STREAM SYSTEMS TECHNOLOGY CENTER

STREAM NOTES

To Aid in Securing Favorable Conditions of Water Flows

January, 1994

STREAMFLOW and RECREATION

This issue of STREAM NOTES is devoted to the subject of recreational instream flows. The intent is to assist those who may need to quantify instream flows for recreation. We have selected two references that are indispensable reference aids for anyone beginning an instream flow study.

Streamflow and Recreation

The first must-have reference is General Technical Report RM-209, *Streamflow and Recreation*, authored by **Bo Shelby**, a Professor in the Department of Forest Resources at Oregon State University, **Tom Brown**, an Economist with the Rocky Mountain Research Station, and **Jonathan Taylor**, a Research Social Scientist with the U.S. Fish and Wildlife Service National Ecology Research Center in Fort Collins..

Streamflow and Recreation begins with an overview of the legal and institutional framework for protecting instream flows. The paper discusses federal protection of instream flows such as implied statutory controls that arise from the Organic Administration Act which established the national forests; direct statutory mandates like the Wild and Scenic Rivers Act; federal reserved water rights; federal permitting like Federal Energy Regulatory Commission (FERC) relicensing; and federal consultation requirements as required by the National Environmental Policy Act (NEPA).

A brief review of state instream flow regulations follows. The authors list state laws that allow protection of instream flows and indicate which of those laws specifically designate recreation or aesthetics as beneficial uses for which instream flows are protected. A primary impediment to the establishment of instream flows at the state level is the traditional requirment that water be diverted from natural water courses to establish a water right under the Prior Appropriation doctrine.

STREAM NOTES *is produced quarterly by the Stream Systems Technology Center, Fort Collins, Colorado.*

The PRIMARY AIM *is to exchange technical ideas and transfer technology among scientists working with wild-land stream systems.*

CONTRIBUTIONS *are voluntary and will be accepted at any time. They should be typewritten, single-spaced, limited to two pages in length. Graphics and tables are encouraged.*

Ideas and opinions expressed are not necessarily Forest Service Policy. Trade names do not constitute endorsement by the Forest Service.

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IN THIS ISSUE

The roles and policies of the major federal agencies, including the Bureau of Reclamation, Corps of Engineers, Tennessee Valley Authority, Bureau of Land Management, Fish and Wildlife Service, Forest Service, and the Park Service, are discussed. In general, shifts are taking place in the policies of the federal agencies as they attempt to be more responsive to changing societal values. Neither the Forest Service nor the Park Service, however, currently has a standardized methodology for assessing the relation of flow to recreation quality or scenic beauty.

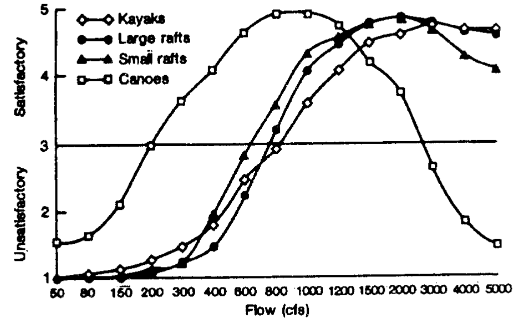
Streamflow and Recreation reviews a wide variety of methods that have been used by social scientists, physical and biological scientists, and engineers to study the relationship between streamflow and recreation.

The paper reviews 28 direct effect or short-term studies of flows on recreational quality in general or on specific recreation attributes such as quality of rapids, fishing success, scenic beauty, or boating travel times. The paper discusses three studies of indirect or long-term effects such as the impacts of flows on the maintenance of gravel bars for camping, improving scenic visibility, or maintaining channel form and function for fish habitat.

Studies can be broadly placed into 5 categories:

1. Studies relying mainly on expert judgment;
2. Systematic assessments of a full range of flows judged by each participant;
3. Studies employing user surveys;
4. Studies using mechanical measures of descriptive effects; and
5. Studies employing models.

These studies have added considerably to our understanding of the relation between streamflow and recreation. All of them show a similar shaped curve for the relation between flow and recreation. The figure in the next column shows a typical curve for the Lower Dolores River developed by a BLM study team headed by Steve Vandas.



