

Reclamation Manual
Design Data Collection Guidelines
Chapter 4 – Specifications Designs

- 1. Dams.** The Introduction (Chapter 1) for these design data collection guidelines contains additional information concerning: preparing a design data collection request, design data collection requirements, and coordinating the design data collection and submittal. This paragraph lists data required for design of a storage dam; however, design data for a diversion dam shall be submitted in accordance with the list so far as the items are applicable. The Project Team and the Design Team for the dam will review the data used for authorization and the changes that have occurred since that time, the damsite selected, and the choice of structure type and recommend a design data collection program to the design office and an estimated schedule.

A. General Map(s) Showing:

- (1) A key map locating the general map area.
- (2) The structure site or sites.
- (3) County and township lines.
- (4) Existing towns, residences, private property, highways, roads, bridges with special loads or size limitations, railroads and shipping points, public utilities such as electric power and telephone lines, pipelines, etc., and stream-gauging stations.
- (5) Locations of potential construction and permanent access roads, and sites for contractor's staging areas, and construction facilities.
- (6) Locations of borrow areas for natural construction materials and disposal areas for waste excavation.
- (7) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project feature such as: recreation areas, fish and wildlife areas, building areas, areas of cultural sensitivity; and areas of archeological, historical and mining or paleontological interest. The locations of these features should bear the parenthetical reference to the agency most concerned; for example, Reclamation (Bureau of Reclamation).
- (8) Rights-of-way for construction, access, and staging areas.
- (9) Sources of construction power and power transmission facilities.

B. General Description of Local Conditions Covering:

- (1) The approximate distance from the nearest railroad shipping terminal to the structure site; load restrictions and physical inadequacies of existing roads and structures and an estimate of remedial improvements to accommodate construction hauling; estimate of length and major structures required for new construction access road; and possible alternative means for delivering construction materials and equipment at the structure site.
- (2) Local freight or trucking rates.
- (3) Availability of or need for permanent buildings for operating personnel.
- (4) Availability or accessibility of public facilities or utilities such as: water supply; sewage disposal; telephone utility; fire protection services; and electric power for construction (give location, power supplier, voltage, number of phases, and capacity of existing transmission lines; power rate schedules; probability of interruption of supply; and requirements for additional transmission line, if needed).
- (5) Climatic conditions that will affect construction and operation and maintenance procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; summer and winter temperatures, with extremes; extreme wind velocities and prevailing directions; and probability of excessive dust or sand.
- (6) Names and telephone numbers of local utilities and contacts within those organizations.

C. Surface Data:

- (1) **Survey Control.** Permanent horizontal and vertical survey control should be established at the earliest possible time. A coordinate system on a true north-south grid should be established with the origin located so that all of the features (including borrow areas) at a major structure will be in one quadrant, and so that the values of the coordinates for any major structure are widely separated numerically. The coordinate system should be related to a state or national coordinate system, if available. All preceding survey work, including topography and location and ground surface elevation of subsurface exploration, should be corrected to agree with the permanent control system; and all subsequent survey work, including location and ground surface elevation of subsurface exploration, should be based on the permanent control. All surveys should be tied to the established coordinate system at each construction site.

- (2) **Topographic Map.** A topographic map covering an area sufficient to accommodate all possible arrangements of structures including dam, spillway, outlet works, and diversion works; normally this should be on a scale of 1 inch equals 50 feet with a contour interval of 2 feet. For large dams and structures, a scale of 1 inch equals 100 feet with a contour interval of 5 feet is acceptable. For flat or gently sloping topography, contour intervals as low as 1 foot may be desirable. Show the coordinate system and existing land survey corner monuments or special control points established for the topographic survey. Show all manmade features in the included area.
- (3) **Aerial Photographs.** Aerial photographs (size 8 by 10 inches, color if feasible) of the sites of major dams and structures. The purpose of the aerial views is to permit early preparation of an artist's rendition of the feature and to permit a study of the environmental impact of the structure. Later such renditions or drawings may be used for inclusion in specifications or for other purposes.

