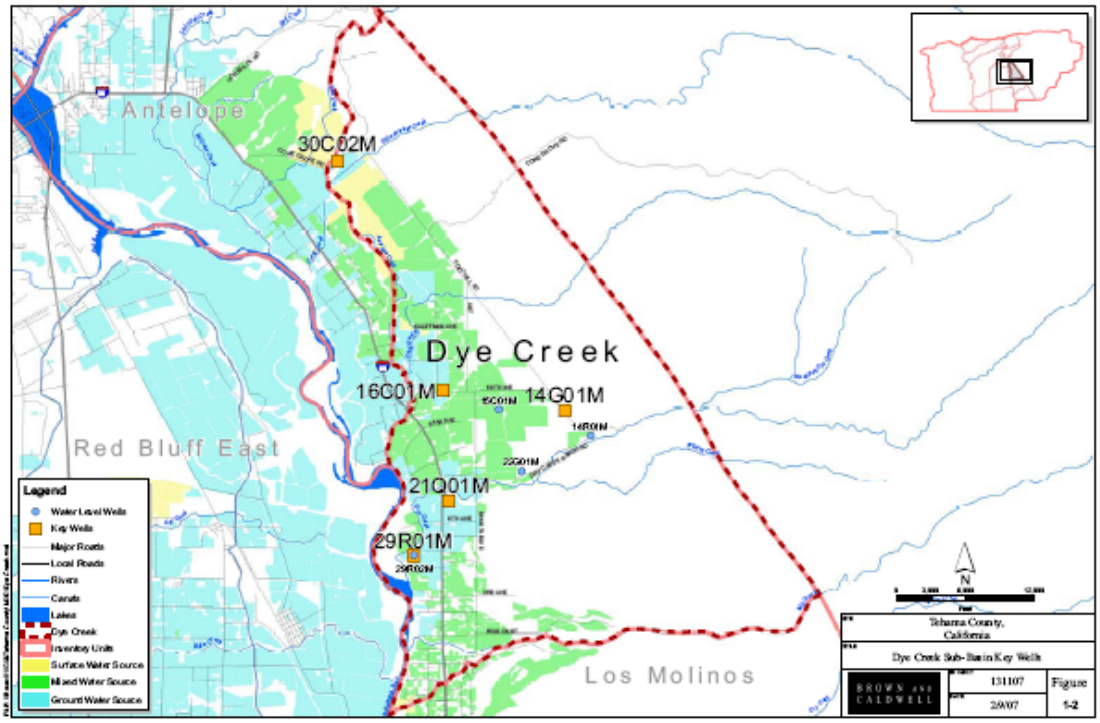
Tehama County AB-3030 Groundwater Management Plan

Technical Memorandum

For the Dye Creek Sub-basin of Tehama County



Draft for Public Review and Comment

Proposed Groundwater Trigger Levels and Awareness Actions

July 1, 2008

Tehama County Flood Control and Water Conservation District
9380 San Benito Avenue
Gerber, CA 96035-9701

(530)-385-1462

BROWN AND CALDWELL

10540 White Rock Road, Suite 180
Rancho Cordova, CA 95670

Technical Memorandum

DRAFT

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 Dye Creek 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.

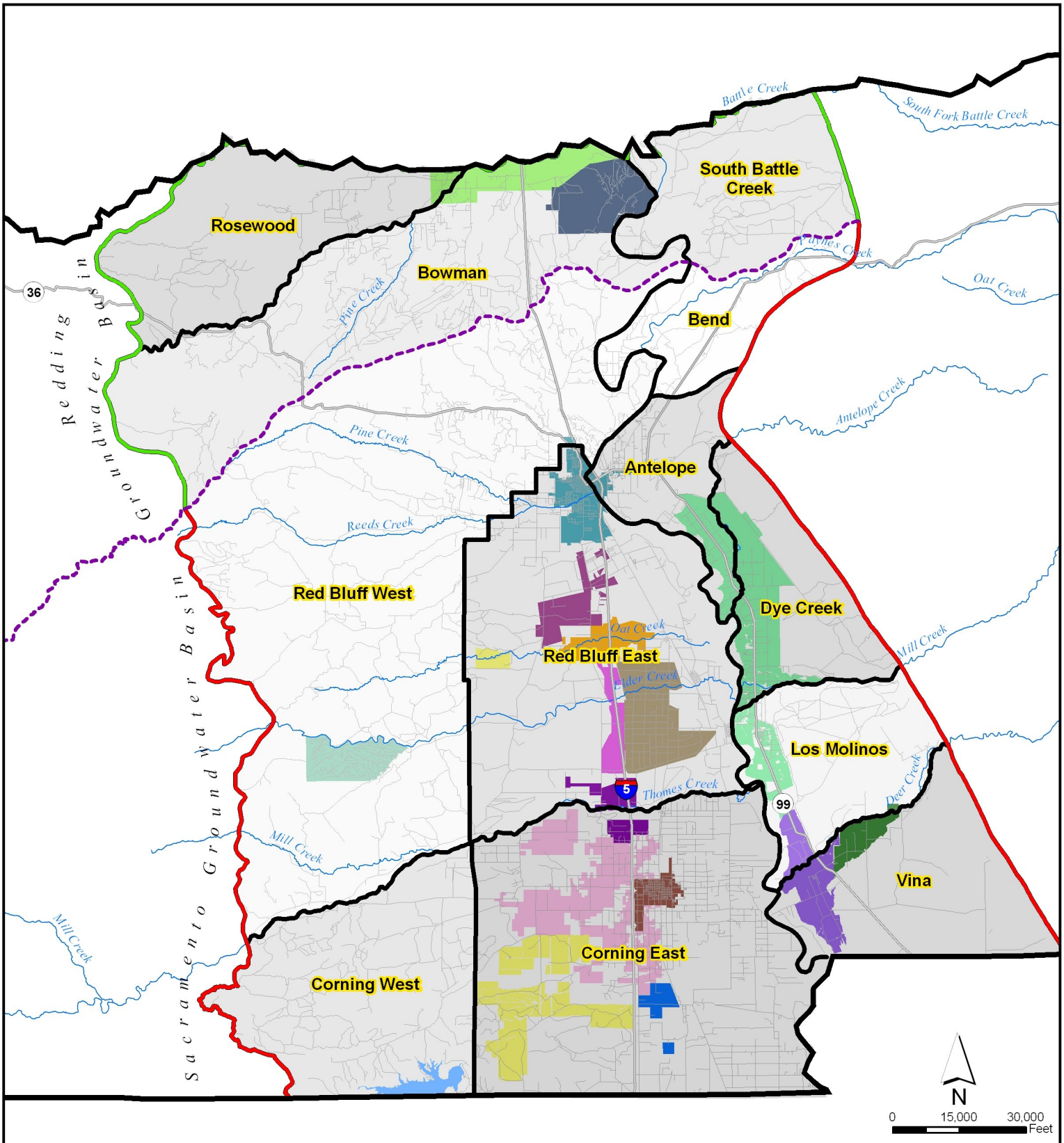
This Plan has provided guidance related to groundwater activities since adoption. Landowners and water purveyors alike recognize the need to move forward with groundwater resource protection by developing measures (trigger levels) that determine the level of active management needed within each sub-basin. 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 Dye Creek 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 Dye Creek 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
- Anderson-Cottonwood
- City of Corning
- City of Red Bluff
- Corning WD
- Deer Creek
- El Camino ID
- Elder Creek ID
- Kirkwood ID
- LMMWC
- Proberta ID
- Rancho Tehama
- Rawson ID
- Rio Alto WD
- Stanford Vina
- Thomes Creek ID

Legend

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

BROWN AND CALDWELL

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

FILE: \\Bcsac01\GIS\Tehama County\MXD\Ground Water Sub-Basins.mxd

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 Dye Creek sub-basin is primarily a rural area, with agriculture throughout 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:

Groundwater Use in Dye Creek:	
Irrigation:	78% (4,500 acre-ft)
Municipal, and Industrial:	22% (1,300 acre-ft)
Number of wells by type in Dye Creek:	
Irrigation:	50 wells
Domestic:	314 wells
Municipal and Industrial:	2 wells

- 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.

