Center for Independent Experts (CIE) Independent Peer Review of Puget Sound Nearshore Habitat Calculator

By

Dr Mike Bradford

West Vancouver, BC, Canada

mbradfor@sfu.ca

December 2023

Executive Summary

The Puget Sound Nearshore Habitat Calculator (hereafter the "Calculator") is a tool to assist environmental managers in evaluating the effects of projects or activities on nearshore and estuarine aquatic habitats and threatened biodiversity. The tool uses equivalency analysis to quantify losses resulting from a project's residual effects, and gains from offsetting or other conservation measures. The tool relies on a common currency (called "service value") which is a surrogate metric for the effects of changes in habitat conditions on salmon populations.

The overall framework for the Calculator is very similar to those used in biodiversity offsetting programs worldwide and is an analytically sound process. The documentation for the Calculator could take advantage of a large international literature to provide additional scientific credibility for the approach.

At the heart of the Calculator are analyses required to translate habitat conditions, and changes to those conditions, to service values for the computation of gains and losses. A combination of scientific and other literature, and knowledge of local experts, was synthesized and used to evaluate the contribution of habitats and habitat changes to salmon. This included a zonation system to stratify habitats with respect to tidal influence, and the development of "Physical and Biological Features (PBFs)" that are the key elements of habitat that contribute to salmon population viability. This review was extensive, and I concluded for the most part, the knowledge inputs to the Calculator was based on the best available science. Analyses of additional habitat types, and offset measures, could be added to the calculator as part of ongoing improvements to the tool.

Results of the knowledge review are then converted to service values for the equivalency analysis. I found the documentation of this step difficult to review and suggest a more formal approach be taken to describing the mathematics and scoring schemes that were used. Attempts were made to break down the PBFs to "effects pathways" but I found the description of the methods used to compute service values were hard to follow, and in some instances, not convincing. There may also be benefit to clearly separating sections that describe the steps for (1) characterizing existing habitats, (2) estimating the residual effects of the proposed project or activity, and (3) evaluating potential benefits of offset or conservation measures designed to increase service values.

Lastly, as currently formulated, the Calculator assumes offsetting or mitigation efforts will be successful, and will provide the expected conservation benefits. Emerging scientific evidence suggests that this may not be true, and the in future the developers of the Calculator should consider explicitly including the risks of failure of offsetting in their equivalency determinations.

Background

The Puget Sound Nearshore Habitat Calculator (hereafter the "Calculator") is a tool to assist environmental managers in evaluating the effects of projects or works on nearshore and estuarine aquatic habitats and threatened biodiversity. The tool assesses project impacts, and measures (known as offsetting, compensation or mitigation) designed to produce improvements in habitat conditions. It adapts a framework for the assessment of accidental environmental damages (Habitat Equivalency Analysis, HEA) developed in the US, but is similar to many frameworks that have been developed internationally (Quetier and Lavorel 2011). The goals of these tools is usually to incorporate available information sources (and uncertainties), be efficient and repeatable, facilitate common understanding between environmental managers and projects proponents, and achieve regulatory goals. The expectation is these tools will avoid some of the challenges with "one-off" assessments that may rely on ad-hoc approaches by regulatory staff (Minns 2015).

Description of the Reviewer's Role in the Review Activity

This was an independent desktop review conducted in September and October 2023. The principle document for the review was Ehinger et al. 2023 "The Puget Sound Nearshore Habitat Conservation Calculator", dated 23 July 2023. Additional supporting material including a spreadsheet containing the Calculator and the user's guide were consulted (Appendix 1). A brief conference call was held at the beginning of the review between reviewers and agency staff to discuss procedure and a few technical details before the review began.

Summary of Findings

The acceptance and use of the tool will likely depend on the a number of factors: (1) simplicity – can the tool capture the critical elements required for decision making while avoiding complexity that may yield only small improvements? (2) transparency – can the process and results be easily explained and understood to avoid fear of the "black box"? (3) scientific defensibility - is the design and parameterization of the tool consistent with current understanding? (4) adaptability – can the tool be used for a range of situations, and can be adapted by more sophisticated proponents for complex projects where a bespoke approach may be needed?

In general, I found the approach sound, and the scientific basis for the Calculator to be well supported by the literature and the use of expert judgement where empirical information was lacking. However, I did find the main document quite difficult to evaluate, given the way the material was presented. Thus many of my comments are directed at the factors outlined in the previous paragraph and are intended as suggestions to make the Calculator more transparent to users.

Below, I provide responses to the TOR questions but note there is overlap among them; consequently some questions are grouped and a combined response follows. Following the TOR responses, I provide more detailed comments on the approach and technical details as they are set out in the Ehinger et al (2023) document.

Responses to TOR questions

1) Analytically sound process:

a) Are the underlying relationships that Nearshore Calculator and the NHVM are built upon (e.g. duration of aquatic access, functional pathways, indicators/metrics) sufficient and well-founded for evaluating effects of changes to nearshore habitat conditions on salmonids, given the stated goals and objectives? Is the analytical approach based on a valid list of habitat attributes (physical and biological functions)?

Developing measures to assess the value of habitats of imperiled salmon populations that might be affected by development or restoration activities is a significant challenge given the many functions that habitats perform, and the lack of quantitative information to link those functions back to fish population performance. However, for the purpose of the equivalency analysis the goal of the habitat assessment is to obtain relative ranking of habitat types so that in cases where offsetting is "out of kind" (i.e., not an exact replacement of lost habitat or function), the benefit provided by the offset can be assessed against lost habitat or function.

It is my opinion that the basic analytical process is fundamentally sound as it is similar to other tools or models that are used to evaluate effects of human activity on habitat or biodiversity. Reasonable metrics or surrogates for habitat function were developed based on current understanding of ecological processes affecting salmon population productivity.

I believe the basic ranking of habitats as set out in Table 3-1 is sound, as it incorporates the variation in inundation that exists across elevations, a concise list of key functions that habitats provide to salmon, and an appropriate weighting of those functions to the overall service value that is used in the equivalency analysis. Table 3-1 is the key structuring used to generate service values, and is a well-conceived element of the Calculator.

