7. Perform Field Investigations

Following the site selection, you must perform detailed field investigations. They can provide the information required to proceed with the harbor layout and design of the new harbor facility. Coordinate and sequence tasks to make the best use of time and resources while reducing costs.

7.10 Surveying

Obtaining proper upland and hydrographic surveys of a proposed harbor site is necessary to optimize the harbor layout. Many problems arise in coastal development when vertical data are not set and consistently adhered to by all contractors, regulatory agencies, and consultants. The accuracy in estimating breakwater and dredging quantities, as well as earthwork for upland access and development, depends on the accuracy of related surveys.

Include SURVEYING when:

1) There are no existing data or when updated information is necessary.

2) Providing data on land value, ownership, etc.: See section 7.11

3) Establishing property boundaries, easements, etc.: See section 7.12

4) Mapping the underwater contours: See section 7.13

Note 1. Ensure control **data** for hydrographic and topographic surveys (MLLW, NGVD, MLW, etc.) **are consistent** for all uses.

Note 2. In most cases, hydrographic, geophysical, and upland surveys can be coordinated and performed at the same time under a single contract.

REFERENCES:

1. ASCE Manual No. 50. Task Committee on Marinas 2000. 1892. *Planning and Design Guidelines for Small Craft Harbors.* New York. Pg 9-20.

2. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 76-79.

3. Davis, R.E., et. al. 1966. *Surveying: Theory and Practice.* New York: McGraw-Hill Inc. Pg. 594-595, 840.

7.11 Surveying: Cadastral

Land ownership plats, titles, deeds, and property line surveys determine the real estate needs and constraints of a proposed development, including rights-of-entry, easements, and other permissions to work at the site or on adjacent property.

Perform CADASTRAL surveys when:

1) There is any new construction.

2) Several property owners may be affected by the project.

3) Survey markers do not exist or cannot be located.

Note 1. If the project is well within the limits of only one property owner, such as the State or a municipality, a Cadastral survey may not be required.

Note 2. You may obtain existing surveys from city offices of the local community, Department of Natural Resources, Division of Lands, or other sources.

REFERENCES:

1. ASCE Manual No. 50. Task Committee on Marinas 2000. 1892. *Planning and Design Guidelines for Small Craft Harbors.* New York. Pg. 9-10.

2. Davis, R.E., et. al. 1966. *Surveying: Theory and Practice.* New York: McGraw-Hill Inc. Pg. 594-595, 840.

3. Tobiasson, B.O. & Kollmeyer, R.C. 1991. Marinas and Small Craft Harbors. New York: Van Nostrand Reinhold. Pg. 76-79.

7.12 Surveying: Topographic

Topographic contour maps also identify existing structures, roads, and upland elevations. These surveys are needed to produce a project base map for showing proposed excavations, grading, and new structures to be developed.

Include TOPOGRAPHIC surveys when:

1) Uplands need to be developed. This is generally to accommodate parking, road access, gear storage, etc.

2) You need up-to-date measurements in enough detail to adequately design the specific project.

Note 1. If recent surveys are necessary, contours should generally be about **0.3 meter (one foot)** throughout the project area.

Note 2. You should note any **rock outcrops**, buildings, or other permanent features that may affect construction.

REFERENCES:

1. ASCE Manual No. 50. Task Committee on Marinas 2000. 1892. *Planning and Design Guidelines for Small Craft Harbors.* New York. Pg. 9-10.

2. Davis, R.E., et. al. 1966. *Surveying: Theory and Practice.* New York: McGraw-Hill Inc. Pg. 630-652, 653-679.

3. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 76-79.

7.13 Surveying: Hydrographic

Hydrographic survey data are the basis for determining the sub-tidal elevations at the proposed harbor site and are needed to assess navigability and shoreline trends. They also help to evaluate wave and current conditions and project layout. You can measure and monitor shoreline changes from historical surveys and aerial photographs.

Include HYDROGRAPHIC surveys when:

1) No existing survey data are available to properly define the proposed site.

2) Additional or updated information is needed.

3) You need to calculate dredge volumes for the mooring basin and channels and/or identify the depth of breakwaters.

Note 1. Bottom contours are generally measured on the order of 0.3m or 1ft.

Note 2. Beach profiles change seasonably or with storm events. If a storm that alters the beach face occurs during the survey period, additional data may be useful.

Note 3. You should note any bottom composition, including bedrock, eelgrass, silts, shellfish, etc.

Note 4. Be sure data format is compatible with engineer drafting software.

Note 5. NOAA nautical charts are the primary source for existing hydrographic data. You can obtain more detailed data through the smoothed boat sheets.

