17. Bridges. 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.

The following data and information are required for specifications (final) design of vehicular bridges. This document can be used to request design data for railroad and pedestrian bridges along with buried box, round, or arch culverts to be constructed under roadways. These buried structures qualify as bridges under the American Association of State Highway and Transportation Officials.

AASHTO's definition of a bridge is as follows: "a structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening."

A. **General Map showing:**

(1) A key map locating the general map area within the State.

(2) A legend of symbols used for existing and constructed facilities.

(3) The location of the structure site, alignment of the roadway, highway, access road or railway.

(4) Existing towns, highways, roads, railroads and shipping points, public and private utilities such as electric power, telephone lines, pipelines, etc., transmission lines, substations, canals, dams, rivers and streams, stream-gauging stations (required only for bridges crossing rivers or streams), county, township, range, and section lines.

(5) Locations of potential construction and permanent access roads, detour routes and major crossings.

(6) Locations of borrow areas for natural construction materials, location of commercial quarries, and disposal areas for waste excavation.

(7) Location of contractor's staging areas, storage of construction materials, sites for stockpiling soil.

(8) Limits of construction or physical boundaries of the proposed bridge site, such as restrictions to land uses, easement and right-of-way.

(9) Existing or potential areas or features having a bearing on the design, construction, possible use and future maintenance of the proposed bridge such as: recreation areas, fish and wildlife areas, building areas, 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, NPS, or FWS.

(10) Sources of construction power and potable water to be used for construction.

(11) Scale on the general map should be adequate to clearly show listed details and north arrow.

B. **General Description of Local Conditions Covering:**

(1) **General Engineering Requirements.** There should be a narrative of the project area, which includes a brief description of the surrounding area, the size of the nearest population centers, the condition of bridges and other structures and roads. This description shall include the following (if available):

(a) Location (structure name, structure number, state, county or route number, distance to nearest city or town, etc).

(b) Project description (new structure, replacement, or modification required due to necessary improvements, etc.).

(c) Site description (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.).

(d) Weather and climate conditions that may affect design or construction (temperature extremes, local building code requirements for wind velocities, snow and ice loading, etc.). Rainfall intensity at the site for an estimated 25-year return period event simulated into 5-minute duration increments.

(e) Utilities such as powerlines, waterlines, or telephone lines that require installation on the bridge superstructure or are in the vicinity and may be impacted by the project. Include names, telephone numbers, and internet and email addresses of the local utilities and names of contacts within their organization.

(f) Provide copies of relevant correspondence to and from stakeholders such as Federal, State or local agencies or private entities. These stakeholders input may have an impact in the

design reviews or permitting process. Provide name of contact person, address, telephone number, internet and email address for potential direct contact by the design team.

(g) Provide copies of previous reports or studies that have been prepared by Reclamation or by others.

(h) For bridges crossing rivers or streams, describe waterway condition that may affect design, construction, and operation and maintenance procedures.

(i) 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; and possible alternative means for delivering construction materials and equipment at the structure site.

(j) Local freight or trucking rates.

(k) Estimated construction timeframes (limitations imposed by such items as traffic, environmental concerns and weather).

(l) Detour requirements and how construction may be staged.

C. **Surface Data:**

(1) **Survey Control.** Survey control is required for all surveys including surveys associated with aerial photography. Show coordinate system and existing land survey monuments and special control points established for the survey. All preceding survey work and all subsequent survey work, including topography and location, and ground surface elevations of subsurface exploration, should be revised to conform with the permanent control system.

All points contained in the electronic files should have coordinates for northing and easting and values which correspond to the ground level elevations. Specify the vertical datum, such as National Geodetic Vertical Datum (NGVD), and the horizontal datum, such as the State Plane Coordinates (NAD83) along with epoch date.

Legends should show grid factors and reduction to sea level factor, or a combination of the two.

Feasibility phase: Tying to the State plane coordinate system is recommended.

Specifications phase: Permanent horizontal and vertical survey control should be established at the earliest possible time. The coordinate system should be related to a State or national coordinate system.

