Streamgage HUC Health Draft-

In WY2009, the USGS operated 7,825 continuous streamgages, of which 7,575 are located in the lower 48 states. (An active, continuous streamgage is one that publishes at least 355 days of daily-value discharge data.)

There are 2102 hydrologic cataloging units (HUC 8) in the lower 48 states, and 1704 HUC 8's have at least one active continuous stream gage **(fig. 1)**

Of the 7,825 active streamgages, 4,502 are long-term streamgages with at least 30 years of record. Of the 2102 HUC 8s in the lower 48 states, 1558 HUC 8's have at least one long-term active continuous streamgage **(fig. 2)**

Streamgages have been identified as having natural flow conditions in the basin, (Falcone, 2010). 1,190 out of the 1,848 natural flow streamgages are continuous active streamgages. Of the 2102 HUC 8's in the lower 48, 710 HUCs have at least one natural flow continuous active streamgage. **(fig. 3)** Also, 549 HUC8's have at least one natural flow long-term continuous active streamgages. **(fig 4.)**

Selecting the HUC8 outlet streamgage - The outlet stream-reach of each HUC 8 has been identified in the Enhanced River Reach 2.0 stream network, (Nolan, 2002); with the exception of some costal HUCs where multiple outlets sometimes exist. The outlet stream-reach was determined by selecting the reach in each HUC8 with the largest total drainage area attribute assigned. Then, all continuous active streamgages were linked to stream reach they gage, which assigns the streamgage to the proper stream reach.
Streamgages on the outlet stream reaches were then selected. If a streamgage did not exist on the HUC outlet stream reach, a program was written that then used the next upstream stream reach in the stream network and tried to find a streamgage on this upstream reach. If a streamgage was still not selected, the program used the next downstream reach from the HUC outlet stream reach to find a streamgage.

Once a gage was selected, the reported drainage area assigned to the streamgages was compared with the total area of the HUC 8. The DA of the streamgage had to be larger then 90% of the total area of the HUC. Streamgages that did not have a reported DA in NWIS, the DA derived using the NHDPlus, by Mike Wieczorek, was then used.

Of the 2102 HUC 8's in the lower 48, 819 have a continuous active stream near the HUC 8 outlet. 642 of these streamgages are long-term and 76 are also in a non-regulated, natural flow basin. **(fig 5.)**

A streamgage score for each HUC 8 was determined by:

1 point for every active streamgage
1 point for each long-term streamgage
1 point for each non-regulated streamgage
1 point for each HUC outlet streamgage

The total number of points of each HUC 8 is shown in figures 6 and 7. Both figures use the exact same scoring data but displayed 2 ways. **Fig 6** uses the quantile classification scheme, where each category has the same number of HUCs,; and **fig. 7** uses a natural break classification scheme, which highlights the HUCs with the most points.

Excerpt from:

Falcone, J.A., Carlisle, D.M., Wolock, D.M., and Meador, M.R., 2010. GAGES: A stream gage database for evaluating natural and altered flow conditions in the conterminous United States, *Ecology*, 91 (2), p 621; Data Paper in Ecological Archives E091-045-D1; available online at: http://esapubs.org/Archive/ecol/E091/045/default.htm.

"The first was a hydrologic disturbance index (Falcone et al. 2009) based on seven GIS-generated variables that indicated anthropogenic disturbance of stream flow. The variables were: presence of major dams in the watershed (MAJ_DDENS_2006), change in reservoir storage from 1950–2006 (STOR_2006 - PRE1950_STOR), percentage of streamlines coded canals/ditches/pipelines/artificial_path in the watershed (CANALS_PCT + ARTIFPATH_PCT), road density in the watershed (ROADS_KM_SQ_KM), distance of stream gage to nearest major pollutant discharge site (RAW_DIS_NEAREST_MAJ_NPDES), county-level fresh-water withdrawal estimate (WATER_WITHDR), and fragmentation of undeveloped land in the watershed (FRAGUN_WATERSHED). Stream gages were assigned from 0 to 8 points for each variable based on their percentile value within the data range for all records, then those points were summed for all seven variables, providing an index which ranged from 0 (least likely to have hydrologic disturbance) to 56 (most likely). The index scores were a global metric, calculated the same way for all 6,785 records, but interpreted within the context of individual regions (described below). The index scores were not used as a strict screen; i.e., the scores did not automatically qualify or disqualify a stream gage being classified as a reference watershed, but rather, they were used as one indicator of hydrologic alteration. *The spreadsheet in which the disturbance index scores were calculated is included in the zipped data file package, as a convenience*.

Secondly, we used 7.5' digital topographic maps and imagery to make qualitative observations of each drainage watershed. Topographic maps were searched for evidence of hydrologic alteration and other human activities near the stream gage. We located

each stream gage using Google Earth™ imagery (most imagery post-2000 and typical spatial resolution 1 to 2 m) and examined each watershed and, in particular, the land adjacent to the mainstem and major tributary channels. These images provided evidence of irrigated agriculture (and possible groundwater pumping or streamflow diversions) proximal to or upstream from stream gages. The presence of recently constructed reservoirs also was evident. Further, diversion structures, dams, and constructed channels were often readily visible in high-resolution images. It is noted, however, that it is not possible by visual examination of topographic maps and (even high-resolution) imagery to observe every aspect of flow alteration, particularly very small diversions, wells, and elements of groundwater pumping.

The third source of information for classifying stream gages was local expert judgment about the site as published in USGS Annual Water Data Reports (U.S. Geological Survey, 2008*e*). Most annual data reports (ADRs) provide information about whether and how streamflow at each stream gage is influenced by regulation (e.g., dams) or diversions (e.g., canals, pipelines, or water withdrawals). We searched reports for the most recent water year in both electronic ADRs (available for the years 2002–2007 for approximately 40% of stream gages in this report), and paper reports (the remaining 60%) for every stream gage, and we recorded any information about regulation and diversions."

Supplementary information was used to identify stream gages that were potentially influenced by streamflow withdrawal for irrigation in arid watersheds. For this subset of stream gages we estimated average streamflow withdrawal for the period 1951–2000, by comparing the measured mean monthly discharge for each stream gage to predictions of mean monthly discharge as estimated from a water balance model (Wolock and McCabe, 1999) for the same period. The water balance model estimates the expected runoff based on climatic conditions but does not account for factors such as land use, water use, or water regulation. We concluded that streamflow withdrawal was severe (and therefore disqualified a stream gage as possible reference quality) if the ratio of observed to expected monthly flows during the growing season (May–September) was << 1.

1704 Hydrologic Cataloging Units (HUC8) with at least one Active Streamgage

(Total 2102 HUCs in Lower 48 States)

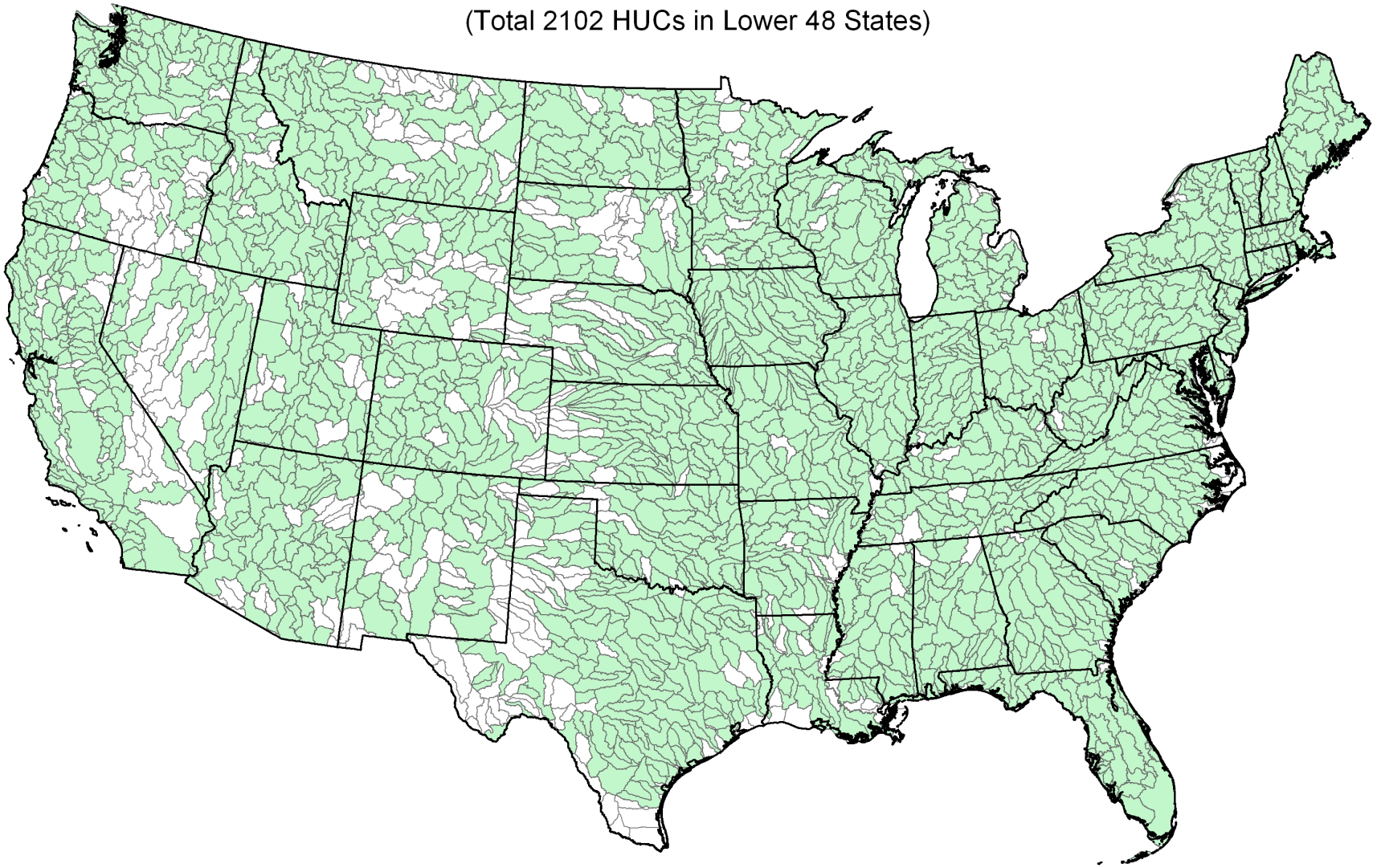


Fig. 1

1558 Hydrologic Cataloging Units (HUC8) with at least one Long-term Active Streamgage

(Total 2102 HUC 8's in Lower 48 States)

