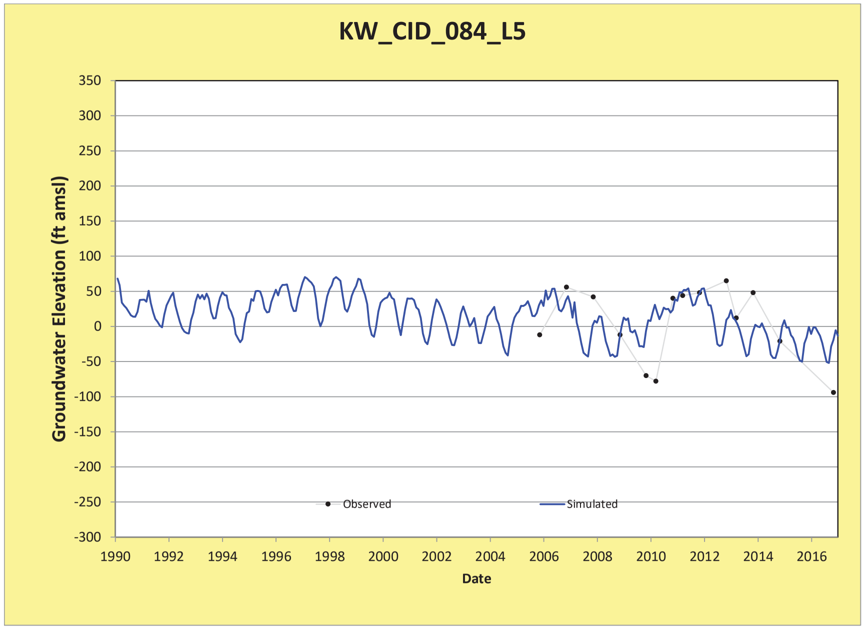
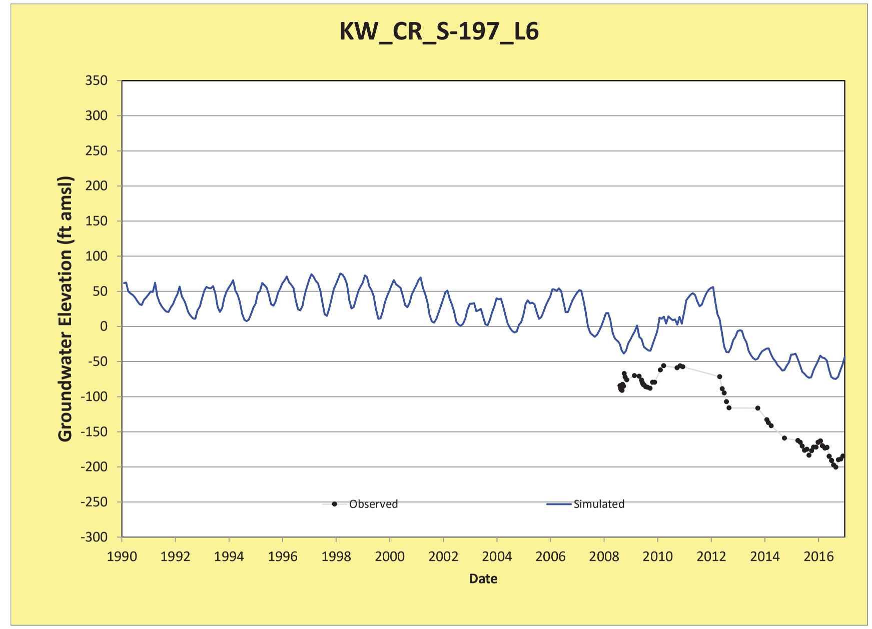
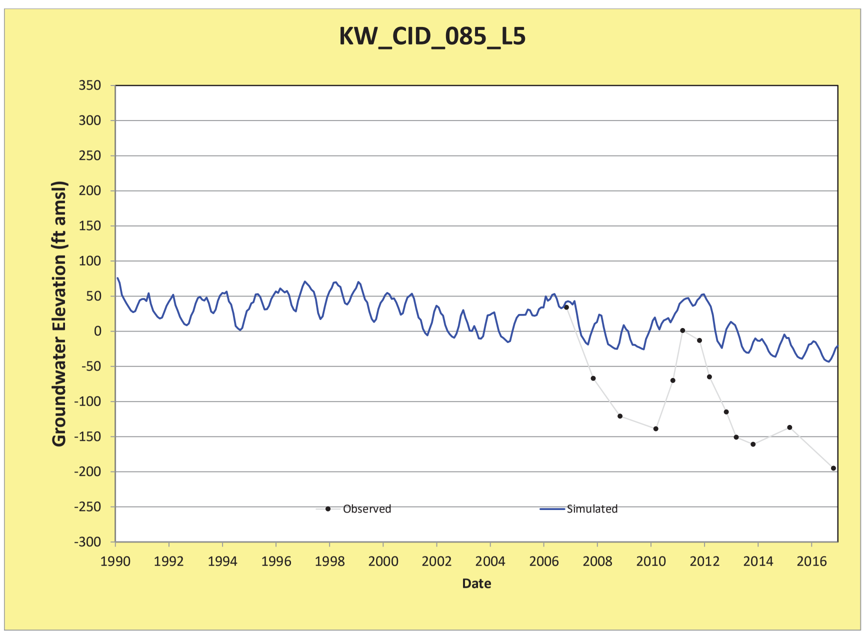
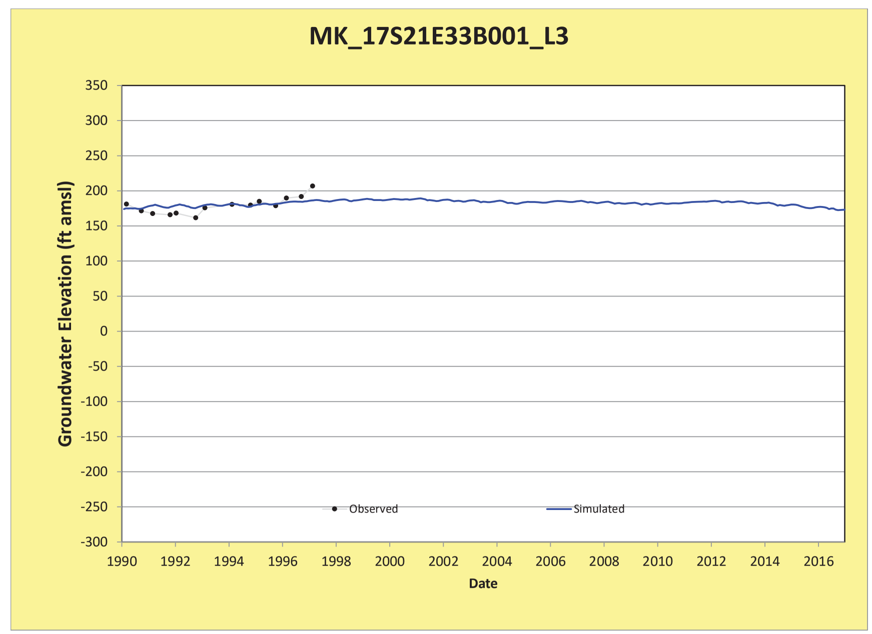
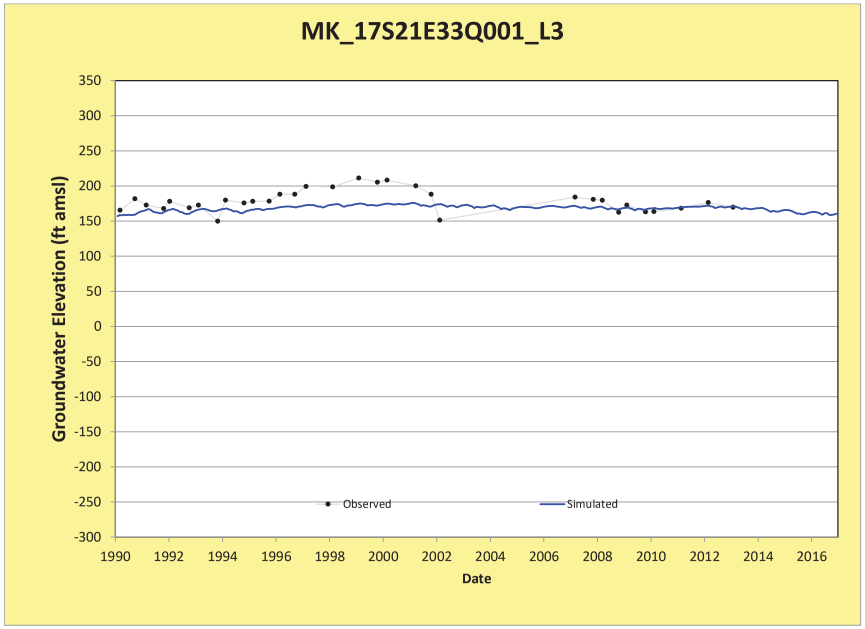
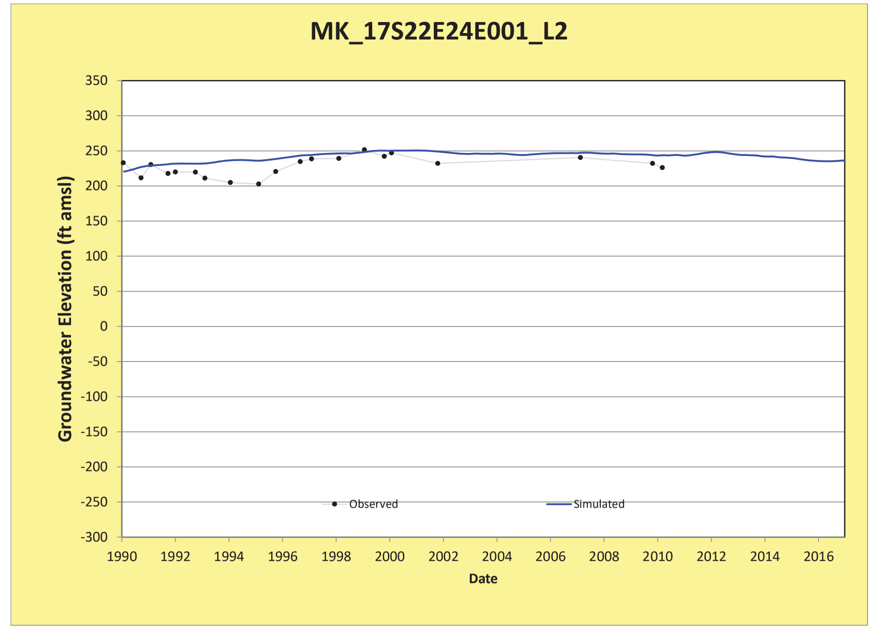

