Chapter 3
Study Formulation and Reporting

3-1. General

This chapter describes hydrologic engineering analysis strategies, applications, and reporting for flood damage reduction studies. Hydrologic engineering analysis are performed for planning investigations, refinements of previous study findings due to changed conditions in the design phases, and studies that provide information of a potential or impending flood hazard. The primary references for the information of this chapter are: ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies, and ER 1110-2-1150, Engineering After Feasibility Studies.

3-2. Overview of Corps Flood Damage Reduction Studies

a. General. The Corps undertakes studies of water and related land resources problems in response to directives or authorizations from Congress. Congressional authorities are contained in public laws or in resolutions. Study authorizations are either unique specific studies or standing program authorities usually called continuing authorities. The focus of the studies are to determine whether a Federal project responding to the problems and opportunities of concern should be recommended within the general bounds of Congressional interest. The Corps studies for planning, engineering and designing flood damage reduction projects are predicated upon these legislative requirements and institutional polices.

b. Planning studies. Planning studies are termed feasibility studies. Most studies are conducted in two phases.

(1) The first, or reconnaissance-phase study, is fully funded by the Federal Government, normally takes 12 months, and determines if there is a Federal interest and non-Federal support.

(2) The second, or feasibility-phase study, takes up to 3 years to complete, is cost-shared equally between the Federal Government and non-Federal sponsor, and results in recommendations to Congress for or against Federal participation in solutions to the problems identified in the study. The recommendation for Federal participation is generally for construction authorization.

c. Preconstruction engineering and design (PED) studies. PED is a continuation of planning efforts following the feasibility study. This phase of the project development encompasses all planning and engineering necessary for construction. These studies review previous study data, obtain current data, evaluate any changed conditions, and establish the plan for accomplishing the project and design of the primary features. The preparation of general design memorandums, design memorandums, and plans and specifications are cost-shared as required for project construction.

d. Engineering and design. Once the preconstruction engineering and design is completed, remaining engineering and design will continue when the project is funded for construction or land acquisition. This phase includes all remaining feature design memorandums, plans, and specifications needed to construct the project.

e. Continuing authorities studies. These studies are standing study and construction authorities conducted in the same two-phase process as feasibility studies authorized by Congress. Section 205 for small flood control projects and Section 208 for snagging and clearing for flood control (USACE 1989) with limits of $5,000,000 and $500,000, respectively, are continuing authorities specific for flood damage reduction.

f. Federal role in flood damage reduction. The Corps represents the Federal perspective in flood damage reduction actions. Studies are performed in response to congressional directives. Problems are identified, solutions proposed and evaluated, and recommendations made to Congress. The principal Federal interest for flood damage reduction studies is in furthering the economic development of the nation. Provided the solution is economically feasible, protection of damageable property from floods is in the Federal interest (USACE 1989).

3-3. Planning and Managing the Hydrologic Investigation

a. General. The hydrologic engineering study must be planned and detailed to allow the effective and efficient management of the technical work. Before any hydrologic modeling or analytical calculations are undertaken, considerable planning effort should be performed.

b. Scope of study. The scope of the study should be resolved early through meetings with the entire interdisciplinary study team and the local sponsor. The time and cost required are a direct function of the study scope and amount of detail required to fully evaluate the range of problems and potential solutions for the water resources problem(s). The hydrologic engineer should formalize these scoping meetings and any ideas on addressing the problems through preparation of hydrologic engineering work plans which are presented and upgraded through the various phases of the study process. The work plans should be reviewed by the technical supervisor and should be furnished to the study manager. Unusual problems or solutions would make it wise to receive division review also. Work plans are especially important to develop after the reconnaissance report has identified the problems for further analysis in (and prior to initiating) the feasibility report.

c. Study team coordination. Every cost-shared feasibility study has an interdisciplinary planning team (IPT) assigned, headed by a study manager. The team consists of working-level members from economics, hydraulics, geotechnical, design, real estate, environmental, cost estimating, etc. The local sponsor is also a member, although the sponsor may not wish to attend all IPT meetings. Depending on the level of study activity and complexity, frequent meetings of the IPT should be held ranging from once a week to once a month. The advantage of frequent meetings lies in frequent communication and the exchange of ideas between team members. The most successful studies are those having free and easy communication among team members.

