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# Groundwater Levels in the Kabul Basin, Afghanistan, 2004–2013

Open-File Report 2013–1296
USGS Afghanistan Project Product No. 182

**U.S. Department of the Interior**
**U.S. Geological Survey**

**Cover.** *Top*, A village elder observes the Afghanistan Geological Survey (AGS) hydrogeology engineers collecting differential Global Positioning System (GPS) data at a well in the Kabul Basin, Afghanistan; photograph by the AGS. *Bottom*, AGS hydrogeology engineers collecting differential GPS data at a hand-pump well in the Kabul Basin, Afghanistan; photograph by the AGS.

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SALLY JEWELL, Secretary

**U.S. Geological Survey**
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2014

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# Foreword

In July 2004, the Afghanistan Geological Survey initiated a water-level monitoring network in the Kabul Basin, Afghanistan. At that time, the Afghanistan Geological Survey was rebuilding its basic capabilities, with assistance from the U.S. Geological Survey, after the country had endured more than 30 years of political upheaval as a result of military invasion and civil war. Data collection, in a country where environmental data collection is difficult, at times hazardous, and data collection networks are rare, is now in the 10th year of the effort. The water-level monitoring network of the Afghanistan Geological Survey is valuable in that it allows for monitoring of groundwater resources in the capitol city of Afghanistan, which has seen a tremendous population growth in the last decade. The monitoring network that has resulted from the partnership of the U.S. Geological Survey and the Afghanistan Geological Survey can serve as a model for similar networks in other population centers in a country where utilization of natural resources is important in the Nation's endeavors for economic and political stability.

H.E. Haji Mohammad Akbar Barakzai

Minister
Ministry of Mines and Petroleum

The Islamic Republic of Afghanistan

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The groundwater-level monitoring network described in this report was funded by the U.S. Agency for International Development (USAID), between 2004 and 2008. From 2009 to present, the AGS Hydrogeology Group benefited from collaboration with the U.S. Department of Defense Task Force for Business and Stability Operations (TFBSO) and the U.S. Geological Survey on hydrologic investigations at mineral areas.

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# Figures



# Conversion Factors and Datums

SI to Inch/Pound

| Multiply | By | To obtain |
|---|---|---|
| | Length | |
| inch (in) | 0.03937 | millimeter (mm) |
| foot (ft) | 3.281 | meter (m) |
| mile (mi) | 0.6214 | kilometer (km) |
| yard (yd) | 1.094 | meter (m) |
| | Area | |
| acre | 247.1 | square kilometer ($km^2$) |

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:
°F = (1.8 × °C) + 32.

Vertical and horizontal coordinate information is referenced to the World Geodetic System 1984 (WGS 84).

# Groundwater Levels in the Kabul Basin, Afghanistan, 2004–2013

By Mohammad R. Taher,[1] Michael P. Chornack,[2] and Thomas J. Mack[2]

## Abstract

The Afghanistan Geological Survey, with technical assistance from the U.S. Geological Survey, established a network of wells to measure and monitor groundwater levels to assess seasonal, areal, and potentially climatic variations in groundwater characteristics in the Kabul Basin, Afghanistan, the most populous region in the country. Groundwater levels were monitored in 71 wells in the Kabul Basin, Afghanistan, starting as early as July 2004 and continuing to the present (2013). The monitoring network is made up exclusively of existing production wells; therefore, both static and dynamic water levels were recorded. Seventy wells are in unconsolidated sediments, and one well is in bedrock. Water levels were measured periodically, generally monthly, using electric tape water-level meters. Water levels in well 64 on the grounds of the Afghanistan Geological Survey building were measured more frequently. This report provides a 10-year compilation of groundwater levels in the Kabul Basin prepared in cooperation with the Afghanistan Geological Survey.

Depths to water below land surface range from a minimum of 1.47 meters (m) in the Shomali subbasin to a maximum of 73.34 m in the Central Kabul subbasin. The Logar subbasin had the smallest range in depth to water below land surface (1.5 to 12.4 m), whereas the Central Kabul subbasin had the largest range (2.64 to 73.34 m). Seasonal water-level fluctuations can be estimated from the hydrographs in this report for wells that have depth-to-water measurements collected under static conditions. The seasonal water-level fluctuations range from less than 1 m to a little more than 7 m during the monitoring period. In general, the hydrographs for the Deh Sabz, Logar, Paghman and Upper Kabul, and Shomali subbasins show relatively little change in the water-level trend during the period of record, whereas hydrographs for the Central Kabul subbasin show water level decreases of several meters to about 25 m.

## Introduction

The Afghanistan Geological Survey (AGS), with technical assistance from the U.S. Geological Survey, established a water-level monitoring network in the Kabul Basin, Afghanistan, in 2004 to assess seasonal, areal, and potentially climatic variations in groundwater characteristics (Akbari and others, 2007). This water-level network provides a 10-year data record that is remarkable in a country where there are few hydrologic data and basic monitoring operations are restricted by the effects of war. This network has been used to assess trends of the effects of climate on the levels of groundwater within the 10-year period and of current and future population growth on groundwater sustainability in the Kabul Basin (Mack and others, 2010, 2013).

In the early data collection efforts, the water-level monitoring network consisted of 69 wells (Akbari and others, 2007) selected from an inventory of 148 wells (Broshears and others, 2005, fig. 5) that were used for water-level and water-quality measurements in the Kabul Basin. Information on well location, depth, and water quality is provided by Broshears and others (2005). By the end of 2007, water-level monitoring was discontinued at 3 of the original 69 monitoring wells due to access restrictions. Five wells were added to the network after 2007. The water-level monitoring network currently (2013) consists of 71 wells.

This report describes water-level data collection and presents hydrographs for each well in the network. The network wells are distributed in six subbasins that make up the Kabul Basin (fig. 1). The boundaries for the subbasins approximately coincide with drainage basins for the major rivers and streams flowing through the Kabul Basin.

[1]Afghanistan Geological Survey.

[2]U.S. Geological Survey.

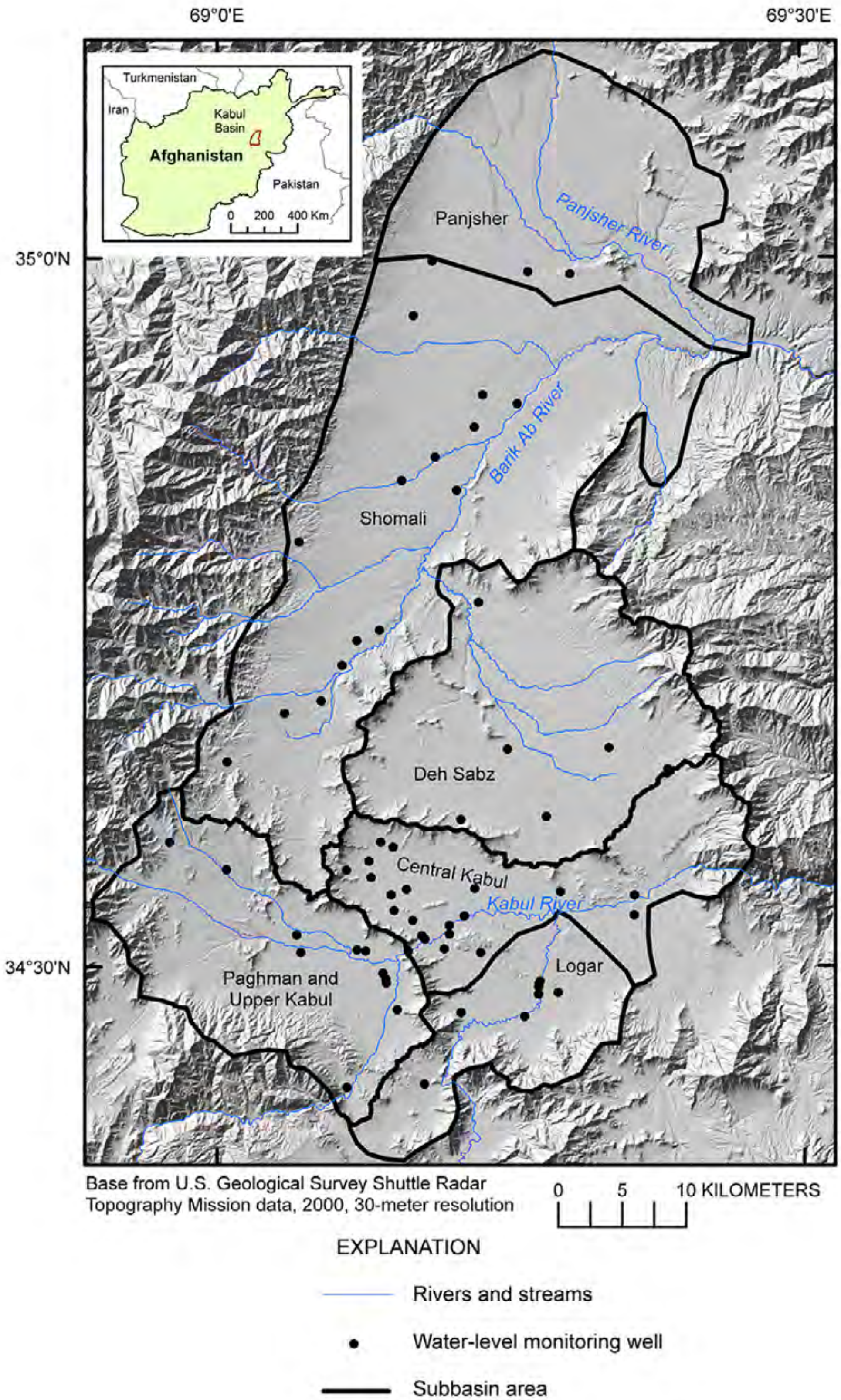



**Figure 1.** Location of the Kabul Basin study area in Afghanistan.

## Description of Study Area

The topography of the Kabul Basin is strongly influenced by regional and local faulting and fluvial processes (Mack and others, 2010). The basin is bounded by mountain ranges and contains interbasin ridges that form boundaries between some of the subbasins. The central plains within the subbasins are depositional centers for sediments derived from the surrounding mountains and ridges. The central plains gently slope up toward the adjacent mountains and interbasin ridges. Alluvial fans have developed on some of the mountain and ridge slopes.

The geology of the Kabul Basin has been described by Broshears and others (2005) and Mack and others (2010). Faulting in the Kabul Basin has resulted in a series of subbasins surrounded by mountains. The six subbasins are the Central Kabul, Deh Sabz, Logar, Paghman and Upper Kabul, Shomali, and Panjsher (fig. 1). The two wells in the Panjsher subbasin are very close to the boundary with the Shomali subbasin. These wells are included as part of the discussion of the Shomali subbasin. The boundaries for the subbasins generally coincide with surface-water drainage basins. The subbasins are filled with Quaternary and Tertiary sediments and rocks. The surrounding mountains and interbasin ridges comprise uplifted crystalline and sedimentary rocks. Quaternary sediments are typically less than 80 m thick in the valleys. The underlying Tertiary sediments have been estimated to be as much as 800 m thick in the city of Kabul and may be more than 1,000 m thick in some areas of the valley (Mack and others, 2010).

Groundwater flow in the Kabul Basin is primarily through saturated alluvium and other basin-fill sediments. The water table generally follows the topography, and groundwater flows in the direction of the surface-water drainage. Mean annual precipitation is about 330 millimeters (mm), and evapotranspiration is estimated to be much greater. The major source of groundwater recharge in the Kabul Basin is from the infiltration of surface water from rivers and irrigation (Mack and others, 2010). Snow melt runoff from the surrounding mountains is the source of most of the surface water flowing through the Kabul Basin. Local precipitation during the winter months and summer monsoonal storms also contributes to the groundwater recharge.

## Well Locations

The locations and ground-surface elevations for the wells in the original monitoring network were established in World Geodetic System 1984 (WGS 84) coordinates by differential global positioning system (GPS) measurements (Broshears and others, 2005; Akbari and others, 2007). The locations and ground-surface elevations for the five wells added to the monitoring network after 2007 were located using standard GPS receivers. Well location information, along with other well characteristics, is presented with each well hydrograph in the Water-Level Hydrographs section.

## Data Collection Methods

Water-level data are collected monthly using 100-m electric tapes with a manufacturer's stated accuracy of ±1 mm. The only well in the monitoring network that is measured more frequently is well 64, which is on the grounds of the AGS building.

Correction factors for tape stretch or borehole deviation were not applied to the water-level data for several reasons. The depths to water being measured are generally shallow with only about 20 percent being greater than 20 m. Therefore, it is assumed that any mechanical stretch of the electric tapes is negligible. Also, depth corrections for well deviation were not calculated because no information on borehole deviation was available for the monitoring wells. The shallow depth of most of the wells would limit the amount of borehole deviation.

A reference point on or at a well was used to maintain a consistent water-level measurement point. The distance from the reference point to the ground surface, the reference point distance, was used to calculate the depth to water below ground surface. The depth-to-water measurement from the reference point was determined by down-hole measurements using electric water-level tapes. The depth to water from ground surface is calculated by subtracting or adding the reference point distance from or to the depth-to-water measurement. Water-table elevation was calculated by subtracting the calculated depth to water from the land-surface elevation at the well site.

Depth-to-water measurements collected for each site visit to a well are recorded on a field form along with the well status, static or pumping, when the measurement was taken. If the well had been pumped recently, the amount of time since pumping had stopped is recorded on the form. The information recorded on the field form and the water-level measurements are maintained in project databases by the AGS.

# Water-Level Hydrographs

This section presents the water-level hydrographs for the 71 wells in the Kabul Basin that comprise the AGS monthly water-level monitoring network. The heading for each well hydrograph provides a short summary about the location and basic attributes of the well. The hydrographs have a time scale, from July 1, 2004, through July 1, 2013, although not all wells have data for this entire period. The vertical (y) axis on the hydrographs displays the water level in meters below land surface; the scale of the vertical axis is adjusted to display adequate detail of water-level variations for each well. Discrete water-level measurements are indicated with a solid diamond symbol, and the discrete measurements are connected with a solid line to indicate the trend in water levels at the well. A linear trend line is shown on each plot to provide a visual indicator of the general water-level trend. The statistical significance of the trend lines and the implications for groundwater sustainability in the Kabul Basin are analyzed by Mack and others (2013).

Water levels between the measurements could vary by an unknown amount between the actual measurements. However, it is very unlikely that, in the absence of pumping, the water levels vary substantially at the hourly or daily timescale. Water-level measurements were collected under static (nonpumping) and dynamic (pumping or recently pumped) conditions. Water levels that were collected under dynamic conditions are indicated by an open diamond symbol on the horizontal (x) axis of the hydrograph. Many of the shallow wells are equipped with hand pumps where pump capacity limits withdrawal and associated drawdown. The deeper production wells are equipped with electric pumps and are pumped more frequently; therefore, it may be difficult to determine static water levels in these wells. Seasonal variations are evident in many of the water-level hydrographs for these wells. Many of the measurements taken under dynamic conditions are clearly indicated by sharp drops in the water levels on the hydrographs.

Each hydrograph has an explanation containing information on the attributes of the well site. The “Number” is the identifying number for the well in the AGS database. Some of the well numbers contain decimal points that indicate that the well originally chosen for monitoring has been replaced by another well in the same general area. The “Name” is generally a descriptive location of the well. The “Datum” is the land surface elevation in meters above sea level. The “Depth” is the total drilled depth of the well below land surface. The “Surficial geology” is the stratigraphic unit abbreviation, or code, followed by the descriptor of the unit at the well location using the mapped data and nomenclature from Bohannon and Turner (2005). In the stratigraphic unit codes shown the prefix “Q” designates Quaternary age sediments. For example, the code “Q3loe” is followed by the descriptor “loess” indicating a Quaternary age loess is mapped at that location. The “Description” provides a more detailed description of the location of the well and can include the well’s proximity to a local landmark or may provide the name of the village where the well is located.

## Central Kabul Subbasin

The Central Kabul subbasin (fig. 2) comprises 419 square kilometers ($km^2$) and includes the city of Kabul in the western part and more rural lands in the eastern part of the subbasin. The subbasin encompasses the Kabul River downstream from the confluence with the Paghman Stream. There are 23 monitoring wells in the Central Kabul subbasin, ranging in total depth from 19.5 to 160 m. The majority of the wells are in the western part of the subbasin, which coincides with the primary population center in the Kabul Basin. The geologic map of Bohannon and Turner (2005) indicates that all the wells are on Quaternary loess, fan alluvium and colluvium, or conglomerate and sandstone. Wells 208 and 210 (fig. 2) are municipal production wells and are within 1 kilometer (km) of the Kabul River. Wells 218, 219, and 220 are also municipal production wells in the northwestern corner of the Central Kabul subbasin on an alluvial fan developed on the flanks of the Paleoproterozoic gneiss that forms the hills to the north and west of Kabul city. In addition to these wells, a number of the wells in the monitoring network are major production wells for the inhabitants of the city of Kabul.

The depth to water in the monitoring wells under static conditions ranged from a minimum of 2.64 m (1,790.6 m above sea level) in well 133 during April 2009 to a maximum of about 73.34 m (1,778.6 m above sea level) in well 65 during June 2013. The large range in depths to water in the wells in this subbasin is a result of the large differences in the ground-surface elevations of the wells. The ground-surface elevation at well 133 is 1,793.2 m above sea level and the ground-surface elevation at well 65 is 1,851 m above sea level. Monitoring wells, which were not affected by pumping, have seasonal fluctuations from about 0.5 to 2.7 m. Whereas the water levels in other wells were monitored about once a month, the water level in well 64 was monitored more often, about once a week. The water-level summary plot for well 64 shows distinct seasonal variations for the entire monitoring period with water-level fluctuation averaging about 3 m from the spring high to the late summer low. In general, it appears that the water levels have decreased in most of the wells during the monitoring period. Only wells 153 and 208 showed an increase in the water level during the entire monitoring period. The water level in well 163 increased from the initial measurement during November 2004 until the well was closed to measurements in October 2008. The water-level summary plots for wells 218, 219, and 220 (fig. 2) show pumping induced drawdowns and recoveries that range from about 10 to 25 m based on consecutive monthly water-level measurements taken under static and dynamic conditions. Other production wells show similar drawdowns and recoveries from the wells being pumped.