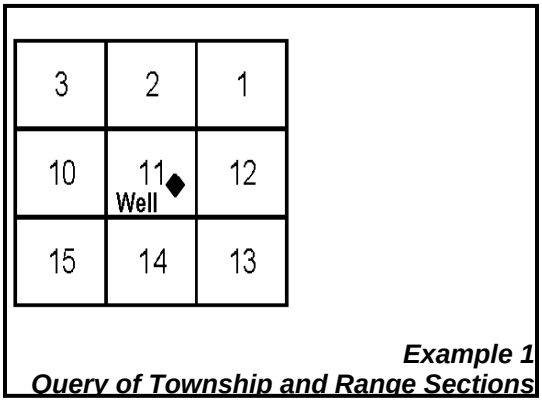
Step 2: Select one or more key wells within the sub-basin

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:



Example 1
Query of Township and Range Sections

- **26N02W14G01M (14G01M) –** This monitoring well is in the eastern portion of the sub-basin and is 152 feet deep and has an unknown screened interval. This well is situated uphill from pasture irrigated with both surface and groundwater. This well has a period of record of 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 13 domestic wells with an average depth of 115 feet below ground surface (bgs), and 3 irrigation wells with an average depth of 343 feet bgs.
- **27N02W30C02M (30C02M) –** This monitoring well is in the northern portion of the sub-basin and is 296 feet deep with a screened interval from 133 to 296 feet bgs. This well is situated near orchards irrigated with groundwater and areas irrigated with surface water. This well has a period of record of 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 105 domestic wells with an average depth of 87 feet bgs, and 26 irrigation wells with an average depth of 217 feet bgs.
- **26N02W16C01M (16C01M) –** This monitoring well is in the west central portion of the sub-basin and is 50 feet deep and has an unknown screened interval.. This well is situated near pasture irrigated with both surface water and groundwater, and orchards irrigated with groundwater. This well has a period of record of more than 26 years, which provides information on water levels during the drought of the late 1980s and early 1990s. The nine square miles near this well contain 119 domestic wells with an average depth of 87 feet bgs, and 46 irrigation wells with an average depth of 139 feet bgs.
- **26N02W21Q01M (21Q01M)–** This monitoring well is in the southeast portion of the sub-basin and is 55 feet deep with a screened interval from 48 to 55 feet bgs. This well is situated near orchards irrigated with groundwater. This well has a period of record of 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 95 domestic wells with an average depth of 92 feet bgs, and 42 irrigation wells with an average depth of 125 feet bgs.
- **26N02W29R02M (29R02M)–** This monitoring well is in the southeast portion of the sub-basin and is 840 feet deep with an unknown screened interval. This well is situated near orchards

Antelope

Red Bluff East

Los Molinos

Dye Creek

30C02M

16C01M

14G01M

15C01M

14R01M

22G01M

21O01M

29R02M

29R01M

HOGSBACK RD

CONE GROVE RD

FOOTHILL RD

KAUFFMAN AVE

68TH AVE

66TH AVE

8TH AVE

3RD AVE

WILSON ST

DRY CREEK RANCH RD

SHASTA BLVD

A ST

Little Antelope Creek

North Fork Dye Creek

Wildcat Creek

Mill Creek

Dry Creek

Elder Creek

Oat Creek

Red Bank Creek

Craig Creek

Long Gulch

Millrace Creek

Little Salt Creek

Salt Creek

Dibble Creek

Antelope Creek

36

99

Legend

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

N

0 3,000 6,000 12,000

Feet

SITE	Tehama County, California
TITLE	Dye Creek Sub-Basin Key Wells
BROWN AND CALDWELL	PROJECT 131107
	DATE 2/9/07
	Figure 1-2

FILE: \\Bcsac01\GIS\Tehama County\MXD\Figure 1-2 Dye Creek.mxd

irrigated with groundwater. This well has a period of record of 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 171 domestic wells with an average depth of 94 feet bgs, and 33 irrigation wells with an average depth of 143 feet bgs.

There are currently no monitoring wells in the southeastern corner of the Dye Creek 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.

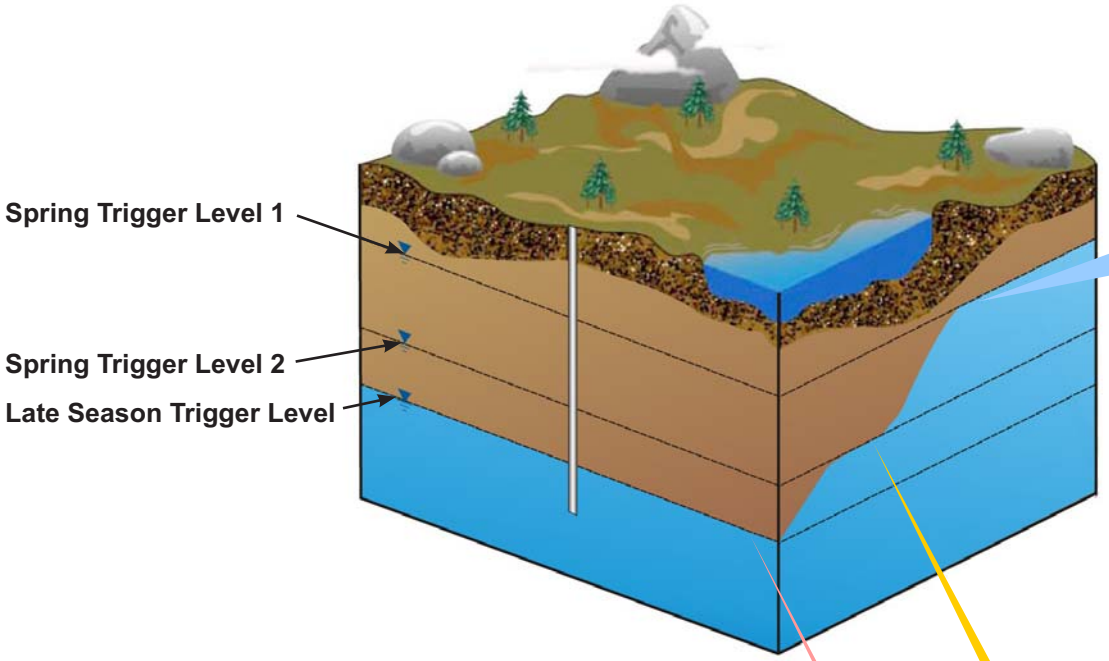
The District suggests that spring measurements be used to set trigger levels with associated awareness actions, and late season measurements (summer and fall) be used to set an additional trigger level with associated awareness actions that is sensitive to groundwater levels during the seasons of heavy 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 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



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 a 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

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 1-18 present hydrographs and suggested trigger levels for each of the five Dye Creek 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 Dye Creek sub-basin are provided in Table 1-1.

Table 1-1. Trigger Level Methodology

Groundwater Trigger Level and Awareness Action	Dye Creek Monitoring Well Number				
	14G01M	30C02M	16C01M	21Q01M	29R02M
Spring Trigger Level 1 – Notify and Inform Public	Historical low of spring measurements plus 20 % of the range of spring measurements				
Monitor and investigate Cause	Second consecutive year of groundwater levels at or below Spring Trigger Level 1				
Spring Trigger Level 2 – Consider Management Options	Historical low of spring measurements				
Late Season Trigger Level – Notify public and begin investigations	Historical low of late season groundwater measurements				
Data Anomalies	None	None	None	None	None

