

Plan Monitoring Program BASI

Streamflow

Best available scientific information (BASI): the responsible official shall document in the decision document how BASI was used to inform the plan monitoring program. This document provides additional detail to support the decision document, including how information was determined to be BASI and was determined to be most relevant, accurate, and reliable.

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| Desired condition in the Forest Plan | <p>From Goal 5.1: Watersheds, streams, groundwater recharge areas, springs, wetlands and aquifers are managed to assure the sustainability of high quantity and quality water. Where new or re-authorized water extraction or diversion is allowed, those facilities should be located to avoid long-term adverse impacts to national forest water and riparian resources.</p> <p>From Goal 5.2: The desired condition is that watercourses are functioning properly and support healthy populations of native and desired nonnative riparian dependent species.</p> <p>From Goal 6.2: Flow regimes in streams that provide habitat for threatened, endangered, proposed, candidate, and/or sensitive aquatic and riparian-dependent species are sufficient to allow the species to persist and complete all phases of their life cycles.</p> <p>Habitat conditions sustain healthy populations of native and desired nonnative fish and game species. Wildlife habitat functions are maintained or improved, including primary feeding areas, winter ranges, breeding areas, birthing areas, rearing areas, migration corridors, and landscape linkages. Fish habitat functions are maintained or improved, including spawning areas, rearing areas, and upstream and downstream migration, where possible.</p> |
| Monitoring Question | How do streamflows compare with historical records? |
| Monitoring Indicators | Monthly Streamflows, Timing and Magnitude of Peak Flows, Degree of Variation |
| Describe how monitoring question and indicators evaluate changes and management effectiveness of the plan. | This question and its indicators will detect changes in streamflows over time, which is particularly needed to address uncertainty about the potential influence of climate change on streamflows in Southern California. The monitoring results would enable evaluation of the effectiveness of the plan in achieving the desired conditions specified above. In particular, this monitoring will help determine how to balance water needs of the National Forests against requests for water use in a changing climate and may inform habitat protection and restoration efforts. |
| How can the effects of management activities on the indicator be differentiated from those due to climate change? (Optional) | Large-scale water use on the National Forest is monitored, whereas effects of land management on water supply are less well known. The analysis that would be needed to discriminate between climate change and ordinary streamflow variation falls beyond the scope of this monitoring question. Instead, trends could be identified over time to inform water and land management. |

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| Describe how this monitoring relates to one or more of the eight required items for forest plans. | This monitoring would reveal “(i) the status of [a] select watershed condition” as well as “(ii) the status of [a] select ecological condition including key characteristics of terrestrial and aquatic ecosystems.” Changing streamflows also clearly constitute “(vi) measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.” |
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Best Available Scientific Information

Lettenmeier, Wood, and Wallis (1994) used monthly streamflows among other variables to evaluate trends in hydro-climatological observations across the U.S. and found that detectable trends were due to both climatic and water management effects. Lins and Michaels (1994) used monthly streamflows to document increasing streamflows across the U.S. due to “greenhouse forcing.” Lins and Slack (1999) also found a trend of increasing streamflow across the U.S. using stream gage data. All three studies support the use of streamflow data to evaluate the effects of climate change, but no study was found that focused on changes in Southern California. The use of similar methods is therefore needed to provide local analysis of streamflow change.

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| Rationale for choice of question and indicators, informed by BASI. | The potential for climate change to affect streamflow for the Southern California National Forests, where any changes could substantially affect riparian ecosystems and water users, warrants monitoring. |
| Monitoring protocol, method, or data source; rationale informed by BASI. | Compare monthly streamflows, timing and magnitude of peak flows, and degree of variation for the period being monitored with streamflow baseline data prior to 1990. While the referenced studies suggest that streamflows were already being affected by climate change by 1990, data reliability would be reduced with the use of an earlier baseline and the pace of change is likely to have increased since then. |

BASI Determination

Lettenmeier, Wood, and Wallis (1994), Lins and Michaels (1994), and Lins and Slack (1999) all evaluated streamflow trends across the U.S. in relation to climate change, and similar methods would be suitable for analysis of streamflow trends on the Southern California National Forests.

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| Relevant – BASI is relevant to the plan area, question and indicators, the desired condition, objective, and required monitoring item. | The three references provided are studies conducted across the U.S., pertain directly to evaluating streamflow trends due to climate change using gage data, evaluate flow conditions that support water supply, riparian function, and wildlife, and investigate watershed and ecological conditions with measureable changes related to climate change and other stressors. |
| Accurate – BASI describes the true condition. To support monitoring methods, the method has been shown to provide evidence that can answer the question and address the desired condition. | The use of streamflows from gage data in all three studies enabled analysis of nationwide trends in streamflows over time. Trends at the level of the Southern California National Forests can be analyzed with similar methods. |

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| Reliable – BASI uses appropriate scientific methods that are consistent with scientific principles (e.g., peer-reviewed articles). To support monitoring methods, BASI reliability also includes methods that produce reliable measurements with statistical rigor. | All three articles were published in peer-reviewed journals and have been cited by numerous additional studies. Because the monitoring question and indicators do not include correlation of streamflow with climatic data, less sophisticated statistical methods will be needed. |
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References Cited

Lettenmaier, D.P., E.F. Wood, and J.R. Wallis. 1994. Hydro-climatological trends in the continental United States, 1948-88. *Journal of Climatology* 7: 586-607.

Lins, H.F. and P.J. Michaels. 1994. Increasing U.S. streamflow linked to greenhouse forcing. *Eos, Transactions, American Geophysical Union* 75(25): 281, 284, 285.

Lins, H.F. and J.R. Slack. 1999. Streamflow trends in the United States. *Geophysical Research Letters* 26(2): 227-230.