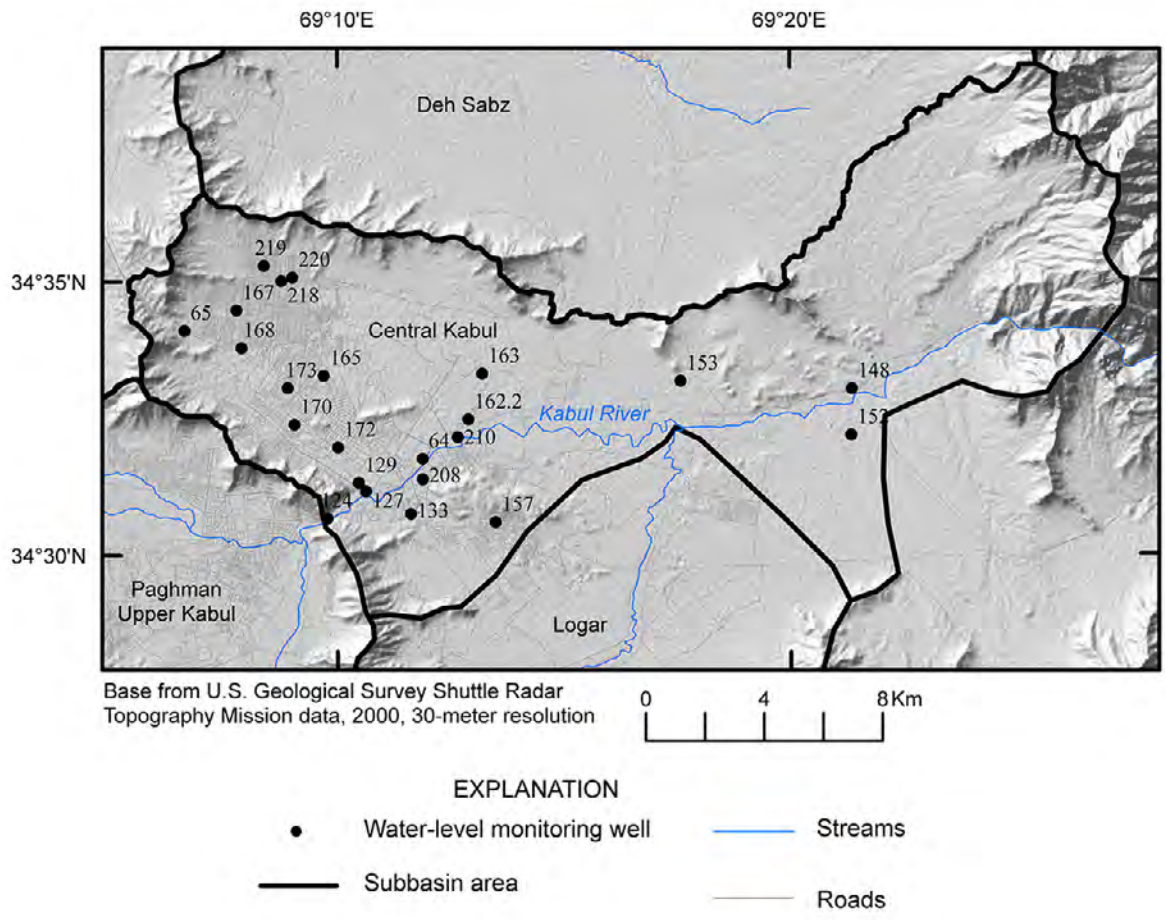


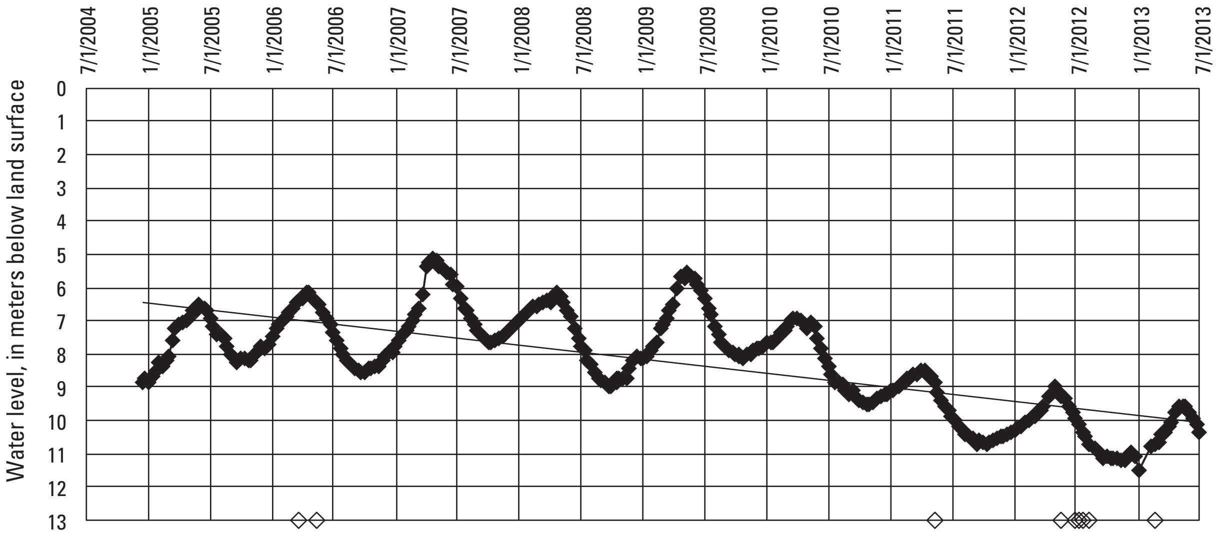

**Figure 2.** Location of wells in the Central Kabul Subbasin.

**Number—64**

Name—Afghanistan Geological Survey (AGS) well

Datum—1,792.4 m
Depth—40 m

Surficial geology—Q3loe; loess
Description—In the AGS office complex

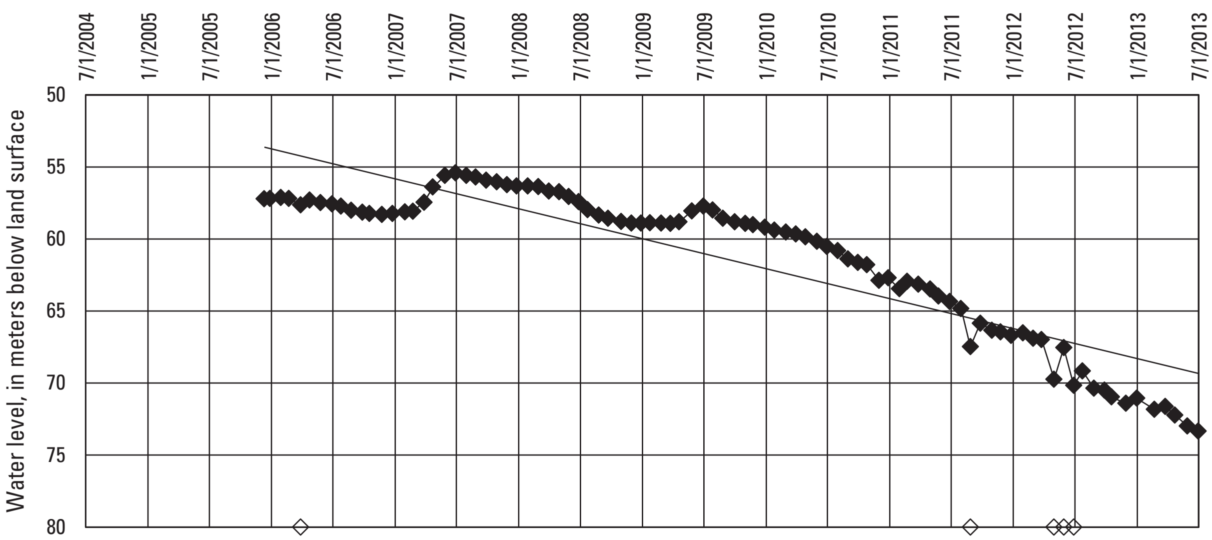



**Number—65**

Name—Well at Khair Khana village

Datum—1,851 m
Depth—140 m

Surficial geology—Q3loe; loess
Description—Khair Khana village




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—124**

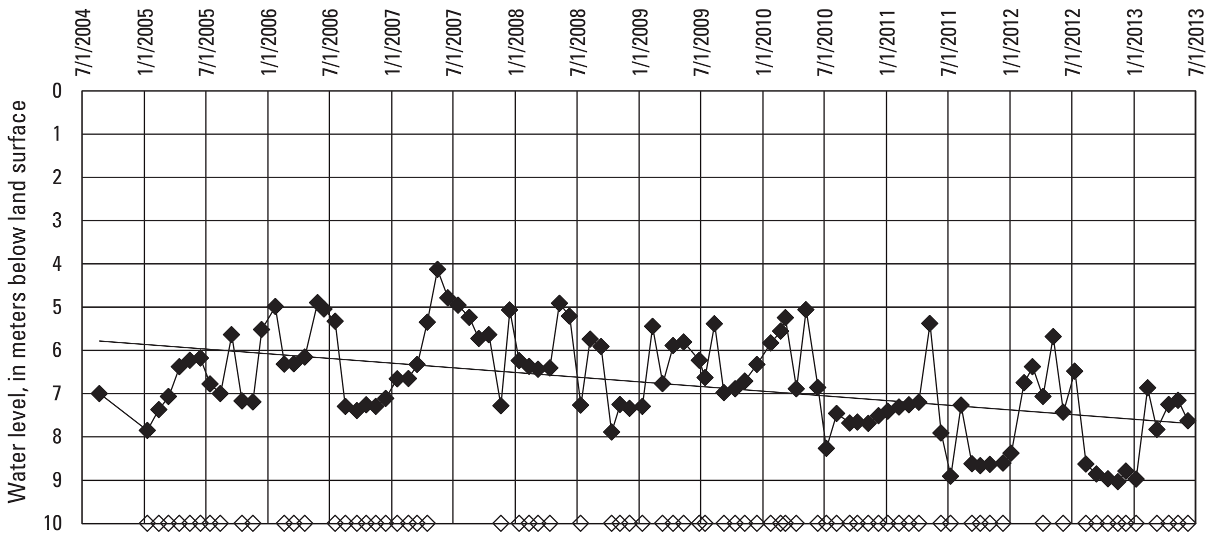
Name—Well at Pole Baghe Omomi village

Datum—1,799.2 m

Depth—60 m

Surficial geology—Q4a; conglomerate and sandstone

Description—Pole Artal




**Number—127**

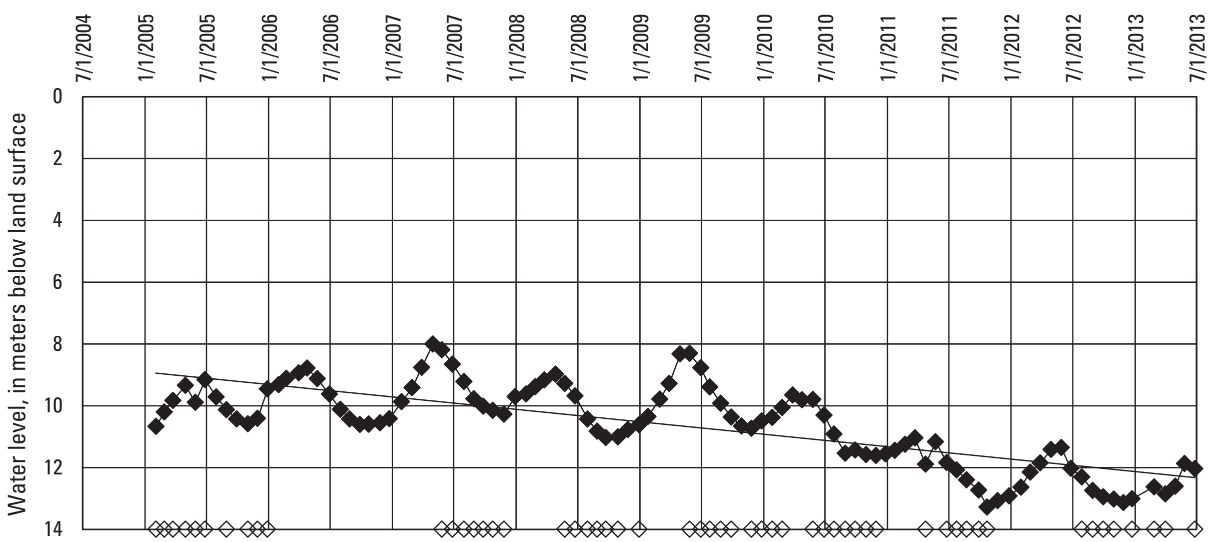
Name—Well at Pole Baghe Omomi village

Datum—1,803 m

Depth—45 m

Surficial geology—Q3loe; loess

Description—Dental clinic

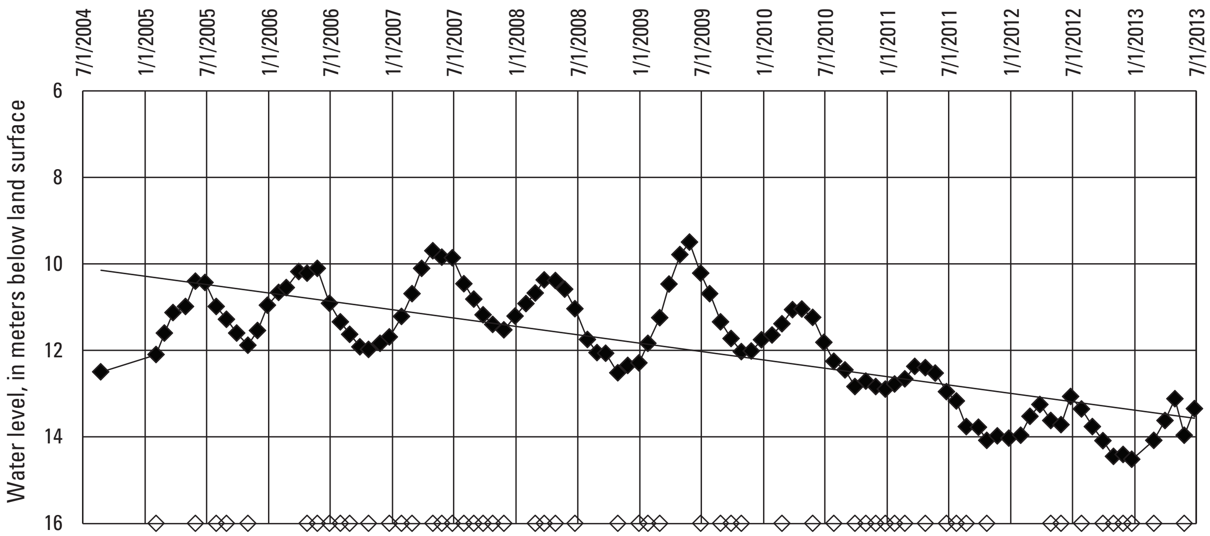



**EXPLANATION**

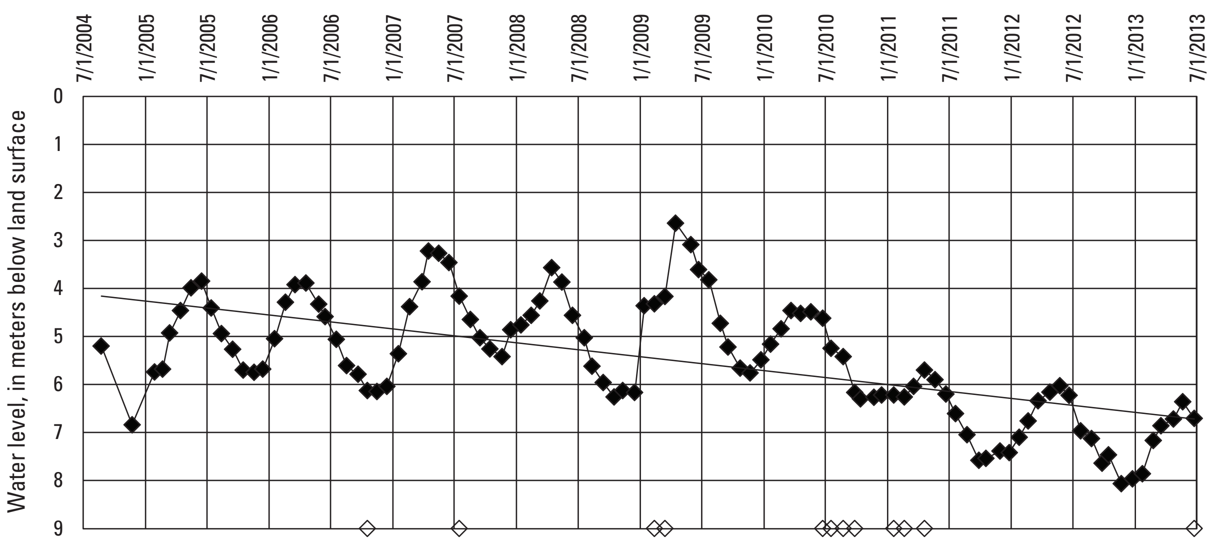
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—129**
Name—None
Datum—1,806 m
Depth—40 m
Surficial geology—Q3loe; loess




**Number—133**
Name—Well at Darwazy Lahury
Datum—1,793.2 m
Depth—27 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Vaccine Production Center

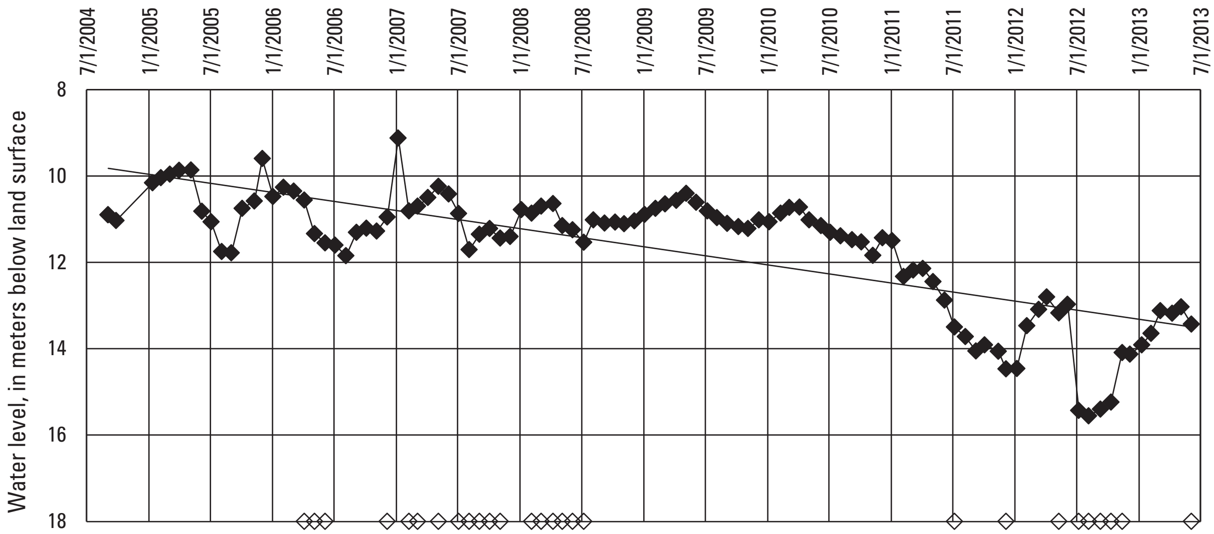



**EXPLANATION**

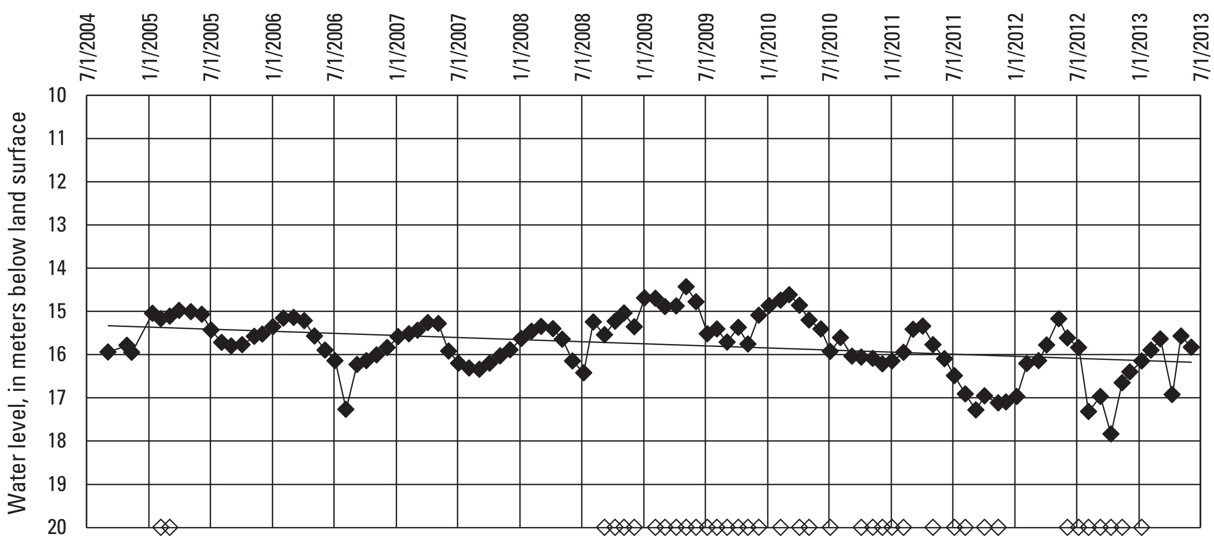
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—148**
Name—Well at Sare Pole village
Datum—1,781.3 m
Depth—20.6 m
Surficial geology—Q2a; conglomerate and sandstone
Description—Beside the fuel station




**Number—152**
Name—Well at Jabarkhan village
Datum—1,788.9 m
Depth—27 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Swedish Committee for Afghanistan (SCA) hand pump 116

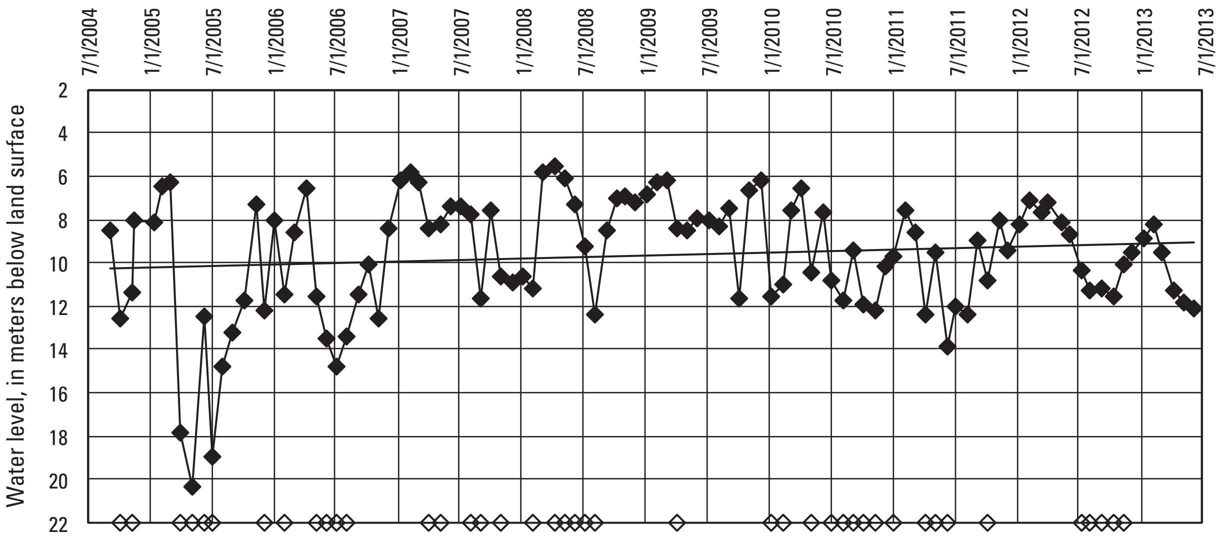



**EXPLANATION**

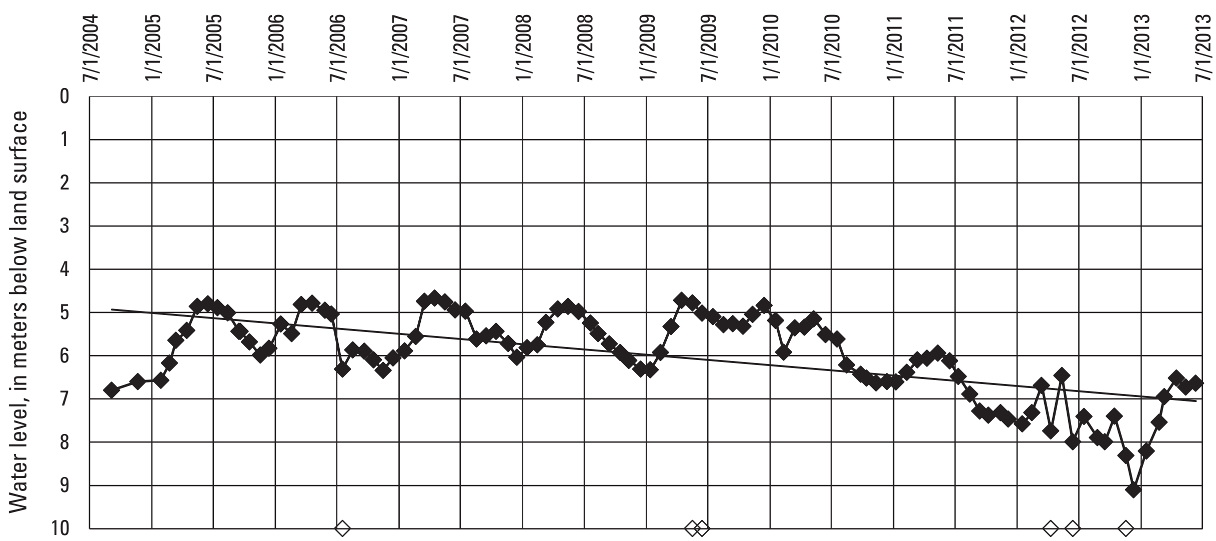
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—153**
Name—Well at Parkhae Sonati village
Datum—1,781.9 m
Depth—160 m
Surficial geology—Q34ac; fan alluvium and colluvium
Description—Spingar Fabric




**Number—157**
Name— Well at Karte Now village
Datum—1,794.7 m
Depth—35 m
Surficial geology—Q2a; conglomerate and sandstone
Description—street N 3




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—162.2**

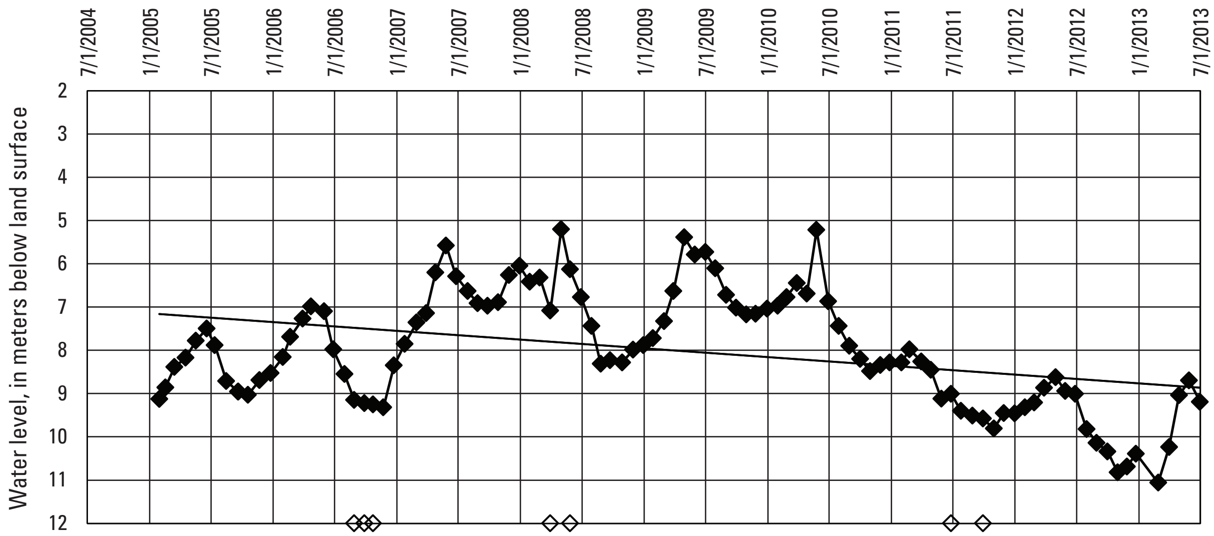
Name—Well at Yakatoot village

Datum—1,799 m

Depth—19.5 m

Surficial geology—Q3loe; loess

Description—Beside the radio station




**Number—163**

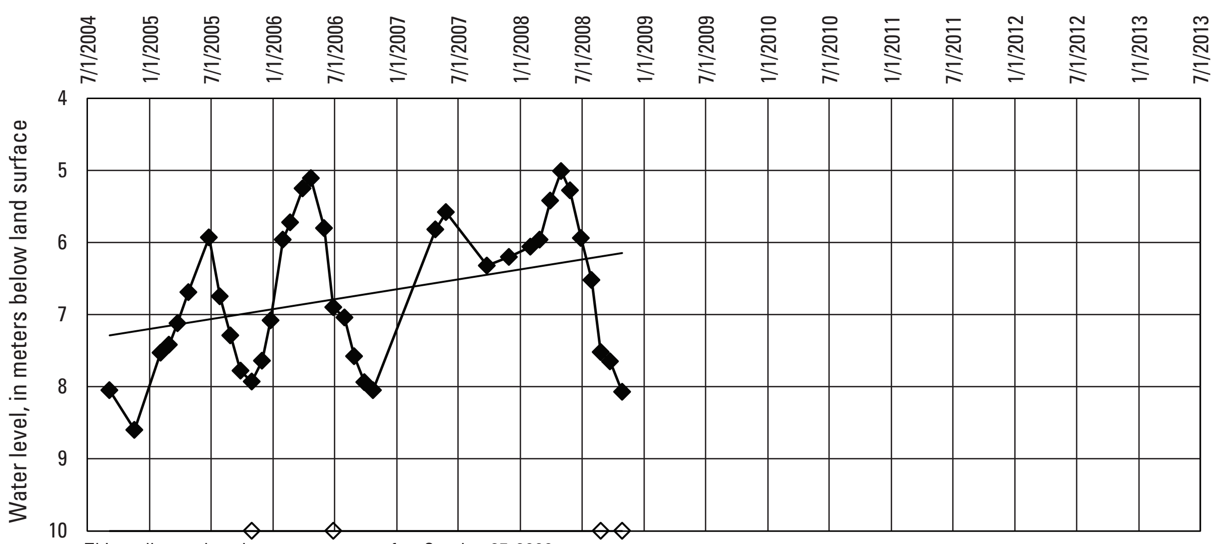
Name—Well at Khoja Rawash village

Datum—1,787.7 m

Depth—20 m

Surficial geology—Q3loe; loess

Description—East of airport




This well was closed to measurement after October 27, 2008.

