 ASSESSMENT METHODOLOGY

The effects criteria described in Section 9.1 and Tables 9.1-1 and 9.1-2 are applied to any residual effects identified in Chapters 5.0, 7.0 and 8.0. The assessment methodology is used to determine the significance that can reasonably be assigned to each of the residual effects. It was recognized that certain effects criteria are more important than others and that importance is criteria-dependent. For this reason, numerical weights were not assigned to the individual criteria, nor was there an attempt to calculate significance levels mathematically. Instead, with consideration for the individual criteria levels in an appropriate balance, professional judgement was used in a structured (methodical) manner to assign the overall significance of the residual effect. Based on this assessment, one of the following significance levels was allocated to each residual effect:

- **Minor Adverse Effect:** The residual adverse effect is minor or insignificant.
- **Significant Adverse Effect:** The residual adverse effect is significant. Additional or more effective mitigation to reduce the impact of the effect is not considered possible.
- **Beneficial Effect:** The residual effect is considered an improvement to existing (baseline) conditions.

The overall assessment of significance is based on professional judgment recognizing that some of the criteria may have greater importance than others. For example, if an adverse effect were identified as having a high magnitude, regional extent and long-term duration, the residual adverse effect would be categorized as a significant adverse effect.

9.3 RESULTS OF SIGNIFICANCE DETERMINATION

Based on the results of the assessment of effects of the Project on the environment (Chapter 5.0), several residual effects were identified and advanced for determination of significance:

- Aquatic Environment – fish impingement;
- Hydrogeology - tritium in groundwater;
- Radiation and Radioactivity – collective dose to workers during refurbishment activities;
- Transportation – effects of traffic during refurbishment activities;
- Socio-Economic (adverse residual effects):
 - increased competition for construction labour;
 - reduced use and enjoyment of community and recreational features;
 - ad hoc or short-term increases in community service requirements; and,
 - reduced use and enjoyment of property.
- Socio-Economic (positive residual effects):
 - increased proportion of the population associated with or directly dependent on PNGS B related employment;
 - creation of new direct, indirect and induced employment opportunities and maintenance of existing jobs;
 - creation of new business activity;
 - increased attractiveness of the Region of Durham to leading-edge industry and research organizations involved in the energy sector; and,
 - improved financial status for the City of Pickering and the Region of Durham.

The evaluation of credible Malfunction and Accident scenarios in Chapter 7.0 identified one conventional accident (a transformer oil spill), one radiological accident (a spill of tritiated water to Lake Ontario), and three nuclear accidents which may result in exposure to the public. The cumulative effects assessment in Chapter 8.0 identified three adverse residual effects; namely, changes to regional labour market, reduced use and enjoyment of community and recreational features, and reduced use and enjoyment of property.

The evaluation of significance is presented in Sections 9.3.1 through 9.3.5 and summarized in Tables 9.3-1 through 9.3-5. Residual adverse biophysical effects during both phases of the Project are presented in Section 9.3.1 and Table 9.3-1 and include fish impingement, tritium in groundwater, radiation and radioactivity, and increased local traffic. Residual adverse socio-economic effects are presented in Section 9.3.2 and Table 9.3-2 and residual positive socio-economic effects are presented in Section 9.3.3 and Table 9.3-3. Section 9.3.4 and Table 9.3-4 present residual adverse biophysical effects related to malfunctions and accidents, and Table 9.3-5 summarizes the residual adverse cumulative effects related to socio-economics.

9.3.1 Biophysical Effects

9.3.1.1 Aquatic Environment

For the life of the Project, fish will continue to be impinged at the CW intake screens due to the operation of the turbine generator and auxilliary systems. As explained in Section 5.6.2, refurbishment of PNGS B will not increase the rate of fish impingement, although it will result in this existing effect being extended with continued operation of PNGS B. Valued fish species are infrequently impinged, with fewer than 50-150 individual fish removed from each VEC fish population each year due to the operation of PNGS B. The largest quantity of impinged fish are alewife (~85%) which are non-native forage fish and the most abundant fish in Lake Ontario. The immediate effect is limited to the Site Study Area. However, recruitment from the Regional and Local Study Areas will likely replace the impinged fish. This slight change in the abundant fish populations would not be measurable. Therefore, as outlined in Table 9.3-1, this was considered to be a minor adverse effect and is not significant.

9.3.1.2 Groundwater Quality

Tritium in groundwater near the IFB-B is an existing operational condition and there is a potential for this condition to continue for both phases of the Project. It is a maintenance and repair issue during normal operation of the auxilliary systems. It has been demonstrated that there is no adverse effect from tritium emissions in surface water. There are also no effects from groundwater tritium loadings associated with the overall surface water (Lake Ontario) radiological loading. Therefore, as outlined in Table 9.3-1, this was assessed to be a minor adverse effect that is not significant.

