6. Pipelines. 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 design data requirements included in this section cover pressure and gravity or open (low-pressure) pipeline systems.

A. **General Map(s).** 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 Maps.** 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) For distribution systems, show ownership, turnout locations, and irrigable areas served.

(i) Sources of power for construction and operation and maintenance.

(j) 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.

(k) 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.

(l) 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.

(m) Linear feature (canal, pipeline, wasteway, drains, etc.), together with structures and stations. Structures and delivery locations are normally shown by symbol.

(n) Legend of symbols for existing and proposed facilities.

(o) Right-of-way and land ownership data.

(2) **Distribution Systems.** Where the source of the water is a canal, reservoir, or pipeline with turnout or headworks located outside the distribution system area boundary, topographic maps should be submitted covering all the areas in which the connecting feeder main is to be located. The water surface elevation range in the source canal or reservoir or hydraulic grade line range in the source pipeline should be shown. Also, where appropriate, data such as capacities, grades, etc., should be shown.

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

(12) List similar construction in the area.

D. **Survey Control.** Survey control is required for all surveys including surveys associated with aerial photography. Use of an existing coordinate system or a system tied to the township and range system is acceptable but tying to the State plane coordinate system is recommended.

If designs are required to modify an existing system, verification of the original coordinate system and datum should be made.

E. **Topographic Maps:**

(1) **General.** Topographic maps will serve as the base on which the design and layout of the pipe system will be made. A survey with a scale of 1 inch equals 100 feet to 1 inch equals 400 feet and a 2-foot contour interval is satisfactory for these maps; depending on the size of project and topography. The contour interval may be increased in hilly or mountainous terrain. If the project area is flat or small, a 1-foot contour interval may be required.

The map must cover the entire project area, including water source where it is outside the distribution service area. These maps will show:

(a) Existing significant features, natural and manmade.

(b) Ownerships, giving delivery water surface elevations and irrigable acres for each turnout location.

(c) Available survey information to include township and range lines, section lines, etc.

(d) Source of water (canal, reservoir, pipeline, wells, or combination of surface and ground water, etc.), giving operating water surface elevations or operating hydraulic gradients, rates of flow, flood data, etc., where appropriate.

(e) When preliminary studies have included a system layout, the layout should be submitted for consideration in feasibility designs as a part of these data.

(f) Cross drainage areas and potential scour depths.

F. **Plan and Profile Drawings.** Plan and profile drawings are normally requested for linear features such as roads, canals, and pipelines. Drawings are prepared so that both plan and profile are plotted on one sheet. Strip topography may be used for the plan view. The plan view may not be required if shown on other drawings. These drawings are normally prepared with a 1 inch = 10 feet vertical scale and the horizontal scales from 1 inch = 100 feet to 1 inch = 400 feet unless more or less detail is required. The scale should be adjusted, as required, if it is necessary to show details. Plan and profile drawings should show features such as:

(1) **General:**

(a) For feasibility studies, strip topography should be provided.

(b) North arrow and land survey lines.

(c) Proposed centerline and stationing and curve data.

(d) Location of existing features such as highways, railroads, public utilities, major drainages, and any other features that will affect the location and cost of proposed project facilities.

(e) Ties and stationing for turnouts, sublaterals and deliveries, as well as road crossings, railroad crossings and utility crossings. Grid coordinates for major structures such as pumping plants, flow control stations, tanks, reservoirs, etc.

(f) Land control survey lines with ties to alignment where appropriate.

(g) Survey data to include stationing, ties to existing features, etc.

(h) Existing ground surface contours with date of surveys and mapping. Significant topographic features.

(i) Existing utility lines within the right-of-way and requirements for relocation.

(j) Location of any existing intersecting facilities, watercourses, or other physical features affecting the new line or riprap protection on steep slopes.

(k) Cross drainage and direction of flow. Location of riprap protection on steep slopes. For major cross drainages, include flow (ft^3/s) and associated frequency (years)

(l) Low wire elevations and station of power lines (include voltage) where they cross the alignment.

(m) Buildings, fences, and other obstructions.

(n) Right-of-way.

(o) Feature alignment, curve data, and stationing.

(p) Hydraulic properties by reaches of proposed features (including hydraulic gradeline, feature dimensions, and pressure class for pipelines).

(q) Structures (including conduit size for siphons, turnouts, and culverts).

(r) Alignment of laterals, sublaterals, overflow wasteways, reservoirs, and access roads.

(s) Crossings: Individual drawings should be furnished that show the plan and the profile, drawn to appropriate scales, of the following types of crossings:

- Railroad crossings.
- Highway crossings which cannot be constructed by open-cut methods.
- River or canal crossings.

(t) Roads, borrow pits, and waste areas.

(u) Anticipated right-of-way widths and minimum radius of curve that should be used to establish right-of-way (ROW) limits at points of intersection on pipeline centerline alignment. Where possible, curves having a minimum radius of 500 feet should be used at horizontal changes in the direction of the pipeline alignment. On large diameter pipelines, curve radii of 1,000 feet or more may be desirable to permit use of "pulled" joints in pipe or curves rather than concrete encasements.

(v) Areas where special construction effort is required, such as directional drilling, microtunneling, compacting pipe trench backfill up to the ground surface, excavating the pipe trench using shoring or a safety shield, limits of encasement under proposed drains or canals, etc.

(w) Profile: Existing ground surface, centerline elevations of pipelines, canals, hydraulic gradeline, utilities or other subsurface features where they cross the alignment.

