

Central Ground Water Board



A detailed topographic map of the Khatola area. The map features numerous contour lines indicating elevation, with labels such as 100.0, 120.0, 140.0, 160.0, 180.0, 200.0, 220.0, and 240.0. Various place names are marked, including Kishanpur, Khatola, Bhatoli, and others. A prominent road or path runs through the center of the map. The map also shows a river or stream flowing along the bottom edge. The overall terrain appears hilly and rugged.

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भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
केन्द्रीय भूमि जल बोर्ड
Government of India
Ministry of Jal Shakti
Water Resources, River Development
and Ganga Rejuvenation Department
Central Ground Water Board

REPORT ON
GROUND WATER FLOW MODELLING OF
JAISALMER DISTRICT
AND PARTS OF JODHPUR DISTRICT, RAJASTHAN
(50,000 sq.km)

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Executive Summary

The “*Great Indian Thar Desert*” forms the extreme western part of India, which is characterised by NE SW trending parallel chains of parabolic stable sand dunes and a variety of desertic vegetation with very less rainfall and extremely high evaporation rates. The inter-dunal flat areas are favourable for agricultural activities. Jaisalmer and Jodhpur Districts are the parts of this great desert where use of groundwater has brought profound structural change in the land use and economic boost resulting in uplifting of socio-economic status of the people having limited resources. However, the groundwater boom has also led to serious concern in the absence of surface drainage, insufficient rainfall and presence of thick piles of sand as dunes that does not allow the rainwater to reach the aquifers. Thus, managing the water resources in the area is a big challenge.

To increase understanding of the groundwater system and assist in the long-term management an attempt has been made in an area of 50,000 sq.km comprising of all three blocks of Jaisalmer District and eleven blocks of adjoining Jodhpur District through a numerical groundwater flow model. This model incorporates understanding of the groundwater flow system to date and is generally capable of simulating the regional aquifer system in the area.

Groundwater in the area occurs in unconfined conditions in alluvium in the extreme western part and the eastern part is occupied by hard sandstone formation of Jodhpur and Nagaur Group of Marwar Supergroup. Based on the water table elevation contours developed from 2014 to 2020 water level data, potential lateral groundwater inflow and outflow along the model boundary were defined for pre-development conditions. The hydraulic gradients determined through potentiometric surface maps indicate that, in general, the direction of groundwater flow in the study area is from the east to the northwest and west. A 200 m thick two layered model has been conceptualised for this area where the thickness of first layer is ~150 m.

The model was calibrated by matching the observed and simulated potentiometric heads of both steady state and transient state modelling runs for the 2014 to 2018 period that simulate the dynamic changes in the hydrologic conditions in response to time-varying recharge and pumping stresses. The scanty rainfall contributes a very little amount which is confined only to monsoon season. The inter-formational flow between the hydrostratigraphic layers has led to redistribution of groundwater that is recharged into different layers as a result of variation in hydraulic properties, hydraulic heads and topography. The model was validated for two years viz. 2019 and 2020. The model also allows predictive modelling for 2021 with continued similar stress conditions of draft and recharge. The interventions suggested in the National Aquifer Management Studies of Jaisalmer and Jodhpur Districts were also considered for predicting different scenarios.

The findings of the present study should also be considered in the context of the fact that this area has a hot dry summer, with low precipitation rate (~200 to 300 mm/year) and higher temperature (~50°C) than average values of Rajasthan. Monitoring activities have improved the knowledge of ground water regime. The groundwater exploration work has brought out the subsurface information and an insight of the aquifer properties.

One important result from this study is identification of critical knowledge gaps and the further work required to ensure that model predictions of aquifer response to management scenarios are as accurate as possible. It was established from this modelling study that there is inter flow between the layers through leakage. Substantial changes occur in model errors in the eastern hard rock area when the horizontal hydraulic conductivity or recharge is increased or decreased whereas the western part covered with sand dunes has almost negligible impact. The drawdowns would be least prominent along the western part of the area. Drawdowns in the eastern part would start developing during post monsoon periods to almost the whole central part of the area under extremely low recharge conditions. Through different scenarios this can be concluded that the increase in recharge or decrease in draft by adopting micro irrigation techniques or through crop diversification is not going to impact much to this over exploited area, but it can help a bit in improving the sustainability of resources of the area.

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Introduction

Ground water models provide a tool to estimate ground water availability for various water use strategies and to determine the cumulative effects of increased water use and drought conditions. A ground water model is a numerical representation of the aquifer system capable of simulating historical and predicting future aquifer conditions. Inherent to the ground water models, are a set of equations which are developed and applied to describe the physical processes considered to be controlling ground water flow in the aquifer system. It can be argued that ground water models are essential to performing complex analyses and in making informed predictions and related decisions (Anderson and Woessner, 1992).

As a part of AAP, the ground water flow modelling of 50,000 sq.km comprising Jaisalmer District and parts of Jodhpur District was taken up in 2019-20 and 2020-21. Within the constraints of the data availability in terms of aquifer parameters and water level data near the international border, a sensible and justified attempt has been made to calibrate the model. The steady state and transient models were developed to evaluate the regional effects or changes in ground water resources associated with increased water demands and development. The model is developed and calibrated on the basis of hydrogeological data generated and collected during various previous studies viz. groundwater exploration, Aquifer Mapping Studies etc. in Jaisalmer and Jodhpur Districts. Integrated hydrogeological, hydrological and geophysical data include the water levels of shallow and deeper zones along with the information of aquifers in terms of their depth ranges and thickness, lithological information and hydraulic properties.

Objective

The objective of the study is to understand the groundwater dynamics and to correlate the NAQUIM interventions to evaluate the groundwater sustainability.

Introduction of Model Area

The study area has divergent issues related to groundwater and as a first step an attempt has been made to develop the mathematical model for the Jaisalmer and parts of Jodhpur Districts of Rajasthan which forms part of Great Thar Desert. The total geographical area of the model area is 50,000 sq.km. The model area covers fourteen administrative blocks viz. 3 blocks of Jaisalmer- Sam, Sankra and Jaisalmer and 11 blocks of Jodhpur District viz. Balesar, Baori, Bap, Bapini, Dechu, Phalodi, Osian, Tiwari, Lohawat, Shekhala and Shergarh. The area shares its western boundary with Pakistan, northern boundary with Bikaner District, southern boundary by Barmer District and eastern boundary by Bhopalgarh, Luni and Mandore Blocks of Jodhpur District itself. Spanning about 2 degrees of latitude between 26°00'07" N and 28°02'27" N and about 4

degrees of longitude between 69°28'30"E and 73°23'53"E, (Figure 1) the area experiences the most arid climate of the country. The physiographic and climatic features of both the districts are different and highly perplexing and heterogeneous.

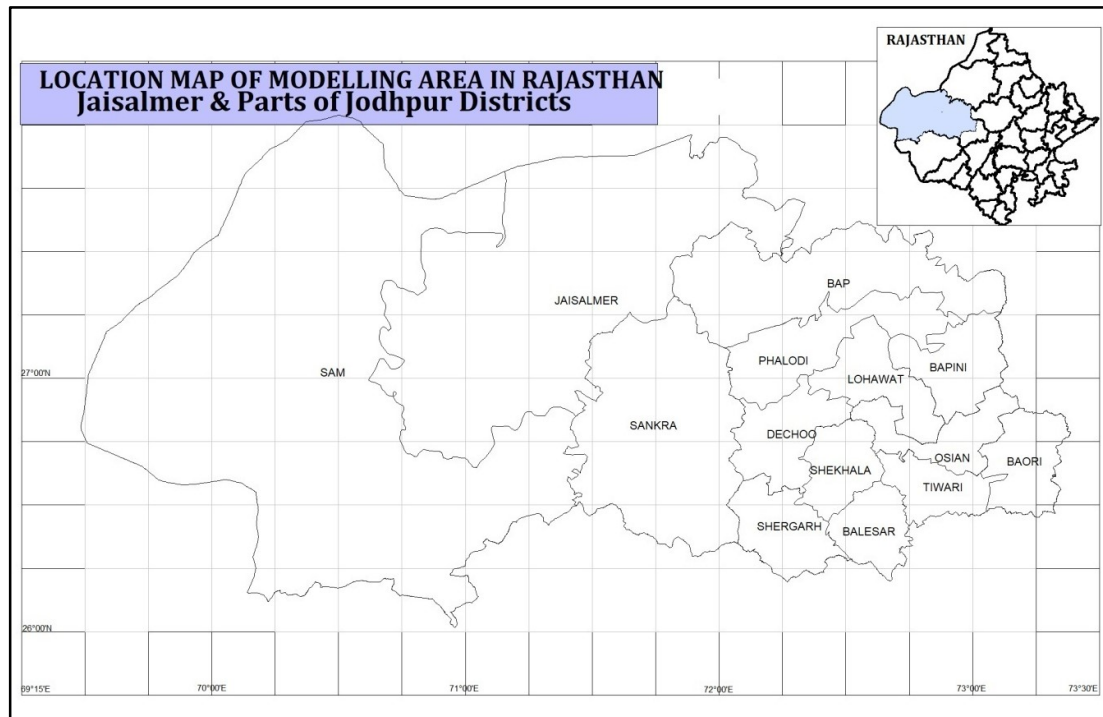


Figure 1: Location Map of Model Area

Physiography

The aeolian processes are highly active in the area producing vast sand dunes and sandy hummocks. In fact, sand dunes, interdunal plains and other sandy undulating terrain cover more than 60% area of the Jaisalmer district, except in the central tract where the terrain is distinctly rocky and gravelly, with occasional hills, and in the south-central part where there are vast stretches of gravel-strewn surfaces. Under extremely arid situation the terrain features assume a barren and faceted look. In contrast soil cover is generally very thin, except in the sandy terrain. Streams are very few and insignificant. Generation of surface run-off is unpredictably low and erosion through water is negligible. The potable subsurface water sources are confined to a few aquifers.

Unlike many districts, Jodhpur has an immense variety of landscape ranging from thickly populated irrigated pockets, good quality dry farming lands, dune chains to rugged hills and nearly desolate gravelly plains. It will be no exaggeration to say that by far a majority of landscape units occurring in arid zone are represented in this district. Dominant land-form of the district is an old alluvial plain further transformed in its major part by wind action which is frequently interrupted by the outcrops of hard rocks forming small hills or plateaus, often 25 to 100 metres above ground level. The hills are surrounded by short piedmont and pediment plains.



Figure 2: Physiography map of the area

General surface elevation ranges between 300 m above mean sea level to 30 m amsl of the western part of the model area. The surface elevation map of the area through DEM and elevation contours is presented in figures 3 and 4.

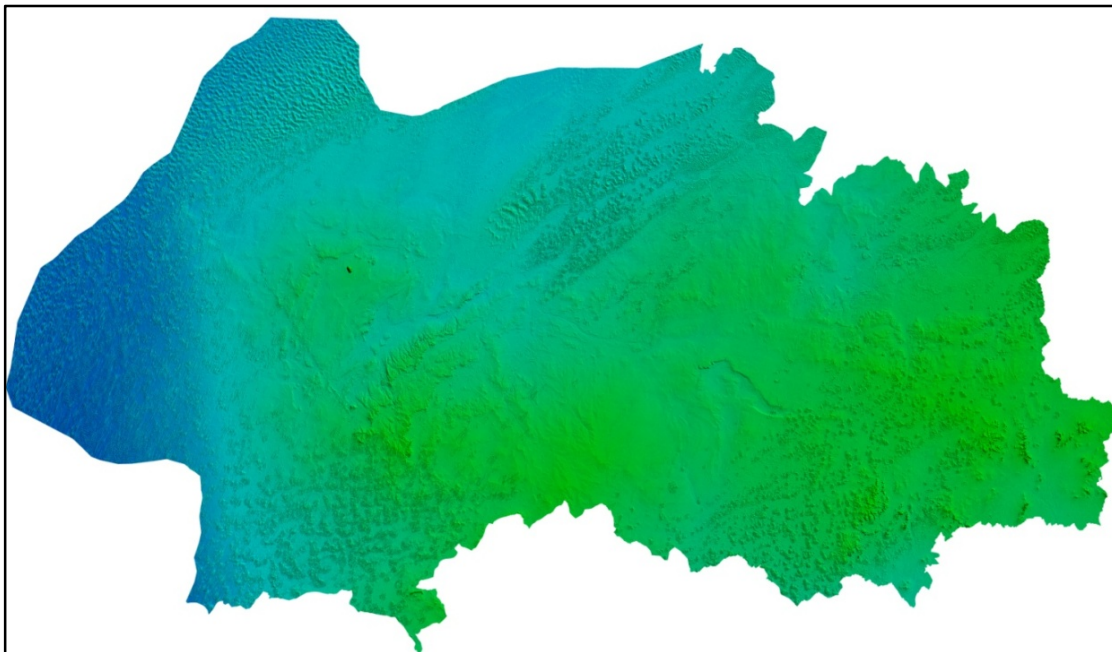


Figure 3: DEM of Model Area

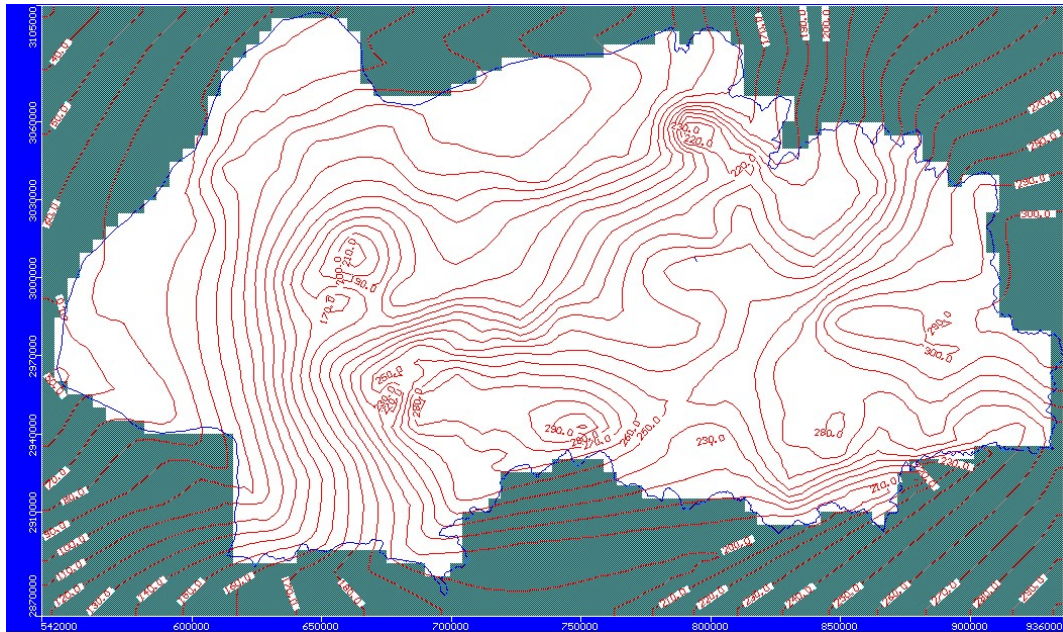


Figure 4: Surface Elevation Contours in Model Area

Drainage

There is no perennial river in the area and no natural lakes in Jaisalmer and Jodhpur Districts. During rainy season water accumulates in several low-lying areas and interdunal flats which are used for drinking and domestic purposes.

Climate

The average rainfall of the study area for a period of 30 years from 1990 to 2019 is 215 mm in Jaisalmer District and 302 mm in Jodhpur District. About 90% of rainfall is received during south-western monsoon season where the number of rainy days is ~10. The average monsoon and non monsoon rainfall received in all the blocks of the model area is presented in figures 5 and 6. Occurrence and distribution of the rainfall is highly erratic. Evaporation far exceeds the precipitation. The maximum temperature during the summer months often sores to ~50°C, while during winter the daily minimum temperature sometimes goes down to the freezing point.

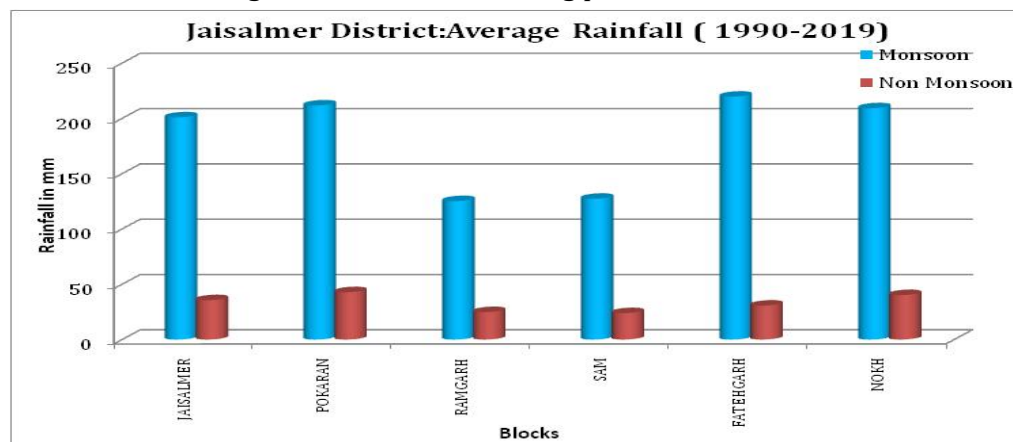


Figure 5: Average Rainfall in Jaisalmer District

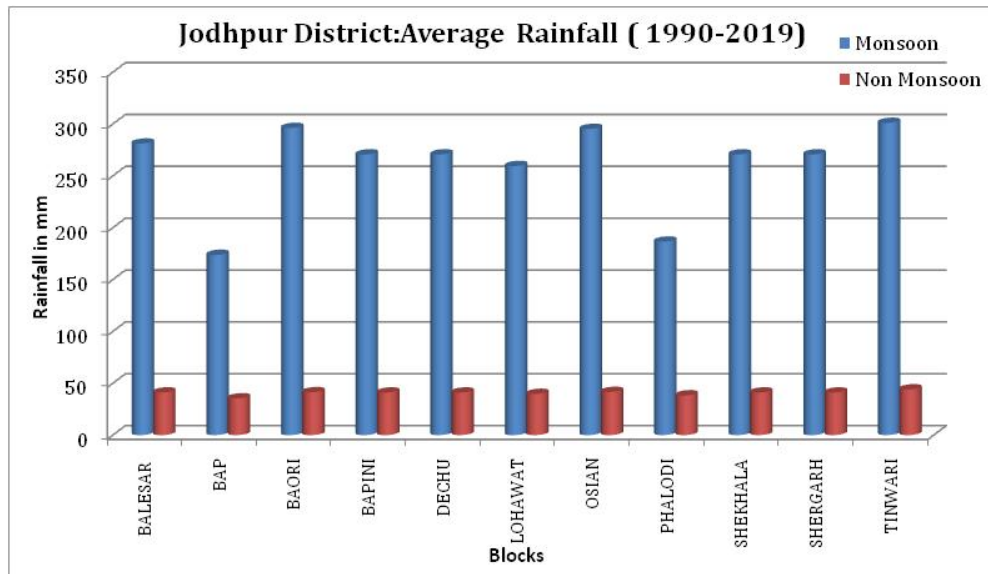


Figure6: Average Rainfall in Jodhpur District.

Geology

The area is occupied by formations from Archean to Quaternary Age. Jaisalmer District is occupied by Quaternary Alluvium, Tertiary sandstone in central and Baisakhi, Jaisalmer and Lathi Sandstone formations of Mesozoic Age in the southern part of the District and some granitic and basaltic rock formations in the south eastern and eastern parts respectively. Jodhpur District is occupied by Quaternary Younger Alluvium, Older Alluvium, Cambrian Nagaur and Jodhpur Sandstone, Bilara Limestone of Marwar Supergroup and Pre-cambrian Malani Rhyolite formations.

Groundwater Level Data

The groundwater level data from 157 Hydrograph Stations (CGWB & State GW Dept.) was used for preparing water table elevation contours. The water level data from observation wells as well as the static water level data of the exploratory wells were also taken into consideration, in the area where no observation stations of CGWB or State Ground Water department.

Out of 157 water level monitoring stations only 77 monitoring station were considered after validation (duplicate, erratic values). The water table map of the area is presented in Figure 7. The water table contours of the area were drawn which clearly indicates that the ground water flow direction follows the topographic slope viz. from south-east to north-west and west.

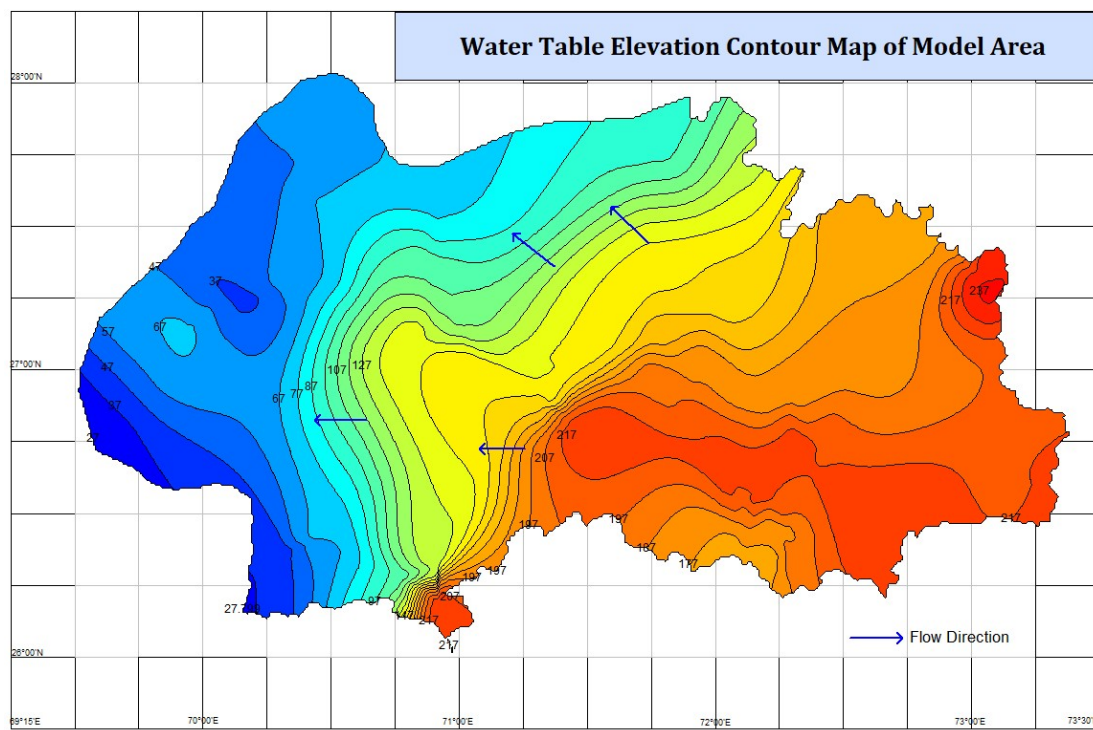
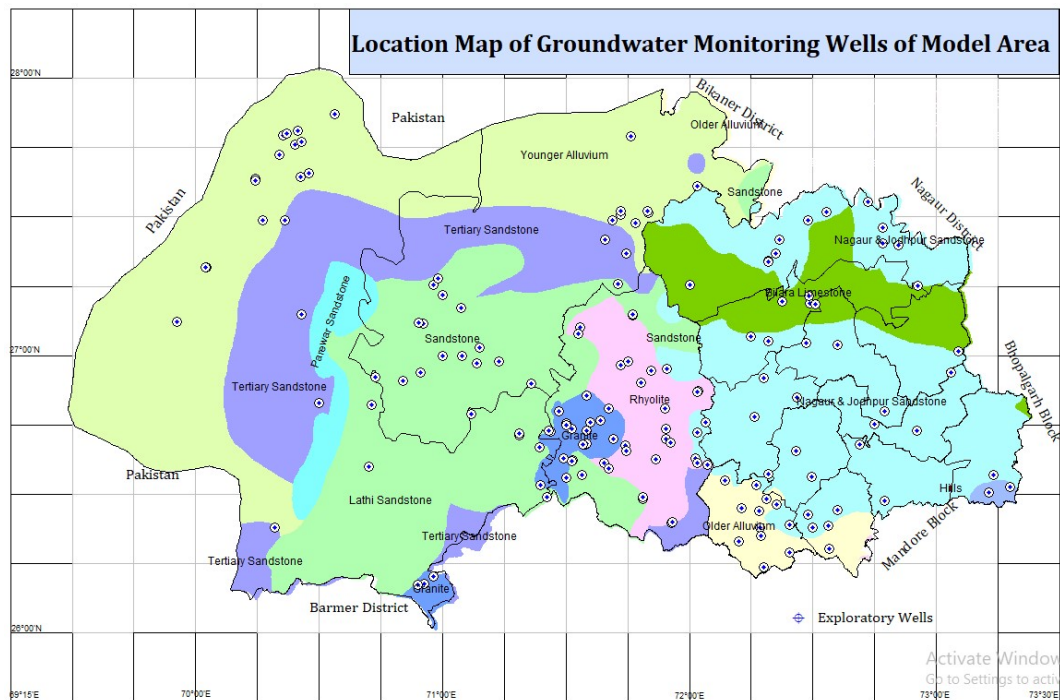


Figure 7 : Location of Groundwater Monitoring Wells of the Area

Figure 8: Water Table Elevation Contour Map of Model Area.

