Ground Water Resources Investigation in Seti and Mahakali Zones, Western Terai, Nepal.

Prepared cooperatively by
the United States Geological Survey and the Department of Irrigation and Hydrology, Ministry of Food and Agriculture, HMG, Nepal
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Ground Water Resources Investigations in Seti and Mahakali Zones, Western Tarai, Nepal

by

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Abstract

This third and last interim report, based largely on field work from December 1973 to June 1974, describes the preliminary results of hydrologic studies and exploratory drilling to evaluate the water bearing properties of alluvial deposits underlying the Tarai area of the Seti and Mahakali Zones of the western part of southern Nepal. The investigation and drilling were jointly undertaken by His Majesty's Government of Nepal (HMG) and the U.S. Agency for International Development (USAID) with technical assistance of advisory from the U.S. Geological Survey (USGS).

The Seti and Mahakali Terai compreses about 3, 720 square kilometers of gently sloping cultivated lands and dry jungle lying between the Siwalik Hills on the north and the Indian border on the south. Monsoon rains occur from mid-June to October and the remaining months are largely dry, Most of the almost 197,000 people of the area live in villages and towns and subsist on crops grown during the mansoon and livestock. Dry season irrigation from streams and rivers is only practicable in areas nearby the major rivers.

Use of tubewells for irrigation in mush of the Seti and Mahakali Tarai appears to present the best prospects for year-long irrigation and a three-crop economy. During the ground water exploration operations in the Seti and Mahakali area 45 test wells totalling roughly 19,300 feet were drilled on a 14-15 km (Kilometers)east-west and a 7-8 km north-south grid pattern. Aquifer tests to determine the hydraulic characteristics of the water-bearing beds were carried out at 34 selected test-well sites.

The areas where tubewells can be successfully developed for irrigation are not uniformly distributed in the Seti and Mahakali Tarai. Generally, the Bhabar zone and the flood plain areas of the Karnali and Sarda Rivers are best suited to large scale ground Water exploitation. The Seti and Mahakali Tariai has the best potential for ground water development among the three areas investigated in the Western Tarai. A relative small wedge-shaped area in the middle of the Kailali District of the Seti Zone has the poorest potential for

irrigation form tubewells. Even in this area, however, transmissivities can exceed 10,000 (gal/day/ft.) indicating the wells screening multiple aquifers may be used successfully for irrigation. Aquifers with head sufficient to flow at land surface are encountered over considerable areas in the Seti and Mahakali Tariai. Successful drilling in flowing artesian zones requires the use of heavy barite based drilling mud to contain the artesian pressure until the aquifer can be fully penetrated by the drill and the well casing can be set and cemented. Without proper mud control and cementing, wells penetrating aquifers with positive head "blow out" resulting in uncontroled flow from the annulus around the well and from the well itself.

The chemical quality of water from the artesian and semi-artesian aquifers in the area is generally good and suitable with few exceptions, for domestic supply, livestock, industry, and irrigation.

Introduction

Purpose and Scope of Report

This interim report is the third and last of a series and summarizes data collected in the Seti and Mahakali Zones during the fifth field season, extending from December 1973 to June 1974, in a project designed to explore the ground water potential and geohydrology of the Western Tarai region of Nepal. The report also presents preliminary conclusions regarding the occurrence, quantity, and chemical quality of ground water in the Ganetic alluvium and Bhabar zone deposits underlying the Seti and Mahakali Zones of the Western Tarai region. Accompanying tabulations present part of the basic data on which a final interpretative report will be based. Although not in final form, this information will be useful to prospective users of ground water as well as to those planning large-scale tubewell irrigation in the area. Readers not technically grounded in the field will find the applicable basic principals of geohydrology described in the first and second of the report series, "Ground Water Resources Investigations in Lumbini Zone, Western Tariai, Nepal" and " Ground Water Resources Investigations in Bheri Zone, Western Tarai, Nepal".

The present investigation of the Western Tarai has been jointly sponsored by His Majesty's Government (HMG) Department of Irrigation and Hydrolog , Ministry of Food and Agriculture and the United States Agency for International Development (USAID). Technical advisory were assigned to the Project by the United States Geological Survey (USGS).

Location and Extent of Area.

The area of investigation lies entirely within the Tarai section of the Seti and Mahakali Zones of Nepal and is located between 28°25' and 29°05' North latitudes and 80°00' and 81°30' East longitudes and includes the major part of the somewhat more extensive Kailali and Kanchanpur Districts. The area extends about 120 kilometers (kms)east-west and ranges in width from 20 to 42 kms north-south and covers approximately 3720 square kilometers (fig.1). The eastern limit of the Seti Tarai is marked by the Kauriala River which is a distributary

of the larger Karnali River nearby to the east. A small area of flood plain between the two rivers lies within the adjacent Bheri Zone, but nonetheless within the area covered by this report. The Kauriala River also marks the eastern boundary of the exploratatory drilling although extrapolation of data from test holes west of this line indicate similar groundwater conditions for the inter-river plain area located in the Bheri Zone.

The Sarda River roughly marks the western limit of the Mahakali Tarai although the actual bonndary, the Nepal-Indian border, is located slightly east of the river to the north and as much as 6kms west of the river to the south. The northern limit lies along the base of the Siwalik Hills and the southern limit is again the Nepal-Indian border The Principal towns in the area are Dhangarhi and Mahendranagar, zonal headquarters for the Seti and Mahakali Zones, respectively.

Economic and Cultural Features

Dhangarhim the population and economic center of the Seti Tarai, is served by a grass airstrip located on the nothern edge of town, Mahendranagar, the largest village in the Mahakali Tarai also has a grass airstrip located 2 km west-southwest of town. Both these air fields are inoperative during part of the monsoon. The Indian Government Railway terminates at Gauriphanta about 4 kms from the border south of Dhangarhi. Although not a transit railway entry point, a spur railway supporting logging operations terminates at Indian village of Chandan Chawki south of the village of Kailali in Nepal. This spur line extended at one time as far east as Kauriyalaghat in India across the border from Rajapur, but is no longer operative.

Dhangarhi is the southern terminus of the Western Hills Road, a Joint HMG-USAID road construction Project, extending northward 143 kms to the hill town of Dandeldhura. The base construction camp for the road is located at Godawari 23 kms north of Dhangarhi near the base of the Siwalik Hills. The work shops, service facilities, and residential complex add an aspect of a modern industrial society to the otherwise rural surroundings. This road is currently (1974) open to truck traffic as far as km 86 and to small 4-wheel drive vehicles for its entire length during part of the dry season.

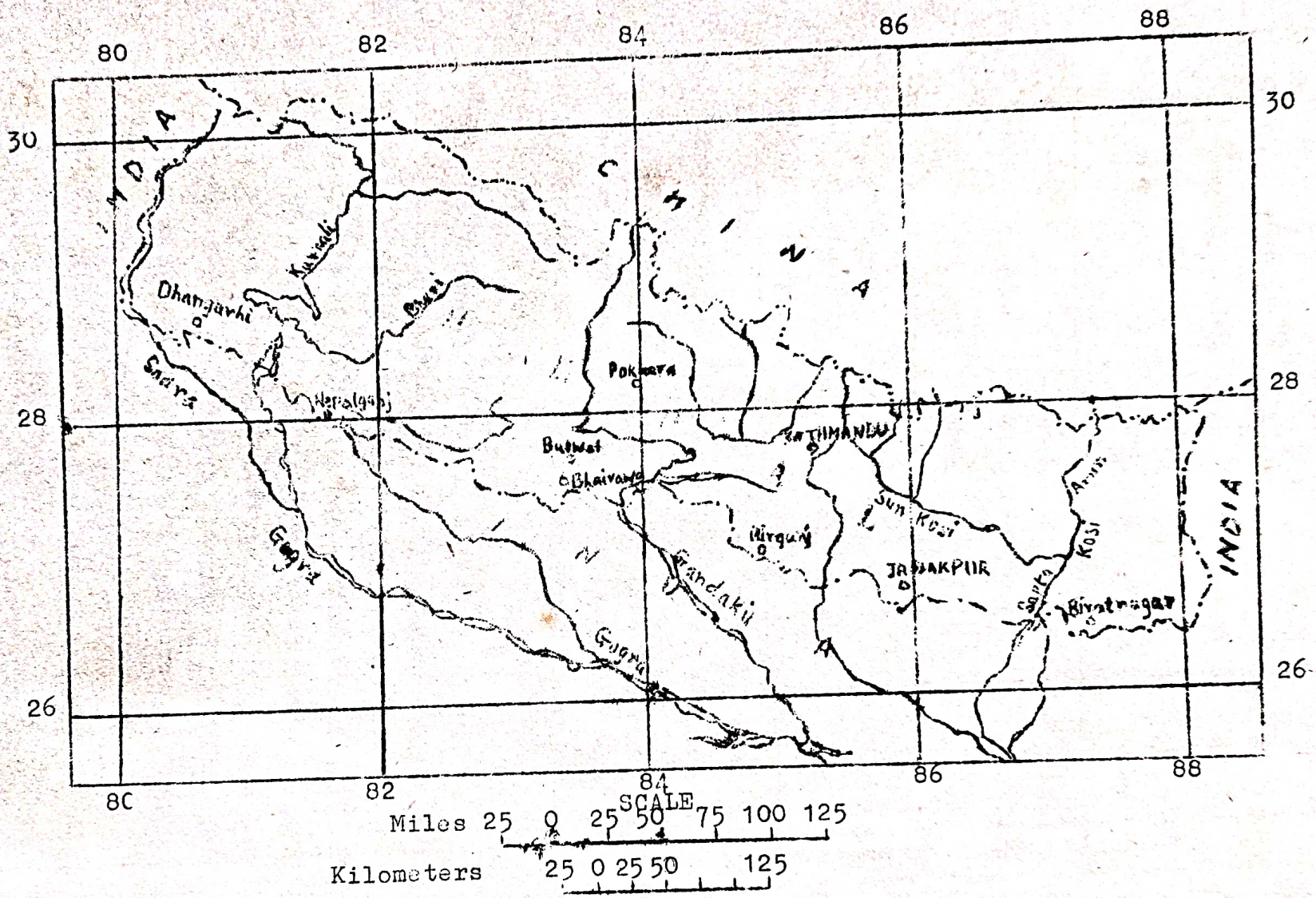

Figure 1. Map of Nepal showing the area of study

When completed, most types of vehicles will be able to traverse the entire length of the road year around. Road access southward into India, however, is somewhat limited by the fact that permanent bridges have yet to be constructed over several rivers between Dhangarhi in Nepal and Palia in India. Consequently, during the monsoon when the temporary causeways wash out, travel by road ceases until new causeways can be constructed the following November or December.

Access to India from Mahendranagar is by may of a barrage across the Sard River about 10 km west of town, Mahendranagar and Dhangarhi are linked by an inproved dirt track that extends eastwards to the Karnali River. Eventually it is planned to extend the east-west highway across the entire area dnd preliminary surveys by HMG, Roads Departm-ent are already complete for the Dhangarhi-Mahendranagar link. A number of north-south forest tracks cross the area.

As elsewhere in the Nepal Tarai, most dirt tracks are usable only in the dry season and then only by 4-wheel drive vehicles or bullock carts, Monsoon travel off the surfaced roads is limited to travel on foot or by elephant.

The 1971 census of Nepal indicates a population of 128 877 for the Kailali District and 68,863 for the Kanchanpur Distri t of the more extensive Seti and Mahakali Zones. Small parts of the Kailali and Kanchanpur Districts lie outside of the Tarai and the concern of this report. The great majority of the population, however, lives in the Tarai sections of these districts. The population is composed, for the most part, of the indigenous Tharus although increasingly people from the midlands and from across the southern border are evident through out the area.

Previous Investigations.

For non-hydrologists use of this report is keyed to the earlier interim reports on the Lumbini and Bheri Zone. The basis for planning the present investigation of the Tarai sections of the Seti and Mahakali Zones was provided by W.V. Swarzenski and H.M. Babcock (1968).

Acknowledgements

This report is the product of the cooperative efforts of personnel of HMG Ground Water Section, Department of Irrigation and Hydrology and U.S. Advisors assigned to the Project by USAID. It is the first result of approximately one year's field work. Project personnel in all catagories, professional, sub-professional, and administrative have each, according to his station and job, contributed to the success of the field operations. Thanks are also due to the many government officials and private individuals who assisted from time to time in project objectives.

Geography.

Topography and Drainage

The Seti and Mahakali Tarai is similar to the Tarai of the Lumbini and Bheri Zones as the same basic geomorphic pattern persists. The Siwalik Hills with summit altutides of 3,000 to 5,000 feet form the nothern boundary of the area. Coarse grained fluvial deposits have been laid down in the piedmont Bhabar Zone by streams decouching from these hills. The Bhabar depostits form alluvial fans overlying and in part intercallated with the finer grained Gangetic alluvial deposits to the south. Extensive Bhabar deposits occur, however, only near the Kauriala, Karnali, and Sarda Rivers. The same pattern of the Bhabar deposits persists in the Seti and Mahakali Tarai as in the Lumbini and Bheri Tariai with the larger streams developing more extensive alluvial fans and smaller streams depositing small fans. The interfluvial areas between streams are often devoid of Bhabar deposits.

The Seti and Mahakali Tarai is traversed by two major rivers and numerous smaller rivers and streams. The Karnali River, the largest river in Nepal, together with its distributary, the Kauriala, forms the eastern limit of the report area. The somewhat smaller Sarda River approximately marks the western limit of the Mahakali Tarai. Smaller rivers and streams heading in the Siwalik Hills flow only intermittently in their upper reaches south of the hills during the dry season. Flow is for the most part continuous, although small, during the dry season downstream of the Bhabar zone in the smaller rivers and streams.

The Surface Water Section of the Department of Irrigation and Hydrology maintains a gaging station in the Karnali River at Chisapani. Data from this station are summarizediin the Bheri Zone report and are not repeated here. Streamflow information for the Sarda River is collected by the Indian Government but was not available for this report. There are no other stream-ganging stations in the Seti or Mahakali Tarai although HMG, makes random measurements on several rivers and maintains at least, three gaging stations north of the report area in the midlands.

There are few perennial lakes in the extreme eastern part of the Seti Tarai and lakes, for the most part, are absent in the Mahakali Tarai. There is an abundance of perennial natural lakes, however, in the central and western Seti Tarai. These lakes range in area from less than a hectare to several square kilometers. Whereas some of the lakes are obviously oxbows, most appear unrelated to the existing or ancient drainage system. Furthermore, these lakes are not concentrated areally but are scattered at random between the Siwalik Hills and Indian border. Although the sause for the presence of these lakes is not immddiately apparent, one possible explanation is that the lakes are fed by leakage from the underlying ground water system. The distribution of the lakes appears to coincide roughly with the area of flow-well artesian water extending 40 km east of Dhangarhi. As this area of flow well artesian water also is present westward out side of the zone of lakes, structural movements which ruptured confining beds may also have contributed to localizing artesian leakage.

Climatic Features

Meteorological stations are maintained by HMG at Chisapani, Dhangarhi, Santipur, and Mahendranagar. As data from the Chisapani station are already summarized in the Bheri Zone report, they are not repeated here. Data from the other stations are summarized in tabele. 1.

Rains tend to start later and be less intense as the monsoon moves westward across the Nepal Tarai. Consequently, the Seti and Mahakali Tarai receives somewhat less rainfall than the Lumbini and Bheri Tarai, although the same climatological patterns persist. The monsoon rains start in June and end in September and only occasional and scattered rains occur during the remaining months of the year. Rainfall is usually greater near the Siwalik hills front than along the Indian border.

Agriculture and Industry

Most of the population of the Seti and Mahakali Zones is engaged in agriculture or agriculturally related occupations. Probably about 60 to 70 percent of the Seti and Mahakali Tarai, however, is covered by commercial forest or forest preserves.

Most existing irrigation systems in the Seti and Mahakali Tarai are based on stream flow. As elsewhere in the Western Tarai of Nepal, the most successful systems are those constructed, managed and maintained by the local cultivatory. Although these locally built irrigation systems are limited by lack of water during the dry season, they make full utilization of the water available.

A canal system built by HMG to irrigate the area nearby the Kula Nadi in the eastern Seti Zone can be utilized only during the monsoon. Similarly another canal system further east diverting water from the Kauriala River can only be used during the monsoon season. Both of these irrigation systems suffer extensive damage annually from monsoon floods that necessitates expensive annual repairs.

Much of the western Mahakali Tarai will be irrigated by a major canal system now (1974) being constructed to distribute water form the Sarda River. This system may prove more successful than similar systems elsewhere in the Nepal Tarai because the point of diversion is well upstream of the area to be irrigated. Other systems utilizing major rivers have intakes at the Nepal-Indian border thereby restricting the head available for east-west distribution to that of the head of water in the reservoir.

Major industries of the Seti and Mahakali Tarai include the now defunce turpentine factory north of Dhangarhi. The raw materials for this factory were obtained from the Siwalik Hills. Operations of the factory was sanctioned by HMG in 1968, but subsequently withdrawn when the damage caused by tapping the pine forests in the hills became evident. Other major industries include brick making and lumber production. Rice and oil seed mills are among the local minor industries.

Table 1 Monthly Rainfall, in millimeters, at Dhangarhi 1956 - 1973,
Santipur 1971-73& Mahendranagar 1971-73

Dhangarhi

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total Annual Rain fall
1956	NR 1/	NR	NR	NR	NR	NR	57.6	521.6	146.0	217.2	15.2	3.5	
1957	72.2	NIL	27-7	6.1	7.6	200.6	637.2	251.9	198.7	25.1	5.3	20.8	1453.2
1958	27.2	3.4	5.1	2.8	2.0	111.5	404.9	451.8	431.0	36.3	NIL	18.5	1494.5
1959	55.1	10.4	12.1	NIL	127.0	81.3	554.6	617.0	311.4	139.4	16.0	NIL	1924.3
1960	0.5	NIL	53.9	0.5	37.4	246.8	666.8	454.1	222.5	236.7	NIL	23.6	1942.8
1961	55.7	80.7	NIL	1.3	18.4	273.8	574.5	480.2	323.7	465.1	NIL	NIL	2273.4
1962	NR	NR	NR	NR	NR	373.1	649.5	518.0	353.8	NIL	0.2	2.3	
1963	23.6	2.9	72.0	NIL	40.2	171.4	502.3	619.4	99.6	77.6	16.0	16.0	1641.0
1964	8.0	6.4	25.0	3.0	30.8	255.0	509.2	255.2	538.6	NIL	NIL	19.8	1651.0
1965	25.4	18.6	24.6	2.5	NIL	107.2	261.0	181.0	307.0	10.0	NIL	NIL	937.3
1966	23.0	26.5	NIL	NIL	NIL	309.2	444.0	70.0	120.2	12.0	NIL	NIL	1004.9
1967	0.0	0;0	64.0	6.2	0.0	154.0	559.8	376.4	136.8	5.0	0.0	17.6	1319.8
1968	59.3	28.0	15.0	4.0	6.0	481.9	700.4m	361.3	263.6	0.0	0.0	0.0	1916.9
1969	53.0	7.3	0.0	12.6	91.6	80.5	535.9	556.8	436.0	3.1	0.0	0.0	1776.8
1970	79.9	22.3	11.3	0.0	36.9	385.0	412.7	390.8	117.5	121.1	0.0	0;0	1577.5
1971	NR	39.1	26.2	123.2	132.0	232.0	464.0	388.7	136.4	47.6	22.4	0.0	
1972	0.0	31.4	0.0	0.0	0.0	88.4	364.0	335.6	516.2	31.2	0.0	0.0	1366.8
1973	1.0	12.0	15.0	0.0	15.0	138.2	201.8	174.4	691.0	NR	NR	NR	
Average	33.8	17.0	22.2	2.8	28.0	211.0	509.8	385.9	287.4	83.1	2.7	8.4	1591.4
						Santipur							
1971	NR	51.5	30.0	110.5	109.0	193.5	339.4	645.0	430.0	74.5	8.0	0.0	
1972	1.0	110.0	2.0	0.0	2.0	54.0	464.5	460.5	477.6	94.0	10.5	4.5	1680.6
1973	36.0	24.0	12.2	0.0	117.4	606.3	362.4	366.5	270.2	158.5	0.0	0.0	1953.5
Average	18.5	67.0	7.1	0.0	59.7	330.2	413.5	413.5	373.9	126.9	5.2	2.2	1817.1
						Mahendranagar							
1971	NR	40.4	11.7	93.9	157.2	338.2	365.4	506.4	232.2	95.2	14.0	0.0	
1972	3.1	50.4	0.0	1.6	2.8	12.0	377.8	381.8	339.8	32.0	20.0	0.0	1221.3
1973	31.3	13.4	8.4	0.0	46.4	347.6	179.6	365.0	262.0	169.0	0.0	0.0	1422.7
Average	17.2	31.9	4.2	0.8	24.6	179.8	278.7	373.4	300.9	100.5	10.0	0.0	1322.0

1/NR = No records available.

Well Numbering System.

The test wells in the Seti and Mahakali Tarai, were drilled on a grid roughly 14 to 15 km east-west and 7 to 8 km north-south. For reasons of access to sites, however, there are exceptions to this spacing. Numbering begins in the south-east corner of the report area and wells are numbered serially from south to north on each line. The eight grid lines, in turn, are numbered serially from east to west. For example, well 5/7 at Geta is the seventh well north of the southermost drill site on the fifth grid line west of the eastern boundary of the area. Test well locations are shown in figure 2.

