

**REPORT OF THE
STREAMGAGING TASK FORCE
TO THE
ADVISORY COMMITTEE ON WATER INFORMATION
April 3, 2002
(Editorial revisions made August 29, 2003)**

Introduction

The Advisory Committee on Water Information in 1998 formed the Streamgaging Task Force. The Task Force was charged with developing a strategy to achieve a robust, sustainable system to ensure the availability of streamflow information for all users. It was to consider a nationwide system to produce, archive, and share surface-water quantity information about rivers, streams, canals, lakes, reservoirs, wetlands and inflows to estuaries and near coastal areas. The Task Force included a number of organizations such as the Western States Water Council and the Association of State Floodplain Managers whose members have a vested interest in the Nation's stream monitoring network. The Task Force also includes representatives from Federal agencies that support or use data from the streamgaging network. This report serves as the final report of the Task Force and includes a brief background on the activities of the Task Force and its recommendations to the Advisory Committee on Water Information.

Scope

The Task Force developed a plan for defining a streamgaging network to meet the streamflow information needs of the Nation. This plan, which was approved by the ACWI in 2000, consists of the following components:

1. Define the goals of a national streamgaging network.
2. Compile information on all streamgaging stations operated by the U. S. Geological Survey (USGS) and other organizations, including stations that have been discontinued.
3. Assess how well the existing network met the goals defined by the Task Force.
4. Define an optimal streamgaging network.
5. Recommend funding responsibilities for the optimal network.

Two events occurred since the Task Force developed its plan that greatly facilitated the work of the Task Force. First, the USGS developed their own plan for a National Streamflow Information Program. This plan was designed to support some of the major goals of a streamgaging network as proposed by the Task Force. More importantly, the USGS developed a network analysis tool, which enabled the Task Force to assess how well the existing streamgaging network met the goals proposed by the Task Force. The second event was the commissioning of the Interstate Council on Water Policy (ICWP) to conduct a series of workshops in 2001 to obtain perspectives from Federal, State and local water resource managers on the National Streamflow Information Program being proposed by the USGS. The Task Force participated in these workshops, presented the

results of their analyses, and gathered comments and perspectives from the more than 200 participants of the workshops.

Information about the National Streamflow Information Program (NSIP) and the findings of the Interstate Council on Water Policy is available in the following reports:

National Streamflow Information Program, Implementation Plan and Progress Report, U. S. Geological Survey Fact Sheet 005-01.

A Critique of the USGS National Streamflow Information Program and Considerations in Establishing a National Streamgaging Network, Interstate Council on Water Policy, February 2002.

The Task Force worked very closely with both the USGS and ICWP. The USGS used their network evaluation tool to assess the goals proposed by the Task Force. The ICWP was an active participant in the activities and deliberations of the Task Force. Both the USGS and the ICWP considered the comments and initial findings of the Task Force. The NSIP Plan and the ICWP Critique both reflect the input of the Task Force. Thus the Task Force is in agreement on most of the specifics of streamgaging network and the funding strategy proposed by the USGS and the ICWP.

Background

Task Force Membership

The following organizations and agencies are members of the Streamgaging Task Force and have participated in most if not all the meetings and work activities of the Task Force:

American Association of State Geologists
American Society of Civil Engineers
Association of State Floodplain Managers
Bureau of Reclamation
Interstate Council on Water Policy
National Weather Service
Tennessee Valley Authority
U. S. Army Corps of Engineers
U. S. Geological Survey
Western States Water Council

In addition, the following organizations and agencies provided comments on the network goals proposed by Task Force or its' final recommendations:

American Water Resources Association
Association of Western State Engineers

Federal Emergency Management Agency
Ground Water Protection Council
Natural Resources Conservation Service
Sierra Club
The Universities Council on Water Resources
U. S. Environmental Protection Agency
U. S. Forest Service

Network Identification

One of the first activities of the Task Force was to identify the existing stations that comprised the current national streamgaging network. The base of this network is the stations currently operated by the USGS. The current stations and inactive stations (stations previously operated for one or more years) were readily available from the files of the USGS. Various Task Force members were assigned to obtain information about stations currently being operated by other Federal, State and local agencies or their contractors. The USGS offices in each State also were contacted for information about stations operated by others. Stations with sufficient attributes for defining a location on a data layer for a geographical information system (GIS) were added to the file of USGS stations.