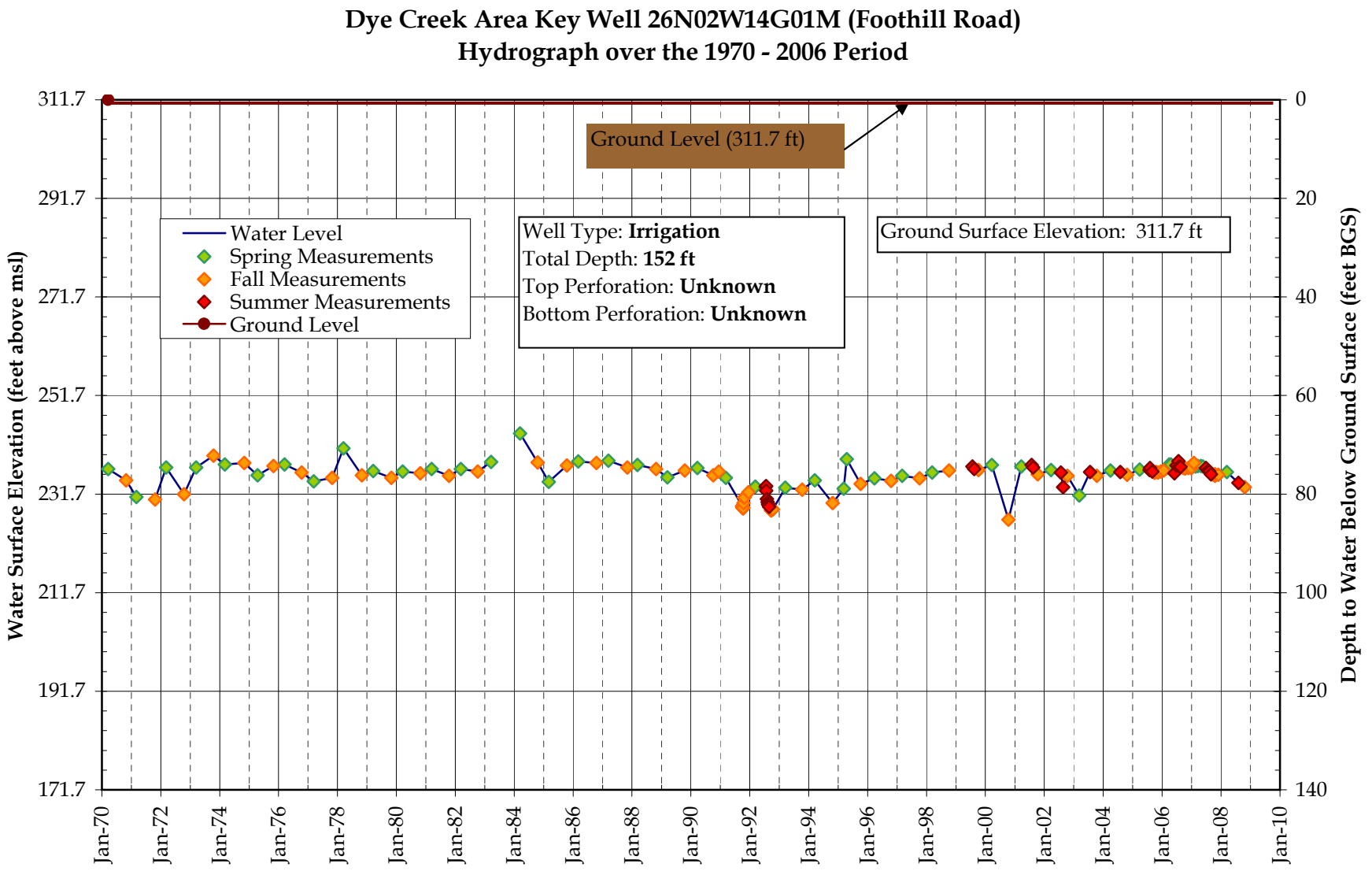


Figure 1-4
Hydrograph of Key Well 26N02W14G01M

Updated 12-01-08

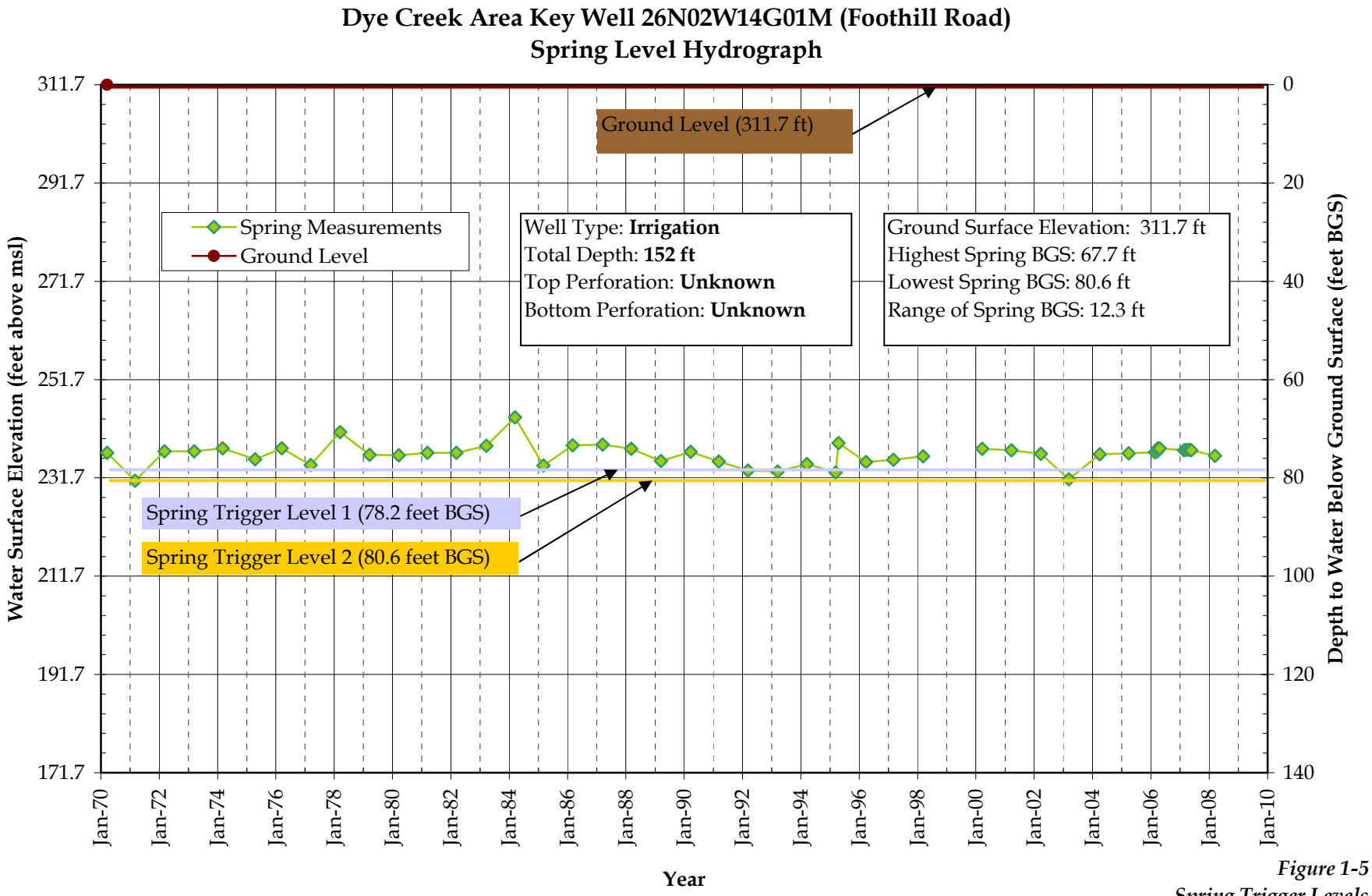


Figure 1-5
Spring Trigger Levels

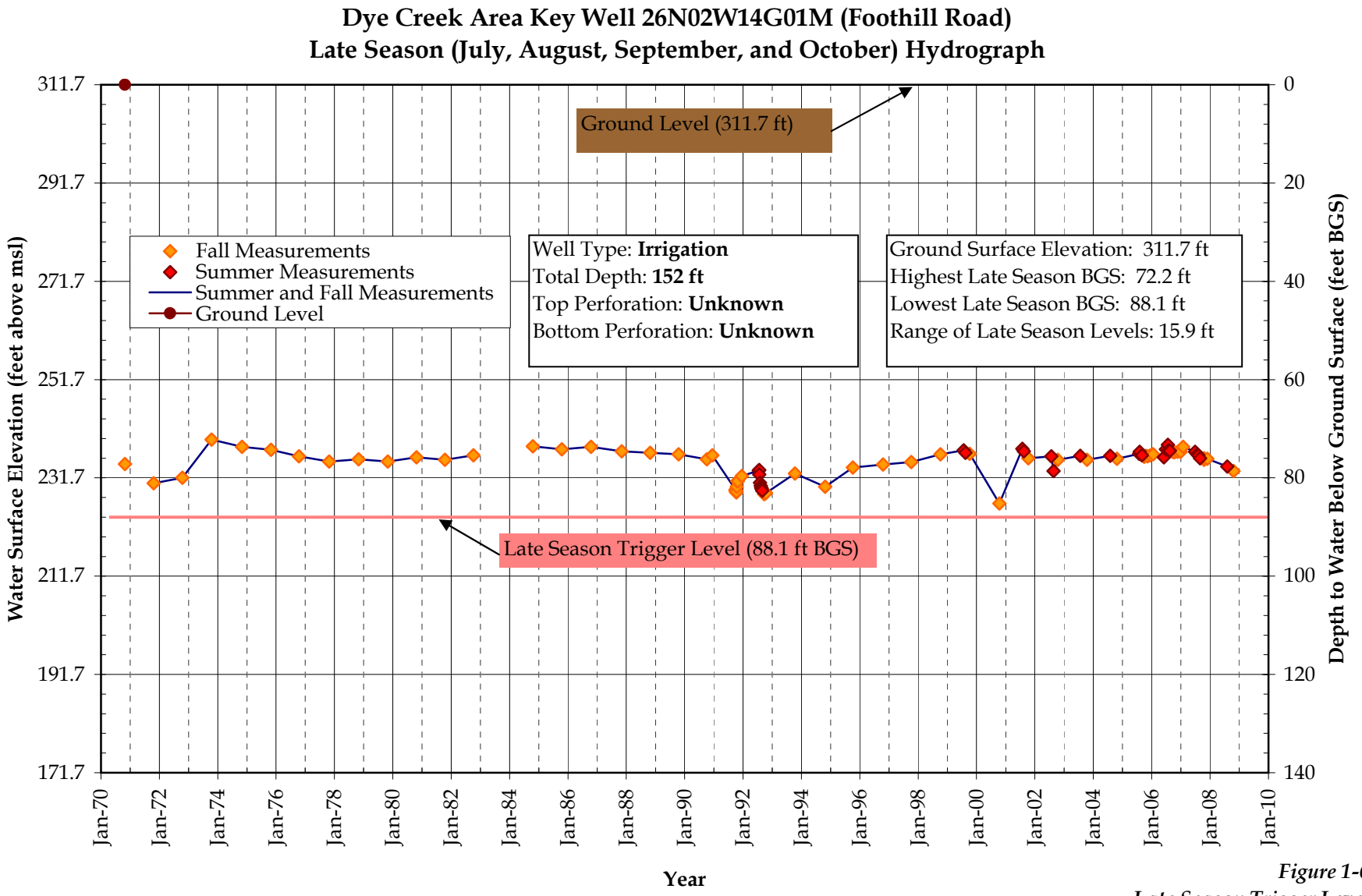


