INFORMATION COMPONENTS TO INFORM SECTION 73 OF THE *SPECIES AT RISK ACT* FOR REDSIDE DACE (*CLINOSTOMUS ELONGATUS*) AND SILVER SHINER (*NOTROPIS PHOTOGENIS*), AND REVIEW OF THE PROPOSED CUMULATIVE EFFECTS ASSESSMENT FRAMEWORK - ONTARIO HIGHWAY 413 PROJECT

1. Context

The Ministry of Transportation Ontario (MTO; the Proponent) is proposing to develop the Highway 413 Project (the Project), a highway located in the northwest Greater Toronto Area. The Project is anticipated to contain approximately 97 stream or watercourse crossings through the Credit River, Humber River, and Sixteen Mile Creek watersheds in the municipalities of Vaughan, Caledon, Brampton, and Halton Hills, Ontario. The Project area is within (but not limited to) traditional lands of the Huron-Wendat, Mississaugas of the Credit First Nation, and Williams Treaties First Nations. Approximately 20 of the proposed watercourse crossings are in, or upstream of, areas that contain Redside Dace (*Clinostomus elongatus*; *Species at Risk Act* [SARA] Schedule 1: Endangered) and/or Silver Shiner (*Notropis photogenis*; SARA Schedule 1: Threatened) based on Fisheries and Oceans Canada's (DFO) current understanding of the Project. The Project was originally subject to an Impact Assessment pursuant to the *Impact Assessment Act* (IAA)*;* however, following a judicial review, a Canada–Ontario Memorandum of Understanding (MOU) on the Assessment of Effects in Areas of Federal Jurisdiction of the Highway 413 Project was formed. Under this MOU, the Proponent must meet the requirements of any federal permits or authorizations pursuant to applicable laws, including the *Fisheries Act* (FA) and SARA.

Section 73 of SARA describes pre-conditions that must be met before an activity that affects a listed species can be authorized. Specifically, the Act indicates that:

- S.73(1) "*the competent minister may enter into an agreement with a person, or issue a permit to a person, authorizing the person to engage in an activity affecting a listed wildlife species, any part of its critical habitat or the residences of its individuals*" only if:

  - S.73(2)(c) "*affecting the species is incidental to carrying out the activity*";
  - S.73(3)(a) "*all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted*";
  - S.73(3)(b) "*all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals*"; and,
  - S.73(3)(c) "*the activity will not jeopardize the survival or recovery of the species*".

As part of the SARA permitting process, it is the proponent's responsibility to provide information to demonstrate that the pre-conditions of Section 73 have been met. To address pre-condition of S.73(3)(c), proponents are to "*describe any changes that the activity may cause to the listed wildlife species, its critical habitat or the residences of its individuals, the possible effects of those changes and the significance of those effects*" (Government of Canada 2021).

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Science advice has been requested by DFO's Fish and Fish Habitat Protection Program (FFHPP) and the Species at Risk Program (SARP) to describe the information to be submitted by the Proponent to demonstrate that the pre-conditions of Section 73(3) have been met for the Project as it relates to Redside Dace and Silver Shiner.

In addition, the Proponent provided a proposed cumulative effects assessment (CEA) framework (CEA Framework) in October 2023 (MTO 2023) as part of what was, at the time, Stage 2 of the Environmental Assessment for the Project. DFO Science has been asked to review the proposed CEA Framework with specific focus on the quality and adequacy of the contents of the framework. The CEA Framework is also relevant to the FA because before an Authorization under the FA can be issued, "*the cumulative effects of the carrying on of the work, undertaking or activity referred to in a recommendation or an exercise of power, in combination with other works, undertakings or activities that have been or are being carried on, on fish and fish habitat*" shall be considered (Section 34.1(1) d).

This Science Response Report addresses these requests in two sections - the information components of a jeopardy assessment (referred to herein as the Jeopardy Assessment Checklist) and a review of the proposed CEA Framework (referred to herein as the CEA Framework Review).

The objective of the Jeopardy Assessment Checklist section is to:

1. Identify the information components and known datasets that would support DFO's assessment of the federal SARA S.73(3) pre-conditions for Redside Dace and Silver Shiner for this Project.

The objectives of the CEA Framework Review are to:

1. Assess the quality and adequacy of the framework presented and determine if any relevant components within the steps outlined are missing or require modification.

2. Provide recommendations for additional components to assess cumulative effects on fish and fish habitat, including Redside Dace and Silver Shiner.

This Science Response Report results from the September 9-10, 2024, regional peer review on Information Components to Inform Section 73 of the *Species at Risk Act* for Redside Dace (*Clinostomus elongatus*) and Silver Shiner (*Notropis photogenis*) and Review of the Proposed Cumulative Effects Assessment Framework - Ontario Highway 413 Project.

2. Background

2.1. Jeopardy Assessment Checklist

For the Jeopardy Assessment Checklist (see Section 3.1), existing guidance is available to help proponents determine the information that is necessary to satisfy SARA permitting requirements (Government of Canada 2010, 2021).

Government of Canada (2010) provides questions that, when answered, ensure relevant information is provided by proponents to allow for an assessment of Section 73(3) pre-conditions. The questions are as follows (selected questions provided and shortened for brevity):

1. What are the current population trends?

2. Which project components could interact with the species?

3. Where is the species located within the project zone of influence?

4. Has a habitat map of the project area or zone of influence been developed?

5. What is the proportion of the population that uses the project study area?

6. Can the project affect potentially limiting intrinsic attributes of the species at risk?

7. Could the project components influence ecological processes and functions critical to the maintenance of habitats?

8. How will the project contribute to the threats to the species at risk that have been identified?

9. What are the pressures that are thought to be negatively affecting species at risk population viability, other than the project?

10. How would the project contribute to/affect these other pressures?

11. Are there other existing activities or projects, or likely future activities or projects, that will exacerbate the pressures?

12. How can the project influence recovery of the species at risk?

13. How many individuals may be affected?

14. What would be the overall effect on the local/regional/national population?

15. How long would the effect last? Is it reversible?

These questions provide a scientific basis to describe the relevant effects of an activity on SARA-listed species.

Government of Canada (2021) indicates that in addition to "*describing any changes that the activity may cause to the listed wildlife species, its critical habitat or the residences of its individuals, and possible effects of those changes and the significance of those effects*", the following information may also be used to make a determination of S.73:

1. Current status of the species, its habitat, and any broader ecological processes directly relevant to the species' survival or recovery.

2. Terms of any other federal, provincial, or territorial permits issued or being issued for the project.

3. Status and sensitivity of the ecosystem where the activity is taking place.

4. Cumulative effects of the proposed activity or other activities affecting the same species.

5. Tracking or monitoring systems in place to track the impact of the activity.

6. Potential effect to the species including life cycle of the species – temporal and spatial scale and capacity of the species to recover.

7. Timeline alignment with other tools such as recovery strategies and actions plans.

8. Reporting and monitoring conditions that allow for action based on monitoring results.

2.2. CEA Framework Review

The Proponent is committed to a CEA for the Project and a proposed CEA Framework was made publicly available (MTO 2023). Cumulative effects (CE) are the positive or negative effects of past, present or future human activities within a project study area on the environment

or to health, social or economic conditions (IAAC 2023). In addition, DFO defines CE as any cumulative harmful impacts on fish and fish habitat that are likely to result from the work, undertaking or activity in combination with other works, undertakings, or activities that have been or are being carried out (DFO 2019a). Consideration of CE on the environment requires understanding of the current state and natural processes within the system(s) being impacted and how different activities can alter those states and processes (Dubé et al. 2013, Noble et al. 2017). This understanding can be informed by scientific studies, environmental monitoring, planning, and local and Indigenous knowledge. Environmental monitoring conducted by DFO, other agencies (such as Toronto and Region Conservation Authority and Credit Valley Conservation), and academic institutions (such as University of Toronto at Scarborough) within the Highway 413 Project Route Planning Study Area can provide data relevant to the proposed CEA Framework. The Indigenous peoples whose traditional lands fall within the study area may also have knowledge to inform both of the assessments.

3. Analysis and Response

3.1. Jeopardy Assessment Checklist

This science advice provides additional detail in the form of a checklist of information components for the Project that would support an assessment of Section 73(3) based on a review of existing advice and scientific components that can inform a jeopardy assessment (DFO 2022a). While the identified information components inform a jeopardy assessment, they may also inform or support other permitting requirements. In situations where the recovery of listed species has been deemed to be feasible, as is the case for both Redside Dace (DFO 2024) and Silver Shiner (DFO 2022b), assessing S.73(3)(c) involves determining whether the project would jeopardize achieving the recovery objectives outlined in the federal recovery strategies.

