Allocation of Managed Recharge Impacts and Capacity Limitations – ESPAM2.1

Prepared by Mike McVay, Neal Farmer, Mat Weaver

Presented by Mike McVay P.E., P.G.

May 1, 2015

IDAHO Water Resource Board

Goal for Today

- Look at recharge modeling and ESPA hydrogeology.
    - Where and when impacts due to recharge occur.
    - Why recharge impacts occur as they do.
- A lot of information.
- Think of it as a story, and the basics of recharge will make sense.

Aquifer Water Balance

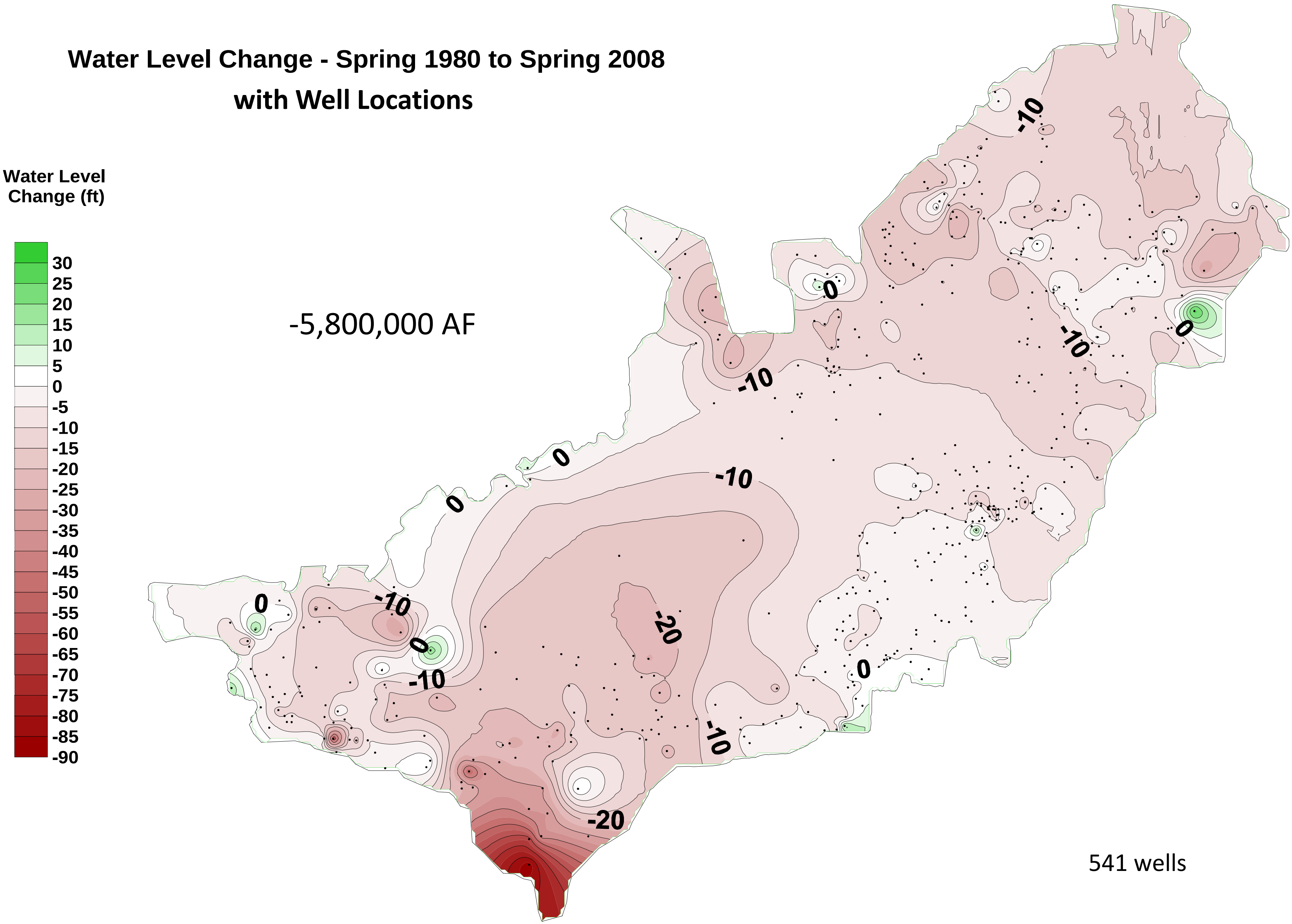
Inflow – Outflow = ΔStorage

ESPA Inflows = Incidental recharge from SW irrigation, Canal Seepage, Perched River Seepage, Tributary Underflow, Precipitation.

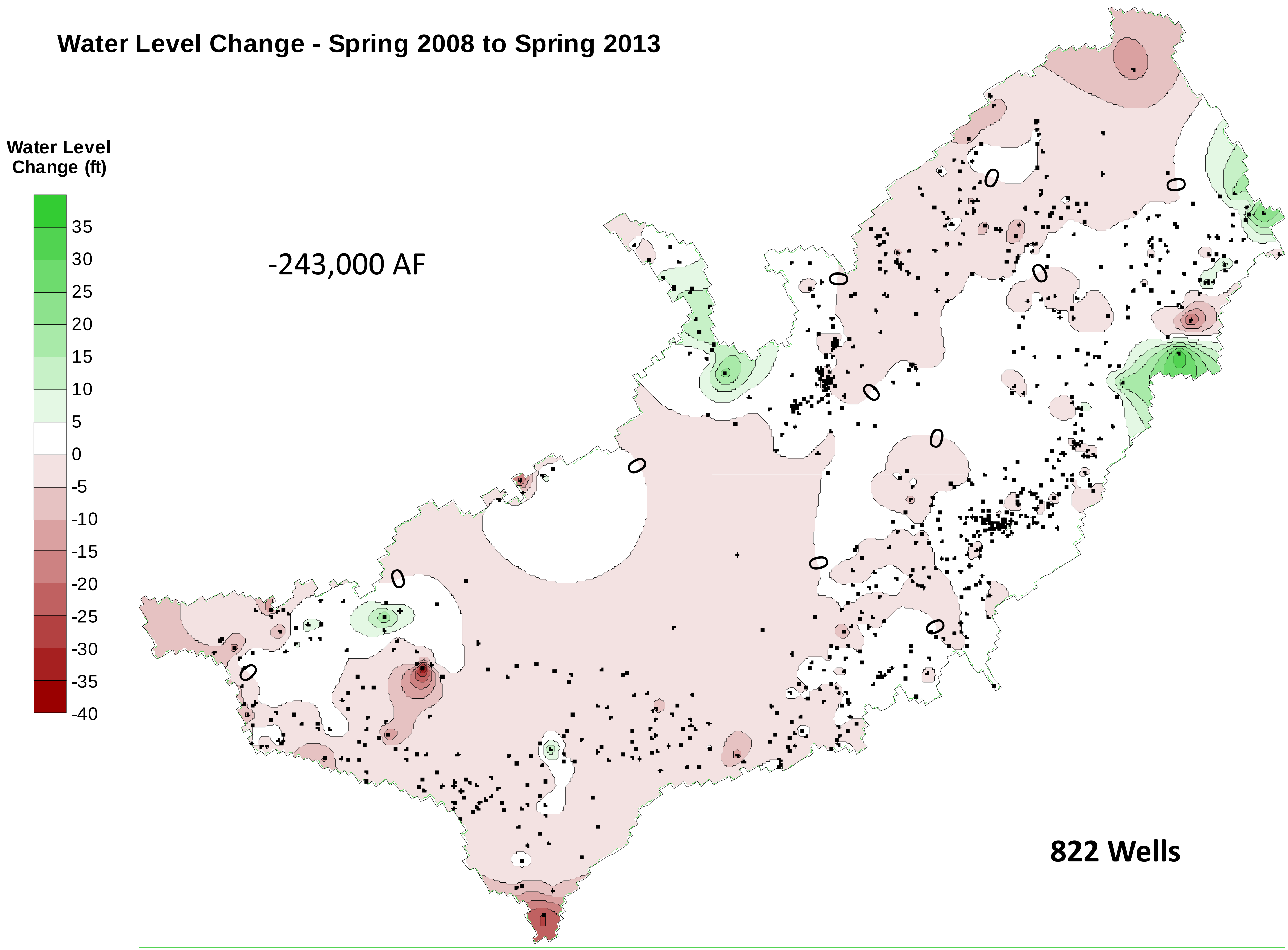
ESPA Outflows = Evapotranspiration, Spring Discharge, Well Pumping

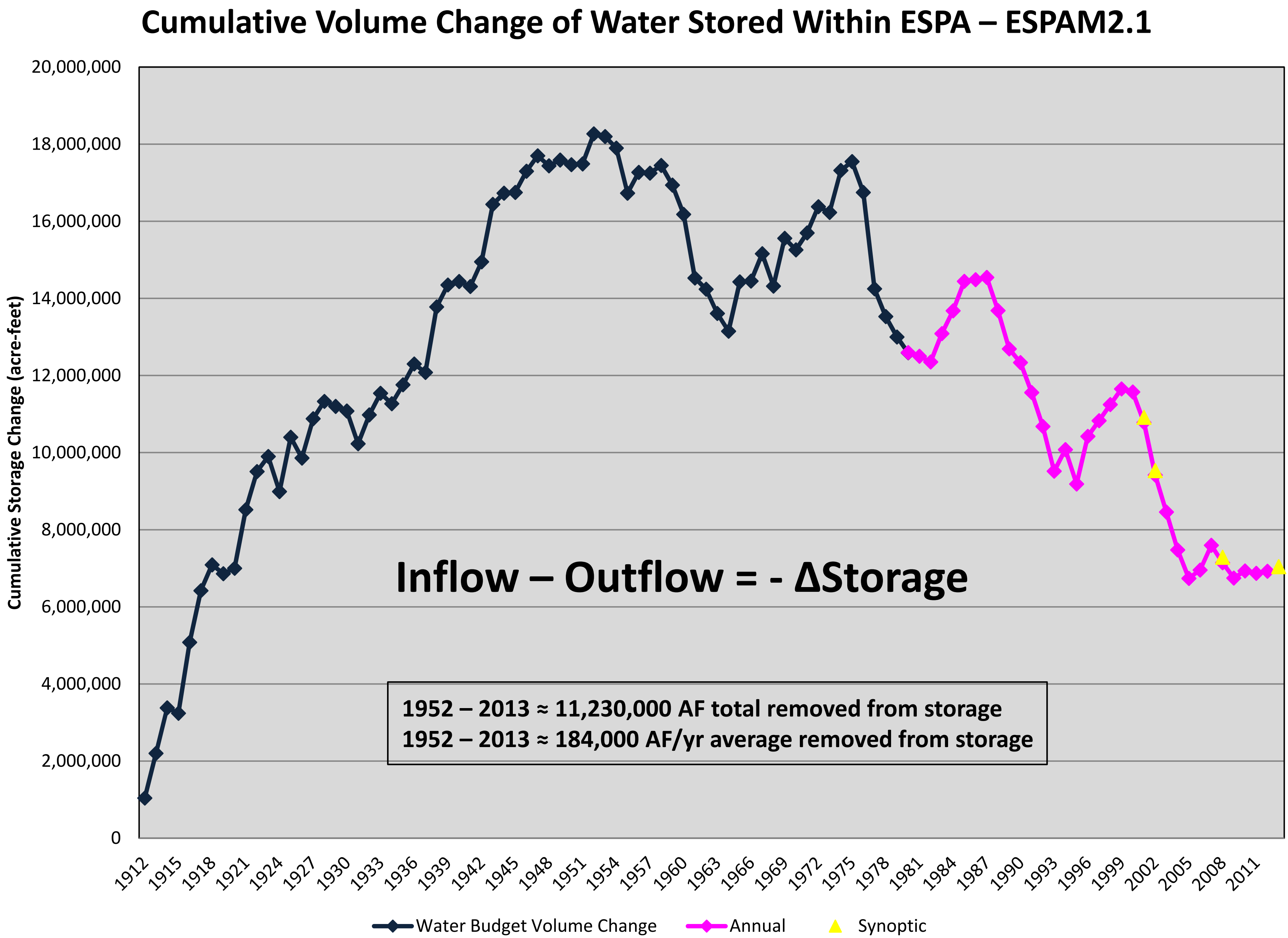
We can use estimates of aquifer storage to generate an aquifer "history."

Water Level Change - Spring 1980 to Spring 2008
with Well Locations



Water Level Change - Spring 2008 to Spring 2013




Cumulative Volume Change of Water Stored Within ESPA – ESPAM2.1
Cumulative Storage Change (acre-feet)
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
1912
1915
1918
1921
1924
1927
1930
1933
1936
1939
1942
1945
1948
1951
1954
1957
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
Inflow – Outflow = - ΔStorage
1952 – 2013 ≈ 11,230,000 AF total removed from storage
1952 – 2013 ≈ 184,000 AF/yr average removed from storage
Water Budget Volume Change
Annual
Synoptic

How can we "balance the budget?"

The [CAMP] water budget adjustment mechanisms include:

A. Ground water to surface water conversions.
B. Managed aquifer recharge.
C. Demand reduction.
D. Pilot weather modification program.
E. Minimizing loss of incidental recharge.

-ESPA CAMP January 2009

This presentation is based upon modeling efforts and analysis that were started by Dr. Johnson.

Re-run with ESPAM2.1.

Prioritization of Aquifer Recharge Sites Based on Hydrologic Benefits

Prepared for the
Idaho Department of Water Resources
and
Idaho Water Resource Board

by
Gary S. Johnson
Idaho Water Resources Research Institute
University of Idaho, Dept. of Geological Sciences
April, 2012

Where to Recharge?

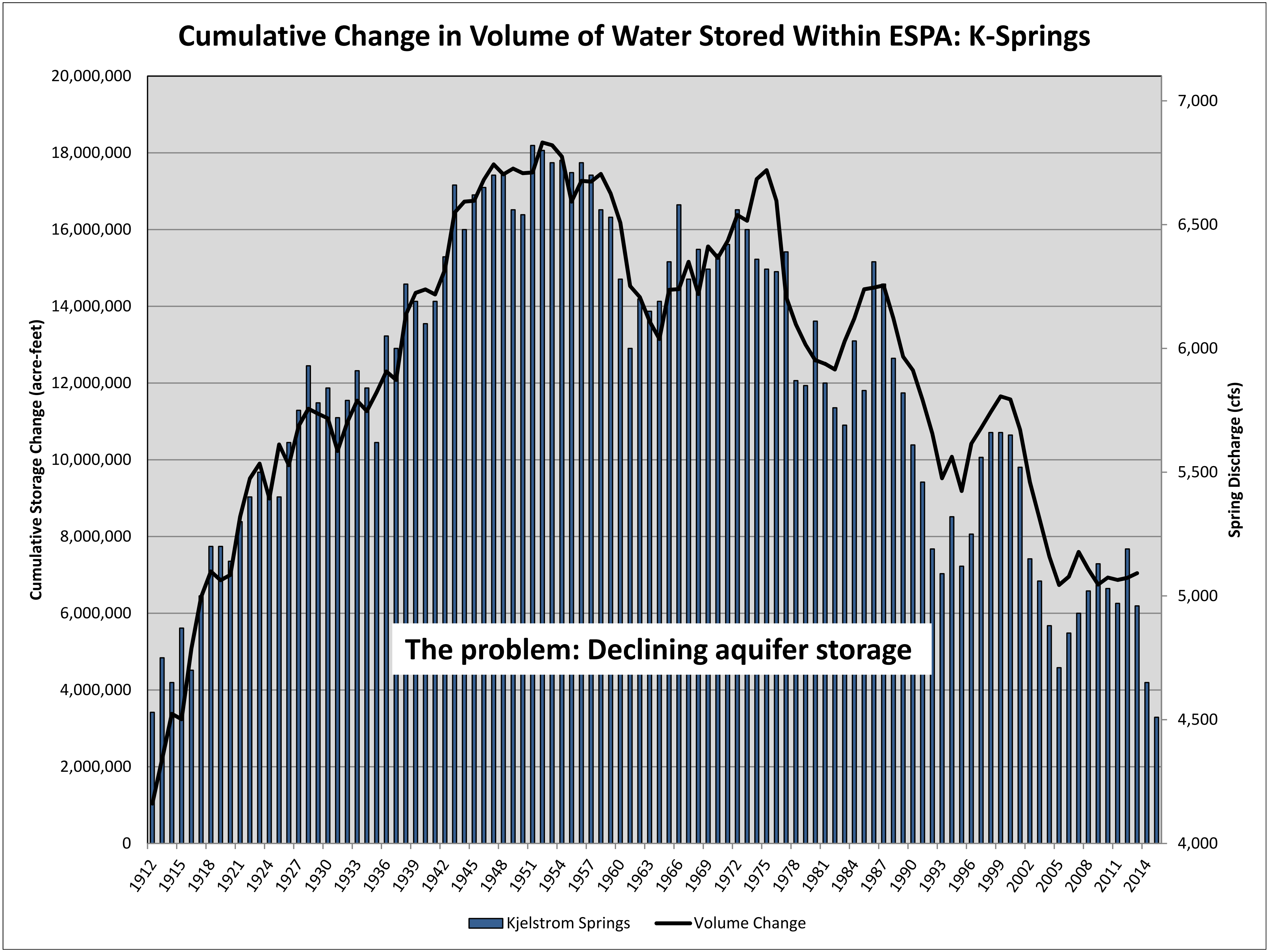
Criterion 1A: Percent of a single, one-month recharge discharged in the below Milner reach within 3 years.
Criterion 1B: Percent of continuous recharge as additional spring discharge below Milner after one year.
Criterion 2A: Percent of a single, one-month recharge discharged below Milner between 3 and 30 years.
Criterion 2B: Percent of long-term, continuous recharge in springs below Milner three years after recharge ends.
Criterion 3: Percent of annual recurring March recharge discharge above Minidoka July through September. The values are calculated for the 30th year of recurring recharge.
Criterion 4: Same as Criterion 3 except for returns in the months of November through February.
Criterion 5: Percent of a single, one-month recharge discharged above Minidoka between 3 and 30 years after the recharge activity.
Criterion 6: Average water level in the A&B area after 10 years of continuous recharge at 100,000 AF/yr.
Criterion 7A: Percent of single, one-month recharge volume retained in aquifer storage 10 years after the recharge activity.
Criterion 7B: Average water level change in the Snake River Plain aquifer after 10 years of continuous recharge at 100,000 AF/yr.

Dr. Johnson was asked to evaluate recharge locations in an effort to prioritize IWRB managed recharge.

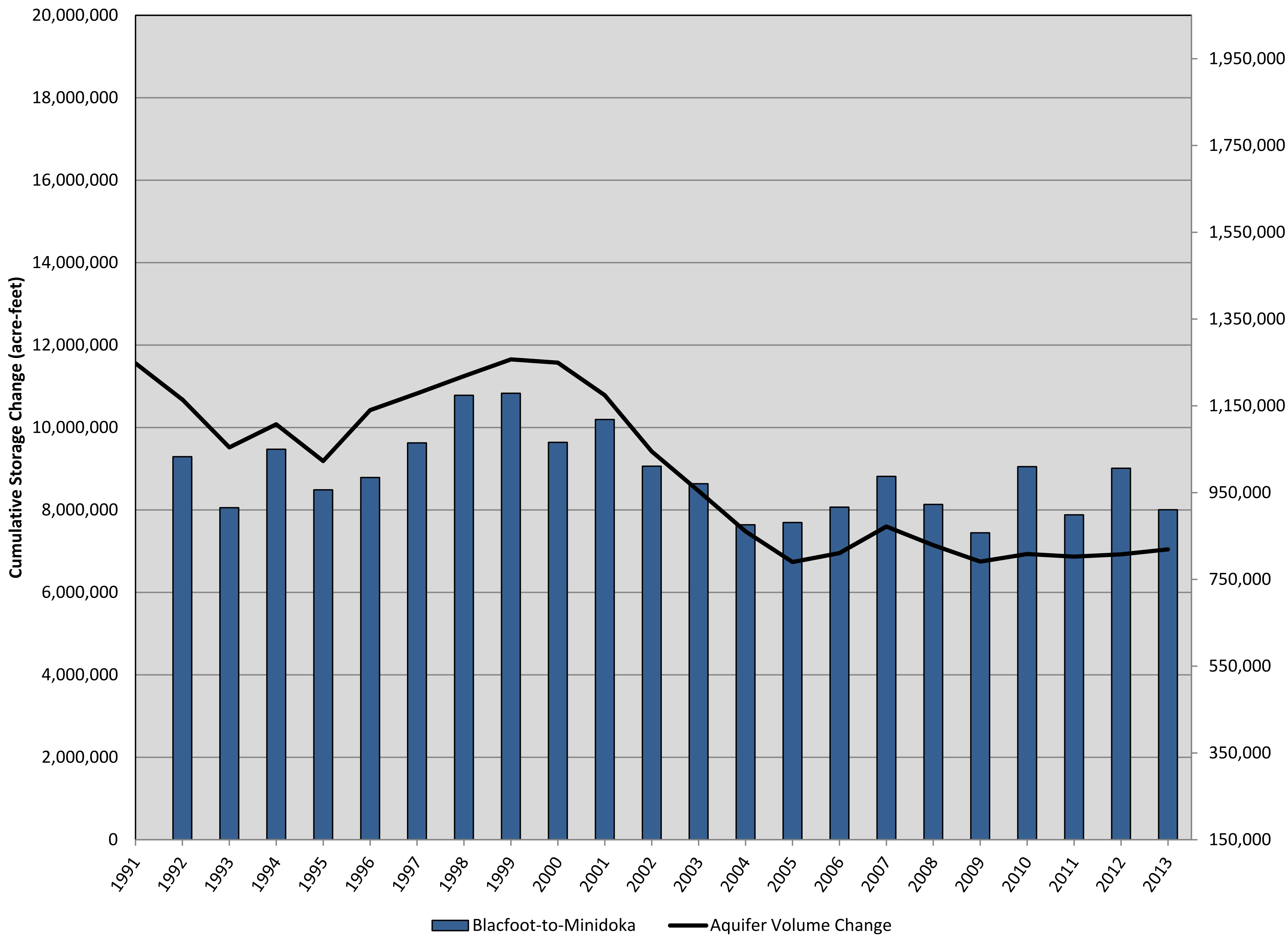
Where to Recharge: Depends

The general message from Dr. Johnson's work is:

Where best to recharge depends on the goal of recharge.


Cumulative Change in Volume of Water Stored Within ESPA: K-Springs
Cumulative Storage Change (acre-feet)
Spring Discharge (cfs)
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
7,000
6,500
6,000
5,500
5,000
4,500
4,000
1912 1915 1918 1921 1924 1927 1930 1933 1936 1939 1942 1945 1948 1951 1954 1957 1960 1963 1966 1969 1972 1975 1978 1981 1984 1987 1990 1993 1996 1999 2002 2005 2008 2011 2014
The problem: Declining aquifer storage
Kjelstrom Springs
Volume Change

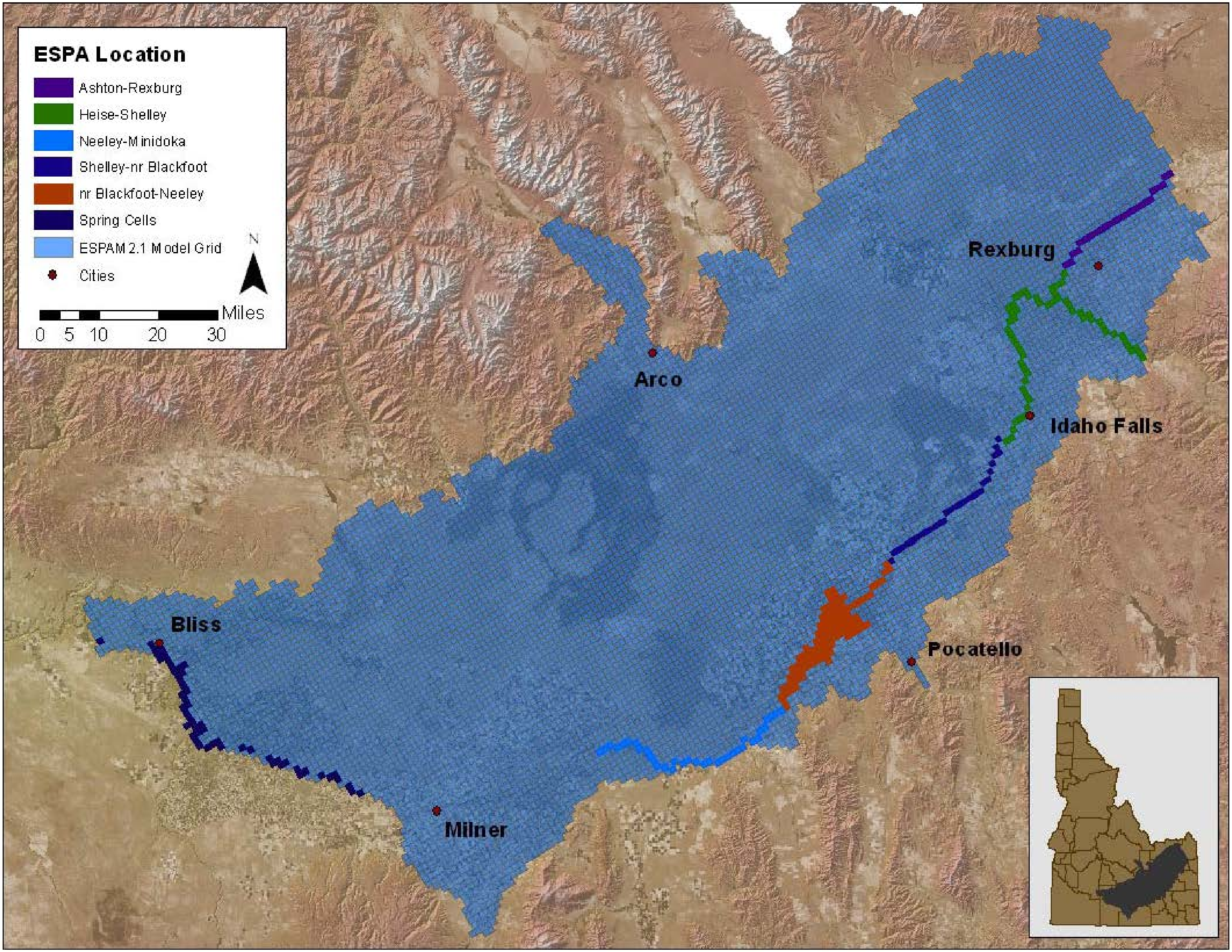
Cumulative Change in Volume of Water Stored Within ESPA: Blkft-Min

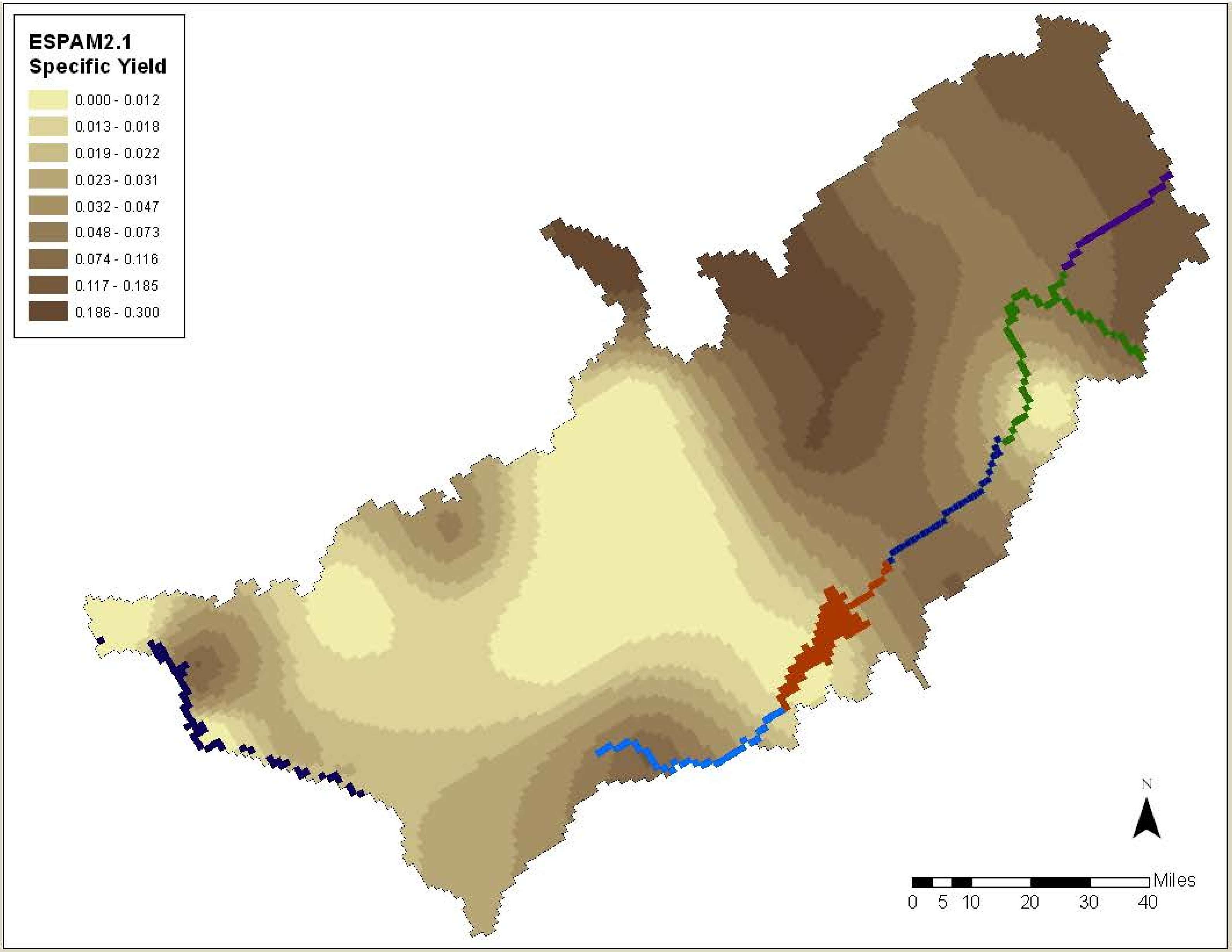


The IWRB Recharge Goal

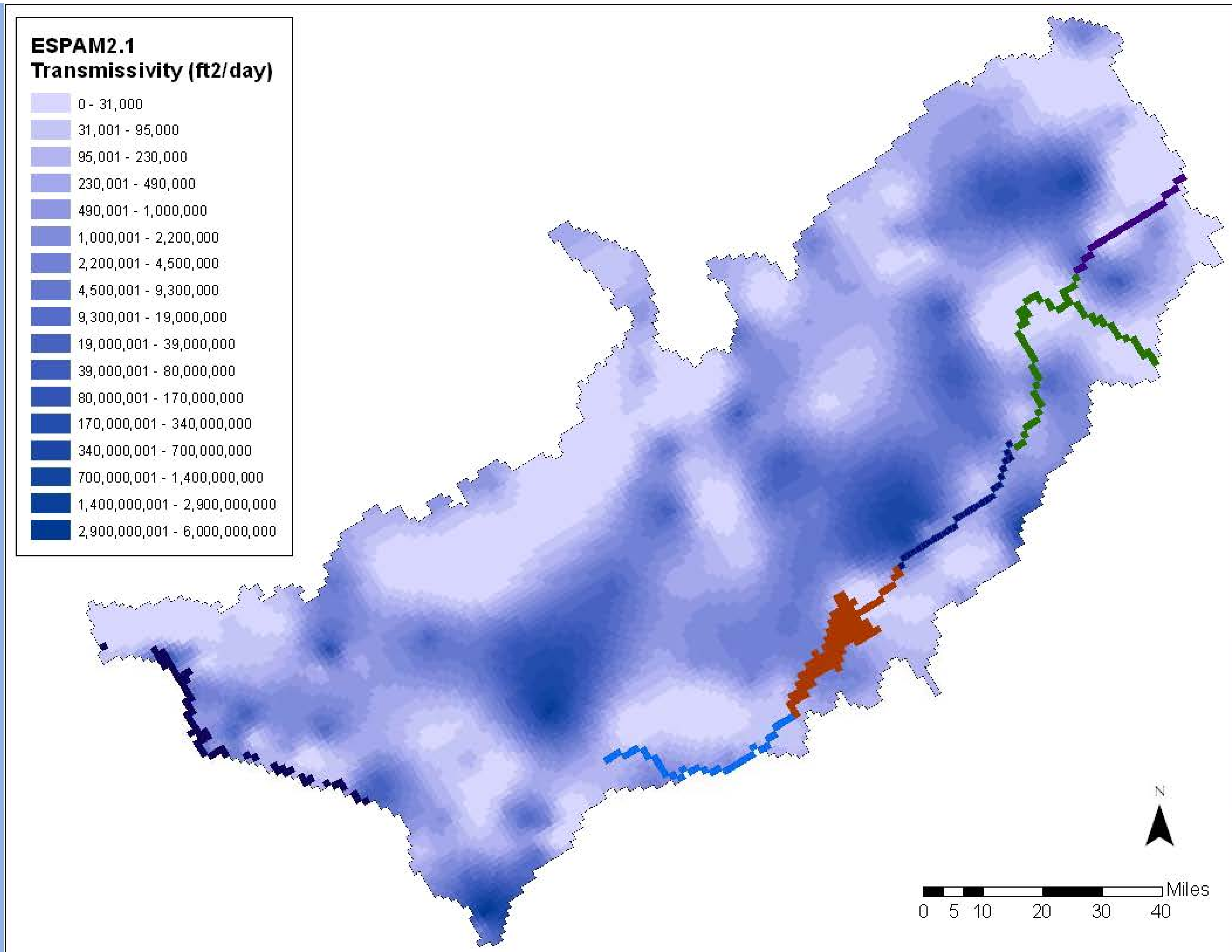
“The long-term objective of the [ESPA Comprehensive Aquifer Management] Plan is to incrementally achieve a net ESPA water budget change of 600 thousand acre-feet annually.”

-ESPA CAMP January 2009

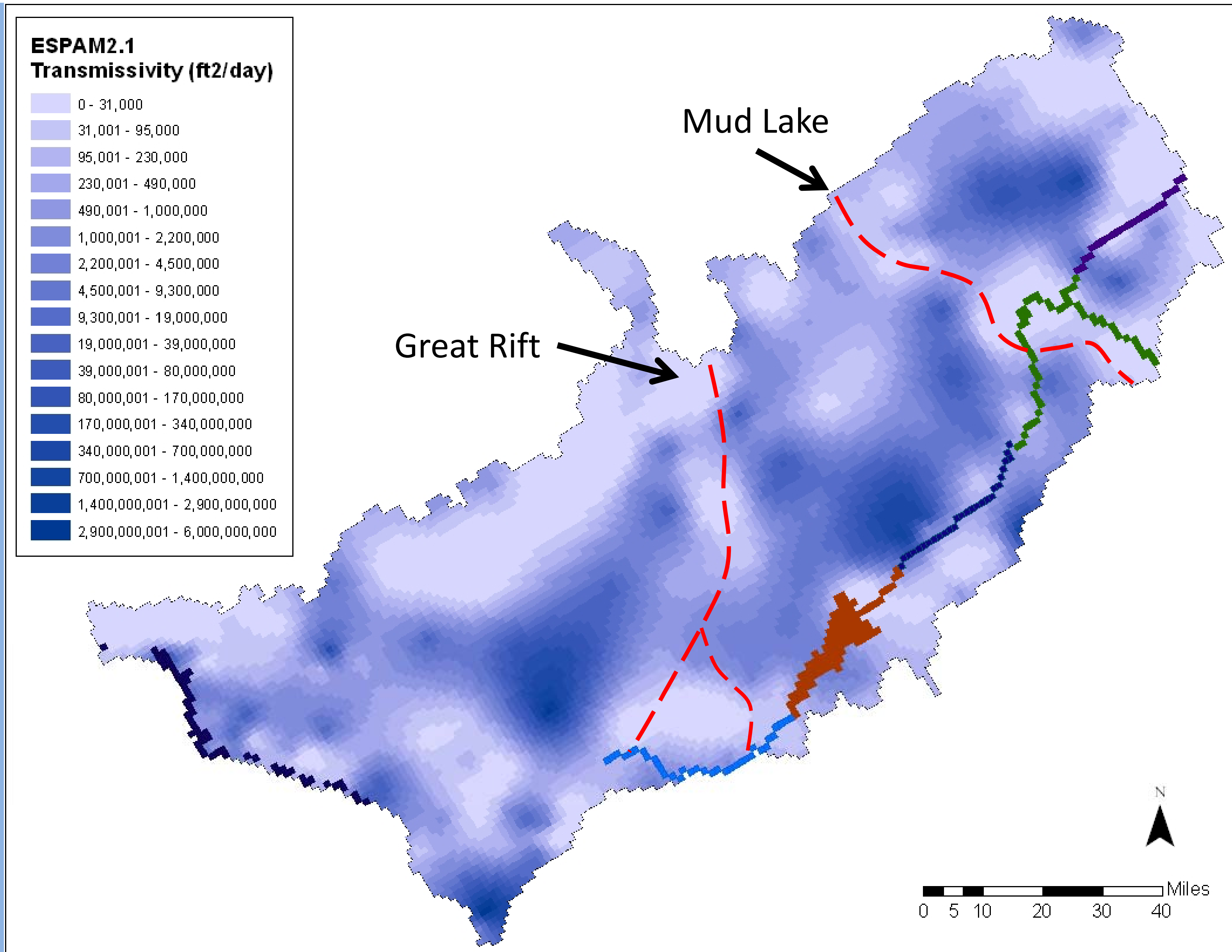

ESPA Location
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Spring Cells
ESPAM 2.1 Model Grid
Cities
N
0 5 10 20 30
Miles
Rexburg
Arco
Idaho Falls
Bliss
Pocatello
Milner



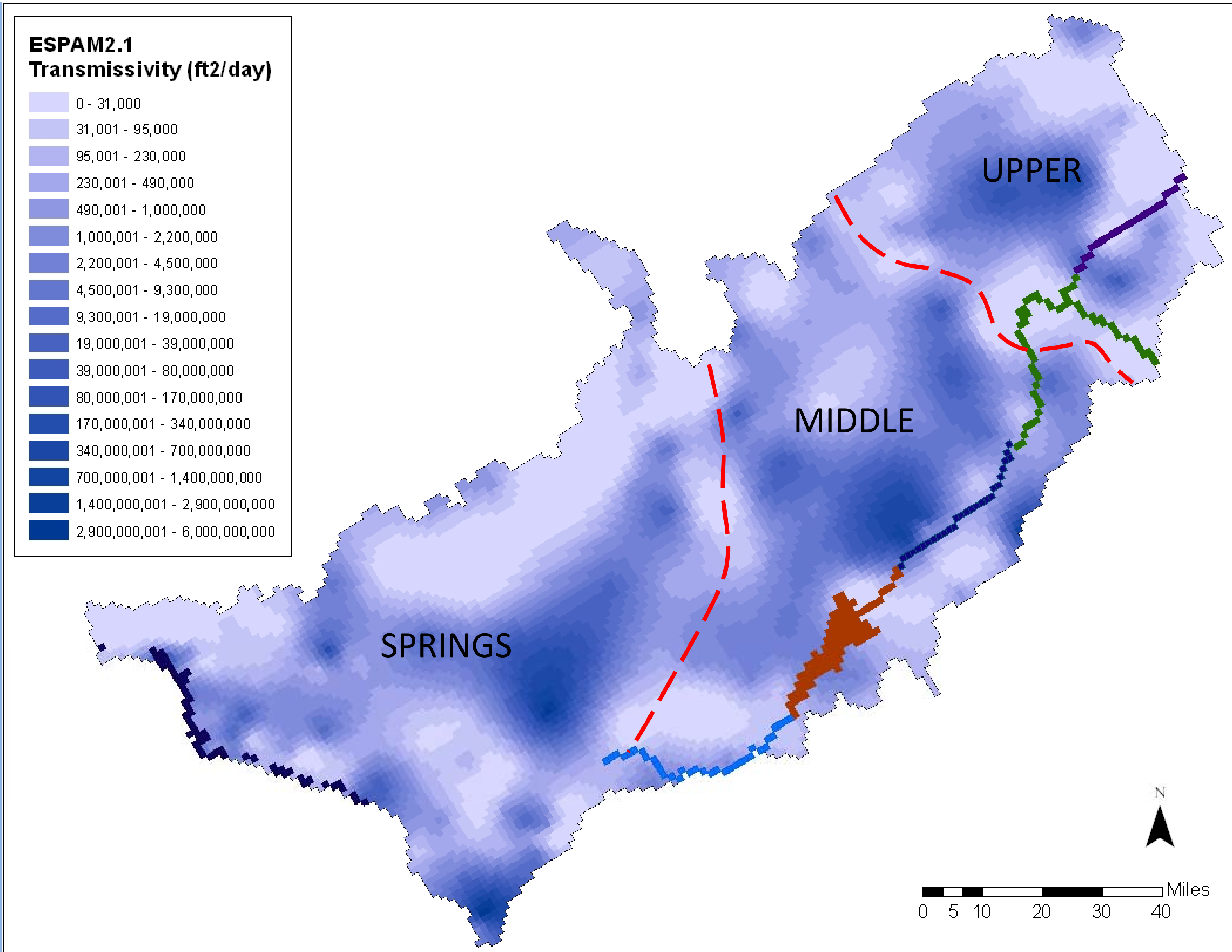
Lower Specific Yield results in less change in storage per change in water level.



Higher Transmissivity results in more widespread, smaller magnitude water-level responses.



The Great Rift and Mud Lake "Barriers" are important controls on the impacts due to recharge.



The Great Rift and Mud Lake "Barriers" are important controls on the impacts due to recharge.

How to Evaluate Recharge

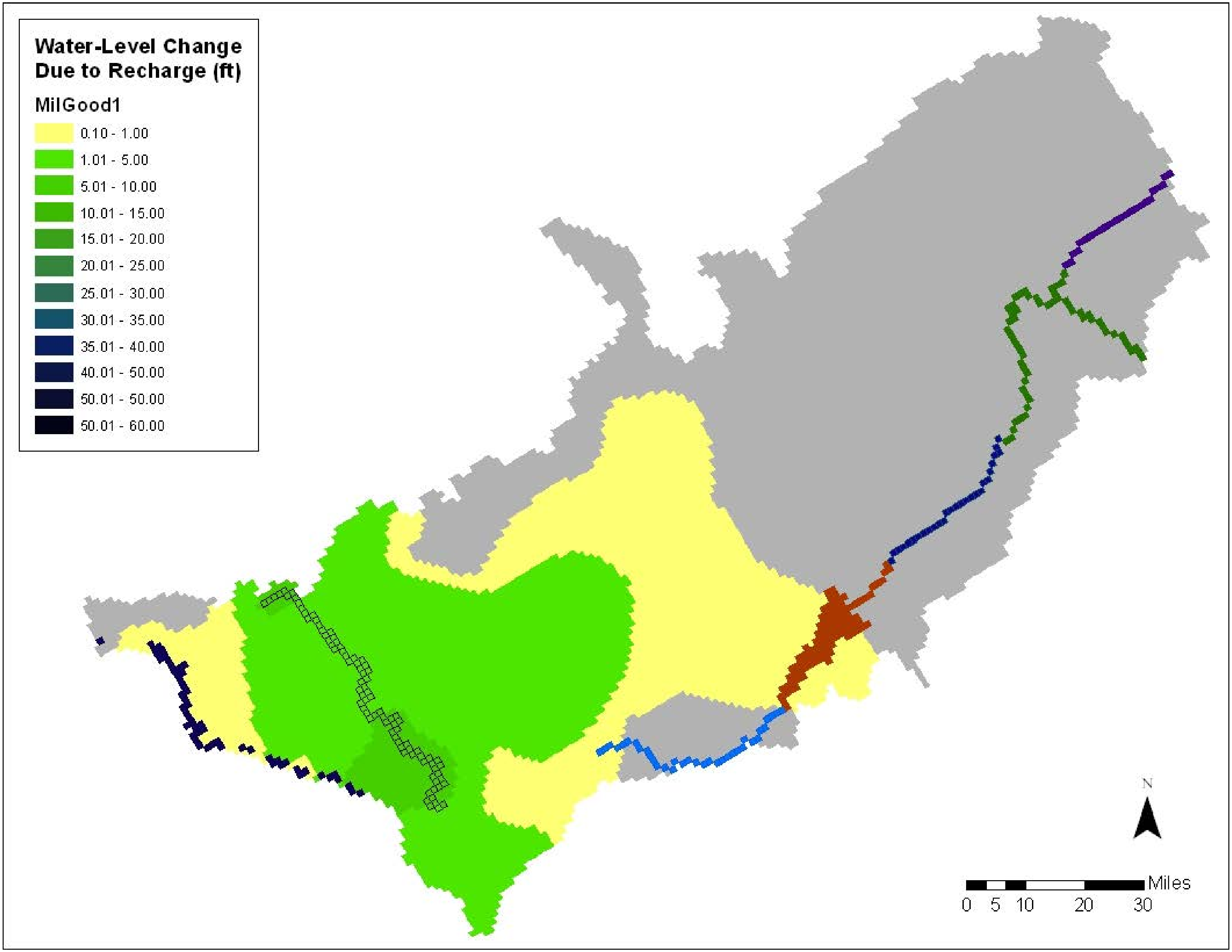
- Location is very important. The best way to evaluate the effect of recharge location is to model the same volume of recharge at each location.
- The best way to evaluate the total impact of recharge at a site is to model with recharge limits.
- Some recharge limits are well known, others need more refinement as concerted recharge efforts progress.
- Consistency is the key to recharge success.
- We will look at all three aspects to recharge.

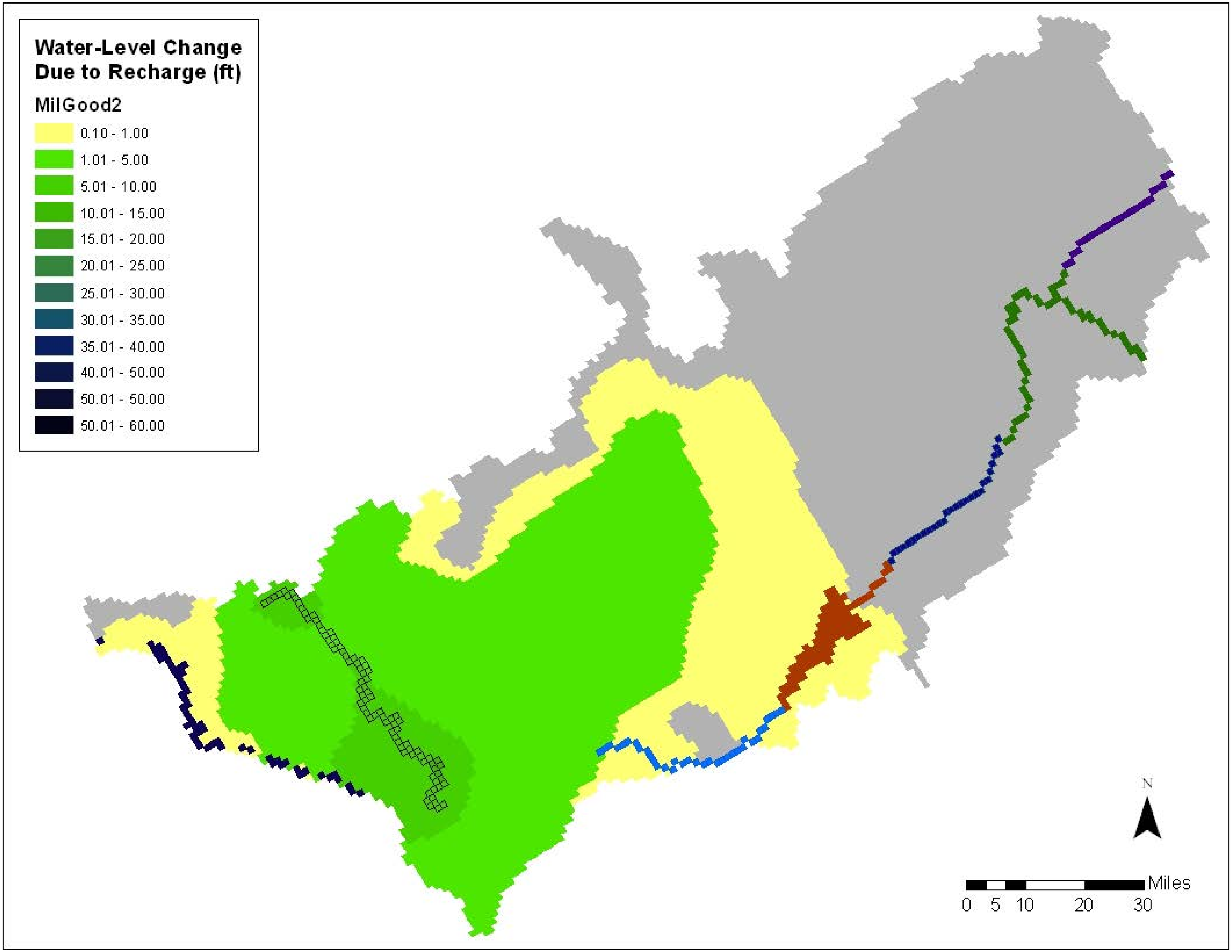
Modeling Jargon

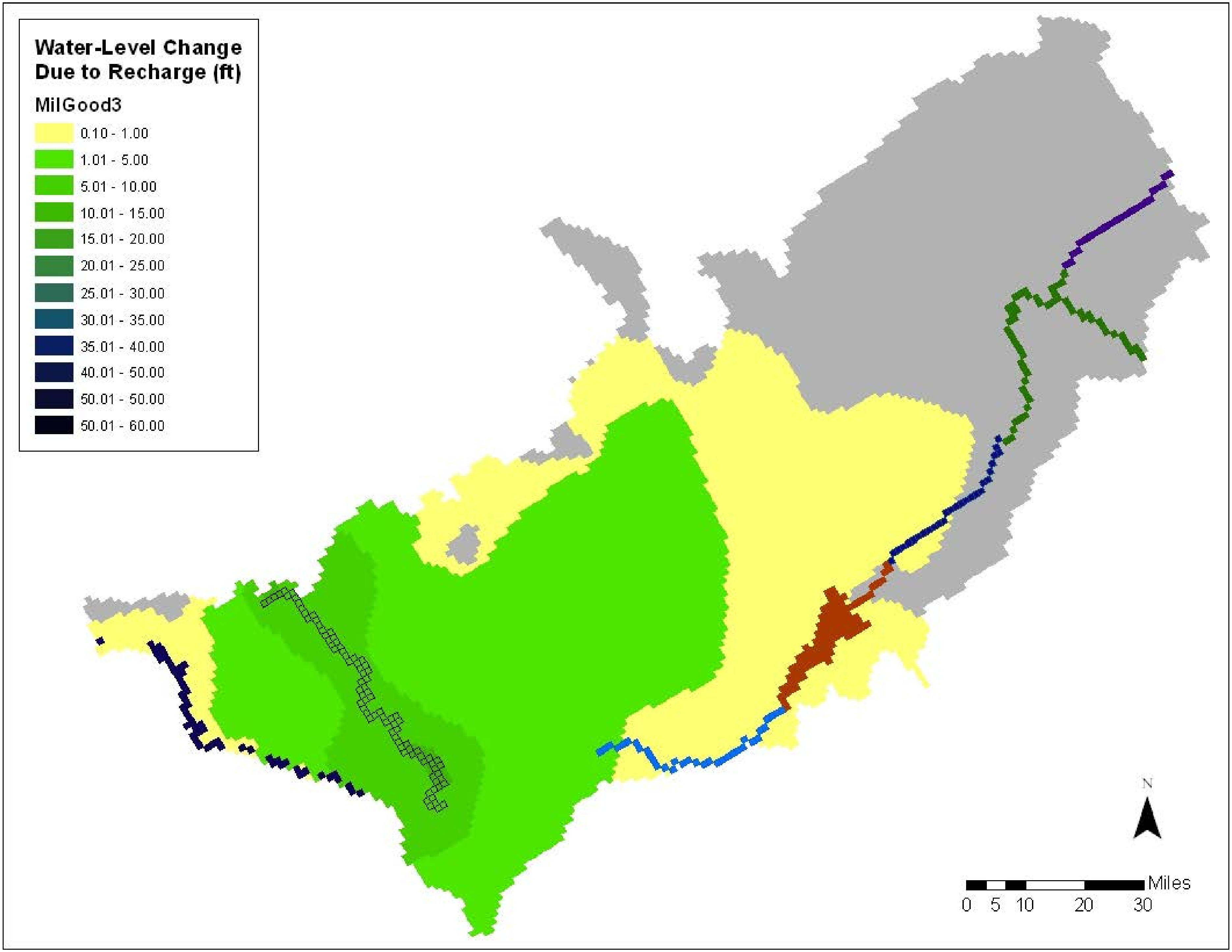
- Model run in Full Mode – Model runs include information about recharge, discharge, weather, etc.
- Model run in Superposition Mode – Model runs only include stress that we give it (recharge).
- Aquifer Properties – Describe how water moves (Transmissivity) and how water is stored (Storage). This is what we get from a calibrated model. The aquifer properties are the relationships between locations.
- Model Cell – The model is divvied up into equal area cells. Aquifer Properties are uniform within a cell.

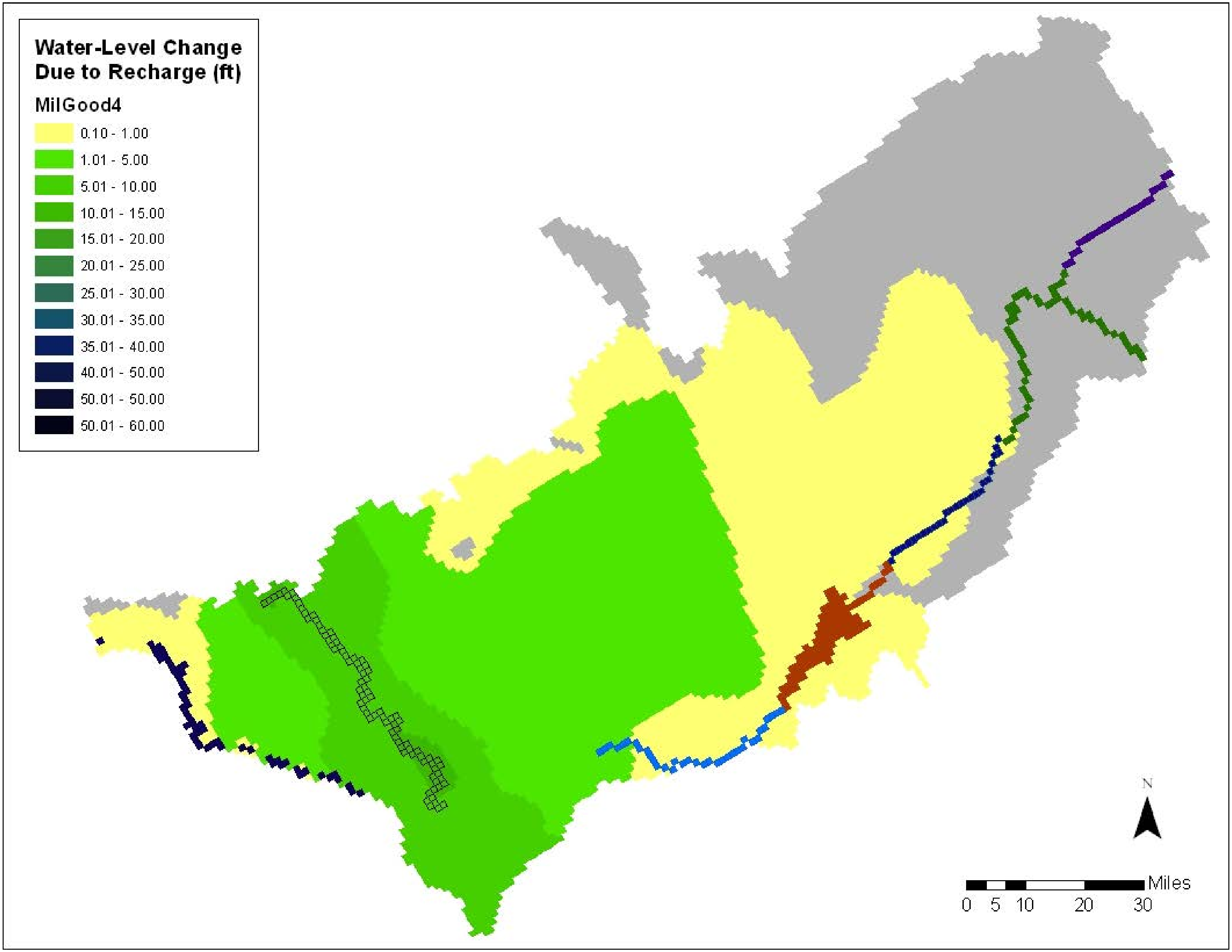
"Johnson" Recharge Evaluation

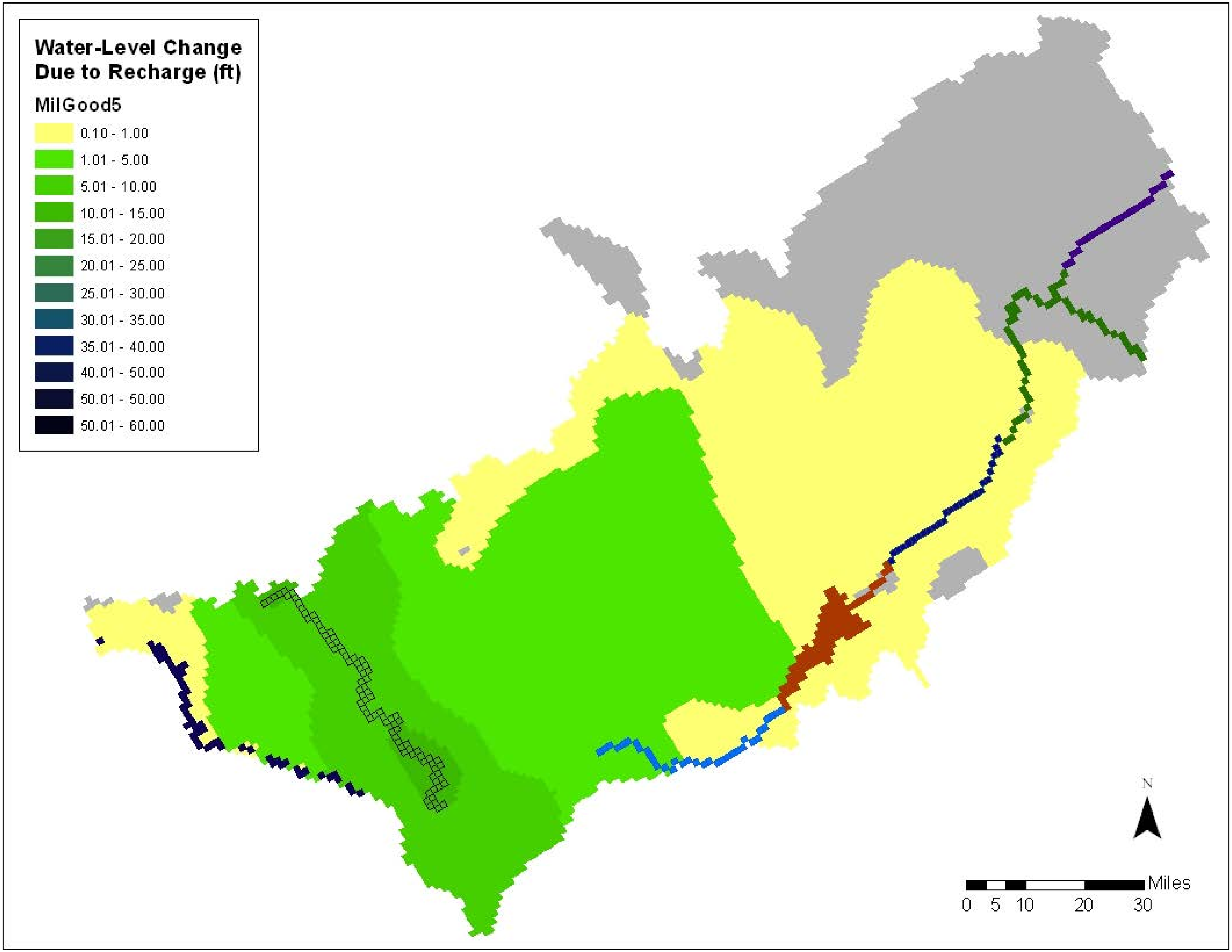
- Recharge each location at 100,000 AF/year
  - Model run in Superposition Mode.
  - Model represents recharge as direct injection into regional aquifer.
  - Exaggerated rate allows illustration of aquifer behavior.
  - Does not include transmission losses to discrete sites.


Water-Level Change
Due to Recharge (ft)
MilGood1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

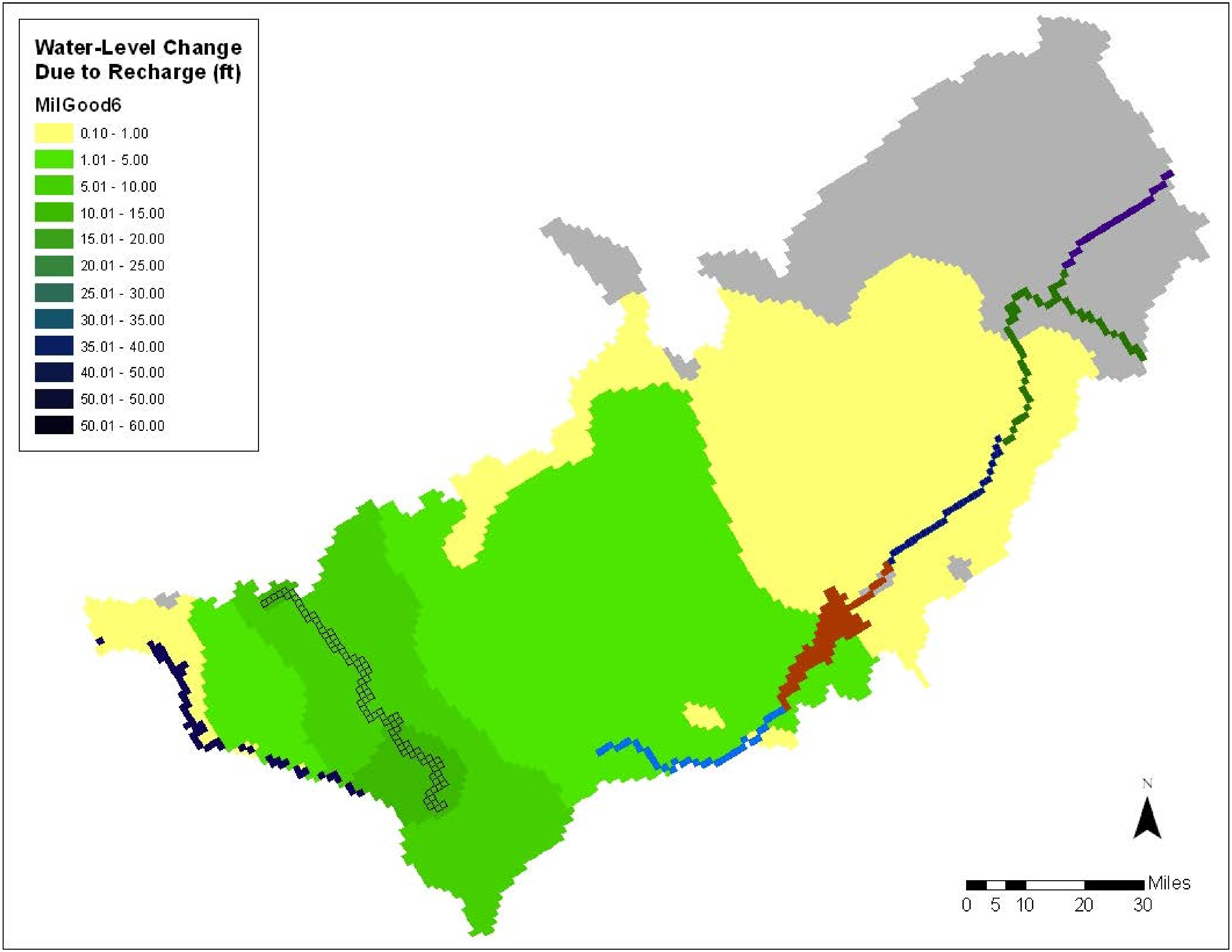

Water-Level Change
Due to Recharge (ft)
MilGood2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
MilGood3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30 Miles

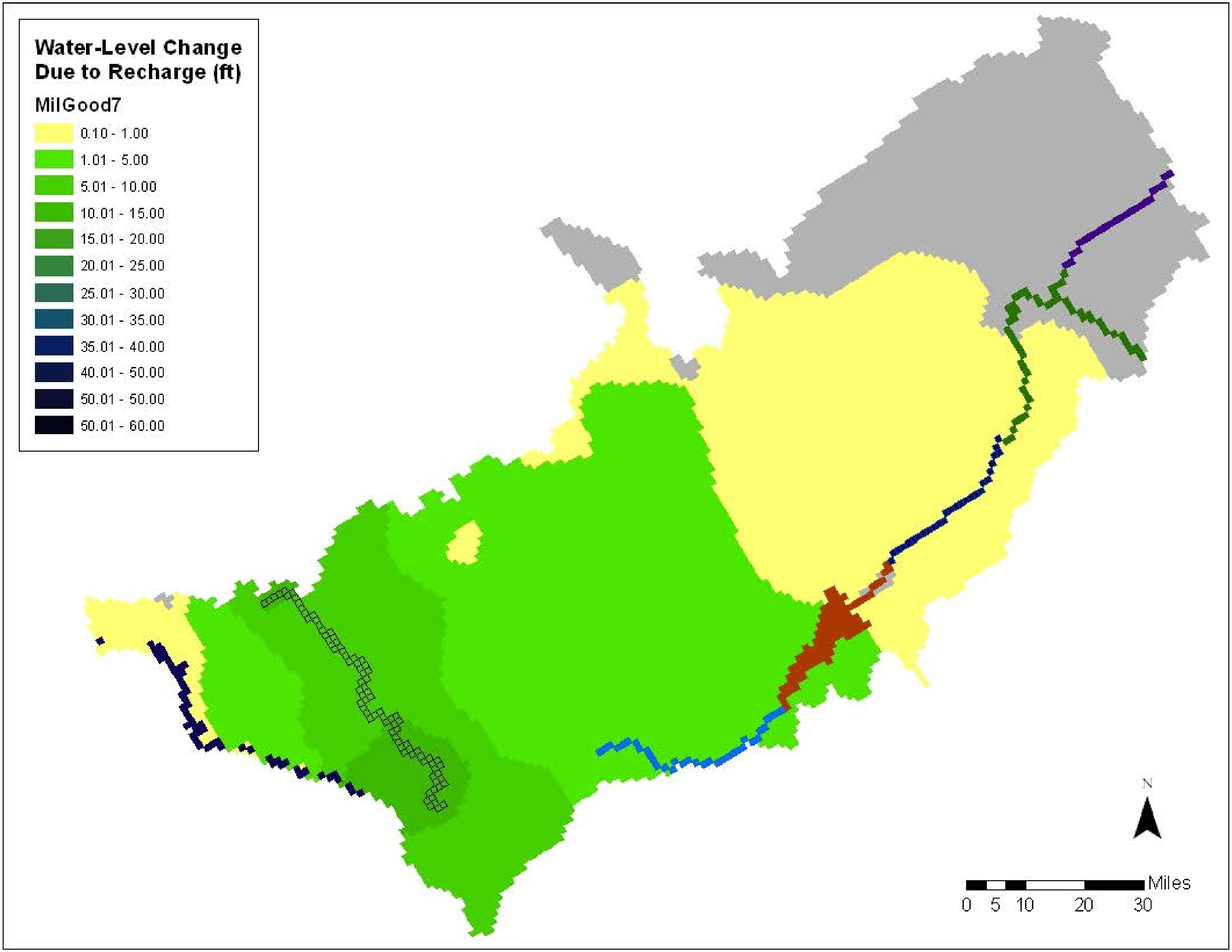

Water-Level Change
Due to Recharge (ft)
MilGood4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

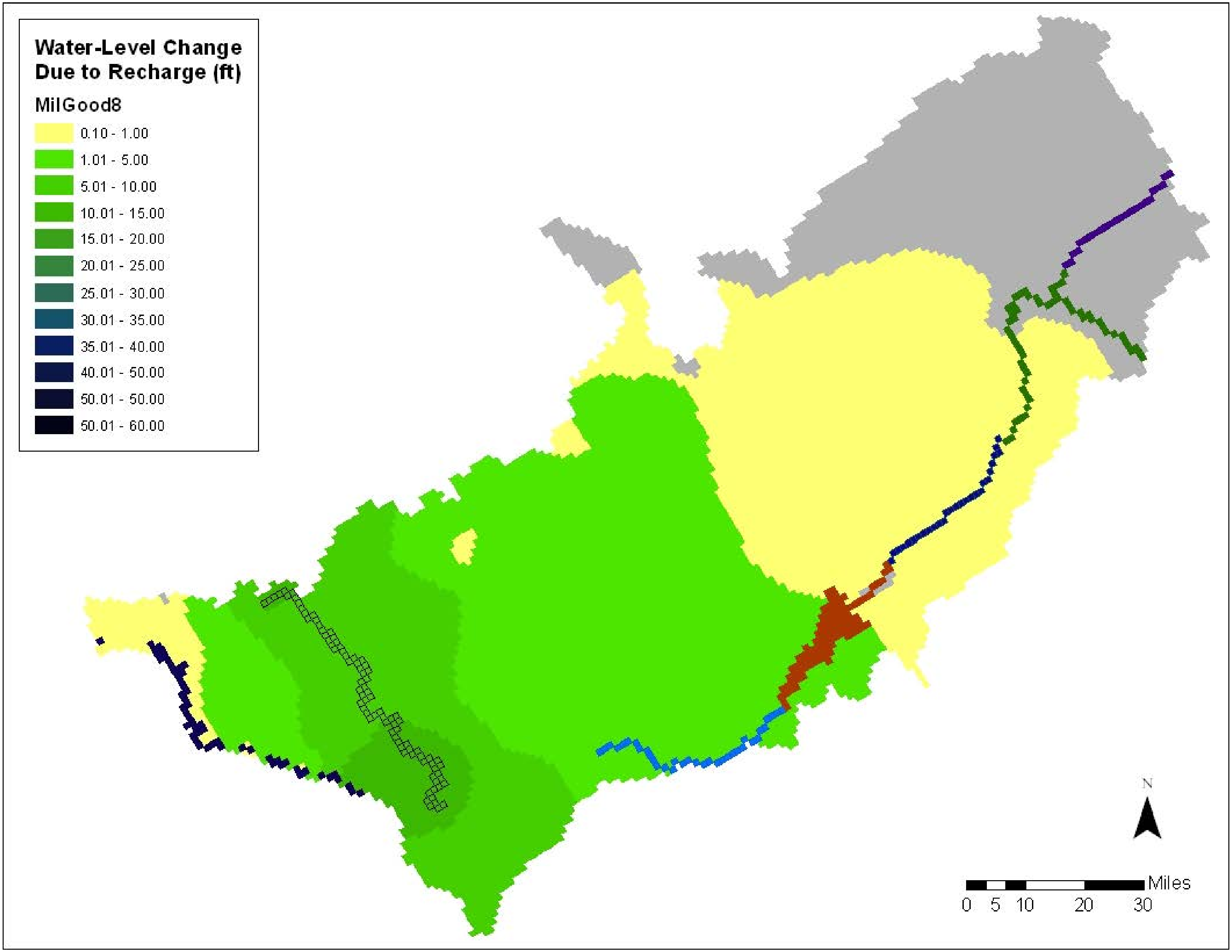


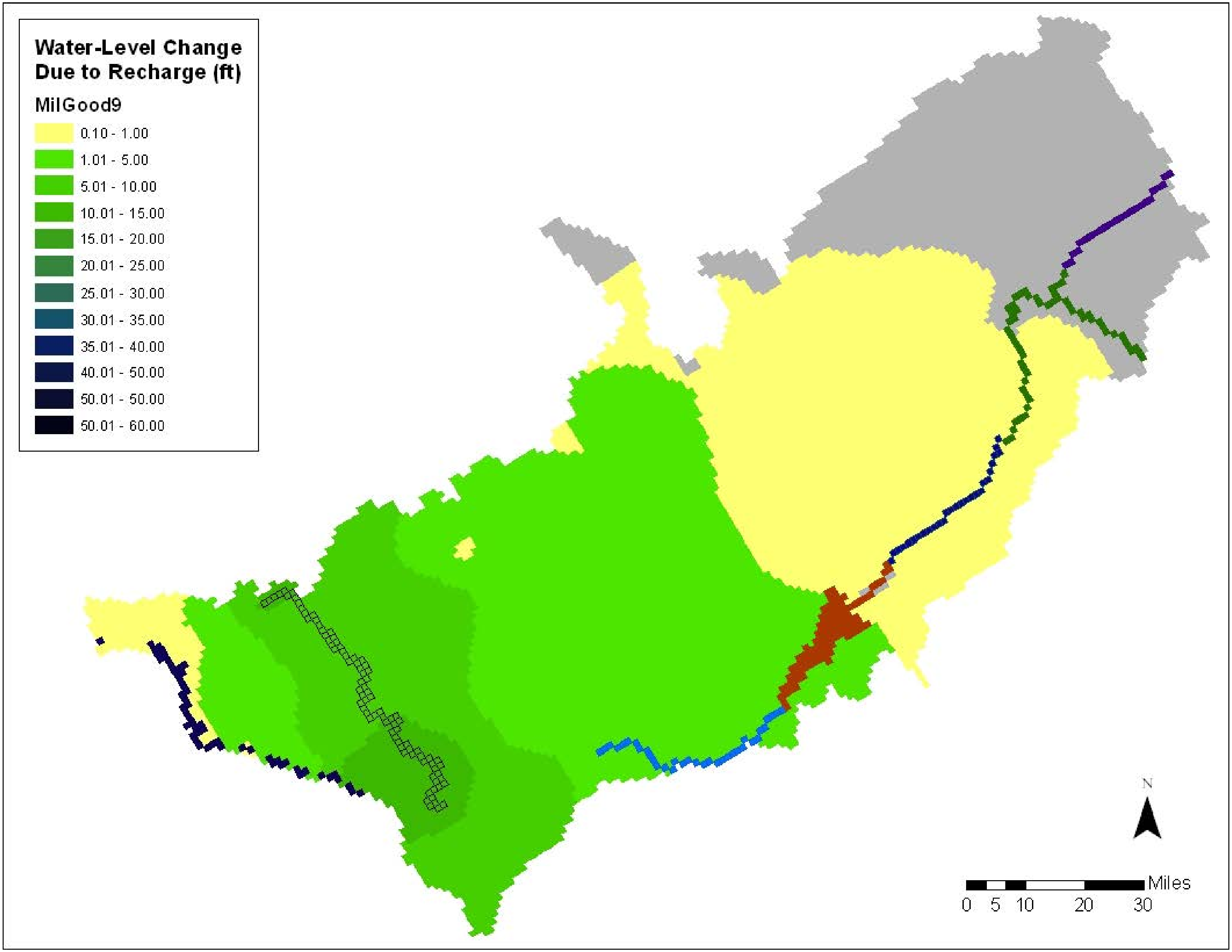
Water-Level Change
Due to Recharge (ft)
MilGood5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles



