19. Water Treatment Plants. 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 is a list of possible data required for feasibility design of water treatment facilities. The size and complexity of the process system and structures should govern the amount and detail of the design data required.

A. **General Map Showing:**

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

(2) The plant site and other applicable construction areas.

(3) Existing towns, highways, roads, railroads, public utilities, streams, stream-gauging station, canals, drainage channels, townships, range, and section lines.

(4) Locations of construction access roads, permanent roads, and sites for required construction facilities.

(5) Sources of natural construction materials and disposal areas for waste material, including the extent of mitigation required.

(6) 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; and areas of archeological, historical, and mining or paleontological interest.

(7) Water sources to be treated such as surface water or underground water.

(8) Brine disposal ponds

(a) Location of potential sites for brine disposal ponds.

(b) Location of channels and storage sites for brines, sludge, and chemicals.

(c) Disposal areas for pond residue waste material.

(9) Scale of the general map should be adequate to clearly show listed details.

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

(1) The capabilities of and constraints imposed by local shipping and transportation facilities.

(2) Availability of housing and other facilities in nearest towns, requirements for a construction camp, and need for permanent buildings for operating personnel.

(3) Availability or accessibility of public facilities or utilities such as: water supply, sewage disposal, telephone, and electric power for construction.

(4) Climatic conditions that will affect operation and maintenance and construction procedures such as: amount, rate, and distribution of rain and/or snow; ice conditions; frost depth; monthly maximum and minimum (or at least summer and winter) temperatures, and relative humidity; and extreme wind velocities and prevailing directions. (Extensive tabulations are not necessary.)

(5) Copies of existing planning or assessment reports.

(6) Permits or permit requirements and any past permit violations or exceedences.

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 line surveys should be tied to the established coordinate system at each plant site.

(2) **Topographic Map.** A topographic map covering an area sufficient to include all practical arrangements of the facilities including intake, product and reject lines, brine ponds, switchyard or substation, service area, sludge disposal area, trash disposal area, and visitor facilities. Show all manmade features in the included area on the map. A scale of 1 inch equals 50 feet with a 2-foot contour interval is suitable for most structures. The scale, contour interval, and detail should be based on the conditions and need at each particular site.

(3) **Photographs**. Photographs of the sites are desirable, with proposed structures marked in ink.

D. **Foundation Data**.

The amount and detail of foundation data required for a feasibility design will vary. The guiding criteria should be to provide sufficient data to allow the designer to determine the type of foundation required for the structures and to identify major foundation problems. Adequate foundation data may be obtained for small structures from an inspection of surface conditions and one or two exploratory holes to determine type of overburden and foundation conditions some distance below the base of the structure. These data, and any other data in the following paragraph that are relevant, along with a brief description of geologic conditions of the site, can be included in the design data.

A geologic report shall be prepared and a field conference should be held, including an inspection of the site to determine the geologic investigations program. In developing the geologic program and in preparing the geologic report, the following should be considered:

(1) A description of regional geology.

(2) A description and interpretation of site geology "including physical quality and geologic structure of the foundation strata, ground water and seismic conditions, existing and potential slide areas, and engineering geologic interpretations as appropriate."

(3) Geologic logs of all subsurface exploration. All exploratory hole locations and elevations should be based on the same survey control system.

(4) A geologic map, plotted on the topographic map of the site, showing surface geology and the location of geologic sections, soil profiles, and all subsurface exploration.

(5) Geologic sections, with soil profiles as required, showing known and interpreted subsurface conditions.

(6) Samples of foundation strata as needed for visual examination or laboratory testing.

(7) A determination of natural ground water conditions at the site.

(8) Overburden soils (see *Earth Manual*). Note geologic sections and soil profiles in (5) above.

(a) A classification, in accordance with the Unified Classification System of the soil in each major stratum.

(b) A description of the undisturbed state of the soil in each major stratum.

(c) A delineation of the lateral extent and thickness of critical, competent, poor, or potentially unstable strata in foundations and excavation slopes, especially those to be permanently exposed.

(d) An estimate or a determination by limited test of the significant engineering properties of the strata, such as density, permeability, shear strength, and consolidation or expansive characteristics, and the effect of structure load, changes in moisture, and fluctuations of permanent rise of ground water on these properties.

(9) **Bedrock.** Note geologic sections and soil profiles in (5) above.