Ground Water Exploration

More than 287 tubewells are drilled in Model Area till now by CGWB and GWD. Out of these tube wells drilled, 84 wells having complete data, was used in this study to demarcate different layers. The locations of exploratory wells drilled in the area are shown in Figure 9.

The aquifer parameters viz. transmissivity, storativity, computed during the Aquifer tests wells were used as input parameters in the model.

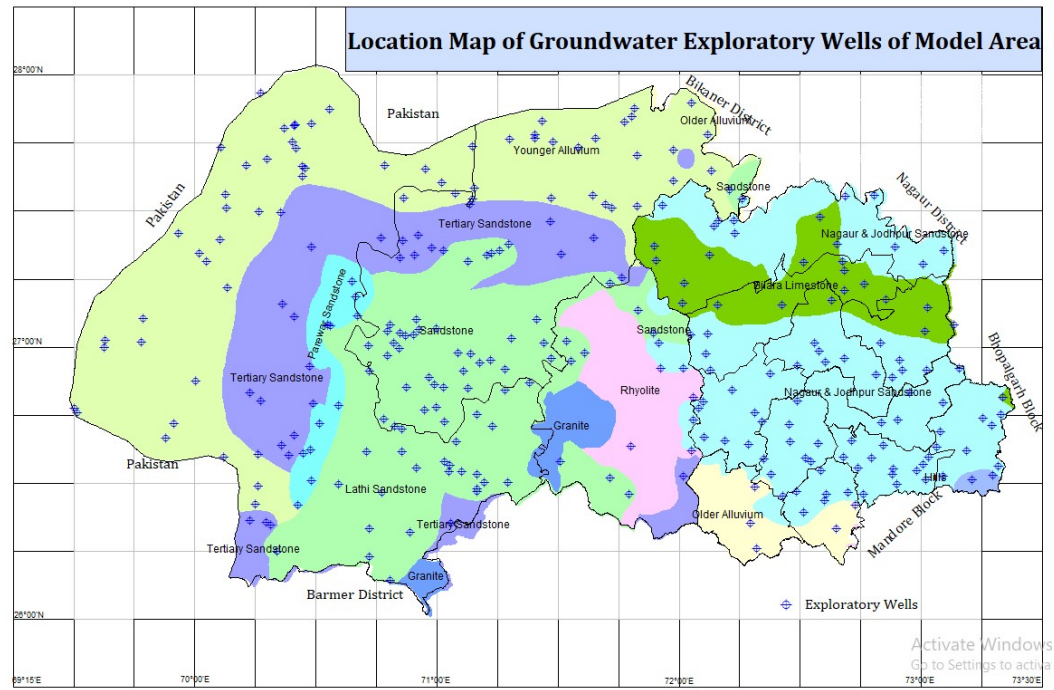


Figure 9: Location of Groundwater Exploratory Wells of the Area

Modelling Protocol

The modelling protocol used in this study for the construction of a numerical model involves the following steps:

- Data collection, acquisition and processing of primary data
- Conceptual model building by field data input
- Numerical model building
- Model design/application by parameter input
- Model Calibration and Validation
- Presentation of Results

Development of Conceptual Model

Based on the available geological, hydrogeological, hydrological, geophysical and meteorological data, a ground water model of the area has been conceptualized. The study area is occupied by different formations of different periods with lateral as well as vertical variations having altogether different hydrogeological characteristics and

varying ground water potentials. Groundwater is found to occur in unconfined conditions in the weathered formation and unconfined/confined in alluvium at deeper depths, separated by an impervious layer viz. aquitard and fractured sandstone formation especially in northern part of Jaisalmer District adjoining to the International Border. The ground water exploration in this area has been carried out down to 300 m bgl thus the existence of 3 major layers was experienced in this area. But in rest of the area that is mostly occupied by various sandstone formations viz. Nagaur Jodhpur sandstone, Lathi sandstone, Jaisalmer sandstone, Tertiary sandstone Bilara Limestone, granites and rhyolites existence of only 2 layers in unconfined conditions was confirmed through the exploratory data. Hence all these conditions were hindering to decide the number of layers of the model. Finally it was decided to leave the confined aquifer as it exists in only small part of the model area and a two layered model of 200 m thickness was conceptualized.

Several attempts were made to establish a model with all these formations. But due to the lateral variations in the hydraulic parameters of different formations it could not be conceptualized.

Hence a two-layer model of 200 m thickness with hydraulic parameters of sandstone formation was conceptualized.

Grid Design

The total area of the model is 50,000 sq. Km which is discretised into 46 rows and 80 columns, with the cell size of 5000 x 5000 m (Figure 10). Active cells are 2205 used to cover the study area shown as white coloured cells. Remaining inactive cells are 1475 are not considered for computation are shown in green colour and are outside the study area.

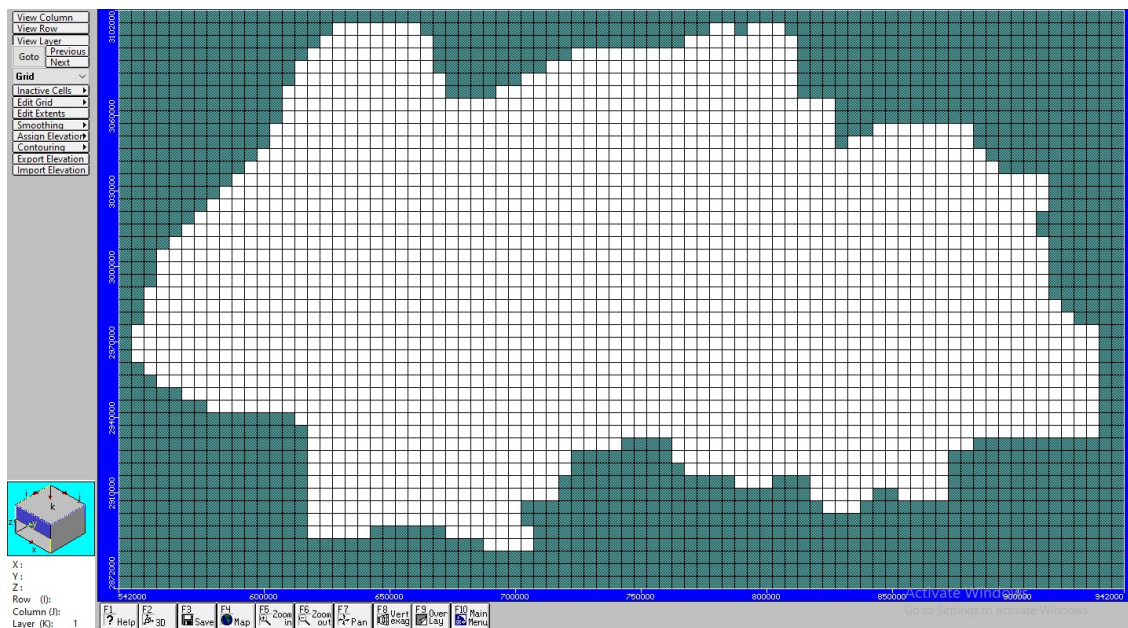


Figure 10: Model Grid

The available elevation data for EW's and water level monitoring stations has been assigned and interpolated for grid model by natural neighbour method.

Assumption in Conceptual Model

Following general simplified assumptions are used in the development and calibration of model:

1. A two-layer aquifer system has been assumed Figure 11.
2. General ground water flow direction is from south east to west and north-west.

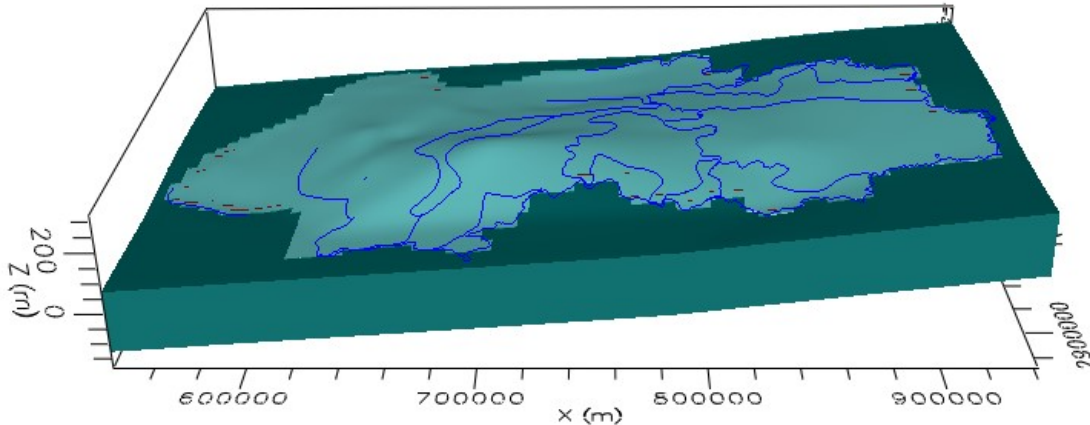


Figure11: Assumed model.

Aquifer Geometry

The physical parameters, that include aquifer top and bottom elevations, are assigned to the model. The aquifer geometry is mainly derived from the subsurface characterization using the borehole logs of 84 exploratory wells, dug well section and geological information collected during the field work. Based on lithologs, the model is characterized in two layers, as below

Layer Settings				
To assign multiple layers select appropriate rows by <Ctrl>- or <Shift> click on row indicator bar				
Layer	LAYCON	Interblock transmissivity	Layer type	
1	01	00:Harmonic mean	1:Unconfined	
2	03	00:Harmonic mean	3:Confined/Unconfined, variable S, T	

Table 1: Layer Characterization of Model

Layers	Aquifer Type	Top Elevation Range (m amsl)	Bottom Elevation Range (m amsl)	Average Thickness (m)
Layer I	Unconfined	43 to 315	165 to -107	150
Layer II	Unconfined/semiconfined	165 to -107	115 to -157	50

Boundary Conditions

Defining the boundary conditions of the modelling area was a difficult task, as there is no physical / geomorphological feature in and around the study area such as neither river nor hill etc. Hence, water table contours were used to decide the boundary conditions the boundaries are shown in figure 12.

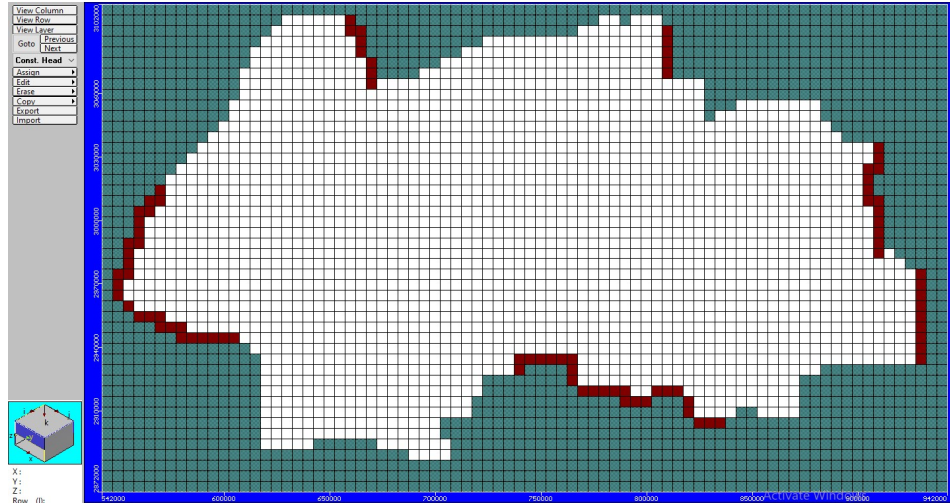


Figure 12: Boundary Conditions of the Modelling Area.

Input Parameters

Initial Groundwater head

After detailed analysis of the hydrographs, rainfall and water level fluctuation, it was decided that the average water table elevation of pre-monsoon season from May-20149 will be taken as initial heads in steady state simulation. As there were no control points in the western part of the model area, the static water level data of the exploratory tubewells was considered for initial head values. For Initial heads, data of 70 wells was considered whereas the data of only 77 observation points was available in time series, for input in head observations in transient model. The initial head contours are presented in figure 13.

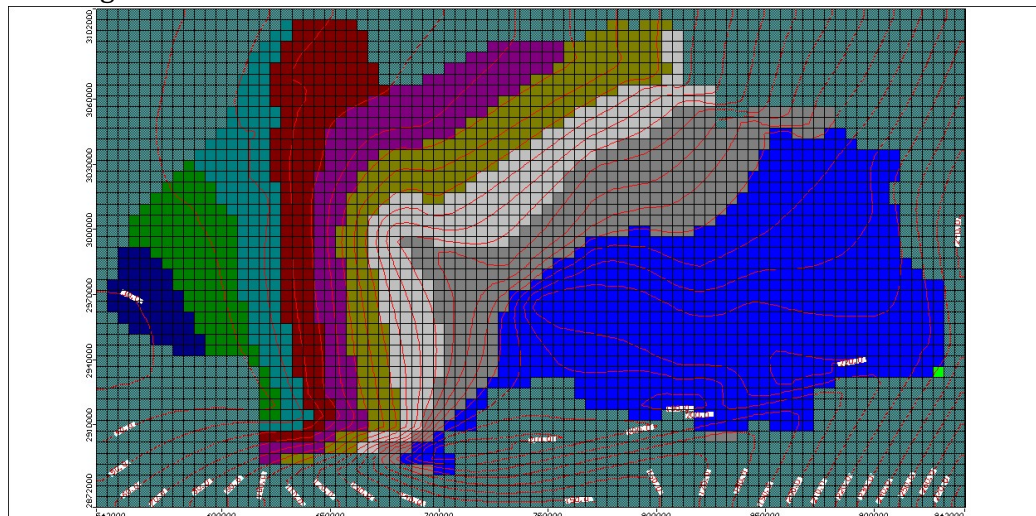


Figure 13: Initial Head Contours

Hydraulic conductivity and specific yield

In the model area sandstone of different ages extends throughout the area except for the northern part which possesses Quaternary Alluvium that is a derivative of these sandstone formations, so the complete area is assigned the hydrogeologic properties of sandstone. Hydraulic conductivity and Storage Parameters considered and assigned are given below.

Table 2: Aquifer Parameters of the hydrogeological formations as assigned to the model

Hydrogeological Zones	K	Ss	Sy	Effective Porosity	Total porosity
Sandstone- Layer1	0.08	1.00E-05	0.015	0.15	0.3
Sandstone- Layer 2	0.003	1.00E-03	0.01	0.15	0.3

Recharge due to rainfall

Recharge to this model consisted of infiltration from precipitation. Recharge was applied to the active model area as a spatially varying, specified flux to the uppermost active layer. In general, precipitation recharge varies spatially with land-surface permeability, which is a function of soil characteristics and land use. In model area, being a dry deserted area as such no significant land use pattern is there especially in Jaisalmer District. In Jodhpur District, rainfall received by the western blocks that are adjacent to the Jaisalmer District is different from the rainfall amounts of eastern blocks. The recharge for monsoon and non-monsoon seasons is calculated on the basis of actual rainfall received which is taken from the Rajasthan water resources department's website and the rainfall infiltration factor is taken as 0.05, as considered during resource estimation.

Draft

Within the study domain, discharge input is the groundwater pumping in the area. The time variant groundwater draft has been assigned to each grid using the annual draft from Ground Water Resource Estimation. Block-wise draft generated in the area has been subtracted from the recharge and net recharge is assigned to each block as mentioned in the table 3. The zones for assignment of stress are shown in figure 14.

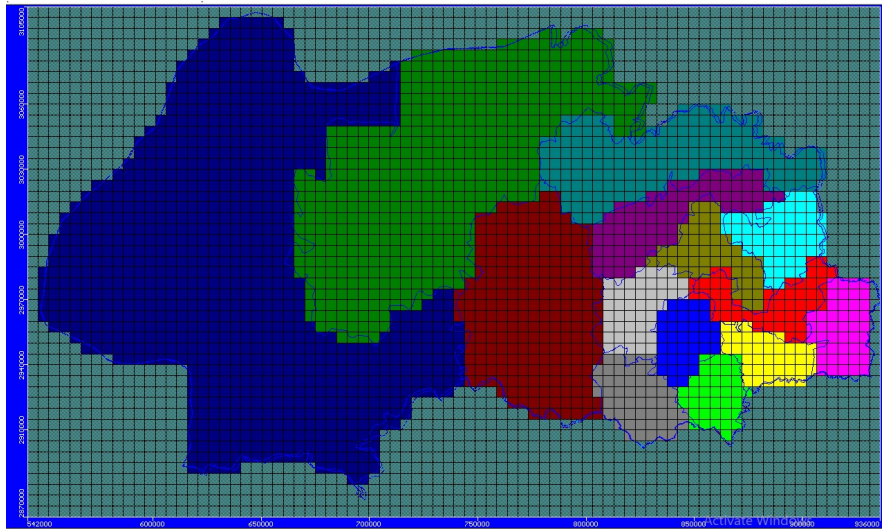


Figure 14: Blockwise Assignment of Stress

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
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Table 3: Recharge and Draft for all Blocks for all time steps

Start Time	Block	Draft (m/day)	Recharge (m/d)per unit area	Net Recharge (m/day) (Recharge-Draft)
0	BALESAR			0
120	BALESAR	0.000072	0.000097	0.000025
365	BALESAR	0.000106	0.000013	-0.000093
485	BALESAR	0.000067	0.000098	0.000031
730	BALESAR	0.000098	0.000000	-0.000098
850	BALESAR	0.000061	0.000131	0.000070
1095	BALESAR	0.000089	0.000000	-0.000089
1215	BALESAR	0.000062	0.000145	0.000083
1460	BALESAR	0.000092	0.000014	-0.000077
1580	BALESAR	0.000064	0.000143	0.000079
1825	BALESAR	0.000093	0.000000	-0.000093
0	BAORI			
120	BAORI	0.00022	0.000102	-0.00012
365	BAORI	0.00032	0.000013	-0.00031
485	BAORI	0.00021	0.000102	-0.00010
730	BAORI	0.00030	0.000000	-0.00030
850	BAORI	0.00019	0.000155	-0.00004
1095	BAORI	0.00028	0.000000	-0.00028
1215	BAORI	0.00020	0.000101	-0.00010
1460	BAORI	0.00029	0.000010	-0.00028
1580	BAORI	0.00020	0.000092	-0.00011
1825	BAORI	0.00030	0.000000	-0.00030
0	BAP		0	0
120	BAP	0.000019	0.000084	0.00006
365	BAP	0.000028	0.000011	-0.00002
485	BAP	0.000015	0.000084	0.00007
730	BAP	0.000022	0.000010	-0.00001
850	BAP	0.000011	0.000051	0.00004
1095	BAP	0.000016	0.000000	-0.00002
1215	BAP	0.000011	0.000043	0.00003
1460	BAP	0.000016	0.000000	-0.00002
1580	BAP	0.000011	0.000040	0.00003
1825	BAP	0.000016	0.000000	-0.00002
0	BAPINI		0.000000	0.00000
120	BAPINI	0.00011	0.000102	-0.00001
365	BAPINI	0.00016	0.000017	-0.00014
485	BAPINI	0.00011	0.000102	-0.00001
730	BAPINI	0.00017	0.000012	-0.00015
850	BAPINI	0.00012	0.000111	-0.00001
1095	BAPINI	0.00017	0.000000	-0.00017
1215	BAPINI	0.00012	0.000148	0.00003
1460	BAPINI	0.00018	0.000000	-0.00018
1580	BAPINI	0.00012	0.000039	-0.00008
1825	BAPINI	0.00018	0.000000	-0.00018
0	DECHU		0.000000	0.00000
120	DECHU	0.00008	0.000097	0.00002
365	DECHU	0.00011	0.000014	-0.00010
485	DECHU	0.00008	0.000098	0.00002
730	DECHU	0.00012	0.000014	-0.00010
850	DECHU	0.00008	0.000099	0.00002
1095	DECHU	0.00012	0.000000	-0.00012
1215	DECHU	0.00008	0.000183	0.00010
1460	DECHU	0.00012	0.000000	-0.00012
1580	DECHU	0.00009	0.000051	-0.00004
1825	DECHU	0.00013	0.000000	-0.00013
0	LOHAWAT		0.000000	0.00000
120	LOHAWAT	0.00011	0.000097	-0.00001
365	LOHAWAT	0.00015	0.000014	-0.00014
485	LOHAWAT	0.00010	0.000098	0.00000

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Start Time	Block	Draft (m/day)	Recharge (m/d)per unit area	Net Recharge (m/day) (Recharge-Draft)
730	LOHAWAT	0.00015	0.000000	-0.00015
850	LOHAWAT	0.00010	0.000088	-0.00001
1095	LOHAWAT	0.00014	0.000000	-0.00014
1215	LOHAWAT	0.00010	0.000060	-0.00004
1460	LOHAWAT	0.00015	0.000000	-0.00015
1580	LOHAWAT	0.00010	0.000104	0.00000
1825	LOHAWAT	0.00015	0.000000	-0.00015
0	OSIAN		0.000000	0.00000
120	OSIAN	0.00017	0.000102	-0.00007
365	OSIAN	0.00025	0.000017	-0.00023
485	OSIAN	0.00015	0.000102	-0.00004
730	OSIAN	0.00021	0.000012	-0.00020
850	OSIAN	0.00012	0.000111	-0.00001
1095	OSIAN	0.00018	0.000000	-0.00018
1215	OSIAN	0.00013	0.000148	0.00002
1460	OSIAN	0.00019	0.000000	-0.00019
1580	OSIAN	0.00013	0.000096	-0.00003
1825	OSIAN	0.00019	0.000000	-0.00019
0	PHALODI		0.000000	#REF!
120	PHALODI	0.00006	0.000084	0.00002
365	PHALODI	0.00009	0.000012	-0.00008
485	PHALODI	0.00006	0.000085	0.00002
730	PHALODI	0.00009	0.000010	-0.00008
850	PHALODI	0.00007	0.000093	0.00003
1095	PHALODI	0.00010	0.000000	-0.00010
1215	PHALODI	0.00007	0.000126	0.00006
1460	PHALODI	0.00010	0.000023	-0.00008
1580	PHALODI	0.00007	0.000058	-0.00001
1825	PHALODI	0.00010	0.000000	-0.00010
0	SEKHALA		0.000000	#REF!
120	SEKHALA	0.00007	0.000097	0.00003
365	SEKHALA	0.00010	0.000013	-0.00009
485	SEKHALA	0.00009	0.000098	0.00001
730	SEKHALA	0.00013	0.000013	-0.00012
850	SEKHALA	0.00011	0.000131	0.00002
1095	SEKHALA	0.00016	0.000000	-0.00016
1215	SEKHALA	0.00011	0.000145	0.00003
1460	SEKHALA	0.00016	0.000014	-0.00015
1580	SEKHALA	0.00011	0.000143	0.00003
1825	SEKHALA	0.00017	0.000000	-0.00017
0	SHERGARH		0.000000	#REF!
120	SHERGARH	0.00007	0.000097	0.00003
365	SHERGARH	0.00010	0.000014	-0.00009
485	SHERGARH	0.00007	0.000098	0.00003
730	SHERGARH	0.00010	0.000013	-0.00008
850	SHERGARH	0.00006	0.000099	0.00003
1095	SHERGARH	0.00009	0.000000	-0.00009
1215	SHERGARH	0.00007	0.000183	0.00012
1460	SHERGARH	0.00010	0.000000	-0.00010
1580	SHERGARH	0.00007	0.000099	0.00003
1825	SHERGARH	0.00010	0.000000	-0.00010
0	TINWARI		0.000000	#REF!
120	TINWARI	0.00016	0.000102	-0.00006
365	TINWARI	0.00024	0.000017	-0.00022
485	TINWARI	0.00016	0.000102	-0.00006
730	TINWARI	0.00024	0.000014	-0.00022
850	TINWARI	0.00016	0.000111	-0.00005
1095	TINWARI	0.00023	0.000000	-0.00023
1215	TINWARI	0.00016	0.000173	0.00001
1460	TINWARI	0.00024	0.000000	-0.00024

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

1580	TINWARI	0.00016	0.000060	-0.00010
Start Time	Block	Draft (m/day)	Recharge (m/d)per unit area	Net Recharge (m/day) (Recharge-Draft)
1825	TINWARI	0.00024	0.000000	-0.00024
0	Jaisalmer		0.000000	#REF!
120	Jaisalmer	0.00001	0.000042	0.00003
365	Jaisalmer	0.00002	0.000000	-0.00002
485	Jaisalmer	0.00001	0.000043	0.00003
730	Jaisalmer	0.00002	0.000006	-0.00001
850	Jaisalmer	0.00001	0.000050	0.00004
1095	Jaisalmer	0.00002	0.000000	-0.00002
1215	Jaisalmer	0.00001	0.000070	0.00006
1460	Jaisalmer	0.00002	0.000006	-0.00001
1580	Jaisalmer	0.00001	0.000048	0.00003
1825	Jaisalmer	0.00002	0.000000	-0.00002
0	Sam		0.000000	#REF!
120	Sam	0.00000	0.000032	0.00003
365	Sam	0.00000	0.000007	0.00000
485	Sam	0.00000	0.000041	0.00004
730	Sam	0.00001	0.000000	-0.00001
850	Sam	0.00001	0.000045	0.00004
1095	Sam	0.00001	0.000000	-0.00001
1215	Sam	0.00001	0.000029	0.00002
1460	Sam	0.00001	0.000000	-0.00001
1580	Sam	0.00001	0.000010	0.00000
1825	Sam	0.00001	0.000000	-0.00001
0	Sankra		0.000000	#REF!
120	Sankra	0.00002	0.000041	0.00002
365	Sankra	0.00003	0.000000	-0.00003
485	Sankra	0.00002	0.000032	0.00001
730	Sankra	0.00003	0.000006	-0.00003
850	Sankra	0.00002	0.000009	-0.00001
1095	Sankra	0.00003	0.000000	-0.00003
1215	Sankra	0.00002	0.000086	0.00007
1460	Sankra	0.00003	0.000010	-0.00002
1580	Sankra	0.00002	0.000035	0.00001
1825	Sankra	0.00003	0.000000	-0.00003

Steady State Simulation

The model was simulated in steady state condition using the finite-difference approximation of three-dimensional partial differential equation of groundwater flow in the aquifer using average water table elevation of pre-monsoon season from May 2014 to Nov 2018 in the area.

