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Beneficial Use of Dredged Material Decision Tool

RESES PROJECT REPORT

Office of Research and Development
Center for Computational Toxicology and Exposure
Great Lakes Toxicology and Ecology Division

EPA/600/R-20/409
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Beneficial Use of Dredged Material Decision Tool

RESES Project Final Report

by

Kathleen Williams, Keahna Margeson, Sebastian Paczuski, Rosita Clarke, and Karla Auker, and Joel Hoffman
Great Lakes Toxicology and Ecology Division
Duluth, Minnesota 55804

Regional Environmental Science and Sustainability Research Program (RESES)

Rosita Clarke, USEPA Region 5 Land, Chemicals & Redevelopment Division
Project Lead

Joel Hoffman, USEPA Office of Research and Development
ORD Lead Project Officer

Great Lakes Toxicology and Ecology Division
Center for Computational Toxicology and Exposure
Duluth, Minnesota 55804

Notice/Disclaimer Statement

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Abstract

Domestic and international transportation of good and commodities on the Great Lakes provides 227,000 U.S. and Canadian jobs and saves about $3.6 billion annually compared to overland transport. Navigation channels in rivers and harbors must be routinely dredged to mandated depths to allow this industry to operate cost-effectively Historically dredged material has been disposed in deep water offshore or placed in confined disposal facilities on land. These disposal options are no longer available in some places (e.g., Ohio where open lake disposal was banned in July 2020), requiring new solutions for the disposition of dredged material. Sustainable beneficial uses of dredged material include use as fill or construction material, for habitat restoration, or for brownfields remediation projects. To support and promote these beneficial uses, USEPA Region 5 developed a Dredged Materials Management Tool (DMDT) to help communities characterize and quantify the environmental and social considerations of beneficially using dredged material. The purpose of the DMDT is to is to allow social and environmental considerations to be quantified so they can be considered along with economic considerations when making dredged material management decisions. USEPA Region 5 has collaborated with USEPA Office of Research Development scientists to help refine the DMDT to enhance its usability using insights from a series of workshops attended by stakeholder groups involved in dredging decisions. Based on these workshops and related research, a user-friendly interface was created for the tool along with an instruction manual that describes how to use it. The revised DMDT can be used to quantify and weigh the environmental, social and economic aspects of dredged material management options the user is considering. Once the options are evaluated, the tool can then be used to communicate the evaluation process and results to decision makers and the community via spreadsheets and bar graphs.

This report was submitted in fulfillment of a Regional Environmental Science and Sustainability (RESES) Program grant by USEPA Region 5 Land, Chemicals and Redevelopment Division, Redevelopment and Program Services Branch and the Center for Computational Toxicology and Ecology′s Great Lakes Toxicology and Ecology Divison. This report covers a period from September 2018 to December 2020.

Foreword

The U.S. Environmental Protection Agency (USEPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, USEPA strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. Moreover, USEPA is building the scientific basis necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future. To meet legislative and science-based mandates, USEPA's Office of Research and Development (ORD) contributes research, data and technical support to assist the Agency and its partners in solving environmental problems.

The following report is a culmination of collaborations among USEPA's Region 5, ORD-Great Lakes Toxicology and Ecology Division within the Center for Computational Toxicology and Exposure and several state and local municipalities. It is an overview and instruction manual for the application of the Dredged Material Decision Tool (DMDT). The DMDT is has been developed to facilitate the evaluation and communication of decisions surrounding the beneficial use of dredged material.

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Acronyms and Abbreviations

CDF	**Confined Disposal Facility**
PAH	**Polycyclic Aromatic Hydrocarbon**
PCB	**Polychorinated Biphenol**
USACE	**United States Army Corps of Engineers**
USEPA	**United States Environmental Protection Agency**
DMDT	**Dredged material decision tool**

Acknowledgments

Keahna Margeson, Sebastian Paczuski, and Katie Williams drafted the report with assistance from Rosita Clarke, Karla Auker, and Joel Hoffman. We also acknowledge Ted Angradi and Brook Furio who provided reviews that greatly enhanced the quality of this report.

We acknowledge previous efforts by USEPA Region 5 (Karla Auker, Brooke Furio, and Brad Stimple) and Region 5's technical assistance contractor TetraTech, Inc. for developing the initial DMDT in 2017-2018. USEPA and TetraTech worked with the City of Cleveland, the Cleveland Cuyahoga County Port Authority, Ohio EPA, the US Army Corps of Engineers, numerous other local stakeholders to develop the inputs for, and vet ,the initial tool. The development of the initial DMDT would not have been possible without the dedication and effort provided by these stakeholders.

Finally, we acknowledge our collaborators in the Duluth-Superior Harbor Dredged Materials Management Team, Coordinated by the US Army Corps of Engineers. Other team members include the Minnesota Pollution Control Agency, Minnesota Department of Natural Resources, Wisconsin Department of Natural Resources, Port of Duluth and Superior, Metropolitan Interstate Council, Natural Resources and Research Institute, and the City of Duluth who shared much of their time, knowledge, and experiences with the team through their participation to refine the materials.

Cover photo credits:
Left: Stakeholder workshop on March 13, 2020 (USEPA)
Right: St. Louis River habitat restoration at Interstate Island (USEPA)

1.0 Introduction

1.1 Background and introduction

Domestic and international transportation of goods and commodities on the Great Lakes provides 227,000 U.S. and Canadian jobs and saves about $3.6 billion annually compared to overland transport. To support this economic activity the US Congress has authorized the dredging of 136 federal harbors and 745 miles of navigation channels to a depth of 30 feet to facilitate domestic and international maritime commerce. Annually, about 4 million cubic yards of sediment are dredged from these harbors and channels to keep them safely operational. A problem facing both the US Army Corps of Engineers (USACE) who is responsible for the maintenance of navigation channels, and the port authorities that manage the harbors is how to dispose of the materials that are dredged from channels and harbors. Where dredged material has exceeded water quality criteria for contaminants, including heavy metals, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), dioxins, and furans, it has generally been placed in a confined disposal facility (CDF; USACE and USEPA 2003). However, these CDFs , which are owned by states or port authorities and operated by the USACE, have a finite capacity. In many ports, these facilities have reached capacity. Replacing CDFs is expensive and complicated, requiring contributions from non-federal partners and requiring the use of scarce port property for the purpose (USACE 1998). Another disposal option for sediments has been open water disposal or placement. At a minimum, open water disposal of sediment is subject to state environmental water quality permitting and approval and is generally prohibited in Ohio, Minnesota, and Wisconsin.

Owing to the Clean Water Act and the environmental stewardship of the public and private sectors, the Great Lakes have seen improvements in both water and sediment quality. Consequently, sediments dredged from Great Lakes rivers and harbors now frequently meet toxicity criteria and can be considered for beneficial use. Beneficial use of sediments is the use or placement of dredged materials for a productive use (Great Lakes Dredging Team 2020). Examples of beneficial use include placement for beach nourishment, use as fill or cap material on brownfields and construction sites, and use as feed stock for manufactured soil or compost. Considering dredged sediment as a resource as opposed to a waste can lead to both economic as well as environmental benefits.

Representatives from USEPA Region 5 worked with Ohio stakeholders engaged in finding alternatives to traditional placement and disposal practices for dredged materials in the Cleveland Harbor. As a part of that effort USEPA Region 5 hosted a “Dredged Sediment Stakeholder Engagement Charrette” on April 12, 2018. Hosted by Brooke Furio of USEPA Region 5, the charrette included an engaging discussion of beneficial use alternatives and associated short- and long-term goals. Stakeholders in this effort included the City of Cleveland, Ohio Environmental Protection Agency, Cleveland Port Authority, and local representatives from private businesses and nonprofit groups with a vested interest in how the dredged materials from the Cuyahoga River are managed. Building from the outcomes of this charrette, USEPA tasked Tetra Tech, Inc. to develop a spreadsheet-based, decision support tool that can compare several alternatives based on economic, environmental, and social criteria. The goal was to provide a simple tool that local and state stakeholders can use to evaluate various alternatives for handling dredged sediment from federal navigation channels in not just Cleveland Harbor, but the entire Great Lakes basin.

One solution for beneficially using sediment that arose in the Cleveland context was using materials on brownfields sites. Brownfields sites provide opportunities to beneficially use dredged sediment because they are often located in urban areas near Great Lakes rivers and harbors. A brownfield is a property where the expansion, redevelopment, or use of which may be complicated by the presence or potential

presence of a hazardous substance, pollutant, or contaminant (https://www.epa.gov/brownfields).

Common remedies for brownfields sites include a cap to cover contaminated soil or fill for voids left when contaminated soil has been removed. Although there are challenges to using dredged materials on brownfields (i.e., composition, quantity, and transportation costs) dredged materials can be amended to meet environmental or geotechnical standards and provide vital social and environmental benefits. For example, beneficially using dredged materials can conserve CDF space, reduce demand on borrow sites, provide growing medium, and protect aquatic environments. Because using dredged materials can be costly, it is important to be able to identify and quantify the benefits of using the materials. For example, amending dredged materials to meet environmental and geotechnical requirements can increase the overall cost to use the material compared to native soil. Moreover, transportation of materials can also be costly. The spreadsheet tool was designed to help cities and states quantify and explain the social and environmental benefits of beneficially using dredged sediment.

Using the initial decision tool created by USEPA Region 5 and Tetra Tech in 2018, USEPA Region 5 and the Office of Research and Development worked together under this RESES grant to further develop the tool by refining the decision criteria, creating user-friendly interface worksheets, writing step-by-step instructions, and creating a supplemental database of beneficial use case studies. We now refer to the refined tool and supplemental database as the Dredged Material Decision Tool (DMDT). The research that supported the refinement and enhancement of the original tool utilized several methodologies. We utilized case study research to characterize beneficial use of dredged material decision criteria to ground the tool in the experiences of dredgers, resource managers, and community development staff. We then refined the criteria and instructions using insights gained from collaborative stakeholder workshops. Finally, an inventory of beneficial use of dredge projects was organized into a database to supplement the tool as a resource. Based on our research, the original version of the tool was revised to characterize types of habitat restoration, decision criteria, and social benefits. The revised tool helps facilitate transparent decision-making through collaborative problem-solving. The “right” answer will be revealed through discussion which has fully considered all the priorities and mandates of participating agencies.

This report is an instruction manual for the DMDT. The first of four sections of the report provides background for the problem and an overview of the DMDT. Section 2 of the report provides an overview of the steps necessary and information needed to characterize and compare the ecological and social impacts of dredging projects. This process includes collecting background information, identifying interested stakeholders, and characterizing both the dredged material composition and beneficial use alternatives for the material. Section 3.0 provides the instructions for efficiently using the tool. Section 4.0 describes how to interpret the results of the tool and potential next steps. Appendices to the report include copies of the worksheets and scorecards described in Section 2, a sample beneficial use management alternative profile, a description of how to adjust criteria, a description of the research that informed the revision of the tool, and instructions for database.

1.2 DMDT description and overview

The DMDT is designed to compare among potential beneficial use projects based on multiple criteria (i.e., biophysical, social, and economic). USACE requires that dredged materials are disposed of in the least-costly manner. However, with traditional disposal methods such as open water disposal and placement in CDFs becoming less feasible or prohibited, there is a need to for alternative disposal options or sustainable uses of the material. The DMDT calculates the benefits and costs of beneficially using dredge materials to assist communities in making decisions.

Because the beneficial use of dredge materials includes ecological, economic, and social factors, decision making can be complex. A tool to facilitate these decisions should consider regulatory and organizational structures, attributes of dredged materials, and potential beneficial end-uses. The first step in using the DMDT is to compile background information, including potential stakeholders, beneficial uses, pertinent rules and regulations, and funding sources. After assembling the background information and completing the assessment worksheets to create a project profile (Fig.1), potential beneficial use projects can be scored based on material suitability and the benefits of its use. In the scoring step, the results from the worksheets and beneficial use management alternative profile are entered into a spreadsheet with the materials types to characterize and quantify the benefits of using the dredged materials. In the decision step, adjustments can be made based on the discussion with stakeholders. It is important to note that the DMDT process is iterative. As new information and insights arise, they can be added to the profile and the process repeated.

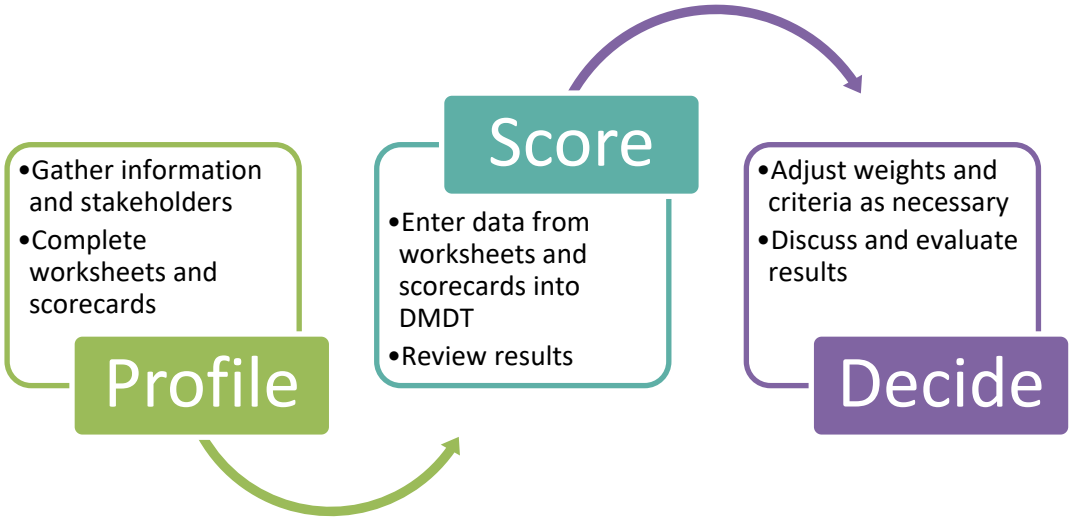


Figure 1. DMDT use flow. First, users profile the management alternative by gathering information and stakeholders and completing the worksheets and scorecards. Secondly, users apply the findings in the profiling steps to enter the data into the DMDT and review the results. Finally, users make decisions based on the DMDT output.

The DMDT is designed to collect and organize information into categories of decision criteria that normally inform dredged material management decisions. The categories, which were derived from research and confirmed through participatory workshops, represent the environmental, regulatory, and economic reasons for making decisions about beneficially using dredged materials (Table 1). The broad categories in the DMDT are governance, built environment, biophysical environment, economic costs and benefits, and social benefits (Table 1). These categories represent the original decision criteria included from the first version of the tool and are intended to capture the constraints decision makers face in making decisions to beneficially use dredged materials. A complete list of the decision criteria can be found in the worksheets in Appendix A.

Table 1. Description of the categories of criteria contained in the DMDT.

Category	Description
Biophysical environment	The habitat restoration applications of dredged materials.
Economic	Funding details, placement costs and options, and transportation.

Governance	The rules, regulations, and organizational decision factors.
Social	Benefits to the community including improving ecosystems services.
Built environment	How dredge is utilized for construction.

The DMDT works through a series of steps that organize the complex details of the beneficial use of dredged materials. The decision criteria are the details that are reviewed throughout the process. The materials developed to support the tool are designed to break the project planning and prioritization process down into manageable steps (Fig. 2). The process starts with gathering information and people. The information is used by people to individually and collectively create a list of viable beneficial use alternatives through the use of worksheets and scorecards. The data from the worksheets and scorecards are then entered into the DMDT. Finally, the DMDT scores or results can be reviewed to make a decision. The process is further detailed through this report.

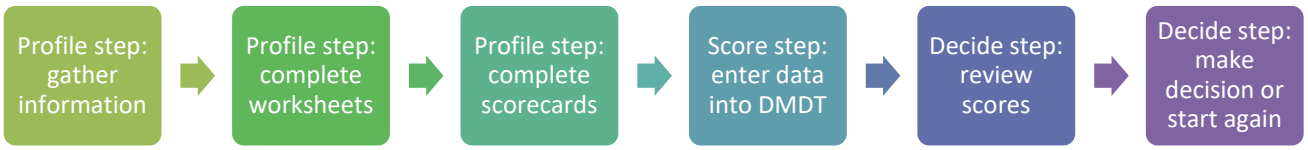


Figure 2. The steps to use DMDT.

2.0 DMDT profile creation process

2.1 Preliminary steps – preparing to use the tool

The following preliminary steps do not necessarily occur sequentially. The order will vary depending on the specific circumstances of each project. For more information about these preliminary steps, see the *Army Corps of Engineers Beneficial Use Planning Manual*.

First, obtain a copy of the DMDT – a fillable copy of the worksheets, tool spreadsheet, and database from Katie Williams at williams.kathleen@epa.gov.

2.1.1. Identify lead stakeholder group

In many cases, one stakeholder group (Fig. 3) will take responsibility for organizing and maintaining communication among the other stakeholder groups and should be known as the lead stakeholder group. Identifying the lead stakeholder group early in the process will help to centralize and provide timely, purposeful communication. This organization should function as facilitator for the group meaning that they take on the role of planning meetings, sending out meeting invitations and reminders, take and disseminate notes, and conduct meeting follow-up. Other stakeholders may take on additional support roles, such as inviting other stakeholders, retrieving necessary documents, and identifying potential management alternatives for the use of dredged materials.

