

**7. Drawings.** Drawings provided with the design data submittal should show both existing data and the proposed features and facilities. Section 4, “Surveying,” and Section 5, “Topographic Maps” describe surveying requirements and existing and proposed features which should be shown on the drawings. The following drawings may be required: topographic maps, location maps, plan and profile drawings, and site plans. Topography and associated data may be shown on any of the drawings. Location maps normally show the layout of linear features (canals, pipelines, roads, etc.) at a scale of approximately 1 inch = 1,000 feet to 1 inch = 2,000 feet. Plan and profile drawings are also used to show linear features but show more detail at an enlarged scale (1 inch = 100 feet to 1 inch = 400 feet). Site plans show locations of specific structures at smaller scales of from 1 inch = 10 feet to 1 inch = 100 feet, depending on the size and type of feature. The scales may be adjusted to clearly show required data. The arrangement of all drawings should conform to requirements described in Reclamation Drafting Standards. The drawings should be prepared in digital electronic format suitable for feasibility or specifications use and with consideration for final CAD drawing production as required. The design team must determine drawing requirements based on the need to produce the design in the most effective and efficient method possible.

**A. 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. 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. These details are not required to be shown on the location map if they are shown on other drawings.
- (c) Topography and ownership information should be shown unless they are shown on other drawings.
- (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 or density of the structures or other features is such that individual stationing and naming is impractical and/or a blowup at a larger scale may be included elsewhere on the drawing and referenced to its proper location, the information should be shown in tabular form and station marks shown on the alignment.
  - (l) Linear feature (canal, pipeline, wasteway, drains, etc.), together with structures and stations. Structures and delivery locations are normally shown by symbol.
  - (m) Legend of symbols for existing and proposed facilities
  - (n) Right-of-way and land ownership information.
- (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 of the same scale and contour interval provided for above 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.
- (3) **Wells:**
- (a) Locations of the well site(s), transportation facilities, cultural facilities, and communities.
- (4) **Transmission Lines:**
- (a) Proposed alignments for any new transmission lines and alignments for existing transmission lines.
  - (b) Show terminal and intermediate substation locations.

(5) **Drains:**

- (a) A topographic map usually at a scale of 1 inch equals 2,000 feet showing approximate location of existing drains, roads, railroads, power lines, and gravel sources.

**B. 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. 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 ( $\text{ft}^3/\text{s}$ ) 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.
- (2) **Canals:**
- (a) Hydraulic and section properties: bottom width, side slopes, water depth, hydraulic equation used, and associated coefficient are often shown in a table.
  - (b) Areas where special construction effort is required: low-density soils, high ground water table, bedrock, etc.

- (c) Profile: The profile should show, as a minimum, bottom grade, original ground surface, water surface, and utilities and other subsurface features where they cross the alignment.

(3) **Pipelines:**

- (a) 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.
- (b) 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.
- (c) Profile: Existing ground surface, centerline elevations of pipelines, canals, hydraulic gradeline, utilities, and other subsurface features where they cross the alignment.

(4) **Drains:**

- (a) The plan should depict location of drains, location and size of manholes, and drain stationing.
- (b) Structures (including conduit size for siphons and culverts).
- (c) Hydraulic properties (normally tabulated) by reaches of proposed section.
- (d) Typical sections: Show proposed earthwork dimensions for open and closed drains. For concrete lined drains, detail views of the lining may be required for clarification.
- (e) Areas where special construction effort is required.
- (f) Profile: The profile should depict existing ground surface, bottom grade, water surface elevation, and section.

(5) **Transmission Lines:**

- (a) Key map, and plan and profile sheets.
- (b) Profile: The profile should show the existing ground surface.

(6) **Bridges:**

- (a) Coordinate with the required cross section for roadways or railroads.
- (b) 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.
- (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) For railroad bridges:
  - 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.
  - 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.
  - Location, type, and nominal dimensions of all required structures and operating facilities (bridges, culverts, ditches, passing tracks, sidings, motorcar setoffs, etc.).
  - Location of protective ditches and dikes.
  - Location and type of ROW fencing and gate.
- (h) High water surface elevations
- (i) Profile: Vertical position on road centerline of the original ground surface, new subgrade (with complete information on grades, elevations, and vertical curves), existing road surface for 500 feet each way from points of intersection, any datum equations, and utilities and other subsurface features where they cross the alignment.

**C. Site Plans.** The site plan normally shows all of the required design data discussed in Section 4, “Surveying” and Section 5, “Topographic Maps”: the survey data, existing features, and proposed features.