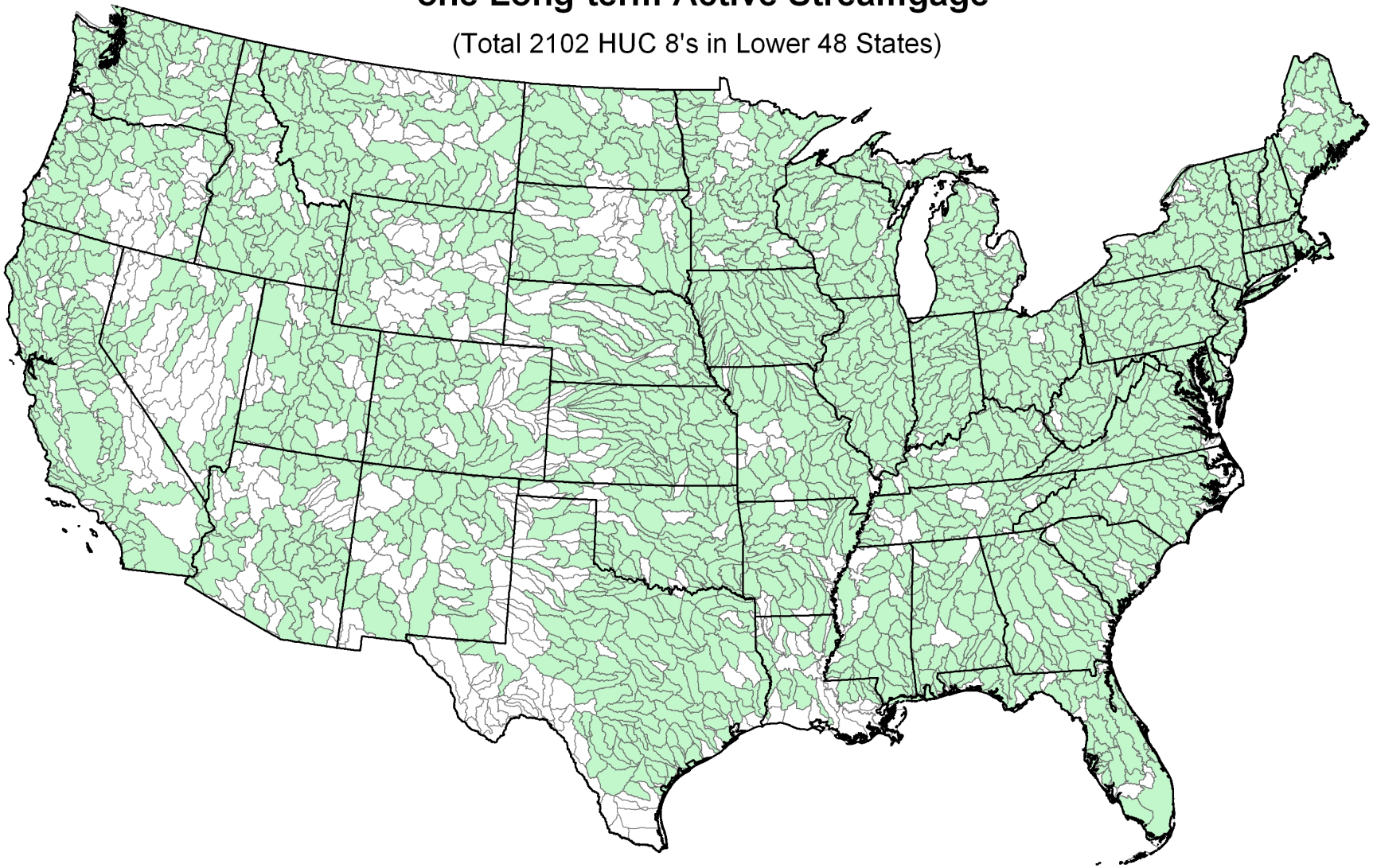


Fig. 2

710 Hydrologic Cataloging Units (HUC8) with at least one Natural Flow Active Streamgage

(Total 2102 HUC 8's in Lower 48 States)

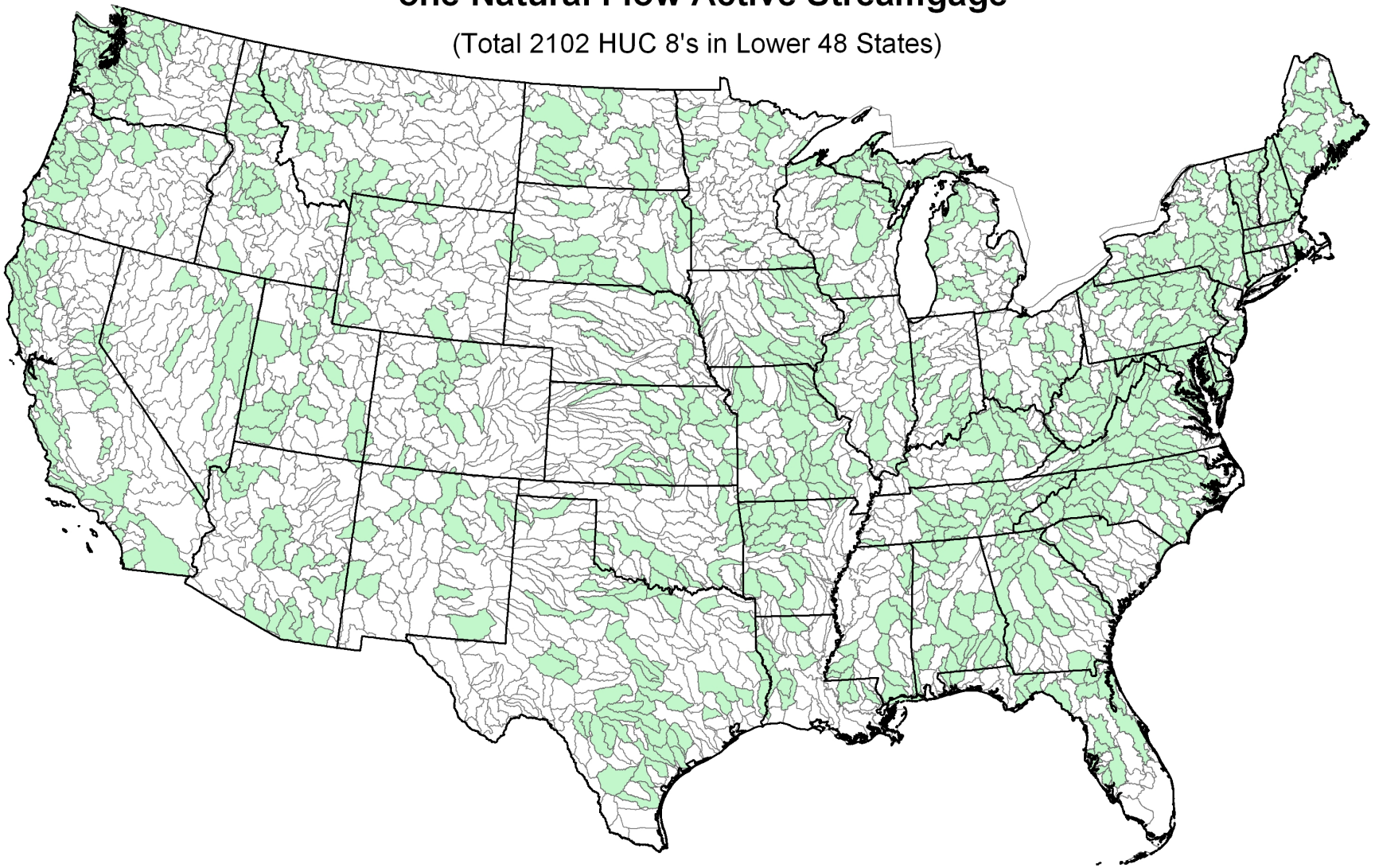


Fig. 3

549 Hydrologic Cataloging Units (HUC8) with at least one Long-term Active Non-regulated Streamgage

(Total 2102 HUC 8's in Lower 48 States)

