ENGINEERING AND CONSTRUCTION BULLETIN

US Army Corps of Engineers

No. 2024-9 **Issuing Office:** CECW-EC **Issued:** 16 Aug 24 **Expires:** 16 Aug 26

SUBJECT: Guidance for Incorporating Greenhouse Gas Emissions Analysis in National Environmental Policy Act Reviews

CATEGORY: Guidance.

1. **References.** See Attachment C.

2. **Purpose.** This Engineering and Construction Bulletin (ECB) issues guidance for incorporating greenhouse gas (GHG) emissions analysis for compliance with the National Environmental Policy Act (NEPA). This ECB is effective immediately and applies to all projects that must comply with NEPA. This ECB provides guidance for incorporating the following:

- Council on Environmental Quality's (CEQ) *Interim NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change* [reference a]
- Executive Order (EO) 14057: *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability* [reference b]
- EO 14072: *Strengthening the Nation's Forests, Communities, and Local Economies* [reference c]
- EO 14008: *Tackling the Climate Crisis at Home and Abroad* [reference d]
- EO 13990: *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis* [reference e]
- Interagency Working Group on Social Cost of Greenhouse Gas (SCGHG) *Memorandum on Social Cost of Greenhouse Gas* [reference f].

Per the policy listed above, agencies must consider the effects of GHG emissions in the formulation and evaluation of alternatives in NEPA documents, for all current and future studies. Agencies must also consider the effects of GHG emissions in supplemental NEPA documents; hence, agencies must also apply the requirements of this guidance to projects already in the pre-construction engineering and design (PED) and construction phases.

This ECB was produced with coordination from disciplines within the US Army Corps of Engineers (USACE) including Civil Works and Military Construction (MILCON) with comprehensive review from subject matter experts, districts, divisions, headquarters, legal counsel, and the Office of the Assistant Secretary of the Army for Civil Works (OASACW).

3. **Objective.** The objective of this ECB is to enhance USACE analysis of GHG emissions for planned, new, and existing USACE projects to consider how GHG emissions impact climate change and vice versa. To address the objective, this ECB summarizes best practices and provides the latest guidance and policy. This ECB applies to any USACE action that requires NEPA compliance, including actions analyzed under supplemental NEPA documents.

4. **Background.** Climate plays a role in modulating water levels that underpin flood risk management, aquatic ecosystem restoration, navigation, coastal storm risk management, water supply, and hydropower. Therefore, it is important for all USACE Civil Works and Regulatory projects to consider the effects of GHG emissions on climate change. GHG emissions reductions requirements for federal agencies date back to 1999 with EO 13123: *Greening the Government Through Efficient Energy Management* [reference g]. The requirement to include GHG emissions analysis in NEPA studies was formalized in the 2016 CEQ Memorandum "*Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews*" [reference h]; however, many federal agencies quantified GHG emissions for projects even before the 2016 CEQ Memorandum. At that time, there was no established methodology, and thus, agencies used various quantification methods. Today, there are numerous emissions models to choose from, many with distinct geographic applicability. Due to the varied history and resulting variations in how to perform a GHG emissions analysis, this ECB summarizes best practices for performing a GHG emissions analysis for documents prepared in NEPA reviews.

5. **Performing GHG Emissions Analysis for Project Planning and NEPA.**

a. **Best Practices for Emissions Analysis.** The project delivery team must produce estimates of GHG emissions using the most relevant and current emissions models and emissions factors available. Do not use emissions models and emissions factors specific to a certain region or state for projects in locations where they do not apply. For example, the California Emissions Estimator Model (CALEEMOD) [reference i] and Emissions Factor (EMFAC) model [reference j] are specific to the State of California and must only be used for emissions analyses associated with that state. In cases where no emissions models or emissions factors exist, the project delivery team can use alternative modeling results or emissions factors that closely approximate expected emissions. The Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP can help project delivery teams identify the best alternative model (see Attachment B). The project delivery team can also find alternative models through academic research and consultation with relevant agencies (e.g., the United States Environmental Protection Agency or a state air quality management agency). When using incorporation by reference to adopt GHG emissions results and analysis from a similar project (e.g., similar project scope, complexity, project features being built), the project delivery team must identify in the NEPA document whether the adopted analysis could overestimate or underestimate emissions. As part of that documentation, the project delivery team must note any differences in the equipment list, activity, and other factors to provide transparency for how emissions quantities from an adopted analysis may differ from the actual emissions for the project.

Within NEPA documents and relevant appendices, the project delivery team must provide clear information so that the public or other reviewing federal agencies can understand how emission analysis results were obtained or calculated. The following list provides some best practices:

- Include all relevant equations (and their defined variables) and data sources
- Use a consistent format throughout all results tables for easy review

- List key assumptions (e.g., equipment list details, distances and hours that equipment is used)
- If applicable, include a discussion of modeling assumptions to elucidate how these assumptions may result in higher or lower emissions estimates.