KW_CID_084_L5
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

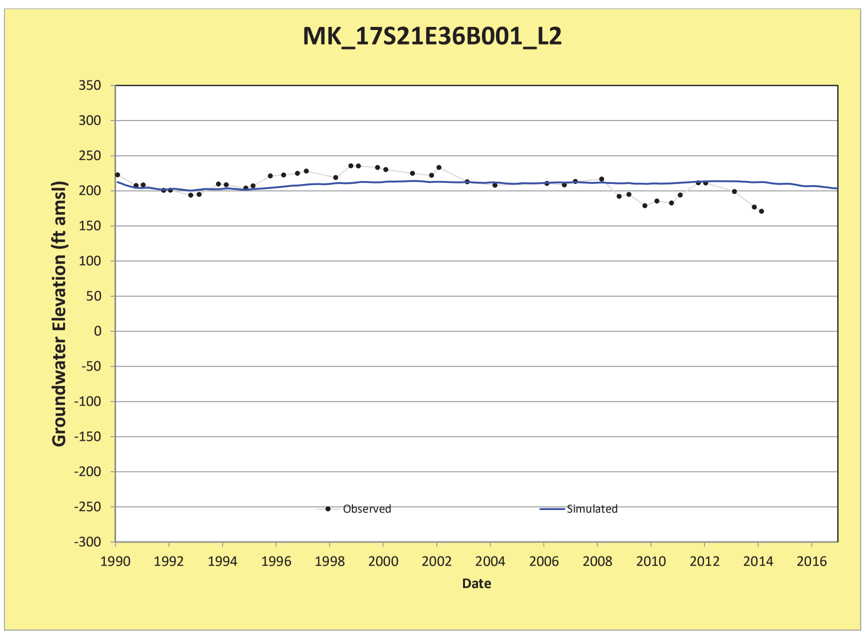

KW_CR_S-197_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

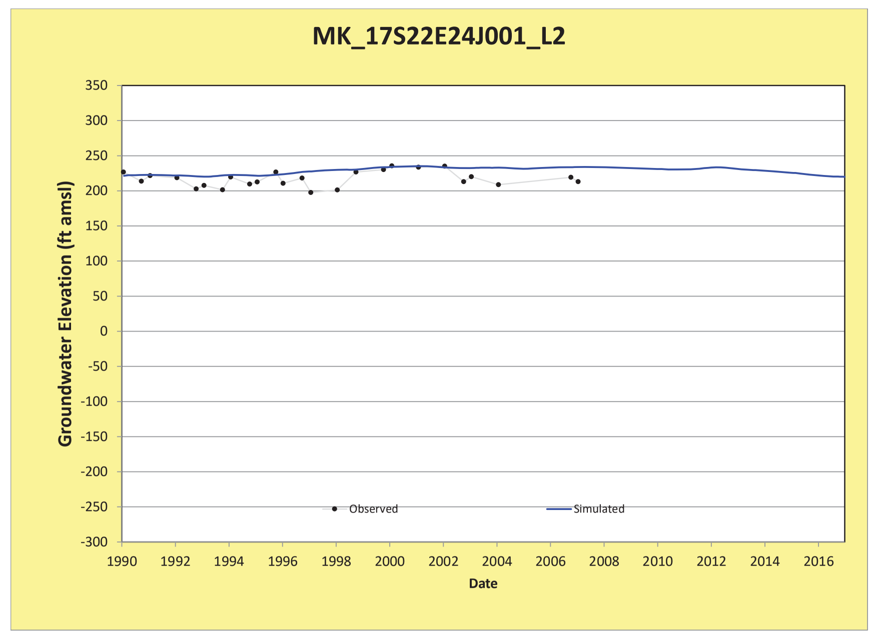

KW_CID_085_L5
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

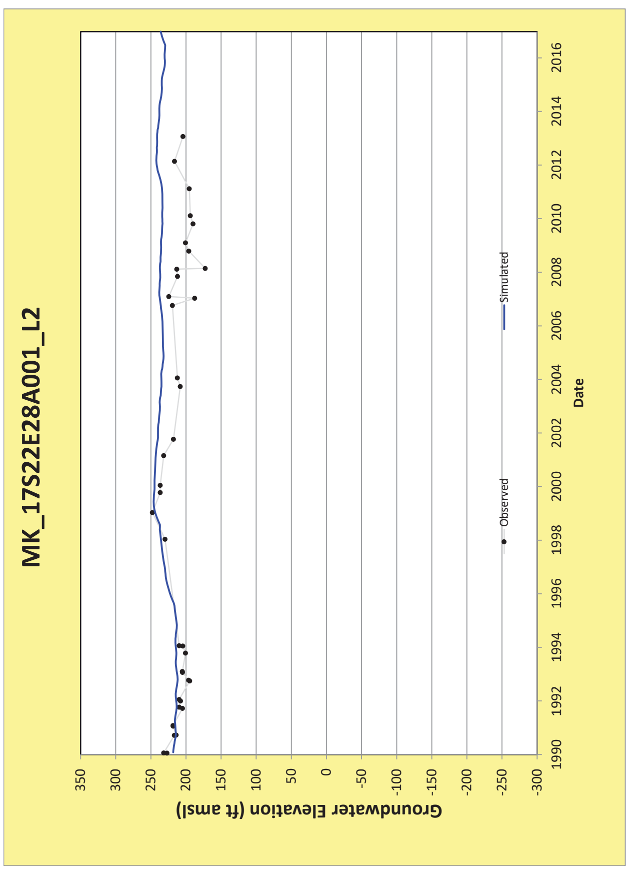

MK_17S21E33B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

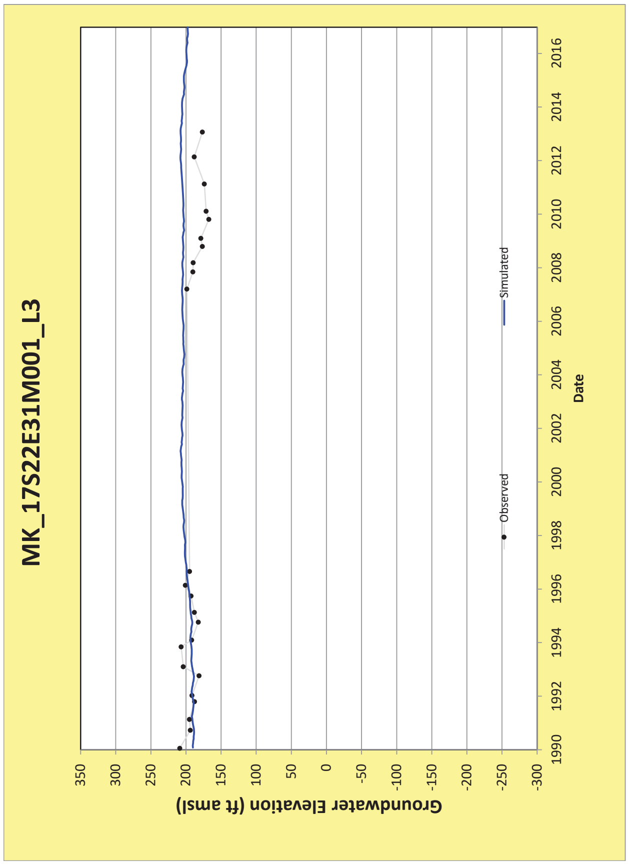

MK_17S21E33Q001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

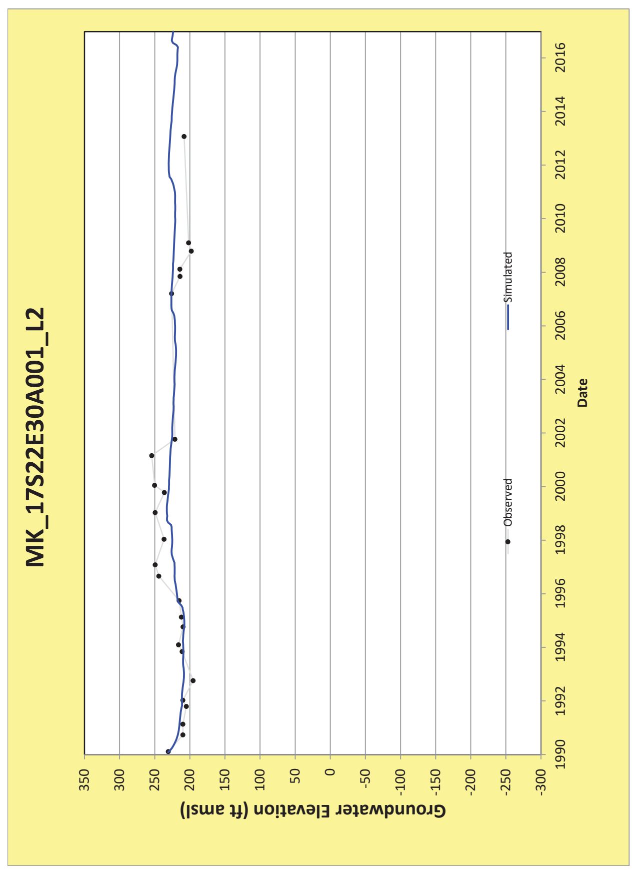

MK_17S22E24E001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

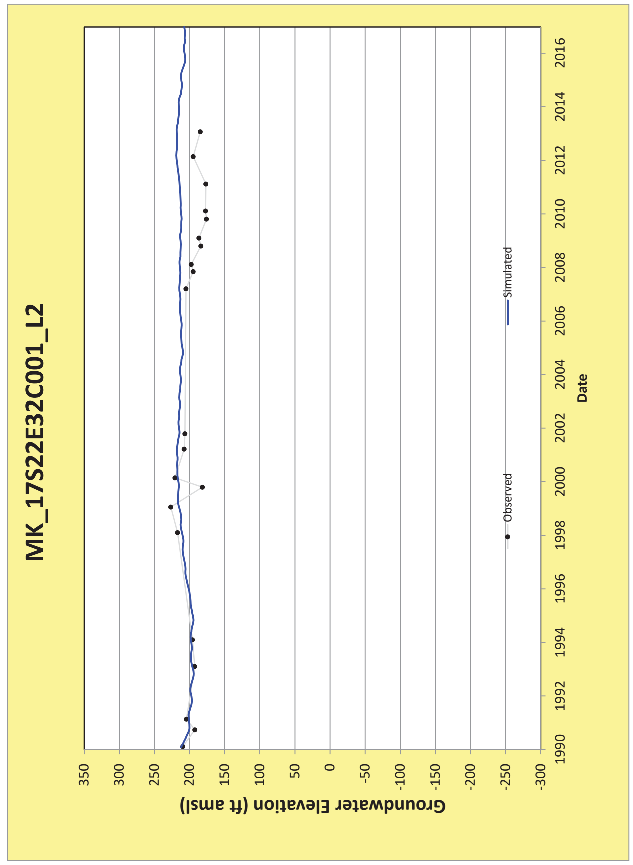

MK_17S21E36B001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

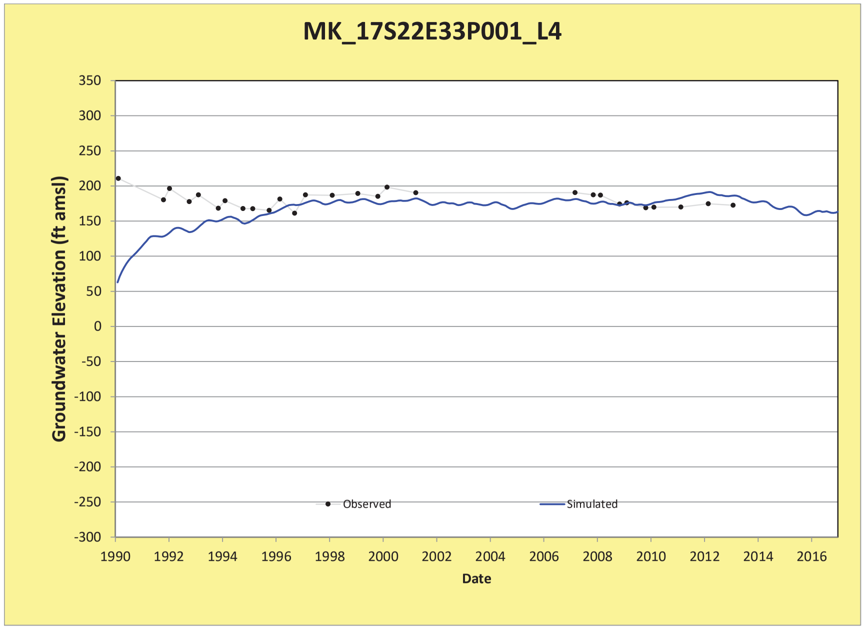

MK_17S22E24J001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

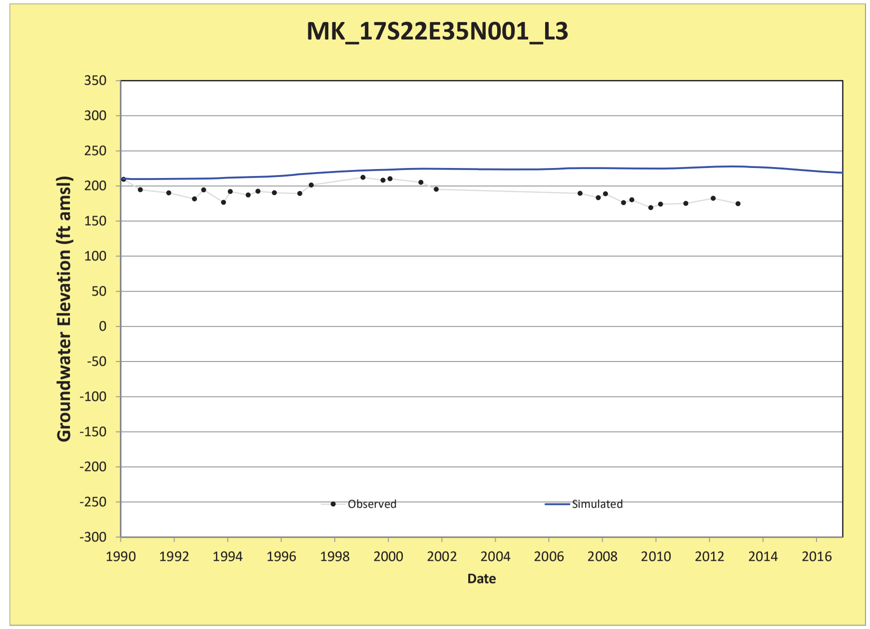

MK_17S22E28A001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

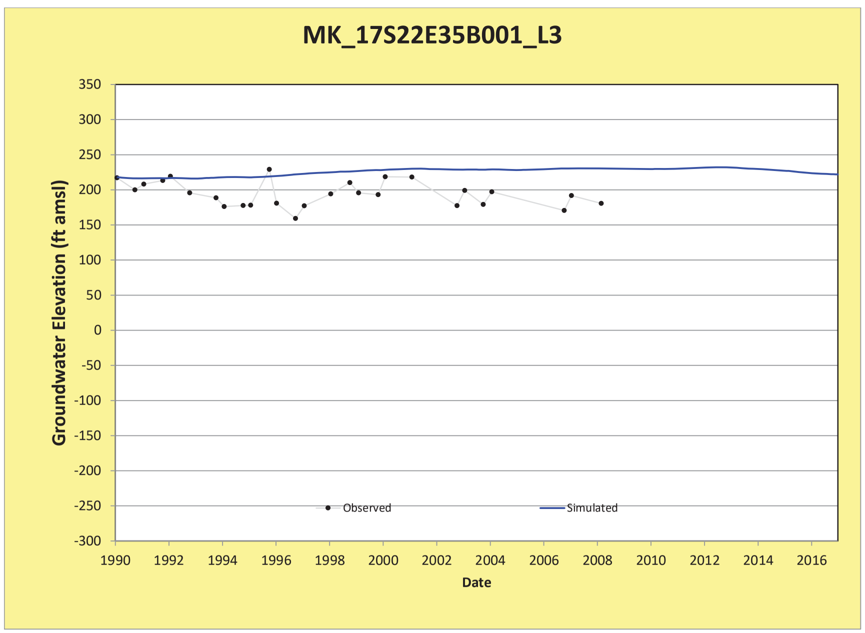

MK_17S22E31M001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

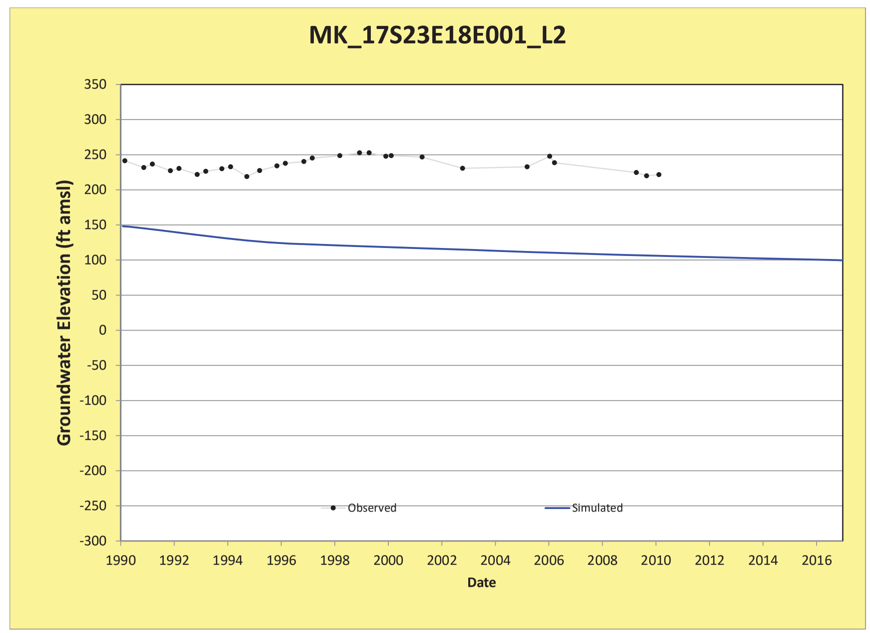

MK_17S22E30A001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

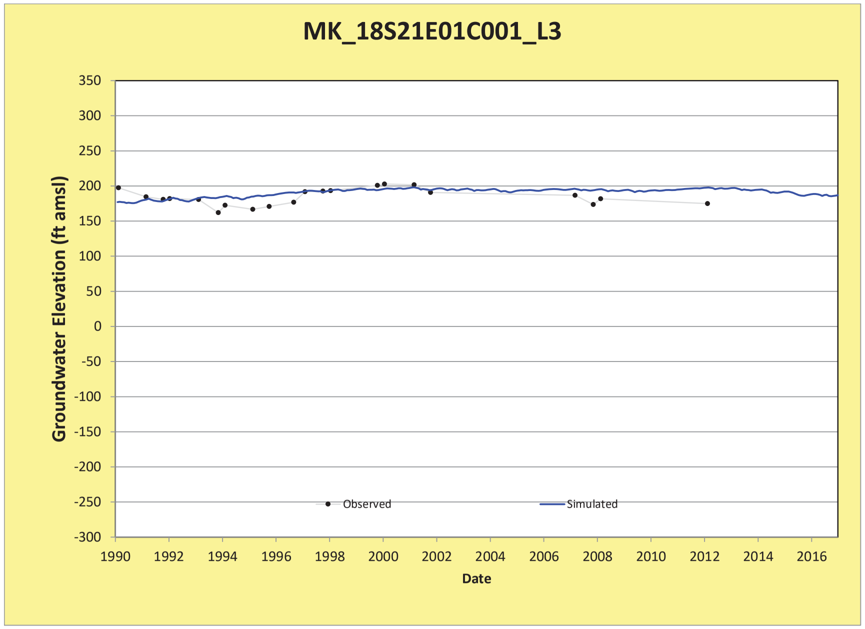

MK_17S22E32C001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

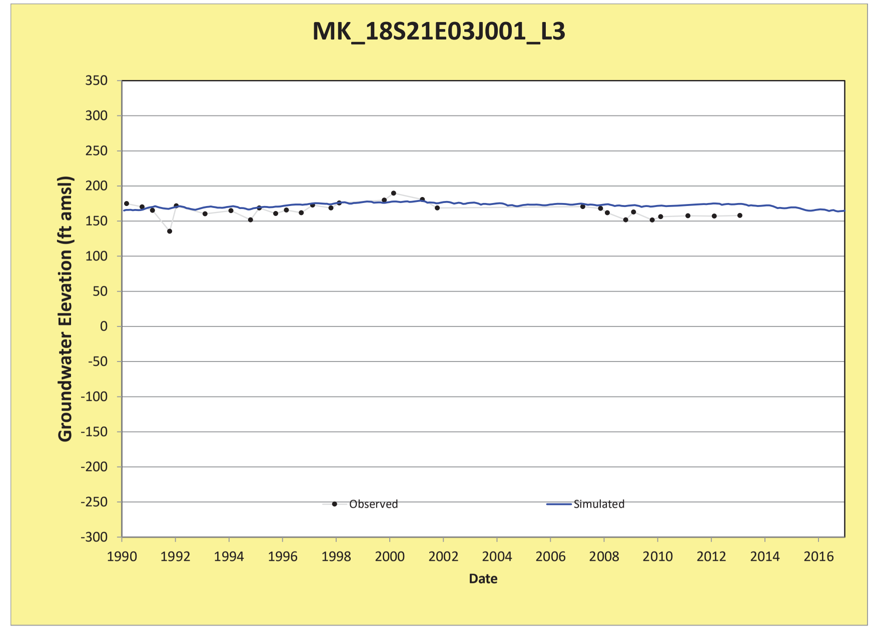

MK_17S22E33P001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

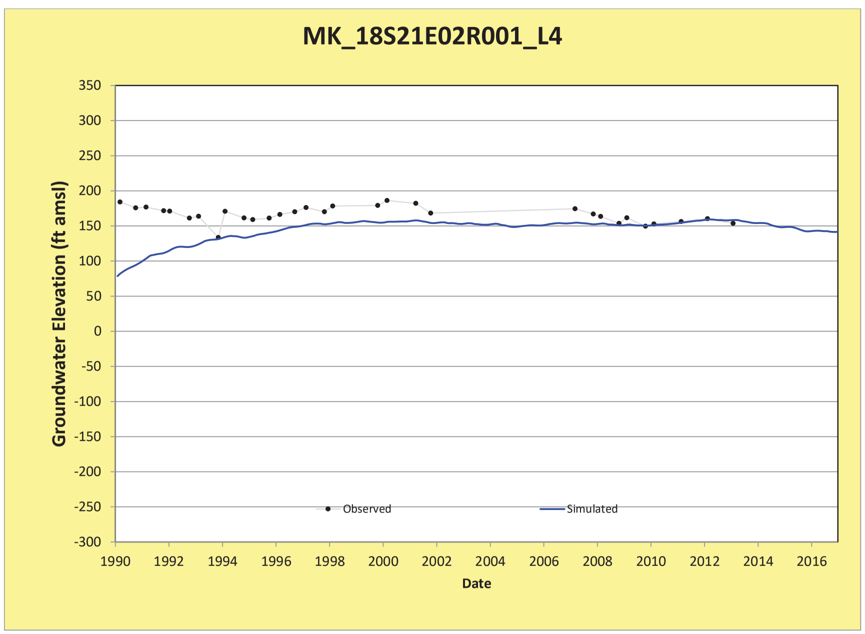

MK_17S22E35N001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

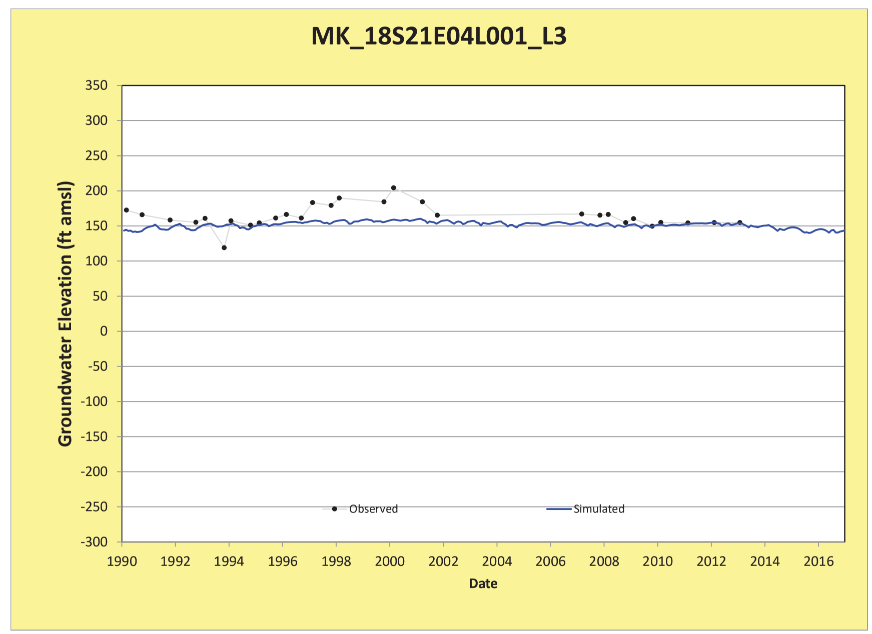

MK_17S22E35B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

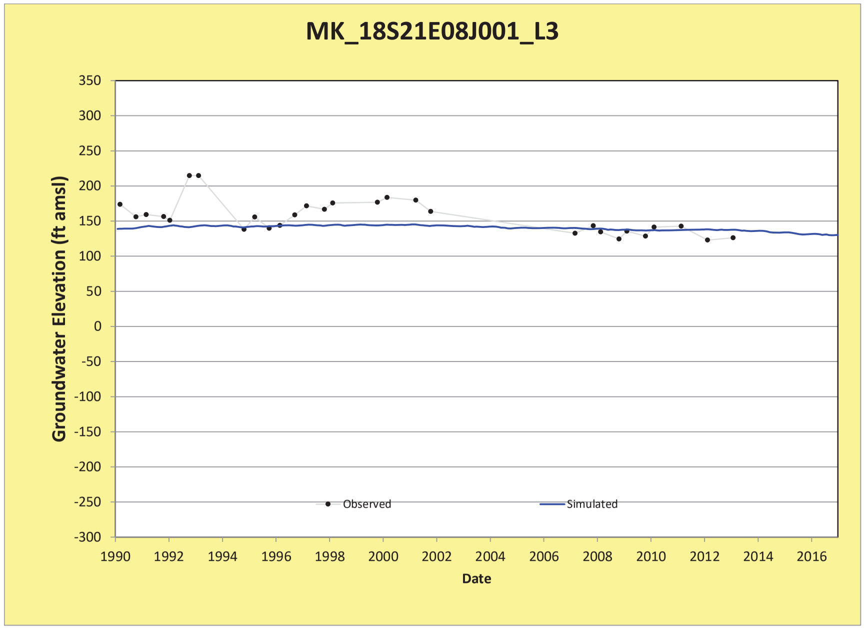

MK_17S23E18E001_L2
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

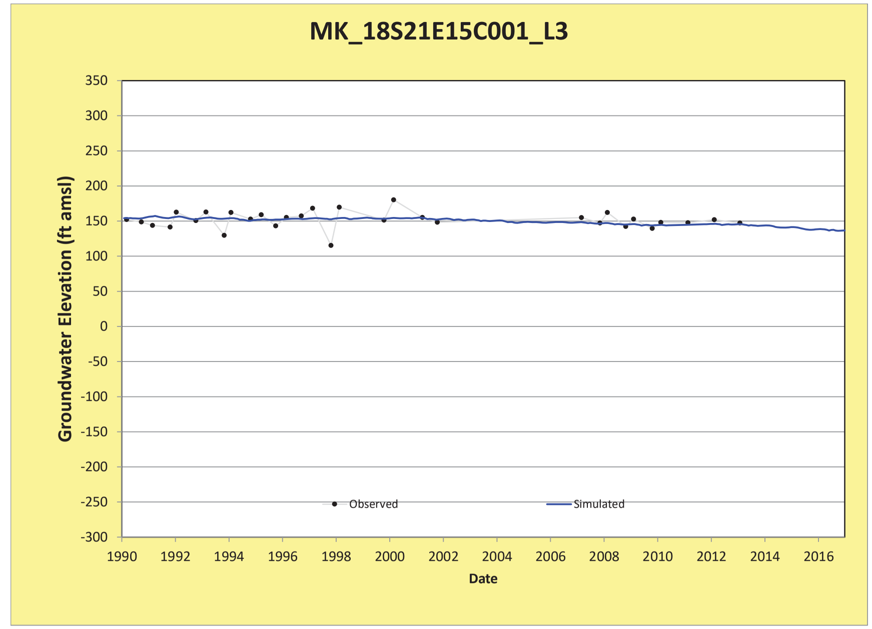

MK_18S21E01C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

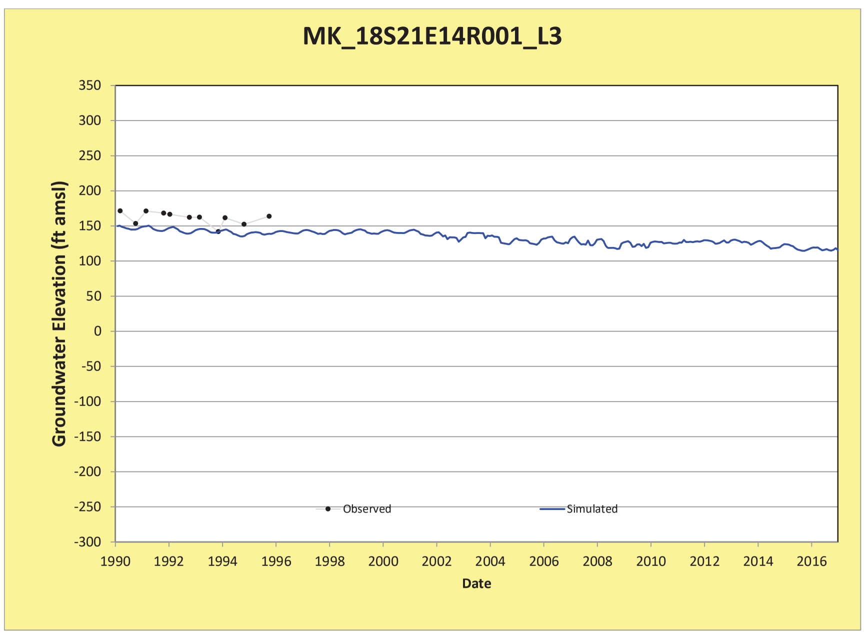

MK_18S21E03J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

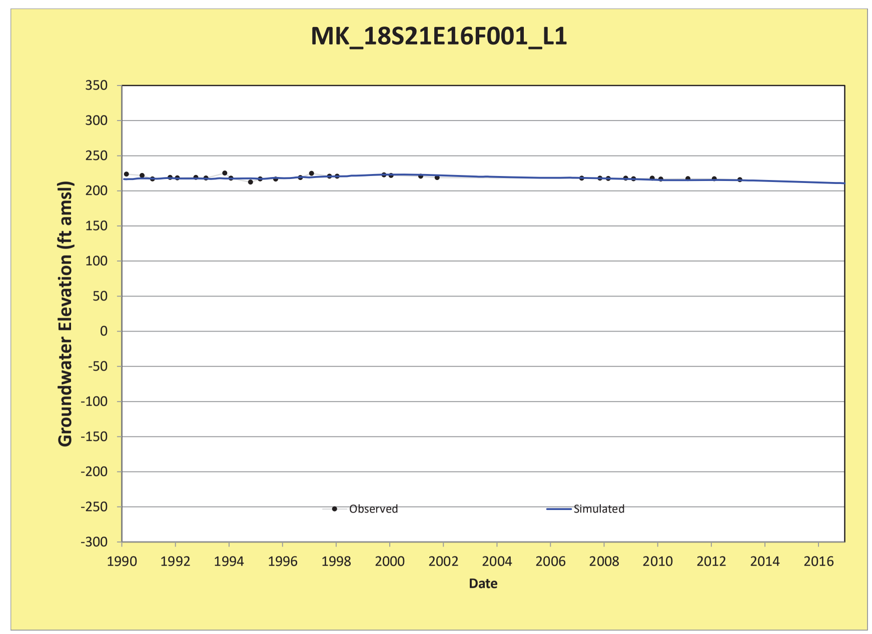

MK_18S21E02R001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

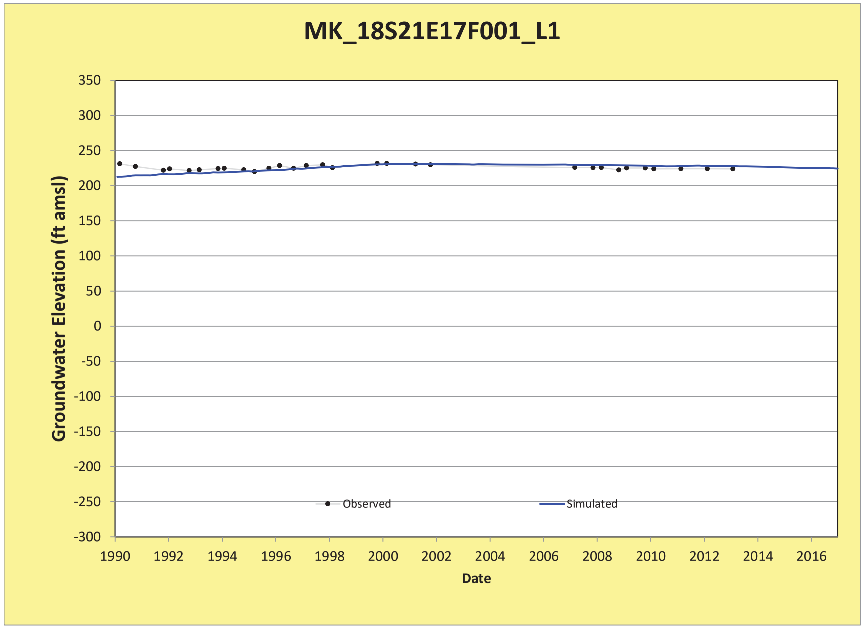

MK_18S21E04L001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

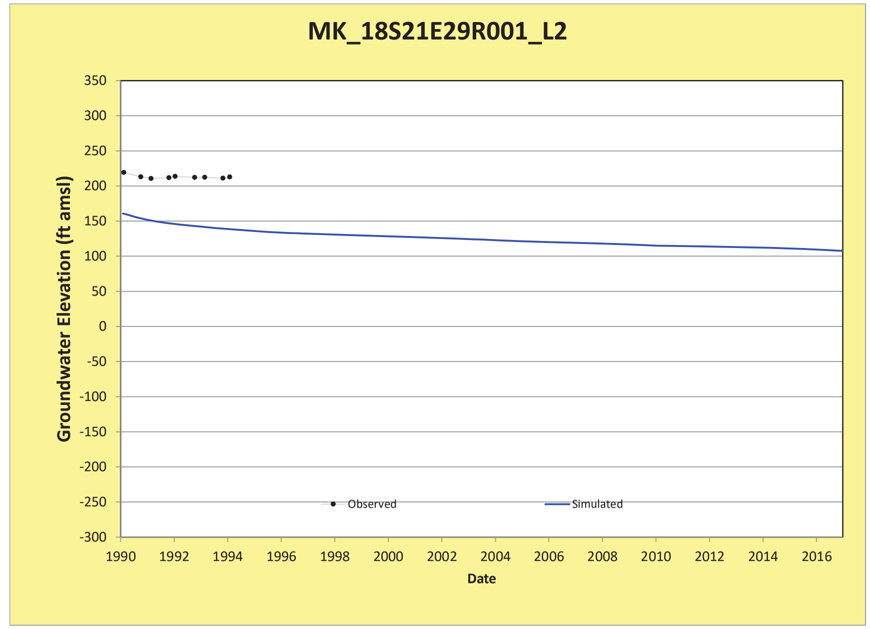

MK_18S21E08J001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

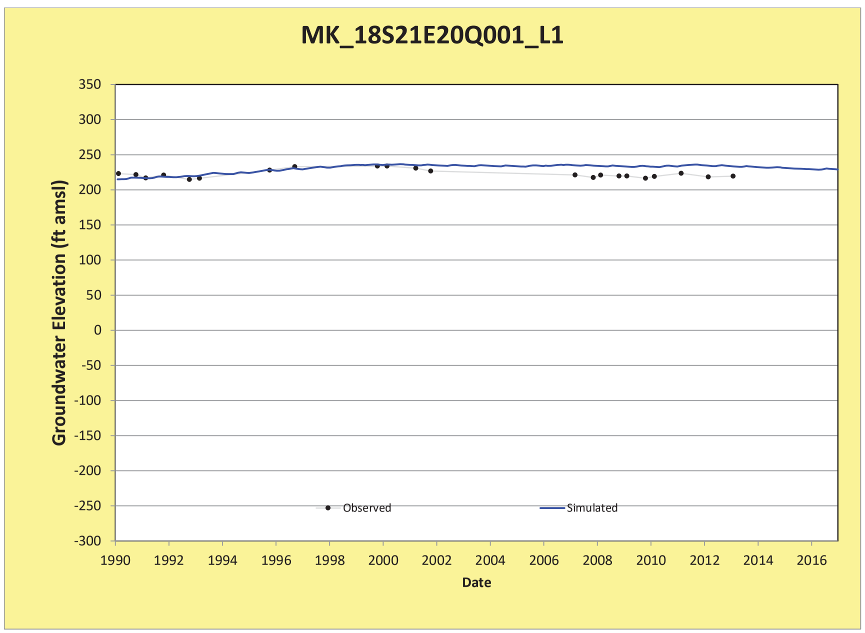

MK_18S21E15C001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

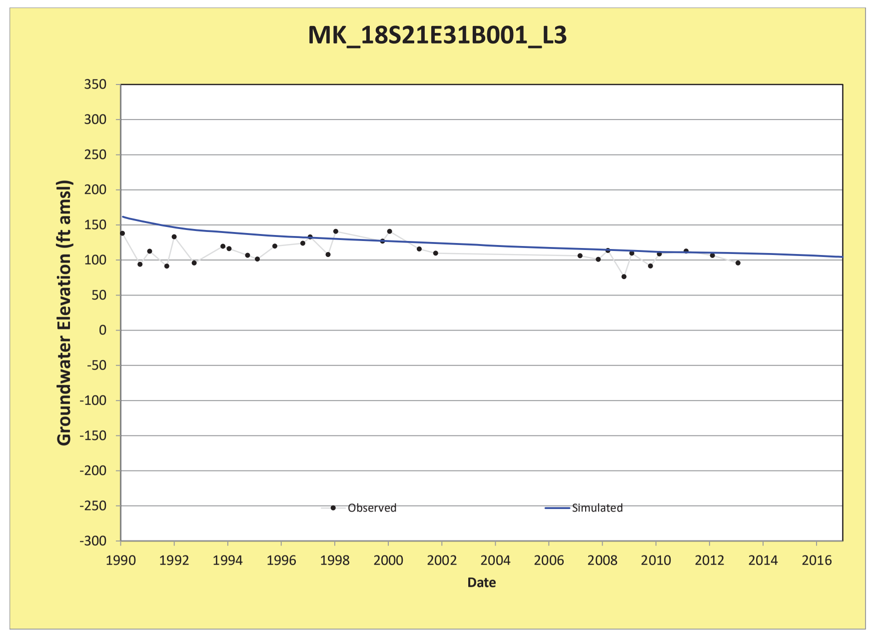

MK_18S21E14R001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

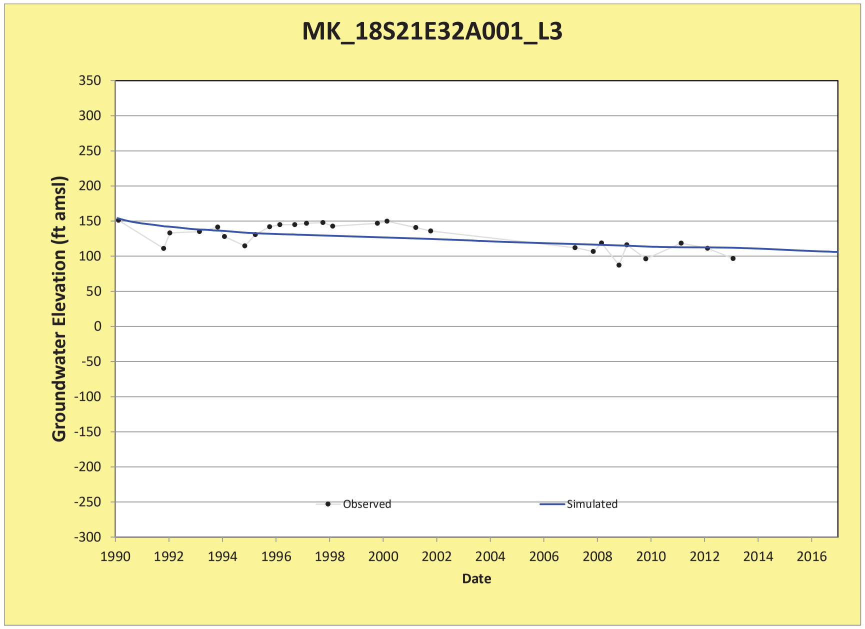

MK_18S21E16F001_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

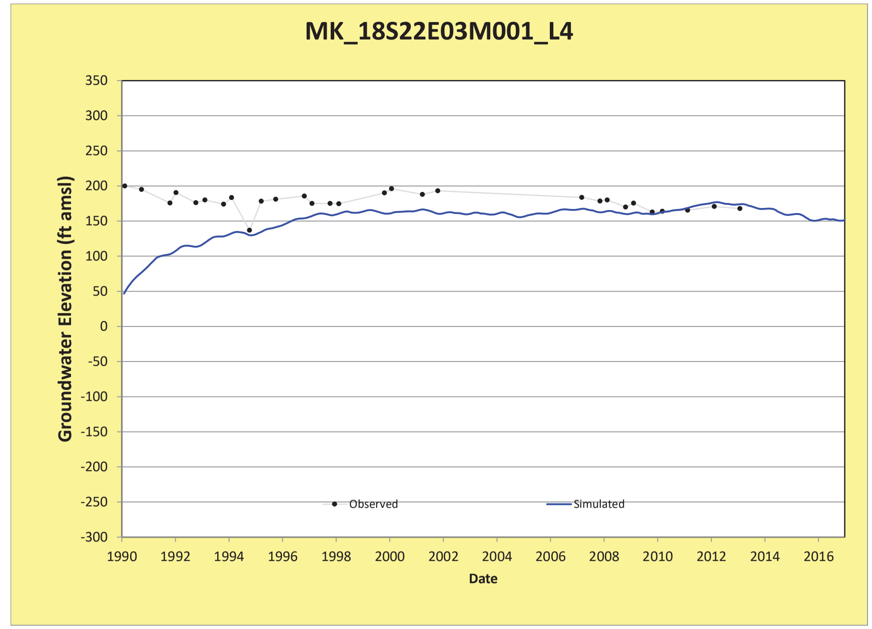

MK_18S21E17F001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

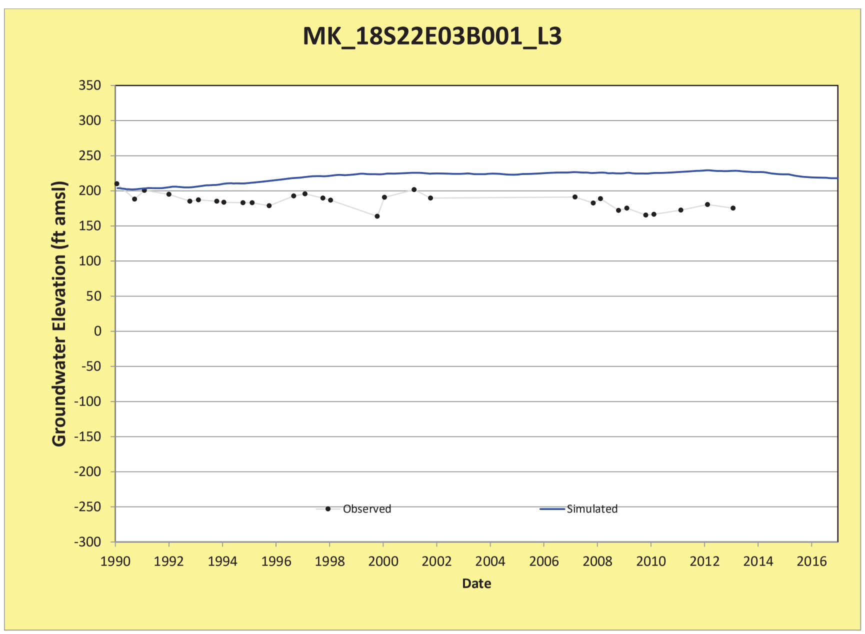

MK_18S21E29R001_L2
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

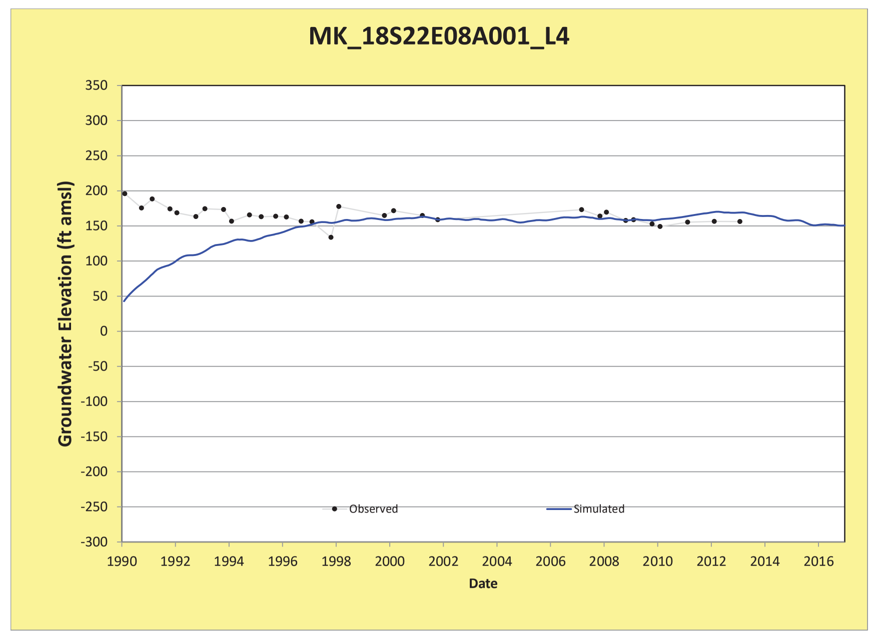

MK_18S21E20Q001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

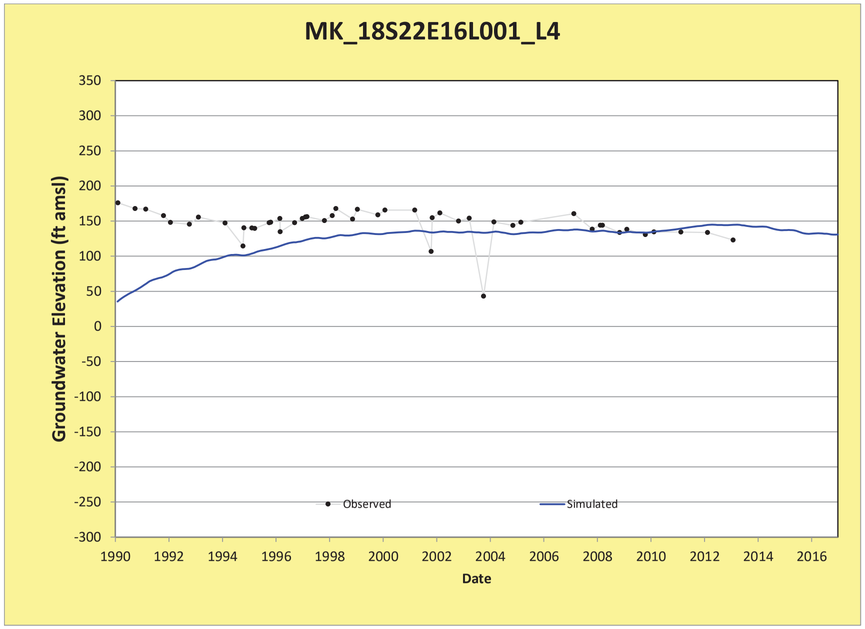

MK_18S21E31B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

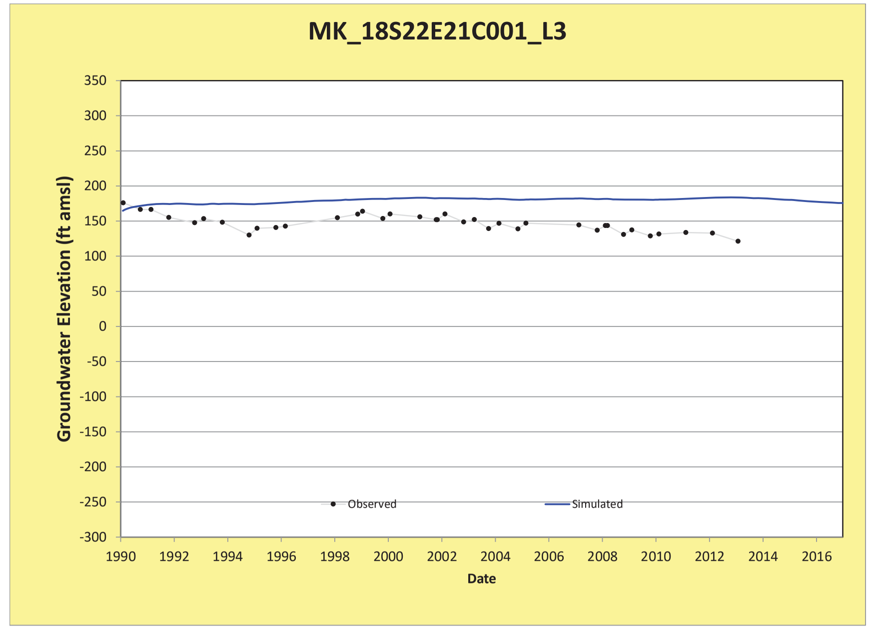

MK_18S21E32A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

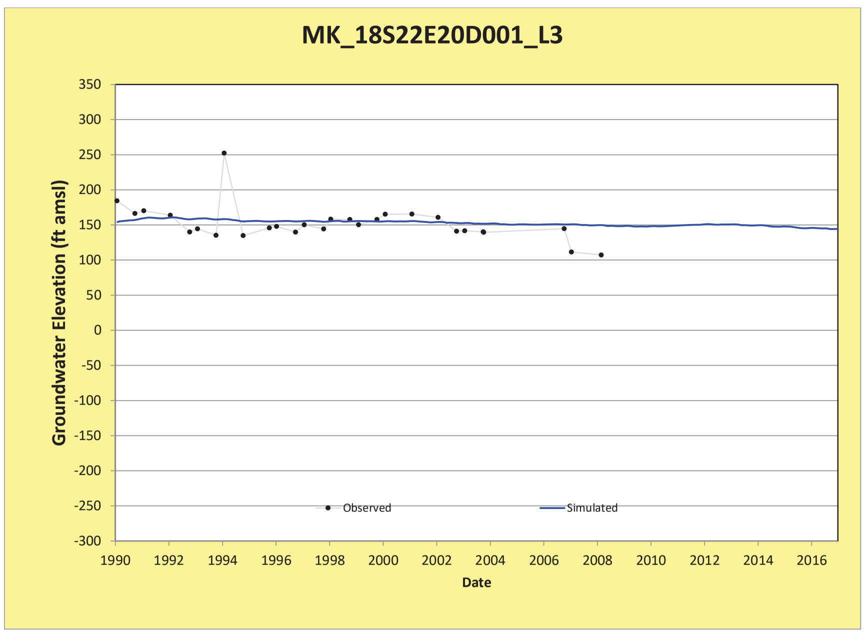

MK_18S22E03M001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

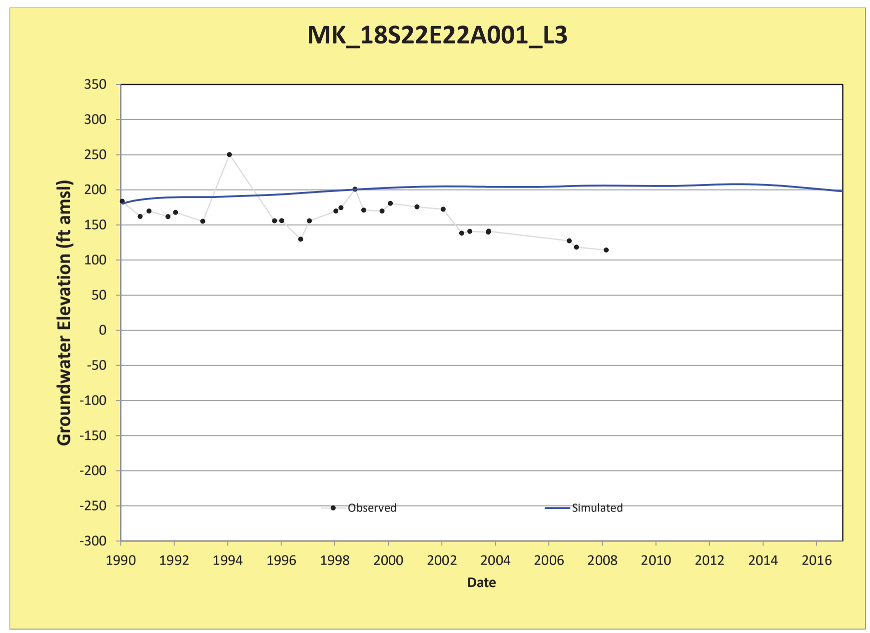

MK_18S22E03B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

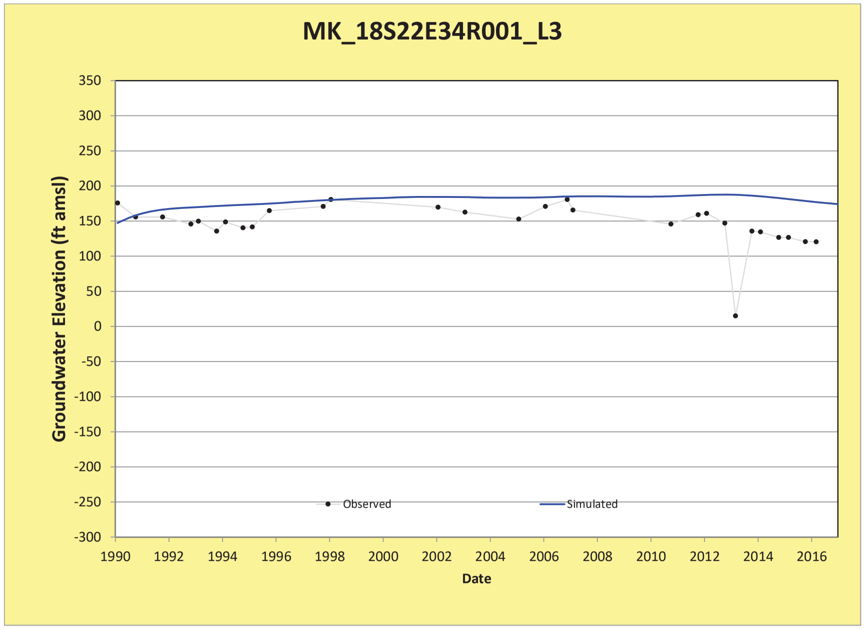

MK_18S22E08A001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

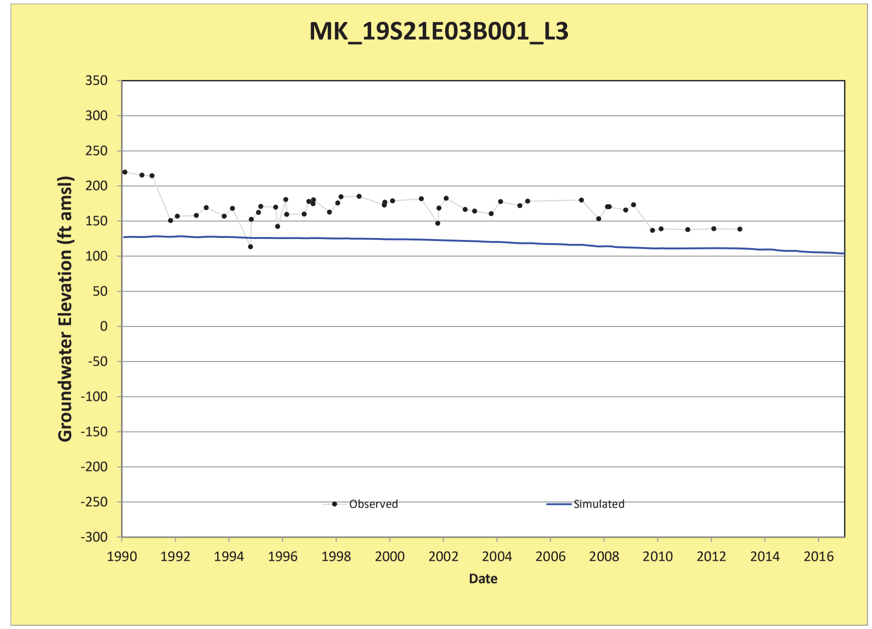

MK_18S22E16L001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

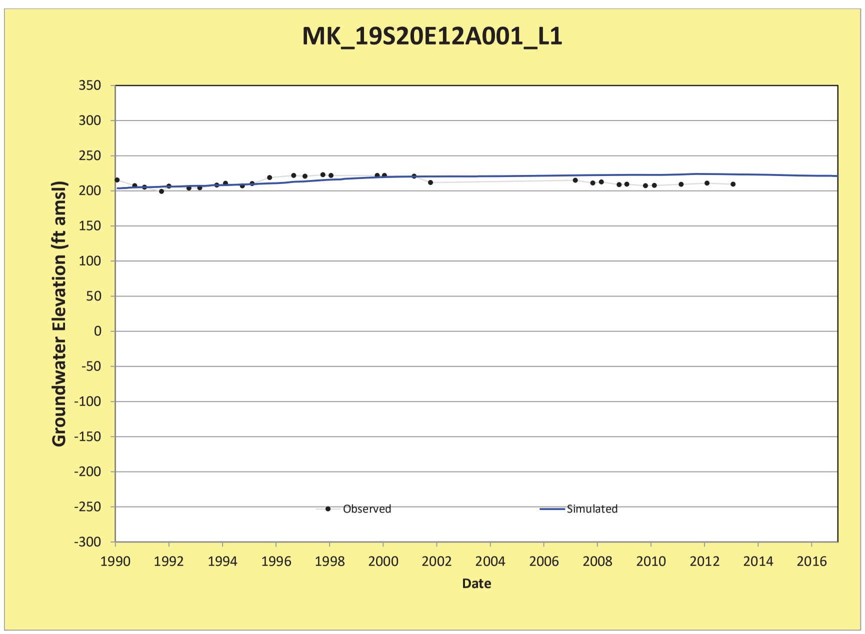

MK_18S22E21C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

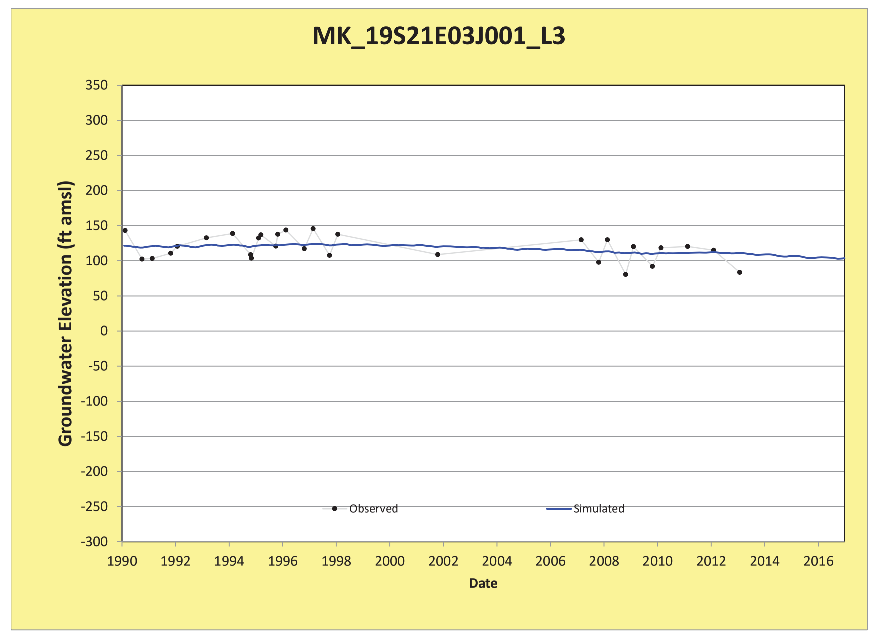

MK_18S22E20D001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

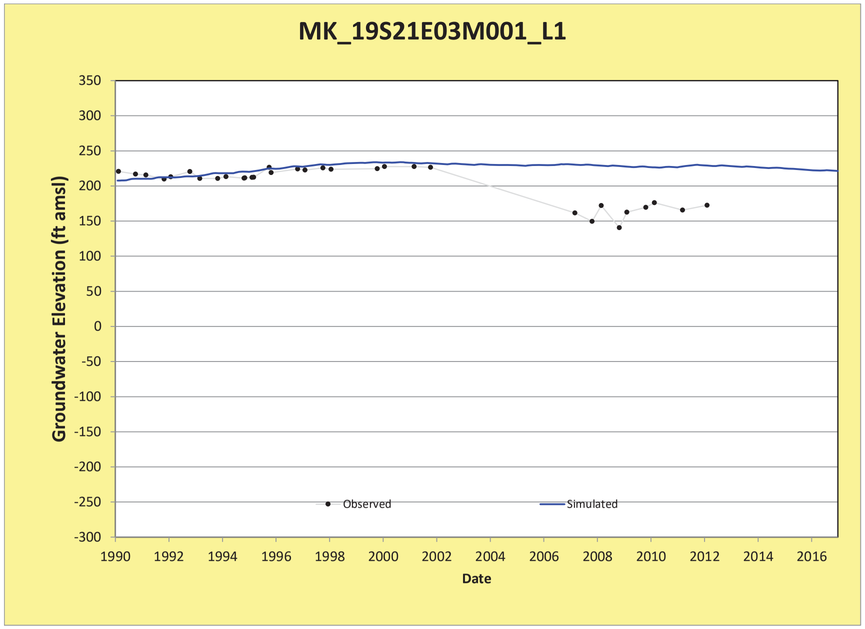

MK_18S22E22A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

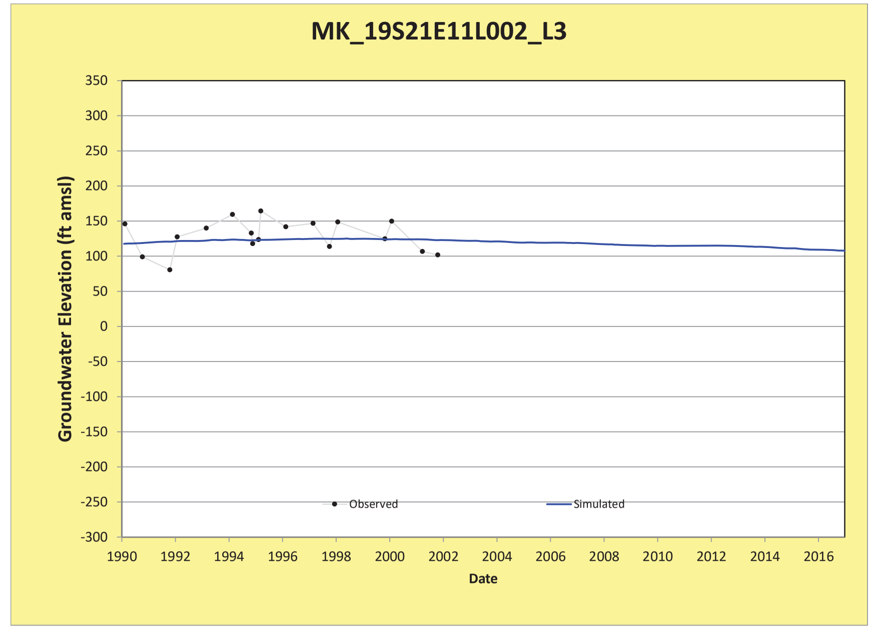

MK_18S22E34R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

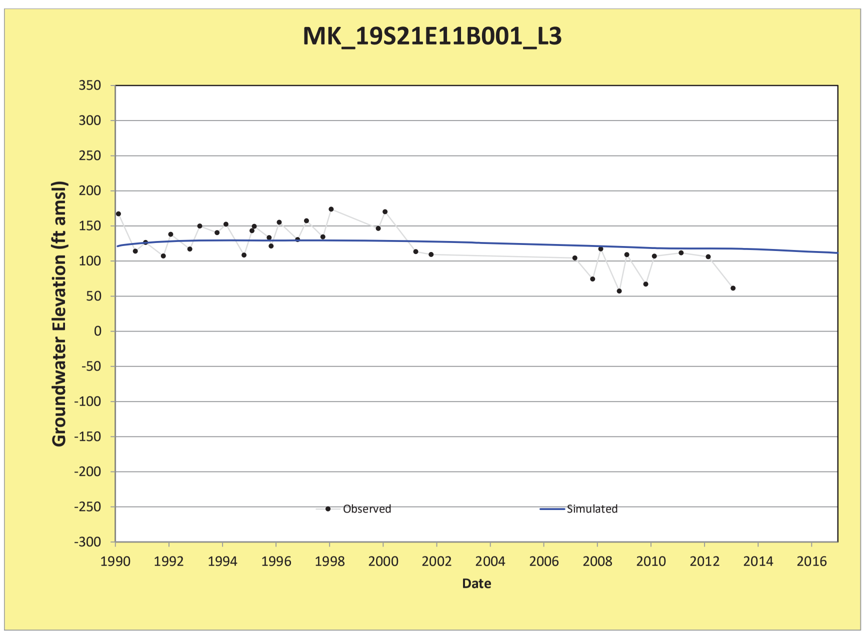

MK_19S21E03B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

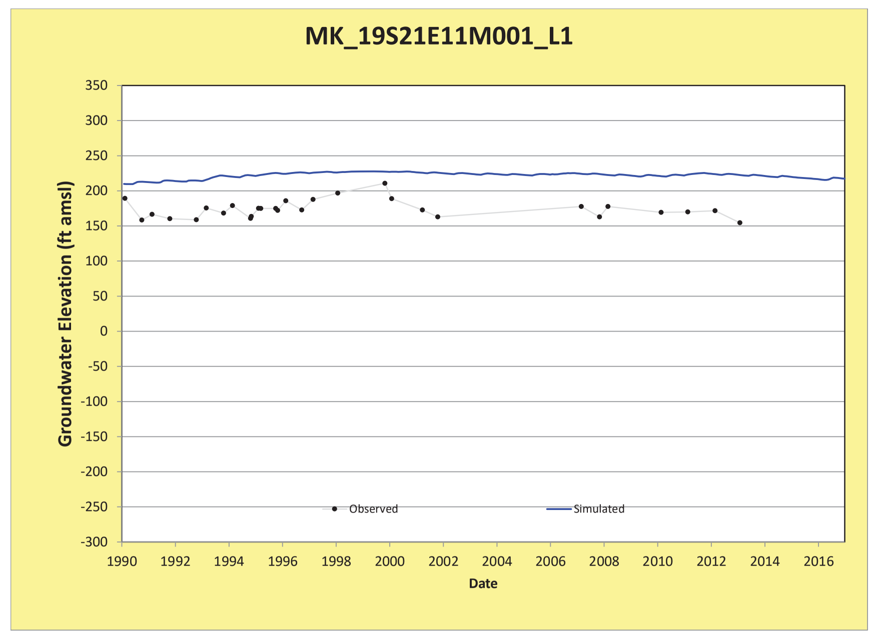

MK_19S20E12A001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

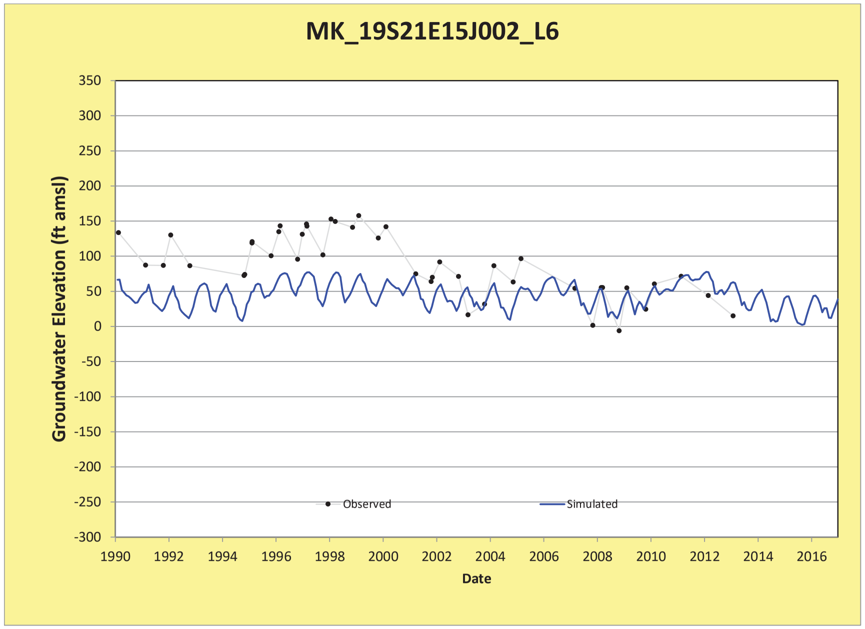

MK_19S21E03J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

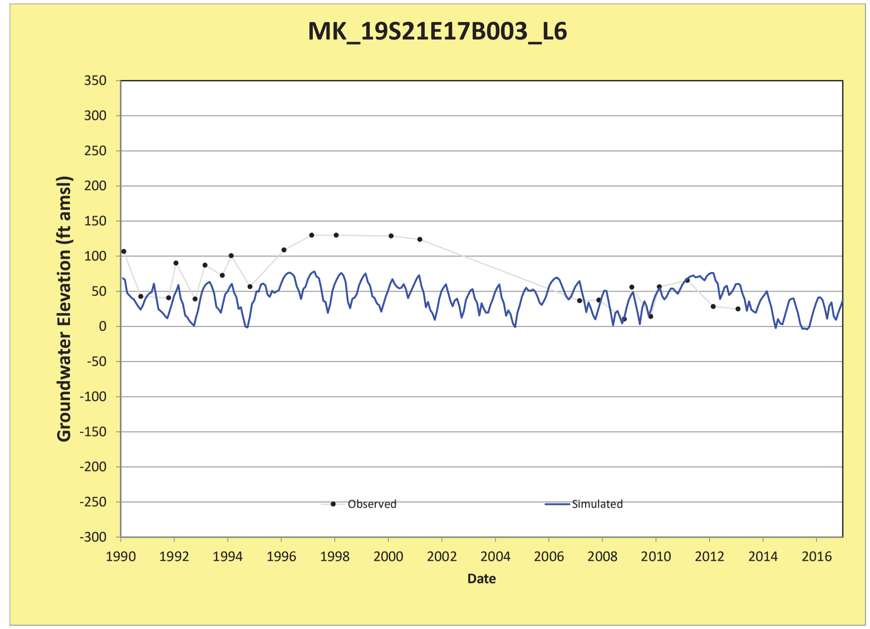

MK_19S21E03M001_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

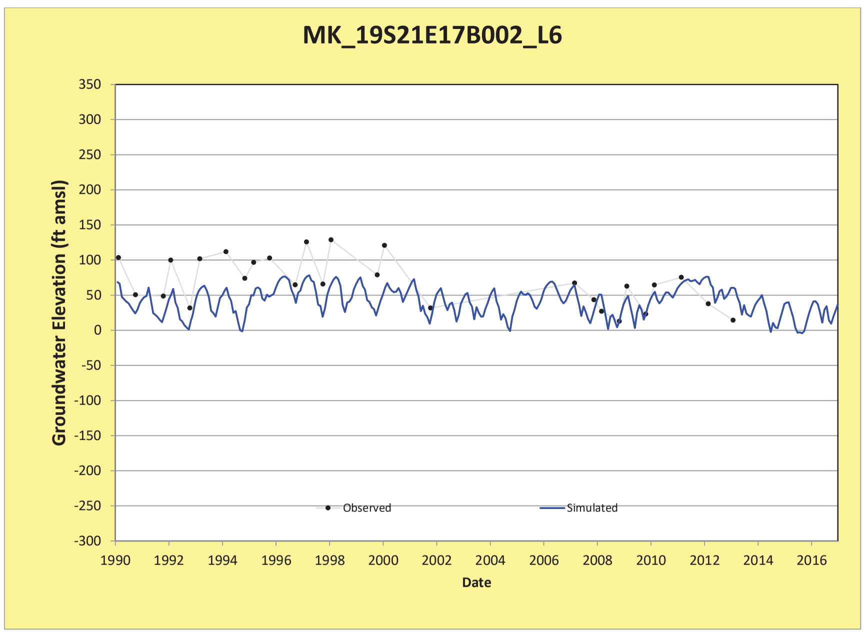

MK_19S21E11L002_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

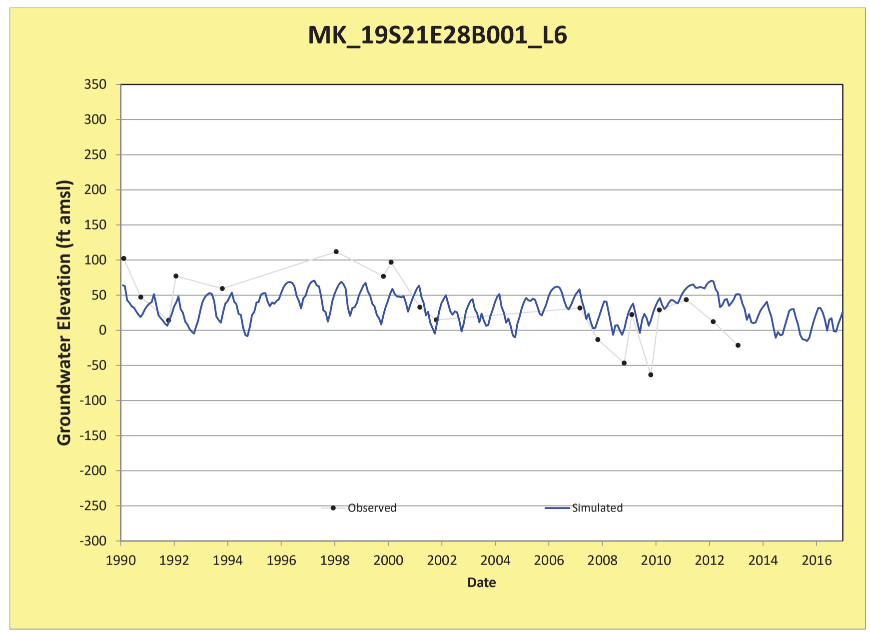

MK_19S21E11B001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

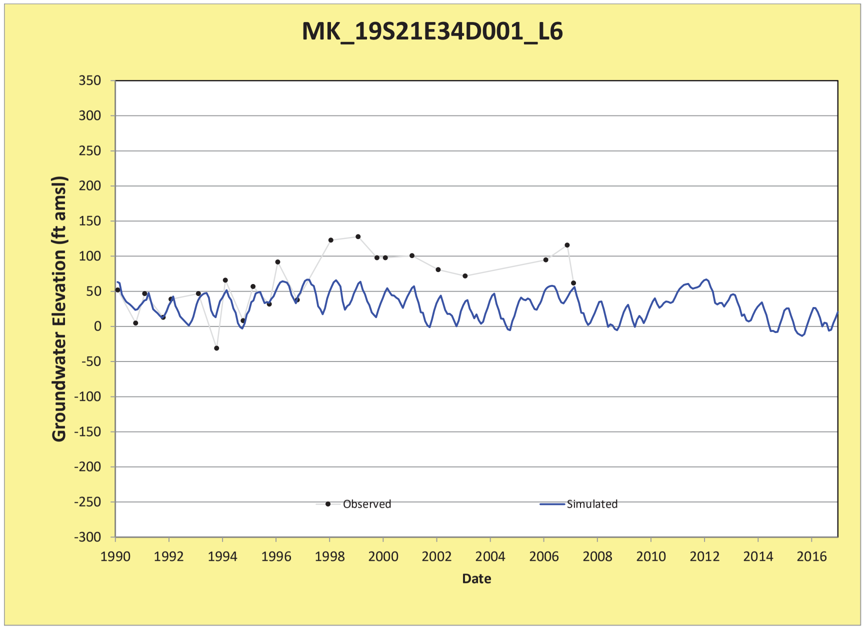

MK_19S21E11M001_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

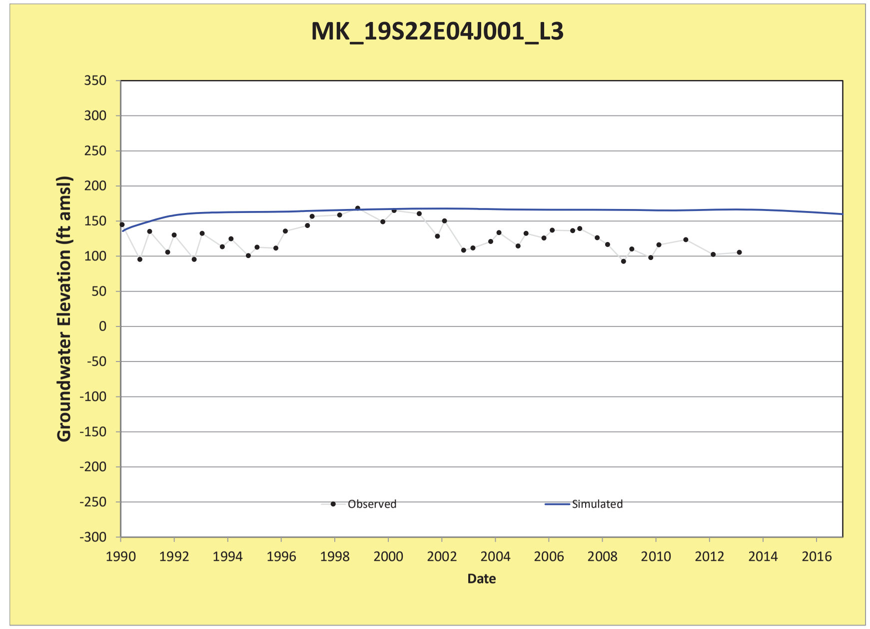

MK_19S21E15J002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

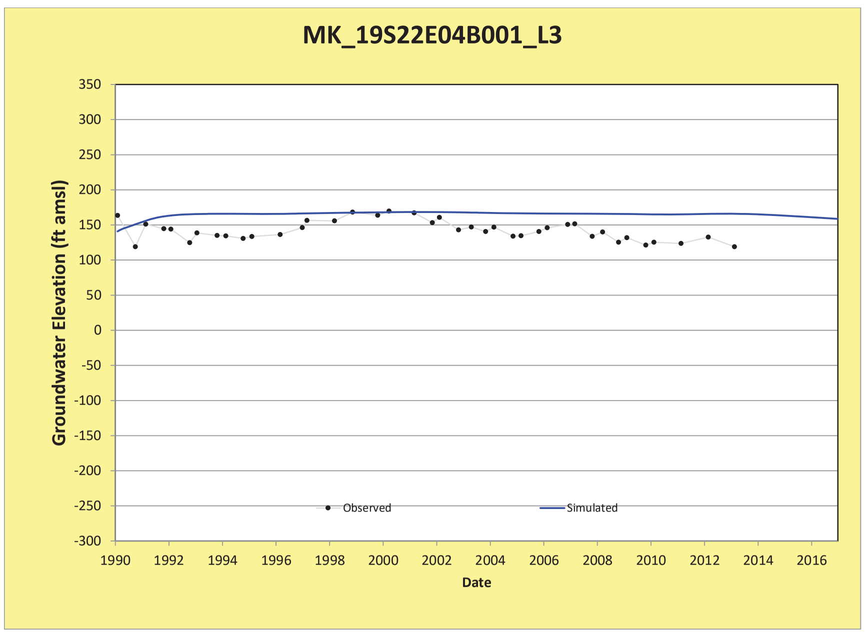

MK_19S21E17B003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

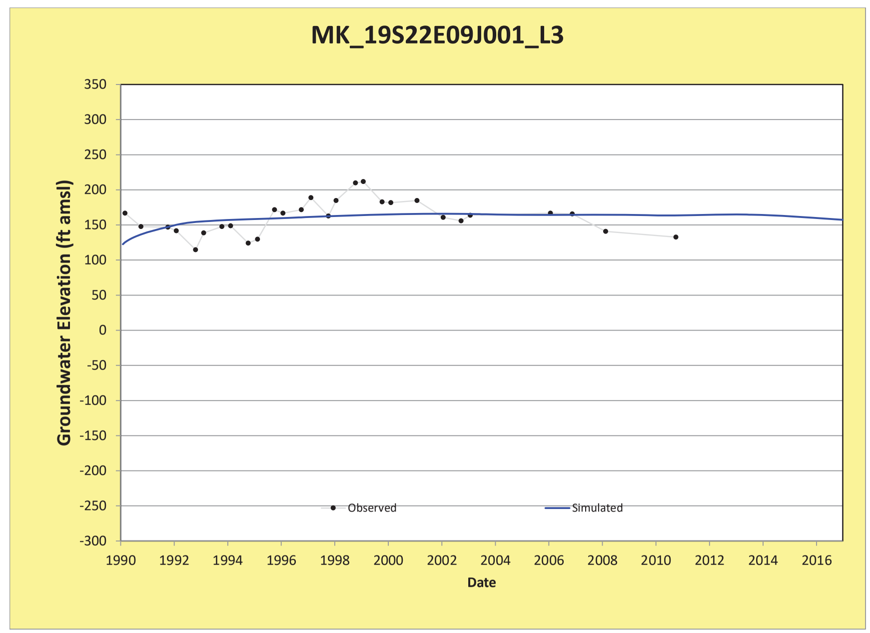

MK_19S21E17B002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

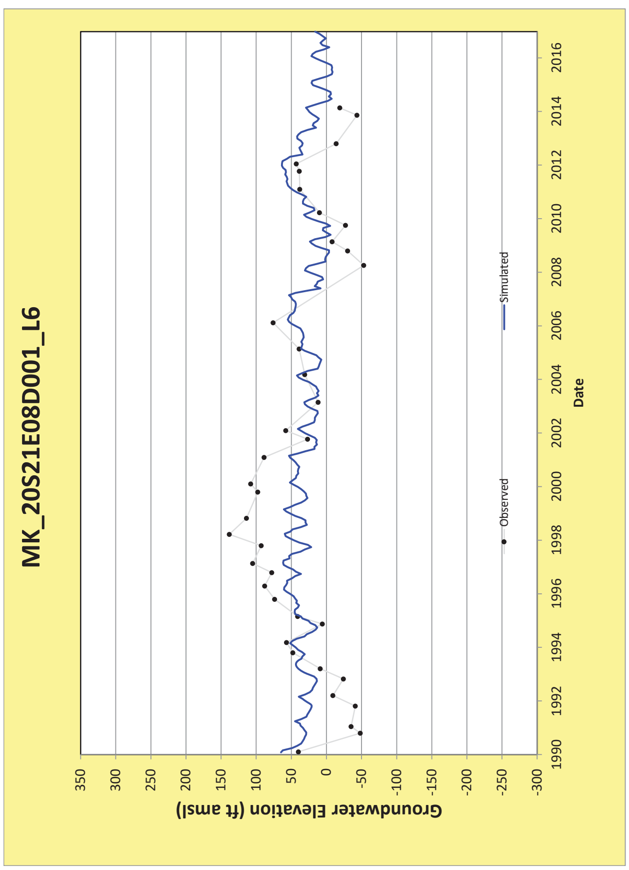

MK_19S21E28B001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

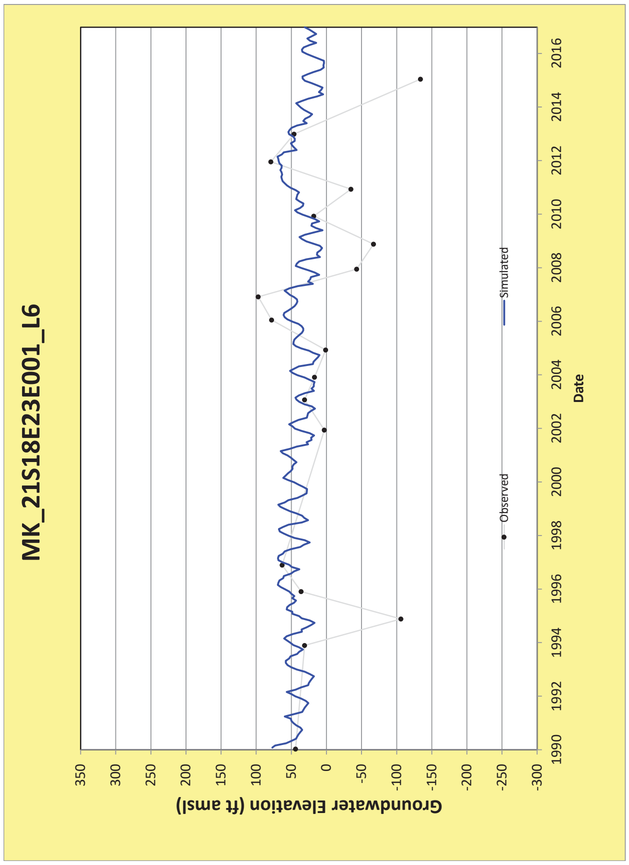

MK_19S21E34D001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

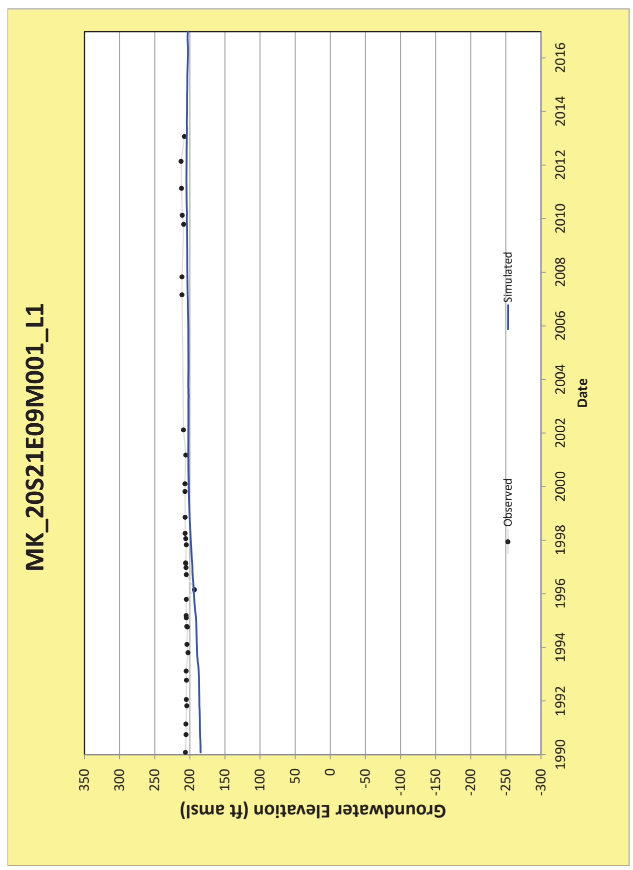

MK_19S22E04J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

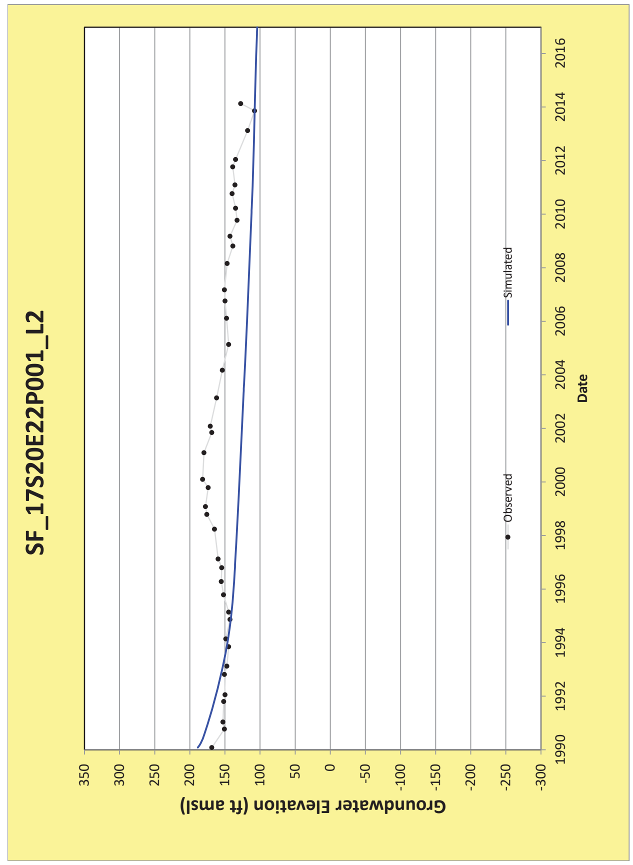

MK_19S22E04B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

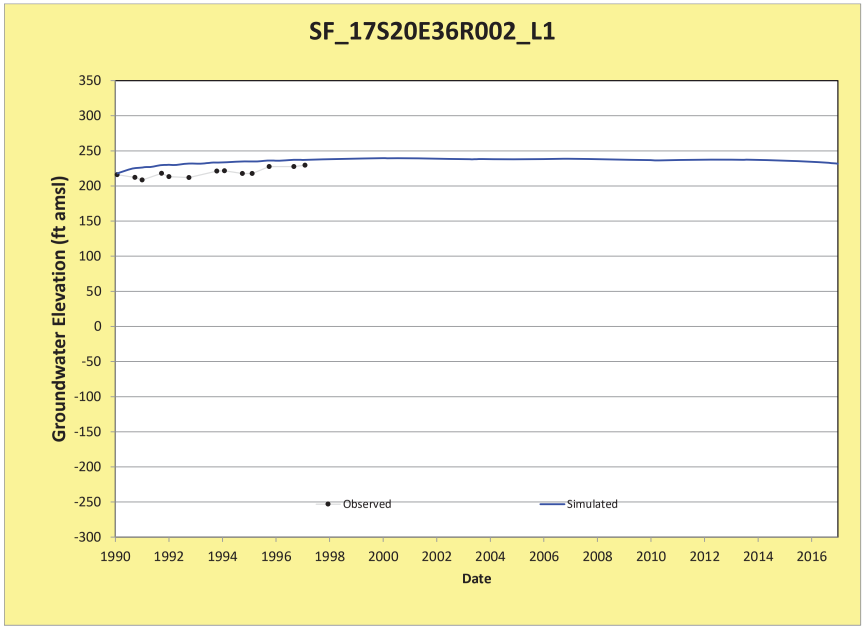

MK_19S22E09J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

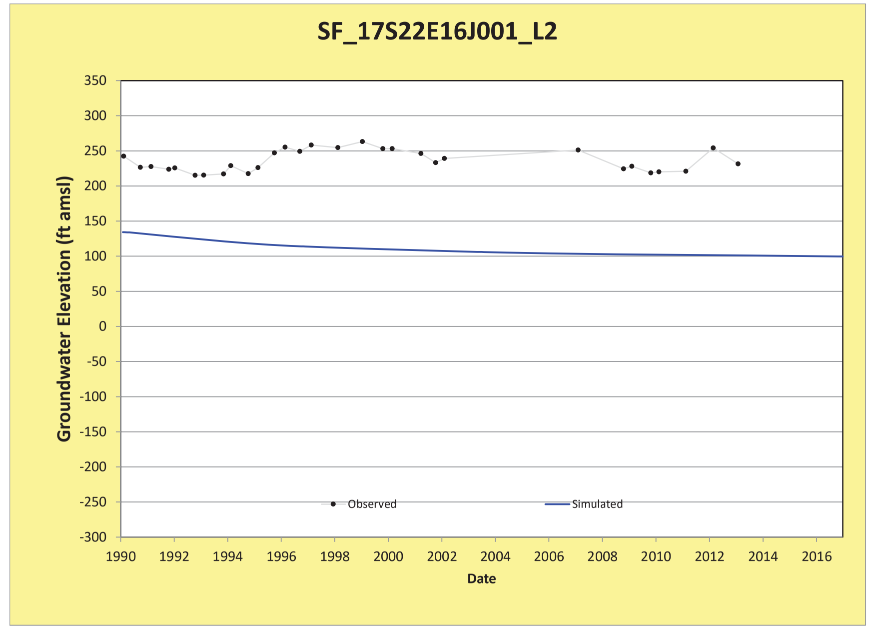

MK_20S21E08D001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

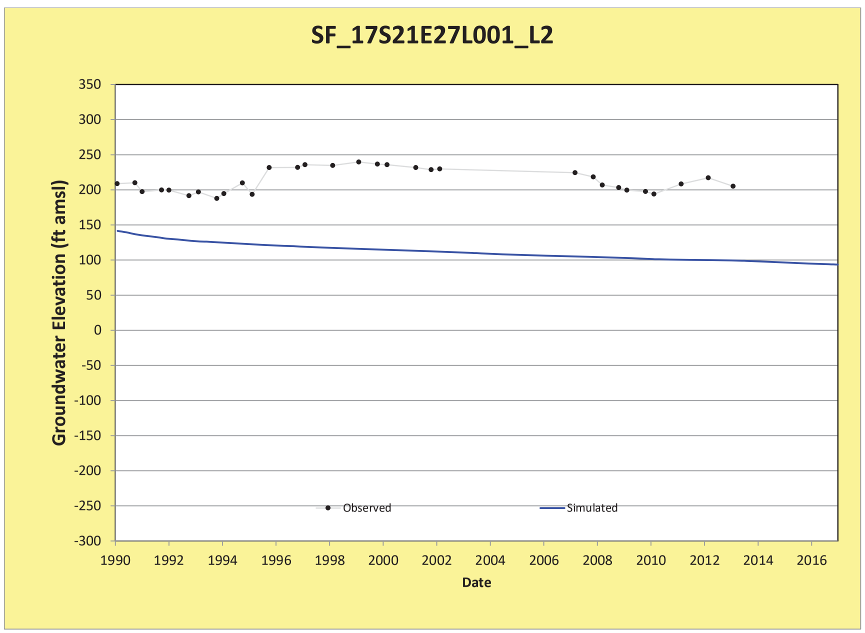

MK_21S18E23E001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

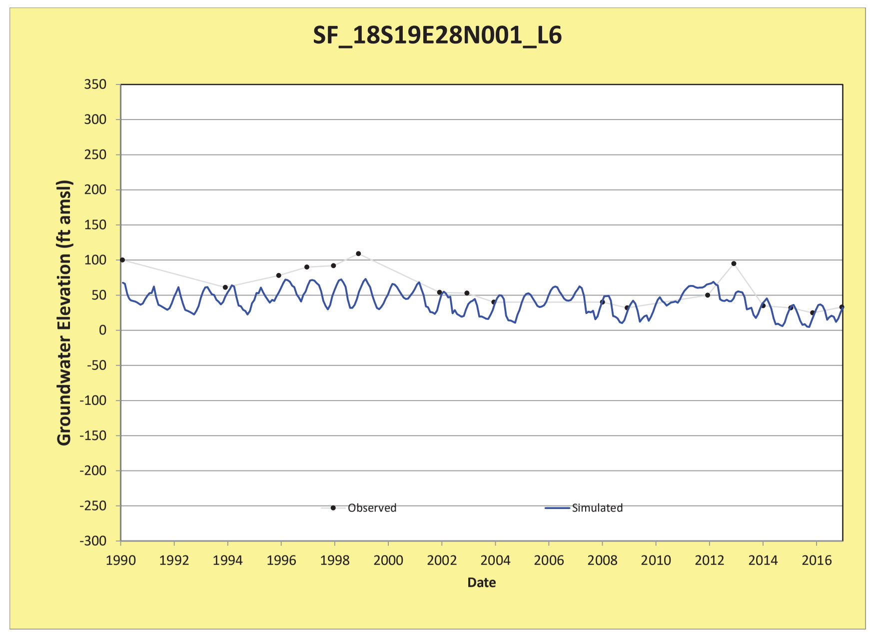

MK_20S21E09M001_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

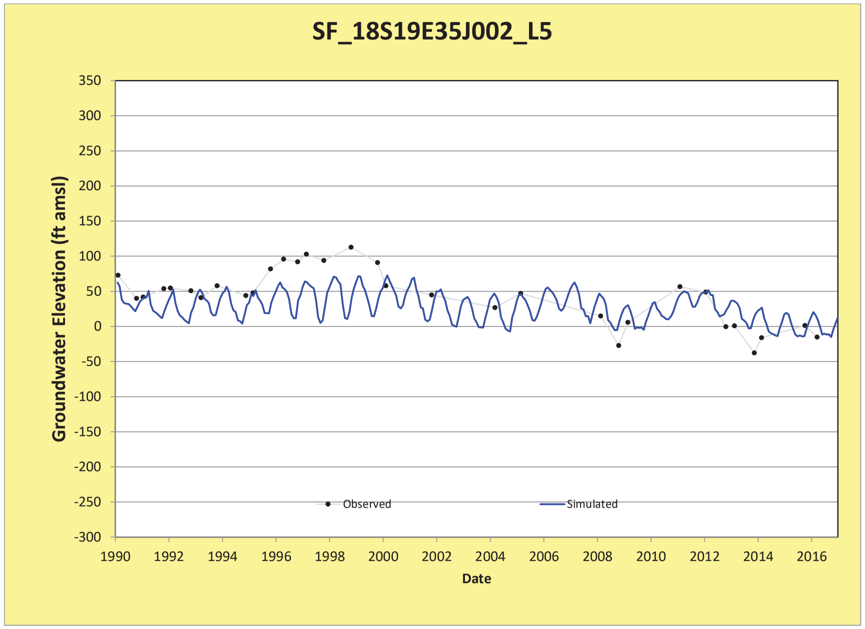

SF_17S20E22P001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

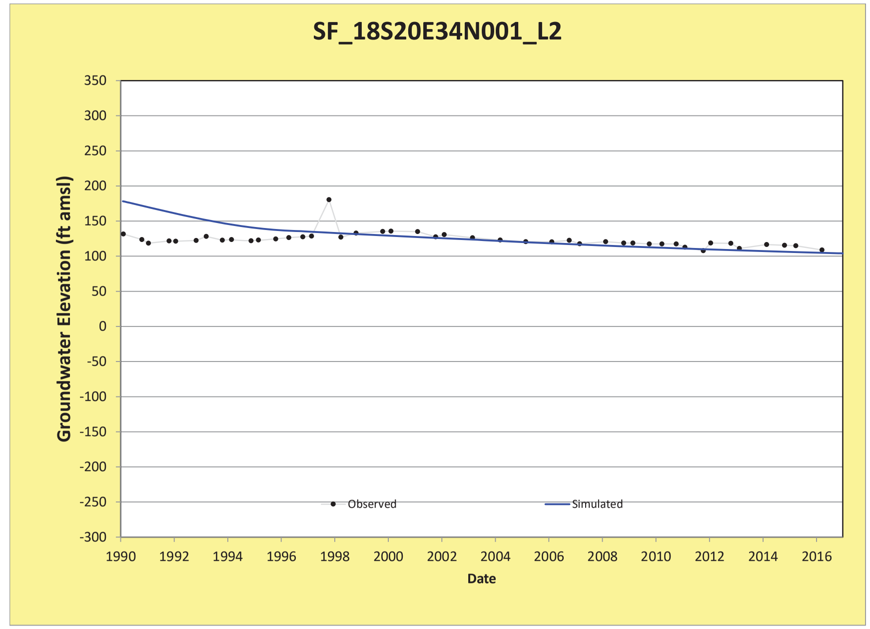

SF_17S20E36R002_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

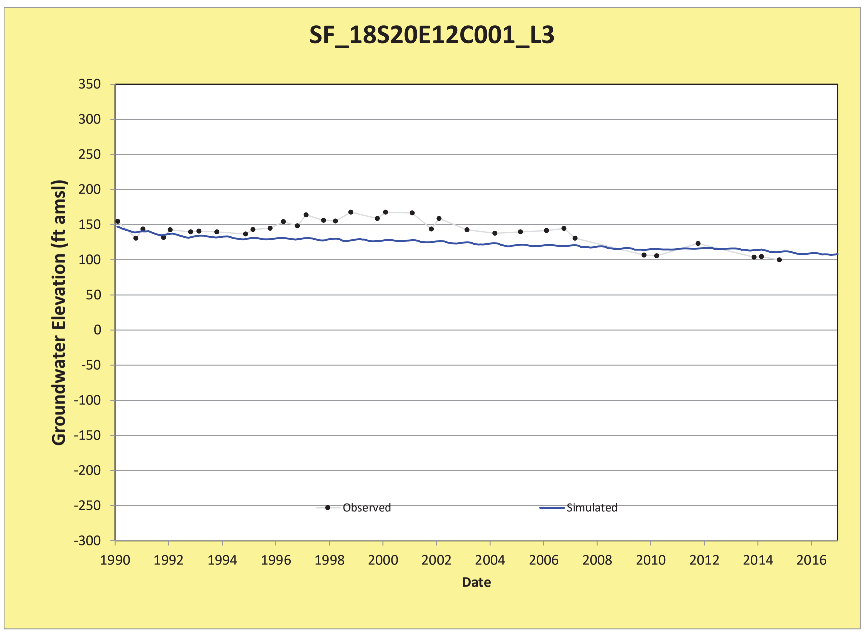

SF_17S22E16J001_L2
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

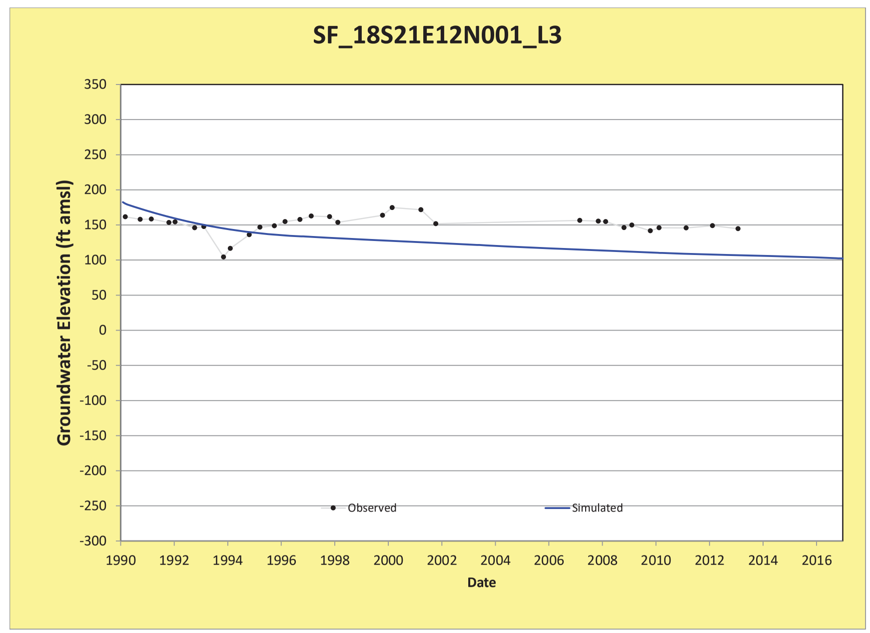

SF_17S21E27L001_L2
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

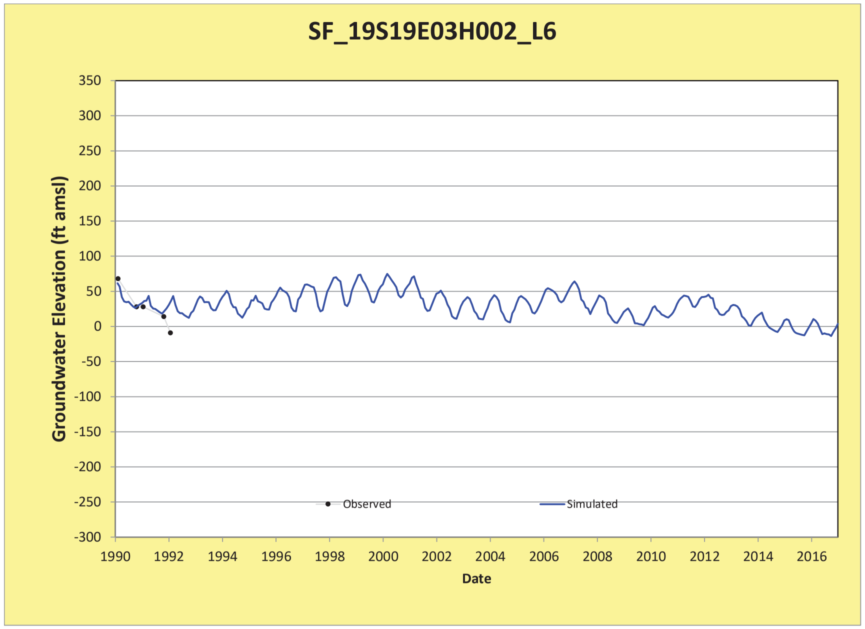

SF_18S19E28N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

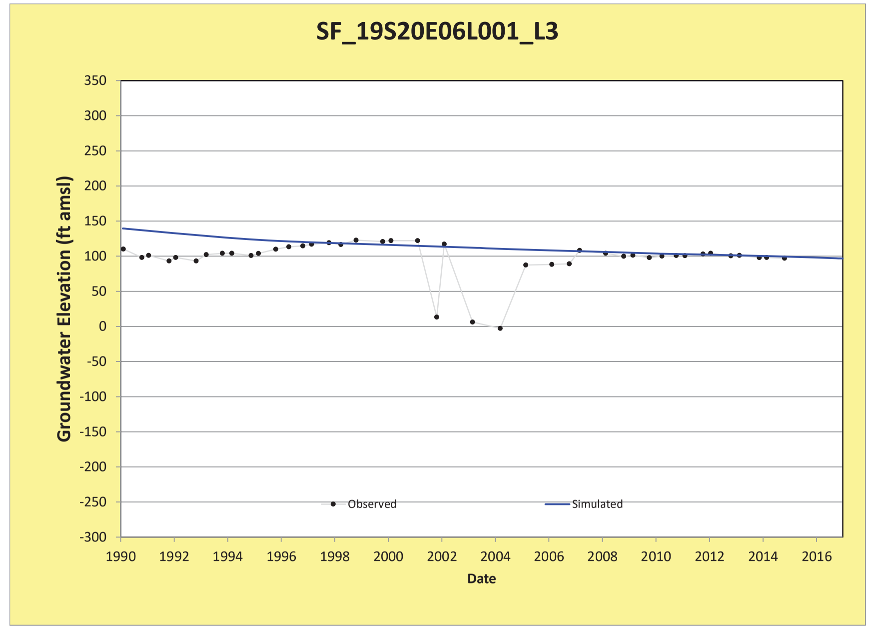

SF_18S19E35J002_L5
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

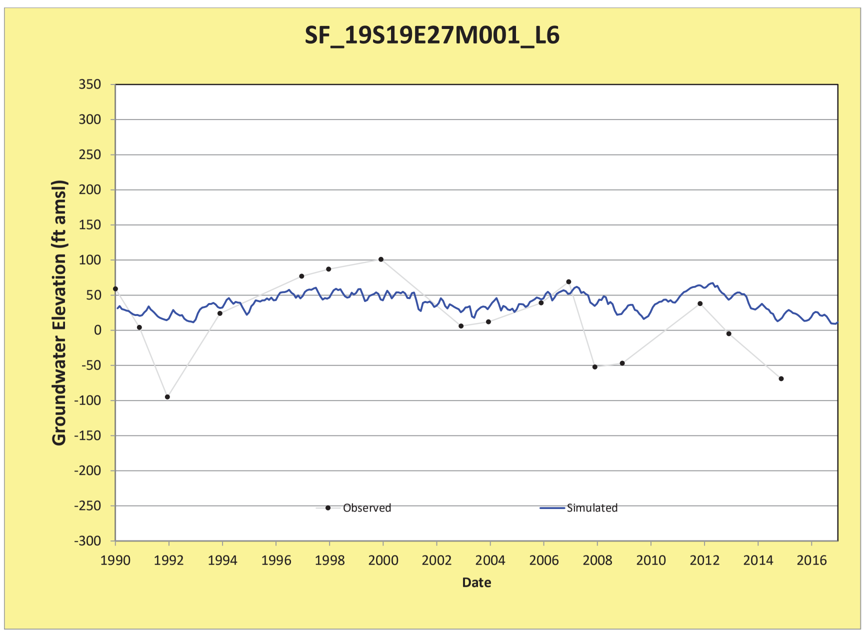

SF_18S20E34N001_L2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

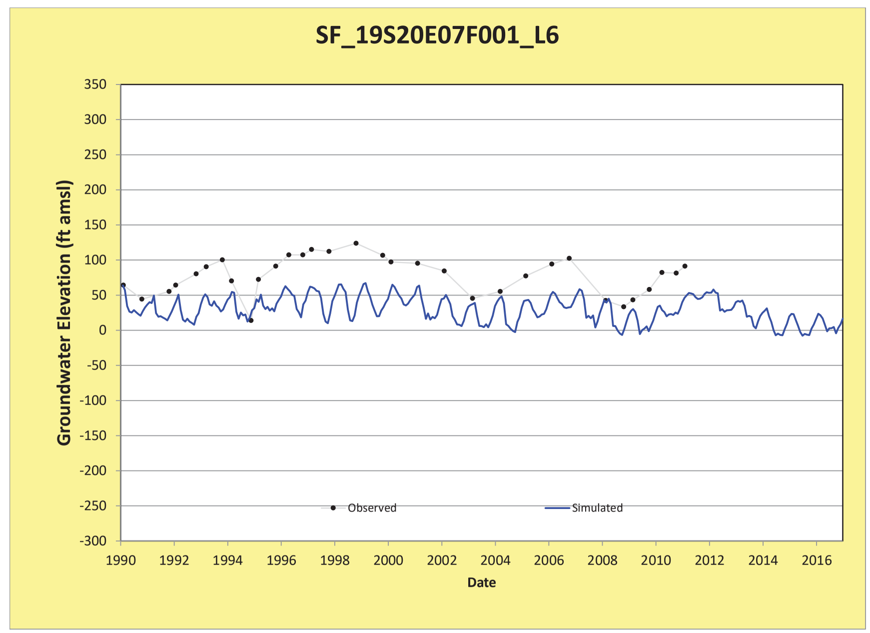

SF_18S20E12C001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

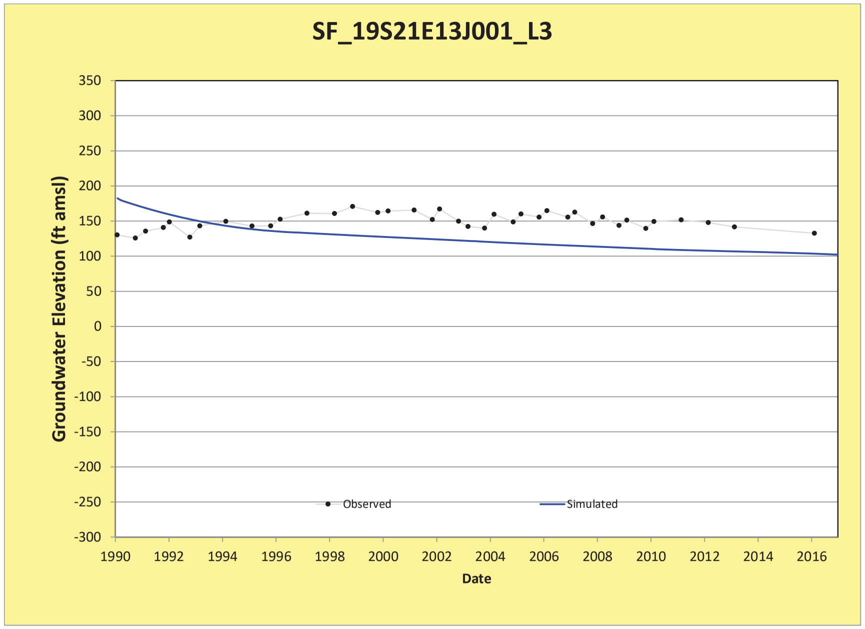

SF_18S21E12N001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

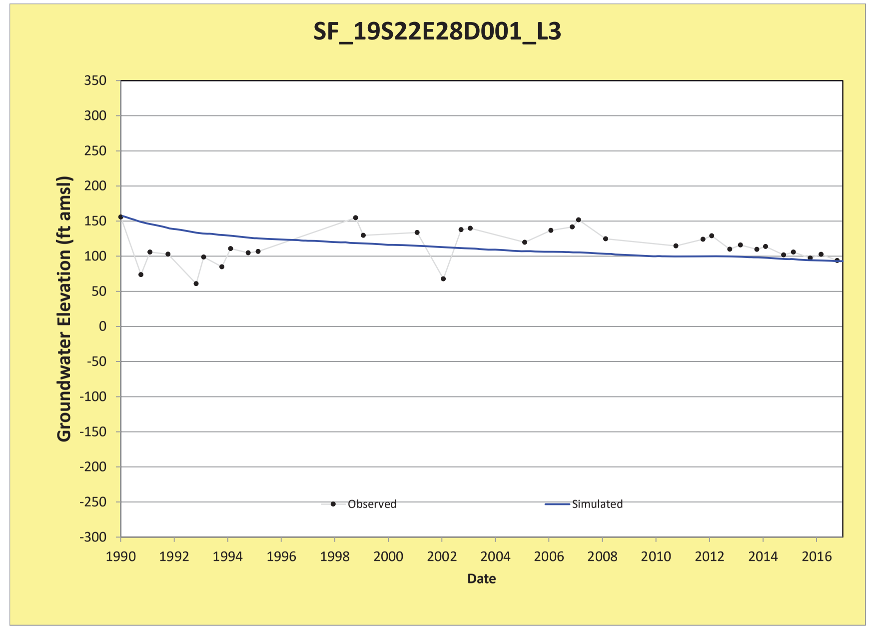

SF_19S19E03H002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

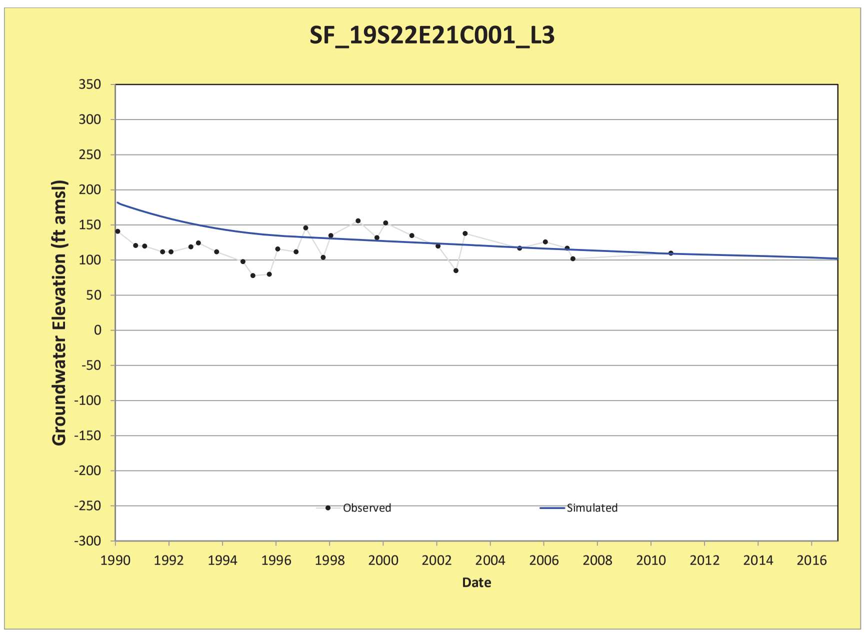

SF_19S20E06L001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

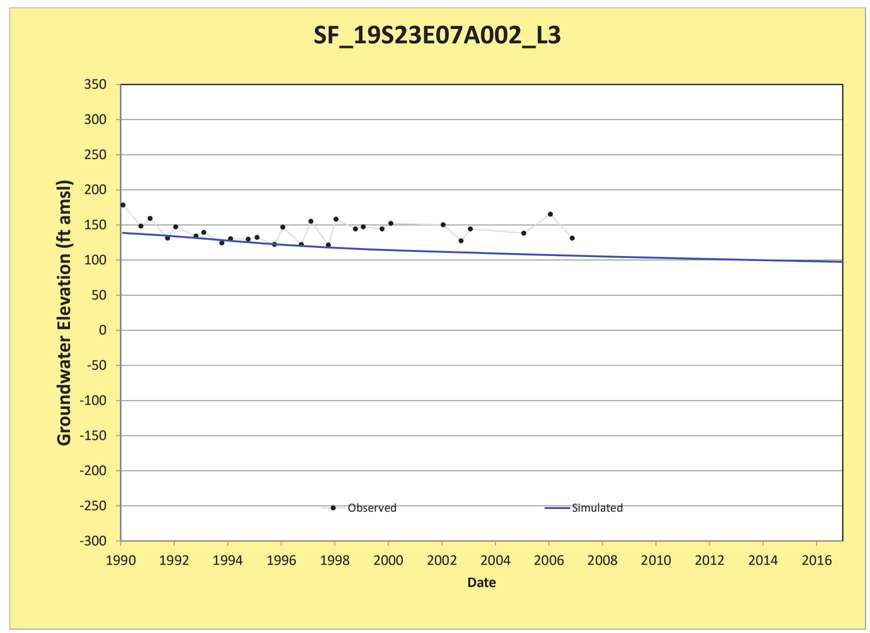

SF_19S19E27M001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

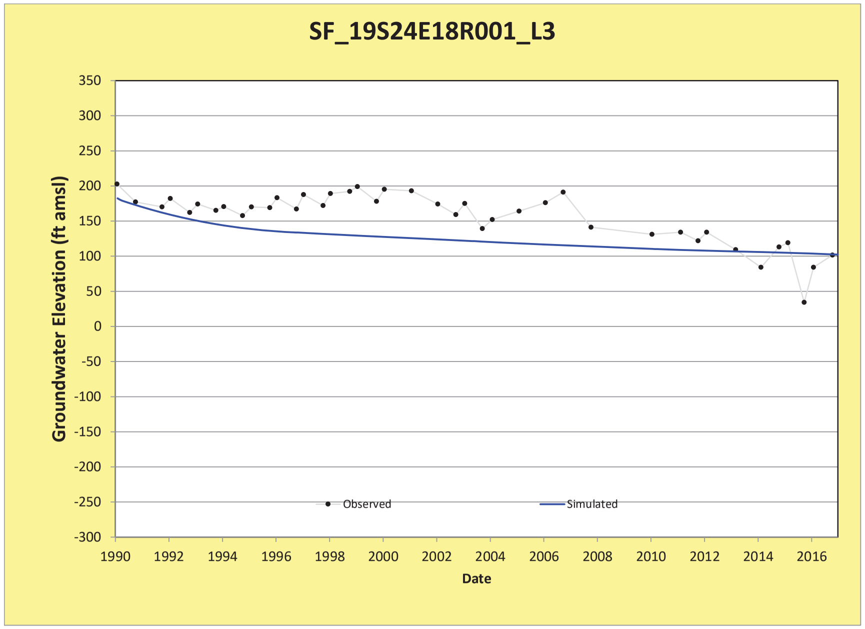

SF_19S20E07F001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

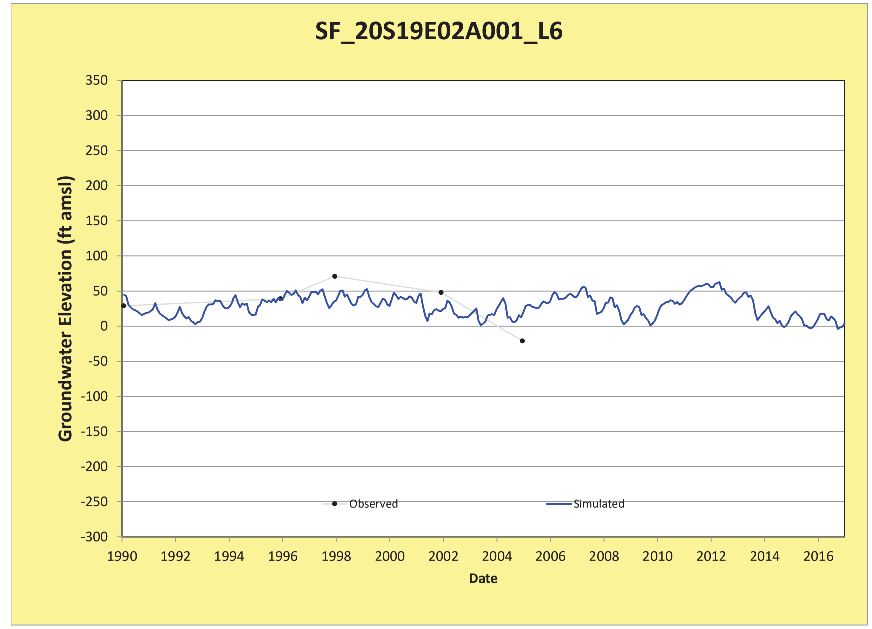

SF_19S21E13J001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

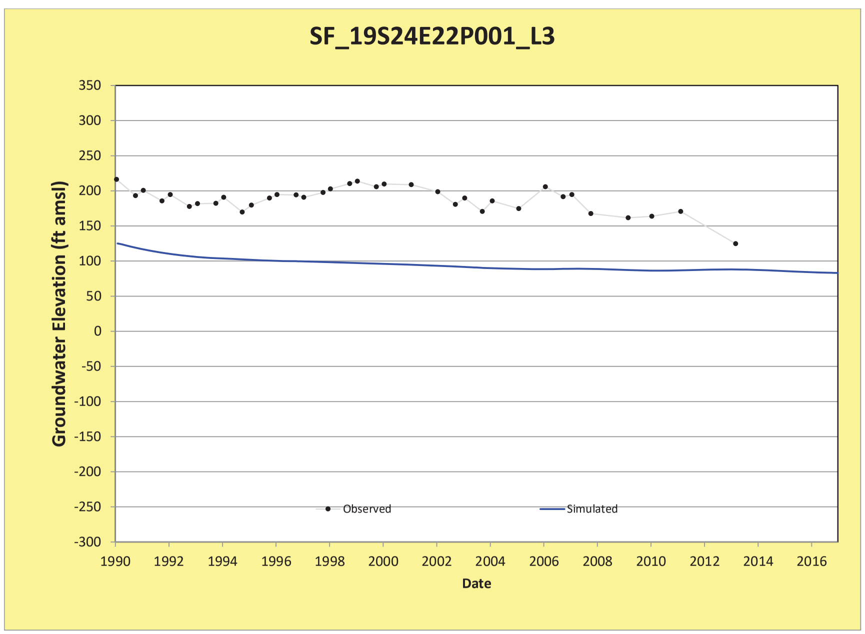

SF_19S22E28D001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

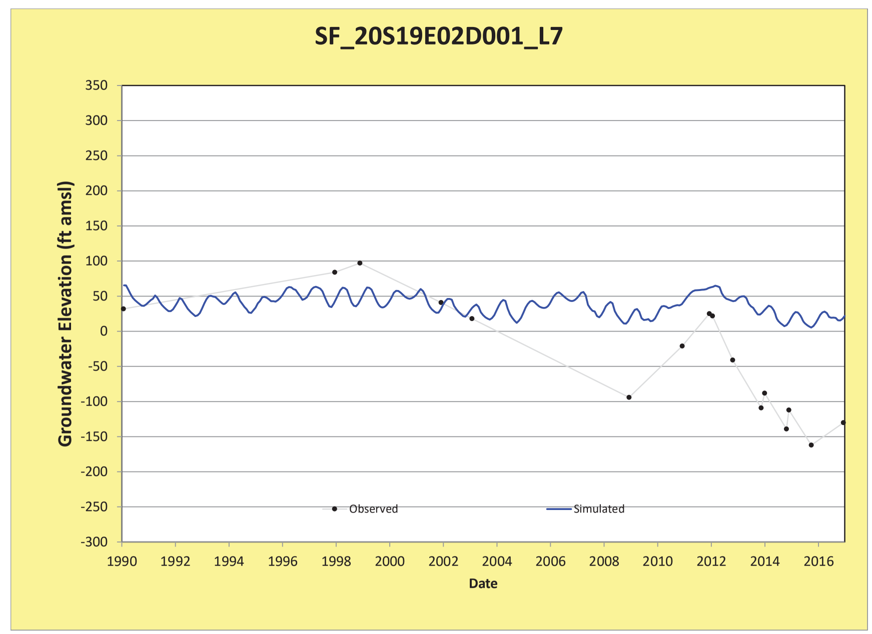

SF_19S22E21C001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

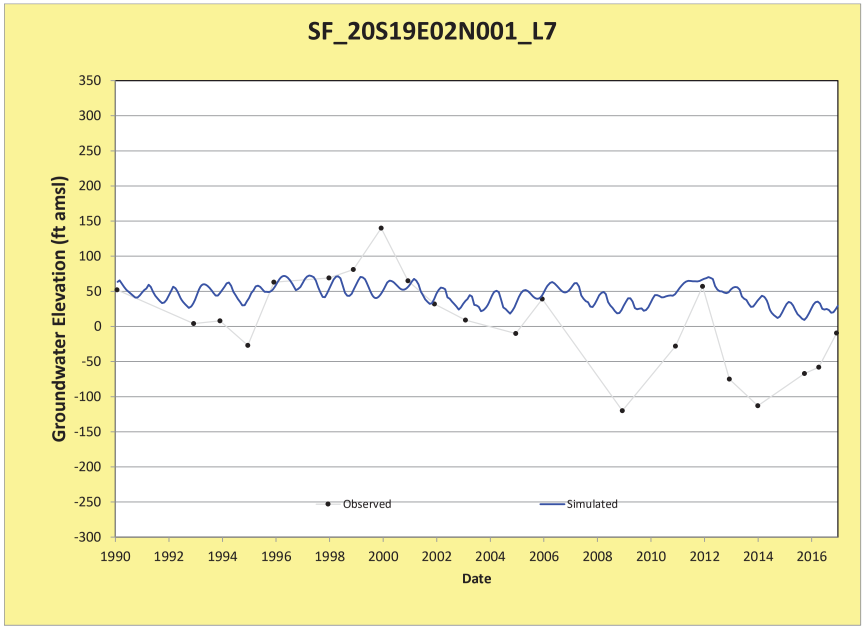

SF_19S23E07A002_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

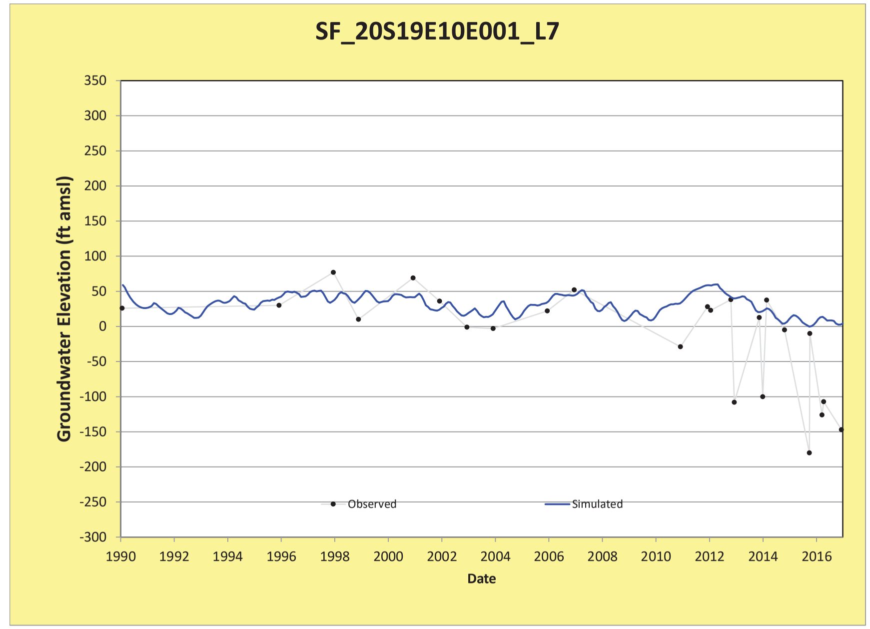

SF_19S24E18R001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

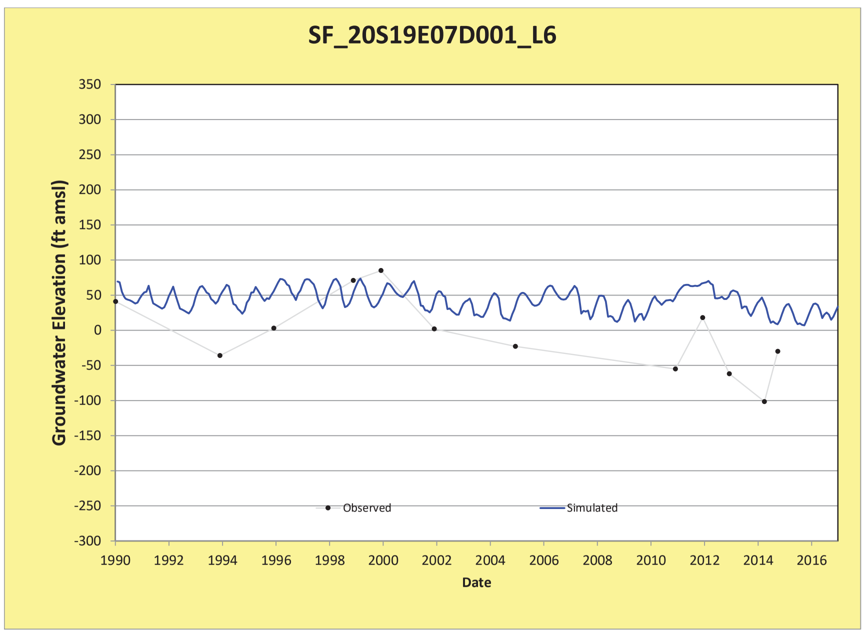

SF_20S19E02A001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

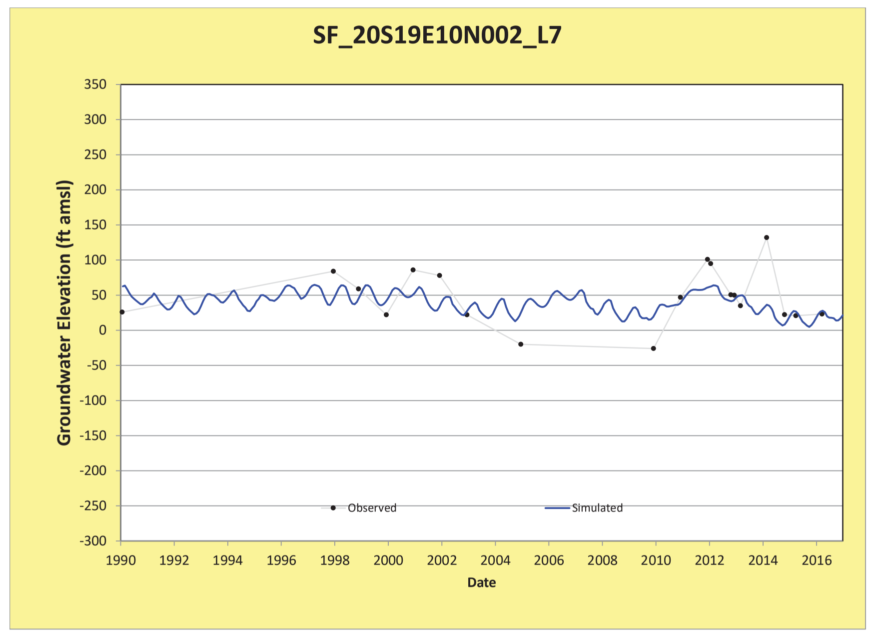

SF_19S24E22P001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

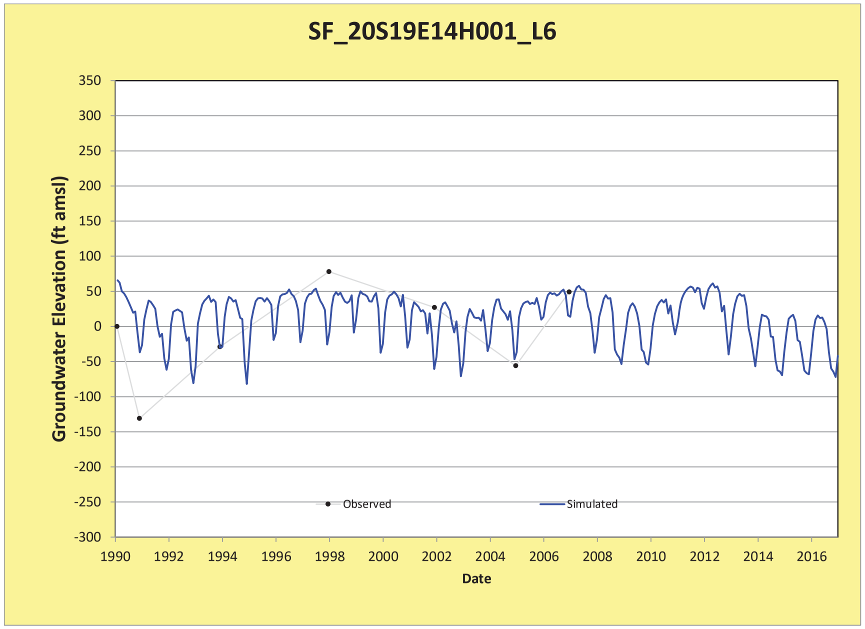

SF_20S19E02D001_L7
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

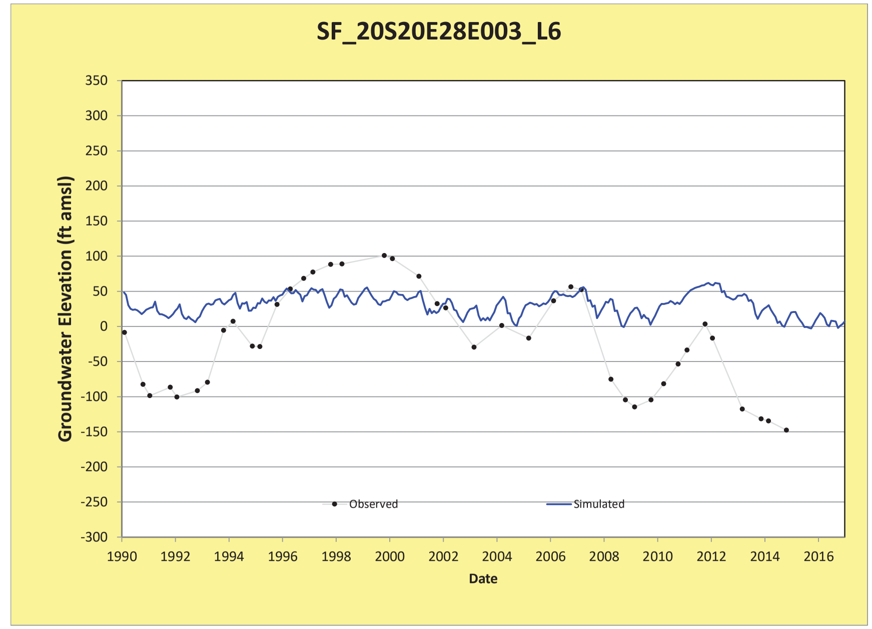

SF_20S19E02N001_L7
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

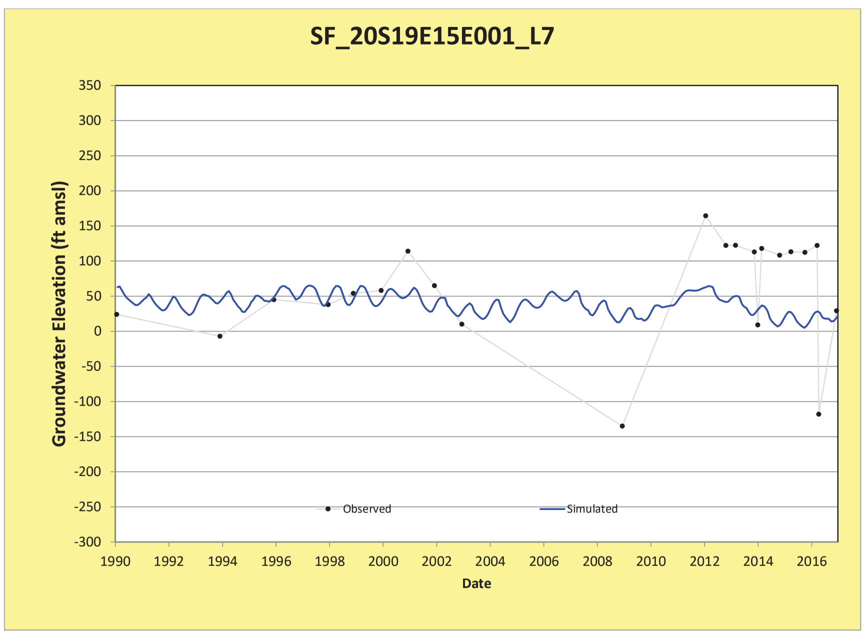

SF_20S19E10E001_L7
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

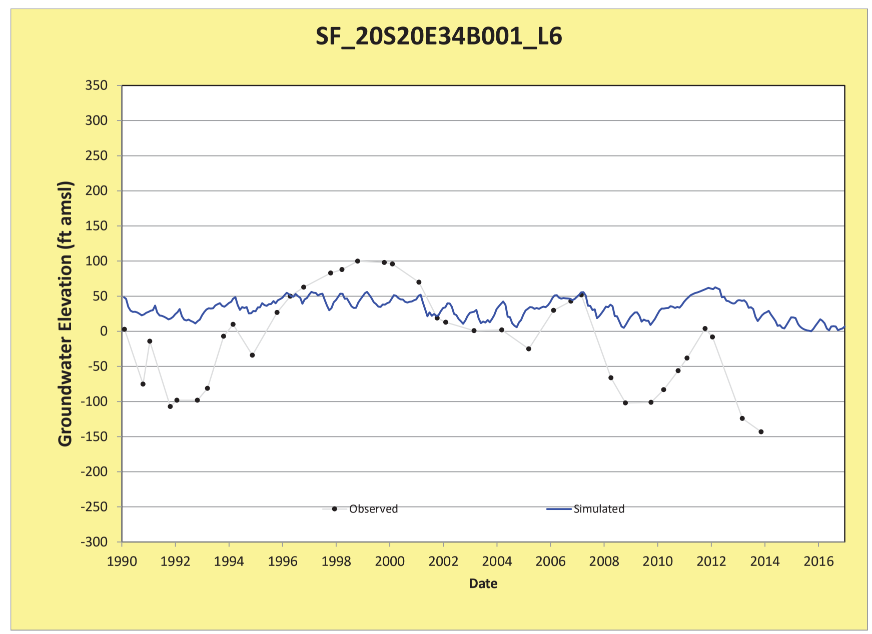

SF_20S19E07D001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

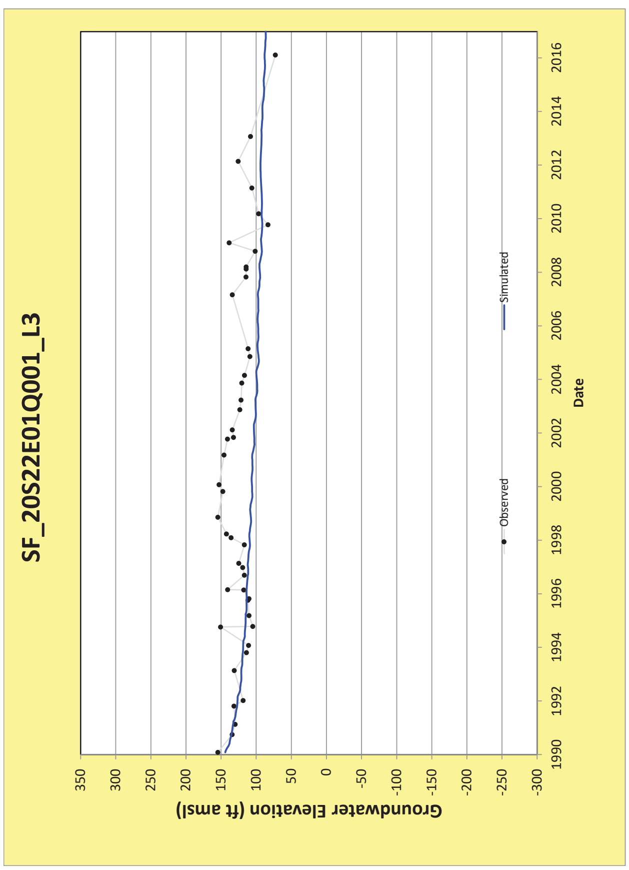

SF_20S19E10N002_L7
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

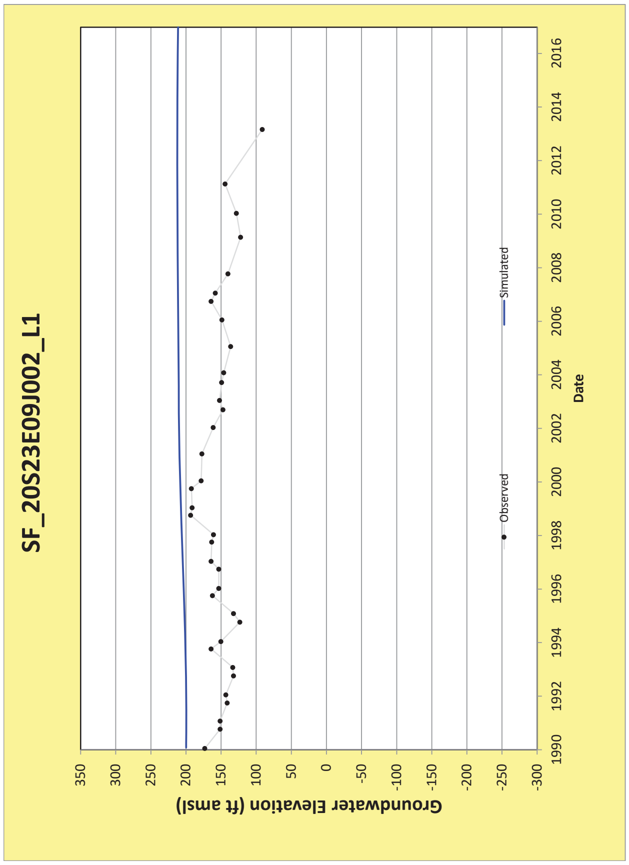

SF_20S19E14H001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

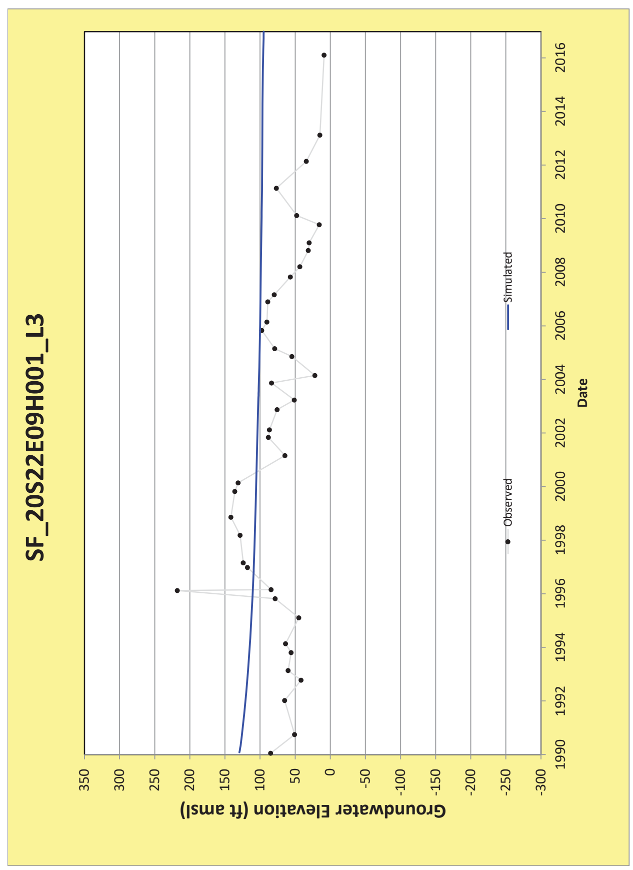

SF_20S20E28E003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

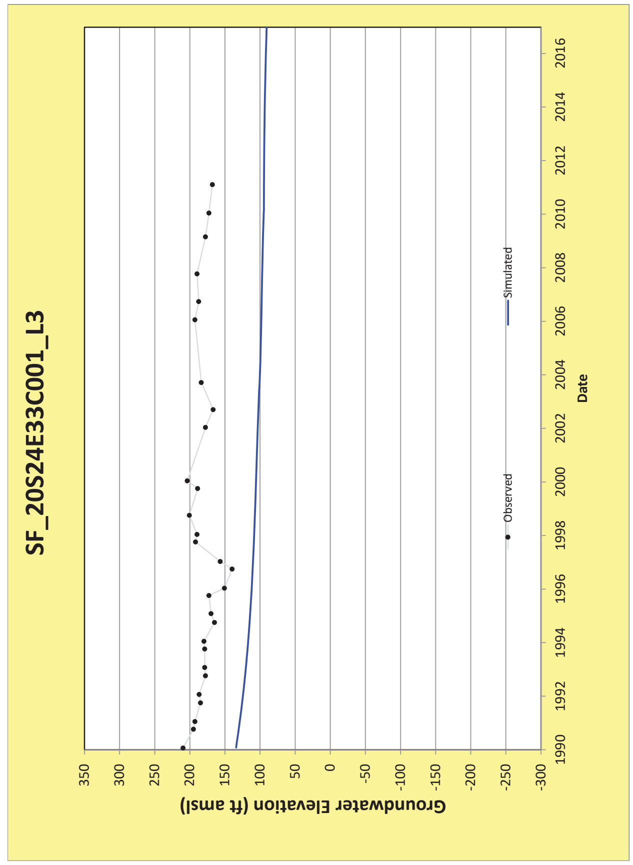

SF_20S19E15E001_L7
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

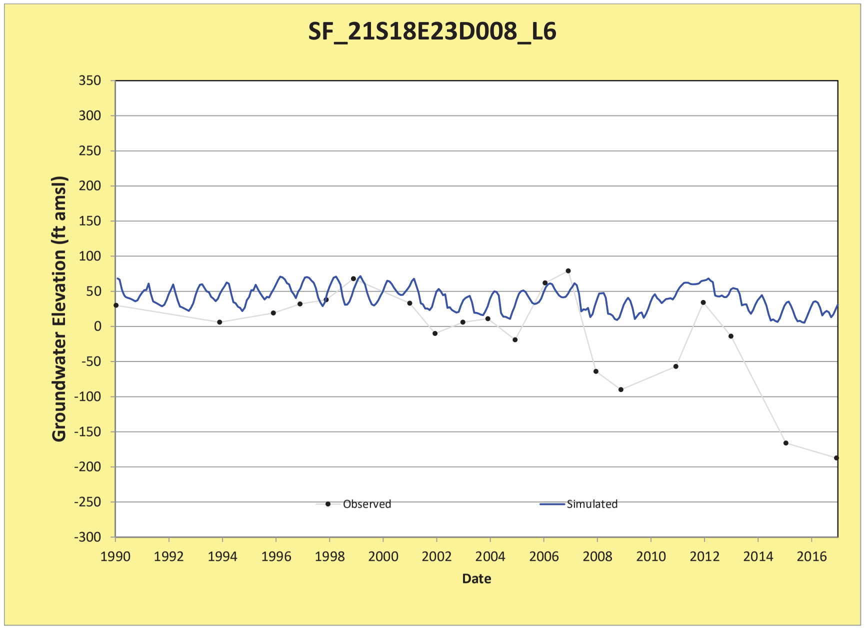

SF_20S20E34B001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

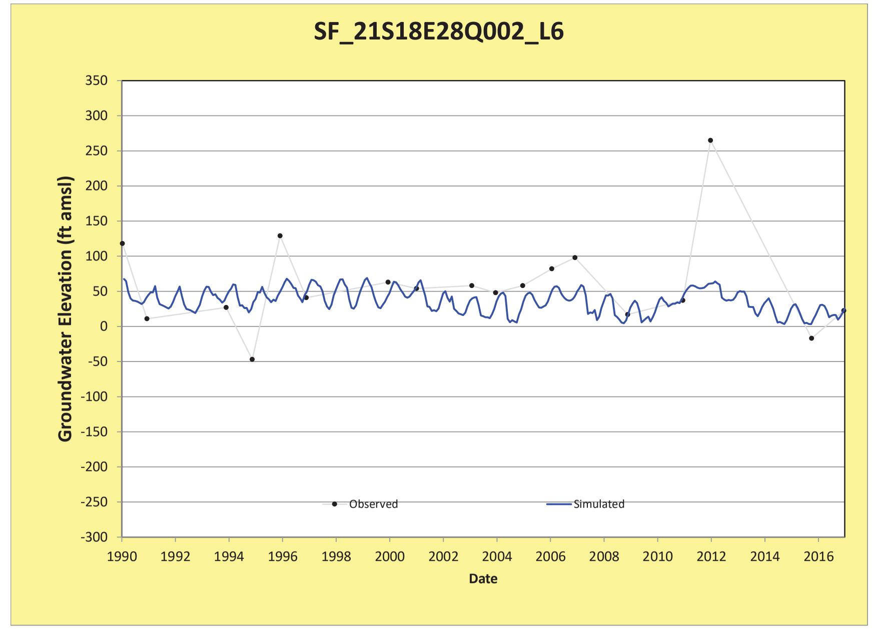

SF_20S22E01Q001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

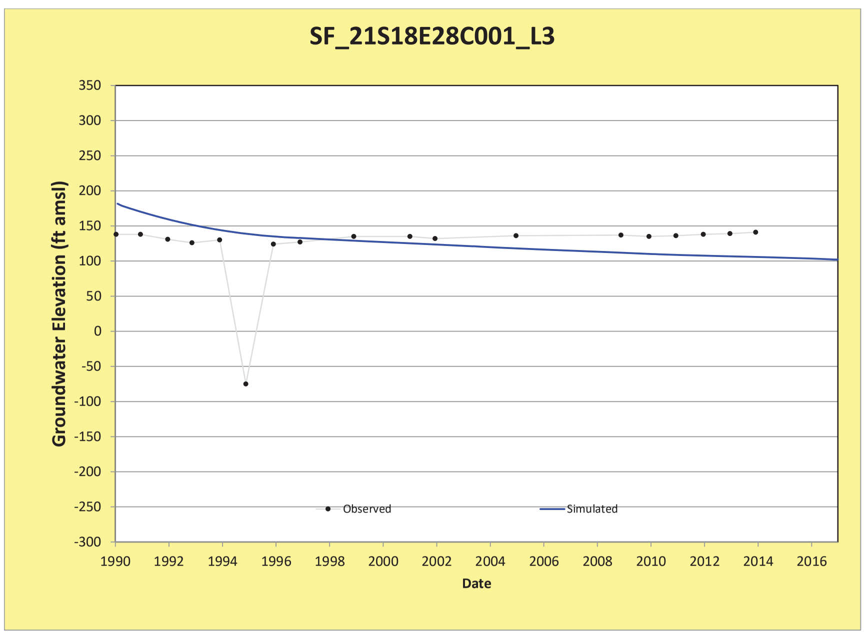

SF_20S23E09J002_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

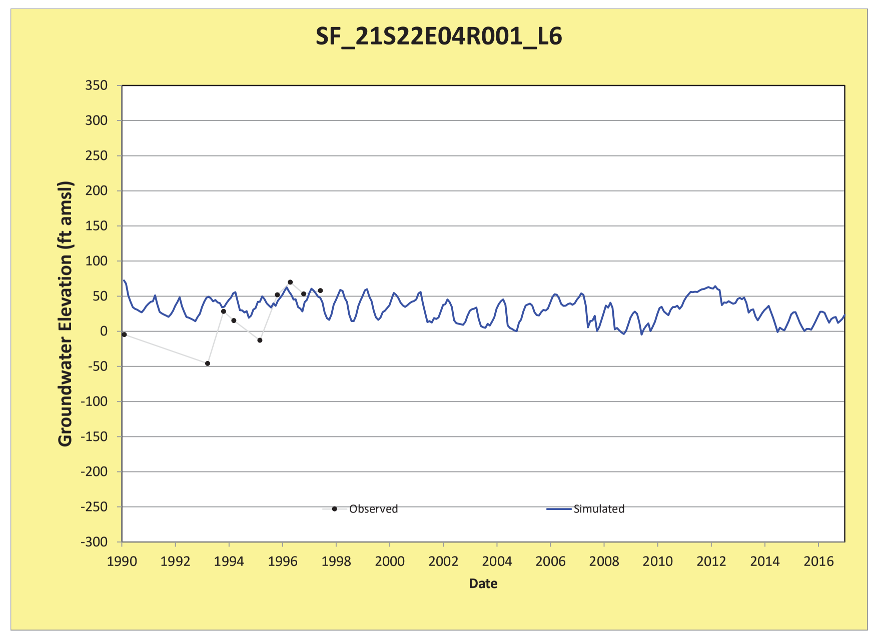

SF_20S22E09H001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

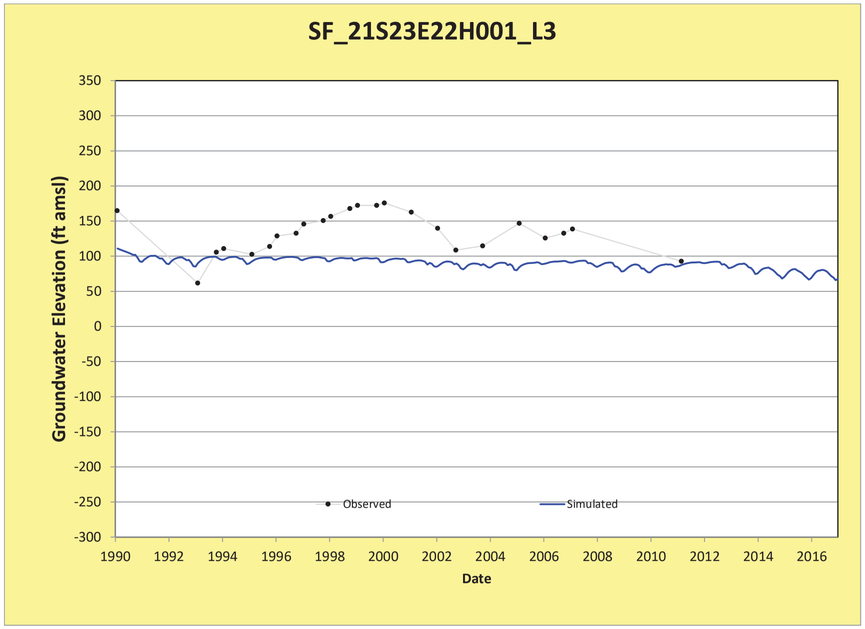

SF_20S24E33C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

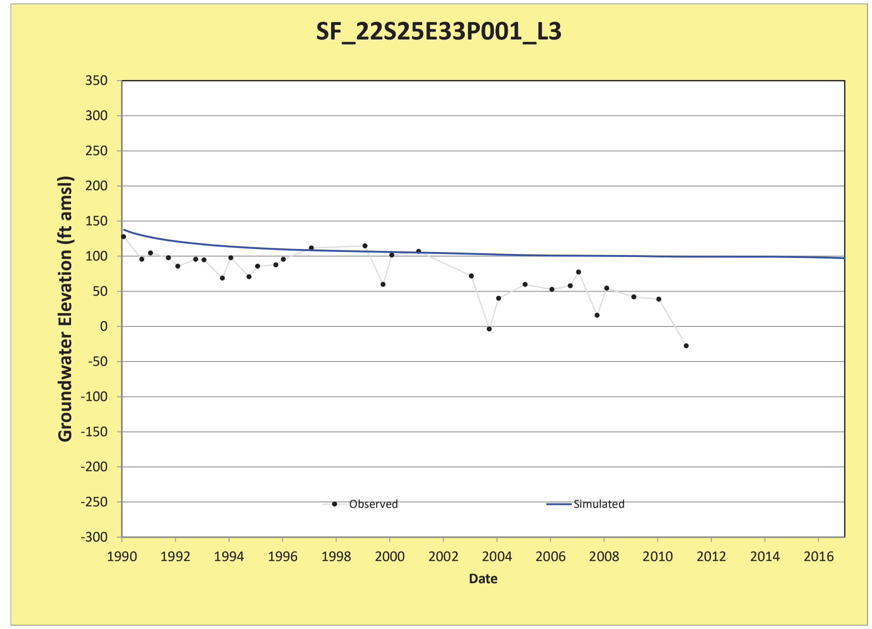

SF_21S18E23D008_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