9.3.1.3 Radiation Environment

Collective dose to workers (NEWs) carrying out refurbishment activities will be higher than that associated with normal operations. Nonetheless, individual worker doses will continue to be

within regulatory limits. A range of ALARA mitigation measures, such as reduction of source term radiation fields, remote tooling, shielding, and primary system decontamination, is being considered to reduce worker dose during refurbishment activities. Specific measures to be implemented will be determined during the detailed engineering work. Therefore, as outlined in Table 9.3-1, this effect was considered to be minor and not significant, as all regulatory criteria will be adhered to.

9.3.1.4 Transportation

During the Refurbishment Phase, increased traffic congestion will likely occur at intersections near the PN site due, in part, to the additional traffic related to contractors working on the PN site. However, the predicted increase in traffic congestion is almost entirely a result of population growth in the Region of Durham, and not a direct result of the PNGS B Project. Also, the affected intersections are currently operating at capacity; hence, the additional traffic due to refurbishment activities is predicted to make conditions only marginally worse. Therefore, as outlined in Table 9.3-1, traffic effects related to the Project are considered minor and not significant.

9.3.2 Adverse Socio-Economic Effects

Changes to the regional labour market during the Refurbishment Phase is a “low magnitude” effect that will essentially be a one-time event that is likely manageable by labour market adjustments.

Reduced use and enjoyment of the Waterfront Trail during the Refurbishment Phase is considered a minor adverse effect because it is not likely to affect the majority of Trail users or residents.

Similarly, reduced use and enjoyment of property due to effects from increased traffic disruption along Sandy Beach Road was determined to be a minor adverse effect. The effect may be noticeable at residential locations along the traffic route during shift changes, particularly in the afternoon.

Additional involvement of local fire, police and related services (i.e. health and safety) during the Refurbishment Phase is also considered a minor adverse effect. Demands are likely to be infrequent and not likely to affect availability or quality of service to the community.

Therefore, as outlined in Tables 9.3-2 and 9.3-5, these minor adverse socio-economic effects are not considered to be significant.

9.3.3 Positive Socio-Economic Effects

The Project will result in direct and induced employment opportunities and maintenance of existing jobs. This has been assessed to be a minor positive effect.

Creation and/or maintenance of employment as well as continuing tax revenues to the City of Pickering from PNGS B has been assessed to be a minor positive effect. The increased tax revenues are minor in the context of overall tax revenue growth for the City of Pickering.

Therefore, as outlined in Table 9.3-3, these minor positive socio-economic effects are not considered to be significant.

9.3.4 Malfunctions and Accidents

Conventional Accident

In the event of a transformer fire, the deluge system would be activated; this could result in overtopping of the containment structure. The spilled transformer oil, along with the deluge water, would then be spilled to the ground surface and could ultimately enter Lake Ontario. The analysis of the bounding scenario indicated that in the short term, the local aquatic environment could be degraded, and fish near the point of discharge could be affected. The local water supply plants (e.g. Ajax WSP) would be able to treat any residual oil that entered the intake pipe; hence, no effect on human health would be expected. As outlined in Table 9.3-4, the effect of an oil spill is considered to be minor and not significant.

Radiological Accident

A break in the moderator D₂O transfer system during the operation of the PNGS B reactors, could result in a release of tritium to Lake Ontario. The analysis of the bounding scenario indicated that drinking water concentrations could exceed the Canadian and Provincial criteria for tritium in drinking water at the intake of a water supply plant (e.g. Ajax WSP). A maximum dose to an individual, assuming an ingestion of 2 L of water at the maximum predicted water concentration is well below the annual dose from background radiation exposure.

Also for this scenario, 72 Mg of moderator grade D₂O is assumed to be released to floor surfaces and available for evaporation. In addition, a conservative (four pump operation) discharge rate of 60 kg/s is also assumed. In this scenario, the maximum dose to a member of the public was estimated to be approximately 2.0 mSv (OPG 2005c), of the same order as the annual dose from

natural background radiation of 1.35 mSv (OPG 2006). There are no adverse effects expected to terrestrial biota from the atmospheric release associated with this radiological accident.

This scenario is based on very conservative assumptions that are unlikely to occur. The effect is considered to be minor and not significant.

