Chapter - III

WATER BEARING CHARACTER AND OCCURRENCE OF GROUNDWATER IN GIRJA RIVER BASIN

INTRODUCTION:

In the Deccan volcanic province, representing basaltic flows of Cretaceous-Eocene age are the most extensive geological formation of Peninsular India. They cover total area of Girja River basin and 82% area of Maharashtra state. The basaltic aquifers are regarded as anisotropic because of variability in type and morphology of flows; the presence of dykes, tuff beds, lava tubes, channels; and the unpredictable patterns of vesicularity weathering and jointing with respect to their extent and thickness, as also to the frequency and inter-connections of joints. A wide variation in aquifer parameters such as storability, transmissivity and specific yield of the well can be attributed to such anisotropism.

The Girja River sub-basin area is included in Deccan Trap ground province comprising of hard rock formations. Massive Trap does not possess any granular primary porosity hard compact nature have low primary porosity, generally unproductive. However, the secondary porosity is developed due to weathering, jointing and fracturing. The groundwater occurs in secondary porosity. The joints and fracture provided channels for the groundwater movement and spaces for storages.

WATER BEARING CHARACTER:

Ground water occurs in the open spaces such as joints, fractures and spore spaces etc. The capacity of basalt to hold groundwater depends upon
Porosity permeability of rock which in turn depends on joint spacing and joint pattern. If joints are closely spaced then rock is highly permeable and can transmit large quantity of water (fig. 39). If the joints are broadly spaced permeability is less and such rock holds small quantity of water (fig. 40). These joints become tight at certain depth hence do not allow further percolation of water.

Top portion of compact basalt flow up to certain depth is always hydrothermally altered, vesicular and amygdaloidal. This portion is unjointed when fresh. But due to heavy weathering sheet jointing is developed in it. On the other hand amygdaloidal (fig. 41) basalt is free from jointing. It is susceptible to weathering if it contains mineral chlorophaeite. Due to weathering it always develops sheet jointing through which heavy percolation is possible only up to shallow depth. Top portion of amygdaloidal basalt is gray and hydrothermally altered. It is very hard and tough when fresh (fig. 42). Hence possibility of percolation in it depends on thickness of weathered zone.

Basaltic lava flows create the bulk and constituent which are most important aquifers. Openings within or between the flows are responsible for high permeability in general. Near vertical dykes of dense impermeable rock may separate high-level groundwater in inland area from basal groundwater in the coastal lowlands.

**Hydrological Techniques:**

Topographic maps furnish a wealth of information about the landforms including major planar surfaces, nature of the valleys, drainage pattern etc.
Fig. No. 39 Closely spaced jointing in compact basalt.

Fig. No. 40 Compact porphyritic basalt showing brodaly spaced jointing watershed GP-20
Accordingly detailed hydrogeological mapping is undertaken in the Girja River basin with the aim to reveal the physical set up of the different basalt flow units and groundwater occurrence and movement therein. Basalt flows of
the Girja river basin have been mapped. The dug wells selected on geological map and hydrogeological map of the basin is prepared (fig. 43).

Therefore selected area of the Girja river basin for applying an integrated approach involving various techniques such as geomorphological and hydrological study which stand for the complicated problem of occurrence of groundwater.

The watershed GP-3 of the Girja river basin is hilly exhibiting the rugged topography, whereas the middle and lower part is gently sloping thus offering favorable conditions for groundwater accumulation and movement. The Girja river basin exhibits the dendritic drainage pattern in general.

Maximum part of Girja River basin is covered by the basalt flows and shallow river alluvium an alternate sequence of vesicular and compact basalt units within a vertical succession of basalt flows the aquifer systems. Rough and pitted appearances seen in bed rock of river basin. The basaltic flow (fig. 44 & 45) which are exposed in the lower and middle part mark the gently sloping area of the basin which enclose, form the potential aquifers, whereas basalt flows occurring on the hilly terrain (fig. 46), do not form potential aquifer owing to limited extent of weathering and fracturing. Alluvium succession consisting of sands, gravels, pebbles, and admixture of these in varying proportions, does not form the separate aquifer as a whole, but its contact with the lower basalt sub unit forms an aquifer system (fig. 47). Groundwater inflows are concentrated in the lower part of the alluvium and along the contact between alluvium and lower basalt sub unit.
Fig. No. 43 Dugwell selected for observation in study area.
Fig. No. 44 Rugh and pitted appearance due to removal of plagiocase phenocryst by wethering in bed rock of Girja river

Fig. No. 45 The basaltic flow exposed in the lower and middle part of sloping area in Girja river.
Groundwater occurs under semi-confined and confined conditions in the formations. The weathered basalt rock and the alluvial formations form the major aquifers, whereas the deep fractures in the basaltic flows and potential
confined to semi-confined aquifers. The groundwater is mainly tapped in large diameter dug wells.

**Fracture System:**

Fractures cutting across the basalt flows are very common on both the sides of Continental divide [Auden J.B.-1954, Karamarkar-1973, Gupte-1980] fractures are developed due to slow earth movements. The flow junction passes across the fractures undisturbed, which indicate that no movement has taken place along the fracture.

Fractures are commonly oriented in North- South direction. They get opened out at the surface up to some depth. But at the deeper level they become tight due to percolation of water. Sheet jointed and weathered zone are developed along the fracture. But as fractures become tight at the deeper level, Percolation through them is restricted and no weathered zone is developed along the fractures (fig. 48).

Basalt flows in the basin exhibits well developed horizontal fractures and sub-vertical to vertical columnar fractures produced by several vertical and equidistant sets intersecting each other sheet joints are developed at the top and base of the vesicular amygdaloidal basalt sub unit. Sheet joints may be formed due to dilation of rocks as a result of the removal of superincumbent load by erosion (ollier, 1976). Development of sheet joints along the contact between the upper vesicular amygdaloidal basalt and the lower compact basalt is more pronounced and acts as groundwater inflow zone. The compact basalt unit exhibits the well developed jointing patterns of vertical or polygonal columnar
joints. These patterns are referred to as ‘colonnade and entablature’ and occur at the top of compact flow units.
The Deccan trap flows also play an important role in groundwater accumulation and movement.

Weathering:

Weathering is the breaking down of rocks, soils and minerals as well as artificial materials through contact with the Earth's atmosphere, both biota and waters. Weathering occurs in situ, or "with no movement", and thus should not be confused with erosion, which involves the movement of rocks and minerals by agents such as water, ice, wind, and gravity.