REFERENCES:

1. ASCE Manual No. 50. Task Committee on Marinas 2000. 1892. *Planning and Design Guidelines for Small Craft Harbors.* New York. Pg. 9-10.
2. Davis, R.E., et. al. 1966. *Surveying: Theory and Practice.* New York: McGraw-Hill Inc. Pg. 763-835.
3. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 76-79.

7.20 Geotechnical

A geotechnical investigation and report provide the designer with the engineering properties of the materials on site. Information about surface materials, subsurface materials, and hard rock quarry sources are needed to determine material suitability for the construction and for estimating costs. An awareness of detrimental conditions, such as shallow bedrock or unconsolidated silt, early in the design process will aid in optimizing layouts or lead to exploring alternative sites.

GEOTECHNICAL surveys that you may need to include are:

1)	Surface Materials:	see section 7.21
2)	Sub-Bottom Materials:	see section 7.22
3)	Quarry Investigation:	see section 7.23

Note 1. You may **incorporate geotechnical** investigations **with hydrographic** survey.

REFERENCES:

1. State of Alaska DOT&PF. 1983. *Geotechnical Procedures Manual.* Division of Standards and Technical Services Materials Section. Anchorage, Alaska.
2. Hunt, Roy E. 1986. *Geotechnical Engineering Techniques and Practices.* New York: McGraw-Hill. Pg. 1-29

7.21 Geotechnical: Surface Materials

Classification, grain size distribution, and related statistical data within the dynamic area of beach and submerged surfaces, ranging from several inches to several feet, are used to assess the engineering parameters of the proposed site.

Include SURFACE material investigation:

1) Almost always! Unless a recent investigation was done, a material investigation is needed.

- Particular items you must evaluate:
  - Surface characteristics and material properties on the surface. These are used to predict beach dynamics. See sec. 5.5.
    Storm events may change surface materials periodically.
    This information is also used as input for littoral transport models.
  - Ease and cost of dredging and excavation. Choose appropriate equipment as necessary.
  - Beach nourishment and upland fill. Determine what material is available for beneficial use.

Note 1. If you observe **bedrock** near shore, composition and hardness may be a factor for pile driving, drilling pile sockets, or rock blasting for excavation or pile placement.

REFERENCES:

1. ADOT & PF Geotechnical groups.
2. NOAA Nautical charts.

7.22 Geotechnical: Sub-Bottom Materials

Sub-bottom materials provide the foundation for breakwaters and anchor piles. Evaluation of the types and conditions that will be encountered is very important.

You may need SUB-BOTTTOM investigation when:

1) The project will require dredging where bedrock may be a factor.

2) The project requires pile driving where bedrock or unconsolidated sediments may be encountered.

3) Rubble breakwater foundation is being placed on unconsolidated sediments.

Note 1. Assess suitability of material for use in construction purposes.

Note 2. Geophysical "Sonic" survey is one of the most cost-effective methods for mapping "depth to bedrock."

Note 3. Since geophysical surveys have a high cost, you should schedule these after the most viable site(s) have been identified.

Note 4. Expertise: geophysical engineer.

REFERENCES:

1. CIRIA SPECIAL PUBLICATION 83, CUR REPORT 154. 1991. *Manual on the Use of Rock in Coastal and Shoreline Engineering.* Rotterdam, Netherlands: A.A. Balkema Publishers. Pg 230-233.

7.23 Geotechnical: Quarry Investigation

You must select a rock source for use in marine structures based on detailed assessment of the rock's physical properties. Generalized criteria on quarry sources may be helpful in the preliminary selection of a potential site. These criteria may include the type of rock, weathering, shape, transport and handling influences on properties, and general discontinuity patterns of the material. The marine structure design should optimize use of available quarry material.

You may need a QUARRY INVESTIGATION when:

1) The project requires rock source for rubble - mound breakwaters, shore revetment, or upland fill.

2) Geologic consideration of source material is needed to establish boundary conditions.

Note 1. An approximation of stone sizes and quantities should be available before the investigation.

Note 2. **Take samples**!

Note 3. **Take photos** with identifiable scale.

Note 4. Expertise: geophysical engineer.

REFERENCES:

1. CIRIA SPECIAL PUBLICATION 83, CUR REPORT 154. 1991. *Manual on the Use of Rock in Coastal and Shoreline Engineering.* Rotterdam, Netherlands: A.A. Balkema Publishers. Chapter 3.

7.30 Environmental

It is important to obtain appropriate scientific studies early in the planning of a harbor. Addressing environmental concerns by gathering data and completing appropriate studies will assist in obtaining approvals and making informed decisions. It can also show the community the value of the changes being made.

