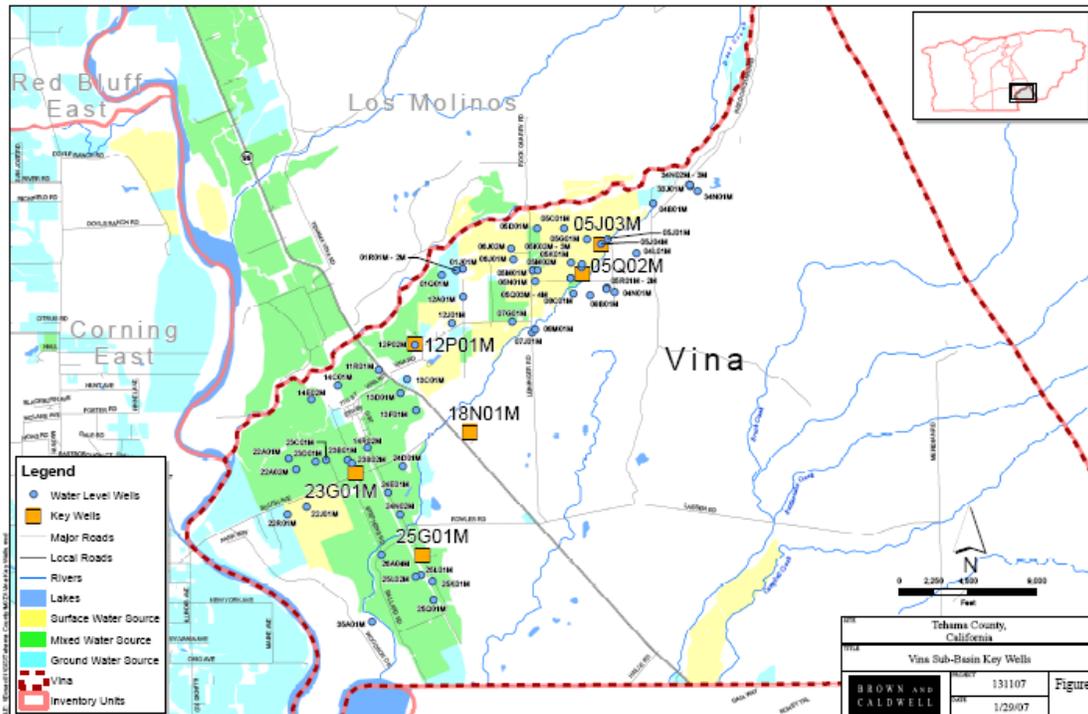


Tehama County AB-3030 Groundwater Management Plan



Technical Memorandum

For the Vina Sub-basin of Tehama County



Draft for Public Review and Comment

Proposed Groundwater Trigger Levels and Awareness Actions

July 1, 2008

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Prepared for: Tehama County Flood Control and Water Conservation District

Project Title: BMO Trigger Level Development

Project No: 131107

Technical Memorandum

Subject: Proposed Groundwater Trigger Levels and Awareness Actions for the Vina Sub-basin

Date: July 1, 2008

To: Mr. Ernie Ohlin, Water Resources Manager

From: John Ayres, PG

Prepared by: John Ayres, PG

Reviewed by: Robert Vince, PG, CHG

1. INTRODUCTION

The Tehama County Flood Control and Water Conservation District (District) cooperated with private landowners, County groups, and local agencies overlying the groundwater basin to develop a Groundwater Management Plan (Plan) focusing on groundwater resources protection and management. The Plan took three years to develop with citizen input, review, approval, and achieving final adoption by the Tehama County FCWCD in 1998.

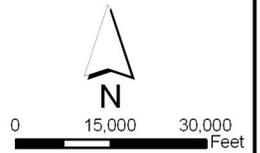
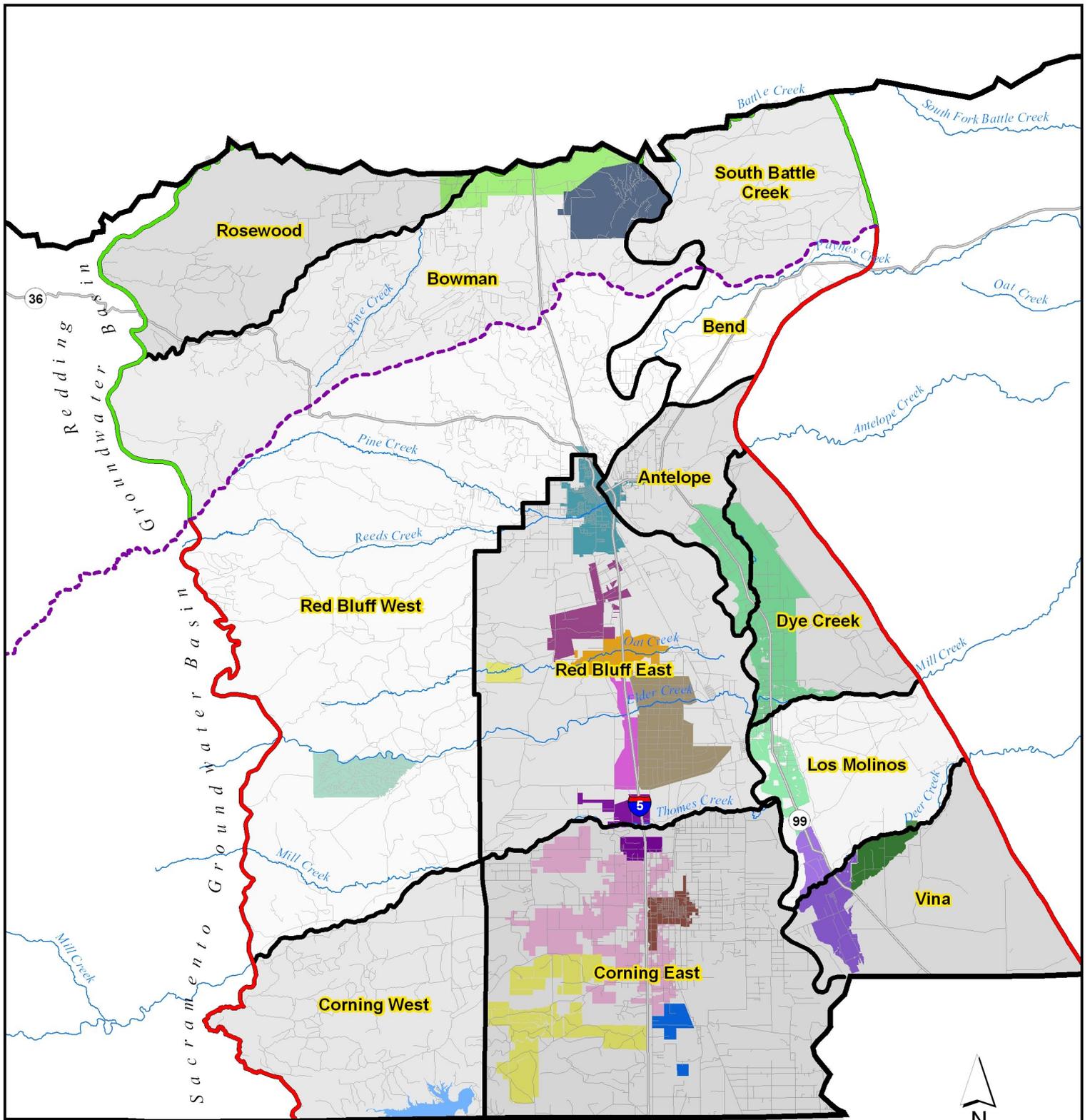
This Plan has provided guidance related to groundwater activities since adoption. Landowners and water purveyors alike recognize the need to move forward with groundwater resource protection by developing measures (trigger levels) that determine the level of active management needed within each sub-basin. Trigger levels can be established for groundwater levels, groundwater quality, or inelastic land subsidence due to groundwater extraction. This Technical Memorandum (TM) focuses on groundwater level trigger level development for the Vina sub-basin.

Groundwater trigger levels represent declines in groundwater levels that, when reached or exceeded, may cause some type of action such as public outreach, increased monitoring, or consideration of modifying the groundwater trigger level. The Plan defines trigger levels as increasing stages of groundwater decline that correspond with various levels of increased groundwater discussion, investigation or local management actions. This TM identifies trigger levels that correspond to two decreasing levels of groundwater in the spring, and one trigger level that corresponds with decreasing levels of groundwater in the summer and fall.

The Plan states that one of the District's functions under the Plan is to provide guidance in the development of trigger levels. Sections 325 through 329 of the Plan describe the trigger level concept and the District's role in Trigger level development. The District, working with a Technical Advisory Committee (TAC) composed of local representatives, identified twelve groundwater sub-basins where trigger levels may be established (Figure 1-1).

This TM presents the process for developing groundwater elevation trigger levels and provides specific suggestions for the Vina sub-basin. Additional information on the trigger level development process and regional hydrogeology is available in the *Trigger Level Background Technical Memorandum*, available on the District's website at: <http://www.tehamacountywater.ca.gov/>.

The District understands that final trigger levels should reflect stakeholders' in-depth knowledge and management objectives for their sub-basin. Representatives from each sub-basin will review and provide input on the proposed trigger levels and suggested management actions contained herein for use in their sub-basin. The District is open to revisions that reflect stakeholder knowledge of groundwater conditions in their sub-basin. Ultimately, it is the District's desire to have management objectives that are understood and supported by groundwater users in the respective sub-basin.



Irrigation Districts

- Aaction
- Corning WD
- Kirkwood ID
- Rawson ID
- Anderson-Cottonwood
- Deer Creek
- LMMWC
- Rio Alto WD
- City of Corning
- El Camino ID
- Proberta ID
- Stanford Vina
- City of Red Bluff
- Elder Creek ID
- Rancho Tehama
- Thomes Creek ID

Legend	
---	Red Bluff Arch
---	Redding Groundwater Basin
---	Sacramento Valley Groundwater Basin

BROWN AND CALDWELL	PROJECT 131107	SITE	Tehama County Groundwater Sub-Basins	Figure 1-1
	DATE 1/18/07	TITLE		

1.1 Groundwater Level Trigger Level Development Methodology

Groundwater trigger levels are derived through interpretation of historic groundwater levels. A series of awareness actions are proposed for each trigger level stage. Development of groundwater level triggers is a five-step process as illustrated below:

Step 1: Describe the trigger level's purpose.

Step 2: Select one or more key wells within the sub-basin.

Step 3: Designate the time of seasonal measurement.

Step 4: Establish trigger levels in the selected key wells.

Step 5: Define awareness actions associated with each trigger level.

Step 1: Describe the trigger level's purpose

The Vina sub-basin is primarily a rural area, with agriculture in northern and western portions of the area. Groundwater is used for agricultural and domestic purposes. Additional water use information is available in the Tehama County Water Inventory and Analysis, available in PDF format at:

http://www.tehamacountywater.ca.gov/grndwtr_inv_ana.htm. The trigger level's purpose in this sub-basin should reflect the needs of local water users. Some suggested trigger level purposes are:

- Maintain groundwater at an elevation that promotes the continued economical use of groundwater for irrigation, domestic, and municipal needs.
- Protect groundwater supplies for current and future domestic and irrigation use.
- Maintain a stable trend of groundwater in storage to ensure adequate drinking water and agricultural supplies during future drought periods.
- Monitor groundwater levels to record and compare changes to aid in identifying conditions that cause declines in groundwater levels.

Groundwater Use in Vina:	
Irrigation:	98% (8,400 acre-ft)
Municipal, and Industrial:	2% (200 acre-ft)
Number of wells by type in Vina:	
Irrigation:	66 wells
Domestic:	115 wells
Municipal and Industrial:	4 wells

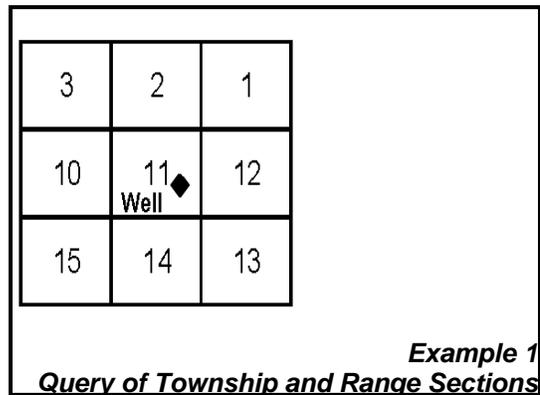
Step 2: Select one or more key wells within the sub-basin

Key wells are monitoring wells that are representative of groundwater conditions within a particular aquifer interval, or range of aquifer intervals underlying the sub-basin. Groundwater levels in key wells provide information necessary to begin management activities.