Two important classifications of weathering processes exist: physical and chemical weathering. Mechanical or physical weathering involves the breakdown of rocks and soils through direct contact with atmospheric conditions, such as heat, water, ice and pressure. The second classification, chemical weathering, involves the direct effect of atmospheric chemicals or biologically produced chemicals (also known as biological weathering) in the breakdown of rocks, soils and minerals. As with many other geological processes, the distinction between weathering and related processes is diffuse.

The chemical degradation of the basaltic flows yields lateritic and black-cotton soil. Lateritic soil is mostly observed at relatively higher elevations capping the hill tops; whereas thick deposition of black-cotton soil is observed at the lower level of the basin. Thick deposits of 3-4 meters of black-cotton soil also are observed at low laying area. In this belt the black-cotton soil is followed by calcareous silts or clay. Vesicular amygdaloidal basalt units in the basaltic sequence of the basin are more weathered than the compact basalt units. Vesicular amygdaloidal basalt units wherever exposed on surface or in the wells are observed to be highly to moderately weathered as compare with the compact basalt unit. Spheroidal weathering is more pronounced in the compact basalt unit where these units are exposed at the surface.

Groundwater Occurrence:
The occurrence and movement of groundwater is governed by types of rock topography, slope, Lithology, geological structures, hydrogeology fractured system, weathered zone thickness, drainage pattern, land forms, land use and climatic parameters.

Massive basalts with their weathered material along with the jointed and fractured zones and the vesicular basalts with their interconnected vesicles together form the water bearing domains of the basaltic rock. The ground water occurs as water table condition upto a depth of 30m. Below 30m. depth, it occurs under both semi confined and confined condition where thick layer of massive basalt overlying the vesicular basalt, acts as a confining layer and jointed compact basalt & weathered Amygdaloidal basalt act as a unconfined configuration. (fig. 49)

In the trappean terrain, soil cum weathered zone, fractured and jointed trap and the vesicular and zeolitic basalt act as important water bearing horizons.

- Massive basalt is generally very compact, and poorly permeable. Productive horizontal only when they are weathered and highly jointed.(fig.50)

- Vesicular basalt is potential aquifers in the area where vesicles are open and interconnected and occur at shallow depth.

- Red bole acts as marker horizon. It is impermeable, 0.5 to 1m in thickness, comprises of ferruginous clay and inhibits movement of groundwater. (fig. 51)

Groundwater in isolated alluvial pockets occurs mostly under water table conditions. The thickness of alluvium is limited the aquifer material comprises of clay, silt, sand and gravels. The sand gravel beds have high
degree of porosity and permeability and form highly potential aquifer in the area.

**Groundwater Potential Zone:**

It is interesting to note that unlike other consolidated rocks, the Deccan Trap of the sub-basin behaves as multi aquifer system somewhat similar to sedimentary rock sequence.

A potential water bearing horizon is found sandwiched between massive basalt giving rise to confined condition. Lineament, fault weathered zone, closely jointing and shear zone are promising locations for occurrence of groundwater. The pattern and intensity of fracture determine whether the groundwater occurs under water table conditions or under confined conditions. When fractures are vertical unconfined condition is likely to exit, but if the fractures are inclined with little inter-connections between them, then confined condition is likely to prevail in individual inclined joints.

The groundwater storage is promising in lower area of valleys and more so in the areas where tributary stream intersect. The groundwater storage is poor in the areas located in hill slopes or along with stream divides. The streams and nala’s generally flow along slop & weak planes such as
lineaments, fault, joints and fissures, such locations are good for groundwater storage and movement.
Watershed in study area:

The Girja river basin consist of seven watershed area geologically it is cover with basalt rock and alluvium. A watershed is land area from which water ultimately drains into a river which then dumps into the main stream Purna River.

Watershed refers to the land over and through which water flows to reach a common water body. It has two components - surface drainage and subsurface or groundwater drainage. An underground drainage area is sometimes called a ground watershed. Just as surface water flows over the surface of the land in response to gravity, groundwater flows through permeable soils and fractures in bedrock in response to gravity. Groundwater, however, flows much more slowly. A surface watershed divide is the set of points separating one watershed from another. Surface watershed divides are usually mountains and high points of land. Ground watershed divides separate ground watersheds from each other. Surface watershed divides may be in different places than ground watershed divides.

In every watershed, small streams flow into larger streams, which flow into rivers, lakes, and bays. The smallest streams at the outer limits of a watershed are called headwaters. These headwater streams have no tributaries and are called first order streams. Commonly all other streams have tributaries. Second order streams form when first order streams meet. Third order streams form when second order streams meet, and so on. In regions like New England that have varied terrain we often describe water as flowing from the mountains to the sea or to a lake. The water follows gravity and the contours of the landscape. A watershed is identified by the name of the water body that serves as the collecting basin for that drainage are. All land is a part of some watershed! Not only do streams and rivers flow to a collecting basin, but they also do the impacts that humans have upon those water bodies. Human activities that impact the quality of the river water flowing into a basin also impact the basin itself.
Water bearing characters of the rock exist the watershed.

Amygdaloidal Basalt Flows:

As mentioned previously, in amygdaloidal basalt original gas cavities are filled up with secondary minerals obliterating their original vesicular nature. In addition to this, they are unjointed therefore they occur as homogeneous, watertight mass in fresh, unweathered conditions. Therefore no rain water percolates through fresh amygdaloidal basalt to form groundwater. However, it is observed that, if amygdaloidal basalt has undergone intermediate stage of weathering, sheet jointing and secondary porosity are induced in it. Such weathered amygdaloidal basalt contains groundwater. However, quantity of groundwater depends upon the thickness and extent of weathered zone (Karmarkar 1997).

Compact Basalt Flows:

Every compact basalt flow can broadly be demarcated into two parts according to their hydrological characters. The top portion of compact basalt flow is always vesicular, amygdaloidal, unjointed and watertight in fresh condition (fig. 52). Only in weathered condition ground water occurs in it due to development of sheet jointing and secondary porosity. If fresh amygdaloidal top portion of compact basalt flow is exposed at the surface rain water does not percolates through it. But if weathered, sheet jointed amygdaloidal top portion of the flow is exposed at the surface then only rain water enters through it forming ground water. (fig. 53)

Volcanic Breccia:

Volcanic Breccias with Tachylytic matrix and grey lava matrix occur as water tight rock. Therefore no rain water percolates through them. In volcanic
breccias in which rock fragments are held together by zeolites, some voids occur, therefore small quantity of water may percolates through them and it joints are broadly space or unjointed no change to percolation. As mentioned previously, middle and lower portions of compact basalt flows are jointed. It jointed portions of thick unjointed Compact basalt (fig. 54) flow are exposed at the surface; rain water percolates through joints forming ground water.