The project delivery team must document assumptions for emissions analysis commensurate with the anticipated GHG emissions. Projects that have large amounts of anticipated GHG emissions (e.g., mega projects, general investigation studies) must include a more detailed scope of analysis by using items identified by project engineers specific to the project alternatives such as equipment lists, specific distances and hours for equipment use, and emissions processes (e.g., idling and low speed emissions). Please refer to the *GHG Standard Operating Procedure* for scoping analysis examples (reference k). Projects with low amounts of GHG emissions are generally those that can be built within one construction season (e.g., applicable Continuing Authority Program projects, operations and maintenance [O&M] projects) and require minimal operations and maintenance emissions. The project delivery team can simplify documented assumptions for smaller projects for equipment lists, emissions processes (i.e., exclude idling), and distances and hours (e.g., assume one distance or set of hours). Use of other simplifying assumptions for calculated GHG emissions is encouraged, when appropriate. For example, for small and medium projects if the project delivery team can estimate fuel volumes from similar projects or similar construction activities, GHG emissions may be calculated using fuel emissions factors to convert from a unit volume of fuel into GHG quantities.

The GHG emissions analysis should quantify a conservative scenario to estimate the reasonable maximum emissions anticipated for each alternative, and the NEPA document must detail how the actual GHG emissions from each alternative may vary due to analysis assumptions. A discussion of how natural and anthropogenic processes are included or absent from analysis assumptions must be included to relate how actual GHG emissions from the action can vary from what is estimated in the emissions analysis. For example, natural wetting and drying cycles and anthropogenic nutrient inputs may decrease freshwater wetland methane emissions below what is estimated by using a constant methane emissions rate. If the methodology to quantify GHG emissions does not follow the same methodology and scope used in the emissions analysis for Clean Air Act criteria air pollutants, the project delivery team must provide an explanation within the NEPA document to provide the rationale for the difference in methodology and possible sources of discrepancy between the two modeling approaches for transparency with the public. The emissions analysis must not be a lifecycle carbon analysis that quantifies all emissions. For example, there is no need to quantify factory emissions for creating heavy construction equipment if it is reasonable to assume they would exist regardless of the specific construction project.

All quantitative GHG emissions analyses use the following generalized steps:

- Account for reasonable emissions and sequestration for each unique GHG type (i.e., carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O]) under each alternative

including the no action alternative. To quantify the total emissions for each unique GHG for each alternative, subtract the sequestered quantity from the emitted quantity.

- Convert each unique gross GHG to carbon dioxide equivalent (CO_{2e}) units using the global warming potentials per 40 C.F.R. § 98 Appendix Table A-1 [reference l].
- Calculate the net GHG emissions to compare emissions from each alternative to the no action (baseline) alternative. To calculate net emissions, subtract the no action alternative total emissions from each of the action alternative emissions totals for each unique GHG and CO_{2e}.

Global warming potential must only be used in calculating CO_{2e}. GHG emissions must not be calculated by using the global warming potential as a conversion factor to convert the outputs of one unique GHG to calculate outputs of a different GHG. Reporting CO_{2e} must never be used to justify not reporting both CO_2 and CO_{2e}.

b. **Incorporating GHG Emissions Analysis in the USACE Planning Process.** Starting at the earliest stages of planning, the project delivery team must qualitatively evaluate GHG emissions to determine the appropriate NEPA document. If the preliminary qualitative analysis anticipates a significant effect from GHG emissions and/or from other environmental effects, a Categorical Exclusion (CATEX) may not be used and an EIS followed by a ROD would be needed, otherwise if less than significant effects from both GHG emissions and other environmental effects are anticipated, then an EA/FONSI would be needed unless the specific action is covered by an applicable CATEX. The qualitative emissions analysis must also be used for identifying and eliminating alternatives for the final array of alternatives in reaching the Tentatively Selected Plan and Agency Decision Milestone if applicable.

The project delivery team must use a quantitative estimate of gross and net GHG emissions (e.g., grams, pounds, metric tons including both GHG emissions and sequestration) as a metric to compare all alternatives including the no action alternative, proposed action, and each reasonable action alternative in the final alternatives array for public review of NEPA documents including integrated draft feasibility reports. Alternatives with elevated net GHG emissions may still be selected due to other benefits; for example, freshwater wetland restoration may increase the net methane emissions but still be selected as the action alternative based on the additional ecosystem services anticipated. The project delivery team may need to refine the quantitative GHG emissions analysis as alternatives are adjusted throughout the project planning process.

If any changes to an emissions analysis occur after the public review, the project delivery team must document the changes in the final NEPA document. If changes occur to an emissions analysis after public review and if the changes result in a determination of significant effects for the recommended plan, the project delivery team must redistribute the NEPA document as a supplemental draft to the public before finalization. Otherwise, if changes to anticipated GHG emissions between the public draft and the final draft do not change the effect determination for the recommended plan, no additional public review is required.

c. **Metric for NEPA Effects Analysis.** The GHG emissions analysis must identify the metric for determining significant effects, per 40 C.F.R. § 1501.3(d), at the beginning of the effects section [reference m]. Although a numerical threshold has not been determined for federal projects as of the date of this guidance, the project delivery team must identify state or agency specific thresholds in the NEPA document to provide transparency for public review. If the project delivery team uses a nonfederal threshold to determine significant effects from GHG emissions, it must be clearly stated in writing that the nonfederal threshold is not being formally adopted for any pending or future matter as the "USACE agency standard" for determining significant effects. Additionally, the project delivery team must obtain approval to use a nonfederal threshold from the vertical team including the applicable Major Subordinate Command (MSC) Environmental Chief and reviewer(s) from USACE Headquarters.