**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

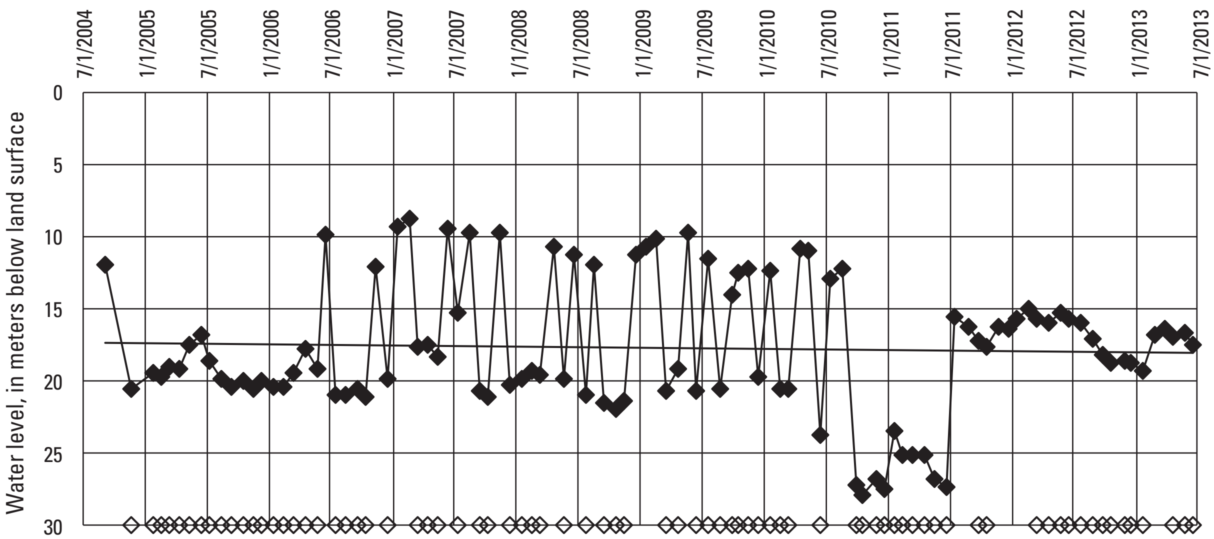
**Number—165**

Name—Well at Qala-i-Fathulla village

Datum—1,788.2 m

Depth—51.3 m

Surficial geology—Q3loe; loess




**Number—167**

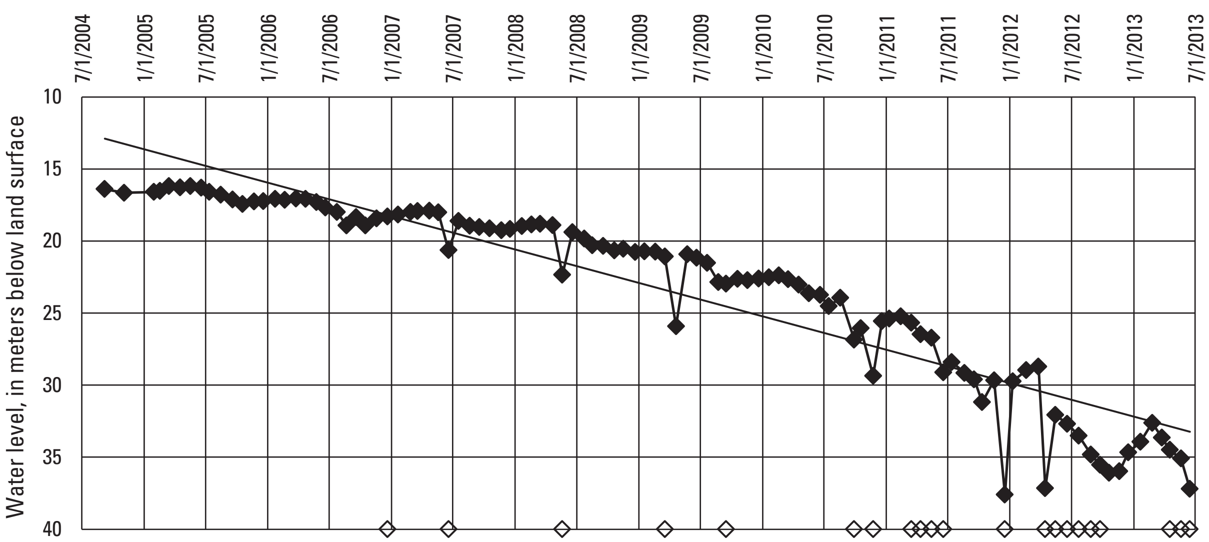
Name—Well at Khair Khana village

Datum—1,796.7 m

Depth—60 m

Surficial geology—Q34ac; fan alluvium and colluvium

Description—Khedamat Takhniky

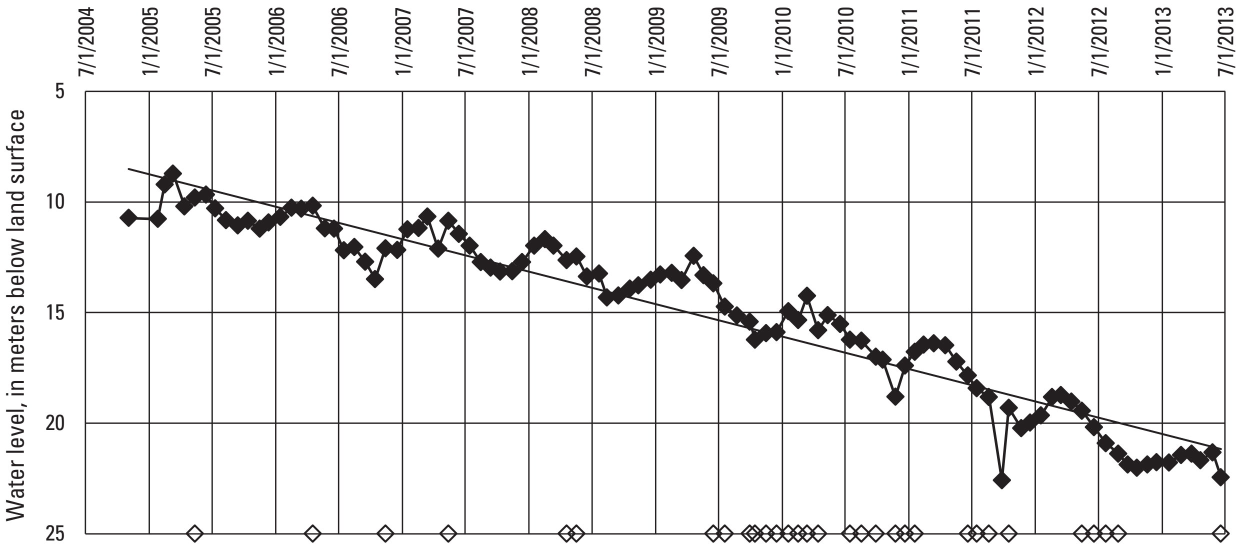



**EXPLANATION**

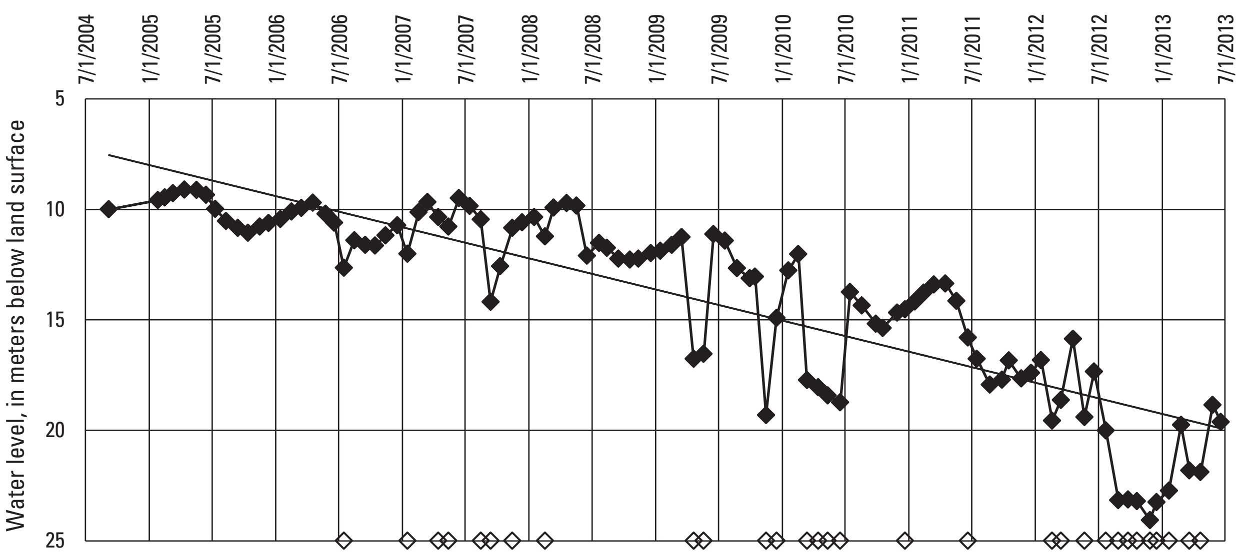
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—168**
Name—Well at Shahrak Police village
Datum—1,790.7 m
Depth—25 m
Surficial geology—Q34ac; fan alluvium and colluvium




**Number—170**
Name—Well at Kolola Pashta Blocks village
Datum—1,779.4 m
Depth—42.9 m
Surficial geology—Q3loe; loess
Description—Block 5

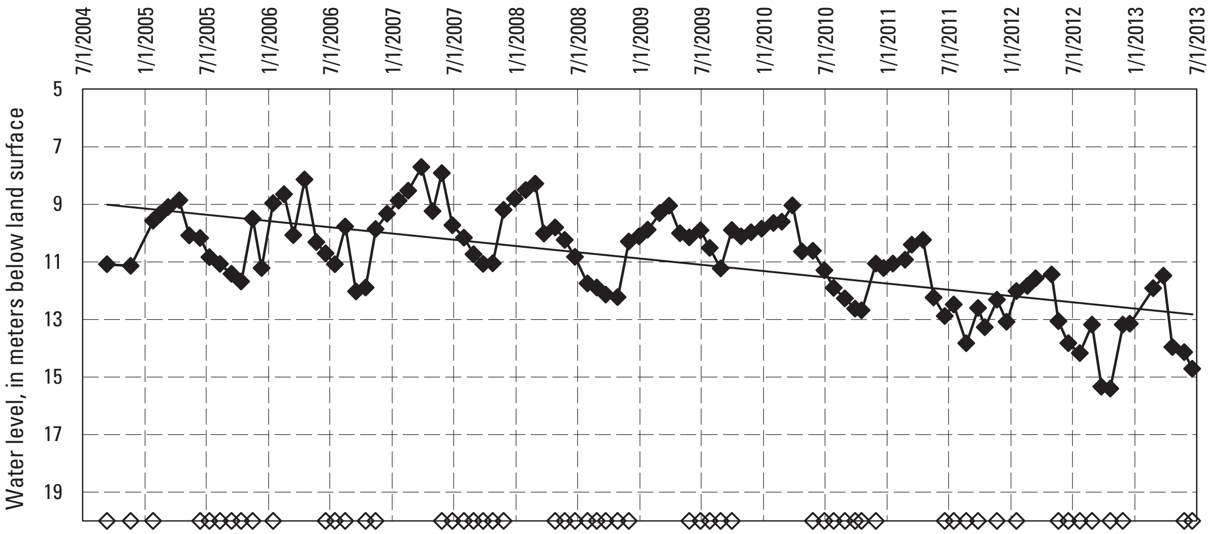



**EXPLANATION**

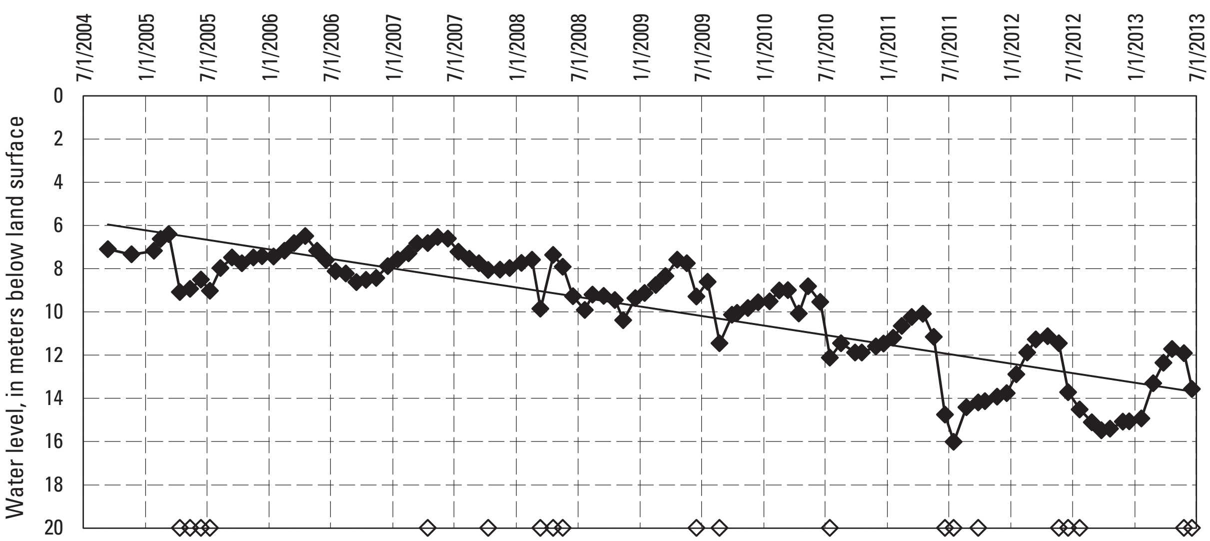
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—172**
Name—Well at Share Now village
Datum—1,794.9 m
Depth—59.7 m
Surficial geology—Q3loe; loess
Description—In the park




**Number—173**
Name—Well at Taimany village
Datum—1,786.9 m
Depth—34.9 m
Surficial geology—Q3loe; loess
Description—Mosque

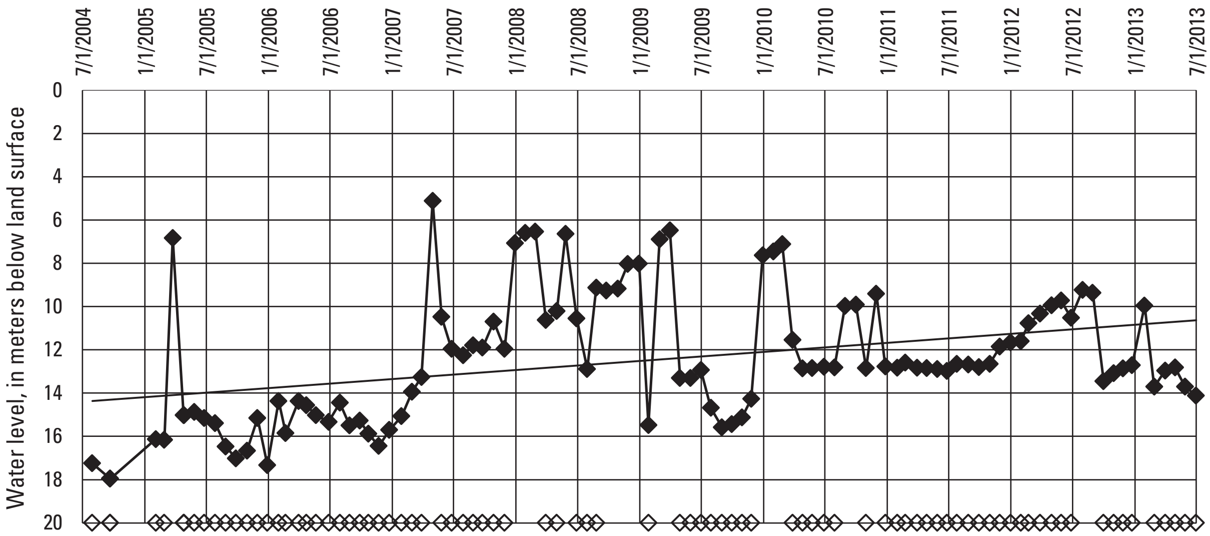



**EXPLANATION**

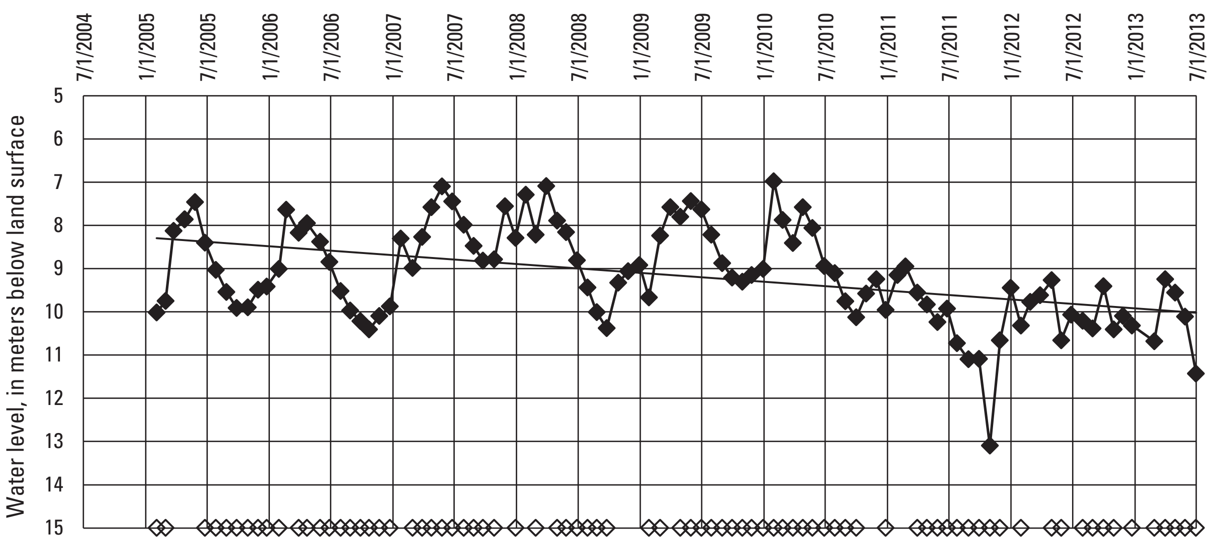
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—208**
Name—Well at Microrayan village
Datum—1,792.7 m
Depth—38.9 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Microrayan well 1




**Number—210**
Name—Well at Microrayan village
Datum—1,790.5 m
Depth—27.4 m
Surficial geology—Q3loe; loess
Description—Microrayan well 6




**EXPLANATION**

◆ Water-level measurement

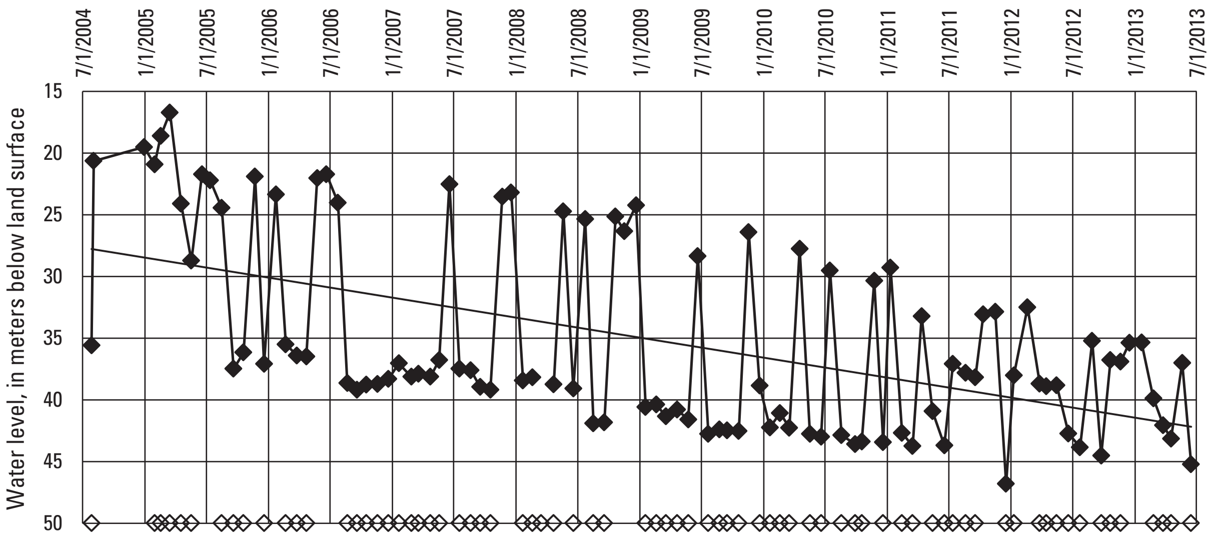
◇ Indicates recent pumping at time of measurement

**Number—218**

Name—Well at Khair Khana village

Datum—1,799.3 m
Depth—124.4 m

Surficial geology—Q34ac; fan alluvium and colluvium
Description—Supplemental well 1

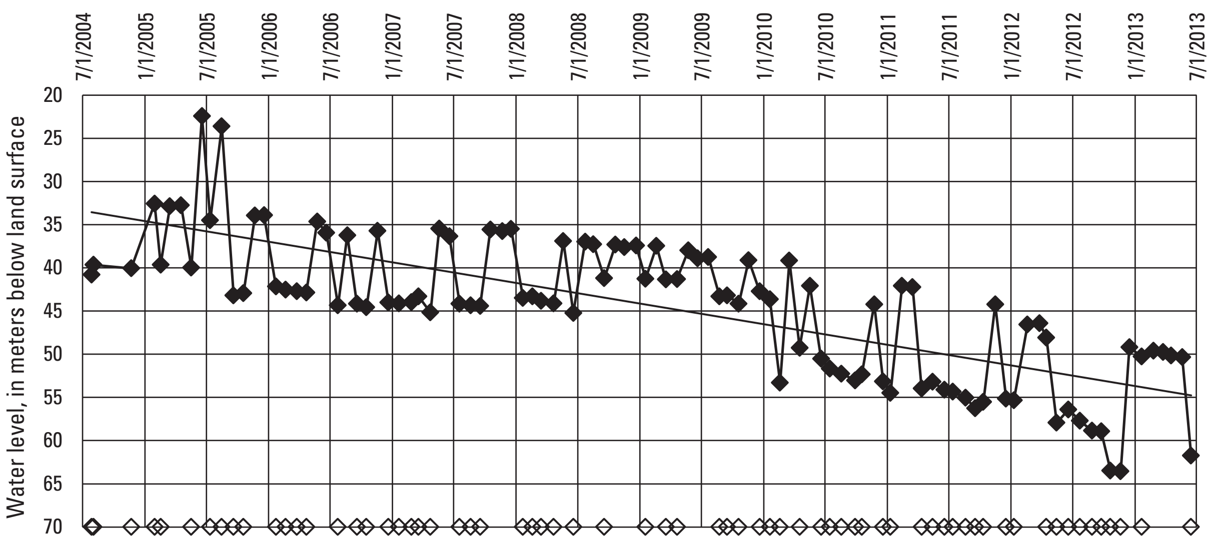



**Number—219**

Name—Well at Khair Khana village

Datum—1,812.9 m
Depth—94.6 m

Surficial geology—Q34ac; fan alluvium and colluvium
Description—Supplemental well 3

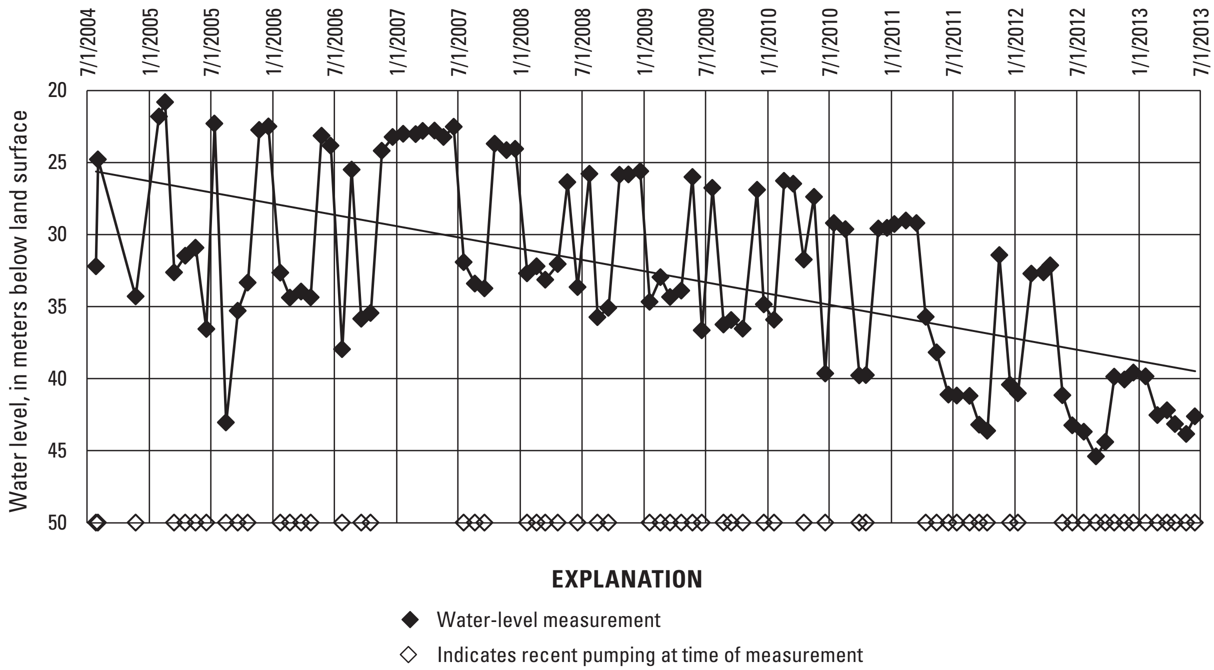



**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—220**
Name—Well at Khair Khana village
Datum—1,801.4 m
Depth—119.5 m
Surficial geology—Q34ac; fan alluvium and colluvium
Description—Supplemental well 4



## Logar Subbasin

The Logar subbasin (fig. 3) comprises 190 $km^2$ and includes urban and rural lands. There are eight monitoring wells in the subbasin, ranging in total depth from 25 to 79.1 m. The surficial geology at the wells varies from Quaternary loess to Quaternary conglomerate and sandstone. Wells 201, 202, 203, and 204 (fig. 3) are production wells and are adjacent to the Logar River. The remaining wells are village wells or irrigation wells.

Depth-to-water measurements under static conditions range from a minimum of 1.5 m (1,783.4 m above sea level) in well 201 adjacent to the Logar River in May 2005 to a maximum of 12.4 m (1,784.8 m above sea level) in well 135 in October 2004. The small range in depths to water in the wells in this subbasin is partly a result of the small differences in the ground-surface elevations at the wells. The ground-surface elevation at well 201 is 1,784.9 m above sea level, and the ground-surface elevation at well 135 is 1,797.1 m above sea level. The seasonal water-level fluctuation in well 135 from April 2006 until September 2006 was 4.3 m. The seasonal water-level fluctuation in well 143 from April 2006 until September 2006 was 4.3 m, and from April 2007 until September 2007, 2.2 m. The frequency of pumping in wells 201, 202, 203, and 204 makes it difficult to accurately identify seasonal water-level trends in these wells. However, there appears to be seasonal recharge in the wells that can be correlated to times of peak flow during late winter and spring in the Logar River. The hydrographs for wells 135 and 143 show some seasonal water-level fluctuations. Many of the hydrographs show an overall increase in the water level from 2004 until the seasonal water-level highs in 2009 or 2010. After the 2009 or 2010 water-level highs, the water levels decrease in these wells. Wells 202, 203, and 204 all show substantial water-level decreases during the monitoring period. The difference between nonpumping and pumping water levels in wells 201, 202, 203, and 204 range from about 4 to 6 m. Water levels in these wells also appear to recover rapidly after pumping has stopped.