However, quantity of percolation of water depends upon joint spacing and pattern of jointing. In closely spaced jointed (fig. 55) basalt considerable quantity of rain water may percolate through the joints. But if joints are broadly spaced limited quantity of water percolates through them. Basalt having inconsistent jointing occurs as watertight mass even though it is jointed. Joints generally open out at the surface but gradually, at the lower level, they become tight and occur as only weak planes.
Fig. No. 52 Hydrothermally altered top portion of compact basalt flow unjointed and watertight

Fig. No. 53 Thin weathered portion of compact basalt flow no. 4
Although water percolates through the joints of compact basalt, large percolation up to deeper level cannot take place and therefore, compact basalt always holds limited quantity of water.
Watershed GP-3

The watershed GP-3 is come under the toposheet No 46 P/8 and having maximum elevation is 865 m. and minimum of 650 m. The hydrology of the watershed depends on the rock formation. Generally they consist of basalt rock formation and the sub morpho zone runoff zone and average rain fall 900 m. (fig. 56)

The zone is the runoff zone. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this runoff zone. Aquifers refer to places within the runoff zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells. Some of the precipitation that falls becomes surface water (fig. 57 & 58). The geology and topography of the land determine how surface water flows.

The fifteen observation well selected at Deolana BK., Miasmal, Wanegaon, Kanakshil, and Bazar Savangi village. Seven year (2006 to 2012) Pre-monsoon and Post monsoon watertable level is taken in well inventory survey (Table No. 4) and comparative Graph is prepare(Graph No. 1). In this watershed at Village Kanakshil (Pre-monsoon) show deepest water table and at Village Miasmal dugwell No.1 and 2 show very shallow water table only 2 to 3 m. depth (Postmonsoon) winter and in summer water scarcity problem for irrigation and drinking also only near Bazar Savangi village hydrogeological character suitable for recharge. Some high yielding well`s are found in this area. Average water table depth in Gp-3 watershed in between 4 to 19 m. depth.
Fig. No. 56 Observation wells of watershed GP-3
Fig. No. 57 Observation well at Deolana (BK) village at watershed GP-3

Fig. No. 58 Observation well at Wanegaon village at watershed GP-3
TABLE NO. 4
WELL INVENTORY DATA OF GP-3 WATERSHED AREA

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Village Name</th>
<th>Attitude</th>
<th>Longitude</th>
<th>Well No.</th>
<th>Depth m.</th>
<th>Diameter</th>
<th>Water Table Depth different villages of pre &amp; Post Monsoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deolana BK</td>
<td>20°04'03&quot;</td>
<td>75°16'17&quot;</td>
<td>1</td>
<td>23</td>
<td>1.55</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>20</td>
<td>1.60</td>
<td>22.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>20</td>
<td>1.55</td>
<td>1.99</td>
</tr>
<tr>
<td>2</td>
<td>Mahismal</td>
<td>20°04'50&quot;</td>
<td>75°11'15&quot;</td>
<td>1</td>
<td>8.6</td>
<td>3</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2.1</td>
<td>11.35</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>Wanegaon</td>
<td>20°06'30&quot;</td>
<td>75°22'45&quot;</td>
<td>1</td>
<td>23</td>
<td>1.55</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>14.3</td>
<td>7.8</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3.3</td>
<td>11.6</td>
<td>2.1</td>
</tr>
<tr>
<td>4</td>
<td>Kanakshil</td>
<td>20°06'40&quot;</td>
<td>75°17'00&quot;</td>
<td>1</td>
<td>24</td>
<td>1.55</td>
<td>23.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>14.3</td>
<td>7.8</td>
<td>13.4</td>
</tr>
<tr>
<td>5</td>
<td>Bazar Savangi</td>
<td>20°07'30&quot;</td>
<td>75°18'30&quot;</td>
<td>1</td>
<td>13.2</td>
<td>3.3</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2.1</td>
<td>11.35</td>
<td>3.6</td>
</tr>
</tbody>
</table>
GRAPH NO. 1:
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-3 IN PRE AND POST MONSOON.
The Graphical conclusions of the watershed GP-3 shows that the total observation well show different depth of water table because of rain fall and few structure are not suitable for percolation. Well inventory data of Deolana shows that there is no water in summer but except in May 2006. However the water table went up after the monsoon. In 2008 the well was dry but in 2009 water table went up drastically because of the rainfall in the year 2009. But it went down again in subsequent years till 2011 up. In 2012 again water table has raised. This suggests that even though there is percolation tank near to this well geological and Geohydrological conditions are not favorable for the recharging of well. Geological succession revels that the rock present in the vicinity of Deloana is basically amygdaloidal basalt followed by compact basalt and volcanic breccia. Compact basalt has broadly spaced joints and joints are tight. No opening has been observed along the joint plane. Volcanic breccia is also impervious. In this watershed the deepest water table has been observed at Miasmal in pre-monsoon period and considerable increase in the water level in the month of October after the post-monsoon period. In pre-monsoon period Wanegoan and Bazaar Savangi are the two villages where there is availability of groundwater consistently from 2007 to 2009. But there is lowering of water table in the year 2010 in case of Kanashil. Kanashil, as it is situated on the hilly area the water table are lower however there is large variation in the water table level in pre and post-monsoon period. It shows that the geological conditions are favorable for the recharging in that area. In post-monsoon period water table becomes quite shallow at Wanaygon. However there is lowering of watertable consistently in 2007 onwards till 2012. Similar is the case with Bazar Savaing. Both these locations are at the lower elevations and adjacent to the river beds. In all villages there is increase in the level in Oct 2006, but after that there is lowering of level in 2007. Again there
was a little rise in 2008 and there was a fall in 2009. This area is predominantly composed of Amygdaloidal basalt. On the higher elevation there is presence of Compact basalt. Well located in Miasmal shows Amygdaloidal basalt up to the depth of 516m and hydrothermally altered Amygdaloidal basalt up to the depth of 485m. Sheet jointing has been developed prominently in the rock. As the well is near to the river there is lateral percolation of water through the sheet jointing specially during post-monsoon period. In summer the river becomes totally dry.

Watershed GP-7 :

The watershed GP-7 comes under the toposheet No 46 P/8 and having maximum elevation of 640 m. and minimum of 618 m. (fig. 59) The hydrology of the watershed is depends on the rock formation generally they consist of basaltic rock formation which and weathered and fractured massive basalt vesicular basalt type of aquifer and the sub morpho zone runoff zone and average rain fall 700 m.