G. **Geologic Data:**

(1) Surface geologic investigations sufficient to define:

(a) Approximate boundaries of major areas of soil and unconsolidated material and exposed bedrock outcrops, and estimated range and average depth of the soils strata overlying bedrock. Identify areas of common and rock excavation.

(b) Location and extent of areas of unusual conditions such as: existing or potential landslides, low-density or expanding clay soils, spoil banks, hazardous materials or corrosive soils.

(c) Estimated depth to ground water where shallow enough to be encountered in pipe trenches.

(d) Location and quantities of materials needed for construction.

H. **Operating Data:**

(1) Develop hydraulic data and basic criteria for sizing pipelines and deliveries. Operational data required depends on the pipeline ultimate use (irrigation or M&I).

(a) Irrigation system

- Note distribution of irrigable acres along the irrigation system.
- Seasonal requirement. This is usually stated in terms of acre-feet per productive acre per year for irrigation (application efficiency already considered).
- Monthly requirement. Expressed as a percentage of seasonal requirement for each month of operation. Irrigation flows will be distributed over the irrigation season and will vary based on crop requirements per month.
- Peak requirement. This is the basic criteria for sizing pipelines and can be based on the maximum demand for a month, peak day or other time period. The demand should be stated as the number of productive acres to be served by a flow of 1 ft^3/s or a flow rate of a specified number of gallons per minute required to irrigate 1 acre.
- Criteria for reducing irrigable acres to productive acres. This can be expressed as a percentage of the irrigable area.
- Basic criteria for sizing farm deliveries. This may be shown as a table showing the maximum and minimum number of productive acres to be served by deliveries of 1, 2, 3, 4, etc., ft^3/s.
- Type of farm distribution system, including pressure required at farm delivery for sprinkler or drip irrigation systems.
- Controls and equipment to be included in farm deliveries such as flow meters, control valves, open stands, and pressure-reducing valves.

(b) Municipal and industrial system

- Yearly requirement. This is usually stated in terms of acre-feet per year.
- Monthly requirement. Expressed as a percentage of the yearly

requirement for each month of operation. M&I systems may be spread out equally over the entire year when better data is not available.

- Peak requirement. This is the basic criteria for sizing pipelines and can be based on the maximum demand for a month, peak day or other time period. Delivery demands can be stated in acre-feet per month or ft^3/s and pressure requirements at the delivery points.
- Capacity for future development.
- Controls and equipment to be included in deliveries such as flow meters, control valves, altitude valves and pressure-reducing valves, etc.
- Chlorination requirements.
- Fire demand.
- Lifeline designation?

(2) Data on water source:

(a) Operating water surface elevations or hydraulic gradients.

(b) Data on turnout, dam outlet, pumping plant, etc., from which water will be delivered.

(c) Water quality information.

(3) Control Systems

Determine whether automatic and/or supervisory control is desired (including future provisions). If supervisory controlled, give location of master station.

(4) Filling and Draining Criteria

Data on allowable outage times based on operation and maintenance requirements.

(5) Storage Requirements:

(a) Fire code

(b) County or State regulations

I. **Miscellaneous Data:**

(1) Screening requirements at source of water (turnout, pumping plant, dam outlet, etc.).

(2) Location, reliability and data on source of existing electrical power.

(3) Criteria for road crossings (mostly for open lateral system) and other significant structures required.

(4) Minimum earth cover over the pipelines. This is usually set by the depth of frost penetration into the ground, water table location, depth of cultivation, potential scour at cross-drainage sites, traffic considerations, etc.

(5) Details of any existing utilities that may be in the area or cross the proposed alignment, such as gas pipelines, electrical powerlines, etc.

(6) Information about cathodic protection systems that may be employed in the project area.

(7) Information about Reclamation or private pipelines constructed in the project area including, corrosion protection, construction data and maintenance issues.

(8) Determine if there is a client preference for a type of pipe and what pipe types have been used in the project area previously.

(9) Soil resistivity surveys if metallic pipe or fittings are to be used as options.

(10) Compaction requirements for the pipe trench backfill where the alignment passes through existing farmers fields and underneath roads.

(11) Determination of the minimum ROW limits for construction and the permanent ROW limits required after completion should be obtained.

(12) The method for determining the ROW and how the ROW will be obtained should be described.

(13) Electrical Data:

(a) Names and telephone numbers of power suppliers and contacts within their organizations.

(b) Locations where connections to power supply will be made.

(c) System voltage at which power will be supplied, number of phases, and whether service will be overhead or underground.

J. **Environmental Considerations.** Information should be included which will aid the designer in minimizing the environmental impacts due to construction of these systems. The following items should be considered in preparing design data:

(1) Photographs of the environmental setting.

(2) Cultural (historical, archeological, architectural, and paleontological) resources along any alignment or within the area of the distribution system.

(3) Wildlife or refuge areas.

(4) Existing or potential wetland areas.

(5) Any threatened and/or endangered critical habitat within or adjacent to the pipeline system.

(6) Areas of heavy public use should be clearly identified.

(7) The need for restoring borrow areas and reseeding spoil banks

(8) The water quality and location of return flows.

K. **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:

(a) For reservoirs, include a curve showing estimated cost of ROW versus elevation of reservoir water surface from normal elevation to maximum estimated surcharge elevation or other physical or economic limit. 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.).

L. **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.

M. **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.