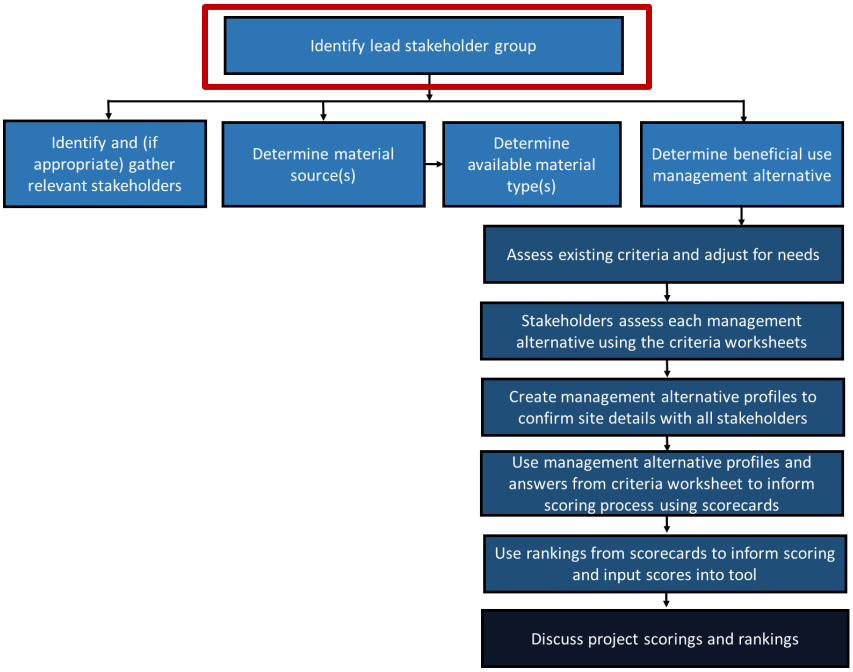


Figure 3. This diagram illustrates the flow of the DMDT process, where the box indicates the current step. Identify lead stakeholder group step is highlighted as the current step in the process.

Guiding questions for this step

- Who is responsible for dredging or beneficial use management alternative? This group may be the obvious choice for lead stakeholder group
- Is there contention about who should be the lead organization? It may help to clarify that the "lead" for the process is a facilitator. Lead does not imply there is an organization that dominates and steers the decision towards a predetermined end. The organization leading this process can delegate responsibilities and even share the "lead" position. Moreover, the process is designed to be transparent such that participants will have access to all of the materials that inform the decision. Participants should be reassured that all viewpoints will be heard and considered.
- What kind and level of communication is likely to be needed? Stakeholders with the capacity to manage communication among groups may be successful in the role of lead stakeholder group or an active supporter. Possible materials to share with collaborators include:
    - Fact sheets about the project,
    - List of pertinent regulations,
    - List of potential management alternatives, and
    - Meeting invitations, notes, and supplementary materials.

2.1.2. Identify and gather relevant stakeholders

The US Great Lakes region is made up of eight states, each with different policies, programs, and procedures for management of dredged material (Great Lakes Dredging Team 2016). To ensure the

greatest understanding of how to apply these policies, programs, and procedures within a local context, it is important to involve stakeholders and experts who represent diverse interests related to dredged materials management (Fig. 4). It is important to have a wide range of stakeholders because dredged materials can be another stock resource for construction that may be used in a range of applications including backfill, road base, sand, and structural fill. Relevant stakeholders are those who make decisions about or who have an interest or "stake" in decisions about dredging, materials management, and disposal, placement or use of dredged materials, although the group may wish to include others who have knowledge or background that can inform materials management decisions. Working groups or project teams that include stakeholders or other experts from a variety of disciplinary backgrounds (Table 2) can stimulate innovative dialogue and collaboration when working through the complex process of beneficially using dredged material.

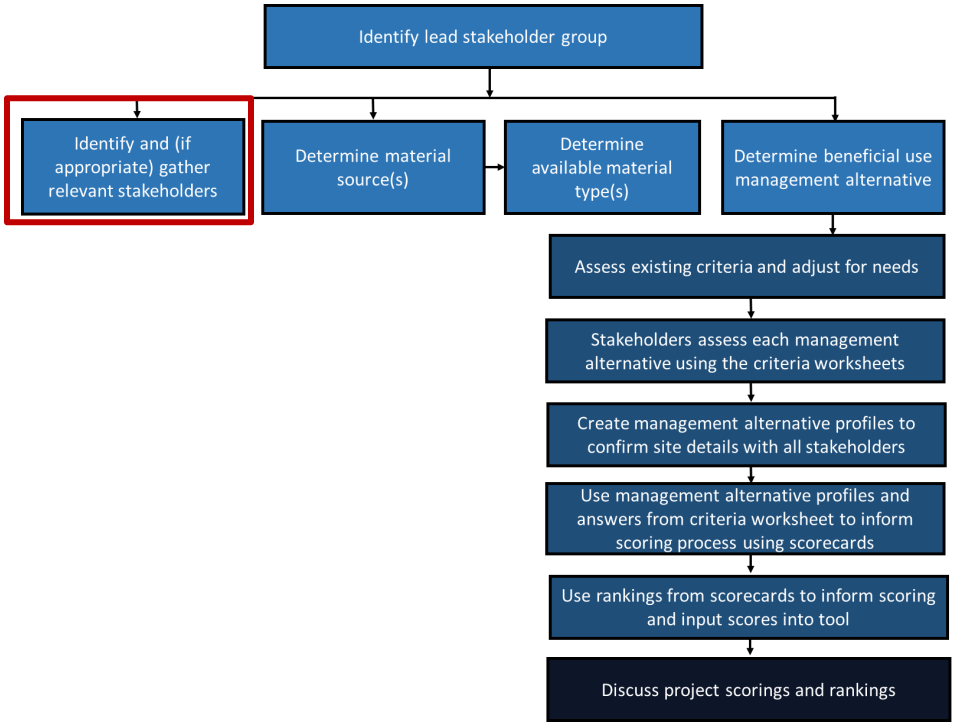


Figure 4. Identify and gather stakeholders and other participants step.

Table 2. List of potential stakeholders and collaborators.

Potential stakeholders and collaborators	
Advocacy organizations	Port authorities
City government agencies	Private businesses
Construction firms	Private residents
Conservation organizations	Recreation (outdoor) organizations and businesses
County government agencies	Regional or municipal development authority
County water or soil conservation districts	State natural resource and regulatory agencies
Developers	State health, parks, transportation, and tourism departments

Dredging contractors	Technical advisory groups
Engineering firms	US Army Corps of Engineers
National Estuarine Research Reserves	US Environmental Protection Agency
National Oceanic and Atmospheric Administration	US Fish and Wildlife Service
	US Geological Survey

Guiding questions for this step

- Who has an interest in the project?
    - If it a strong or direct interest, they could be involved in decision making. If it is a tangential or indirect interest, they may only need to be informed about the project.
    - Who will be impacted by the project? Stakeholders who may be impacted in the short or long term by the by the project could be provided opportunities to participate in the discussion.
- Are there different perspectives on the impacts or benefits of using dredged material for projects in the community? By giving participants an opportunity to share their perspectives, it may be possible to resolve conflicts that arise.

2.1.3. Determine material source(s)

As part of the federal dredged material management program, USACE and USEPA receive funding to encourage partnerships for beneficial use (Fig. 5; USACE 2007). Previous beneficial use projects have used Operations and Maintenance Dredging by the USACE, Strategic Navigational Dredging by the USACE, and private dredging by contracted operators as the source of material for beneficial uses such as a cover for contaminated soil or restoration of aquatic habitat. Some beneficial use projects are partly motivated by a need to place excess dredged material when open lake disposal or confinement are not options. In other cases, there may be non-use disposal options, but a project might commence because affordable material is needed for a project that is beneficial to the community.

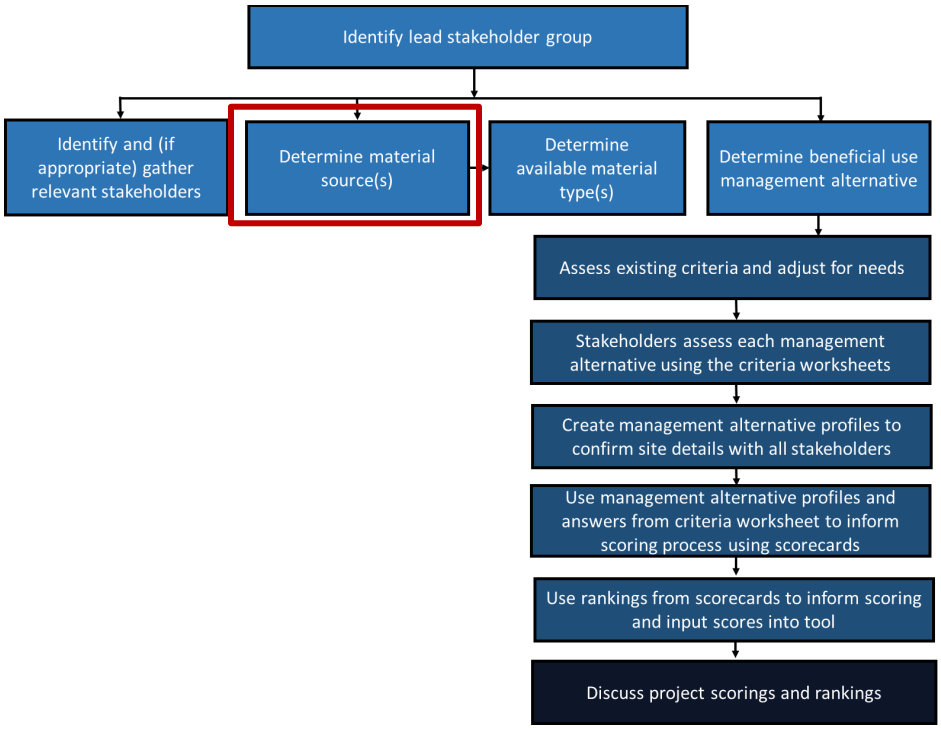


Figure 5. Determine the source for the material (i.e., maintenance dredging, private dredging, etc.).

Guiding questions for this step.

- What is the source of the material? How feasible is it to move the material from the source to the site of the beneficial use management alternative?
- What is the available volume and physical, chemical, and geotechnical composition of the material?
- Is there a CDF nearby? Is there capacity in that CDF?
- Are there alternatives to placement in the CDF? Use the DMDT to determine the benefits of different management alternatives.

2.1.4 Determine available material type(s)

Depending on its source location, dredged material varies in its physical and chemical characteristics. The available material must be characterized according to federal and state guidelines so that its suitability for beneficial use can be assessed (Fig. 6). For testing the DMDT we considered four broad classifications of material using Wentworth classifications (pp. 2-41 of the USACE Engineering Manual): clay (.00049-.0038mm), organic fines (.0039-.0624mm), sand (.0625-2.00 mm), and gravel or pebble (2.01-64.00mm). For more information on material evaluation refer to state guidance and the Army Corps of Engineers Dredging and Dredged Material Management Manual.

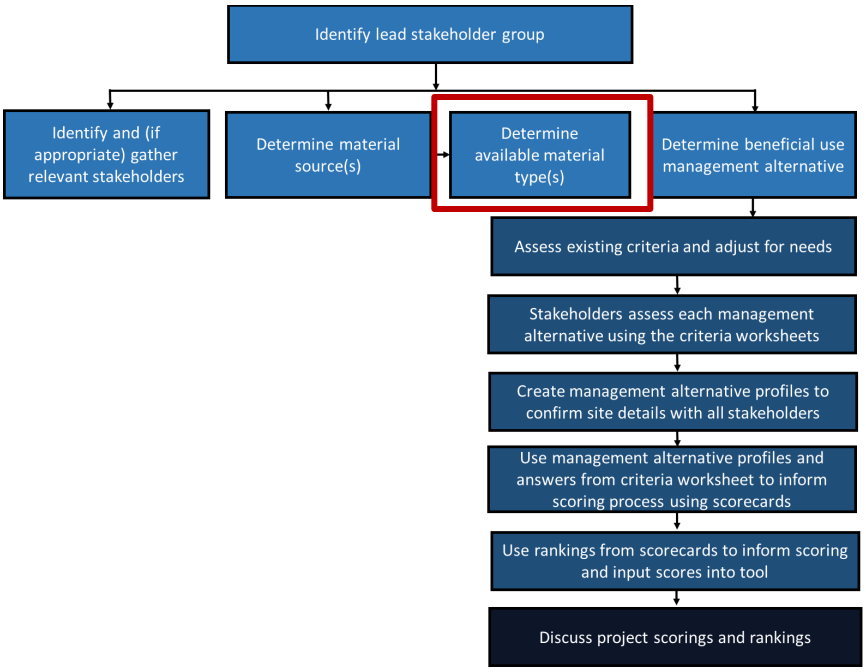


Figure 6. Determine available material type(s).

2.1.5. Determine potential management alternatives

To input information into the DMDT, potential beneficial use management alternatives must be proposed by the stakeholders and other collaborators (Fig. 7). Moreover, transportation to the beneficial use management alternative site must be feasible because transport cost is a significant barrier to beneficial use. This can be a difficult and time-consuming step in the process, especially if stakeholder groups vary in their experience with the beneficial use of dredged material. There are many potential applications for the use of dredged material, and when considering management alternative options, the following list may be helpful:

- Agricultural amendment,
- Brownfield site remediation,
- Cement constituent,
- Construction material, including for roads,
- Greenspace creation and enhancement,
- Habitat restoration,
- Beach nourishment, and
- Superfund site remediation.

Appendix B includes examples of two beneficial use management alternative profiles for two cases, one in the Duluth-Superior Harbor and one in the Port of Cleveland. The profiles and supplemental database can help facilitate discussion by providing illustrative examples to stimulate ideas about potential beneficial use management alternatives.

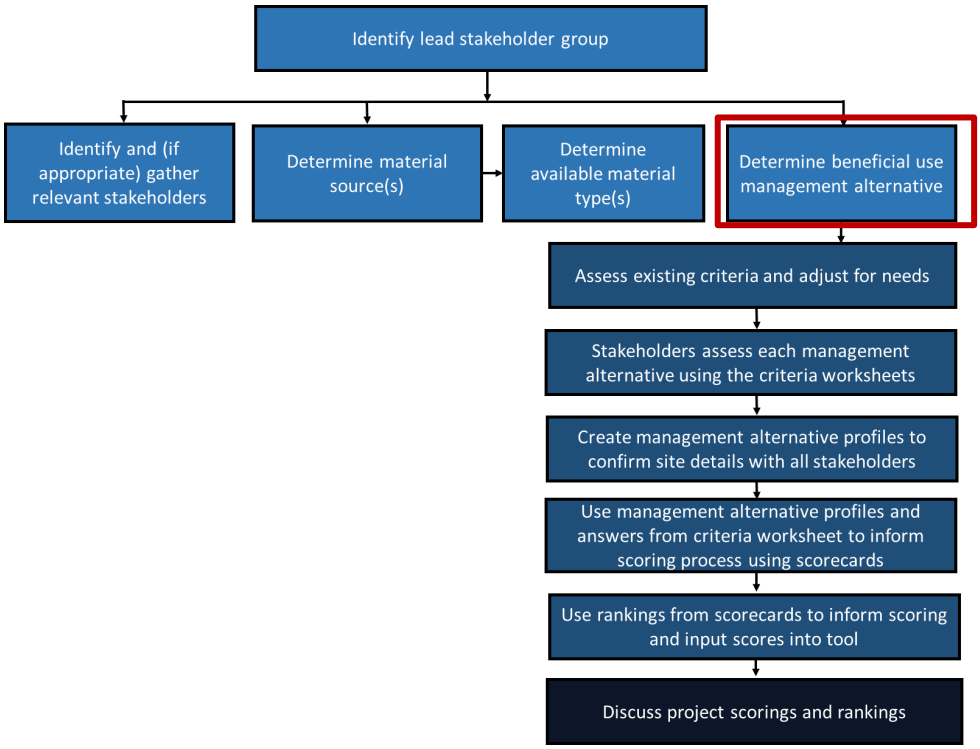


Figure 7. Identify potential management alternatives.

Additional considerations for this step

It is important to communicate with a wide network of potential stakeholders and collaborators to generate a list of potential beneficial use management alternative options for inclusion in the analysis. As the list of alternatives evolves and priorities are solidified, the key collaborators may change. One approach is to identify possible needs for dredged material in your area and invite the property owners or managers. For example, in the Duluth-Superior Harbor, there was a need for material for habitat restoration, so the evaluation for this study was conducted with the Duluth-Superior Harbor Dredge Material Management Team. Many of the team members are natural resource managers. On the other hand, in Cleveland, there was a need for clean fill where buildings had been demolished, requiring the participation of the City of Cleveland and the Cuyahoga Land Bank.

2.2. Using the criteria worksheets, scorecards and DMDT

2.2.1. Assessing and adjusting existing criteria

Review the list of criteria (Table 3; Appendix A), as these are the baseline criteria that will be captured in the worksheets, scorecards, and DMDT (Fig. 8). The lead stakeholder group may need to adjust criteria to ensure the criteria being considered are relevant to each of the potential beneficial use management alternatives (Fig. 8). If the existing criteria do not fit the scope of the alternative under

consideration, it is possible to adjust the criteria to make them relevant to the context. This may include renaming, replacing, or removing the criteria to fit the alternative. Prior to adjusting the criteria, consider consulting with stakeholders to determine which criteria are relevant and what should be added or changed. Replace the criteria to update and add extra lines for additional criteria as needed in the worksheets, scorecards, and DMDT. Instructions for replacing criteria are detailed later in this report.