(a) A description of the contour of bedrock surface; thickness of weathered, altered, or otherwise softened zones; and other structural weaknesses and discontinuities.

(b) A delineation of structurally weak, pervious, and potentially unstable zones and strata of soft rock and/or soil in foundation or excavation slopes, especially those to be permanently exposed.

(c) A determination by limited 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 these properties.

(10) Brine disposal ponds

(a) Excavation, fill and slope lines for ponds

(b) Special problems such as possible ground water contamination and regulations governing seepage losses should be addressed.

(c) Major soil types should be identified including significant factors such as expansive and low-density soils, dispersive soils, and rock. Material tests should be performed as required to identify problem soils.

(d) Water table elevation

(e) Lining recommendations. See *Brine Disposal Pond Manual*.

E. **Construction Materials Including:**

(1) Location and distance to suitable borrow material for pervious and impervious backfill and embankments and riprap material.

(2) Sources of concrete aggregate.

(3) Data on commercial concrete plants in the area.

F. **Hydrologic Data:**

(1) Description of feed water source (surface water, ground water, drains, wells, wastewater, partially treated wastewater, etc.).

(2) Monthly periodic fluctuations of feed water flows shown by tables or charts summarizing operation studies for normal and minimum and maximum periods. Include periods of expected no-flow or aquifer size and recharge rate monthly averages.

(3) Maximum, maximum and minimum operating water surface elevations; flood flows; average flow. For under ground sources, include expected drawdown during pumping as a function of pumping rate.

(4) Recommend minimum trashrack or gate deck elevation.

(5) Anticipated occurrence and amounts of silt, sediments, biomass, ice (thickness) and drift (trash), and possible effect on feedwater source outlets to pretreatment plants or inlets to desalting plants.

(6) Potential location for and volume of reservoir's) suitable for leveling of daily or annual fluctuation in flow or salinity of water source.

(7) Where unwatering of a plant 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.

(8) Determine composition of feed water; see table 1 at the end of this section.

(9) For brine disposal ponds obtain flood frequency flows for major surface channels.

G. **Operating and Maintenance Data**.

(1) Product water data to include the following:

(a) Desired salinity and pH of product water and limits on specific ion levels, if applicable.

(b) Desired percent of water recovery.

(c) Proposed initial and ultimate plant capacity.

(d) Desired use and projected quantity of product water delivery on demand basis or minimum delivery required over useful plant life.

(e) Maximum acceptable cost of product water, dollars per thousand gallons.

(2) Current estimated dollar value of:

(a) Product water.

(b) Salt removed.

(c) Water to replace reject.

(3) The availability and cost of possible energy sources:

(a) Electrical.

- Location and direction of existing or proposed incoming powerlines terminating at site.
- Source and voltage of incoming power. Name of agency or utility supplying power, limitation on motor starting voltage drops and number of starts, power factor limitation, and distance to source.
- If a switchyard is required, refer to Section 10, “Switchyards and Substations.”

(b) Fossil fuel.

(c) Solar, geothermal, wind, other.

(4) Disposal sites for:

(a) Plant reject flow.

(b) Debris, biomass, sediment, and sludge.

(c) Spent chemicals from pretreatment and desalting cleaning and storage solutions.

(d) The suggested disposal sites should be able to meet requirements of either State or the U.S. Environmental Protection Agency for discharge of pollutants.

(5) Nature of operation, i.e., whether attended, semiautomatic, fully automatic, or supervisory controlled. If supervisory controlled, give location of master station.

(6) Flow, pressure, or other parameters and measurement accuracy requirements.

(7) Availability, cost, and method of shipment of treatment chemicals, such as:

(a) Lime, CaO, and $Ca(OH)_2$.

(b) Soda ash, Na_2CO_3.

(c) Ferric sulfate.

(d) Chlorine.

(e) Carbon dioxide.

(f) Sulfuric acid, H_2SO_4.

(g) Sodium hexametaphosphate.

(h) Others.

(8) For brine disposal ponds:

(a) Source and quantity of water.

(b) Water surface elevations and capacity at the inlet control.

(c) Annual net evaporation rates and monthly distribution.

(d) Average monthly wind velocities and prevailing direction.

(e) Plan of operation for disposal pond controls including extent of supervisory control.

(f) Provisions for surface drainage in the area of disposal ponds.

(g) Provisions for cleaning ponds and delineation of disposal areas for residue from ponds.

