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Corps of Engineers
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Pamphlet
No. 1100-2-2

1 December 2019

Global Changes
CIVIL WORKS SUSTAINABLE
INFRASTRUCTURE PRACTICES GUIDEBOOK

1. Purpose. The U.S. Army Corps of Engineering (USACE) Environmental Operating Principles (EOP) encourages staff to "create mutually supporting economic and environmentally sustainable solutions" (Refs. 5.a., 5.b.). USACE defines sustainable solutions as "solutions that balance environmental, economic, and social benefits and impacts to meet present needs without sacrificing the ability of future generations to meet their needs" (Ref. 5.c.). This pamphlet provides information on sustainable infrastructure practices applicable to Civil Works (CW) projects, programs, and other activities.

2. Applicability. This pamphlet applies to all Headquarters U.S. Army Corps of Engineers (HQUSACE) elements, major subordinate commands, districts, laboratories, centers and field operating activities having CW responsibilities.

3. Distribution Statement. Approved for public release. Distribution is unlimited.

4. Records Management (Record Keeping) Requirements. Records management requirements for all record numbers, associated forms and reports required by this regulation are included in the Army's Records Retention Schedule – Army (RRS-A). Detailed information for all record numbers, forms, and reports associated with this regulation are located in the RRS-A at https://www.arims.army.mil.

5. References.

a. Engineer Regulation (ER) 200-1-5, Policy for Implementation and Integrated Application of the USACE EOP and Doctrine, 30 Oct 2003; https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_200-1-5.pdf

b. CECW-CP Memorandum, 14 October 2016, Subject: Reissuance of the USACE EOP; https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/4196

c. Engineer Pamphlet (EP) 1100-1-3, USACE Sustainability: Definition and Concepts Guide, July 2018; https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf

d. Engineer Regulation (ER) 5-1-11, USACE Business Process, July 2018; https://www.publications.usace.army.mil/Portals/76/ER_5-1-11.pdf?ver=2019-05-02-093141-910

6. Background and Overview.

a. Practices that reflect sustainability offer significant benefits to USACE and its partners, including improved quality and performance, resource efficiency, and environmental protection. This pamphlet provides a collection of more than 100 practices particularly targeting CW infrastructure. It provides fact sheets for each practice, including detailed descriptions, potential actions, and implementation considerations. More than 750 potential actions are identified in all. Sources for obtaining additional information are also provided for each practice.

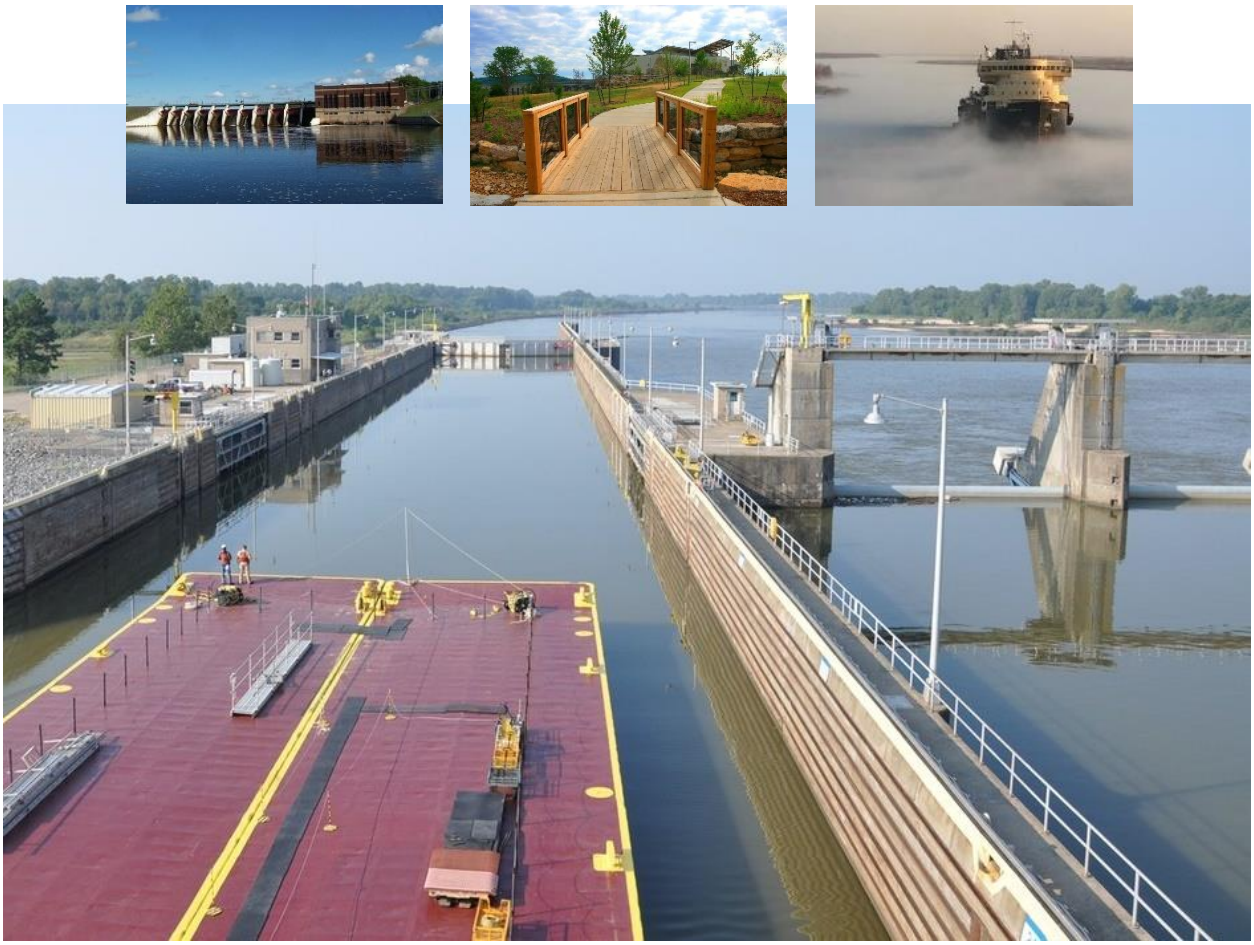
b. USACE requires individuals to check for applicable best practices prior to beginning any new project, activity, or service (Ref. 5.d.). The practices contained in the pamphlet represent a broad spectrum of activities applicable to CW, and each practice touches on one or more major components of sustainability – environmental, economic, and social. Adoption of practices contained in the pamphlet is voluntary although references to mandatory requirements are made where applicable. USACE personnel are encouraged to incorporate practices into their activities based on the benefits, specific needs of stakeholders, and the resources required to implement.

c. This pamphlet demonstrates USACE's commitment to and leadership in promoting sustainability and innovation in all its activities. The pamphlet was prepared by the HQUSACE Engineering and Construction Division in coordination with the USACE Sustainability Activities Steering Committee.

FOR THE COMMANDER:

KIRK E. GIBBS
COL, EN
Chief of Staff

CIVIL WORKS
SUSTAINABLE INFRASTRUCTURE PRACTICES GUIDEBOOK



US Army Corps of Engineers

Cover photographs: White Rapids Dam; Table Rock Lake Dewey Short Visitor Center; Dredge McFarland; and McKlellan-Kerr Arkansas River Navigation System

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1. Introduction

The U.S. Army Corps of Engineers Environmental Operating Principles encourage staff to "create mutually supporting economic and environmentally sustainable solutions." The Civil Works Sustainable Infrastructure Practices Guidebook applies to projects, programs, and other activities particularly relevant to CW infrastructure. The guidebook compiles more than 100 practices based on a review of CW activities and research from related industries. Fact sheets are provided for each practice, including detailed descriptions, potential actions, implementation considerations, and references. More than 750 potential actions are identified in all. Benefits of using the guidebook include improved quality and performance, resource efficiency, and environmental protection.

The strategies and practices detailed in the guidebook do not supersede or replace existing requirements (e.g., Engineering Regulations). Use of this guidebook is voluntary, although relevant requirements are discussed where appropriate.

This guidebook has two main sections: 1) Sustainable Infrastructure Practices Matrix; and 2) Sustainable Infrastructure Fact Sheets.

Sustainable Infrastructure Practices Matrix

The Sustainable Infrastructure Practices Matrix lists the practices contained in this Guidebook and organizes them into the following categories:

1. General
2. Planning
3. Engineering and Construction
4. Operations and Regulatory
5. Emergency Management

For each practice, the matrix identifies whether the practice supports economic, environmental, and/or social aspects of sustainability. The matrix also indicates whether the practice relates to existing USACE and/or other federal requirements; although use of the guidebook is voluntary, some practices leverage or build off existing requirements. Additionally, the page number where each practice fact sheet can be found in this guidebook is also provided.

Sustainable Infrastructure Fact Sheets

Each practice identified in the Sustainable Infrastructure Practices Matrix is described in detail on individual fact sheets. The fact sheets provide the following information:

- **Description and Benefits –** provides overview of the practice and benefits
- **Related Federal Mandates/ Policies/Programs (if applicable) –** lists major statutes, regulations, policies, programs, and other mandatory requirements
- **Potential Actions –** identifies specific potential actions that may be taken to implement the practice
- **Implementation Considerations –** discusses general items to keep in mind when applying the practice; including ease of implementation
- **Examples/References –** provides sources for obtaining additional information on a practice

Sustain the Mission – Secure the Future

The Civil Works Sustainable Infrastructure Practices Guidebook affirms USACE's long-standing commitment to sustainability. It identifies and discusses practices to help USACE staff incorporate sustainability principles in their work. The guidebook may be used by all parties interested in improving the sustainability of their systems and activities.

2. Sustainable Infrastructure Practices Matrix

Practice ID		Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
1. GENERAL							
General	G1	Include Sustainability in Project Kick-Off Meeting	✓	✓	✓	✓	17
	G2	Incorporate Sustainability in Project Management Plan Prior to, During, and Post Construction	✓	✓	✓	✓	19
	G3	Use Paperless Communication and Documentation When Possible	✓	✓		✓	21
	G4	Assess and Reduce Environmental Impact from Team Commuting and Travel		✓	✓	✓	23
	G5	Promote Local Employment, Workforce Preparedness, and Skills Development	✓		✓	✓	25
	G6	Review and Incorporate Sustainability Lessons Learned	✓	✓	✓	✓	27
	G7	Promote Sustainability Education/Awareness	✓	✓	✓	✓	29
	G8	Enhance Stakeholder and Community Engagement	✓		✓	✓	31
	G9	Perform Life Cycle Cost Analyses	✓			✓	33
	G10	Encourage Sustainable Innovation Practices in Planning, Engineering, Construction, Operations and Regulatory, and Emergency Management	✓	✓	✓	✓	35
	G11	Apply Engineering With Nature (EWN) Principles and Practices	✓	✓	✓	✓	37
Risk	R1	Incorporate USACE Resiliency Framework including PARA Principles (Prepare, Absorb, Recover, Adapt)	✓	✓	✓	✓	39
	R2	Consider and Address Natural Hazards and Climate Vulnerabilities	✓	✓	✓	✓	41
	R3	Incorporate Changing Disaster Event Frequency	✓	✓	✓	✓	45
	R4	Consider Human-Induced Hazards	✓	✓	✓	✓	47
	R5	Incorporate Risk Informed Decision Making	✓	✓	✓	✓	49

[1] Federal/USACE requirement(s) may be applicable in certain applications including Executive Orders, Statutes, Engineer Regulations, etc.

Sustainable Infrastructure Practices Matrix (Continued)

	Practice ID	Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
2. PLANNING							
Planning	P1	Consider Broad Objectives in Plan Formulation and Evaluation	✓	✓	✓	✓	55
	P2	Consider Impacts Beyond the Period of Analysis	✓	✓	✓	✓	57
	P3	Consider System Wide Sediment in Riverine Environment		✓		✓	59
	P4	Consider Tribal Trust Responsibilities			✓	✓	61
	P5	Maintain or Restore Natural Processes and Hydrology, and Promote Functional Geomorphic Process	✓	✓	✓	✓	63
	P6	Preserve and Manage Watershed		✓	✓	✓	67
	P7	Preserve Biological Health in Bodies of Water		✓	✓	✓	71
	P8	Consideration of Historic Properties during Planning		✓	✓	✓	73
3. ENGINEERING & CONSTRUCTION							
Engineering	E1	Minimize Project's Footprint of Disruption	✓	✓	✓	✓	77
	E2	Conduct Dam/Levee Safety Inspections and Periodic Assessments	✓	✓	✓	✓	79
	E3	Incorporate Stormwater Management into Constructability Considerations, As Appropriate		✓		✓	83
	E4	Incorporate Low Impact Development	✓	✓	✓	✓	85
	E5	Protect Soil Health		✓		✓	87
	E6	Minimize Heat Island Effect		✓	✓		89
	E7	Design and Construct Lighting to Minimize Pollution		✓	✓		91
	E8	Implement Erosion Control and Minimize Vulnerability to Erosion		✓		✓	93
	E9	Use Sustainably Sourced Materials	✓	✓	✓	✓	95
	E10	Consider and Implement Value Engineering	✓			✓	97

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Sustainable Infrastructure Practices Matrix (Continued)

Practice ID		Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
3. ENGINEERING & CONSTRUCTION (Continued)							
Construction	C1	Consider Contractor Sustainability Incentives in Acquisition Planning	✓	✓	✓	✓	101
	C2	Reduce Air, Water, and Soil Pollutants		✓	✓	✓	103
	C3	Minimize Energy and Water Use During Construction	✓	✓	✓	✓	107
	C4	Abate and Mitigate Construction Noise/Vibration and Light Pollution		✓	✓	✓	109
	C5	Perform Sequence and Route Planning for Project Transport	✓	✓		✓	111
Material & Equipment	ME1	Minimize and Manage Material Surplus	✓	✓			113
	ME2	Optimize Use of Salvageable, Local, and Durable Materials	✓	✓	✓	✓	115
	ME3	Enhance Material Life Cycle	✓	✓		✓	117
	ME4	Incorporate Waste Management Practices		✓	✓	✓	119
	ME5	Utilize Sustainable Temporary Facilities	✓	✓	✓		121
	ME6	Consider Selective Demolition versus Conventional Demolition	✓	✓			123
	ME7	Utilize Sustainable Large-Scale Earthwork and Grading Operations	✓	✓			125
	ME8	Support Responsible Raw Material Extraction	✓	✓	✓		127
	ME9	Maintain Clean Tire Roadworthy Vehicles	✓	✓			129
	ME10	Use Full Transport / Equipment Capacity	✓	✓			131
	ME11	Reduce Idling and Right-Size Construction Equipment	✓	✓	✓	✓	133
	ME12	Use Alternative Fuel or Low Emission Construction Equipment		✓		✓	135

[1] Federal/USACE requirement(s) may be applicable in certain applications including Executive Orders, Statutes, Engineer Regulations, etc.

Sustainable Infrastructure Practices Matrix (Continued)

Practice ID		Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
4. OPERATIONS & REGULATORY							
Operations & Maintenance	OM1	Ensure Reliable Storage and Reallocation of Water Supply when Available	✓	✓	✓	✓	139
	OM2	Provide Public Access to Reservoir/Canal/River Data within Security and Data Requirements			✓	✓	141
	OM3	Incorporate Beneficial Uses for Dredged Material	✓	✓	✓		143
	OM4	Manage Sedimentation (Beach Nourishment and Sand Reuse)	✓	✓	✓	✓	145
	OM5	Maintain Black Start Capabilities for Applicable Hydropower Facilities	✓	✓	✓	✓	147
	OM6	Identify Opportunities to Improve Reliability and Availability of Hydropower Generation Capability	✓	✓	✓	✓	149
	OM7	Maintain and Optimize Operations of Floating Plant Fleet (Dredgers, Barges, Cranes)	✓	✓		✓	151
	OM8	Incorporate Life Safety	✓	✓	✓	✓	153
	OM9	Employ Sustainable Rivers Program Practices	✓	✓	✓	✓	155
	OM10	Maintain Fish Passage Capabilities		✓		✓	159
	OM11	Manage Aquatic Plants		✓	✓	✓	163
	OM12	Monitor Environmental Mitigation and Assess Impacts to Environment		✓		✓	167
	OM13	Minimize Light Pollution		✓	✓		169
	OM14	Maintain Water Quality		✓	✓	✓	171
	OM15	Improve Air Quality		✓	✓	✓	173
Natural Resource Management	NR1	Visitor Use Management and Recreation	✓	✓	✓	✓	175
	NR2	Land Use Management	✓	✓	✓	✓	177
	NR3	Promote Environmental Stewardship	✓	✓	✓	✓	179
	NR4	Consider and Manage Invasive Species Proactively		✓		✓	181
	NR5	Protect Threatened and Endangered Species and Habitat		✓		✓	183
	NR6	Reduce Invasive Species Impacts	✓	✓	✓	✓	187
	NR7	Protect Cultural Resources	✓	✓	✓	✓	189
	NR8	Include of Tribal Consultation in Operations and Regulatory Projects			✓	✓	191

[1] Federal/USACE requirement(s) may be applicable in certain applications including Executive Orders, Statutes, Engineer Regulations, etc.

Sustainable Infrastructure Practices Matrix (Continued)

Practice ID		Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
4. OPERATIONS & REGULATORY (Continued)							
Life Cycle	LC1	Develop and Update O&M Manuals	✓	✓	✓	✓	193
	LC2	Reuse and Recycle Materials	✓	✓			195
	LC3	Reduce and Monitor Operational Waste	✓	✓		✓	197
	LC4	Plan for Long-Term Monitoring and Maintenance	✓		✓	✓	199
	LC5	Incorporate Asset Management Practices	✓				201
	LC6	Standardize Features/Components (gates, locks, etc.)	✓			✓	203
	LC7	Consider Project De-authorization	✓	✓	✓	✓	205
	LC8	Consider Operation and Maintenance, Repair, Replacement & Rehab	✓	✓	✓	✓	207
Federal Scorecard	S1	Reduce Energy Consumption	✓	✓		✓	209
	S2	Identify Efficiency Measures/Investment	✓	✓	✓	✓	211
	S3	Incorporate Renewable Energy Sources	✓	✓		✓	213
	S4	Reduce Potable Water Consumption and Optimize Water Reuse	✓	✓		✓	215
	S5	Implement the Guiding Principles for Sustainable Federal Buildings	✓	✓	✓	✓	217
	S6	Reduce Fleet Petroleum Use	✓	✓	✓	✓	219
	S7	Increase Percentage of Sustainable Acquisitions of Total Actions	✓	✓	✓	✓	221
	S8	Reduce Greenhouse Gas Emissions	✓	✓	✓	✓	223
	S9	Improve Reliability of Energy Source	✓	✓	✓	✓	225
	S10	Identify Opportunities for Alternative Energy Systems	✓	✓		✓	227
	S11	Design for High Efficiency Technology Facility Fixtures	✓	✓		✓	229
	S12	Reduce Water Contamination	✓	✓	✓	✓	231
	S13	Collect, Remediate, and Reuse Gray Water and/or Optimize Stormwater	✓	✓		✓	233
	S14	Perform Water Metering, Sub-Metering, & Analysis	✓	✓		✓	235
	S15	Perform Energy Metering, Sub-Metering, & Analysis	✓	✓		✓	237
	S16	Use Remote Energy Performance Assessment Auditing Technology	✓	✓		✓	239

[1] Federal/USACE requirement(s) may be applicable in certain applications including Executive Orders, Statutes, Engineer Regulations, etc.

Sustainable Infrastructure Practices Matrix (Continued)

Practice ID		Practice Description	Economic	Environmental	Social	Includes Requirement(s)[1]	Page #
4. OPERATIONS & REGULATORY (Continued)							
Federal Scorecard (Continued)	S17	Participate in Energy Demand Programs	✓	✓	✓		241
	S18	Track Performance Data with EPA ENERGY STAR Portfolio Manager	✓	✓		✓	243
	S19	Monitor Fleet Use and Idle Time	✓	✓	✓	✓	245
	S20	Utilize Performance Contracting to Meet Energy and Water Goals	✓	✓		✓	247
	S21	Promote Water and Energy Saving Strategies with Personnel	✓	✓	✓	✓	249
5. EMERGENCY MANAGEMENT							
Emergency Management	EM1	Perform Emergency Planning, Preparedness, and Recovery	✓	✓	✓	✓	253
	EM2	Perform Regular Emergency Training and Preparedness	✓	✓	✓	✓	255
	EM3	Consider Disaster Survivability	✓	✓	✓	✓	257
	EM4	Reduce or Mitigate Flooding On Site	✓	✓	✓	✓	259
	EM5	Perform a Construction Risk Assessment for Natural Disasters	✓	✓		✓	261

[1] Federal/USACE requirement(s) may be applicable in certain applications including Executive Orders, Statutes, Engineer Regulations, etc.

3. Sustainable Infrastructure Fact Sheets

3.1. General Fact Sheets

General

Risk

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G1: Include Sustainability in Project Kick-Off Meeting

Description and Benefits

A kick-off meeting can serve as an introduction to a project involving the project team, partners, and stakeholders. This meeting can be critical for team staffing and organizing plans for a project. Integrating sustainability in the project kick-off meeting can help ensure consistent project progression and successful completion with respect to sustainability-related requirements. This can enable improved leadership and increased collaboration between the project development team and partners. Information gathered from the kick-off meeting can be used in a description of how the scope, scale, and complexity of a project are achieving sustainability consistent with EP 1100-1-3, USACE Sustainability: Definition and Concepts Guide. Sustainability should be considered from a Triple Bottom Line (TBL) perspective to include environmental, economic, and social factors. The project kick-off meeting can include a review of the inputs and outcomes of the project from a TBL perspective to ideally enhance the efficiency and resilience of the project.

Related Federal Mandates/Policies/Programs (if applicable)

- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Develop and define sustainability goals for the project at the kick-off meeting
- Document a project's environmental, economic, and social objectives based on the authorized study or project
- Identify any interested stakeholders that would add value to achieving study or project objectives related to sustainability
- Determine next steps and relevant policies to achieve sustainability objectives
- Determine the potential project first costs and economic costs of implementing sustainable strategies that contribute to sustainable goals
- Determine an organizational structure for project implementation of sustainability strategies

Implementation Considerations

The effort to incorporate sustainability into the team kick-off meeting is relatively easy for most projects. Organization and planning before a meeting are recommended to execute a productive kick-off meeting. All necessary materials should be included in the meeting. Conversations between the USACE project delivery team and partner should be promoted to fully understand how to integrate sustainable practices into the project while remaining within the project's scope.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

G2: Incorporate Sustainability in Project Management Plan Prior to, During, and Post Construction

Description and Benefits

Sustainable practices can sometimes add complexity to project management because they may deviate from conventional practices with which project teams may be more familiar. New plans, designs, or approaches may fall away during project execution as schedule and cost overruns take a perceivably higher priority. In particular, supporting USACE sustainability priorities, such as enabling adaptive management, extending mission capability, considering Total Cost of Ownership (i.e., considering the first costs to operating costs of a project), practicing cost-optimized preventative maintenance, etc., involves complex and interrelated pieces that may require diligent tracking to ensure success. Using a cost-benefit analysis to understand reliability gained relative to cost should be considered. Incorporating sustainability in project management can aid these efforts by establishing procedures and expectations and ensuring sustainable delivery objectives are communicated and executed from pre-construction through commissioning.

Potential Actions

- Distribute a prioritized list of all environmental, economic, and social sustainability aspects of the project to the project team to stress the importance of completing given tasks to meeting broader goals
- Establish roles, responsibilities, and expectations of project owners and project teams to avoid conflicts, duplications, or miscommunication
- Create a plan that is adaptable, flexible, and efficient
- Include design, construction, operations, and maintenance considerations
- Periodically revisit sustainability components of the project management plan through implementation to adapt to changing conditions, monitor implementation performance, and take course corrections
- Identify roles/responsibilities, resources, schedule milestones, and beneficial metrics related to sustainability to support continued attainment of objectives
- Post-implementation, identify and document implementation success, lessons learned, and opportunities for improvements to support changes to processes and tools for future projects
- Incorporate sustainability performance metrics into post-implementation evaluation report

Implementation Considerations

This is a process/procedure-oriented practice. Integrating sustainability into project management may involve proceduralizing sustainability actions and design intents. This may be approached through a lens of continual improvement in USACE implementation practices, as sustainability goals are identified, carried out, and evaluated post-implementation to identify opportunities for improved implementation.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. USACE Business Process. ER 5-1-11. Available at: https://www.publications.usace.army.mil/Portals/76/ER_5-1-11.pdf?ver=2019-05-02-093141-910
- United States Army Corps of Engineers (USACE). 1996. Partners and Support (Work Management Guidance and Procedures). EP 1130-2-500. Available at: https://corpslakes.erdc.dren.mil/employees/policy/EP/EP-1130-2-500.pdf
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

G3: Use Paperless Communication and Documentation When Possible

Description and Benefits

Paperless communication and documentation in the construction phase can substantially benefit the productivity of the project team. Administrative costs, physical storage space, and waste can be reduced while improving efficiency by using electronic records and data. Mobile communication and electronic document management can expedite decision-making and information sharing. Construction software and document management solutions now exist that can further help streamline workflow and allow real-time field reporting. This strategy aligns with USACE's commitment to increased efficiency and material conservation as a sustainable solution.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Reduce paper-based communications and replace with digital forms
- Identify a secure server or cloud storage solution to best fit the e-communication needs
- Use mobile solutions for timesheet management
- Use software and mobile apps to manage documentation needs, such as daily logs, checklists, and requests for information, throughout the construction phase
- Develop digital data collection systems and real-time field reporting technologies
- Implement green meeting practices by distributing meeting materials digitally and maximizing use of web conferencing and screen sharing
- Modify default printer settings to double-sided printing, and use recycled paper

Implementation Considerations

Implementing paperless communication in recent years has become more feasible with technologies and programs now available. Depending on the project size, reducing paper use may just include establishing a document control plan or involve purchasing specialized software and training the staff. In general, going paperless can help reduce costs, avoid lost documents, and improve efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Sustainable Acquisitions. Available at: https://www.usace.army.mil/Business-With-Us/Contracting/Sustainable-Acquisitions/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Department of Transportation. 2017. Addressing Challenges and Return on Investment (ROI) for Paperless Project Delivery (e-Construction). FHWA Publication No. FHWA-HRT-16-068. Available at: https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/16068/16068.pdf

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G4: Assess and Reduce Environmental Impact from Team Commuting and Travel

Description and Benefits

Considering team commuting and travel for USACE actions, projects, programs, and general daily commuting to the office can offer sustainable solutions to reduce the overall environmental impact of vehicle use and greenhouse gas emissions. Costs may be realized with fuel savings and potential parking or toll fees. Team commuting and travel can offer time savings, increased efficiency, and team building/development opportunities because staff can spend more time together. USACE staff can be empowered and held accountable for actively pursuing improvement through their individual roles and responsibilities.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018
- Energy Independence and Security Act

Potential Actions

- Consider ridesharing and carpooling options for commuting to work or to/from meetings and project sites
- Offer incentives for ridesharing, carpooling, and alternative modes of travel (i.e., designated parking spots; discounted fares or reimbursement of fares)
- Encourage participation in authorized alternative work schedule and telework opportunities
- Increase the number vehicles in the fleet for employees to use during the workday (preferably alternative fuel vehicles)
- Increase consumption of alternative fuel
- Assess the availability, feasibility, and use of transportation options (e.g., rail, water, active transportation, or mass transportation access)

Implementation Considerations

The effort to implement team commuting and travel has become more feasible in recent years because transportation programs in communities are becoming more efficient and connected. USACE staff can be directly engaged and easily implement this sustainability practice in their actions, projects, and programs. This strategy can offer a collaborative opportunity and partnership between divisions to reduce redundancy, effectively use resources, and increase the overall value of USACE work. In general, team commuting and travel can help reduce costs, greenhouse gas and fuel emissions, and vehicles miles traveled, and improve levels of service and overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

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G5: Promote Local Employment, Workforce Preparedness, and Skills Development

Description and Benefits

Recognizing the value of investing in workforce development and preparedness is the primary goal of this strategy. The project operation stage can offer a great opportunity to expand the knowledge, skills, and capacity of the workforce, thereby improving the ability to grow, develop, and acclimate to changes in the workforce. Transitioning to a more sustainable practice may require significant growth and education throughout the infrastructure workforce. Sustainable solutions may often include new materials, methodologies, or technologies that require new skills and capabilities within the workforce and local community. Building local skills may help to lower costs, improve delivery efficiency, and deliver high-quality results. Long-term benefits can also be achieved because skills and capacity building within a workforce can create systemic change that carries over to future projects and the larger local community. This strategy can increase the environmental, economic, and social benefits of sustainability.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Population and Low-Income Populations, Feb 1994
- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Improve training programs for local skill development
- Identify specific skills and capability gaps in the local workforce, and establish training programs to target these gaps
- Work with local/state workforce development agencies to access local employment and education needs
- Provide training and skill development programs specifically targeting economically depressed, underemployed, or disadvantaged communities

Implementation Considerations

Efforts to promote local employment, workforce preparedness, and skills development can be relatively easy and can provide a long-term benefit to the project and the community depending on the scale and duration of the project. The scope of training can be designed relative to the scale of the project. Additional public agencies and social services should be incorporated to better implement community-based training programs.

Examples/References

- United States Army Corps of Engineers (USACE). 2010. Career Development Guide for Civil Works Natural Resources Management Team Members. EP 690-2-2. May 14. Available at: https://www.publications.usace.army.mil/-Portals/76/Publications/EngineerPamphlets/EP_690-2-2.pdf?ver=2013-08-22-094134-803
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

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G6: Review and Incorporate Sustainability Lessons Learned

Description and Benefits

After the completion of a project, the sustainability performance over the length of the project should be reviewed. The sustainability practices that worked best and those that could have used additional attention should be reflected on, identified, and documented. Knowing which efforts are the most effective or least beneficial can help to build an understanding of what strategies to prioritize for future projects. Sustainability lessons learned can be incorporated into the design of a new project when discussing early project decisions, evaluating sustainability goals, and discussing methods to improve environmental performance, etc.

Related Federal Mandates/Policies/Programs (if applicable)

- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Engineer Regulation No. 1110-1-8159: DrChecks

Potential Actions

- Retrieve documentation of all sustainability activities implemented during a similar project
- Implement any desired or relevant previous sustainability lessons into the integrated design
- Create a scoring system to evaluate the effectiveness of each sustainability activity included in a project
- Include stakeholders' insights about sustainability successes and necessary improvements
- Complete a post-implementation evaluation report for the project that contains sustainability lessons learned
- Use the evaluation report as a benchmark for future projects

Implementation Considerations

This strategy should be included in any post-implementation discussions of a project. The project management directly involved with the project's sustainability should present all sustainability activities performed and their effectiveness scores. The most challenging aspect might be contacting individuals involved with sustainability who left the project before the end discussion is held.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2010. Career Development Guide for Civil Works Natural Resources Management Team Members. EP 690-2-2. May 14. Available at: https://www.publications.usace.army.mil/-Portals/76/Publications/EngineerPamphlets/EP_690-2-2.pdf?ver=2013-08-22-094134-803
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

G7: Promote Sustainability Education/Awareness

Description and Benefits

A project's sustainability achievement should be shared with the public. During construction and after the completion of a project, consider integrating educational/awareness tools throughout the project that highlight sustainable strategies and solutions and how they influence the environment, society, and economics. These tools can include plaque signage with descriptions, interactive displays with mobile parts, transparent encasings revealing sustainable equipment, or posters covered with illustrations and diagrams. The displays should be made visible and accessible to project workers, stakeholders, occupants, and visitors. Topics should also include the Center for the Advancement of Sustainability Innovations' technology focus areas that support USACE sustainability requirements. Promoting sustainability education/awareness can also offer additional value to future projects with stakeholder and community involvement as a long-term sustainable solution.

Related Federal Mandates/Policies/Programs (if applicable)

- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016

Potential Actions

- List all sustainability goals of a project, and disseminate them throughout a community in/on libraries, restaurants, offices, project sites, websites, community forums, pamphlets, newsletters, etc.
- Locate effective areas to add signage or displays throughout a completed project (e.g., indoors, outdoors)
- Determine methods to highlight sustainable strategies and solutions (e.g., posters, interactive displays, brochures, group tours)
- Observe project user and visitor interaction with the educational opportunities
- If feasible, coordinate with educational institutions to organize student interaction with the project
- Hold in-person community conversations open to the public to discuss ongoing sustainable practices of a project
- Identify possible initiatives for the community to become involved with and learn about sustainability (i.e., volunteer work to clean sites or plant trees)

Implementation Considerations

Depending on the complexity, some educational opportunities may have to be planned before the construction phase to be implemented during construction. Other educational opportunities can be planned after the project is completed if desired.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2014. Center for the Advancement of Sustainability Innovations (CASI). Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/article/476729/center-for-the-advancement-of-sustainability-innovations-casi/
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4

G8: Enhance Stakeholder and Community Engagement

Description and Benefits

Promoting stakeholder engagement can provide opportunities for stakeholder participation, which can assist with maximizing the benefits and potential acceptance of a project. It can also provide an opportunity for stakeholders to build consensus around sustainable practices. An effective stakeholder engagement process can promote collaboration, sharing of sustainable practices, and buy-in for a project. When an inclusive, representative group of stakeholders is engaged throughout the project, the results can satisfy the community. Stakeholders and the community should be well-informed about a project's intended sustainable initiatives by receiving information through public communications, signage around the project, etc. Increased awareness about sustainable initiatives during a project is important for stakeholders and the community to understand how they can contribute to a project and help foster goal completion. When project teams collaborate with key stakeholders and the surrounding community in the earlier stages of the planning process, a wider array of practical sustainability strategies can be identified that reflect capabilities, needs, challenges, and conflicting interests to maximize the value of a project. This strategy strongly supports USACE's definition of delivering sustainable solutions.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Population and Low-Income Populations, Feb 1994

Potential Actions

- Coordinate early with stakeholders and partners
- List all sustainability goals of a project and potentially disseminate them throughout community project sites, websites, community forums, pamphlets, newsletters, etc.
- Hold in-person community conversations open to the public to discuss ongoing sustainable practices of a project
- Encourage discussion on how to improve sustainable programs
- Determine incentives for community participation if feasible
- Identify possible initiatives for the community to become involved with (e.g., volunteer work to clean sites or plant trees, sponsor a project to provide reusable water bottles during construction, or discuss how to sustainably maintain the operations of a project)
- Establish centralized recordkeeping to encourage and facilitate information sharing across all departments

Implementation Considerations

Engaging stakeholders can require effective communication and interaction with the public to select and confirm the most appropriate sustainability strategies and programs. Tools, such as meeting minutes, regular summary memorandums, and an information sharing platform such as a website or newsletter, can help throughout the process. The project manager can build a work plan to engage stakeholders and the community at project key decision points.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2018. Risk and Decision Science: Risk Decision Advisory Services and Tool for Federal Government and Other Agencies. Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/920870/risk-and-decision-science/
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

G9: Perform Life Cycle Cost Analyses

Description and Benefits

A Life Cycle Cost Analysis (LCCA) is a method to evaluate the cost of a project. A LCCA accounts for more than just the capital cost and incorporates operations and maintenance cost, replacement cost, end-of-life residual value, and discount techniques to adjust for the time-value of money. In addition to cost considerations, planning and design decisions need to be based on a consideration of the long-term performance of the project as stated in the Life Cycle Design and Performance Engineering Regulation. In addition, a life cycle view takes into account changes over time, providing new opportunities and constraints as stated in the USACE Sustainability: Definition and Concepts Guide. Sometimes a new study may be required to perform a LCCA. Design engineers use life cycle design as the basis for selection of project elements such as materials, structural systems, mechanical equipment, and scour protection on all projects. These design decisions need to be consistent throughout all project phases, including value engineering studies, and will be based on a minimum project service life of 100 years for major infrastructure projects such as locks, dams, and levees.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-2-8159, Life Cycle Design and Performance
- Engineer Regulation No. 1110-1-8173, Energy Modeling and Life Cycle Cost Analysis
- Engineer Regulation No. 1110-2-1302, Civil Works Cost Engineering
- Code of Federal Regulations, 10 CFR 436, Federal Energy Management and Planning Programs, Subpart A, Methodology and Procedures for Life-Cycle Cost Analyses
- Executive Order 13123: Greening the Government Through Efficient Energy Management

Potential Actions

- Establish a base case, including a no-go alternative, against which to compare designs
- Assess categories of costs and benefits, including capital cost, operations and maintenance cost, replacement cost, and residual value
- Monetize costs and benefits as incremental to the base case
- Use discounting techniques to incorporate the time-value of money over a consistent time period to evenly compare alternatives at net present value
- Account for the capacity of a project to evolve or expand its mission capability over time, and incorporate risk to changing future conditions
- Expand LCCA to include quantification of social and environmental impacts and benefits of design alternatives

Implementation Considerations

Implementing LCCA adds time and effort to the engineering process but is an important aspect of looking at long-term USACE mission requirements and operating efficiencies. The LCCA process can moderately affect the engineering process.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- U.S. Department of Commerce. 1996. Life-Cycle Costing Manual for the Federal Energy Management Program. NIST Handbook 135. Available at: https://www.wbdg.org/FFC/NIST/hdbk_135.pdf
- Office of Management and Budget (OMB). Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs. Available at: https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf

G10: Encourage Sustainable Innovation Practices in Planning, Engineering, Construction, Operations and Regulatory, and Emergency Management

Description and Benefits

Innovation includes sustainable practices that go beyond normal requirements and includes strategies identified in this guidebook. This strategy is intended to recognize exemplary and innovative performance in the methods, technologies, or processes during the planning, engineering, construction, operations and regulatory, and emergency management phases of a project. Using reliable metrics and indicators to manage ongoing sustainability performance and the effectiveness of strategy implementation is strongly encouraged. Benefits can vary across environmental, economic, and social factors. USACE has an annual Innovation of the Year Award where staff are recognized for their excellence. Teams/individuals are judged based on innovativeness, impact, and applicability.