Table 3-1 represents an assessment of the maximum services provided by the various habitats. It would be useful to have a succinct table of the attributes of habitat needed to generate maximal values. This could help guide the analysis for less than optimal or impacted habitats. Service values in Table 3-1 should be identified as being on a aerial basis (e.g., per acre). In my view the shading of this table is unnecessary and distracting and should be removed. Also, the headings for the Scores are not clearly labelled. The text implies that Duration of Access is a PBF (although it is not listed as such in other sections). The other 4 columns are PBF scores. I suggest simplifying the heading for all 5 columns as "PBF Scores".

It is apparent that the team has both reviewed the literature and consulted local experts and arrived at an appropriate assessment of the current state of knowledge. It is always a challenge to find the balance between limited empirical and scientific evidence and the opinions of biologists that may be based on a variable range of experiences. There may be some opportunities to strengthen these linkages by a more explicit consideration of quantitative data such as juvenile salmon diet (e.g, the proportion of prey items that come from various pathways of production). Secondary production (invertebrates) has also been used as a metric for equivalency calculations and can be used to provide weights for the various habitat types for the forage PBF (see Bradford et al. 2016 for a review). As this is a living document, continued efforts to refine the indicators and metrics using scientifically defensible methods and information is encouraged.

b) Are there ways to strengthen the functional relationships the Nearshore Calculator is based on?

c) Include in your findings a description of strengths and weaknesses.

d) For weaknesses, please outline possible solutions considering the stated goals and the data availability, and if possible, provide references.

Modifying site specific service values-After having established maximum service values, Section 3 of the report describes how site-specific conditions are used to modify service values. This analysis is a weakness of the Calculator. I found description of methods difficult to follow, and the associated diagrams confusing. There are also inconsistencies among sections. My concerns are detailed in the section-specific comments below.

As an alternative, I wonder if a simpler approach might meet the needs of the program without adding excessive complexity. Other jurisdictions have adopted qualitative habitat scoring schemes to address variation in habitat quality within habitat classes, and used a simple scoring scheme to compute "biodiversity points" or a similar metric that can be used for offsetting exchanges. One example has been developed by DEFRA in the UK, and others can be easily found:

https://www.gov.uk/government/publications/technical-paper-the-metric-for-the-biodiversity-offsetting-pilot-in-england

For example, for each habitat zone/type a 4 or 5 point scheme (e.g., None-Low-Medium-High) with descriptors could be developed, and a modifier on a 0-1 scale can be used to scale the individual entries in Table 3-1. This is similar to some of the scoring systems developed for the individual effects (i.e., Table 3-4 or 3-7) but operates at a the higher level of the PBF scores. The ratings would be anchored by the proposed table that describes the optimal conditions that result in the service values of Table 3-1.

Although I can understand the desire to drill down from the PBF scores, this approach requires the development of a scoring system for individual effects, as well as a weighting among effects, both of which rely on increasingly granular levels of expert judgment. The more simplified approach (such as the DEFRA scheme) allows assessors to take a more integrated, wholistic approach to the assessment. Guidance and training help to ensure consistency in outcomes.

Evaluating effects of development impacts, offsets, and restoration activities- Having evaluated the status of existing habitat, the Calculator can compute the change in habitat service associated with activities that might decrease or increase habitat values. I found the analytical process for calculating these change was not clearly set out in the documentation and was difficult to review. Many elements of the evaluation of project impacts are integrated into the descriptions of habitat service evaluations in Section 3, with additional information in Section 4. There was little guidance on how to evaluate the effects of offsetting and restoration measures on service values.

I would suggest the authors consider separating the components that deal with the assessment of habitats (generally the pre-development state) from the generation of service values for estimating changes caused by measures or activities. For example, Section 3 would be devoted to evaluating existing habitat conditions in the context of PBFs. Then Section 4 could deal with the main development categories, each in separate sections. For each PBF and Zone the way the activity may affect service values can be identified, and advice provided on how to score those changes in the calculator. A third section could be devoted to valuing offset or conservation measures.

Dividing the analysis into these 3 sections is also way to consolidate and organize the background scientific material for each input to the calculator.

Development projects may impact a number of habitat types (elevation zones), and have effects on a number of PBFs. It may be instructive to present “pathways of effects” (or “influence diagrams” or “conceptual models”) to illustrate the ways projects or activities could impact on the service values for each PBF and zone. These diagram can be used to identify avoidance and minimization efforts and the remaining residual effect. Diagrams can also be used as an accounting tool to ensure all effects are incorporated into the Calculator for the assessment of the total residual effect.

Greater consideration of other offset types- The analysis currently has a discussion of the value of pile removal and wrack placement as offset measures, and implicitly considers vegetation planting (although not in detail). However, the suite of potential offset measures may be much larger. For example, in estuaries, intertidal salt marshes are constructed to provide cover and invertebrate production, dykes and other channel constraining infrastructure can be breached or modified to provide access and better habitat conditions, and in coastal areas artificial reef structures are used to create cover and hard substrate. Guidance for assessing these measures for the Calculator may be needed in the future and this may an area for further work.

2) Scientifically sound process:

a) Does the Nearshore Calculator systematically and appropriately incorporate and interpret the highest priority and best available scientific information given the stated goals and objectives?

b) Indicate if and what relevant information is missing, provide references.

Is the calculator intended for estuary and nearshore habitats? - The domain for the application of the Calculator is not clearly indicated but some of the text indicates that estuary habitats could be included. If that is the case, then an important habitat type that is not clearly identified and valued are saltwater or tidal marshes that are often found in salmon estuaries. Research indicates these are important habitats with abundant structure and food production (e.g., Levy and Northcote 1976; Chalifour et al. 2021) and probably provide greater service values than marine intertidal zones. I note that this limitation is identified in the user guide, but not the main document.

In estuaries there is also the potential impact of anoxia and other factors on benthic production and consequently forage for salmonids. Excessive eutrophic inputs, as well as restrictive circulation as a result of infrastructure development can contribute to the development of accumulation of organic material and development of anoxic areas. Sediment quality may be a attribute that could contribute significantly to benthic production in some estuaries. Project impacts on sediment conditions can be important considerations in design. There is also potential to improve existing impacts to sediment quality through offsets such as dyke breaching.

I recommend that the current scope of application be clearly set out in the document and if estuaries are included, additional effort may be needed to ensure all habitat types are evaluated for their service contributions.

c) Indicate if interpretations need to be refined, and if possible, provide references.