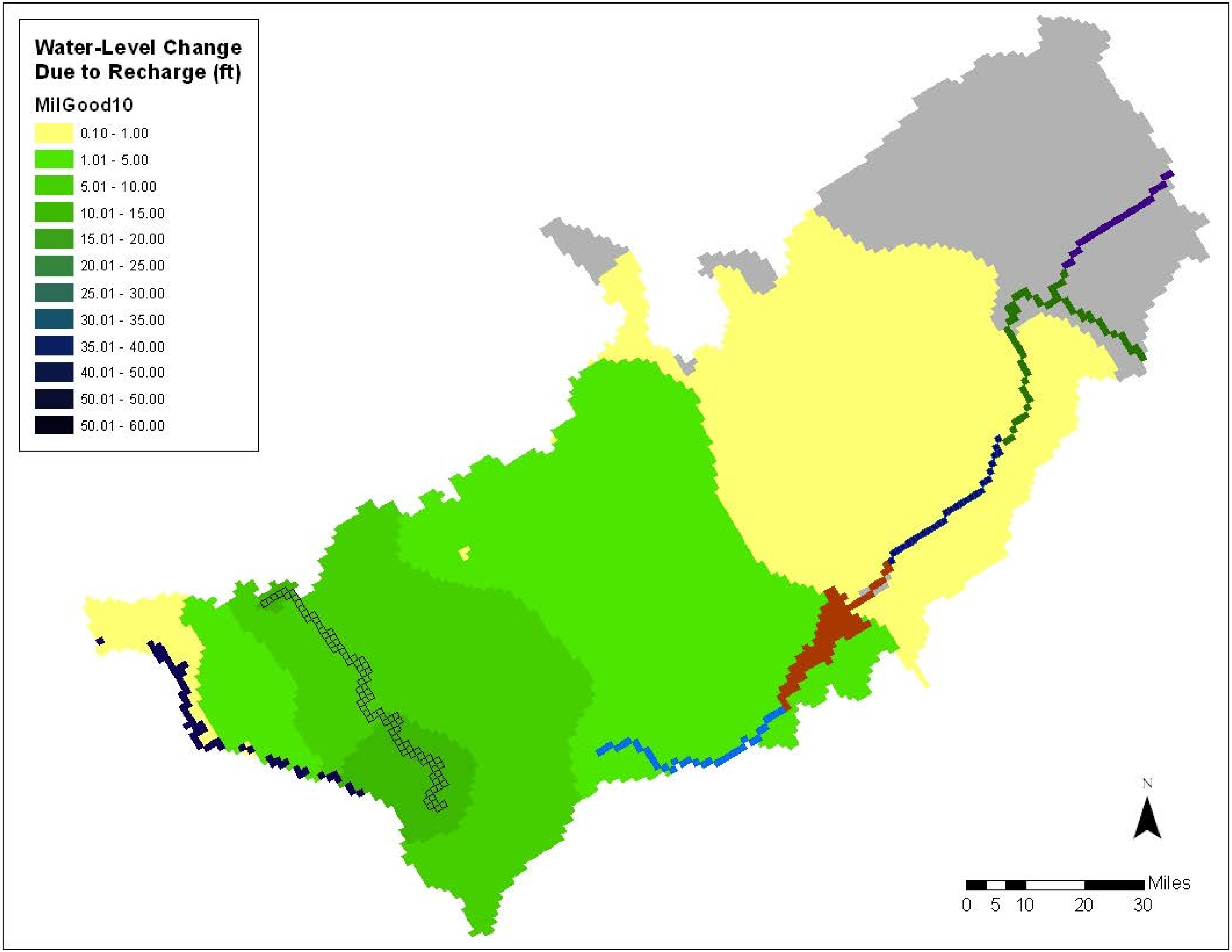
Water-Level Change
Due to Recharge (ft)
MilGood6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
MilGood7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

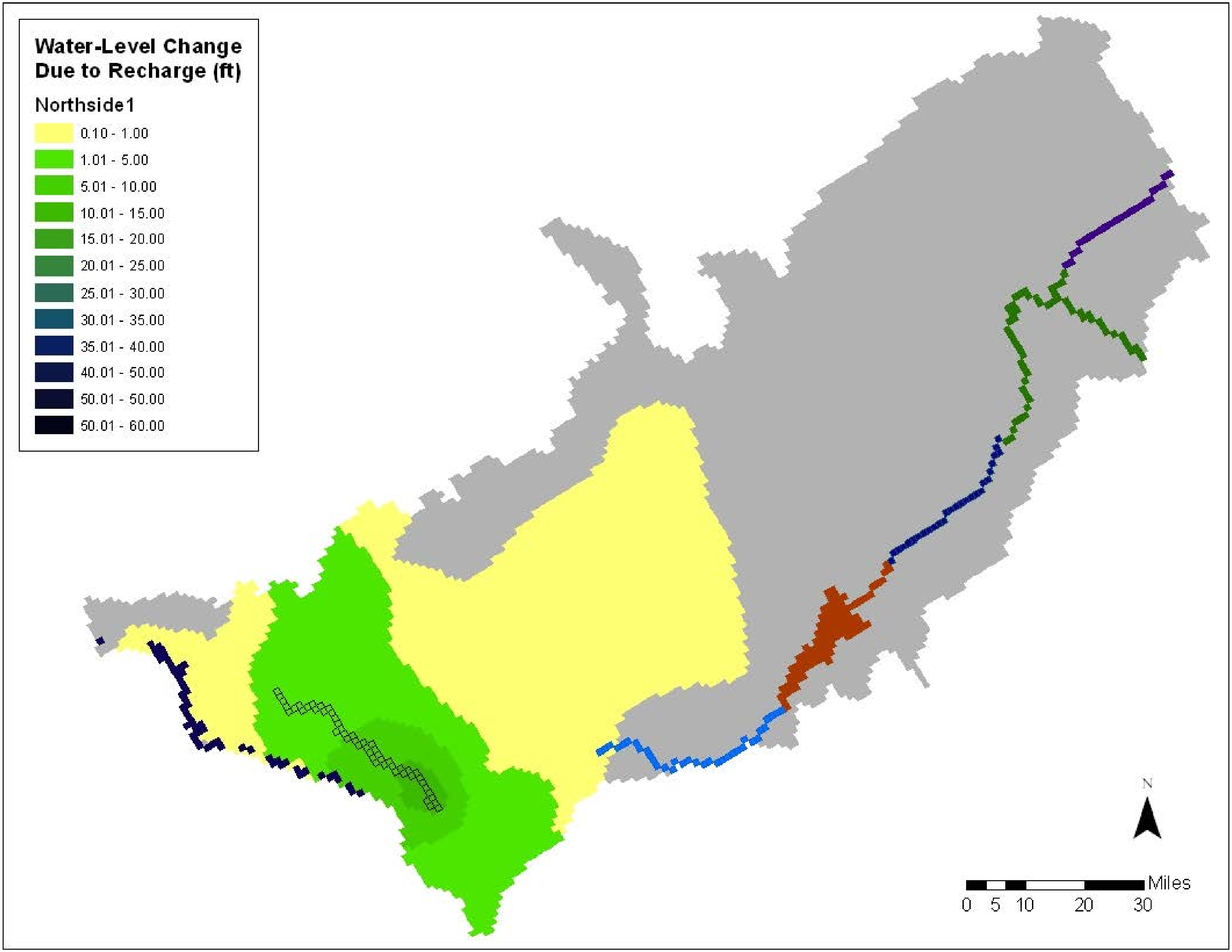

Water-Level Change Due to Recharge (ft)
MilGood8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



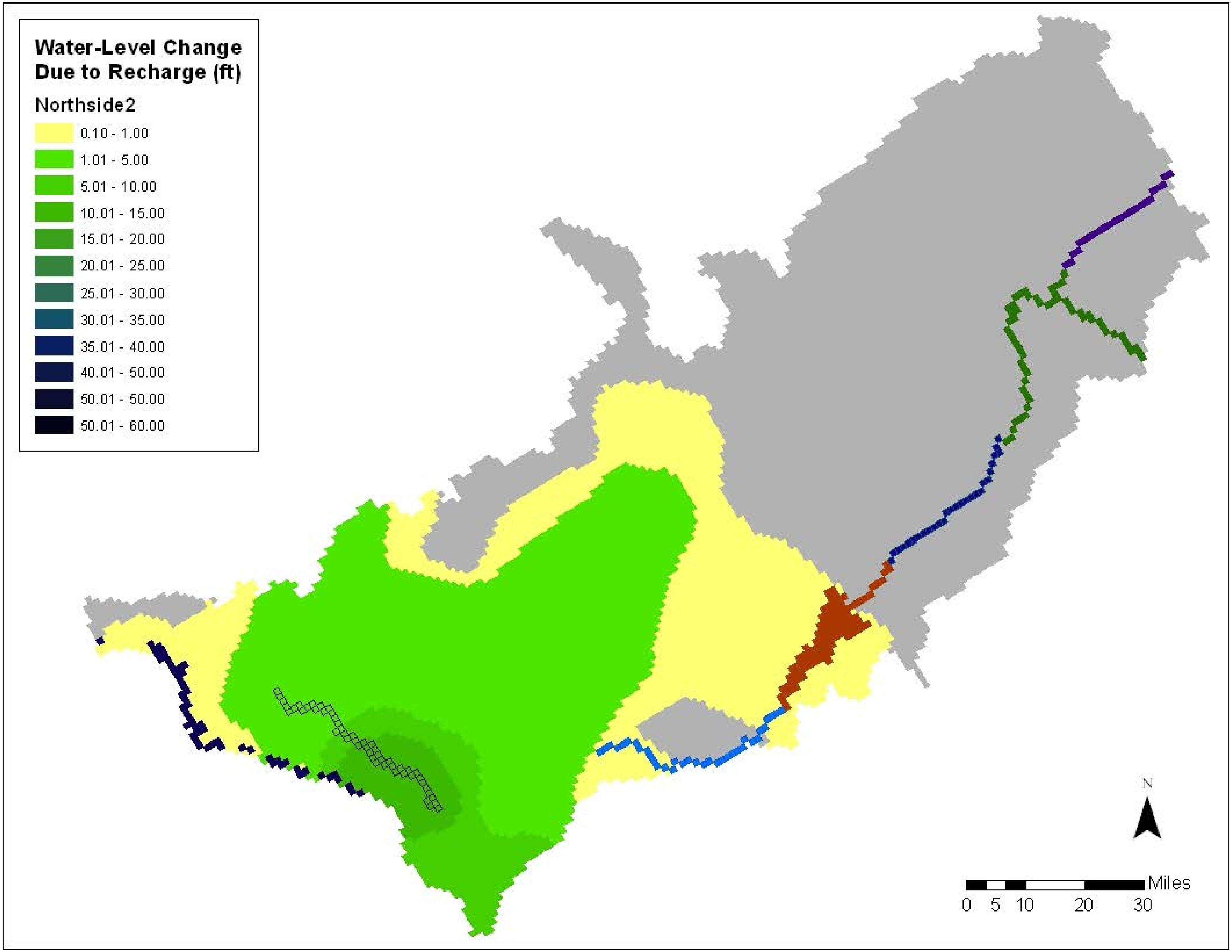
Water-Level Change
Due to Recharge (ft)
MilGood9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

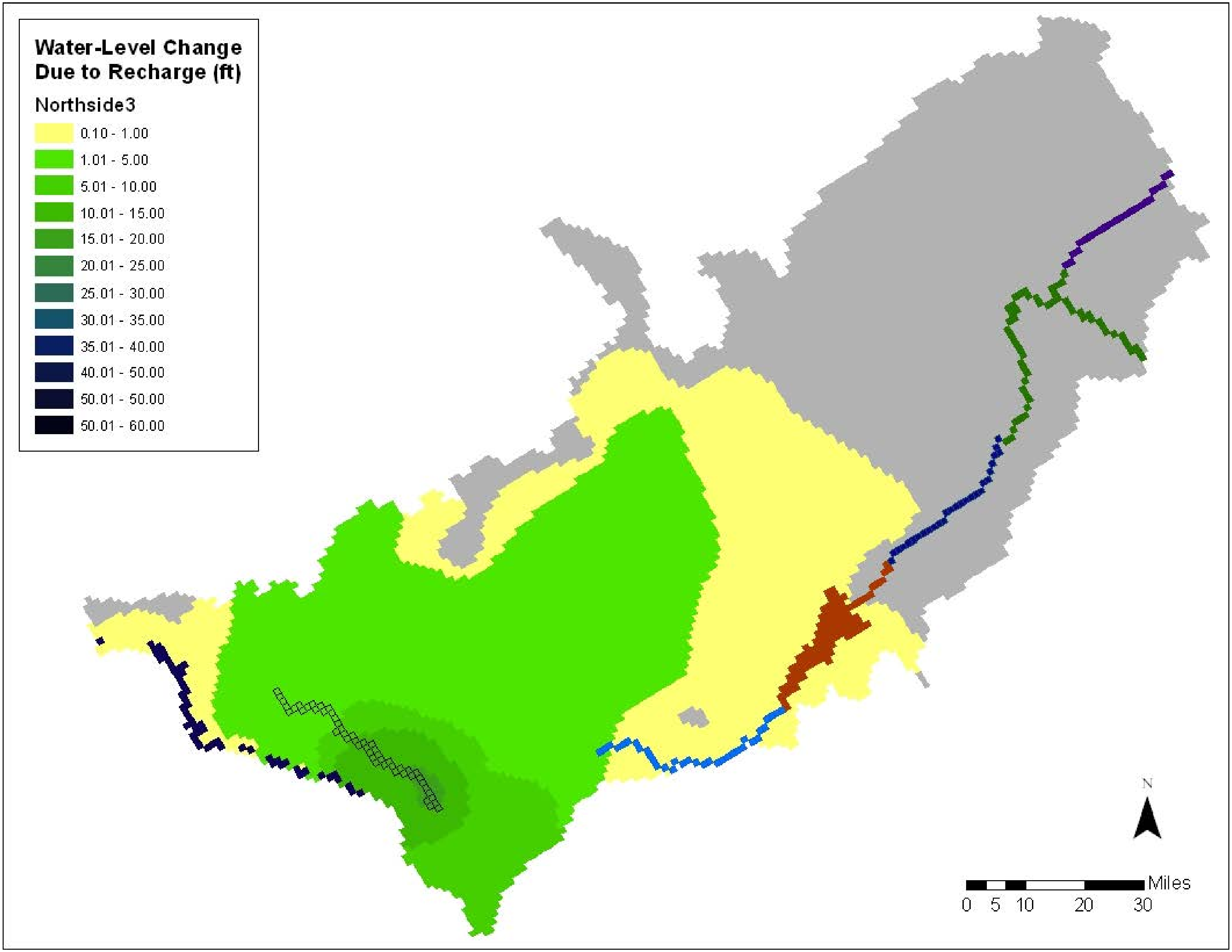


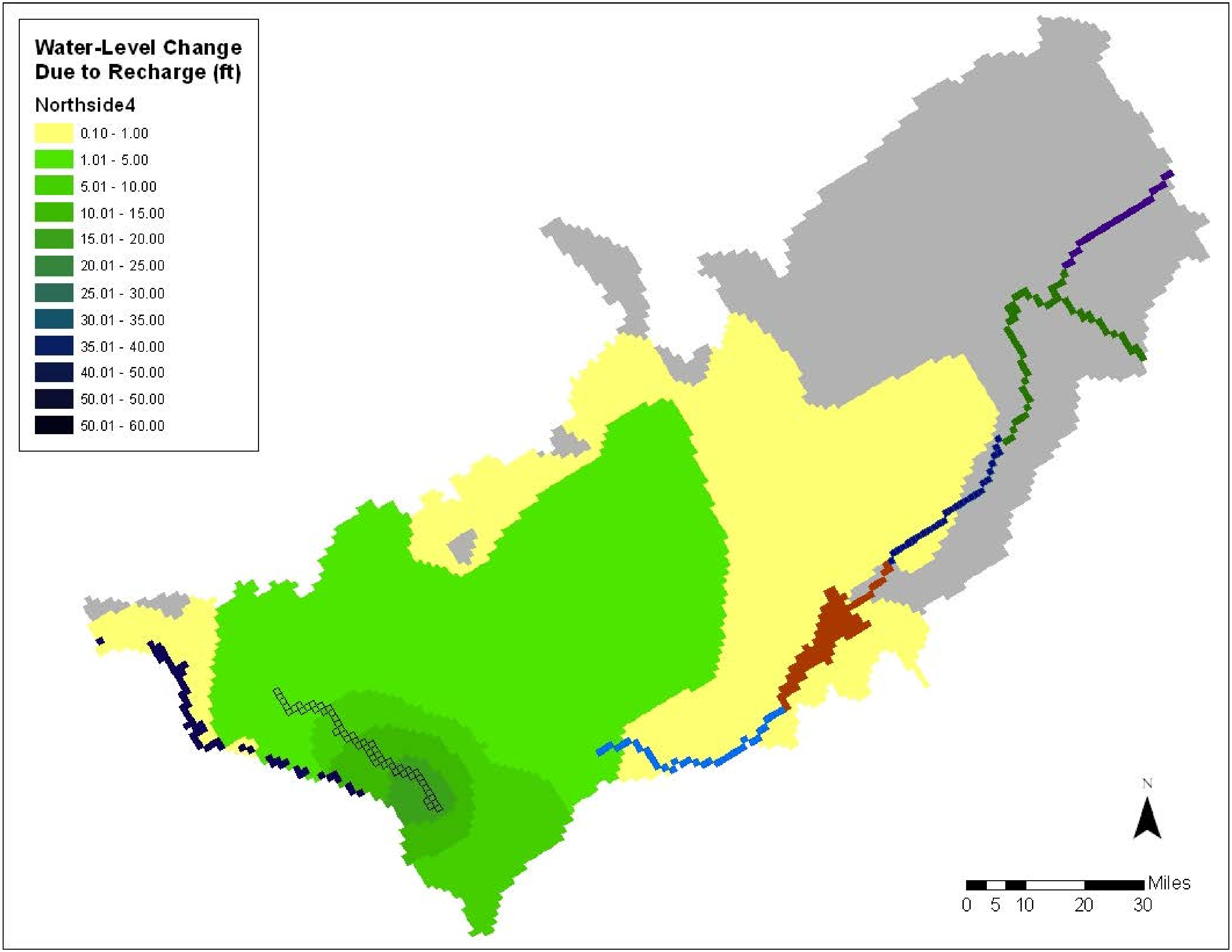
Water-Level Change
Due to Recharge (ft)
MilGood10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0
5
10
20
30



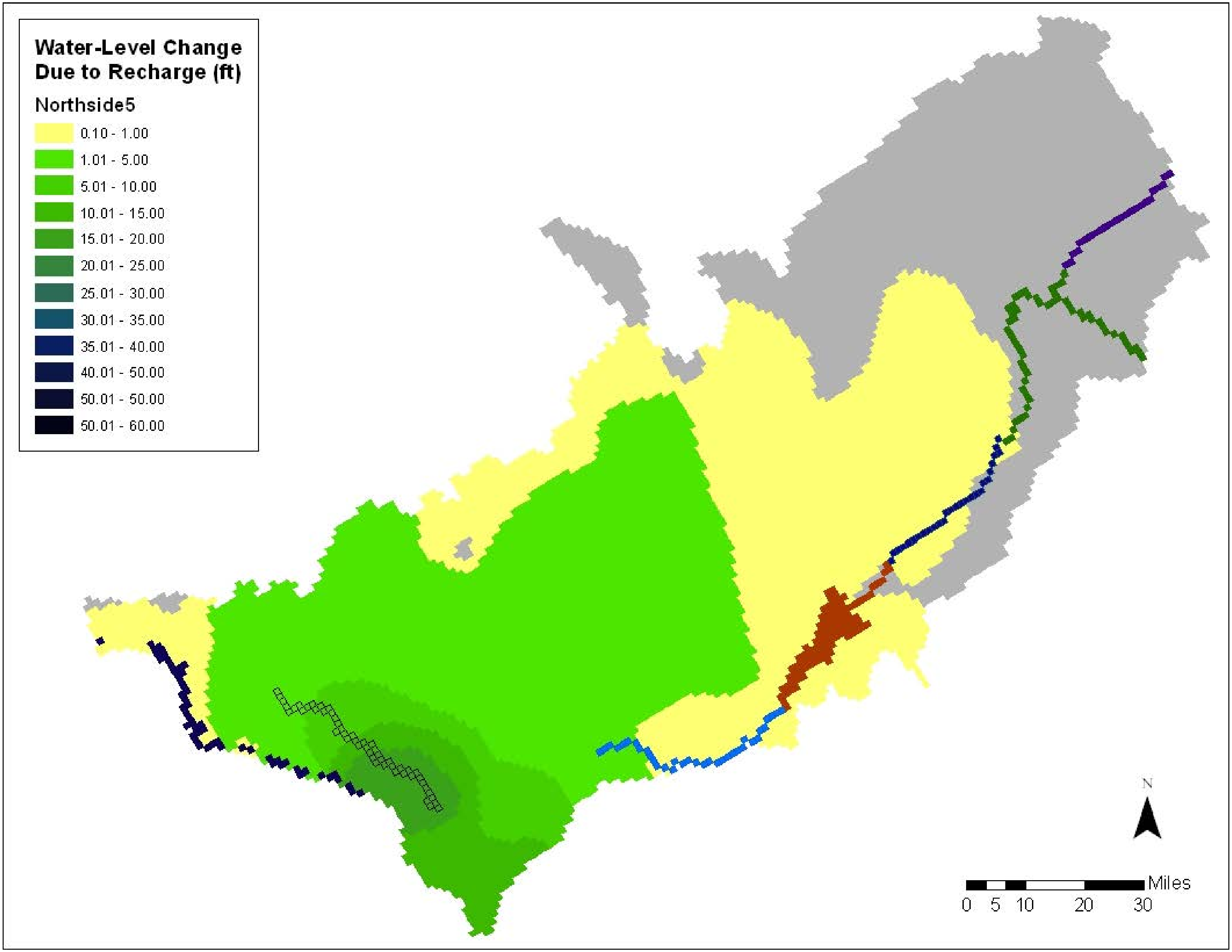
Water-Level Change Due to Recharge (ft)
Northside1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

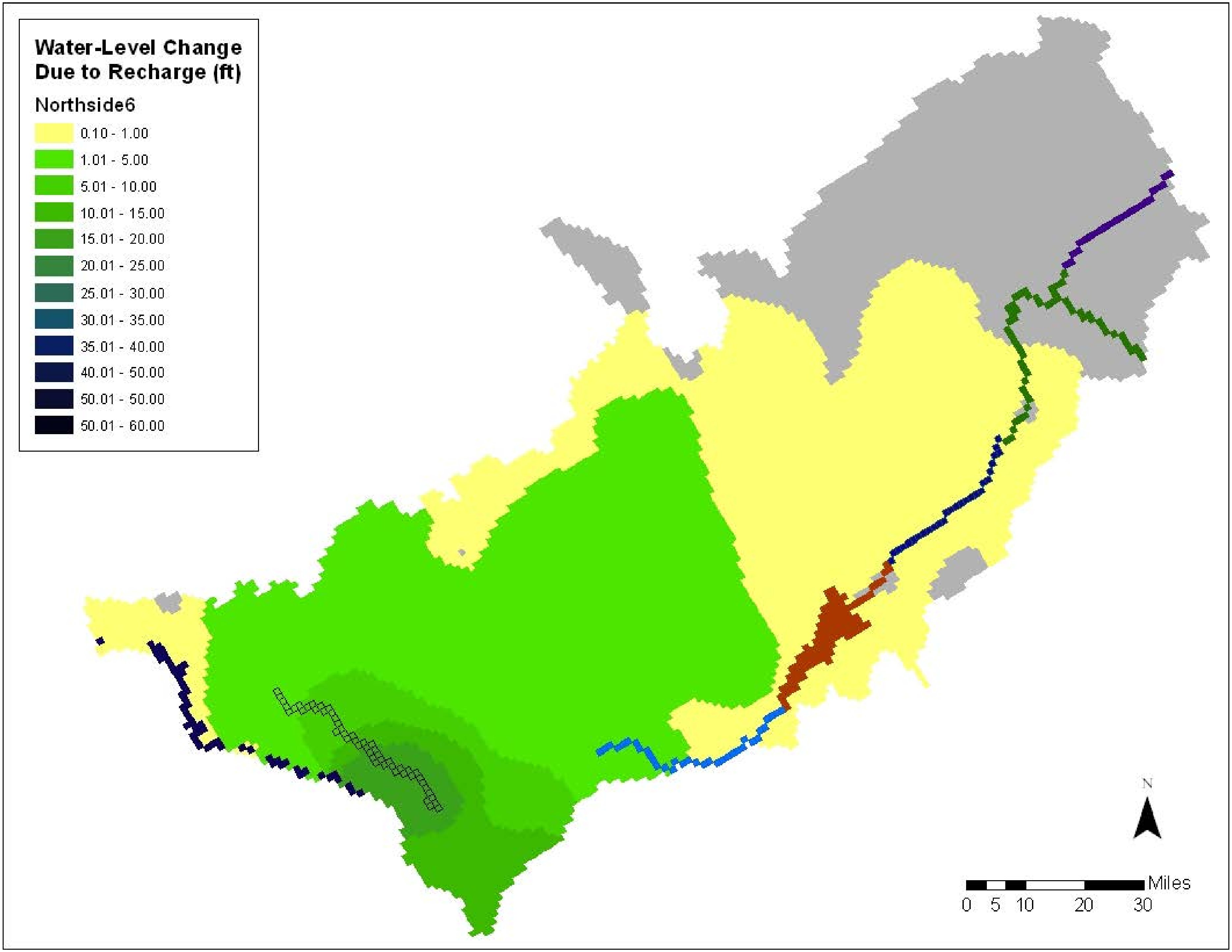

Water-Level Change
Due to Recharge (ft)
Northside2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Northside3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

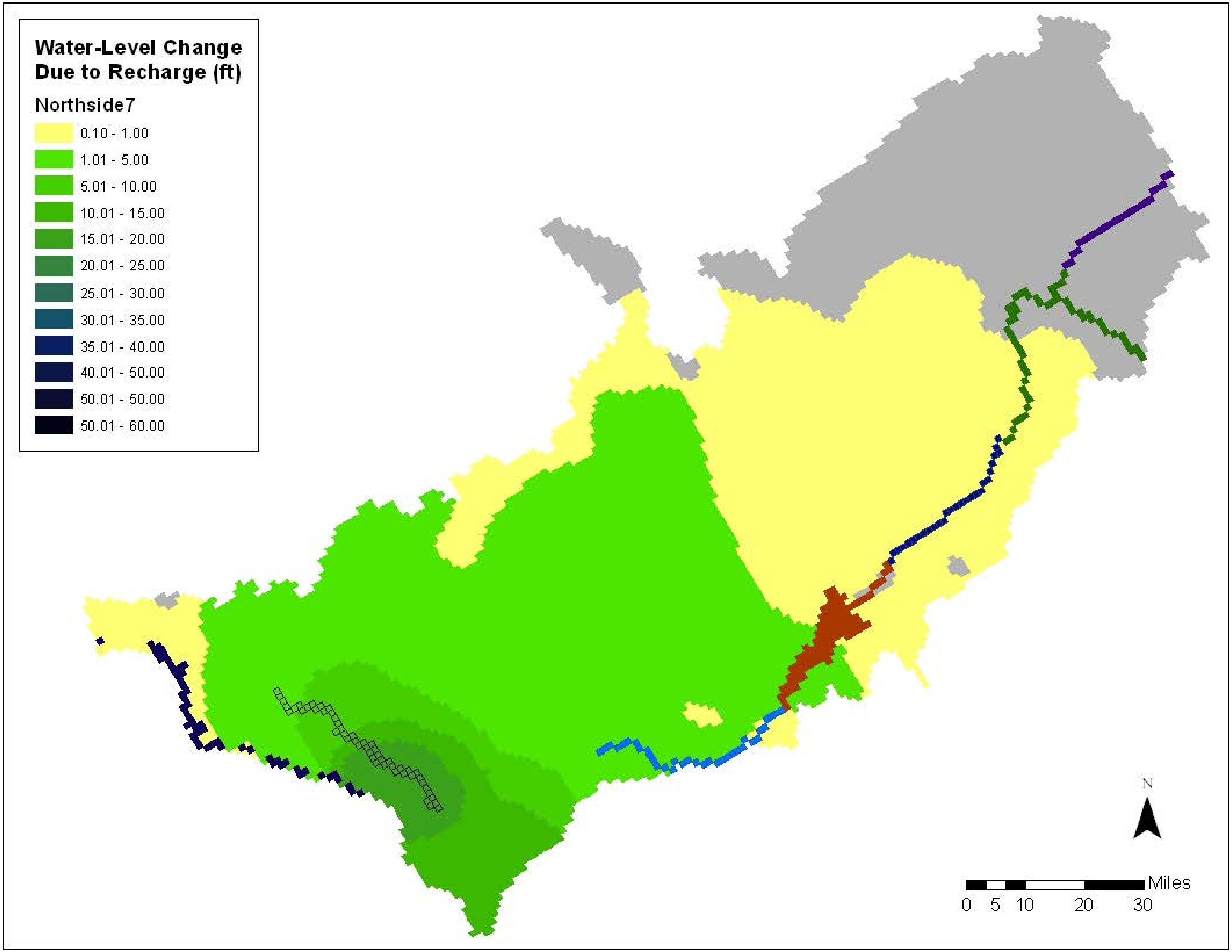


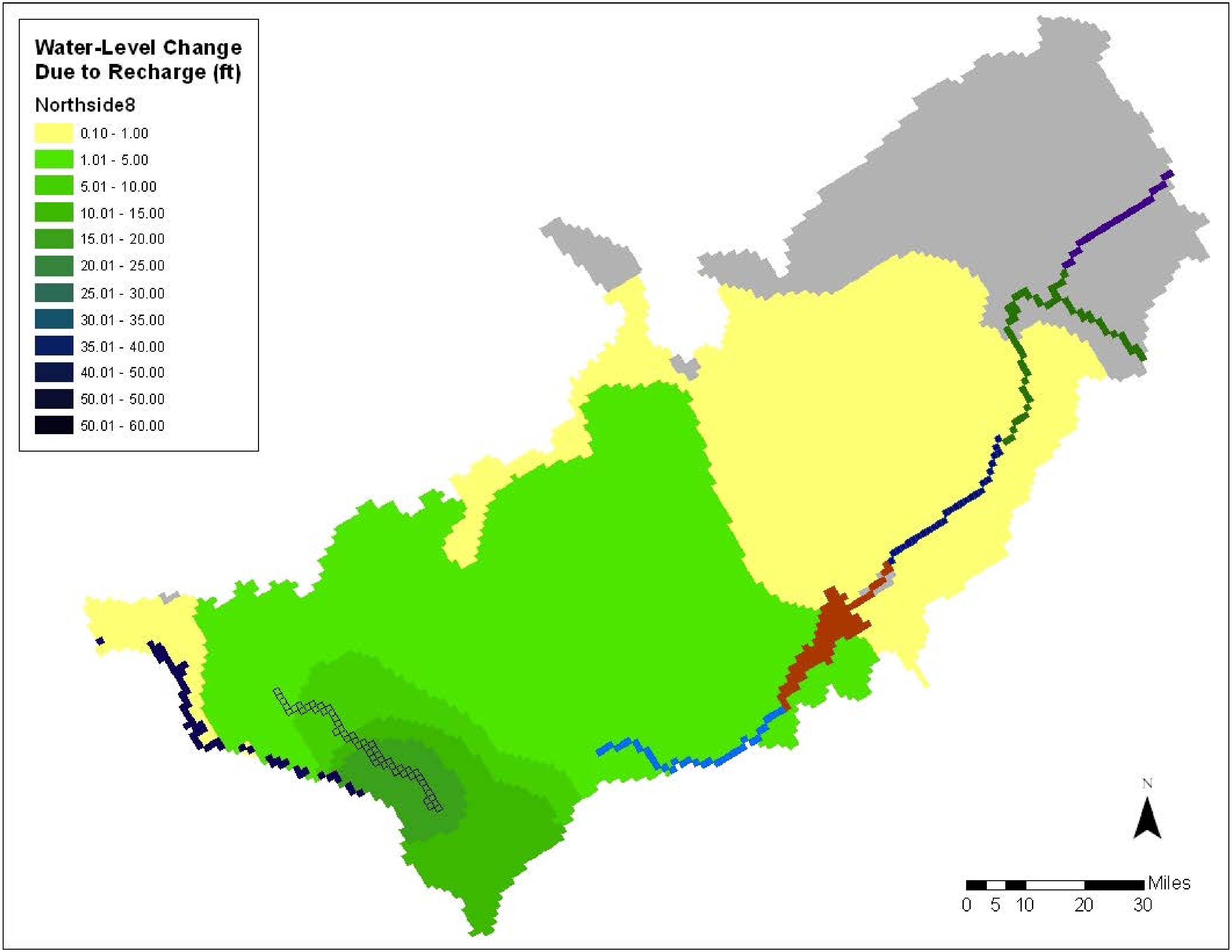
Water-Level Change Due to Recharge (ft)
Northside4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Northside5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

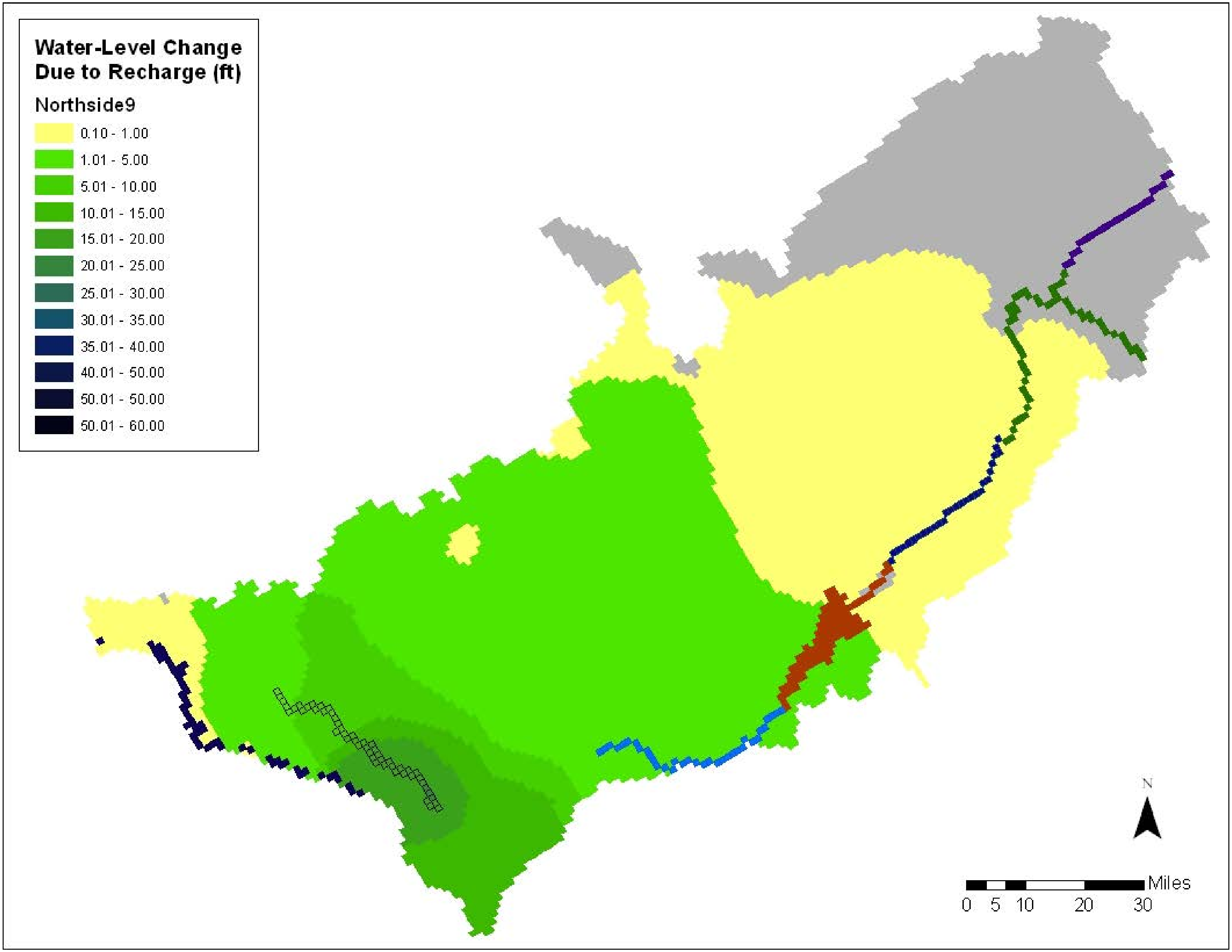


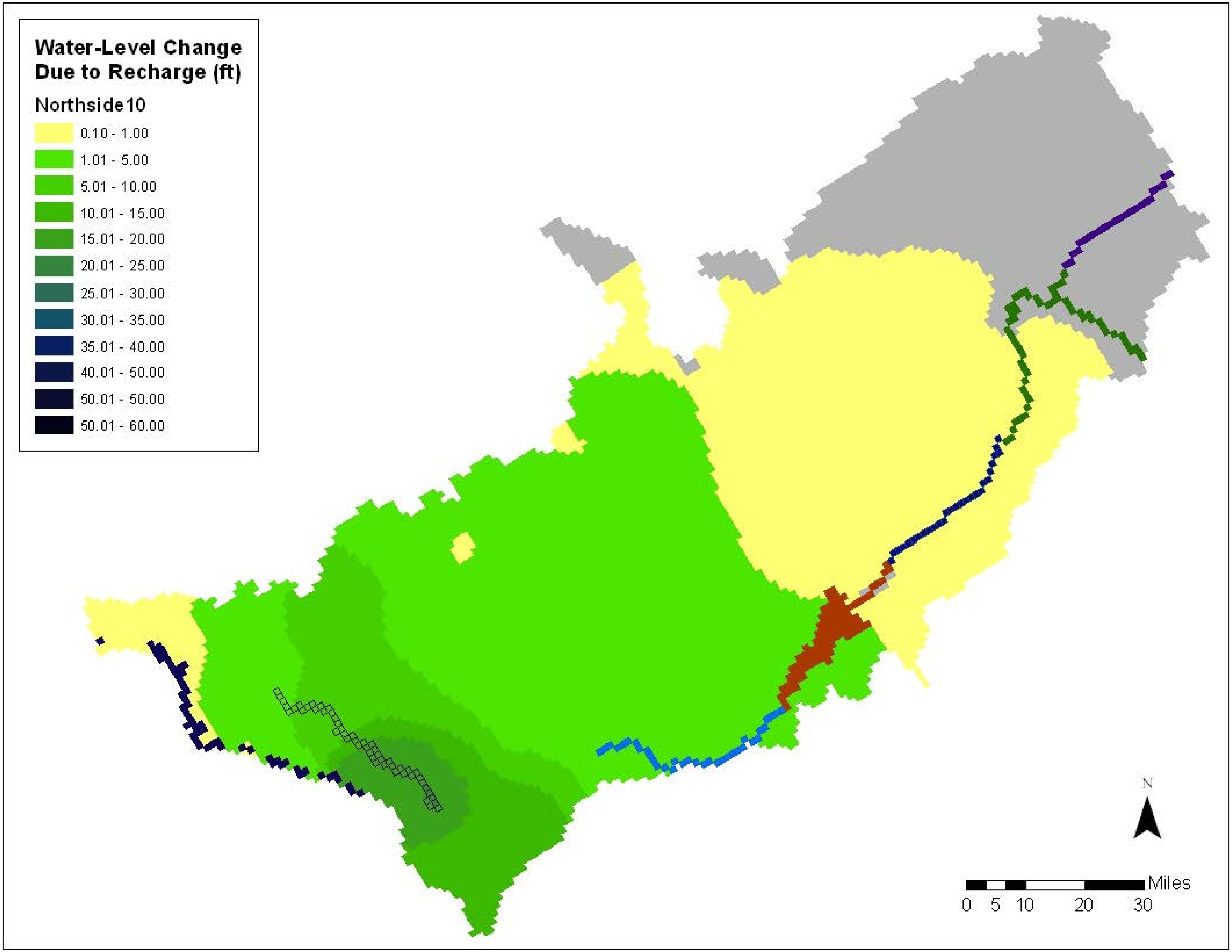
Water-Level Change
Due to Recharge (ft)
Northside6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Northside7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

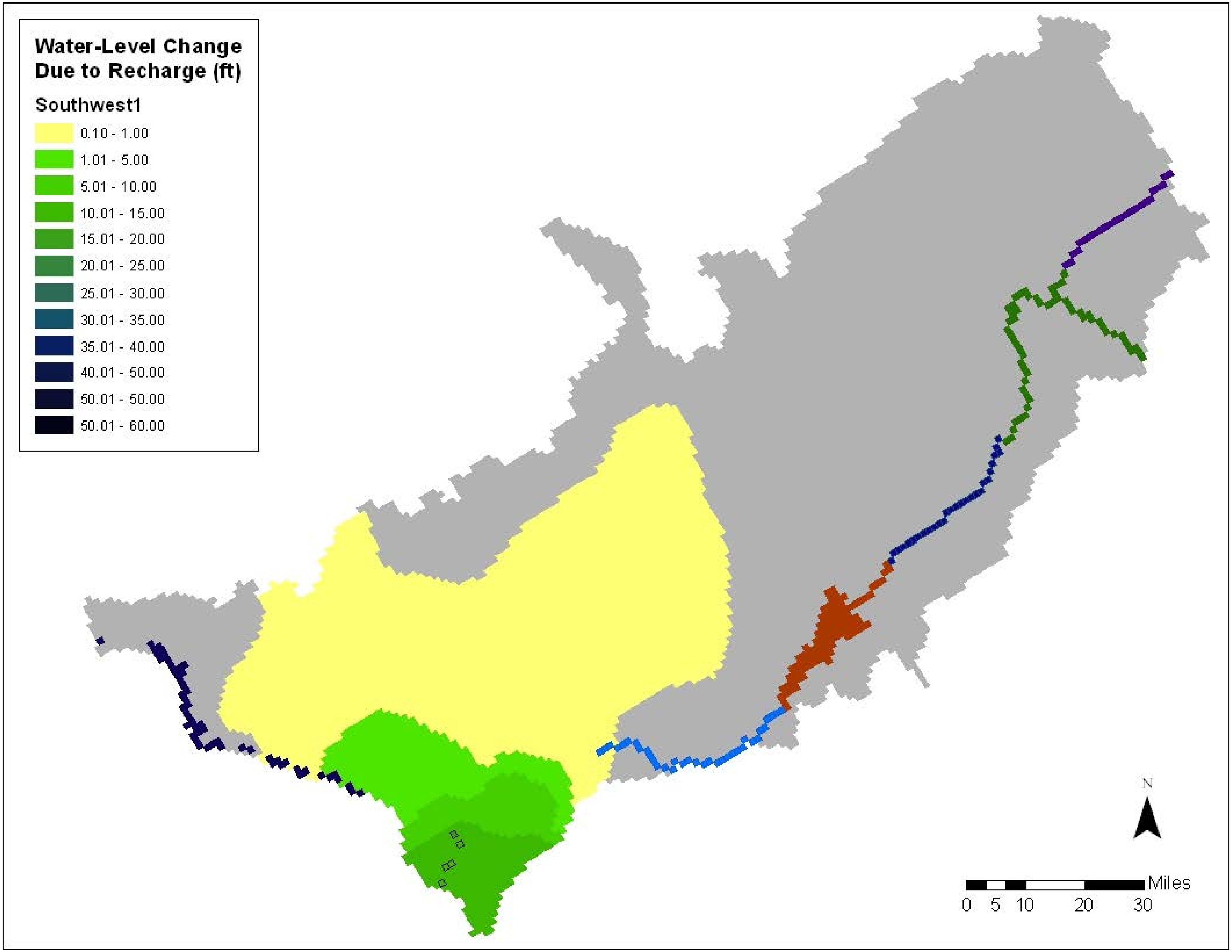


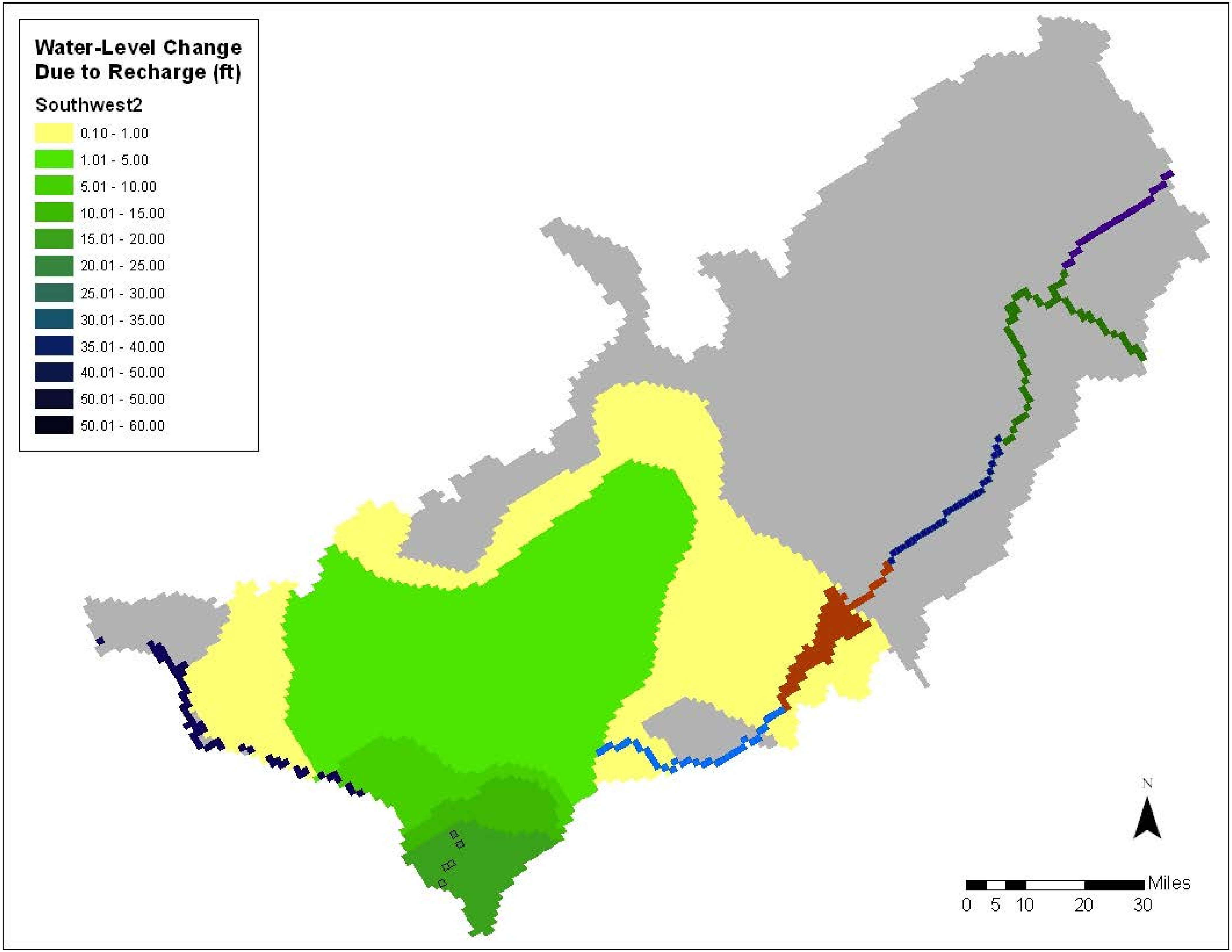
Water-Level Change Due to Recharge (ft)
Northside8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
Northside9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

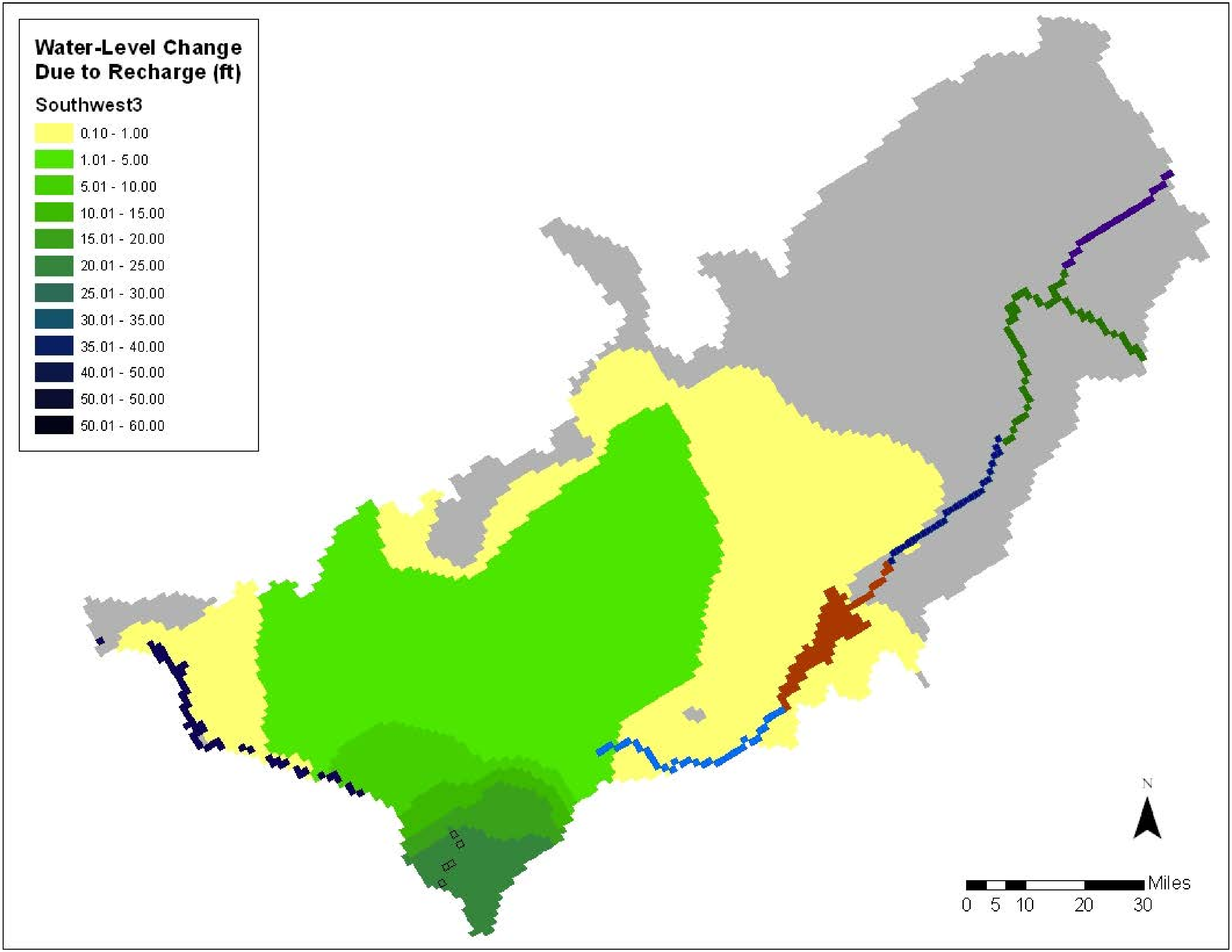


Water-Level Change
Due to Recharge (ft)
Northside10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

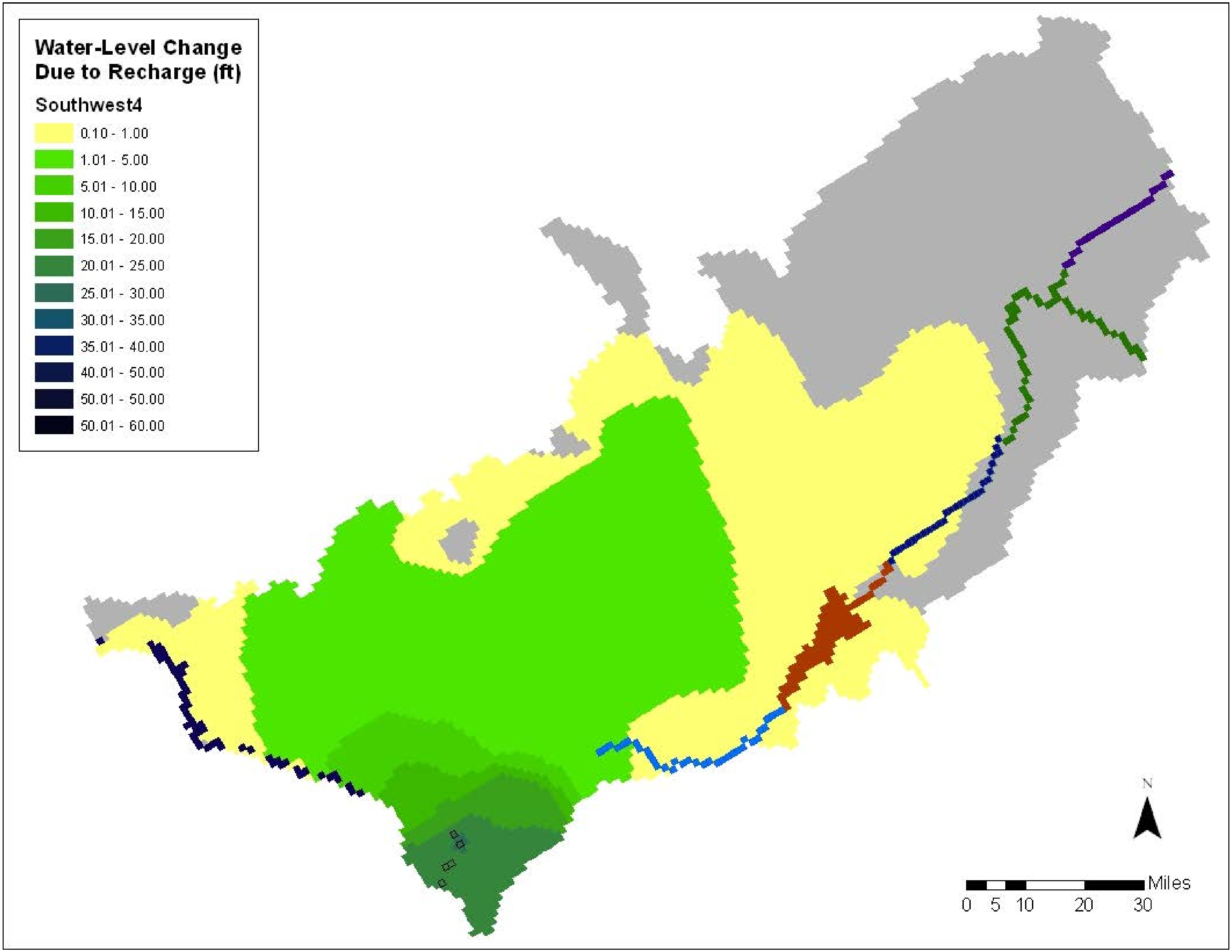

Water-Level Change
Due to Recharge (ft)
Southwest1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

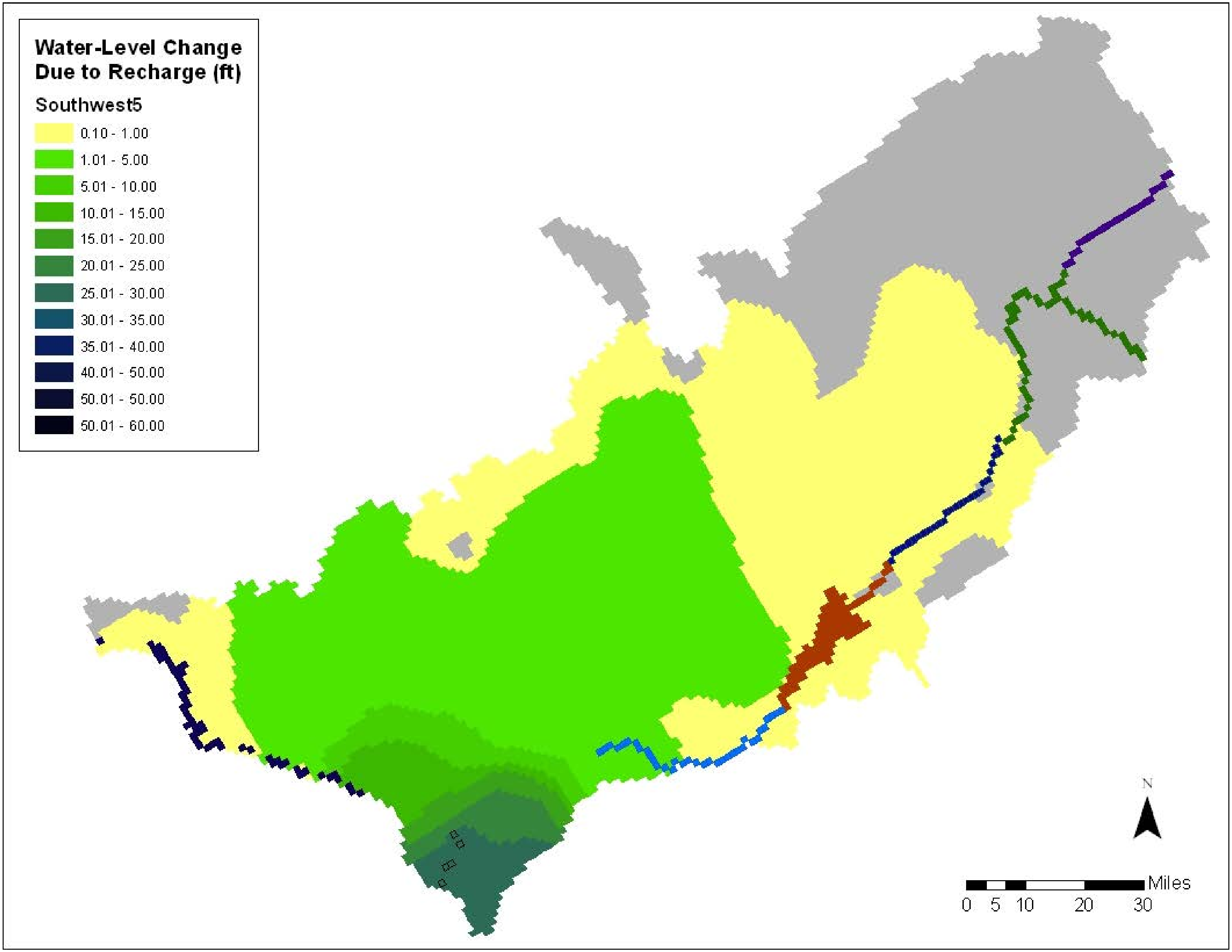


Water-Level Change
Due to Recharge (ft)
Southwest2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles

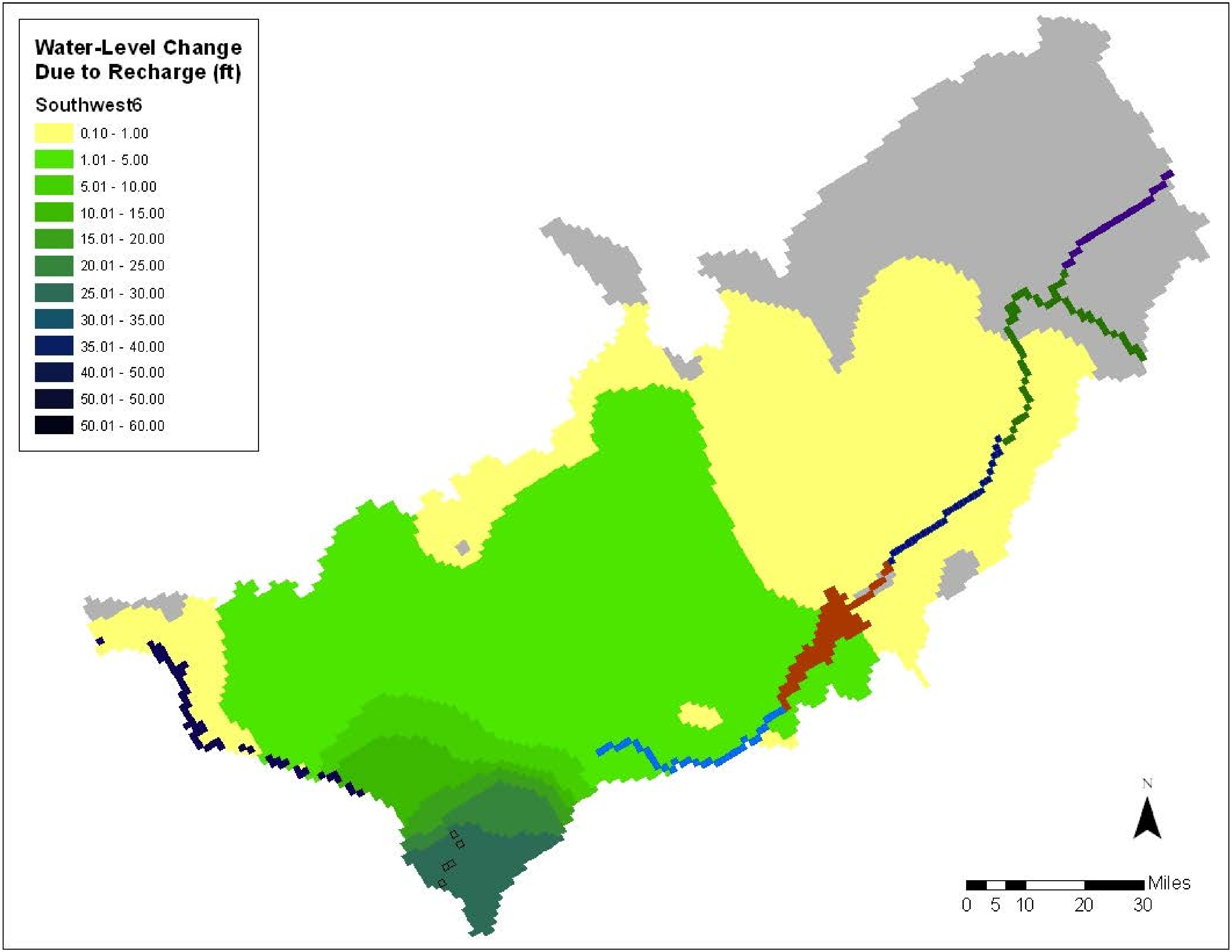


Water-Level Change
Due to Recharge (ft)
Southwest3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

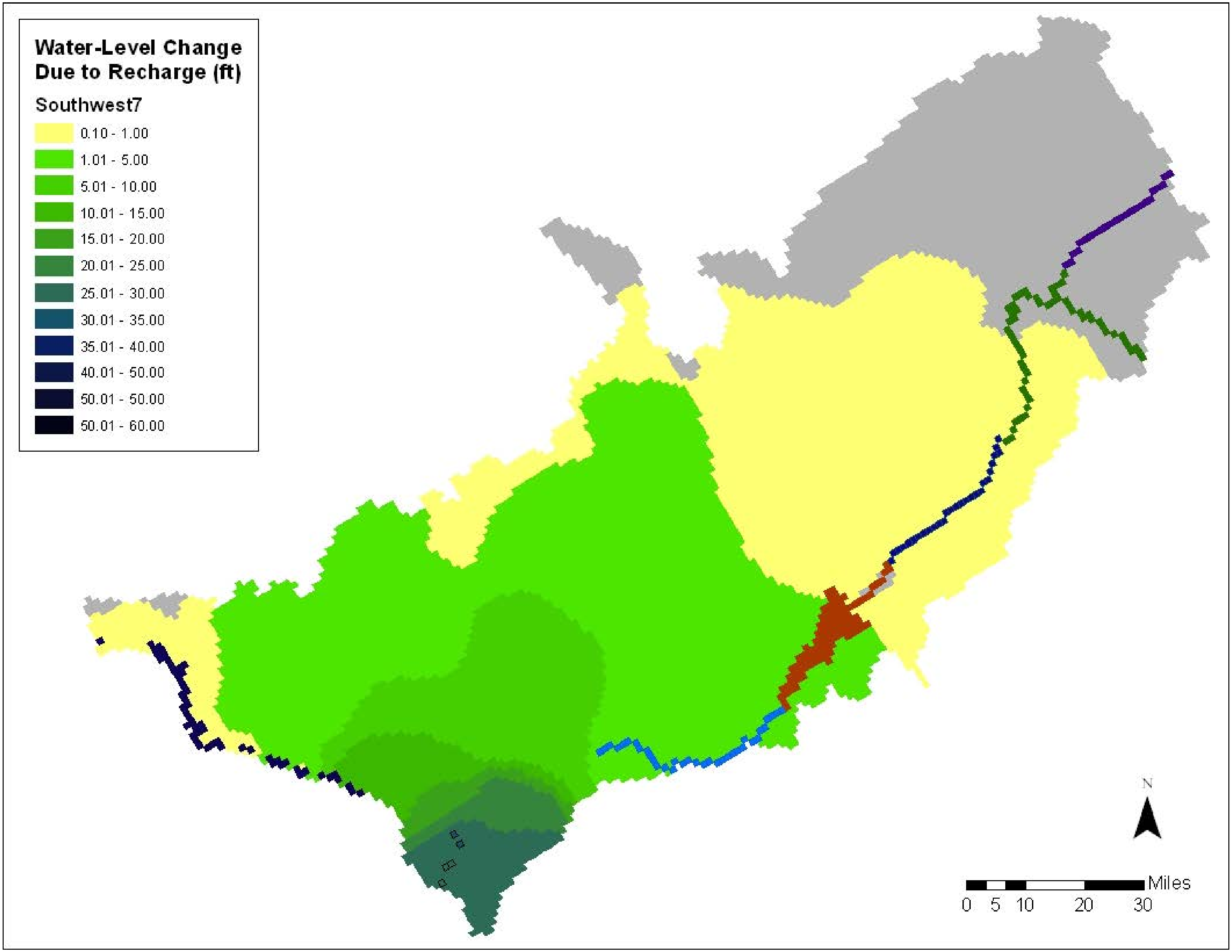

Water-Level Change
Due to Recharge (ft)
Southwest4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles

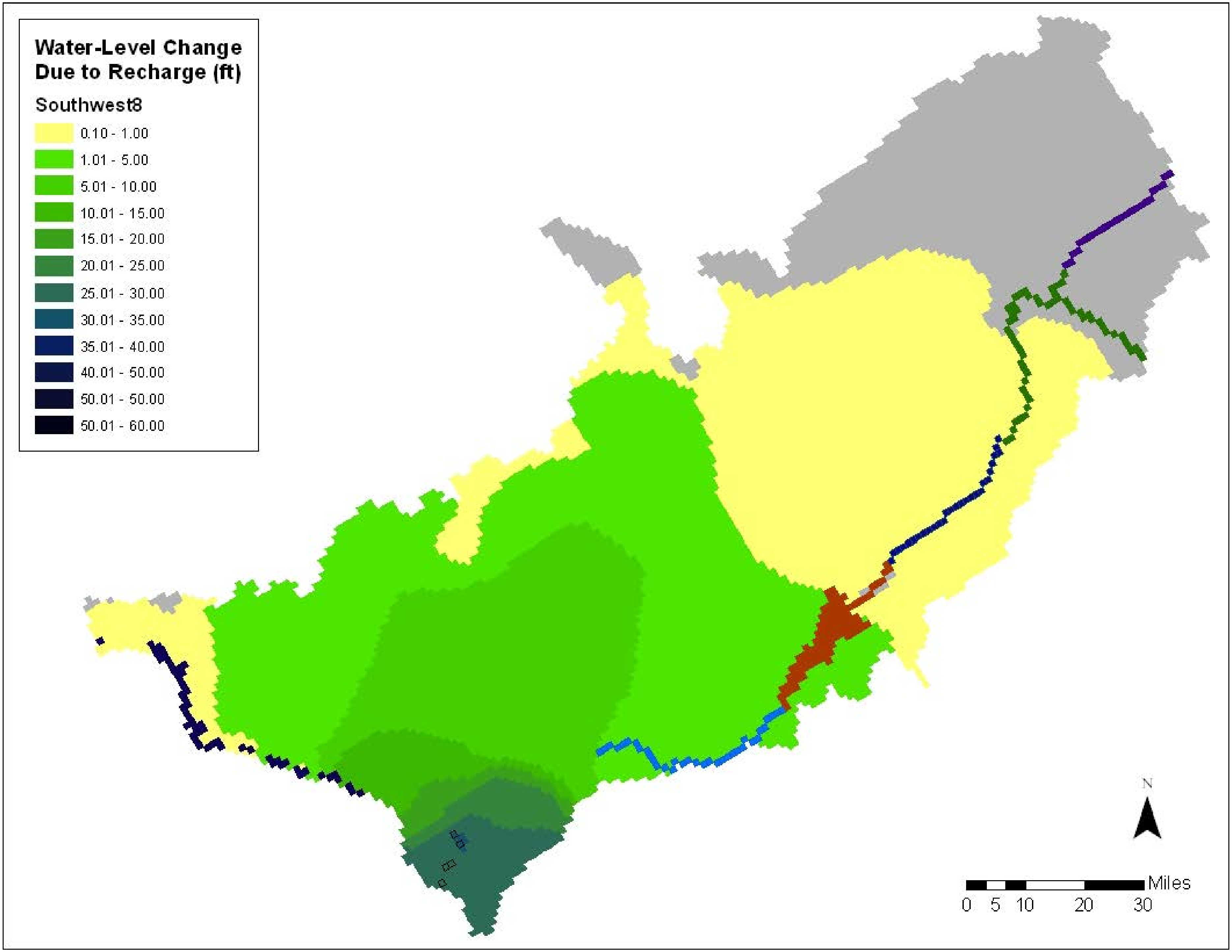


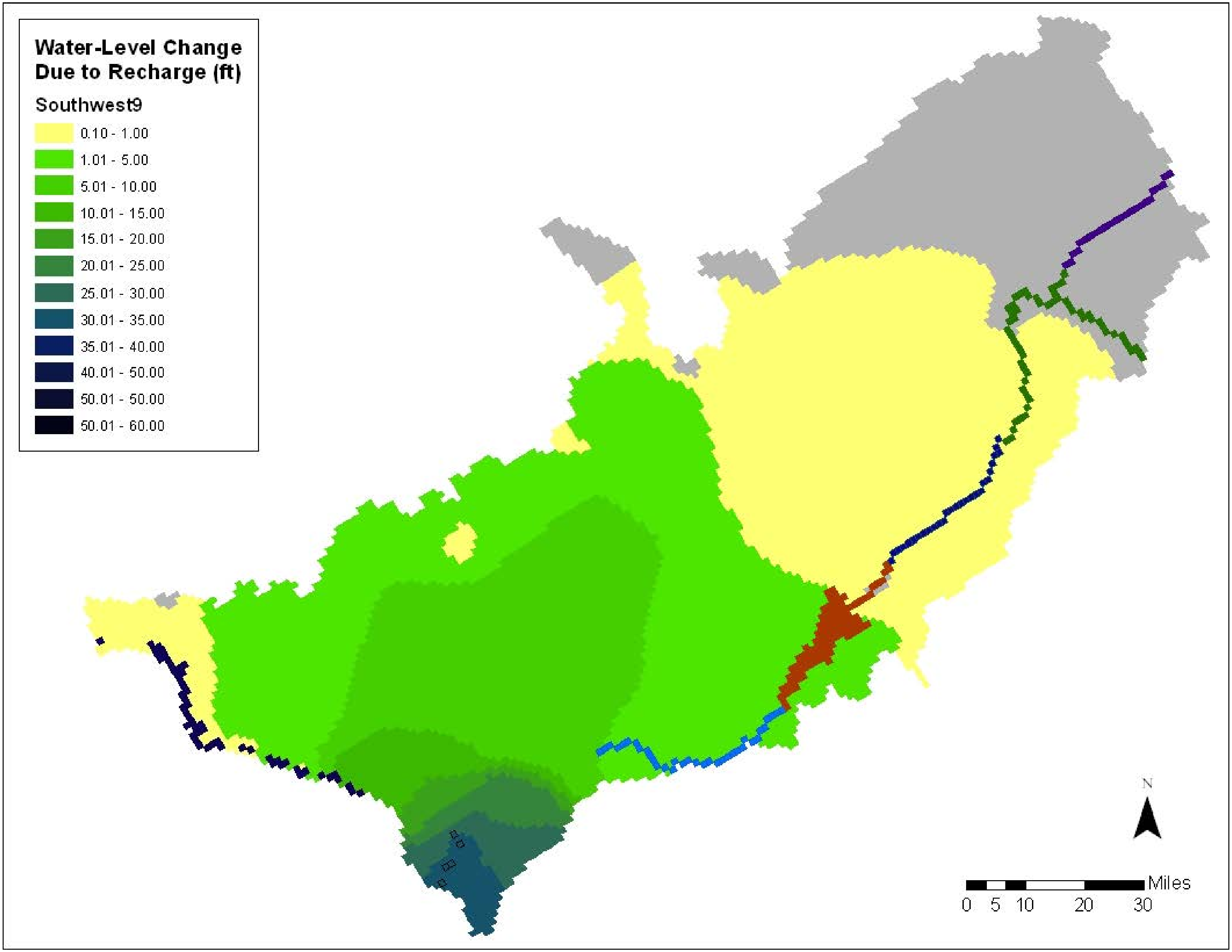
Water-Level Change
Due to Recharge (ft)
Southwest5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