Related Federal Mandates/Policies/Programs (if applicable)

- Director's Policy Memorandum, Innovative Delivery of 2018 Emergency Supplemental Projects, Sep 2018

Potential Actions

- Determine what is exemplary about the innovation, what it was designed to solve, and how it delivers on that problem
- Evaluate the obstacles that need to be overcome to implement this innovation
- Evaluate the social, economic, or environmental impacts of the innovation (e.g., jobs created or safeguarded, increase in customer satisfaction, benefits to public, improved quality, timely delivery) and the impact it has on the stakeholders
- Determine the measures required to expand this innovation throughout the Regional, Community of Practices, or USACE and the impact it could have if implemented USACE-wide
- Develop pilot or demonstration projects with regard to sustainability planning and design strategies to improve the environment, aesthetics, community benefit, and public health
- Participate in conferences and other knowledge-sharing opportunities to stay abreast of the industry, share lessons learned, and share sustainable practices
- Identify innovative strategies associated with project management, site, water, energy, materials, and resilience that can be incorporated into the planning and design stage of a project
- Identify comprehensive strategies that demonstrate quantifiable environmental benefits

Implementation Considerations

Implementing innovation in the planning stage can be a cost-effective way to promote advanced sustainable practices. Significant benefits can be achieved to improve resource sustainability and reduce operations and maintenance costs. Identifying potential candidate projects early in the process can improve overall performance and optimize system efficiency. Innovation also offers an opportunity to create an outreach and education platform for the public.

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Center for the Advancement of Sustainability Innovations (CASI). Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/article/476729/center-for-the-advancement-of-sustainability-innovations-casi/
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- United States Green Building Council (USGBC). 2012. Leadership in Energy and Environmental Design (LEED) for Neighborhood Development (ND): Innovation in Design Credit Catalog.

G11: Apply Engineering with Nature Principles and Practices

Description and Benefits

The USACE Engineering with Nature® (EWN)® Initiative is advancing sustainability by promoting an approach to infrastructure development based on pursuing *intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration*. The goal of the approach is to identify and act on opportunities to leverage natural systems and processes to support infrastructure and engineering functions while also developing and operating infrastructure to support environmental functions and outputs. By taking advantage of such opportunities, the benefits produced through infrastructure can be expanded and diversified to include a range of economic, environmental and social benefits. There are four key elements of the EWN approach: (1) using science and engineering to produce operational efficiencies; (2) using natural processes to maximize benefits; (3) increasing the value provided by projects to include social, environmental, and economic benefits; (4) using collaboration to organize, engage, and focus the interests of stakeholders and partners.

Related Federal Mandates/Policies/Programs (if applicable)

- Director's Policy Memorandum, Further Advancing Project Delivery Efficiency and Effectiveness of USACE Civil Works, Jun 2017
- Memorandum for the Commanding General of USACE, Implementation Guidance for 1184 of the Water Resources Development Act of 2016, Nov 2017
- Water Resources Development Action of 2018, Sec. 1149 on the use of Natural and Nature-Based Features and Natural Infrastructure.

Potential Actions

- Assemble diverse Project Delivery Teams to engage a broad range of perspectives, technical disciplines, and experiences in identifying opportunities to enhance project value.
- Actively engage other organizations and project stakeholders, beginning early in the project life cycle, to develop new ideas, collaborations, and partnerships to create efficiency and expanding project value.
- Host and participate in EWN seminars, workshops, training opportunities, etc. to share and gain knowledge and experience about successful EWN projects and practices across USACE and other organizations.
- Visit the EWN website (www.engineeringwithnature.org) to learn about upcoming events and new opportunities, tools and projects. Submit a District project for inclusion in the next volume of *Engineering With Nature®: An Atlas*.
- Share your District's successes and/or challenges in applying EWN approaches with the national EWN team to foster USACE-wide learning and technology transfer.
- Develop an opportunity for a demonstration or pilot-scale project by leveraging research supporting EWN at the Engineer Research and Development Center and EWN partnering organizations (to identify EWN partners relevant to your area see the EWN website).
- Take advantage of opportunities to document the multi-purpose value produced by your projects.
- Recommend your District become an EWN Proving Ground.

Implementation Considerations

Successful implementation of EWN principles and practices within projects begins by building a productive collaboration of interests and perspectives that are focused to expand project value. Relevant innovations for improving the project are identified and plans and measures are developed for managing the uncertainties and risks posed by applying the innovations. Consideration of the four EWN elements is relevant at all stages of a project's life cycle as a means for identifying opportunities to create efficiency and multi-purpose value in the form of economic, environmental and social benefits. Finally, investments made in documenting project outcomes will ensure that lessons learned and best practices can be communicated across the enterprise.

Examples/References

- Engineering With Nature® Website: www.engineeringwithnature.org
- Engineering With Nature: An Atlas, https://ewn.el.erdc.dren.mil/atlas.html
- Engineering With Nature: Advancing System Resilience and Sustainable Development, http://themilitaryengineer.com/index.php/tme-articles/tme-magazine-online/item/539-engineering-with-nature-advancing-system-resilience-and-sustainable-development
- A Multifactor Ecosystem Assessment of Wetlands Created Using a Novel Dredged Material Placement Technique in the Atchafalaya River, Louisiana: an EWN Demonstration Project, ERDC. TR-17-5. https://erdc-library.erdc.dren.mil/xmlui/handle/11681/28041

R1: Incorporate USACE Resiliency Framework including PARA Principles (Prepare, Absorb, Recover, Adapt)

Description and Benefits

Resilience has always been an inherent factor in USACE Civil Works projects and programs given the organization's missions to maintain safe operation of navigation and flood control facilities. USACE defines resilience as the ability to anticipate, prepare for, and adapt to changing conditions; and withstand, respond to, and recover from disruptions. The USACE Resilience Initiative Roadmap outlined strategies to further develop resilience in USACE through evolving resilience practices, supporting community resilience, and focusing on priority areas. To apply resilience thinking at the project or system level, an evaluation should be performed using the prepare, absorb, recover, adapt principles during pre-construction designs, engineering during construction designs, and/or during repair/rehabilitation designs as frequently and as needed based on engineering judgment and reflective of project complexity and assessed risk. Analyses and outcomes should be formally documented. Where appropriate, interconnections between project components and systems, and their individual and cumulative effect on project performance should be considered. These evaluations will likely result in recommendations for consideration by the project team for measures that improve resilience. These recommendations may be incorporated into the design when permitted by project authorities and do not significantly increase total project life cycle cost, including recovery costs. In some cases, recommendations that result in significant cost increases may be considered, but recommendations must still be appropriately justified.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineering Pamphlet 1100-1-2: USACE Resilience Initiative Roadmap 2016
- Engineering and Construction Bulletin 2018-2: Implementation of Resilience Principles in the Engineering and Construction Community of Practice
- Presidential Policy Directive / PPD-8: National Preparedness
- Executive Order 13834: Efficient Federal Operations, May 2018
- Engineering Regulation 1110-2-1156: Safety of Dams: Policies and Procedures

Potential Actions

- Prepare – Consider measures that reduce risks or costs under loading conditions beyond those required by technical standards (USACE, International Building Code, International Existing Building Code®, American Society of Civil Engineers, American Society of Mechanical Engineers, etc.)
- Absorb – Identify cost effective measures to limit damage to, or loss of function of, a project component or system due to both acute and chronic loading conditions, including conditions beyond those used for the design; also consider adding system component robustness, redundancy, and increased reliability
- Recover – Identify cost effective measures that allow for rapid repair or function restoration of a project component or system
- Adapt – Identify cost effective modifications to a project component or system that will maintain or improve future performance based on lessons learned from a specific loading condition or loadings associated with changed conditions

Implementation Considerations

Implementation of this strategy involves incorporating resilience considerations throughout project entities. The effort to implement such considerations relates to how pervasive risk-informed and resilience-based decision making is within the local USACE district and division as well as with project stakeholders and the surrounding community.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Climate Preparedness and Resilience. Available at: https://www.usace.army.mil/corpsclimate/Climate_Preparedness_and_Resilience/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- U.S. Department of Defense. 2016. Directive 3020.40 Mission Assurance. Available at https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/302040_dodd_2016.pdf
- U.S. Department of the Army. 2015. Energy Security and Sustainability (ES^2) Strategy. Available at: https://www.army.mil/e2/c/downloads/394128.pdf

R2: Consider and Address Natural Hazards and Climate Vulnerabilities

Description and Benefits

This strategy considers how natural hazards and climate vulnerabilities can affect projects and make them more resilient to change in the long term. Increases to average temperature may vary regionally and over time and may have widespread impacts, ranging from reduced ice volume and extent on lakes, rivers, oceans, and in glaciers; changed evapotranspiration impacting reservoirs and soil moisture; increased risk of wildfires; changes in water and energy demand; altered habitat suitability; warmer sea surface temperatures; and potentially altered circulation patterns etc. Natural hazards and climate vulnerabilities, such as hurricanes, storms and heavy rains, drought and extreme heat, earthquakes, and wildfires, should be considered in the operating parameters of USACE projects, infrastructure, systems, and programs to enhance resilience, reduce vulnerability, and ultimately be in alignment with the USACE missions and operations. The key concepts of resilience (prepare, absorb, recover, adapt) can help identify and address climate change impacts for mission critical water, energy, communication, and transportation demands. USACE's Civil Works infrastructure resilience should consider climate impacts through climate-resilient design and management elements in the operation, repair, and renovation of existing buildings and the design of new buildings. Further, this can support USACE's resilience goal to increase performance reliability in anticipated use, reduce the risk of failure during extreme events, maintain primary function during changing conditions, and/or help meet specific community resilience goals.

Related Federal Mandates/Policies/Programs (if applicable)

- Energy Independence and Security Act
- Engineer Regulation No. 1110-2-103: Strong Motion Instrument for Recording Earthquake Motions on Dams
- Engineer Regulation No. 1110-2-1941: Drought Contingency Plans
- Engineer Regulation No. 1110-2-1806: Earthquake Design & Evaluation of Civil Works Projects
- Engineer Regulation No. 1110-2-1802: Reporting Earthquake Effects
- Engineer Regulation No. 1100-2-8162: Incorporating Sea Level Changes in Civil Works Programs
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Presidential Policy Directive / PPD-8: National Preparedness
- National Environmental Policy Act (NEPA)

Potential Actions

- Use the Federal Emergency Management Agency's (FEMA's) Disaster Assistance tool to locate the closest FEMA Disaster Recovery Centers from a project location site to prepare for emergency assistance
- Identify the most common natural hazards in the project area
- Stay informed of the community's emergency alerts with the Emergency Alert System and National Oceanic and Atmospheric Administration Radio
- Make a plan to keep important documents safe or keep password-protected digital copies
- Organize an emergency preparedness kit that includes food, water, first-aid supplies, flashlights, batteries, battery-powered radio, backup generators, emergency communication devices, and medications
- Plan an evacuation and sheltering plan for different types of natural hazards
- Determine a recovery strategy, if applicable, after a natural hazard subsides
- Stay informed with FEMA updates and guidance on how to prepare for natural hazards
- Collaborate with stakeholders to incorporate structural details for natural hazard and climate change resilience, and comply with local, state, and federal regulations
- Evaluate the frequency, duration, and spatial extent of natural hazard events (i.e., drought or storm) to account for changing climate conditions, demographics, and water demand
- Consider that increases in natural hazard events may require increased emergency preparedness, response, and recovery
- Compare and contrast contents and methods previously used for forecasting natural hazard frequency and intensity to evaluate gaps and robustness
- Reference USACE's web portal that centrally stores water control manuals, deviation policies, and current and historic deviations
- Consider addressing impacts of changing municipal and industrial water supplies, more variable stream flow and lake levels, changing water conditions for ecosystems, frequency of coastal and riverine flooding, stormwater runoff, levels of pollutants in runoff, sediment regimes, snowmelt onset and volume
- Consider and mainstream climate variability and change to enhance USACE's asset management program
- Consider potential increases in energy costs for cooling facilities and potential offsets for heating
- Account for potential changes in vertical construction equipment, material, and operating responses to increased temperature
- Account for changes in the form of precipitation, water temperature (water quality, lake stratification), ecosystem structure and function, invasive species or pest distribution, river and ocean ice regimes, glacial processes, permafrost, altered ocean circulation (changing tide and surge regimes), evapotranspiration, and increased extreme events (heat/cold waves, ice/dust storms, blizzards)

Implementation Considerations

In a changing climate with more frequent and intense storms and droughts, rebuilding the infrastructure systems to be stronger can be critical. Systems can potentially risk falling into a costly cycle of perpetual repair. Improving infrastructure's resilience to climate change and extreme weather costs is an upfront investment, but one that typically pays off by reducing direct and indirect costs after future natural hazards. Furthermore, changes in tropical storm and hurricane frequency and intensity are masked by large natural variability whereas drought is easier to measure because of its long duration. This strategy is in alignment with USACE's resilience goal to increase performance reliability in anticipated use, reduce the risk of failure during extreme events, maintain primary function during changing conditions, and helps to meet specific community resilience goals. USACE has overarching climate preparedness and resilience policies and technical guidance that support this practice. The benefit of such a consideration can include continued effective and efficient operations in the short- (5–10 years) and long-term (10–50 years), thereby reducing long-term costs and limiting disruptions. Further adjustments can be made to a completed project in preparation for hurricane seasons: Jun 1 to Nov 30 for the Atlantic hurricane season, and May 15 to Nov 30 for the Pacific hurricane season.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Natural Hazards & Adaptation. Available at: https://www.usace.army.mil/Missions/Sustainability/Building-Resilience/Natural-Hazards/
- United States Army Corps of Engineers (USACE). 2018. Responding to Natural Disasters. Available at: https://www.usace.army.mil/About/History/Brief-History-of-the-Corps/Responding-to-Natural-Disasters/
- United States Army Corps of Engineers (USACE). 2014. Climate Change Adaptation Plan. Available at: https://www.usace.army.mil/Portals/2/docs/Sustainability/Performance_Plans/2014_USACE_Climate_Change_Adaptation_Plan.pdf
- United States Army Corps of Engineers (USACE). 2015. USACE Drought Contingency Planning in the Context of Climate Change. CWTS report 15-15. Available at: https://usace.contentdm.oclc.org/digital/api/collection/p266001coll1/id/6727/download
- United States Army Corps of Engineers (USACE). 2016. USACE Resilience Initiative Roadmap. EP 1100-1-2. May 13. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1100-1-2.pdf?ver=2017-11-02-082317-943
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps (USACE). 2007. Earthquake Design and Evaluation of Concrete Hydraulic Structures. EM 1110-2-6053. May 1. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-6053.pdf
- United States Army Corps (USACE). 2014. Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation. ETL 1100-2-1. Available at: https://www.publications.usace.army.mil/portals/76/publications/engineertechnicalletters/etl_1100-2-1.pdf
- United States Army Corps (USACE). 2014. Appropriate Application of Paleoflood Information for Hydrology and Hydraulics. ETL 1100-2-2. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerTechnicalLetters/ETL_1100-2-2.pdf?ver=2014-11-10-112314-997
- United States Department of Homeland Security. 2018. Disaster Assistance. Available at: https://www.disasterassistance.gov/
- United States Department of Homeland Security. 2018. Federal Emergency Management Agency (FEMA). Available at: https://www.fema.gov/

R3: Incorporate Changing Disaster Event Frequency

Description and Benefits

The expected frequency of weather-related disasters should be considered when planning and designing a project. Event frequency may affect the physical criteria for the project (e.g., the 100-year flood for a levee) or its predicted life cycle (e.g., facilities at a campsite in the event of a wildfire). Traditionally, frequency estimations for future events have been based on frequency of past events; however, extreme weather events are occurring more frequently due to a changing climate. Therefore, what may have been estimated as a 1,000-year flood a decade ago might now be closer to a 200-year flood. By considering the most complete estimation for weather event frequency, the planning and design project team can potentially decrease maintenance, rehabilitation, and replacement costs; increase service life; and improve infrastructure resilience during and after an extreme weather event. Doing this can also improve emergency planning and preparedness to save lives and reduce economic and environmental consequences in the event of a disaster.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Consider which weather-related disasters could have an impact on the project
- Consider how weather-related disasters could affect the project both during the event and in the long term (e.g., a hydropower dam could lose power supply in a wildfire event or lose the ability to produce power during a drought)
- Consider trends and changes when assigning frequency data for the project by evaluating the existing local and regional frequency data for the identified weather-related disasters (e.g., flood modeling should be updated to consider recent large storms)

Implementation Considerations

The implementation effort may vary based on location, climate, and project type, but should be proportional to the overall cost of the project and estimated consequences created by the project in the event of a disaster. For instance, a project for a small inland marina with minimal construction and operational costs that would have little negative impact in the event of an extreme weather condition should consider the impacts of increasing extreme weather events but would likely not need modeling completed to refine a frequency curve. Alternately, a large flood control structure with a large population at risk downstream should have detailed analysis and modeling completed to provide the most accurate frequency curves possible.

Examples/References

- United States Army Corps of Engineers (USACE). 1993. Hydrologic Frequency Analysis. EM 1110-2-1415. Available at: https://www.publications.usace.army.mil/portals/76/publications/engineermanuals/em_1110-2-1415.pdf
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

R4: Consider Human-Induced Hazards

Description and Benefits

Considering human-induced hazards while assessing risks during the planning process aids decision making by identifying and illustrating potential impacts of given options. Risk assessment includes describing and analyzing the nature, likelihood, and magnitude of risk associated with a project or planning action. While natural hazards are historically well within the scope of USACE risk consideration (e.g., flood, drought), human-induced hazards can pose a significant threat at the local, regional, or national level as well. In addition to mitigating the risk of natural and human-induced hazards to USACE infrastructure systems, USACE provides emergency response services when hazards do occur. Preparing for and mitigating the vulnerability of USACE projects to human-induced hazards can reduce risks.

Related Federal Mandates/Policies/Programs (if applicable)

- Unified Facilities Criteria 4-010-01: DoD Minimum Antiterrorism Standards for Buildings
- USACE National Dam Safety Program
- USACE National Flood Risk Management Program
- USACE National Levee Safety Program

Potential Actions

- Assess the criticality of the project components to the successful execution of authorized performance
- Identify potential human-induced hazards to a project that can cause harm or reduce potential for gain
- Determine the likelihood of potential human-induced hazards
- Assess the vulnerability and consequence of potential human-induced impacting project components
- Assess the vulnerability of emergency response plans to human-induced hazards
- Develop strategies to mitigate the threat of project components to human-induced hazards (e.g., hardening of levees and dams, protection of freshwater resources)
- Consider cost-effective strategies in the decision-making process

Implementation Considerations

A risk management framework is most effective when implemented through every stage in a project. Project directors may choose to integrate risk management in this way. Assessing the likelihood and nature of human-induced hazards to a given project is crucial to enabling effective mitigations. Existing (confidential) Department of Defense resources may help with this assessment.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Risk Management Center (RMC) Center Of Expertise. Available at: https://www.iwr.usace.army.mil/about/technical-centers/rmc-risk-management-center/
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 2018. Risk-Informed Decision Making and Planning Support Tools. Available at: https://planning.erdc.dren.mil/toolbox/tools.cfm?Id=305&Option=Risk-Informed%20Decision%20Making%20and%20Planning%20Support%20Tools

R5: Incorporate Risk Informed Decision Making

Description and Benefits

Risk Informed Decision Making (RIDM) grew out of Theme 2 of the "12 Actions for Change" program initiated by USACE in 2006 following Hurricane Katrina. RIDM and the risk-informed planning process described in the USACE manuals, Planning Manual Part II and Principles of Risk Analysis for Water Resources, can be defined as an analytical and deliberative decision-making framework evolved specifically for making decisions under uncertainty. It is a reframing of the original USACE six-step planning process articulated in the 1983 Principles and Guidelines (P&G), acknowledging that a level of uncertainty is inherent in any planning decision and emphasizing that planning is cyclical in nature. USACE has adopted a Risk Framework to address risk in many programs, including the USACE major rehabilitation program, the national dam safety program, the national levee safety program, the flood risk management program, Specific, Measurable, Attainable, Risk, Informed, Timely (SMART) planning, and other initiatives. Project teams are encouraged to reference existing manuals published by USACE for risk informed practices. Incorporating a risk management framework into the planning process facilitates decision-making by helping to illustrate the potential impact of available options.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 10-2-55: Roles and Responsibilities Risk Management Center
- Engineer Regulation No. 1105-2-101: Risk Assessment for Flood Risk Management Studies
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook, Apr 2000
- Engineer Regulation No. 1110-2-1156: Safety of Dams – Policy and Procedures
- Engineering and Construction Bulletin 2019-3. Risk Informed Decision Making for Engineering Work During Planning Studies.
- USACE National Dam Safety Program
- USACE National Flood Risk Management Program
- USACE National Levee Safety Program

Potential Actions

- Reference the Principles of Risk Analysis for Water Resources and the Planning Manual Part II: Risk-Informed Planning published by USACE
- Adopt the four-step process to RIDM: Analysis, Communication, Assessment, and Management
- Assess the criticality of the project components to the successful execution of authorized performance
- Identify the risks facing the project, and develop a risk profile for each risk
- Distinguish between risks of loss and risks of potential gain
- Assess the likelihood and consequence of each risk
- Evaluate the level of risk acceptance or risk tolerance appropriate for each risk
- Characterize the nature and degree of uncertainty in the risk analysis
- Characterize the risk qualitatively or quantitatively with appropriate attention to baseline and residual risks, risk reductions, transformations, and transfers
- Develop cost-optimized mitigation strategies to bring the project up to the required level of risk tolerance
- Monitor, Evaluate, and Modify approaches in response to what is learned, after implementation
- Communicate the risks in a project to key decision-makers and stakeholders

Implementation Considerations

RIDM and risk-informed planning requires a change in mindset from the traditional USACE planning approach. In any decisions being made throughout the planning process, the degree of uncertainty underlying the factors informing that decision should be spelled out with clarity. This will often lead to a range of potential future outcomes rather than a single, "most likely," outcome. Expressing this range, the level of confidence that the project team has in that range, and the risk of loss or risk of unrealized gain if a project does not perform as expected, can improve the stakeholder engagement process and improve decision-making quality. The RIDM approach can become a complex analytical process, but this can be mitigated by effectively managing the approach throughout the planning process (e.g., by matching the appropriate level of effort to the appropriate level of detail).

Examples/References

- United States Army Corps of Engineers (USACE). 2006. 12 Actions for Change. Available at: https://www.pnwa.net/new/Articles/12%20Actions%20for%20Change.pdf
- United States Army Corps of Engineers (USACE). 2011. Risk and Reliability Engineering for Major Rehabilitation Studies. EC 1110-2-6062. Available at: http://asktop.net/wp/download/23/ec%201110-2-6062%20Engineering%20and%20Design%20Risk%20and%20Reliability%20Engineering%20for%20Major%20Rehabilitation%20Studies.pdf
- United States Army Corps of Engineers (USACE). 2015. SMART Planning Feasibility Studies: A Guide to Coordination and Engagement with the Services. Available at: https://planning.erdc.dren.mil/toolbox/library/smart/SmartFeasibility_Guide_highres.pdf
- United States Army Corps of Engineers (USACE). 2018. Risk Analysis Gateway. Available at: https://www.iwr.usace.army.mil/Missions/Risk-Analysis/Risk-Analysis-Gateway/
- United States Army Corps of Engineers (USACE). 2018. Risk Management Center (RMC) Center Of Expertise. Available at: https://www.iwr.usace.army.mil/about/technical-centers/rmc-risk-management-center/
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 1999. Tools for Risk-Based Economic Analysis. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/99r02.pdf
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 2017. Planning Manual Part II: Risk-Informed Planning. Available at: https://planning.erdc.dren.mil/toolbox/library/Guidance/-PlanningManualPartII_IWR2017R03.pdf
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 2017. Principles of Risk Analysis for Water Resources. Available at: https://planning.erdc.dren.mil/toolbox/library/iwrserver/-2017_R_01_PrinciplesofRiskAnalysisforWaterResources.pdf
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 2018. Risk-Informed Decision Making and Planning Support Tools. Available at: https://planning.erdc.dren.mil/toolbox/tools.cfm?Id=305&Option=Risk-Informed%20Decision%20Making%20and%20Planning%20Support%20Tools
- Federal Energy Regulatory Commission (FERC). 2016. Risk Informed Decision Making (RIDM). Available at: https://www.ferc.gov/industries/hydropower/safety/guidelines/ridm.asp

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3.2. Planning Fact Sheets

Planning

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P1: Consider Broad Objectives in Plan Formulation and Evaluation

Description and Benefits

Considering broad objectives in plan formation and evaluation refers to the process of considering study objectives that meet local, state, and other federal objectives beyond national economic development. In the alternatives selection practice described in the 1983 Principles and Guidelines (P&G), the alternative that "reasonably maximizes net national economic development (NED) benefits, consistent with the Federal objective [of protecting the Nation's environment]" is identified as the NED plan and is typically recommended. However, opportunities may exist for significant broader benefits if additional factors are considered. The 1983 P&G establishes four accounts to facilitate evaluation and display effects of alternative plans: the NED account, the environmental quality (EQ) account, the regional economic development (RED) account, and the other social effects (OSE) account. Display of the RED and OSE accounts is discretionary, but considering these additional factors in plan selection may lead to broader benefits for a project. In addition to the NED plan, the National Ecosystem Restoration (NER) plan, the Combined NED/NER Plan, and the Locally Preferred Plan (LPP) are alternative plans that may be selected. These alternative plans result from including aspects that are holistically beneficial and consistent with the federal objective but may not directly cause NED benefits. An example of this may include choosing to restore the natural hydrology of a wetland or waterway to mitigate flood risk instead of constructing a concrete channel, benefiting ecological health and creating recreational opportunities while meeting the project objective and while staying cost-effective. This strategy may be applicable to design decisions at existing USACE-owned facilities in addition to new projects.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- National Environmental Policy Act

Potential Actions

- Consider RED and OSE accounts when selecting a preferred alternative
- Consider NER outputs and LPPs when selecting a preferred alternative
- Consider co-benefits or secondary objectives when evaluating alternatives to identify where a design may benefit other aspects of the project context
- Design for flexibility by accounting for the potential need for a project to evolve or expand its mission capability over time, subject to benefit-cost analysis
- Consider the Cumulative Effects of proposed actions on past, present, and reasonably foreseeable future actions

Implementation Considerations

Implementation of plans that consider objectives outside of the federal objective or USACE mission areas will likely be the responsibility of the non-federal partner to implement.

Examples/References

- Council on Environmental Quality. 1997. Considering Cumulative Effects Under the National Environmental Policy Act. Available at: https://ceq.doe.gov/publications/cumulative_effects.html
- United States Army Corps of Engineers (USACE). 2011. Memorandum: Corps of Engineers Civil Works Cost Definitions and Applicability. Available at: https://planning.erdc.dren.mil/toolbox/library/MemosandLetters/11sep12-DCWCostMemo.pdf
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 1996. Planning Manual. Available at: https://planning.erdc.dren.mil/toolbox/library/IWRServer/96r21.pdf
- United States Army Corps of Engineers (USACE) Institute for Water Resources (IWR). 2017. Planning Manual Part II: Risk-Informed Planning. Available at: https://planning.erdc.dren.mil/toolbox/library/Guidance/-PlanningManualPartII_IWR2017R03.pdf
- United States Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1256524&ext=pdf

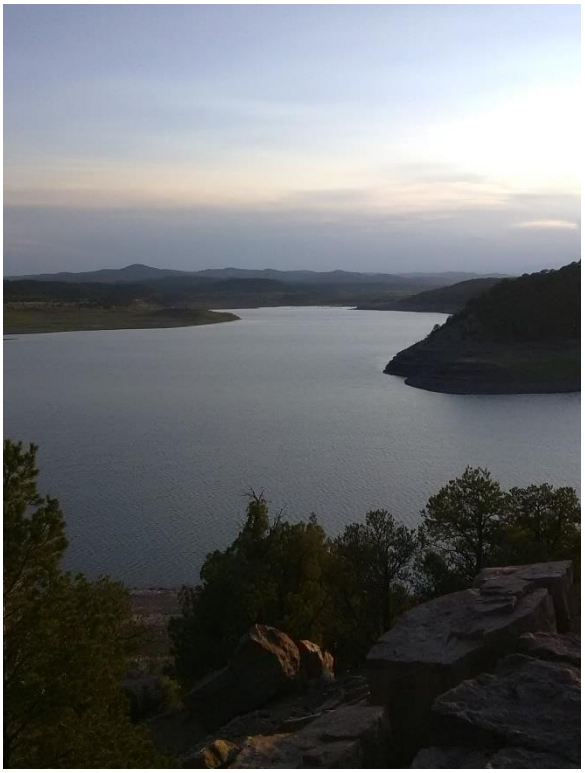
P2: Consider Impacts Beyond the Period of Analysis

Description and Benefits

As a part of the typical planning process within USACE, for each project an inventory and forecast of the impact on critical resources (e.g., physical, demographic, economic, social) is developed. The considerations are carried out for a period of analysis that is defined by USACE as follows—time required for implementation plus the lesser of: (1) the period of time over which any alternative plan would have significant beneficial or adverse effects, (2) a period not to exceed 50-years except for major multiple purpose reservoir projects, or (3) a period not to exceed 100 years for major multiple purpose reservoir projects. However, since Civil Works projects typically have an actual physical life far beyond the period of analysis, careful consideration of adaptability becomes an important factor in project formulation and development. Appropriate consideration should be given to environmental factors that may extend beyond the period of analysis by indicating how changes in economic and other conditions are likely to have an impact on problems and opportunities generated through the project. This results in an opportunity for USACE to make its infrastructure more resilient.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook



Potential Actions

- Develop a sequence of decisions allowing for adaption, as a method to address uncertainty (i.e., conditions beyond those identified in the risk assessment)
- Identify design or operations and maintenance measures that could be implemented to minimize adverse consequences while maximizing beneficial effects
- Anticipate evolving needs, and integrate adaptation strategies into capital improvement plans to mitigate retrofit costs

Implementation Considerations

Impact assessments are the basis for plan evaluation, comparison, and selection. Preparing an inventory and gathering information about potential future conditions requires forecasts, which should be made for selected years over the period of analysis through proper expertise and resources. Information gathering and forecasts will most likely continue throughout the planning process.

Examples/References

- U.S. Army Corps of Engineers, Institute for Water Resources. 1996. Planning Manual. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/96r21.pdf
- Council on Environmental Quality. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1256524&ext=pdf

P3: Consider System Wide Sediment in Riverine Environment

Description and Benefits

Sediment management and use is a necessary component of many USACE projects. The USACE's Regional Sediment Management (RSM) program recognizes sediment as a local and regional resource and prioritizes sediment use across projects, environments, and communities. Through collaboration with stakeholders and other projects, this approach can result in short- and long-term economically viable and environmentally sustainable solutions for healthier systems. Benefits can include natural exchange of sediments, adaptive management, improved ecosystem, reduced life cycle costs, and improved operational efficiencies.

Related Federal Mandates/Policies/Programs (if applicable)

- Rivers & Harbors Act of 1899, Section 10
- National Regional Sediment Management Program of 1999

Potential Actions

- Protect navigable waters
- Reduce re-handling of material
- Extend dredge cycles
- Share equipment in linked projects, where possible
- Improve interagency and stakeholder relationships by coordinating sediment management activities with other federal, state, and local agencies within the boundaries of physical systems including inland watersheds, rivers, estuaries, and the coast
- Find opportunities to collaboratively leverage financial and manpower resources with others
- Better understand the regional sediment processes to optimize utilization and movement of sediment locally and regionally
- Share regional-scale data management systems, models, and other tools to improve project-level decisions and to achieve greater consistency in analytical results among studies and projects within a region
- Avoid duplication of data collection
- Consider reintroduction of sediment into sand-starved littoral systems to reduce the requirement for beach nourishment and sustain habitat for threatened and endangered systems, where possible and within the project scope
- Plan and justify the reservoir sedimentation investigation program to achieve functional, operational, planning, and design objectives and to provide timely information

Implementation Considerations

USACE has a focused program for improving collaboration for sediment management among projects within regions and with various stakeholders. USACE staff should consider whether implementing the RSM approach to sediment management is appropriate for the project because this approach can help overcome challenges with sediment management, assist in decision making, and apply adaptive management strategies. Appropriate sediment management may help to achieve short- and long-term efficiencies both locally and regionally while reducing costs and improving partnerships and environmental stewardship.

Examples/References

- United States Army Corps of Engineers (USACE). 1995. Sedimentation Investigations. ER 1110-2-8153. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-8153.pdf?ver=2013-09-08-233428-213
- United States Army Corps of Engineers (USACE). 1995. Sedimentation Investigations of Rivers and Reservoirs. EM 1110-2-4000. Available at: http://www.dtic.mil/dtic/tr/fulltext/u2/a403481.pdf
- United States Army Corps of Engineers (USACE). 2018. Regional Sediment Management (RSM). Available at: http://rsm.usace.army.mil/
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. National Regional Sediment Management Program. Available at: http://rsm.usace.army.mil/initiatives/facts/FY18-RSM_FactSheet.pdf
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. Regional Sediment Management Tools and Technologies. Volume I Coastal. Available at: http://rsm.usace.army.mil/pubs/brochures/2018_RSM_Coastal_Tools_Technologies_Brochure.pdf

P4: Consider Tribal Trust Responsibilities

Description and Benefits

Considering tribal trust responsibilities is integral to USACE's Tribal Nations Program, which implements USACE's Tribal Consultation Policy and adheres to the USACE Tribal Policy Principles. The primary goals of the USACE Tribal Nations Program are to: 1) consult with Federally Recognized Tribes that may be affected by USACE projects or policies; 2) reach out and partner with Tribes on water resources projects; and 3) provide technical services through USACE's Interagency and International Services Program. USACE recognizes that Tribal governments are to be treated on a government to government basis, and works to meet trust obligations, protect trust resources, and obtain Tribal views of trust and treaty responsibilities. USACE and Tribal leaders meet as governments and collaborate before and throughout the decision-making process to ensure the timely exchange of information and consideration of input. Each District and Division has a designated Tribal Liaison to assist with the consideration of Tribal concerns as part of project planning.

Related Federal Mandates/Policies/Programs (if applicable)

- American Indian Religious Freedom Act
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Executive Order 11593: Protection and Enhancement of the Cultural Environment, May 1971
- Executive Order 13007: Indian Sacred Sites, May 1996
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments, Nov. 2000
- National Historic Preservation Act of 1966, as amended (54 U.S.C. 300101 et. seq.)
- Water Resources Development Act of 2018, Sec. 1129; requires tribal consultation.

Potential Actions

- Begin consultation early, establishing processes and goals, and often working with the Tribal Center of Expertise, District/Division Tribal Liaison, and Tribal point-of-contact
- Consult with Tribes regarding Trust resources (i.e., fishing sites, sacred sites, and access to clean water) that may be impacted by the project
- Consider the potential Trust responsibilities (i.e., practice of traditional ceremonies and protection against terrorist threats) impacted by the project (Note: the extent of Trust responsibility is open to interpretation)
- Develop consultation procedures for individual projects at the local level to meet the needs of the particular Tribe(s)
- Understand the Tribes' cultural actions that may prevent access to certain lands during tribal holidays and during some unscheduled tribal events such as funerals; should consider tribal holidays when developing project schedules and reviews
- Develop a dispute resolution process during consultation that includes a provision to elevate the consultation to higher USACE and Tribal levels
- To the extent permitted by law and policy, partner with Tribes on studies, projects, programs, and permitting procedures
- Involve tribal members early in planning process where interests may be impacted as a way to develop trust and communication; understand that tribal culture may make it difficult to divulge details regarding cultural sites and other information that could impact project
- Participate in a cultural immersion course hosted by Tribe (USACE PROSPECT Course No. 950: Native American Perspectives on Corps Missions)
- Participate in a Consulting with Tribal Nations training

Implementation Considerations

In addition to complying with federal regulations and USACE policies, considering Tribal trust responsibilities is the federal government's requirement to honor its obligations to Tribes and to represent the best interests of the Tribes, their resources, and their members. Tribal trust responsibilities should be implemented throughout the life of the project. USACE will act to fulfill its obligations to preserve and protect trust resources and to consider the potential effects of USACE projects on natural and cultural resources. USACE strives to involve Tribes in programs, projects, and other activities that will help build economic capacity and manage Tribal resources while preserving cultural identities.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Cultural Resources Documents. Available at: https://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/tribal_culturalres/
- United States Army Corps of Engineers (USACE). 2018. Tribal Nations Overview. Available at: https://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/

P5: Maintain or Restore Natural Processes and Hydrology, and Promote Functional Geomorphic Process

Description and Benefits

Maintaining and restoring natural processes (e.g., drainage areas such as wetland areas and native landscapes and soils) by supporting healthy native plants, native biological communities, water storage, and infiltration can be beneficial because projects are able to contribute positively toward the natural environment while maintaining or potentially enhancing other project objectives. Restoring natural hydrology can lead to functional geomorphic processes as water travels and carries sediments, reshaping the ground and forming landscapes. Geomorphic processes can create critical hydrology that supplies water to ecosystems, provides habitats for fish and wildlife, controls flooding, and prevents erosion. Water resources, in particular, require recognition of multiple conditions, relationships, interactions, constraints, and feedbacks that influence and are influenced by unnatural activities. Natural processes and features can also help achieve study objectives (i.e., solve problems and avoid constraints). USACE addresses the complexities of natural resources systems to create a range of desired services and economic and social benefits through projects.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Engineer Regulation No. 1110-2-1464: Hydrologic Analysis of Watershed Runoff
- Engineer Regulation No. 1165-2-501: Civil Works Ecosystem Restoration Policy
- Sustainable Rivers Program

Potential Actions

- Perform an environmental site assessment, surveying topography, hydrology, climate, vegetation, soils, existing infrastructure, and potential human health threats
- Map and identify natural hydrology locations on or surrounding a project site (i.e., lakes, streams, estuaries, wetlands, watersheds, and rivers)
- Avoid contamination of natural hydrology by applying stormwater/runoff management
- Incorporate dry or vegetated drainage pathways that integrate inline/offline stormwater retention/detention opportunities; this could include creating micro drainage areas to avoid concentrated flow and/or using (or creating) high-permeability soil areas as open space for infiltration
- Maximize permeable surface area; integrate pervious features on large parcels (i.e., parking lots) to reduce runoff volume; maximize placement of infiltration systems, depressed vegetated islands, and perimeter swales for multiple infiltration opportunities
- Recharge groundwater and aquifers by implementing permeable pavement on site
- Prevent rainwater overflows by collecting rainwater to use for non-potable applications
- For dam projects, consider investigating how modifying operations to control water release (to the extent practicable) could restore the diversity of species that previously existed downstream
- Conserve the site's existing natural qualities for runoff management and treatment; preserve existing trees as site amenities; if located within existing floodplain, maintain pre-development infiltration and water quality
- Apply retention walls or dams, if applicable, to control water flow
- Favor placement of detention/retention/infiltration facilities in upstream areas to capture runoff close to its source; analyze project's watershed; and identify locations most appropriate for infiltration
- Perform an empirical analysis to determine flow characteristics
- Incorporate historical geomorphic patterns of the local area to understand potential flooding threats
- Mitigate hydro-modification and/or preserve/restore watercourse stability and natural streambed sediment transport
- Make additional channels or streams that naturally control flooding and prevent erosion
- Limit disturbance of soil during construction activities to minimize the need for additional restoration; in areas that will be re-vegetated, restore soil characteristics necessary to support the selected vegetation types
- Consider long-term environmental changes and effects on a given project

Implementation Considerations

Recognizing long-term impacts of projects on natural hydrology is essential to maintaining geomorphic processes. The project should aim to maintain and restore natural hydrology while undergoing construction and during operation. Excessive interference with natural systems can degrade the quality of the surrounding environment, potentially affecting the quality of the project. This strategy can be applied during project planning and formulation, alternatives development, and during the final formulation of the selected project. Consider incorporating long-term planning, design, management, operations, and decision-making to continue to maintain and restore natural hydrology and promote geomorphic processes. Programs, such as the Sustainable Rivers Program, integrate water flow control of reservoirs to promote natural processes and enhance biodiversity of species. Protecting natural processes can offer benefits to human health and access to food supplies by creating local benefits to air, water, and soil quality.