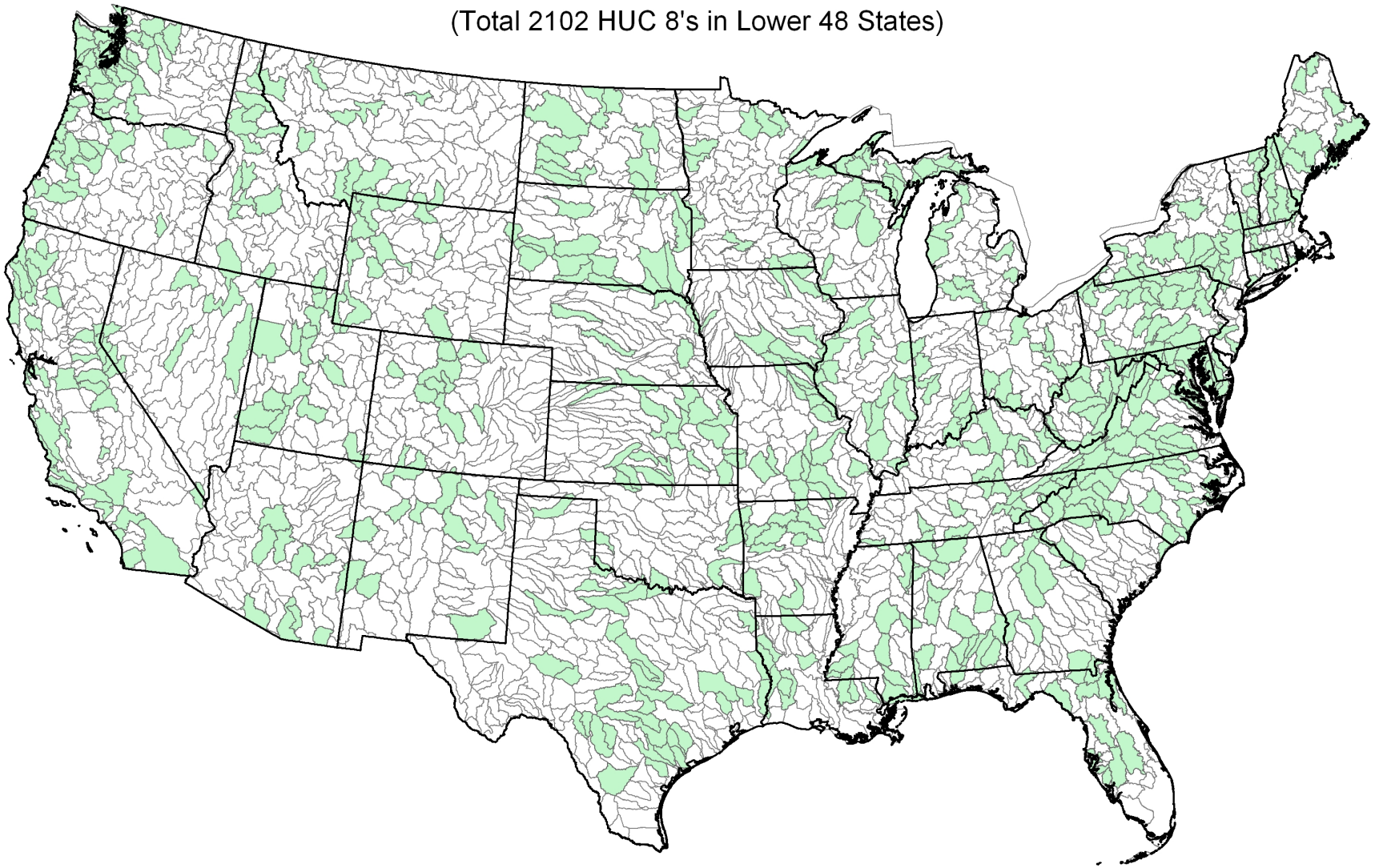


Fig. 4

819 Hydrologic Cataloging Units (HUC8) with Active Streamgage Near Outlet

(Total 2102 HUC 8's in Lower 48 States)

