Basin Management Objective
Butte County
Sub-Inventory Unit – ESQUON

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Description of the Esquon Sub-Inventory Unit –
The Esquon Sub-Inventory Unit (SIU) covers an area of about 11,600 acres in the northern portion of the East Butte Inventory Unit. It is bordered by the Pentz SUI to the north, Western Canal SIU to the south, Cherokee SIU to the east, and Butte Creek to the west. The Esquon SIU almost corresponds to the water service areas associated with the Durham Mutual Water Company. Agricultural land use within the SIU includes production of orchards, rice, and grain crops supported by both surface water and groundwater. In a normal year, about 27% of the Esquon SIU is in summer agricultural productions supported by groundwater.

Butte Creek supports a generally declining population of spring run Chinook salmon. In 1998, Rancho Esquon worked with Ducks Unlimited to install a state of the art fish ladder and screen on an existing diversion. This project was designed according to California Department of Fish and Game standards to help with the passage of spring run Chinook salmon. The biological benefits of the project are improved passage of juvenile and adult fish, and a curtailment of juvenile fish in the diversion. The water from the Rancho Esquon diversion supplies water to the orchards, rice and state, federal and private wetlands within the Esquon sub-inventory unit. The water diverted form Butte Creek is believed to help with the recharge of groundwater in the Durham/Nelson area according to the Department of Water Resources, Northern District.

Management Objective –
To maintain the groundwater surface elevation during the peak summer irrigation season (July and August) in all aquifer systems at a level that will assure an adequate and affordable irrigation groundwater supply. It is the intent of this management objective to assure a sustainable agricultural supply of good quality water now and into the future, and to assure the water supply can be utilized without injuring groundwater quality or inducing land subsidence. The management objective is also to assure an adequate groundwater supply of adequate quality from the alluvial aquifer system for all domestic users in the SIU.

Geologic Formations Identified In Sub-Inventory Unit –
Geologic formations in the Esquon SIU, from youngest (shallowest) to oldest (deepest), include:

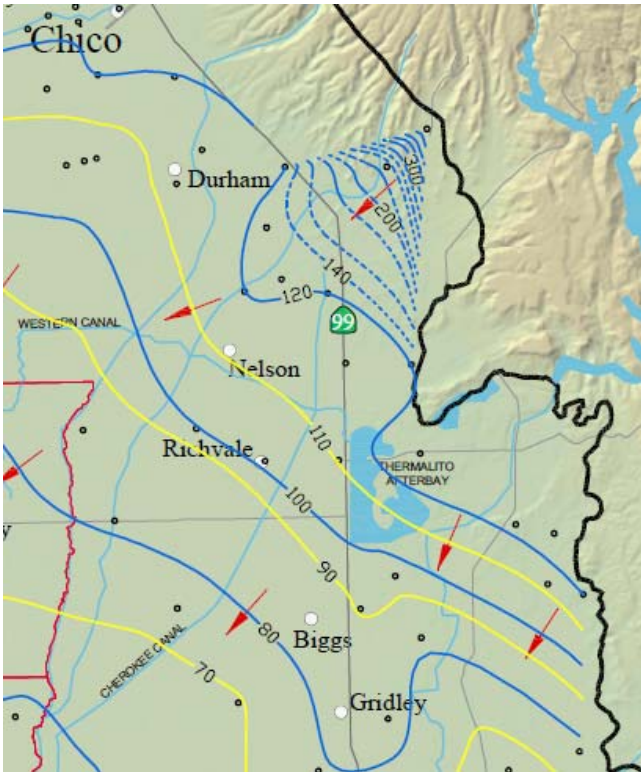
Basin Deposits
Modesto Formation
Tuscan Unit C (Upper Tuscan)
Tuscan Unit B (Lower Tuscan)

Fresh Water-bearing Units. In the Sacramento Valley Region of Butte County, fresh groundwater-bearing units include, from youngest (shallowest) to oldest (deepest), the Modesto, Riverbank, Laguna, Tehama and Tuscan Formations. Those included in the Esquon SIU are:

Modesto Formation
Tuscan Unit C (Upper Tuscan)
Tuscan Unit B (Lower Tuscan)

Groundwater Flow in the Esquon Sub-Inventory Unit –

The below figure is a cropped segment of a map prepared by DWR Northern District. It shows the groundwater elevation contours in your sub-inventory unit with arrows indicating the direction of groundwater movement. This graphic indicates that the regional pattern of spring groundwater movement in the Esquon SIU is in a south-to-southwesterly direction, at a gradient of about 4 feet per mile, adjacent to Butte Creek.



Arrows show the direction of groundwater movement.

2009 Groundwater contours were constructed using groundwater level measurements taken by the Department of Water Resources and Local Cooperators between March 1st and March 20th, 2009. Groundwater contours are based on groundwater level measurements taken from wells constructed within the middle portion of the aquifer system (100 to 400 feet deep). This portion of the aquifer supplies approximately 70% of all domestic, agricultural and municipal wells. Blue contour lines represent 20 foot intervals and yellow contour lines represent 10 foot intervals. Full size contour maps are included in the annual Groundwater Status Report posted on the Department of Water and Resource Conservation website.

BMO Key Wells Selected for Groundwater Level Monitoring – SPRING

Well ID	Aquifer System	Well Type	Stage 1 & 2Alerts Mid point of Average & Historic Low Elev. (ft)	Stage 3Alerts Lowest Recorded Elev. (ft)
20N02E09G01M	Lower Tuscan	Monitoring	114.7	100.0
20N02E09L01M	Lower Tuscan	Irrigation	123.2	120.4
21N02E20P01M	Upper Tuscan	Irrigation	127.3	113.0

FALL

Well ID	Aquifer System	Well Type	Stage 1 & 2Alerts Mid point of Average & Historic Low Elev. (ft)	Stage 3Alerts Lowest Recorded Elev. (ft)
20N02E09G01M	Lower Tuscan	Monitoring	108.9	97.5
20N02E09L01M	Lower Tuscan	Irrigation	109.8	104.5
21N02E20P01M	Upper Tuscan	Irrigation	106.6	85.6

An additional domestic well (SWN 20N02E08H03) was added to the DWR monitoring network in the Esquon Sub-Inventory Unit in 2008. Groundwater elevation data will be presented in this BMO once enough years of data have been collected for analyzation.