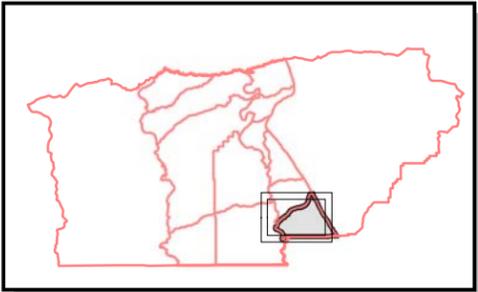
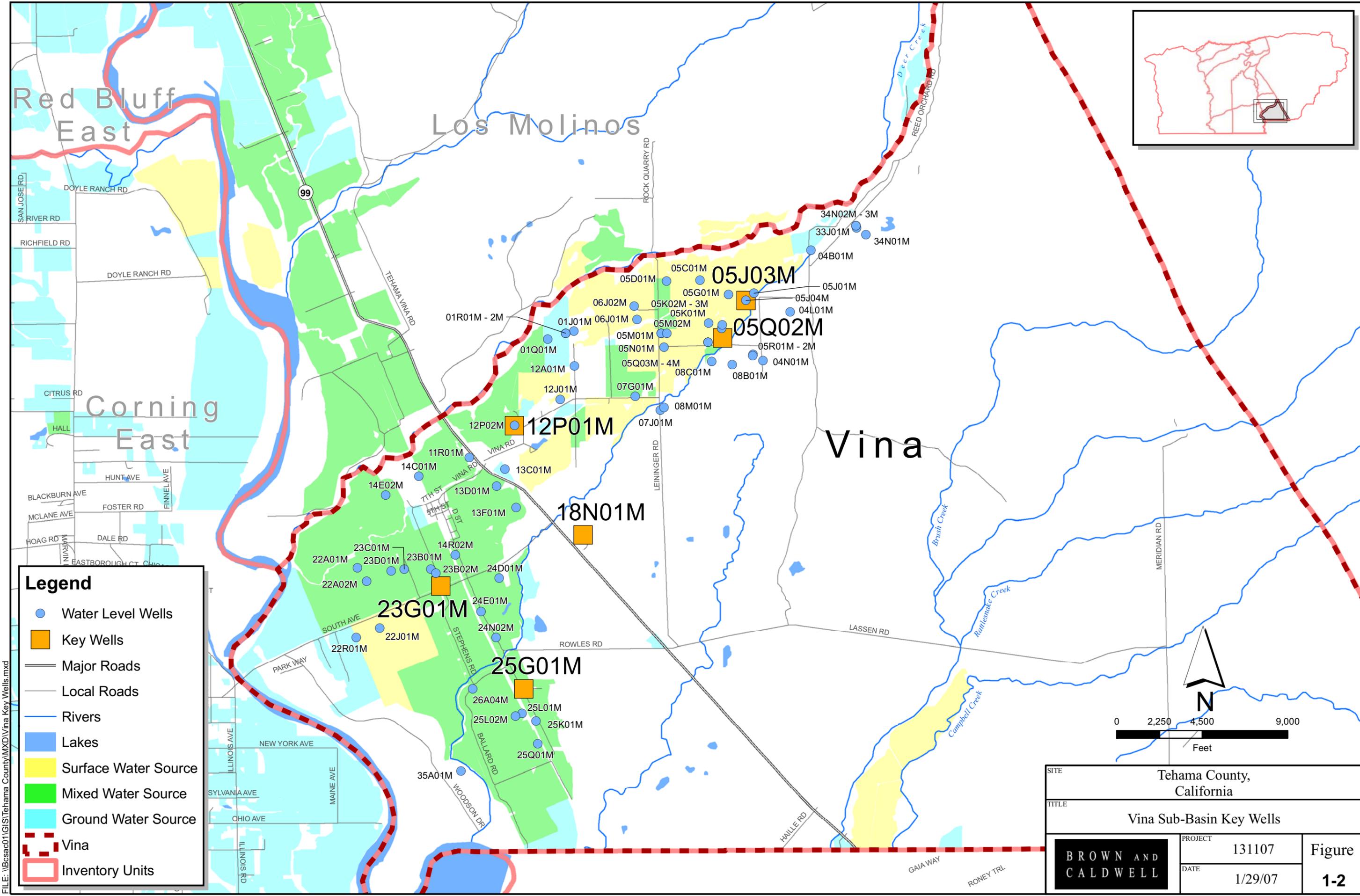
Key wells should be selected from the County groundwater level monitoring well network with consideration of duration of monitoring. The monitoring period of record in some wells is more than 30 years; the long period of record helps identify seasonal and long-term aquifer response over a wide range of climatic conditions (wet, normal or drought), changes in agricultural and domestic development, and changes in available water supply. Some monitoring wells may have short periods of record, but are located in a key area and have preferable depth and screened intervals. These wells may be useful as key wells also.

Key wells should be selected from the County groundwater level monitoring well network with consideration of location, total well depth, perforated interval from which the well produces water, and other well drilling records. Key wells should be distributed as evenly as possible throughout the sub-basin. Monitoring wells with screened intervals or depths near 100 to 250 feet below ground surface correspond to the average depth of domestic wells in the sub-basin and are good candidates for monitoring aquifer conditions associated with domestic use.

The locations of five proposed key wells are presented in Figure 1-2. A query was conducted to find nearby wells, their uses, and average depths. The query located wells in the section the well was in, and the eight sections surrounding that section (Example 1). Each section is one square mile in size. Each well is described in detail below:

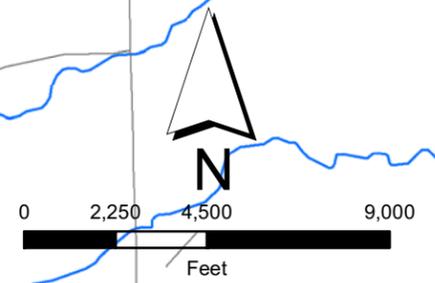


- **24N01W05J03M (05J03M)** – This monitoring well is in the northeast portion of the sub-basin and is 1005 feet deep and has a screened interval from 295 to 305 feet below ground surface. This well is situated near grain crops, pasture, and orchards irrigated with surface water. This well has a period of record of more than 8 years. The nine square miles near this well contain 26 domestic wells with an average depth of 149 feet bgs, and 11 irrigation wells with an average depth of 460 feet bgs.
- **24N01W05Q02M (05Q02M)** – This monitoring well is in the northeast portion of the sub-basin and is 150 feet deep with a screened interval from 60 to 150 feet below ground surface. This well is situated near pasture and orchards irrigated with surface water. This well has a period of record is more than 30 years, which provides information on water levels during the drought of 1976-1977 and the drought during the late 1980s and early 1990s. The nine square miles near this well contain 26 domestic wells with an average depth of 149 feet bgs, and 11 irrigation wells with an average depth of 460 feet bgs.
- **24N01W18N01M (18N01M)** – This monitoring well is in the west central portion of the sub-basin and is 102 feet deep with a screened interval from 64 to 102 feet below ground surface. This well is situated away from irrigated areas. This well has a period of record is more than 30 years, which provides information on water levels during the drought of 1976-1977 and the drought during the late 1980s and early 1990s. The nine square miles near this well contain 44 domestic wells with an average depth of 146 feet bgs, and 9 irrigation wells with an average depth of 373 feet bgs.
- **24N02W12P01M (12P01M)**– This monitoring well is in the north central portion of the sub-basin and is 370 feet deep with a screened interval from 164 to 359 feet below ground surface. This well is situated near pasture irrigated with groundwater and surface water. This well has a period of record of more than 8 years. The nine square miles near this well contain 64 domestic wells with an average depth of 115 feet bgs, and 10 irrigation wells with an average depth of 367 feet bgs.
- **24N02W23G01M (23G01M)**– This monitoring well is in the south western portion of the sub-basin and is 362 feet deep with a screened interval from 83 to 362 feet below ground surface.. This well is situated near orchards irrigated with both groundwater and surface water. This well



Legend

- Water Level Wells
- Key Wells
- Major Roads
- Local Roads
- Rivers
- Lakes
- Surface Water Source
- Mixed Water Source
- Ground Water Source
- Vina
- Inventory Units



SITE Tehama County, California		
TITLE Vina Sub-Basin Key Wells		
BROWN AND CALDWELL	PROJECT	131107
	DATE	1/29/07
		Figure 1-2

FILE: \\Bcsac01\GIS\Tehama County\MXD\Vina Key Wells.mxd

has a period of record of more than 8 years. The nine square miles near this well contain 65 domestic wells with an average depth of 100 feet bgs, and 34 irrigation wells with an average depth of 360 feet bgs.

- **24N02W25G01M (25G01M)**– This monitoring well is in the western portion of the sub-basin and is 256 feet deep with a screened interval from 108 to 256 feet below ground surface. This well is situated near orchards irrigated with both groundwater and surface water. This well has a period of record is more than 30 years, which provides information on water levels during the drought of 1976-1977 and the drought during the late 1980s and early 1990s. The nine square miles near this well contain 29 domestic wells with an average depth of 118 feet bgs, and 39 irrigation wells with an average depth of 385 feet bgs.

There are currently no monitoring wells in the south and southeastern portions of the Vina sub-basin reflecting that no wells are monitored in that area. This may represent an area within the sub-basin where an additional monitoring well may eventually need to be established to begin to develop a groundwater level history in the southwestern area.

Step 3: Designate the time of seasonal measurement

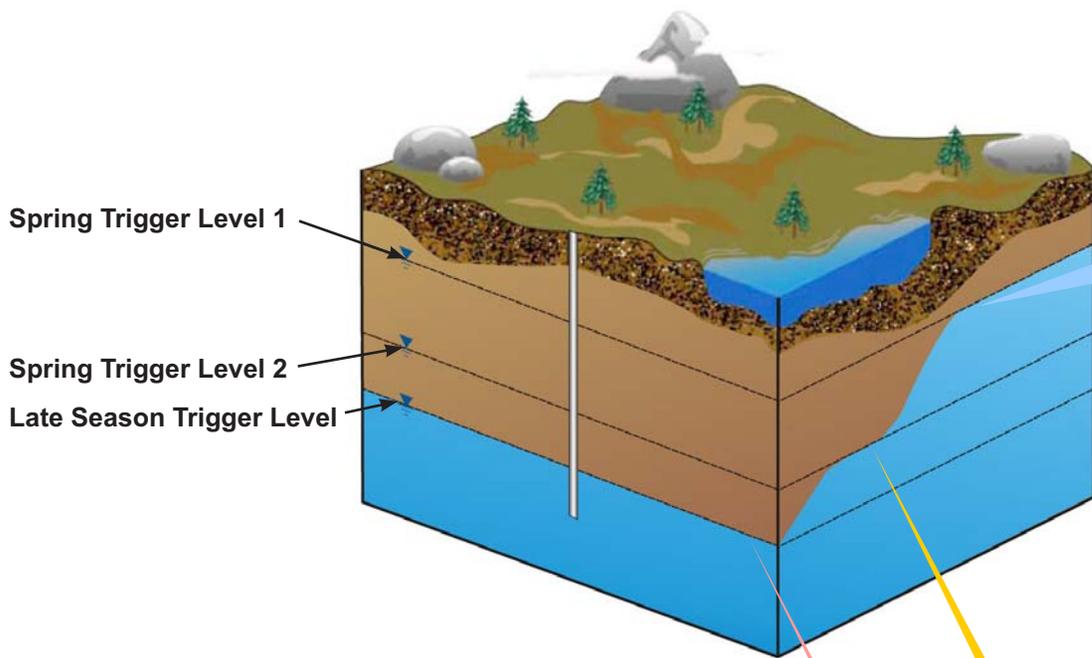
Groundwater levels fluctuate seasonally, and measurements from the different seasons provide different snapshots of groundwater conditions. Spring measurements provide information on whether the basin has recharged during the wet season to elevations observed in previous years. Typically, spring water levels are the highest water levels observed during the year. Summer and fall water level elevation measurements provide information about decreased water levels during groundwater pumping and illustrate the cumulative pumping impacts from a sub-basin within a season.

The District suggests that spring measurements be used to set trigger levels with associated awareness actions, and late season measurements (summer and fall) be used to set an additional trigger level with associated awareness actions that is sensitive to groundwater levels during the seasons of heavy groundwater use and can provide a warning of potential issues such as increased groundwater demand.

Steps 4 and 5: Establish trigger levels in selected key wells and define awareness actions associated with each trigger level

Trigger levels act as an early warning system for identifying potential problems. A trigger level corresponds to a predetermined target groundwater level during a season of measurement. For example, if a trigger level is set at a water surface elevation of 50 feet below ground surface (bgs) in the spring, then only spring measurements should be compared to the trigger level. A spring measurement of 40 feet bgs would not require an awareness action in this case. A spring measurement of 60 feet bgs, on the other hand, would be below the trigger level, and should prompt awareness actions (Figure 1-3).