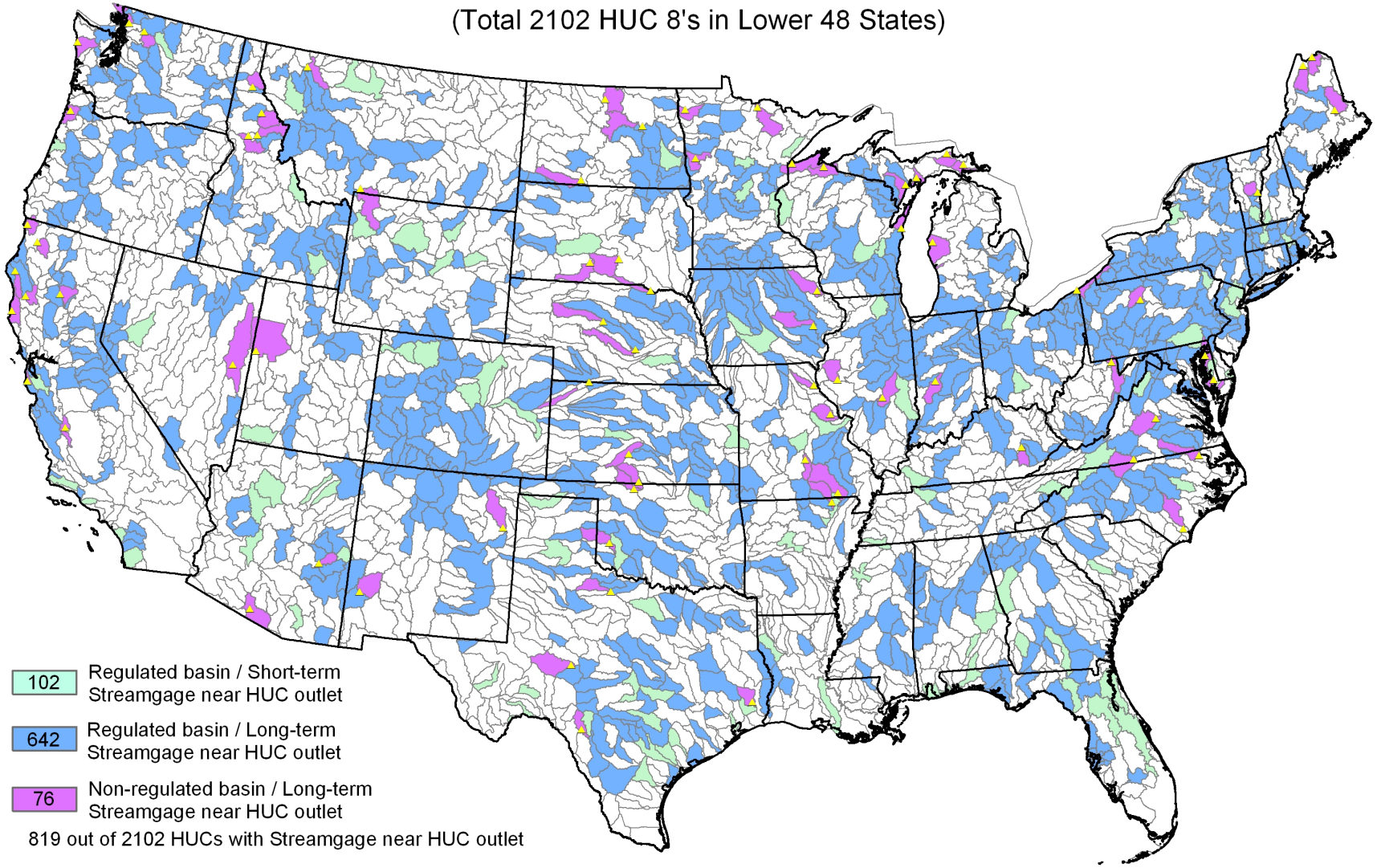


Fig. 5

Hydrologic Cataloging Unit Streamgage Score

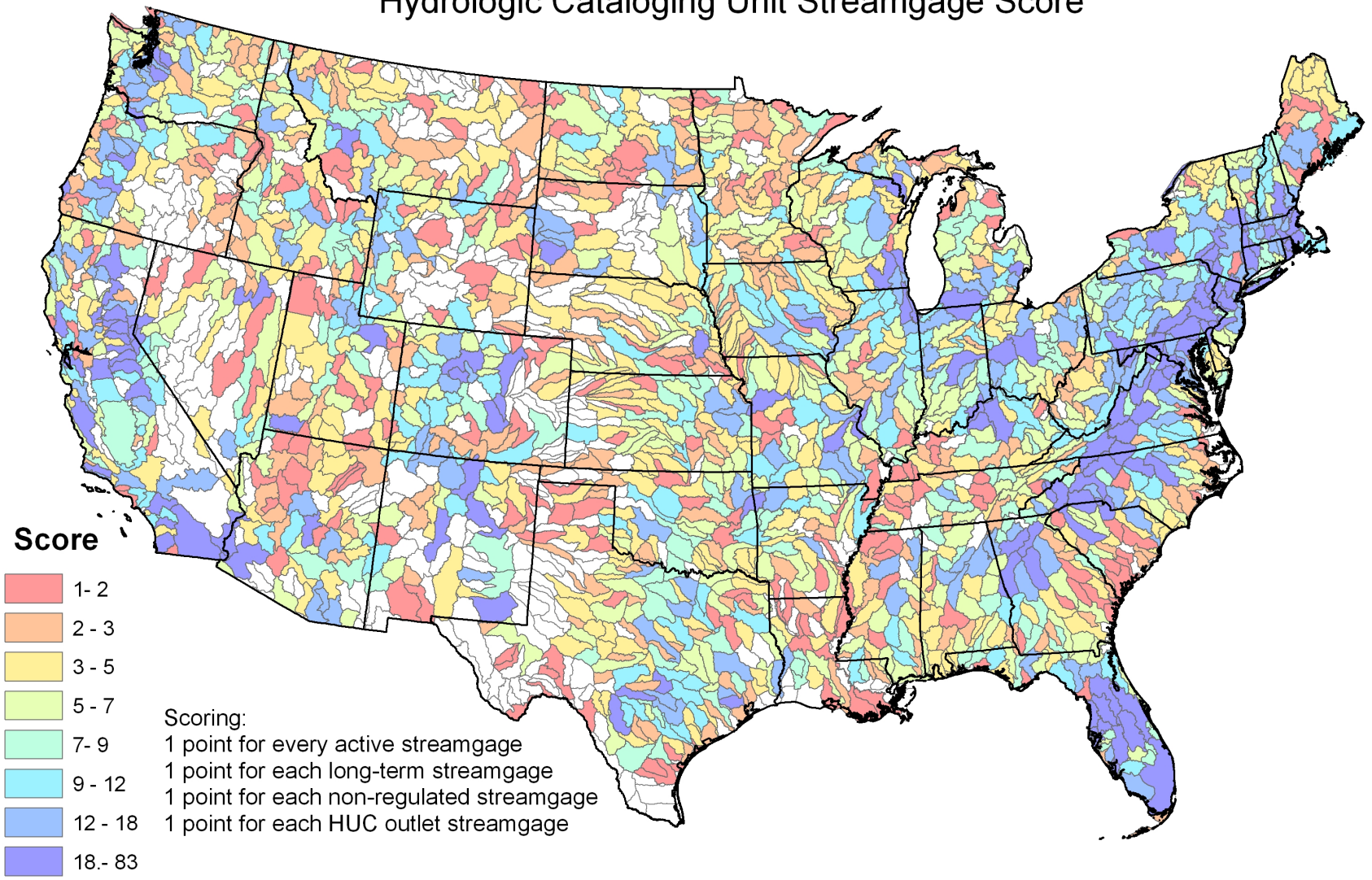


Fig. 6

Hydrologic Cataloging Unit Streamgage Score

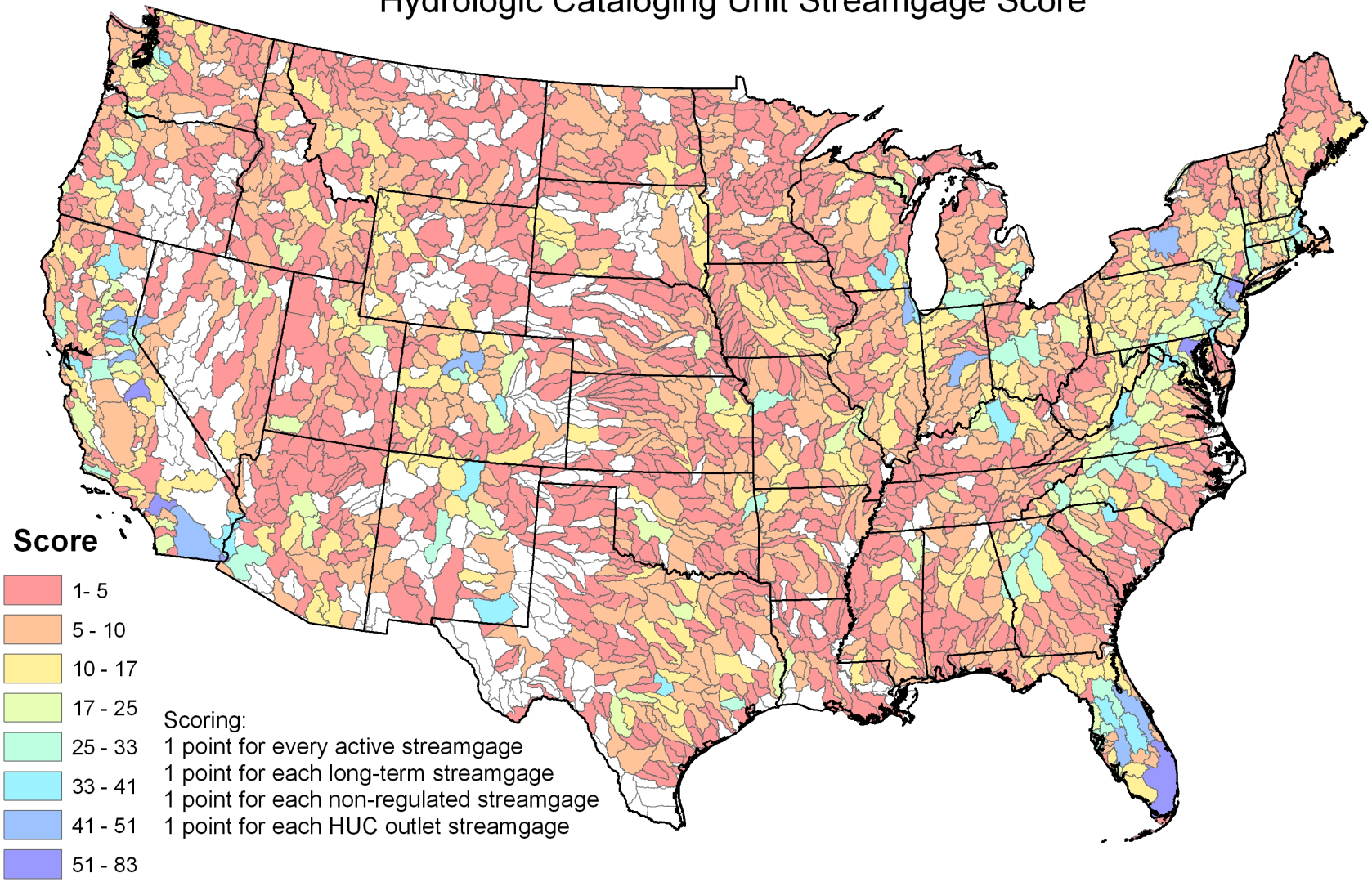


Fig. 7

1704 Hydrologic Cataloging Units (HUC8) with at least one Active Streamgage

(Total 2102 HUCs in Lower 48 States)