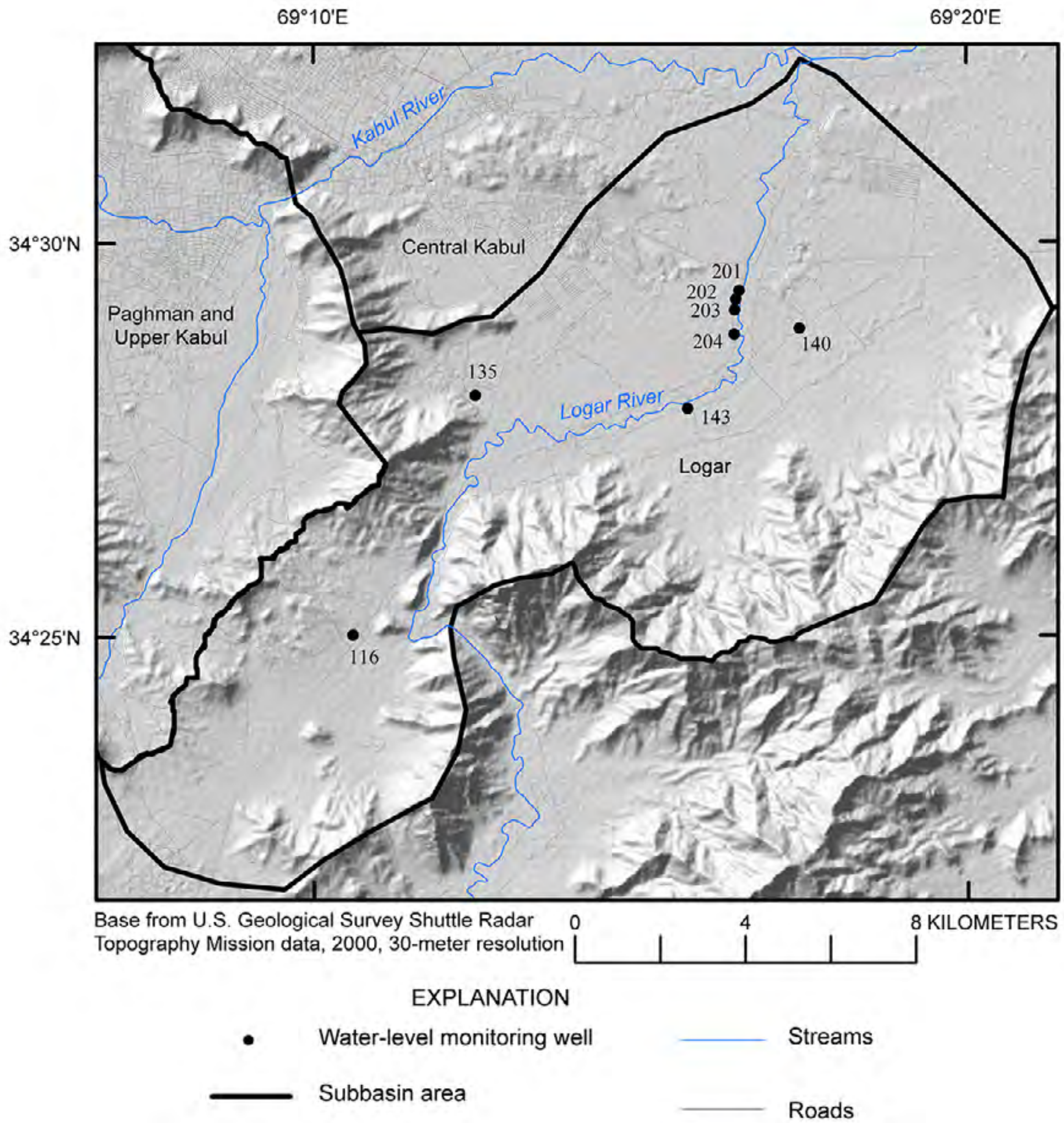



**Figure 3.** Locations of wells in the Logar Subbasin.

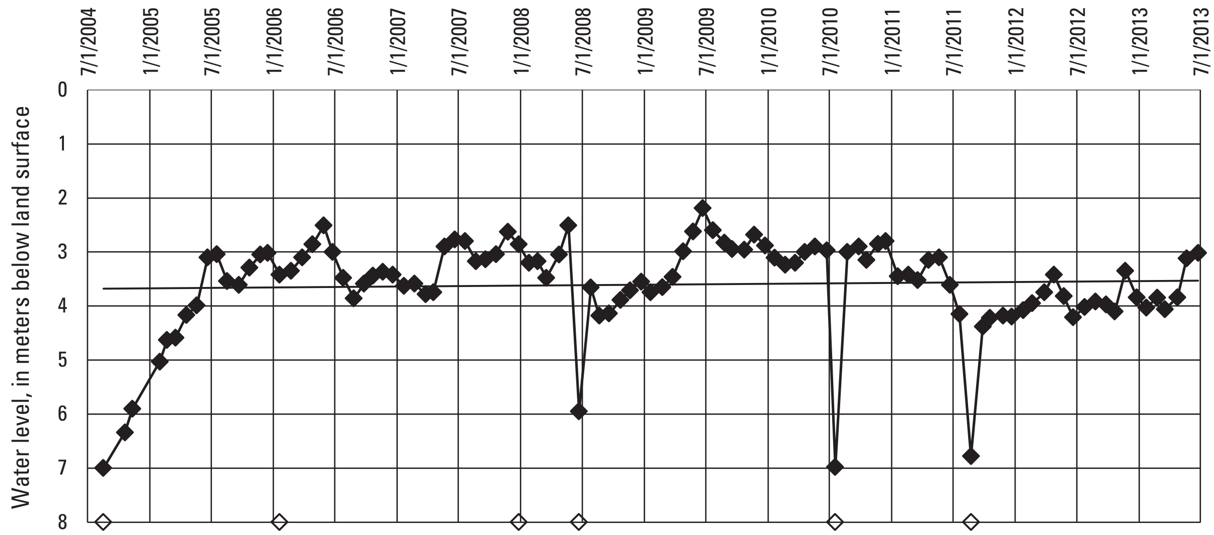
**Number—116**

Name—Well at Khairabad village

Datum—1,809.2 m

Depth—30 m

Surficial geology—Q3loe; loess



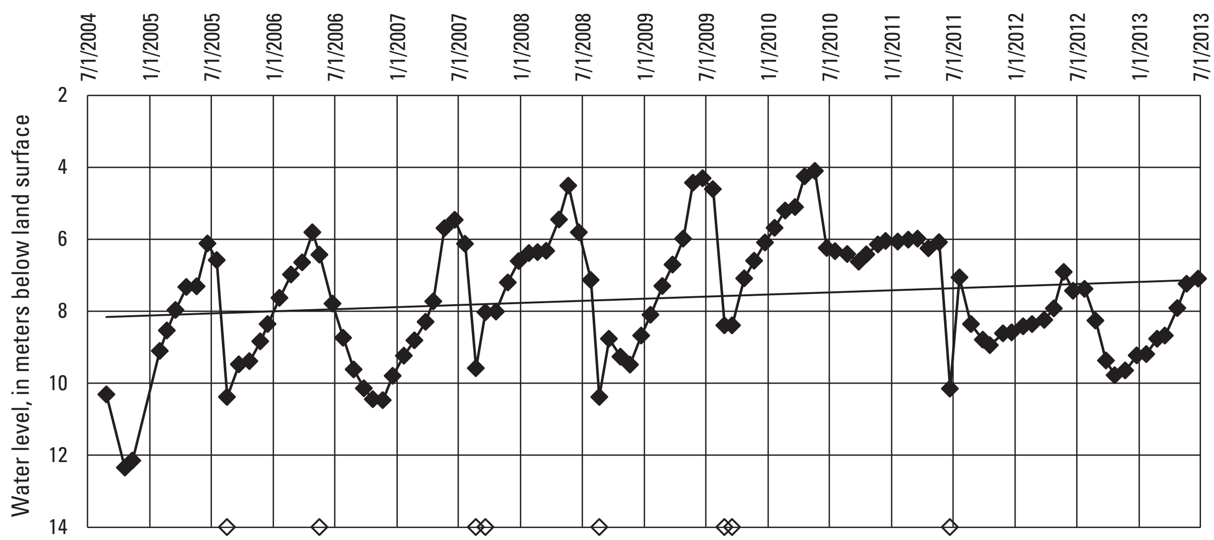

**Number—135**

Name—Well at Qala-i-Baqhalak village

Datum—1,797.1 m

Depth—26 m

Surficial geology—Q3loe; loess

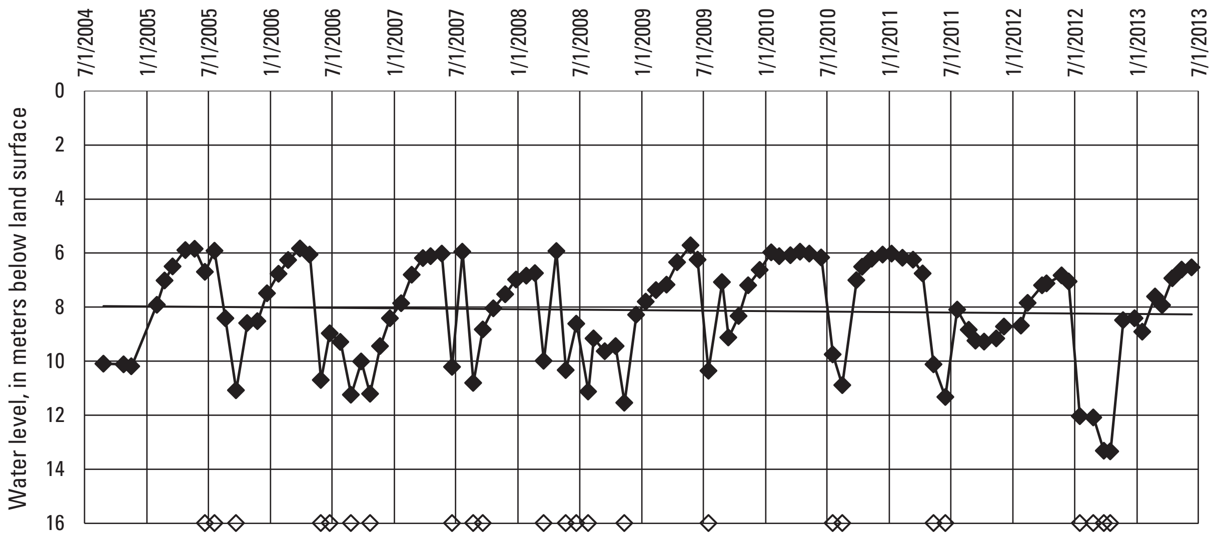



**EXPLANATION**

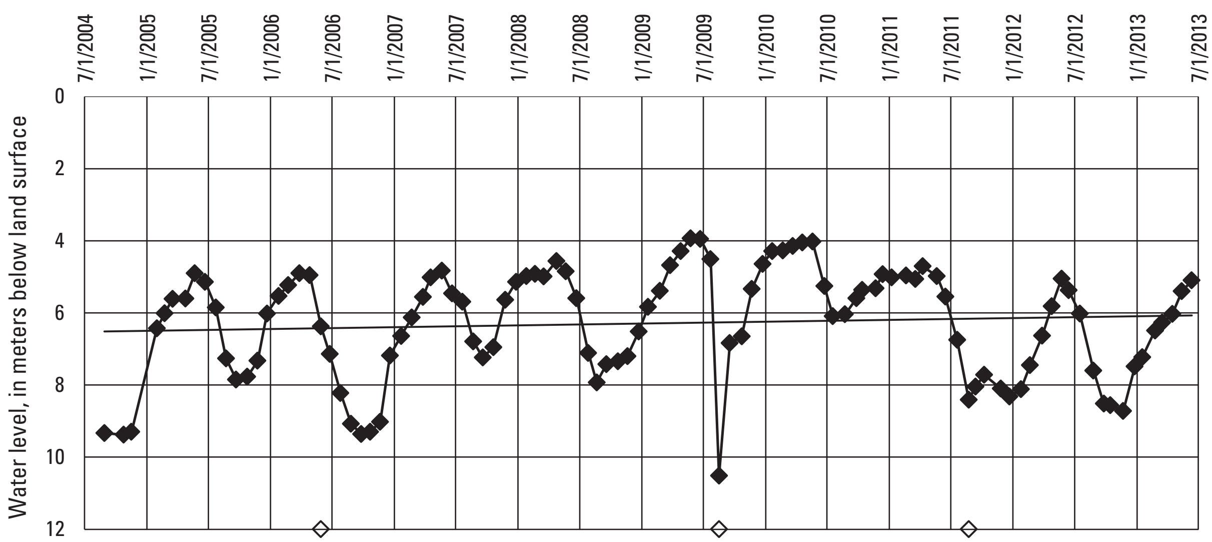
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—140**
Name—Well at Kamari village
Datum—1,791.3 m
Depth—60 m
Surficial geology—Q3loe; loess



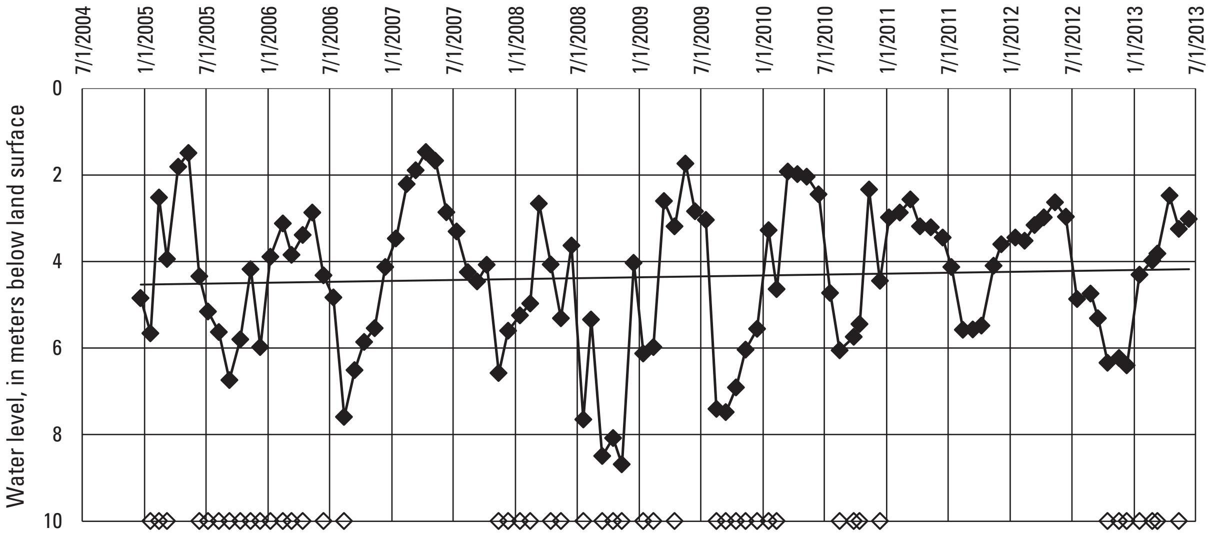

**Number—143**
Name—Well at Noborja village
Datum—1,792.5 m
Depth—25 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Inside the village



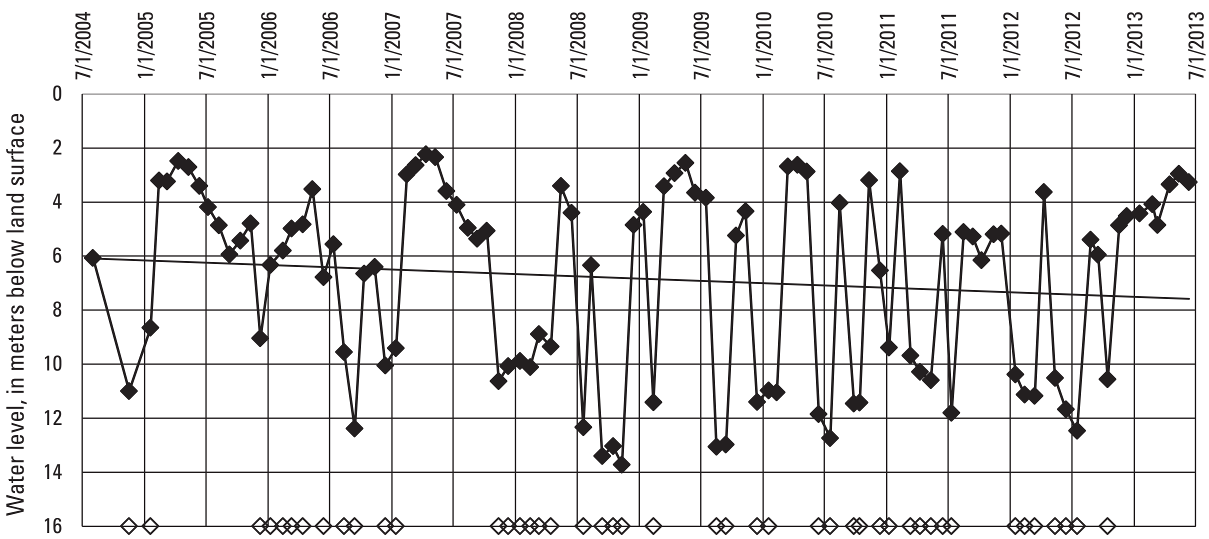

**EXPLANATION**

- ◆ Water-level measurement
- ◇ Indicates recent pumping at time of measurement

Number—201
Name—Well at Logar village
Datum—1,784.9 m
Depth—54.3 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Logar Well 1




Number—202
Name—Well at Logar village
Datum—1,787.9 m
Depth—51.5 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Logar Well 3

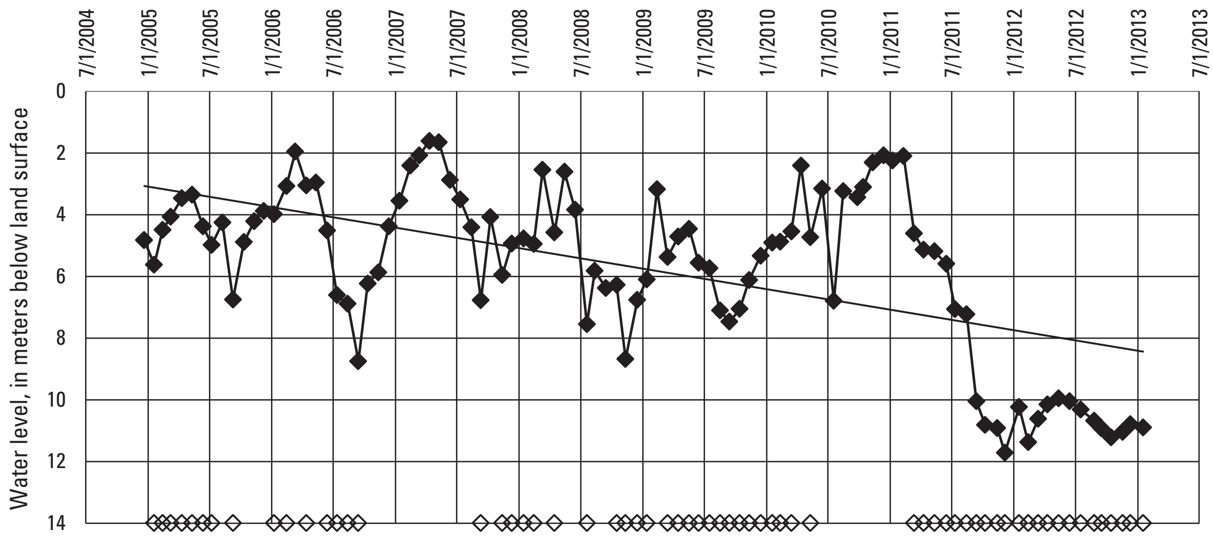



**EXPLANATION**

◆ Water-level measurement

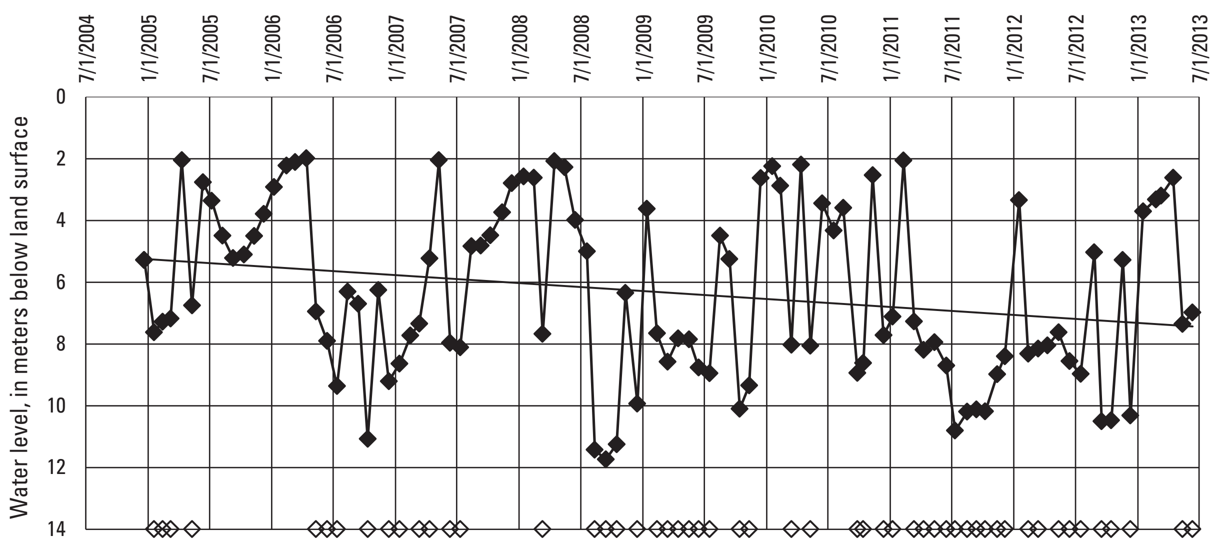
◇ Indicates recent pumping at time of measurement

**Number—203**
Name—Well at Logar village
Datum—1,786.9 m
Depth—64.3 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Logar Well 5




Well was reported as "could not be measured" from February to June 2013.

**Number—204**
Name—Well at Logar village
Datum—1,787.2 m
Depth—79.1 m
Surficial geology—Q4a; conglomerate and sandstone
Description—Logar Well 10




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

## Deh Sabz Subbasin

The Deh Sabz subbasin is very rural and covers 464 $km^2$ (fig. 4). There are no perennial rivers or streams in this subbasin, although there are some perennial springs that discharge from the base of the mountains on the east side of this subbasin. There are eight monitoring wells in the subbasin, ranging in depth from 7.2 to 150 m. Five of the wells are more than 50 m deep. The surficial geology at the wells varies from Quaternary loess to Quaternary conglomerate and sandstone. Most of the wells in this subbasin are family production wells, village production wells, or irrigation wells, except for well 9, which is the production well for a construction project.

Depth-to-water measurements under static conditions range from a minimum of 4 m (1,963.5 m above sea level) in well 7 in early March 2007 to a maximum of 44.8 m (1,807.8 m above sea level) in well 59.1 in August 2008, although this measurement could have been affected by pumping during the previous month. The majority of seasonal water-level fluctuations range from 0.5 to 2 m. The hydrograph for well 8 shows the best seasonal water-level fluctuations not affected by pumping. The seasonal fluctuations in well 8 from the spring high to the winter low were 1.9 m in 2005, 2.3 m in 2006, 2.2 m in 2007, and 1.7 m in 2008. Well 59.1, the deepest well in this subbasin, had as much as 9 m of seasonal water-level fluctuation. The water level in well 8 increased during the monitoring period by almost 2 m. The water level in well 13 increased from 2004 until spring 2010, after which the water level began to decrease. The hydrograph for well 2.2 shows a decrease in the water level of about 7 m during the monitoring period. The water-level measurements for this well were collected under nonpumping conditions. Well 37 had a slight decrease in the water level during the monitoring period. Although there were fluctuations in the water levels in the other wells in the Deh Sabz subbasin, the overall trends were fairly flat for the monitoring period. The pumping-induced drawdowns in well 59.1 were large. Water-level measurements taken in 2006 show 41 m of drawdown and 39 m of recovery for measurements taken during 3 consecutive months. In 2008, pumping induced drawdowns and recoveries in well 59.1 were 39 m and 30 m.