d. Quality control and review. The assurance of quality work and an adequate review come from both the technical supervisor and the IPT. The development of a HEMP and the supervisor's concurrence in the methods and procedures for study analysis give the hydrologic engineer a "road map" for the entire study. Frequent updates and consultations between the engineer and the technical supervisor are important. With these steps followed, technical quality should be acceptable for the final report. Similarly, scoping of the problems and necessary hydrologic information supplied to other IPT members will be accomplished through IPT meetings and discussions. Unusual technical problems or policy issues may require the review of higher level authority.

e. Relationship with cost-share partner. The cost-share partner is a full member of the IPT and often provides valuable technical assistance in many areas of the study. The partner also has valuable insights on the study area and its problems which may not be apparent to the study team. The cost-share partner should have as much (or as little) input and access to the planning and technical analysis as he/she wants. All hydrologic engineering negotiations with the cost-share partner must involve the hydrologic engineer. Sponsor participation in the study process should be continuous. Study layout and scoping, IPT meetings and decisions, alternative evaluation and project selection, and report recommendations and review should all involve the local cost-share partner.

3-4. Hydrologic Engineering Analysis Strategy

a. Overview. Three interrelated activities proposed as a study strategy are establishing a field presence in the study area, performing preliminary analyses, and conducting full-scoped technical analyses using traditional tools and methods tailored to the detail defined by the study type and conditions.

b. Field presence. The hydrologic engineer must spend time in the field throughout all phases of the analysis, from the reconnaissance-phase study through the actual construction. A field presence is required to gather data needed for the study and to maintain continuous contact with local interests involved with the proposed project. Credibility is quickly lost when the engineers involved in the project recommendations have spent little or no time in the study area. The hydrologic engineer's field presence is needed to establish and maintain contacts of local counterparts and determine survey needs, historic event data, channel and floodplain conveyance characteristics, and operation procedures of existing facilities. Field visits should often include other members of the study team and the local sponsor.

c. Preliminary analysis techniques. These techniques represent a suitable strategy to scope the complexity of the overall study, identify problems and tentative solutions, and roughly determine the extent of Federal interest in continuing the project. A preliminary analysis could involve all of the following techniques:

(1) Simplified techniques--often the application of an equation for a peak discharge for a specific frequency, like the USGS regional regression equations. A rough estimate for a design discharge could be used to estimate the required dimensions of a channel modification for costing purposes. Simplified Techniques are discussed in Chapter 11.

(2) Field evaluations--experienced hydrologic engineers can often lay out typical flood reduction measures during a field visit, such as, estimating alignment and height of a levee for protection of a cluster of flood-prone

structures. Problems associated with certain flood-reduction alternatives can often be ascertained in a field inspection.

(3) Results of previous studies--most urban areas have flood insurance studies identifying flood profiles for the 10-, 2-, 1-, and 0.2-percent chance exceedance frequency floods. Although not in sufficient detail to rely on for design studies, this information is often used to estimate existing flooding and potential damage reduction values. Hydrologic studies by other Federal agencies, as well as State, local, and private agencies are also of value.

(4) Application of existing computer models--many study areas have been previously analyzed by the Corps of Engineers or other agencies. An existing computer model of some or all of the study area is often useful to identify flood hazard levels and potential flood reduction measures.

d. Detailed analysis techniques. Detailed studies are a suitable approach for the feasibility-phase and design studies of a project. Detailed analyses are also appropriate during the reconnaissance-phase investigation, although the analyses may be more abbreviated and approximated than for subsequent studies. Essentially all feasibility-phase flood damage reduction studies require detailed analysis of precipitation-runoff, floodflow by frequency and/or modeling, river hydraulics, and storage routing. Each of these component studies may represent a significant effort. Therefore, it is not unusual for a hydrologic engineer assigned to a feasibility study to require 12 to 24 months of intensive, full-time effort to perform the analyses (USACE 1988).