Riparian zone width-I found no discussion of the role of riparian zone width for the provision of habitat services in Section 3. This is an often discussed parameter for freshwater habitats, as factors such as shade, slope stability, resistance to wind, filtration are affected by both the composition and width of the riparian zone. An operational definition of the riparian "zone" should be used, perhaps based on finding from freshwater buffer zone considerations. I note that reduction in service to 30% is proposed for vegetation 130 ft from the shore in section 4 but no rationale is provided. The spreadsheet and used guide seems to indicate 130 ft is also effectively the width of the RZ for the purposes of service calculations but justification is lacking.

Adjustment Factors-The presentation of "Adjustment Factors" is an area where the interpretation of scientific information could be refined in the context of the evaluation of service values. Service values are a means to quantify the effect of habitat attributes on the target biodiversity, which in this case is chum and chinook salmon. Thus it is reasonable to assume that habitats that fish are more likely to use will have more service value than habitats that are less likely to be used. Similarly, habitats that are potential areas of forage fish production in the nearshore zone will have greater service value than areas that do not.

In my view, these weightings should be applied in the initial step of determining service values for specific areas as part of the "before" or baseline assessment. It seems that the non-global adjustment factors (forage fish spawning) can still be applied in the pre-development assessment; this would cause the habitat to be more highly valued, and the losses caused by development would be proportionately greater.

This approach also permits the application of risk management approaches for these habitats since they will be identified in the first phase of analysis. For example, regulators may place restrictions or deny permits for projects that have residual effects in high value areas. Offset ratios may be increased to reduce the risk of offset failure, or limits may be placed on the type of offsetting that can occur (e.g., Defra 2012).

There is also a risk that the number of "special cases" requiring adjustments could increase, perhaps with decreasing levels of scientific support, causing service values to be more a result of adjustments than the original deliberation on their roles for salmon population viability. The author team should reflect on the interaction between the adjustment factors and the process that went into developing the relative service values (Table 3-1) because continuously inflating service values with adjustments means that the base value contained in Table 3-1 reflect essentially poor habitat from the perspective salmon-oriented service values. I suspect the development of Table 3-1 was probably influenced by thinking about habitat conditions that would represent high service values. Perhaps some of the adjustment factors could be reversed to decrement habitats that have less than maximal value so that the intention of Table 3-1 is retained.

Lastly, the motivation for the "Adjustment factor for new structures" is not compelling. The HEA should account for the impacts that occur for a project, and should result in larger loss of service for a new project, over maintenance or replacement of an existing project, because in the latter case the existing habitat ("before state") will have been degraded by the old structure. Similarly, in the Calculator, service losses for a structure placed in good habitats should be larger than those in poorer habitats. If it is felt that the results from the calculator does not reflect the actual loss of service, then inputs to the Calculator may need re-evaluation. At the moment, the Adjustment factor seems like a post-hoc manipulation of the outputs based on a lack of comfort with results that the core model produced.

3) Useful/realistic output:

a) Does the Nearshore Calculator generate reasonable and well-supported quantifications of the impacts (positive, negative, neutral) to nearshore habitats and salmon?

The calculator seems to generate reasonable relative quantifications of effects in terms of service value indicator, which is what is needed for regulatory decision-making. It should be noted that service values are designed to be wholistic surrogates for effects on salmon populations so there is never an intent to "quantify impacts to salmon" as the question suggests.

b) If warranted, include in your findings a description of where the Nearshore Calculator likely over- or under-estimates impacts or benefits to salmon and their habitat.

c) If warranted, outline possible solutions for better supported quantifications and if possible, provide references.

Footprint effects- There is only a brief section (4.7) that describes how projects that eliminate habitat are to be handled in the calculator. Certainly, the area (footprint) of a structure will result in it being removed as habitat for some of the PBFs, although in some cases, rip-rap embankments may have some habitat value such that the edges of infilled projects may need to be considered differently (e.g., Macdonald et al. 2018). I did not see how migration effects are handled for this activity- in theory, some structures could influence juvenile salmon migration in a much more significant way that was suggested for boat ramps, or float shading, for example.

The assessment of salmon migration effects should be reviewed to ensure the effects of larger breakwaters or other structures are captured appropriately.

Computation of DSAYs- It is difficult to evaluate the methods used to calculate Discounted Service Acre Years (DSAYs) as the formulas are not formally presented, although they can be found in various cells of hidden sheets in the Calculator spreadsheet.

The Calculator generates a value called "Conservation Offsets/Habitat Loss" which is 100*DSAY in the RZ sheet. This looks the same as "Conservation Credits/Debits" in the summary sheet. On page 79 there is reference to "Conservation Points". None of these are explained in the document; it should be clarified that these values cannot be readily converted to a present-day amount of offsetting. Rather, the appropriate amount of offsetting to provide the needed DSAY has be derived using the discount rate and a time trend of service value for the offset.

Formulas for the calculation of DSAY should be written out, and definitions of Conservation Credits and other terms given in mathematical form.

The value of offsets: Although the literature is not comprehensive, there is evidence that conservation offset programs (and offsets themselves) do not always provide expected or desired biodiversity benefits. This can occur because project impacts are underestimated, proponents do not meet their requirement for offset delivery (compliance issues), or the offset measures fail to deliver the expected benefits, or fail in time. There is resent literature on this topic: examples include Souza et al. (2023), zu Ermagassen et al (2019) and Theis et al. (2021).

This issue is raised in the documents but is not an explicit part of the calculator. In other jurisdictions, risks associated with offset performance are usually managed using ratios or multipliers, which serve to counteract risk by increasing the amount of offset to be delivered. Theoretical analyses show that accounting for all risks, and taking a very risk-adverse approach, large multipliers may be required, but in application, ratios of 2:1 to 5:1 seem to be employed (Clarke and Bradford 2014). There is also the potential to invoke a variable risk adjustment depending on the nature of the habitats being impacted by the project.

It is not clear whether NOAA has policy regarding uncertainty about offsets but it is my opinion that by not making some sort of risk adjustment in the Calculator this issue might not get the level of attention it deserves.

A couple of approaches to dealing with the risk associated with offsets are:

1.Incorporate an offset ratio (or ratio policy) into the Conservation Credit calculation to ensure that conservation credits meet a predetermined policy. The exact ratio to use might be somewhat arbitrary but values such as 2:1 appear to be commonly used by other agencies (see Clarke and Bradford 2016 for a discussion of ratios).