For Redside Dace, the stated population and distribution objectives are:

- Long-term population objective: To ensure that all populations/sub-populations (both extant and historical) within the […Humber River, Credit River, Sixteen Mile Creek watersheds…] demonstrate signs of reproduction and recruitment, and are stable or increasing with low risk from known threats.

- Long-term distribution objective: To ensure the survival of self-sustaining populations/sub-populations within currently and, where feasible and warranted, historically occupied reaches in the […Humber River, Credit River, Sixteen Mile Creek watersheds…].

For Silver Shiner, the stated population and distribution objectives are:

- Population objective: To ensure populations in […Sixteen Mile Creek (and East Sixteen Mile Creek)…] demonstrate signs of reproduction and recruitment, and are stable or increasing, with low risk from known threats.

- Distribution objective: To maintain the species' current distribution and restore its distribution in historically occupied reaches, where feasible and warranted, in the following waterbodies: […Sixteen Mile Creek (including East Sixteen Mile Creek)…].

Therefore, the information components need to describe any changes that the Project may cause to Redside Dace and Silver Shiner (including changes to habitat, threats, and recovery

measures), the possible effects of those changes, and the significance of those effects as they relate to achieving the stated population and distribution objectives.

Based on the need to satisfy S.73(3) pre-conditions, a stepwise list of information components is provided that pertains specifically to the Project, as well as recommended approaches to achieve the components, and known data sources (Table 1). The second column of Table 1 describes the information components to be submitted by the Proponent to allow DFO to make a determination of S.73(3). The third column describes recommended approaches to ensure that the information component provides sufficient scope and detail to allow for a comprehensive assessment. The fourth column describes known data sources and references that the Proponent may use, but is not restricted to using, when assembling and compiling the information components. Additional information about the data sources is provided in Table 2. Undertaking the recommended approaches would require detailed analysis, with analytical decisions justified based on the scientific literature, including literature not included in Table 2. For example, additional literature is required to describe the potential environmental effects of highway construction, operation, and modification. For all steps in Table 1, a detailed description of the uncertainty, along with consideration of the consequences of the uncertainty, of each information component is necessary to ensure that the intended outcome of each step is achieved.

A selection of relevant data sources that may be used by the Proponent to provide information for each step in Table 1 are outlined in Table 2. Many data sources in Table 2 are held by external agencies, and DFO has not verified the quality or potential suitability of the data in relation to the information components identified in Table 1. Several data sources outlined in Table 2 are not publicly available and will require data sharing agreements between the Proponent and relevant data holders. References in DFO (2022b, 2024a) and additional scientific literature may also help to assemble the information components for each step in Table 1.

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Table 1. Stepwise list of information components, recommended approaches, and known data sources and references to inform the assessment of Section 73(3) for the Ontario Highway 413 Project.

Step	Information Component	Recommended Approach	Known Data Sources and References
1.	A description of the proposed project activities	A description of the spatial extent, duration, frequency, and overall timeline of project activities that have the potential to affect relevant watercourses, separated into the construction, operation, and modification phases (hereafter, project phases), including the estimated zone of influence (which requires consideration of all downstream and upstream aquatic habitats) for each affected watercourse during each phase. The post-construction phase should include all activities associated with the project operation following construction that have the potential to affect relevant watercourses, such as road salt application, the potential for contaminants or spill events into watercourses, and all other relevant highway operation and modification activities.	Materials supplied by proponent
2.	A description of the current (i.e., pre-construction) state of aquatic habitat in the affected watercourses	A description of the landscape-, meso-, and local-scale aquatic habitat features of the affected watercourses, within and beyond the zone of influence, per project phase. Pertinent variables include: catchment area and landcover, channel morphology (including pool-riffle sequences) and descriptions of the meander belt, wetted channel area, hydrology (surficial discharge through time; groundwater contribution, water velocity and depth), channel geometry (e.g., bankfull and low-flow channel width, bed level, water depth at time of survey, and bank profiles, to allow hydrodynamic and morphodynamic analyses and modelling), riparian and aquatic vegetation, water temperature, turbidity, dissolved oxygen, substrate, interruptions to aquatic connectivity, and the availability of aquatic and terrestrial prey items, described through continuous and spot-based measurements. For Redside Dace, the occurrence, spatial distribution, and abundance/relative abundance of nest-building Leuciscidae species is a key habitat attribute.	Materials supplied by proponent. Table 2 (items 1-17).

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Step	Information Component	Recommended Approach	Known Data Sources and References
3.	A description of the current state of the sub-populations/populations in the affected watercourses	A description of the spatial extent and trajectory (and abundance/relative abundance/density, if available) of Redside Dace and Silver Shiner in the affected watercourses, including the proportion of each population that is within the projected zone of influence, per project phase, per watercourse. A description of the degree of reproduction and recruitment (e.g., number and distribution of spawning locations, spawning success, year-class strength) of Redside Dace and Silver Shiner in the affected watercourses, including the proportion occurring in the project zone of influence. A description of current or best available vital rates of the populations in the affected watercourses (survival, reproduction, growth), as well as migration/movement, and whether these rates are assumed to differ within and beyond the zone of influence, per project phase. Any other information about Redside Dace and Silver Shiner populations to describe project effects, such as age structure, growth, diet, behaviour, and contaminant effects.	Materials supplied by proponent. Table 2 (items 10-13, 16-21).
4.	A description of threats and recovery measures that are contributing to the current state of the habitat and sub-populations/populations within the affected watersheds	A description of the threats influencing Redside Dace and Silver Shiner within the affected watercourses, including specific threats within and beyond the project's zone of influence in the affected watercourses. Relevant threats include those identified by COSEWIC (2011, 2017), DFO (2013, 2019b), and DFO (2022b, 2024a). The ecological consequences for each species and its habitat from each threat in the affected watercourses should be described. A description of the recovery measures influencing Redside Dace and Silver Shiner within the affected watercourses, including specific recovery measures within and beyond the project's zone of influence in the affected watercourses. Pertinent recovery measures include those contained in DFO (2022b, 2024a) and informed by the Ontario Redside Dace Implementation Team.	Materials supplied by proponent. Table 2 (items 12-19).

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Step	Information Component	Recommended Approach	Known Data Sources and References
5.	A description of the direct and indirect causal linkages about how the project activities (step 1) will lead to changes in the identified aquatic habitat (step 2), sub-populations/populations (step 3), and threats/recovery measures (step 4) within the affected watercourses	Descriptions of the likelihood, magnitude, frequency, duration, and overall timeline of the projected changes to aquatic habitat, threats/recovery measures, and sub-populations/populations, per project phase. A conceptual model presented as a flow chart is recommended to clearly describe the direct and indirect causal linkages. DFO's Pathways of Effects should be used to inform linkages between project activities and the changes in aquatic habitat variables. Habitat changes need to be linked to changes in vital rates (survival, reproduction, growth), as well as migration/movement, to allow projected changes in sub-populations/populations to be described. The effect of changes imposed by contaminants (if any) should be included in this step.	Materials supplied by proponent. Table 2 (items 16, 17, 22, 23).
6.	A description of how the project activities can be avoided.	A description of the established and defensible measures to avoid negative impacts to Redside Dace and Silver Shiner populations and habitat, including the effect of each avoidance measure on steps 1-5.	Materials supplied by proponent.
7.	A description of how the project activities can be mitigated.	A description of the established and defensible measures to mitigate negative impacts to Redside Dace and Silver Shiner populations and habitat, including the effect of each mitigation measure on steps 1-5.	Materials supplied by proponent.
8.	A description of how the project activities will lead to changes in the affected habitat and sub-populations/populations, and the significance of those effects as they relate to attaining the stated population and distribution objectives.	A description of how the sub-population/population vital rates will respond to habitat changes. A population model to quantify how the predicted changes in habitat, threats, recovery measures, and vital rates from step 5 lead to changes in the sub-populations/populations (trajectory, abundance) within and beyond the zone of influence after applying avoidance and mitigation measures (steps 6 and 7), including the timeline of impact and recovery. Include a description of the uncertainty of the population model, its input parameters, and the predicted model outputs. A description of the predicted change in reproduction/recruitment (e.g., change in number and distribution of spawning locations, spawning	Materials supplied by proponent. Table 2 (items 16-19, 22, 23).