Data Analysis

A streamgaging network analysis tool developed by the USGS was a critical component of the data analysis accomplished by the Task Force. The network tool included a series of GIS data layers for assessing whether the existing streamgaging network met each of the goals proposed by the Task Force. The individual streamgaging stations and the metric for measuring each goal were linked to a file of river reaches known as the RF1 reach file, originally developed by the U. S. Environmental Protection Agency. The file includes 60,000 stream reaches in the conterminous U. S. The locations of more than 20,000 streamgaging stations, including 7,000 active USGS stations and 1,800 active stations operated by other agencies were linked to the river reaches. Other files that were linked to the RF1 river reach file included National Weather Service (NWS) and Natural Resources Conservation Service (NRCS) forecast sites, communities in the National Flood Insurance Program, National Pollution Discharge Elimination System permits, reservoirs, and whitewater recreation locations.

The network analysis tool enabled the Task Force to identify existing streamgaging stations that met one or more of the proposed network goals. The tool also identified river reaches where additional stations would be needed to fully meet the intent of the goal. Unfortunately, the RF1 file is limited to the conterminous U. S. so our analysis of the network goals did not include requirements for Alaska, Hawaii, Puerto Rico and the Virgin Islands. The metrics for each goal, which are described in the next section, were incorporated into an algorithm to select the best stations or river reaches when there were multiple choices. The general priority for selecting stations was active USGS stations,

then other agency stations, then inactive USGS stations, and finally new stations. A station that met more than one goal was given a higher priority than a station that met only one goal. The Task Force did not differentiate between stations with and without telemetry. It was assumed that most if not all stations in the national streamgaging network would be capable of transmitting real-time river stage and discharge data.

National Streamgaging Network Goals

The Task Force proposed a comprehensive set of goals for a national streamgaging network. The goals were proposed based on streamflow information needs and without a clear indication of the size and cost of the required network to meet the needs. Most of the goals would require real-time river stage and discharge data, and the Task Force assumed that most if not all the stations in the network would be capable of transmitting real-time data. The network analysis tool enabled the Task Force to evaluate the impact of each of the proposed goals on a total streamgaging network.

The goals, metrics, and the results of how well the network met each goal within the conterminous U. S. are listed below. The first five goals are nearly equivalent to the goals of the USGS's National Streamflow Information Program. Goal 1 was modified by the Task Force to include the forecast locations of the Natural Resources Conservation Service. Goal 3 was modified to include tribal boundaries.

1. Provide stage and discharge data for each NWS service location and each NRCS forecast site

Metric: Operate a streamgaging station at each NWS or NRCS service location or be able to provide flow data from other nearby stations.

Network requirement: A total of 3,127 stations are required to meet the NWS part of this goal, including 2,004 active USGS stations, 235 active other agency stations, 583 inactive stations and 305 new stations. There are 519 NRCS forecast sites and 273 of these coincide with NWS sites. An additional 246 stations are required to meet the NRCS part of this goal, including 96 new stations.

2. Provide representative discharge data for each of the major river basins in the Nation

Metric: Operate streamgaging stations at the terminus of each hydrologic accounting unit (6-digit HUC). Drainage area of the stations should not be less than 90 percent or more than 110 percent of the accounting unit. For units with multiple rivers draining to closed basins or oceans, as much area as possible should be gaged, but no more than 2 stations should be required.

Network requirement: A total of 384 stations are required to meet this goal, including 310 active USGS stations, 4 active other agency stations, 46 inactive stations, and 24 new stations.