Nuclear Accidents

Radiation exposure to members of the public from nuclear accidents is assessed for three postulated scenarios:

- EPRC8 – bounding waterborne release event was selected from the safety analysis involving fuel damage and chronic steam generator tube leakage, with release to the environment resulting from prolonged steam generator blowdown lasting up to three hours. This scenario results in a release of radiation to surface water.
- EPRC9 – a severe accident which is mitigated by the containment system. Radiation is released to the atmospheric environment through the filtered air discharge system for long-term controlled release.
- EPRC5 – a slow accident progression that results in late (>24 hours) releases from containment with potential for severe core damage in more than one unit (5A) or in a single unit (5B)

The probability of EPRC8 and 9 accident scenarios are well below the Siting Guide maximum frequency limits. Also, the maximum predicted individual dose for EPRC 8 and 9 is well below the Siting Guide maximum dose limits for design basis accidents. In addition, there is low probability of these events occurring. Therefore, they are considered to be not significant.

The EPRC5 accident scenario is based on very conservative assumptions and has a very low probability of occurring; thus, it is considered to be highly unlikely (i.e. not credible). It is important to note that the risk of such an accident would not change as a result of the PNGS B Project; that is, the risk is no different today than it would be following refurbishment (i.e. during continued operation).

The maximum predicted individual dose from an EPRC5 accident is well below the Siting Guide maximum dose limits for design basis accidents. The majority of the dose to the public is due to residual soil contamination, but on average this annual dose rate would be within the range of the dose from natural background radiation. The incremental risk of cancer from an EPRC5 event is extremely small and not detectable; that is, about 0.002% of the baseline cancer risk. Acute

doses to on-site non-human biota are expected to exceed reference dose rates, and may result in mortality of some individual biota on-site at the time of the initial release. However, no effects on local or regional populations of non-human biota are expected.

As noted above, the assessment of significance of an EPRC5-type nuclear accident with respect to physical health indicates only a moderate effect due to its short duration and a predicted low dose to individuals. If the Province were to order sheltering or an evacuation, these actions could affect the psychosocial health of some individuals, as noted in Section 7.3.4.5. Based on the results from extensive psychological studies regarding Three Mile Island, and the rigorous emergency planning in place for PNGS, it is likely that psychosocial effects from a nuclear incident at PNGS requiring an evacuation would abate over time for most of the local population. Nevertheless, the psychosocial health category has been ranked “High”. Adverse economic effects that may occur as a result of a temporary evacuation would vary widely depending on factors such as the time of the year, day of the week, duration and geographic extent of the evacuation, the extent and duration of the release initiating an evacuation, and the amount of remediation or cleanup (if any) required. As noted in Section 7.3.4.5, the enhanced reactor safety systems, detailed emergency response planning, and modern communication abilities between nuclear operators, regulators, the media and the public all lessen the potential effects from a nuclear accident and any protective action.

Based on the very low probability of an EPRC5-type event occurring, and all of the above-noted factors, an EPRC5 accident is assessed to have a minor adverse effect that is not significant.

9.3.5 Cumulative Effects

Increased changes to the regional labour market during the Refurbishment Phase is considered a minor adverse effect and not significant. It is a “low magnitude” effect that will essentially be a one-time event and is likely manageable by labour market adjustments.

Reduced use and enjoyment of the Waterfront Trail during the Refurbishment Phase is considered a minor adverse effect that is not significant because it is not likely to affect the majority of Trail users or residents.

Similarly, reduced use and enjoyment of property due to effects from increased traffic was determined to be a minor adverse effects that is not significant. The effect would only occur during shift changes during the Refurbishment Phase and is likely to be noticeable at only a few residential locations along the traffic route.

9.3.6 Summary of Significance Determination

Based on the foregoing analysis, taking into account the identified mitigation measures, no significant adverse residual effects would likely result from the works and activities associated with the refurbishment and continued operation of the PNGS B reactors.

9.3.7 Implications of Possible Future Project Design Modifications

During the course of any nuclear project, following the EA study and further engineering development work, it is not unusual for some aspects of a final project design (system design, facility layout, etc.) to differ in detail from the conceptual design used as a basis for the EA Study. However, for this Project, such differences are expected to be minor with no significant incremental adverse environmental consequences. There are two primary factors supporting this outlook:

- (1) the technologies to be used for the Project are well established, being based on directly applicable experience in reactor refurbishment, construction of storage structures, and operation of PNGS B.
- (2) the EA study was comprehensive in scope, being based on a sound conceptual design and including assessment of likely or potential effects associated with the proposed Project, using conservative assumptions and scenarios.

