SATIS 2.0

Stillwater reservoir

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INTRODUCTION AND SYLLABUS

This unit is based on the roles played by geological experts and others when a new reservoir is being planned. It is designed for use with students taking advanced geology courses, but may be tried with any group of students able to understand the problems on even a fairly superficial level. Since it involves discussion of general as well as particular issues, it carl make a valuable contribution to a general studies programme.

In this unit, students are asked to take on the roles of participants in a real debate after they have been given data which is as realistic as possible. The decision making and evaluation involved provide very good practice for facing the problems of life in general and the life of a geologist in particular.

SCIENCE, TECHNOLOGY AND SOCIETY

This unit illustrates:

- the importance of water resources and the need to provide and conserve them.
- a procedure for decision-making
- a variety of factors which can influence a major engineering project

This unit gives students the opportunity to:

- analyse an issue in terms of its scientific, technological and social components,
- consider alternative solutions to a problem and justify a preferred solution,
- communicate logically and persuasively.

SPECIALIST EARTH SCIENCE

This unit:

- covers the main factors involved in the siting of water reservoirs,
- illustrates the economic importance of earth science,
- shows links between earth science and other areas of study.

During the unit students will have the opportunity to:

- interpret topographic and geological maps,
- analyse geological information,
- evaluate environmental issues.

USING THE UNIT

TIMING

The class time taken will depend on the approach adopted (see below). The full treatment requires about 90 minutes in class..

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A SUGGESTED APPROACH

Students are asked to take on the roles of different interested parties in a debate. about the siting of a water reservoir. The simulation may be used in two ways.

ALTERNATIVE 1

Students are divided into six groups, each group representing one of the six interested parties (hydrogeologists, conservationists and so on). Each group prepares its submission - which takes 20 - 30 minutes. Then the groups are brought around the 'conference table' and a speaker for each group in tum presents their submission to the conference and answers questions from the other 'delegates'. This is carefully controlled by the person in the chair (the teacher or a student elected by others. at the conference).

At the end of the debate, students are asked to vote for the most suitable site on the basis of the evidence and arguments which they have heard. A voting system by secret ballot is best - you can ask the students to close their eyes while calling for a show of hands. The debate and vote take 40 - 50 minutes..

ALTERNATIVE 2

Students are asked to carry out the whole exercise for themselves. They are asked to put themselves in the position of each of the six interested parties in tum and to rank the four sites from the most suitable to the' least suitable with reasons. They are then asked to stand back and evaluate all the rankings and reasons, and decide upon the best site. Their decision should then be presented with supporting data.

The unit can be used in this way either in class or at home. This alternative encourages written expression but does not require preparation or evaluation at such a deep level as alternative 1. However in alternative 2, students have to take on more roles than in alternative 1.

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Stillwater reservoir

Study Guide

INTRODUCTION

There are plans to build a new reservoir to increase the water supply to a large city on the coast. A meeting has been called to select a suitable site. Those at the meeting will include experts advising the water authority (including hydrologists, hydrogeologists and engineering geologists), conservationists, farmers, and members of the local planning authority. At a previous meeting these people have already agreed to narrow down the list of possible sites to four.

In preparation for the meeting you and the others in your group must select a preferred site and prepare arguments in favour of your choice. You have a topographic map and a geological map for each of the four sites together with summaries of the relevant data.

Study the maps carefully using the map keys.

Note that:

1. Each of the four catchment areas is of similar size,
2. The volume of the reservoirs formed would be the same at each site (25 million cubic metres).

NOW DECIDE

Which of the interested parties you represent. It may help if a member of your group takes the chair and another person agrees to keep a record of the discussion. You will be given a brief description of the main concerns of the people you represent

SUGGESTED PROCEDURE

STEP 1

Carefully shade the maps to make them clearer.
A: On the four topographical maps, shade and colour the reservoir area.
B: Shade the geological map key, then use the same colours or symbols to shade the geological maps.

STEP 2

After Analysis and discussion of the data, select the best reservoir site from the point of view of the interests of your group.

STEP 3

Prepare a justification of your choice of site by highlighting its advantages and pointing out the problems with other sites.

STEP 4

Decide which member of your group will present your case to the others at the public meeting

STEP 5

When all of the cases have been presented and discussed, make a final decision on the most suitable site - following the guidance of the person charing the full debate.

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SIX INTERESTED GROUPS

STILLWATER RESERVOIR

HYDROLOGISTS

You are concerned with the water supply to the reservoir through tributary streams and surface runoff. You also have to consider losses of surface water.