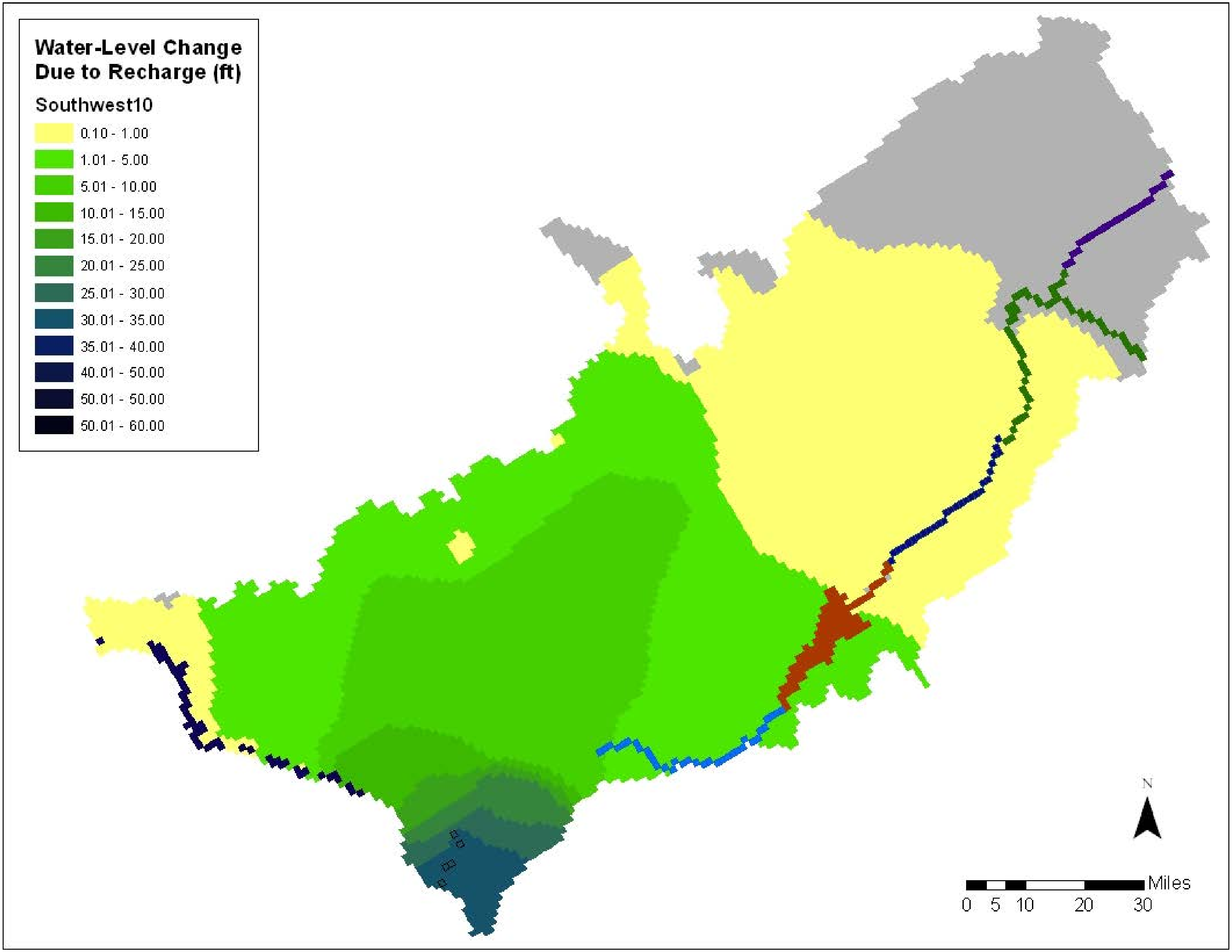


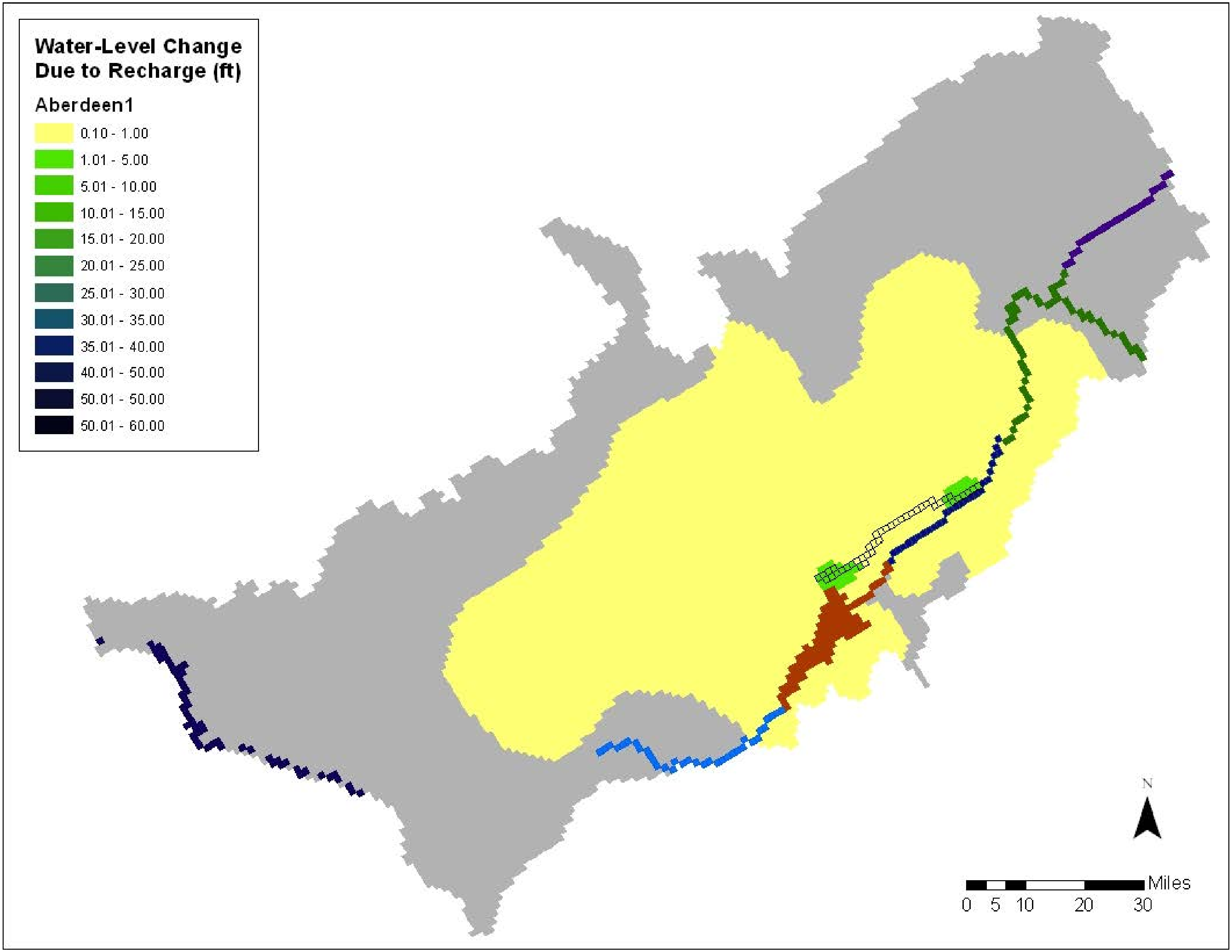
Water-Level Change
Due to Recharge (ft)
Southwest6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles


Water-Level Change
Due to Recharge (ft)
Southwest7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

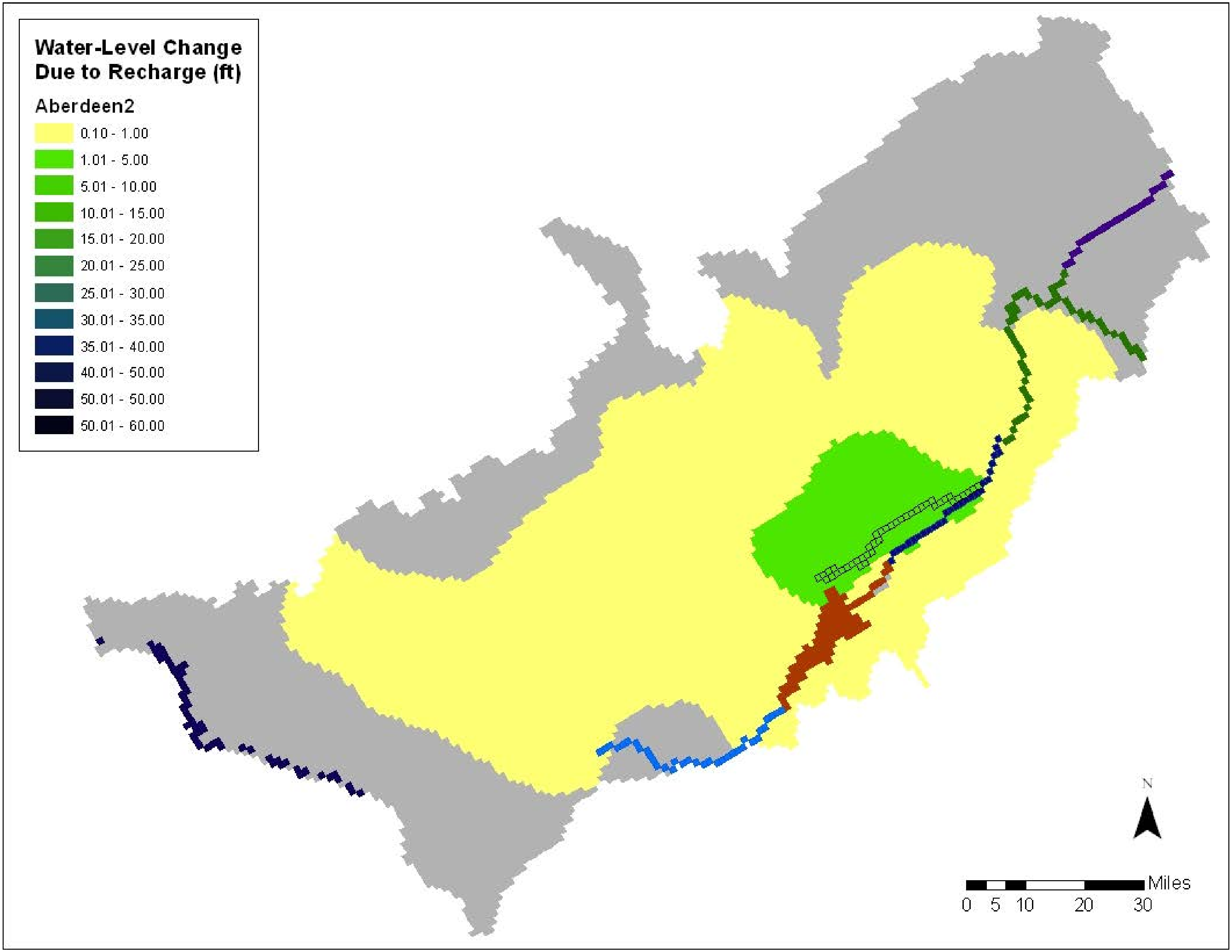

Water-Level Change
Due to Recharge (ft)
Southwest8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Southwest9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Southwest10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles



Water-Level Change
Due to Recharge (ft)
Aberdeen1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
Aberdeen2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
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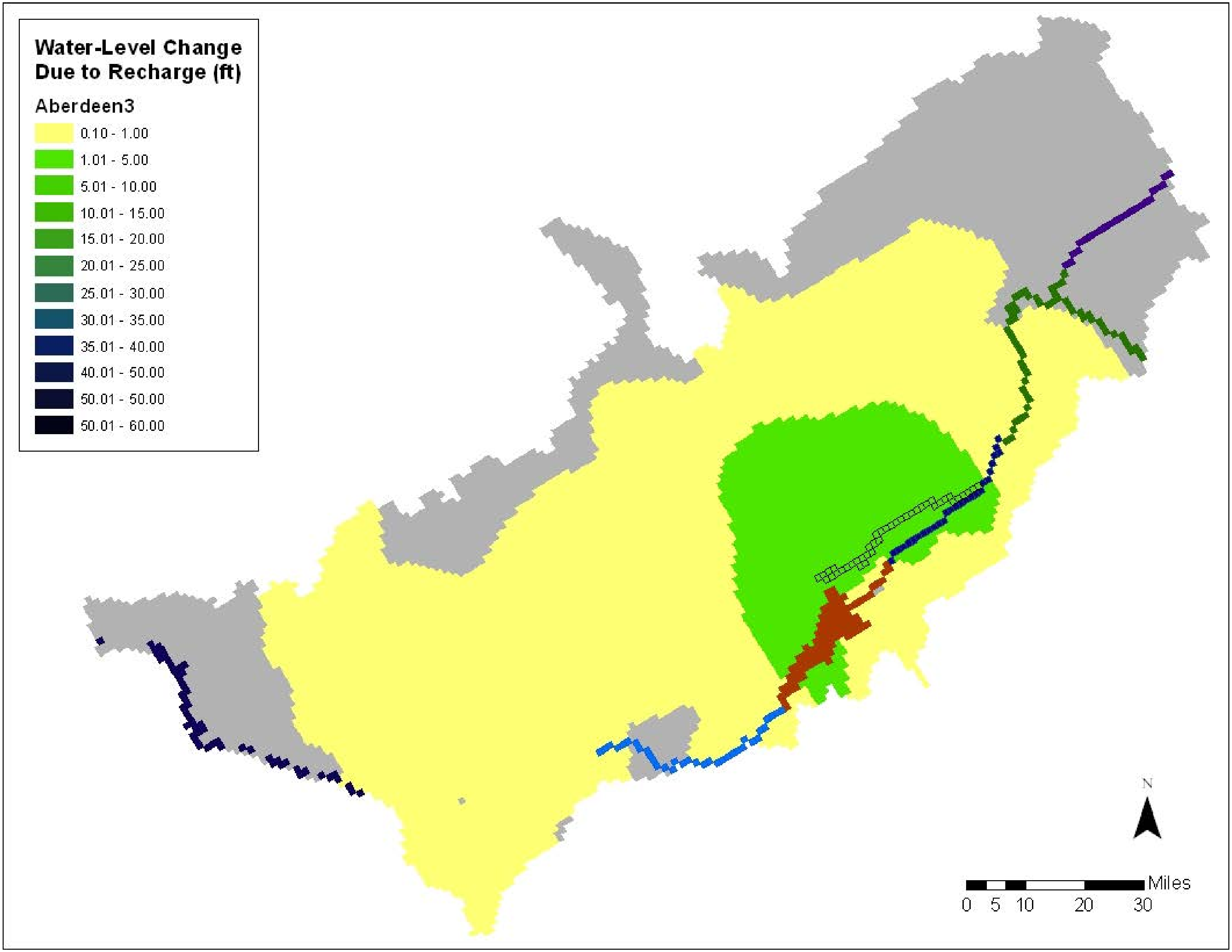
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0
5
10
20
30


Water-Level Change
Due to Recharge (ft)
Aberdeen3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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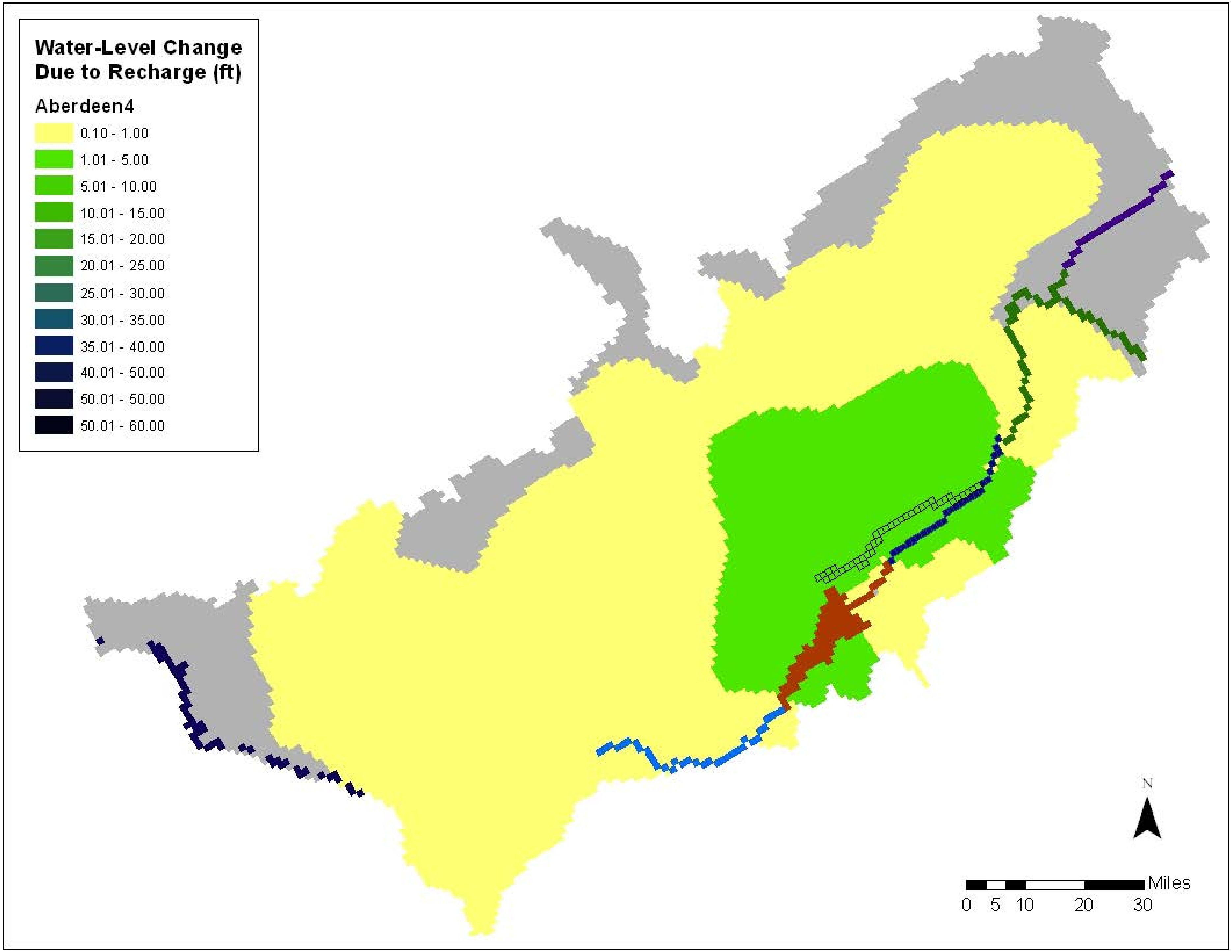
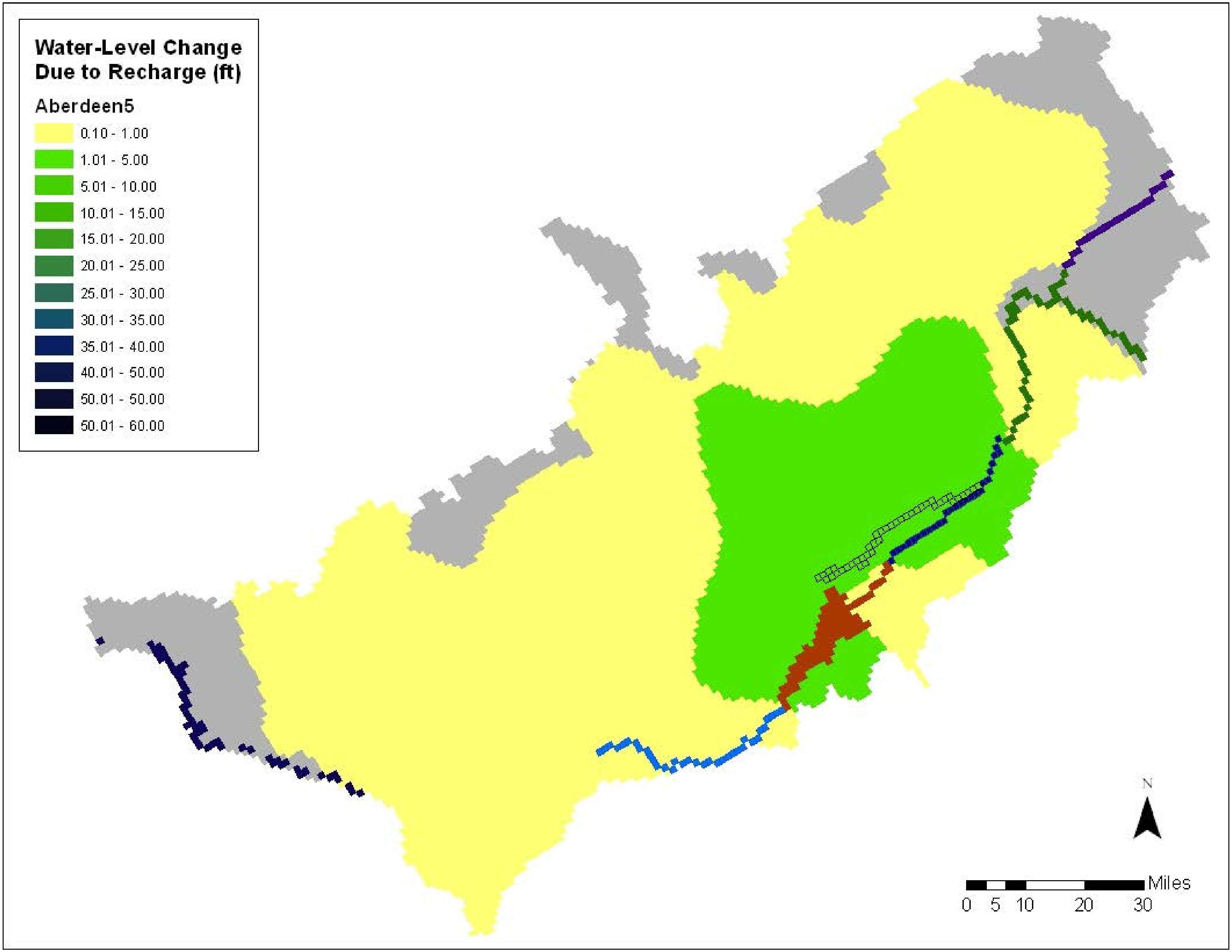
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
Aberdeen4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
Aberdeen5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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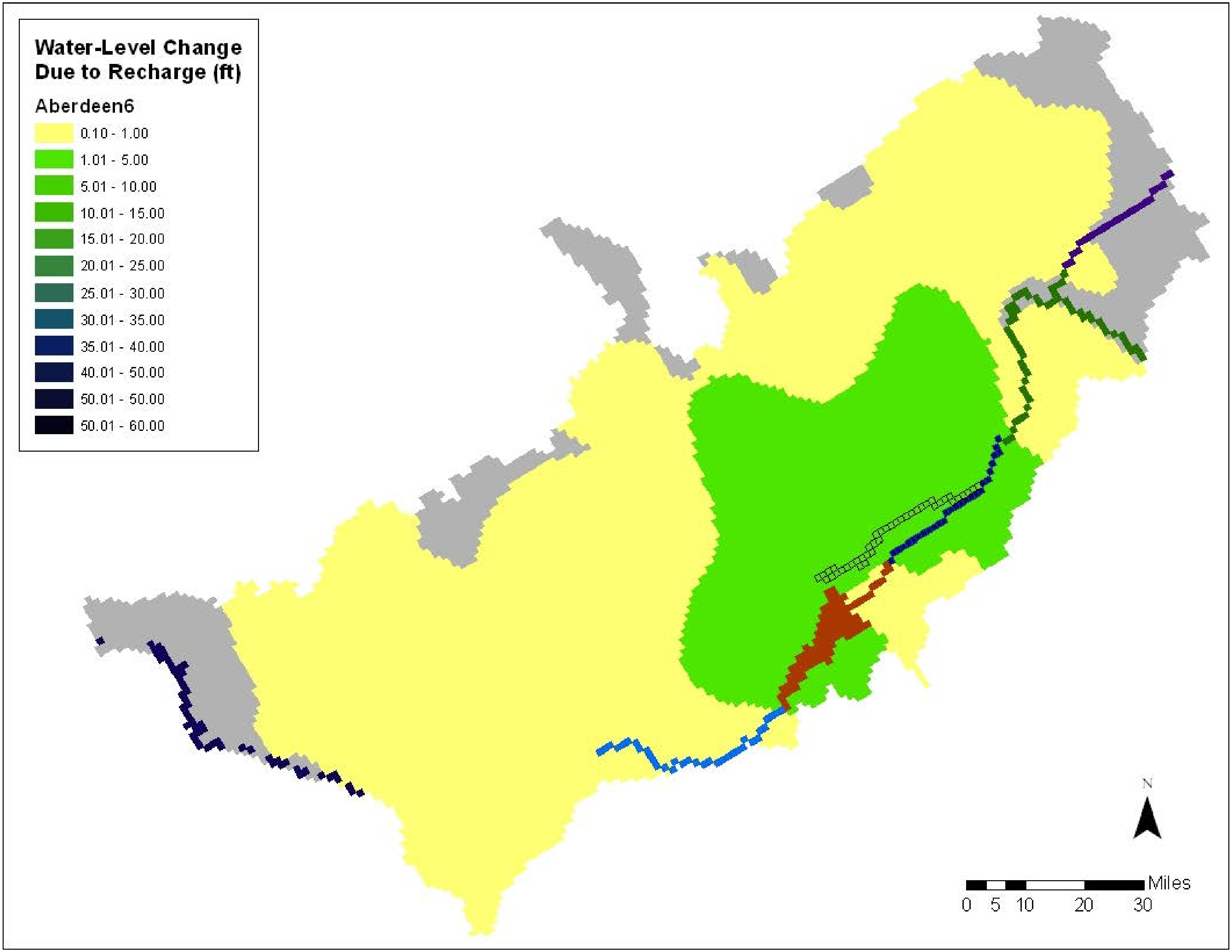
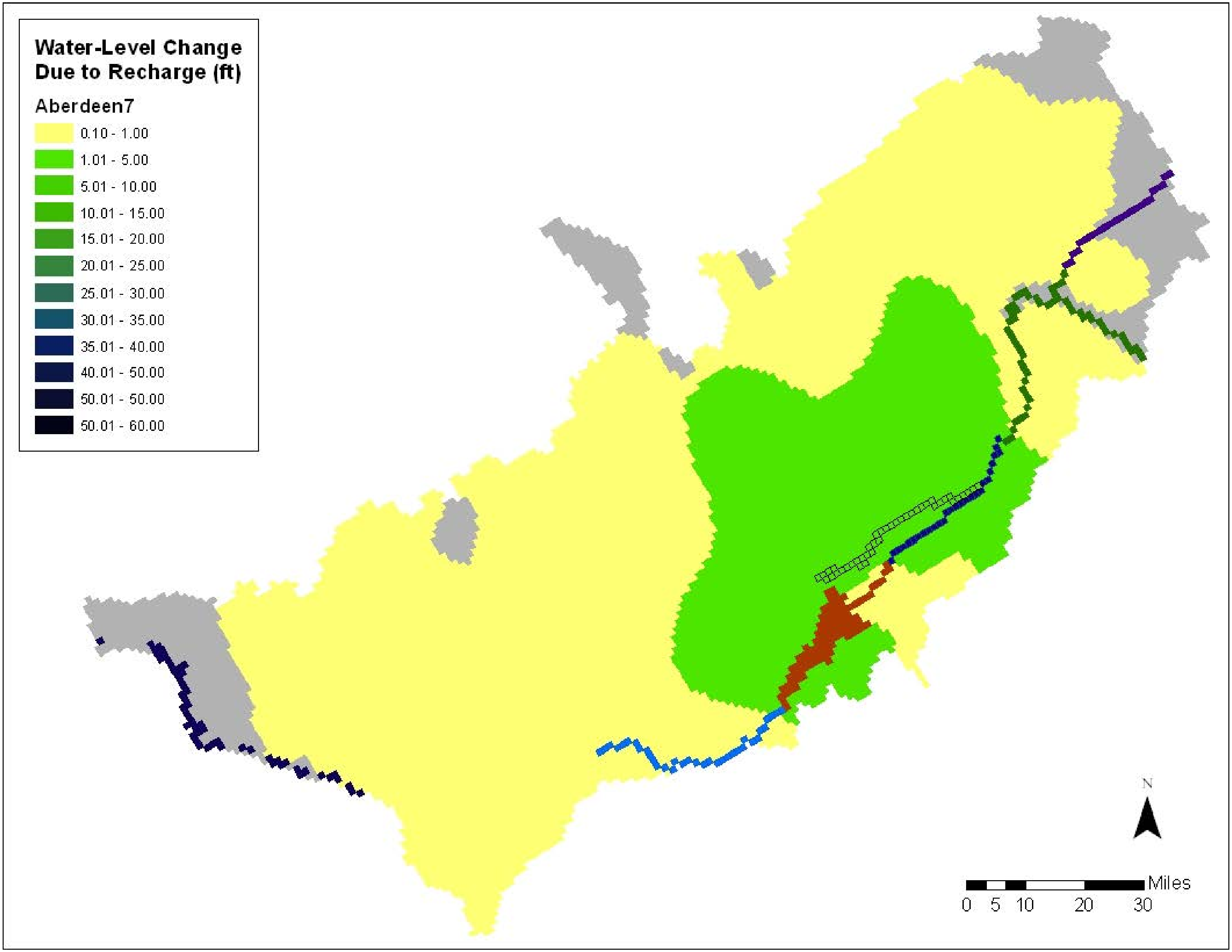
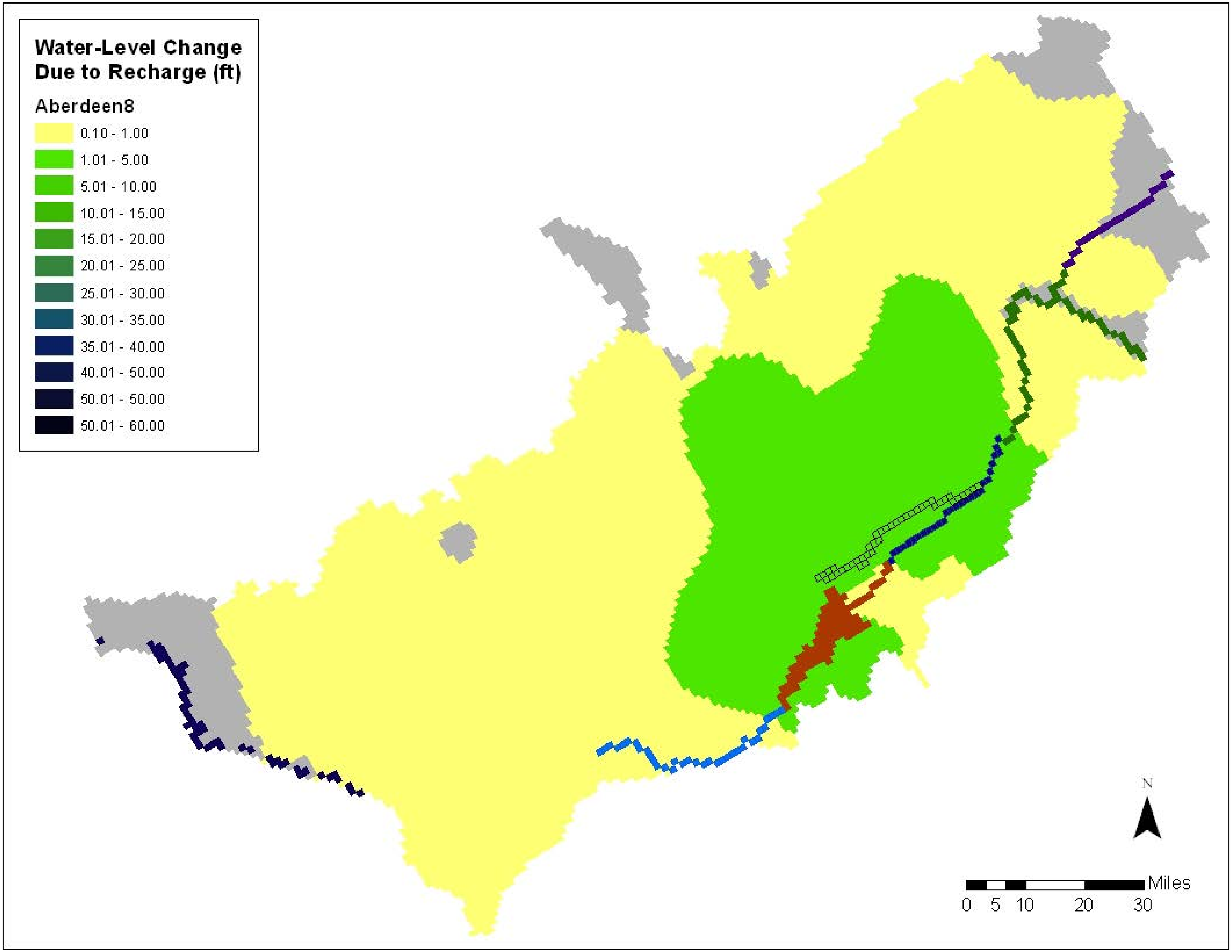
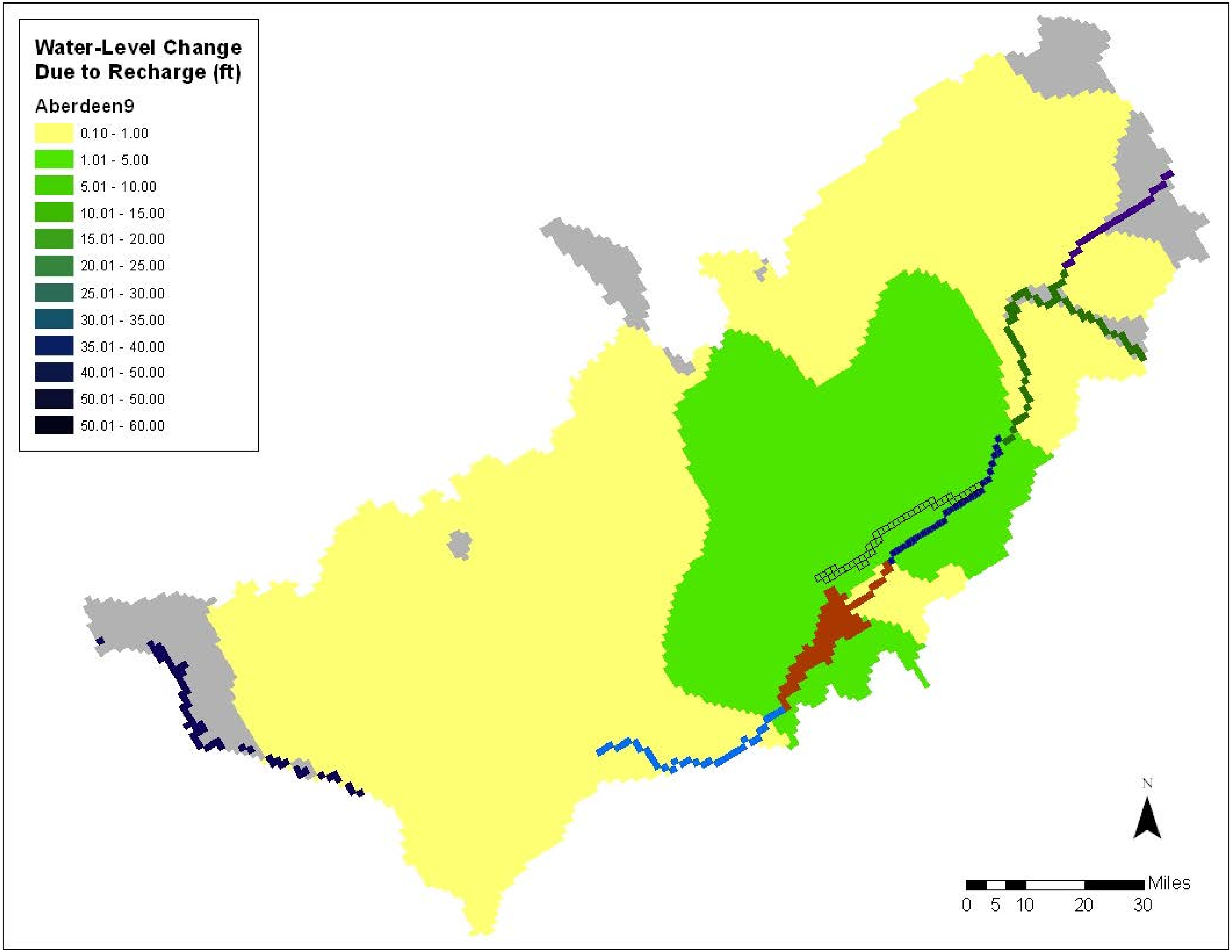
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

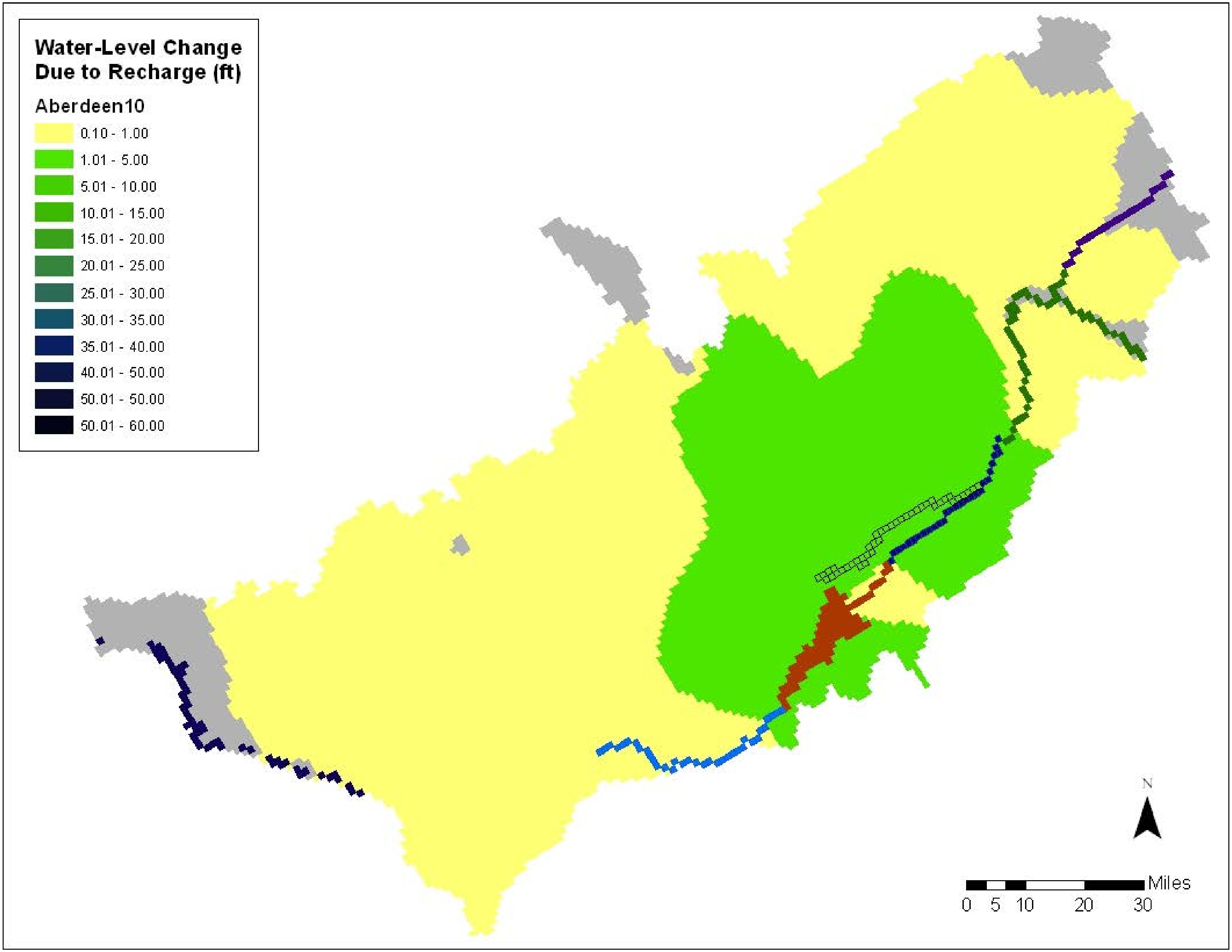

Water-Level Change
Due to Recharge (ft)
Aberdeen6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

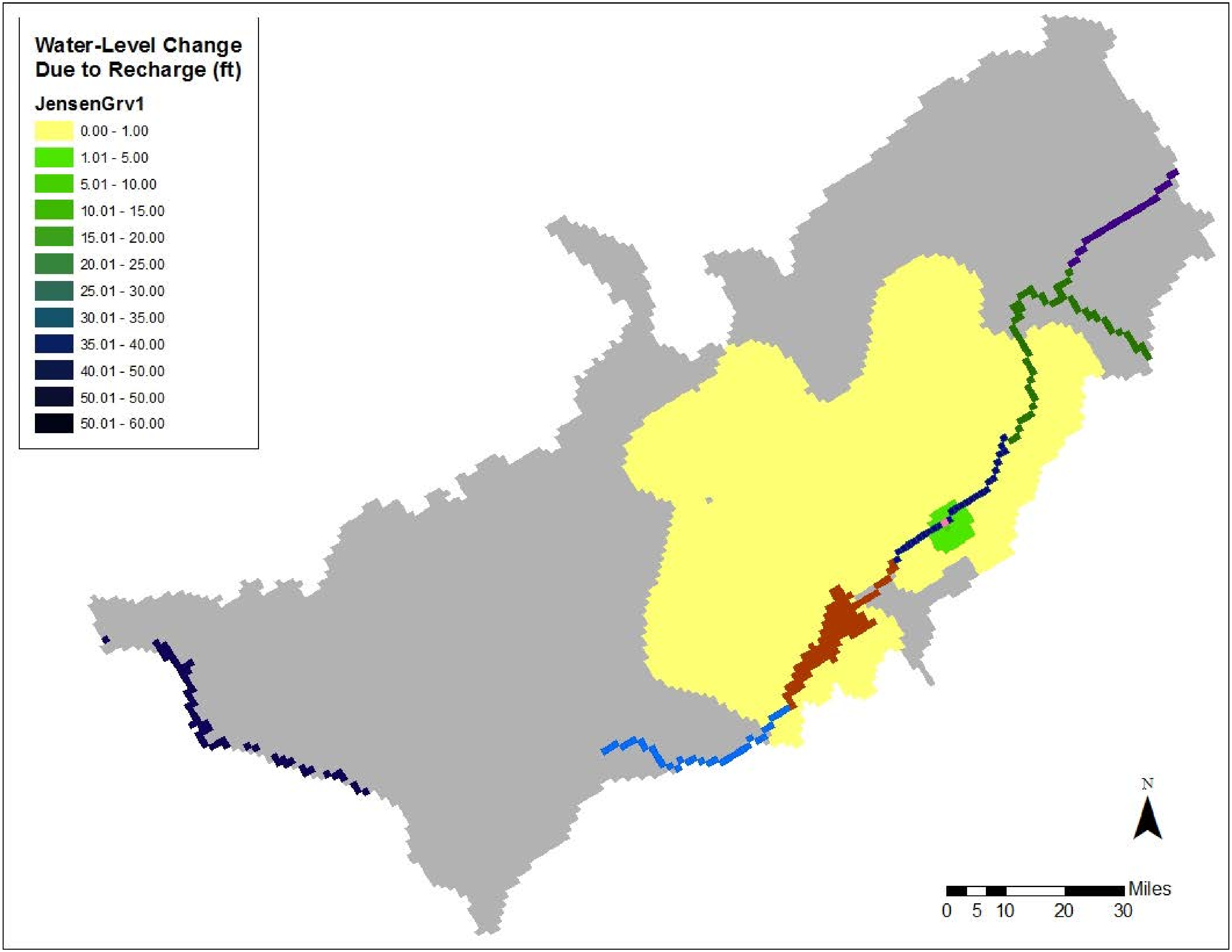


Water-Level Change Due to Recharge (ft)
Aberdeen7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

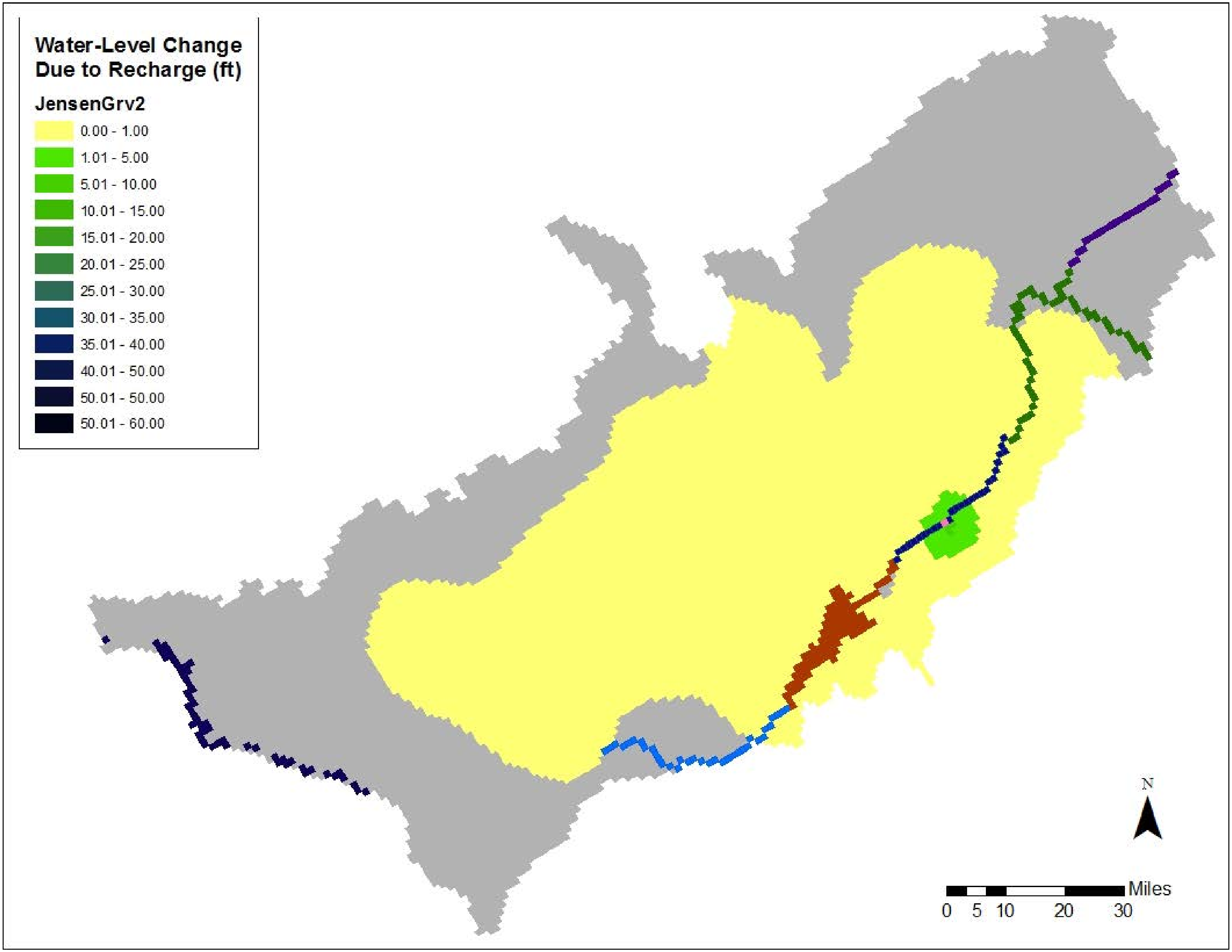

Water-Level Change Due to Recharge (ft)
Aberdeen8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
Aberdeen9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

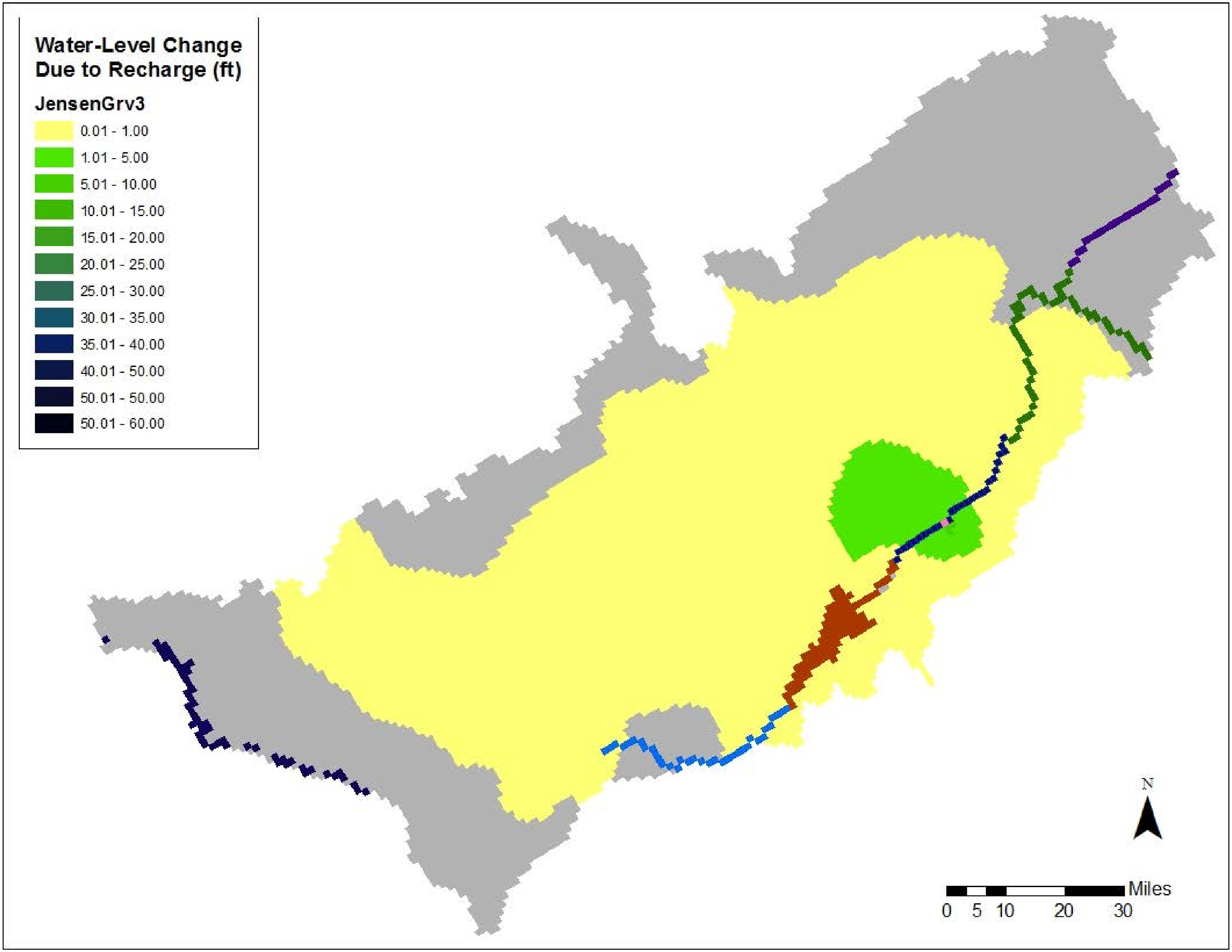

Water-Level Change
Due to Recharge (ft)
Aberdeen10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

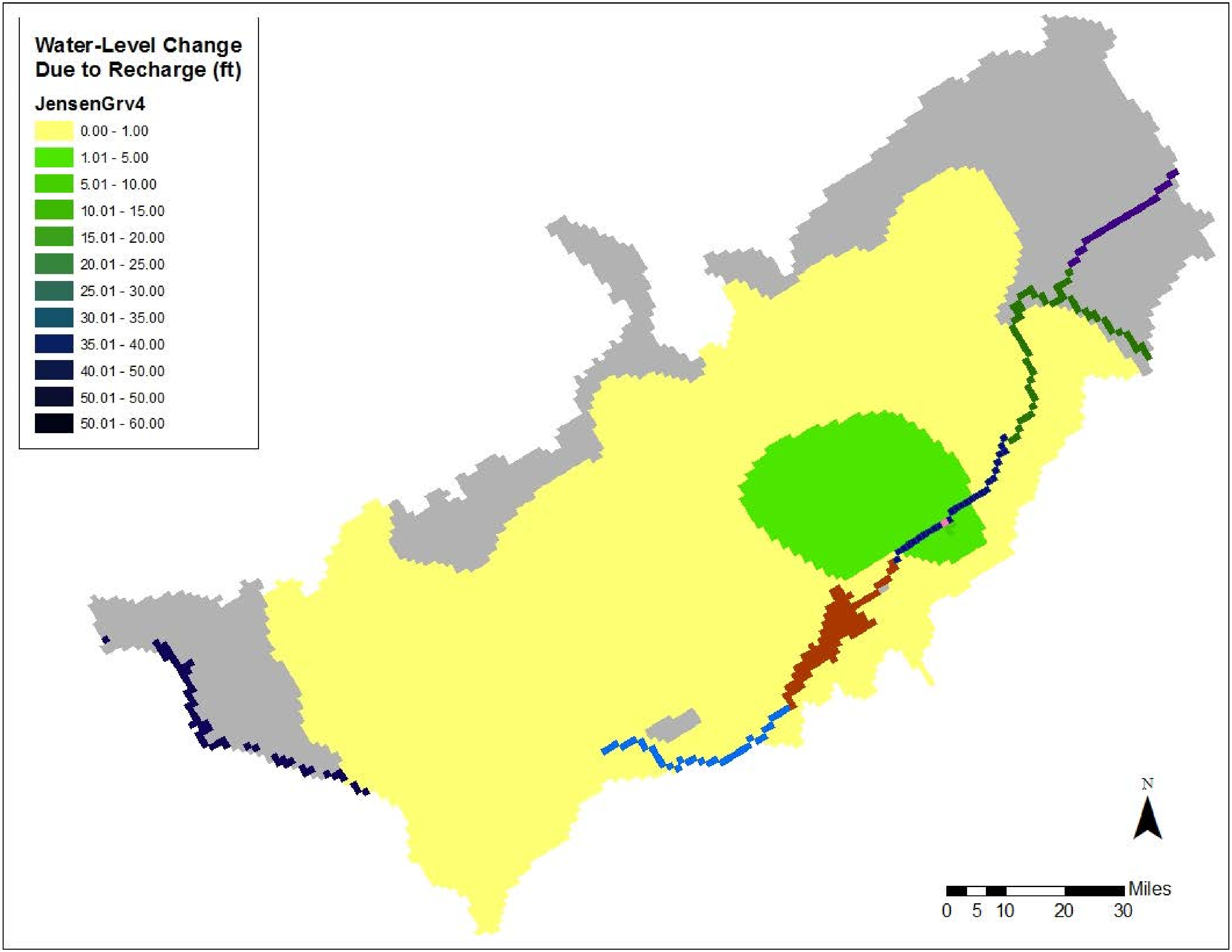


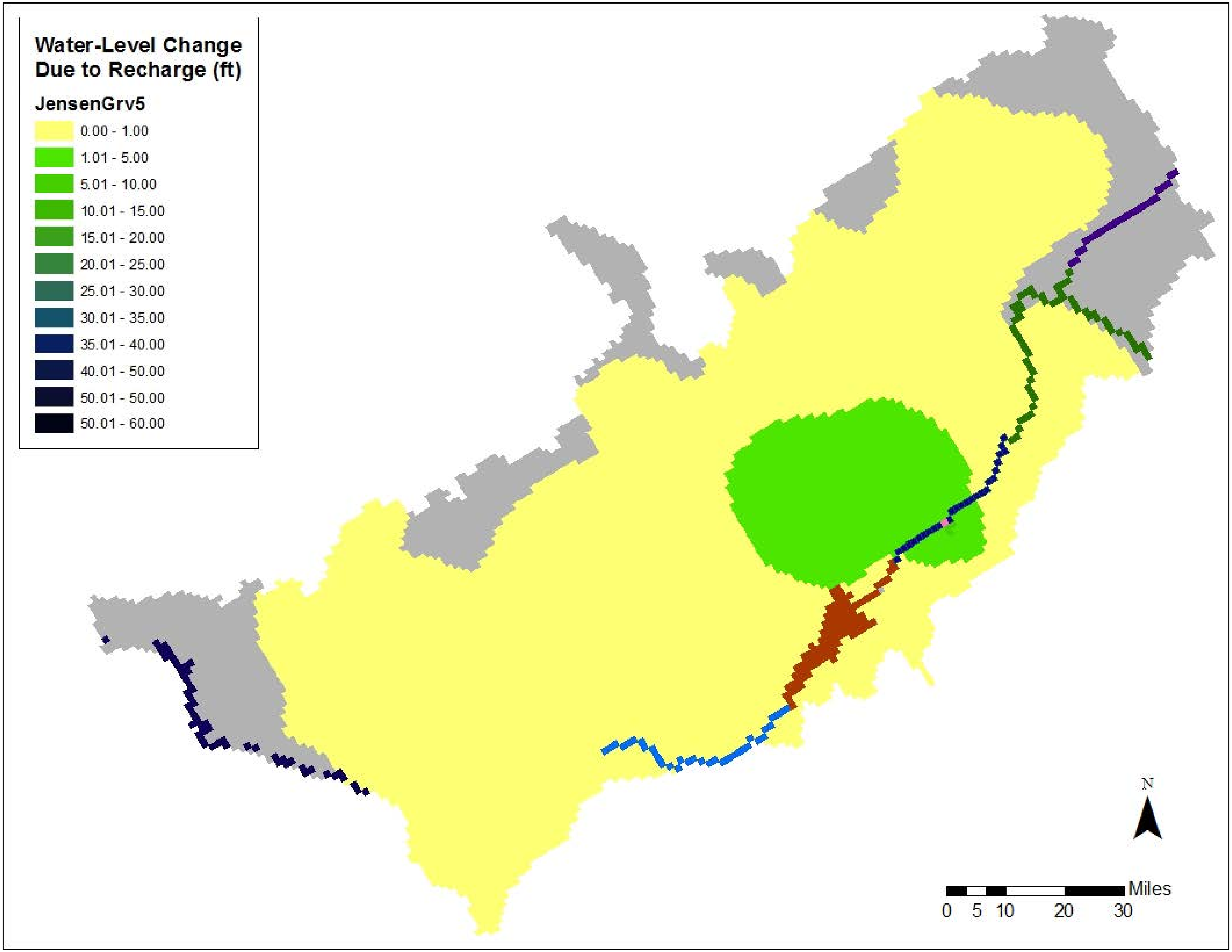
Water-Level Change
Due to Recharge (ft)
JensenGrv1
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



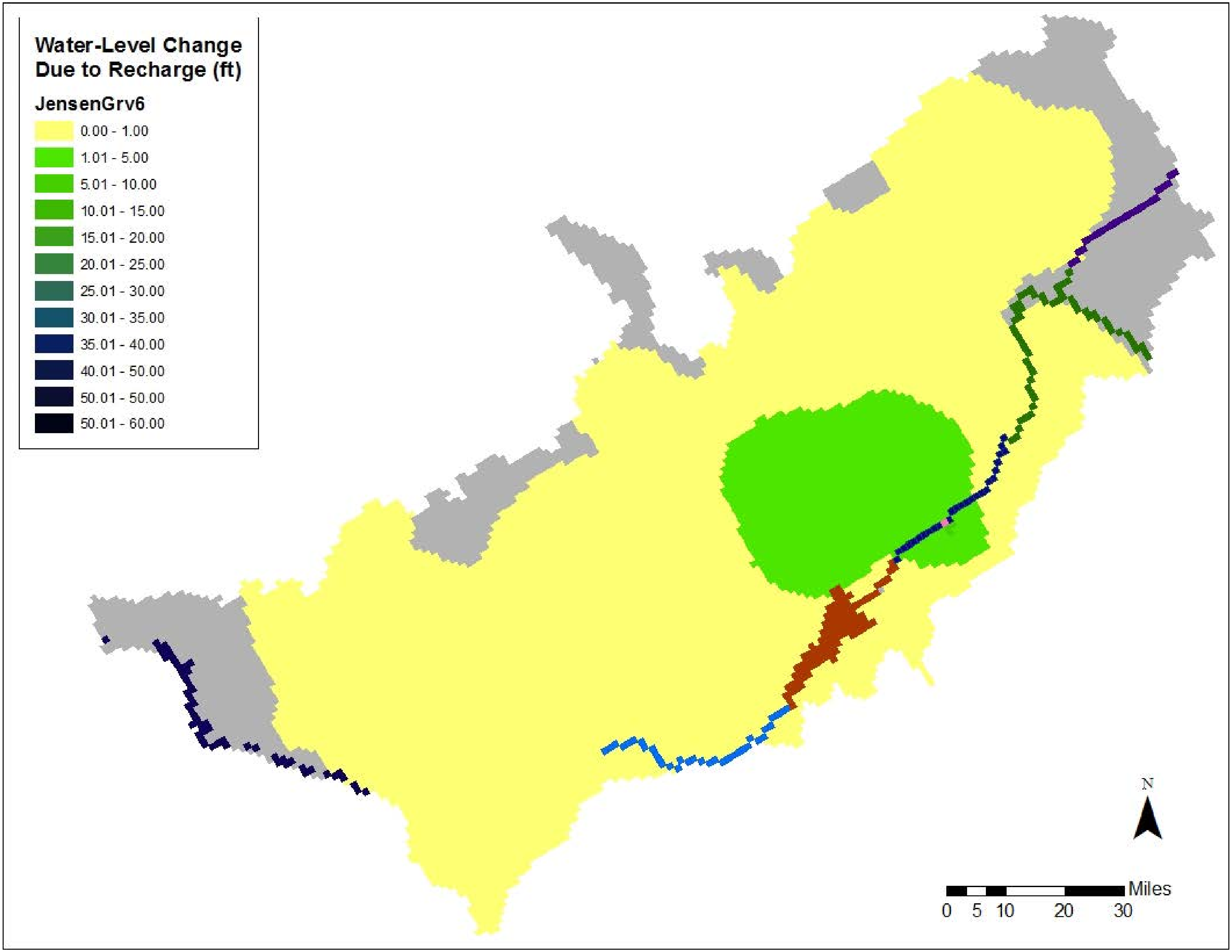
Water-Level Change Due to Recharge (ft)
JensenGrv2
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

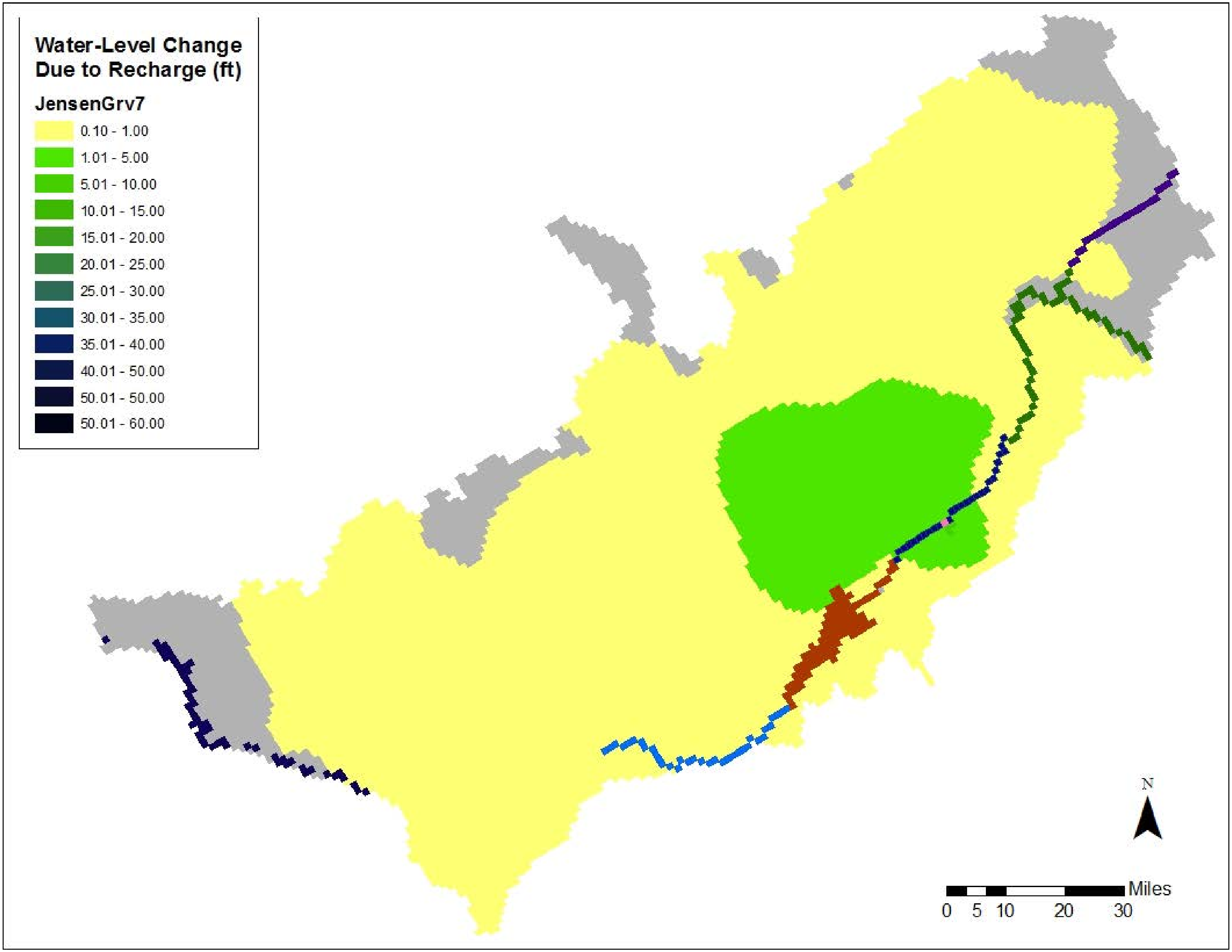

Water-Level Change
Due to Recharge (ft)
JensenGrv3
0.01 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