**TABLE 9.3-1
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B PROJECT – BIOPHYSICAL EFFECTS**

Environmental Component	Residual Environmental Effect	VEC Affected	Magnitude	Geographic Extent	Duration	Frequency /Probability	Reversibility	Effect on Physical Human Health	Effect on Psycho-Social Human Health	Ecological Importance	Societal Value	Significance of Residual Effect
Aquatic Environment – Fish Impingement	Continued fish impingement due to operation of turbine generator and auxiliary systems.	Round Whitefish, Lake Trout, Northern Pike, Walleye, Smallmouth Bass, Emerald Shiner, White Sucker.	Low Few VEC specimens entrained historically and/or during recent monitoring. The vast majority of impinged fish are non-native forage species (e.g. alewife) and no measurable effect on populations are expected.	Site Effect is generally limited to the Site Study Area. Recruitment from Regional and Local Study Areas would not be measurable due to the abundance of fish populations.	Medium-Term Effect limited to Refurbishment and Continued Operation Phases.	Often Minor effects will continue seasonally throughout the Refurbishment and Continued Operation Phases.	Moderate Effects will cease following Continued Operation Phase of the Project.	Low No direct physical effects on human health.	Low No effects on fishing and no visual, odour or other nuisance effects, therefore would not be noticeable to the public.	Limited Value Effect is limited to the Site Study Area and to a few VEC individuals removed from an abundant population.	Low Effect is limited to the Site Study Area. There is no commercial fishery in the area. Recreational fishery in the area for salmonids and walleye.	Minor Adverse Effect Not Significant. Effect is limited to the Site Study Area, and few VEC individuals will be removed from the fish population.
Groundwater Quality	Tritium in groundwater associated with maintenance and repair during normal operations of auxiliary systems.	Potential pathway to Member of the Public, and Aquatic and Terrestrial Environments.	Low Contribution of tritium-contaminated groundwater from PNGS A and B is a small fraction (approximately 5%) of routine tritium discharges from PNGS.	Site Effect is not detectable within the affected zone of Lake Ontario in the Site Study Area. There are approximately 200 groundwater monitoring wells on site to monitor tritium levels.	Medium Term Incremental change in baseline of on-site tritium-contaminated groundwater would persist beyond planned operational life of the plant due to the low groundwater flow rates (1×10^{-4} to 1×10^{-7} cm/sec) and tritium half-life (12.3 y).	Occasionally Effect is associated with infrequent malfunctions or spills.	Moderate Effect on Lake Ontario not fully reversible within the operational period, but is reversible after the operational period because tritium decays with time (12.3 y half-life).	Low Tritium in groundwater generally does not extend beyond the site; the groundwater contribution of tritium to Lake Ontario discharge is only approximately 5% of the total. The total discharge is well within regulatory limits. There is no measurable effect on drinking water.	Low Tritium in groundwater does not extend beyond the site; therefore, would not be noticeable to the public.	Limited Value The affected portion of the site and adjacent area of Lake Ontario is not a unique or rare ecosystem.	Moderate Value Resource has no provincial or local designation.	Minor Adverse Effect Not Significant. The radiological effect on the mean annual surface water tritium emissions to Lake Ontario are summarized in Section 4.6 and discussed in the Radiation and Radioactivity TSD, where it is demonstrated that there are no adverse effects from tritium emissions in surface water. Therefore, there are also no effects from groundwater tritium loadings associated with the overall surface water (Lake Ontario) radiological loading.

TABLE 9.3-1 (Cont'd)
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B PROJECT – BIOPHYSICAL EFFECTS

Environmental Component	Residual Environmental Effect	VEC Affected	Magnitude	Geographic Extent	Duration	Frequency /Probability	Reversibility	Effect on Physical Human Health	Effect on Psycho-Social Human Health	Ecological Importance	Societal Value	Significance of Residual Effect
Radiation Environment – Worker Doses During Refurbishment	Collective dose to workers carrying out refurbishment activities will be higher than that associated with existing operations. Individual worker doses will remain within regulatory dose limits.	Nuclear Energy Workers (NEWs)	Low Collective dose will be comparable to other major nuclear refurbishment projects, given dose rate and work scope variations. Limited effect on NEWs as individual doses will remain within regulatory dose limits and ALARA principles will be applied to reduce worker dose (both collective and individual).	Site Limited to Site Study Area.	Short Term Effects will be limited to the Refurbishment Phase.	Often Minor effect will continue throughout the Refurbishment Phase.	Reversible Increased collective dose will cease when major nuclear components have been replaced. Collective dose will return to baseline during continued operation.	Low Although collective dose will be higher than existing operations, individual worker doses will remain within regulatory dose limits. These limits are set at values that are protective of human health.	Low No anticipated change to radiation and radioactivity levels and should not be noticeable to the public.	Not Applicable	High Human health is highly important and plays a direct role in maintaining people's sense of health, safety and well-being.	Minor Adverse Effect Not Significant Effect is limited to the period of major nuclear component replacement. All applicable regulatory criteria will be met and ALARA principles will be applied to minimize worker dose.
Transportation	Increased local traffic due to increase in workers during refurbishment phase.	Members of the public; workers at the PN site.	Moderate Traffic volume may exceed traffic capacity and Level of Service may be degraded at some intersections.	Local Effect is limited to roads South of Hwy 401 between Brock Road and Sandy Beach Road	Medium Term Effects will continue throughout the Refurbishment Phase.	Often Minor effects will continue throughout the Refurbishment Phase.	Reversible Effects due to refurbishment traffic will cease once refurbishment activities are complete.	Low Slight increase to traffic that is already congested may slightly increase critical injuries.	Moderate The slight increase to already congested traffic may increase stress in driving.	Not Applicable	Moderate Traffic effects are of moderate importance to the local population.	Minor Adverse Effect Not Significant Marginal effects are limited to the immediate Local Study Area and are largely driven by increases in background traffic due to population growth, and not to the PNGS B Project per se.