These photographs should be taken from locations that would best show the proposed structure and from a vertical angle of approximately 20E to 30E above the horizontal. Where possible, indicate known tie points to the topographic maps. These photographs should be taken between 11 a.m. and 2 p.m., so as not to show the principal area of the proposed structure in shadow. Also submit the negatives or color slides.

Each region is urged to provide these photographs for smaller dams or auxiliary structures whenever it is considered that artist's conceptions would be beneficial to the project and the architectural designs would be influenced by the physical characteristics of the area.

- (4) **Photographs.** Color photographs of all existing facilities or structures in the vicinity of the proposed dam and closeup views of any features which may affect designs. Black and white photographs are acceptable for structures to be removed or demolished. Color or Black and White Photographs of structure sites with structure locations marked in ink.

D. Foundation Data:

- (1) **General Engineering Requirements:** The need for foundation data should be established by the joint efforts of originating office personnel and the office(s) providing design services. For major structures it is recommended that a field conference be held, including an inspection of the site. This conference should result in a geologic investigations program outlining the need for and extent of surface and subsurface studies, and other requirements. The geologic investigations program

must be based on site conditions and the type of structure. The complexity of the site will determine the detail of the investigation.

- (2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for this type of facility. The geologist should apply these guidelines with good judgment and sound reasoning, elaborating upon them as required by the particular geologic setting and engineering requirements. Because the collection of geologic data is a dynamic process and often continues into the preparation of final designs, all stages of the specification design geologic exploration program must be constantly coordinated with the designer through the appropriate geology office. The regional or Technical Service Center (TSC) geologic and geophysical staff will provide necessary assistance and guidance in the gathering of these design data.
- (a) Compilation, summary, and reporting of Reclamation and non-Reclamation geologic information on the area, with attention being paid to the sequence of explorations and historical geologic events.
 - (b) Surface geologic map of dam and entire reservoir area showing location of explorations. Locations of all existing explorations should be indicated by coordinates or stationing of the permanent survey control system for the facility. Include evaluation of water-holding capability of reservoir.
 - (c) Conduct specific foundation exploration at site of all dams and appurtenant structures, diversion or outlet works, spillways, pumping or generating plants. Furnish data adequate for preparing bedrock contour maps, geologic cross sections or other illustrations required to demonstrate foundation conditions.
 - (d) Factual narrative description of surficial deposits with attention being paid to engineering geologic matters, such as swelling minerals, low-density materials, presence of gypsum and other sulfates, caliche, erodibility (see *Engineering Geology Field Manual*).
 - (e) Factual narrative description of bedrock with attention being paid to engineering geologic matters such as compressive strength, shear strength, elastic modulus, swelling minerals, presence of gypsum and other sulfates; depth of weathering, fracturing, joints, faults, and other discontinuities.
 - (f) Photographs, preferably in color, of representative or particular geologic conditions.

- (g) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, compressive and shear strength, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the design office.
- (h) Summary and data obtained from exploration by geophysical methods (seismic, resistivity, etc.), if performed.
- (i) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation, occurrence of unconfined and confined aquifers, potential reservoir leakage, water-producing capabilities, chemistry, and land subsidence.
- (j) Logs of explorations. Logs of drill holes advanced by churn drilling, chop and wash or other methods which result in less than adequate sample recovery may need to be augmented by appropriate borehole electric (geophysical) logs.
- (k) Evaluation of landslide, snowslide, and rockfall conditions. A complete map of possible landslide areas with as much detail as practicable.
- (l) Determine age, location, and characteristics of faulting in the vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismicity of the site by specialists.
- (m) Document past, present, and possible future petroleum, water, and mineral extraction operations in vicinity.
- (n) Determine geologic conditions which may affect construction methods such as, boulders on ground surface, marshes, drilling conditions, and stability of grout or footing holes, ground temperatures, gases. Any potential surface water runoff problems should be brought to the attention of a regional hydrologist.
- (o) Geological information pertinent to reservoir water-holding capability, operation and use, location and type of mines or mining claims, potential landslides and major faults.

E. Corrosion Survey:

- (1) In situ electrical resistivity measurements of geologic materials in the area of construction. Additional measurements should be made in the areas

where there is a pronounced change in type of geologic materials, drainage, and/or moisture conditions.