Sub-basin representatives review and provide input on the proposed trigger levels within their sub-basin and the awareness actions associated with each level. Potential trigger levels, and the accompanying awareness actions, may range from a small decrease in groundwater levels compared to historical levels, indicating a need to disseminate information or further investigation of



Spring Trigger Level 1

Spring Trigger Level 2

Late Season Trigger Level

AWARENESS ACTIONS

- Spring Trigger Level 1 Awareness Actions**
- ONE YEAR BELOW TRIGGER LEVEL 1**
- TAC meetings to address issues in the area
 - Water user/stakeholder meeting for the subbasin
 - Send mail to known water users in subbasin, notifying them about an overall decrease in water levels or quality in the subbasin
 - Notify public of groundwater issue
 - County to make a press release
 - Updates to the District website
 - District to attend agriculturally related and city meetings
 - Site visits
 - Review recent precipitation trends to look for drought trends
- CONSECUTIVE YEARS BELOW TRIGGER LEVEL 1**
- Continue to inform water users and general public
 - Verify data
 - Increase monitoring frequency in subbasin
 - Add new monitoring location in subbasin
 - Begin monitoring land subsidence
 - Install data loggers
 - Investigate cause of low groundwater levels

AWARENESS ACTIONS

- Spring Trigger Level 2 Awareness Actions**
- Continue Spring Trigger Level 1 Awareness Actions
 - Solicit voluntary public involvement in resolving issues in the area
 - Consider groundwater recharge efforts
 - Review condition of approval for new development reliant on groundwater by the County
 - Review of the County's approval process regarding water supply for development or additional groundwater pumping projects
 - Increase land subsidence monitoring

AWARENESS ACTIONS

- Late Summer Trigger Level Awareness Actions**
- Perform Spring Trigger Level 1 and 2 Awareness Actions
 - Investigate potential higher groundwater demand or other causes

Figure 1-3
Trigger Levels and Awareness Actions

groundwater levels to a larger change in groundwater levels, indicating a need to take action to stop or reduce the lowering of groundwater levels.

For each trigger level, sub-basin representatives should work with local groundwater users and the District to implement the awareness actions associated with the trigger level. Management actions may include providing information on trigger level exceedance to the public, investigating the trigger level exceedance, and taking action to remedy the issue.

Suggested trigger levels and corresponding awareness actions were selected by the TAC and the District to provide the appropriate level of management in response to exceedance of trigger levels. The trigger levels and corresponding awareness actions should coincide with the severity of groundwater issues in the sub-basin. Figure 1-3 shows three suggested spring trigger levels and one suggested late season trigger level with corresponding actions. The methodology for the suggested trigger levels is provided in Table 1-1. A summary of associated awareness actions include:

Spring Trigger Level 1: The first trigger level would cause the dissemination of information to the public about the potential groundwater issue. Additional awareness actions are triggered by a second consecutive year of groundwater levels at or below Spring Groundwater Trigger Level 1.

Spring Trigger Level 2: The second and deeper spring groundwater trigger level would lead to increased monitoring activities and continued public information on the groundwater condition plus investigations and the development of actions to remedy the groundwater issue.

Late Season Trigger Level: The late season trigger level would cause the dissemination of information to the public and the beginning of investigations to understand the cause. Late season measurements are sensitive to groundwater levels during the seasons of heavy groundwater use and can provide a warning of potential issues such as increased groundwater demand.

Figures 1-4 through 1-21 present hydrographs and suggested trigger levels for each of the five Vina key wells. The figures are groundwater level hydrographs, showing water level elevation measurements over the monitoring period of record and the suggested trigger levels during a particular season. On each figure, the date of measurement is indicated on the bottom axis, the depth to water in feet is on the right vertical axis, and the water surface elevation is indicated on the left vertical axis. The methodologies used to determine the suggested trigger levels for the key wells in the Vina sub-basin are provided in Table 1-1. Some trigger levels were set using exceptions from the methodologies to account for measurements that are outside the range of normal spring and summer measurements. Three key wells (05J03M, 12P01M, and 25G01M) had limited historic records of groundwater level measurements that did not include a significant drought cycle, so the method of proposing spring and late season trigger levels was modified and is subject to change in annual reviews as more experience is gained.

Table 1-1. Trigger Level Methodology

Groundwater Trigger Level and Awareness Action	Vina Monitoring Well Number					
	05Q02M	18N01M	23G01M	05J03M	12P01M	25G01M
Spring Trigger Level - 1 Notify and Inform Public	20% of the range of spring measurements above the historical low			Historical low of spring measurements		
Monitor and investigate Cause	Second consecutive year of groundwater levels at or below Spring Stage 1					
Spring Trigger Level 2 – Consider Management Options	Historical low of spring measurements			Historical low of spring measurements minus the range of spring measurements		
Late Season Trigger Level – Notify public and begin investigations	Historical low of summer and fall measurements					
Data Anomalies	None	None	None	None	None	None

Vina Area Key Well 24N01W05J03 (Near Reed Orchard Road)
 Hydrograph over the 1970 - 2006 Period

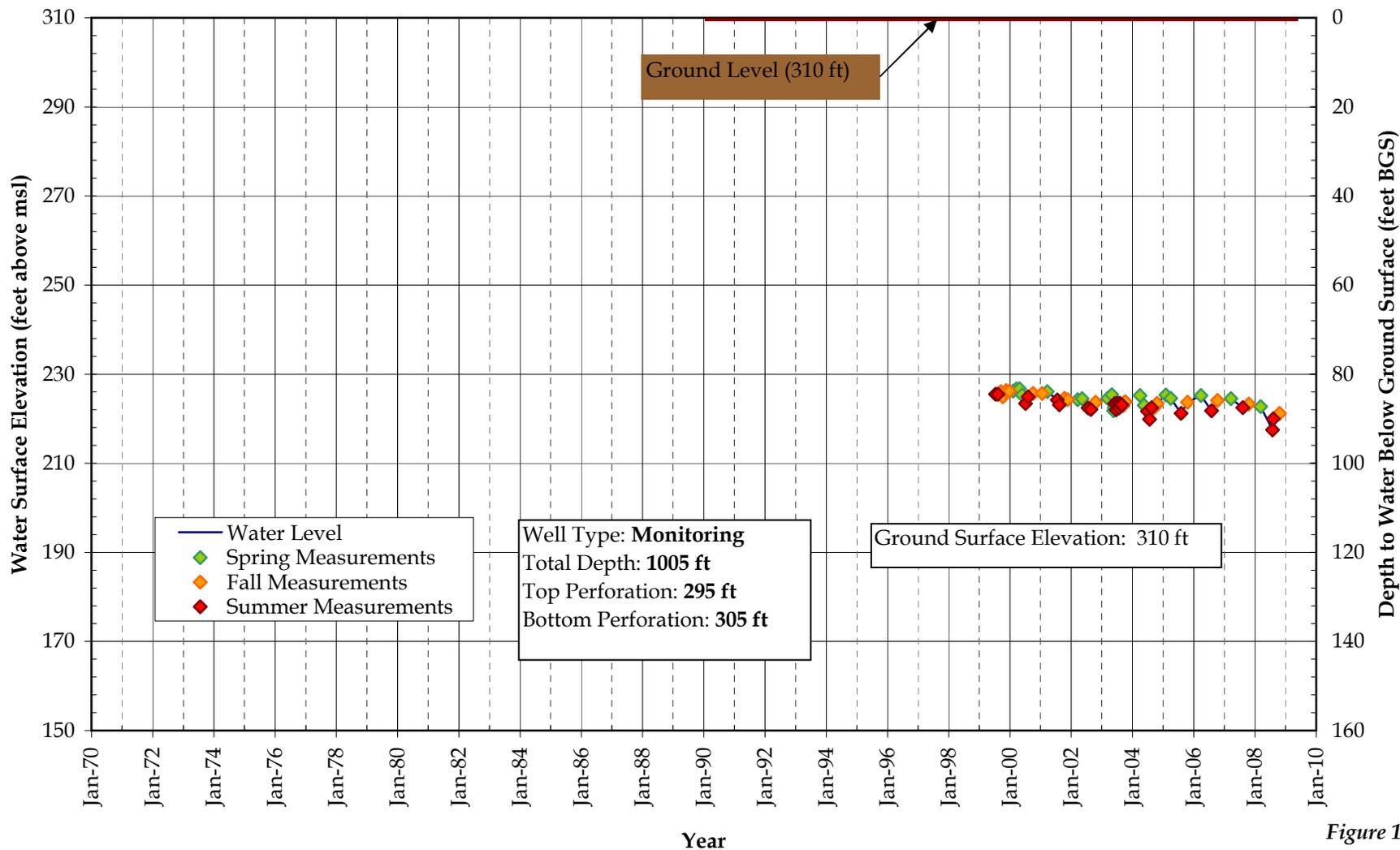


Figure 1-4
 Hydrograph of Key Well 24N01W05J03

Vina Area Key Well 24N01W05J03 (Near Reed Orchard Road)
Spring Level Hydrograph

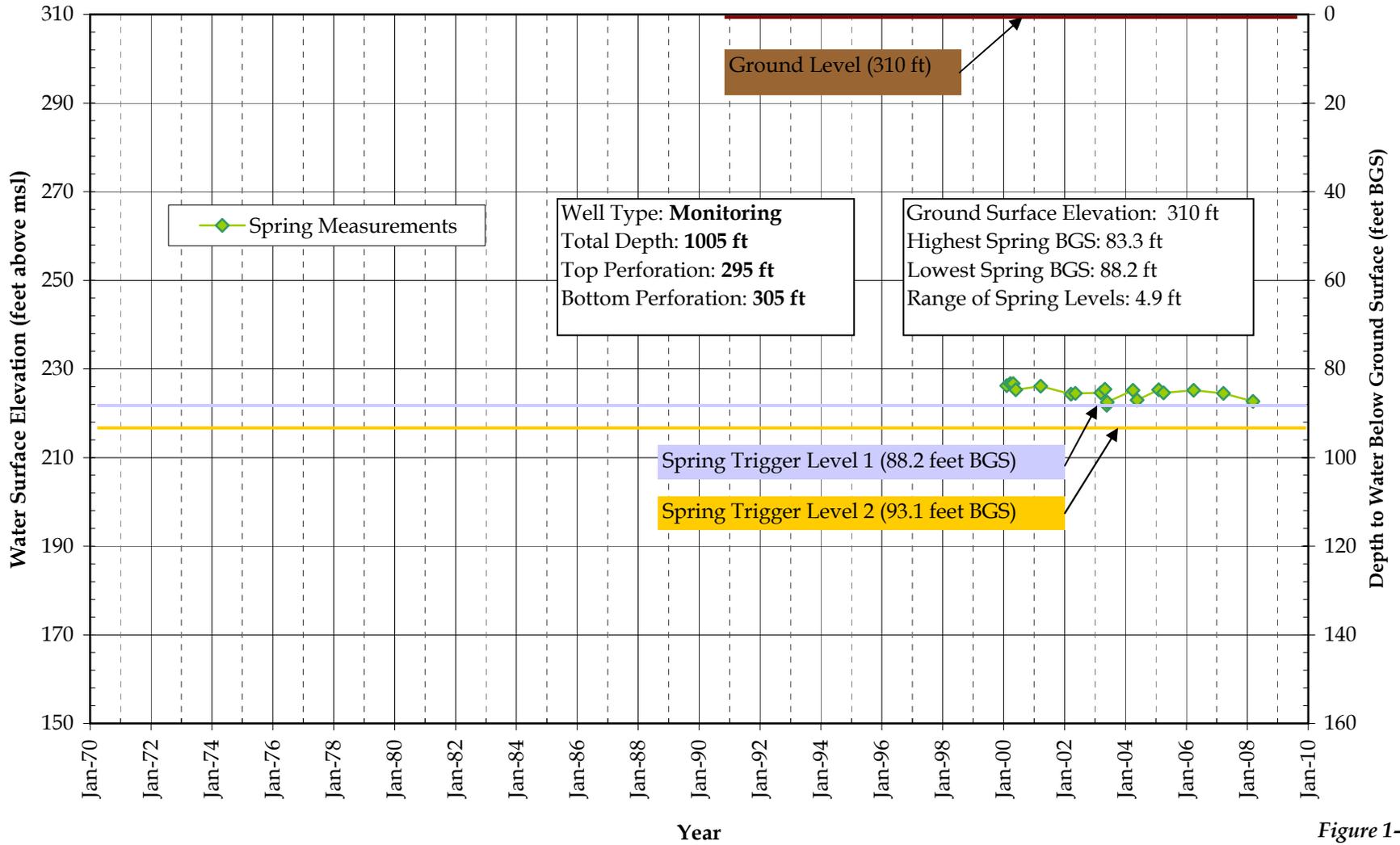


Figure 1-5
Spring Trigger Levels

Vina Area Key Well 24N01W05J03 (Near Reed Orchard Road)
 Late Season (July, August, September, and October) Hydrograph