3. Provide river discharge data to meet the operational requirements of river basin compacts and Supreme Court decrees and at each point where major rivers cross international, state, and tribal boundaries

Metric: Operate a streamgaging station on the RF1 reach mandated by the compact or decree and on or near crossings when the drainage area of the river is greater than 500 square miles. Drainage area of the stations should not be less than 90 percent or more than 110 percent of the drainage area at the crossing.

Network requirement: The USGS part of this goal requires 496 stations. The Task Force goal requires 42 additional stations to document flow at tribal boundaries. The Task Force goal includes 439 active USGS stations, 16 active other agency stations, 61 inactive stations, and 22 new stations.

4. Provide streamflow data for representative parts of the Nation for flow estimation and long-term trend assessments

Metric: Operate a discharge station that is unaffected by regulation in a spatially distributed network throughout the Nation. Note that spatial distribution will be achieved by locating stations in polygons formed by the intersection of Hydrologic Accounting Units and Ecoregions.

Network requirement: A total of 849 stations are required to meet this goal, including 505 active USGS stations, 16 other agency stations, 210 inactive stations, and 118 new stations.

5. Provide discharge data for all stations that are part of USGS water-quality monitoring networks

Metric: Operate a discharge station at or near each site where water-quality samples are collected as part of the Hydrologic Benchmark, NASQAN, and NAWQA Low-Intensity Phase programs.

Network requirement: A total of 209 stations are required to meet this goal, including 208 active USGS stations and 1 other agency station.

6. Provide data for the accurate determination of base flood (1-percent annual chance) discharges and base flood elevations for each “participating” community in the National Flood Insurance Program

Metric: Operate a streamgaging station or crest-stage gage on the river reach on which the community is located (Only communities whose centroid is within 2 kilometers of an RF1 river reach were considered).

Network requirement: A total of 7,297 stations are required to meet this goal, including 1,492 active USGS stations, 210 other agency stations, 1,057 inactive stations, and 4,538 new sites.

7. Provide river discharge data for all watersheds that have impaired water quality based on EPA's 303(d) process

Metric: Operate a discharge station on each RF1 river reach with impaired water quality. Add additional stations on the same river only when the drainage area increases by 20 percent.

Network requirement: A total of 9,123 stations are required to meet this goal, including 1,616 active USGS stations, 207 other agency stations, 1,221 inactive stations, and 6,079 new stations.

8. Provide river discharge data at river reaches with National Pollution Discharge Elimination System permits

Metric: Operate a discharge station on each RF1 reach when the accumulative, permitted discharge exceeds 10 MGD. Add additional stations on the same river for each incremental increase of 10 MGD of permitted discharge.

Network requirement: There are 65,000 sites with NPDES permits, and 20,722 sites have permitted discharge values. A total of 2,116 stations are required to meet this goal, including 554 active USGS stations, 107 other agency stations, 226 inactive stations, and 1,229 new stations.

9. Provide stage or discharge data for rivers that are used for canoeing, kayaking or rafting so river sports enthusiasts will know when the rivers are safe for paddling

Metric: Operate a discharge or stage-only station on each river reach or adjacent reach that have been identified by the American Whitewater Affiliation as suitable for paddling. Add stations on the same river only when the drainage area increases by 20 percent.

Network requirement: A partial analysis of whitewater reaches indicates that 2,175 stations would be needed to meet this goal in the 50 percent of the rivers documented. This includes 450 active USGS station, 31 other agency stations, 368 inactive stations, and 1,326 new stations.

10. Provide river discharge data for all rivers draining parcels of Federal land that are equal to or greater than 1,000 square miles

Metric: Operate a streamgaging station at the point where the river leaves Federal land. Drainage area of the stations should not be less than 90 percent or more than 110 percent of the drainage of the river at the boundary.

Network requirement: A total of 89 stations are required to meet this goal, including 36 active USGS stations, 7 other agency stations, 18 inactive stations, and 28 new stations.