- (2) Performance history of materials of construction that have been used in the area.
- (3) List of structures in the vicinity of (within 1/4 mile) the proposed structure and appurtenant features. Determine if buried structures in the vicinity have corrosion protection and, if so, the type of corrosion protection.
- (4) List location, output, and purpose of the direct-current sources in the earth situated within 1/4 mile of the proposed structure and appurtenant features. If the purpose of the direct current is for cathodic protection, describe the structure protected and its location.
- (5) Chemistry of geologic materials, ground water, and/or product water.

F. Construction Materials Data Including:

- (1) Inventory of available impervious and pervious embankment materials and rock for riprap and rockfill. Location of and distance to borrow areas and approximate quantities available.
- (2) Information on concrete aggregates. (See *Concrete Manual*.)
- (3) Information on sources and character of acceptable road surfacing materials. Consider required excavation material as a possible source.
- (4) Data on commercial concrete plants within practical hauling distances from the structure site.
- (5) References to results of sampling and analysis of materials including previous tests and photographs of sources.
- (6) Report alkali conditions in soil and water which might affect the choice of sulfate resisting cement.
- (7) Statement of availability of timber for structural work and lumber for other purposes.
- (8) Environmental impacts associated with removing or obtaining construction materials.
- (9) Requirements concerning permanent stockpiles and suggested permanent stockpile locations.

- (10) Information including catalogues on firms, within practical hauling distance from the site, manufacturing precast concrete products and brick or other masonry units.

G. **Water for Construction Purposes.** For large rivers, this item may be unimportant. For small streams and offstream reservoirs, the item becomes critical. Determine if up to 2-cubic-foot-per-second (ft³/s) diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If necessary to use ground water, obtain information on probable sources and yields. Furnish information on locations and yields of existing wells in the vicinity. Determine restrictions, if any, to use of ground water for this purpose. It may be necessary to obtain permits from State or other governing agencies. Retrieve water quality samples for testing and evaluation.

H. **Hydrologic Data.** The hydrologic data for a dam will be documented in a report for the feasibility designs and will have been updated based on any additional information developed since the feasibility designs. The specifications design data submittal shall reference this document and thus eliminate the need to repeat the information enumerated below. If, for any reason, the information enumerated below is not contained or is not updated in the report prepared for the feasibility design then this information should be provided for the specifications design.

- (1) Inflow design flood and possible preceding and recurring flood hydrographs with recommended routing criteria. For a diversion dam involving little or no storage, normally a probability curve of flood peak discharges up to the 100-year point will be sufficient. However, if the structure is judged to pose a significant threat to a downstream population, the design flow may be based on a longer recurrence interval.
- (2) Flood hydrographs for frequencies of 5, 10, and 25 years for use in diversion during construction. Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.
- (3) Data for preparation of specifications hydrographs, including the location of gauging station at or near the damsite and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.
- (4) Method of reservoir operation for flood control and maximum permissible releases.

I. **Reservoir Data:**

- (1) Area capacity curves and/or tables to at least the dam crest elevation.

- (2) Topography for small reservoirs, on a scale of 1 inch equals 400 feet and a contour interval of 5 feet; for large reservoirs, on a scale of 1 inch equals 2,000 feet and a contour interval of 10 feet.
- (3) Completed reservoir storage allocations, showing storage allocations and corresponding elevations.
- (4) Physical, economic, or legal limitations to maximum reservoir water surface.
- (5) Anticipated occurrence and amounts of sediment, ice (thickness), and drift (trash), and possible effect on reservoir outlets, spillway, and other appurtenances.
- (6) Extent of anticipated wave action including a discussion of wind fetch.