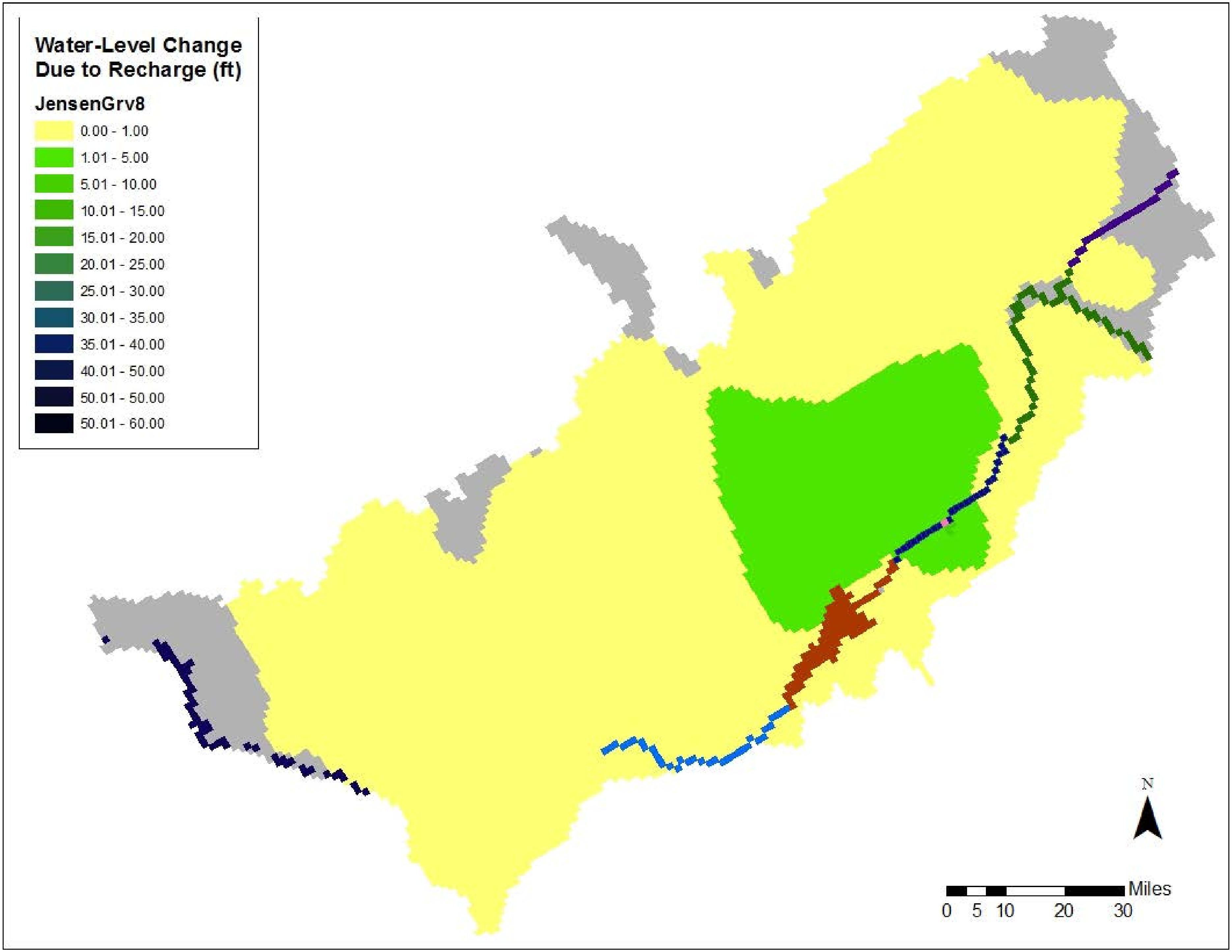

Water-Level Change
Due to Recharge (ft)
JensenGrv4
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
JensenGrv5
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
JensenGrv6
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
JensenGrv7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
JensenGrv8
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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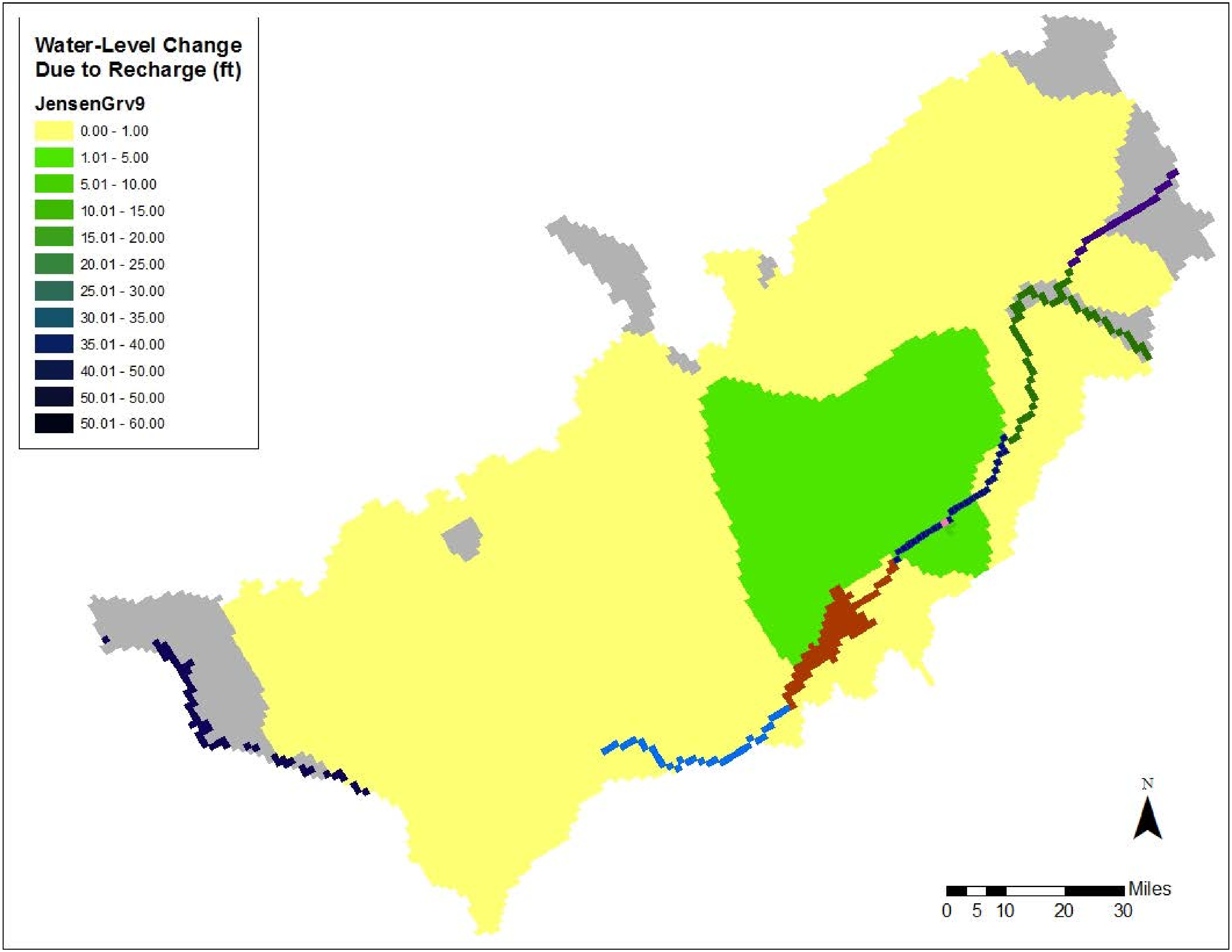
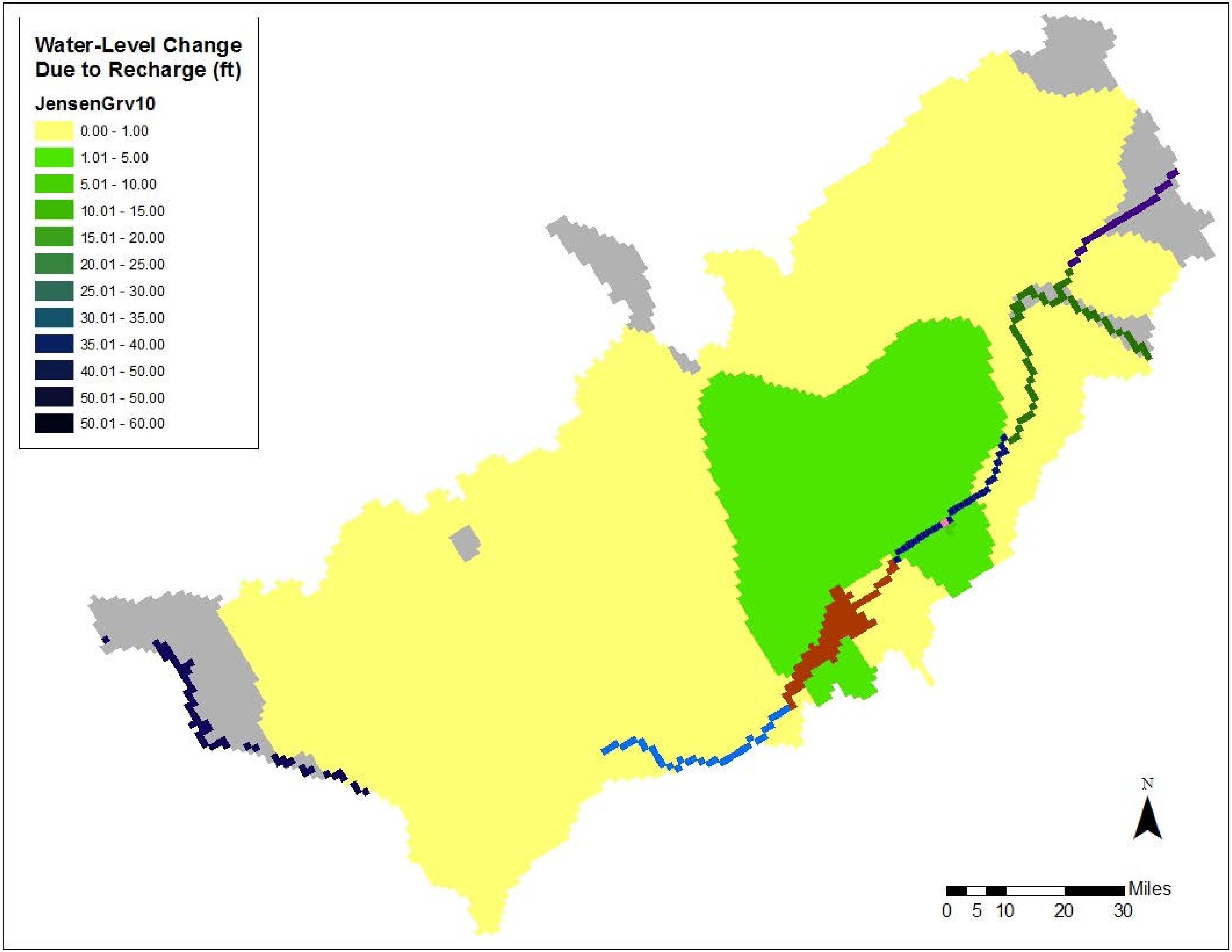
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
JensenGrv9
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
JensenGrv10
0.00 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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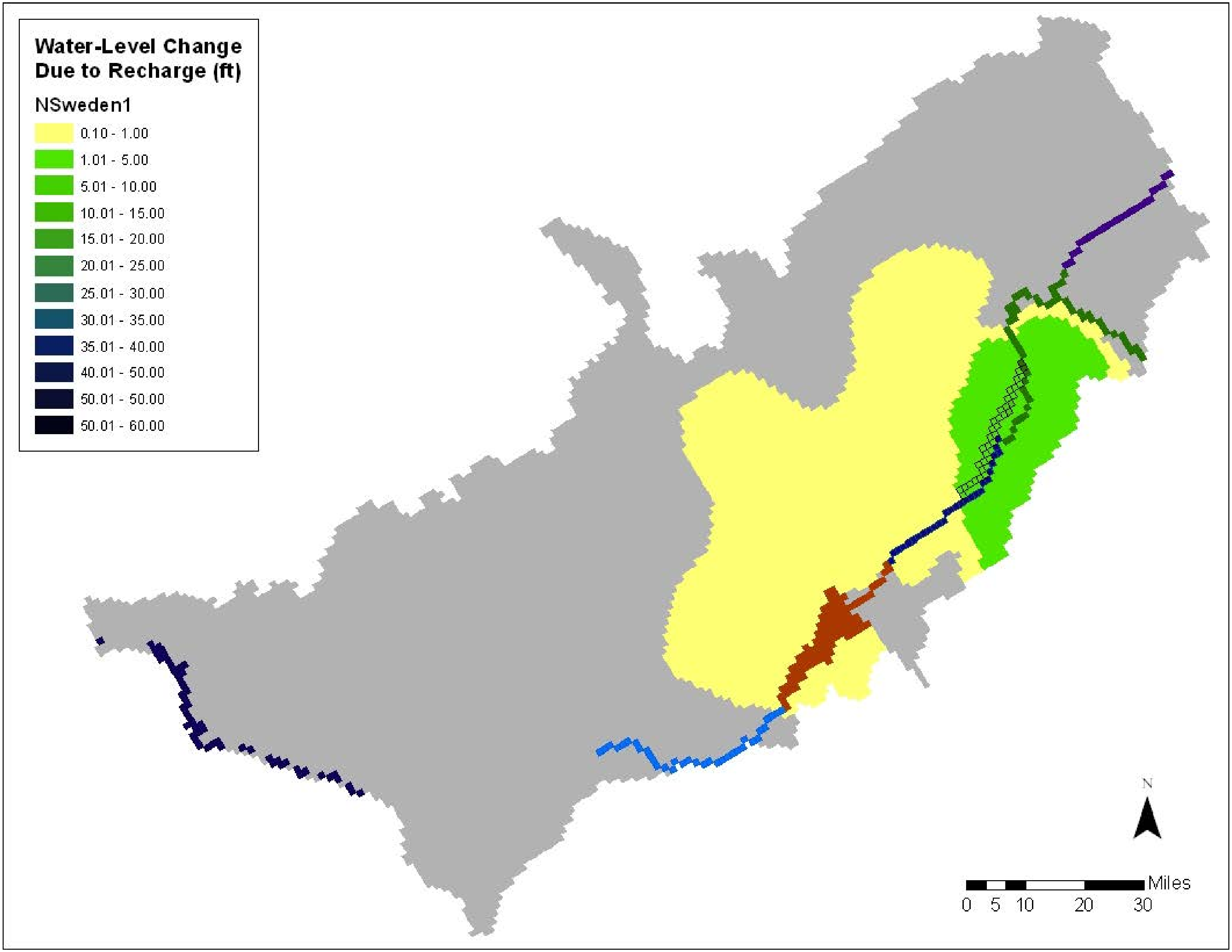
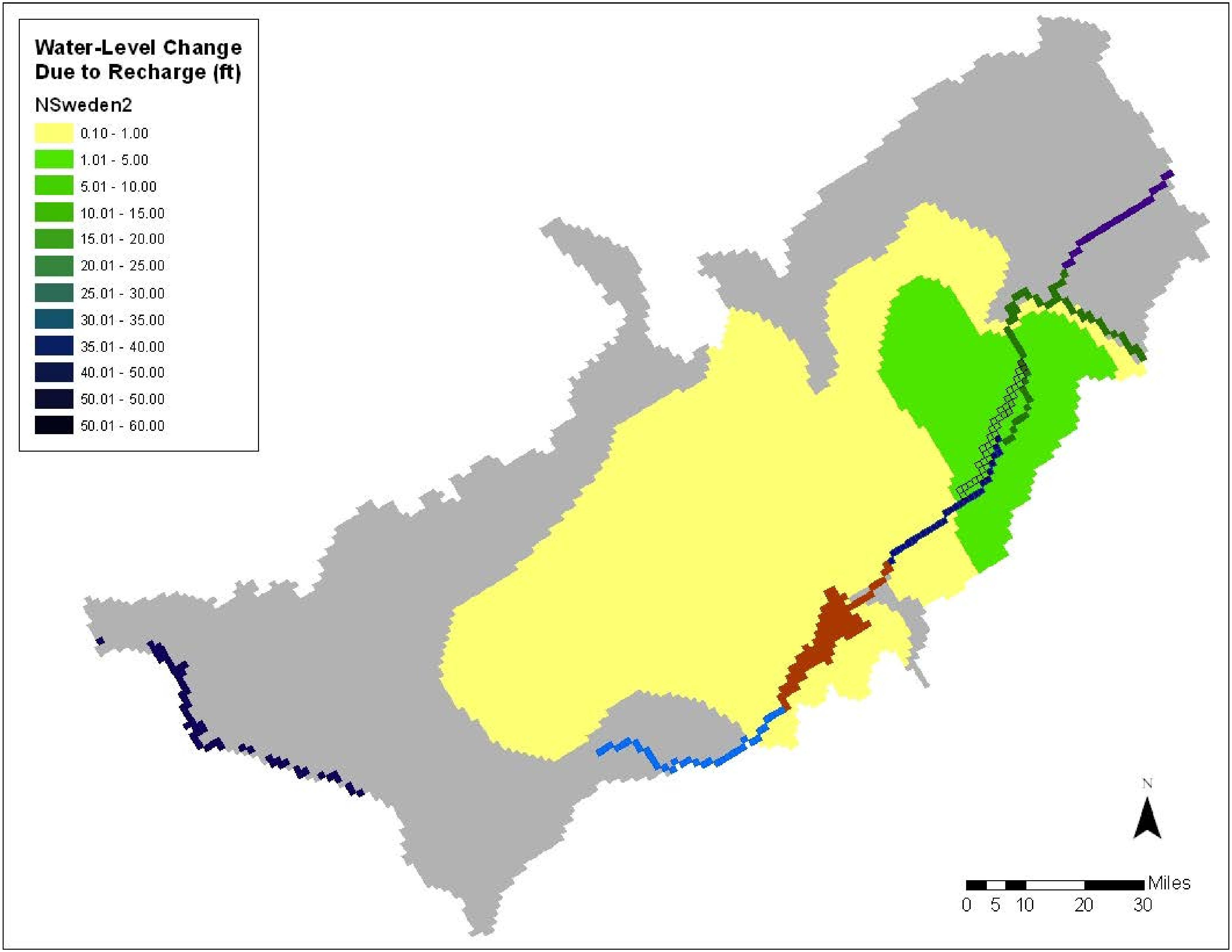
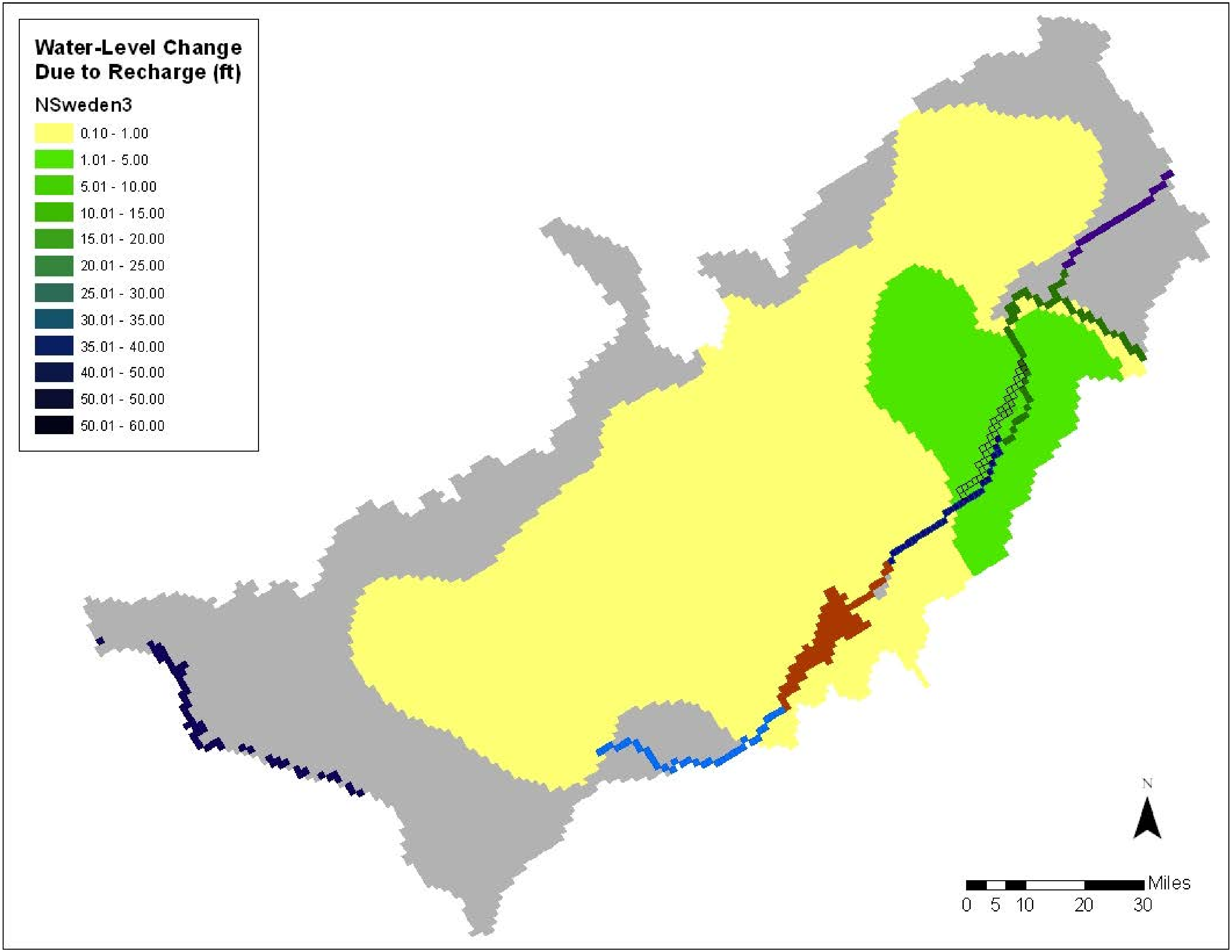
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

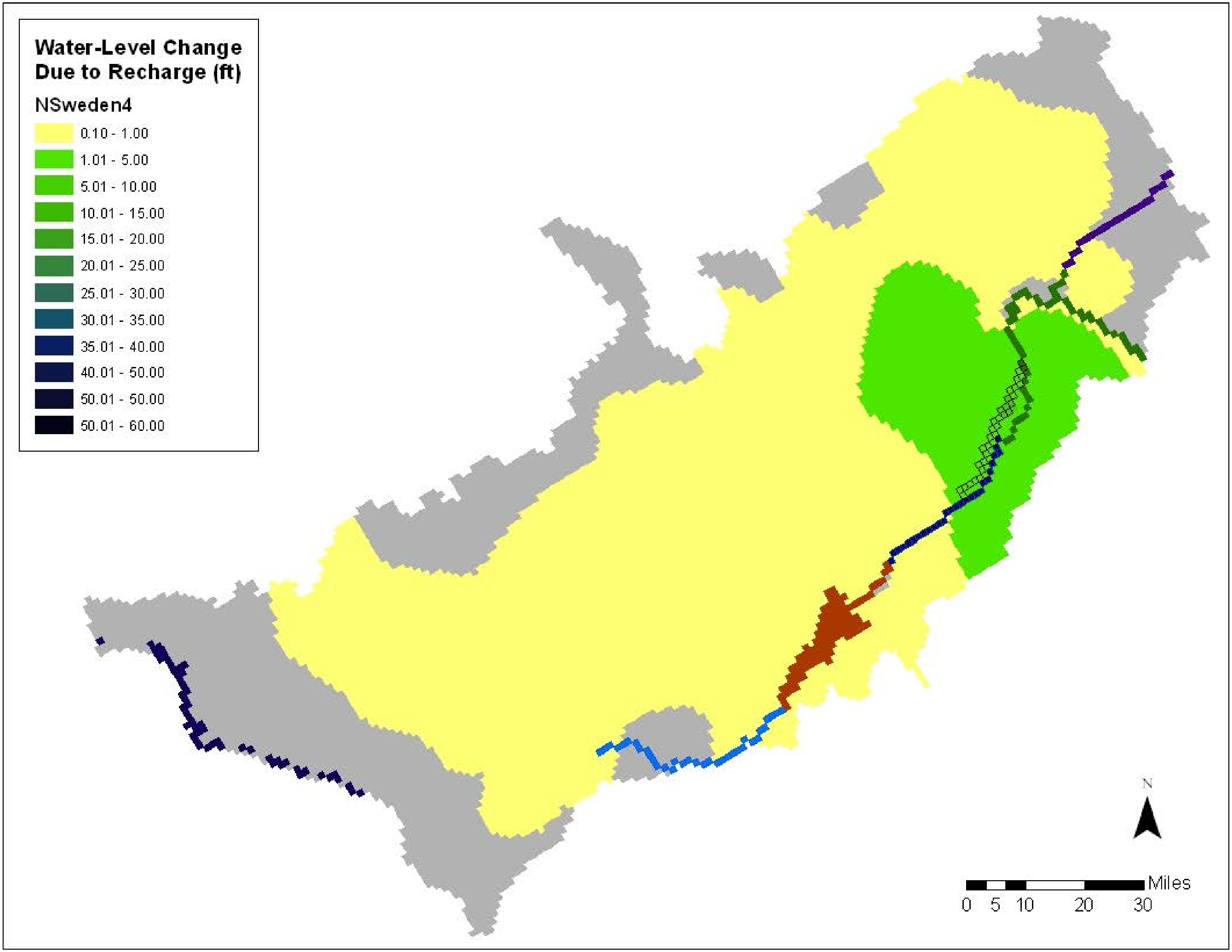


Water-Level Change Due to Recharge (ft)
NSweden1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
NSweden2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change Due to Recharge (ft)
NSweden3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
NSweden4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
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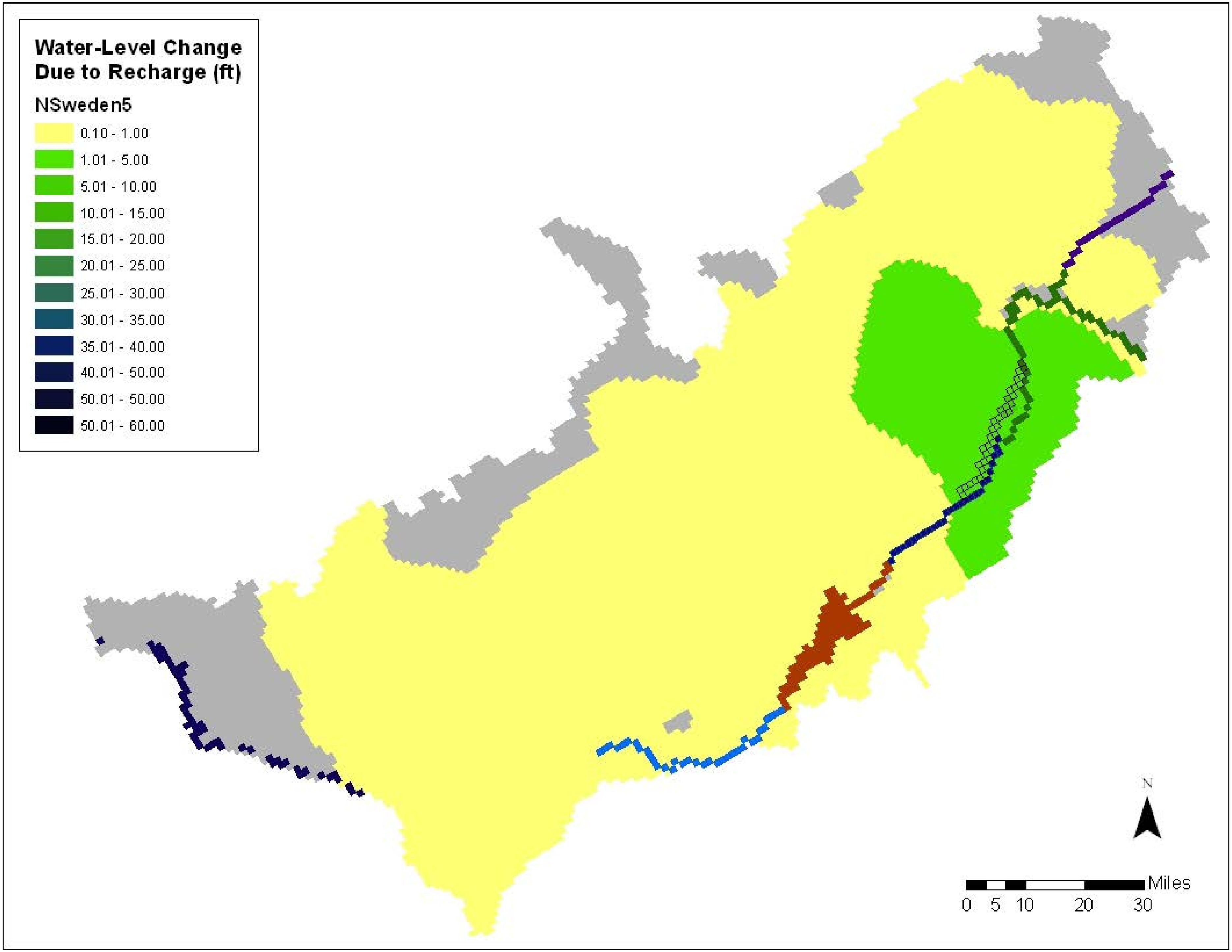
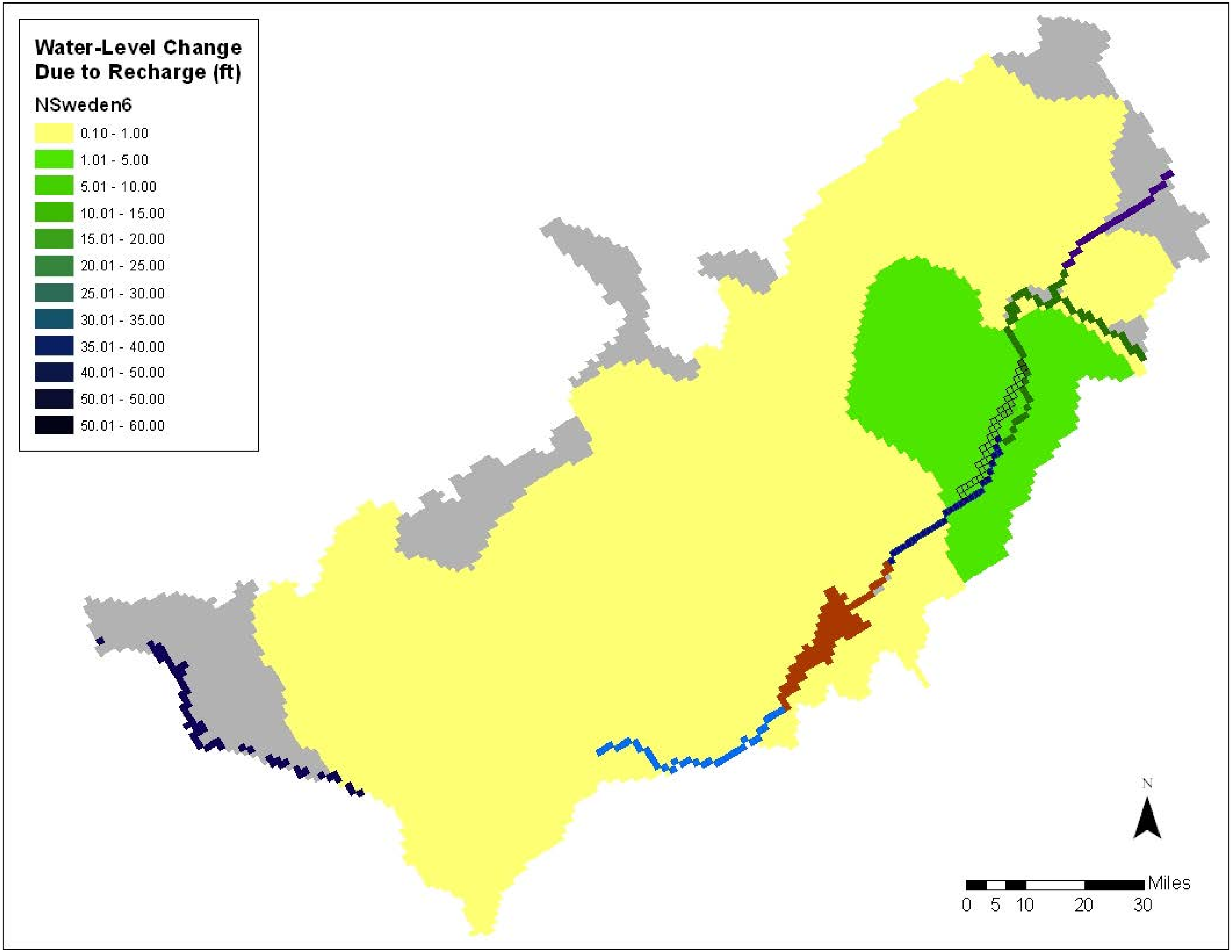
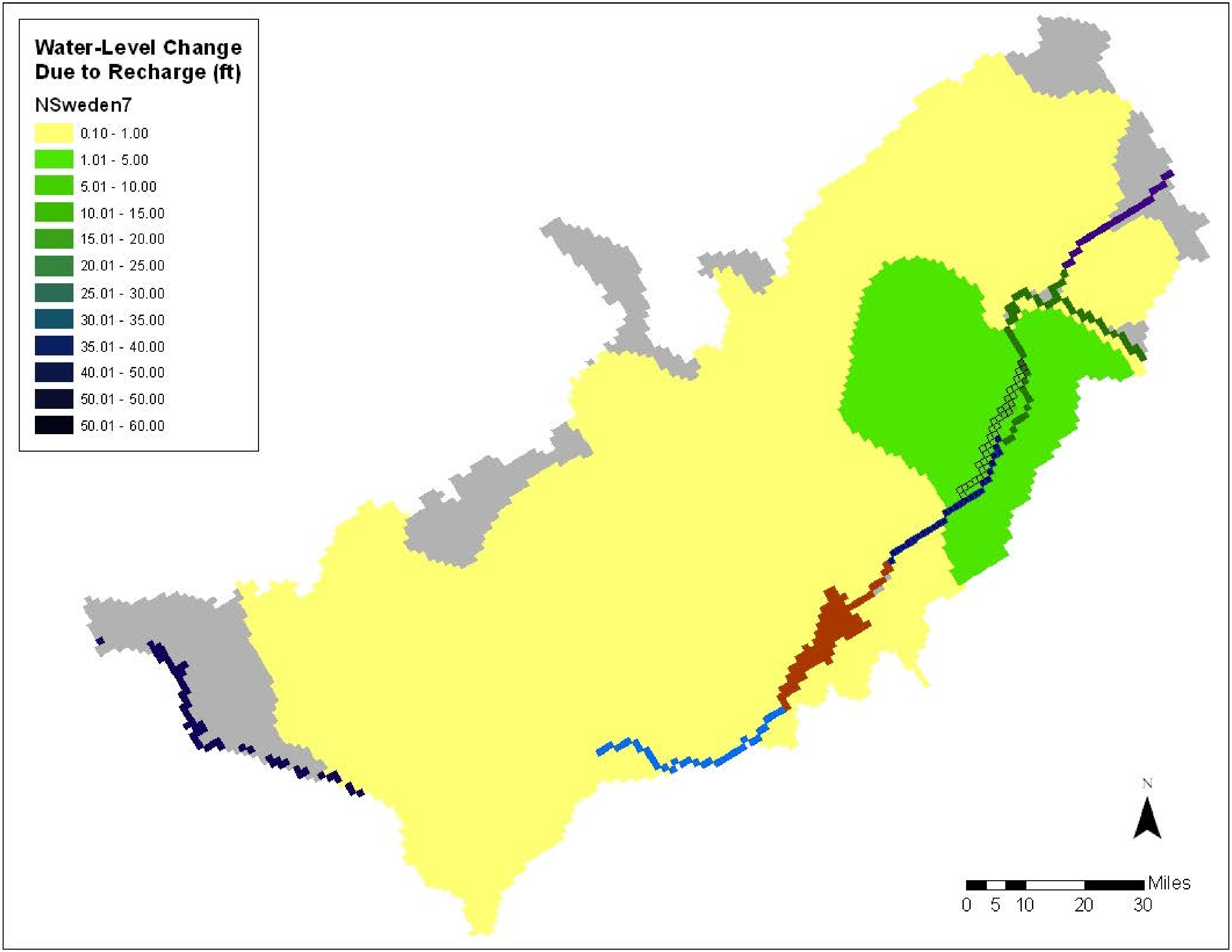
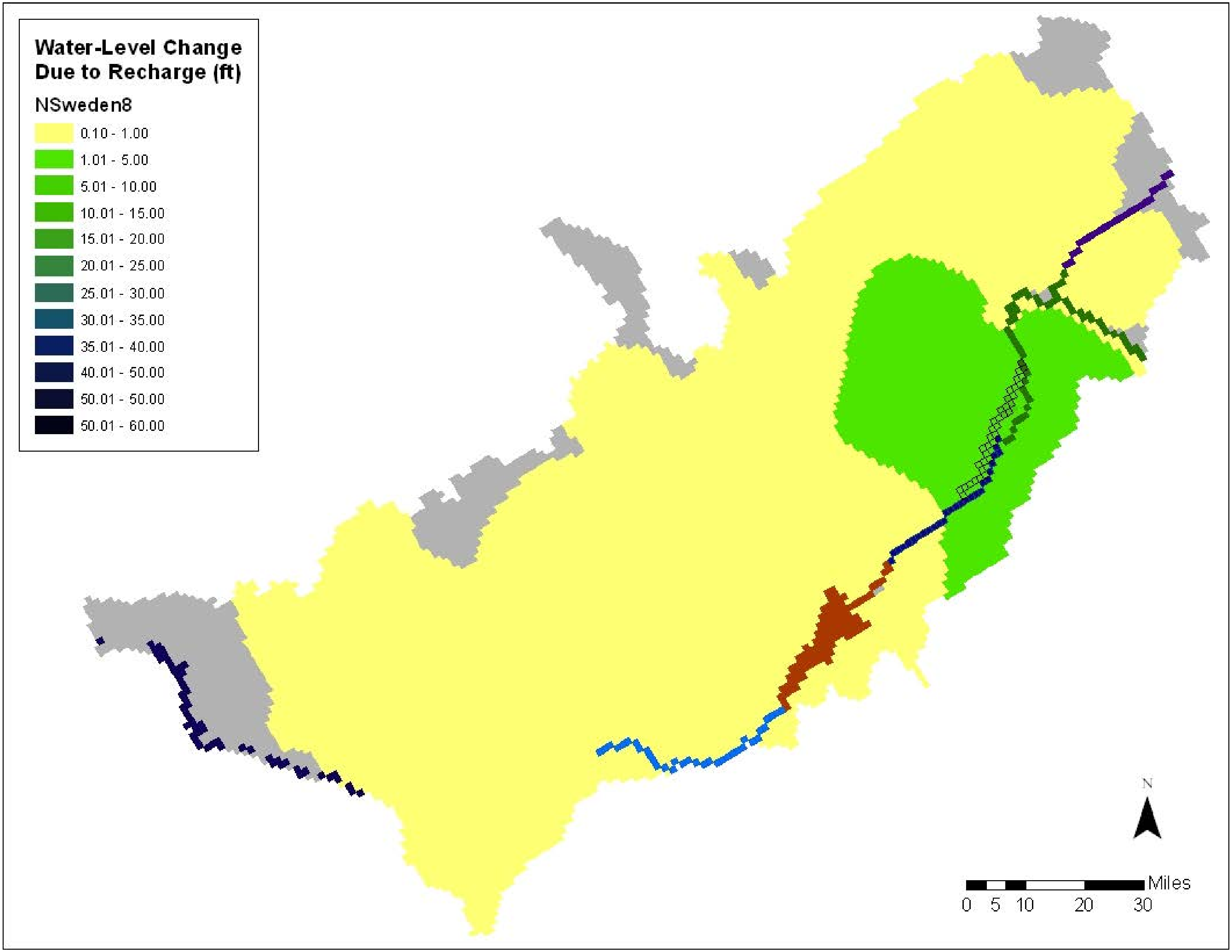
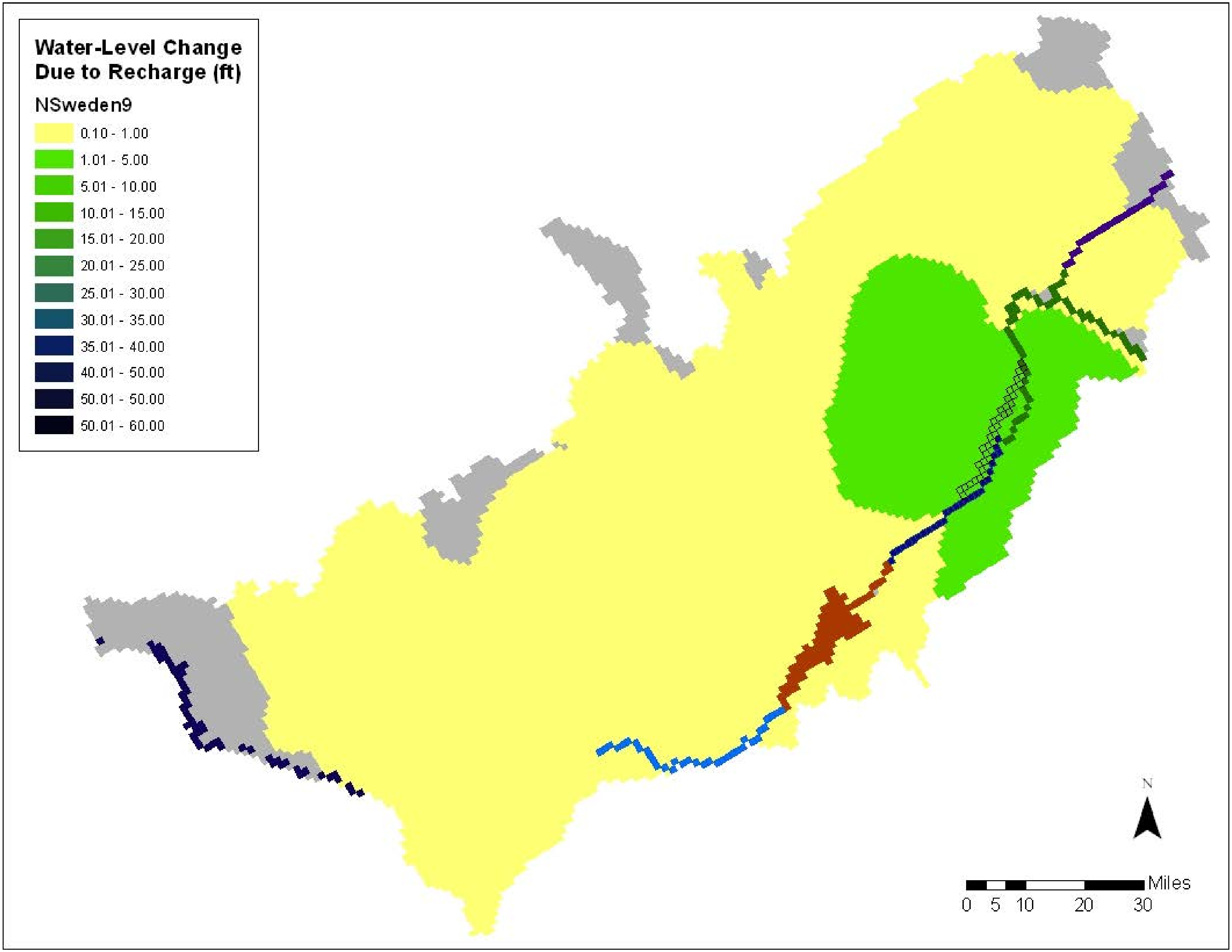
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
NSweden5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

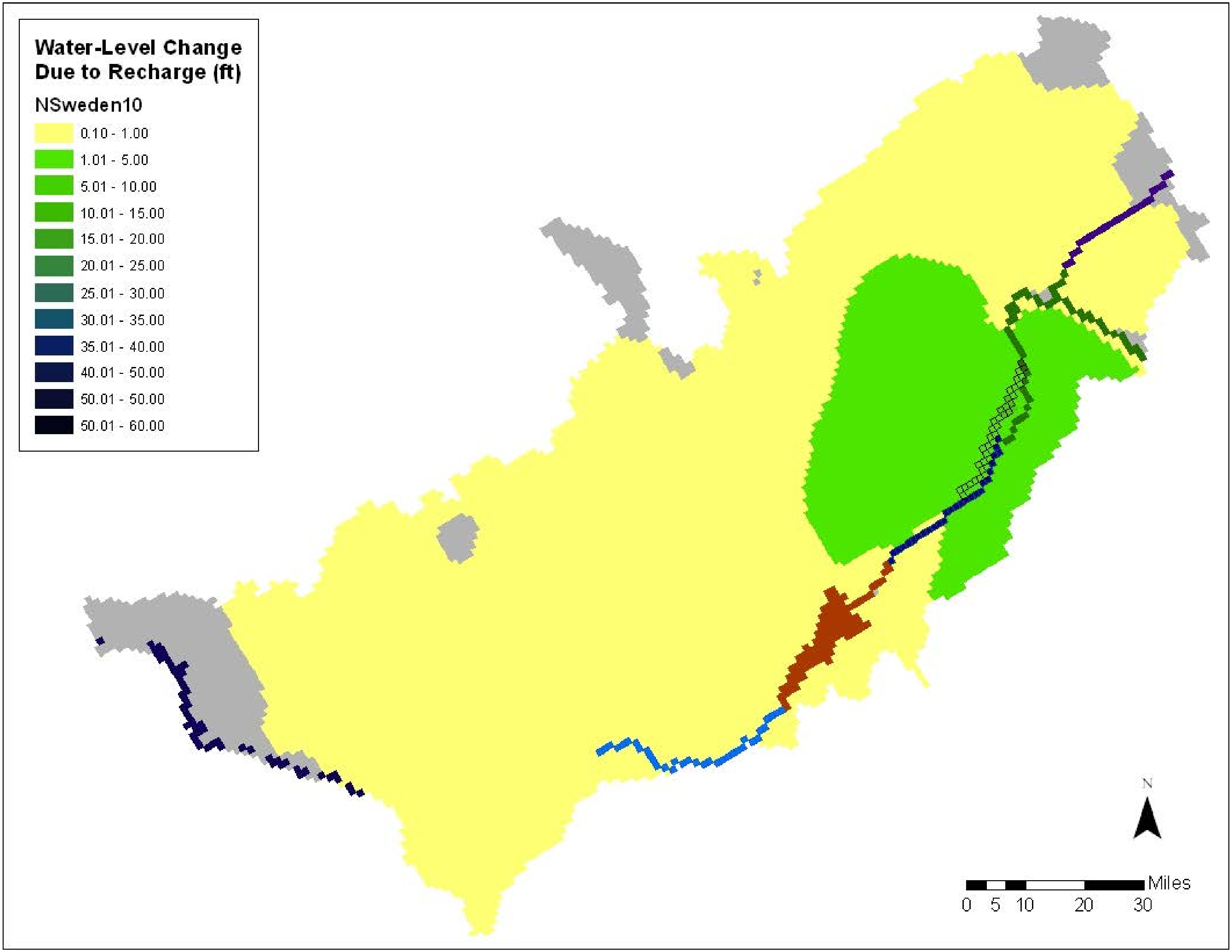

Water-Level Change Due to Recharge (ft)
NSweden6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
NSweden7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
NSweden8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
NSweden9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
NSweden10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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40.01 - 50.00
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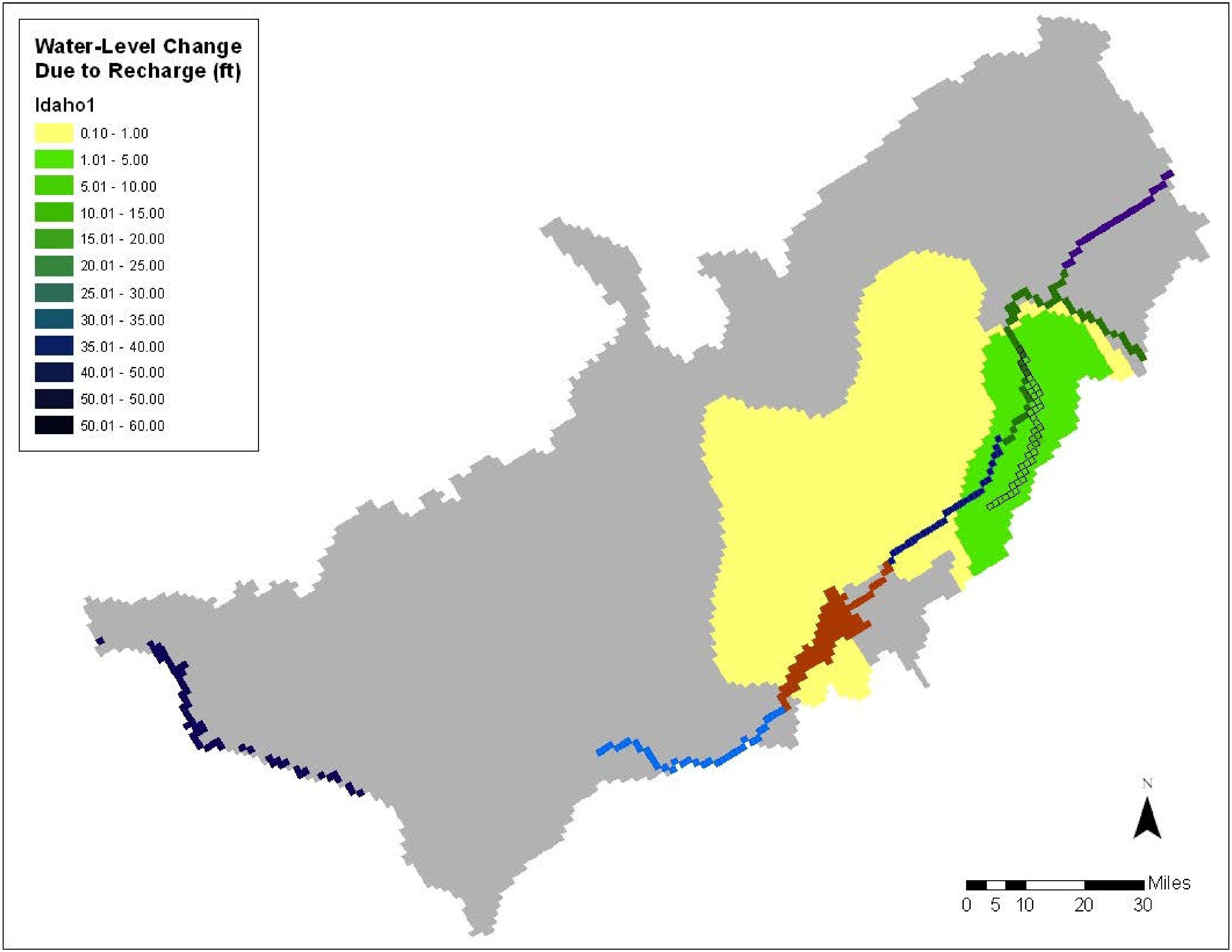
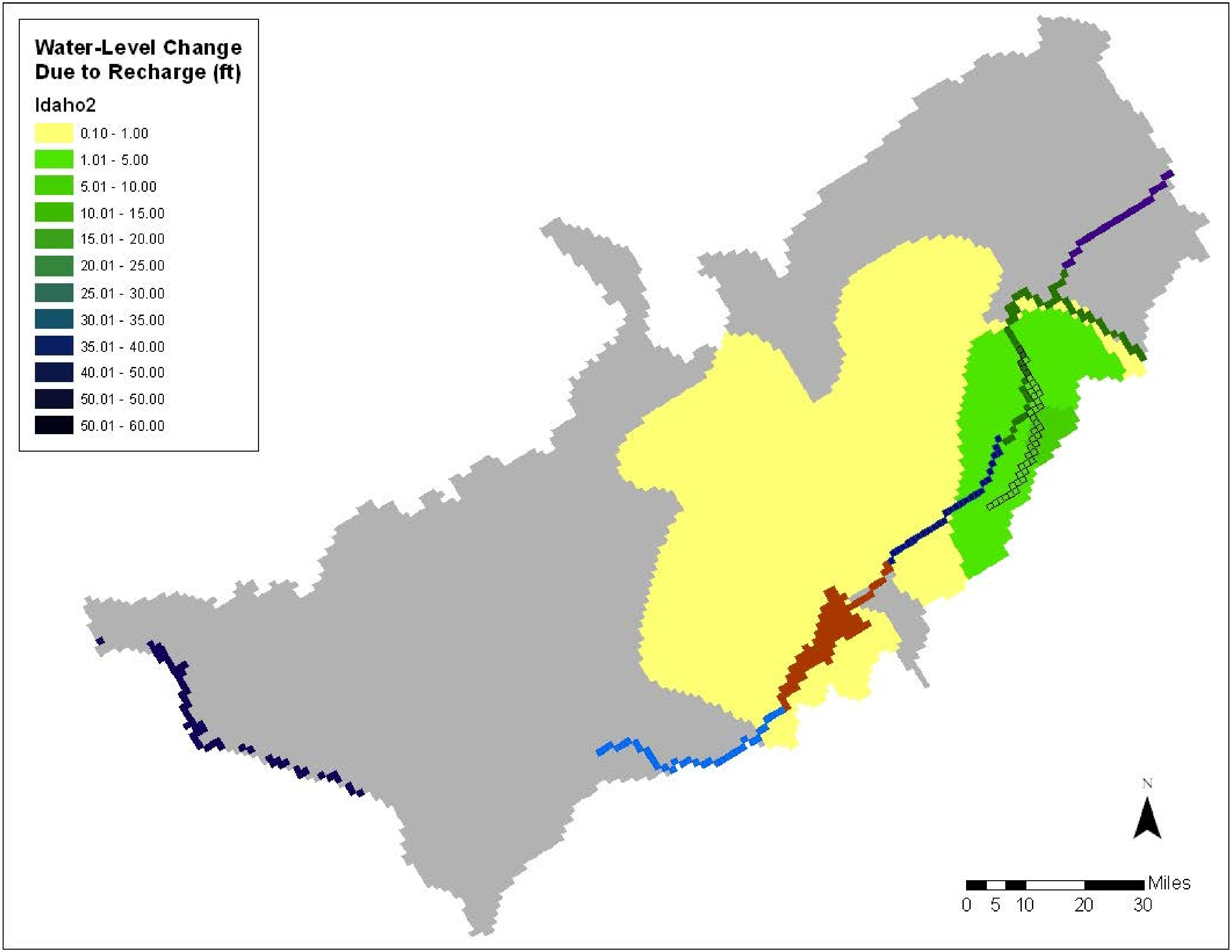
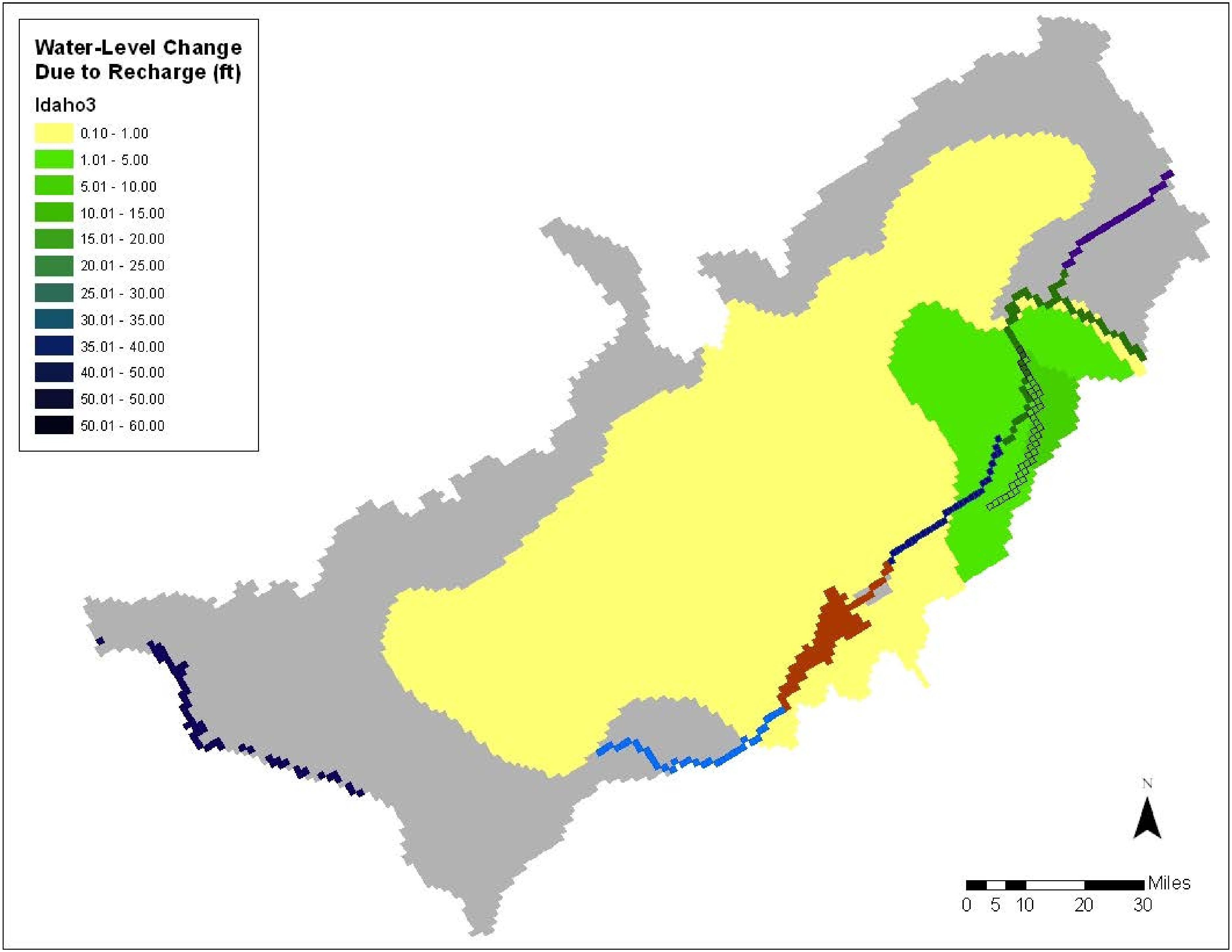
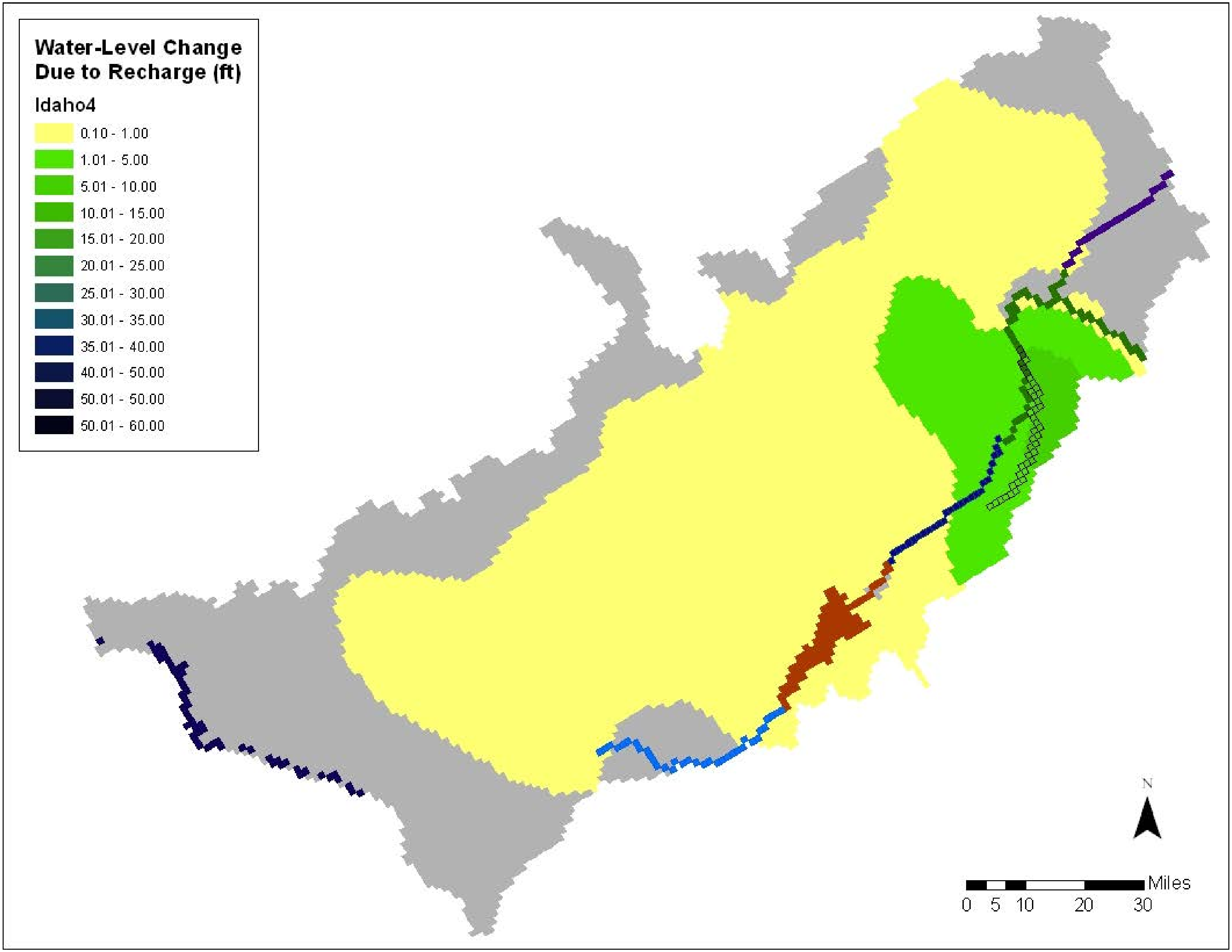
50.01 - 60.00
N
Miles
0 5 10 20 30

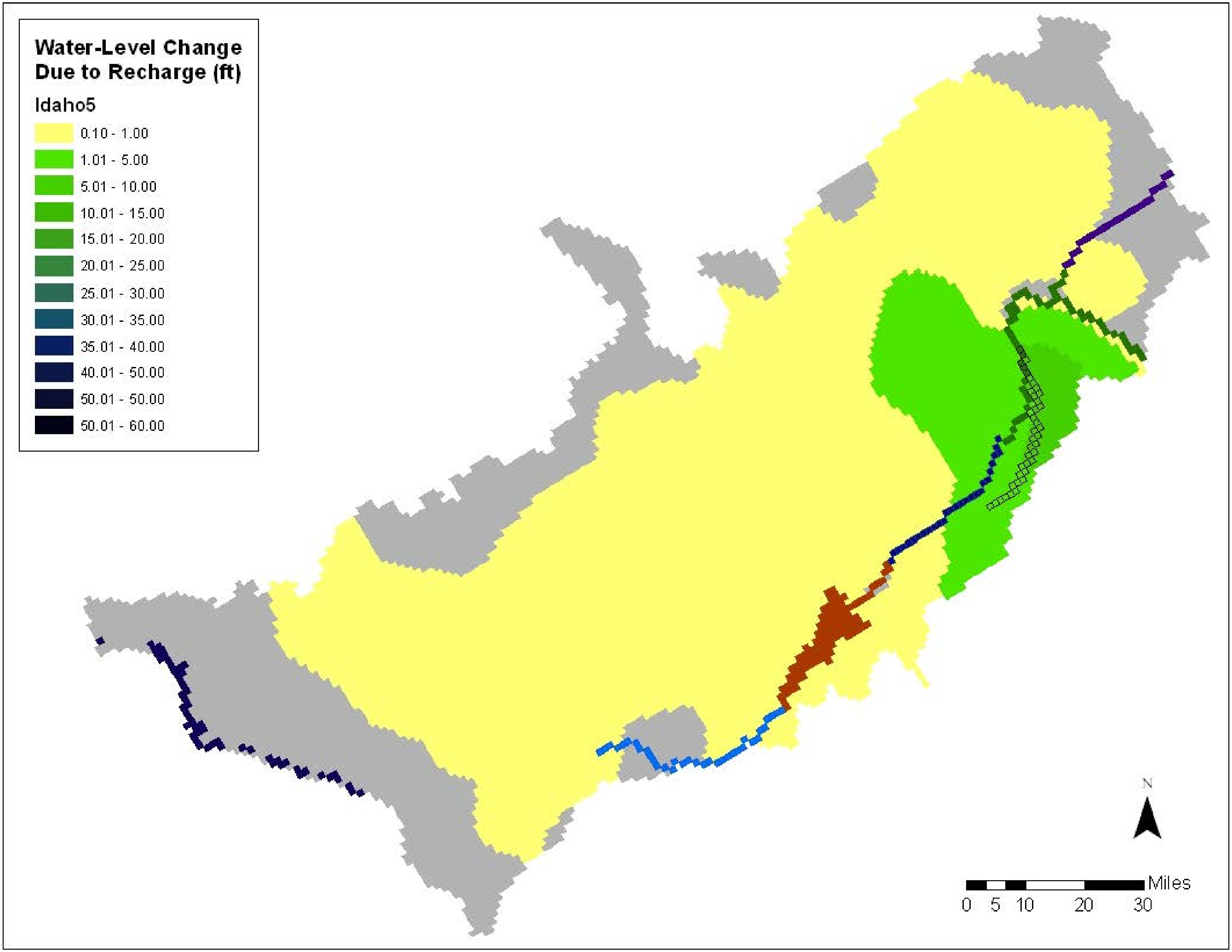


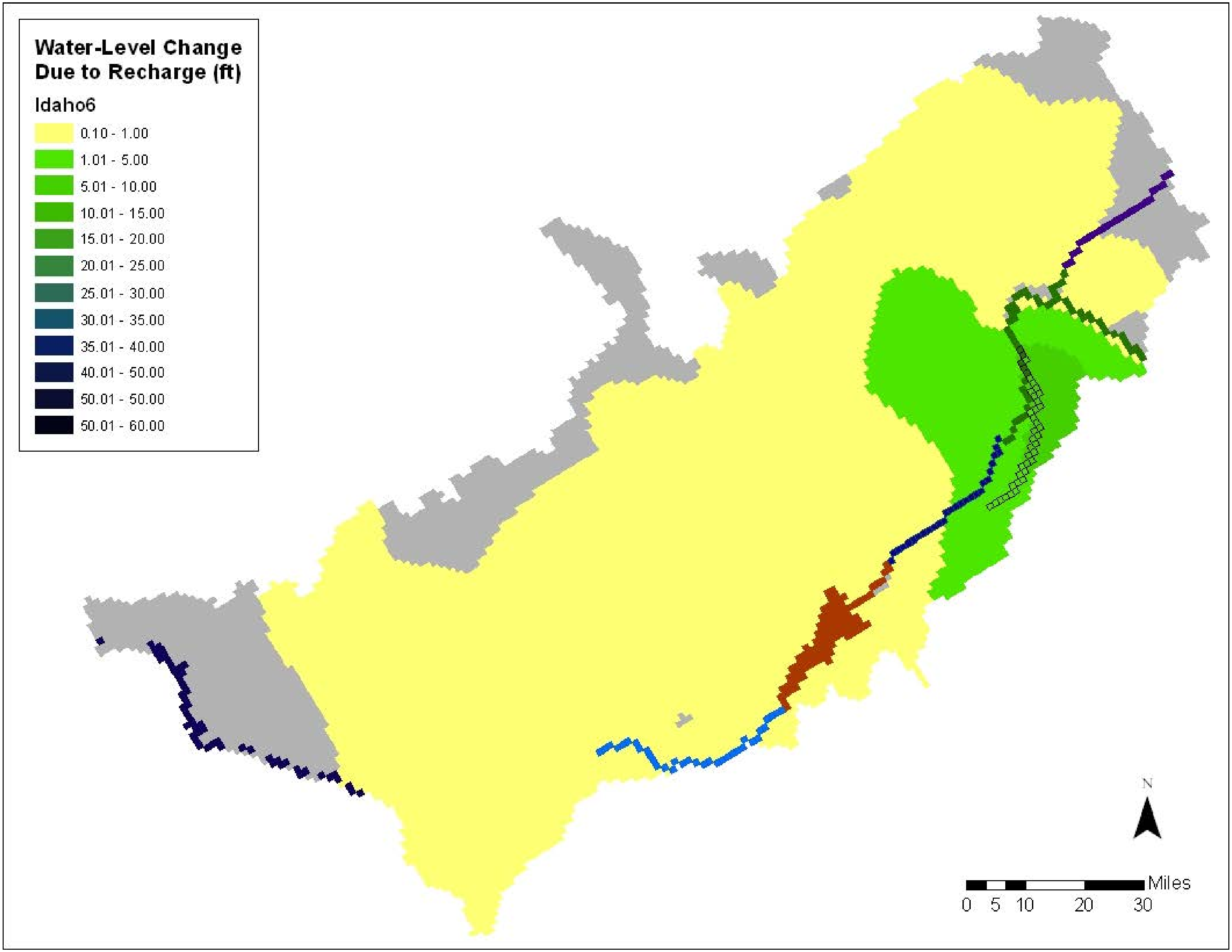
Water-Level Change
Due to Recharge (ft)
Idaho1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

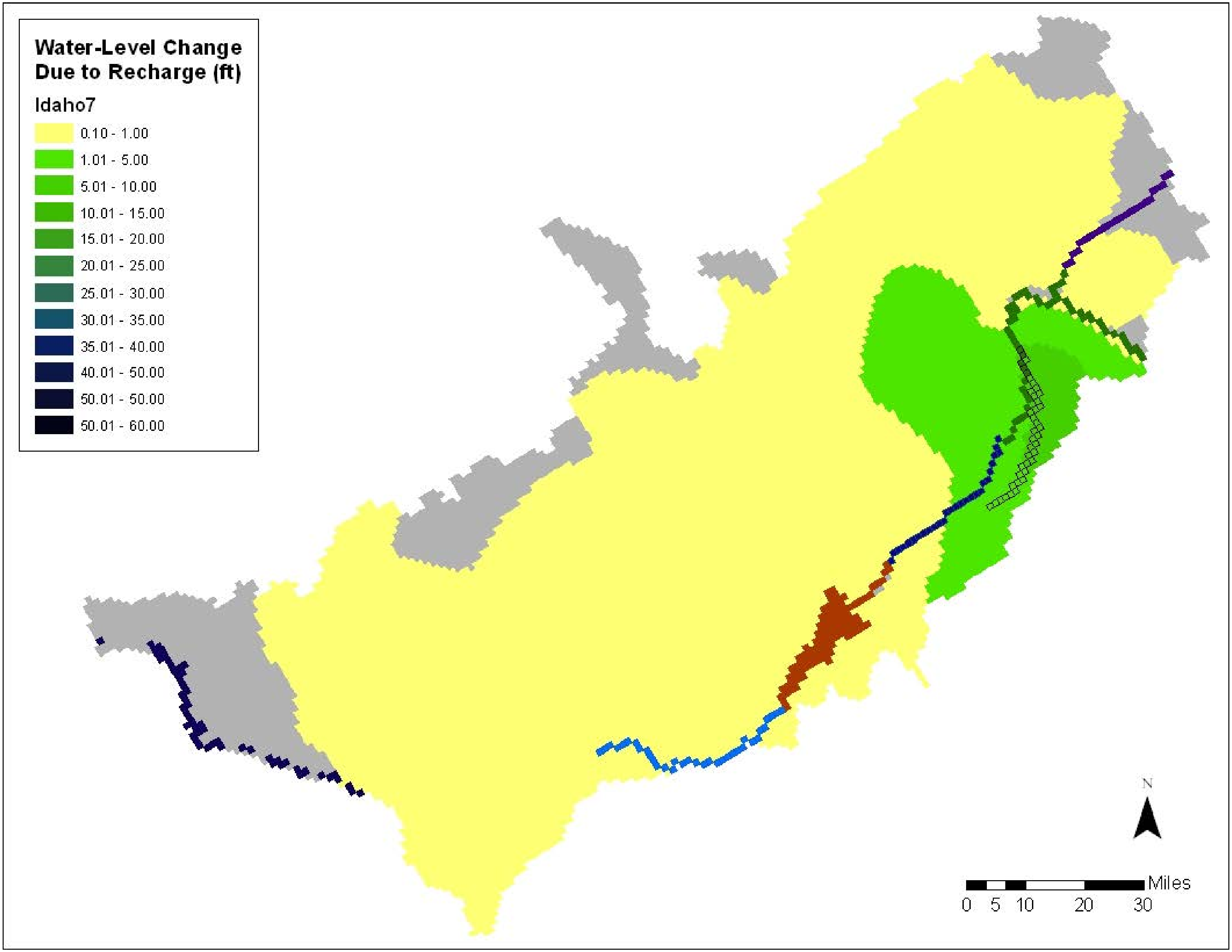

Water-Level Change Due to Recharge (ft)
Idaho2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0
5
10
20
30


Water-Level Change
Due to Recharge (ft)
Idaho3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

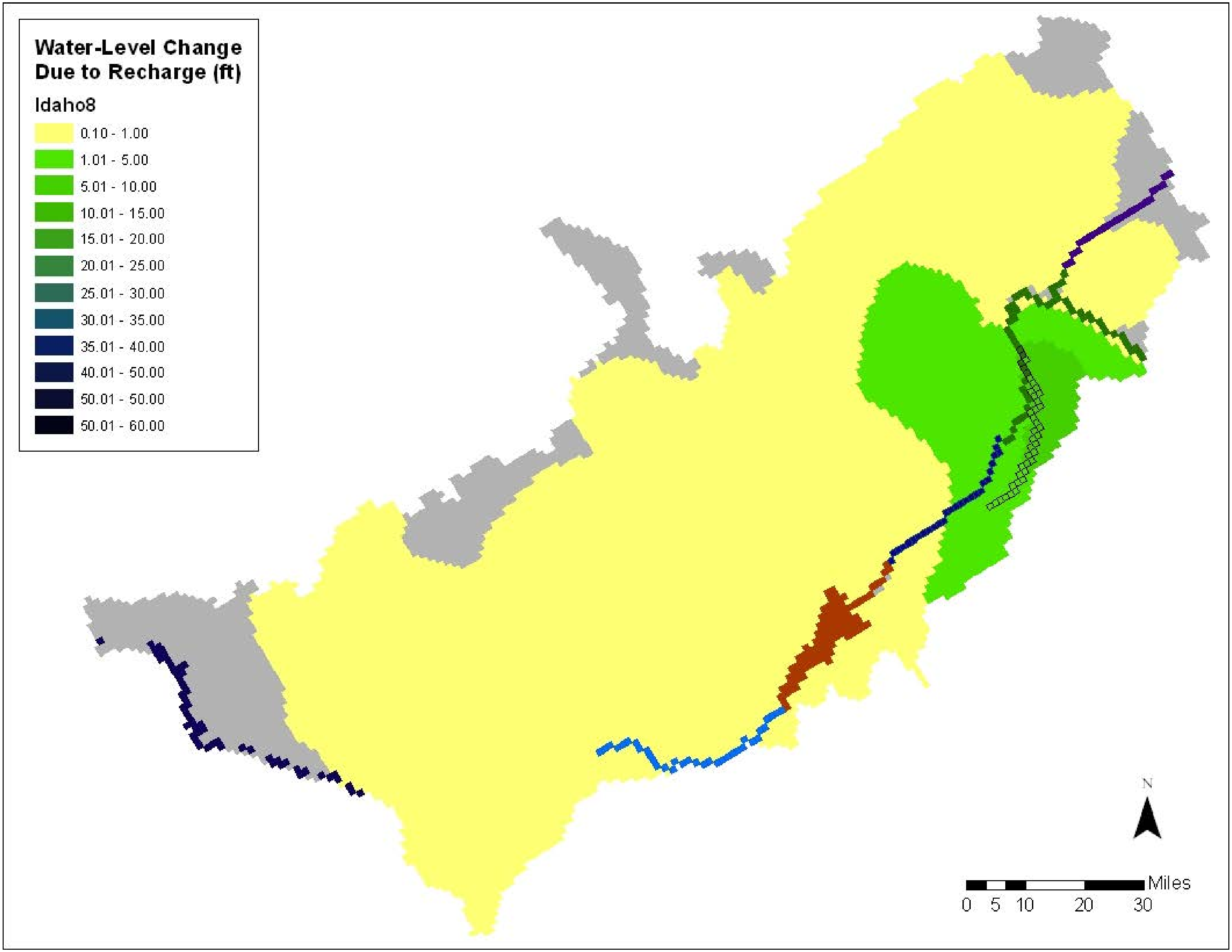

Water-Level Change
Due to Recharge (ft)
Idaho4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

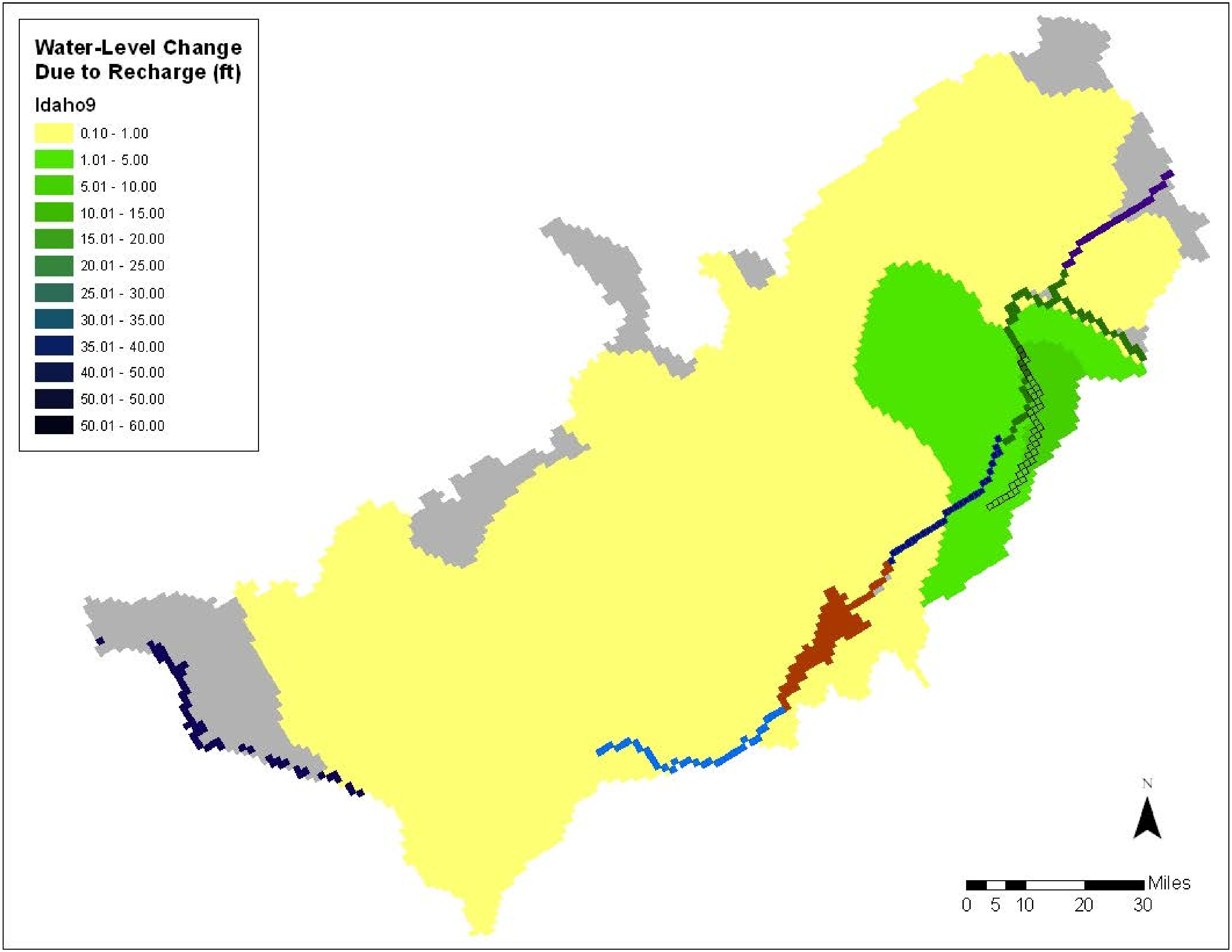

Water-Level Change Due to Recharge (ft)
Idaho5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Idaho6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