Table 2 is a cross reference between test well numbers used in this report and test well numbers used to file records in the HMG, Department of Irrigation and Hydrology and USAID/Kathmandu. The file numbers reflect the chronology of the drilling program. For example, HD 2/4 in the file numbering system refers to the fourth well drilled by the Hydrology Department's drilling rig number. 2.

Geohydrology

The northern limit of the Seti and Mahakali Tarai lies along the base of the Siwalik Hills. Rocks exposed by streams cutting through the Siwalik Hills consist of interbedded fine-grained sandstone with clay vugs, shale, conglomerate, and freshwater limestone all of the Siwalik Formation of late Tertiary age. The rocks dip generally northward. The Siwalik Hills form the outermost folded belt of the Himalaya. The rocks of Siwalik Formation provide the source of most of the stream-deposited alluvial materials underlying the Bhabar Zone and the contiguous Gangetic Plain immediately to the south. Also, the larger rivers crossing Seti and Mahakali Tarai have transported and deposited alluvium derived from older metamorphic rocks of the Mahabharat Range.

The Bhabar zone deposits and Gangetic alluvium south of the Siwalik Hills contain the principal aquifers of the Seti and Mahakali Terai. The deepest test hole (3/1) in the Seti Tarai penetrated unconsolidated deposits of fulvial origin throughout and entire 1,500 foot depth drilled. Siwalik bedrock was not encountered in any of the test holes. The alluvium appears to be of considerable thickness even near its.

Table 2. - Cross-reference of test hole report numbers and office file numbers.

Report No.	File No.	Report No.	File No.
1/1	HD-1/10	5/3	HD-1/2
2/1	HD-1/9	5/4	NB-16
2/2	HD-2/15	5/5	HD-2/17
2/3	NB-11	5/6	HD-1/1
2/4	NB-12	5/7	NB-1
2/5	NB-13	5/8	HD-1/2
2/6	NB-14	5/9	HD-2/3
3/1	NB-15	6/1	HD-2/4
3/2	HD-1/7	6/2	HD2/9
3/3	HD-2/13	6/3	HD-1/3
3/4	HD-2/14	6/4	NB-2
3/5	NB-8	6/5	NB-3
3/6	NB-9	6/6	NB-4
3/7	NB-10	7/1	HD-1/4
3/8	HD-1/8	7/2	HD-2/5
4/1	NB-6	7/3	HD-2/6
4/2	HD-2/10	7/4	HD-2/7
4/3	HD-2/11	7/5	HD-2/8
4/4	HD-2/12	7/6	NB-5
4/5	NB-7	7/7	HD-1/5
5/1	Dhangarhi City Well	7/8	HD-1/6
5/2	HD-1/1	8/1	Mahendranagar City Well

HD = Hydrology Department

NB = N.B. Tube wells.

contact with the Siwalik Formation, possibly indicating a westward extension of the hige-line fault postulated in the Lumbini and Bheri Zones along the southern base of Siwalik Hills.

The Bhabar Zone deposits consist of boulder, cobble, and pebble gravel and coarse sand interbedded with some silt and clay. In the Seti and Mahakali Zones, the bhabar deposit occur in broad alluvial fans extending downstream from the points where streams debouch from the Siwalik Hills, except along the Karnali and Barda Rivers. Along these major rivers, the Bhabar deposits are much more extensive in effect blanketing the flood plain and extending as far downstream as the Nepal-Indian border and beyond. The Bhabar deposits contain large quantities of ground water and properly constructed wells in these deposits produce large yields. The Bhabar deposits provide intake areas for recharge to the ground-water system and are much mor extensive in the Seti and Mahakali Tarai than the Lumbini or Bheri Tarai.

The Gangetic alluvium interfingering with, underlying, and bordering the Bhabar zone deposits consist of intercalated lenticular beds of silt, clay, aand, and pebble gravel. In the interfulvial areas near the Siwalik foothills the proporation of silt and clay is greater than that of sand and gravel. The Gangetic alluvium constitutes roughly 70 to 80 percent of the bulk of the deposits underlying the Seti and Mahakali Terai. The beds dip gently to the sout and are contiguous with Gangetic alluvium in India.

As in the Lumbini and Bheri Terai, the thickness and areal extent of aquifers in the Seti and Mahakali Terai appears to be controlled by an ancient drainage system which is a subsurface reflection of the present drainage pattern. Aquifers underlying the present-day river flood plains are the thickest and most coarse-grained.

Water in the Bhabar deposits occurs under both water table and semi-confined conditions whereas water in the Gangetic alluvium generally occurs under confined conditions. In roughly 40 percent of the Seti and Mahakali Tarai ground water occurs under sufficient head to flow in wells at land surface. Tubewells constructed to penetrate these flowing aquifers require cementing around the annulus and also need to be drilled with heavy barite-based mud to control the positive

water pressure. Mud control and cementing procedures are described in the first interim report, "Ground Water Resources Investigations in Lumbini Zone, Western Terai, Nepal". Figure 2 shows areas of flowing artesian water and the location of the test wells drilled during the present investigation.

The Seti and Mahakali Terai has the best potential for ground water development by tubewells among the three areas investigated in the Western. Terai. Figure 6 shows areas of high and low potential for yields from tubewells. Aquifers in all the Mahakali Terai and roughly 80 percent of the Seti Tearai have transmissivities.of 25,000 (gal/day/ft.) or more. A relative small wedge-shaped area in the middle of the Kailali District has the poorest potential for irrigation from tubewells. Even in this area, however, transmissivities can exceed 10,000 (gal/day/ft.) indicating that wells screening multiple aquifers may be used successfully for irrigation.

Perhaps the most significant discovery made during the 1973-74 field season was that of a high-yield aquifer at shallow depth in western Kanchanpur District. Tubewells drilled at Bichhuwa (7/5) encountered a high yield aquifer between 49 and 59 feet below land surface. Subsequent aquifer tests indicated a transmissivity averaging 194,000 (gal/day/ft.) One of the tubewells was pumped at 60 gallons per minute (gpm) with a drawdown of only 5.88 feet indicating that considerable water could be developed for irrigation by low-left. pumping.

Exploratory Drilling

Exploratory drilling operations in the Seti Zone were started the first part of January 1974 with the arrival of the HMG drilling rigs from Nepalganj. The first test hole, 5/1, at Dhangarhi was drilled by rig No. 1 while rig No. 2 started operations in test hole 5/6 at Geta. The drilling contractor arrived in mid-February 1974 and began operations by drilling a 1,000 foot slim test hole, 5/7 also at Geta, which was subsequently screened between 280 to 290 feet for use as an observation well for an aquifer test. Upon completion of the Dhangarhi-Godawari base line, drilling operations moved westward

to complete exploratary drilling in the Kanchanpur District. Operations east of the base line in the Kailali District started in March 1974. Subsequently, and until the end of the season's drilling operations in mid-June 1974, a total of 45 test wells were put down for an aggregate footage of about 19,300 feet. The HMG Department of Irrigation and Hydrology drilling rigs. operated by Nepali personnel, completed 23 test holes, including several drilled by the slower more difficult percussion method, whereas the contractor completed 22 test holes.

Aquifer Tests.

Two major hydraulic characteristics that affect the development of an aquifer are its ability to transmit water and its capacity to yield water from storage. These characteristics, which affect the water levels or artesian pressures and yields of tubewells, are called the transmissivity, originally defined by Theis (Ferris and others, 1962, P. 72-73), and storage coefficients (Ferris and others 1962,p.74-78), respectively. More recently these terms have been redefined by Lohman and others (1972). When these aquifer characteristics are known for an aquifer or part of an aquifer, it is possible to forecast approximate water level or artesian pressure trends at different rates of withdrawal from producing tubewells.

To establish the transmissivities and storage coefficient of aquifers in the Seti and Mahakali Terai, 34 aquifer tests were made at selected sites. The tests were made on both flowing artesian and non-flowing (subartesian) tubewells. The results of these tests are summarized in table 4 and are described in more detail in the following pages.

Durgauli site - Tubewell 1/1, drilled near the flood plain of the Karnali River at Durgauli, was screened in coarse cobble and pebble gravel from 50 to 80 feet. The well was pumped at 57 gpm(gallons per minute) for 24 hours with a total drawdown of 3.1 feet. The plotted theis recovery curve indicated a very high transmissivity of 233,000 gpd/ft (gallons per day per foot). This is a relatively high value.

but is considered of the right magnitude owing to the coarse texture of the deposits in the flood plain of the Karnali River of Bhabar zone. Well spacing in this area would need to be only minimal.

Bhajani and Joshipur sites - Single well recovery tests were made on tubewells 2/1 near Bhajani and 2/2 at Joshipur using the Theis recovery method. Tubewell 2/1, screened in fine sand and gravel from 239 to 258 feet, was pumped at 56 gpm for 24 hours with a total drawdown of 4.1 feet. The plotted recovery curve indicated a moderately high transmissivity of 64,280 gpd/ft. A definite change in the slope of the plotted data occurred after only 20 minutes pumping indicating that transmissivity increased from 13,400 to 64,280 gpd/ft. This change could result from the interception by the come of depression of a recharge area or more likely a lateral change in permeability of the aquifer.

Tubewell 2/2, at Joshipur, was pumped for 24 hours at 59 gpm with a total drawdown of 4.3 feet. The plotted recovery data indicated a relatively high transmissivity value of 92,900 gpd/ft. The well was screened in pebble and cobble gravel from 137 to 156 feet.

Semri site - Aquifer tests were conducted on three different water bearing horizons at Semri. On may 27 1974 a multiple well aquifer test was conducted using tubewells 2/4 and 2/5 which were screened from 59 to 69 feet in medium gravel with pebbles and cobbles. Well 2/5 was pumped for 24 hours at 57 gpm for a total drawdown of 8.15 feet During this pumping the water level, declined 1.15 feet in well 2/4, located 70 feet away. The recovery rate coincided with drawdown to indicate a transmissivity of 43,000 to 46,000 gpd/ft. The storage coefficient ranged from 5.34×10^{-4} to 5.48×10^{-4}. The hydraulic characteristics were computed using the Theis nonequilibrium and Cooper-Jacobs modified formulas.

Theis single well recovery tests were conducted on tubewells 2/3 and 2/6 also at Semri. The plotted recovery data indicated relatively high transmissivity values of 108,000 gpd/ft in tubewell 2/3 and 100,300 gpd/ft in tubewell 2/6. Tubewells 2/3 and 2/6 were screened in gravel from 220 to 240 and 132 to 142 feet, respectively. Water could be pumped for irrigation from the deeper aquifer as well as the shallow aquifer in this area with minimum interference. The shallow

aquifer, however, would require more careful spacing of wells.

Basanta and Katanipur sites - Theis single - well recovery tests conducted on tubewell 3/1 near Basanta and 3/2 near Katanipur indicated relatively low transmissivity values of 11,900 and 9,300 gpd/ft, respectively. Tubewell 3/1, screened in fine to medium sand from 155 to 175 feet, was pumped for 24 hours at 57 gpm with a total drawdown of 11.8 feet. Well 3/2 at Katanipur, screened from 130 to 150 in coarse sand with clay, had a drawdown of 21.1 feet after pumping for 24 hours at 55 gpm.

Bijayapur site - The aquifer test conducted on tubewells 3/3 and 3/4 near Bijayapur indicates low transmissivity values ranging from 2,430 to 3,960 gpd/ft.

Tubewell 3/3 was pumped at 57 gpm for 24 hours with a total draw down of 25.2 feet. During this period the water level in observation well 3/4, located 50 feet away, declined 14.8 feet. The computed storage coefficients ranged from 2.73×10^{-4} to 5.24×10^{-4}, A change in slope or trend of the plotted data, which occurred after 40 minutes of pumping, suggests that a hydrologic boundary or a change in permeability of the aquifer was encountered by the cone of depression about 153 feet from the observation well.

Transmissivity values along traverse 3 from Bijayapur south to Basanta are generally low and suggest that wells in this area will not produce water sufficient to sustain large irrigation wells.

Sasaiya site - Two tests were conducted at Sasaiya between April 30 and May 5, 1974 on two separate producing zones. Tubewell 3/5, screened in coarse to medium sand from 575 to 595 feet, flowed at 63 gpm for 24 hours with a pressure decline of 19.3 feet. After shutdown the pressure head returned to the original static level of 44.2 feet above land surface. The plotted recovery data using the Theis recovery method indicate a low transmissivity value of only 2,380 gpd/ft. The unusually low transmissivity for this tubewell does not correspond to the high positive head. The dificulty encountered in developing the tubewell in this screened zone may

partly explain the anamoly. Nevertheless, the aquifer could have both high head and low permeability.

The aquifer test conducted on the shallow aquifer at Sasaiya indicated an average to moderately high range of transmissivity. Tube well 3/7, screened in fine gravel and sand between 56 to 76 feet, was pumped for 24 hours at 54 gpm with a total drawdown of 4.26 feet. During this period the water level declined 2.13 feet in the observation will 3/6 located 50 feet away. The recovery rate coincided with drawdown to indicate a transmissivity in the range of 21,600 to 44,700 gpd/ft. The computed storage coefficient ranged from 1.34×10^{-3} to 3.23×10^{-4} using the Theis non-equilibrium and Cooper-Jacobs modified formulas.

Ganeshpur site - The Theis single well recovery test conducted on flowing artesian tubewell 3/8 at Ganeshpur indicated an average to moderately high transmissivity of 45,000 gpd/ft. The tubewell, screened in gravel and sand from 263 to 279 feet, flowed for 24 hours at 162 gpm with a pressure decline of about 2.9 feet. After 24 hours the pressure head returned to the original static head of 61.6 feet above land surface.

Phulverria site - The Theis single well recovery method was used to determine the transmissivity of the aquifer penetrated by tubewell 4/1 near Phulverria. The well, screened in medium to coarse gravel and sand from 255 to 280 ft, was pumped for 24 hours at 57 gpm with a total drawdown of 3.26 feet. The plotted recovery data indicated a moderately high transmissivity of 66,470 gpd/ft.

Gadriya and Dhabai sites - Theis single well recovery tests were conducted on the flowing tubewells 4/2 at Gadriya and 4/5 at Dhabai. The plotted recovery data indicated average transmissivity values of 32,500 and 32,200 gpd /ft, respectively. Tubewell 4/2, which had a static head of 13.6 feet above land surface, flowed for 24 hours at 74 gpm with a pressure decline of about 2.6 feet. Tubewell 4/5, at Dabai, screened in gravel and sand from 295 to 315 feet, flowed for 24 hours at 50 gpm with a pressure decline of about 3.1 feet. The

static head of well 4/5 was 38.6 feet above land surface.

Bhada site - On April 4, 1974 an aquifer test was conducted near Bhada using two flowing artesian tubewells. Tubewell, 3/3, screened in gravel and sand from 282 to 303, was allowed to flow for 24 hours at 54 gpm. During this period the pressure declined about 1.3 feet. in observation well 3/4, screened in the same zone 50 feet away. The hydraulic characteristics, computed using the Theis non-equilibrium and Cooper Jacobs modified formulas, indicate moderately high transmissivity values in the range of 45,000 to 51,200 gpd/ft. The storage coefficient ranged from 7.36×10^{-4} to 2.93×10^{-4} .

Dhangarhi Water Tower site - A rather wide range in transmissivity values were encountered in the three aquifer tests conducted on spearate horizons near the Dhangarhi water tower. Tubewell number 5/1, the city water well, screened in sand and gravel from 118 to 185 feet, was pumped for 24 hours at 250 gpm with a total drawdown of 12. 2 feet. The water level in observation well 5/2 , located 100 feet away, declined 4.9 feet during the pumping period. The plotted data indicated moderately high transmissivity values in the range of 42,800 to 49,000 gpd /ft using the Theis non-equilibrium and Cooper Jacobs modified formulas. The storage coefficient ranged from 8.19×10^{-4} to 1.04×10^{-3} .

Theis single well recovery tests were conducted on the flowigg artesian tubewells 5/3 and 5/4 located near the water tower. The plotted data indicated a relatively low transmissivity value of 6,480 gpd/ft for the deeper aquifer screened in tubewell 5/3, where as the shallower zone screened in tubewell 5/4 indicate an average transmissivity of 38,100 . Both tubewells were screened in sand and gravel, however, continuous wire wrapped screen was use in well 5/4 whereas slotted pipe was placed in 5/3.

Boradandi (Army Camp) site - The Theis single well recovery test conducted on tubewell 5/5 at the Army Camp indicated a low transmissivity value of 3,100 gpd /ft, Tube well 5/5 was screened in gravel with sand between 297 and 307 and 277 to 283 feet. Tubewell 5/5,

which had a static head of 23. 2 feet above land surface, flowed at 25 gpm for 24 hours with a pressure decline of more than 6.8 feet.

Geta site - A multiple well aquifer test was conducted on two flowing artesian tubewells near Geta. Tubewell 5/6, screened in gravel with coarse sand between 281 and 295 feet, flowed for 24 hours at 227 gpm. During this period the pressure declined 5.4 feet in observation tube well 5/7 located 100 feet away. The recovery rate coincided with the drawdown to indicate an average to moderately high transmissivity in the range of 26,600 to 38,600 gpd/ft and storage coefficient of 1.33 X 10^{-4} to 1.25 X 10^{-4} . The hydraulic characteristics were computed using both the Theis non-equilibrium and Cooper-Jacobs modified formulas.

Autaria and Teghari sites - The Theis single well recovery test on the flowing artesian tubewell 5/8 near Autaria indicated an averave transmissivity of 29,900 gpd/ft. Tubewell 5/8, screened in fine to medium gravel from 382 to 400 feet, flowed for 24 hours at 60 gpm with a pressure decline of about 2.7 feet.

Tubewell 5/9 near Teghari screened in pebble and cobble gravel from 250 to 270 feet was pumped for 24 hours at 59 gpm with a total drawdown of 4.63 feet. The plotted data indicated a high transmissivity value of about 164,000 gpd/ft. This tubewell was located near the southern limits of the Bhabar zone near the Siwalik Hills and the mouth of a small khola debouching from the mountains.

Cha Goan (Punarbas) site - The multiple-well aquifer test conducted on tubewells 6/1 and 6/2 at Cha Goan in the Punarbas Resettlement Area indicated average to moderatly high transmissivity values. Tubewell 6/2, screened in fine to coarse sand and gravel from 269 to 300 feet, was pumped for 24 hours at 329 gpm with a total drawdown of 32.1 feet. During this period the measured decline in the water level in observation tubewell 6/1, screened in the same zone 50 feet away, was 8.1 feet. The recovery rate coincided with drawdown to indicate transmissivity values in the range of 34,000 to 40,800 gpd/ft and storage coefficient of 1.98 X 10^{-4} to 1. 63 X 10^{-4} . The hydraulic characteristics were computed using the Theis non-equilibrium and Cooper-Jacobs modified formulas.

An anomaly occurred at an estimated distance of 1,225 feet from the observation well after about 120 minutes pumping. The slope of plotted data diminished or flattened indicating an increase in transmissivity to 125,000 gpd/ft. This could result from the interception of a recharge boundary or possibly change in permeability of the aquifer in one or more directions.

Water for irrigation could be obtained from aquifers in this area with judicious spacing of wells especially if drilled in the direction of the suspected anomaly. The placing of wells in lower lying areas could also reduce the lifts and the pumping costs. Tubewells 6/1 and 6/2 were located on top of a low ridge.

Amaraiya and Kaspa sites - Single well recovery tests conducted on tubewells 6/3 at Amaraiya and 6/4 at Kaspa indicated a widerange in transmissivity values. Tubewell 6/3, screened in gravel and sand from 130 to 150 feet, was pumped for 24 hours at 55 gpm with a total draw down of 7.9 feet. The plotted data indicated a moderately high transmissivity value of 70,000 gpd/ft using the Theis recovery method.

The Theis recovery test run on tubewell 6/4 at Kaspa, however, indicated a low transmissivity value of 6,400 gpd/ft after the first 10 minutes of pumping. The test is considered unreliable and the results unrepresentative, as the water level declined more than 102 feet in less than 10 minutes before establishing a normal rate of decline, The cause of the anomaly is unknown.

Dekhatbhuli and Bandi sites - Tests on flowing artesian tubewells 6/5 at Dekhatbhuli and 6/6 at Bandi alos indicated a wide range in transmissivity values. Tubewell 6/5, screened in coarse sand and gravel from 287 to 307 feet, had a positive head of 33 feet above land surfce The tubewell flowed for 24 hours at 200 gpm with a decline in head of about 3.7 feet. The plotted recovery data indicated high transmissivity value of 94,300 gpd/ft using the Theis recovery method.

A Theis single well recovery test on tubewell 6/6 near Bandi indicated an average to low transmissivity value of 18,700 gpd/ft. Tubewell 6/6, which had a positive head of 27.5 feet above land surface, flowed for 24 hours at only 7 gpm with a pressure decline of

about 2.1 feet. The relationship between the high positive head and very low yield is questionable. The well may have been poorly developed or the screen improperly located.

Pachui (Calcutta) and Amlia sites - Single well recovery tests were made on tubewells 7/1 at Pachui (Calcutta) and tubewell 7/2 near Amlia using the Theis recovery method. Tubewell 7/1, screened in siltstone gravel from 291 to 311 feet, was pumped for 24 hours at 60 gpm with a total drawdown of 4.3 feet. The plotted recovery data indicated a high transmissivity value of 198,000 gpd/ft. The residual drawdown during this test was quite small causing erratic measurements during the pumping cycle. The recovery data plotted more reasonably, however, the transmissivity value is believed to be a little to high.