Steady State calibration

The model was calibrated for steady state conditions. The average water table elevation of pre-monsoon season of May 2014 was considered for steady state model calibration. Several trial runs have been made by varying the hydraulic conductivity and storage parameters so as to achieve a good agreement between the observed and computed heads in space and time.

The calibration process involved altering (a) the recharge rates, and (b) the horizontal hydraulic conductivity of the sedimentary, until the model simulated water table matched (perfectly) the interpreted water table.

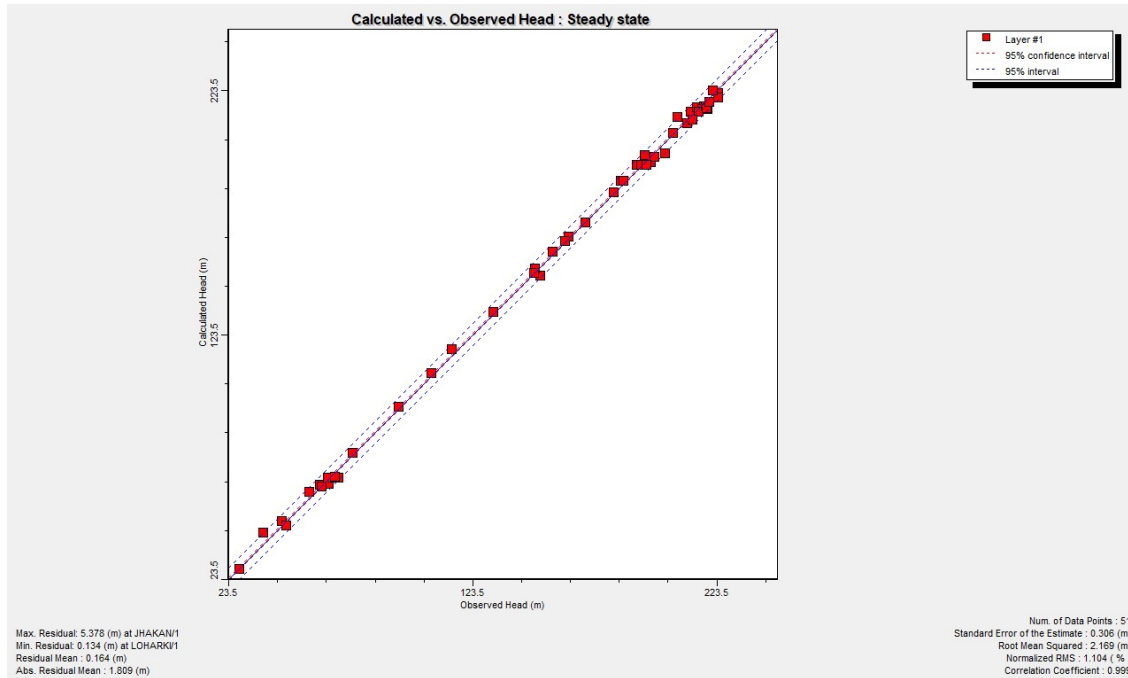


Figure16. Scatter Plot computed and observed groundwater head under steady state

Transient State Simulation

In Transient state, head changes with time thus it is also called time dependent, unsteady, non-equilibrium, or non-steady state problem.

As the calculated heads of steady state were superimposing the observed heads same values were taken as initial heads in transient state. In addition to the final hydraulic conductivity values and storage parameters of steady state model, grid wise calculated ground water recharge and draft has been assigned to the transient state model. Transient state simulation was carried out for a period of 5 years from May 2014 to May 2018 with two stress periods per year viz. pre and post monsoon seasons of 120 days and 245 days respectively. In the monsoon season the draft from groundwater is less whereas it increases in the non monsoon season.

Transient State calibrations

The calibration of transient model was achieved by after assigning the stress to the model i.e. recharge and draft. In this model the recharge and draft was calculated for all the 14 blocks of both Jaisalmer and Jodhpur Districts falling in the model area. The net recharge was assigned to the different blocks as per the stress periods and the resultant is generated in the form of contours and graphs between observed heads and calculated heads. The model's accuracy was calculated using the Root Mean Square Error (RMSE) in meters and Normalised Root Mean Square Error percentage.

Quantitative comparison of Potentiometric Heads

The contours generated for different stress periods show the effect of recharge in monsoon and high draft in the non-monsoon periods especially when the non-monsoon rainfall is negligible (figures 17 to 26). The difference in the head values due to these stresses are reflected by the head observations in the graphs are shown in figure 27.

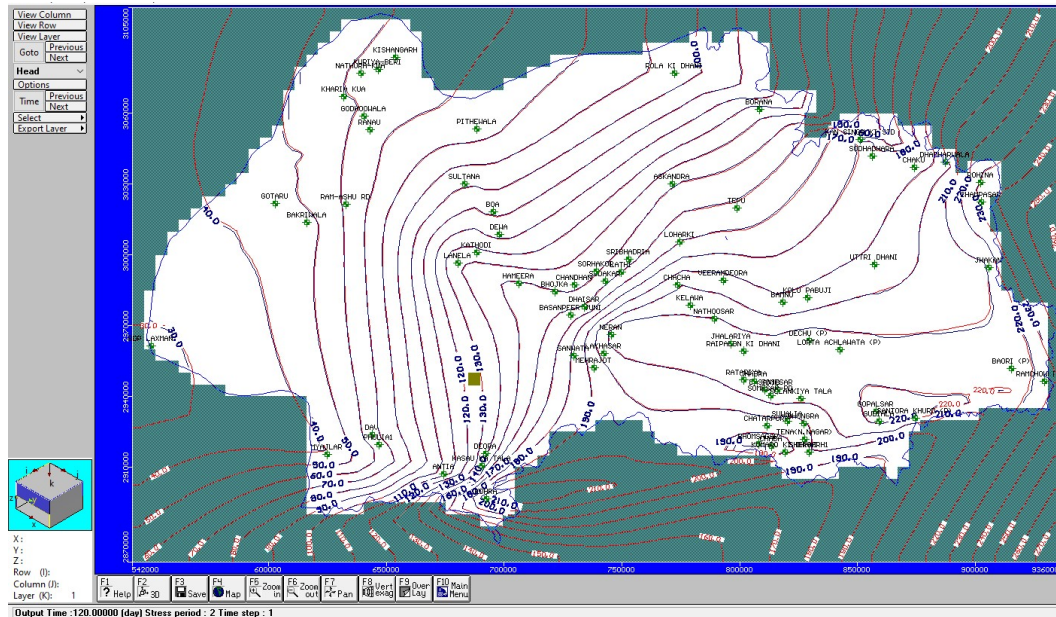


Figure 17: Initial Head Vs Calculated Potentiometric Head Contours Day 1 (May 2014)

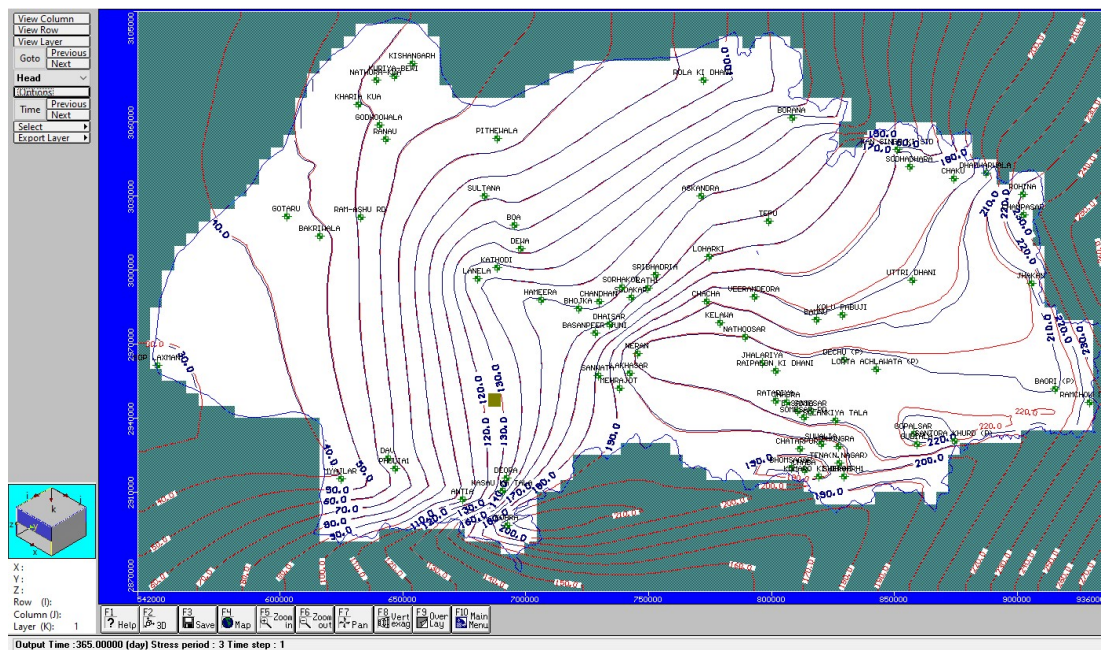


Figure 18: Initial Head Vs Calculated Potentiometric Head Contours Day 365 (Nov 2014)

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

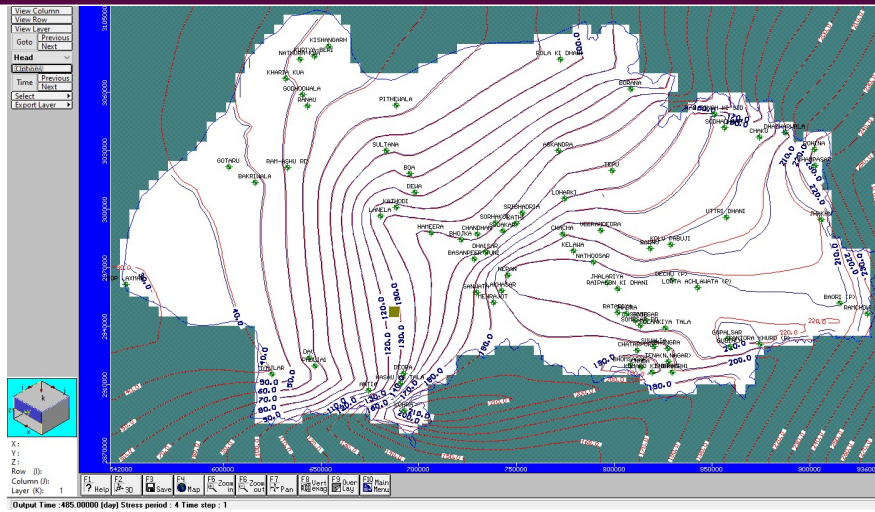


Figure 19: Initial Head Vs Calculated Potentiometric Head Contours Day 485 (May 2015)

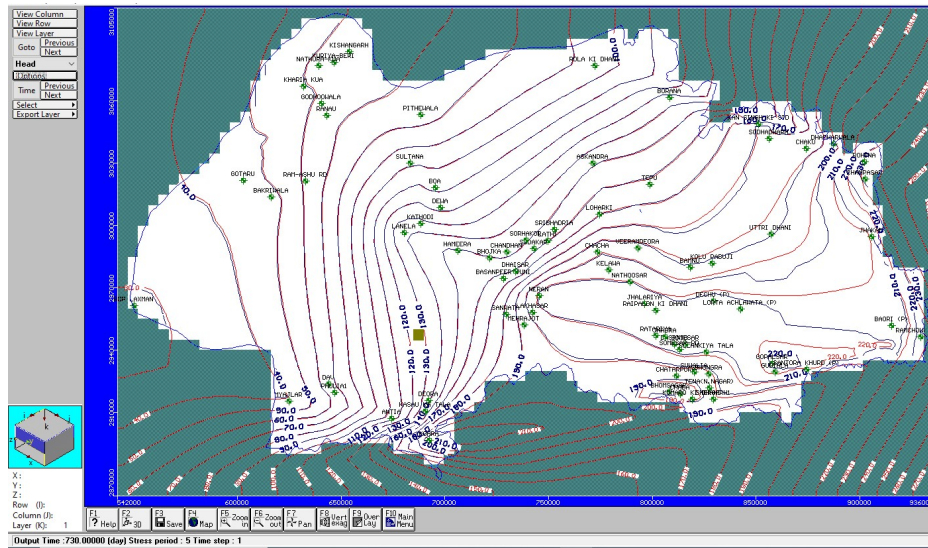


Figure 20: Initial Head Vs Calculated Potentiometric Head Contours Day 730 (Nov 2015)

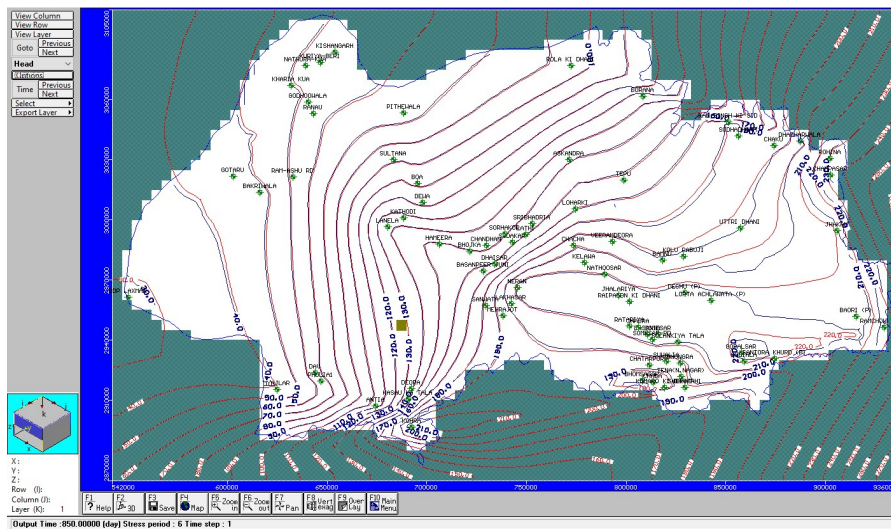


Figure 21: Initial Vs Calculated Potentiometric Head Contours Day 850 (May 2016)

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

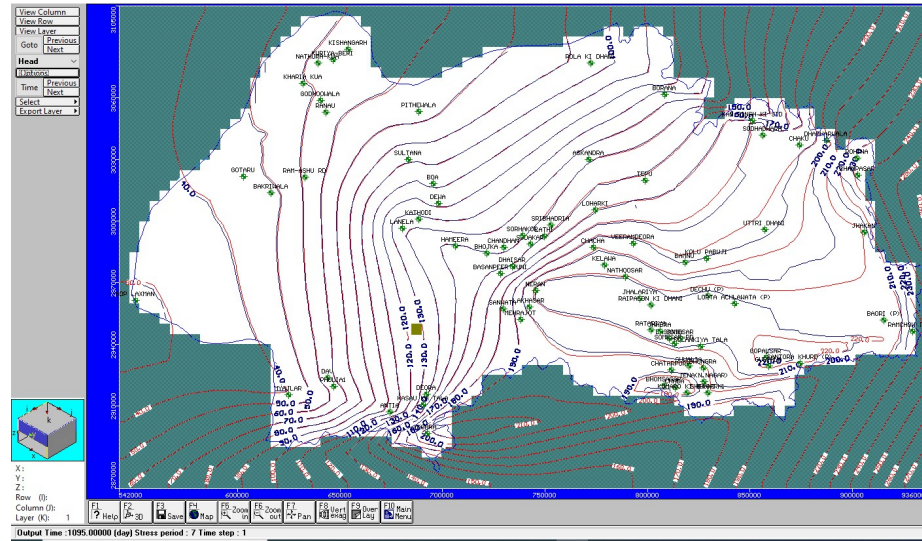


Figure 22: Initial Vs Calculated Potentiometric Head Contours Day 1095 (Nov 2016)

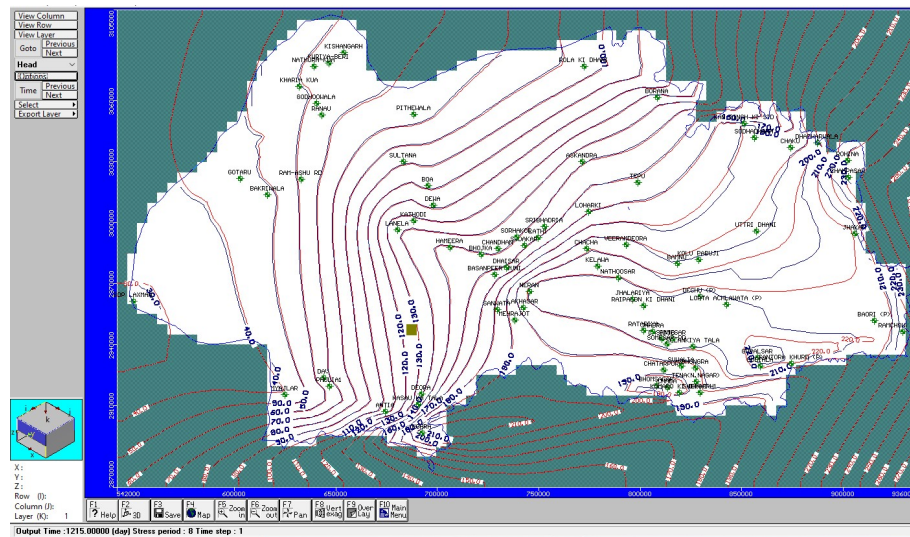


Figure 23: Initial Vs Calculated Potentiometric Head Contours Day 1215 (May 2017)

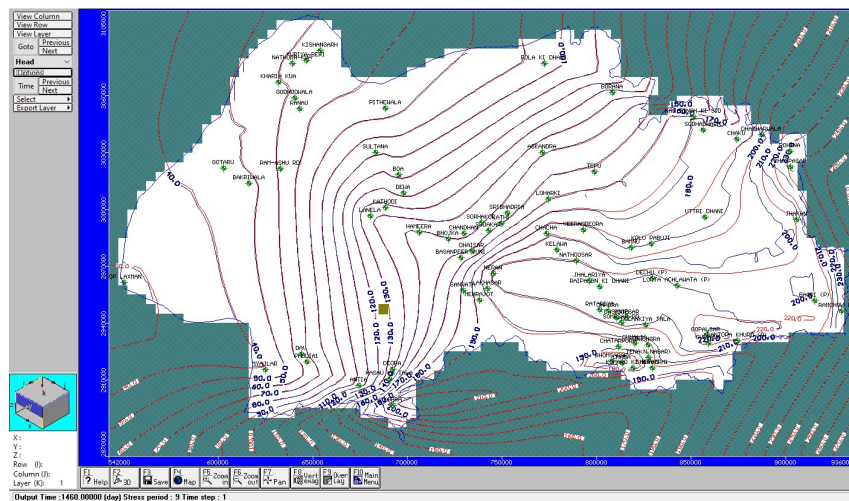


Figure 24: Initial Vs Calculated Potentiometric Head Contours Day 1460 (Nov 2017)

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

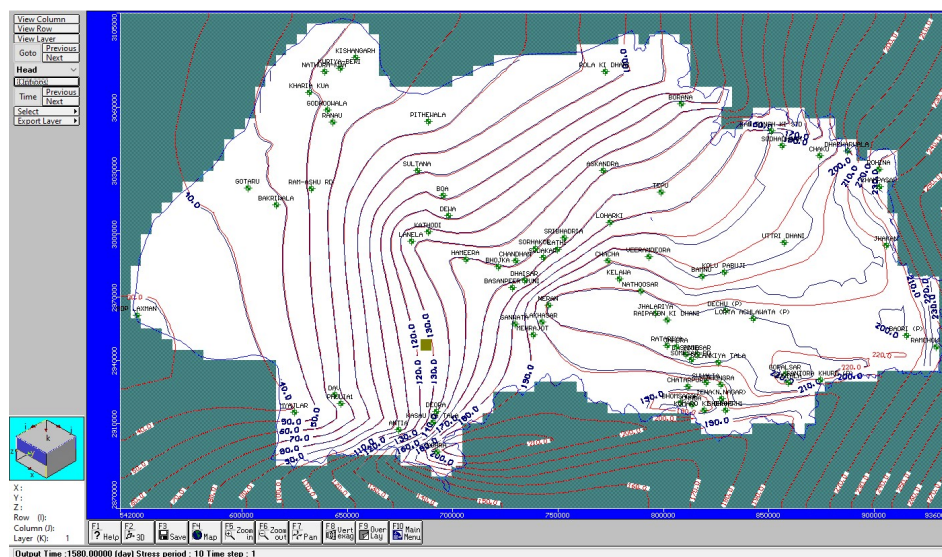


Figure 25: Initial Vs Calculated Potentiometric Head Contours Day 1580 (May 2018)