TABLE 9.3-2
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B PROJECT – SOCIO-ECONOMIC EFFECTS

Environmental Component	Residual Environmental Effect	VEC Affected	Magnitude	Geographic Extent	Duration	Frequency/Probability	Reversibility	Physical Human Health	Psycho-social Human Health	Societal Value	Significance of Residual Effect
Socio-Economic Conditions	Change to Regional Labour Market.	Employment	Low Labour competition will be noticeable in selected trades within the construction industry; however, there is no anticipated adverse change in the economic base.	High Effect is likely to be widespread across the Local and Regional Study Areas and beyond.	Short Term Effect is only likely to be evident during the Refurbishment Phase.	Rarely Competition will be effectively be a one-time event at the commencement of the Site Preparation and Refurbishment Phase.	Reversible Adverse effects are manageable and can be reversed through labour market adjustments.	N/A Effect is not directly related to physical human health.	N/A Effect is not directly related to psycho-social human health.	High Value The VEC plays a highly important and direct role in maintaining the economic base.	Minor Adverse Effect Not Significant Low magnitude effect will effectively be a one-time event that is likely to be manageable by the labour market adjustments.
	Reduced Use and Enjoyment of Community and Recreational Features (i.e. Waterfront Trail).	Recreational and Community Features / Resource Use.	Low Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Low Effect is likely to be noticeable to a few Waterfront Trail users.	Medium Term Effect is only likely to be evident during the Refurbishment Phase.	Often Waterfront Trail users may be disrupted on a daily basis during shift changes.	Moderate Adverse effects are manageable but may not be reversible during the project phase within which they occur.	Low Accidents involving pedestrians (i.e. Trail users) considered unlikely.	Low A small proportion of the population are likely to experience a change in their sense of health, safety and well-being. Few residents are likely to change their behaviours as a result of changed attitudes.	Moderate Value The VEC plays an important yet indirect role in maintaining the character of local communities.	Minor Adverse Effect Not Significant Low magnitude effect that is not likely to affect majority of Waterfront Trail users or residents.
	Additional Involvement of Local Fire, Police and Related Services.	Health and Safety Facilities and Services.	Low Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Low Effect is likely to be noticeable to some community service workers.	Short Term Effect is only likely to be evident during the Refurbishment Phase.	Rarely Conditions or phenomena causing the effect to occur are infrequent.	Reversible Adverse effects are manageable and reversible.	Low The Project will place a high priority on safety. Workplace accidents that might affect service levels at local hospitals are not anticipated to be frequent.	Low A small proportion of the population are likely to experience a change in their sense of health, safety and well-being. Few residents are likely to change their behaviours as a result of changed attitudes.	High Value The VEC plays a highly important and direct role in maintaining people's sense of health, safety and well-being.	Minor Adverse Effect Not Significant Low magnitude and infrequent demands are not likely to affect availability or quality of service to community members.
	Reduced use and Enjoyment of Property.	Use and Enjoyment of Property.	Low Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Low Effect is likely to be noticeable at a few residential locations along Sandy Beach Road and/or the Local Study Area.	Medium Term Effect is only likely to be evident during the Refurbishment Phase.	Often Residents may be disrupted on a daily basis but only during shift changes.	Moderate Adverse effects are manageable but may not be reversible during the project phase within which they occur.	Low Increased noise and dust from traffic is not anticipated to exceed reference criteria or guideline values.	Low A small proportion of the population are likely to experience a change in their sense of health, safety and well-being. Few residents are likely to change their behaviours as a result of changed attitudes.	Moderate Value The VEC plays an important yet indirect role in maintaining people's sense of health, safety and well-being.	Minor Adverse Effect Not Significant Low magnitude effect that would occur only during shift changes.