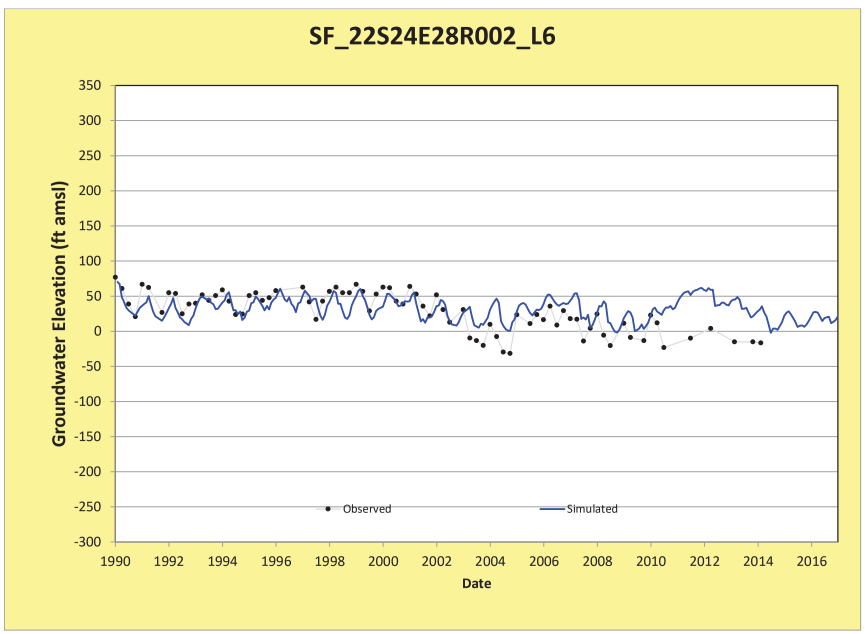

SF_21S18E28Q002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

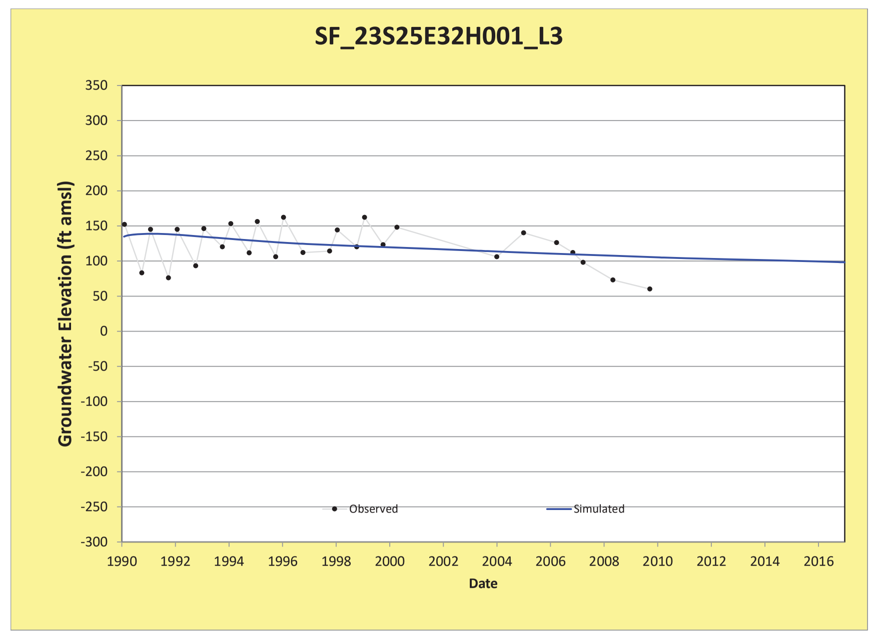

SF_21S18E28C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

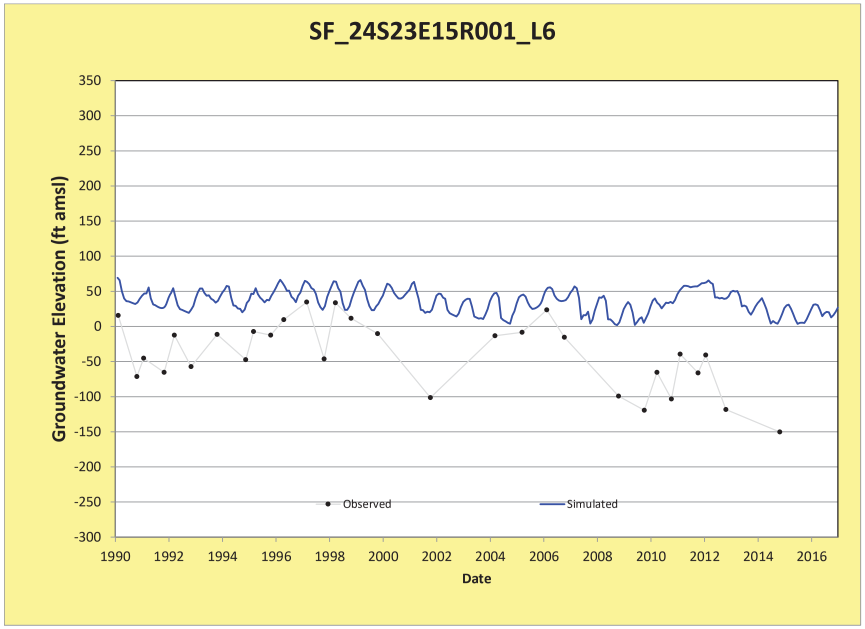

SF_21S22E04R001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

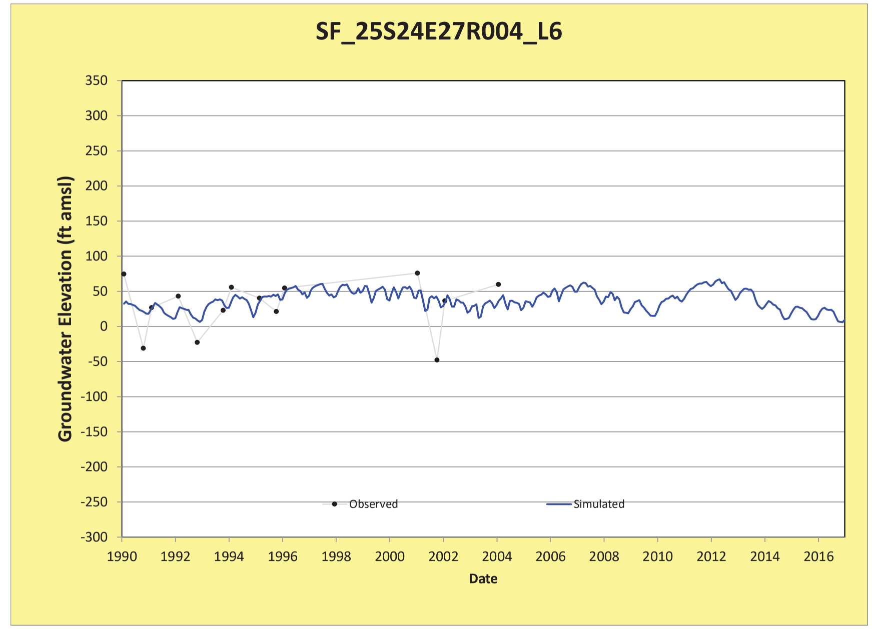

SF_21S23E22H001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

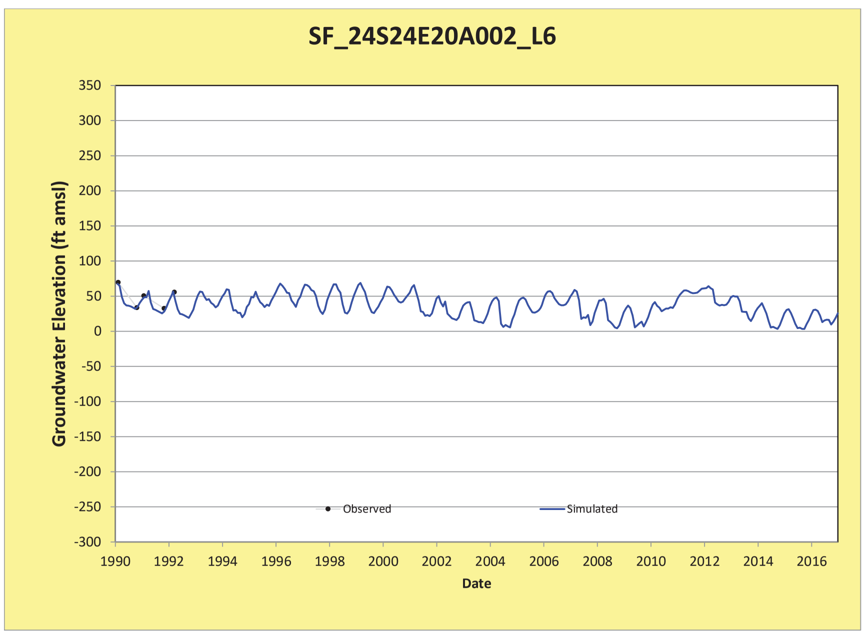

SF_22S25E33P001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

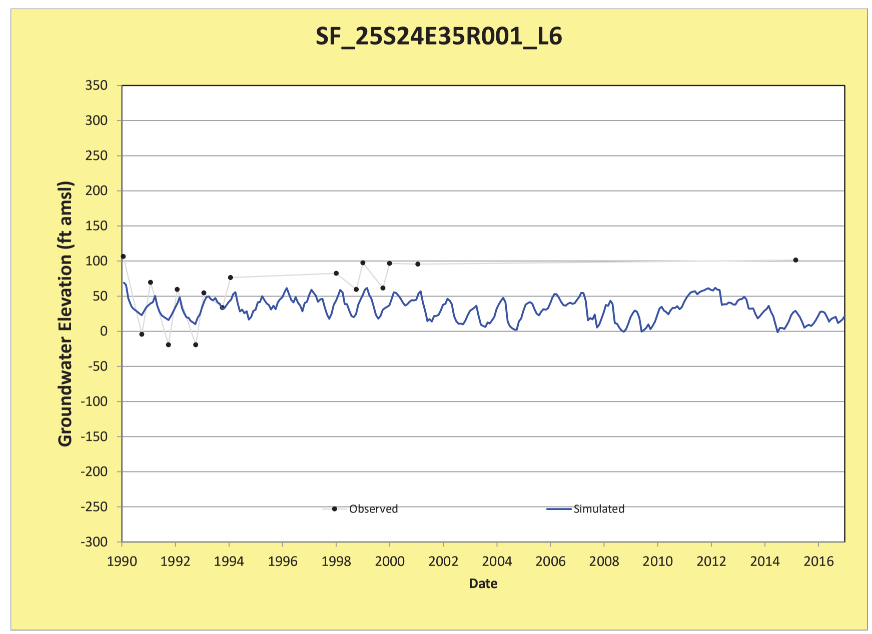

SF_22S24E28R002_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

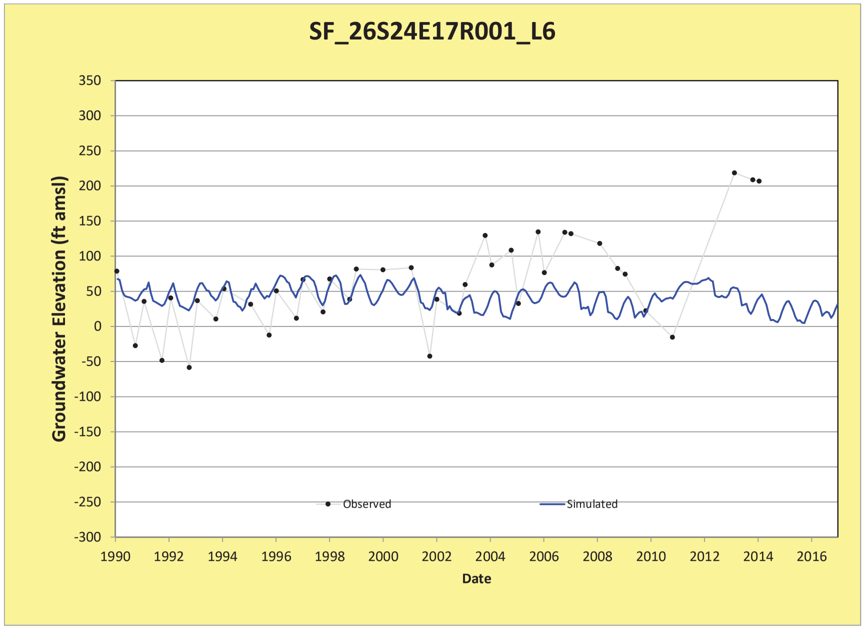

SF_23S25E32H001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

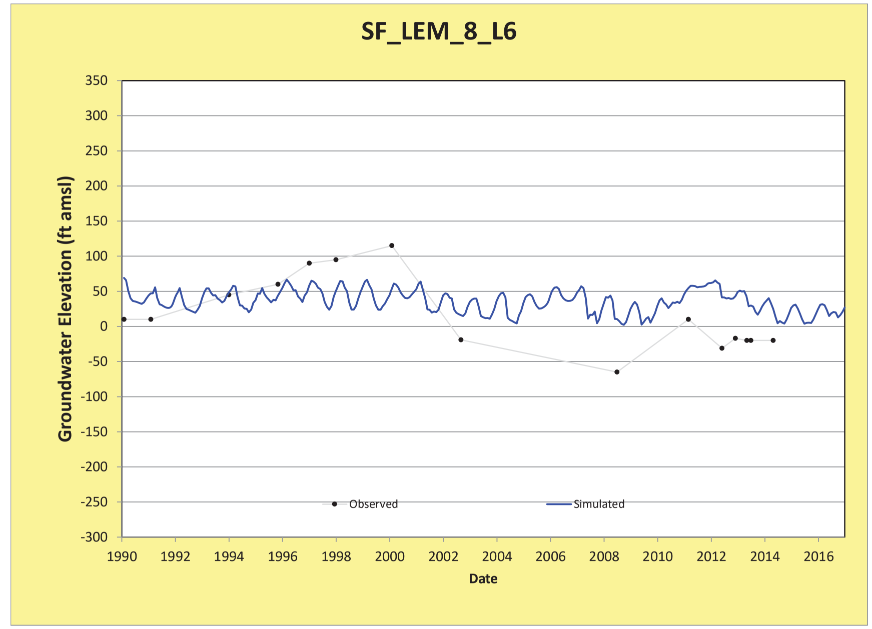

SF_24S23E15R001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

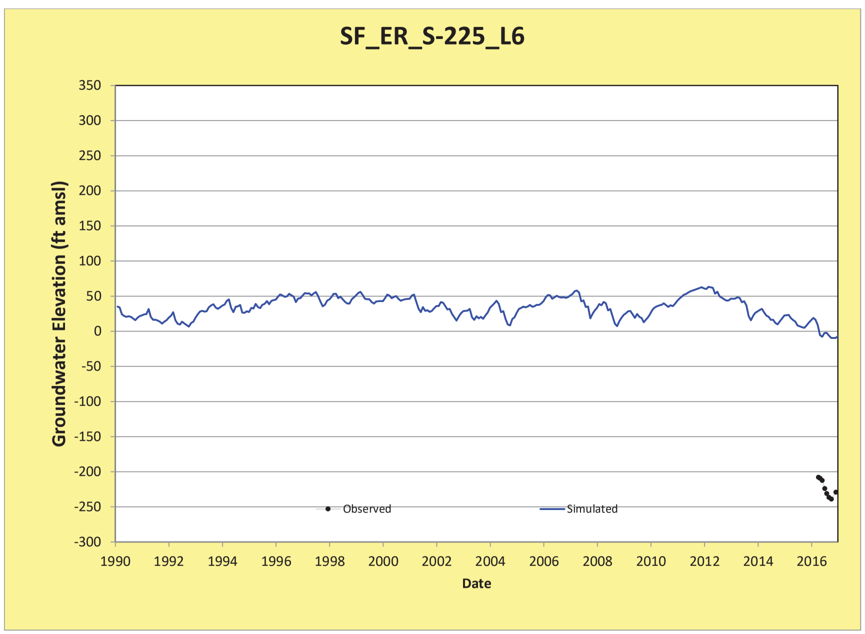

SF_25S24E27R004_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

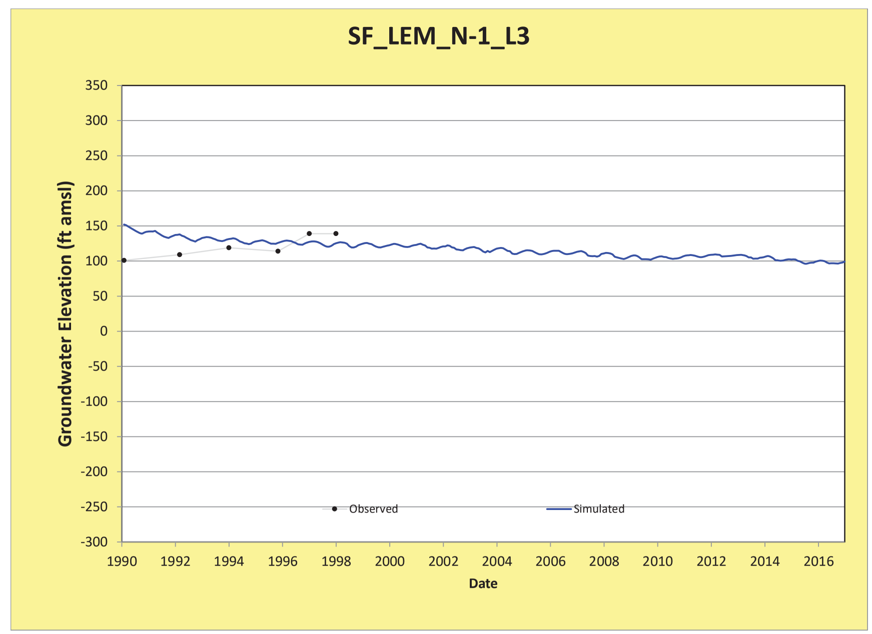

SF_24S24E20A002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

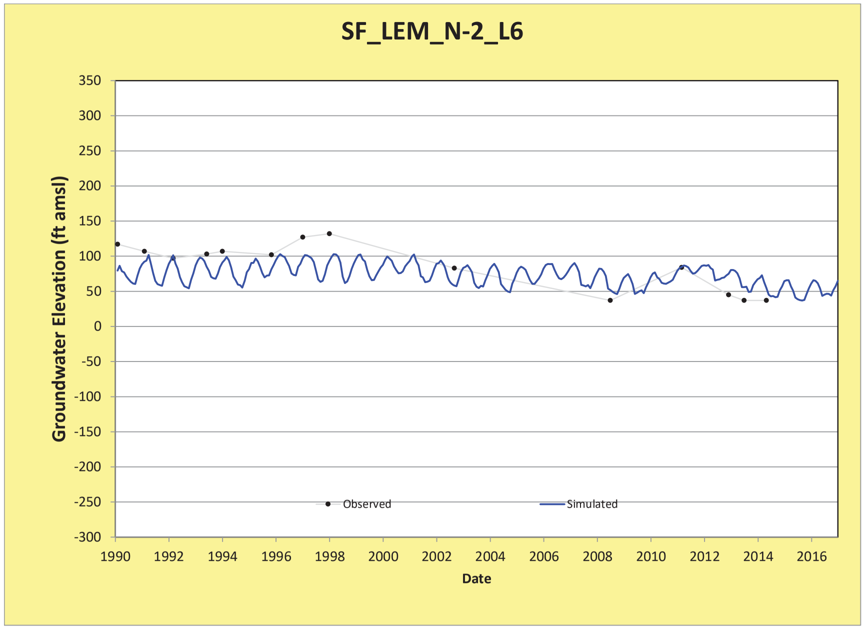

SF_25S24E35R001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

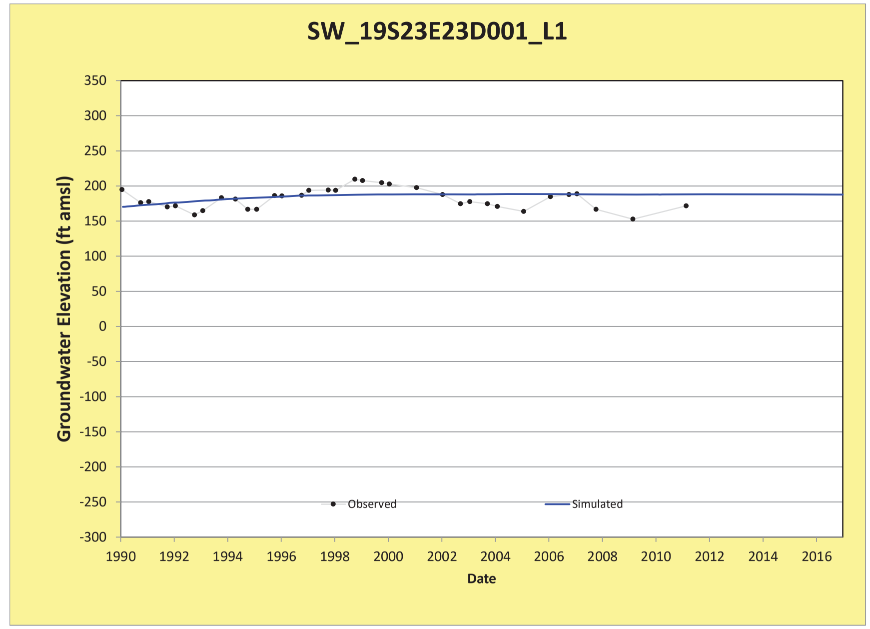

SF_26S24E17R001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

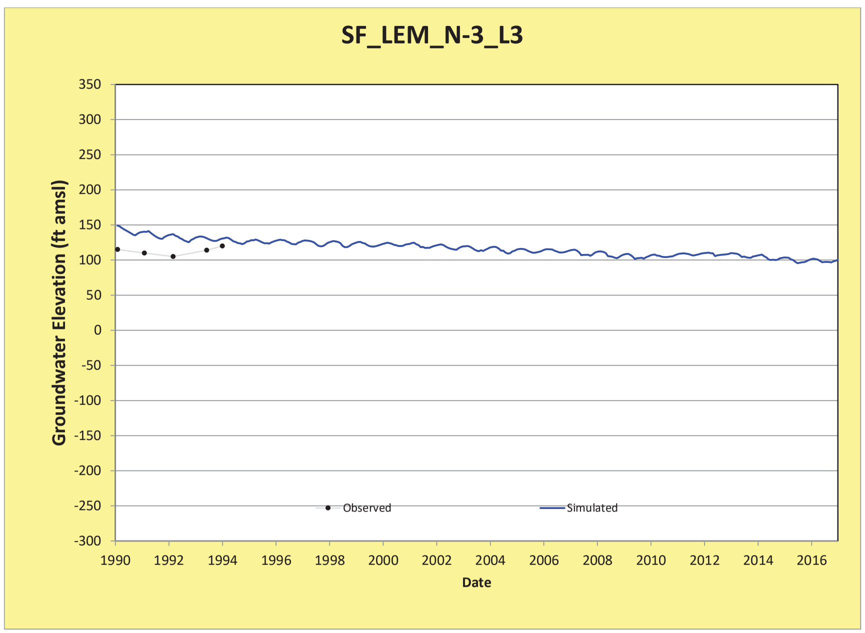

SF_LEM_8_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

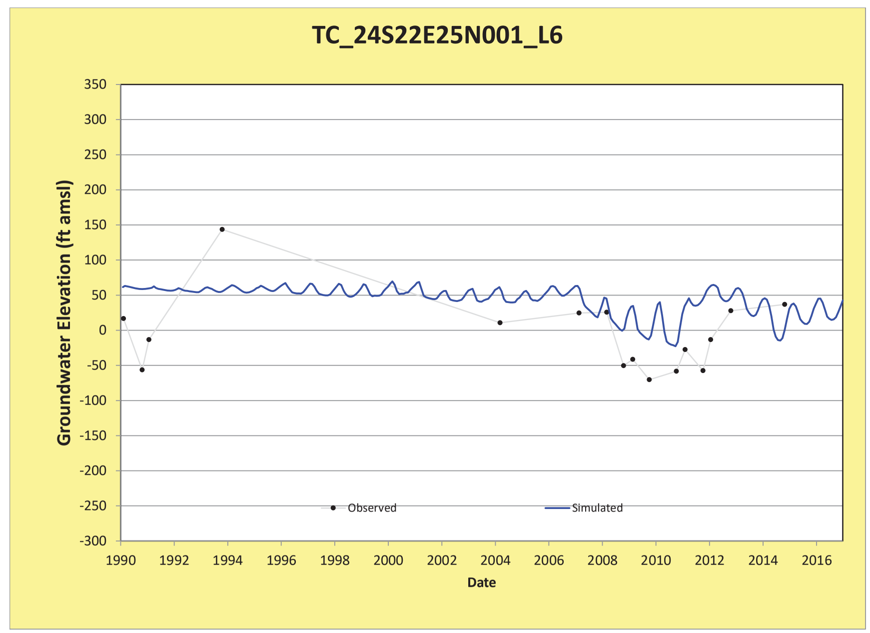

SF_ER_S-225_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

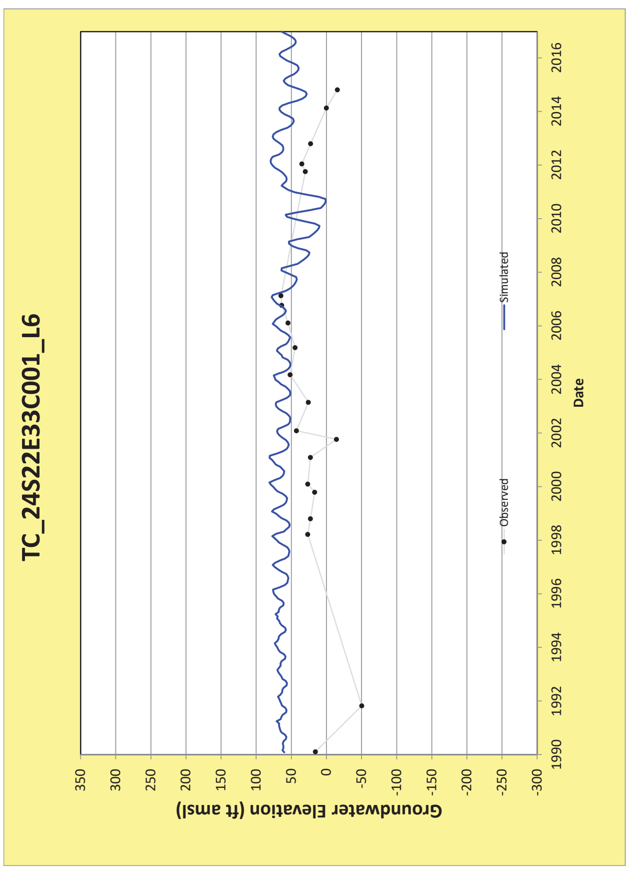

SF_LEM_N-1_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

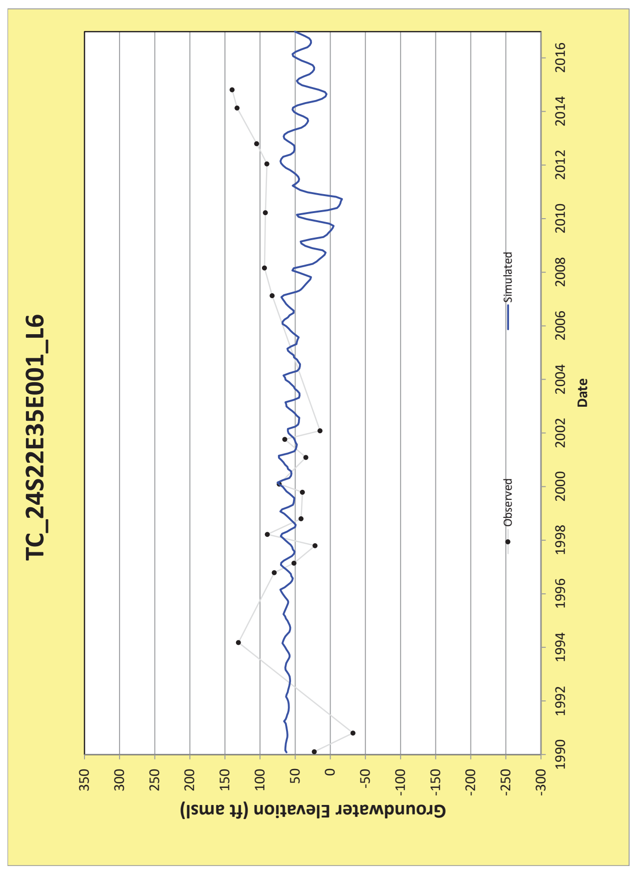

SF_LEM_N-2_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

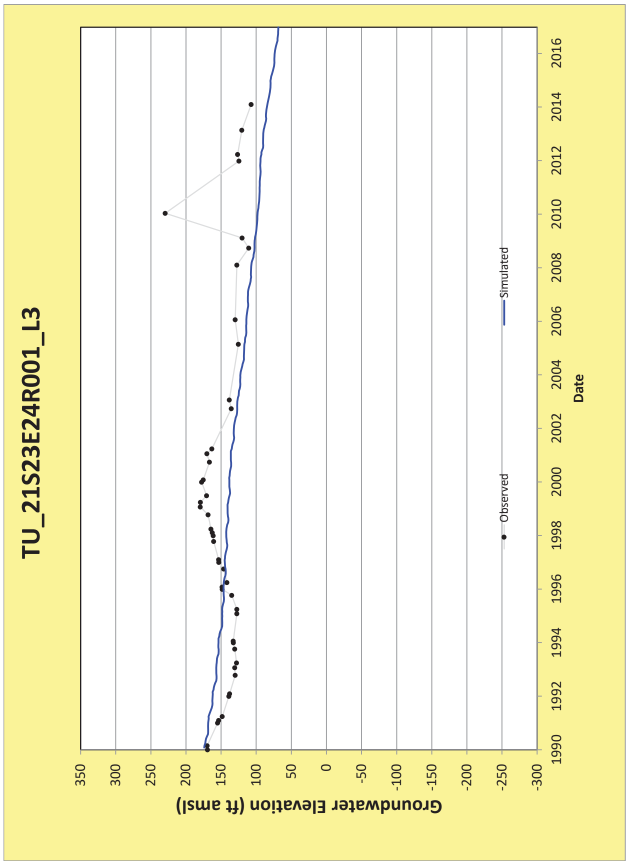

SW_19S23E23D001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

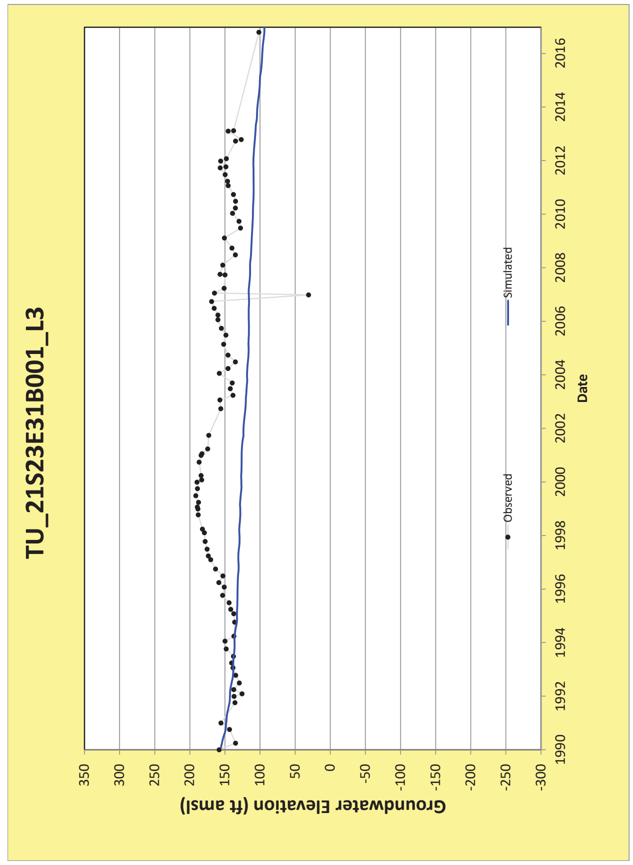

SF_LEM_N-3_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

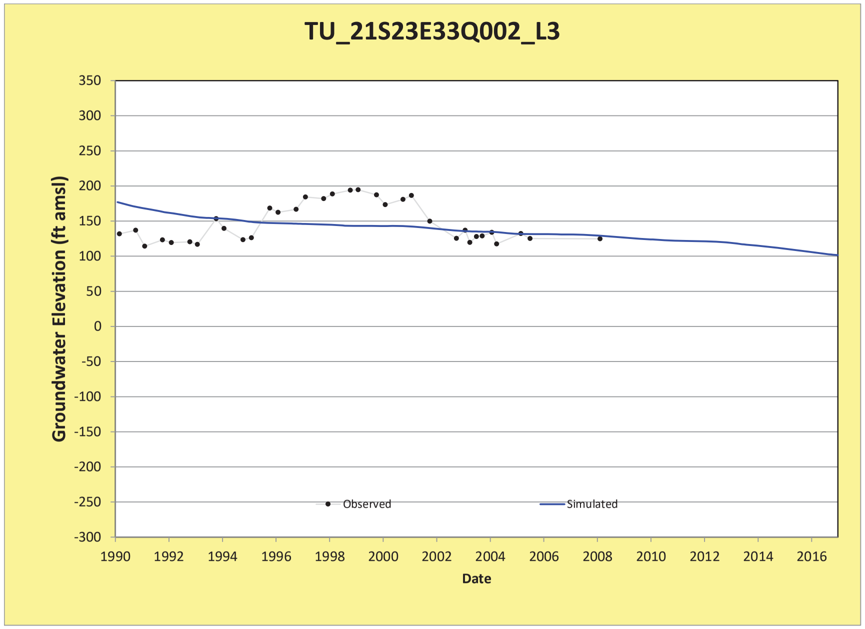

TC_24S22E25N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

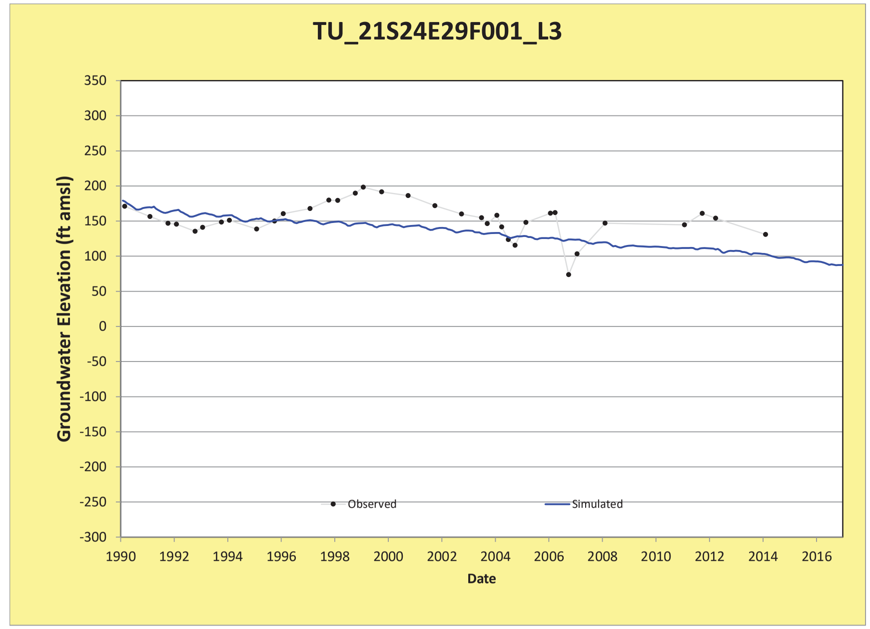

TC_24S22E33C001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

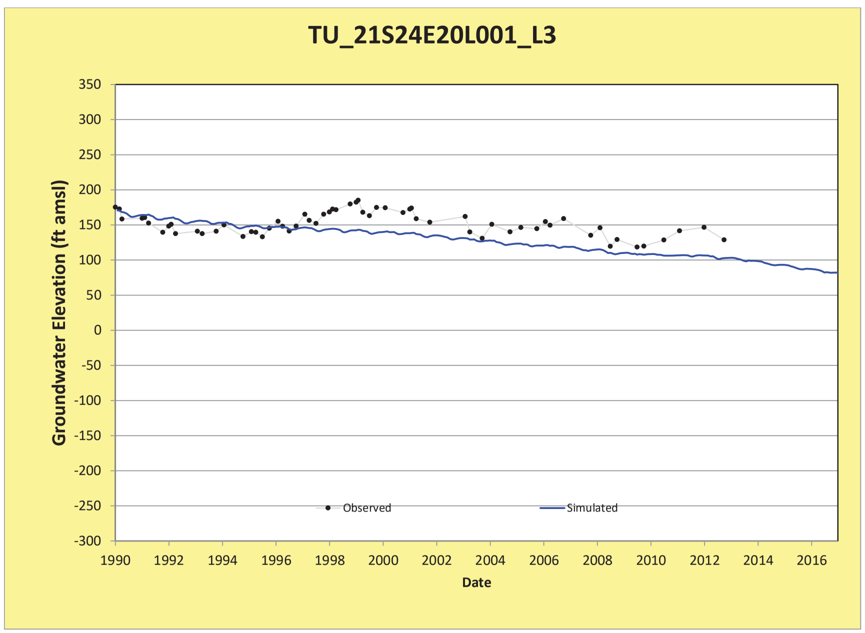

TC_24S22E35E001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

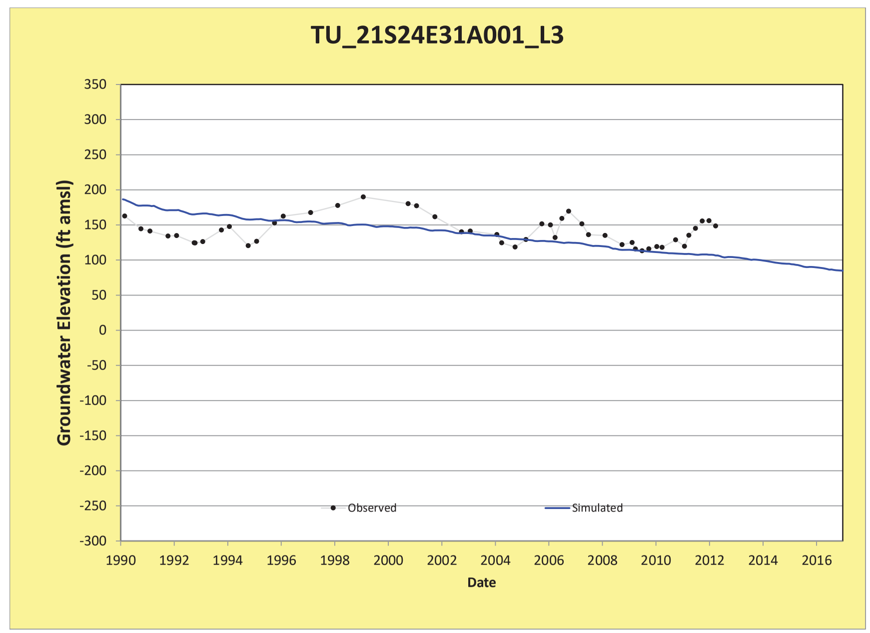

TU_21S23E24R001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

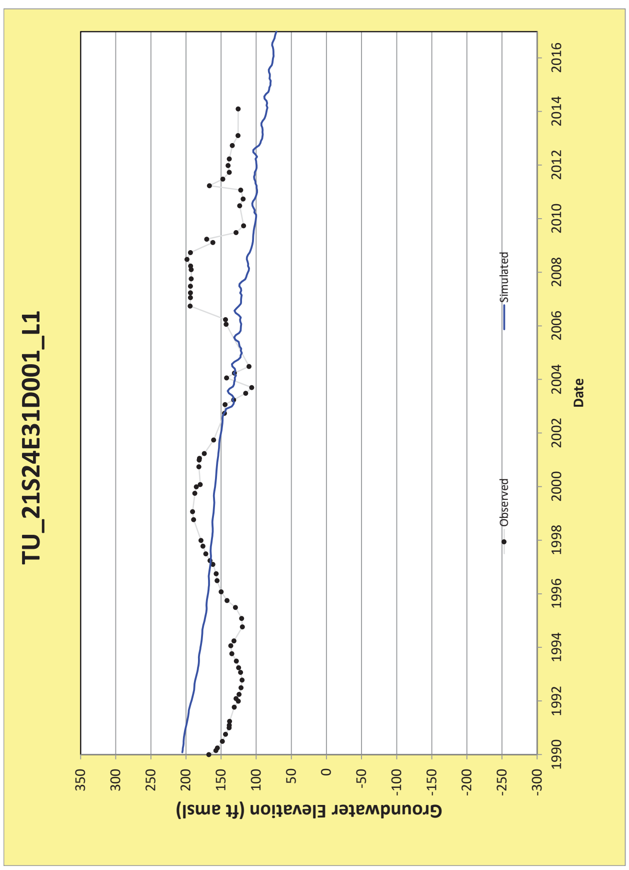

TU_21S23E31B001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

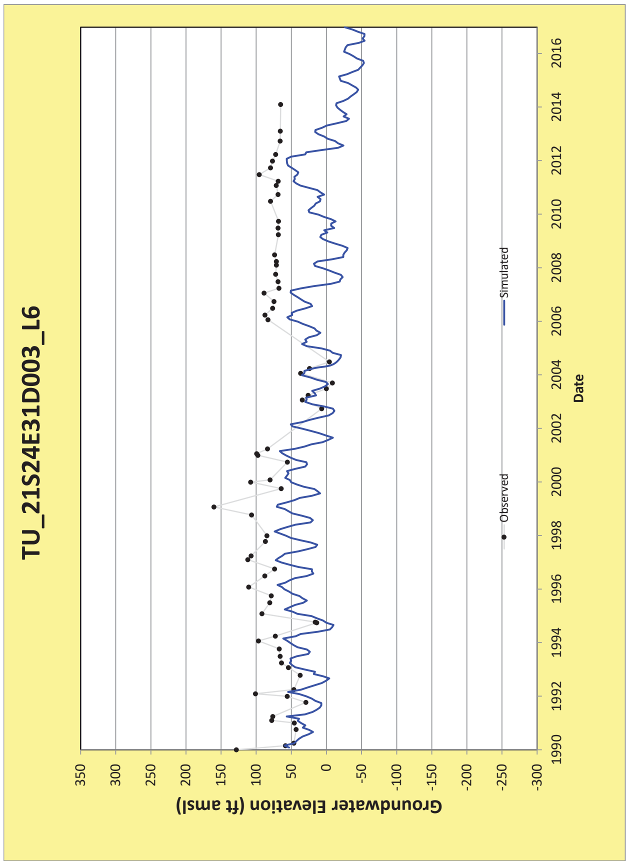

TU_21S23E33Q002_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

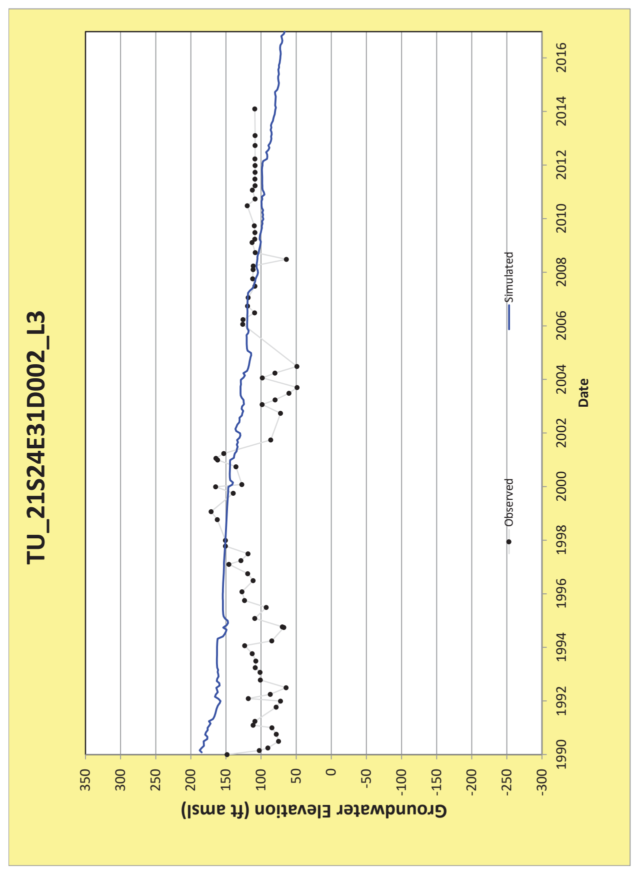

TU_21S24E29F001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

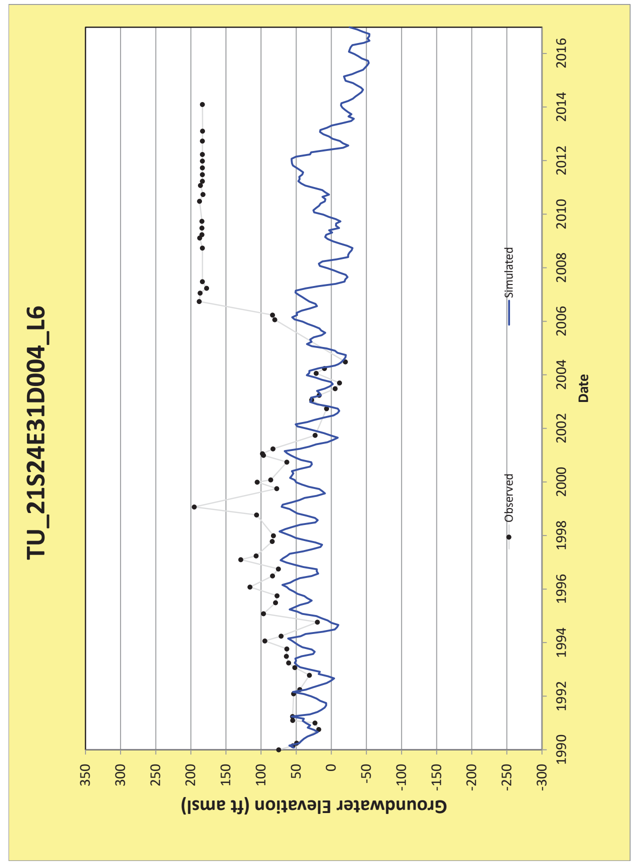

TU_21S24E20L001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

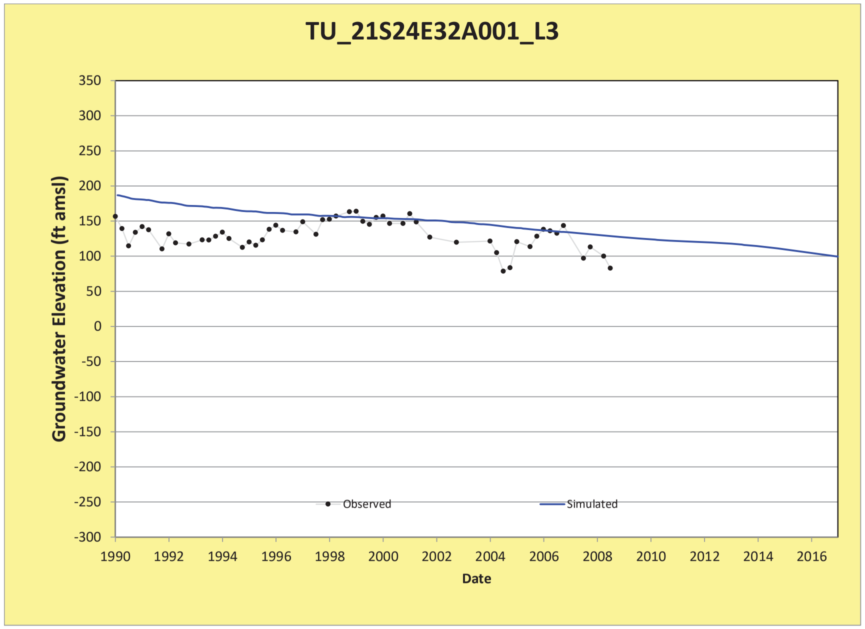

TU_21S24E31A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

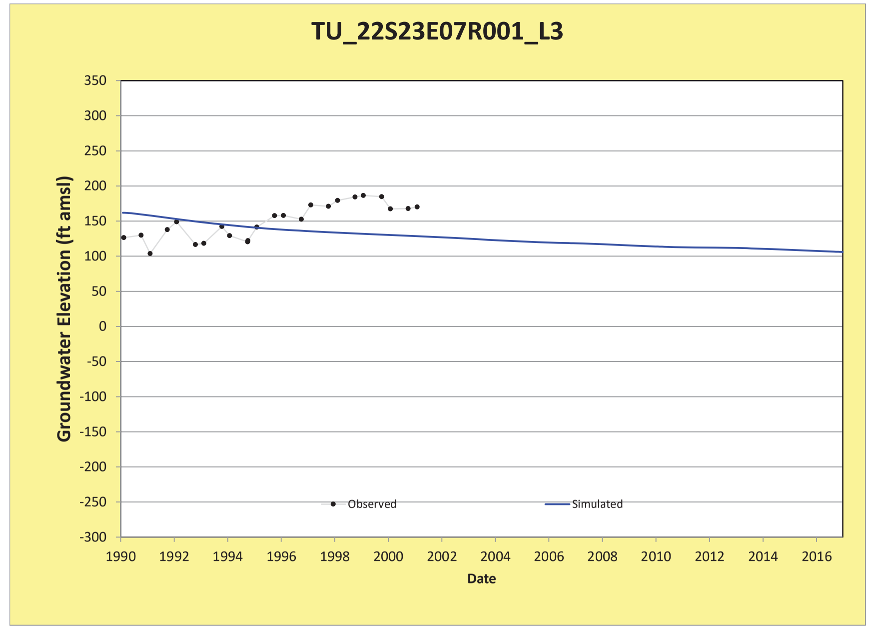

TU_21S24E31D001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

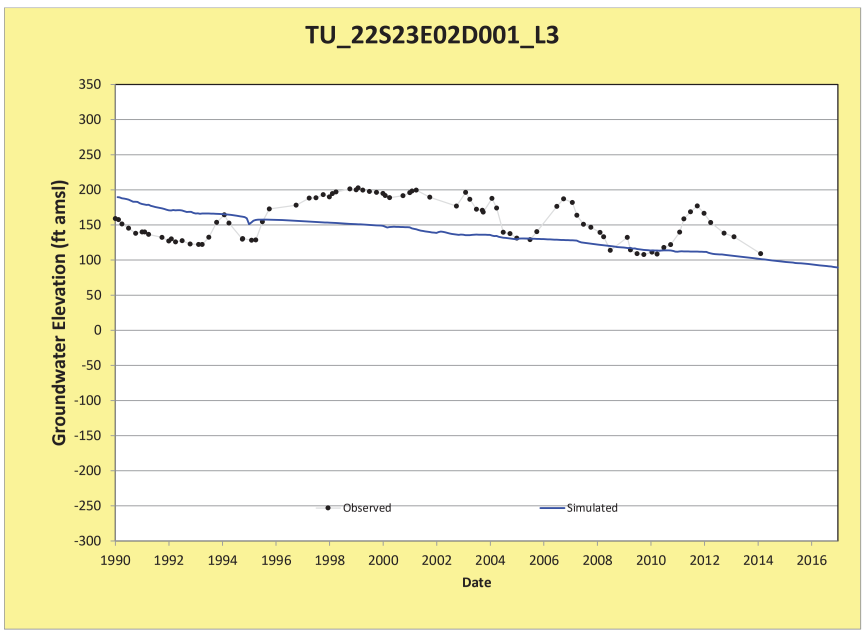

TU_21S24E31D003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

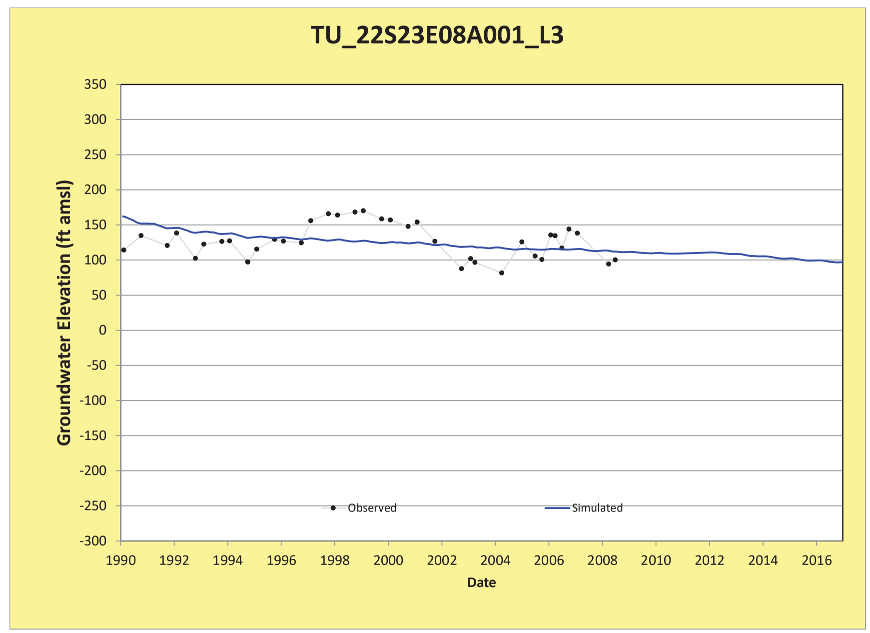

TU_21S24E31D002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

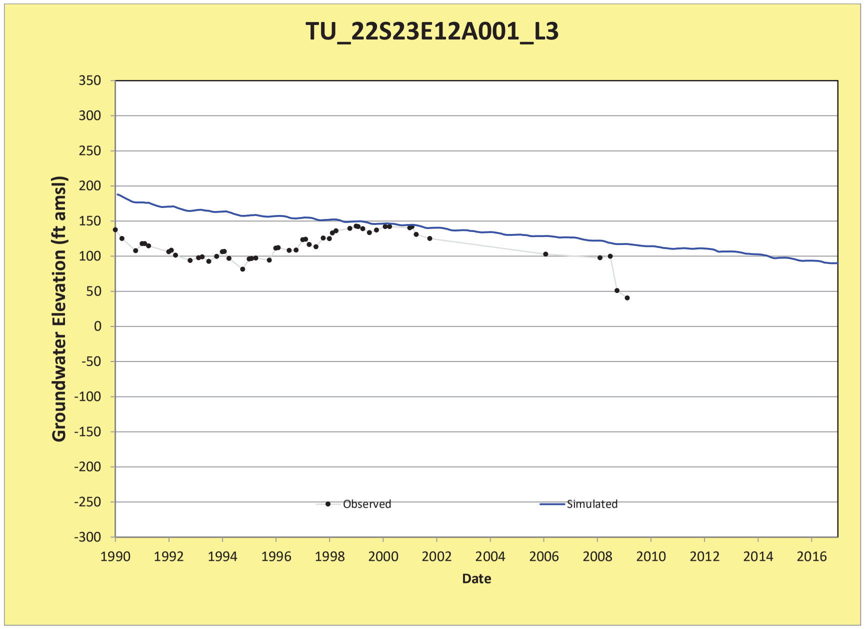

TU_21S24E31D004_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

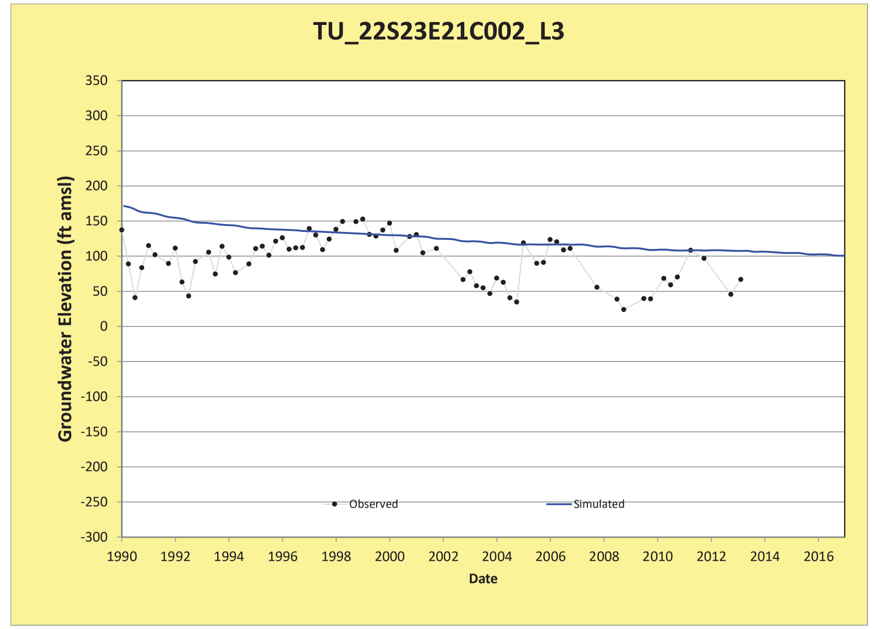

TU_21S24E32A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

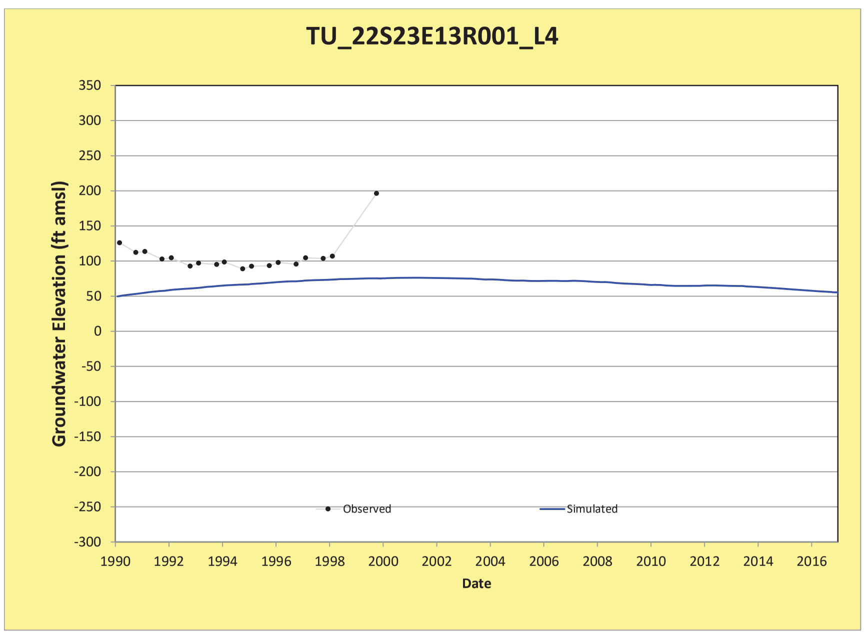

TU_22S23E07R001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

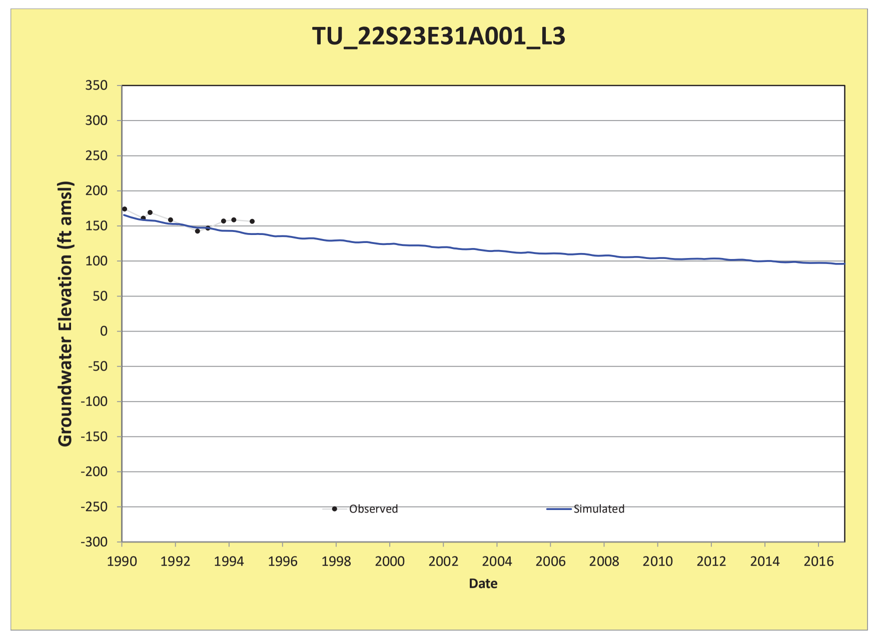

TU_22S23E02D001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

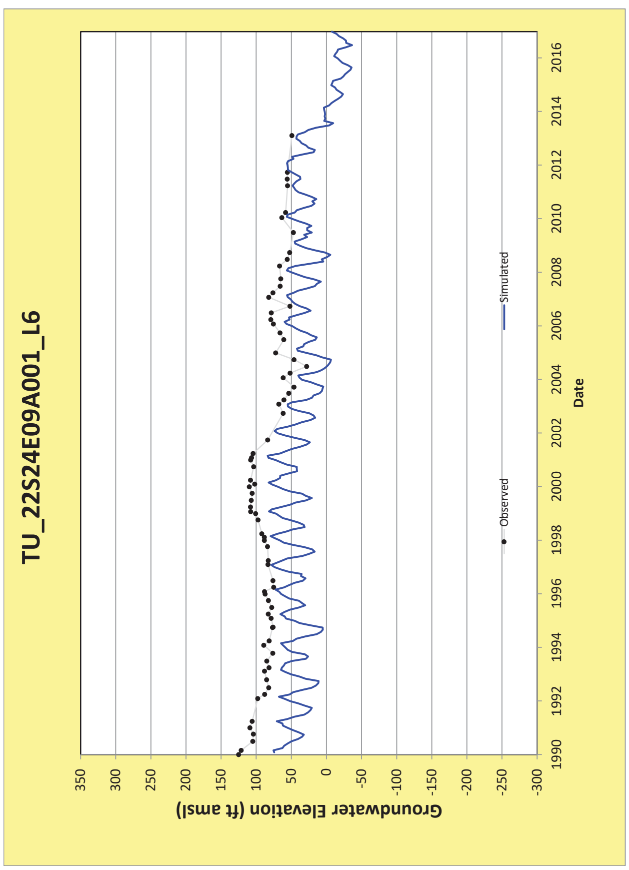

TU_22S23E08A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

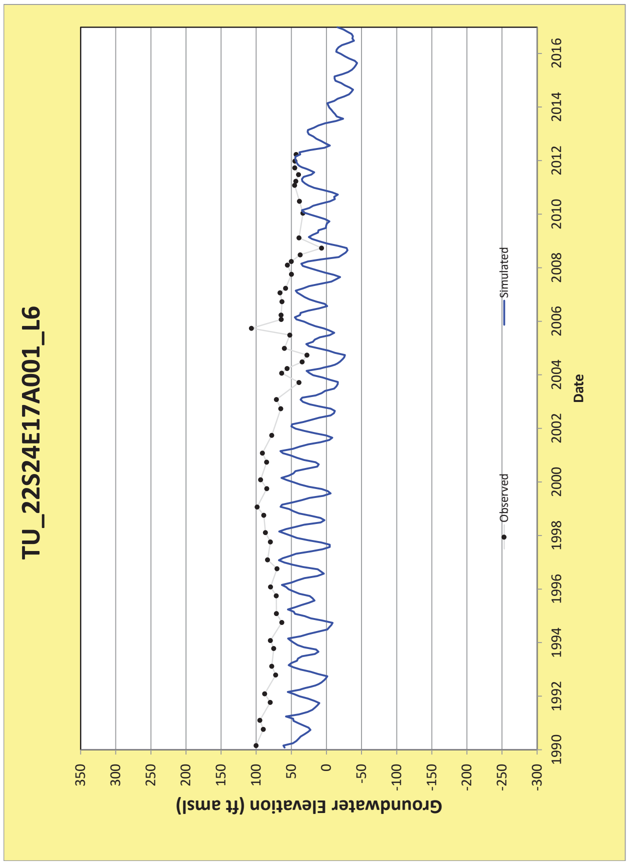

TU_22S23E12A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

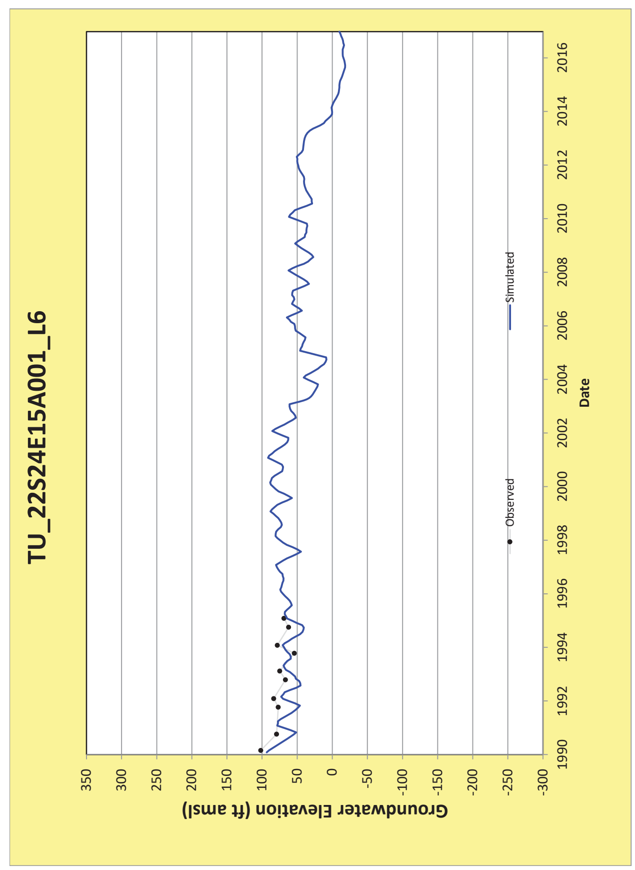

TU_22S23E21C002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

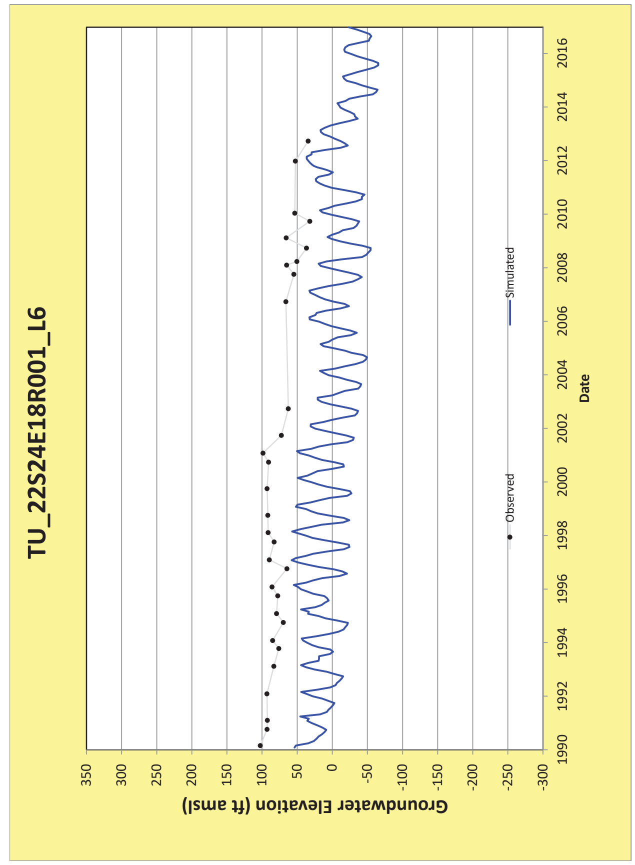

TU_22S23E13R001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

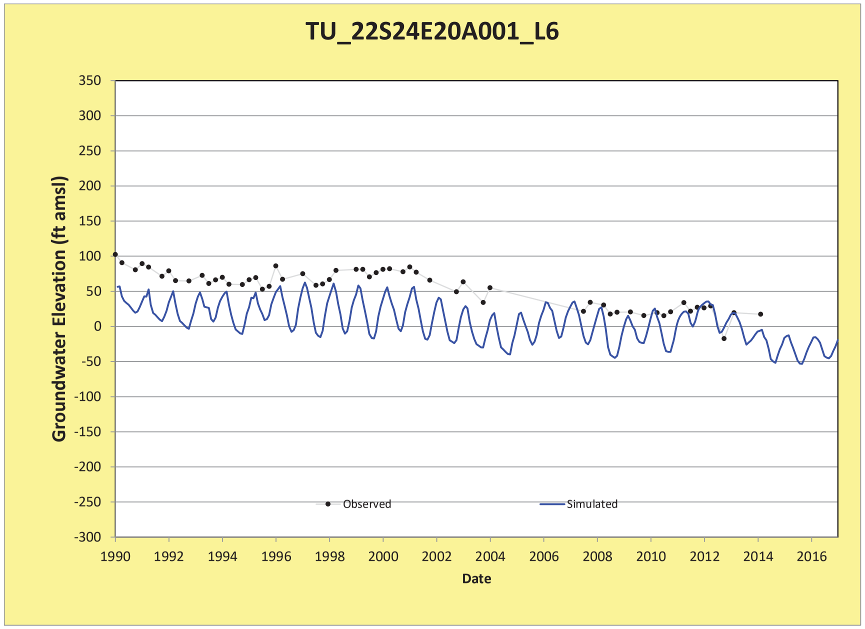

TU_22S23E31A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


TU_22S24E09A001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

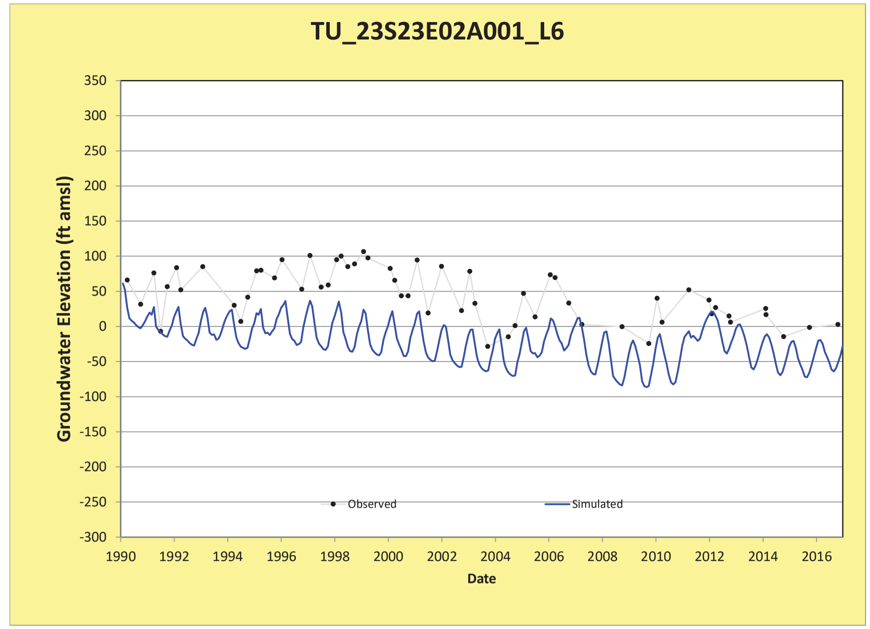

TU_22S24E17A001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


TU_22S24E15A001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

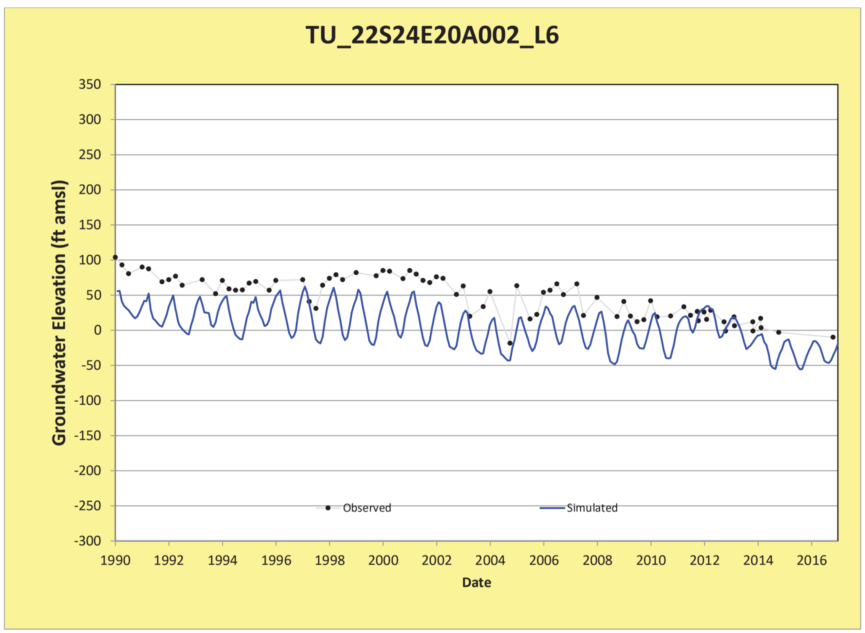

TU_22S24E18R001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated



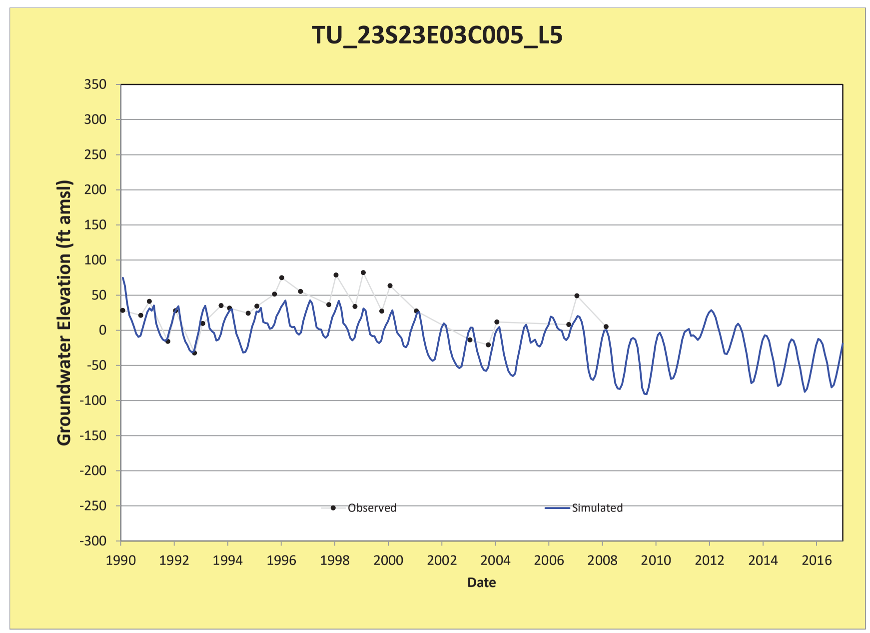
TU_22S24E20A001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated



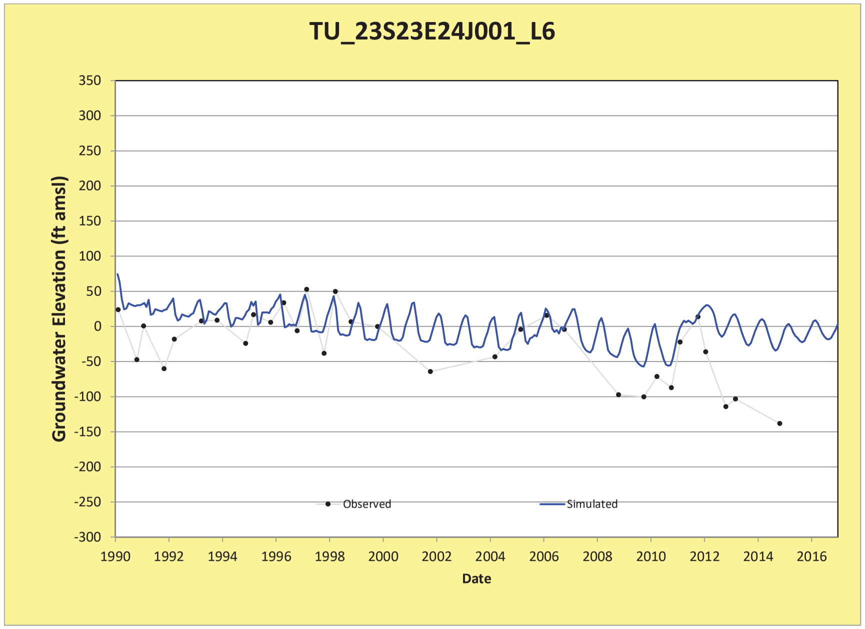
TU_23S23E02A001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

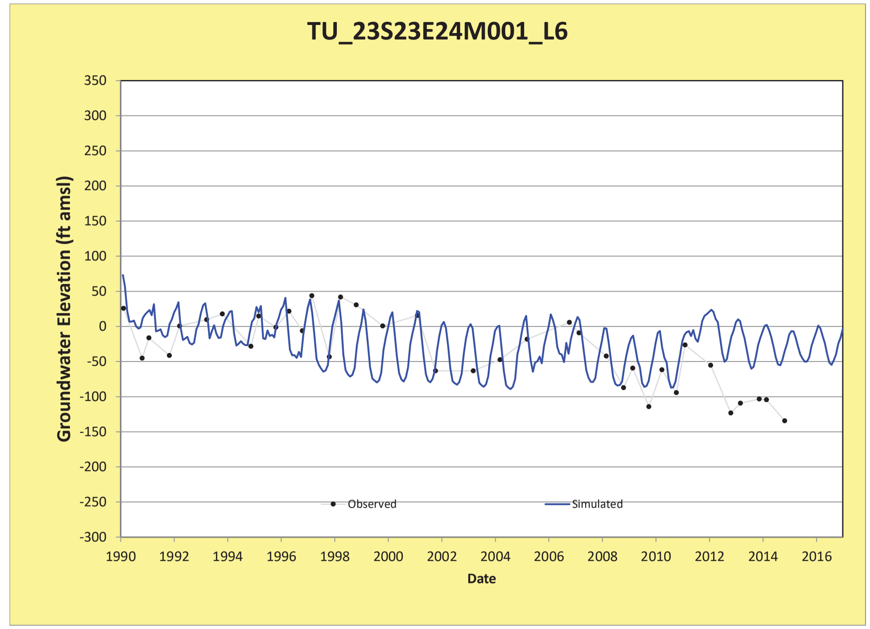


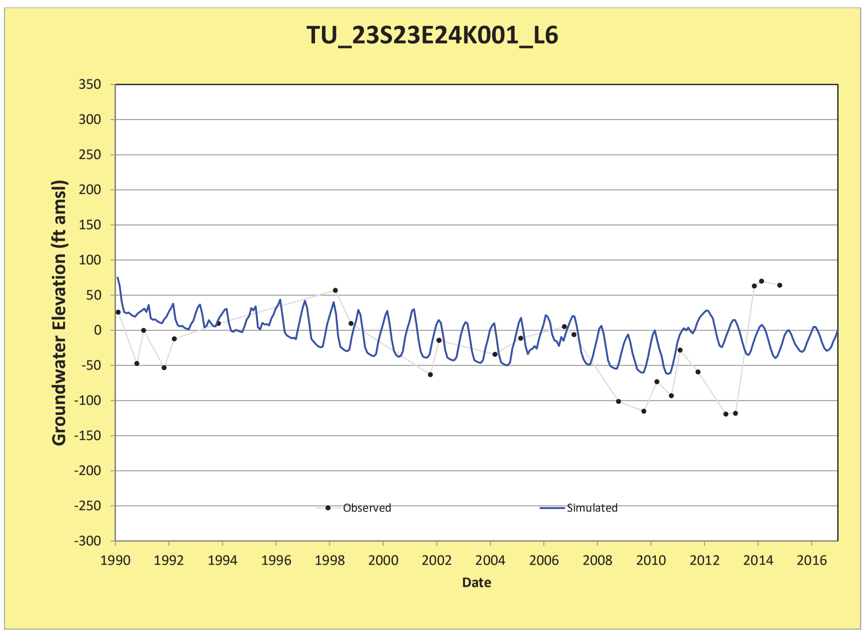
TU_22S24E20A002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

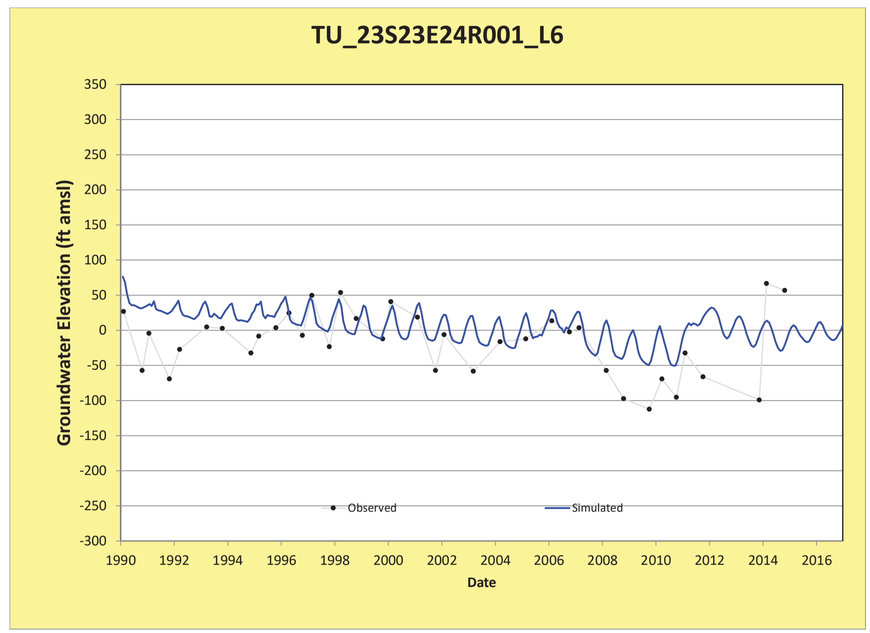


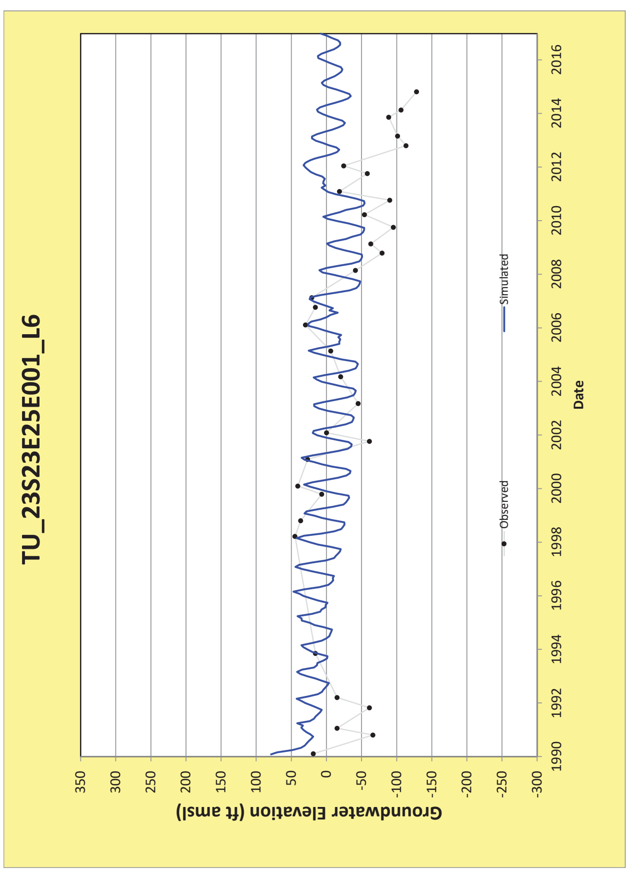
TU_23S23E03C005_L5
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

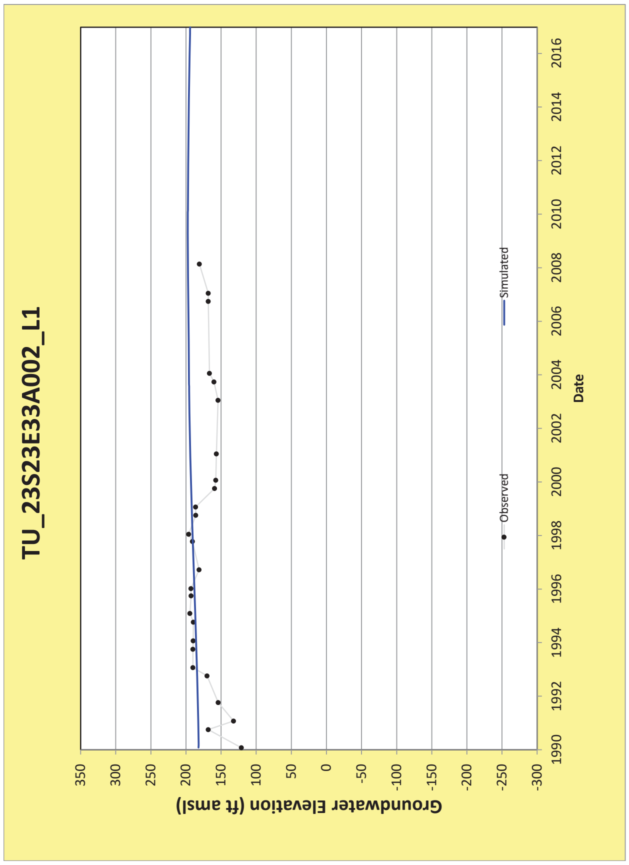

TU_23S23E24J001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

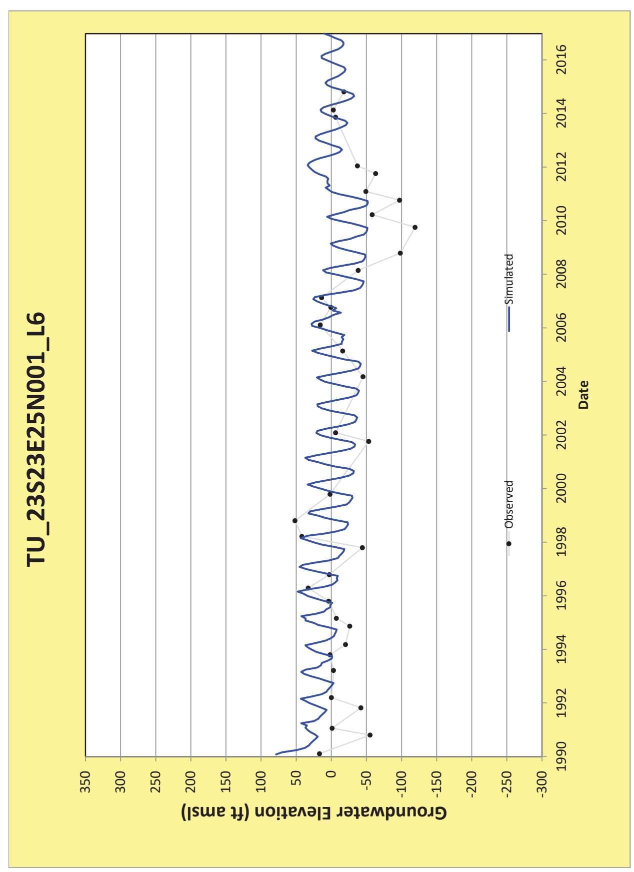

TU_23S23E24M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

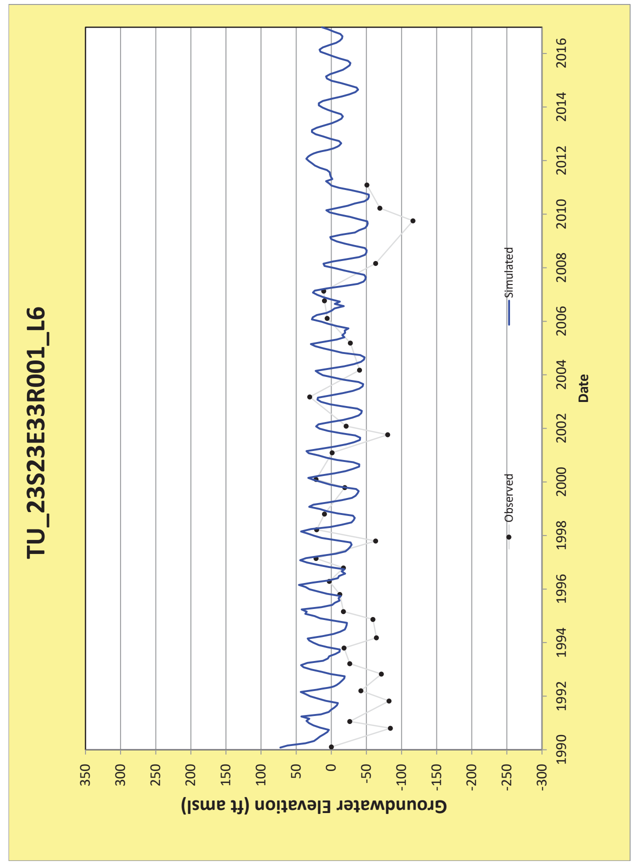

TU_23S23E24K001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


TU_23S23E24R001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

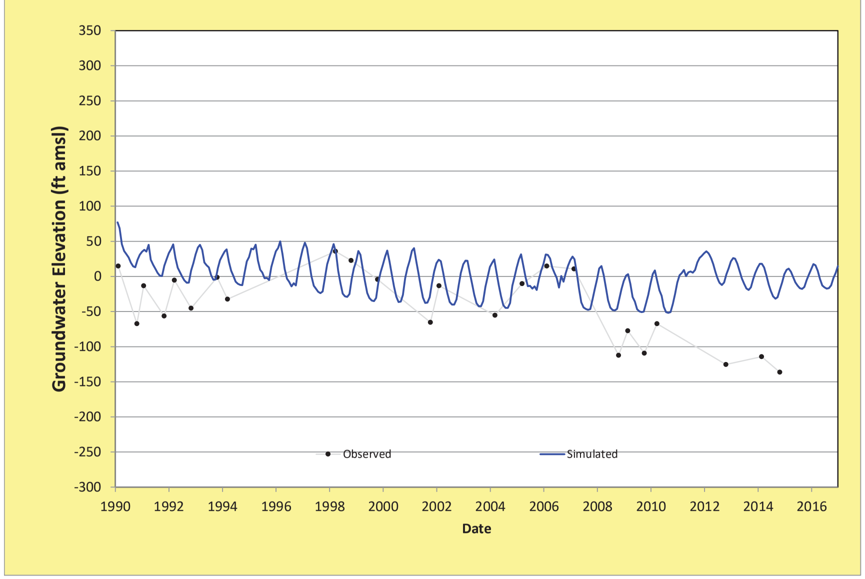

TU_23S23E25E001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


TU_23S23E33A002_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

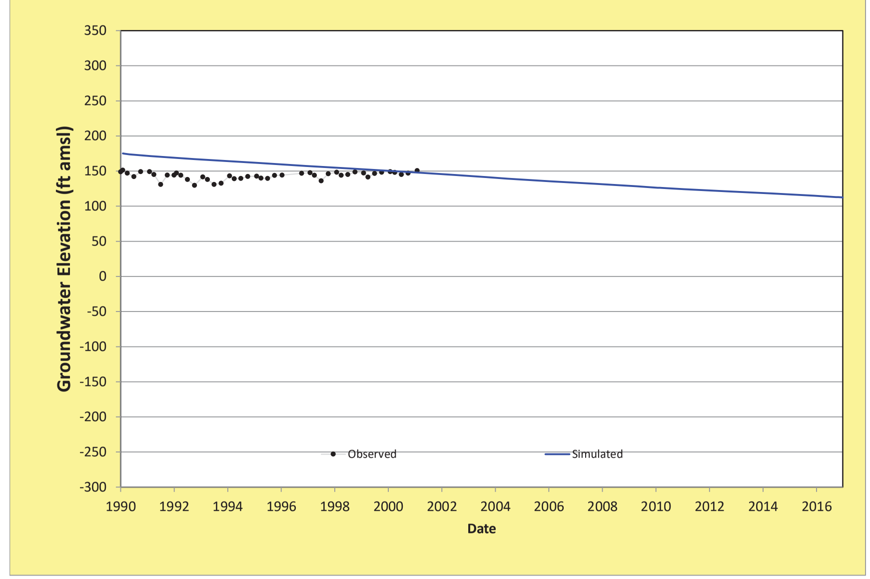

TU_23S23E25N001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


TU_23S23E33R001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

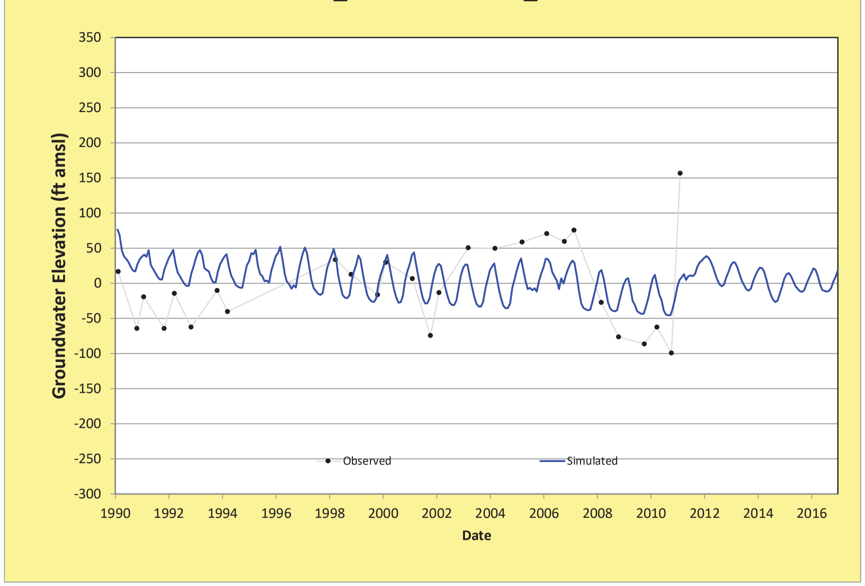
TU_23S23E36E001_L6



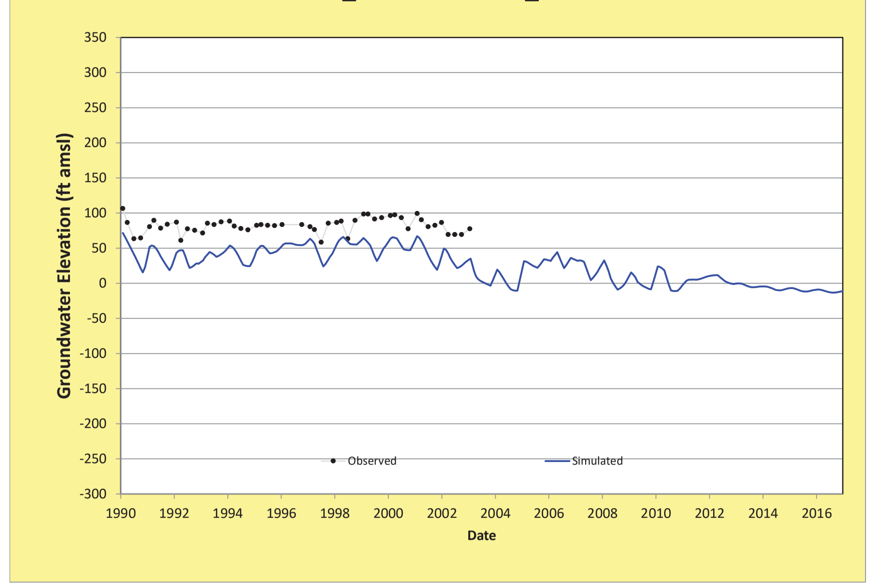
TU_23S24E07G001_L3

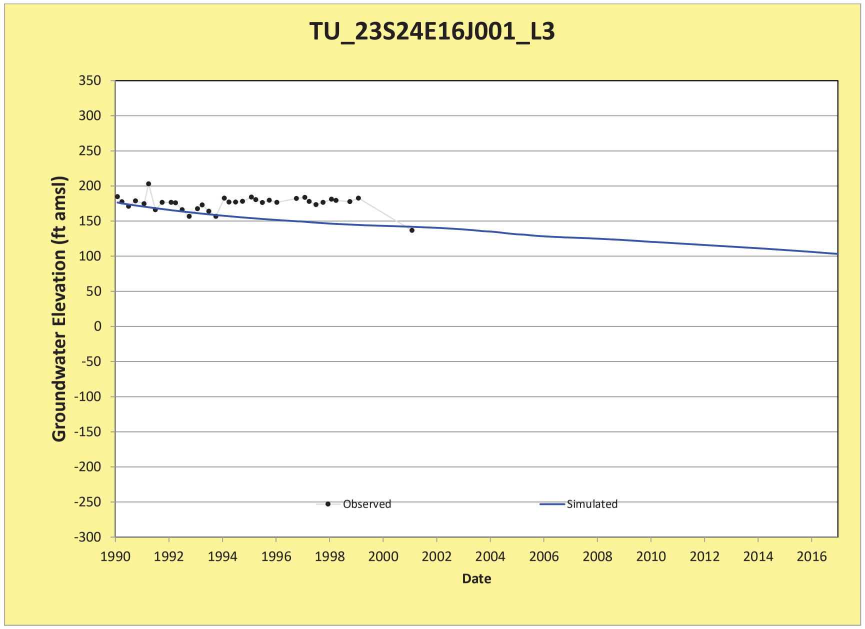


TU_23S23E36M001_L6

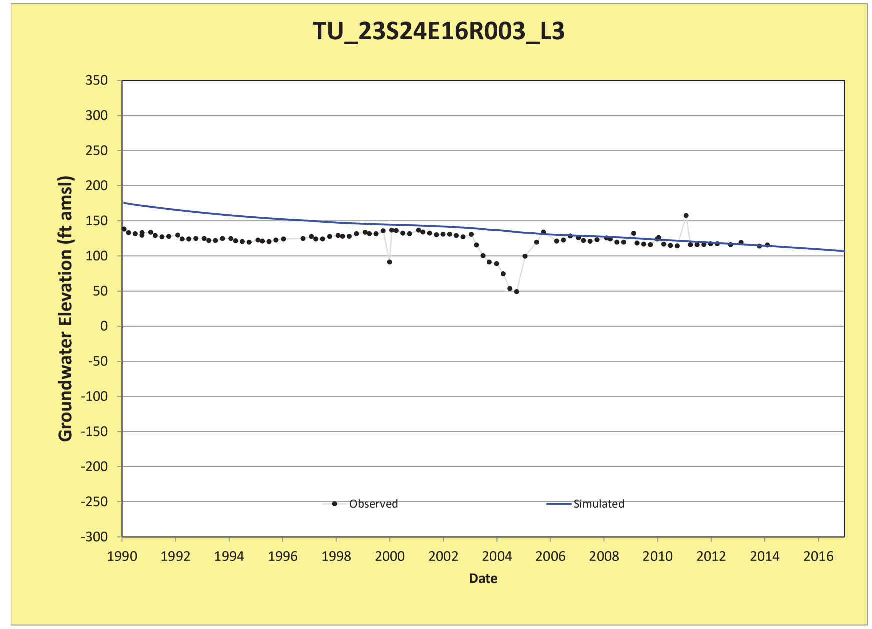


TU_23S24E10A001_L6

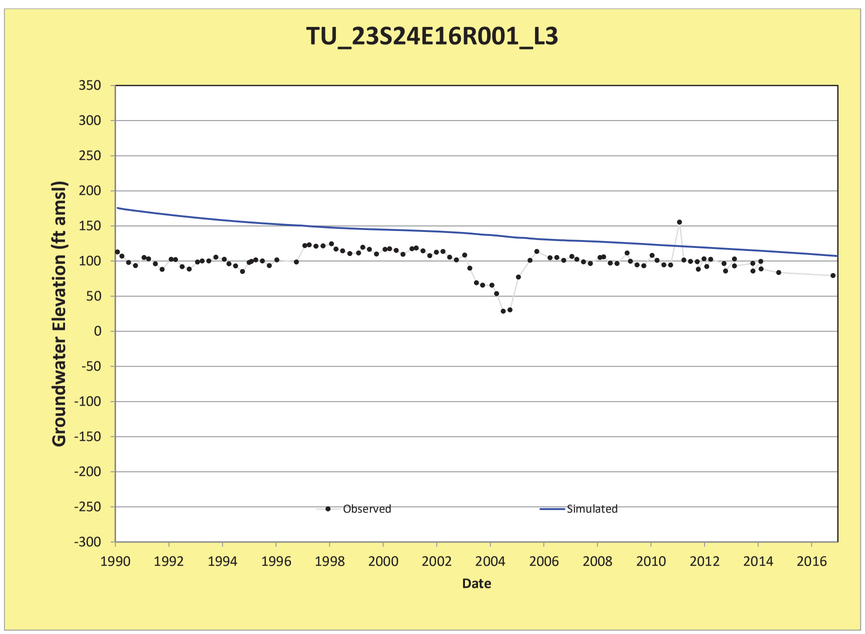




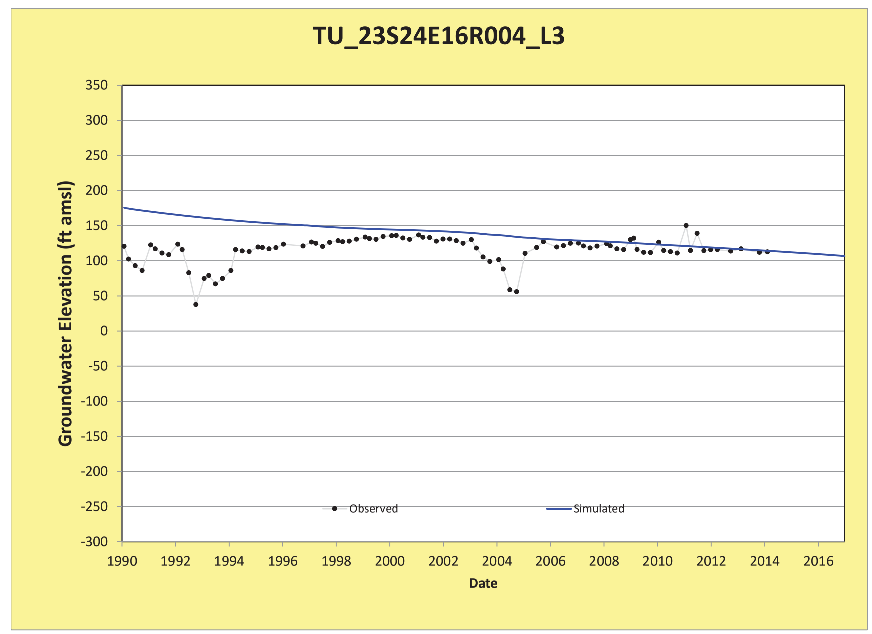
TU_23S24E16J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated



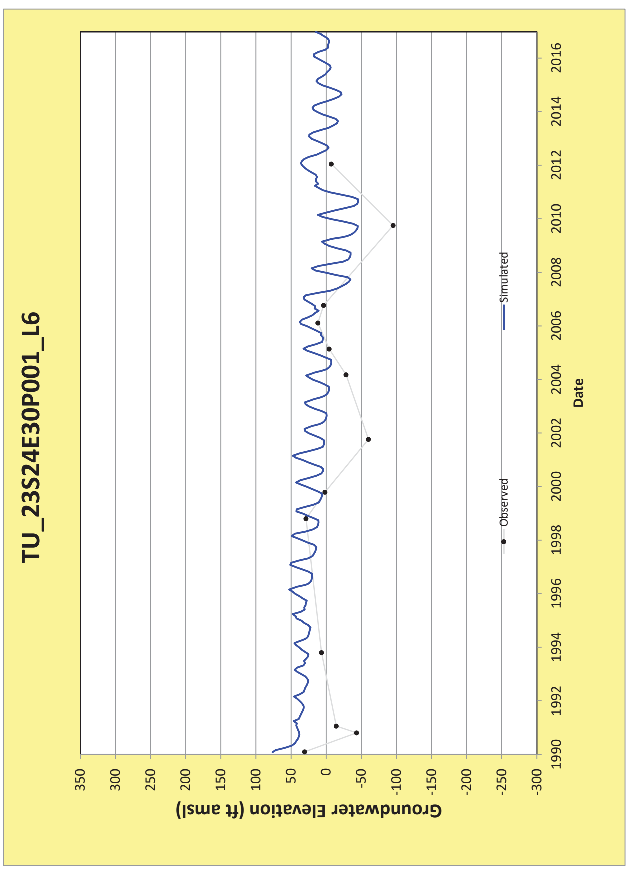
TU_23S24E16R003_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

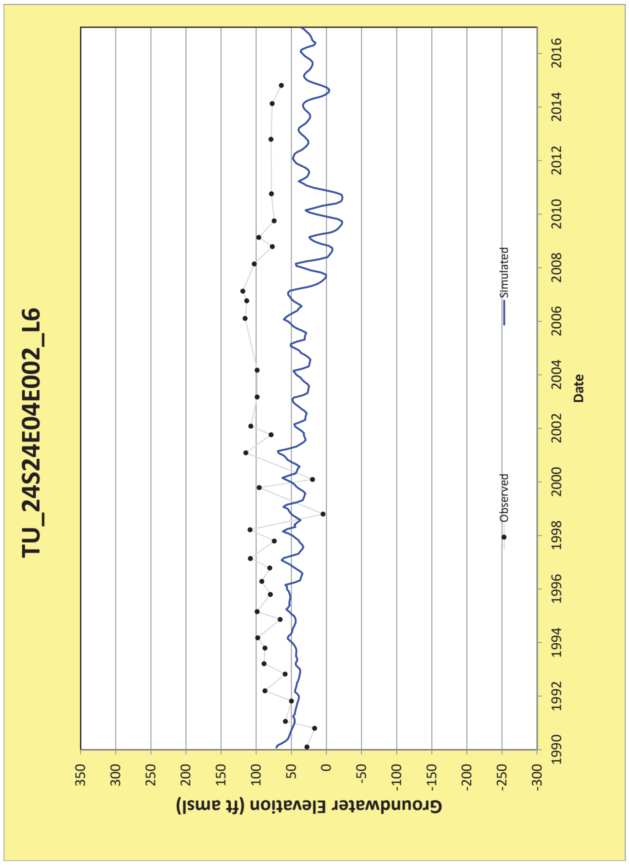


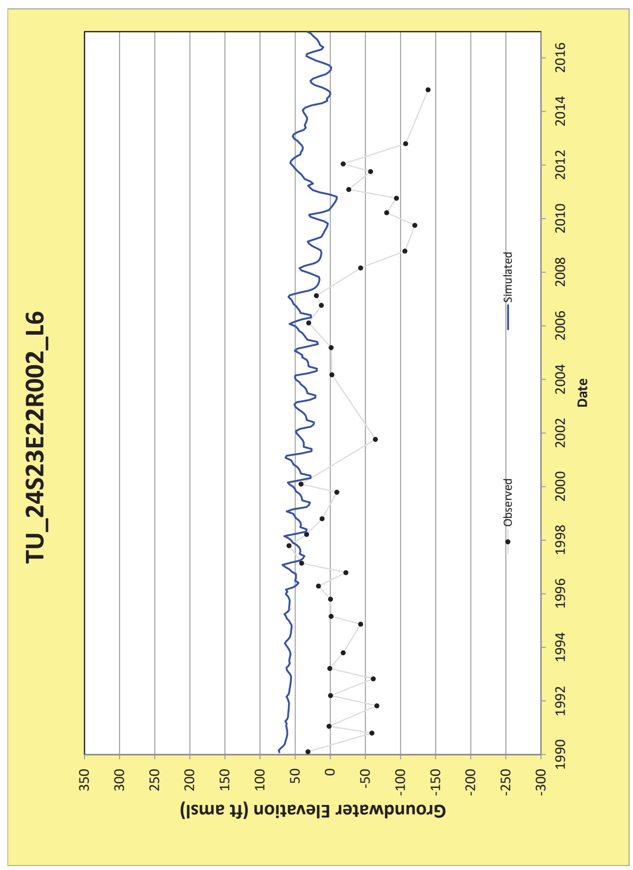
TU_23S24E16R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

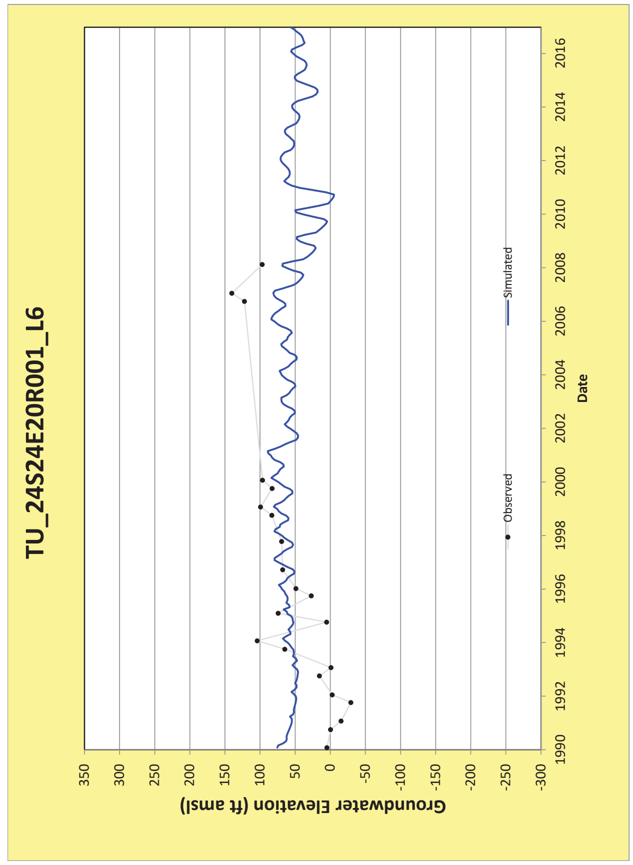


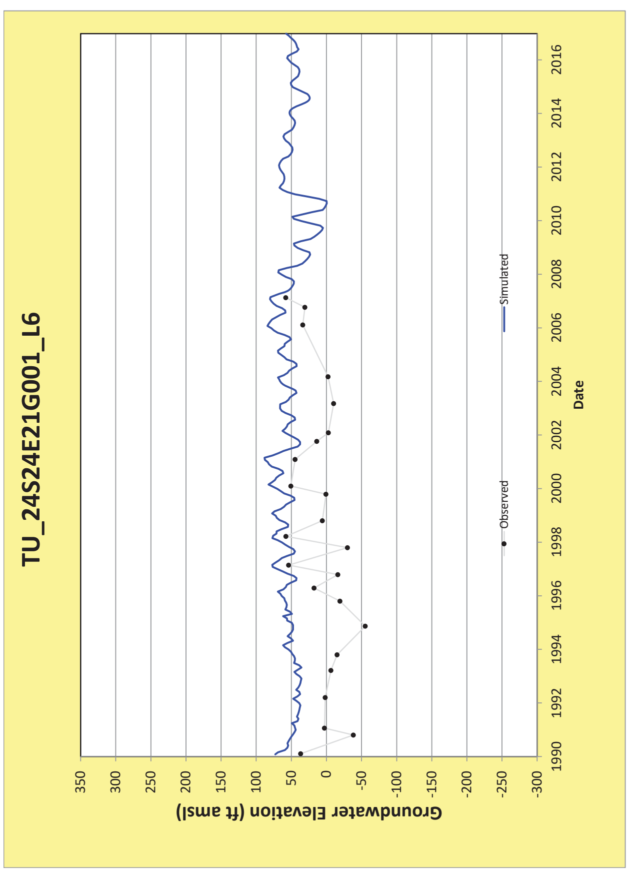
TU_23S24E16R004_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

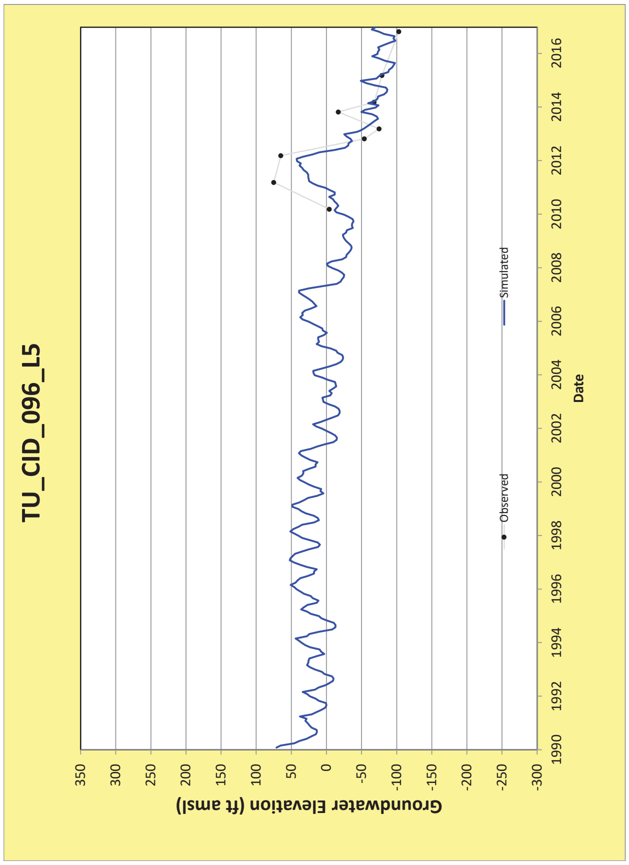

TU_23S24E30P001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

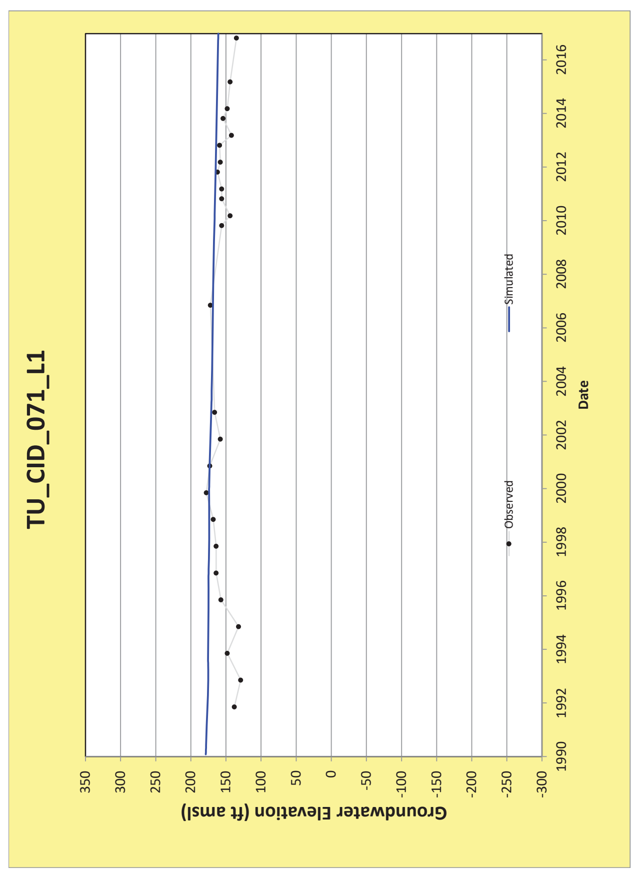

TU_24S24E04E002_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

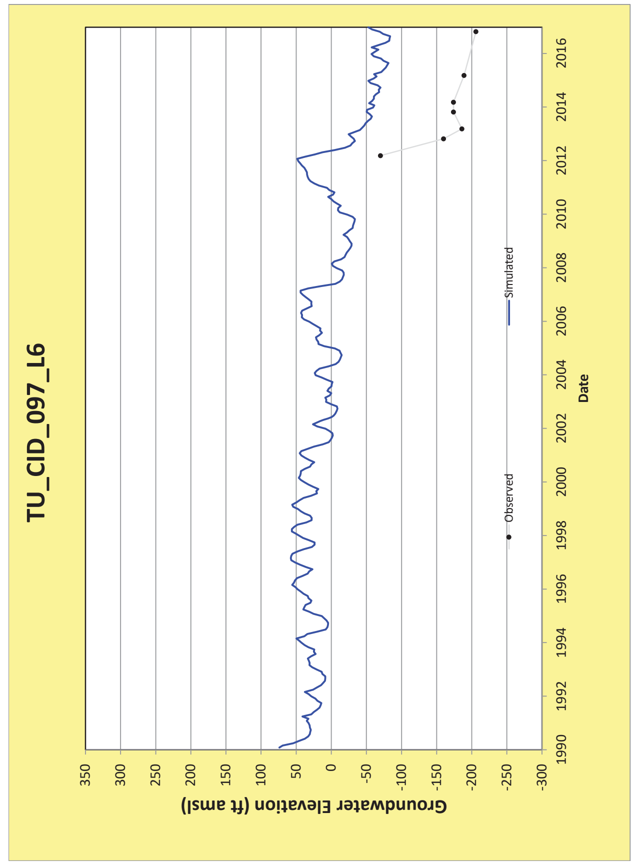

TU_24S23E22R002_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

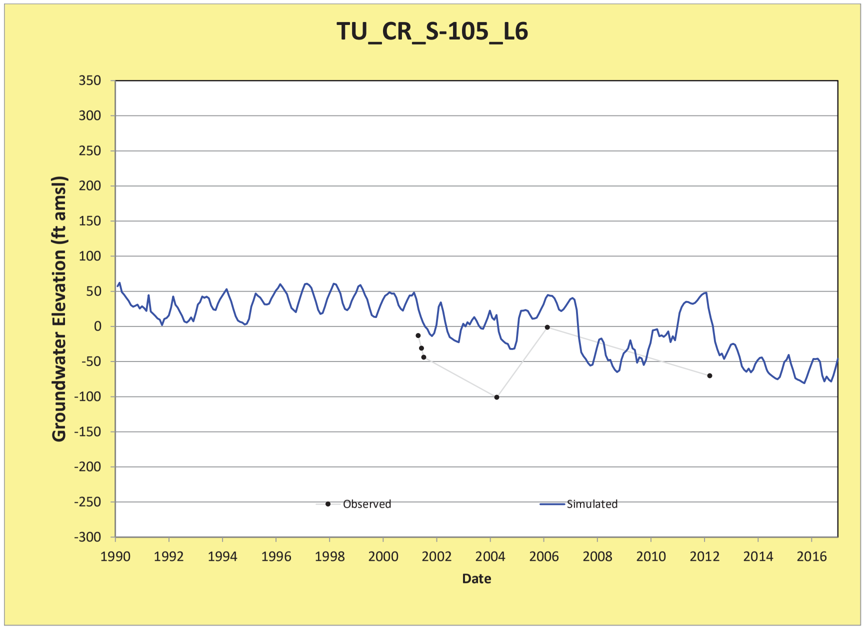

TU_24S24E20R001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

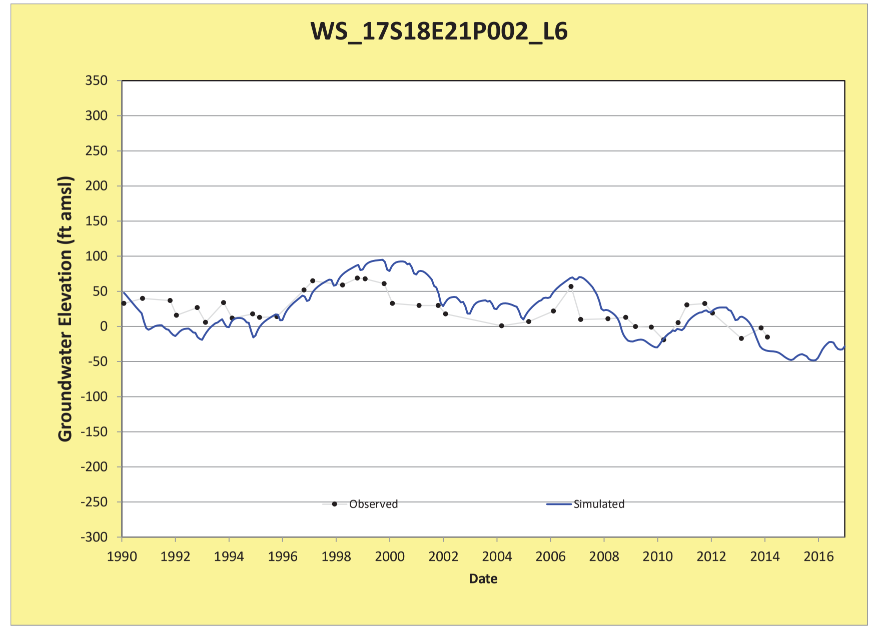

TU_24S24E21G001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

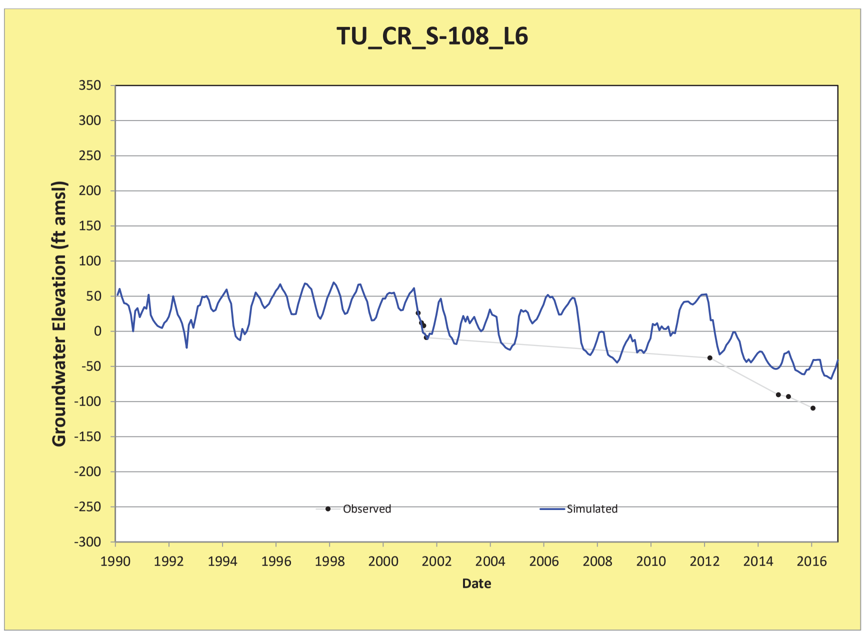

TU_CID_096_L5
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

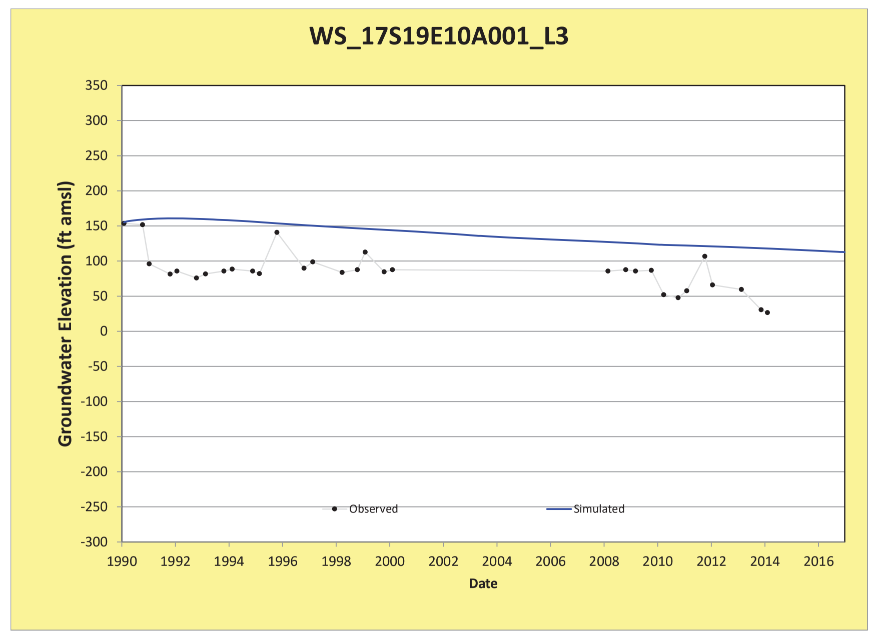

TU_CID_071_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

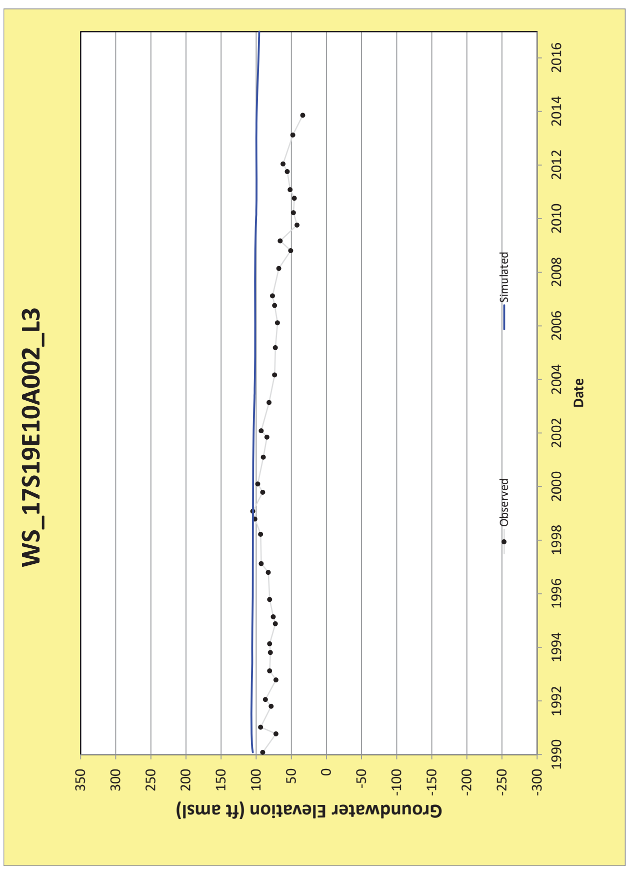

TU_CID_097_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

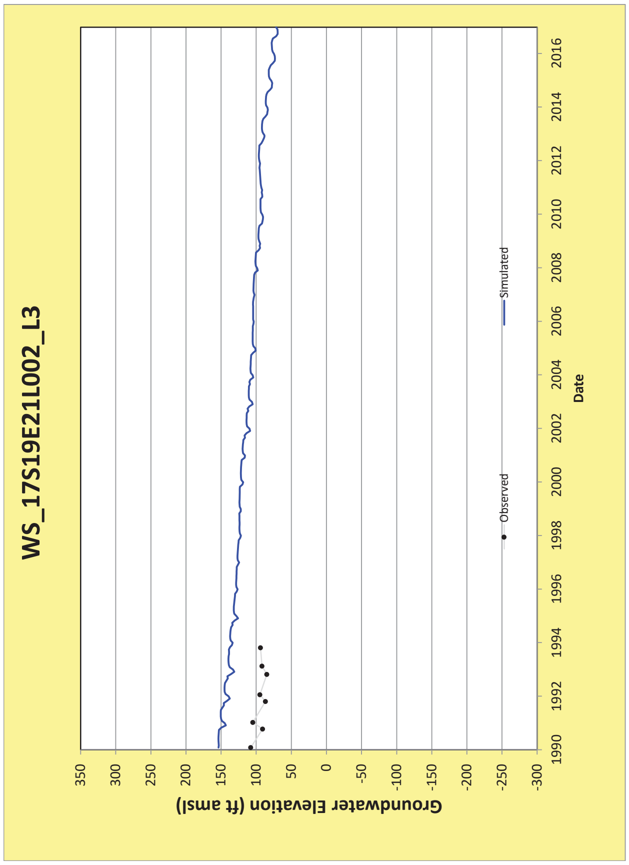

TU_CR_S-105_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

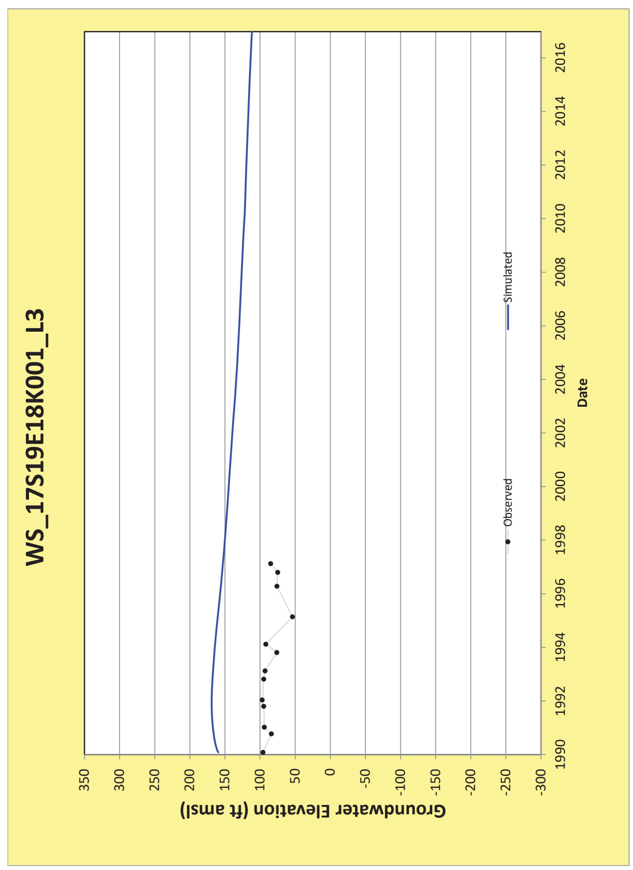

WS_17S18E21P002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

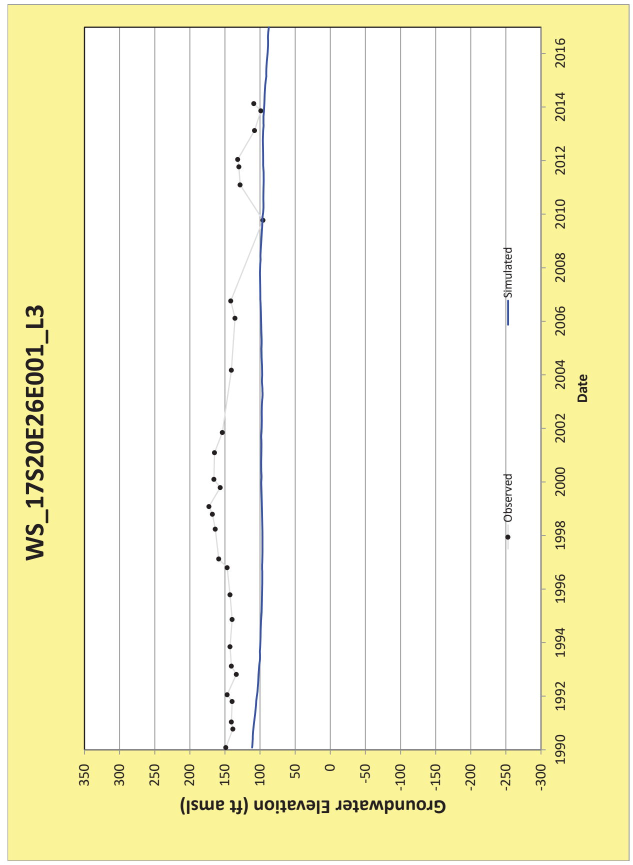

TU_CR_S-108_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

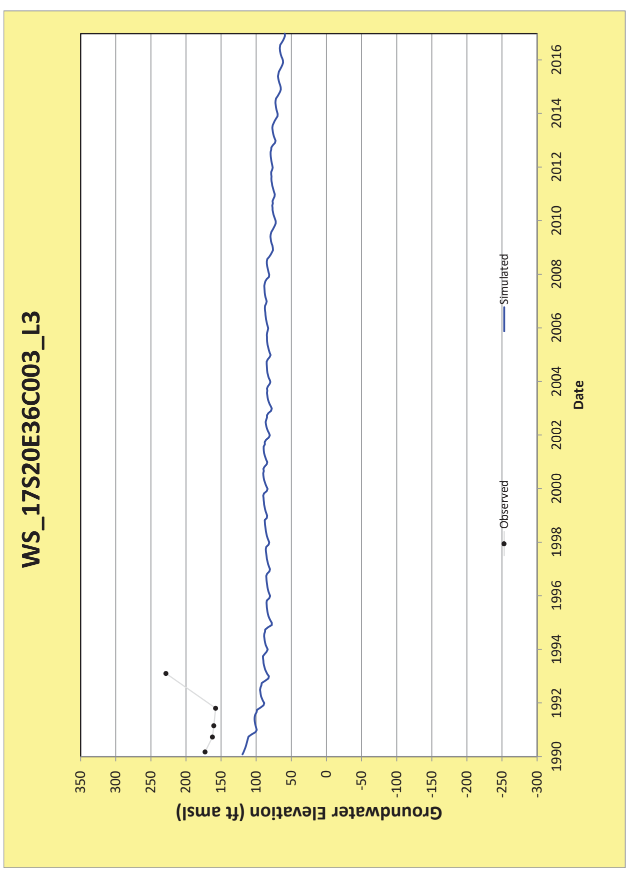

WS_17S19E10A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

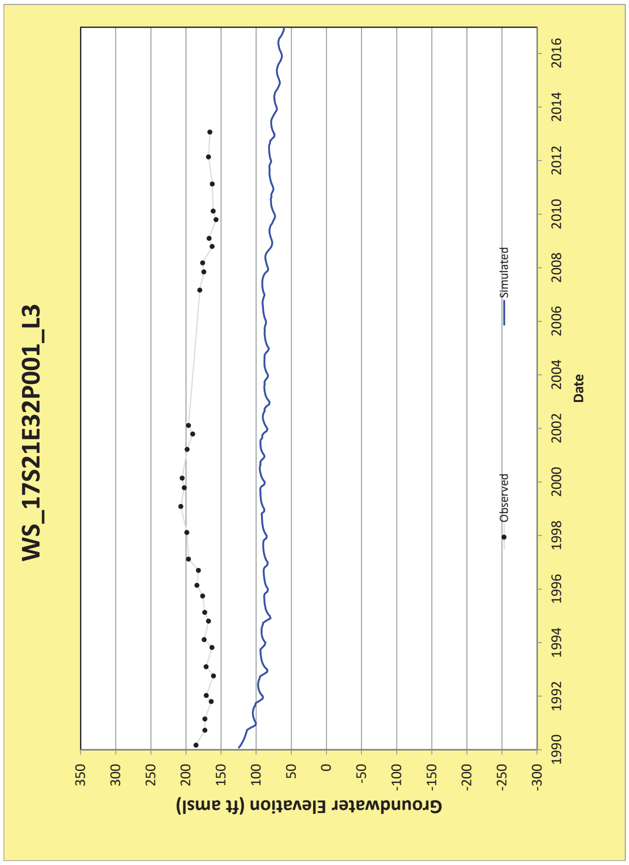

WS_17S19E10A002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

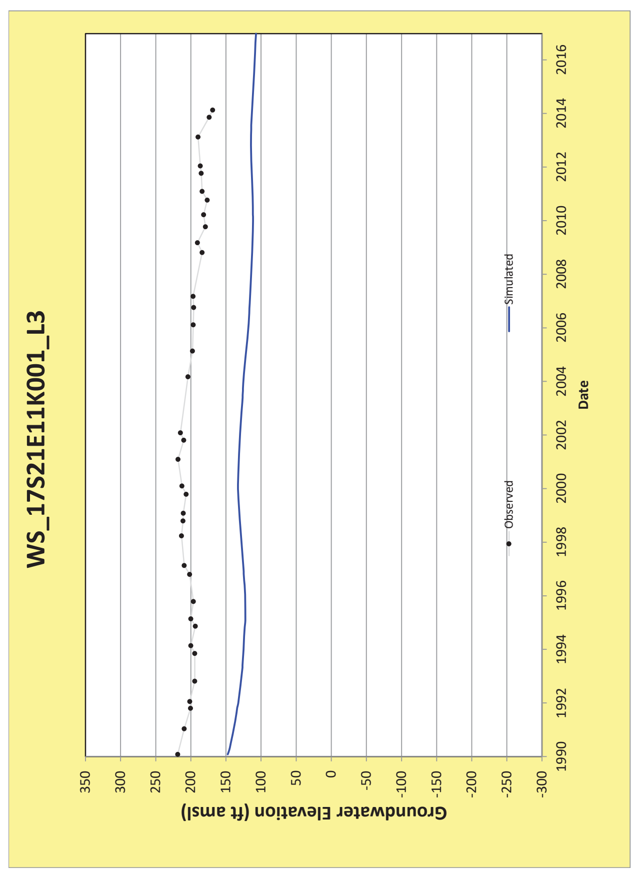

WS_17S19E21L002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

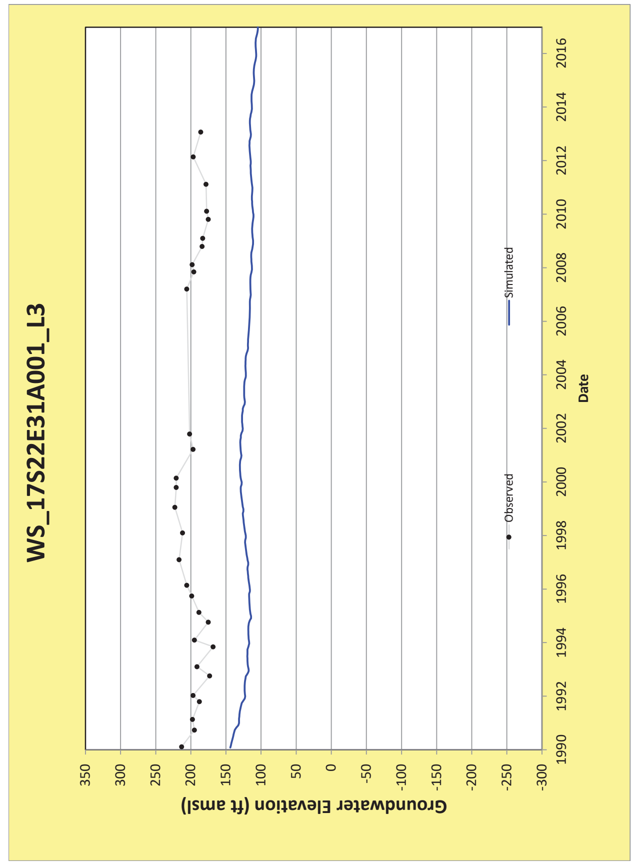

WS_17S19E18K001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

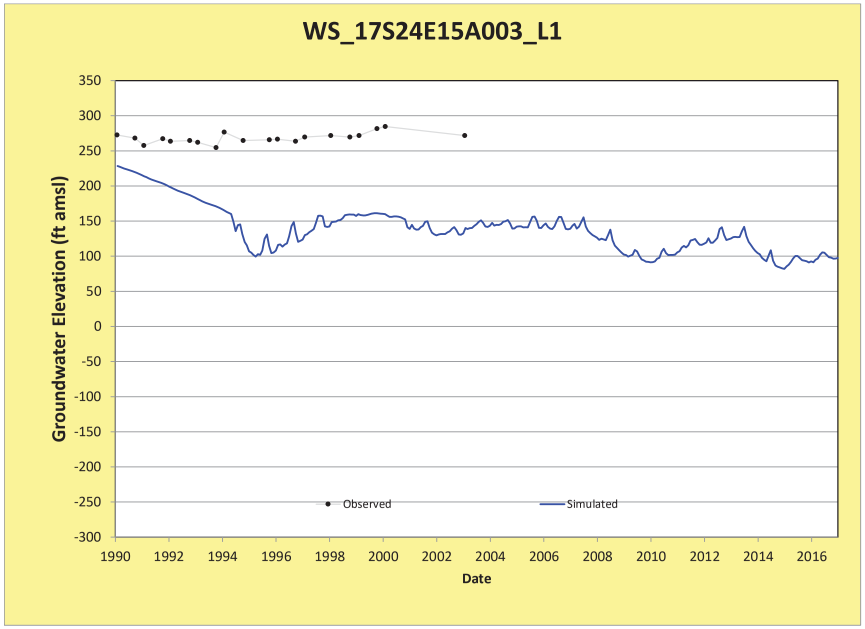

WS_17S20E26E001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

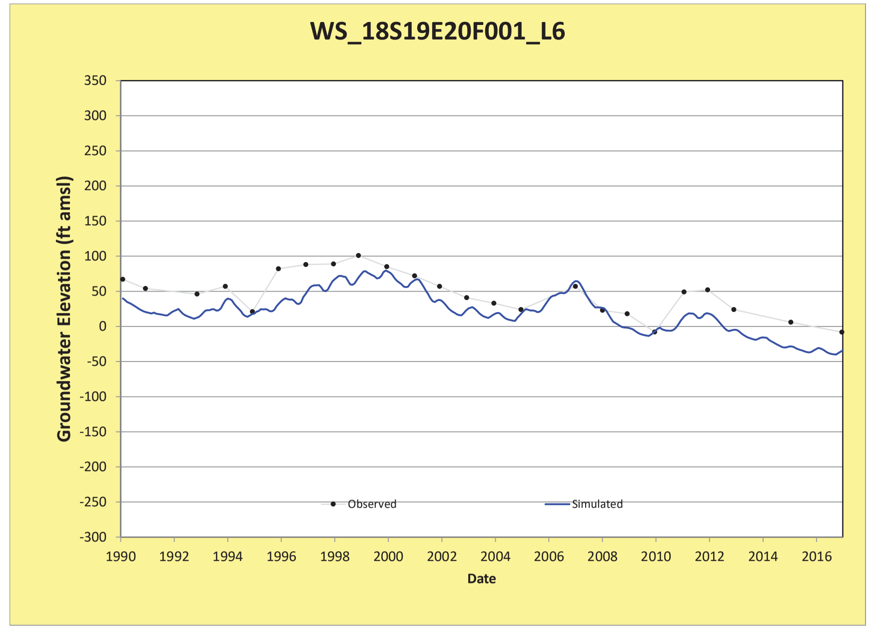

WS_17S20E36C003_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

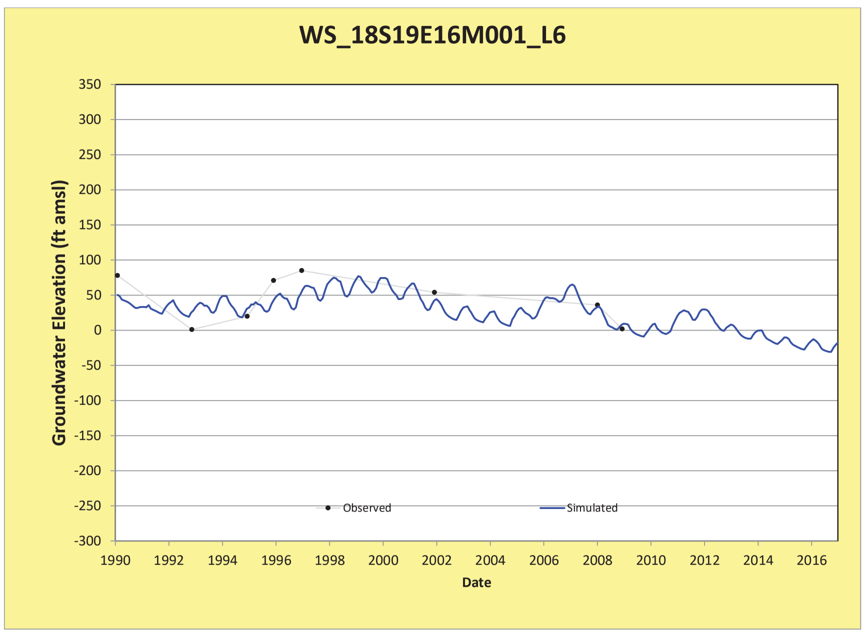

WS_17S21E32P001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

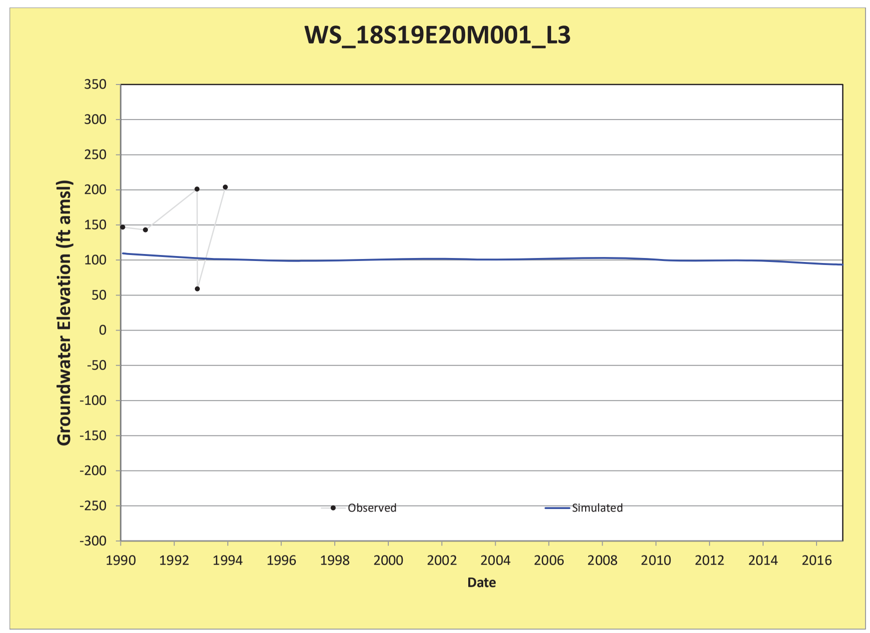

WS_17S21E11K001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

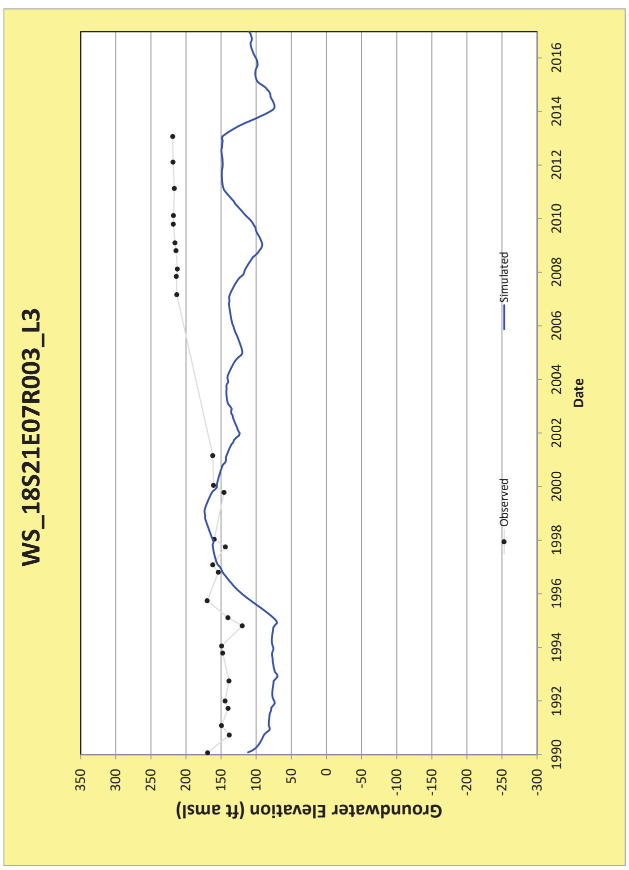

WS_17S22E31A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

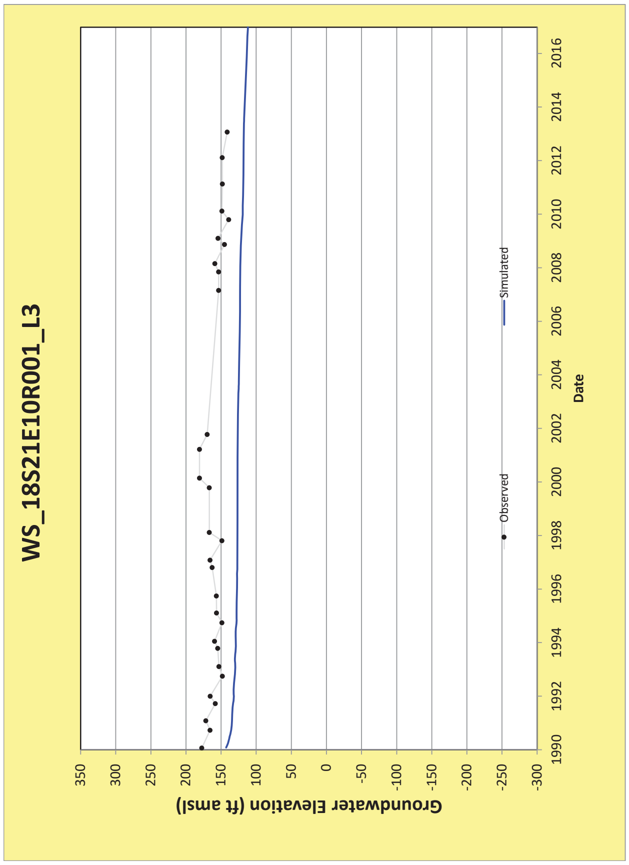

WS_17S24E15A003_L1
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

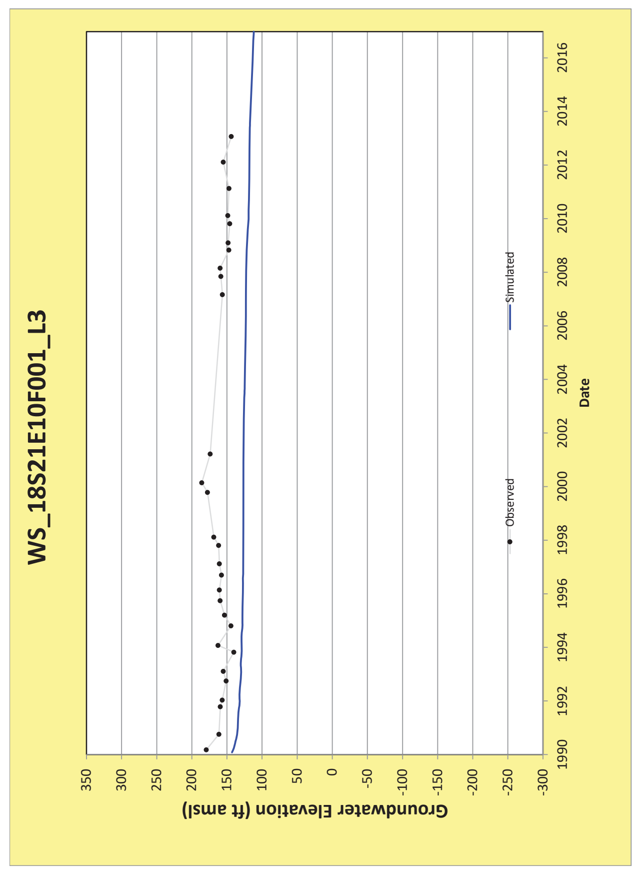

WS_18S19E20F001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

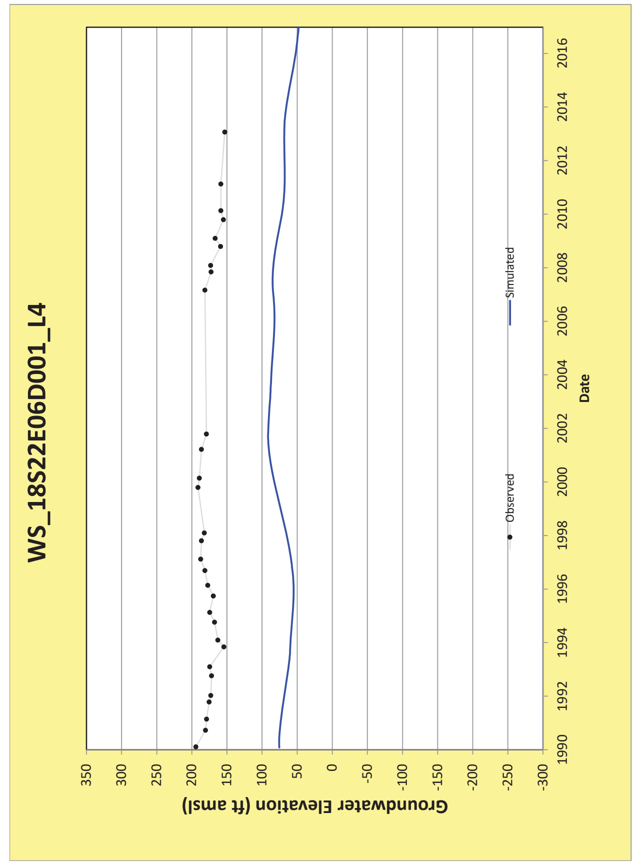

WS_18S19E16M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

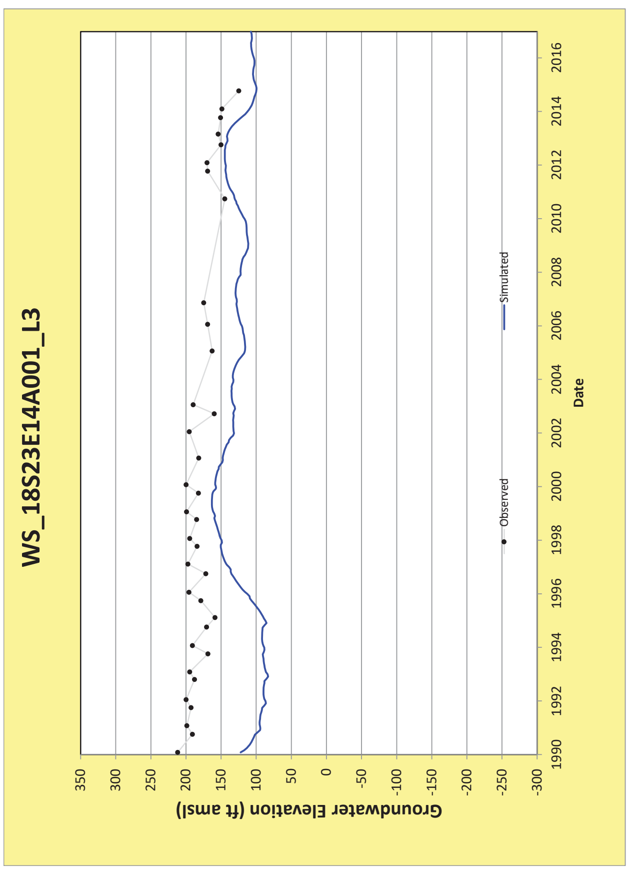

WS_18S19E20M001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

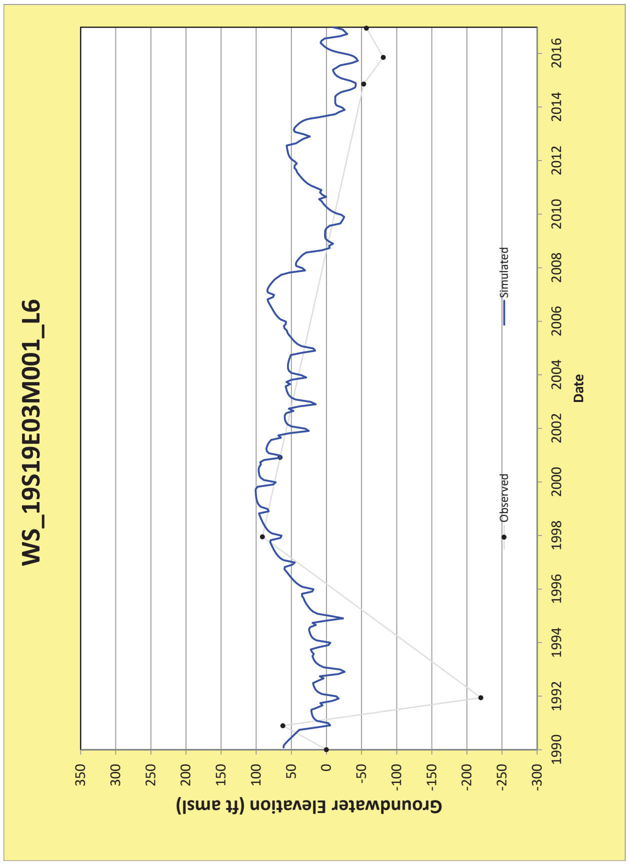

WS_18S21E07R003_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

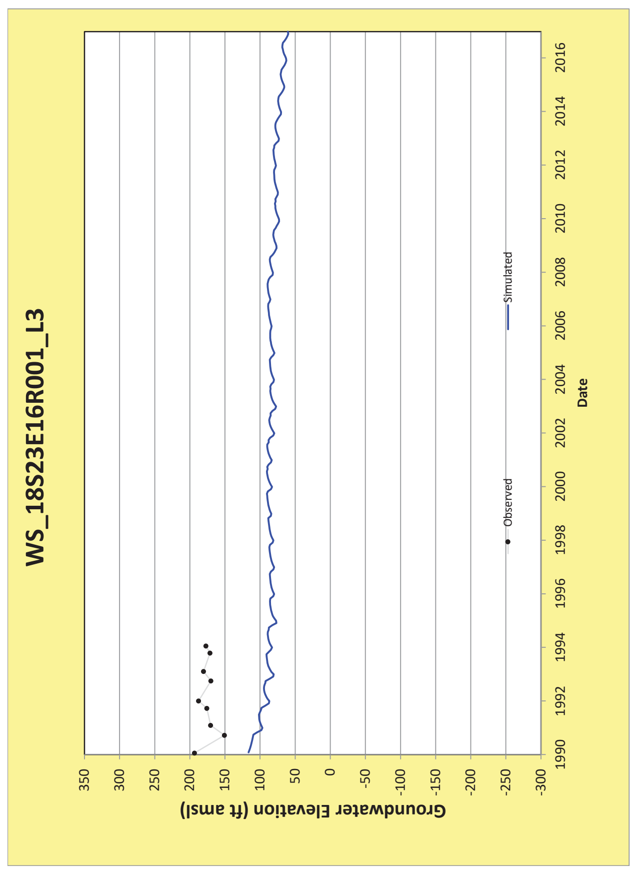

WS_18S21E10R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

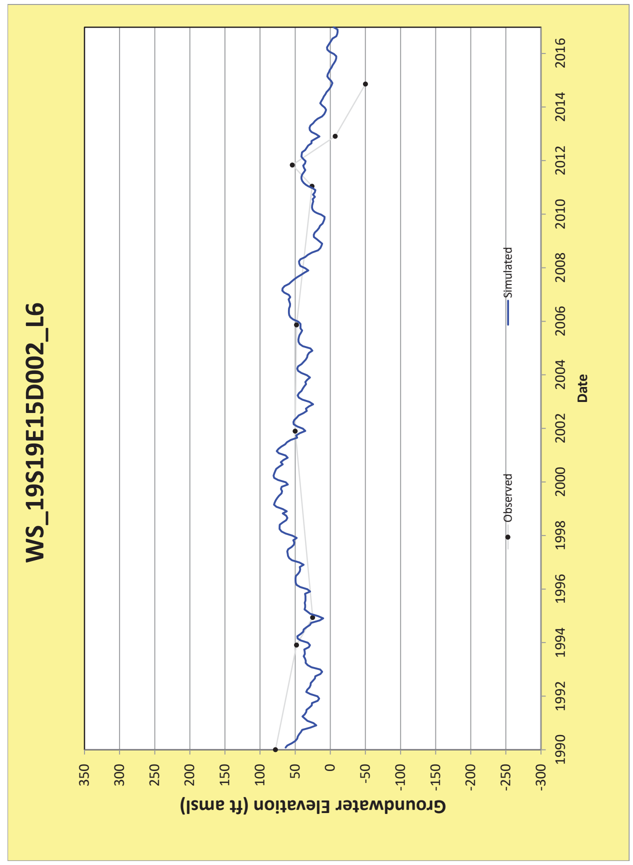

WS_18S21E10F001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_18S22E06D001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