BMO Key Wells Selected for Groundwater Quality Monitoring–

Groundwater Temperature - 2002 through 2009

Sub-area	2002 Temp ^{o}C	2003 Temp ^{o}C	2004 Temp ^{o}C	2005 Temp ^{o}C	2006 Temp ^{o}C	2007 Temp ^{o}C	2008 Temp ^{o}C	2009 Temp ^{o}C
Esquon	19.7	18.9	19.6	20.1	20.7	19.0	19.6	19.0

Groundwater pH - 2002 through 2009

Sub-area	2002 pH	2003 pH	2004 pH	2005 pH	2006 pH	2007 pH	2008 pH	2009 pH
Esquon	7.3	7.5	7.1	7.4	7.5	7.4	7.2	7.4

Groundwater EC - 2002 through 2009

Sub-area	2002 EC	2003 EC	2004 EC	2005 EC	2006 EC	2007 EC	2008 EC	2009 EC
Esquon	388.0	526.0	470.0	557.0	507.0	480.0	439.0	419.0

BMO Key Well(s) Selected for Land Subsidence Monitoring–
State Well Number 20N01E18L03M located in the Western Canal Water District. Maximum annual inelastic land subsidence shall not exceed 0.01 feet per year.

Butte County staff participated in the Sacramento Valley Height Modernization Project during March 2008 as a means to enhance the subsidence monitoring program in the county and the region. This cooperative project between the Department of Water Resources (DWR), the

Bureau of Reclamation and local County agencies helped to establish baseline ground elevations in Butte County and other portions of the valley. Land elevations were measured using Global Positioning System (GPS) survey equipment and survey monuments located on an approximate three to five mile grid. Re-observations are to be done in approximately three years, and will give measurements to compare against the baseline data in order to determine whether or not any subsidence has occurred.

BMO Alert Stage Definitions and Compliance Methodologies–

The Esquon Sub-Inventory Unit will use the following guidelines in the management of the groundwater resources. The groundwater level and land subsidence management objectives are intended to trigger predetermined voluntary Ground Water Management Actions, as defined in the accompanying Cover Report, to remedy declining ground water levels that are not recovering to compliance levels for each index well.

Groundwater Levels –

The Butte Basin Groundwater model uses the historical hydrology (e.g. precipitation pattern, stream inflows) from October 1970 through October 1999 in the base case simulation. Using historical hydrology allows for the assessment of water resources conditions based on a known range of hydrology, from wet to critical. Each hydrograph for the BMO process shows the static groundwater elevation measurements from the time period of 1970 to 2006, or as many recent years of data available for each selected key wells. The measurements taken during this 36 year window reflect periods of drought and recovery, as well as wet years. These methodologies will apply for both Spring and Fall analysis.

A. For wells that have a period of record dating back to at least 1970, the subcommittee suggests that the range of measurements from the first year through 2006 be used in calculating Alert Stages 1 and 2 and the Historic Low will be used as the Alert Stage 3. Once the range is defined for each well, 20% of that range will be calculated and added to the Historic Low to establish Alert Stages 1 and 2. The measurements plotted after 2006 are for reference purposes only, and are not included in the calculation of the range.

B. In the instances where the period of record does not date back to 1970, the Historic Low before 2006 will be used for Alert Stages 1 and 2, and the Historical Low minus the range of measurements shall be used for Alert Stage 3. The measurements plotted after 2006 are for reference purposes only, and are not included in the calculation of the range.

Groundwater Quality –

Any change that exceeds *a 20 percent change* from Butte County's 2009 water quality assessment will be cause for review and investigation by the Technical Advisory Committee.

Land Subsidence –

Land Subsidence will be monitored at the closest extensometers located in the M&T and Western Canal sub inventory units. Maximum annual inelastic land subsidence shall not exceed 0.01 feet per year.

Stage 1: is reached when the annual elastic subsidence exceeds the average annual elastic subsidence measured over the period of record of the extensometer.

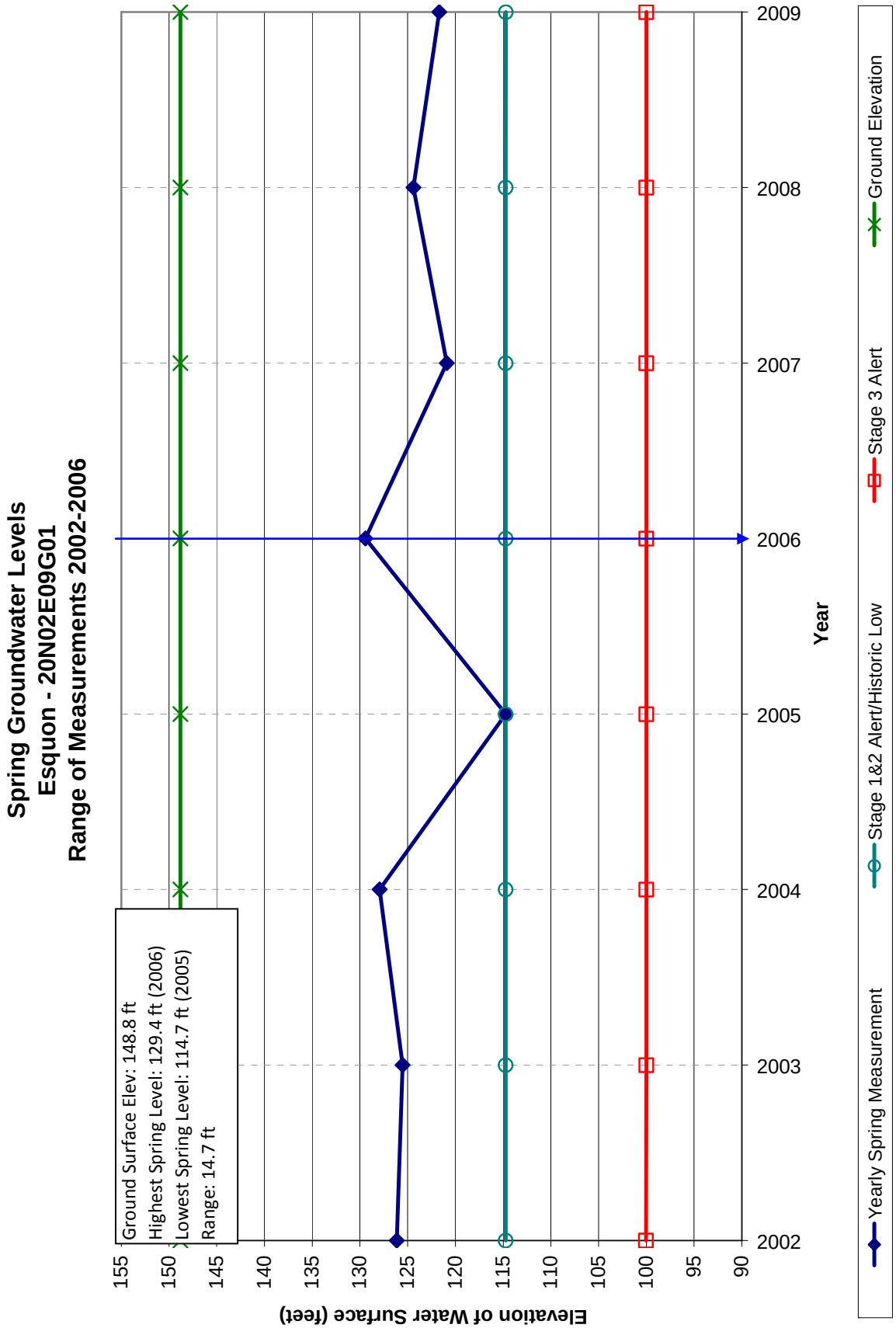
Stage 2: is reached when the annual elastic subsidence exceeds the maximum recorded elastic subsidence over the period of record for the extensometer.