(2) **Topographic Map.** When the horizontal alignment of the proposed bridge is known, the topographic map should embrace a minimum area of 100 feet upstream and 100 feet downstream and 100 feet beyond the ends of the structure. This area may have to be enlarged to cover any alternate alignments being evaluated or specific construction items such as cut and fill limits and channel modifications. Generally, both a map and an electronic file, in AutoCAD or compatible format, of the topography covering the structure site should be provided. The topographic map should be plotted to a scale of 1 inch equals 10 feet to 1 inch equals 20 feet with a maximum contour interval of 2-feet (if the project area is flat or small, a 1-foot contour interval may be required). Elsewhere, larger contour intervals may be acceptable. The location and identification of all subsurface explorations should be shown on the map. Details to be included are:

(a) Proposed bridge location.

(b) Underwater contours.

(c) Locate and identify existing site features which would be important design information such as roads, parking, turnarounds, buildings, structures, power lines, buried utility lines, campgrounds, picnic areas, springs, marsh areas, overflow channels, channel changes, edge of water, high water marks, types of vegetative cover, large boulders, exposed rock, etc.

(d) Existing right-of-way and proposed acquisition of additional right-of-way should be discussed.

(e) Provide a profile along the existing or proposed road centerline extending at least 500 feet beyond the ends of the bridge. The profile should be plotted to a horizontal scale of 1 inch equals 20 feet. Indicate recommended grade; elevations of extreme low, present and extreme high water; elevations of the stream bottom in the vicinity of the proposed piers or abutments; and type of foundation material underlying the substructure locations.

(f) Provide water surface elevations on the date of the survey and a thalweg of the stream bottom where practical for a minimum distance of 500 feet upstream and 500 feet downstream from the centerline of the proposed bridge. These profiles should be plotted

to a horizontal scale of 1 inch equals 50 feet and a vertical scale equals 10 feet.

(g) Provide at least four cross sections of the stream. Sections should be taken immediately upstream and downstream of the structure, and the other sections should be taken at each end of the stream profile. These cross sections should be typical of the stream. Indicate the elevations of low, present, and high water.

(3) **Aerial Photographs.** Aerial photographs (9-inch by 9-inch color infrared photos at 1:24,000 scale) of the bridge site. The purpose of the aerial views is to permit early preparation of an artist's rendition of the bridge 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.

(4) **Photographs.** Digital color photographs of all existing facilities or structures in the vicinity of the proposed bridge site with close-up views of any features which may affect designs. These photographs should be taken to best show the proposed structure and, if possible, indicate known tie points to the topographic maps.

(a) All photos should be keyed to the site map. Photos should show problem or hazardous areas, location of the proposed bridge, location of possible access points to the site from existing routes, and close ups of existing features such as buildings and other structures. These photos should also show favorable offsite views that should be preserved and considered when determining bridge location.

D. **Foundation Investigation Data:**

(1) **General Engineering Requirements.** The need for foundation data should be established by originating office personnel with assistance from the region and TSC representatives. For major bridge structures and unusual or difficult road alignments, it is recommended that an onsite inspection and a field conference be held.

The purpose of performing foundation investigations is to determine the elevation of suitable foundation materials to support the bridge abutments and piers. The foundation investigations help determine the profile of the subsurface materials in the areas of the abutments or piers and show graphic logs of the subsurface exploration. Although some foundation investigation is usually required for all structures, in some cases an extensive exploration program may not be necessary for smaller buried structures.

The TSC design team will prepare preliminary bridge design layouts and a field exploration request. The TSC geologic and geophysical staff will work with the appropriate field staff and provide necessary assistance and guidance in the gathering of these design data.

(2) **Geologic Data.** The following list of geologic design data provides general guidelines for the collection and reporting of geologic information for bridges. The data should reflect a recognition and consideration of the scope and size of bridge structure anticipated. 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.

(a) A description of the regional geology.

(b) 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.

(c) A surface geologic map of the bridge site, plotted on the topographic map of the bridge site, showing surface geology and the location of geologic sections, soil profiles, and of all subsurface explorations, including coordinates or stationing.

(d) A description and interpretation of site geology including physical quality and geologic structure of the foundation strata, seasonal ground water, ground subsidence, existing and potential landslide, snowslide and rock fall areas, surface water runoff; and engineering geologic interpretations appropriate to the structure involved, including the conditions expected during excavation and construction.