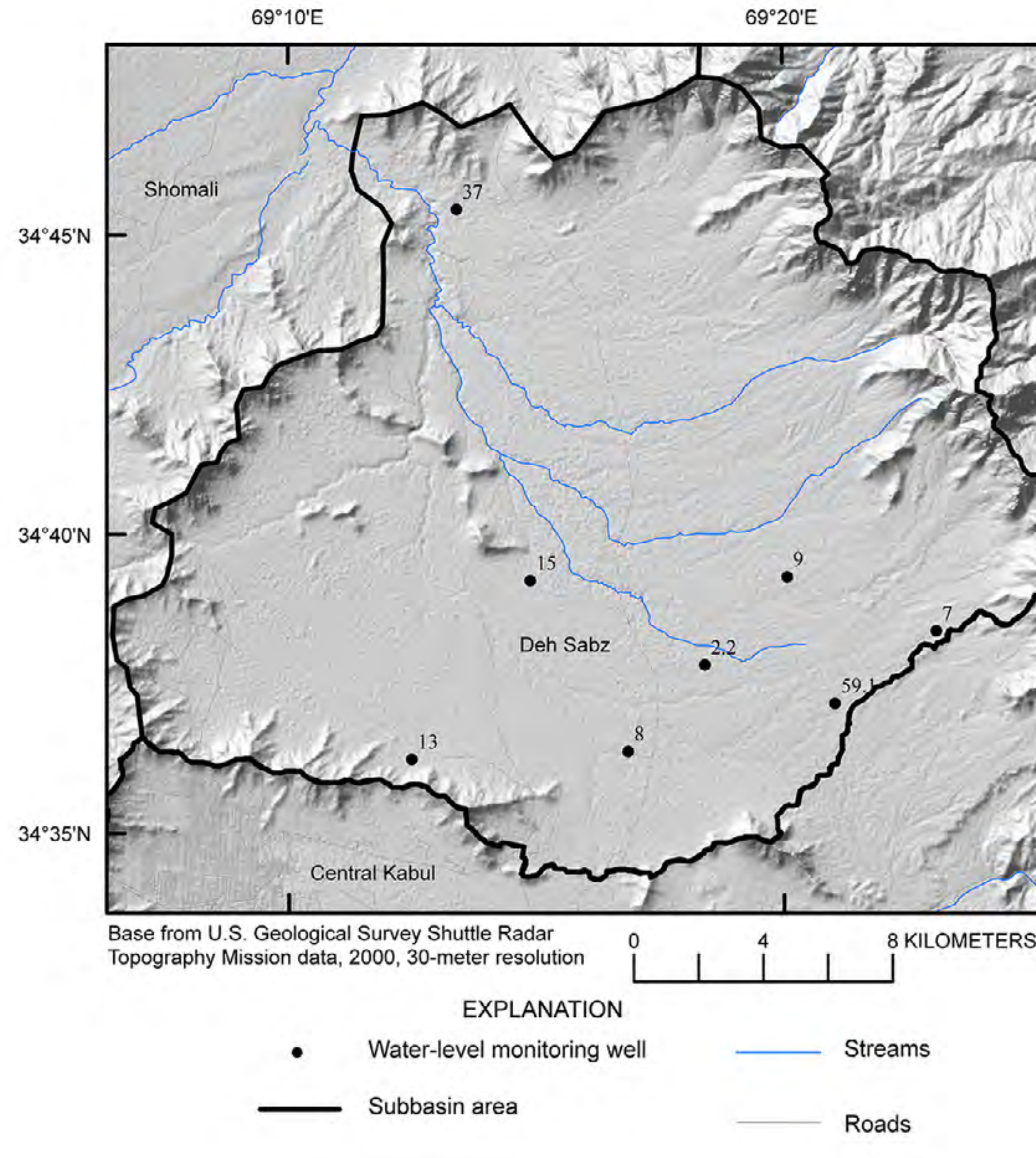



**Figure 4.** Locations of wells in the Deh Sabz Subbasin.

**Number—2.2**

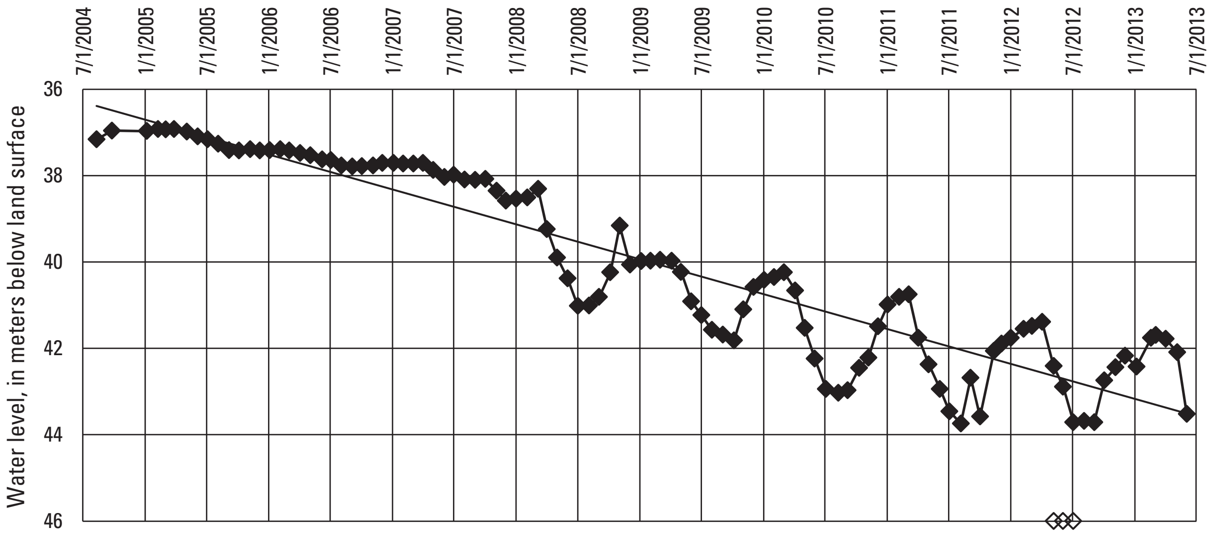
Name—Well at Sharak Sabz village

Datum—1,798.5 m

Depth—100 m

Surficial geology—Q3loe; loess

Description—West side, 100 m from well 2.1



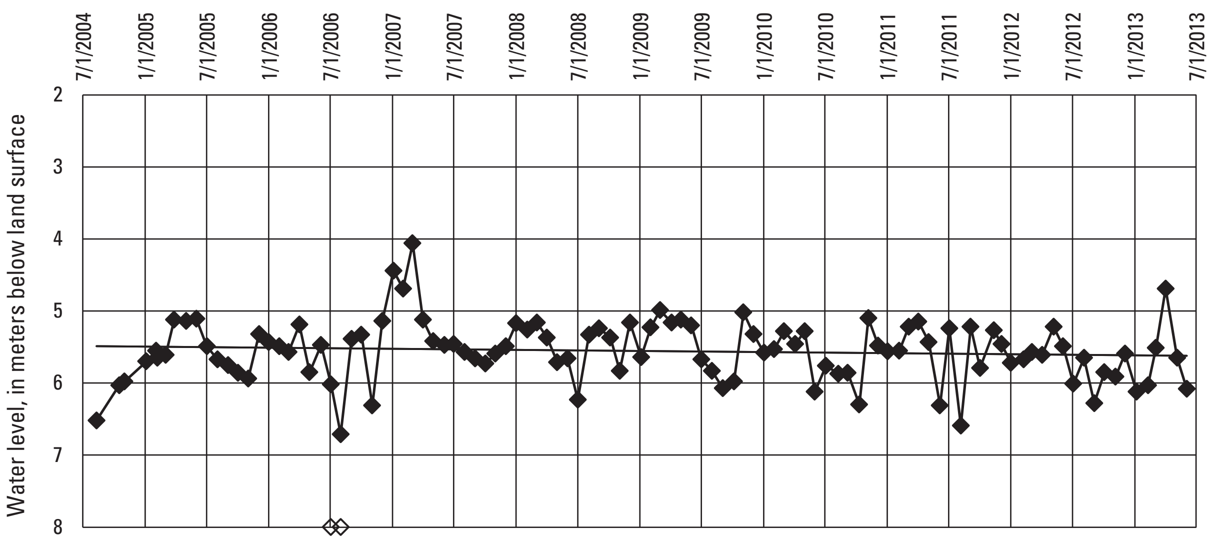

**Number—7**

Name—Well at Akhand Zada village

Datum—1,967.6 m

Depth—7.2 m

Surficial geology—Q34ac; fan alluvium and colluvium

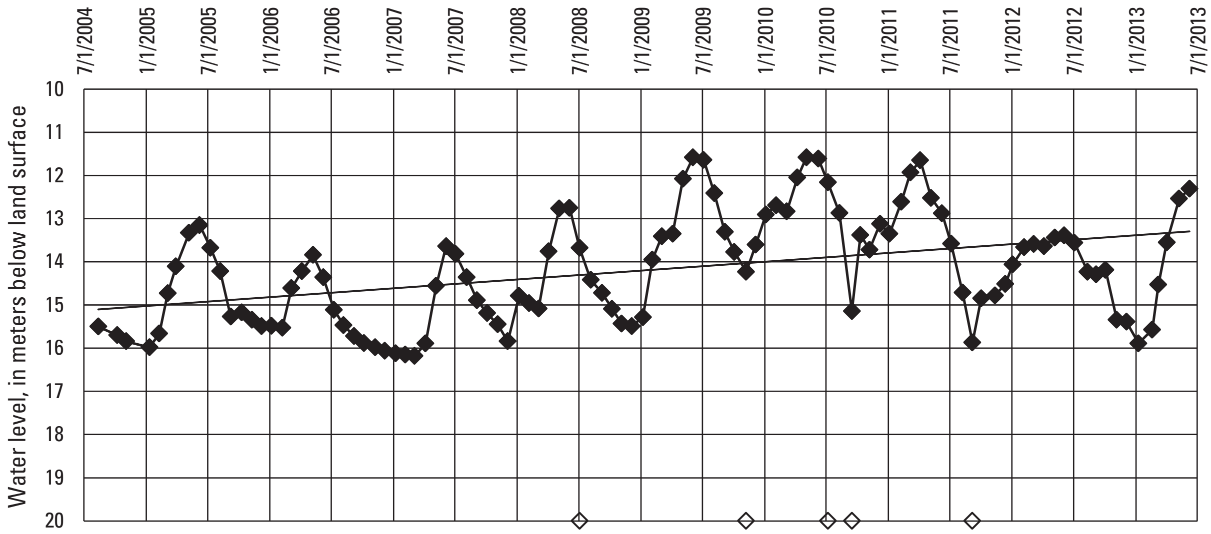



**EXPLANATION**

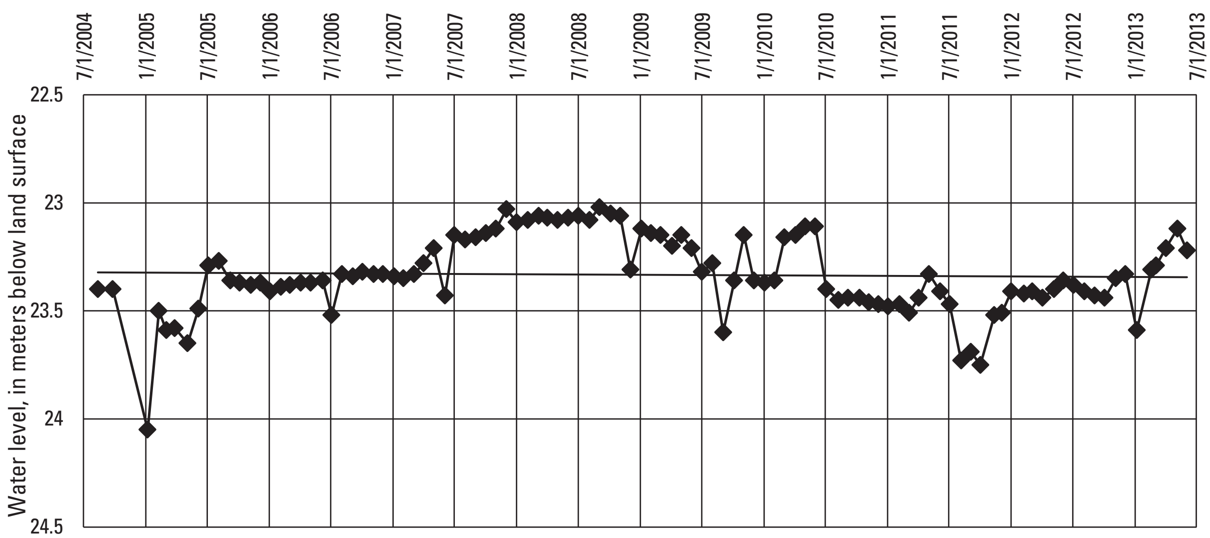
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—8**
Name—Well at Bakhat Yaran village
Datum—1,775.7 m
Depth—30 m
Surficial geology—Q3loe; loess




**Number—9**
Name—Well at Dehkada N 2 village
Datum—1,848.5 m
Depth—70 m
Surficial geology—Q3a; conglomerate and sandstone
Description—Construction project




**EXPLANATION**

◆ Water-level measurement

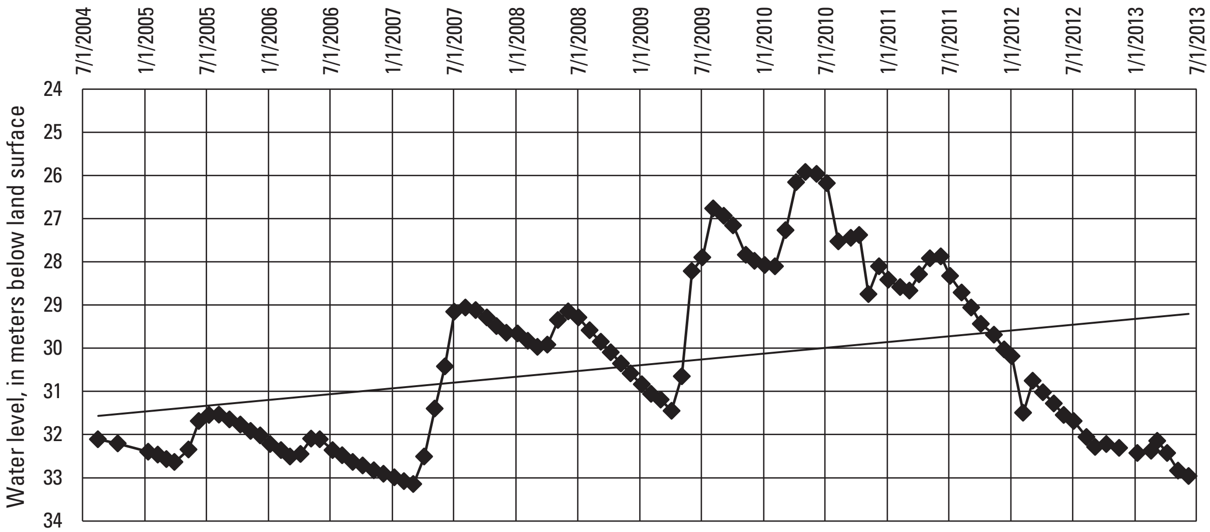
◇ Indicates recent pumping, or nearby pumping at time of measurement

**Number—13**

Name—Well at Pacha Sahab village

Datum—1,783.6 m
Depth—53.2 m

Surficial geology—Q34ac; fan alluvium and colluvium
Description—In the yard of the Padsha Saheb Shrine

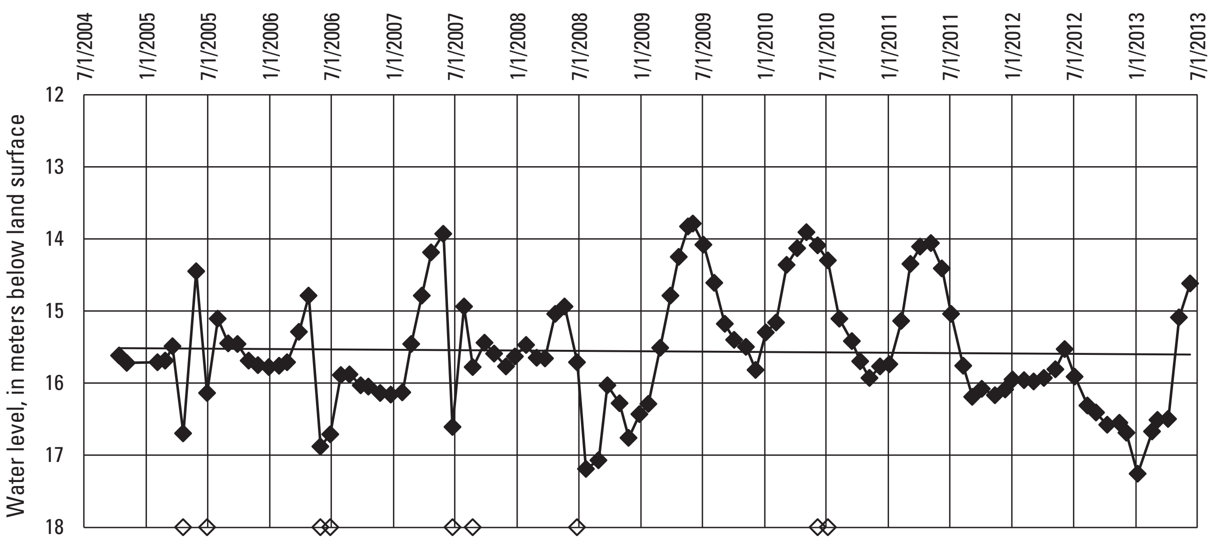



**Number—15**

Name—Well at Khoja Chashat village

Datum—1,743.6 m
Depth—39.3 m

Surficial geology—Q3loe; loess
Description—In the garden

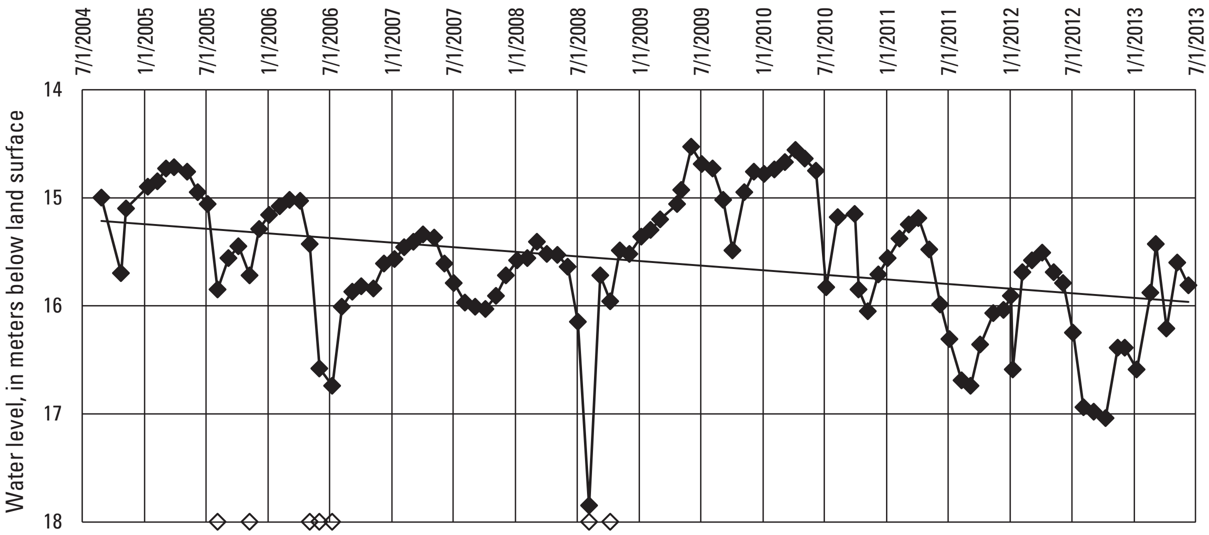



**EXPLANATION**

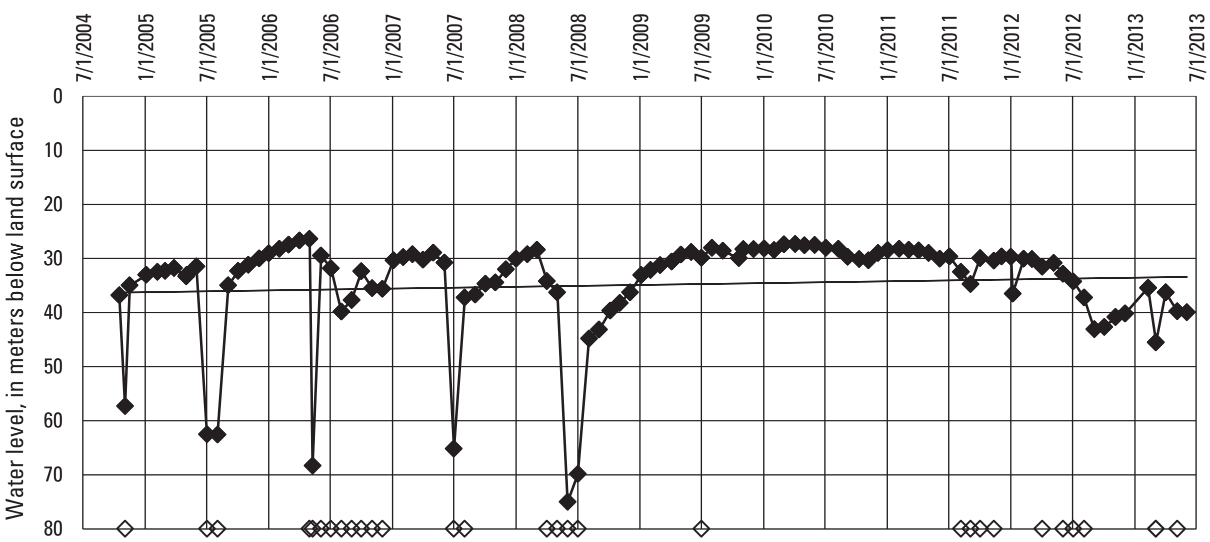
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—37**
Name—Well at Shekhu village
Datum—1,646.2 m
Depth—52 m
Surficial geology—Q3a; conglomerate and sandstone
Description—In the garden




**Number—59.1**
Name—Well at Kata Khel village
Datum—1,852.6 m
Depth—150 m
Surficial geology—Q3loe; loess
Description—Inside the farm




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

## Paghman and Upper Kabul Subbasin

The Paghman and Upper Kabul subbasin (fig. 5) includes the urban population centers of western Kabul city and is 348 $km^2$. There are 12 monitoring wells in the Paghman and Upper Kabul subbasin that range in depth from 4.9 to 99.7 m. Well 100 is on an outcrop of gneiss; all other wells are in loess, alluvium, or colluvium. Five of the wells used for collecting depth-to-water data are production wells. Wells 211, 212, and 213 are approximately 1 km west of the Kabul River and close to the confluence of the Kabul River and Paghman Stream. Wells 216 and 217 are much further west of the Kabul River, but are within 1 km of the Paghman Stream. Well 216 is south of the Paghman Stream, and well 217 is north of the Paghman Stream. Most of the monthly water-level measurements taken in the production wells were collected under dynamic (pumping) conditions as indicated by the open diamonds of the hydrographs.

Depth-to-water measurements under static conditions ranged from 2.9 m (1,805.7 m above sea level) in well 212 in April 2006 to 27.9 m (1,840.4 m above sea level) in well 217 in November 2011. Although the water-level measurement taken in well 217 is listed as being static, it is possible that the water level could have been affected by drawdown caused by substantial pumping prior to the measurement and then slow water-level recovery. Well 212 is approximately 1 km from the Kabul River, and well 217 is approximately 0.5 km from the Paghman Stream. The hydrograph for well 104 shows seasonal water-level fluctuations under mostly static conditions, ranging from about 1 to 3 m. Seasonal water-level fluctuations cannot be determined for some of the production wells because of the frequency of pumping in these wells. The water level in well 115 was increasing from 2004 until January 2008, but in February 2008, the well was reported as being dry. The water level in well 216 was increasing from 2004 until March 2010 when the well collapsed and monitoring stopped. The hydrographs for wells 112, 214, and 217 indicate a substantial decrease in water level during the monitoring period, but many of the water-level measurements were collected under dynamic conditions as indicated by the open diamonds on the hydrographs. The water level in well 112 decreased by about 7 m, in well 214, by about 8 m, and in well 217, by about 4.5 m. Wells 112 and 214 are only about 0.8 km apart and are north of the Paghman Stream. Well 217 is also on the north side of the Paghman Stream, but is about 5 km from the other two wells. The hydrographs for wells 113, 212, and 213 indicate a decrease of 1 m or less in the water level trends during the monitoring period. The other monitoring wells in this subbasin showed little change in water-level trends with only minor increases or decreases.