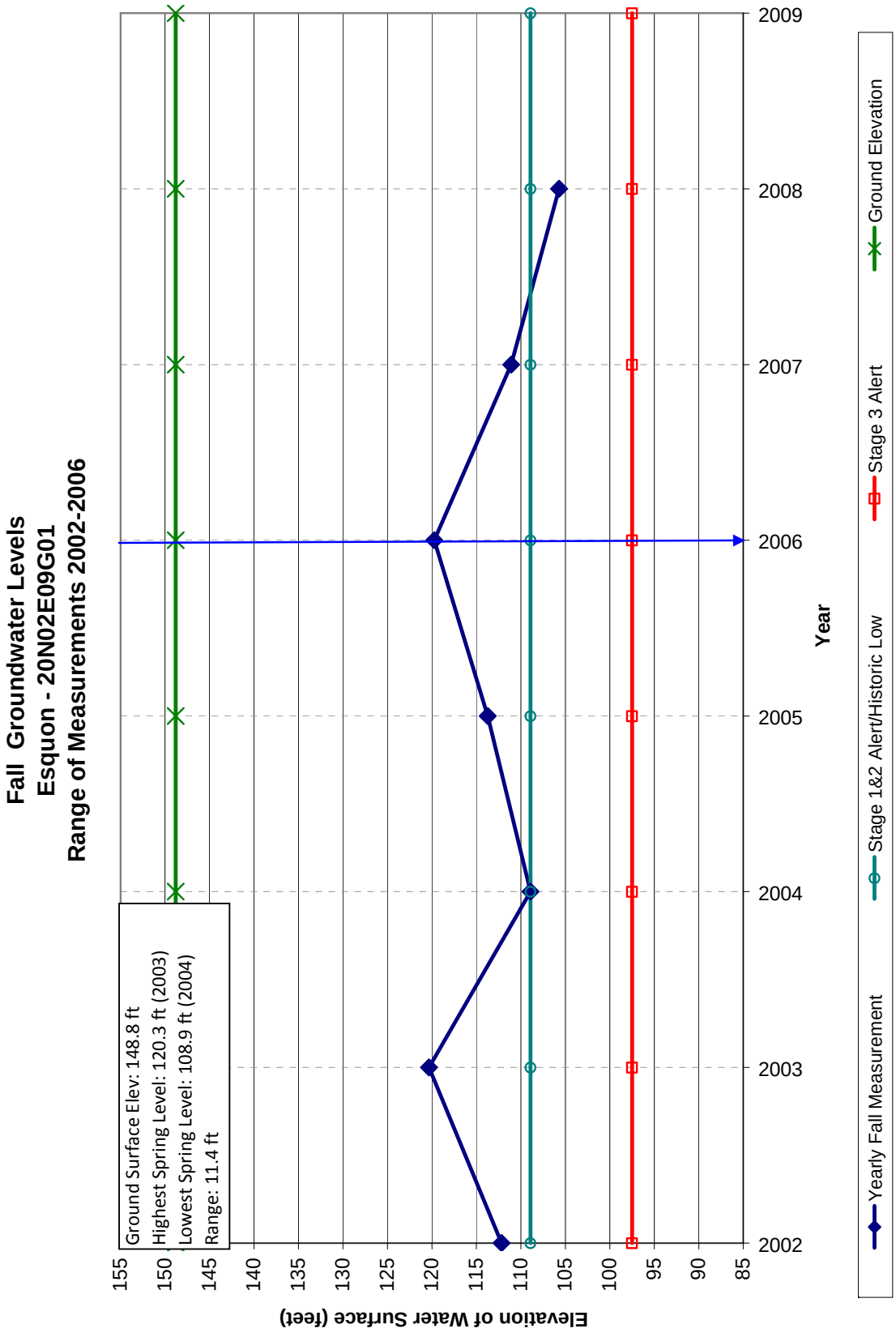
Stage 3: is when inelastic subsidence is detected. Inelastic subsidence shall be detected by comparing reading from the extensometer taken on March 1 of each year against previous March 1 measurements.

