

- 4. Tunnels.** 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. Obtaining reliable data to support feasibility cost estimates for tunnels is both difficult and costly. The critical item in the design data is geologic information. This aspect should receive maximum attention during the data-gathering phase of the study.
- A. General Map.** The General Map should cover the project area and the area immediately surrounding the project within approximately 2 or 3 miles. The scale of the General Map should be adequate to clearly show listed details. A scale of approximately 1 to 3 miles per inch is commonly used. The following data are shown on a General Map for feasibility and specifications level design data collection:
- (1) A key map locating the general map within the State.
 - (2) A legend of symbols used for existing and constructed facilities.
 - (3) North arrow.
 - (4) Existing or potential areas or features having a bearing on the design, construction, operation, or management of the project. The locations of these features should bear the parenthetical reference to the agency or entity which owns or operates the property; for example, the Bureau of Reclamation (Reclamation):
 - (a) Name of agency responsible for maintaining and/or managing the affected land.
 - (b) Recreation areas; fish and wildlife areas; building areas; highways, railroads, and shipping points; housing; areas of cultural sensitivity; areas of archeological, historical, and mining or paleontological interest; and bridges with special loads or size limitations.
 - (c) Existing towns, residences, private property, roads, transmission lines, substations, stream-gauging stations.
 - (d) Areas of environmental concern.
 - (e) Public utilities such as electric power and telephone lines, pipelines, etc.
 - (f) County, range, township, and section lines.
 - (g) Land use restrictions such as easements and rights-of-way.

- (5) Rights-of-way:
 - (a) Show rights-of-way required or available for facility/structure sites, construction access, and staging areas.
 - (b) Land ownership boundaries and legal jurisdictions. Indicate ownership by agency acronym or private land with “private.”
- (6) The proposed structures and features:
 - (a) Location of features to be constructed or modified.
 - (b) Locations of potential construction and permanent access roads, sites for contractor’s staging areas and construction facilities, and sites for temporary water treatment facilities.
 - (c) Locations of borrow areas for natural construction materials, locations of commercial quarries, and disposal areas for waste excavation.
 - (d) Sources of construction power and power transmission facilities.
 - (e) Sources of water for construction.

B. Location Map. Location maps are commonly used as a condensed method of showing location and alignment of the features and associated structures. The location map may be combined with the general map, site plan, or plan and profile drawings for small areas. A scale of 1 inch = 1,000 feet to 1 inch = 2,000 feet is commonly used for location maps. The location map should show:

- (1) **General:**
 - (a) North arrow.
 - (b) Proposed alignment, major structures, and delivery locations by symbols. Station and appropriate ties to section lines, section corners, existing buildings, pipelines, roads, railroads, etc.
 - (c) Topography and ownership information should be shown.
 - (d) Towns, roads, railroads, streams, existing pipelines, canals, reservoirs, etc.
 - (e) Transportation facilities and other cultural features.
 - (f) Location of borrow areas, riprap sources, sources of special pipe embedment material, if required

- (g) Disposal areas for wasting excess excavation.
- (h) Sources of power for construction and operation and maintenance.
- (i) Existing or potential areas or features having a bearing on the design, construction, or operation and maintenance such as: recreation areas, fish and wildlife areas, railroads, housing, and areas of archeological, historical, and mining and paleontological interest.
- (j) Where the scale does not permit proper detail of a congested area, a blowup at a larger scale may be included elsewhere on the drawing and referenced to its proper location. Where density of the structures or other features is such that individual stationing and naming is impractical, the information should be shown in tabular form and station marks shown on the alignment.
- (k) Linear feature (tunnel), together with structures, adits, and stations. Structures and delivery locations are normally shown by symbol.
- (l) Legend of symbols for existing and proposed facilities
- (m) Right-of-way and land ownership information

C. **General Description of Local Conditions.** The following data may be required for feasibility and specifications designs:

- (1) Information relating to access for possible site visit by the design team, access for foundation exploration and construction, and access limitations due to environmental restrictions, etc.
- (2) Access to the site for operation and maintenance (O&M) forces.
- (3) Permits or permit requirements and any past permit violations or exceedences.
- (4) Name and description of similar construction in the area or region.
- (5) 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 access road length and major structures required for new construction; and possible alternative means for delivering construction materials and equipment to the structure site.

- (6) 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).
 - (a) Names, telephone numbers, email addresses, and Web sites of local utilities and contacts within those organizations.
 - (7) Climatic conditions that will affect design, construction, and O&M such as amount, rate, and distribution of rain, snow, and hail; ice conditions; heating and air-conditioning design temperatures; summer and winter temperatures with extremes; maximum wind velocities and their directions; probability of excessive dust or sand.
 - (8) Local frost depths.
 - (9) Ground water presence and depths.
 - (10) Vegetation to be cleared or preserved including kinds, sizes, and density of growth.
 - (11) Road detour requirements.
- D. **Topographic Map.** The proposed alignment of the tunnel should be shown on a current USGS map (7½-minute quad sheets 1:24000 scale). Smaller scale topographic maps of the portals are useful if available. In the absence of portal topography, photographs of the portals will aid the designer in determining conditions and design problems.
- E. **Geologic Data.** It is expected that one to five drill holes will be made during the feasibility study. Maximum effort should be directed toward obtaining geologic data along the tunnel alignment geology. This information will aid the designer and estimator in assessing problems such as competence of bedrock, method of construction, fault zones, water flows including hot water. It will also aid in selecting the appropriate tunnel shape and the need for or type of initial support and final lining. Drilling of portals will be included when major problems are anticipated. Maximum use should be made of existing data available from other Federal agencies, State and private sources, and educational institutions, as well as Reclamation data. The information will be put into a concise geologic report which will include a geologic section along the proposed tunnel route.
- F. **Operating Data:**
- (1) Reference any associated studies.