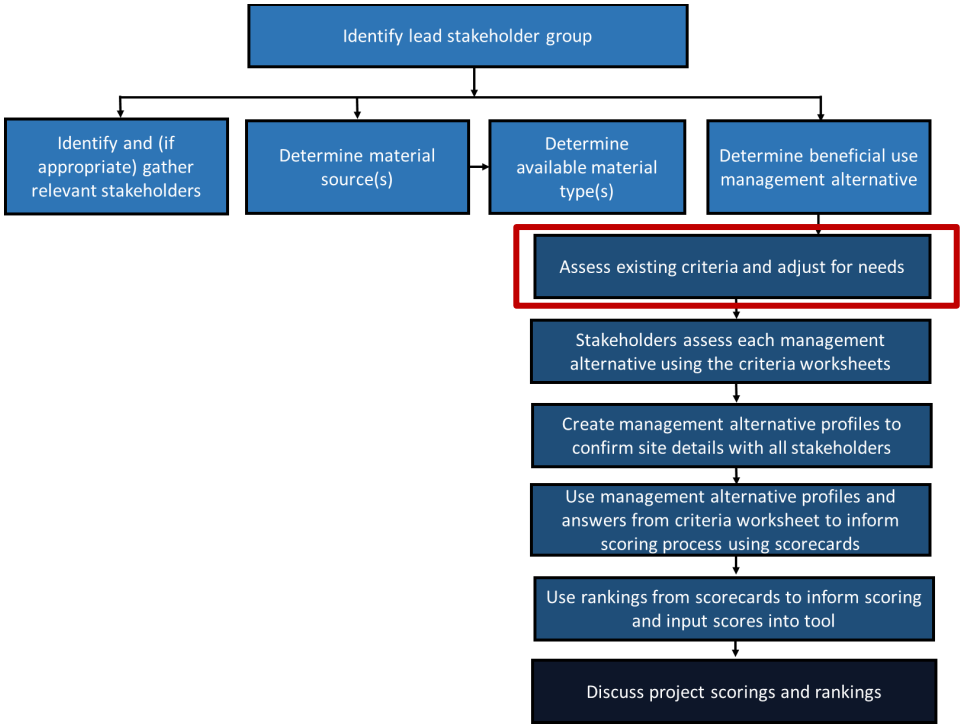


Figure 8. Assess existing criteria and adjust if needed.

Table 3. Categories and criteria in DMDT.

Category	Criteria
Biophysical Environment	Rivers and streams habitat quantity gain/loss
	Lakes and ponds habitat quantity gain/loss
	Near coastal marine/estuarine habitat quantity gain/loss
	Open water habitat quantity gain/loss
	Wetlands habitat quantity gain/loss
	Urban/Suburban habitat quantity gain/loss
	Barren/rock and sand habitat quantity gain/loss
	Rivers and streams habitat quality improved/diminished

	Lakes and ponds quality improved/diminished
	Near coastal marine/estuarine quality improved/diminished
	Open water quality improved/diminished
	Wetlands quality improved/diminished
	Urban/Suburban quality improved/diminished
	Barren/rock and sand quality improved/diminished
	Impact on priority habitat
	Benefit to species of management concern
	Restoration of native vegetation
	Reduction of invasive species
	Increase stormwater control/protection
	Influence biophysical environment by reducing contamination
Economy	Funding pathway identified
	Funding application prepared
	Partnerships established
	Potential partnerships identified
	Feasible transportation of dredged materials to the use site
	Accept materials (5 years)
	Accept materials long-term (20 years)
	Lead to creation/growth of viable business
	Secondary benefits created
	Long-term maintenance required
Social	Improve access to parks or natural spaces
	Potential for indirect job creation
	Improve aesthetics
	Community engagement
	Reduced human exposure to contaminants
	Improved access to ecosystem services
	Improved infrastructure condition
	New/improved infrastructure services for community
Governance	Maintain navigation channels

Built Environment	Enrollment in voluntary program
	Able to complete within Environmental Windows
	Included in existing guidance documents
	Permitting timeline conducive with project timeline
	Meets zoning requirements
	Flexible timeframe
	Replicable
	Site ownership
	Reduce contamination
	Diversion to construction
	Cap or fill for development site
	Cap or fill for construction
	Cap or fill for roads
	Cap or fill for park or greenspace

2.2.2. Stakeholder assessment of beneficial use management alternatives using the criteria worksheets

Each stakeholder or stakeholder group can assess the beneficial use management alternatives by completing a worksheet addressing all the relevant criteria for each alternative (Fig. 9). The criteria worksheets, named DMDT Beneficial Use Worksheets in Appendix A, are used to tabulate necessary information about beneficial use management alternatives as input to the DMDT. The worksheets are available as fillable PDFs and contain spaces to capture the management alternative information, dredging information, as well as governance, biophysical, built environment, economic, and social criteria.

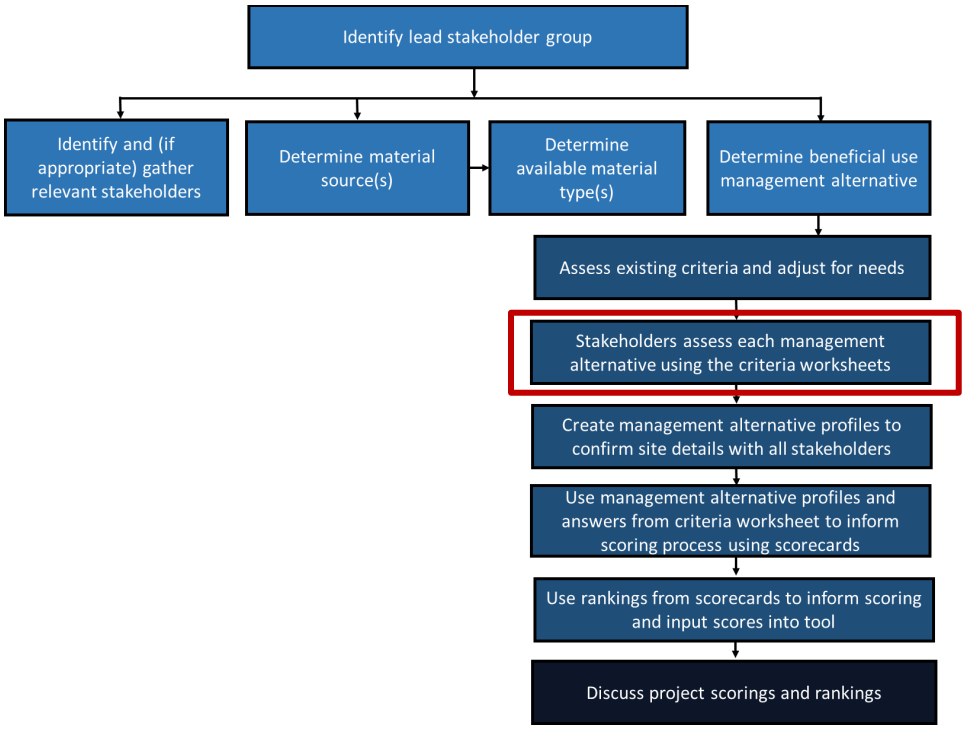


Figure 9. Stakeholders can complete the worksheets to clarify their own priorities and rankings.

Each stakeholder or stakeholder group can fill out a copy of the worksheet for each beneficial use management alternative based on their knowledge and perceptions of the specific case. Worksheets should be filled out to the best of the participants' knowledge. We encourage the stakeholders to discuss whether the information does or does not represent their agency's positions. The purpose of the worksheets is to help create a common understanding of and set of goals for evaluating criteria. This is important because each stakeholder or group fills out their own worksheet, so all of the perspectives of participants becomes part of the process. Specific instructions for filling out the worksheet are available on the "Instructions" section of the worksheet file. Criteria worksheets and instructions can be found in Appendix A.

2.2.3. Create site or alternative descriptions to confirm details with all stakeholders

After stakeholders have applied the criteria to the proposed beneficial use management alternatives using the criteria worksheets, the lead organization should compile stakeholder responses and share them with the group (Fig.10). One method for compiling this information is to create a "beneficial use management alternative profile" for each management alternative or beneficial use project. A beneficial use management alternative profile should include stakeholders' feedback about governance, biophysical, economic, built environment, and social criteria for each alternative, taking care to include any diverging opinions or minority perspectives. If questions were raised pertaining to specific criteria or beneficial use management alternatives, they should also be included in the profile, so stakeholders can address and discuss them.

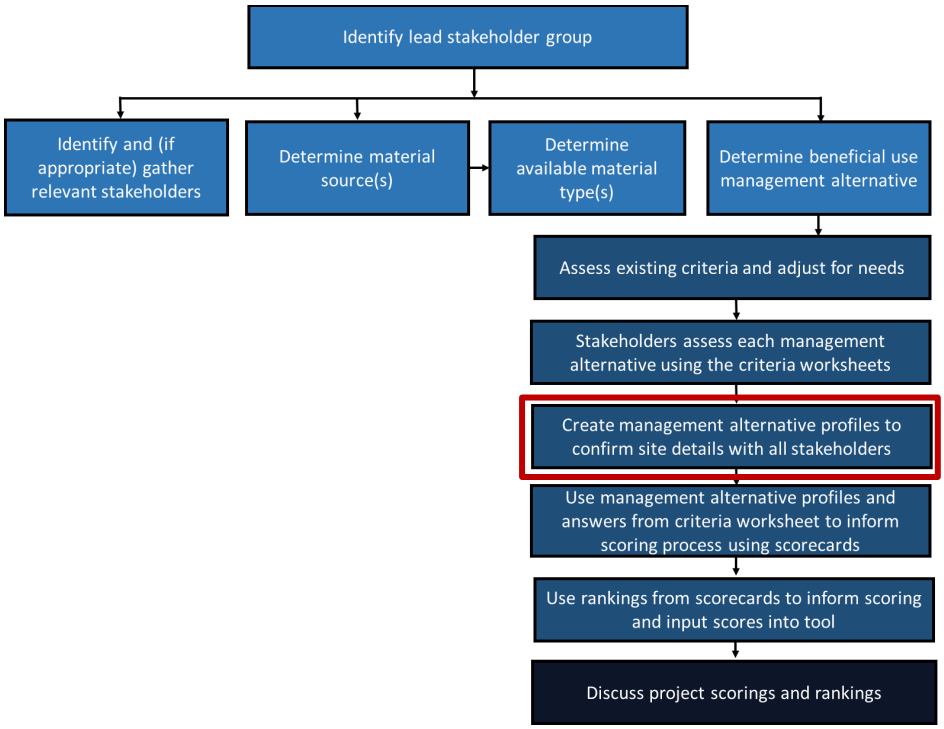


Figure 10. Create beneficial use management alternative profile based on worksheet outputs to share with other stakeholders.

Compiling responses and then providing the beneficial use management alternative profiles for review will enable stakeholders to discuss the details of each beneficial use management alternative according to each of the categories of criteria. Creating beneficial use management alternative profiles also increases familiarity with beneficial use management alternatives prior to use of the DMDT. The profile also provides a comprehensive overview of the alternative in one concise description. Screenshots located in Appendix B.1 depict a simple beneficial use management alternative profile based on information that was shared by stakeholder groups through their worksheets. After creating the beneficial use management alternative profile in Appendix B, stakeholders gathered at a workshop to review the profiles and discuss the criteria for the alternative before implementing the DMDT.

2.2.4. Use beneficial use management alternative descriptions and answers from criteria worksheets to inform the scoring process

After completing the steps listed above, stakeholders should be able to reach a common understanding about the ways they, and other stakeholders, perceive the details for each beneficial use management alternative (Fig. 11). At this point, each stakeholder or stakeholder group completes one of two criteria scorecards. Stakeholders are encouraged to use the scorecards prior to using the DMDT because the scoring system and criteria are the same, the tool allows for only one set of scores to be entered for each criterion and the scorecards allow *all* stakeholders to score based on their respective priorities. The scoresheets provide an opportunity for stakeholders to assign numeric value to criteria, come back together and discuss their scores, and then agree upon a single set of criteria scores to include in the DMDT. The process of using the worksheets to establish mutual understanding of projects, then using the scorecards to ensure agreement on scoring of criteria will mitigate potential disagreement and misunderstanding when entering scores into the DMDT. Ideally, the in-depth and transparent nature of

this process will allow for a smoother transition from determining a beneficial use management alternative to implementing a project.

Two options for scoring criteria are available: five-point Likert scaling or yes/no scoring (Appendix C). It is acceptable to use either approach, but all stakeholders must use the same one. Scorecards may be completed by each stakeholder or collectively by the group. Following scorecard completion, the lead organization compiles the scores for each category of criteria, then shares the results with the rest of the stakeholders.

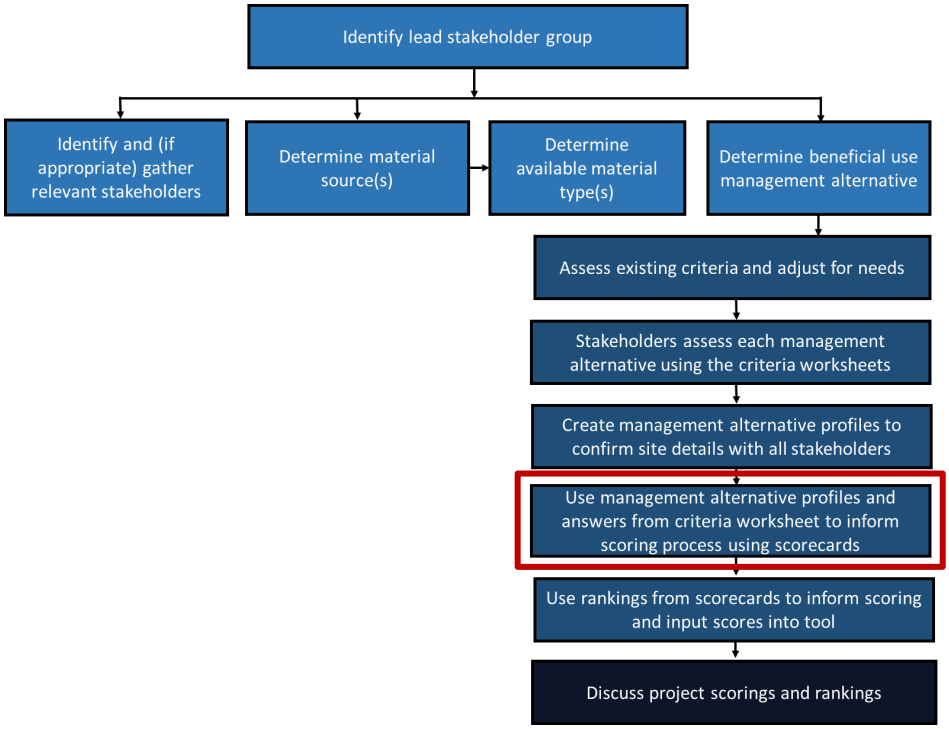


Figure 11. Use beneficial use management alternative descriptions and answers from worksheet to use scorecards.

One method to compile score card results is to estimate a measure of central tendency, such as the arithmetic mean or mode for each category of criteria. Alternatively, measures of spread such as quartiles or confidence intervals can be used to identify where there are substantial scoring differences among stakeholders. The binary option of scoring can be used to identify points of agreement and disagreement. Regardless of the method used to summarize the scores, make note of any outliers for group discussion. Following compilation, present results to participants for feedback and discussion.

3.0 DMDT scoring instructions

This section demonstrates the next step in the process, entering the data from the worksheets (Appendix A) and scorecards (Appendix C) into the DMDT (Fig. 12).

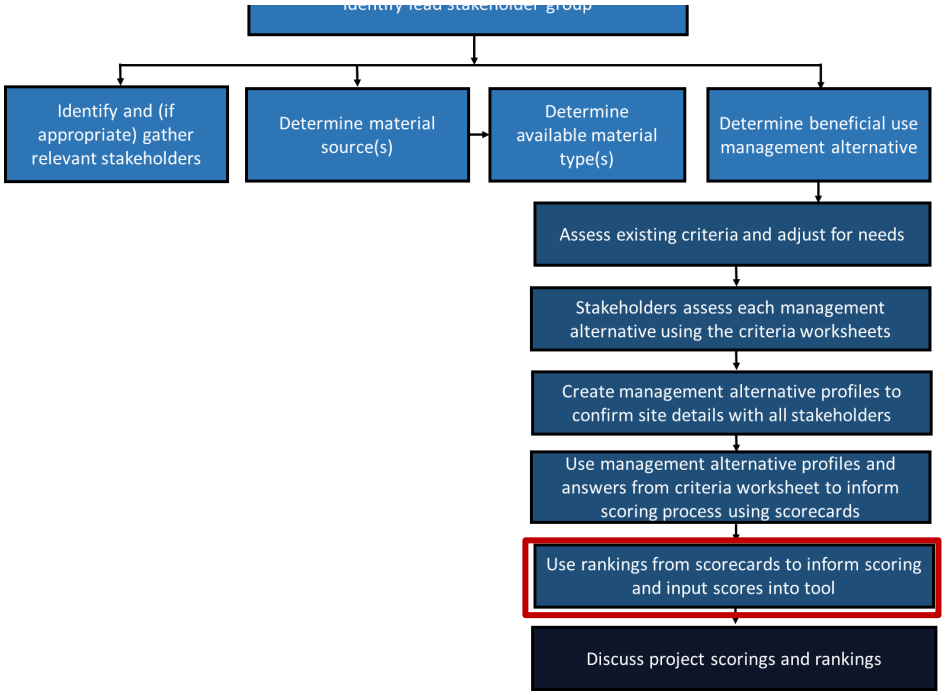


Figure 12. Using the rankings from scorecards, enter data into the DMDT.