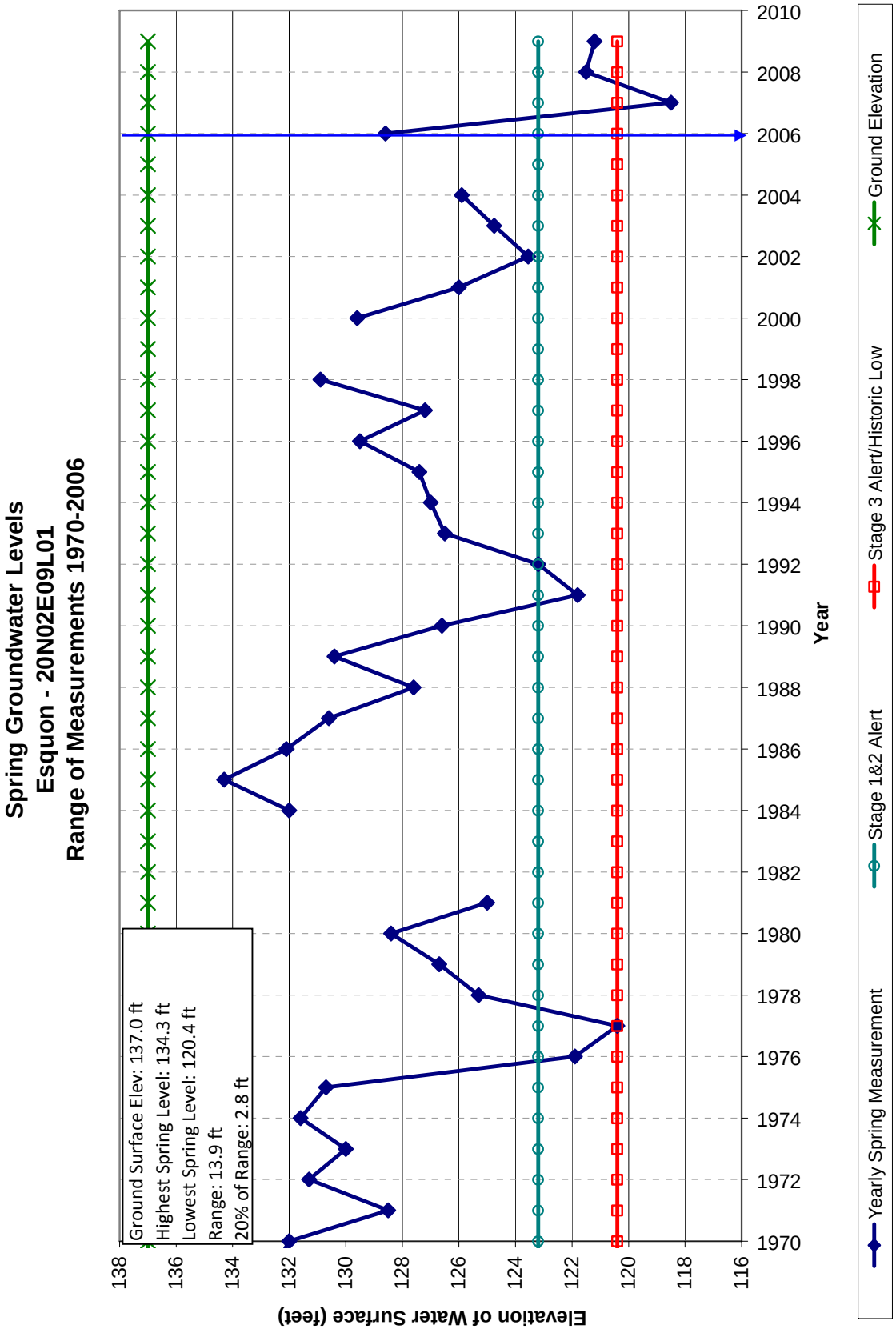
Future Monitoring Recommendations –
Continue to explore options for installing multi-completion monitoring wells to more accurately measure aquifer specific water quality and levels.

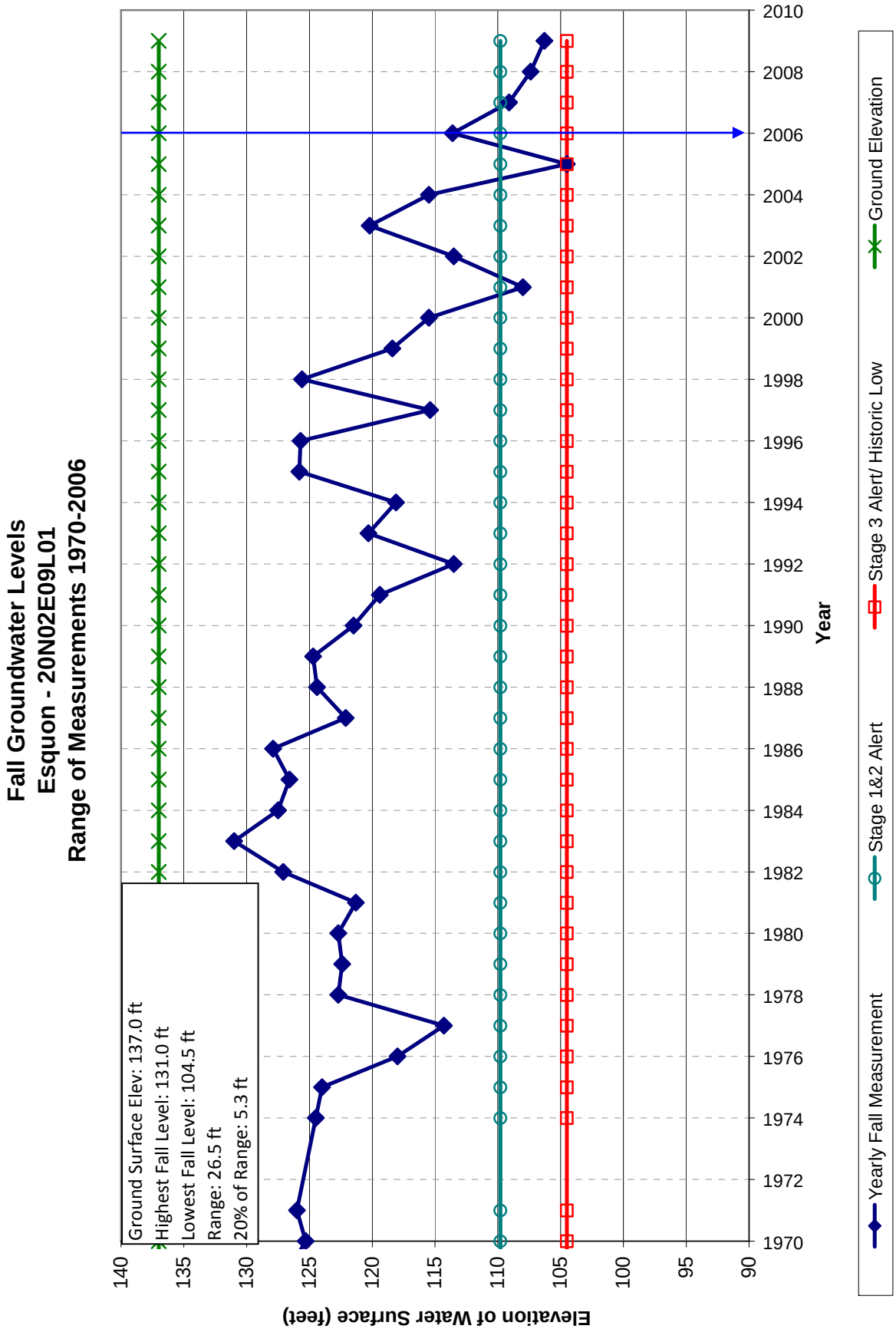
Supporting Data –
Hydrographs depicting yearly spring level measurements, including 2009 data, with established alert levels for the 2010 calendar year.