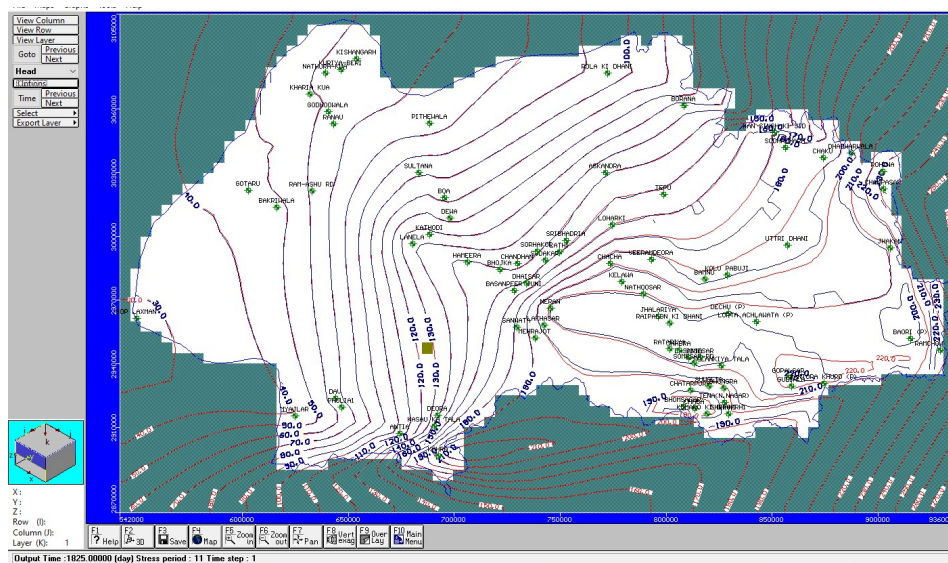
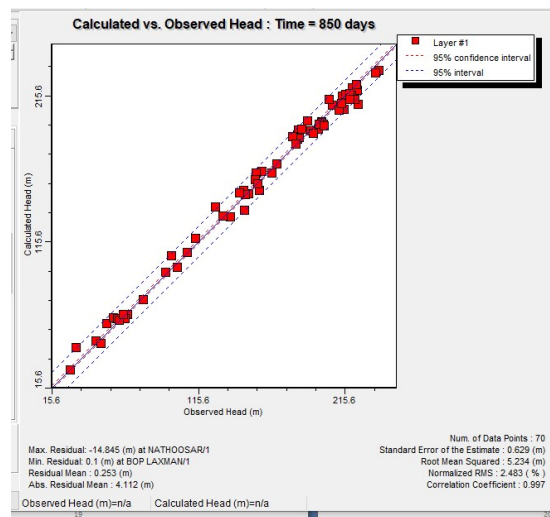
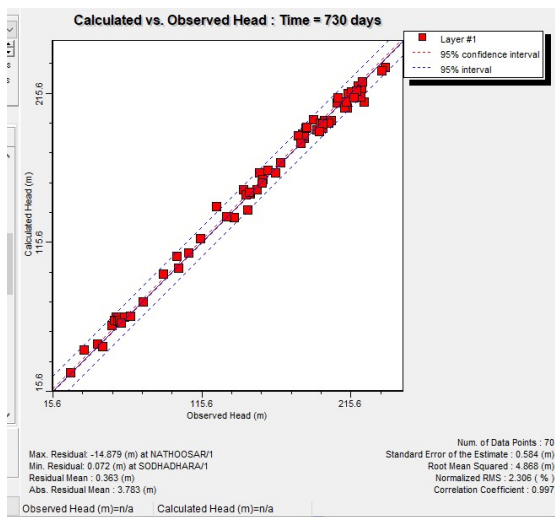
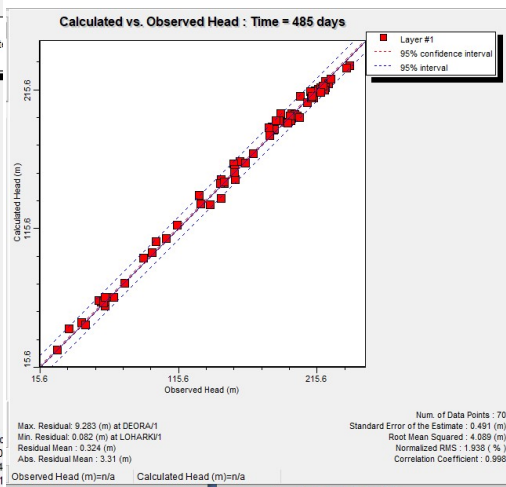
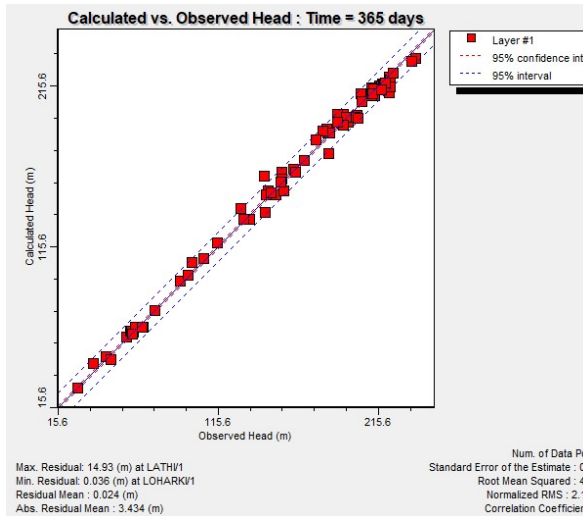
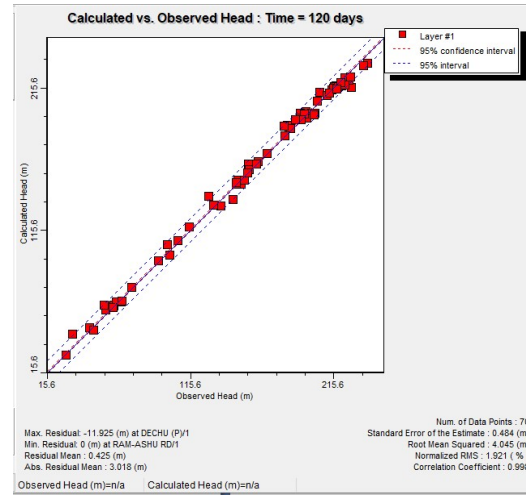
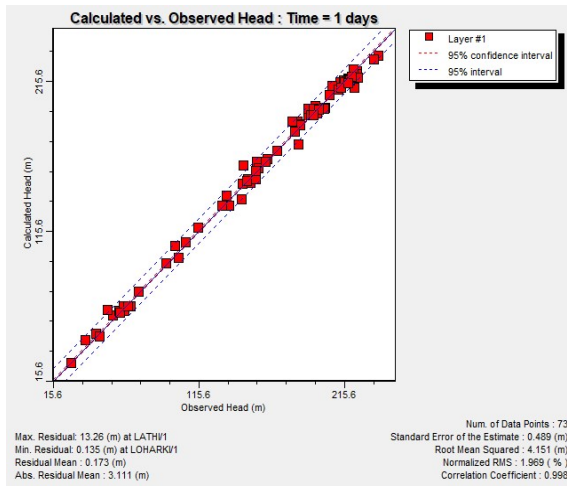


Figure 26: Initial Vs Calculated Potentiometric Head Contours Day 1825 (Nov 2018)

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)



**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

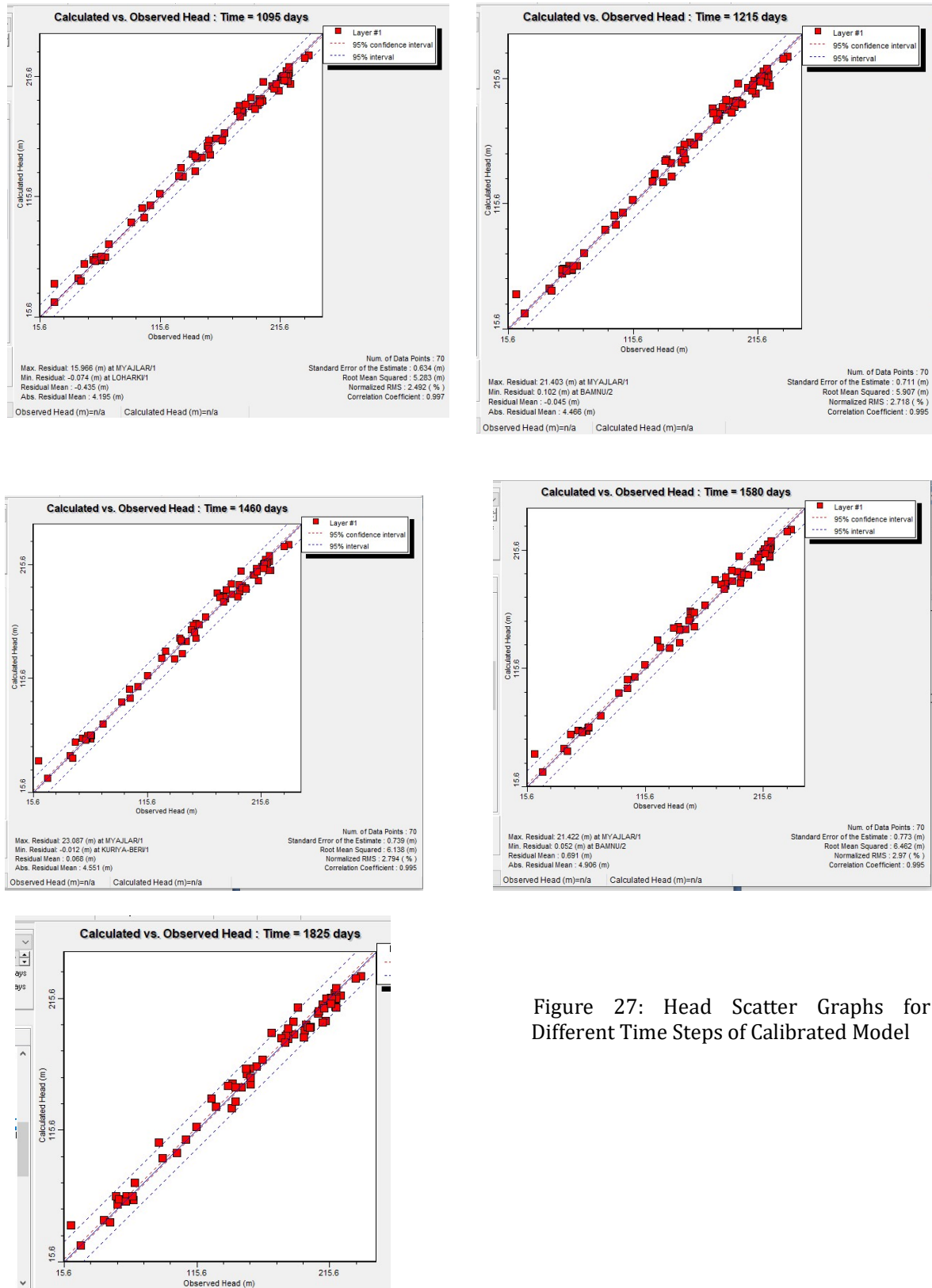


Figure 27: Head Scatter Graphs for Different Time Steps of Calibrated Model

Observed and Calculated Head Difference

The difference in observed/ measured head values and the values calculated by the model for each time step viz. calibrated as well as validated is presented in the tables 4. The hydrographs of some wells with observed and calculated heads are shown in Figure 28.

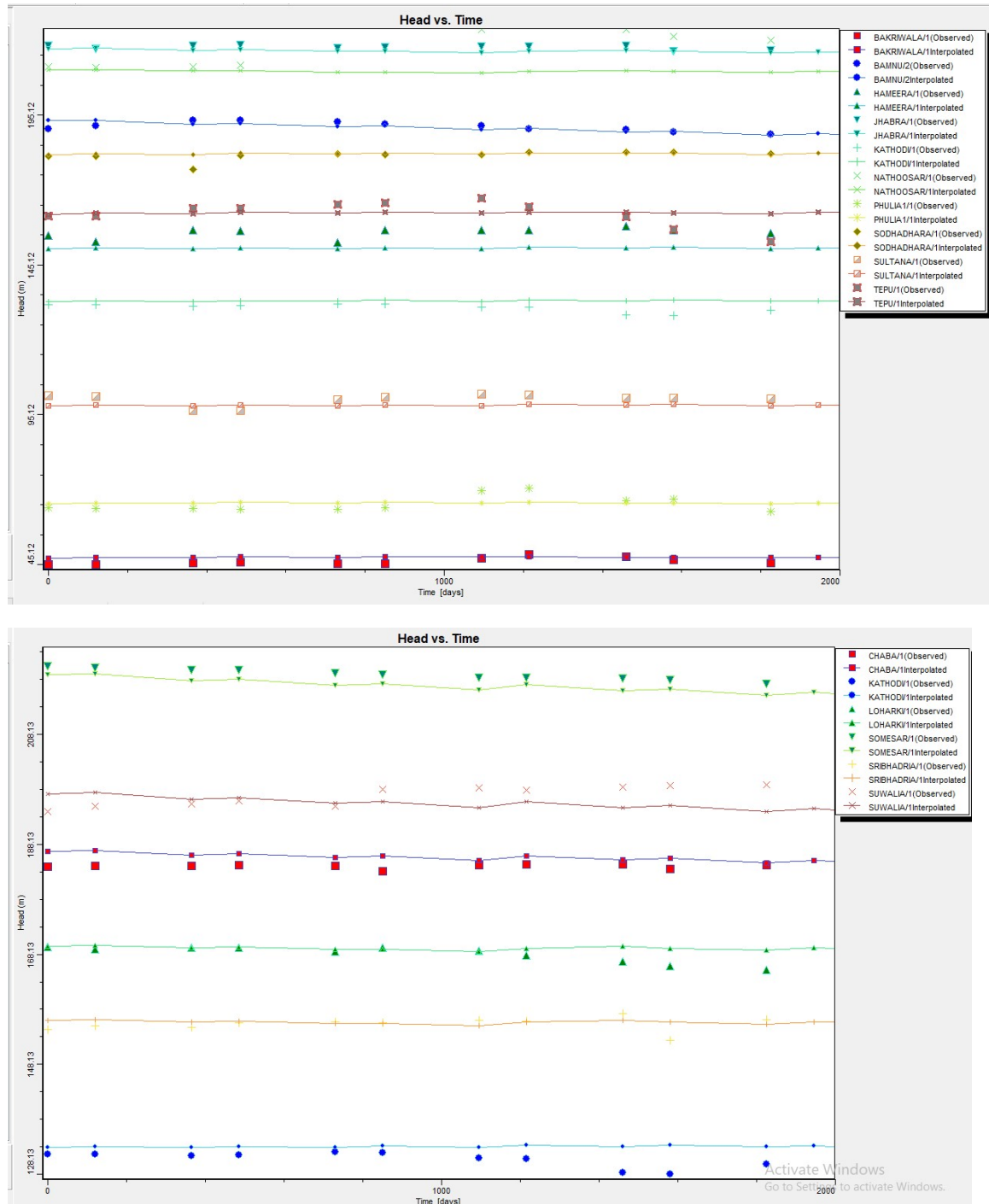


Figure 28: Hydrographs of Observation Points

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 4: Difference in Observed and Calculated heads of Calibrated Data for 2014 to 2018

	Initial	Pre 2014	Post 2014	Pre 2015	Post 2015	Pre 2016	Post 2016	Pre 2017	Post 2017	Pre 2018	Post 2018
Well/Point Name	1	120	365	485	730	850	1095	1215	1460	1580	1825
ANTIA/1	6.28	6.54	6.64	6.86	6.69	7.32	9.16	6.06	5.48	6.18	5.70
ASKANDRA/1	-3.05	-2.84	-2.93	-3.37	-0.51	0.08	-1.52	-1.60	-6.13	-1.08	-1.77
BAKRIWALA/1	2.13	2.36	2.31	2.19	1.76	2.41	2.28	0.56	-0.93	-0.25	0.61
BAMNU/2	2.77	2.92	0.55	-0.91	-2.22	-1.22	-1.84	-0.60	-0.61	-0.15	-0.84
BAORI (P)/2	2.01	1.14	-4.44	-3.96	-7.32	-6.98	-11.41	-10.75	-12.86	-12.02	-14.86
BASANPEERJUNI/1	0.86	1.08	1.08	1.25	3.95	4.24	4.84	1.81	3.02	5.68	9.94
BHOJKA/1	1.70	1.92	1.84	3.86	4.43	7.22	4.39	8.73	8.74	7.21	7.11
BHOMSAGAR/1	5.76	5.86	5.32	5.52	5.11	5.35	5.02	5.80	4.78	5.11	4.69
BHUNGRA/1	3.41	3.64	1.90	4.31	-0.09	-0.24	-2.91	-1.64	-2.36	-1.94	-2.19
BOA/1	1.45	1.67	1.62	1.74	1.69	1.61	0.24	1.45	1.19	1.36	1.41
BOP LAXMAN/1	0.20	0.20	-0.40	0.30	-0.10	0.50	0.10	0.50	-0.50	-0.10	-0.70
BORANA/1	-4.10	-3.90	-4.24	-2.83	-6.13	-4.34	-5.18	-1.48	-7.15	-6.56	-3.81
CHABA/1	2.70	2.90	1.88	2.23	1.34	1.82	1.99	1.69	0.72	1.15	1.16
CHACHA/1	-4.48	-4.35	-2.30	-4.73	-2.14	-5.38	-2.86	-0.36	4.53	1.13	3.44
CHAKU/1	1.20	1.65	1.26	2.20	2.18	2.92	2.83	3.45	3.37	3.97	3.92
CHAMPASAR/1	-5.96	-5.55	-6.33	-5.66	-6.27	-5.59	-5.95	-6.34	-6.63	-6.92	-6.87
CHANDHAN/1	2.22	2.45	0.21	2.48	2.19	2.66	0.04	2.45	2.46	2.54	2.96
CHATARPURA/1	-2.44	-2.21	-3.66	-3.27	-4.44	-3.84	-5.56	-4.04	-5.30	-4.71	-5.85
DASANIA/1	1.29	1.49	-0.63	-0.31	-2.06	-1.35	-2.32	-1.07	-2.28	-1.82	-2.66
DAV/1	-3.19	-2.98	-1.45	-2.68	-3.03	7.83	-1.69	3.63	1.43	2.61	-2.26
DECHU (P)/1	-3.64	-3.51	-13.36	3.32	-0.66	0.04	-4.20	-2.84	-0.35	0.60	-2.37
DEORA/1	4.54	4.77	11.13	10.27	9.10	14.12	12.47	6.81	7.00	8.12	13.19
DEWA/1	3.08	3.31	3.30	3.42	3.53	3.80	4.32	3.03	2.86	2.66	2.71
DHADHARWALA/1	7.04	7.48	5.47	8.28	8.60	7.92	8.15	6.96	8.18	9.16	9.36
DHAISAR/1	6.53	6.77	6.40	7.19	6.55	7.99	7.46	6.41	5.73	6.74	6.85

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

	Initial	Pre 2014	Post 2014	Pre 2015	Post 2015	Pre 2016	Post 2016	Pre 2017	Post 2017	Pre 2018	Post 2018
Well/Point Name	1	120	365	485	730	850	1095	1215	1460	1580	1825
GODHOOWALA/1	1.33	1.55	1.57	1.75	2.62	3.61	2.66	-3.41	-3.72	-3.42	-3.69
GOPALSAR/2	-1.69	-1.52	-1.96	-0.85	-1.09	0.29	-0.59	0.39	-0.17	1.50	0.40
GOTARU/1	-1.64	-1.42	-2.41	-2.65	-2.65	-2.97	-3.03	-3.45	-4.20	-4.26	-4.12
GUDIALA/1	-3.42	-3.27	-6.78	-3.37	-5.23	-3.67	-5.95	-3.70	-6.08	-4.04	-4.71
HAMEERA/1	-4.34	-4.13	-2.33	-5.93	-5.83	-1.75	-6.30	-5.92	-6.10	-7.15	-6.26
JHABRA/1	-1.07	-0.93	-0.42	-1.43	-2.09	-1.03	-1.91	-1.49	-2.01	-2.14	-0.78
JHAKAN/1	5.36	5.30	4.92	6.08	5.26	3.06	0.48	-0.44	-1.16	-2.72	-3.08
JHALARIYA/1	-1.12	-0.98	-1.00	-1.33	-3.99	1.97	1.58	-1.45	-1.37	-1.98	-4.31
KAN SINGH KI SID/1	-10.20	-9.80	-10.62	-10.74	-11.22	-13.20	-13.74	-13.06	-12.59	-12.93	-13.10
KASAU KA TALA/1	13.45	13.70	13.80	21.50	18.88	21.83	19.25	24.34	24.12	23.99	23.12
KATHODI/1	1.21	1.42	1.24	1.79	1.44	1.17	0.99	2.43	2.24	5.02	4.95
KELAWA/1	0.92	1.06	1.69	0.82	-2.97	-5.60	-6.06	-4.21	-5.06	-3.96	-4.79
KHARIA KUA/1	2.74	2.95	3.09	1.50	-3.13	4.49	6.98	7.22	1.20	7.26	7.09
KISHANGARH/1	10.04	10.26	7.83	3.01	5.06	6.94	6.18	3.81	3.73	4.72	4.81
KOHRA/1	-21.27	-21.15	-24.49	-18.86	-18.63	-18.03	-18.88	-18.02	-19.02	-18.13	-25.44
KOLU PABUJI/2	0.25	0.40	0.61	3.05	3.84	6.98	7.29	10.45	11.58	13.57	14.44
KUMARO KI DHANI/1	8.84	9.08	6.87	7.42	6.19	7.20	6.45	7.96	6.41	7.55	6.07
KURIYA-BERI/1	1.62	1.84	0.77	0.12	0.32	4.09	2.39	-2.04	-3.55	-0.03	0.32
LANELA/1	-7.93	-7.73	-8.38	-7.75	-9.27	-8.97	-10.01	-7.02	-9.35	-8.92	-7.54
LOHARKI/1	0.13	0.28	0.26	0.13	-0.31	0.41	-0.63	0.51	1.01	2.26	2.74
LORTA ACHLAWATA (P)/	-0.91	-0.69	-1.43	1.33	1.88	5.87	6.70	10.25	10.32	12.71	14.01
MYAJLAR/1	5.10	5.34	9.72	5.68	6.83	6.92	11.34	16.10	21.23	23.08	21.28
NATHOOSAR/1	-1.18	-1.04	-1.10	-1.29	-2.16	-14.92	-15.19	-13.93	-15.31	-14.15	-12.14
NATHURA-KUA/1	-1.85	-1.65	0.65	1.87	1.50	3.07	-2.56	0.71	4.05	0.68	-0.04
NERAN/1	-10.77	-10.67	-11.15	-10.93	-9.71	-11.26	-11.83	-10.17	-10.54	-10.32	-9.29
PHULIA1/1	1.32	1.54	1.62	2.10	2.10	2.38	1.67	-3.90	-5.00	-0.76	-1.57
PHULIA2/1	-8.69	-8.47	-8.50	-8.21	-8.41	-8.14	-8.34	-8.22	-8.41	-8.42	-8.59

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

	Initial	Pre 2014	Post 2014	Pre 2015	Post 2015	Pre 2016	Post 2016	Pre 2017	Post 2017	Pre 2018	Post 2018
Well/Point Name	1	120	365	485	730	850	1095	1215	1460	1580	1825
PITHEWALA/1	1.16	1.39	1.29	-0.02	-0.65	-0.33	-1.81	3.53	-0.47	-0.68	-2.18
RAIPALON KI DHANI/1	-1.66	-1.52	-4.09	-1.85	-4.95	0.56	0.06	-5.61	-7.34	-4.65	-5.48
RAM-ASHU RD/1	-0.19	0.03	-0.03	0.22	0.24	0.49	0.41	0.41	-0.02	0.36	-0.64
RAMCHOWKI (P)/2	1.56	1.56	-3.49	-1.09	-2.19	0.08	0.39	1.01	0.96	0.99	1.42
RANAU/1	-1.53	-1.31	-1.95	-1.82	3.37	-1.40	1.47	-0.79	-1.97	0.12	-1.93
RATARIYA/2	-3.04	-2.91	-2.91	-3.32	-3.62	-3.73	-4.35	-4.31	-4.88	-3.98	-4.69
ROHINA/1	-5.22	-4.80	-5.90	-4.96	-5.80	-5.03	-5.38	-4.69	-4.77	-4.78	-4.77
SANTORA KHURD (P)/2	-6.50	-6.77	-8.15	-7.91	-8.00	-9.10	-10.66	-9.67	-12.24	-11.62	-12.71
SODAKAR/1	1.57	1.80	1.40	2.62	2.23	1.72	3.80	3.69	5.02	3.82	4.14
SODHADHARA/1	0.46	0.89	0.42	5.56	0.53	0.34	0.37	0.52	-0.51	-0.24	-0.73
SOLANKIYA TALA/1	-1.69	-1.47	-1.98	-1.33	-2.13	-2.58	-3.77	-2.12	-2.32	-2.64	-3.32
SOMESAR/1	-1.49	-1.31	-2.43	-1.69	-2.80	-1.97	-2.86	-1.18	-2.39	-1.91	-2.89
SOMESAR-PD/1	-3.20	-3.00	-4.28	-3.96	-5.20	-4.46	-6.86	-5.62	-5.93	-5.35	-6.15
SORHAKOR/1	0.29	0.51	1.43	0.56	0.34	2.18	5.76	5.00	8.10	4.39	9.75
SRIBHADRIA/1	1.61	1.77	0.61	1.00	-0.23	-0.35	-0.58	-0.39	-0.47	-1.70	2.84
SULTANA/1	-3.29	-3.08	-3.12	1.81	1.65	-1.73	-2.79	-3.43	-3.42	-2.13	-2.43
SUWALIA/1	3.23	3.46	1.25	1.06	-0.45	0.90	-3.27	-2.44	-3.19	-3.40	-4.74
TENA(N.NAGAR)/1	-1.31	-1.09	-6.26	-7.30	-8.19	-1.73	-7.01	-3.25	-8.80	-7.99	-9.50
TEPU/1	0.64	1.08	0.63	-1.31	-1.61	-2.64	-3.36	-4.68	-2.18	1.52	5.13
UTTRI DHANI/1	0.85	0.78	-1.22	-2.07	-4.58	-4.50	-5.62	-5.88	-7.14	-7.74	-10.06
VEERAMDEORA/2	-1.32	-1.18	4.30	2.95	6.70	6.74	6.66	6.26	5.36	8.15	8.45

Model Validation

The transient model was validated for two years viz. May 2019, November 2019, May 2020 and November 2020. The calculated and observed values of head was found to be comparatively matching with RMS error of 5.72 and 6.16 and the normalised RMS error varies between 2.7 and 2.92 for 2019 and 2020 respectively. The head scatter plot for validation periods is shown in figure 29. The normalised RMS of all the time steps is shown in figure 30.

