# CHAPTER 6. PRELIMINARY SITE INVESTIGATION

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Soon after a dam site has been tentatively selected, the geologist makes a preliminary investigation of the site. This consists of a field study and a review of available literature and maps relating to regional geology and physiography. For watershed protection projects (Public Law 566), this preliminary investigation is usually made in the work-plan stage to obtain information needed to determine both physical and economic feasibility.

The geologist and the engineer must work together closely during the preliminary site investigation. They should discuss geologic conditions that may influence the design, construction, cost, and functioning of the proposed structure. Where these conditions appear adverse, a more intensive investigation may be required to determine site feasibility.

## Purpose

The purpose of a preliminary site investigation is to establish the geologic feasibility of the site and to determine the extent and precision of detailed subsurface investigation required to obtain the information needed for design and construction. For some sites the preliminary investigation, together with experience in the area, may be adequate to determine the geologic conditions and the engineering characteristics of materials. At other sites enough information on subsurface materials can be readily obtained during the preliminary examination from test pits, hand-auger borings, trenching, or other methods so that a detailed subsurface investigation is not required. But a detailed subsurface investigation must be scheduled where enough information for design cannot be obtained with the tools available during the preliminary examination. Then the results of the preliminary examination provide a basis for planning the detailed investigation. This planning requires consideration of such items as depth, number, and location of borings; kinds and locations of samples to be taken; equipment required; requirements for clearing, staking, and mapping the site; and need for access roads.

## Assembly of Data

Before beginning a field study of a site, review the available geologic, physiographic, and engineering-experience data. The usual sources of reference data are publications of the U.S. Geological Survey; State geological surveys; U.S. Department of Agriculture soil survey reports; special reports and papers in scientific publications; and Federal, State, or local engineering-experience information where available. A base map on a usable scale, topographic sheets, aerial photographs, and geologic and soil maps are also helpful. Preliminary information on the location of the proposed dams is essential. The following site information is needed.

1. Purpose of dam and reservoir.
2. Estimates of height of dam and cubic yards of compacted fill required.

3. Estimated maximum and normal pool elevations.
4. Class of structure (see Engineering Memorandum SCS-27).
5. Approximate area in reservoir basin.
6. Approximate location of emergency spillway.
7. Approximate location of outlet structure.

Geologic and topographic maps are useful for determining the general geology, and soil maps are helpful for the general delineation of boundaries of particular kinds of surface materials.

Wherever possible, the geologist should make use of the general design and construction experience and the performance of structures in the area. Interviews with engineers or other technicians familiar with the design and operation of these structures and visits to structures under construction are particularly helpful in areas where the geologist has had little or no experience. Available reports on laboratory analyses of local materials should be reviewed to determine physical and engineering properties for possible application to the site in question.

Use of Aerial Photographs

A study of aerial photographs of the general area of the site is helpful. Color tone, vegetation, landforms, and drainage patterns often are indicators of geologic features, including kinds of rock, fractures, sinks, and landslides, and of moisture and soil conditions. Stereoscopic prints provide three-dimensional impressions that help in establishing the general geology during subsequent field studies.

Tones in a photograph and vegetative pattern can indicate moisture conditions or differences in the kind of soil or rock. Very dark tones may indicate water close to the surface and very light tones, low surface moisture. Sands and gravels tend to produce light tones, whereas fine-grained soils produce darker tones. A change in vegetative pattern may indicate a change in kind or texture of soil or rock.

Since landforms are the result of geologic processes, their identification may give some indication of geologic structure as well as of soil and rock materials. Drumlins, eskers, outwash and alluvial fans, talus cones, landslides, slumps, sinkholes, and abrupt changes in slope are some of the landforms that can be recognized.