2. Provide guidance to users for setting the service value of created or restored habitat that might be used for offsets. For example, if the evidence suggests eelgrass planting typically only reach 50% of the stem density of high quality natural habitats, then the service value should be scaled accordingly. This approach will require some effort to review the literature and local knowledge to develop defensible recommendations.

In future revisions of the Calculator, consideration should be given to including an explicit risk adjustment, potentially in the form of a multiplier on the offset requirement.

Section-Specific comments on Ehinger et al. 2023 "The Puget Sound Nearshore Habitat Conservation Calculator"

Section 1.

Page 2: There's little doubt that estuaries and nearshore habitats are important for some salmon populations, based on the densities, growth and periods of residence for juveniles from ocean-type chinook and chum salmon populations. However, linkages between estuary and particularly nearshore habitats and survival are largely inferred as there's little direct evidence to link survival and habitat condition. In my view the wording within the paragraphs on page 2 should be revised to better reflect the current state of empirical evidence. Many of the papers cited only inferred the role of estuary condition on salmon survival and population status.

A minor revision of this text would ensure existing knowledge is characterized correctly.

Section 2.4

Better frame the role of Equivalency Analysis and take advantage of an expansive international literature. Equivalency Analysis is a tool that is normally part of a larger environmental management system based on a societal expectation that proponents of works or projects are responsible for minimizing or eliminating environmental impacts of their actions. A cornerstone of that system is the so-called "mitigation hierarchy"; proponents are expected to first take actions to avoid or minimize (or mitigate) effects of their project, and then compensate (offset) the residual effects that remain. Because uncertainty about the success of measures increases from avoid-mitigate-offset, avoidance and mitigation are usually considered preferred options. It appears on reading text on pages 3-5 that this is also the basis of the regulatory process used under ESA, although it is not emphasized.

I suggest outlining the mitigation hierarchy and consider including the typical diagram (see Fig 1 of Quetier et al. 2011 or Fig 1 of DFO 2019 for examples) to provide context to where the Calculator fits in, and to emphasize the hierarchy.

Explicit definitions for the phases of the hierarchy (and consistent usage) are needed for this document as terms vary among jurisdictions. In the document "mitigation", "minimization", "compensation", "conservation credits", and "offsetting" are sometimes used inconsistently.

Although the use of offsetting in environmental management has a 40+ year old history in both Canada and the US, in recent years the mitigation hierarchy has become more prevalent throughout the world. There in an opportunity to enhance the scientific rigor and status of the Puget Sound Nearshore Habitat Calculator by setting the Calculator within the frameworks and research that currently exists.

A few paragraphs with citations that outline the use of equivalency computations in the mitigation/offsetting framework could be added to section 1 or 2, showing how the Calculator is *largely consistent with international developments. Some useful papers that provide an entry into the literature are BBOB (2012), IUCN (2013), Levrel et al. (2012), Quetier and Lavorel (2011), and DFO (2019).*

Equivalency analysis requires a series of policy decisions and model assumptions for its application. The document does not articulate these clearly, and appears to lump policy choices with the technical assumptions.

First and foremost, it is the overall program policy goal that sets out the need for equivalency analysis. Usually this is in the form of "no-net-loss" of some ecological service, ecosystem, or biodiversity. But I note there are other policies such as "net gain" (In fact, the UK has a 10% gain policy). Offsetting programs can also have limits, for example, to protect particularly important habitats or services. In these cases, risks associated with offsetting for losses in critical habitats may be deemed too great (IUCN 2013).

A hierarchy of offsetting measures can also be applied to better achieve policy goals. For example, local "like-for-like" offsetting may be preferred, particularly for small projects, as the equivalency determination is simple, and likelihood of achieving no-net-loss may be more readily realized. Where nearby like-for-like is not feasible, policy may speak to unlike offsetting, locations further from the project, alternatives such as cash contributions to existing restoration projects or research, habitat banks, chemical and biological manipulations to increase productivity, invasive species removal or artificial propagation (e.g., DFO 2019).

It has also been suggested that offsets may be more effective when they are part of a larger overall strategic plan for the ecosystem, or priority biodiversity (such as imperiled species; Maseyk et al. 2016), similar to suggestions for restoration proposed by the expert panel (Appendix K). Some aspects of spatial considerations are discussed in the section on Service Area, but could be consolidated earlier in the document.

To the extent possible, it would be useful to articulate policy choices that are in place that guide the use of the HEA approach within the Puget Sound Calculator.

Provide the mathematical basis for HEA:- Section 2.4 contains a narrative approach to HEA with examples, but the section could be streamlined by restricting the discussion to the mathematical equations, explanation of parameters and assumptions. Symbolic notation of key parameters, and showing how they enter into HEA helps to reduce the "black box" nature of the calculator, and for proponents, may allow customized applications when project complexity (either as impacts, mitigations, or offsets) may make the Calculator difficult to use.

For example, in Section 3.3 the description of the calculation of maximum service values is provided. As before, this could be much more succinct if the mathematical basis for the calculation is provided so the reader can understand what was done first, before specific entries are described (e.g., the site specific details and rationale). It is currently difficult to extract what was done from the material in this section.

Section 2.4 should begin with a mathematical description of HEA. There are many examples in the literature that could guide this suggestion (e.g., Levrel et al. 2012; Minns 1997 etc.). The specific application and adaptation to Puget Sound can occur in later sections.

Section 3.3 First, the section could include a figure or table to show the components of the habitat service values with some information on their rationale (i.e. Duration, Forage, Cover, Migration, Water Quality). See figure 1 of Maseyk et al. (2016) as an example. Then, the equation used to combine and scale these attributes would be presented. This leads directly into the development of Table 3-1.

For example, maximum service values for zone i appear to be computed as:

$$HSV_i = \frac{Dur_i + For_i + Cov_i + Migr_i + WQ_i}{Dur_{LSZ} + For_{LSZ} + Cov_{LSZ} + Migr_{LSZ} + WQ_{LSZ}}$$

Here the scores (ranging from 0 to 1 for Duration, and 0-0.5 for the PBFs) are summed and standardized against the those for LSZ, which was the zone of highest value.

2.4 Page 12. Discount rate—while discount rate is designed to emulate preference for benefits in hand than in the future, it may be worth noting that it is also useful in the context of ESA species as population recovery will be accelerated with early, rather than later interventions.