Canoeing, kayaking, and rafting activities are shown. For all activities, low flows below a certain point are unacceptable. Somewhere in the middle range, flows reach an optimum and at very high flows, flows again become unacceptable. The specific points at which flows are minimally acceptable, optimum, and too high vary for different size channels, recreation activities, and user skill levels.

The authors of *Streamflow and Recreation* review existing models relating flow to recreation and find models most useful when: site specific studies are too time consuming or too expensive; a reasonable range of flows cannot be directly observed; the user population is difficult to identify; or assessments must be made for flow-regulating facilities that do not yet exist. For most applications they encourage the use of carefully designed site specific studies relying on user judgment.

Copies of Streamflow and Recreation, *1992, USDA Forest Service General Technical Report RM-209, by Bo Shelby, Thomas C. Brown, and Jonathan G. Taylor can be obtained from STREAM upon request. Please send requests via the Data General to STREAM:S28A if possible. Alternatively, FAX requests to (303) 498-2306, or phone Penny Williams at (303) 498-1731.*

Instream Flows for Recreation: A Handbook on Concepts and Research Methods

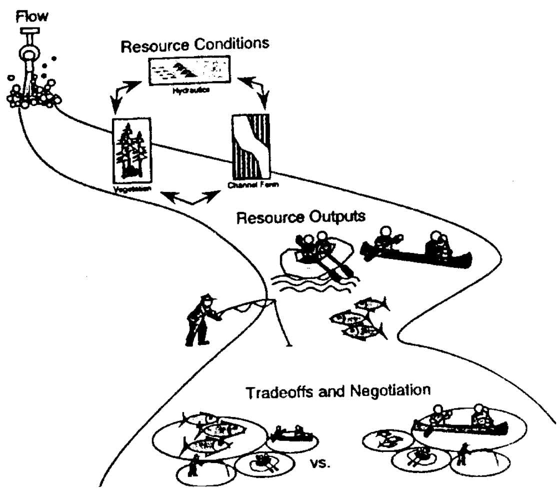
The second must-have reference is a National Park Service handbook, *Instream Flows for Recreation: A Handbook on Concepts and Research Methods*, by **Doug Whittaker**, a Recreation Planner with the National Park Service in Alaska, **Bo Shelby**, a Professor in the Department of Forest Resources at Oregon State University, **William Jackson**, Water Operations Branch Chief of the National Park Service, and **Robert Beschta**, a Professor in the Department of Forest Engineering at Oregon State University.

The handbook is designed to address the need for systematic, rigorous, and defensible information about instream flow needs for recreation. The 103-page document provides a more complete treatment of recreational instream flows than *Streamflow and Recreation*. However, the authors point out that the handbook is not intended to be a comprehensive guide for conducting flow-recreation studies. Rather, they prefer to think of the handbook as a "road map" to the ideas and methods that are the basis for effective studies.

Technical specialists may be disappointed at the lack of specific how-to-do-it instructions common to handbooks. The handbook is written for a lay audience interested in the technical aspects of instream flow studies and is intended to help them understand the logic behind these studies so they can ask critical questions. Nonetheless, natural resource specialists will profit from the overviews provided of technical studies for topics outside of their area of expertise.

The handbook presents a conceptual framework for assessing the effects of instream flows on recreation or other resource outputs pictured in the next column.

The authors propose a step-wise study process to follow in the design of instream flow studies. Descriptions and examples of the steps in the



process make up the individual chapters of most of the handbook. The process is best viewed as a general outline rather than a fixed set of steps. Users are expected to adapt the steps to fit local resources, politics, and administrative realities.

The steps include:

1. Define study purpose and objectives.
2. Describe resources.
3. Define recreation opportunities and qualities.
4. Describe hydrology.
5. Describe flow-condition relationships.
6. Evaluate flow needs for specific opportunities.
7. Integrate flow needs.
8. Develop strategies to protect/obtain flows.

The information in the handbook is well presented, using a series of sidebars to cover selected topics in greater detail. Sidebars include such topics as streamflow measurement techniques, river channel classification, response of rivers to flow changes, conducting effective resource reconnaissance, normative theory, and how to conduct effective surveys.

