**SCIENTIFIC RESEARCH AND COLLECTING PERMIT**

Grants permission in accordance with the attached general and special conditions

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<th>United States Department of the Interior National Park Service</th>
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<td>Sequoia &amp; Kings Canyon National Parks</td>
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**Study #: SEKI-00153**  
**Permit #: SEKI-2006-SCI-0001**  
**Start Date: Feb 01, 2006**  
**Expiration Date: Dec 31, 2006**  
**Park Code: SEKI-2006-0153**

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**Project title:**  
Water balance & carbon cycling across the snow line in forested landscapes

**Purpose of study:**  
The purpose is to develop strategies to accurately measure and model water and carbon fluxes in forested areas across the rain-snow transition using a blend of remotely sensed and ground-based information. This will result in more-accurate estimates of snowpack, snowmelt and the partitioning of snowmelt into runoff, infiltration and evapotranspiration, plus the interaction of the water cycle with bi-directional fluxes of carbon between forests and the atmosphere. Our basic hypothesis is that strategically placed instrument clusters, designed to complement satellite remote sensing information, provide the basis for more accurately and efficiently measuring and scaling water balance components, and thence basin-scale fluxes, than does an approach that relies on widely distributed snowpack and weather-station point measurements of the type now available. A corollary to this is that water balance estimates provided by the measurement system will improve forecasts of snowmelt runoff and other water balance components using emerging hydrologic models, and thence provide a more-accurate projection of mountain water supply and the timing of its runoff. This new information will also provide significantly improved indices that will enable better management of forest and aquatic habitats, as water storage amounts and fluxes provide important indicators of how the systems can and do respond to climate variability and change.

**Locations authorized:**  
Studies will be carried out at sites in non-wilderness areas in the general vicinity of Wolverton, and extending through the non-wilderness area as far south as Panther Meadow and as far east as Panther Gap. Three sites are being considered for an intensive instrument cluster. Instruments will be deployed in a 1-km² area around the central point. In addition, instruments will be deployed in Wolverton Creek above the water treatment plant, in the other tributaries that joins the creek before entering the meadow, and in the tributary that flows through the meadow. Instruments will also be deployed on transects between these points and the upper part of the basin. Vegetation in the Wolverton Creek Drainage is classified by Sequoia National Park as largely Red Fir Forest in the upper reaches, with selected areas of White Fir-Mixed Conifer Forest. Areas
classified as Ponderosa-Mixed conifer Forest lie on either side of the large meadow. A tower for eddy correlation flux measurements that extends 5 m above the canopy will form the center of the instrument cluster. Canopy heights in this region reach about 35-40 m. Another instrument cluster (no tower) will be placed near Bear Hill.

**Transportation method to research site(s):**
Access to the sites near Wolverton will be by vehicle on the road from Generals Highway, including the Wolverton parking loop, and by foot on the existing trails around Wolverton. For those sites in the non-wilderness areas extending south to Panther Meadow and east to Panther Gap, access will be by foot, snowshoes, or skis on the existing trail. Access to the Bear Hill instrument cluster will be by foot, snowshoes, or skis on the trails originating at Generals Highway.

**Collection of the following specimens or materials, quantities, and any limitations on collecting:**
Incidental collection of water and soil samples for analysis, upon request and approval. In the Wolverton area the researchers are allowed to install pressure transducers on two inlets and the outlet to record stream stage so that stream discharge rates can be estimated at various times through the year using a salt dilution method. This will involve withdrawing 50-100 L of stream water, mixing about 1-5 kg of salt with the water (more salt at high flow, less at low flow), and slowly returning the water to the stream over about a 15-min period. The researcher will then measure the change in stream dissolved solids 10-50 m downstream using a conductivity meter. Further downstream the effect will not be measurable because of mixing. Consequently, the researcher may add sufficient salt to approximately double the background dissolved solids at the injection point. This level of salt addition is well below what will result in any impact on stream biota. The same approach will be used for proposed pressure transducers locations on Clover and Siliman Creeks, and the Marble Fork. However, at high flows the researcher can use Rhodamine rather than salt. The levels that they propose to use will be detectable with a fluorimeter, but not visible downstream to the naked eye. This level of rhodamine addition is well below what will result in any impact on stream biota.

**Specific conditions or restrictions (also see attached conditions):**
Construction of installations may not proceed until sites have been approved by NPS. If an installation requires a foundation, an Environmental Analysis may be required. Review park and wilderness regulations and guidelines with all field personnel prior to arrival. Show permit and check in at a ranger station at start of field work. A digital copy of any reports or publications stemming from this research is due upon publication. Data collected must be provided to NPS upon request.

**Recommended by park staff(name and title):**

![Signature]
Peter G. Rowlands
Chief, Division of Natural Resources

**Approved by park official:**

![Signature]
Craig C. Axtell,
Superintendent

Date Approved: May 26, 2006

**I Agree To All Conditions And Restrictions Of this Permit As Specified**
(Not valid unless signed and dated by the principal investigator)

Principal investigator’s signature (Date)

THIS PERMIT AND ATTACHED CONDITIONS AND RESTRICTIONS MUST BE CARRIED AT ALL TIMES WHILE CONDUCTING RESEARCH ACTIVITIES IN THE DESIGNATED PARK(S)