"Time between impact and offset" – In this paragraph "temporal change" rather than "losses" should be used. In some cases, offsetting can occur before impacts, resulting in increased credits (e.g., habitat banks). Discounting can further inflate credits in this case, reflecting preference for sooner, than later interventions. It might more appropriate to state temporal change in service interacts with the discount rate in the calculation of DSAY.

Page 12 "Assumptions underlying HEA". This section needs review as some of it is unclear, and may not be correct. I suggest focusing on the generic HEA without introducing Puget Sound details.

The first point, that a single currency (metric) is needed to facilitate an offset exchange, is true and supported by papers that describe equivalency approaches (See review in Bradford et al. 2016).

The second: "type and quality of impacted and compensated ecological services are equal" is not an assumption of HEA, but is a common situation when a "like for like" exchange occurs in the same time frame. In these cases, an equivalency calculation may not be necessary. For "out of kind" offsetting, or when there are temporal trends in impacts or offsetting, the common metric and calculus of equivalency analysis is required.

The third: "the value of impacted services has to equal the compensatory services" is a policy decision of the program, not an assumption of the model. In many cases a goal is to have the predicted value of the offset is higher than the loss, to account for the risk of partial offset failure, or to contribute to gains in biodiversity.

The fourth: “services are constant over time” is not required in equivalency analysis in general. Any trajectory for project effects or offsets can be used in the analysis; those trajectories will interact with the discount rate to determine the total services provided over the time window.

Section 3.4 describes adjustments to habitat quality- In this section, modifiers are introduced to adjust service values in cases where conditions are not likely to produce the maximum values in Table 3-1. This step is difficult to follow in the document for a number of reasons.

First, the section introduces VSP parameters and suggests they are endpoints (see Figure 3-5), yet as I understand it, changes to VSP parameters resulting from changes to the PBF’s are inferred (i.e., are not part of the formal analysis). Habitat Service values remain the endpoint of the analysis from which equivalency computations are made.

From the perspective of equivalency analysis, it is useful to distinguish between the steps to modify the PBFs for habitats that are not be optimal or maximal in the “pre-development” phase, and those needed for the assessment of project impacts. My expectation was that this section provided information to scale PBF’s for existing conditions. That is, this step results in the modification of values in Table 3-1 for habitats that are not maximal. A second step is needed to compute how much PBFs change when the residual effects of a proposed project are being considered (or if an offsetting or restoration project is being assessed). Currently the discussion of Section 3 seems to confound the 2 steps needed for HEA.

I assume that the goal of this section is to provide modifiers to the maximum PBF scores in Table 3-1 (or similar) to reflect local habitat conditions. This can be done by using a 0-1 multiplier on the PBF scores for each zone, or across zones. To aid in identifying an appropriate score, each PBF is broken down to a number of contributing effects or feature that provide the service, called “effects pathways”. This approach, (perhaps first set out for habitat management by Jones et al. 1996) has seen extensive development and use in a variety of settings in the form of influence diagrams or pathways of effects diagrams or models. The diagrams are an organizing tool to identify the most important contributors to the endpoints, and their interrelations. They are also useful for organizing scientific material to provide the evidence supporting a pathway. In Canada, they are extensively used to discuss avoidance and mitigation measures that can be used to reduce the residual effects and the need for offsetting (https://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html). Scientific reviews are also well structured when they are based on the influence diagrams (e.g., Brownescombe and Smokorowski 2021).

The use of “indicators” and “metrics” is unclear. It appears that some of the indicators and metrics highlighted in Figures 3-5 and 3-6 are changes in conditions as a result of development activities (e.g., boat ramps) while others are attributes of a site (density of SAV). I found both of these figures hard to reconcile with the text description. I would have expected a pathway from left to right (or top to bottom) that shows the linkage between the various components leading to a modified PBF and ultimately a HSV. It's unclear why VSPs in are in Figure 3-5, or what IMSS is in 3-6.

There also appears to be a different algorithm being used to develop the depth-zone specific HSVs here, compared to Section 3.3. In 3.3, the scores are weighted 33% inundation, and ~17% for each of the other 4 PBFs. However, in 3.4 the weighting schemes are different, and inundation is not included. Further, some of the PBFs have slightly different names between Tables 3-1 and 3-5/6. I also don't understand the column "Percent adjusted for NHVM" in Tables 3-2 and 3-3 (also I believe the column labelled "Percent" should be "Proportion").

In the introductory sections (1 or 2) of the report, insert a stand-alone sub-section that describes the assumptions and information that is used to infer that PBZs can be used as surrogates for salmon survival or VSPs. Then this issue does not need to be revisited in later sections as it tends to add confusion to what is being done (for example, the introduction of VSPs in Figure 3-5).

In mathematical notation, and with generic flow diagrams, clearly explain the process for computing site-specific conditions. The equations might be (noting that my interpretation may be incorrect):

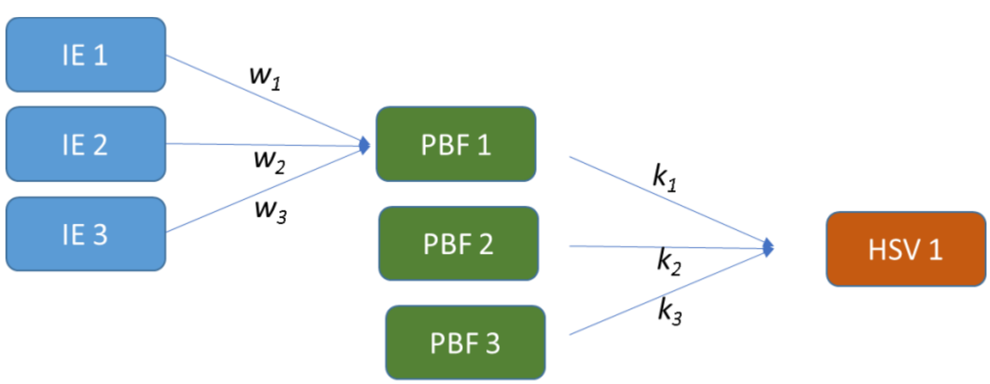
$$PBF_{i,z} = \sum w_{i,j,z} IE_{i,j,z}$$

and

$$HSV_z = \sum k_{i,z} PBF_{i,z}$$

Where i identifies PBFs in each zone (either 3 or 4), j indexes "indicator effects pathways" (1 up to 3), and z specifies zone (5). Weights are w, the relative contribution of IE (indicator effects), and k, the contribution of individual PBFs to the HSV score for that zone. With the weights w and k each summing to 1, and the IE scores with range 0-1, HSV values will range from 0-1.