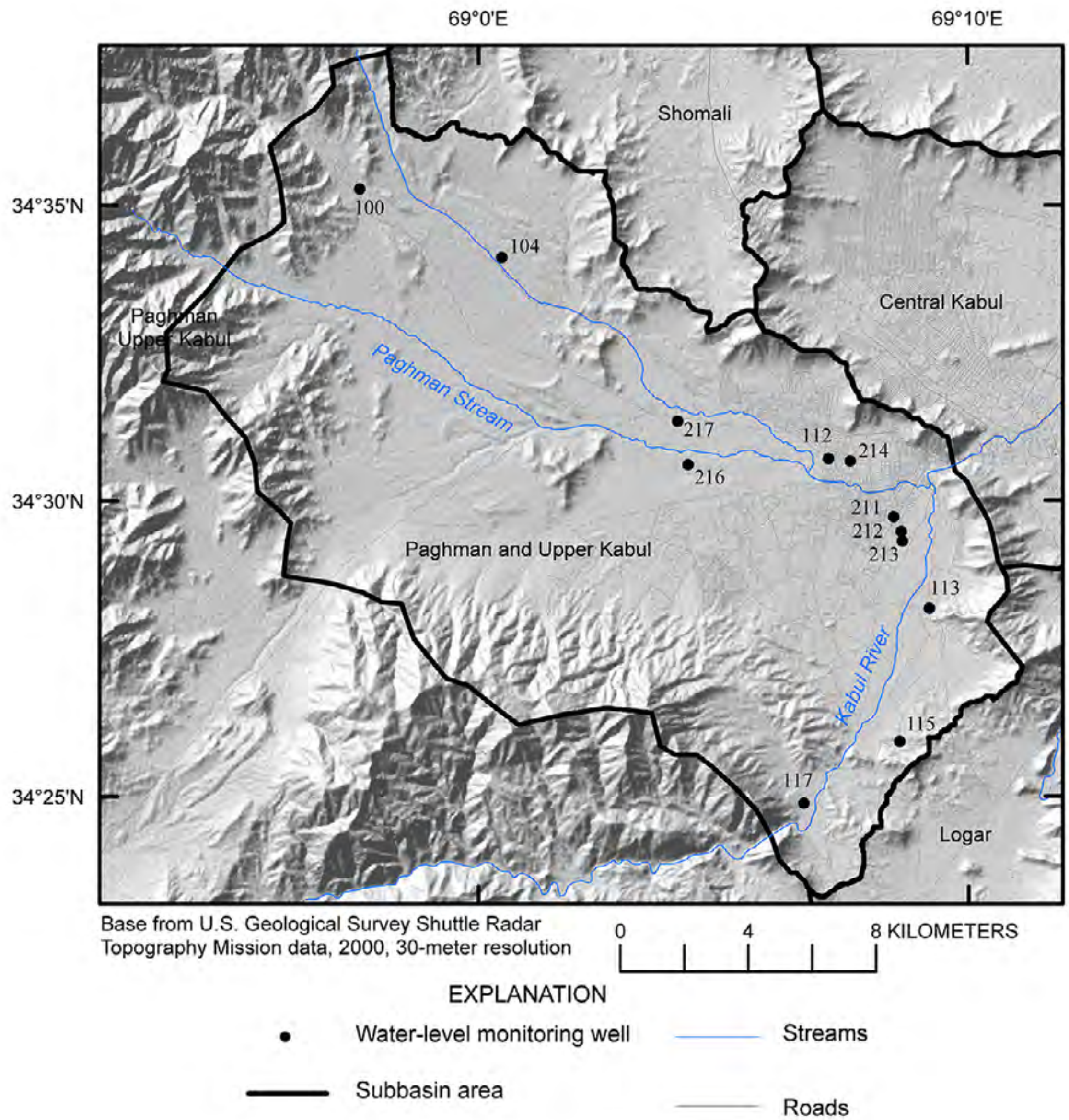


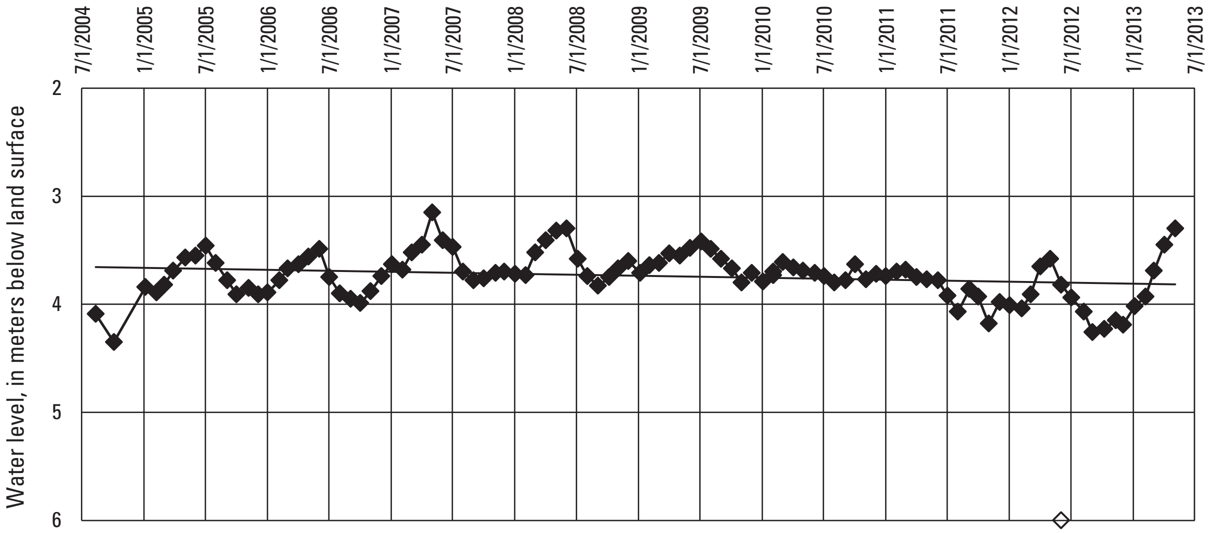

**Figure 5.** Locations of wells in the Paghman and Upper Kabul Subbasin.

**Number—100**

Name—Well at Chandal Bai Bazar village

Datum—2,283.1 m
Depth—4.9 m

Surficial geology—gneiss
Description—Swedish well 224

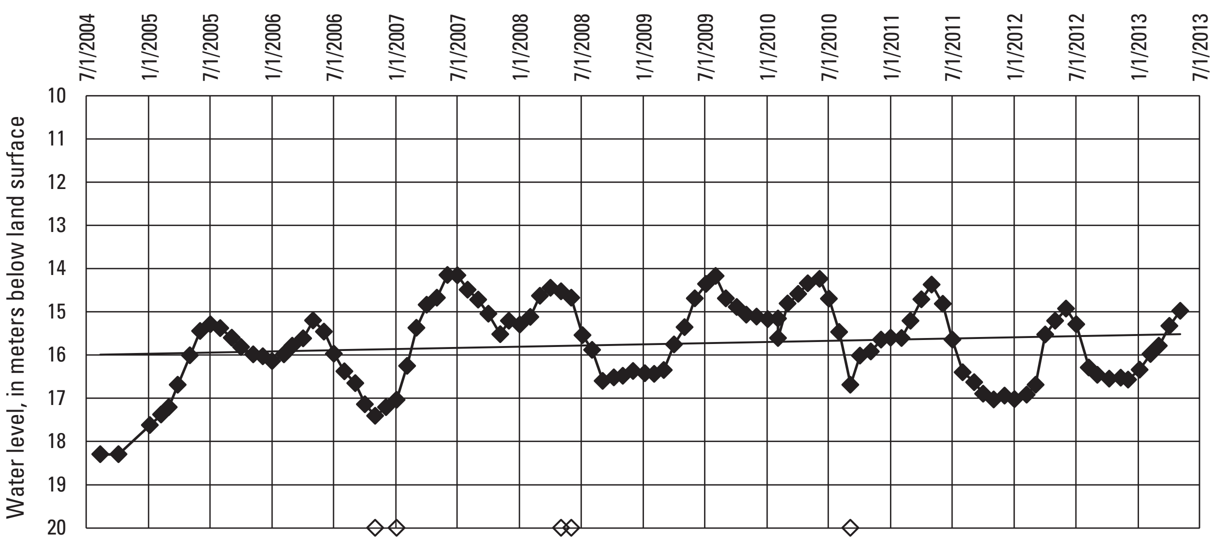



**Number—104**

Name—Well at Dodamast village

Datum—2,080.4 m
Depth—19 m

Surficial geology—Q3loe; loess
Description—In front of mosque

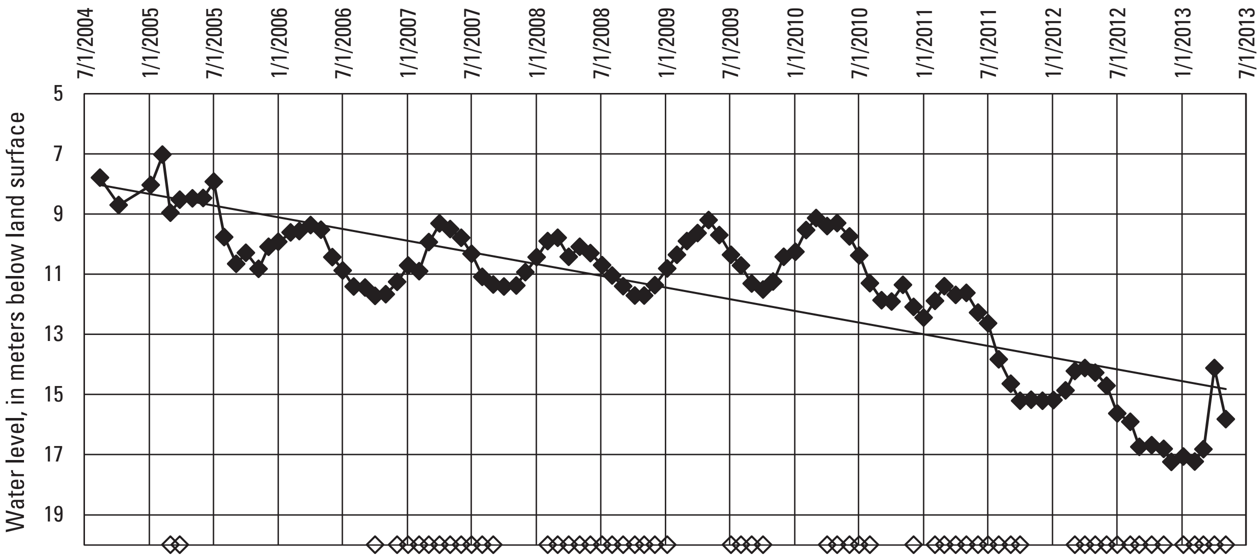



**EXPLANATION**

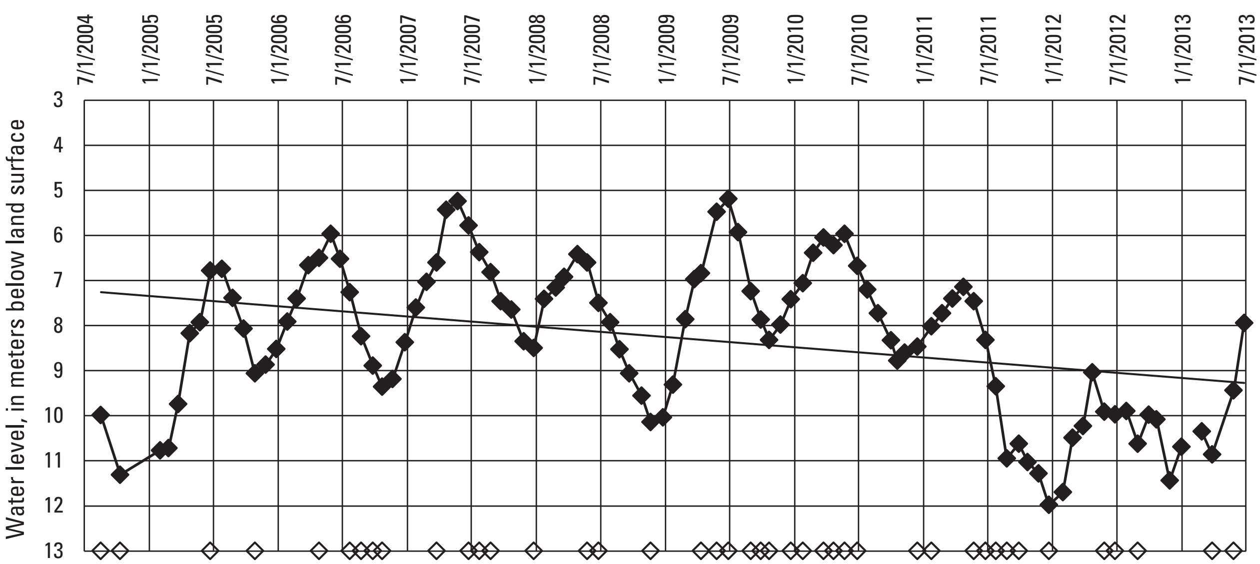
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—112**
Name—Well at Kote Sangi village
Datum—1,818.6 m
Depth—25 m
Surficial geology—Q3loe; loess
Description—beside the road




**Number—113**
Name—Well at Chelstoon village
Datum—1,814.5 m
Depth—99.7 m
Surficial geology—Q3loe; loess
Description—Beside the Chelstoon garden




**EXPLANATION**

◆ Water-level measurement

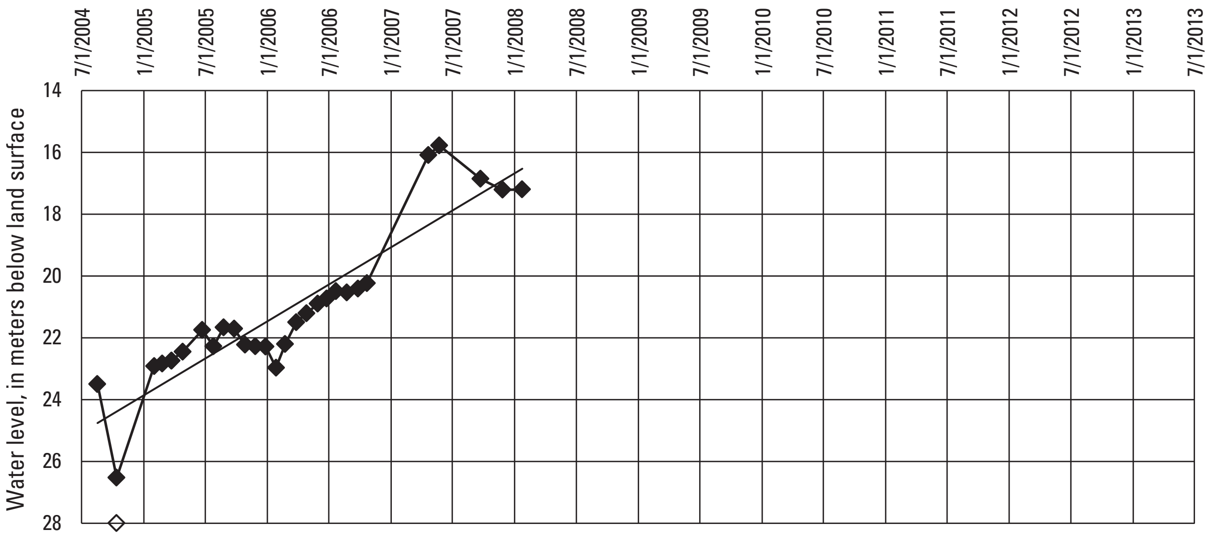
◇ Indicates recent pumping at time of measurement

**Number—115**

Name—Well at Rishkhor village

Datum—1,869.2 m
Depth—70 m

Surficial geology—Q3loe; loess
Description—Beside the Mosque

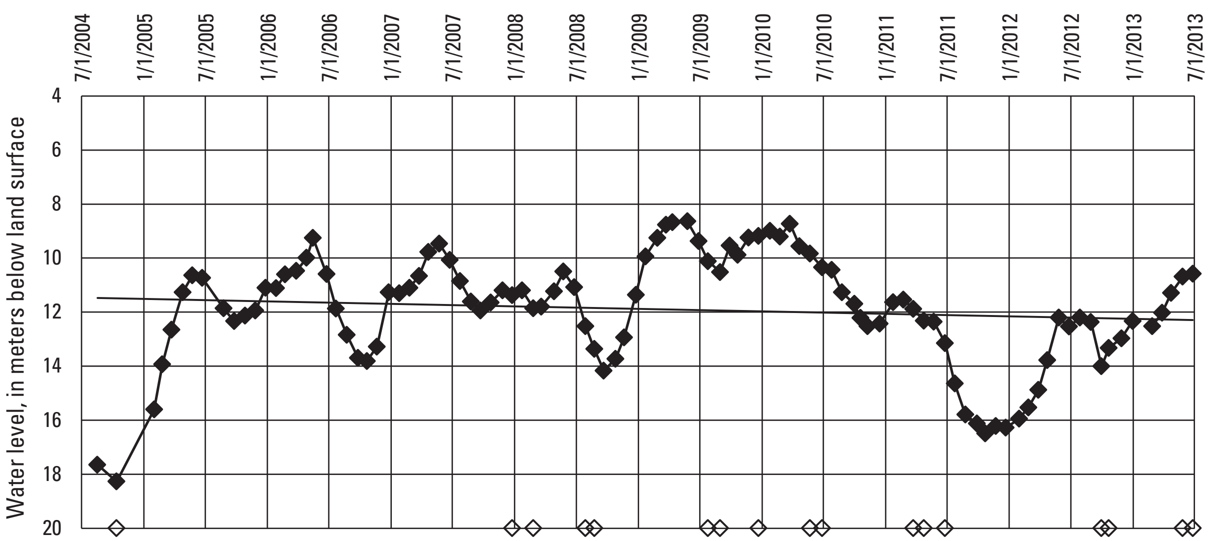



**Number—117**

Name—Tangi Saedon village

Datum—1,853.7 m
Depth—34.5 m

Surficial geology—Q34ac; fan alluvium and colluvium
Description—Inside the clinic

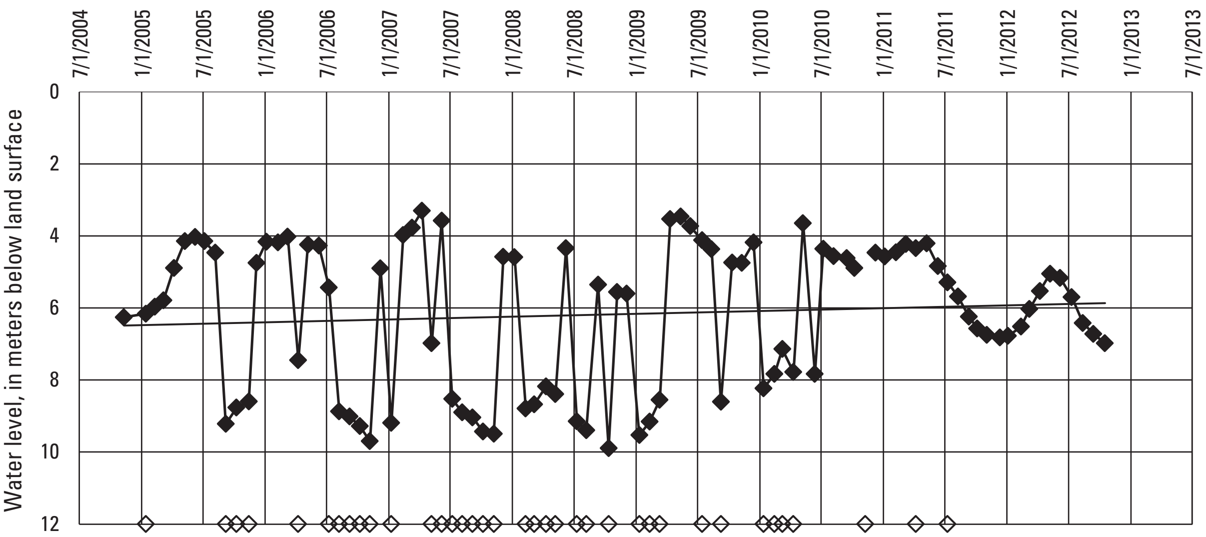



**EXPLANATION**

◆ Water-level measurement

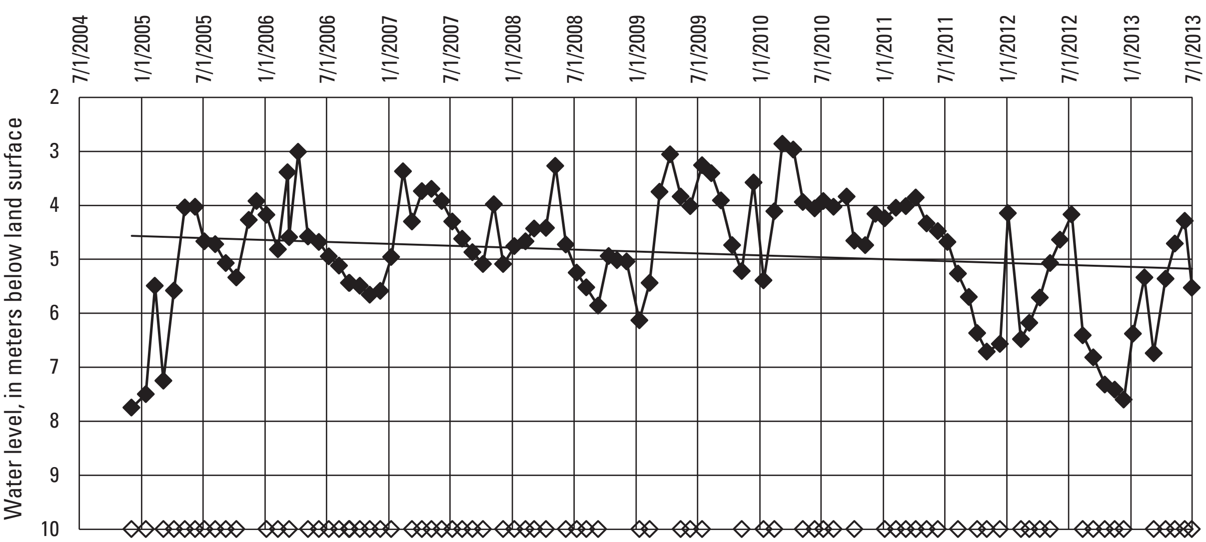
◇ Indicates recent pumping at time of measurement

**Number—211**
Name—Alluddin Well 1
Datum—1,808.7 m
Depth—49.8 m
Surficial geology—Q4a; conglomerate and sandstone




Well closed to measurements after October 2012.

**Number—212**
Name—Alluddin Well 3
Datum—1,808.4 m
Depth—57.3 m
Surficial geology—Q3loe; loess

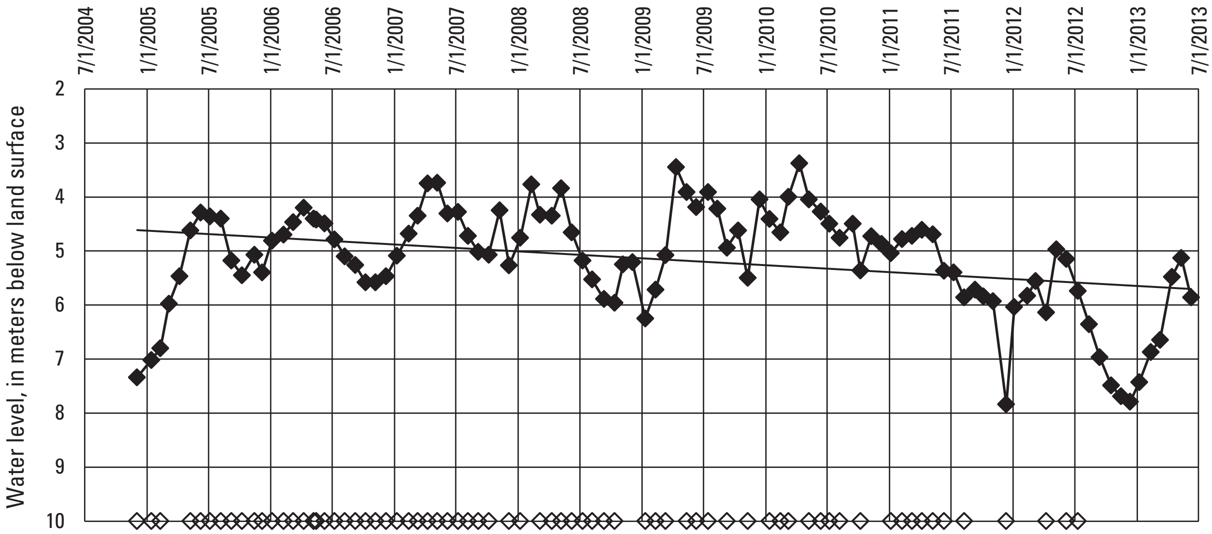



**EXPLANATION**

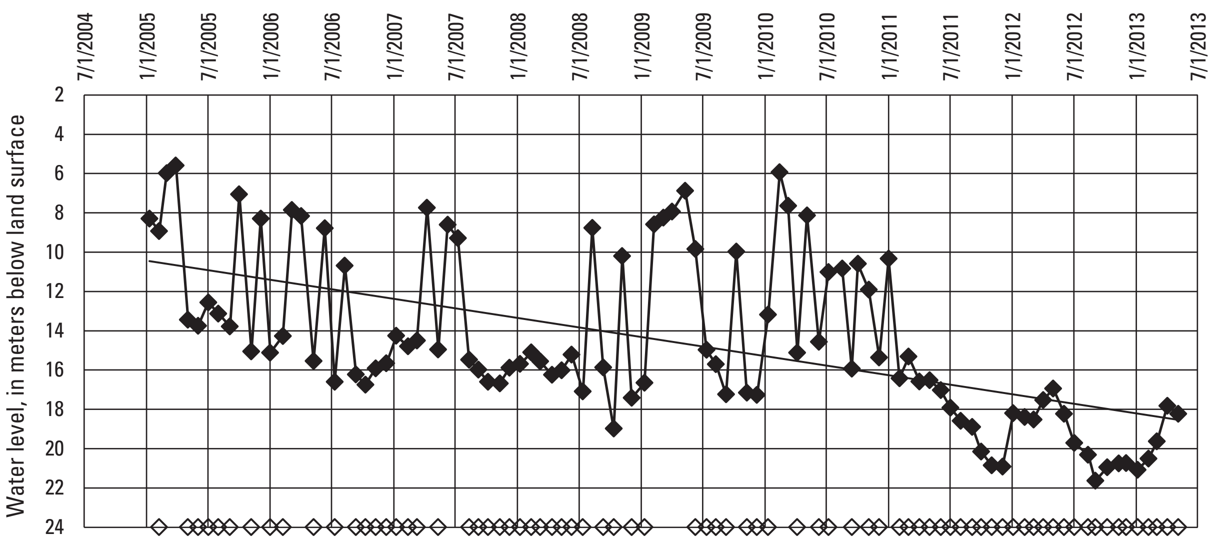
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—213**
Name—Alluddin Well 4
Datum—1,809.2 m
Depth—44.5 m
Surficial geology—Q3loe; loess




**Number—214**
Name—Well 214
Datum—1,822 m
Depth—40 m
Surficial geology—Q3loe; loess
Description—Kabul University




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—216**

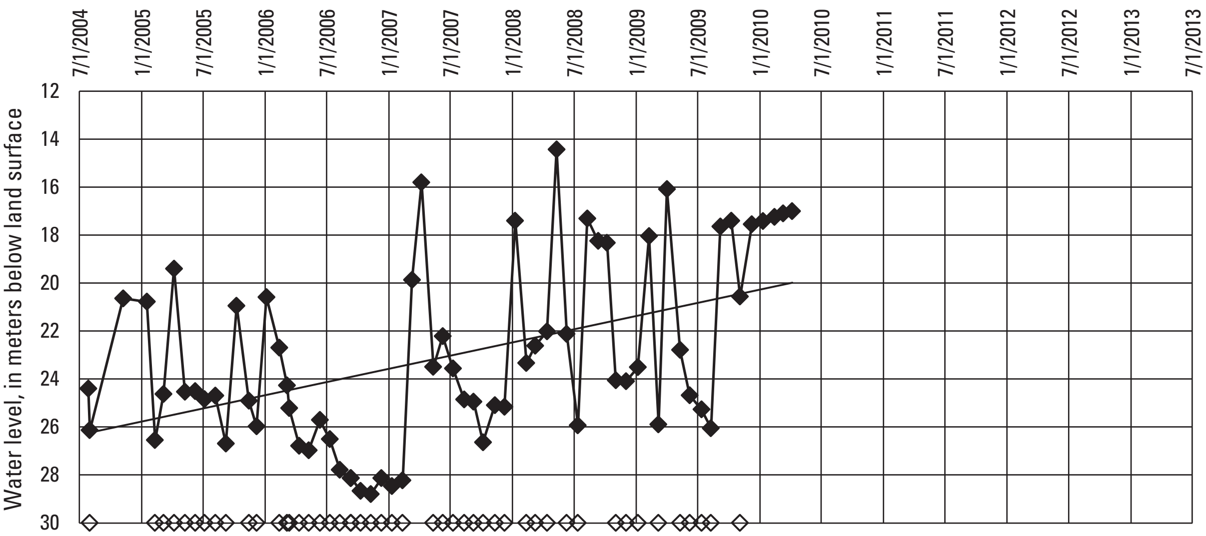
Name—Afshar Well 6

Datum—1,857.2 m

Depth—47.8 m

Surficial geology—Q3loe; loess

Description—Well at Afshar village




Well reported as "collapsed" on May 5, 2010.

**Number—217**

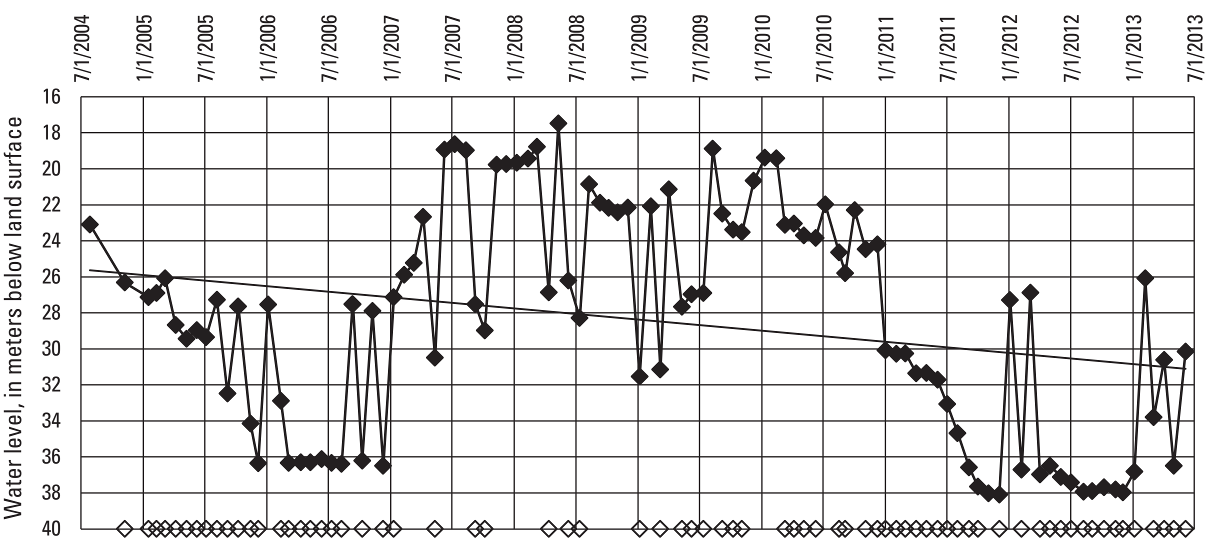
Name—Afshar Well 10

Datum—1,868.3 m

Depth—69.8 m

Surficial geology—Q3loe; loess

Description—Well at Afshar village




**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

## Shomali Subbasin

The Shomali subbasin (fig. 6) is a predominantly rural 2,490 $km^2$ area that contains the largest agricultural area in the Kabul Basin. A number of springs discharge water from the mountains on the western border of this subbasin. The flow from these springs is the source for some small perennial streams in the subbasin. The water in these streams is used for irrigation with much of it being diverted to irrigation canals. As a result, these small streams usually dry up some distance from their source and do not contribute flow to the large streams in the subbasin. The perennial and ephemeral streams in the subbasin are potential sources of recharge, especially during years when the mountains to the west of this subbasin receive near or above average amounts of precipitation. There are 20 monitoring wells in the Shomali subbasin, which are monitored on a monthly basis. The wells range in depth from 9 to 102 m. The surficial geology at the well locations consists of Quaternary loess or Quaternary fan alluvium and colluvium. Wells 33 and 52 are at the base of the mountains on the west side of the Shomali subbasin. The other wells are more centrally located in a generally north-south alignment with many being near small and in most cases ephemeral streams. Wells 67 and 68 in the Panjsher subbasin near the Shomali and Panjsher subbasin divide (fig. 6) are included in the discussion of the Shomali subbasin.