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Step	Information Component	Recommended Approach	Known Data Sources and References
		success, year-class strength) within and beyond the zone of influence, per project phase.	
9.	If the project activities cannot be avoided or mitigated and offsetting measures are proposed, a description of the effect of potential offsetting measures	A description of the species-specific offsetting measures (spatial extent, magnitude, duration, frequency, timeline, and predicted effect on Redside Dace and Silver Shiner and their habitat) and their role and influence on steps 1-5. Due to the limited evidence of offset function for species at risk, a description of the uncertainty of offset function through time and how that uncertainty influences steps 1-5, including how the timing of implementation could influence the identified uncertainties. A comparison between the benefits projected from the offsetting measures and the residual project impacts and their effects on achieving the recovery objectives. This comparison should include identified uncertainties and risks associated with offsetting for species at risk.	Materials supplied by proponent. Table 2 (items 16, 17, 22, 26).
10.	A description of the monitoring systems that will be implemented to detect changes associated with steps 1-9.	A description of the proposed monitoring systems, including the ability to detect anticipated and unanticipated outcomes in steps 1-9, and the feasibility and effectiveness of stop-gap measures that would allow the effects to be mitigated.	Materials supplied by the proponent Table 2 (items 21, 24, 25, 27)

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Table 2. Description of known relevant data sources and references, including data holder, conditions of use, a description of the data source or reference, and link to metadata/location information.

Item	Data Source or Reference	Data Holder	Conditions	Description	Link
1	Flowing Waters Information System (FWIS)	FWIS	Available upon request through Data Sharing Agreement	Many data providers from varied projects (largely Ontario Stream Assessment Protocol monitoring data); includes fish community, benthic invertebrates, and habitat data.	Centre for Community Mapping (2024)
2	Aquatic Ecosystem Classification	Ontario Ministry of Natural Resources	Publicly available	These data are meant to provide a universal and consistent spatial framework for Ontario's flowing waters that captures the general ecological nature of streams and rivers. A science-based tool is provided that classifies rivers and streams based on their physical attributes (e.g., water temperature, channel gradient, shape and size) and watershed characteristics (e.g., upstream drainage area, land use).	MNR (2024)
3	Redside Dace habitat associations at landscape scale	DFO	Publicly available	The objectives of this study were to identify geophysical variables associated with the occurrence of Redside Dace across its geographic range in Canada and to determine if particular habitat features differed between sites with local extirpations and those presently supporting populations.	Lamothe et al. (2021)
4	Water Survey of Canada gauge station data	Environment and Climate Change Canada (ECCC)	Publicly available	Current and historical hydrometric data from established monitoring stations.	Government of Canada (2024a)

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
5	CVC fish community records	Credit Valley Conservation (CVC)	Publicly available	Fish community/species occurrence records in CVC jurisdiction.	Credit Valley Conservation (2022a) Credit Valley Conservation (2022b)
6	CVC Real-time monitoring network	CVC	Publicly available	11 real time stations in the Credit River watershed. Stations send information in real time on current environmental conditions (water quality and level, precipitation, climate) to better understand, predict, and warn about flooding, threats to water quality, and low water levels.	Credit Valley Conservation (2024)
7	CVC Integrated Watershed Monitoring Program	CVC	Available upon request through Data Sharing Agreement	92 active stream stations are monitored annually or bi-annually for fish, benthos, and habitat (rapid habitat assessment).	NA
8	TRCA Regional Watershed Monitoring Program	Toronto and Region Conservation Authority (TRCA)	Available upon request through Data Sharing Agreement	35+ fixed sites that are monitored every 3 years for fish and habitat. Only some fixed sites are spatially relevant for Redside Dace. Additional (~100) temperature loggers have been deployed throughout the watershed.	NA
9	CH fish community monitoring	Conservation Halton (CH)	Some available through FWIS, others available upon request through Data Sharing Agreement	Fish community sampling is conducted by watershed every other year on rotation. Species at risk data are typically restricted, depending on the purpose.	NA

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
10	Silver Shiner distribution and habitat use	DFO	Publicly available	Targeted sampling for Silver Shiner was conducted in four watersheds to better understand habitat use. An electivity index was used to compare occupied habitat to total available habitat.	Glass et al. (2016)
11	Biodiversity Science database	DFO	Data up to 2020 posted; more recent data available upon request	The Biodiversity Science Database is a compilation of fish community data from DFO Science surveys. Data includes: sampling site, date, fish counts, fish species, and associated habitat information. Data from 2003-2020 are available online. Data from 2021-2023 are available upon request. Includes detailed records for Silver Shiner (all populations) and Redside Dace (Lake Huron populations).	Government of Canada (2023)
12	Redside Dace COSEWIC assessment and status report	COSEWIC	Publicly available	COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. Status re-examined and assessed as Endangered in November 2017.	COSEWIC (2017)
13	Silver Shiner COSEWIC assessment and status report	COSEWIC	Publicly available	COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. Status re-examined and assessed as Threatened in May 2011.	COSEWIC (2011)
14	CVC land use change by catchment	CVC	Available upon request through Data Sharing Agreement	Assessment of land-use change over time by catchment that includes percent impervious land cover.	NA

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
15	TRCA Humber River land use change	TRCA	Publicly available	Assessment of land-use change over time that includes percent impervious land cover.	TRCA Open Data Portal (arcgis.com)
16	Redside Dace Recovery Potential Assessment	DFO	Publicly available	DFO Science advice related to biology, abundance, distribution, life history parameters, habitat requirements, threats and limiting factors, recovery targets, mitigations, and harm assessment. Includes a population model. Advice developed for informing listing decisions under SARA, development of recovery strategies/action plans, and permitting considerations. Information up to 2017.	DFO (2019b) van der Lee et al. (2019) Reid et al. (2019) Drake and Poesch (2020) Lebrun et al. (2020)
17	Silver Shiner Recovery Potential Assessment	DFO	Publicly available	DFO Science advice related to biology, abundance, distribution, life history parameters, habitat requirements, threats and limiting factors, recovery targets, mitigations, and harm assessment. Includes a population model; it should be noted that two different growth patterns were explored but subsequent research has supported the growth pattern associated with the shorter lifespan (Burbank et al. 2021, 2022). Advice developed for informing listing decisions under SARA, development of recovery strategies/action plans and permitting considerations. Information up to 2012 (life history information revised in 2021).	DFO (2013) Bouvier et al. (2013) Young and Koops (2013) Burbank et al. (2021) Burbank et al. (2022)
18	Redside Dace Recovery Strategy (federal)	DFO	Publicly available	This document was prepared to meet the SARA requirements of both a recovery strategy and an action plan. As such, it provides strategic direction for the recovery of the species, including the population and distribution objectives for the	DFO (2024a)

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
				species, as well as the more detailed recovery measures required to achieve the recovery objectives.	
19	Silver Shiner Recovery Strategy (federal)	DFO	Publicly available	This document was prepared to meet the SARA requirements of both a recovery strategy and an action plan. As such, it provides the strategic direction for the recovery of the species, including the population and distribution objectives for the species, as well as the more detailed recovery measures required to achieve the recovery objectives.	DFO (2022b)
20	Redside Dace occurrence database	DFO/other	Available upon request to DFO	Occurrence records of Redside Dace in Canada. Includes historical records, some Redside Dace specific projects, and records from SARA-permit data. Up to present day.	NA
21	Silver Shiner targeted sampling in Sixteen Mile Creek	DFO	Publicly available	A species-specific monitoring protocol was developed for adult Silver Shiner in Sixteen Mile Creek to act as a baseline for future comparisons. *A priori* habitat sampling was used to inform site selection for fish sampling based on a site depth-occupancy relationship developed for adult Silver Shiner. Fieldwork completed in 2022 and revisited in 2023 (forthcoming). White et al. (2024) describes targeted sampling for Silver Shiner in Sixteen Mile Creek from 2016-2018.	Lopez et al. (2024) White et al. (2024)