ENVIRONMENTAL surveys you may include:

1)	Prospective Contamination:	see section 7.31
2)	Fish Migration:	see section 7.32
3)	Underwater Biota Assay:	see section 7.33
4)	Wetland Assay:	see section 7.34
5)	Dredge Disposal/Upland Development:	see section 7.35

Note 1. In order to maintain good flushing and circulation harbor layout, design basin geometry and perimeter protection for adequate water quality within the harbor.

REFERENCES:

1. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 45-63, 75-76, 215-216.
2. ASCE Manual No. 50. Task Committee on Marinas 2000. 1892. *Planning and Design Guidelines for Small Craft Harbors.* New York. Pg. 10-13.
3. Section 6217. *Protecting Coastal Waters*. Coastal Zone Act Reauthorization Amendments of 1990. Non Point Source Guidelines. Appendix I.

7.31 Environmental: Prospective Contamination

You must establish a viable plan for dredging requirements of the project. Information needed includes dredging location(s), volumes to be dredged, and disposal alternatives. In addition to the physical characteristics (see 7.21 and 7.22), you must evaluate the chemical and biological characteristics of sediments to determine potential dredging methods, beneficial use, disposal, or treatment options. The potential for environmental impacts affects the extent of biological testing requirements, and the necessity and content of a source control program. Awareness of possible contamination can help avoid costly mitigation later. Sampling can determine the extent of possible contaminants.

CONTAMINATION. Include chemical and biological investigation if:

1) The site is near commercial development.

2) Maintenance dredging or expanding an existing site is necessary.

3) The site is near an ADEC known spill database area.

4) The site is near outfall or discharge from industrial operations.

5) Sewage outfall is near the proposed site.

6) The site is near historically known mining operations.

7) Bottom material is silty - may retain contaminants. Cobble, gravel, or large material usually does not.

Note 1. Smaller villages without commercial activity or existing harbors are usually not subject to detailed investigation.

Note 2. Coordinate core sampling with geotechnical investigation.

Note 3. See Permits and Approvals (Appendix C) for types of permits required.

REFERENCES:

1. Army Corps of Engineers, EPA. 1992. Evaluating Environmental Effects of Dredged Material Management Alternatives--A Technical Framework. EPA842-B-92-008. Washington D.C.

2. Tobiasson, B.O. & Kollmeyer, R.C. 1991. Marinas and Small Craft Harbors. New York: Van Nostrand Reinhold. Pg. 45-53, 62.

7.32 Environmental: Fish Migration

Harbors and marine structures impeding fish migration or compromising water quality are design issues. You should consider both issues. To address these concerns, you may, for example, provide mildly sloping, curvilinear breakwaters and basin geometry to improve the aspect ratio and exchange rates. The design should also include non-point source pollution control (see Appendix I).

Include FISH MIGRATION investigation when:

1) Anadromous fish streams are affected by the placement of the harbor site.

2) The site is near a known fish rearing area.

Note 1. Avoid barriers steeper than about 1.5:1 so that juvenile salmonids can use them as habitat and migration passageway.

Note 2. Early in the project, coordinate with the Department of Fish and Game to determine the extent of detailed investigation necessary.

Note 3. Providing a breach through breakwaters has historically arisen as a means of improving fish migration. However, research has shown that breaches may provide little benefit to aid fish passage and in some cases, may decrease water quality and habitat.

REFERENCES:

We could obtain no reference material on breakwater design as it pertains to fish migration, although early coordination and assessment is indicated.

We suggest researching fish migration and rearing patterns on "artificial reef" vs. "natural" reef breakwaters as a way of mitigation.

7.33 Environmental: Underwater Biota

Coordinate with biologists or regulatory agencies to determine the biota that will be impacted by development of the harbor. Competent surveys will catalog quality and quantity of the species in the area. If the biotic communities will be adversely affected, mitigation may be necessary.

Include UNDERWATER BIOTA assay if:

1) The environmental agencies determine harbor site and study requirements during the environmental scoping process or permit review.

- Particular items that may be included in the evaluation:
  - Productive plant species, such as eelgrass.
  - Known fish rearing areas (herring, salmon fry).
  - Rich shellfish beds (clams, mussels, etc.).

Note 1. Use of an underwater video camera may give a sense of the conditions before a detailed study is directed.

Note 2. As a form of mitigation, we suggest surveying fish migration habits and using rock breakwaters to provide additional habitat in the inter-tidal zone.

REFERENCES:

1. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 78-79.

7.34 Environmental: Wetlands

Surveys to determine the species that inhabit a wetland area may be necessary when wetlands are impacted by the development of harbors and adjacent uplands. A qualified survey should include indexing the quantity and quality of the species present.