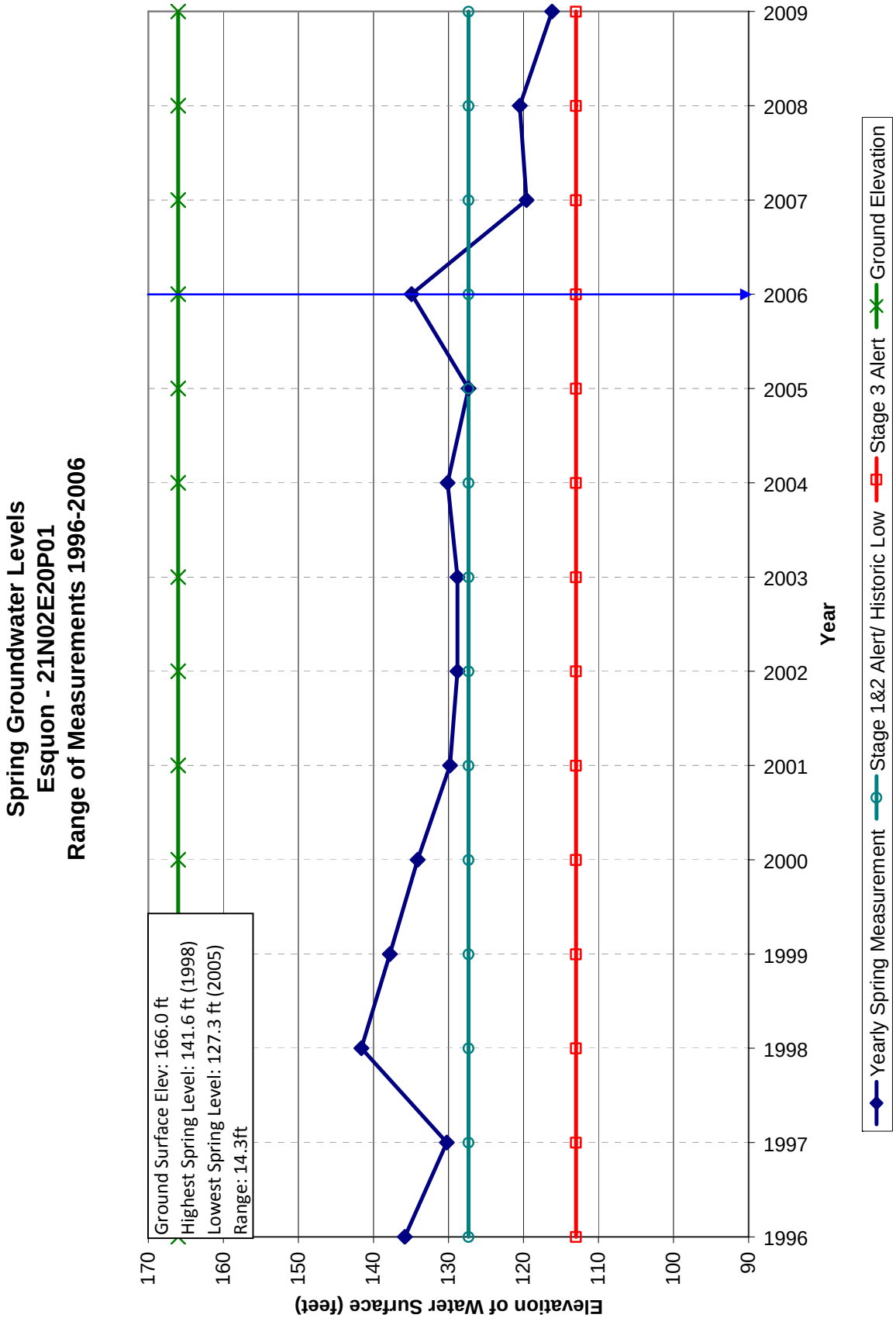
Summary charts of water quality monitoring.