The recommended metric for determining significant effects is to evaluate whether anticipated GHG emissions from each alternative prevent the federal GHG reduction goal from being met [reference n]. To the extent practicable, the project delivery team should provide information on the portion of the future emissions reduction goal most closely related to the project to better contextualize how the metric is used. For example, project delivery teams should compare construction emissions from a project to the portion of the future emissions reduction goal that is specific to construction emissions.

d. **Key Quantities for NEPA Documents.** During alternatives evaluation and comparison, the project delivery team must quantify total (gross) emissions in the NEPA document for primary GHG types (e.g., CO_2, CH_4, and N_2O) and for CO_{2e}. This ECB does not require quantification of secondary GHG types (e.g., carbon monoxide [CO]) that can later form a primary GHG with further chemical reactions. The project delivery team must quantify net emissions in the NEPA document for each primary GHG type and CO_{2e} and summarize emissions based on their type.

Emission Types:

- Direct (short term, long term, local, remote)
- Indirect (short term, long term, local, remote)
- Downstream
- Upstream
- Connected

For example, emissions during a typical construction phase may be typically categorized as direct, short-term, and local emissions, and summarized all in one table. Discrete O&M emissions necessary to support the function of the planned structure are indirect emissions and must be summarized in a table alongside long-term emissions. The project delivery team must also quantify and summarize connected emissions, which are from connected actions[1] related to

[1] Actions are connected if they: (i) automatically trigger other actions that may require a NEPA document; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; or (iii) are interdependent parts of a larger action and depend on the larger action for their justification.

a proposed action that would not be emitted if not for the action, in the emissions analysis and add the connected emissions to each of the alternative totals to support a net emissions calculation. For example, if separate phases of a project had different NEPA documents, the GHG emissions analysis from each NEPA document must include emissions from all project phases. Finally, the total gross emissions must be disclosed for each alternative in the NEPA document, which are the totals of each unique GHG across all emissions types (e.g. direct, indirect, downstream, upstream, and connected).

e. **SCGHG.** The Social Cost of Greenhouse Gas Emissions Intergovernmental Working Group (SCGHGIWG) issued a memo on December 22, 2023, stating that agencies can use social cost estimates from sources other than the SCGHGIWG [reference o]. The SCGHGIWG memo coincided with the release of the EPA's *Final Report on the Social Cost of Greenhouse Gases* [reference p]. These 2023 EPA social cost estimates are the most current, accepted social costs available and are used in the USACE Net Emissions Analysis Tool (NEAT model) [reference q] as the standard approach for calculations. The USACE updates the NEAT model when new social cost estimates are approved for use. Project delivery teams must use the social cost estimates from the current version of the NEAT model at the time of the GHG emissions Analysis to calculate the SCGHG.

The project delivery team must calculate SCGHG whenever quantifying GHG emissions. The project delivery team must calculate and report the gross SCGHG for each GHG in a summary table of the NEPA document with SCGHG calculated from sequestration of GHG emissions used to subtract from the total SCGHG of each alternative. The SCGHG must be calculated using the emissions from the specific year the emissions are produced and include a sum over the entire project lifetime to get the total SCGHG. In cases where the exact year is not included in the social cost estimate table, the project delivery team must use the closest year for which there is data available. The SCGHG estimates table must never be extrapolated for social cost estimates in future years. The project delivery team must write the social cost estimates in dollar values of a particular year according to the SCGHG estimates being used. For example, the 2023 EPA GHG social cost estimates use 2020 dollars and must not be converted into current dollar values. SCGHG estimates use damage functions that calculate costs on varying scales (e.g., global, national) that are not applicable for calculating benefits or costs for project alternatives at a local or regional scale. Do not calculate SCGHG using CO_{2e}, as there are unique social costs for each GHG. Do not use SCGHG as a metric to make a determination of significant effects in NEPA documents.

Project delivery teams must provide a comparison of the no action, proposed action, and each reasonable action alternatives' SCGHG in the NEPA document using the net SCGHG. To calculate the net SCGHG, subtract the no action alternative's gross SCGHG from each of the action alternatives' gross SCGHG. The project delivery team must not calculate project emissions through use of the SCGHG tables of values to convert project construction costs to emissions [reference p].

Avoidance, Minimization, and Mitigation. To the extent practicable, the project delivery team should configure project alternatives to minimize or avoid disturbance to GHG sequestration processes and reduce or avoid GHG emissions. To do so, the project delivery team should consider these factors when comparing alternatives. Similarly, SCGHG should be minimized or avoided for each project alternative to the extent practicable and should be used in consideration of project alternatives. This ECB does not establish a new compensatory mitigation requirement.

f. **Incorporating GHG Emissions Analysis in Supplemental NEPA Documents.** Inclusion of a GHG emissions analysis per requirements of this ECB must be performed for supplemental NEPA documents that are necessary due to new circumstances or information bearing upon environmental effects of the action that were not originally analyzed as directed in 40 CFR 1501.5 and 40 CFR 1502.9 [references r and s]. Inclusion of a GHG emissions analysis must not form the basis to complete a new supplemental NEPA document if a GHG emissions Analysis was not required when the original NEPA document was concluded [references r and s]. Supplemental NEPA documents must bring the original document up to date with applicable guidance, laws, and policy, including the CEQ's *Interim NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. As such, the items included in this ECB also apply to supplemental NEPA documents with a prospective approach for the analysis. Therefore, the emissions analysis must not include emissions from project construction that has already been completed; the project delivery team must only estimate those emissions for portions of the project that are not yet constructed. Following the same formulation of project alternatives in the supplemental NEPA document, GHG emissions analysis must include all relevant emissions.