(e) Geologic logs of all subsurface exploration. An exploratory drill hole is required at each critical bridge foundation element (abutment or pier). The coordinate location and ground surface elevation of all existing and subsequent exploratory drill holes should conform to the permanent survey control system.

(f) Exploratory drill holes should be at least 50 feet long or extend 10 feet into competent bedrock. Logs shall include split tube blow counts at a minimum of 5-foot intervals.

(g) Geologic cross sections, with detailed soil profiles as required, showing known and interpreted subsurface conditions. Soil classification in accordance with the Unified Soil Classification System.

(h) Digital color photographs of pertinent geologic and topographic features of the terrain.

(i) Selected determination of engineering properties of surficial deposits and bedrock by laboratory or field tests (in-place density, penetration resistance, permeability, shear strength, and consolidation or expansion characteristics, etc.). The type and number of samples and tests required should be determined in cooperation with the TSC.

(j) Samples of foundation strata as needed for visual examination or laboratory testing. Test pits and results of material testing should be included.

(k) For bridges over rivers and streams, in-stream material samples to determine D_{50} for scour analysis.

(l) Soil survey to determine suitability of soils and type of materials to be used for backfill behind bridge abutments and wing walls.

(m) Determine age of faulting in vicinity, especially if suspected to be late Pleistocene or Holocene, to assist in the determination of the seismic loading by design specialists in the TSC.

(n) Determine ground water conditions with attention being paid to water levels and their seasonal fluctuation occurrence of unconfined and confined aquifers, potential seepage areas, water-producing capabilities, chemistry, and land subsidence.

(o) 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

(3) **Engineering Data:**

(a) Surficial soils (see *Earth Manual*, latest edition). Note geologic sections and soil profiles in (2) (c) above.

- A classification, in accordance with the Unified Soil Classification System, of the soil in each major strata.

- A description of the undisturbed state of the soil in each major strata.

- A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata, including swelling minerals, gypsum and other sulfates, caliche, etc., in foundations and excavation slopes, (especially those to be permanently exposed).

- An estimate or a determination by tests of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansion characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on these properties.

- A determination by tests of the corrosive properties and sulfate content of the soil and ground water

(b) Bedrock (see *Engineering Geology Field Manual*). Note geologic sections and soil profiles in (2) (c) above.

- A contour map of the top of bedrock. A description of thickness of weathered, altered, fractured, or otherwise softened zones and other structural weaknesses and discontinuities.

- A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundations and excavation slopes (especially those to be permanently exposed) with attention being paid to engineering matters such as swelling minerals, presence of gypsum and other sulfates, caliche, etc.

- An estimate or a determination by tests of the significant engineering properties of the bedrock such as density, absorption, permeability, shear strength, and strain characteristics; and the effect of structure load, changes in moisture, and fluctuations or permanent rise of ground water on those properties

E. **Hydrologic Data (required for bridges crossing rivers and streams):**

(1) Annual periodic fluctuations of stream or river water levels.

(2) Flood frequency design flows for 50 and 100 year intervals.

(3) Estimated water surface elevations on date of survey.

(4) Provide a profile of the centerline of the river or stream bottom where practical for a minimum distance of 500 feet upstream and 500 feet downstream from the centerline of the proposed bridge structure. The profile should be plotted to a horizontal scale of 1 inch equals 50 feet and a vertical scale of 1 inch equals 10 feet.

(5) Provide at least three cross sections of the stream. One section should be taken at or near the centerline of the bridge and the other sections at each end of the stream profile. These cross sections should be typical of the stream. Indicate the elevations of low, present, and high water.

(6) Drainage area located upstream of the bridge site.

(7) Include information on any existing downstream natural barriers or river control works affecting tailwater and available data on past degradation or aggradation of stream channel and possibility of future changes.

(8) Where unwatering of a bridge site adjacent to a stream or lake is required, give maximum water levels expected during the construction period and the possibility of controlling water levels by operation of upstream or downstream facilities.

(9) Information for preparation of specifications hydrographs at the TSC, including the location of gauging stations at or near the structure site and the dates for which hydrographs should be prepared. Copies of the daily discharge record should be supplied for stations with unpublished records.

(10) Anticipated occurrence and amounts of sediment, ice (thickness), and drift (trash).