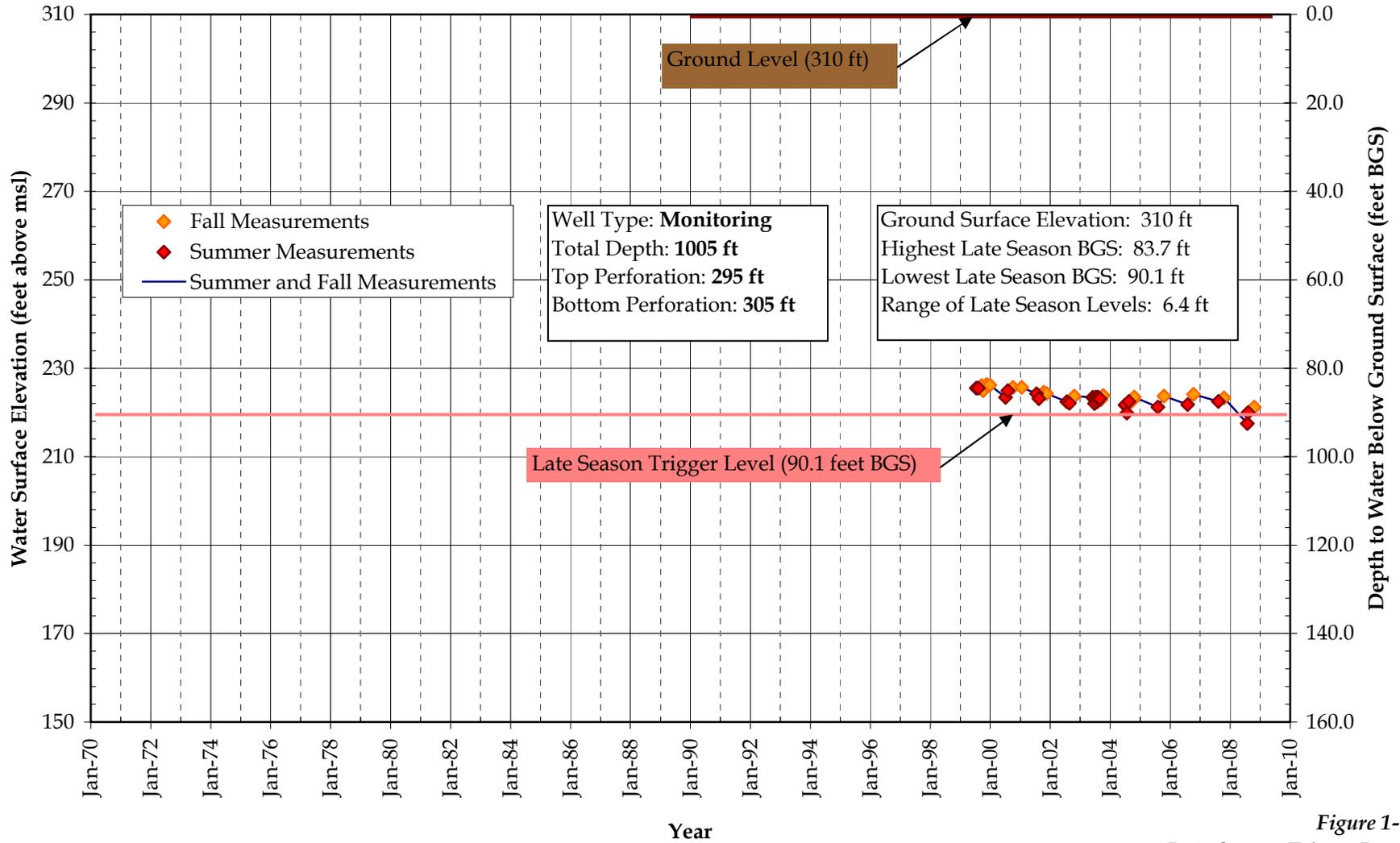


Figure 1-6
 Late Season Trigger Level

Vina Area Key Well 24N01W05Q02 (Near Reed Orchard Road)
Hydrograph over the 1970 - 2007 Period

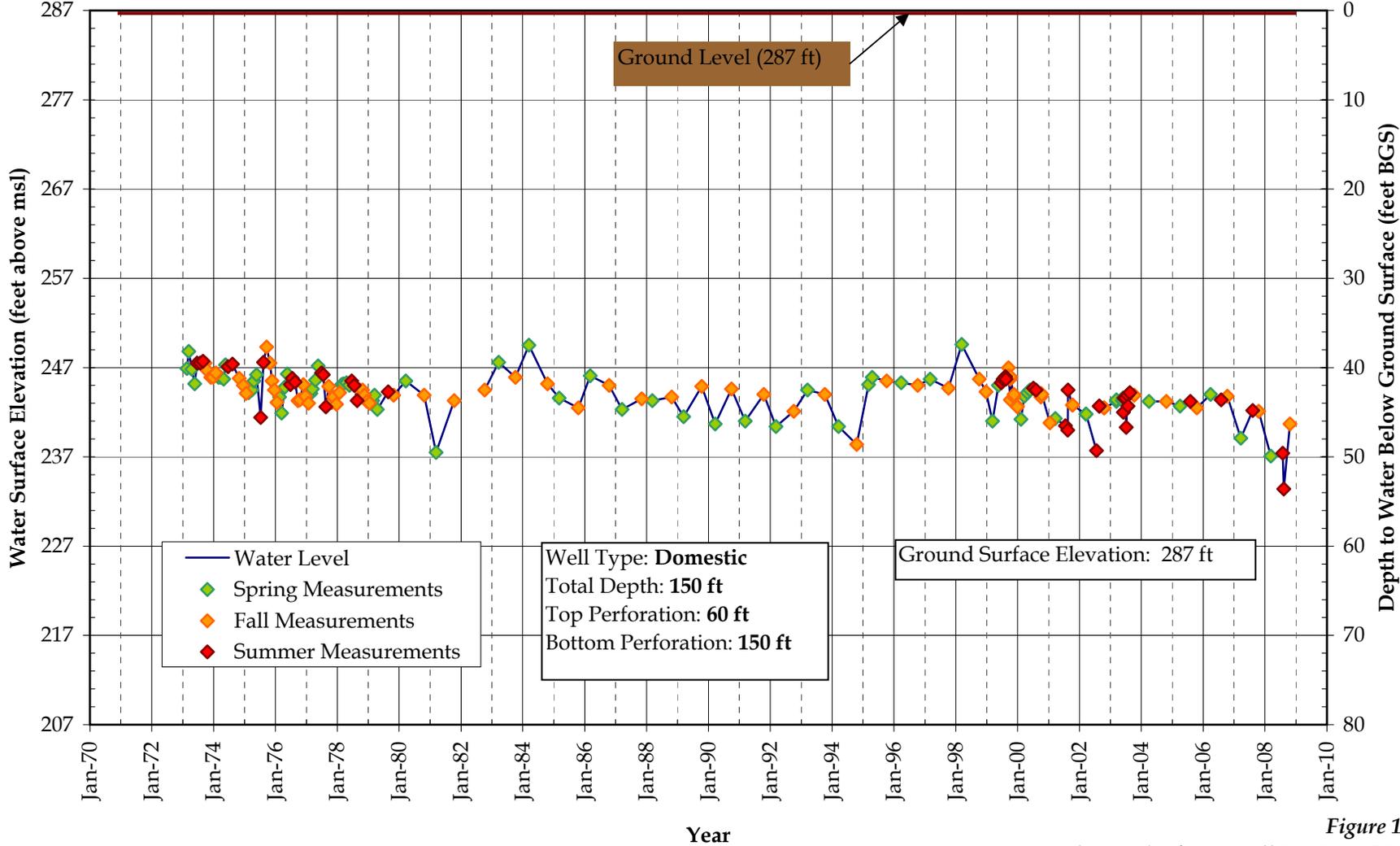


Figure 1-7
Hydrograph of Key Well 24N01W05Q02

Vina Area Key Well 24N01W05Q02 (Near Reed Orchard Road) Spring Level Hydrograph

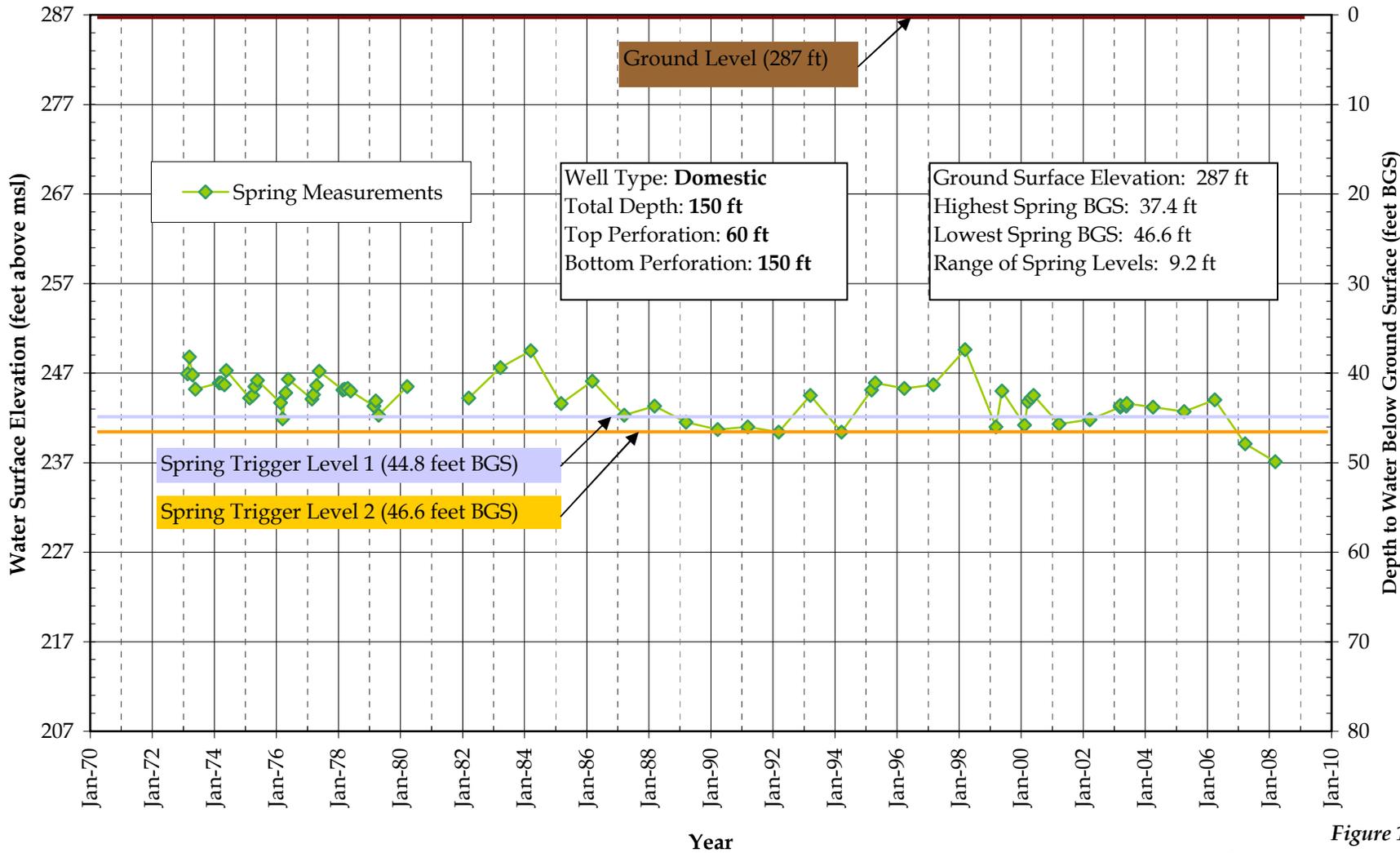


Figure 1-8
Spring Trigger Levels

Vina Area Key Well 24N01W05Q02 (Near Reed Orchard Road) Late Season (July, August, September, and October) Hydrograph