Figure 1-6
Late Season Trigger Level

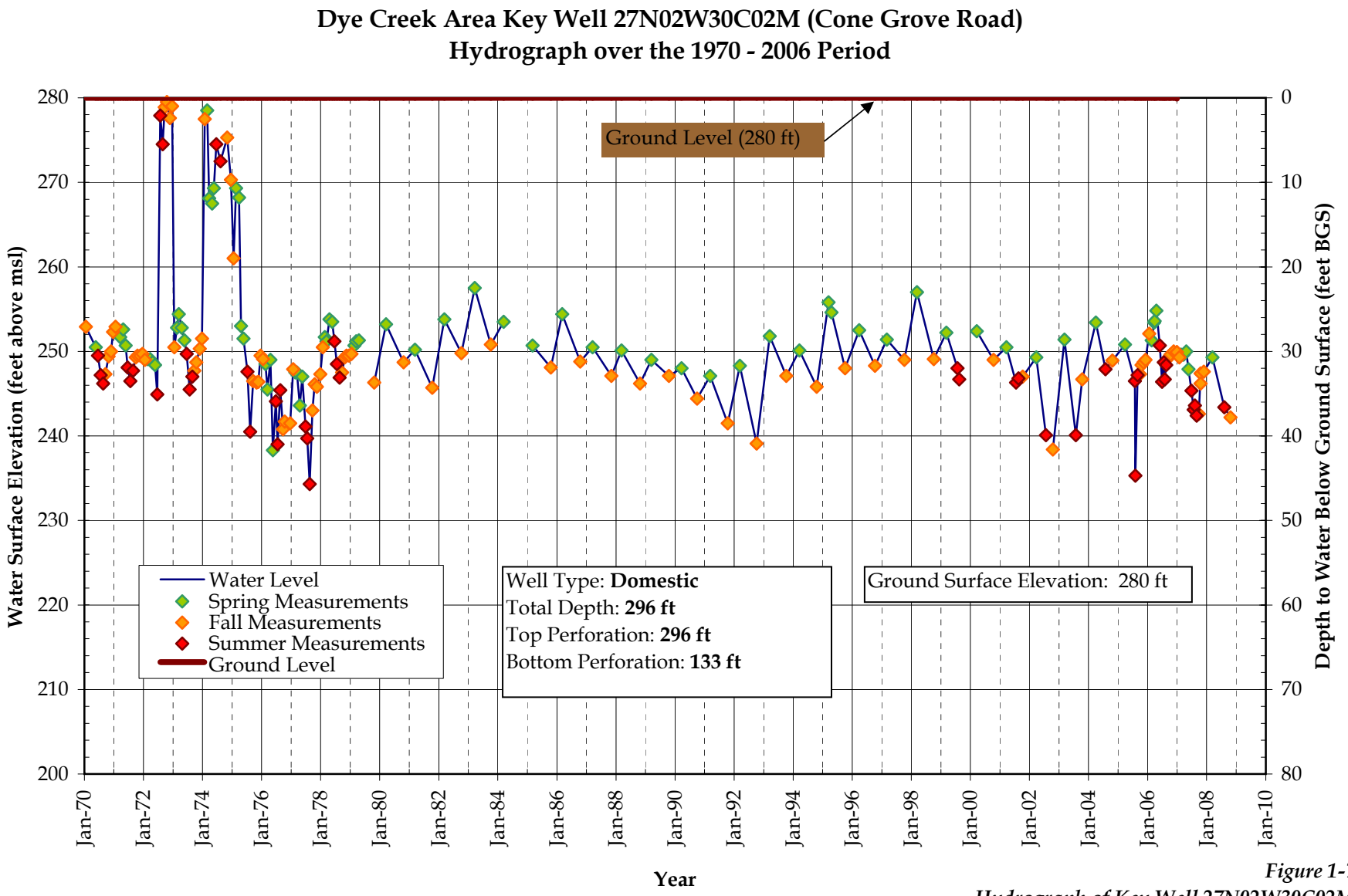


Figure 1-7
Hydrograph of Key Well 27N02W30C02M

Updated 12-01-08

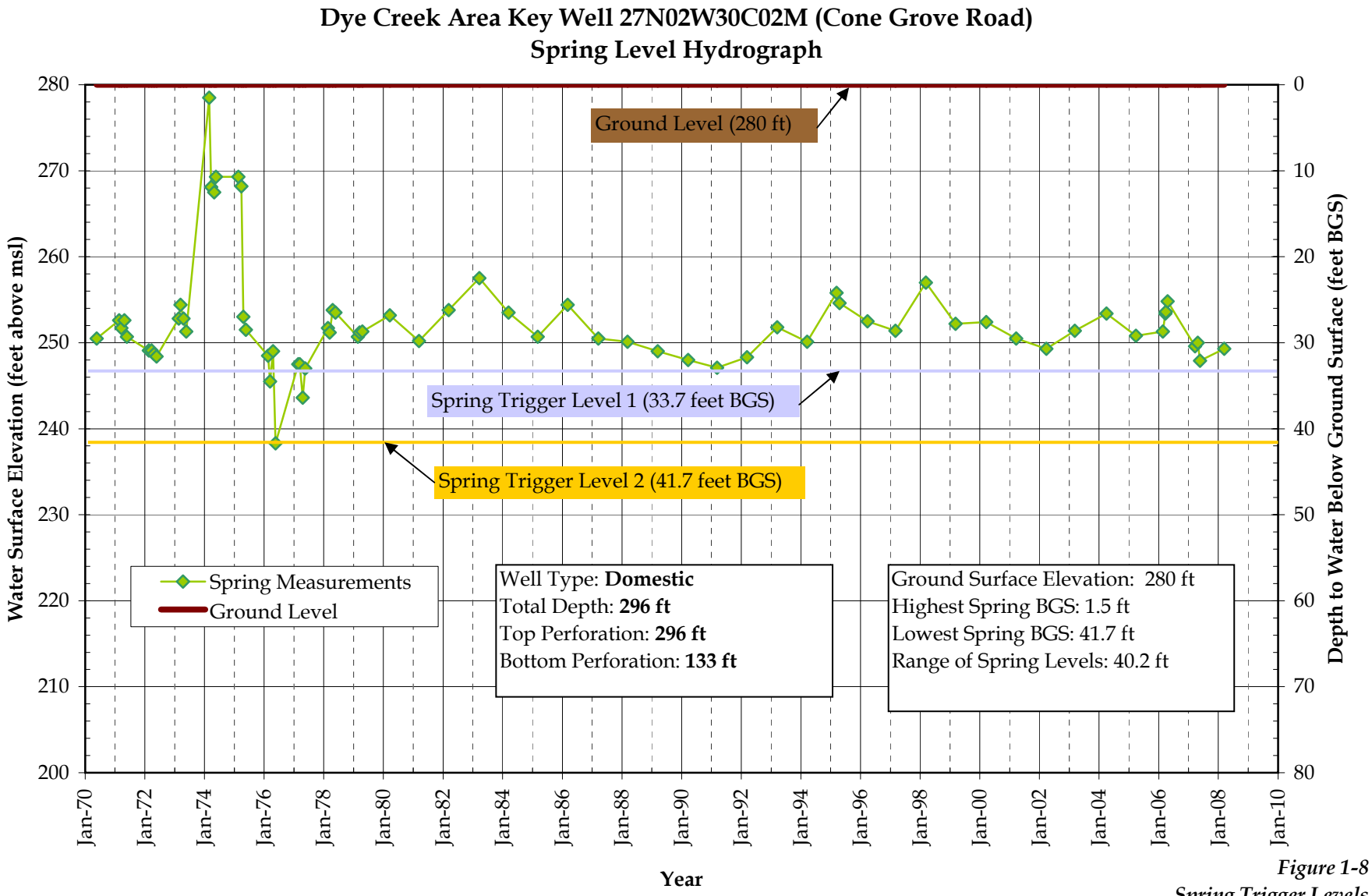


Figure 1-8