**TABLE 9.3-3
SIGNIFICANCE OF RESIDUAL POSITIVE EFFECTS OF THE PNGS B PROJECT – SOCIO-ECONOMIC EFFECTS**

Environmental Component	Residual Environmental Effect	VEC Affected	Magnitude	Geographic Extent	Duration	Frequency/Probability	Reversibility	Physical Human Health	Psycho-social Human Health	Societal Value	Significance of Residual Effect
Socio-Economic Conditions	Increased Proportion of the Population associated with, or directly dependent on PNGS B related employment.	Population	Low Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	High Effect is likely to be widespread across the Local and Regional Study Areas.	Short Term Effect is only likely to be evident during the Refurbishment Phase.	Often Increase in population is an ongoing condition.	Reversible Positive effects are evident only during the project phase in which they occur.	N/A Effect is not directly related to physical human health.	N/A Effect is not directly related to psycho-social human health.	High Value The VEC plays a highly important and direct role in maintaining the economic base, social structure and community stability.	Minor Positive Effect Not Significant Low magnitude effect. Likelihood that effect will be realized depends on co-operative OPG and business community effort.
	Creation of new direct, indirect and induced employment opportunities and maintenance of existing jobs.	Employment	Moderate Effect is clearly evident.	High Effect is likely to be widespread across the Local and Regional Study Areas	Short Term Effect is only likely to be evident during the Refurbishment Phase.	Often Increased employment is an ongoing condition.	Reversible Positive effects are evident only during the project phase in which they occur.	N/A Effect is not directly related to physical human health.	Low New employment opportunities are likely to result in an increase in people's sense of health, safety and well-being for a small proportion of the population who gain project related employment.	High Value The VEC plays a highly important and direct role in maintaining the economic base, social structure and community stability.	Minor Positive Effect Not Significant Increased tax revenues are minor in context of overall tax revenue growth in the City of Pickering.
	Creation of new business activity.	Business Activity and Tourism	Moderate Effect is clearly evident.	High Effect is likely to be widespread across the Local and Regional Study Areas	Short Term Effect is only likely to be evident during the Refurbishment Phase.	Often Increased household spending is an ongoing condition.	Reversible Positive effects are evident only during the project phase in which they occur.	N/A Effect is not directly related to physical human health.	N/A Effect is not directly related to psycho-social human health.	High Value The VEC plays a highly important and direct role in maintaining the economic base.	Minor Positive Effect Not Significant Low magnitude effect. Likelihood that effect will be realized depends on co-operative OPG and business community effort.
	Increased Attractiveness of Durham Region to leading-edge industry and research organizations involved in the energy sector.	Employment Business Activity	Low Effect is evident only when compared to existing conditions.	High Effect is likely to be widespread across the Local and Regional Study Areas.	Moderate Effect is likely to be evident during Refurbishment and Continued Operation Phases.	Often Conditions or phenomena causing the effect are ongoing conditions.	Not Reversible Positive effects extend beyond the project phase within in which they occur and are likely to be permanent.	N/A Effect is not directly related to physical human health.	N/A Effect is not directly related to psycho-social human health.	High Value The VEC plays a highly important and direct role in maintaining the economic base.	Minor Positive Effect Not Significant Increased tax revenues are minor in context of overall tax revenue growth for the City of Pickering.
	Improved Financial Status.	Municipal Finance	Low Effect is evident only when compared to existing conditions and there is no anticipated adverse change in the economic base, social structure, community stability or the character of local communities.	Low Effect is only likely to be noticeable for the City of Pickering.	Moderate Effect is likely to be evident during the Continued Operation Phase.	Often Conditions are ongoing conditions during the project phase in which they occur.	Reversible Positive effects are evident only during the project phase in which they occur.	N/A Effect is not directly related to physical human health.	N/A Effect is not directly related to psycho-social human health.	High Value Tax revenues play a highly important and direct role in maintaining community stability.	Minor Positive Effect Not Significant Low magnitude effect.