Examples/References

- United States Army Corps of Engineers (USACE). 1999. Ecosystem Restoration – Supporting Policy Information. EP 1165-2-502. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1165-2-502.pdf
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2011. Sustainable Rivers Project: Benefiting Rivers, Communities and the Nation, Understanding the Past Vision for the Future. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/sustainablerivers/Sustainable_Rivers_Project-Vision.pdf
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2017. Sustainable Rivers Program EAB Work Session in Davis, CA PowerPoint Presentation by John Hickey, Lisa Morales, Mindy Simmons, and Gretchen Benjamin.

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P6: Preserve and Manage Watershed

Description and Benefits

A watershed is the area of land where all surface water drains into different rivers and streams and typically flows into a common outlet, such as a basin or ocean. Watersheds accommodate physical, societal, and economic human needs while sustaining ecological communities. Preserving and managing watersheds results in improved ecosystems, better water resource management, and reduced risk of flooding and drought. Given the regional scale of watersheds, a great degree of coordination and cooperation is needed between organizations, agencies, and communities for effective watershed management. Discussing the benefits of Watershed Management Plans with local and national entities is vital to this cooperation. USACE advocates collaborating with stakeholders and other authorities as a sustainable solution to maximize the benefit of a project.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Planning Bulletin 2019-01, Subject: Watershed Studies
- Guidance Memo: Application and Compliance of SMART Planning and the 3x3x3 Rule to Watershed Assessment Studies, Jul 2014
- Tribal Partnership Program: Section 203 of the Water Resources Development Act of 2000
- Public Law 93-251, Planning Assistance to the States Program: Section 22 of the Water Resources Development Act of 1974

Potential Actions

- Conduct more comprehensive and strategic evaluations and analyses that include diverse political, geographic, physical, institutional, technical, and stakeholder considerations.
- Define the overall shared vision for the watershed, water and related resources as developed by the partners involved in the watershed study, and to present the coordinated study framework and associated activities that clearly support the shared vision.
- Map surrounding wetlands referencing an inventory of local, state, or national wetlands
- Determine whether a wetland is federally protected
- Perform a watershed study focusing on present conditions
- Identify problems affecting the watershed, and suggest methods of improvement
- Determine preservation and management goals while collaborating with stakeholders and other authorities
- Avoid contamination of watersheds by applying stormwater/runoff management
- Prevent rainwater overflows by collecting rainwater to use for non-potable applications
- Conduct soil and water quality tests before a project begins construction, during construction, and after completion
- Consider project impacts on the watershed in relation to hydrologic and environmental characteristics
- Incorporate all gathered information into a Watershed Management Plan
- Consider long-term environmental changes and effects of implementing preservation and management strategies

Implementation Considerations

Be informed of any existing tribal programs that may interfere with implementing preservation and management strategies. The Watershed Management Plan should consist of strategies that focus on short- and long-term preservation and management and how that could affect a project near a wetland. Several watershed studies have been accomplished by Tribal nations under the Tribal Partnership Program.

Examples/References

- United States Army Corps of Engineers (USACE). 2002. Tribal Partnership Program: Issues Relevant to Working with Native Americans and Alaska Natives on Section 203 Studies. Prepared as part of the USACE Institute for Water Resources Policy Studies Program. Available at: https://www.usace.army.mil/Portals/2/docs/civilworks/tribal/blue_book.pdf
- United States Army Corps of Engineers (USACE). 2014. Application and Compliance of SMART Planning and the 3x3x3 Rule to Watershed Assessment Studies. Available at: https://planning.erdc.dren.mil/toolbox/library/MemosandLetters/14Jul-watershed.pdf
- United States Army Corps of Engineers (USACE). 2015. Planning Assistance to States. Available at: http://www.nae.usace.army.mil/Missions/Public-Services/Planning-Assistance-to-States/
- United States Army Corps of Engineers (USACE). 2018. Navajo Nation Watershed Study. Available at: https://www.spl.usace.army.mil/Missions/Civil-Works/Projects-Studies/Navajo-Nation-Watershed-Study/
- United States Army Corps of Engineers (USACE). 2019. Subject: Watershed Studies. Available at: https://planning.erdc.dren.mil/toolbox/library/PB/PB2019-01.pdf

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P7: Preserve Biological Health in Bodies of Water

Description and Benefits

USACE is committed to protect estuaries, rivers, lakes, and navigable waters, as supported by federal mandates outlined in the Clean Water Act and USACE's Environmental Operating Principles. Implementing strategies that can help to preserve biological health in bodies of water and support the prosperity of aquatic ecosystems will help meet present and future water resource needs. Healthy aquatic ecosystems naturally filter bodies of water to maintain sustainability and further support healthy ecosystems on the surrounding land. Clean water promotes recreational use, improving the public's connection to the outdoors and thereby increasing the public's willingness to protect water resources. Strategies should maintain appropriate water quality throughout the design, construction, operation, and maintenance stages of projects, and should not result in negative impacts to environments upstream, downstream, or surrounding the body of water.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Water Act
- Engineer Regulation No. 1110-2-8154: Water Quality Management, May 2018
- National Environmental Policy Act

Potential Actions

- Perform biological assessments observing changes in natural indicators, such as algae levels (phytoplankton and zooplankton), macroinvertebrates, mussels, and fish
- Establish a water quality monitoring and data evaluation program to maintain appropriate water quality and establish quality thresholds or goals
- Use data to effectively evaluate a project's performance
- Track the trends of water quality and changes in biological health, and consider compiling information into real-time models
- Identify potential problems deteriorating aquatic ecosystems, and determine effective strategies to mitigate the problems that do no further harm to the environment
- Collaborate with governmental and non-governmental entities about activities that may affect or be affected by the strategies implemented
- Incorporate ecological sustainability, and consider system response in all water resource activities
- Communicate findings and preservation activities with the public to support educational benefits

Implementation Considerations

Be informed of any existing tribal programs that may interfere with implementing management strategies. Strategies should focus on both short- and long-term monitoring and management and consider the effect on a project near critical sources of water. Governmental and non-governmental entities may provide financial support for implementing strategies. To more consistently and accurately track trends, consider applying water quality models and watershed-based management tools to predict changes in water quality.

Examples/References

- United States Army Corps of Engineers (USACE). 1988. Procedures for Implementing NEPA. ER 200-2-2. Available at: https://www.gsa.gov/cdnstatic/Department_of_Army_Procedures_for_Implementing_NEPA.pdf
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2014. Pittsburgh District Water Quality: Biological Assessment. Available at: https://www.lrp.usace.army.mil/Missions/Water-Management/Water-Quality/

P8: Consideration of Historic Properties During Planning

Description and Benefits

Historic properties are finite, non-renewable resources which must be considered in formulating recommendations for planning projects. As early in the planning process as possible, historic properties should be identified, characterized and taken into account with regards to the measures and alternatives being proposed as part of a planning project. Coordination with the state historic preservation offices, Tribal historic preservation offices, the Advisory Council on Historic Preservation, and other interested parties should occur from the initiation of the planning study. Each district and division has an archaeologist or other cultural resources specialist that can undertake Section 106 compliance with the National Historic Preservation Act.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Executive Order 11593: Protection and Enhancement of the Cultural Environment, May 1971
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments, Nov. 2000
- National Environmental Policy Act
- National Historic Preservation Act of 1966 as amended (54 U.S.C. 300101)

Potential Actions

- The integrated feasibility report and National Environmental Policy Act document will describe identified cultural resources and historic properties that will/may be affected by the selected plan as well as provide determinations of effect and efforts to resolve adverse effects.
- Inclusion of the cultural resources and historic properties compliance within the integrated feasibility report and National Environmental Policy Act document will allow for a wider public review of the Section 106 compliance through the public review of the report.
- Estimates for mitigation or other treatment of historic properties affected by project alternatives and/or the selected plan will be included in the computation of total project cost and included in the comparison of all alternatives to determine the selected plan.
- Planning teams, working with the study Project Manager, should brief engineering and construction team members who will carry feasibility study projects into design and construction about mitigation requirements and/or avoidance strategies to ensure they are incorporated into the design and implementation of the project.

Implementation Considerations

Early and frequent coordination on proposed alternatives and identified historic properties will assist in the planning activities and allow, to the extent practicable, avoidance or minimization of adverse effects to historic properties.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Cultural Resources Documents. Available at: https://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/tribal_culturalres/
- United States Army Corps of Engineers (USACE) 2019. Planning Community Toolbox. Available at https://planning.erdc.dren.mil/toolbox/index.cfm

3.3. Engineering & Construction Fact Sheets

Engineering

Construction

Material and Equipment

E1: Minimize Project's Footprint of Disruption

Description and Benefits

During construction operations, excessive damage to or interference of existing vegetation, soil, infrastructure, environments, and societies should be minimized. A project can easily and unnecessarily extend beyond its boundaries that can negatively affect existing infrastructure in proximity, landscape, ecosystems, and can potentially disrupt neighboring societies. Associated consequences can be prevented by clearly defining and following the boundaries of a project's site or limit of disturbance.

Environmental interference and harm to trees and vegetation can be reduced with a plan consisting of clear strategies for preservation and communication within a project team. This practice can often save costs for revegetation. The environmental consequences of all project activities can be considered proactively, and a project team can then act accordingly to protect and enhance natural environments.

Related Federal Mandates/Policies/Programs (if applicable)

- National Environmental Policy Act

Potential Actions

- Illustrate the intended geographical scope of work of the project on a map
- Host a pre-meeting to inform all individual workers of a project's clear boundaries and limit of disturbance
- Use markers, such as construction stakes, flags, and tape, to identify boundaries on site
- Select equipment and grading methods that minimize damage to the existing site
- Measure the initial intended square footage of a project site then compare results to the total square footage the project had to be extended to during construction operations
- Specify equipment and grading methods that minimize damage to existing working surfaces (physically and abstractly)
- Observe and protect neighboring cultural/historical sites
- Determine areas where staging, stockpiling, and soil compaction can occur
- Identify any trees/vegetation that should be saved and removed prior to commencement of project construction
- Mark/label trees/vegetation that should be removed and protected in the field
- Count the total number of removed trees/vegetation and track any that were not included in prior planning
- Install temporary boundaries to identify prohibited areas close to the construction site

Implementation Considerations

A project's limit of disturbance should be reviewed with the project team early and clearly mark on site. Personnel should have experience in sustainable practices, particularly in construction. Multiple vendors may have to be contacted to identify quality and sustainable construction equipment. All contracting actions must be conducted such as FARS, AFARS, and EFARS. Meetings with the workforce could become more frequent if individual workers' awareness of a project's boundaries is minimal. The effort to implement can increase with a project area's environmental/social sensitivity. The ability to limit areas of disturbance can be of moderate difficulty. The cost savings of limiting areas of disturbance can be substantial to avoid revegetation. The practice of protecting trees and vegetation can be moderate to difficult depending on site characteristics. Proper communication may be required to inform the project team of off-limit zones and any alterations throughout a project including trees to protect.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130

E2: Conduct Dam/Levee Safety Inspections and Periodic Assessments

Description and Benefits

Dams and levees can play a large role in protecting surrounding existing infrastructure and communities and can be critical to watershed management. These structures can benefit communities and the environment by managing flood risk, providing water, applying hydropower, preserving fish and wildlife, and more. Therefore, regular safety inspections and periodic assessments of levees and dams can ensure the projects deliver their maximum benefits to supply and protect communities and the environment, minimizing the risks of loss of life, property, and environmental damage. USACE has well-established Dam and Levee Safety Programs involving continuous assessment, communication, and management in support of its overall mission to ensure life safety. The programs are based on USACE's risk-informed approach that allows USACE to repair its dams/levees in the most effective manner within a constrained budget.

Related Federal Mandates/Policies/Programs (if applicable)

- Rehabilitation and Inspection Program (Public Law 84-99)
- National Levee Safety Act
- Engineer Regulation No. 1110-2-100: Periodic Inspection and Continuing Evaluation of Completed Civil Works Structures
- Engineer Regulation No. 1110-2-401: Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors
- Engineer Regulation No. 1110-2-1156: Safety Of Dams - Policy and Procedures
- Engineer Circular 1165-2-218 Levee Safety Program - Policy and Procedures (Under Development).
- United States Army Corps of Engineers (USACE) Dam Safety Program
- United States Army Corps of Engineers (USACE) Levee Safety Program

Potential Actions

- Document existing project sites that include dams or levees with location and relevant specifications
- Incorporate measurable metrics useful to understand baselines and that can be used for developing trends
- Communicate findings to the public, and determine if next actions are necessary to repair, restore, renovate, etc. a dam or levee
- Organize community conversations to observe any community concerns
- Review opportunities to improve safety inspections and assessments by coordinating with Dam and Levee Safety Officers and the Emergency Operations group
- Refer to the National Levee Database and National Inventory of Dams online to review material relevant to inundation risk, hazard potential, flood fighting, design, construction, operation, maintenance, repair, and inspection

Implementation Considerations

USACE has established a Dam Safety Program and a Levee Safety Program that is publicly accessible. These programs involve collaboration with local sponsors and stakeholders to ensure that these infrastructures provide their intended benefits. Further, USACE is responsible for assessing, managing, and communicating flood risks to residents and businesses that may be impacted by it. The programs include routine (annual) and periodic (every 5 years) inspections that are conducted by USACE multidisciplinary teams that include the levee/dam sponsor and is led by a professional engineer. The teams help to evaluate, prioritize, and recommend flood risk management actions along with incorporating changes and improvements associated with state-of-the-art professional engineering practices into USACE's dam/levee safety policy and procedures. The periodic inspections involve evaluating annual inspection items; verifying proper operation and maintenance; evaluating operational adequacy, structural stability, and safety of the system; and comparing current design and construction criteria with those in place when the dam/levee was built.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Levee Safety Program: A Summary of Risks and Benefits Associated with the USACE Levee Portfolio. Available at: https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7167
- United States Army Corps of Engineers (USACE). 2018. USACE Levee Portfolio Report: Levee Safety Update, Volume 2, Issue 1. Available at: https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll8/id/3822
- United States Army Corps of Engineers (USACE). 2018. USACE Levee Inspection Checklist. Available at: http://cdm16021.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/1747
- United States Army Corps of Engineers (USACE). TBD. Federal Guidelines for Levees (Under Development).
- United States Army Corps of Engineers (USACE). 1989. Environmental Engineering and Local Flood Control Channels. EM 1110-2-1205. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1205.pdf?ver=2013-09-04-070754-657
- United States Army Corps of Engineers (USACE). 2008. Memorandum for Commanders, Major Subordinate Commands: Policy Guidance Letter - Periodic Inspection Procedures for Levee Safety Program. Available at: https://www.mvr.usace.army.mil/Portals/48/docs/EC/LSP/PIGuidanceLetterLevees.pdf
- Federal Emergency Management Agency (FEMA). 2004. Federal Guidelines for Dam Safety. Available at: https://www.fema.gov/media-library-data/20130726-1502-20490-5785/fema-93.pdf
- U.S. Department of the Interior, Bureau of Reclamation. 1983. Safety Evaluation of Existing Dams, A Water Resources Technical Publication. Available at: https://www.usbr.gov/tsc/techreferences/mands/mands-pdfs/SEED.pdf

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E3: Incorporate Stormwater Management into Constructability Considerations, As Appropriate

Description and Benefits

Stormwater is surface water produced during precipitation or snow/ice melt and can soak into soil, evaporate, or runoff into nearby bodies of water. Stormwater runoff can degrade water quality by carrying contaminants off-site and ultimately into bodies of water. Managing stormwater on a site during construction can support several environmental goals. These include maintaining soil permeability, preventing groundwater contamination, managing sedimentation and soil erosion, and others. Appropriate planning, sequencing, and scheduling, and development of procedures and program manuals can support the effectiveness of stormwater management measures in construction. Incorporating stormwater management into constructability considerations supports USACE's goal of conserving natural resources, protecting the environment, and improving flood/drought resilience.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Water Act
- Executive Order 13834: Efficient Federal Operations, May 2018
- United States Environmental Protection Agency National Pollutant Discharge Elimination System

Potential Actions

- Preserve pervious surfaces by limiting traffic of vehicles, equipment, materials, and workers to designated areas
- Prevent erosion by predicting changes in the site's pervious surface throughout construction
- Develop and use an erosion and sediment pollution control program manual
- Eliminate possibility of contamination to the site's natural estuaries
- Formulate a spill plan
- Manage erosion by slowing down surface water (e.g., maintain wetlands, construction sediment ponds, pervious pavement)
- Clean water prior to leaving the site to maintain water quality
- Place excavated material on uphill sides of trenches to prevent surface water from entering trench
- Provide protection against groundwater contamination when using exterior concrete sealers (e.g., geomembranes)

Implementation Considerations

Incorporating stormwater management plans early on in the construction planning, sequencing, and scheduling processes can make a difference in ensuring the success of the strategies. Coordination may be needed between project designers, construction managers, and contractors for the project. Stormwater management can be particularly beneficial for projects in locations with high rain volumes, high flood potential, low access to water resources, or contaminant runoff concerns.

Examples/References

- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

E4: Incorporate Low Impact Development

Description and Benefits

While conventional stormwater management techniques pipe and convey runoff as quickly as possible off the site to reduce flooding, this can cause issues at the larger watershed level such as increased peak flow, erosion, contaminant levels, and other ecological damages. Low Impact Development (LID) or Green Infrastructure can address stormwater management priorities while minimizing other damages by mimicking natural hydrological processes. These techniques include limiting the impervious area of a site, slowing runoff rates (e.g., by capturing in a swale), and reducing stormwater/contaminant runoff volume through filtration, infiltration, evaporation, and/or evapotranspiration. Additionally, considering the landscape design aspect of green infrastructure can be beneficial to the community or aesthetic aspects of a project.

Related Federal Mandates/Policies/Programs (if applicable)

- Energy Independence and Security Act of 2007, Section 438
- Executive Order 13834: Efficient Federal Operations, May 2018
- Unified Facilities Criteria 1-200-02: High Performance and Sustainable Building Requirements
- Unified Facilities Criteria 3-210-10: Low Impact Development

Potential Actions

- Follow green infrastructure and stormwater sustainable practices as specified in the Energy Independence and Security Act, Section 438 guidance
- Implement applicable sustainable locations and site development requirements as described in Unified Facilities Criteria 1-200-02
- Limit the proportion of impervious areas covering a site
- Install swales and other stormwater collection features to reduce the volume and peak flow rate of runoff exiting the site
- Use engineered soils and selected vegetation to filter contaminants and infiltrate or make use of stormwater

Implementation Considerations

For projects that begin with a planning phase, addressing LID strategies as part of project planning can maximize benefits and minimize cost through early-stage site design. For improvements to existing USACE infrastructure, the impact that LID strategies can have on existing operations and maintenance practices should be considered.

Examples/References

- United States Army Corps of Engineers (USACE). 2013. Army Low impact Development Technical User Guide. Available at: https://www.usace.army.mil/Portals/2/docs/Sustainability/Hydrology_LID/-Army_LID_Technical_User_Guide_January2013.pdf
- United States Army Corps of Engineers (USACE). 2018. Hydrology and Low Impact Development (LID) Center of Expertise (CXS). Available at: https://www.usace.army.mil/Missions/Sustainability/Hydrology-and-Low-Impact-Development/
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- MILCON Requirements, Standardization, and Integration (MRSI). 2018. Hydrology and Low Impact Development (LID). Available at: https://mrsi.erdc.dren.mil/sustain/cx/lid/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

E5: Protect Soil Health

Description and Benefits

Soil health, or soil quality, is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Healthy soil can filter pollutants and help prevent excess runoff, erosion, sedimentation, and flooding. The management of soil health is essential to conserving soil on site, reducing erosion, preventing land degradation, protecting water quality, assisting in flood reduction efforts, and maintaining ecosystem vitality and microbial diversity. Management of soil health can ensure that the project protects, maintains, and improves existing habitats and appropriately removes and manages any undesirable elements that contribute to the loss of ecosystem function. When implemented effectively, protecting soil health can ultimately conserve biodiversity and improve the long-term health and vitality of the project site.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-1-5: Plant Pest Quarantined Areas and Foreign Soil Samples

Potential Actions

- Minimize physical, chemical, and biological activities that can cause soil disturbance and disrupt soil microbes
- Maintain suitable habitat for inhabitants of the soil food web
- Use vegetation as appropriate for site conditions, climate, and design intent
- Create and communicate a soil management plan
- Establish clear construction boundaries to minimize disturbance to healthy soil and vegetation
- Identify disturbed soil that will be revegetated and restored
- Communicate soil management requirements to site contractors through site drawings and written specifications
- Monitor soil health and use soil quality assessments to evaluate the effects of soil health management

Implementation Considerations

USACE is partnered with the National Resources Conservation Service in improving the management of water and related land sources. USACE staff should consider planning for soil health and restoration in the design and engineering stage and limiting soil disturbance during construction. The implementation effort is generally minimal when considered as part of the overall site management.

Examples/References

- United States Army Corps of Engineers (USACE). 1970. Calibration of Laboratory Soils Testing Equipment. EM 1110-2-1909. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/-EngineerManuals/EM_1110-2-1909.pdf?ver=2013-09-04-070812-107
- United States Army Corps of Engineers (USACE). 1970. Laboratory Soils Testing. EM 1110-2-1906. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1906.pdf?ver=2013-09-04-161123-567
- United States Army Corps of Engineers (USACE). 1992. Bearing Capacity of Soils. EM 1110-1-1905. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-1905.pdf
- United States Army Corps of Engineers (USACE). 2011. USACE and Natural Resources Conservation Service (NRCS) Partnership. Available at: https://www.iwr.usace.army.mil/about/partnerships/federal-agency-partnerships/natural-resources-conservation-service/
- United States Army Corps of Engineers (USACE). 2017. Soil Health Appendix F of Red River of the North Watershed. Available at: http://www.mvp.usace.army.mil/Portals/57/docs/Civil%20Works/Projects/-Red%20River/F00_AppendixF_Soil_Health_Final_June2017.pdf?ver=2018-04-18-101738-700
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2001. Soil Quality Institute: Guidelines for Soil Quality Assessment in Conservation Planning. Available at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051259.pdf
- United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). 2018. Soil Health. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/

E6: Minimize Heat Island Effect

Description and Benefits

Urban heat island effect refers to the phenomenon of elevated temperatures in developed areas compared to more rural, landscaped surroundings. The urban heat island effect is caused by development and changes in radiative and thermal properties of urban infrastructure and buildings (e.g., pavements, roof surfaces, heat released from building cooling systems) that affect the local micro-climate. Heat islands are influenced by a city's geographic location and local weather patterns, and their intensity changes on a daily and seasonal basis. Higher surface and atmospheric temperatures in heat islands can cause a host of impacts, including increased energy consumption, elevated emissions of air pollutants and greenhouse gases, compromised human health and comfort, impaired water quality, and consequently economic impacts from the energy and health implications. However, several effective strategies can be implemented to minimize the adverse effects of heat islands at the site development and design stage.

Related Federal Mandates/Policies/Programs (if applicable)

- U.S. Environmental Protection Agency's Heat Island Reduction Program

Potential Actions

- Include adequate trees and vegetation in site design; shade trees and soft, vegetative surfaces can mitigate heat island effects through evapotranspiration cooling and shade
- Implement Cool Pavements; paving materials with high albedo (reflectivity) are better than dark, heat-absorbing surfaces such as conventional asphalt
- Include water in the site design (assuming the project has available water); water bodies and features can cool the air and serve other functions such as stormwater and flood management
- Plan for improved urban geometry with proper dimensions and spacing of buildings and structures that influences shade and air flows
- Implement Cool Roofs; buildings with reflective roof materials that are light colored can be 50 to 60°F cooler than buildings using conventional materials
- Consider Green Roofs for buildings; a vegetative layer on a roof can cool surrounding air and reduce energy consumption for cooling building interiors

Implementation Considerations

The efforts to mitigate urban heat island effects can be relatively easy to include in site design. Although there is some additional cost in implementation, many of the strategies have shown a net cost-benefit when considering energy savings and health/comfort benefits.

Examples/References

- U.S. Environmental Protection Agency (EPA). 2008. Reducing Urban Heat Islands: Compendium of Strategies. Available at: https://www.epa.gov/heat-islands/heat-island-compendium
- Heat Island Community Actions Database (EPA). Available at: https://www.epa.gov/heat-islands/heat-island-community-actions-database

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E7: Design and Construct Lighting to Minimize Pollution

Description and Benefits

Strategies to minimize light pollution should be identified during the engineering phase of a project and incorporated into the construction phase, ensuring infrastructure is sufficient to execute the strategies. Excessive artificial lighting can have damaging environmental consequences for humans, wildlife, and the climate. Light pollution includes glare (visual discomfort from uncontrolled brightness), sky glow (accumulated brightness in the night sky), light trespass (light falling on unwanted areas), and clutter (brightness from the concentration of light sources). Often a significant amount of light emitted from human sources is not concentrated on where it is needed and illuminates the greater surroundings and night sky. This is further magnified by trying to compensate for dullness by using lightbulbs with higher wattage, concentrating lighting fixtures (requiring more overall), and keeping them on for longer periods of time. Uncontrolled lighting can result in disturbed ecological behavior, wasted energy use, and warmer global temperatures.

Potential Actions

- Identify light-sensitive characteristics surrounding a project site
- Apply interior shading on windows to retain lighting indoors at night
- Use applicable outdoor lightbulbs with warm-colored light-emitting diode or compact fluorescent bulbs
- Determine if local, state, or federal rebates or incentives apply to strategies related to minimizing light pollution
- Integrate light dimmers, timers, and motion sensors to reduce illumination and conserve energy
- Use lighting fixtures with cut off shields considering placement, height, and aim of light concentration to mitigate light pollution and energy waste
- Design light fixture placements to be more dispersed instead of concentrated, meeting required level of illuminance
- Measure the average illuminance (in foot-candles) where light is most needed and determine if lighting is inefficient
- Observe, record, and address community complaints

Implementation Considerations

The effort to minimize light pollution will somewhat scale with the project or facility size. For small and simple facilities, the consideration of light pollution can be easily incorporated into a broader evaluation of energy usage. For larger installations, the effort can be moderately difficult, requiring design planning and collaboration with local, state, and federal entities.

Examples/References

- International Dark-Sky Association (IDA). 2018. Light Pollution. Available at: http://darksky.org/light-pollution/

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E8: Implement Erosion Control and Minimize Vulnerability to Erosion

Description and Benefits

Construction activities can instigate erosion that can have negative impacts on the environment. Common types of erosion are induced by wind or water. Excessive ground exposure to wind can cause top portions of the ground to become overly arid and more susceptible to erosion. Construction site operators are required by the Clean Water Act to develop a Stormwater Pollution Prevention Plan that includes erosion and sediment controls to protect the soil and ground surface from excessive degradation and to preserve sensitive bodies of water, such as estuaries, lakes, and wetlands. Erosion control measures should avoid further negative impacts on the environment and be planned in advance before construction activities begin.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Water Act (CWA)
- USACE Shoreline Protection and Beach Erosion Control Program

Potential Actions

- Perform a ground quality assessment to understand the soil's characteristics
- Estimate erosion by using empirical methods and equations presented in USACE Engineering and Design: Drainage and Erosion Control Mobilization Construction (EM 1110-3-136)
- Complete a site evaluation to identify effective strategies for each unique construction site and surrounding area
- Incorporate mulch, hydroseed with tackifier, and/or straw for general applications where no turbulent flows of drainage are predictable
- Consider riprap for hydraulic structures discharging into open channels
- Consider turf, rock-filled baskets, and/or precast slabs for special cases
- Consider modifying the topography of the site to flatten steep slopes and reduce runoff velocity
- Plan to divert excess water away from exposed soil
- Schedule construction activities with intense erosive forces during the dryer seasons when exposure to wind and water are minimal
- Limit disturbance with local vegetation to help the ground retain moisture and reduce runoff velocity
- Incorporate erosion control blankets on steep slopes when topographic modification is not possible
- Apply sediment control methods (e.g., straw rolls, silt fences, sand bags) to manage additional water runoff
- Define a maintenance schedule to inspect and repair erosion control measures, especially after storms
- Check dams at pipe inlets, driveway crossing, and/or periodically along swales
- Consider installing other pretreatment devices to reduce erosion and pollutant discharges.

Implementation Considerations

The effort to implement erosion control can vary from moderate to difficult depending on the site characteristics. Erosion control strategies need to be established before construction activities begin. Budget and resources need to be allocated for extra supplies required to implement action items. A vulnerability assessment is typically undertaken by a team of experts with access to various tools that can assist in identifying, quantifying, and ranking vulnerability toward erosion using different metrics. Designing and implementing erosion control measures is based on this vulnerability assessment.

Examples/References

- United States Army Corps of Engineers (USACE). 1984. Engineering and Design: Drainage and Erosion Control Mobilization Construction. EM 1110-3-136. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-3-136.pdf?ver=2013-09-04-161200-380
- United States Army Corps of Engineers (USACE). 2012. Sediment and Erosion Control Guidelines for Pipeline Projects. Available at: https://www.swl.usace.army.mil/portals/50/docs/regulatory/sedimenatation-erosion%20control.pdf
- United States Army. 2013. Army Low Impact Development Technical User Guide. Available at: https://www.usace.army.mil/Portals/2/docs/Sustainability/Hydrology_LID/Army_LID_Technical_User_Guide_January2013.pdf
- Association of Illinois Soil and Water Conservation Districts (AISWCD). 2018. Illinois Urban Manual (IUM). Appendix B: Soil Quality & Urban Technical Notes. Available at: http://www.aiswcd.org/wp-content/uploads/2013/06/IUM_June20131.pdf

E9: Use Sustainably Sourced Materials

Description and Benefits

Minimizing the environmental, economic, and social life cycle impact of material should be a prime consideration for infrastructure projects. This can begin with sourcing sustainably manufactured materials, using recycled materials, and ensuring materials originate locally (where possible). This strategy can encourage the transparency of material life cycle information and reduce its impact. This can be beneficial by reducing the burden of materials and products acquired during construction.

Related Federal Mandates/Policies/Programs (if applicable)

- Resource Conservation and Recovery Act (RCRA)
- Farm Security and Rural Investment Act

Potential Actions

- Write standards into the project specifications that support the intent of this strategy
- Identify regional sources for materials and products, including those that are salvaged or reused or contain recycled content
- Confirm that any re-wholesalers and retailers obtain their products regionally
- Reduce energy use for transportation, and increase demand for regional materials by supporting the use of local resources
- Establish sufficient site areas available for contractor stockpiles and storage to minimize the extent of trucking required
- Streamline efficient use of truck trips during construction
- Purchase wood products extracted only from non-threatened tree species, and use wood certified as following the Forest Stewardship Council's Principles and Criteria
- Establish a project goal for recycled content, and identify material suppliers or local products that can help achieve this goal
- Reduce the consumption of virgin materials, and avoid landfilling useful materials by purchasing products with recycled content
- Use crushed concrete for aggregate bases; specify new asphalt with recycled asphalt aggregate; specify high recycled content steel; use spent iron and foundry sand as fine aggregate in concrete
- Protect ecosystems, respect cultural and community values, and improve land use through responsible extraction of raw materials for site design and construction
- Follow responsible extraction criteria for mined or quarried materials, bio-based materials, and new wood products, and request third-party verified corporate sustainability reports
- Evaluate the environmental and community impacts of different approaches to constructor-optional job sites or near-job site pre-fabrication/pre-assembly/pre-coating

Implementation Considerations

Establishing project goals for sustainably sourced materials and identifying suppliers early in the project process can help to achieve a responsible level of performance.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/

E10: Consider and Implement Value Engineering

Description and Benefits

Compliance with value engineering (VE) statutory and regulatory requirements is critical and accomplished through disciplined adherence to business processes, policies, and procedures that USACE sets forth. For all federally funded projects beyond a certain cost threshold, establishing and maintaining cost effective VE procedures and processes is mandatory, but projects totally funded from non-federal agencies are exempt from VE requirements. It is important to consider that VE studies are budgeted for, scheduled and resourced, or waived per Engineer Regulation 11-1-321: Army Programs Value Engineering. USACE has a VE program in place, by which the project delivery team develops a plan to ensure that VE activities are properly scheduled and resourced. The VE methodology uses five basic steps (information, speculation, analysis, development, and presentation) to analyze the functions of a program, project, system, item of equipment, building, facility, service or supply of an executive agency, in order to improve performance, reliability, quality, safety, and life cycle costs. The core intention is to increase project value by proactively searching for and resolving issues through very open, short-term workshops, and to stretch precious taxpayer resources by providing the required function(s), most amenities, and the highest quality project(s), at the lowest life cycle cost. A multidisciplinary team of designers, stakeholders, and the product delivery team should be involved in this VE process ideally at 35% completion of the design; additional earlier VE studies should also be considered when appropriate. A VE study can help to validate the design and enhance the overall functionality and quality of the project. A VE study can potentially identify opportunities to reduce life cycle costs through increased consideration of operations and maintenance requirements associated with different design options. One possible benefit of performing a VE study on a project that is within budget is to roll over the possible savings on VE suggestions into increased, sustainable design features for a project.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 11-1-321: Army Programs Value Engineering
- Public Law 111–350, §3, Jan. 4, 2011, 124 Stat. 3718 41 USC 1711 - Value Engineering
- Office of Management and Budget (OMB) Circular No. A-131, Value Engineering, Revised Dec 2013
- Office of Management and Budget (OMB) Circular A-11, Preparation, Submission and Execution of the Budget, Appendix 7, Value Management. Jul 2017
- Federal Acquisition Regulation Clause: 52.248-3: Value Engineering-Construction

Potential Actions

- Develop a structure to create and maintain an awareness of the importance of VE
- Encourage the discussion of potential VE proposals among contractors
- Encourage the use of VE to improve non-procurement items, such as expediting project schedules and improving project management processes
- Identify similar projects where VE studies were previously conducted and borrow from lessons learned; this may allow for a VE waiver to be requested for a specific project if enough precedents are available
- Ensure VE study team members are independent of the project design team so as to encourage the maximum interface and development and acceptance of proposals
- Ensure VE Officers provide annual recommendations to their organizations on VE training needs and encourage that these needs are incorporated in the Individual Development Plans
- Make a concerted effort to train in-house employees in the VE process

Implementation Considerations

The effort to implement VE throughout the life cycle of projects and programs can be moderate. A VE Officer is typically appointed at each District who serves as a special assistant to the Commander on issues relating to VE and upward reporting. The process of reviewing the Value Engineering Change Proposals can be resource intensive. Additionally, intensive outreach and collaboration efforts with internal and external parties may be required. The end goal would be to establish mutually beneficial and long-term partnerships to achieve the common goal of quality engineering products and services at reasonable or acceptable costs.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. VE Guidance Resources. Available at: https://www.usace.army.mil/VE_GUIDANCE/
- United States Army Corps of Engineers (USACE). 2018. VE Requirements Narrative v 3.0.1. Available at: https://www.usace.army.mil/Portals/2/docs/Value%20Engineering/VE_Requirements_Narrative-031318_v3.0.1.pdf
- United States Army Corps of Engineers (USACE). 2016. Area/Resident Engineer Management Guide. EP 415-1-260. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_415-1-260.pdf
- United States Army Corps of Engineers (USACE). 2018. Value Engineering Factsheet. Available at: https://www.hnc.usace.army.mil/Portals/65/docs/PAO/Fact%20Sheets/2018%20Fact%20Sheets/VE%201809.pdf?ver=2018-10-12-094012-773
- SAVE International Standards. 2015. Value Methodology Standard. Available at: https://c.ymcdn.com/sites/value-eng.site ym.com/resource/resmgr/Standards_Documents/vmstd.pdf
- Department of Defense Instruction (DODI) 4245.14, DoD Value Engineering (VE) Program, Sep 2012. Available at: https://www.usace.army.mil/Portals/2/docs/Value%20Engineering/DoDI_VE_4245_14_26Oct2012.pdf
- COVE Policy Letter #2015-02, USACE VE Workshop Standard and Evaluation Index. Available at: http://www.usace.army.mil/Portals/2/docs/Value%20Engineering/COVE%202015-02-USACE%20VE%20Standard-050715.pdf
- COVE Policy Letter #2017-01, VE in Civil Works Planning (24 MAY 2017) https://cops.usace.army.mil/sites/VE/Portal/Policy%20%20Guidance/COVE%20Policy%20Documents/COVE_2017-01_USACE_VEinPlanning-v4.pdf

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C1: Consider Contractor Sustainability Incentives in Acquisition Planning

Description and Benefits

USACE has existing sustainable acquisitions guidance to support compliance with federal sustainable acquisition requirements (Federal Acquisition Regulation). One performance goal for USACE is to ensure that contract actions demonstrate compliance with applicable sustainable acquisition requirements. In addition to meeting federal requirements, improving sustainable acquisition practices supports the USACE goal of enabling environmentally sound mission success. A challenge in transitioning all USACE contracting practices to follow sustainable acquisition requirements is providing sufficient training on sustainable practices and sufficient data collection to verify performance. Contractor incentives may be a vehicle to improve performance in lieu of these challenges.