The corresponding flow chart could look like this:



With the notation and mathematics used in the Calculator clearly set out, then the narrative can explain into how each of the IEs and weights were estimated or arrived at. While my interpretation of what was done may not be correct, the steps outlined above would help clarify the approach taken in the Calculator.

Section 3.4.1 and beyond provides detailed rationale for effects/indicator for PBF scoring- Unfortunately this section is also hard to follow as the algorithm for translating the summary of knowledge about habitat, development impacts, and offsets to numerical values for the Calculator is sometimes unclear. I interpret Table 3-2 as showing there may be one to three effects pathways (effectively sub-indicators) per indicator/PBF. It seems as if the IE scores presented in the table represent the maximum influence the effect would have on the indicator and represent the contributions that would occur under “good” habitat conditions. It is not clear how sub-optimal conditions are scored (or effects of development) for the IEs.

On page 35, after the discussion of IEs and the mechanisms by which migration disruption could occur and the effect it might have, it appears that the scoring is based on the Indicator (not the Indicator Effects” of Table 3-2), with the proportion of shading used as the metric. It remains very unclear to me what role the scoring of IEs in Table 3-2 plays in the Calculator, if the modifications occur to the Indicator metrics, rather than the IEs.

Section 3.4.2.1. -Make explicit what is being assumed for zonal effects (in terms of the computations in the Calculator). Something like “effects on migratory pathways are assumed to occur in all zones except RZ, where there is no effect”. It is not accurate to suggests the effects are “shared” as that ignores the shape or nature of the project.

Section 3.4.3 Forage and cover- As noted earlier, in section 3.3 “forage” and “cover” are treated as separate PBFs but are combined here. This needs to be reconciled. As above, a clear statement of how indicators will vary by zone needs to be added.

Section 3.4.3.1- In each of these sections describing the indicators, it would be useful to make and explicit statement at the beginning like “For the Lower Shore Zone we chose (1) submerged aquatic vegetation and (2) sediment associated invertebrate production as indicators.” rather than using bold font in the text, which seems to vary in usage.

For each PBF-Zone combination consider presenting a small table with the Indicator, the Metric, and where appropriate, the scoring categories that have been developed where the indicator is not continuous. For example, Figure 3-9 could be represented as a table, since it is described as being categorical in the text. Table 3-4 is an example of those categories.

Section 3.4.4.1.3-There is a different scoring system implied in the WQ section- this should be converted to numerical values to be consistent with the others.

3.4.5- Riparian zone. As in other sections the scoring system is not well explained. In figure 3-10 there are 4 pathways with scores (out of 11) leading to VSPs, which are not in the Calculator. Then in Figure 3-11 there is another scoring system leading to a sum of 55. I infer the value of 55 is meant to relate to the maximum service value of 0.55 in Table 3-1 that was arrived at by a different series of computations. All of this can be explained more clearly.

3.7 Service area- The delineation of Service areas is a policy choice. It's unclear how this affects the Calculator directly as I assume that proposed offsets would have to meet Service area requirements as set out by Policy before being entered into the calculator. Global considerations such as service area should precede the detailed description of the Calculator.

4.1 Structure replacements. I found the description of how structure replacement are managed to be unusual as it seems to assume that the proponent of the replacement project is in effect "responsible" for the changes that may have occurred during the initial structure installation, which means the proponent would be responsible for offsetting impacts that may have occurred in the past.

4.2 Riparian zone assessment- The algorithm for deducting service value based on distance and armoring should be written out as equations. Bullet Point #1 refers to the seaward edge of the riparian zone. Is there any consideration for the width of the riparian zone?

4.3 Overwater structure- The 4^{th} column of Table 4-3 should be labelled "Proportion" not "percent".

4.6 Dredging- The concepts of a temporary loss of function for components of the LSZ zone from dredging is reasonable. However, it is difficult to understand the contents of Table 4-7 and how that affects service values for this zone. The column title "Percent Influence NHVM" is both incorrect (it is proportion) and unclear in its meaning.

5 Adjustment factors – Figure 5-1 is unclear: what do x and xx signify?

The second column is also unclear- it might be more consist to display the multipliers (1.5, 1.3 etc.) here. Also the multiplier for new structures does not generate more "credit" so the column title needs revising.

7. Research Needs: There is a need to evaluate the benefits of offsetting or other activities design to achieve conservation gains. In the Calculator there is the assumption that offsets will work as proposed, and that function will be sustained over a long period of time. If offsets are not successful, then the overall program will need to be evaluated, and adjusted accordingly. This is a worldwide knowledge gap.

References (Please contact the author of this review for any of these).

BBOP. 2012. Resource Paper: No Net Loss and Loss-gain Calculations in Biodiversity Offsets. Business and Biodiversity Offsets Programme, Washington, D.C.

Bradford, M.J., Smokorowski, K.E. Clarke, K.D., Keatley, B.E. and Wong, M.C. 2015. Equivalency metrics for the determination of offset requirements for the Fisheries Protection Program. DFO Can. Sci. Advis. Sec. Res. Doc. 2015/nnn. vi+32 p. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2016/2016_046-eng.html

Brownscombe, J.W., Smokorowski, K.E. 2021. Review of Pathways of Effects (PoE) diagrams in support of FFHPP risk assessment. DFO Can. Sci. Advis. Sec. Res. Doc. 2021/079. iv + 55 p. https://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2021/2021_079-eng.html

Chalifour, L., et al. 2019. Habitat use by juvenile salmon, other migratory fish, and resident fish species underscores the importance of estuarine habitat mosaics. Marine Ecology Progress Series 625:135-162.

Clarke, K.D. and Bradford, M.J. 2014. A Review of Equivalency in Offsetting Policies. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/019. https://www.dfo-mpo.gc.ca/csas-sccs/publications/resdocs-docrech/2014/2014_109-eng.html

Macdonald, J.S., H.E. Herunter, and E. Chiang . 2018. Small craft harbours in the Pacific region: habitat impact, benign alteration or habitat creation? Can. Tech. Rep. Fish. Aquat. Sci.3255: v + 58 p.

Levrel, H., Pioch, S., and Spieler, R. 2012. Compensatory mitigation in marine ecosystems: which indicators for assessing the “no net loss” goal of marine ecosystem services and ecological functions? Marine Policy 36:1202-1210.