The watershed GP-7 zone is the runoff zone and recharge zone. Where the spaces between soil particles contain only water. The water table is the uppermost edge of this runoff zone. Aquifers refer to places within the sub morpho zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells. Some of the precipitation that falls becomes surface water. The geology and topography of the land determine how surface water flows. Observation well selected for well inventory data and ground water data collection(fig. 60 & 61).
Fig. No. 59 Observation well of watershed GP-7 and GP-8
Fig. No. 60 Observation well at Khamgaon village at watershed GP-7

Fig. No. 61 Observation well at Pal village at watershed GP-7
The fifteen observation well selected in Khamgaon, Nidhona, Pal, Hiwra, and Bodhagaon village Seven year (2006 to 2012) Pre-monsoon and Post monsoon watertable level is taken in well inventory survey (Table No. 5) and comparative Graph is prepared (Graph No. 2). In this watershed at Village Nidhona (Pre-monsoon) show deepest water table and at Village Pal Khamgaon and Bodhagaondugwell show very shallow water table only 2 to 4m. depth. Average water table depth in GP-7 watershed in between 10 to 15 m. depth in winter and only in pal village groundwater condition in summer also show high yielding.

Nidhona and Hiwra are the villages at the higher elevation because of which the water table is at the lowest. Even after the post-monsoon period there is rise in water table till 2008 and went down till 2012. Except Nidhona all the wells were dry in pre-monsoon 2007. There was increase in the water table in the year 2008. but Nidhona faces adverse effect and water table has gone down by 1 meter. There was considerable rise in the water level in the well at Pal. It has been raised from 12m to 6.9 in 2006. The area being predominantly composed of sheet jointed Amygdaloidal basalt which is highly permeable. Which is the not only the cause of rise in water level but rain fall was also high in the year 2006 and 2008 respectively. It further raised to 5.9 m in 2007. However, there is decline in the water level consistently till 2010 due to increase in irrigation without improper water management. In general all wells have shown substantial rise in water level till May 2009 and lowered down consistently till May 2012.

There is no drastic rise in the water table even after the post-monsoon period. The geological set up present in this area composed of well jointed compact basalt on the top followed by the Volcanic breccia and below it
TABLE NO. 5
WELL INVENTORY DATA OF GP-7 WATERSHED AREA

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Well No.</th>
<th>Depth m.</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Khamgaon</td>
<td>20° 11’05”</td>
<td>75° 29’35”</td>
<td>1</td>
<td>13.7</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>13.40</td>
<td>10.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>12.9</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Nidhona</td>
<td>20° 11’50”</td>
<td>75° 22’30”</td>
<td>1</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>12</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>14</td>
<td>5.8</td>
</tr>
<tr>
<td>3</td>
<td>Pal</td>
<td>20° 13’45”</td>
<td>75° 26’45”</td>
<td>1</td>
<td>22</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>20</td>
<td>12.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Hiwra</td>
<td>20° 13’45”</td>
<td>75° 26’45”</td>
<td>1</td>
<td>22</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>Bodhagaon</td>
<td>20° 12’37”</td>
<td>75° 27’52”</td>
<td>1</td>
<td>13.1</td>
<td>3.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>14</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>15</td>
<td>3.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
<th>May-06</th>
<th>Oct-06</th>
<th>May-07</th>
<th>Oct-07</th>
<th>May-08</th>
<th>Oct-08</th>
<th>May-09</th>
<th>Oct-09</th>
<th>May-10</th>
<th>Oct-10</th>
<th>May-11</th>
<th>Oct-11</th>
<th>May-12</th>
<th>Oct-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Khamgaon</td>
<td>13.5</td>
<td>5.1</td>
<td>13.05</td>
<td>7.1</td>
<td>13.1</td>
<td>7.25</td>
<td>12.3</td>
<td>8.9</td>
<td>12.5</td>
<td>6</td>
<td>13.4</td>
<td>9.3</td>
<td>13.65</td>
<td>10.1</td>
</tr>
<tr>
<td>2 Nidhona</td>
<td>23.1</td>
<td>12.2</td>
<td>19.5</td>
<td>10</td>
<td>21.5</td>
<td>15</td>
<td>21.9</td>
<td>16.35</td>
<td>21.7</td>
<td>10</td>
<td>21.35</td>
<td>15.45</td>
<td>21.8</td>
<td>20</td>
</tr>
<tr>
<td>3 Pal</td>
<td>10.6</td>
<td>1.99</td>
<td>11.15</td>
<td>8.1</td>
<td>15.4</td>
<td>12</td>
<td>15.9</td>
<td>11.35</td>
<td>19.7</td>
<td>8.5</td>
<td>10</td>
<td>2.45</td>
<td>12.8</td>
<td>1.77</td>
</tr>
<tr>
<td>4 Hiwra</td>
<td>14.3</td>
<td>9.9</td>
<td>12.5</td>
<td>8.7</td>
<td>16</td>
<td>12</td>
<td>13.3</td>
<td>10.4</td>
<td>13.3</td>
<td>10.1</td>
<td>14.7</td>
<td>12.8</td>
<td>15.9</td>
<td>12.5</td>
</tr>
<tr>
<td>5 Bodhagaon</td>
<td>13.2</td>
<td>2.1</td>
<td>13.2</td>
<td>9.3</td>
<td>13.2</td>
<td>6.85</td>
<td>13.2</td>
<td>6.1</td>
<td>12.2</td>
<td>5.1</td>
<td>11.6</td>
<td>5.9</td>
<td>12.25</td>
<td>11.9</td>
</tr>
</tbody>
</table>

90
GRAPH NO. 2:

WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUGWELL OF WATERSHED GP-7 IN PRE AND POST MONSOON
Amygdaloidal basalt. This condition is favorable for the occurrence of groundwater.

Except Pal, all the wells in post-monsoon period show increase in water level up to 2007. However there is consistent decline in water level in subsequent years up to 2010. This is because of watershed development activities taken up in this region. Water table has risen up. Irrigation has also increased in this area due to which after two years there is steady decline in water table.

**Watershed GP-8**

The watershed GP-8 comes under the toposheet No 47 P/8 and having maximum elevation 645 m. and minimum of 610 m. The watershed consist of basalt rock formation and weathered and fractured massive basalt & vesicular basalt type of aquifer and the sub runoff zone and average rain fall is 600 m. (fig. 59) The zone is the runoff zone in watershed GP-8. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this runoff zone. Aquifers refer to places within the sub runoff zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells. Some of the precipitation that falls becomes surface water (fig. 62 &63). The geology and topography of the land determine how surface & subsurface water flows. Observation well selected well inventory and groundwater data collection for watershed GP-8.