Related Federal Mandates/Policies/Programs (if applicable)

- Army Federal Acquisition Regulation Supplement
- Executive Order 13834: Efficient Federal Operations, May 2018
- Federal Acquisition Regulation

Potential Actions

- Where applicable, develop contracts with fee incentives for meeting sustainable acquisition targets (e.g., bio-based products, Electronic Product Environmental Assessment Tool-registered equipment, etc.)
- Develop contracting standards and train relevant contracting personnel on sustainable practices for enabling sustainable acquisition goals in contractor selection
- Improve upon data collection procedures to verify sustainable acquisition performance

Implementation Considerations

Sustainability considerations in acquisition planning may require specific contracting requirements to be used in the contractor selection process. Developing performance-based incentives for contractor sustainable acquisition practices may enable greater flexibility in meeting requirements and encourage more active participation.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2017. USACE Acquisition Instruction. Available at: https://www.usace.army.mil/Business-With-Us/Contracting/Resources/
- United States Army Corps of Engineers (USACE). 2018. Sustainable Acquisitions Contracting. Available at: https://www.usace.army.mil/Business-With-Us/Contracting/Sustainable-Acquisitions/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

C2: Reduce Air, Water, and Soil Pollutants

Description and Benefits

Reducing air, water, and soil pollutants can be beneficial to the natural environment while maintaining or potentially enhancing other project objectives. Reducing air pollutants through the use of alternative fuel or low emissions construction equipment can ultimately help to reduce greenhouse gas (GHG) and gasoline/diesel fuel emissions. The reduction in air pollutants can also contribute to USACE reaching its goal to reduce Scope 1 and 2 GHG emissions by 23.1 percent by 2020. Reducing water pollutants can help to improve water quality not only within a project area but can also benefit the overall watershed. Reducing soil pollutants can help to prevent land degradation, reduce soil erosion, protect water quality, and maintain ecosystem vitality. This strategy aligns with USACE's commitment to deliver sustainable solutions through conserving resources, improving overall health, promoting efficiency, and reducing costs.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Air Act
- Clean Water Act
- Safe Drinking Water Act
- Resource Conservation and Recovery Act
- Energy Independence and Security Act
- Engineer Regulation No. 200-2-3: Environmental Compliance Policies
- Engineer Regulation No. 1110-1-5: Plant Pest Quarantined Areas and Foreign Soil Samples
- Engineer Regulation No. 1110-2-240: Water Control Management
- Engineer Regulation No. 1110-2-1462: Water Quality & Water Control Considerations for Non-Federal Hydropower
- Engineer Regulation No. 1110-2-8154: Water Quality and Environmental Management for Corps Civil Works Projects
- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Improve non-tactical vehicle fleet fuel efficiency (i.e., use ultra-low sulfur diesel fuel for all non-road diesel equipment), and reduce the use of construction equipment with Tier 0 engines
- Increase consumption of alternative fuel
- Develop infrastructure for electric vehicle/zero emission vehicle charging stations
- Partner with agency stakeholders to educate vehicle operators on the importance of alternative fuel use
- Retrofit engines with technologies designed to reduce emissions, or replace older equipment with newer, cleaner engines and equipment
- Implement a preventative maintenance plan for all equipment according to engine manufacturer specifications
- Analyze traffic impacts for different site work hour schedules, and consider limiting construction work hours to accommodate traffic flow during rush hour periods
- Conserve the site's existing natural qualities for runoff management and treatment; preserve existing trees and mature vegetation as site amenities; if located within existing floodplain, maintain pre-development infiltration and water quality
- Integrate inline/offline stormwater retention/detention opportunities
- Use a Water Quality Management Plan to maintain water quality throughout construction and all stages of the project
- Establish a water quality monitoring and data evaluation program to maintain appropriate water quality
- Consider alternatives to pesticide and fertilizer usage or closely monitor the use of fertilizers for restoration and nutrient supplementation to ensure ecosystems are well balanced
- Limit disturbance of soil during construction activities to minimize the need for additional restoration; in areas that will be re-vegetated, restore soil characteristics necessary to support the selected vegetation types
- Use vegetation for appropriate for site conditions, climate, and design intent
- Establish a soil management plan (SMP), and communicate the SMP to site contractors
- Monitor soil health, and use soil quality assessments to evaluate the effects of soil health management

Implementation Considerations

The effort to implement the reduction of air, water, and soil pollutants during engineering and construction should focus on both short- and long-term monitoring and management and how these actions could affect a project. Additionally, technology has considerably advanced to help minimize pollutants. Encouraging the practices of reducing air, water, and soil pollutants can help mitigate the impacts associated with climate change, reduce operations and maintenance costs, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- United States Army Corps of Engineers (USACE). 1986. Laboratory Soils Testing. EM 1110-2-1906. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1906.pdf?ver=2013-09-04-161123-567
- United States Army Corps of Engineers (USACE). 1970. Calibration of Laboratory Soils Testing Equipment. EM 1110-2-1909. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1909.pdf?ver=2013-09-04-070812-107
- United States Army Corps of Engineers (USACE). 1987. Reservoir Water Quality Analysis. EM 1110-2-1201. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1201.pdf?ver=2013-09-04-161056-070
- United States Army Corps of Engineers (USACE). 1999. Digest of Water Resources Policies and Authorities. EP 1165-2-1. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1165-2-1.pdf

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C3: Minimize Energy and Water Use During Construction

Description and Benefits

Optimization of the consumption of natural resources is not limited to the operations phase of a project once built, but is also equally critical during the construction phase. It is important to understand what construction processes use energy and water, how much is being used, where it is being wasted, and what behaviors and/or technologies can be introduced to successfully reduce the energy and water consumption during construction. Water use and energy use are inextricably linked. Often, the cost of energy associated with water (e.g., for pumping or heating water) is greater than the cost of the water itself. Thus, a valuable driver for reducing water use on construction sites is provided by consideration of the impact on the energy consumption of water use. Strategies can be identified to optimize site operations during construction to reduce energy and water consumption. Environmental benefits for a project can include a smaller carbon footprint and reduced emissions associated with construction energy and water use. The project can benefit economically by reducing energy and water costs associated with total consumption during construction.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook

Potential Actions

- Incorporate requirements for temporary facilities on site to be inherently sustainable, minimizing energy use during periods of inactivity
- Calculate carbon savings associated with energy and water conservation measures
- Identify avenues for reducing energy and water consumption in typical construction activities (general dust suppression, suppression on site roads and wheel washes, cleaning of construction equipment, and concrete production)
- Modify work schedules to shift activities during the day to reduce electricity demand for lighting, and use daylight controls and motion sensors, where applicable
- Use energy efficient equipment for temporary services
- Monitor the types of energy sources used on site, and consider alternative fuels to reduce environmental impacts and associated emissions
- Determine water needs based on construction processes/activities, and identify alternatives to potable water use (e.g., recycled water for dust control, cleaning of construction equipment, and concrete production)
- Leverage the expertise of a resource efficiency manager

Implementation Considerations

Identifying the areas where energy and water conservation measures can be implemented during the construction phase requires additional planning and thought. A resource efficiency manager who is typically responsible for construction coordination and oversight may be able to ensure the implementation of the identified measures during construction.

Examples/References

- Ko, J. 2010. Carbon: Reducing the Footprint of the Construction Process: An Action Plan to Reduce Carbon Emissions. Report 006. Prepared on behalf of the Strategic Forum for Construction and the Carbon Trust.
- Rubenstone, J. 2010. New construction trailer models coming to jobsites in several shades of 'green.' Engineering News-Record.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

C4: Abate and Mitigate Construction Noise/Vibration and Light Pollution

Description and Benefits

Construction activities generate noise levels that could significantly affect on- and off-site receptors. This, coupled with light pollution generated from artificial lighting installed on site, can have a detrimental impact on the immediate surroundings. Construction can easily disturb neighboring environments because of equipment noise, and can cause soil degradation via excessive vibrations that loosen the top layers of soil. Construction activities can induce light pollution by adding artificial lighting to the night sky, causing sky-glow and glare. Strategies can be developed to abate and mitigate construction noise, light pollution, and vibration interference, especially in highly sensitive areas such as environments with nocturnal species, through commonly accepted engineering and administrative controls. This strategy adheres to the USACE definition of sustainability as contributing to environmental preservation by limiting noise/vibration and excess lighting levels and by reducing negative environmental impacts from surplus energy generation.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook

Potential Actions

- Identify specific sources of noise and vibration disturbances and light pollution
- Identify sensitive characteristics surrounding a project site
- Deploy portable noise barriers, shields, mufflers, rubber-tire equipment, or noise-deadening material
- Adjust work hours around time periods when noise and vibration are highly impactful (i.e., typically mornings and evenings in residential areas)
- Configure the construction site to mitigate disturbances (e.g., enable trucks to move in a circle instead of reversing)
- Utilize lighting fixtures with cut-off shields considering placement, height, and aim of light concentration to mitigate light pollution and energy waste
- Avoid using blue-rich white light sources because they contribute to glare and adversely affect wildlife
- Observe, record, and address community complaints
- Coordinate with stakeholders to learn about new technology that muffles noise or softens vibrations
- Site noisy equipment as far away as possible from workers and nearby residents; build temporary barriers/enclosures (e.g., plywood with sound-absorbing materials) around noisy equipment to further reduce noise impacts

Implementation Considerations

The effort to minimize noise and light pollution at a construction site can be moderately difficult, but there are certain engineering and administrative controls that can be easily implemented without significant upfront costs or resources. However, personnel can become aware of community concerns related to noise and light pollution as a project progresses that may need to be addressed by the project team.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- Laborers' Health & Safety Fund of North America. n.d. Controlling Noise on Construction Sites . Available at: https://www.lhsfna.org/LHSFNA/assets/File/bpguide%202014.pdf

C5: Perform Sequence and Route Planning for Project Transport

Description and Benefits

When transportation is involved and/or a project must go mobile, site transport logistical parameters should be considered, such as the quantity of all associated equipment and technology, transportation methods, sequences of vehicles, and appropriate routes to effectively reach a destination with minimal disturbance. Efficient transportation can reduce risks that could prolong the completion of a project, inflict damage on expensive equipment, cause traffic backups, and harm workers. Efficient transportation can also reduce greenhouse gas emissions, reduce fuel use, and avoid disruptions to local environments and communities. Sequence and route planning focus on conserving resources (less damage to construction equipment and time), improving job site efficiency (more loads transported in less time), and minimizing impact on the environment (fewer emissions and less ground impact), all of which align with the concepts of sustainability within USACE. There can be a cost benefit to implementing this practice effectively.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook

Potential Actions

- Monitor resources required for implementation (i.e., personnel, construction equipment, transported cargo, time, funds, and fuel)
- Consider adjusting work hours to accommodate traffic hours and local community concerns
- Identify any significant changes in traffic during mobilization and adjust accordingly if necessary
- Use signage on transporting equipment that indicates the safety hazards for adjacent traffic
- Document petroleum fuel use for fleet vehicles
- Track emissions emitted from the transportation fleet during travel times
- Consider using telematics to remotely track the use of vehicles
- Observe, record, and address complaints from the community or workers

Implementation Considerations

Implementation of this strategy may be challenging and complex. This strategy may require strong organizational skills before, during, and after mobilization of a project, and multiple transports may be necessary during the length of a project. Personnel with enhanced leadership, organizational, and communication skills are strongly recommended. Personnel should be responsible for documenting important parameters and metrics that ensure successful transportation on a project, and this may be more difficult to coordinate in areas with significant traffic congestion or limited route options.

Examples/References

- United States Army Corps of Engineers (USACE). 2016. OMB Scorecard on Sustainability: Transportation/Fleet Management. Available at: https://www.usace.army.mil/Missions/Sustainability/
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

ME1: Minimize and Manage Material Surplus

Description and Benefits

Effective management of materials is a complex and comprehensive process involving resources and technologies that assist in sourcing, planning, quantification, supplier qualification, purchasing, supplier quality assurance/quality control, expediting, transportation, logistics, and control of materials and associated information across the life cycle of a project. Determining a close estimation of materials needed for a project during the planning stages can help to minimize and manage material surplus during construction. Generation of surplus can have negative environmental impacts from additional extraction, manufacturing, transportation, and disposal, which can be avoided by ensuring that the appropriate amount of materials is used. Minimizing material surplus will also help to address waste generation through source reduction, and reduce disposal costs and landfill tipping fees in addition to lowering labor costs due to less material to handle and cut. This practice supports USACE's commitment to conserving resources and increasing resource efficiency while meeting mission requirements.

Related Federal Mandates/Policies/Programs (if applicable)

- Solid Waste Disposal Act
- Pollution Prevention Act
- USACE Non-Hazardous Solid Waste Diversion and Materials Management Policy, Sep 2017

Potential Actions

- Incorporate a structured procurement or materials management plan
- Estimate material quantities as accurately as possible, and check to ensure that the correct amount of each material is delivered to the site
- Maintain an up-to-date material ordering and delivery schedule to minimize the amount of time that materials are on site and reduce the chance of damage
- Reduce packaging waste by choosing products with minimal or no packaging
- Clearly mark areas for material storage, central cutting, and recycling stations
- Consider requirements for suppliers to take back or buy-back substandard, rejected, or unused items
- Fractionalize the estimate to place an initial order for materials
- Order additional materials as the project progresses
- Quantify cost savings from not over-purchasing materials
- Reuse leftover building materials for the next job

Implementation Considerations

The effort to implement is moderate. Suitable expertise may need to be engaged from the planning phases of a project to ensure that the estimation of material quantities is as accurate as possible in order to minimize material surplus as a project progresses. There may be limited project resources to provide for storage locations, transportation, or other activities to manage surplus. Therefore, early collaboration with partners and stakeholders specialized in material estimation can improve the initial judgment. Personnel may be responsible for updating remaining quantities of materials and procuring additional materials if necessary.

Examples/References

- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction. Global Procurement & Materials Management (Best Practice). Available at: https://www.construction-institute.org/topic-summaries/rt-201-300/global-procurement-matl-mgmnt-best-practice

ME2: Optimize Use of Salvageable, Local, and Durable Materials

Description and Benefits

Construction projects, particularly for large infrastructure assets, can generate significant waste. In addition to recycling of excess construction materials and diversion from landfill, there is an opportunity to lower the cost and environmental impact of the construction phase by seeking salvageable, local, and durable materials. Salvageable materials, such as reusable shoring, formwork, or scaffolding, can reduce cost and environmental impact by enabling the reuse of materials across several projects or even on a repeated basis in the same project. Durable construction materials, while perhaps at a higher capital cost, can last longer than less durable counterparts, which can save contractor operating costs and reduce generation of waste. Where available, local/regional materials can similarly save costs, especially while considering delivery time and fuel consumption benefits, and provide co-benefits of lower emissions from transportation and generation of local jobs.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018
- USACE Non-Hazardous Solid Waste Diversion and Materials Management Policy, Sep 2017

Potential Actions

- Quantify costs/benefits from using salvageable, local, and durable materials to support efforts in future projects
- Quantify construction waste diversion from baseline, conventional, and operations to enable reporting of Construction and Demolition Waste Diversion
- When cost effective, use durable and reusable construction materials (e.g., shoring, formwork, scaffolding)
- Design projects to align with modular dimensions of pre-fabricated / salvageable construction materials to limit the need for custom dimensions
- Seek opportunities to make beneficial use of materials otherwise considered waste
- Seek opportunities to make beneficial use of local materials (e.g., locally balanced cut and fill)
- Seek sustainable material substitution opportunities when appropriate (e.g., fly ash as a cement substitute, salvaged concrete as sub-base material)
- In evaluating local/regional materials versus imported materials, consider product price, availability, delivery time, fuel consumption, and triple bottom line benefit opportunities (e.g., supporting local jobs)

Implementation Considerations

Engagement may be necessary by the project planning and design teams with construction personnel to maximize the use of salvageable, local, and durable materials. Potential actions may not always be enforceable for the contractor unless they are written into project contract documents, but consideration of actions can be encouraged. Evaluating the total cost of ownership/procurement can help to justify material selection decisions and help to support due diligence efforts in avoiding burdensome cost to the project.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). Construction Waste Diversion and Mitigation Knowledge Resource. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Construction-Waste-Diversion-and-Mitigation/
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

ME3: Enhance Material Life Cycle

Description and Benefits

Although life cycle cost analyses (LCCA) may be carried out at the initial phases of design, LCCA is meant to be an iterative tool that informs design decisions and site operations throughout the design-construction process. Long-term performance, reliability, and durability of project materials, components, and systems should be considered during project development, aside from first costs and maintenance costs associated with those materials. Strategies can be identified to enhance the life cycle of the selected materials that may factor back into the LCCA through the reuse or recycling of materials during construction instead of sending materials to a landfill after first use. Materials can be re-serviced, repaired, or rehabilitated to a newer product. Sustainable material management will ensure a longer material lifespan. Enhancing material life cycle can result in avoidance of acquiring more materials and is considered a USACE sustainable solution, preserving the environment and providing economic benefits.

Related Federal Mandates/Policies/Programs (if applicable)

- Code of Federal Regulations, 10 CFR 436, Federal Energy Management and Planning Programs, Subpart A, Methodology and Procedures for Life-Cycle Cost Analyses
- Engineer Regulation No. 1110-1-8173: Energy Modeling and Life Cycle Cost Analysis
- Engineer Regulation No. 1110-2-8159: Life Cycle Design and Performance

Potential Actions

- List materials that can be reused or recycled after initial use (i.e., concrete and asphalt, limestone, wood, metals), especially job site materials such as concrete forms and fencing
- Use salvaged materials from other job sites
- Practice material storage and handling procedures to prevent loss or damage to materials
- Consider establishing on-site repurposing areas to reduce time to repair
- Track inventory of all materials in use
- Send materials to be re-serviced, repaired, or rehabilitated if quality is too poor to continue to use
- Procure durable materials or EPEAT-registered products, and comply with USACE Federal Acquisition Regulation Clause: 52-223-13, 52-223-14, and 52-223-16
- Quantify materials repurposed and diverted from a landfill after initial use
- Enforce rules to ensure sustainable material usage by organizing periodic meetings and receiving progress updates

Implementation Considerations

The effort to implement strategies to enhance material life cycle is easy to moderate. When performing the LCCA, USACE is required to consider material lifespan, first costs, operations and maintenance cost, reliability of the product, replacement cost, and residual value at the end-of-life among other things. Additional consideration must be given to develop strategies to further enhance the life cycle of the selected materials and implement a sustainable material management plan.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- U.S. Department of Commerce. 1996. Life-Cycle Costing Manual for the Federal Energy Management Program. NIST Handbook 135. Available at: https://www.wbdg.org/FFC/NIST/hdbk_135.pdf

ME4: Incorporate Waste Management Practices

Description and Benefits

USACE activities can generate significant volumes of non-hazardous solid waste, much of which is disposed of in landfills. USACE's Non-Hazardous Solid Waste Diversion and Materials Management Policy, Sep 2017, includes two goals with respect to such waste: 1) divert at least 50-percent of non-hazardous solid waste, including food and compostable material, and visitor-generated non-hazardous solid waste; and 2) divert at least 60-percent of non-hazardous Construction and Demolition (C&D) material and debris. A C&D waste management plan can support USACE goals by establishing specific waste streams (i.e., materials) for reduction/reuse/recycling before beginning the construction or demolition plan. This can include identifying opportunities for salvaging/reuse of materials, specifying whether materials will be separated or commingled, where they will be stored on site, how they will be transported off-site for reuse/recycling, and other landfill diversion strategies. Establishing these practices before beginning the construction/demolition phase can add value to the cost and efficacy of waste diversion strategies.

Related Federal Mandates/Policies/Programs (if applicable)

- Solid Waste Disposal Act
- Engineer Regulation No. 200-2-3: Environmental Compliance Policies
- Executive Order 13834: Efficient Federal Operations, May 2018
- Federal Acquisition Regulation Clause 52.223-10: Waste Reduction Program
- Pollution Prevention Act
- USACE Non-Hazardous Solid Waste Diversion and Materials Management Policy, Sep 2017

Potential Actions

- Develop construction or demolition waste management plans for major projects and facilities
- Measure volumes of total waste reused/recycled or diverted from a landfill from listing all items
- Quantify cost savings from reducing transportation and fees
- Ensure recycling infrastructure is available or accessible
- Incorporate recycled materials for new construction, potentially from demolition projects
- Consider incorporating selective demolition practices for demolition projects
- Maximize reuse of excess USACE personal property and equipment through transfer or sale per the USACE Non-hazardous Solid Waste Diversion and Materials Management Policy
- Promote waste minimization by providing sustainable acquisition training to appropriate personnel

Implementation Considerations

One potential barrier to implementation of this strategy is that waste diversion practices can break away from conventional construction practices. Successful implementation may require a degree of diligence and training upfront to establish new practices, as well as communication to ensure that other project priorities are being met and inadvertent cost increases are avoided. These actions should be considered during the engineering phase and included, if warranted, in the project contract documents.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE) Buffalo District. 2010. Niagara Falls Storage Site Waste Management, Transportation, and Disposal Plan. Available at: https://www.lrb.usace.army.mil/portals/45/docs/fusrap/nfss/sow/nfss-bldg401demo-wmp-2010-08.pdf
- United States Department of the Army. 2017. Sustainable Design and Development Policy Update. Available at: https://www.wbdg.org/FFC/ARMYCOE/POLICY/Army_SDD_Policy_Update_2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

ME5: Utilize Sustainable Temporary Facilities

Description and Benefits

Temporary facilities built on construction sites have an environmental impact. These facilities may include: areas for material storage, parking lots, offices, break/dining and toilet facilities, stockpiles, temporary power generation, fuel storage and refueling stations, and infrastructure tie-ins, among others. The overall sustainability of a project can be enhanced with better planning and design of these temporary job site facilities. Applying sustainable practice standards to temporary site facilities would help to minimize energy and water consumed during facility operation, amount of demolition waste from facility construction, amount of demolition waste upon disposal, transportation (including related noise and air quality impacts), and indoor air quality, while also positively impacting the well-being of occupants (construction site workers). The sustainability impacts of sizing and locating temporary facilities should be considered in conjunction with USACE's sustainability goal to support sustainable communities at the worksite and incorporate environmental balance.

Potential Actions

- Identify all temporary facilities that will be needed for the entire construction process
- List environmental and economic impacts of implementing these facilities on-site or remotely
- Incorporate energy efficient site lighting while reducing light pollution
- Install ENERGY STAR equipment in the temporary facilities
- Consider using portable/modular structures, solar-powered structures, and structures with rainwater capture capability, among others
- Consider serving temporary water needs (entirely or partially) through permanent water supply systems, thereby reducing local traffic impacts from transport trucks and the need for salvaging/recycling of materials/components of the temporary supply system upon project completion
- Measure energy consumption from all facilities
- Document waste generated, and implement any reduction strategies

Implementation Considerations

It can be an easy to moderate effort to incorporate sustainable specifications for temporary facilities on sites. However, incorporating energy efficient fixtures and equipment can require additional coordination and potentially additional upfront cost. Often temporary facilities become semi-permanent, so it is important to consider energy and water savings from day one.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction

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ME6: Consider Selective Demolition versus Conventional Demolition

Description and Benefits

Conventional demolition is the act of flattening facilities in one fell swoop or demolishing facilities with no selection of materials to be reused prior to demolition. Selective demolition can reduce waste, repurpose reusable materials, and lessen environmental impact by salvaging and sorting materials within a site before flattening. The inside of structures or facilities is deconstructed to recover reusable materials that can be used for other projects (sometimes for the same project needing upgrades or expansions). The goals of this practice are to reduce pollution impacts, increase resource and economic efficiency in the adaptation and eventual removal of buildings, and recover components and materials for reuse, re-manufacturing, and recycling. This strategy can be incorporated into a waste reduction program to comply with USACE's sustainability provisions and clauses related to the Waste Reduction Program. This strategy can also support USACE's commitment to environmental stewardship by considering the life cycles of materials, using resources efficiently, and reducing/diverting waste thereby reducing landfill burden.

Related Federal Mandates/Policies/Programs (if applicable)

- Solid Waste Disposal Act
- USACE Non-Hazardous Solid Waste Diversion and Materials Management Policy, Sep 2017
- USACE Federal Acquisition Regulation Clause: 52-223-10

Potential Actions

- Identify the area(s) to apply selective demolition cost effectively
- Evaluate implications of sending mixed recyclables to recycling centers versus sorting on-site
- Measure the volume of recyclable material diverted from a landfill
- Determine if local recycling infrastructure is established
- Compare the total costs of purchasing raw material for new projects with reusing recovered material and avoiding additional cost for disposal
- Prepare a demolition and disposal plan before demolition activities begin

Implementation Considerations

Additional time may be needed to plan for selective demolition because it takes longer to recover and sort materials. It should be determined early whether selective demolition can be included in a project. Projects that require a significant amount of demolition can benefit the most from this strategy. Additional resources may be required to determine the methods of collection, segregation, storage, and conveyance of waste materials, along with determining the required facilities and equipment to support these functions.

Examples/References

- United States Army Corps of Engineers (USACE). Public Works Technical Bulletin 200-1-120. Oct 2012. Opportunities to Increase Construction and Demolition Waste Diversion. Available at: https://www.wbdg.org/FFC/ARMYCOE/PWTB/pwtb_200_1_120.pdf
- Demolition Services Inc. (DSI). 2012. Demolition and Disposal Plan. Available at: http://www.nab.usace.army.mil/Portals/63/docs/SpringValley/Glenbrook_Rd._Demolition_and_Disposal_Plan.pdf
- Center for Construction and Environment; and Esherick, Homsey, Dodge & Davis Architecture. 2006. Design for Deconstruction and Materials Reuse. Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.624.9494&rep=rep1&type=pdf
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

ME7: Utilize Sustainable Large-Scale Earthwork and Grading Operations

Description and Benefits

Large-scale earthwork and grading operations during construction involve heavy construction equipment due to the amount of material to be moved. The impact of such operations include increased noise and congestion, loss of landscape characteristics, increased fuel consumption, increased equipment use, degraded soil health, loss of microbial biodiversity, introduction of invasive species, disrupted hydrology, and increased greenhouse gas and air pollutant emissions. Project teams are encouraged to design the project to balance cut and fill to the furthest extent practicable to reduce excavated material taken off–site, thereby reducing transportation and environmental impacts. Strategies can be developed to sustainably handle excavated soils and improve grading efficiency. Additional benefits may include improved productivity, time savings (e.g., reduced idle time and traffic interference), quality, and performance. The benefits of sustainable large-scale earthwork and grading operations can support USACE's sustainability mission of resource efficiency and environment preservation.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13783, Promoting Energy Independence and Economic Growth, Mar 2017

Potential Actions

- Identify opportunities to minimize grading, retain soil on site, and/or eliminate the need to transport additional soil to the site
- Determine methods to reuse excavated soil on site or on nearby properties or other projects
- Implement Global Positioning System technologies instead of conventional staking methods for grading operations
- Measure the volume of reduced earthwork
- Gather complete data for a construction site to reduce overall waste generated

Implementation Considerations

Successful implementation of this strategy may require a high level of effort to carefully consider all sustainable impacts of modifying earthwork and grading operations. Personnel are recommended to be knowledgeable about methods or technologies for enhancing earthwork efficiency. Real-time data collection for equipment may become useful to determine a baseline for operations and indicate what to improve; however, real-time data collection for earthwork and grading operations may be challenging to strategize.

Examples/References

- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/FFC/DOD/DODHDBK/fieldg.pdf
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

ME8: Support Responsible Raw Material Extraction

Description and Benefits

Infrastructure projects are major consumers of materials, and USACE should consider its ability to influence higher sustainability performance upstream in the material manufacturing chain. This strategy involves supporting suppliers and manufacturers that disclose information on the environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain. Sustainable materials such as bio-based products or wood certified by the Forest Stewardship Council have less environmental impacts. During responsible extraction, ecosystems can be protected, historical/cultural areas undisturbed, and land use monitored. This strategy is a USACE sustainable solution recognizing environmentally, economically, and socially preferable life cycle impacts.

Potential Actions

- Advocate for sustainable extraction of raw materials to suppliers and manufacturers
- Consider suppliers that can report annual environmental performance by a Global Reporting Initiative or equivalent
- Choose to purchase materials/products from those facilities that sustainably extract raw materials
- Quantify a percentage of total purchased materials/products to source from a responsible supplier
- Consider responsible extraction criteria for various extracted materials from the SITES Rating System for Sustainable Land Design and Development
- Monitor the purchase and usage of sustainable materials on site

Implementation Considerations

The procurement of sustainable materials that come through responsible raw material extraction may come at an added cost and reduced product selection. Requirements for sustainable procurement practices can be established through a policy or program for effective implementation.

Examples/References

- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

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ME9: Maintain Clean Tire Roadworthy Vehicles

Description and Benefits

As a part of construction equipment management, it is important to minimize the off-site tracking of materials and contaminants via construction trucks onto public roads and into storm drains. Tire cleaning of roadworthy construction vehicles when they are leaving a construction site is an effective practice to control and eliminate the pollution of public roads. Various methods of tire cleaning can be identified, but a key technical aspect of this practice involves high volume of water consumption required for cleaning along with proper means of collecting and disposing of liquid wastes. Further, using non-potable water in lieu of potable water for cleaning the tires can significantly reduce the consumption of natural resources during construction.

Potential Actions

- Designate washing areas for construction equipment to clean tires if needed prior to entering surrounding roadways
- Establish a collection method for gray/stormwater, and use gray/stormwater to clean tires
- Implement a collection and disposal method for liquid wastes
- Measure the volume of non-potable water used
- Observe, record, and address community complaints related to contamination
- Consider high volume water at low pressure for tire cleaning as opposed to high pressure cleaning because the latter may result in wasted water and energy
- Consider dry wheel wash, rumble strips, site pavement gravel/riprap, and compost layer placed at egress points of the construction site as alternatives to using water for tire cleaning, if effective
- Regularly inspect egress points and adjacent roadways to monitor effectiveness of implementation of this practice

Implementation Considerations

Implementation of this strategy may require moderate effort. Before the commencement of construction activities, personnel may need to determine the best location for tire-washing stations on-site and implement a collection method for liquid wastes. This practice may involve both front end and operational costs but will ultimately help address construction activity pollution. A requirement for tire cleaning may potentially be included as part of an environmental risk assessment carried out prior to work beginning on site. It can also be particularly important on sites that contain land that is contaminated, and may be a requirement of planning permissions.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Considerate Constructors Scheme Best Practice Hub. Dry Wheel Wash (Case Study). 2017. Available at: https://ccsbestpractice.org.uk/entries/dry-wheel-wash/
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

ME10: Use Full Transport / Equipment Capacity

Description and Benefits

Using construction equipment efficiently can avoid waste generated and reduce costs of operation. When using equipment to transport material, equipment should be traveling with full loads to reduce the total number of trips and associated environmental impacts, or the right-sized generators with appropriate capacities should be used to avoid paying additional costs for unnecessary power generation. The associated benefits can include reduced truck trips, improved air quality, and reduced emissions. Right sizing equipment and fully maximizing efficiency of delivery of materials and equipment to a site can potentially save a project on construction costs if the schedule is not impacted.

Potential Actions

- Identify all required construction equipment for a project
- Determine full load sizes or capacities for each equipment
- Ensure these numbers are met when equipment are in operation by implementing a management plan
- Consider reducing on-site trucking (e.g., proper logistics planning such as staging material in close proximity to installation location)
- Consider using performance metrics, such as equipment capacity utilization, or proportion of truck deliveries that are at or near full capacity, to track implementation of this practice and identify where the processes can be improved
- Consider using construction process simulation models as a tool to optimize the efficiency of particular processes or technologies

Implementation Considerations

Personnel should determine a management plan that outlines operational procedures to ensure construction equipment is used at efficient capacities. Workers should be informed of such procedures to follow when operating equipment. Coordination of transport trips may involve a certain degree of logistical planning and supplier and/or carrier buy-in.

Examples/References

- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

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ME11: Reduce Idling and Right-Size Construction Equipment

Description and Benefits

During construction, leveraging technology and equipment management to reduce operating expenses and environmental impacts is crucial. Construction equipment with specifications appropriately tailored to a project should be used. Idling is the practice where a piece of equipment is located on a job site and the engine is burning fuel, but no ground engaging or other components are actively engaged in meaningful work. Keeping nonproductive equipment hours to a minimum should be a priority. Idling can also pertain to construction vehicles that are in slowed or no motion while in operation. Many construction activities can easily cause construction equipment to idle and therefore waste fuel, emit more greenhouse gases, and produce unnecessary noise. Reduction in petroleum fuel consumption is a goal assessment for USACE's efficient federal operations/management. This strategy supports USACE's environmental stewardship by mitigating environmental impacts and collaborating with stakeholders about new technologies for monitoring construction equipment operational efficiency and anti-idling policies.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Air Act
- Energy Policy Act of 2005
- Executive Order 13834: Efficient Federal Operations, May 2018

Potential Actions

- Consider leasing construction equipment to reduce costs
- Request specifications and sustainable information for equipment
- Consider annual carbon savings potential as a factor in selecting equipment
- Establish a time limit for equipment vehicle idling
- Incorporate idle-control technologies or procure equipment with idle-control technologies
- Avoid mobility during rush hours to reduce the amount of time spent in slowed traffic
- Use Global Positioning System to avoid traffic and use the most efficient route
- Consider the use of telematics to track the location and performance of construction equipment
- Develop strategies that reduce wait times for material loading, delivery, and unloading
- Track amount of idling time for each equipment vehicle
- Measure petroleum use associated with idling

Implementation Considerations

The effort to incorporate specifications to ensure right-sizing of construction equipment is moderate, considering that multiple factors need to be recognized in the process such as cost, availability, convenience, capacity, and sustainability aspects (e.g., fuel type, quantity, and type of emissions, noise, and other performance issues). Reduced idling may be difficult if a project site is located in an extreme environment requiring equipment to run at all times to remain operational. Limiting idling and adding new technology to trucks to reduce emissions may increase the expense of the vehicles. Also, shutting down an engine can create a delay in re-entering the work stream and therefore reduce operational efficiency. Personnel should develop a strategy that best identifies how to address idling equipment; this may involve collaborating with local vendors that can assist with deliveries or other services.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Environmental Protection Agency (EPA) Office of Transportation and Air Quality. 2006. Compilation of State, County, and Local Anti-Idling Regulations. Available at: https://www.epa.gov/sites/production/files/-documents/CompilationofStateIdlingRegulations.pdf
- United States Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy. 2018. Idle Reduction Resources. Available at: https://www.energy.gov/eere/vehicles/idle-reduction
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

ME12: Use Alternative Fuel or Low Emission Construction Equipment

Description and Benefits

The use of alternative fuel or low emissions construction equipment is an objective under USACE's strategic goal to manage the life cycle of water resource infrastructure systems to consistently deliver sustainable services. The strategy helps USACE reduce Scope 1 and 2 greenhouse gas (GHG) emissions and fleet petroleum use. This strategy also aligns with USACE's commitment to deliver sustainable solutions through conserving resources and promoting efficiency.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations, May 2018
- Energy Independence and Security Act
- Clean Air Act

Potential Actions

- Improve non-tactical vehicle (NTV) fleet fuel efficiency (i.e., use ultra-low sulfur diesel fuel for all non-road diesel equipment)
- Reduce the use of construction equipment with Tier 0 engines
- Increase the acquisition and use of low/no emission and alternative fuel vehicles in the NTV fleet
- Procure larger, heavier-duty vehicles in an alternative fuel configuration
- Develop infrastructure for electric vehicle charging stations
- Partner with agency stakeholders to educate vehicle operators on the importance of alternative fuel use
- Select construction contractors committed to reducing diesel emissions from construction equipment and vehicles
- Limit total run-time hours of construction equipment depending on the type of engine (Tier 4 or higher engines would have more hours versus Tier 2 engines)
- Retrofit engines with technologies designed to reduce emissions
- Replace older equipment with newer, cleaner engines and equipment
- Implement a preventative maintenance plan for all equipment according to engine manufacturer specifications

Implementation Considerations

The effort to implement the use of alternative fuel or low emissions construction equipment is feasible given the advancement in technology to meet the demand in alternative fuel options. USACE should consider the reuse and recycling of heavy construction equipment, and promote the progressive retirement of diesel-powered machines in favor of those fueled by cleaner energy sources such as liquefied natural gas. Additionally, USACE's culture related to NTV fleet management and utilization has shifted to encourage the reduced use of petroleum fuel. In general, the use of alternative fuel or low emissions construction equipment in lieu of petroleum fuel equipment can ultimately help to reduce GHG emissions, mitigate impacts of climate change, reduce operations and maintenance costs, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2016. Construction Equipment Ownership and Operating Expense Schedule. EP 1110-1-8 (Vol 1-12). Available at: https://www.publications.usace.army.mil/USACE-Publications/Engineer-Pamphlets/u43545q/313131302D312D38/
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

3.4. Operations & Regulatory Fact Sheets

Operations and Maintenance

Natural Resource Management

Life Cycle

Federal Scorecard

OM1: Ensure Reliable Storage and Reallocation of Water Supply when Available

Description and Benefits

USACE provides storage at its reservoirs for water that is contractually obligated to be provided to other organizations (e.g., water supply organizations, irrigation entities, hydropower companies, etc.). USACE is responsible for ensuring reliable storage and supply of that water. Storage in the reservoirs is included for water supply in an amount sufficient to yield the gross amount of water to be withdrawn (or released) under projected hydrologic conditions, taking into account both the projected withdrawals and the projected return flows, if any.