Tubewell 7/2, near Amlia, was pumped for 24 hours at 62 gpm with a total drawdown of 4.3 feet. The plotted recovery data indicated an average transmissivity value of 28,200 gpd/ft.

The shallow water levels, relatively small drawdown effects, and high transmissivity values suggests that limited amounts of water for irrigation could be developed in the Pachui and Amlia areas using low lift centrifugal pumps. The spacing of wells near Amlia, however, would have to be carefully controlled.

Bichhuwa and Bichhuwa Jhala sites - On March 16, 1974 a multiple will aquifer test using three tubewells was conducted on the shallow aquifer near Bichhuwa. All three tubewells were screened in a fine to coarse sand with gravel from 49 to 59 feet. Tubewell 7/5 was pumped for 24 hours at 60 gpm with a total drawdown of 5.9 feet. During this period the water level declined 0.42 feet in tubewell 7/3, located 75 feet away, and 0.36 feet in tubewell 7/4 located 100 feet away. The recovery rates coincided with drawdowns to indicate very high transmissivity values ranging from 171,600 to 226, 300gpd/ft. The storage coefficient ranged from 2.28×10^{-5} to 8.85×10^{-4}. The Theis non-equilibrium and Cooper-jacobs modified formulas were used to compute the hydraulic characteristics.

The Theis single well recovery method was used to determine the transmissivity of the sand and gravel aquifer penetrated from 287 to 307 feet by tubewell 7/6 near Bichhuwa Jhala. Tubewell 7/6 was pumped for 24 hours at 59 gpm with a total drawdown of 5.6 feet. The plotted recovery data indicated a moderately high transmissivity value of 73,400 gpd/ft.

Patia site - The flowing artesian tubewell 7/7 near Patia indicated an average transmissivity value of 34,200 gpd/ft using the Theis recovery method. Tubewell 7/7, screened in fine sand and gravel from 197 to 217 feet, flowed at 136 gpm for 24 hours with a pressure decline of about 2.5 feet. After shut in the pressure head returned to the original head of 22. 6 feet above land surface.

Mahendranagar site - Tubewell 8/1, the Mahendranagar tubewell, was drilled near the Sarda River flood plain in the Bhabar zone. The tube well, screened in coarse sand with boulders and cobbles from 52 to 102 feet, was pumped for 24 hours at 246 gpm with atotal drawdown of 25.1 feet. The plotted data indicated an average transmissivity of 146,600 gpd/ft using the Theis recovery method.

The aquifer at this point isbelieved to be semi-artesian as the plotted recovery data indicated an increase in transmissivity from 43,300 to 249,800 gpd/ft after 12 minutes of pumping. Tubewells could be used for irrigation in this area with minimal well spacing.

Well Interference and Spacing

In areas of artesian pressure, especially where confined water is just beginning to be utilized, it is beneficial for the water economy to space tubewells to maintain optimum yields with minimum interference effects between wells. Failure to space wells properly results in premature decline of artesian pressure and loss of free flow in the tubewells. It is equally important in areas of non-flow to space wells so as to minimize the decline of water levels and concurrent increased pumping lifts. The hydraulic characteristics and other hydrological data obtained from the aquifer tests indicate a wide range in the water yielding capacity of the aquifers of the Seti and Mahakali Tarai. Using data obtained from the aquifer tests it is possible to estimate approximately how long a well will flow or can be pumped at a given rate and also what the interference effects will be with respect to nearby tubewells in the same area.

Relatively small effects were noticed in tubewells tested in the eastern part of Seti Terai near the Karnali River; in the western part of Mahakali Terai near the Sarda River; and in the Bhabar zone near the mountain front where the artesian aquifers have high transmissivities. Near Joshipur, where tubewell 2/2 indicated a transmissivity of 93,000 gpd/ft, a single well pumped at 500 gpm would cause a decline in artesian head, or the potentiometric surface, of 14.7 feet at a distance of 10 feet from the tubewell after 1,000 days of continuous pumping. After pumping for 10,000 days at the same rate, the total decline in head would be 16.5 feet (fig.3). If the discharge rate were increased to 1,000 gpm, however, the decline in head at a distance of 10 feet from the tubewell would be 29.5 feet after 1,000 days of continuous pumping.

Single producing tubewells are not the rule, however, in any given area. More commonly tubewells are clustered in groups of two or more so that the head in any one tubewell is the sum of its own drawdown plus interference effects of other producing tubewells nearby. Graphs (fig.4) have been constructed using a method (Lang, 1961) that modifies the Theis non-equilibrium formula. This method

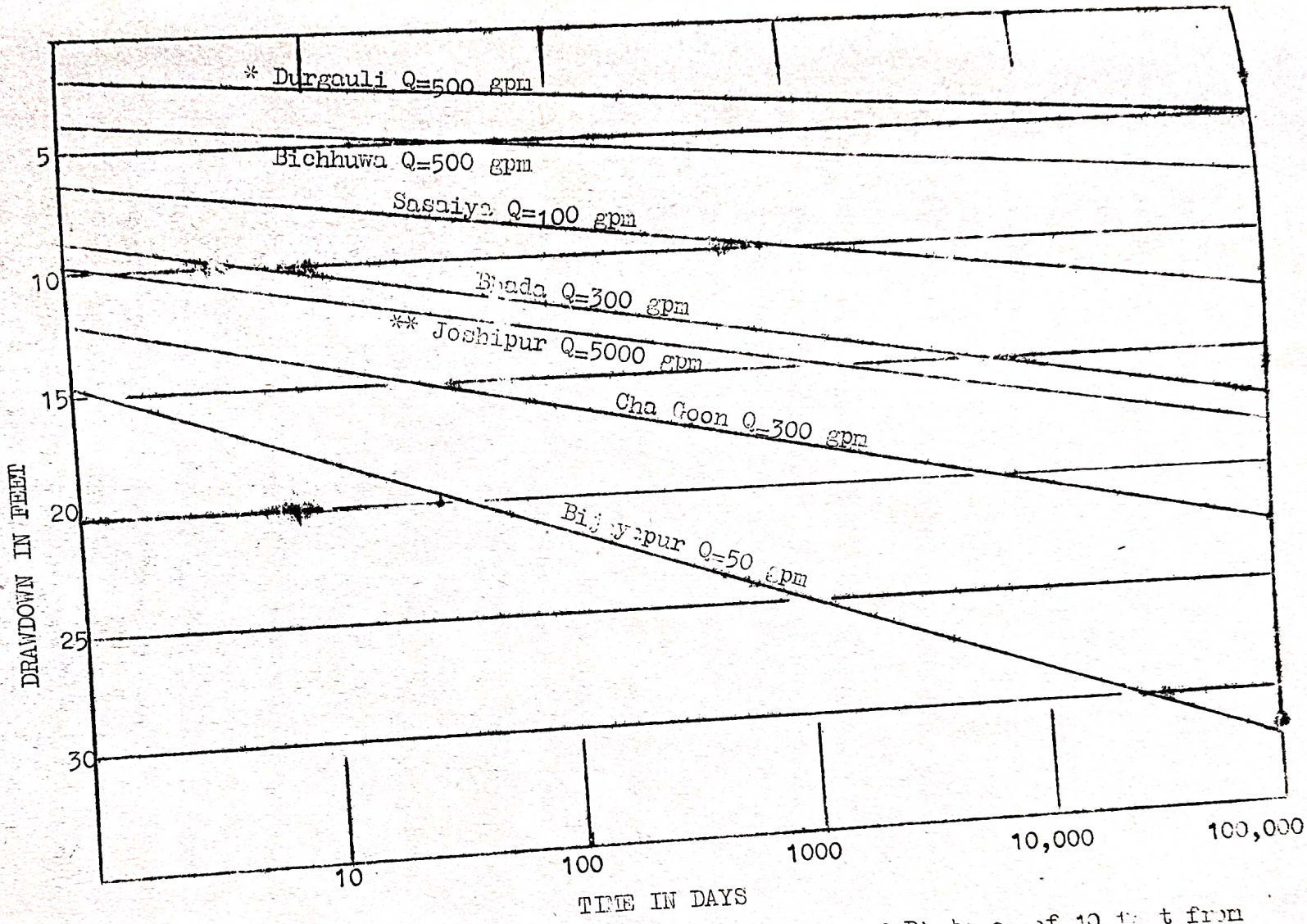

Figure 3 Graph showing Predicted Decline in Head of Distance of 10 feet from Tubewell at Various Discharge Rates

* Specitic yield of 0.20. assumed ** Average Coefficient of storage assumed

helps resolve problems related to the proper spacing of two tubewells of the same construction and yield that tap a common aquifer. Thus two tubewells near Joshipur each pumping at 500 gpm would have a combined pressure decline of 21.5 feet if spaced 1,000 feet apart or 18.8 feet if located 10,000 feet from each other when pumping continuously for 100 days. Likewise, if the discharge of the wells were 100 gpm the combined pressure decline in each tubewell would be only 4.3 feet if spaced 1,000 feet apart when pumping continuously for 100 days. As shown above the total decline in head resulting from prolonged discharge will be the sum total of the interference figures of all wells within the area of influence of each well. The pressure decline can be minimized by optimum spacing of wells and the judicious use of water. In other areas where the transmissivity values are between 50,000 and 100,000 gpd/ft such as Bhajani (2/1) Semri (2/3), Phulverria (4/1), Amaraiya (6/3), Dekhatbhuli (6/5), Pachui (7/1), and Bichhuwa Jhala (7/6) the declines in pessure head would be similar to those near Joshipur.

Aquifer tests conducted on the flowing artesian tubewells 4/3 and 4/4 at Bhada; the shallower tubewells 2/4 and 2/5 at Semri; and tubewells 5/1 and 5/2 at the Dhangarhi water tower indicated moderatel high transmissivities of about 50,000 gpd/ft. The estimated decline in head that would result 10 feet from tubewell 4/3 near Bhada, yielding a constant 300 gpm would be 13.8 1 feet after 1,000 days (fig.3.) . The predicted interference between two indentical wells in this area pumping at 300 gpm continuously for 100 days would be 23.51 feet if spaced 1,000 feet apart. If the discharge of the wells was reduced to 100 gpm the combined pressure decline would be 7.8 feet. The predicted decline in head and interference between wells computed from the aquifer tests of the shallow pumped tubewells near Semri and Dhangarhi were similar to Bhada and so were not plotted on the graphs of figures 3 and 4.

Aquifer tests conducted in tubewells 6/1 and 6/2, at Cha Goan, and in tubewells 5/5 and 5/6, at Geta, indicated transmissivity values in the average to moderately high range of about 38,000 gpd/ ft. The estimated decline in head that would result 10 feet from tubewell 6/1, near Cha Goan, yielding a constant 300 gpm, would be

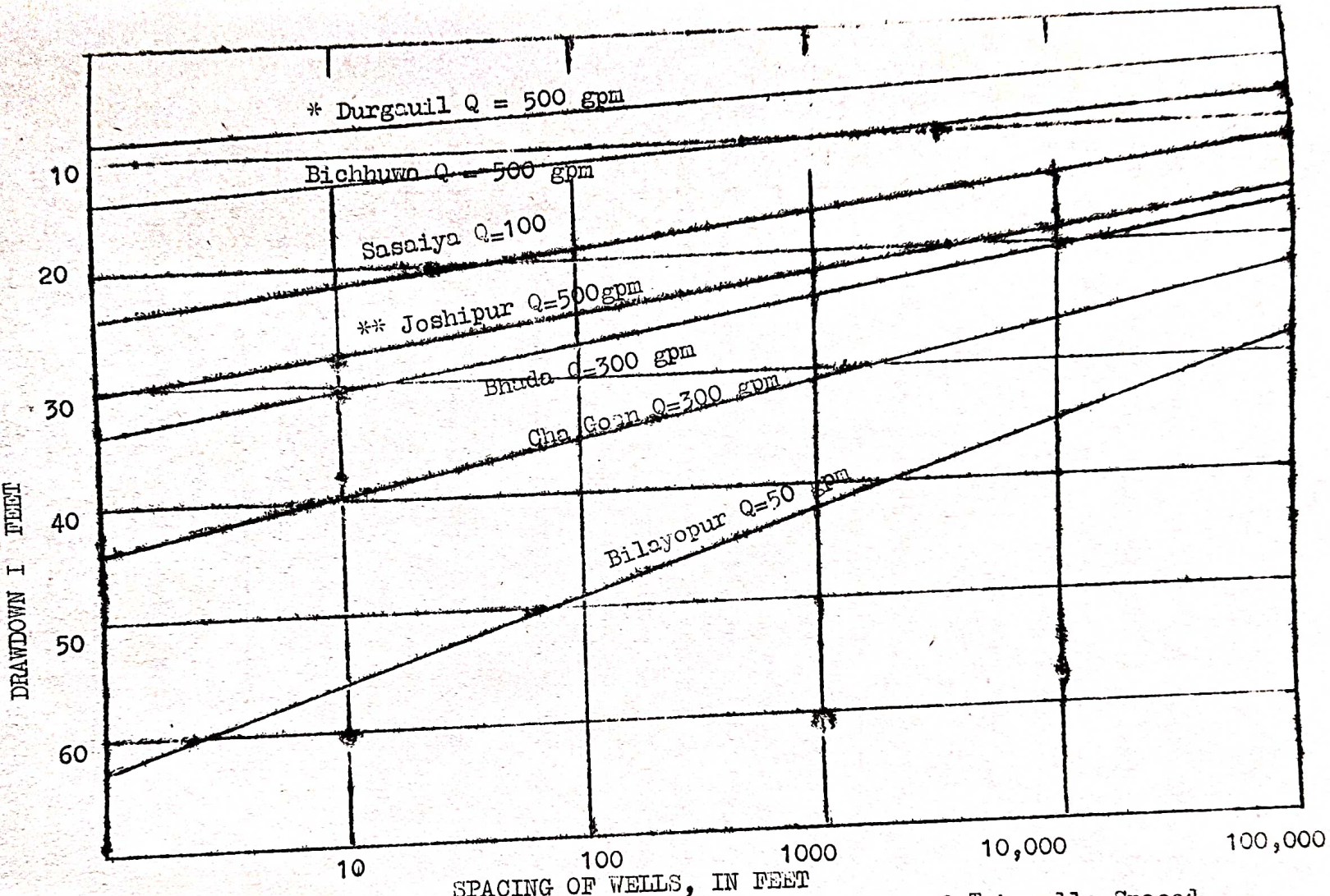

Figure 4 Graph showing Predicted Intrference between 2 Tubewells Spaced at Varing Distances after 100 days continuous Discharge.

Specific yield of 0.20 assumed

** Average Coefficient of storage used

would 18.8 feet during the same period. The predicted interference between two identical wells in each of these two areas yielding 300 gpm continously for 100 days would be about 30.8 feet at Cha Goan and 31.8 feet at Geta, if each were spaced 1,000 feet apart. The increase in predicted decline in head and well interference between the tests at Bhada and Cha Goan illustrates that the distance of spacing between wells should increase as the transmissivity of the water-bearing formations decreases. Similar conditions could be encountered in aquifers near Ganeshpur (3/8), Gadriya (4/2), Dhangarhi (5/4), Autaria (5/8), Amlia (7/2), and Patia (7/7).

The aquifer test conducted on the shallow tubewells 3/6 and 3/7 at Sasaiya, indicated an average to low transmissivity value of about 22,000 gpd/ft. The estimated decline in head that would result 10 feet from tubewell 3/6 yielding a constant 100 gpm would be about 10.1 feet after 1,000 days. The predicted interference between two identical wells in this area yielding 100 gpm continuously for 100 days would be about 16.4 feet if spaced 1,000 feet apart.

The aquifer test conducted on tubewell 3/3 near Bijayapur indicated an exceptionally low transmissivity value of 3,800 gpd/ft. The estimated decline in head that would result 10 feet from a tubewell near Bijayapur yielding a constant 50 gpm would be about 25.1 feet after 1, 000 days. The predicted interference between two identical wells yielding 50 gpm continuously for 100 days at a distance of 1,000 feet would be about 41.9 feet. It is evident from these figure that the yield of wells and the interference effects are high in this area. These conditions limit the potential of the area for extensive irrigation. Similar conditions could be encountered in aquifers near Katanipur (3/2) and Basanta (3/1).

The multiple will aquifer test donducted on the shallow water bearing zone at Bichhuwa indicated a high transmissivity of about 200,000 gpd/ft$\frac{1}{2}$ Although the aquifer is relatively shallow it is confined and has a static water level of about 6 feet below land surface. A single tubewell pumped at the rate of 500 gpm would cause

an estimated decline in head of about 6 feet at a distance of 10 feet from the tubewell after 1,000 days. The predicted interference between two identical wells yielding 500 gpm continuously for 100 days would be about 10.1 feet if spaced 1,000 feet apart. Surface observations suggest that this shallow aquifer may be part of an old river channel and thus may of limited extent at least in a lateral direction.

Tubewell 1/1 , at Durgauli, drilled in the Bhabar zone near the Karnali River flood plain, indicated a high transmissivity value of about 233,000 gpd/ft. Using an assumed specific yield of 0.20, which is an approximate average value for unconfined coarse gravel, future water level decline and well interference figures can be predicted as previously done with multiple well aquifer tests. A single well, near Durgauli, discharging at a rate of 500 gpmwould have a water level decline of about 3.7 feet at a distance of 10 feet from the well after 1,000 days of continuous pumping. If the discharge rate were increased to 1,000 gpm the decline in water level would be 7.4 feet after 1,000 days continuous pumping. Two tubewells, near Durgauli each pumping at 500 gpm would have a combined decline in head of 6.0 feet if spaced 1,000 feet apart or 5.2 feet if located 10,000 feet from each other when pumping continuously for 100 days. Likewise, if the discharge of the wells were increased to 1,000 gpm the combind decline in head in each tubewell would be 12.0 feet if spaced 1,000 feet apart. Predicted declines in water level and attendant interference between wells are minimal in this area of flood plain or Bhabar zone deposits and should present few or no problems with well spacing. In other areas where the transmissivity values are more than 100,000 gpd/ft such as at tubewell 8/1, at Mahendranagar, near the flood plain of the Sarda River, and Teghari (5/9), in the Bhabar zone near the mountain front the decline in water levels would be similar to those described bear Durgauli.

Owing to lack of information at this writing all previously predicted declines in water levels and pressure heads are based upon conditions at a specific time and have not taken into consideration annual recharge to the aquifers. During the high rainfall of the monsoon, the recharge is undoubtedly of considerable magnitude. Future monitoring of water levels and water use shoud provide information on the amount of recharge that may occur to the aquifers systems of the Seti and Mahakali Terai.

Chemical Qualityoff Water

The chemical quality of water from the artesian and semi-artesian aquifers of the Seti and Mahakali Tarai is generally good and is suitable, with a few exceptions, for domestic supply, livestock, and irrigation. Analyses of water from 35 tubewells (table 5) show that all the water is potable and that most of the ion concentrations are below the maximum limits suggested by the U.S. Public Health Service (1961) for drinking water. The water from the aquifers in Seti and Mahakali Terai is moderately hard, generally ranging from 100 to 350 parts per million (PPm) total hardness as $CaCO_3$.

The water from the aquifers of the Seti and Mahakali Terai is suitable in chemical quality for irri ation on many types of soild. Most of the water analyses, when plotted on the classification diagram (fig.5) described in Lumbini report, indicate a low to very low sodium hazard and a medium salinity hazard. The effects of the salinity hazard may be overcome by leaching of cultivated soils by excess irrigation or haturally with rainfall. The artesian water is predominantly a bicarbonate type with varying proportions of calcium magnesium and sodium ions The bicarbonate ion concentration is fof the most part relatively high, ranging generally from Semri (2/4) and Mahendranagar (8/1) exceed the suggested "residual sodium carbonate" (HCO_3 hazard) limits of 2.5 me/liter. However, good management practices often make it possible to use marginal waters for irrigation

Areas of Ground Water Potential for Utilization

The following discussions amplify the information presented in figure 6.