3-5. Hydrologic Requirements for Planning Studies

a. Overview. The analysis scope and detail required to conduct a hydrologic study depends on the type of study, complexity of the study area, problems identified, potential solutions, and availability of needed data and information. This is particularly true in the reconnaissance-phase investigation, after which the scope and detail becomes more focused. A description of the study requirements and associated hydrologic analyses methods typically needed for reconnaissance and feasibility studies follows. The methods are variable and should be scoped to specific study needs.

b. Reconnaissance-phase study. The reconnaissance-phase study develops and documents the information for a decision to proceed with feasibility-phase investigations. It also forms the basis for negotiating the feasibility study cost-sharing agreement (FSCA). Reconnaissance-phase studies are conducted over 12 months or for special cases 18 months. Table 3-1 lists the technical elements for conducting the hydrologic engineering analysis of a reconnaissance-phase flood damage reduction study. The objectives are to define the flood problem, determine whether further study will likely result in a feasible solution to the flood problem, determine if there is Federal interest, identify a local cost-sharing sponsor; and, if the findings are positive, determine the scope and define the tasks for completing the feasibility investigation. The hydrologic engineer is a key participant in objectives 1 and 2 and must formulate in detail the HEMP as part of the Initial Project Management Plan (IPMP) for the feasibility-phase study (objective 5). Appendix B provides a generic example of the HEMP for a typical flood damage reduction study. The HEMP should be modified in scope to meet specific study requirements.

(1) Ideally, it is desirable in the reconnaissance-phase to develop the complete hydrologic engineering analysis for the existing without-project conditions in the detail needed for the feasibility-phase study. The reason for this detail is that the project feasibility is highly sensitive to the hydrologic engineering and economic analyses. This concept is possible in some situations. However, in other situations the lack of available data, the complexity of the study area, and limited time may dictate that a less detailed analysis be performed.

(2) A range of alternatives are formulated that would be reasonable to implement and that represent different kinds of solutions to the specified problems. The alternatives are analyzed in sufficient detail for approximate benefit/cost analyses, to eliminate obviously inferior alternatives from future consideration, and to provide for accurately developing the strategy, resources and cost of the feasibility study. The benefit and thus hydrologic engineering analysis is normally based only on existing, without-project conditions previously described. The existing with-project conditions are evaluated to the detail required to determine whether a feasible plan with Federal interest will likely result from further study. Future conditions analyses are normally not required for the reconnaissance-phase study.

c. Feasibility-phase study.

(1) The objective of flood damage reduction feasibility-phase studies is to investigate and recommend solutions to flood related problems. The feasibility-phase is

Table 3-1
Reconnaissance-Phase Study Technical Elements of Work Plan for Hydrologic Engineering Analysis (USACE 1988)

I. Hydrologic engineering study objectives

II. Definition of study area for hydrologic engineering analysis

III. Description of available information

- A. Maps, correspondence, documents, and reports
- B. Observed flood information
- C. Previous study data and analysis results

IV. Definition of existing conditions flood hazard

- A. Historic floods documentation
- B. Hypothetical floods development
- C. Existing without-project conditions flow frequency, water surface profiles, etc.
- D. Appraisal of special technical issues: such as erosion/sedimentation, unsteady flow, water quality, future development etc.

V. Existing with-project conditions

- A. Appraisal of broad range of flood loss reduction measures.
- B. Existing with-project conditions flow frequency, water surface profiles.
- C. Documentation of flood hazard reduction performance for selected measures.

VI. Initial project management plan for feasibility-phase study (HEMP, time, cost, schedule)

cost shared 50\50 with a non-Federal sponsor. Typical studies are completed in 18 to 36 months. The majority of hydrologic engineering work is performed in this phase. The hydrologic engineering analysis must be complete so that the project recommended in the feasibility report is essentially what is constructed after detailed engineering and design are completed.

(2) Once the without-project conditions are detailed, the formulation process is iterative, increasing in detail and specificity as the viable measures and plans become more defined. The later stages of the feasibility study therefore show an increase in the engineering and design effort. Sufficient engineering and design are performed to enable further refinement of the project features, baseline cost estimates, and design and construction schedules. The engineering and design also allow design of the selected plan to begin immediately following receipt of the PED funds and the project to proceed through PED without the need for reformulation, General Design Manuals, or postauthorization changes.

(3) Working closely with the study manager, economist, cost engineer, and other members of the IPT, the hydrologic engineer completes the with- and without-project evaluations so that an economically feasible plan is recommended at the completion of the feasibility phase. This end result requires a continuous exchange of technical information among the various disciplines. The planning process within which the hydrologic engineer functions consists of six major tasks: specification of problems and opportunities, inventory and forecast, alternative plans, evaluation of effects, comparison of alternative plans, and plan selection.