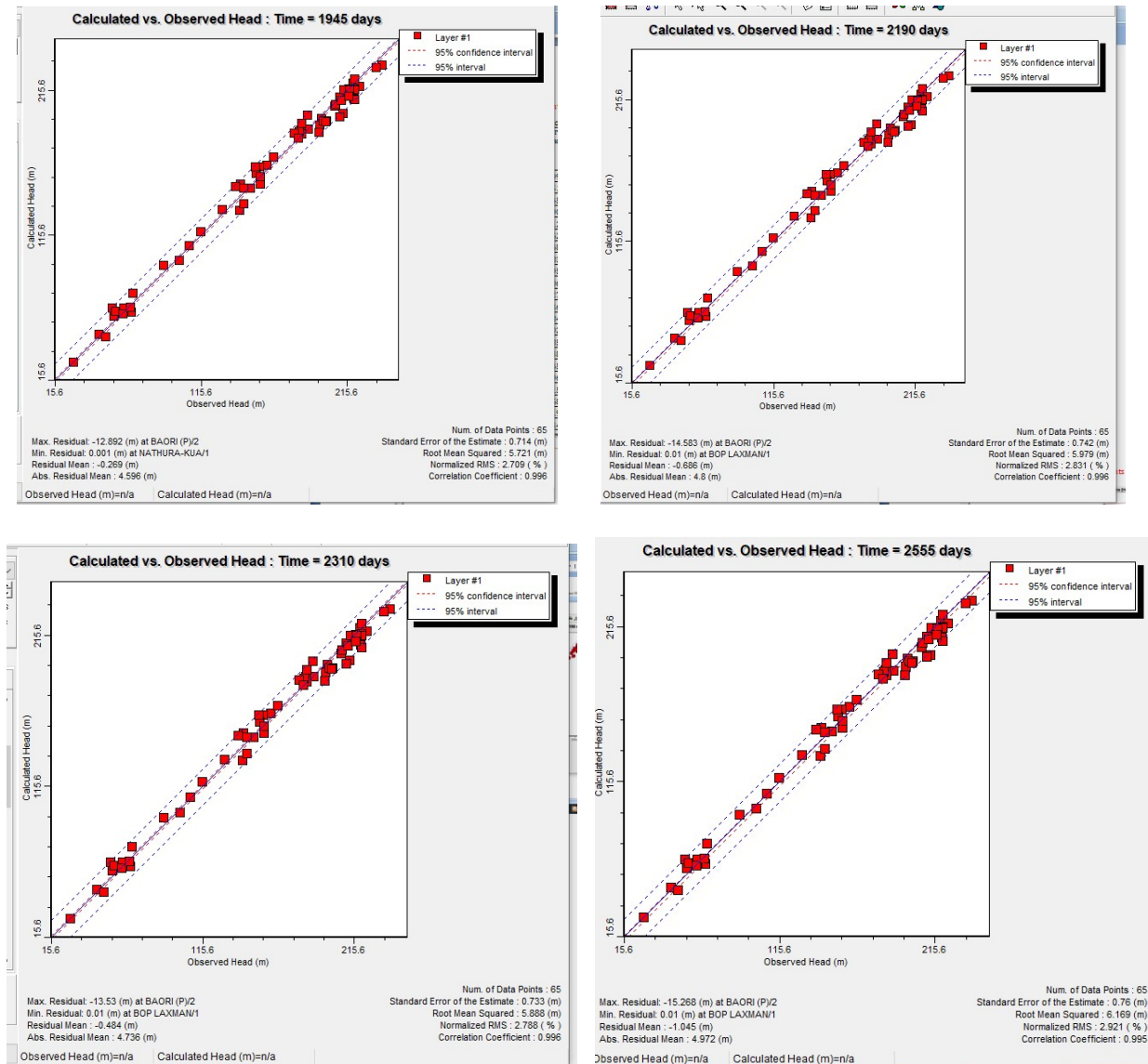


Figure 29 : Head Scatter Graph of Observation Points for Validation Periods 2019 and 2020.

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

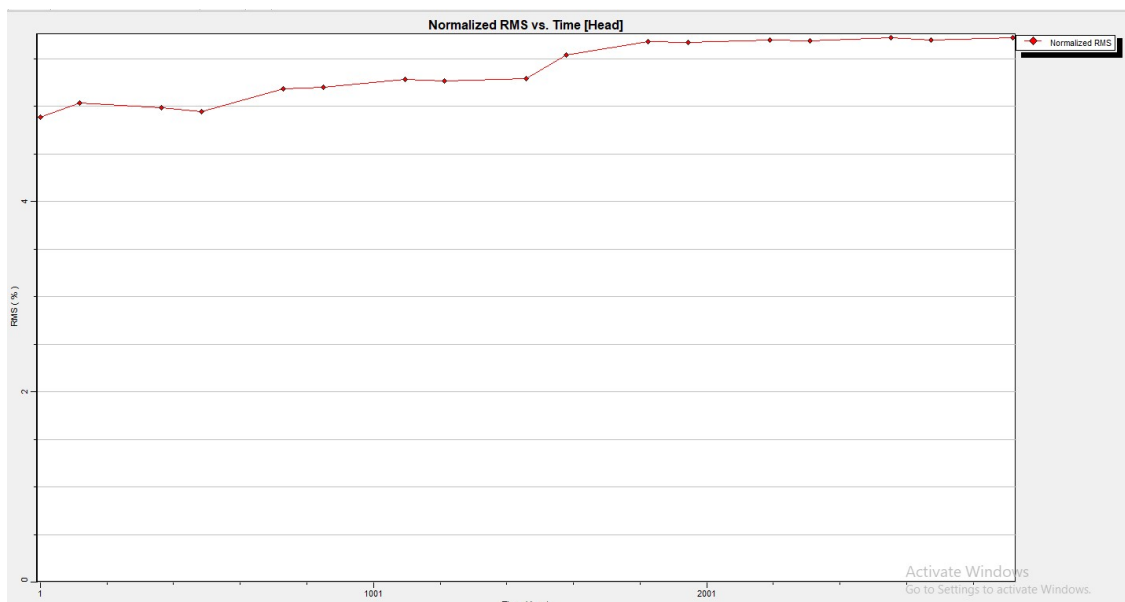


Figure 30 : Normalised RMS of all the time steps.

Table 5 : Calculated vs observed heads of validated data for 2019 and 2020

Well/Point Name	Validation			
	2019		2020	
	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
ANTIA/1	19.35	24.48	26.61	26.28
ASKANDRA/1	-1.01	-0.69	-0.35	-0.52
BAKRIWALA/1	1.65	0.76	4.38	4.52
BAMNU/2	0.27	-0.24	-0.44	-0.19
BAORI (P)/2	-13.81	-15.61	-13.71	-17.20
BASANPEER JUNI/1	3.61	1.67	3.47	2.88
BHOJKA/1	8.54	-3.48	9.36	9.69
BHOMSAGAR/1	4.81	3.85	3.60	3.48
BHUNGRA/1	-1.66	-5.34	-2.77	-3.03
BOA/1	1.08	-22.94	-23.10	-23.76
BOP LAXMAN/1	0.01	-0.10	0.50	0.10
BORANA/1	-9.43	-2.39	-2.06	-9.74
CHABA/1	0.72	-0.68	-0.71	-1.17
CHACHA/1	-13.20	-9.69	-11.49	-10.79
CHAKU/1	4.51	6.55	6.82	8.17
CHAMPASAR/1	-6.65	0.02	0.77	2.56
CHANDHAN/1	3.43	14.61	9.45	11.29
CHATARPURA/1	-5.48	-3.82	-3.75	-4.51
DASANIA/1	-2.07	-1.68	-1.13	-1.42
DAV/1	10.44	14.68	15.30	27.93
DECHU (P)/1	0.50	-1.58	-0.80	0.83

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Well/Point Name	Validation			
	2019		2020	
	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
DEORA/1	13.09	20.26	21.88	21.02
DEWA/1	2.99	5.86	3.71	2.04
DHADHARWALA/1	9.57	9.31	9.28	9.06
DHAISAR/1	6.98	12.22	15.58	-15.02
GODHOOWALA/1	-5.13	6.27	6.38	6.52
GOPALSAR/2	1.00	2.25	4.62	1.83
GOTARU/1	-4.56	8.37	-1.51	-2.87
GUDIALA/1	-5.45	-6.70	-4.34	-5.64
HAMEERA/1	-4.90	-4.19	-4.35	-4.53
JHABRA/1	-1.00	-1.43	-10.23	-3.10
JHAKAN/1	-2.96	-3.81	-3.67	-6.32
JHALARIYA/1	1.98	-16.79	-6.10	-16.89
KAN SINGH KI SID/1	-13.17	19.04	18.79	18.62
KASAU KA TALA/1	24.28	27.89	29.02	29.17
KATHODI/1	3.34	3.81	0.15	-2.52
KELAWA/1	-2.11	-6.64	-8.44	-5.73
KHARIA KUA/1	3.75	-13.74	-12.62	-11.99
KISHANGARH/1	6.19	-5.02	-5.40	-8.76
KOHRA/1	-24.43	-24.31	-23.23	-24.17
KOLU PABUJI/2	17.03	17.40	18.68	23.32
KUMARO KI DHANI/1	7.06	8.04	9.12	6.87
KURIYA-BERI/1	0.44	-5.13	-5.01	-9.37
LANELA/1	-7.39	1.72	3.55	2.87
LOHARKI/1	3.53	3.16	3.36	-0.93
LORTA ACHLAWATA (P)/1	17.85	18.28	22.06	22.79
MYAJLAR/1	22.33	26.90	16.52	10.17
NATHOOSAR/1	-10.85	-1.35	0.34	-7.95
NATHURA-KUA/1	-0.15	2.49	2.11	2.23
NERAN/1	-8.95	14.42	-29.40	-30.70
PHULIA1/1	2.68	2.54	2.55	2.43
PHULIA2/1	-8.58	-8.72	-8.71	-8.83
PHULIA3/1	-24.48	-24.61	-24.60	-24.73
PHULIA4/1	-24.72	-24.85	-24.84	-24.96
PITHEWALA/1	6.63	6.53	6.15	4.29
RAIPALON KI DHANI/1	-4.53	-5.41	-5.22	-5.51
RAM-ASHU RD/1	-0.60	-3.64	-36.02	-35.88
RAMCHOWKI (P)/2	2.91	3.05	4.66	4.92
RANAU/1	-1.33	9.48	9.60	10.23
RATARIYA/2	-5.19	-0.69	1.51	2.21
ROHINA/1	-4.61	-1.09	-0.82	-0.48

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Well/Point Name	Validation			
	2019		2020	
	Pre monsoon	Post monsoon	Pre monsoon	Post monsoon
SANTORA KHURD (P)/2	-11.38	-9.29	-7.85	-8.14
SODAKAR/1	5.26	17.29	16.64	18.48
SODHADHARA/1	0.12	26.75	27.52	27.36
SOLANKIYA TALA/1	-2.47	-0.87	-2.81	-3.08
SOMESAR/1	-1.80	-1.06	0.47	-0.33
SOMESAR-PD/1	-5.22	-7.51	-6.45	-7.73
SORHAKOR/1	10.24	7.95	7.29	10.63
SRIBHADRIA/1	-0.85	-4.76	-3.06	-3.84
SULTANA/1	-1.97	-4.09	-4.25	-5.42
SUWALIA/1	-4.52	-7.11	-5.53	-6.29
TENA(N.NAGAR)/1	-7.16	-2.38	0.69	-1.57
TEPU/1	9.66	11.95	14.22	7.07
UTTRI DHANI/1	-9.41	-9.86	-9.27	-11.80
VEERAMDEORA/2	8.11	7.38	13.08	8.29

Cumulative Budget – Transient State

Block-wise budget zones were calculated using zone-budget to determine the overall hydraulic budget for the area. The ground water budget for transient state simulation in all 14 blocks presents an accounting of recharge to block, discharge from the block and flow between hydrogeologic units viz., Storage, Constant Heads, Wells, Recharge etc in the block. The ground water of each formation (zone for the transient run for different stress periods along with the percent discrepancy between the total in and out is given in Table 7 A to table 7 N.

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 A: Budget of ground water for the transient run in Sam Block, Jaisalmer District

Zone 2	Sam Block, Jaisalmer District															
	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8	Period 9	Period 10	Period 11	Period 12	Period 13	Period 14	Period 15	Period 16	Period 17
	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Storage	0	40450	0	261280	0	270240	0	250180	36693	209160	1955.5	179280	569.28	157430	230.43	141450
Constant Head	854.59	830.12	799.07	787.88	758.48	749.13	730.01	721.78	712.68	703.9	694.62	685.73	676.47	667.77	658.64	650.62
Recharge	628680	0	838230	0	838230	0	419120	6270.7	0	0	0	0	0	0	0	0
Zone 1 to 2	7366.1	7080.2	6828.7	6703	6368.8	6333.6	6098.2	968.79	6237.6	8399.4	8259.5	35484	32341	56663	51306	72166
Zone 3 to 2	960.93	925.33	913.49	918.06	925.25	892.49	974.31	494.61	1023.9	975.71	1030.4	946.37	1003.4	923.95	982.57	906.39
Zone 5 to 2	558.69	527.14	514.59	499.52	477.77	467.48	501.77	258630	502.63	484.4	487.55	451.05	456.86	424.32	431.62	401.42
Total IN	638420	49813	847290	270190	846770	278690	427420	6606	45170	219720	12428	216840	35047	216110	53609	215580
Storage	580010	920.3	737380	0	726410	0	332030	0	235.95	0	2334	0	27803	0	47103	0
Constant Head	0	8017.5	7948.9	7529.5	7472.8	7075.6	6973.1	6606	6461	6128.4	5999.3	5695.8	5580.3	5302	5198.1	4942
Recharge	0	0	0	209560	0	209560	0	209560	0	209560	0	209560	0	209560	0	209560
Zone 2 to 1	49526	40386	101470	52607	112390	61555	87937	41991	38010	3559.7	3635.5	1111.1	1199.4	768.1	839.95	589.86
Zone 2 to 3	480.68	488.68	493.84	490.19	490.52	496.84	476.54	476.35	462.23	473.06	459.04	478.77	464.01	482.64	467.33	485.25
Zone 2 to 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total OUT	638420	49813	847290	270190	846760	278690	427420	258630	45170	219720	12428	216840	35046	216110	53609	215580
Difference: In-Out	-0.45474	0.077	0.05113	-0.04684	0.24128	-0.19207	0.039877	-0.00194	0.50931	0.063103	-0.28399	-0.01975	0.291	0.024269	0.38397	0.23933
Percent Discrepancy	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 B: Budget of ground water for the transient run in Jaisalmer Block, Jaisalmer District

Zone 3	Jaisalmer Block, Jaisalmer District																
Time	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	123590	0	127570	0	239370	0	148290	0	246810	0	333830	0	311080	0	294600
Constant Head	12.953	7.149	11.622	5.8602	10.49	2.8487	11.552	0.98867	5.3303	0.9992	8.9668	3.2857		9.2131	22.989	14.247	28.41
Recharge	356080	356080	0	356080	0	474770	0	712150	0	356080	0	356080	0	356080	0	356080	0
Zone 1 to 3	1787.5	1742.8	1814.3	1613.7	1755.7	1494.2	2617.4	1383.5	1345.5	1281.1	2049.4	1190.4	23149	1734.1	45636	13025	62022
Zone 2 to 3	480.11	480.68	488.68	493.84	490.19	490.52	496.84	476.54	476.35	462.23	473.06	459.04	478.77	464.01	482.64	467.33	485.25
Zone 4 o 3	456.81	490.15	465.3	509.01	501.55	500.21	513.96	480.56	478.41	478.96	476.5	466.58	465.44	456.44	456.82	448.48	449.95
Zone 5 to 3	833.99	824.92	785.33	769.62	738.4	695.97	694.43	717	710.76	699.5	693.96	673.36	651.08	633.31	615.65	599.75	585.25
Total IN	359650	359620	127160	359470	131070	477950	243700	715210	151310	359000	250510	358870	358590	359370	358300	370630	358170
Output Report																	
Storage	356870	328190	0	323310	0	428880	0	653360	0	301120	0	318980	0	347200	0	367570	0
Constant Head	2003.8	1985.3	1877.4	1861.7	1759.6	1755.5	1641.1	1659	1563.9	1556	1450	1445	1331.4	1330.1	1226.7	1227.8	1132.3
Recharge	0	0	118690	0	118690	0	237380	0	118690	0	237380	0	356080	0	356080	0	356080
Zone 3 to 1	274.54	28440	5613.3	33338	9648.3	46340	3737.8	59168	30032	55252	10648	37358	182.13	9779.8	13.959	788.19	0
Zone 3 to 2	957.59	960.93	925.33	913.49	918.06	925.25	892.49	974.31	968.79	1023.9	975.71	1030.4	946.37	1003.4	923.95	982.57	906.39
Zone 3 to 4	51.717	48.506	51.004	46.693	47.351	47.821	46.085	50.066	50.114	50.288	50.219	51.497	51.158	52.358	51.887	53.031	52.467
Zone 3 to 5	0	0	0	0	0	1.2219	1.132	0	0.17345	0.82445	0.92636	2.1048	3.1065	4.138	4.8874	5.8147	6.383
Total OUT	360160	359620	127160	359470	131070	477950	243700	715210	151310	359000	250510	358870	358590	359370	358300	370630	358180
Difference:																	
IN-OUT	-512.72	0.40416	0.01981	0.013279	-0.04586	0.38781	0.037227	0.068836	0.19425	0.25447	0.07597		0.03997	0.28036	-0.29088	-0.24508	-0.09232
Percent Discrepancy	-0.14%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 C: Budget of ground water for the transient run in PhalodiBlock, Jodhpur District

Zone 4	Phalodi Block, Jodhpur District																
Stress Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (Days)	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input																	
Storage	0	0	84740	0	55635	0	56197	0	53873	0	86914	0	113530	0	103460	0	96090
Constant Head	24.498	18.385	23.827	16.625	20.271	16.536	20.139	17.46	20.876	18.117	23.424	21.529	28.338	26.075	32.242	29.714	35.416
Recharge	242310	242310	0	282700	0	161540	0	121150	0	121150	0	80770	0	80770	0	80770	0
Zone 1 to 4	392.93	383.09	465.4	354.62	368.52	328.26	391.44	330.31	449.43	343.53	840.34	538.42	9477.4	3005.9	19265	11474	26601
Zone 3 to 4	51.717	48.506	51.004	46.693	47.351	47.821	46.085	50.066	50.114	50.288	50.219	51.497	51.158	52.358	51.887	53.031	52.467
Zone 5 to 4	152	142.51	138.64	125.04	119.07	109.15	105.29	119.24	118.23	115.56	114.62	111.98	106.31	104.16	99.362	97.574	93.402
Zone 6 to 4	364.74	312.89	172.95	132.65	52.568	59.486	12.969	27.363	8.2796	6.8879	0	0.2819	0	0	0	0	0
Zone 12 to 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total IN	243300	243220	85591	283370	56243	162100	56773	121700	54520	121690	87943	81494	123200	83958	122910	92424	122870
Output Report																	
Storage	242050	223380	0	257050	0	135280	0	97658	0	99581	0	68964	0	81342	0	90400	0
Constant Head	392.93	383.09	363.82	354.62	336.78	328.26	311.75	303.86	288.57	281.27	267.12	260.36	247.26	241.01	228.88	223.09	211.85
Recharge	0	0	80770	0	40385	0	40385	0	40385	0	80770	0	121150	0	121150	0	121150
Zone 4 to 1	174.04	18807	3784.2	25212	14668	25646	15035	22819	12794	20753	5681.7	11059	471.59	1069.5	113.57	410.12	13.959
Zone 4 to 3	456.81	490.15	465.3	509.01	501.55	500.21	513.96	480.56	478.41	478.96	476.5	466.58	465.44	456.44	456.82	448.48	449.95
Zone 4 to 5	13.936	20.217	22.136	30.981	34.286	40.602	42.615	34.408	34.727	36.569	36.671	38.419	41.251	42.726	45.077	46.36	48.366
Zone 4 to 6	78.349	84.433	103.31	119.24	193.09	182.33	326.39	253.67	359.19	372.21	499.43	490.72	583.04	571.07	657.36	643.33	724.97
Zone 4 to 12	38.56	49.561	82.56	91.828	124.03	125.59	158.44	150.39	180.06	186.89	211.27	214.68	232.76	235.23	251.31	253.13	267.73
Total OUT	243200	243210	85591	283370	56243	162100	56773	121700	54520	121690	87943	81494	123200	83958	122910	92424	122870
Difference:																	
IN - OUT	93.969	0.40977	0.095629	0.12334	-0.13592	-0.2593	-0.14933	0.05032	0.026095	-0.057	-0.02888	0.11722	0.17312	0.18006	0.35807	-0.08352	0.2012
PercentDiscrepancy	0.04%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 D: Budget of ground water for the transient run in SankraBlock, Jaisalmer District

Zone 5	Sankra Block, Jaisalmer District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	148090	0	132050	21674	113500	0	81835	0	123730	0	204180	0	183460	0	168530
Constant Head	2343.5	2282.8	2190.2	2135	2049.3	2002.9	1927.4	1855.4	1778.6	1732.5	1670.7	1629.6	1587.1	1546.8	1506.3	1467.1	1429.9
Recharge	109330	109330	0	54667	0	0	0	382670	0	54667	0	0	0	0	0	0	0
Zone 1 to 5	575.14	561.12	18036	11870	34001	34880	52472	16372	29624	22270	42443	38083	71216	63751	91844	82186	106700
Zone 2 to 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 3 to 5	0	0	0	0	0	1.2219	1.132	0	0.17345	0.82445	0.92636	2.1048	3.1065	4.138	4.8874	5.8147	6.383
Zone 4 to 5	13.936	20.217	22.136	30.981	34.286	40.602	42.615	34.408	34.727	36.569	36.671	38.419	41.251	42.726	45.077	46.36	48.366
Zone 6 to 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 8 to 5	9.818	9.8796	0	0.94957	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 9 to 5	124.62	128.08	90.677	98.46	74.155	88.553	60.23	78.645	49.098	57.04	34.779	45.605	32.41	42.969	30.444	40.058	28.344
Total IN	112400	112340	168420	68802	168210	58687	168010	401010	113320	78764	167920	39799	277060	65387	276890	83745	276740
Output Report																	
Storage	108300	99165	0	64504	0	0	0	396940	0	74833	0	35973	0	61748	0	80267	0
Constant Head	619.28	609.99	568.17	558.15	520.56	507.89	479	479.92	451.09	443.34	416.28	407.41	379.12	371.54	345.64	339.12	316.16
Recharge	0	0	164000	0	164000	54667	164000	0	109330	0	164000	0	273340	0	273340	0	273340
Zone 5 to 1	2338.3	10827	2094.9	2043.6	1943.8	1896.2	1803.7	1832.1	1673.6	1632.6	1552.9	1514.9	1441	1405.6	1337.1	1304.3	1240.7
Zone 5 to 2	563.99	558.69	527.14	514.59	499.52	477.77	467.48	501.77	494.61	502.63	484.4	487.55	451.05	456.86	424.32	431.62	401.42
Zone 5 to 2	833.99	824.92	785.33	769.62	738.4	695.97	694.43	717	710.76	699.5	693.96	673.36	651.08	633.31	615.65	599.75	585.25
Zone 5 to 4	152	142.51	138.64	125.04	119.07	109.15	105.29	119.24	118.23	115.56	114.62	111.98	106.31	104.16	99.362	97.574	93.402
Zone 5 to 6	101.83	101.9	133.13	127.31	154.59	137.05	175.55	174.33	201.57	201.19	230.79	225.17	238.99	233.36	246.87	241.23	254.5
Zone 5 to 8	43.013	43.089	92.998	84.749	135.75	114.46	178.93	155.79	223.5	232.38	288.88	288.94	321.2	315.61	345.75	343.8	371.7
Zone 5 to 9	64.043	63.021	81.744	76.099	92.24	81.806	100.9	88.415	113.49	103.36	130.64	116.77	132.35	118.71	135.36	121.15	138.86
Total OUT	113020	112340	168420	68803	168210	58688	168010	401010	113320	78764	167910	39799	277060	65387	276890	83745	276740
Difference:																	
IN- OUT	-614.26	0.3538	0.04791	-0.23277	0.060167	-0.78083	0.036368	-0.09945	-0.01697	0.45749	0.084817	0.076199	0.074682	0.088315	-0.03188	-0.20352	-0.01156
Percent Discrepancy	-0.54%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 E: Budget of ground water for the transient run in Bap Block Jodhpur District