The project delivery team must use the baseline emissions to compare the action alternatives through the net emissions calculation. However, the baseline emissions depend on the formulation of the supplemental NEPA document. If there is a no action alternative to abandon construction as previously planned in the original NEPA document, no action alternative emissions must be quantified using the most reasonable land use that would result. If the baseline alternative is to finish the originally planned remaining work, no action alternative emissions must include both the future emissions anticipated for completing construction work as originally planned and all O&M emissions per the original plan. The GHG emissions for each action alternative from a supplemental NEPA document must include all remaining work with specific changes to reflect the differences for how work would be performed compared to the original formulation, and the O&M emissions specific to each alternative.

g. **GHG Emissions Analysis for Regulatory Projects.** This ECB directs the USACE Regulatory Division to revise applicable Decision Document Templates to include GHG emissions analysis requirements from this ECB, and the CEQ *Interim NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change* within 1 year of the release of this ECB.

h. **GHG Emissions Analysis for MILCON Projects.** MILCON projects may be subject to the requirements of this ECB if a directive has been given that MILCON projects integrate the CEQ's *Interim NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate*

Change into their NEPA studies. If there is any conflict between this ECB and the directives given to MILCON via any Assistant Secretaries of the Army (ASAs), the ASA directives will control.

6. **Effect of the Guidance.** This guidance is effective upon date of issuance and USACE decision-makers from all mission areas must use this guidance to inform their NEPA analysis for all new proposed agency actions. USACE Civil Works and Regulatory must immediately apply this guidance for ongoing actions that have not yet issued a draft environmental document. Project delivery teams should use professional judgment when considering how to apply this guidance to analyze actions at the feasibility stage of review.

The intent of this document is to provide clarity to USACE for compliance with NEPA regarding existing requirements under the laws, EOs, and USACE policies. To the extent there is any inconsistency between the provisions of this guidance regarding GHG emissions Analysis requirements with any federal laws or regulations, the laws or regulations will control.

7. **Update.** All new requirements will be included in the next appropriate policy document update prior to the expiration of this ECB.

8. **Point of Contact**. The point of contact for this ECB is Jason D. Emmons, SPN-PME-N, Jason.D.Emmons@usace.army.mil.

//S//
PETE G. PEREZ, P.E., SES
Chief, Engineering and Construction Division
U.S. Army Corps of Engineers

Encl.
Attachment A – GHG Emissions Analysis Checklist
Attachment B – Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP Leads and Agency Technical Review Cadre Leads
Attachment C – References

Attachment A: GHG Emissions Analysis Checklist

This section provides additional detail about the conduct of emissions analysis required under this ECB, NEPA, and use in planning activities under the USACE Planning Process (EC 1165-2-217).

Greenhouse Gas Emissions Analysis Checklist

Requirements Compilation for Analysis Creation and Review

This document provides a checklist for including relevant information in a greenhouse gas (GHG) emissions analysis and an accompanying National Environmental Policy Act (NEPA) document.

Contents

GHG Emissions Analysis Requirements

To determine the overarching GHG emissions analysis requirements, the project delivery team completes the following steps.

1. Identify the scope (complexity and detail) of a GHG emissions analysis. To make this determination, consider factors such as:
    - Whether the project has potential for positive or negative GHG impacts based on type of construction proposed and the operations and maintenance activities
    - The potential positive impacts on GHG emissions (i.e., sequestration) associated with ecosystem restoration
    - The relative size of the project (reference similar USACE-built projects for this determination) and whether it takes one versus multiple construction seasons to build, and the total emissions anticipated by including the operation and maintenance period

2. Perform a Qualitative Emissions Analysis to estimate emissions for use in deciding the NEPA document and eliminating alternatives to form the final array of alternatives. The qualitative analysis can use various metrics for comparing alternatives such as:
    - Fuel volume estimates for each alternative
    - Quantity of what is being built (e.g., linear feet of levee, cubic yards to dredge, acres to restore)
    - Activity hours estimate (number of hours each piece of equipment will be used) informed by the project schedule and preliminary equipment list

3. Perform a Quantitative Emissions Analysis using the best science and applicable models for the project location and equipment, ecosystem processes, and land use.
    - The quantitative emissions analysis is only for alternatives in the final array of alternatives and is to be used as a basis for alternatives comparison.
    - Consult with an Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP Lead as needed to ensure GHG emissions are analyzed and used in the planning process in compliance with NEPA.

Summarizing GHG Emissions By Emission Type

Emissions results from the Quantitative Analysis should be summarized by their Emissions Type (direct or indirect) and further distinguished for their timing (long term and short term) as well as location (remote and local). In addition to these types there are also upstream, downstream, and connected emission types to distinguish which relates the origin of emissions to the project. Note, emission types should be grouped as applicable (e.g., emissions from construction are direct and can also be dually local and short term).

Direct Emissions: Direct Emissions are a *direct result of the project* (e.g., construction, operations and maintenance (O&M]) and are quantified for carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and carbon dioxide equivalents (CO_{2e}). If expected, the analysis

must also quantify other GHG emissions such as from refrigerants. Refer to CFR Title 40 Chapter I Subchapter C Part 98 for the full list of GHGs. The quantification of carbon monoxide and other secondary GHGs are optional.