11. Provide discharge data for all major rivers with surface-water diversions that exceed 25 percent of the mean annual flow of the river

Metric: Operate a streamgaging station at the terminus of each hydrologic cataloguing unit where the surface-water use in 1995 was greater than 25 percent of the flow of the unit.

Network requirement: A total of 27 stations are required to meet this goal, including 11 active USGS stations, 4 other agency stations, 3 inactive stations, and 9 new stations.

12. Provide river discharge data for the inflow and outflow of all reservoirs with more than 50,000 ac-ft of total storage

Metric: Operate a discharge station on at least one upstream reach or a stage station on the reservoir. Operate a discharge station immediately below the reservoir or the next downstream reach.

Network requirement: There are 763 reservoirs in the U. S. with at least 50,000 ac-ft of total storage capacity. There are 162 reservoirs with both inflow and outflow stations, 399 with only outflow stations, 41 with only inflow stations, and 160 without inflow or outflow stations. An additional 762 stations would be needed to satisfy both the inflow and outflow metrics.

13. Provide streamflow data for coastal rivers that support a migratory fish population

Metric: Operate a discharge station in each coastal hydrologic cataloguing unit (8-digit HUC). Station should be on a river with a drainage area of less than 100 square miles.

Network requirement: There are 296 hydrologic cataloguing units that drain directly into the Atlantic and Pacific Oceans, the Gulf of Mexico, or the Great Lakes. Eighty-five active USGS stations, 12 other agency stations, 85 inactive stations, and 114 new stations are required to meet this goal.

14. Provide river stage or discharge data for all rivers that are used for commercial navigation

Metric: Operate a discharge and/or stage station at 100-mile intervals on the non-tidal Mississippi River and Missouri River. Operate a station in each pool of rivers with locks and dams.

Network requirement: There are 194 locks and dams on 37 different rivers in the conterminous U. S. The metric also would require stations on the Mississippi River between New Orleans and St. Louis and stations on the Missouri River between St. Charles, MO and Yankton, SD. A total of 208 stations are needed to meet this goal, including 55 active USGS stations, 34 other agency stations, 31 inactive stations, and 88 new stations.

Summary of Network Requirements

If each goal proposed by the Task Force were considered individually, the total requirement would be 30,631 stations within the conterminous United States (Table 1).

Table 1. – Summary of requirements to meet the streamgaging network goals proposed by the Streamgaging Task Force.

Network Goal	Number of Requirements
NWS and NRCS forecasting	3,373
Major river basin	384
Compacts and borders	538
Flow estimation and trends	849
Water-quality monitoring	209
NFIP communities	7,297
Impaired water quality	9,123
NPDES permits	2,116
River safety	4,350
Federal lands	89
Surface-water diversions	27
Reservoirs	1,526
Migratory fish habitat	296
Commercial navigation	208
Total individual requirements	30,631
Number of stations required	18,330

Some of the goals are overlapping and some stations will meet more than one goal. There are 149 stations that meet 5-9 of the 14 goals, 1,800 stations that meet 3-4 goals, and 4,170 stations that meet 2 goals. There are 12,210 stations that would be needed to meet a single goal. The 14 goals combined would require 18,330 stations (figure 1).