Related Federal Mandates/Policies/Programs (if applicable)

- Flood Control Act of 1944
- Fish and Wildlife Coordination Act
- Water Supply Act
- Federal Water Pollution Control Act
- Endangered Species Act (ESA)
- Water Resource Development Acts
- Engineer Regulation 1110-2-240: Water Control Management

Potential Actions

- Maintain updated forecasting models of basin supply and reservoir levels and inflows
- Properly maintain flow release mechanisms, and seek opportunities for improvements in instrumentation and monitoring
- Maintain updated Master Water Control Manuals to document the operational goals and contractual agreements of a reservoir

Implementation Considerations

Reallocation of USACE reservoir storage often requires congressional approval and is extremely difficult to achieve. Prior to any change approvals, lengthy Environmental Impact Statements or operational manual modifications are often required and lawsuits may follow.

Examples/References

- United States Army Corps of Engineers (USACE). 2017. Management of Water Control Systems. EM 1110-2-3600. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-3600.pdf
- United States Army Corps of Engineers (USACE). Pittsburgh District Water Control Manuals. Available at: https://www.lrp.usace.army.mil/Missions/Planning-Programs-Project-Management/Key-Projects/Water-Control-Manuals/
- United States Army Corps of Engineers (USACE). Folsom Dam Water Control Manual Update. Available at: http://www.spk.usace.army.mil/Missions/Civil-Works/Folsom-Water-Control-Manual-Update/

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OM2: Provide Public Access to Reservoir/Canal/River Data within Security and Data Requirements

Description and Benefits

The Freedom of Information Act provides the public the right to request access to records from any federal agency except for information that falls within a statutory exemption (e.g., protects personal privacy, national security, or law enforcement). The Access to Water Resources Data – Corps Water Management System (CWMS) Data Dissemination tool is a map-based repository of water resources data accessible to the public and all stakeholders. Utilization of the tool supports the USACE mission as visualizations and reports provide transparency, assessment, and awareness while also improving the dissemination of information to the public and stakeholders. This can lead to more effective and productive decision making, and a reduction in risks to people, property, and the environment.

Related Federal Mandates/Policies/Programs (if applicable)

- Freedom of Information Act
- Engineer Regulation No. 1110-1-8156: Policies, Guidance, and Requirements for Geospatial Data and Systems
- Engineer Regulation No. 1110-2-1406: Coastal Field Data Collection
- Engineer Regulation No. 1110-2-1925: Field Control Data for Earth and Rockfill Dams
- Engineer Regulation No. 1110-2-248: Requirements for Water Data Transmission Using GOES/DCS
- Engineer Regulation No. 1110-2-249: Management of Water Control Data Systems
- Engineer Regulation No. 1110-2-8155: Hydrometeorological Data Management and Archiving
- Engineer Regulation No. 5-1-18: Corps Project Notebook: A Database of Project Geographic Locations

Potential Actions

- Encourage all districts and projects to provide data on CWMS
- Establish a uniform set of terminology and data standards to maintain consistency between districts
- Make the CWMS data accessible and usable beyond the purpose for which they were originally collected
- Expand the CWMS to show data from non-reservoir or lock & dam projects (i.e., riverine, estuarine, and coastal projects)
- Improve interagency and stakeholder relationships by coordinating the sharing of data and results with other federal, state, and local agencies within the boundaries of physical systems including inland watersheds, rivers, estuaries, and the coast
- Share regional-scale data management systems, models, and other tools to improve project-level decisions and to achieve greater consistency in analytical results among studies and projects within a region
- Ensure technologies and software are sufficient for meeting the advances in science and policies
- Build a water data community by creating an environment where data users/analysts can operate and share knowledge

Implementation Considerations

USACE staff should include plans and procedures to share project information in the CWMS for public access. Additional information can also be disclosed on a project-specific website for interested parties and stakeholders. This strategy can help to reduce costs of gathering data for internal studies, allow development of analytical tools applicable to all districts, provide new insights to address water resource challenges, and improve interagency collaboration, public awareness, and environmental stewardship.

Examples/References

- United States Army Corps of Engineers (USACE). 2012. Geospatial Data and Systems. EM 1110-1-2909. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-1-2909.pdf
- United States Army Corps of Engineers (USACE). 2015. USACE Opens Access to Water Resource Data – Corps Water Management System (CWMS) Database for Public Access Available at: https://www.usace.army.mil/Media/News-Releases/News-Release-Article-View/Article/623043/usace-opens-access-to-water-resource-data-corps-water-management-system-cwms-da/
- United States Army Corps of Engineers (USACE). 2018. Access to Water Resources Data: Water Management Data Dissemination. Available at: http://water.usace.army.mil/a2w/f?p=100:1:0:
- Duke Nicholas Institute for Environmental Policy Solutions. 2018. Creating Data as a Service for U.S. Army Corps of Engineers Reservoirs. Report NI R 18-01. Available at: https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_r_18-01.pdf

OM3: Incorporate Beneficial Uses for Dredged Material

Description and Benefits

Navigational dredged material is managed with intent for either disposal or for beneficial use. Much of the material dredged for navigation is natural sediment, which is a resource that can be used to ensure ecosystem preservation and sustainable development. Accurate tracking of navigational dredged material can enable USACE to better understand Regional Sediment Management (RSM) actions or opportunities to improve the use of sediments. Beneficial use of dredged material is a priority for USACE and can result in cost savings, enhanced ecosystem vitality, balance, and diversity, and engineering efficiencies.

Related Federal Mandates/Policies/Programs (if applicable)

- National Regional Sediment Management Program (1999)
- Marine Protection, Research and Sanctuaries Act

Potential Actions

- Consider the following approaches of dredged material management for beneficial use:
  - Placement for increasing land elevation for wildlife habitat, island creation, flood/storm surge protection or land development
  - Stockpiling with the intention of reusing a portion of the dredged sediment (e.g., rehandling for landfill cover, mine reclamation, construction fill)
  - Beach or nearshore placement for shoreline protection or beach nourishment (stable or feeder berms)
  - Shallow water placement for wetland or marsh habitat also provides storm and surge protection
  - Placed unconfined into a river, lake, bay, estuary, or territorial sea, including flow lane placement, side-casting, agitation dredging, and other unconfined in-water placement for maintaining sediment in the littoral system
  - Placed to a defined footprint such as a nearshore disposal facility that will support subaquatic vegetation, essential fish habitat, etc.
  - Ocean placement for designed Marine Protection, Research, and Sanctuaries Act site
- Consider project-level tracking of dredged material management
- Implement a regional/national tracking system to better understand practices and trends
- Improve interagency and stakeholder relationships by coordinating management activities with other federal, state, and local agencies within the boundaries of physical systems including inland watersheds, rivers, estuaries, and the coast
- Better understand the regional sediment processes to optimize utilization of sediment locally and regionally
- Share regional-scale data management systems, models, and other tools to improve project-level decisions and to achieve greater consistency in analytical results among studies and projects within a region

Implementation Considerations

USACE has a focused program for improving collaboration among projects within regions and with various stakeholders to help implement sediment management and reuse. Most of these considerations will require a local sponsor that must agree to share cost, operation, and maintenance of the project. USACE staff should consider implementing the RSM approach to sediment management and use to help overcome challenges with sediment management, assist in decision making, and apply adaptive management strategies while reducing costs and improving partnerships and environmental stewardship.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Regional Sediment Management (RSM). Available at: http://rsm.usace.army.mil/
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2015. Dredged Material Management Categories for Tracking Beneficial Use. DOER Technical Notes Collection. ERDC TN-DOER-R22. Available at http://el.erdc.usace.army.mil/elpubs/pdf/doerD##.pdf
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. National Regional Sediment Management Program. Available at: http://rsm.usace.army.mil/initiatives/facts/FY18-RSM_FactSheet.pdf
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. Regional Sediment Management Tools and Technologies Volume I Coastal. Available at: http://rsm.usace.army.mil/pubs/brochures/2018_RSM_Coastal_Tools_Technologies_Brochure.pdf
- United States Army Corps of Engineers (USACE). 2015. Use of Natural and Nature-Based Features (NNBF) for Coastal Resilience. ERDC-SR-14-1.

OM4: Manage Sedimentation (Beach Nourishment and Sand Reuse)

Description and Benefits

Sediment management and use is a necessary component of many USACE projects, especially those related to navigation and flood control. The USACE's Regional Sediment Management (RSM) program recognizes sediment as a local and regional resource and prioritizes its use across projects, environments, and communities. Coastal sediment management can result in short- and long-term economically viable and environmentally sustainable solutions for healthier coastal systems. Benefits include natural exchange of sediments, adaptive management, reduced life cycle costs, and improved operational efficiencies. Inland, sediment behind dams can be reused for wetland restoration.

Related Federal Mandates/Policies/Programs (if applicable)

- National Regional Sediment Management Program (1999)
- Engineer Regulation No. 1110-2-8153: Technical Project Sedimentation Investigations

Potential Actions

- Consider reintroduction of sediment into sand-starved littoral systems to reduce the requirement for beach nourishment and sustain habitat for threatened and endangered systems
- Track volume of dredged material relocated versus removed within the littoral system
- Include both location-specific (i.e., upland, near-shore, in-water, and ocean) and intent (i.e., disposal or beneficial use) discharge information to allow tracking efficiencies
- Improve interagency and stakeholder relationships by coordinating management activities with other federal, state, and local agencies within the boundaries of physical systems including inland watersheds, rivers, estuaries, and the coast
- Better understand the regional sediment processes to optimize utilization of sediment locally and regionally
- Share regional-scale data management systems, models, and other tools to improve project-level decisions and to achieve greater consistency in analytical results among studies and projects within a region

Implementation Considerations

USACE has a focused program for improving collaboration among projects within regions and with various stakeholders that can help in implementing sediment management given its regional nature. USACE staff should consider whether implementing the RSM approach to sediment management is appropriate for their project or facility and adopt adaptive management strategies where possible. This strategy can help to achieve short- and long-term efficiencies both locally and regionally while reducing costs and improving partnerships and environmental stewardship.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Regional Sediment Management (RSM). Available at: http://rsm.usace.army.mil/
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2015. Dredged Material Management Categories for Tracking Beneficial Use. DOER Technical Notes Collection. ERDC TN-DOER-R22. Available at http://el.erdc.usace.army.mil/elpubs/pdf/doerD##.pdf
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. National Regional Sediment Management Program. Available at: http://rsm.usace.army.mil/initiatives/facts/FY18-RSM_FactSheet.pdf
- United States Army Corps of Engineers (USACE) Engineer Research and Development Center. 2018. Regional Sediment Management Tools and Technologies Volume I Coastal. Available at: http://rsm.usace.army.mil/pubs/brochures/2018_RSM_Coastal_Tools_Technologies_Brochure.pdf
- United States Army Corps of Engineers (USACE). 1989. Sedimentation Investigations of Rivers and Reservoirs. EM 1110-2-4000.
- United States Army Corps of Engineers (USACE). 2015. Engineering and Design, Beach Surveying Methodology. EC 1110-1-107. May 29. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1110-1-107.pdf

OM5: Maintain Black Start Capabilities for Applicable Hydropower Facilities

Description and Benefits

Black start capability is the ability of an electrical power station to restore power to an electric grid after loss of power. Maintaining black start capability within the electric grid is a significant way to improve the energy resilience of a region. Hydroelectric power facilities require little power for a black start as compared to thermal power plants, often made possible with backup diesel generators or battery energy storage. Because of this, USACE policy directs applicable hydropower facilities to serve as a restart power supply for other thermal power plants on the grid.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1130-2-510: Hydroelectric Power Operations and Maintenance Policies

Potential Actions

- Engage a team to address black start capabilities including local utility providers
- Establish collaboration in the areas of generator modeling, monitoring, and control optimization
- Establish collaboration to develop capabilities to optimize generator control setting for essential reliability services, compliance, and real-time market opportunities
- Provide adequate backup power supply at the hydropower plant to enable black start capability
- Consider time to restore power in the design of the black start procedure as a key metric in improving resilience
- Conduct field testing of black start capabilities

Implementation Considerations

The project team should consider black start capabilities early in the process, engage utility providers and key stakeholders for collaboration, and coordinate field testing of black start capabilities. Regional coordination will be required to consider power grids and interdependency.

Examples/References

- Bonneville Power Administration (BPA), in association with USACE. 2018. Frequency Response and Black Start Tuning of Hydro Governors: BPA and USACE Experience. Available at: https://ipcgrid.ece.msstate.edu/presentations/2018/Kosterev&Yang_2018%20IPCGRID%20Frequency%20Response%20and%20Blackstart%20Tuning%20of%20Hydro%20Governors.pdf
- Federal Energy Regulatory Commission. 2018. Grid Operators Have Sufficient 'Black start' Capability, Study Says. May 2. Available at: https://www.ferc.gov/media/news-releases/2018/2018-2/05-02-18.asp#.W6qSm0NKi70
- National Hydropower Association. 2018. Hydropower. Available at: https://www.hydro.org/waterpower/hydropower/

OM6: Identify Opportunities to Improve Reliability and Availability of Hydropower Generation Capability

Description and Benefits

Two key elements associated with hydropower performance across the USACE portfolio include availability and reliability. Specific metrics that are considered include: the percent of time units are available during periods of peak demand (availability) and the percent of time units are out of service due to unplanned outage (reliability). Improving on these two metrics can allow hydropower to better serve the national electric grid by supplying electricity when it is most needed. As the national energy mix trends toward increasing levels of variable renewable sources (e.g., solar, wind), hydropower may be seen as an increasingly valuable resource for balancing the national grid. As such, upgrades to existing hydropower facilities may be justified, such as upgrading equipment to improve reliability and retrofitting facilities to increase efficiency, peak output, or flexibility of the resource.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-2-1: Provisions For Future Hydropower Installations At Corps Of Engineers Projects

Potential Actions

- Conduct preventative maintenance actions on generation equipment to improve reliability
- Consider a Reliability, Availability, Maintainability, Cost approach to developing sustainment requirements for hydropower generation systems
- Where life cycle is cost effective, upgrade or expand generation equipment at existing hydropower facilities to increase efficiency, peak output, flexibility, and/or other metrics that benefit the regional or national electric grid
- Annually convene the technical team to review capabilities, reporting and the hydropower asset management strategy

Implementation Considerations

Identifying opportunities to improve the reliability and availability of hydroelectric power may require engineering or operations and maintenance studies to pinpoint specific potential improvements. Implementing these improvements may require moderate effort, including integration with capital improvement plans or prioritizing opportunities following a risk-based asset management approach.

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Sustainable Solutions to America's Water Resource Needs: Civil Works Strategic Plan 2014-2018. Available at: https://www.usace.army.mil/portals/2/docs/civilworks/news/2014-18_cw_stratplan.pdf
- Hydropower Modernization Initiative: Risk-Based Asset Management Decision Making Tool, 2011
- United States Army Corps of Engineers (USACE). 1995. Planning and Design of Hydroelectric Power Plant Structures. EM 1110-2-3001. Available at: https://www.publications.usace.army.mil/portals/76/publications/engineermanuals/em_1110-2-3001.pdf
- United States Department of Defense (DoD). 2009. Reliability, Availability, Maintainability, and Cost Rationale Report Manual. Available at: https://www.dau.mil/tools/Lists/DAUTools/Attachments/133/DoD-RAM-C-Manual.pdf

OM7: Maintain and Optimize Operations of Floating Plant Fleet (Dredgers, Barges, Cranes)

Description and Benefits

Floating plant operations use floating cranes, debris boats, towboats, tugs, survey boats, and other vessels for conducting navigation services such as dredging, surveying, sediment management, and engineering missions. Maintenance and optimal operations of the floating plant fleet help to assure safe and healthful working conditions for employees by setting and enforcing standards and by providing training, outreach, education, and assistance. Maintenance and optimal operations of the floating plant fleet may also reduce overall risks to human health and the environment, increase cost savings, and improve operational efficiencies.

Related Federal Mandates/Policies/Programs (if applicable)

- Occupational Safety and Health Act
- National Regional Sediment Management Program (1999)

Potential Actions

- Upgrade engines and technology to improve fuel consumption and reduce maintenance
- Ensure all plants are inspected before being placed into use and at least annually by a qualified person
- Ensure all dredgers, barges, cranes, and other vessels meet all regulations and applicable standards
- Perform naval architecture analysis to determine crane safety
- Develop spill plan documents for spills involving USACE or USACE contractor operations on USACE owned or leased land
- Ensure compliance with the management, generation, storage, transportation, treatment, and disposal of hazardous wastes
- Identify and support management practices or training programs that encourage vehicle operators and managers to learn the latest in vehicle operation
- Refer to Safety and Health Requirements Manual EM 385-1-1
- Coordinate with regional stakeholders to optimize use and transport of floating plant fleets and decrease down time

Implementation Considerations

The maintenance and optimal operation of the floating plant fleet is feasible because the vessels are managed by the Marine Design Center. The Marine Design Center continually applies innovative strategies and technologies for naval architecture and marine engineering as it supports USACE's floating plant fleet. This strategy may help to reduce overall operational costs, improve efficiencies, and promote environmental stewardship.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Floating Plant. Available at: http://www.sam.usace.army.mil/Missions/Civil-Works/Navigation/Floating-Plants/
- United States Army Corps of Engineers (USACE). 1996. Environmental Quality Environmental Compliance Guidance and Procedures. EP 200-2-3. 1996. Available at: http://corpslakes.erdc.dren.mil/employees/policy/EP/EP-200-2-3.pdf
- United States Army Corps of Engineers (USACE). 2014. Safety and Health Requirements: Section 19, Floating Plant and Marine Activities. EM 385-1-1. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf
- United States Army Corps of Engineers (USACE) Marine Design Center. 2013. Marine & Floating Plant Newsletter. Issue #18. Available at: http://www.nap.usace.army.mil/Portals/39/docs/MDC/MDC_Newsletter_18_Mar_2013.pdf
- United States Army Corps of Engineers (USACE). 2015. Use of Natural and Nature-Based Features (NNBF) for Coastal Resilience. ERDC-SR-14-1.
- United States Army Corps of Engineers (USACE). 2015. Dredging and Dredged Material Management. EM 1110-2-5025. Available at: https://www.publications.usace.army.mil/portals/76/publications/engineermanuals/em_1110-2-5025.pdf
- United States Army Corps of Engineers (USACE). 2014. Construction Equipment Ownership and Operating Expense Schedule. EP 1110-1-8 (Vol 1-11). Available at: https://www.publications.usace.army.mil/USACE-Publications/Engineer-Pamphlets/u43545q/313131302D312D38/

OM8: Incorporate Life Safety

Description and Benefits

Incorporating life safety as it relates to Flood Risk Management (FRM), i.e. dam/levee safety, includes the following three main aspects:

- Maintain effective FRM systems – Dams; levees; channels; and hurricane and shore protection projects; safety program governance framework; accomplished through a combination of competent staff; updated and relevant guidance; and credible processes and tools
- Increase the understanding of benefits and risks of FRM systems of all stakeholders; involves assessing and communicating the risks and benefits associated with dam/levee systems through FRM Safety Program activities
- Contribute to effectively and efficiently managing flood risk in communities with levees and dams by identifying recommended risk management actions to meet Tolerable Risk Guidelines

Program activities and recommendations will support making wise federal investments and encouraging actions to manage flood risk outside of federal investments. Risk management will be accomplished through a Dam and Levee Safety Program portfolio perspective and through a dam and levee system perspective.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Engineer Regulation No. 1110-2-1156: Safety of Dams – Policy and Procedures
- Engineer Circular No. 1165-2-218: Levee Safety Policy and Procedures (in Draft)
- Engineer Circular No. 1110-2-212: Guidance for Emergency Action Plans, Incident Management and Reporting, and Inundation Maps for Dams and Levee Systems
- Executive Order 12196: Occupational Safety and Health Programs for Federal Employees, Feb 1980
- Federal Emergency Management Agency: Federal Guidelines for Dam Safety

Potential Actions

- Determine that society is willing to live with the risk associated with the flood risk management structure to secure the benefits of living and working in the leveed area
- Determine that there is a continuation of recognition of the dam/levee risk because the risk associated with FRM systems are not broadly acceptable and cannot be ignored
- Determine that risks associated with the dam/levee system are being properly monitored and managed by those responsible for managing the risk
- Determine that those responsible for managing the risk associated with a FRM system continue to reduce the risk still further as practicable

Implementation Considerations

Projects should consider implementing measures that prioritize maintaining site safety and acknowledging rippling impacts throughout neighboring communities. Creating safe environments characterizes projects as beneficial instead of as disturbances.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2014. Safety and Health Requirements. EM 385-1-1. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf

OM9: Employ Sustainable Rivers Program Practices

Description and Benefits

Healthy and sustainable ecosystems provide a wide array of services to human communities, including improved water quality, protection from floods and storms, and provision of the food and fiber that we rely on as part of our everyday lives. Rivers have been highly altered by human actions. River ecosystems respond to changes in the patterns of river flows and water quality. As points of management in river systems, reservoirs offer an opportunity to affect the timing and magnitudes of flows to meet the needs of both human and natural communities and are important resources unto themselves (water bodies, in-lake fisheries, habitat, shorelines, easement area lands).

The Corps of Engineers owns and operates more than 500 reservoirs. According to a national survey completed in 2013, over 80% of reservoirs with federally authorized flood space have an authorized purpose related to the environment (fish and wildlife, water quality, or recreation). The mission of the Sustainable River Program is to improve the health and life of rivers by changing dam operations to restore and protect ecosystems, while maintaining or enhancing other project benefits. The Program works with scientists and water managers to develop and implement management decisions that manipulate water and land-water interactions to achieve ecological or environmental goals.

At the time of this report, Sustainable Rivers involves work on 66 reservoirs in 16 river basins. The Program uses a shared sustainability ethic as a foundation to build capacity within the water management community for implementation of environmental strategies, engage partners to focus on sustainability and avoid conflict, and advance environmental innovations.

Related Federal Mandates/Policies/Programs (if applicable)

- Sustainable Rivers Program (SRP)
- United States Army Corps of Engineers (USACE) Environmental Operating Principles
- Engineering Regulation No. 1110-2-240, Water Control Management
- Engineering Regulation No. 1110-2-1400, Reservoir/Water Control Management

Potential Actions

- Define environmental flows for a river-reservoir system
- Explore opportunities to implement environmental flows within the operational flexibility of the river-reservoir system of interest
- Incorporate SRP methods and strategies into water management policy updates
- Contact Program representatives for more information
- Attend an SRP activity to increase awareness and gain knowledge about the Program
- Determine which river system already engaged in SRP is most similar to your area of interest and learn about the experiences of that river team
- Work with other organizations to collectively advance environmental strategies related to reservoirs
- Connect scientists and water managers to encourage use of science in water resource planning and decision-making
- Submit an idea for consideration as site-based work

Implementation Considerations

Affecting how water and land-water interactions are managed is not easy, but can be an effective and efficient way to increase the benefits of built civil works infrastructure. The Corps is increasingly challenged to manage rivers to provide more environmental benefits. More and more of the Corps' largest and most expensive environmental efforts are driven by litigation and compliance. Sustainable Rivers works proactively and collaboratively to identify and implement environmental strategies with high potential and relatively low costs - thereby helping to steer operations of Corps reservoirs away from conflict and towards more sustainable futures. Methods of the Sustainable Rivers Program are available to all and have been applied to civil works planning, engineering, and operations.

Examples/References

- United States Army Corps of Engineers (USACE). 2011. Improving the health and life of rivers, enhancing economies, benefiting rivers, communities and the nation. Sustainable Rivers Program. Available at: https://www.iwr.usace.army.mil/portals/70/docs/sustainablerivers/Sustainable_Rivers_Project-Status.pdf
- United States Army Corps of Engineers (USACE). 2011. Understanding the past, vision for the future. Sustainable Rivers Program. Available at: https://www.iwr.usace.army.mil/portals/70/docs/sustainablerivers/Sustainable_Rivers_Project-Vision.pdf
- United States Army Corps of Engineers (USACE) Institute for Water Resources. Hydrologic Engineering Center. 1994. Authorized and Operating Purposes of Corps of Engineers Reservoirs. PR-19. Available at: https://www.hec.usace.army.mil/publications/ProjectReports/PR-19.pdf
- United States Army Corps of Engineers (USACE) and The Nature Conservancy (TNC). 2000. Effective and Efficient Management of Biological Resources, Corps' Civil Works Missions. Memorandum of Understanding between USACE and TNC.
- United States Army Corps of Engineers (USACE) and The Nature Conservancy (TNC). 2011. Enduring and Essential Water Resource Solutions for Large Working Rivers. Memorandum of Understanding between USACE and TNC.
- United States Army Corps of Engineers (USACE). 2016. Status and Challenges for USACE Reservoirs. National Portfolio Assessment for Water Supply Reallocations. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/iwrreports/2016-RES-01.pdf
- Engineer Manual No. 1110-2-3600. 2017. Management of Water Control Systems. https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-3600.pdf?ver=2017-10-23-143606-973

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OM10: Maintain Fish Passage Capabilities

Description and Benefits

Although USACE hydropower, dam, reservoir, and diversion projects provide irrigation water, flood mitigation, navigation and recreation, they can also critically impact fish species. As such, USACE strives to balance these human uses with the needs of the aquatic life through the installation of fish passage facilities. This can help to maintain fish populations and protect the local ecosystem. Consideration of fish passage capacities can also provide new insights to address the water resource challenge, enhance transparency and relationships with the public and stakeholders, and potentially improve interagency collaboration, public awareness, and environmental stewardship. Programs, such as the Sustainable Rivers Program, improve the health and life of rivers by changing dam operations to restore and protect ecosystems while maintaining or enhancing other project benefits. Protection of species and their habitats can sustain ecosystems for future populations, maintain biodiversity, and provide crucial habitats for fish and other wildlife.

Related Federal Mandates/Policies/Programs (if applicable)

- Endangered Species Act
- National Environmental Policy Act
- Water Resources Planning Act, as amended 42 U.S.C. 1962a-2
- Executive Order 11990 Protection of Wetlands
- Engineer Regulation No. 1165-2-501: Civil Works Ecosystem Restoration Policy
- Sustainable Rivers Program

Potential Actions

- Improve interagency and stakeholder relationships by collaborating on fish passage development and implementation with other federal, state, and local agencies and with the public
- Consider enhancing habitat downstream from the USACE facility to improve the likelihood of fish survivability and success
- Modify flows of the water body and maintain flood control to encourage the spawning cycles of fish
- Encourage training, staff exchanges, and the use of new technologies, including software to simulate reservoirs and ecosystems, to advance the implementation of environmental flows at USACE reservoirs
- Use computer software (i.e., Hydrologic Engineering Center-Regime Prescription Tool) to evaluate potential water management scenarios and understand the trade-offs between different uses of water
- Integrate inspection and reporting criteria for monitoring plans to track the progress of the fish passage facility and re-evaluate approaches if goals are not met
- Monitor plants, animals, and geologic characteristics of rivers before and after environmental flows are released from reservoirs to help evaluate the effects of re-operations and determine if ecological goals are being achieved
- Partner with universities, non-governmental organizations, and federal, state, and local agencies to expand knowledge and share data

Implementation Considerations

USACE staff should work with stakeholders to develop fish passage facilities as an integral part of USACE projects where fish may be impacted. Information and updates can also be disclosed to interested members of the public on a project-specific USACE website to maintain transparency. In collaboration with other agencies and non-government organizations, USACE should consider applying its aquatic ecosystem restoration authorities and capabilities to mitigate the decline of freshwater biodiversity in the United States.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Portland District Environmental Stewardship. Available at: http://www.nwp.usace.army.mil/environment/
- United States Army Corps of Engineers (USACE). 2018. 2018 Fish Passage Plan, Chapter 1 - Overview. Available at: http://pweb.crohms.org/tmt/documents/fpp/2018/
- United States Army Corps of Engineers (USACE). 1999. Ecosystem Restoration – Supporting Policy Information. EP 1165-2-502. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1165-2-502.pdf
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2011. Sustainable Rivers Project: Benefiting Rivers, Communities and the Nation, Understanding the Past Vision for the Future. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/sustainablerivers/Sustainable_Rivers_Project-Vision.pdf
- United States Army Corps of Engineers (USACE) and United States Geological Survey. 2010. Sustainable Rivers Project PowerPoint Presentation by Lisa T Morales and Ward Staubitz. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/projects/02Feb10/1-USGS_USACE_TNC_Sustainable_Rivers_Program.ppt
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2017. Sustainable Rivers Program EAB Work Session in Davis, CA PowerPoint Presentation by John Hickey, Lisa Morales, Mindy Simmons, and Gretchen Benjamin.
- United States Army Corps of Engineers (USACE). 2006. Regime Prescription Tool HEC-RP User's Manual. Version 1.0 CPD-84.
- United States Water Resources Council. 1983. Economic and Environmental Principles for Water and Related Land Resources Implementation and Environmental Guidelines for Water and Related Land Resources Implementation Studies (Principles & Guidelines). Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1256524&ext=pdf

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OM11: Manage Aquatic Plants

Description and Benefits

In the course of managing aquatic vegetation, USACE staff should consider integrated pest management (IPM) strategies that promote maintenance control to minimize negative impacts of invasive aquatic plant growth. Proactive monitoring of systems will help reduce negative impacts of invasive aquatic growth by allowing projects to address smaller populations of invasive plants and minimize the amount of man-hours and herbicide needed to remove the problem. The IPM program prevents pests and disease vectors from causing unacceptable damage to operations, people, property, and the environment using targeted, sustainable methods including chemical control, habitat modification, biological control, genetic control, cultural control, mechanical controls, physical control, and regulatory actions. Properly implemented and managed, these strategies can help minimize costs for management and reduce the impacts that invasive aquatic plants have on the project.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13751: Safeguarding the Nation from the Impacts of Invasive Species, Dec 2016
- Endangered Species Act
- Engineer Regulation No. 200-2-3: Environmental Compliance Policies
- Engineer Regulation No. 1110-1-5: Plant Pest Quarantined Areas and Foreign Soil Samples
- Engineer Regulation No. 1130-2-540; Environmental Stewardship Operations and Maintenance Guidance and Procedures
- Invasive Species Leadership Team Program Management Plan
- Federal Insecticide, Fungicide, and Rodenticide Act
- John C. Dingell Act

Potential Actions

- Develop a pest management program specific to the project to outline biological, chemical, and physical control methods for pest management on USACE federal administered lands as required by ER1130-2-540
- Consider the use of biological control agents and/or competition through establishment of native plant species either through planting or encouragement of the existing native seed bank
- Implement routine control and maintenance to manage already established invasive pest species to control spreading from their current location or manage them within their location to meet mission goals
- Implement early detection rapid response/eradication approach to focus on newly discovered or established pest species during the incipient stage of infestations before they become too large
- Monitor sites to ensure there is no new establishment or re-establishment of pest species and ecosystem health is maintained
- Follow the guidelines of the label during all pesticide applications; the label is the law when it comes to pesticide application. Consult the Invasive Species Leadership Team (ISLT) if staff needs technical support before administering an application.
- Consider public engagement to openly communicate project progress and monitoring results

Implementation Considerations

Maintaining aquatic plant control and water quality for projects is integral in USACE's mission as shown in the IPM program and Sustainable Rivers Project, and implementation should be included as part of an ongoing assessment of project operational impacts. This strategy can help to protect the ecological integrity of ecosystems while meeting human needs for water. Ultimately, this can help reduce operations and maintenance costs, improve overall operational efficiency, and maintain healthier ecosystems.

Examples/References

- United States Army Corps of Engineers (USACE). 1987. Reservoir Water Quality Analysis. EM 1110-2-1201. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1201.pdf?ver=2013-09-04-161056-070
- United States Army Corps of Engineers (USACE). 2012. Dworshak Nutrient Supplementation. May 3. Walla Walla District. Available at: http://www.nww.usace.army.mil/Portals/28/docs/programsandprojects/-dnsp/FactSheet_DNSP.pdf
- United States Army Corps of Engineers (USACE). 2014. Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures. ETL 1110-2-583. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerTechnicalLetters/ETL_1110-2-583.pdf
- United States Army Corps of Engineers (USACE). 2017. Aquatic Pest Management Program Implementation Instructions. Walla Walla District. Available at: http://www.nww.usace.army.mil/Portals/28/docs/-programsandprojects/PestManagement/170822Final%20Aquatic%20Integrated%20Pest%20Management%20Program%20Instructions.pdf
- United States Army Corps of Engineers (USACE), United States Geological Survey, and The Nature Conservancy. 2010. Sustainable Rivers Project. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/-sustainablerivers/Sustainable_Rivers_Project-Vision.pdf

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OM12: Monitor Environmental Mitigation and Assess Impacts to Environment

Description and Benefits

Incorporating environmental mitigation can help USACE to reach its goal to improve the safety and resilience of communities and water resource infrastructures. This strategy aligns with USACE's objective to effectively and efficiently execute response, recovery, and mitigation within its own specific authorities and programs such as flood risk management. USACE is given jurisdiction under Section 404 of the Clean Water Act to evaluate a project's potential discharge of dredged or fill material into wetlands, streams, and other waters of the United States. When there is a proposed discharge, all appropriate and practicable steps should first be taken to avoid and minimize impacts to aquatic resources. These should be in the form of avoidance, minimization, and mitigation measures. For unavoidable impacts, compensatory mitigation is required to replace the loss of wetland, stream, and/or other aquatic resource functions. Methods of compensatory mitigation include restoration, establishment, enhancement, and preservation of aquatic resources. This strategy aligns with USACE's commitment to deliver sustainable solutions through conserving resources, promoting a healthy environment, and balancing economic development.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Water Act (CWA), Section 404
- National Environmental Policy Act

Potential Actions

- Collaborate across districts to achieve greater consistency
- Prioritize efforts in the following order: avoidance, minimization, restoration, and compensation
- Document mitigation strategies used and how they were prioritized
- Establish a schedule with clear goals and milestones
- Put in place plans, processes, and personnel sufficient to ensure that long-term sustainable protection, mitigation, and enhancement measures have been incorporated into the project
- Ensure comprehensiveness of long-term monitoring, implementation goals, and commitment of resources to fund activities
- Collect data during monitoring to evaluate effectiveness of mitigation
- Develop a schedule for future re-evaluation and modification of the activities based on monitored data

Implementation Considerations

The effort to implement environmental mitigation during the operations and regulatory phase focuses on executing a comprehensive and streamlined process that reduces the impacts of ongoing activities. The mitigation would generally be specified by the National Environmental Policy Act and some aspects would need congressional funding and a local cost-sharing sponsor. Failure to adequately maintain and monitor systems can also lead to significant environmental, social, and/or financial impacts. Implementation of a comprehensive mitigation monitoring and maintenance plan can help to reduce long-term costs, curtail potential environmental impacts, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Mitigation Information. Available at: https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/mitig_info/
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

OM13: Minimize Light Pollution

Description and Benefits

Excessive artificial lighting can have damaging environmental consequences for humans, wildlife, and the climate. Light pollution includes glare (visual discomfort from uncontrolled brightness), sky glow (accumulated brightness in the night sky), light trespass (light falling on unwanted areas), and clutter (brightness from the concentration of light sources). Often a significant amount of light emitted from human sources is not concentrated on where it is needed and illuminates the greater surroundings and night sky. This is further magnified by trying to compensate for dullness by using lightbulbs with higher wattage, concentrating lighting fixtures (requiring more overall), and keeping them on for longer periods of time. Uncontrolled lighting can result in disturbed ecological behavior and warmer global temperatures.

Potential Actions

- Identify light-sensitive characteristics surrounding a project site
- Apply interior shading on windows to retain lighting indoors at night
- Replace applicable outdoor lightbulbs with warm-colored light-emitting diode or compact fluorescent bulbs
- Determine if local, state, or federal rebates or incentives apply to strategies related to minimizing light pollution
- Install light dimmers, timers, and motion sensors to reduce illumination and conserve energy
- Install cutoff shields on lighting fixtures considering placement, height, and aim of light concentration to mitigate light pollution and energy waste
- Measure the average illuminance (in foot-candles) where light is most needed, and determine if lighting is inefficient
- Observe, record, and address community complaints

Implementation Considerations

The effort to minimize light pollution can be moderately difficult at the operational phase given that the lighting infrastructure is likely already in place. However, the consideration of light pollution can be easily incorporated into energy efficiency or environmental assessments of a project or facility, and small measures can be taken that could have large impacts (e.g., window shading, bulb replacement, motion sensors).