The project delivery team quantifies all applicable direct emissions:

- Quantify short term direct emissions for each GHG and CO_{2e} (e.g., construction emissions from equipment to build the project)
- Quantify long term direct emissions for each GHG and CO_{2e} (e.g., construction emissions for projects that take more than 10 consecutive years to build)
- Quantify local direct emissions (e.g., construction emissions from equipment on site to build the project)
- Quantify remote direct emissions (e.g., electricity generation to power equipment on site to build the project)

Indirect Emissions: Indirect emissions are those that would *not* be produced if not for the project (e.g., emissions from increased ship or truck traffic due to channel improvements).

The project delivery team quantifies all applicable indirect emissions:

- Quantify short-term indirect emissions for each GHG and CO_{2e} (e.g., increased emissions from road closures during construction that cause detours)
- Quantify long term indirect emissions for each GHG and CO_{2e} (e.g., emissions from a road closure that causes increased emissions from a detour for more than 10 consecutive years)
- Quantify local indirect emissions for each GHG and CO_{2e} (e.g., emissions from ship traffic after channel improvements)
- Quantify remote indirect emissions for each GHG and CO_{2e} (e.g., emissions from out of region electricity generation used for operations)

Downstream Emissions: Downstream Emissions are the result of any action alternative, consistent with the CEQ's *Interim NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. They are resultant because of the project action, but are not directly linked to the project in timing or location (e.g., emissions from later burning of fossil fuels that are produced by a project to build a refinery)

Upstream Emissions: Upstream Emissions are those necessary emissions that must be emitted for building, operating, and maintaining a project that are directly incorporated into the project. Upstream emissions are *not* lifecycle emissions tracking back to when products were made for goods that are produced which are not incorporated into the project (e.g., factory emissions from building a bulldozer would not be included since there is a reasonable assumption the bulldozer wasn't specifically built for the project and would be used for many subsequent projects). Upstream emissions should include emissions that are reasonably anticipated as necessary to allow for construction, operation, and maintenance of a project (e.g., factory emissions from creating the cement that gets used for building a flood wall).

Connected Emissions: Connected Emissions are those from other project actions which are deemed connected under NEPA. Actions are connected if they: (i) automatically trigger other actions that may require a NEPA document; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; or (iii) are interdependent parts of a larger action and depend on the larger action for their justification.

Action Alternative GHG Emissions for the Quantitative Analysis

The project delivery team must include the following in the GHG emissions analysis for all action alternatives in the final array of alternatives. The following key items and calculations are required components of the quantitative GHG emissions analysis:

1. Use the projected environment and conditions anticipated after the action to identify emissions sources that would be reasonable for the project area within the project lifetime if an action were taken.
2. Identify the appropriate GHGs (e.g., CO_2, CH_4, N_2O, perfluorocarbons, hexafluoride, etc.) that should be quantified including sequestration of emissions.
3. Quantify action alternative emissions including those from relevant equipment used during construction and operations/maintenance, land use, land management, ecosystem type, and summarize them according to the emission types as detailed above.
4. Equipment emissions factors must be state or county specific. Use only respective sources. For example, California emissions factors derived from the Emissions Factor (EMFAC) model must not be used for projects in other states unless there is prior knowledge that specified equipment for construction is California certified.

No Action Alternative (Baseline) GHG Emissions for the Quantitative Analysis

The project delivery team considers the following when quantifying the GHG emissions for the no action alternative:

1. Use the affected environment and/or baseline conditions as background information to identify emissions sources that would be reasonable for the project area within the project lifetime if no action were taken.
2. Identify the appropriate GHGs (e.g., CO_2, CH_4, N_2O, perfluorocarbons, hexafluoride, etc.) that should be quantified including sequestration of emissions.
3. Quantify no action alternative emissions including those from relevant land use, land management, ecosystem type, and summarize them according to the emission types as detailed above.

GHG Emissions Equations for the Quantitative Analysis

The below equations are the most widely used equations that will be needed for an emissions analysis but may not include those needed for converting units (unit conversions), and to

quantify other emissions processes such as those from land use (e.g., emissions from grazing animals), land management (e.g., emissions from prescribed fires), and ecosystem processes.

Aquatic Habitat GHG Emissions and Sequestration

For wetland and aquatic habitats, the project delivery team includes the following details:

1. Quantify emissions or sequestration of emissions from wetlands and aquatic habitat using the area, time, and rate consistent with the plan formulation for each alternative.

2. Calculate the aquatic habitat emissions using the following formulas:

Carbon dioxide sequestration:

$$CO_2seq = -SR * A * T$$

Where:

CO_{2seq} = the quantity of CO_2 sequestered (grams, pounds, metric tons).

SR = CO_2 sequestration rate, mass per unit area, per unit of time

A = area of wetland or aquatic habitat to be created

T = the unit of time for the benefits calculation (50 years typically, though may be reduced with sea level rise)

Note: Sequestration emissions have a negative value because sequestration removes CO_2 from the atmosphere and therefore the amount of CO_2 sequestered should subtract from the CO_2 gross total.