(h) Possible utilization of residue from ponds such as reclaiming chemicals, etc.

(i) Evaporation enhancement programs to be considered such as spray or dyes.

(9) Location of nearest railroad spur.

(10) If recalcination is to be considered provide information for determining the feasibility of recalcination, such as environmental factors and market potential for excess lime.

(11) Market potential for treatment by products such as sludge or brine.

(12) Regional comprehensive operating scheme, including possible integration with any existing scheme.

(13) Recommendation for a major or minor machine shop or service area in the plant.

(14) Recommendation for maintenance facilities in the plant.

(15) Recommendations concerning whether the plant should be indoors or outdoors.

H. **Environmental Considerations**. Design data should include, as a minimum, a brief description of the environment that could be affected by the proposed development. The emphasis should be on those areas in the range of alternatives open to the designers in developing a process and plant design. The following items should also be considered in preparing design data:

(1) Historical and archeological values.

(2) Recommendations for maintenance of water quality standards including:

(a) Suppression of nitrogen, adequate oxygen levels, and temperature control and control of turbidity during construction; also requirements for multilevel intakes.

(b) Post treatment requirements for pH and limitations on chemical constituents for the desalting plant product water and brine reject.

(c) Published guidelines and regulations for air and water quality standards.

(3) Background on the need for fish facilities, fishways, and barriers.

(4) Impact of moving construction materials on existing road facilities, including consideration of such factors as traffic congestion, effect on road condition, air pollution, etc.

(5) Erosion and sediment control.

(6) The need for blending structures with the surroundings, including placing transmission circuits underground.

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

(8) Anticipated public use around the structure.

(9) Recommendations for landscaping and source of irrigation water.

(10) Brine disposal ponds.

(a) The environmental setting.

(b) Photographs.

(c) The need for escape structures and/or protective fences for human beings, deer, or other wildlife.

(d) Any laws or regulations that pertain to seepage of ground water or disposal of residue from ponds.

(e) Local effects of increased humidity due to evaporation.

I. Site Security:

(1) Security requirements for protection of plant and equipment from vandalism or sabotage.

(2) 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.

J. Coordination with Other Agencies:

(1) List of agencies and organizations outside of Reclamation which will have design and construction requirements inputs. Also, give names of contact persons, mailing addresses, telephone numbers, email addresses, and web sites.

(2) Design requirements.

(3) Review requirements.

K. Miscellaneous Data:

(1) Recommendations for visitor facilities.

Table 2 – Feedwater quality data requirements

Parameter	Units
Total Hardness as $CaCO_3$	mg/L
Calcium (Ca^{+2})	mg/L
Magnesium (Mg^{+2})	mg/L
Sodium (Na^{+})	mg/L
Potassium (k^{+})	mg/L
Total Cations	meq/L
Total Alkalinity as $CaCO_3$	mg/L
Carbonate (CO_3^{-2})	mg/L
Bicarbonate (HCO_3^{-})	mg/L
Sulfate (SO_4^{-2})	mg/L
Fluoride (F^{-})	mg/L
Chloride (Cl^{-})	mg/L
Nitrate (NO^{-3})	mg/L
Phosphate (PO_4^{-3})	mg/L
Total Anions	meq/L
Aluminum (Al^{+3})	mg/L
Barium (Ba^{+2})	mg/L
Copper (Cu^{+2})	mg/L
Iron (Total)	mg/L
Iron (Dissolved-Fe^{+2})	mg/L
Manganese (Total)	mg/L
Manganese (Dissolved-Mn^{+2})	mg/L
Arsenic (As^{+3})	µg/L
Selenium (Total)	mg/L
Selenium (Dissolved-Se^{-2})	µg/L
Strontium (Sr^{+2})	mg/L
Dissolved Oxygen (O_2)	mg/L
Hydrogen Sulfide/Sulfide	mg/L
Total Suspended Solids	mg/L
Silica (SiO_2)	mg/L
Specific Conductivity	µohm/cm
Total Dissolved Solids (TDS, Evap @ 180 ^{o}C)	mg/L
Total Organic Carbon	mg/L
Temperature	^{o}C
Turbidity	NTU
pH	Unitless

Notes: Monthly minimums, maximums and average concentrations of the above parameters for 12 consecutive months is ideal. May need bacteriological (cryptosporidium, giardia, e-coli) data. May need PAH's, HAA's, or TTHM data.