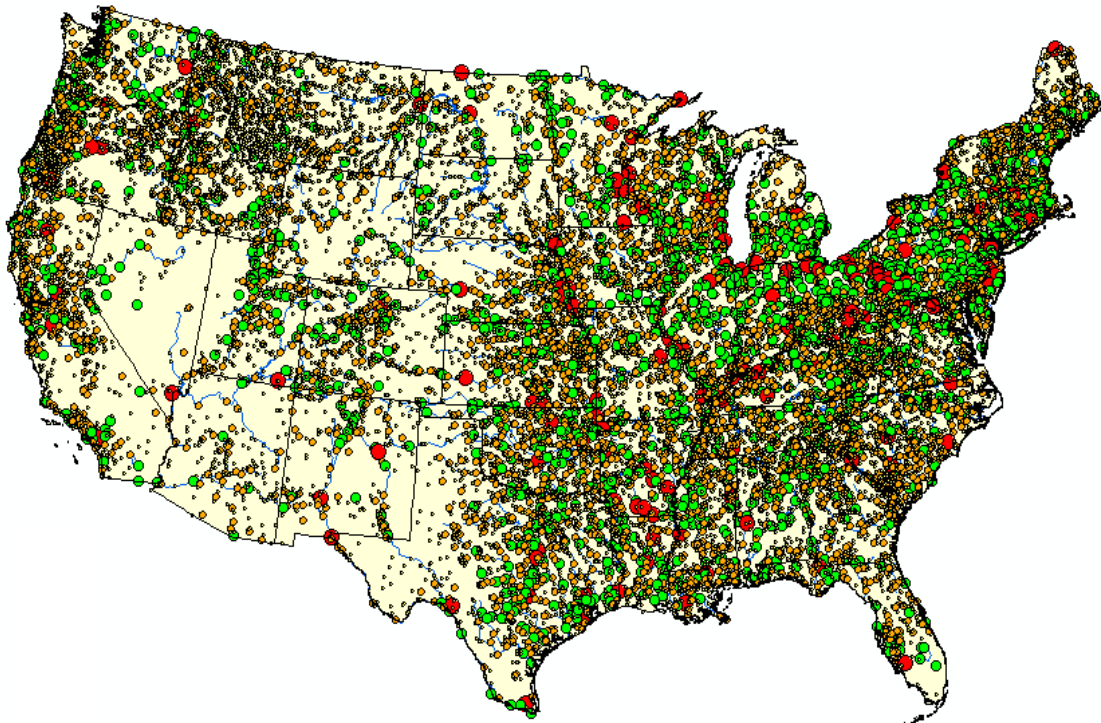


Figure 1. Map showing the 18,330 stations that meet the 14 proposed goals of the Streamgaging Task Force. The large red circle shows stations that meet 5-9 goals, the green circle shows stations that meet 3-4 goals, the orange circle shows stations that meet 2 goals, and the black dot shows stations that meet a single goal.

Recommendations

The recommendations section of this report is divided in two parts: recommendations for the network and recommendations for funding and related strategies.

Network

After completing the analysis of the 14 goals that it proposed for a national streamgaging network, the Task Force worked with the USGS, the ICWP, and participants of the streamgaging workshops to craft a realistic plan for a national network. It was obvious that the 14 goals proposed by the Task Force would require a very dense network of streamgaging stations and many of those stations would only serve one purpose. The Task Force considered both the NSIP Plan proposed by the USGS and the revised plan proposed by the ICWP. After considerable deliberation, the Task Force agreed that the network proposed by the ICWP would best meet the basic streamflow information needs of the Nation. The network proposed by the ICWP provides a denser coverage of major rivers in the U. S., and thus will provide data to support many of the original goals proposed by the Task Force, including water quantity and quality management, recreation, and public safety.

Recommendation 1. -- The Task Force recommends that the following goals be adopted by the USGS for the streamgaging network funded through the National Streamflow Information Program:

A. Provide stage and discharge data at each NWS and NRCS service location for the purposes of flow forecasting (flood, normal and drought).

The Task Force believes support of the forecasting done by both the NWS and the NRCS is a critical Federal function. The forecasting provides outlooks for farmers and water managers during droughts; it provides advanced warning for communities, businesses and homeowners during floods; and it provides day-to-day operational information for water suppliers, wastewater utilities, and navigation and recreational users of our Nation's rivers. The USGS Plan calls for stations at each NWS service location. Adding the NRCS forecast locations to this goal will increase the number of stations or requirements from 3,246 to 3,492.