- (2) Purpose - vehicular or water.
- (3) Capacity of tunnel.
- (4) Location, hydraulic section water surface of inlet and outlet channels.
- (5) Flow controls required.

G. Miscellaneous Data:

- (1) Location of disposal area for excavated material.
- (2) Flood protection of tunnel portals.
- (3) Information on the design and construction of nearby tunnels.
- (4) Information on unusual waters being conveyed (i.e., acidic).

H. Environmental Considerations. Design data should include, as a minimum, the environmental issues and/or requirements that would affect tunnel design and 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 considered in preparing design data:

- (1) The environmental setting. Photographs, both black and white and color, are helpful.
- (2) Cultural (historical, archeological, architectural, and paleontological) resources in the area of the tunnel.
- (3) Recommendations for ensuring water quality standards are met including control of turbidity during construction.
- (4) Need for fish barriers.
- (5) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.
- (6) Erosion and sediment control.
- (7) The need for blending structures with the surroundings.
- (8) Anticipated public use around the structure.

I. Construction Considerations. The following design data items should be considered for feasibility and specifications designs:

- (1) Construction schedule:
 - (a) One contract or several contracts.
 - (b) Any construction timeframe restrictions
 - (c) Are designers required to provide a construction schedule and/or logic diagram?
 - (d) Recommended period for construction.
 - (e) Recommended period for completion of construction work and features of the work that should be completed early.
 - (f) Permissible times to make connections to existing facilities.
 - (g) Whether construction schedule will be adaptive, (e.g., provide a remedy, observe the effects, and then modify remedy as required).
- (2) Allowable in-river materials (permanent and temporary).
- (3) Construction constraints including allowable construction methods, traffic considerations, environmental restrictions, climatic restrictions, blasting limitations, etc.
- (4) Filling and draining criteria for dam, ponds, and pipelines
- (5) Unusual conditions for excavation or construction.
- (6) Extent of construction surveying to be accomplished by Government surveyors.
- (7) 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 feet per second of diversion flow for construction purposes can be assured to the contractor. The Government should obtain the water rights required. If it is 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.
 - (a) Water treatment requirements for return flows

- (8) Requirements for maintaining streamflow or diversions during construction and maximum length, time, and number of permitted interruptions.
- (9) Required permits from government agencies and others.
- (10) Requirements for meeting criteria for suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction.
- (11) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.
- (12) 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.
- (13) Comments on disposal of special excavation problem materials such as lignite.
- (14) Give borrow area and temporary haul road restoration requirements such as stockpiling of topsoil, grading of the area, general cleanup, etc.
- (15) Give consideration to using required excavated material in lieu of material from other borrow sources wherever possible.

J. **Cost Data for Field Cost Estimate.** The field cost estimate is an estimate of the capital costs of a feature or project from award to construction; non-contract costs are not included. Cost data developed in previous or other studies (either by Reclamation or others) should be included with the design data submittal. Include a description or outline of estimating methods and data used. The following design data for feasibility and specifications levels designs should be considered for submittal:

- (1) **Procurement Strategy.** Will solicitation be advertised and awarded under other than full and open competition? This includes solicitations which will be set aside under socio-economic programs that may limit competition or allow award to other than the lowest bid or proposal.
- (2) Estimate of cost of ROW for all features including reservoirs, dams, and appurtenant works. Include supporting data:
- (3) Information on local labor supply and labor problems.
- (4) Local freight or trucking rates.

- (5) Housing accommodations.
- (6) Interest rate for economic studies.
- (7) Power rate in mills per kilowatt-hour, interest rate, and plant factor for economic tunnel, and pipeline sizing studies in cases where transported water is pumped.
- (8) Estimated cost for construction items which cannot readily be determined in the design office and include the supporting data:
 - (a) Clearing reservoir area and for removing or replacing private improvements in the area.
 - (b) Earthwork (common and rock), excavation with freehaul distance. For canals, include compacting embankment, canal lining, and borrow (with free haul distance)
 - (c) Riprap, guardrail, culverts, row fencing, and gates.
 - (d) 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 area with defined limits or unit price per acre for area with limits subject to change during construction). Use separate payment items for clearly defined areas differing in growth density and difficulty of clearing operations. If vegetation to be cleared is very sparse or 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 appropriate items of work.
- (9) Where buildings are located within the area to be cleared by the prime contractor, and if disposal will be the contractor's 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. Drawings should be provided of these buildings, if available, that depict dimensions, construction materials, the structural system for the building, and major electrical and mechanical equipment. Determine if disposal will be the responsibility of the prime contractor. If not, submit dates when disposal will be completed by others.
- (10) Information on important construction work that is in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

- (11) If potential actions exceed anticipated funding, an assessment should be made as to whether the cost estimate will reflect incremental costs of these potential actions. Provide any known increment or arrangement of the incremental costs.
- (12) Local and tribal taxes.
- (13) Estimates of costs for relocating railroads, highways, roads, water systems, and other public utilities. Include supporting data.
- (14) Method for projecting cost into the future if required.
- (15) Cost of local materials (precast concrete, etc.).

K. 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 Part 444 – Physical Protection and Facility Security, Chapters 1 and 2 is required.