CHAPTER 2

PROJECT IDENTIFICATION

Section I. Navigation Systems

2-1. General Considerations. During the design of an individual navigation dam project within a series of projects, one must consider the total navigation system. The total system of dams must be considered during preliminary site selection to establish the complete navigation layout. Navigation dams should be designed and located to provide for passage of flood flows and safe transit for all traffic expected to use the waterways when flow conditions permit. Other multipurpose functions such as irrigation and power may need to be accommodated. Site alternatives are usually considered and initial site selection determined in the early stages. Other disciplines (geotechnical, structural, etc.) should be involved in the site selection as in all major design decisions. The site selection is made by evaluating the physical characteristics of each potential site and making comparative estimates of costs and advantages for each site that would be adaptable to either a single or multipurpose project plan. Consideration must be given to whether one site has important hydraulic, foundational, operational, economic, or environmental advantages over other alternatives.

Section II. Project Purposes

2-2. General. Project purposes and their overall social, environmental, and economic effects greatly influence the hydraulic design of navigation dams. Optimization of the hydraulic design and operation requires an awareness by the designer of the reliability, accuracy, sensitivity, and possible variances of the data used. The ever-increasing importance of environmental considerations requires that the designer maintain close liaison with many disciplines to be sure environmental and other objectives are satisfied in the design, General project purposes and related design considerations are briefly discussed in the following paragraphs.

2-3. Purposes.

a. Navigation. Reservoirs that store water for subsequent release to downstream navigation usually discharge at lower capacity than flood-control reservoirs, but the need for close regulation of the flow is more important. The navigation season often coincides with the season of low rainfall, and close regulation aids in the conservation of water.

b. Flood Control. Flood control structures are designed for relatively large capacities where close regulation of flow is less important than are other requirements. When large discharges must be released under high heads, the design of gates, water passages, and energy dissipators should be carefully developed.

c. Irrigation. The gates or valves for controlling irrigation flows are often basically different from those used for flood control due to the necessity for close regulation and conservation of water in arid regions.

Irrigation discharge facilities are normally much smaller in size than flood regulation facilities. The irrigation outlet sometimes discharges into a canal or conduit rather than to the original riverbed. These canals or conduits are usually at a higher level than the bed of the stream.

d. Water Supply. Municipal water supply intakes are sometimes provided in dams built primarily for other purposes. Such problems as future water supply requirements and peak demands for a municipality or industry should be determined in cooperation with engineers representing local interests. Reliability of service and quality of water are of prime importance in water supply problems. Multiple intakes and control mechanisms are often installed to assure reliability, to enable the water to be drawn from any selected reservoir level to obtain water of a desired temperature, and/or to draw from a stratum relatively free from silt or algae or other undesirable contents. Ease of maintenance and repair without interruption of service is of primary importance. An emergency closure gate for priority use by the resident engineer is required for water supply conduits through the dam.

e. Power. Power plants are not within the scope of this manual. However, if power plants are to be located in the vicinity of the locks and/or dams, they should be designed so as not to cause conditions that are adverse to navigation or spillway operation such as adverse flow patterns in lock approaches, high pool-level fluctuations, or surge waves.

f. Low-Flow Requirements. Continuous low-flow releases are required at some dams to satisfy environmental objectives, water supply, downstream water rights, etc. To meet these requirements multilevel intakes, skimmer weirs, or other provisions must be incorporated separately or in combination with other functions of the navigation dam facility.

g. Multiple Purpose. Any number of purposes may be combined in one project. However, each added purpose will impact on project features and generally complicate project operational requirements.

Section III. Project Studies

2-4. General. The development of a navigation system involves a number of studies to determine the basic engineering feasibility of the proposed design. Study details are covered in later chapters, but a general discussion of some study purposes follows.

2-5. Project Water Requirements. Navigation projects require a minimum water supply for continuous operation. For projects with lock and dam structures, water supplies must be adequate to meet the following uses: lock filling and emptying needs (these depend on the proposed lock chamber size, lock lift, and maximum anticipated traffic); evaporation from the impounded pool; ground seepage from the pool; seepage under the dam; and leakage past spillway gates and other structural features. Minimum flows must also be adequate to meet the needs of other water-using project purposes such as water supply, irrigation, hydropower, environmental, etc. Procedures for evaluating minimum available flows are covered in Chapter 3.

