

PHOTO-INTERPRETATION FOR HYDROLOGICAL STUDIES

The study of water resources of a region requires knowledge of nature of lithological units occurring therein, their structural disposition, geomorphic set up, the surface and ground water conditions and the climatic conditions obtained over it. The central concept of hydrology is the hydrological cycle, and its different elements have to be evaluated directly or indirectly using aerial photographs and satellite images. In this respect aerial photos greatly aid in determining the hydrological conditions of any region.

Stereoscopic pairs of vertical and oblique photographs, and aerial mosaics are of fundamental value in several phases of hydrological studies. In addition to panchromatic photographs, infra-red photographs are also useful specially in studying surface water bodies, delineation of shore and bank lines and demarcating relative soil moisture content and vegetation.

Photo-interpretation in hydrology is an aiding tool though it may not be effective in some areas. Air photos when interpreted carefully provide useful clues, which are useful in hydrological evaluation of terrain. These clues are as follows:

- i) general climatic conditions
- ii) drainage conditions
- iii) landuse patterns
- iv) seepage and springs
- v) marshy conditions
- vi) infiltration of surface water

Principle of interpretation

The different reflectance properties of the object on the ground provide different tonal expression on the photographs. This, together with other parameters like shape, size, drainage pattern, texture and the stage of geomorphic development of rock formations enable an experienced photo-geologist to distinguish between different lithological units and structural patterns from the photographs. The technique of photo-interpretation enables delineation of major hydrological regions and recharge zones and the selection of exploration sites. Thus aerial photos and satellite imagery have been proved to be of great use in reconnaissance and preliminary survey for water resources prior to detailed groundwater exploration as it aids in detailed ground water exploration immensely.

Hydrological photo-interpretation is done with the help of landform study and other elements such as tone, texture, shape of physiographic features, erosion pattern, vegetation and soil pattern and several combinations of these factors in relation to groundwater occurrences.

Interpretation of lithology

Water study of a region requires fundamental knowledge of lithological units occurring in the area. Different rock formations can be identified and demarcated with the aid of photo recognition elements.

In granular sedimentary rocks with additional development of joints and fractures, ground water possibilities are generally very good, unless they are highly compacted and cemented. Unconsolidated granular material like gravel and coarse sand deposits are highly potential aquifers. Coarse drainage textures with infiltration zones (disappearance of surface drainage) along stream courses are readily observable on aerial photographs of such areas.

Crystalline rocks hold water depending on the depth of zone of weathering and the size, orientation and intensity of joints, fractures and fissures in the rocks. The permeability of unweathered crystalline rocks is attributable to the presence of joints and fractures, hence the term, 'fracture permeability'. On aerial photos weathered zone appear as dark linear due to their moisture bearing capacity. Distribution and extent of weathering phenomena of hard rock areas is usually highly complex in India. Thus, interpretation of the non-outcrop areas for hydrological purposes is an extremely difficult task, since sufficient care has to be exercised for delineating the influence of the extent of fracture zones, to give the desired results.

In soluble rocks such as limestone, solution cavities and solutionally enlarged joints creating secondary porosity allow occurrence of groundwater. However, groundwater occurrence and potential will also depend on other geological factors and climatic conditions.

Interpretation of structures

Geological structures like syncline, faults, unconformities, dipping strata, sills, dykes and quartz reefs help to locate possible potential zones. Geological structures are easily identified on aerial photographs. Lineaments – represent lithological contact, joints, fractures and faults, which can be easily recognised on aerial photos as they appear as dark lines or by tonal contrast. Alignment of vegetation and springs is also useful in detection of lineaments.

Interpretation of Geomorphology

In areas of high relief, a greater part of precipitation flows out as surface runoff. Such areas offer a rather poor condition for infiltration. Low and gentle relief areas have much better opportunities for the infiltration. On aerial stereo photo pairs, relative relief of the terrain can be better studied than in the field.

There is large number of landforms particularly of aggradational (depositional) nature, which are helpful in delineating ground water potential zones. The landforms like pediments, alluvial fans, bajada, valley fills, playa lakes etc.

Study of drainage patterns is also important for hydrogeological studies and can be interpreted from aerial photos and satellite images. Coarse textured drainage or absence of surface drainage may signify highly permeable materials. The fine textured drainage indicates the presence of less permeable material offering much surface runoff.

All these interpretations are interrelated and the interpretation is done by keeping in mind the relationship between all the factors. The ultimate aim of hydrological studies is to produce a concise and systematic picture of landforms and related phenomena, by preparation of hydro-geomorphological maps. In hydro-geomorphological maps stress is

laid on the hydro-morphological units and morphometric information and data on surface and ground-water conditions are added by way of symbols.

It should be pointed out that aerial photographs though very useful in speeding up investigations and providing additional information still have certain limitations due to various photo image distortions. Too many factors contributing the occurrence of ground water may confuse the interpreter, therefore for more reliable hydrological studies and more accurate results the aerial photo-interpretation should be carried out in conjunction with selective field checks and laboratory investigations.

Photo-interpretation for Deccan Trap areas:-

The following is the suggested approach for preparation of photo-interpreted map for ground water studies in Deccan Trap areas:

- i) carefully trace each individual outcrop of a flow or weathered horizon.
- ii) Prepare a very detailed drainage (channel & sheet flow) of the area.
- iii) Trace and map the fractures and master joints in areas covered by thin veneer of soil and also in areas with no soil cover.
- iv) Map the weathered zones.
- v) Identify and indicate the irrigated areas from wells and also show the tanks & reservoirs.
- vi) Trace the alluvial/colluvial deposits along the major rivers, streams and nalas.
- vii) Indicate the intertrappean zones (i.e. weathered and permeable layers).

Landscape of Deccan Trap rocks are of varied nature. Rugged erosional topographic features are the easiest to interpret, but in such areas there is usually little ground water requirement. The photo-interpretation on flat topography is very difficult. Once the pattern of weathering and the relationship among the various factors controlling the occurrence of groundwater, is understood by field studies, photo- interpretation in Deccan Trap areas may have more success in identifying the groundwater bearing zones for exploration.