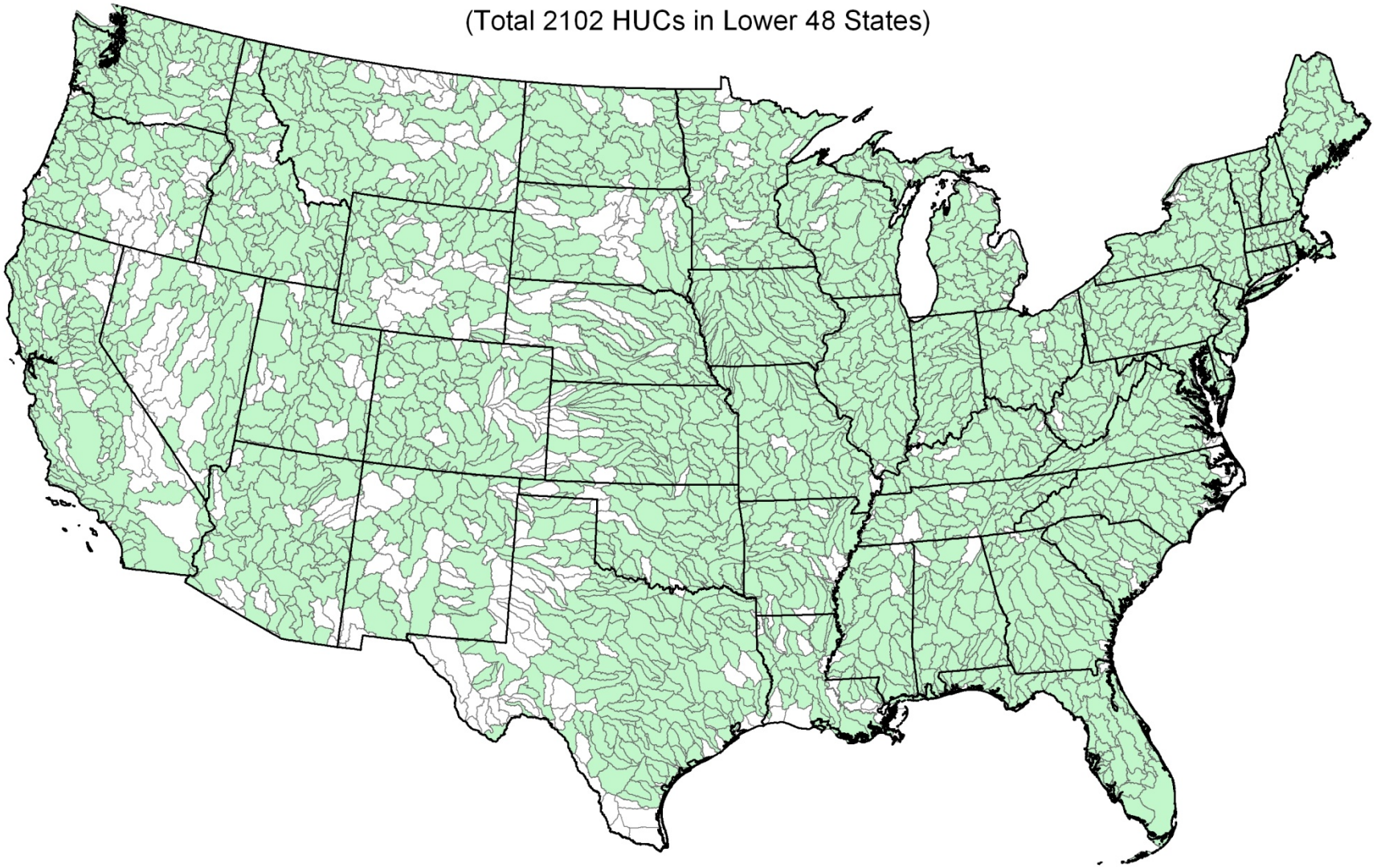


Fig. 1

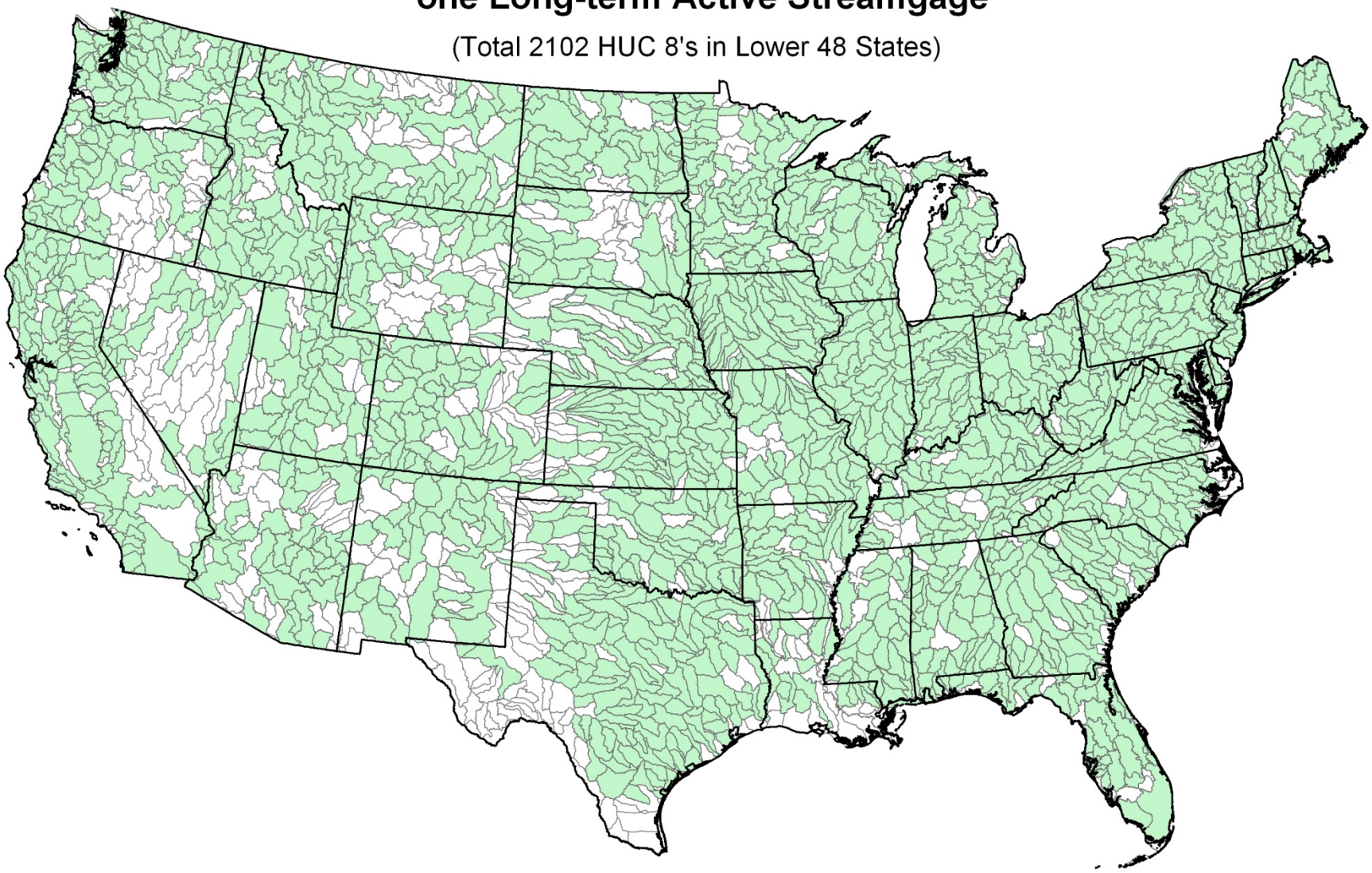

1558 Hydrologic Cataloging Units (HUC8) with at least one Long-term Active Streamgage
(Total 2102 HUC 8's in Lower 48 States)

Fig. 2

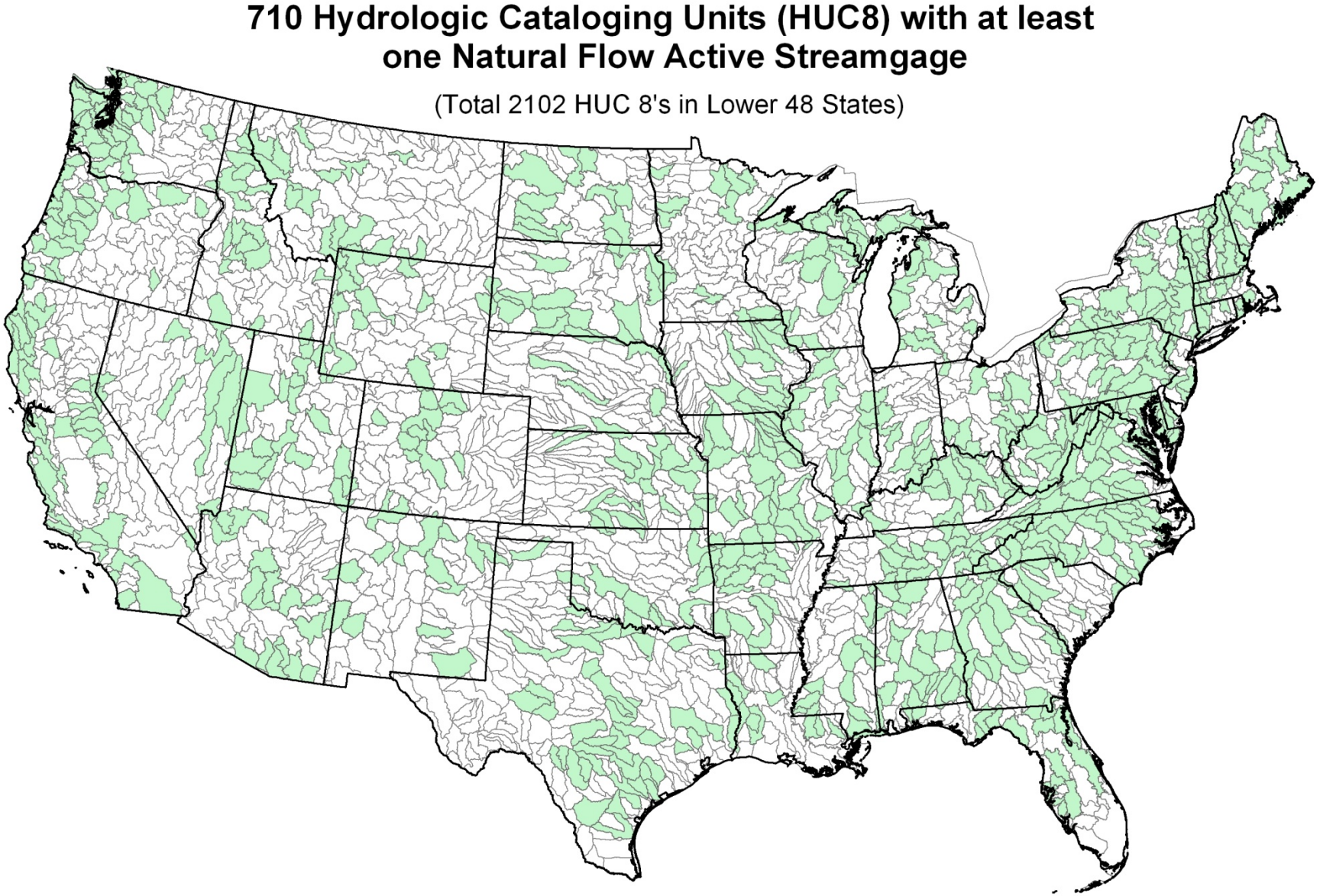

710 Hydrologic Cataloging Units (HUC8) with at least one Natural Flow Active Streamgage
(Total 2102 HUC 8's in Lower 48 States)

Fig. 3

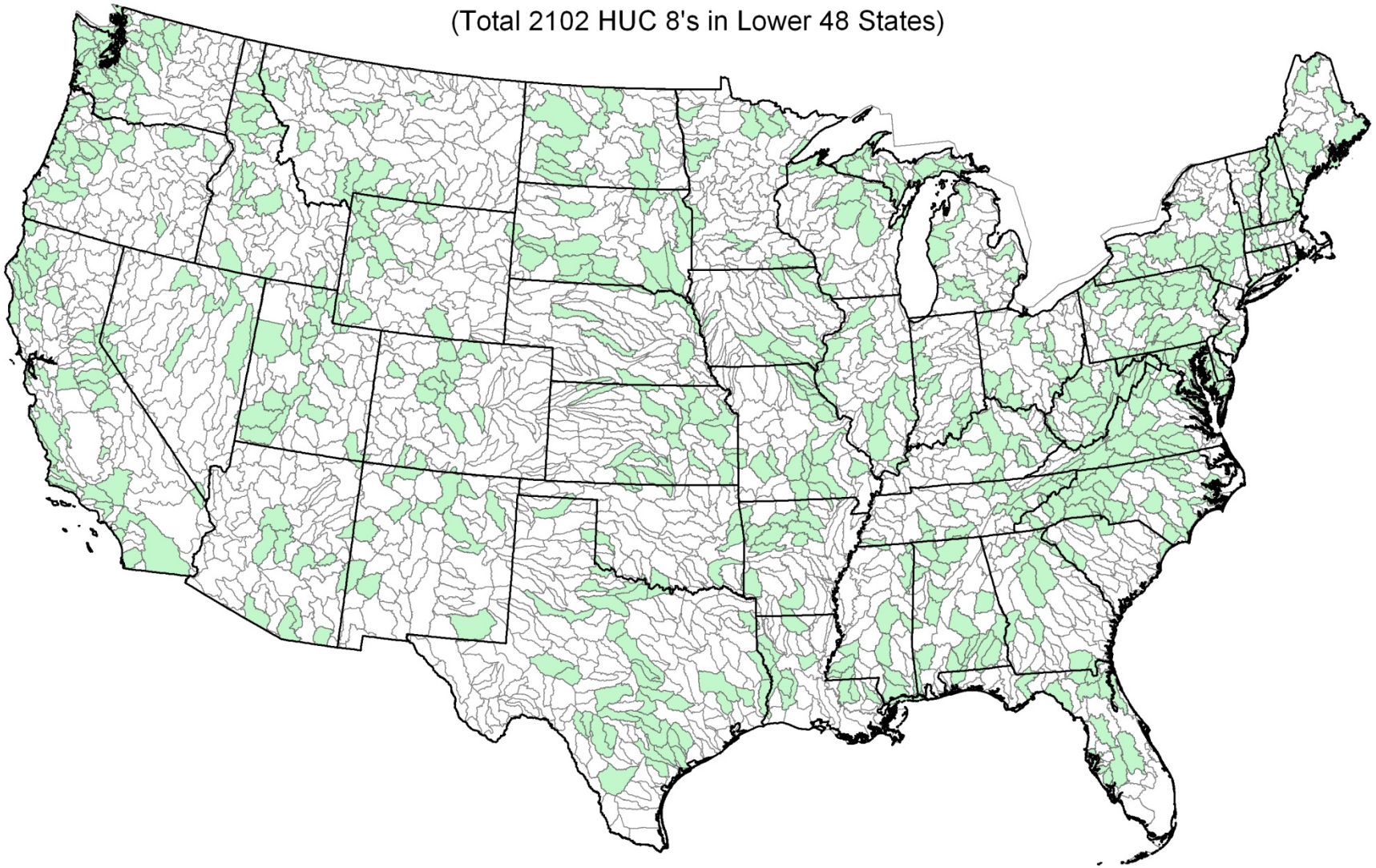

549 Hydrologic Cataloging Units (HUC8) with at least one
Long-term Active Non-regulated Streamgage
(Total 2102 HUC 8's in Lower 48 States)