NOTES

1. Runoff volume and rate of runoff are greater on steep slopes with thin soils than on shallow slopes with thick soils.
2. Evaporation rates are affected by the surface area of the water and by climate (cloud cover, temperature, humidity, windspeed and so on).

STILLWATER RESERVOIR

NATURE CONSERVANCY GROUP

You are concerned with the preservation of particular sites of biological, geological and historical importance, together with the maintenance of ecological balance and the quality of the environment in general.

NOTES

1. SSSIs are designated sites of special scientific interest protected by law.
2. New reservoirs may prove to be assets to wildlife such as water fowl.

STILLWATER RESERVOIR

HYDROLOGISTS

You are concerned with groundwater flows and the underground water supply to the reservoir. You have to make sure that the reservoir will not leak. Primary porosity is determined by the amount of empty space between the grains of the rock itself. Secondary porosity develops when there are gaps in the rock created by cracks, joints and faults.

Rock type	Primary porosity	Primary permiability	Potential for secondary porosity and permeability
Granite	0%	low	fairly high
Thermally metamorphosed slate	0%	low	fairly high
Sandstone	10-30%	low to high	fairly high
Shale	15-20%	low	low
Limestone	0-10%	usually low	high
Coal	0%	low	low
Clay	50-80%	low	low

NOTES

1. The porosities and permeabilities of the major rock types are shown in the table
2. Reservoirs which would leak due to the permeability of the underlying rocks may be sealed by using a clay lining, but this is a very expensive operation, particularly if it is needed over a large area
3. Groundwater flow into the reservoir must be free of pollutants

SIX INTERESTED GROUPS

STILLWATER RESERVOIR

ENGINEERING GEOLOGISTS

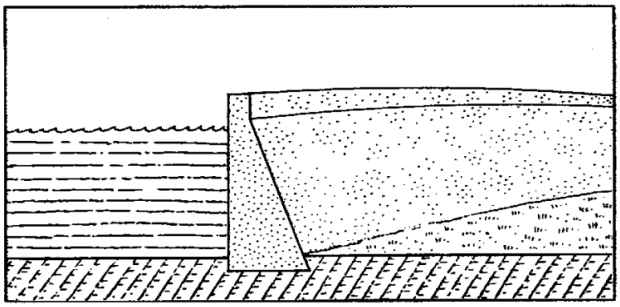
You are concerned with the feasibility and cost of building a dam. You prefer a simple, low-cost dam.

NOTES

1. You must consider primary rock strengths and secondary weaknesses such as joints and faults.
2. You have a choice of three main types of dam:

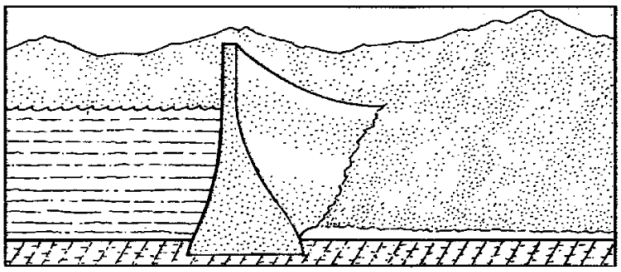
A GRAVITY DAM

The weight holds the dam in position. The foundations must be excavated to sound bedrock. This type of dam needs a large volume of concrete or masonry and so the contractor will be looking for a nearby source of suitable rock or sand for aggregate.



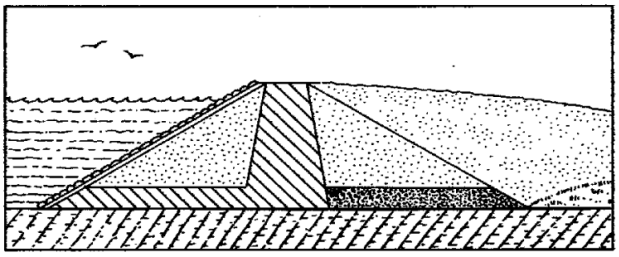
AN ARCH DAM

The curved shape holds the dam in position against the walls and floor or gorge-like valleys. It needs solid bedrock. Joints and fractures in the rock are potential weaknesses. The volume of sand and aggregate required is fairly small.



AN ARCH DAM

Weight and size hold the dam in posltlon. The foundations must be fairly firm. It has a very large volume and so a very large quantity of low-quality fill from a nearby source is needed.



STILLWATER RESERVOIR

A LOCAL FARMERS GROUP

The curved shape holds the dam in position against the walls and floor or gorge-like valleys. It needs solid bedrock. Joints and fractures in the rock are potential weaknesses. The volume of sand and aggregate required is fairly small.