J. Operating Data:

- (1) Details of required downstream control sections, measuring devices, gauging stations, or other operating works.
- (2) Reservoir backwater curves, including the effect of sediment deltas if upstream right-of-way will be critically affected or damaged.
- (3) Location, hydraulic section, and water surface elevation of irrigation or power canal diverting from the reservoir.
- (4) Annual periodic fluctuations of reservoir levels shown by tables or charts summarizing reservoir operation studies for the critical and normal climatic periods. Include any annual reservoir drawdowns for operation and maintenance purposes.
- (5) Tailwater curves, sedimentation studies, degradation and aggradation studies should be included.
- (6) Required outlet and sluiceway capacities for respective reservoir water surfaces; and sill elevations. Give type and purpose of reservoir releases and the time of year to be made; include minimum release during winter. If temperature or water quality control of releases is anticipated, the degree and purpose of the control should be included.
- (7) Type of operation, i.e., full-time resident caretaker, remote control, etc.
- (8) The operational impacts of the project that require alternative designs, e.g., outlet works and downstream river temperature, spillways and gas supersaturation, increased channel scour, and downstream channel protection, etc.

K. Miscellaneous Data:

- (1) Requirements for roadway on crest of dam (and approaches) including guardrails, street lighting, and guideposts. Present or future requirement for highway crossing on dam, including application of public law for highway bridges on Federal dams.
- (2) Requirements for temporary or permanent facilities for illuminating the downstream face of the dam during filling and operating conditions.
- (3) Requirements for temporary construction access roads, permanent access and service roads, and relocation of existing roads or railroads. Include any limiting requirements imposed by road owners for public access/haul roads.
- (4) Details of fishways and screens with recommendations of State and Federal fish authorities.
- (5) Existing works to be replaced by incorporation into dam.
- (6) Future powerplant or power development.
- (7) Navigation facilities.
- (8) Possibility of raising crest of dam in future.
- (9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.
- (10) Anticipated future river channel improvement or other construction which might change downstream river regimen.
- (11) Required provisions for public safety and visitor facilities.
- (12) Data on upstream dams and reservoirs.
- (13) Anticipated recreation facilities that will affect the dam design and/or should be included in original design.
- (14) (For concrete storage dams), daily readings of maximum, minimum, and mean temperatures of air and river water. Until a weather station is established, temperatures should be obtained whenever possible. Date, time of day, and corresponding air and water temperatures should be recorded.
- (15) Recommended period for construction.

- (16) Commitments for delivery of water or power.
- (17) Unusual local pest (termites, borers, etc.) action and recommended preventive measures.
- (18) Designated areas to be cleared of vegetation, with description of kinds, size, and density of growth. State recommended method of payment; i.e., lump-sum price for specific area with defined limits, or unit price per acre for specific area whose limits may change during construction. If there is a variation in the density of growth or in the difficulty of clearing operations for the designated area to be cleared, the work should be segregated into not more than three items with the limits of respective areas clearly established. If vegetation to be cleared is very sparse or is such as can be removed without special equipment or separate operations, the cost of clearing should be included in the prices bid for excavation or prices bid for other items of work.
- (19) Provide data on the method(s) of brush and tree disposal permitted by local and State pollution regulatory agencies.
- (20) Problems of bank erosion in reservoir area.
- (21) Description of existing project fire protection and security plans which will be applied to this feature, together with any specific requirements for this dam.
- (22) Provide information on upstream and downstream log booms, including whether or not it needs to be relocated.

L. Cost Data:

- (1) Estimate of cost of right-of-way or easements for reservoir, dam, and appurtenant works. Include supporting data.
- (2) Curve showing estimated cost of right-of-way versus elevation of reservoir water surface from normal elevation to maximum estimated surcharge elevation or other physical or economic limit. Include supporting data.
- (3) Estimates of cost for clearing reservoir area and for removing or replacing private improvements in the area. Include supporting data.
- (4) Estimates of cost for relocating railroads, highways, roads, water systems, and other public utilities from the damsite or reservoir area. Include supporting data. Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be his responsibility, designate building groups by number and furnish detailed list of buildings

for each group. Details should include general description, size, materials, and general condition. Determine if disposal will be the responsibility of prime contractor. If not, submit dates when disposition will be completed by others.