3.1 Step 1: Entering project information in the DMDT (Scoresheet A or B)

After completing either or both Scorecard A (scoring criteria on a Likert 1-5 scale) and Scorecard B (yes or no), the responses can be added to scoresheets A and B the DMDT (need link to tool here). The management alternative scoring process begins with entering project information in **red-shaded** cells from B5 to B15 (Figs.13 and 14). The **blue-shaded** cells (cells B8, B11, and B13) will fill with updated information automatically as the user enters data. The DMDT is configured to compare among up to 3 alternatives. In green shaded cells K23, N23, and Q23, the user enters the expected dredged material available for each alternative. In the pink-shaded cell I24, the user enters the amount of dredged material that can be used (disposed) for the alternative. NOTE: The user must enter project information on whichever scoresheet they use. If both Scoresheet A and B are used, the project information must be entered separately on both.

	A	B	C	D
1	Duluth-Superior Harbor Working Draft			
2	12/11/2020			
3				MAINTE
4				
5	Port	Duluth-Superior Harbor		
6	Project No.	ABC-123		
7	Dredge Location (lat/long)			
8	Volume (cy)	Alternative 1: 50K; Alternative 2: 50K; Alternative 3: 50K		
9	Soil classification			
10	Elevated contaminants			
11	Weighting factor adjusted	No adjustment		
12	Trial	001		
13	Scorecard No.	Du-2020-2-19-001		
14	Prepared by	<Enter Name>		
15	Prepared on	<Enter Date>		
16	Checked by	<Enter Name>		
17	Checked on	<Enter Date>		
18	Last Modified	2/19/2020		
19				
20				

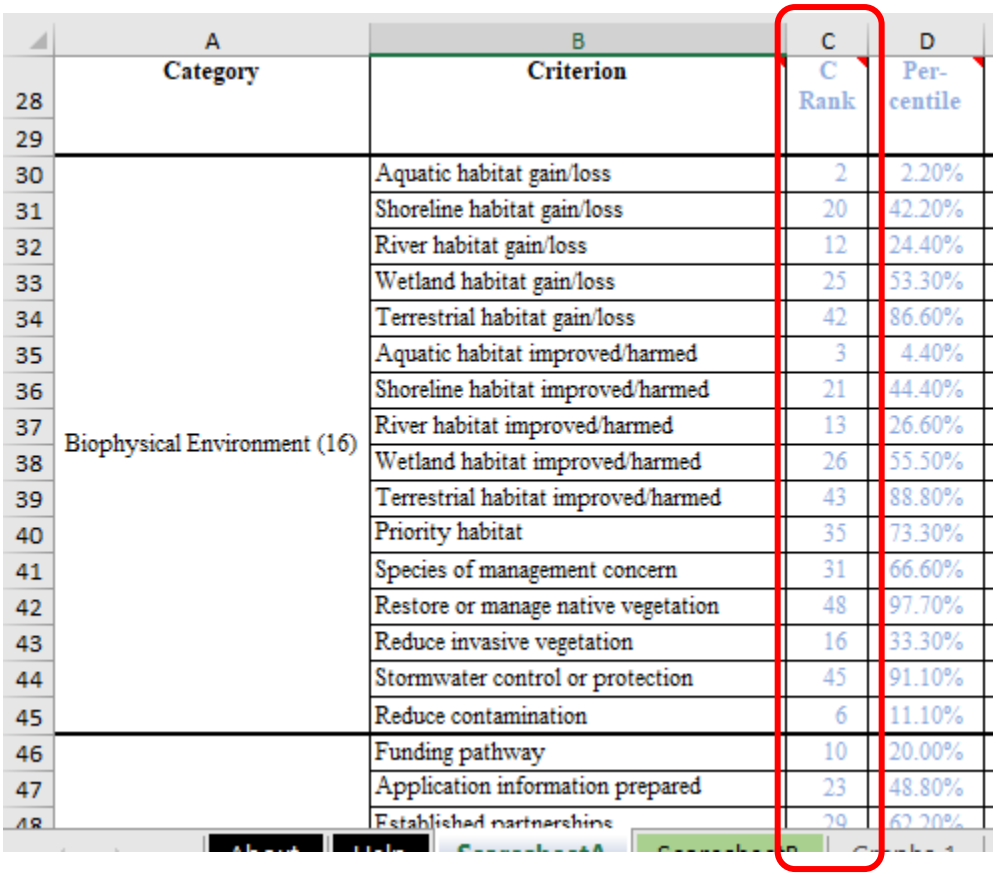
Figure 13.Project information data cells located in the upper left of Scoresheets A and B.

		Scoring		
		Alternative 1	Alternative 2	Alternative 3
		Description	*Description*	*Description*
Sediment to be dredged		50,000 cy	50,000 cy	50,000 cy
Disposal capacity available on	7/19/19	5,000,000 cy	1,000,000 cy	50,000 cy
Is sediment dredged ≤ available disposal capacity		OK	OK	OK

Figure 14.Project information data cells located above spreadsheet in rows 23 and 24 of Scoresheets A and B.

3.2. Step 2: Ranking criteria (Scoresheet A or B)

Criteria rank is a way to identify which criteria are most important to the stakeholder completing the scoresheet. Rank affects the score generated by each criterion; scores associated with criteria ranked higher (closer to 1) will generate more points than those scores associated with criteria ranked lower (closer to 0). That is, if "Aquatic habitat gain/loss" is ranked higher than "Reduce invasion vegetation" and both criteria score a 4 on scorecard A , then "Aquatic habitat gain/loss" adds more points to the total score than "Reduce invasion vegetation" even though they scored the same (Fig. 15). The corresponding criteria from project Scoresheets A and B are listed in Column B, grouped by category displayed in Column A. The ranking for each criterion is displayed in Column C, with the corresponding ranking percentage displayed in Column D. Initially, the criteria will be in a default ranking set by the DMDT based on numbering the criterion in order. The user is encouraged to adjust this according to their goals and preferences. The spreadsheet is designed to allow for rank ties, so it is not necessary that each criterion has a unique rank. Enter criteria rankings in Column C (Fig.15). The corresponding ranking percentages in Column D update automatically upon criteria ranking entry. The process for ranking criteria is outlined and facilitated by Scorecard C in the worksheet package.
NOTE: Criteria rankings must be adjusted separately for whichever scoresheet is being used.



	A	B	C	D
28	Category	Criterion	C Rank	Per-centile
29				
30	Biophysical Environment (16)	Aquatic habitat gain/loss	2	2.20%
31		Shoreline habitat gain/loss	20	42.20%
32		River habitat gain/loss	12	24.40%
33		Wetland habitat gain/loss	25	53.30%
34		Terrestrial habitat gain/loss	42	86.60%
35		Aquatic habitat improved/harmed	3	4.40%
36		Shoreline habitat improved/harmed	21	44.40%
37		River habitat improved/harmed	13	26.60%
38		Wetland habitat improved/harmed	26	55.50%
39		Terrestrial habitat improved/harmed	43	88.80%
40		Priority habitat	35	73.30%
41		Species of management concern	31	66.60%
42		Restore or manage native vegetation	48	97.70%
43		Reduce invasive vegetation	16	33.30%
44		Stormwater control or protection	45	91.10%
45		Reduce contamination	6	11.10%
46		Funding pathway	10	20.00%
47		Application information prepared	23	48.80%
48		Established partnerships	29	62.20%

Figure 15. Percentile ranking column on Scoresheet A and B. Ranks come from user priorities.

3.3. Step 3: Weighting factors (Scoresheets A or B)

A user may wish to emphasize the relative importance of certain criteria by adjusting the weighting factors (WF) of those criteria. For example, an agency may wish to signify the importance of a policy priority by giving it a higher weight. Users can complete Scorecard C (Appendix C) to prioritize their organizational or agency priorities by ranking all of the criteria in the DMDT. Some users in our pilot scored each factor on 1-5 Likert scale. The weighting factor control for each criterion is in Column E (Column F on Scoresheet B) under the "Adjust WF" column header (Fig. 16). The default setting for the Scoresheet is for each criterion to be weighted equally at a weighting of "1" (displayed in column "Adjust WF" as "1X"). An increase to "2" for a criterion doubles its point value relative to any criterion with a "1" weighting factor, for example.
NOTE: Weighting factors must be adjusted for whichever scoresheet is being used.

B	C	D	E	F
Criterion	C Rank	Per-centile	Adjust WF	Weighting Factor (WF) Scale: 0.1 to 1.0
Aquatic habitat gain/loss	2	2.20%	1X	0.98
Shoreline habitat gain/loss	20	42.20%	1X	0.60
River habitat gain/loss	12	24.40%	1X	0.77
Wetland habitat gain/loss	25	53.30%	1X	0.49
Terrestrial habitat gain/loss	42	86.60%	1X	0.18
Aquatic habitat improved/harmed	3	4.40%	1X	0.96
Shoreline habitat improved/harmed	21	44.40%	1X	0.58
River habitat improved/harmed	13	26.60%	1X	0.75
Wetland habitat improved/harmed	26	55.50%	1X	0.47
Terrestrial habitat improved/harmed	43	88.80%	1X	0.16
Priority habitat	35	73.30%	1X	0.30
Species of management concern	31	66.60%	1X	0.37
Restore or manage native vegetation	48	97.70%	1X	0.07
Reduce invasive vegetation	16	33.30%	1X	0.68
Stormwater control or protection	45	91.10%	1X	0.13
Reduce contamination	6	11.10%	1X	0.89
Funding pathway	10	20.00%	1X	0.81
Application information prepared	23	48.80%	1X	0.54
Established partnerships	29	62.20%	1X	0.41
Working partnerships	41	84.40%	1X	0.20
Transport cost	9	17.70%	1X	0.93

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Figure 16. Weighting factor adjustment column.

3.4. Step 4: Entering user scores in the DMDT

Users may choose to enter scores for alternative comparison into Scoresheet A using Likert 5-point scoring or into Scoresheet B using yes/no (binary) scoring (0 – no effect or absence, 1 – some effect or presence). The corresponding criteria from project Scorecards A and B in the worksheet package are listed in Column B, grouped by category displayed in Column A. In each criterion row, users enter the score for that criterion under the "U" column (Column K for "Alternative 1," Column N for "Alternative 2," and Column Q for "Alternative 3."). As the user inputs scores, the DMDT will calculate and update the scoring according to the criteria ranking and weighting factors. See the instructions for Scoresheet A and Scoresheet B below.

3.4.1. Scoresheet A

On Scoresheet A, user scores for criteria are input based on a 5-point Likert scale corresponding to the stakeholder scoring exercise on Scorecard A in the worksheet package. The higher a score is (closer to "5"), the more positive an effect it has on an alternative's total score. In the "U" (user score entry) columns, enter criteria scores from 1 to 5 for each criterion in Column K based on how Scorecard A results were compiled for Alternative 1 (Fig.17). This process is repeated for the scoring of other

alternatives for comparison in the "U" columns for Alternative 2 (Column N) and Alternative 3 (Column Q). After scores have been entered for all criteria for a beneficial use management alternative, the alternative total score and associated rank (among the management alternatives considered) will be displayed in the Total Score row (Row 77, Fig. 18). The higher the score, the greater the positive benefits of the alternative based on the input. The alternative with the highest score is assigned the lowest rank (#1).

A	B	C	K	L	M	N	O	P	Q	R	S
Category	**Criterion**	**C Rank**	***U***	***W***	***C***	***U***	***W***	***C***	***U***	***W***	***C***
Biophysical Environment (16)	Aquatic habitat gain/loss	2	1	1.0	38%	4	3.9	62%	3	2.9	59%
	Shoreline habitat gain/loss	20	4	2.4		5	3.0		5	3.0	
	River habitat gain/loss	12	1	0.8		3	2.3		4	3.1	
	Wetland habitat gain/loss	25	1	0.5		1	0.5		1	0.5	
	Terrestrial habitat gain/loss	42	5	0.9		3	0.5		5	0.9	
	Aquatic habitat improved/harmed	3	1	1.0		3	2.9		3	2.9	
	Shoreline habitat improved/harmed	21	4	2.3		5	2.9		5	2.9	
	River habitat improved/harmed	13	1	0.8		3	2.3		3	2.3	
	Wetland habitat improved/harmed	26	1	0.5		1	0.5		1	0.5	
	Terrestrial habitat improved/harmed	43	5	0.8		3	0.5		5	0.8	
	Priority habitat	35	5	1.5		5	1.5		5	1.5	
	Species of management concern	31	5	1.9		5	1.9		5	1.9	
	Restore or manage native vegetation	48	1	0.1		5	0.4		1	0.1	
	Reduce invasive vegetation	16	1	0.7		3	2.0		1	0.7	
	Stormwater control or protection	45	1	0.1		1	0.1		1	0.1	
	Reduce contamination	6	1	0.9		1	0.9		1	0.9	
	Funding pathway	10	5	4.1		4	3.2		5	4.1	
	Application information prepared	23	5	2.7		3	1.6		5	2.7	
	Established partnerships	29	5	2.1		5	2.1		5	2.1	

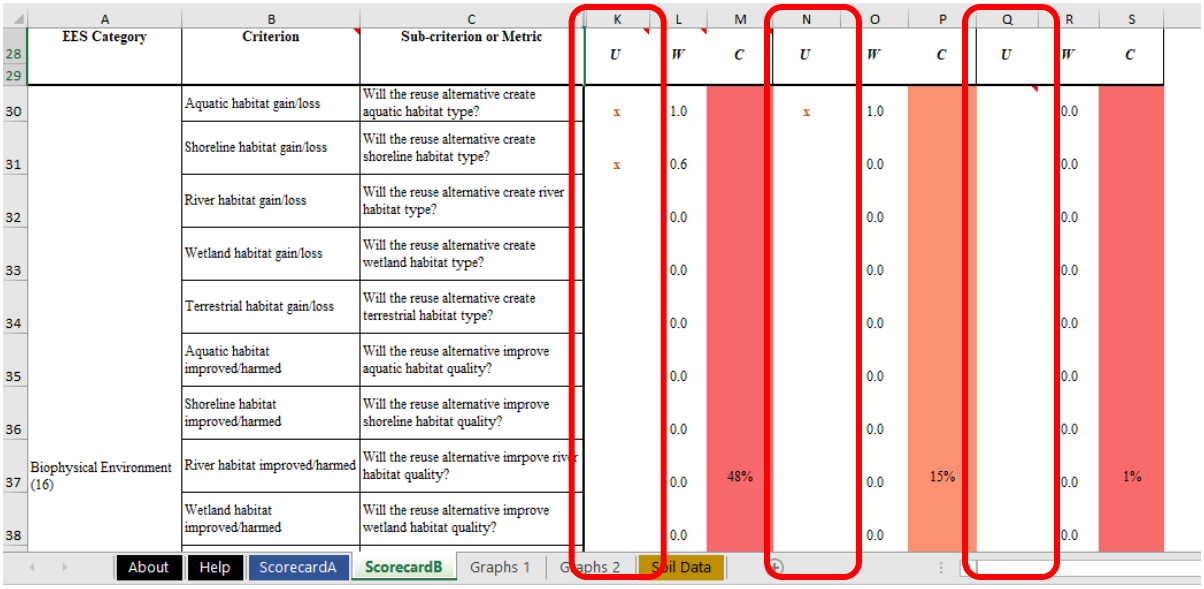
Figure 17. User entry score columns, Scoresheet A.

	A	B	C	D	E	F	G	J	K	L	M	N	O	P	Q
76												**Total Score**			
77	**Total Score**								**19.79**			**6.94**			**6.97**
78									of 24.15			of 24.15			of 24.15
79									82%			29%			29%
80									Rank: 1			Rank: 3			Rank: 2
81															

Figure 18. Total score display rows.

3.4.2 Scoresheet B

Scoresheet B uses a binary scoring system; criteria are scored either as "yes" or "no" corresponding to the Scorecard B worksheet. Metric queries are included on Scoresheet B in Column C to guide the user's responses. Enter an "x" in the "U" (user score entry) column in Column K for criteria that were scored with a "yes." Criteria scored with an "x" generate points based on each criterion's individual ranking and weighting factor. Criteria receiving a "no" score are left **BLANK** in the "U" columns and generate zero points toward the considered alternative's cumulative score (Fig.19). This process is repeated for Beneficial Use Management Alternative 2 (scores entered in Column N) and Alternative 3 (scores entered in Column Q). After scores have been entered for all criteria for each alternative, the alternative total scores will be displayed in the Total Score row (Row 77, Fig. 20). The higher the score, the greater the positive impacts of the management alternative based on the input. The beneficial use management alternative with the highest score is assigned the lowest rank (#1).