STILLWATER RESERVOIR

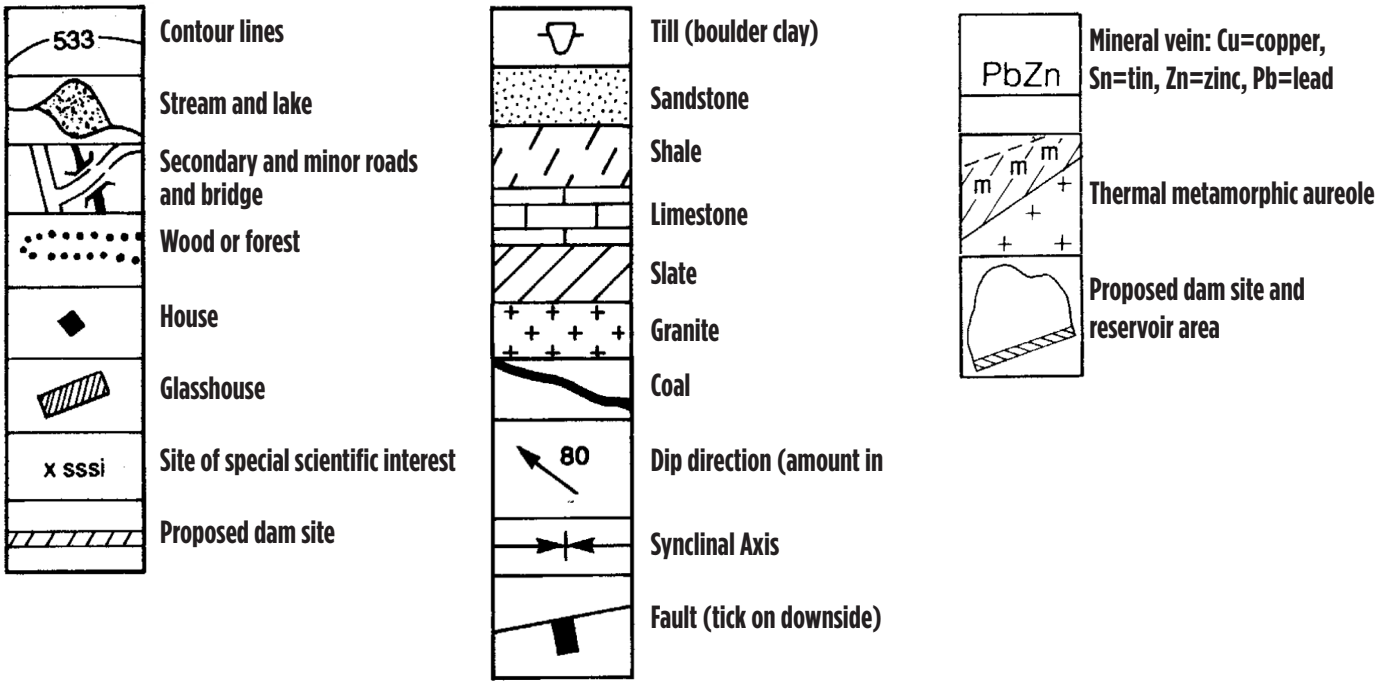
MEMBERS OF THE LOCAL PLANNING COMMITTEE

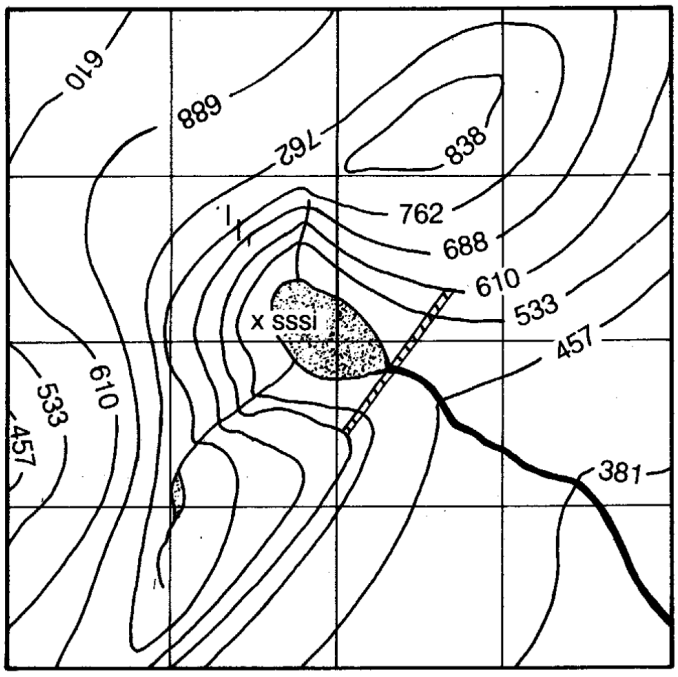
You are concerned to see a new, low-cost, pollution-free water supply for the conurbation. However, the reservoir will have additional value it it can be used to generate hydroelectric power or to provide opportunities for watersports.