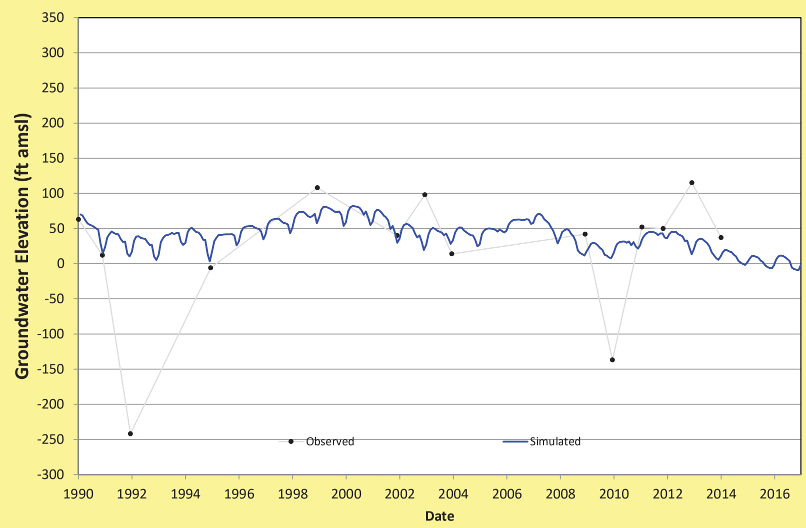

WS_18S23E14A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


WS_19S19E03M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

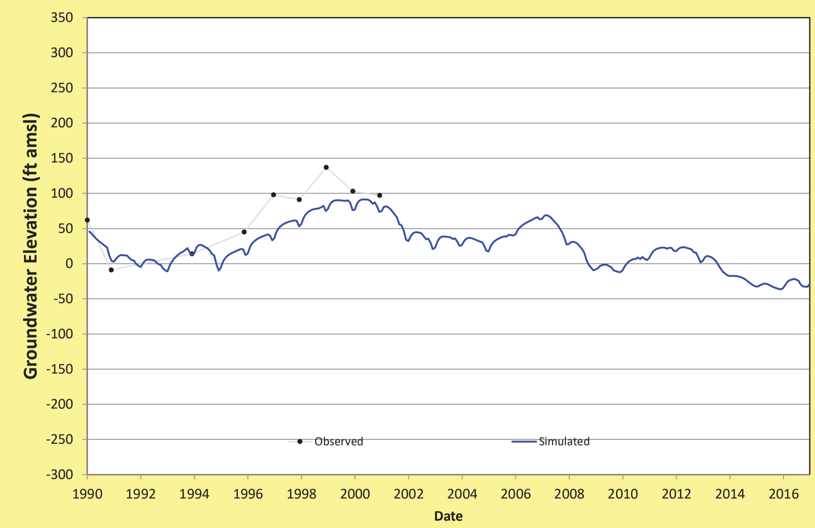

WS_18S23E16R001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated


WS_19S19E15D002_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

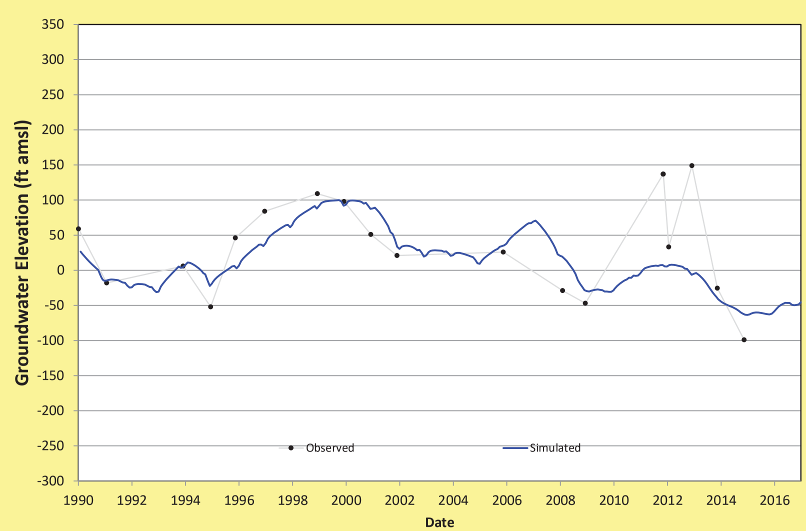
WS_19S19E15E001_L6



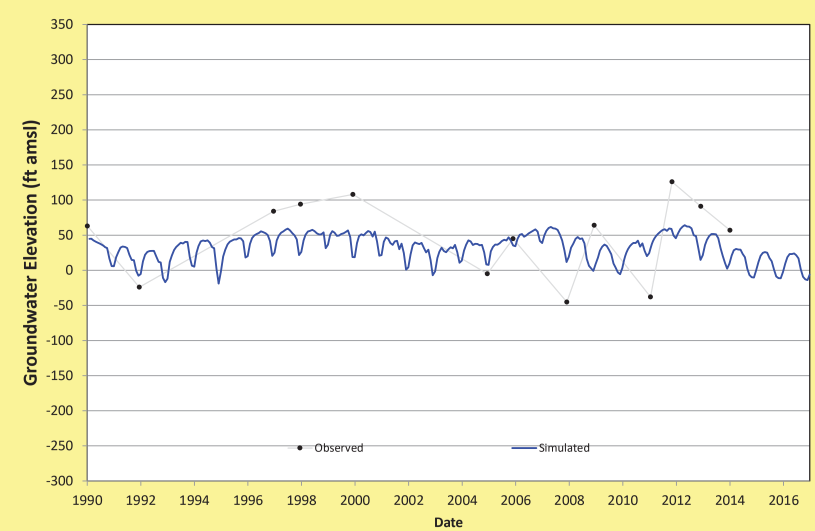
WS_19S19E20G001_L6

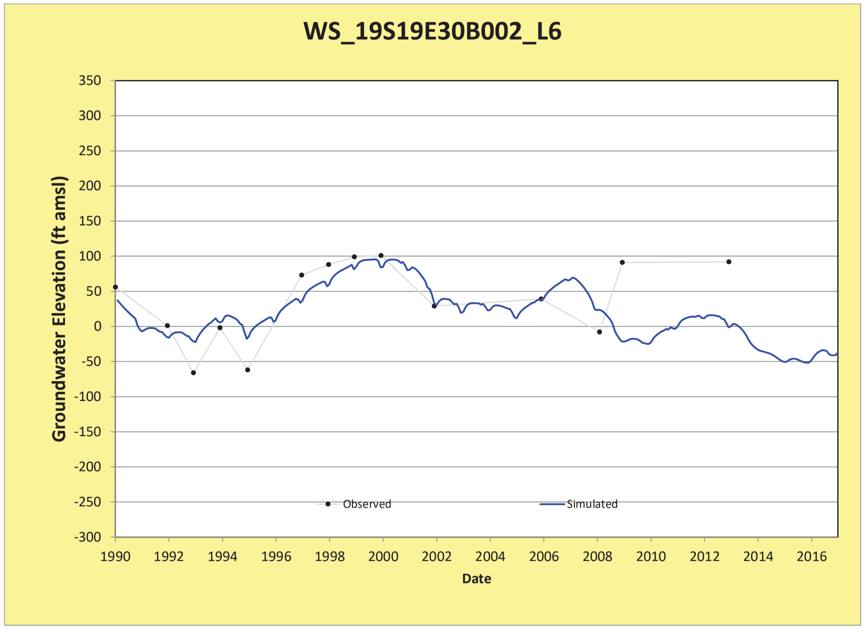


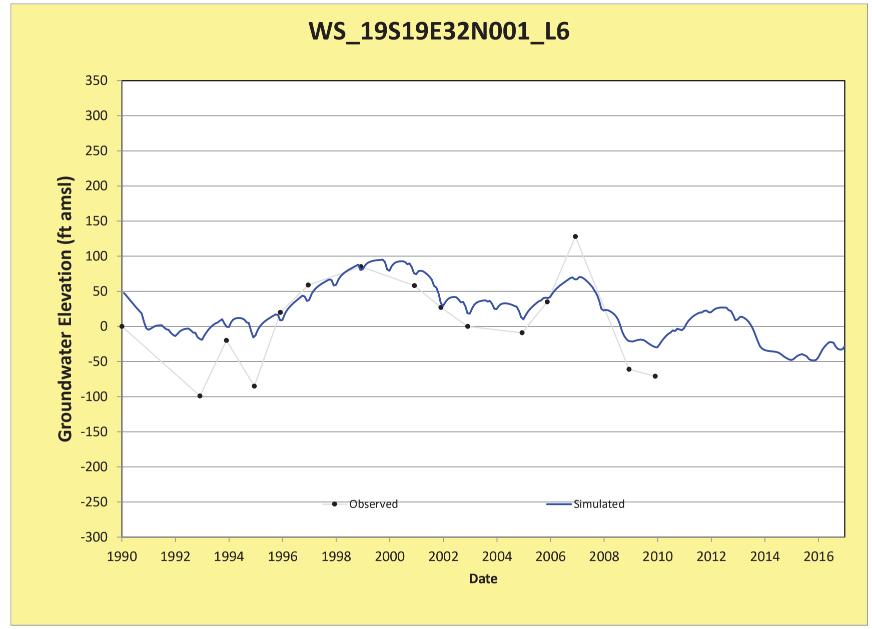
WS_19S19E19K001_L6

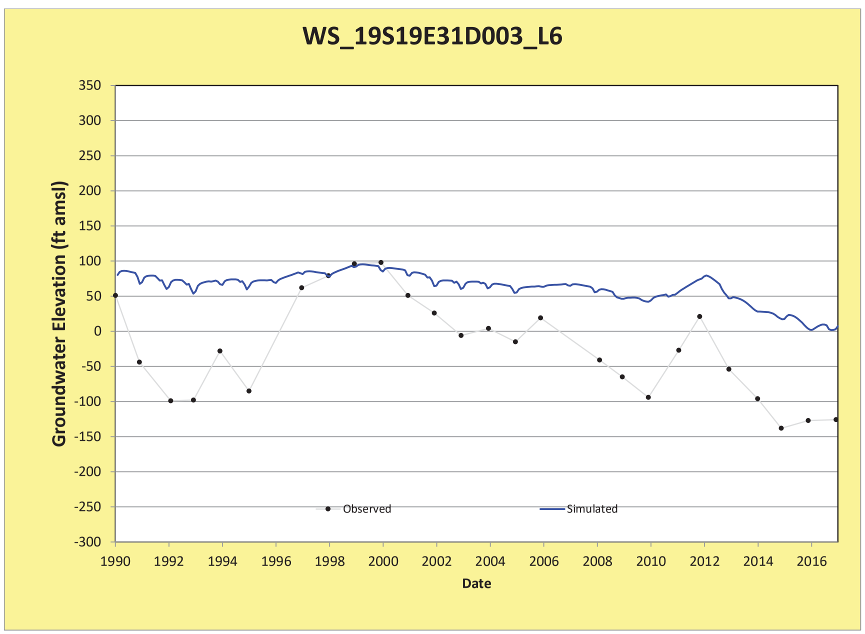


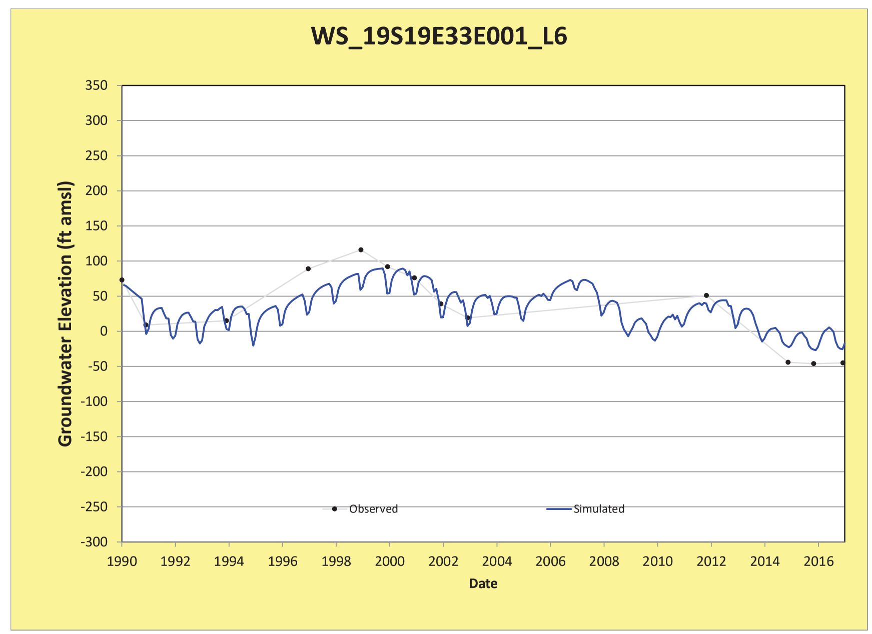
WS_19S19E28K001_L6

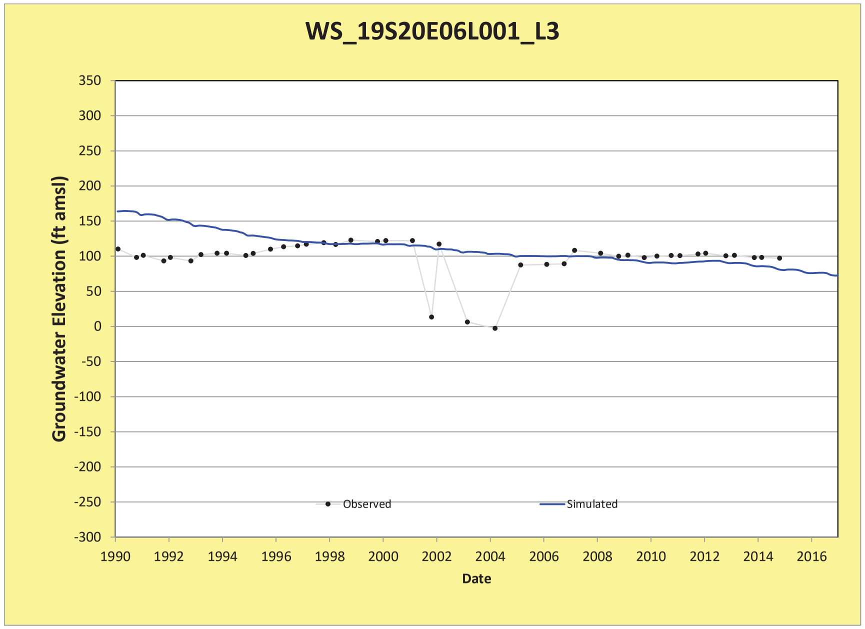


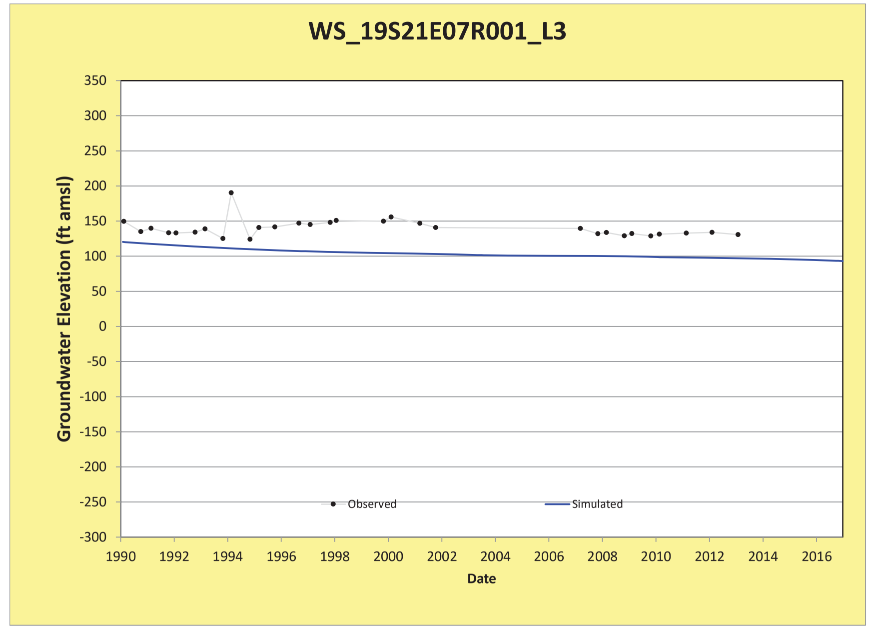

WS_19S19E30B002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

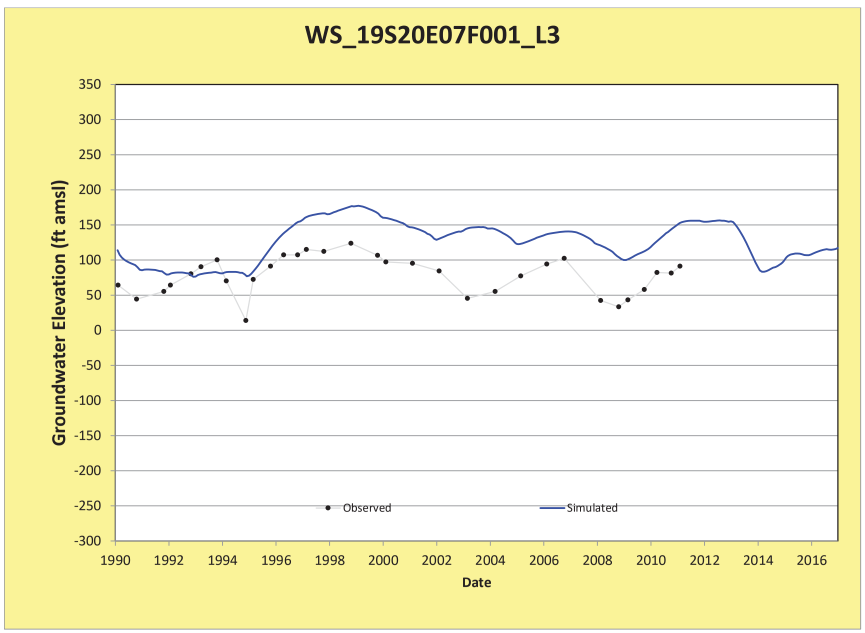

WS_19S19E32N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

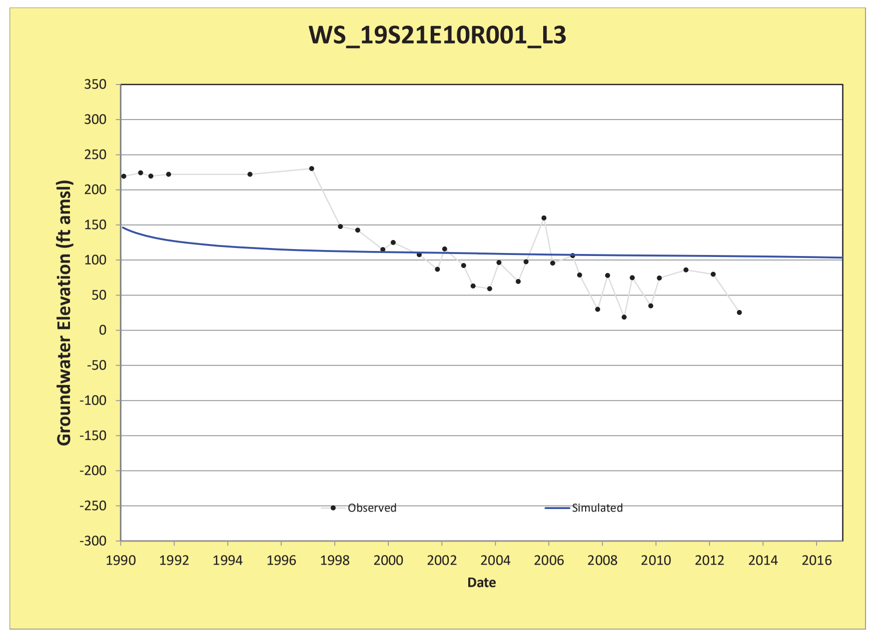

WS_19S19E31D003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

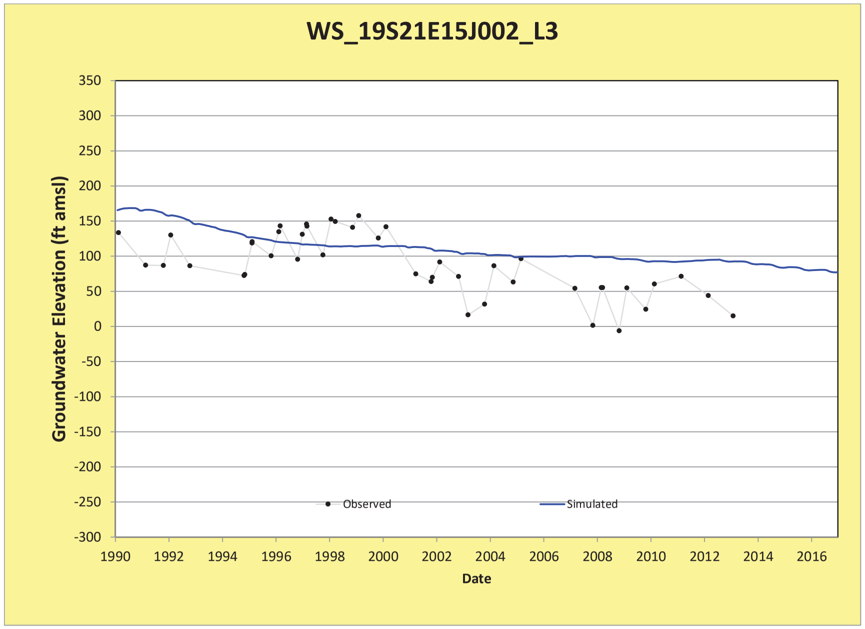

WS_19S19E33E001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

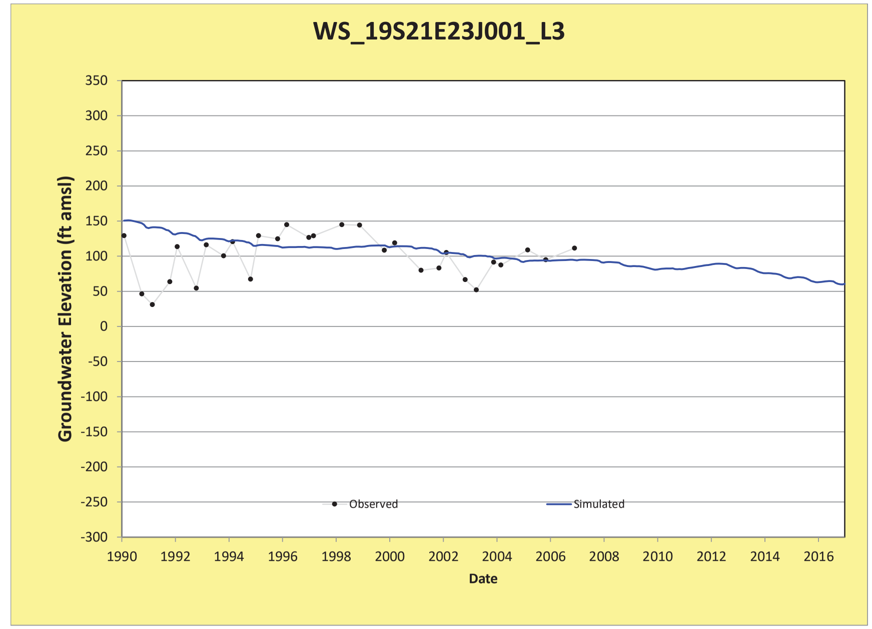

WS_19S20E06L001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

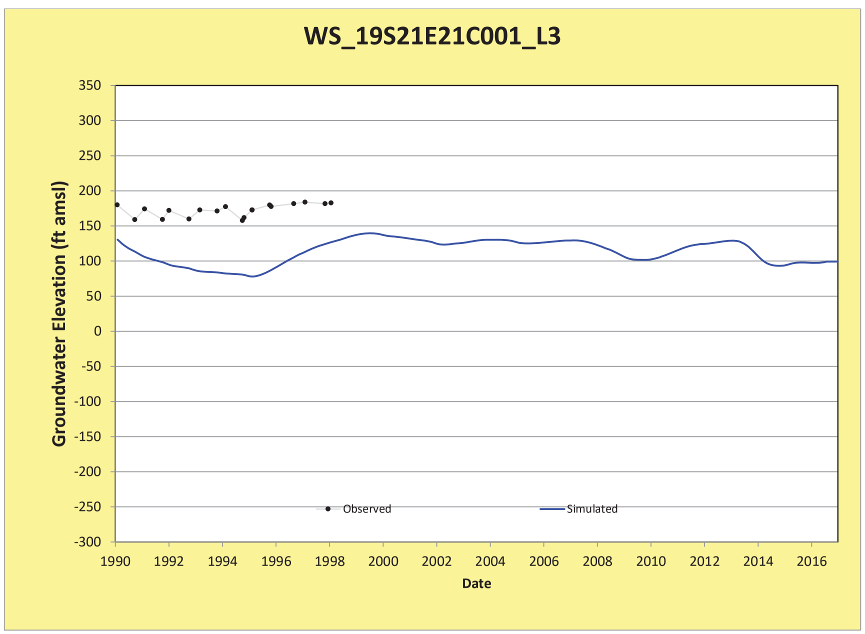

WS_19S21E07R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

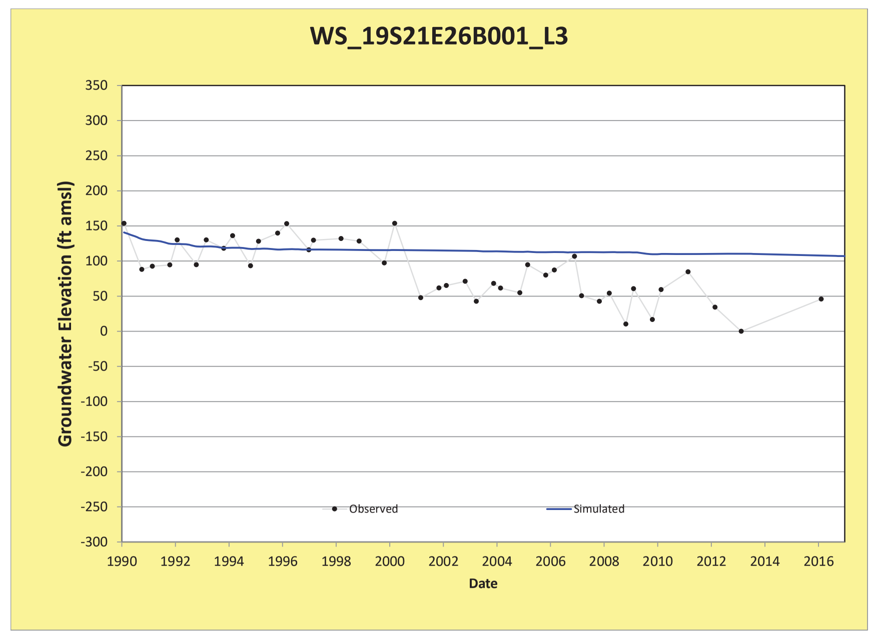

WS_19S20E07F001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

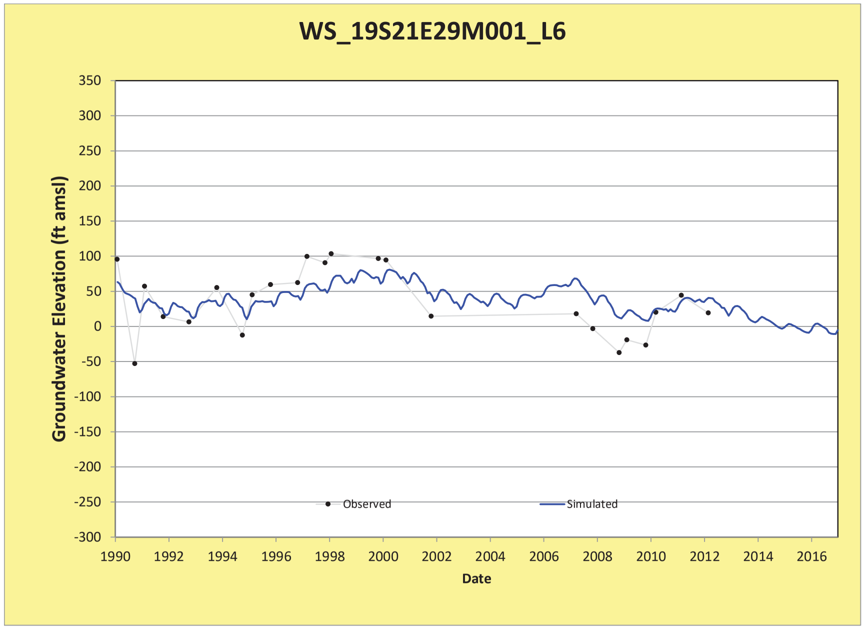

WS_19S21E10R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_19S21E15J002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

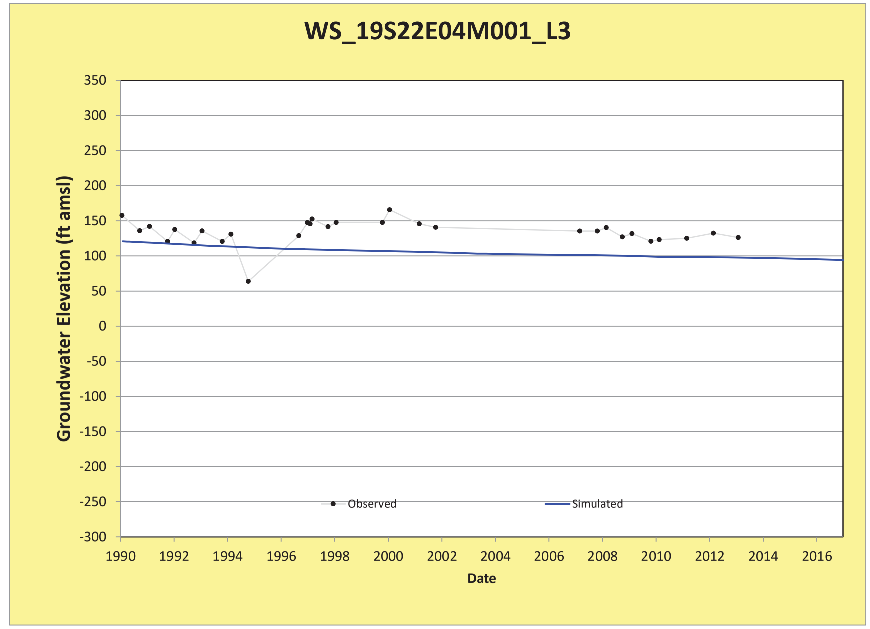

WS_19S21E23J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_19S21E21C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

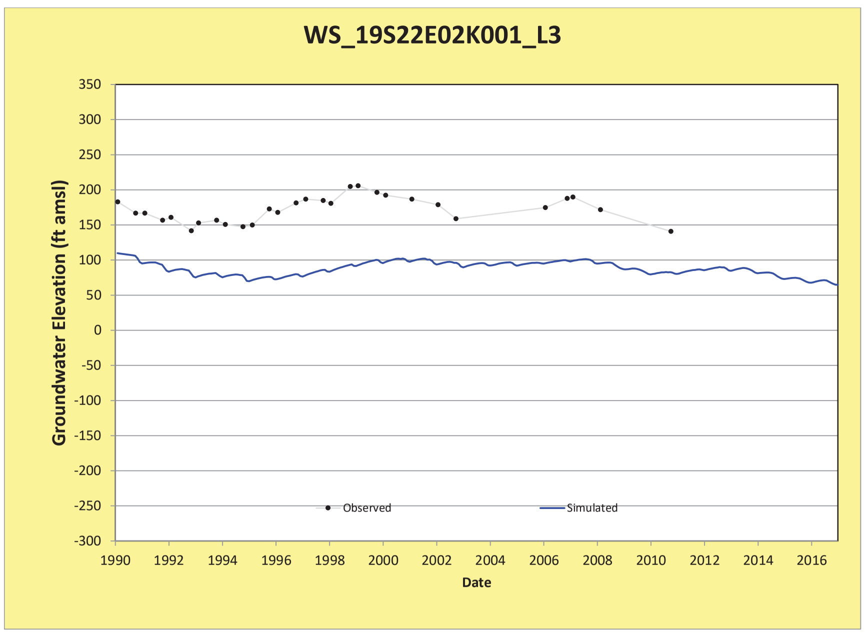

WS_19S21E26B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated



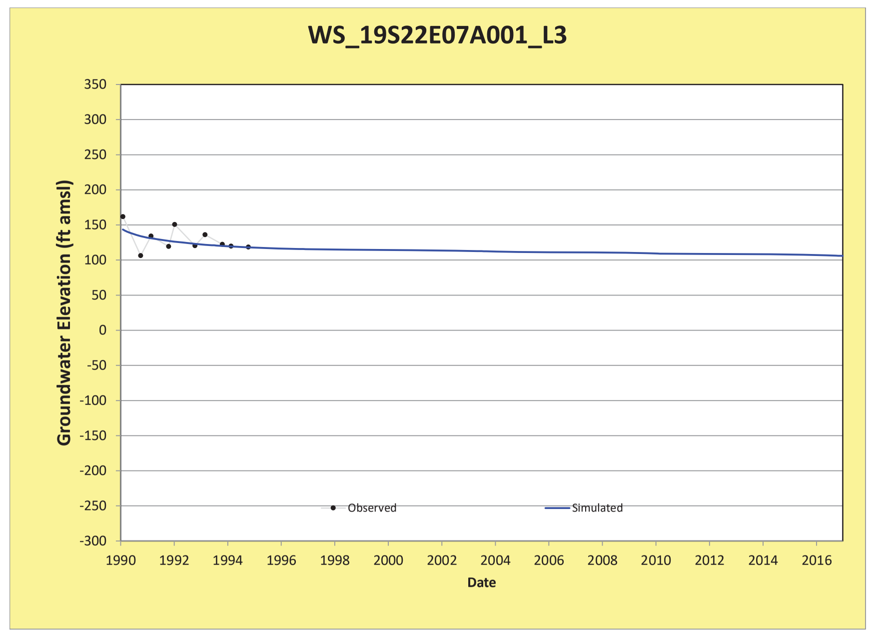
WS_19S21E29M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated



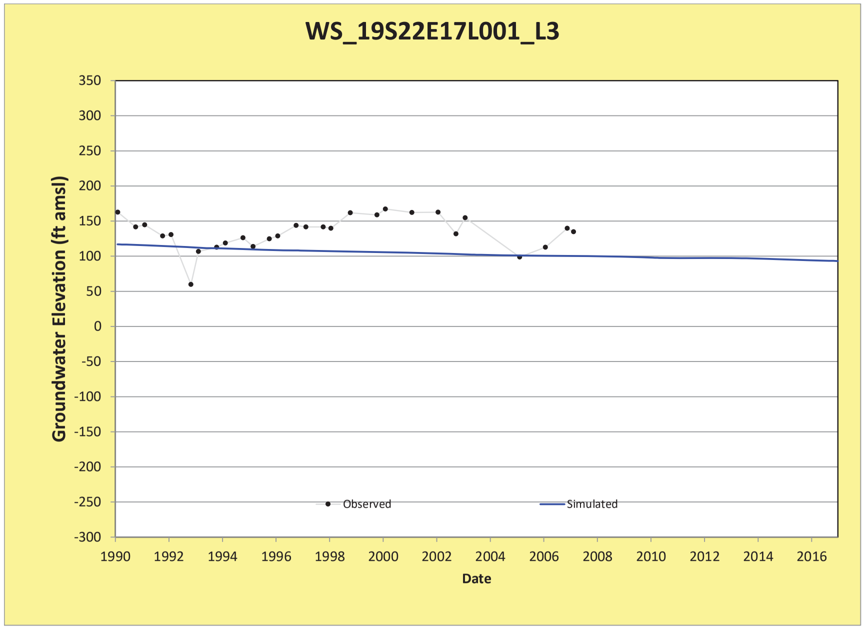
WS_19S22E04M001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

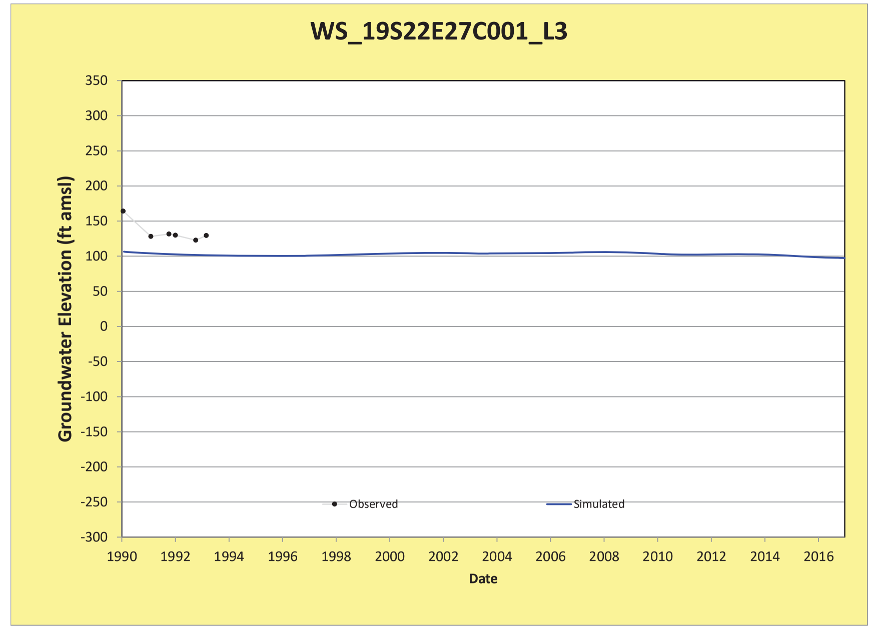


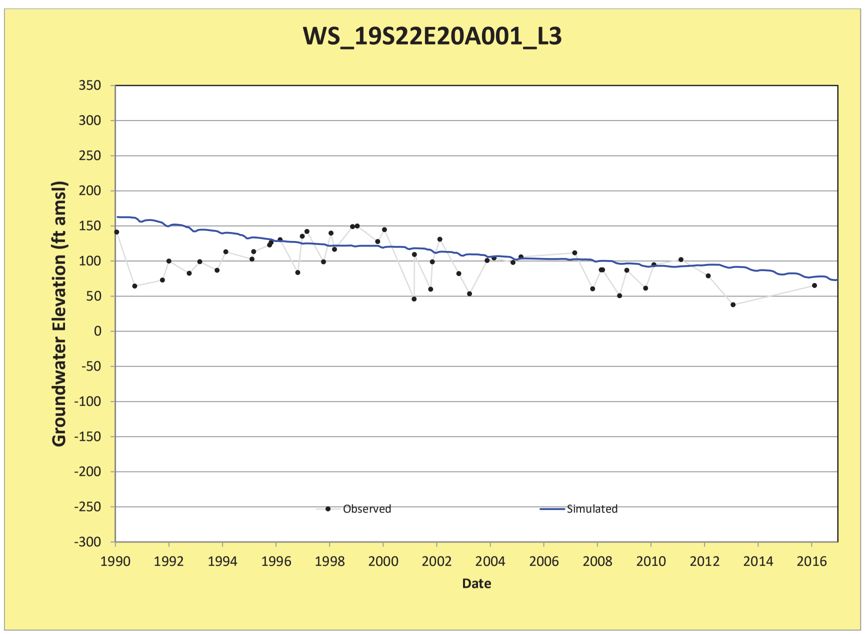
WS_19S22E02K001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

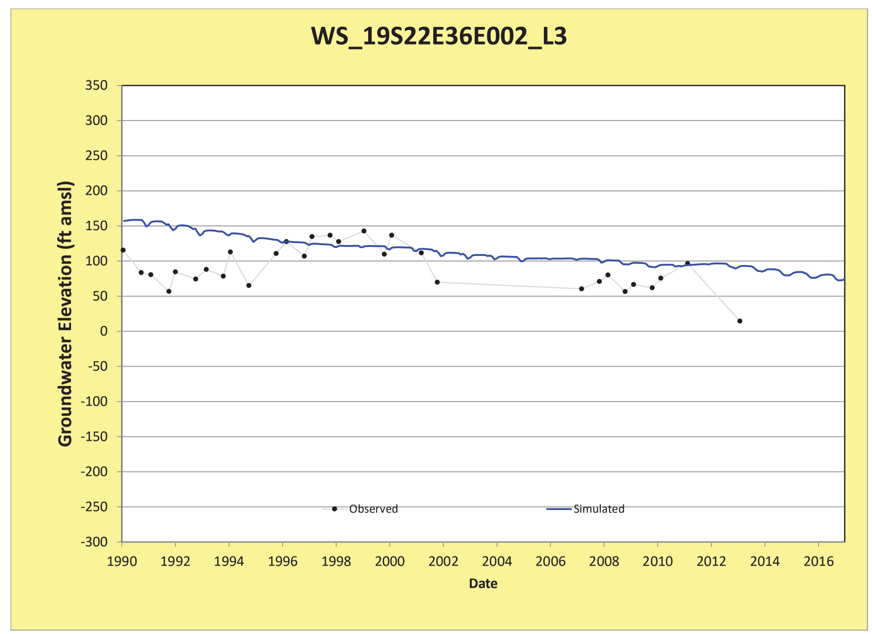


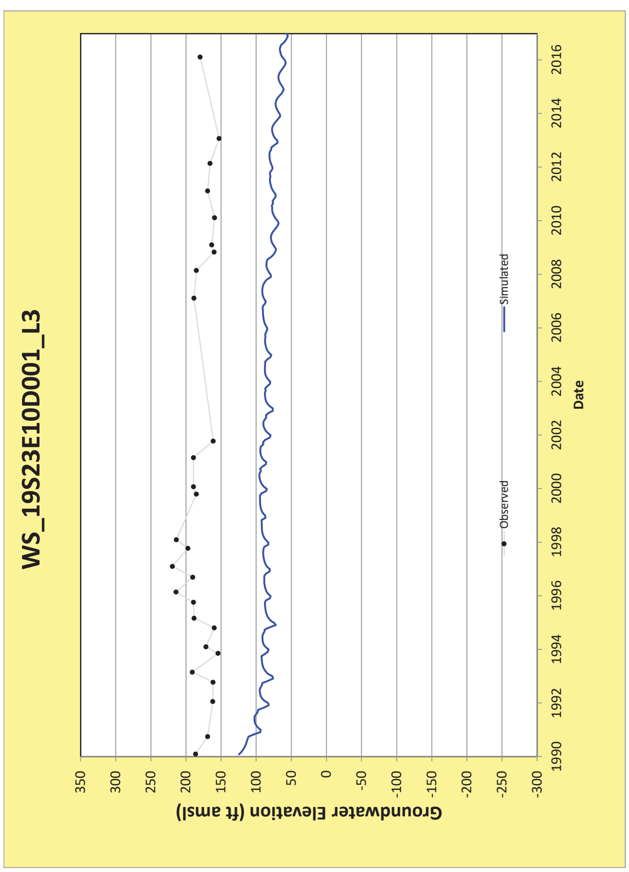
WS_19S22E07A001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

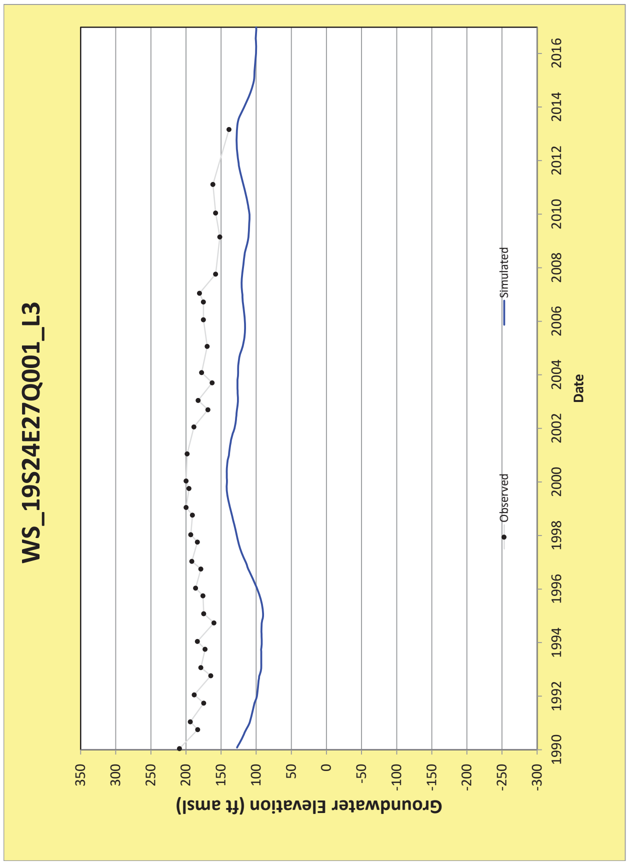

WS_19S22E17L001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

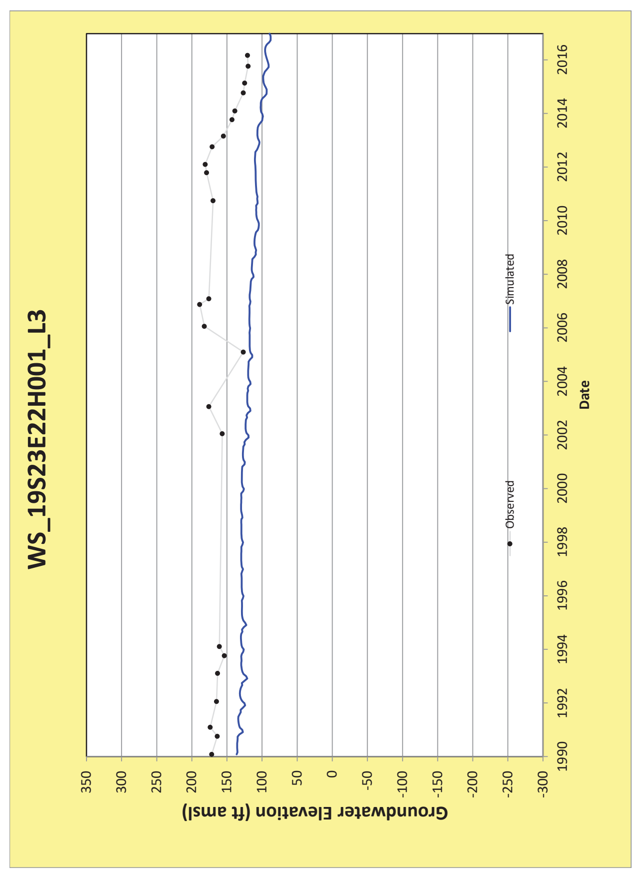

WS_19S22E27C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

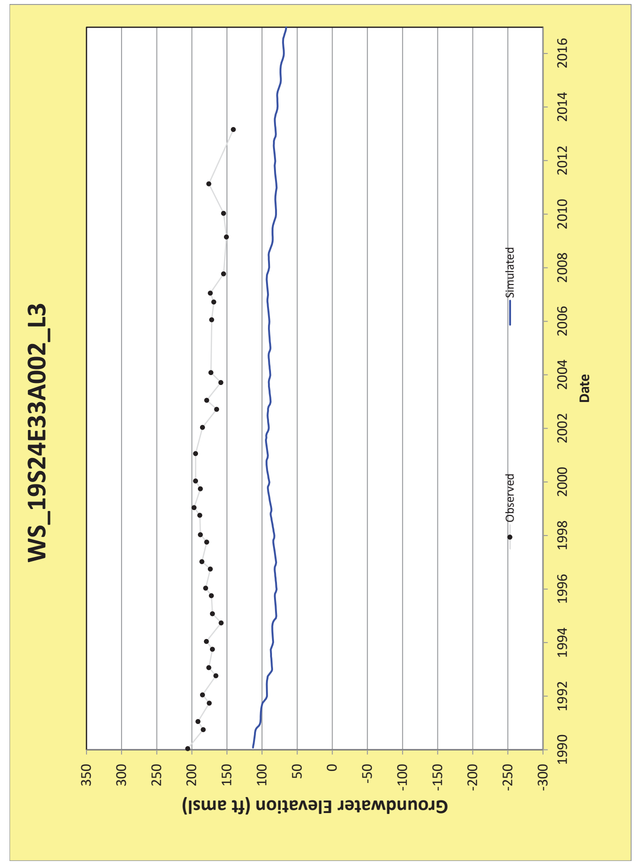

WS_19S22E20A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

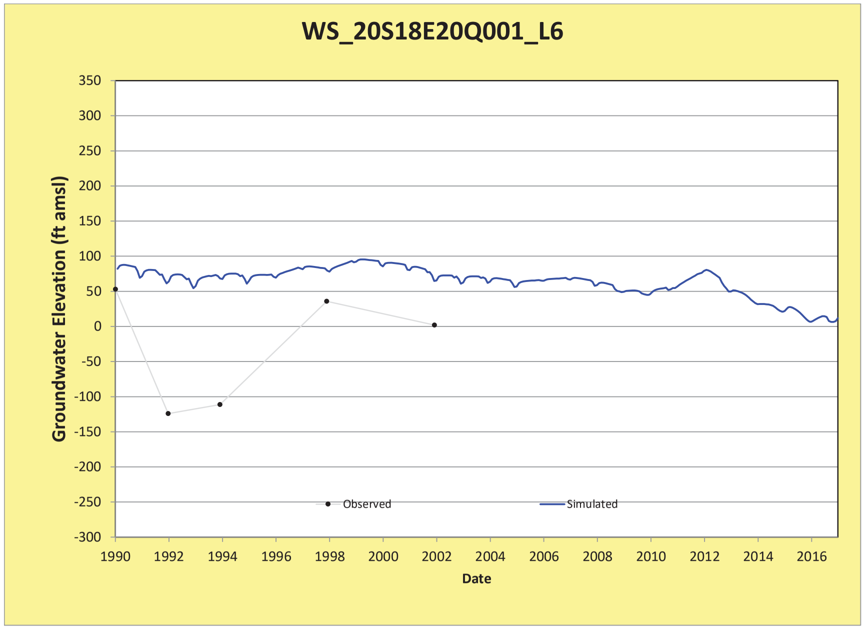

WS_19S22E36E002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

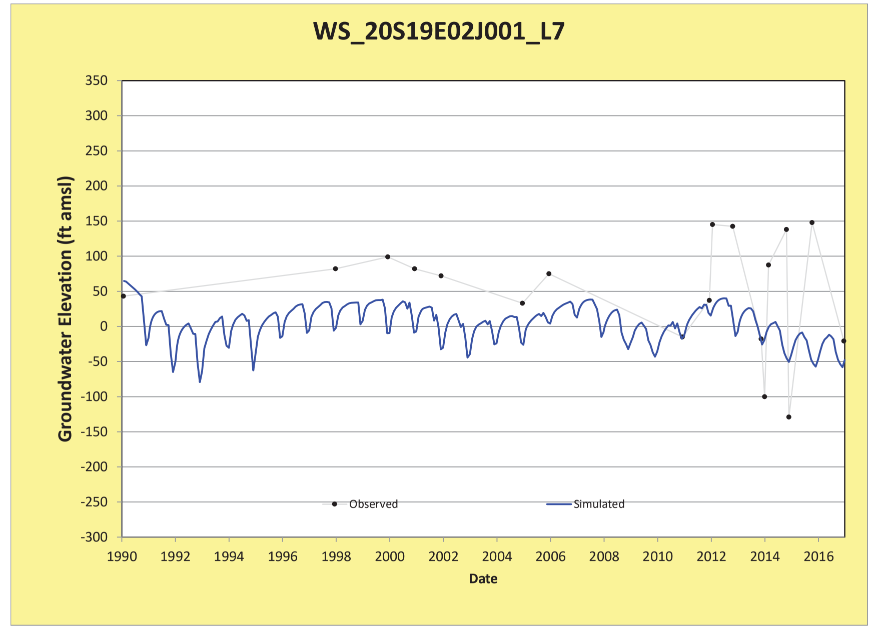

WS_19S23E10D001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

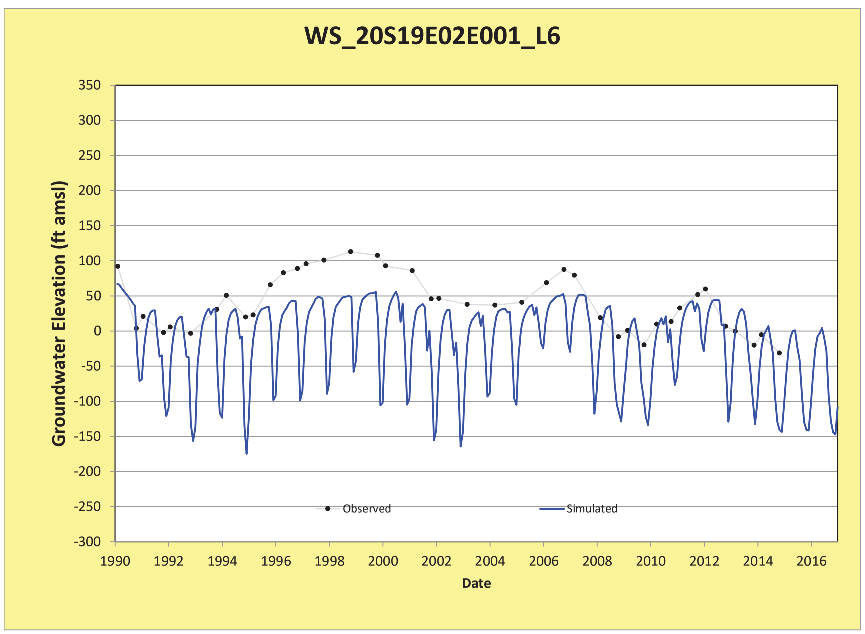

WS_19S24E27Q001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

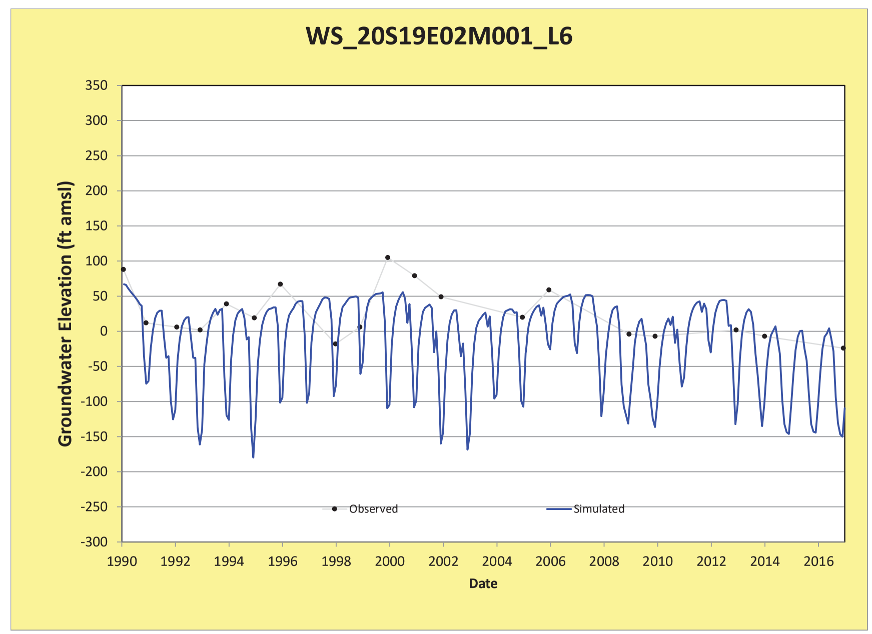

WS_19S23E22H001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

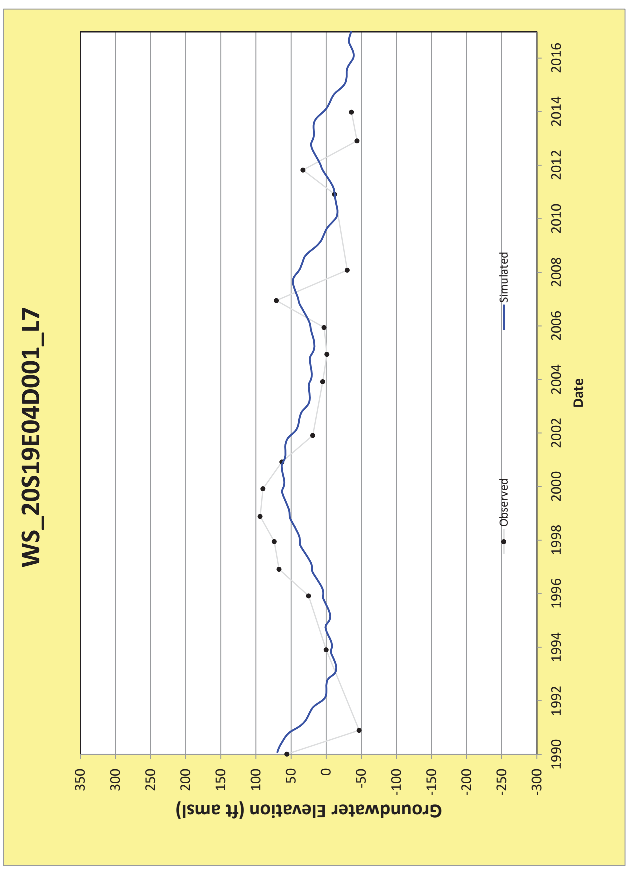

WS_19S24E33A002_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

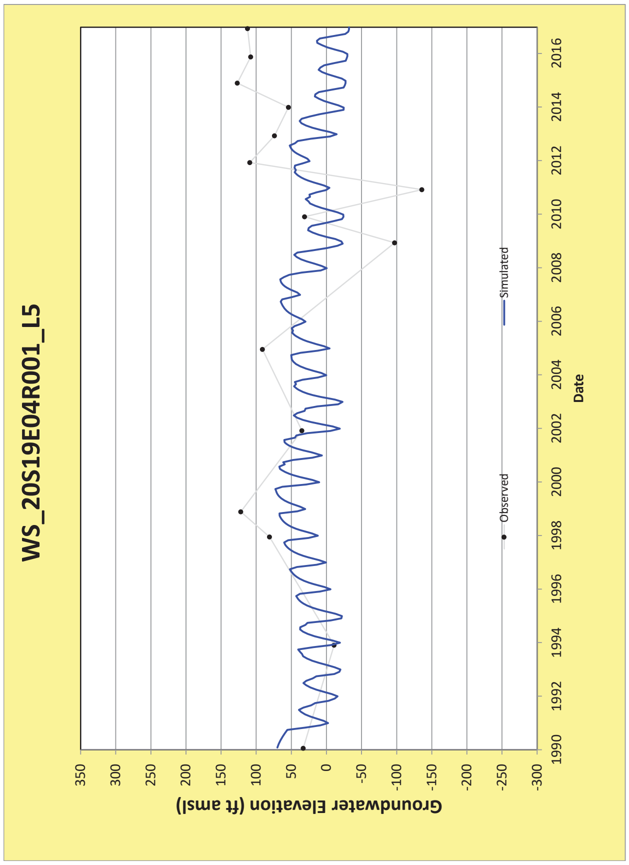

WS_20S18E20Q001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Observed
Simulated
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date

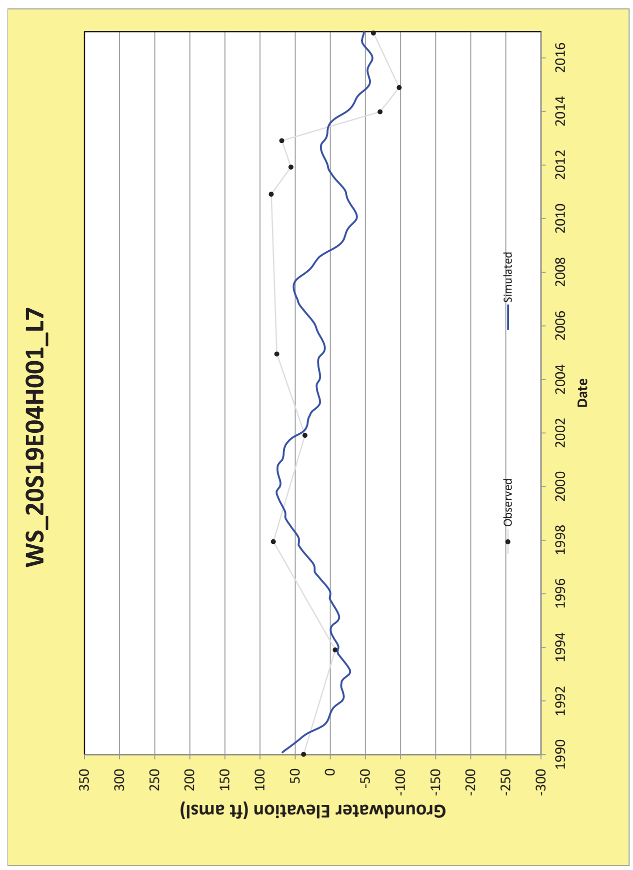

WS_20S19E02J001_L7
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Observed
Simulated
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date

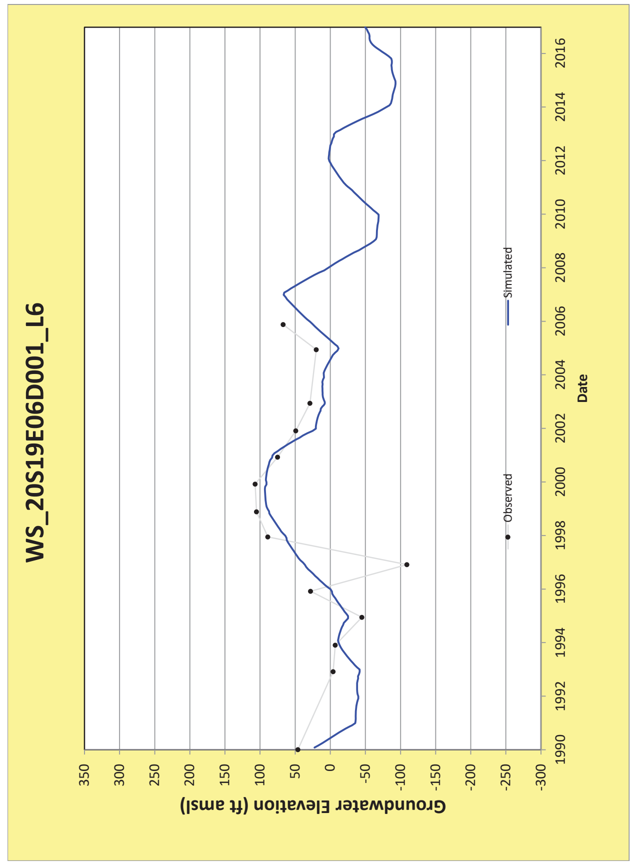

WS_20S19E02E001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Observed
Simulated
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date

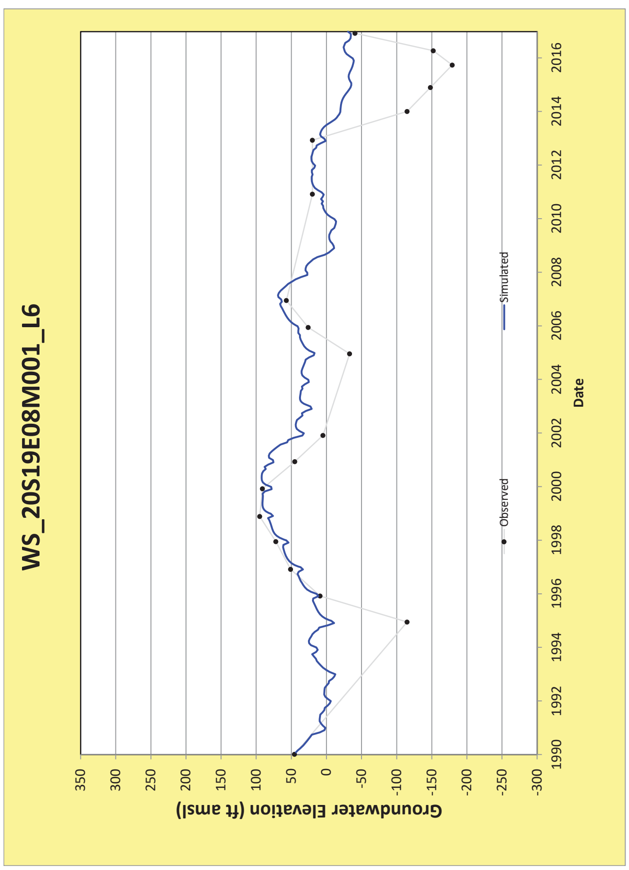

WS_20S19E02M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Observed
Simulated
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date