The fifteen observation well selected at Pathri, Phulambri, Wadod Bazar, Sanjuland Babhulgaon village. Seven year from 2006 to 2012 Pre-monsoon and Post monsoon water table level is taken in well inventory survey (Table No. 6) and comparative Graph is prepared (Graph No. 3). In this watershed at Village Wadod Bazar (Pre-monsoon) show deepest water table
Fig. No. 62 Observation well at Pathri village at watershed GP-8

Fig. No. 63 Observation well at Sanjul village at watershed GP-8
<table>
<thead>
<tr>
<th>Well. No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitud e</th>
<th>Well No.</th>
<th>Depth m.</th>
<th>Diamete r</th>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pathri</td>
<td>20°07'50&quot;</td>
<td></td>
<td>1</td>
<td>11.3</td>
<td>3.9</td>
<td>6.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°29'07&quot;</td>
<td>2</td>
<td>12.3</td>
<td>4.3</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°29'07&quot;</td>
<td>3</td>
<td>11.6</td>
<td>5.2</td>
<td>6.4</td>
</tr>
<tr>
<td>2</td>
<td>Phulambri</td>
<td>20°05'25&quot;</td>
<td></td>
<td>1</td>
<td>14.9</td>
<td>4.2</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°25'10&quot;</td>
<td>2</td>
<td>15</td>
<td>5.2</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°25'10&quot;</td>
<td>3</td>
<td>16</td>
<td>6.2</td>
<td>13.2</td>
</tr>
<tr>
<td>3</td>
<td>Wadod Bazar</td>
<td>20°07'45&quot;</td>
<td></td>
<td>1</td>
<td>12</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°31'30&quot;</td>
<td>2</td>
<td>14</td>
<td>10</td>
<td>5.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°31'30&quot;</td>
<td>3</td>
<td>11.3</td>
<td>3.9</td>
<td>6.2</td>
</tr>
<tr>
<td>4</td>
<td>Sanjul</td>
<td>20°12'37&quot;</td>
<td></td>
<td>1</td>
<td>10.2</td>
<td>4.9</td>
<td>23.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°27'52&quot;</td>
<td>2</td>
<td>11.6</td>
<td>5.2</td>
<td>6.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°27'52&quot;</td>
<td>3</td>
<td>14</td>
<td>10</td>
<td>5.8</td>
</tr>
<tr>
<td>5</td>
<td>Babhulgaon</td>
<td>20°11'17&quot;</td>
<td></td>
<td>1</td>
<td>8</td>
<td>2.1</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°26'05&quot;</td>
<td>2</td>
<td>14.9</td>
<td>4.2</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>75°26'05&quot;</td>
<td>3</td>
<td>11.6</td>
<td>5.2</td>
<td>6.4</td>
</tr>
</tbody>
</table>
GRAPH NO. 3:
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-8 IN PRE AND POST MONSOON

May-06
Oct-06
May-07
Oct-07
May-08
Oct-08
May-09
Oct-09
May-10
Oct-10
May-11
Oct-11
May-12
Oct-12

Pathri
Phulambri
Wadod Bazar
Sanjul
Babulgaon
upto 20m. and at Village Pathridugwell No.1 and 2 show very shallow watertable only 2 to 3 m. depth post monsoon. Average water table depth in Gp-8 watershed in between 5 to 10 m. depth in winter and in summer season dugwell show good recharge condition from present K.T. wear and percolation dam.

At Sanjul village, the flows present in the well are Compact aphanitic basalt and compact porphyritic basalt. These are jointed rocks having inconsistent and broadly spaced jointing pattern along with closely spaced jointing pattern. Converting rock in to Prismatic jointing at places. The joints are not tight and show separation from a few millimetres to 5 centimetres. At places spheroidal weathering is observed. At the bottom volcanic breccia is present which is impermeable and having ability to hold water above it and acts as aquitard. Therefore even though the village is located at higher elevation there is occurrence of groundwater in post monsoon period. But there is steady refuse in the water table after Oct 2007 till 2012.

Pathri, Phulambri and Wadod Bazar villages, even though are very close to the river basin there is scarcity of water in the month of May. Because the rock present at that level is amygdaloidal basalt which is impervious in nature followed by another flow of impervious volcanic breccia. The water availability in the post monsoon period is due to the movement of water laterally along the sheet jointing developed in the upper part of the flow. But even after that there is decline in the water level from 2006 till 2012 even in post monsoon period. This decline is because of improper management of water usage for the irrigation purpose.

Pathri is having same type of geological formations like Sanjul. Therefore there is occurrence of groundwater in this region even in the month of May. In Post monsoon period there is drastic rise in the water table during 2006. However it declined consistently till 2012. Because of inadequate rainfall and high irrigation activities without proper water management in this area.
Watershed GP- 14 :

The water shade GP-14 come under the toposheet No 46 P/12 and having maximum elevation of 625 m. and minimum of 600 m. The hydrology of the watershed is depends on the rock formation generally they consist of basalt rock formation which is weathered and fractured massive basalt vesicular basalt type of aquifer and the sub runoff zone and average rain fall is 600 m. (fig. 64)
The zone is the runoff zone in watershed GP-14. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this runoff zone. Aquifers refer to places within the sub runoff zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells (fig. 65 & 66). Some of the precipitation that falls becomes surface water. The geology and topography of the land determine how surface water flows. Well selected for observation for collection of groundwater data in watershed GP-14.