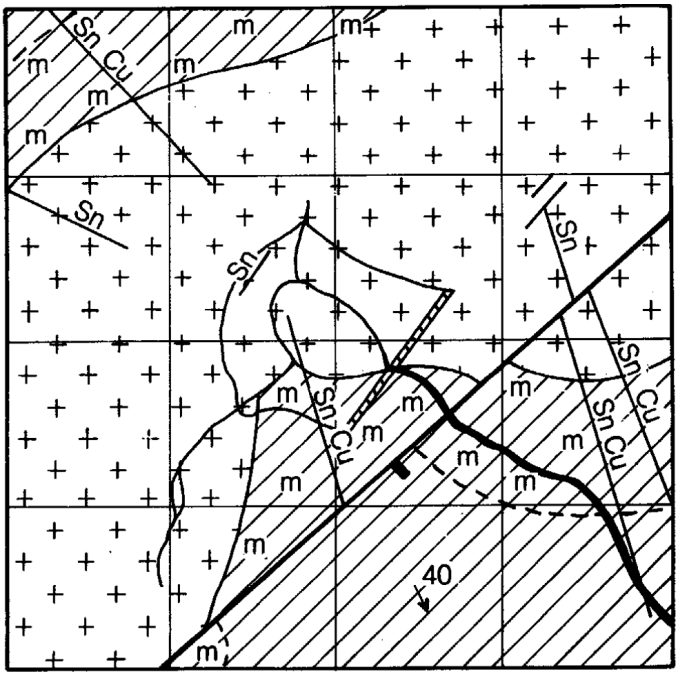
NOTES :

1. Hydroelectric power stations need a good head of water and a large volume construct.
2. A reservoir suitable for water sports has a large surface area.
3. New access roads will have to be built.
4. The company, in consultation with the planning committee, will have to divert any roads that will be drowned. Any people displaced will have to be rehoused.