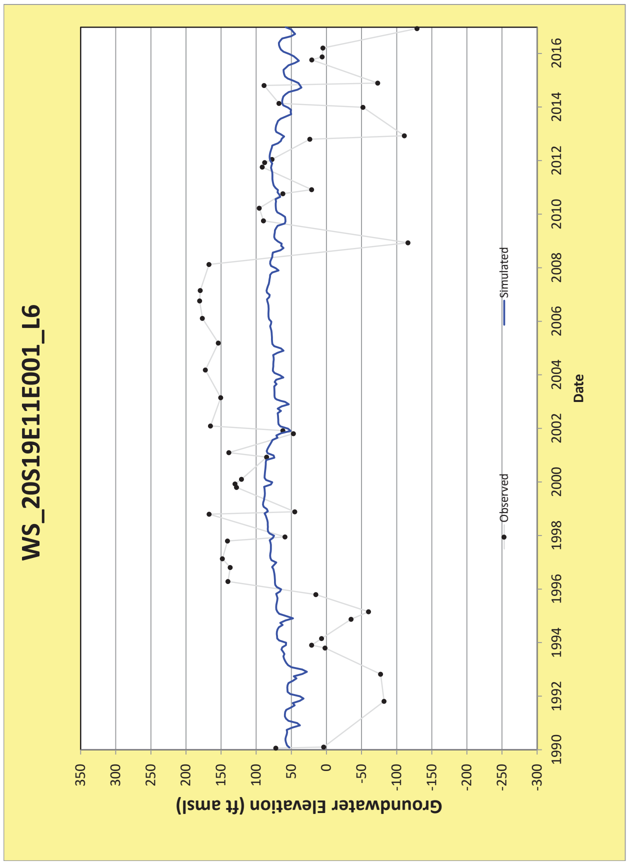

WS_20S19E04D001_L7
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

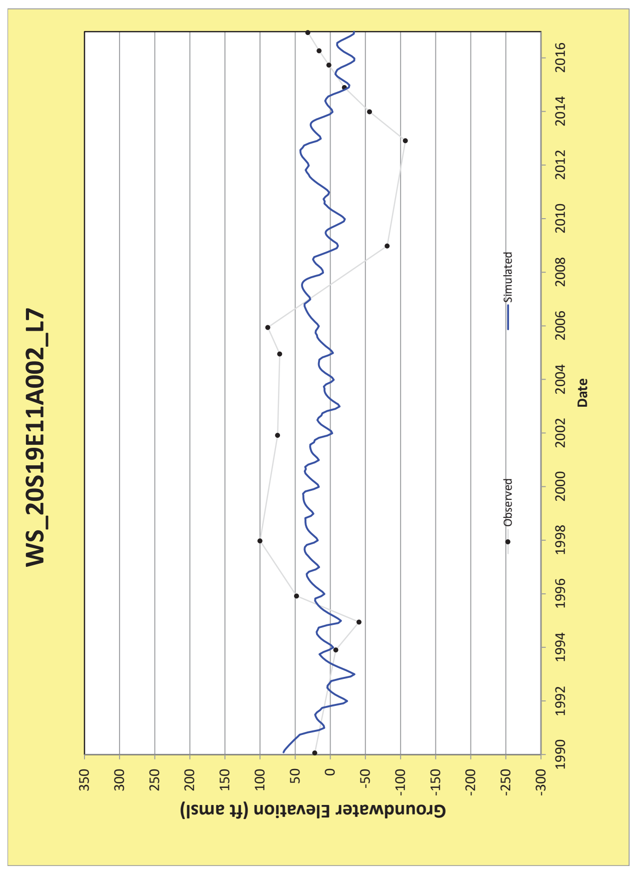

WS_20S19E04R001_L5
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

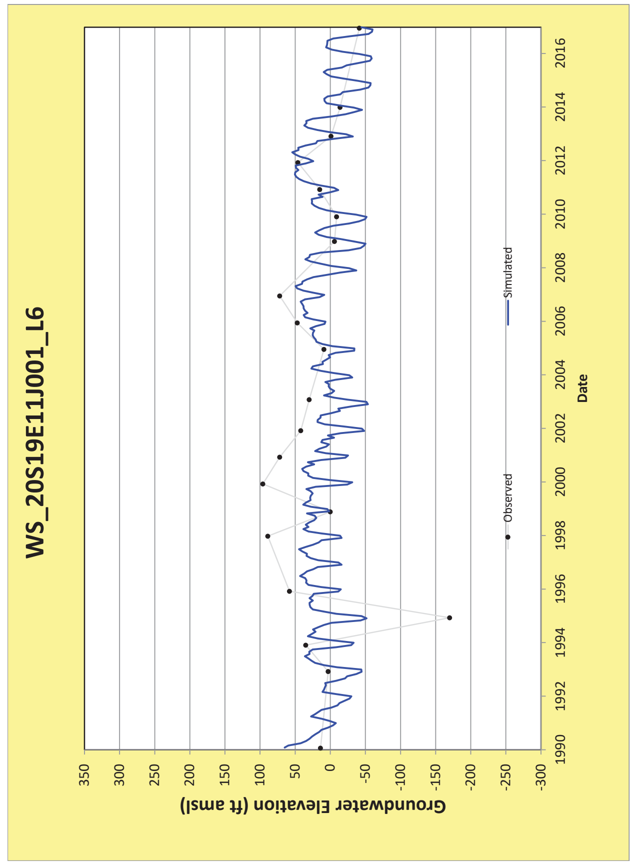

WS_20S19E04H001_L7
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

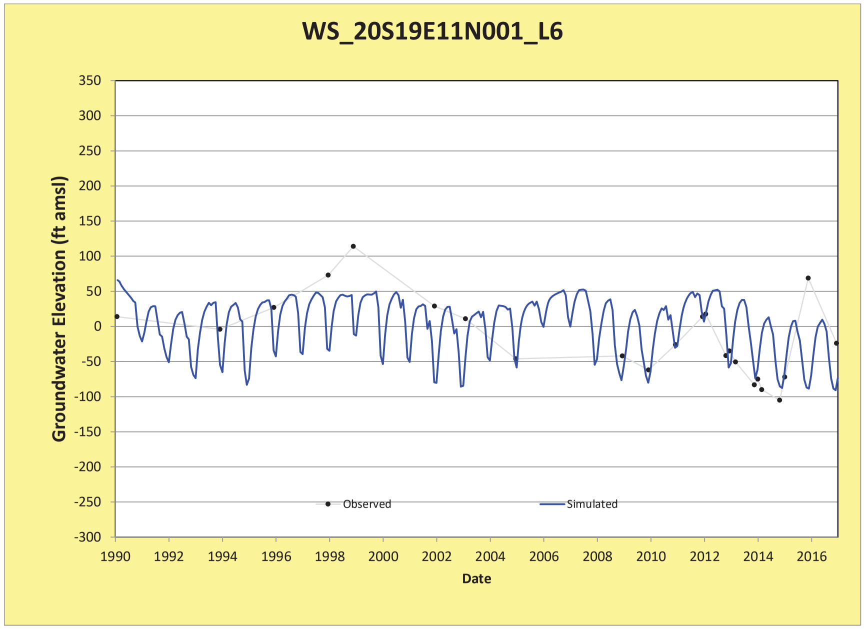

WS_20S19E06D001_L6
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

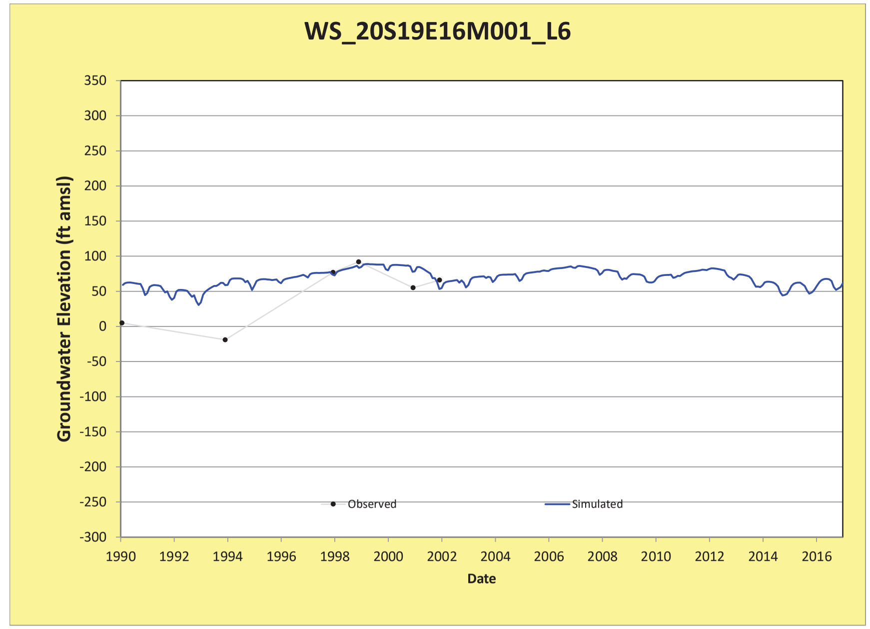

WS_20S19E08M001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

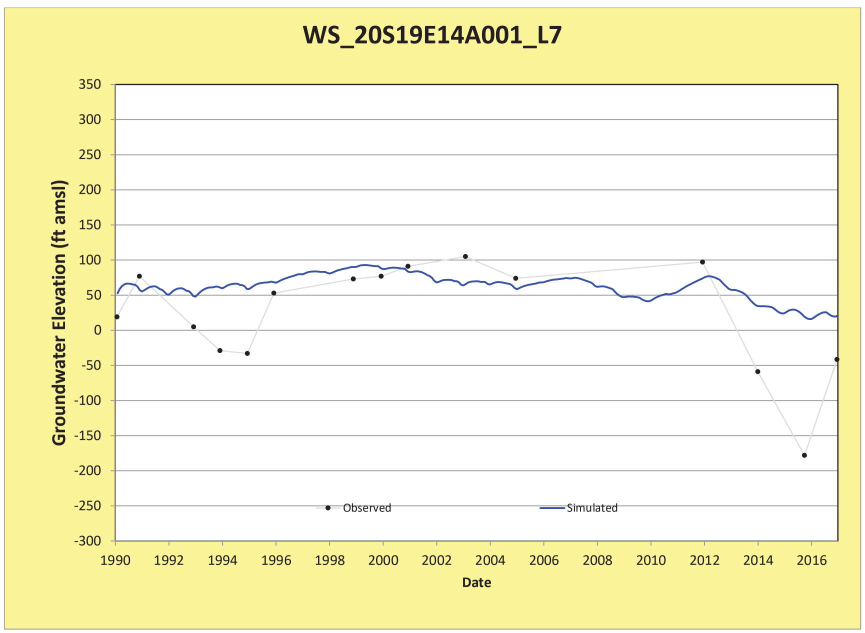

WS_20S19E11E001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

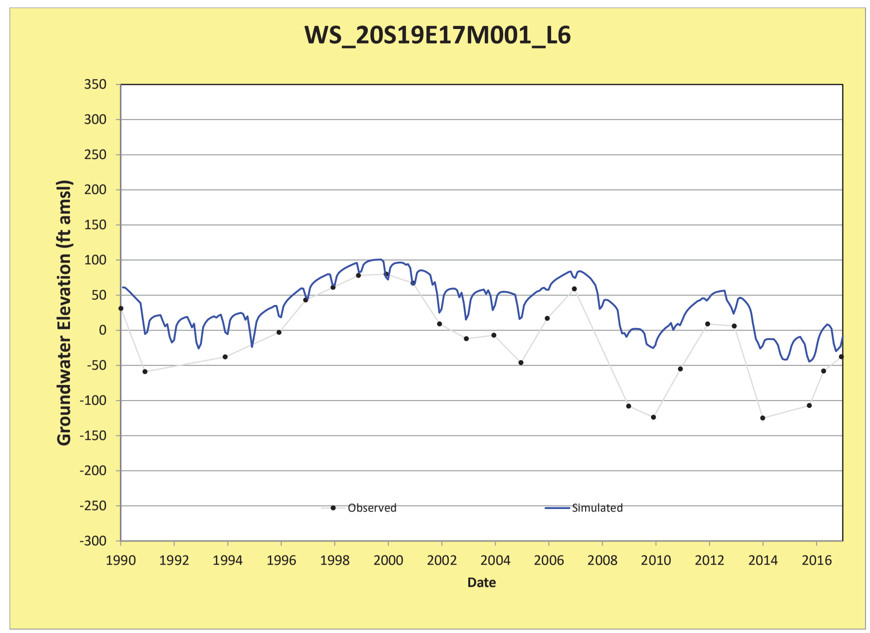

WS_20S19E11A002_L7
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

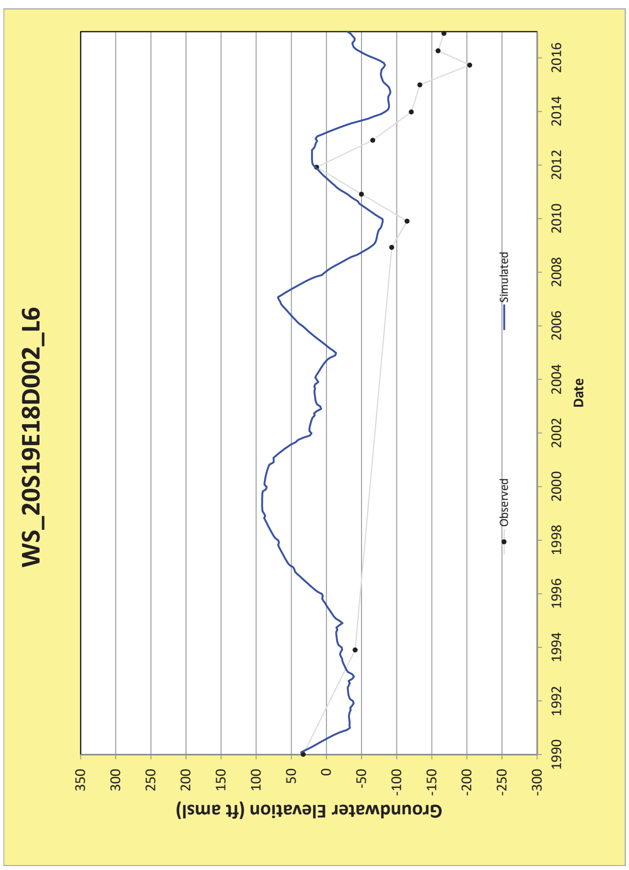

WS_20S19E11J001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

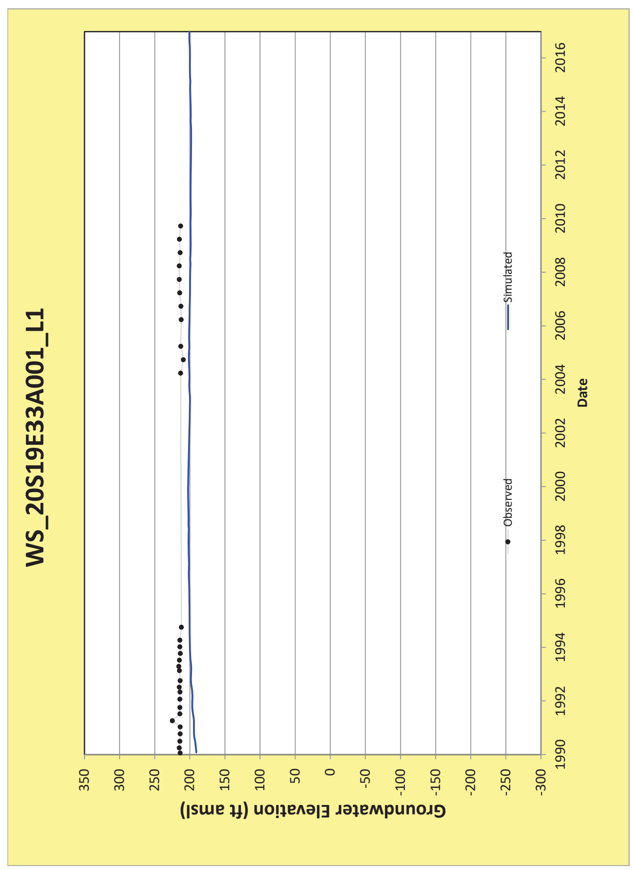

WS_20S19E11N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

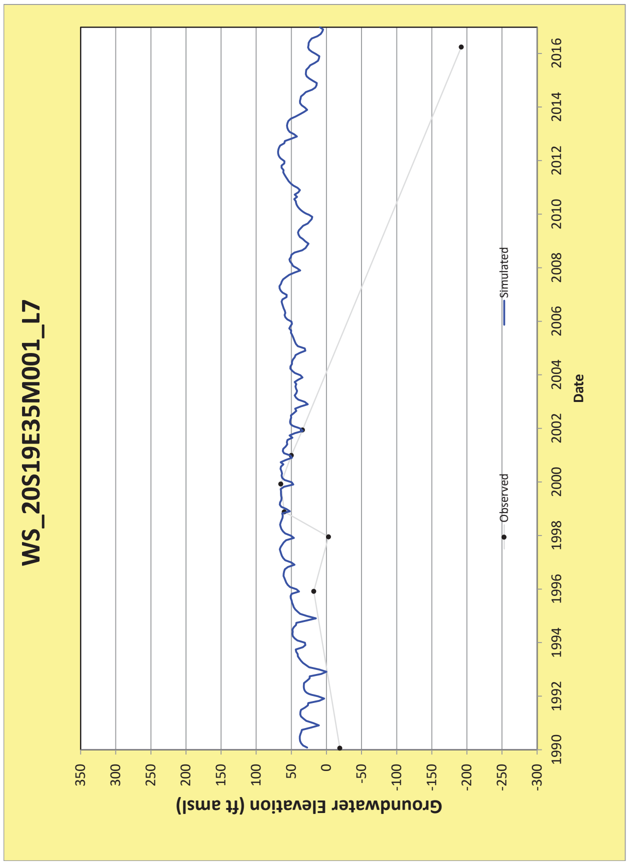

WS_20S19E16M001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

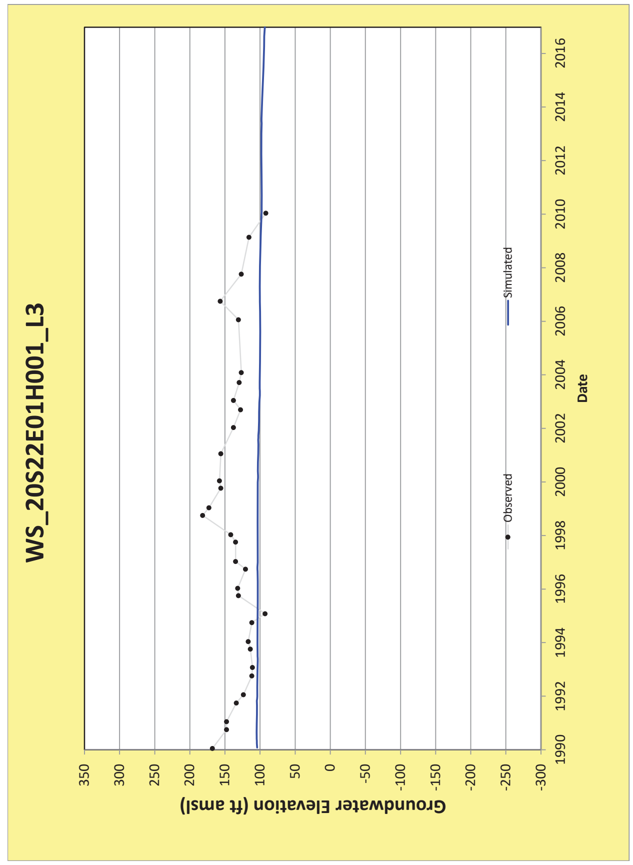

WS_20S19E14A001_L7
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

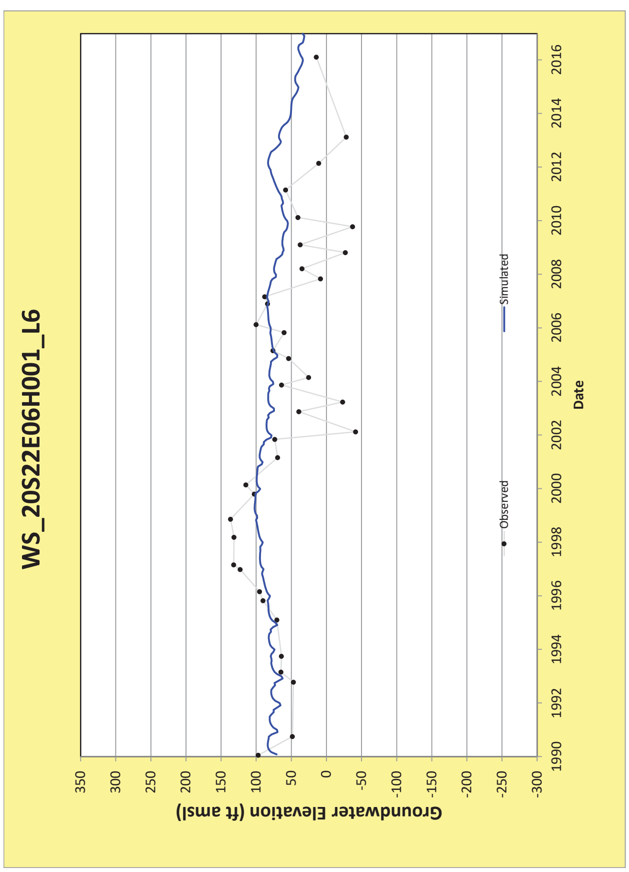

WS_20S19E17M001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

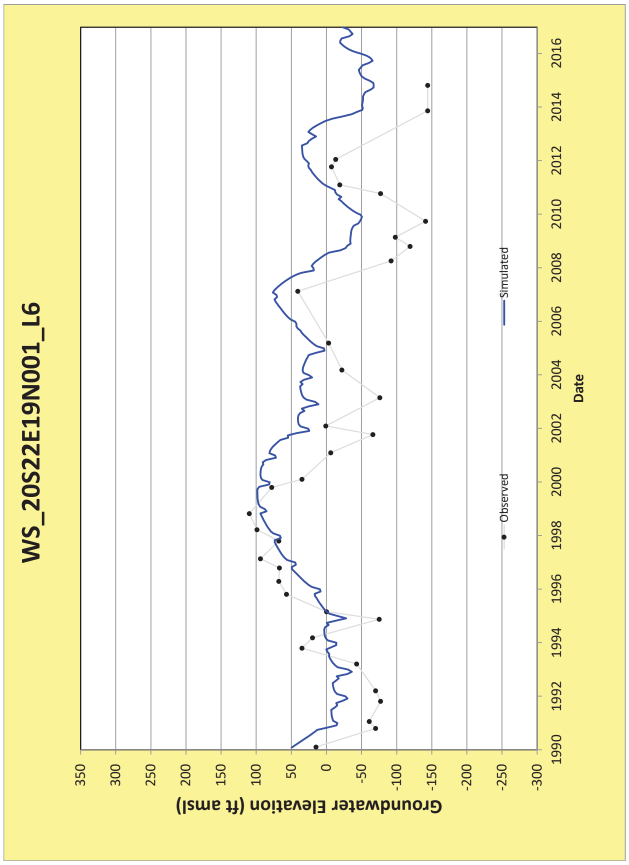

WS_20S19E18D002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

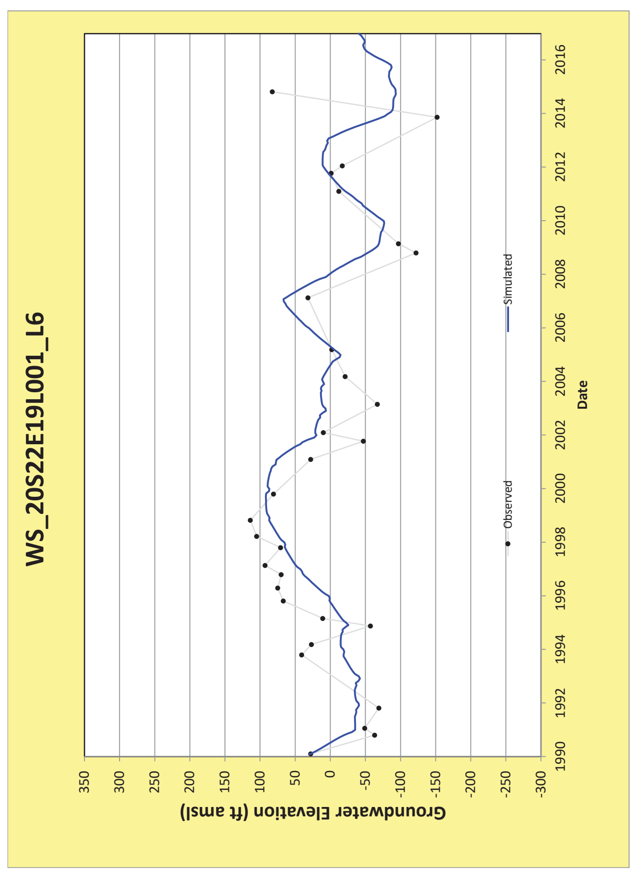

WS_20S19E33A001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

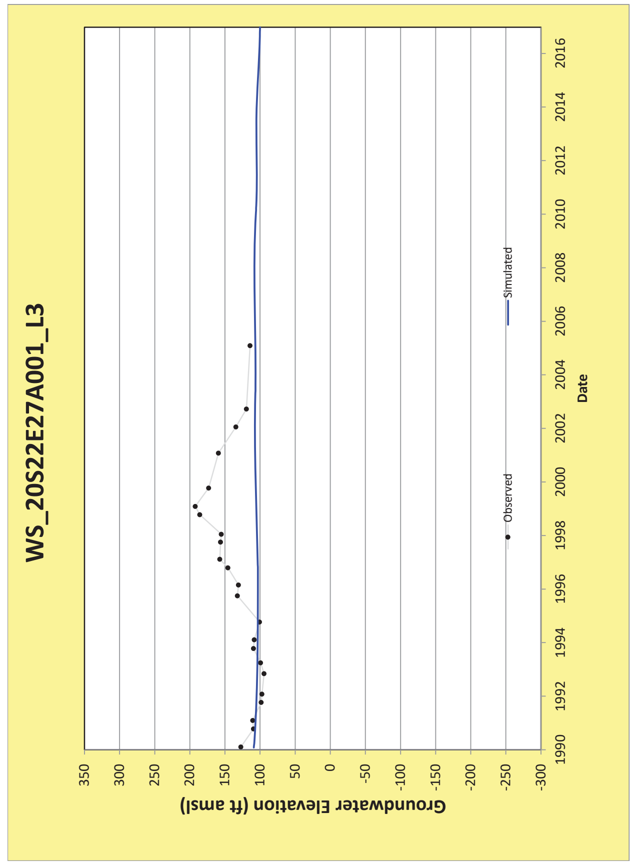

WS_20S19E35M001_L7
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

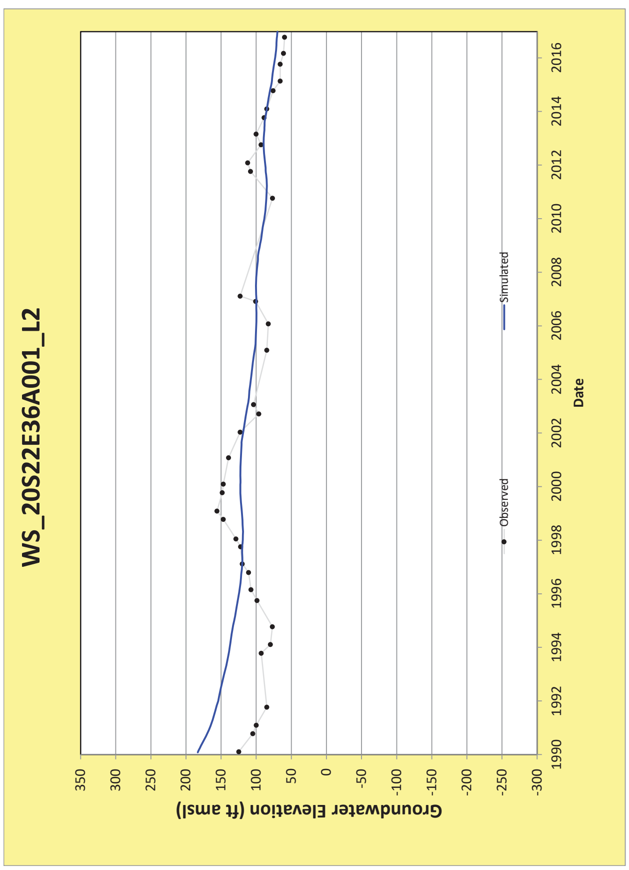

WS_20S22E01H001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

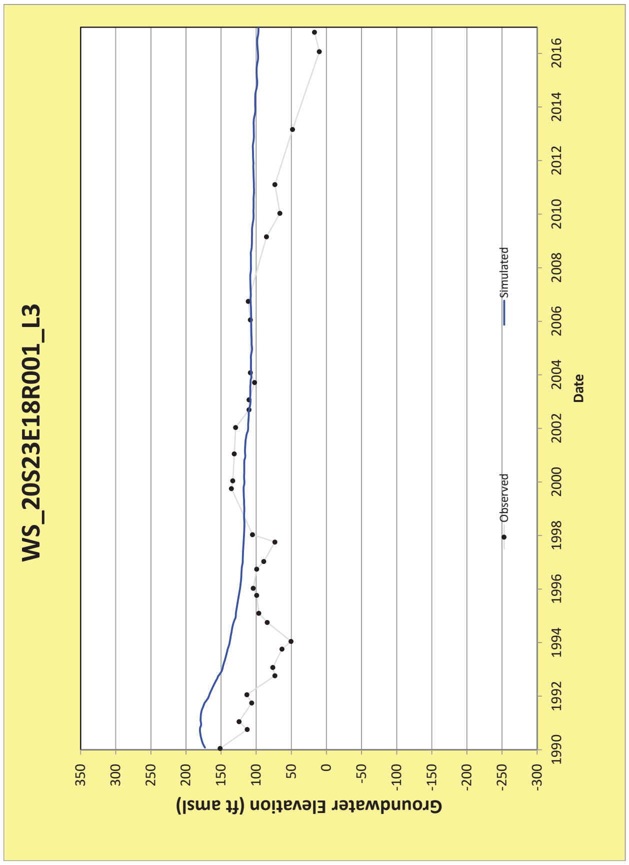

WS_20S22E06H001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

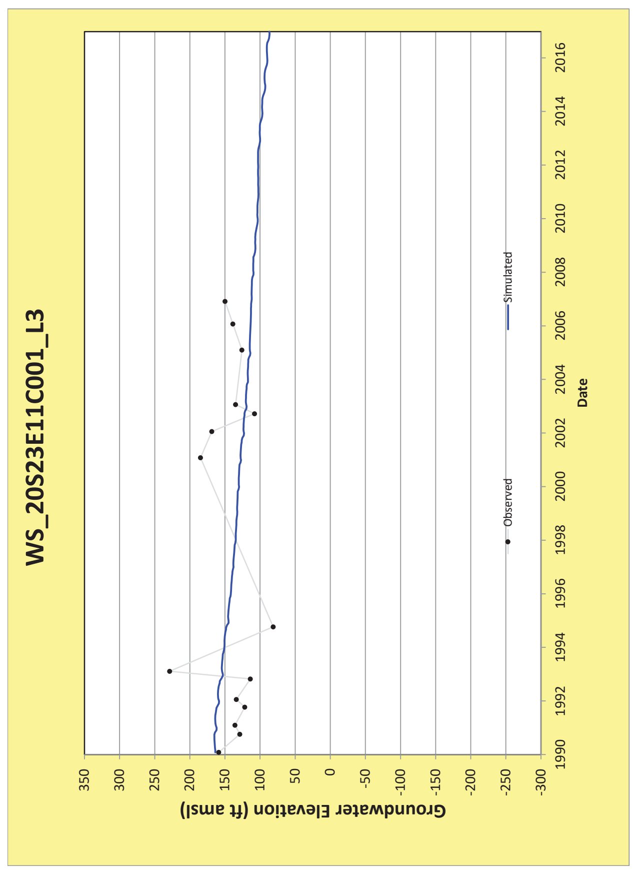

WS_20S22E19N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

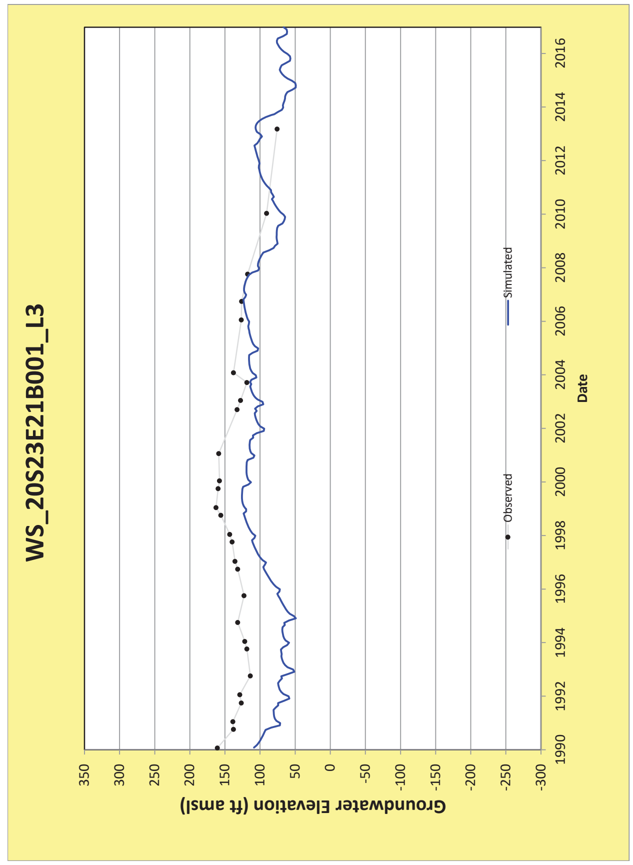

WS_20S22E19L001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

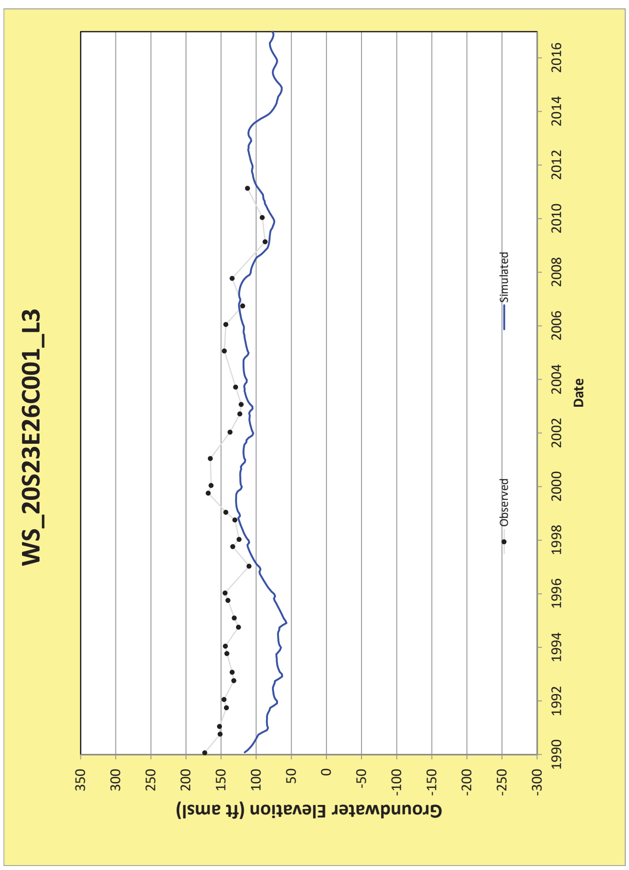

WS_20S22E27A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

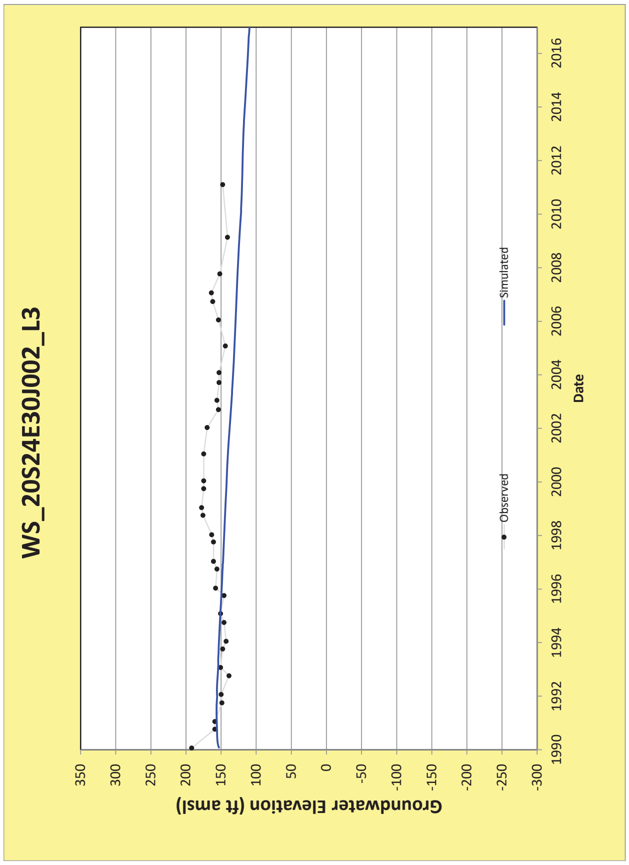

WS_20S22E36A001_L2
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

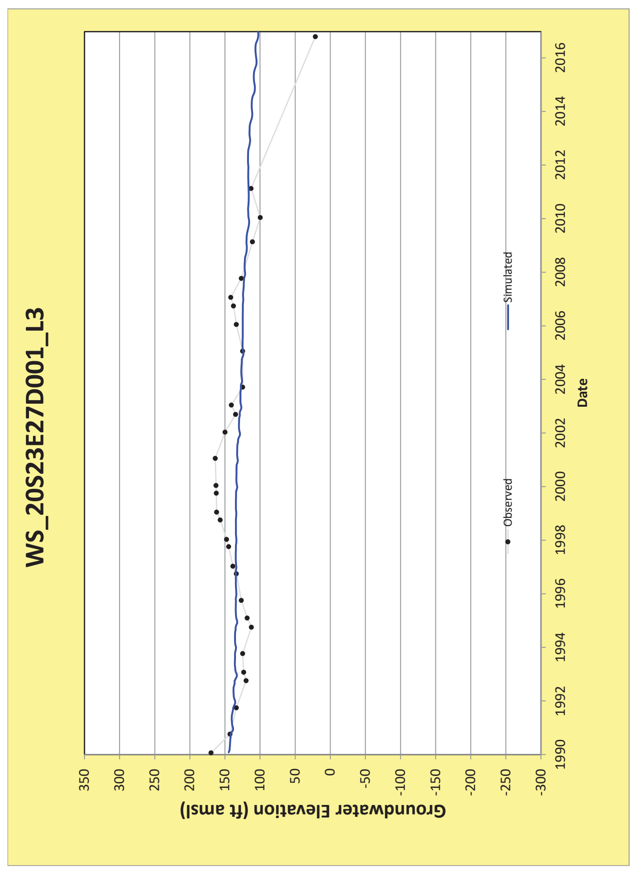

WS_20S23E18R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

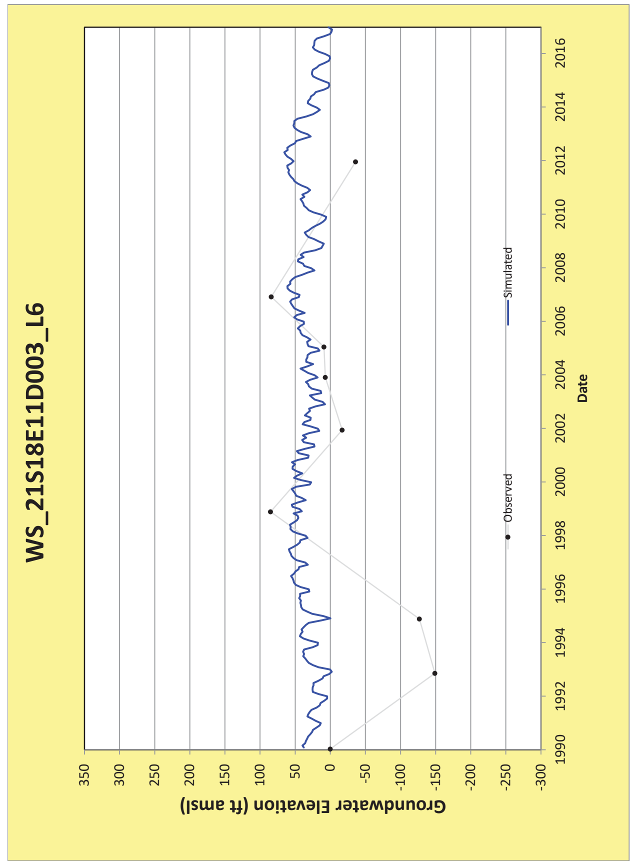

WS_20S23E11C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

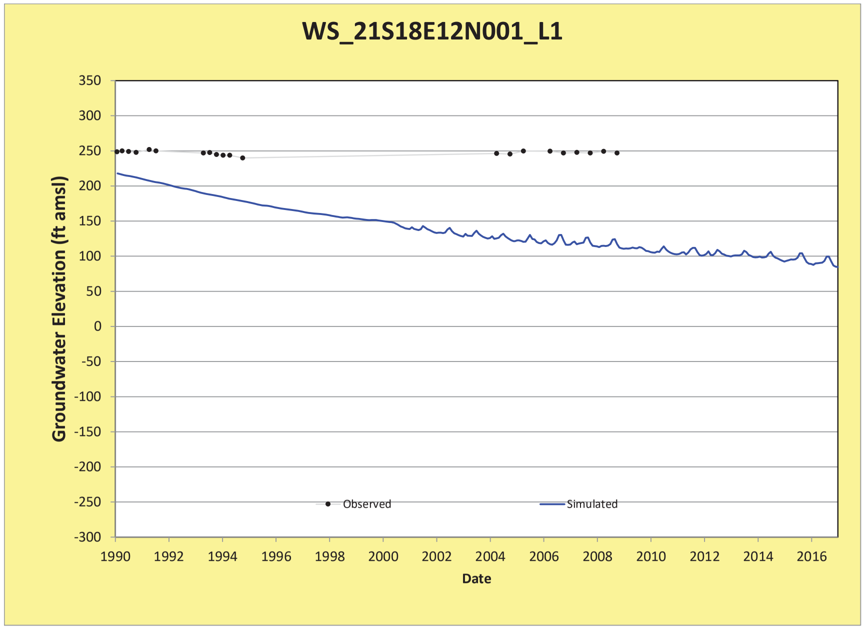

WS_20S23E21B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

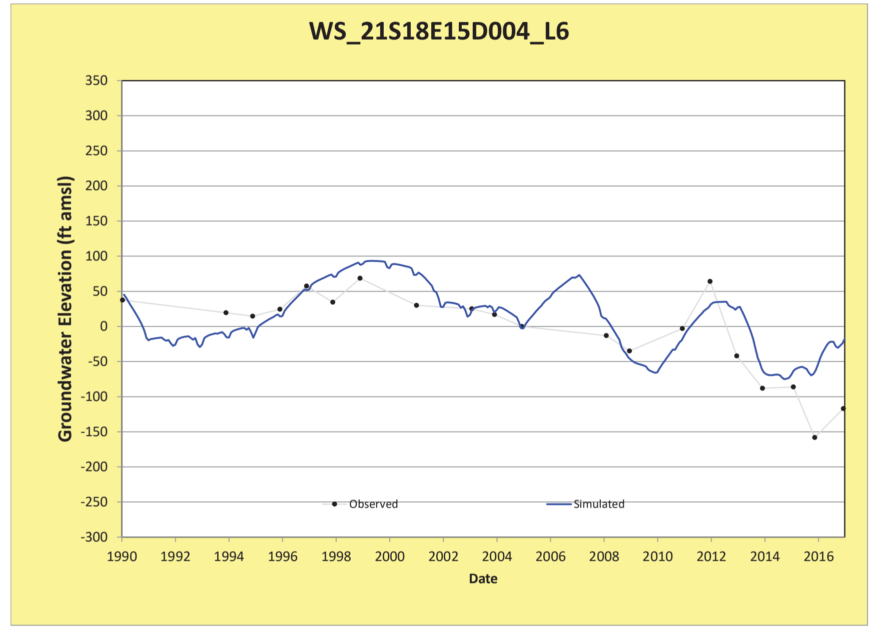

WS_20S23E26C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

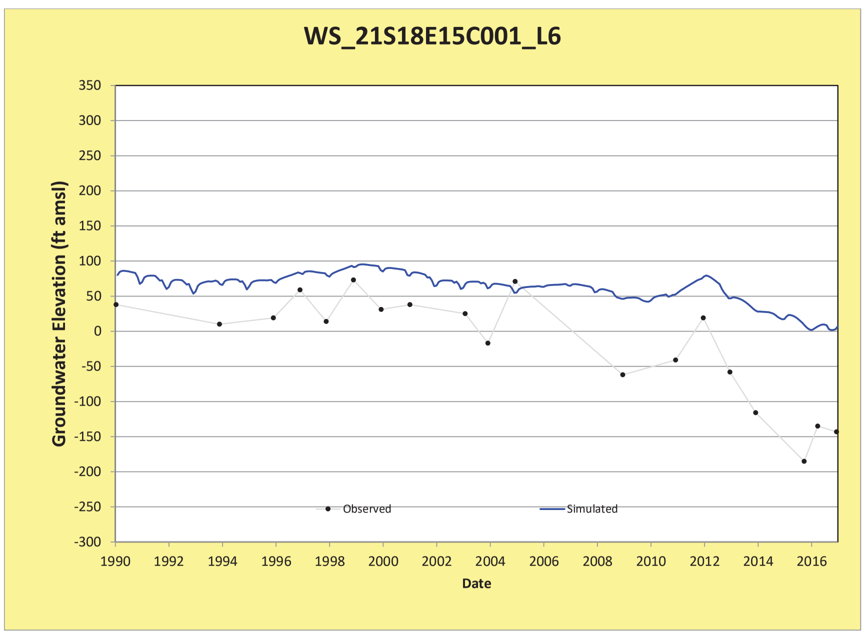

WS_20S24E30J002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

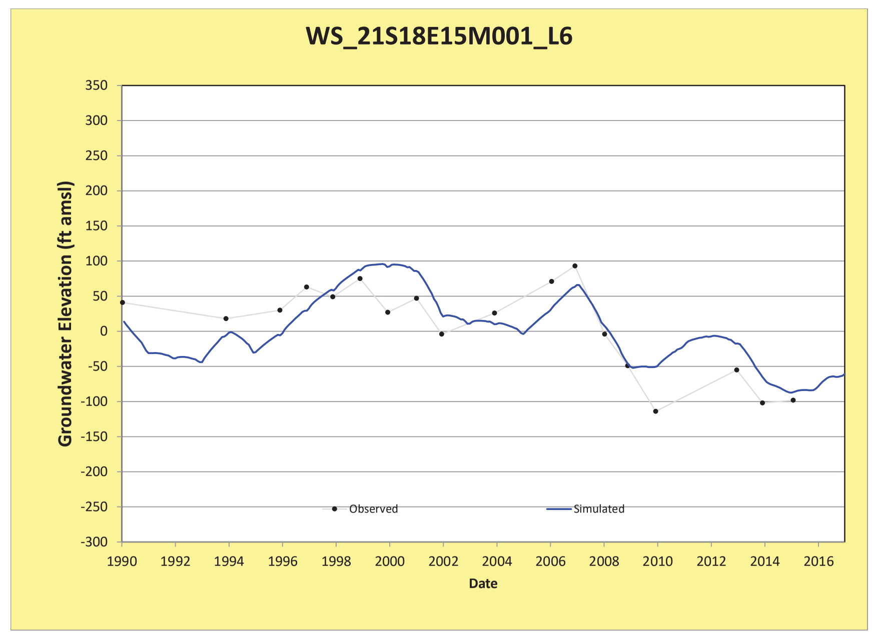

WS_20S23E27D001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

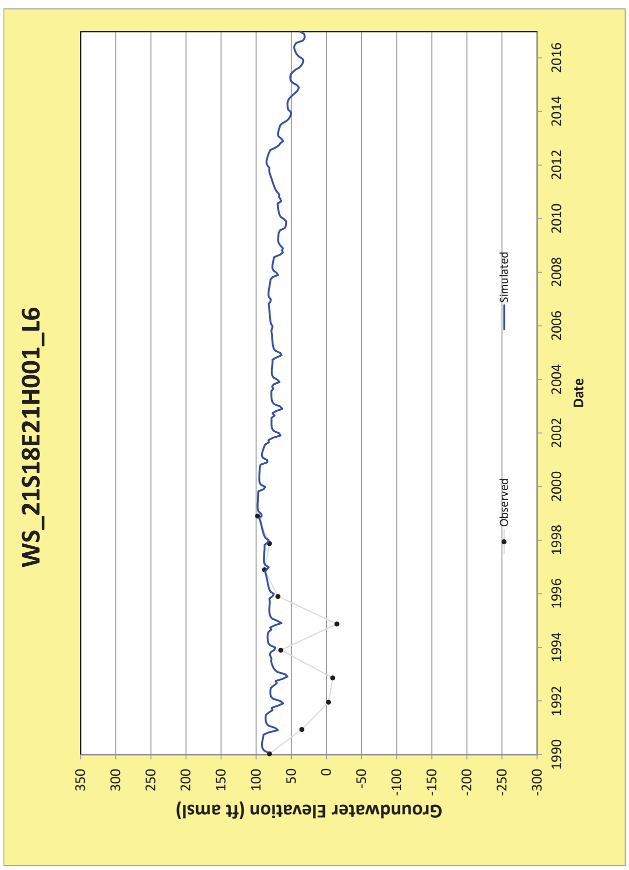

WS_21S18E11D003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

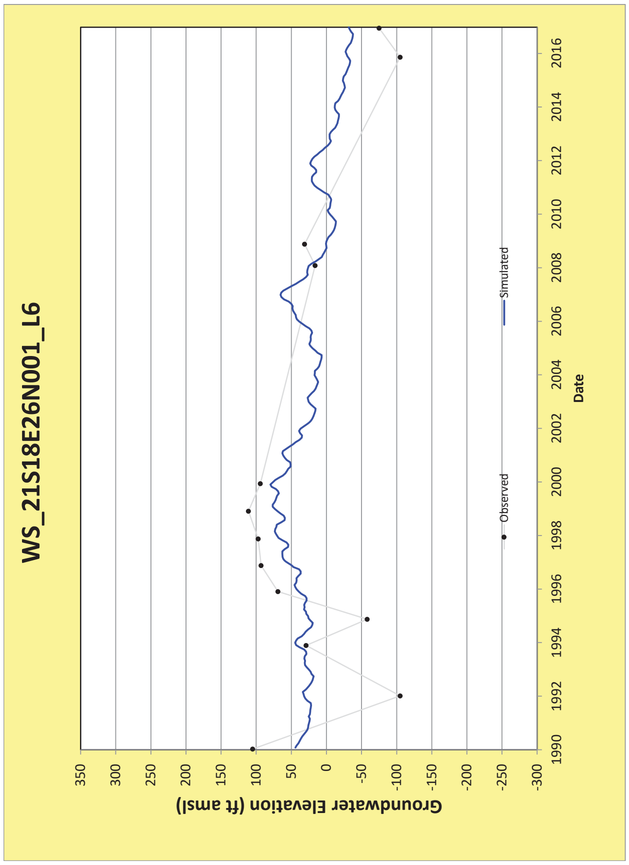

WS_21S18E12N001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

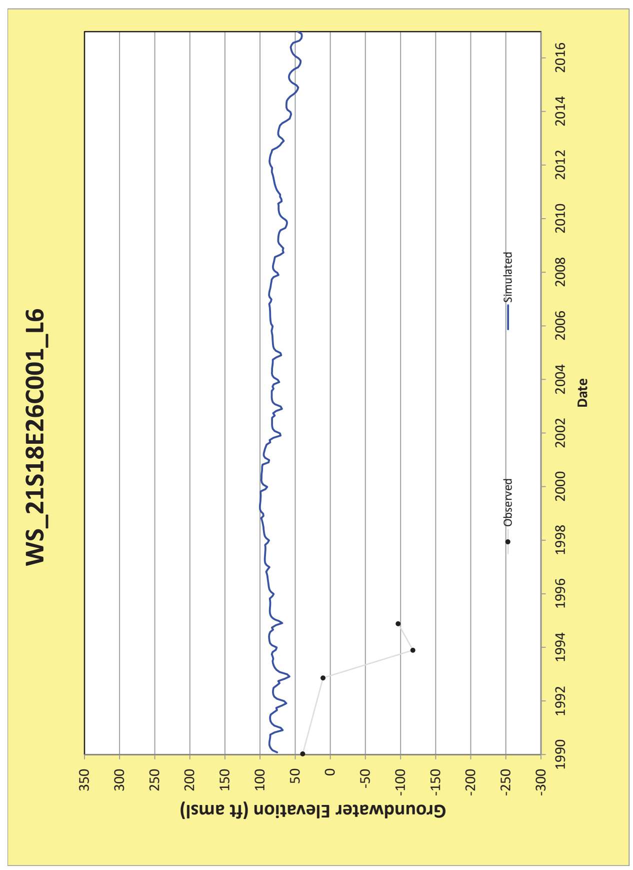

WS_21S18E15D004_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

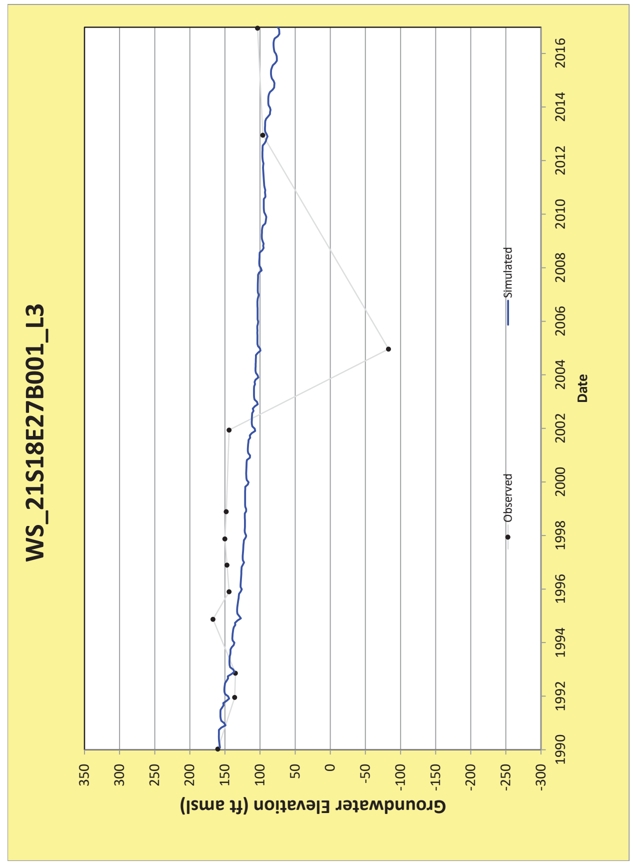

WS_21S18E15C001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

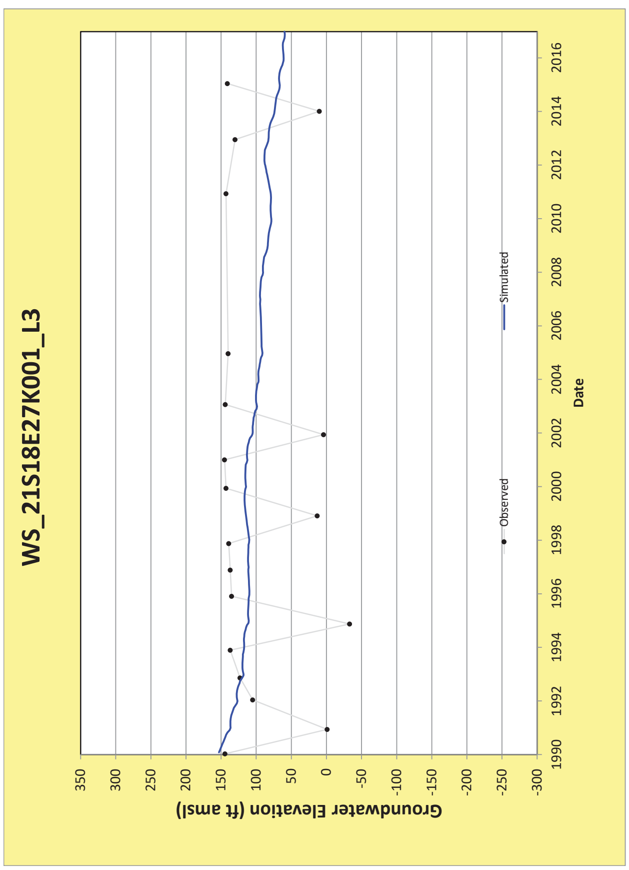

WS_21S18E15M001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

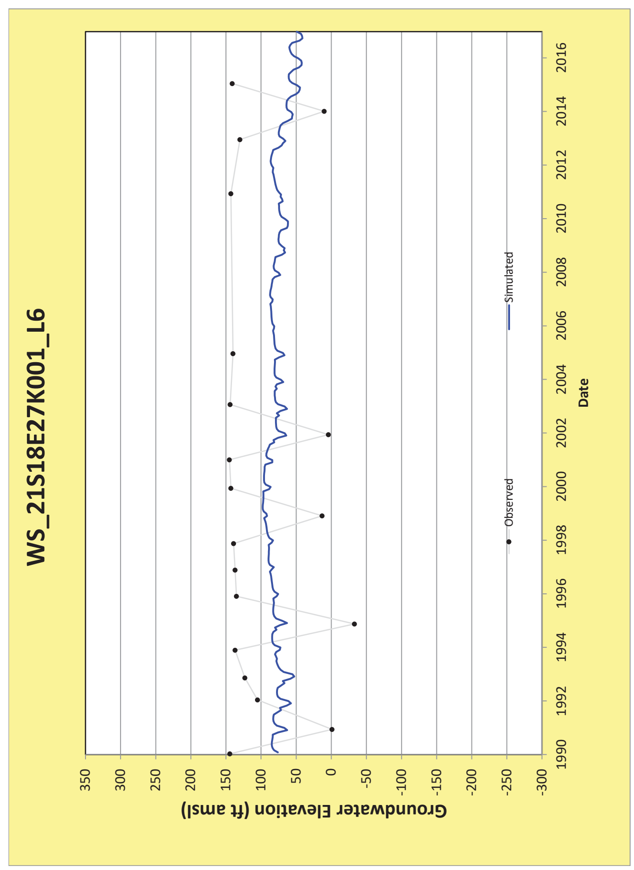

WS_21S18E21H001_L6
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

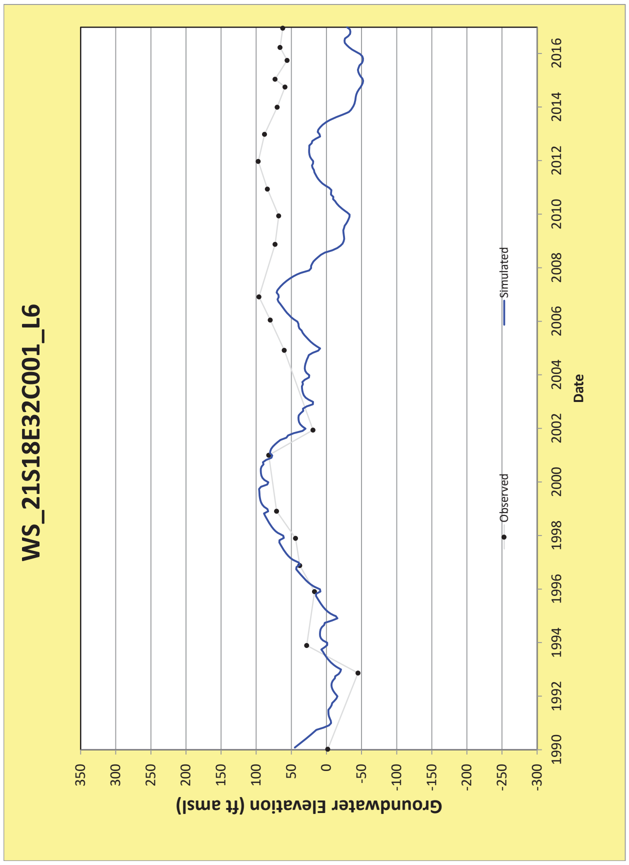

WS_21S18E26N001_L6
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

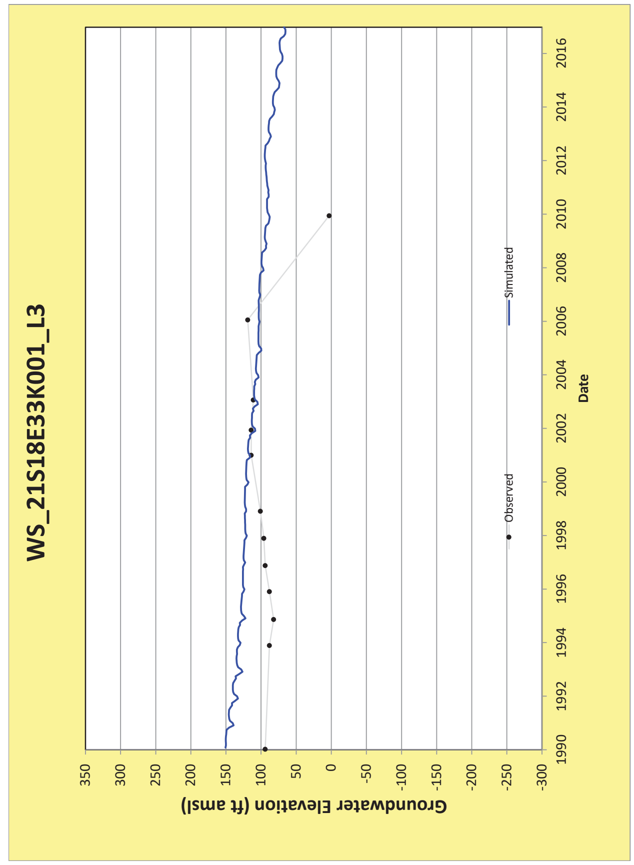

WS_21S18E26C001_L6
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

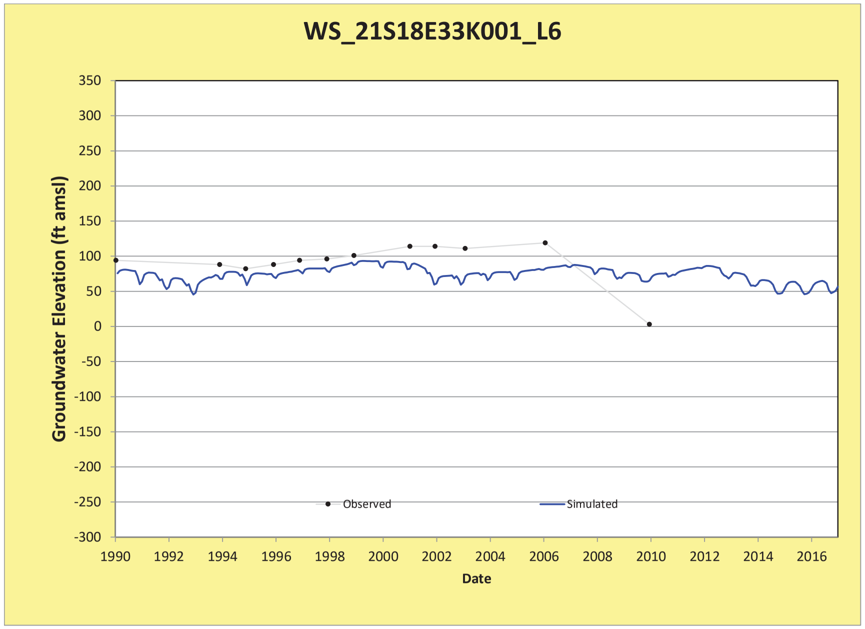

WS_21S18E27B001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

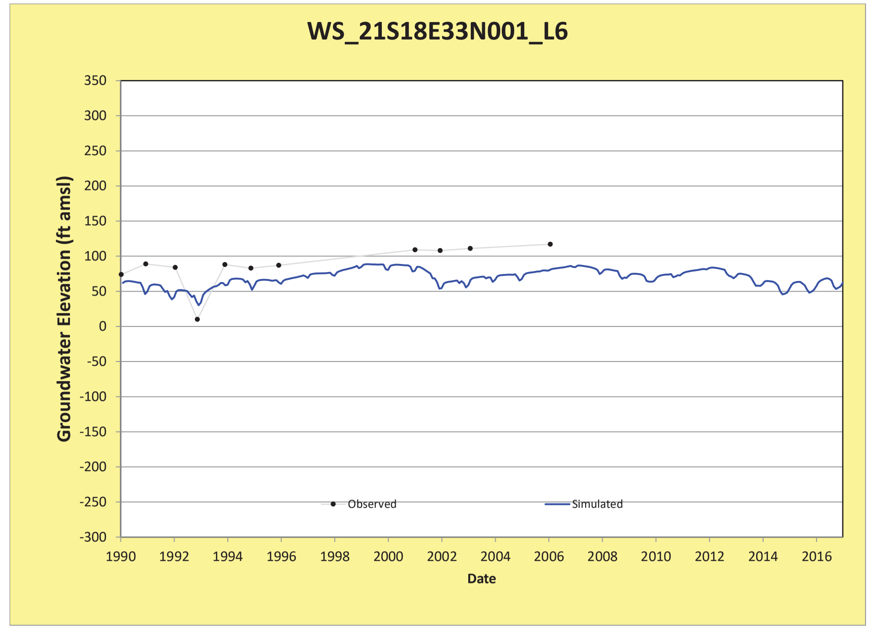

WS_21S18E27K001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

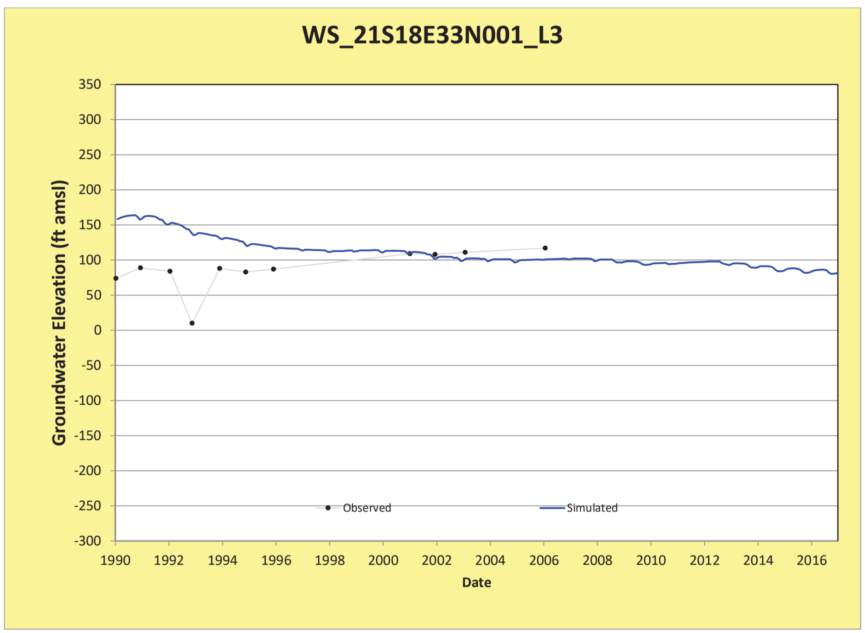

WS_21S18E27K001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

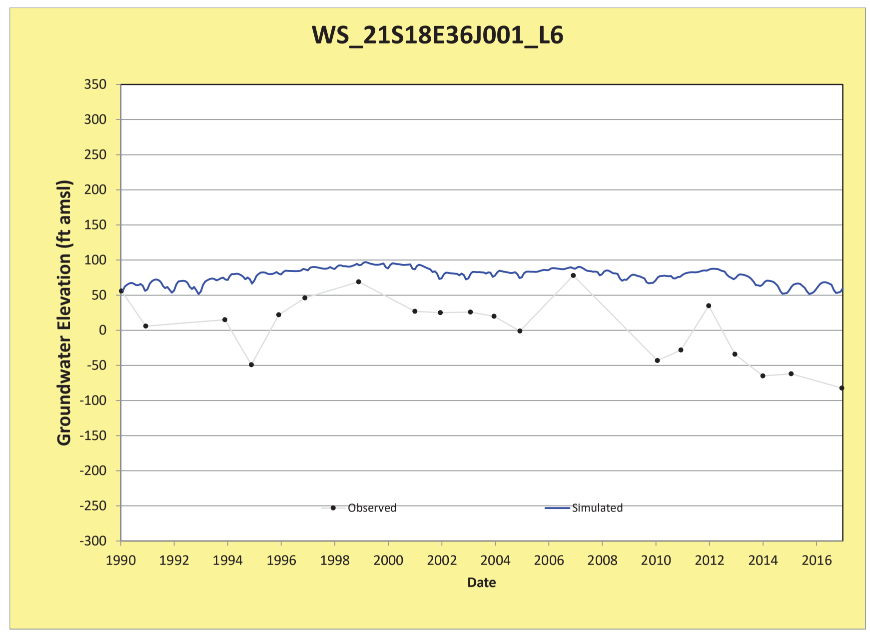

WS_21S18E32C001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

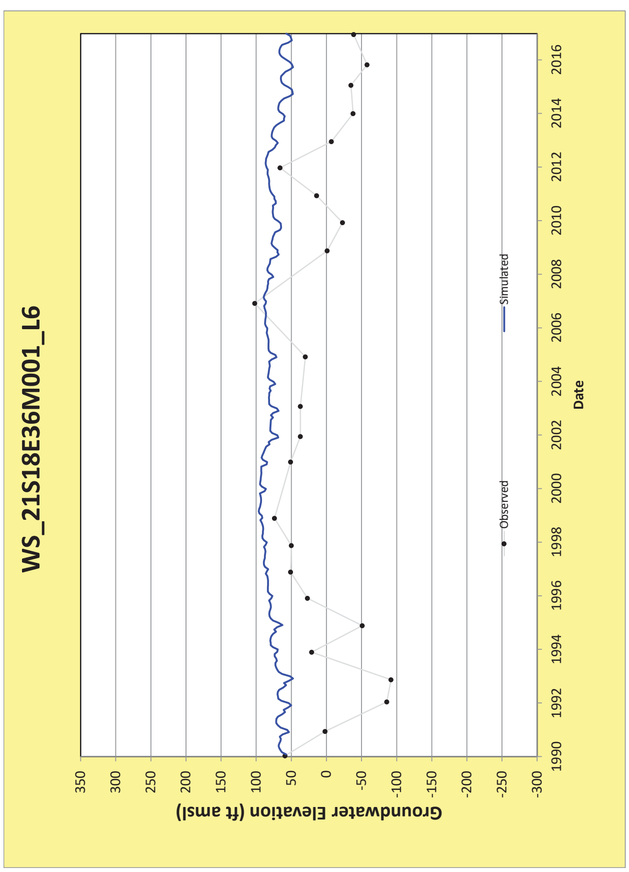

WS_21S18E33K001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

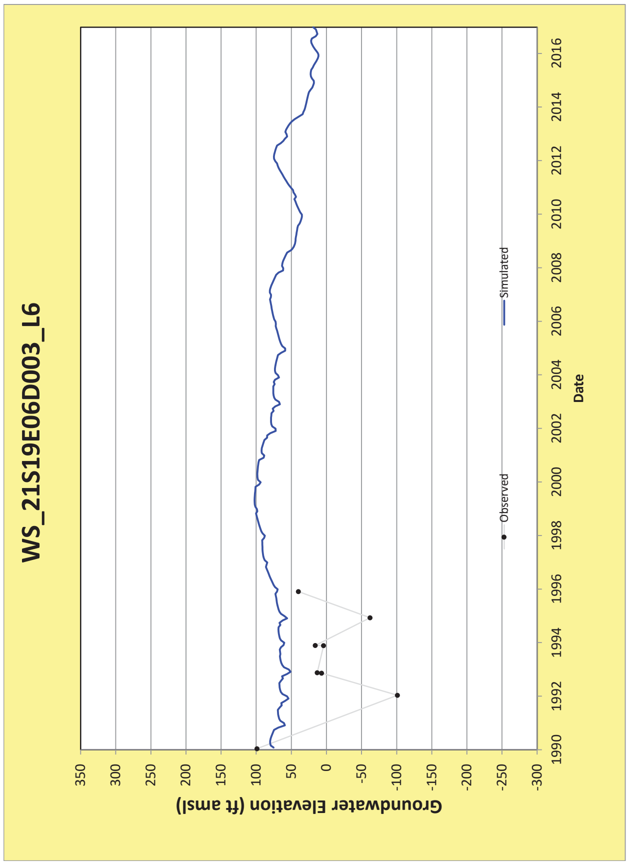

WS_21S18E33K001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

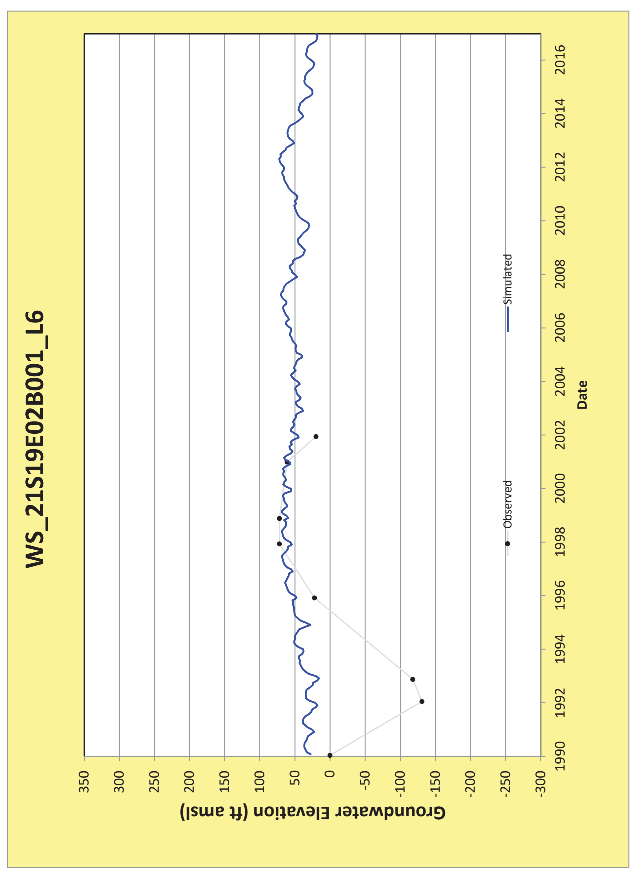

WS_21S18E33N001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

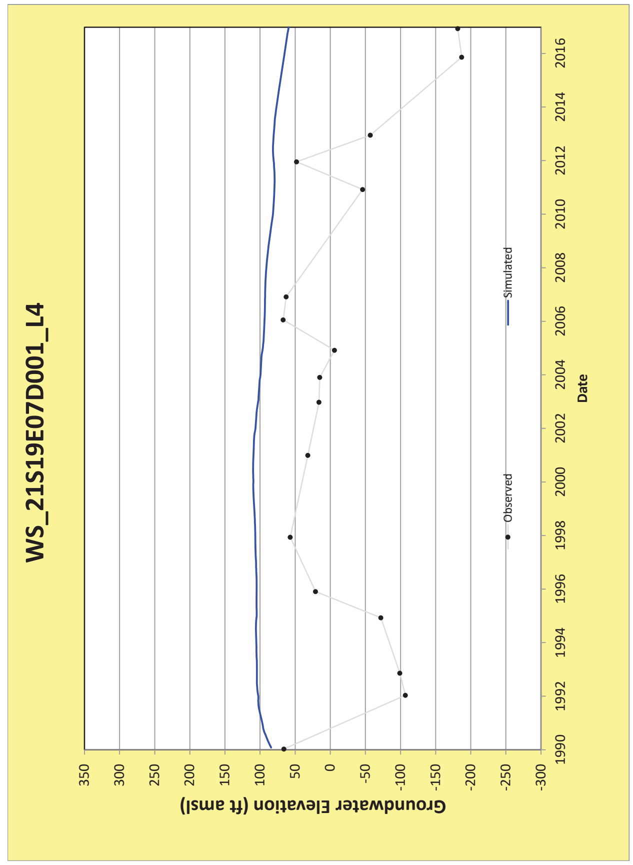

WS_21S18E33N001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

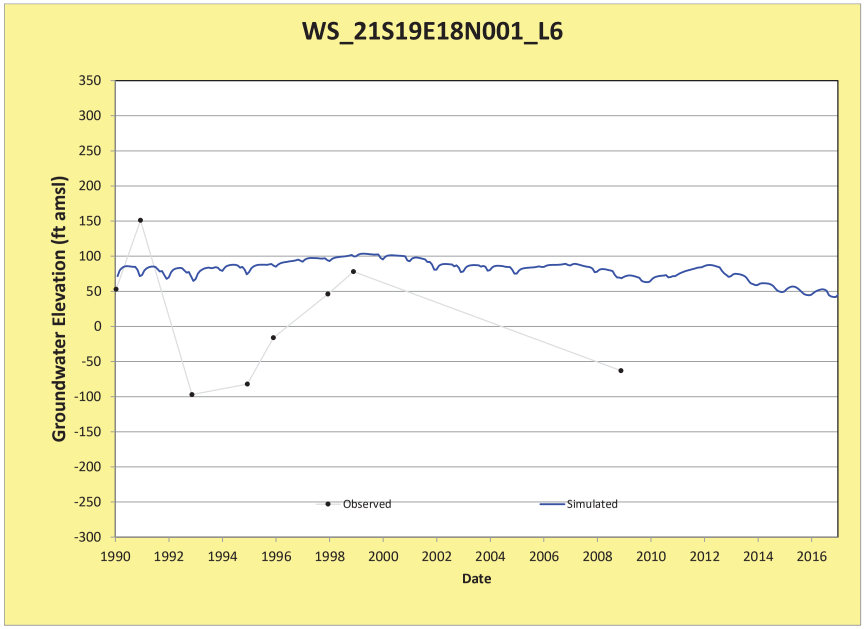

WS_21S18E36J001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

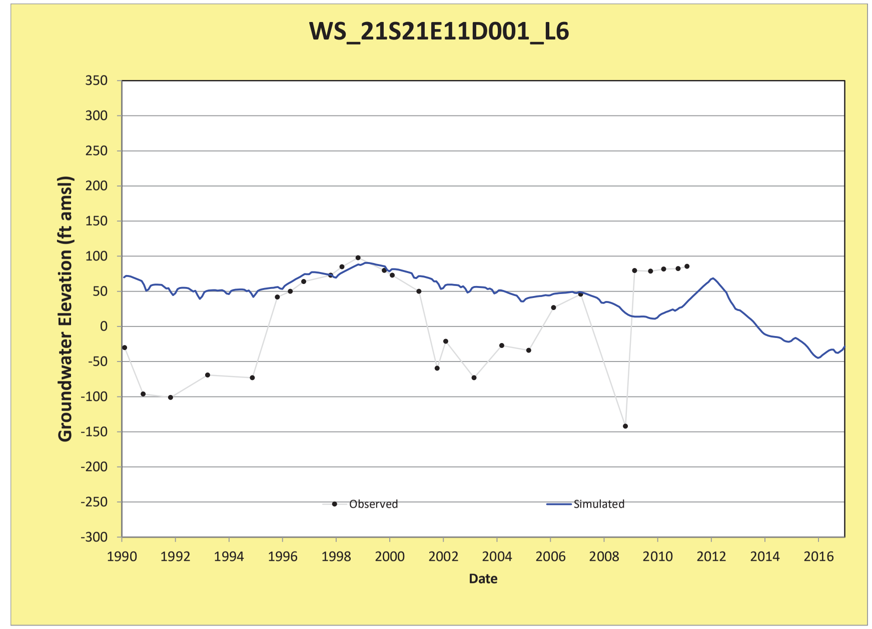

WS_21S18E36M001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

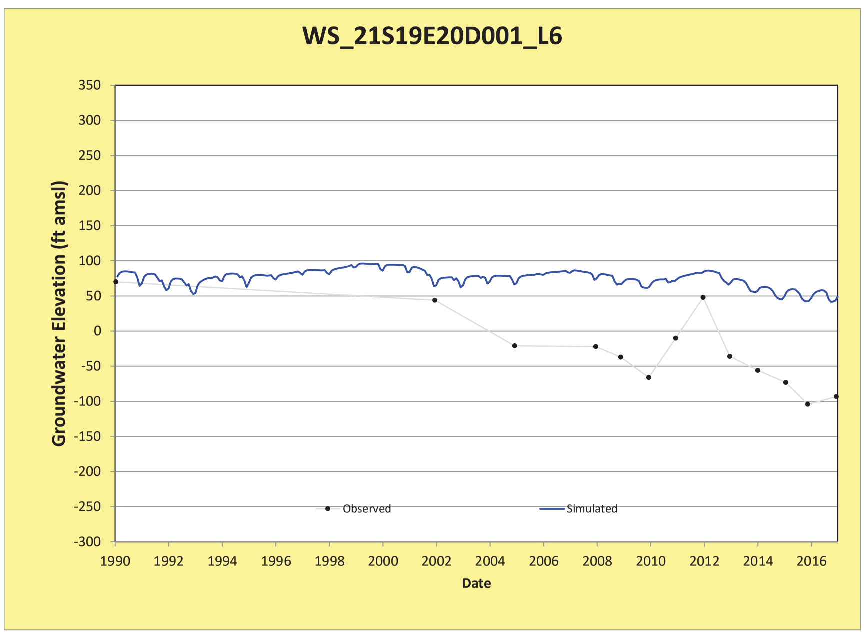

WS_21S19E06D003_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

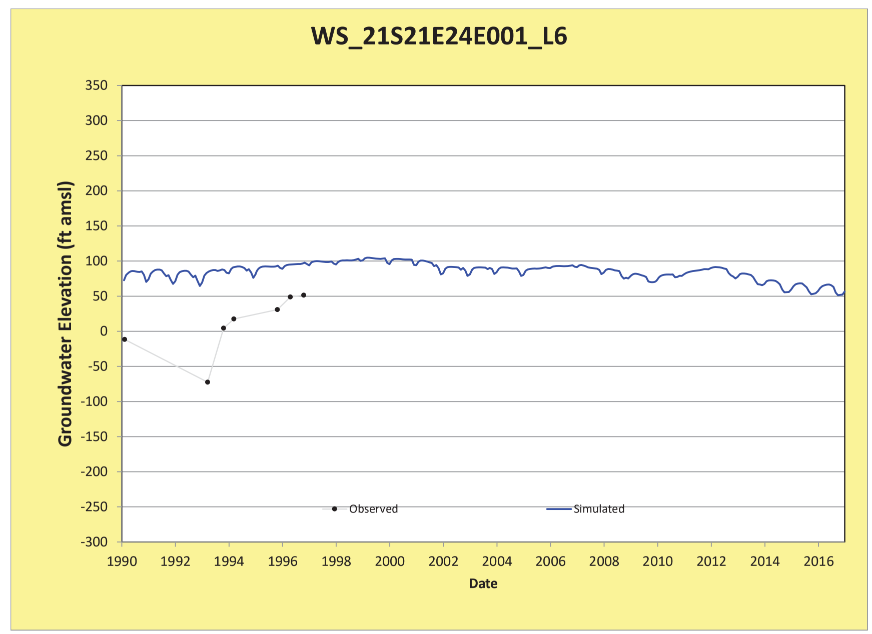

WS_21S19E02B001_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

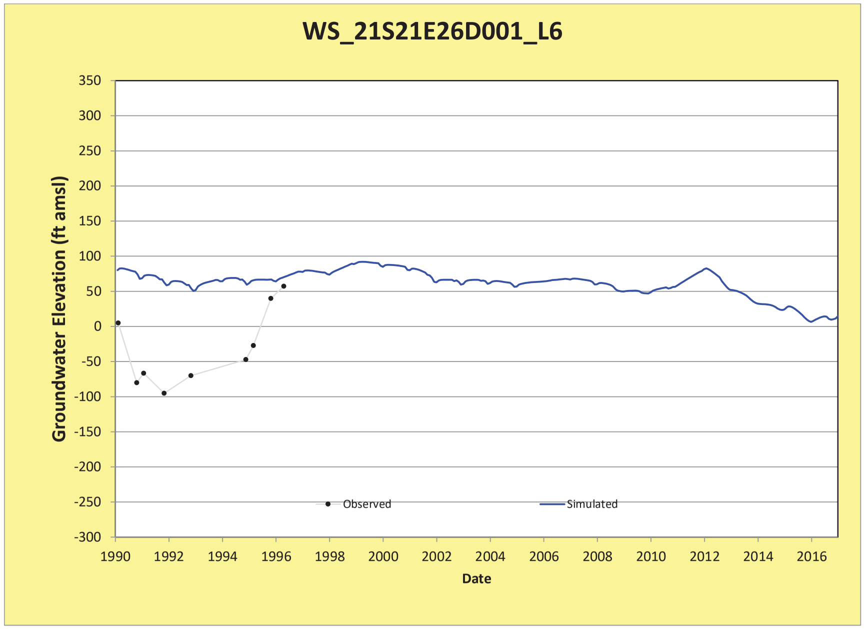

WS_21S19E07D001_L4
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

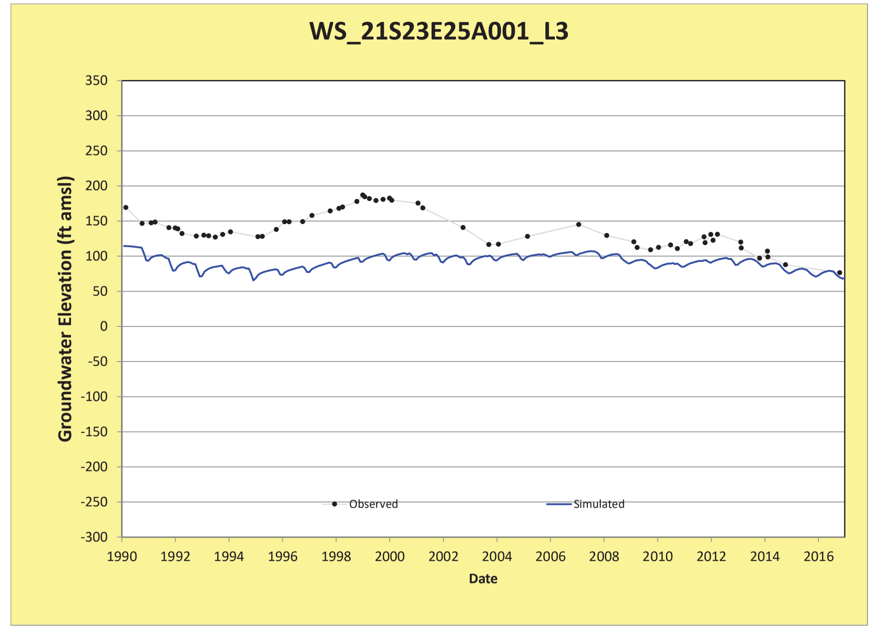

WS_21S19E18N001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

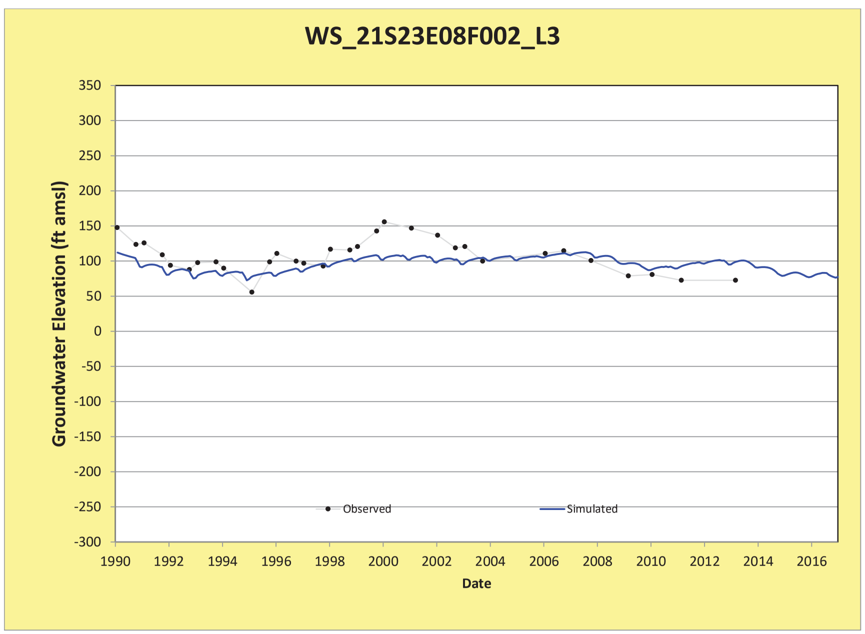

WS_21S21E11D001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

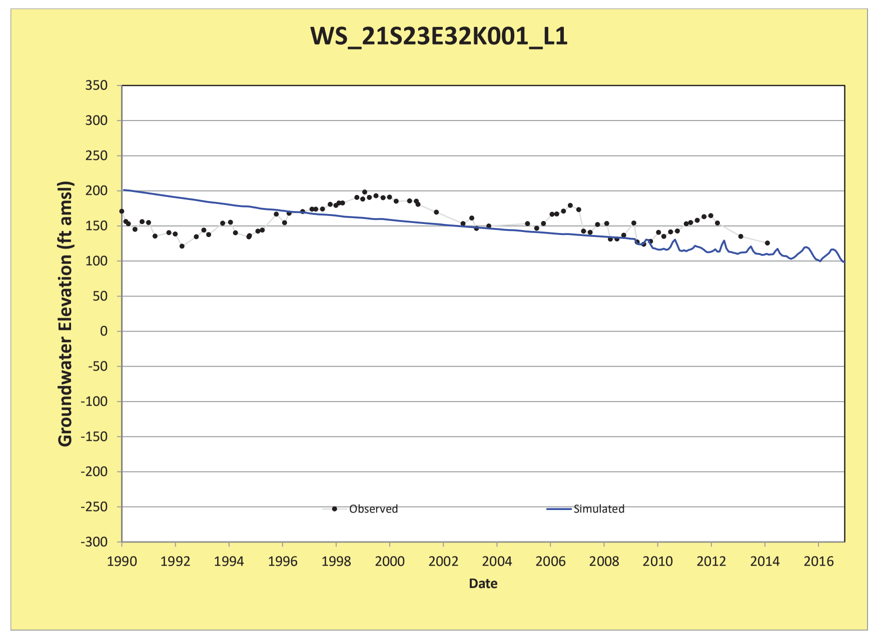

WS_21S19E20D001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

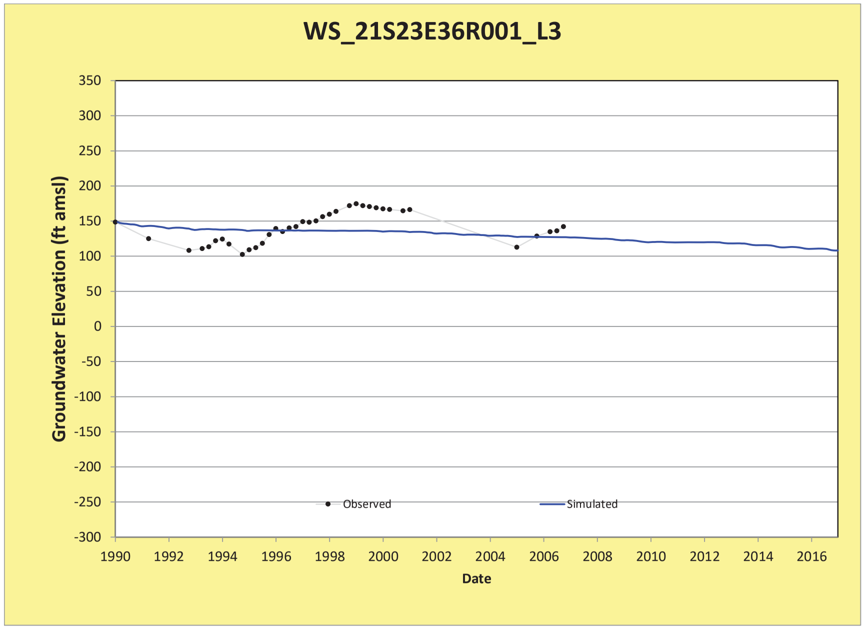

WS_21S21E24E001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

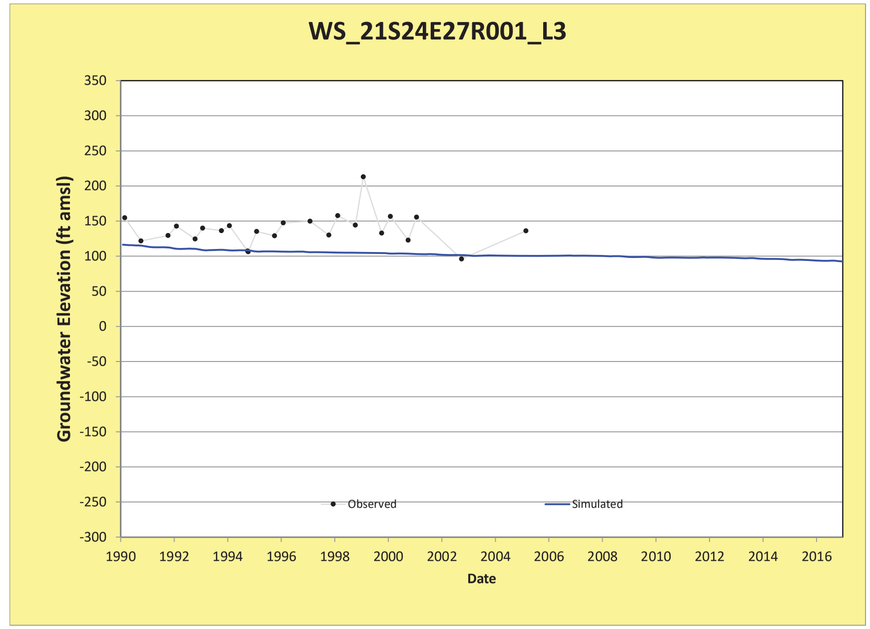

WS_21S21E26D001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

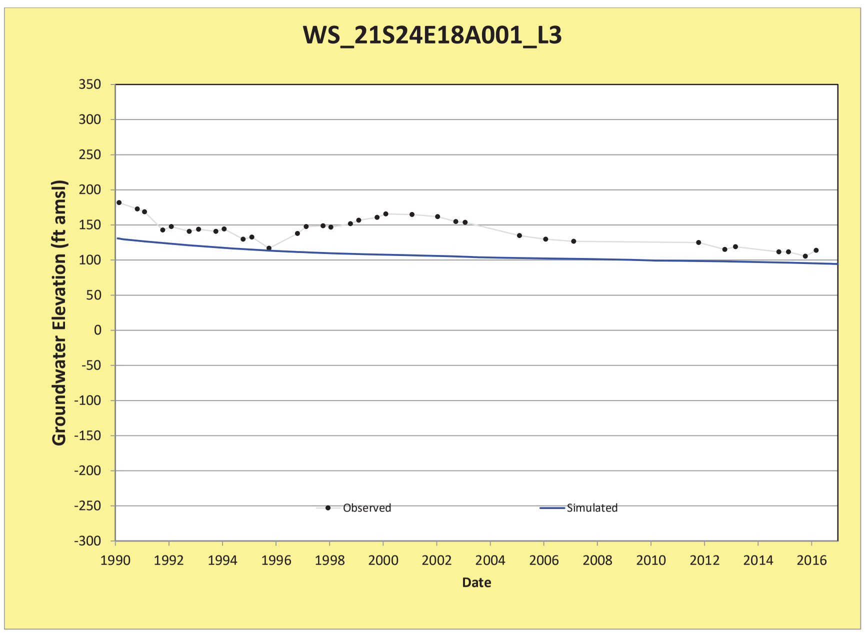

WS_21S23E25A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

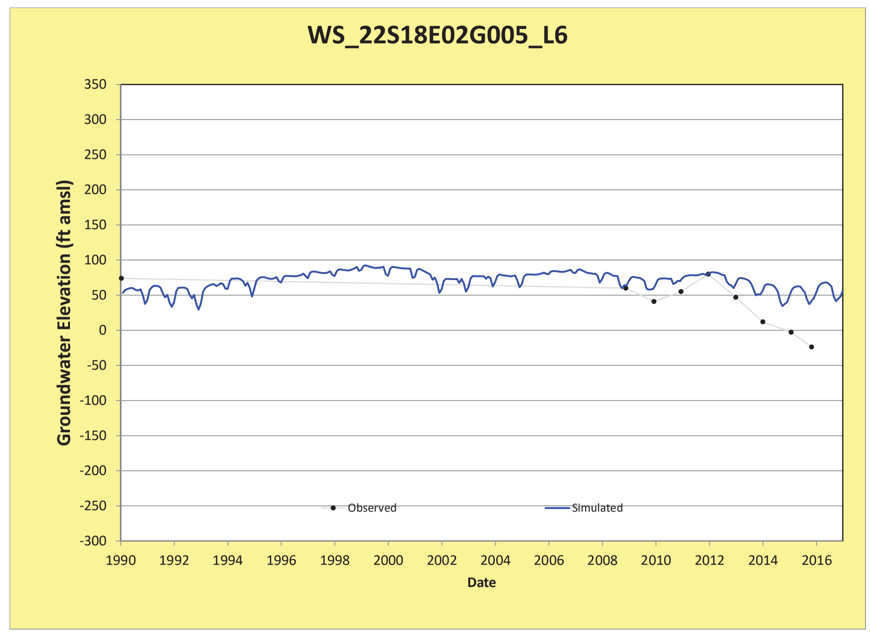

WS_21S23E08F002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

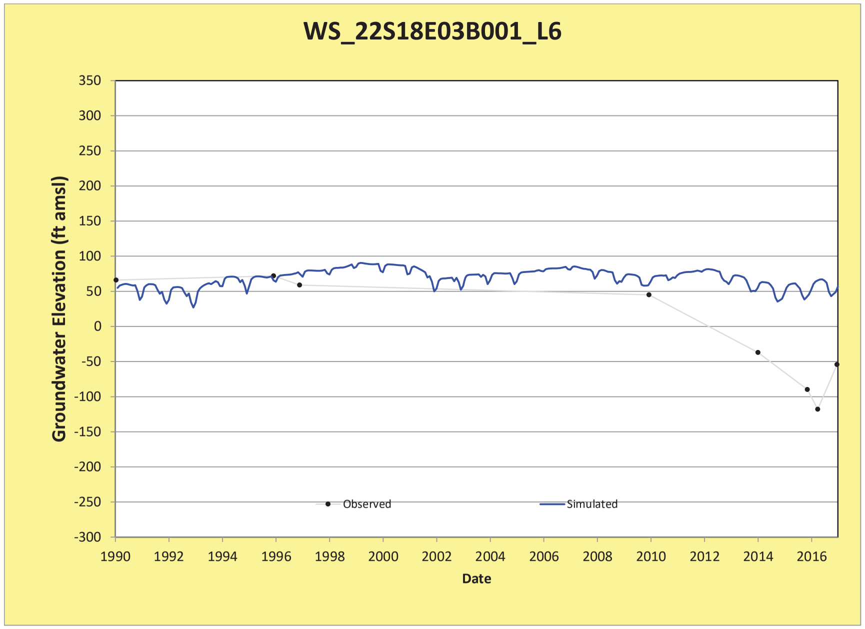

WS_21S23E32K001_L1
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

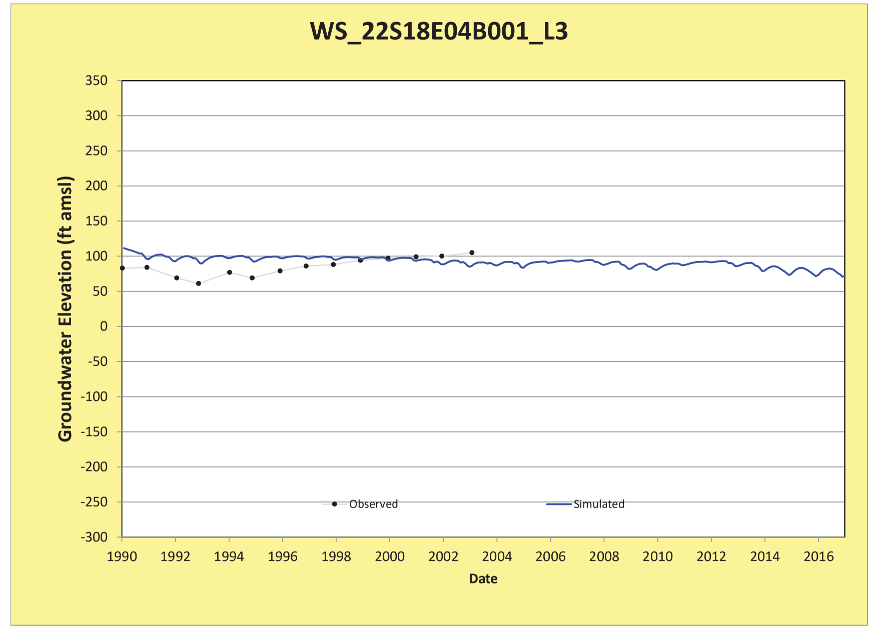

WS_21S23E36R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

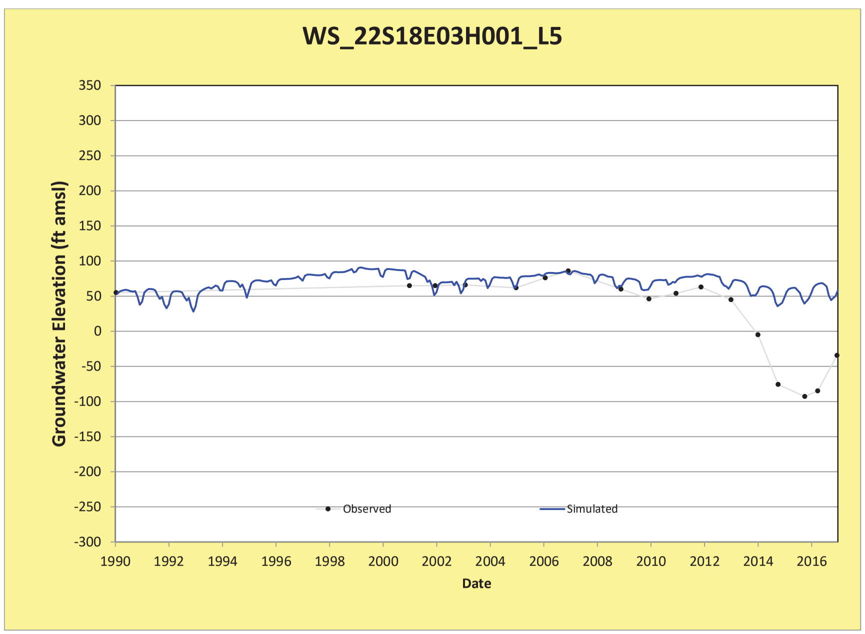

WS_21S24E27R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

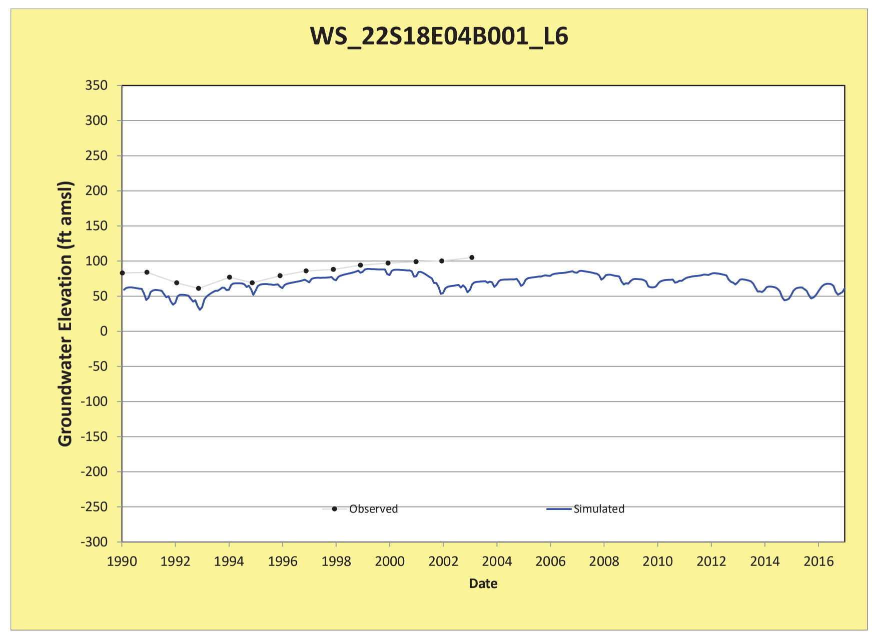

WS_21S24E18A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

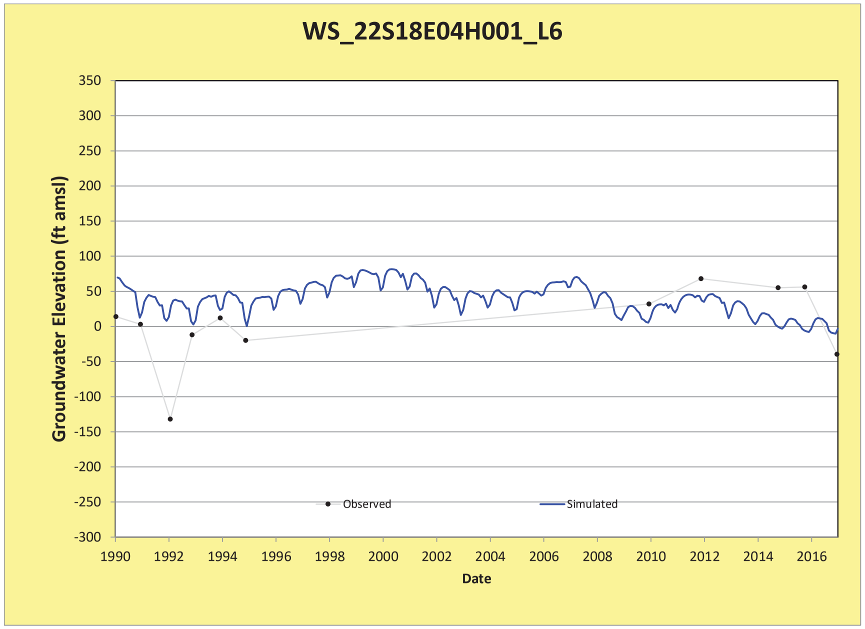

WS_22S18E02G005_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

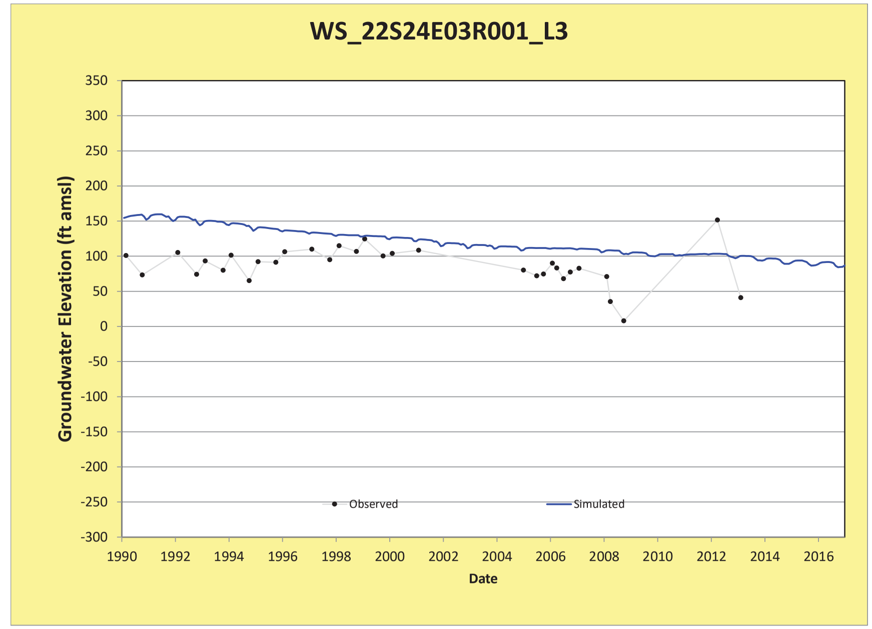

WS_22S18E03B001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

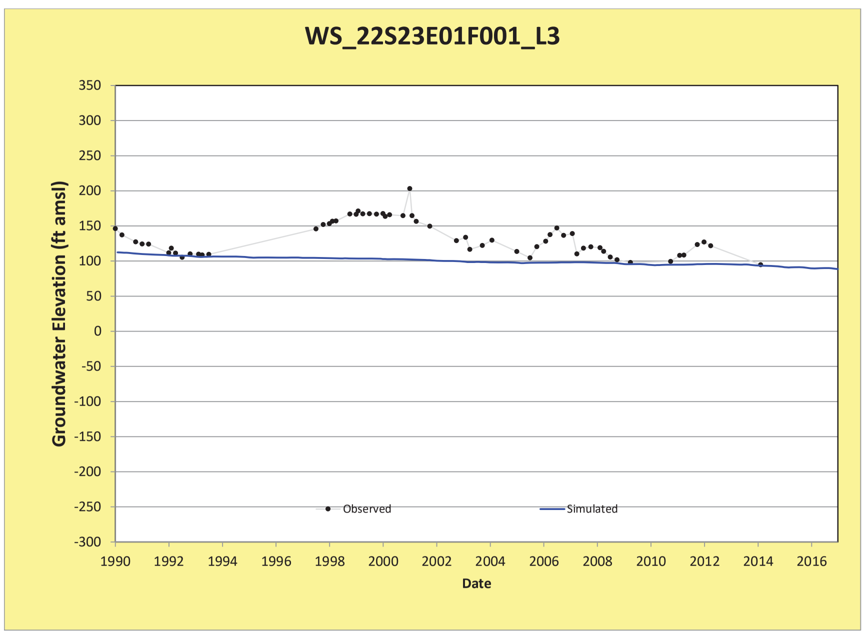

WS_22S18E04B001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

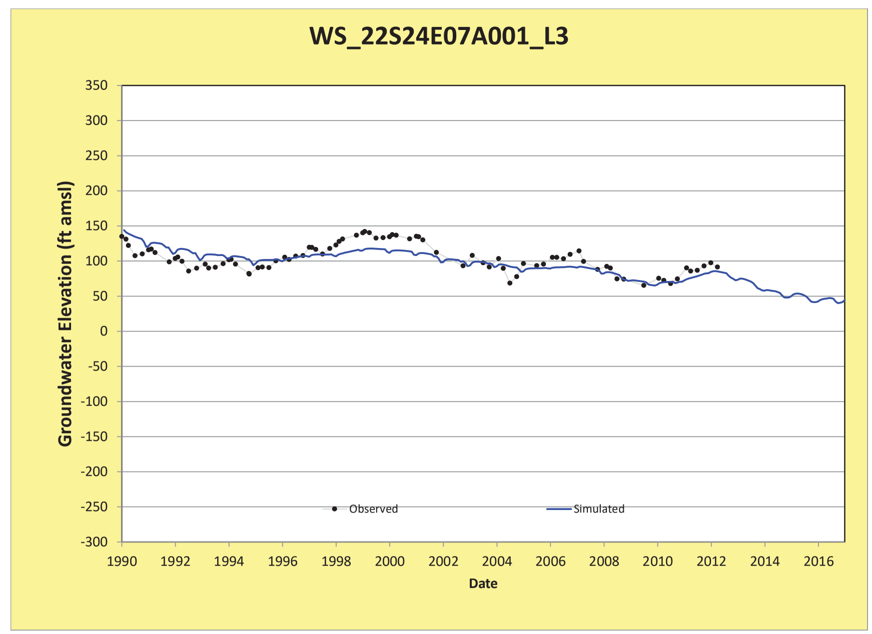

WS_22S18E03H001_L5
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

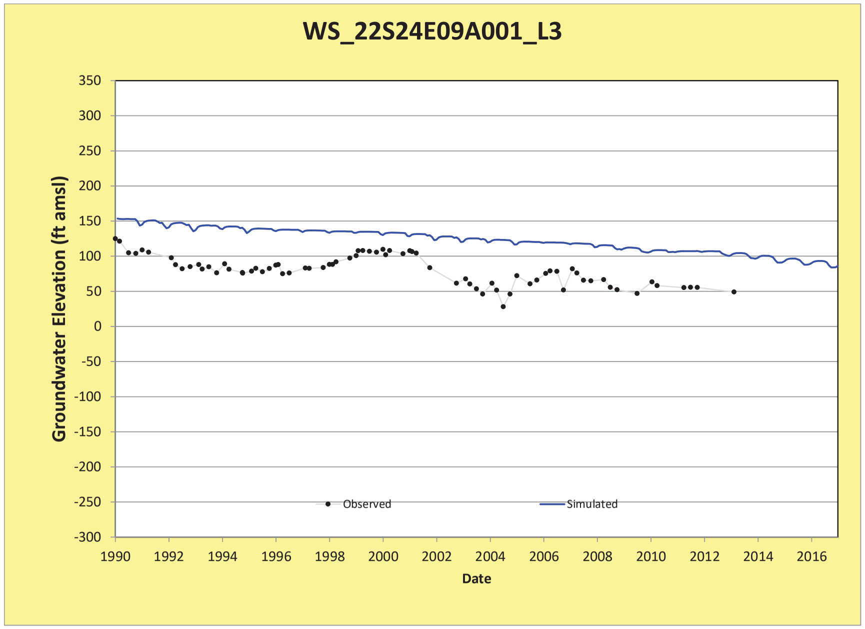

WS_22S18E04B001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

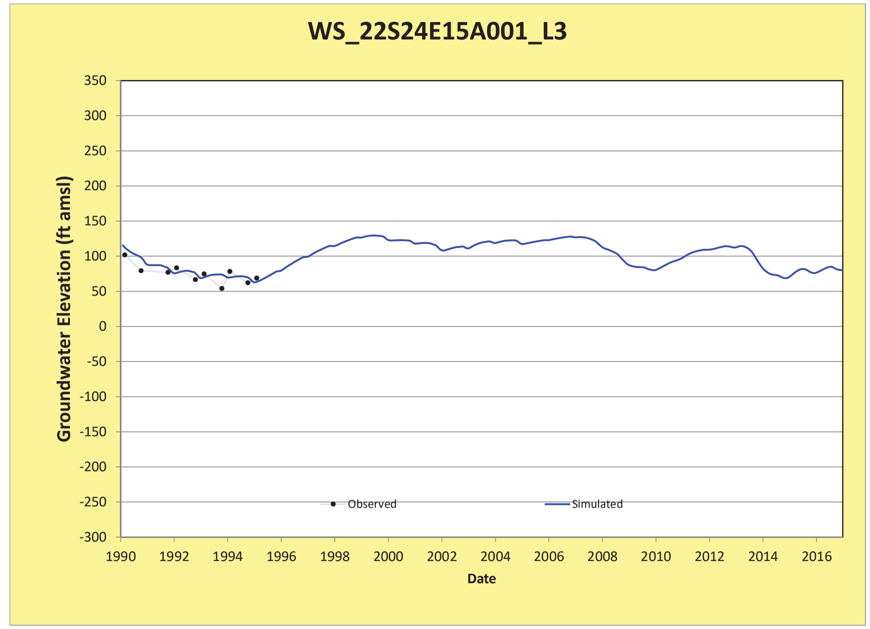

WS_22S18E04H001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

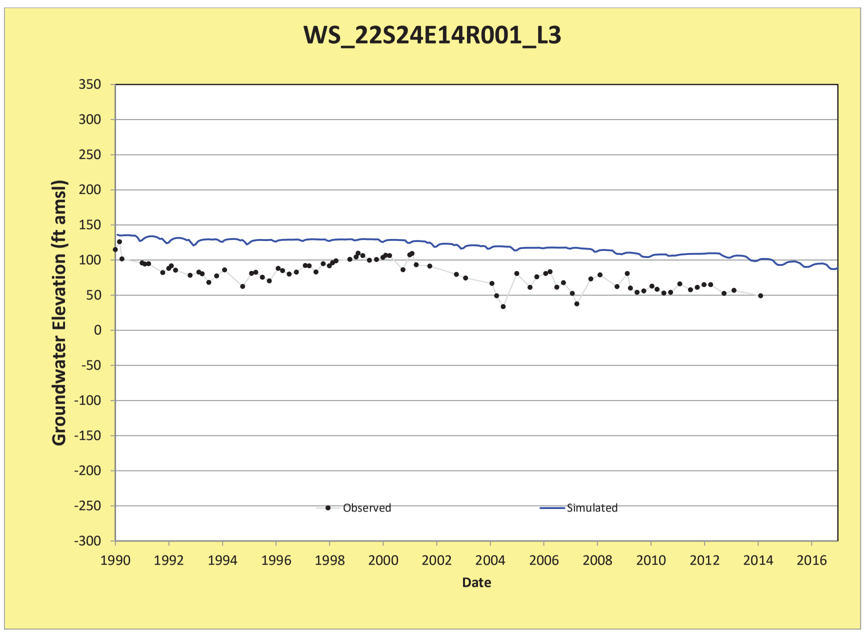

WS_22S24E03R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

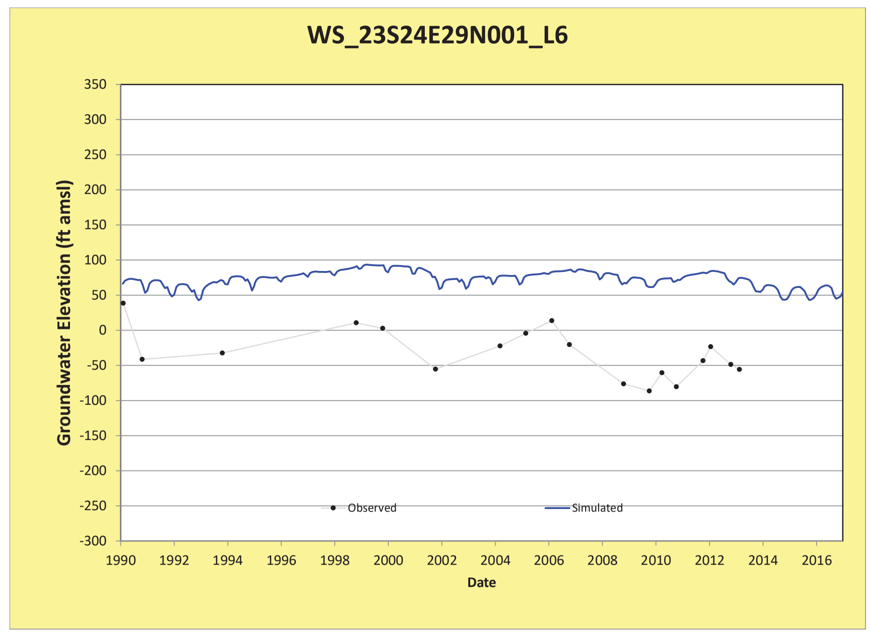

WS_22S23E01F001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

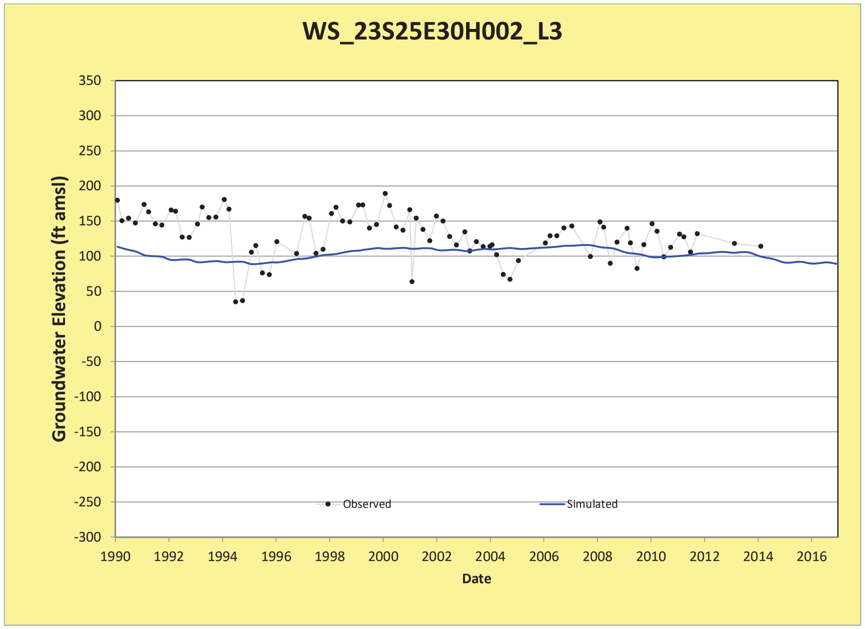

WS_22S24E07A001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

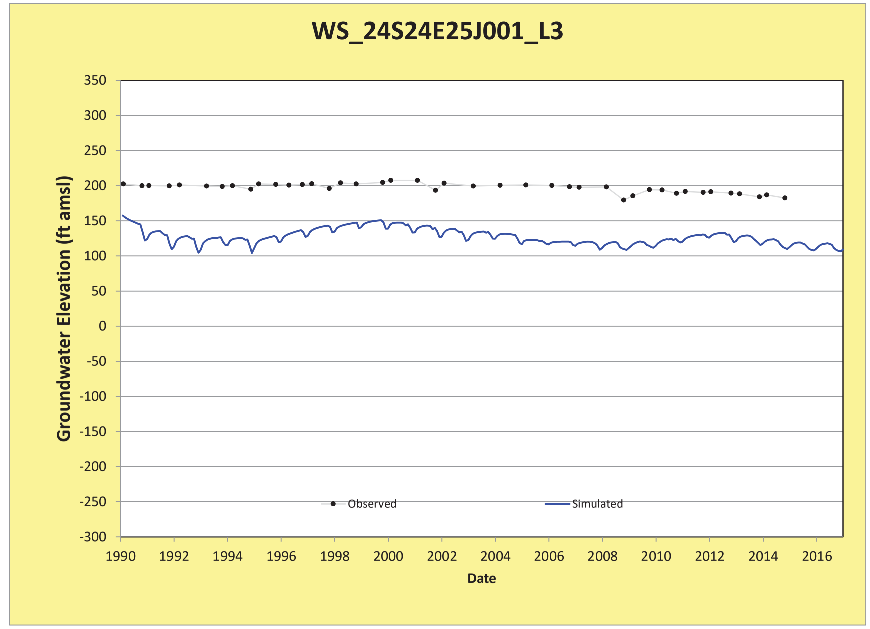

WS_22S24E09A001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

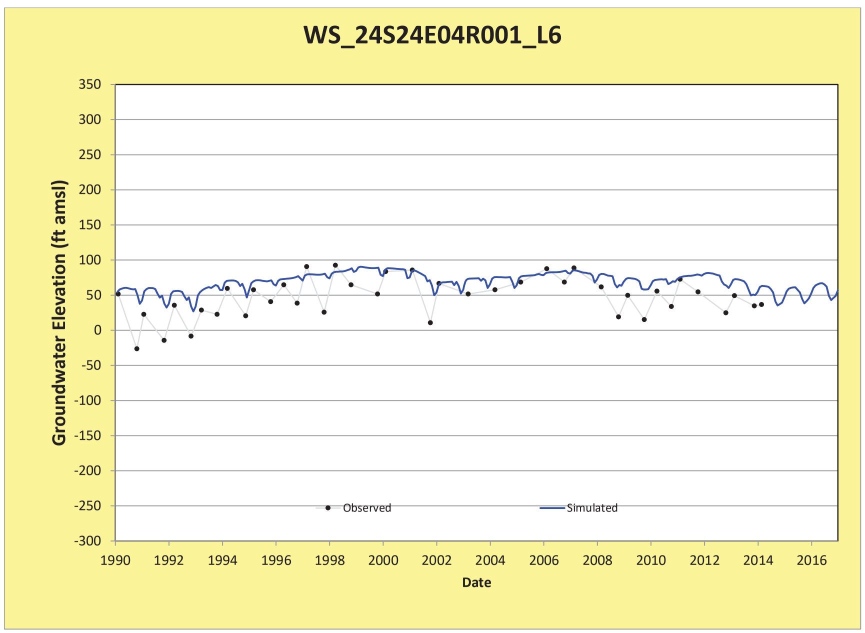

WS_22S24E15A001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

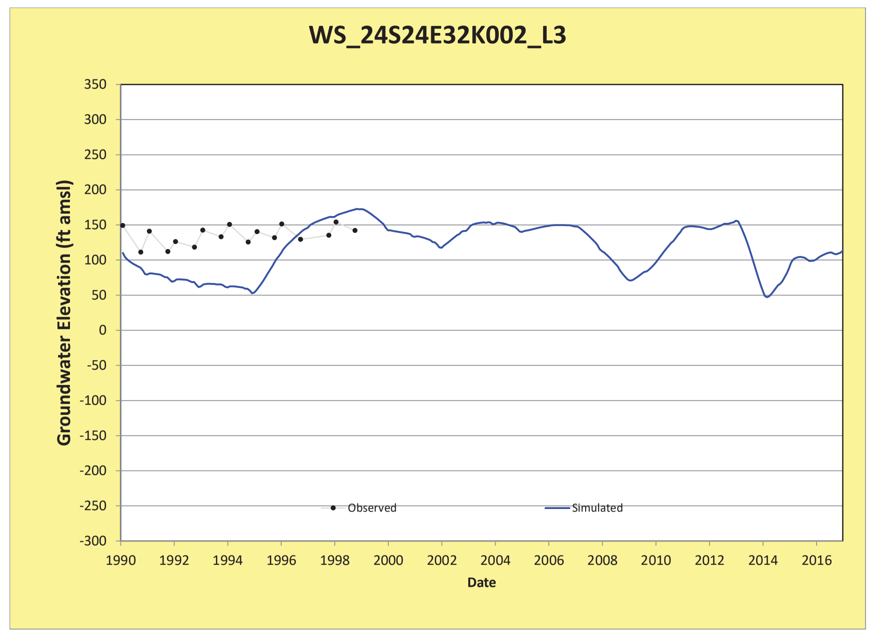

WS_22S24E14R001_L3
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

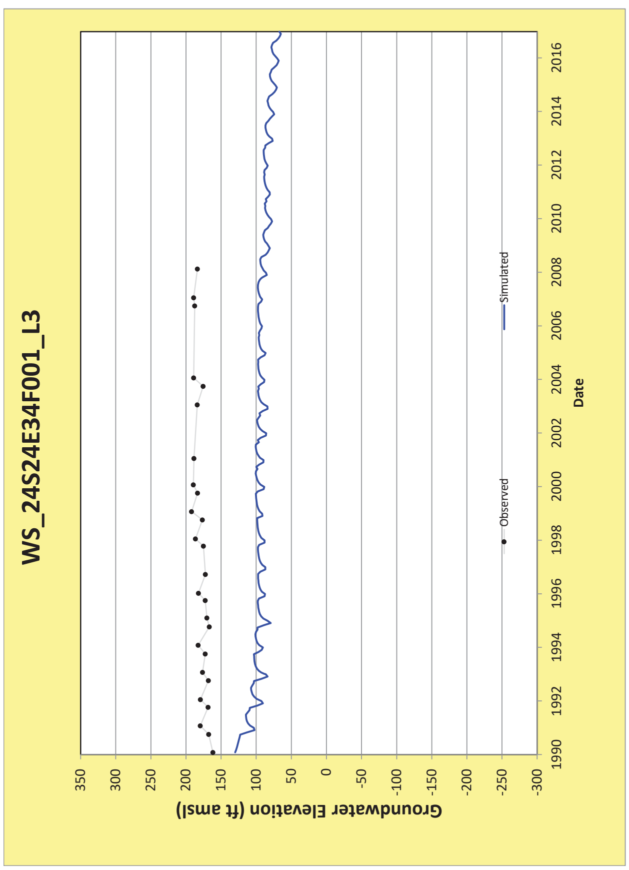

WS_23S24E29N001_L6
Groundwater Elevation (ft amsl)
350 300 250 200 150 100 50 0 -50 -100 -150 -200 -250 -300
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
Date
Observed
Simulated

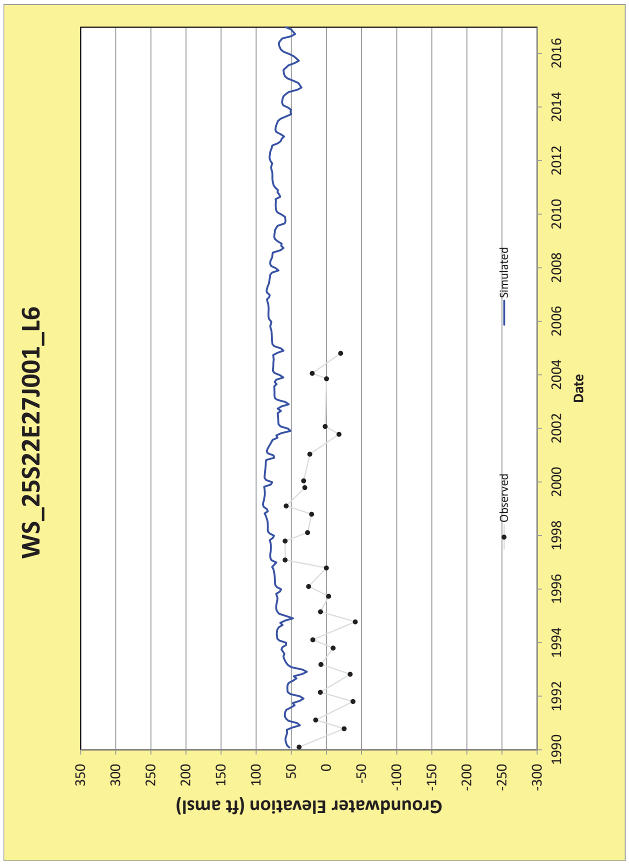

WS_23S25E30H002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

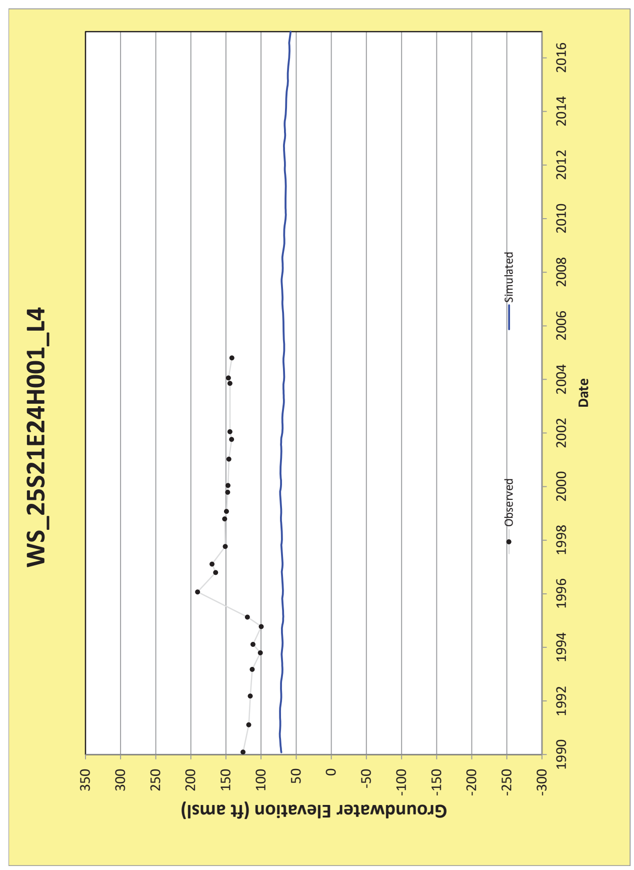

WS_24S24E25J001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

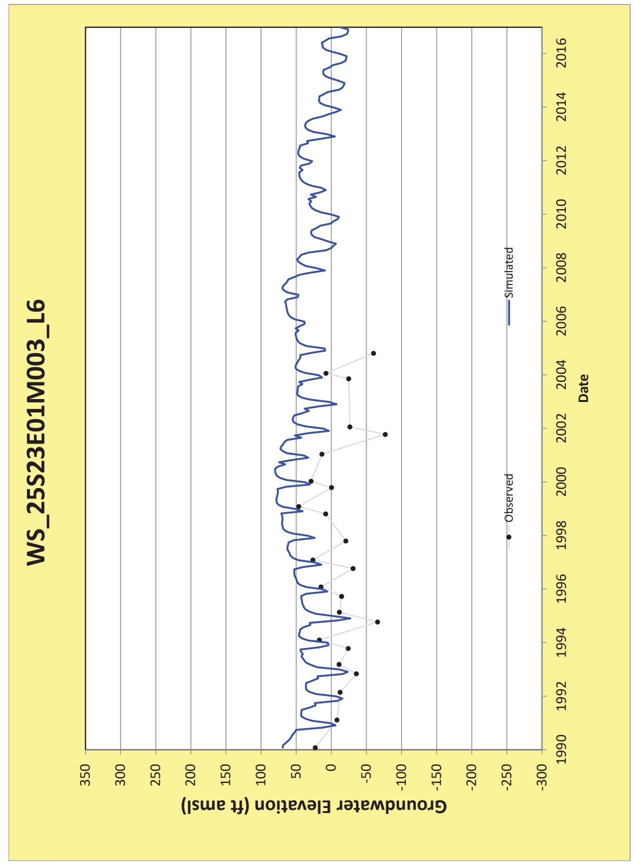

WS_24S24E04R001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

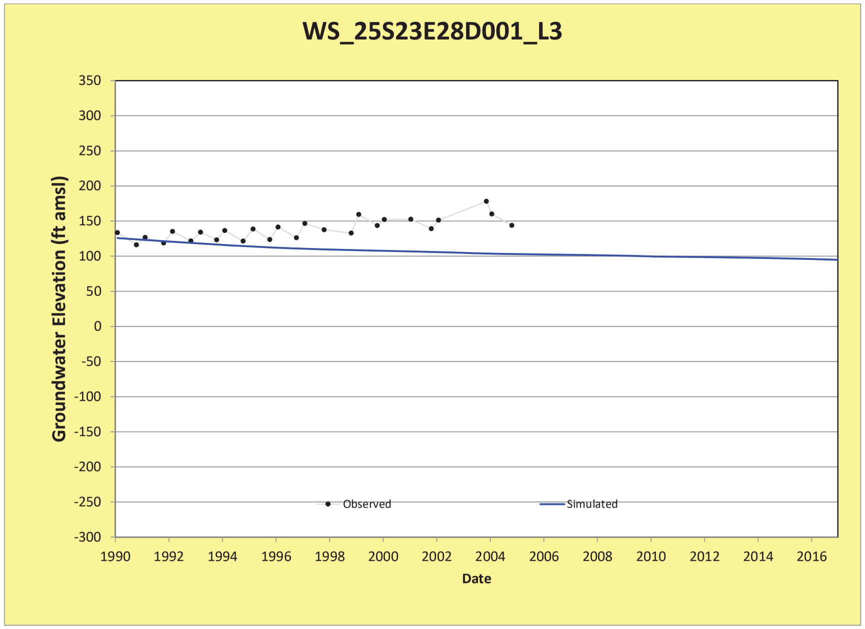

WS_24S24E32K002_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

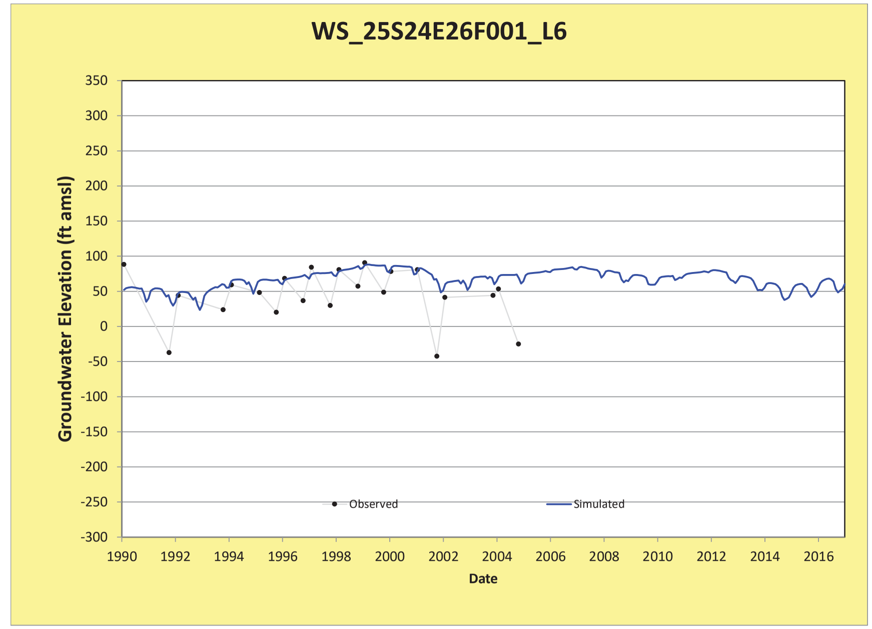

WS_24S24E34F001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

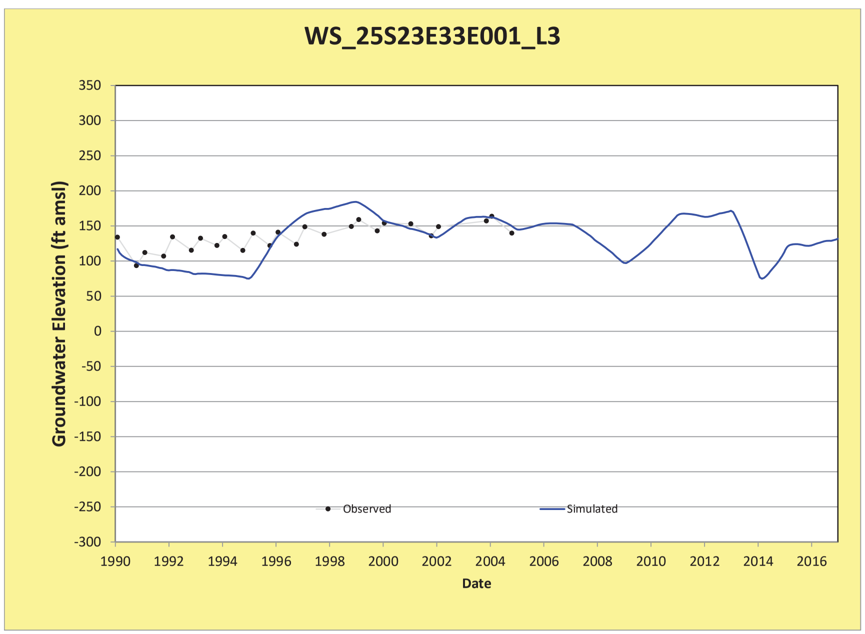

WS_25S22E27J001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

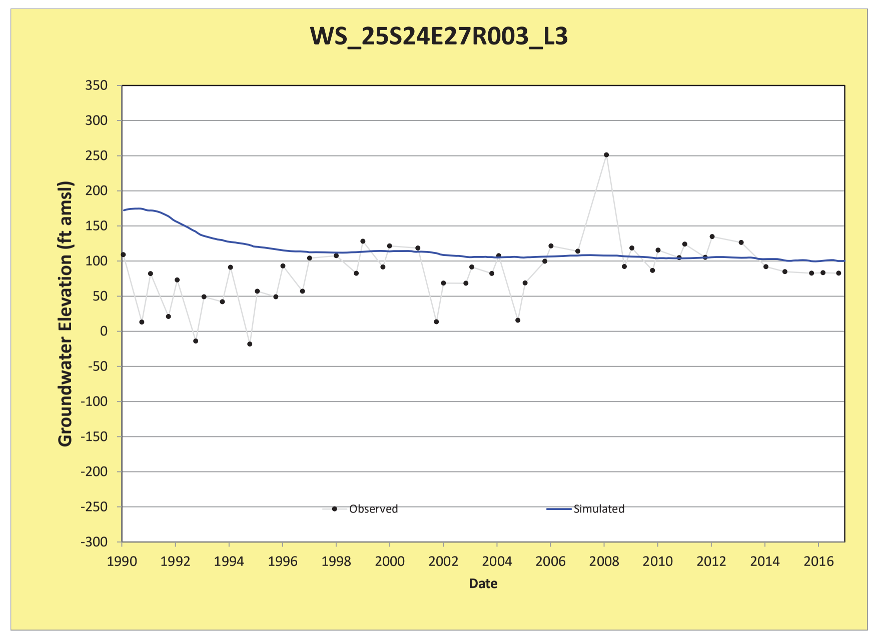

WS_25S21E24H001_L4
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

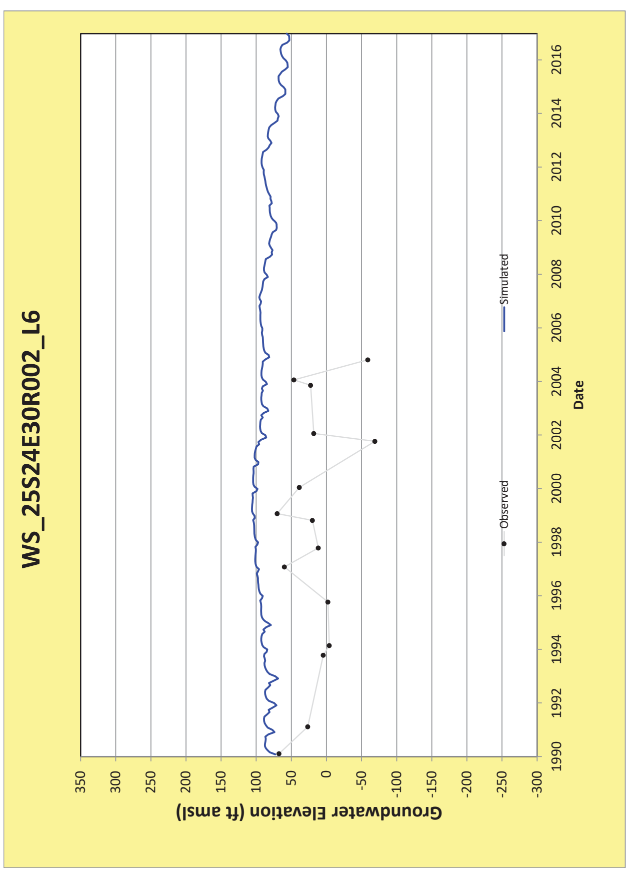

WS_25S23E01M003_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

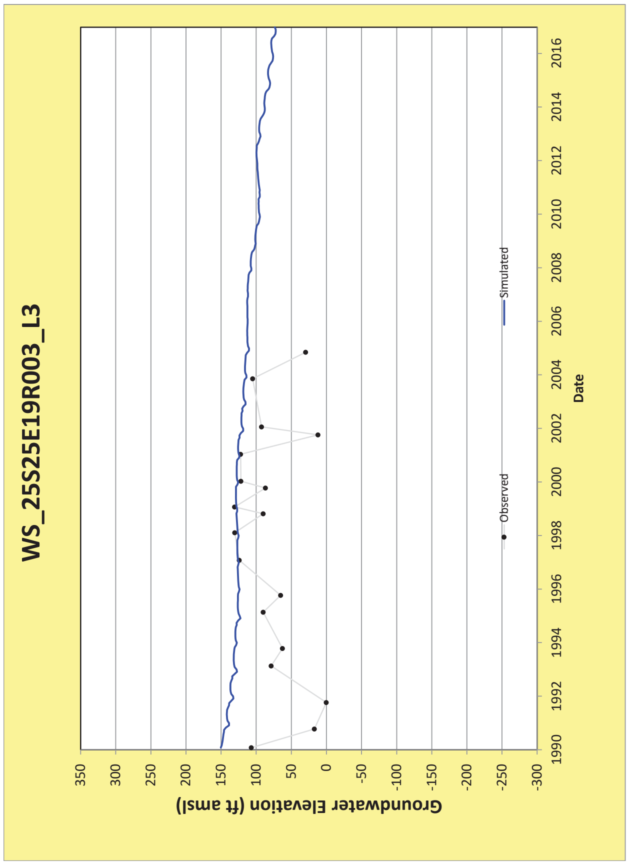

WS_25S23E28D001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

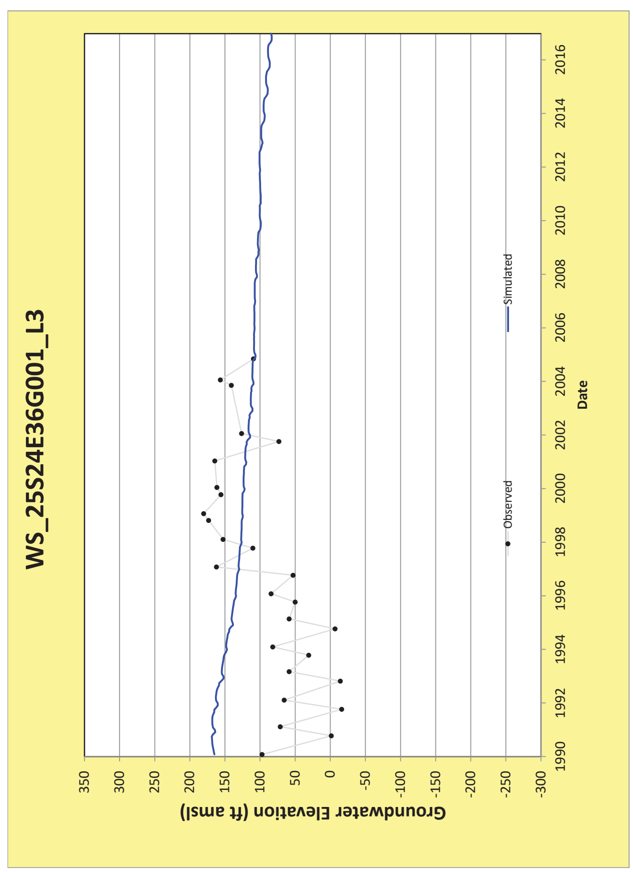

WS_25S24E26F001_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

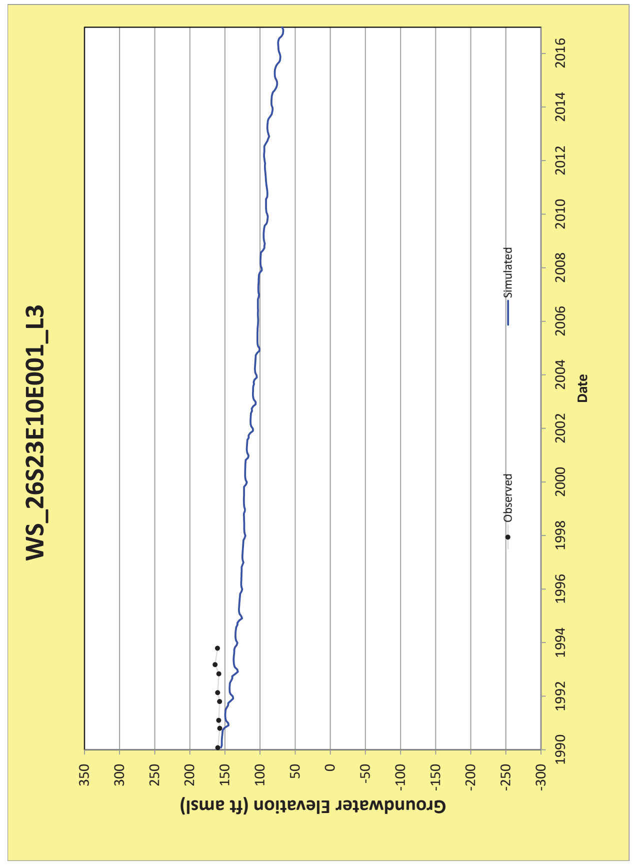

WS_25S23E33E001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

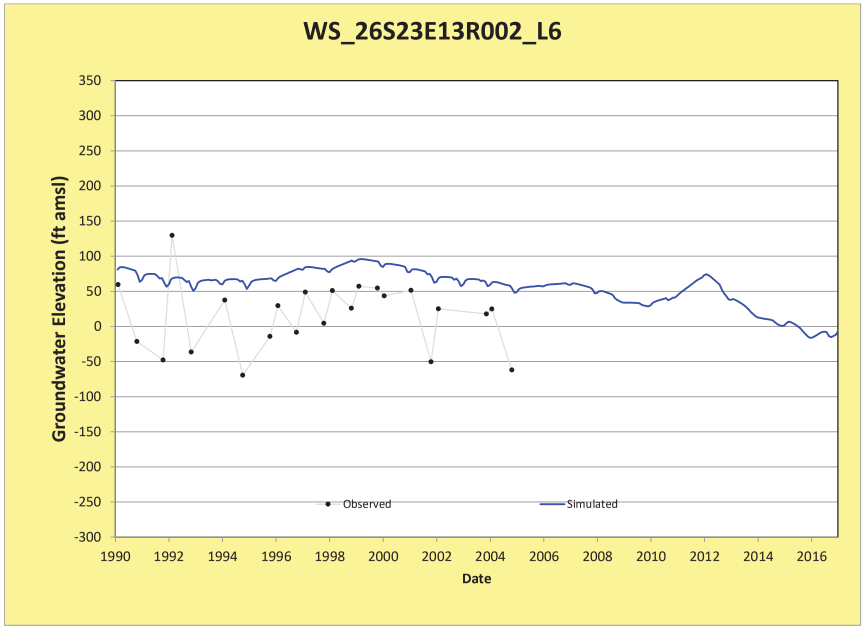

WS_25S24E27R003_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated

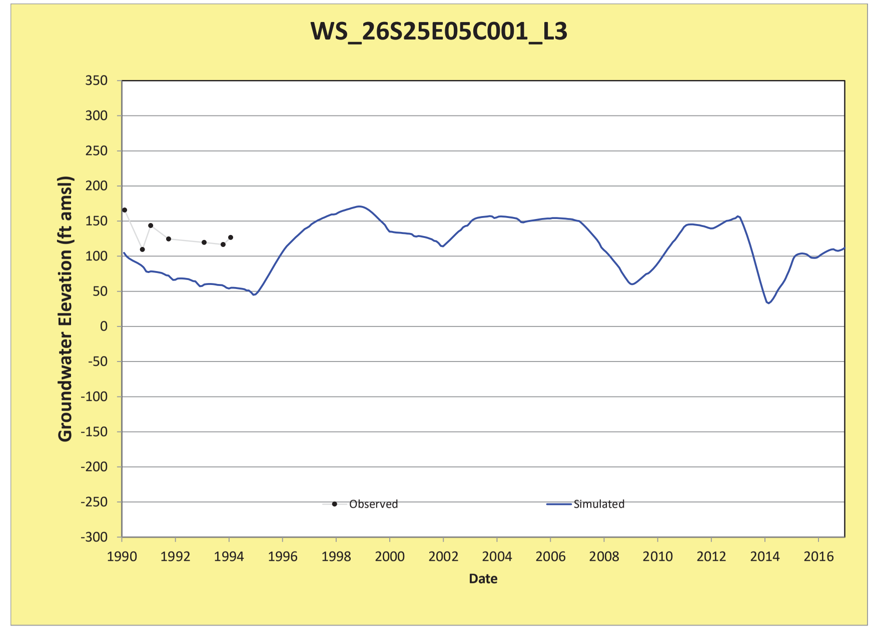

WS_25S24E30R002_L6
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

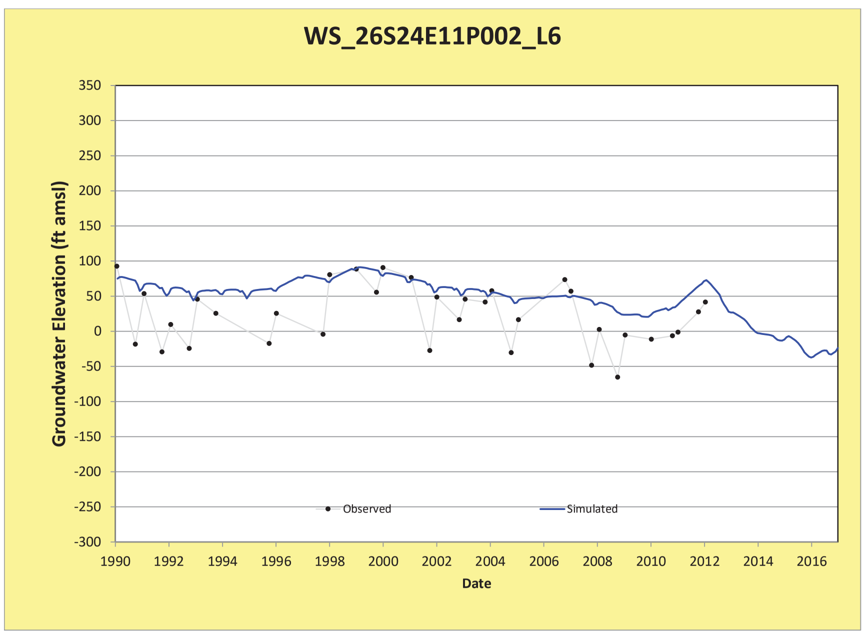

WS_25S25E19R003_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

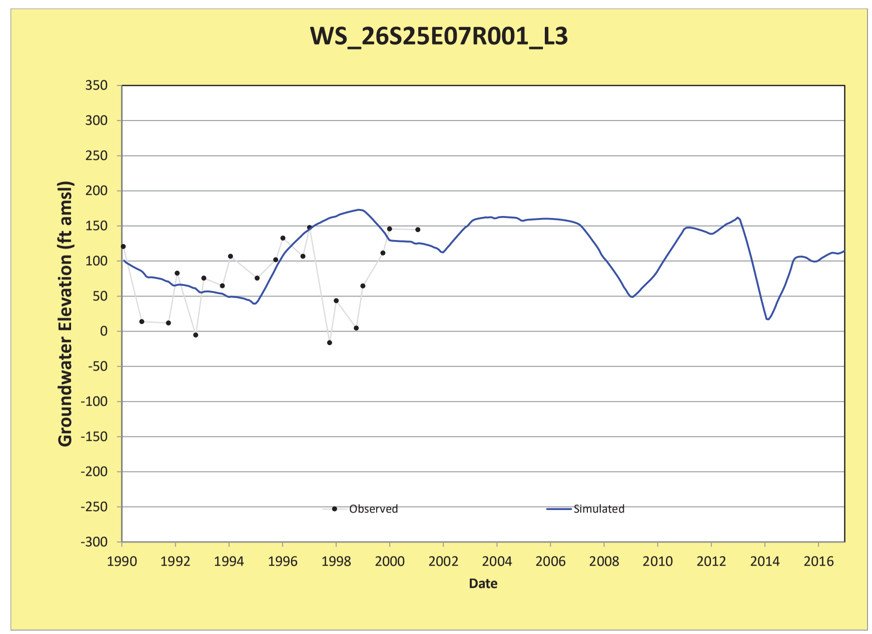

WS_25S24E36G001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

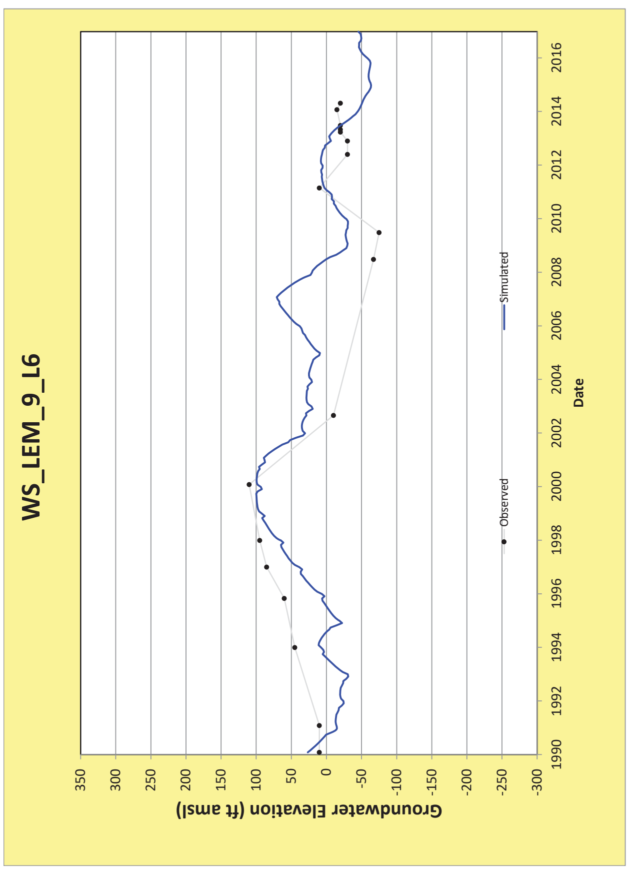

WS_26S23E10E001_L3
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
Date
Observed
Simulated

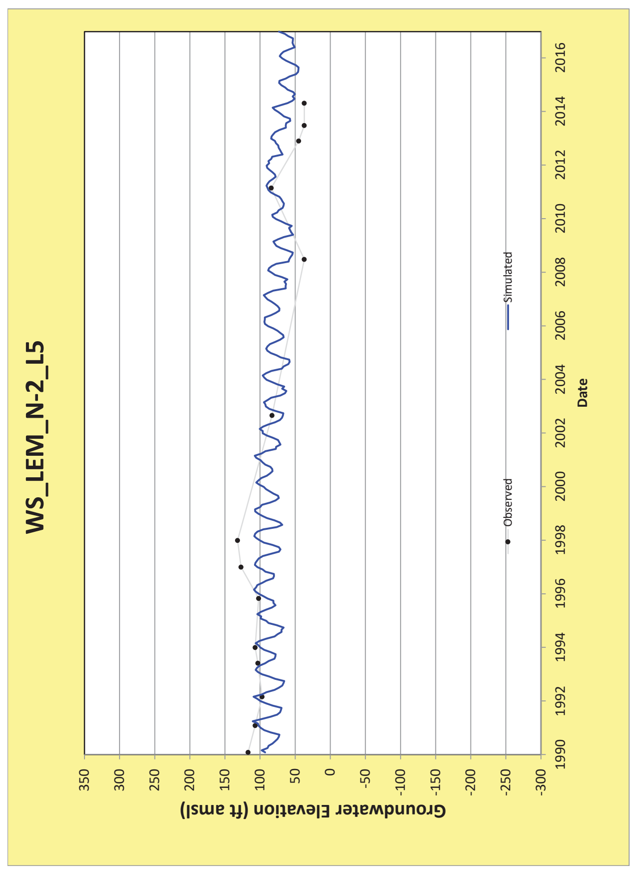

WS_26S23E13R002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_26S25E05C001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_26S24E11P002_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_26S25E07R001_L3
Groundwater Elevation (ft amsl)
Date
Observed
Simulated


WS_LEM_9_L6
Groundwater Elevation (ft amsl)
Date
Observed
Simulated
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016


WS_LEM_N-2_L5
Groundwater Elevation (ft amsl)
Date
Observed
Simulated
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016

Appendix D6
Peer Review of TLSBHM

GSA GeoSystems Analysis, Inc.
Innovations in Hydrology

08 November 2019

Bill Pipes
Principal Hydrogeologist
Wood Plc.
1281 East Alluvial Avenue, Suite 101
Fresno, CA 93720-2659

Re: Kings County – Tulare Lake Subbasin GSP Project: Groundwater Model Peer Review

As requested, I performed a technical peer review of the Tulare Lake Subbasin Hydrologic Model (TLSBHM) and associated report developed by Wood Environment & Infrastructure Solutions, Inc. ("Wood"). This model has been and is continuing to be utilized as a tool for evaluation of hydrologic impacts of future water management scenarios being considered as part of the Groundwater Sustainability Plan (GSP) for the Tulare Lake Subbasin (TLSB) as part of the required Sustainable Groundwater Management Act (SGMA) implementation for that planning region. My review focused of four aspects of the model, specifically:

- the model objectives,
- the Hydrogeologic Conceptual Model (HCM) of the TLSB,
- the development and documentation of numerical groundwater model as a predictive simulation tool based on the HCM, and
- documentation of model development and application in a report that is included as an appendix as part of the final GSP report.