Spring Trigger Levels

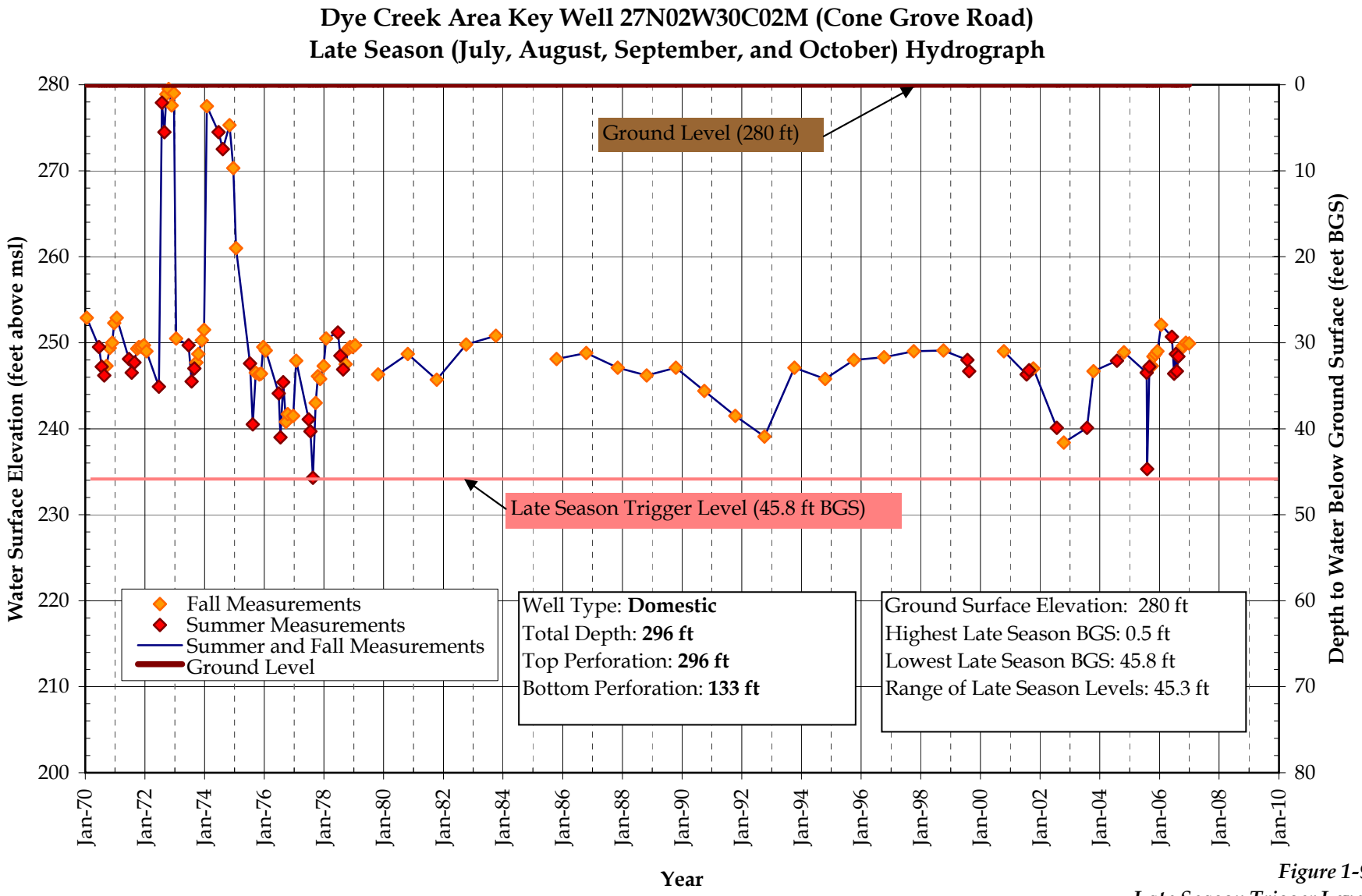


Figure 1-9
Late Season Trigger Level

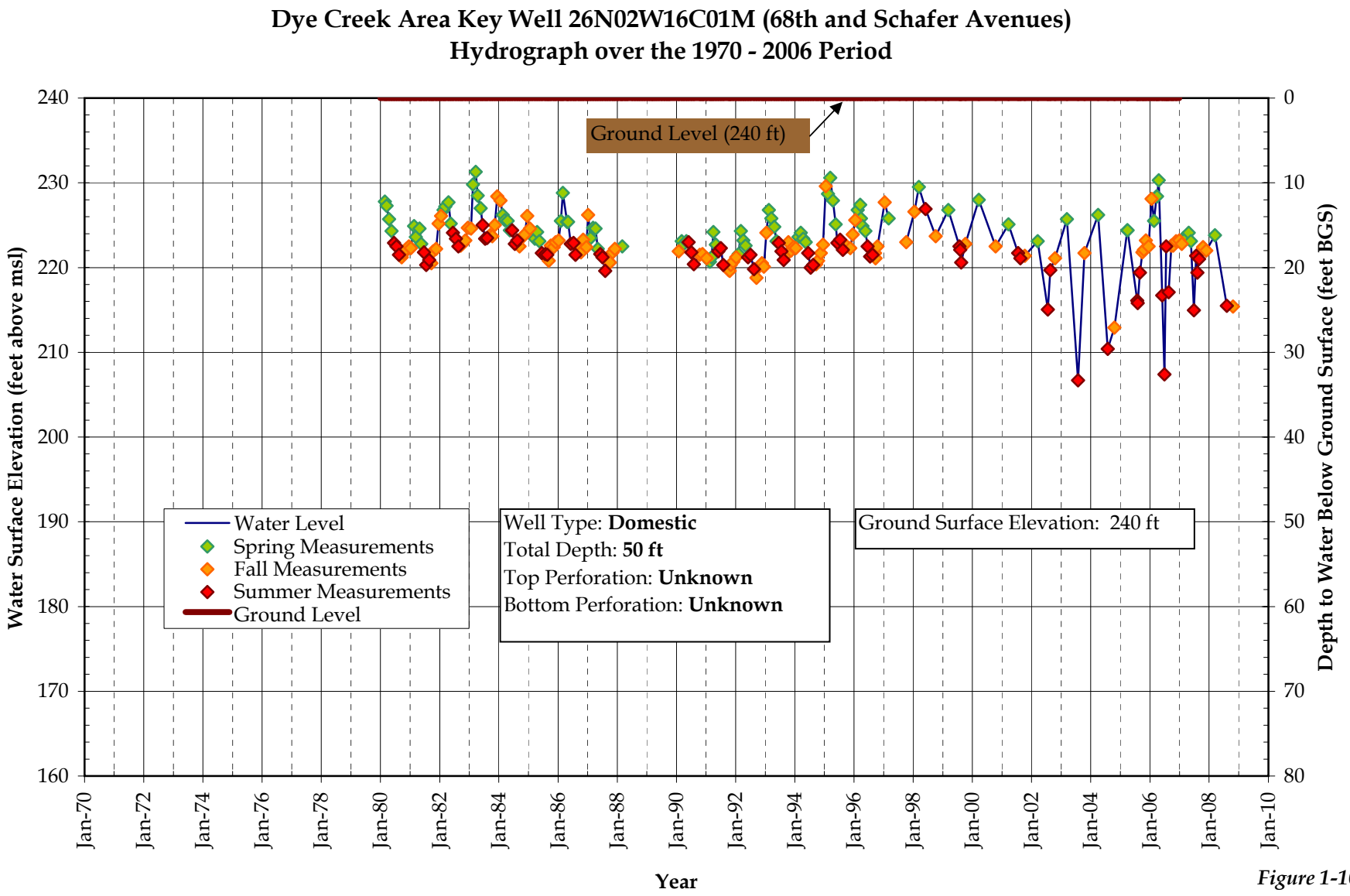


Figure 1-10
Hydrograph of Key Well 26N02W16C01M