Methane emissions:

$$CH_4 = MR * A * T$$

Where:

CH_4 = the quantity of CH_4 emitted (grams, pounds, metric tons)

MR = methanogenesis rate in unit mass of CH_4 per unit area, per unit of time

A = area of wetland or aquatic habitat to be created

T = the unit of time for the emissions calculation (50 years typically, though may be reduced with sea level rise)

Nitrous oxide emissions:

$$N_2O = NR * A * T$$

Where:

N_2O = the quantity of N_2O emitted (grams, pounds, metric tons)

NR = N_2O production rate in unit mass of N_2O per unit area, per unit of time

A = area of wetland or aquatic habitat to be created

T = the unit of time for the emissions calculation (50 years typically, though may be reduced with sea level rise)

Net Emissions:

When reporting action emissions in net total metric tons (required), pounds (optional), and calculated, use the following equation:

$$\boldsymbol{E_{Net} = A_E - NA_E}$$

Where:

E_{Net} = net emissions for each action alternative (grams, pounds, metric tons)

A_E = total emissions for the action alternative (subtracting sequestered emissions)

NA_E = total emissions for the no action alternative.

Equipment Emissions:

Calculate equipment emissions using the following equation:

$$\boldsymbol{Emissions = LF * D * EF}$$

Where:

Emissions = the mass or weight of each GHG

LF = load factor (unitless)

D = operation data (time or distance)

EF = emissions factor (emissions per time or distance)

Carbon Dioxide Equivalents (CO2e):

CO_{2e} must be calculated from the *global warming* potential of each unique GHG (full list of GHGs not shown) using the below equation:

$$\mathrm{CO2e = X * CO2 + Y * N2O + Z * CH4}$$

Where:

X = 100 Year Global Warming Potential for CO_2 = 1

Y = 100 Year Global Warming Potential for N_2O = 298

Z = 100 Year Global Warming Potential for CH_4 = 25.

CFR Title 40 Chapter I Subchapter C Part 98: Table A-1 Global Warming Potential

Social Costs of GHG (SCGHG):

SCGHG will be calculated using the below the equation for each year in which emissions are anticipated over the project lifetime:

$$\text{SCGGHG} = \sum_{I}^{j} CO_2 * SCCO_2 + \sum_{I}^{j} N_2O * SCN_2O + \sum_{I}^{J} CH_4 * SCCH_4$$

Where:

period I to J represents the project lifetime

SCGHG = total social costs of all GHGs in dollars

CO_2 = metric tons of carbon dioxide

$SCCO_2$ = social cost of carbon dioxide specific for each year in period I to J

N_2O = metric tons of nitrous oxide for each year in period I to J

SCN_2O = social cost of nitrous oxide specific for each year in period I to J

CH_4 = metric tons of methane for each year in period I to J

$SCCH_4$ = social cost of methane specific for each year in period I to J

Social Cost of GHG Emissions

For quantitative analysis of the social cost of GHG (SCGHG), the project delivery team includes the following:

1. Analysis of SCGHG must use the latest approved SCGHG estimates which can be found in the Net Emissions Analysis Tool (NEAT) at the time the analysis is performed. As of the date of this publication the current SCGHG are from Table A.5 of the USEPA *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*, November 2023. https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf
2. Social costs must be calculated according to the year in which specific GHG emissions are anticipated. The gross and net SCGHG must be calculated for each GHG.
3. SCGHG should only be used to compare alternatives from the final array.
4. SCGHG from each Emissions Type and for each specific GHG should be summarized along with the gross and net totals.

Reporting in NEPA Documents

GHG emissions analyses must be represented in the *main body of the NEPA document* to inform identification and evaluation of impact significance, effects, and mitigation discussions. The project delivery team can include more detailed technic al analyses in referenced appendices crafted to inform, not just specialists, but general readership.

The project delivery team must include 1) a background sub-section where the regulatory framework and supporting details are included as well as 2) the effects analysis sub-section which includes the metric for significant effects, analysis results summaries, and final effects determination. The below requirements are summarized for each of these two sections:

Baseline Conditions, Regulatory Framework, and Supporting Details Sub-Section

1. The introduction to greenhouse gas emissions may be a part of the climate change sub-section or separate, though regardless should include a discussion of the baseline emissions for the region so that project emissions can be contextualized within the output of the larger regional emissions output.

2. The general process for climate change and factors that contribute to climate change (e.g., GHG emissions) should be discussed, specifically for how the pertinent GHGs contribute to global warming from absorption and reemission of radiation that would normally escape the atmosphere.

3. A summary of all relevant laws, guidance, and climate change/GHG reduction goals should be included (e.g., GHG reduction goals may include the federal, state, county, and even city levels of govt.).

4. Background information for the basis of the metric for determining significant effects must be included that it can be used later in the document in the effects analysis section.

GHG Effects Analysis Sub-Section

For a successful GHG effects analysis, the project delivery team includes the following details:

1. Begin the effects analysis section by clearly stating the metric for determining significant effects using the directive from section 5(c) of the Engineering and Construction Bulletin: *Guidance for Incorporating Greenhouse Gas (GHG) Emissions Analysis into Documents Prepared to Address National Environmental Policy Act (NEPA)* which this checklist is originally attached as the following: *the GHG emissions from an alternative will be considered to cause significant impacts if GHG emissions would prevent the Federal 2050 Net-Zero GHG Emissions Reduction Goal from being met*.

2. When using the Federal 2050 Net Zero GHG Emissions Reduction Goal- do not adopt the GHG reduction goal per se, state clearly that it is only for use as a metric. Identify supporting text and quantities for the Federal 2050 Net Zero GHG Emissions goal.

3. Document the methodology and the equations used to calculate GHG emissions. Document any changes in the analysis between the draft and final document for how the methodology changed. To communicate the changes to numerical results, use footnotes in updated tables and narrative in the body of the document when results are discussed.