The range of depth to water under static conditions was from 1.4 m below land surface in well 47 (1,472.8 m above sea level) in late May 2013 to 41.0 m below land surface (1,474 m above sea level) in well 70 in November 2008. Seasonal water-level fluctuations can be seen in many of the hydrographs for the 20 wells that were monitored in this subbasin. The hydrographs for wells 25, 33, 52, and 70 show distinct seasonal fluctuations for the entire monitoring period. In well 25, the seasonal water-level fluctuation was 2.2 m in 2005, 3.1 m in 2006, and 1.1 m in 2009. The water level in this well increased during the monitoring period even though the size of the seasonal fluctuations decreased. The seasonal water-level fluctuations in well 33 were 0.9 m in 2005, 1.5 m in 2006, and 1 m in 2011. There was very little change in the water level in this well during the monitoring period. The hydrograph for well 70 shows two distinct cycles of seasonal water-level fluctuation during the monitoring period. The water level dropped from 37.6 m in July 2007 to 39.9 m in February 2008, a change of 2.3 m. The water level rose to 38.9 m in June 2008 and then dropped to 41.0 m in December 2008, a change of 2.1 m. Fourteen of the wells showed some overall increase in water level during the monitoring period. Well 22.1 had the largest increase in water level from 27.8 m in August 2004 to 12.2 m in June 2013, an increase of 15.6 m. Wells 42 and 66 had slight decreases in overall water levels. The water levels in wells 33 and 52 showed very little change during the monitoring period. The effects of pumping drawdown and recovery are shown on the hydrographs for wells 28 and 67. In well 28, as much as 8 m of drawdown and 6 m of recovery are recorded by sequential monthly measurements. As a result of pumping in well 67, the water level dropped from 37 m below land surface in October 2008 to 48 m below land surface in November 2008. The water level then rose to 37.7 m below land surface in December 2008 after the pumping stopped. Water-level monitoring was discontinued in well 66 after March 2009 and well 69 after the January 2011 measurement.

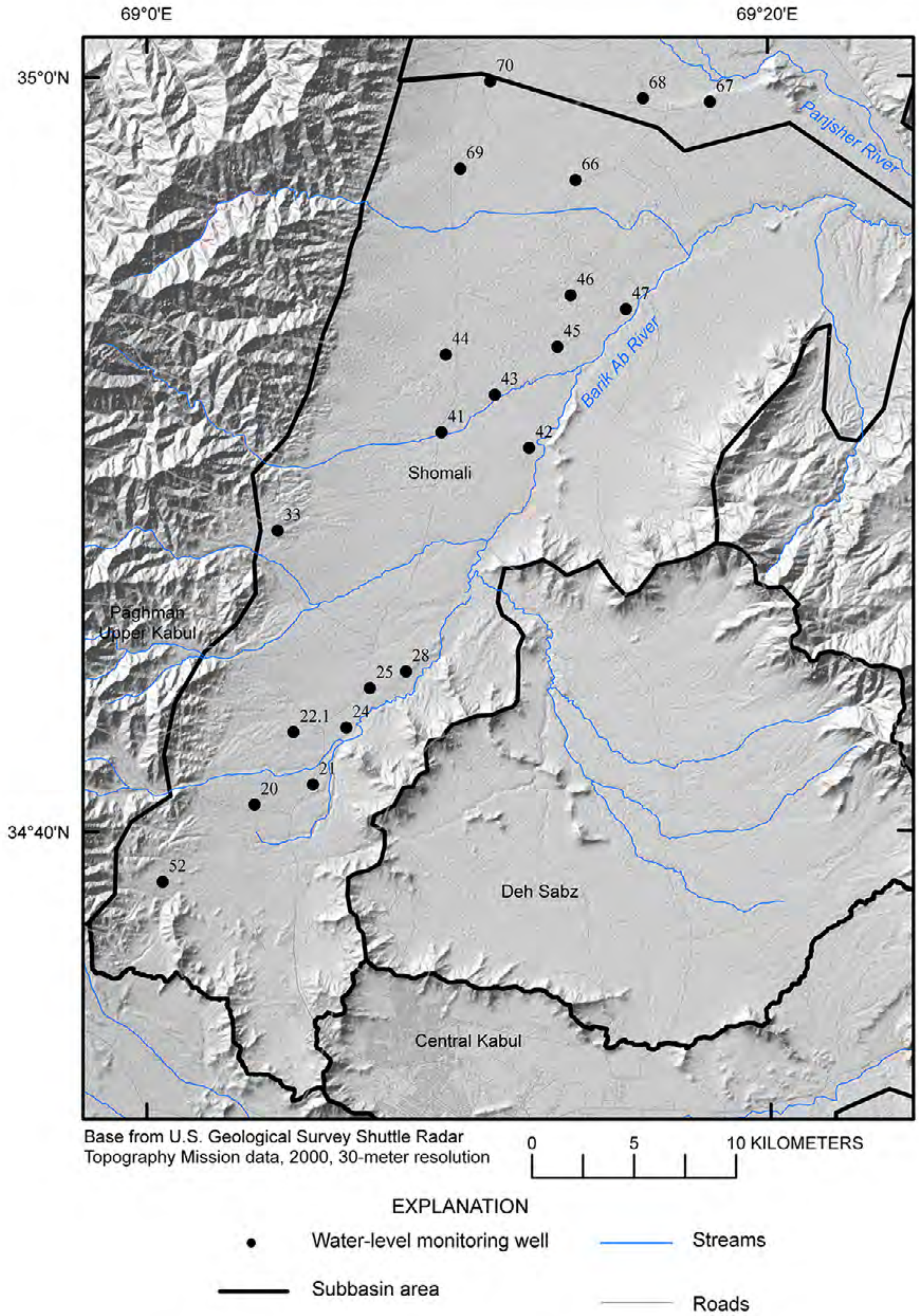
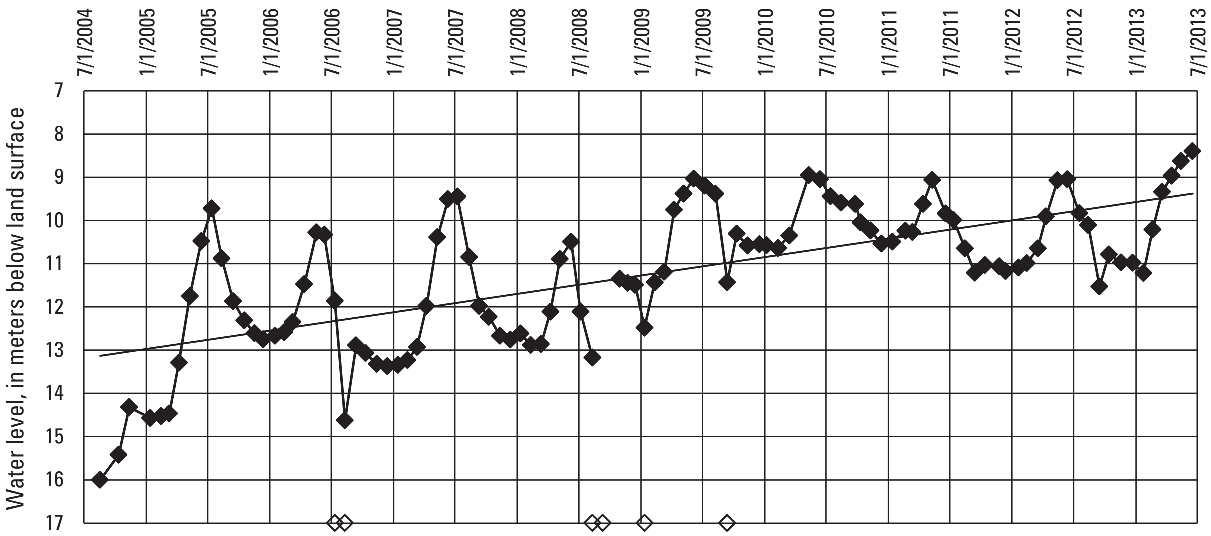
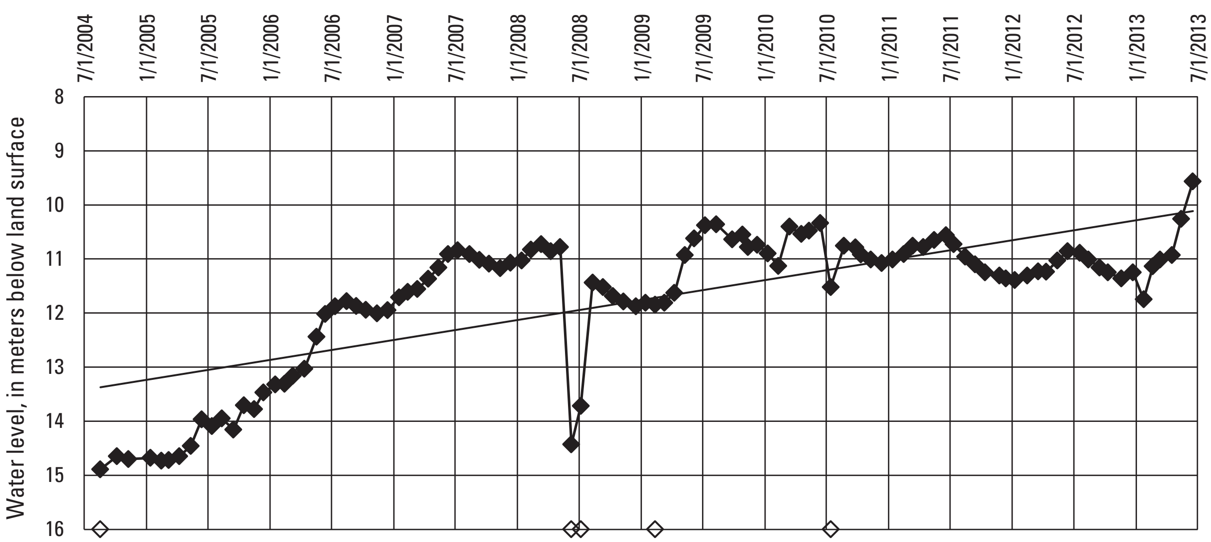



**Figure 6.** Locations of wells in the Shomali Subbasin.

**Number—20**
Name—Well at Aqa Ali Khoja village
Datum—1,915.6 m
Depth—18.3 m
Surficial geology—Q3loe; loess




**Number—21**
Name—Well at Bazar Sari House village
Datum—1,812.1 m
Depth—49.2 m
Surficial geology—Q3loe; loess
Description—In front of Mosque

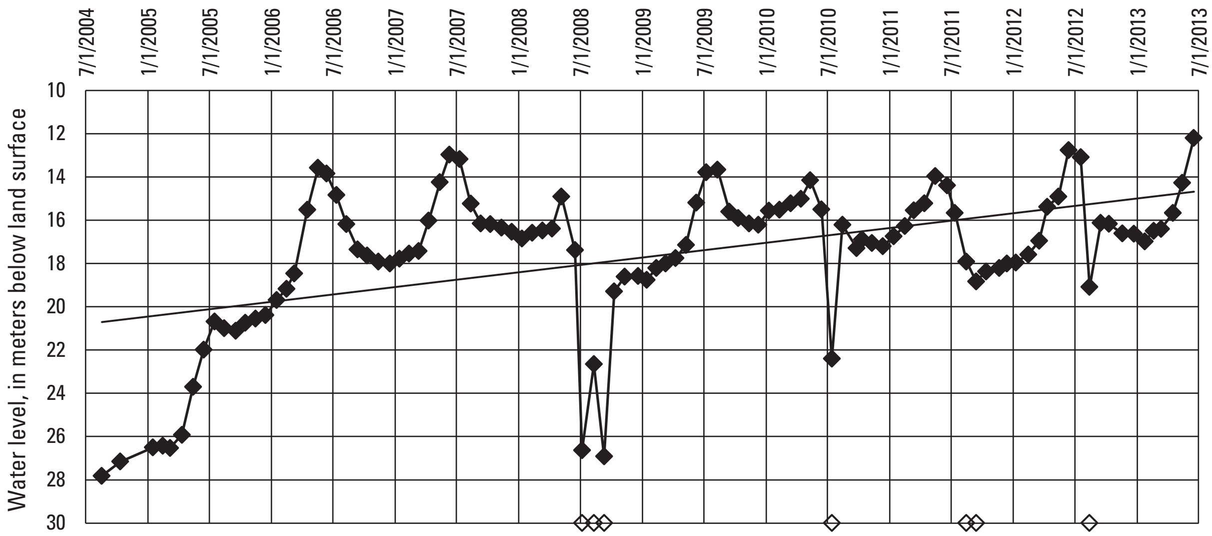



**EXPLANATION**

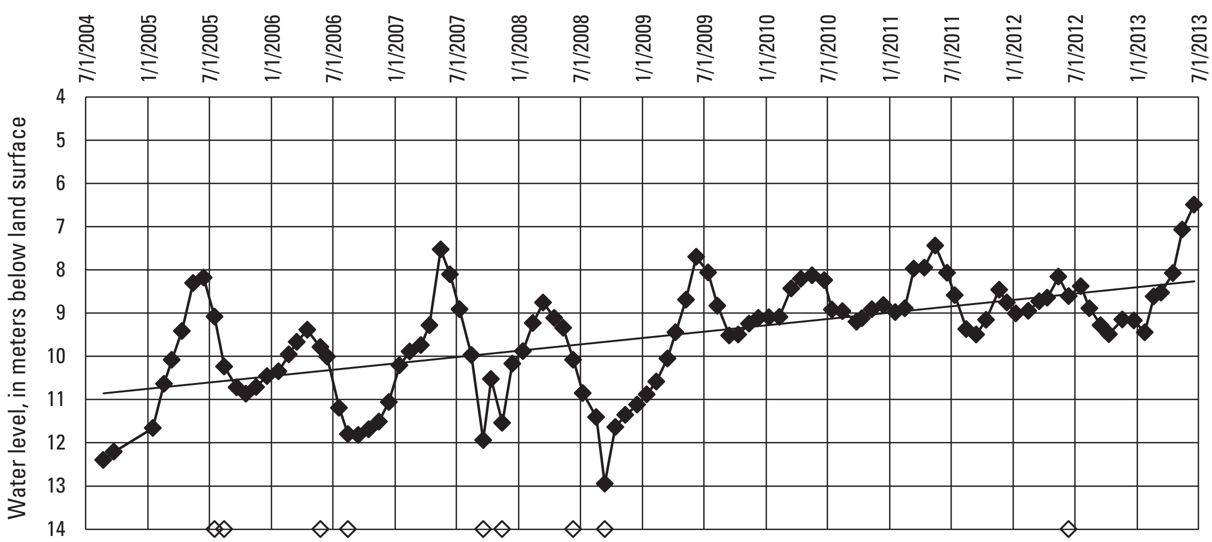
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—22.1**
Name—Well at Salehkhil village
Datum—1,812.7 m
Depth—102 m
Surficial geology—Q3loe; loess
Description—In the garden




**Number—24**
Name—Well at Gozar village
Datum—1,726 m
Depth—61.7 m
Surficial geology—Q3loe; loess
Description— Mir Amanullah Base

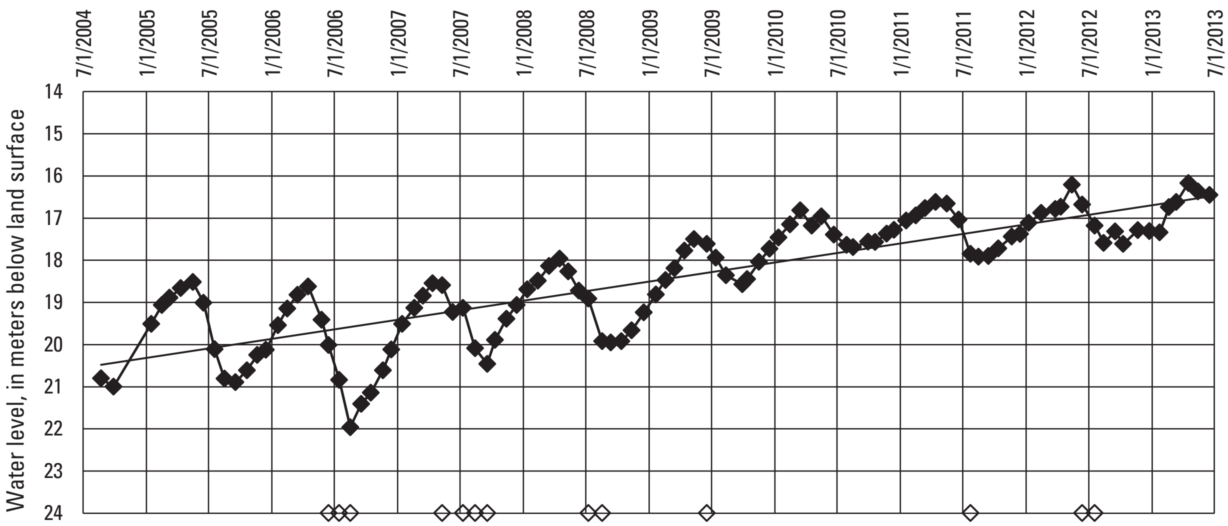



**EXPLANATION**

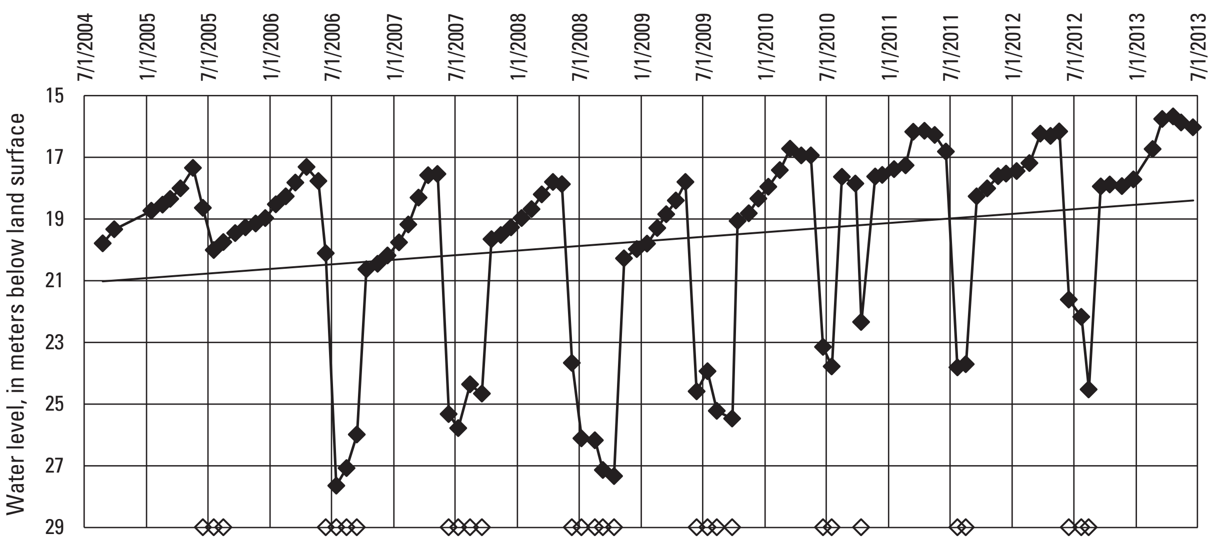
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—25**
Name—Well at Shekhan village
Datum—1,692.8 m
Depth—39.8 m
Surficial geology—Q3loe; loess
Description—In the Sakina Clinic




**Number—28**
Name—Well at Obchakan Ball village
Datum—1,663.9 m
Depth—93 m
Surficial geology—Q3loe; loess
Description—Southeastern side of new school

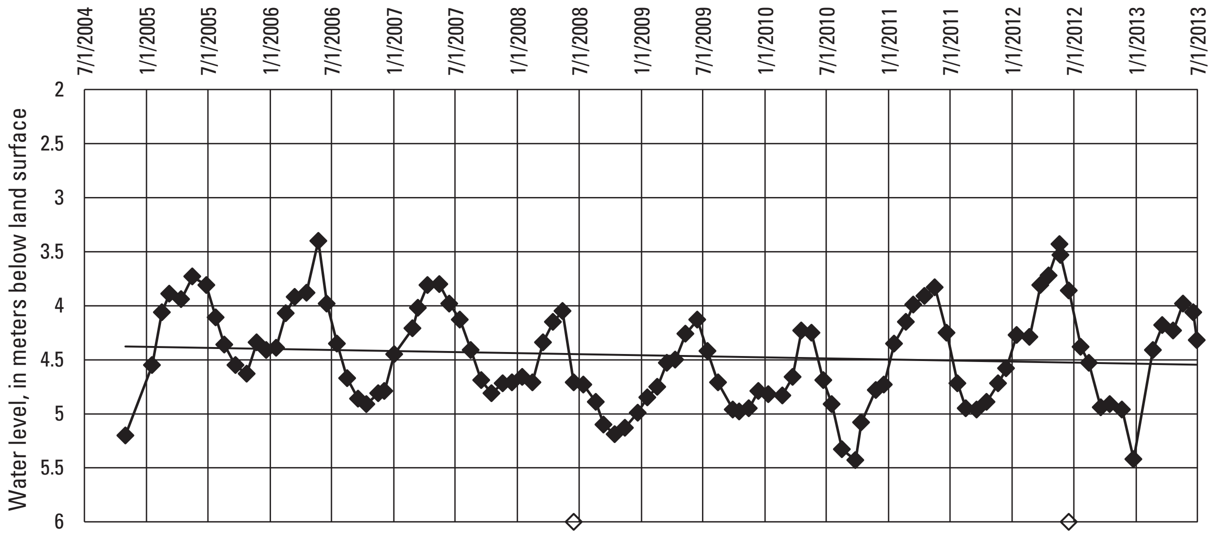



**EXPLANATION**

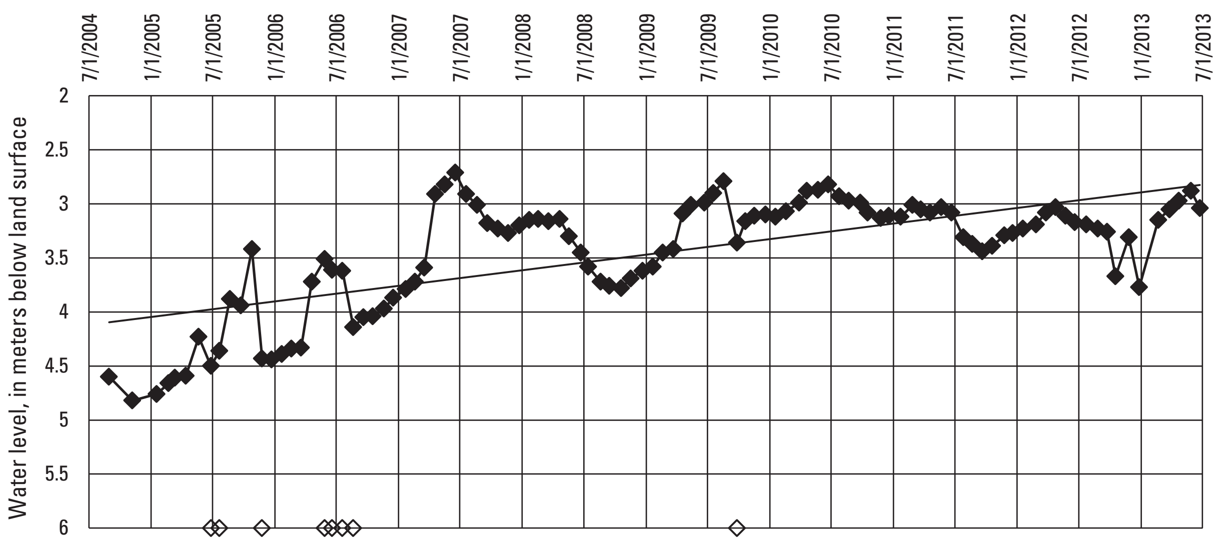
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—33**
Name—Well at Mir Afghan village
Datum—1,881.1 m
Depth—40 m
Surficial geology—Q3loe; loess
Description—In the Farza Clinic




**Number—41**
Name—School well at Qarabagh village
Datum—1,543.4 m
Depth—48.1 m
Surficial geology—Q3loe; loess
Description—Inside the Qarabagh School

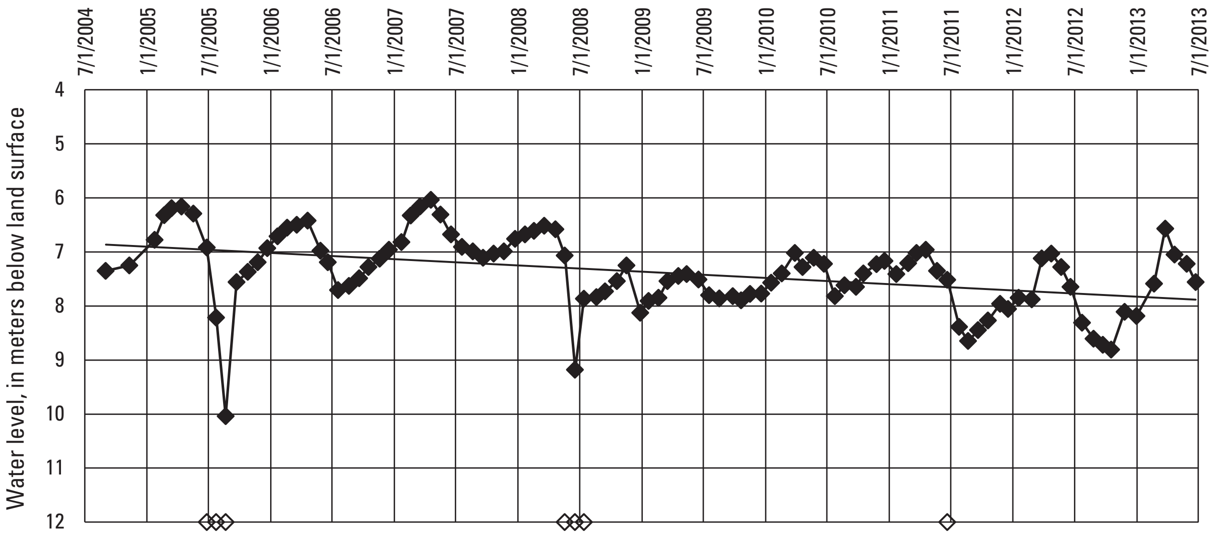



**EXPLANATION**

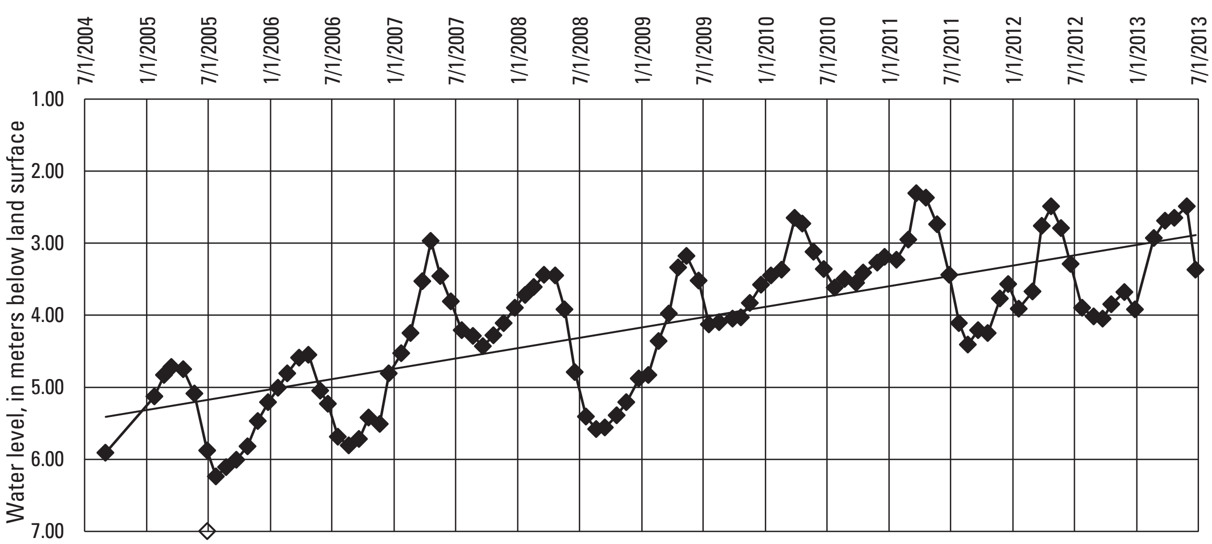
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—42**
Name—Well at Godar village
Datum—1,513.9 m
Depth—40 m
Surficial geology—Q3loe; loess
Description—In the garden