(a) Specification of problems and opportunities. This initial step establishes the base conditions for the planning process, defines the potential type and range of solutions, and provides the essential insight necessary to perform the remaining steps. The major components are definition of flood problem and specification of opportunities. The definition of flood problem component defines the problems and opportunities for solutions to those problems. The information provides the basis for subsequent project development. The nature of flooding, location of threatened properties, and existing project physical and operational characteristics are determined. Information is assembled from the reconnaissance-phase study, field reconnaissances, and other information. Hydrologic engineering investigations develop the specific characteristics of flooding potential in the study area (flood flows and frequency, flood elevations, and floodplain boundaries), character and variability of flooding (shallow or deep, swift, debris-laden, etc.). The specification of opportunities component defines the general nature of solutions that might be appropriate. The general geography of the watershed, location and density of development, and nature of the flood hazard all interact to reveal possible solutions. Solutions involving reservoirs, levees, and bypasses must be physically possible, reasonable, and not in obvious conflict with critical community values and environmental resources. The community is also a valuable source of ideas early on and throughout the investigation. It is important at this stage to be comprehensive in the exploration of possible solutions, yet equally important for practicality is best use of study time and resources. The hydrologic engineer's practical experience on what does and does not work is most helpful in this phase.

(b) Inventory and forecast. This step develops detailed information about the existing and most-likely future conditions within the watershed and study area. Existing conditions for the study area consist of measures and conditions presently in place. Base condition refers to the first year that the proposed project is operational. Hydrologic engineering analyses are performed for existing and future without-project conditions. Existing measures, implemented prior to the base year, and measures authorized and funded for construction completion prior to the base year are assumed to be in place and included for both the with and without conditions. Future without-condition analyses are conducted for the most likely future development condition projected to occur without the project. This includes changes in land use and conveyances. The assessments are performed for specific time periods. Determination of without-plan conditions is an important aspect of the study process. It is the basis from which the alternatives are formulated and evaluated. Assessments of the without-project conditions should be of sufficient detail to establish viable economic (cost and flood damage), social, and environmental impact assessments of the with-project conditions without future refinements throughout the remaining planning and design study process. Hydrologic analyses include the assembly of data for estimating the flood characteristics, developing discharge-frequency relationships at desired locations, and defining the performance of the without-project conditions. Specific tasks include the following.

• Final data assembly. Most or all of these tasks may have been conducted previously. These data should represent the final information used for feasibility and design studies.

- Obtaining survey and mapping information. Maps showing land use, soil types, vegetation, storm sewer layouts, bridge plans, and other information from local agencies.

- Precipitation data from the National Weather Service or other agencies.

- Stream gauge stage, discharge, and sediment information from the U.S. Geological Survey or other agencies. Document historic event high-water marks and flood characteristics.

• Hydrologic analysis. This study aspect develops information used in the modeling of the study area and performs the technical analysis.

- Final delineation of watershed and subbasin boundaries based on stream topology, gauge locations, high-water marks, damage reach flood damage analysis requirements, and location of existing and potential flood damage reduction measures.

- Develop basic information for hydrologic model (i.e., subbasin areas, rainfall-runoff variables, base flow, recession, and routing criteria).

- Optimize runoff and loss rate variables using historic event data.

- Calibrate model to historic event high-water marks and gauged discharge-frequency relationships.

- Estimate existing without-conditions discharge-frequency relationships at desired ungauged locations using hydrologically and meteorologically similar gaged basins data, regression analysis, and initial hydrologic model results.

- Determine best estimate discharge-frequency relationships at ungauged locations and, if necessary, adjust initial model variables to calibrate to frequency relationships.

- Adjust the model runoff and routing variables for most likely future without-project conditions for specific time periods and determine discharge-frequency relationships at desired locations.

- Provide discharge (or storage)-frequency relationships and other information (risk, performance of the system for a range of events, warning times, etc.) to economists, cost estimators, environmentalist, study manager, and project manager. The information should also be reviewed by the local sponsor counterparts.

(c) Alternative plans. Alternative plans are formulated to address the flood problems and accomplish other planning objectives. The alternatives are formulated to achieve the national goal of economic development consistent with preservation and enhancement of cultural and environmental values. One or more measures and one or more plans should be formulated to enable the full range of reasonable solutions to emerge from the investigation. In general, the array of alternatives developed should be comprehensive and not simply a range of sizes of a particular measure. The plan formulation exercise is a team process. The hydrologic engineer's knowledge and experience is invaluable to this task and critical to the ultimate formulation of meaningful projects. There are numerous factors to consider when formulating measures and plans. The study authorization should be reviewed as it may require or limit certain actions. The without-conditions analysis defines primary damage centers and flood hazard situations that may tend towards specific types of measures. Real estate and obviously high costs may prohibit certain measures. Environmental and cultural features may require or negate certain actions. The local sponsor may bring specific insights as to problems and potential solutions. In summary, the measures and plans formulated should emphasize comprehensive solutions and also address specific, clearly localized problems.