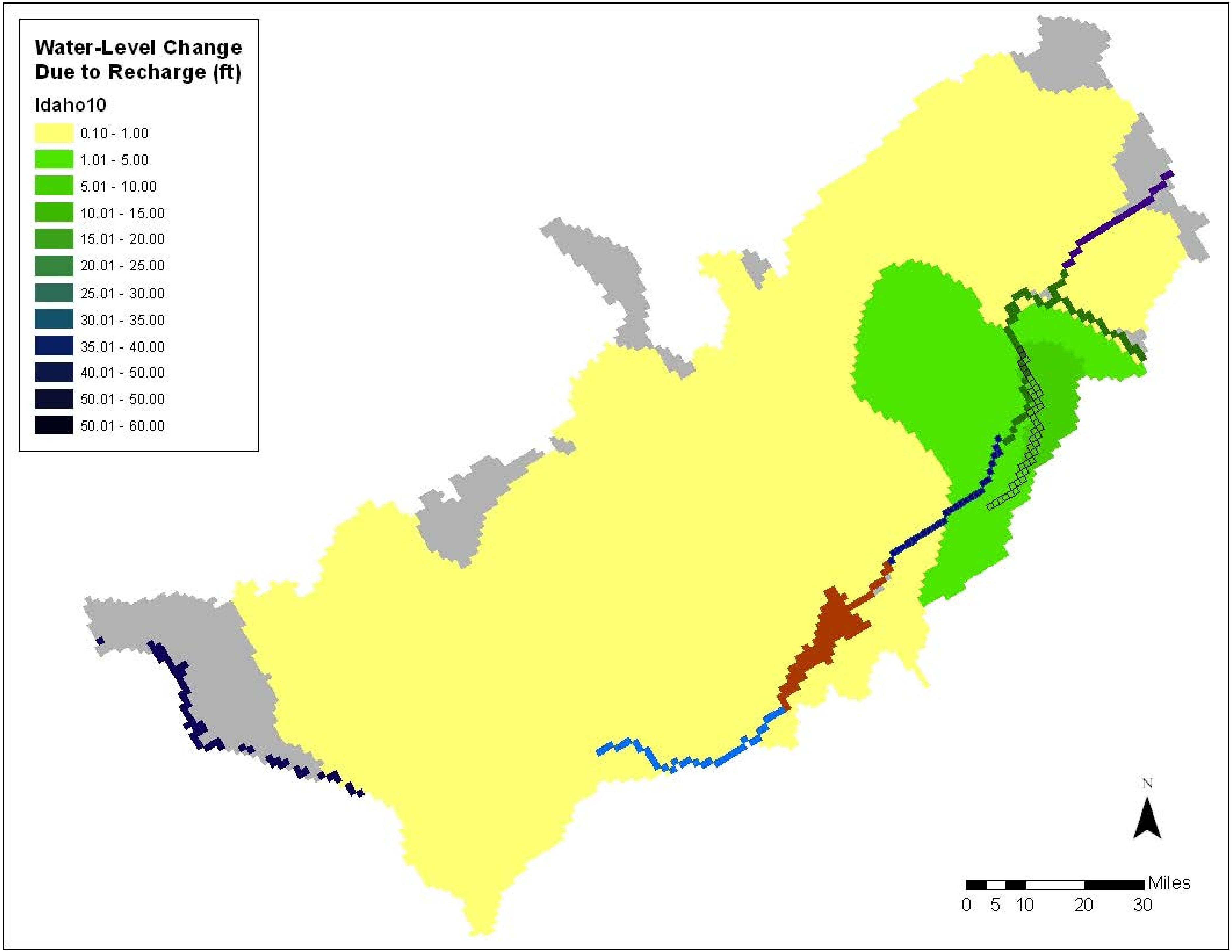


Water-Level Change
Due to Recharge (ft)
Idaho7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
Idaho8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
Idaho9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
Idaho10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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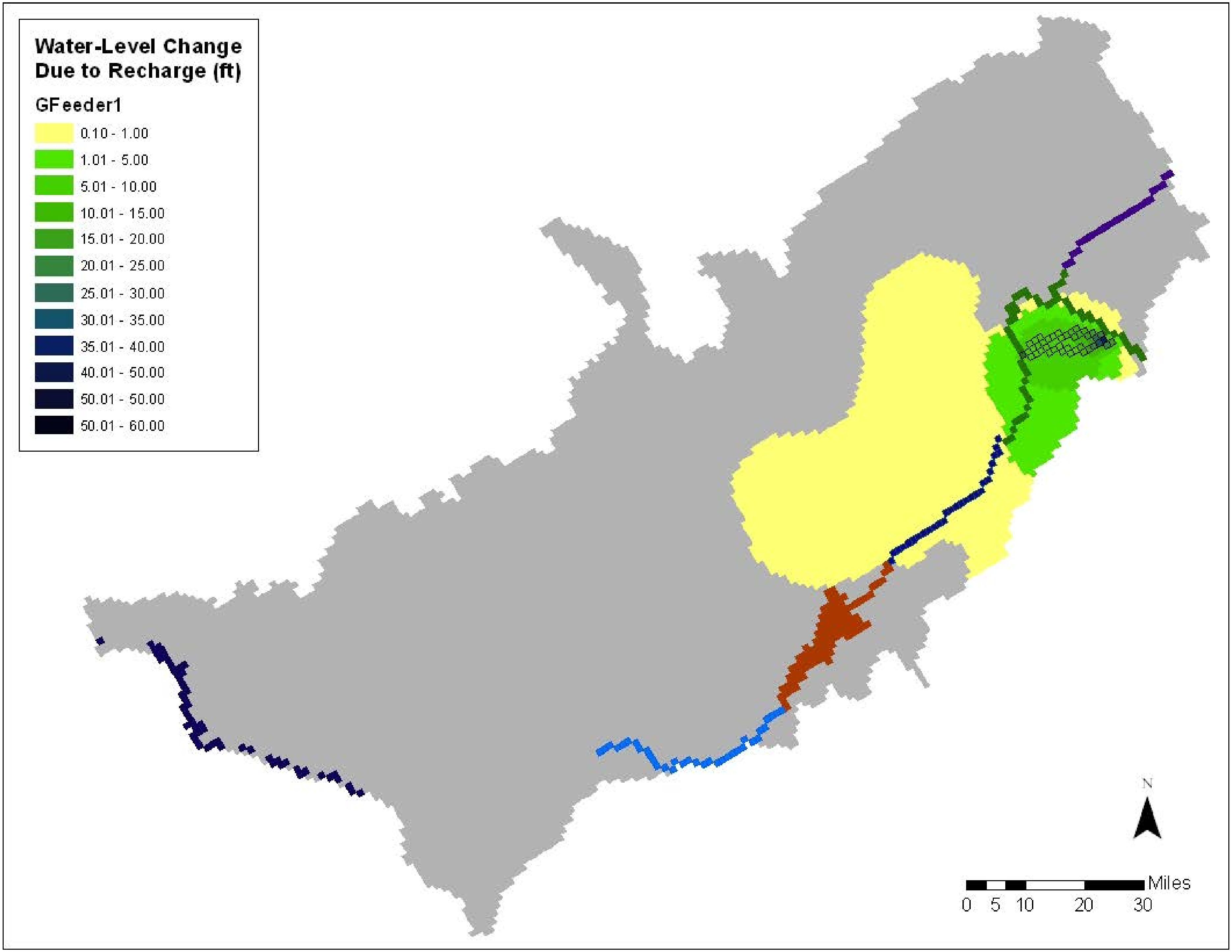
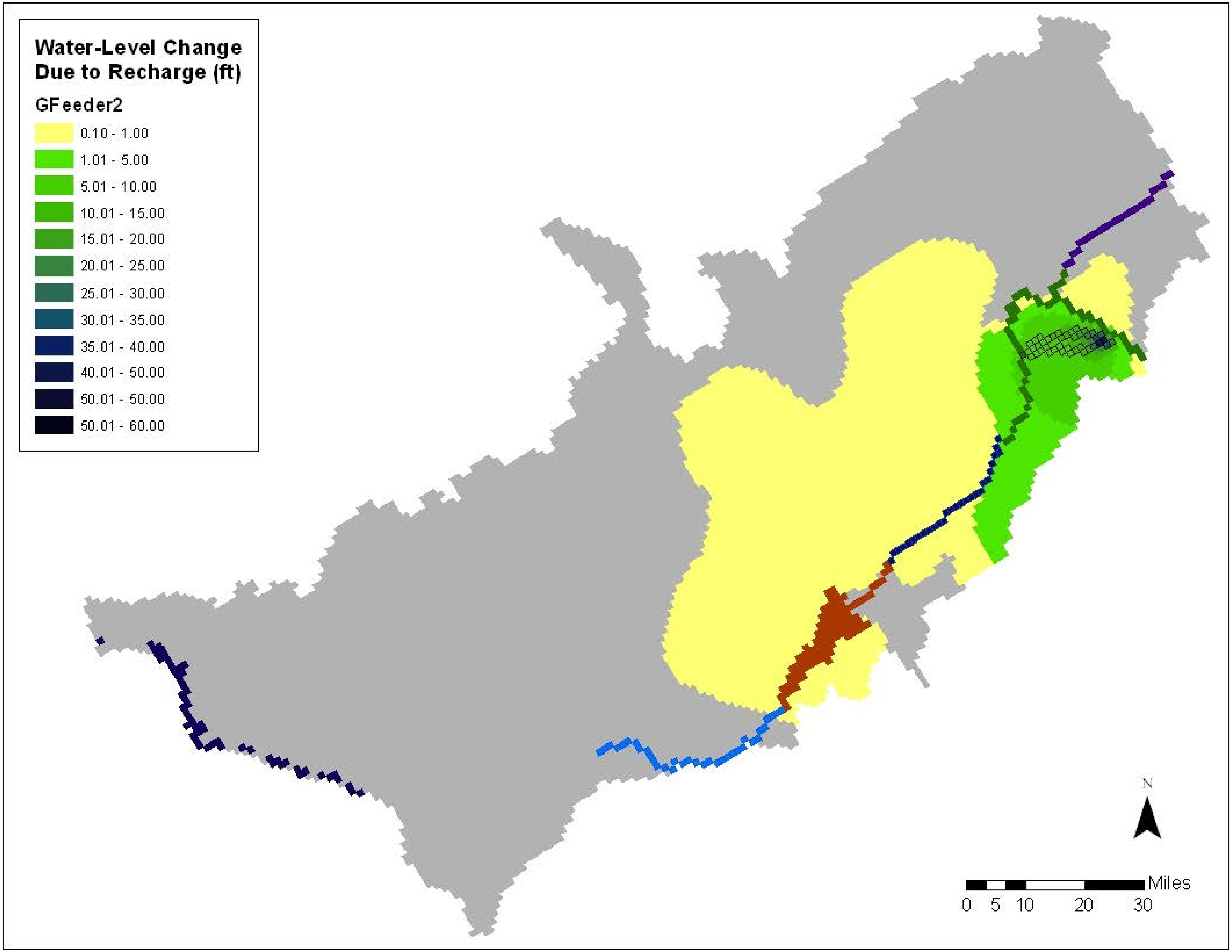
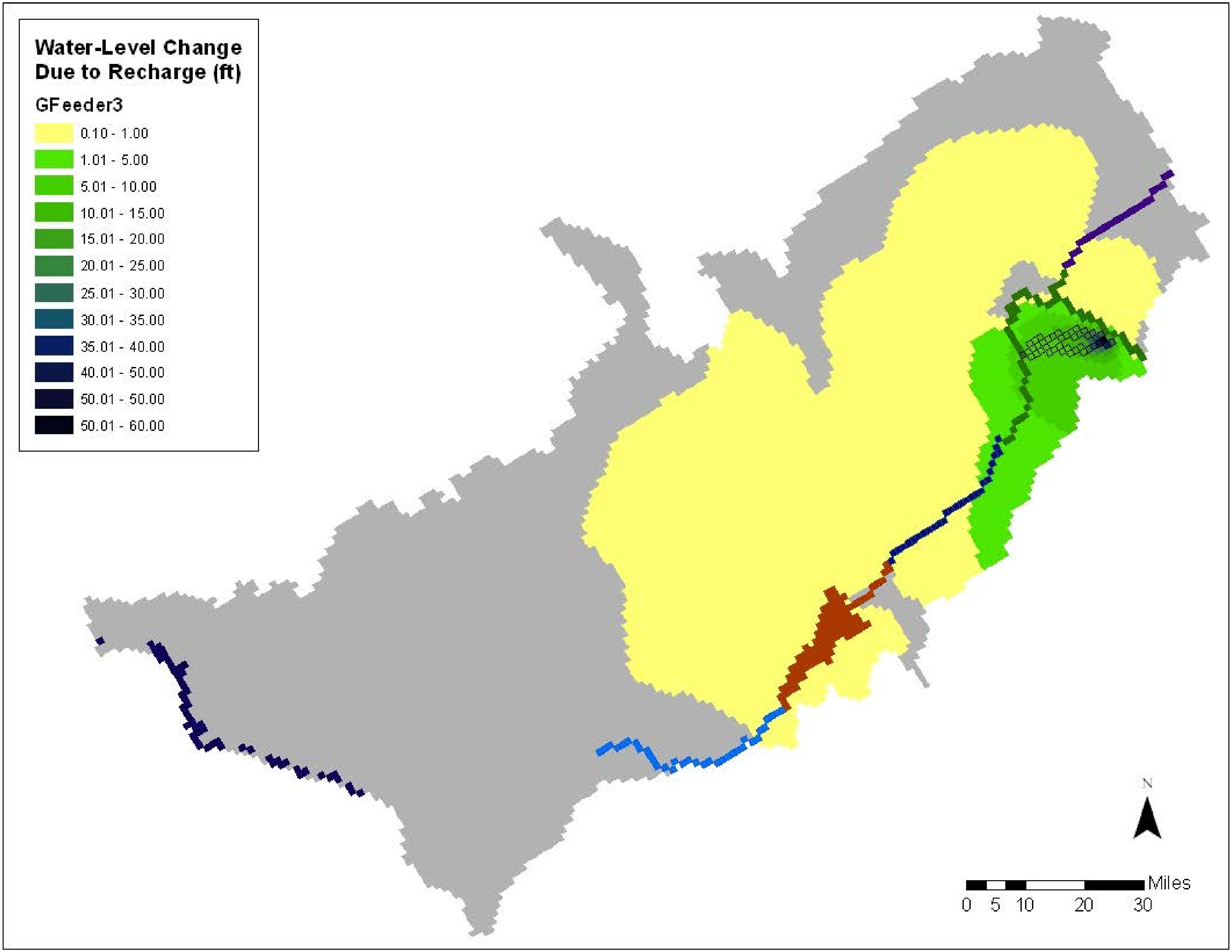
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
GFeeder1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
GFeeder2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
GFeeder3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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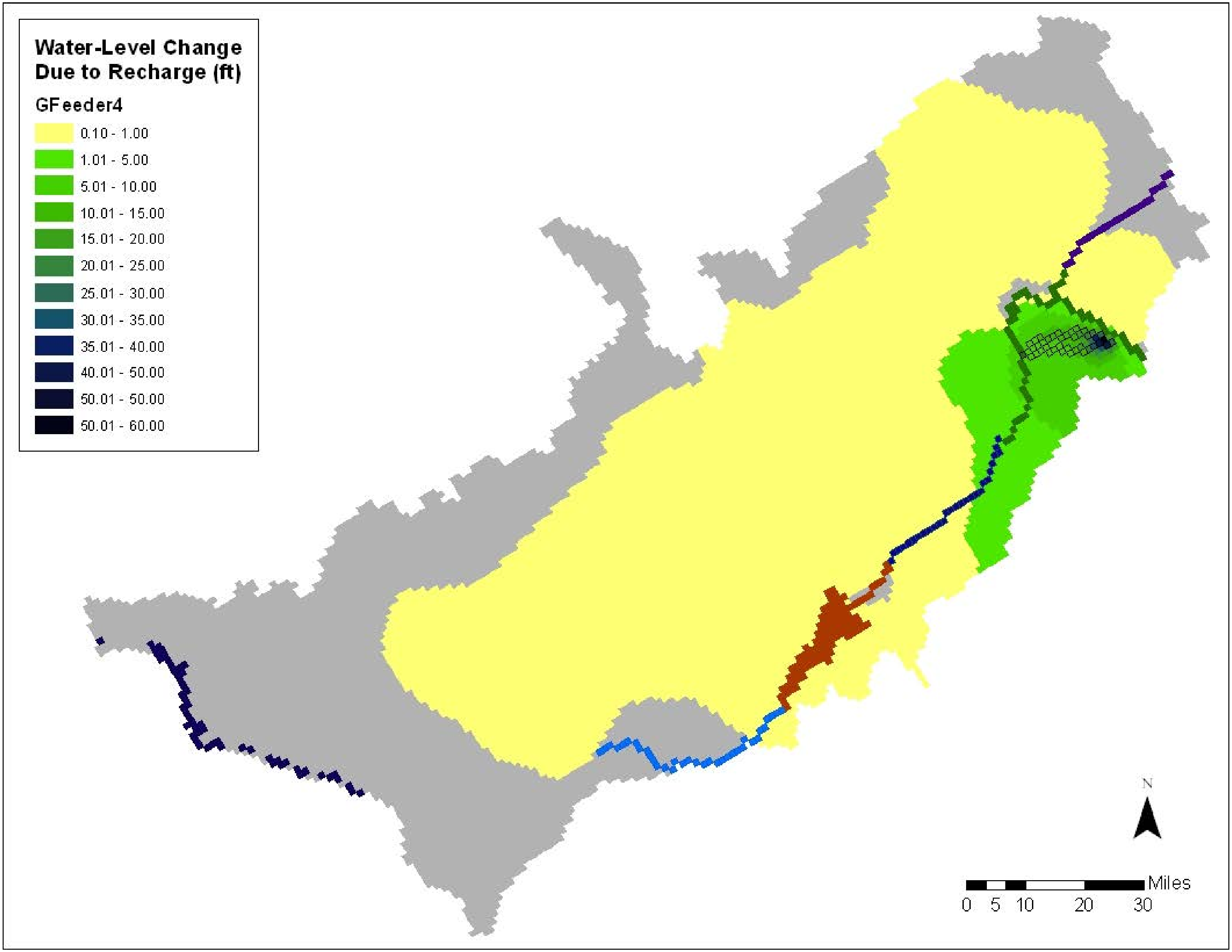
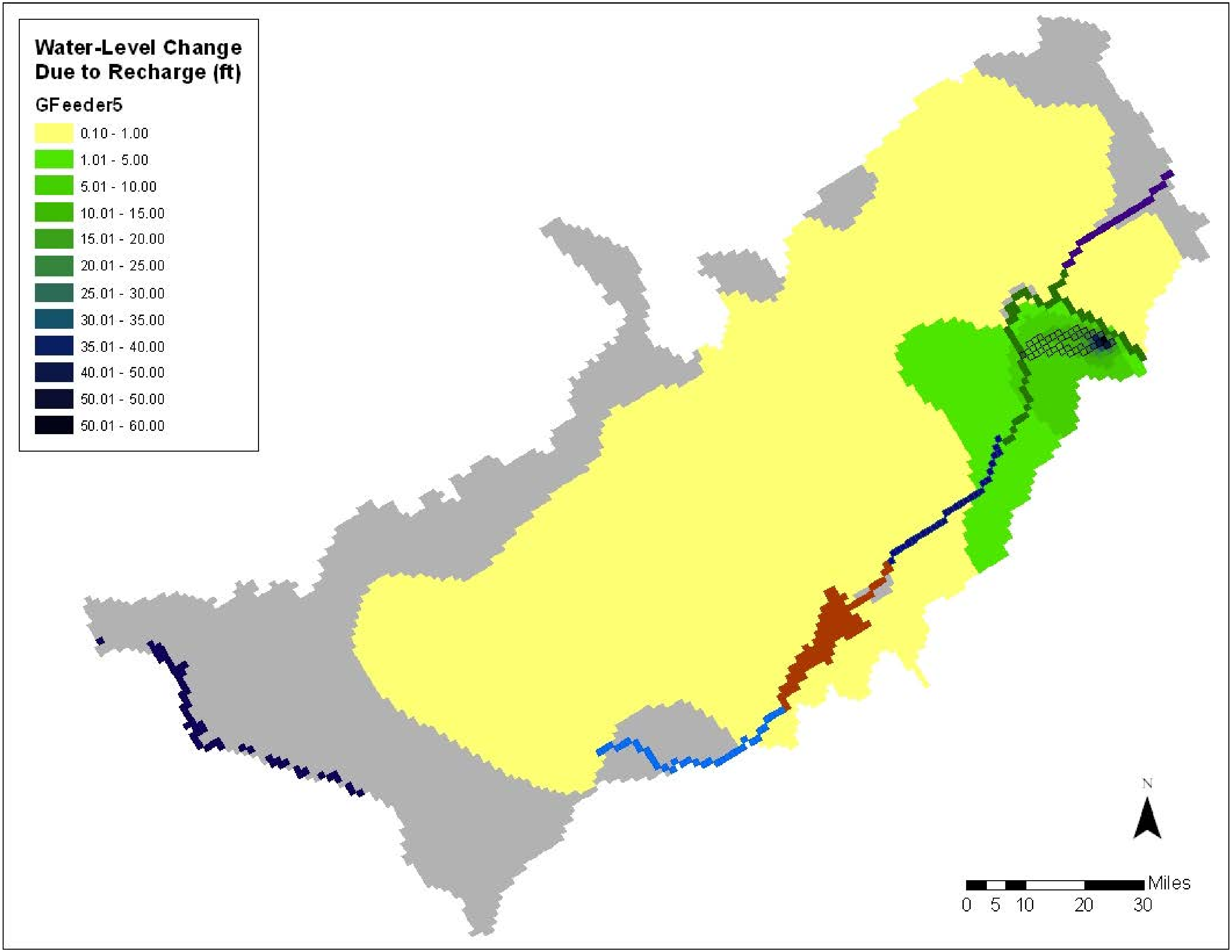
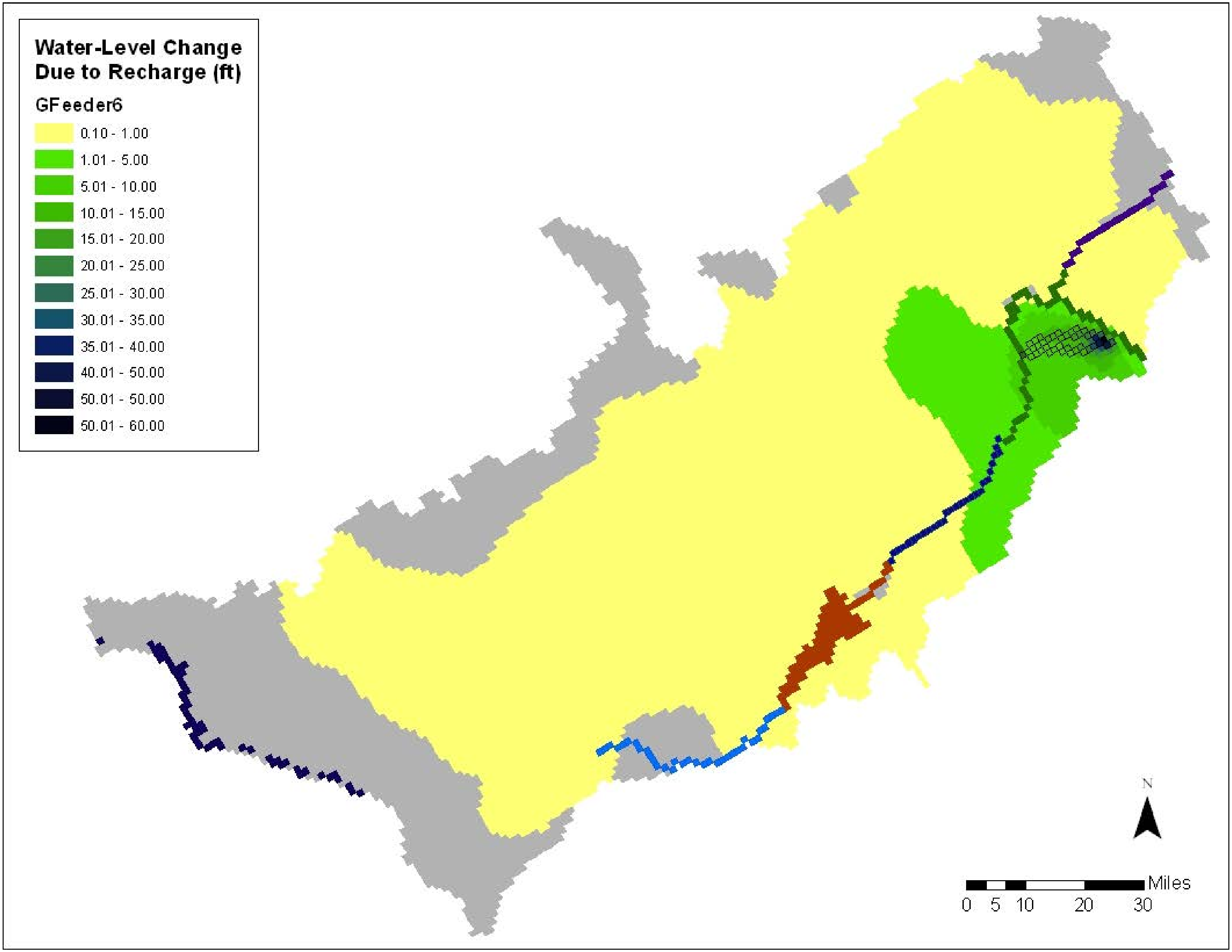
50.01 - 60.00
N
Miles
0 5 10 20 30

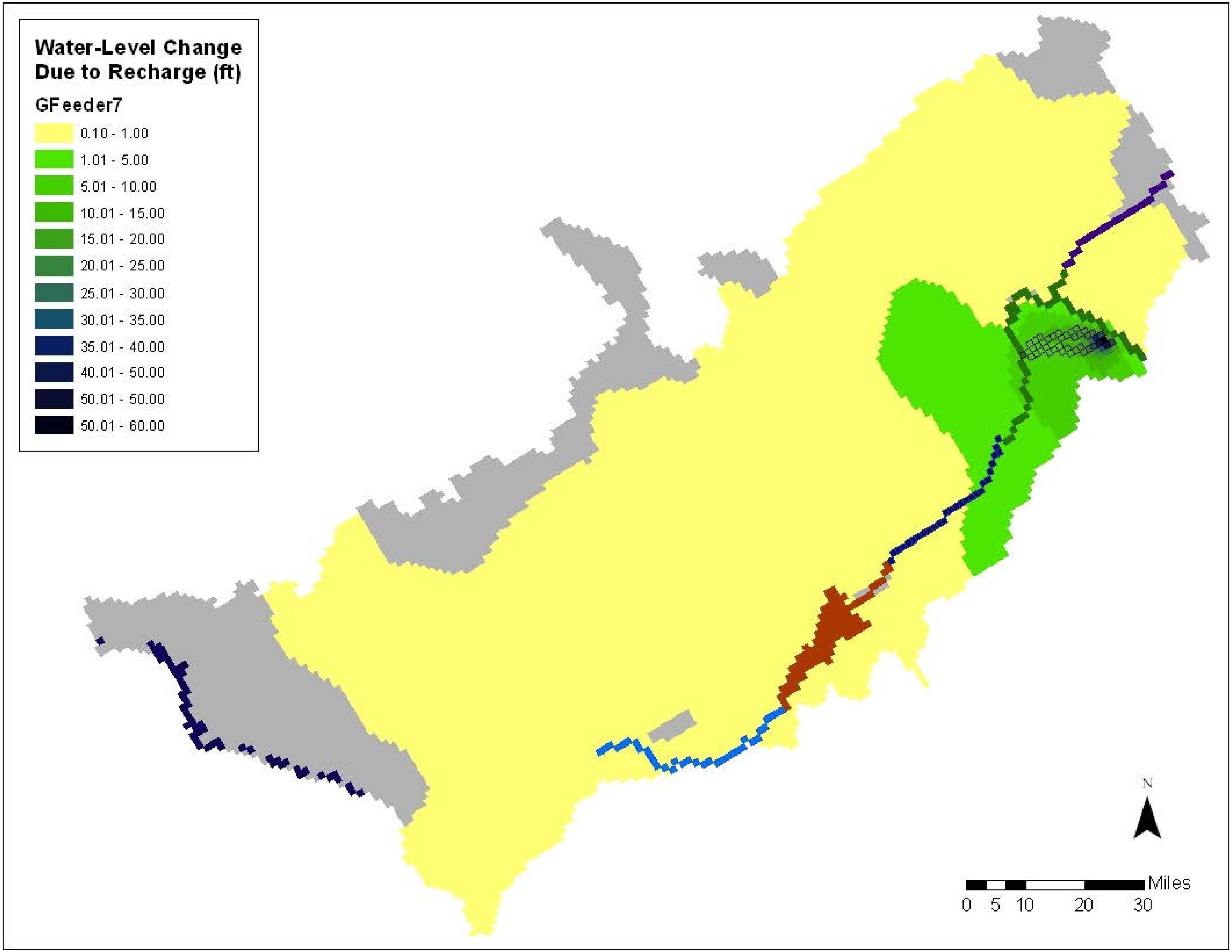


Water-Level Change
Due to Recharge (ft)
GFeeder4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

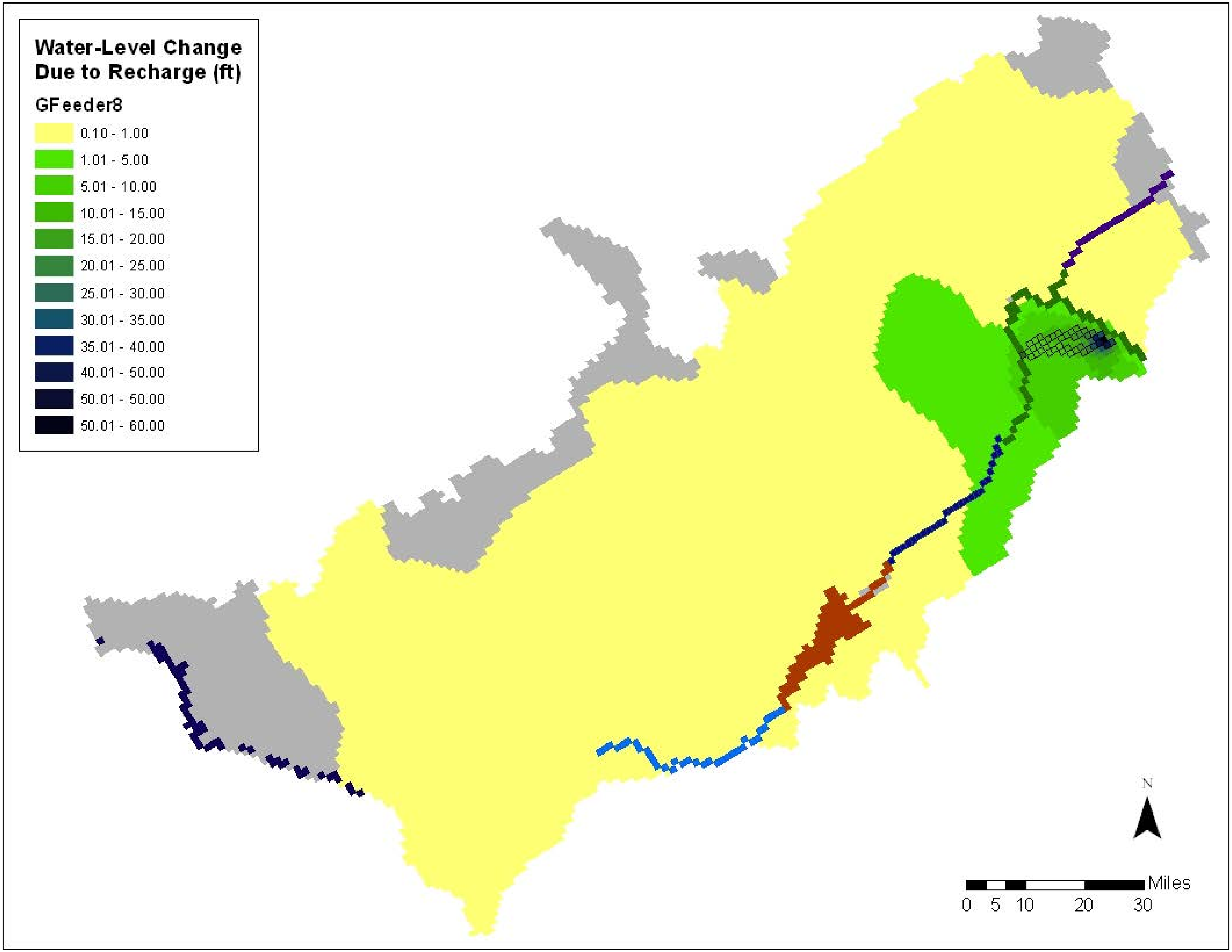

Water-Level Change
Due to Recharge (ft)
GFeeder5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

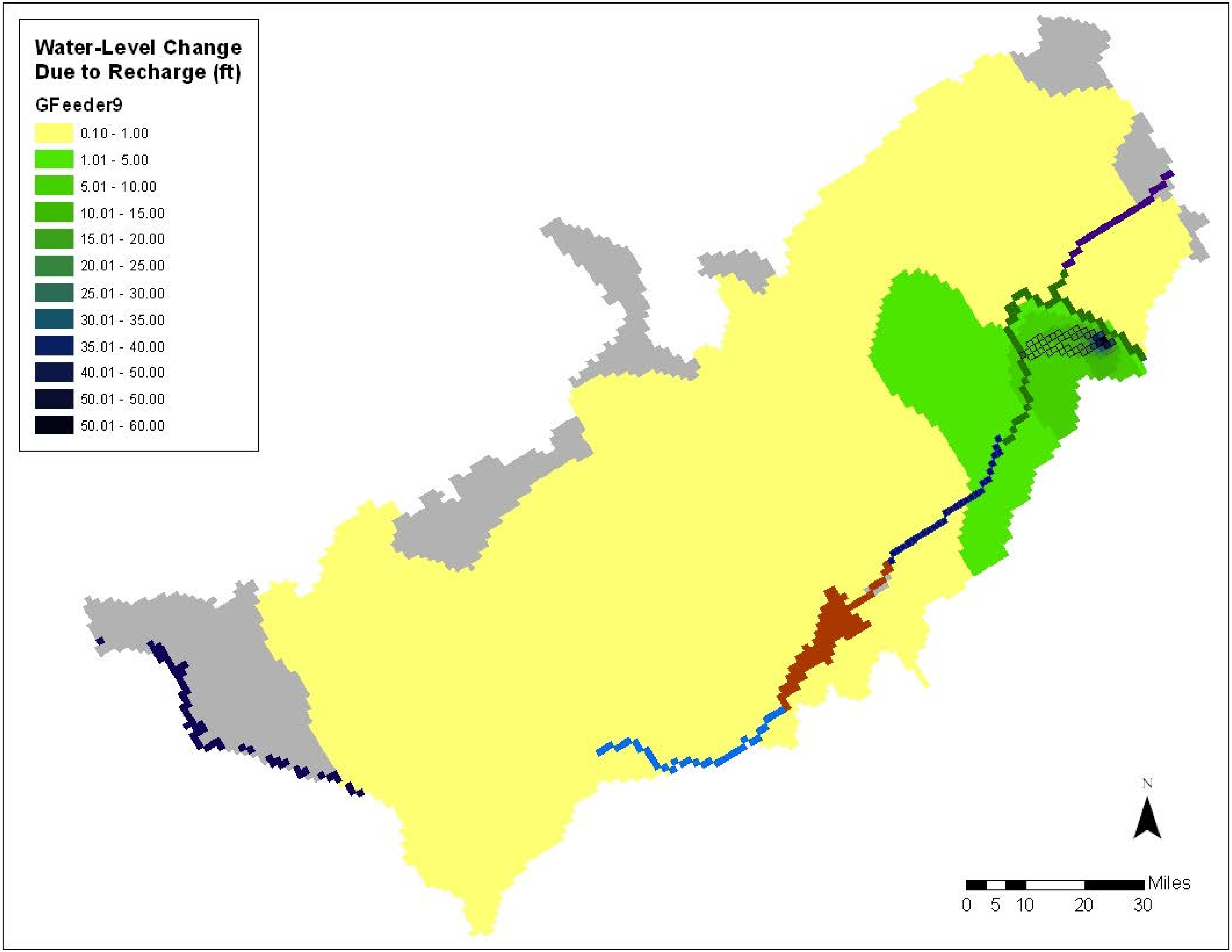


Water-Level Change Due to Recharge (ft)
GFeeder6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles



Water-Level Change
Due to Recharge (ft)
GFeeder7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
GFeeder8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change Due to Recharge (ft)
GFeeder9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
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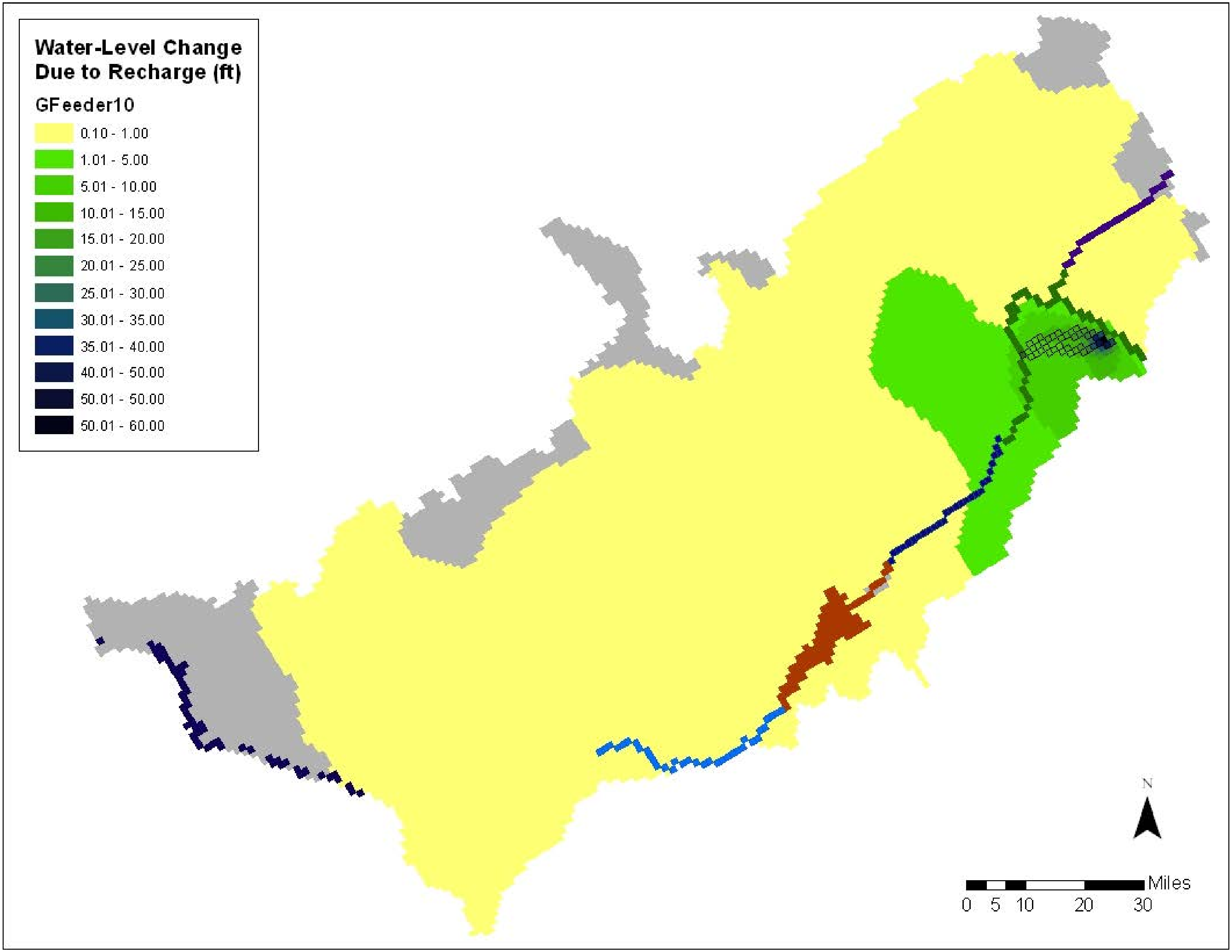
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
GFeeder10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
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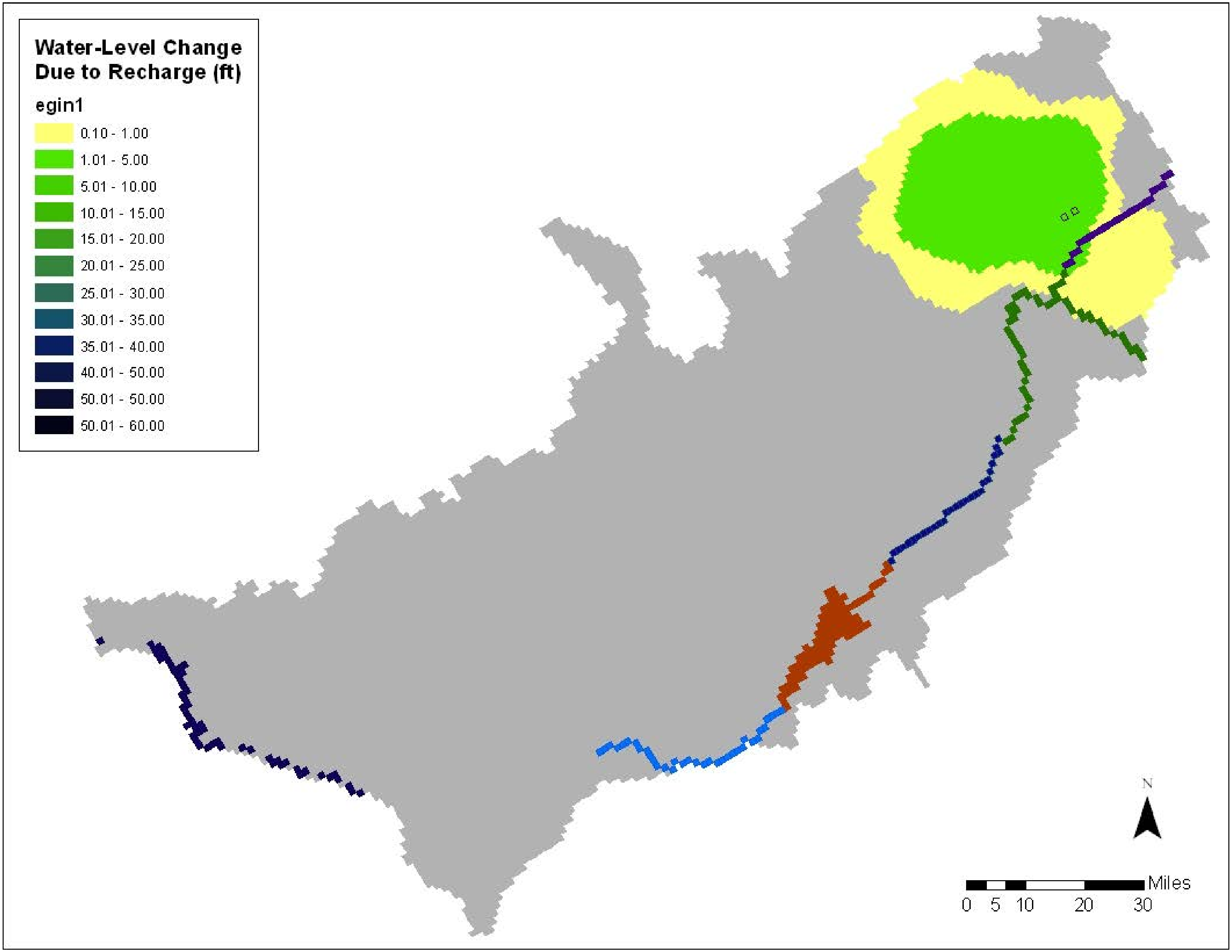
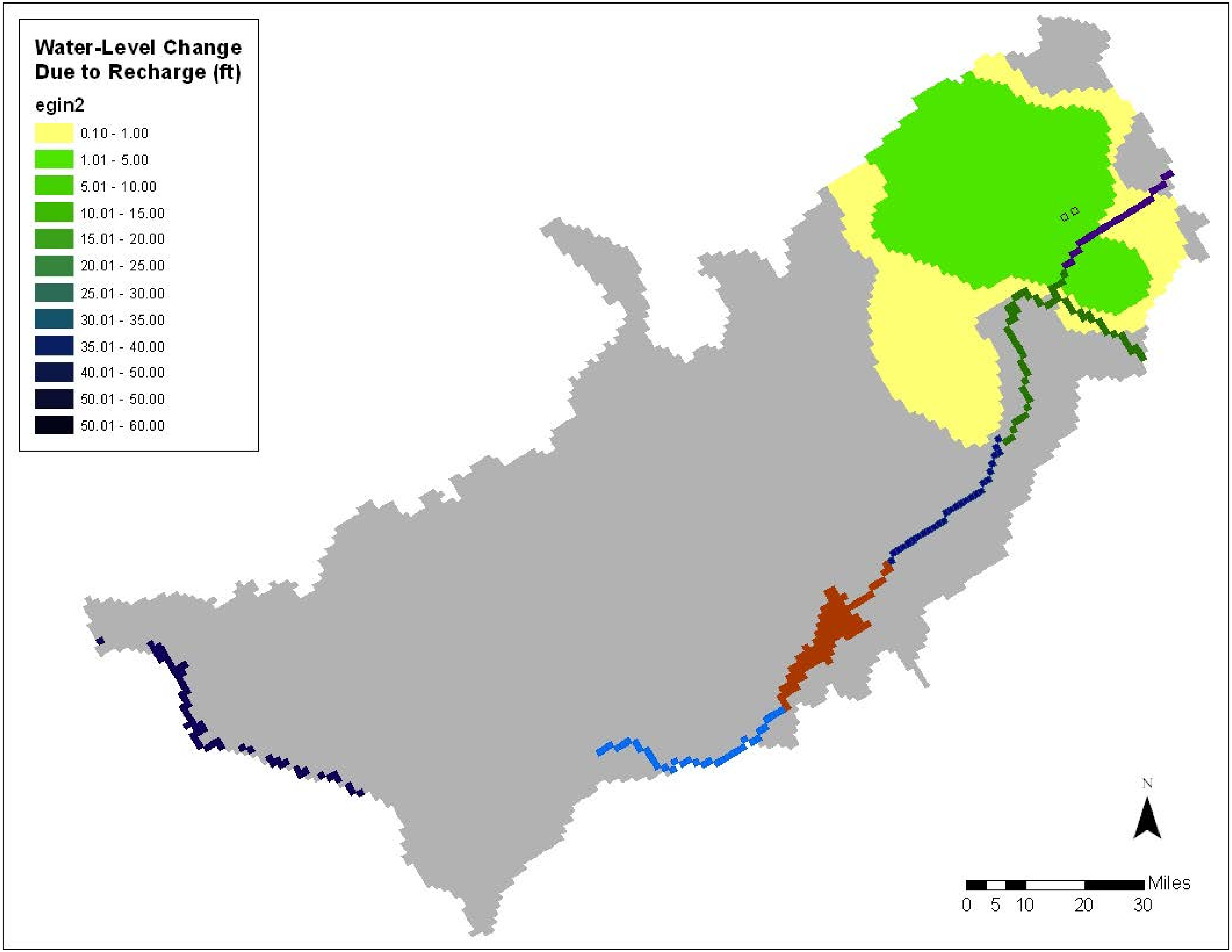
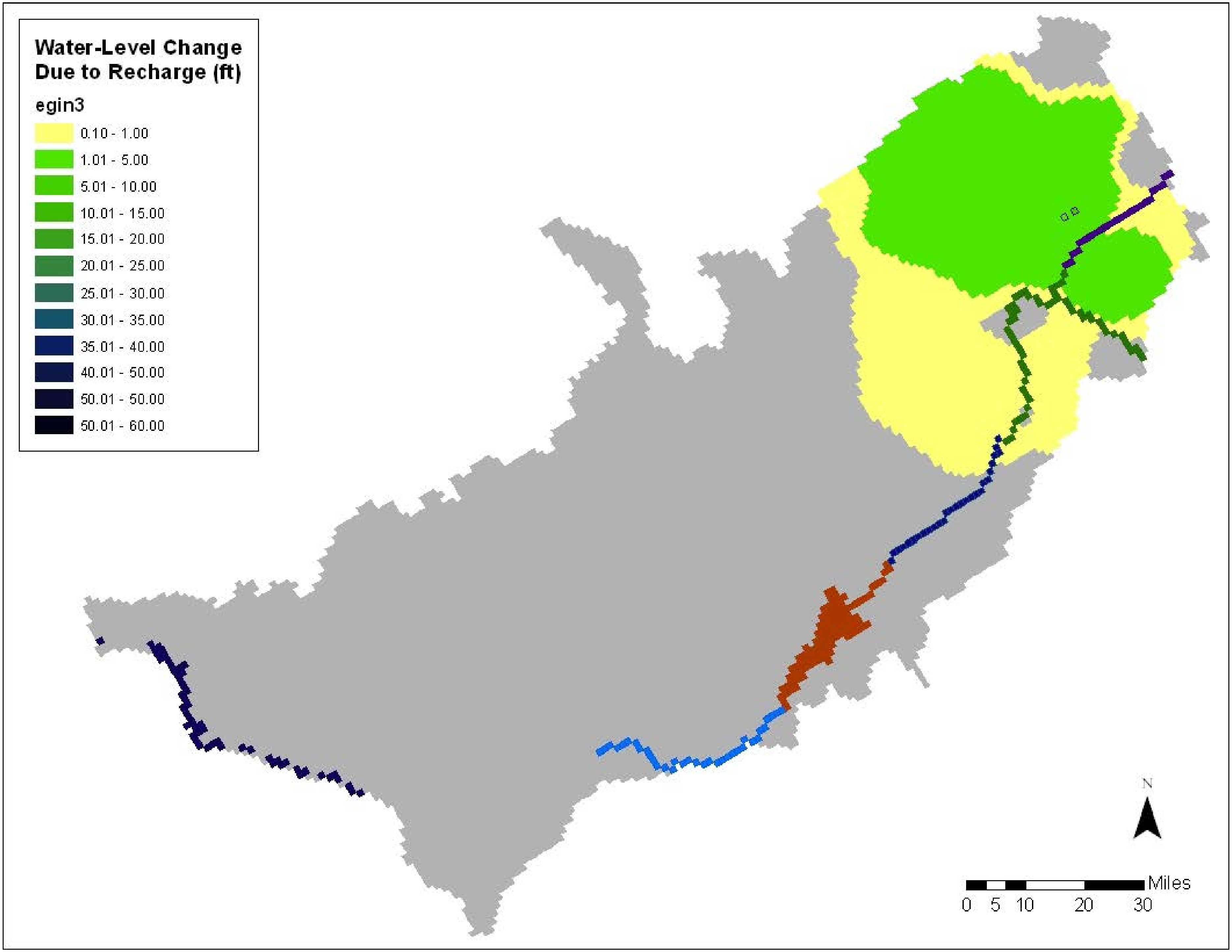
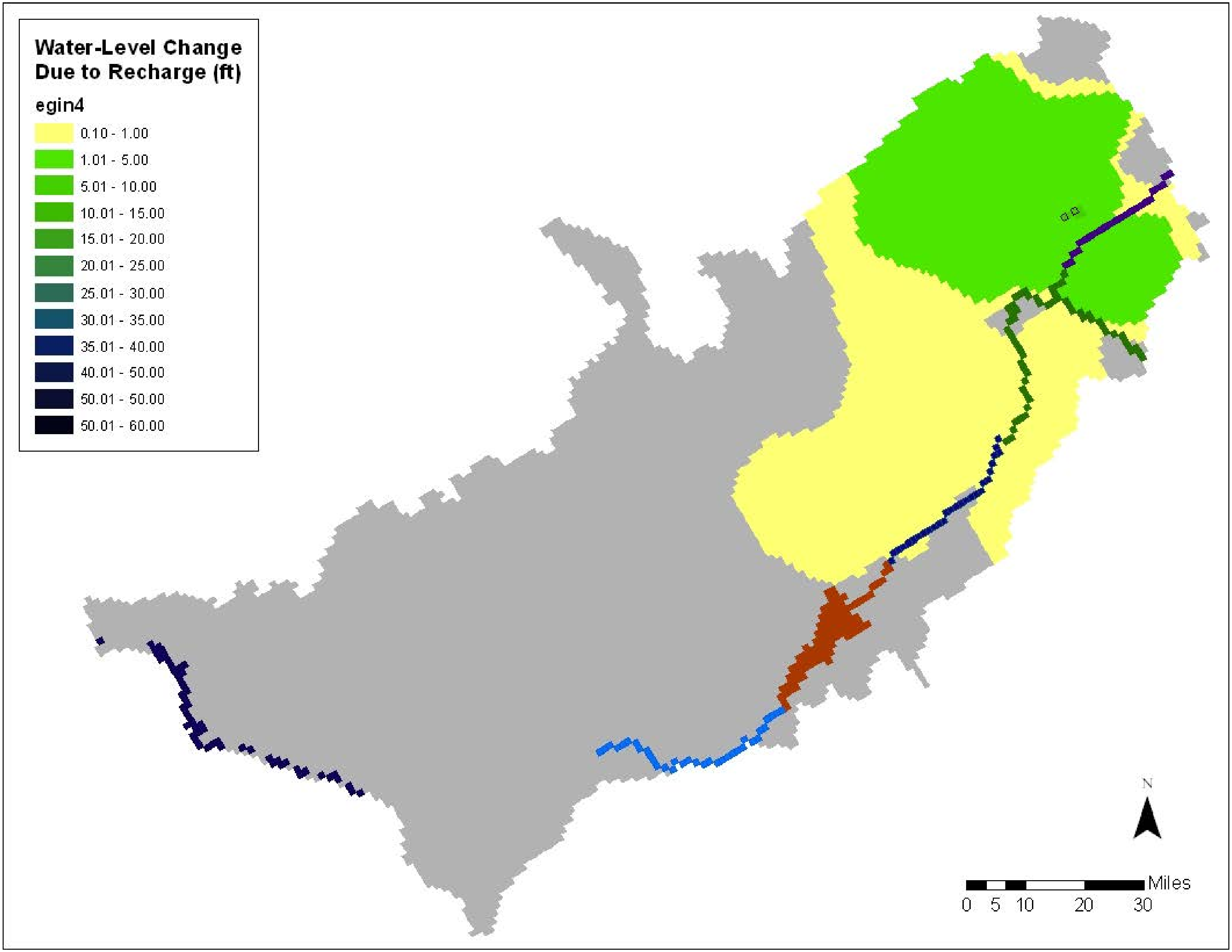
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



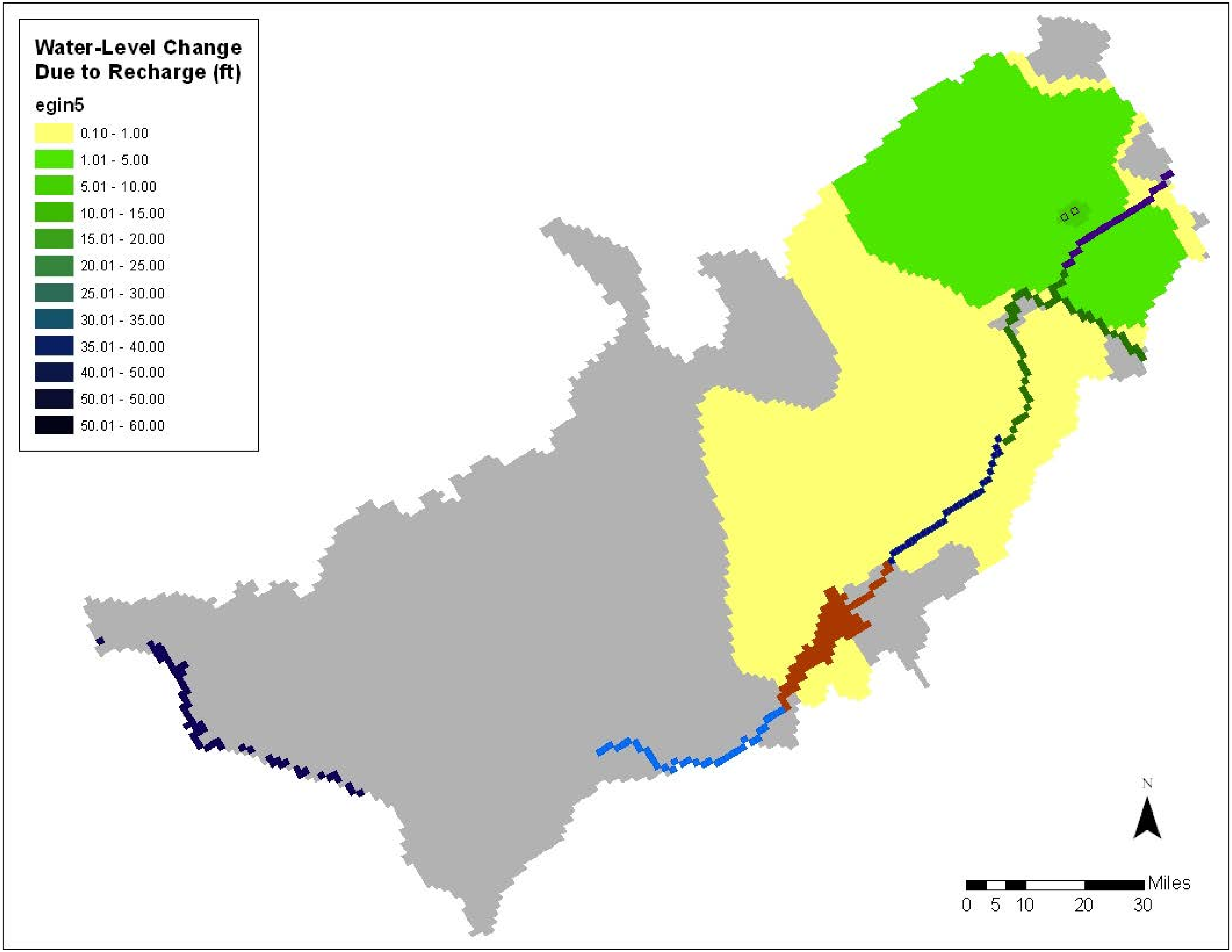
Water-Level Change
Due to Recharge (ft)
egin1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
egin2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

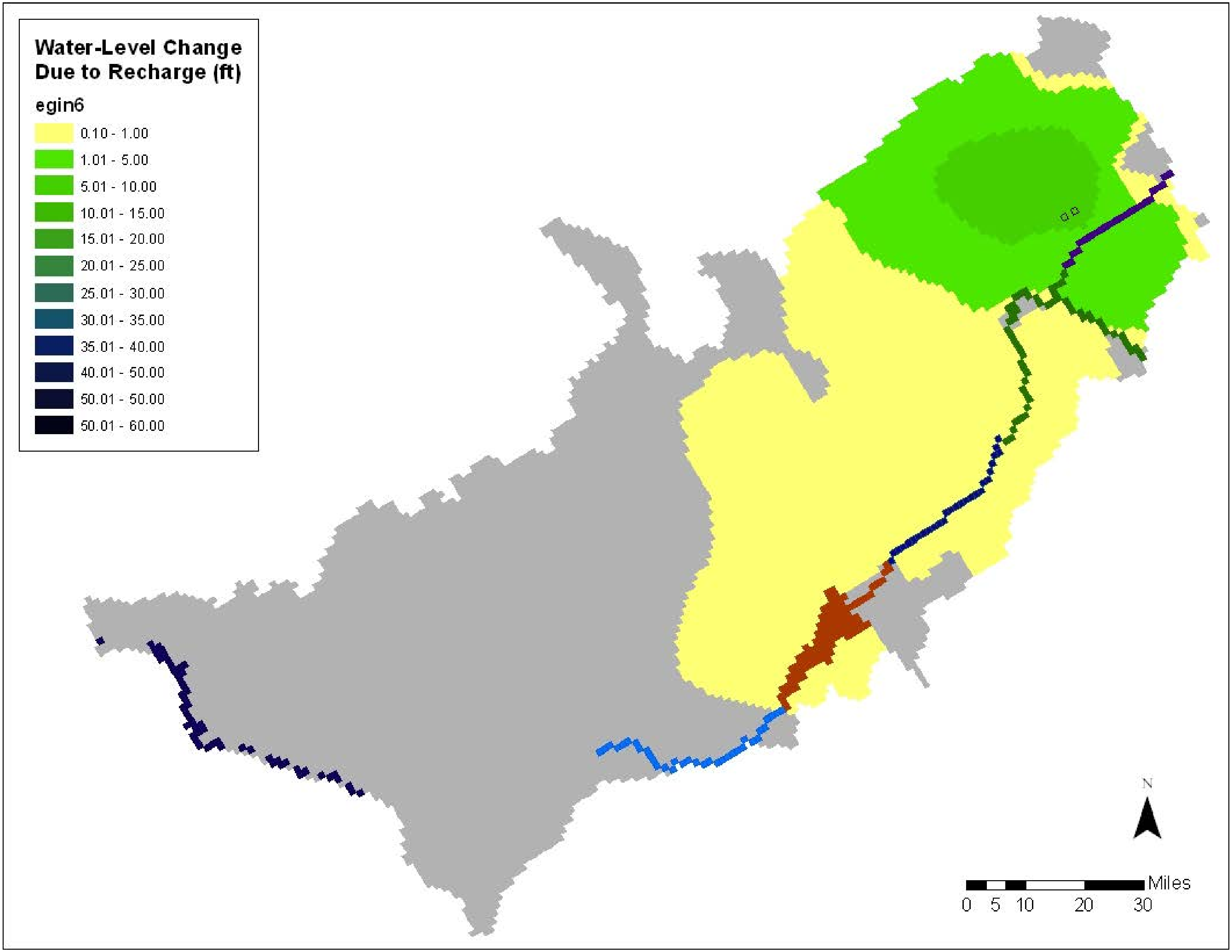

Water-Level Change
Due to Recharge (ft)
egin3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
egin4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change
Due to Recharge (ft)
egin5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



Water-Level Change Due to Recharge (ft)
egin6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
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40.01 - 50.00
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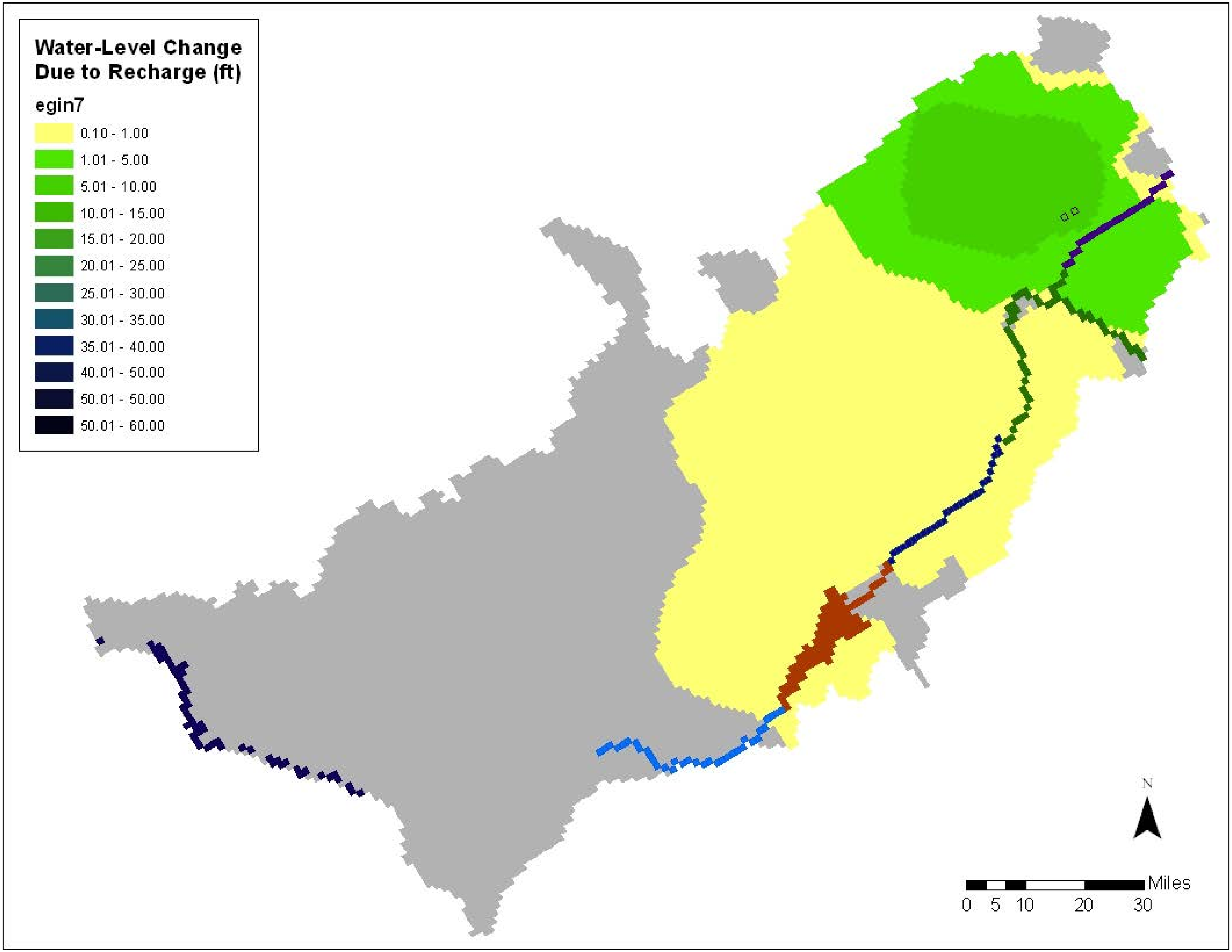
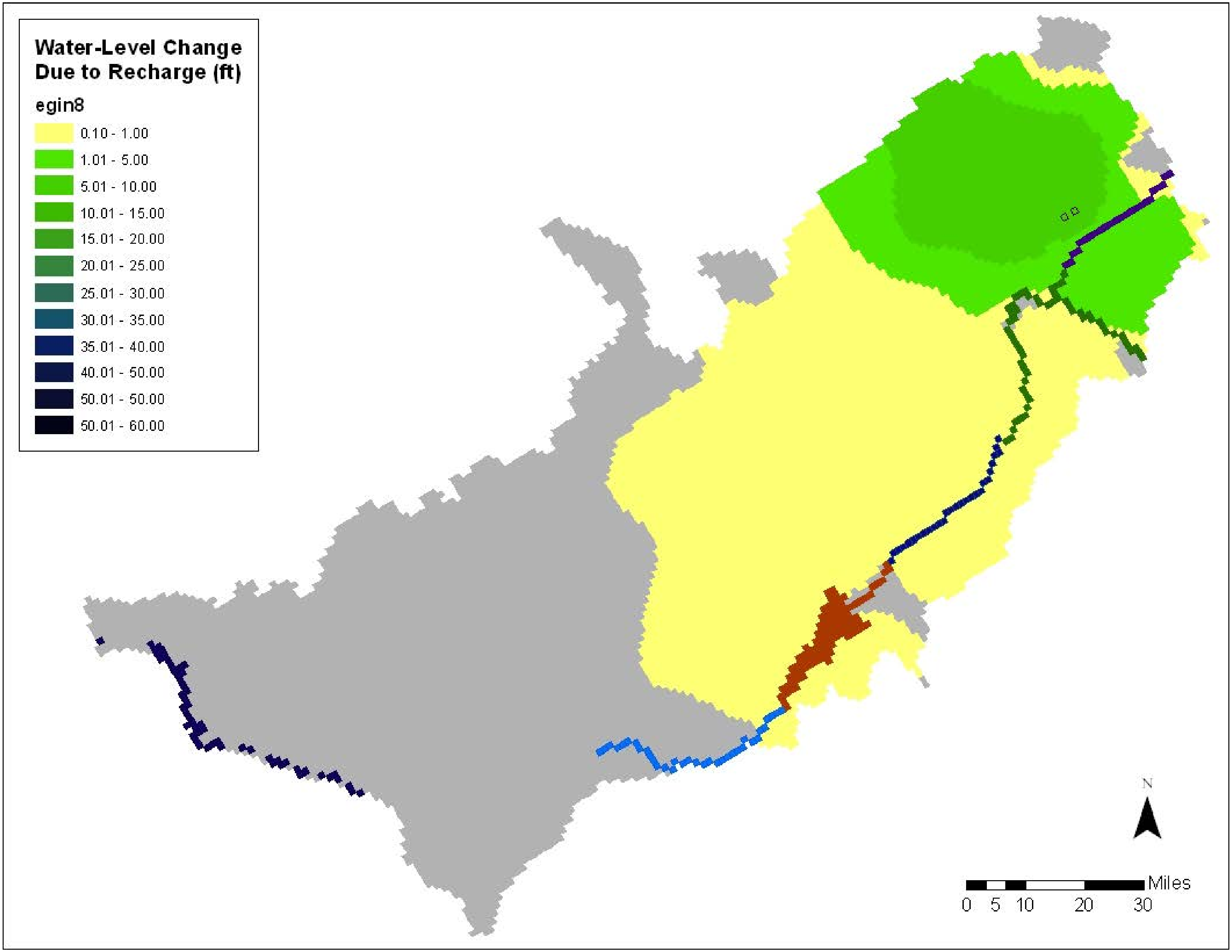
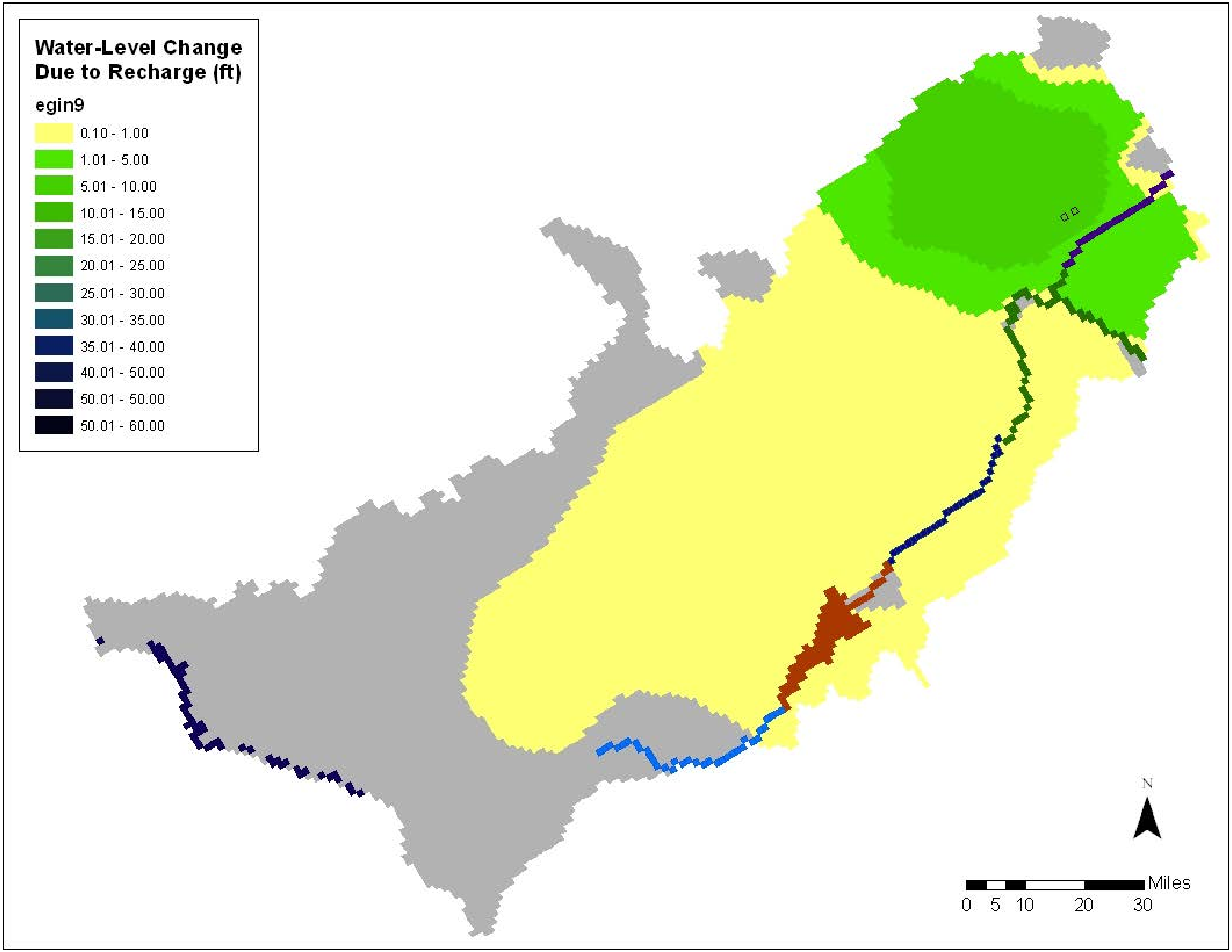
50.01 - 60.00
N
Miles
0 5 10 20 30

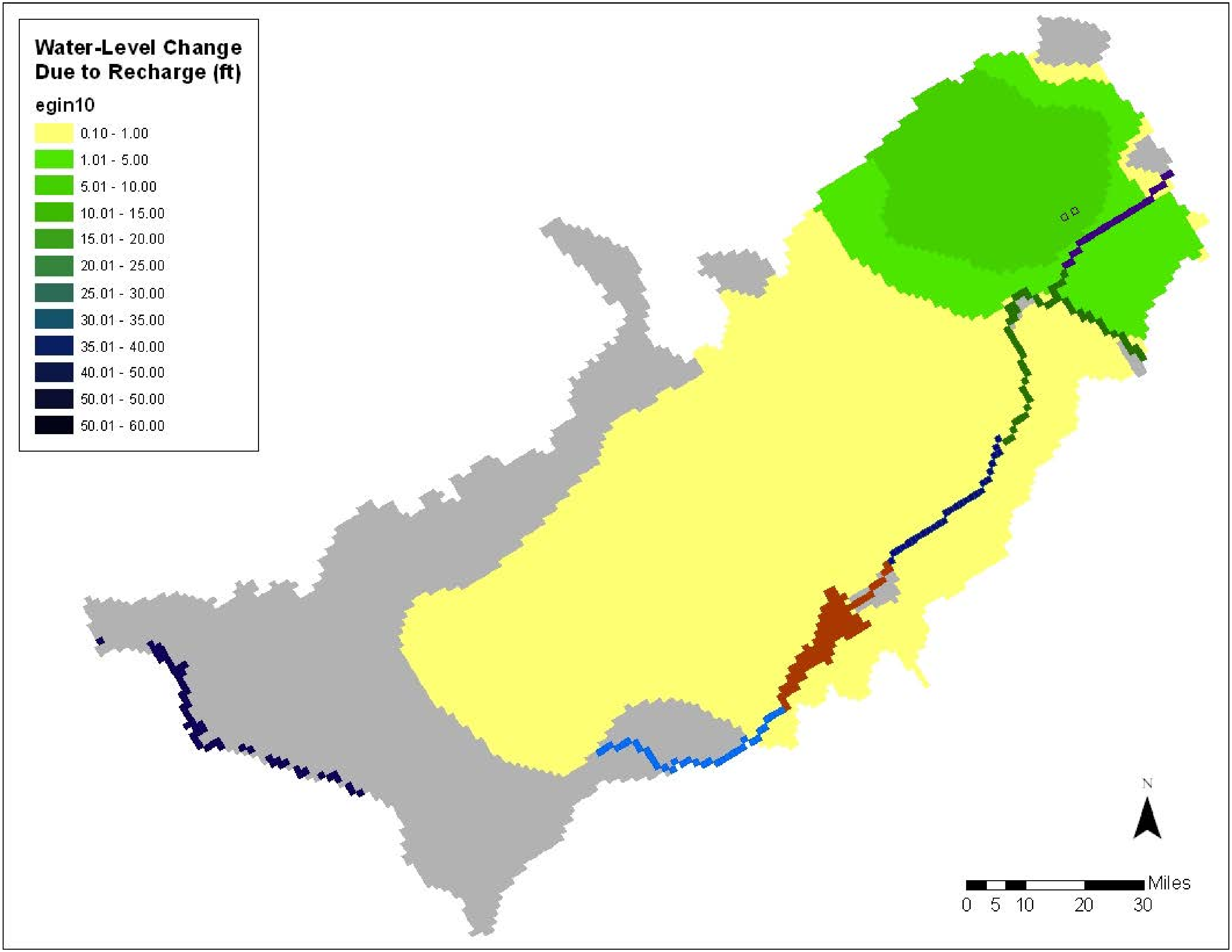

Water-Level Change
Due to Recharge (ft)
egin7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles

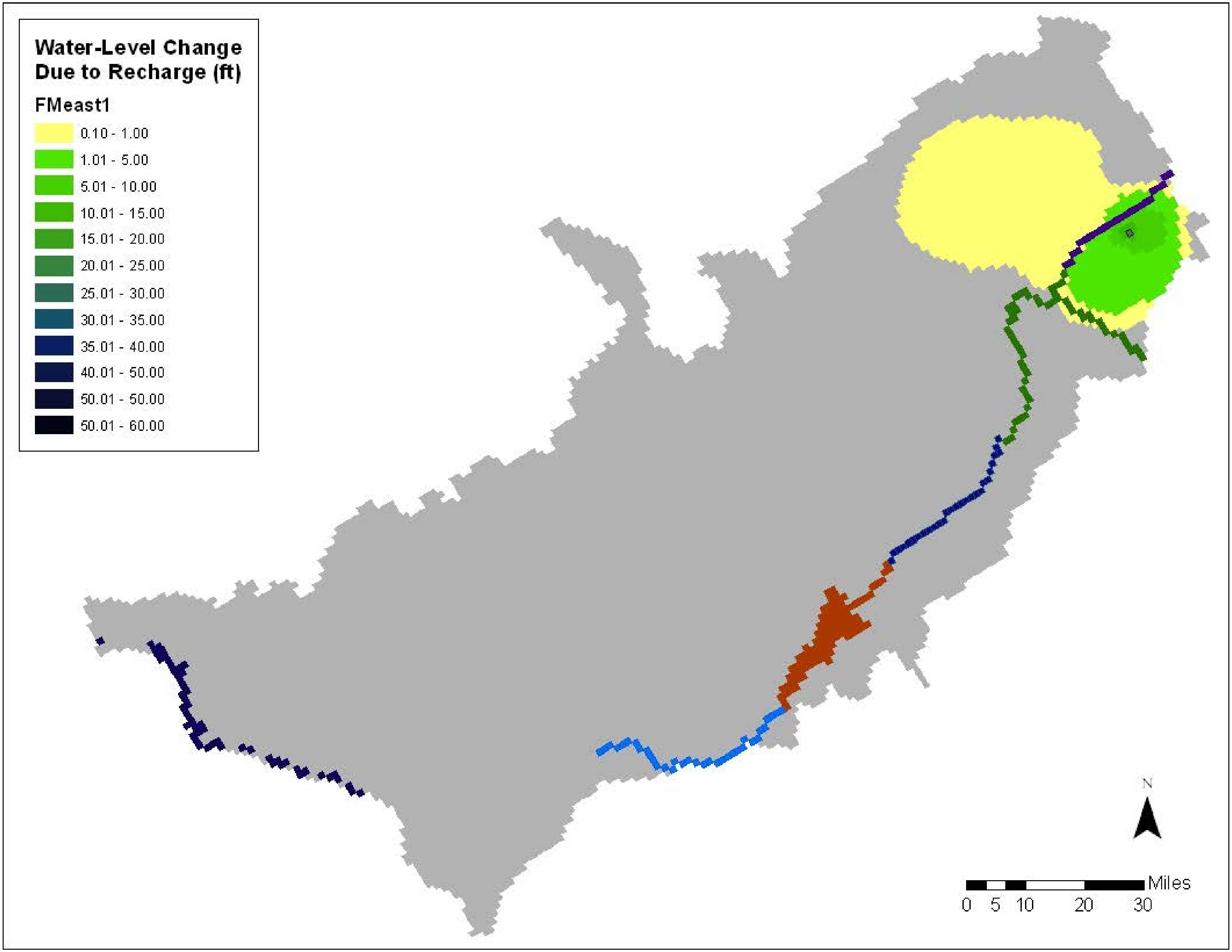


Water-Level Change
Due to Recharge (ft)
egin8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

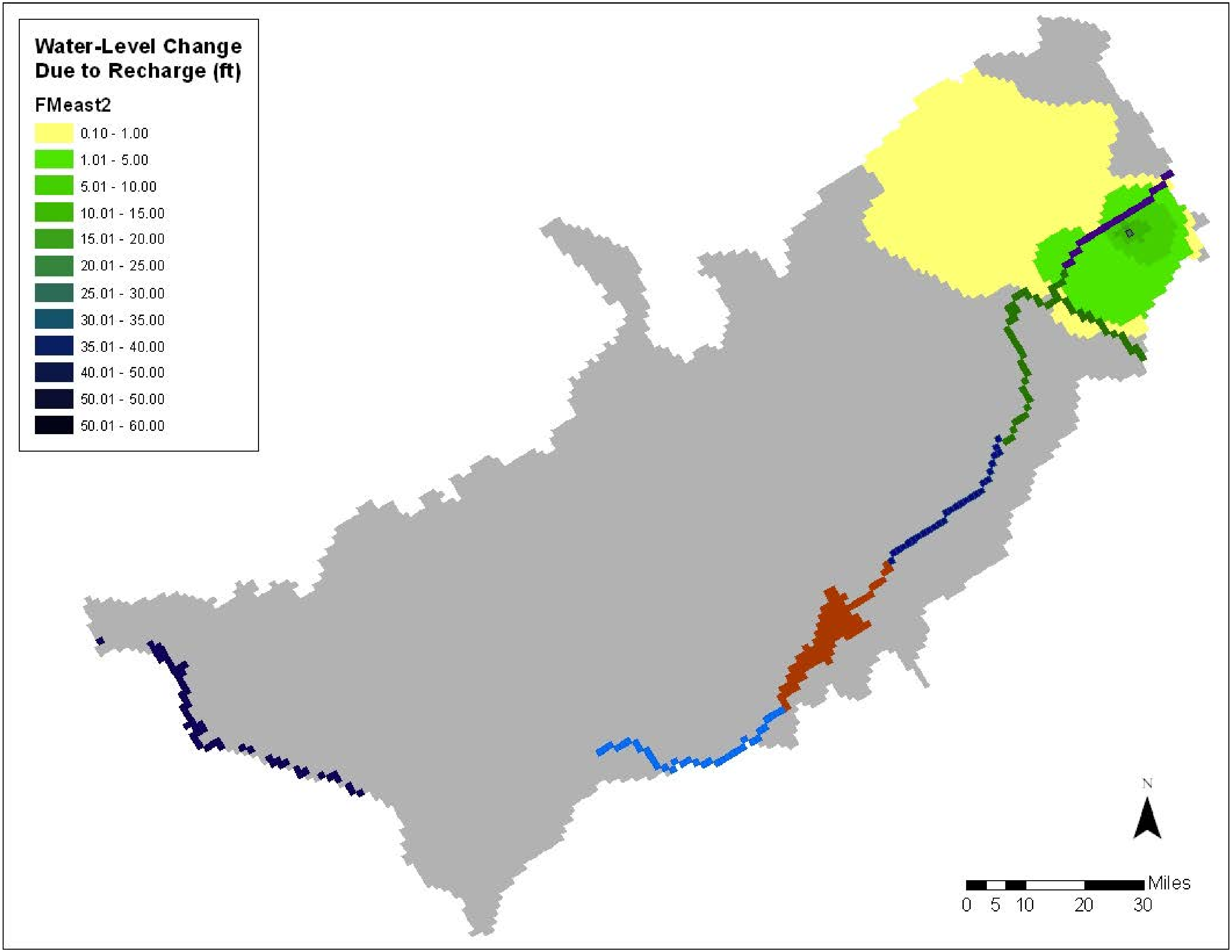


Water-Level Change
Due to Recharge (ft)
egin9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

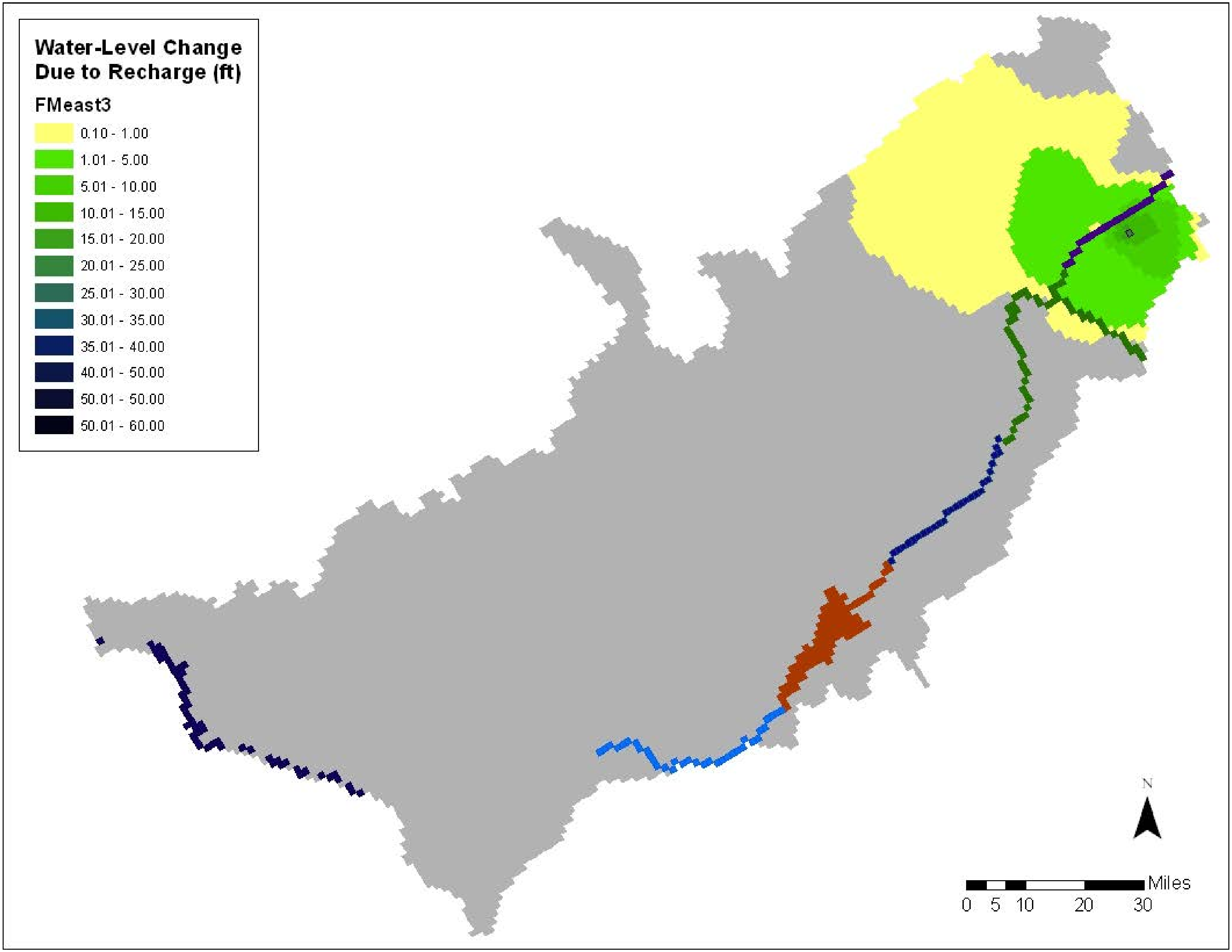

Water-Level Change
Due to Recharge (ft)
egin10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0
5
10
20
30



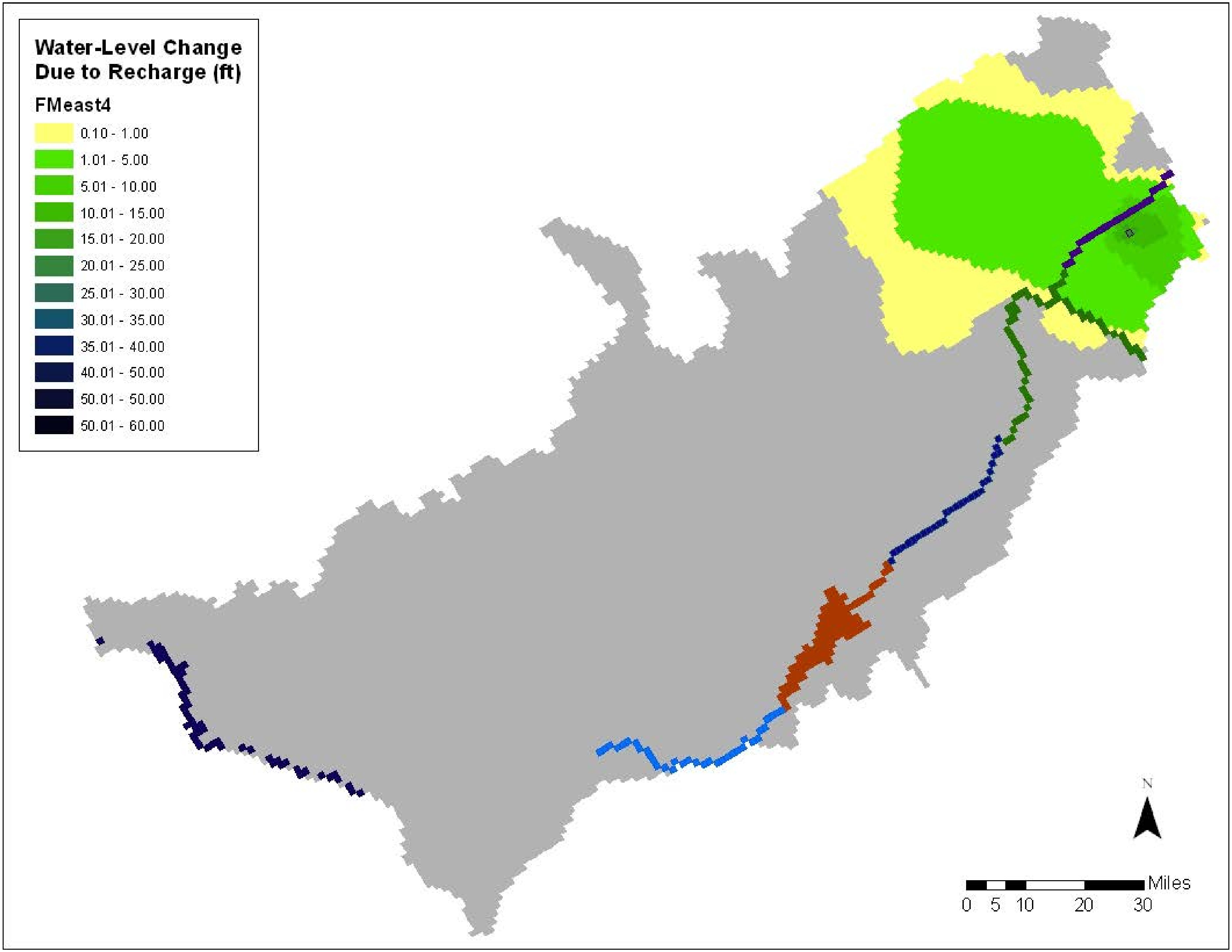
Water-Level Change Due to Recharge (ft)
FMeast1
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30



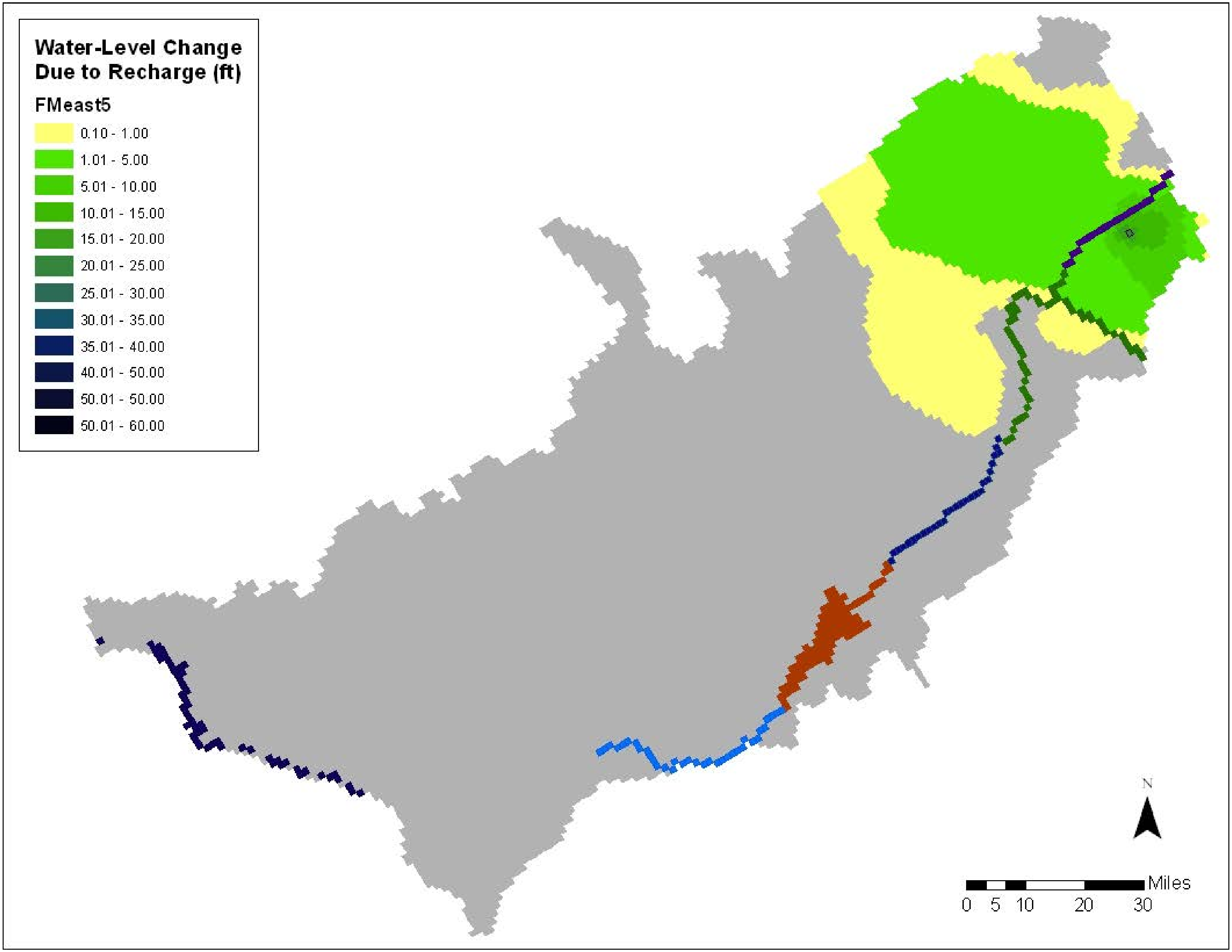
Water-Level Change
Due to Recharge (ft)
FMeast2
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0
5
10
20
30

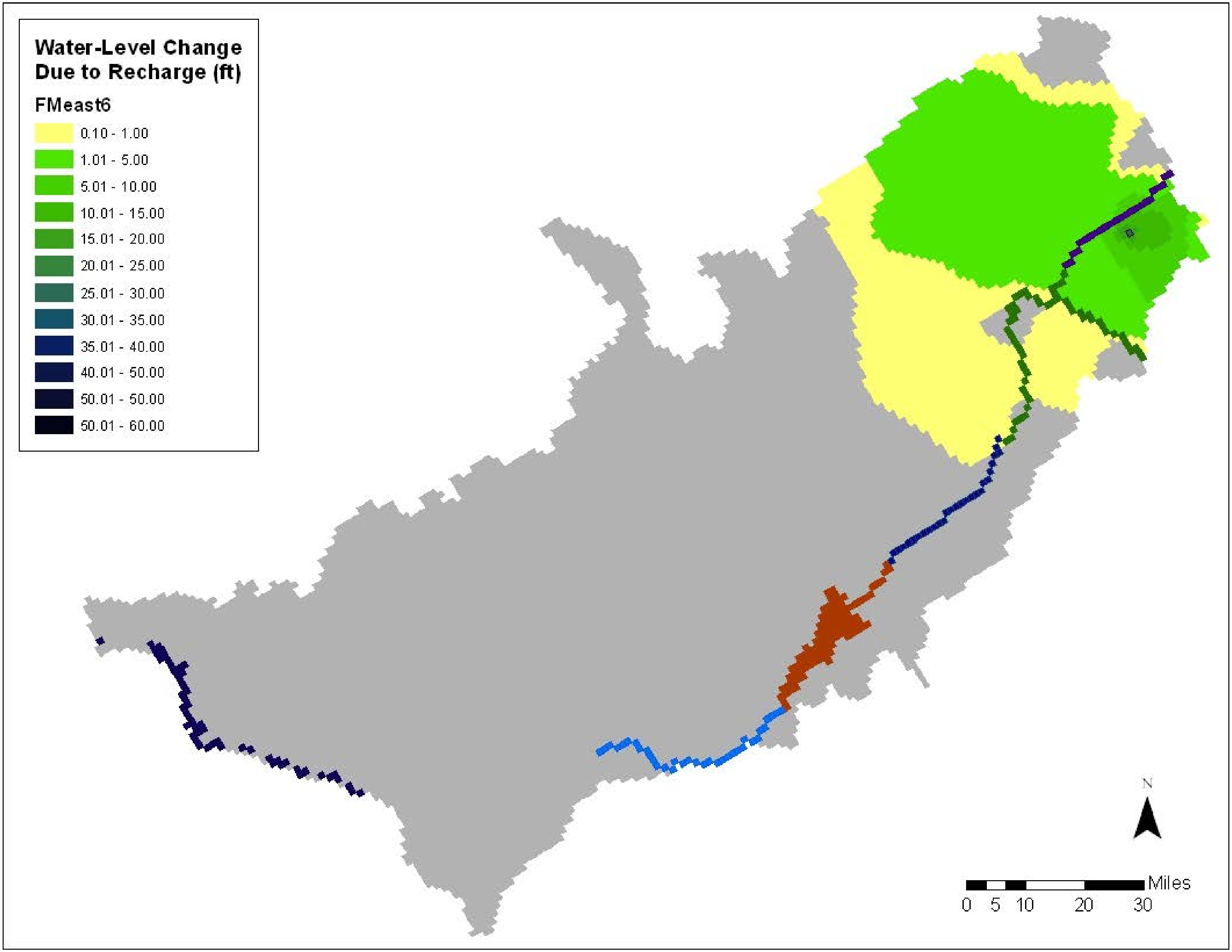


Water-Level Change Due to Recharge (ft)
FMeast3
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30 Miles

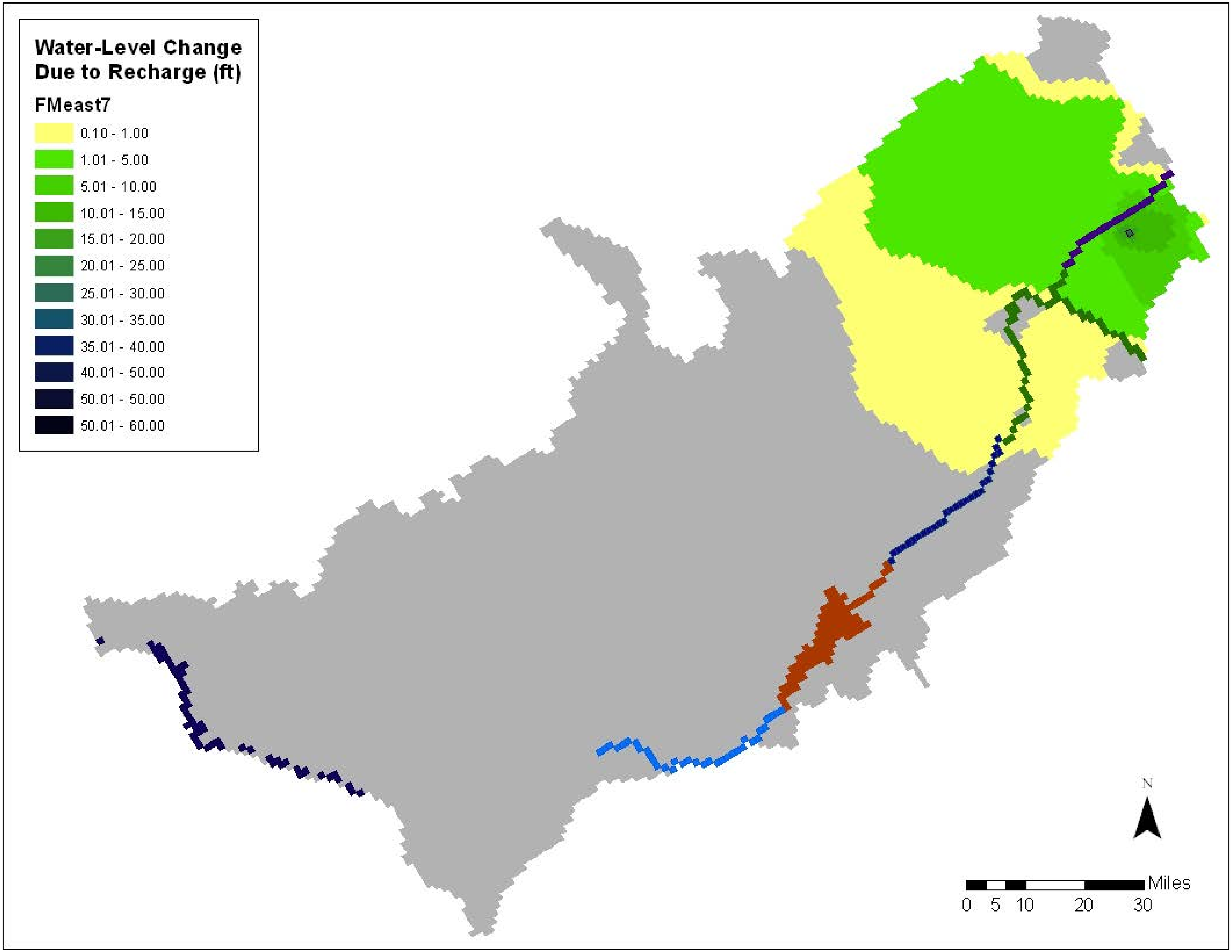


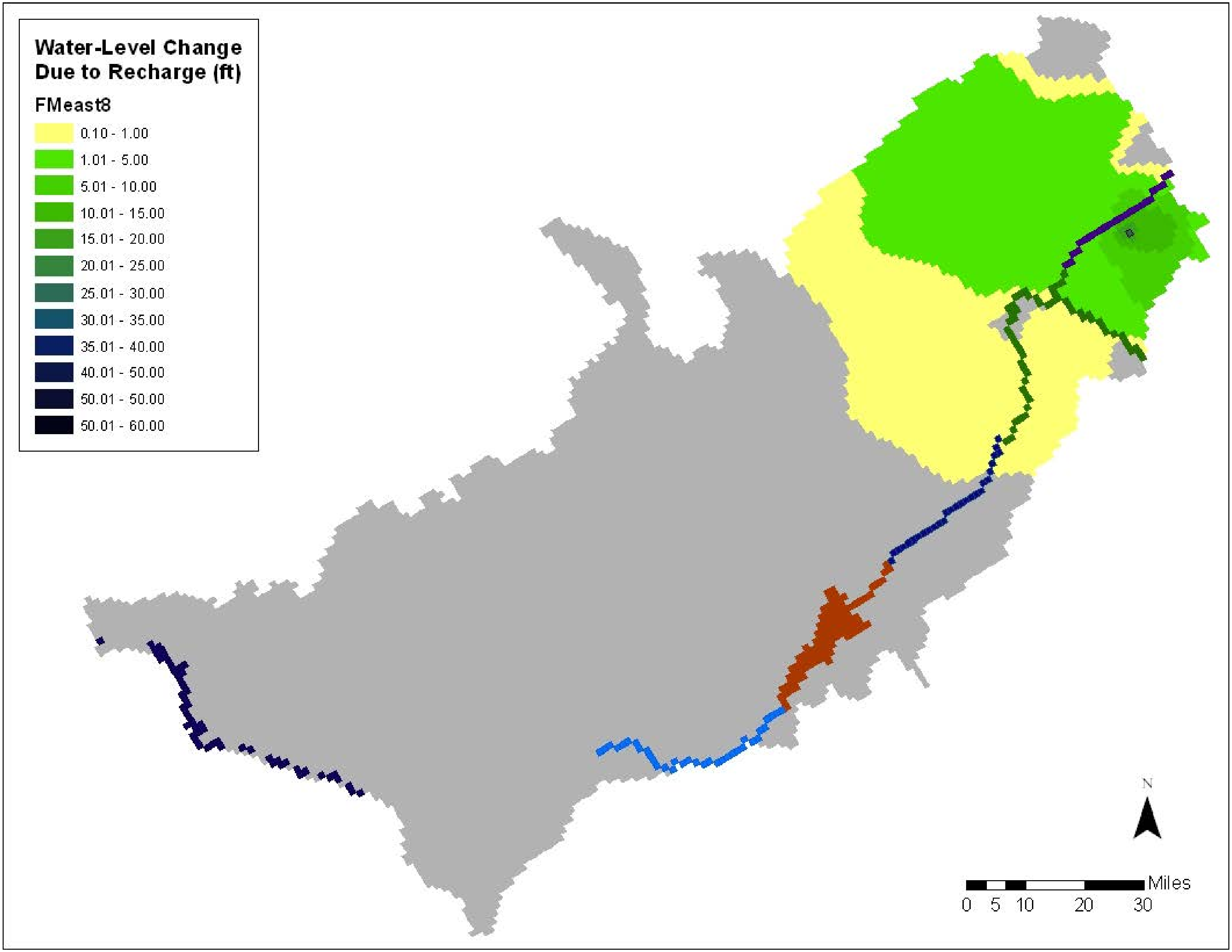
Water-Level Change Due to Recharge (ft)
FMeast4
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
0 5 10 20 30
Miles

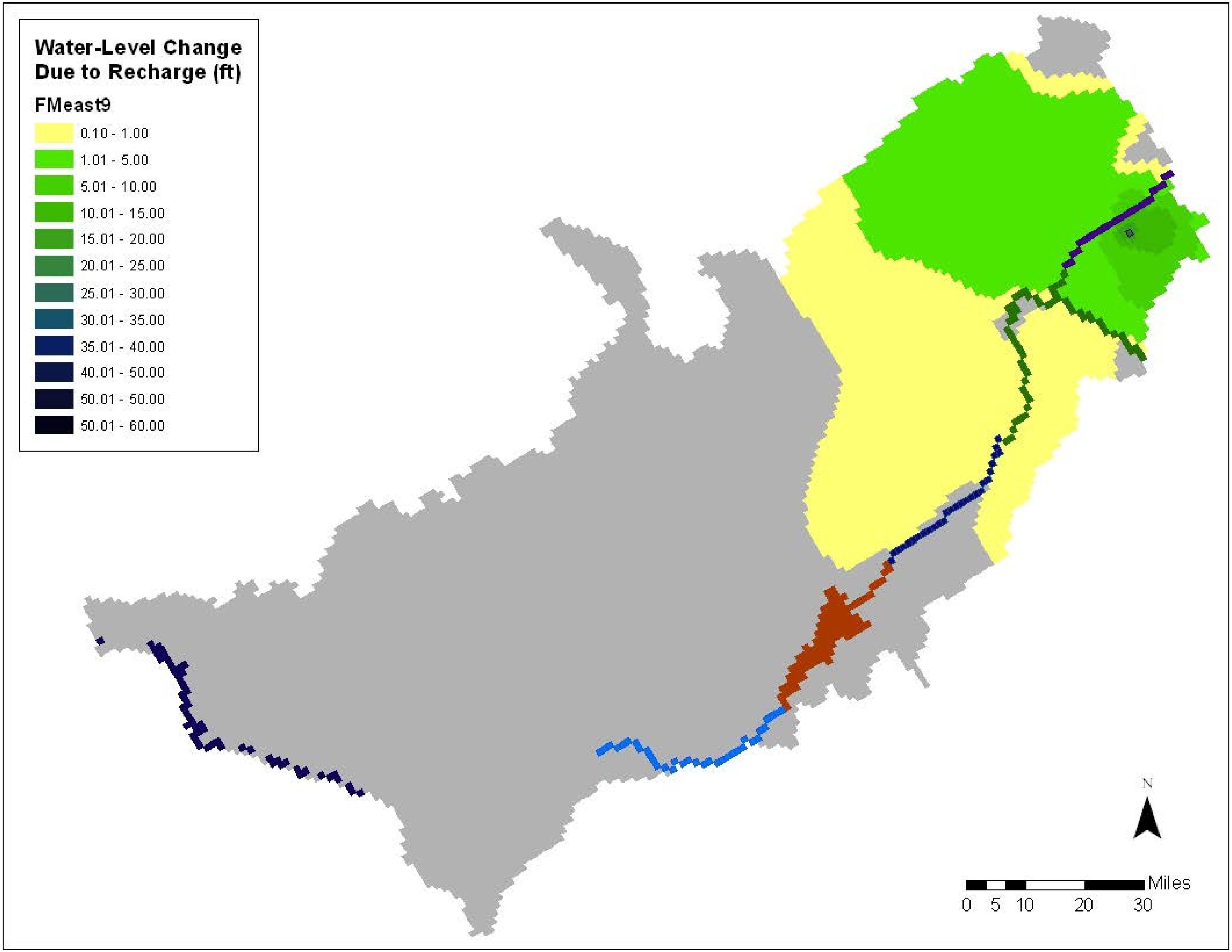

Water-Level Change
Due to Recharge (ft)
FMeast5
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

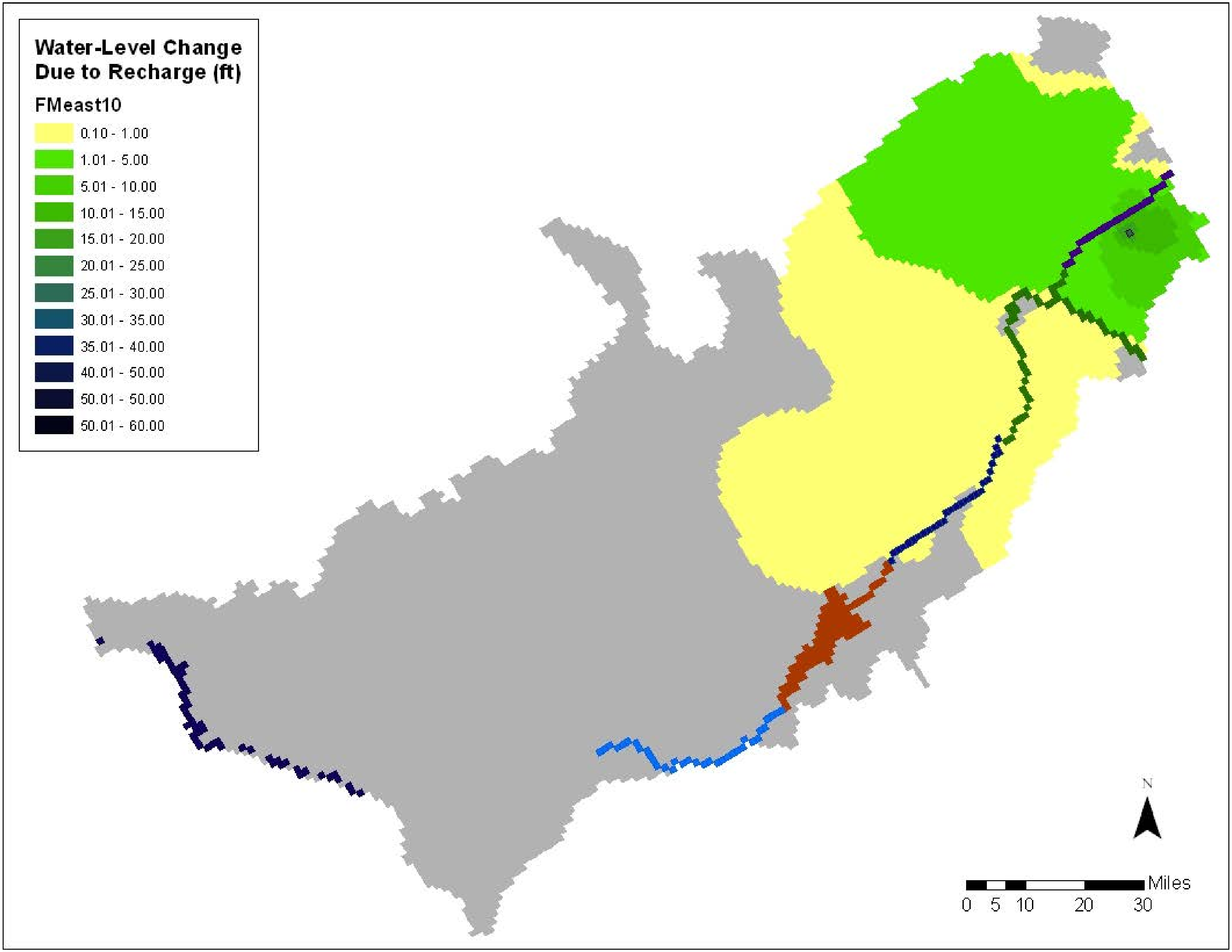


Water-Level Change
Due to Recharge (ft)
FMeast6
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
FMeast7
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change
Due to Recharge (ft)
FMeast8
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

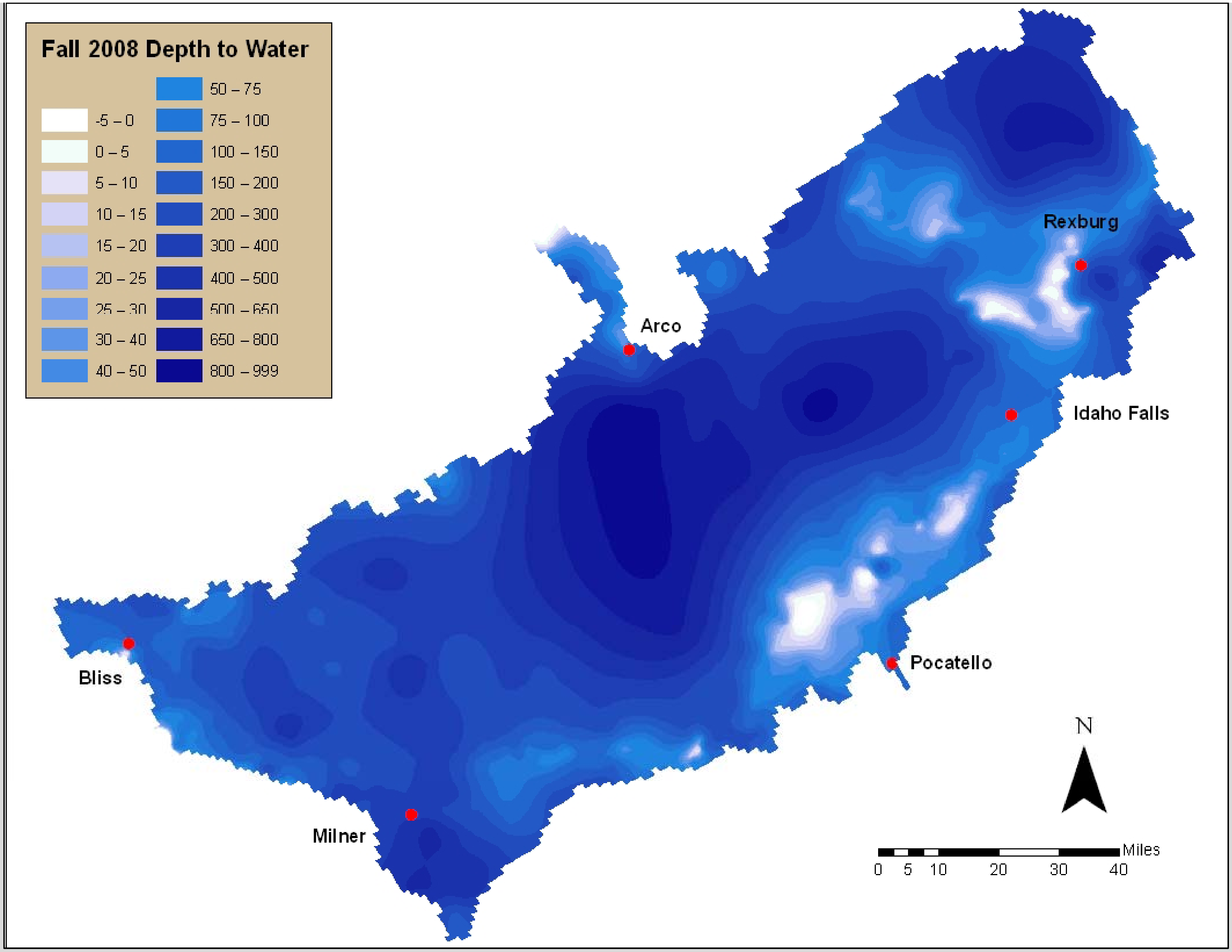

Water-Level Change
Due to Recharge (ft)
FMeast9
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30


Water-Level Change Due to Recharge (ft)
FMeast10
0.10 - 1.00
1.01 - 5.00
5.01 - 10.00
10.01 - 15.00
15.01 - 20.00
20.01 - 25.00
25.01 - 30.00
30.01 - 35.00
35.01 - 40.00
40.01 - 50.00
50.01 - 50.00
50.01 - 60.00
N
Miles
0 5 10 20 30

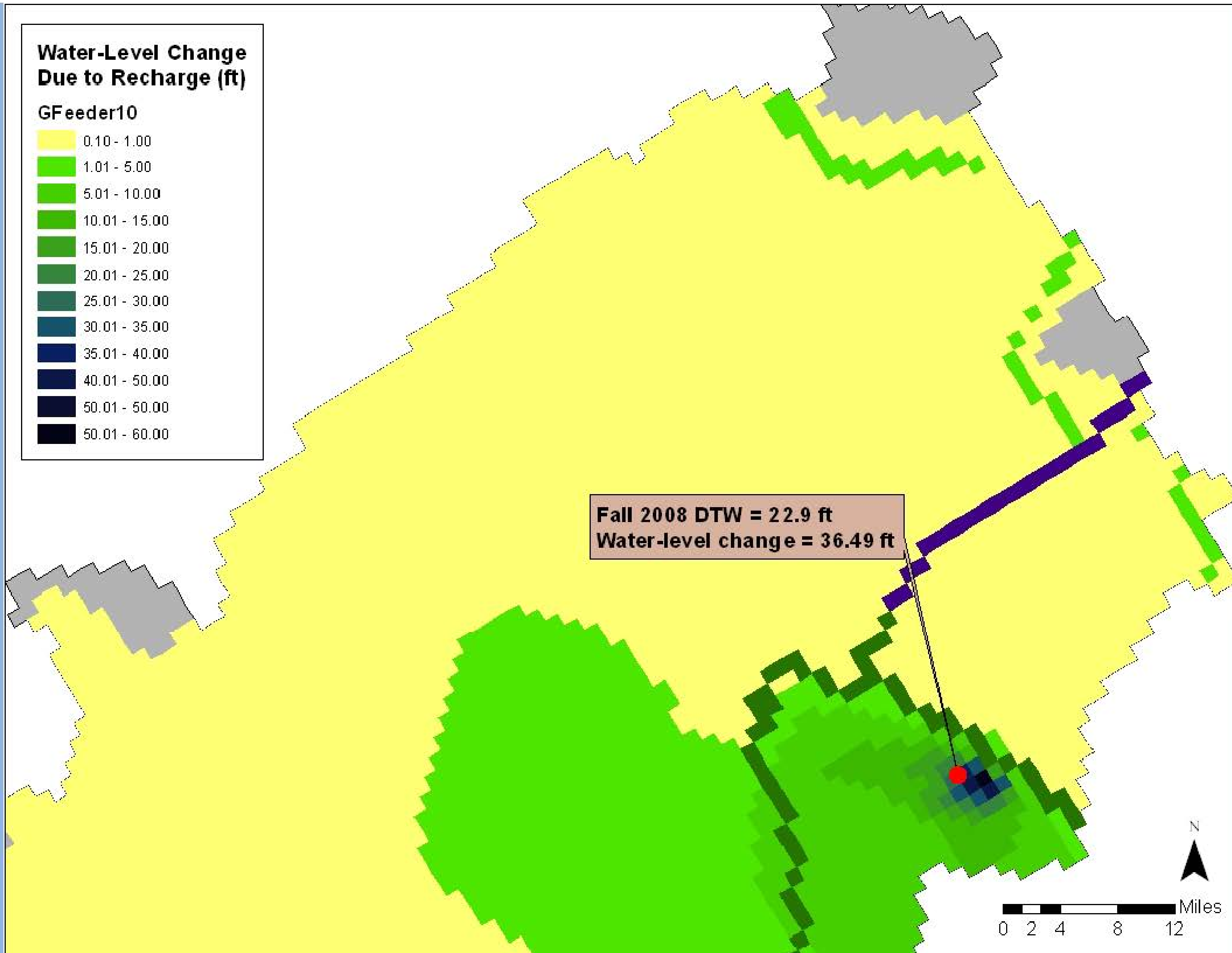
Value of Modeling Continuous 100,000 AF/yr Recharge at Individual locations

•Good way to *illustrate* the effects of Managed Recharge. The large, constant stress allows us to visualize how the aquifer responds to recharge.

•May be misleading as to the ability of a location to ***divert* and *accept*** recharge. Model can predict favorable Aquifer Storage benefits at locations that do not have the physical capacity to place large amounts of recharge into aquifer storage.



Observation: Several locations exhibit shallow groundwater that may make Managed Recharge less effective than modeled results.



Example of a location where the model predicts water-level changes above land surface.

Is the ESPAM2.1 Predicting Geysers?

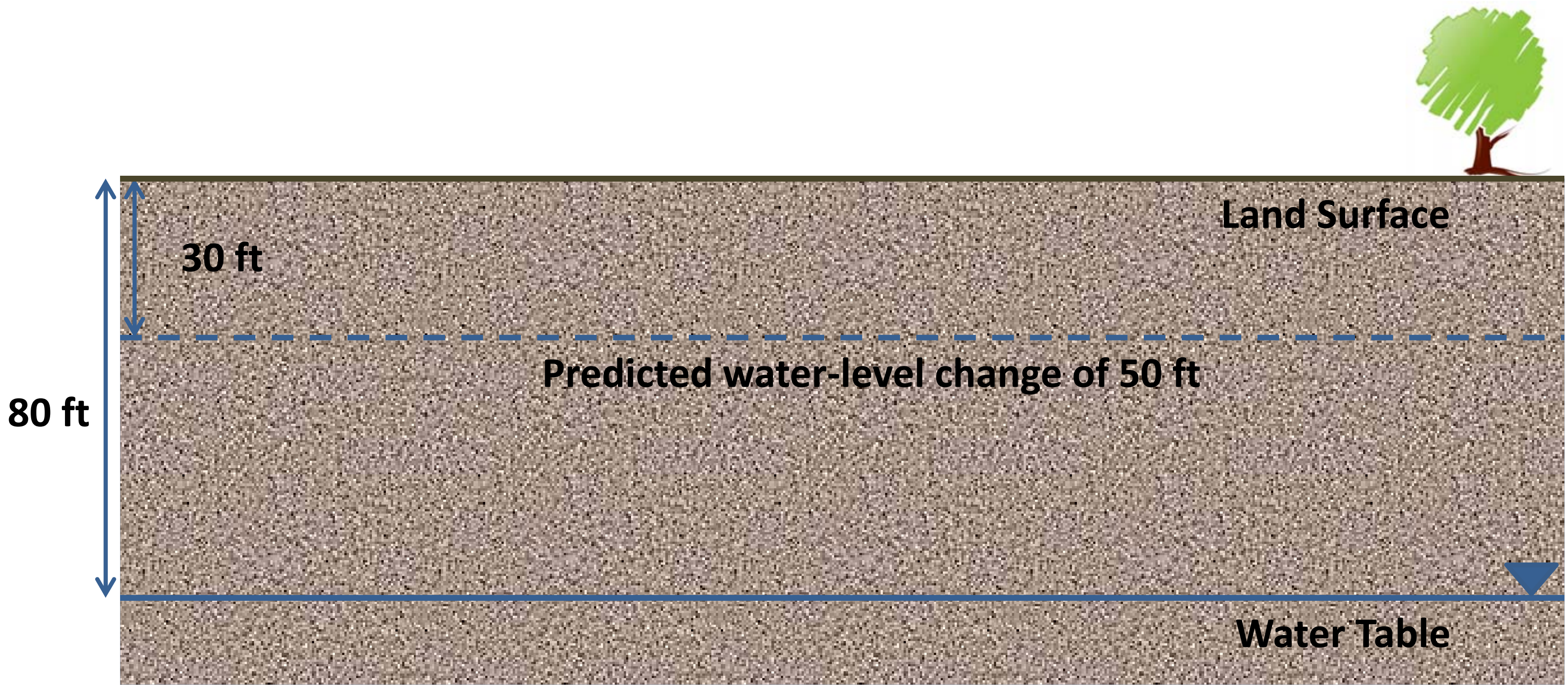
No. The model has not been given any information about land surface.
We must remember we are the brain, the model is the tool.

In the areas where the model predicts water-level changes that are
at or above land surface, it is important to remember the model is not wrong.

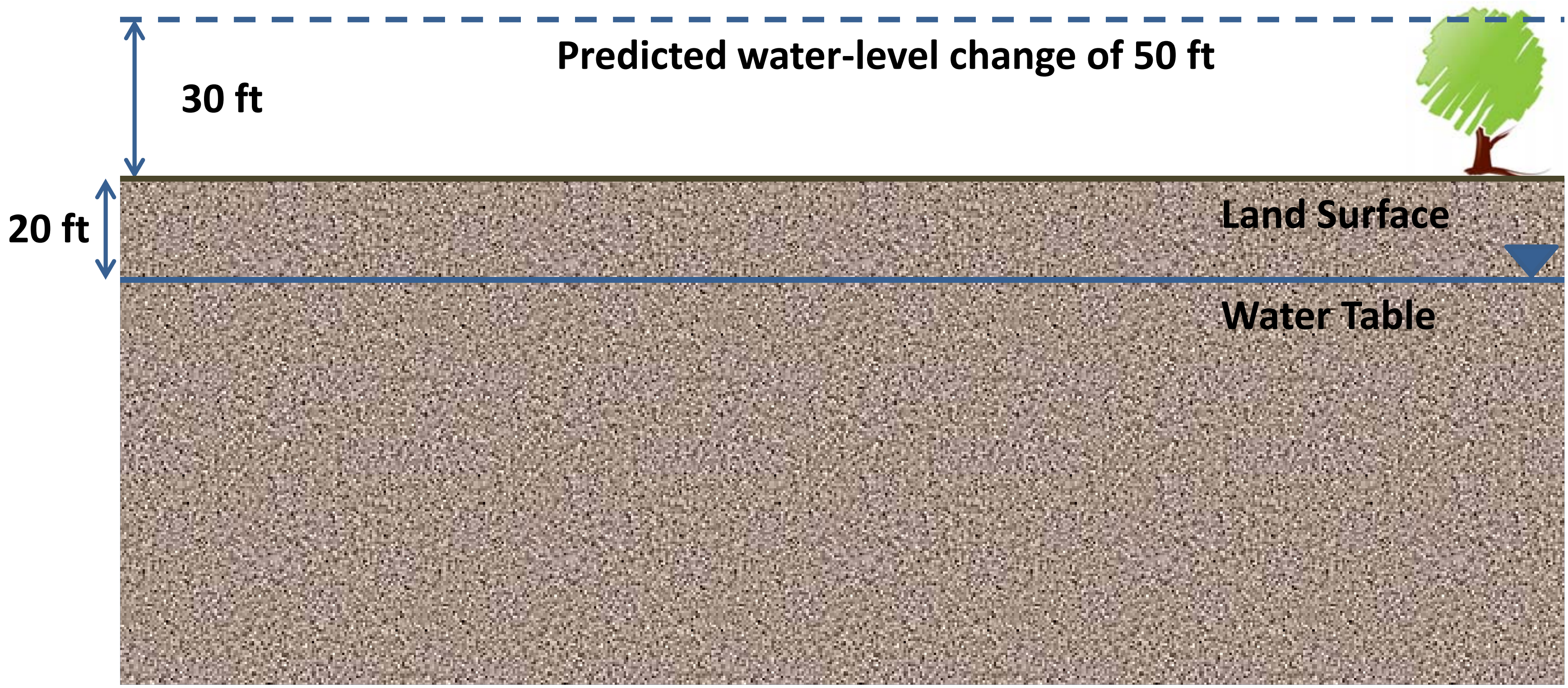
The model is telling us something. That something is **Recharge Capacity.**

50 ft water-level change at 100,000 AF/yr Recharge

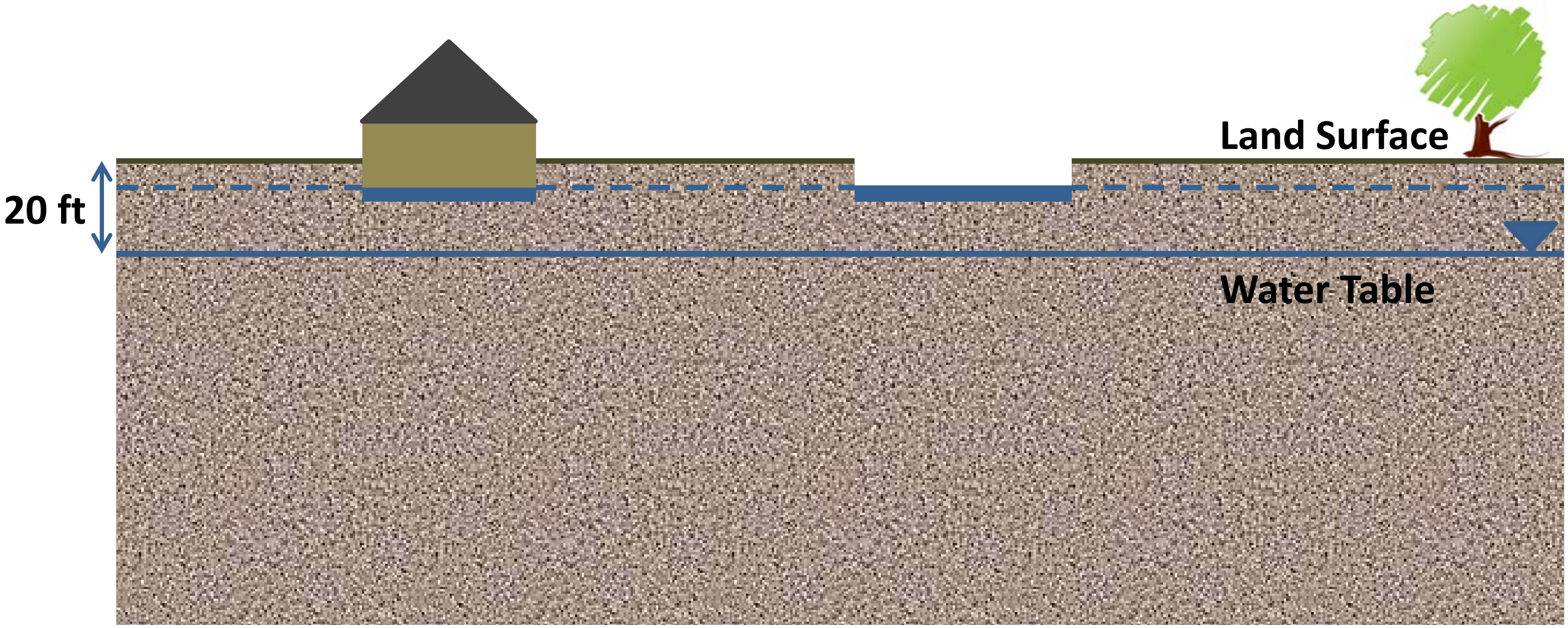
Recharge Capacity ≈ 100,000+ AF/yr



50 ft water-level change at 100,000 AF/yr Recharge
20 ft water-level change at 40,000 AF/yr Recharge
Recharge Capacity ≈ 40,000- AF/yr

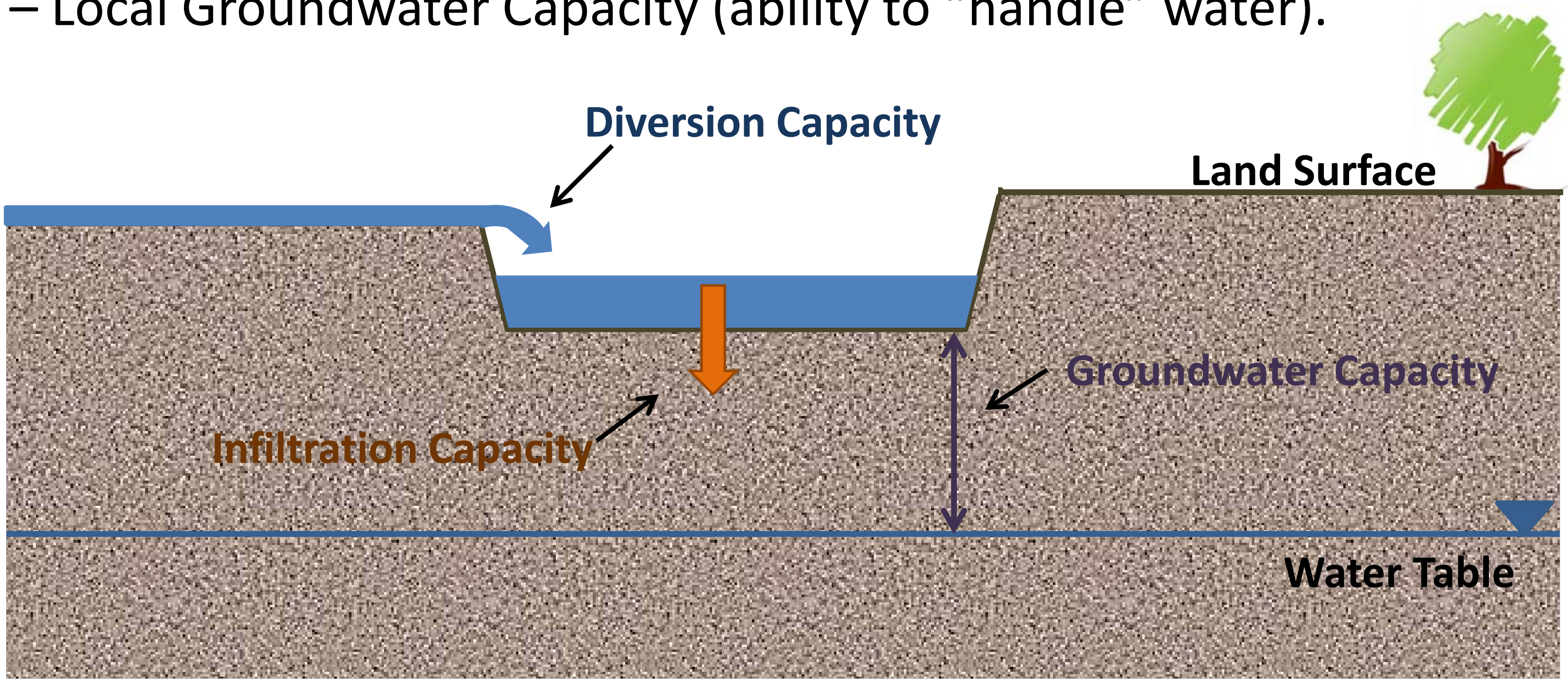


In determining if there is "enough room" for recharge, we must also consider factors like drains and basements, time of year, and location characteristics. Furthermore, depth-to-water is only one factor in determining Recharge Capacity.



Recharge Capacity Factors

- Recharge Capacity involves several factors.
  - Location Diversion Capacity (ability to get water).
  - Location Infiltration Capacity (ability to accept water).
  - Local Groundwater Capacity (ability to “handle” water).



Assessment of location Diversion Capacity

Diversion Capacity

Location	Diversion Capacity (AF/month)	Comments
Aberdeen	10,900	Based on historic recharge diversions.
Egin	15,300	Based on historic recharge diversions.
FMeast	10,900	Based on historic recharge diversions.
GFeeder	200,000+	Based on Dry Bed nr Ririe flows.
Hilton	7,700	Based on historic recharge diversions.
Idaho	1,000	Based on historic recharge diversions.
JensenGrv	1,800	Based on water-right exam diversion data.
MilGood	46,500	Based on historic recharge diversions and MP31 design.
Minidoka	6,100	Based on proposed capacity of recharge location.
MP31	18,400	Based on proposed capacity of recharge location.
Northside	30,700	Based on estimated 500 cfs diversion capacity.
Nsweden	3,200	Based on historic recharge diversions.
Shoshone	19,900	Based on historic recharge diversions.
Southwest	3,600	Based on historic recharge diversions.

Assessment of Infiltration Capacity

Infiltration Capacity		
Location	Infiltration Cap (AF/month)	Source
Aberdeen	6,600	Calibrated ESPAM2.1 canal seepage rate.
Egin	2,200	Published data from 2009 IWRRI recharge report.
FMeast	6,500	Calibrated ESPAM2.1 canal seepage rate.
GFeeder	5,600	Calibrated ESPAM2.1 canal seepage rate (14,800 AF historic recharge diversions).
Hilton	7,600	Published data from 1996 IWRRI recharge report.
Idaho	300	Calibrated ESPAM2.1 canal seepage rate.
JensenGrv	165	Based on water-right exam data.
MilGood	8,200	Discussions with canal company manager.
Minidoka	6,100	Assumed from design, injected.
MP31	24,200	Discussions with canal company manager.
Northside	22,200	Published data from 1996 IWRRI recharge report.
Nsweden	1,600	Calibrated ESPAM2.1 canal seepage rate plus recharge pond infiltration data.
Shoshone	21,200	Discussions with canal company manager.
Southwest	3,600	Assumed from diversion, injected.

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Water Resource Board

Assessment of Groundwater Conditions

- Groundwater conditions vary by season, and are based on the depth-to-water.
- Recharging in areas of deep groundwater means there is "enough room" to accept the recharge.
- Recharging in areas of shallow groundwater results in water **not going into aquifer storage**. In areas of shallow groundwater, recharge water is likely:
  - **AT RISK** of causing or exacerbating problems.
    - Water in basements, water in sewer system, foundations, etc.
  - **AT RISK** of being wasted (effort and money).
    - Cycling recharge directly into drains, into returns, into places where attempts to dewater are already occurring.

Using ESPAM2.1 to Assess Groundwater Conditions

- Based on depth-to-water from the 2008 Spring and Fall Synoptic water levels.
- Used ESPAM2.1 to monitor water-level changes relative to land surface (with a 15-foot buffer).
- Groundwater capacity reached when 5% of recharge enters the buffer area.

Recharge Limits due to Shallow Groundwater Conditions

SPRING Recharge Limit

Location	GW Recharge Capacity
Aberdeen	2,300
Egin	5,000
FMeast	17,000
GFeeder	20,000 +
Hilton	3,200
Idaho	8,500
JensenGrv	20,000+
MilGood	20,000 +
Minidoka	20,000 +
MP31	20,000 +
Northside	20,000 +
Nsweden	20,000 +
Shoshone	20,000 +
Southwest	20,000 +

FALL Recharge Limit

Location	GW Recharge Capacity
Aberdeen	< 100
Egin	3,800
FMeast	12,300
GFeeder	< 100
Hilton	2,800
Idaho	< 100
JensenGrv	7,500
MilGood	20,000 +
Minidoka	20,000 +
MP31	20,000 +
Northside	20,000 +
Nsweden	3,800
Shoshone	20,000 +
Southwest	20,000 +

Physical Limitations to Recharge

The highlighted cells illustrate the physical limitation to Recharge at each location.

Note: Some locations not listed.

SPRING Physical Limitations to Recharge

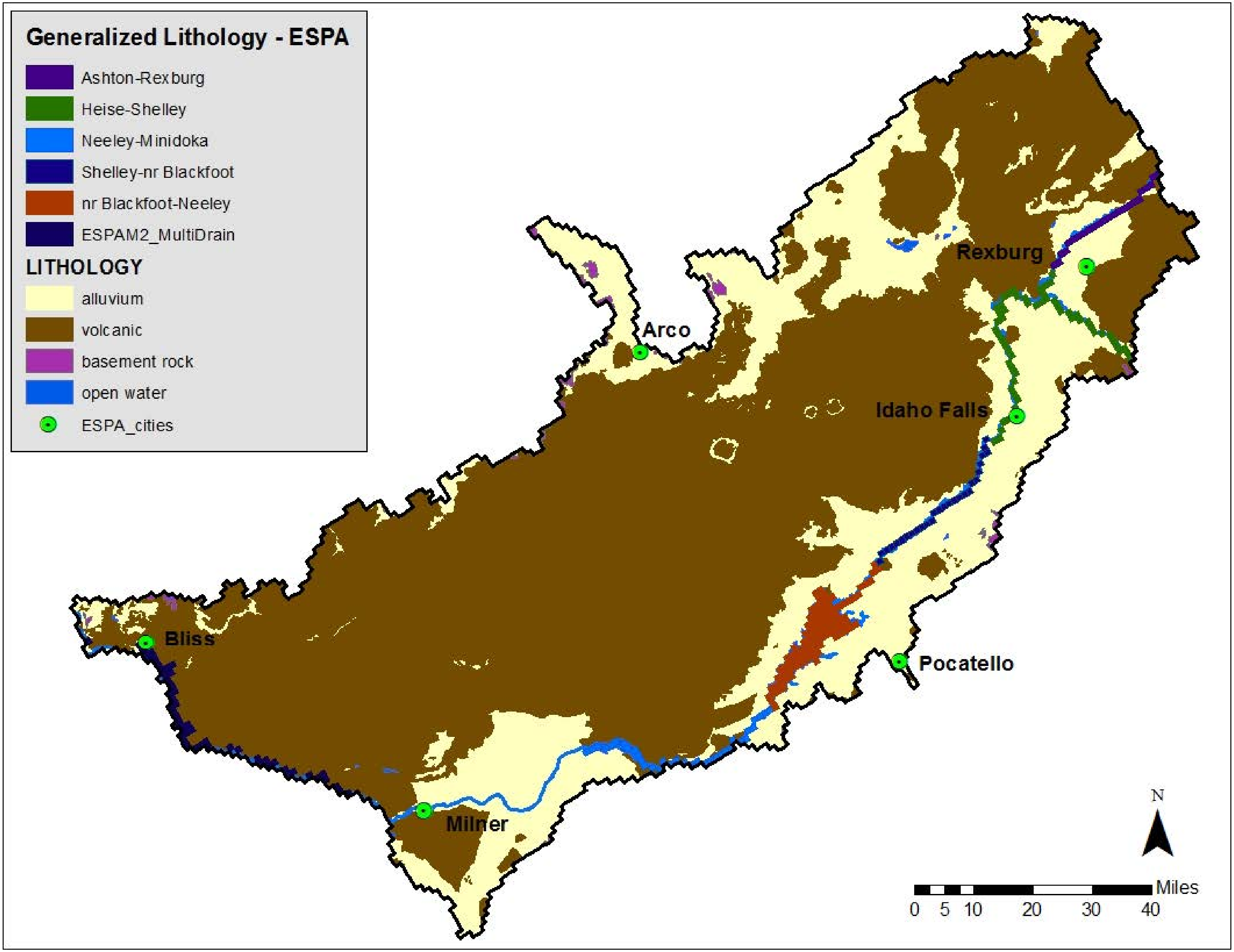
Location	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	200,000	5,600	20,000
Hilton	7,700	7,600	3,200
Idaho	1,000	300	8,500
JensenGrv	1,800	165	20,000
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

FALL Physical Limitations to Recharge

Location	Diversion Capacity	Infiltration Capacity	GW Capacity
Aberdeen	10,900	6,600	100
Egin	15,300	2,200	3,800
FMeast	10,900	6,500	12,300
Gfeeder	200,000	5,600	100
Hilton	7,700	7,600	2,800
Idaho	1,000	300	100
JensenGrv	1,800	165	7,500
MilGood	46,500	8,200	20,000
Minidoka	6,100	6,100	20,000
MP31	18,400	24,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	3,800
Shoshone	19,900	21,200	20,000
Southwest	3,600	3,600	20,000

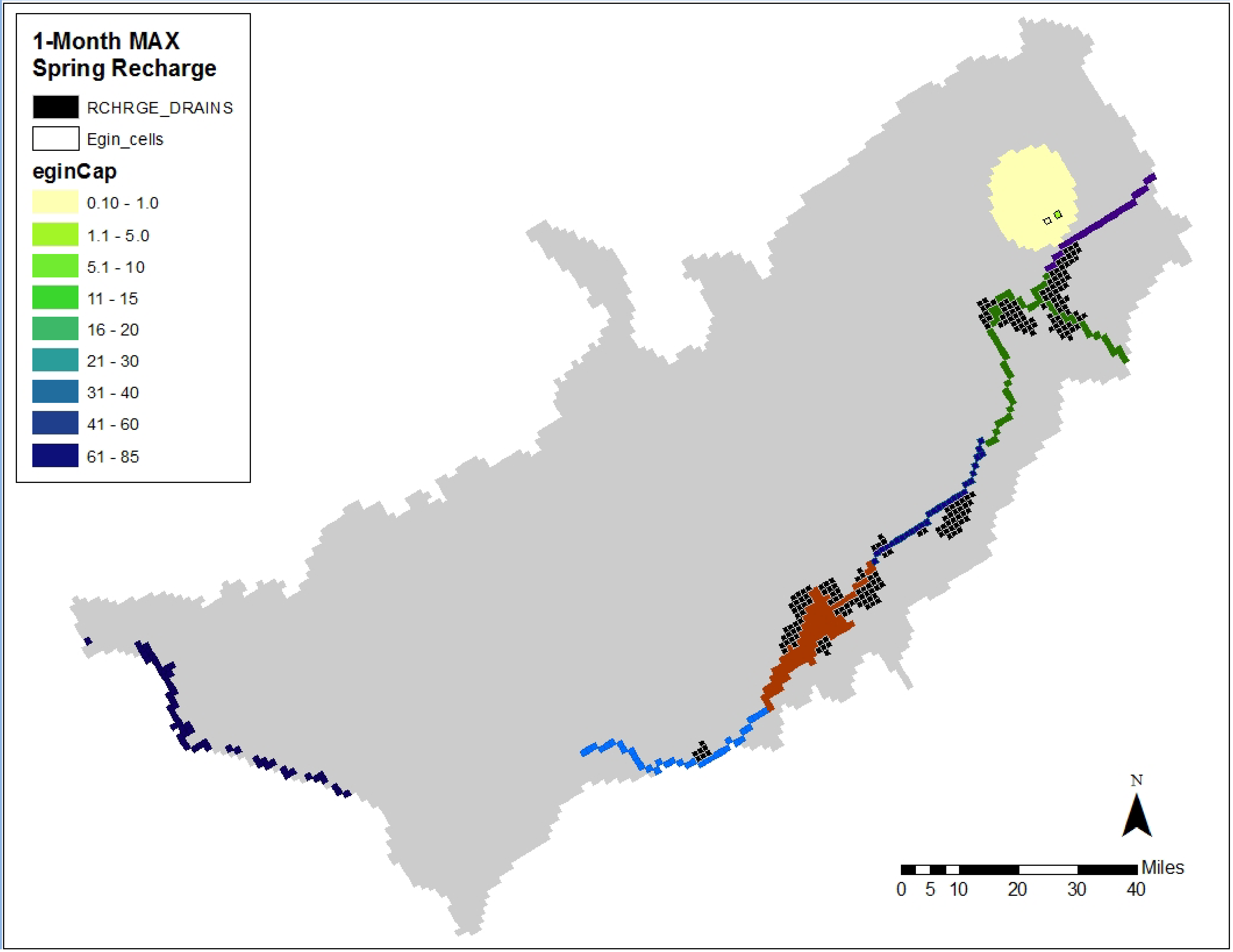
Recharge and Hydrogeology

- Hydrogeology deals with the occurrence and distribution of underground water.
- Look at the influence that the subsurface has on recharged water.