- (5) Information on local labor supply and labor problems.
- (6) Information on important construction work in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

M. **Right-of-Way.** A marked print shall be submitted showing the following data:

- (1) Proposed right-of-way boundaries for construction purposes in the vicinity of damsite.
- (2) Proposed right-of-way boundaries for access purposes (if required).
- (3) Designation of areas within right-of-way boundaries for the following special purposes:
 - (a) Disposal of waste material.
 - (b) Contractor's plant, storage, and other incidental purposes.
 - (c) Borrow sources.
 - (d) Government's construction facilities (if applicable).
- (4) Existing private or public easements and right-of-way across or adjacent to alignment.

N. **Environmental Considerations.** Implementation of design features should be consistent with environmental commitments listed in the National Environmental Policy Act compliance document. Implementation of design features should be consistent with agreements reached between Interior bureaus, Federal agencies, and other governmental agencies.

Design data should include, as a minimum, a brief description of the environmental resources that could be affected by the proposed development. The emphasis should be on those areas within the range of alternatives open to the designers in developing a structural design. The following items should also be included in the design data:

- (1) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the dam and the reservoir basin.
- (2) The need for blending structures with the surroundings.

- (3) Comments on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect layout or conceptual design.
- (4) Indicate the suitability and possibility of present and future use of land adjacent to Reclamation facilities by the public for recreation, hobbies, sports, leisure, education, health, housing, etc. Provide data on zoning regulations and subdivision proposals.
- (5) Furnish data on allowable noise limits in the vicinity of the proposed plant where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime or nighttime ambient noise levels in the area; and distances to the nearest residential units.
- (6) Identify special environmental compliance requirements including water quality standards such as suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; preservation of existing growth adjacent to construction; obliteration of temporary roads and restoration to original appearance; dust abatement, etc. Give recommendations on steps to be taken to meet these requirements.
- (7) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.
- (8) Background on the need for fish facilities such as screens, fishways, and barriers.
- (9) Comments on disposal of special excavation problem materials such as lignite.
- (10) Give borrow area and temporary haul road restoration requirements such as stockpiling of top soil, regrading of the area, general cleanup, etc.
- (11) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.
- (12) Erosion and sediment control.
- (13) The need for a field conference to resolve critical environmental problems with participation of other agencies.
- (14) Review of designs by other agencies including at what stage of design and level of their review, and the findings of the Fish and Wildlife Coordination Act Report.

- (15) Reservoir clearing plan to consider fish and wildlife requirements.
 - (16) Anticipated public use around the structure.
 - (17) Environmental permit requirements (401, 404, Storm Water Runoff, etc.)
 - (18) Special environmental requirements for transmission lines or underground transmission systems.
 - (19) Location, volume, and contamination levels or any solid waste or hazardous waste facilities within the reservoir basin.
 - (20) Location of any underground storage tanks within the reservoir basin.
- O. **Electrical Data.** Data listed below will be required to initiate design. The data furnished should be sufficient to permit designers to complete the basic design (single-line diagram) for the dam. After designs have progressed enough to develop details of electrical system needs, designers will prepare a list of additional data required to complete final design of electrical installation.
- (1) Names and telephone numbers of electrical power suppliers and contacts within those organizations.
 - (2) Location of point where connection to power supply will be made.
 - (3) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.
 - (4) Electrical system reliability criteria.
 - (5) Discuss requirements for an alternate power source. If an alternate supply is required, indicate:
 - (a) If required by a State or local authority.
 - (b) If source should be an engine-generator.
 - (c) If a threat to life or property will result if normal power supply is lost.
 - (d) Loads requiring service from alternate source.
 - (6) Requirements for remote monitoring of conditions at the facility. Discuss location of remote station, and items required to be monitored.
 - (7) Requirements for supervisory control, including location of station from which supervisory control is exercised.
 - (8) Requirements for voice and data communications between the supervisory master station and the remote facility.

- P. **Site Security.** Many Reclamation projects may require a security risk assessment. The need for a site-specific security risk assessment should be considered for feasibility designs where an assessment may impact the field cost estimate and for specifications designs. Specific issues to consider are contained in Section 14 of Chapter 7 – Site Security and Public and Worker Safety. If assistance is required to determine specific design data needs, contact the Office of Security, Safety and Law Enforcement. Where design data and designs include site-specific security assessment, compliance with Reclamation Manual DM Part444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.