Fig. 4

819 Hydrologic Cataloging Units (HUC8) with Active Streamgage Near Outlet

(Total 2102 HUC 8's in Lower 48 States)

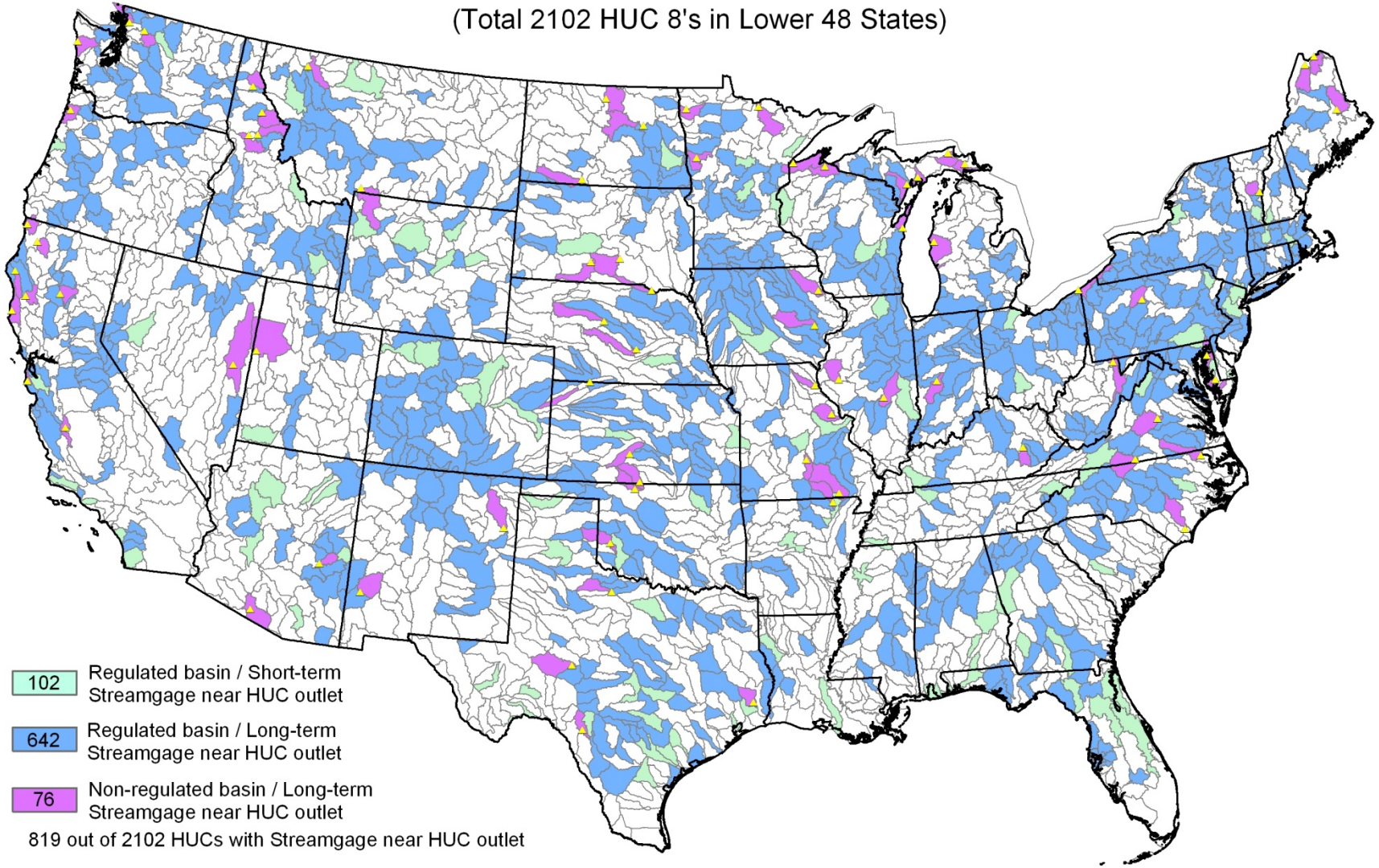


Fig. 5

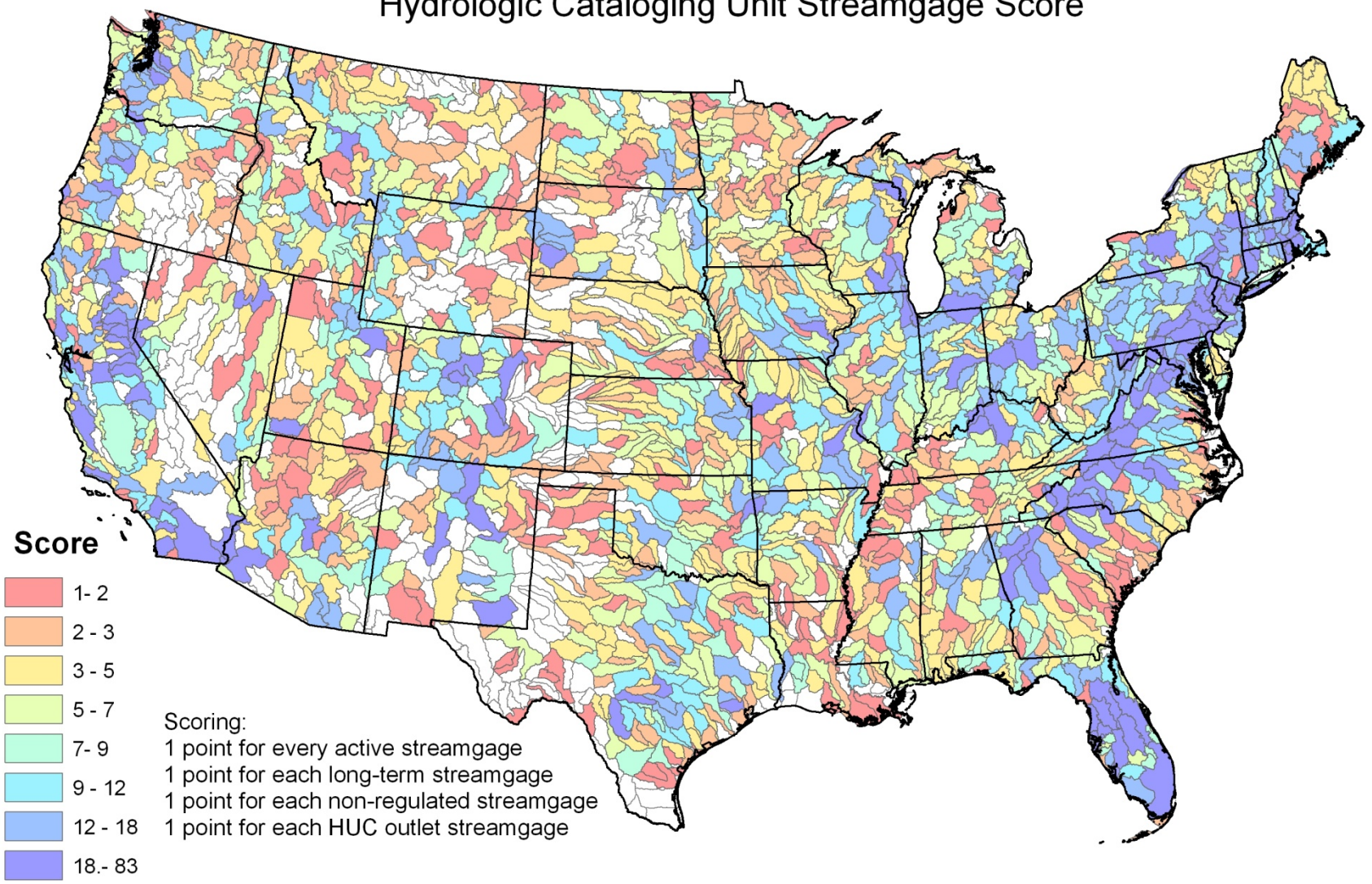

Hydrologic Cataloging Unit Streamgage Score
Score
1- 2
2 - 3
3 - 5
5 - 7
7- 9
9 - 12
12 - 18
18.- 83
Scoring:
1 point for every active streamgage
1 point for each long-term streamgage
1 point for each non-regulated streamgage
1 point for each HUC outlet streamgage