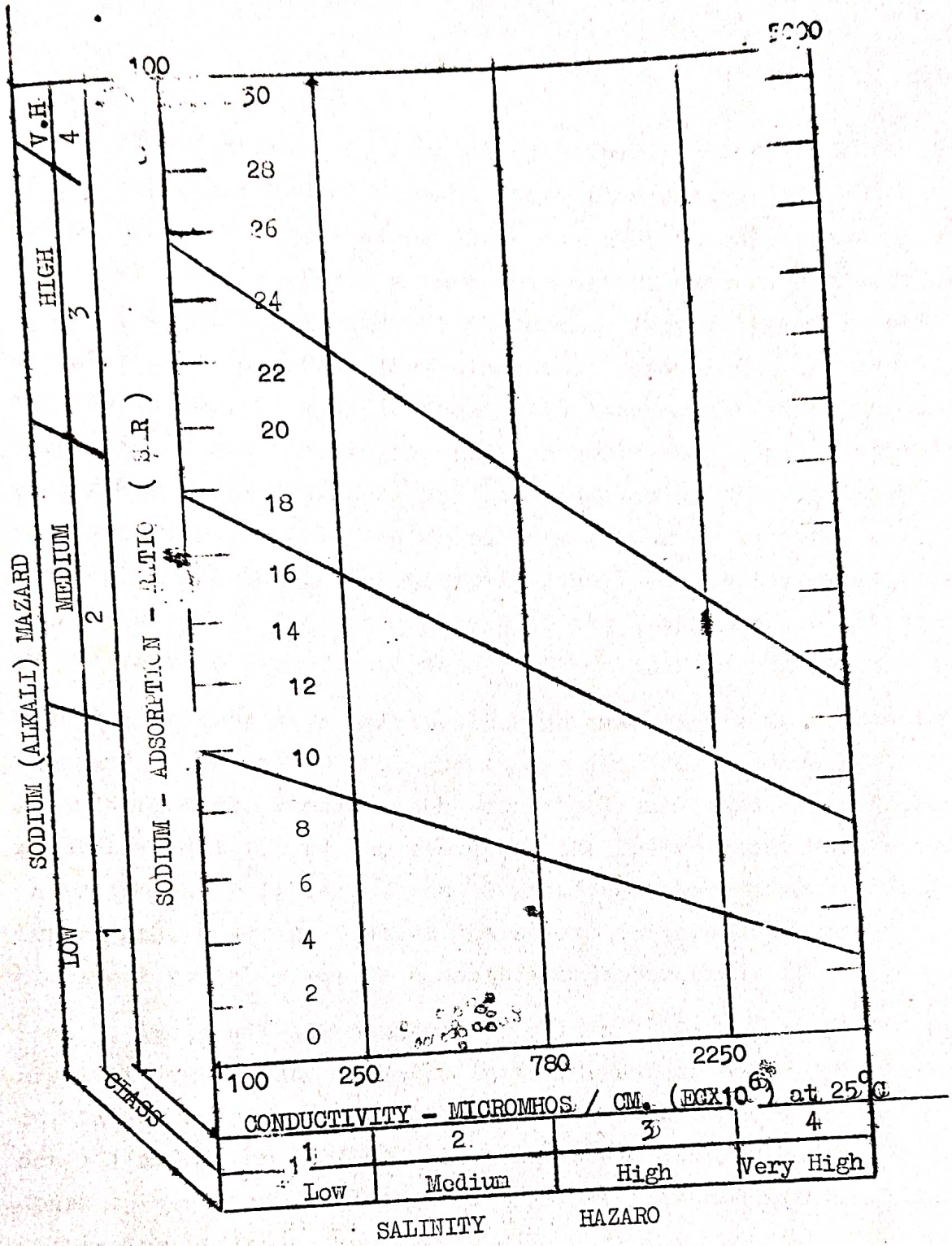

Figure 5. Diagram showing classification of waters from Tubewells in Seti and Mahakali Zones, Western Tarai, with Respect to Suitability for Irrigation.

Zone 1. The Bhabar zone, located principally along the flood plains of the major antecedent streams where they emerge from the mountains and to a lesser extent along the consequent streams where they leave the Siwalik Hills, forms a piedmont belt of extremely coarse deposits of boulder and cobble gravel. The coarse deposits contain water table or subartesian aquifers that have high transmissivities ranging from 100,000 to 300,000 gpd/ft. These high transmissivities indicate that large yields can be obtained from properly constructed tubewells with relatively small drawdown. Spacing of wells drilled in these areas are not as critical, as in the Bheri Tarai, because interference effects between tubewells will be minimal. Zone I conditions exist near the Karnali River in the eastern part of the area, near the Sarda River in the Western sector, and to a limited extent along the mountain front.

Zone 2. Aquifers with relatively high transmissivity values in the range of 50,000 to 100,000 gpd/ft are included in zone 2. This zone extends from the Bhabar zones near the Karnali and Sarda Rivers and mountain front toward the center of the report area. Well spacing near the outer limits of zone 2 would be maters of increasing importance, however, towards the lower limits. The artesian aquifers of zone 2 probably extend beneath the Bhabar zone.

Zone 3. Areas with transmissivity values of 25,000 to 50,000 gpd/ft are included in zone 3. Wells in this zone can be used for irrigation, although interference between wells will be more pronounced than zones 1 and 2. Production wells should, therefore, be spaced further apart to minimize cumulative drawdown effects and attendant increase of pumping lifts.

Zone 4. Aquifers with transmissivity values of less than 25,000 gpd/ft constitute zone 4. Production wells in this zone would have relatively low specific capacities, but could be used for small scale or supplemental irrigation. The yields of wells, moreover, with aquifer transmissivities of 15,000 to 25,000 gpd/ft could be increased by screening multiple aquifers. Wells with transmissivity values of less than 10,000 gpd/ft should be limited generally to domestic and public supply and in specialized industrial use where the high unit cost for pumping could be economically justified.

General Conclusions and Recommendations

Conclusions:

1. The areas where tubewells can be successfully developed for irrigation are not uniformly distributed in the Sotl and Mahakali Terai. Generally the Bhabar zone and the flood plain areas of the Karnali and Sarda Rivers are best suited to large scale ground water exploitation.

2. Although the Bhabar zone has the best potential for ground water development, the water levels are generally below land surface and pumping will be required to lift water for irrigation.

3. There is an extensive zone of flow well artesian water in the central part of the report area extending from east of Basaiya (3/5) to west of Patia (7/9) and covering an area of about 80 kms long and 15-18 kms wide. The positive artesian pressure encountered in test holes recently (1974) drilled ranges from near land surface to more than 60 feet above land surface with a positive head of about 30 feet as a general average. The lower yields of wells and more pronounded well interference in this area would be at least partially offset initially by the absence of pumping cost.

4. Aquifers, other than those of the Bhabar zone and flood plains, occur in relatively thin layers of sand and gravel interstratified with clay layers of variable thickness which dip generally to the south throughout the report area.

5. The area of poorest potential for ground water development is located in the southeast part of the report area along traverse 3 from Basanta (3/1) through Bijayapur (3/3).

6. The chemical quality of water for both flowing and non-flowing aquifers in the report area is generally good and suitable, with few exceptions, for domestic supply, livestock, industry, and irrigation. The bicarbonate ion concentration is for the most part relatively high as in other sections of the Terai.

Recommendations:

1. The observation well program established by the Ground Water Project in the Seti and Mahakali Tarai should be continued. Data obtained from this monitoring program will become increasingly important as the ground water resource is developed and utilized. Whereas aquifer test data provide a basis for planning a production well program, long term observations of withdrawals, water levels and pressure head are essential for proper management of the ground water resource. This is particularly true relative to achieving the optimum utilization of the resource and balancing natural and artificial discharge with recharge to the aquifer systems.

2. Generally, most tubewells drilled for irrigation use should be located in zones 1,2, and 3 of the Seti and Mahakali Terai (fig .6) Spacing of tubewells should be planned to minimize interference between wells.

3. All tubewells constructed in the flow-well artesian area should be properly cemented, and the yield and flow regulated by control valves. Yields from flowing wells should be limited to the amount of water actually required for the crop. After the irrigation requirement is satisfied, valves on the wells should be closed and remain closed until the next irrigation requirement. Conservation of pressure head and the ground water resource by preventing needless waste of water will ential government supervision and enforcement.

4. Generally, new production wells should be preceeded by a pilot "Slim hole" to verify geohydrologic conditions at a new site. This same slim hole can subsequently be reamed to the planned diameter of the production well.

5. A number of wells resulting from the Ground Water Project investigations in the Seti and Mahakali Tarai have yields sufficient for irrigation. These have been turned over for use to the HMG Department of Irrigation and Hydrology, To establish practical

guidelines of the economics of irrigation from tubewells in the Seti and Mahakali Terai, it is suggested that several small pilot irrigation projects be established at several typical sites.

6. Yields from tubewells drilled in the less productive aquifers of zone 4 as well as in better aquifers of zones 2 and 3 can be increased by screening several aquifers. Caution needs to be exercised, however, in screening several artesian aquifers in the same well where considerable head differential exists between aquifers. In such cases, the yield may decrease at least until the head differentials equalize and may be less than initial yield even after equalization.

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Explanation to Accompany Tables 3, 4 and 5

1. Numbers are assigned to a series of north-south trending traverses beginning near the Karnali River at the eastern boundary of the area and progressing westward at 16 km. intervals. Test holes are numbered in sequence in each traverse from the Indian border northward. Example: Traverse 3, borehole 2 is numbered 3/2.

2. Name of village near which corresponding test hole is located.

3. Approximate elevations, in feet above mean sea level, have been transferred from the Benchmark at Gauri Phanta Railway Station using transit or theodolite. Figures are to the nearest foot.

4. Depth of test hole, in feet below land surface.

5. Day, month, and year testhole was completed.

6. API line pipe (mild steel tubing) was used to case most of the tubewells and extends from tubewell head near land surface to the top of screen.

7. a. The screen set in most boreholes is perforated pipe.

   b. Depth, in feet below land surface, to top and bottom of perforated pipe or well screen.

   c. Type of material screened, (s) sand, (g) gravel; (f,m.c) fine, medium, coarse.

8. Pressure head at time well was drilled, in feet above (+) or below (-) land surface datum.

9. Yield, in U.S. gallons per minute (gpm) by natural flow (f), by airlift (a), or pump (p) measured after initial development.

10. Drawdown, decline in head or potentiometric surface, in feet, resulting from pumping or natural flow.

11. Specific capacity, ratio of gallons per minute of yield per foot of decline in head resulting from pumping or natural flow of a well.

12. Other Information

A: Abandoned hole, casing pulled and hole plugged.
T: Flow or pumping test carried out at tubewell.
F: Foxboro pressure recorder installed
S: Stevens water stage recorder installed
G: Geologic log in table 6
E: Electric log in files
C: Chemical analysis in table 5

13. Remarks.

Table 3-Records of Selected Testholes in Seti & Mahakali Zones, Western Terai Area, Nepal

Test Hole No.	Location	Approximate Elevation (Ft. above M.S.L)	Total Depth (ft)	Date Completed	Screen Information: dia-meter inches	Screen Information: Setting: fitbelow L.S.	Screen Information: Materials Screened	Instial Head (ft) +LSD	Instial Yield (gpm)	Draw down Ft	Specific Capacity (Gal/ft)	Other Information	Remarks
1/1	Durgauli	545	86	11.5.74	4	50-80	g,w/pebbles & cobbles	-11.05	57(p)	3.08	18.5	T,G,C	Drilled by percussion method. Well located on Karnali River flood plain.
2/1	Bhajani	494	606	29.4.74	4	239-258	s,f,w/g	-11.7	56(p)	4.06	13.9	T,G,E,C	Silt stone in aquifer may be inter bedded.
2/2	Joshipur	521	175	14.5.74	4	137-156	g,w/cobbles & pebbles	-13.24	59(p)	4.43	13.3	T,G,E,C	Good yield from shallow deeps.
2/3	Semri	529	512	12.5.74	4	220-240	g,m,c,w/ cobbles & pebbles	- 6.52	57(p)	5.52	10.3	T,G,E,E	
2/4	,,	529	85	18.5.74	6	59-69	g,m,w/cobbles & Peb	10.0	57(p)	1.15	49.5	T,G,C	Producing well for aquifer test. good yield from shallow depth.
2/5	,,	529	85	19.5.74	4	59-69	g,m,w/cob. and peb.	-9.96				T,G	Yield not determined. OBS. Well for aquifer test.
2/6	,,	529	180	21.5.74	4	132-142	g,s,w/s	-7.85	57(p)	7.65	7.5	T,G,C	
3/1	Basanta	522	1500	29.5.74	4	155-175	s,f,-m	+17.11	57(p)	11.80	4.8	T,G,C	Depth stratigraphic test.
3/2	Katanipur	531	651	8.4.74	4	130-150	s,c,w/clay	-4.22	55(p)	21.08	2.6	T,G,E,C	Poor yield.
3/3	Bijapur	552	378	17.4.74	4	307-317 275-285	g,w/s,f-c	-6.0	57(p)	24.22	2.3	T,G,E,C	Producing well for aquifer test.
3/4	,,	552	327	21.4.74	4	275-285 307-317	g,w/s,f-c	-6.0				T,G	Yield not determined. Obs. Well for aquifer test.
3/5	Sisaiya	547	1158	19.4.74	4	575-595	g,m-c	+44.20	63(f)	36.0	1.75	T,G,E,C	Continuous warapped commercial screen installed. Well +ve head with relavivelly low yield.
3/6	,,	547	72	26.4.74	4	53-68	s,f	+19.0				T,G	Yield not determined. Obs. Well for aquifer test.
3/7	,,	547	80	27.4.74	8	56-76	g,f,w/s	+19.29	54(p)	4.26	12.7	T,G,C	Producing well for aquifer test.
3/8	Ganashpur	546	401	21.4.74	4	263-279	g,w/s	+61.61	162(f)	43.93	5.68	T,G,E,C	Highest +ve. head incountered during investigation.

Location	Approximate Elevation (Ft.above M.S.L)	Total Depth (ft)	Date Completed	Screen Information: dia-meter inches	Setting: ft.below L.S	Materials Screened	Insitial Head (ft) ±L.S.D	Yield (gpm)	Draw down Ft	Specific Capacity (Gal/ft)	Other Information	Remarks.
Phulwariya	541	1000	19/3/74	4	255-280	g,c-mw/g	-9.62	57(p)	3.26	17.5	T,G,E,C	
Kadriya	545	428	24/3/74	4	219-240	g,w/s,c	+13.60	74(f)	13.60	5.4	T,G,E,C	
Bhada	560	321	29/3/74	4	282-303	g,w/s	+51.0	54(f)			T,E,C	Producing well for aquifer test.
,,	560	310	2/4/74	4	284-305	g,w/s	+31.01	54(f)			T,G	Obs.well for aquifer test.
Dhabai	598	645	9/4/74	4	295-315	g,m	+58.56	50(f)	38.0	1.29	T,G,E,C	
Dhangarhi city well	590	220	25/8/73	8	118-185	s,m,w/g,p	- 9.82	250(p)	12.15	20.6	T,G,C	Municipal supply.proudicing well for aquifer test not drill by G.W.P
Dhangarhi Water tower	590	168	21/1/74	4	138-158	s,m,c,w/g	-9.0	150(a)			T,G,E	Obs. Well for aquifer test. utilisi ng 5/1 as proudicing well.
,,	590	417	13/6/74	6	357-376	g,w/s,f-m	+30.25	110(f)	17.14	6.42	T,G,E,C	Stand by municipal supply. yields 5
,,	590	500	10/6/74	6	302-325	g,f,w/s	+20.74	75(f)		3.2	T,G,C	Stand by municipal supply.
Boradadi (Army Comp)	593	413	28/5/74	4	297-307 377-397	g,w/s,c	+23.22	25(f)			T,G,E,C	First well drilled at the site on successful.
Geta	616	414	7/1/74	6	281-295	g,w/p	+33.86	227(f)	33.0	6.7	T,G,C	Proudicing well for aquifer test.
,,	616	1000	2/2/74	4	280-290	g,w/s,m-c	+33	100(f)			T,G,E	Obs. well for aquifer test.
Autairaja	640	436	25/1/74	4	382-400	g,f-m	+38.35	60(f)	10.33	5.8	T.G.E.C	Well used by HIG Road Departments
Taghariya	698	318	28/1/74	4	252-270	g,w/p	-5.30	59(p)	4.63	12.7	T,G,E,C	Well may be located in vabour zone
Cha Goan	563	455	14/2/74	4	273-304	g,w/s,m-c	-45.0	47(p)	6	7.8	T,G,E	Obs. well at Punarbas for aquifer te
,,	563	310	15/3/74	6	269-300	s,f-c,w/g	-44.9	329(p)	32.06	10.3	T,G,C	Proudicing well for aquifer test.
Amariya	548	517	7/2/74	4	150-160	g,w/s-	-12.41	55(p)	7.94	6.9	T,G,E,C	
Kaspa	558	1000	13/2/74	4	222-232	g,m,w/s,c	- 3.20	30(p)	102.8		T,G,E,C	Well likely improperly screened or poorly developed.
Dehatbuli	586	500	18/2/74	4	287-307	s,c,w/g,f	+33.05	200(f)	27.61	7.24	T,G,E,C	
Bundi	626	477	24/2/74	4	235-260	g,f,w/s	+27.54	7(f)			T,E,G,C	Well not properly developed.
Pachri(sal)	543	501	19/2/74	4	291- 311	g,silt Stone	-12.42	60(p)	4.35	13.9	T,G,E,C	

Test Hole No.	Location	Approximate Elevation Ft. above M.S.L	Total Depth (Ft.)	Date Completed	Screen Information: Diameter (Inches)	Screen Information: Setting (Ft. below S.L)	Screen Information: Material	Initial: Head Ft.	Initial: Yield gpm	Draw-down: Ft.	Specific Capacity: gal/ft.	Other Information	Remarks
7/2	Amlia	557	420	1/3/74	4	274-295	g	-7.62	62(p)	5.27	11.8	T,G,E,C	
7/3	Bichhuwa	570	65	8/4/74	4	48-59	s,f-m,w/g	-6.0				T	Yield not determind. Obs. well for aqui test.
7/4	,,	570	65	9/4/74	4	48-58	s,f-m,w/g	-6.0				T	,, ,,, ,, ,,
7/5	,,	570	65	10/4/74	6	49-59	s,f-m,w/g	-6.16	60(p)	5.88	10.2	T,G,E,C	Producing well for aquifer test. Good yield from shallow depth.
7/6	Bichhuwa Jhala	573	1000	7/5/74	4	287-307	g,m-c,w/s,f	-2.72	59(p)	5.58	10.6	T,G,E,C	
7/7	Partia	585	236	24/2/74	4	197-217	g,w/s,f	+22.58	136(f)	22.0	6.02	T,G,E,C	Well yield abundant black sand.
7/8	Sudha	644	131	27/3/74	4	119-129	g,w/p	+2.0	1(f): 33(p)	85	0.39	T,G	Drilled partly by precussion method. Well not properly constructed.
8/1	Mahendranagar		113	6/73	6	52-105	s,c,w/b	-8.15	246(p)	25.1	9.8	T,C,C	Not drilled by G.W.P.

Table No. 4 - Summary of Aquifer Tests, Seti and Mahakali Zones, Western Terai Nepal.

Well No:	Location	Screened Internal:	Date of test	Duration (hrs)	Yield (gpm)	SWL(Head) in feet ± LSD	Draw down (feet)	Specific Capacity (gal/ft)	Transmissivity (gal/day/ft) Theis Non-equilibrium: Cooper & Jacob	Theis Recovery:	Coofficient of Storage: Theis Non-equilibrium: Cooper & Bacoob	Remarks
1/1(p)	Durgauli	50-80	21.5.74	24	57	-11.05	5.08	18.5		232,890		
2/1(p)	Bhajani	239-238	14.5.74	24	56	-11.74	4.06	13.8		64,280		Change in slope after 20 min.initial T-13,400 .
2/2(p)	Joshipur	137-156	18.5.74	24	59	-13.24	4.43	13.3		92,910		
2/3(p)	Semri	220-240	25.5.74	24	57	- 6.52	5.52	10.3		108,040		
2/5(o)	,,	59-69	27.5.74									
2/4(o)	,,	59-69	27.5.74	24	57	-9.96	8.15	7.0	45,480	46,580	42,990 5.34×10^{-4}	5.48×10^{-4}
2/6(p)	,,	132-142	30.5.74	24	57	-7.85	7.65	7.5			100,320	
5/1(p)	Basanta	155-175	4.6.74	24	57	-17.11	11.80	4.8			11,900	
3/2(p)	Katanipur	130-150	23.4.74	24	55	- 4.22	21.08	2.6			9,320	
3/4(o)	Bijayapur	275-285	8.5.74	24		- 6.0						
3/3(p)	,,	307-317 275-285 307-317	8.5.74	24	57	- 6.0	25.22	2.3	5,730	3,960	2,430 2.75×10^{-4}	5.25×10^{-4} Chaing shope after 40 min.
3/5(f)	Sisaya	575-595	30.4.74	24	63	+44.20	36.04	1.75			2,380	
3/6(o)	,,	53-68	5.5.74	24		-19.0						
3/7(p)	,,	56-76	5.5.74	24	54	-19.29	4.26	12.7	21,920	21,650	44,730 1.34×10^{-3}	3.74×10^{-4}
3/8(f)	Gaineshpur	263-279	25.4.74	24	163	+61.61	43.93	3.68			45,020	
4/1(p)	Phulvarria	255-280	11.4.74	24	57	-9.62	3.26	17.5			66,470	
4/2(f)	Gadriya	219-240	14.4.74	24	74	+13.16	15.6	5.44			32,560	
4/4(o)	Bhada	284-305	16.4.74	24		+51.01						
4/3(f)	,,	282-305	16.4.74	24	54	+51.01			45,390	51,180	7.36×10^{-4}	2.93×10^{-4}
4/3(r)	Dhavai	295-315	19.4.74	24	50	+58.56	38.56	1.29			32,200	
5/2(o)	Dhangarhi W.T	138-158	2. 2.74	24		- 9.0						
5/1(p)	,, C.W	118-185	2.274	24	250	-9.52	12.15	20.6	45,840	42,760	48,960 8.19×10^{-4}	1.04×10^{-3}

5/3(f): Dhan[illegible]arhi W.T	357-376: 4.2.74	24	110	+33.25	17.14	6.42					
5/4(f): "	302-323: 18.6.74	24	75	+20.74	14.30	5.2					
5/5[illegible]: [illegible]oradandiA.C:	257-288: 6.15.74: 277-285	24	25	+25.22							
6/7(o): Geta	280-290: 9.2.74	24	100	+33.0							
5/6(f): "	281-295: 9.2.74	24	227	+33.86	33.86	6.70	38,500	36,590	1.33x10^{-4}	1.25x10^{-4}	Change in slope after 1.10 min.
	"										
5/8(f): Autaria	382-400: 13.2.74	24	60	+38.35	10.33	5.8		29,890			
5/9(p): Teghari	250-270: 18.2.74	24	59	- 5.30	4.65	12.7		165,990			
6/1(o): Cha Goan	273-304: 31.3.74	24	47	-45.0	6.0	7.8					
6/2(p): "	269-300: 31.3.74	24	329	-44.90	32.05	10.5	34,280	38,950	40,770	1.98x10^{-4}	1.65x10^{-4}
6/5(p): Anaraiya	150-160: 24.2.74	24	55	-12.41	7.94	6.9			69,990		An anamoly after 120 min. possible recharge boundary about 1225 feet from Obs.well. Test unreliable.
6/4(p): Kaspa	222-232: 28/2/74	24	30	-3.20	102.8				6,350		
6/5(f): Dekhatbhuli	287-307: 4.3.74	24	200	+33.05	27.61	7.24			94,290		
6/6(f): Bandi	235-260 6.3.74	24	7	+27.54					18,740		
7/1(p): Pachui(cal.)	291-311: 10.3.74	24	60	-12.42	4.35	13.9			197,980		
7/2(p): Amlia	274-295: 13.3.74	24	62	-7.62	5.27	11.8			28,220		
7/3(o): Bichuwa	48-58 :16.3.74	24									
7/4(o): "	48-59 16.3.74	24									
7/5(p): "	49-59 :16.3.74	24	60	-6.16	5.88	10.2	171,590	226.290	185,150	8.85x10^{-4}	2.28x10^{-5}
7/6(p): " Jhala	287-307 19.3.74	24	59	-2.72	5.58	10.6			73,390		
7/7(f): Patia	197-217: 25.3.74	24	136	+22.58	22.58	6.02			34,190		
8/1(p): Mahendranagar	52-106: 7.4.74	24	246	-8.15	25.1	9.8			146,550		

Table -5 Chemical Analysis, in Parts Per Million, of Selected Wells in Seti and Mahakali Zones, Western Terai, Nepal.