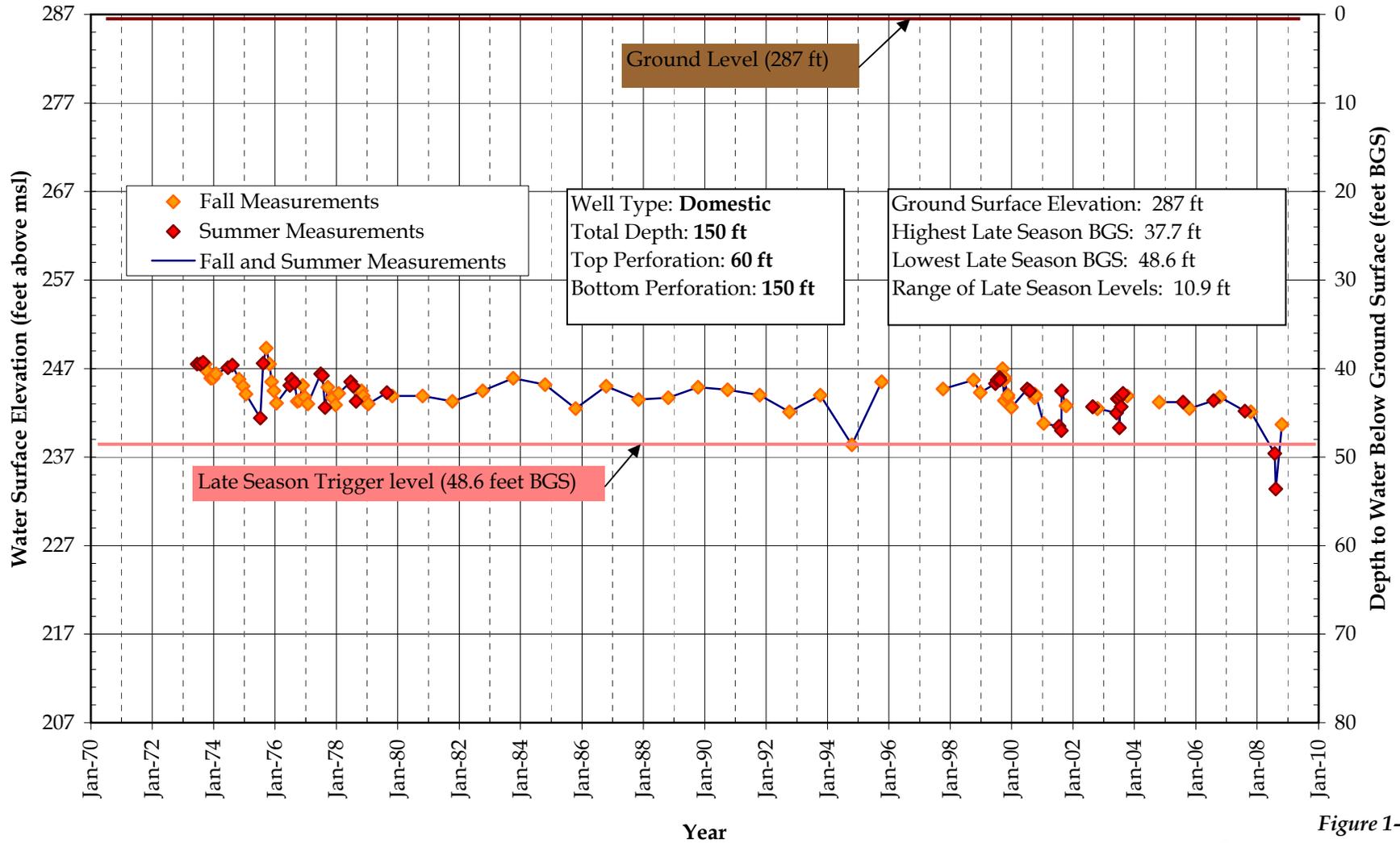


Figure 1-9
Late Season Trigger Level

Vina Area Key Well 24N01W18N01 (Near Highway 99)
Hydrograph over the 1970 - 2007 Period

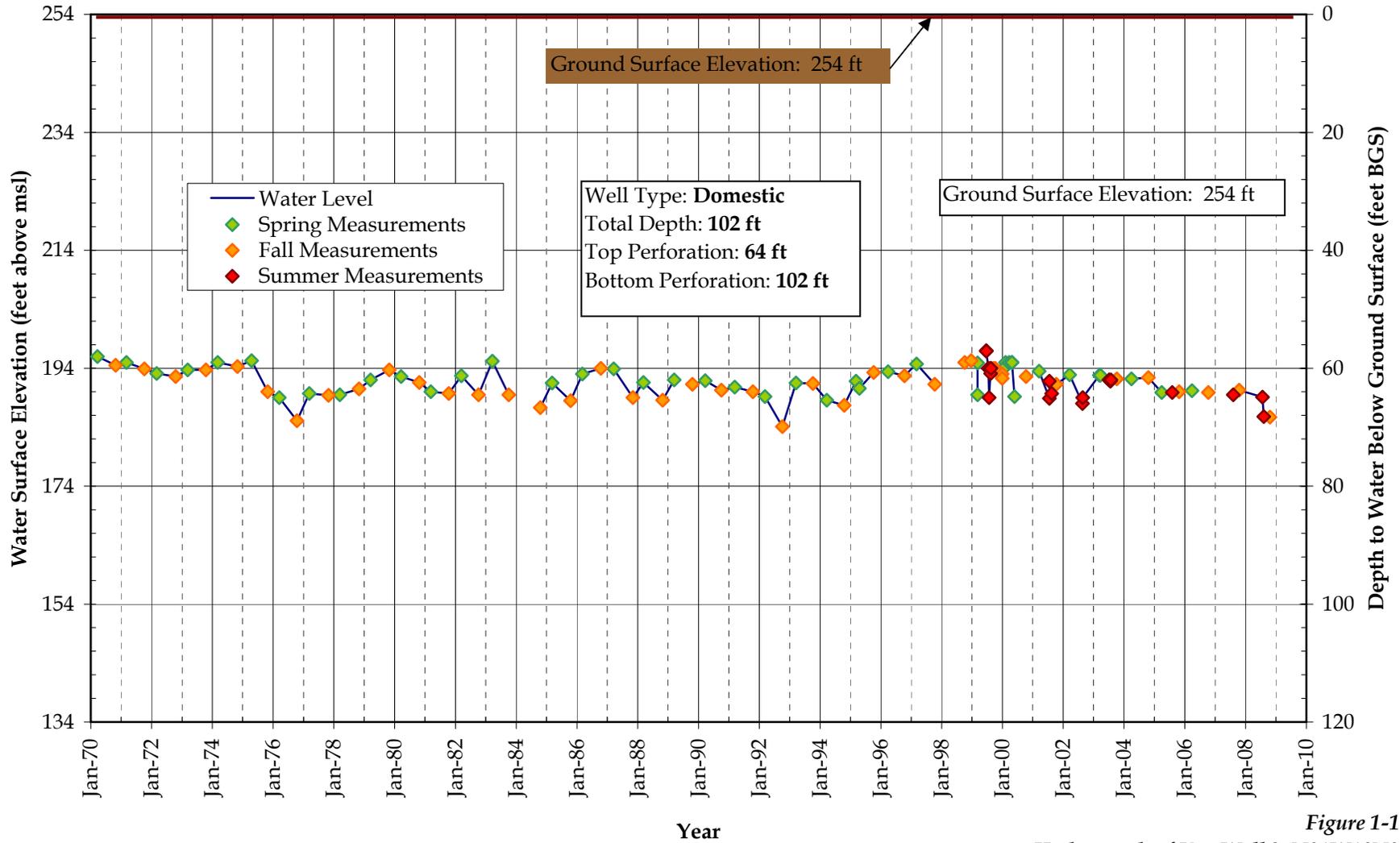


Figure 1-10
Hydrograph of Key Well 24N01W18N01

Vina Area Key Well 24N01W18N01 (Near Highway 99) Spring Level Hydrograph

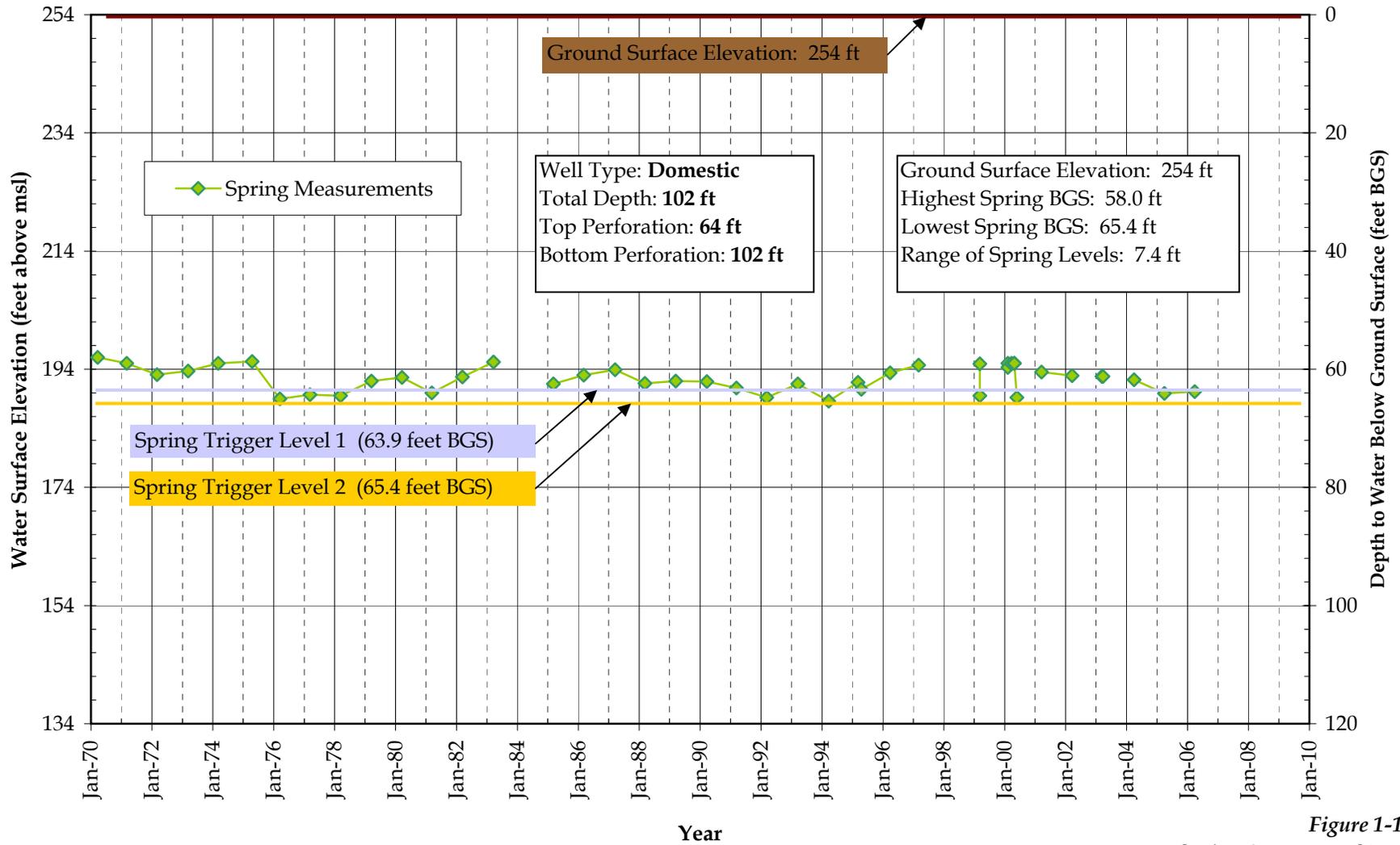


Figure 1-11
Spring Awareness Stages

Vina Area Key Well 24N01W18N01 (Near Highway 99)
Late Season (July, August, September, and October) Hydrograph