Zone 6	Bap Block, Jodhpur District																
StressPeriod	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
InputReport																	
Storage	0	0	133850	0	119470	0	143050	0	103080	0	126200	0	115060	0	106920	0	100960
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	38415	38415	0	38415	0	57622	0	115240	0	0	0	0	0	0	0	0	0
Zone 1 to 6	0	0	19550	14575	33835	25928	48565	34699	50207	46602	65381	60238	76469	70204	84572	77487	90493
Zone 4 to 6	78.349	84.433	103.31	119.24	193.09	182.33	326.39	253.67	359.19	372.21	499.43	490.72	583.04	571.07	657.36	643.33	724.97
Zone 5 to 6	101.83	101.9	133.13	127.31	154.59	137.05	175.55	174.33	201.57	201.19	230.79	225.17	238.99	233.36	246.87	241.23	254.5
Zone 7 to 6	169.72	148.29	68.739	62.521	17.386	14.307	8.4905	1.3926	0	0.50349	0	0.34806	0	0	0	0	0
Zone 8 to 6	130.69	130.97	119.65	120.79	111.13	110.39	101.96	114.88	96.36	91.172	82.282	79.029	72.059	71.417	65.288	62.983	57.781
Zone 12 to 6	89.832	82.413	59.466	56.872	45.59	43.909	34.54	34.628	23.154	20.019	13.702	12.424	8.9814	7.9515	4.9969	4.1382	1.5388
Total	38985	38963	153890	53476	153820	84038	192260	150520	153970	47287	192400	61046	192440	71088	192470	78439	192500
Output																	
Storage	38760	35622	0	53286	0	83850	0	150270	0	27794	0	41527	0	51538	0	58859	0
Constant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	153660	0	153660	0	192080	0	153660	19207	192080	19207	192080	19207	192080	19207	192080
Zone 6 to 1	27.879	2999.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 6 to 4	364.74	312.89	172.95	132.65	52.568	59.486	12.969	27.363	8.2796	6.8879	0	0.2819	0	0	0	0	0
Zone 6 to 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 6 to 7	17.752	19.307	24.496	25.001	49.412	62.712	85.178	136.46	178.84	149.28	178.58	150.66	182.13	155.2	188.33	162.41	196.35
Zone 6 to 8	0	0	0	0	0	0	0	0	0	0	1.4959	2.3167	3.7378	3.9434	5.1748	5.7824	6.8001
Zone 6 to 12	5.9271	9.5892	27.843	32.233	60.897	66.45	89.48	90.909	120.41	129.42	149.37	157.87	176.05	183.17	198.51	204.69	217.94
Total OUT	39177	38963	153890	53476	153820	84039	192260	150520	153970	47287	192400	61046	192440	71088	192470	78439	192500
Difference:																	
IN-OUT	-191.13	-0.29329	-0.0774	0.1706	0.095262	-0.05896	-0.07939	0.11797	-0.12347	-0.14144	0.065285	0.22369	0.065583	0.1078	-0.05454	-0.08127	0.012381
Percent Discrepancy	-0.49%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 F: Budget of ground water for the transient run in Lohawat Block Jodhpur District

Zone 7	Lohawat Block Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	11859	10865	140960	0	123790	0	110480	0	98416	0	102860	0	97472	0	93516	0	90615
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 1 to 7	8.5124	914.83	24457	21986	41596	38308	54873	52986	66795	60043	74241	66743	79703	71659	83711	75266	86651
Zone 6 to 7	17.752	19.307	24.496	25.001	49.412	62.712	85.178	136.46	178.84	149.28	178.58	150.66	182.13	155.2	188.33	162.41	196.35
Zone 8 to 7	85.241	90.312	99.914	102.18	109.65	112.79	112.6	137.82	133.77	122.23	120.92	110.75	111.55	104.57	106.22	98.822	101.02
Zone 12 to 7	57.349	57.288	55.607	53.242	47.617	48.289	34.578	52.631	38.273	23.134	16.772	7.3434	4.4987	0.12483	0	0	0
Zone 13 to 7	84.848	65.834	26.313	21.275	8.2112	10.886	6.6969	18.078	10.242	8.9396	5.1034	3.1403	0.35803	0	0	0	0
Total IN	12112	12012	165620	22187	165600	38543	165600	53331	165570	60346	177420	67015	177470	71919	177520	75528	177560
Output Report																	
Storage	0	0	0	22043	0	26615	0	5973.9	0	60238	0	66867	0	71719	0	75278	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	11820	11820	165480	0	165480	11820	165480	47280	165480	0	177300	0	177300	0	177300	0	177300
Zone7 to 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 7 to 6	169.72	148.29	68.739	62.521	17.386	14.307	8.4905	1.3926	0	0.50349	0	0.34806	0	0	0	0	0
Zone 7 to 8	6.9843	5.9002	3.2159	2.7959	0.66659	0.077956	0	0	0	0	0	0	0	0.30462	0	1.1895	0.3226
Zone 7 to 12	21.514	21.488	20.773	22.134	23.665	23.474	29.346	20.026	26.371	37.782	43.74	57.472	61.107	77.534	79.805	98.938	98.444
Zone 7 to 13	7.4039	16.713	51.795	57.074	77.098	69.781	79.149	55.78	65.934	69.7	80.227	90.368	112.49	121.95	141.31	149.61	164.94
Total OUT	12026	12012	165620	22188	165600	38542	165600	53331	165570	60346	177420	67015	177470	71919	177520	75528	177560
Difference:																	
In-Out	86.681	-0.13294	0.010948	-0.2019	0.091429	0.41898	-0.03214	0.032758	-0.07985	0.022997	-0.0536	-0.13534	-0.06053	0.011832	0.085515	0.096845	-0.0612
Percent Discrepancy	0.72%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 G: Budget of ground water for the transient run in Dechu Block, Jodhpur District

Zone 8	Dechu Block, Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	98565	0	87698	0	99135	0	96678	6430.1	94466	0	84597	0	78110	0	72642
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	22655	22655	0	22655	0	22655	0	113280	0	0	0	0	0	0	0	0	0
Zone 1 to 8	0	0	14835	11592	25685	21347	36864	24369	39323	38871	52728	50915	62515	58831	68949	56891	74358
Zone 5 to 8	43.013	43.089	92.998	84.749	135.75	114.46	178.93	155.79	223.5	232.38	288.88	288.94	321.2	315.61	345.75	324.45	371.7
Zone 6 to 8	0	0	0	0	0	0	0	0	0	0	1.4959	2.3167	3.7378	3.9434	5.1748	0	6.8001
Zone 7 to 8	6.9843	5.9002	3.2159	2.7959	0.66659	0.077956	0	0	0	0	0	0	0	0.30462	0	0	0.3226
Zone 9 to 8	0	0	0	0	0.96568	1.1391	3.9333	4.5861	7.7231	14.896	19.632	31.612	34.877	43.608	45.804	40.678	60.191
Zone 10 to 8	84.891	87.01	88.968	86.771	78.987	79.594	70.732	62.552	56.451	67.976	60.668	71.58	63.558	72.741	64.449	55.329	66
Zone13 to 8	5.3815	0.47692	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IN	22795	22791	113590	34422	113600	44197	136250	137870	136290	45617	147560	51309	147540	59268	147520	57312	147500
Output Report																	
Storage	22641	20731	0	34103	0	43871	0	137490	0	0	0	5731.7	0	25035	0	35331	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	113280	0	113280	0	135930	0	135930	45310	147260	45310	147260	33982	147260	21636	147260
Zone 8 to 1	16.277	1745.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 8 to 5	9.818	9.8796	0	0.94957	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 8 to 6	130.69	130.97	119.65	120.79	111.13	110.39	101.96	114.88	96.36	91.172	82.282	79.029	72.059	71.417	65.288	107.56	57.781
Zone 8 to 7	85.241	90.312	99.914	102.18	109.65	112.79	112.6	137.82	133.77	122.23	120.92	110.75	111.55	104.57	106.22	124.57	101.02
Zone 8 to 9	61.74	59.203	53.876	51.939	42.982	42.09	30.824	28.577	20.095	10.048	7.4242	3.9766	2.9171	0.43083	0	1.2706	0
Zone 8 to 10	24.042	21.875	17.734	20.312	29.687	29.218	42.513	59.701	68.045	46.657	57.294	37.197	49.477	32.858	45.853	64.879	41.104
Zone 8 to 13	0	2.2083	19.486	22.204	31.927	31.597	34.309	37.903	39.819	36.241	38.613	36.746	41.727	40.545	45.028	47.539	47.313
Total OUT	22968	22791	113590	34421	113600	44197	136250	137870	136290	45616	147560	51309	147540	59267	147520	57313	147500
Difference:																	
IN - OUT	-173.22	0.28865	-0.03692	0.23269	-0.06692	-0.23415	-0.05844	-0.13375	0.1819	0.4821	-0.04194	-0.10981	-0.04702	0.17881	0.088739	-0.97328	-0.17733
Percent Discrepancy	-0.76%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 H: Budget of ground water for the transient run in Shergarh Block, Jodhpur District

Zone 9	Shergarh Block Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	99010	0	78173	0	82864	0	84275	0	88883	0	83087	0	78843	0	75937
ConstantHead	1751.2	1705.6	1647	1602.9	1545.6	1503.6	1442.8	1401.2	1356	1318.5	1279.9	1243	1213.9	1174.7	1151.5	1113.7	1093
Recharge	37676	37676	0	37676	0	37676	0	150700	0	37676	0	37676	0	37676	0	37676	0
Zone 1 to 9	425.94	415.31	14156	9822.7	22398	17231	30219	15506	28817	23001	36706	30091	42473	35275	46687	39070	49807
Zone 5 to 9	64.043	63.021	81.744	76.099	92.24	81.806	100.9	88.415	113.49	103.36	130.64	116.77	132.35	118.71	135.36	121.15	138.86
Zone 8 to 9	61.74	59.203	53.876	51.939	42.982	42.09	30.824	28.577	20.095	10.048	7.4242	3.9766	2.9171	0.43083	0	0	0
Zone 10 to 9	75.666	75.839	74.746	69.672	52.997	52.65	31.961	21.004	13.113	15.852	8.5389	11.417	4.5575	7.522	1.2211	4.0169	0
Zone11 to 9	158.99	157.82	154.23	154.6	147.91	156.49	156.6	150.05	153.4	163.21	163	172	170.37	178.79	176.15	118.32	55.079
Total IN	40214	40153	115180	49454	102450	56744	114860	167900	114750	62288	127180	69315	127080	74431	126990	78103	127030
Output Report																	
Storage	37678	34904	0	47339	0	54787	0	166060	0	60592	0	67735	0	72950	0	76681	0
Constant Head	565.92	559.94	512.17	508.61	468.26	466.42	426.43	439.97	400.89	401.11	363.16	363.96	335.4	333.49	310.18	308.86	286.27
Recharge	0	0	113030	0	100470	0	113030	0	113030	0	125590	0	125590	0	125590	0	125590
Zone 9 to 1	1673.5	4540.9	1526.3	1488.3	1414.6	1379.5	1311.2	1278.5	1215.3	1185	1126.4	1098.4	1044	1018.1	967.71	943.66	896.99
Zone 9 to 5	124.62	128.08	90.677	98.46	74.155	88.553	60.23	78.645	49.098	57.04	34.779	45.605	32.41	42.969	30.444	40.058	28.344
Zone 9 to 8	0	0	0	0	0.96568	1.1391	3.9333	4.5861	7.7231	14.896	19.632	31.612	34.877	43.608	45.804	59.25	60.191
Zone 9 to 10	0	0	0	0	3.0796	3.2362	8.8125	16.999	28.176	24.412	34.691	30.746	40.386	36.334	45.711	41.342	52.179
Zone 9 to 11	19.377	19.699	19.712	19.555	20.999	17.838	16.776	19.777	17.538	13.993	13.099	9.9071	9.6293	6.6855	6.8458	28.828	119.02
Total OUT	40062	40153	115180	49454	102450	56744	114860	167900	114750	62288	127180	69315	127080	74431	126990	78103	127030
Difference:																	
IN- OUT	152.26	-0.05896	0.031637	-0.03634	0.050674	-0.33966	0.033004	-0.0743	0.036625	-0.12979	-0.0172	0.061796	-0.07962	0.016737	-0.02598	-0.13657	0.12569
Percent Discrepancy	0.38%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 I: Budget of ground water for the transient run in Shekhala Block, Jodhpur District

Zone 10	Shekhala Block, Jodhpur District																
StressPeriod	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	72201	0	87068	0	101870	0	93256	0	94841	0	89343	0	85317	0	82648
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	27334	27334	0	9111.2	0	18222	0	27334	0	27334	0	27334	0	27334	0	27334	0
Zone 1 to 10	0	0	10079	8376.5	22526	18859	34959	29320	43453	36956	50971	43716	56472	48661	60495	52288	63493
Zone 8 to 10	24.042	21.875	17.734	20.312	29.687	29.218	42.513	59.701	68.045	46.657	57.294	37.197	49.477	32.858	45.853	27.233	41.104
Zone 9 to 10	0	0	0	0	3.0796	3.2362	8.8125	16.999	28.176	24.412	34.691	30.746	40.386	36.334	45.711	41.342	52.179
Zone11 to 10	84.714	83.433	80.839	86.979	98.91	111.68	143.34	157.77	192.92	202.56	228.79	236.41	258.25	264.48	283.12	163.43	19.26
Zone13 to 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone15 to 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total IN	27443	27439	82379	17595	109730	37225	137030	56888	137000	64564	146130	71354	146160	76329	146190	79854	146250
Output Report																	
Storage	27071	25047	0	17214	0	36834	0	56554	0	64198	0	70963	0	75911	0	79414	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	82001	0	109330	0	136670	0	136670	0	145780	0	145780	0	145780	0	145780
Zone 10 to 1	19.47	2108.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 10 to 8	84.891	87.01	88.968	86.771	78.987	79.594	70.732	62.552	56.451	67.976	60.668	71.58	63.558	72.741	64.449	74.666	66
Zone 10 to 9	75.666	75.839	74.746	69.672	52.997	52.65	31.961	21.004	13.113	15.852	8.5389	11.417	4.5575	7.522	1.2211	4.0169	0
Zone 10 to 11	19.01	19.628	19.946	17.716	12.381	7.7383	0	0	0	0	0	0	0	0	0	0	44.876
Zone 10 to 13	54.458	77.403	131.39	136.58	154.66	154.24	149.25	145.69	142.87	150.52	147.17	158.77	161.98	172.66	174.01	184.05	184.07
Zone 10 to 15	8.135	23.674	62.649	70.242	91.459	97.024	107.58	104.33	117.21	131	136.89	149.44	153.05	164.73	166.7	177.77	178.54
Total OUT	27332	27439	82379	17595	109730	37225	137030	56888	137000	64564	146130	71354	146160	76329	146190	79854	146250
Difference:																	
IN - OUT	110.13	-0.07805	0.015589	0.057035	0.050531	0.15841	0.005664	0.08415	0.021303	0.14775	0.04354	-0.05984	0.023153	0.34029	0.02462	0.010923	-0.01654
Percent Discrepancy	0.40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 J: Budget of ground water for the transient run in Balesar Block, Jodhpur District

Zone 11	Balesar Block, Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	0	0	68348	0	61469	0	51395	0	46514	0	55738	0	54511	0	53607	180930	277170
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.9696	153.47
Recharge	20931	20931	0	25955	0	58608	0	69492	0	66143	0	66143	0	66143	0	0	0
Zone 1 to 11	917.61	894.66	10773	7771.3	17669	11442	19470	12221	19392	12420	21125	13983	22404	15137	23349	37981	82465
Zone 9 to 11	19.377	19.699	19.712	19.555	20.999	17.838	16.776	19.777	17.538	13.993	13.099	9.9071	9.6293	6.6855	6.8458	28.828	119.02
Zone 10 to 11	19.01	19.628	19.946	17.716	12.381	7.7383	0	0	0	0	0	0	0	0	0	0	44.876
Zone 15 to 11	176.32	168.93	148.13	142.69	126.26	120.68	105.03	104.36	88.832	81.564	70.776	64.596	55.833	50.414	43.11	59.764	89.205
Total	22064	22034	79309	33906	79298	70196	70987	81837	66012	78658	76946	80200	76981	81336	77005	219000	360040
Output Report																	
Storage	20634	18958	0	32441	0	68708	0	80314	0	77047	0	78545	0	79650	0	0	0
Constant Head	1182.3	1167.5	1067.6	1059.7	969.21	977.32	898.18	912.31	839.98	854.1	776.96	792.86	719.22	736.65	666.06	591.23	495.98
Recharge	0	0	77864	0	77864	0	69492	0	64468	0	75352	0	75352	0	75352	217680	359180
Zone 11 to 1	14.846	1596.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 11 to 9	158.99	157.82	154.23	154.6	147.91	156.49	156.6	150.05	153.4	163.21	163	172	170.37	178.79	176.15	118.32	55.079
Zone 11 to 10	84.714	83.433	80.839	86.979	98.91	111.68	143.34	157.77	192.92	202.56	228.79	236.41	258.25	264.48	283.12	163.43	19.26
Zone 11 to 15	43.875	71.266	141.97	163.13	217.99	242.84	296.8	302.51	357.28	390.59	424.9	454.05	480.4	506.66	527.27	446.48	288.64
Total OUT	22119	22034	79309	33906	79298	70196	70987	81836	66012	78658	76946	80200	76981	81336	77005	219000	360040
Difference:																	
IN	-55.35	-0.11502	0.11708	0.12333	-	-	0.03941	-0.04306	0.24323	0.028569	0.056396	-	-	-	-0.006	0.030054	0.025354
Percent Discrepancy	-0.25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 K: Budget of ground water for the transient run in Bapini Block, Jodhpur District

Zone 12	Bapini Block, Jodhpur District																
Stress Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	13730	12543	161570	0	152580	0	159280	0	147810	25762	141560	7979.3	127110	0	116560	0	108840
Constant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	0	0	0	0	40631	0	0	0	0	0	0	0	0	0
Zone 1 to 12	9.8731	1057	28066	26285	50520	46467	70809	60495	82212	82305	101880	99978	116240	112890	126740	122320	134400
Zone 4 to 12	38.56	49.561	82.56	91.828	124.03	125.59	158.44	150.39	180.06	186.89	211.27	214.68	232.76	235.23	251.31	253.13	267.73
Zone 6 to 12	5.9271	9.5892	27.843	32.233	60.897	66.45	89.48	90.909	120.41	129.42	149.37	157.87	176.05	183.17	198.51	204.69	217.94
Zone 7 to 12	21.514	21.488	20.773	22.134	23.665	23.474	29.346	20.026	26.371	37.782	43.74	57.472	61.107	77.534	79.805	98.938	98.444
Zone 13 to 12	35.194	21.469	0.44091	0.048612	0	0	0	0	0	2.4504	2.2235	5.0353	1.7262	4.0798	1.2738	3.3672	0.85816
Total	13841	13702	189770	26431	203310	46682	230360	101390	230350		243850	108390	243830	113390	243820	122880	243820
Output																	
Storage	0	0	0	12732	0	32991	0	101250	0	0	0	0	0	5006	0	14498	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	13544	13544	189610	13544	203160	13544	230240	0	230240	108350	243790	108350	243790	108350	243790	108350	243790
Zone12 to 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone12 to 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone12 to 6	89.832	82.413	59.466	56.872	45.59	43.909	34.54	34.628	23.154	20.019	13.702	12.424	8.9814	7.9515	4.9969	4.1382	1.5388
Zone12 to 7	57.349	57.288	55.607	53.242	47.617	48.289	34.578	52.631	38.273	23.134	16.772	7.3434	4.4987	0.12483	0	0	0
Zone12 to 13	14.339	18.217	42.766	46.04	61.098	55.563	49.335	48.043	43.755	29.76	29.261	22.525	29.841	22.995	30.422	23.624	30.994
Total OUT	13705	13702	189770	26431	203310	46682	230360	101390	230350	108420	243850	108390	243830	113390	243820	122880	243820
Difference:																	
IN-OUT	135.62	0.22667	0.034472	-0.14584	-0.08786	0.029126	0.04925	0.10653	-0.15871	0.034474	0.024948	0.01961	0.008108	0.15844	0.057412	0.018409	0.022331
Percent Discrepancy	0.98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 L: Budget of ground water for the transient run in Osian Block, Jodhpur District

Zone 13	Osian Block, Jodhpur District																
Stress Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days)	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
InputReport																	
Storage	85817	79336	236890	3795.1	173950	0	136260	0	129050	0	130410	0	141850	0	132210	0	125160
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	0	0	0	0	24625	0	0	0	0	0	0	0	0	0
Zone 1 to 13	61.724	6680.6	45992	45151	71997	65669	85177	74664	92514	86046	103550	97885	116710	109710	126330	118360	133370
Zone 7 to 13	7.4039	16.713	51.795	57.074	77.098	69.781	79.149	55.78	65.934	69.7	80.227	90.368	112.49	121.95	141.31	149.61	164.94
Zone 8 to 13	0	2.2083	19.486	22.204	31.927	31.597	34.309	37.903	39.819	36.241	38.613	36.746	41.727	40.545	45.028	43.097	47.313
Zone 10 to 13	54.458	77.403	131.39	136.58	154.66	154.24	149.25	145.69	142.87	150.52	147.17	158.77	161.98	172.66	174.01	184.05	184.07
Zone 12 to 13	14.339	18.217	42.766	46.04	61.098	55.563	49.335	48.043	43.755	29.76	29.261	22.525	29.841	22.995	30.422	23.624	30.994
Zone 14 to	69.015	57.861	32.461	27.179	11.875	11.903	3.9343	1.263	0	0	0	0	0	0	0	0	0
Zone	109.34	113.78	118.35	107.49	87.903	74.096	41.341	42.479	8.8004	0.88109	0	0	0	0	0	0	0
TotalIN	86133	86303	283270	49342	246370	66066	221790	99620	221870	86333	234260	98193	258900	110070	258930	118760	258950
Output Report																	
Storage	0	0	0	0	0	53625	0	99411	0	49126	0	36298	0	48153	0	56821	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	86188	86188	283190	49250	246250	12312	221620	0	221620	36937	233940	61562	258560	61562	258560	61562	258560
Zone 13 to 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 13 to 7	84.848	65.834	26.313	21.275	8.2112	10.886	6.6969	18.078	10.242	8.9396	5.1034	3.1403	0.35803	0	0	0	0
Zone 13 to 8	5.3815	0.47692	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 13 to 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 13 to 10	35.194	21.469	0.44091	0.048612	0	0	0	0	0	2.4504	2.2235	5.0353	1.7262	4.0798	1.2738	3.3672	0.85816
Zone 13 to 12	17.818	27.24	59.187	71.162	112.02	112.59	150.57	178.37	209.97	221.15	252.94	254.59	268.29	269.94	282.18	283.9	294.9
Zone 13 to 14	0	0	0	0	1.4991	5.0567	12.69	12.583	21.244	36.81	58.815	69.902	71.376	82.011	82.705	93.013	93.105
Total	86331	86303	283270	49342	246370	66066	221790	99620	221870	86333	234260	98193	258900	110070	258930	118760	258950
IN	-197.46	0.065714	0.11728	-0.25375	0.005676	-0.01489	-0.04967	-0.13834	-0.07401	-0.0616	0.021557	0.13549	-0.03092	0.02201	-0.07909	0.044537	0.11596
Percent Discrepancy	-0.23%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 M : Budget of ground water for the transient run in Baori Block, Jodhpur District