**Number—43**
Name—Well at Miyan Joy village
Datum—1,517 m
Depth—44.7 m
Surficial geology—Q3loe; loess
Description—In the garden




**EXPLANATION**

◆ Water-level measurement

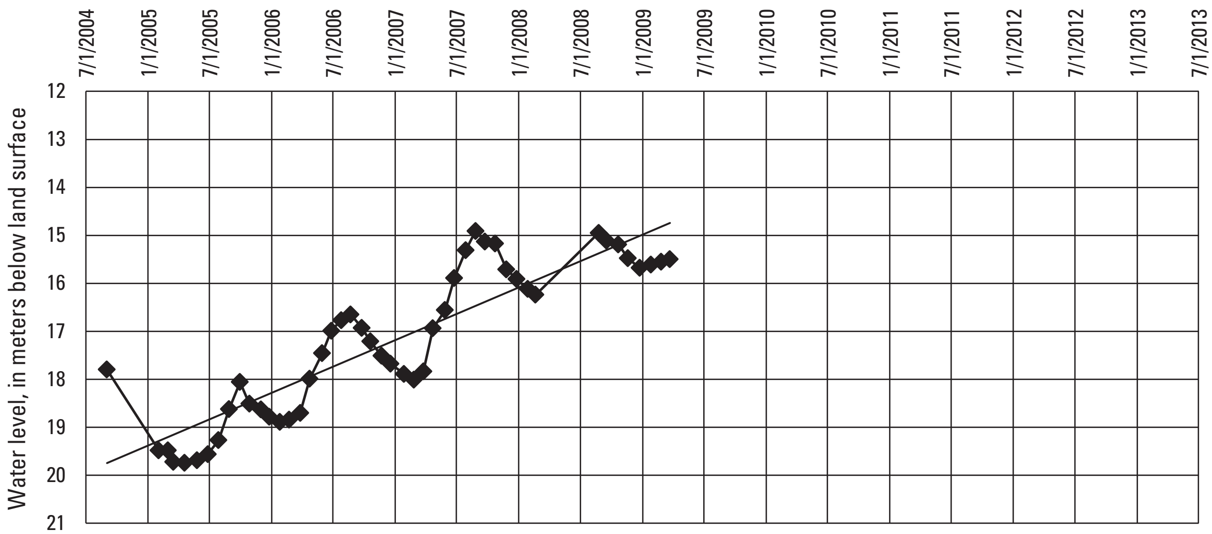
◇ Indicates recent pumping at time of measurement

**Number—44**

Name—Well at Nangikhele Bala village

Datum—1,547.8 m
Depth—37.8 m

Surficial geology—Q34ac; fan alluvium and colluvium
Description—In the garden



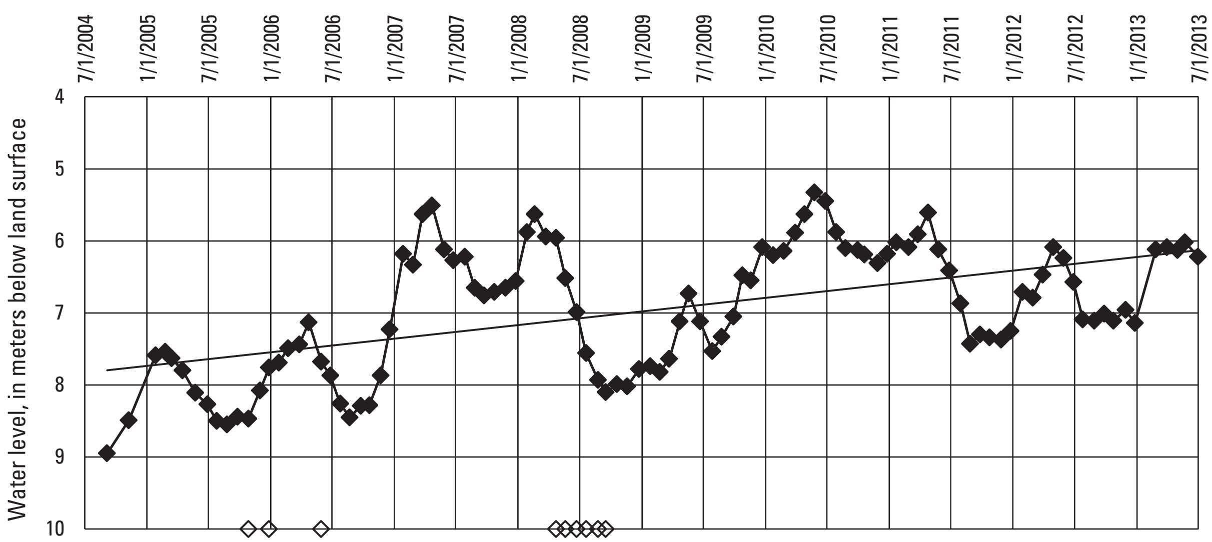

Well reported as collapsed March through July 2008 and on April 22, 2009.

**Number—45**

Name—Well at Bagh Alam village

Datum—1,499.4 m
Depth—39 m

Surficial geology—Q3loe; loess

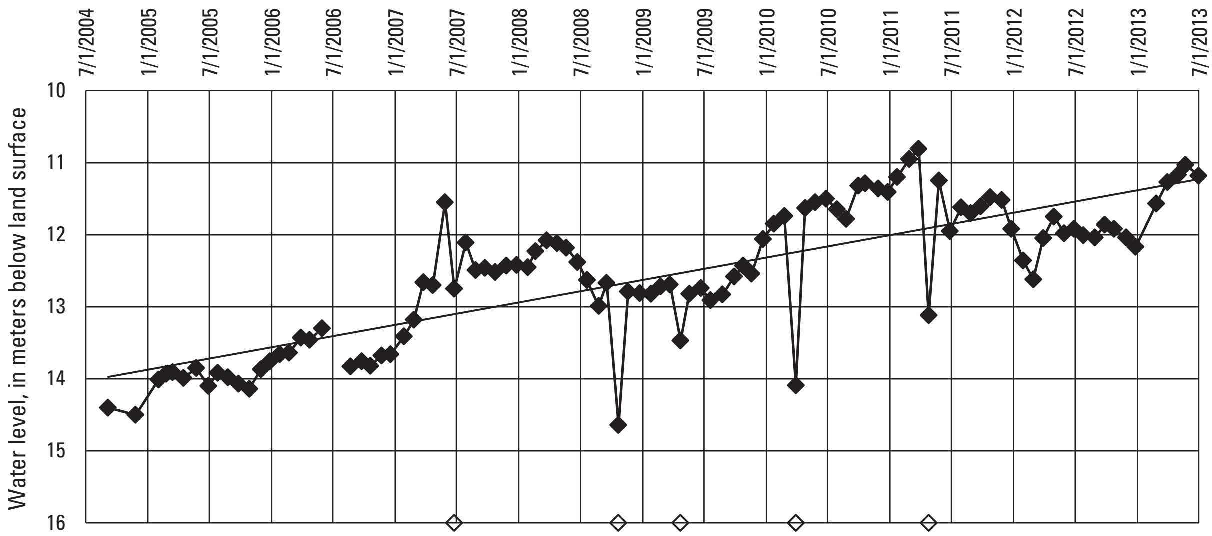



**EXPLANATION**

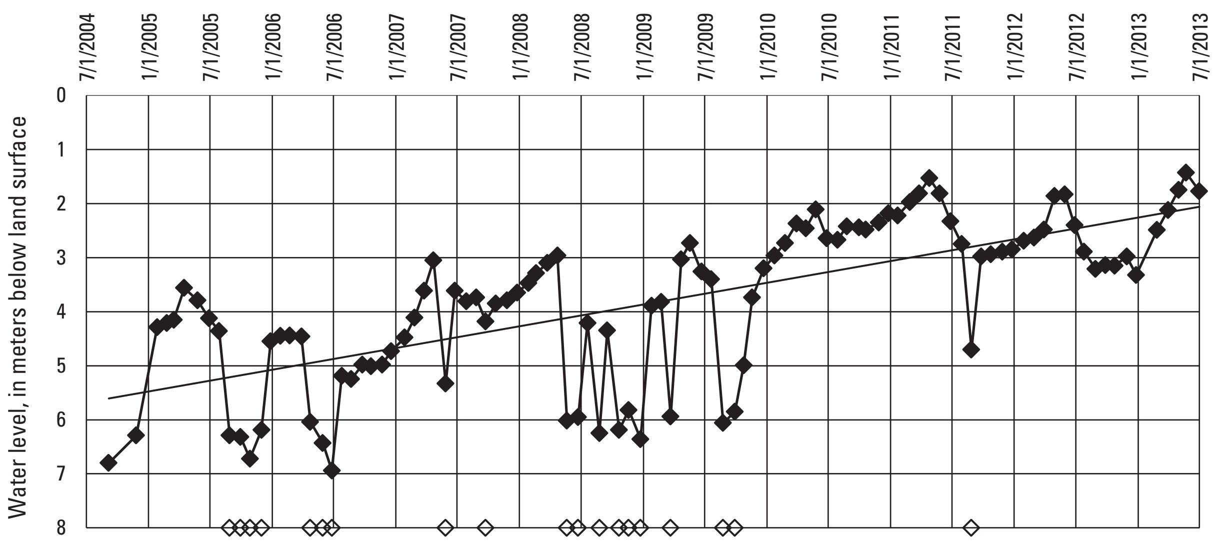
◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—46**
Name—Well at Qala Musa-e-Pain village
Datum—1,496.1 m
Depth—32 m
Surficial geology—Q3loe; loess
Description—In the garden




**Number—47**
Name—Well at Dewana village
Datum—1,474.2 m
Depth—9 m
Surficial geology—Q3loe; loess
Description—In the garden

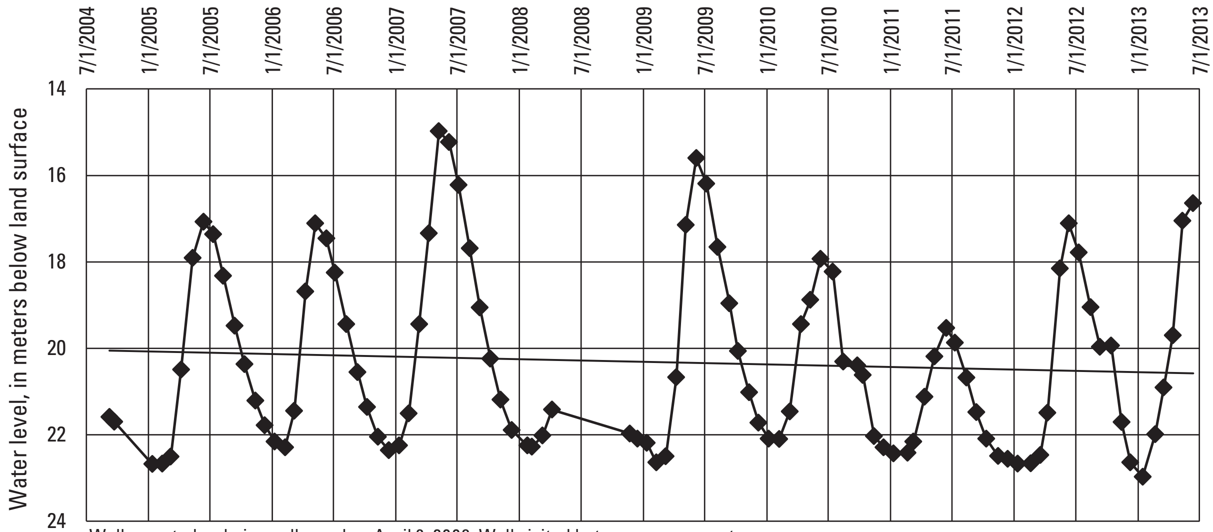



**EXPLANATION**

◆ Water-level measurement

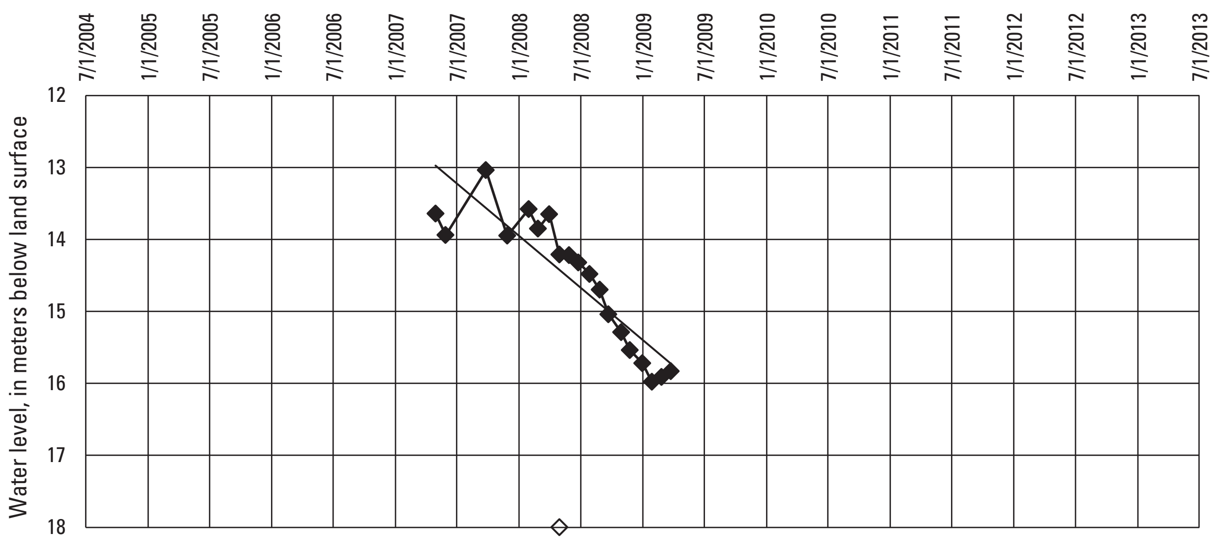
◇ Indicates recent pumping at time of measurement

**Number—52**
Name—Well at Gaza Kakakhel village
Datum—2,110.5 m
Depth—23.1 m
Surficial geology—Q3loe; loess
Description—In the garden




Well reported as being collapsed on April 6, 2008. Well visited but no measurements taken in May, June, July, August, September, or October 2008.

**Number—66**
Name—Mahay Geer village
Datum—1,509 m
Depth—40 m
Surficial geology—Q3loe; loess
Description—Eastern side of mosque of the village




Water-level measurements were discontinued in this well after the March 24, 2009, measurement.

**EXPLANATION**

◆ Water-level measurement

◇ Indicates recent pumping at time of measurement

**Number—67**

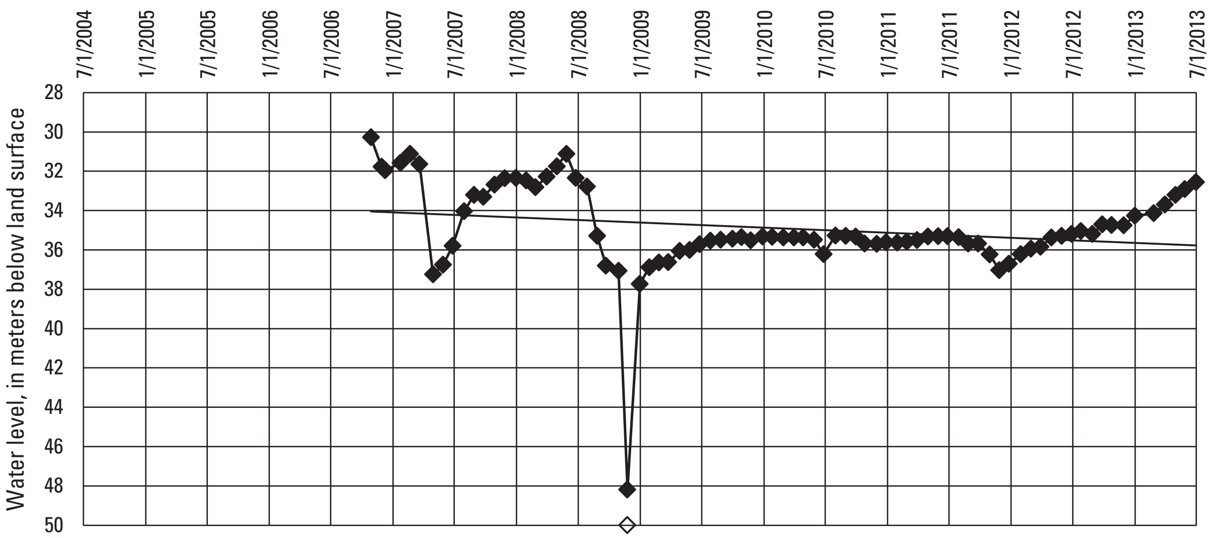
Name—Sayyad Bala village

Datum—1,498 m

Depth—Unknown

Surficial geology—Q3loe; loess

Description—Eastern side of Sayad Street in Sayad village




**Number—68**

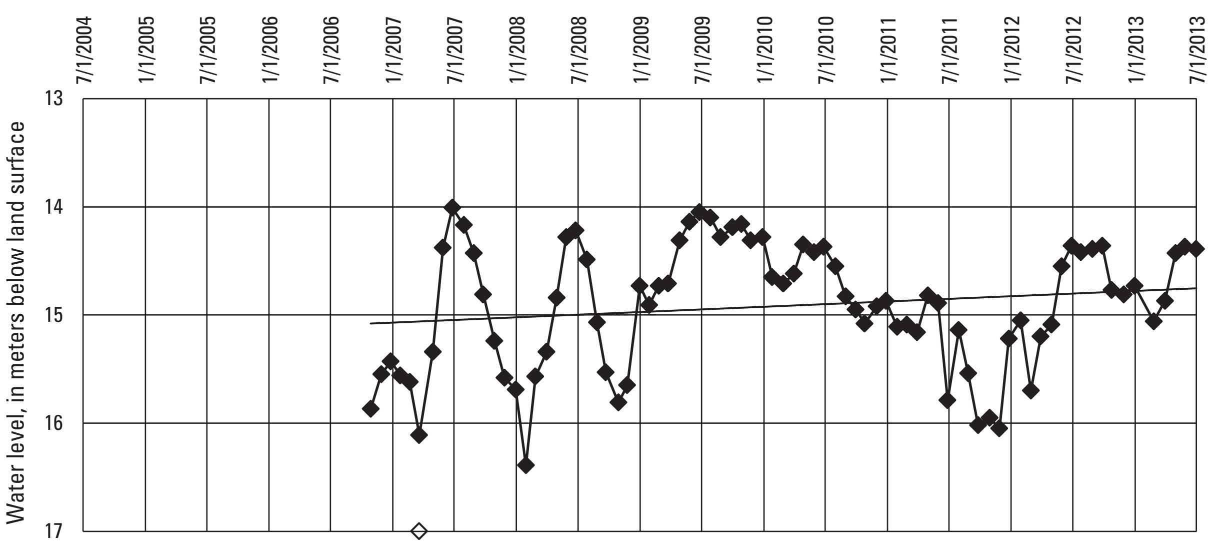
Name—Bland Aawa Turkman village

Datum—1,511 m

Depth—18 m

Surficial geology—Q3loe; loess

Description—None

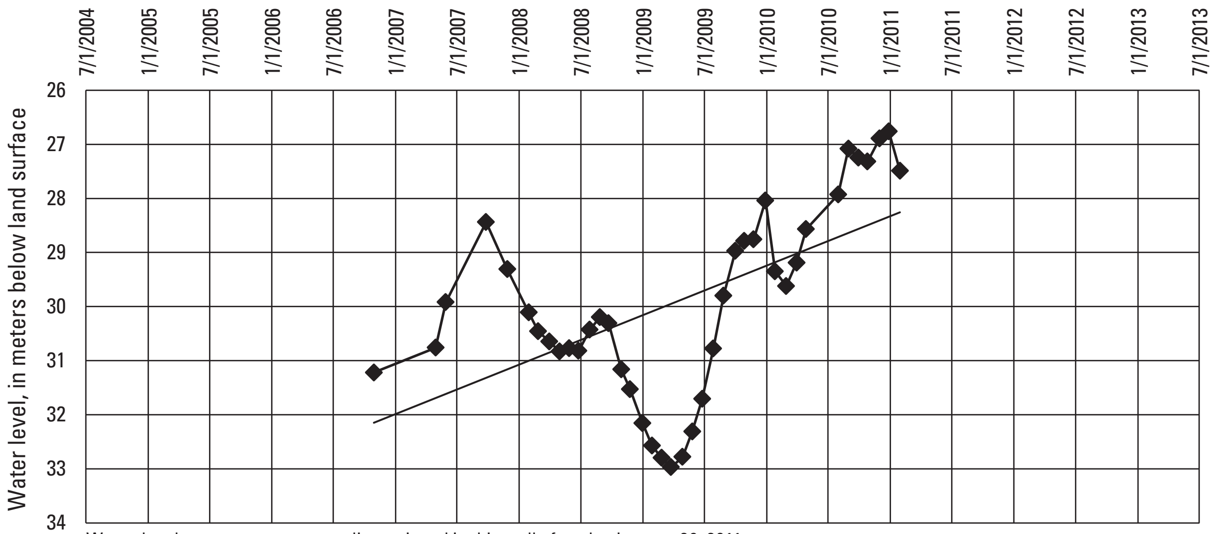



**EXPLANATION**

◆ Water-level measurement

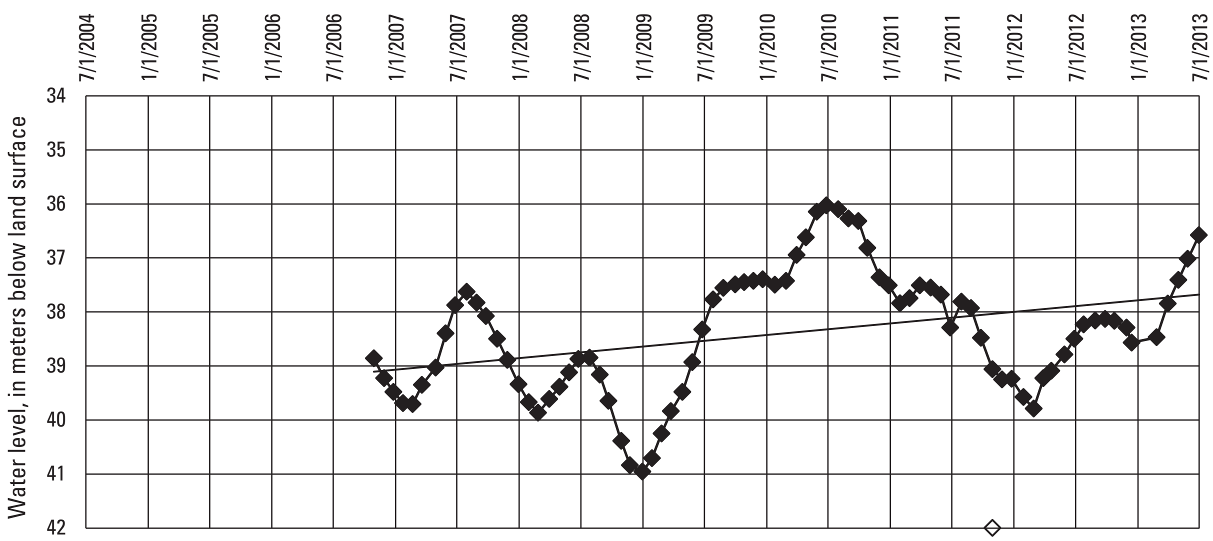
◇ Indicates recent pumping at time of measurement

**Number—69**
Name—Dih Muskeen village
Datum—1,544 m
Depth—40.5 m
Surficial geology—Q34ac; fan alluvium and colluvium
Description—Center of the village




Water-level measurements were discontinued in this well after the January 29, 2011, measurement.

**Number—70**
Name—Pol Zargaran village
Datum—1,515 m
Depth—48 m
Surficial geology—Q3loe; loess
Description—Center of the village




**EXPLANATION**

- ◆ Water-level measurement
- ◇ Indicates recent pumping at time of measurement

# References Cited

Akbari, M.A., Tahir, Mohammad, Litke, D.W., and Chornack, M.P., 2007, Ground-water levels in the Kabul Basin, Afghanistan, 2004–2007: U.S. Geological Survey Open-File Report 2007–1294, 46 p.

Bohannon, R.G., and Turner, K.J., 2005, Geologic map of quadrangle 3468, Chak Wardak-Syahgerd (509) and Kabul (510) quadrangles, Afghanistan: U.S. Geological Survey Open-File Report 2005–1107–A, 1:250,000, 1 sh.

Broshears, R.E., Aklbari, M.A., Chornack, M.P., Mueller, D.K., and Ruddy, B.C., 2005, Inventory of ground-water resources in the Kabul Basin, Afghanistan: U.S. Geological Survey Scientific Investigations Report 2005–5090, 34 p.

Mack, T.J., Akbari, M.A., Ashoor, M.H., Chornack, M.P., Coplen, T.B., Emerson, D.G., Hubbard, B.E., Litke, D.W., Michel, R.L., Plummer, L.N., Rezai, M.T., Senay, G.B., Verdin, J.P., and Verstraeten, I.M., 2010, Conceptual model of water resources in the Kabul Basin, Afghanistan: U.S. Geological Survey Scientific Investigations Report 2009–5262, 240 p.

Mack, T.J., Chornack, M.P., and Taher, M.R., 2013, Groundwater-level trends and implications for sustainable water use in the Kabul Basin, Afghanistan: Environment Systems and Decisions, v. 33, no. 3, p. 457–467, accessed December 5, 2013, at *http://link.springer.com/article/10.1007%2Fs10669-013-9455-4#*.

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