B. Monitor representative discharge from each hydrologic cataloguing unit (8-digit HUC).

The network of stations at or near the terminus of hydrologic accounting units (6-digit HUC) provides a good coverage of the major rivers of the Nation. However, the Task Force concurs with the ICWP that the network is too coarse to provide information to support effective water management. Therefore, we support a USGS funded and operated network of stations at or near the terminus of the hydrologic cataloguing units. This larger network of stations also will provide data to support some of the other goals proposed by the Task Force such as water-quality management, flood mitigation, recreation, reservoir operations, and navigation. The USGS Plan calls for 445 stations. Monitoring the smaller hydrologic cataloguing units will increase the number of requirements from 445 to 2,569.

C. Provide flow data for rivers governed by compacts or Supreme Court decrees and for rivers crossing international boundaries.

Water conflicts and the adjudication of water rights is a regional and state-by-state issue. It is important for the USGS to support these issues when mandated by Court decrees or when the U. S. Government is a signatory of River Management Compacts. It also is a Federal interest rather than an individual State interest to monitor rivers that cross our Nation's border. However, the Task Force does not agree that it is necessary for the Federal government to monitor all major rivers at State borders. The USGS Plan calls for monitoring 506 rivers. By not monitoring major rivers at State borders, the number of requirements for this goal is reduced from 506 to 256.

D. Monitor long-term changes in streamflow using an expanded Hydrologic Benchmark network.

The Task Force supports the concept of a network of small watersheds for monitoring the ever-changing status of the Nation's water resources as it responds to changes in climate and land use. However, we believe the network proposed by the USGS is more than what is needed for this goal. We concur with the ICWP that the existing Hydrologic Benchmark Network should be supplemented to meet this goal. Specifically, we recommend that the existing network be expanded so there is at least one small watershed being monitored in each Physiographic section of the conterminous U. S. We also recommend that the small watersheds in the USGS Plan for Alaska, Hawaii, and Puerto Rico be included in the Hydrologic Benchmark Network.

We also believe that many of the stations being proposed to meet goal 2 will provide information for evaluating long-term trends in streamflow. A cursory analysis of goal 2 indicates there are 319 active stations that could serve as both the monitoring station at the terminus of hydrologic cataloging units and a long-term trend station. These are stations on rivers that are unaffected by diversions or reservoir operations that would affect monthly streamflow.

The USGS Plan calls for 874 Sentinel stations. Adoption of this revised goal would reduce the number of requirements from 874 to 131.

Table 2 shows a summary of the requirements of the network that is recommended by the ICWP and the Streamgaging Task Force.

Table 2. – Number of requirements and stations needed to meet the goals of the streamgaging network proposed by the ICWP and the Streamgaging Task Force.

Network Goal	Active USGS Stations	Other agency stations	Inactive Stations	New Stations	Total
Flow Forecasting	2,070	262	726	434	3,492
Major river basins (HUC8)	1,097	167	379	926	2,569
Compacts and International borders	241	8	3	4	256
Hydrologic Benchmark	120	5	0	6	131
Sum of requirements	3,528	442	1,108	1,370	6,448
Stations needed	2,778	304	830	1,285	5,197

Recommendation 2. --The Task Force also recommends that the watershed approach for meeting other streamflow information needs be adopted by the USGS through its Cooperative Water Resources Program. With this approach the ICWP and the Task Force recommends that the USGS and the cooperative members of the streamgaging network consider locating additional stations within 25 percent of the the watersheds defined by the new or to-be-defined 10-digit hydrologic units (HUC 10). The priority for establishing stations within the HUC 10 watersheds should be based on the goals identified by the USGS District offices and their cooperators, the need for areal coverage, and any of the other previously defined goals for a national streamgaging network. The incorporation of local, state, and national goals will ensure the continued success and relevancy of the network. New stations in HUC 10 watersheds should be funded through the USGS Cooperative Water Resources Program or directly by the agency or organization that needs the information.