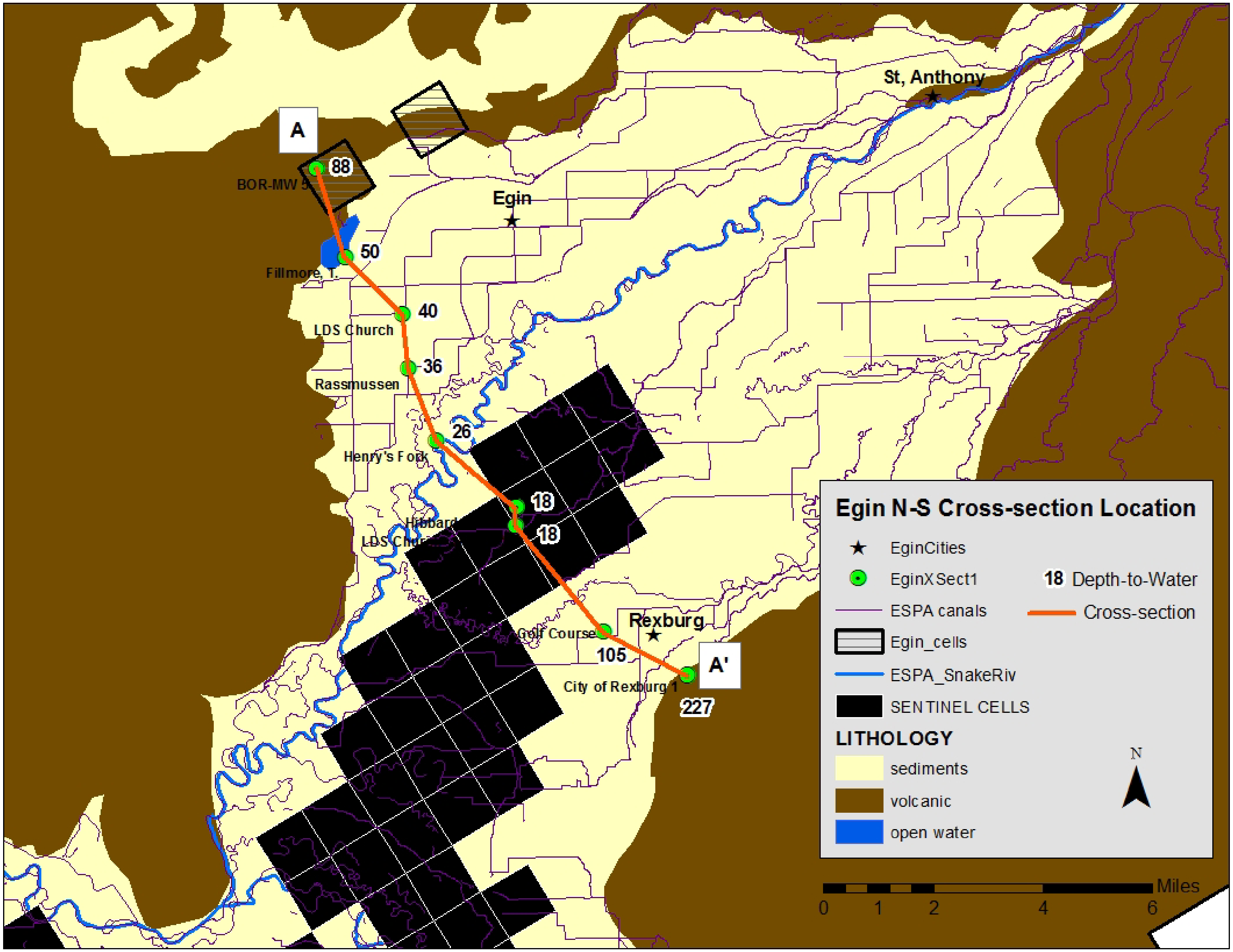


Generalized Lithology - ESPA
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
basement rock
open water
ESPA_cities
Rexburg
Arco
Idaho Falls
Bliss
Pocatello
Milner
N
Miles
0 5 10 20 30 40

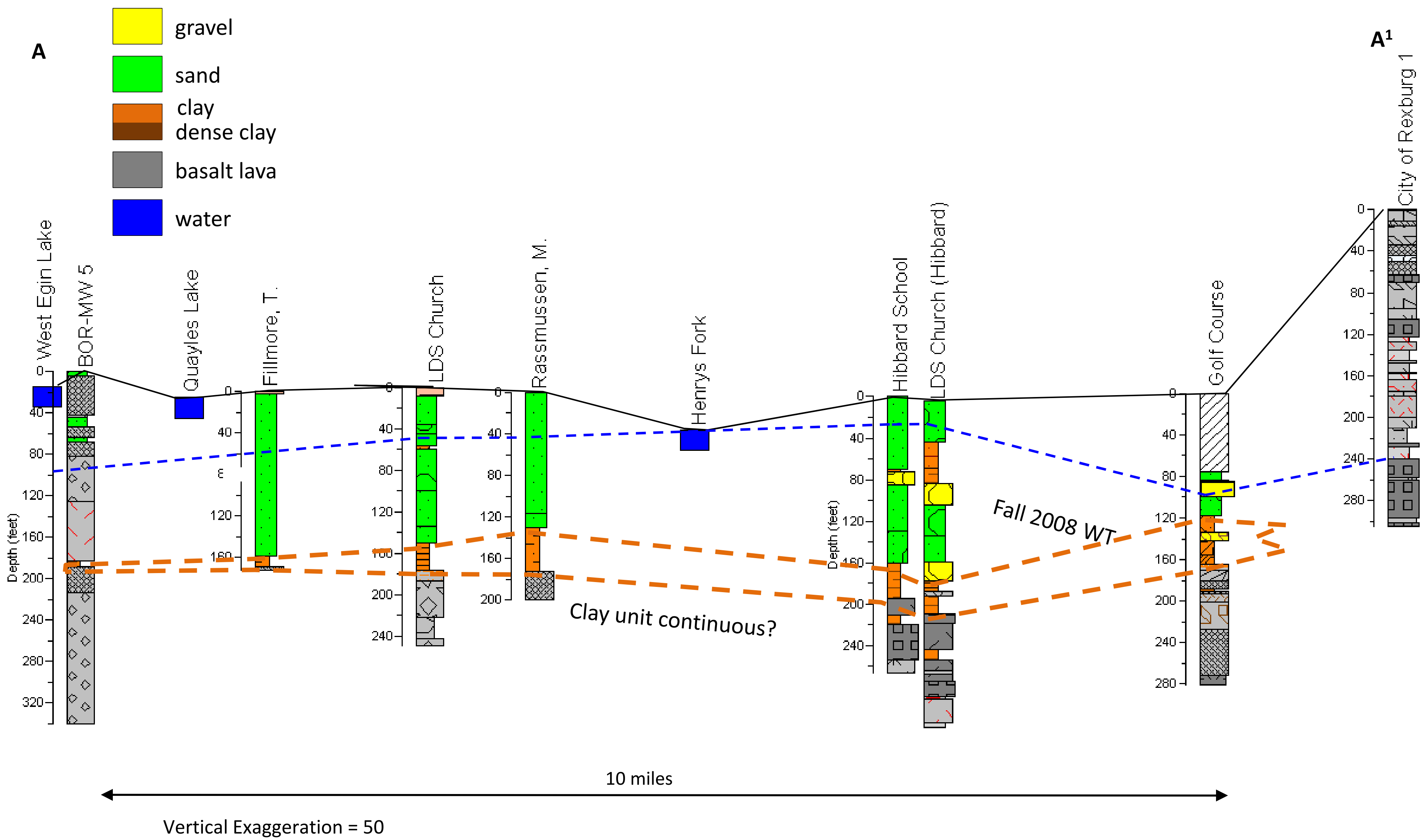
Recharge at Egin



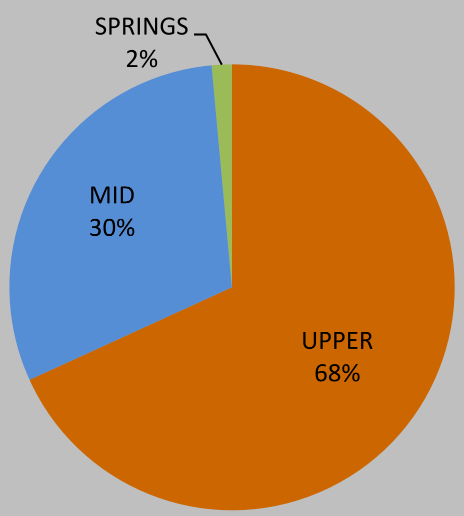
Egin Recharge Area: N – S Cross Section



Egin Bench to Rexburg Cross Section



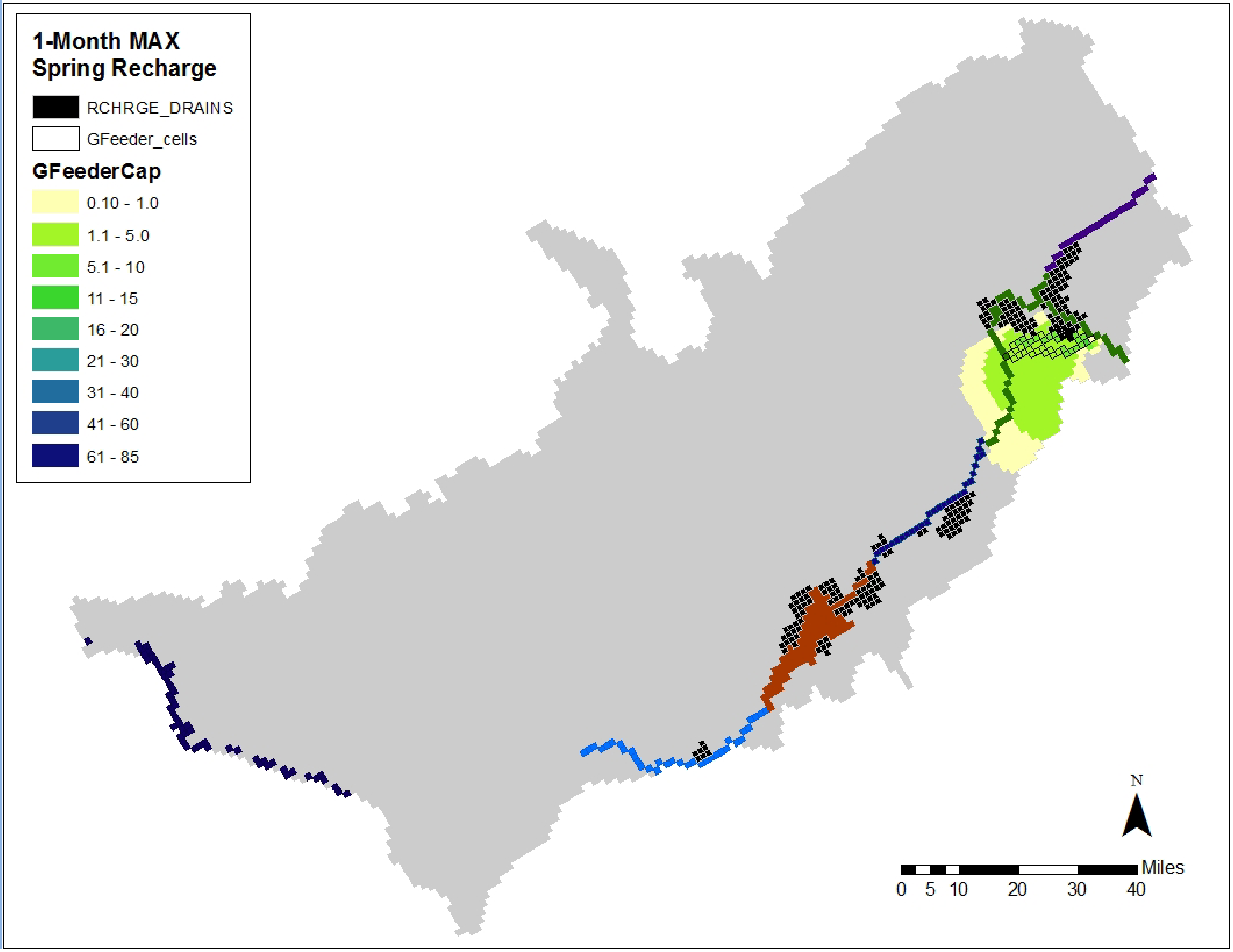
Summary of Recharge at Egin



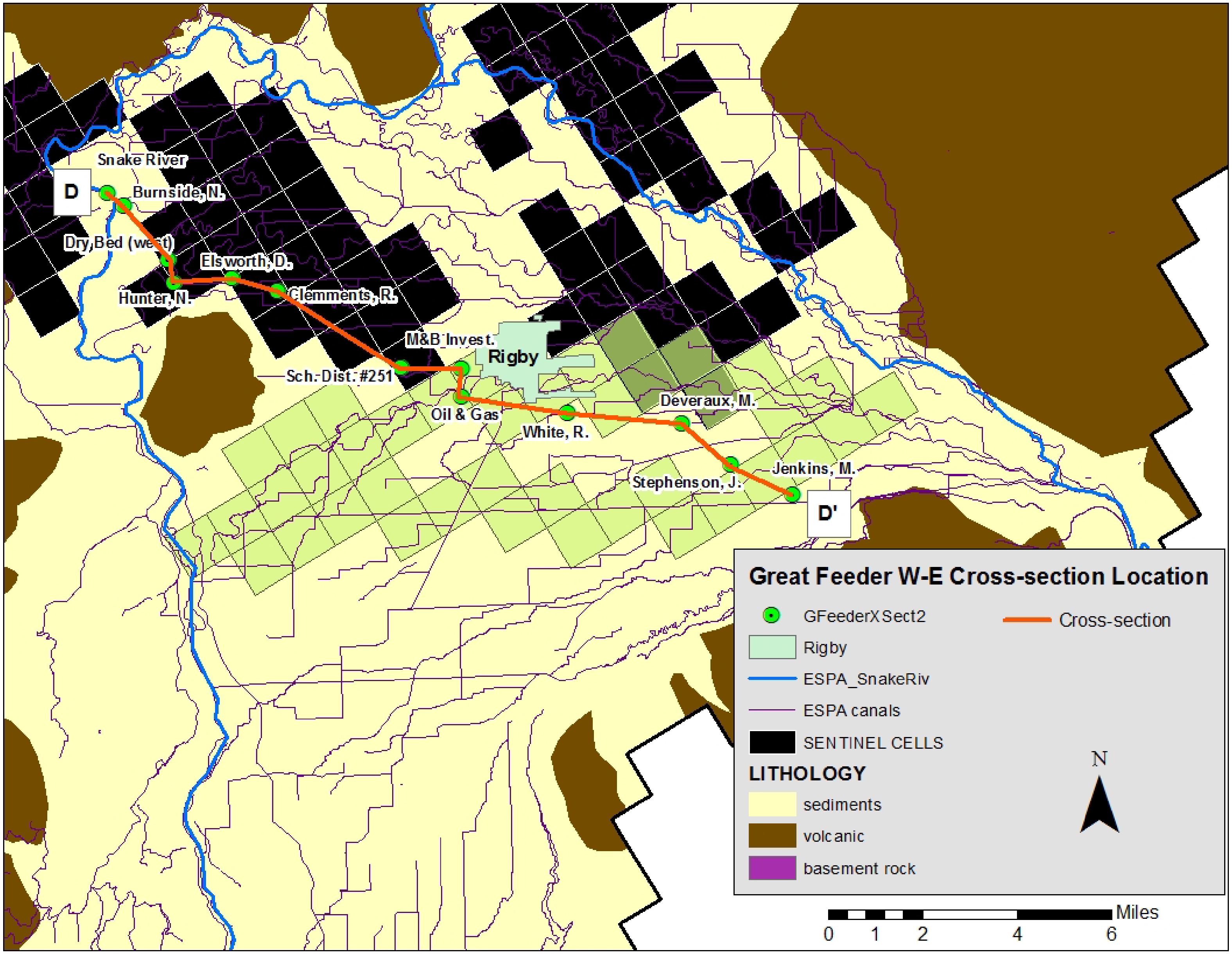
Ultimate Fate of Recharged Water

- Recharge via off-canal locations.
- Subsurface is primarily sediments.
- Located near an area of shallow groundwater.
- Location lies on the edge of the regional aquifer and a shallow system.
- Majority of recharge water discharges: Upper Reaches (Henry's Fork).
- Recharge Limited by: **Infiltration Capacity**.

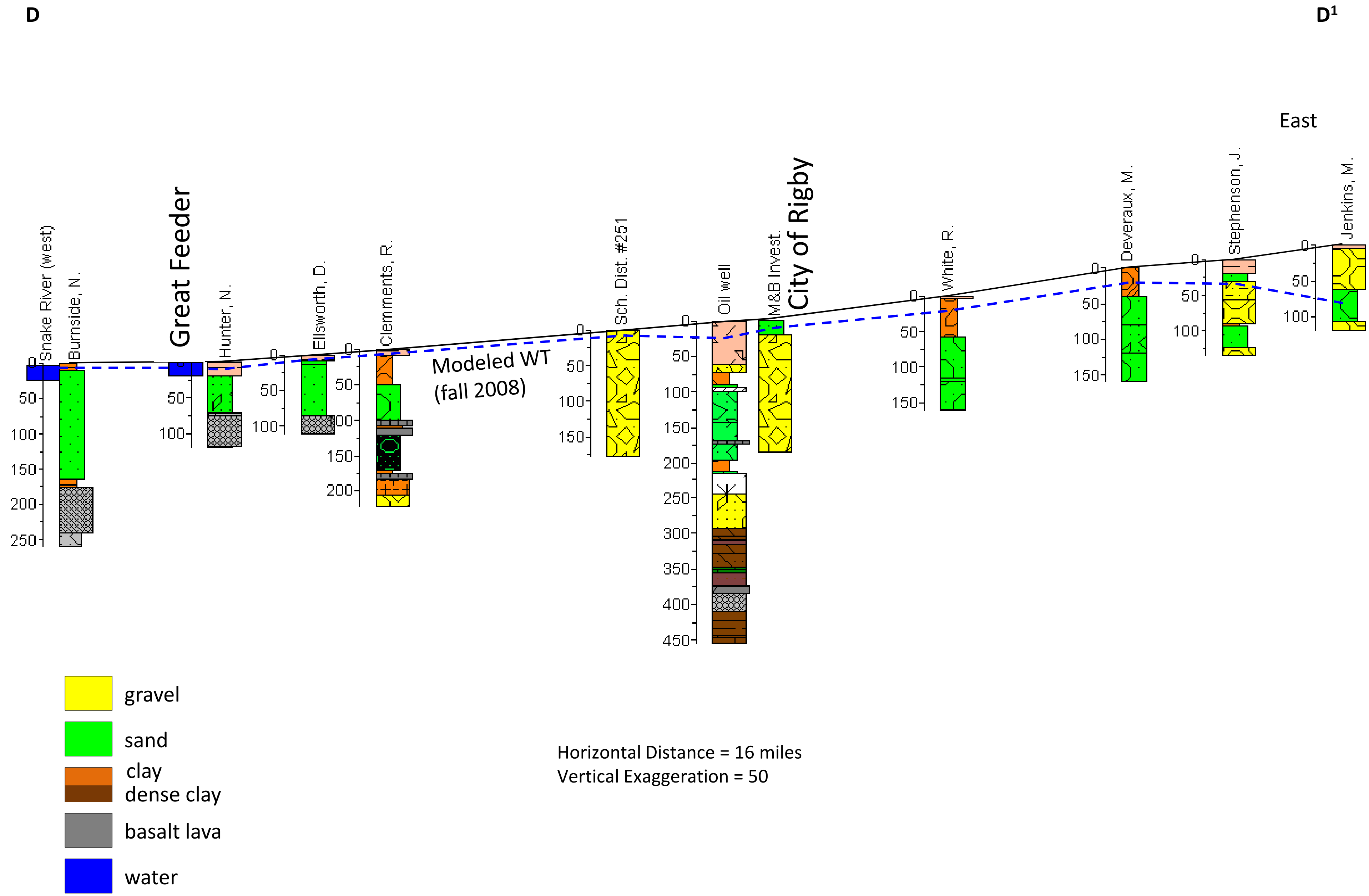
Recharge at GFeeder



Great Feeder Recharge Area: W – E Cross-Section

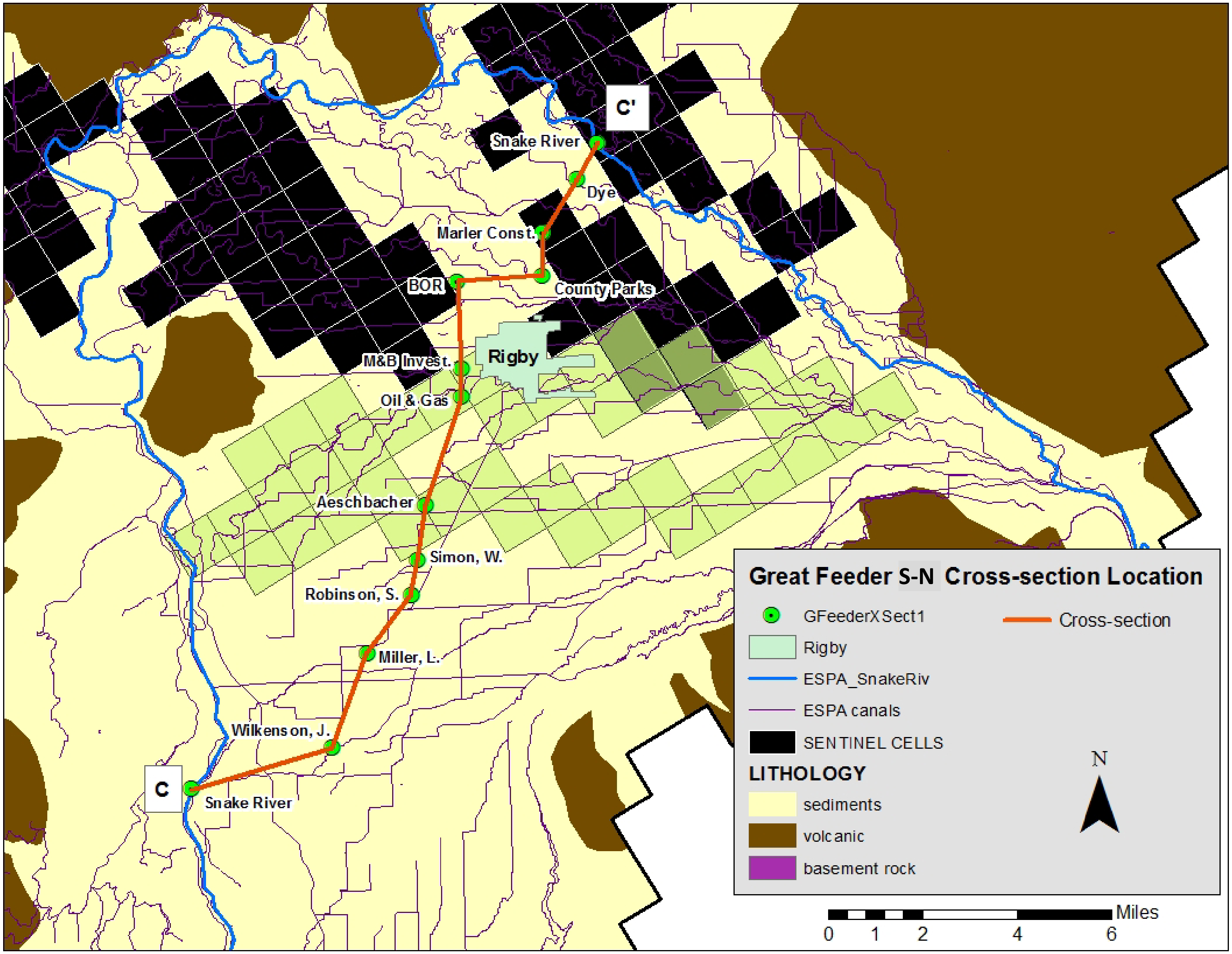


Great Feeder Area W – E Cross Section

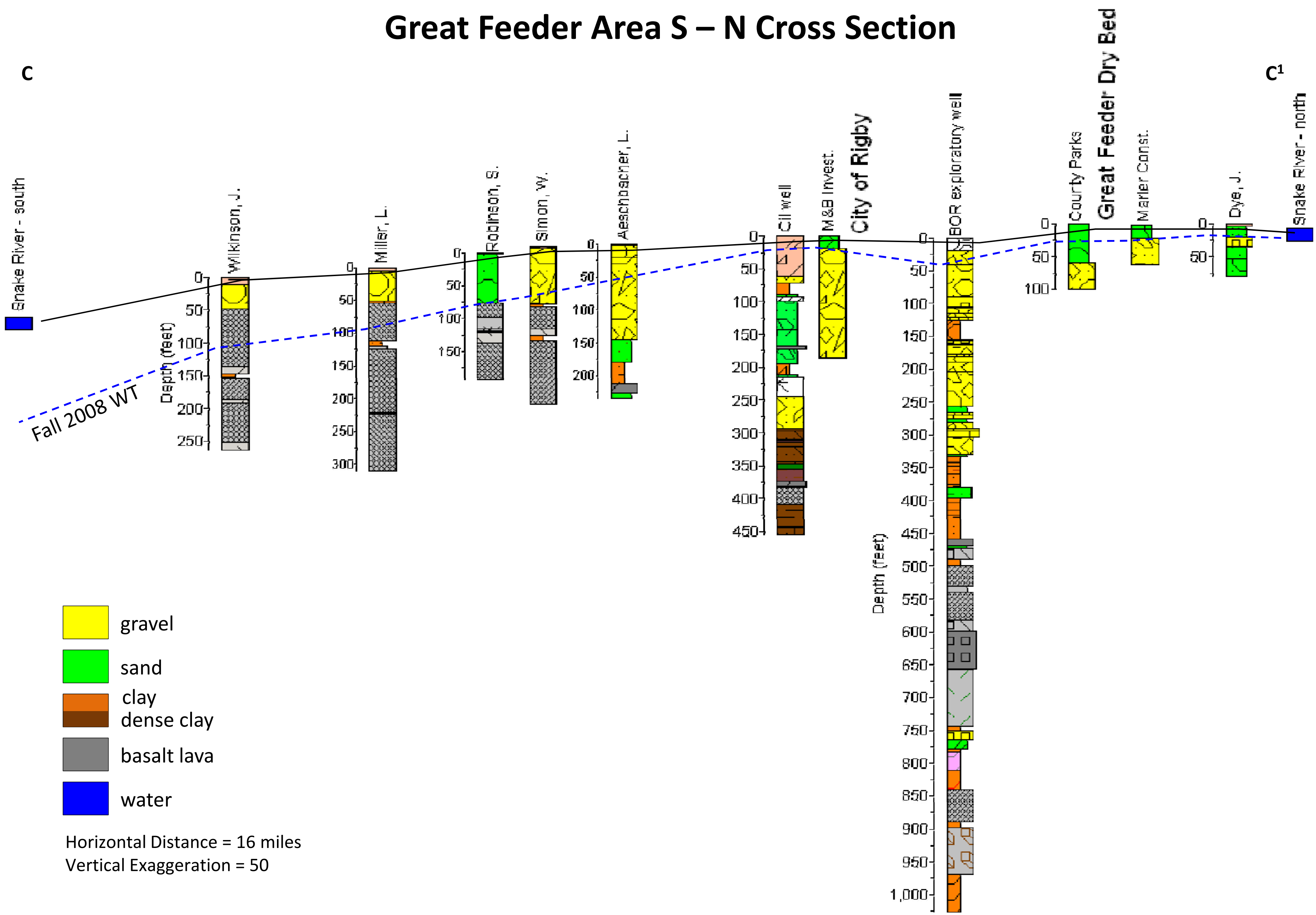


Horizontal Distance = 16 miles
Vertical Exaggeration = 50

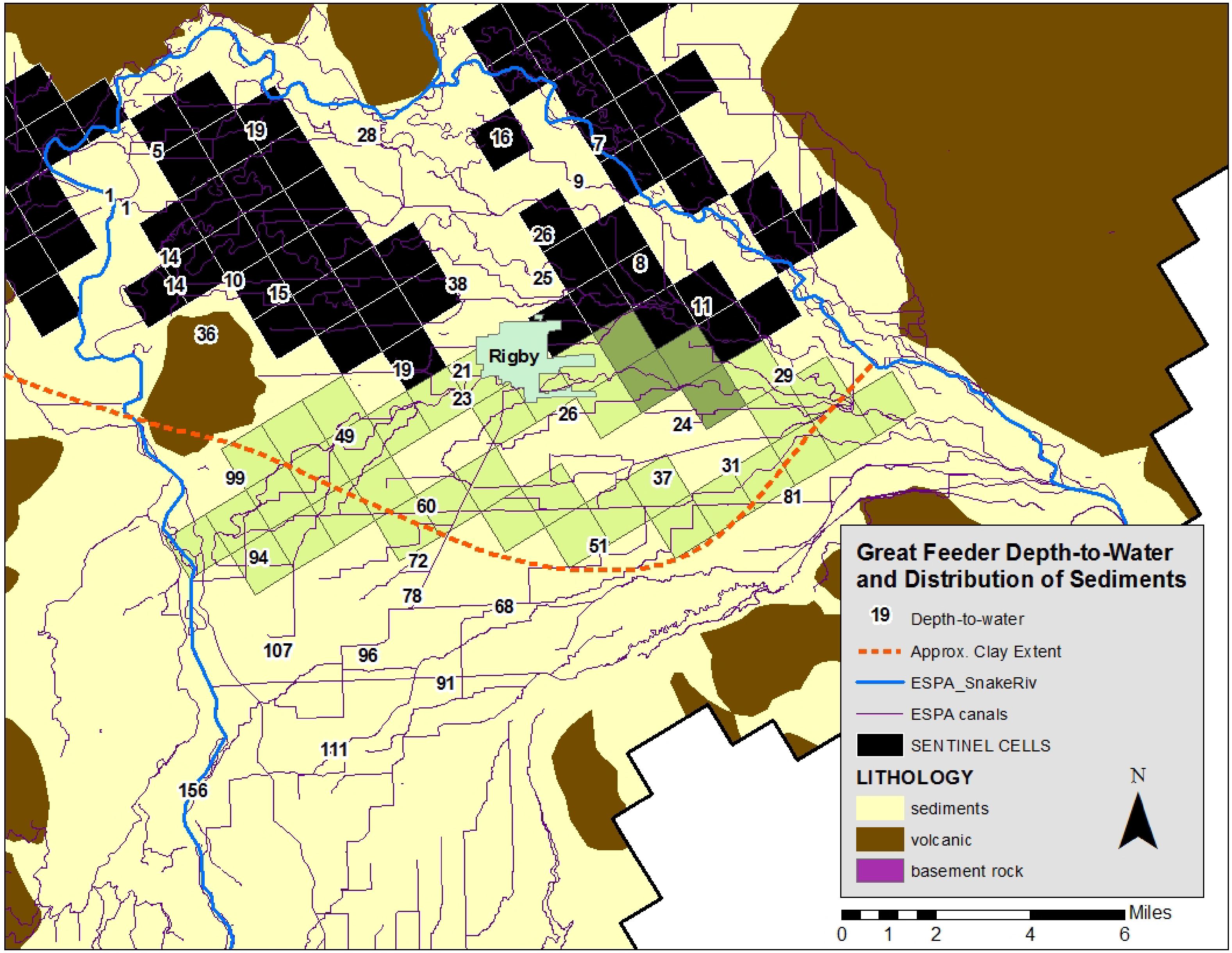
Great Feeder Recharge Area: S – N Cross-Section



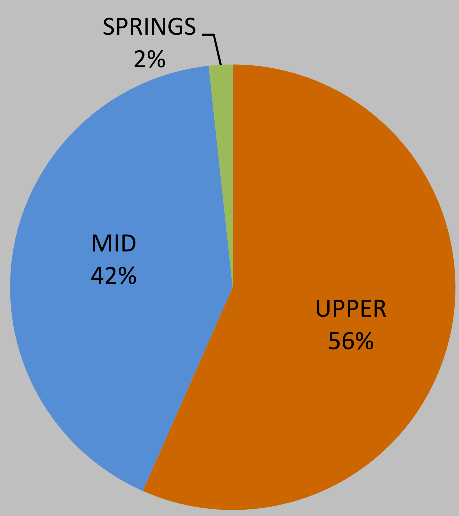
Great Feeder Area S – N Cross Section



Great Feeder Depth-to-Water and Sediment Extent



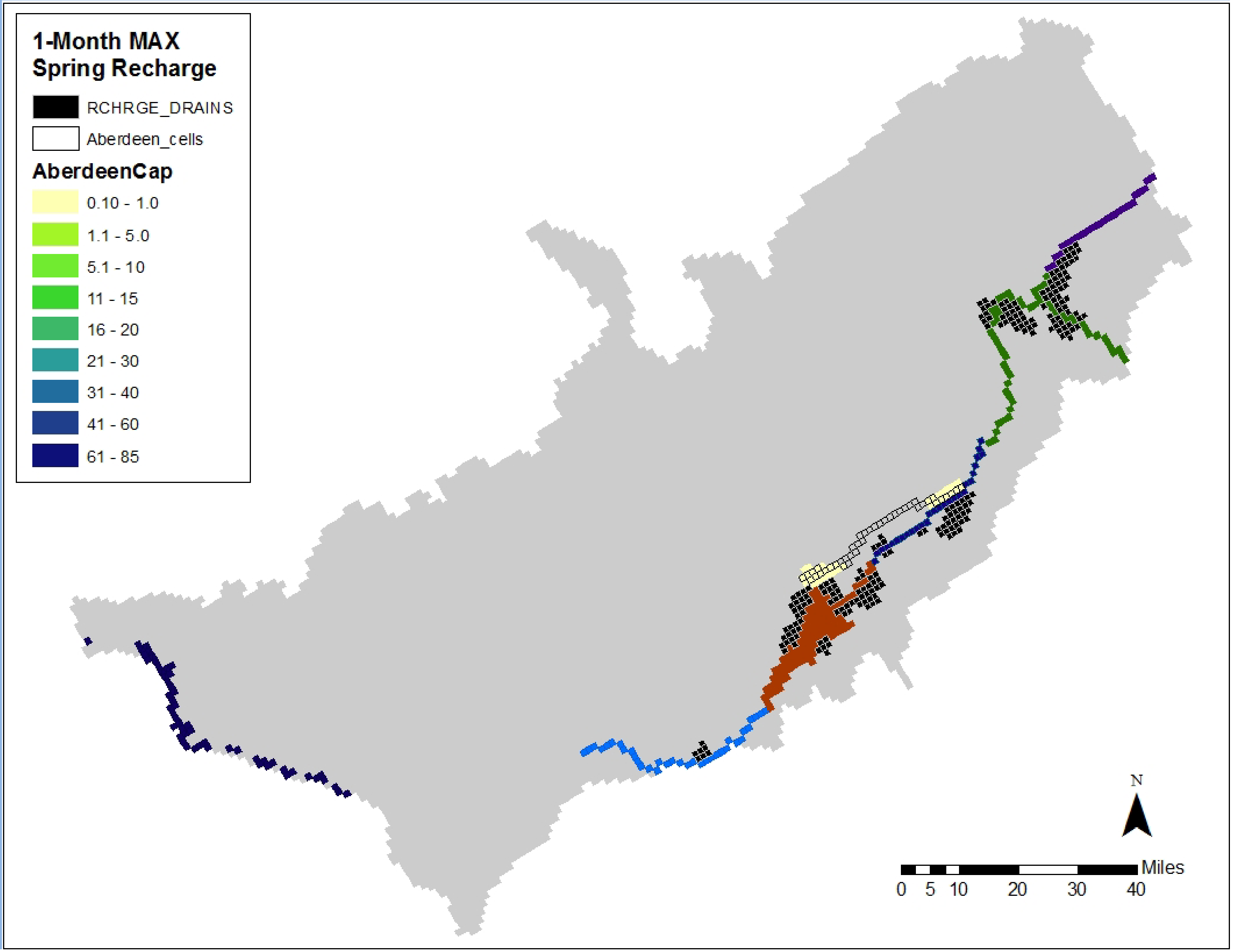
Summary of Recharge at Great Feeder

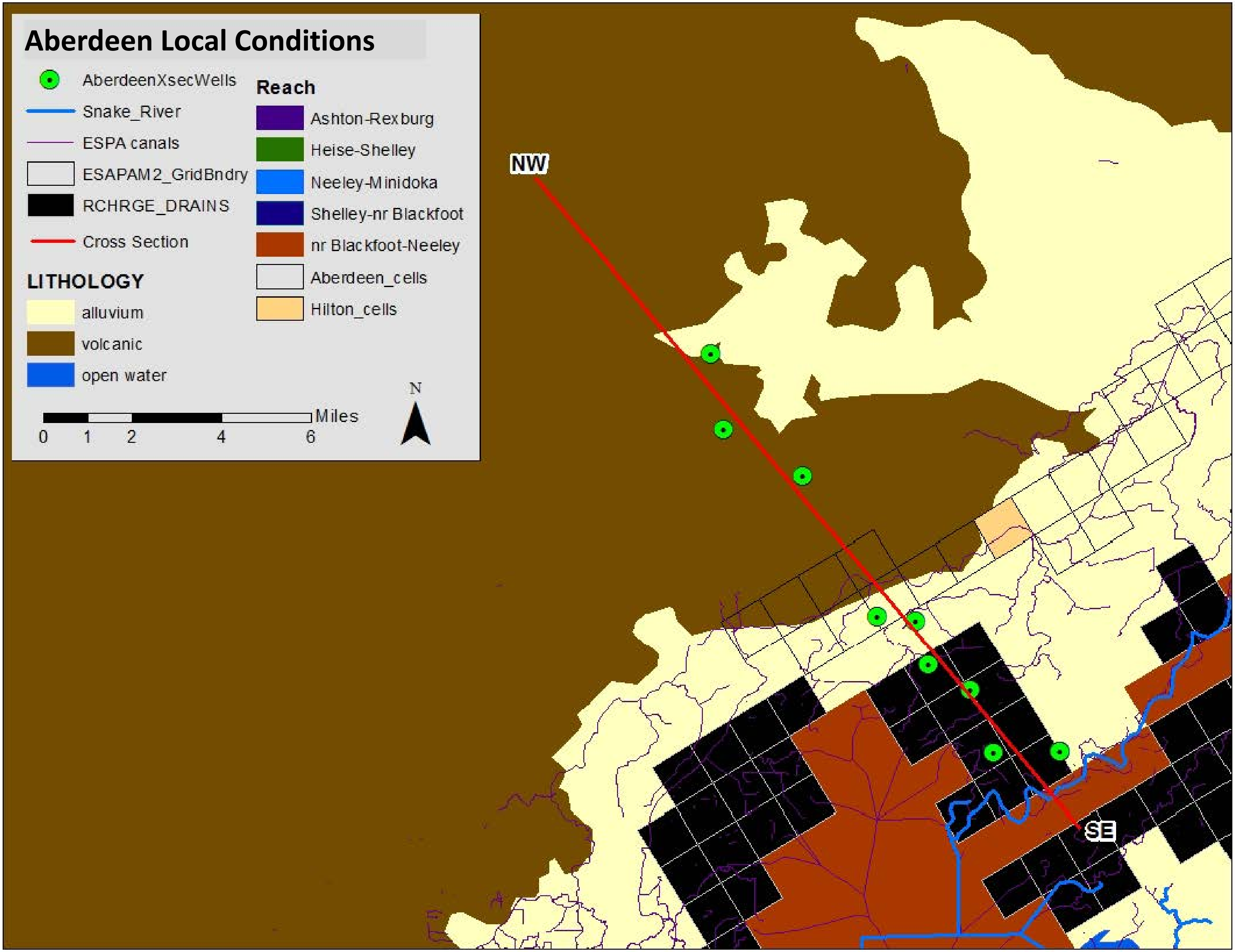


Ultimate Fate of Recharged Water

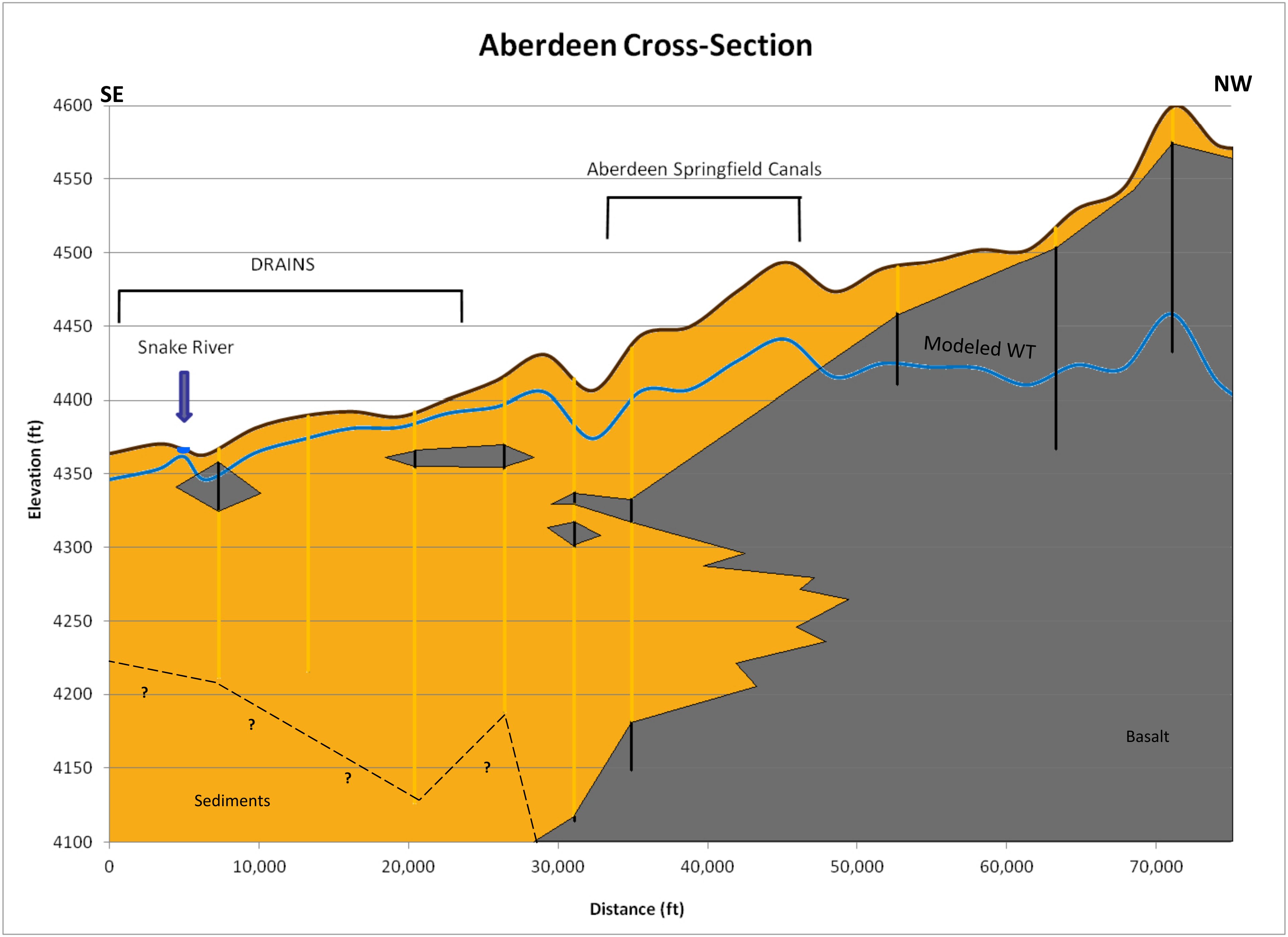
- Recharge via canal seepage.
- Subsurface is primarily sediments.
- Located in an area of shallow groundwater.
- Northern portion in shallow system, grades to regional aquifer to the south.
- Majority of recharge water discharges: Upper Reaches.
- Recharge Limited by: Spring-**Infiltration Capacity**; Fall- **Shallow Groundwater**.

Recharge at Aberdeen



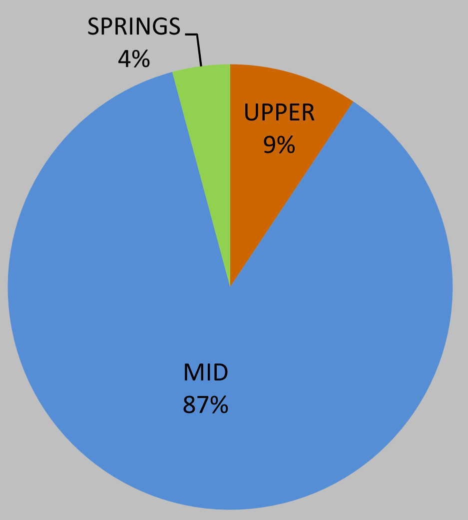


Aberdeen Local Conditions
AberdeenXsecWells
Snake_River
ESPA canals
ESAPAM2_GridBndry
RCHRGE_DRAINS
Cross Section
LITHOLOGY
alluvium
volcanic
open water
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Aberdeen_cells
Hilton_cells
0 1 2 4 6 Miles
N
NW
SE



Aberdeen Cross-Section
SE
NW
Aberdeen Springfield Canals
DRAINS
Snake River
Modeled WT
Basalt
Sediments
?
?
?
?
Elevation (ft)
4600
4550
4500
4450
4400
4350
4300
4250
4200
4150
4100
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Distance (ft)

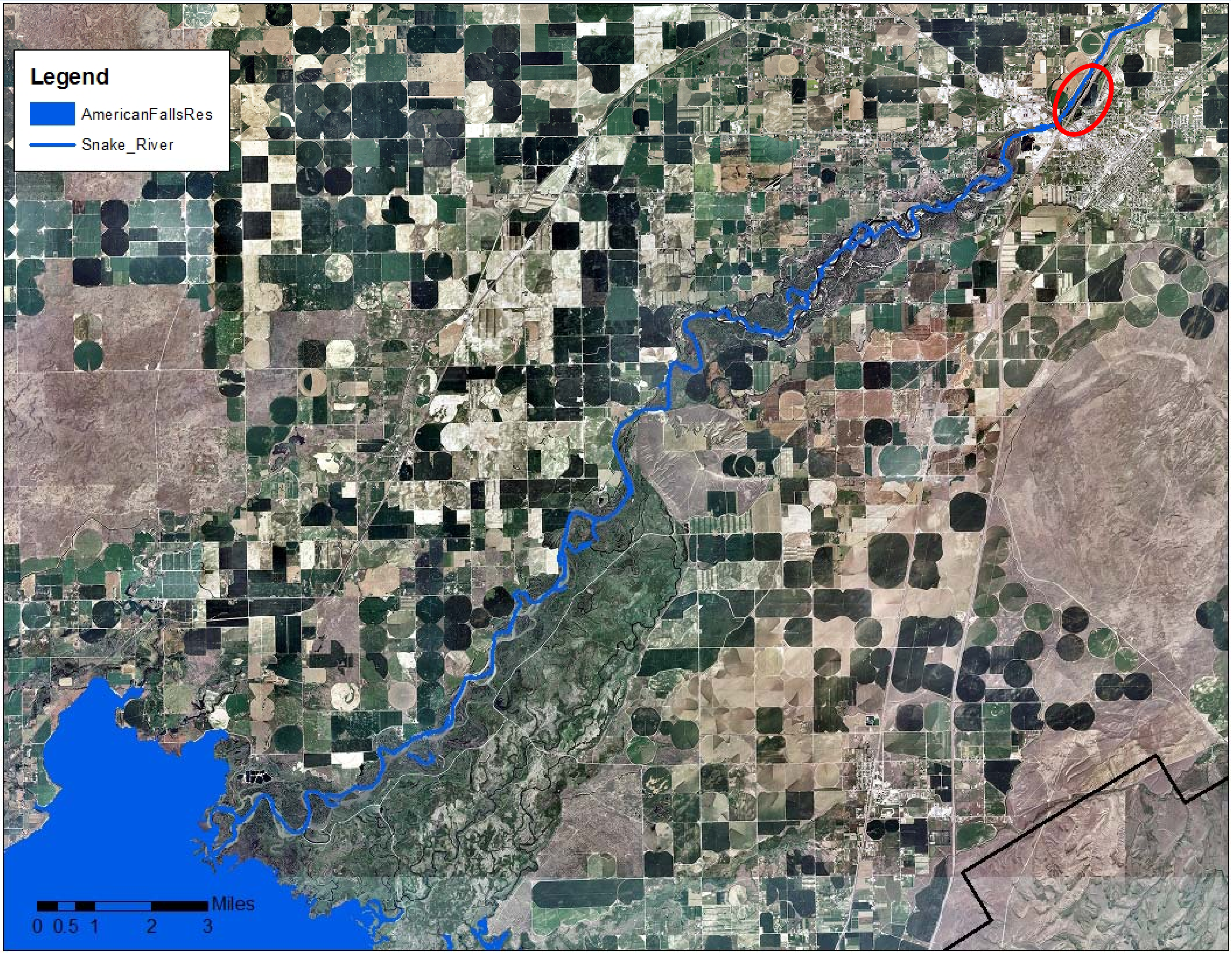
Summary of Recharge at Aberdeen



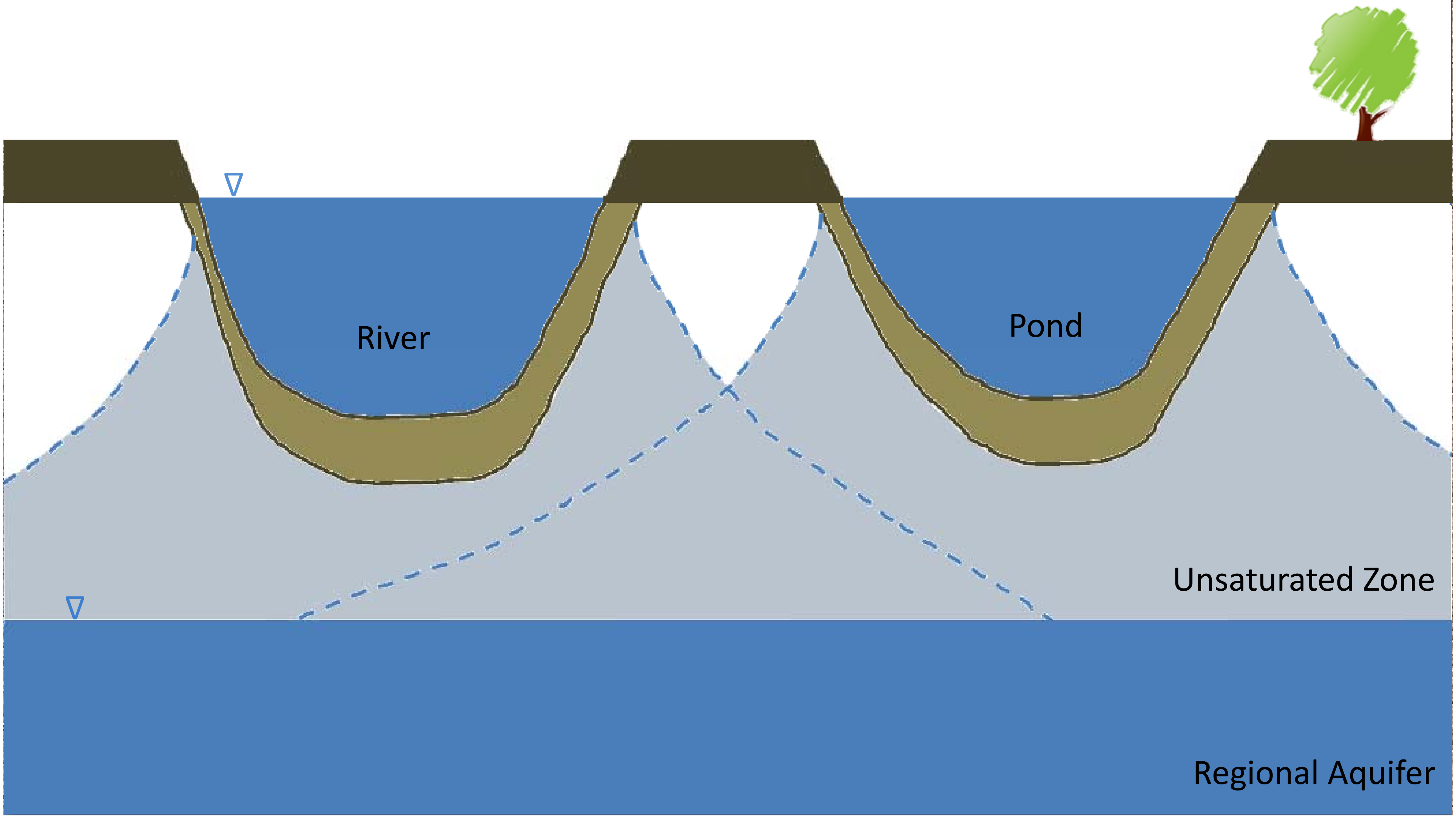
Ultimate Fate of Recharged Water

- Recharge via canal seepage.
- Subsurface is primarily sediments.
- Located in an area of shallow groundwater and groundwater discharge.
- Canal Company is planning a drainage well to remove standing water due to canal seepage.
- Majority of recharge water discharges: Middle Reaches.
- Recharge Limited by: **Shallow Groundwater**.

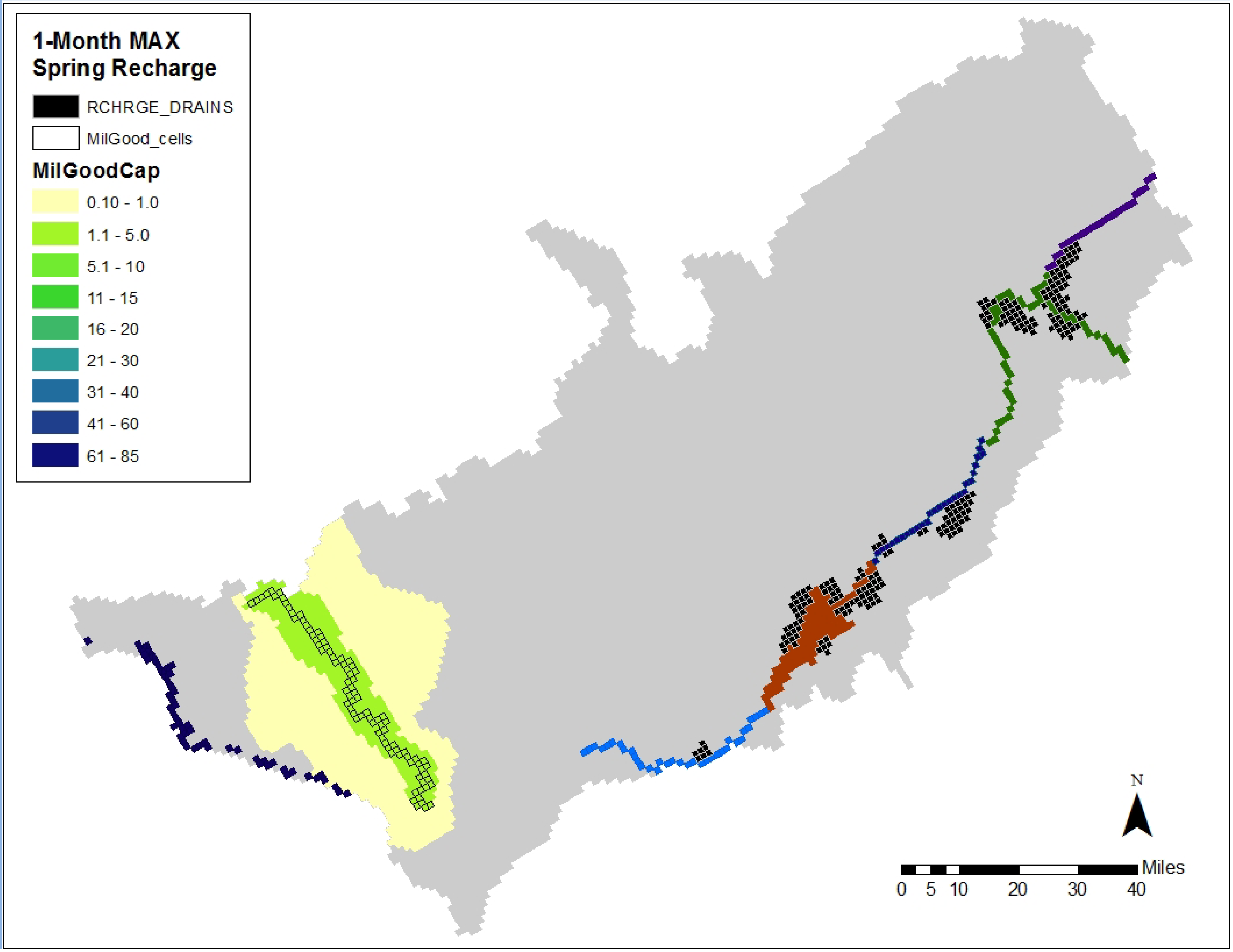
Recharge at Jensen’s Grove

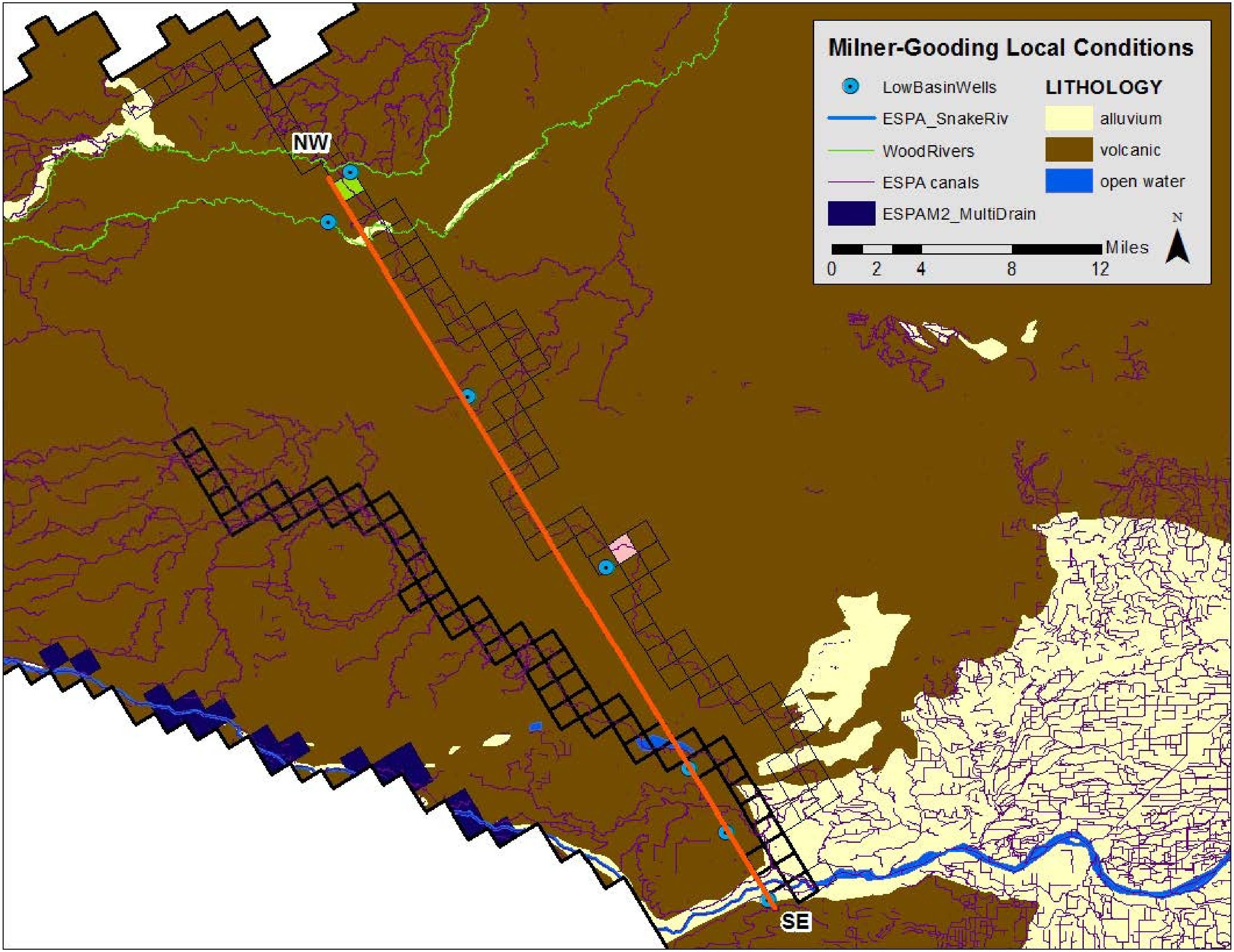


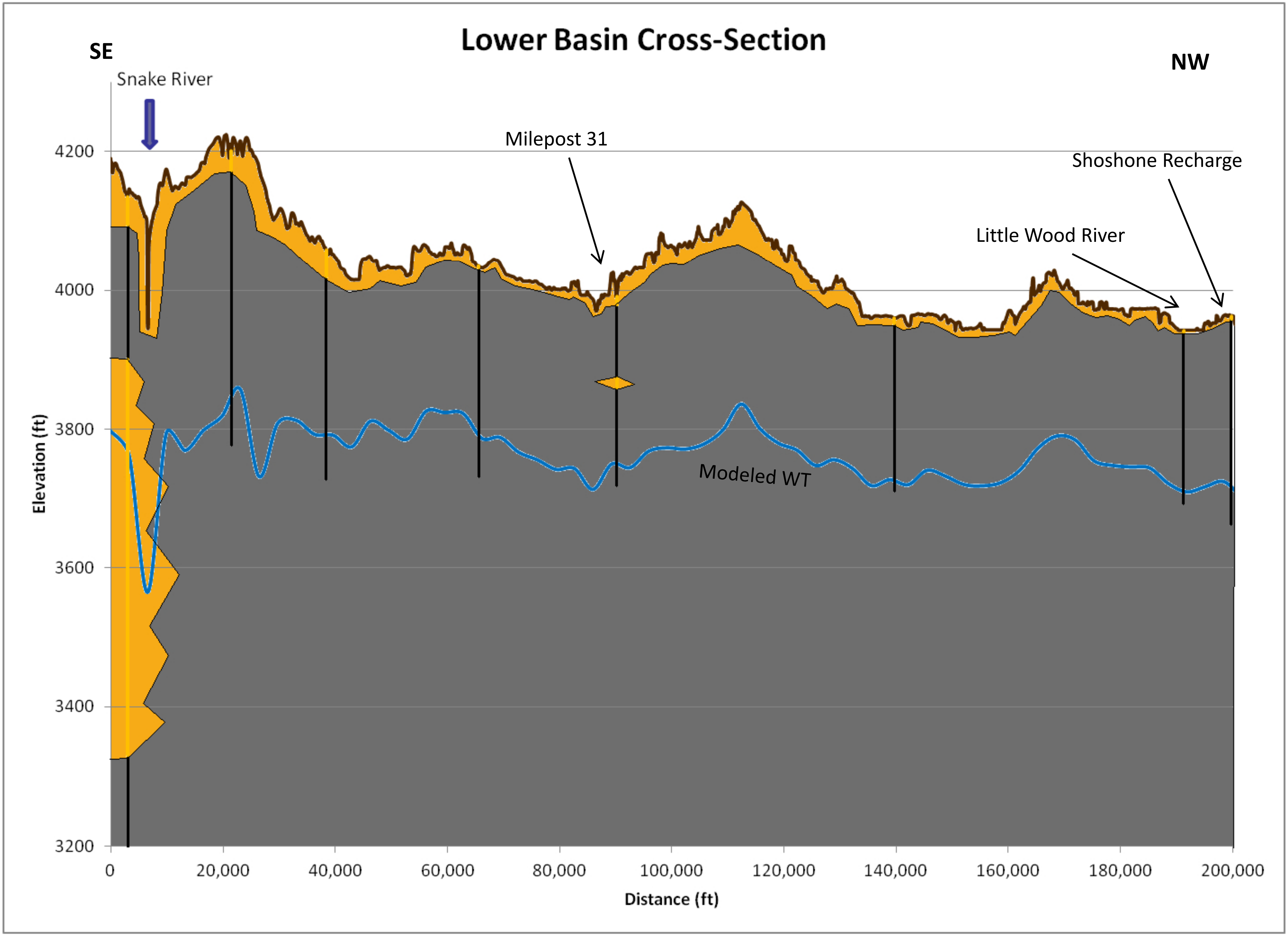
Cross-section of Jensen’s Grove



Recharge at MilGood

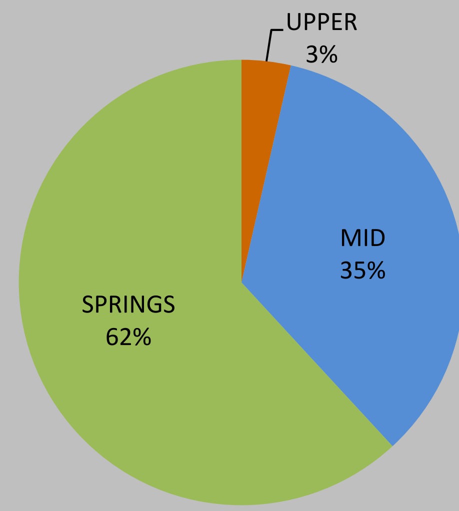



Milner-Gooding Local Conditions
LowBasinWells
ESPA_SnakeRiv
WoodRivers
ESPA canals
ESPAM2_MultiDrain
LITHOLOGY
alluvium
volcanic
open water
N
Miles
0
2
4
8
12
NW
SE



Lower Basin Cross-Section
SE
NW
Snake River
Milepost 31
Shoshone Recharge
Little Wood River
Modeled WT
Elevation (ft)
4200
4000
3800
3600
3400
3200
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
160,000
180,000
200,000
Distance (ft)

Summary of Recharge at Milner-Gooding



Ultimate Fate of Recharged Water

- Recharge via canal seepage and off-canal locations.
- Subsurface is primarily basalt.
- Located in an area of deep groundwater.
- Majority of recharge water discharges: Springs.
- Recharge Limited by: **Infiltration Capacity**.

Recharge Comparisons

We assess recharge by looking at benefits to:

- Aquifer Storage.
- Reach Gains / Spring Discharge.

- Location is very important. The best way to evaluate the effect of recharge location is to model the same volume of recharge at each location.
- The best way to evaluate the total impact of recharge at a location is to model with recharge limits.
- The key to recharge success is consistency.

- The following scenarios will probe all three aspects of recharge.

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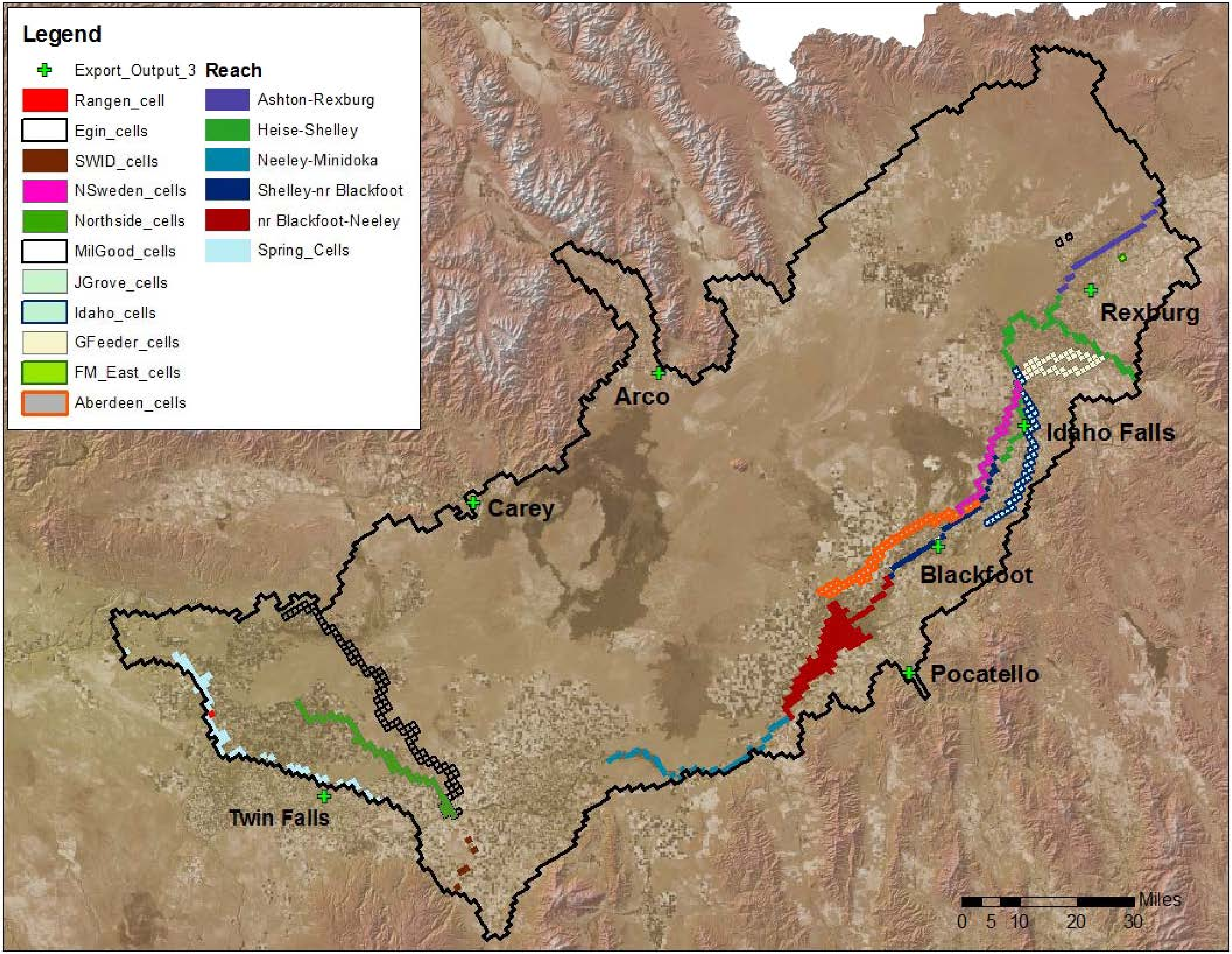
Reasons for Doing Recharge

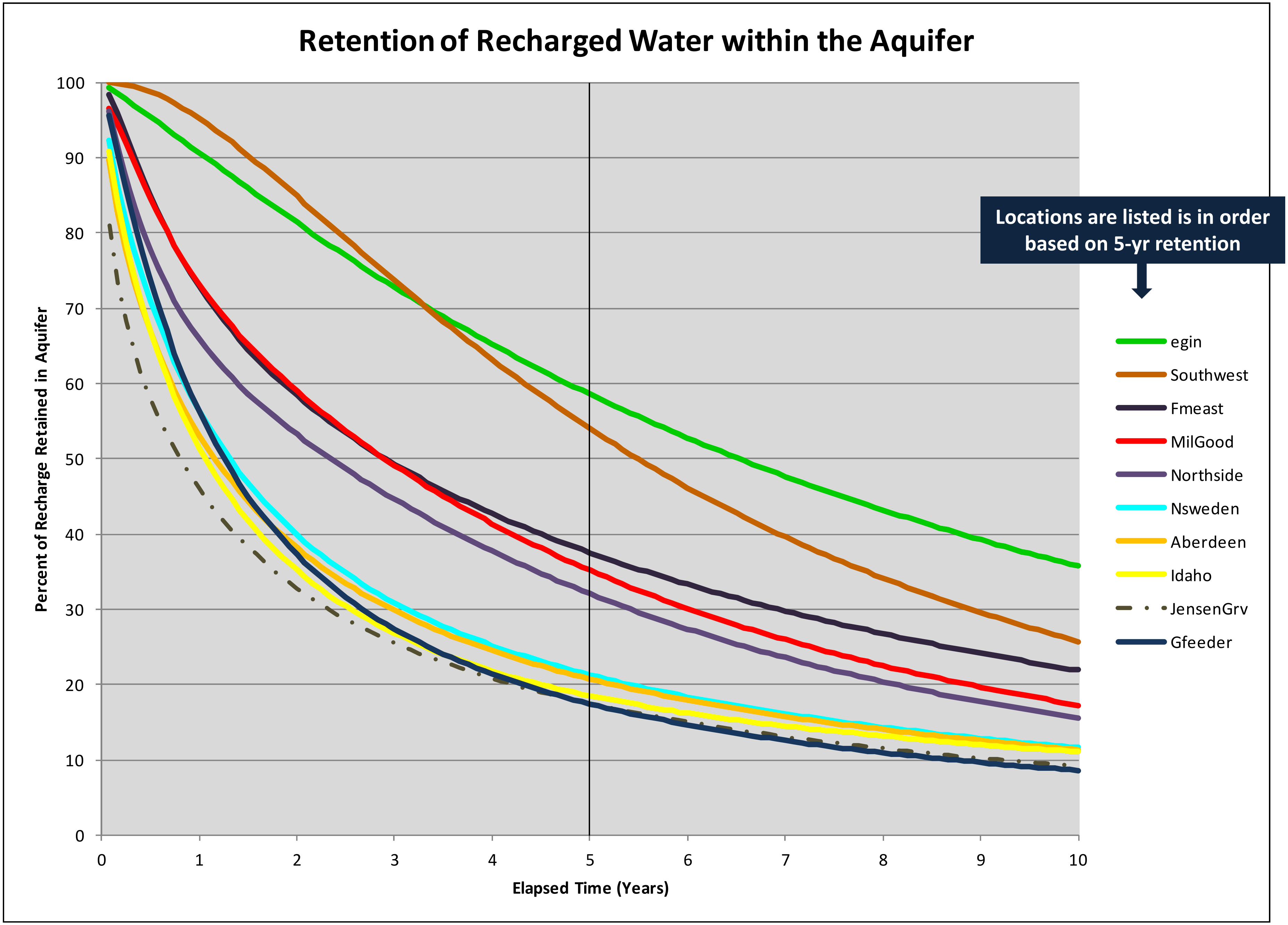
- Reservoir Analogue – Increase the amount of water held in storage.
  - Allows for use of water during time of need.
- Mitigation – Offset junior water use to make senior water user whole.
  - Increase natural discharge in a particular location or reach.
- Water Filtration – This is an important result of recharging surface water, but not a goal that requires managed recharge in Idaho.
- Water Intrusion – Prevent undesirable water from degrading aquifer.
  - Sea water, thermal water.
  - Not a significant issue in Idaho



Legend
Export_Output_3
Rangen_cell
Egin_cells
SWID_cells
NSweden_cells
Northside_cells
MilGood_cells
JGrove_cells
Idaho_cells
GFeeder_cells
FM_East_cells
Aberdeen_cells
Reach
Ashton-Rexburg
Heise-Shelley
Neeley-Minidoka
Shelley-nr Blackfoot
nr Blackfoot-Neeley
Spring_Cells
Rexburg
Arco
Idaho Falls
Carey
Blackfoot
Pocatello
Twin Falls
Miles
0 5 10 20 30

Reservoir Analogue

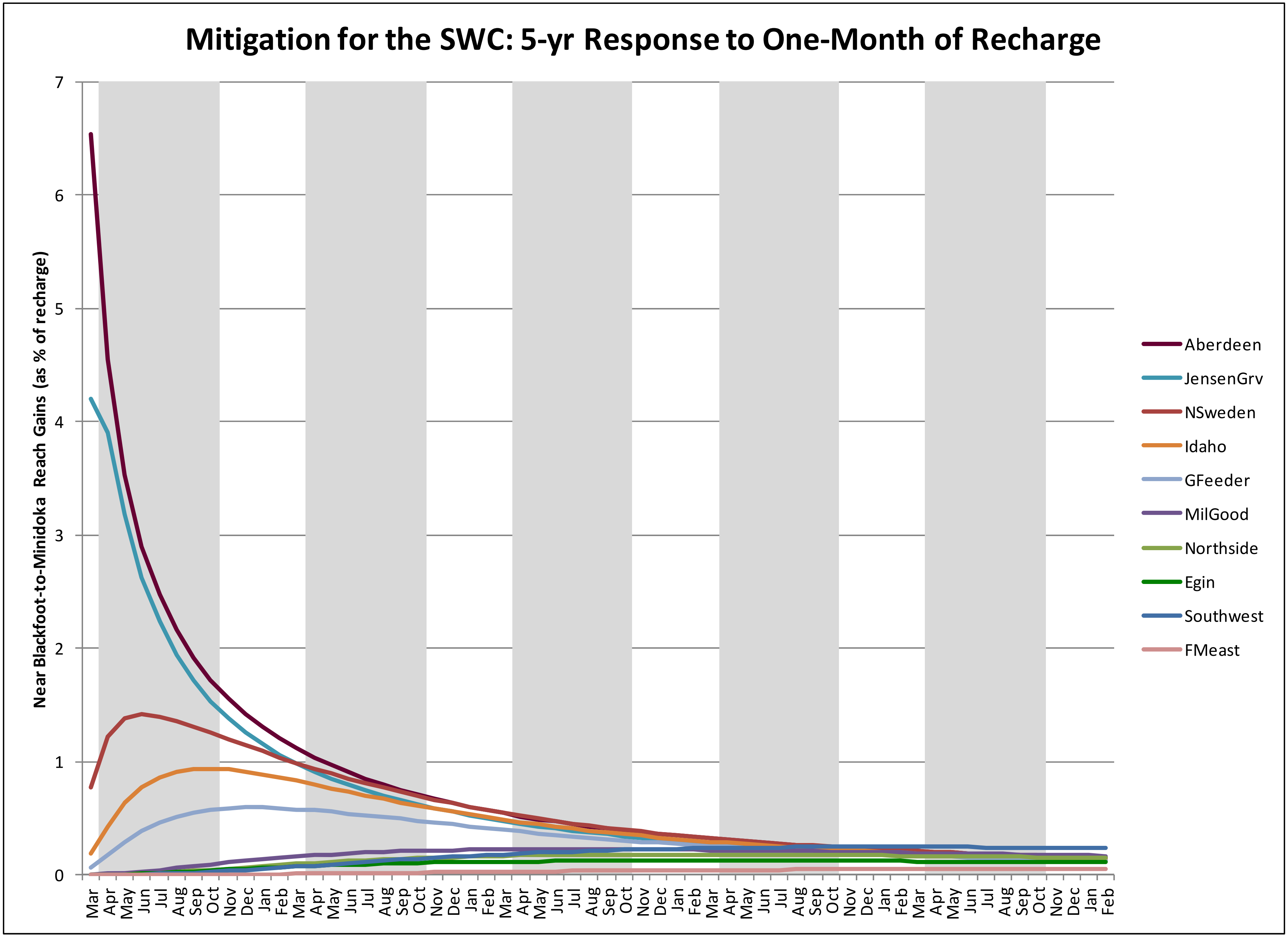
- Increase the amount of water held in storage for use when we want it.
- This aquifer leaks.
  - This allows for the multiple uses that we have developed.
  - Can make recharge challenging.
- Want to maximize retention time.
  - This is how we maximize return on recharge investment.
- Successfully replenishing the “reservoir” makes everything better (water levels, river flows, spring discharge).
- One-month scenarios, recharge of 100 AF at each location.
  - Illustrates importance of location.