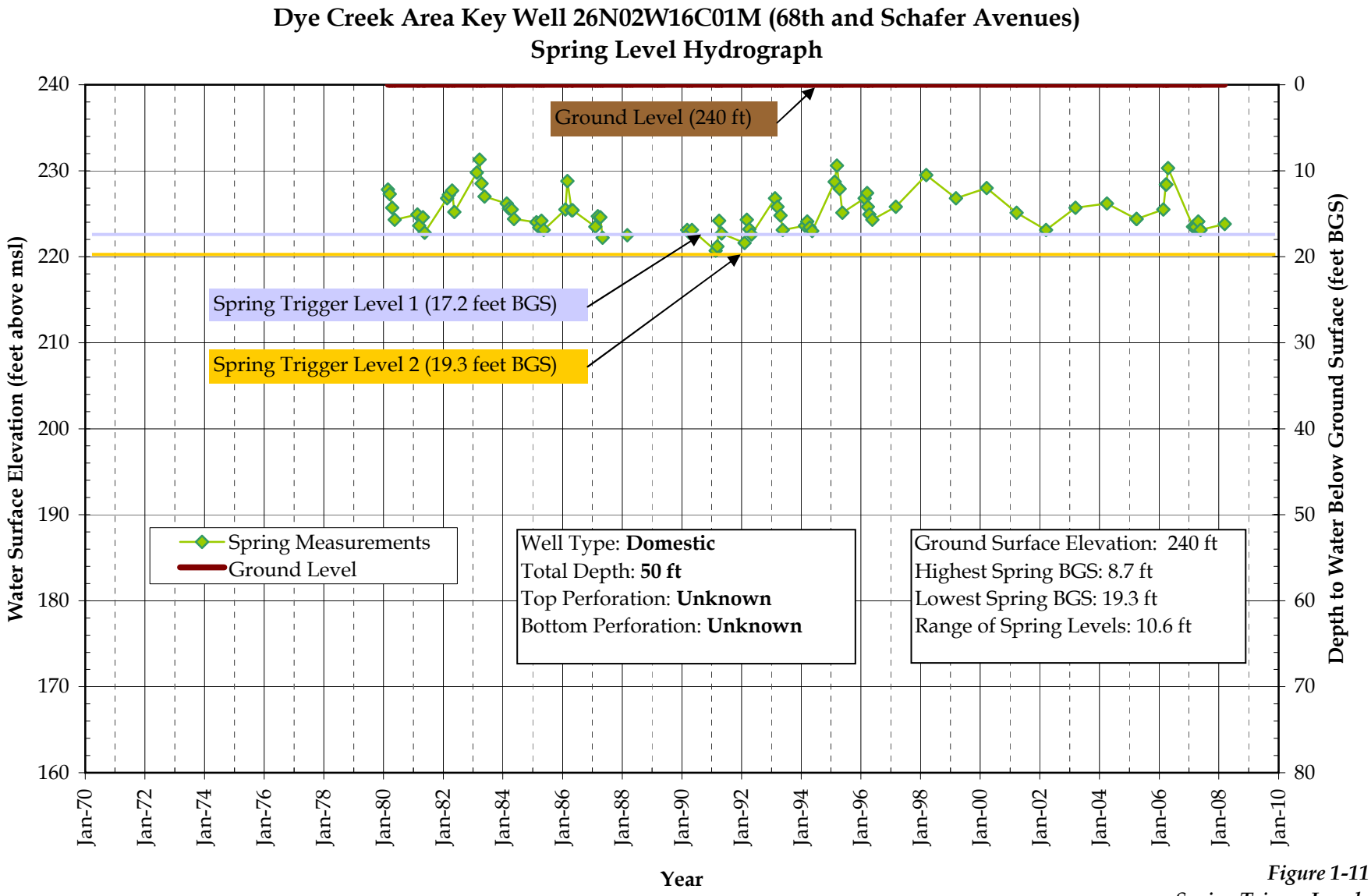


Figure 1-11
Spring Trigger Levels

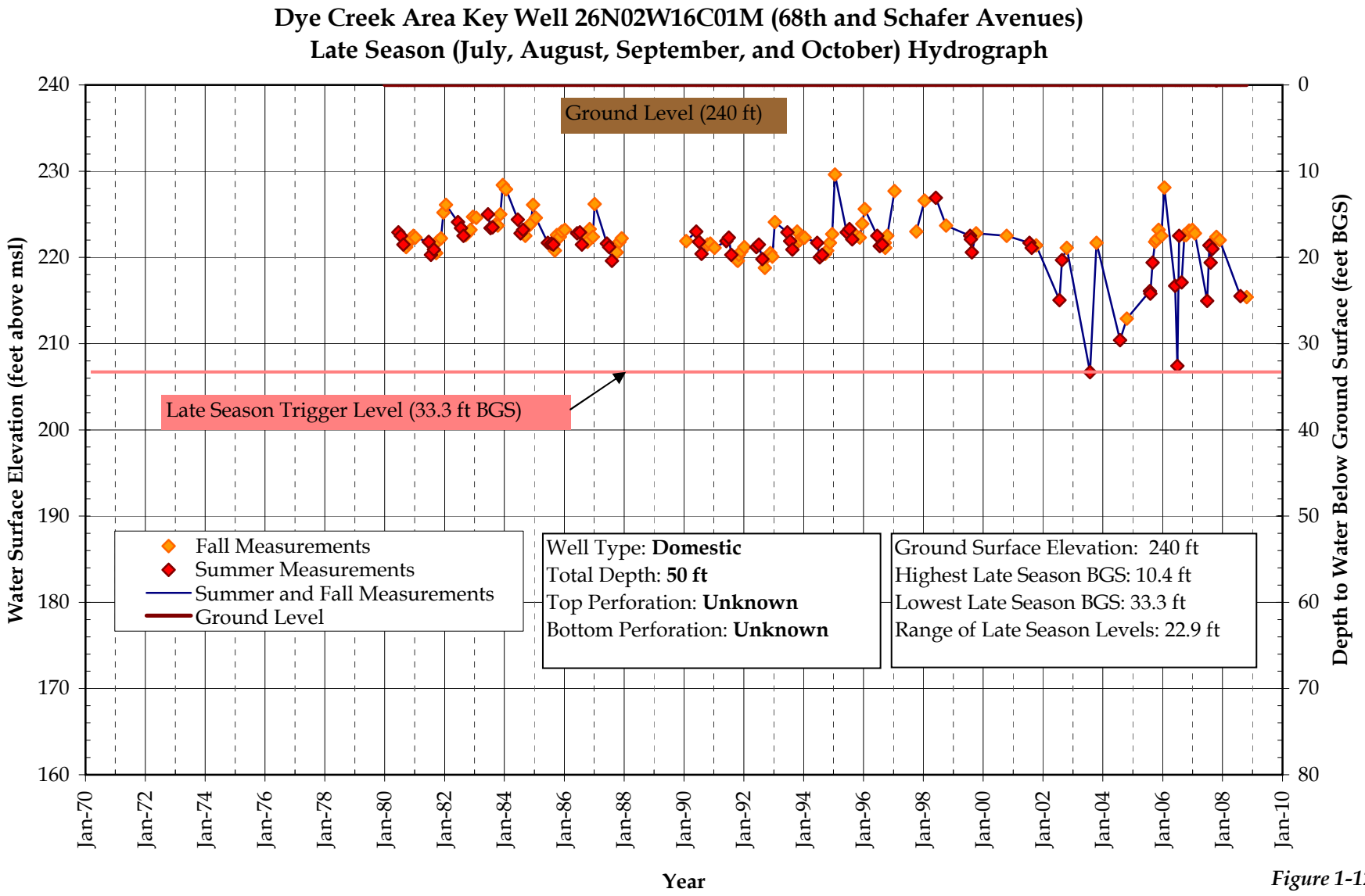


Figure 1-12
Late Season Trigger Level

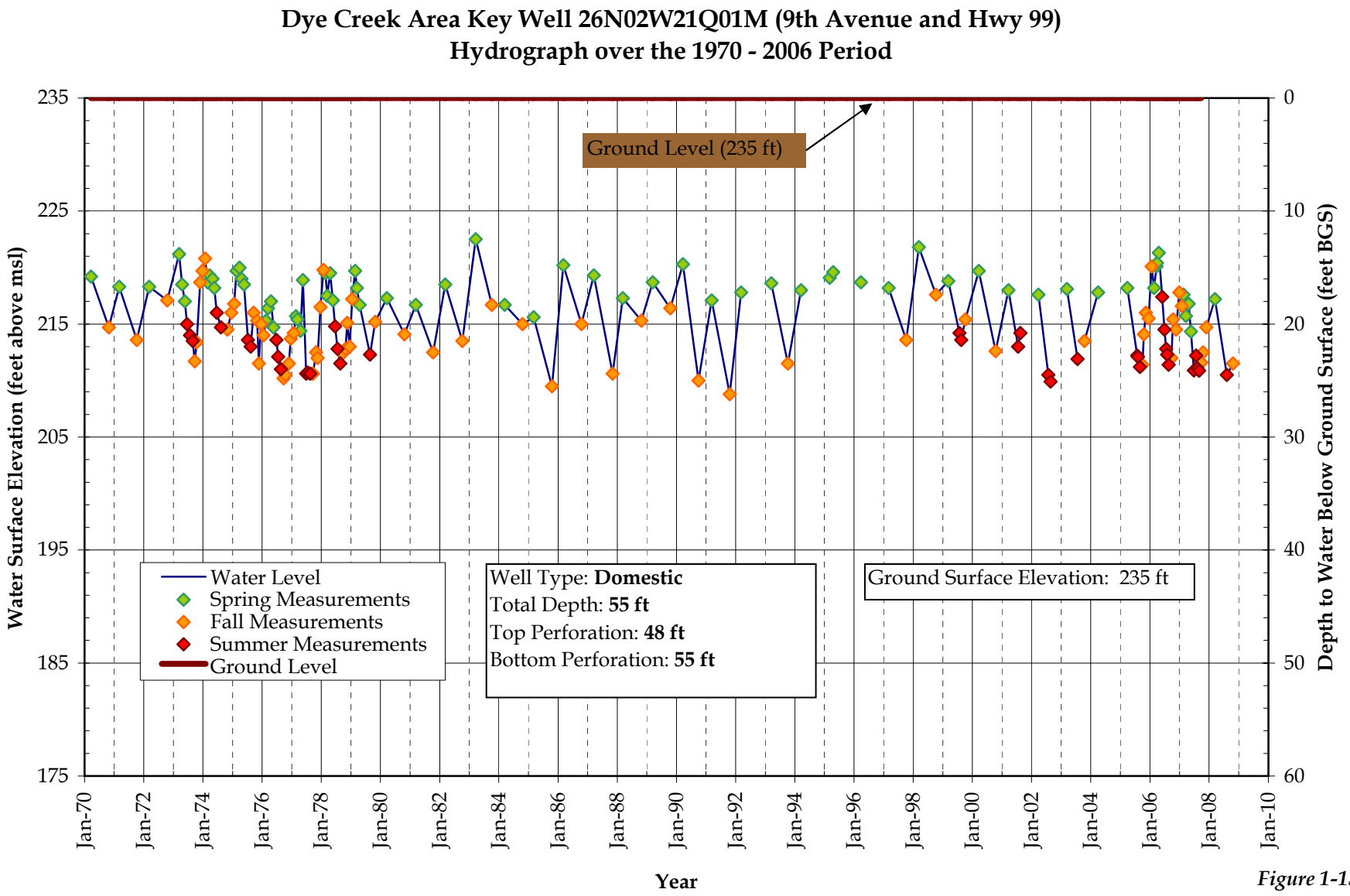


Figure 1-13
Hydrograph of Key Well 26N02W21Q01M