Zone 14	Baori Block, Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (days):	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	105900	97740	228060	39671	187690	0	152910	0	137050	0	140090	0	129370	0	121540	0	115820
Constant Head	1189.4	1226.4	1454.6	1457.2	1628.4	1589.8	1718.1	1698.9	1806.7	1785.8	1893.1	1867.2	1960.9	1932.2	2015.9	1985.7	2062.1
Recharge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 1 to 14	1570.4	9685.9	47363	49505	78427	73280	95189	92451	110740	107100	125170	120060	135680	129490	143330	136350	148890
Zone 13 to 14	17.818	27.24	59.187	71.162	112.02	112.59	150.57	178.37	209.97	221.15	252.94	254.59	268.29	269.94	282.18	283.9	294.9
Zone 15 to 14	18.514	25.868	61.748	67.482	94.665	85.626	95.97	116.74	117.63	112.34	123.29	118.1	128.56	123.49	133.52	128.57	138.23
Total IN	108700	108710	277000	90771	267950	75068	250060	94445	249920	109220	267530	122290	267410	131810	267300	138750	267200
Output Report																	
Storage	0	0	0	0	0	37658	0	3999.7	0	10047	0	23244	0	32877	0	39920	0
Constant Head	1494.3	1456.7	1454.6	1348.1	1280	1247.5	1184.4	1154.3	1095.9	1068	1013.8	987.94	937.75	913.77	867.24	845	801.85
Recharge	106380	106380	274820	88650	265950	35460	248220	88650	248220	97515	265950	97515	265950	97515	265950	97515	265950
Zone 14 to 1	826.38	805.71	765.31	746.01	708.61	690.74	656.12	639.59	607.54	592.5	562.59	548.43	520	507.88	482.48	470.36	446.86
Zone 14 to 13	69.015	57.861	32.461	27.179	11.875	11.903	3.9343	1.263	0	0	0	0	0	0	0	0	0
Zone 14 to 15	13.583	4.9823	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total OUT	108780	108710	277000	90771	267950	75068	250060	94445	249920	109220	267530	122290	267410	131810	267300	138750	267200
IN - OUT	-82.687	0.20665	-0.11327	-0.06549	0.072278	-0.04299	0.0326	0.015907	0.0425	-0.083	-0.0738	0.01706	-0.05245	-0.07773	-0.00298	-0.16173	0.010062
Percent Discrepancy	-0.08%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT, RAJASTHAN (50,000 sq.km)

Table 7 M: Budget of ground water for the transient run in Tinwari Block, Jodhpur District

Zone 15	Tinwari Block, Jodhpur District																
Stress Period:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Time (Days)	1	120	365	485	730	850	1095	1215	1460	1580	1825	1945	2190	2310	2555	2675	2920
Input Report																	
Storage	56447	51977	172900	22115	148600	0	139380	0	137390	7833.7	122550	0	111740	0	103830	0	98327
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	0	0	0	0	9357.5	0	0	0	0	0	0	0	0	0
Zone 1 to 15	40.598	4376.1	33089	34114	57267	55116	75672	67301	86912	85378	101600	98574	112320	108210	120150	115250	125920
Zone 10 to 15	8.135	23.674	62.649	70.242	91.459	97.024	107.58	104.33	117.21	131	136.89	149.44	153.05	164.73	166.7	177.77	178.54
Zone 11 to 15	43.875	71.266	141.97	163.13	217.99	242.84	296.8	302.51	357.28	390.59	424.9	454.05	480.4	506.66	527.27	446.48	288.64
Zone 13 to 15	0	0	0	0	1.4991	5.0567	12.69	12.583	21.244	36.81	58.815	69.902	71.376	82.011	82.705	93.013	93.105
Zone 14 to 15	13.583	4.9823	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	56553	56453	206190	56463	206170	55461	215460	77078	224800	93770	224770	99247	224760	108960	224760	115970	224810
Output Report						Report											
Storage	0	0		0	0	8392.9	0	76814	0	0	0	5489.5	0	15214	0	22205	0
Constant Head	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recharge	56145	56145	205860	56145	205860	46778	215220	0	224580	93575	224580	93575	224580	93575	224580	93575	224580
Zone 15 to 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 15 to 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Zone 15 to 11	176.32	168.93	148.13	142.69	126.26	120.68	105.03	104.36	88.832	81.564	70.776	64.596	55.833	50.414	43.11	59.764	89.205
Zone 15 to 13	109.34	113.78	118.35	107.49	87.903	74.096	41.341	42.479	8.8004	0.88109	0	0	0	0	0	0	0
Zone 15 to 14	18.514	25.868	61.748	67.482	94.665	85.626	95.97	116.74	117.63	112.34	123.29	118.1	128.56	123.49	133.52	128.57	138.23
Total OUT	56449	56454	206190	56463	206170	55461	215460	77078	224800	93770	224770	99247	224760	108960	224760	115970	224810
Difference:																	
IN- OUT	103.72	-0.08828	0.0849	0.13386	-0.06703	-0.07856	0.035556	0.12	0.056254	0.19734	0.013316	0.12197	-0.02853	-0.22828	0.038454	-0.07976	-0.10329
Percent Discrepancy	0.18%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Prediction

With continued recharge and draft of 2020 predictions were made for 2021. The head values generated for 2021 as prediction are presented in Table 8 below.

Table 8: Predicted Head values for Pre monsoon and Post monsoon seasons 2021

Well/Point Name	Pre-monsoon 2021	Post-monsoon 2021
ANTIA/1	106	105.9
ASKANDRA/1	147.9	147.5
BAKRIWALA/1	47.18	47.08
BAMNU/2	187.1	186.2
BAORI (P)/2	194.8	192.7
BASANPEER JUNI/1	163.7	163.4
BHOJKA/1	150.6	150.2
BHOMSAGAR/1	187.8	187.4
BHUNGRA/1	195.1	194.1
BOA/1	108.1	107.7
BOP LAXMAN/1	28	28
BORANA/1	132.1	131.7
CHABA/1	184.3	183.7
CHACHA/1	196	195.5
CHAKU/1	186.5	186.1
CHAMPASAR/1	231.9	231.4
CHANDHAN/1	147.7	147.3
CHATARPURA/1	190.1	189.1
DASANIA/1	212.2	211.2
DAV/1	65.09	64.98
DECHU (P)/1	208.6	207.6
DEORA/1	139.2	139.1
DEWA/1	117.9	117.5
DHADHARWALA/1	197.5	197.2
DHAISAR/1	162.4	162
GODHOOWALA/1	62.18	62.07
GOPALSAR/2	217.2	211.8
GOTARU/1	45.29	45.18
GUDIALA/1	215.3	209.8
HAMEERA/1	150.4	149.9
JHABRA/1	214.7	214.1
JHAKAN/1	201.4	200.1
JHALARIYA/1	214.4	213.9
KAN SINGH KI SID/1	172.9	172.5
KASAU KA TALA/1	143.8	143.7
KATHODI/1	132.9	132.5
KHARIA KUA/1	59.17	59.06

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Well/Point Name	Pre-monsoon 2021	Post-monsoon 2021
KISHANGARH/1	62.9	62.79
KOHRA/1	202.5	202.3
KOLU PABUJI/2	187.1	186.1
KUMARO KI DHANI/1	185	184
KURIYA-BERI/1	62.29	62.18
LANELA/1	136.8	136.3
LOHARKI/1	167.8	167.3
LORTA ACHLAWATA (P)/1	207.6	206.1
MYAJLAR/1	42.84	42.74
NATHOOSAR/1	208.3	207.8
NATHURA-KUA/1	62.39	62.27
NERAN/1	209.5	209
PHULIA1/1	65.2	65.09
PHULIA2/1	65.2	65.09
PHULIA3/1	65.2	65.09
PHULIA4/1	65.2	65.09
PITHEWALA/1	75.45	75.35
RAIPALON KI DHANI/1	215.2	214.7
RAM-ASHU RD/1	61.28	61.17
RAMCHOWKI (P)/2	223.6	223.6
RANAU/1	65.39	65.28
RATARIYA/2	214.5	213.9
ROHINA/1	230.3	229.9
SANTORA KHURD (P)/2	205.6	202.7
SODAKAR/1	157.9	157.5
SODHADHARA/1	181.7	181.3
SOLANKIYA TALA/1	207.6	206.6
SOMESAR/1	214.3	213.2
SOMESAR-PD/1	210.4	209.4
SORHAKOR/1	149	148.6
SRIBHADRIA/1	154.4	153.9
SULTANA/1	97.97	97.56
SUWALIA/1	193.3	192.4
TENA(N.NAGAR)/1	192.6	191.6
TEPU/1	161.9	161.5
UTTRI DHANI/1	184.9	183.6
VEERAMDEORA/2	191.6	191

With continued recharge and draft of 2020 predictions were made for 2021 depicts that the drawdown will go on increasing with time. The graph drawn between time and drawdown shown in Figure 31 shows the effect of continuation of same stress conditions.

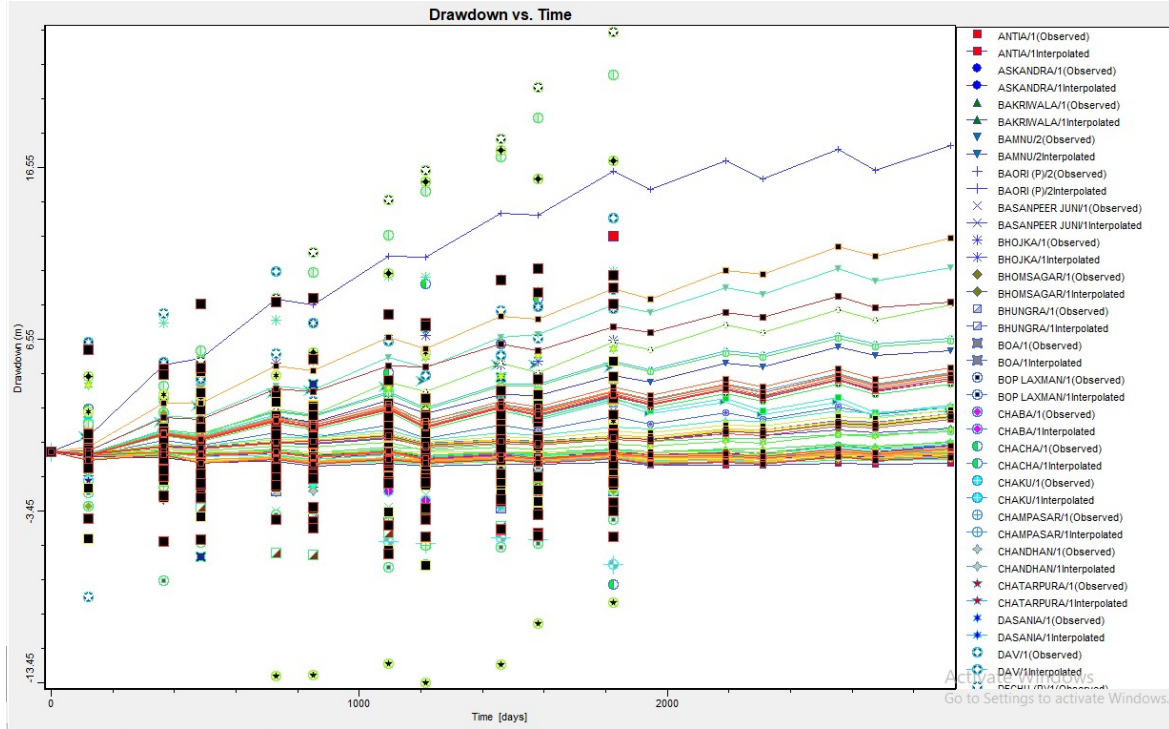


Figure 31: Time Vs Drawdown Graph

For further scenario generation the interventions suggested in the Aquifer Management plans of all the blocks were considered. The supply side interventions that suggest conservation of surplus available water by constructing water conservation structures which will save water and there will be additional recharge available which is used for scenario generation. In the similar way interventions are suggested for implementing water efficient irrigation through sprinklers and switching to water efficient crops will save the water which will reduce the groundwater draft. The block-wise water conservation and reduced draft after interventions and impact on the stage of groundwater extraction is presented in Table 9.

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Table 9: Demand and Supply side Interventions of NAQUIM & Stage of GW Extraction

	Management Options						Stage of GW Extraction %		
	Supply Side			Demand Side					
Blocks	No. of Ponds with Recharge Shaft	Community Tankas	Supply side Saving (mcm)	No. of Sprinkler proposed	Irrigated Area under wheat proposed for Gram cultivation (ha)	Demand Side Saving (mcm)	Present	After Supply Side Intervention	After both Demand & Supply Side Intervention
Balesar	15	54	16.3	25	12806	8.66	308	101	75
Baori	0	0	0	25	12418	14.26	350	349	238
Bap	0	0	0	25	16519	20.24	65	65	36
Bapini	10	40	12.07	0	0	22.08	358	224	133
Bhopalgarh	0	0	0	25	8177	7.44	207	206	176
Bilara	10	40	12.07	25	6289	5.82	227	165	145
Deechoo	10	40	12.07	0	0	21.83	297	173	98
Lohawat	10	40	12.07	0	0	25.91	352	202	106
Luni	0	0	0	25	1934	2.71	39	39	36
Mandore	0	0	0	25	1938	2.71	144	143	129
Osian	0	0	0	25	27244	14.35	313	313	183
Phalodi	25	40	12.17	25	60102	38.79	191	137	72
Pipar City	0	0	0	0	0	7.02	152	151	124
Shekhala	10	40	12.07	0	0	9.27	260	159	122
Shergarh	5	64	19.23	25	11524	9.79	188	94	75
Tinwari	10	40	12.07	0	0	11.81	400	231	164
Jodhpur District	105	398	120.09	250	158954	222.68	219	167	117
Jaisalmer	0	0	0	0	16927	9.32	332.71	333	286
Sam	0	0	0.0042	0	26769	14.11	125.33	125	70
Sankra	3	0	0.1197	0	12300	6.71	331.66	334	294
Jaisalmer District	3	0	0.1239	0	55996		248.84	248	201

Scenario Generation

Three conditions were considered for generating the scenarios for future. These three conditions are

1. When the interventions suggested for demand side options the draft to ground water reduces and the recharge will remain same.
2. When the interventions suggested for supply side options are implemented the recharge to ground water increases and the draft will remain same.
3. When both demand and supply side interventions are implemented then the recharge will be increased and draft will be reduced

Scenario 1: When the interventions suggested for demand side options the draft to ground water is reduced by 252.82 mcm by implementing the water efficient micro irrigation techniques and water efficient crops are grown in the area and the recharge will remain same.

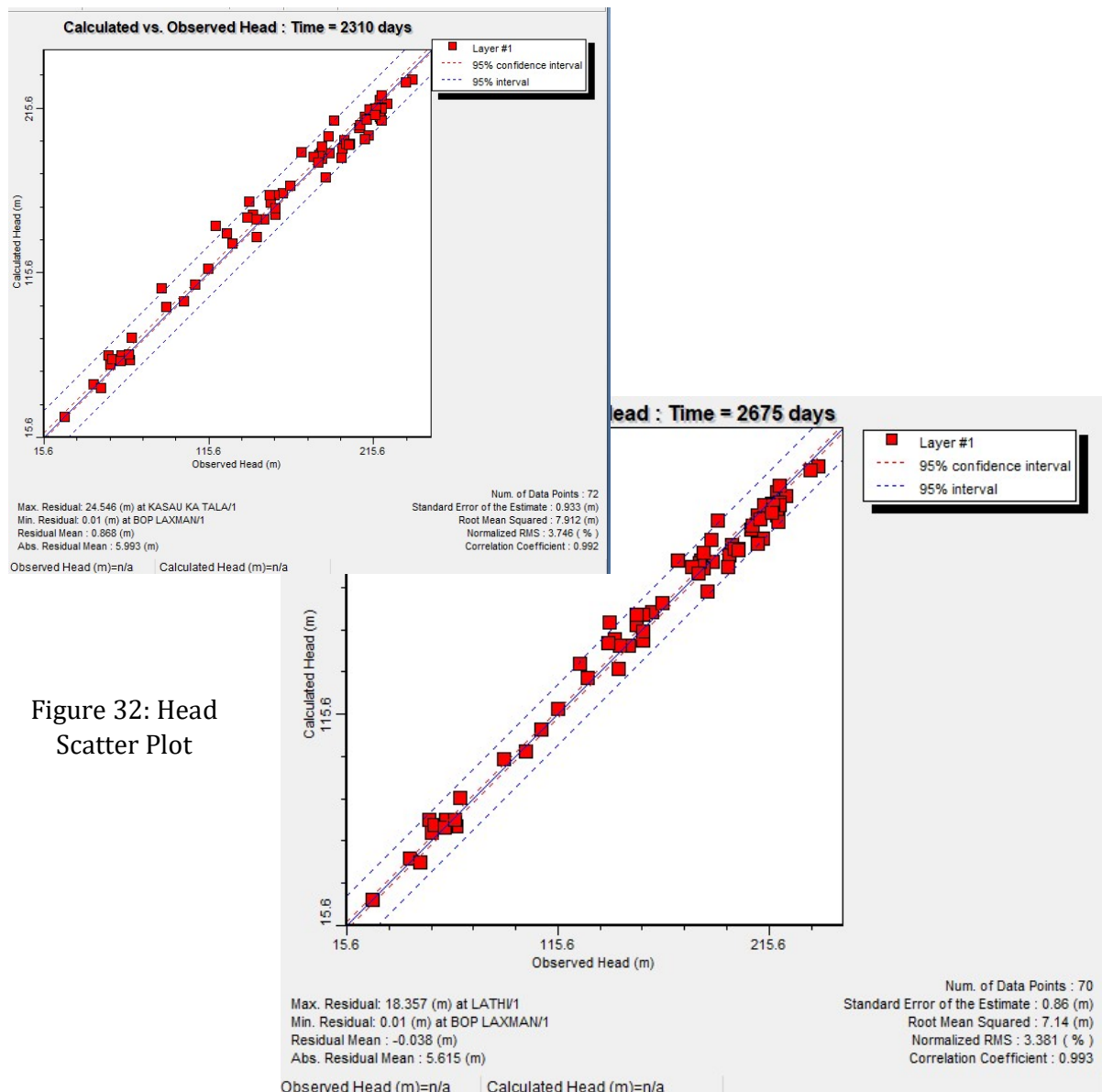


Figure 32: Head Scatter Plot

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

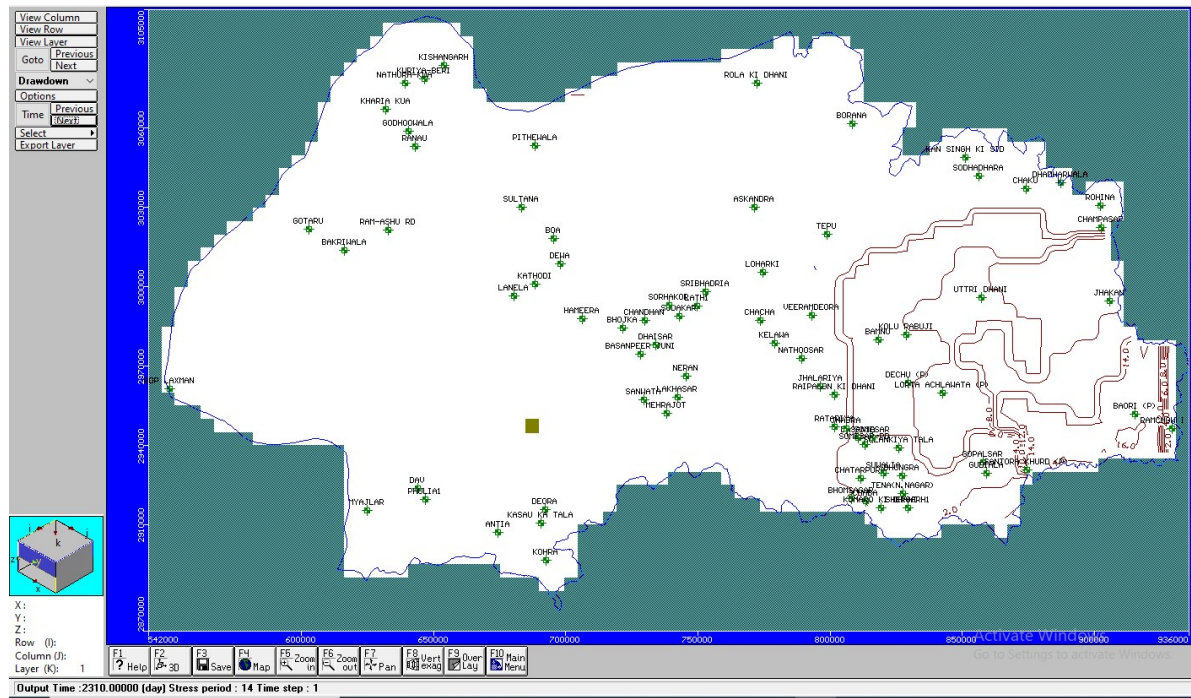


Figure 33: Drawdown Contours of Scenario 2 (2310 days-May 2020)

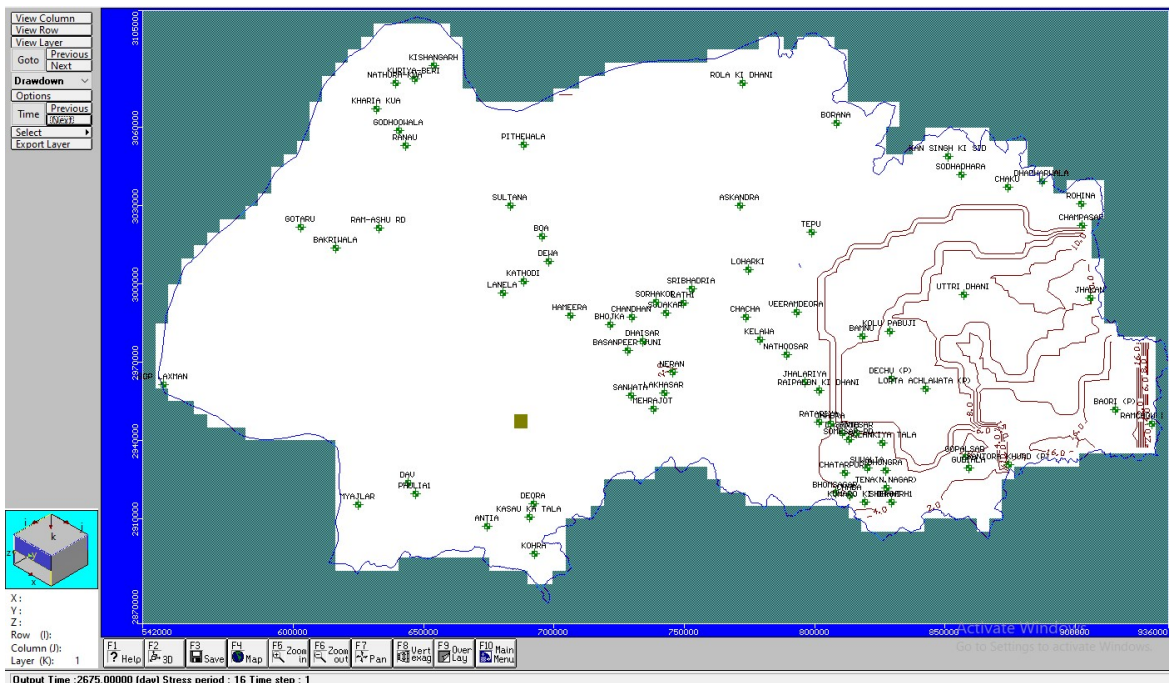


Figure 34: Drawdown Contours of Scenario 2 (2675 days-May 2021)

Scenario 2: When the interventions suggested for supply side options are implemented and water conservation structures will be constructed the annual recharge to ground water will increase by 120.21 mcm and the draft will remain same.