Well No	Location	Date Collected	Depth to top of aquifer (feet)	Material Screened	Iron (Fe)	Cal. (ca)	(Mg)	(Na+K)	HCO_3	SO_4	Cl	CO_3	Total Dissolved Solids	$CaCO_3$	Alkalinity	Specific Conductance (micromhos at 25°C)	PH	SAR	HCO_3 Hazard (meg/leter)	Remarks.
1/1	Durgauli	21.5.74	50	g,w/peb. & cob.	0.0	81	2	45	340	10	15	0	298	210	279	533	7.5	0.78	1.37	
2/1	Bhanjani	14.5.74	239	s,f,w/g	0.01	36	24	75	364	43	6	0	286	190	298	533	8.0	1.14	2.20	
2/2	Joshipur	18.5.74	137	g,w/cob. & peb.	0.04	69	1	62	386	29	10	0	244	178	267	436	7.7	0.63	1.82	
2/3	Semri	25.5.74	220	g,m-c,w/cob.& peb	0.0	64	26	53	410	37	8	0	308	270	336	600	7.5	0.41	1.39	
2/4	,,	27.5.74	59	g,m,w/cob & peb.	0.0	101	24	37	454	43	8	0	500	350	372	738	7.8	4.42	4.97	
2/6	,,	30.5.74	132	g,f,w/s	0.01	88	14	58	446	27	9	0	336	280	366	600	7.5	0.28	1.77	
3/1	Basanta	4.6.74	155	s,f-m	0.01	42	15	93	394	32	8	0	196	166	323	505	7.5	1.33	3.13	
3/2	Katanipur	23.4.74	130	s,c,w/clay	0.02	44	6	74	314	24	10	0	240	136	257	400	7.8	1.13	2.46	
3/3	Bijaypur	8.5.74	275	g,w/s,f-c	0.0	59	0	76	334	20	13	0	248	148	274	480	7.7	1.53	2.53	
3/5	Sisaiya	30.4.74	575	s,m-c	0.01	57	2	79	340	24	9	0	254	150	284	457	7.5	1.29	2.57	
3/7	,,	5.5.74	56	g,f,w/s	0.0	44	20	39	298	18	9	0	270	190	244	384	7.9	-	1.03	
3/8	Ganeshpur	25.4.74	263	g,w/s	0.04	48	13	28	248	21	9	0	210	176	203	343	7.9	-	0.59	
4/1	Phulverria	11.4.74	255	g,c-m,w/	0.02	59	18	102	432	70	10	0	334	220	354	565	7.8	0.83	2.66	
4/2	Gadriya	14/4/74	219	g,w/s,c	0.22	56	10	60	366	5	4	0	250	180	300	544	7.2	1.36	2.39	
4/3	Bhada	16.4.74	282	g,w/s	0.0	70	1	82	356	44	12	0	258	178	292	457	7.8	0.75	2.27	
4/5	Dhabai	19.4.74	295	g,m	0.02	62	7	53	302	38	9	0	244	184	248	436	7.8	0.52	1.29	
5/1	Dhangarhi City Well	2.2.74	118	s,m,w/g & peb.	0.01	57	7	55	324	18	5	0	248	172	266	469	7.4	0.97	1.89	
5/5	Dhangarhi W.Tower.	4.2.74	357	g,w/s,f-m	0.04	60	10	41	334	0	4	0	228	190	274	492	7.4	0.80	1.66	
5/4	,,	18.6.74	302	g,f,w/s	0.04	59	3	37	286	0	5	0	232	160	234	544	7.3	1.78	1.50	

5/5 Bord[illegible]ali (M.Comp)	13.6.74	257	s,m-f,w/g	0.02	41	16	40	264	24	10	0	182	170	216	384	7.7	0.36	0.96
5/[illegible]	9.2.74	281	g,w/peb.	0.0	44	1	64	242	43	8	0	342	166	198	331	7.7	0.96	1.69
5/8: Autaria	13.2.74	382	g,f-m	0.0	21	10	38	158	32	9	0	106	94	129	196	8.2	0.09	0.72
5/9: Teghari	18.2.74	250	g,w/peb. & cob.	0.0	45	16	24	240	20	9	0	186	178	197	345	7.6	-	0.36
6/2 Cha Goan	31.3.74	269	s,f-c,w/g	0.04	30	23	44	288	12	14	0	252	172	236	369	8.2	0.23	1.35
6/3: Amaraiya	24.2.74	150	g,w/s	0.01	42	17	46	316	8	5	0	216	176	259	417	7.9	0.51	1.68
6/4: Kaspa	28.2.74	222	g,m,w/s,c	0.02	89	4	58	418	11	8	0	320	240	343	600	7.7	0.80	2.08
6/5: Dekhatbhuli	4.3.74	287	s,c,w/g,f	0.0	32	14	17	200	5	6	0	116	140	164	282	8.1	0.06	0.53
6/6: Bandi	6.3.74	235	g,f,w/s	0.01	24	14	16	168	9	4	0	124	118	138	240	8.3	0.05	0.40
7/1: Pachui(Cal.)	10.3.74	291	g,silts-tone.	0.01	54	19	54	366	24	5	0	304	216	300	565	7.8	0.96	1.75
7/2 Amlia	13.3.74	274	g	0.0	31	24	26	270	9	5	0	190	182	221	384	8.2	-	0.06
7/5: Bichhuwa	16.3.74	49	s,f-m,w/g	0.06	53	5	46	292	0	9	0	232	152	239	449	7.5	1.17	1.74
7/6: ,, Jhala	19.3.74	287	g,m-c,w/s,c	0.0	76	36	9	416	8	4	0	320	336	341	505	7.5	-	0.07
7/7: Patia	25.3.74	197	g,w/s,f	0.0	46	26	28	312	20	5	0	220	224	256	457	8.1	0.09	0.67
7/8: Sudha	5.4.74	119	g,w/peb	0.04	90	27	36	466	24	5	0	394	336	382	689	7.4	0.10	0.95
8/1: Mahendranagar City Well	7.4.74	52	s,c,w/ boulders	0.0	113	1	100	568	25	9	0	482	288	466	738	7.3	0.98	3.59

* (SAR) Sodium Adsorption Ratio computed using an estimated value for the Sodium ion (Na) concentration.

** Symbols explained in Table 3.

Table 6 well logs

Test hol: No. 1/1
Location: Durgauli
Drilled by: Hydrology Department
Altitude of Land Surface: 545 feet
Static Water level (Head): -11 ft. ISD

Drilling Started 7/5/74
Completed 11/5/74
Log By: N.B. Gurung

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil	4	4
Boulders	16	20
Sand W/Pebbles & cobbles	7	27
Sand, coarse	2	29
Pebbles & cobbles	4	33
Sand, medium	7	40
Pebbles & cobbles W/sand	20	60
Sand W/pebbles & cobbles	21	81
Boulders	5	86

Well Completion Data:

Casing: 4 in to 84 ft
Screened Zone : 50 to 80 ft/4 in
Yield: 57 gpm (Pumped)
Drawdown: 3.1 ft.

Table 6 Well Logs

Test Hole No.: 2/1 — Drilling Started 26/4/74

Location: Bhajani — Completed 29/4/74

Drilled by: Hydrology Department — Log By: N.B. Gurung

Altitude of Land Surface: 494 feet

Static Water Level (Head): - 11.7 feet ISD

Lithologic Description	Thickness (feet)	Depth (feet)
Soil	6	6
Clay, sandy W/siltstone	19	25
Clay, yellow W/Siltstone	14	39
Sand, medium	12	51
Sand, coarse W/gravel	9	60
Gravel, coarse	14	74
Clay black	16	90
Sand	36	126
Gravel, coarse	2	128
Sand, fine	11	139
Clay, grey	4	143
Sand, fine w/siltstone	23	166
Clay, yellow	36	202
Clay, yellow, sandy	15	217
Sand and gravel w/siltstone	15	232
Clay, black	3	235
Sand, fine w/siltstone gravel	11	246
Gravel, coarse	7	253
Clay, yellow	68	321
Clay, yellow, sandy	30	351
Clay, yellow	15	366
Clay, yellow, sandy	135	501
Clay, yellow	30	531
Clay, yellow, sandy	15	546
Clay, yellow	60	606

Well Completion Data:

Casing: 6 in to 96 ft/4 in. to 263 ft.

Screened Zone: 239 to 258 ft/4 in.

Yield: 56 gpm (Pump)

Drawdown: 4.1 feet.

Table 6 well logs

Test Hole No. 2/2
Location: Joshibur
Drilled by: Hydrology Department
Altitude of Land Surface: 521 feet
Static Water level (Head) : 13 feet ISD

Drilling Started 10/5/74
Completed 14/5/74
Log by: B.D. Kharel & K.C.

Lithologic Description	Thickness (feet)	Depth (feet)
Surface soil, yellowish-grey	2	2
Clay, yellow, sticky	11	13
Clay, yellow, sandy	15	28
Sand, fine	7	35
Gravel w/cuttings of cob les and pebbles	30	65
Clay, black, sticky	10	75
Clay, with gravel	5	80
Clay, black	15	95
Clay, black, sticky	38	133
Gravel w/cuttings of cobbles and pebbles	17	150
Clay, yellowish-grey	2	152
Gravel w/cuttings of cobbles & pebbles	13	165
Clay	8	173

Well Completion Data:

Casing: 4 in to 160 ft.
Screened Zone 137 to 156 ft/4 in
Yield: 59 gpm (pump)
Drawdown: 4.4 feet.

Table 6 Well Logs

Test Hole No. 2/3
Location: Senri
Drilled by: N.B. Tubewells
Altitude of Land Surface: 529 feet
Static Water level (Head): -6.5 feet LSD

Drilling Started 1/5/74
Completed 12/5/74
Log by: D.C. Parajuli & B.D. Kharel.

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	2	2
Silt, yell w w/fine kankar	10	12
Clay, yellowish-grey, loose w/fine kankar	18	30
Clay, grey w/fine kankar	10	40
Gravel, fine w/sand & cuttings of cobbles, pebbles	10	50
Gravel, medium w/cuttings of cobbles, pebbles	10	60
Gravel, coarse w/sand & cuttings of cobbles, pebbles	28	88
Clay, yellow with some medium grained gravel	11	99
Clay, grey, plastic with medium size gravel	9	108
Clay, yellowish-grey, plastic w/fine gravel	20	128
Clay, Greyish-yellow w/fine gravel	12	140
Gravel, coarse w/cuttings of cobbles & pebbles	15	155
Gravel, medium to fine w/sand & cuttings of cobbles & pebbles	13	168
Silt, yellowish	2	170
Clay, greyish-yellow, loose	19	189
Silt, dark grey	13	202
Gravel, medium to coarse w/cuttings of cobbles & pebbles	73	275
Clay, yellow, loose	25	300
Clay, yellowish-grey, loose	10	310
Clay, yellow, loose	10	320
Clay, greyish-yellow	20	340
Silt yellow	10	350
Silt, grey	16	366
Silt, yellowish-grey	22	388
Silt, grey	10	398
Silt, greyish-yellow	12	410
Silt, yellow	11	421
Silt, dark grey w/quartizite pieces	8	429
Gravel, medium to fine w/cuttings of cobbles	6	435
Clay, yellow, loose	4	439
Gravel, medium t fine w/cuttings of cobbles & Pebbles	28	467

Table 6 Well Logs

Test Hole No. : 2/3 (cont.)

Lithologic Description	Thickness (feet)	Depth (feet)
Gravel, fine w/sand & cuttings of cobbles, pebbles.	9	476
Clay, yellow, loose w/fine gravel	14	490
Clay, grey w/medium size gravel	10	500
Gravel, fine to medium w/cuttings of cobbles & Pebbles.	12	512

Well Completion Data:

Casing : 6 in to 40 ft / 4 in to 246 ft.
Screened Zone : 220 to 240 ft/4 in
Yield : 57 gpm (Pump)
Drawdown : 5.5 feet.

Table 6 Well Logs

Test Hole No: 3/4

Location: Samal

Drilled by: N.B. Tubewells

Drilling Started 17/5/74

Completed 18/5/74

Log by: D.C. Parajuli & B.D. Shrestha

Altitude of Land Surface: 529 feet

Static Water level (Head) - 10 LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	3	3
Silt, yellow w/kankar	17	20
Clay, greyish-yellow w/kankar	10	30
Clay, grey w/kankar	13	43
Silt, greyish	15	58
Gravel, medium w/cuttings of cobbles & Pebbles	27	85

Well Completion Data:

Casing: 6 in to 74 ft.

Screened Zone: 59 to 69 ft/6 in

Yield: 57 gpm

Drawdown: 1,15 ft.

Table 6 Wells Logs

Test Hole No: 2/5
Location: Semri
Drilled bY: N.B. Tubewells

Drilling Started 18.5.74
Completed 19.5.74
Log by: D.C. Parajuli & B.D. Shrestha

Altitude of Land Surface : 529 ft.
Static Water level (Head) - 10. 0 feet LSD.

Lithologic Description	: Thickness : (feet)	Depth (feet)
Sub-soil yellow	3	3
Silt, yellow w/kankar	7	10
Clay, grey w/kankar	20	30
Clay, grey, sticky	19	49
Clay, grey, sticky w/kankar	9	58
Gravel, medium w/cuttings of cobbles Pebbles	27	85

Well Completion Data:

Casing: 4 in to 74 ft.
Screened Zone 59 to 69 ft/4 in .

Table 6 Well Logs

Test Hole No; 2/6
Location: Semri
Drilled by: N.B. Tubewells

Drilling Started 19.5.74
Completed 21.5.74
Log by: D.C. Parajuli & B.D. Shrestha.

Altitude of Land Surface: 529 feet.
Static Water level (Head): -7.9 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	3	3
Silt, yellow	7	10
Clay, grey w/sand and kankar	10	20
Clay, grey W/kankar	21	41
Clay, yellowish-grey W/Kankar	11	52
Clay, greyish-yellow w/kankar	5	57
Gravel, medium w/cuttings of cobbles & Bebbles	31	88
Clay, yellow, sticky	22	110
Clay, grey, sticky	13	123
Clay, grey w/kankar	4	127
Clay, greyish-yellow, sticky	2	129
Gravel, fine sub-rounded w/sand	26	155
Clay, grey, sticky	25	180

Well Completion Data:

Casing: 4 in to 146 ft.
Screened Zone: 132 to 142 ft/4 in
Yield: 57 gpm (pump)
Drawdown: 7.65 feet.

Table 6 well Logs

Test Hole No. 3/1
Location: Basanta
Drilled by: N.B. Tubewells

Drilling Started 23.5.74
Completed 29.5.74
Log. By: D. C. Parajuli & B.D. Shrestha

Altitude of Land Surface: 522 feet.
Static Water Level (Head) : -17.1 ft. LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, light yellow	2	2
Clay, dark yellow, loose w/kankar	12	14
Clay, dark yellow w/kankar	7	21
Sand, fine	10	31
Clay, dark grey w/kankar	9	40
Clay, yellowish-grey w/kankar	10	50
Clay,brownish-yellow, sticky w/kankar	10	60
Clay, light grey w/kankar	26	86
Clay, yellowish-grey w/kankar	19	105
Clay, dark-grey w/kankar	8	113
Sand, fine w/fine sub-founder pebbles	12	125
Clay, yellowish-grey loose w/kankar	10	135
Clay, greyish-yellow, loose w/kankar	13	148
Silt, light yellow w/kankar	12	160
Sand, fine to medium	35	195
Clay, greyish-yellow, loose	9	204
Clay, light grey w/kankar	7	211
Clay, yellow w/kankar	21	232
Clay, grey, sticky	8	249
Clay, grey, sticky and plastic	13	253
Clay, greysih-yellow, plastic	9	262
Silt, grey	4	266
Clay, greyish-yellow, sticky	9	275
Clay, grey w/kankar	22	297
Clay, grey, sticky w/kankar & medium subrounded SST.	14	311
Clay, yellowish-grey, sticky and plastic	10	321
Clay, grey, sticky	12	333
Clay, grey w/kankar	21	254
Clay, grey, sticky	14	368
Clay, grey w/kankar and subrounded to subangular SST particles	10	378
Clay, grey w/kankar and SST particles	23	401
Sand, coarse w/kankar and rounded SST gravel	21	422
Clay, grey w/kankar	10	432
Clay, grey w/sand	11	442

Clay, grey w/kankar	26	468
Silt, yellow w/kankar	15	483
Clay, yellowish-grey w/sand	12	495
Clay, greyish-yellow w/kankar & medium subrounded to subangular gravel.	10	505
Silt, grey w/kankar	6	511
Clay, grey	9	520
Silt, yellow w/kankar	21	541
Clay, yellow w/kankar	21	562
Silt, yellow w/kankar and some gravel	13	575
Silt, yellow w/medium subrounded SST Gravel	30	605
Silt, yellowish-grey w/medium subrounded SST gravel	10	615
Clay, yellow w/fine SST gravel	10	625
Clay, yellow w/fine subrounded SST gravel	10	635
Silt, yellowish-grey w/rounded to sub-rounded SST Gravel	5	640
Clay, light grey w/kankar & subrounded SST gravel	20	660
Silt, light brownish-yellow w/kankar	10	670
Silt, greyish-yellow w/kankar	20	690
Clay, grey, sticky	10	700
Clay, greyish-yellow loose	10	710
Clay, greyish-yellow, loose w/kankar	10	720
Clay, yellow	12	732
Silt yellow	18	750
Silt, yellowish-grey	10	760
Silt, yellowish-grey w/kankar & some SST gravel	30	790
Silt, greyish-yellow w/kankar and SST gravel	10	800
Clay, yellowish-grey w/fine sand	22	822
Clay, greyish-yellow w/SST gravel and kankar	10	832
Clay, grey w/SST gravel and kankar	18	850
Silt, yellow	10	860
Silt, yellow w/kankar and SST	10	870
Silt, greyish-yellow	20	890
Silt, yellowish-grey w/subrounded SST gravel	10	900
Silt, greyish-yellow	20	920
Clay, grey w/limonite nodules	15	935
Clay, grey, loose	25	960
Silt, yell w w/kankar	22	982
Clay, yellow W/subrounded SST gravel	18	1000
Silt, yellow	10	1010
Clay, greyish-yellow w/small subrounded SST and kankar	17	1027
Clay, grey w/fine subrounded SST and kankar	18	1045
Silt, yellowish-grey	10	1055
Clay, yellowish-grey w/subrounded SST	12	1067
Silt, grey w/SST gravel and kankar	13	1080
Clay, yellowish-grey, loose	7	1087
Clay, yellow w/kankar	20	1107
Clay, yellow w/kankar and some SST gravel	11	1118
Clay, grey, sticky	9	1127
Clay, grey, loose	20	1147

Table 6 Well Logs

Test hole No. 3/1 9Cont.)

Clay, grey, sandy	10	1157
Clay, grey, loose	12	1169
Silt, grey	10	1179
Clay, grey, loose	8	1187
Clay, yellow, sticky	8	1195
Clay, grey, sticky	25	1220
Clay, greyish-yellow, sticky	19	1239
Clay, greyish-yellow w/subrounded SST	10	1249
Clay, grey, sticky, plastic	20	1269
Clay, greyish-yellow, sticky	10	1279
Silt, greyish-yellow	11	1290
Clay, grey, sticky	10	1300
Clay, grey	21	1321
Silt, grey	6	1327
Clay, greyish-yellow, loose	10	1337
Clay, grey, sticky	10	1347
Silt, grey w/kankar	12	1359
Silt, grey	41	1400
Silt, yellowish-grey	30	1430
Clay, grey, loose	21	1451
Silt, greyish-yellow	19	1470
Clay, grey, sticky	10	1480
Silt, grey	20	1500

Well Completion Data:

Casing: 6 im to 106 ft/4 in to 182 ft.
Screened Zone 155 to 175 ft/4 in
Yield: 57 gpm
Drawdown: 11.8 feet.