POTENTIAL RESERVOIR SITE A



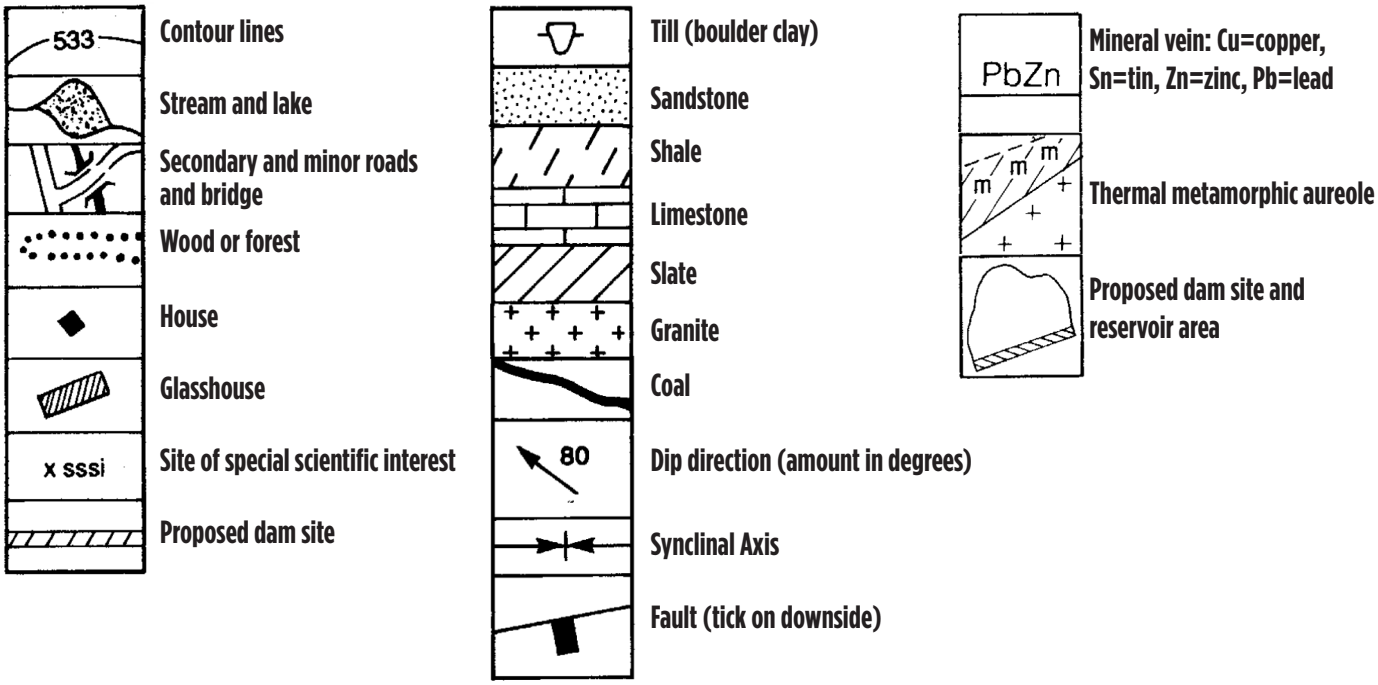


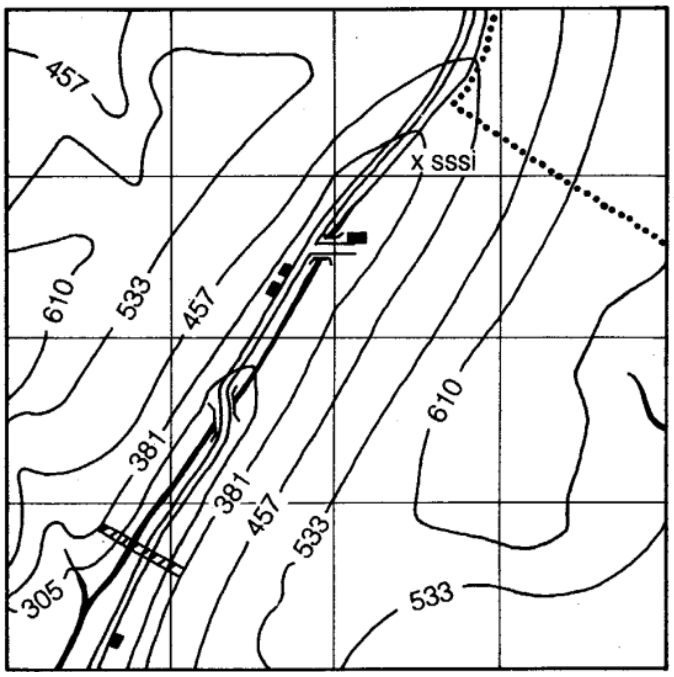


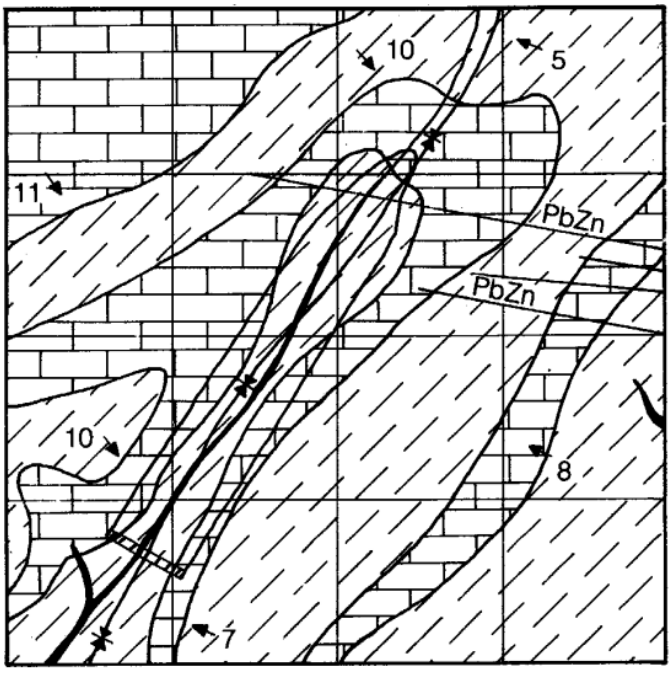
SITE DATA - SITE A

Distance from conurbation: 162km
Annual rainfall: 2123 mm
Main farming types: Sheep, plan for afforestation being held in abeyance
Geology: Odovician slates extruded by granite
Points of importance: Rare alpine flora native (i.e. naturally occurring in the area). SSSI - rare flower locality, a 12km access road will be needed if the reservoir us built on this site
Reservoir potential: Water supply, hydroelectric