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
22	Jeopardy Assessment Framework	DFO	Publicly available	A science-based framework to evaluate activities that may affect a SARA-listed aquatic species, their critical habitat or residence that would help the department ensure that permitting or offsetting decisions around Section 73(3) are made in a rigorous, transparent, and nationally consistent manner.	DFO (2022a) Drake et al. (2022)
23	Revised Pathways of Effects in support of FFHPP risk assessment	DFO	Publicly available	Pathways of Effects (PoE) are used to link classes of activities in or near water to effects on fish or fish habitat they are likely to cause. PoE diagrams are intended to focus on the aspects of Works/Undertakings/Activities (WUAs) - pressures - endpoints that DFO manages. They are tools used to communicate potential negative impacts of WUAs on fish and fish habitat.	DFO (2024b) DFO (2021) Brownscombe & Smokorowski (2021)
24	Redside Dace Monitoring	DFO	Publicly available	Scientific advice on the design of a comprehensive long-term monitoring program for Redside Dace to inform recovery and management decisions. Includes consideration of sampling effort to detect Redside Dace.	DFO (2023) Lamothe et al. (2023)
25	Pool habitat availability for monitoring SARA-listed stream fishes	DFO	Publicly available	Quantitative information on the number, size, and spatial distribution of riverine habitat features are used to develop a framework based on statistical relationships for estimating habitat availability for pool-dwelling fish species that will help guide the design of future monitoring efforts and refine population-level recovery objectives. A worked example is provided for Redside Dace.	Lamothe et al. (2022)

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Item	Data Source or Reference	Data Holder	Conditions	Description	Link
26	Accounting for uncertainties and risks in offsetting	DFO/Other	Publicly available / behind paywall	Uncertainty exists in the measurement of harm, calculation of equivalency metrics, and offset efficacy. Time delays in delivery and functionality of offsets can produce inequalities. Dealing with these risks and uncertainties has been previously reviewed by Clarke and Bradford (2014). Bradford (2017) described a Monte Carlo simulation approach to determining offset ratios to account for uncertainty in the losses and gains from project impacts and offsets. This approach explicitly quantifies the uncertainty in impact estimates and offset efficacy. Bradford (2017) provides an example based on an 80% equivalency threshold (i.e., a 1 in 5 chance the offset does not adequately account for the impact); the ratios required to account for the risks were between 1.5:1 and 2.5:1. Higher equivalency thresholds (e.g., when the risk tolerance associated with the impact is lower) will result in higher offset ratios.	Clarke and Bradford (2014) Bradford (2017)
27	Operational guidance on functional monitoring	DFO	Publicly available	Science advice on standardized monitoring design and metrics appropriate for undertaking functional monitoring. Metrics are presented that represent surrogate(s) of fish productivity in marine and freshwater environments and could be used to assess the effectiveness of mitigation, offsetting, and restoration measures.	DFO (2019c)

The information components and recommended approaches described in this document will ensure that a thorough and complete assessment of the scope, scale, and ecological significance of the Project in relation to S.73(3) can occur. Compiling the information components does not guarantee that jeopardizing Redside Dace and Silver Shiner would be avoided because a full assessment of the potential for jeopardy is necessary. To facilitate collaboration between the Proponent and DFO on the assessment of effects from the Project and to ensure that the requirements of SARA are achieved, it is recommended that the Proponent provide the information components to DFO for stepwise review as follows:

1. The initial plan for assembling the information components outlined in Table 1 to inform S.73(3), including proposed data sources, methods, and analytical framework for steps 1-10.

2. The preliminary results of steps 1-8.

3. The preliminary results of steps 9-10.

4. The final information components in steps 1-10 to inform the Project review in relation to S. 73(3) pre-conditions.

3.2 CEA Framework Review

The Proponent has provided FFHPP with a proposed CEA Framework (MTO 2023) that has four overarching sections:

1. Purpose,

2. Background,

3. CEA Framework, and

4. Consultation and Engagement Program.

The CEA Framework (section 3) is broken down into a 5-step approach: Scoping, Analysis, Mitigation, Significance, and Follow-up. This review focuses on the CEA Framework and associated steps; however, higher-level comments have also been provided on sections 2 and 4. Broadly, the elements of the proposed CEA framework are based on guidance from the Impact Assessment Agency of Canada (IAAC), provincial documents, and past projects; however, there are opportunities to clarify content, elaborate on details, and consider additional recommendations for some elements.

3.2.1. Review of CEA Framework Background

Proponent's position

The Proponent reviewed background documents in order to "*develop a framework to assess potential cumulative effects of the Project*". These documents included various federal and provincial guidance documents, and examples from projects that have undergone federal assessment. A list of these documents is provided in Section 2.1 of the CEA Framework.

DFO Science's analysis and assessment

DFO Science notes that the CEA Framework is informed by various relevant IAAC guidelines, provincial documents, and past project assessments. One project that does not appear to be included in the table, but is potentially relevant, is "Project 4 - All-Season Road Connecting Berens River to Poplar River First Nation" and the documentation therein, particularly the

Environmental Assessment Report (CEAA 2017). DFO Science suggests that it would be beneficial for the Proponent to review and integrate information from this project because it involves the construction and operation of a 94.1 km all-season, two-lane gravel highway, and there are likely process elements and valued components (VCs) that could apply to the Project.

DFO Science's recommendations

- DFO Science recommends that the Proponent review the documentation for Project 4 – All-Season Road Connecting Berens River to Poplar River First Nation and incorporate relevant elements into their CEA Framework.

- DFO Science recommends that a Reference section be added listing all literature cited throughout the CEA Framework.

3.2.2 Review of CEA Framework 5-Step Approach: Step 1.1: Identifying Valued Components (VCs)

Proponent's position

For identifying VCs, the Proponent's general approach is to use a basic list of VCs (MTO 2023, Appendix A) and then review and refine this list using criteria from IAAC (IAAC 2018). In Appendix A, each VC is broken down into the main Factor (e.g., fishes and fish habitat) and Sub-Factors (e.g., fish habitat, fish community). The Proponent notes that "[*T*]*o ensure consistency throughout the Project, the factors and sub-factors previously used in the route alternatives assessment (Appendix A) will be considered as the initial list of VCs and will be reviewed and evaluated using the criteria recommended by IAAC in the Interim Technical Guidance: Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act, 2012, Draft Version 2 (IAAC, 2018)*". The criteria in Table 3.1 include "[*1*]. *Has residual environmental effects resulting from the potential environmental impacts, 2. Are highly valued by experts or by the public, stakeholders, and Indigenous communities…4. Are analyzable, based on reliable and adequate data, in terms of both the reference case and historical information.*"

"[F]or each of the VCs, the team will gather information on the VCs of particular relevance to the CEA through consulting with key stakeholders and the public (e.g., comments from the public, Indigenous communities, experts, government and nongovernmental organizations). To do so, the team will develop a registry of VCs that may have residual effects based on the results of the project-specific effects assessment."

Once those VCs are finalized, the Proponent will "[*d*]*evelop a registry of VCs that may have residual effects based on the results of the project-specific effects assessment*". The Proponent intends to gather "*information of specific interest to the CEA*" only for the VCs predicted to have residual effects. The Proponent lists 10 categories of sources that may contain relevant information (e.g., scientific literature, current legislation), with an initial list of data and information sources provided in Appendix B (MTO 2023).

DFO Science's analysis and assessment

The approach used by the Proponent to identify VCs is generally acceptable but difficult to evaluate without more detailed information for each Factor, Sub-Factor, and indicators for those Sub-Factors. The text suggests that the initial list of VCs will be evaluated against the criteria listed in Table 3.1 of the CEA Framework and after consultation with Indigenous communities, the public, and stakeholders. However, it is not clear from the text whether the VCs list will be modified after the planned consultations.

In Appendix A, it would be informative to provide a list and description of the specific indicators intended to be used for each Sub-Factor. Having appropriate, identified indicators is critical to evaluate current state and change(s). This information would provide clarity and allow readers to better evaluate whether it is possible to report on that VC and/or allow experts to provide alternative or additional indicators. For example, the Sub-Factor "*fish community*" does not provide further detail on the indicators that would be used to measure the community (e.g., species richness, abundance, indices of biotic integrity, or functional diversity). Explicit indicators and details for Sub-Factors are required because overly broad or inadequately described VCs may be incorrectly attributed and subsequently removed from the CEA, if deemed not to have residual effects.

Criterion 4 of Table 3.1 states that VCs will be selected if they are "[*a]nalyzable, based on reliable and adequate data, in terms of both the reference case and historical information*", but no details have been provided on how the reliability and adequacy of the data will be evaluated. More details are also required to describe how the reference case will be determined. There is also confusing language for the rationale provided for Criterion 4 that could be simplified to state that "analyzable data associated with measurable indicators provide a means to quantify residual effects resulting from project activities".