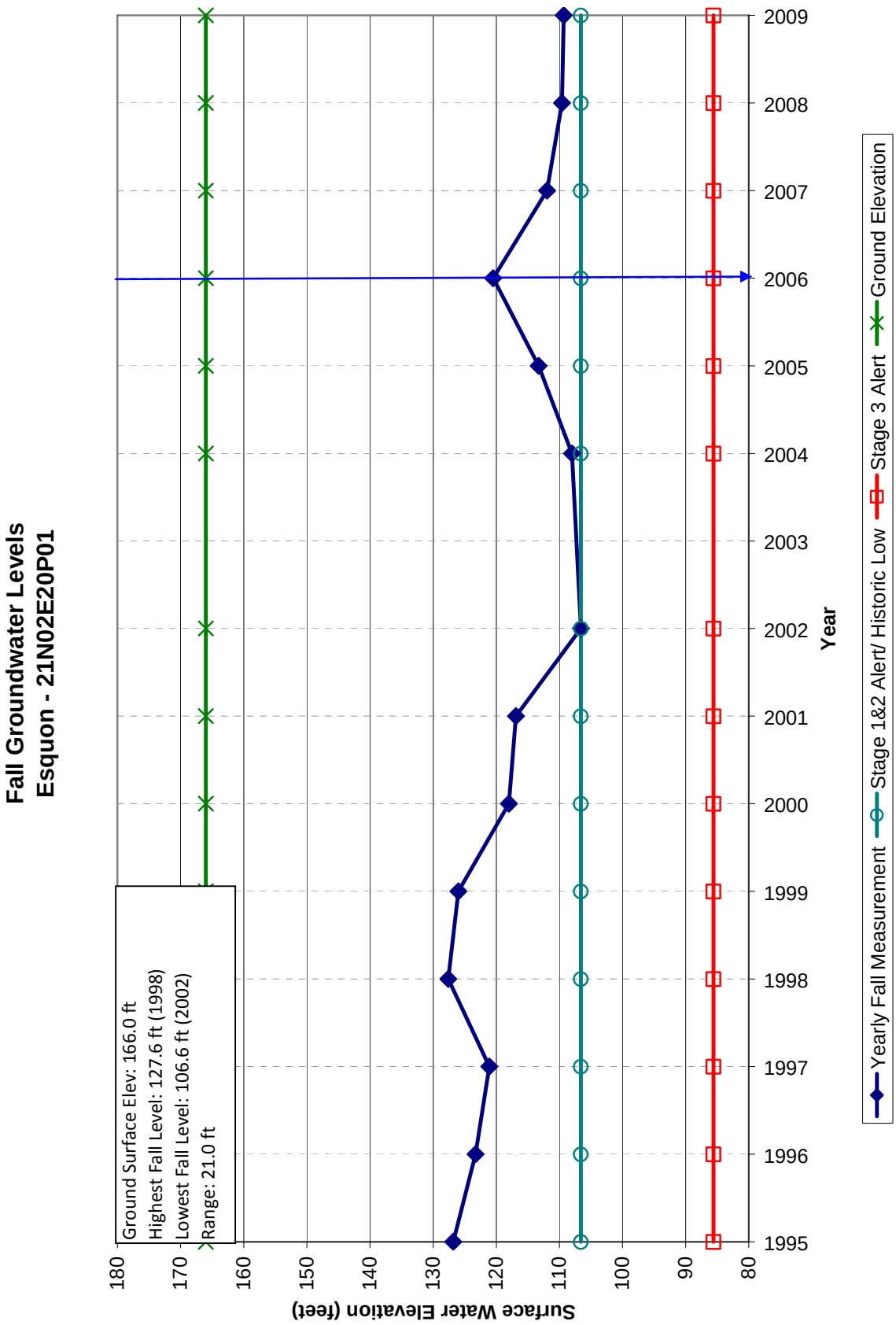

Spring Groundwater Levels
Esquon - 20N02E09G01
Range of Measurements 2002-2006
Ground Surface Elev: 148.8 ft
Highest Spring Level: 129.4 ft (2006)
Lowest Spring Level: 114.7 ft (2005)
Range: 14.7 ft
Elevation of Water Surface (feet)
155
150
145
140
135
130
125
120
115
110
105
100
95
90
2002
2003
2004
2005
2006
2007
2008
2009
Year
Yearly Spring Measurement
Stage 1&2 Alert/Historic Low
Stage 3 Alert
Ground Elevation