**TABLE 9.3-4
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B PROJECT - MALFUNCTIONS AND ACCIDENTS**

Malfunction and Accident Scenario	Residual Environmental Effect	VEC Affected	Magnitude	Geographic Extent	Duration	Frequency /Probability	Reversibility	Effect on Physical Human Health	Effect on Psycho-Social Human Health	Ecological Importance	Societal Value	Significance of Residual Effect
Oil Release	Release of transformer oil due to a Main Output Transformer fire.	Fish VEC species in Lake Ontario; Members of the Public	High Fish near point of discharge would likely be affected. Members of the public unlikely to be affected.	Regional Effect could extend to water supply plants in Regional Study Area.	Short-Term Effect limited to within a few days of the release.	Rarely Postulated bounding malfunction and accident not expected to occur.	Moderate Effects will cease within a few days of the release.	Low Although a sheen on Lake Ontario may be visible, the Water Supply Plants would be able to treat any oil that entered the intake pipe. No effect on human health would be expected.	High A reportable spill of oil to Lake Ontario would be of concern to the local public.	Limited Value The potentially affected fish are common and abundant within the Local Study Area.	High Value Water supply is highly important and plays a direct role in maintaining people's sense of health, safety and well-being.	Minor Adverse Effect Not Significant. This scenario is based on very conservative assumptions that are unlikely to occur. No human health effects are predicted, and no lasting or population effects on VEC fish species are expected.
Moderator D₂O Release	Release of moderator water (D ₂ O): a) to surface water; b) to atmosphere.	Member of the Public through: a) Water Supply Plants; and b) through release to the atmosphere a+b) non-human biota	a) Moderate Drinking water criteria for tritium may be exceeded b) Low Dose to members of the public and biota may exceed baseline	a) Regional Effect could extend to Water Supply Plants in the Regional Study Area b) Local Effect limited to Local Study Area	a&b) Short-Term Effect limited to within a few hours of the release	a&b) Rarely Postulated bounding malfunction and accident not expected to occur.	a) Moderate Effects will cease within a few days of the release b) Reversible Effect will cease once source is removed	a) Low Though water quality criteria may be briefly exceeded, no effect on human health would be expected. b) Low No effect on human health would be expected.	a) High Reportable spill of tritium to Lake Ontario would be of concern to the local public. b) Low Effect not generally noticeable to the public.	a&b) Limited Value No effect to aquatic or terrestrial biota would be expected.	a&b) High Value Water supply and air quality is highly important and plays a direct role in maintaining people's sense of health, safety and well-being.	a&b) Minor Adverse Effect Not Significant. This scenario is based on very conservative assumptions that are unlikely to occur. A maximum dose to an individual is predicted to be well below the annual dose from background radiation exposure.

**TABLE 9.3-4 (Cont'd)
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B
PROJECT - MALFUNCTIONS AND ACCIDENTS**

Magnitude	Geographic Extent	Duration	Frequency /Probability	Reversibility	Effect on Physical Human Health	Effect on Psycho-Social Human Health	Ecological Impact
<p>Low Predicted individual dose is approximately equivalent to annual background dose, and below regulatory guideline values. Individual doses are below Health Canada and IAEA Guidance for sheltering, but within the range for consideration of sheltering specified by the Province of Ontario.</p> <p>Acute doses to non-human biota are expected to be less than Guidelines.</p>	<p>Regional Effect could extend across the Regional Study Area; however, doses drop off rapidly beyond the Site Study Area.</p>	<p>Short-Term Controlled atmospheric release over a one-month period through a filtered pathway. Waterborne release from steam generator blowdown over a three-hour period.</p>	<p>Rarely Postulated malfunction and accident not expected to occur.</p>	<p>Moderate Reversible Effects may persist beyond the release period.</p>	<p>Low Predicted individual dose is approximately equivalent to annual background dose, and is below regulatory guideline values.</p> <p>Individual doses are below Health Canada and IAEA Guidance for sheltering, but within the range for consideration of sheltering specified by the Province of Ontario.</p>	<p>High A release from a nuclear accident would be of concern to the local public. A requirement for sheltering could cause stress in some individuals.</p>	<p>Limited Acute doses to human biota are expected to be less than guideline values. No mortality is expected.</p> <p>The potential for affected biota (fish, invertebrates and mammals) at the site, birds near Turbine 1 are common and abundant. Site Study Area Local Study Area.</p>
<p>Moderate Predicted individual dose is approximately three times higher than annual dose from natural background radiation, but is below guideline values.</p> <p>Individual doses are below Health Canada and IAEA Guidance for sheltering, but within the range for consideration of sheltering specified by the Province of Ontario.</p> <p>Acute doses to non-human biota are expected to be less than Guidelines.</p>	<p>Regional Effect could extend across the Regional Study Area; however, the dose drops off rapidly beyond the Site Study Area.</p>	<p>Short-Term Controlled release over a one-month period through a filtered pathway.</p> <p>Waterborne releases are insignificant.</p>	<p>Rarely Postulated bounding malfunction and accident not expected to occur.</p>	<p>Moderately Reversible Effects may persist beyond the release period.</p>	<p>Low Predicted individual dose is approximately 3 times higher than background dose, but is below guideline values.</p> <p>Individual doses are below Health Canada and IAEA Guidance for sheltering, but within the range for consideration of sheltering specified by the Province of Ontario.</p>	<p>High A release from a nuclear accident would be of concern to the local public. A requirement for sheltering could cause stress in some individuals.</p>	<p>Limited Acute doses to human biota are expected to be less than guideline values. No mortality is expected.</p> <p>The potential for affected biota (plants, mammals, birds) near Turbine 1 are common and abundant. Site Study Area Local Study Area.</p>