It would be beneficial to clarify language and intent regarding the inclusion of all VCs predicted to have residual effects versus the significance of the residual effects mentioned in Table 3.1. All VCs with residual effects should be included in the CEA Framework (IAAC 2018). Significance (as defined in Step 4 – Table 3.3) is evaluated for the cumulative effect rather than the significance of each residual effect. The criteria in Table 3.1 also apply to the indicators for the Sub-Factors and VCs rather than the VCs themselves, please clarify this wording.

For the process identified to compile relevant information for the VCs and associated Appendix B, there are two elements that DFO Science considers to be missing. First, although there is an initial list of categories that may have relevant information, including "*scientific and science-based literature*", "*scientific and monitoring datasets*" is not identified in this list and should be included. Second, Appendix B provides a sparse initial list of data and information sources; however, many open datasets are not listed and could be used to further populate the table prior to consultation and engagement, such as:

- [Ontario Geohub](#) (MNR 2024)

- [Open Science and Data Platform](#) (Government of Canada 2024b)

- [Great Lakes Data Stream](#) (DataStream 2024)

- [Conservation Ontario, CA data](#) (Conservation Ontario 2024a)

- [Environment and Climate Change Canada Data Catalogue](#) (ECCC 2024)

- [Watershed Report Card](#) (Conservation Ontario 2024b)

- An inventory of data related to fish, fish habitat, and stresses that could inform this CEA Framework in [Hodgson et al. (2022)](#).

Baseline studies are listed as a potential source of information for the VCs. It is not clear whether this information will be gathered from existing baseline studies or studies carried out by the Proponent.

Understanding what data are readily available prior to consultation and engagement, and presenting this information during discussions, may lead to more productive meetings as more time would be available to focus on gathering local information. The additional data and information sources identified through discussions can be added to Appendix B. DFO Science also notes that additional Acts relevant to some VCs, such as the *Clean Water Act*, should be included in Appendix B prior to consultation and engagement.

DFO Science's recommendations

- DFO Science recommends that the Proponent provide a description of the specific indicators for each Sub-Factor (and the additional Sub-Factors recommended) in Appendix A.

- DFO Science recommends that the initial list of VCs be updated after planned engagement and consultation with Indigenous communities, the public, and stakeholders.

- DFO Science recommends that the Proponent ensures that all relevant legislation for relevant VCs is correctly identified in Appendix B.

- DFO Science recommends that Appendix B be populated after a thorough review of the historical record and other reliable sources, such as reports, and that the methods to populate Appendix B are documented prior to engagement and consultation sessions. Appendix B can be updated again after those sessions.

- DFO Science recommends that the Proponent document how the residual environmental effects will be predicted for each VC and provide clarity regarding when all versus significant residual effects will be considered in the CEA Framework.

- DFO Science recommends that the Proponent review additional publicly available datasets prior to consultation and engagement to facilitate informed discussions about each VC.

- DFO Science recommends that the registry include all VCs (and their indicators) with residual effects, and that the language around significance of residual effects be clarified.

- DFO Science recommends that additional details be provided describing how the reliability, adequacy, and reference case will be determined.

3.2.3. Review of CEA Framework 5-Step Approach Steps 1.2 and 1.3: Identifying Valued Components (VCs), Spatial and Temporal Boundaries

Proponent's position

Once each VC is identified, the Proponent's CEA Framework involves identifying the spatial and temporal boundaries for each VC. For spatial boundaries, the Proponent states "*[t]ypically, spatial boundaries will vary according to the VC, either based on ecosystem or urban planning considerations, which will, in turn, facilitate the data collection and historical trend analysis. Similar to the potential environmental effects assessment, a [Zone Of Influence] ZOI will be determined for each VC in accordance with the relevant regulation*". For temporal boundaries, the Proponent states that the temporal boundaries will be set as the construction and operations phases. Typical time horizons also include decommissioning and abandonment, but the Proponent notes that in this case, "*[d]ecommissioning and abandonment timelines are not applicable to the project since highways are considered permanent infrastructure*". The Proponent also states that "*[T]emporal boundaries will support the consideration of cumulative effects for each VC identified for the CEA. Past and present temporal boundaries will be*

determined for each VC through analyzing available information in order to determine a reasonable time range. Past temporal boundaries will be based on available historic information for each VC."

DFO Science's analysis and assessment

Construction and operations phases have been identified by the Proponent, which is consistent with IAAC guidance. However, the FA specifies project phases as: construction, operation, modification, decommissioning, or abandonment. The inclusion of a modification phase is applicable and beneficial for the proposed CEA Framework because modification can include activities associated with foreseeable changes to the highway (e.g., lane expansions and road maintenance).

Spatial boundaries of some VCs may be discrete while others will vary temporally (e.g., runoff will affect greater spatial areas over time), so it is important to accurately capture the spatial boundaries or areas of impact over the construction, operations, and modification time frames. It is unclear how the ZOIs will be determined when spatial boundaries associated with regulation or legislation are not readily available. For example, runoff from the highway during the operations phase will affect the Surface Water Quality and Quantity Sub-Factor, so how will the lateral and downstream ZOIs be determined if regulations or legislation are not available? It is important to report which VCs have ZOIs that are readily available and the analyses that will be required to determine the spatial boundaries and/or ZOIs for VCs without readily available boundaries. The Aquatic Ecosystem Assessments for Rivers (Metcalfe et al. 2013 and references therein) provides guidance on methods that can be used to determine ZOIs for riverine ecosystems.

The determination of temporal boundaries is crucial for understanding how VCs, such as fishes and fish habitats, will be impacted over time. Depending on how timeframes are defined, there can be differences between project timescales and environmental timescales. It is not clear what "*a reasonable time range*" is or how the time ranges associated with construction and operational (and modification) activities will be determined.

DFO Science's recommendations

- DFO Science recommends that a 'modification' phase be added to the Project (i.e., the phases will include construction, operations, and modification), and that this phase is incorporated into the subsequent analyses for each relevant VC, and overall CEA.

- DFO Science recommends that the methods used to estimate the spatial boundaries of each VC be added to the CEA Framework.

- DFO Science recommends that for VCs where spatial boundaries are dependent on regulations or legislation, the associated regulation or legislation be listed and linked to the VC.

- DFO Science recommends that for VCs without regulated or legislated boundaries, the information, data, and/or methods to determine the spatial boundaries and or ZOIs be added to the temporal boundary descriptions.

- DFO Science recommends that the methods to determine the changes in spatial boundaries through time during the construction, operations, and modification phases be documented within the Framework.

- DFO Science recommends that the spatial boundaries for VCs related to Redside Dace and Silver Shiner consider the distribution of their critical habitat and the upstream and downstream effects during the Project phases.

- DFO Science recommends that the timeframes and activities associated with the construction, operations, and modification phases, and how they were defined be documented in the CEA Framework.

- DFO Science recommends that the methods used to define the past and present temporal boundaries for each VC be added to the CEA Framework.

3.2.4. Review of CEA Framework 5-Step Approach Step 1.4 and 1.5: Examining Physical Activities that have or will be carried out

Proponent's position

The Proponent states that "*[R]easonable effort should be made to identify past and existing physical activities based on direct evidence available from the historical record and other reliable sources, such as reports, community knowledge or ITK*." The Proponent states that "*[D]ata and information on existing physical activities, or those that occurred in the recent past, are much easier to find. Sources include recent EA reports and land-use planning documents. Refer to Appendix B for the initial list of data and information sources anticipated to be utilized for this assessment.*" In addition, "*[I]t would also be useful to consider another type of past action that is not presently specified in the IAAC guidance documents, which is the effect of regulations. For example, species protection, urban planning or pollution regulations. These affect a "physical" component but are not "physical activities" as such. In an area like the one affected by this project, they may be important factors to consider either in past, present or future effects.*" Criteria are also listed so "*[A] future physical activity could be considered reasonably foreseeable and should generally be included in the Highway 413 CEA.*"

DFO Science's analysis and assessment

Having more details for the characterization of current and future physical activities would allow for a better evaluation of whether the proposed approach is sufficient. For example, it would be useful to provide examples of what physical activities are in or out of scope under both the current and future scenarios. Are the activities strictly physical or would stressors related to those activities be within scope (e.g., biological or chemical stressors)? Appendix B is a start to understanding potential data sources and the types of information that may be included to synthesize current and future physical activities, but the Appendix can be further populated to allow for more fulsome review. It is not clear what "*reasonably foreseeable*" means and what is intended with some of the criteria; for example, "*[A]ll physical activities required for the Project to proceed*" and "*[T]he physical activity is under regulatory review (i.e., the application is in process).*"

The consideration of activities resulting from regulations is a good addition to the CEA Framework, but requires further explanation regarding how the regulations are linked to activities or how the regulations have influenced activities in the past or could in the future.