	A	B	C	K	L	M	N	O	P	Q	R	S
28	EES Category	Criterion	Sub-criterion or Metric	U	W	C	U	W	C	U	W	C
29												
30		Aquatic habitat gain/loss	Will the reuse alternative create aquatic habitat type?	x	1.0		x	1.0			0.0	
31		Shoreline habitat gain/loss	Will the reuse alternative create shoreline habitat type?	x	0.6			0.0			0.0	
32		River habitat gain/loss	Will the reuse alternative create river habitat type?		0.0			0.0			0.0	
33		Wetland habitat gain/loss	Will the reuse alternative create wetland habitat type?		0.0			0.0			0.0	
34		Terrestrial habitat gain/loss	Will the reuse alternative create terrestrial habitat type?		0.0			0.0			0.0	
35		Aquatic habitat improved/harmed	Will the reuse alternative improve aquatic habitat quality?		0.0			0.0			0.0	
36		Shoreline habitat improved/harmed	Will the reuse alternative improve shoreline habitat quality?		0.0			0.0			0.0	
37	Biophysical Environment (16)	River habitat improved/harmed	Will the reuse alternative imrpove river habitat quality?		0.0	48%		0.0	15%		0.0	1%
38		Wetland habitat improved/harmed	Will the reuse alternative improve wetland habitat quality?		0.0			0.0			0.0	

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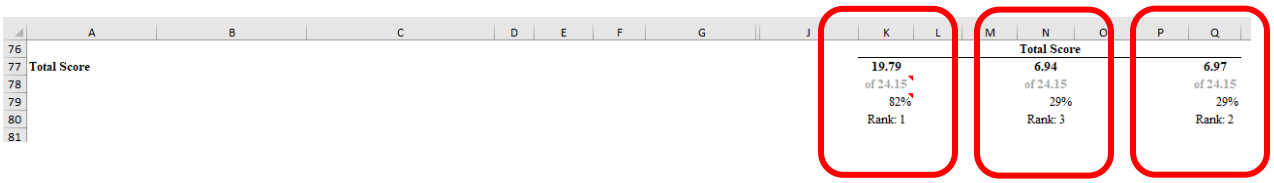
Figure 19. User entry score columns, Scoresheet B.



	A	B	C	D	E	F	G	J	K	L	M	N	O	P	Q
76															
77	Total Score								19.79			6.94			6.97
78									of 24.15			of 24.15			of 24.15
79									82%			29%			29%
80									Rank: 1			Rank: 3			Rank: 2
81															

Figure 20. Total score display rows.

4.0 Discuss decision process

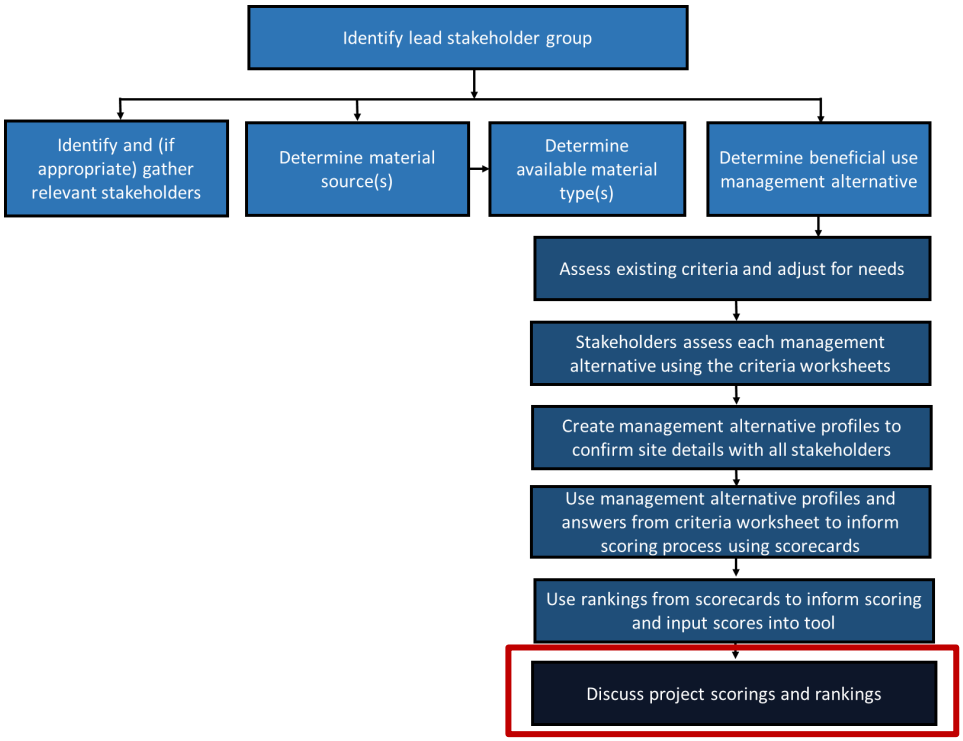


Figure 21. Discuss project scoring and rankings.

4.1 Scoresheet result graphs

Graphs visually displaying the scoring results from Scoresheet A or B Scoresheet B can be found on the workbook pages "Graphs A" and "Graphs B," respectively. The graphs are bar graphs that display how each alternative scored in each category section, compared to the maximum potential score for a category section, which is represented by the transparent green bar graph in the background (Fig. 22). These graphs show how alternatives compare to each other in the different category sections, as well as how alternatives compare to a potential maximum score according to the user's criteria priorities.

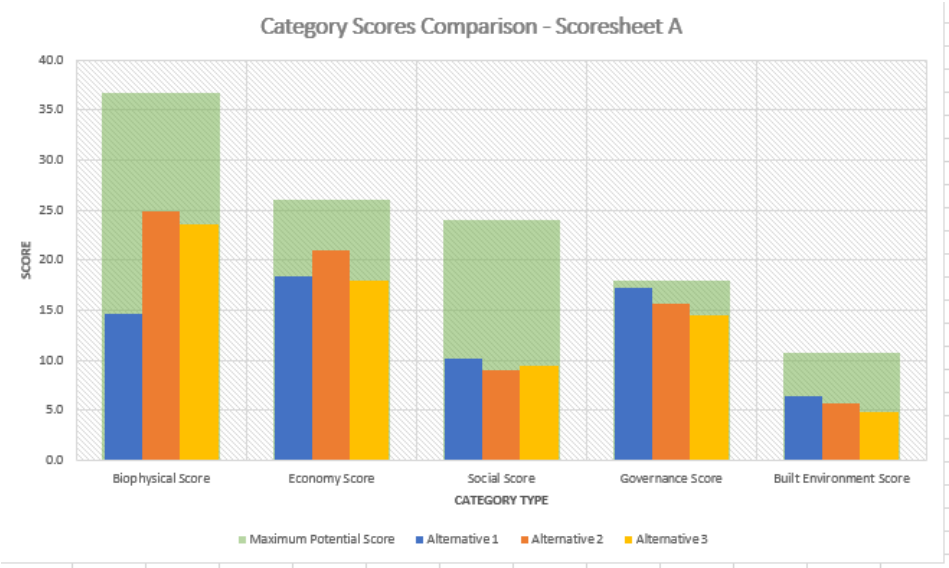


Figure 22. Graphical display of scoring results.

USEPA and TetraTech's purpose for the DMDT was to present information to the user in an easy to understand way. Because beneficial use of dredged material projects are complex with many different factors, they can be challenging to compare. After following the steps to use the DMDT, the final output graphs organize all that information in an easy to understand graph.

4.2 Summary

The DMDT provides a structured method for evaluating different beneficial use alternatives. The value the DMDT provides is increased transparency and a structured method to consider a comprehensive set of criteria that includes environmental, economic, and social costs and benefits of beneficially using dredged materials. Moreover, the DMDT organizes complex details into an easy to visualize output. The highest scoring alternative will be the alternative that best meets a combination of stakeholder and agency priorities, that conforms to regulatory and budget parameters, and which produces biophysical environment gains and social benefits for the community.

After scoring the alternatives, one alternative may score higher than the others. In some cases, however, projects may have similar or tied scores. Should this happen, collaborating stakeholders can return to an earlier point in the process, make adjustments to the input information, as appropriate given new information and insights, and rerun the DMDT. Comparison of results among runs of the tool will show which alternatives are most robust to variation in assumptions and inputs. The details collected to inform the DMDT can be used for further discussion, inform future project plans, or outline budgets. The

relationships formed through this process will facilitate continued progress on implementing the chosen dredged material beneficial use management alternative.

4.3 Limitations and future research

We did accomplish the main goal of this research, which was to create a user-friendly method to facilitate the use of the DMDT by a wide audience. However, we also recognize a few limitations in this applied research study. The intent of USEPA Region 5 was to consider the environmental, economic, and social elements of beneficial use management alternatives to inform decisions. The DMDT does indeed include environmental, economic, and social criteria, and it will help organize, rank, and score the priorities of stakeholders. But the associations between criteria and community benefits need to be determined by site-specific studies. For example, building fish habitat may improve community wellbeing through increased fishing. However, the benefit is not assumed. Moreover, the benefit may also not be apparent to stakeholders. A logical continuation of this research area is to identify additional community benefits associated with common beneficial uses to accompany the DMDT (e.g., preserving CDF space reduces the cost to taxpayers, thus creating a social good). Another area of potential need is to study whether it improves the DMDT application to tailor scorecards to meet the needs of decision makers (i.e., have one scorecard for community officials responsible for site remediation and a different scorecard for natural resource managers).

Another limitation we encountered was that not all stakeholders recognized dredged materials as a potential resource. For example, a barrier in the Duluth-Superior Harbor is the lack of infrastructure to process dredged materials into a geotechnically useful commodity. Whereas coarse-grain materials are desirable for beach nourishment and habitat restoration, it is very difficult to identify applications for fine-grain materials. A purpose of the DMDT is to expand the conservation around both applications and community impacts of dredged material beneficial use, and in doing so grow awareness of its potential as a resource.

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5.0 Appendices

Appendix A: Dredged material decision tool (DMDT) criteria worksheet

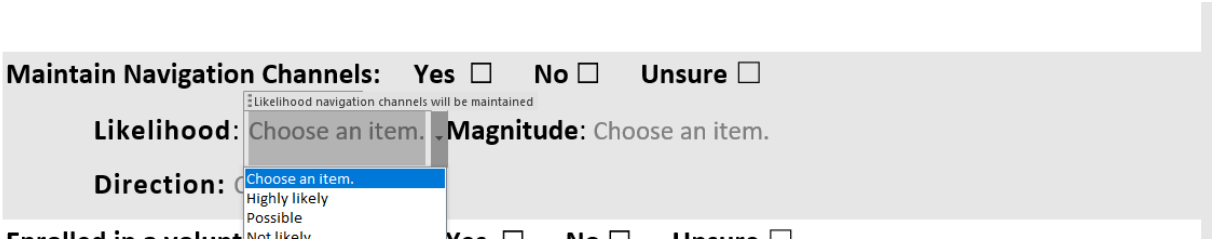
Objectives

The following worksheet is designed to collect the information necessary to populate the Dredged Material Decision Tool (DMDT). Depending on the details of the proposed beneficial use management alternative, some of the information may be unknown or unavailable. Fill in what you can based on what you know and can infer; leave fields blank if details are unknown.

Instructions

The worksheet is structured so that some categories will require you to fill in the blanks, while others provide a range of options in a drop-down list for you to choose from. For each criterion, there will be an option to select "yes," indicating that criterion will be met, "no" indicating it will not be met, or "Unsure," indicating uncertainty regarding that criterion. After choosing "yes," "no," or "unsure," read through the content under each criterion and fill in what you can before moving on.

While you are working through the worksheet, click on each blank/drop-down box and a small, long box will pop-up above the blank box with direction for exactly what information is required. If the criterion has defined answers such as the one in the example below, you will click on the arrow on the right side of the drop-down box to select your answer:



Definitions

There are three different measures of impact characterization under each criterion: likelihood, magnitude, and direction. There is a place at the end of the section for each category of criteria to comment on the strength of evidence for the responses for that category. Each of the impact characterization terms are defined below.

1. **Likelihood** refers to the probability that an effect will happen with respect to the criterion. The values are "highly likely," "possible," or "not likely."

2. **Magnitude** indicates the expected size of the effect associated with the specific criterion. This can be described using the values “high,” “moderate,” or “low.” For criterion with a quantitative effect, a high magnitude would refer to a larger quantitative impact than moderate or low magnitude. For example, the creation of 100 acres of a certain type of habitat could be characterized as “high” while the creation of 10 acres could be “low.” A qualitative example would be determining the magnitude of impact that being enrolled in a voluntary program has on a beneficial use management alternative. If the alternative can only be completed through enrollment, the expected effect of enrollment is “high.” If enrollment is optional and will not provide many resources for the alternative, the effect is “low.” The drop-down boxes provide guidance as to how the magnitude should be ranked.
3. **Direction** indicates how criteria will affect different aspects of the beneficial use alternatives. For each category of criteria, the direction refers to the different goals listed below:
    a. Biophysical environment: The goal of biophysical environment criteria is to assess the harmful and beneficial effects of the beneficial- use alternative on habitat and the organisms that utilize the habitat. Responses explain how each beneficial use management alternative will change the biophysical environment (habitat and organisms).
    b. Economic: The goal of economic criteria is to assess the feasibility of the alternative given potential economic incentives and constraints. Responses explain how project funding elements and costs impact the economic feasibility of the alternative.
    c. Social: The goal of social criteria is to assess how the proposed alternative will impact human health and well-being. Responses explain how each alternative has the potential to change human health and well-being outcomes in the community.
    d. Governance: The goal of governance criteria is to assess the feasibility of beneficial use management alternatives and ensure they are compliant with place and project-relevant governance structures, including funding and regulations. Responses explain how different funding and regulatory requirements might impact the feasibility of the alternative.
    e. Built environment: The goal of built environment criteria is to assess the feasibility of beneficial use managment alternatives based on an alternative’s end uses and the ways that dredged materials will be utilized in construction. Responses explain how the beneficial use management alternative will be utilized in as a construction material.

4. **Strength of Evidence** refers to the quality and reliability of the evidence used to determine your evaluation of each criterion. Evidence can include personal experience, knowledge from colleagues, information from research conducted elsewhere, scientific literature. A blank space for comments on the strength of evidence has been included at the end of each section. When using this box, indicate which criterion you are referring to in your comments and what evidence was used. Please include any other thoughts or insights at the end of the worksheet in the provided “Comments” box.

DMDT Beneficial Use Worksheet

Type of Site: Select Site (source: https://www.epa.gov/report-environment/contaminated-land#types)

If "other," identify type of site: Click or tap here to enter text.

Owner: Select Owner **Name of Owner (if known):** Click or tap here to enter text.

State: Select State

Name of Site: Click or tap here to enter text.

Purpose: Choose an item. **If "other," identify purpose:** Click or tap here to enter text.

Dredging information

Dredging location (lat/long): Click or tap here to enter text.

Name of dredge site (if applicable): Click or tap here to enter text.

Volume (cubic yards): Click or tap here to enter text.

Program (Operations & Maintenance, Strategic Navigation, Private, Other): Click or tap here to enter text.

Soil Classification:

Primary soil type: Choose an item. **Secondary soil type:** Choose an item.

Cost: Click or tap here to enter text.

Funded by: Click or tap here to enter text.

Type/mode of transportation: Click or tap here to enter text.

Elevated contaminants: Click or tap here to enter text.

Contracting:

- ☐ **Reasonable expectations**
- ☐ **Available**
- ☐ **Affordable**

Biophysical Environment

Habitat Gain or Loss (QUANTITY)

Lakes and ponds: Gain ☐ Loss ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Near coastal marine/estuarine: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Open water: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Wetlands: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Urban/suburban: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Barren rock/sand: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Impact on priority habitat: Gain ☐ Loss ☐ No impact ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Type of priority habitat gained or lost: Click or tap here to enter text.

QUALITY of Habitat

Lakes and ponds: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Near coastal marine/estuarine: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Open water: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Wetlands: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Urban/suburban: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Barren rock/sand: Improved ☐ Diminished ☐ No impact ☐ Unsure ☐ N/A ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Benefit or protect species of management concern: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Restore or manage native vegetation: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Reduce invasive vegetation: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Increase stormwater control or protection: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Influence biophysical environment by reducing contamination: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Strength of Evidence: Click or tap here to enter text.

Economic

Funding pathway identified: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Funding application prepared: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Partnerships are established: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Potential partnerships have been identified: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Transportation to the site is feasible: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Project site can accept materials for 5 years: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Project site can accept materials for 20 years (long term): Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Lead to the creation or growth of a viable business: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Secondary benefits created: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Require long-term maintenance or management: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Strength of Evidence: Click or tap here to enter text.

Governance

Maintain Navigation Channels: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Consideration of liability (past, present and future for site):

Yes Click or tap here to enter text. **No ☐ Unsure ☐**

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Enrolled in a voluntary program (often assessment/clean-up support): Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Able to be completed inside of relevant environmental windows: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Referred to or included in existing guidance documents: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Which documents reference this project: Click or tap here to enter text.

Permitting timeline conducive to project timeline: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Meets zoning requirements: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Flexible timeframe: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Replicable in other harbors, ports, jurisdictions, or projects: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Strength of evidence: Click or tap here to enter text.

Social

Improve access to parks or natural spaces: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Potential for indirect job creation: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Improvement of aesthetics: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Involvement of local community (providing feedback, planning): Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Reduction of human exposure to contaminants: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Improved access to ecosystem services: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Improved infrastructure condition: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

New or improved infrastructure services for community: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Strength of Evidence: Click or tap here to enter text.