Examples/References

- International Dark-Sky Association (IDA). 2018. Light Pollution. Available at: http://darksky.org/light-pollution/

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OM14: Maintain Water Quality

Description and Benefits

USACE commits to environmental compliance to protect estuaries, rivers, lakes, and navigable waters, as supported by federal mandates and USACE's Environmental Operating Principles, and maintaining water quality is a vital step in protection. Analysis of the impact a project could have on water quality is vital when developing a Water Quality Management plan that outlines strategies to maintain water quality throughout the design, construction, operation, and maintenance stages of all projects. Communication with stakeholders about the project and the potentially impacted water resource should help to identify sustainable strategies with minimal conflict.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Water Act
- Engineer Regulation No. 200-2-3
- Engineer Regulation No. 1110-2-8154: Water Quality Management
- Engineer Regulation No. 1130-2-540
- Engineer Pamphlet No. 1130-2-540
- National Environmental Policy Act

Potential Actions

- Ensure water quality affected by project activities remains suitable for intended purposes and compliant with local, state, and federal laws and regulations
- Establish a water quality monitoring and data evaluation program to maintain appropriate water quality
- Track the trends of water quality and consider compiling information into real-time models
- Identify potential problems affecting or degrading water quality, and determine effective strategies to mitigate the problems
- Collaborate with governmental and non-governmental entities about activities that may affect or be affected by water quality or water quality management strategies
- Ensure strategies have minimal negative influence on the aquatic environments
- Incorporate ecological sustainability, and consider system response in all water resource activities
- Communicate findings and water quality activities with the public to support educational benefits

Implementation Considerations

Be informed of any existing tribal programs that may interfere with implementing management strategies. The Water Quality Management Plan should consist of strategies that focus on short- and long-term monitoring and management and how that could affect a project near critical sources of water. Governmental and non-governmental entities may provide financial support for implementing strategies. To more consistently and accurately track trends, consider applying water quality models and watershed-based management tools to predict changes in water quality.

Examples/References

- United States Army Corps of Engineers (USACE). 1987. Reservoir Water Quality Analysis. EM 1110-2-1201. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-1201.pdf?ver=2013-09-04-161056-070
- United States Army Corps of Engineers (USACE). 1991. Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects. ER 1110-2-1462. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1462.pdf?ver=2013-09-08-233425-557
- United States Army Corps of Engineers (USACE). 2017. Committees on Tidal Hydraulics, River Engineering, Water Quality, and Hydrologic Engineering. ER 15-2-14. Available at: https://www.publications.usace.army.mil/Portals/76/ER_15-2-14.pdf?ver=2017-06-19-115611-087
- United States Environmental Protection Agency (EPA). 2017. History of the Clean Water Act. Available at: https://www.epa.gov/laws-regulations/history-clean-water-act

OM15: Improve Air Quality

Description and Benefits

Improving air quality has helped USACE to reduce Scope 1 and 2 greenhouse gas emissions from FY2008 by nearly 20-percent in FY2018. This strategy aligns with USACE's commitment to deliver sustainable solutions through conserving resources, providing a healthy environment, and promoting efficiency. Air quality considerations should include long-term operational emissions from equipment and materials as well as short-term and temporary emissions from maintenance and construction activities.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Air Act
- Executive Order 13834: Efficient Federal Operations, May 2018
- Energy Independence and Security Act
- National Environmental Policy Act

Potential Actions

- For sites with occupied structures, ensure building activities, such as painting and roof repairs, carpet installation, and repair and other activities likely to involve usage of chemicals or solvents, are conducted after normal working hours where possible in a manner that will prevent exposure to occupants and with appropriate air flow controls in place to protect workers
- Evaluate condition of the air-handling system for proper operation, make-up air supply, blocked dampers or diffusers, cleanliness of ducts and filters, and standing water or wet areas
- Avoid contamination of heating, ventilation, and air conditioning (HVAC) systems
- Educate employees and supervisors concerning measures to help maintain acceptable indoor air quality in the work areas (i.e., no unauthorized modifications to the HVAC systems such as blocking vents, removing ceiling tiles)
- Protect employees from involuntary exposure to environmental tobacco smoke in working and public living environments
- Consider performing mold assessment when needed and as indicated
- Control pollutant sources and interrupt contamination pathways (e.g., chromium exposure, crystalline silica)
- Sequence installation of materials to avoid contamination of absorptive materials such as insulation and carpeting
- Protect stored or installed absorptive materials from moisture damage
- Avoid using permanently installed air handlers for temporary heating/cooling during construction
- Perform a flush-out or test the air contaminant levels in the building prior to occupancy and monitor at regular intervals and consider replacing all filtration media immediately prior to occupancy

Implementation Considerations

Advancements in air quality technology can be used to reduce air pollutants during project planning to meet the higher emission standards. USACE staff should apply indoor air quality management in all workplace settings for maintaining employee health and confidence. In general, improved air quality can result in the reduction of air pollutants and can ultimately help to reduce greenhouse gas, reduce operations and maintenance costs, and improve overall operational efficiency and personnel health.

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Safety and Health Requirements. EM 385-1-1. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_385-1-1.pdf
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

NR1: Visitor Use Management and Recreation

Description and Benefits

The USACE Recreation Program manages facilities that accommodate more than 250 million visitors each year on less than two percent of the Federal land base at more than 400 lake and river projects in 43 states. More than 90% of the lakes are within 50 miles of a metropolitan area. The management of this intense visitation is a critical component of all USACE missions. Appropriate siting and design of recreation facilities, public safety, crowd and traffic control, security measures, patrols, permitting of activities and events and enforcement of park regulations all work to ensure the public does not interfere with USACE project purposes and provides protection of the natural resources.

Visitors to USACE recreation areas can find 55,390 miles of shoreline; 7,892 miles of trails; 93,101 campsites and 3,748 boat ramps nationally. $11 billion is spent annually by visitors at USACE projects, supporting 189,000 jobs.

Related Federal Mandates/Policies/Programs (if applicable)

- Flood Control Act of 1944. Authorized the Secretary of the Army to construct, maintain, and operate public park and recreational facilities at water resource development projects and directs all such projects will be open to public use generally for boating, swimming, bathing, fishing, and other recreational purposes.
- Forest Cover Act 1960. Directed USACE to develop Master Plans for balancing natural resources with compatible use of project lands and authorized project purposes
- Flood Control Act of 1970. Initiated a ranger citation pilot program that began the task of Park Rangers protecting CW project missions.

Potential Action

- Communicate the protections that visitor management and the recreation program provide to all project purposes.
- Follow guidance in ER1130-2-550 for Recreation Request to insure proposed development does not interfere project purposes and is in the public best interest.
- Update Project Master Plans to identify land use capabilities and areas of project development compatible with project purposes and natural resources protection
- Promote public safety, especially water safety through USACE
- Encourage Park Ranger professional development through training, developmental assignments and use of knowledge management.
- Improve knowledge management systems through innovative tools and applications that improve content and access of information.

Implementation Considerations

The USACE Recreation Program is a critical component to the success of Operations and Maintenance of all mission areas and should be communicated and managed to illustrate the importance of managing visitors in the public best interest compatible with authorized purposes.

Examples/References

- United States Army Corps of Engineers (USACE). 1996. Environmental Stewardship Operations and Maintenance Guidance and Procedures. EP 1130-2-540. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-540.pdf?ver=2013-08-22-104519-387
- United States Army Corps of Engineers (USACE). 1996. Recreation Operations and Maintenance Guidance and Procedures. EP 1130-2-550. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf?ver=2014-05-06-112201-410

NR2: Land Use Management

Description and Benefits

USACE Civil Works manages over 12 million acres of land and water located in a mix of rural areas with many land use pressures including increasing populations, high demand for requests to use USACE lands and growing request for infrastructure crossing USACE lands.

USACE owns 143,148 land tracts, totaling over 7.6 million acres and manages another 153,634 land tracts, totaling over 4.4 million acres for a total of 12 million acres. USACE has 61,400 real property outgrants with annualized rent of $10,153,778. USACE manages nearly 38,000 miles of boundary property line which is six times more than the borders of Canada and Mexico combined with heavy pressures, encroachments and illegal activities. Also nearly 75,000 shoreline dock and vegetation permits exist which require inspection and management to ensure compliance.

Related Federal Mandates/Policies/Programs (if applicable)

- Forest Cover Act. Directed USACE to take action to protect fee owned property at reservoirs for conservation and develop Master Plans.
- National Environmental Policy Act of 1969, Section 101. Declared that it is the continuing policy of the Federal Government, in cooperation with State and local governments to use all practicable means and measures, including financial and technical assistance, in a manner to create and maintain conditions under which man and nature can exist in productive harmony and to fulfill the social economic, and other requirements of present and future generations of Americans.
- Endangered Species Act. Provided a means for Federal agencies to conserve and protect endangered and threatened species.
- Authorizing statute for specific Civil Works project where lands are managed. Provides the authorized purposes for which USACE is required to manage the project lands, with some authorizing legislation setting priorities among the purposes.

Potential Actions

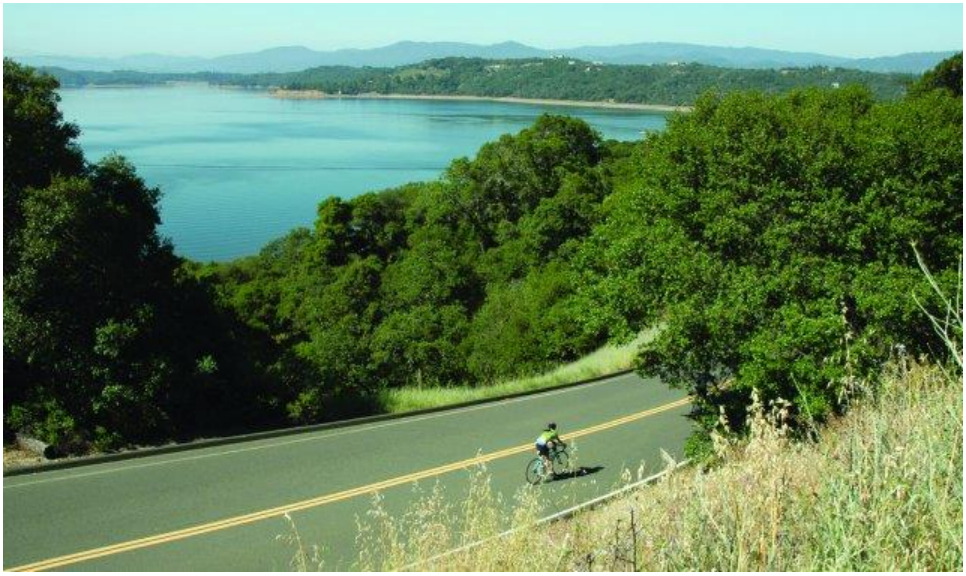
- Ensure boundary lines and flowage easement lines are clearly marked and identified.
- USACE will follow recent policies and procedures on timely identification of boundary encroachments and resolution.
- Use innovative tools like shoreline management GIS and database management.
- Policies on both Recreation and Non-recreation land use requests should be followed closely to ensure proposed development requests are compatible with project purposes and comply with applicable environmental, natural resource, and restoration requirements. Requirements around lease terms, reporting, and financial protection for USACE also need to be met.

Implementation Considerations

Proper land management at USACE projects require close coordination between the Operations and Real Estate communities. Most land use issues get worse with time and require proactive preventative and correction actions to reduce the likelihood of complex legal disputes and expenditure of USACE resources to address the issues.

Examples/References

- United States Army Corps of Engineers (USACE). 1996. Environmental Compliance Guidance and Procedures. EP 200-2-3. Available at: https://www.publications.usace.army.mil/-Portals/76/Publications/EngineerPamphlets/EP_200-2-3.pdf?ver=2013-08-22-090145-910
- United States Army Corps of Engineers (USACE). 1996. Environmental Stewardship Operations and Maintenance Guidance and Procedures. EP 1130-2-540. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-540.pdf?ver=2013-08-22-104519-387
- United States Army Corps of Engineers (USACE). 1996. Recreation Operations and Maintenance Guidance and Procedures. EP 1130-2-550. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-550.pdf?ver=2014-05-06-112201-410



NR3: Promote Environmental Stewardship

Description and Benefits

Environmental stewardship protects, preserves, and restores significant ecological resources throughout USACE's projects. This strategy is aligned with the USACE's Natural Resources Management mission to manage, conserve, and preserve natural resources consistent with ecosystem management principles while providing quality public outdoor recreation experiences to serve the needs of present and future generations. In all aspects of natural and cultural resources management, USACE promotes awareness of environmental values and adheres to sound environmental stewardship, protection, compliance, and restoration practices.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1130-2-540: Environmental Stewardship Operations and Maintenance Policies
- Engineer Pamphlet No. 1130-2-540: Environmental Stewardship Operations and Maintenance Guidance and Procedures
- Forest Cover Act. Directed USACE to take action to protect fee owned property at reservoirs for conservation and develop Master Plans.
- National Environmental Policy Act
- USACE Stewardship Support Program of 2002
- National Historic Preservation Act of 1966 as amended (54 U.S.C. 300101)
- Endangered Species Act
- Migratory Bird Treaty Act

Potential Actions

- Promote regional environmental values on project lands with preferential treatment toward the management of ecosystems, communities, and habitats with special status species
- Apply forest and woodland management to develop, maintain, protect, and/or improve vegetation conditions for timber, fish, wildlife, soil, recreation, and water quality
- Seek to maintain populations of targeted wildlife species through the management of habitat in conjunction with other federal, state, and local agencies
- Protect native grasslands or prairie and/or improve vegetative conditions as a soil conservation, watershed protection, fish and wildlife habitat, or range management practice
- Protect, conserve, and maintain existing wetlands with no net loss of wetlands, or for hydric soil, emphasize the consideration and management of returning, operating, and/or maintaining wetlands for wetland plant communities
- Consider Natural Resources Conservation Service land use and conservation practices recommendations for soil management including erosion control, sediment management, and bank stabilization
- Consider landscape-scale factors when making management decisions, such as the value of habitat as a wildlife corridor providing connectivity within the broader ecoregion

Implementation Considerations

Environmental stewardship and sound practices are part of the USACE environmental management mission. USACE staff should continue to promote good environmental stewardship during project implementation and operation in addition to day-to-day actions. This strategy can ensure the conservation, preservation, and protection of natural resources for present and future generations.

Examples/References

- United States Army Corps of Engineers (USACE). 1996. Environmental Compliance Guidance and Procedures. EP 200-2-3. Available at: https://www.publications.usace.army.mil/-Portals/76/Publications/EngineerPamphlets/EP_200-2-3.pdf?ver=2013-08-22-090145-910
- United States Army Corps of Engineers (USACE). 1996. Environmental Stewardship Operations and Maintenance Guidance and Procedures. EP 1130-2-540. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1130-2-540.pdf?ver=2013-08-22-104519-387
- United States Army Corps of Engineers (USACE). 1996. Environmental Stewardship Operations and Maintenance Policies. ER 1130-2-540. Available at: https://www.publications.usace.army.mil/Portals/76/-Publications/EngineerRegulations/ER_1130-2-540.pdf

NR4: Consider and Manage Invasive Species Proactively

Description and Benefits

Invasive species, including plants, animals, and other organisms, can be a threat to natural resources and infrastructure. They can seriously hinder navigation; adversely affect flood risk management, hydropower generation, and water supply; and limit recreational use by the public. For USACE, monitoring and managing invasive species is critical due to the stewardship of millions of acres of public land and waters nationwide and the mission to prepare, prevent, and protect USACE infrastructure from such threats. Damage to local ecosystem services can be limited by developing and implementing an active management plan for the control and subsequent management of known invasive plants found on site, and by ensuring that no invasive species are brought to the site. Project teams should reference the Aquatic Nuisance Species Research Program and Aquatic Plant Control Research Program developed by USACE to address this practice.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13112, Invasive Species, Feb 1999
- U.S. Army Corps of Engineers Invasive Species Policy, Jun 2009
- Engineer Regulation No. 1130-2-540; Environmental Stewardship Operations and Maintenance Guidance and Procedures
- Invasive Species Leadership Team Program Management Plan
- John C. Dingell Act
- National Invasive Species Council
- Armed Forces Pest Management Board

Potential Actions

- Consult with the USACE Invasive Species Leadership Team (ISLT) and use appropriate contacts/agencies/POCs.
- Develop policies to prevent the introduction of invasive species; the policies may include sustainable practices to ensure that materials and equipment used during construction are free of invasive species and seeds
- Conduct a site assessment to evaluate and document whether invasive species are present on the project site
- Identify whether eradication will require indefinite ongoing monitoring and management.
- Contact local and state governmental agencies, consultants, and educational facilities to learn the most appropriate and effective management techniques for invasive species identified on site
- Ensure the landscaping plan does not include any invasive species in the local context; species common in one region or climate may be invasive when introduced to another
- Consulting with ISLT and ERDC, explore the latest economically efficient technologies and research, and explore biological, mechanical, and chemical control methods for invasive species management
- Consider using bio-control agents, new use patterns for aquatic pesticides, barrier systems, and innovative pesticide application techniques

Implementation Considerations

Prevention is the first line of defense. Invasive species can often be introduced through transportation pathways and disturbed sites during construction. The construction management plan can prevent accidentally introducing invasive species to the site. Invasive species can be viewed on federal and regional lists, including U.S. Department of Agriculture Natural Resources Conservation Service PLANTS Database, Invasive Plant Atlas of the United States website, State Noxious Weed laws, and Federal Noxious Weed laws. USACE has an existing Invasive Species Policy applicable to all projects, and this policy meets the spirit of the National Invasive Species Management Plan developed by the National Invasive Species Council.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Aquatic Nuisance Species Research Program (ANSRP) Reports. Available at: https://el.erdc.dren.mil/ansrp/ansrp.html
- United States Army Corps of Engineers (USACE). 2018. Aquatic Plant Control Research Program (APCRP). Available at: https://el.erdc.dren.mil/aqua/aqua.html
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- U.S. Army Corps of Engineers Invasive Species Policy. 2009. Available at: http://www.nae.usace.army.mil/Portals/74/docs/regulatory/InvasiveSpecies/policy.pdf

NR5: Protect Threatened and Endangered Species and Habitat

Description and Benefits

Protecting threatened and endangered species and their habitats aligns with USACE's mission to restore, protect, and manage aquatic ecosystems. One of the Civil Works Program's goals is to focus on restoring aquatic habitats to a more natural condition in ecosystems whose structures, functions, and dynamic processes have become degraded. Multiple stresses, including agricultural and urban development, introduction of non-native species, invasive species, and alteration and fragmentation of aquatic and wetland habitats, have contributed to declining biodiversity and the loss of species. Programs, such as the Envieornmental Stewardship Progran and the Sustainable Rivers Program, improve the health and life of rivers by changing dam operations to restore and protect ecosystems while maintaining or enhancing other project benefits. Protection of species and their habitats can sustain ecosystems for future populations, maintain biodiversity, and provide crucial habitats for wildlife.

Related Federal Mandates/Policies/Programs (if applicable)

- Endangered Species Act
- National Environmental Policy Act
- Water Resources Planning Act, as amended 42 U.S.C. 1962a-2
- Executive Order 11990 Protection of Wetlands
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook
- Engineer Regulation No. 1165-2-501: Civil Works Ecosystem Restoration Policy
- Sustainable Rivers Program

Potential Actions

- Use systems analysis methods and tools to understand, assess, and model the interconnected nature of hydrologic systems (e.g., watersheds) and the ecologic systems they support
- Collaborate with other agencies and non-government organizations to apply habitat restoration strategies and mitigate the decline of biodiversity (e.g., Sustainable Rivers Program with The Nature Conservancy)
- Minimize any adverse impacts to the environment (i.e., reduce adverse impacts to the nation's wetlands and waterways through an effective, transparent, and efficient regulatory process)
- Ensure that infrastructure is sited to avoid impacts to ecological areas that serve as a diverse habitat, or if avoidance is impossible, ensure that mitigation measures are taken to minimize disruption of systems
- Avoid the introduction of contaminants (e.g., through stormwater runoff, pesticides, or fertilizers)
- Carefully design projects to minimize habitat fragmentation and promote connectivity of wildlife movement
- Establish effective protective buffer zones or conservation easements around areas of high ecological value through restoration of areas or conservation of surrounding areas
- Ensure that projects are sited on previously developed land instead of undeveloped lands (greenfields) to minimize the impact of new habitat fragmentation
- Prioritize protecting and enlarging habitats (through an authorized acquisition of an adjoining contiguous parcel of equal or higher quality) to create a functional habitat to support ecosystems for a large range of species and to promote genetic diversity

Implementation Considerations

In addition to complying with the federal Endangered Species Act, the effort to implement the protection of threatened and endangered species and habitat can be incorporated as part of the planning process for projects. USACE can protect ecosystem function by avoiding development of areas that contain habitat for threatened or endangered plant and animal species or, in the event development must occur, minimizing disruption to existing habitats and protecting species from damage or removal. In collaboration with other agencies and non-government organizations, USACE should consider applying its aquatic ecosystem restoration authorities and capabilities to mitigate the decline of freshwater biodiversity in the United States.

Examples/References

- United States Army Corps of Engineers (USACE). 1999. Ecosystem Restoration – Supporting Policy Information. EP 1165-2-502. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerPamphlets/EP_1165-2-502.pdf
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2011. Sustainable Rivers Project: Benefiting Rivers, Communities and the Nation, Understanding the Past Vision for the Future. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/sustainablerivers/Sustainable_Rivers_Project-Vision.pdf
- United States Army Corps of Engineers (USACE) and United States Geological Survey. 2010. Sustainable Rivers Project PowerPoint Presentation by Lisa T Morales and Ward Staubitz. Available at: https://www.iwr.usace.army.mil/Portals/70/docs/projects/02Feb10/1-USGS_USACE_TNC_Sustainable_Rivers_Program.ppt
- United States Army Corps of Engineers (USACE) and The Nature Conservancy. 2017. Sustainable Rivers Program EAB Work Session in Davis, CA PowerPoint Presentation by John Hickey, Lisa Morales, Mindy Simmons, and Gretchen Benjamin.
- United States Water Resources Council. 1983. Economic and Environmental Principles for Water and Related Land Resources Implementation and Environmental Guidelines for Water and Related Land Resources Implementation Studies (Principles & Guidelines). Available at: https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1256524&ext=pdf

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NR6: Reduce Invasive Species Impacts

Description and Benefits

USACE staff will consider the Integrated Pest Management (IPM) program to support practices that reduce impacts from invasive and nuisance species and diseases from causing unacceptable damage to operations, people, property, or the environment. Properly implemented IPM is an effective and environmentally sensitive approach to pest management that can minimize impacts to the environment and reduce the need for pesticides. Properly managing invasive species through IPM may lead to reduced pesticide applications and reduced man-hours to conduct work, ultimately driving a reduction in expenditures. Proper IPM and resistance management will minimize risk of resistance or pesticide tolerance development.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13751: Safeguarding the Nation from the Impacts of Invasive Species, Dec 2016
- Endangered Species Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Engineer Regulation No. 200-2-3: Environmental Compliance Policies
- Engineer Regulation No. 1130-2-540; Environmental Stewardship Operations and Maintenance Guidance and Procedures
- Engineer Pamphlet No. 1130-2-540
- ISLT Program Management Plan
- USACE Invasive Species Policy
- John C. Dingell Act

Potential Actions

- Develop a pest management program specific to the project and compatible with the project's Master Plan
- Document pest management activities
- Consider the use of biological control agents, natural predators or competitors through establishment of native plant species and/or encouragement of the native seed bank
- Implement routine control and maintenance to manage already established invasive pest species to control spreading from their current location or managing them within their location to meet mission goals
- Implement early detection rapid response/eradication approach to focus on newly discovered or established pest species during the incipient stage of infestations before the species can establish a viable population
- Conduct adequate monitoring to monitor for new establishment or re-establishment of invasive species that may impact ecosystem health

Implementation Considerations

Implementation of IPM practices for USACE projects is already a part of USACE's normal business practices. The IPM is a holistic, multifaceted approach to support reductions in invasive species impacts at projects and ultimately protecting project purposes and the environment. Projects should consider implementing maintenance control philosophies as well. Maintenance control promotes maintaining invasive species at the lowest feasible level to reduce application and man-hour costs. Ultimately, the long-term goal is to reduce invasive species and the species impacts to our project missions. This can help reduce operations and maintenance costs, improve overall operational efficiency, and establish healthier ecosystems.

Examples/References

- United States Army Corps of Engineers (USACE). 1984. Plant Pest Quarantined Areas and Foreign Soil Samples. ER 1110-1-5. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/-EngineerRegulations/ER_1110-1-5.pdf?ver=2013-09-08-233406-777
- United States Army Corps of Engineers (USACE). 2014. Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures. ETL 1110-2-583. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerTechnicalLetters/ETL_1110-2-583.pdf
- United States Army Corps of Engineers (USACE). 2017. Aquatic Pest Management Program Implementation Instructions. Walla Walla District. Available at: http://www.nww.usace.army.mil/Portals/28/docs/-programsandprojects/PestManagement/170822Final%20Aquatic%20Integrated%20Pest%20Management%20Program%20Instructions.pdf
- United State Army Corp of Engineers (USACE). 2019. Invasive Species Leadership Team. Natural Resources Management Gateway. Available at: https://corpslakes.erdc.dren.mil/employees/islt/islt.cfm

NR7: Protect Cultural Resources

Description and Benefits

Operations

Cultural resources protection and preservation is a part of stewardship activities at Civil Works Operating Projects. Each operating project on USACE lands should have a program to systematically identify, preserve and protect cultural resources. Operating projects should use geographic information systems and/or other land management tools to manage and protect cultural resources. Proposed undertakings at operating projects should consider the impact of the proposed activity on historic and cultural resources. Protection and preservation of cultural resources extends to the artifacts, associated records, etc., associated with cultural resources. Each district and division has an archaeologist or other cultural resource specialist to assist in the stewardship of cultural resources on operating projects.

Regulatory

As part of pre-application consultations, the identification and consideration of historic properties under Section 106 of the National Historic Preservation Act should be undertaken at the earliest practical time. This will allow for the discussion with the applicant of measures or alternatives to avoid or minimize effects on historic properties. Each district and division has an archaeologist or other cultural resources specialist to assist in the consideration of historic properties consistent with 33 CFR 325 and other applicable guidance.

Related Federal Mandates/Policies/Programs (if applicable)

Operations

- Archaeological Resources Protection Act
- Curation of Federally-Owned or Administered Archeological Collections (36 CFR 79)
- ER 1130-2-540 Environmental Stewardship Operations and Maintenance Policies
- EP1130-2-540 Environmental Stewardship and Maintenance Guidance and Procedures
- Executive Order 11593: Protection and Enhancement of the Cultural Environment
- Executive Order 13175, Consultation and Coordination with Indian Tribal Governments
- National Environmental Policy Act
- National Historic Preservation Act of 1966 (as amended, 54 U.S.C. 300101)
- Protection of Historic Properties (36 CFR 800)
- Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)
- Reburial and Conveyance Authority (Section 208 of Water Resources Dev. Act of 2000)
- USACE Tribal Consultation Policy, May 2012

Regulatory

- Processing of Department of the Army Permits (33 CFR 325)
- National Historic Preservation Act of 1966 (as amended, 54 U.S.C. 300101)
- Protection of Historic Properties (36 CFR 800)

Potential Actions

Operations

- Use GIS and other technology to maintain information about the location and condition of known sites and areas previously subjected to surveys and field investigations
- Develop a monitoring system of cultural resources and historic properties to recognize changes in condition over time.
- Develop a program to educate visitors about site specific cultural resources and historic properties as well as prohibitions on collecting and site damage to assist in site protection.
- Use construction fences, flags, or tape to protect cultural/historical areas and prevent construction encroachment
- Use GIS and other technology to maintain confidentiality of locations identified as suitable for lands for the reinternment of Native American remains originally or inadvertently discovered from within USACE operating projects.

Regulatory

- Inform district or division archaeologist or other cultural resources specialist as soon as possible of potential impacts to historic properties.

Implementation Considerations

Personnel should be responsible for identifying all possible project threats to adjacent cultural resources and historic properties; Cultural Resources Management Plans and Historic Properties Management Plans should be developed and updated periodically to identify known resources on operating projects, their condition, and for historic properties, site specific treatments prepared in coordination with the State Historic Preservation Office. Cultural resources management plans should identify roles and responsibilities of Corps personnel and relevant training. Operating project personnel may have to follow-up with individual workers whose lack of awareness is persistently threatening to these attributes.

Examples/References

- United States Army Corps of Engineers (USACE). 1988. Procedures for Implementing NEPA. ER 200-2-2. Available at: https://www.gsa.gov/cdnstatic/Department_of_Army_Procedures_for_Implementing_NEPA.pdf
- United States Army Corps of Engineers (USACE). 2018. Cultural Resources Documents. Available at: https://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/tribal_culturalres/
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.

NR8: Include Tribal Consultation in Operations and Regulatory Projects

Description and Benefits

Considering tribal trust responsibilities is integral to USACE's Tribal Nations Program, which implements USACE's Tribal Consultation Policy and adheres to the USACE Tribal Policy Principles. The primary goals of the USACE Tribal Nations Program are to: 1) consult with Tribes that may be affected by USACE projects or policies; 2) reach out and partner with Tribes on water resources projects; and 3) provide technical services through USACE's Interagency and International Services Program. USACE recognizes that Tribal governments are sovereign nations and works to meet trust obligations, protect trust resources, and obtain Tribal views of trust and treaty responsibilities. USACE and Tribal leaders meet on government-to-government basis to collaborate before and throughout the decision-making process to ensure the timely exchange of information and consideration of input. Each District and Division has a designated Tribal Liaison to assist with the consideration of Tribal concerns as part of project planning.

Related Federal Mandates/Policies/Programs (if applicable)

Operations

- American Indian Religious Freedom Act
- ER 1130-2-540 Environmental Stewardship Operations and Maintenance Policies
- EP1130-2-540 Environmental Stewardship and Maintenance Guidance and Procedures
- Executive Order 11593: Protection and Enhancement of the Cultural Environment
- Executive Order 13007: Indian Sacred Sites
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments
- National Historic Preservation Act of 1966 as amended (54 U.S.C. 300101)
- Protection of Historic Properties (36 CFR 800)
- Native American Graves Protection and Repatriation Act (25 USC 3001 et seq.)
- Reburial and Conveyance Authority (Section 208 of Water Resources Dev. Act of 2000)
- USACE Tribal Consultation Policy, May 2012
- Water Resources Development Act of 2018, Sec. 1129; requires tribal consultation

Regulatory

- Processing of Department of the Army Permits (33 CFR 325)
- Procedures for the Protection of Historic Properties, (33 CFR 325, Appendix C)

Potential Actions

Operations

- Consultation with Tribes regarding activities on operating project should follow all relevant regulations and policies, particularly the USACE Tribal Policy and Program as identified in Planning Fact Sheet Section 2 above (P2: Consider Trust Responsibilities).
- Consultation for activities on Operating projects should utilize the district and division designated Tribal Liaisons
- Consultation with Tribes should take place to develop a plan to provide Tribes access to sacred sites located on operating projects.

Regulatory

- Pre-application meetings, to the extent practicable, should involve Tribes to assist applicants with planning project elements.
- Public notice notification should include all relevant Tribes, however, issuance of a public notice alone does not initiate consultation.
- Consultation should include feedback to the Tribe to identify how Tribal concerns and comments were incorporated and considered in the permit process.

Implementation Considerations

In addition to complying with federal regulations and USACE policies, considering Tribal trust responsibilities is the federal government's requirement to honor its obligations to Tribes and to represent the best interests of the Tribes, their resources, and their members. Tribal trust responsibilities should be implemented throughout the life of the project. USACE will act to fulfill its obligations to preserve and protect trust resources and to consider the potential effects of USACE projects on natural and cultural resources. USACE strives to involve Tribes in programs, projects, and other activities that will help build economic capacity and manage Tribal resources while preserving cultural identities.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Tribal Nations Overview. Available at: https://www.usace.army.mil/Missions/Civil-Works/Tribal-Nations/

LC1: Develop and Update Operation and Maintenance Manuals

Description and Benefits

The intent of developing maintenance manuals is to include preventative maintenance information consisting of systematic inspections and subsequent corrective actions to ensure long-term utilization of project features. A timely preventative maintenance program can reduce and prevent damage to constructed features by early corrective action, and can ultimately enable the orderly and efficient use of constructed features to meet project goals and objectives. Maintenance manuals should be developed and kept up-to-date for all facilities and assets. Regular and thorough maintenance can increase service life, improve efficiency, maintain operational safety, and reduce the need for costly repairs or replacement. Service life can be extended by using preventive care practices to avoid corrosion and deterioration of items such as control gates or turbines. Equipment such as motors or power supply components can be regularly maintained to reduce loss of efficiency over time. Safety concerns can be more readily identified with regular maintenance such as mowing of embankments to observe signs of distress. Thorough and up-to-date maintenance manuals can result in less pollution and waste, improved health and safety of workers and the public, and long-term cost savings for facility repair and replacement.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-2-401: Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors
- Engineer Regulation No. 1130-2-500: Partners and Support (Work Management Policies)

Potential Actions

- Incorporate development of operation and maintenance manuals as part of start-up and operations costs
- Fund implementation and upkeep of maintenance manuals
- Ensure manuals include specifics about frequency, procedures, and criteria for maintenance
- Review and update manuals on a regular basis to remain in line with the risks and costs associated with repair or operational failure
- Create a central location (e.g., digital library) that provides easy access to maintenance manuals and all updates

Implementation Considerations

The operation and maintenance requirements are initially identified during the feasibility phase and considered in the economic analysis when weighing project costs and benefits. Developing maintenance procedures, plans, and manuals can require more upfront and annual costs but can generally result in cost savings over time by maintaining optimal and efficient operations and avoiding costly repairs or replacements. For some systems, the manual can provide critical information needed in emergencies to activate or erect critical infrastructure; therefore, ready availability of thorough and clear documentation could have safety benefits. Maintenance manuals should be revised on a regular basis to reflect changes in operations, industry guidelines, and regulatory requirements.

Examples/References

- United States Army Corps of Engineers (USACE). 2005. Operation and Maintenance Manual for Princeton Refuge Habitat Rehabilitation and Enhancement, Upper Mississippi River System, Environmental Management Program, Pool 14, Mississippi River Miles 504.0-506.4R, Scott County, Iowa. Available at: http://www.mvr.usace.army.mil/Portals/48/docs/Environmental/EMP/HREP/MVR/PrincetonRefuge/OM_Manual2005.pdf
- Los Angeles District, Corps of Engineers, Los Angeles, California. 1999. Operation, Maintenance, Repair, Replacement and Rehabilitation Manual. Los Angeles County Drainage Area, California. Available at: https://dpw.lacounty.gov/lacfcd/WDR/files/WG/040215/ARMY%20CORPS%20O&M%20(1999%20LACDA).pdf

LC2: Reuse and Recycle Materials

Description and Benefits

Consider implementing a waste diversion plan that includes methods to reuse materials. Federal requirements through the Guiding Principles address the need for waste diversion for existing and new buildings during operation by providing recycling and reuse services for buildings occupants. USACE targets to achieve sustainable green buildings by incorporating the Guiding Principles into USACE projects. Developing a recycling and reuse program for all projects in operation is a USACE sustainable solution that avoids excess waste generation and can meet Federal Acquisition Regulation Clause: 52.223-10: Waste Reduction Program.