Table 6 Well Logs

Test Hole No. 3/2 — Drilling Started 6.4.74
Location: Katanipur — Completed 8.4.74
Drilled by: Hydrology Department — Log by: B.N. Gurung
Altitude of Land Surface: 531 feet
Static Water level (Head) : - 4.2 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Top soil	5	5
Clay, grey, sticky	13	18
Clay, yellow, loose	6	24
Clay, yell w, sticky	8	32
Sand, fine	4	36
Clay, black w/siltstone	41	77
Clay, yellow w/siltstone	7	84
Gravel, siltstone	15	99
Clay, black w/siltstone	12	111
Sand, coarse w/siltstone gravel	15	126
Sand, coarse w/siltstone & yellow clay	15	141
Clay, grey w/siltstone gravel	15	156
Clay, loose, w/siltstone	15	171
Clay, grey, sticky	60	231
Siltstone w/clay	30	261
Clay, black, sticky	30	291
Clay, yellow, sticky w/siltstone	36	327
Clay, sandy, loose	20	347
Sand, fine	5	352
Clay, w/siltstone	9	361
Clay, loose w/siltstone	5	366
Clay, yellow, loose	47	413
Clay w/siltstone	28	441
Sand	15	456
Clay, yellow, loose	15	471
Clay, yellow w/siltstone	15	486
Clay, yellow	124	610
Clay, yellow w/siltstone	9	619
Clay sandy	3	622
Clay, yellow w/siltstone	29	651

Well Completion Data:

Casing :	6 in to 97 ft/4 in to 155 ft.
Screened Zone :	130 to 150 ft/ 4 in
Yield:	55 gpm)pump)
Drawdown:	21.1 feet.

Table 6 Wells Logs

Test Hole No. 3/3 — Drilling Started 15.4.74

Location : Bijayapur — Completed 17.4.74

Drilled by: Hydrology Department — Log by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface: 552 feet.

Static Water level (Head) -6.0 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Surface soil, yellowish-grey	2	2
Clay, grey, sticky	18	20
Sand, fine w/clay	20	40
Clay, grey, sticky w/siltstone	28	68
Gravel, mostly siltstone w/sand	12	80
Clay, grey w/alternate layers of siltstone & gravel	70	150
Gravel w/fine to coarse sand	12	162
Clay, grey, sticky	6	168
Sand, w/some gravel	9	177
Clay, yellowish-grey, sandy	8	185
Sand w/gravel & clay	40	225
Clay, grey, sticky	45	270
Gravel w/fine to coarse sand	17	287
Clay & gravel, alternate layers	18	305
Gravel w/fine to coarse sand	17	322
Clay w/some gravel	15	337
Gravel w/fine to medium sand	25	362
Clay, grey, loose	2	364
Gravel, sub-angular to sub-rounded	11	375
Clay, grey, sticky	3	378

Well Completion data:

Casing : 6 in to 98 ft/4 in to 324

Screened Zone: 275 to 285 & 307 to 317 ft/4 in

Yield: 57 gpm (pump)

Drawdown: 25.2 feet.

Table 6 Well Logs

Test Hole No. 3/4 — Drilling Started 18.4.74

Location: Bijayapur (Observation) — Completed 21.4.74

Drilled by: Hydrology Department — Log by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface: 522 feet

Static Water level (Head) . - 6.9 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Surface soil, yellowish-grey	3	3
Clay, grey, sticky	17	20
Sand, fine to medium	20	40
Clay, grey, sticky w/some siltstone	25	65
Gravel, mostly siltstone w/sand	15	80
Clay, Grey W/alternate layers of siltstone gravel	70	150
Gravel w/fine to coarse sand	10	160
Sand and gravel w/thin layers of clay	17	177
Clay, sandy, loose	8	185
Sand w/gravel & clay	40	225
Clay, grey, sticky	45	270
Gravel w/fine to coarse sand	17	287
Clay & gravel, alternate layers	18	305
Gravel, subangular w/fine sand	17	322
Clay, grey, sticky	15	327

Well Completion Data:

Casing 4 in to 323 ft.

Screened Zone: 275 to 285 ft & 307 to 317 ft/ 4 in.

Table 6 Well Logs

Test Hole No. 3/5
Location: Sisaiya
Drilled by. N,B. Tubewells

Drillin Started 14.4.74
Completed 19.4.74
Log by. D.C. Parajuli & B.D. Shrestha.

Altitude of Land Surface: 547 feet.
Static Water level (Head) 1 +44.2 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-Soil, yellow	3	3
Clay, dark grey, plastic	7	10
Clay, light grey	11	21
Clay, dark grey w/kankar	10	31
Clay, light grey w/kankar	18	49
Gravel, fine, sub-rounded-SST, qtz, kankar w/sand	21	70
Clay dark grey	10	80
Clay, dark grey w/kankar	30	110
Clay, greyish-yellow w/kankar & fine sub-rounded gravel	10	120
Clay, grey, sticky w/kankar	18	138
Clay, yellow, loose w/kankar	21	159
Clay, grey, sticky	30	189
Clay, greyish-yellow, loose	6	195
Clay, greyish-yellow	10	205
Clay, greyish-yellow, sticky	15	220
Clay. grey, sticky	10	230
Clay, yellowish-grey, loose	10	240
Clay, browish-yellow w/kankar	13	253
Clay, yellow, loose w/kankar	20	273
Clay, greyish-yellow, loose w/fine kankar	12	285
Clay, yellowish-grey, loose w/fine kankar	22	317
Clay, grey, loose w/fine kankar	10	327
Clay, grey, w/fine kankar	10	337
Clay, yellowish-grey w/fine kankar	13	350
Clay, yellow, loose	20	370
Silt, yellow w/fine kankar	11	381
Silt, yellowish-grey w/fine kankar	10	391
Silt, yellow w/fine kankar	21	412
Clay, yellow, sticky	14	426
Clay, grey, loose w/kankar	8	434
Clay, dark grey, sticky	18	452
Silt, yellow w/fine kankar and fine sub-rounded sand	25	477
Clay, grey, sticky	9	486
Sand, medium to coarse w/fine sub-rounded SST gravel	12	498
Sand, w/fine sub-rounded SST gravel and sticky grey clay	6	504

Table 6 Well Logs

Test Hole No. 3/5 (cont.)

Sand, medium to coarse w/fine sub-rounded SST gravel	13	517
Clay, grey, sticky	8	525
Clay, yellow, sticky	25	550
Clay, greyish-yellow, sticky	10	560
Clay, greyish-yellow, loose	10	570
Silt, greyish	14	584
Sand, medium to coarse w/fine sub-rounded SST gravel	20	604
Silt, yellowish	20	624
Clay, greyish-yellow, loose	24	648
Silt, greyish-yellow	22	670
Silt, greyish-yellow w/kankar & fine sub-rounded SST gravel	20	690
Clay, greyish-yellow, loose w/kankar	10	700
Clay, yellow, loose w/sand & fine sub-rounded SST gravel	13	713
Clay yellow	16	729
Clay, greyish-yellow, loose	20	749
Clay, grey, sticky	11	760
Clay, grey, loose	9	769
Clay, grey, sticky	26	795
Clay, yellowish-grey, loose	22	817
Clay, dark grey w/kankar and fine sub-rounded SST gravel	13	830
Clay, yellow, sticky w/kankar	10	840
Clay, greyish-yellow, loose	23	863
Clay, grey, loose	6	869
Silt, greyish-yellow	11	880
Clay, yellow, loose	11	891
Clay, dark grey, loose w/kankar	9	900
Clay, yellow, loose w/fine kankar	10	910
Clay, yellowish-grey, loose	20	930
Clay, yellow, loose	10	940
Clay, yellow, loose w/fine sub-rounded SST gravel	10	950
Clay, grey w/fine sub-rounded SST gravel	20	970
Clay, greyish-yellow	24	994
Clay, yellow, loose	20	1014
Clay, grey, loose	10	1024
Clay, yellowish-grey, loose	20	1044
Clay, yellowish-grey, loose w/sand	12	1056
Clay, grey, loose	30	1086
Clay, grey	10	1096
Clay, greyish-yellow , loose	9	1105
Clay, yellowish-grey, loose	10	1115
Clay, greyish-yellow	15	1130
Clay, yellow, loose	10	1140
Clay, greyish-yellow, loose	18	1158

Well Completion Data:

Casing : 6 in to 106 ft/4 in to 595 ft

Screened Zone: 575 to 595 ft/4 in Johnson Screen, 20 slot

Yield: 63 gpm (flowing)

Table 6 Well Logs

Test Hole o. 3/6
Location: Sisaiya
Drilled By: n.b. Tubewells

Drilling Started 26.4.74
Completed 26.4.74
Log By: D.C. Parajuli & B.D. Shresth..

Altitude of Land Surface: 547 feet
Static Water level (Head) -19 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	3	3
Clay, grey, plastic	10	13
Clay, yellowish-grey w/fine kankar	17	30
Silt, dark grey	10	40
Clay, yellowish-grey, loose	10	50
Sand, fine	20	70
Clay, grey, sticky	2	72

Well Completion Data:

Casing: 4 in to 71 ft.
Screened Zone: 53 to 68 ft/4 in.

Table 6 Wells Logs

Test Hole No. 3/7
Location: Sisaiya
Drilled by: N.B. Tubewells

Drilling Started 27.4.74
Completed ,,
Log by: D.C. Parajuli & B.D. Shrestha.

Altitude of Land Surface: 547 feet.
Static Water level (Head) - 19.2 feet LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	3	3
Clay, grey, loose	17	20
Clay, yellowish-grey, loose	13	33
Clay, grey, sticky	21	54
Gravel, fine, sub-rounded to rounded, SST kankar	24	78
Clay, grey, sticky	2	80

Well Completion Data:

Casing: 8 in to 76 ft.
Screened Zone: 56 to 76 ft 8 in
Yield: 54 gpm (pump)
Drawdown: 4.3 feet.

Table 6 Well Logs

Test Hole No. 3/8
Location: Ganeshpur
Drilled by: Hydrology Department
Altitude of Land Surface : 546 feet
Static Water Level (Head): +61 feet LSD

Drilling Started 18.4.74
Completed 21.4.74
Log by: B.N. Gurung

Lithologic Description	Thickness (feet)	Depth (feet)
Top soil	5	5
Clay, yellow, loose	6	11
Sand, fine	14	25
Sand, medium	3	28
Sand, soarse	7	35
Gravel, fine	3	38
Gravel, coarse	8	46
Gravel, coarse w/cobbles	6	52
Clay, black sticky	18	70
Clay, sandy	11	81
Clay, yellow	19	100
Gravel w/siltstone	14	114
Clay w/gravel	4	118
Gravel	5	123
Clay loose	18	141
Clay, yellow (few gravels)	45	186
Clay	15	201
Clay, yellow	15	216
Clay	47	263
Gravel w/sand	13	276
Clay, yellow	4	280
Gravel w/sand	10	290
Clay, yellow, sticky	71	361
Gravel w/siltstone	13	374
Clay, yellow, sticky	27	401

Well Completion Data:

Casing: 6 in to 100 ft/ 4 in to 284 ft
Screened zone: 263 to 279 ft 3/4 in
Yield: 162 gpm (flow)

Table 6 Well Logs

Test Hole No. 4/1 — Drilling Started 15.3.74

Location: Phulverria — Completed 19.3.74

Drilled by:- N.B. Tubewells — Log by: D. C. Parajuli & B.D. Shrestha.

Altitude of Land Surface: 541 feet

Static Water level (Head) -10 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, grey	5	5
Clay, yellow w/kankar	10	15
Gravel & pebbles, fine, SST, qtz. qtzi, subrounded w/fine tocoarsesand	27	42
Clay, yellow	8	50
Clay, grey, sticky w/kankar	30	80
Clay, yellowish-grey w/kankar	8	88
Clay, grey w/kankar	47	135
Clay, grey w/sand and kankar	30	165
Clay, yellowish-grey w/sand and kankar	34	199
Clay, yellow w/sand	12	211
Clay, yellowish-grey w/kankar	18	229
Clay, yellowish-grey, loose	20	249
Gravel & coarse to medium, subrounded qtz. SST, qtzi, kankar sand	35	284
Clay, yellowish-grey, sticky	12	296
Clay, yellowish-grey w/sand	17	313
Clay, yellow, loose	10	323
Clay, yellow w/kankar	33	356
Clay, grey w/sand and kankar	10	366
Clay, greyish-yellow, sticky	10	376
Clay, grey w/kankar	20	396
Clay, yellow, loose w/kankar	3	399
Clay, grey, loose w/kankar	12	411
Clay, grey w/kankar	6	417
Clay, grey w/sand and kankar	16	433
Clay, grey, loose w/sand	8	441
Clay, grey w/sand and kankar	18	459
Clay, grey w/pebbles and kankar	22	481
Clay, grey, loose w/kankar	18	499
Clay, grey, w/sand	18	517
Clay, grey w/fine kankar	20	537
Clay, grey w/sand	20	557
Clay, grey	11	568

Test Hole No. 4/1 (cont.)

Clay, grey w/sand	22	590
Clay, yellowish-grey	6	596
Clay, grey w/sand and kankar	16	612
Clay, grey w/sand and kankar	8	620
Clay, grey, loose w/sand and kankar	13	633
Clay, grey w/sand and kankar	31	664
Clay, grey, loose W/kankar and sand	42	706
Clay, grey w/sand and kankar	8	714
Clay, grey, loose	22	736
Clay, grey, loose w/sand	28	764
Clay, grey, loose w/kankar	51	815
Clay, grey, loose	30	845
Clay, grey w/sand and kankar	31	876
Clay, yellow, loose w/sand	20	896
Silt, grey	20	916
Clay, grey, sticky w/kankar	20	936
Clay, grey w/kankar	10	946
Clay, grey, loose	24	970
Clay, grey w/sand and kankar	14	984
Clay, grey	16	1000

Well Completion Data:

Casing	6 in to 99 ft/4 in to 285 ft
Screened Zone	255 to 280 ft/4 in
Yield:	57 gpm (pump)
Drawdown:	3.3 feet.

Table 6 Well Logs

Test Hole No. 4/2
Location: Gadriya
Drilled by: Hydrology Department

Drilling Started 21.3.74
Completed 24.3.74
Log by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface 543 feet
Static Water level (Head) +13.6 ft LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, yellow	2	2
Clay, yellow, loose	15	17
Sand, medium to fine	20	37
Sand, medium to coarse w/gravel	20	57
Clay, yellow w/siltstone	10	67
Clay, yellow, loose	28	95
Sand, fine to coarse w/siltstone	9	104
Clay, yellow, loose	3	107
Sand, fine to coarse w/siltstone	4	111
Clay, yellow, sticky	104	215
Clay, yellow, sticky	9	224
Gravel, subangular to subrounded w/coarse sand	20	244
Clay, yellow, sticky	14	258
Clay, yellow, sticky w/gravel in alternate layers	12	270
Clay, yellowish-grey	10	295
Clay, yellow, loose	10	305
Clay, yellow, sandy	20	325
Clay, yellow loose	30	355
Clay, yellow, sticky	73	428

Well Completion Data:

Casing: 6 in to 100 ft/4 in to 245 ft.
Screened Zone: 219 to 240 ft/4 in
Yield: 74 gpm (flow)

Table 6 Well Logs

Test Hole No. 4/3
Location: Bhada
Drilled by: Hydrology Department
Drilling Started 28.3.74
Completed 29.3.74
Log by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface: 560 feet

Static Water level (Head): +31 feet LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, grey	2	2
Clay, yellow	2	4
Clay, grey	6	10
Clay, yellow	6	16
Clay, yellowish-grey w/siltstone	19	35
Sand, fine to coarse	15	50
Clay, grey	15	65
Clay, w/gravel	15	80
Clay, yellow w/siltstone gravel	90	170
Clay, yellow	18	188
Gravel	2	190
Clay	15	205
Clay w/thin layers of gravel	13	218
Sand, medium w/gravel	25	243
Clay, sticky	9	252
Gravel, subangular to subrounded w/sand	53	305
Clay	5	310
Gravel	5	315
Clay	6	321

Well Completion Data:

Casing	6 in to 115 ft/4 in to 310 ft.
Screened Zone	282 to 303 ft/4 in
Yield:	54 gpm (flow)

Table 6 Well Logs

Test Hole No. 4/4 (Observation)
Location: Bhada
Drilled bY; Hydrology Department
Altitufe of Land Surface: 560 feet
Static Water level (Head): +31 feet LSD.

Drilling Started 30.3.74
Completed 2.4.74
Log by: B.D. Kharel & Kesab K.C.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, grey	2	2
Clay, yellow	2	4
Clay, grey	6	10
Clay, yellow	6	16
Clay, yellowish-grey w/siltstone	19	35
Sand, fine to coarse	15	50
Clay, grey	15	65
Clay, w/gravel	15	80
Clay, yellow w/siltstone gravel	90	170
Clay, yellow	18	188
Gravel	2	190
Clay	15	205
Clay, w/thin layer of gravel	13	218
Sand, medium w/gravel	25	243
Clay sticky	9	252
Gravel w/sand	53	305
Clay	5	310

Well Completion data:

Casing: 4 in to 310 ft.
Screened Zone: 284 to 305 ft/4 in.
Yield: 54 gpm (flow)

Table 6 Well Logs

Test Hole No. 4/5
Location: Dhabai
Drilled by: N.B.Tubewells

Drilling Started 7.4.74
Completed 9.4.74
Log by: D. C. Parajuli & B.D. Shrestha.

Altitude of Land Surface: 589 feet.
Static Water Level (head) +38 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellowish-grey	3	3
Clay, yellow, sticky	7	10
Clay, yellow, sticky w/kankar	10	20
Clay, yellow, sticky	23	43
Clay, yellow, sticky w/kankar	7	50
Gravel, medium, sub-rounded to sub-angular	7	57
Clay, greyish-yellow, sticky	13	70
Clay, grey, sticky	13	83
Clay, dard grey, sticky	29	112
Clay, light grey, sticky w/kankar	13	125
Clay, yellow, sticky	10	135
Clay, yellowish-grey w/kankar and gravel	45	180
Clay, yellow w/kankar & fine sand	31	211
Clay, yellow, loose w/medium sand	10	221
Clay, yellow, loose W/fine gravel	10	231
Clay, yellow w/medium sized gravel,(SST) Sub-angular	19	250
Gravel, medium to fine, sub-rounded to sub-angular	12	262
Clay, yellowish-grey, sticky	21	283
Gravel, medium, composed of SST w/grey clay	10	293
Gravel, medium, sub-rounded to sub-angular qtz. SST. qtzi.	27	320
Clay, yellow, sticky	35	355
Silt yellow	10	365
Clay, yellowish-grey, sticky	8	373
Clay, yellow, sticky	17	390
Clay, yellow, plastic w/some SST gravel	10	400
Clay, yellow, loose	10	410
Gravel, fine, rounded w/coarse sand	12	422
Clay, yellow, loose	10	432
Clay, light-brown w/sand	7	439
Clay, light yellow, sticky	5	444
Clay, light, brown, sticky	4	448
Clay, greyish-yellow w/sand	6	454
Clay, grey, sticky	11	465
Clay, yellow, loose	6	471
Silt, yellowish grey	28	499

Table 6 Well Logs

Test Hole No. 4/5 (cont.)

Silt, grey	18	517
Clay, yellow w/sand	8	525
Clay, yellow, sticky	17	542
Clay, yellowish-grey w/sand	10	552
Clay, yellow w/sand	10	562
Clay, yellow w/sand and SST Particles	9	571
Clay, yellowish-grey	20	591
Clay, yellow w/sand	12	622
Silt, yellowish-grey	19	610
Clay, yellow, loose	21	643

Well Completion Data:

Casing : 6 in to 100 ft /4 in to 320 ft.
Screened Zone: 295 to 315 ft/4 in
Yield: 50 gpm (flow)

Table 6 Well Logs

Test Hole No. 5/1 — Drilling Started

Location: Dhangarhi City Well — Completed 25.6.73

Drilled by: Indian Contractor — Log by: Driller's log

Altitude of Land Surface: 590 feet

Static Water level (Head) -9.5 feet LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil	4	4
Clay, sticky	10	14
Clay, black, sticky	24	38
Sand, med. to coarse w/small boulders	9	47
Boulders, large	11	58
Clay, black, hard	2	60
Clay, yellow, sticky	40	100
Clay, black	18	118
Sand, med. w/pebbles & kankar	32	150
Sand, med. w/pebble gravel & kankar	25	175
Clay, black	10	185
Sand, fine to medium	15	200
Sand, fine w/Sandy clay	20	220

Well Completion Data:

Casing: 14 in to 93 ft/8 in to 201 ft.

Screened Zone: 118 to 185 ft/ 8 in.

Yield: 250 gpm)pump)

Drawdown: 12.2. feet.