Built Environment

Contamination reduced to levels necessary for end use: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Demand on terrestrial borrow sources reduced: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Provision of fill or a cap:

Development Site: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Construction: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Road: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

Park or greenspace: Yes ☐ No ☐ Unsure ☐

Likelihood: Choose an item. **Magnitude**: Choose an item.

Direction: Choose an item.

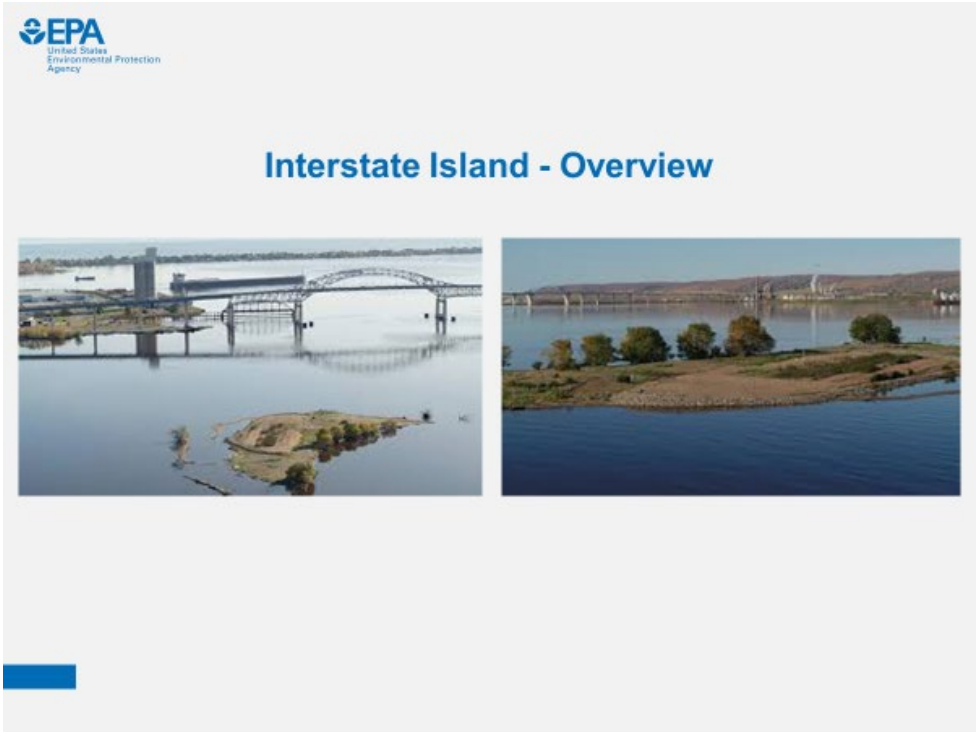
Strength of evidence: Click or tap here to enter text.

Additional Comments: Click or tap here to enter text.

Appendix B: Sample beneficial use management alternative profiles for Interstate Island and Cleveland Lakefront Nature Preserve

B.1. Beneficial use management alternative profile for Interstate Island, Duluth-Superior Harbor

This sample site profile can be used as a template to display information gathered from criteria worksheets. Using this format allows stakeholders and others to review known data about the beneficial use management alternatives and make corrections and additions to the details as needed. It can also be used as a guide to identify missing information about the alternatives.



Dredging Information

Dredging location (latitude/longitude)	46.749175, -92.110075
Name of dredge site and program	Dredge program: Operation and Maintenance Site: Anchorage and East Gate Basin
Volume (yd^3)	60,000-70,000
Soil classifications	Organic fines
Cost and funding source	Cost: $1,000,000 Sources: Harbor Maintenance Trust Fund, US Army Corps, Great Lakes Restoration Initiative
Mode of transportation	Mechanical dredging to slurry box and hydraulic discharge to Interstate Island
Elevated contaminants or species of concern (in dredging area)	No, meets state standards.
Contracting	• Reasonable • Available • Affordable

Governance

Maintenance of navigation channels	• Will be maintained • High impact for amount of channel maintained • Makes the project much more feasible
Enrollment in a voluntary program	• Not likely to be enrolled, little impact
Completion within environ. windows	• Unsure, may be highly likely • Environmental Windows largely impact the project • Completion w/in EW makes project much more feasible
Reference in existing guidance docs	• Referenced in AOC project plans, Habitat Plan • This effect is high and project is much more feasible
Permitting conducive to timeline	• Highly likely, very impactful • The project is more feasible
Zoning requirements met	• Highly likely, very impactful • The project is much more feasible
Contingency plan est.	• US Army Corps- contingency plan? • Minimal impact
Replicable in other places	• May be replicable in other places • The impact of replicability is moderate to high • This makes the project slightly more feasible

Governance

Comments:

1. This is a St. Louis River Area of Concern management action.
2. The goal is improving Common Tern nesting habitat. Restricted dates apply for in-water placement to avoid work during nesting season.
3. Interstate Island is moving into the design and contract phases with US Army Corps of Engineers (USACE). The States of Wisconsin and Minnesota and USACE have been working together for the past year to utilize beneficial use of dredged material at the island.
4. This will potentially be a huge success story for the St. Louis River Estuary.
5. Difficult issues to overcome were real estate, timing of permits, design and contracting challenges and the US Army Corps dredging timeline.
6. This beneficial use project will hopefully provide a good model of similar projects in the future.

Economic

Funding pathway	• Funding possibly/likely secured • Identified pathway is impactful, project more feasible
Application info prepared	• Possibly prepared • Having application prepared benefits, the project and make it more feasible
Established partnerships	• Partnerships are established • Moderate to highly impactful for the project
Working partnerships	• Potential partnerships have also been identified • Moderate to high impact on the project, making it more feasible
Transport cost	• Uncertainty about cost for transportation • Agreement that transportation is feasible
Accept materials (5 yrs.)	• Uncertainty about ability to accept for 5 years • Impact of being able to do so is low to moderate • Being able would increase feasibility slightly
Accept materials long-term (20 yrs.)	• Uncertainty about ability to accept for 20 years • Impact of being able to do so is low to moderate • Being able would increase feasibility slightly
Lead to viable business	• Not likely • Not impactful to project
Secondary economic benefits	• Possible-very likely • Moderate to high impact • Beneficial
Long-term maintenance	• Possibly requires long term maintenance • Moderately impactful • Impacts feasibility

Biophysical

Type of Habitat	Quality	Quantity
Aquatic	• Improved or diminished? Unsure of impact	• Uncertainty about gain/loss • Unsure of impact of gain/loss • Some confident about loss, some unsure about gain
Shoreline	• Very likely improved • Moderate to high improvement • Beneficial	• Highly likely to be gained • Moderate to high change • Beneficial
River	• Uncertainty about gain/loss • Likely few changes • Unsure how project impacts river	• Uncertainty about gain/loss • Few likely changes • Project will still be beneficial
Wetland	• Improved or not impacted? Unsure of impact and benefit	• Uncertainty about gain/loss and impact
Terrestrial	• Improved or no impact? Unsure of impact, effect and benefit	• Uncertainty about gain/loss and impact

Biophysical (cont.)

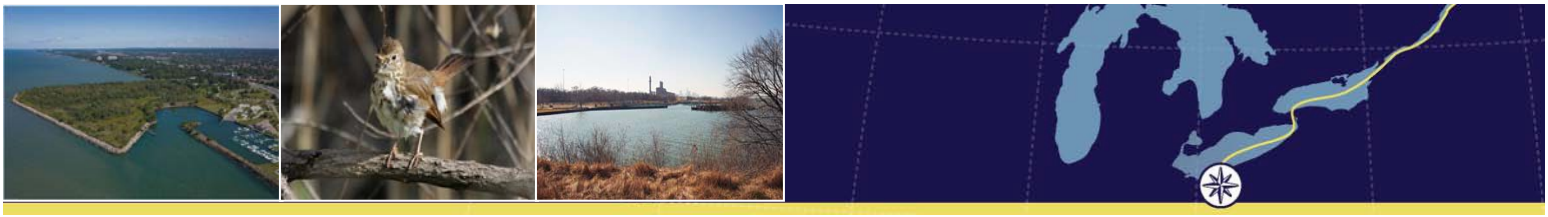
Priority Habitat	• Very likely • High impact • Beneficial
Species of Management Concern	• Very likely • High impact • Beneficial
Restoration of native species	• Very likely • High impact • Beneficial
Reduction of invasive species	• Likely to highly likely • Moderate impact • Unsure if harmful or beneficial
Stormwater control/protection	• Not likely • Stormwater control has little impact on the project
Contamination reduction	• Unsure but possible • Moderate impact • Would be beneficial
Strength of evidence: materials with elevated concentrations of contaminants of concern can be managed appropriately	

Built Environment

Reduction of contamination for end use	• Unsure if contaminants will be reduced for end use • It is not likely they can be, but there are few contaminants to reduce • Makes the project more feasible
Reduced demand for terrestrial borrow sources	• Highly likely • Large extent of reduction • Makes the project much more feasible
Provision of fill/cap for-	
Development site	• Unsure, possible provision of fill or cap • Moderate impact • Could make project more feasible
Construction	• Unsure, possible provision of fill or cap • Moderate impact • Could make project more feasible
Road	• Not likely • Low impact • Doesn't impact feasibility
Park or greenspace	• Not likely • Low impact • Doesn't impact feasibility
Strength of evidence: a controlled wildlife management area	

Social Considerations

Improve park access	• No • Unclear about benefit to human health and wellbeing
Potential for indirect job creation	• Likely doesn't lead to indirect job creation • Unclear about benefit to human health and wellbeing
Improve aesthetics	• May be likely to improve aesthetics • If improves aesthetics, impact is high • Beneficial to human health and wellbeing
Community involvement	• Unsure- community involved? • Would be moderately to highly impactful • Would be beneficial for human health and wellbeing
Reduce exposure	• Could reduce exposure • Low impact
Access to ecosystem services	• Possible to highly likely • Moderate to highly impactful
Infrastructure condition	• Not likely to improve infrastructure condition
New/improved infrastructure services	• Uncertain- may or may not be considered infrastructure improvements • Could be impactful
Strength of evidence: Duluth/Superior is a birding destination- social and economic well-being are improved.	



B.2. Cleveland Lakefront Nature Preserve Fact Sheet

The Cleveland Lakefront Nature Preserve (CLNP), formerly known as Dike 14, is an 88-acre manmade peninsula and is the only nature preserve in Cuyahoga County. It is a designated National Audubon Society important bird area because it is a haven for a remarkable variety of migratory birds and butterflies. CLNP is located at the intersection of four migratory bird routes. It also provides one-of-a-kind recreational and educational opportunities for children and adults to connect with nature on the waterfront. The Cleveland-Cuyahoga County Port Authority manages this community asset. CLNP officially opened to the public in February 2012 with great assistance from partners such as the City of Cleveland, State of Ohio Department of Natural Resources, Cleveland Metroparks and the Environmental Educational Collaborative.

Background

Cleveland Lakefront Nature Preserve was previously called Dike 14, a confined disposal facility (CDF) for sediments dredged from the Cuyahoga River and Cleveland Harbor. Dredging is the removal of sediments that build up on the bottom of the river. In order to maintain a safe shipping channel, the sediments are removed to allow ships to pass. Prior to the Clean Water Act of 1972, river sediments were put in the open lake or along the shoreline as fill to create more land. A CDF is a protected place to put the soils and sediments from the river's shipping channels and harbor to limit contaminated sediments from harming the health of the lake. Dike 14 was built in compliance with federal law to permanently hold and confine these sediments.

From 1979 to 1999, dredged sediments were placed in Dike 14 until filling operations ceased in 1999. Since 1999, this approximately 88-acre CDF began its natural transformation to a diverse natural area along Lake Erie. Over the years, this area has become naturalized with diverse habitats including forest, grasslands, meadows, and wetlands. It is now home to a diverse array of birds, including 23 of Ohio's 29 Endangered Species, and butterflies and mammals. This significant site provides a unique opportunity for public access to Lake Erie and is a natural oasis right in the heart of Cleveland. Cleveland's Dike 14 has earned the title *Cleveland Lakefront Nature Preserve*.

Environmental Investigations

Once sediment placement ended at Dike 14, the community began to imagine what the future would be for this area. Concerns lingered over possible contamination in the dredged sediments at the Dike. Over the years, the dredged sediment fill has dried out to now be considered soil. Grass, shrubs and trees began to grow across the once barren CDF. Wildlife came to this lakeside land for rest and shelter. Then the people began to visit the former CDF to see the results of this transformation.

In 2006 the Cuyahoga County Soil and Water Conservation District (SWCD) received a grant from U.S. EPA to assess the sediment within Dike 14. The environmental assessment was completed in 2007. Soil and water samples were collected to determine if elevated levels of contaminants were present. Exposures to contaminants were evaluated for recreational users, both adults and children, as well as for wildlife. Data was collected at Dike 14 to allow the community to determine if the Dike could be safely used as a nature preserve.

Overall, the data collected showed Dike 14 can be used safely as a nature preserve. Most of the 88- acre site does not need any environmental cleanup. An approximate 5-acre area which is located in the area of the former landfill has higher levels of some contaminants which include polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and some metals including chromium, lead, and mercury. These pollutants are present at levels above the cleanup criteria that were calculated for safe long-term use of the Dike. In 2008, further testing was conducted to determine how the soils at Dike 14 compared to the naturally occurring background levels of some metals in the Cleveland Eastern Lakefront area. Results showed that some metals present at Dike 14 in the area of the original landfill are higher than background levels. This testing further defined the area where remedial action is recommended.

Proposed Environmental Cleanup Objectives

The purpose of the cleanup of the property is to reduce the potential risks from direct contact with the soils containing higher levels of contaminants that are located within the approximately 5-acre former landfill area. It is the Cleveland-Cuyahoga County Port Authority's goal to improve and maintain the entire site as a nature preserve for the long-term protection of both human health and the environment. Consequently, the contaminant exposures have been assessed in consideration of these current and potential future uses. The proposed remedial actions in this 5-acre area will result in this 88-acre natural area meeting the cleanup goal and support the community's vision of having a low impact nature preserve with walking paths and viewing areas to observe wildlife. The Cleveland- Cuyahoga County Port Authority is committed to continuing to work with the community to enhance the Cleveland Lakefront Nature Preserve provide community access to the lakefront and create educational opportunities for generations to come.

Proposed Remedial Action Plan and Cleanup Alternatives

A "Proposed Remedial Action Plan and Analysis of Cleanup Alternatives" (RAP) has been prepared by Hull and Associates, Inc. for the Cleveland- Cuyahoga County Port Authority.

The remedial actions outlined in the RAP are based on findings and conclusions of the previous environmental assessment activities conducted between March 2007 and October 2008.

The following potential cleanup alternatives have been evaluated for their technical and economic feasibility, protectiveness of human health and the environment, ability to achieve the cleanup criteria, cost effectiveness, community acceptance, implementation time frame, and overall advantages and disadvantages, to determine which remedial option should be selected to remediate the approximately 5-acre former landfill area at the site:

No Further Action would involve no further remedial activities at the site, which means there is no cost and a short implementation time frame. The environmental concerns remain on site. Access to the Cleveland Lakefront Nature Preserve would be limited. The alternative would not provide for mitigation of the actual and potential risks posed by the contaminated soil and would not ensure long term protection of human health and the environment.

Permanent Fencing would require maintaining a permanent fence to limit public access. It requires low cost and short implementation time frame. The alternative would not provide for mitigation of the actual and potential risks posed by the contaminated soil and would not ensure long term protection of human health and the environment.

Excavation, Removal and Off-site Disposal would involve removing the contaminated soil from this area and disposing of it at an authorized off-site disposal facility. This approach presents risks to workers, risk to the public during transport, and moves the contaminated material to a new location. This alternative ensures long term protection of human health and the environment but has a high cost and takes a moderate amount of time to complete the work.

Soil Capping would involve limited disturbance of soils at the site in the approximately 5-acre area identified by the earlier environmental studies. The exposure pathway associated with direct contact would be mitigated by capping or covering the contaminated soil with a minimum of four feet of imported soils meeting the site-specific cleanup criteria. This alternative has a moderate cost and a moderate implementation time frame. Soil capping is generally cost-effective, implementable, and ensures long term protection of human health and the environment.

Next Steps

The Cleveland Cuyahoga County Port Authority has applied for funding from the U.S. Environmental Protection Agency Brownfield Revolving Loan Fund (administered by the Cuyahoga County Department

of Development) for the environmental remediation of a 5-acre area of Cleveland Lakefront Nature Preserve.

The documents regarding the project are available for public review until July 12, 2012, at the Cuyahoga County Department of Development at 1701 East 12th Street, 1st Floor, Cleveland, Ohio.

The public is asked to comment on the "Proposed Remedial Action Plan and Analysis of Cleanup Alternatives." All public input will be inclusive, engaged and part of the responsiveness summary. This responsiveness summary will be available in early fall 2012. To maintain community engagement activities, the Cleveland –Cuyahoga Port Authority will continue to communicate with the public as this process moves forward. Educational opportunities for the general public will be in partnership with the Environmental Educational Collaborative for the overall goal for the community to enjoy the Cleveland Lakefront Nature Preserve.