4. Report all emissions in annualized gross total metric tons for the total during the construction and O&M periods to quantify the emissions over the project's lifetime.

5. O&M emissions must cover the entire project lifetime of 50 years. If not, document the assumption used in text or footnotes and explain how emissions are reduced in a future year, consistent with plan formulation.

4. For tables, include applicable footnotes defining gas species, data sources, and any other applicable information.

6. Include summary tables for emissions from each applicable emissions type for each action alternative and the no action alternative:

    - Direct emissions (from construction, emitted for building the project). Direct emissions can be short-term, long-term, local, and remote.
    - Indirect emissions (emissions from O&M emissions). Indirect emissions can be short-term, long-term, local, and remote.
    - Upstream Emissions (emissions necessary for operating project features that would not otherwise be emitted). Upstream emissions are *not* for lifecycle emissions tracking back to when products were made.
    - Downstream emissions (emissions that would not occur if not for the project being built).
    - Show any mitigated emissions subtracting from the total of each emissions type (e.g., sequestered emissions from wetlands, carbon credits, etc.)
    - Connected emissions from connected actions. Actions are connected if they: (i) automatically trigger other actions that may require a NEPA document; (ii) cannot or will not proceed unless other actions are taken previously or simultaneously; or (iii) are interdependent parts of a larger action and depend on the larger action for their justification.

    Include summary tables which detail:

    - Connected emissions (emissions from other projects that would not be emitted but for the project [i.e., programmatic or tiered projects]).
    - Cumulative Emissions (the gross totals of each GHG).
    - Net Emissions (e.g., the total from subtracting the gross no action alternative emissions from each of the gross action alternative emissions).

7. Include supporting text explaining any notable results consistent with the CEQ's *NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*

8. It is recommended to report, in text, the alternative with the largest net total GHG emissions in CO_{2e}, the no action alternatives total gross emissions, and the total net emissions from the selected plan (alternative) in CO_{2e}.

9. It is recommended to identify, in plain language, the alternative with the highest net SCGHG, the no action alternative SCGHG, and the total net SCGHG from the selected plan (alternative).

10. *Include a sub-section at the end of the effects analysis for the effects determination to clearly state whether each alternative is anticipated to result in significant effects per the metric used*

for determining significant effects.

11. At the end of the GHG effects analysis section, provide an emissions summary (using plain language) indicating which alternatives have less than significant effects. For the summary, use the metric for determining significant effects as the basis for the determination.

GHG Emissions Analysis Appendix

The below items should be included as applicable in a GHG analysis appendix section:

1. Document the timing or duration for each phase of construction, if used, in the analysis. The timing and duration must be consistent with plan formulation activities indicated for the without project alternative as well as each phase of each alternative.

2. Include all relevant tables from calculations and any additional equations and data to prepare the analysis such that a novice can follow how the analysis was performed.

3. Include a list of assumptions that were made to complete the analysis for each alternative including the no action alternative.

4. Document and reference equipment emission factors.

5. Define unit conversion factors. For each step of the analysis, include the unit conversion factors and display the units used for each analysis quantity in column headers or table headers.

6. Identify the Input parameters for distance or time a piece of equipment is used, along with any load factors and power ratings, according to referenced source data. Check that the information is consistent with applicable assumptions from the plan formulation.

Note: this checklist is not exhaustive for what should be included in a GHG emissions analysis and NEPA document but gives a generalized list that can be used for undergoing an analysis and review of an analysis.

Key GHG Emissions References

Reference applicable Executive Orders (EO) with supporting text. The following lists EOs that may apply:

EO 14057. Catalyzing Clean Energy Industries and Jobs through Federal Sustainability, Dec 8, 2021. Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability | The White House

EO 14072. Strengthening the Nation's Forests, Communities, and Local Economies, April 27, 2022. Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies | The White House

EO 14008. Tackling the Climate Crisis at Home and Abroad, January 27, 2021. Executive Order on Tackling the Climate Crisis at Home and Abroad | The White House

EO 13990. Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, January 20, 2021. Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis | The White House

EO 14030. Executive Order on Climate Related Financial Risk, May 20, 2021. Executive Order on Climate-Related Financial Risk | The White House

CEQ. *Interim Guidance on Greenhouse Gas Emissions and Climate Change*, January 9, 2023. NEPA | National Environmental Policy Act - Final Guidance on Greenhouse Gases and Climate Change (doe.gov)

Interagency Working Group on Social Cost of Greenhouse Gases. *Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*. February 2021. Technical Support Document: Social Cost of Carbon, Methane, (whitehouse.gov)

Note: this references list is not exhaustive- there may be other Assistant Secretary of the Army memos, Engineering Circulars, and Engineering Bulletins that should be referenced. The project delivery team must *also present any applicable guidance or regulations from states, local governments, or state sponsored air quality management districts, with supporting text.*

Appendix A: Emissions Models and Resources

Net Emissions Analysis Tool (NEAT) Download and Information

The Model Certification information and Standard Operating Procedure document includes the following:

- Step by step walkthrough of the model
- Helpful tips for using the model
- Full list of references used for NEAT development
- Enterprise Service Desk's AppPortal

Enterprise Service Desk's AppPortal (may require an ACE IT service request). Users can download the following from the AppPortal:

- CALEEMOD (for California Only)
- MOVES 4.0 (CONUS)
- Other emissions models.