Related Federal Mandates/Policies/Programs (if applicable)

- Federal Acquisition Regulation Clause: 52.223-10: Waste Reduction Program
- Resource Conservation and Recovery Act (RCRA)
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Pollution Prevention Act

Potential Actions

- Identify possible reusable materials (either reused on-site or transported to other facilities)
- Ensure recycling infrastructure is available and accessible for recyclables to be transported to a recycling facility
- Determine effective locations for collection methods that yield higher volumes of recyclables
- Use a central area for processing and storage of materials appropriate for reuse
- Provide additional signage that illustrates acceptable reusable and recyclable materials
- Keep hazardous waste separate
- Quantify cost savings from reusing and recycling materials
- Measure the volume and weight of collected waste that has been reduced
- Have all subcontractors and suppliers propose methods for waste minimization through all processes (e.g., supply, packaging, storage, pre-cutting)
- Procure from suppliers that use sturdy, returnable pallets and containers, and have suppliers pick up pallets and empty containers
- Publicize reuse and recycling efforts and results for educational benefits and to increase participation
- Perform life cycle assessments on reusable and recycled materials focusing on environmental benefits
- Reuse job site materials such as concrete forms and fencing
- Use salvaged materials from other jobs (if available), and save excess materials for use on future jobs
- Construct temporary structures using methods that allow for reuse (e.g., screws rather than nails)
- Replace toxic materials with non-toxic product, where available, to reduce hazardous packaging

Implementation Considerations

Collaborate with stakeholders to receive financial support and suggestions on how to effectively implement a recycling and reuses plan that can be further supported by local entities and existing infrastructure. Initial investment to assess recycling and reuse opportunities and setup programs can result in long-term costs savings in addition to environment benefits of reducing waste.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- The Pennsylvania State University. 2004. Field Guide for Sustainable Construction. Available at: https://www.wbdg.org/ffc/dod/handbooks/field-guide-sustainable-construction

LC3: Reduce and Monitor Operational Waste

Description and Benefits

Consider reducing operational waste consumption and monitoring waste streams generated by frequently reporting the percentage of total operational waste diverted from disposal. For buildings, refer to the Guiding Principles to identify appropriate waste management that adheres to federal requirements also outlined in Executive Order 13834 and supports USACE's goal to implement more Guiding Principles and increase its green building portfolio. For USACE buildings and other infrastructure projects, USACE has required contractors to establish a cost-effective waste reduction program in all operations and facilities covered by contract included in the USACE Sustainable Acquisition Requirements and the Federal Acquisition Regulation Clause: 52.223-10: Waste Reduction Program. Reducing disposal volumes can benefit the environment, avoiding further contamination of natural resources, such as land, water, and air. Costs associated with transporting waste to disposal locations can also be decreased.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Pollution Prevention Act
- Federal Acquisition Regulation Clause: 52.223-10: Waste Reduction Program

Potential Actions

- Identify activities or processes where the amount of operational waste generated can be reduced
- Identify types of operational waste that can be diverted from landfills
- Frequently quantify volumes of waste diverted from landfills to recycling, reuse, or composting
- Apply compostable waste to organic applications, such as open space garden beds for building occupants to access
- Consider applying waste-to-energy applications onsite
- Develop a waste management plan that includes goals and procedures on how to reduce and monitor waste
- Identify personnel responsible for sorting and monitoring operational waste
- Consider other diversion methods that are on-site or consider remote-facility composting, sending to manufacturers as post-consumer recycled content, on-site reusing or recycling, or sending to recycling facilities
- Collaborate with local entities to identify existing waste disposal contracts and infrastructure

Implementation Considerations

Consider applying waste management strategies to cost-effectively reduce, reuse, recycle, compost, or recover operational waste to align with federal goals and the Guiding Principles. Initial investment to assess waste reduction opportunities and setup programs can result in long-term costs savings in addition to environment benefits of reducing waste. Hazardous waste should not be included with operational waste and should be handled according to local, state, and federal law.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

LC4: Plan for Long-Term Monitoring and Maintenance

Description and Benefits

USACE projects can have a long lifespan and involve complex systems of inflows, outflows, changing uses, and changing conditions. For passively or reactively maintained assets, this can lead to underperforming infrastructure over time. Preventative maintenance and adaptive management of infrastructure assets can help USACE to stay ahead of this evolution through the lifespan of the facility or project. These approaches have been identified as a strategic objective and cross-cutting strategy, respectively, in the Civil Works Strategic Plan 2014-2018.
Planning for long-term monitoring and maintenance at the outset of a project can help to ensure that the necessary proactive measures are continually made throughout a project life cycle. Design and procurement decisions made early on can lower the life cycle maintenance needs of an asset, lowering the risk of falling short of maintenance requirements. Meanwhile, installing adequate monitoring systems can facilitate a streamlined and risk-based approach to asset management.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation 1110-1-1300: Cost Engineering Policy and General Requirements
- Engineer Regulation 1110-2-1302: Civil Works Cost Engineering
- Engineer Regulation 1110-1-8173: Energy Modeling and Life Cycle Cost Analysis
- Engineering Manual 1110-2-3001: Planning and Design of Hydroelectric Power Plant Structures

Potential Actions

- Seek durable and longer-lasting materials
- Design for ease of access for maintenance and repair personnel with minimal disruption to operations
- Consider life cycle cost analysis, total cost of ownership, and implementation costs (e.g., operations, maintenance, repair, rehabilitation, and replacement costs) in design/procurement decisions
- Monitor ongoing energy/water consumption to identify sudden or gradual changes in performance
- Install remote sensors to facilitate routine monitoring as well as monitoring during periods of critical attention (e.g., hurricanes, forest fires)
- Identify key personnel and durable funding sources to cover the ongoing cost of maintenance
- Develop a schedule for periodic re-evaluation and modification of maintenance planning based on monitored data

Implementation Considerations

Planning for long-term monitoring and maintenance should begin early in a project process to capture the greatest savings on operational costs and continue to be evaluated on regular intervals in line with project costs and risks of operational issues.

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Sustainable Solutions to America's Water Resource Needs: Civil Works Strategic Plan 2014-2018. Available at: https://www.usace.army.mil/portals/2/docs/civilworks/news/2014-18_cw_stratplan.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/

LC5: Incorporate Asset Management Practices

Description and Benefits

Asset management is a systematic approach of accounting for operating, maintaining, and replacing assets in an infrastructure system. According to the USACE 2016 Sustainability Plan, "USACE is approaching asset management holistically by looking at all USACE assets with a focus first on critical assets -- such as locks and dams." Following this approach can help USACE to manage, maintain, and replace assets that are the highest priority for meeting performance requirements in a least-cost or resource-constrained way.

Related Federal Mandates/Policies/Programs (if applicable)

- USACE Operations and Maintenance 20/20 Framework

Potential Actions

- Approach "risk-based" asset management to prioritize actions based on criticality of the asset to authorized performance and vulnerability to hazards or threats
- Complete asset inventory in implementing the USACE Maintenance Management Improvement Plan
- Prepare and implement a water asset management plan to maintain desired level of service at lowest life cycle cost

Implementation Considerations

Asset management as a sustainability strategy is an important aspect to USACE for sustaining and maintaining infrastructure systems. This strategy should be incorporated throughout the life of a project.

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Sustainable Solutions to America's Water Resource Needs: Civil Works Strategic Plan 2014-2018. Available at: https://www.usace.army.mil/portals/2/docs/civilworks/news/2014-18_cw_stratplan.pdf
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/

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LC6: Standardize Features/Components (Gates, Locks, Etc.)

Description and Benefits

Coordinate and collaborate with the Inland Navigation Design Center Mandatory Center of Expertise to develop standardized criteria for the design of new features and major components of existing facilities at USACE infrastructure projects. USACE is burdened by a lack of interchangeable parts and major components (locks, gates, etc.), resulting in operational and financial inefficiencies. Standardized design criteria can eliminate the complications and elevated costs from repairing facilities with unique major components that are not sustainable to obtain and can maximize the life cycle value of materials. The new criteria can also provide standardized maintenance and repair procedures, ensuring consistent execution with an understanding that safety is a high priority.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation 1110-1-8168: Roles and Responsibilities of the Inland Navigation Design Center Mandatory Center of Excellence

Potential Actions

- Retrieve information regarding sustainable practices and lessons learned about component design and repair protocols
- Create a manual containing specifications of major components and standardized maintenance procedures
- Identify the components and repair guidelines that are most beneficial to the project or facility
- Quantify cost savings associated with standardizing components
- Perform life cycle cost analysis on standardized components

Implementation Considerations

Solutions for interchangeable components should consider cost savings from design, contracting, quality improvements, reduced outage durations, reduced storage yard requirements, sustainable practices and lessons learned, and other USACE Guiding Principles.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. USACE Standardization of Components and Repairs for Navigation Locks and Dams Nationwide Initiatives.
- United States Army Corps of Engineers (USACE). 2018. USACE Inland Navigation Design Center Fact Sheet – Standardization for Locks.
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf

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LC7: Consider Project De-authorization

Description and Benefits

Project de-authorization can occur either for unconstructed projects, which have been deemed no longer viable or failed to receive obligation funding for a set number of years, or for constructed projects deemed suitable for divestiture. A Disposition Study can be conducted for projects owned and operated by USACE to determine whether they should be de-authorized. Before a project is de-authorized, the Disposition Study process includes a review of additional opportunities that the existing project may serve, such as ecosystem restoration or recreational functions, to support USACE performance without making full divestiture. If a project is recommended for full or partial de-authorization based on the Disposition Study, the project undergoes a disposal process to permanently divest the project or project elements from USACE control and responsibility. Project disposal can include sale to other entities and/or full or partial demolition.

For many projects, disposal is a possibility as they reach the end of their design life cycle. Significant benefit (financial, environmental, or community) can be gained from a project if de-authorization and disposal are considered early in the planning and design phases. Planning for end-of-life in this way can enable possibilities such as reconfiguration, flexibility, deconstruction, beneficial reuse, maximizing residual value, and others.

Related Federal Mandates/Policies/Programs (if applicable)

- Water Resources Development Act

Potential Actions

- Consider modification of a project as an alternative to full disposal
- Consider the marketability of a project from the real estate perspective
- Consider beneficial reuse of demolition or waste materials, such as dredge materials or demolished concrete
- Develop a project end-of-life plan in the planning/design phase of the project
- Provide opportunities for reconfiguration, future expansion, flexibility, salvageability, and/or repurposing
- Consider environmental, social, and economic costs and opportunities in the disposal process

Implementation Considerations

Seeking opportunities for beneficial reuse of de-authorized projects is currently embedded in the project de-authorization process. For existing projects, there may be limited opportunities for this depending on project conditions. For new projects, forward-thinking planning and design can have a large impact on the reusability of a project pending de-authorization.

Examples/References

- United States Army Corps of Engineers (USACE). 2016. Interim Guidance on the Conduct of Disposition Studies. Available at: https://planning.erdc.dren.mil/toolbox/library/MemosandLetters/2016_Disposition_Memo.pdf
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- Congressional Research Service. 2018. Army Corps of Engineers: Water Resources Authorization and Project Delivery Processes. Available at: https://fas.org/sgp/crs/natsec/R45185.pdf

LC8: Consider Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R)

Description and Benefits

Operations and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) is an extension of the term for O&M (Operations and Maintenance) by adding additional aspects to address maintenance and repair over time rather than just operating and maintaining projects. As stated in Engineer Regulation 1110-2-401: Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors, repair is considered to entail those activities of a routine nature that maintain the project in a well-kept condition. Replacement covers those activities taken when a worn-out element or portion thereof is replaced. Rehabilitation refers to a set of activities as necessary to bring a deteriorated project back to its original condition. Normally, the Engineering Division will be assigned the overall responsibility for preparing a draft OMRR&R manual with appropriate inputs from other disciplines and, in consultation with the project sponsor, furnishing the draft manual to the project manager for coordination with the project sponsor, and preparing the final OMRR&R manual for approval.

Typically the manual includes the history of the area relative to the project purposes and summary information that would be pertinent to the OMRR&R of the project that was developed during planning and design studies, such as: for a flood control project, provide a summary of the climate, weather, hydrologic data to include norms and extremes, etc.; for a navigation project, provide information on currents, winds, waves, tides, navigation aids, hazards, etc.; for a shore protection project, provide erosion/accretion storm responses and annual volumes, wind and wave roses, tides, etc.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-2-401: Operation, Maintenance, Repair, Replacement, and Rehabilitation Manual for Projects and Separable Elements Managed by Project Sponsors
- Engineer Regulation No. 1130-2-500: Partners and Support (Work Management Policies)
- Engineering Circular No. 1165-2-217: Review Policy For Civil Works

Potential Actions

- For projects where the local sponsor will be in charge of OMRR&R, develop an O&M manual for the project to provide to the sponsor
- Indicate that protection of project benefits is a prime objective of OMRR&R
- Cover the maintenance and inspection details required for the proper care and efficient operation of the various project elements
- Identify the operations of the project that are necessary for the safe and efficient functioning of the project to produce the benefits set forth in the project authorization
- Present the emergency operation plans that cover preparations for and responses to project emergency conditions
- Outline the maintenance and inspection records to be maintained and available for inspection

Implementation Considerations

Some projects may involve long-term monitoring to track whether a project is being well-maintained and to potentially proactively address emerging problems more effectively. Consider incorporation of the long-term value of planning for maintenance needs in the future from the beginning of a project, which may help lower life cycle costs and improve performance of projects.

Examples/References

- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2018. Civil Works Review Policy. Available at: https://www.usace.army.mil/Missions/Civil-Works/Review-Policy/
- United States Army Corps of Engineers (USACE). 2018. Water Resources Policies and Authorities Review Policy for Civil Works. EC 1165-2-217. Available at: https://www.publications.usace.army.mil/Portals/76/-Publications/EngineerCirculars/EC_1165-2-217.pdf?ver=2018-05-01-105219-217

S1: Reduce Energy Consumption

Description and Benefits

For many projects, operational energy consumption can make up a significant portion of operational cost and greenhouse gas emissions. Actively pursuing energy demand reduction opportunities can save on construction or operating cost and positively affect the life cycle performance of a project. The time spent in the planning and engineering phases of a project to identify cost-effective energy conservation measures can be marginal compared to the life cycle operational cost and emissions associated with a suboptimal design. Further, reducing energy demand can not only reduce the life cycle cost of a project but can also insulate a project from ongoing changes to electricity prices, natural gas prices, and energy availability. Reducing energy consumption can also support energy and water security and preparedness requirements to support project objectives.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Engineer Regulation No. 1110-1-8173: Energy Modeling and Lifecycle Cost Analysis
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Energy Independence and Security Act
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Incorporate energy-efficient lighting (i.e., light-emitting diode [LED] lighting) and energy-efficient pumps (if applicable)
- Ensure sustainable acquisition requirements include energy-efficient products (i.e., ENERGY STAR products or Federal Energy Management Program-designated products) at the time of contract award
- Consider energy savings opportunities in the planning phase of a project, such as strategic siting of assets (e.g., solar orientation), opportunities for synergy/shared resources (e.g., district energy), or developing the capacity to manage energy consumption and peak demand (e.g., microgrids)
- Integrate energy modeling and conservation-oriented thinking into the engineering design process of a project (if applicable)
- Establish a reliable energy baseline against which to compare modeled performance
- Limit energy conservation strategies to those projected to be life cycle cost effective to limit financial risk

Implementation Considerations

Incorporating life cycle cost-effective energy conservation measures into a project is an increasingly well-established practice. For infrastructure projects, a challenging step may be establishing an appropriate energy demand baseline against which to compare improvements. Incorporating LED lights and other cost-effective energy strategies can be relatively easy to implement with minimal upfront cost. There may be opportunities to further increase energy savings by bundling measures that have rapid cost paybacks with measures that offer deeper energy savings but have a longer cost payback.

Examples/References

- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Department of Energy (USDOE). ENERGY STAR. Available at: https://www.energystar.gov/
- United States Department of Energy (USDOE). Federal Energy Management Program (FEMP). Available at: https://www.energy.gov/eere/femp/federal-energy-management-program
- United States Department of Defense (US DoD). 2018. Unified Facilities Criteria (UFC) 1-200-02: High Performance and Sustainable Building Requirements. Available at: https://www.wbdg.org/FFC/DOD/UFC/ufc_1_200_022016_c3.pdf

S2: Identify Efficiency Measures/Investment

Description and Benefits

Identifying efficiency measures and investment can align with the Office of Management and Budget (OMB) Scorecard goal that states "agencies are assessed on Energy Independence and Security Act (EISA) Section 432 facility evaluations, identifying Energy Conservation Measures, and whether performance contracting was utilized." This strategy aims to maximize the use of performance contracting to help achieve energy, water, and infrastructure goals. Identifying and implementing energy and water efficiency measures can help to reduce operating costs and contribute toward energy efficiency and greenhouse gas emission goals. Typically, due to the nature of efficiency projects, costs are paid upfront and savings accrued annually, making it difficult to fund projects. Energy Savings Performance Contracts (ESPCs) and Utility Energy Service Contracts (UESCs) can enable the creation of beneficial partnerships to alter the cost structure of efficiency projects, saving on upfront construction costs.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Energy Policy Act of 2005
- Energy Independence and Security Act

Potential Actions

- Identify energy efficiency and water efficiency measures, and estimate life cycle costs of improvements
- Work with USACE to understand whether pursuing ESPCs/UESCs is appropriate for the project
- When appropriate, use performance contracting on projects to execute energy/water efficiency measures and renewable energy technologies to ensure all life cycle cost effective measures are being implemented
- Track annual energy (i.e., British thermal unit) saved per $1 of investment for efficiency/renewable measures

Implementation Considerations

Early in the implementation process, it is important to determine whether energy and water saving measures can use ESPCs/UESCs. EISA Section 432 requires federal agencies to identify "covered facilities" that constitute at least 75 percent of their total facility energy use. Only "covered facilities" are subject to the OMB Scorecard for efficient federal operations/management goals. ESPCs/UESCs are most applicable for existing building projects such as renovations.

Examples/References

- Department of Energy (DOE). 2008. Facility Energy Management Guidelines and Criteria for Energy and Water Evaluations in Covered Facilities. Available at: https://www.energy.gov/sites/prod/files/2013/10/f3/eisa_s432_guidelines.pdf
- Department of Energy (DOE). 2010. Building Energy Use Benchmarking Guidance. Available at: https://www1.eere.energy.gov/femp/pdfs/eisa432_guidance.pdf
- Department of Energy (DOE). 2014. Commissioning For Federal Facilities. Available at: https://www.energy.gov/sites/prod/files/2014/07/f17/commissioning_fed_facilities.pdf
- Pacific Northwest National Laboratory (PNNL). 2010. Operations & Maintenance Best Practices: A Guide to Achieving Operational Efficiency (Release 3.0). Available at: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-19634.pdf
- Pacific Northwest National Laboratory (PNNL). 2015. Metering Best Practices: A Guide to Achieving Utility Resource Efficiency, Release 3.0. Available at: https://www.energy.gov/sites/prod/files/2015/04/f21/mbpg2015.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S3: Incorporate Renewable Energy Sources

Description and Benefits

Renewable energy sources, including solar, wind, geothermal, hydropower, and others, can offer several benefits to the energy system of a project. Renewable energy can: reduce operational energy demand and save project cost on a life cycle basis; reduce reliance on off-site energy sources, which reduces the risk of critical infrastructure systems to disruption from grid outages; reduce greenhouse gas emissions and mitigate the associated risks from climate change; and improve the overall reliability of the site-wide energy system. Depending on scale, localized renewable energy within a broader system can also defer capacity increase requirements (e.g., transformer up-sizing) in the distribution system.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 1110-1-8173: Energy Modeling and Lifecycle Cost Analysis
- Executive Order 13834: Efficient Federal Operations

Potential Actions

- Assess the project for potential renewable energy opportunities
- Assess the energy cost savings potential on a life cycle basis for solar, wind, geothermal, hydropower, and other renewable energy sources
- Account for ancillary benefits of renewable energy sources when evaluating life cycle performance, such as improvements to energy reliability/resilience, deferred capacity upgrades, improvements to power quality, etc.
- Install a diversity of renewable energy sources to improve the availability of energy under varying weather conditions
- Consider energy storage in conjunction with renewable energy sources to further save project cost and improve the availability of variable renewables (e.g., solar, wind)

Implementation Considerations

The potential initial effort to implement renewable energy for a project can be moderate to difficult depending on the circumstances. Additional funding may be required, and additional planning, engineering, and construction requirements may be needed. Incorporating renewable energy opportunities should be considered as part of the project feasibility phase of a project, so that it becomes part of the authorized project scope and costs. For existing USACE projects, renewable energy opportunities should be considered during preliminary engineering analyses, so that funding requests for construction are adequate to cover design and installation costs.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Wind Energy Knowledge Resource. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Wind-Energy/
- United States Army Corps of Engineers (USACE). 2018. Solar Photovoltaic CXS. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Solar-Photovoltaic/
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2016. Power Purchase Agreement Program. Available at: https://www.hnc.usace.army.mil/Portals/65/docs/PAO/Fact%20Sheets/2016%20Fact%20Sheets/PPA07-16.pdf?ver=2016-07-07-093008-367
- United States Army Corps of Engineers (USACE). 2018. Energy Division—Power Purchase Agreement. Available at: https://www.hnc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/484227/energy-division-power-purchase-agreement-ppa-program/

S4: Reduce Potable Water Consumption and Optimize Water Reuse

Description and Benefits

Potable water consumption can be reduced by using water conservation strategies, such as automatic faucets and low-flow toilets in restrooms, regular maintenance of faucets and water lines to prevent leaks, and potential reuse of stormwater for non-potable purposes such as irrigation. Metering and monitoring of potable water use can help identify locations of water waste where flow could be reduced or non-potable water could be used. Flow sensors can also be used at facilities where large water mains or pipes could leak, break, or experience operational error such as a valve or gate being left open. The overall goal is to minimize potable water use where feasible and efficiently reuse water where possible and cost effective. Water consumption needs to meet the stipulated federal requirements for annual reduction in potable water consumption intensity per square foot of building space as well as the overall reduction targets by 2020 against a set baseline. Reducing potable water consumption can result in conservation of water resources and potential savings on operational expenses.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Energy Policy Act of 2005
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Review and analyze opportunities to feasibly harvest, store, and use stormwater
- Regularly inspect and perform maintenance on water infrastructure to prevent leaks
- Install flow sensors on water mains or pipes to determine if a leak, break, or operational error has occurred
- Incorporate metering and monitoring to track performance and to identify areas for water use reduction
- Install automatic faucets that shut off after a specified time
- Incorporate low-flow fixtures and ultra-low-flow toilets
- Consider native drought tolerant plants to reduce irrigation and landscaping water demands
- Consider architectural alternatives that require no water

Implementation Considerations

The demand for potable and non-potable water, and therefore the potential for water conservation, may vary significantly with factors such as climate, land use, and development type. Water conservation begins at the planning phase through operations. Determining appropriate system sizing requires an accurate quantitative analysis of water. Further, a stormwater harvesting plan may require input from specialists to properly and efficiently design the systems. There may be local limitations or permit requirements from local or state governments for the storage and reuse of stormwater. Stormwater management systems may also require maintenance that should be accounted for in the operations phase.

Examples/References

- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Army Corps of Engineers (USACE). 2017. Management of Water Control Systems. EM 1110-2-3600. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/-EM_1110-2-3600.pdf
- United States Army. 2013. Army Low Impact Development Technical User Guide. Available at: https://www.usace.army.mil/Portals/2/docs/Sustainability/Hydrology_LID/Army_LID_Technical_User_Guide_January2013.pdf
- United States Environmental Protection Agency (USEPA). 2013. Rainwater Harvesting: Conservation, Credit, Codes, and Cost Literature Review and Case Studies. Available at: https://www.epa.gov/sites/production/files/2015-11/documents/rainharvesting.pdf

S5: Implement the Guiding Principles for Sustainable Federal Buildings

Description and Benefits

Executive Order (EO) 13834 sets the focus and intent driving the application of the Guiding Principles for Sustainable Federal Buildings, stating that agencies are to "ensure that new construction and major renovations conform to applicable building energy efficiency requirements and sustainable design principles; consider building efficiency when renewing or entering into leases; implement space utilization and optimization practices; and annually assess and report on building conformance to sustainability metrics."

The Guiding Principles, referenced below, defines the targets and goals that applicable federal projects are encouraged to achieve. This requirement should be addressed during upgrades and major maintenance to existing USACE-owned infrastructure. Meeting the goals related to integration of operations and design, energy performance, water conservation, indoor environmental quality, materials, and climate change risk advances the objective of EO 13834 to "reduce waste, cut costs, enhance the resilience of Federal infrastructure and operations, and enable more effective accomplishment of its mission."

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Unified Facilities Criteria 1-200-02: High Performance and Sustainable Building Requirements
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Follow the Guiding Principles to:
  - Employ Integrated Assessment, Operation, and Management Principles
  - Employ Integrated Design Principles
  - Optimize Energy Performance
  - Protect and Conserve Water
  - Enhance Indoor Environmental Quality
  - Reduce the Environmental Impact of Materials
  - Assess and Consider Climate Change Risks

Implementation Considerations

Implementation strategies for EO 13834, Efficient Federal Operations, and the Guiding Principles begin with early integration to cost effectively integrate strategies. First costs need to be balanced with life cycle costs to determine effective strategies. The strategies should be discussed at the kick-off stage of the project with the larger project team.

Examples/References

- United States Army Corps of Engineers (USACE). 2019. Centers of Expertise in Sustainability (CSX). Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/
- Council on Environmental Quality. 2016. Guiding Principles for Sustainable Federal Buildings and Associated Instructions. Available at: https://www.sustainability.gov/pdfs/guiding_principles_for_sustainable-_federal_buildings.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Department of Energy (DOE). 2016. Guiding Principles for Sustainable Federal Building Updates Crosswalks: Existing Buildings and New Construction or Modernization. Available at: https://www.energy.gov/eere/femp/downloads/2016-guiding-principles-sustainable-federal-buildings-updates-crosswalks

S6: Reduce Fleet Petroleum Use

Description and Benefits

The reduction of fleet petroleum use is a sustainability goal under USACE's 2018 Sustainability Report and Implementation Plan, and may help reduce Scope 1 and 2 greenhouse gas (GHG) emissions. This strategy aligns with USACE's commitment to deliver sustainable solutions through the conservation and efficient use of resources. This goal emphasizes adaptive operations and aligns with USACE's aim to integrate environmental considerations in the operation, maintenance, and rehabilitation of existing projects. Annual targets can be set to measure the progress in reducing the use of traditional petroleum fuels (i.e., gasoline and diesel) in the non-tactical vehicle (NTV) fleet.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Energy Independence and Security Act
- Energy Policy Act of 2005

Potential Actions

- Consider ridesharing and carpooling options to travel to/from meetings and project sites
- Offer incentives for ridesharing, carpooling, and alternative modes of travel (i.e., designated/preferred parking spots; discounted fares or reimbursement of fares; support for bicycle riders with racks, on-site showers, parking lockers, and flexible work scheduling)
- Consider telecommuting/conference call opportunities for work and meetings
- Improve NTV fleet fuel efficiency through the acquisition and use of low/no emission and alternative fuel vehicles
- Procure larger, heavier-duty vehicles in an alternative fuel configuration
- Develop infrastructure for electric vehicle charging stations
- Partner with agency stakeholders to educate vehicle operators on the importance of alternative fuels and reducing petroleum use

Implementation Considerations

The effort to implement the reduction of fuel petroleum use is feasible given the advancement in technology to meet the demand in alternative fuel and fuel efficient options. Additionally, USACE's culture related to the NTV fleet management and utilization has shifted to encourage the reduced use of petroleum fuel. In general, a reduction in petroleum fuel use can help reduce GHG and gasoline/diesel fuel emissions, mitigate impacts of climate change, reduce operations and maintenance costs, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S7: Increase Percentage of Sustainable Acquisitions of Total Actions

Description and Benefits

Increasing the percentage of sustainable acquisitions of total actions can maximize the number and dollar amount of items procured and implemented with sustainable attributes, such as high recycled content materials, low-emitting materials, alternative energy, waste reduction, energy and water reducing products and methods, etc. The many benefits can include potential operational utility savings and healthier indoor environments. This strategy aligns with USACE's sustainability goals and the Office of Management and Budget Scorecard goal that states "Agencies will be assessed on the change from prior year performance of the percentage of contract actions and dollar value of sustainable acquisitions as reported in the FPDS, to include the mandatory clauses for the purchase of bio-based, energy-efficient, recycled content and/or other sustainable attributes."

Related Federal Mandates/Policies/Programs (if applicable)

- USACE Contracting Policy Alert #18-006, Sustainable Acquisition Guidance, Nov 2017
- Federal Acquisition Regulation
- Unified Facilities Criteria (UFC) 1-200-02, High-Performance and Sustainable Building Requirements
- Executive Order 13834: Efficient Federal Operations

Potential Actions

- Meet recycled content requirements set forth by the U.S. Environmental Protection Agency (EPA) by using the list of EPA-designated products
- Set a recycled materials target (up to 50 percent of weight, volume, or cost) including materials with recycled content and/or reused existing structures or materials
- Use products that meet the Bio Preferred Program requirements referencing the U.S. Department of Agriculture-designated product categories
- Use energy and water efficient products for items referencing the U.S. Department of Energy-covered product categories
- Print all deliverables on double-sided paper that contains post-consumer fiber (recycled content)
- Use low or non-toxic or hazardous chemicals (e.g., low volatile organic compound paint)
- Use chemicals and products that do not contain ozone-depleting substances
- Use bio-based products for equipment maintenance
- Consider "Priority Products," which are products with multiple, most sustainable attributes on the market

Implementation Considerations

Infrastructure projects can be major consumers of materials, and projects should consider the ability to influence higher sustainability performance in the material manufacturing chain by requiring transparency in sustainable credentials. In line with the Executive Order 13834, USACE is required to promote sustainable acquisition by ensuring that environmental performance and sustainability factors are considered to the maximum extent practicable for all applicable procurements in the planning, award, and execution phases of acquisition. For building construction, many of these requirements have been included in UFC 1-200-02 and the UFC Specifications. Project teams should always ensure that all project materials meet the necessary quality and performance criteria required for the intended application, whether, for example, recycled or not.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Environmental Protection Agency (EPA). EPA-Designated Products. Available at: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program
- United States Department of Energy (DOE). Covered Product Categories. Available at: https://energy.gov/eere/femp/search-energy-efficient-products
- Federal Facilities Environmental Stewardship & Compliance Assistance Center (FedCenter). Priority Products. Available at: https://www.fedcenter.gov/members/workgroups/sustainableacquisition/priorityproducts/
- General Services Administration (GSA). Green Procurement Compilation: Guidance and Supplier Directory. Available at: https://sftool.gov/greenprocurement
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S8: Reduce Greenhouse Gas Emissions

Description and Benefits

One goal of the Office of Management and Budget's Scorecard is to reduce Scope 1 and 2 greenhouse gas emissions (GHG) by 23.1 percent by 2020. This also aligns with USACE's commitment to deliver sustainable solutions through conserving resources and promoting efficiency. Based on federal mandates, USACE will continue to focus on reducing facility energy use, improve non-tactical vehicle (NTV) fleet fuel efficiency, increase alternative fuel consumption, and increase acquisition and use of low and no emission vehicles. This strategy can also help USACE to meet the annual targets in reducing the use of traditional petroleum fuels (i.e., gasoline and diesel) in the NTV fleet and fleet-wide per-mile GHG emissions.

Related Federal Mandates/Policies/Programs (if applicable)

- Clean Air Act
- Executive Order 13834: Efficient Federal Operations
- Energy Independence and Security Act

Potential Actions

- Identify opportunities for reducing commuter emissions and increasing telework
- Consider ridesharing and carpooling options to travel to/from meetings and project sites
- Identify, raise awareness of, and increase leadership support for sustainable commuting options for USACE employees
- Offer incentives for ridesharing, carpooling, and alternative modes of travel (i.e., designated/preferred parking spots; discounted fares or reimbursement of fares; support for bicycle riders with racks, on-site showers, parking lockers, and flexible work scheduling)
- Consider telecommuting/conference call opportunities for work and meetings to reduce emissions generated from business travel
- Improve NTV fleet fuel efficiency through use of low and no emission vehicles in the NTV fleet
- Increase consumption of alternative fuel in vehicles, machinery, and buildings
- Develop infrastructure for electric vehicle charging stations
- Incorporate a requirement for lessors to disclose energy consumption and carbon emissions data into all new agency lease solicitations for fully serviced building leases over 10,000 rentable square feet
- Consider hydropower options as a renewable energy resource for USACE facilities
- Use energy efficient appliances and machinery when replacement is needed
- Monitor energy use through metering and sub-metering to identify areas of inefficient energy use and opportunities to reduce consumption
- Identify and support management practices or training programs that encourage employee engagement in addressing GHG reduction

Implementation Considerations

The effort to implement strategies to reduce GHG emissions in the operations and regulatory phase of projects will correlate with volume of equipment, buildings, machinery, vehicles, and personnel involved in the project. Implementation is becoming increasingly feasible given constant advancements in low emission and energy efficient technology. Additionally, USACE's culture related to fuel consumption continues to encourage conservation of resources. This strategy can ultimately help reduce GHG and petroleum fuel emissions, mitigate impacts of climate change, reduce operations and maintenance costs, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Construction Industry Institute (CII). 2014. A Framework for Sustainability during Construction.
- Green Business Certification Inc. 2014. SITES v2 Rating System: For Sustainable Land Design and Development. Available at: http://www.sustainablesites.org/
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S9: Improve Reliability of Energy Source

Description and Benefits

Improving the energy reliability of a project begins with a holistic risk management process. This process includes evaluating the criticality of given energy systems for supporting mission-critical functions, assessing the vulnerability of the energy system or components to all possible risks and hazards facing the system, and prioritizing corrective actions to improve reliability. For USACE Civil Works, improving the reliability of energy sources can support mission assurance and minimize risk. The American National Standards Institute/Telecommunications Industry Association-942 Data Center Standards Overview, the telecommunications industry data standards for tiered reliability, can be sourced to categorize energy systems or components into four levels of reliability performance: Tier 1 (basic), Tier 2 (redundant components), Tier 3 (concurrently maintainable), and Tier 4 (fault tolerant). Following this framework can ensure specific targets are set to achieve a desired level of reliability where needed, and can conserve resources by allowing lower levels of reliability where the risk of disrupting the project's mission/function is correspondingly lower.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13783, Promoting Energy Independence and Economic Growth, Mar 2017
- Department of Defense Mission Assurance Strategy of 2012
- Engineering Pamphlet 1130-2-551: Hydropower Operations and Maintenance Policy: Implementation of Bulk Power System Reliability Compliance Program

Potential Actions

- Investigate alternative energy sources, such as hydropower, solar power, and fuel cells, to increase on-site power availability during a grid outage
- Improve the electrical distribution grid to support reliable power
- Provide redundant energy sources when possible on mission-critical projects
- Evaluate the criticality of the energy system/components to support mission-critical functions
- Assess the potential impact and likelihood of all possible hazards and threats facing the energy system/components
- Assess the vulnerability of the energy system/components to the potential hazards and threats
- Identify the risk tolerance of the energy system/components by setting a reliability target (e.g., Tier 1 through 4)
- Design the energy system/components to achieve the targeted level of reliability

Implementation Considerations

The effort to improve energy reliability can range based on the availability of risk management data to the project planners or design engineers. Gathering this information to establish an energy reliability target may require requesting information through the proper USACE channels. Once established, energy reliability targets can be folded into the conventional engineering design process.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Fuel Cells for Energy Security. Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476732/fuel-cells-for-energy-security/
- United States Department of the Army. 2006. Technical Manual 5-698-5: Survey of Reliability and Availability Information for Power Distribution, Power Generation, and Heating, Ventilating and Air Conditioning (HVAC) Components for Commercial, Industrial, and Utility Installations. Available at: https://www.wbdg.org/FFC/ARMYCOE/COETM/tm_5_698_5.pdf
- Peninsula Warrior. Army Engineer: Microgrids are the Future of US Energy Security. Jun 2018. Available at: https://www.militarynews.com/peninsula-warrior/news/army_news/army-engineer-microgrids-are-the-future-of-u-s-energy/article_425d47d6-7a4c-11e8-ba04-0bab6cefc57b.html
- American National Standards Institute/Telecommunications Industry Association (ANSI/TIA). 2006. TIA-942: Data Center Standards Overview. Prepared by ADC Telecommunications, Inc. Available at: https://www.accu-tech.com/hs-fs/hub/54495/file-15894024-pdf/docs/102264ae.pdf

S10: Identify Opportunities for Alternative Energy Systems

Description and Benefits

Alternative energy is any energy source that is an alternative to fossil fuel, of which renewable energies are only a part. On-site electricity generation from alternative sources can offer many benefits. In particular, alternative energy systems may complement variable renewable energy supplies (e.g., solar) as a dispatchable energy resource that can be cycled up and down to fill in the "gaps" in variable supply. In many cases, alternative energy systems can also produce electricity at a rate lower than the local utility. In critical infrastructure projects, a steady supply of inexpensive and reliable baseload power can significantly enhance performance in terms of power reliability, availability, and resilience.

Sources of alternative energy can include hydropower, which is a source that USACE has already developed extensively and is encouraged to expand where possible; natural gas in the form of gas turbines; combined heat and power (CHP); fuel cells, hydrogen, small modular nuclear reactors (SMR); and thermal combustion with carbon capture and storage. Fuel cells can offer several advantages over other technologies depending on project-specific considerations, including: more efficient electrical generation; modular installations; quieter and cleaner operation that can ease siting constraints; and greater reliability (potential configuration as uninterruptible power supply).

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13783, Promoting Energy Independence and Economic Growth, Mar 2017
- Engineer Regulation No. 1110-1-8173: Energy Modeling and Lifecycle Cost Analysis
- Department of Defense Mission Assurance Strategy of 2012

Potential Actions

- Conduct feasibility analyses to determine the most applicable (and financially viable) alternative energy system for the project
- Consider hydrogen and fuel cells for transportation and other diverse applications such as material handling, stationary, portable, and emergency backup power applications
- Consider CHP for projects that have relatively high year-round thermal loads
- Consider sourcing energy from new SMR technologies
- Consider opportunities for active capture and storage of carbon dioxide emissions associated with energy generation

Implementation Considerations

Determining the most appropriate alternative energy system for the project involves bringing on a team of experts to conduct a feasibility study. Selecting the proper system for a specific application will include minimal maintenance costs and high availability. Installing CHP systems for projects may involve early coordination with the utility company and environmental agencies.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Engineering and Construction Bulletin (ECB) 2018-5. TechNotes: Solar Thermal, Microhydropower, and Combined Heat & Power (CHP). Available at: https://www.wbdg.org/FFC/ARMYCOE/COEECB/ecb_2018_5.pdf
- United States Army Corps of Engineers (USACE). 2018. Fuel Cells for Energy Security. Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/476732/fuel-cells-for-energy-security/
- United States Department of Energy (US DOE). 2016. CHP Deployment Program. Available at: https://www.energy.gov/sites/prod/files/2016/09/f33/CHP%20Deployment%20Program%20Fact%20Sheet_FINAL_compliant.pdf

S11: Design for High Efficiency Technology Facility Fixtures (Toilets, Lightbulbs, Etc.)