Appendix C: Scorecards

Scorecard A

Objectives

These scorecards are designed to utilize the knowledge developed by filling out and discussing the criteria worksheets. Scoring is based on either a Likert scale (score 1 through 5) or a yes/no (binary scale) denoting effect/no effect. The scorecards can be used to compare the criteria, and the scores can be transferred directly to the DMDT. Scorecards are best completed after stakeholders have worked through the Criteria Worksheet and feel comfortable with their understanding about the environmental, economic, social, governance, and build environment changes for each management alternative.

Instructions

Each tab of this MS Excel workbook is a scorecard containing the criteria from the DMDT. Reference the Criteria Worksheet for each management alternative to determine the likelihood, feasibility, and impact of each criterion for the alternative being considered. Definitions of each term are in the Criteria Worksheet Instructions and can be referenced throughout the scoring process.

Scorecard A

Scorecard A uses a 1-5 Likert scale to score each category of criteria. For most criteria, 1 represents low impact and 5 represents high impact. Criterion where the directional effect of scoring is negative will require reverse scoring. These criteria are identified on the scorecard, and the reverse scoring scale is written next to the criterion. To score each criterion, determine which number represents the impact of the criterion on the alternative being considered. Mark only one number per criterion. Mark N/A if a criterion is not applicable to the site being scored.

Scorecard B

Scorecard B uses a binary scoring system. Each criterion is assessed based on its presence or absence, with "yes" = present and "no"= absent. When transferred to the tool, “yes” responses score full points and “No” responses do not accumulate any points. To score the criteria, determine whether each criterion is present or absent and mark it accordingly. For Habitat Quantity and Quality, mark each habitat type “yes” if quality will be improved or quantity will be increased, and mark “no” if quality will be diminished or quantity will be decreased. Mark only one answer per criterion. Mark N/A if a criterion is not applicable to the management alternative being scored.

Scorecard C

Scorecard C can be used rank criteria for the scoresheets. The default rank is the list of criteria numbered from 1-50. Users are encouraged to also rank the criteria based on their priorities.

Scorecard A: Scoring 1-5

Impact Characterization (likelihood, impact, feasibility)					
5	4	3	2	1	N/A

		Definite	High	Moderate	Somewhat	Low	
Biophysical Environment	Rivers and streams habitat quantity gain/loss						
	Lakes and ponds habitat quantity gain/loss						
	Near coastal marine/estuarine habitat quantity gain/loss						
	Open water habitat quantity gain/loss						
	Wetlands habitat quantity gain/loss						
	Urban/Suburban habitat quantity gain/loss						
	Barren/rock and sand habitat quantity gain/loss						
	Rivers and streams habitat quality improved/diminished						
	Lakes and ponds quality improved/diminished						
	Near coastal marine/estuarine quality improved/diminished						
	Open water quality improved/diminished						
	Wetlands quality improved/diminished						
	Urban/Suburban quality improved/diminished						
	Barren/rock and sand quality improved/diminished						
	Impact on priority habitat						
	Benefit to species of management concern						
	Restoration of native vegetation						
	Reduction of invasive species						
	Increase stormwater control/protection						
	Influence biophysical environment by reducing contamination						

Impact Characterization (likelihood, impact, feasibility)

		5 Definite	4 High	3 Moderate	2 Somewhat	1 Low	N/A
Economy	Funding pathway identified						
	Funding application prepared						
	Partnerships established						
	Potential partnerships identified						
	Feasible transportation of dredged materials to the use site						
	Accept materials (5 years)						
	Accept materials long-term (20 years)						
	Lead to creation/growth of viable business						
	Secondary benefits created						
	Long-term maintenance required						

		Impact Characterization (likelihood, impact, feasibility)					
		5 Definite	4 High	3 Moderate	2 Somewhat	1 Low	N/A
Social	Improve access to parks or natural spaces						
	Potential for indirect job creation						
	Improve aesthetics						
	Community engagement						
	Reduced human exposure to contaminants						
	Improved access to ecosystem services						
	Improved infrastructure condition						
	New/improved infrastructure services for community						

Impact Characterization (likelihood, impact, feasibility)					
5	4	3	2	1	N/A

		Definite	High	Moderate	Somewhat	Low	
Governance	Maintain navigation channels						
	Enrollment in voluntary program						
	Able to complete within Environmental Windows						
	Included in existing guidance documents						
	Permitting timeline conducive with project timeline						
	Meets zoning requirements						
	Flexible timeframe						
	Replicable						
	Site ownership						

		Impact Characterization (likelihood, impact, feasibility)					
		5 Definite	4 High	3 Moderate	2 Somewhat	1 Low	N/A
Built Environment	Reduce contamination						
	Diversion to construction						
	Cap or fill (development sites, roads, greenspace)						

Scorecard B

Scorecard B: Yes/No				
	Criteria	**Yes**	**No**	**N/A**
Biophysical	Rivers and streams habitat quantity gain/loss			
	Lakes and ponds habitat quantity gain/loss			
	Near coastal marine/estuarine habitat quantity gain/loss			
	Open water habitat quantity gain/loss			
	Wetlands habitat quantity gain/loss			
	Urban/Suburban habitat quantity gain/loss			
	Barren/rock and sand habitat quantity gain/loss			
	Rivers and streams habitat quality improved/diminished			
	Lakes and ponds quality improved/diminished			
	Near coastal marine/estuarine quality improved/diminished			
	Open water quality improved/diminished			
	Wetlands quality improved/diminished			
	Urban/Suburban quality improved/diminished			
	Barren/rock and sand quality improved/diminished			
	Impact on priority habitat			
	Benefit to species of management concern			
	Restoration of native vegetation			
	Reduction of invasive species			
	Increase stormwater control/protection			
	Influence biophysical environment by reducing contamination			
Economy	Funding pathway identified			
	Funding application prepared			
	Partnerships established			
	Potential partnerships identified			
	Feasible transportation of dredged materials to the use site			
	Accept materials (5 years)			
	Accept materials long-term (20 years)			
	Lead to creation/growth of viable business			
	Secondary benefits created			
	Long-term maintenance required			
Social	Improve access to parks or natural spaces			
	Potential for indirect job creation			
	Improve aesthetics			
	Community engagement			
	Reduced human exposure to contaminants			

	Improved access to ecosystem services			
	Improved infrastructure condition			
	New/improved infrastructure services for community			
Governance	Maintain navigation channels			
	Enrollment in voluntary program			
	Able to complete within Environmental Windows			
	Included in existing guidance documents			
	Permitting timeline conducive with project timeline			
	Meets zoning requirements			
	Flexible timeframe			
	Replicable			
	Site ownership			
Built Environment	Reduce contamination			
	Diversion to construction			
	Cap or fill (development sites, roads, greenspace)			

Scorecard C

Scorecard C: Ranking		
Criteria		**Rank**
Biophysical	Rivers and streams habitat quantity gain/loss	
	Lakes and ponds habitat quantity gain/loss	
	Near coastal marine/estuarine habitat quantity gain/loss	
	Open water habitat quantity gain/loss	
	Wetlands habitat quantity gain/loss	
	Urban/Suburban habitat quantity gain/loss	
	Barren/rock and sand habitat quantity gain/loss	
	Rivers and streams habitat quality improved/diminished	
	Lakes and ponds quality improved/diminished	
	Near coastal marine/estuarine quality improved/diminished	
	Open water quality improved/diminished	
	Wetlands quality improved/diminished	
	Urban/Suburban quality improved/diminished	

	Barren/rock and sand quality improved/diminished	
	Impact on priority habitat	
	Benefit to species of management concern	
	Restoration of native vegetation	
	Reduction of invasive species	
	Increase stormwater control/protection	
	Influence biophysical environment by reducing contamination	
Economy	Funding pathway identified	
	Funding application prepared	
	Partnerships established	
	Potential partnerships identified	
	Feasible transportation of dredged materials to the use site	
	Accept materials (5 years)	
	Accept materials long-term (20 years)	
	Lead to creation/growth of viable business	
	Secondary benefits created	
	Long-term maintenance required	
Social	Improve access to parks or natural spaces	
	Potential for indirect job creation	
	Improve aesthetics	
	Community engagement	
	Reduced human exposure to contaminants	
	Improved access to ecosystem services	
	Improved infrastructure condition	
	New/improved infrastructure services for community	
Governance	Maintain navigation channels	
	Enrollment in voluntary program	
	Able to complete within Environmental Windows	
	Included in existing guidance documents	
	Permitting timeline conducive with project timeline	

	Meets zoning requirements	
	Flexible timeframe	
	Replicable	
	Site ownership	
Built Environment	Reduce contamination	
	Diversion to construction	
	Cap or fill (development sites, roads, greenspace)	

Appendix D: Criteria List Adjustment Directions

Criteria List Adjustment
On the Scoresheets, default criteria are listed in Column B with their categorical grouping displayed in Column A. If users seek to add/remove/replace criteria:

1. Determine categorization of new criteria
2. Determine holdover criteria from default list
3. Swap new criteria with undesired default criteria as able
4. Add new rows for new criteria in categories that ran out of rows and enter new criteria
5. Delete remaining undesired criteria
6. Adjust formula datasets for each section required (see below)

Adjust formula datasets for each section required:
Note: Variables requiring adjustment color coded in instructions to assist user

- Percentile calculation
  - Column D: =PERCENTRANK.INC(C$30:C$**79**,C**x**,3)
  - **79** → adjust to row number Column C is increased or reduced to
  - **x** → corresponding cell row

- Weighting Factor
  - Column F: =ROUND((1-((1-**F$29**)/(MAX($D$30:$D$**79**)-MIN($D$30:$D$**79**))*D**x**))*E**x**,2)
  - **F$29** → weighting factor scale cell – user can input lower limit; default is set to .05 in cell **F29**
  - **79** → adjust to row number Column D is increased or reduced to
  - **x** → corresponding cell row

- Weighting Factor Sum (per criteria category)
  - Column G: =SUM(F**x**:F**y**)
  - **x** → beginning cell row for corresponding criteria category section
  - **y** → ending cell row for corresponding criteria category section

- Weighting Factor Share (per criteria category)
  - Column H: =G**x**/SUM(G$30:G$**79**)
  - **79** → adjust to row number criteria columns are increased or reduced to
  - **x** → cell row in Column G that each criteria category section begins

- Calculated score columns (“W” – weighting factor applied calculated score)
  - Column **L**: =$F**x***K**x***(**K**$25=”OK”)
  - **NOTE: There are 3 scoring sections; Column **L’s** formula is for the 1st scoring section*
    - *For Column **O** (2nd scoring section), replace Column **K** with Column **N***

        - *For Column **R** (3rd scoring section), replace Column **K** with Column **Q***
    - **x** → corresponding cell row
- Category score display ("C" – category score percentage)
    - Column **M**: =SUBTOTAL(9,L**x**:L**y**)/$W**x**
    - **NOTE: There are 3 category score displays; Column **M's** formula is for the 1st scoring section*
        - *For Column **P** (2nd scoring display), replace Column **L** with Column **O***
        - *For Column **S** (3rd scoring display), replace Column **L** with Column **R***
    - **x** → beginning cell row for corresponding criteria category section
    - **y** → ending cell row for corresponding criteria category section

- Total points score (Point total scores for each of the 3 alternatives)
    - **K**81 =SUM(L**x**:L**y**)
    - **NOTE: There are 3 point total scores; cell **K**81's formula is for the 1st alternative total score*
        - *For **N**81 (2nd total point score), replace **L** with **O***
        - *For **Q**81 (3rd total point score), replace **L** with **R***
    - **x** → beginning criteria row in Column **L**, Column **O**, and Column **R**
    - **y** → ending criteria row in Column **L**, Column **O**, and Column **R**

- Percentage of maximum total score (for each of the 3 alternatives)
    - **K**83 =**K**81/$W81
    - **NOTE: There are 3 percentage of maximum total score displays; cell **K**83's formula is for the 1st percentage of maximum total score display*
        - *For **N**83 (2nd percentage of maximum total display), replace **K** with **N***
        - *For **Q**83 (3rd percentage of maximum total display), replace **K** with **Q***

- Percentage check
    - H77 =SUM(H30,H46,H56,H64,H73)
    - (H30,H46,H56,H64,H73) represents all of the category score percentages – any categories added/removed need to be included/removed from this formula

- Criteria denominator calculations (Maximum score calculation for each individual criterion)
    - Column V =F**x***J$29
    - **x** → corresponding criteria cell row

- Criteria category section calculations (Maximum score calculation for each criteria category)
    - W**x** =SUBTOTAL(9, V**x**:V**y**)
    - **x** → beginning criteria row for category section

- **y** → ending criteria row for category section

- Graph controls
  - Columns AA to AE (*see Figure 9*)
  - Each criteria category section score for each alternative is calculated by the formula: =SUM(**L**x:**L**y) ; where L is used for Alternative 1 and is substituted by **O** (Alternative 2) or **R** (Alternative 3)
  - **x** → beginning cell row for corresponding criteria category section
  - **y** → ending cell row for corresponding criteria category section
  - *Maximum Potential Score* transfers the criteria category section calculations that have been performed previously in Column W
    - =W**x** ; **x** → beginning cell row for corresponding criteria category section

	AA	AB	AC	AD	AE
27					
28	**Graph Controls**				
29	Category	*Alternative 1*	*Alternative 2*	*Alternative 3*	***Maximum Potential Score***
30	Biophysical Score	16.0	26.0	24.8	41.9
31	Economy Score	18.5	21.1	18.0	26.3
32	Social Score	10.2	9.1	9.5	23.9
33	Governance Score	17.3	15.6	14.6	18.0
34	Built Environment Score	6.4	5.5	4.7	10.7
35					

Figure 23. Comparison graph controls.

Appendix E: Background research and workshops

We utilized translational science principles to better connect the interests of stakeholders who varied in their technical, policy, social, and ecological knowledge about the beneficial use of dredged material. Translational ecology seeks to "link ecological knowledge to decision making by integrating science with the social dimensions that underlie today's complex environmental issues" (Wall et al. 2017, p551). This translational approach is part of the larger set of approaches such as the co-production of science and policy, boundary work, and usable science, that is meant to close the gap between the researchers who produce science, the practitioners who apply scientific knowledge, and the public (Dilling and Lemos 2011; Lemos and Morehouse 2005).

Translational approaches maintain the integrity of different perspectives (e.g., USEPA Region 5, USEPA ORD, USACE, Great Lakes Dredging Team) and facilitate communication among them. Ecosystem services related to the beneficial use of dredged materials have biophysical and social dimensions, thus can be used as a boundary concept or concept that has meaning to different audiences even if the meaning is not the same (Mollinga 2010). Recognizing the ecosystem services dimension to dredged materials facilitates the consideration of social values in the beneficial use of dredged material, which has not previously been addressed in the Great Lakes.

We had two main objectives of this applied research project:

1) Comprehensively characterize the barriers, opportunities, programs, and human benefits associated with dredge material beneficial use, and
2) Translate this research into actionable information for stakeholders and decision-makers (including USEPA Regional Offices) using collaborative methodologies in collaboration with stakeholders.

To better understand beneficial use of dredged materials and begin scoping the required decision input knowledge and data, we qualitatively analyzed successful brownfields revitalization projects that used dredged materials. We employed the Neighborhood Model (Williams et al. 2018) to identify and characterize the decision elements. The documents were analyzed with both deductive and inductive approaches to content analysis (Hsieh and Shannon, 2005; Creswell, 2013). All analyses were conducted using NVivo (QSR International, 2017) computer-aided qualitative data analysis software. NVivo was used to aid in researcher coding of documents, and compilation of materials for the analysis.

Additionally, we identified case studies of the beneficial use of dredged materials both within and outside the United States. Cases were compiled and organized into a database that both informed this research and can be used as a supplementary resource to this manual. The instructions for the database can be found in Appendix F.

Through the case study analysis, we identified regulatory and administrative requirements, including biophysical characteristics of the sediment and the desired outcomes for each decision. The initial sites we studied were in Duluth, Minnesota. The first site studied was the Duluth-Winnipeg-Pacific brownfields remediation and habitat restoration, where dredge material was used as a cap to cover contaminated soils. We chose this site because the City of Duluth identified it as a community revitalization success. The study of this site was supplemented with a similar analysis of two other sites in the Duluth-Superior Harbor: the 40th Avenue West aquatic habitat restoration and the Atlas Cement brownfields remediation. We were able to extract the most relevant decision criteria for three different scenarios: aquatic habitat restoration, brownfields remediation to industrial use, and brownfields remediation to terrestrial habitat restoration, by mapping the governance structure using a who-what-

how-outcomes frame (Williams et al. 2018).

Presentations and workshops were conducted with stakeholders from the Duluth Dredge Materials Management Team led by the USACE. This team agreed to participate in this research because of their interest in collaboratively managing dredge materials and promoting beneficial use when feasible. An initial meeting was held with the stakeholders to introduce the DMDT in October 2019. Based on discussions at this meeting, we became concerned the tool was too complex or abstract for some users. To remedy this challenge, a set of worksheets and scorecards (Appendix A and B) were created to ensure that users would have the background knowledge and technical details needed to use the DMDT.

A second meeting was held in February 2020 to share the decision criteria that had emerged from research (Table 3). Stakeholders provided valuable insight that was used to revise the criteria, worksheets, and scorecards. This research was utilized to create two exercises for stakeholders to apply to a beneficial use decision at an in-person workshop in March 2020 (Fig. 22; beneficial use management alternative profiles in Appendix C). To enhance the learning potential, a case that was already familiar to the participants was chosen as an example. This approach provided an opportunity to use the DMDT in a familiar context. The group made suggestions for how to enhance definitions, alerted the team to important details and distinctions, and explained to the team why the DMDT would have utility for them.