"*Induced development*" can have consequences for Redside Dace and Silver Shiner. For example, the conversion of natural spaces and farmland to support urban and sub-urban development could lead to changes in the runoff dynamics and flow regimes of the intersecting Redside Dace and Silver Shiner habitats, and hinder their recovery (Reid and Parna 2017, DFO 2022b, DFO 2024a).

DFO Science's recommendations

- DFO Science recommends that the term "physical activities" be defined within the CEA Framework and that examples be provided for what activities would be in or out of scope.

- DFO Science recommends that the definition of "reasonably foreseeable" be further refined and quantified given that the timeframe associated with "reasonably foreseeable" is directly related to the spatial and temporal boundaries of the VCs.

- DFO Science recommends that the linkages between regulations and activities be documented in the CEA Framework.

- DFO Science recommends that the VCs and Sub-Factors selected for Redside Dace and Silver Shiner include the indicators that can be used to evaluate residual effects on the fishes and their habitats during the construction, operations, modification, and assessment case scenarios.

3.2.5. Review of CEA Framework 5-Step Approach Step 2: Analysis of Valued Components

Proponent's position

The analysis of VCs in Step 2 is specific to analyzing how physical activities may affect each VC. To do this, the Proponent proposes to examine each VC identified in Step 1, and their spatial and temporal boundaries under Base, Application, and Reasonably Foreseeable Development assessment cases. The Proponent states that in order "[*T*]*o make decisions about which data is to be collected or generated, the team will need to have a clear understanding of how the data and information will be used in the assessment, how to establish a proper scale of analysis, and what methodologies and specific methods will be employed for their analysis*."

The Proponent also states that "[*t*]*he residual effects analysis is based on the environmental interactions that are determined to be primary in the pathway analysis*" and that "[*a*] *past baseline will be established based on available and reliable data.*" and "[*a*] *critical review of available information will be done to establish the most accurate baseline possible.*"

The Proponent also mentions they "*will collect and incorporate available community knowledge and ITK [Indigenous traditional knowledge] to the extent that communities are willing to share for the assessment of cumulative effects and will describe and include it as a part of the selected methodological approach, without breaking obligations of confidentiality, if any, while also maintaining appropriate ethical standards.*"

DFO Science's analysis and assessment

This step builds on the VCs identified in Step 1 by determining potential effects that physical activities may have on VCs and proposes analyses of available data and knowledge within the appropriate spatial and temporal boundaries. This section also outlines the approach to address data limitations and uncertainty. However, VCs in Step 1, Sub-Factors, indicators and specific spatial and temporal components, as well as the pathway analysis require further definition in order to evaluate whether the proposed approach is sufficient.

DFO Science notes that the Proponent intends to analyze the environmental interactions that are determined to be primary in the pathway analysis. It is not clear what "pathway analysis" means and whether this will be based on, for example, expert judgment or environmental modelling. There is also little information on how the primary pathway will be determined (e.g., through quantitative assessment, Bayesian inference, qualitative ranking or expert judgement)

when multiple pathways exist. There is also no mention in the CEA Framework about interactions among the indicators for the VCs and how those interactions may be considered for the VC assessments, mitigation measures, and to determine significance. For example, changes in the Sub-Factor Surface Water Quality will have residual effects on the Sub-Factor Fish Habitat. The Pathways of Effects (PoE) for Fish and Fish Habitat (Brownscombe and Smokorowski 2021) provides some guidance on how activities could affect fishes and fish habitat and potential interactions among the proposed VCs. The PoE can also be used to inform Step 1 (scoping) to identify VCs and predict how the project activities may affect them.

DFO Science notes that a clear understanding of existing data from multiple sources also requires documentation and consideration of the data collection methods and interoperability/standardization approaches. For example, for Sub-Factor 1.1.2 Fish Community, a potential indicator is species richness. The data used to determine species richness may be collected using different sampling protocols (e.g., gear, effort, season) that could affect the variety and quantity of species caught (Millar et al. 2023). Therefore, efforts should be made to standardize these data (e.g., Peterson and Paukert 2009) prior to any interpretation in historical trends or current state of this indicator.

Further, the Proponent mentions that data would only be used if they are reliable, but no details are provided on how the reliability of the data will be evaluated. It also mentions that a critical review of available data will be done to establish the most accurate baseline, but there is no mention of how this will be accomplished.

Regarding engagement with ITK and community knowledge, the CEA Framework does not outline how data-sharing agreements will be established and what practices will be used to ensure the ethical handling of such data.

DFO Science's recommendations

- DFO Science recommends that the Proponent incorporate additional Sub-Factors and include indicators to monitor current state and potential impacts to VCs. The Pathways of Effects for Fish and Fish Habitat (Brownscombe and Smokorowski 2021) is one such resource for identifying appropriate VCs and scoping potential pathways.

- DFO Science recommends that the Proponent document the analyses applied to determine the spatial and temporal boundaries associated with the project phases, and base, application, and reasonably foreseeable development cases.

- DFO Science recommends that the CEA Framework include a description of the methods for the pathway analyses, and how and why primary pathways will be identified and included in the analyses.

- DFO Science recommends that meta-data describing the study/monitoring designs (e.g., location of sampling, gear and protocols applied, spatial resolution of the data) are documented and reviewed when existing data are compiled for the VCs.

- DFO Science recommends that the Proponent include the specific criteria used to determine data reliability in the CEA Framework.

- DFO Science recommends that the Proponent document how the baselines and "most accurate baseline" were established for each VC in the CEA Framework.

- DFO Science recommends that the Proponent discuss and apply the First Nations principles of ownership, control, access, and possession (OCAP) with communities, as communities deem appropriate, and when establishing data and knowledge agreements.

3.2.6. Review of CEA Framework 5-Step Approach Step 3: Mitigation

Proponent's position

Step 3 of the Proponent's CEA Framework approach relates to mitigation. It is stated that "[o]nce project components and/or activities with the potential to affect the surrounding environment are identified and mitigation measures are determined, a pathways analysis is used to further assess potential residual effects." This step leads to the identification of "[p]rimary pathways that may lead to residual effects after incorporating mitigation are carried forward to Step 4 for residual effects characterization."

DFO Science's analysis and assessment

DFO Science notes that the VCs and their associated Sub-Factors are currently too broad, and the pathway analysis methods are too vague to determine whether the proposed mitigation approach is sufficient. A detailed description of the methods describing how the pathway categories will be determined (e.g., quantitative assessment, Bayesian inference, qualitative ranking or expert judgement) would allow for better determination of the proposed approach. The pathway categories also require clarification. It is recommended that direct and indirect pathways be included in CEAs (IAAC 2024), but it is not clear whether indirect and direct pathways will be eligible as possible primary pathways or whether indirect pathways will be classified as Secondary. Additionally, the pathways that may have no linkages, or secondary linkages at one point in time, may change under different project phases or assessment cases. It would be informative to include clarification on how this type of situation will be handled in the analyses. Further, because a VC can be affected by multiple pathways, all of them (primary and secondary) should be considered before determining whether there will be residual effects.

The Proponent presents a general description of potential linkages, but no details are given regarding the types of mitigation actions, how the appropriate mitigation actions will be determined, nor how mitigations could be applied within the pathway analysis to pre-emptively lower the residual effect. It would be informative to include descriptions of the potential mitigation measures for each VC, the thresholds that may trigger mitigation, the methods/rationales used to determine whether those measures are appropriate, and the potential effectiveness of the mitigation measures.

DFO Science's recommendations

- DFO Science recommends that detailed methods for the pathway analyses be included in the CEA Framework.

- DFO Science recommends that the Proponent document the methods for determining the No, Secondary, and Primary linkages in the CEA Framework.

- DFO Science recommends that the Proponent consider multiple PoE, and the Secondary linkages when determining residual effects, and consider potential changes in linkage type under the Project phases, as well as the assessment scenarios. Consideration of only primary linkages is insufficient for a CEA.

- DFO Science recommends that the Proponent include for each applicable VC, a detailed list of applicable mitigation measures, how they contribute to reducing residual effects, how the

mitigation measures were determined, and a description of the pathway analysis with mitigation.

3.2.7. Review of CEA Framework 5-Step Approach Step 4: Significance

Proponent's position

The Proponent's recommended approach to determine if a project is likely to cause significant adverse environmental effects consists of three stages: determining whether there are adverse residual environmental effects, determining whether those effects are significant, and likely. Criteria listed for determining adversity are: magnitude, geographic extent, timing, frequency, duration, and reversibility.