Each of these topics is discussed in separate subsections below.

<u>Model Objectives</u>

Model objectives are clearly stated in Section 1.2, and importantly the stated objectives are consistent with model requirements define in the SGMA (Sustainable Groundwater Management Act of 2014) regulations. Specifically, as required by SGMA, the stated objectives include development of a model capable of forecasting groundwater management actions over a 50-year planning horizon (Cal. Water Code §10727.2(c)), establishment of measurable objectives and critical / minimum thresholds (Cal. Code of Regulations, "CCR," §354.29 and CCR §354.30), and development of a numerical model to quantify and evaluate projected water budget conditions (CCR §354.18).

3393 North Dodge Blvd
Tucson, Arizona 85716
phone: 520-628-9330
fax: 520-628-1122

Hydrogeologic Conceptual Model

A hydrogeologic conceptual model (HCM) is the fundamental basis upon which a numerical model of groundwater flow is based. The HCM is basically a narrative description of the physical system, including:

- the areal extent of the model (typically referred to as the model domain)
- the hydrostratigraphic units within the model domain, including a description of the spatial distribution (area covered, depth, continuity, and thickness)
- the water sources and sink, also referred to as the inflows and outflows, within the model domain
- a description of the flow system functioning, and a preliminary water budget.

Section 2 of the Wood report covers the HCM, utilizing block diagrams to illustrate key flow components under both pre-development and developed conditions. The report section on the HCM covers all items listed above, including a narrative description of the evolution and chronology of hydrogeologic conditions in the basin / study area since development began. The conceptual model describes all recharge sources and surface water sources available and applied to meet water demands in the study area. Land subsidence due to groundwater withdrawal is explicitly described in the HCM, setting the stage for explicit simulation of subsidence in the TLSB numerical model. The HCM section also includes a separate subsection on the basin water budget, citing ranges of values for each of the inflow and outflow components. It is recommended that a table be added that summaries the preliminary water budget documented in the HCM section.

Development and Documentation of Numerical Groundwater Model

As previously noted, CCR §354.18 requires the development of a model to quantify and evaluate projected water budget conditions for the GSP. While a simple spreadsheet model can be employed for development of historical water budgets based on available data, a more quantitative approach is need for predict basin sustainability into future conditions. A numerical model is the most common tool employed for quantitative predictions of basin response to future stresses. Per SGMA requirements, the numerical model must: include publicly available supporting documentation; be based on field or laboratory measurements and calibrated against site specific field data; and developed using public domain, open-source software (CCR §352.4(f)(1-3)) As part of the model documentation, the Wood (2019) groundwater model report notes that the model was developed using the MODFLOW-2005-NWT code, and cites publicly available background documents related to this code, its mathematical development, capabilities, and user guide. The Wood (2019) report also describes the preliminary application of the MODFLOW-OWHM code, and explains why that code ultimately was not utilized for this current phase of the TLSB GSP project. The “Model Design” section of the Wood (2019) report provides a detailed description of each of the key model inputs and data sources for assigning/developing input values, including all the boundary conditions used. The methodology employed to develop agricultural pumping estimates are well-described, as well as the methodology for accounting for in-basin storage and management of excess surface inflows in wet years (for subsequent irrigation when surface inflow supplies are insufficient to meet demands).

The model calibration section describes in detail calibration criteria employed, as well as a description of the calibration data. It appears that that significant effort was invested in gathering and compiling whatever calibration data could be obtained from public sources, as well as from stakeholders / participants in the GSP process. For example, the 1990 – 2016 calibration period included 16,621 groundwater level observations collected from 593 observation wells across the model domain. The 1998 – 2010 "normal hydrology" calibration period included 7,028 groundwater level observations collected from 544 observation wells across the model domain. Wood (2019) also note that additional data was available and reviewed as part of the calibration process, but ultimately was not used due to data uncertainty / data quality concerns. The trial & error calibration procedure is well described, and plots are presented showing "goodness-of-fit for wells employed in the calibration process. The final calibration statistics are presented, showing that the final calibrated model generally meets defined criteria for an adequately calibrated model (e.g., Normalized Root Mean Squared Error < 10%).

Detailed water balance results are presented for the calibrated model, including for interactions between the TLSB and adjacent subbasins in the southern San Joaquin Valley. The calibration model simulated subsidence is also presented, although Wood (2019) notes that additional calibration of the model to observed subsidence is needed.

Consistent with good model practice, a model parameter sensitivity analysis is presented to show that the sensitivity of the model results to changes in hydraulic conductivity and storage parameters. The sensitivity analysis showed the calibrated model to be quite robust to changes in model parameters, and the importance of the Kv parameter of the Corcoran Clay layer, and Kh for the shallow and deeper aquifers (above and below the Corcoran, respectively).

Finally, the Wood (2019) report summarizes forecast models to predictive TLSB hydrologic condition 50 years into the future under two future scenarios:

- a Baseline Forecast scenario projecting current cropping patterns into the future, a slow growth rate in municipal pumping(0.3% per year) with a 50-year hydrology driver that accounts for climate change following the guidelines of the California Natural Resources Association (CNRA) for applying "change factors" to historical precipitation, ET demand, and surface water delivery data to make historical data consistent with forecasted conditions under climate change.
- multiple Project Forecast simulations; that involved by modifying the Baseline Forecast and incorporating various potential projects and management actions developed by the GSAs for the TLSB and surrounding subbasins. Potential projects and management action considered include: (i) Above ground surface water storage projects, (ii) Intentional recharge basins, (iii) On-Farm Recharge, (iv) Aquifer Storage and Recovery (ASR), and (v) Agricultural demand reductions.

The results for the Forecast model results include projected water budgets into the future, as well as piezometric levels and changes to basin storage (both elastic and inelastic) for the Baseline and Sustainability Project scenarios. The forecast model results are also presented for water level hydrographs for selected Compliance Wells (which were identified in the main body of the GSP report) in Figures 7-6 and 7-15 and predicted subsidence for Subsidence Compliance

Monitoring points (Figures 7-8 and 7-17). Identification of and calculation of responses at designated Compliance Monitoring points meets the SGMA requirement that the model be able to quantify Sustainability Indicators (23 CCR §354.28(b)), which are clearly defined in Chapter 4 of the GSP report.

<u>Summary</u>

The TLSB groundwater model developed to support groundwater sustainability planning for the TLSB was reviewed and evaluated against explicit needs and requirements for basin sustainability planning under SGMA. Based on this Peer Review of the model, it was found that the model was developed following good groundwater modeling practice in terms of compilation and integration of historical available data and information, groundwater calibration criteria, sustainability analyses, forecasts of future conditions under Baseline and implementation of sustainability Projects, and clear documentation of model development and application. As required under SGMA, the model develops a rigorous groundwater budget under the historical calibration period as well as under the two future Forecast scenarios (Baseline and Project). In addition, it also quantifies groundwater response at key monitoring points in the basin in the context of sustainability criteria and thresholds identified in Chapter 4 of the GSP.

If you have any questions, please do not hesitate to contact me. As always, we appreciate this opportunity to work with the Wood – Provost & Pritchard team.

Best Regards,

James T. McCord

Jim McCord, PhD, PE
Principal Hydrogeologist

APPENDIX E

GSP CHECKLIST

Appendix E - GSP Checklist

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
Article 5. Plan Contents, Subarticle 1. Administrative Information				
354.4	10733.2	General Information	a. Executive Summary- written in plain language b. A list of references and technical studies. Groundwater Sustainability Agencies (GSAs) must provide the California Department of Water Resources (DWR) an electronic copy of documents that are not available to the public	a. Executive Summary p. ES-1 to ES-40 b.Ch. 8, References p. 8-1 to 8-12
354.6	10733.2	Agency Information	a. GSA Mailing Address b. Organization and Management Structure including persons with management authority for Groundwater Sustainability Plan (GSP) implementation c. Contact Information of Plan Manager d. Legal Authority of GSA e. Estimate of Implementation Costs	a. Appendix A b. Section 1.4.1 (p. 1-6) c. Appendix A d. Section 1.4.2 (p. 1-6) e. Section 1.4.3 (p. 1-7)
354.8.(a)	10733.2	Map(s)	1. Area covered by GSP 2. Adjudicated areas, other agencies within the basin, and areas covered by an Alternative 3. Jurisdictional boundaries of federal or state land 4. Existing Land Use Designations & identification of water use sector/water source type 5. Density of wells per square mile	1. Chapter 2 (p. 2-1) 2. Section 2-1, (p. 2-3) 3. Section 2-1, (p. 2-3) 4. Chapter 2 (p. 2-1) 5. Chapter 2 (p. 2-2)
354.8.(b)	10733.2	Description of the Plan Area	b. Written summary of jurisdictional areas and other features	Section 2-1, (p. 2-3)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
354.8.(c, d, e)	10733.2	Water resource monitoring and management programs	c. Description of water resources monitoring and management programs d. Description of how water resource monitoring or management programs may limit operational flexibility e. Description of Subbasin's conjunctive use programs	c. Section 2.2.1 (p. 2-10) d. Section 2.2.2 (p. 2-13) e. Section 2.2.3 (p. 2-14)
354.8.(f)	10733.2	Land Use Elements or Topic Categories of Applicable General Plans	1. Summary of general plans and other land use plans 2. Description of how implementation of the GSP may change water demands or affect achievement of sustainability and how the GSP addresses those effects 3. Description of how implementation of the GSP may affect the water supply assumptions of relevant land use plans 4. Summary of the process for permitting new or replacement wells in the basin 5. Information regarding the implementation of land use plans outside the basin that could affect the ability of the Agency to achieve sustainable groundwater management	1. Section 2.3.1 (p. 2-15) 2. Section 2.3.2 (p. 2-15) 3. Section 2.3.3 (p. 2-16) 4. Section 2.3.4 (p. 2-18) 5. Section 2.3.5 (p. 2-20)
354.8.(g)	10727.4	Additional GSP Contents	Additional GSP elements	Section 2.4 (p. 2-21)
354.10	10733.2	Notice and Communication	a. Description of beneficial uses and users b. List of public meetings c. GSP comments and responses d. Communication section including the following:	a. Section 2.5.3 (p. 2-28) and Appendix B b. Appendix B c. Appendix C D. Appendix B

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			1. Explanation of GSA's decision making process 2. Identification of opportunities for public engagement and how public input will be used 3. How agencies will encourage diverse active involvement from community 4. How the GSAs will inform the public about progress of the GSP	1. Section 2.5.2 (p. 2-27) 2. Section 2.5.4 (p. 2-29) 3. Section 2.5.5 (p. 2-31) 4. Section 2.5.4 (p. 2-29)
Article 5. Plan Contents, Subarticle 2. Basin Setting				
354.14.(a-b)	10727.2	Hydrogeologic Conceptual Model (HCM), descriptive text	a. Hydrogeologic Conceptual Model and maps of the physical components and interaction of the surface water and groundwater systems in the basin. b. The HCM will include: 1. Regional geologic and structural setting of the Subbasin, as well as surrounding areas 2. Lateral basin boundaries including major geologic features 3. Definable bottom of the basin 4. Principal aquifers and aquitards including: a. formation names b. physical properties of aquifers and aquitards c. structural properties of the Subbasin that restrict groundwater flow within the aquifers d. General water quality of principal aquifers e. identification of primary uses of each aquifer including domestic, irrigation, municipal water supplies f. Identification of data gaps and uncertainty in the HCM	a. Section 3.1 (p. 3-2) and Appendix D b. HCM summarized in written descriptions within: 1. Sects 3.1.1 to 3.1.3 (p. 3-2) 2. Section 3.1.6 (p. 3-14) 3. Section 3.1.7 (p. 3-17) 4a. Section 3.1.8 (p. 3-20) 4b. Section 3.1.8 (p. 3-20) 4c. Section 3.1.8 (p. 3-20) 4d. Section 3.2.5 (p. 3-33) 4e. Section 3.1.11 (p. 3-27) 4f. Section 3.1.12 (p. 3-28)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
354.14.(c-d)	10733.2	HCM, Maps	c. Include at least 2 cross section maps of the HCM that depict major stratigraphic and structural features of the Subbasin d. Map(s)pf physical characteristics of the Subbasin 1. Topographic information 2. Surficial geology (by USGS or other applicable agency) 3. Soil characteristics (by NCRS or other applicable agency) 4. Delineation of existing recharge areas, potential recharge areas, and discharge areas 5. Surface water bodies 6. Source and point of delivery for imported water supplies	c. Figures 3-14a to 3-14c d1. Figure 3-7 d2. Figure 3-12 d3. Figures 3-9 to 3-11 d4. Figure 3-22 d5. Figure 3-5 d6. Section 3.1.1.6 (p. 3-8)
354.16	10733.2	Groundwater Conditions	a. Groundwater elevation data 1. Groundwater elevation contour maps (depict groundwater table or potentiometric surface) 2. Hydrographs for long term groundwater elevations, historic levels, and hydraulic gradients b. Estimate of groundwater storage (graph). Graph must include annual and cumulative change in the volume of groundwater in storage between seasonal high groundwater conditions including annual use and water year type c. Seawater intrusion conditions (including maps and cross sections for each principal aquifer) d. Groundwater quality issues including locations of known groundwater contamination sites and plumes e. Extent, cumulative total, and annual rate of land subsidence (including map of total subsidence based on data from DWR)	a1. Figures 3-24 to 3-27 a2. Figures 3-23 through 3-28d and Appendix D b. Figures 3-29a,b,c c. Section 3.2.4 (p. 3-32) d. Section 3.2.5 (p. 3-33) e. Section 3.2.6 (p. 3-35) f. Section 3.2.8 (p. 3-37) g. Section 3.2.8.1 (p. 3-38)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			f. Identification of interconnected surface water systems and estimate of quantity and timing of the depletions using DWR data g. Identification of groundwater-dependent ecosystems (using data from DWR)	
354.18.(a-b)	10733.2	Water Budget Information	a. Water budget that provides an assessment of total annual volume of groundwater and surface water entering and leaving the Subbasin (including historic, current, and projected) b. The water budget shall quantify the following through estimates or direct measurements: 1. Total surface water entering and leaving the Subbasin (by water source type) 2. Inflow to the groundwater system by water source type 3. Outflows from the groundwater system by water use sector 4. Change in annual volume of groundwater in storage 5. Quantification of overdraft over a period of years including water year and water supply conditions compared to average conditions 6. Water year type associated with annual supply, demand, and change in groundwater 7. Estimate of sustainable yield	a. Section 3.3 (p. 3-40) b1. Section 3.3.1 (p. 3-41) b2. Section 3.3.1 (p. 3-41) b3. Section (3.3.1 p. 3-41) b4. Section 3.3.2 (p. 3-49) b5. Section 3.3.3 (p. 3-50) b6. Section 3.3.4 (p. 3-51) b7. Section 3.3.4 (p. 3-51)
354.18.(c)	10733.2	Quantification of Water Budget	c. Each Plan shall quantify the current, historic, and projected water budget including: 1. Current water budget information including current inflows and outflows 2 Historical water budget must include the following:	1. Section 3.3.5 (p. 3-52) 2. Section 3.3.6 (p. 3-52) 3. Section 3.3.7 (p. 3-54)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			• Quantitative evaluation of availability/reliability of historical surface water supply (by water source type and water year type) *must be based on the most recent 10 years of data • Quantitative evaluation of historic water budget to project the future water budget information and future aquifer response to GSP implementation • Description of how historical conditions have impacted GSA ability to create sustainable yield 3. Projected water budget to estimate future baseline conditions for GSP implementation and identify uncertainties. This section should include the following: • Projected hydrology must include 50-year historical precipitation, evapotranspiration, and streamflow information as the baseline *climate change must also be incorporated • Projected water demand will utilize the most recent land use, evapotranspiration, and crop coefficient data. Projected changes in local land use planning, pop growth and climate must be included • Projected surface water supply will use most recent data and also consider historical surface water supply	
354.18 (d)	10733.2	Water Budget Data Source	d. The Agency shall utilize the following information provided by the DWR (or other comparable data) to develop the Water Budget 1 .Historical water budget information: use mean annual temperature, mean annual precipitation, water year type, and land use 2. Current water budget information for temperature, water year type, evapotranspiration, and land use	d. Section 3.3 (p. 3-40) 1. Section 3.3.6 (p. 3-52) 2. Section 3.3.5 (p. 3-52) 3. Section 3.3.7 (p. 3-54)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			3. Projected water budget information for population, population growth, climate change.	
354.18 (e, f)	10733.2	Water Budget	e. Must use a numerical groundwater and surface water model or the Plan must identify and describe an alternate method f. DWR will provide the Ca Central Valley Groundwater-Surface Water Simulation Model and the Integrated Water Flow Model for GSA use. (GSA can also select an alternate method but must be called out by type)	e. Appendix D f. Noted
354.20	10733.2	Management Areas	a. Define management areas and if they will have different measurable objectives (MOs) and minimum thresholds (MTs) b. Describe the following on Management areas: 1. Reason for creation of each management area 2. MO/MTs for each management area and why those values were selected if vary from Subbasin 3. Level of monitoring and analysis in each management area 4. Why MO/MTs can differ without causing undesirable results c. GSP must include descriptions and maps of management areas.	a. Section 3.4 (p. 58) b1. Section 3.4 (p. 58) b2. Section 3.4 (p. 58) b3. Section 3.4 (p. 58) b4. Section 3.4 (p. 58) c. Section 3.4 (p. 58)
Article 5. Plan Contents, Subarticle 3. Sustainable Management Criteria				
354.24	10733.2	Sustainability Goal	Description of the Sustainability Goal	Section 4.1.1 (p. 4-2)
354.26	10733.2, 10721, 10723.2, 10727.2, 10733.2, 10733.8	Undesirable Results	a-b. Description of Undesirable Results, including: 1. Cause of Groundwater Conditions that would lead to Undesirable Results 2. Criteria used to define Undesirable Results for each sustainability indicator	a-b. Section 4.2 (p. 4-4) 1. Causes of undesirable results are discussed in Section 4.2.1 (p. 4-4)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			3. Potential effects of Undesirable Results on beneficial uses and users of groundwater c. Evaluation of multiple MTs and monitoring sites to determine undesirable results	2. Criteria to define undesirable results are discussed in Section 4.2.2 (p. 4-10) 3. Potential effects of undesirable results are discussed in Section 4.2.2 (p. 4-10) c. Section 4.3 (p. 4-11)
354.28 (a-b)	10723.2, 10727.2.(d).1, 10727.2.(d).2,	Minimum Thresholds	a-b. Description of each MT and how they were established for each sustainability indicator, including numeric values. 1. Information and criteria that establish and justify the MTs for each sustainability indicator 2. Relationship between MTs for each sustainability indicator 3. How MTs have been selected to avoid undesirable results for each sustainability indicator 4. How MTs may affect the interest of beneficial uses and users of groundwater 5. How state, federal, or local standards relate to the relevant sustainability indicator 6. How each MT will be quantitatively measured	a-b. Section 4.3 (p. 4-11) describes each MT 1. Section 4.3.1 (p. 4-12) 2. Section 4.3.1 (p. 4-12) 3. Section 4.4.1 (p. 4-12) 4. Section 4.3.1 (p. 4-12) 5. Section 4.3.1 (p. 4-12) 6. Section 4.3.2 (p. 4-16)
354.28 (c-d)	10733.2	Minimum Thresholds	c. Definition of MTs for each sustainability indicator: 1. Chronic lowering of groundwater levels a. Rate of groundwater elevation decline based on historical trends, water year type, and projected use b. Potential effects on other sustainability indicators 2. Reduction of groundwater storage	c. Section 4.3 (p. 4-11) 1. Section 4.3.1.1 (p. 4-12) a. Section 4.3.1.1 (p. 4-12) b. Section 4.3.1.1 (p. 4-12) 2. Section 4.3.1.2 (p. 4-14) 3. N/A

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			3. Seawater intrusion 4. Degraded water quality 5. Land subsidence a. Identification of land uses and property interests affected by land subsidence and explanation of how the GSAs have determined and considered those uses and interests b. Maps and graphs showing the extent and rate of land subsidence 6. Depletions of interconnected surface water a. The location, quantity, and timing of depletions of interconnected surface water b. Description of the groundwater and surface water model used to quantify surface water depletion (or an equally effective method) d. Representative MT for groundwater elevation to serve as the value for multiple sustainability indicators e. Undesirable results related to sustainability indicators that are not present in the basin are not required to establish MTs	4. Section 4.3.1.4 (p. 4-15) 5. Section 4.2.1.3 (p. 4-7) a. Section 4.2.1.3 (p. 4-7) b. Figures 3-34, 3-34a, and 3-34b 6. N/A a. N/A b. N/A d. Section 4.3 (p. 4-11) e. N/A

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
354.30	10727.2.(b).1, 10727.2.(b).2, 10727.2.(d).1 10727.2.(d).2, 10727.4, 10733.2	Measureable Objectives	a-b. Establishment of the measureable objectives for each sustainability indicator c. Description of how a reasonable margin of operational flexibility was established for each measureable objective d-e. Description of a reasonable path to achieve and maintain the sustainability goal, including a description of interim milestones f-g. Optional inclusion of additional MOs, interim milestones where appropriate	a-b. Section 4.4.1 (p. 4-19) c. Section 4.4.2 (p. 4-21) d-e. Section 4.4.3 (p. 4-22) f-g. N/A
Article 5. Plan Contents, Subarticle 4. Monitoring Network				
354.34.(a-b)	10727.2.(d).1, 10727.2.(d).2, 10727.2.(e), 10727.2.(f)	Monitoring Network	a-b. Description of Monitoring Network objectives and how the network will be developed and implemented with sufficient spatial and temporal frequency to: 1. Demonstrate progress towards achieving MOs 2. Monitor impacts to beneficial uses or users of groundwater 3. Monitor changes in groundwater conditions relative to MOs and MTs 4. Quantify annual changes in water budget components	a-b. Section 5.1.1. (p. 5-5) 1. Sections 5.1.5 through 5.1.8 (p. 5-8 through 5-12)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
354.34.(c)	10727.2.(d).1, 10727.2.(d).2, 10727.2.(e), 10727.2.(f)	Monitoring Network	c. Description of how the monitoring network provides adequate coverage of sustainability indicators: 1. Chronic lowering of groundwater levels a. Sufficient density of monitoring wells b. Static groundwater elevation measurements collected two times per year 2. Reduction of groundwater storage 3. Seawater intrusion 4. Degraded water quality 5. Land subsidence 6. Depletions of interconnected surface water d. Adequate coverage of sustainability indicators to evaluate conditions in the basin e. Site information and monitoring data from existing sources	c. Section 5.1 (p. 5-2) 1. a. Section 5.1.5 (p. 5-8) b. Section 5.1.5 (p. 5-8) 2. Section 5.1.6 (p. 5-11) 3. N/A 4. Section 5.1.7 (p. 5-11) 5. Section 5.1.8 (p.5-11) 6. N/A d. Section 5.1.3 (p. 5-7) e. Section 5.1.3 (p. 5-7)
354.34.(e-i)		Monitoring Network	f. Density of monitoring sites and frequency of measurements required to demonstrate short-term, seasonal, and long-term trends determined by: 1. Amount of current and projected water use 2. Aquifer characteristics that affect groundwater flow 3. Impacts to beneficial uses and users 4. Whether the Agency has long-term existing monitoring results to demonstrate aquifer response g. Scientific rational (or reason) for site selection	f. Section 5.1 (p. 5-3) 1. Section 3.3.5 (p. 3-51); Section 3.3.7 (p. 3-54) 2. Section 3.1 (p. 3-2) 3. Section 3.1.11 (p. 3-27) 4. Section 5.1.3 (p. 5-7) g. 1. Section 5.2 (p. 5-13) 2. Section 5.2 (p. 5-13)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
			1. Consistency with data and reporting standards 2. Corresponding sustainability indicator, MTs, MOs, and interim milestone h. Location and type of each monitoring site within the basin displayed on a map, and reported in tabular format, including information regarding the monitoring site type, frequency of measurement, and the purposes for which the monitoring site is being used i. Description of technical standards, data collection methods, and other procedures or protocols to ensure comparable data and methodologies	h. Figures 5-1 through 5-5; Tables 5-1 through 5-6 i. Section 5.2 (p. 5-13)
354.36		Representative Monitoring	a. Description of representative sites with defined quantitative MTs, MOs, and interim milestones b. Demonstration of adequacy of using groundwater elevations as proxy for other sustainability indicators c. Adequate evidence demonstrating representative monitoring sites reflects general conditions in the area	a. Section 5.3 (p. 5-15) b. N/A c. Section 5.4 (p. 5-16)
354.38		Assessment and Improvement of Monitoring Network	a. Review and evaluation of the monitoring network b-c. Identification and description of data gaps 1. Location and reason for data gaps 2. Local issues and circumstances that limit or prevent monitoring d. Description of steps to fill data gaps before the next 5-year assessment e. Adjustment of monitoring frequency and site density to provide site-specific surface water and groundwater conditions	a. Section 5.4 (p. 5-16) b-c. Section 5.4.1.2 (p. 5-18) 1. Section 5.4.1.2 (p. 5-18) 2. Section 5.4.1.2 (p. 5-18) d. Section 5.4.1.3 (p. 5-20) e. Section 5.4.1.3 (p. 5-20)

GSP Regulation Section	Water Code Section	Requirement	Description	Section(s) and Page Number(s) in the GSP
354.40	10733.2	Reporting Monitoring Data to the Department	Monitoring data stored in the data management system developed pursuant to Section 352.6 and included in the Annual Report	Noted
Article 5. Plan Contents, Subarticle 5. Projects and Management Actions				
354.44 (a-b)		Projects and Management Actions	a-b. Description of projects and management actions, including the following: 1. List of projects and management actions with a description of the MO that it addresses a. The circumstances and criteria to trigger project implementation and the process by which the GSAs will determine the conditions requiring implementation b. How the GSAs will notice the public and other agencies that projects will be implemented	a-b. Sections 6.3 (p. 6-5) and 6.4 (p. 6-18) 1. Sections 6.3 (p. 6-5) and 6.4 (p. 6-18) a. Section 7.2 (p. 7-2) b. Appendix B
354.44 (c-d)			c. Projects and management actions shall be supported by the best available science d. Level of uncertainty associated with the basin should be taken into account when developing projects or management actions	c-d. Occurs throughout Chapter 6.

APPENDIX F

INTERIM OPERATING AGREEMENT

[illegible]

[illegible]

THIS INTERIM OPERATING AGREEMENT FOR THE TULARE LAKE SUBBASIN TO DEVELOP AND IMPLEMENT A GROUNDWATER SUSTAINABILITY PLAN ("this Agreement") is effective September 1, 201[illegible], among the MID-KINGS RIVER GROUNDWATER SUSTAINABILITY AGENCY, SOUTH FORK KINGS GROUNDWATER SUSTAINABILITY AGENCY, EL RICO GROUNDWATER SUSTAINABILITY AGENCY, SOUTHWEST KINGS GROUNDWATER SUSTAINABILITY AGENCY, TRI-COUNTY WATER AUTHORITY, and ALPAUGH IRRIGATION DISTRICT. The signatories to this Agreement are hereinafter referred to collectively as the "Parties" or individually as "Party".

RECITALS

WHEREAS, the Parties are all located within the Tulare Lake Hydrologic Region, San Joaquin Valley Groundwater Basin, Tulare Lake Subbasin, a groundwater subbasin recognized by the California Department of Water Resources ("DWR") Bulletin 118 (2016) as Groundwater Basin No. [illegible]-22.12 (hereinafter "Subbasin") and a depiction of the Subbasin is attached hereto as Exhibit "A" and incorporated herein by this reference; and

WHEREAS, the State of California has classified the entire Subbasin as an Economically Distressed Area and each community within the Subbasin as a Disadvantaged Community; and

WHEREAS, all lands within the Subbasin are included within one of the six groundwater sustainability agencies ("GSAs") that are the Parties to this Agreement, and each Party has been or are in the process of being determined an "exclusive" GSA by DWR; and

WHEREAS, the Sustainable Groundwater Management Act ("SGMA") requires the development and establishment of groundwater sustainability plans ("GSPs") which are designed to ensure the sustainability of groundwater basins and subbasins; and

WHEREAS, DWR has identified the Subbasin as a critically overdrafted subbasin; and

WHEREAS, SGMA allows local agencies or a combination of local agencies overlying a groundwater basin to serve as a GSA to develop and implement a GSP over an entire basin, subbasin, or a portion of a basin; and

WHEREAS, pursuant to Water Code §10727, SGMA allows for the preparation of a GSP by three methods: (a) a single GSP covering the entire basin/subbasin developed and implemented by one GSA; (b) a single GSP covering the entire basin/subbasin developed and implemented by multiple GSAs; or (c) multiple GSPs implemented by two or more GSAs that are subject to a single Coordination Agreement that covers the entire basin/subbasin; and

WHEREAS, Water Code §10727.6 requires that if multiple GSPs will be implemented within a subbasin, then a Coordination Agreement must be prepared to ensure that the GSPs utilize the same data and methodologies within that subbasin for the following items: (a) groundwater elevation data; (b) groundwater extraction data; (c) surface water supply; (d) total water use; (e) change in groundwater storage; (f) water budget; and (g) sustainable yield; and

WHEREAS, the Parties acknowledge that multiple GSAs have been formed within the Subbasin and those GSAs currently seek to explore the possibility of developing and implementing a single GSP. The Parties also acknowledge the desire to have a single GSP may not be achievable, but regardless of whether one or more GSPs are developed for the Subbasin, an interim agreement is beneficial to the Parties in proceeding to initially develop and coordinate the data and methodologies required by SGMA for the Subbasin; and

WHEREAS, the Parties acknowledge that the GSAs need to do further data collection prior to making decisions with regard to GSP preparation and implementation, but the Parties agree that in the future a Coordination Agreement (or an amendment to or replacement of this Agreement) will be necessary based on the additional information obtained and decisions made by the Parties under this Agreement; and

WHEREAS, the purpose of this Agreement is to provide a framework among the Parties for a cooperative means of gathering the initial data and information for a single GSP, applying for grant funding, selecting consultants, and coordinating on other SGMA-related issues for the Subbasin.

NOW, THEREFORE, in consideration of the mutual promises, covenants, and conditions hereinafter set forth and the above Recitals, which are hereby incorporated herein by this reference, it is agreed by and among the Parties hereto as follows.

ARTICLE 1. DEFINITIONS

1.1 "Tulare Lake Subbasin" or "Subbasin" refers to that subbasin identified and described in California Department of Water Resources Groundwater Bulletin 118 as part of the Tulare Lake Hydrologic Region, San Joaquin Valley Groundwater Basin, Tulare Lake Subbasin (also identified as Groundwater Basin No. 5-22.12) and is depicted in Exhibit A to this Agreement.

1.2 "Groundwater Sustainability Agency" or "GSA" means one or more local agencies that implement the provisions of SGMA as defined by Water Code §10721(j).

1.3. "Groundwater Sustainability Plan" or "GSP" means a plan of one or more GSAs proposed or adopted under SGMA as defined in Water Code §10721(k).

1.4 "Coordination Agreement" shall be the agreement whether one or more GSPs are developed within the Subbasin to ensure coordination of the data and methodologies used by each GSA in developing the GSP(s) within the Subbasin for the following assumptions: (a) groundwater elevation data; (b) groundwater extraction data; (c) surface water supply; (d) total water use; (e) change in groundwater storage; (f) water budget; and (g) sustainable yield (Water Code §10721(d); §10727.6).

[illegible]

2.1 The Parties are entering into this Agreement to perform the following:

(a) Set forth their mutual intent to work towards the development of a single GSP for the Subbasin.

(b) Authorize research and collection of the data required for the GSP according to a mutually agreeable timeline.

(c) The Parties agree to utilize their best efforts in selecting and fully cooperating with the consultants gathering the information, preparing grant applications, and preparing the GSP.

(d) The Parties agree that after they gather data and determine an appropriate governance structure, they will either (1) amend or replace this Agreement to reflect specifics required to finalize a GSP or (2) if a single GSP is not to occur, prepare and enter into a Coordination Agreement setting forth appropriate assumptions based on information gathered and developed as a result of this Agreement.

[illegible]

3.1 The Parties agree that if grant funds are available for grant applications, efforts necessary to develop a GSP(s), facilitation and/or consultant costs, and similar efforts to develop a GSP(s) for the Subbasin, then the Parties have the authority to and shall act jointly in applying for and seeking to obtain such grant funds. Any grant funds received on behalf of the Subbasin and/or all of the Parties, shall first be applied to eligible costs incurred after July 1, 2017. Should any funds then remain, the Parties may develop a method for reimbursing relevant costs incurred by the Parties prior to the effective date of this Agreement.

3.2 The Parties agree to the following formula identified in the table below for sharing costs to develop and implement the actions taken within the confines of this Agreement. As shown below, after combining the El Rico GSA and Alpaugh Irrigation District, one-half the costs shall be allocated one-fifth to each of the participants and one-half of the costs shall be allocated in proportion to the relative acreage of each Party. The overall proportionate cost of each Party is shown as the Total Cost Allocation in the table below.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Mid-Kings River GSA	97,384.6	0.09084	0.1	0.19084
South Fork Kings GSA	71,310.9	0.06652	0.1	0.16652
El Rico GSA/Alpaugh ID	228,653.4	0.21328	0.1	0.31328
Southwest Kings GSA	90,037.1	0.08398	0.1	0.18398
Tri-County WA	48,656.5	0.04538	0.1	0.14538
Totals	536,042.5	0.50000	0.5	1.00000

3.3 All decisions related to implementing or amending this Agreement shall require a unanimous vote of the authorized representatives of each of the five (5) entities[1] identified in the table shown in Section 3.2 of this Agreement. A quorum is represented by any four (4) authorized representatives of these five (5) entities. Decisions may include, but are not limited to hiring experts or consultants to prepare and draft documents associated with this Agreement that would exceed $100,000, developing the Coordination Agreement (if necessary), applying for grant funding, and/or developing all or portions of a GSP(s).

[illegible]

4.1. Term. This Agreement shall become effective on the date first above written and shall remain in effect until superseded by amendment to this Agreement or another agreement among the Parties which shall address more specifics that are not available at this time for the final development and implementation of the GSP(s).

4.2 Withdrawal. Any Party shall have the right to withdraw from this Agreement by giving each of the other Parties written notice at least 30 days prior to its date of withdrawal ("Withdrawal Date"). The withdrawing Party shall be responsible for its share of any costs incurred under this Agreement up to its Withdrawal Date. Except as set forth in the preceding sentence, and except for the withdrawing Party's obligations under Section [illegible] hereof relating to confidential information, effective as of the Withdrawal Date, the withdrawing Party shall be

[1] For purposes of cost sharing and voting, the El Rico GSA and Alpaugh ID are to be considered as one entity. It shall be up to those two GSAs to determine their internal cost-sharing and voting process.

relieved and released of all obligations under this Agreement.

□.3 Construction of Terms. This Agreement is for the sole benefit of the Parties and shall not be construed as granting rights to or imposing obligations on any person other than the Parties.

□.□ Good Faith. Each Party shall use its best efforts and work in good faith for the completion of the purposes and goals of this Agreement and the satisfactory performance of its terms.

□.□ Rights of the Parties and Constituencies. This Agreement does not contemplate the Parties taking any action that would (a) adversely affect the rights of any of the Parties or (b) adversely affect the constituencies of any of the Parties.

□.6 Counterparts. This Agreement may be executed in counterparts and the signed counterparts shall constitute a single instrument. The signatories to this Agreement represent that they have the authority to sign this Agreement and to bind the Party for whom they are signing.

□.□ Governing Law. This Agreement and all documents provided for herein and the rights and obligations of the Parties hereto shall be governed in all respects, including validity, interpretation and effect, by the laws of the State of California (without giving effect to any choice of law principles).

□.8 Waiver. The failure of any Party to insist on strict compliance with any provision of this Agreement shall not be considered a waiver of any right to do so, whether for that breach or any subsequent breach. The acceptance by any Party of either performance or payment shall not be considered to be a waiver of any preceding breach of the Agreement by any other Party.

□.9 Recitals and Exhibits. The Recitals and Exhibits are incorporated into the Agreement.

□

□

[illegible]D[illegible]R[illegible]

□.1 Confidential Information. The confidential information to be disclosed under this Agreement ("Confidential Information") includes data, information, modeling, projections, estimates, plans that are not public information and in which each Party has a reasonable expectation of confidentiality, regardless of whether such information is designated as Confidential Information at the time of its disclosure.

□.2 Duty to Protect. In addition to the above, Confidential Information shall also include, and the Parties shall have a duty to protect other confidential and/or sensitive information which is (a) disclosed in writing and marked as confidential (or with other similar designation) at the time of disclosure, and/or (b) disclosed in any other manner and identified as confidential at the time of disclosure or is summarized and designated as confidential in a written memorandum delivered within thirty (30) days of the disclosure.

□.3 Limited Use. The Parties shall use the Confidential Information only for the purposes set forth in this Agreement.

□.□ Limited Disclosure. The Parties shall limit disclosure of Confidential Information within its own organization to its directors, officers, partners, members and/or employees having a need to know and shall not disclose Confidential Information to any third party (whether an individual, corporation, or other entity) without prior written consent of all the Parties. The Parties shall satisfy their obligations under this paragraph if they take affirmative measures to ensure compliance with these confidentiality obligations through their employees, agents, consultants and others who are permitted access to or use of the Confidential Information.

□.□ Allowable Disclosure. This Agreement imposes no obligation upon the Parties with respect to any Confidential Information (a) that was possessed before receipt; (b) is or becomes a matter of public knowledge through no fault of receiving Party; (c) is rightfully received from a third party not owing a duty of confidentiality; (d) is disclosed without a duty of confidentiality to a third party by or with the authorization of the disclosing Party; or (e) is independently developed.

IN WITNESS WHEREOF, the Parties hereto have executed this Agreement to be effective as of the date first above written.

(the remainder of this page has been intentionally left blank)

Mid-Kings River Groundwater Sustainability Agency

By: *Barry McCutcheon* Title: *Chairman*

Name: *Barry McCutcheon*

South Fork Kings Groundwater Sustainability Agency

By:____________________ Title:________________

Name: ____________________

El Rico Groundwater Sustainability Agency

By:____________________ Title:________________

Name: ____________________

Southwest Kings Groundwater Sustainability Agency

By:____________________ Title:________________

Name: ____________________

Tri-County Water Authority

By:____________________ Title:________________

Name: ____________________

Alpaugh Irrigation District

By:____________________ Title:________________

Name: ____________________

Mid-Kings River Groundwater Sustainability Agency

By:____________________________ Title:_________________

Name: ____________________________

South Fork Kings Groundwater Sustainability Agency

By: Joe Neves Title: Chairman

Name: Joe Neves

El Rico Groundwater Sustainability Agency

By:____________________________ Title:_________________

Name: ____________________________

Southwest Kings Groundwater Sustainability Agency

By:____________________________ Title:_________________

Name: ____________________________

Tri-County Water Authority

By:____________________________ Title:_________________

Name: ____________________________

Alpaugh Irrigation District

By:____________________________ Title: _________________

Name: ____________________________

Mid-Kings River Groundwater Sustainability Agency

By:______________________________ Title:______________

Name: ______________________________

South Fork Kings Groundwater Sustainability Agency

By:______________________________ Title:______________________

Name: ______________________________

El Rico Groundwater Sustainability Agency

By: [signature] Title: CHAIRMAN

Name: JEOF WYRICK

Southwest Kings Groundwater Sustainability Agency

By:______________________________ Title:______________

Name: ______________________________

Tri-County Water Authority

By:______________________________ Title:______________

Name: ______________________________

Alpaugh Irrigation District

By:______________________________ Title: ______________

Name: ______________________________

Mid Kings Groundwater Sustainability Agency

By:______________________ Title:______________

Name: ______________________

South Fork Kings Groundwater Sustainability Agency

By:______________________ Title:______________

Name: ______________________

El Rico Groundwater Sustainability Agency

By:______________________ Title:______________

Name: ______________________

Southwest Kings Groundwater Sustainability Agency

By: [signature] Title: President

Name: William D Phillimore

Tri-County Water Authority

By:______________________ Title:______________

Name: ______________________

Alpaugh Irrigation District

By:______________________ Title:______________

Name: ______________________

Mid Kings Groundwater Sustainability Agency

By:________________________ Title:________________

Name: ________________________

South Fork Kings Groundwater Sustainability Agency

By:________________________ Title:________________

Name: ________________________

El Rico Groundwater Sustainability Agency

By:________________________ Title:________________

Name: ________________________

Southwest Kings Groundwater Sustainability Agency

By:________________________ Title:________________

Name:________________________

Tri-County Water Authority

By:________________________ Title: Chairman

Name: MATTHEW H. HURLEY

Alpaugh Irrigation District

By:________________________ Title: ________________

Name: ________________________

Mid-Kings River Groundwater Sustainability Agency

By:________________________ Title:______________

Name: ________________________

South Fork Kings Groundwater Sustainability Agency

By:________________________ Title:______________

Name: ________________________

El Rico Groundwater Sustainability Agency

By:________________________ Title:______________

Name: ________________________

Southwest Kings Groundwater Sustainability Agency

By:________________________ Title:______________

Name: ________________________

Tri-County Water Authority

By:________________________ Title:______________

Name: ________________________

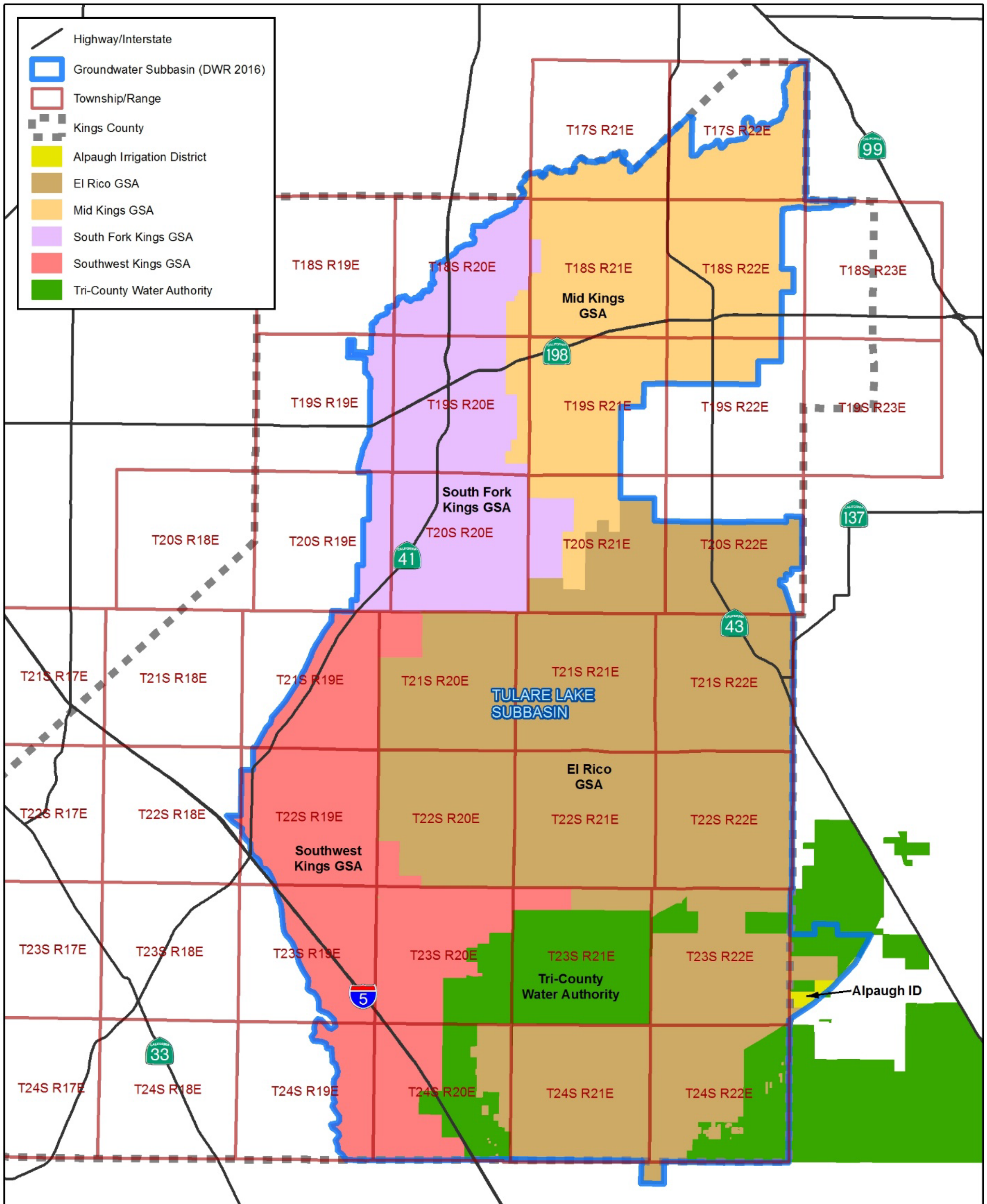
Alpaugh Irrigation District

By: [signature] Title: G.M.

Name: BRUCE HOWARTH

□□□□□□□□□ □□

Map o□Tulare Lake Subbasin as Described in DWR Bulle□in 118



EST. 1968
PROVOST& PRITCHARD
CONSULTING GROUP
An Employee Owned Company

N

0 2 4
Miles

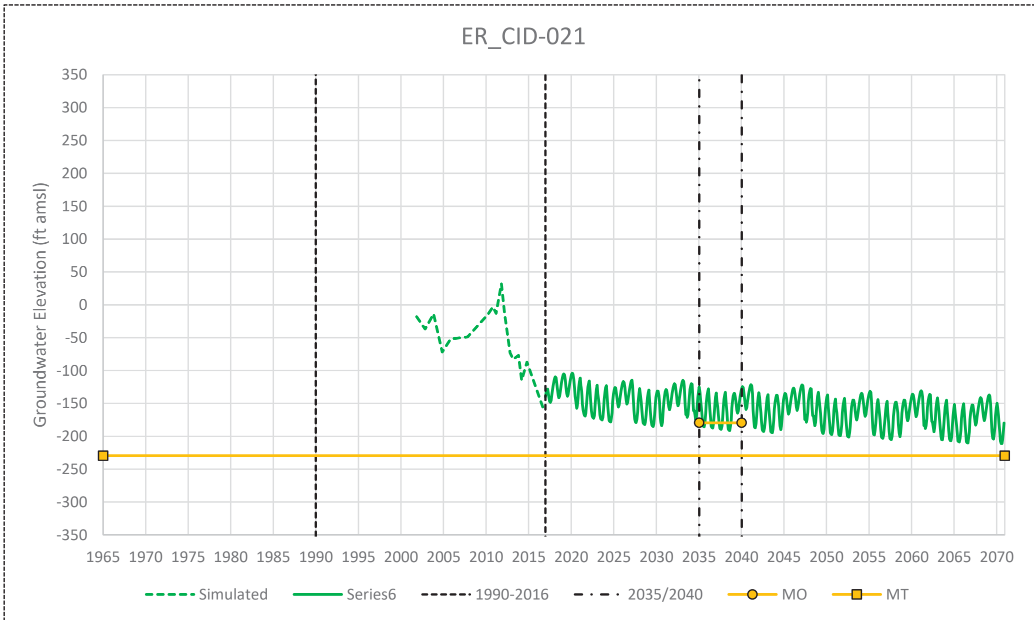
EXHIBIT A

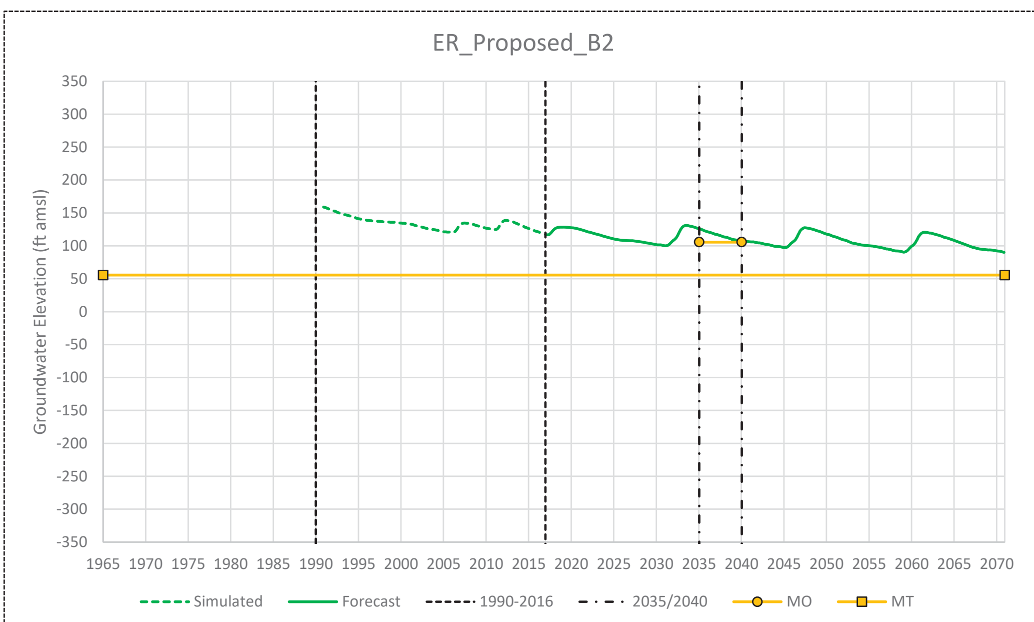
Map of Tulare Lake Subbasin as Described in DWR Bulletin 118

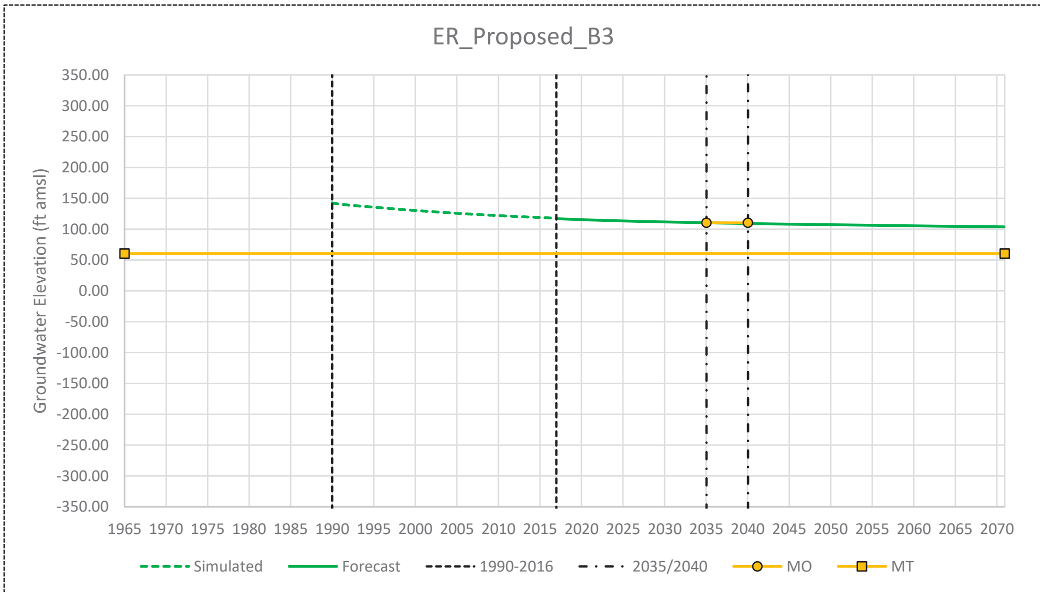
7/14/2017 : G:\Southwest Kings GSA-2612\GIS\Map\Subbasin\tularelake_sub_gsa.mxd

APPENDIX G

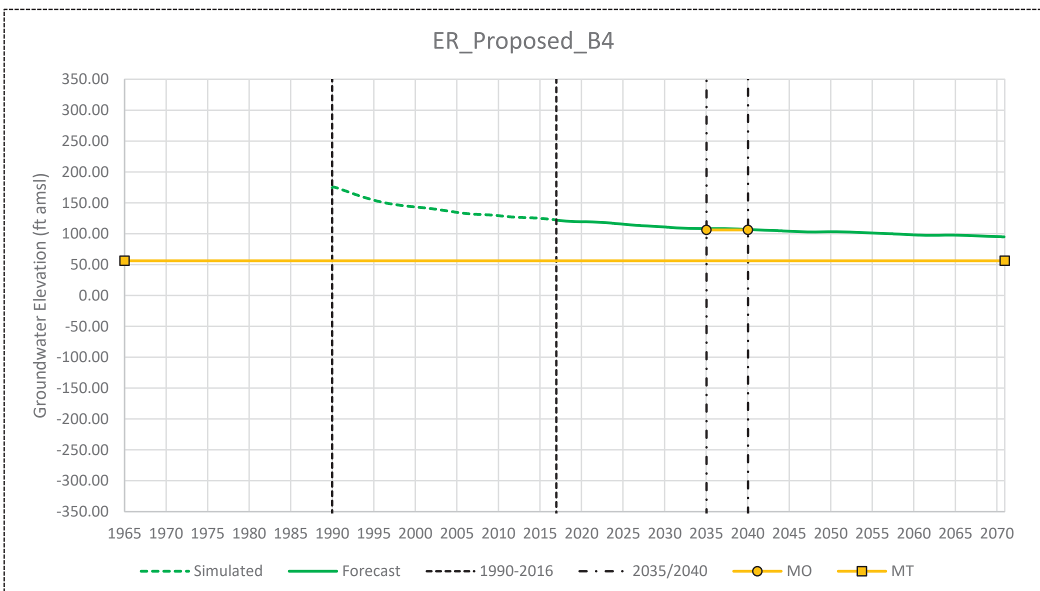
REPRESENTATIVE MONITORING SITES FORECAST HYDROGRAPHS


ER_CID-021
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Series6
1990-2016
2035/2040
MO
MT

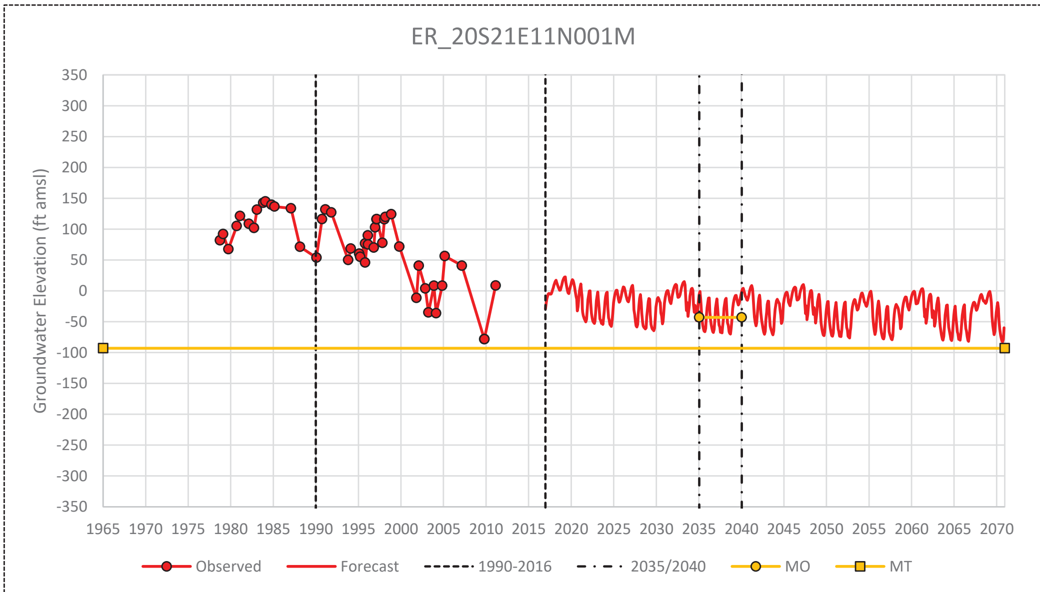

ER_Proposed_B2
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

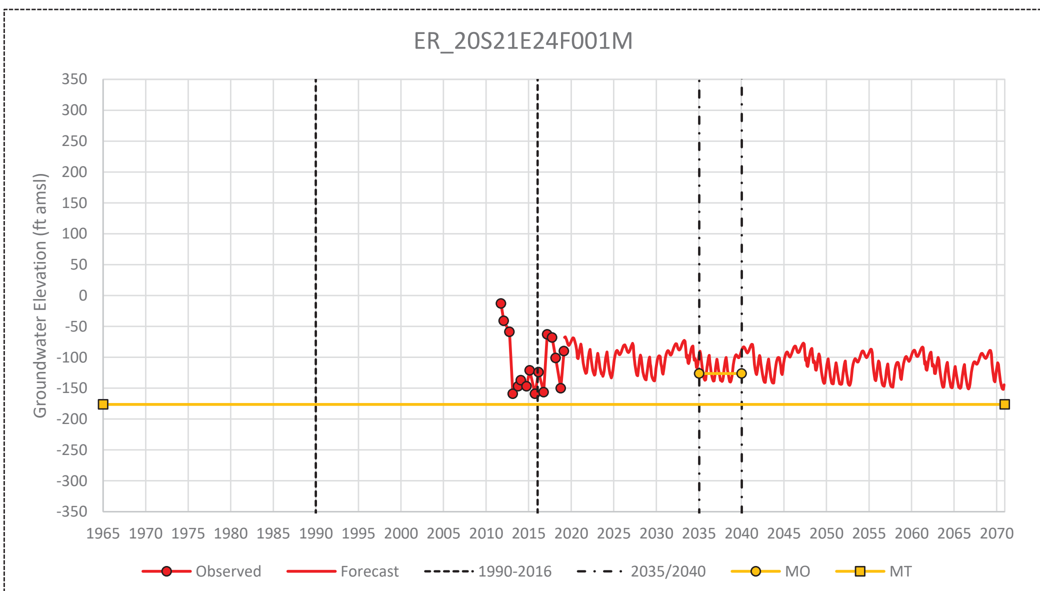


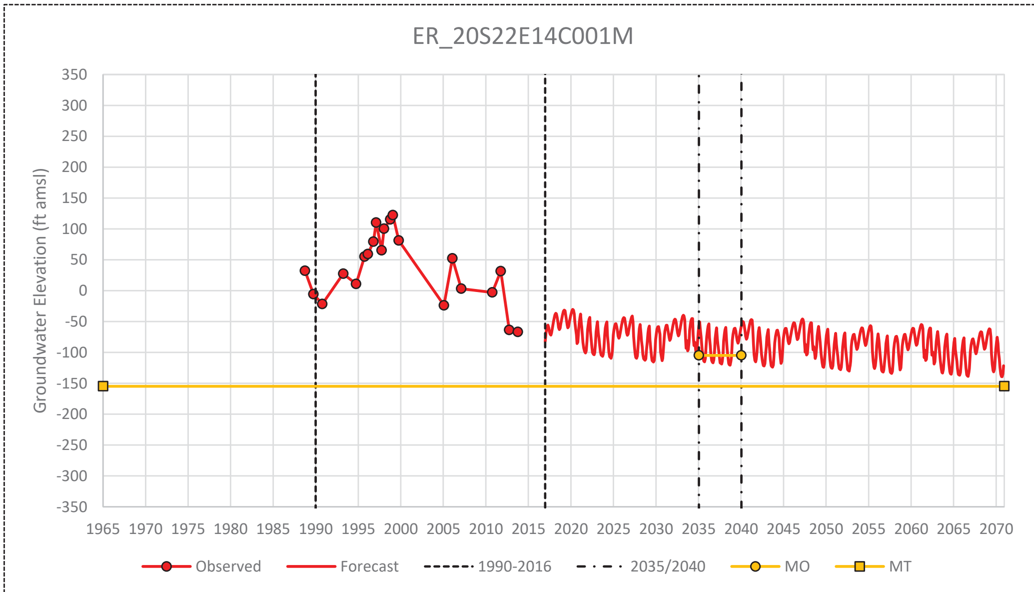
ER_Proposed_B3
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

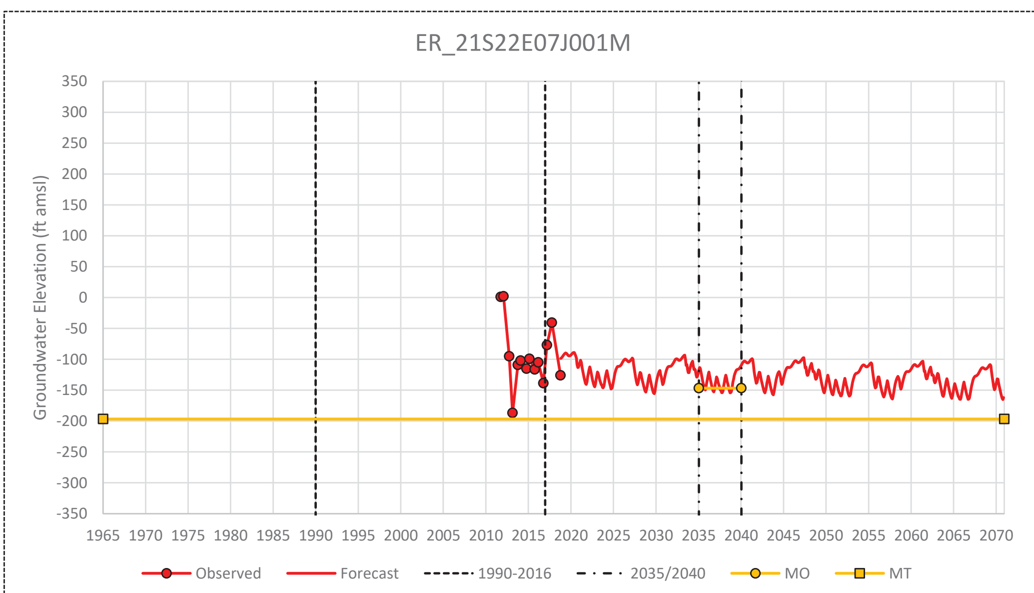


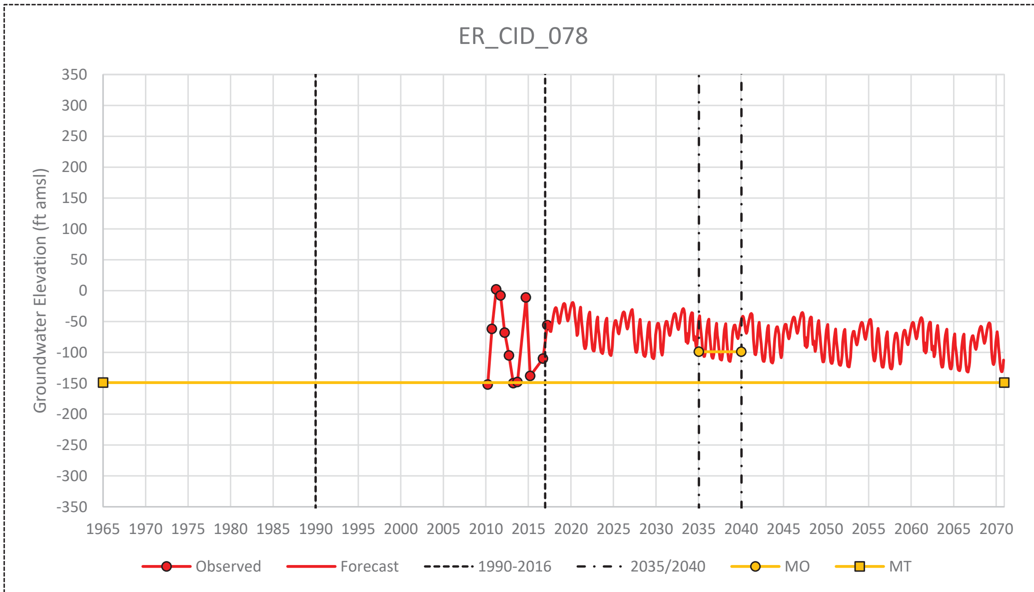
ER_Proposed_B4
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

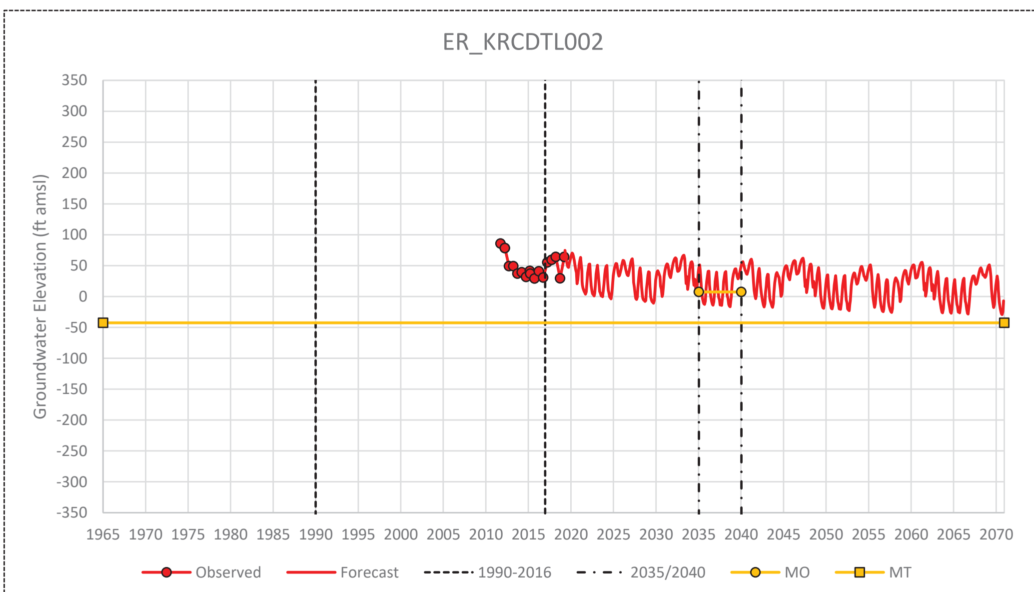

ER_20S21E11N001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

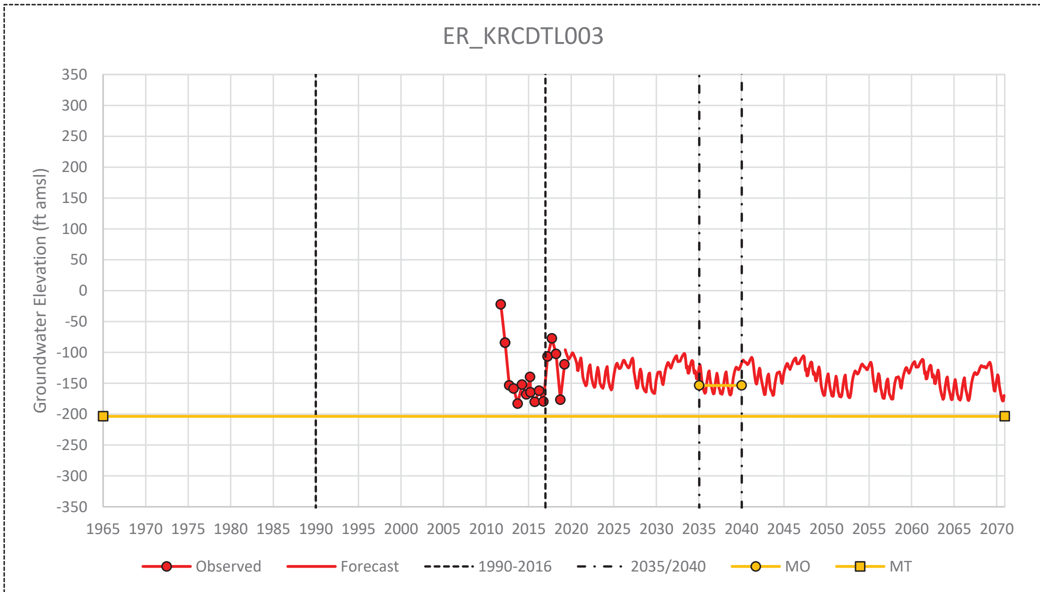

ER_20S21E24F001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


ER_20S22E14C001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

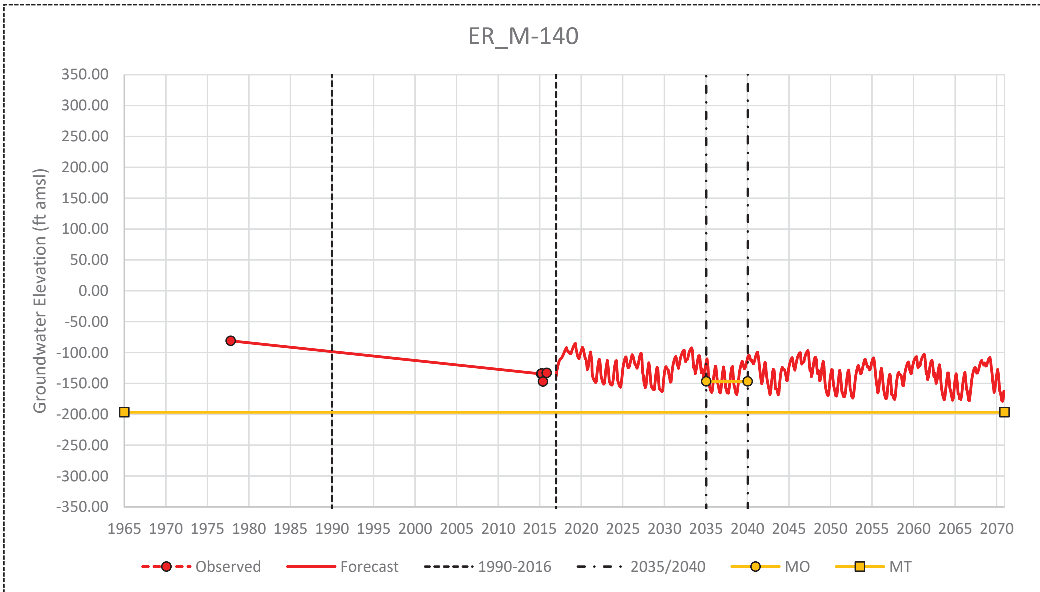

ER_21S22E07J001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


ER_CID_078
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

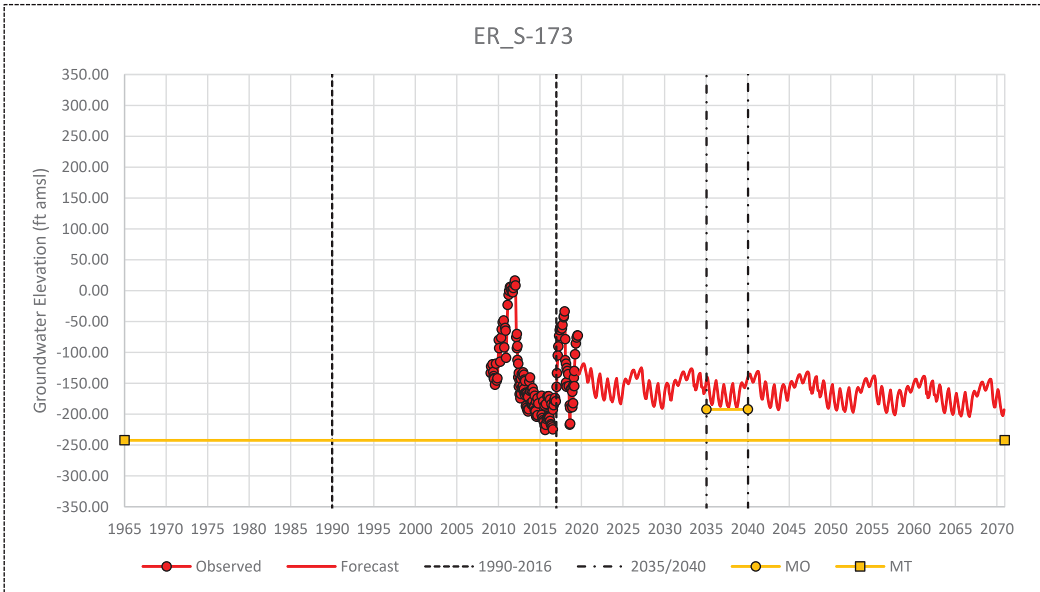

ER_KRCDTL002
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

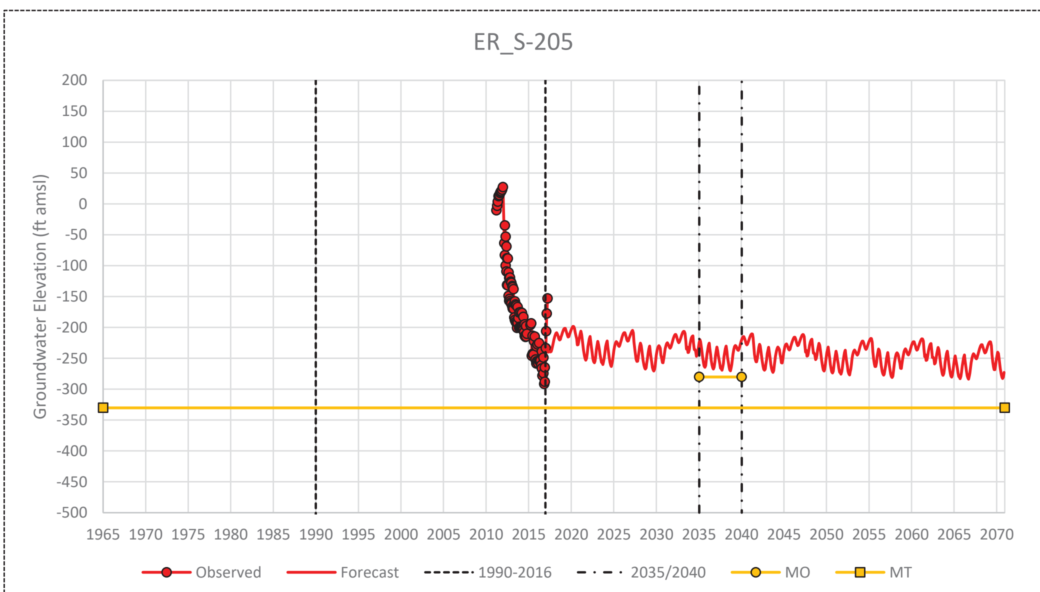


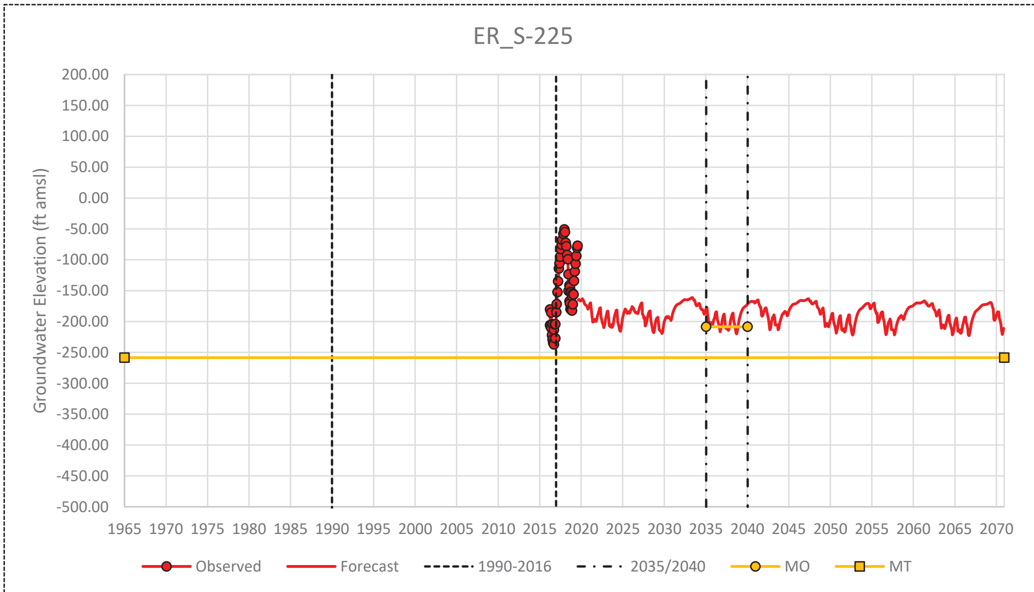
ER_KRCDTL003
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

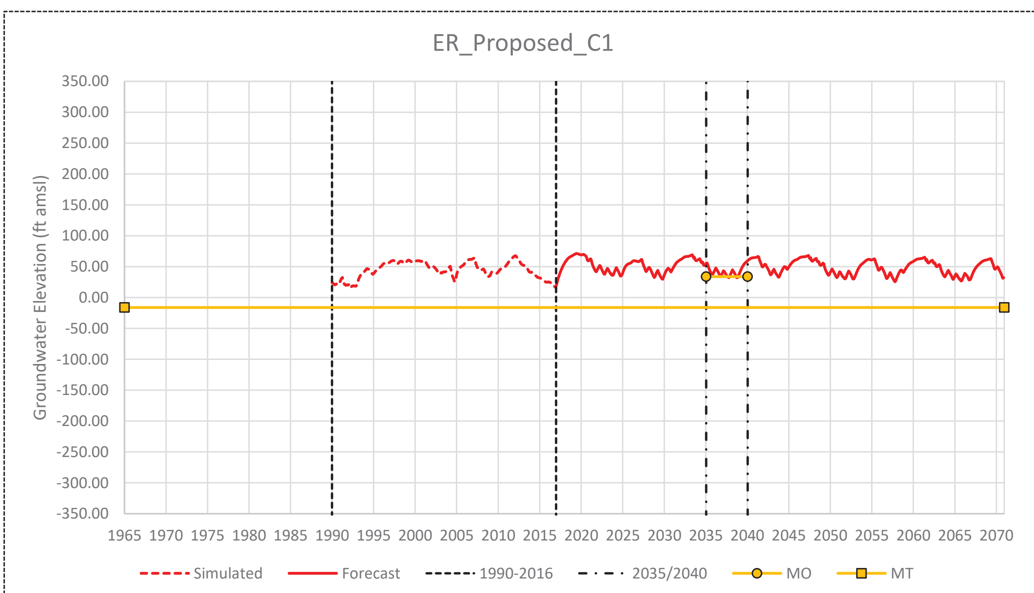


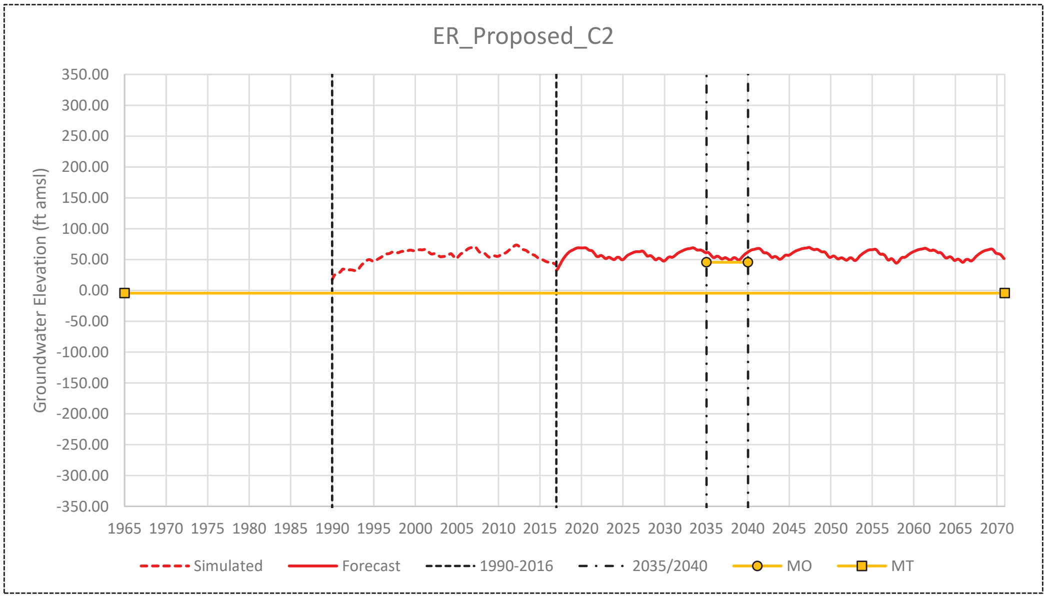
ER_M-140
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

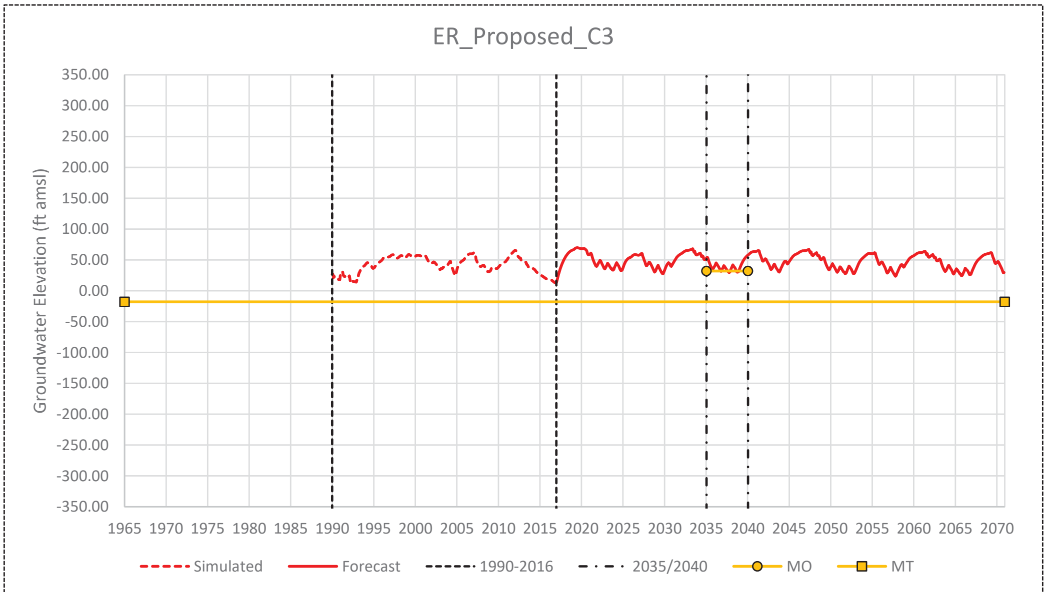

ER_S-173
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

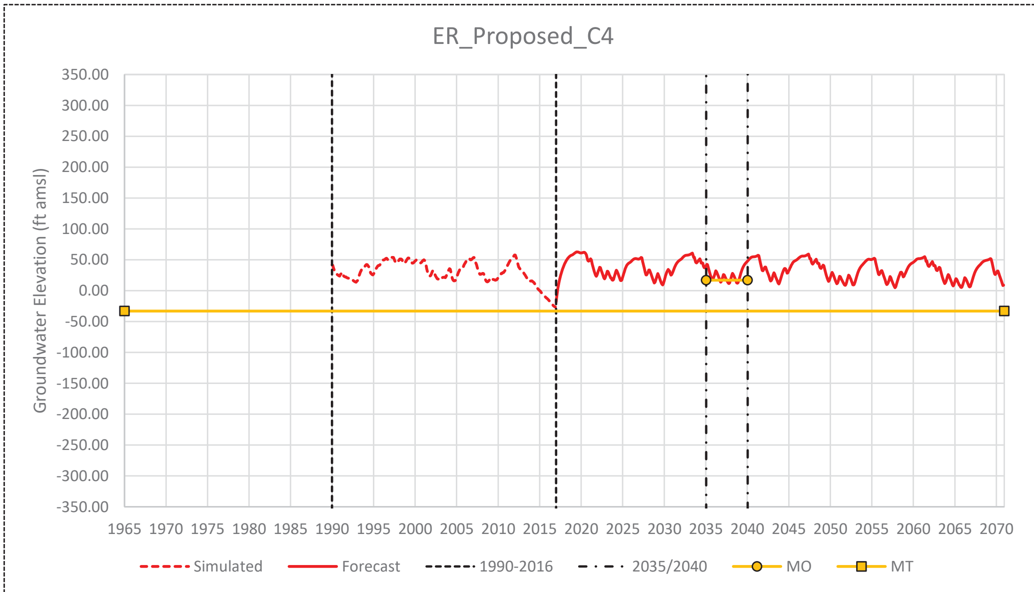

ER_S-205
Groundwater Elevation (ft amsl)
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

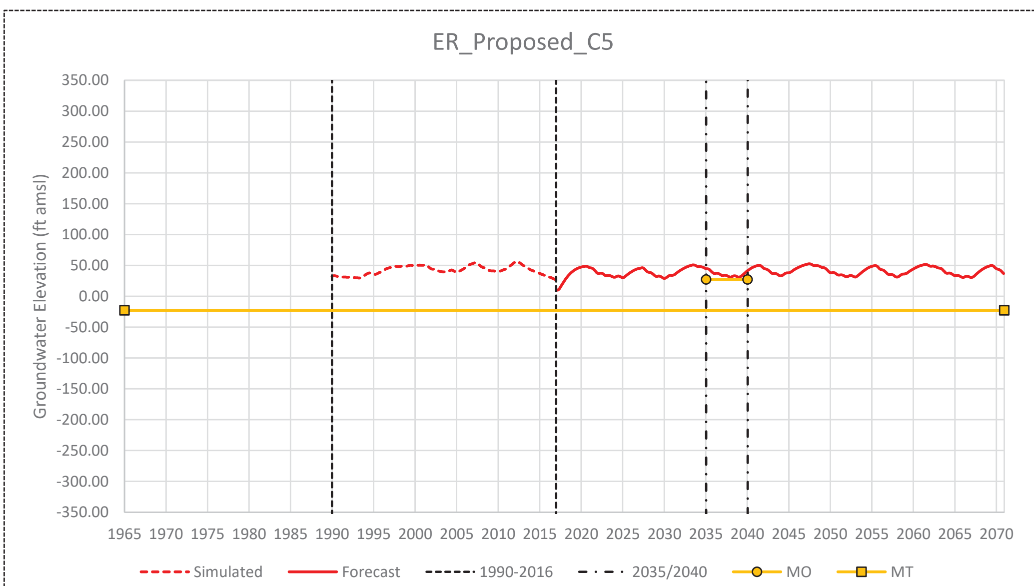

ER_S-225
Groundwater Elevation (ft amsl)
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
-400.00
-450.00
-500.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