The fifteen observation well selected at WadodKh., Aland, BorgaonArj, Nygoan and Savta village Seven year (2006 to 2012) Pre-monsoon and Post monsoon water table 20m. level is taken in well inventory survey (Table No. 7) and comparative Graph is prepare (Graph No. 4). In this watershed at Village Aland (Pre-monsoon) show deepest water table and at Village NygaonWadhodKh. BorgaonArjdugwell show very shallow water table only 2 to 3 m. depth. Average water table depth in GP-14 watershed in between 10 to 15 m. depth in winter and in summer water table at very low level and groundwater yielding also very less.
Fig. No. 65 Observation well at Aland village at watershed GP-14

Fig. No. 66 Observation well at Borgaon (Arja) village at watershed GP-14
<table>
<thead>
<tr>
<th>Well No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WadodKh.</td>
<td>20° 09' 22” N</td>
<td>75° 37' 53” E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Aland</td>
<td>20° 11' 35” N</td>
<td>75° 33' 10” E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>BorgaonArj</td>
<td>20° 09' 00” N</td>
<td>75° 33' 10” E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Nygaon</td>
<td>20° 09' 02” N</td>
<td>75° 34' 40” E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Savta</td>
<td>20° 09' 10” N</td>
<td>75° 33' 30” E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
GRAPH NO. 4 :
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-14 IN PRE AND POST MONSOON

Wadod Kh. Aland Borgaon Arj Nygaon Savta

BorgaonArjExceptSavta all the wells were dry in pre-monsoon 2007. There was increase in the water table in the year 2007. but Aland faces adverse effect and water table has gone down by 1 meter. There was considerable rise in the water level in the well at Nygon. It has been raised from 12m to 6.9 in 2006. The area being predominantly composed of sheet jointed Amygdaloidal basalt which is highly permeable. Which is the not only the cause of rise in water level but rain fall was also high in the year 2008 and 2010 respectively it further raised. However, there is decline in the water level consistently till 2012 due to increase in irrigation without improper water management.

However the geological conditions are not at all suitable for recharging of wells in this area. There is interesting case of Aland. There is consistency in the water table in May as well as in October. In summer there is occurrence of groundwater. There is no drastic rise in the water table even after the post-monsoon period. The geological set up present in this area composed of well jointed compact basalt on the top followed by the Volcanic breccia and below it amygdaloidal basalt. This condition is favorable for the occurrence of groundwater.

Except BorgaonArj, all the wells in post-monsoon period show increase in water level up to 2009. However there is consistent decline in water level in subsequent years up to 2012. This is because of watershed development activities taken up in this region. Water table has risen up. Irrigation has also increased in this area due to which after two years there is steady decline in water table.

**Watershed GP- 14 B :**

The watershed GP-14B is come under the toposheet No 46 P/12-56 P/12 and having maximum elevation is 606 m. and minimum is 575 m. The hydrology of the watershed is depends on the rock formation generally they
consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer and the sub saturated zone and average rain fall is 600 m. Well selected for observation for collection of groundwater data in watershed GP-14B. (fig. 71)

The zone is the saturated zone in watershed GP-14B. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this saturated zone. Aquifers refer to places within the sub saturated zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells. Some of the precipitation that falls becomes surface water(fig. 67 & 68). The geology and topography of the land determine how surface water flows.

The fifteen observation well selected at Gosegaon, Hasnabad, Wazerkhed, Kota and Javkheda Bk. village Seven year (2006 to 2012) Pre-monsoon and Post monsoon water table level is taken in well inventory survey (Table No. 8) and comparative Graph is prepared (Graph No. 5). In this watershed at Village Hasnabad, Wazerkheda and Kota (Pre-monsoon) show deepest water table upto 26 m. and at Village Gosegaon Hasnabad, Wazerkhed, Kota and Javkheda Bkdugwell show very shallow water table only 1 to 4 m. depth. Average water table depth in GP-14B watershed in between 1 to 21 m. depth in winter and Feb. to May water scarcity for drinking purpose also.

In this watershed the deepest water table has been observed at Hasnabad in pre-monsoon period and considerable increase in the water level in the month of October after the post-monsoon period. In pre-monsoon period
Fig. No. 67 Observation well at Hasnabad village at watershed GP-14 B

Fig. No. 68 Observation well at Javkheda (Bk) village at watershed GP-14 B
TABLE NO. 9

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Well No.</th>
<th>Depth m.</th>
<th>Diameter</th>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gosegaon</td>
<td>20°08'10&quot;</td>
<td>75°37'15&quot;</td>
<td>1</td>
<td>9.95</td>
<td>2.8</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>13.7</td>
<td>2.8</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>13.40</td>
<td>10.5</td>
<td>2.3</td>
</tr>
<tr>
<td>2</td>
<td>Hasnabad</td>
<td>20°08'32&quot;</td>
<td>75°37'40&quot;</td>
<td>1</td>
<td>11.6</td>
<td>10.3</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2.1</td>
<td>11.35</td>
<td>3.6</td>
</tr>
<tr>
<td>3</td>
<td>Wazerkhed</td>
<td>20°08'30&quot;</td>
<td>75°37'35&quot;</td>
<td>1</td>
<td>19.25</td>
<td>4.9</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6</td>
<td>1.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2.1</td>
<td>11.35</td>
<td>3.6</td>
</tr>
<tr>
<td>4</td>
<td>Kota</td>
<td>20°09'40&quot;</td>
<td>75°35'50&quot;</td>
<td>1</td>
<td>10</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>20</td>
<td>12.3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>18</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>Javkheda. Bk</td>
<td>20°08'32&quot;</td>
<td>75°37'40&quot;</td>
<td>1</td>
<td>8.23</td>
<td>2.2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>14</td>
<td>4.1</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>13.5</td>
<td>5.1</td>
<td>1.3</td>
</tr>
</tbody>
</table>

107
GRAPH NO. 5:
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-14-B IN PRE AND POST MONSOON

May-06
Oct-06
May-07
Oct-07
May-08
Oct-08
May-09
Oct-09
May-10
Oct-10
May-11
Oct-11

Gosegaon  Hasnabad  Wazerkhed  Kota  Javkheda. Bk
Gosegaon and Kota are the two villages where there is availability of groundwater consistently from 2006 to 2012. But there is lowering of water table in the year 2010 in case of Wazerkheda. Javkheda, as it is situated on the hilly area the water table. However there is large variation in the water table level in pre and post-monsoon period. It shows that the geological conditions are favorable for the recharging in that area.

In post-monsoon period water table becomes quite shallow at Hasnabad it has recorded 1.00m in oct 2008. However there is lowering of watertable consistently in 2010 onwards till 2012. Similar is the case with Gosegaon. Both these locations are at the lower elevations and adjacent to the river beds. In all villages there is increase in the level in Oct 2008, but after that there is lowering of level in 2007. Again there was a little rise in 2008 and there was a fall in 2009. This area is predominantly composed of Amygdaloidal basalt. On the higher elevation there is presence of Compact basalt. Well located in Gosegaon shows Amygdaloidal basalt up to the depth of 516m and hydrothermally altered Amygdaloidal basalt up to the depth of 485m. Sheet jointing has been developed prominently in the rock. As the well is near to the Girja river there is lateral percolation of water through the sheet jointing specially during post-monsoon period. In summer the river becomes totally dry.