(11) Analysis of water for chemical and physical characteristics and biological quality. Analysis should include a water quality analysis of intake water to include major ions and cations, corrosivity, and parameters listed as maximum contaminant limits in the Surface Water Treatment Rule, Safe Drinking Water Act.

(12) Erosion protection requirements and calculated scour depths, which will be used for support structure foundation design.

F. **Design Standards:** For vehicular bridges, the design code is the AASHTO LRFD Design Specifications published by AASHTO. Applicable state design standards will also be followed when these requirements are more stringent than AASHTO's. The following is a list of the types of facilities carried by the bridge structures that are designed at the TSC.

(1) Highways and roads open to the public.

(a) New bridge designs shall be based on construction to current standards where traffic count and other considerations show justification. Bridge clear widths on public roads shall meet requirements of State, county, city, or local entity standards for the road classification.

(b) Replacement in kind shall be used where the existing bridge design live load and roadway width are equivalent to current standards and are considered adequate or where there is no justification for upgrading to higher or current standards.

(c) Live load requirements higher than current standards shall be used only when there is a special need or consideration. An example is heavy construction vehicle traffic.

(2) Access roads. Designs shall be based on AASHTO design guidelines for access roads with modifications for unusual circumstances such as the need for higher standards due to the magnitude of the project, special haul problems, recreation needs, etc.

(3) Recreation roads. Relocated roads, highways, or access roads intended for recreation purposes or which will contribute to such purposes may be constructed to higher standards with justifications, and shall be fully identified and described, including the proposed standards, at the feasibility design.

(4) Railroads. Designs shall be based on replacement in kind with consideration given to higher standards as required by AREMA.

(5) Repair and rehabilitation of existing bridges. Designs shall be based on restoration to original load capacity unless there is justification for upgrading to current standards.

(6) Modification of existing bridges. Widening, lengthening, earthquake retrofit, permit load strengthening, or installing other features (fencing, railing, etc) to existing bridges shall have justification and shall be fully identified and described, including proposed standards.

(7) Other unique purpose. They shall be fully identified and described, including proposed standards.

(8) Pedestrian access bridges are to be designed in accordance with AASHTO's *Guide Specifications for Pedestrian Bridges*.

G. **User and Operating Data:**

(1) For road and highways:

(a) Number of traffic lanes, including shoulders.

(b) Typical roadway cross section.

(c) Pedestrian sidewalk requirements.

(d) Design loading other than HS20, load limits.

(e) Deck protection or rehabilitation – thickness and type of surfacing, or future surfacing, i.e. asphalt overlays.

(f) For rehabilitation or replacement – existing structure information including as-built drawings, the condition of concrete, steel, and timber material, etc.

(g) For replacement – the disposal of old bridge.

(h) Existing cross drainage structures located within the proposed construction site, including hydraulic requirements.

(2) Current and future activities and needs: The current and future road classification. The future classification from the county or State Department of Transportation responsible for road maintenance. Include type of equipments or vehicles that will cross the bridge.

(3) For railroad bridges:

(a) Track classification, type of service, limiting grades and curvature, design load limits, other operating limitations or requirements, and typical roadbed section showing depth and type of ballast, weight of rail, size, spacing, and type of tie.

(b) Information on operating facilities, such as communication or signal lines. Provide a point of contact and phone number for the railroad.

(4) Utility requirements of the user (water, electricity, sewer).

H. **Miscellaneous Data:** The bridge roadway design cross section should be coordinated with the required cross section for roadways or railroads. See Section 7 G (1) for typically required data for roadways or railroads. In addition, plan and profile drawings showing the following should be provided:

(1) For highway or road bridges, the plan and profile drawings (prepared in electronic format and plotted on 22 inches by 34 inches, Architectural D, with horizontal scale of 1 inch equals 100 feet and vertical scale of 1 inch equals 10 feet) showing:

(a) Horizontal position of road centerline with complete curve information, right-of-way lines, existing road for 500 feet each way from points of intersection, and any survey ties.

(b) Vertical position on road centerline of the original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing road surface for 500 feet each way from points of intersection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures (bridges, culverts, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new bridge.

(e) Location of protective ditches and dikes.

(f) Location of guardrails, guard posts, or delineators.

(g) Location and type of right-of-way fences and gates.