Include a WETLANDS survey if:

1) The regulatory agencies determine the area requires a detailed wetland assay.

2) Known species of wildlife inhabit the harbor site.

Note 1. Early in the design process, coordinate with the proper regulatory agencies, such as Fish and Game. Normally these agencies will conduct the survey.

Note 2. See Permits and Approvals (Appendix C) for valid information.

REFERENCES:

1. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 78-79.

7.35 Environmental: Dredge Disposal/Upland Development

A harbor project may include developing uplands for commercial use, parking, storage, or other support facilities. Alternatives for disposal of dredged material may include open-water disposal, confined disposal, or beneficial use. You must complete a plan formulated for the alternative disposal. You should give special consideration to beneficial use of dredged material for upland development.

Include DREDGE disposal/upland development when:

1) Dredging is necessary for development. Some plan for handling dredged material is required.

2) Harbor development determines the need to create additional uplands.

Note 1. If the beneficial uses for the material can aid the additional upland requirements, and the placement of dredged material is near the dredged site, rigorous chemical analysis may not be necessary.

Note 2. Material may be suitable for breakwater core. Side slopes can be flattened as necessary. Economics will usually be the deciding factor.

REFERENCES:

1. Army Corps of Engineers, EPA. 1992. Evaluating Environmental Effects of Dredged Material Management Alternatives--A Technical Framework. EPA842-B-92-008. Washington D.C.

7.40 Hydraulic

Measuring the unique site-specific water conditions of the Alaskan coastline that will affect the design parameters is sometimes difficult. Data collection will need to consider the forces the structures will have to tolerate. These conditions can include extreme tidal ranges, currents, river flows, flooding, and ice, along with boat traffic and wakes.

HYDRAULIC investigations you may include are:

1)	Waves:	See section 7.41
2)	Currents:	See section 7.42
3)	Littoral Processes:	See section 7.43

Note 1.

REFERENCES:

7.41 Hydraulic: Waves

Establish a local environmental observer (LEO) program. This will include periodic or storm-specific monitoring of the proposed site using a standard video camera.

Include WAVES investigation:

1) Always!

Note 1.

REFERENCES:

7.42 Hydraulic: Currents

Determine local current conditions early in the study so that the hydraulic engineer can consider the effects they might have on the project, and for use in physical model studies.

Include CURRENTS in the hydraulic studies when:

1) The project involves an existing harbor. What is the existing condition?

2) A river is in close proximity to the proposed harbor site. Track the longshore fresh water flow region.

3) There is potential for scour (usually wave induced longshore currents). Refer to the SPM definition of longshore currents for additional information.

4) They may have impacts on navigation.

5) Fish processing plant or sewer outfall is near the harbor site. Track flow from any outfall near site.

6) A physical model study is included in the study plan.

Note 1. Be certain to factor wind driven effects into the measurement of any tidal currents.

Note 2. If currents are a major factor in the design, you can include a simple float study in the initial site visit. In winter months, snowballs work well. In summer months, oranges, driftwood, or other neutrally buoyant objects are suitable. You can set up temporary range poles on shore for distance measurement.

REFERENCES:

1. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 158-164.

7.43 Hydraulic: Littoral Processes

During the initial field investigation of littoral processes, you must identify supply and demand of sedimentation to establish the sediment budget. The Shore Protection Manual is useful as a guide to littoral processes. A recent aerial photo can also be helpful in predicting the transport mechanisms at the site.

Include LITTORAL PROCESS evaluation when:

1) Establishing the sediment budget for the site.

2) A river or stream will affect the harbor site.

Note 1.

REFERENCES:

1. U.S. Army Corps of Engineers, Dept. of the Army. 1984. Shore Protection Manual. CERC. Vicksburg, Mississippi. U.S. Government Printing Office.

7.50 Planning and Economics

A team of experts in planning and economics will complete this task. However, it may be important for the engineer to aid in the analysis of fleet size, type, and harbor dredging requirements. Knowledge of recent trends in vessel design are vital to predict the future needs of moorage and dock design.

Include PLANNING AND ECONOMICS investigation:

1) Always! The planning and development of a harbor will depend on type, size, and numbers of vessels using the harbor.

Note 1. Optimizing the size of a harbor involves iteration between the economist and design engineer.

Note 2. The recommended National Economic Development (NED) plan on Corps projects has the greatest net benefits. This NED design maximizes the difference between the benefit and cost curves.

REFERENCES:

1. Tobiasson, B.O. & Kollmeyer, R.C. 1991. *Marinas and Small Craft Harbors.* New York: Van Nostrand Reinhold. Pg. 3-44.