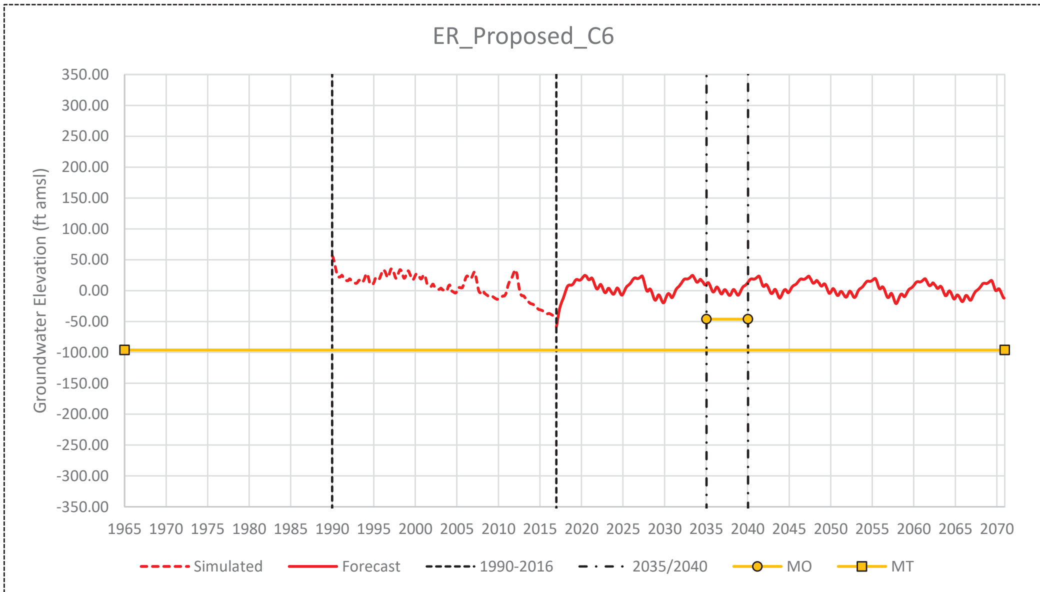

ER_Proposed_C1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

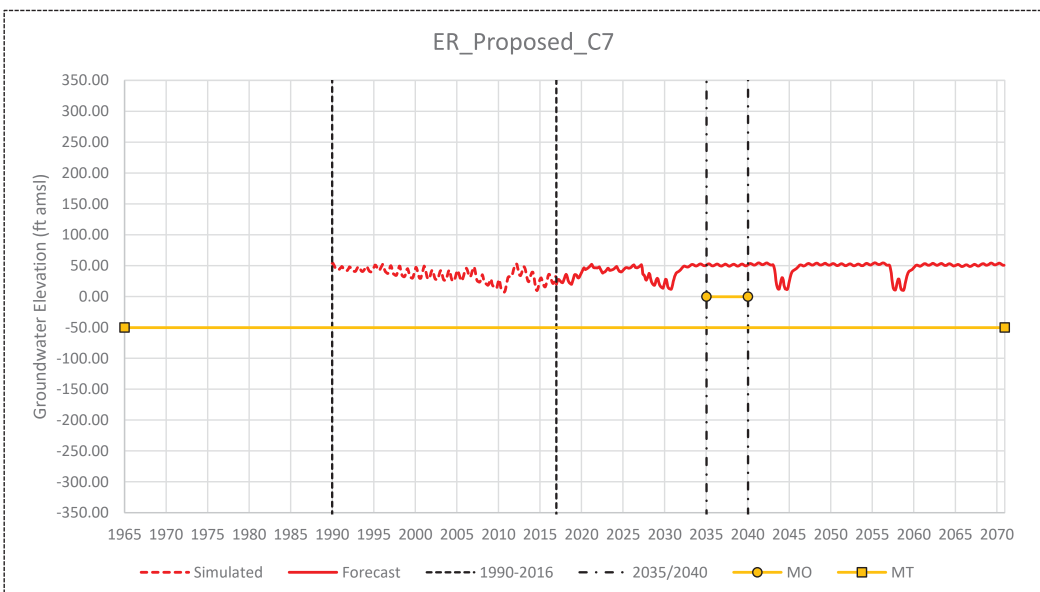

ER_Proposed_C2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

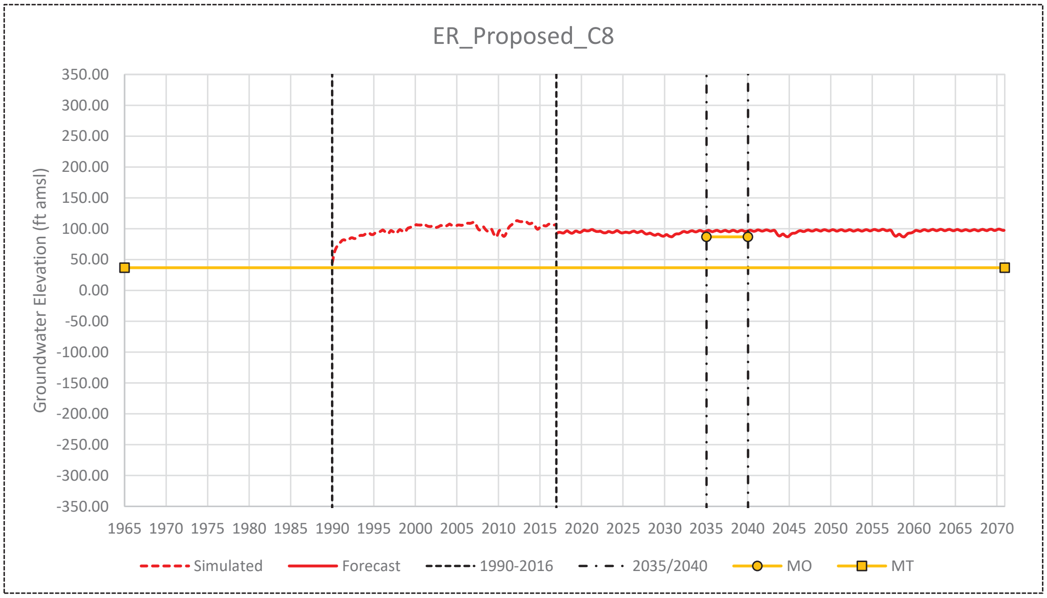

ER_Proposed_C3
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

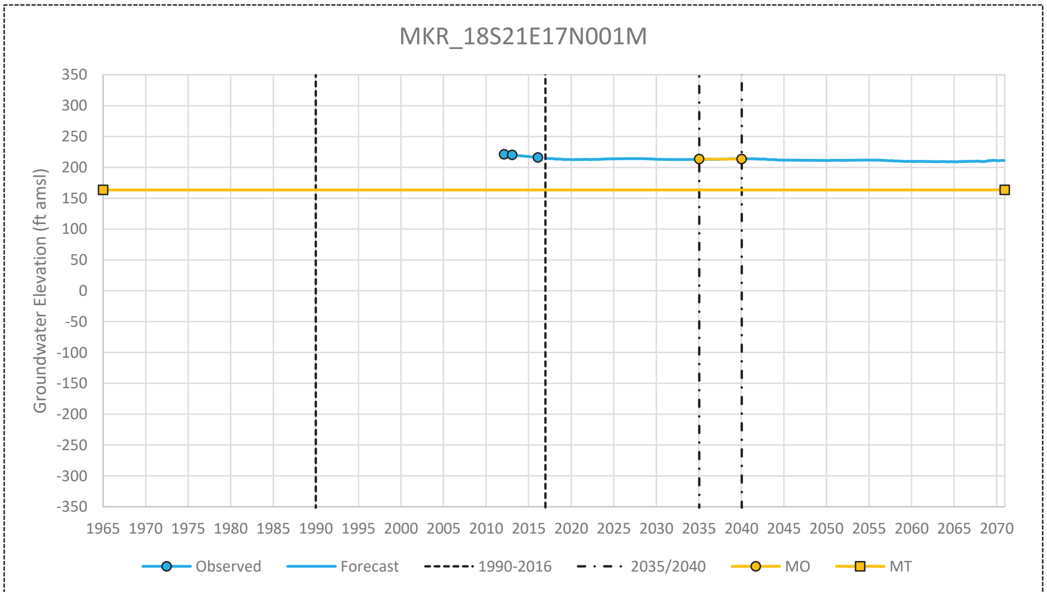

ER_Proposed_C4
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

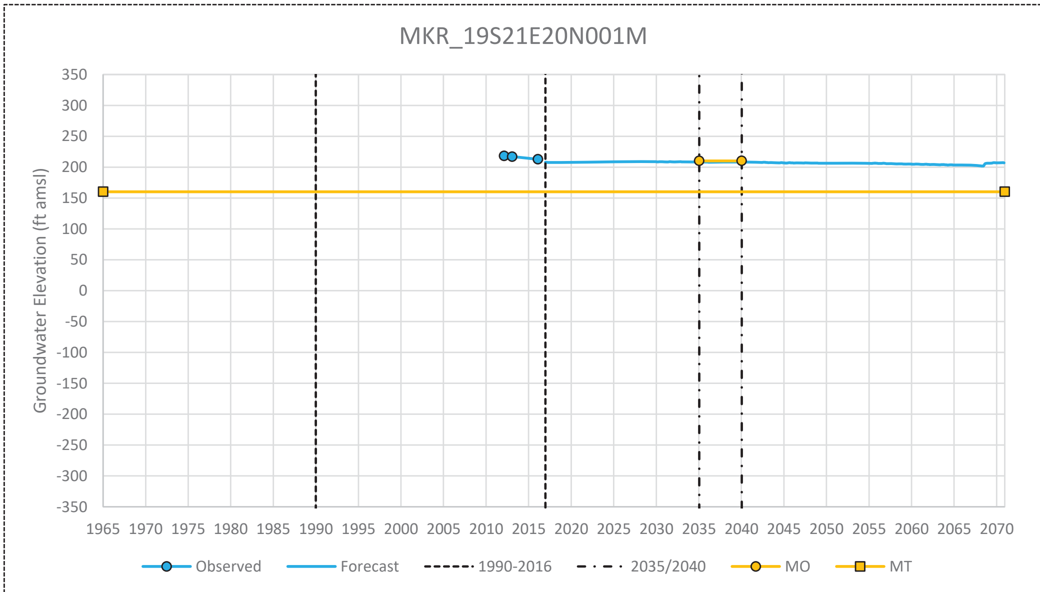

ER_Proposed_C5
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

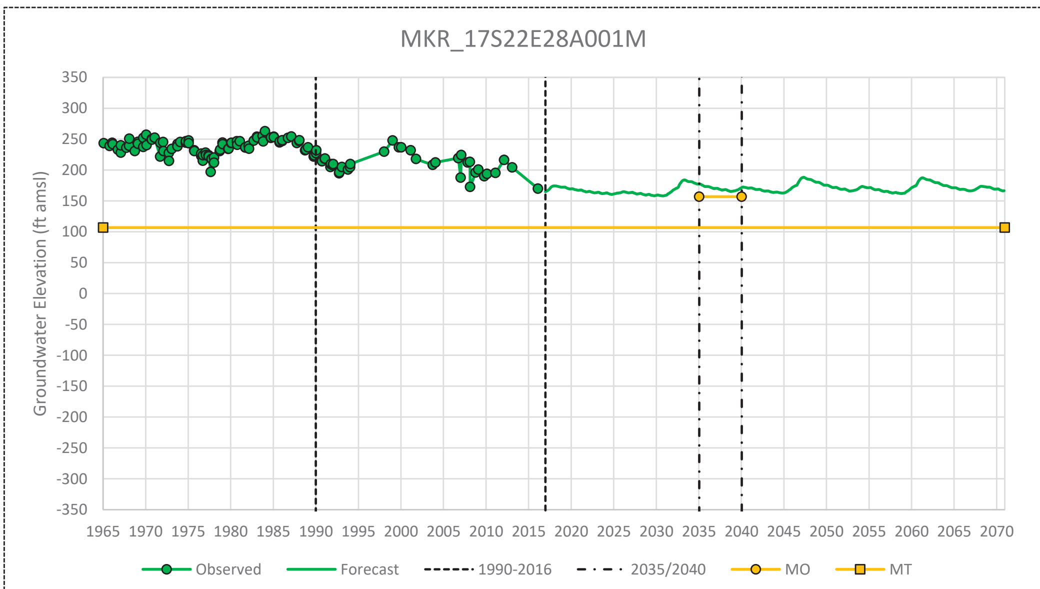

ER_Proposed_C6
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

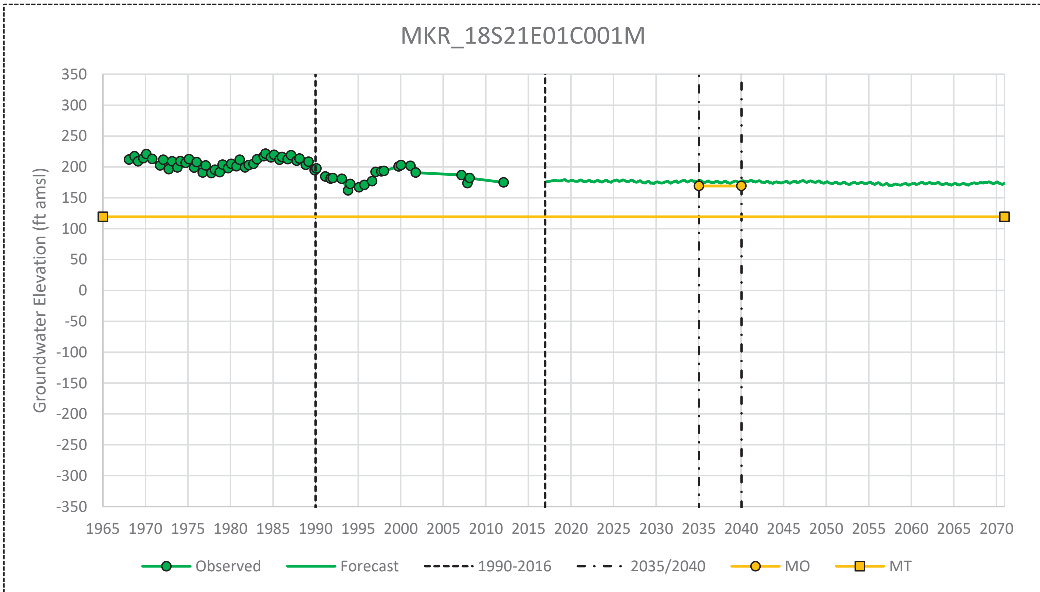

ER_Proposed_C7
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

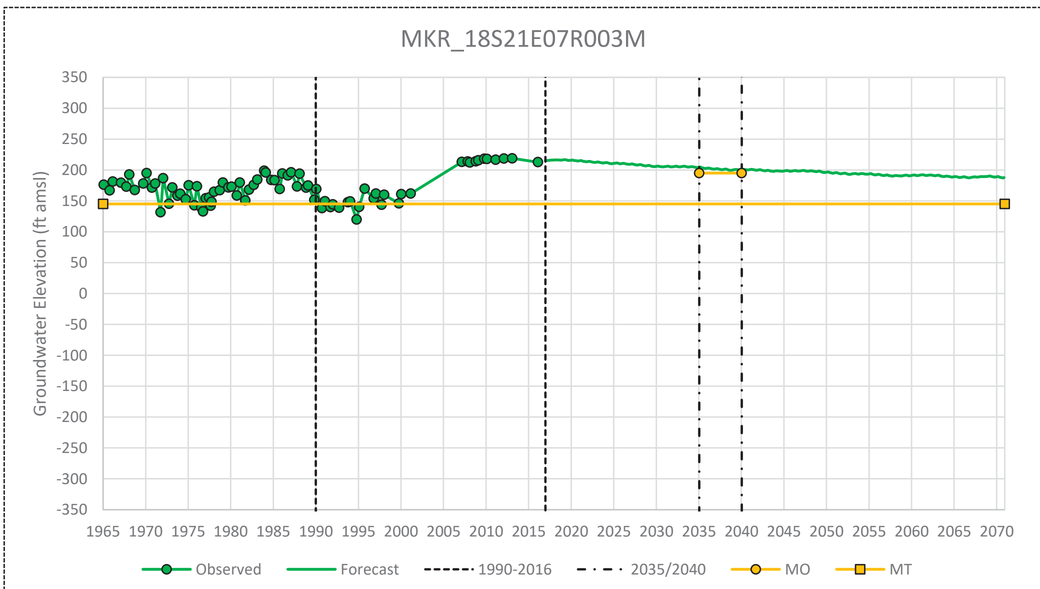

ER_Proposed_C8
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

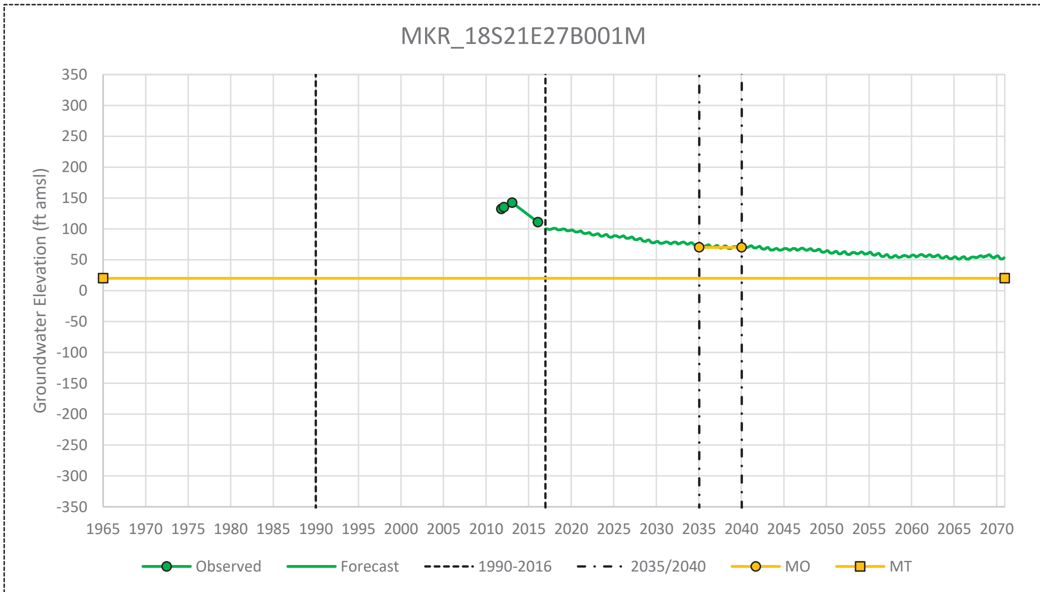

MKR_18S21E17N001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

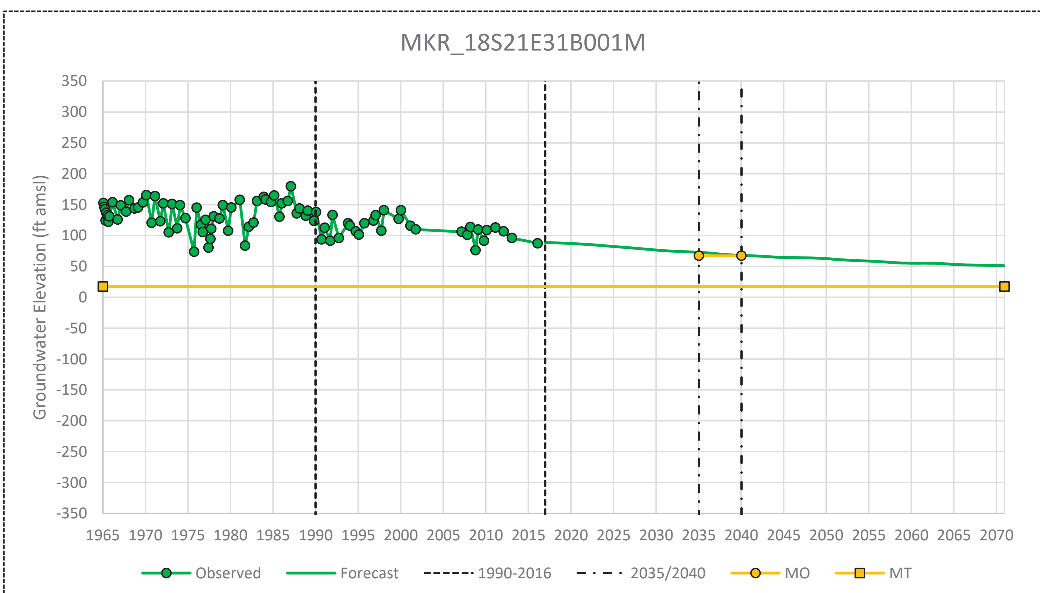

MKR_19S21E20N001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

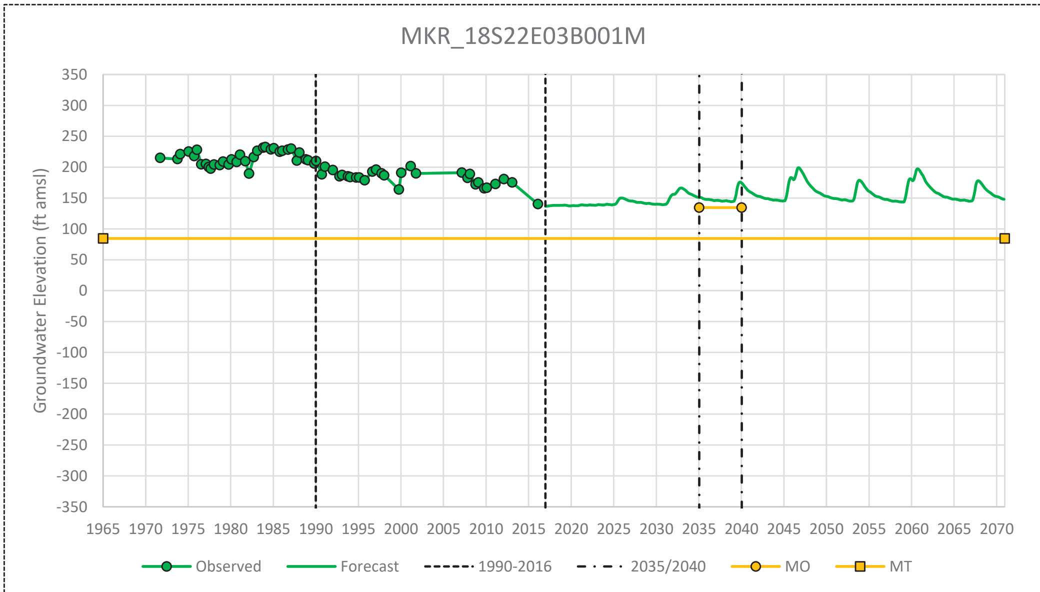

MKR_17S22E28A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

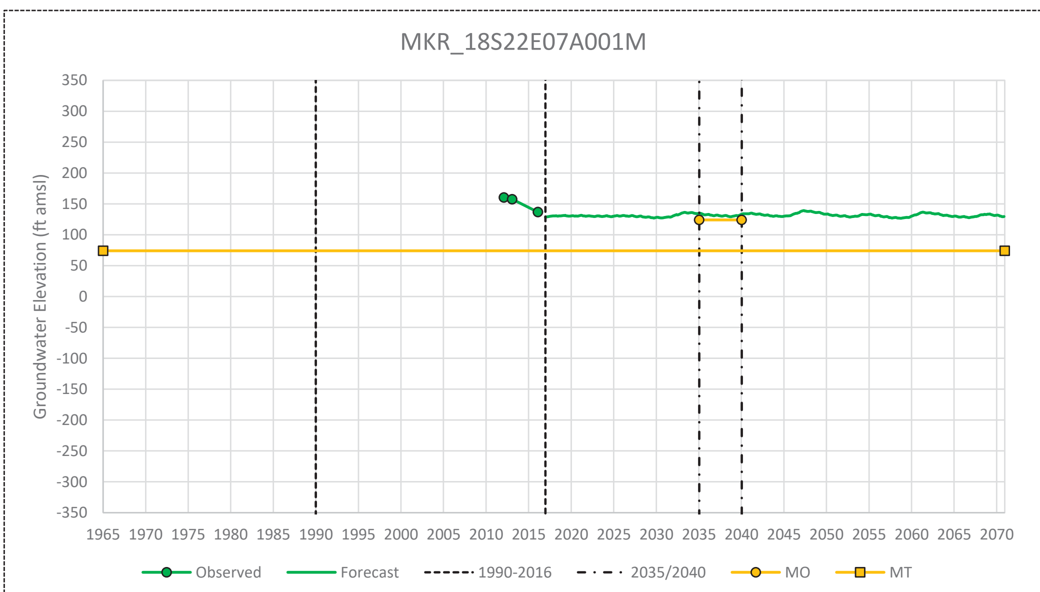

MKR_18S21E01C001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

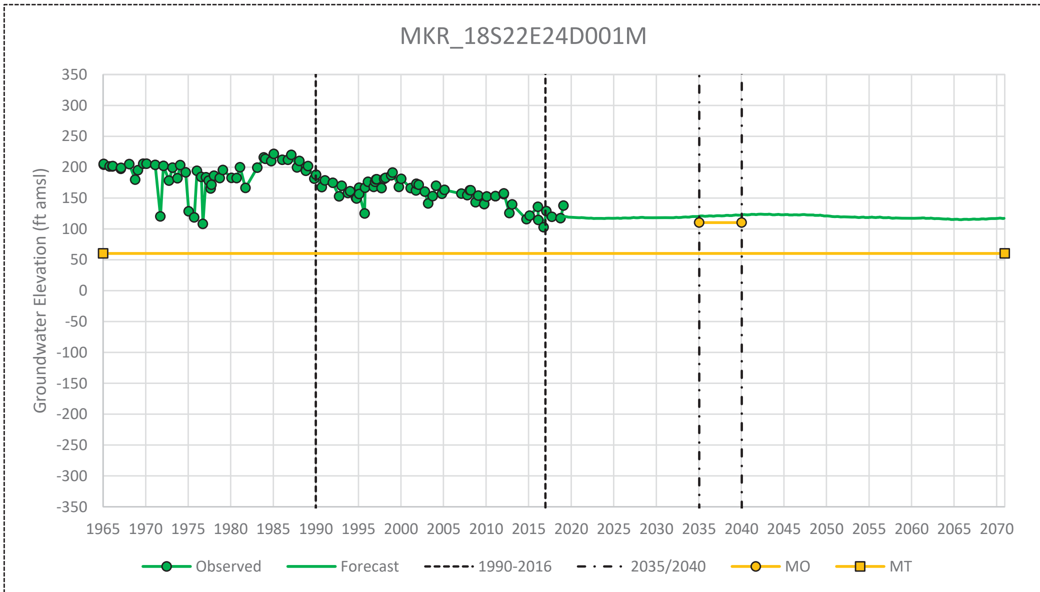

MKR_18S21E07R003M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

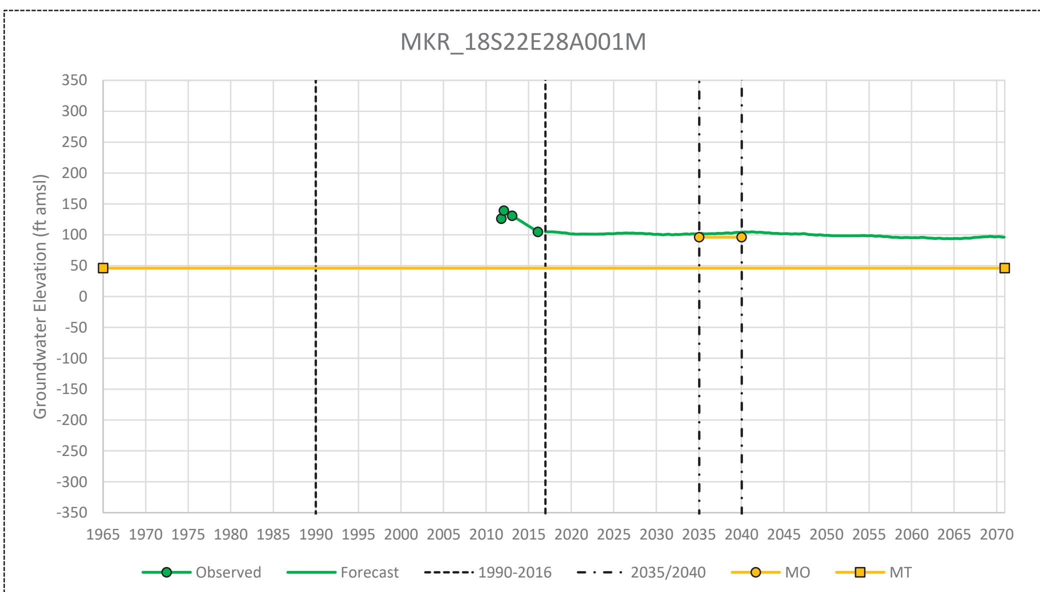

MKR_18S21E27B001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

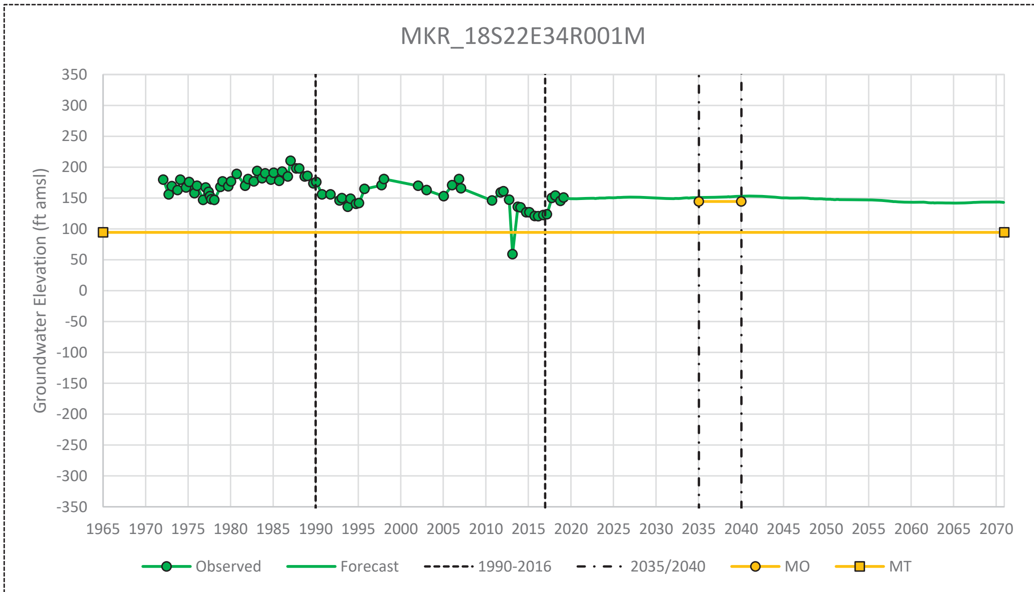

MKR_18S21E31B001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

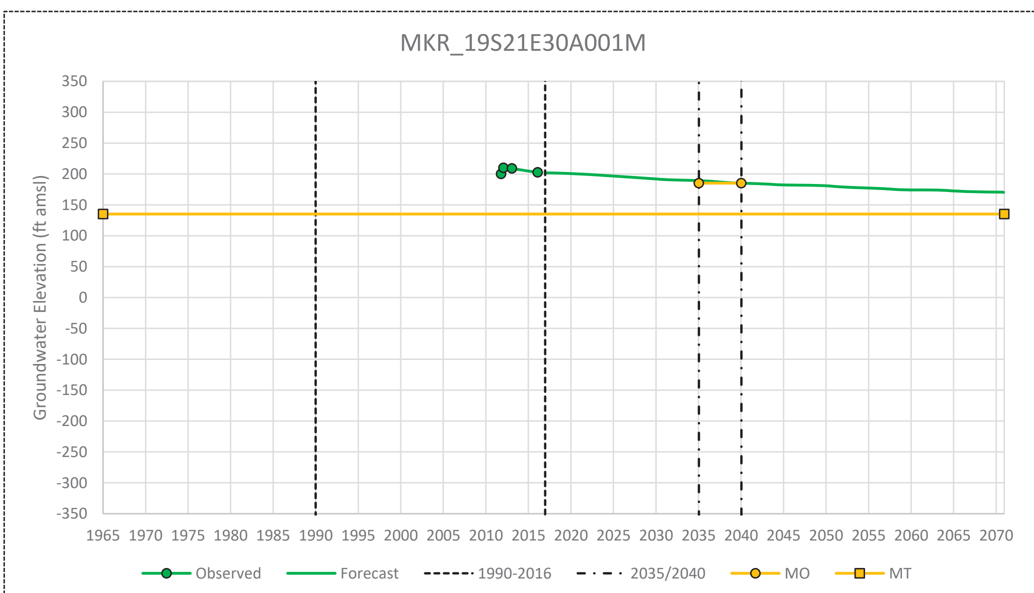

MKR_18S22E03B001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

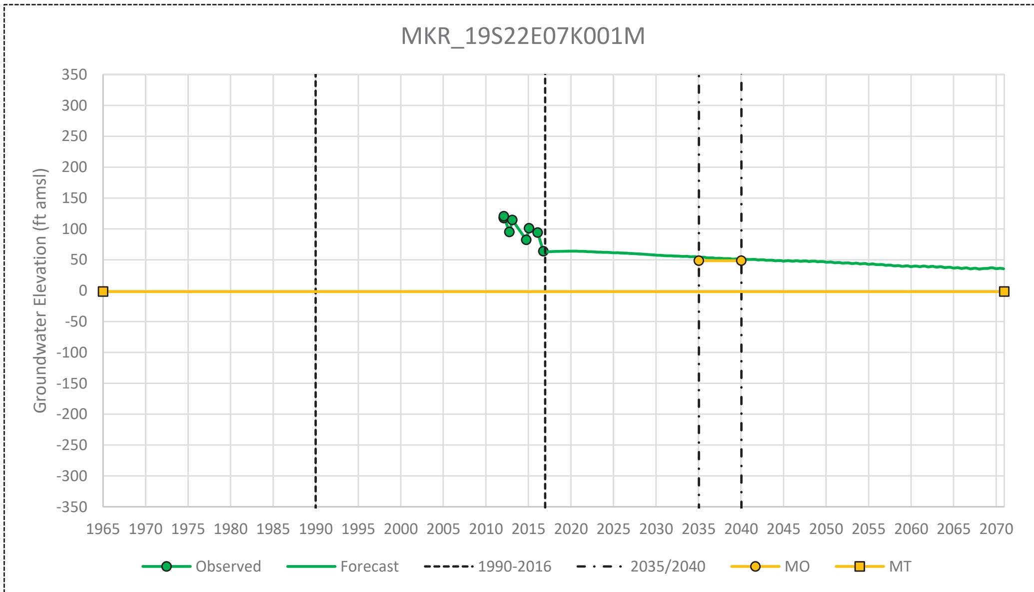

MKR_18S22E07A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

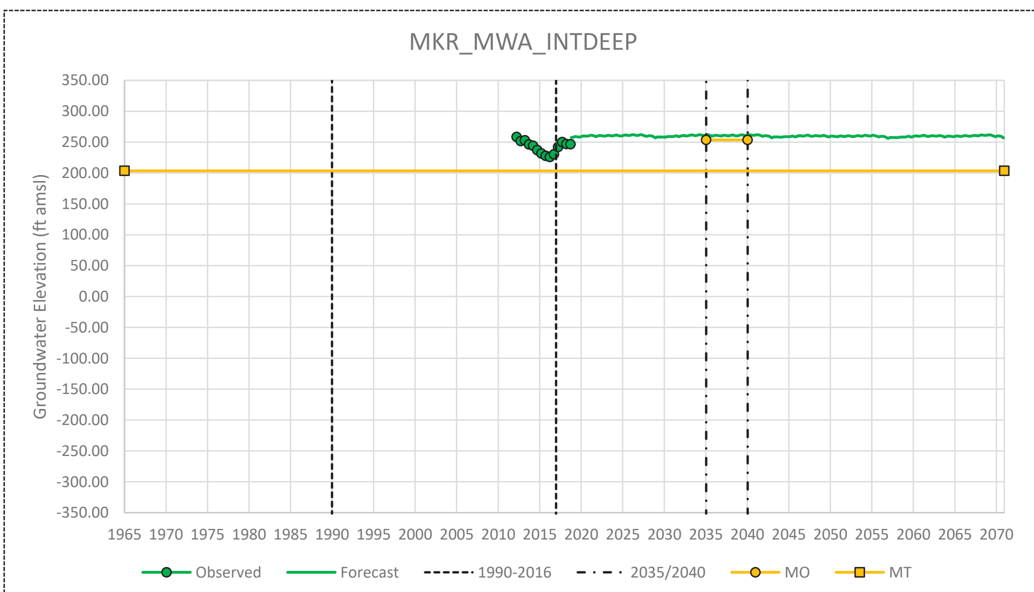

MKR_18S22E24D001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

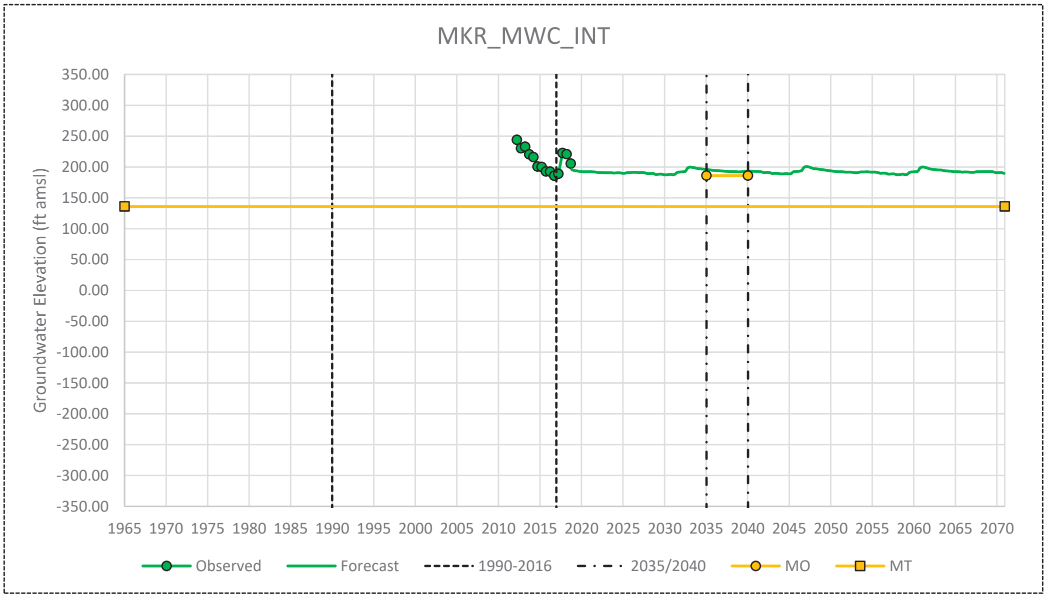

MKR_18S22E28A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

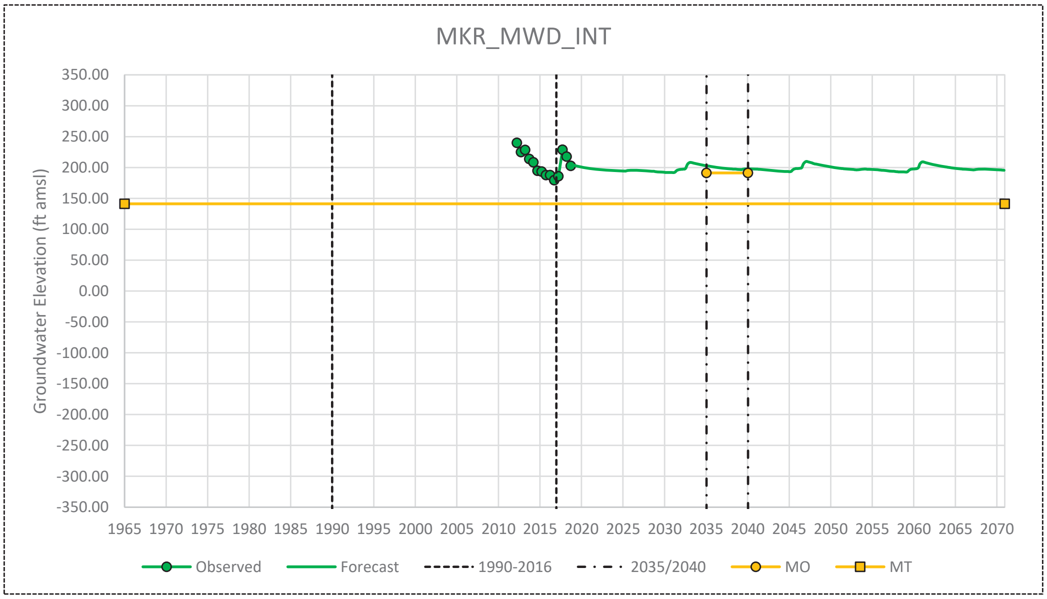

MKR_18S22E34R001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

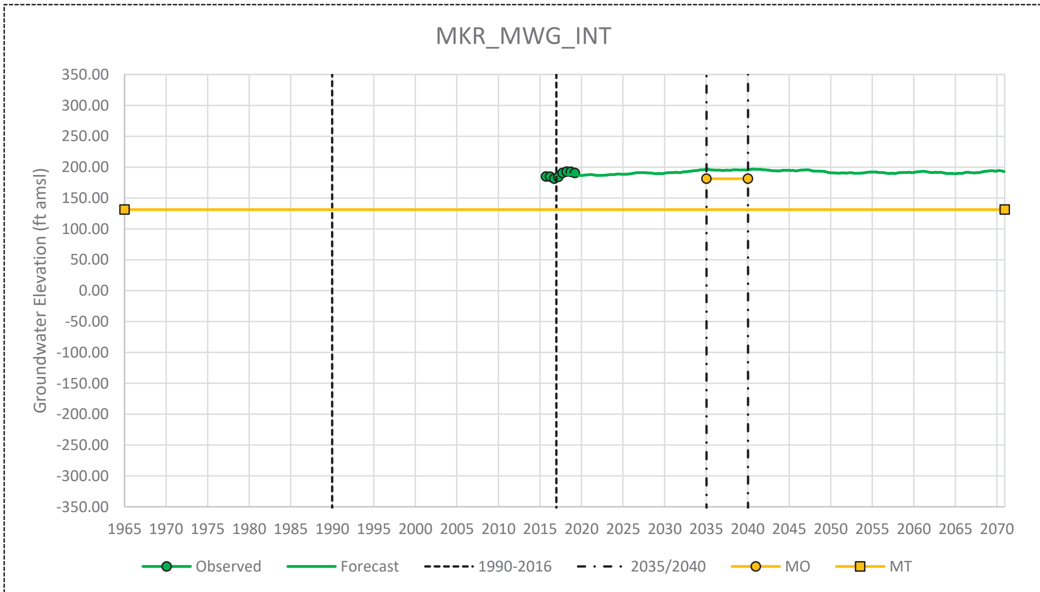

MKR_19S21E30A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

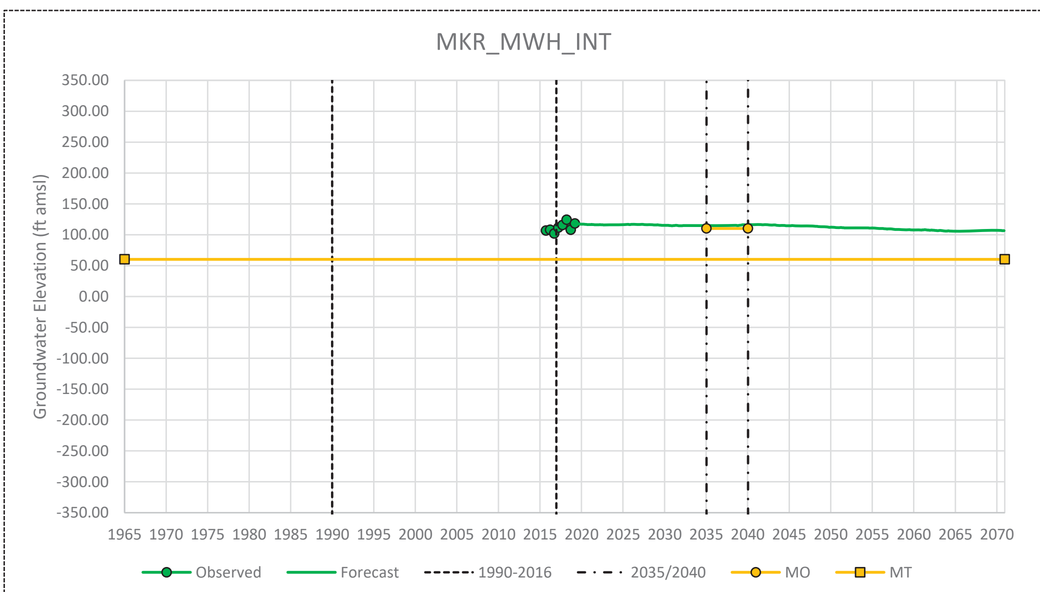

MKR_19S22E07K001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

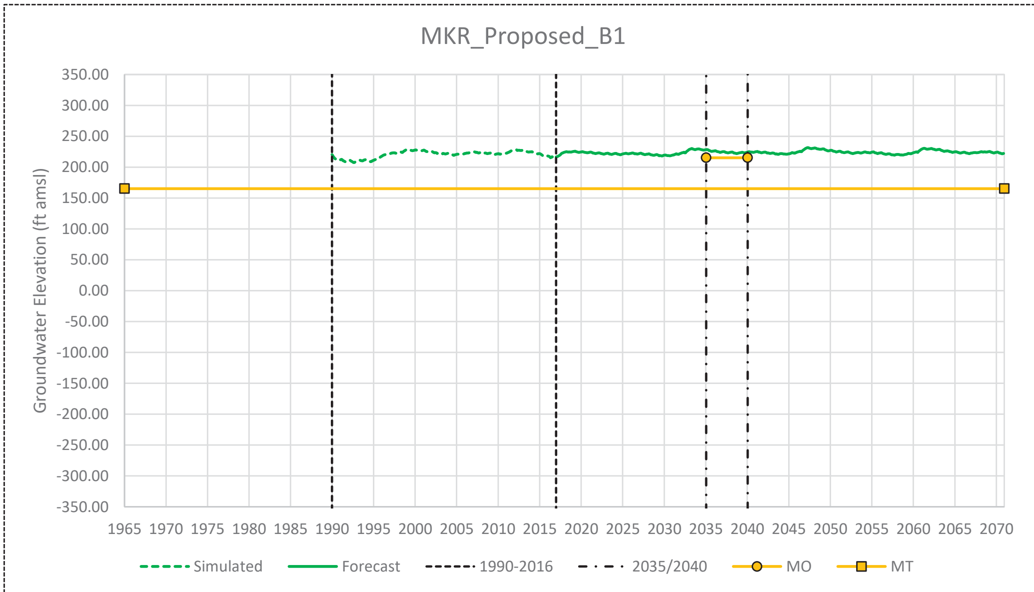

MKR_MWA_INTDEEP
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

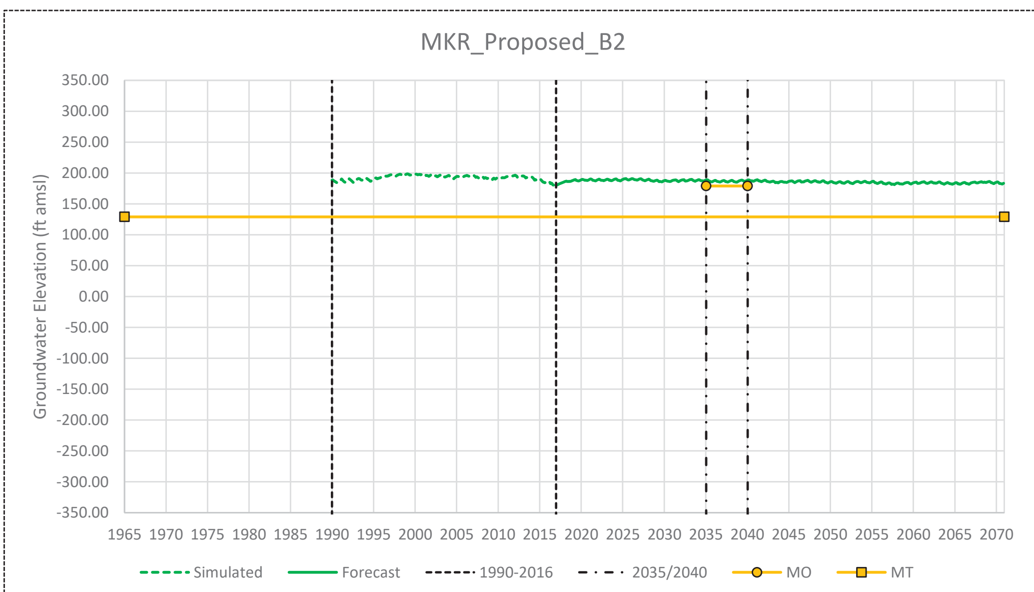

MKR_MWC_INT
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

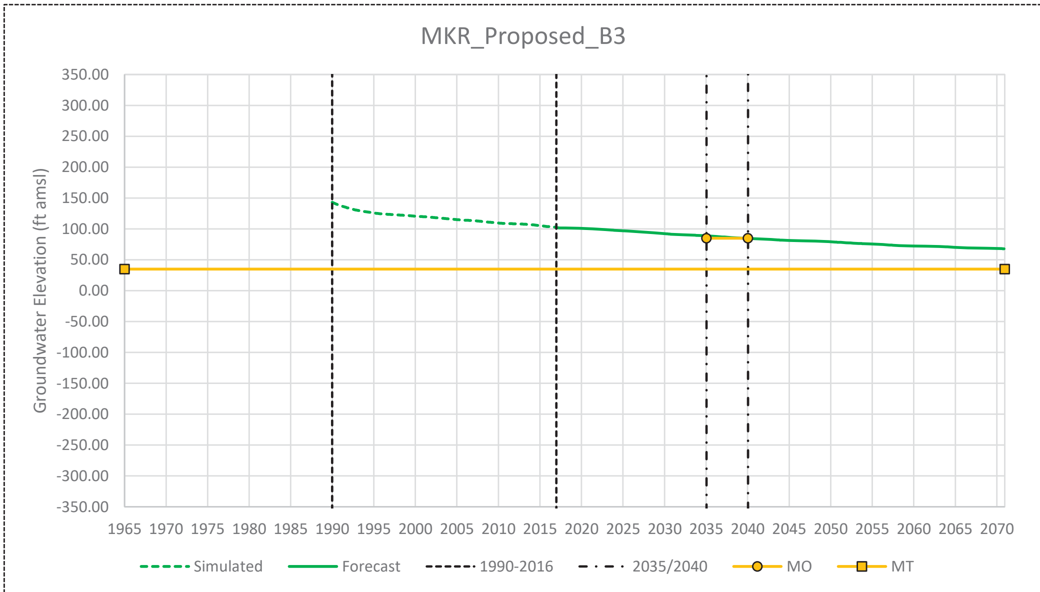

MKR_MWD_INT
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

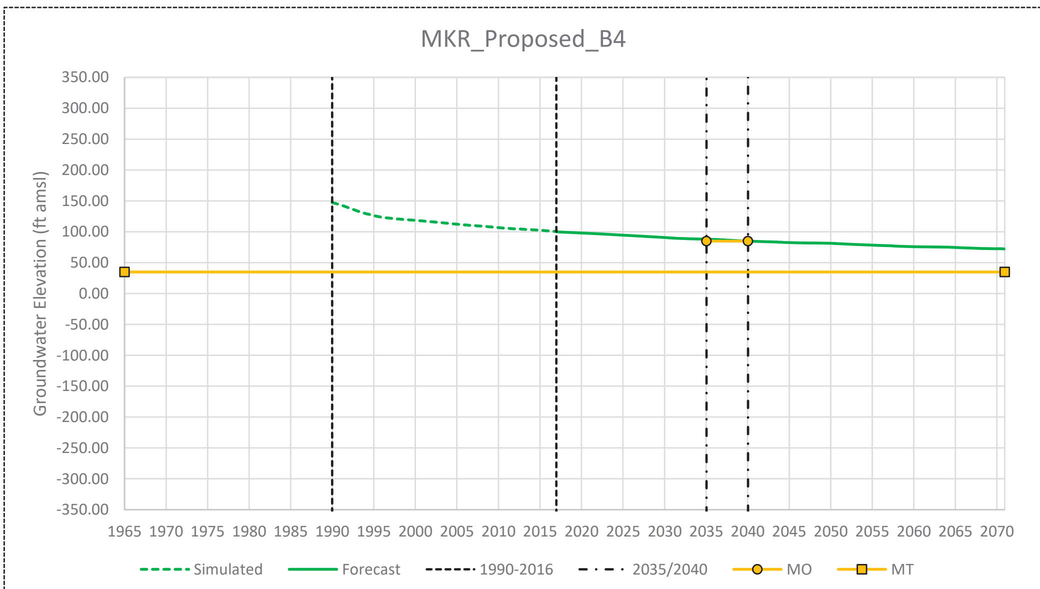

MKR_MWG_INT
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

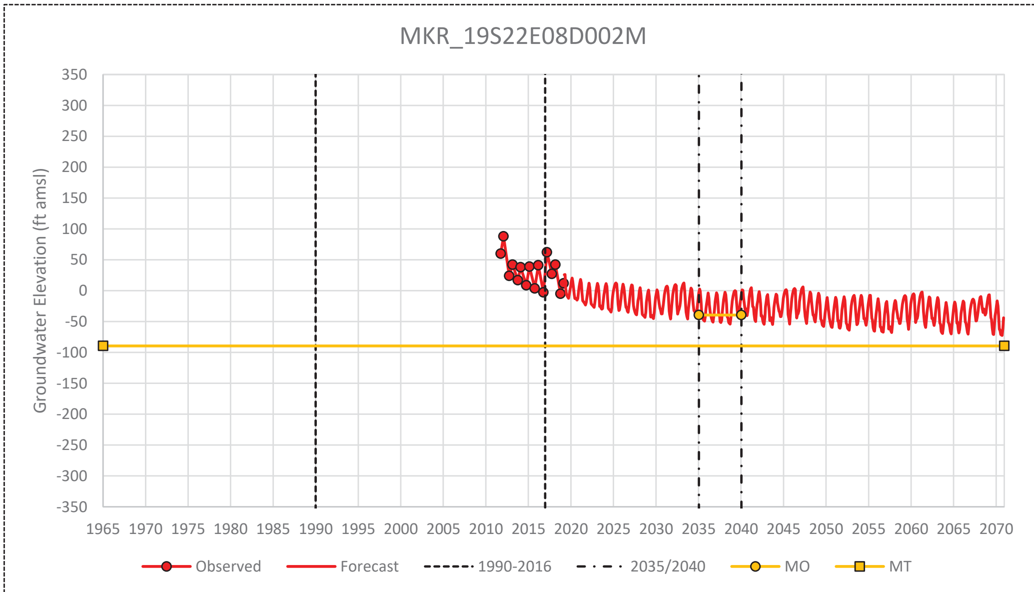

MKR_MWH_INT
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

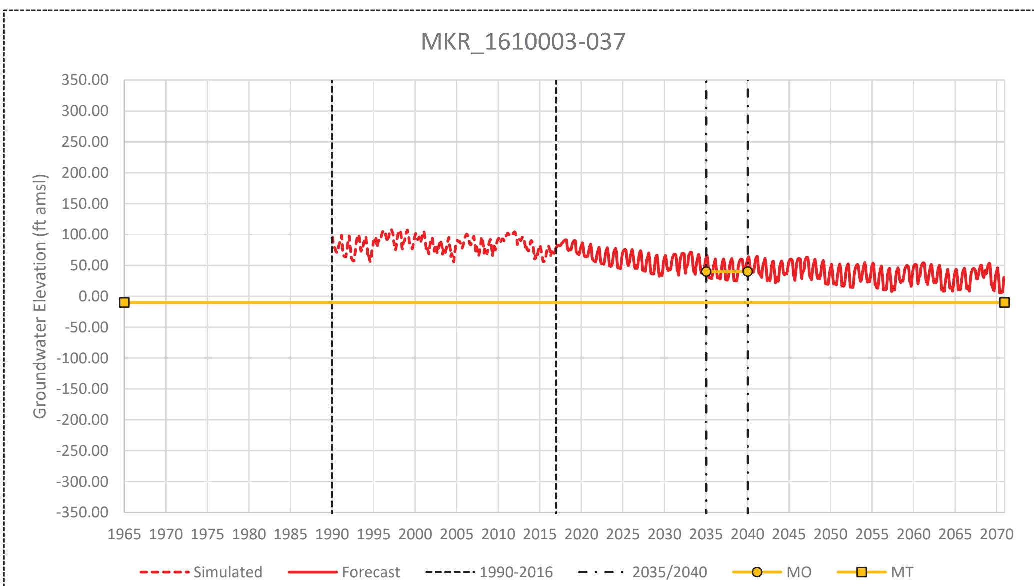

MKR_Proposed_B1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

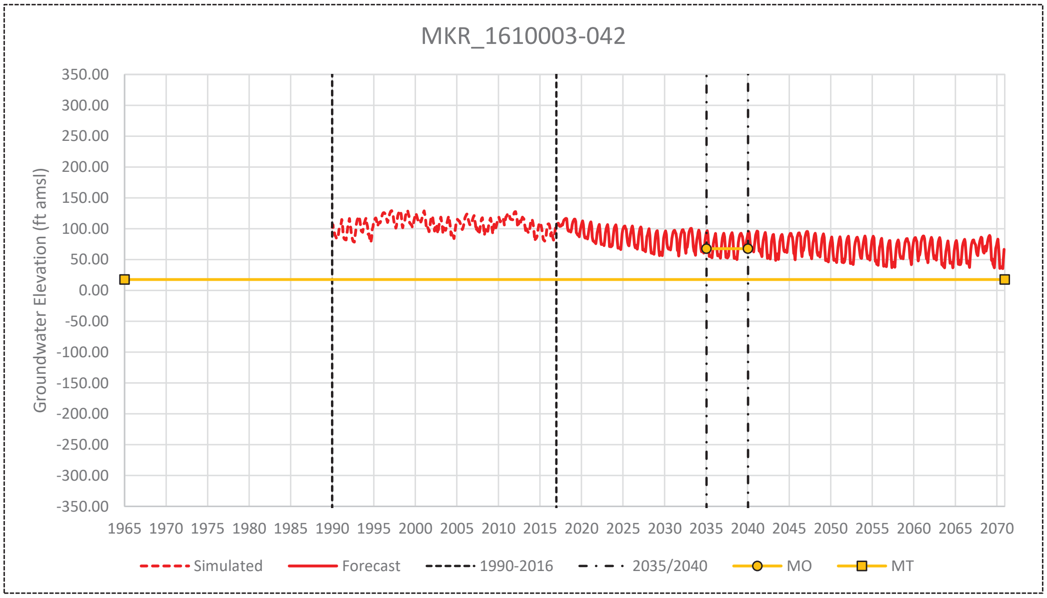

MKR_Proposed_B2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

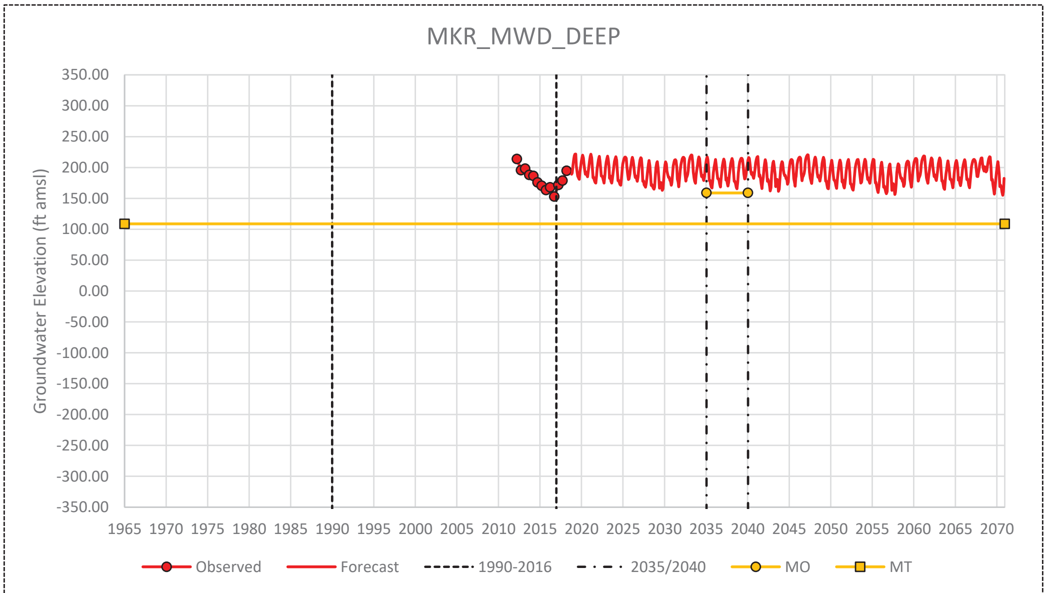

MKR_Proposed_B3
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

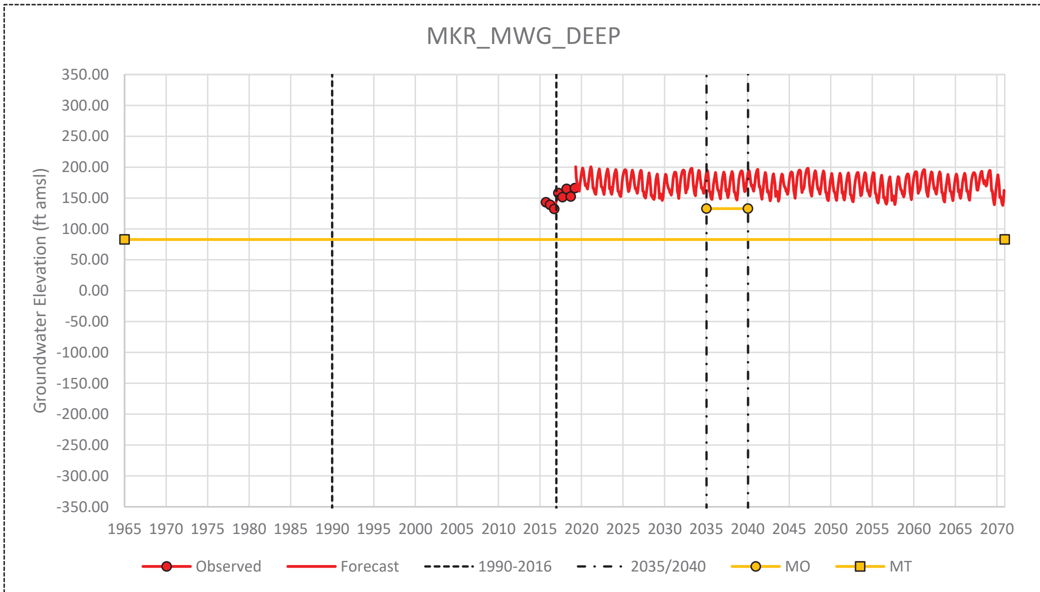

MKR_Proposed_B4
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

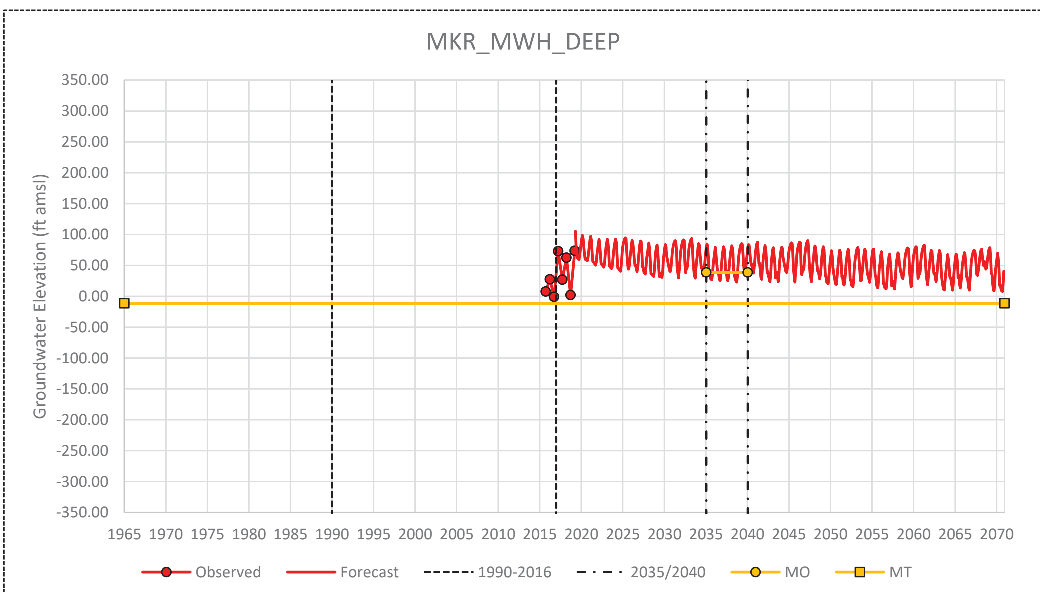

MKR_19S22E08D002M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

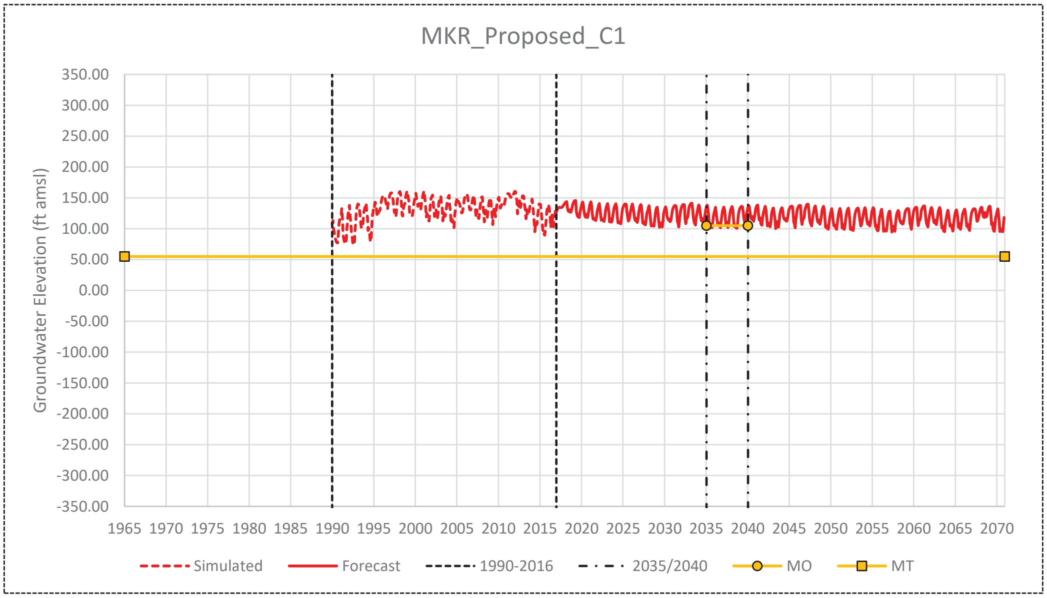

MKR_1610003-037
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

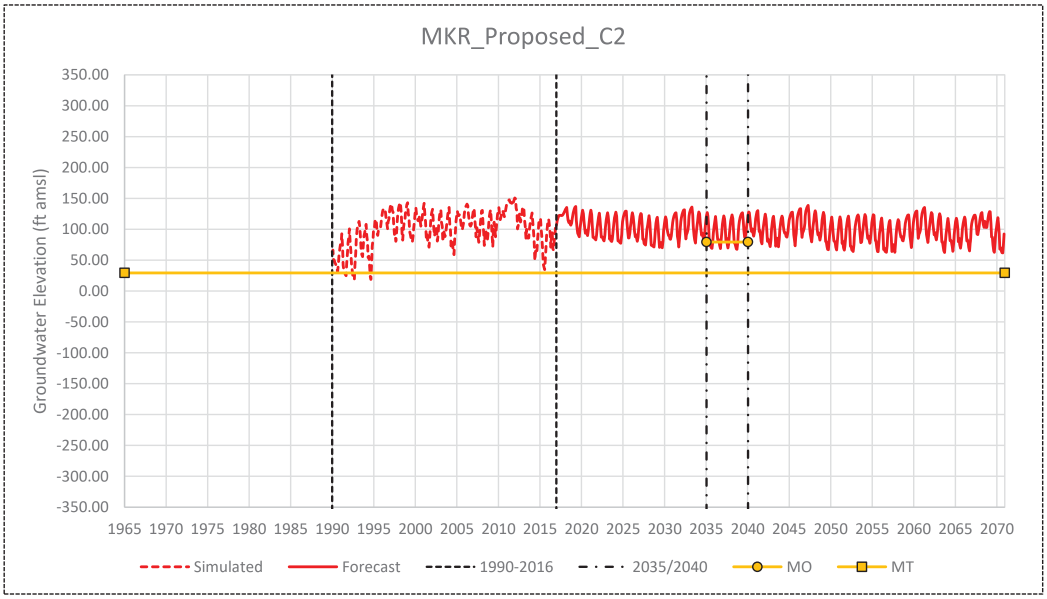

MKR_1610003-042
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

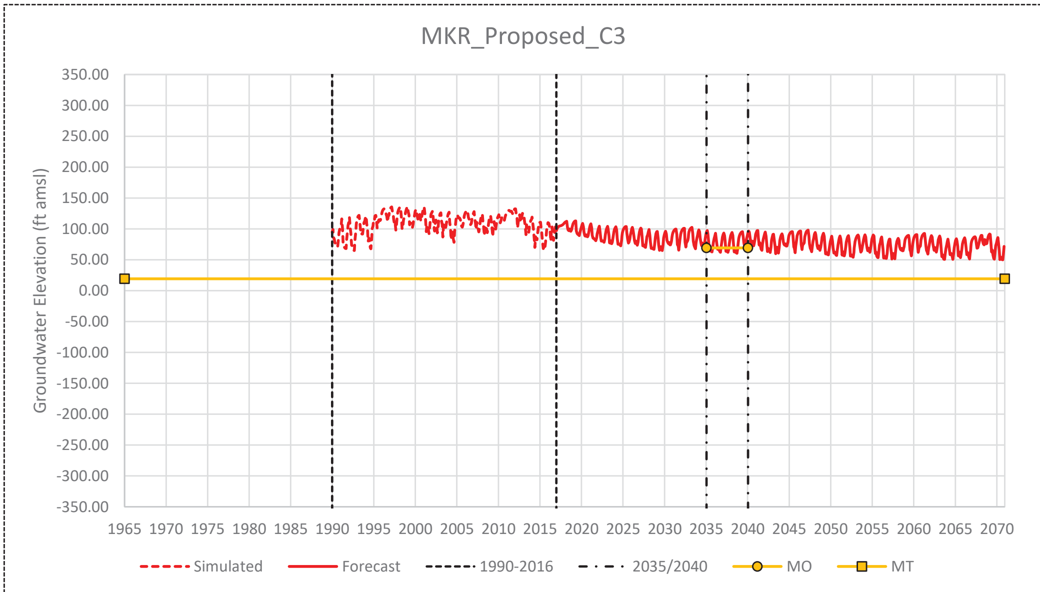

MKR_MWD_DEEP
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


MKR_MWG_DEEP
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

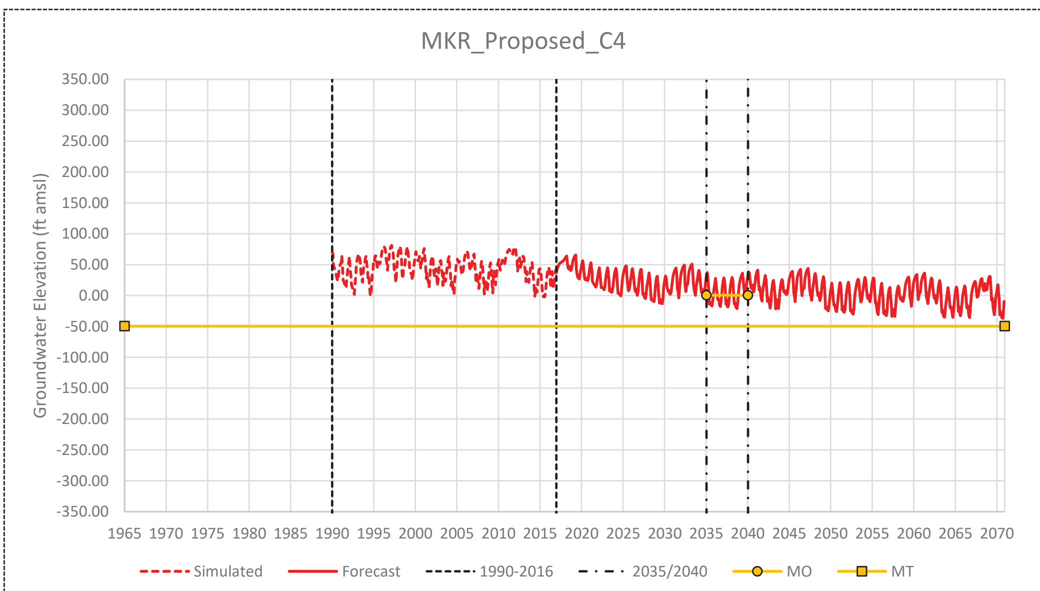

MKR_MWH_DEEP
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


MKR_Proposed_C1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

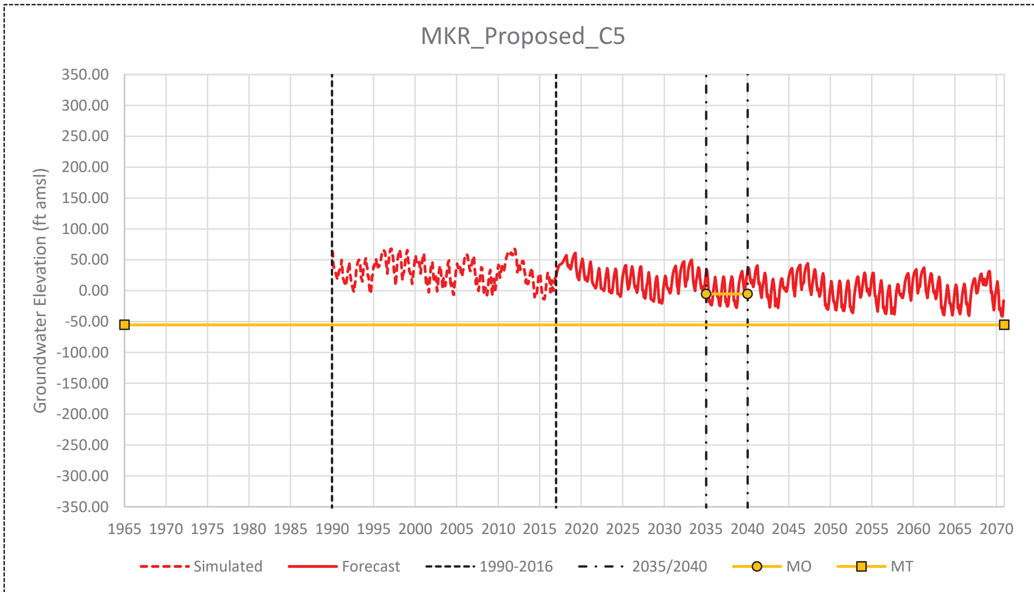

MKR_Proposed_C2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

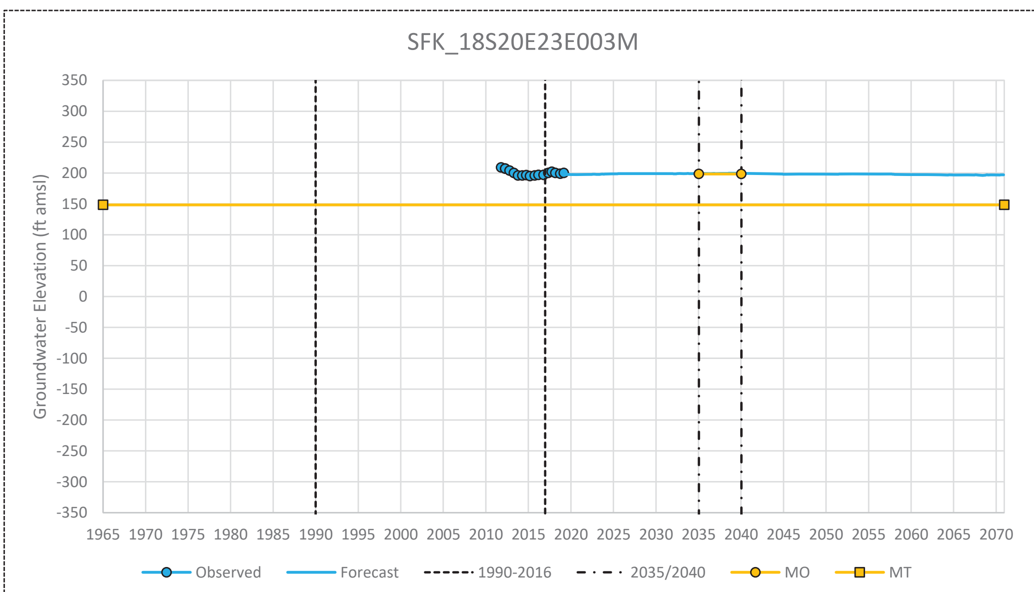


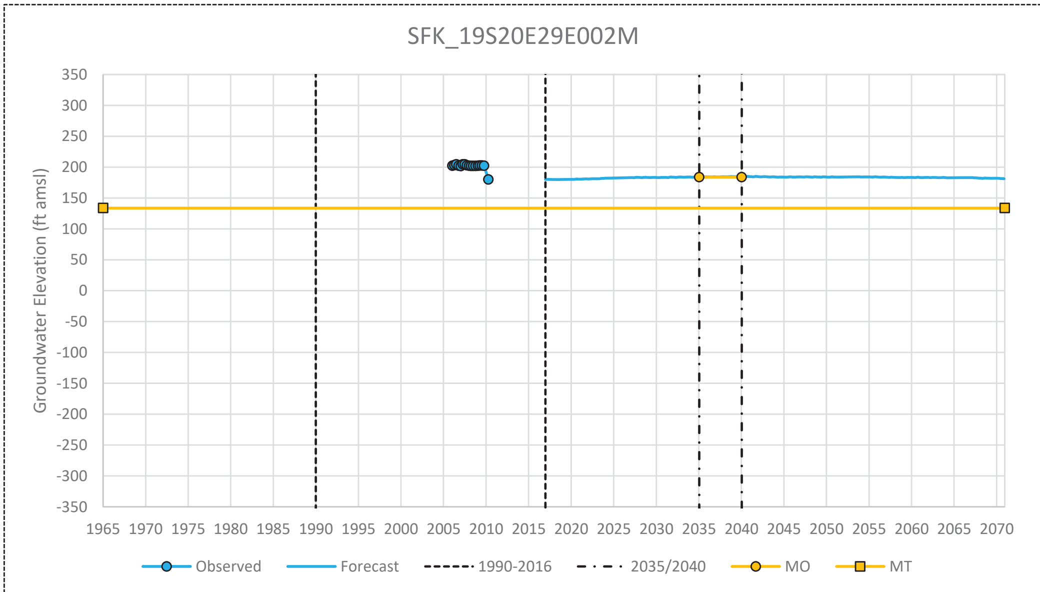
MKR_Proposed_C3
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

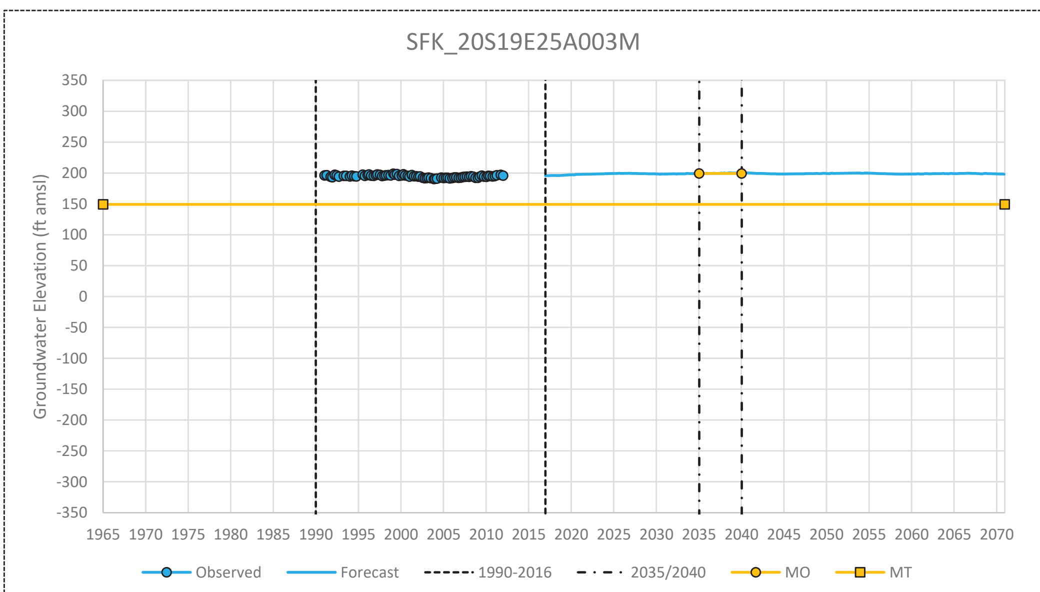


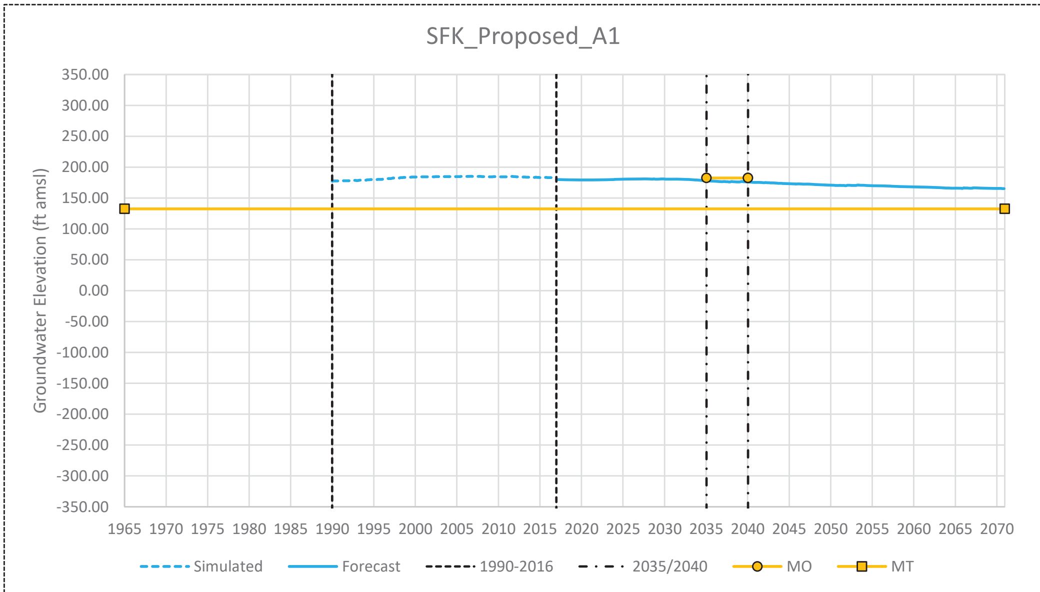
MKR_Proposed_C4
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

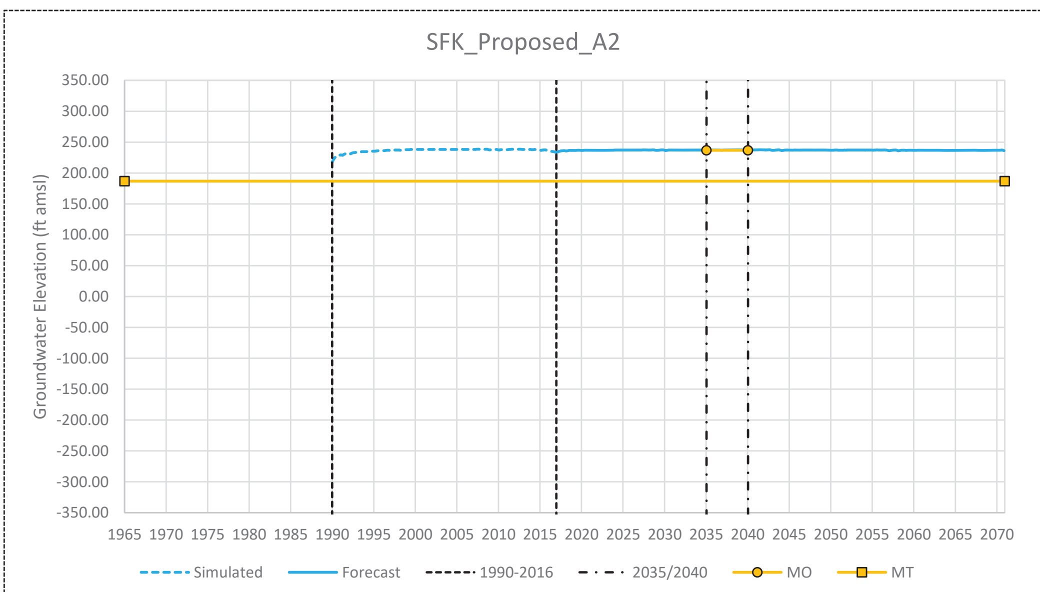

MKR_Proposed_C5
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
Groundwater Elevation (ft amsl)
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

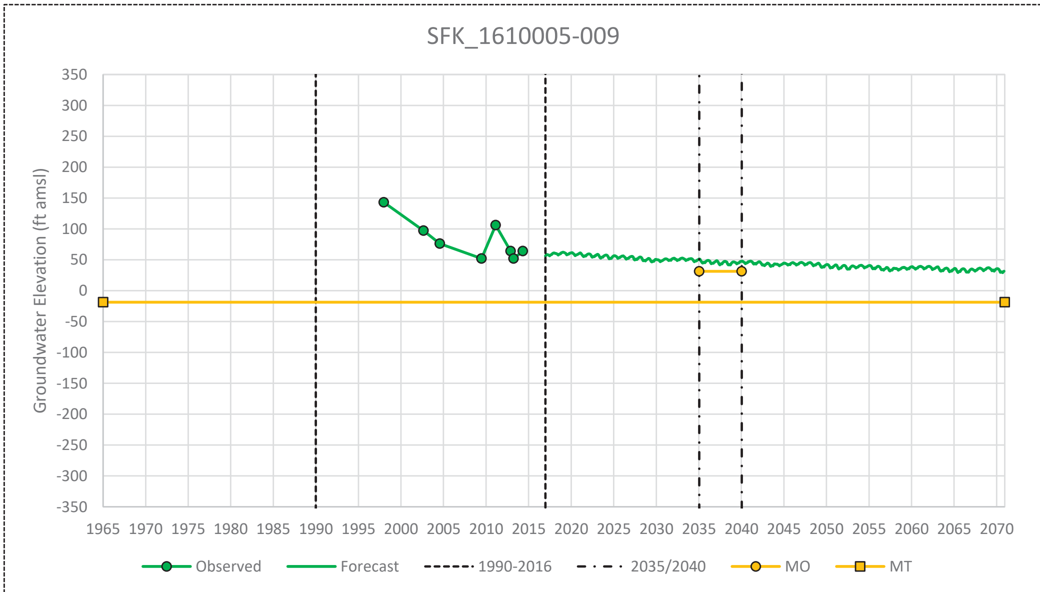

SFK_18S20E23E003M
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
Groundwater Elevation (ft amsl)
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


SFK_19S20E29E002M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

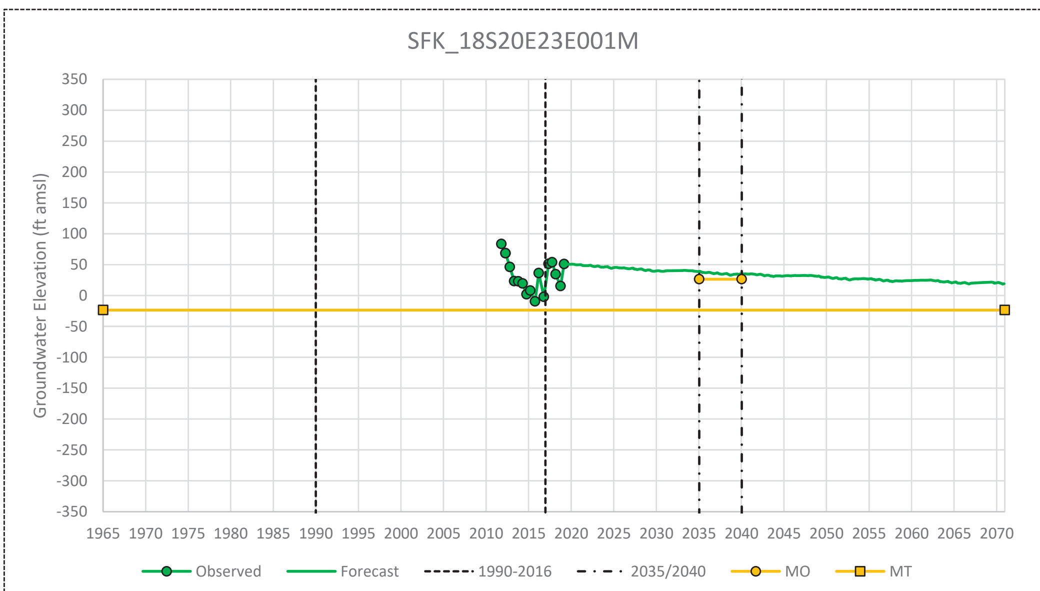

SFK_20S19E25A003M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


SFK_Proposed_A1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

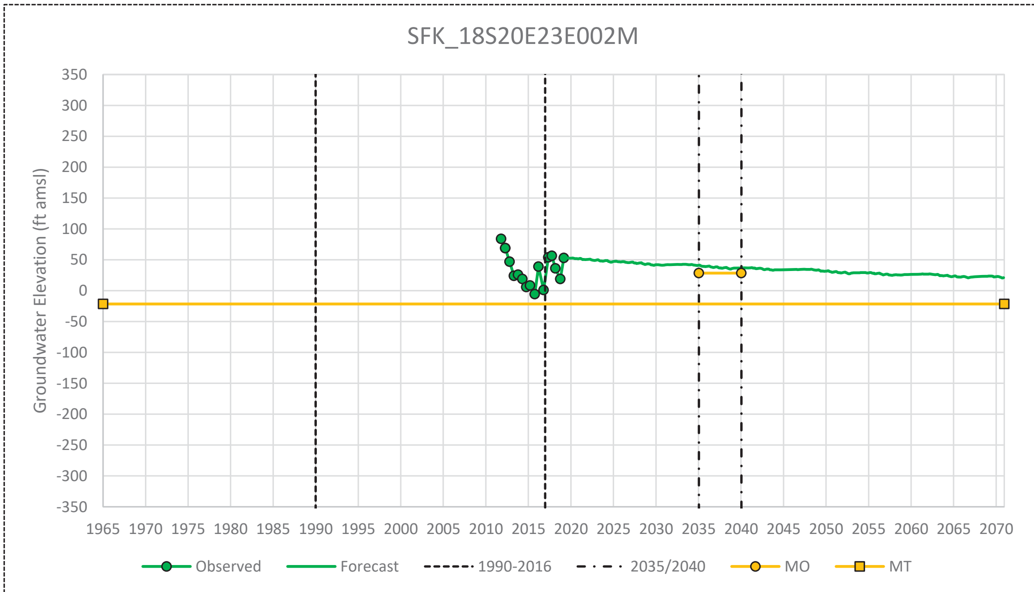

SFK_Proposed_A2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

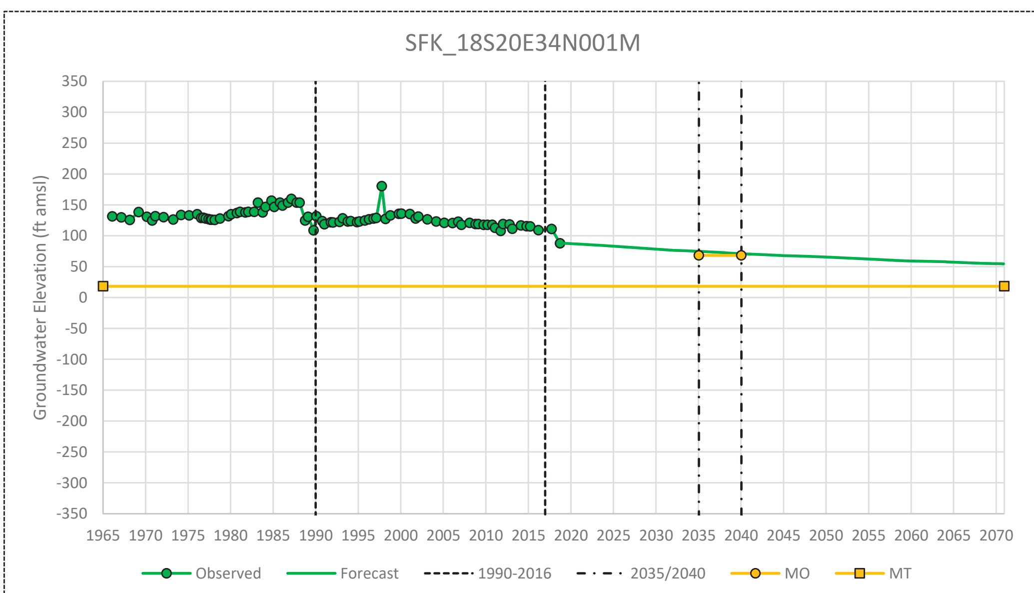


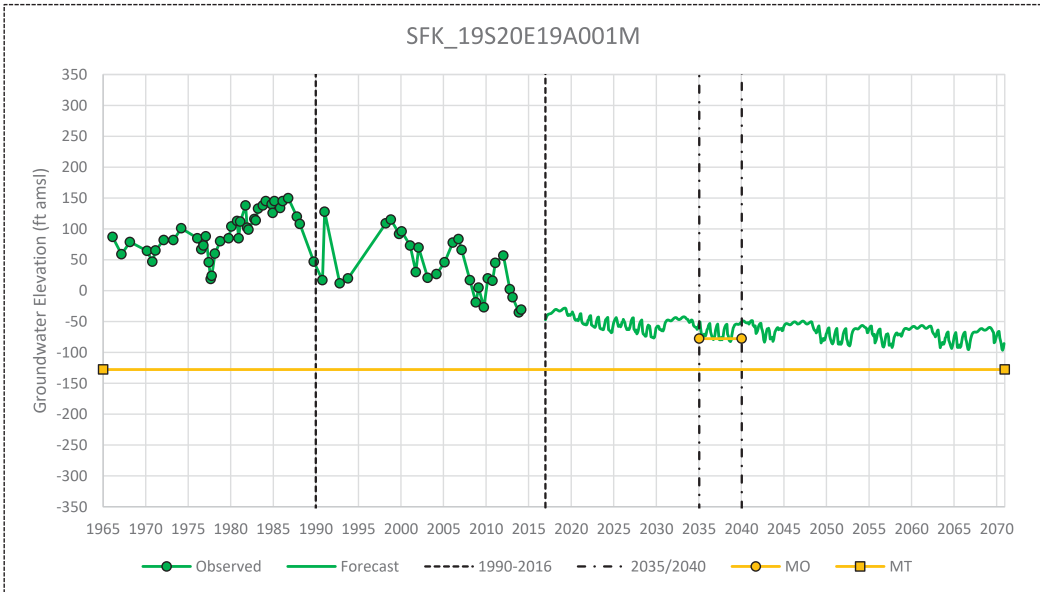
SFK_1610005-009
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT



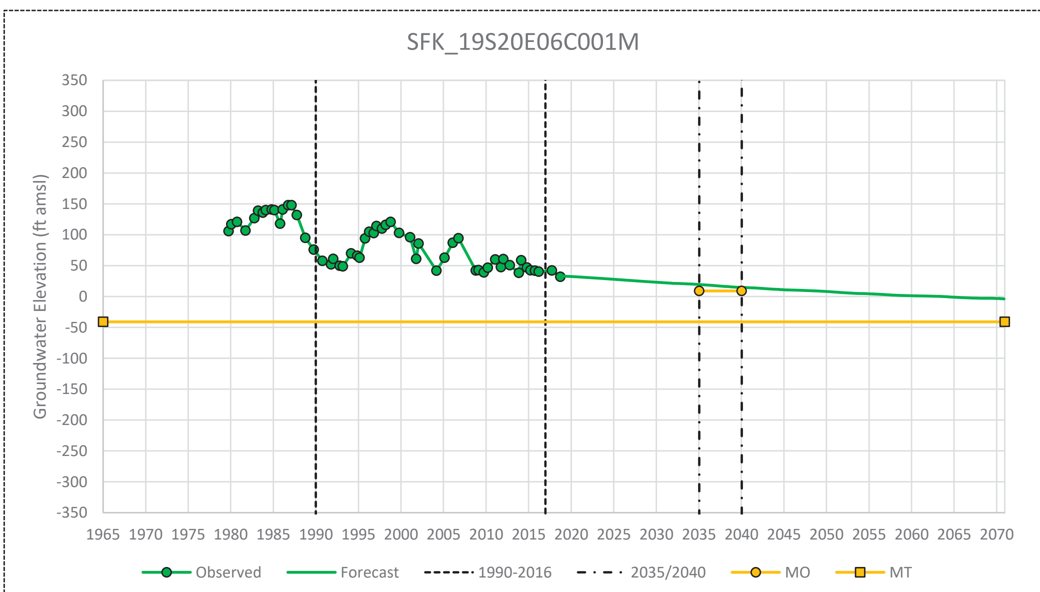
SFK_18S20E23E001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


SFK_18S20E23E002M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

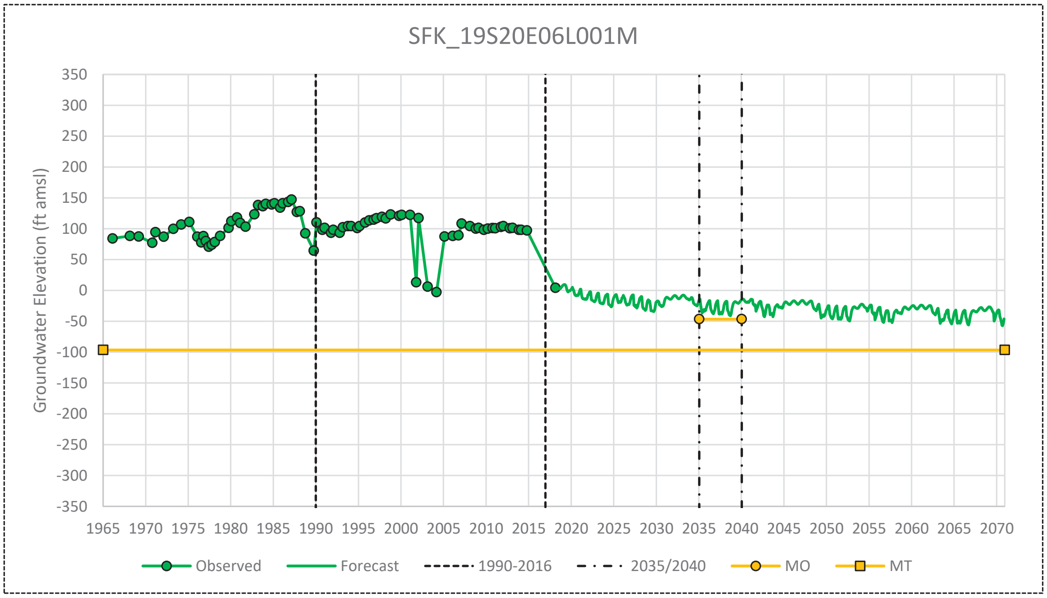

SFK_18S20E34N001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

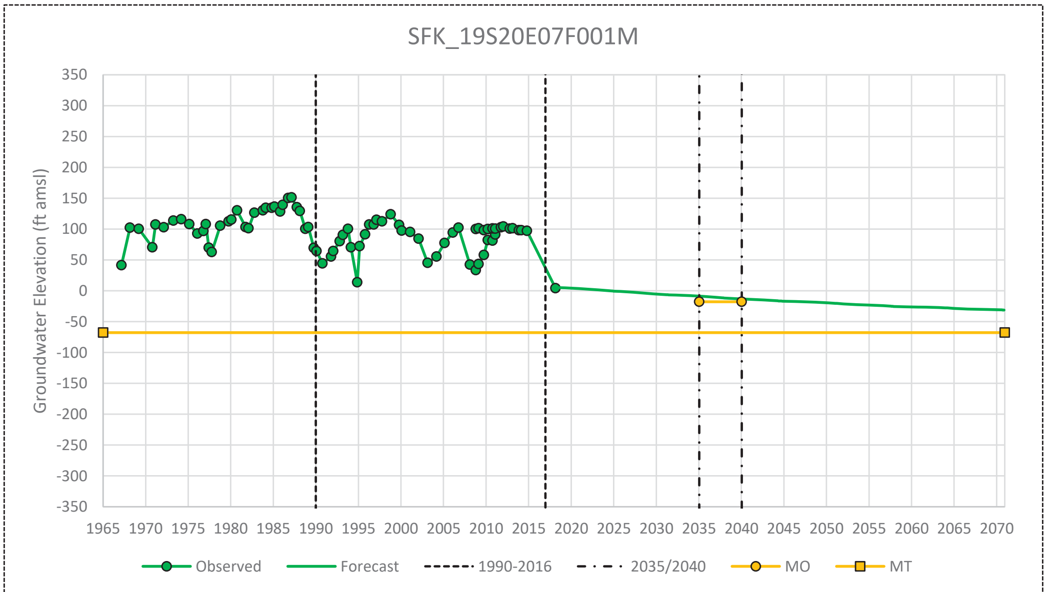


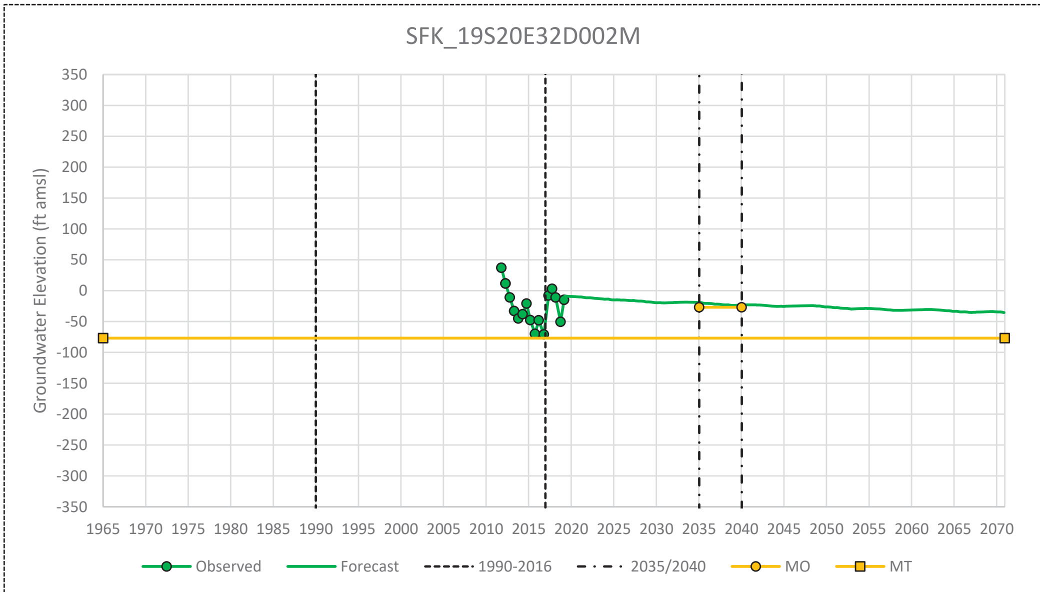
SFK_19S20E19A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

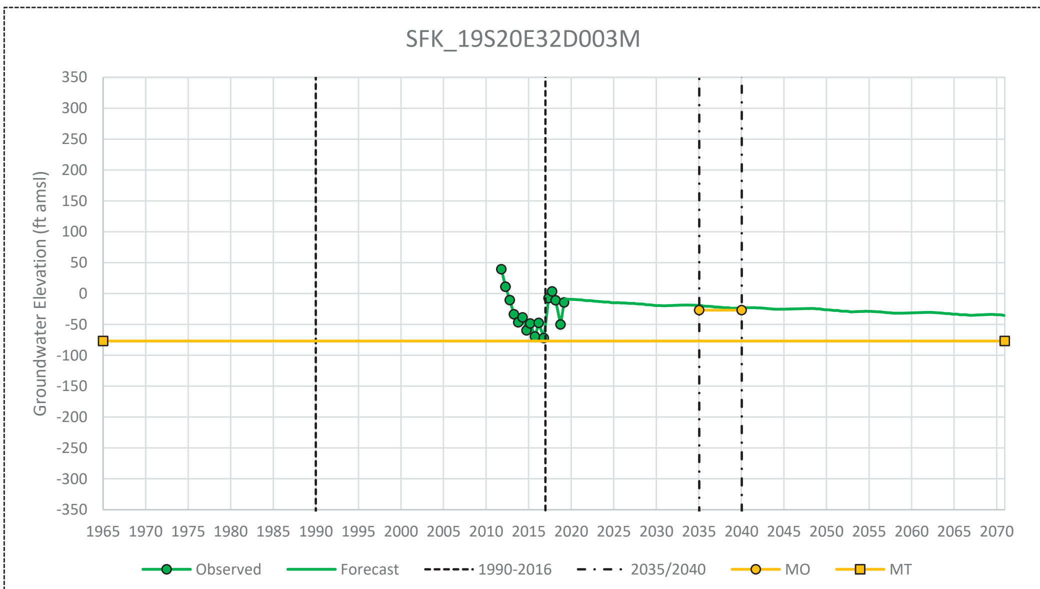


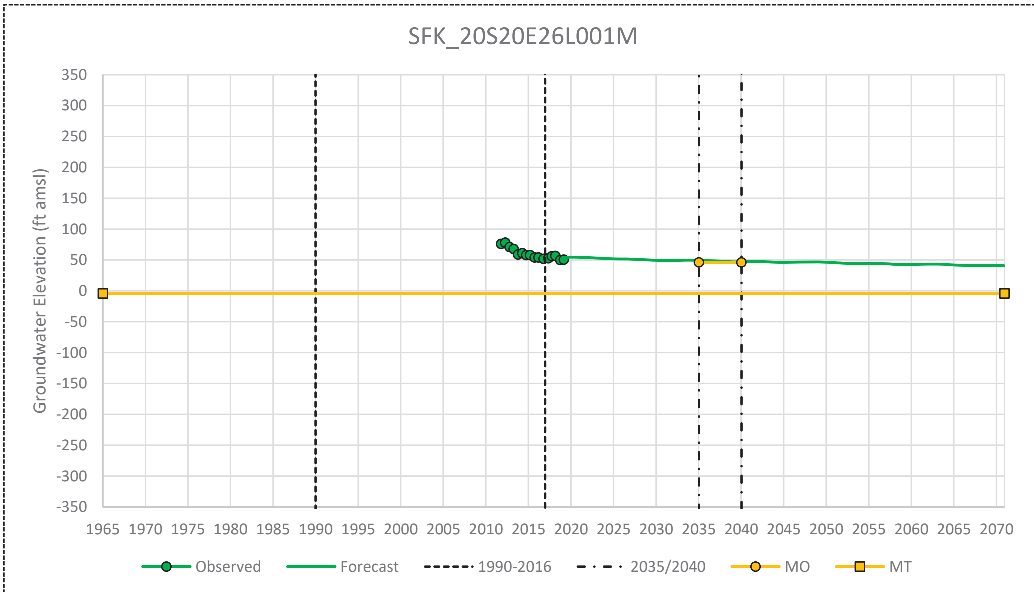
SFK_19S20E06C001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

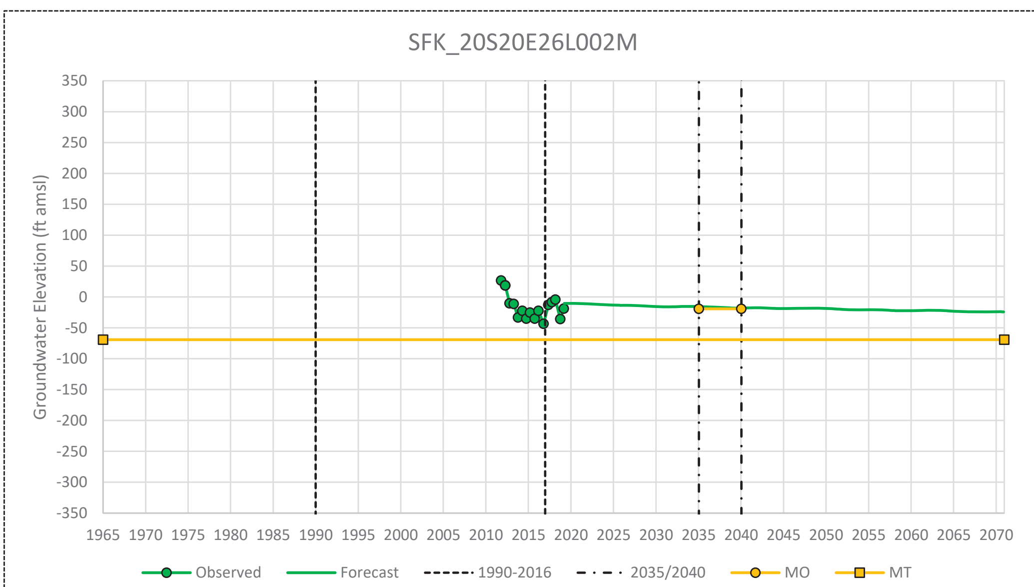

SFK_19S20E06L001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

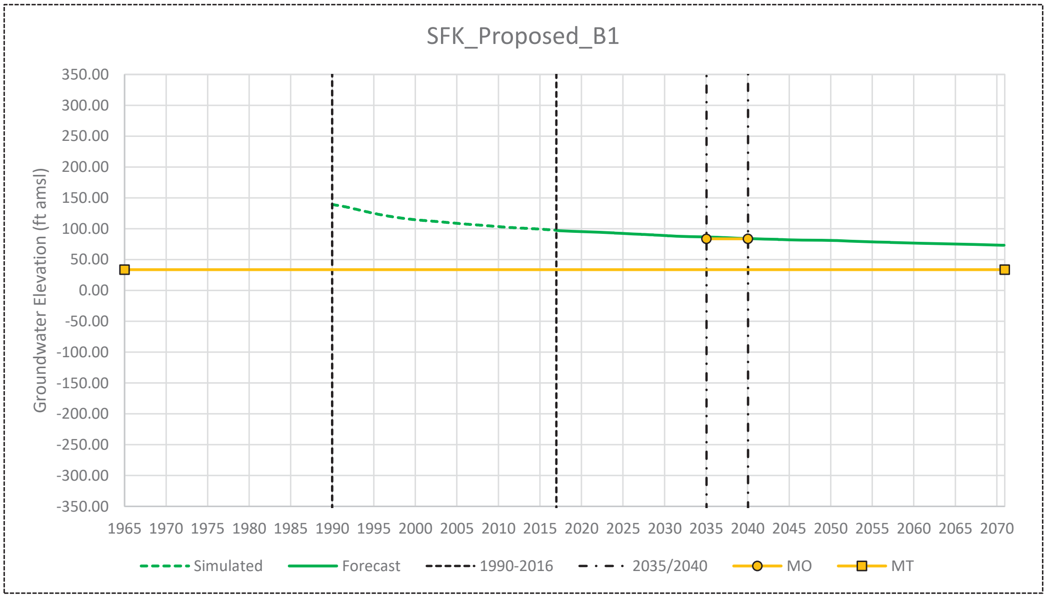

SFK_19S20E07F001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


SFK_19S20E32D002M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

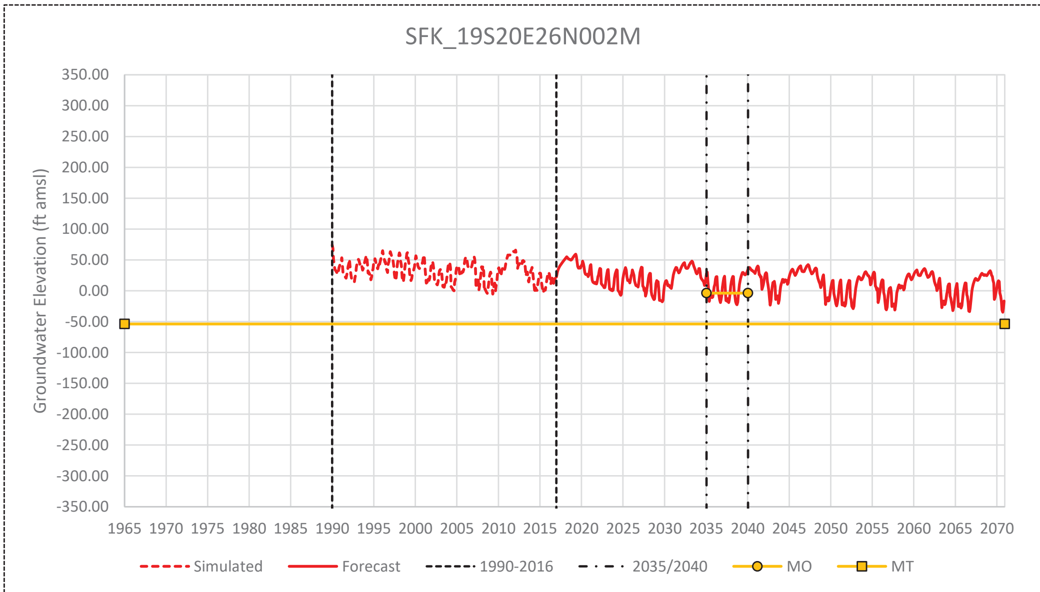

SFK_19S20E32D003M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


SFK_20S20E26L001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

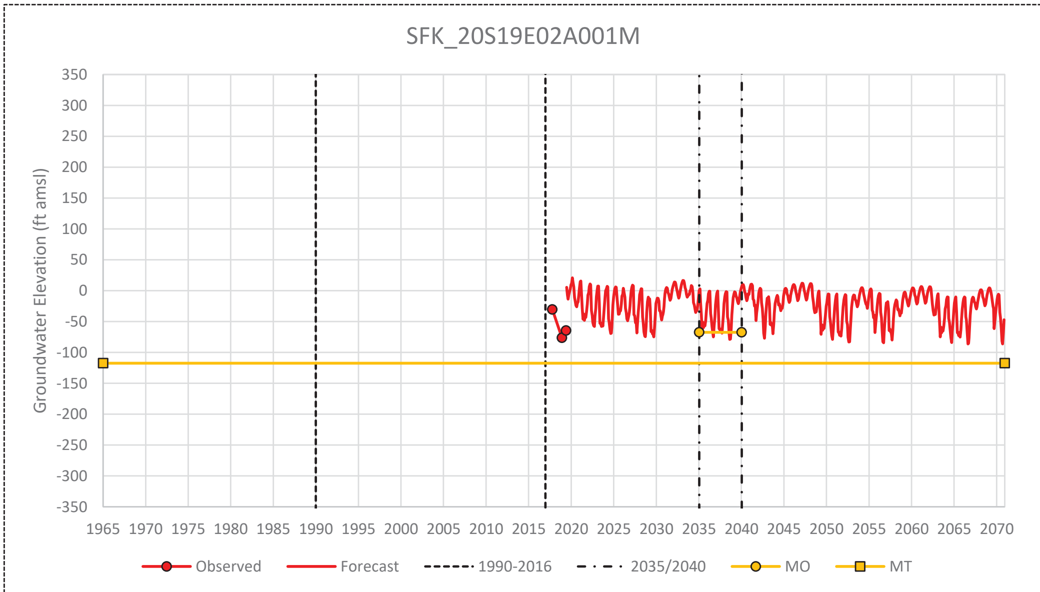

SFK_20S20E26L002M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

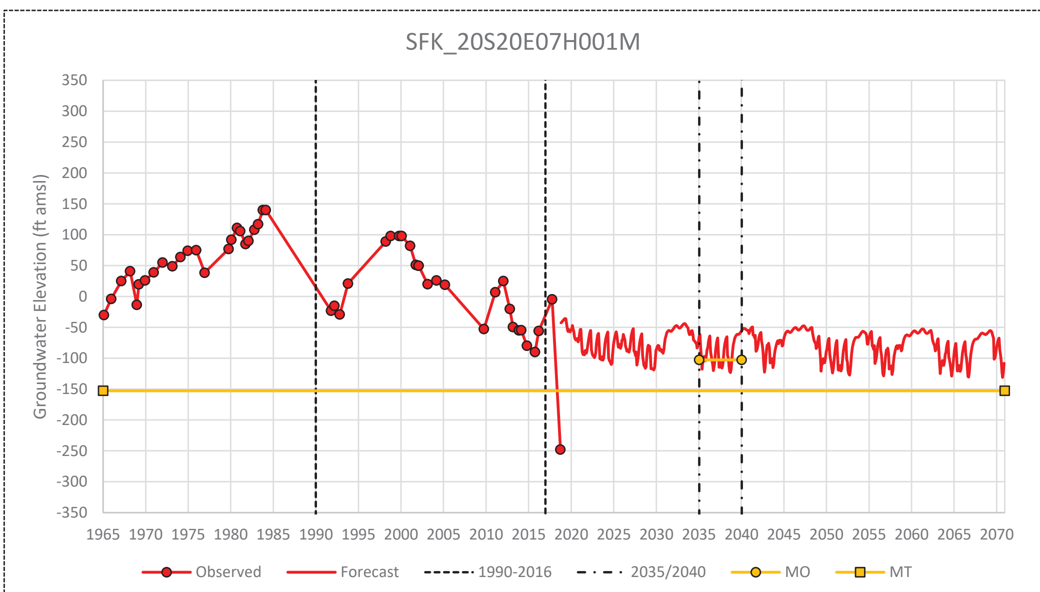


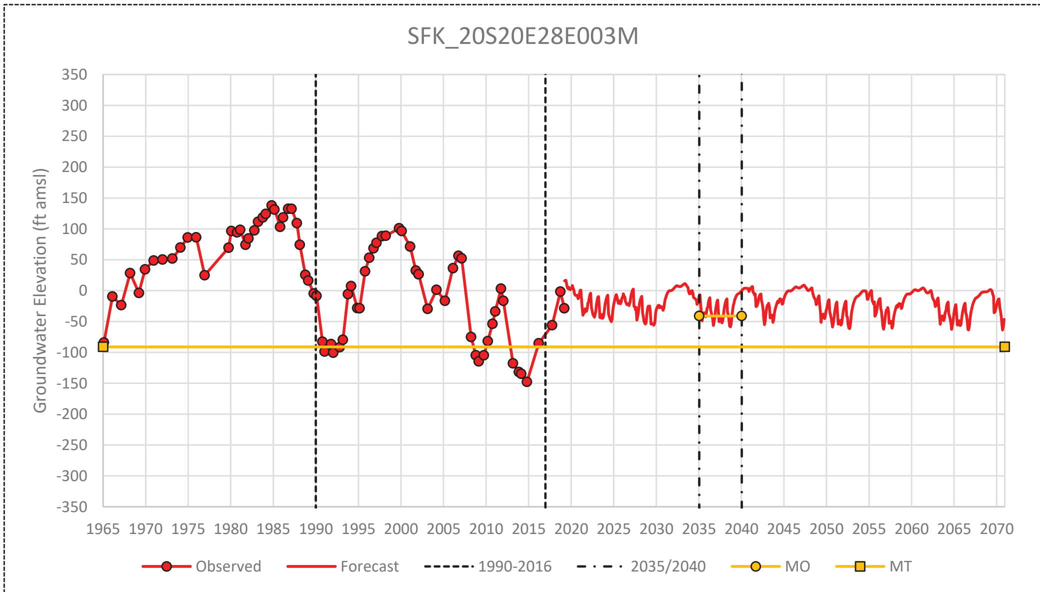
SFK_Proposed_B1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT



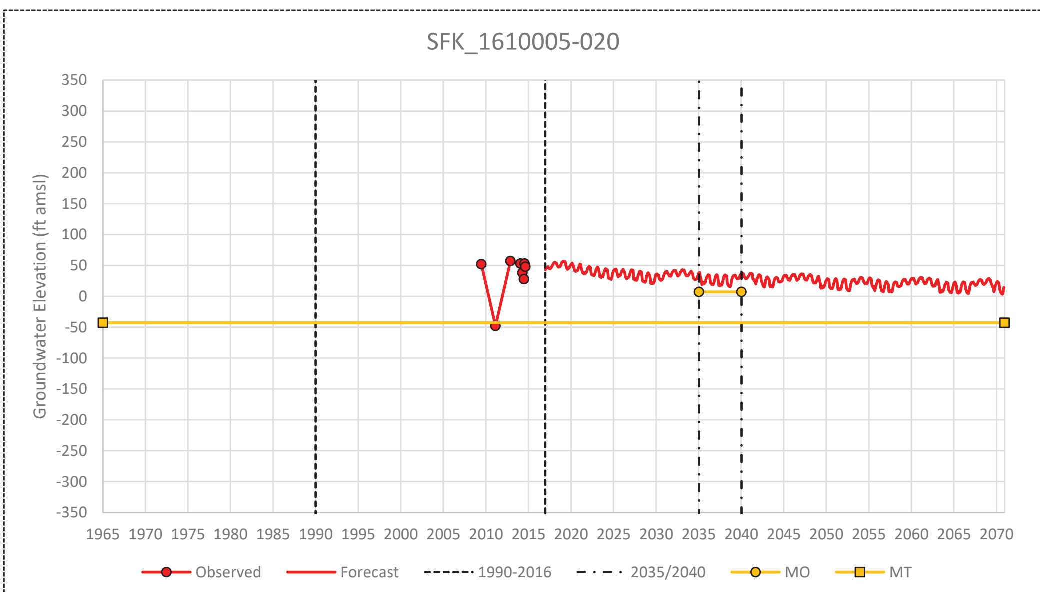
SFK_19S20E26N002M
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT


SFK_20S19E02A001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

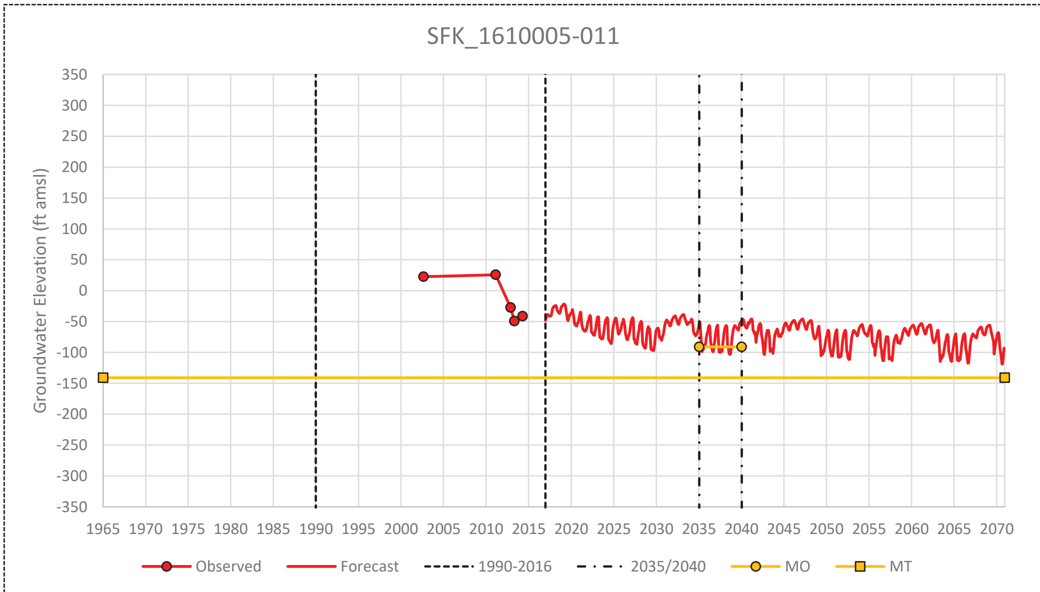

SFK_20S20E07H001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

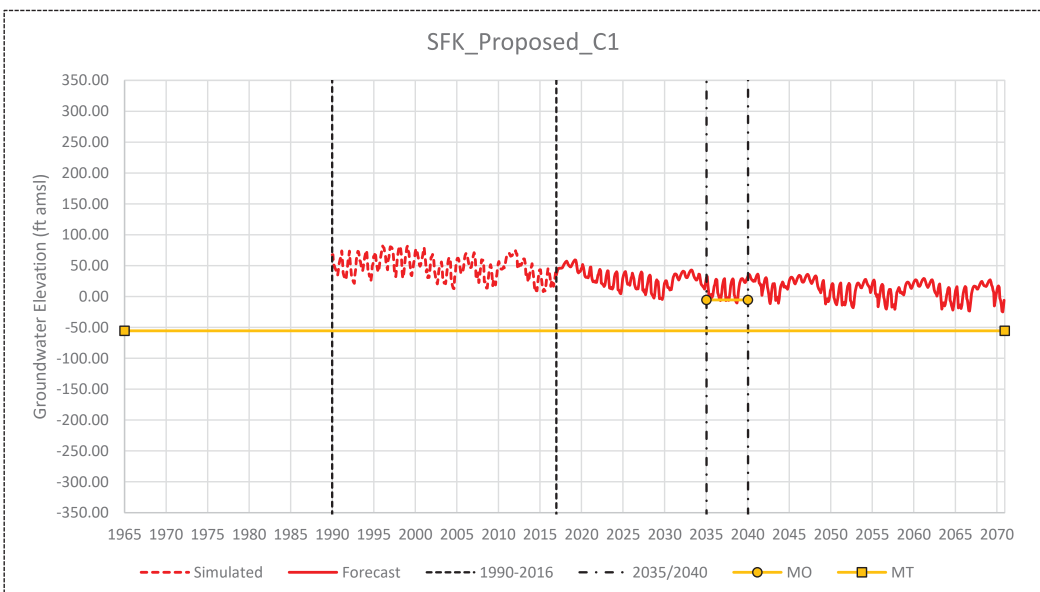


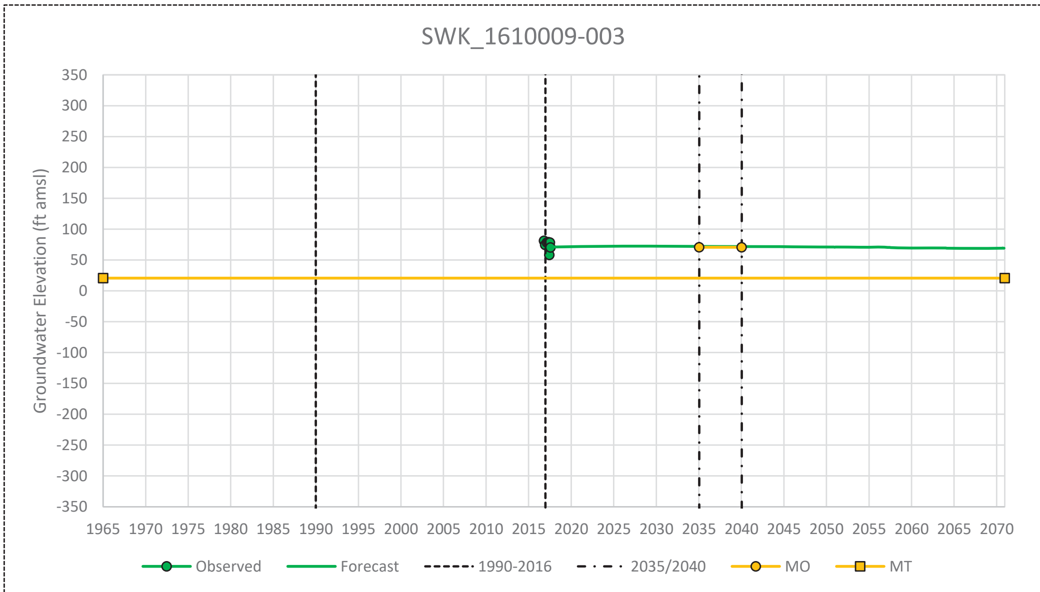
SFK_20S20E28E003M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

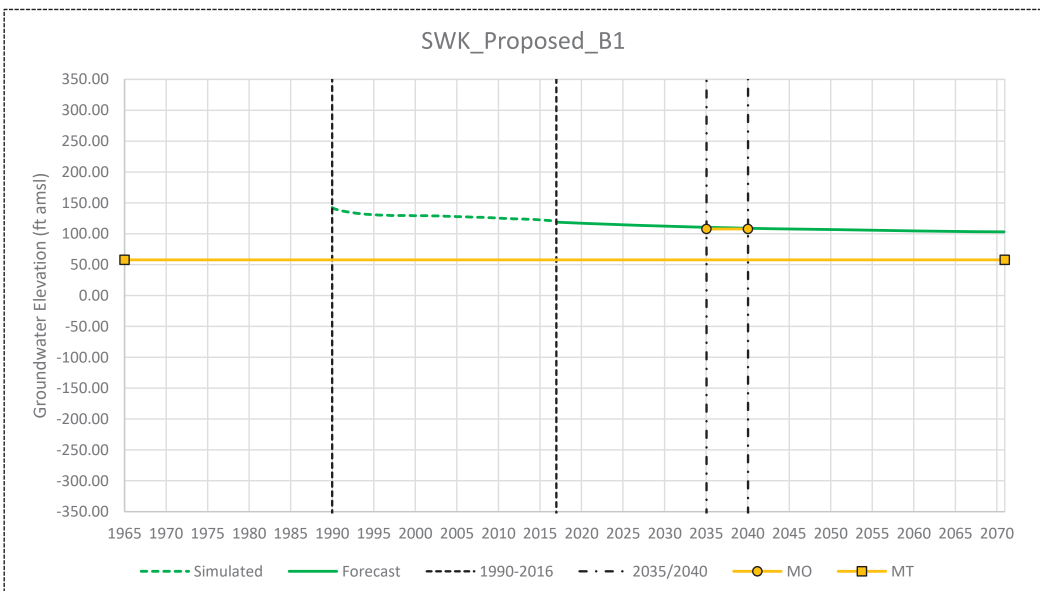


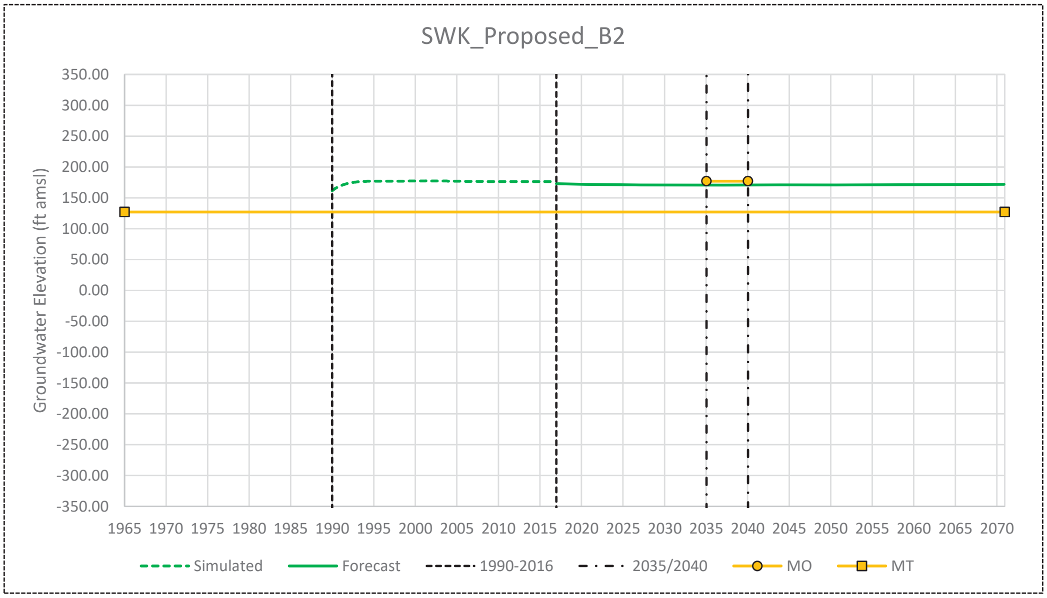
SFK_1610005-020
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