Description and Benefits

Using high-efficiency technology facility fixtures can be an effective way to reduce the life cycle cost and environmental impacts of a project. When high-efficiency fixtures are used, the ongoing operations cost and resource consumption of a project are reduced. This can preserve financial resources for use in other mission critical areas, reduce exposure of the project to utility cost volatility, reduce risk to supply disruptions (e.g., power outages, drought), and lower the life cycle environmental impact of the project. High-efficiency alternatives to conventional products often come at an increased initial cost with life cycle cost savings that yield a longer or shorter payback period. It is therefore recommended to conduct due diligence when selecting product alternatives and ensure products are viable (e.g., durable, maintainable) for life cycle applications.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- ENERGY STAR Program
- WaterSense Program
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Consider the life cycle cost-effectiveness and triple bottom line impact of all available strategies before selecting a preferred alternative
- Install light-emitting diode lightbulbs where available
- Install high-efficiency pumps, fans, and other heating, ventilation, and air conditioning/plumbing equipment where life cycle cost effective
- Install variable frequency drives on new and existing pumps and fans
- Consider other ENERGY STAR rated products and equipment
- Install low-flow, ultra-low-flow, or waterless toilets and urinals where life cycle cost effective
- Install sink aerators and low-flow shower heads where viable
- Consider other WaterSense-rated products and equipment

Implementation Considerations

The cost to implement will vary depending on the project phase and type. Planning and designing for high-efficiency equipment during the early stages of a project will be easier than trying to implement in the operations stage. Consideration should be given to replacing existing equipment with more efficient equipment on a phased schedule as existing equipment begins to need replacement, as a strategy to spread the cost over time.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Department of Defense (US DoD). 2018. Unified Facilities Criteria (UFC) 1-200-02: High Performance and Sustainable Building Requirements. Available at:
- https://www.wbdg.org/FFC/DOD/UFC/ufc_1_200_022016_c3.pdf
- Institute for Sustainable Infrastructure (ISI). 2018. Envision, v3. Available at: https://sustainableinfrastructure.org/
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). 2010. ASHRAE Standard 90.1-2010: Energy Standard for Buildings Except Low-Rise Residential Buildings.
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S12: Reduce Water Contamination

Description and Benefits

During construction, materials and equipment can contaminate surface and groundwater through either direct contact or runoff. Contamination could be from leaked, spilled, or leached chemicals that alter the chemical makeup or pH of the groundwater or body of water. Contamination can also occur in the form of sediments that increase water turbidity. Primary strategies for reducing the risk of water contamination at a construction site include properly sealing materials and equipment, storing materials and equipment on covered impermeable surfaces, and containing areas of contamination to allow safe disposal of contaminated water. Reducing water contamination has primarily environmental benefits for the surrounding ecosystem but can also help avoid health issues for workers and the surrounding communities or costly pollution fines and cleanups.

Related Federal Mandates/Policies/Programs (if applicable)

- Code of Federal Regulations, 33 CFR 320, General Policies for Evaluating Permit Applications, Subpart 320.4 (d) Water Quality
- Clean Water Act, Section 401 and Section 404
- Safe Drinking Water Act
- National Environmental Policy Act
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Identify equipment and materials that could affect chemical makeup, pH, or turbidity of groundwater or surface water in the project vicinity
- Ensure redundant safeguards are in place to avoid leaks, spills, or leaching
- Contain or seal materials and equipment that come into direct contact with groundwater or bodies of water
- Store equipment and materials on surfaces with low permeability and cover them to prevent contact with rainwater, snowmelt, or surface flow
- When construction activities make it difficult to avoid contamination, contain the area of contamination in a manner that allows safe disposal of the contaminated water
- Provide contained equipment wash-down areas
- Monitor groundwater and surface water quality in the vicinity and downstream of the project throughout construction

Implementation Considerations

Implementation may vary based on the number of contaminants present on site and the project's proximity to bodies of water. Efficiencies could be gained by changing the site plan/traffic circulation, activity scheduling, or substituting materials and equipment. Implementation is generally required by permitting and regulations for any project that affects a watershed.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Planner's Study Aid: Water Supply / Water Quality and Watershed. Available at: https://www.usace.army.mil/Missions/Civil-Works/Project-Planning/Products/Study-Aid/
- United States Army Corps of Engineers (USACE). 2018. Reservoir System Prepared for 2018 Runoff Season. Available at: http://www.nwd.usace.army.mil/Media/News-Releases/Missouri-River-Water/Article/1433371/reservoir-system-prepared-for-2018-runoff-season/
- United States Environmental Protection Agency (USEPA). 2018. National Pollutant Discharge Elimination System (NPDES). Available at: https://www.epa.gov/npdes

S13: Collect, Remediate, and Reuse Gray Water and/or Optimize Stormwater

Description and Benefits

Stormwater is surface water produced during precipitation or snow/ice melt and can soak into soil, evaporate, or runoff into nearby bodies of water. Gray water is considered waste water from baths, sinks, washing machines, dishwashers, etc., with the exception of toilets. Gray water and stormwater require less strenuous methods of treatment than black water (i.e., toilet effluent) for reuse. Similarly, gray water and stormwater reuse in non-potable water systems require lower levels of treatment than direct potable reuse. Stormwater runoff can degrade water quality by carrying contaminants off-site into the local watershed, whereas treating and reusing on-site can help remediate stormwater pollution concerns. Equipment and processes to collect, remediate, and reuse gray water or stormwater are most likely to be optimized during planning and design than during post-construction. If cost effective and permitted by local laws and regulations, this strategy can help to limit potable water consumption, stormwater peak flow and pollution levels, and outdoor water use. Reduction in potable water intensity is a goal for USACE efficient federal operations/management and is directly addressed by the collection and reuse of gray water and/or stormwater.

Related Federal Mandates/Policies/Programs (if applicable)

- Energy Independence and Security Act
- Executive Order 13834: Efficient Federal Operations
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Reduce overall water consumption for all facilities and operations
- Ensure local codes do not restrict the use of gray water
- Determine the level of treatment that is needed to reuse gray water or stormwater for different applications
- Detain stormwater runoff by implementing low impact development practices, collecting rainfall from rooftops, etc.
- Determine methods of collection and purification for gray water and stormwater
- List applications to reuse gray water and stormwater, such as treating landscapes or rinsing equipment
- Quantify the volume of gray water produced from project facilities and operations
- Quantify the volume of gray water or stormwater reuse demand
- Use USACE's Gray Water – Black Water Knowledge Resource for assistance with performing life cycle cost analysis to determine applicability and feasibility of related systems

Implementation Considerations

This strategy can be most effective if reduction measures are implemented first to reduce water demand overall for all project facilities and operations. Initial costs of implementing a water retention system can be high with cost savings seen over the life of the project due to reduced use of potable water. Personnel need to ensure that a project's budget allows for a capital investment and that the system is properly maintained. This strategy can be most beneficial for projects that have limited access to water and/or are located in high-precipitation areas.

Examples/References

- United States Army Corps of Engineers (USACE). Gray Water – Black Water Knowledge Resource. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Gray-Water-Black-Water/
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Department of Defense (US DoD). 2018. Unified Facilities Criteria (UFC) 1-200-02: High Performance and Sustainable Building Requirements. Available at: https://www.wbdg.org/FFC/DOD/UFC/ufc_1_200_022016_c3.pdf
- United States Army Corps of Engineers (USACE). 2011. Public Works Technical Bulletin (PWTB) 200-1-101: Greywater Application for Army Installations. Available at: https://www.wbdg.org/ffc/army-coe/public-works-technical-bulletins-pwtb/pwtb-200-1-101
- U.S. Environmental Protection Agency. Office of Wastewater Management. 2012. 2012 Guidelines for Water Reuse. Available at: https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1530.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S14: Perform Water Metering, Sub-Metering, and Analysis

Description and Benefits

To adhere to federally mandated requirements to cost-effectively reduce potable and non-potable water consumption, installation of building-level water meters is recommended for new and existing buildings, and installation of meters is recommended for irrigation systems serving more than 25,000 square feet. Collected data can be used to analyze water consumption trends to establish baseline consumption, identify potential reduction and conservation methods, determine sustainability goals, and more rapidly identify leaks in water distribution. Examples of reduction and conservation methods include installing low-flow toilets and faucets, using non-potable water for irrigation applications, collecting stormwater for later use, and using water efficient landscapes. USACE aims to reduce potable water intensity in its efficient federal operations/management plan and ensure that water as a natural resource is conserved and future water supply needs are not crippled.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Document all potable water end uses (i.e., toilets, irrigation, drinking, mechanical systems)
- Communicate with water utilities the intent to meter water consumption (some utilities may already have metering programs that can be leveraged)
- Determine quantity, location, and type of water meters and sub-meters
- Identify appropriate procurement methods for water meters
- Determine if incentives are available for water use management on local, state, and federal levels
- Install meters and sub-meters, and begin collecting water consumption data
- Involve stakeholders when interpreting data and determining conservation strategies
- Measure the minimum amount of water required for operations
- Measure the maximum amount of water used for certain applications
- Identify potential strategies to implement and reduce water consumption
- Share consumption data with the utility provider, publicly, or within project scope

Implementation Considerations

Meters installed should be permanent and monitor potable water usage and perhaps non-potable water usage. Consumption data should be organized into monthly and annual summaries for better interpretation. Data collection can either be manual or automatic. "Smart" meters may be considered to automatically transmit meter data to a centralized server; however, this type of meter can be more costly.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4
- United States Department of Energy (US DOE). 2015. Metering Best Practices: A Guide to Achieving Utility Resource Efficiency. Available at: https://www.energy.gov/sites/prod/files/2015/04/f21/mbpg2015.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S15: Perform Energy Metering, Sub-Metering, and Analysis

Description and Benefits

Energy savings programs can be limited if metering and sub-metering are not added to energy systems. Without ongoing performance tracking and verification, systems may not be performing as intended and new opportunities for energy savings may be missed. When USACE projects involve upgrades, additions, or modifications to energy systems, there may be an opportunity to include data collection devices and establish integrated data streams into a centralized tracking platform. This may include installing monitoring devices for typical building systems, such as lighting systems and heating, ventilation, and air conditioning (HVAC) equipment, and for USACE Civil Works loads, such as pumps, lighting, floodgates, electric fleet vehicle charging, and other high-power equipment. Installing meters and sub-meters to monitor and analyze these energy systems and loads where cost-effective and appropriate (electricity, natural gas, and steam) can help to identify opportunities for further energy savings and more quickly detect when systems/equipment are not functioning properly (i.e., drawing too much or too little power). Installation, to the maximum extent practicable, of advanced meters or advanced metering devices that report data at least daily and that measure at least hourly consumption of electricity, natural gas, and steam (if applicable), further supports federal requirements.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Energy Independence and Security Act
- Energy Policy Act of 2005
- National Energy Conservation Policy Act (42 U.S.C. 8253(a)(1))
- Department of the Army Sustainable Design and Development (SDD) Policy Update Memorandum, Jan 2017

Potential Actions

- Review current metering infrastructure, if applicable, against the U.S. Department of Energy Federal Energy Management Program's Federal Building Metering Guidance
- Install energy meters at all service lines feeding individual projects or sites
- Install energy sub-meters to monitor all primary energy systems within a project or site, such as:
  - HVAC equipment (including central plant equipment where applicable)
  - Exterior and interior (if applicable) lighting system
  - Individual major pieces of equipment
- Prioritize the order in which advanced meters and advanced metering devices are to be applied to the project
- Integrate all meters and sub-meters into a centralized tracking platform for streamlined energy monitoring

Implementation Considerations

Installing energy meters and sub-meters can be relatively easy to implement. However, ongoing data collection, monitoring, and management of data systems can be more difficult. Installing advanced meters may not always require labor or additional systems to record and transfer data to energy tracking systems. However, it may not be practicable due to physical or administrative complications involving the load serving utility or distribution utility.

Examples/References

- United States Army Corps of Engineers (USACE). 2019. Utility Metering and Controls Knowledge Resource. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Utility-Metering/
- United States Department of Energy (US DOE). 2014. Federal Building Metering Guidance (per 42 U.S.C. § 8253(e), Metering of Energy Use). Available at: https://www.energy.gov/sites/prod/files/2014/11/f19/metering_guidance.pdf
- United States Department of Energy (US DOE). 2015. Metering Best Practices: A Guide to Achieving Utility Resource Efficiency. Available at: https://www.energy.gov/sites/prod/files/2015/04/f21/mbpg2015.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S16: Use Remote Energy Performance Assessment Auditing Technology

Description and Benefits

USACE currently has few buildings equipped with the technologies required to support remote energy performance assessments. Installing this technology can allow for the remote and ongoing monitoring of energy uses across various scales of granularity. When a system of this type is established, it can enable energy conservation opportunities to be identified earlier on, using fewer labor resources, and with greater certainty than when conducting traditional energy audits through manual assessment of facilities that may only provide an instantaneous understanding of energy usage patterns.

Related Federal Mandates/Policies/Programs (if applicable)

- Army Central Metering Program
- Energy Independence and Security Act
- Energy Policy Act of 2005
- Executive Order 13834: Efficient Federal Operations

Potential Actions

- Install meters and sub-meters at primary energy systems and key loads
- Install remote communications infrastructure to channel data to a centralized source for review and analysis
- Integrate remote sensors with energy modeling practices to extrapolate collected data to other applications for further potential savings

Implementation Considerations

Federal regulations require the installation of advanced meters in qualifying project types. Installation can require a moderate level of effort and capital investment to coordinate with project utilities and install the metering and communication infrastructure. Cybersecurity of remote monitoring and controls via advanced meters and similar technology can be a concern, although the Army Central Metering Program has been certifying certain technologies to operate and report data across the service enterprise's network.

Examples/References

- United States Army Corps of Engineers (USACE). 2019. Utility Metering and Controls Knowledge Resource. Available at: https://www.usace.army.mil/Missions/Sustainability/Expertise-in-Sustainability/Utility-Metering/
- United States Department of Energy (DOE). 2014. Federal Building Metering Guidance (per 42 U.S.C. § 8253(e), Metering of Energy Use). Available at: https://www.energy.gov/sites/prod/files/2014/11/f19/metering_guidance.pdf
- United States Department of Energy (DOE). 2015. Metering Best Practices: A Guide to Achieving Utility Resource Efficiency. Available at: https://www.energy.gov/sites/prod/files/2015/04/f21/mbpg2015.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S17: Participate in Energy Demand Programs

Description and Benefits

According to the U.S. Department of Energy (DOE), energy demand (or energy demand response) provides an opportunity for consumers, such as the USACE, to play a significant role in the operation of the electric grid by reducing or shifting electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Demand response programs are being used by some electric system planners and operators as resource options for balancing supply and demand. Such programs can lower the cost of electricity and, in turn, lead to lower retail rates. Ways that USACE can engage in demand response efforts include participating in time-based rates such as time-of-use pricing, critical peak pricing, variable peak pricing, real-time pricing, and critical peak rebates. This strategy also includes direct load control programs that provide the ability for power companies to cycle air conditioners and water heaters on and off during periods of peak demand in exchange for a financial incentive and lower electric bills.

Related Federal Mandates/Policies/Programs (if applicable)

- USACE Commercial Utility Program

Potential Actions

- Engage early in the process with utility providers and stakeholders to understand the energy demand programs for consideration
- Incorporate life cycle costing measures to evaluate the first costs and the long-term operating costs to determine if an energy demand response program is viable
- Incorporate sensors to track actual energy performance and utilize automatic switching to divert or reduce power in strategic places, removing the chance of overload and the resulting power failure (DOE)
- Incorporate advance metering to capture accurate data and to manage the system effectively
- Incorporate real-time energy displays with energy usage and rates to assist with changing behavior and reducing peak period consumption

Implementation Considerations

For applicable USACE projects, enrollment in demand response programs can happen at any time in the project's operational life, including existing and newly completed projects. Considering participation in demand response early in on the process for new construction or major renovations can help a project achieve the full benefits of the programs. The electric power industry considers demand response programs as an increasingly valuable resource option whose capabilities and potential impacts are expanded by grid modernization efforts

Examples/References

- United States Army Corps of Engineers (USACE). 2014. Climate Change Adaptation Plan. Available at: https://www.usace.army.mil/Portals/2/docs/Sustainability/Performance_Plans/2014_USACE_Climate_Change_Adaptation_Plan.pdf
- United States Army Corps of Engineers (USACE). 2016. Commercial Utilities Program. Available at: https://www.hnc.usace.army.mil/Portals/65/docs/PAO/Fact%20Sheets/2016%20Fact%20Sheets/CUP10-16.pdf?ver=2016-11-23-135001-430
- United States Department of Energy (DOE). 2018. Demand Response. Available at: https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid/demand-response

S18: Track Performance Data with EPA ENERGY STAR Portfolio Manager

Description and Benefits

For projects that include vertical buildings, consider using the U.S. Environmental Protection Agency (EPA) ENERGY STAR Portfolio Manager, a free tool to track and analyze energy and water consumption and waste generation. Understanding the trends of consumption and generation can enable building operators to determine baselines and develop benchmarks for improvements. The tool may be used during a building's design phase to get projected energy and water profiles. This information can allow for any necessary modifications in design. Further, the tool may be used when the building is in operation to identify potential reduction or conservation measures. Reducing energy and water consumption can benefit the environment by mitigating associated greenhouse gases and conserving natural resources. Less waste produced reduces the rate of landfill expansion and potential environmental contamination. Additional energy, water, and waste costs can be avoided by consuming less energy and water and requiring less shipping fees to transport waste to landfills. Refer to the Guiding Principles to comply with federal requirements related to optimizing energy performance and to gain additional recommendations.

Related Federal Mandates/Policies/Programs (if applicable)

- Guiding Principles for Sustainable Federal Buildings (Guiding Principles), Feb 2016

Potential Actions

- Visit the ENERGY STAR Portfolio Manager website
- Create a Portfolio Manager account
- Find training resources to understand the basics of the Portfolio Manager
- Perform an analysis of a building during its design phase
- Reuse the tool to analyze a building during operation
- Communicate with stakeholders to ensure that energy, water, and waste are tracked and assessed
- Analyze energy, water, and waste data generated by the Portfolio Manager
- Identify energy, water, and waste sustainable practices to be implemented for a building
- Use ENERGY STAR or Federal Emergency Management Agency-designated products to comply with USACE Sustainable Acquisition Requirement 52-223-15: Energy Efficiency in Energy-Consuming Products
- Document yearly data and initiatives for improvements as records
- Train necessary personnel on how to operate the tool and interpret the data

Implementation Considerations

The ENERGY STAR Portfolio Manager is a free tool designed by the EPA. The tool is widely used to assess a building's performance with various metrics. Made available are free resources to guide the user to understand the tool and to provide results, i.e., reports. Energy, water, and waste can be tracked through the tool. Improvement projects may require high capital costs; however, financial support may be available to support these types of upgrades.

Examples/References

- United States Department of Energy (US DOE). 2017. ENERGY STAR Portfolio Manager. Available at: https://www.energystar.gov/buildings/tools-and-resources/portfolio-manager-0
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- United States Department of Energy (USDOE). Federal Energy Management Program (FEMP). Available at: https://www.energy.gov/eere/femp/federal-energy-management-program
- United States Department of Defense (US DoD). 2018. Unified Facilities Criteria (UFC) 1-200-02: High Performance and Sustainable Building Requirements. Available at: https://www.wbdg.org/FFC/DOD/UFC/ufc_1_200_022016_c3.pdf

S19: Monitor Fleet Use and Idle Time

Description and Benefits

Monitoring fleet use and idle time can help USACE reduce Scope 1 and 2 greenhouse gas (GHG) emissions and fleet petroleum use. This strategy aligns with USACE's commitment to deliver sustainable solutions through conserving resources and promoting efficiency. Reliability is integral to Civil Works' strategic goal to deliver sustainable services and efficiently manage assets in operating and maintaining USACE infrastructure.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations
- Energy Independence and Security Act

Potential Actions

- Leverage the Vehicle Allocation Methodology (VAM) to define fleet inventory and composition (e.g., vehicle size)
- Perform energy audits to identify fleet-wide opportunities for energy efficiency improvements
- Issue fleet guidance for energy efficient operation and maintenance of fleet vehicles
- Use the Fleet Management Information System (FMIS), Federal Automotive Statistical Tool reporting database, Federal Motor Vehicle Registration System, and the Fleet Sustainability Dashboard system to account for agency asset-level fleet data
- Optimize and right-size fleet composition, by reducing vehicle size, eliminating underutilized vehicles, and acquiring and locating vehicles to match local fuel infrastructure using VAM
- Use FMIS to track real-time fuel consumption throughout the year for agency-owned, General Services Administration-leased, and commercially leased vehicles
- Implement vehicle idle mitigation technologies with the implementation of telematics (i.e., after-market auxiliary heaters)
- Partner with agency stakeholders to educate vehicle operators on the importance of fuel efficiency
- Select contractors committed to reducing diesel emissions from equipment and vehicles
- Establish a policy to reduce diesel emissions from idling equipment (i.e., limit unnecessary idling to no more than 5 minutes in any 60-minute period)
- Use Global Positioning System devices to provide data that track machinery's run and idle times
- Determine methods to reduce wait times for material loading and unloading
- Improve coordination to avoid delivery queues and high congestion days
- Refer to the 2018 USACE Sustainability Report and Implementation Plan

Implementation Considerations

The effort to implement the monitoring of fleet use and idle time will likely correlate with fleet size. Implementation is becoming increasingly feasible given constant advancements in vehicle tracking technology. Additionally, USACE's culture related to fuel consumption has shifted to encourage conservation of resources and reduction in GHG emissions. This can ultimately help to reduce GHG and petroleum fuel emissions, mitigate impacts of climate change, reduce operations and maintenance costs, and improve overall operational efficiency.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S20: Utilize Performance Contracting to Meet Identified Energy and Water Efficiency and Management Goals

Description and Benefits

Performance contracting leverages industry expertise and private sector financing to make infrastructure upgrades to federal facilities to reduce energy, water consumption, and waste stream. Energy Savings Performance Contract (ESPC) and Utility Energy Service Contract (UESC) are two examples of the acquisition vehicles a USACE Civil Works project can employ to meet the Army's energy and water reduction goals without upfront capital costs. An ESPC is a partnership between an agency and an Energy Service Company (ESCO) and can range from 10 years to a maximum of 25 years, with the ESCO being paid back over the term of the contract from cost savings generated by the energy efficiency improvements they make. A UESC is similar to the ESPC but uses utility company expertise and capital to meet federal mandates and is limited to a 10-year contract term for Army installations (non-Army up to 25 years). The key benefits of such performance contracting are that the savings are guaranteed, savings must exceed payment each year, measurement and verification are mandatory, and it allows for the replacement of older systems with newer more efficient systems. This practice further supports USACE's commitment with the Department of Energy Federal Energy Management Program to work in partnership to advance U.S. government-wide adoption of performance contracting processes to achieve energy, water, building modernization, and infrastructure goals.

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations

Potential Actions

- Evaluate the feasibility of ESPC/UESC contracts with regard to the project, and engage a project facilitator
- Assemble an ESPC acquisition team, and determine the procurement requirements through an acquisition plan
- Determine the ESCO selection procedure
- Hold a Post-Award Conference in collaboration with the ESCO to secure successful contract performance
- Conduct Post-Installation Inspections and Verifications to verify completion of construction punch list items
- Review Annual Measurement and Verification Reports, and maintain Contract Administration and Contract Modifications

Implementation Considerations

Performance contracting may require building a long-term relationship with a mutual commitment from all involved parties. It can involve the implementation and rigorous use of project management plans and schedules by all partners in the ESPC process to assure timely project implementation and realized savings.

Examples/References

- United States Army Corps of Engineers (USACE). 2012. Utility Energy Services Contracting (UESC) Overview. Huntsville Engineering and Support Center. Federal Utility Partnership Working Group. Spring. Available at: https://www1.eere.energy.gov/femp/pdfs/fupwg_spring12_norton.pdf
- United States Department of the Army (DA). 2008. Policy Guidance for Implementation of an Energy Savings Performance Contract. Available at: http://army-energy.army.mil/funding/docs/ESPC_policy_hdbk_v3_1108.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html

S21: Promote Water and Energy Saving Strategies with Personnel

Description and Benefits

Personnel behavior can play a large role in the water and energy resource consumption associated with ongoing operations. While many conservation improvements can be made through efficiency upgrades, personnel and operator behavior can lead to even greater savings. Working to establish a culture of conservation across USACE departments, offices, workshops, and other facilities can enhance the established values of resource conservation into day-to-day operations, reducing ongoing costs and potentially unlocking greater opportunities for conservation by encouraging creative thinking. This mindset is established in the USACE Sustainability Definition and Concepts Guide (category 2), which states: "We seek to understand conservation measures that we encounter in our daily activities. We explore how to conserve resources while meeting, and ideally improving upon, the success of our missions. We accomplish this by asking ourselves whether resources are used as efficiently as possible, how the same tasks or functions can be performed with fewer resources, and what efforts we can take to improve. Some questions to ask include: What actions can be taken to conserve resources? Can materials be reduced, reused, or recycled? Can the same functions be performed with fewer resources?"

Related Federal Mandates/Policies/Programs (if applicable)

- Executive Order 13834: Efficient Federal Operations

Potential Actions

- Use signs and other communication tools to remind personnel to turn off lights in rooms without motion sensors
- Use signs and other communication tools to encourage personnel to reduce water consumption in restrooms, kitchens, and breakrooms
- Consider the impact on energy and water conservation through waste management practices due to the embodied energy and water of disposed goods (e.g., paper towels, disposable cups and plates)
- Encourage participation in the USACE Sustainability Course.

Implementation Considerations

Ongoing training with staff should occur as a reminder of the long-term benefits of conserving energy and water as well as educational campaigns.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. FY17 Office of Management and Budget (OMB) Scorecard for Efficient Federal Operations/Management. Available at: https://www.sustainability.gov/pdfs/usace_scorecard_fy2017.pdf
- Office of Federal Sustainability, Council of Environmental Quality. 2019. Resources for Implementing Executive Order 13834 Efficient Federal Operations. Available at: https://www.sustainability.gov/resources-eo-efo.html
- United States Army Corps of Engineers (USACE). 2018. USACE Sustainability: Definition and Concepts Guide. EP 1100-1-3. Available at: https://www.publications.usace.army.mil/Portals/76/Users/227/19/2019/EP_1100-1-3.pdf?ver=2018-09-13-113614-130
- United States Green Building Council (USGBC). 2013. Leadership in Energy and Environmental Design (LEED): Reference Guide for Building Design and Construction, v4. Available at: https://new.usgbc.org/leed-v4

3.5. Emergency Management Fact Sheets

Emergency Management

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EM1: Perform Emergency Planning, Preparedness, and Recovery

Description and Benefits

Proper planning and preparation for emergencies can improve the ability to intervene and potentially stop or mitigate an unfolding disaster. This can result in fewer environmental and economic consequences and can potentially save lives and reduce injuries. Emergency Action Plans (EAPs) may be developed to cover both man-made emergencies and natural disasters that could occur at a given facility and have an impact on operations or safety. EAPs can be developed with the input of operations, management, and emergency response personnel, and are recommended to be reviewed and updated on at least an annual basis. Practice drills or tabletop exercises may be performed annually to ensure the key team members and decision makers have a consistent and thorough understanding of the EAP during an emergency. It is also important to frequently communicate with members of the public who would be at risk during an emergency so they can be aware of risks and understand how to react; this can lead to improved response or evacuation in such an event.

Related Federal Mandates/Policies/Programs (if applicable)

- Code of Federal Regulations, 33 CFR 203, Emergency Employment of Army and Other Resources, Natural Disaster Procedures
- Engineer Regulation No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program
- Engineer Pamphlet No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program – Procedures

Potential Actions

- Consider the types of emergencies that could occur at the facility due to both man-made issues and natural phenomena
- Consider whether the emergency would only impact operations or could present a safety concern
- Identify the key individuals and organizations that would be affected by an emergency or involved in the emergency response
- Develop an EAP that outlines risks, warning signs, action plans, responsibilities, as well as evacuation and communication protocols
- Review the EAP and perform drills or exercises with all parties involved to ensure understanding and awareness
- Review and update the EAP at least annually
- Execute public awareness campaigns to communicate risks and plans to the public that may be affected

Implementation Considerations

The implementation effort will vary based on the consequences of an emergency. If the risks at the facility could lead to emergencies that present primarily operational concerns with little possibility of consequences to public safety, resources spent on emergency preparedness can be in line with the economic impacts of the possible emergencies. If the risks at the facility could lead to potential loss of life or significant injury, emergency preparedness will likely need to be incorporated into all levels of operations and management.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Guidance for Emergency Action Plans, Incident Management and Reporting, and Inundation Maps for Dams and Levee Systems. EC 1110-2-6074. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerCirculars/EC_1110-2-6074.pdf?ver=2018-01-22-100438-250
- United States Army Corps of Engineers (USACE). 2018. Emergency Operations. Available at: https://www.usace.army.mil/Missions/Emergency-Operations/

EM2: Perform Regular Emergency Training and Preparedness

Description and Benefits

Regular emergency training and preparedness exercises can improve the readiness of personnel to respond appropriately to emergency situations. Engineer Regulation 11-1-320 for the Civil Works Emergency Management Program describes policies that support USACE in all hazards preparedness, response, recovery, and other contingency operations. Included are several programs and classes to facilitate training objectives and ensure USACE readiness for disasters and emergencies. A fully prepared USACE can ensure continued critical operations and support community needs after an emergency or disaster.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 11-1-320: Civil Works Emergency Management Programs
- Engineer Regulation No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program
- Engineer Pamphlet No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program – Procedures
- Engineer Pamphlet No. 11-1-320: Civil Works Emergency Management Programs Financial Management Process

Potential Actions

- Consider hosting or attending emergency management training and preparedness classes as identified in ER 11-1-320

Implementation Considerations

Training programs may be incorporated into annual or monthly/quarterly schedules in which personnel complete assigned trainings within a given time frame. Emergency preparedness exercises may similarly be scheduled to be performed on a regular basis. Consistencies and efficiencies may also be gained by scheduling training and exercises to correspond with Emergency Action Plan (EAP) drills and exercises.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Climate Preparedness and Resilience. Available at: https://www.usace.army.mil/corpsclimate/Climate_Preparedness_and_Resilience/
- United States Army Corps of Engineers (USACE). 2018. Emergency Operations. Available at: https://www.usace.army.mil/Missions/Emergency-Operations/
- United States Army Corps of Engineers (USACE). 2018. Emergency Response. Available at: https://www.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/475476/emergency-response/
- United States Army Corps of Engineers (USACE). 2018. Emergency Response Disaster Impact Models. Available at: https://www.usace.army.mil/Missions/Emergency-Operations/Disaster-Impact-Models/Exercise-Preparedness-Models/
- United States Army Corps of Engineers (USACE). 2018. USACE Engineers Reachback Operations Center. Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/837377/us-army-corps-of-engineers-reachback-operations-center/
- Federal Emergency Management Agency (FEMA). 2018. Emergency Management Institute. Available at: https://training.fema.gov/emi.aspx

EM3: Consider Disaster Survivability

Description and Benefits

Planning for the continuity of operations is necessary so that USACE can continue to perform essential functions and operations in national emergency situations. Disaster survivability includes preparedness, emergency response, rehabilitation, and hazard risk management. This involves the development of plans, in coordination with appropriate federal, state, and local entities, for response to natural/man-made disasters that are catastrophic in impact to national security (e.g., hurricanes, flooding, earthquakes, terrorist attacks). Disaster survivability should be considered for operations, programs, and projects that are essential to public safety (e.g., dam and levee safety) or that involve critical infrastructure (e.g., major waterway navigation and power).

Related Federal Mandates/Policies/Programs (if applicable)

- Code of Federal Regulations, 33 CFR 203, Emergency Employment of Army and Other Resources, Natural Disaster Procedures
- Engineer Regulation No. 500-1-28: Emergency Employment of Army and Other Resources – National Response Planning Guide
- Engineer Regulation No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program
- Engineer Pamphlet No. 500-1-1: Emergency Employment of Army and Other Resources – Civil Emergency Management Program – Procedures
- Engineer Regulation No. 11-1-320: Civil Works Emergency Management Programs
- Engineer Pamphlet No. 11-1-320: Civil Works Emergency Management Programs Financial Management Process

Potential Actions

- Assess the potential vulnerabilities of a project, program, or operation to natural/man-made disasters
- Determine and maintain functions required to conduct essential operations
- Develop a disaster plan that considers local context and identifies specific actions, a chain-of–command, and communication protocols
- Consider cascading disasters and interdependency of essential services (e.g., power grids, communication, water systems)
- Maintain an organizational structure designed to ensure continuity of operations
- Develop readiness exercises that evaluate emergency plans and training of staff and community
- Identify emergency personnel assignments, emergency duty stations, alert notification procedures, etc.

Implementation Considerations

Implementation of this strategy may involve coordination with different stakeholders. A project's unique location needs to be carefully considered in the process to plan for disaster survivability. Resources related to disaster survivability need to be incorporated into the disaster plan and the plan will need to be updated on a regular basis to ensure relevance and applicability.

Examples/References

- United States Army Corps of Engineers (USACE). 2018. USACE Engineers Reachback Operations Center. Available at: https://www.erdc.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/837377/us-army-corps-of-engineers-reachback-operations-center/
- United States Army Corps of Engineers (USACE). 2018. Emergency Operations. Available at: https://www.usace.army.mil/Missions/Emergency-Operations/
- United States Army Corps of Engineers (USACE). 2018. Climate Preparedness and Resilience. Available at: https://www.usace.army.mil/corpsclimate/Climate_Preparedness_and_Resilience/
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf

EM4: Reduce or Mitigate Flooding On Site

Description and Benefits

Flood risks can affect USACE mission goals across multiple communities of practice, including navigation infrastructure, water supply projects, hydropower operations, recreational objectives, and ecosystem services. Localized flooding on project sites should be addressed through planning, prevention, protection, mitigation, response, and recovery. This includes the appropriate use and resilience of structures such as levees and floodwalls, as well as promoting alternatives (e.g., land acquisition, flood proofing, emergency preparedness and evacuation planning) that reduce the risk of loss of life, interruption to operations, and property damage.

Related Federal Mandates/Policies/Programs (if applicable)

- USACE National Flood Risk Management Program
- Engineer Regulation No. 1105-2-100: Planning Guidance Notebook

Potential Actions

- Incorporate the reduction or mitigation of flooding on site beginning in the planning process and throughout engineering, construction, and operations
- Evaluate the potential for flooding on site from river/stream flooding, overland flooding, and storm surges
- Incorporate planning and design considerations, such as site orientation, grading, raised foundations, and placement of electrical systems, to reduce the probability of flooding or to decrease the damage in the event of a flood
- Use levees or floodwalls where necessary to contain flooding
- Consider impacts from a project site to water flow and the resulting flooding upstream and downstream of a site

Implementation Considerations

Watershed and flood risk management is a cooperative task given the impacts that development or site changes can have on upstream and downstream hydraulics or on adjacent coastlines. Reducing and mitigating flooding on site is a shared responsibility between federal partners, USACE staff, state and local partners, tribal partners (if applicable), national organizations, international partnerships (if applicable), and public partners.

Examples/References

- United States Army Corps of Engineers (USACE). 1995. Flood Proofing. EP 1165-2-314. Available at: https://www.publications.usace.army.mil/portals/76/publications/engineerpamphlets/ep_1165-2-314.pdf
- United States Army Corps of Engineers (USACE). 2000. Flood Proofing: Techniques, Programs, and References. Available at: https://ntrl.ntis.gov/NTRL/dashboard/searchResults/titleDetail/ADA625089.xhtml
- United States Army Corps of Engineers (USACE). 2000. Planning Guidance Notebook. ER 1105-2-100. Available at: https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1105-2-100.pdf
- United States Army Corps of Engineers (USACE). 2018. Climate Preparedness and Resilience. Available at: https://www.usace.army.mil/corpsclimate/Climate_Preparedness_and_Resilience/
- United States Army Corps of Engineers (USACE). 2018. Emergency Operations. Available at: https://www.usace.army.mil/Missions/Emergency-Operations/
- United States Army Corps of Engineers (USACE). 2018. Flood Risk Management Program. Available at: https://www.iwr.usace.army.mil/Missions/Flood-Risk-Management/Flood-Risk-Management-Program/

EM5: Perform a Construction Risk Assessment for Natural Disasters

Description and Benefits

Natural disasters may occur at any time and affect USACE staff from planning through construction. While a well-designed USACE project can appropriately anticipate the risk of a natural disaster and mitigate potential damages to the performance requirements, the surrounding environment, or the community, a natural disaster may occur during the construction phase of a project when not all protections are fully in place. The potential damage that may result from a natural disaster occurring during construction can be mitigated if appropriate protective actions are set in place. By accounting for the possibility of flood, earthquake, hurricane, fire, or extreme rain or snow events, preparations can avoid costly repairs, scheduling overruns, or loss of life.

Related Federal Mandates/Policies/Programs (if applicable)

- Engineer Regulation No. 415-1-15: Construction Time Extensions for Weather
- Engineer Regulation No. 1110-2-8152: Planning and Design of Temporary Cofferdams and Braced Excavations
- USACE National Dam Safety Program
- USACE National Flood Risk Management Program
- USACE National Levee Safety Program

Potential Actions

- Evaluate the likelihood of potential natural disasters that may affect the site during construction
- Evaluate the vulnerability of construction equipment, personnel, etc., including potential damage to the project due to a natural disaster occurring during construction
- Develop construction phasing and processes that account for and mitigate the potential impact of a natural disaster occurring during construction
- Perform ongoing performance of project-specific risk assessments as changes occur during construction

Implementation Considerations

During implementation, it may be important to develop a risk-informed context for the USACE project and to address essential questions, such as: What possible loading events (e.g., flood, storm, earthquake) could occur? How will the facility and construction site perform when subjected to these events? What are the consequences if the facility or construction site does not perform well, in particular, what loss of life could occur?

Examples/References

- United States Army Corps of Engineers (USACE). 2018. Risk Analysis Gateway. Available at: https://www.iwr.usace.army.mil/Missions/Risk-Analysis/Risk-Analysis-Gateway/
- United States Army Corps of Engineers (USACE). 2018. Risk Management Center (RMC) Center Of Expertise. Available at: https://www.iwr.usace.army.mil/about/technical-centers/rmc-risk-management-center/