The Proponent has created a table (Table 3-2) describing criteria for classifying predicted residual adverse effects and overall significance for each VC that will result in residual effects. Within the table, one of the criteria is duration, and long-term duration is defined as "[*E]ffects are not evident beyond the closure and post-closure phases.*" Table 3-3 includes suggested criteria for characterizing extent of significance of adverse federal effects (IAAC 2023).

The Proponent states that "[*O]nce each criterion has been defined and/or assessed for each of the potentially affected VCs, a qualitative assessment will be completed to determine overall effect significance. An important factor in determining significance is whether cumulative effects would require further monitoring and will be carried out to Step 5.*"

DFO Science's analysis and assessment

DFO Science notes that additional details are required to determine whether the approach is sufficient to determine Significance. While Table 3-2 and 3-3 detail the levels of each assessment for classifying predicted residual adverse effects and the extent of significance, it is not clear how the rankings among criteria will be combined to determine significance. Section 3.1.1.9 – Stage 2 suggests that significance is determined by whether monitoring is required. It is not clear how monitoring is integrated with the current proposed criteria or whether it overrides those criteria.

In addition to the criteria outlined in Table 3-2, IAAC guidance for describing effects and characterizing extent of significance includes social context, ecological context, and uncertainty criteria (IAAC 2024). More explicit consideration of these three criteria is required. For example, the Framework could document methods to address uncertainty in, for example, e.g., knowledge, modelling or perspectives learned through the planned consultations (IAAC 2024).

In section 3.1.1.3, the Proponent defines temporal boundaries and states that "*highways are considered permanent infrastructure and therefore there are no plans for closure or post-closure.*" However, in Table 3-2, under the Duration criterion, the Proponent provides four possible options: Short-term, Medium-term, Long-term, and Permanent. The description of "Long-term" includes the close and post-closure period. This is inconsistent with section 3.1.1.3. Given that the VC analysis will include a Reasonably Foreseeable Development Case, an alternative Long-term duration may be – 'Effects are not evident with foreseeable development'.

There are also minor errors within this section of the document. There is text stating "*Section Error! Reference source not found*" that should be fixed. There is also reference to "*marine plants"* and "*marine animals*" that should be changed to "*freshwater plants"* and "*freshwater animals*".

DFO Science's recommendations

- DFO recommends that social context, ecological context, and uncertainty be added as criteria used in the determination of Significance, and that the methods describing how they will be considered are provided in the CEA Framework.

- DFO recommends the addition of more details outlining how the rankings will be combined to determine adverse effects, extent of significance, and overall significance. Qualitative analyses are mentioned but it is not clear how each category within the criteria will be combined to produce the overall significance ranking.

- DFO recommends that the Proponent provide clarification on how monitoring is integrated into the criteria or whether the requirement for monitoring supersedes the other criteria.

- DFO recommends that the Proponent revise Duration criterion to be consistent with section 3.1.1.3.

- DFO recommends minor revisions to the language of the document to correct for the "*Error!*" and references to marine organisms.

3.2.8. Review of CEA Framework Step 5: Follow Up

Proponent's position

Monitoring is proposed to "[v]*erify the effects predictions, identify any unanticipated effects, and provide for the implementation of adaptive management to limit these effects*", and has been classified into three categories: compliance, environmental, and follow-up monitoring. The monitoring that is proposed will track project implementation (compliance monitoring), environmental monitoring during the lifespan of the Project, and follow-up monitoring to track the effects and effectiveness of mitigation actions. In addition, "[W]*here relevant, conceptual monitoring programs will be proposed to deal with the uncertainties associated with the effect predictions and mitigation*."

DFO Science's analysis and assessment

The proposed types of monitoring are generally good, but it would be useful to include timelines and more details about the different types of monitoring being considered for applicable VCs. For example, environmental monitoring during the construction phase would provide information to assess the immediate effects of the Project. While during the operations and modification phases, monitoring may shift to assessing changes in hydrology, road runoff, and the potential for barriers to fish movement, and monitoring for long-term or delayed effects such as changes in population dynamics, habitat quality, and ecosystem health.

Different indicators for the VCs will require different types of monitoring. Therefore, the CEA Framework should include lists of the VCs, Sub-Factors, and indicators for each with residual effects, and the types of monitoring that may be within scope. Monitoring designs for the effects and mitigation effectiveness for Redside Dace and Silver Shiner (Step 10 of the Jeopardy Assessment Checklist) should consider the recovery timelines and generation times of those species.

The Proponent is encouraged to review SARA for monitoring requirements related to permitting and detail the plan to meet those requirements within the CEA Framework. Monitoring may also be required to fulfill the conditions of FA permitting.

DFO Science's recommendations

- DFO Science recommends that details are provided on the monitoring approaches and timelines for the VCs, Sub-Factors, and their indicators.

- DFO Science recommends that the monitoring approaches and programs be responsive to environmental changes that will occur during the construction versus operations and modification phases as well as the Reasonably Foreseeable Development assessment case.

- DFO Science encourages the Proponent to review applicable SARA legislation and monitoring required for permitting and include in the CEA Framework.

- DFO Science recommends that the criteria used to trigger adaptive management responses for different indicators of the Sub-Factors and VCs be included in the CEA Framework.

3.2.9. Review of CEA Framework Consultation and Engagement Program

Proponent's position

The Proponent intends to consult and engage while developing the CEA Framework. They also propose to hold two rounds of consultation and engagement. The main purpose of the consultation and engagement is to "*allow Indigenous communities and key technical stakeholders (i.e., regulatory authorities, namely IAAC, Health Canada, Fisheries and Oceans Canada, Ontario Ministry of the Environment, Conservation and Parks, Ontario Ministry of Citizenship and Multiculturalism (MCM)) to review and comment on the draft Cumulative Effects Assessment Framework*". Part B of the first round of consultation is different, and "*will be centered on seeking feedback from the general public and members of nearby communities*". To help engage with the public and members of nearby communities, "*The Project Team is developing a series of electronic learning (e-learning) modules that will explain the draft CEA Framework in great detail and will be releasing them on the Project website in Fall 2023. In addition, the full draft CEA Framework will also be published on the Project website for public review and comment*".

DFO Science's analysis and assessment

The Proponent wishes to consult and engage with the general public, Indigenous communities, and stakeholders during the development of the CEA Framework, which is general best practice when it comes to CEAs. The public feedback received to date from the IAA project registry should be considered as well.

DFO Science's recommendations

- DFO Science recommends that the Proponent consider public feedback from the IAA project registry.

- DFO recommends flexibility in planning and execution of consultation and engagement as multiple sessions with the same parties may be warranted.

- DFO recommends that the Proponent discuss and apply the First Nations principles of ownership, control, access, and possession (OCAP) with communities, as communities deem appropriate, and when establishing data and knowledge agreements.

3.2.10. Review of CEA Framework Appendix A: Initial List of Potential VCs

Proponent's position

The Proponent provides a list of potential VCs in Appendix A (MTO 2023).

DFO Science's analysis and assessment

DFO Science has reviewed Appendix A and provides the following recommendations in table format for specific VCs.

DFO Science's recommendations

Table 3. DFO Science specific recommendations for each potential VC.

Potential VC	DFO Science Recommendation
1.1 Fish and Fish Habitat	• DFO Science recommends that the Proponent add VCs for Redside Dace (*Clinostomus elongatus*; SARA Schedule 1: Endangered) and Silver Shiner (*Notropis photogenis*; SARA Schedule 1: Threatened), with Jeopardy Assessment results (and other relevant information) informing the Sub-Factors and indicators selected for each. • DFO Science recommends that these species at risk be two distinct VCs because of species-specific differences in ecology and life history that may influence how they respond to cumulative effects.
1.1.1 Fish Habitat	• DFO Science recommends that the Proponent add a Sub-Factor for aquatic habitat connectivity because there is the potential that some of the crossings may disrupt present or future connectivity. • DFO Science recommends that the indicators for the connectivity Sub-Factor account for the morphodynamic and hydrodynamic nature of stream and river flows and the capacity of built infrastructure (i.e., the water crossings) to accommodate that variation without disrupting connectivity for fish movement and habitat use.
1.2 Terrestrial Ecosystems	• DFO Science recommends that the Proponent include riparian vegetation as a Sub-Factor and review Environment Canada (2013) guidance document and DFO (2020) for information on the influence of riparian habitats on aquatic features and water quality because there is the potential to disrupt riparian habitats that are important for both aquatic and terrestrial organisms during the construction phase and where crossings intersect watercourses during the operations and modification phases.