The heads generated during this scenario are as follows

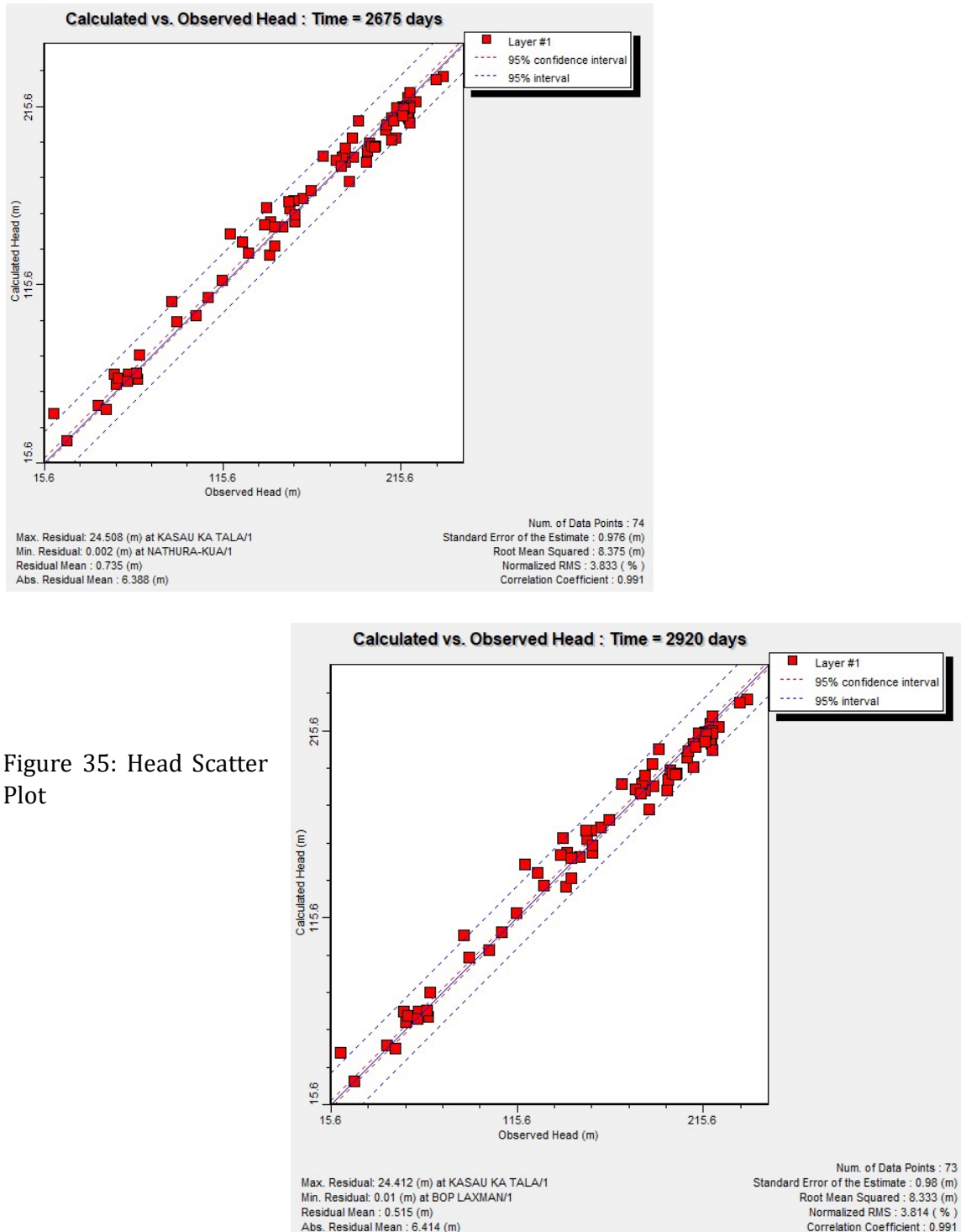


Figure 35: Head Scatter Plot

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

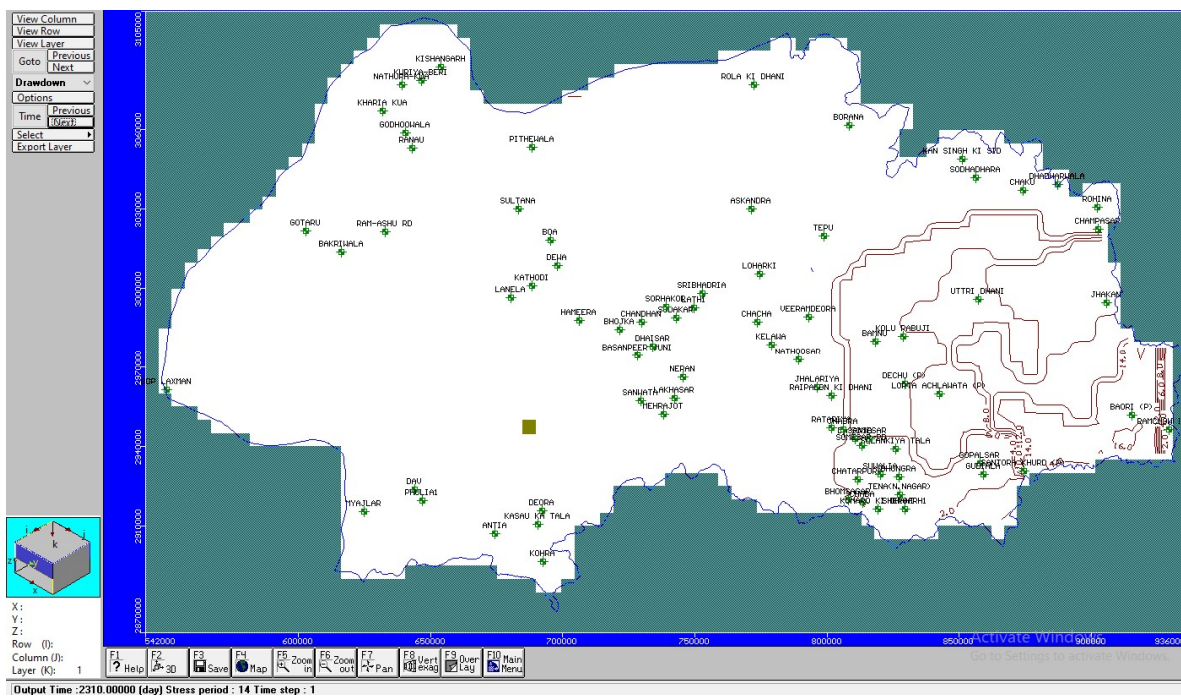
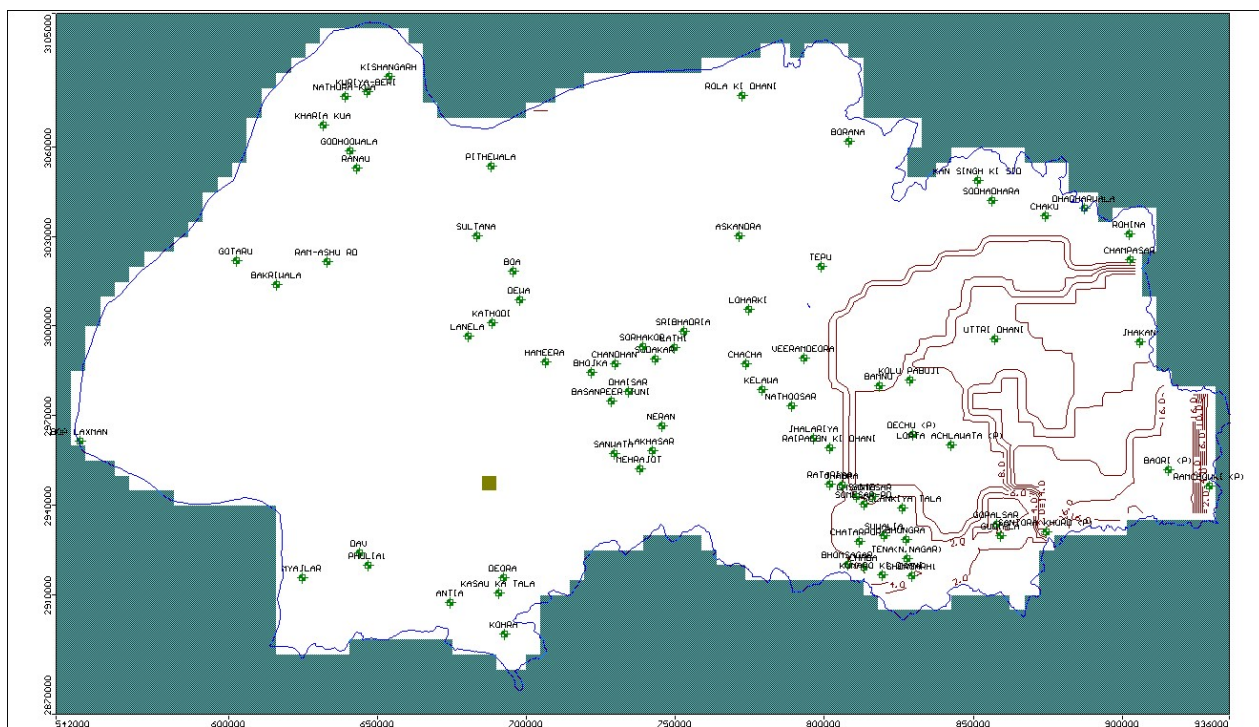


Figure 36: Drawdown Contours of Scenario 1 (2675 days-May 2021) compared with 2310 days (May 2018)



Scenario 3: If in 2021, both supply and demand side interventions are implemented then the recharge will be increased due to construction of water conservation structures and draft will be reduced due to water efficient irrigation techniques and crops.

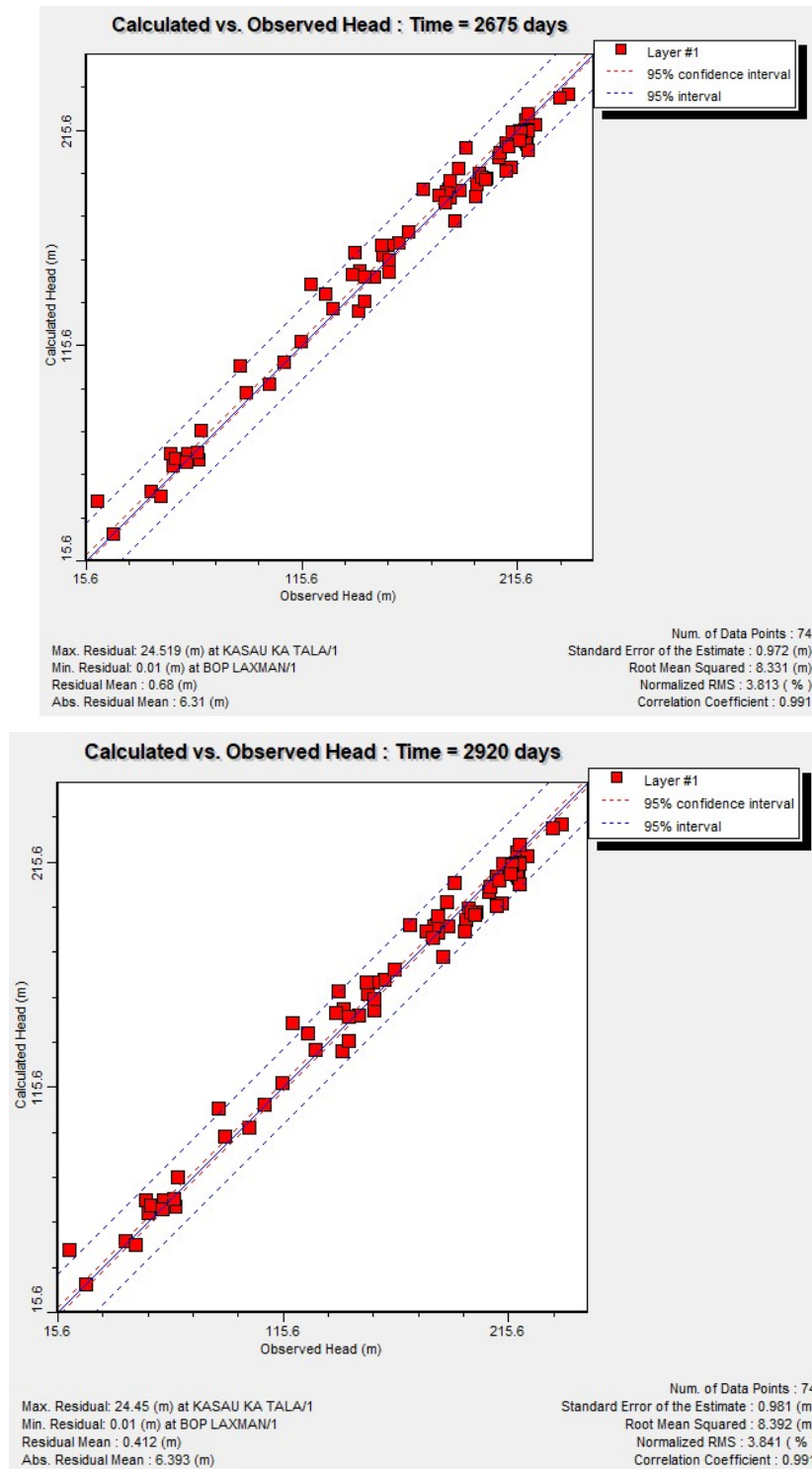


Figure 37: Head Scatter Plot

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

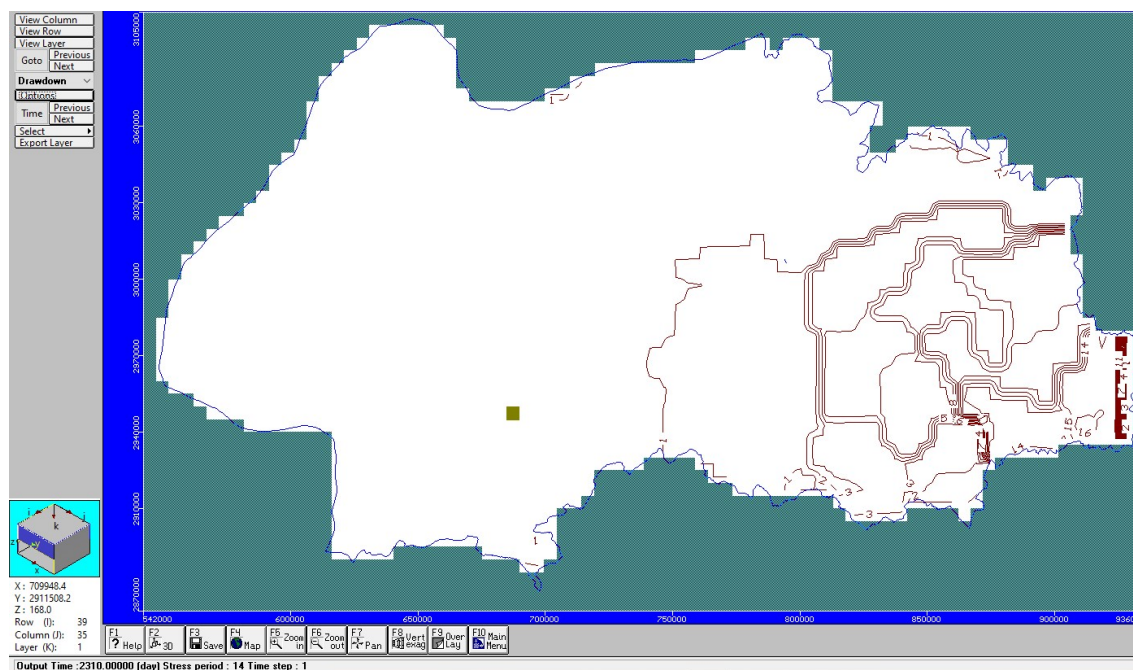


Figure 38: Drawdown Contours of Scenario 3 (2310 days-May 2020)

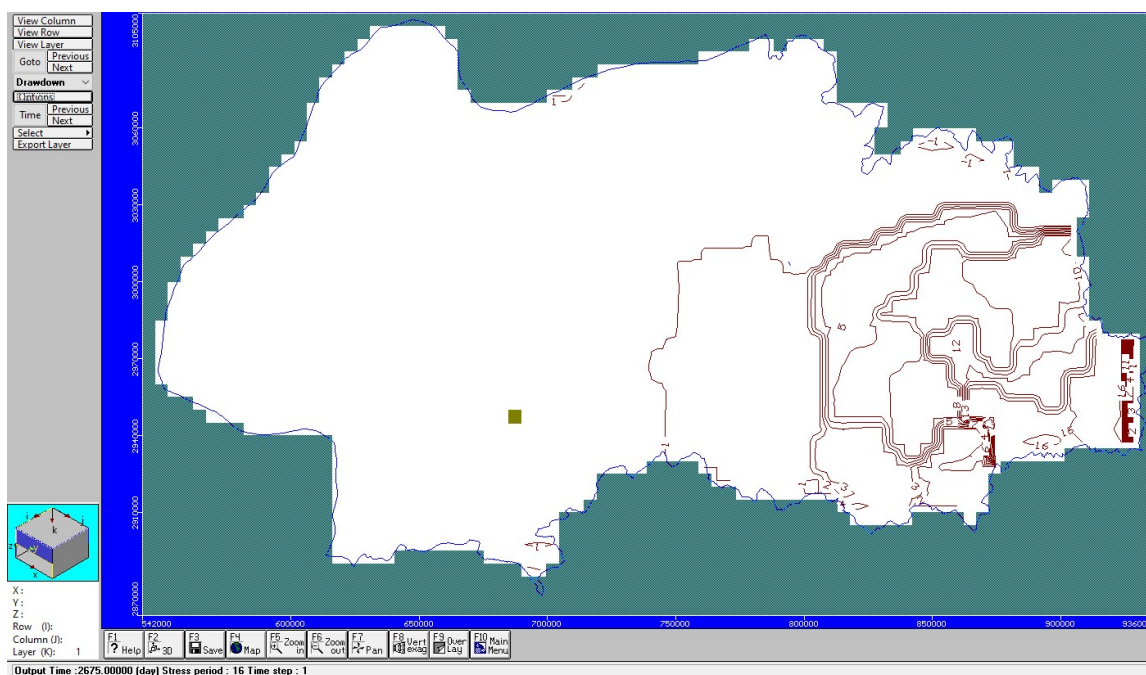


Figure 39: Drawdown Contours of Scenario 3 (2675 days-May 2021)

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Table 10: Difference in Head Values Before and after prediction

Location	Head values before Demand & Supply interventions	Head values after Demand & Supply interventions	Times	Difference in Head Values before & after interventions
ANTIA/1	105.9512	106.3749	2675	-0.4237
ASKANDRA/1	147.8667	147.5469	2675	0.3198
BAKRIWALA/1	47.18208	47.60358	2675	-0.4215
BAMNU/2	187.1454	187.4263	2675	-0.2809
BAORI (P)/2	194.7962	198.3307	2675	-3.5345
BASANPEER JUNI/1	163.7247	163.5429	2675	0.1818
BHOJKA/1	150.5801	150.2596	2675	0.3205
BHOMSAGAR/1	187.7797	188.0269	2675	-0.2472
BHUNGRA/1	195.1063	195.4137	2675	-0.3074
BOA/1	108.1324	107.8121	2675	0.3203
BOP LAXMAN/1	28	28	2675	0
BORANA/1	132.1457	131.8259	2675	0.3198
CHABA/1	184.3447	184.5692	2675	-0.2245
CHACHA/1	195.9656	196.6782	2675	-0.7126
CHAKU/1	186.4903	186.9759	2675	-0.4856
CHAMPASAR/1	231.8635	232.3741	2675	-0.5106
CHANDHAN/1	147.6879	147.3664	2675	0.3215
CHATARPURA/1	190.1208	190.4282	2675	-0.3074
DASANIA/1	212.1835	212.557	2675	-0.3735
DAV/1	65.09186	65.51309	2675	-0.42123
DECHU (P)/1	208.6099	209.6412	2675	-1.0313
DEORA/1	139.1894	139.6118	2675	-0.4224
DEWA/1	117.9379	117.6176	2675	0.3203
DHADHARWALA/1	197.5398	198.0269	2675	-0.4871
DHAISAR/1	162.3793	162.0655	2675	0.3138
GODHOOWALA/1	62.18358	62.60497	2675	-0.42139
GOPALSAR/2	217.245	220.432	2675	-3.187
GOTARU/1	45.29274	45.71414	2675	-0.4214
GUDIALA/1	215.268	218.4554	2675	-3.1874
HAMEERA/1	150.3517	150.0312	2675	0.3205
JHABRA/1	214.6637	215.3968	2675	-0.7331
JHAKAN/1	201.4111	202.7485	2675	-1.3374
JHALARIYA/1	214.3712	215.0841	2675	-0.7129
KAN SINGH KI SID/1	172.9269	173.4129	2675	-0.486
KASAU KA TALA/1	143.8431	144.2687	2675	-0.4256
KATHODI/1	132.8733	132.5529	2675	0.3204
KELAWA/1	204.5299	205.243	2675	-0.7131
KHARIA KUA/1	59.17303	59.59435	2675	-0.42132

**GROUND WATER FLOW MODELLING OF JAISALMER DISTRICT AND PARTS OF JODHPUR DISTRICT,
RAJASTHAN (50,000 sq.km)**

Location	Head values before Demand & Supply interventions	Head values after Demand & Supply interventions	Times	Difference in Head Values before & after interventions
KOLU PABUJI/2	187.1064	188.1327	2675	-1.0263
KUMARO KI DHANI/1	185.1064	185.319	2675	-0.2126
KURIYA-BERI/1	62.29077	62.71217	2675	-0.4214
LANELA/1	136.7516	136.4311	2675	0.3205
LOHARKI/1	167.8336	168.5467	2675	-0.7131
LORTA ACHLAWATA (P)/1	207.6261	207.4415	2675	0.1846
MYAJLAR/1	42.84056	43.26077	2675	-0.42021
NATHOOSAR/1	208.3097	209.0226	2675	-0.7129
NATHURA-KUA/1	62.39135	62.81253	2675	-0.42118
NERAN/1	209.5479	210.1989	2675	-0.651
PHULIA1/1	65.19706	65.6185	2675	-0.42144
PITHEWALA/1	75.45466	75.87408	2675	-0.41942
RAIPALON KI DHANI/1	215.2444	215.9572	2675	-0.7128
RAM-ASHU RD/1	61.2855	61.70394	2675	-0.41844
RAMCHOWKI (P)/2	223.5639	223.5639	2675	0
RANAU/1	65.39138	65.81271	2675	-0.42133
RATARIYA/2	214.4611	215.1732	2675	-0.7121
ROHINA/1	230.335	230.8201	2675	-0.4851
SANTORA KHURD (P)/2	205.6026	206.6526	2675	-1.05
SODAKAR/1	157.8701	157.5518	2675	0.3183
SODHADHARA/1	181.6828	182.1696	2675	-0.4868
SOLANKIYA TALA/1	207.5509	207.8588	2675	-0.3079
SOMESAR/1	214.257	214.6379	2675	-0.3809
SOMESAR-PD/1	210.3979	210.7104	2675	-0.3125
SORHAKOR/1	149.0212	148.7007	2675	0.3205
SRIBHADRIA/1	154.42	155.1343	2675	-0.7143
SULTANA/1	97.9679	97.64941	2675	0.31849
SUWALIA/1	193.24	193.6502	2675	-0.4102
TENA(N.NAGAR)/1	192.558	192.8653	2675	-0.3073
TEPU/1	161.89	162.3776	2675	-0.4876
UTTRI DHANI/1	184.8527	184.8518	2675	0.0009
VEERAMDEORA/2	191.55	192.2654	2675	-0.7154

Conclusions

The overall scenario of the transient run from May 2014 onwards shows that, the effect of the stress is immediately reflected through the shift in head contours in the blocks covered with hard rock which includes eastern parts of the model area viz. Baori, Tinwari, Shekhala Osian, Lohawat. Slowly the effect extends westward and reflection can be seen in Shergarh, Phalodi, Bap and further westward upto Sankra Blocks till May 2020. In these blocks in addition to the hard rock the draft is also high. But Jaisalmer and Sam Blocks that lie in extreme west of the model area are covered by thick alluvial cover present in the form of sand dunes where the draft as well as recharge is very less due to very less rainfall and also very less draft as this area has less population density and almost no agricultural activity. The prediction scenario generated when the draft and recharge of the previous year was continued when compared viz. 1580 days (May 2018) with 2675 days (May 2021) resulted in continuation of increase in drawdown.

The drawdown contours generated for the different prediction scenarios when compared with the normal scenario viz. 1580 days (May 2018) with 2675 days (May 2021) shows the similar immediate reflection is in the eastern blocks of the model area. The prediction scenario when both supply side and demand side interventions suggested in NAQUIM studies are implemented there is an improvement in the water table and due to decrease in draft in the area owing to the use of water efficient crops and irrigation techniques. However, these interventions cannot change the stage of groundwater extraction of the area but it will help in increasing the sustainability of resources in the area.

Model Limitations

In general, the model layers are a simplified representation of the natural thickness of the hydrostratigraphic layers in the study area and may not adequately reflect the natural conditions. The use of the model as a predictive tool with which to estimate the effect of recharge and pumping and realistically manage the groundwater resources in the area is restricted by the following specific limitations in our current understanding of the conceptual model

- Little information on the spatial distribution of hydraulic head values of the aquifer, particularly in the western part.
- Limited knowledge of layer-wise hydraulic parameters of the aquifer across the study area.
- Limited data on interflow between the hydrostatic layers.

Way Forward

Availability of more hydraulic head values in the north and western part of the model especially in the Jaisalmer and Sam Blocks are required to establish the precise flow along the boundary and land use based draft assignment will present the better insights into the regional groundwater dynamics and improve the model's predictive dynamics.

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