Levy, DA, Northcote, TG. 1982. Juvenile salmon residency in a marsh area of the Fraser-River estuary. Canadian Journal of Fisheries and Aquatic Sciences 39:270-276.

Maseyk, FJF, Barea, LP, Stephens, RTT, Possingham, HP, Dutson, G, and Maron M. 2016. A disaggregated biodiversity offset accounting model to improve estimation of ecological equivalency and no net loss. Biological Conservation 204:322-332.

Minns, C.K. 1997. Quantifying “no net loss” of productivity of fish habitats. Canadian Journal of Fisheries and Aquatic Sciences. 54: 2463-2473.

Minns, C.K. 2006. Compensation ratios needed to offset timing effects of losses and gains and achieve no net loss of productive capacity of fish habitat. Canadian Journal of Fisheries and Aquatic Sciences 63: 1172-1182.

Minns, C.K. 2015. Canadian Fish Habitat Management: Symptoms and Remedies. American Fisheries Society Symposium 78:213-248.

Quetier, F. and Lavorel, S. 2011. Assessing ecological equivalence in biodiversity offset schemes: Key issues and solutions. Biological Conservation 144: 2991-2999. Doi: 10.1016/j.biocom.2011.09.002.

Souza et al. 2023. Evaluating the potential of biodiversity offsets to achieve net gain. Conservation Biology DOI: 10.1111/cobi.14094

Theis, S., Ruppert, J. L., Roberts, K. N., Minns, C. K., Koops, M., & Poesch, M. S. (2019). Compliance with and ecosystem function of biodiversity offsets in North American and European freshwaters.Conservation Biology. https://doi.org/10.1111/cobi.13343

zu Ermgassen, S. O. S. E., Baker, J., Griffiths, R. A., Strange, N., Struebig, M. J., & Bull, J. (2019). The ecological outcomes of biodiversity offsets under “no net loss” policies: A global review. Conservation Letters, 12, e12664.

Appendix 1: Bibliography of material provided for review

Main Documents:

● Nearshore Calculator Scientific rationale (central document providing background and information for quantifications developed for Nearshore Calculator) 145 pages + appendices (Ehinger et al. 2023)

● Nearshore Calculator – Excel Spreadsheet, available on NOAAs web page.

● Annotated and updated Excel Nearshore Habitat Values Model.

Background Documents:

● User Guide (provides instruction on how to populate fields and get impact/benefit results from calculator) – available on NOAAs web page at: https://www.fisheries.noaa.gov/resource/tool-app/puget-sound-nearshore-conservation-calculator, 60 pages.

● Cereghino et al. 2023 – (describes GIS layers developed to identify Highest Astronomical Tide (HAT) lines in Puget Sound) 45 pages.

● Historic document Ehinger et al. 2015 on previous model version.

● Lambert and Chamberlin. 2023. Beach nourishment in Puget Sound: status, use, and habitat impacts - in final review by authors.

● Salish Sea Nearshore Programmatic (SSNP) Biological Opinion

Appendix 2: CIE Performance work statement

Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

Center for Independent Experts (CIE) Program

External Independent Peer Review

Under Contract #1305M219DNFFK0025

CIE Desk Review of the Puget Sound Nearshore Conservation Calculator and the integral Puget Sound Nearshore Habitat Values Model

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1].

[1] https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

Scope

NMFS is requesting peer review of the Puget Sound Nearshore Conservation Calculator (Nearshore Calculator) and the integral Puget Sound Nearshore Habitat Values Model to strengthen the quality and credibility of the agency's science, and improve stakeholder's trust that the agency is basing policy decisions on the best scientific information available.

NMFS designated critical habitat for Puget Sound (PS) salmonids in 2005 (70 FR 52629, Sept. 2, 2005). NMFS's designation of salmonid critical habitat describes which physical and biological features (PBFs) support the specific conservation roles of habitat. For estuarine and nearshore marine areas, essential PBFs of habitat for PS Chinook and Hood Canal Summer Run (HCSR) chum salmon include (1) unobstructed rearing and migration corridors; (2) forage including aquatic invertebrates and fish, supporting growth and maturation; (3) natural cover such as submerged aquatic vegetation and large wood;[2] and (4) water quality supporting juvenile and adult physiological transitions. NMFS used these PBFs as a framework for developing the Puget Nearshore Calculator, consistent with how NMFS evaluates effects on critical habitat under ESA section 7.

NMFS West Coast Region (WCR) developed the Nearshore Calculator to assist in analyzing the impact of proposed local development action in nearshore marine habitats within Puget Sound, Washington. The Nearshore Calculator is based on Habitat Equivalency Analysis (HEA) (Described in section 3 of Ehinger et al. 2023). The Nearshore Calculator is an easy-to-use interface for the Nearshore Habitat Values Model (NHVM). NMFS WCR designed the NHVM to consistently determine habitat service values to be used as input parameters in HEA.

For use as an analysis tool for ESA consultations, the Nearshore Calculator is based on evaluation of the PBFs and the conservation roles of those features - survival, growth, and maturation – and likely effects of proposed actions on population level viability (abundance, productivity, spatial structure, and diversity, or "VSP"[3]) for salmonids. The Nearshore Calculator quantifies changes to PBFs of listed salmonid habitat and considers how these changes likely affect salmonid growth, development, and VSP and as a corollary, the relative conservation value of an area of habitat. The formal structure and science-based quantitative assessment results in a more predictable quantification of the impacts of actions during an ESA

---

[2] The description of the estuarine PBFs further outlines "These features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean." ." https://www.federalregister.gov/d/05-16391

[3] The process NMFS typically uses to evaluate impacts on listed salmonids uses the viable salmonid population (VSP) concept (McElhany et al. 2000). McElhany et al. (2000) identified four parameters to evaluate the viability of a population: abundance, population growth rate, population spatial structure, and diversity. When analyzing the effects of actions on listed species as part of an ESA section 7 consultation, NMFS usually analyzes the effects on each of these parameters.

consultation, which is valuable because it improves consistency, efficiency, and transparency. Finally, the Nearshore Calculator is amenable to revision based on new science.

NMFS requests that the CIE reviewers conduct a peer review of the scientific information and framework of the Nearshore Calculator based on the Terms of Reference (TORs) referenced below.