Table 6 Well Logs

Test Hole No. 5/2
Location: Dhangarhi (Water Tank)
Drilled by:- Hydrology Department

Drilling Started 19.1.74
Completed 20.1.74
Log. by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface: 590 feet
Static Water level (Head) -8 feet LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Surface soil, yellow	4	4
Clay, yellow	8	12
Sand, medium to coarse	13	25
Clay, black, sticky	13	38
Sand, fine to medium	4	42
Gravel, subangular to subrounded w/coarse sand	14	56
Clay, greyish-yellow, sticky	29	85
Clay, yellow, sticky	25	110
Clay, black, sticky	7	117
Sand, grey, medium to coarse w/some gravel (may be in thin layer)	5	122
Sand, grey, medium to V. coarse w/gravel	35	157
Gravel, subangular to subrounded, w/medium to very coarse sand	11	168

Well Completion Data:

Casing: 4 in to 169 ft.
Screened Zone: 138 to 158 ft.
Yield: 150 gpm (airlift)

Table 6 well Logs

Test Hole No. 5/3

Location: Dhangarhi (Water Tank)

Drilled by: Hydrology Department

Altitude of Land Surface: 590 feet

Static Water level (Head) +33 ft. LSD

Drilling Started 7.6.74

Completed 13.6.74

Log. by B.D. Kharel & Kesab K.C.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, yellowish-grey	4	4
Clay, yellow, loose	8	12
Sand, fine to coarse	13	25
Clay, black, sticky	14	39
Sand, medium to coarse w/gravel	20	59
Clay, greyish-yellow	21	80
Clay, yellow w/siltstone gravel	20	100
Clay, black, sticky	17	117
Gravel, subangular to subrounded, qtz, sandstone etc.	52	169
Clay, greyish-yellow, sticky	24	193
Gravel, subangular w/siltstone & coarse sand	5	198
Clay, yellowish-grey, loose w/some gravel	21	219
Clay, black, loose w/gravel	21	240
Clay, black, sticky	25	265
Gravel w/siltstone and sandy clay	18	283
Clay, yellow, loose w/some siltstone	9	292
Clay, grey, sticky	18	310
Clay, grey, sticky w/siltstone	30	340
Clay, yellowish-grey, sticky	10	350
Gravel, subangular to subrounded w/siltstone & fine to medium sand	25	375

Table 6 Well logs

Test Hole No. 5/3 (cont.)

Clay, grey, sticky w/siltstone	12	387
Clay, yellowish-grey, sandy w/siltstone gravel (may be thin layer of gravel)	21	408
Clay, yellow, loose	9	417

Well completion Data:

Casing: 10 in to 175 ft/6 in from 159 to 417 ft.

Screened Zone: 357 to 376 ft/6 in

Yield: 110 gpm (flow)

Table 6 Well Logs

Test Hole No. 5/4
Location: Dhangarhi Water Tower
Drilled by: N.B.Tubewells

Drilling Started 6.5.74
Completed 6.7.74
Log by: D.C. Parajuli & B.D. Shrestha.

Altitude of Land Surface. 590 feet
Static Water Level (Head) +20.74 feet LSD

Lithologic Description	Thickness (feet)	Depth (feet)
Sub-soil, yellow	4	4
Clay, yellow	11	15
Clay, grey, sticky w/kankar	5	20
Clay, grey w/fine gravel and kankar	10	30
Clay, dark grey, sticky	10	40
Gravel, medium to coarse, sub-rounded to subangular SST, qtz w/kankar & sand	17	57
Clay, yellow w/very fine pebbles	8	65
Clay, grey w/sand	7	72
Clay, light yellow, sticky w/medium grained gravel	10	82
Silt , yellow	8	90
Clay, yellow w/kankar	10	100
Clay, yellow w/kankar and SST Gravel	10	110
Clay, yellowish-grey w/kankar and SST	8	118
Gravel, fine to coarse, sub-rounded to subangular w/kankar	42	160
Clay, gray	8	168
Silt, grey	10	178
Silt, yellow	5	183
Clay, yellow, sticky	17	200
Clay, yellow, sticky w/SST	10	210
Clay, yellow, sticky	10	220
Silt, yellow	10	230
Silt, grey w/fine gravel	5	235
Clay, grey w/fine gravel	25	260

Table 6 Well logs

Test Hole No. 5/4 (cont.)

Sand, fine to coarse w/some gravel	16	276
Clay, yellow, sticky	25	301
Gravel, fine, sub-rounded to rounded w/kankar and sand	25	326
Clay, greyish-yellow, sticky w/some gravel	20	346
Clay, greyish-yellow w/gravel	16	362
Clay, grey w/sand	20	382
Clay, greyish-yellow, loose	10	392
Clay, grey w/some SST and kankar	12	404
Clay, yellowish-grey w/kankar and SST	14	418
Clay, yellowish-grey, loose	17	435
Silt, yellow	11	446
Clay, grey	22	468
Clay, grey, sticky	4	472
Sand, fine	20	492
Clay, grey, sticky	8	500

Well Completion Data:

Casing: 12 in to 111 ft/8 in to 323 ft.
Screened Zone: 302-323 ft/8 in (johnson Screen)
Yield: 75 gpm (flow)

Table 6 Well Logs

Test Hole No. 5/5
Location: Boradandi (Army Camp)
Drilled by: Hydrology Department

Drilling Started 28/5/74
Completed 30/5/74
Log by: B.D. Kharel & Kesab K.C.

Altitude of Land Surface: 593 feet
Static Water Level (Head) : +23 feet LSD

Lithologic Description	Thickness (Feet)	Depth (Feet)
Soil, surface, grey	3	3
Clay, yellow	6	9
Sand, fine to medium	36	45
Gravel, subangular t subrounded	14	59
Clay, greyish-yellow, loose	21	80
Clay, grey, sticky	23	103
Sand, fine	3	106
Clay, grey, sticky	10	116
Gravel, w/sand	8	124
Clay, grey, sticky	4	128
Gravel, and sand w/clay layer	36	164
Clay, grey, loose	34	198
Sand, fine to medium w/gravel	18	216
Clay, grey, silty, loose	10	226
Gravel w/sand	7	233
Clay, grey, loose	24	257
Gravel w/sand	13	270
Clay, yellowish-grey, sticky	7	277
Gravel w/sand	6	289
Clay, yellow	6	295
Clay, yellowish-grey	4	299
Gravel and sand	8	307
Clay, yellow, sandy	34	341
Gravel, coarse w/sand	17	358
Clay, yellow, sandy	18	376
Gravel w/coarse sand	24	400
Clay, grey, sticky	13	413

Well Completion Data:

Casing	6 in to 11 ft/4 in to 401 ft.
Screened Zone	297-307 and 377-397 feet /4 in
Yield	25 gpm (flow)

Table 6 Well Logs

Test Hole No. : 5/6
Location : Geta
Drilled by: Hydrology Department
Altitude of Land Surface: 616 feet
Static Water level (Head) : +33 ft LSD .

Drilling Started: 6.1.74
Completed: 7.1.74
Log by: B.N. Gurung

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, grey	3	3
Clay, yellow, sticky	6	9
Sand & siltstone gravel	6	15
Sand, grey, fine	24	34
Clay, black, sticky	3	37
Sand, coarse	7	44
Gravel, subrounded to subangular w/some cobbles	20	64
Clay, grey, sticky	10	74
Clay, black, sticky	10	84
Clay, grey, sticky	10	94
Clay, black, sticky	32	126
Clay, grey, sticky	54	180
Clay, yellow, sticky	30	210
Clay, grey, sticky	26	236
Gravel and pebbles	9	245
Clay, grey, sticky	29	274
Clay, yellow, sticky	6	280
Gravel and pebble cuttings	16	296
Clay, yellow sticky	39	335
Clay, grey, sticky	15	350
Clay, yellow sticky	15	365
Clay, grey, sticky	7	372
Gravel w/pebble & cobble cuttings	19	391
Clay, yellow, sticky	23	414

Well Completion Data:

Casing: 302 ft/6 in
Screened Zone: 281-295 ft/6 in
Yield: 227 gpm (flow)

Table 6 Well Logs

Test Hole No. 5/7
Location : Geta
Drilled by: N.B. Tubewells

Drilling Started 27/1/74
Completed 2/2/74
Log by:
D.C. Parajuli & B.D. Shrestha

Altitude of Land Surface : 616 feet
Static Water Level (Head) : + 33 ft LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, yellowish-grey	2	2
Sand, fine	13	15
Clay, grey, sticky	5	20
Clay, grey, sticky	10	30
Gravel, medium	34	64
Clay, yellowish-grey	7	71
Clay, grey, sticky	9	80
Clay, yellow, sticky	10	90
Clay, grey, sticky	43	133
Clay, yellow, sticky	13	146
Clay, yellow, sticky w/medium gravel	24	170
Clay, yellowish-grey, sticky w/sand	24	194
Clay, sandy w/sandstone particle	14	208
Clay, sticky w/sandstone particle	8	212
Clay, w/medium grained gravel	9	221
Clay, yellowish-grey w/gravel	9	230
Gravel, subangular to subrounded qtzi, SST qtz	12	242
Clay, yellow, sandy	10	252
Clay, greyish-yellow, sticky	11	263
Clay, greyish-yellow w/fine gravel	15	278
Gravel w/coarse to medium sand, qtzi, SST, qtz.	12	290
Silt, yellow	10	300
Clay, yellow, sandy	10	310
Clay, greyish-yellow, sticky	10	320
Clay, yellow, sticky	49	369
Clay, greyish-yellow, sandy	9	378
Sand, fine to coarse	5	383
Sand, coarse w/fine gravel, qtzi, SST, qtz.	11	394
Sand, w/sandy clay	32	426
Clay, sticky w/fine sand	4	430
Clay, yellow, sticky	12	442
Clay, yellow, sandy	22	464
Clay, greyish-yellow, sticky	5	469
Sand, coarse	21	490
Clay, greyish-yellow w/kankar	15	505
Clay, greyish-yellow, sandy	22	527
Clay, grey	17	544

Table 6 Well Logs

Test Hole No. 5/7 (cont.)

Clay, grey w/coarse sand	19	563
Clay, grey, sandy	17	580
Sand, fine	10	590
Clay, yellow w/kankar	11	601
Clay, greyish-yellow w/kankar	12	613
Clay, greyish-yellow	17	630
Clay, grey, loose	5	635
Clay, greyish-yellow	22	657
Clay, grey	31	688
Clay, grey, sticky	20	708
Clay, yellowish-grey , sandy	12	720
Clay, greyish-yellow, loose w/SST.	10	730
Clay, yellow, sandy	20	750
Clay, yellow, loose	10	760
Clay, greyish-yellow, sandy	20	780
Clay, greyish-yellow w/SST	16	796
Clay, greyish-yellow w/kankar	7	803
Clay, grey, loose w/sand	13	816
Clay w/kankar	15	831
Clay, grey w/kankar	16	847
Clay, grey, sandy	22	869
Clay, grey	33	902
Clay, greyish-yellow, sandy	48	950
Clay, yellow, sticky	10	960
Clay, grey	10	970
Clay, grey, sandy	10	980
Clay, grey	20	100 0

Well Completion Data:

Casing :	4 in to 295 ft
Screened Zone:	280 to 290 ft/4 in
Yield:	100 gpm (flow)

Table 6 Well Logs

Test Hole No. 5/8

Location: Autaria

Drilled by: Hydrology Department

Altitude of Land Surface: 640 feet

Static Water Level (Head) : + 38 ft LSD.

Drilling Started: 21.1.74

Completed 25.1.74

Log by: B.N. Gurung

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, grey	3	3
Clay, yellow, sticky	10	13
Clay, black, sticky	17	30
Clay, yellow, sticky	11	41
Gravel, medium to fine	10	51
Clay, grey, sticky	13	64
Clay, yellow, sticky	120	184
Clay, yellow, loose	30	214
Clay, yellow, sticky	15	229
Clay, yellow w/siltstone	25	254
Gravel, fine to medium	9	263
Clay, yellow, sticky	10	273
Gravel, medium to fine	11	284
Clay, yellow, sticky	98	382
Gravel, medium to fine	17	399
Clay, yellow, sticky	37	436

Well Completion Data:

Casing : 6 in to 100 ft/4 in from 100 to 304 ft.

Screened Zone: 382 to 400 ft/4 in

Yield: 60gpm (flow)

Table 6 Well Logs

Test Hole No. 5/9
Location: Teghari
Drilled by: Hydrology Department
Altitude of Land Surface: 690 feet.
Static Water Level (Head) : -5.3 ft. LSD.

Drilling Started 22.1.74
Completed 28.1.74
Log. by: B. D. Kharel & Kesab K.C.

Lithologic Description	Thickness (feet)	Depth (feet)
Surface soil, yellow	2	2
Sand, fine to medium	9	11
Clay, yellow, loose, sandy	5	16
Gravel, subangular w/cutting of cobbles & pebbles	16	32
Clay, yellow, sticky	33	65
Sand, medium to coarse w/some gravel, subangular to subrounded.	15	80
Clay, yellow, sticky	25	105
Clay, yellow, sticky w/gravel (thin layer of gravel 120-121)	16	121
Clay, yellow, sticky	11	132
Gravel, subangular to subrounded w/coarse sand (a Thin layer of sand 132' - 133')	25	157
Gravel, subangular to subrounded w/medium to coarse sand.	48	205
Clay, yellow, loose	6	211
Gravel, subangular to subrounded w/sand	12	223
Clay, yellow, sticky	8	231
Sand, coarse w/gravel, subrounded to subangular	10	241
Clay and gravel, alternate layers	6	247
Gravel, subangular t subrounded w/cuttings of pebbles & cobbles	23	270
Clay, yellow, sticky	6	276
Gravel, subangular to subrounded	7	283
Clay, yellow, sticky	35	318

Well Completion Data:

Casing :	4 in to 279 ft.
Screened Zone:	250 to 270 ft/4 in
Yield:	65 gpm (airlift)
	59 gpm (pump)
Drawdown:	4.5 feet.

Table 6 Well Logs

Test Hole No. : 6 .
Location: Cha Goan (Punarbas)
Drilled by: Hydrology Department
Altitude of Land Surface: 563 feet.
Static Water Level (Head) : - 45 ft. LSD.

Drilling Started 6.2.74
Completed 14.2.74
Log by: B.D. Kharel & Kesab K.C.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, & clay, yellow	7	7
Sand, fine	5	12
Clay, grey, loose	6	18
Sand, medium to fine w/gravel	32	50
Clay, grey, loose	13	63
Sand, medium to coarse w/gravel	35	98
Clay, greyish-blue, sticky	10	108
Sand & Clay, alternate layer	15	123
Clay, grey, loose w/gravel	18	141
Clay, grey, loose w/some siltstone gravel	16	157
Clay, bluish-grey, loose w/gravel	13	170
Gravel, mostly siltstone w/loose clay	12	182
Clay, bluish-grey, loose W/siltstone gravel	26	208
Gravel of siltstone and sandstone	7	215
Clay, bluish-grey w/siltstone gravel	38	253
Sand, medium to coarse	11	264
Gravel, subangular to subrounded w/medium to coarse sand	40	304
Clay, grey, sticky w/gravel	22	326
Clay, grey, sticky (a thin layer of gravel embeded)	32	358
Sand, fine w/some gravel & clay bands	29	387
Gravel, subangular to subrounded w/fine sand	24	411
Clay, yellow, sticky	14	425
Gravel, subangular to subrounded	5	430
Clay, yellow, loose w/some siltstone gravel	25	455

Well Completion data:

Casing: 6 in to 116 ft. / 4 in to 309 ft.
Screened Zone: 273 to 283 & 293 to 304 ft/ in
Yield: 47 gpm (Pump)
Drawdown: 6 ft.

Table 6 Well Logs.

Test Hole No. 6/2
Location: Cha Goan (Punarbas)
Drilled by: Hydrology Department
Altitude of Land surface. 563 feet.
Static Water level (Head) -45 feet LSD.

Drilling Started 11.3.74
Completed 15.3.74
Log by: b.D. Kharel & Kesab C. K.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, yellow	2	2
Clay, yellow, loose	5	7
Sand, fine	5	12
Clay, yellow	14	26
Clay, yellow w/siltstone	12	38
Sand, fine w/siltstone gravel	12	50
Clay, grey, sticky	14	64
Sand, fine to medium w/gravel	16	80
Gravel, siltstone & sandstone w/fine sand	19	99
Clay, grey, sticky w/gravel	21	120
Clay, loose w/siltstone gravel	37	157
Gravel, fine w/bluish-grey clay	46	203
Clay, blue.	5	208
Sand, fine to medium w/gravel	6	214
Clay, blue	4	218
Sand, fine to coarse w/gravel	12	230
Clay, blue w/siltstone	17	247
Sand, medium to coarse w/siltstone.	10	257
Sand, fine to coarse	13	270
Sand, fine to coarse w/gravel	34	304
Clay, grey w/siltstone.	6	310

Well Completion Data:

Casing: 10 in to 110 ft/6 in to 310 ft.
Screened Zone: 269 to 279 & 289 to 300 ft.
Yield: 330 gpm (Pump)
Drawdown: 32 ft.

Table 6 Well Logs.

Test Hole No. 6/3
Location: Amaraiya
Drilled by: Hydrology Department
Altitude of Land Surface: 548 feet.
Static Water level (Head) -12 ft. LSD.

Drilling Started 2.2.74
Completed 7.2.74
Log by: B.N. Gurung

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, sandy	2	2
Clay, grey, loose	4	6
Clay, yellow, sticky	16	22
Sand, fine	10	32
Sand, coarse w/fine gravel	14	46
Clay, black, loose	22	68
Clay, black, sticky	12	80
Clay, yellow, sticky	17	97
Clay, blackish-grey, loose w/siltstone.	53	150
Gravel, siltstone w/sand	12	162
Clay, black, loose, sandy	24	186
Clay, grey, sticky	94	280
Sand, fine w/siltstone	33	313
Clay, grey, sticky	26	339
Sand, fine	13	352
Clay, grey, loose	75	427
Clay, grey, sandy	30	457
Clay, grey, sticky	30	487
Clay, grey, loose	30	517

Well Completion Data:

Casing :	6 in to 95 ft/4 in from 95 to 166 ft.
Screened Zone:	150 to 160 ft/4 in.
Yield:	125 gpm (airlift)
	55 gpm (pump)
Drawdown:	8 ft.

Table 6 Well Logs

Test Hole No. 6/4
Location: Kaspa
Drilled bY: N.B. Tubewells
Altitude of Land Surface: 558 feet.
Static Water level (Head) : -3 ft LSD.

Drilling Started 7.2.74
Completed 13.2.74
Log. by: D.C. Parajuli & B.S. Shrestha.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, yellowish-grey	6	6
Clay, yellow	4	10
Clay, yellow w/kankar	5	15
Clay, yellow, w/kankar and sand	5	20
Clay, greyish-yellow w/kankar and sand	15	35
Gravel, & pebbles, medium grained w/coarse sand	10	45
Clay, grey	15	60
Clay, yellow w/sand	11	71
Clay, greyish-yellow w/kankar	9	80
Clay yellow w/kankar	26	106
Clay, grey, loose w/kankar	24	130
Clay, yellowish-grey w/kankar	10	140
Clay, yellow, loose w/kankar	10	150
Clay, yellow, loose w/kankar and sand	10	160
Clay, yellow, sandy w/kankar	10	170
Silt, yellow w/kankar	30	200
Clay, yellow w/medium grained peb les - SST. qtz.	10	210
Clay, yellow w/kankar	12	222
Gravel & medium pebbles w/coarse sand & kankar	12	234
Sand, coarse, subangular to subrounded w/kankar	8	242
Clay, grey w/kankar	15	257
Clay, yellow w/kankar	3	260
Clay, grey, loose w/kankar	12	272
Sand, medium grained, subrounded w/kankar	6	278
Clay, yellow w/kankar	7	285
Clay, grey, sticky	5	290
Clay, grey w/kankar	3	293
Clay, greyish-yellow w/kankar	47	340
Clay, grey w/kankar	20	360
Clay, greyish-yellow, loose w/kankar	30	390
Clay, yellowish-grey w/kankar	10	400
Silt, w/kankar	20	420
Clay, grey, loose w/kankar	10	430
Silt, grey w/kankar	26	456
Clay, grey, sandy	4	460
Clay, yellow, sticky	14	474
Silt, yellow	10	484
Silt, yellow w/kankar	18	502
Clay, grey	9	511
Clay, grey w/kankar	16	527
Clay, light yellow w/kankar	24	551
Clay, greyish-yellow w/fine to coarse sand	28	579

Table 6 Well Logs

Test Hole No. : 6/4 (cont.)

Silt, yellow	10	589
Silt, grey w/kankar	20	609
Clay, grey, sticky	12	621
Silt, w/kankar	29	650
Silt, grey	4	654
Clay, yellow, sandy	11	665
Clay, grey w/fine to coarse sand	10	675
Sand, fine to coarse	5	680
Clay, yellow w/kankar	31	711
Clay, yellow w/kankar	10	721
Clay, grey, loose w/SST	14	735
Sand, fine to medium	14	749
Clay, yellow w/kankar	13	762
Clay, yellow	10	772
Clay, grey w/sand	10	782
Clay, grey w/kankar	10	792
Silt, grey	22	814
Silt, greyish-yellow	26	840
Clay, yellowish-grey, sandy	10	850
Clay, grey, sandy	30	880
Clay, loose w/sand	20	900
Clay, grey, loose, w/sand	20	920
Silt, grey	10	930
Clay, greyish-yellow w/sand	10	940
Silt, grey	10	950
Clay, geey, loose /sand	32	982
Silt, grey	18	1000

Well Completion Data:

Casing:	6 in to 106 ft/4 in to 236 ft.
Screened Zone:	222 to 232 ft/4 in
Yield:	30 gpm (pump)
Drawdown:	103 ft.

