8. Drains. 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 of open drains for the collection of surface and subsurface water requires data primarily on surface conditions, i.e., topography; flood runoff; soil erosion characteristics; outlet requirements for storm water and waste water from irrigation and laterals; and County, State, Federal, and private structure requirements. For subsurface drains to control ground water and salinity, the primary data required are on soils and substrata. Design of subsurface drains is based largely upon hydraulic conductivity of the various soil strata above the uppermost slowly permeable barrier in the soil profile, the position and thickness of these strata, land forms, surface infiltration rates, contemplated land use and irrigation practices, precipitation records, topography, and historic ground water conditions prior to irrigation.

Because a feasibility report requires only sufficient information to determine with reasonable assurance that the project will be successful and able to fulfill the repayment contract, the amount and coverage of the drainage investigations will depend on the knowledge, judgment, and experience of the drainage engineer. The reliability of the drainage requirements and cost estimate will depend on obtaining the right information to be used for additional extrapolation and interpretation in areas not covered in the investigations. Field investigations should be kept to a minimum.

A. **General Map**. A general map showing project area, nearby towns, roads, and railroads.

B. **Location Map.** 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.

C. **General Description as It Affects Drainage Requirements and Covering:**

(1) Regional geology and geomorphology, topography, and climate.

(2) Texture, structure, hydraulic conductivity, infiltration, chemical characteristics, and stratification of soils, subsoils, and substrata.

(3) Chemical characteristics of ground water and irrigation water as they affect project productivity.

(4) Ground water conditions, including sources, position, any artesian pressures, and gradients.

(5) Predicted chemical characteristics of drainage water as it affects human health, and the environment.

(6) Location and class of jurisdictional wetlands.

(7) Contemplated land use, anticipated crops, and irrigation practices.

(8) Natural surface drainage, flood history, and channel locations and characteristics.

(9) General appraisal of subsurface drainability and requirements.

(10) Preliminary plan for surface and subsurface drain systems including types of drains to be provided, rough delineation of areas which may require special treatment, and any unusual excavation problems or working conditions.

(11) Suggested correlation and integration of project drain systems with farm drains, canals, laterals, flood control facilities, and nonproject protective works.

D. **Maps Showing the Following Drainage Data:**

(1) Topographic base maps showing existing drains, roads, improvements, canals, reservoirs, railroads, highways, etc. USGS quad sheets can be used.

(2) A rough depth-to-barrier map for areas where clays, shales, sandstone, or other slowly permeable materials occur at depths which will adversely affect drainage.

(3) A land classification map showing land classes by standard symbols and location of any special deep test holes.

E. **Profiles.** Appropriate multiple profiles across typical areas showing ground surface elevations, stratifications, permeabilities, and ground water levels.

F. **Hydrologic Data:**

(1) Precipitation and runoff records.

(2) Area-discharge curve of 5-, 10-, and 25-year storms for use in design of drains to remove surface water from irrigable lands.

(3) Economic capacity of cross channels based on consideration of probable frequency of flooding and the resultant damages to crops and project works.

(4) Water requirements, including canal and lateral losses, farm application, surface waste, and deep percolation losses.

(5) Hydrographs showing typical ground water fluctuations in selected observation wells.

(6) Stability of natural channels receiving drain flow.

(7) Expected water quality of drain flows

(8) Identify impoundments, streams, and/or wetlands likely to be affected by drain flows.

(9) State water quality criteria for water bodies receiving drain water. Identify probable range of concentrations for various constituents such as pesticides, selenium, etc.

G. **Gravel Sources.** Permeabilities and gradations of gravel sources.

H. **Other Requirements.** Structure requirements of other agencies, corporations, and individuals.

I. **Existing Systems.** Comparative Data from lands in the vicinity having similar soils and drainage conditions and already under irrigation:

(1) Map of the existing drainage system.

(2) General discussions of soil and substrata characteristics and the depths, capacities, and spacings of the drains.

(3) Detailed data on particular drains where the factors affecting drainage are similar to those in the project area. The data will cover type of drain, design, soil and substrata characteristics, ground water conditions, construction and maintenance problems, discharge, land use, irrigation practices, and area effectively drained for good crop production.

J. **Environmental Considerations.** During the investigation studies, the environmental impacts of the drainage system on other features, such as municipal, industrial, recreational, water quality, water quality standards, location of discharge and expected water quality of discharge, fish and wildlife, and aesthetic requirements should be considered. Close cooperation on environmental matters should be established and maintained between drainage personnel and personnel working in other technical disciplines. Liaison should also be established with regulatory agencies the environmental groups in the area.