**Watershed GP- 15 :**

The watershed GP-15 is come under the toposheet No 46 P/12 and having maximum elevation of 610 m. and minimum of 580 m. The hydrology of the water shade is depends on the rock formation generally they consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer runoff zone and recharge zone and the sub saturated zone and average rain fall is 600 m. Well selected for observation for collection of groundwater data in watershed GP-15. The observation well selected at Girsivli and EkgharPadali village. *(fig. 64)*

The zone is the. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this runoff zone and recharge
zone. Aquifers refer to places within the sub runoff zone and recharge zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells (fig. 69 &70). Some of the precipitation that falls becomes surface water. The geology and topography of the land determine how surface water flows.

The fifteen observation well selected at GeoraiGungi, Girsavli, Ranjangaon, EkgharPadali and LowghadNandra village Seven year (2006 to 2012) Pre-monsoon and Post monsoon water table level is taken in well inventory survey (Table No. 9) and comparative Graph is prepare (Graph No. 6). In this watershed at Village GeoraiGungi (Pre-monsoon) show deepest watertable and at Village EkgharPadalidugwell show very shallow water table only 1 to 3 m. depth. Average water table depth in Gp-14 watershed in between 5 to 10 m. depth in winter season and summer groundwater yielding very flow in this watershed.

At GeorajGungi village, the flows present in the well are Compact aphanitic basalt and compact porphyritic basalt. These are jointed rocks having inconsistent and broadly spaced jointing pattern along with closely spaced jointing pattern. Converting rock in to Prismatic jointing at places. The joints are not tight and show separation from a few millimeters to 5 centimeters. At places spheroidal weathering is observed. At the bottom volcanic breccia is present which is impermeable and having ability to hold water above it and acts as aquitard. Therefore even though the village is located at higher elevation
Fig. No. 69  Observation well at Girsavli village at watershed GP-15

Fig. No. 70 Observation well at Ekghar (Padali) village at watershed GP-15
<table>
<thead>
<tr>
<th>Well No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Well No.</th>
<th>Depth m.</th>
<th>Diameter</th>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GeoraiGungi</td>
<td>20° 06'42&quot;</td>
<td>75° 37'19&quot;</td>
<td>1</td>
<td>19.25</td>
<td>4.9</td>
<td>14 1.6 17.65 3.05 19.25 2.35 9.8 5.1 17.8 2.9 18.9 1.85 18.9 2.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>24</td>
<td>1.55</td>
<td>23.1 13 19.1 10 22.4 16 21.9 15.35 20.5 10 19.32 17.55 22 19.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>22</td>
<td>10.6</td>
<td>1.99 6.8 11.15 8.1 15.4 12 15.9 11.35 19.7 8.5 10 2.45 12.8 1.77</td>
</tr>
<tr>
<td>2</td>
<td>Girsavli</td>
<td>20° 06'12&quot;</td>
<td>75° 38'20&quot;</td>
<td>1</td>
<td>18.25</td>
<td>3.9</td>
<td>7 0.6 5.7 7.75 8.4 3.2 10.8 7 10.8 4 6.95 3.6 8.02 0.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>14</td>
<td>10</td>
<td>5.8 1.4 9.2 3.2 7.6 6.1 8.7 5.2 6.4 3.1 12.1 4.2 12.4 2.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11.3</td>
<td>3.9</td>
<td>6.2 1.8 8.4 2.2 8.75 4 9 4.5 5.2 2.3 9.85 2.9 11.3 1.88</td>
</tr>
<tr>
<td>3</td>
<td>Ranjangaon</td>
<td>20° 09'28&quot;</td>
<td>75° 15'42&quot;</td>
<td>1</td>
<td>12</td>
<td>4.5</td>
<td>10.8 2.7 9.2 4.3 10.8 4.15 11 8.2 11.2 3.55 6.95 9.2 11.95 4.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>18.25</td>
<td>3.9</td>
<td>7 0.6 5.7 7.75 8.4 3.2 10.8 7 10.8 4 6.95 3.6 8.02 0.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>8.23</td>
<td>2.2</td>
<td>10 3.6 9.4 6.4 10.2 5.25 11 8 11.2 7.6 11.9 4.2 11.65 2.78</td>
</tr>
<tr>
<td>4</td>
<td>EkhgarPadali</td>
<td>20° 12'53&quot;</td>
<td>75° 22'22&quot;</td>
<td>1</td>
<td>11.2</td>
<td>4.81</td>
<td>4.5 0.5 5.1 2.6 7.5 2.9 6.9 1.5 6.4 0.3 10.4 2.6 7.6 0.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3.9</td>
<td>7.7</td>
<td>1.6 5.4 1.7 5.1 1.55 6.8 2.2 4.6 0.9 3.9 1.8 7.7 1.7 7.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3.95</td>
<td>8.7</td>
<td>2.4 4.3 2.85 5.2 1.9 4.9 3.4 6 1.85 3.95 2.8 4.8 2.3 5.9</td>
</tr>
<tr>
<td>5</td>
<td>NandraLohagad</td>
<td>20° 02'45&quot;</td>
<td>75° 31'00&quot;</td>
<td>1</td>
<td>8.02</td>
<td>1.15</td>
<td>11 2.6 7.6 6 10 3.6 9.8 3.85 9 3.55 11 5.2 11 3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>12</td>
<td>4</td>
<td>9.12 2.5 7.3 3.55 8.5 4 8.1 8.35 7.4 3.8 8.3 6 10.15 5.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>9.95</td>
<td>2.8</td>
<td>11 1.3 9.9 5.1 11 1.7 11 2 7.7 1.2 9 1.6 11 1.7</td>
</tr>
</tbody>
</table>
GRAPH NO. 6:
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-15 IN PRE AND POST MONSOON.
there is occurrence of groundwater in post monsoon period. But there is steady refuse in the water table after Oct 2007 till 2012.

Girsavli and Ranjangon villages, even though are very close to the river basin there is scarcity of water in the month of May. Because the rock present at that level is amygdaloidal basalt which is impervious in nature followed by another flow of impervious volcanic breccia. The water availability in the post monsoon period is due to the movement of water laterally along the sheet jointing developed in the upper part of the flow. But even after that there is decline in the water level from 2006 till 2012 even in post monsoon period. This decline is because of improper management of water usage for the irrigation purpose.

EkgharPadali is having same type of geological formations like LoghadNandra. Therefore there is occurrence of groundwater in this region even in the month of May. In Post monsoon period there is drastic rise in the water table during 2006. However it declined consistently till 2012.