Fig. 6

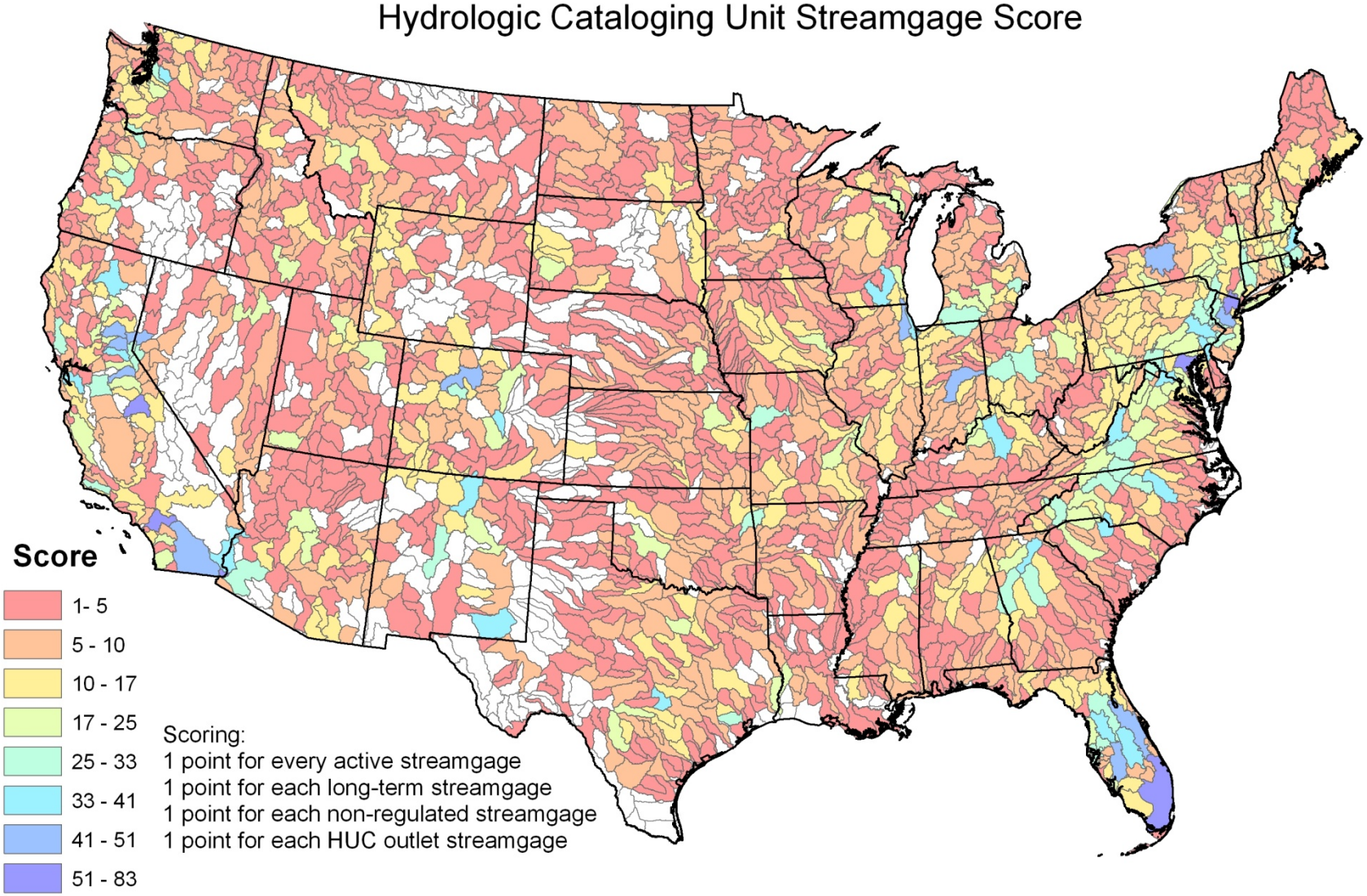
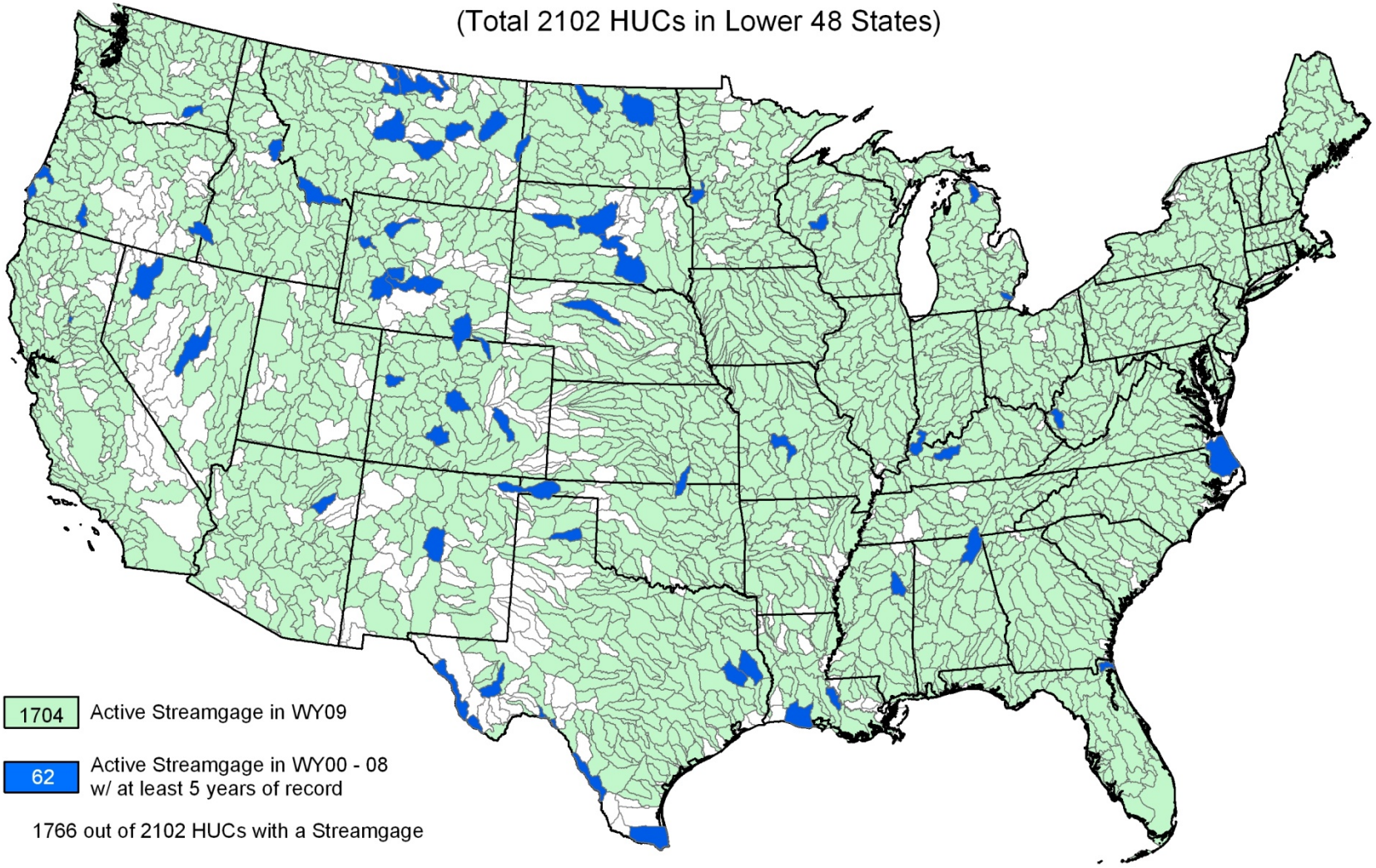

Hydrologic Cataloging Unit Streamgage Score
Score
1- 5
5 - 10
10 - 17
17 - 25
25 - 33
33 - 41
41 - 51
51 - 83
Scoring:
1 point for every active streamgage
1 point for each long-term streamgage
1 point for each non-regulated streamgage
1 point for each HUC outlet streamgage

Fig. 7

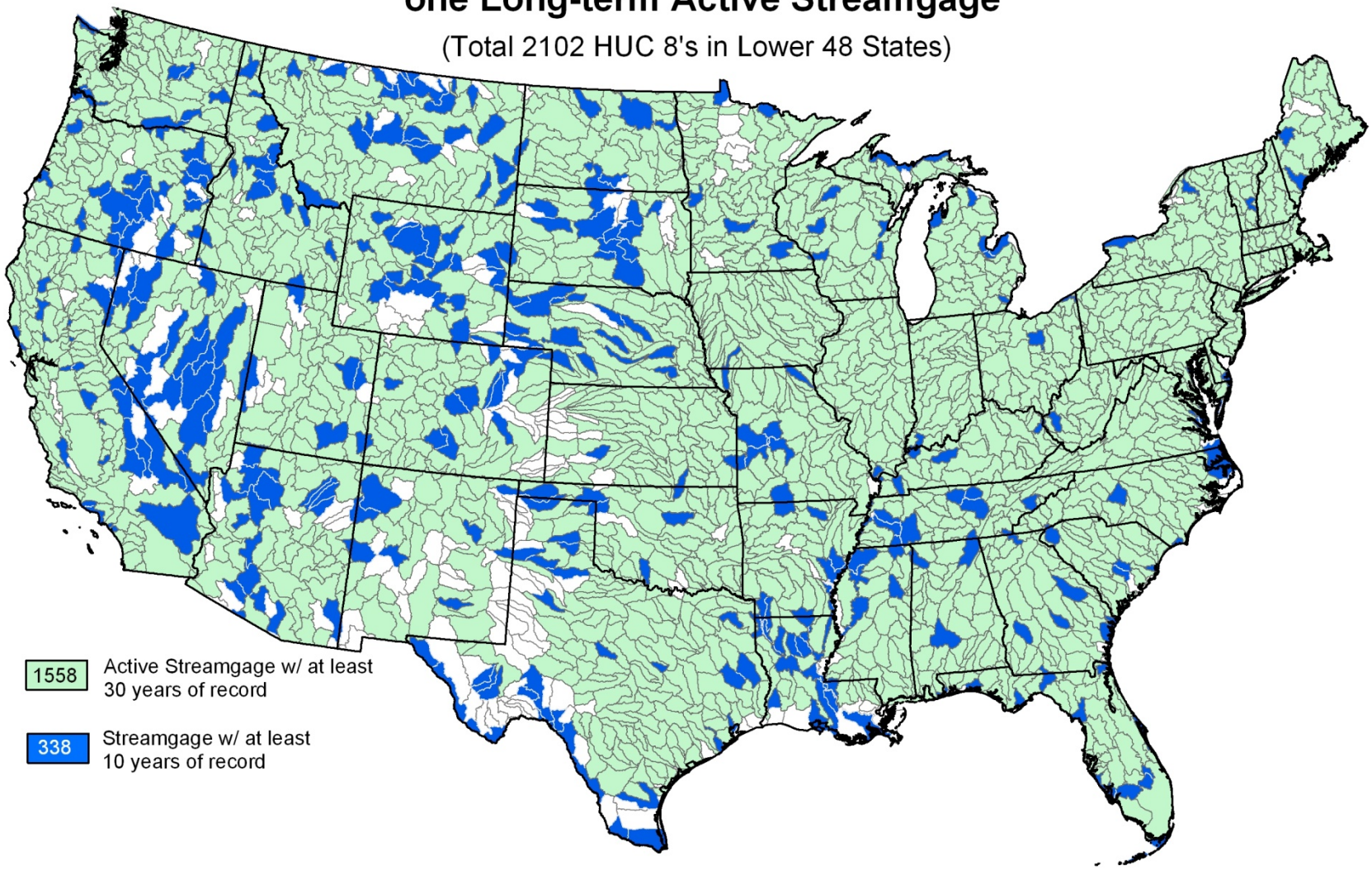
Hydrologic Cataloging Units (HUC8) with at least one WY09 Active Streamgage or WY00 - 08 Active Streamgage, w/ at least 5 Years of Record