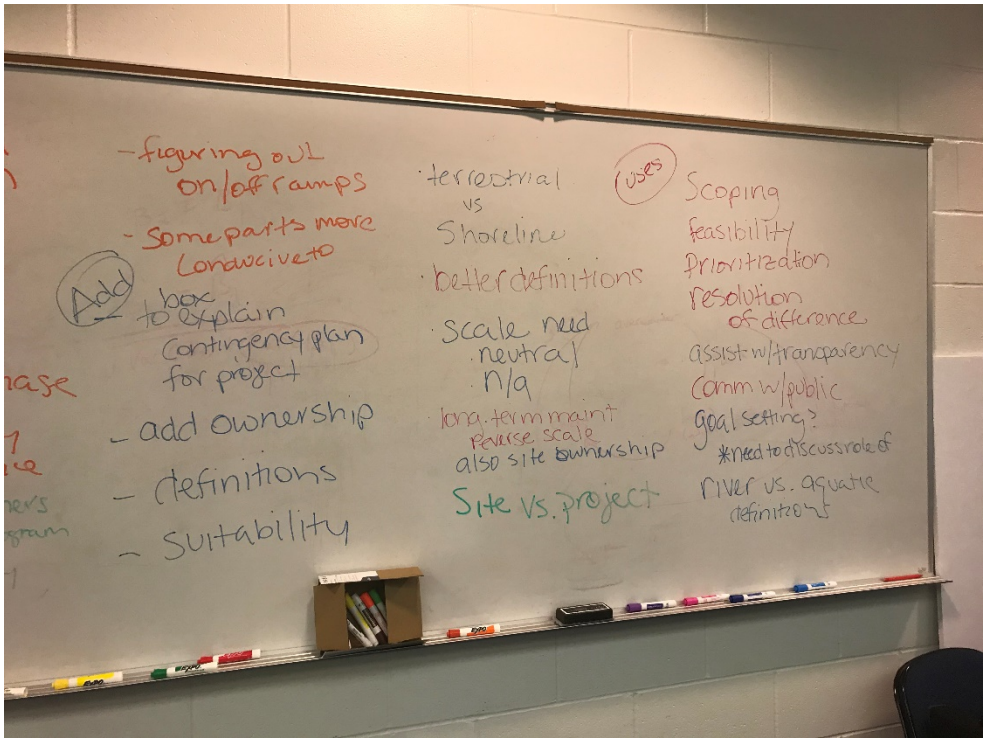


Figure 24. Notes from March 2020 workshop.

This instruction manual was finalized after the last workshop. It reflects both the research that informed the enhancement of USEPA Region 5's decision tool and the experiences of those who experimented with the tool. This project is a translational research product that has connected beneficial use of dredged materials and habitat restoration with the social system of decision making.

Limitations

The intent of USEPA Region 5 was to consider the environmental, economic, and social elements of

beneficial use management alternatives to inform decisions. In our case studies, however, it was not always easy to consider all three elements in any project. Only two elements were actively considered in most the case studies we used to inform this research project. Environmental and economic considerations were the most important decision drivers for the 40th Avenue West case and the Atlas Cement case. The 40th Avenue West case was an aquatic habitat restoration with little public access. The Atlas Cement case was a brownfield that the City of Duluth intends to be industrial development with little public access. Only the Duluth-Winnipeg-Pacific had a social element to the project because it was a terrestrial habitat restoration for recreational use. Future research should try to strengthen the social indicators or criteria.

Another limitation was a change in staff with one of our collaborating agencies left us without a strong collaborator in that agency. We were able to engage closely with the natural resource managers working on the habitat restoration work in the St. Louis River Area of Concern and Duluth-Superior Harbor. The result is that the environmental criteria is strong and represents much of the habitat restoration that may beneficially use dredged materials. We were not, however, able to deepen our social criteria, nor those indicators important to economic developers. This is a gap that should be filled with further research because it will have utility for USEPA Region 5 and other regions who support communities.

When we were able to connect with economic development staff, they indicated that it was difficult to see how dredged materials could be beneficially used in their projects. They cited typical barriers to using the materials – that the materials may not be geotechnically appropriate for construction and it may be difficult to transport. We realized that one of the main challenges to using dredged materials in communities is not just the complexity of the decisions, but also the perceptions that the materials may not be useful. The DMDT was created to address the supply of dredged materials, but not necessarily how to create demand for the materials. The experience is different in Cleveland, Ohio where there is a company in the port that sorts and amends dredged materials to create a geotechnically sound resource.

To demonstrate how to use the tool in the community context, we envision conducting a comparative study in a Great Lakes port with more demand for dredged material by a community. We would suggest this case would need a strong municipal partner to demonstrate how to fill the gap on decision making in and with communities. But most importantly, we look forward to continuing this study.

Appendix F: Beneficial use case database instructions

Introduction to the Database

This database is designed to accompany the beneficial use of dredged material decision tool (DMDT). It is a relational database with tables that represent elements of dredged material management decisions, such as stakeholder type, material type and beneficial use management alternative type. The tables that represent decision elements are interrelated and organized primarily through common data columns in one-to-many relationships between the primary row of one table and one or more rows of related tables. The research demonstrated that users may be most interested in finding similar types of beneficial use management alternatives or projects in a particular type of habitat or site. This structure allows individual projects or beneficial use management alternatives to be associated with several sites, and individual sites to be associated with several projects.

Project information includes the costs, plans and designs for beneficial use projects. Site information includes data pertaining to the geographic locations where materials are beneficially used. Project-site information includes all data specific to the project and site together.

The database currently contains data for 6 projects, which contain 11 sites that have or will receive dredged materials. Some projects are in progress and data collection is ongoing. As that data becomes available it will be added to the database, along with data from other beneficial reuse projects.

Instructions for navigating the database

Naming Conventions

Naming conventions are used to label each type of data. They are used so database users can easily identify the type and purpose of all database objects. These conventions can be confusing at first, so the reference tables below have been created to define the type of information each data label represents. Overlap will occur when tables are connected using the same data fields.

Site Information Table (site_info)	
site_id	Automatically generated site identification number
site_code	Alphabetical site ID using letters from the site name
site_name	Name of site where dredged material is placed
site_lat	Site latitude
site_long	Site longitude
site_owner	Site owner, if applicable
site_municipality	Municipality where site is located
site_state	State where site is located
site_country	Country where site is located
site_classification	Site classification based on reason for placing material at site
site_size	Size of site (acres)

Project Information Table (project_info)	
project_id	Automatically generated project identification number
project_code	Alphabetical project ID using letters from the project name
project_name	Name of project
project_start	Year project began
project_end	Year project ended/will end
project_lead	Lead organization/agency for project
project_cost	Project cost
project_dredging_cost	Total cost of dredging, transportation and placement of dredged materials
project_reuse_purpose	The purpose or reason for using dredged materials as part of the project

Project Site Information Table (project_site_info)	
project_site_id	Automatically generated project site identification number
project_info_id	Foreign key to project_info table. Connects project info to site info.
project_name	Foreign key to project_info table. Used to help identify project in project site table.
site_info_id	Foreign key to site_info table. Connects site info to project info.
site_name	Foreign key to site_info table. Used to help identify site in project site table.
biophys_species_yn	Yes/No, indicates species of concern impacted at project site
biophys_species_list	List of impacted species of concern
biophys_vegetation_yn	Yes/No, indicates increase of native vegetation at project site
biophys_vegetation_list	List of impacted native vegetation
biophys_invasives_yn	Yes/No, indicates invasive species reduced at project site
biophys_invasives_list	List of impacted invasive species
biophys_strmwtr_control_yn	Yes/No, indicates creation of or increased stormwater controls
biophys_contam_reduced_yn	Yes/No, indicates contamination that could harm biophysical environment is reduced
biophys_contam_type	List of contaminants that are reduced
social_access_yn	Yes/No, indicates increased accessibility at project site
social_jobs_yn	Yes/No, indicates jobs created at or near project site
social_aesthetics_yn	Yes/No, indicates aesthetics are positively impacted at project site
social_es_access_yn	Yes/No, indicates increased access to ecosystem services
social_infrastructure_yn	Yes/No, indicates infrastructure is built or improved at project site
social_infrastructure_improvements	List of infrastructure improvements
dredging_material_amount	Amount of dredged materials (c/y) project site accepted/will accept
dredging_contractor_id	Dredging contractor, usually an organization
dredging_entity_id	Entity mandating the dredging work, not necessarily the same as entity doing the dredging work
dredging_site_id	Name of site dredged materials are taken from, pick from list
dredging_sites_other	Write out name of dredging site if not an option on list
barge_transport_type	Yes/No, indicates if barge was used for transport
pipeline_transport_type	Yes/No, indicates if pipeline was used for transport
truck_transport_type	Yes/No, indicates if truck was used for transport

Project Site Stakeholder Table (project_site_stakeholder)	
project_site_stakeholder_id	Automatically generated project site stakeholder identification number
project_site_id	Foreign key to project_site_info table. Connects project site info to list of stakeholder types.
stakeholder_id	Foreign key to stakeholder_types table. Connects list of types of stakeholders to project sites.

Biophysical Habitat Criteria Table (biophysical_habitat_criteria)	
biophysical_habitat_criteria_id	Automatically generated biophysical habitat criteria identification number.
project_site_id	Foreign key to project_site_info table. Connects project site info with habitat info.
habitat_quantity_quality_id	Foreign key to biophysical_habitat_quantity_quality table. Connects changes in habitat quality and quantity to habitat and project site info.
biophysical_habitat_type_id	Foreign key to biophysical_habitat_type table. Connects types of habitat to changes in habitat quality/quantity and project site info.

Project Site & Dredging Category Table (project_site_dredging_category)	
project_site_dredging_category_id	Automatically generated project site dredging category identification number.
project_site_id	Foreign key to project_site_info table. Connects project sites with list of dredging category (type of dredging) info.
dredging_category_id	Foreign key to dredging_category table. Connects type of dredging with project site info.

Project Site & Dredged Material Table (project_site_dredged_material)	
project_site_dredged_material_id	Automatically generated project site dredged material identification number.
project_site_id	Foreign key to project_site_info table. Connects project sites with list of types of dredged material.
dredging_material_type_id	Foreign key to dredged_material_type table. Connects list of type(s) of dredged materials with project info.

Tables

On the left side of the database is a navigation bar entitled “All Access Objects.” In this navigation bar is the subtitle “Tables.” As a user of the database, you can access the data from the tables using pre-constructed reports and queries (instructions are below). If you are familiar with Access databases, you can use the tables to obtain information, but these instructions will focus specifically on reading reports and queries.

Reports and Queries

Reports summarize all available data pertaining to a specific topic, while queries pull information from multiple tables and allow you to retrieve specific data using parameters. No report or query contains all project and site information, but by viewing each of the reports or queries associated with a specific project-site you can view all data pertaining to that project-site. Listed below are all reports and search queries with instructions. To apply new parameters to a query you already have open, select the Refresh All button at the top of the page (Fig. 25).

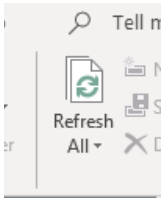


Figure 25. Refresh all button to apply new search parameters.

Project Type

Project, also known as beneficial use management alternative, data consists of data specific to and dependent upon the project plans and designs. This data is located in the project_info table. There are two ways to access project specific data:

1. To view Project Info data for all projects in the database, double click "project_info_query_report" under the Reports tab (the Reports tab is located under All Access Objects in the navigation bar on the left part of the screen). The table in the report contains all existing data from the Project Info table.

2. To search for projects by project type, double click "Search by project type (reuse purpose)" under the Queries tab. This query pulls in the project site information for each project. For each project, the reuse purpose has been assigned a numerical identification number. To sort projects by reuse purpose, type the associated identification number in the search box. The reuse purposes and identification numbers are listed below.

1	Aquatic habitat
2	Beach nourishment
3	Brownfield capping
4	Construction fill
5	Enhancing degraded farmland
6	Incorporation into lightweight aggregate material
7	Landfill capping
8	Manufacturing coal and bricks
9	Mine reclamation
10	Producing manufactured topsoil
11	Recreational greenspace
12	Structural and shoreline protection
13	Terrestrial habitat restoration, creation and development

Stakeholder Type

Stakeholders are the groups and organizations interested in and/or involved with the project. Stakeholders are associated with specific project sites. To search by stakeholder type use one of the following processes:

1. To view Stakeholder data and all associated projects and sites in the database, double click "stakeholder_query_report" under the Reports tab. The table contains a list of each project, site and stakeholder group.
2. To search by stakeholder type, double click "Search by stakeholder type" under the Queries tab. This query pulls in project site data. Each stakeholder type has been assigned a

numerical identification number. To sort projects by stakeholder type, type the associated identification number in the search box. The identification numbers are listed below.

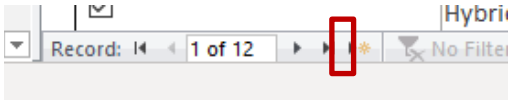
1 Advocacy Organizations, any scale
2 AECOM (American multi-engineering firm)
3 City Council
4 City Department of Tourism
5 City Department of Transportation
6 City Parks and Recreation
7 City Planning Department
8 Conservation Organizations, any scale
9 County Administration
10 County Water/Conservation District
11 Local Citizen or Community Group (organized)
12 National Estuarine Research Reserve
13 National Oceanic and Atmospheric Administration
14 Port Authority
15 Private Business
16 Private Residents
17 Recreation (outdoor) Organizations, any scale
18 Regional or Municipal Development Authority
19 State Department of Health
20 State Department of Natural Resources
21 State Department of Tourism
22 State Department of Transportation
23 State Historical Preservation Society
24 State Parks Service
25 State Pollution Control Agency
26 Technical Advisory Group
27 University
28 US Army Corps of Engineers
29 US Department of Energy
30 US Environmental Protection Agency
31 US Fish and Wildlife Service
32 US Forest Service
33 US Geological Survey

Dredged Material Type

Dredged materials are sediment or excavated material with different organic properties. For classification within this database, dredged materials have been identified as clay (.00049-.0038mm), organic fines (.0039-.0624mm), sand (.0625-2.00 mm), and gravel or pebble (2.01-64.00mm). To search for project sites based on the type of material they required, use one of the following processes:

1. To view dredged material type data and all associated project sites in the database, double click "project_site_dredged_material_type_query_report" under the Reports tab. The report contains tables with the dredged material types and each associated project site. Some project sites utilized several types of dredged materials, so the records repeat for each different

material type. To look at each record, press the arrow at the bottom left of the record (see image below).



2. To search for project sites by dredged material type, double click "Search by dredged material type" under the Queries tab. Each dredged material type has been assigned a numerical identification number. To sort project sites by dredged material type, type the associated identification number in the search box. The identification numbers are listed below.

1	Sand
2	Gravel or pebble
3	Organic fines
4	Clay

Dredged Material Source (dredging category)

Dredged material most often comes from Operations and Maintenance dredging, Capital dredging, project dredging, or confined disposal facilities. To search for project sites based on where the dredged material was sourced, use one of the following processes:

1. To view project sites based on dredged material source, double click "project_site_dredged_material_source_query_report" under the Reports tab. The report contains a table with the dredged material source and each associated project site.
2. To search for project sites by dredged material source, double click "Search by dredged material source" under the Queries tab. Each dredged material source has been assigned a numerical identification number. To sort project sites by dredged material source, type the associated identification number in the search box. The identification numbers are listed below.

1	Capital
2	Operation & Maintenance
3	Project
4	Confined Disposal Facility

Habitat Type

Beneficial use projects can increase or decrease the quantity and improve or diminish the quality of different spatial environments. For this database, these spatial environments are referred to as habitats and include aquatic and terrestrial environmental classes. To search for project sites based on impacted habitat types, follow one of the following processes:

1. To view project sites and the habitats they impact, double click "project_site_habitat_type_query_report" under the Reports tab. The report contains a table with each project site and associated impacted habitat types.

2. To search for project sites by impacted habitat type, double click “Search by impacted habitat type” under the Queries tab. Each habitat type has been assigned a numerical identification number. To sort project sites by habitat type, type the associated identification number in the search box. The identification numbers are listed below.

1	Rivers and streams
2	Lakes and ponds
3	Near coastal marine/estuarine
4	Open ocean and sea
5	Wetlands
6	Forests
7	Agroecosystems
8	Grasslands
9	Scrubland/shrubland
10	Tundra
11	Ice and snow
12	Urban/suburban
13	Barren rock/sand

Ecosystem Services

Ecosystem service are things from nature that benefit human well-being (Boyd and Banzhaf 2007). Search for potentially impacted Ecosystem Services using one of the following processes:

1. Using the habitat identification numbers listed above, you can search for project sites and their potentially impacted ecosystem services. After using the steps above to determine which habitats are impacted by a specific project, double click “Search for ES by habitat ID” under the Queries tab. Type in the identification number for the impacted habitat type and hit enter. All potentially impacted ecosystem services will appear.
2. Using the project identification number, you can search for all potentially impacted ecosystem services associated with a specific project. Double click “Search for ES by project ID” under the Queries tab. To view the ecosystem services associated with a given project, type in the associated ID. Project ID’s can be found in the “project_info_report” or “project_info_query” mentioned earlier.

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