**Watershed GP- 20 :**

The water shade GP-20 is come under the toposheet No 46 P/12-46 P/16 and having maximum elevation of 574 m. and minimum of 593 m. The hydrology of the water shade is depends on the rock formation generally they consist of basalt rock formation and weathered and fractured massive basalt vesicular basalt type of aquifer and the sub saturated zone and average rain fall 600 m. Well selected for observation for collection of groundwater data in watershed GP-20. (**fig .71**)

The zone is the saturated zone in watershed GP-20. Here the spaces between soil particles contain only water. The water table is the uppermost edge of this saturated zone. Aquifers refer to places within the sub saturated zone where the water between soil particles or in fractures in bedrock is readily available and can be obtained by wells(**fig. 72 &73**). Some of the precipitation that falls becomes surface water. The geology and topography of the land determine how surface water flows.
The fifteen observation wells selected at Janefal Dhabadi, Latifpur, Pimpri, Dhabadi and Vita village, Seven year (2006 to 2012) Pre-monsoon and Post monsoon watertable level is taken in well inventory survey (Table No. 10) and comparative Graph is prepare (Graph No. 7). In these watershed at Village Dhabadi (Pre-monsoon) show deepest watertableupto 19 m and in Village Pimpri Vita Janefal Dhabadi dug well show very shallow water table only 1 to 3 m depth. Average water table depth in Gp-14 watershed in between 4 to 8 m depth in winter season and water table at very low level in summer season.

Compact Aphanitic Basalt is Occurring. Three mutually perpendicular joints are predominant along with oblique joints making very closely spaced jointing pattern in this flow. Because of closely spaced jointing the entire rock shows brownish stains of percolated water along the joint planes. Therefore there is occurrence of groundwater in this region in post- monsoon period but there is decline in the water level from 2008 till 2012.

Well near Latifpur shows availability of groundwater in sufficient quantity even in the month of May. Even though the area is predominantly composed of Amygdaloidal basalt this amygdaloidal basalt has been developed sheet jointing extensively in the upper part. Some of the part has undergone hydrothermal alteration and hence the rock is showing secondary porosity and therefore there is occurrence of groundwater in this area. Moreover there is one percolation tank 1.5 km south upstream of a Pimpri village. This percolation tank has found to constructed at right
Fig. No. 72 Observation well at Dabhadi village at watershed GP-20

Fig. No. 73 Observation well at Vila village at watershed GP-20
<table>
<thead>
<tr>
<th>Well No.</th>
<th>Village Name</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Location of Well No</th>
<th>Depth (m)</th>
<th>Diameter</th>
<th>Water Table Depth in different villages of pre &amp; Post Monsoon</th>
<th>May-06</th>
<th>Oct-06</th>
<th>May-07</th>
<th>May-07</th>
<th>May-08</th>
<th>Oct-08</th>
<th>May-08</th>
<th>Oct-08</th>
<th>May-09</th>
<th>Oct-09</th>
<th>May-10</th>
<th>Oct-10</th>
<th>May-11</th>
<th>Oct-11</th>
<th>May-12</th>
<th>Oct-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Janefaldha badi</td>
<td>20° 08'30&quot;</td>
<td>75°37'3&quot;</td>
<td>5&quot;</td>
<td>1</td>
<td>7.7</td>
<td>7.7  1.6  5.4  1.7  5.1  1.55  6.8  2.2  4.6  0.9  7.7  1.8  7.7  1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>11.6</td>
<td>5.2  6.4  2.6  9.8  6.1  8.1  5.6  9.1  4.6  5.6  4.1  11.6  5.1  12.6  3.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>14.9</td>
<td>4.2  13  8.1  13.4  8.65 13.7 7.35 11.8 9.2 13.4 7.6 14.3 7.8 14.3 7.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Latifpur</td>
<td>20° 09'10&quot;</td>
<td>75°34'0&quot;</td>
<td>5&quot;</td>
<td>1</td>
<td>11</td>
<td>3.95 2.4  4.3  2.85 5.2  1.9  4.9  3.4  6  1.85 8.7  2.8  4.8  2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>13.40</td>
<td>10.5 2.3  8.35 3.3  13.4 7.8 13.4 6.3 15 3.2 12 4 10.6 3.2 13.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>11.6</td>
<td>10.3 11.8 4.7  9.25 6.2 11.8 4.9 11.8 6.4 10 4.1 11.8 11.8 11.8 5.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pimpri</td>
<td>20° 10'15&quot;</td>
<td>75°34'3&quot;</td>
<td>5&quot;</td>
<td>1</td>
<td>11.95</td>
<td>4.65 10.2 1.8 9 3 9.4 6.6 10.6 2.5 9 0.9 6.5 3.5 11 3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>18</td>
<td>11 8 8.7 11.4 6.3 14 16.3 16 9.4 16.3 8.2 9.6 2.5 14 6.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>8.23</td>
<td>2.2 10 3.6 9.4 6.4 10.2 5.25 11 8 11.2 7.6 11.9 4.2 11.65 2.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Dhabadi</td>
<td>20° 10'13&quot;</td>
<td>75°22'2&quot;</td>
<td>4&quot;</td>
<td>1</td>
<td>11.5</td>
<td>5 12.4 3.4 10.5 5.2 11.9 8.7 12.2 9.3 11.6 1.7 10.3 9.4 12.4 8.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>22</td>
<td>10.6 1.99 6.8 11.15 8.1 15.4 12 15.9 11.35 19.7 8.5 10 2.45 12.8 1.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2.1</td>
<td>11.35 3.6 8.4 5.4 10.2 5.25 10.1 7.8 10.6 3.5 2.1 5.7 11.65 2.78 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Vita</td>
<td>20° 02'45&quot;</td>
<td>75°25'3&quot;</td>
<td>0&quot;</td>
<td>1</td>
<td>8.03</td>
<td>3.12 14.4 2.8 13.5 4.3 14.4 5.3 14.4 5.4 13.9 3.2 14.4 13.5 14.4 11.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>14.3</td>
<td>7.8 13.4 8.65 13.7 7.35 11.8 9.2 13.4 7.6 14.3 7.8 14.3 7.82 13 8.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>13.2</td>
<td>3.3 13.2 2.1 13.2 9.3 13.2 6.85 13.2 6.1 13.2 6.1 12.6 6.9 12.25 11.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GRAPH NO. 7:
WATER TABLE FLUCTUATION IN DIFFERENT VILLAGE DUG WELL OF WATERSHED GP-20 IN PRE AND POSTMONSOON.