Recommendation 3. -- One additional network recommendation concerns stations that provide flood data for streams and rivers in or near communities that participate in the National Flood Insurance Program (NFIP). The Task Force does not recommend that these stations be funded entirely by the USGS through the National Streamflow Information Program. **However, we recommend that stations that provide flood data for NFIP participating communities be given high priority within the USGS Cooperative Water Resources Program.** We recommend that the USGS and the Federal Emergency Management Agency work together with communities in the NFIP to secure cooperative funding for at least crest-stage gage and stage-discharge rating for each stream or river affecting an NFIP-participating community.

This is the one recommendation that was not a consensus of the Streamgaging Task Force. The Association of State Floodplain Managers advocates that all stations that provide data for mitigating future flood damages should be funded with Federal appropriations through the USGS NSIP program.

Funding and Related Strategies

The ICWP provided findings from the four regional streamgaging workshops rather than recommendations for funding a national streamgaging network. The Task Force generally concurs with the findings and provides the following specific recommendations.

Recommendation 4. -- We support the concept of the National Streamflow Information Program as proposed by the USGS and as modified by the ICWP and the Task Force. We support full funding for NSIP, however, we believe the network should be emphasized in the initial years of the program. **Therefore, we recommend that the Advisory Committee on Water Information encourage the Director of the USGS and the Secretary of the Interior to request funding to fully implement the network components of NSIP over the next five years.**

Recommendation 5. -- The revised NSIP will not meet all the streamflow information needs of the Nation. **We recommend that the USGS and its' cooperators continue to seek funding increases in the Cooperative Water Resources Program (COOP) so that other stations in the national streamgaging network are supported 50 percent by the USGS and 50 percent by cooperating agencies.**

Recommendation 6. -- We agree with the concerns expressed by participants in the regional streamgaging workshops about States losing interest and influence in the national streamgaging network if NSIP funding instead of COOP funding is used to support stations. **We recommend that the network components of NSIP be implemented by using funding increases to add new or reactivated stations and to fund infrastructure costs.** NSIP funds should only be used to fund existing stations if cooperator funds are lost and the stability of the network is affected.

Recommendation 7. -- **We recommend that each USGS District in collaboration with its' cooperators develop a streamgaging strategy for the State or District.** Part of the strategy should be the development of a priority system for adding new streamgaging stations. The priority should be based on the number of NSIP and other COOP network goals met by the stations. An inactive station with five years of previous record should have a higher priority than an entirely new station.

Recommendation 8. -- Stations operated by other organizations can play a key role in providing critical streamflow information. Unfortunately some of these data may not be accurate, reliable, or available to the public. **We recommend that the USGS use NSIP infrastructure funds to verify and upgrade, if necessary, the data quality of these stations and to make the data available through the USGS water resources data web page.** The priority for supporting these stations should be the same as the priority for NSIP and COOP stations.

Recommendation 9. -- It is unlikely that NSIP funding and USGS and other agency COOP funding will ever be sufficient to meet the many needs for streamflow data. **We encourage the USGS to continue to work with the other Federal agencies that need and use streamflow data everyday to support the national streamgaging network.** These include the U. S. Army Corps of Engineers, National Weather Service, Natural Resources Conservation Service, Environmental Protection Agency, Federal Highway Administration, Federal Emergency Management Agency, Bureau of Reclamation, U. S. Fish and Wildlife Service, and the U. S. Forest Service. We also recommend that the Advisory Committee on Water Information encourage the Secretaries of the Departments of Agriculture, Commerce, Defense, Interior and Transportation and the Administrators of the Environmental Protection Agency and Federal Emergency Management Agency to support network funding by their respective agencies.

Recommendation 10. -- The need for streamflow information has changed dramatically in the last few decades as water-quality issues came to the forefront. **We expect the need to continue to be dynamic, and we recommend that a similar evaluation of the national streamgaging network be conducted in another 10 years.**