Standard operating procedures for select emissions models and more information for emissions analyses can be found at the Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP SharePoint Site.

Attachment B: Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP Leads and ATR Cadre Leads

Air Quality and GHG Emissions Analysis Sub-CoP Lead

Jason Emmons, Jason.D.Emmons@usace.army.mil

Air Quality and Greenhouse Gas Emissions Analysis Sub-CoP Division Leads

Great Lakes and Ohio River Division: Herman "Hank" Jarboe, Hank.Jarboe@usace.army.mil

Mississippi Valley Division (RPED South): David Day: David.J.Day@usace.army.mil

North Atlantic Division: Jenine Gallo: Jenine.Gallo@usace.army.mil

Northwestern Division: Aaron Quinn: Aaron.T.Quinn@usace.army.mil

Pacific Ocean Division: Marian Dean, Marian.Dean@usace.army.mil

South Atlantic Division: Andrew Loschiavo, Andrew.J.Loschiavo@usace.army.mil

South Pacific Division: Jason Emmons, Jason.D.Emmons@usace.army.mil

South Pacific Division: Ken Wong, Kenneth.Wong@usace.army.mil

Southwestern Division: Konstantinos "Dino" Kostarelos: Konstantinos.Kostarelos@usace.army.mil

Air Quality and Greenhouse Gas Emissions Analysis Agency Technical Review Cadre Leads

South Pacific Division: Jason Emmons, Jason.D.Emmons@usace.army.mil

Mississippi Valley Division (RPED South): David Day: David.J.Day@usace.army.mil

Southwestern Division: Konstantinos "Dino" Kostarelos: Konstantinos.Kostarelos@usace.army.mil

Website: https://usace.dps.mil/sites/KMP-ENV/SitePages/Air-Quality-Greenhouse-Gas-Emissions-Analysis.aspx?csf=1&web=1&e=0TP3mZ&cid=36f10533-d23e-4791-b395-2085cda763ba

Attachment C: References

a. CEQ. *Interim Guidance on Greenhouse Gas Emissions and Climate Change*, January 9, 2023. NEPA | National Environmental Policy Act - Final Guidance on Greenhouse Gases and Climate Change (doe.gov)

b. EO 14057. Catalyzing Clean Energy Industries and Jobs through Federal Sustainability, Dec 8, 2021. Executive Order on Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability | The White House

c. EO 14072. Strengthening the Nation's Forests, Communities, and Local Economies, April 27, 2022. Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies | The White House

d. EO 14008. Tackling the Climate Crisis at Home and Abroad, January 27, 2021. Executive Order on Tackling the Climate Crisis at Home and Abroad | The White House

e. EO 13990. Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, January 20, 2021. Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis | The White House

f. Interagency Working Group on Social Cost of Greenhouse Gases. *Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990*. February 2021. Technical Support Document: Social Cost of Carbon, Methane, (whitehouse.gov)

g. EO 13123. Greening the Government Through Efficient Energy Management. June 8, 1999. https://www.federalregister.gov/documents/1999/06/08/99-14633/greening-the-government-through-efficient-energy-management

h. CEQ 2016. Memorandum, Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews. https://ceq.doe.gov/docs/ceq-regulations-and-guidance/nepa_final_ghg_guidance.pdf

i. California Emissions Estimator Model (CALEEMOD), available on the Enterprise Service Desk's AppPortal

j. Emissions Factor (EMFAC) Model. Emissions Modeling | Caltrans

k. *Air Quality and Greenhouse Gas Emissions Sub-Community of Practice 2024. GHG Standard Operating Procedure.* *https://usace.dps.mil/:f:/r/sites/KMP-ENV/SiteAssets/SitePages/Air-Quality-Greenhouse-Gas-Emissions-Analysis-Sub-CoP/Tools%20and%20Resources/GHG%20Emissions%20Analysis%20Resources%20and%20SOP?csf=1&web=1&e=TXu0kN*

l. Code of Federal Regulations, Title 40 Part 98 Subpart A, Table A-1, Mandatory Greenhouse Gas Reporting. eCFR: 40 CFR Part 98 -- Mandatory Greenhouse Gas Reporting

m. Code of Federal Regulations, Title 40 Part 1501.3(d), Determine the appropriate level of NEPA review. eCFR :: 40 CFR Part 1501 -- NEPA and Agency Planning

n. United States Department of State and the United States Executive Office of the President. THE LONG-TERM STRATEGY OF THE UNITED STATES: Pathways to Net-Zero Greenhouse Gas Emissions by 2050, November 2021. The Long-Term Strategy of the United States, Pathways to Net-Zero Greenhouse Gas Emissions by 2050 (whitehouse.gov)

o. Interagency Working Group on Social Costs of Greenhouse Gases 2023. Memorandum from the Interagency Working Group on Social Cost of Greenhouse Gases. December 22, 2023. https://www.whitehouse.gov/wp-content/uploads/2023/12/IWG-Memo-12.22.23.pdf

p. EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances, November 2023. https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf

q. USACE Net Emissions Analysis Tool (NEAT model): NEAT model Download and Information and Model Certification information and Standard Operating Procedure

r. Code of Federal Regulations, Title 40 Part 1501.5, Environmental Assessments. eCFR: 40 CFR Part 1501 -- NEPA and Agency Planning

s. Code of Federal Regulations, Title 40 Part 1502.9, Environmental Impact Statement. eCFR: 40 CFR Part 1502 -- Environmental Impact Statement