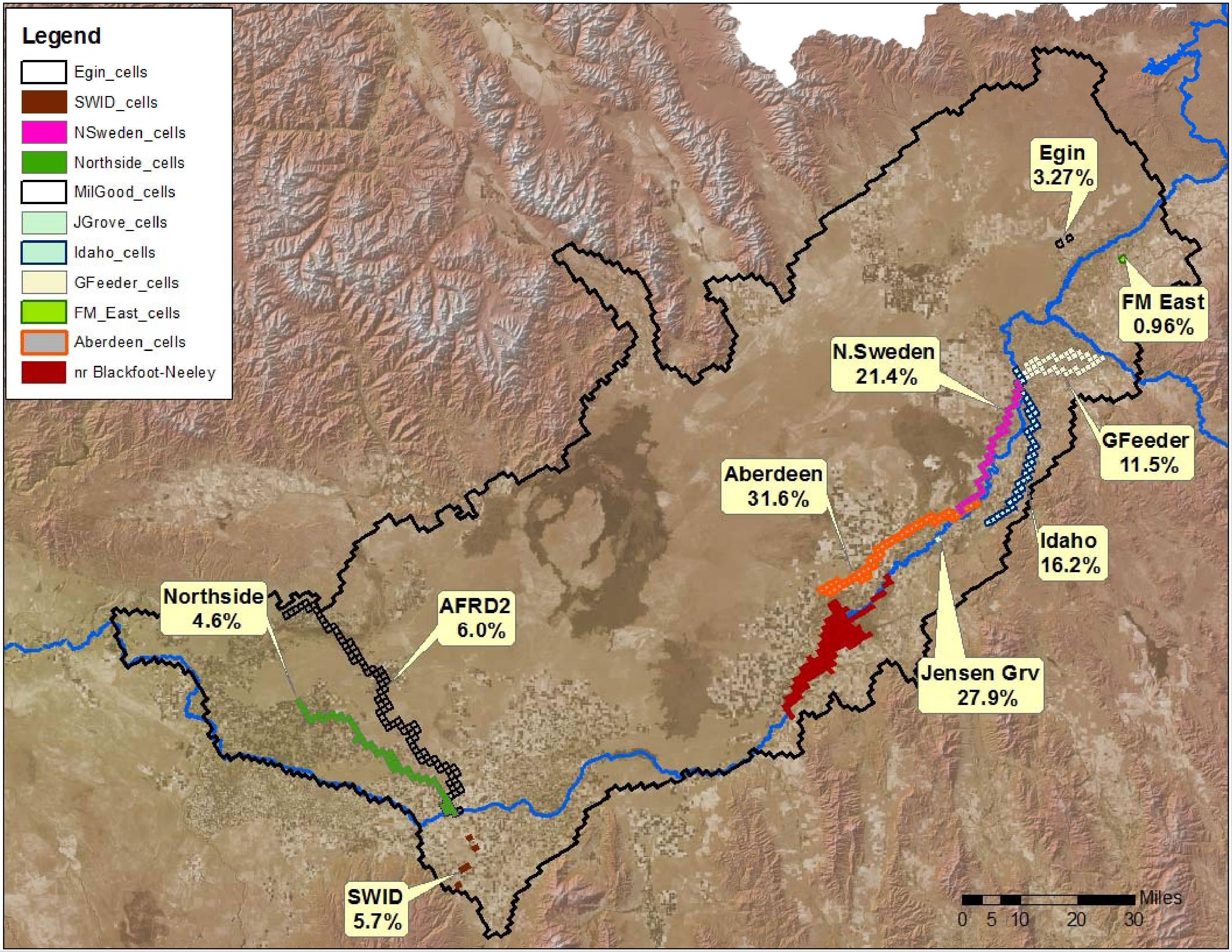
Retention of Recharged Water within the Aquifer
Locations are listed is in order based on 5-yr retention
egin
Southwest
Fmeast
MilGood
Northside
Nsweden
Aberdeen
Idaho
JensenGrv
Gfeeder
Percent of Recharge Retained in Aquifer
Elapsed Time (Years)
0
10
20
30
40
50
60
70
80
90
100
1
2
3
4
5
6
7
8
9

Mitigation

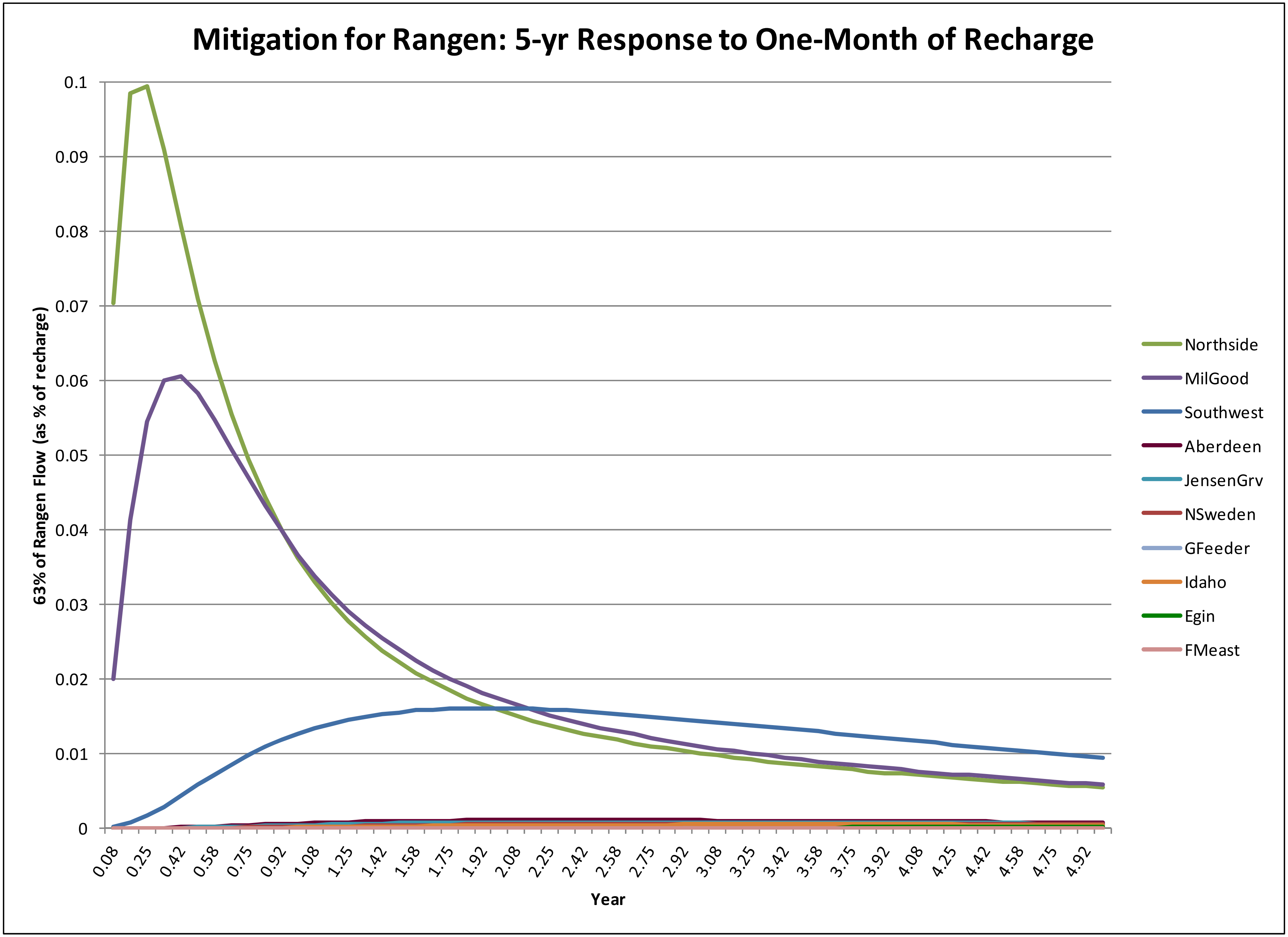
- Intended to offset junior-priority water uses to fulfill senior-priority water uses.
- This aquifer leaks.
  - Mitigation takes advantage of the leaky nature.
- Increase the amount of water discharged from certain springs.
- Increase reach gains (or reduce losses) in certain Snake River reaches.
- Very difficult to “steer” recharge to mitigation goal.
  - Increased focus equates to reduced retention time.
- One-month scenarios, recharge of 100 AF at each location.
  - Illustrates importance of location.



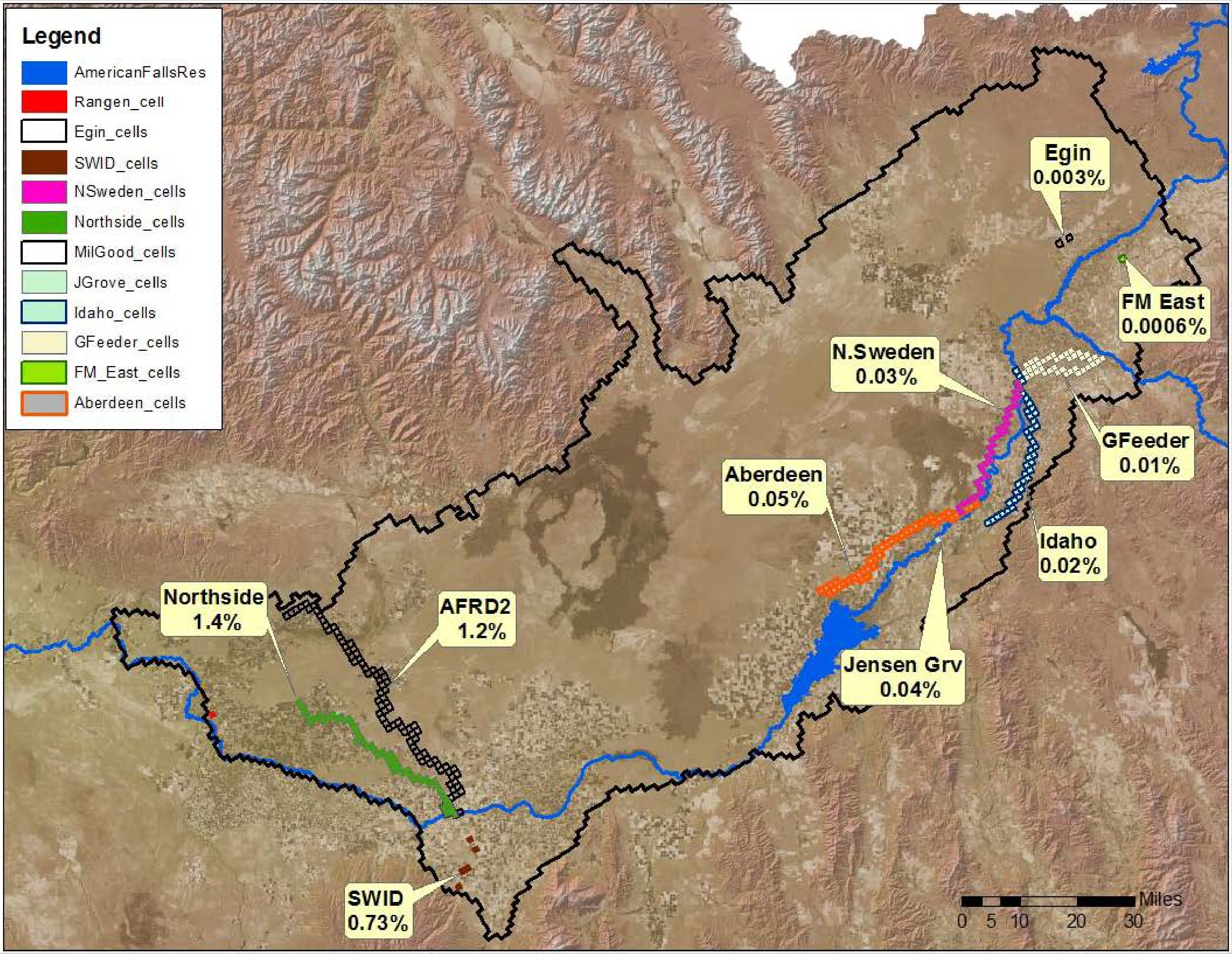
Mitigation for the SWC: 5-yr Response to One-Month of Recharge
Near Blackfoot-to-Minidoka Reach Gains (as % of recharge)
0
1
2
3
4
5
6
7
Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb
Aberdeen
JensenGrv
NSweden
Idaho
GFeeder
MilGood
Northside
Egin
Southwest
FMeast



Percent of a 1-month recharge volume discharged in the nr Blackfoot-to-Minidoka reach, summed for the first five years (irrigation season).

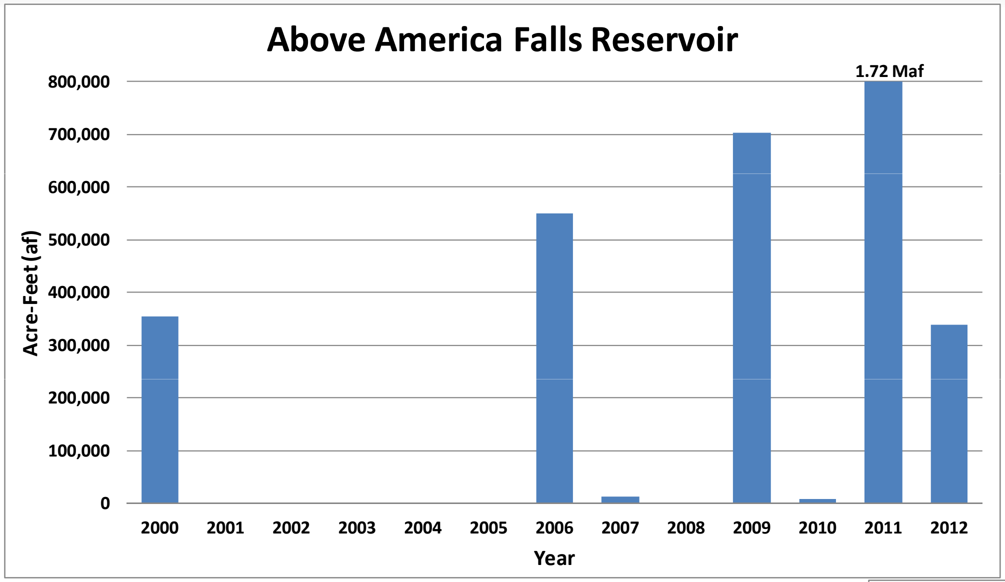


Mitigation for Rangen: 5-yr Response to One-Month of Recharge
63% of Rangen Flow (as % of recharge)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.08 0.25 0.42 0.58 0.75 0.92 1.08 1.25 1.42 1.58 1.75 1.92 2.08 2.25 2.42 2.58 2.75 2.92 3.08 3.25 3.42 3.58 3.75 3.92 4.08 4.25 4.42 4.58 4.75 4.92
Year
Northside
MilGood
Southwest
Aberdeen
JensenGrv
NSweden
GFeeder
Idaho
Egin
FMeast



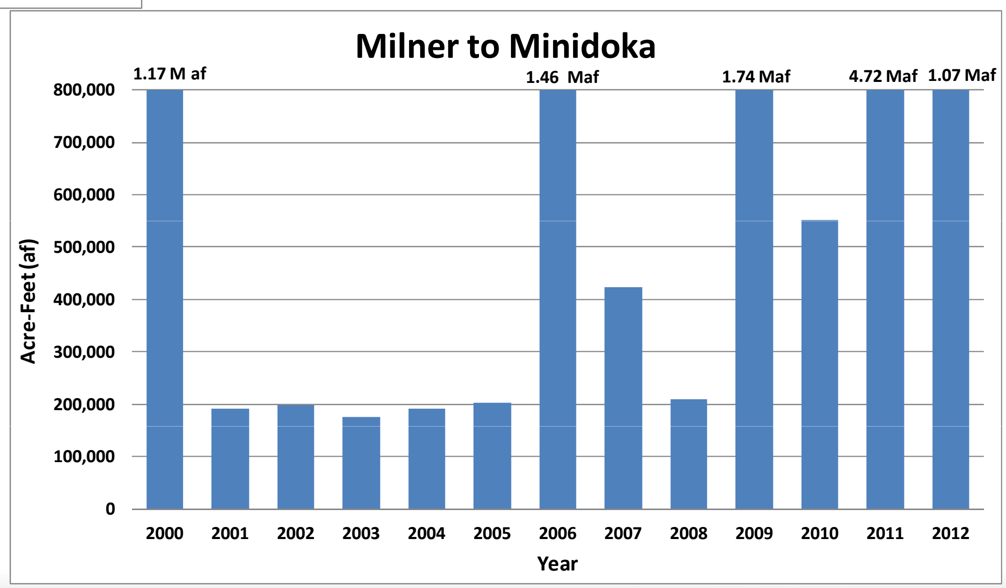
Percent of a 1-month recharge volume discharged at Rangen, summed for the first five years (63% of Rangen model cell).

Recharge with Available Natural Flow



Recharge modeled in Feb and Mar of ‘00, ‘06, ‘09, ‘11, ’12.

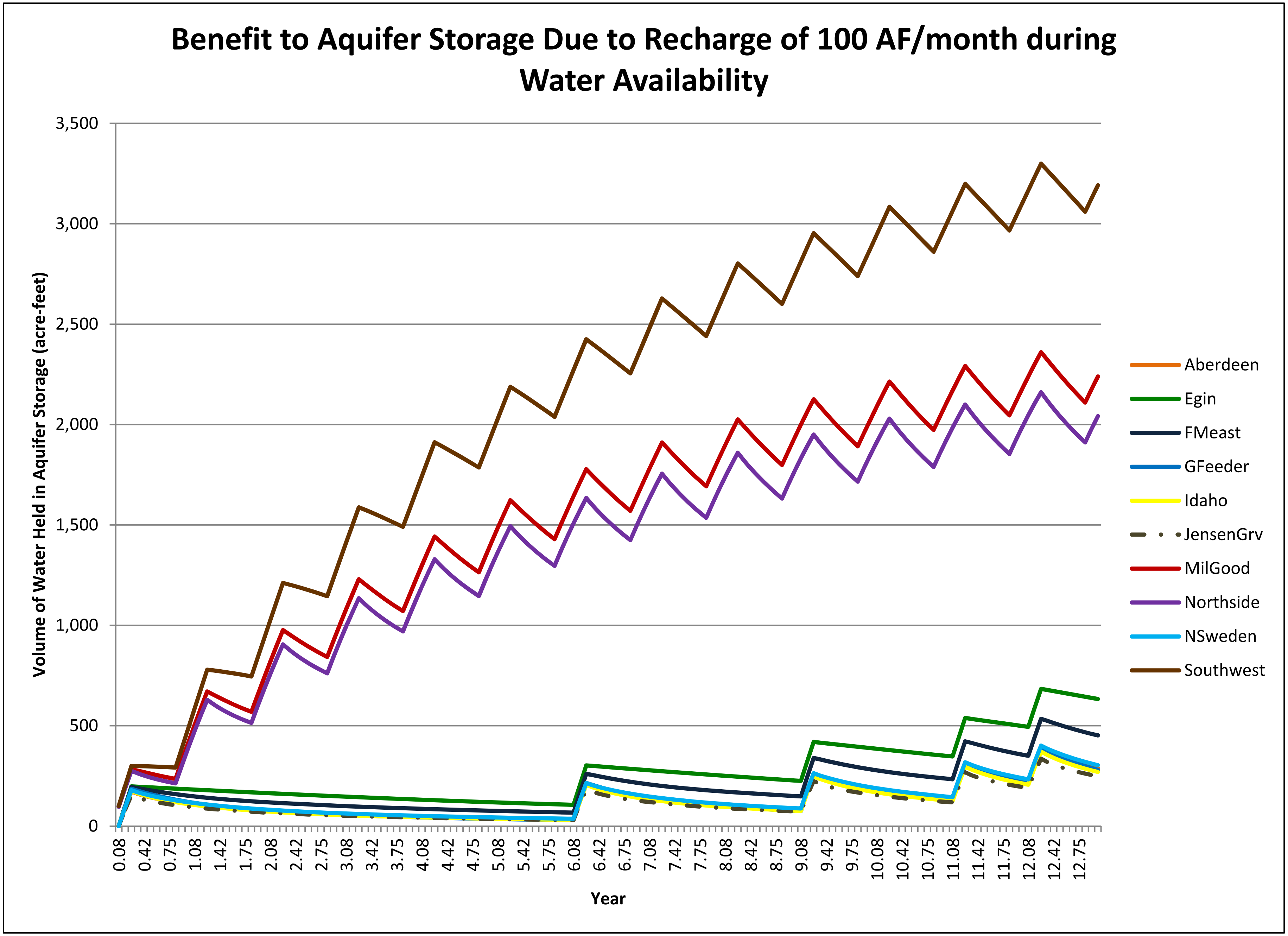
- Scenarios illustrate importance of consistency.



Recharge modeled in Nov, Dec, Jan, Feb, and Mar for 2000-2012.

Reservoir Analogue

- Increase the amount of water held in storage for use when we want it.
- This aquifer leaks.
  - This allows for the multiple uses that we have developed.
  - Can make recharge challenging.
- Want to maximize retention time.
  - This is how we maximize return on recharge investment.
- Successfully replenishing the “reservoir” makes everything better (water levels, river flows, spring discharge).



Benefit to Aquifer Storage Due to Recharge of 100 AF/month during Water Availability
Volume of Water Held in Aquifer Storage (acre-feet)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
Year
0.08
0.42
0.75
1.08
1.42
1.75
2.08
2.42
2.75
3.08
3.42
3.75
4.08
4.42
4.75
5.08
5.42
5.75
6.08
6.42
6.75
7.08
7.42
7.75
8.08
8.42
8.75
9.08
9.42
9.75
10.08
10.42
10.75
11.08
11.42
11.75
12.08
12.42
12.75
Aberdeen
Egin
FMeast
GFeeder
Idaho
JensenGrv
MilGood
Northside
NSweden
Southwest

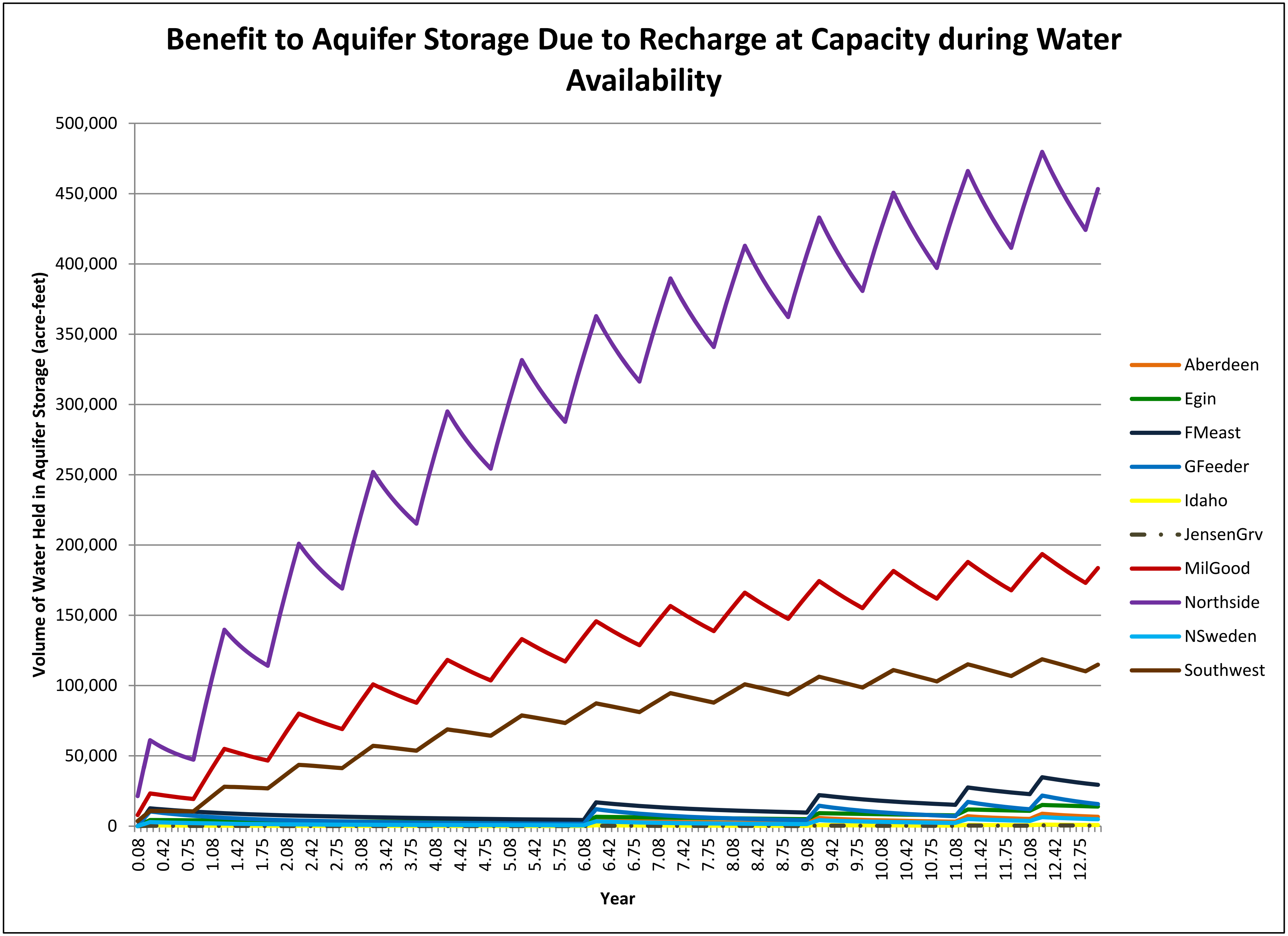
Incorporating Recharge Capacities

SPRING Physical Limitations to Recharge (acre-feet/month)			
Location	**Diversion Capacity**	**Infiltration Capacity**	**GW Capacity**
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	14,800	5,600	20,000
Idaho	1,000	300	8,500
JensenGrv	1,800	165	20,000
MilGood	46,500	8,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Southwest	3,600	3,600	20,000

Viewing mitigation effectiveness as a percentage of monthly recharge is instructive as to how the location of recharge affects aquifer storage.

To truly understand how a particular location can enhance aquifer storage, the amount of recharge must be considered.

Note: Some locations not listed.



Benefit to Aquifer Storage Due to Recharge at Capacity during Water Availability
Volume of Water Held in Aquifer Storage (acre-feet)
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
0.08
0.42
0.75
1.08
1.42
1.75
2.08
2.42
2.75
3.08
3.42
3.75
4.08
4.42
4.75
5.08
5.42
5.75
6.08
6.42
6.75
7.08
7.42
7.75
8.08
8.42
8.75
9.08
9.42
9.75
10.08
10.42
10.75
11.08
11.42
11.75
12.08
12.42
12.75
Year
Aberdeen
Egin
FMeast
GFeeder
Idaho
JensenGrv
MilGood
Northside
NSweden
Southwest

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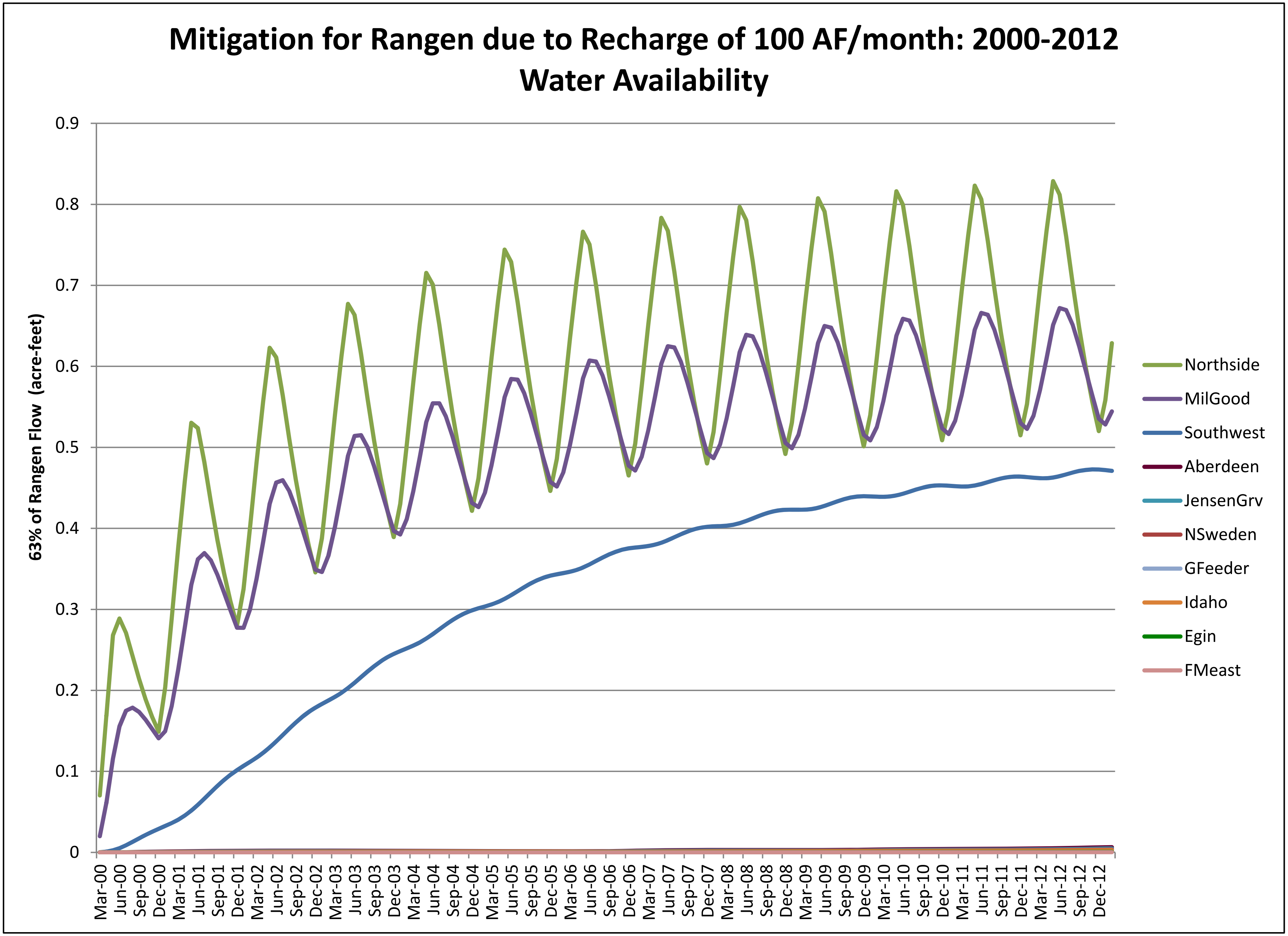
Mitigation

- Intended to offset junior-priority water uses to fulfill senior-priority water uses.
- This aquifer leaks.
    - Mitigation takes advantage of the leaky nature.
- Increase the amount of water discharged from certain springs.
- Increase reach gains (or reduce losses) in certain Snake River reaches.
- Very difficult to “steer” recharge to mitigation goal.
    - Increased focus equates to reduced retention time.



Mitigation for Rangen due to Recharge of 100 AF/month: 2000-2012
Water Availability
63% of Rangen Flow (acre-feet)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
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Mar-05
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Mar-08
Jun-08
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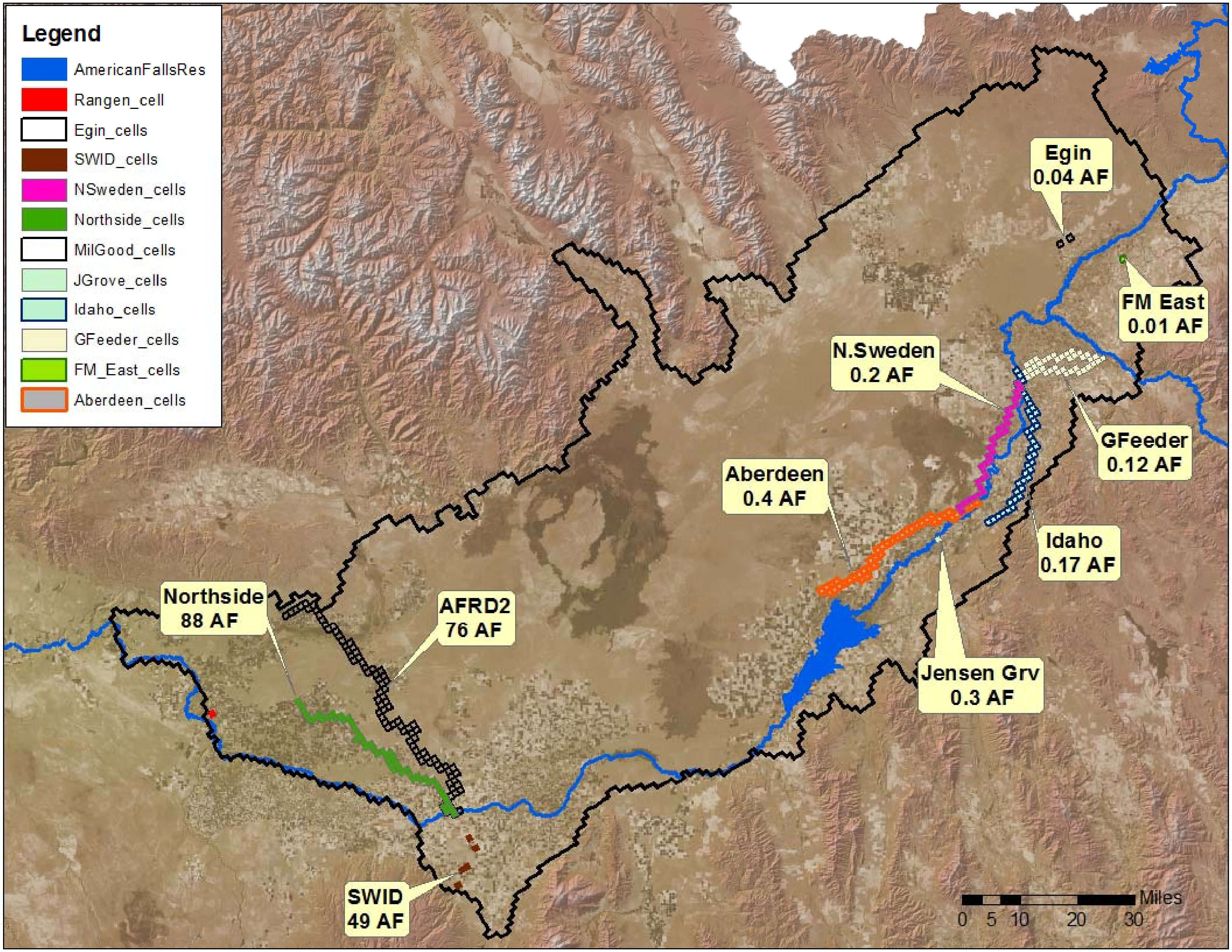
Jun-09
Sep-09
Dec-09
Mar-10
Jun-10
Sep-10
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Northside
MilGood
Southwest
Aberdeen
JensenGrv
NSweden
GFeeder
Idaho
Egin
FMeast



63 % of the volume of water discharged in the Rangen model cell due to 100 AF/month recharge, summed for the 13 years of record (2000-2012).

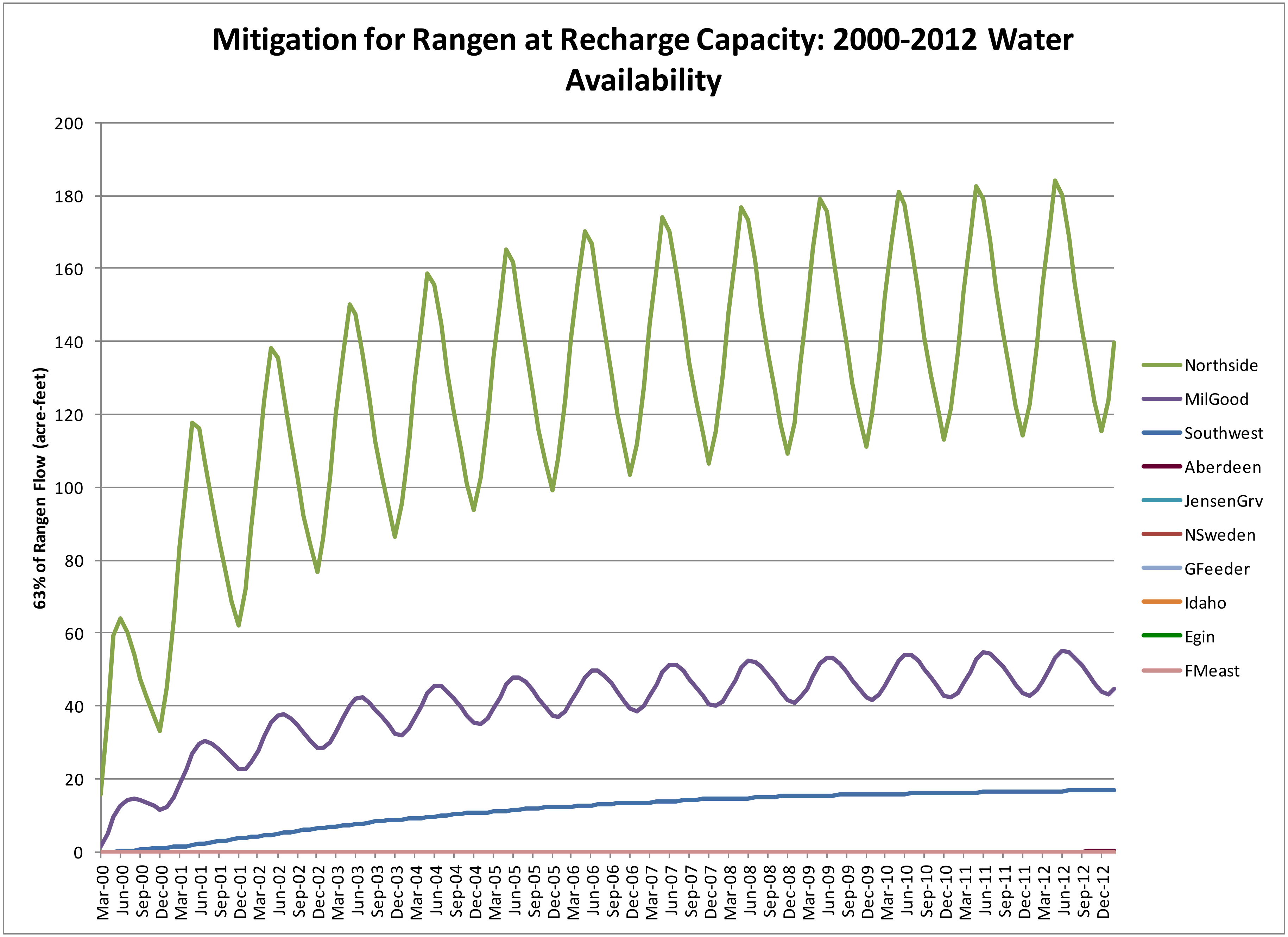
Incorporating Recharge Capacities

SPRING Physical Limitations to Recharge (acre-feet/month)			
Location	**Diversion Capacity**	**Infiltration Capacity**	**GW Capacity**
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	14,800	5,600	20,000
Idaho	1,000	300	8,500
JensenGrv	1,800	165	20,000
MilGood	46,500	8,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Southwest	3,600	3,600	20,000

Viewing mitigation effectiveness as a percentage of monthly recharge is instructive as to how the location of recharge affects mitigation.

To truly understand how a particular location can provide mitigation, the amount of recharge must be considered.

Note: Some locations not listed.



Mitigation for Rangen at Recharge Capacity: 2000-2012 Water Availability
63% of Rangen Flow (acre-feet)
200
180
160
140
120
100
80
60
40
20
0
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
Sep-04
Dec-04
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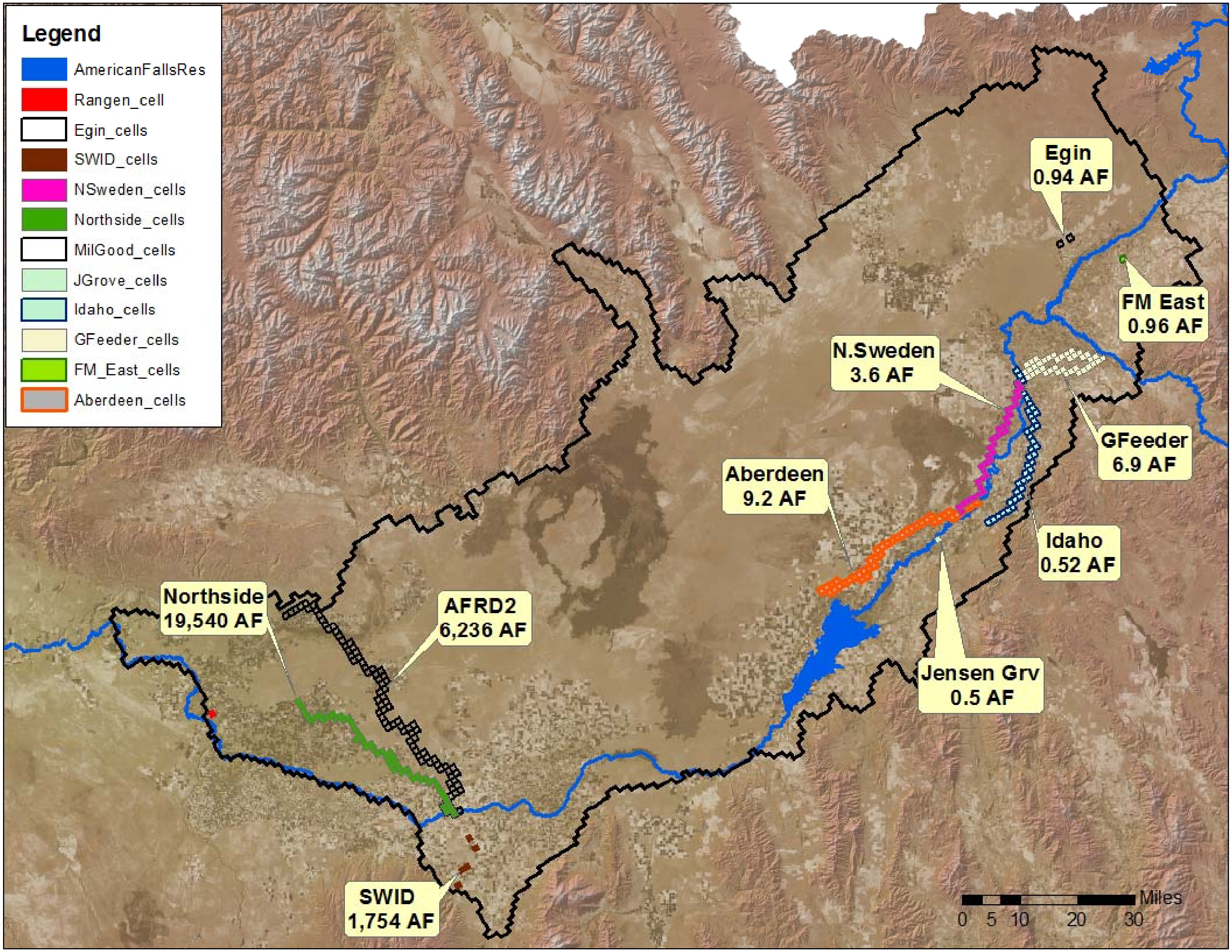
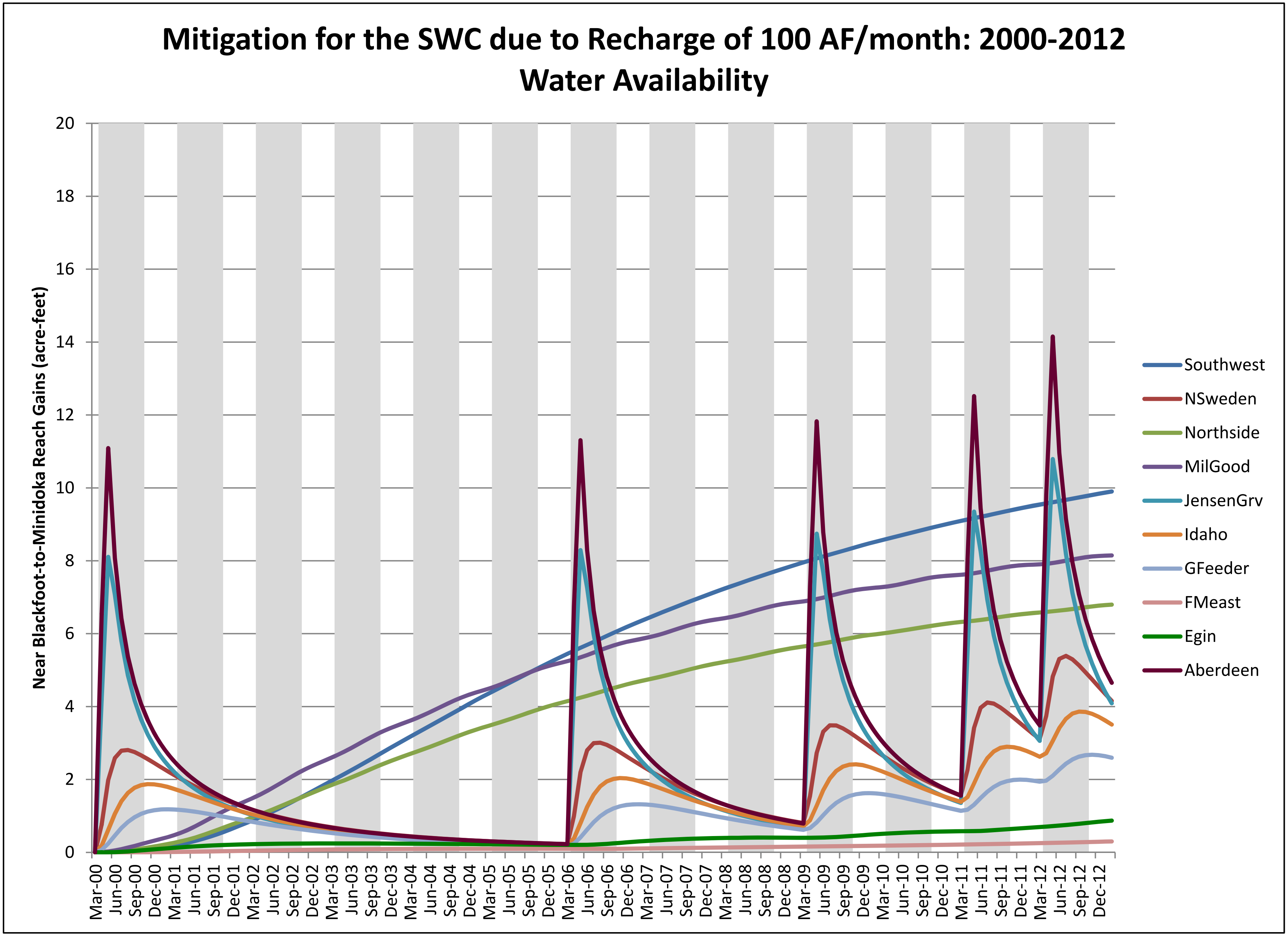
Dec-09
Mar-10
Jun-10
Sep-10
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Northside
MilGood
Southwest
Aberdeen
JensenGrv
NSweden
GFeeder
Idaho
Egin
FMeast



63 % of the volume of water discharged in the Rangen model cell due to recharge at location capacity, summed for the 13 years of record (2000-2012).



Mitigation for the SWC due to Recharge of 100 AF/month: 2000-2012
Water Availability
Near Blackfoot-to-Minidoka Reach Gains (acre-feet)
0
2
4
6
8
10
12
14
16
18
20
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
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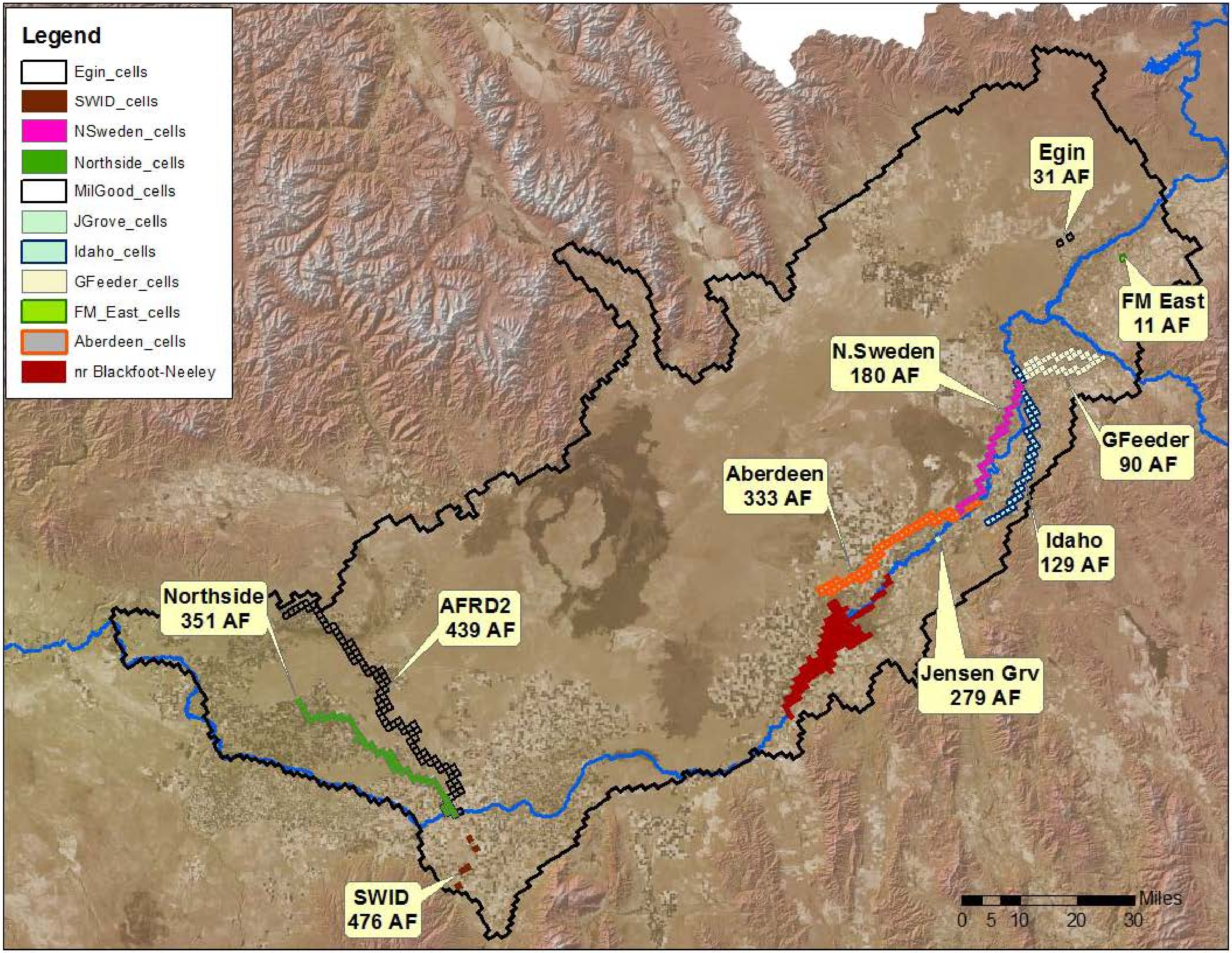
Jun-10
Sep-10
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Southwest
NSweden
Northside
MilGood
JensenGrv
Idaho
GFeeder
FMeast
Egin
Aberdeen



Volume of water discharged in the nr Blackfoot-to-Minidoka reach during the irrigation season due to 100 AF/month recharge, summed for the 13 years of record (2000-2012).

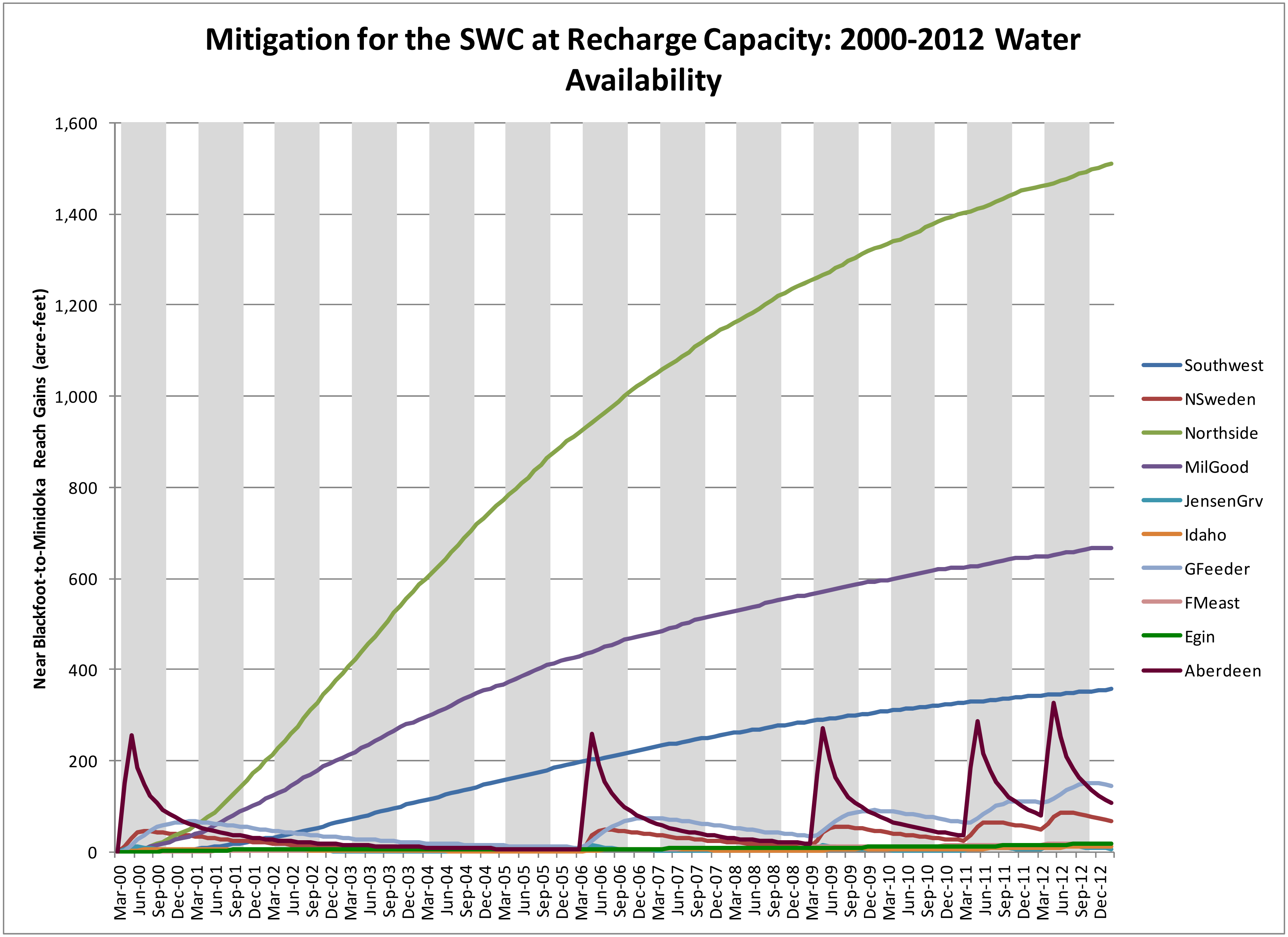
Incorporating Recharge Capacities

SPRING Physical Limitations to Recharge (acre-feet/month)			
Location	**Diversion Capacity**	**Infiltration Capacity**	**GW Capacity**
Aberdeen	10,900	6,600	2,300
Egin	15,300	2,200	5,000
FMeast	10,900	6,500	17,000
Gfeeder	14,800	5,600	20,000
Idaho	1,000	300	8,500
JensenGrv	1,800	165	20,000
MilGood	46,500	8,200	20,000
Northside	30,700	22,200	30,000
Nsweden	3,200	1,600	20,000
Southwest	3,600	3,600	20,000

Viewing mitigation effectiveness as a percentage of monthly recharge is instructive as to how the location of recharge affects mitigation.

To truly understand how a particular location can provide mitigation, the amount of recharge must be considered.

Note: Some locations not listed.



Mitigation for the SWC at Recharge Capacity: 2000-2012 Water Availability
Near Blackfoot-to-Minidoka Reach Gains (acre-feet)
1,600
1,400
1,200
1,000
800
600
400
200
0
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Mar-03
Jun-03
Sep-03
Dec-03
Mar-04
Jun-04
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Mar-05
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Mar-08
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Dec-08
Mar-09
Jun-09
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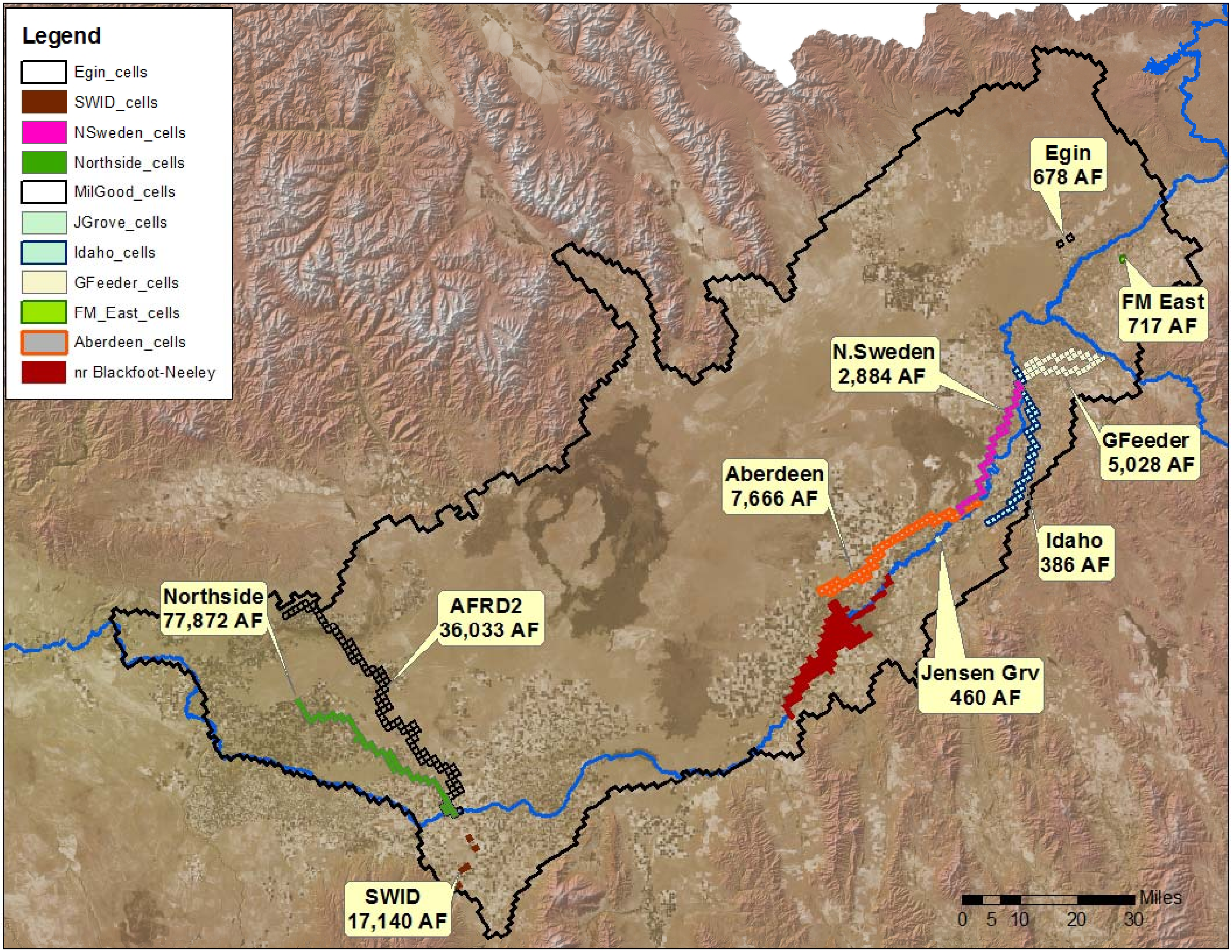
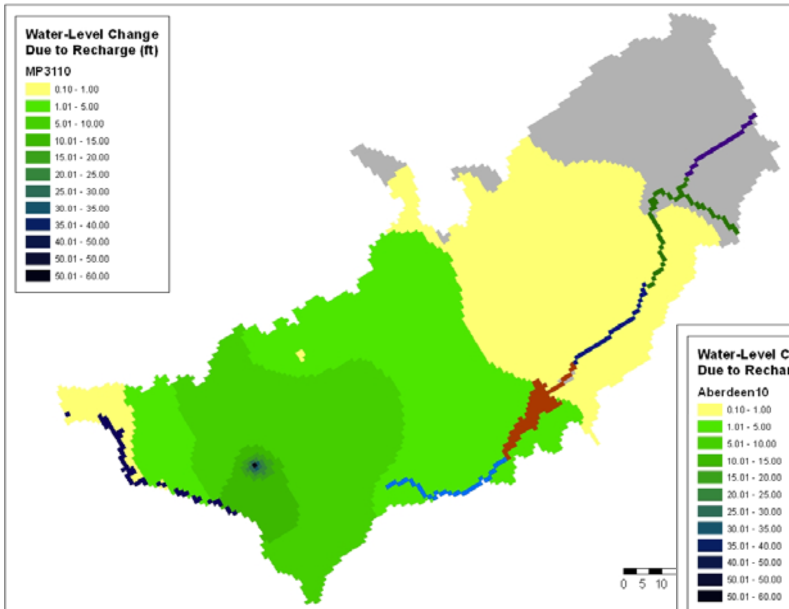
Dec-09
Mar-10
Jun-10
Sep-10
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Southwest
NSweden
Northside
MilGood
JensenGrv
Idaho
GFeeder
FMeast
Egin
Aberdeen

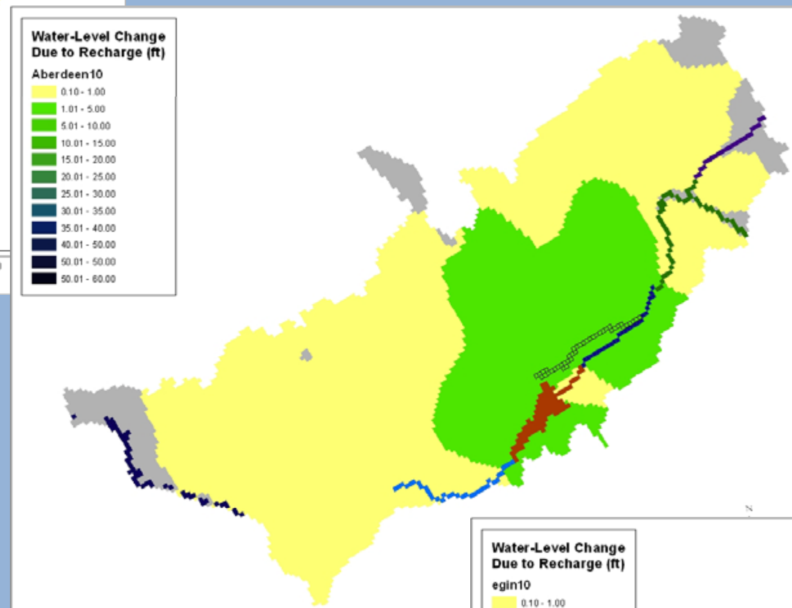


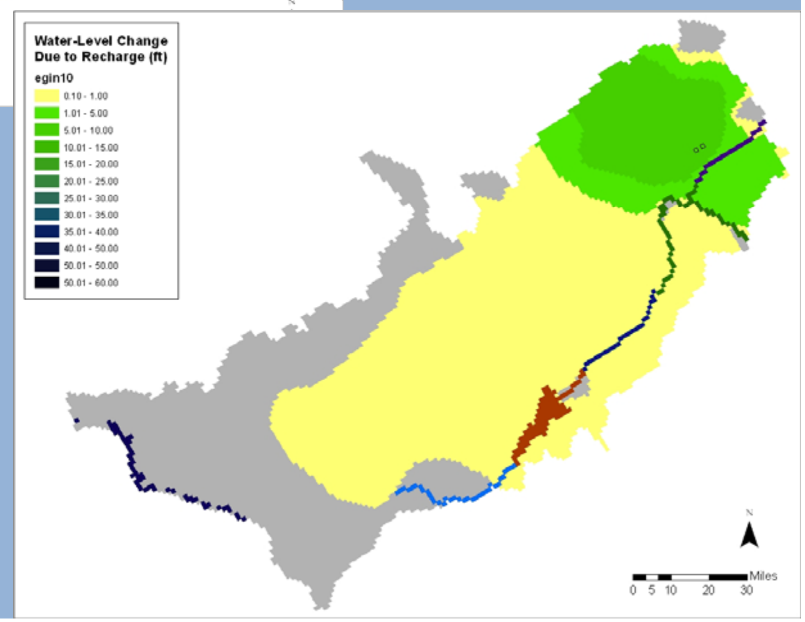
Volume of water discharged in the nr Blackfoot-to-Minidoka reach during the irrigation season due to recharge at capacity, summed for the 13 years of record (2000-2012).

Lets put it all together

Recharge at 100,000 AF/yr is instructive; Illustrating how the aquifer responds to Recharge.







100,000 AF/yr allows us to see how the aquifer Properties influence Recharge Benefits.

- •Location is key
- •Mud Lake “Barrier” and Great Rift
- •Proximity to connected river reach

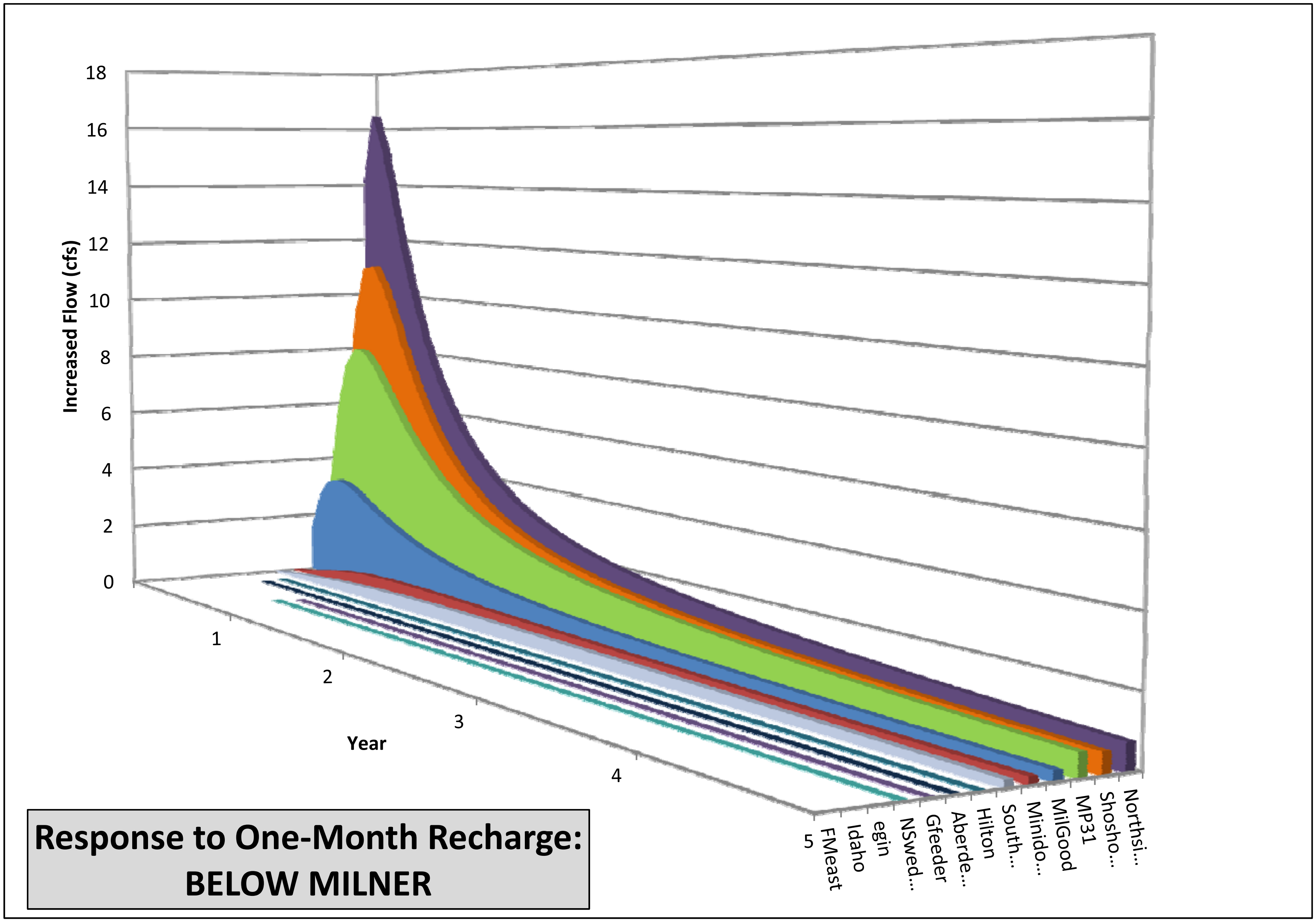
Important Points to Remember about Recharge

- **Location, Location, Location.**
  - Location relative to the goal.
  - Location relative to hydrologic controls.
    - Connection to Snake River (confluence, Blackfoot-Neeley, K-Springs).
  - Location relative hydrogeology.
    - Shallow groundwater, perched aquifer, impermeable material.
- **Consistency is the KEY.**
- **Volume is an (not the) important component.**

- Some things can be changed.
  - Diversion volume, new structures, new PODs, new wells.
- Some things cannot be changed.
  - Retention time, discharge location and timing, shallow groundwater.

Any Questions?

Spring-flow response to recharge at location capacity



Ultimate fate of recharged water (at location capacity)