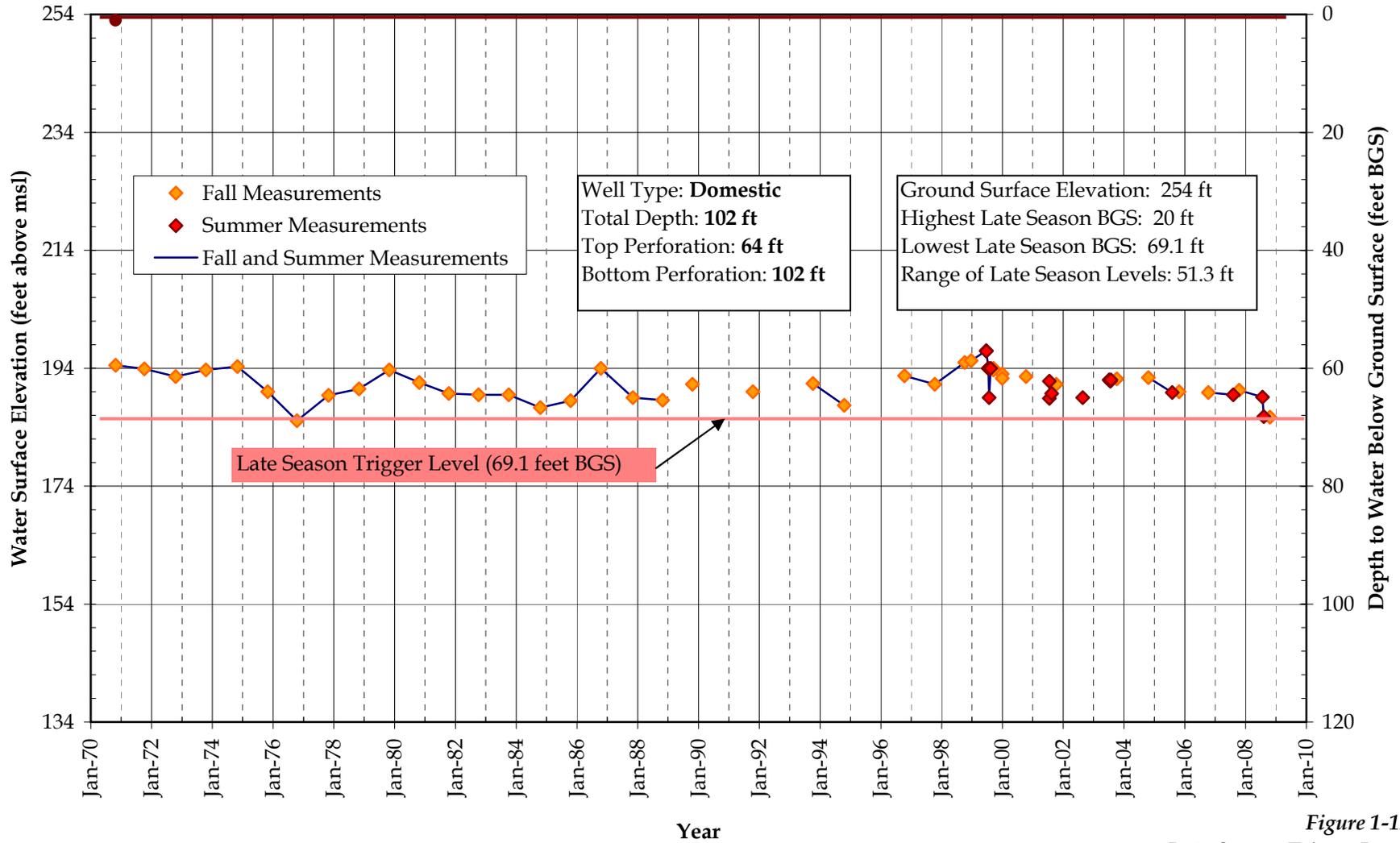


Figure 1-12
Late Season Trigger Level

Vina Area Key Well 24N02W12P01 (Near Vina Road)
Hydrograph over the 1970 - 2007 Period

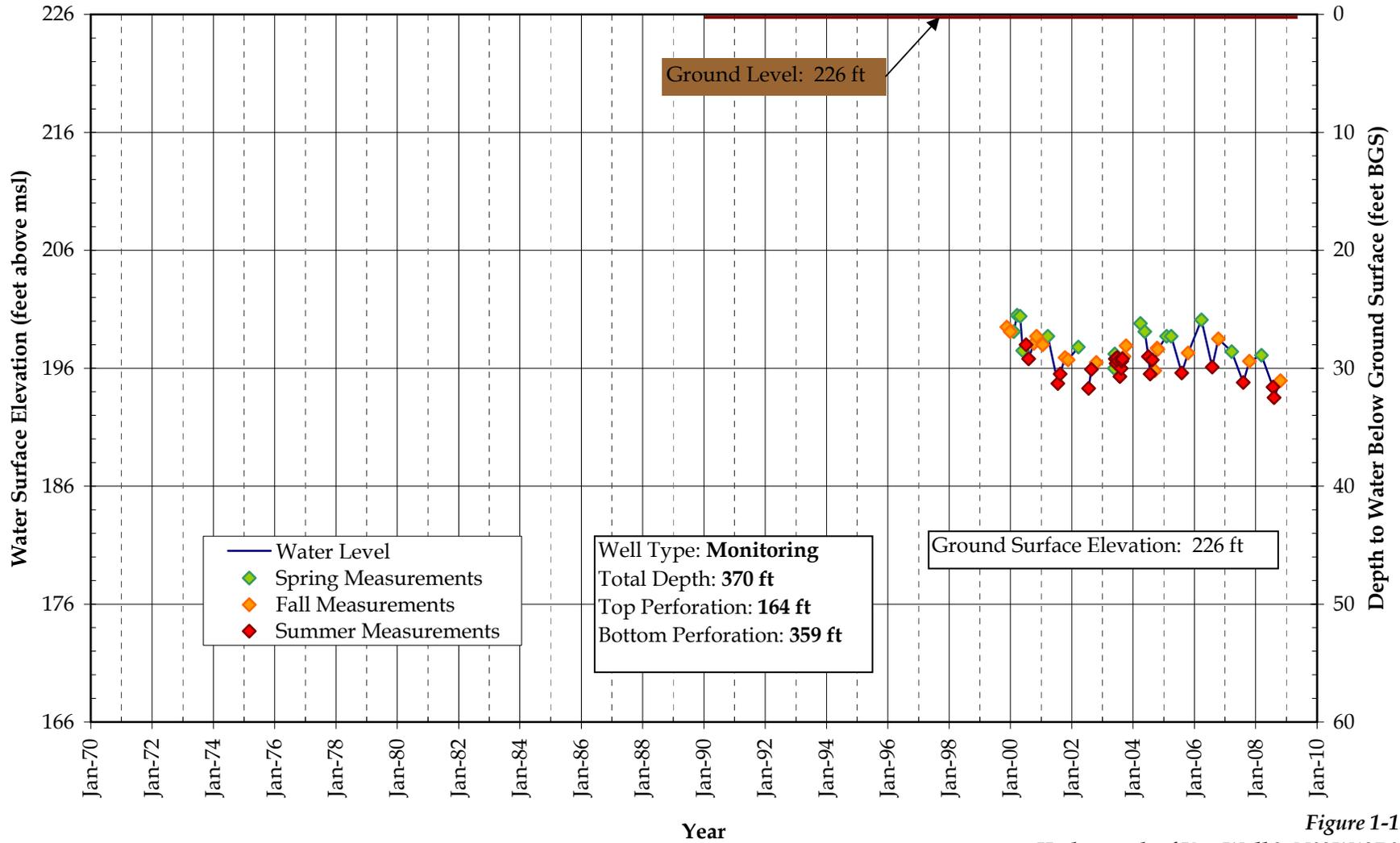


Figure 1-13
Hydrograph of Key Well 24N02W12P01

Vina Area Key Well 24N02W12P01 (Near Vina Road) Spring Level Hydrograph

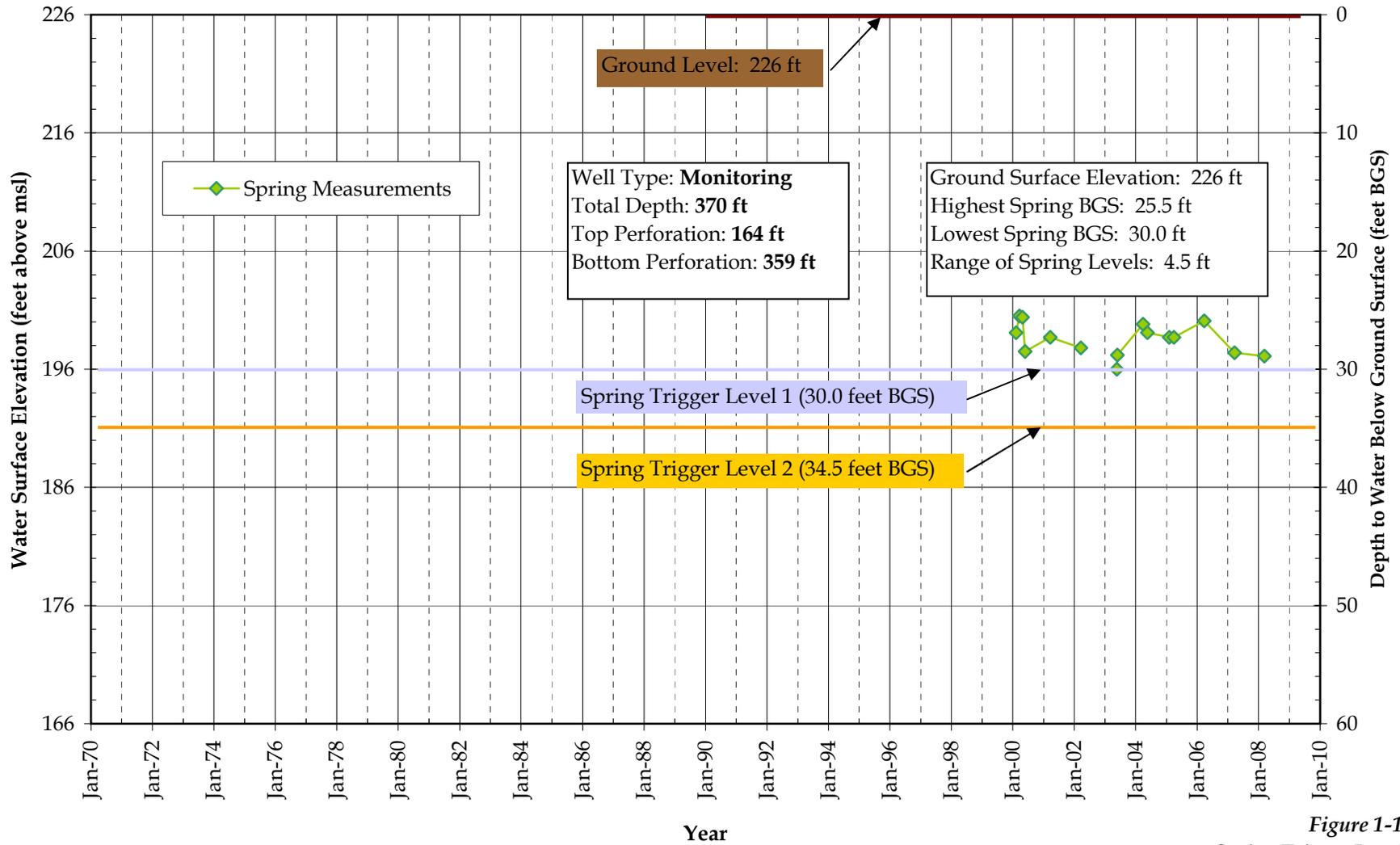
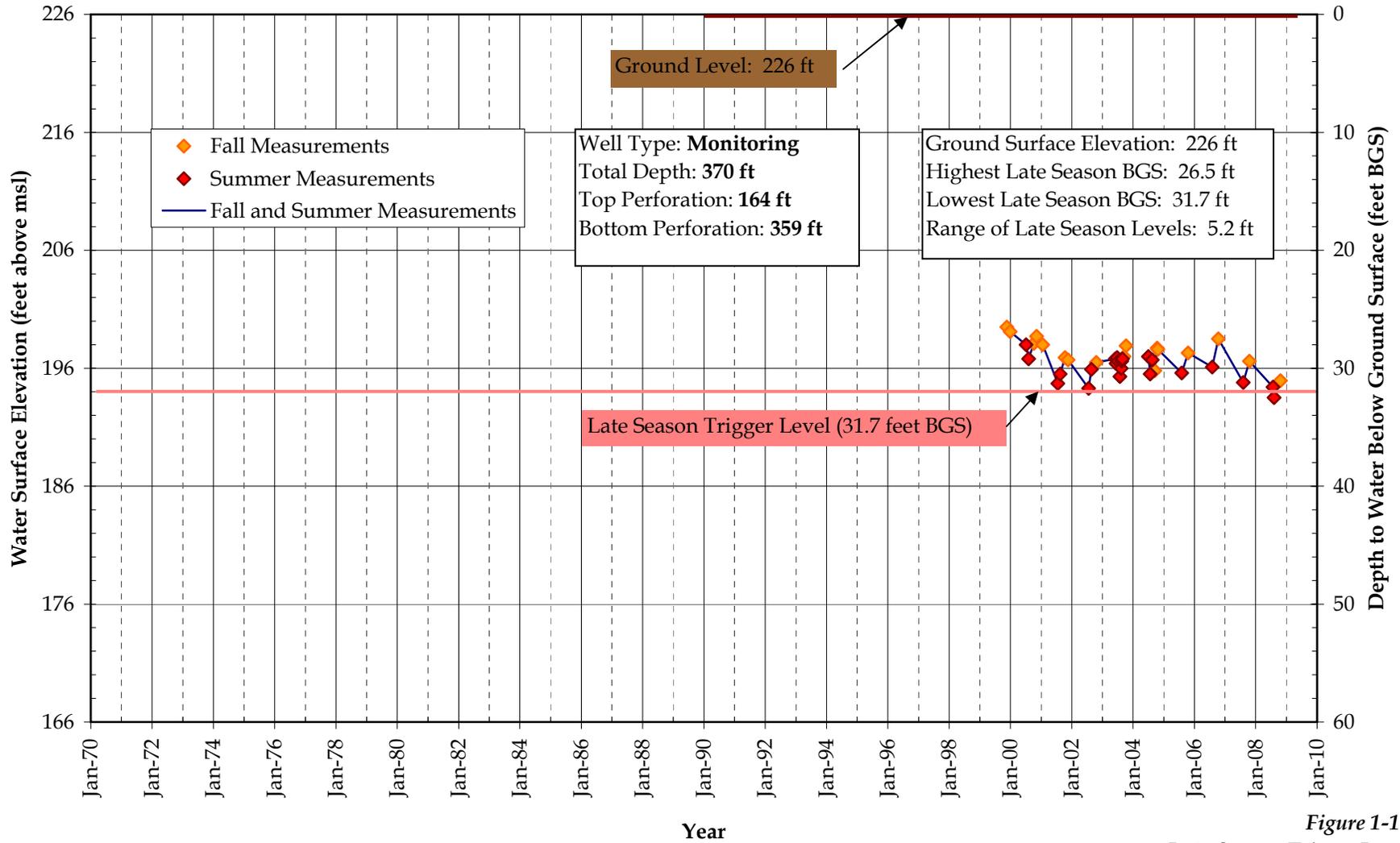