Table 6 well Logs.

Test Hole No. 6/5
Location: Dekhatbhuli
Drilled by:: N.B. Tubewells
Altitude of Land Surface: 586 feet.
Static Water Level (Head): +33 ft LSD.

Drilling Started 17.2.74
Completed 18.2.74
Log by: D. C. Parajuli & B.D. Shrestha.

Lithological Description	Thickness (feet)	Depth (feet)
Clay, yellow	10	10
Clay, yellowish-grey w/kankar	2	12
Clay, grey	13	25
Sand, coarse	10	35
Clay, grey w/kankar	10	45
Clay, yellow w/sand	10	55
Clay, yellow w/kankar and sand	27	82
Clay, yellow w/sand	8	90
Clay, yellow, loose w/kankar	10	100
Clay, grey w/kankar	40	140
Clay, grey, loose W/kankar	30	170
Clay, grey w/kankar	20	190
Clay, yellowish-grey w/kankar	20	210
Clay, yellow w/kankar and sand	26	236
Sand, medium to fine	14	250
Clay, yellow w/kankar and sand	10	260
Clay, yellow w/fine sand	20	280
Clay yellow w/coarse sand	6	286
Sand, coarse	16	302
Sand, coarse w/fine gravel	10	312
Sand, coarse w/yellow sandy clay	8	320
Silt, yellow	62	382
Clay, greyish-yellow, loosew/medium to fine sand	20	402
Clay, greyish-yellow	30	432
Clay, sandy w/kankar	10	442
Clay, yellow, sandy	20	462
Clay, yellow, sandy w/kankar	8	470
Clay w/fine sand	20	490
Silt	10	500

Well Completion Data:

Casing: 6 in to 78 ft/4 in to 312 ft.
Screened Zone: 287 to 307 ft/4 in
Yield: 200 gpm (flow)

Table 6 Well Logs.

Test Hole No.: 6/6
Location: Bandi
Drilled by: N.B. Tubewells
Altitude of Land Surface: 627 feet.
Static Water level (Head) +27 ft. LSD.

Drilling Started 22.2.74
Completed 24.2.74
Log by: D. C. Parajuli & B.D. Shrestha .

Lithologic Description	Thickness (feet)	Depth (feet)
Soil, greyish-yellow	3	3
Clay, yellow, loose w/fine kankar	17	20
Clay, yellow w/kankar and sand	8	28
Clay, grey w/kankar	10	38
Gravel, medium, subrounded an subangular	10	48
Clay, yellow, sandy w/kankar	35	83
Clay, yellow	20	103
Clay, yellow w/kankar	10	113
Clay, greyish-yellow	10	123
Clay, yellow w/kankar	10	133
Clay, greyish-yellow w/kankar	10	143
Clay, yellow w/kankar	20	163
Clay, grey w/kankar	30	193
Clay, yellow w/kankar	41	234
Gravel, fine, subangular to rounded w/sand-	12	246
Gravel, coarse, subangular to rounded SST,qtz.qtzi.	14	260
Clay, grey, loose	10	270
Gravel, fine, subangular to rounded w/sand	10	280
Clay, loose w/kankar	13	293
Sand, fine	8	301
Clay, grey, loose	32	333
Clay, grey, loose w/sand	10	343
Clay, grey	10	353
Clay, grey w/kankar	10	363
Clay, grey w/sand and kankar	10	373
Silt, yellow	30	403
Silt, greyish-yellow	38	441
Clay, grey, loose	19	460
Clay, grey, sticky	17	477

Well Completion Data:

Casing: 6 in to 101 ft/4 in to 266 ft.
Screened Zone: 235 to 260 ft/4 in.
Yield: 7 gpm (flow)

Table 6 Well Logs

Test Hole No.: 7/1
Location: Pachui (Calcutta)
Drilled by: Hydrology Department
Altitude of Land Surface: 542 feet.
Static Water level (Head) : -12 ft. LSD.

Drilling Started 12.2.74
Completed 16.2.74
Log by: B.N. Gurugn

Lithologic Description	Thickness (feet)	Depth (feet)
Top Soil, grey, sandy	2	2
Sand, fine	12	14
Siltstone gravel w/sand	3	17
Sand, fine w/siltstone	19	36
Clay, black w/siltstone	18	54
Siltstone gravel and sand	12	66
Sand, fine	44	110
Sand, w/siltstone	16	126
Sand w/siltstone gravel	57	183
Gravel w/siltstone	6	189
Clay, black, stikky	26	215
Gravel w/siltstone	18	233
Gravel, fine to medium	19	252
Clay, black, sticky	8	260
Clay, black, loose w/siltstone	29	289
Gravel, siltstone	42	331
Clay, black, loose	20	351
Clay, grey, loose w/siltstone	30	381
Clay, yellow, sticky	17	398
Gravel	2	400
Clay, black, sticky	11	411
Clay, yellow, sticky w/fine siltstone	15	426
Clay, black, sticky	17	443
Clay, grey, sandy	4	447
Clay, black, loose w/some siltstone gravel	13	460
Clay, grey, sandy	13	473
Clay, black, sticky	13	486
Clay, grey, sandy	8	494
Gravel	1	495
Clay, grey, sandy	6	501

Well completion Data:

Casing:	6 in to 92 ft/4 in to 321 ft.
Screened Zone:	291 to 311 ft/ in
Yield:	130 gpm (airlift)
	60 gpm (Pump)
Drawdown:	4.5 feet.

Table 6 Well Logs

Test Hole No. 7/2
Location: Amlia
Drilled by: Hydrology Department

Drilling Started 17.2.74
Completed 1.3.74
Log By: B.D. Kharel & Keshab K.C.

Altitude of Land Surface: 557 feet.
Static Water level (Head) : -7 ft LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Soil	2	2
Sand fine	5	7
Sand, fine to coarse	6	13
Sand, fine to medium	37	60
Sand, medium to coarse	35	95
Gravel	4	99
Clay, yellow	7	106
Clay, black	31	137
Gravel w/clay	37	174
Clay, dark, grey	23	197
Gravel	6	203
Clay, grey	18	221
Gravel w/sand	27	248
Clay, black	30	278
Gravel	20	298
Clay, dark grey	16	314
Gravel	18	332
Clay, dark grey	29	361
Gravel w/sand	14	375
Clay, grey	27	402
Gravel w/sand	14	416
Clay	4	420

Well Completion Data:

Casing:	6 in to 107 ft/ in to 300 ft.
Screened Zone:	274 to 295 ft/ in
Yield:	250 gpm (airlift)
	62 gpm (Pump)
Drawdown:	5 feet.

Table 6 Well Logs.

Test Hole No. 7/3, 4 & 5
Location: Bichhuwa
Drilled by: Hydrology Department

Drilling Started 4.4.74
Completed 8.4.74
Log by: B.D. Kharel & Bhagwan K.C.

Altitude of Land Surface: 570 feet.
Static Water level (Head) : -6.0 feet. LSD.

Lithologic Description	Thickness (feet)	Depth. (feet)
Soil	4	4
Clay, yellow, sandy	9	13
Sand, fine	7	20
Clay, black	12	32
Sand w/gravel	28	60
Clay	2	62
Sand	3	65

Well Completion Data:

Casing	6 in to 65 ft.
Screened Zone	49 to 59 ft.
Yield:	60 gpm (Pump)
Drawdown:	6 feet.

Table 6 Well Logs.

Test Hole No. 7/6

Location: Bichhuwa Jhala

Drilled by: N.B. Tubewells

Altitude of Land Surface. 573 feet.

Static Water level (Head) : -3 ft LSD.

Drilling Started 28.2.74

Completed 7.3.74

Log by: D.C. Parajuli & B.D. Shrestha.

Lithologic Description	Thickness (Feet)	Depth (Feet)
Soil, yellow	5	5
Sand, fine	10	15
Sand, coarse	14	29
Gravel & medium pebble w/sand	12	41
Sand, fine w/biottle	18	59
Clay, grey, sticky	10	69
Sand, medium to fine	23	92
Clay, grey, loose	11	103
Clay, grey, sticky w/sand	31	134
Clay, grey, sticky	27	161
Clay, grey w/sand	35	196
Clay, grey, sticky w/sand	4	200
Silt, grey	9	209
Gravel, medium, qtz. SST and sand	3	212
Gravel, coarse, subrounded to angular, qtzi, qtz. SST	3	215
Gravel, fine, rounded to angular, qtzi, qtz. chert, SST.	8	223
Gravel, coarse, subrounded to subangular qtzi, qtz, chert.	27	250
Clay, grey, sticky	14	264
Clay, grey w/sand	10	274
Silt, grey	12	286
Gravel, coarse, subangular to subrounded, qtzi, qtz. SST, and sand	16	302
Clay, grey, loose	3	305
Gravel, medium subrounded to angular w/fine sand	4	309
Clay, grey	3	312
Clay w/pebbles	2	314
Clay, grey, loose	36	350
Silt, grey, loose	12	362
Silt, w/kankar	15	377
Clay, grey w/sand and kankar	24	401
Silt w/kankar	29	430
Clay grey	13	443
Clay, grey w/sand	8	451

Table 6 Well Logs.

Test Hole No. 7/6 (cont.)

Clay, yellowish-grey		
Clay, yellow	14	465
Silt, grey	10	475
Clay, grey w/sand	42	517
Clay, yellowish-grey w/sand	28	545
Clay, greyish-yellow w/sand	30	575
Clay, grey w/sand	20	595
Clay, grey	10	605
Clay, grey w/kankar	30	635
Clay, grey w/fine sand	12	647
Clay, yellowish-grey w/SST.	15	662
Silt, yellowish-grey	5	667
Clay, grey, loose	10	677
Silt, w/kankar	20	697
Clay, grey, loose	8	705
Silt, w/kankar	10	715
Clay, grey, loose	10	725
Silt w/SST.	10	735
Clay, yellow	10	745
Clay, greyish-yellow, sticky	10	755
Silt, yellow w/kankar	20	775
Clay, grey, loose	10	785
Clay yellowish-grey	30	815
Clay, grey, loose	40	855
Clay, yellowish-grey w/sand	20	875
Clay, greyish-yellow, sticky w/sand	20	895
Clay, grey, loose	10	905
Silt W/kankar	10	915
Clay, grey w/kankar	12	927
Clay, grey w/sand	10	937
Clay, grey, sticky	42	979
Clay, yellowish-grey, sticky	6	985
	15	1000

Well Completion Data:

Casing:	6 in to 100 ft /4 in to 311 ft.
Screened Zone:	287 - 307 ft/4 in
Yield:	59 gpm (pump)
Drawdown:	5.5 ft.

Table 6 Well Logs.

Test Hole No. 7/7 — Drilling Started 21.2.74
Location: Patia — Completed 24.2.74
Drilled by: Hydrology Department — Log by: B.N. Gurung
Altitude of Land Surface : 585 feet.
Static Water level (Head) +22 ft LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Top, soil, grey	5	5
Clay, yellow. loose	11	16
Sand, fine	8	24
Sand, coarse	2	26
Gravel	14	40
Clay, grey, sticky	26	66
Clay, grey, loose w/siltstone	41	107
Siltstone, gravel & sand	11	118
Clay, black, sticky	12	130
Clay, black, loose	11	141
Clay, yellow, sticky	52	193
Gravel	8	201
Gravel w/quzrzite cutting	34	235

Well Completion Data:

Casing: 6 in to 100 ft /4 in from 100 to 221 ft.
Screened Zone: 197 to 217/4 in
Yield: 136 gpm (flow)

Table 6 Well Logs.

Test Hole No. 7/8 — Drilling Started 3.3.74
Location: Sudha — Completed 27.3.74
Drilled by; Hydrology Department — Log by: B.N. Gurug
Altifude of Land Surface: 644 feet.
Static Water level (Head): +2.0 ft. LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Top soil	3	3
Clay, yellow, sticky	10	13
Clay, yellow, loose	9	22
Sand, coarse	6	28
Gravel, fine	6	34
Gravel and pebbles	5	39
Gravel	10	49
Sand, fine	6	55
Clay	11	66
Clay	7	73
Sand, fine	4	77
Clay, w /siltstone	3	80
Clay, grey, loose	16	96
Clay, grey, sticky	15	111
Clay, black, sticky	4	115
Siltstone gravel	9	124
Gravel w/cuttings of quarzite and pebbles.	7	131

Well Completion Data:

Casing: 6 in to 103 ft/4 in from 103 to 131 ft.
Screened Zone 119 to 129 ft/4 in
Yield: 1 gpm (flow)
33 gpm (Pump)
Drawdown: 85 feet.

Table 6 Well Logs.

Test Hole No. : 8/1

Location: Mahendranagar municipal Well

Drilling Started:

Completed 1973

Drilled by: Indian Contractor

Log. by: Driller's Log

Altitude of Land Surface:

Static Water level (Head) : - 8.0 feet LSD.

Lithologic Description	Thickness (feet)	Depth (feet)
Clay	7	7
Gravel & boulders, 4" to 12" dia.	20	27
Gravel & boulders w/coarse sand	10	37
Clay, black	15	52
Sand, coarse w/boulders to 8" dia.	61	113

Well Completiondata:

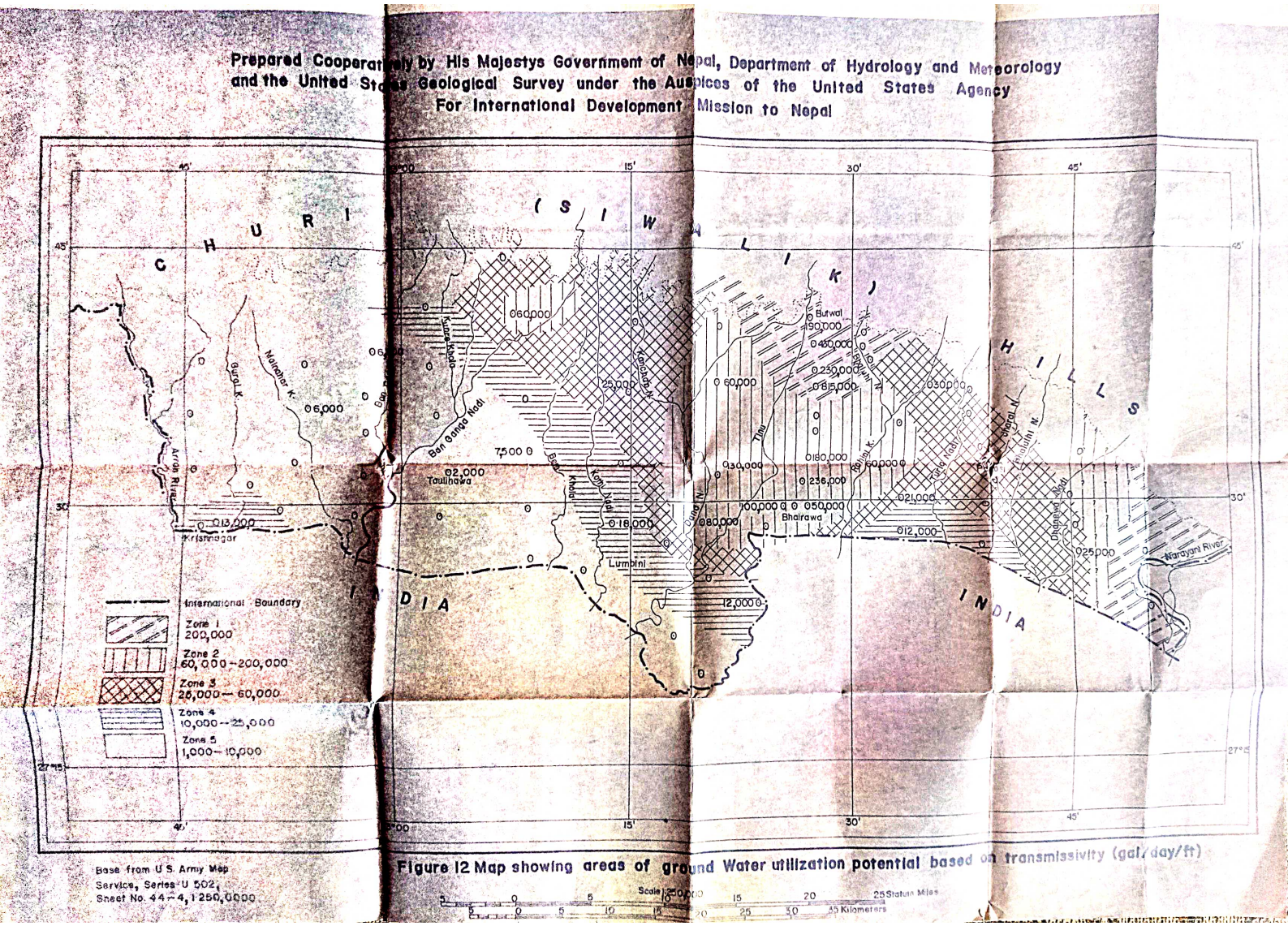
Casing: 12 in to 52 ft/6 in to 105 ft.

Screened Zone: 52 to 105 ft/6 in.

Yield: 246 gpm (Pump)

Drawdown: 25 feet.

Prepared Cooperatively by His Majestys Government of Nepal, Department of Hydrology and Meteorology and the United States Geological Survey under the Auspices of the United States Agency For International Development Mission to Nepal



Base from U S. Army Map Service, Series U 502, Sheet No. 44-4, 1:250,0000

Figure 12 Map showing areas of ground Water utilization potential based on transmissivity (gal/day/ft)

Scale 1:250,000
5 0 5 10 15 20 25 Statute Miles
5 0 5 10 15 20 25 30 35 Kilometers

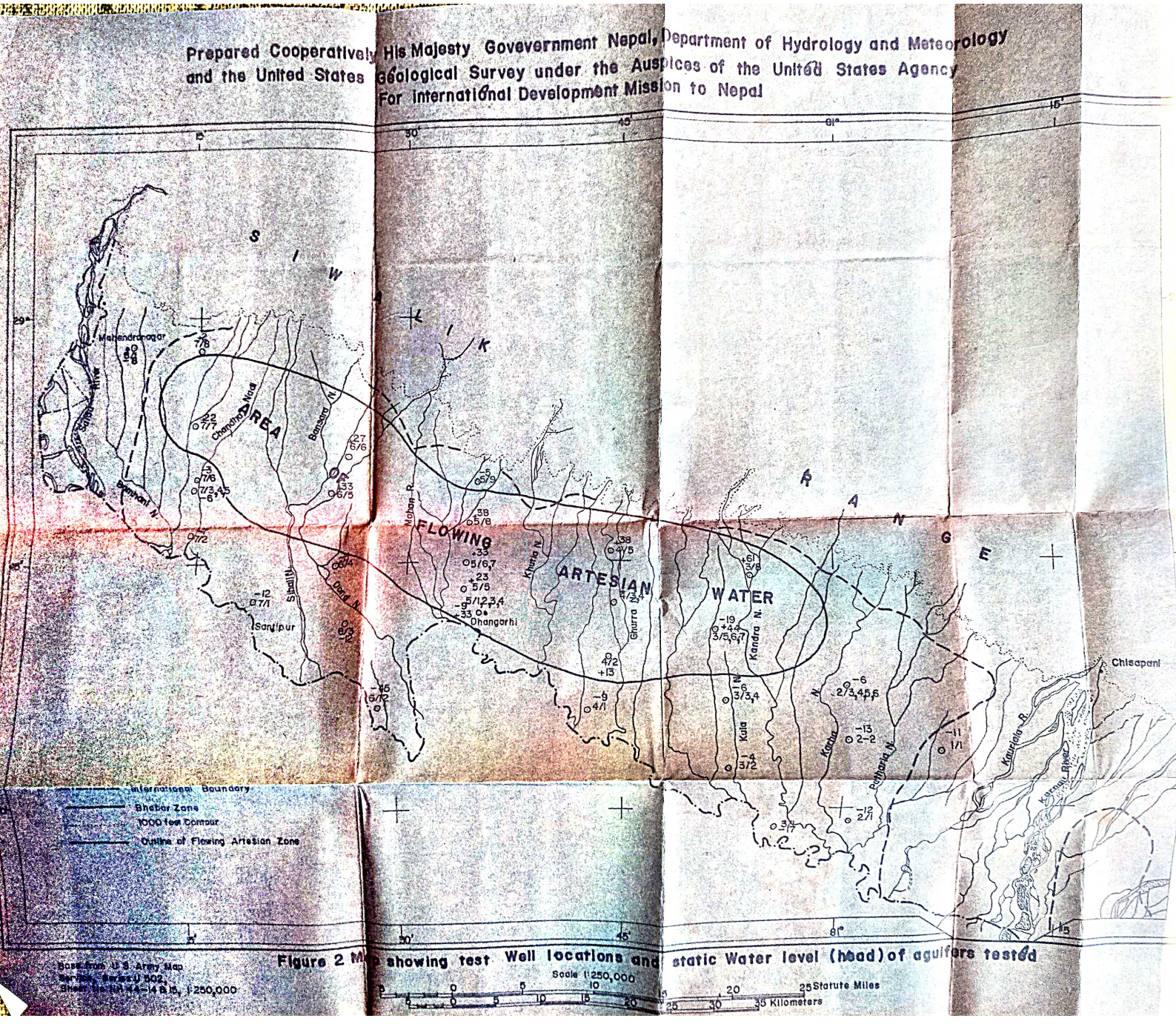


Figure 2 Map showing test well locations and static water level (head) of aquifers tested