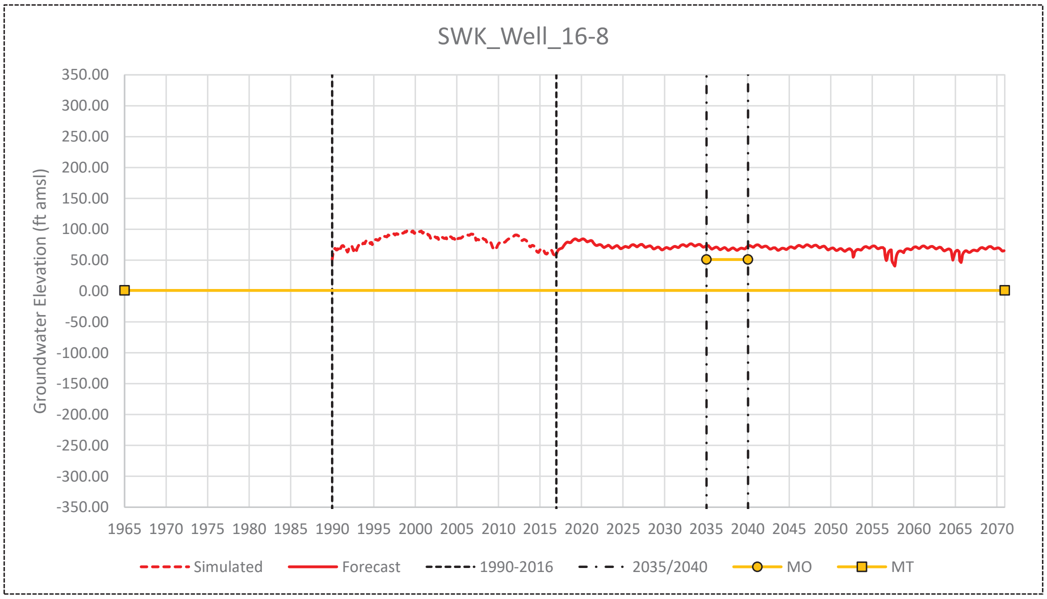

SFK_1610005-011
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

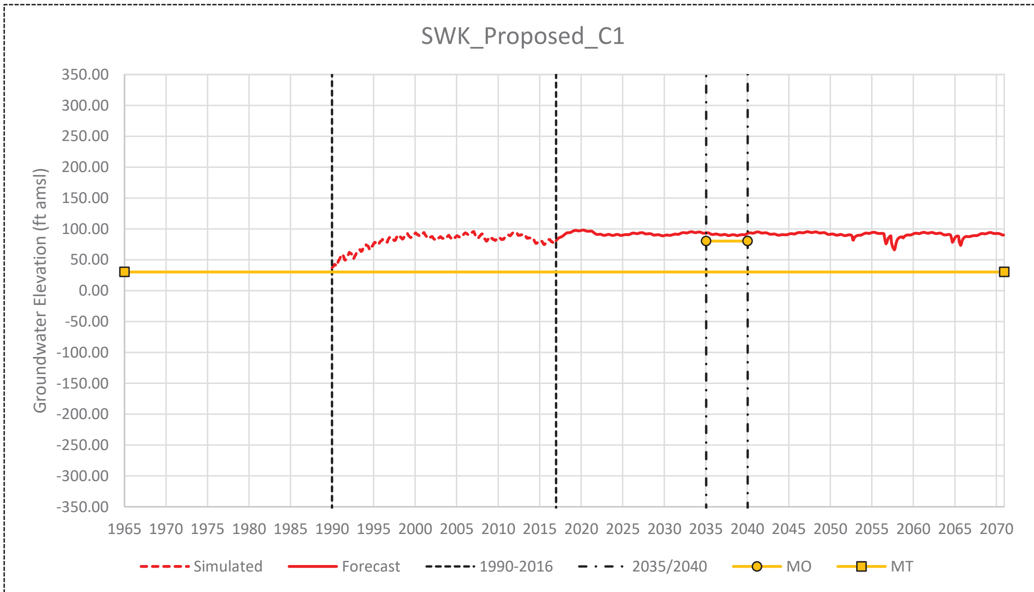

SFK_Proposed_C1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

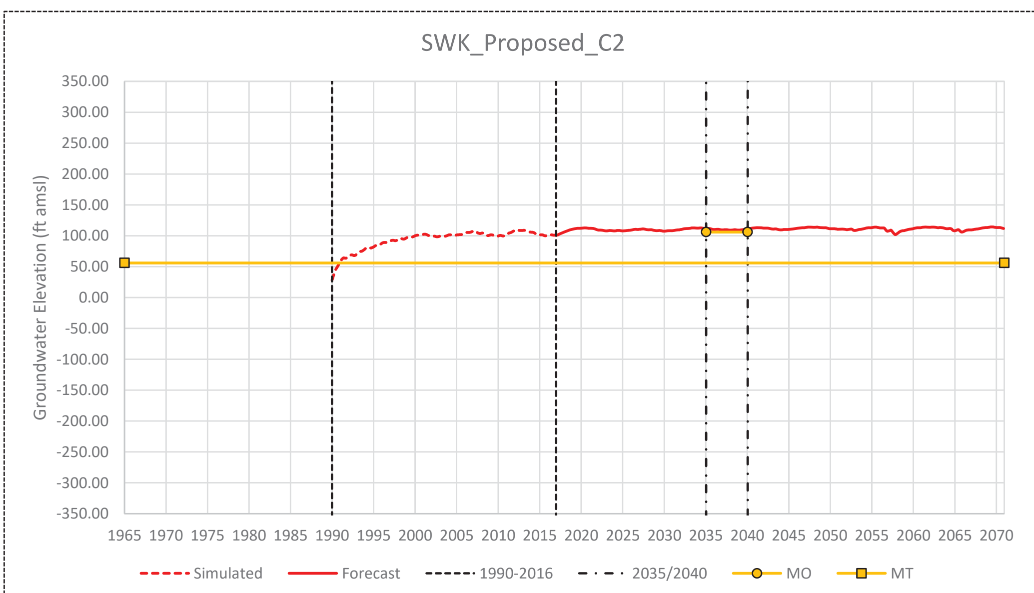

SWK_1610009-003
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

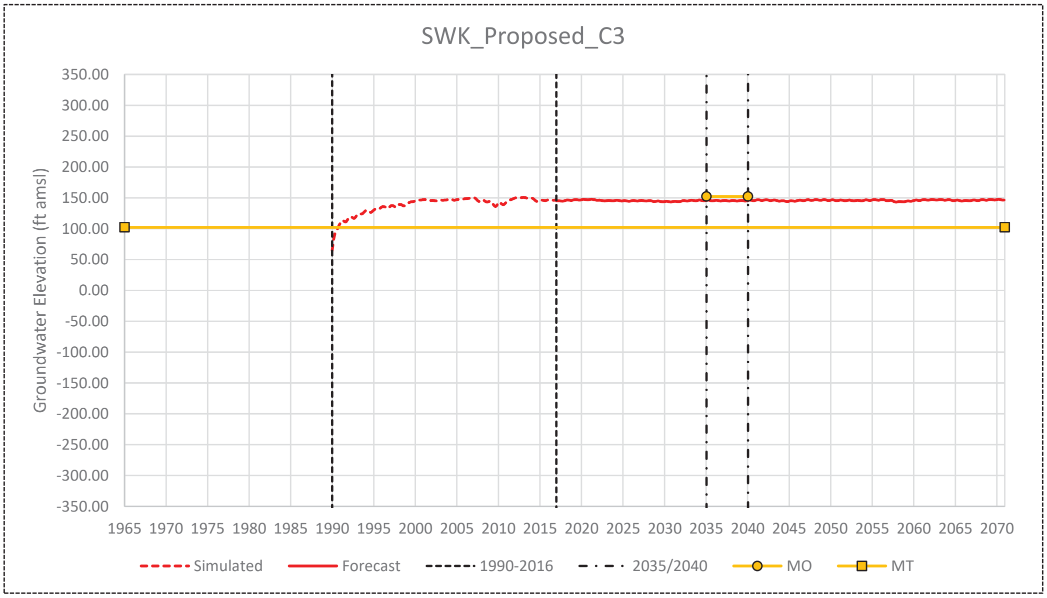

SWK_Proposed_B1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

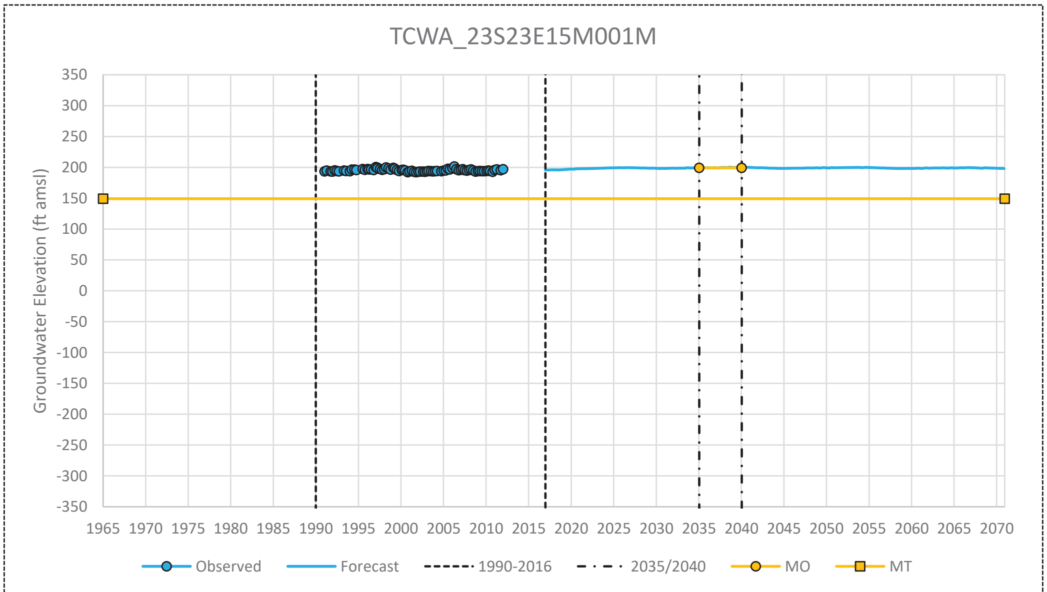

SWK_Proposed_B2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

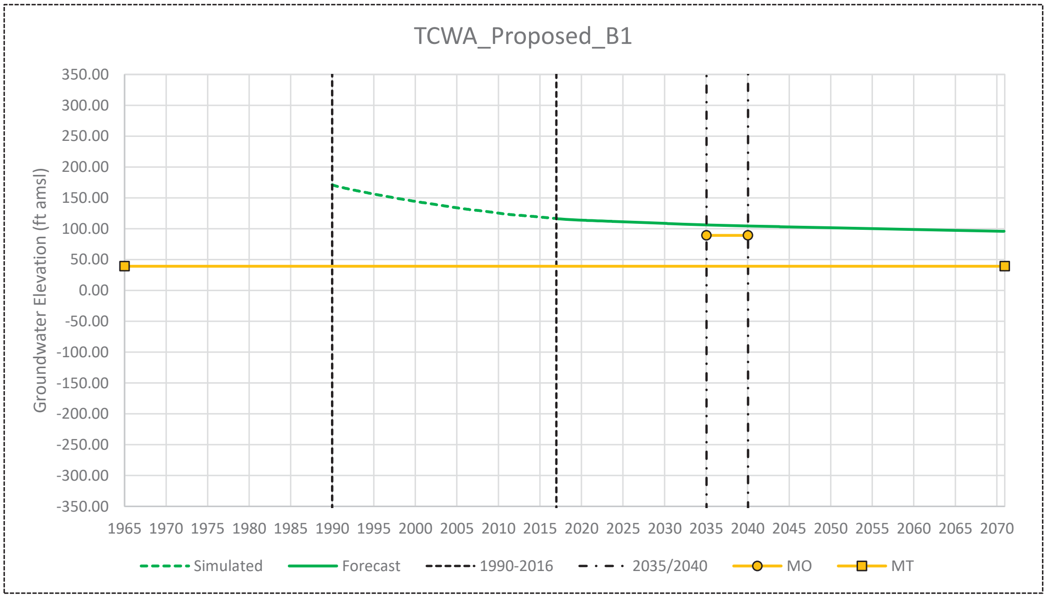

SWK_Well_16-8
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT


SWK_Proposed_C1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

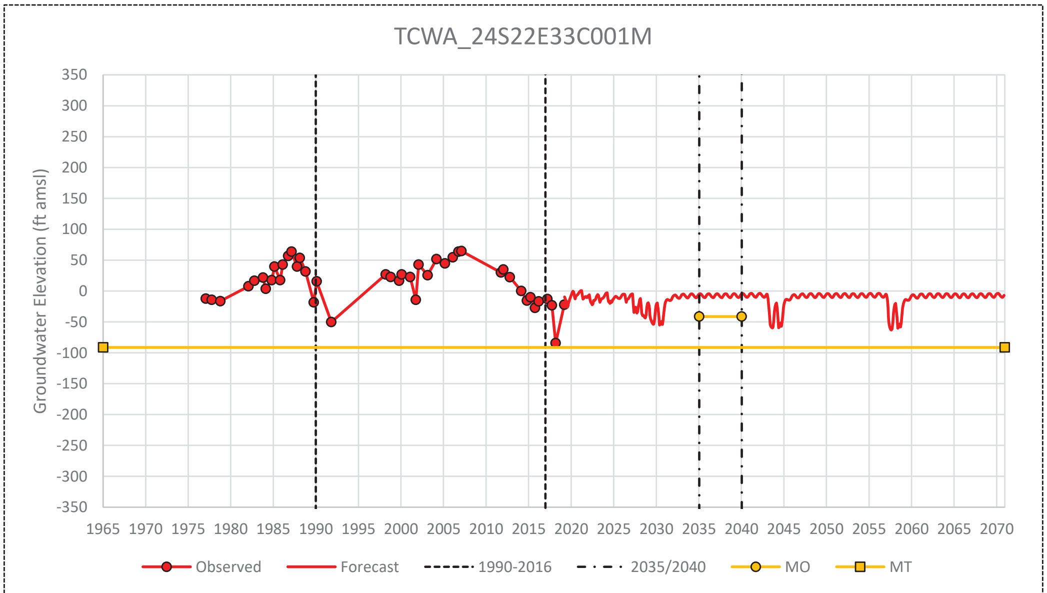

SWK_Proposed_C2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT


SWK_Proposed_C3
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

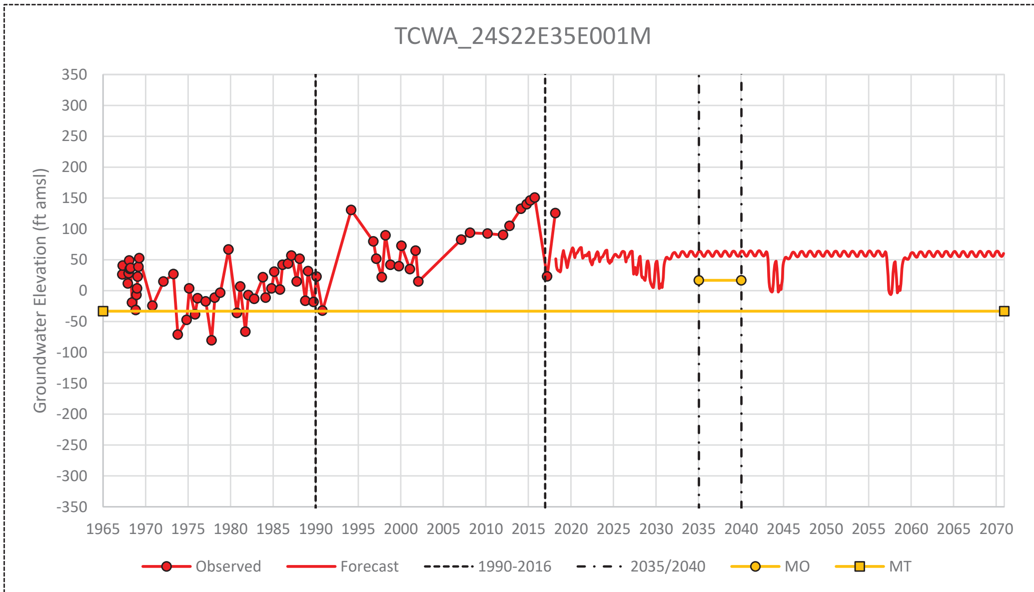

TCWA_23S23E15M001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

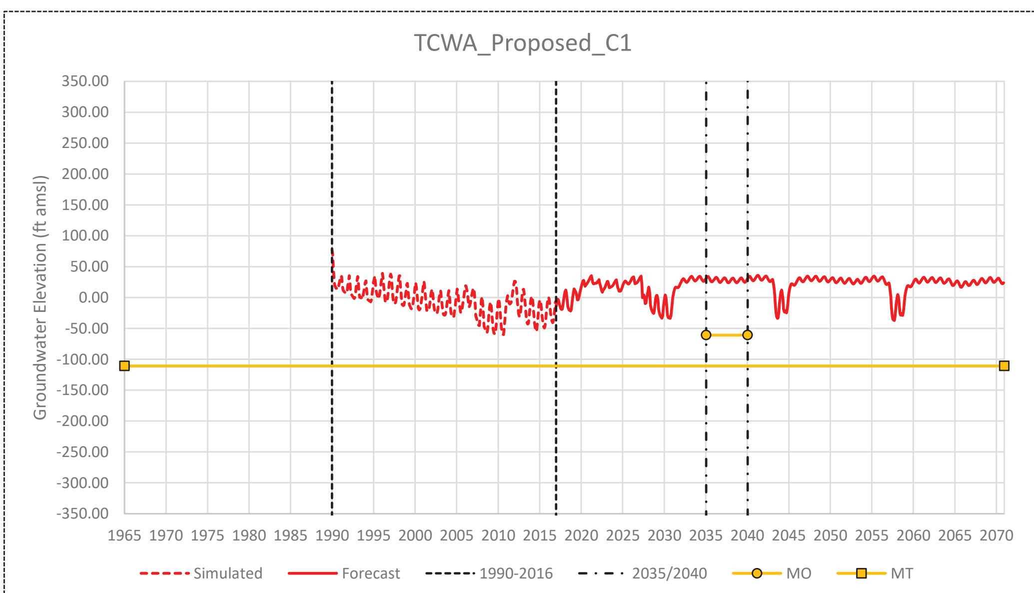


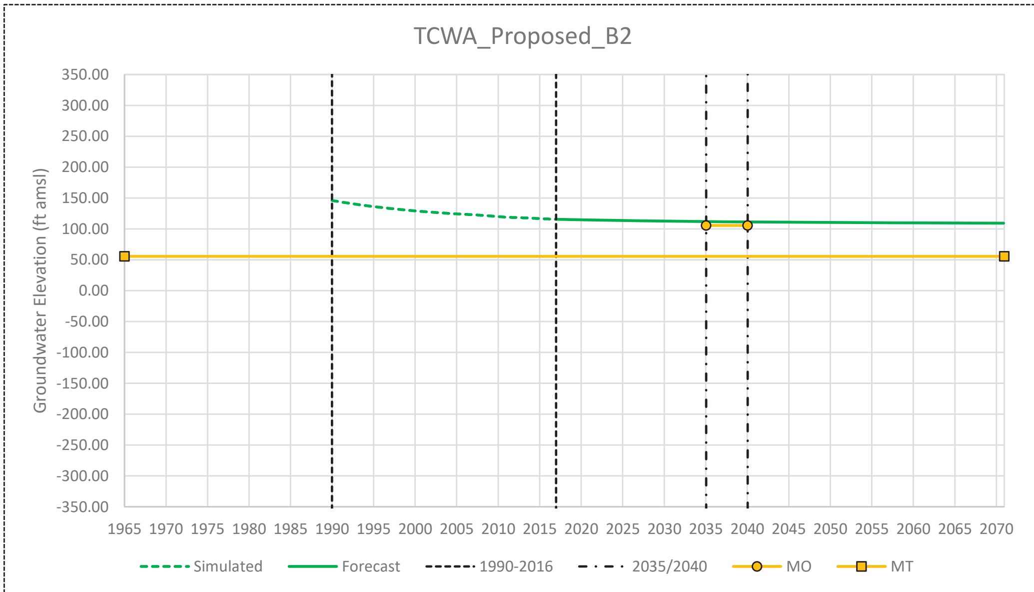
TCWA_Proposed_B1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT



TCWA_24S22E33C001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT


TCWA_24S22E35E001M
Groundwater Elevation (ft amsl)
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
-350
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Observed
Forecast
1990-2016
2035/2040
MO
MT

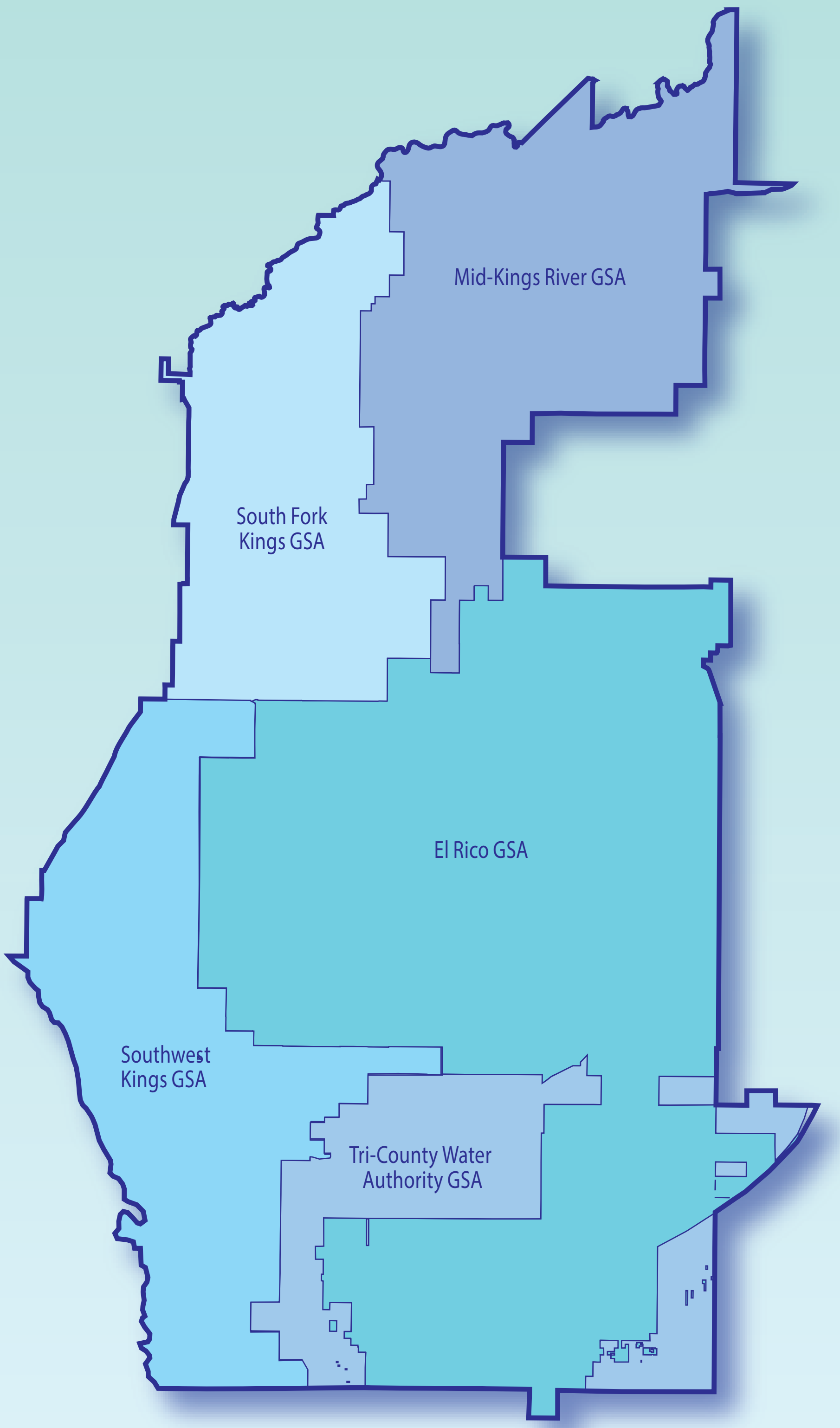

TCWA_Proposed_C1
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT


TCWA_Proposed_B2
Groundwater Elevation (ft amsl)
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
-50.00
-100.00
-150.00
-200.00
-250.00
-300.00
-350.00
1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070
Simulated
Forecast
1990-2016
2035/2040
MO
MT

July 2022

Tulare Lake Subbasin Groundwater Sustainability Plan

Addendum



MID-KINGS RIVER GROUNDWATER SUSTAINABILITY AGENCY

South Fork Kings Groundwater Sustainability Agency

El Rico GSA

SWK Southwest Kings Groundwater Sustainability Agency

TRI-COUNTY WATER AUTHORITY

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
Addendum	2022 Groundwater Sustainability Plan Addendum
AGR	agricultural uses
Amec	Amec Foster Wheeler
BMPs	best management practices
CCR	California Code of Regulations
COC	constituent of concern
CV-SALTS	Central Valley Salinity Alternatives for Long-term Sustainability
DBCP	1,2-dibromo-3-chloropropane
DWR	Department of Water Resources
ESA	European Space Agency
ETc	evapotranspiration
GAMA	Groundwater Ambient Monitoring & Assessment Groundwater Information
gpm	gallons per minute
gpm/ft	gallons per minute per foot
GSAs	Groundwater Sustainability Agencies
GSP	Groundwater Sustainability Plan
ILRP	Irrigated Lands Regulatory Program
InSAR	Interferometric Synthetic Aperture Radar
KRCD	Kings River Conservation District
LMT	local-scale minimum tolerances
MCL	secondary maximum contaminant levels
mg/L	milligrams per liter
MO	measurable objective
MSL	above mean sea level
MT	minimum threshold
MUN	municipal uses
N	nitrogen
OSWCR	Online System of Well Completion Reports
pCi/L	picoCuries per liter
RMS	representative monitoring site
RWQCB	Regional Water Quality Control Board
SGMA	Sustainable Groundwater Management Act
SJV	San Joaquin Valley
SMC	Sustainable Management Criteria
SMCL	secondary maximum contaminant levels
Subbasin	Tulare Lake Subbasin
SWRCB-DDW	State Water Resources Control Board, Division of Drinking Water
TCP	1,2,3-trichloropropane
TDS	total dissolved solids
TRE	TRE ALTAMIRA Inc.
TRS	Township-Range-Section
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTL	upper tolerance limit

1 INTRODUCTION

This Groundwater Sustainability Plan (GSP) Addendum (2022 GSP Addendum) was prepared on behalf of the five Groundwater Sustainability Agencies (GSAs) for the Tulare Lake Subbasin (Subbasin) identified by the Department of Water Resources (DWR) as Basin No. 5-022-12 (Bulletin 118). In compliance with the California Sustainable Groundwater Management Act (SGMA) of 2014, the GSAs adopted the Groundwater Sustainability Plan (2020 GSP) submitted to DWR on January 29, 2020. The five GSAs in the Subbasin are the Mid-Kings River, El Rico, South Fork Kings, Southwest Kings, and Tri-County Water Authority. The GSAs remain committed to coordinating and working together to implement the GSP and subsequent updates.

On January 28, 2022, the GSAs received a determination letter from DWR stating the 2020 GSP was considered "incomplete" alongside nine other Subbasins within the San Joaquin Valley. DWR stated that the GSP was considered incomplete as it "does not define undesirable results or set sustainable management criteria for groundwater levels, subsidence, and water quality in the manner consistent with SGMA and the GSP regulations." Upon receiving the incomplete determination, the Subbasin had 180 days to address the identified deficiencies and submit a revised GSP by July 27, 2022. The GSAs are submitting this 2022 GSP Addendum to address the three deficiencies outlined in the determination letter. The 2022 GSP Addendum has been prepared to specifically address the incomplete determination letter from DWR and should be considered a revision of the 2020 GSP. The decision was made by the GSAs to prepare this response as an addendum to the 2020 GSP for the sake of readability. Attached to the Addendum is a strike-out version of the 2020 GSP that clearly indicates the sections that have been replaced by this Addendum. The modified GSP along with this Addendum together form the complete Tulare Lake GSP.

In preparing this Addendum, the Subbasin management team consisting of the GSA managers communicated with DWR staff to better understand the evaluation criteria utilized by DWR in reviewing the 2020 GSP. While DWR staff were very helpful, the process was cumbersome considering the tight deadline allowed by the GSP Regulations. As such, we look forward to continued engagement with DWR as we prepare the upcoming five-year Plan update.

The GSAs are committed to remain compliant under SGMA and will continue to gather and report data through the Annual Reports while preparing for the upcoming five-year GSP update. Regular updates to the GSP will continue as more data becomes available and will continue to evolve as changes occur to improve sustainability efforts.

This Introduction section presents a summary of the Addendum and why the decision was made to prepare an Addendum, a summary of the stakeholder outreach efforts conducted during preparation of the Addendum, and a summary of the current basin conditions.

1.1 Addendum Outline

The GSAs decided to submit the response to the determination letter as an addendum to the GSP alongside a clean and strikeout version of the 2020 GSP due to the substantial revisions made to the

Sustainable Management Criteria (SMC) chapter of the GSP and additions to the Projects and Management Actions chapter. Chapter 4 of the 2020 GSP presents groundwater levels, subsidence, and water quality SMCs. The 2022 Addendum is organized similarly to the DWR determination letter and focuses on how the GSAs will avoid and minimize undesirable results and how SMCs are established. Deficiencies outlined in the determination letter are covered in Sections 2 through 4 of this Addendum and substantially replace Chapter 4 of the 2020 GSP. In addition, Section 5 of the addendum adds to Chapter 6 of the 2020 GSP which discusses Projects and Management Actions. The amended 2020 GSP is the primary document to reference and is supplemented by this Addendum.

1.2 Stakeholder Communication & Engagement

The stakeholder outreach and engagement efforts started during the preparation of the 2020 GSP were continued subsequent to submittal and during the preparation of this Addendum in general accordance with the existing Stakeholder Communication and Engagement Plan (2020 GSP, Appendix B). These efforts included considering the interests of all beneficial uses and users of groundwater and including them in the development of the 2022 GSP Addendum. The stakeholder engagement process during the limited time available for preparation of the GSP Addendum specifically included the following:

- Updates on the development of the Addendum at each GSA Board of Director meetings
- Updates on the development of the Addendum to GSA member agencies
- Direct outreach to agencies with relevant comments on the 2020 GSP
- Presentations to GSA stakeholder and advisory committees
- Digital communication to interested parties' lists
- Direct input from the public

1.2.1 Board of Director Meetings

The GSA Board of Directors have continued to meet in regularly scheduled monthly or bi-monthly meetings. As the GSP Addendum was discussed and prepared by the subbasin management team key, decisions were presented and discussed at each of the Board meetings. The Board meetings were noticed to the public and allowed for public comment and input.

1.2.2 Engagement with Interested Parties

Governmental agencies and special districts that submitted comment letters on the 2020 GSP were specifically communicated with to discuss their comments. These communications generally consisted of conference calls to better understand their concerns and how those concerns would be addressed in the GSP Addendum. These agencies included DWR State Water Project, DWR Division of Flood Management, and the Central Valley Flood Protection Board. In addition, other agencies that had input into the original GSP were also contacted including Kings County and the Cross Creek Flood Control District.

1.3 Basin Summary

The Subbasin is located in the south-central portion of the greater San Joaquin Valley, almost entirely within Kings County. The Subbasin covers an area of approximately 535,869 acres (about half the area of Rhode Island) and includes a dry lakebed once occupied by the former Tulare Lake. According to the United States Census Bureau, Kings County has an estimated population of 153,443 people as of July 2021. Approximately 57% of the population is Hispanic or Latino, approximately 30% of the population is white and approximately 20% of the population is foreign born. The area also includes the reservation for the historic Tache Tribe south of Lemoore, as well as the US Navy's largest inland base the Lemoore Naval Air Station. The County has an estimated 1,707 total employer establishments and the median household income is $61,556 which is significantly less than the California average of $78,672. The area is extremely rural, with approximately 46,758 housing units and an average population density of 110 people per square mile.

Land use within the Subbasin and surrounding areas is predominantly agricultural with many families having farmed in the area since the 1850s. There are six localized urban areas with the cities of Hanford, Lemoore, and Corcoran and the communities of Armona, Kettleman City and Stratford. It has been estimated that roughly 5-10% of the County's population lives in the rural areas outside of the cities and communities.

The only water generated within the Subbasin is from pumped groundwater which is used for agricultural, municipal/industrial, and domestic needs. The Subbasin receives a significant source of groundwater recharge from surface water received primarily from the Kings, Kaweah, and Tule Rivers as well as imported water from the State Water Project. The Kings River and imported water contribute the most water to the Subbasin while the Kaweah and Tule Rivers only contribute during average to above average rainfall years. Water is imported into the Subbasin through the State Water Project and Central Valley Project as well as operated well fields in the adjacent Tule Subbasin.

Historically, recharge within the Subbasin was dominated by rivers and streams emanating from the Sierra Nevada mountains and lake terrain along the periphery of the Tulare Lake. Over time, development of extensive water supply delivery systems altered recharge, limiting the amount of water received within the Subbasin and offsetting the water balance (inflow versus outflow). The reduction in surface water supply over time has increased reliance on groundwater pumping. The increased reliance on groundwater pumping has also likely resulted in additional land subsidence.

Land subsidence due to groundwater withdrawals has been well documented and has affected significant areas of the San Joaquin Valley since the 1920s, including in the Subbasin. Natural subsidence has and continues to occur in this area as an effect of the dried Tulare Lake and surface water delivery systems.

The Subbasin is located at the bottom of the valley floor and the historic Lake Bottom where floodwater from the largest flood events collects. As the Subbasin faces longer periods of dry years, the dependency on groundwater pumping increases as agriculture is the Subbasin's primary economic driver outside of government services. The GSAs are committed to achieving sustainability and recognize the challenges ahead.

1.4 Context for SMCs

The groundwater conditions in the Subbasin area developed over many decades and the local GSAs have plans to stabilize the groundwater level declines strategically over the SGMA Implementation Period, while avoiding economic impacts that would destabilize the economy of the predominantly agricultural area. The conditions at the beginning of the Implementation Period are:

1. The area has been developed primarily for agriculture and has been using local surface water since the late 1800s. The primary economy for the area outside of government services is agriculture or is agriculturally linked. This economy sustains the local cities and communities in the Subbasin.
2. The climate of the area experiences regular cycles of drought and flood, but the recovery during the flood periods does not completely offset the decrease in storage developed during the drought years.
3. Long-term groundwater level declines in the portions of the Subbasin prior to SGMA Implementation are about 2 to 3 feet per year on average in the aquifer above the Corcoran Clay (also referred to as the E-clay).
4. Historically the area has been known for cotton production. However, through the 1990-2000s, there was a significant transition as dairies moved into the area and as row crops were converted to nut orchards. Now, many farmed acres linked to dairy facilities are required to have multiple crops per year to justify the agronomic use of the waste stream from the dairy. Also, the acres planted to permanent crops have significant water demands that cannot be avoided or reduced in drought years.
5. The useful lifespan of existing wells is 15 to 20 years due to persistent groundwater level declines, particularly during critical droughts.
6. Subsidence is a longstanding issue in the area and is a product of local geology (Tulare Lake bed soils) and wells being drilled to deeper zones when they are replaced. Local subsidence issues have been accommodated for many years prior to the enactment of SGMA, but subsidence rates have increased since 2007.

2 REVISED SMC FOR GROUNDWATER LEVEL

This section summarizes the revised approach to defining the SMC for groundwater level. It will be used in conjunction with the SMC thresholds established previously in the initial GSP submitted in January 2020. This addendum therefore describes SMC values that represent "thresholds" that will be in place until the GSP update in 2025.

This section specifically addresses the Statement of Findings from DWR regarding determination of incomplete status for the Tulare Lake Subbasin GSP submitted in January 2020, as summarized below:

> *The GSP lacks justification for, and effects associated with, the sustainable management criteria for groundwater levels, particularly the minimum thresholds and undesirable results, and the effects of those criteria on the interests of beneficial uses and users of groundwater.*
>
> *The GSP does not explain how it considered and addressed potential impacts of dewatering wells in the context of the undesirable result of significant and unreasonable depletion of supply associated with the chronic lowering of groundwater levels. Furthermore, the GSP does not describe how the GSAs determined that significant and unreasonable depletion of supply will be avoided by managing to the established criteria for chronic lowering of groundwater levels.*
>
> *The GSP does not provide supporting information for how it determined that the selected minimum thresholds are consistent with avoiding undesirable results. Without supporting information, Department staff are unable to assess whether the GSAs have established sustainable management criteria based on a commensurate level of understanding of the basin setting or whether the interests of beneficial uses and users have been considered.*

More specifically, the corrective actions requested by DWR are addressed:

> *Corrective Action 1*
>
> *a. The GSAs should revise the GSP to describe, with information specific to the Subbasin, the groundwater level conditions that are considered significant and unreasonable and would result in undesirable results. The GSAs may choose to define the conditions in terms of the negative effects they mention in their GSP (e.g., water well problems, subsidence, and deterioration of water quality) or may use other methods to establish a different trigger that would define when an undesirable result would be experienced in the Subbasin. The GSAs should then explain or justify how the quantitative definition of undesirable results is consistent with avoiding the effects the GSAs have determined are undesirable results.*
>
> *b. The GSAs must revise the minimum thresholds for chronic lowering of groundwater level to be consistent with the requirements of SGMA and the GSP Regulations. Rather than relying on a projection of continued groundwater level and storage decline to define the undesirable results and minimum thresholds, the GSAs must determine and document criteria based on a significant and unreasonable depletion of groundwater supply, informed by their understanding of the Subbasin's beneficial uses and users. The GSAs must document the effects of their selected minimum thresholds on beneficial uses and users in the Subbasin. In particular, if the GSP retains minimum thresholds that allow for continued groundwater level decline then the GSP should*

explain the anticipated effects of that decline on beneficial uses and users, and should clearly explain whether projects and management actions have been identified to address impacts to those uses and users. If the GSP does not include projects and management actions to address impacts to uses and users that will be impacted by continued declines in groundwater levels, then it should clearly explain the rationale and analysis that led to that decision.

2.1 Potential Effects to Beneficial Uses and Users

In the Subbasin generally, the effects of water level decline to beneficial uses are related to impacts to water supply wells and subsidence. Subsidence related impacts are discussed in detail in Section 3 of this Addendum. The impacts of the water level decline are primarily to municipal, industrial, agricultural, and domestic wells. A review of available Kings County well permits indicates that all four types of wells have been installed to deeper depths since the most recent drought. Agriculture is the main economic enterprise in the Subbasin, so effective management of groundwater is critical to the continuation of economic interests of Subbasin communities.

Continued groundwater level declines have the potential to cause some wells to become unusable requiring deepening and/or replacement to reach groundwater. Continued groundwater level declines could also force some well owners to lower or replace existing pumps if the existing well pump is not sufficiently deep. Decreases in groundwater levels also increase the energy needed for pumping. Groundwater levels that would make a water supply well unusable for supply purposes were considered an impact. The MT values across the subbasin considered available information on well locations and depths to minimize impacts to groundwater uses and users.

The GSAs recognize that municipal and domestic wells with substantially decreased capacity or that are made unusable due to groundwater level declines are an impact that needs to be avoided. While agricultural users represent more than 90% of the groundwater use, the GSA's efforts are focused on setting water levels to protect all uses and users.

2.2 Approach

The revised approach for developing the SMC for groundwater level is based on a regional analysis of aquifer geometry and well completion depths. This approach does not rely on trend analysis of water levels or the results of the groundwater modeling. Instead, it defines a mapping framework within which the groundwater level SMC is defined. Within this framework, the groundwater infrastructure (i.e., wells) used to access the groundwater beneficial uses has been statistically analyzed using DWR's OSWCR database of well completions in the Subbasin. The approach is shown schematically on Figure 2-1 and described in further detail below.

Step 1: The first step involved defining depth ranges for each of the aquifer zones that could be used to query the OSWCR database and identify the wells completed in each zone. The depth criteria used were:

- A-zone = Well Completion Depths < 100 ft
- B-zone = Well Completion Depths 100 to 700 ft

- C-zone = Well Completion Depths >700

This aquifer geometry and well completion criteria are used to quantify the minimum threshold (MT) within each aquifer zone. It should be noted that that the depth of the top of the C-zone (Corcoran Clay) varies across the Subbasin and is much shallower than 700-feet in the northern portion of the Subbasin. This depth variation will be more carefully considered in the future when the data gaps of well location and construction are more fully addressed.

Step 2: The second step involved defining a grid that could be used to characterize the ground surface elevation and the elevation of the top of the C-zone, which is defined by the E-clay (Corcoran Clay). The grid approach was used because in many cases only the well depth is reported in the OSWCR database, which cannot be translated to an elevation and integrated with a groundwater elevation SMC. The grid provides a more uniform and consistent management framework for evaluating the number of wells and completion characteristics in a given area. The grid was established based on Township-Range-Section (TRS), so each grid cell represents one section (640 acres). Using this grid system, wells without elevation reference points can be described in terms of approximate elevation and subjected to statistical analysis. Similarly wells that do not have exact geographic coordinates can be incorporated into an analysis as long as there is a TRS scale location.

Step 3: This step produced two TRS framework maps for the SMC which are shown on Figure 2-2 (ground surface elevation), and Figure 2-3 (top of E-clay elevation). Each of these figures were derived from figures in Chapter 3 of the 2020 GSP and the line contours from these figures were digitized to calculate the average elevation for each grid cell. The line contours for the E-clay were based on an original map prepared by Croft (1972) that was also used and modified by the USGS (Faunt et al, 2009). There are nine color-zones for the E-clay generated at 100-foot elevation intervals, so each color zone corresponds to a specific elevation range. For example, the green areas on Figure 2-3 represent areas where the E-clay is at an elevation of between -200 and -300 feet below mean sea level. Table 2-1 summarizes the classification zones of average E-clay elevation shown on Figure 2-3.

Step 4: This step included a query and classification of over 6,000 wells in the OSWCR database that are located in the Subbasin. Each well was classified according to its TRS grid location, the aquifer zone, the year of completion, and the reported Purpose of Use for the well. Only wells with reported Purpose of Use as Domestic, Public, Agriculture, Irrigation, or Industrial were taken to the next step of the analysis. Wells reported as Unknown, Geotechnical, Monitoring, Abandonment, or other similar purposes were not used in the subsequent analysis. Table 2-2 summarizes the well query by aquifer and color zone. There was no ground-truthing of any wells reported in the OSWCR database to verify their status, location, or completion because the available time did not allow. However, several shallow older wells were removed from the statistical analysis, as described in Section 2.3. A series of maps and tables summarizing Public/Domestic and Agricultural/Industrial wells across the Subbasin was then produced. The maps show the number of wells in each TRS grid section and the purpose of use (Public/Domestic or Agricultural/Industrial). The maps use the elevation of the E-clay as the base-layer, so that each grid cell and number of wells in that cell is associated with an average elevation of the E-clay.

- Figures 2-4a and 2-4b show the number of wells in each TRS grid completed in the A-zone (completion depths of less than 100 feet). Figure 2-4a shows the number of public/domestic wells and Figure 2-4b shows the number of agricultural/industrial wells
- Figures 2-5a and 2-5b show the number of wells in each TRS grid completed in the B-zone (completion depth of 100 to 700 feet). Figure 2-5a shows the number of public/domestic wells and Figure 2-5b shows the number of agricultural/industrial wells
- Figures 2-6a and 2-6b show the number of wells in each TRS grid completed in the C-zone (completion depth greater than 700 feet). Note that these figures include wells that could be completed across the E-clay and also tap into the Lower B-zone. Figure 2-6a shows the number of public/domestic wells and Figure 2-6b shows the number of agricultural/industrial wells

Tables were also produced to summarize the number of wells and completion statistics within each E-clay zone.

- Table 2-3 summarizes the well completion statistics for wells in the C-zone or deeper
- Table 2-4 summarizes the well completion statistics for wells in the B-zone
- Table 2-5 summarizes the well completion statistics for wells in the A-zone

Step 5: A statistical analysis of well completion elevations for B-zone wells was then completed to define MTs across the entire Subbasin for the B-zone. Unlike the original approach to defining the MT in the 2020 GSP, this statistical approach focuses on well completion depths, rather than observed water level trends. In this way, the analysis accounts for all beneficial users, particularly public and domestic uses, and defines an MT throughout the entire Subbasin, regardless of whether there is a designated representative monitoring site (RMS) well. This approach focuses more clearly on broad beneficial use protection and allows quantification of potential impacts to beneficial uses if the MT is reached in each area. A methodology based on a radius around each RMS well was considered, but this would have excluded many wells from the analysis and there would be overlapping areas around individual RMS wells. Because the C-zone is a confined aquifer, well completion elevations were not used to define the MT. Instead, the MT was defined in relation to the elevation of the E-clay to ensure that water-levels do not decline to the top of the E-clay (see Section 2.3.1). A similar approach was taken for the A-zone and the MT is defined with respect to the elevation of the A-clay, which defines the extent of the A-zone aquifer.

Step 6: The final step was to evaluate observed water levels in RMS locations established in the 2020 GSP as a “reality check” to the statistical analysis and E-clay elevations. As noted in Section 2.3, there are a number of potential uncertainties in well completion data contained in the OSWCR database. Similarly, the average elevation of the E-clay across an entire TRS grid cell does not capture fine-scale influences on the observed groundwater level in any given RMS well. The intent of the approach was to use areas to aggregate well completion data across the entire Subbasin for the MT statistical analysis, while being representative of the groundwater flow pattern and how wells are operated across the Subbasin. However, there were instances where the observed water levels in existing RMS wells were at or below the MT as defined by the statistical analysis, despite no documentation for wells going dry in the vicinity of the RMS well. Any methodology based on areas to base MTs on would encounter the same issue, where local influences on the observed groundwater level in each RMS well will not always align with an area-based MT.

2.3 Undesirable Results Lowering of Groundwater Level

23 CCR §354.26(a) *Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

Undesirable results occur when groundwater conditions within the Subbasin result in significant and unreasonable impacts to a sustainability indicator. The revised SMC for groundwater level defines an undesirable result with respect to exceedance of a numerical threshold (a minimum threshold or MT) which would cause a significant and unreasonable loss of beneficial uses for water supply, particularly for domestic/public supply. The MT for groundwater level is a groundwater level that would make a water supply well unusable for supply purposes.

2.4 Minimum Thresholds for Lowering of Groundwater Level

23 CCR §354.28 (a) *Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.*

This section describes the methodology for quantifying the undesirable result and associated MT for groundwater level for each aquifer (A-, B-, and C-zone). The methodology used to calculate the MT is different than what was used in the 2020 GSP

2.4.1 C-Zone

C-zone wells are completed at depths of greater than 700 feet in a confined aquifer, so the ability to maintain sufficient groundwater supply is not dependent on the completion elevation of the well, but is more related to well performance and whether pumping causes water levels to drop below the top of the confining layer. When pumping in a confined aquifer lowers water levels below the confining layer, the aquifer in the immediate vicinity of the well converts from a confined to unconfined aquifer. There is limited published literature regarding effects of the transition from confined to unconfined aquifer conditions, but a recent white paper prepared to the Southern Trinity Groundwater Conservation District in Texas (Yelderman, 2020) summarized the limited evaluations of this phenomenon and found that, in general, conversion resulted in reduced well yields and reduced rates of drawdown. In the oil and gas industry, casing/well failures resulting from reservoir depletion are not uncommon. A review of historical casing/well failure events in a highly compacting sandstone oil field included a comprehensive geomechanics analysis of various casing-damage mechanisms (tension, axial compression, shear, and bending) related to reservoir depletion (Furui, 2012). Similar geomechanical principles also affect wells when there is ground subsidence. The potential for conversion from confined to unconfined conditions, combined with how mechanical forces act on both the well casing and surrounding formation materials in a confined aquifer, indicates that lowering of groundwater levels below the elevation of the confining layer could make a water supply well unusable for supply purposes.

The MT for groundwater level in the C-zone is defined with respect to the elevation of the E-clay, which is the principal regional confining unit in the Subbasin. To quantify the MT, an analysis of the typical specific capacity of wells completed in the C-zone was conducted. Specific capacity is calculated by dividing the pumping rate by the observed drawdown and is reported in units of gpm/ft. A well with a high specific capacity can produce a given flow rate with less drawdown compared to a well with a low specific capacity. By assigning a target flow rate for a well completed in the C-zone, the drawdown (in feet) at that pumping rate can be calculated from the specific capacity. This drawdown (in feet) is then simply added to the elevation of the E-clay to represent the minimum water level elevation that would allow pumping at the target flow rate without lowering groundwater levels below the E-clay during pumping.

There are limited pumping test data available within the Subbasin, but a compilation of 17 aquifer tests by the USGS indicates a median specific capacity of 68 gpm/ft and a 90th-Percentile specific capacity of 20 gpm/ft (McClelland, 1962). These results are similar to a summary of 75 specific capacity tests in the C-zone in the Tule Subbasin (TCWA Tule GSP, 2020). The schematic of Figure 2-7 illustrates the methodology for calculating the C-zone MT.

The MT for groundwater level in the C-zone is defined based on the expected drawdown from a C-zone well at a pumping rate of 1,000 gpm, at a specific capacity of 20 gpm/ft. The value of 1,000 gpm was selected based on discussions with stakeholders for their wells completed in the C-zone. Using this methodology, the expected drawdown is 50 feet (1,000 gpm divided by 20 gpm/ft). This expected drawdown is simply added to the elevation of the E-clay to define a groundwater elevation. If groundwater elevations fall below this level, 10% of wells in the C-zone would not be able to pump at 1,000 gpm without drawing water levels below the E-clay. The quantitative definition of significant and unreasonable lowering of groundwater levels in the C-zone is therefore a groundwater elevation of 50 feet above the elevation of the E-clay. As the E-clay varies in elevation across the Subbasin, the MT will also vary across the Subbasin.

This methodology has a number of uncertainties associated with the actual depth to the E-clay and how representative the specific capacity data are for wells in the Subbasin. However, it produces TRS-scale management criteria that are representative of actual hydrogeologic conditions, typical pumping rates, and general well performance. It also aligns with minimizing the effects of ground subsidence, since drawdown below the top of the E-clay accelerates compaction of the E-clay and exacerbates ground subsidence. The methodology does not account for situations such as interference drawdown between adjacent pumping wells, or other complicating factors that may have affected the pumping test data used in the analysis.

2.4.2 B-Zone

Minimum thresholds (MT) for the B-zone were established using the OSCWR database records and reflect a condition to minimize impacts to all uses and users. The MT was calculated to represent conditions where water-levels fall below the bottom elevation of wells in the B-zone. The quantitative definition of the MT elevations is based on a statistical percentile for well completion elevations in the B-zone.

The percentile statistic represents the number of wells completed above or below the percentile elevation. For example, an 90th percentile statistic equal to 50 feet means that 90% of the population of wells are completed below an elevation of 50 feet. This means that if the groundwater elevation was 50 feet, 10% of the wells in that well population would be potentially vulnerable to failure because they are completed at or above an elevation of 50 feet. This percentile calculation is made for each population of wells within a given E-clay zone. Figure 2-8 illustrates the percentile approach for calculating the MT for the B-zone.

In order to calculate the MT, the OSWCR database was modified based on a review of the Kings County well permit database and a number of wells from the B-zone were removed from the statistical calculation. In this region, as groundwater levels have declined over time, wells have been drilled deeper and generally the shallower wells are no longer in use. The OSWCR database illustrates that there have been periods when the number of shallow wells installed in the Subbasin has decreased as water levels in the B-zone aquifer have declined over time. Historically, well owners in the Subbasin have adapted to a “typical” lifespan for shallower wells of 30 years or less. As water levels have declined, well owners have become accustomed to having to re-drill or deepen their wells. This is illustrated in Figure 2-9, where the number of wells completed at elevations shallower than 200 feet reaches relative highs in 1977, 1992 and 2003 and then drops significantly. By 2010, the number of well completions shallower than 200 feet was less than five per year, presumably because it became “common knowledge” that water levels had declined below 200 feet and were unlikely to recover. For this reason, wells completed at depths shallower than 200 feet and before the year 2000 have a high likelihood of either being abandoned, deepened, or not used currently for beneficial uses. Therefore, these wells were removed for the percentile statistics calculation. While the OSWCR database shows a total of 2,048 wells in the B-zone, the MT statistics were calculated based on a total of 1,421 wells in the B-zone.

Other MT statistical methods, such as choosing a radius around RMS well locations, were considered but were not used because they would have excluded many wells and created overlapping areas around individual RMS wells. A key objective of the regional approach to defining the MT was to ensure that all wells likely to be actively providing beneficial uses for domestic/public supply were incorporated into the statistical analysis so that an MT could be specified across a broad area and not solely at a single RMS location.

Table 2-6 summarizes the percentile statistics used to establish the MT for wells in the B-zone. The percentile statistic was translated into two additional quantitative values as follows:

- The number of wells that would be potentially vulnerable to failure (Table 2-7). The value is calculated by simply multiplying the number of wells in a given zone by a percentile level. For example, there are 358 public/domestic wells in the Orange zone. The 90th percentile statistic of well records represents a groundwater level where 10% of the well records reflect completion at an elevation shallower than 56 feet MSL (see Table 2-7). Therefore, records indicate 36 wells in the Orange zone (358 x 10%) may be vulnerable to failure if groundwater levels drop below an elevation of 56 feet MSL.
- The available drawdown within the B-zone (Table 2-8). This calculation represents how much saturated thickness remains below a given percentile elevation. It is simply the difference between the percentile elevation and the top of the E-clay. Areas where there is a large saturated

thickness below the percentile elevation are more favorable for deepening wells in the B-zone to avoid or mitigate the impact compared to areas with a small saturated thickness.

For wells where the observed water levels were at or below the MT as defined by the statistical analysis, the MT was set 20 feet below the lowest recorded water levels since 2015. These values would still be protective of water uses and users in the area as the water levels have already dropped to these levels. Shallower wells in the area would have already been impacted prior to SGMA implementation.

Table 2-6 also includes separate percentile statistics for areas near the Kings River. This area, designated as the R-zone, is recharged by higher water quality from the Kings River and remains a viable groundwater supply for public/domestic uses. This area is shaded and designated as the R-zone in Figure 2-4. Based on the OSWCR database query, there are 60 public/domestic wells in the R-zone. In these areas, MTs are defined based on percentile statistics for well completion depth, similar to the methodology used for the B-zone.

The SMC approach presented here provides an initial statistical approach to quantifying significant and unreasonable lowering of groundwater level across the large number of wells in the Subbasin. The GSAs selected the 90th percentile groundwater elevation to define the MT associated with significant and unreasonable lowering of groundwater level. This MT is protective of beneficial uses because 90% of the domestic wells completed in the B-zone have completion intervals below this elevation. This MT also implies that the GSAs in the Subbasin are potentially willing to mitigate as many 152 B-zone wells and 25 R-zone wells used for domestic or public supply.

The GSAs believe that the MT will be protective of beneficial uses in the B-zone and, in conjunction with a mitigation program (described in Appendix D), will avoid a significant and unreasonable loss of beneficial uses. The GSAs recognize that mitigation and adaptation to the proposed SMC for groundwater level requires better information on actual well conditions and will require case-by-case assessments of whether beneficial uses have been impacted at a given point in time. Work is currently underway to develop an improved well database and web-interface that will enable the GSAs to efficiently verify well locations and/or implement registration of well information by individual landowners. This will then link to Kings County's parcel and well permit systems. The GSAs are committed to working with landowners to protect beneficial uses and implementing appropriate mitigations to insure continued access to beneficial uses.

2.4.3 A-Zone

A-zone wells are completed at depths of less than 100 feet in a thin unconfined aquifer that relies primarily on recharge from uncontrolled, poor quality, stormwater and agricultural run-off and leakage from irrigation canals. This results in generally poor water quality and significant variability in seasonal water levels and water availability. The A-zone supplies can be used for public/domestic supply with treatment, but the aquifer is not regionally reliable supply as it is connected with surface water recharge that does not occur in dry years. The GSAs would not encourage use of the A-zone as a groundwater supply for public/domestic use primarily because of the reliability issues. Also, the GSAs would not have the authority to stop local water rights holders from converting their earthen canals to pipelines to minimize seepage and losses.

There are reportedly as many as 377 A-zone wells used for domestic or public supply. As described previously, the number of these wells that are used for beneficial use is not known and is likely less. Historically, groundwater levels have routinely dropped to the top of the A-clay (see Appendix A), presumably making many of these wells unsuitable for water supply on a regular basis. These fluctuations in water level are not the result of pumping conditions that the GSA can regulate. They are the result of variations in precipitation, run-off, and delivery of water for irrigation. Wells in the A-zone will be included in the well registration efforts currently in progress and the GSAs will attempt to verify well locations and document beneficial use. The GSAs will also consider appropriate mitigation or management efforts for A-zone wells (in accordance with the mitigation plan framework described in Appendix D). Mitigation approaches will include consideration of deepening of A-zone wells into the B-zone, restricting agricultural pumping in areas where there are clusters of domestic wells, or filtration requirements that would improve water quality.

2.4.4 Summary and Relationship to Other Sustainability Indicators

The proposed MT for groundwater levels is summarized in Table 2-9 for each aquifer and E-clay zone. The groundwater level MTs are considered "stand-alone" thresholds for groundwater level but are related to SMCs for groundwater storage and subsidence as described below.

DWR's requested corrective action did not include a request to update the Groundwater Storage SMC, so the original groundwater storage MTs and Measurable Objectives (MOs) from the 2020 GSP have not been changed. However, the groundwater storage SMC will be revisited for the 2025 GSP update through further analysis using a groundwater flow model. The groundwater level MTs specified in this addendum will be factored into the revision of the groundwater flow model, which will then be used to calculate the minimum groundwater storage volume associated with the groundwater level MT. This will then factor into the definition of the groundwater storage MT and thereby tie it to beneficial uses in each aquifer zone.

DWR's requested corrective action includes a request to update the Ground Subsidence SMC, which is described in Section 3. The subsidence SMC described in Section 3 is focused on DWR's specific request to *"define metrics for undesirable results and minimum thresholds based on the level of subsidence that substantially interferes with surface land uses."* In this regard, the SMC is focused on levels of subsidence that would result in impacts to specific types of infrastructure, which are assumed to represent the surface land uses that are being protected by the Subsidence MT. However, groundwater levels in the B-zone and C-zone aquifers generate the relative magnitudes of the effective stresses acting on the clays in the aquifer system and are the underlying physics driving subsidence. This is described in greater detail in Section 3. The MTs for groundwater levels represent one component of what levels of subsidence might occur, but the variables and relationships that cause subsidence are very complex and require modeling to produce quantitative values. The connection between groundwater level and subsidence will be revisited for the 2025 GSP update through a revision of the groundwater flow model, which will be then used to calculate groundwater pumping levels that would minimize subsidence and avoid associated undesirable results. This will more explicitly link groundwater pumping to observed and projected subsidence at different levels of pumping.

2.5 Representative Monitoring Sites (RMS) for Groundwater Level

Table 2-10 presents a revised table of MTs for each RMS well originally identified in the 2020 GSP (Chapter 5) and Figure 2-10 shows the RMS well locations. Table 2-10 includes both the original MO/MT elevations from the 2020 GSP and the revised MTs based on the methodologies described in previous sections. These MTs for each RMS well will remain in place until the GSP update in 2025. Appendix A contains hydrographs for each RMS well, along with the MT.

The E-clay elevation zones were selected as relevant areas to define the general shape and hydrogeologic structure of the groundwater flow system. In the B-zone, groundwater generally flows “on top of” the topography of the E-clay, and flows “beneath” the E-clay in the C-zone, creating a pressure head above the elevation of the E-clay. By using these areas to aggregate well completion data across the entire Subbasin, the MT statistical analysis is representative of both the groundwater flow pattern and how wells are completed and operated across the Subbasin. A more arbitrary methodology for defining the area for calculating well completion statistics (for example a radius around each RMS well) would have excluded many wells from the analysis and there would be overlaps in the areas around each RMS well. While the statistical approach is useful for quantifying beneficial uses in a given area, there are fine-scale influences on the observed groundwater level in a given RMS well that are not related to the elevation of the E-clay or the statistical distribution of wells. Any methodology to calculate areas on which to base statistical well completion analysis will encounter the same issue, where fine-scale influences on the observed groundwater level in a given RMS well will not always align with a statistically generated MT. The GSAs believe this is the most appropriate management approach to monitor groundwater thresholds and avoid undesirable results. Further investigation of conditions in and around RMS locations where the operating range is less than 20 feet will occur to confirm stratigraphic conditions and influences on observed water levels in these areas. These RMS locations are highlighted on Table 2-10.

It is anticipated that the 2025 update to the GSP will include changes to both the distribution of RMS locations and the numeric values for the MT. During the implementation period, the GSAs will be working to update and verify well locations to improve the accuracy of the well statistics used to derive the MT. The GSAs will also be conducting an analysis of water levels, stratigraphy, and well completion intervals, as well as the relationships between groundwater levels and other SMCs such as groundwater storage and subsidence, as described in the previous section.

2.6 Measurable Objectives for Lowering of Groundwater Level

23 CCR §354.30 *(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.*

DWR’s corrective action for Groundwater Level SMC did not include a request to update Measurable Objectives (MOs), so the original MOs from the GSP have not been changed. In the interest of clarity, this section outlines the approach currently being considered for the 2025 GSP revision.

The revised SMC methodology for MTs creates clearly defined thresholds derived to be protective of public/domestic beneficial uses and based on the documented infrastructure used for beneficial uses. The proposed MTs are protective of both public/domestic and agricultural/industrial beneficial uses. The MO for groundwater levels will not be derived from well completion data but will rather be tied to the groundwater storage SMC, subsidence SMC and associated projects and management actions that will inform groundwater pumping to avoid undesirable results (including groundwater level and subsidence). This will entail additional analysis of overall groundwater budget, further evaluation of sustainable yield, and groundwater/subsidence modeling under different pumping and recharge scenarios within the Subbasin.

2.7 Data Gaps

The following data gaps were identified and will be addressed during GSP implementation:

Well Registry - The GSAs recognize that there is limited information on the currently active wells across the area. While some GSAs have implemented well registry programs there has not been a consistent requirement across the Subbasin resulting in a significant data gap. A comparison of the OSWR database with Kings County well permit information clearly showed the need for a comprehensive well registry. In particular, the information on active domestic well operations are limited and inconsistent. Working with local agencies and stakeholders, a comprehensive well registry will be prepared.

Updated Groundwater Model – As part of the SGMA Implementation Grant recently awarded to the Subbasin, an updated groundwater model will be prepared utilizing the data that has been collected since the submittal of the 2020 GSP, including updates to well locations, stratigraphy and pumping rates by aquifer zone. The results of the updated model will then be used to conduct a native yield study and to forecast subsidence rates.

Native Yield Study - The SGMA Implementation Grant also included funds for the proposed native yield study. The study will utilize the results of the updated model, with input from stakeholders to further evaluate the sustainable yield available to landowners. The results of the study will help determine the amount of water available to each landowner.

2.8 Protective Efforts

Several on-going and additional protective efforts have been or will be taken by the GSAs to better manage water levels in the area. These efforts will be coordinated with those listed in the subsidence and water quality Sections.

Well Registration – The GSAs will implement a well registry of active wells locations and their construction information. The information will provide additional clarification on the amount of pumping in each aquifer zone.

Mitigation – The GSAs understand that there will likely be impacts to some domestic well users during the implementation period. As such, each GSA will prepare a well mitigation plan following the general requirements of the Mitigation Plan Framework presented in Appendix D. The GSAs are seeking to coordinate these mitigation programs with existing programs administered by local groups and is actively pursuing funding alternatives.

3 REVISED SMC FOR LAND SUBSIDENCE

This section summarizes the revised approach to defining the SMC for ground subsidence. It will be used in conjunction with the SMC thresholds established previously in the 2020 GSP. Again, this addendum describes SMC values that represent the thresholds that will be in place until the GSP update in 2025. The SMCs were developed based on the current level of understanding of the basin setting.

This section specifically addresses the Statement of Findings from DWR regarding determination of incomplete status for the Tulare Lake Subbasin GSP submitted in January 2020, as summarized below:

> *Department staff conclude that the GSP does not define undesirable results, minimum thresholds, and measurable objectives for subsidence in the manner required by SGMA and the GSP Regulations. Specifically, the GSP did not define metrics for undesirable results and minimum thresholds based on the level of subsidence that substantially interferes with surface land uses, informed by, and in consideration of, the relevant and applicable beneficial uses and users in the Subbasin.*
>
> *Department staff conclude that the GSP failed to explain how minimum thresholds, based on maximum simulated subsidence in 2070 under status quo conditions, at the representative monitoring sites are consistent with the requirement to be based on subsidence that represents substantial interference with surface land uses.*
>
> *Department staff are unable to assess whether the GSAs have established sustainable management criteria based on a commensurate level of understanding of the basin setting or whether the interests of beneficial uses and users have been considered.*

More specifically, the corrective actions requested by DWR are addressed:

> *Corrective Action 2*
>
> a. *The GSA should revise their undesirable results to be consistent with SGMA and the GSP Regulations, and to contain sufficient detail to demonstrate that they are reasonable, supported by best available information and science, are commensurate with the level of understanding of the basin, and consider the interests of beneficial users in the Subbasin. If the GSAs are concerned with the functionality of critical infrastructure, then they should clearly describe the critical infrastructure in the Subbasin, and the level of subsidence that would substantially interfere with that infrastructure.*
>
> b. *The GSA should revise their discussions of measurable objectives and minimum thresholds to be consistent with the requirements of SGMA. Rather than basing those criteria on projections of status-quo subsidence, they should be informed by the site-specific consideration of the level of subsidence that would substantially interfere with land surface uses.*
>
> c. *In resolving this discrepancy, the GSAs should demonstrate that their representative monitoring sites, where minimum thresholds and measurable objectives are defined, are commensurate with monitoring for the undesirable results, such as impacts to critical infrastructure, that they are trying to avoid through implementation of the GSP.*

d. *In resolving this discrepancy, Department staff recommend including flood protection infrastructure in the assessment of users susceptible to potential interference from subsidence. Department staff recommend engaging with flood management agencies in the basin and region, as appropriate.*

3.1 Technical Background

3.1.1 Subsidence Overview

Subsidence in the San Joaquin Valley (SJV) and thus in the Subbasin is primarily attributed to compaction[1] of subsurface clay layers (i.e., fine-grained soils) in response to groundwater extraction. The geotechnical mechanisms that contribute to subsidence are described in Appendix B. Groundwater levels and subsidence rates in the SJV have been shown to be tied to one another, with decreasing water levels associated with increasing subsidence, and vice versa (Lees et al. 2021). How closely the water levels are tied to the rate of subsidence is an ongoing area of study. However, there are numerous complexities associated with this relationship, some of which are discussed more in the following sections and in Appendix B. We have assumed that as groundwater level is ultimately stabilize over the next 20 years, subsidence is anticipated to mirror this and will likewise stabilize to a minimum residual "background" level. If subsidence is not directly observed to decrease and stabilize in line with pumping, additional analysis will be required to identify potential mitigation actions required to minimize subsidence.

Since the rate and amount of subsidence in a given area are primarily dependent on groundwater levels, minimizing subsidence itself will be accomplished and managed through MTs and MOs set for groundwater levels. The following sections instead focus on how impacts that result from subsidence will be identified, monitored, and managed, until ultimately such impacts cease with the reduction of subsidence through time.

3.1.2 Subsidence Monitoring

Subsidence monitoring is accomplished through two primary approaches: 1) point monitoring using survey monuments or extensometers, and 2) regional monitoring, using satellite imagery, also known as Interferometric Synthetic Aperture Radar (InSAR). Point monitoring can be useful in that it provides accurate subsidence measurements, but this technique is limited to a localized area and requires a dense monitoring network to provide information on variations in subsidence for a larger area. Although a network of point locations can provide some information on regional conditions and variations, the resolution of a feasible monitoring network may not be useful for the scales of differential subsidence that are most likely to impact infrastructure. InSAR data provides a more comprehensive dataset that shows variability across the region as well as local variations which can be used to identify areas of differential subsidence that could impact infrastructure.

[1] Geotechnical engineers use the term consolidation to describe the process by which a soil layer dissipates (i.e., expels) pore water pressures and decreases in volume. Geologists use the term compaction to describe consolidation. Compaction is known by geotechnical engineers as the densification of soils by the application of mechanical energy (e.g., Holtz and Kovacs, 1981). The term compaction, together with the term consolidation, will be used herein for consistency with literature on the topic of subsidence in the SJV.

InSAR data for the subbasin are collected by the European Space Agency (ESA) Sentinel-1A satellite and processed by TRE ALTAMIRA Inc. (TRE). Sentinel-1A InSAR data coverage within the Subbasin began on June 13, 2015. The datasets include point data that represent total vertical displacement values, including GIS rasters files interpolated from the point data showing average total displacement for 100 meter by 100 meter areas. Raster data are available for total vertical displacement relative to 2015, and for annual vertical displacement.

The InSAR data will be used in conjunction with the existing point monitoring program. Since the submittal of the 2020 GSP, the GSAs have worked with the Kings River Conservation District (KRCD) to incorporate their subsidence monitoring program. KRCD began point monitoring for subsidence in 2010 and continues to expand their network as needed. The monitoring program uses existing monuments along the Kings River (levees, bridges, etc.) to measure subsidence near infrastructure. Currently, the subsidence monitoring network has 25 points from KRCD along with the two previously identified for a total of 27 locations (Figure 3-11). The GSAs have designated these monitoring points as RMS locations for subsidence monitoring. These monitoring points are used to fill data gaps within the InSAR data coverage and are used to ground truth the InSAR data. The monitoring points also provide local coverage near critical infrastructure including near the California Aqueduct and other key canals. In addition, the GSAs utilize subsidence measurements in the Annual Reports which are submitted to DWR.

3.1.3 Total versus Differential Subsidence

Total subsidence is measured by the total vertical change in elevation of a point or area relative to some baseline elevation. Figure 3-1 illustrates the total amount of subsidence between 2015 and 2022 within the Subbasin from InSAR data, which shows the general range and distribution of subsidence in recent years across the Subbasin.

Differential subsidence refers to the change in elevation over a given distance over a given time period. Differential subsidence is expressed in terms of slope gradient or angular distortion, where the difference in change in elevation over a given period of time between two contiguous points is divided by the horizontal distance between them. This value is then multiplied by 100 to express it as a percentage. Since differential subsidence numbers are small (i.e., fractions of one percent), another way to express differential subsidence is using fractions. For example, if a 0.1 meter (m) change in elevation difference was measured between two points that are 100 m apart, then 0.1/100 = 0.001 (or 0.1%). The change in slope between the two points can also be expressed as 1/1,000.

If subsidence is uniform (i.e., of equal value) across the extent of a piece of infrastructure, impacts will generally be minimal. If subsidence is variable across a small area, this can result in localized ground disturbance such as cracks and fissures or localized depressions. If subsidence is variable across a larger area, this can result in changes in topographic slopes. Both small-scale and large-scale variations in subsidence are defined as differential subsidence, and this variability in subsidence across the ground surface at various scales is typically the most likely cause for impacts to infrastructure.

3.1.4 Time-Varying Subsidence Issues

It is well documented (e.g., Lees et al. 2021, Borchers and Carpenter 2014, Lofgren and Klausing 1969) that subsidence resulting from groundwater extraction does not all occur instantaneously, but rather some lingering "deferred subsidence" can occur over extended periods of time, well after groundwater extraction has occurred. Appendix B describes more fully the mechanics of subsidence and time rate effects.

It is important to recognize this time lag in evaluating current and projected subsidence, in that current/ongoing subsidence is likely in part related to historical groundwater extraction activities. Subsidence cannot be completely stopped once a stress change has been applied and maintained for a period of time (e.g., groundwater extraction). As such, areas of the SJV that have experienced subsidence will continue to exhibit subsidence for some time, albeit at a lower rate, even if piezometric levels are returned to levels preceding groundwater pumping in the SJV. As such, with reductions in groundwater pumping, subsidence rates and total subsidence values can be minimized and leveled off, but deferred subsidence from historical pumping will persist into the future regardless of current and future activities.

3.1.5 Infrastructure Issues

The impacts of subsidence or other ground disturbances are directly related to the types of land use and infrastructure that are subjected to subsidence and how specific infrastructure is designed. Infrastructure is typically designed to accommodate a certain amount of ground disturbance, along with a multitude of other design criteria such as earthquake magnitude, flood elevations and so on. Some types of infrastructure can tolerate higher amounts of ground subsidence compared to others. The same infrastructure can be designed to withstand different levels of subsidence or ground disturbance. For this reason, the type of infrastructure that could be affected by subsidence is closely tied to how it could be described in terms of an undesirable result under SGMA. Table 3-1 summarizes the types of infrastructure within the Subbasin, the amount of each infrastructure type present inside of and within three miles of the Subbasin, and the geotechnical subsidence issues that can lead to infrastructure impacts. The list of possible impacts highlights how the scale of differential subsidence that impacts each type of infrastructure is variable. For example, for differential subsidence to impact a building, there must be variation in the amount of subsidence within the footprint of the building, which can be quite a small, localized area. In contrast, for differential subsidence to impact a canal, the primary concern is whether the slope of the canal between two points changes, which could be miles apart. Table 3-1 thus illustrates the challenge of developing MTs that capture the range of potentially undesirable results that could occur to this array of infrastructure.

As described previously, differential subsidence is typically the most important expression of subsidence that can cause damage to infrastructure. Areas where there is a uniform amount of subsidence, regardless of magnitude, are less likely to cause infrastructure damage compared to areas where there is high differential subsidence. There are a variety of references and sources of information regarding engineering tolerances to subsidence for various types of infrastructure. A more detailed description of how and why impacts to infrastructure from subsidence occur is provided in Appendix B, along with threshold subsidence values based on engineering design standards and criteria.

3.2 Potential Effects of Subsidence

The potential effects to infrastructure include the following:

Density of Infrastructure - In the Subbasin, generally the amount of local infrastructure is much denser in cities and communities than in rural agricultural areas. The corridors along Highways 198, 43 and 41 are considered areas of dense infrastructure because there are significant local highways and facilities that cross them. The corridor along the California Aqueduct is also considered an area of dense infrastructure because of the number of facilities that have been developed that cross over the canal along its alignment. These areas of dense infrastructure were considered in terms of their cumulative risk related to subsidence.

Flood Channels - Rivers and creeks generally begin in watersheds in the coastal hills to the west and the Sierra Nevada Mountains to the east of the Subbasin and flow downhill toward the historic Tulare Lake. Part of the Subbasin's history involves regular floods, and that is why dams were built on local rivers and streams to protect communities and farmlands from flood events. However, even though the dams exist, they only provide protection up to a certain magnitude flooding event. Subsidence has not been observed to diminish the capacity of local flood channels, but it theoretically could impact capacity under the right circumstances. Also, subsidence could cause a change to the amount of sediment that is moved by the system. However, there are parties responsible for the maintenance of these channels and incremental impacts are being addressed through on-going maintenance.

Local Flood Control - Ground surface changes can affect flood zones as well as flood control levees. Local flood control levees are maintained by agencies responsible for maintaining their effectiveness. In 2017, a local flood control levee was raised by several feet to address subsidence concerns, but that was the first such project on that levee in decades and it was completed in just a few months. The planned development of new basin projects and the increased use of wet year surface water should mitigate potential modifications to existing flood zones.

Local Canals - These linear facilities are a critical part of the water management strategy across the Subbasin. Impact to these facilities such as a reduction in capacity is significant and may require GSAs to shift to pumping reductions in the vicinity.

Regional Canals - These linear facilities, like the California Aqueduct, usually have regional significance and have users across large sections of the southern San Joaquin Valley. Due to the significant regional effects, impacts on these facilities need to be minimized and avoided. For that reason, other management strategies like pumping allocations in the vicinity to stabilize groundwater levels may be imposed.

Shallow Wells - Shallow wells that do not have significant exposure to the confined aquifer below the Corcoran Clay do not appear to be at risk from subsidence.

Deep Wells - Wells that have significant exposure to the confined aquifer below the Corcoran-Clay are at risk of collapse due to subsidence that is mostly linked to that zone. Because subsidence has been active in this area for many years, owners and well drillers have been including compression sleeves and thickening well casings to make wells more resilient to subsidence. The area has experienced roughly 4 feet of subsidence in the Corcoran area since 2015. It is believed that a significant percentage of deep wells would experience structural impacts if an additional 10 feet of subsidence occurred.

Railroads - There are several railroads throughout the Subbasin that convey goods along predefined routes and the facilities also have flood control structures, like culverts, along their alignments. The observed grade changes that have occurred from subsidence do not appear to be significant for local railroads and their culverts appear to be staying stable with adjacent properties. However, steep localized subsidence can be a significant issue in terms of the cost of repairs and need to be minimized and avoided.

Property Drainage - Subsidence generally is a phenomenon that occurs over relatively large areas and is gradual enough that it is difficult to identify without a survey. Because of this, many issues that may be related to subsidence are addressed by local parties annually during maintenance efforts. Drainage on very large parcels could be impacted by subsidence, but in discussions with local parties there was almost no evidence of that situation documented by local landowners.

3.3 What Is Important to Protect

3.3.1 Infrastructure of Statewide Importance

California Aqueduct - The California Aqueduct is unique in the Subbasin as it is critical infrastructure that has statewide importance. Most of the water conveyance facilities in the Subbasin use the natural ground surface slope towards the historic Tulare Lake Bottom to deliver supplies to parties in the Subbasin. However, the Aqueduct was designed to convey supplies from the Sacramento River to San Diego and make deliveries to contractors along its alignment. The Aqueduct is located along the coastal hills on the far west side of the Subbasin, opposite where the highest rates of subsidence occurred. Again, due to the significant regional effects, impacts to the Aqueduct need to be minimized and avoided. For that reason, other management strategies like pumping allocations or limitations in in the vicinity to stabilize groundwater levels may be imposed.

High Speed Rail – While the HSR project is a statewide facility only a limited portion has been constructed. Subsidence was evaluated by California High Speed Rail (HSR) and they concluded that with the appropriate design considerations, that subsidence was not expected to significantly impact the HSR ride performance (Amec, 2017).

3.3.2 Local Communities

Power systems - These are critical to maintain for the health and human safety of residents of the area, but local agencies are not aware of any evidence of subsidence damage.

Municipal water systems - The depth of municipal wells varies across the Subbasin. Based on available information, it appears that municipal wells have been completed to deeper depths over time. The GSAs have committed to preparing and implementing mitigation plans for municipal wells.

Sewer systems – Discussions with local communities indicated that grade dependent sewer systems have not seen significant issues due to subsidence.

Canal Systems – Minimizing the impacts from subsidence to the canal systems are a high priority for the Subbasin. These are necessary to continue to deliver surface water for Management Strategies and projects to be effective.

Deep Wells - The vast majority of deep wells in the area are either agricultural, municipal or industrial. These wells are viewed as being at risk from subsidence, while shallow wells are not. Some rate of impact to these facilities is not significant, given that the mitigation for these same users is likely to be pumping restrictions. However, rates of impact that would affect a significant portion of the users with these facilities would be significant for the Subbasin.

3.4 Data Gaps

The following data gaps were identified related to subsidence impacts and will be addressed during GSP implementation:

Correlation - Subsidence has been compared to many different monitored conditions (groundwater levels, groundwater storage, pumping, well collapse, etc.) and no good correlation has been found given available data. Further evaluation across the region will be conducted with the neighboring Subbasins to define the correlation between these conditions and subsidence.

Subsiding Zone - Although it is understood that the majority of subsidence is being developed below the Corcoran Clay in fine grained sediments that are depressurized, it is not understood whether it is a specific zone of clay lenses that is subsiding or a very broad zone of clay lenses in that aquifer.

Maintenance – Impacts are often difficult to observe because regular maintenance can address incremental issues. The GSAs will reach out to the various agencies involved in maintaining key infrastructure to discuss on-going impacts that they have had to address.

Well Collapse – Currently there is no mechanism to track well failures due to subsidence. The GSAs will work with Kings County to identify well failures due to subsidence.

Flood Zones – There is limited data on how subsidence may impact flood zones as the low spot across the Subbasin is moving away from communities, and planned projects are expected to reduce the amount of floodwaters that reach the low spot.

3.5 Subsidence Triggers

The most likely triggers for subsidence include the following:

Geologic Conditions - The geology of the Subbasin appears to have greater potential for subsidence closer to the former Tulare Lake bottom on the east side of the Subbasin. There is minimal subsidence in the Kettleman City area on the west side of the subbasin as it appears that the geology in that area is not susceptible to extensive subsidence. However, it should be noted that there is little groundwater pumping in that area and resulting in the relatively small amount of subsidence measured in that area.

Deep Pumping - The GSAs understand that deep pumping from pressurized aquifer zones is primarily related to subsidence. In the Subbasin, this would generally be below the Corcoran Clay. However, the specific zone below the Corcoran Clay that is subsiding is not currently well understood.

Groundwater Level Declines & New Deeper Wells - The GSAs understand that the chronic lowering of groundwater levels is related to the triggers for subsidence. As groundwater levels decline, landowners tend to drill deeper wells to restore access to available groundwater supplies. When new deeper wells are drilled, the geology below the previous well and above the base of the new well is subjected to new impacts from the new well. Pumping from the new well could result in increased subsidence when it begins to reduce the pressure in that zone enough for the fine-grained sediments to depressurize. Generally, the GSAs view the effort to stabilize groundwater levels as critical to future success in dealing with subsidence. As groundwater pumping is reduced across the Subbasin, groundwater level declines will diminish, and fewer wells will be drilled deeper which will reduce the development of subsidence across the Subbasin.

3.6 Undesirable Results

> **23 CCR §354.26(a)** *Each Agency shall describe in its Plan the processes and criteria relied upon to define undesirable results applicable to the basin. Undesirable results occur when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin.*

The undesirable results related to land subsidence are defined as "the significant loss of functionality of a critical infrastructure or facility, so the feature(s) cannot be operated as designed, requiring either retrofitting or replacement to a point that is economically unfeasible." This definition is largely qualitative and subjective, but it is representative of what would generally be construed as "undesirable" by landowners, agencies, and the general public. A significant loss in functionality that could be mitigated through retrofitting but is considered economically feasible would not be considered undesirable. While "significant loss of functionality" is considered a general description, what is an undesirable result must eventually be quantified as an MT.

Defining quantitative metrics for MT and MO that will avoid undesirable results is not a straightforward analysis, since as described previously, there are multiple components related to both the actual amount and type of subsidence (i.e., total versus differential), the general type of infrastructure that is affected (e.g., canals versus roadways), and actual site-specific conditions at and around a given piece of infrastructure (design parameters, soil conditions, etc.). Similarly, the terms "significant loss of functionality" and "economically unfeasible" are difficult to quantify at a subbasin scale and are best addressed using a regional risk assessment approach, where undesirable results are not simply defined as static impacts to infrastructure, but rather combine the key elements of subsidence analysis; specifically:

- the amount and type of subsidence;
- the type of infrastructure that could be affected;
- the engineering design factors that are typically used for each type of infrastructure; and
- the consequence and/or cost of infrastructure failure.

The GSAs have considered these key elements for subsidence in this Addendum by focusing on primary (California Aqueduct) and secondary (outside of aqueduct) infrastructures. The total subsidence undesirable results are as follows:

California Aqueduct – In a recent correspondence with the DWR State Water Project staff, they reiterated their requirements from their May 14, 2020, letter that the rate of subsidence be limited to 0.01 feet per year by 2040 as a reasonable measurable objective with a goal of no subsidence thereafter. This amount of subsidence was estimated by the DWR as having a significant impact to the capacity of the regionally significant linear surface water conveyance facility. The GSAs agree that the MT for the Aqueduct be set at a rate of 0.01 feet per year until 2040 and limited to residual subsidence thereafter. As such, the GSAs will require all new wells within three miles of the Aqueduct to provide a subsidence evaluation and appropriate coordination with DWR as part of the requirement to obtain a permit. The limited number of existing wells in the area, believed to be approximately six wells, will be limited to historic pumping rates.

Outside of Aqueduct - In the area outside of the California Aqueduct alignment, Undesirable Results were viewed differently. Given that there currently is a limited correlation between subsidence and groundwater levels, groundwater storage, groundwater pumping, or groundwater well collapse in the Subbasin, a general relationship considering multiple factors that developed a protective condition was agreed to by the GSAs. This amount of subsidence was compared with the subsidence experienced since 2007 and the known impacts that have been documented and mitigated in the Subbasin for perspective/reasonableness. Also, there was an acknowledgement that the depth of aquifer across the Subbasin varied significantly, so that less subsidence could be accommodated in shallower aquifers. The general protective condition related to an amount of subsidence that 1) would be protective of local communities' critical facilities, 2) would avoid impacts to a large number of deep wells beyond their current ability to withstand significant structural damage, 3) would avoid requiring significant modification to known flood control levees while still acknowledging reduced floodwater from developing projects, and 4) would avoid the increase in potential for significant capacity impacts to flood control channels and canals with increased subsidence that cannot be economically mitigated.

To address the corrective actions requested by DWR and observe differential subsidence, local-scale minimum tolerances (LMTs) are defined that relate to specific infrastructure tolerances associated with standard engineering design. In addition, a regional scale risk framework is also defined that is derived, in part, from the LMTs and other factors to identify areas (not specific infrastructure) that are most prone to undesirable results. These two approaches will be used together in an iterative process as follows:

1. Areas across the Subbasin where impacts are most likely occurring will be identified through the risk framework;
2. In high-risk areas, more detailed assessments of targeted infrastructure will be used to identify LMT exceedances;
3. Potential impacts from identified exceedances will be verified through visual inspection and field monitoring if necessary in order to quantify actual impacts;
4. Underlying causes for those impacts (including groundwater pumping) will be managed to minimize further impacts; and
5. LMTs and the risk framework will be updated regularly based on identification (or lack thereof) of impacts.

The qualitative definition of undesirable results is not changed from the 2020 GSP.

3.7 Minimum Thresholds

> **23 CCR §354.28** (a) *Each Agency in its Plan shall establish minimum thresholds that quantify groundwater conditions for each applicable sustainability indicator at each monitoring site or representative monitoring site established pursuant to Section 354.36. The numeric value used to define minimum thresholds shall represent a point in the basin that, if exceeded, may cause undesirable results as described in Section 354.26.*

The MT is a marker set by the GSAs to reflect their current view of where, beyond this point, Undesirable Results are expected to occur. In the case of Subsidence, the MT will be conveyed as ground surface or reference point elevations across the Subbasin at RMS locations. This way when the RMS locations for subsidence are regularly surveyed and the InSAR Data is evaluated at those locations, the monitored data can be compared against the established MT elevation. DWR regulations and published Best Management Practices (BMPs) require that GSAs produce a rate and an extent to avoid or minimize subsidence. The GSAs have set MTs for total subsidence but will monitor differential subsidence as a leading indicator of potential impacts to infrastructure. As discussed in Section 3.1.3, it is viewed that differential subsidence, on a local and regional level, is greatest concern for infrastructure.

In considering the MT for total subsidence, the GSA considered the technical evaluation conducted on the critical infrastructure along with discussions of the operators of the infrastructure. The evaluation considered impacts from both local differential subsidence and regional impacts. In addition, the GSAs considered that many of the historic impacts have been mitigated. Based on the results of the evaluation, the GSAs set the MT at values that would be protective of the critical infrastructure.

The vertical extent of subsidence at each RMS location is listed in Table 3-2 where surveyed elevations in 2015 are shown along with the MT elevation at that site, which is understood to be protective against Undesirable Results. The GSAs have also agreed that a rate of 36 inches in three years would indicate an Undesirable Result as this represents the highest rate of subsidence across the Subbasin. Subsidence has been an on-going concern for decades in the area although most areas experience a much slower rate. This rate has allowed the agencies responsible for the infrastructure to adapt and incorporate any impacts into their regular maintenance programs.

The MTs Values for total subsidence were set based on the following approach at each RMS location:

1. The InSAR data from 2016 through 2022 was evaluated to calculate the annual rate of subsidence. This time period was considered to represent current conditions and experienced a wet-dry climate cycle.

2. The rate of subsidence was then repeated at the seven-year cycle through 2040. A cumulative total subsidence was then calculated for each RMS location. This represented the baseline value for total subsidence.

3. Separately, estimates were made on when projects and management actions would be implemented. The implementation of these actions would result in the reduction of the rate of subsidence. This reduction was similar to the values determined by the groundwater model in 2020 GSP. Again, the cumulative total subsidence was calculated for each RMS location and is included in the "GPS Implementation" column in Table 3-2.

The MT was set at the calculated "GSP Implementation" values as exceedance of those values would likely represent undesirable results to critical infrastructure and land use. Impacts to critical infrastructure will be monitored using the methods described in Sections 3.8 and 3.9. This will serve as an "early warning" to areas that experience impacts and allow the GSA to evaluate if other management actions are required.

The GSAs will use management strategies like groundwater pumping limits, following programs and projects like recharge basins to stabilize groundwater levels across the Subbasin and thereby avoid and minimize the triggers of subsidence. Some GSAs have already implemented groundwater pumping allocations and others are evaluating the need for allocations. In addition, several local projects were recently funded by a DWR Implementation Grant and are planned to be completed prior to June 2025.

As discussed in Section 3.6, the MT for the California Aqueduct will be set at a rate of 0.01 feet per year until 2040 and limited to residual subsidence thereafter. As such, the GSAs will require all new wells within three miles of the Aqueduct to provide a subsidence evaluation and appropriate coordination with DWR as part of the requirement to obtain a permit. The limited number of existing wells in the area, believed to be approximately six wells, will be limited to historic pumping rates.

3.8 Local Scale Minimum Tolerances

The LMTs for subsidence are defined for each type of applicable infrastructure that could be impacted by subsidence. The focus of the LMTs is on differential subsidence since this is the most damaging expression of subsidence to infrastructure at a local scale. Table 3-3 summarizes the engineering tolerances for differential subsidence for each infrastructure type. These are the LMTs for subsidence and reaching these tolerances at or near specific critical infrastructure could lead to undesirable results (i.e., the significant loss of functionality requiring either retrofitting or replacement to a point that is economically unfeasible).

While these LMTs are specific to the type of infrastructure, they do not address site specific conditions that could cause a specific piece of infrastructure to have a higher or lower tolerance to subsidence (e.g., engineering design of a structure; the direction of flow of a canal relative to the direction of topographic slope change, etc.). The LMTs are thus intended to be used to guide GSA managers and stakeholders on focusing subsidence investigations; evaluating the potential for undesirable results; and assessing how groundwater pumping relates to exceedances of these tolerances at specific locations. The LMTs are also used directly in the regional-scale risk framework described in the next section.

3.9 Regional-Scale Risk Framework

The regional-scale approach to defining a MT is based on a Township/Range/Section (TRS) geographic framework similar to that used for groundwater level. The regional-scale approach considers infrastructure and subsidence in aggregate, rather than individual infrastructure types and engineering tolerances as used to define the LMTs.

A simple risk assessment formula was applied to each TRS grid cell to define aggregate risk of undesirable results. The aggregate risk in each TRS cell can also be depicted in map format and used to evaluate where the risk of undesirable results is high versus where it is low. The definition of Aggregate Risk is as follows:

Aggregate Risk (R) = Hazard (H) x Vulnerability (V) x C (Consequence), where

- H = the observed subsidence at a point in time or over a given time period for a given TRS grid cell.
- V = the aggregate vulnerability of infrastructure to the hazard (H).
- C = the consequence of damage to a given piece of infrastructure subjected to the hazard.

The consequence was not included in this risk assessment, as the quantitative data (e.g., monetary values for repair or replacement of infrastructure, secondary economic impacts due to impacted infrastructure, etc.) necessary to accurately represent consequence for each type of infrastructure was not available. However, this could be included if such information is developed, to better define high risk areas within the Subbasin.

The first step was to generate maps that summarize the aggregate total subsidence and aggregate differential subsidence (i.e., the hazard, H) for each TRS:

- Figure 3-2 shows average total subsidence values between 2021 and 2022 in each TRS based on InSAR data. This represents the level of hazard posed to infrastructure (i.e., H-Map).
- Figure 3-3 shows average differential subsidence between 2021 and 2022 in each TRS based on InSAR data. Differential subsidence in each TRS was estimated by calculating the slope between each adjacent raster cell from the 100 meter by 100-meter total subsidence InSAR raster, and then taking the average slope value for each TRS. This provides a different representation of the hazard posed to infrastructure (i.e., H-Map), and is the more likely hazard to impact infrastructure, and thus the more useful indicator of potential higher risk areas.

The next step was to generate an infrastructure density map and an infrastructure vulnerability map:

- Figure 3-4 shows the total infrastructure density in the Subbasin. The infrastructure density map shows total infrastructure in each TRS based on the total sum of infrastructure, assuming each point location represents 1 unit of infrastructure (i.e., 1 bridge equals 1 unit of infrastructure), and each 1 mile of linear infrastructure represents 1 unit of infrastructure (i.e., 1 mile of railroad equals 1 unit of infrastructure). The following types of infrastructure are included and counted as noted:
    - Canals and Aqueduct (linear, count is 1 per mile)
    - Levees (linear, count is 1 per mile)
    - Pipelines (linear, count is 1 per mile)
    - Railroads (linear, count is 1 per mile)
    - High Speed Rail (linear, count is 1 per mile)
    - Emergency Facility Buildings (points, count is 1 per building)
    - Airports/Airport runways (points, count is 1 per airport)

- Bridges (points, count is 1 per bridge)
- Roads (linear, count is 1 per mile)

Note that wells are excluded from this list and density maps, as impacts to wells will be addressed separately with well registration and mitigation plans. Subsidence damage to public/domestic supply wells will be evaluated on a case-by-case basis to evaluate the root cause(s) of failure and address those causes.

- Figure 3-5 shows total infrastructure density in the Subbasin, excluding roads. Roads were excluded from the calculation of risk because they are in general considered less critical than other types of infrastructure, have a relatively high tolerance to subsidence, and are routinely maintained as part of normal uses. Including roads in the aggregate was determined to "dilute" the risk of other (higher consequence) infrastructure, and thus was not included in the calculation described below. The infrastructure density map was used to generate an infrastructure vulnerability map (V-Map) as described below.
- Figure 3-6 shows the aggregate infrastructure vulnerability map excluding roads (V-Map), used for differential subsidence risk calculations. The value of V for each TRS was generated using the sum product of the magnitude of each infrastructure type multiplied by its associated LMT for that type of infrastructure. For example, if there are 4 miles of canals and 2 miles of high-speed rail in a given TRS, this value would be calculated as 4 miles of canal multiplied by 1/600 (the canal tolerance LMT on Table 3-3), plus 2 miles of high-speed rail multiplied by 1/80 (the rail tolerance LMT on Table 3-3). A TRS with a high density of infrastructure would have a higher V value compared to one with a low density of infrastructure. Similarly, infrastructure with higher tolerances results in a lower V value compared to infrastructure with lower tolerances for subsidence. Further details on the calculation of V are also provided in Appendix B.
- Figure 3-7 shows the aggregate total subsidence risk map used for total subsidence risk calculations. This map was generated by multiplying the raster map shown in Figure 3-2 (average total subsidence values between 2021 and 2022) by the raster map shown in Figure 3-5 (total infrastructure density in the Subbasin excluding roads).
- Figure 3-8 shows the Aggregate Differential Subsidence Risk Map, which was generated by multiplying the raster map shown in Figure 3-3 (average differential subsidence between 2021 and 2022) by the raster map shown in Figure 3-6 (aggregate infrastructure vulnerability map excluding roads).
- Figures 3-9 and 3-10 are risk series maps, each showing the map inputs (H and V) and final risk map for total (Figure 3-9) and differential subsidence (Figure 3-10). Both risk maps show a general concentration of higher risk areas in the northern and eastern portions of the Subbasin, where both higher subsidence and more concentrated infrastructure areas overlap. Figure 3-10 (differential subsidence) takes into account LMTs by infrastructure type and is thus more fine-tuned in its display of potentially higher risk areas.

The risk framework provides a tool for evaluating where subsidence risks to individual infrastructure are most likely occurring and will be used to focus further investigation or analysis to evaluate whether a specific piece of infrastructure is at risk of experiencing an impact. While the risk map (either total or differential subsidence) does not directly identify undesirable results, it will be used to define actions related to investigations of subsidence that will evaluate the contribution of groundwater pumping to subsidence in “high risk areas.” Individual infrastructure within a given TRS is still managed to the LMT for that specific infrastructure type.

3.9 Relationship to Other Sustainability Indicators

The subsidence SMC incorporates multiple levels of management criteria because of the complexity and inter-relationships between subsidence, vulnerable infrastructure, and groundwater levels. The LMTs for subsidence are essentially “stand-alone” tolerances for specific infrastructure types. The regional risk framework integrates actual observed subsidence with the LMTs to identify and prioritize areas of concern. The ultimate goal of minimizing subsidence to the maximum extent practicable is achieved through management of groundwater pumping via the Groundwater Level and Groundwater Storage SMC.

As described previously, DWR’s requested corrective action did not include a request to update the Groundwater Storage SMC, but it will be revisited for the 2025 GSP update through further analysis using a groundwater flow model. The groundwater model will also be able to project subsidence based on the MT and MO for groundwater level and groundwater storage, as well as project pumping and managed recharge configurations currently under development. The variables and relationships that cause subsidence are very complex and require modeling to define, analyze and evaluate their relative sensitivity factors (or combination of factors) that can be managed by the GSA to avoid subsidence and associated undesirable results. The connection between groundwater level, groundwater pumping, and subsidence will be revisited for the 2025 GSP update, which will integrate groundwater pumping into the regional risk framework and LMTs for subsidence.

3.10 Measurable Objectives for Land Subsidence

> **23 CCR §354.30** *(a) Each Agency shall establish measurable objectives, including interim milestones in increments of five years, to achieve the sustainability goal for the basin with 20 years of Plan implementation and to continue to sustainably manage the groundwater basin over the planning and implementation horizon.*

The measurable objective for land subsidence is defined qualitatively as: *“continued operation of critical infrastructure, with economically feasible retrofitting or replacement if necessary.”* The measurable objective for subsidence will ultimately be achieved through the MTs and MOs set for groundwater levels and storage, which is expected to result in decreasing subsidence over time. Ongoing monitoring of subsidence through the use of the InSAR data, regional subsidence risk framework, and subsidence LMTs will further define needed adjustments to groundwater level and storage MTs and MOs. The process described below will be followed to regularly implement and update the risk framework, LMTs, and ultimately identify the need to adjust groundwater level and storage MTs and MOs.

The regional-scale risk maps will be updated annually using InSAR data to identify changing conditions and to prioritize monitoring and investigation efforts. Based on the regional-scale risk assessment results, high-risk areas (i.e., those in the upper 2 red/orange risk categories shown in Figures 3-7 and 3-8) indicate areas that are potentially approaching MTs and thus require a localized assessment of differential subsidence values relative to thresholds for each type of infrastructure. All high risk TRS locations will be subject to a localized assessment that will have two components:

1. Assess differential subsidence at individual scales most appropriate for each type of potentially impacted infrastructure (e.g., 100s of feet for point locations such as buildings and bridges versus several miles for linear infrastructure such as canals, aqueduct, and rail) using full-scale InSAR data (i.e., not TRS scale), which is available on a quarterly basis. Review will be relative to the specific footprint of potentially impacted infrastructure within high-risk areas to see if the LMT is being exceeded. If values are approaching threshold values for any infrastructure types, a visual inspection of potentially impacted infrastructure will be completed to confirm and characterize potential impacts. LMTs for specific infrastructure may be revised upward or downward based on this initial investigation. In addition, the need for local point monitoring (e.g., survey points or extensometers) will be evaluated.
2. If potential specific impacts to infrastructure are confirmed, an analysis of how groundwater pumping has contributed to the observed local impacts will be conducted and actions will be undertaken to change pumping patterns to minimize further subsidence and associated impacts.

3.11 Representative Monitoring Sites (RMS) for Subsidence

Monitoring of subsidence will occur through InSAR supplemented by site-specific subsidence monitoring. As noted in Section 3.1.2, the RMS locations have already been expanded to 27 locations and may be expanded further as needed. InSAR data will be reviewed and used to update the regional risk model annually. In addition, quarterly releases of InSAR data will be reviewed in areas of high risk identified from the risk model. Additionally, site-specific monitoring (e.g., either through existing monitoring locations or through installation of instruments at new locations) will be implemented if site-specific data are needed to better characterize and understand localized occurrences of subsidence. Subsidence RMS locations are presented in Figure 3-11.

3.12 Protective Efforts

Several additional protective efforts will be undertaken by the GSAs to better manage and understand subsidence triggers in the area.

Mitigation - The GSAs want to avoid and minimize the impacts of subsidence. A mitigation plan needs to be developed with significant local input and a broader understanding of the potential costs for various levels of mitigation. The Subbasin would pursue grant funds for subsidence mitigation and after a mitigation plan is developed, evaluate developing local funding options.

Well Registration - The GSAs currently does not have a complete registry of active wells and their construction information. This information will be needed to better evaluate why subsidence is occurring in some areas.

Totalizing Flowmeters - Some GSAs currently require totalizing flowmeters on all deep wells but that is not consistent across the Subbasin. Much of the efforts to date have focused on using Crop evapotranspiration (ET) to evaluate groundwater use, but that doesn't account from which aquifer the extraction is occuring. The installation of meters or other measuring methodologies along with the well registration program will help to better evaluate groundwater extraction by location and depth. This information will be needed to better evaluate the triggers of subsidence in some areas.

Local monitoring Network Expansion - The subsidence monitoring network will be expanded as need to better observe elevations at key facilities where impacts need to be minimized. Regular observations from the monitoring network will provide timely information to the GSAs so that Management Strategies can be pursued to avoid Undesirable Results. Since submittal of the 2020 GSP, the GSAs have incorporated the KRCD point monitoring program to evaluate subsidence within the Subbasin that could affect critical infrastructures. The GSAs will continue annual monitoring and reporting at these points.

Data Collection - The GSAs have several monitoring wells that have long periods of record, but have limited construction information. It has been suspected that several wells are not categorized in the correct aquifer zone but clarifying this has been challenging. Downhole video surveys to verify construction information in the wells would answer the question of from which zone(s) each well is pumping.

Pressure Levels - The GSAs plan to increase the number of dedicated monitoring wells that provide information from below the Corcoran Clay. The effort would be to expand the understanding of the pressurized head levels (piezometric levels) in the confined aquifer throughout the year and develop an understanding that could better inform modeling efforts in zones where subsidence is occurring.

Identification of Subsiding Zone - The GSAs require additional information on which geologic zone is subsiding. The GSAs would like to partner with DWR and the USGS to develop an extensometer in the Subbasin to collect the data needed to better address subsidence triggers. However, currently the development and maintenance costs for such a facility are considered prohibitive without additional funding sources.

Groundwater-Subsidence Modeling - Given the current lack of data to develop a subsidence model, the modeling effort would have to be pursued after more extensive and higher quality data are collected. The GSAs anticipate that with extensometer records and groundwater logger readings from below the Corcoran Clay in several locations, a groundwater-subsidence model for the Subbasin or region could be developed. The GSAs have been working towards collecting the needed data.

4 REVISED SMC GROUNDWATER QUALITY

In the incomplete determination letter DWR noted in Deficiency 3 the absence in the 2020 GSP of identified undesirable results and other sustainable management criteria for degraded groundwater quality, as well as shortcomings with the proposed monitoring network. The corrective action stated in the determination letter indicated the GSP must provide a more thorough discussion of how implementation of SGMA can impact the Subbasin's groundwater quality by the following:

> *The reliance on existing regulations and policies to define undesirable results that represent degraded water quality conditions occurring throughout the Subbasin for the purpose of SGMA does not satisfy the requirements of the GSP Regulations.*

More specifically, the corrective actions requested by DWR are addressed:

> *Corrective Action 3*
>
> *a. Characterize historic and current groundwater quality conditions within the principal aquifers including the primary constituents of concern. Describe how the constituents will be monitored and how the baseline concentrations or federal and state standards will be assessed to evaluate potential degradation. Provide details for constituents which are partially or entirely linked to existing programs, the monitoring and management that those programs implement, and how they align with the requirements of a GSA under SGMA. Describe how the GSAs intend to coordinate and work with existing agencies and programs to evaluate and assess how GSP implementation may impact groundwater quality.*
>
> *Define sustainable management criteria based on the GSAs level of understanding of the historic and current groundwater conditions as required by the GSP Regulations. In defining sustainable management criteria, the GSAs should evaluate and utilize components of existing programs, including federal, state, and agricultural water quality standards. Include a discussion of the methodology used to determine which constituents are included in the sustainable management criteria and describe the potential affects the undesirable results and minimum thresholds may have on groundwater supply and beneficial users.*

The following sections present the revised SMC for groundwater quality developed to address the required Corrective Action.

4.1 Potential Effects to Beneficial Uses and Users

Beneficial uses and users of groundwater in the Subbasin generally include domestic, municipal, agricultural, and environmental uses and users. All identified beneficial uses and users of groundwater, and their associated land uses and property interests, were considered in establishing MTs for degraded water quality. A description of how MTs may affect the interests of beneficial uses and users of groundwater or land uses and property interests is contained herein.

- **Domestic**. Minimum thresholds for degraded water quality are designed to protect groundwater quality accessed by domestic well users in some areas of the Subbasin, ensuring that the groundwater quality is maintained such that treatment is not necessary due to impacts from GSA actions to meet drinking water standards. In areas of the Subbasin where ambient water quality is above drinking water standards, MTs are established to be consistent with California's Antidegradation Policy and not result in additional burden of treatment for domestic well users related to GSP activities.

- **Municipal**. Similar to domestic uses and users, MTs established for degraded water quality are designed to preserve groundwater quality accessed by municipal well users in applicable areas of the Subbasin, ensuring that new or additional treatment will not be needed due to impacts from GSA actions to meet drinking water standards and are consistent with California's Antidegradation Policy.
- **Agricultural.** Drinking water standards tend to require higher quality water than for many agricultural uses, which vary by crop type. Growers in the Subbasin have adapted to current groundwater quality by either blending groundwater with surface water to dilute elevated concentrations of constituents of concern, installing wellhead treatment, or changing crop types. Therefore, although some MTs for degraded water quality based on drinking water standards may results in impacts to specific crop types, overall they are not anticipated to significantly negatively impact agricultural uses and users of groundwater and will preserve the quality of groundwater for agricultural use.
- **Environmental**. Similar to domestic uses and users, where present within the Subbasin, environmental users of groundwater typically rely on shallow groundwater where accumulation of salts from applied water, applied fertilizers, or septic systems are most likely to impact these users. These impacts are from non-GSA activities and GSA projects and actions within the Subbasin occur below this zone. As such, impacts to environmental users are not anticipated to occur within the basin due to GSA projects or actions.

4.2 What's Important to Protect

The GSAs recognize that municipal and domestic wells with substantially decreased water quality are an undesirable result that needs to be minimized and avoided. As discussed in subsequent sections, sources of degraded water quality or both naturally occurring and from anthropogenic sources that are not related to SGMA activities.

4.3 Approach

The SMCs for each constituent of concern (COC) were developed using a pro-active approach using statistical analysis developed as part of the California Code of Regulations Title 27 (CCR Title 27) for establishing concentration limits and trend analysis to evaluate COCs annually. The pro-active approach includes actions that will be taken if upward trends are observed prior to reaching undesirable results. The SMCs are also based on federal and state water quality standards for each of the COCs. Details of this approach are provided in the following Sections.

Characterization of historic and current groundwater quality conditions within the Subbasin were discussed within the 2020 GSP, which included specific constituents as illustrated on Figures 3-30 through