The specified format and contents of the individual peer review reports are found in Annex 1. The Terms of Reference (TORs) of the peer review are listed in Annex 2.

Requirements

NMFS requests five (5) reviewers to conduct an impartial and independent peer review in accordance with the performance work statement (PWS) and the TORs below. Each reviewer should have working knowledge and recent experience in a minimum of three of the following areas:

(1) Salmon ecology;
(2) Marine nearshore ecology and/or conservation biology;
(3) Development of models preferably in the context of making decisions to avoid, minimize, or mitigate potential impacts;
(4) Science of valuing habitat for fishes based on ecological functions and services;
(5) Quantifying effects of physical changes (like the installation of shoreline armoring) on habitat conditions and functions;
(6) Quantifying effects of changes in habitat condition (structure & functions including vegetation, prey productions, water quality) on fish (preferably salmon) growth and survival.

In addition, knowledge and experience with Habitat Equivalency Analysis is helpful, though not required. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Tasks for Reviewers

Each CIE reviewer shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables herein.

1. Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site to the CIE reviewer all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review:

Main Documents:

- Nearshore Calculator Scientific rationale (central document providing background and information for quantifications developed for Nearshore Calculator) 145 pages + appendices (Ehinger et al. 2023)
- Nearshore Calculator – Excel Spreadsheet, available on NOAAs web page.
- Annotated and updated Excel Nearshore Habitat Values Model.

Background Documents:

- User Guide (provides instruction on how to populate fields and get impact/benefit results from calculator) – available on NOAAs web page at: https://www.fisheries.noaa.gov/resource/tool-app/puget-sound-nearshore-conservation-calculator, 60 pages.
- Cereghino et al. 2023 – (describes GIS layers developed to identify Highest Astronomical Tide (HAT) lines in Puget Sound) 45 pages.
- Historic document Ehinger et al. 2015 on previous model version.
- Lambert and Chamberlin. 2023. Beach nourishment in Puget Sound: status, use, and habitat impacts - in final review by authors.
- Salish Sea Nearshore Programmatic (SSNP) Biological Opinion

2. Webinar: Approximately two weeks after the CIE reviewers receive the pre-review documents, they will participate in a webinar with the NMFS Project Contact and Nearshore Calculator team members to address any clarifications that the reviewers may need regarding the TORs or the review process. The NMFS Project Contact will provide the information for the arrangements for this webinar.

3. Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role unless specified herein. Modifications to the PWS and TORs cannot be made during the peer review, and any PWS or TORs modifications prior to the peer review shall be approved by the Contracting Officer's Representative (COR) and the CIE contractor.

4. Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the PWS. Each CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. Each CIE reviewer shall complete the independent peer review addressing each TOR as described in **Annex 2**.

Place of Performance

Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Period of Performance

The period of performance shall be from the time of award through September 2023. The CIE reviewers' duties shall not exceed 10 days to complete all required tasks.

Schedule of Milestones and Deliverables

The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewers
No later than two weeks prior to the review	Contractor provides the pre-review documents to the reviewers
September 2023	Each reviewer conducts an independent peer review as a desk review
Within two weeks after review	Reviewers submit draft peer-review reports to the contractor for quality assurance and review
Within three weeks of receiving draft reports	Contractor submits five (5) final independent Peer-Review reports to the Government

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards:

(1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

Since this is a desk review travel is neither required nor authorized for this contract.

Restricted or Limited Use of Data

The contractors may be required to sign and adhere to a non-disclosure agreement.

Project Contact:

Kim Kratz

kim.kratz@noaa.gov

NMFS, West Coast Region

1201 NE Lloyd Blvd, Suite 1100, Portland, OR 97232

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specifically whether the Nearshore Calculator represents the best available science and if not, what specific improvements you recommend.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each TOR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the TORs.
3. The reviewer report shall include the following appendices:
    1. Appendix 1: Bibliography of materials provided for review
    2. Appendix 2: A copy of the CIE Performance Work Statement

Annex 2: Terms of Reference (TOR) for the Peer Review

The reviewers will provide input on the following questions. During your evaluation, please keep in mind that the Nearshore Calculator must use the best available science, Endangered Species Act consultations cannot be delayed until better science becomes available, and the Nearshore Calculator can be modified over time as additional science becomes available.

1) **Analytically sound process:**
   a) Are the underlying relationships that Nearshore Calculator and the NHVM are built upon (e.g. duration of aquatic access, functional pathways, indicators/metrics) sufficient and well-founded for evaluating effects of changes to nearshore habitat conditions on salmonids, given the stated goals and objectives? Is the analytical approach based on a valid list of habitat attributes (physical and biological functions)?
   b) Are there ways to strengthen the functional relationships the Nearshore Calculator is based on?
   c) Include in your findings a description of strengths and weaknesses.
   d) For weaknesses, please outline possible solutions considering the stated goals and the data availability, and if possible, provide references.
2) **Scientifically sound process:**
   a) Does the Nearshore Calculator systematically and appropriately incorporate and interpret the highest priority and best available scientific information given the stated goals and objectives?
   b) Indicate if and what relevant information is missing, provide references.
   c) Indicate if interpretations need to be refined, and if possible, provide references.
3) **Useful/realistic output:**
   a) Does the Nearshore Calculator generate reasonable and well-supported quantifications of the impacts (positive, negative, neutral) to nearshore habitats and salmon?
   b) If warranted, include in your findings a description of where the Nearshore Calculator likely over- or under-estimates impacts or benefits to salmon and their habitat.
   c) If warranted, outline possible solutions for better supported quantifications and if possible, provide references.

Objectives for the Nearshore Calculator

In summary, the Nearshore Calculator is designed to be:

- Rapid and Efficient – quantify habitat services using data typically provided as part of ESA-consultation packages.
- Accessible – invite use by biological consultants, agency personnel, and applicants.
- Transparent – allow users to review every element of an assessment.
- Consistent – produce repeatable results through the use of objective indicators and criteria. Expert opinion is thoroughly developed and reviewed and then frontloaded into the Nearshore Calculator rather than applied by individual biologists.
- ESA-based – references PBFs of critical habitat and effects on the survival, abundance, and productivity of listed salmonids.
- Duration-sensitive – consider the duration of impacts and benefits.
- Scaled to level of effects – evaluate the small difference in common project types, for example, the changes in shading caused by the size of overwater structures and the use of grating.
- Adaptable – allow for the incorporation of new science or best available information.