Drainage patterns may be indicative of surface materials, topography, and geologic structure. A radial pattern in which streams flow outward from a center indicates an uplifted dome or a volcanic cone. A dendritic or treelike pattern typically develops on horizontally bedded rock. A parallel pattern implies a uniform slope such as a coastal plain. A rectangular or lattice pattern characterized by right-angle bends in both the main stream and its tributaries indicates structural control from joints or faults. A trellis pattern, also characterized by right-angle bends and junctions but more regular than a rectangular pattern and having main streams and their larger tributaries parallel, is also due to structural control and is typical of steeply dipping or tightly

folded sediments. An annular or ringlike pattern is due to rock structure and is usually associated with maturely dissected dome or basin structures.

In addition, local interruption or modification of drainage, such as a stream pushed to one side of the valley, overfalls, swampy conditions, incised meanders, braided streams, and oxbow lakes and abandoned or buried channels, may be helpful in interpreting the conditions at the site.

Delineate any features of tone, vegetation, landform, and drainage on the aerial photographs or on overlays for subsequent checking in the field.

## Field Study

A field study of the site and the surrounding area should include a traverse of the valley for about a mile above and a mile below the site. It should include a study of slopes, tributary valleys, landslides, springs and seeps, sinkholes, exposed rock sections, and the nature of unconsolidated overburden to obtain information on the general geology of the area. An inspection of upland and valley slopes may provide clues to the thickness and sequence of formations and to rock structure. The field study should also include inspections of the shape and character of channels and the nature of residual, colluvial, alluvial, fan, slide, and other kinds of deposits. Any observations of ground-water occurrence, especially in alluvial deposits, should be recorded. Possible sources and approximate amounts of borrow material should be noted. A few hand-auger borings or test pits may be needed.

The geologist should make a thorough inspection of the dam and reservoir area. He should identify and describe all geologic formations visible at the surface and note their topographic positions. He should determine the local dip and strike of the formations and note any stratigraphic relationships or structural features that may lead to problems of seepage, excessive water loss, and sliding of the embankment.

He should locate and delineate any faults. If they are numerous, active, or of large displacement, it may be necessary to relocate the dam or the principal spillway. In addition to other problems, faults and fault zones may cause serious leakage.

Hand-auger borings or test pits may be needed for some preliminary exploration at the dam site. If power tools are available, they should be used if conditions warrant. If there are geologic conditions that indicate that the site may not be feasible, they should be thoroughly investigated immediately.

Depth to ground water, depth to bedrock, thickness of recent alluvium and colluvium, and availability of suitable borrow material are conditions that may require further definition.

## Mapping

It is always advisable to prepare a geologic map of the site. Use the best available base map or aerial photograph. Plane-table surveys may be needed. Features to be shown on the map include --

1. Areal geology of all surface formations, including delineation of unconsolidated deposits.
2. Texture of surficial deposits.
3. Structure of bedrock, including dip and strike, faults or fractures, stratification, porosity and permeability, schistosity, and weathered zones.
4. Ground-water features, including seeps, springs, observable water tables, and drainage.
5. Areas of modern deposits (result of accelerated erosion).
6. Unstable slopes, slips, and landslides.

## Report of Preliminary Investigation

Prepare a report of the preliminary geologic investigation and make recommendations on the need for further investigation.

Form SCS-375, Preliminary Geologic Examination of Dam Sites, may be used. Use form SCS-533, Log of Test Holes, to record information obtained from any power drilling, test pits, or hand augering. Send one copy of both forms to the EWP Unit engineering geologist. This information is useful in planning a detailed subsurface investigation if one is necessary. Since form SCS-375 is for in-Service use only, its distribution should be restricted to SCS personnel.

In some situations the preliminary site investigation and knowledge and experience in the area provide enough information for design purposes without further detailed investigation. Thus for small structures in areas where site conditions are not complex and where there is little variation in conditions or materials from one site to the next, previous investigations in the general area may be applicable. For these sites prepare forms SCS-35A, - 35B, and -35C from the hand-auger data and submit them with the report. If samples from other sites with similar conditions have been analyzed and the data are used as criteria in preparing the recommendations, include in the report a reference to these samples and note the availability of the data.

For those sites where previous information permits a preliminary investigation to be used for design, it is necessary to locate and delineate borrow areas. This can be done only by subsurface exploration. A detailed investigation must be made of all borrow areas.