Potential VC	DFO Science Recommendation
1.3 Ecosystem Services	• DFO Science recommends that the Proponent clarify which type of ecosystem services this VC includes (i.e., provisioning, regulating, cultural, and/or supporting). This clarification should include Sub-Factor(s) to better reflect focus/foci. Example syntheses of ecosystem services provided by different landscapes or ecosystems within the study area can be found here in Potschin et al. (2016) and Mengist et al. (2020).
1.4 Groundwater, 1.4.6 Groundwater – Sensitive Ecosystems	• DFO Science has no specific recommendation but would like to comment that this Factor is particularly important for fen wetlands and cold- and/or cool-water fish riverine habitats occurring within the Project study area.
1.5 Surface Water 1.5.1 Watershed / Subwatershed Drainage Features/ Patterns	• DFO Science recommends that the Proponent include more specific Sub-Factors and indicators for this VC such as morphodynamics, channel sinuosity, flow regimes, sedimentation regimes, and channel width at watershed/sub-watershed scales (i.e., Sub-Factors that reflect how the hydrology and hydrodynamics may be affected by the approximately 97 watercourse crossings).
1.5.2 Surface Water Quality and Quantity	• DFO Science recommends that the Proponent separate water quality and quantity. • DFO Science recommends Surface Water Quality include Sub-Factors and indicators for water chemistry such as dissolved oxygen, total suspended solids, chloride, heavy metals such as cadmium, microplastics, 6PPD-quinone, Polycyclic aromatic hydrocarbons (PAHs) concentrations, and water temperature. These Sub-Factors and associated indicators will be particularly important during the operations phase considering road salt applications, vehicle use, PAH deposition, and changes in instream thermal regimes, which can occur with the increase in impervious cover. • DFO Science recommends Surface Water Quantity to include Sub-Factors and indicators describing how the water balance in the Project Study Area may be affected by the addition of impervious cover and approximately 97 watercourse crossings.

**Science Response: Information
Components for SARA S.73 and CEA**
Ontario and Prairie Region   **Framework Review - Ontario Highway 413 Project**

Potential VC	DFO Science Recommendation
1.6 Air Quality and Climate Change	• DFO Science recommends that these VCs be separated because climate change is impacting more than air quality and Greenhouse Gases. Changes in air temperature and precipitation are also impacting flow and thermal regimes of streams in Ontario (Azarkhish et al. 2021). In addition to Greenhouse Gas Emissions, Sub-Factors, and indicators for Climate Change could include indicators such as number of extreme heat days, extreme precipitation days, and magnitude of flood and drought events.
2.4 Land Use – Resources	• DFO Science recommends that the Proponent add a Sub-Factor for protected areas with indicators reflecting the types of protected areas that may occur within the Project study area.
2.7 Landscape Composition, 2.7.2 Vegetation	• Terrestrial Ecosystems include 1.2.3 Woodlands and Vegetation, and 2.7 Landscape Composition lists 2.7.2 Vegetation. DFO Science recommends that the differences between the two be defined in the CEA Framework.
5.1 Species at Risk	• DFO Science recommends that the Proponent add VCs for each fish and wildlife species at risk and embed within the previous VC sections rather than aggregate as differences in habitat preferences, sensitivities to disturbance, and listing warrants individual consideration.
5.2 Human Health, Sub-Factor 5.2.2 Air Quality and Climate Change	• DFO Science recommends that the Proponent add water quality as another important Sub-Factor for human health.

4. Conclusions

Several overarching conclusions were identified following the review and discussion of both sections of this report. These include:

• Alignment of the language used to describe the phases of the Project defined by the Proponent with the *FA* project phases is recommended: construction, operation, modification, decommissioning, and abandonment. Decommissioning and abandonment are not expected project phases (see section 3.2.3), as outlined in the CEA Framework. The addition of 'modification' is recommended because it is likely that further highway infrastructure development will occur in the future.

• An ecosystem approach for both the jeopardy and cumulative effects assessments is recommended, where all aquatic ecosystem conditions (abiotic and biotic) within the relevant watersheds are considered.

- It is anticipated that project construction, operation, and modification phases will have multiple associated impacts to VCs (including species at risk), which may differ in significance. Therefore, it is recommended that the analyses used to calculate the residual effects consider the activities associated with each phase and assessment case.

- Climate change considerations are applicable to both the jeopardy and cumulative effects assessments; although climate change is listed as a VC in Appendix A of the CEA Framework, it is already interacting, and will continue to interact, with different VCs. It is recommended that the Proponent provide residual effects analyses for each VC in the cumulative effects assessment.

- Within both the Jeopardy Assessment Checklist and CEA Framework Review there is inclusion of stressors related to water quality such as pollutants and spills. As these are not exclusively under DFO's mandate, other agencies (e.g., ECCC, MECP, MTO, Transport Canada) will likely have relevant data, information, and/or regulatory responsibilities. Consideration of how these and other stressors impact at-risk fishes and other VCs is needed for both the jeopardy and cumulative effects assessments.

- It is recognized that the Proponent is proposing monitoring during Step 5 (Follow-up) of the CEA Framework, and that monitoring was identified as a component of the Jeopardy Assessment Checklist (see Table 1, Step 10). However, it is also recommended that the Proponent review all relevant sections of FA and SARA to ensure all monitoring requirements are considered (e.g., SARA Section 79(2), authorization regulations).

- This Report is based on current knowledge of the project regarding scope and existing documentation. As more information is made available, further advice may be required.

4.1. Jeopardy Assessment Checklist

- The information components include any changes that the Project may cause (during the construction, operation, and modification phases) to Redside Dace and Silver Shiner (including changes to habitat, threats, and recovery measures), the possible effects of those changes, and the significance of those effects as they relate to achieving the population and distribution objectives of both species.

- Achieving the intent of the recommended approaches would require detailed analyses, with analytical decisions justified based on the scientific literature and all available data, including literature beyond the sources described in Table 2. For example, additional literature would be required to describe the effects of highway construction, modification, and operation.

- To achieve the intent of the recommended approaches, a detailed description of the relevant uncertainties of each component in Table 1 is required.

- It is recommended that the Proponent provide the compiled information components to DFO in a stepwise manner (as outlined in Section 3.1) to allow for collaboration, timely feedback, and to ensure that the requirements of SARA are achieved.

4.2. CEA Framework Review

The Proponent's proposed CEA Framework contains the elements consistent with IAAC guidance, and past projects under the former *Canadian Environmental Assessment Act* (2012 but repealed in 2019); however, details are lacking that limit the review. Recommendations have been provided for elements of the CEA Framework that require clarification, further

consideration or elaboration that once addressed, would allow for further evaluation of its quality and adequacy. This review is based on the October 2023 version of CEA Framework; the following bullets describe recommendations to improve:

- Step 1 (Identifying VCs) and 2 (Analysis) – clarify and specify the definition of and methods for ZOI calculations for the project area and each VC under the Project construction, operations, and modification phases as well as the Base (past and current activities), Application (project activities), and Reasonably Foreseeable Development assessment cases.

- Step 1 and 2 – clarify the timelines associated with the project phases and assessment cases.

- Step 1 – clarify the specific activities that will be associated with the project phases and assessment cases.

- Step 2 – clarify inputs, methods, and outputs associated with pathway analyses being proposed to determine residual effects and environmental interactions.

- Step 2 – primary pathways alone are insufficient for a CEA and the analyses should also consider how interactions between or among effects and VCs may change through each project phase in the assessment cases.

- Step 3 (Mitigation) – recommend describing the methods used to determine which mitigation measures are appropriate for the VCs and their indicators. Like Step 2, mitigation should consider all pathways between or among VCs and their indicators as they may change through the different project phases and assessment cases.

- Step 4 (Significance) – recommend adding more detailed descriptions of the methods used to determine significance of effects, including definitions and thresholds.

- Step 4 (Significance) – recommend incorporating social context, ecological context, and uncertainty as criteria for evaluating and measuring significance. Additionally, recommend describing how the combinations of rankings for each criterion will be considered together to determine significance.

- Step 5 (Follow-up) – monitoring is a key component of CEAs. It is recommended that the CEA Framework include which VC factors, Sub-Factors, and indicators will be subject to the different proposed monitoring approaches, and that the monitoring and management are responsive to potential changes in environmental conditions associated with activities during the project phases and assessment cases.

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