(d) Evaluation of effects. This step develops the information needed to determine and display the accomplishments and negative effects of measures and plans as compared to the without-project condition. The evaluation process is conducted across the full perspective of concerns - hydrologic engineering, economic, environmental, and others. Hydrologic analysis of flood damage reduction measures and actions are performed for several combinations of measures and plans, operation plans, and performance targets. The initial evaluation should assess the potential for improved operation of the existing system if such components are in place. If improved operation procedures are found viable, they should be detailed and incorporated as part of the existing without-project conditions. The hydrologic analysis procedures for existing and future with-project conditions are similar to the without conditions. The measure effects are incorporated or determined by the modeling process. Frequency and project performance information at all important locations are defined by the without-project condition analysis. The analysis includes the full range of hydrologic events including those that exceed the design levels.

(e) Comparison of alternative plans. This step is identified separately to ensure that the measures are compared on a consistent basis. Direct application of hydrologic analysis criteria may include project performance and safety information (design flows, risk, warning times, consequences of design exceedance, etc.), safety, and operation considerations. Indirectly, hydrologic analysis information is used to assist in determination of flood damage, stream profiles, fluvial hydraulics, environmental effects, and cost aspects. Therefore, the hydrologic engineer is an active participant in the comparison of alternative plans for flood damage reduction.

(f) Plan selection. Plan selection takes place in a diffused decision process. The study manager, technical staff, including the hydrologic engineer, and the local sponsor may strongly influence the recommended plan. The selecting officer at the field level is the district engineer. The division and Board of Engineers for Rivers and Harbors perform subsequent independent review and may recommend a different plan, but in most circumstances the district's plan is ultimately implemented. Plan selection at the district field office level must consider existing laws and regulations applicable to the Corps and other agencies. The recommended plan must be the plan that meets all the statutory tests and maximizes the economic contribution to the nation. It is at this stage that the hydrologic engineer must demonstrate that the recommended plan can perform its intended flood damage reduction function safely and reliably over the full range of hydrologic events.

3-6. Preconstruction Engineering and Design (PED) Phase

a. The PED phase begins after the division engineer issues the public notice for the feasibility report and PED funds are allocated to the district. Emphasis in this phase is typically on the hydraulic design aspects, since the hydrologic analyses should have been completed in the feasibility-phase study. If, however, it is determined during the PED phase that a general design memorandum (GDM) will be necessary because the project has changed substantially or for other reasons, part or all of the hydrologic analyses may need redoing. The hydrologic engineering analysis would be conducted as a feasibility-phase study and reported and documented as such in a GDM.

b. The hydrologic engineer is more involved in the detailed design of the project components, with the overall component capacities, general design, etc., held relatively constant from the feasibility report. For instance, the feasibility report may have recommended 5 miles of channel modifications having specified channel dimensions. The design memorandum would refine these dimensions to fit the channel through existing building and bridge constraints; to perform detailed hydraulic design of tributary junctions, bridge transitions, drop structures, and channel protection; and conduct detailed sediment transport studies to identify operation and maintenance requirements and other hydraulic design aspects. If necessary, physical model testing is also performed during the design memorandum phase. No additional plan formulation, economics, etc., should be required. Structural design, geotechnical analysis, cost engineering, and other disciplines work to finalize their analyses with the additional topographic site surveys and subsurface information normally obtained in this phase. The hydraulic design is often being continuously modified to reflect these ongoing design problems prior to completion of detailed design.

3-7. Construction and Operation

Unforeseen problems during construction frequently involve further modification and adaptation of the hydraulic design for on-site conditions. Similarly, most projects require detailed operation and maintenance manuals, and hydrologic engineering information can be a critical part of these manuals. The operation of reservoirs, pumping stations, and other flood mitigation components can require considerable hydrologic operation studies to determine the most appropriate operating procedures. Postconstruction studies are necessary for most projects. Most of these studies monitor sediment deposition and scour caused by the project to ensure that adequate hydrologic design capacity is maintained to monitor the correctness of the data used in analyzing the project and to estimate the remaining useful life of the project.