POTENTIAL RESERVOIR SITE C



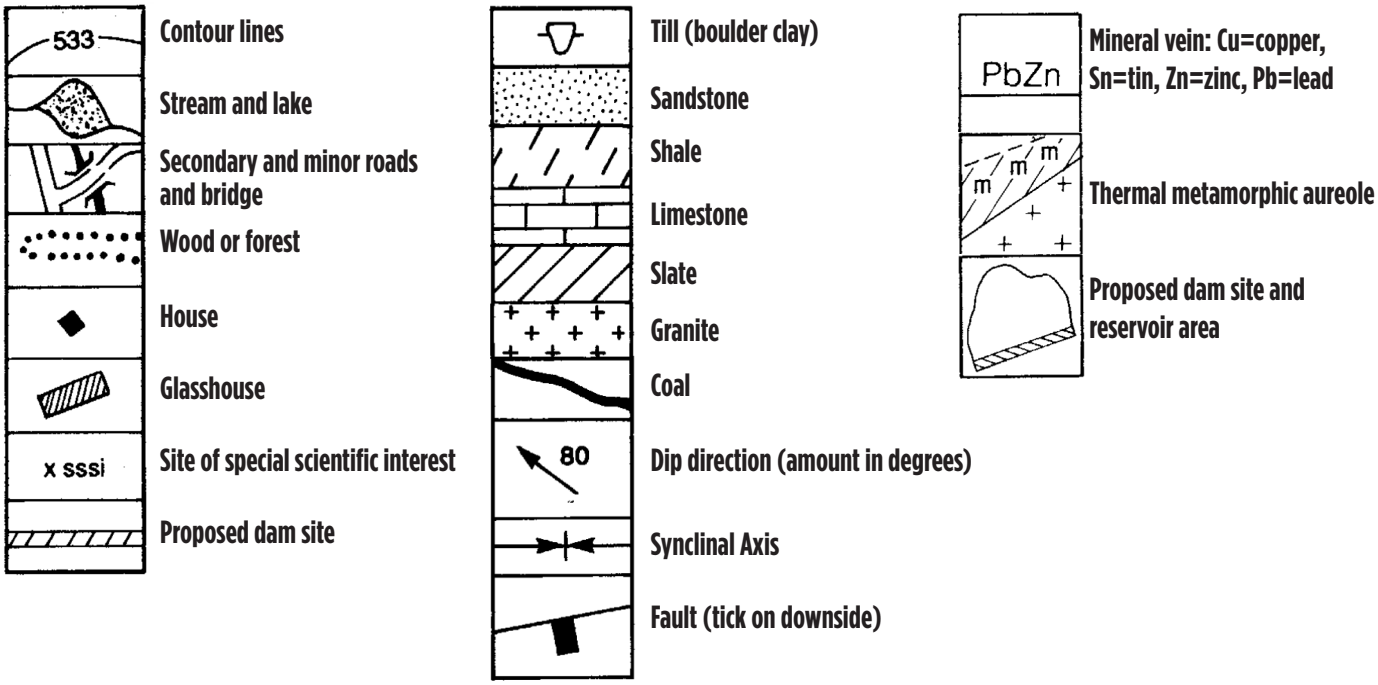


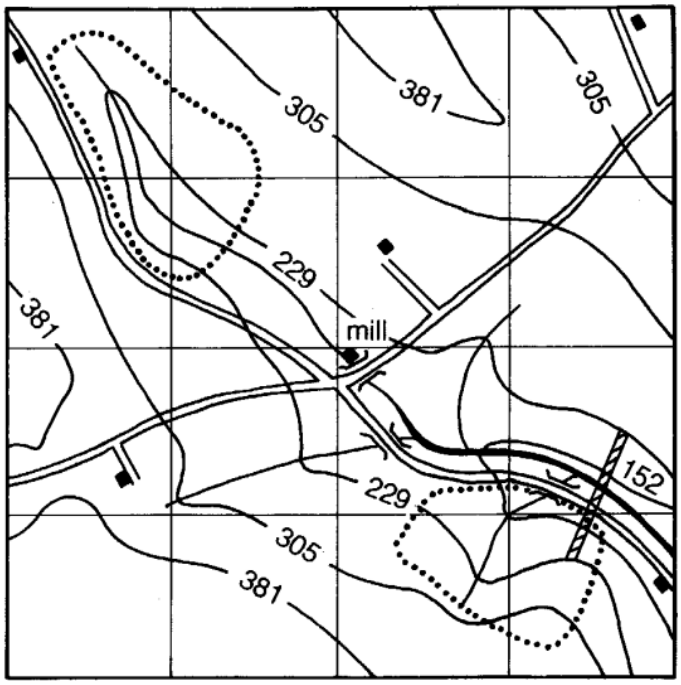


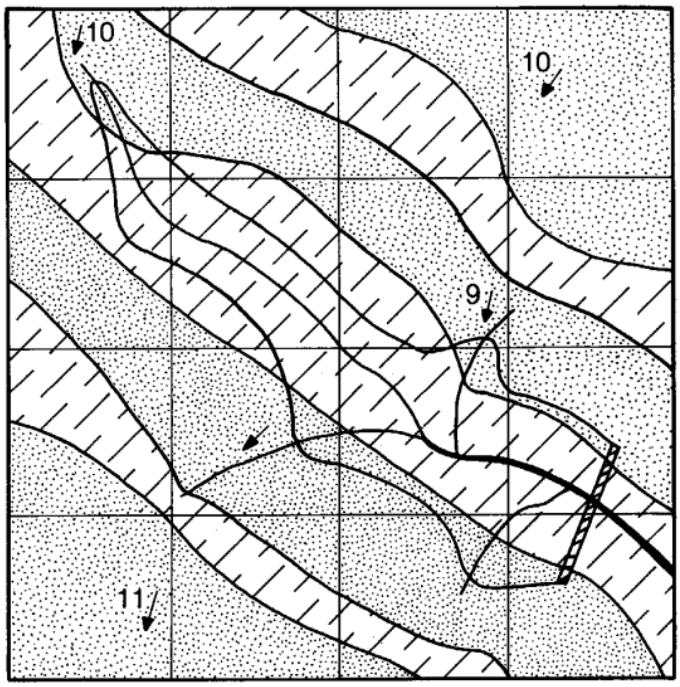
SITE DATA - SITE B

Distance from conurbation:	77km
Annual rainfall:	1741 mm
Main farming types:	**Sheep on valley sides, beef and dairy cattle on valley floor**
Geology:	**Syncline in Silurian limestone/shale sequence**
Points of importance:	Area inside national park. SSSI - fossil locality
Reservoir potential:	Water supply, tourism (fishing, sightseeing etc)