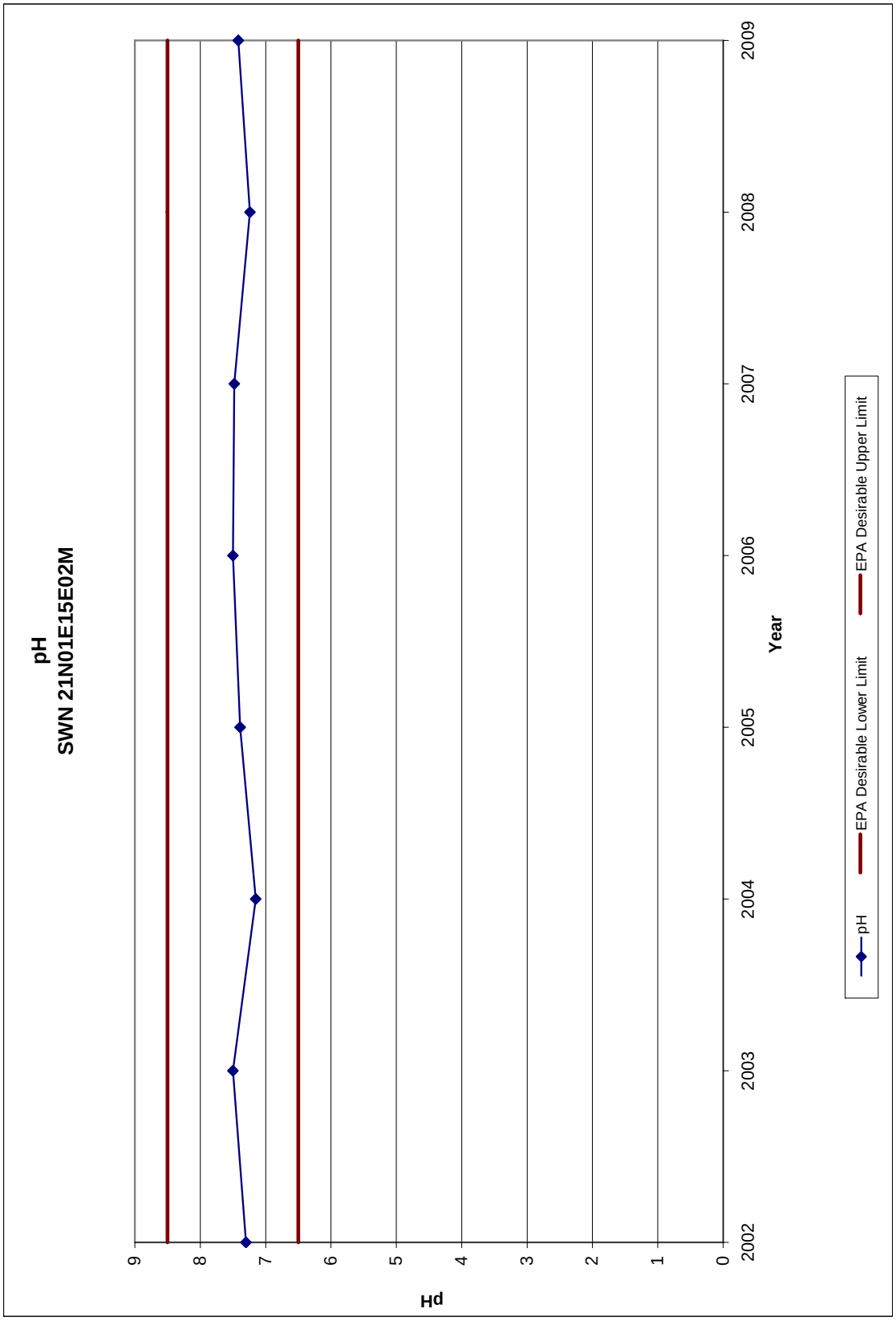

Fall Groundwater Levels
Esquon - 20N02E09G01
Range of Measurements 2002-2006
Ground Surface Elev: 148.8 ft
Highest Spring Level: 120.3 ft (2003)
Lowest Spring Level: 108.9 ft (2004)
Range: 11.4 ft
Elevation of Water Surface (feet)
155
150
145
140
135
130
125
120
115
110
105
100
95
90
85
Year
2009
2008
2007
2006
2005
2004
2003
2002
Yearly Fall Measurement
Stage 1&2 Alert/Historic Low
Stage 3 Alert
Ground Elevation

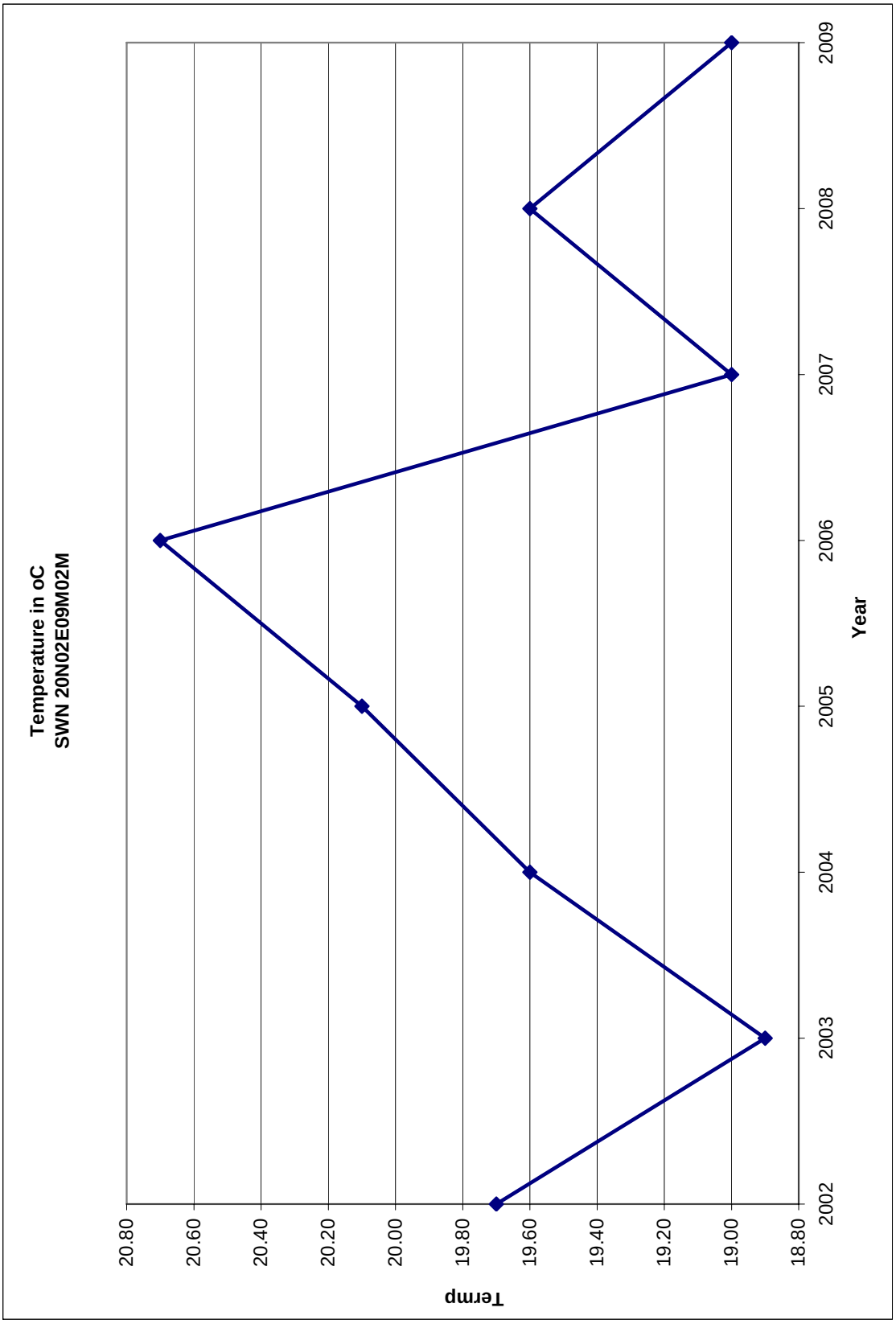

Spring Groundwater Levels
Esquon - 20N02E09L01
Range of Measurements 1970-2006
Ground Surface Elev: 137.0 ft
Highest Spring Level: 134.3 ft
Lowest Spring Level: 120.4 ft
Range: 13.9 ft
20% of Range: 2.8 ft
Elevation of Water Surface (feet)
138
136
134
132
130
128
126
124
122
120
118
116
Year
2010
2008
2006
2004
2002
2000
1998
1996
1994
1992
1990
1988
1986
1984
1982
1980
1978
1976
1974
1972
1970
Yearly Spring Measurement
Stage 1&2 Alert
Stage 3 Alert/Historic Low
Ground Elevation