3-8. Reporting Requirements

a. General. Reporting requirements for the various types of studies are described in applicable ER's. In addition, hydrologic and hydraulic Engineer Technical Letters (ETL's) summarize the array of hydrologic data that must be presented for planning reports and suggest display formats. The goal of reporting (investigation findings) should be to describe in basic terms the nature of the flood problem, status and configuration of the existing system, the proposed system and alternatives, performance characteristics of the proposed system, and important operation plans. This section presents a general structure for reporting results of the hydrologic studies commensurate with the basic concepts of feasibility-phase studies. Note that it is sometimes suggested that economic and other data be included so that the consequences of the hydrologic evaluations may be better judged. Hydrologic reporting requirements should include a description of the without conditions, an analysis of alternative flood loss reduction plans, analytical procedures and assumptions used, and system implementation and operation factors influencing the hydrologic aspects of the study.

b. Existing system. The existing system should be defined and displayed schematically and by the use of maps, tables, and plates. The layout of the location of existing flood damage reduction measures should be indicated on aerial photographs or other suitable cartographic materials. Important environmental aspects, damage locations, and cultural features should also be indicated.

c. Without-project conditions.

(1) Physical characteristics and features of existing condition flood-loss mitigation measures will be described and shown in tables and plates. Dimensions of gravity outlets, channels, and other measures shall be specified. Area capacity (storage-area-elevation) data of detention storage areas will be presented. Watershed and subbasin boundaries will be shown on a plate or map.

(2) The hydrologic analysis approach adopted, critical assumptions, and other analysis items for existing conditions will be described and illustrated as necessary. Historic and/or hypothetical storms, loss-rate parameters, runoff-transform parameters, routing criteria, and seepage will be described and depicted via tables and plates. Hydrologic flow characteristics, peak discharge, duration, frequency, and velocity information will be presented for important locations (damage centers, high hazard areas, locations of potential physical works). Schematic flow diagrams indicating peak discharges for a range of events will be included for urban areas. Presentation of several hydrographs of major hydrologic events, including precipitation and loss rates and runoff transforms, can greatly assist in explaining the nature of flooding.

(3) Future without-project conditions will be described as they impact on hydrologic conditions, assumptions, and procedures. Changes in runoff and operation resulting from future conditions will be described in terms similar to the existing conditions description. Procedures adopted for parameter estimation for future conditions should be described.

d. Hydrologic analysis of alternatives.

(1) The location, dimensions, and operation criteria of components of the alternative plans will be described and depicted on tables and plates. Locations of the alternative measures or plans will be displayed on aerial photographs and/or other cartographic materials so that comparisons with existing conditions may be readily made. Impacts of measures and plans on flood hydrographs (peaks, durations, velocities) for a range of events will be provided at similar locations, as for without conditions. Display of the effects on hydrographs should be included. Display of residual flooding from large (1-percent chance and standard project flood) events is required.

(2) The hydrologic description of the various alternative plans will include a description of the required local agreements and maintenance requirements. The hydrologic consequences of failure to adequately fulfill these requirements will also be presented.

(3) Also presented are the basis and results of hydrologic and hydraulic studies required to determine the functional design and real estate requirements of all water control projects.

(4) The residual flood condition with the selected plan in place will be described. As a minimum, the information will include the following: warning time of impending inundation; rate-of-rise, duration, depth and velocity of inundation; delineation of the best available mapping of the flood inundation boundaries; identification of potential loss of public service; access problems; and potential damages. This information will be developed for each area of residual flooding for historic, standard project flood, 1-percent chance flood and the flood event representing the selected level of protection. This information will be incorporated into the operation and maintenance manual for the project and disseminated to the public (ER 1110-2-1150, EM 1110-2-1413, ER 1105-2-100).

3-9. Summary

a. The Corps of Engineers utilizes feasibility planning, requiring the local partner to participate financially in the study process. These Corps of Engineers fiscal requirements of the partner must also allow more partner participation in the study selection process. Further local sponsor understanding of the hydrologic engineering analysis requirements, from the feasibility study through the detailed design, should allow for a better final product.

b. The hydrologic engineering study must be planned in enough detail to enable effective and efficient management of the technical analysis. Detailed scoping of the study will enable the study manager to identify and address any potential problems early. The cost-shared partner should be considered a full member of the team. All hydrologic engineering negotiations with the cost-shared partner must involve the hydrologic engineer.