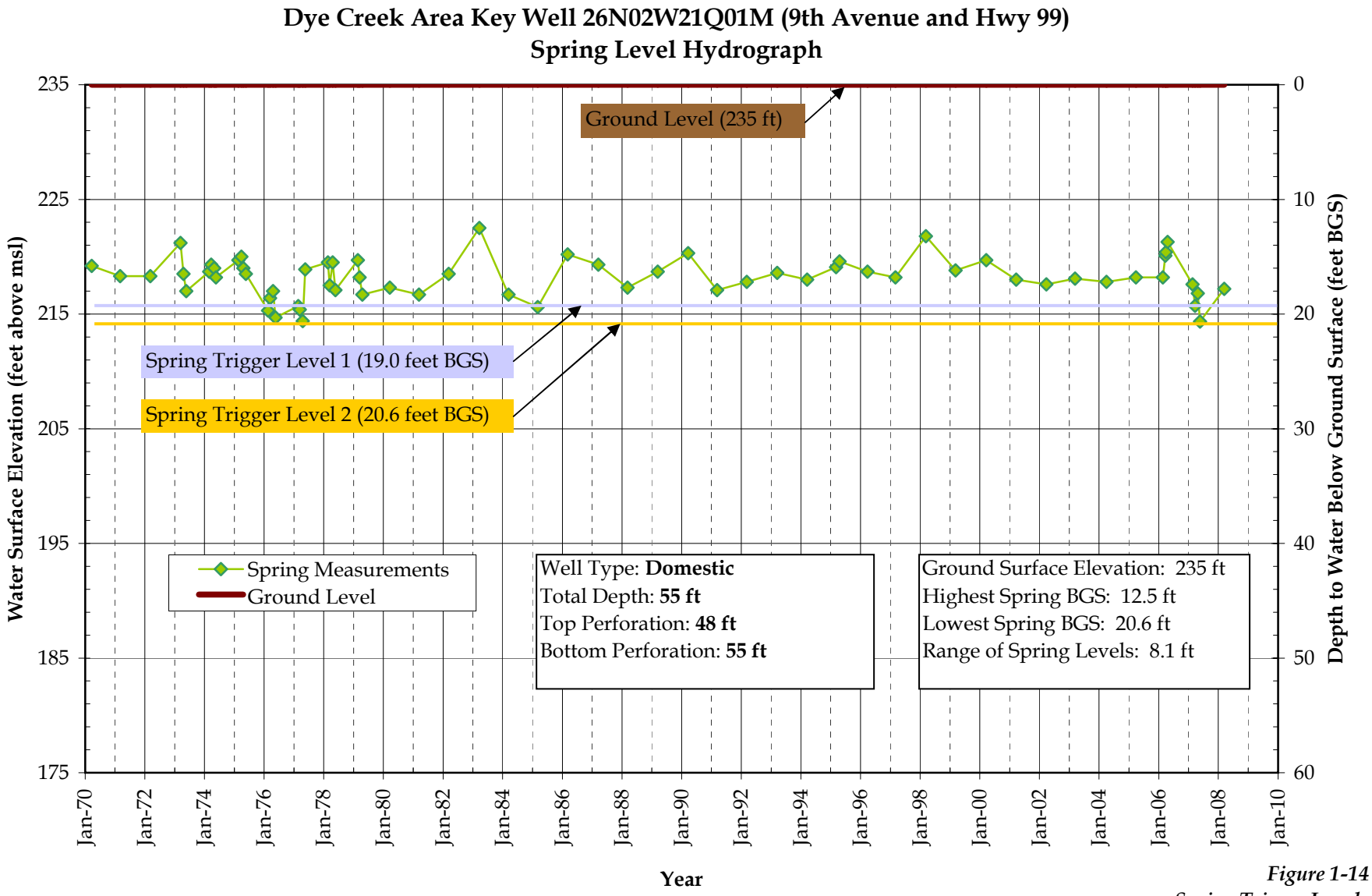


Figure 1-14
Spring Trigger Levels

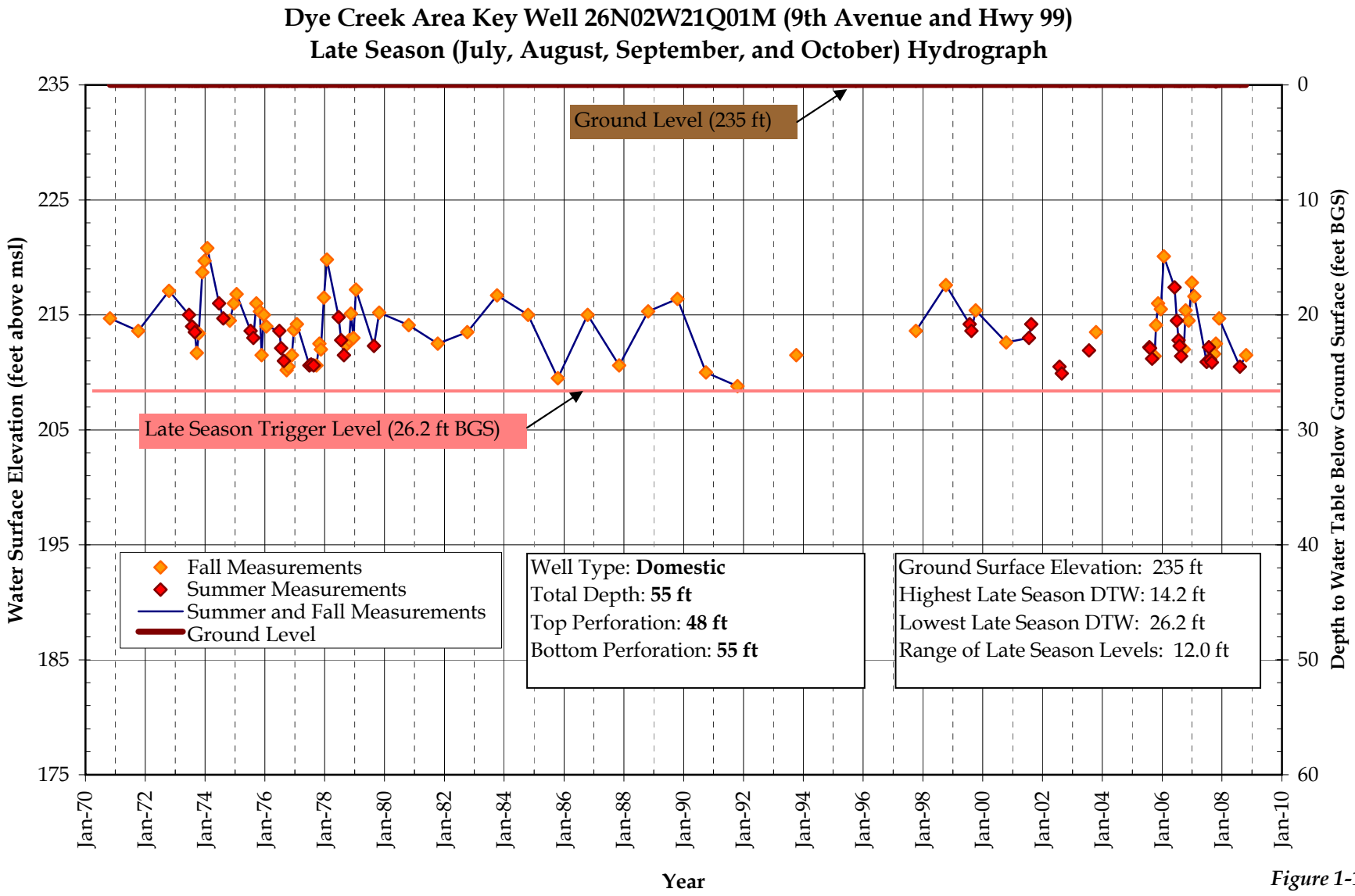


Figure 1-15
Late Season Trigger Levels

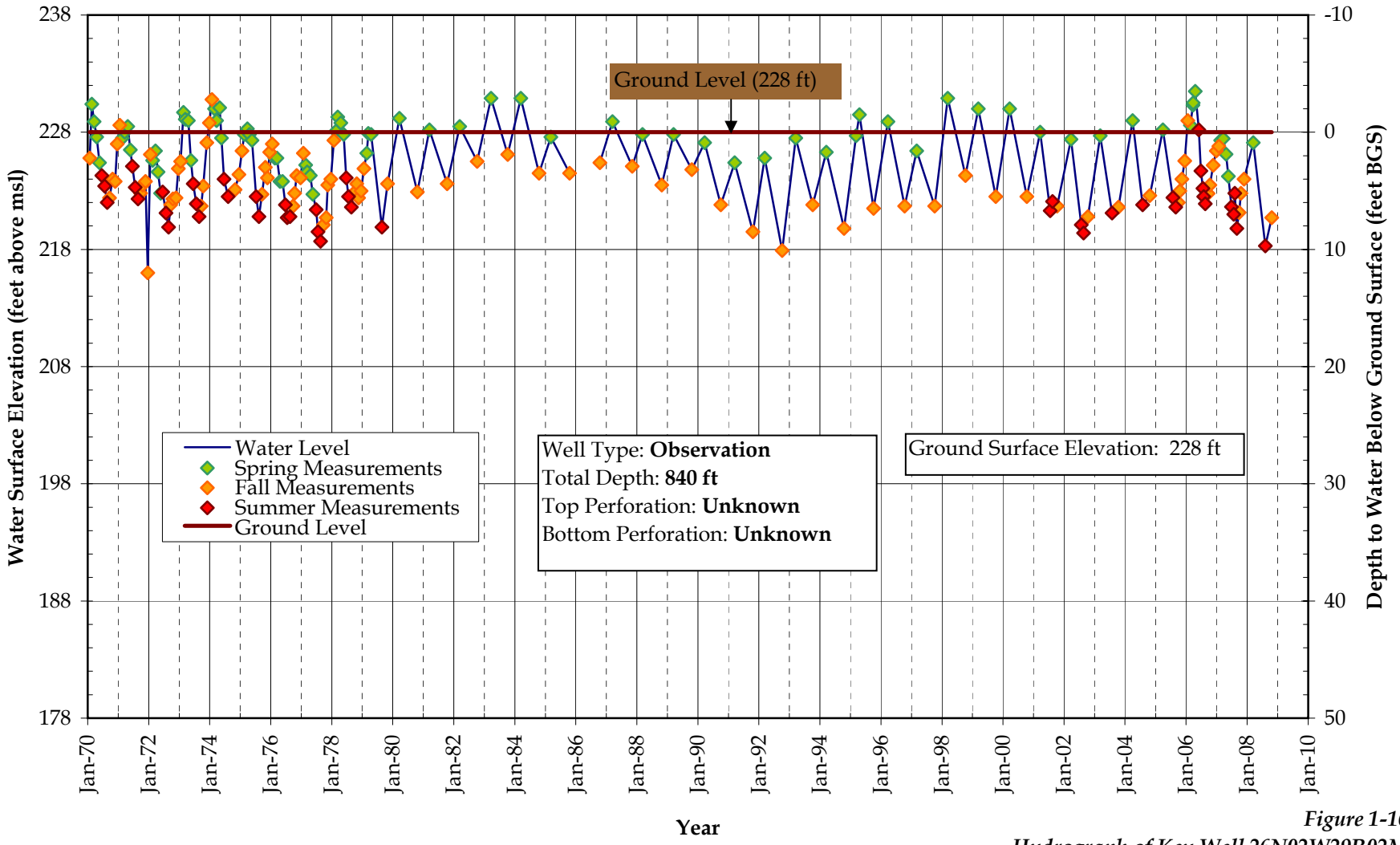