2-6. Pool Levels. Navigation pool levels must be adequate to accommodate the drafts of design vessels plus the necessary clearances. Selected pool levels determine the dam classification. Dams with heads between 10 and 40 feet are generally considered low-head dams and those over 40 feet high-head dams. Because of the problems connected with overbank flooding, the pools of most navigation dams are essentially contained within the natural riverbanks, and would consequently be low-head projects. However, as explained in paragraph 3-11, navigation conditions are enhanced by the pool stability provided with high-head dams. If economically and environmentally feasible, high-head dams should be preferred.

2-7. Pool Storage. Inflow into navigation pools must always equal or exceed all outflows to ensure maintaining the navigation pool level. If natural minimum flows are inadequate to maintain the pools, flood storage should be provided to supplement natural flows during the low-flow periods. In an effort to minimize navigation pool fluctuations, the necessary storage should be provided in separate storage projects located in the drainage basin headwaters or on storage projects located on major tributaries.

2-8. Environmental. The general philosophy and guidance for preservation, mitigation, and/or enhancement of the natural environment have been set forth (item 33). Many scientific and engineering disciplines are involved in the environmental aspects of hydraulic structures. Some studies influencing the navigation dam design are briefly discussed below. Pertinent data from these studies should be presented in the design memorandum. The designers should have a working knowledge of these data and their limitations.

a. Fish and Wildlife. Navigation dam design and operation can maintain, enhance, or damage downstream fish and wildlife. Flow releases not compatible with naturally seasonal stream quantity and quality can drastically change aquatic life. These changes may be beneficial or may be damaging, such as adverse temperatures, chemical composition, or nitrogen supersaturation. Information from fish and wildlife specialists on the desired stream regimen should be obtained and considered in the design. Downstream wildlife requirements may fix minimum low-flow discharges. The water quality presentation should include summary data on requirements and reference to source studies.

b. Recreation. Recreation needs including fishing, camping, boating, and swimming facilities, scenic outlooks, etc., should be considered in the design of the project. These requirements are usually formulated by the planning discipline in cooperation with local interests. To accomplish the desired objectives, close cooperation between the hydraulic and planning engineers is required. Special consideration should be given to facilities for the handicapped, such as wheelchair ramps to fishing sites below stilling basins. Safety fences for the protection of facilities and the public are important. Appreciable damage to stilling basins has resulted from rocks thrown in by the public.

c. Water Quality. An awareness of maintaining and/or enhancing the environment within the past decade has brought into existence a relatively new and expanded art of reservoir hydrodynamics. Until recently, the study of

reservoir hydrodynamics has been limited to a few prototype vertical temperature gradients and recognition of the seasonal inversions accompanying the fall surface water cooling. However, environmental considerations of today have necessitated the development of preproject capability for prediction of the expected seasonal reservoir stratification and circulation to permit construction and operation of navigation dams designed to meet storage and outflow regimes needed for the reservoir and downstream environment. Reservoir hydrodynamic studies may be done by other than the hydraulic designer (such as the hydrologic engineers) and they would specify the withdrawal requirements (quantity, elevation, etc.). The hydraulic engineer then designs the navigation dam to meet these requirements. However, the hydraulic designer furnishes some of the information for the hydrologic studies. The most common water quality parameter that needs consideration for low-head navigation dams is the downstream DO concentration. The reaeration of the discharge from these types of projects will need to be given consideration in design. Also see paragraph 1-13.

d. Environmental Impact Statements. Section 102(2)(c) of the National Environmental Policy Act (NEPA)[a] requires detailed documentation in the project design memoranda on the impact of the planned project on the environment. The hydraulic engineer may be required to cooperate in the preparation of impact statements. An analysis of 234 Corps of Engineers environmental impact statements on various projects is given in IWR Report No. 72-3 (item 31 of Appendix A). This report can be used as a guide to the type of material needed and format to be used in developing these statements. Basic to environmental impact statements are studies made to define the preproject and project functions and their effects on the environment. In most cases the effect of each project function must be set forth in detail. Item 12 of Appendix A summarizes the concepts involved and presents examples relative to water resources impact assessments. Presentation of the hydraulic design in design memoranda must identify environmental requirements and demonstrate how these are satisfied by the hydraulic facility.

2-9. Foundations. Foundation information of interest to the hydraulic designer includes: composition and depth of overburden, quality of underlying rock, and quality of exposed rock. In addition, sideslope stability is of considerable importance in the design of riprap protection. Tailwater stage change rates are required for bank stability design. Sufficient foundation data and/or reference to its source should be included in the hydraulic presentation to substantiate the energy dissipator and exit channel design.