POTENTIAL RESERVOIR SITE B



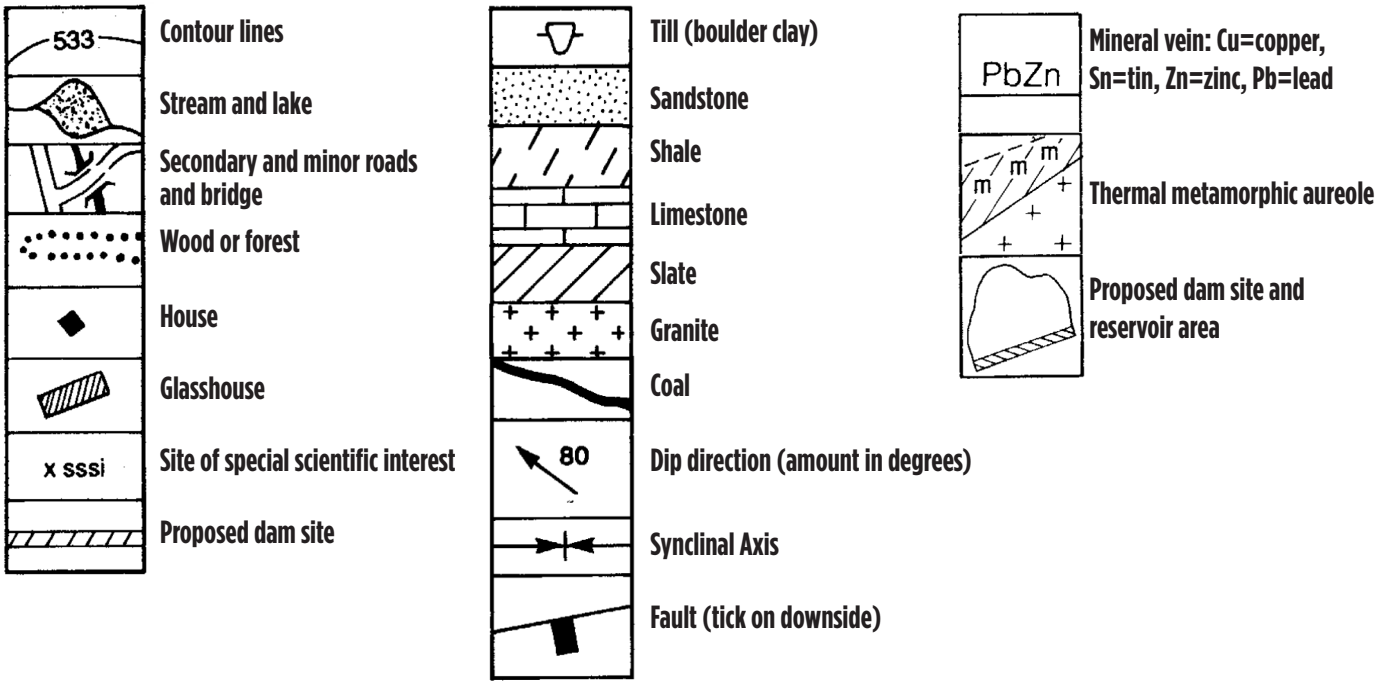


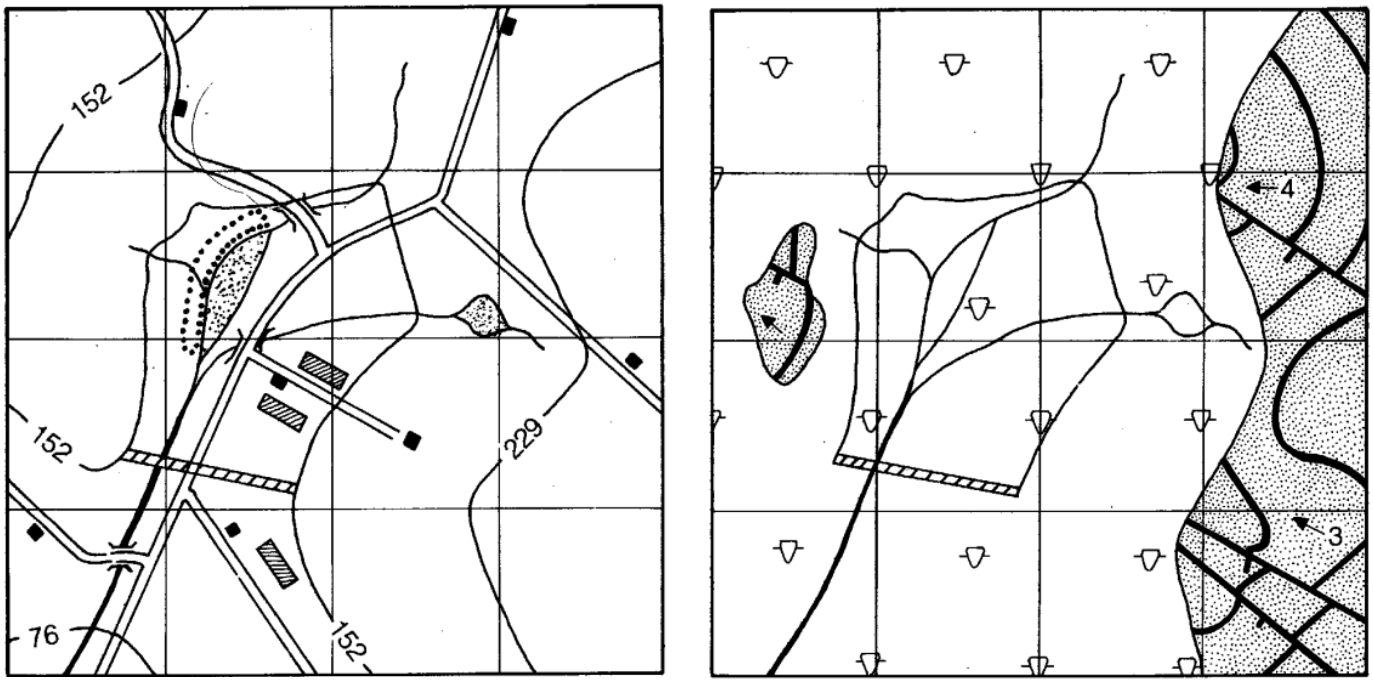


SITE DATA - SITE C

Distance from conurbation:	45km
Annual rainfall:	1,304mm
Main farming types:	Beet, dairy and arable farming
Geology:	Dipping Carboniferous sandstone - shale sequence
Points of importance:	Two areas of ancient natural woodland, 15th century mill
Reservoir potential:	Water supply, watersport amenity for nearby town, fishing, birdwatching etc

POTENTIAL RESERVOIR SITE D





SITE DATA - SITE D

Distance from conurbation:	21km
Annual rainfall:	720 mm
Main farming types:	Dairy, arable and market gardening
Geology:	Dipping carboniferous coal measures overlain uncomfortably by till (boulder clay)
Points of importance:	Mereside bird sanctuary, local wildlife under pressure
Reservoir potential:	Water supply, watersport amenity for nearby town, fishing, birdwatching etc