(Total 2102 HUCs in Lower 48 States)



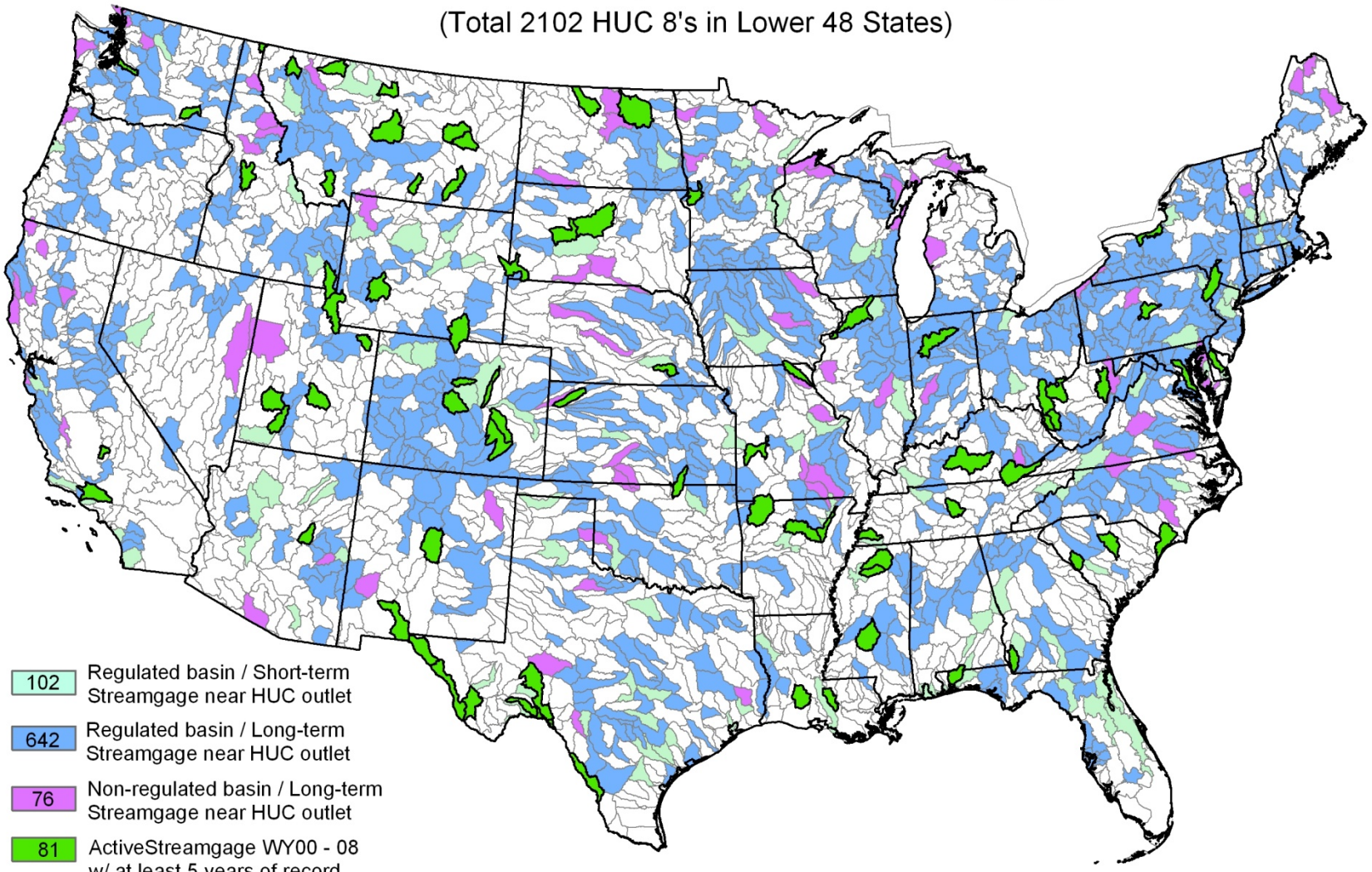
1896 Hydrologic Cataloging Units (HUC8) with at least one Long-term Active Streamgage

(Total 2102 HUC 8's in Lower 48 States)



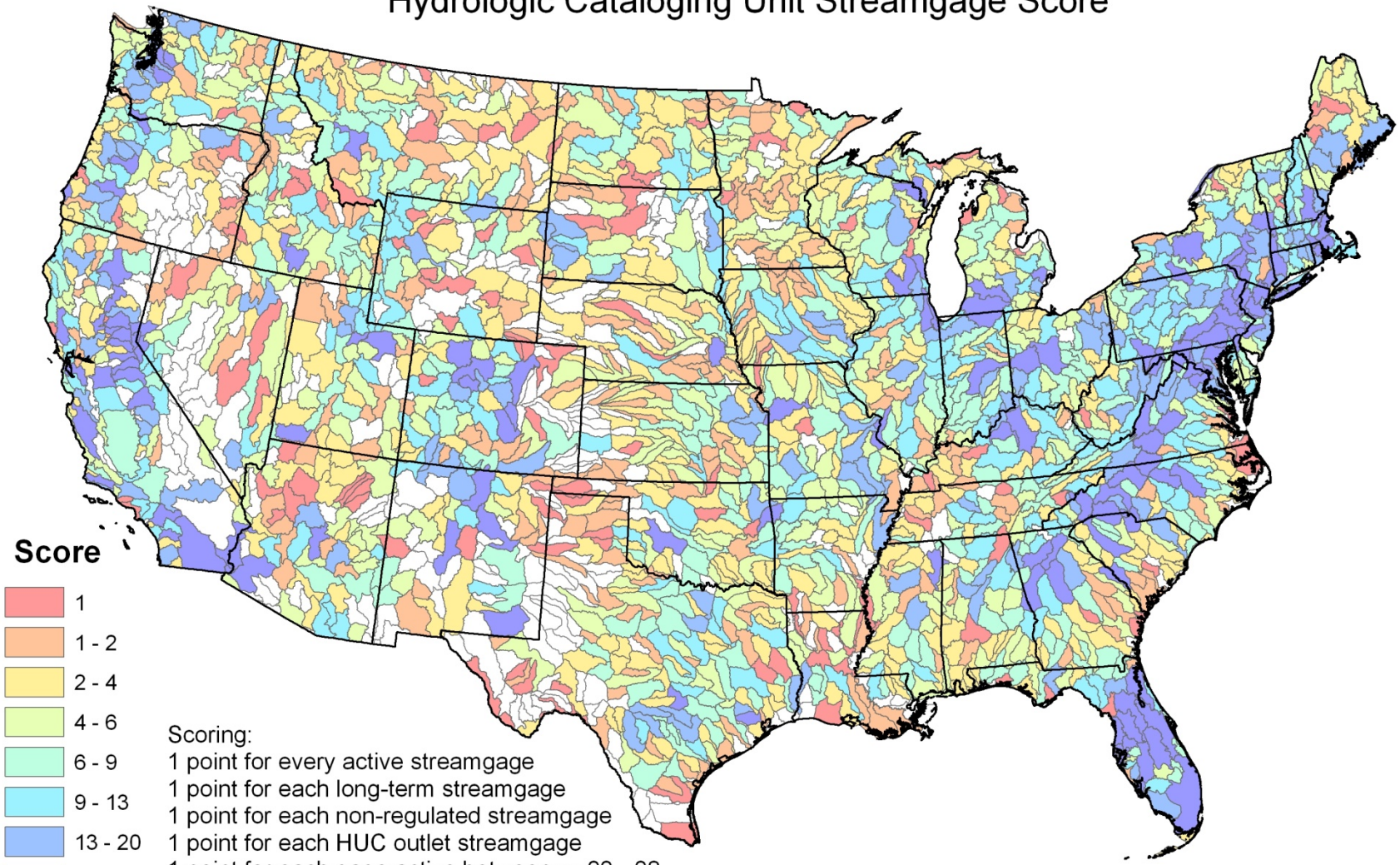
Hydrologic Cataloging Units (HUC8) with WY09 Active Streamgages or Active WY00 - 08 w/ at least 5 yrs of record Streamgage Near Outlet

(Total 2102 HUC 8's in Lower 48 States)



900 out of 2102 HUCs with Streamgage near HUC outlet

Hydrologic Cataloging Unit Streamgage Score



Hydrologic Cataloging Unit Streamgage Score