Figure 1-14
Spring Trigger Levels

**Vina Area Key Well 24N02W12P01 (Near Vina Road)
Late Season (July, August, September, and October) Hydrograph**



*Figure 1-15
Late Season Trigger Level*

Vina Area Key Well 24N02W23G01 (Vadney Ave and Rowles Road)
Hydrograph over the 1970 - 2007 Period

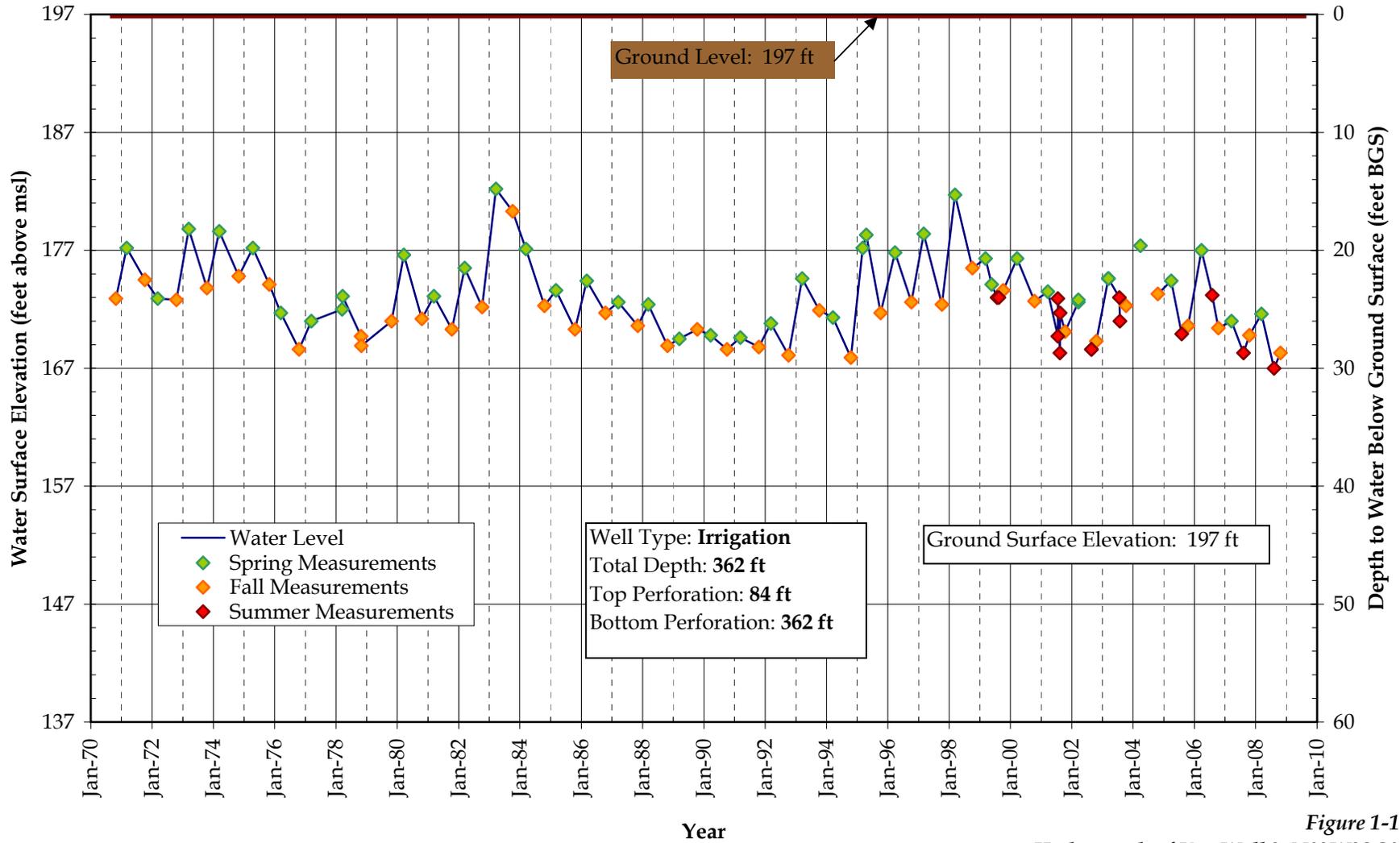


Figure 1-16
Hydrograph of Key Well 24N02W23G01

Vina Area Key Well 24N02W23G01 (Vadney Ave and Rowles Road) Spring Level Hydrograph

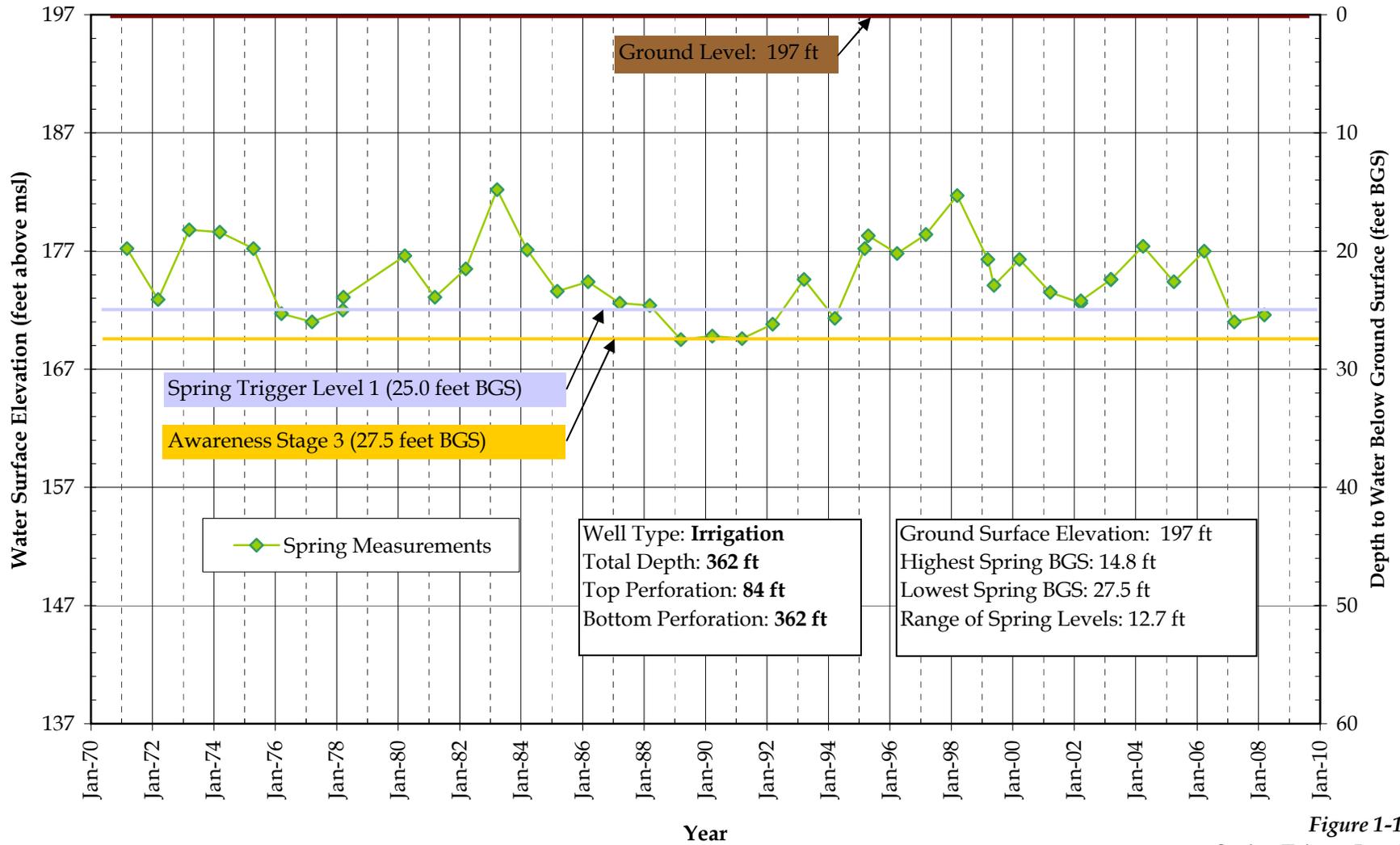


Figure 1-17
Spring Trigger Levels

Vina Area Key Well 24N02W23G01 (Vadney Ave and Rowles Road)
Late Season (July, August, September, and October) Hydrograph

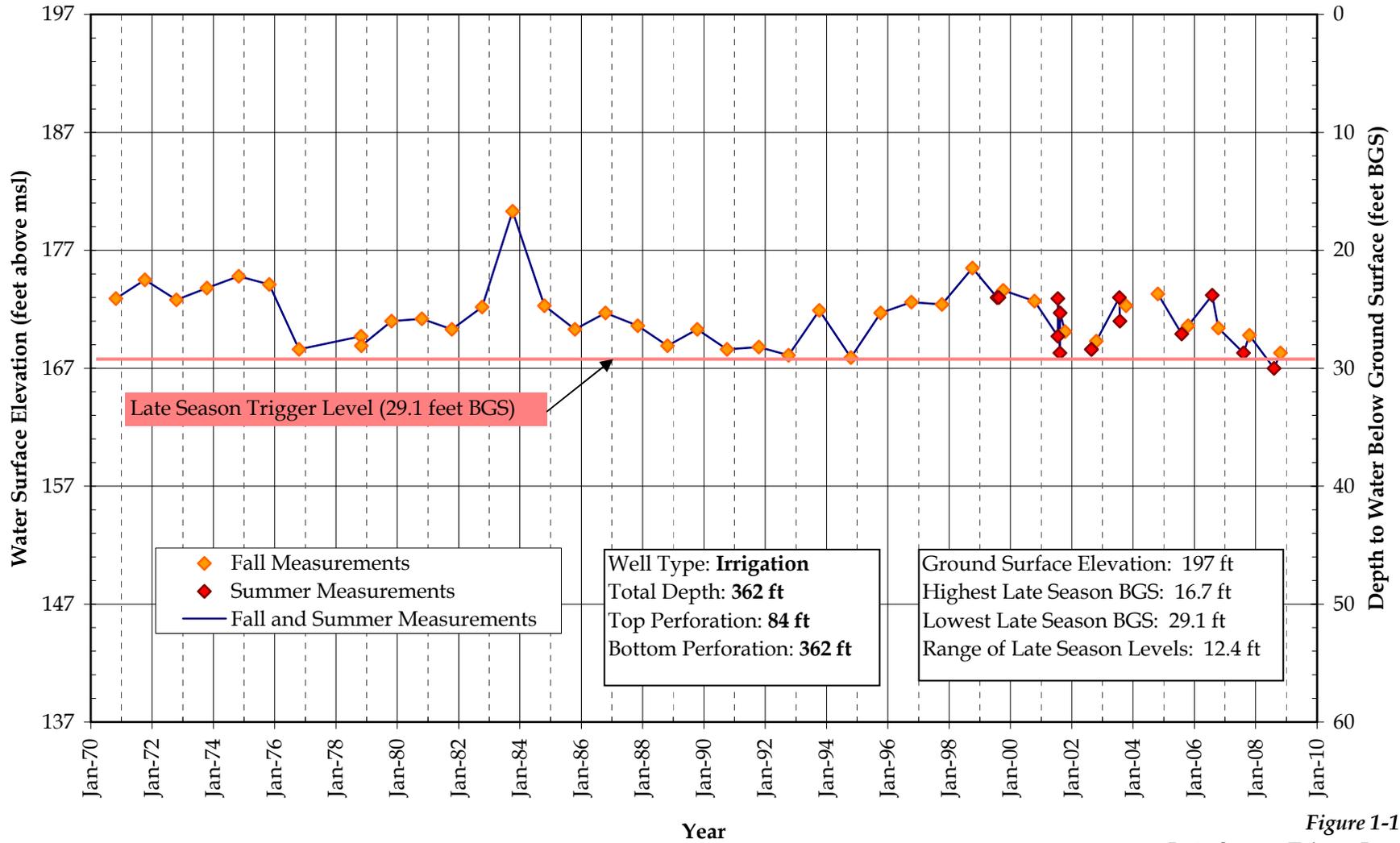


Figure 1-18
Late Season Trigger Level

Vina Area Key Well 24N02W25G01 (South Ave and Stephens Road) Hydrograph over the 1970 - 2007 Period