(2) For railroad bridges, the plan and profile drawings (prepared in electronic format and plotted on 22 inches by 34 inches, Architectural D, with horizontal scale of 1 inch equals 200 feet and vertical scale 1 inch equals 20 feet) showing:

(a) Horizontal position of track centerline with complete curve and spiral information, right-of-way lines, existing track for 1,000 feet each way from points of connection, and any survey ties.

(b) Vertical position on track centerline of original ground line, new subgrade (with complete information on grades, elevations, and vertical curves), existing subgrade for 1,000 feet each way from points of connection, and any survey ties or datum equations.

(c) Location, type, and nominal dimensions of all required structures and operating facilities (bridges, culverts, ditches, passing tracks, sidings, motorcar set-offs, etc.).

(d) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line.

(e) Location of protective ditches and dikes.

(f) Location and type of right-of-way fencing and gate

I. **Construction Materials Data Including:**

(1) Location and estimated available quantities: Distance to suitable borrow areas for permeable and impermeable soil materials required for fill or embankment; distance to quarry or stockpile for riprap required for channel or slope protection. If quantities are limited, give approximate volumes available.

(2) An earth materials report containing complete detailed information on those potential sources of soils and rocks that have been selected for final consideration. (See *Earth Manual*.).

(3) Information on concrete aggregates. (See "Final Investigations" in *Concrete Manual*.)

(4) Data on commercial concrete and precast concrete plants within practical hauling distance from the bridge site.

(5) Estimated quantities for all construction schedule items which cannot readily be determined in design office, i.e., earthwork (common and rock), overhaul of roadway excavation with free-haul distance, riprap guardrail, culverts, and right-of-way fencing and gates.

(6) Results of sampling and analysis of materials, including previous tests conducted at the TSC.

(7) Geologic data describing construction materials to be obtained from commercial sources.

J. **Cost Data:**

(1) Estimate of cost of right-of-way or easements. Include supporting data.

(2) Information on local labor supply and labor problems.

(3) Information on important construction works in progress or planned in the vicinity and the presence of interested contractors or subcontractors in the area.

(4) Estimates of cost for relocating public utilities within the construction area. Include supporting data.

(5) Estimates of cost for removal of buildings and other structures within the construction area. Include a general description and recommended disposal of the structures.

(6) Provide any pertinent cost estimates or information that has been prepared or obtained by Reclamation or the owner. The cost estimates shall include a description or outline of estimating methods and data used.

(7) 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

K. **Environmental Considerations.** Implementation of design features should be consistent with the environmental commitments listed in the project's NEPA 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 railroad or highway relocation, an access road alignment, or a bridge structural design. The following items should also be considered in preparing design data:

(1) Cultural (historical, archeological, architectural, and paleontological) resources along or adjacent to any potential alignment.

(2) The need for blending the bridge structure with the surroundings and the need for restoring and for reseeding cuts and fills.

(3) Comment on any ecological, aesthetic, or other environmental aspects peculiar to this location which would affect the bridge layout or roadway approaches.

(4) Indicate the suitability and possibility of present or 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 bridge where fixed by law or local ordinance, or where otherwise considered necessary or advisable; measurements of existing daytime and 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 or abandoned roadways 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 protection and passage during construction at stream crossings.

(9) Recommendations or commitments to maintain specific flow requirements for biological and/or recreational resources.

(10) Any threatened and/or endangered critical habitat in/or adjacent to the potential alignments.

(11) The need for game/livestock protection, including crossings, fencing, etc.

(12) Wildlife, wetlands, required environmental permits, construction window, traffic restrictions, and detour requirements.

(13) Comment on disposal of material from clearing operations. Consider State and local burning regulations, burying or chipping of materials, and maximum utilization of merchantable timber.

(14) Limitations that may affect in-stream construction, foundation investigation work. Restrictions for encroaching onto the waterway for placing falsework, cofferdams, sheet piles, etc.

(15) Erosion and sediment control.

(16) The need for a field conference to resolve critical environmental problems with participation of other agencies.

(17) Review of designs by other agencies.

(18) Railroad, highway, or access road clearing plan to consider fish and wildlife requirements.

(19) Anticipated public use of Reclamation access roads.

(20) State and local building codes when applicable.

(21) Water for construction purposes.

(22) Applicable permits and monitoring requirements.

L. **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.