Figure 1-16
Hydrograph of Key Well 26N02W29R02M

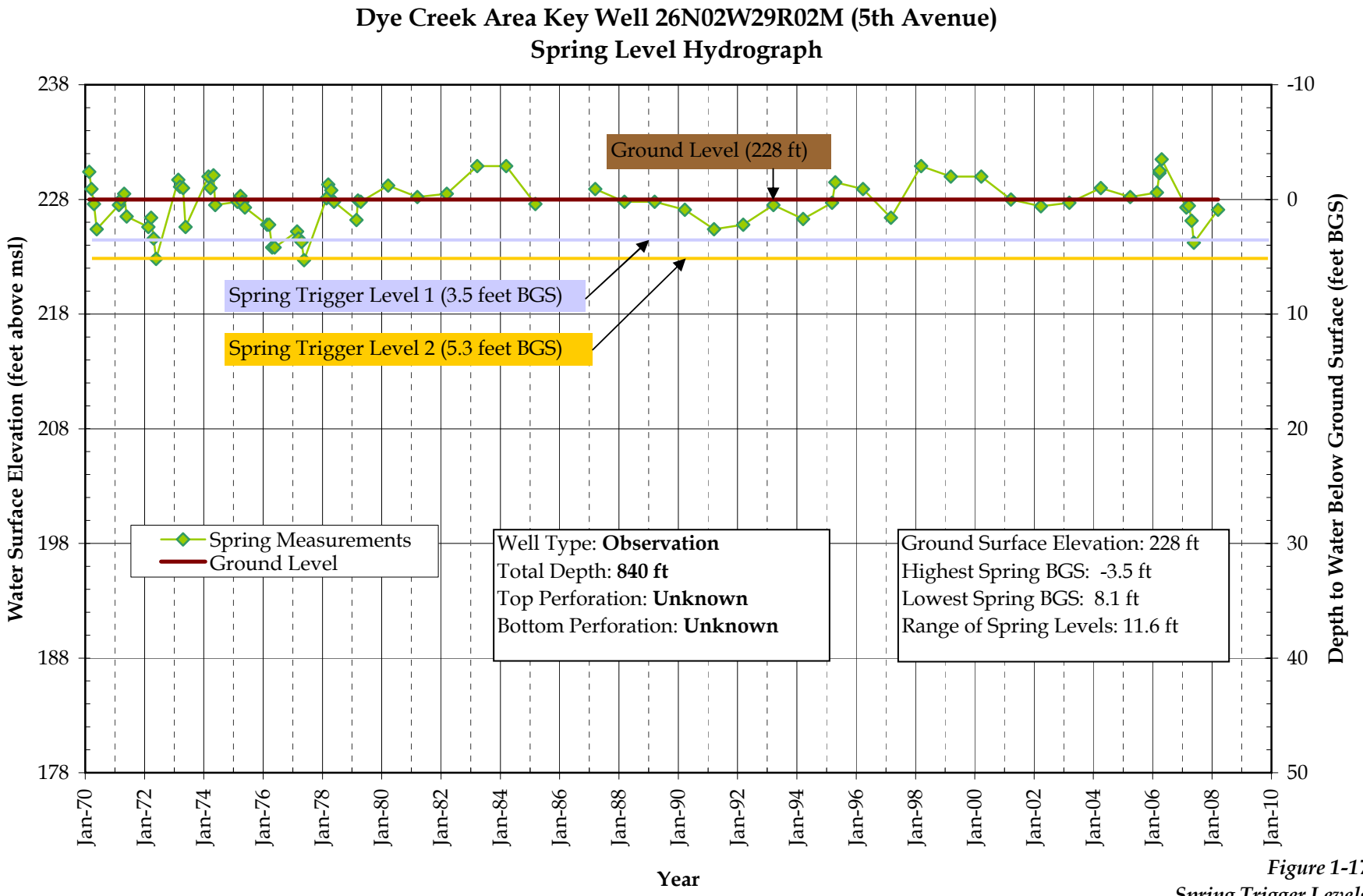


Figure 1-17
Spring Trigger Levels

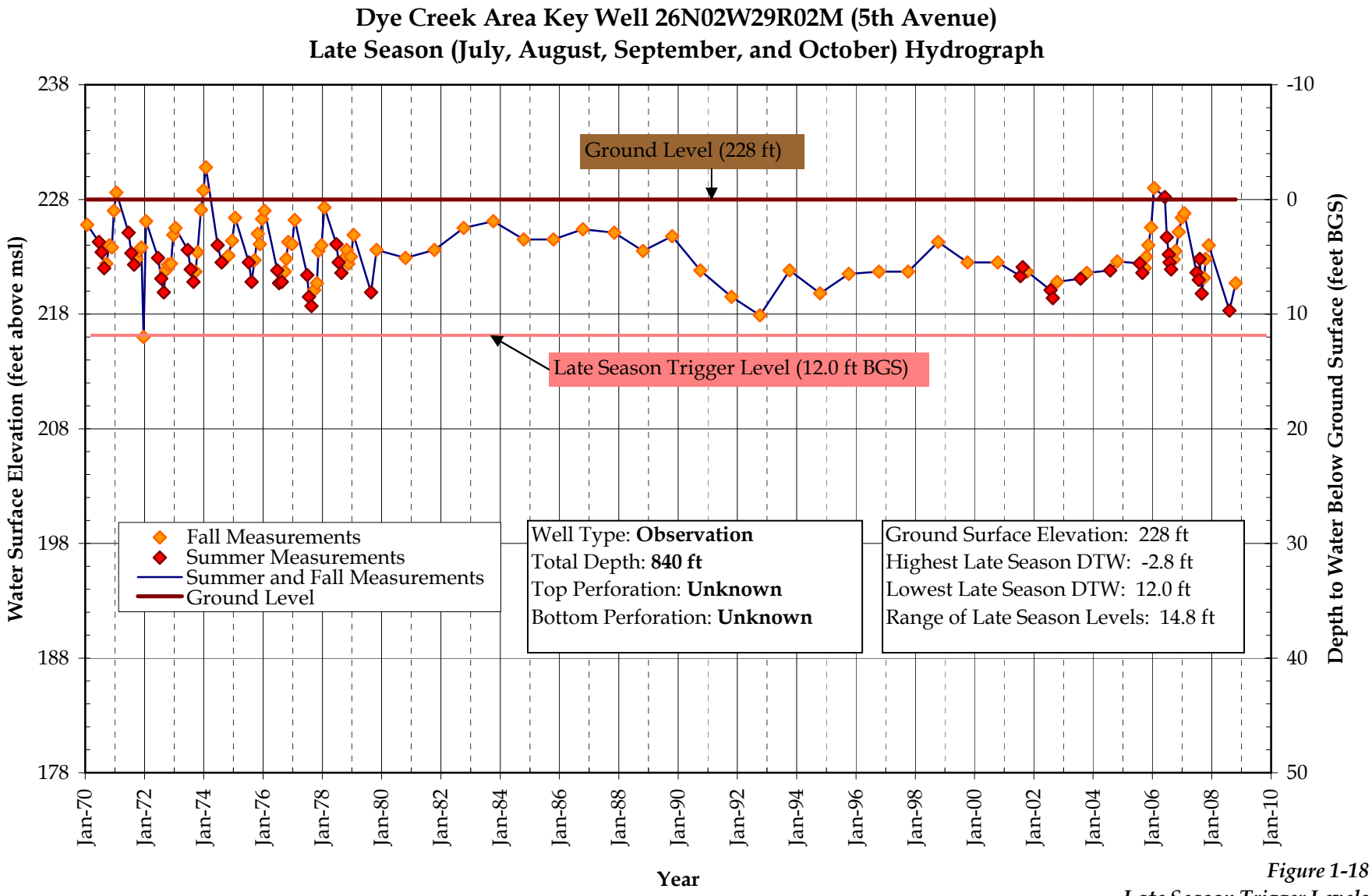


Figure 1-18
Late Season Trigger Levels