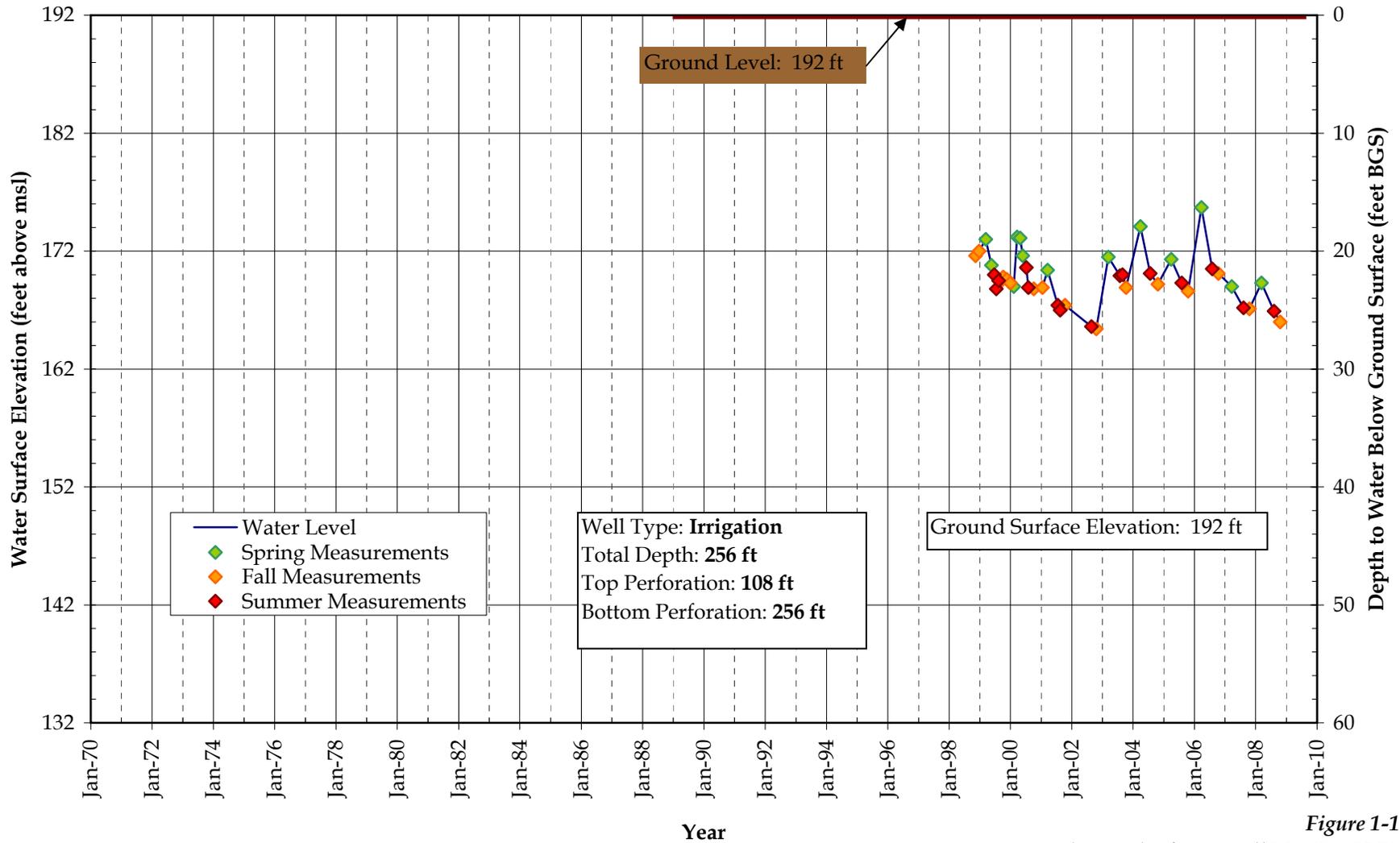
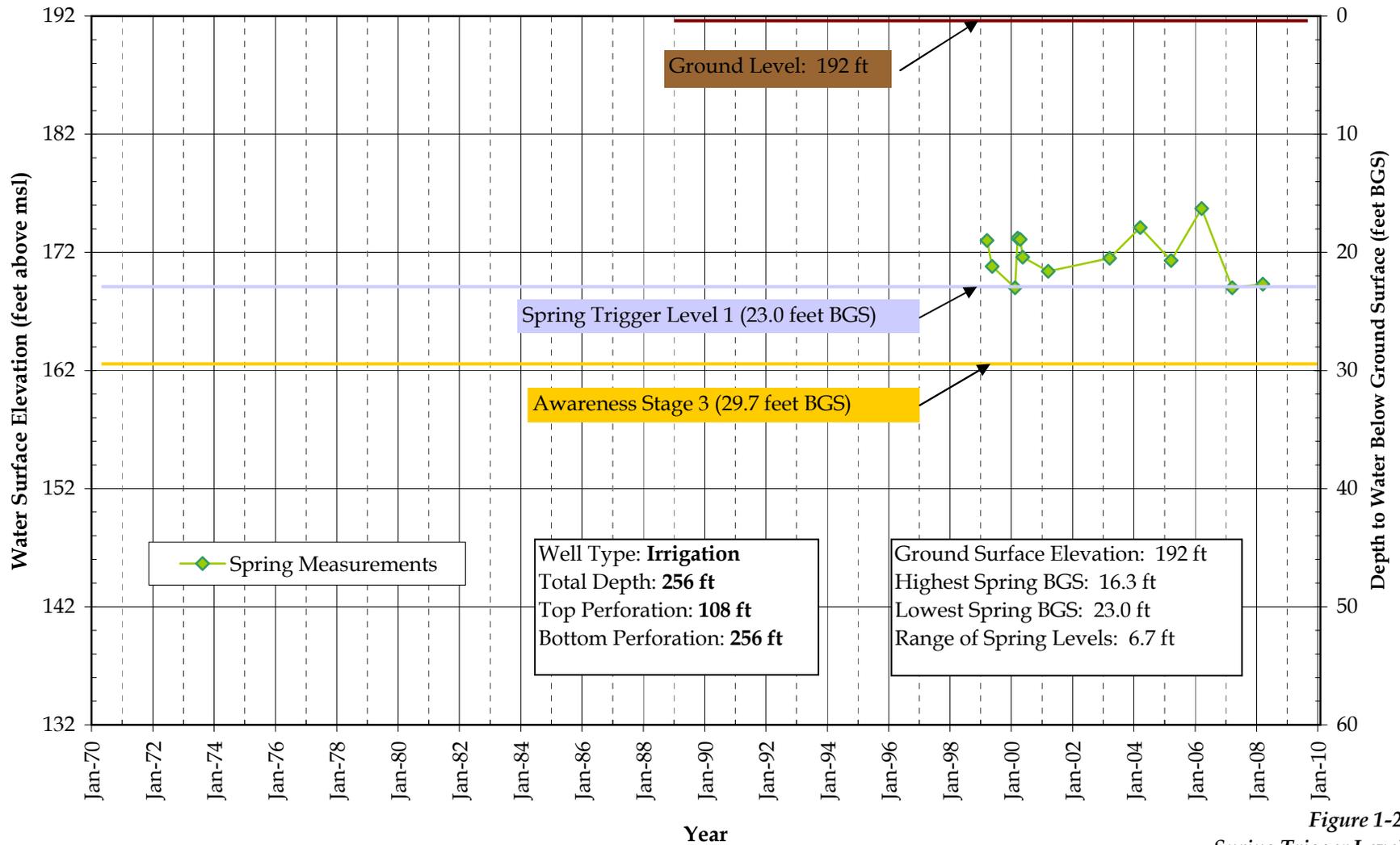


Figure 1-19
Hydrograph of Key Well 24N02W25G01

Vina Area Key Well 24N02W25G01 (South Ave and Stephens Road) Spring Level Hydrograph



*Figure 1-20
Spring Trigger Levels*

Vina Area Key Well 24N02W25G01 (South Ave and Stephens Road)
Late Season (July, August, September, and October) Hydrograph

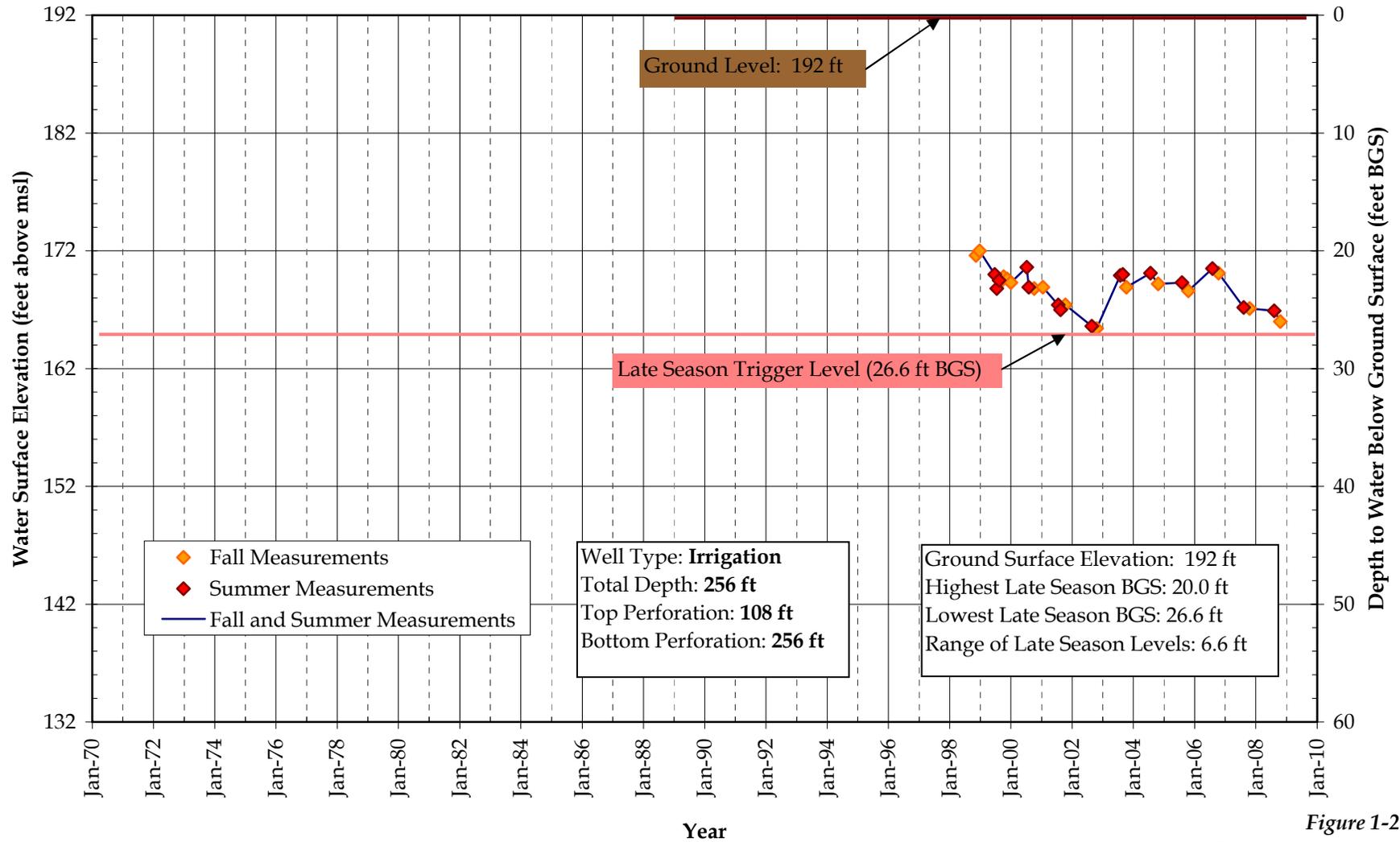


Figure 1-21
Late Season Trigger Level