TABLE 9.3-4 (Cont'd)
SIGNIFICANCE OF RESIDUAL ADVERSE EFFECTS OF THE PNGS B
PROJECT - MALFUNCTIONS AND ACCIDENTS

Magnitude	Geographic Extent	Duration	Frequency /Probability	Reversibility	Effect on Physical Human Health	Effect on Psycho-Social Human Health	Eco Imp
<p>ate ing no ve measures, m predicted al dose at 1 ng early accident is nately 15 opping to 4 mSv at 3 al dose in the ase exceeds Canada and uidance for ng, but is heir Guidance uation. r, this dose is he range for ration of on (within 3 cified by the e of Ontario. de of effect t increase rrent baseline n as a result roject. oses to on- -human biota he early f the accident cted to eference e guidelines. ortality of al biota on e expected.</p>	<p>Regional Some limited effect could extend across the Regional Study Area; however, the dose drops off rapidly beyond the Site Study Area</p>	<p>Short-Term Majority of dose is due to residual soil contamination. Some dose would continue to accumulate; however, on average the annual dose rate from soil contamination within 3 km would be within the range of the dose from natural background radiation within a short time frame</p>	<p>Rarely Postulated malfunction and accident is not considered credible using the CNSC criterion and is unlikely to occur.</p>	<p>Moderately Reversible Effects may persist beyond the release period.</p>	<p>Moderate The effect of the radiation exposure to the population within 100 km of the plant would be to slightly increase the expected numbers of fatal cancers. Regardless of whether such an accident occurred in 2007 or 2060, the incremental risk from cancer arising from the event is extremely small and not detectable, about 0.002% of the baseline cancer risk. Precautionary measures and mitigation such as monitoring and soil clean-up will minimize the effects.</p>	<p>High A release from a nuclear accident would be of concern to the local public. If sheltering or a temporary evacuation were to occur, some individuals would experience psychological stress. Also, the availability of emergency responders for other emergencies could be diminished during an evacuation, thereby affecting the physical and mental well- being of some individuals. An evacuation could cause adverse economic effects, such as temporary loss of business and lost wages, both during an evacuation and post- evacuation. The magnitude of the effects would be related to the extent and duration of the release as well as duration of the evacuation. On an individual level, there would be direct costs associated with evacuation (e.g. food, lodging) and lost wages. An evacuation could affect the social well-being of some individuals through temporary loss of use and enjoyment of property.</p>	<p>Limited Acute d site non- biota du phase of are expe exceed r dose-rat and som of indiv on site. expecte The pote affected biota (p mamma birds on Turbine are com abundan Site Stu Local S</p>

**TABLE 9.3-5
SIGNIFICANCE OF RESIDUAL ADVERSE CUMULATIVE EFFECTS OF THE
PNGS B PROJECT – SOCIO-ECONOMIC EFFECTS**

Magnitude	Geographic Extent	Duration	Frequency/Probability	Reversibility	Physical Human Health	Psycho-social Health
Competition will be evident; there is no net adverse effect on the economic vitality of local communities.	High Effect is likely to be widespread across the Local and Regional Study Areas and beyond.	Short Term Effect is only likely to be evident during part of the Refurbishment Phase.	Rarely Competition will be effectively be a one-time event at the commencement of the Refurbishment Phase.	Reversible Adverse effects are manageable and can be reversed through labour market adjustments	N/A Effect is not directly related to physical human health	N/A Effect is not directly related to psycho-social human health
Waterfront Trail in the vicinity of the site and the Trail will be clearly visible; however, there is no anticipated adverse effect on the social fabric or the character of the communities.	Low Effect is likely to be noticeable to a few Waterfront Trail users and Regional Study Area residents who change their attitudes as a result of the Project.	Medium Term Effect is likely to be evident during the Refurbishment Phase.	Often Waterfront Trail users may be disrupted on a daily basis during shift changes. Residents who think most frequently about the PN site are most likely to change their attitudes.	Moderate Adverse effects are manageable but may not be reversible during the project phase within which they occur.	Low Frequent accidents involving pedestrians (i.e. trail users) considered unlikely.	Low A small proportion of the population may experience a change in their sense of safety and well-being. Few residents are likely to change their behaviours or attitudes.
Increased noise is evident only in residential conditions.	Low Effect is likely to be noticeable at a few residential locations within the Local Study Area	Medium Term Effect is only likely to be evident during the Refurbishment Phase.	Often Residents who think most frequently about the PN site are most likely to change their attitudes.	Moderate Adverse effects are manageable but may not be reversible during the project phase within which they occur.	Low Increased noise from traffic is not anticipated to exceed reference criteria or guideline values.	Low A small proportion of the population may experience a change in their sense of safety and well-being. Few residents are likely to change their behaviours or attitudes.