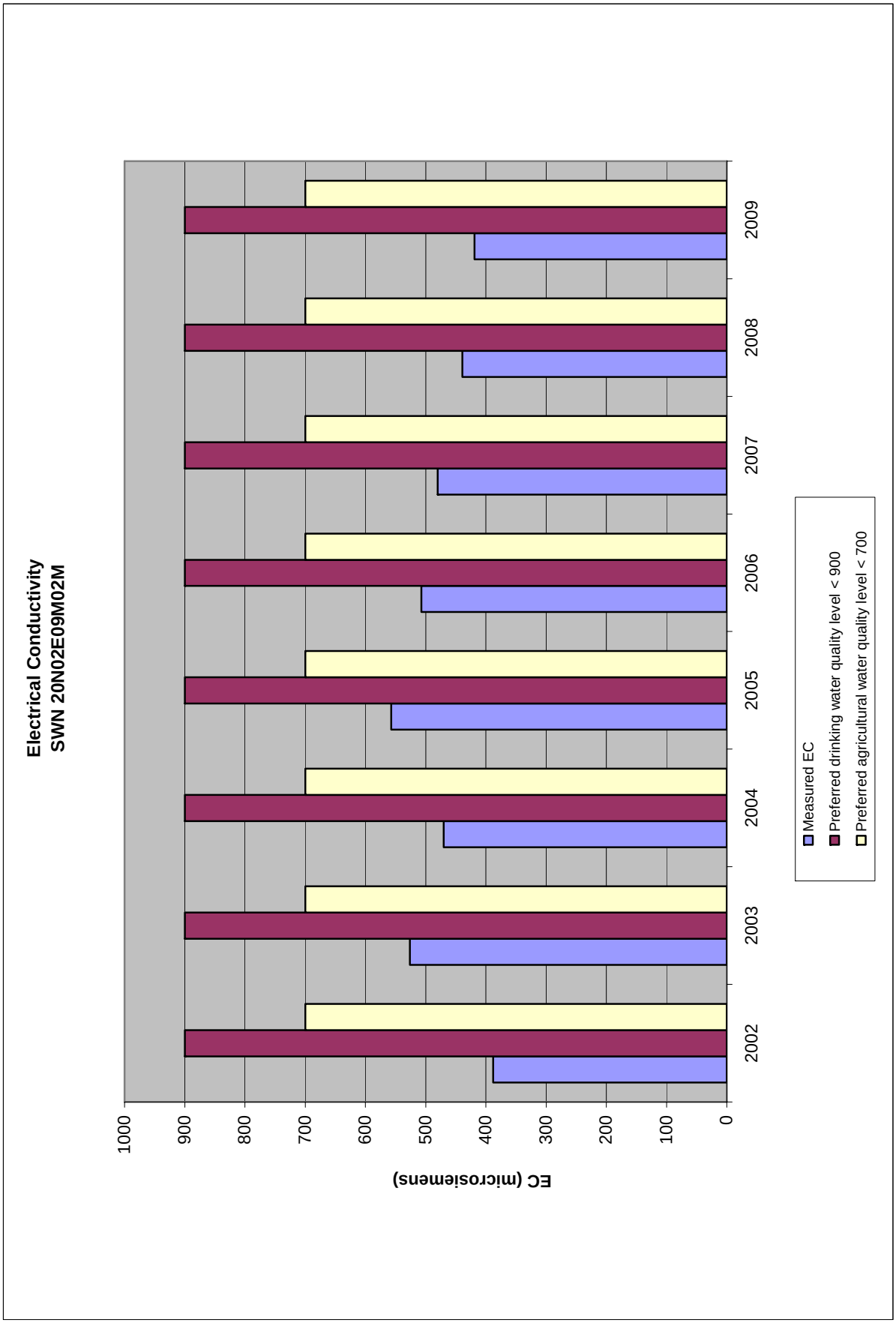

Fall Groundwater Levels
Esquon - 20N02E09L01
Range of Measurements 1970-2006
Ground Surface Elev: 137.0 ft
Highest Fall Level: 131.0 ft
Lowest Fall Level: 104.5 ft
Range: 26.5 ft
20% of Range: 5.3 ft
Elevation of Water Surface (feet)
140
135
130
125
120
115
110
105
100
95
90
Year
2010
2008
2006
2004
2002
2000
1998
1996
1994
1992
1990
1988
1986
1984
1982
1980
1978
1976
1974
1972
1970
Yearly Fall Measurement
Stage 1&2 Alert
Stage 3 Alert/ Historic Low
Ground Elevation


Spring Groundwater Levels
Esquon - 21N02E20P01
Range of Measurements 1996-2006
Ground Surface Elev: 166.0 ft
Highest Spring Level: 141.6 ft (1998)
Lowest Spring Level: 127.3 ft (2005)
Range: 14.3ft
Elevation of Water Surface (feet)
170
160
150
140
130
120
110
100
90
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
Yearly Spring Measurement
Stage 1&2 Alert/ Historic Low
Stage 3 Alert
Ground Elevation


Fall Groundwater Levels
Esquon - 21N02E20P01
Ground Surface Elev: 166.0 ft
Highest Fall Level: 127.6 ft (1998)
Lowest Fall Level: 106.6 ft (2002)
Range: 21.0 ft
Surface Water Elevation (feet)
180
170
160
150
140
130
120
110
100
90
80
Year
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
Yearly Fall Measurement
Stage 1&2 Alert/ Historic Low
Stage 3 Alert
Ground Elevation


pH
SWN 21N01E15E02M
pH
Year
0
1
2
3
4
5
6
7
8
9
2002
2003
2004
2005
2006
2007
2008
2009
pH
EPA Desirable Lower Limit
EPA Desirable Upper Limit


Temperature in oC
SWN 20N02E09M02M
Temp
20.80
20.60
20.40
20.20
20.00
19.80
19.60
19.40
19.20
19.00
18.80
2002
2003
2004
2005
2006
2007
2008
2009
Year


Electrical Conductivity
SWN 20N02E09M02M
EC (microsiemens)
0
100
200
300
400
500
600
700
800
900
1000
2002
2003
2004
2005
2006
2007
2008
2009
Measured EC
Preferred drinking water quality level < 900
Preferred agricultural water quality level < 700