The discussion of individual techniques is well organized, consisting of an overview followed by a discussion of advantages and disadvantages. A section titled "Keys to Success" is especially useful for those who may wish to apply techniques in the field since it provides the reader with the collective wisdom of the authors pertaining to actually doing the work.

The various ways of evaluating flows or resource conditions are placed into 5 categories:

1. Historical use method
2. Professional judgment methods
3. User survey-based methods
   a. Interview/focus group meetings
   b. Single flow surveys
   c. Flow comparison surveys
4. Prediction-based modeling methods
   a. Single transect method
   b. Incremental method (IFIM)
   c. Predicting from hydrologic variables
      (1) Corbett method
      (2) Tennant method
   d. Physical modeling methods.

The handbook provides a decision-tree for selecting among evaluation methods. In general, the authors appear to prefer direct survey methods that find out directly from users their flow preferences rather than relying on complicated modeling.

A final chapter discusses ways to explore trade-offs among the flow needs for different recreation opportunities and suggests alternative flow protection strategies.

The handbook includes several appendices and references at the end of each chapter for those who may want to explore a topic in greater detail. The appendix of example questions for surveys of recreationists or expert users should help anyone who may need to conduct a survey.

Copies of Instream Flows for Recreation: A Handbook on Concepts and Research Methods, *1993, National Park Service, Anchorage, Alaska, by Doug Whittaker, Bo Shelby, William Jackson, and Robert Beschta can be obtained by writing the National Park Service, Recreation Resource Assistance Division, P.O. Box 37127, Washington, DC 20013-7127.*

Ask DOCTOR Hydro

Dear Doc Hydro: When I work with Wolman pebble counts, what size class do I put bedrock in? Is bedrock included in the size class when I graph the cumulative particle size distribution curve?

Many geomorphic and hydraulic problems require information about particle sizes. The Wolman pebble count procedure was developed in 1954 by Gordon Wolman to sample coarse riverbed material where the samples required using traditional bulk sampling would be both too large and too heavy to be routinely carried into the laboratory for weighing.

Pebble count data is generally used to provide some quantitative expression of sediment size on the surface of a stream channel, in pools, in riffles, or on gravel bars in rivers. Pebble counts can be used as a descriptive characteristic of channel types and are very useful in demonstrating physical differences between channels. Fisheries biologists frequently use bed composition data to characterize substrate for evaluating its quality for various life stages of fish and macroinvertebrates. Surface particle size is important because it determines the surface roughness which is influential in determining the velocity of water flowing in a channel. Particles on the surface are also the material immediately available for transport and therefore can be a significant component of bedload.

Bedrock is never mentioned in Wolman's original paper. One would not expect to encounter bedrock when sampling certain stream features such as point bars, for example.

Most people tally bedrock separately and do not give it a size class. The information about the occurrence of bedrock is used mostly as an index of the relative area of bedrock in the channel. However, since most pebble counts cover a very small area of the channel, measuring bedrock area with pebble counts would not be nearly as accurate as a quick sketch map of a larger area of channel. Since interest in pebble counts usually centers around establishing roughness or the characteristics of particles on the streambed for use in sediment transport calculations, bedrock "hits" are not used in the plotting of cumulative particle size distribution curves.

While it is true that bedrock outcrops are usually larger than the largest particles sampled (very large boulders 80-160 inches in intermediate diameter) and since the x-axis of a cumulative frequency plot is labeled "percent finer," at first glance it appears appropriate to include bedrock in distribution curve plots. However, this ignores the primary purposes for collecting information about particle size distribution.

Non-bedrock particles are the only ones that are actually mobilized by flow. Therefore, investigators need an estimate of the proportion of the bed occupied by potentially movable grains.

In terms of resistance, smooth bedrock, although it may be quite massive in size, offers little in the way of form resistance (unless it's a bedrock step or fall, etc.). In this case, bedrock acts more like the particles at the finest end of the curve rather than the large boulders found at the other extreme of the cumulative distribution curve. Other types of bedrock may have protrusions that extend into the flow imparting significant roughness. In terms of roughness, these could act more like cobbles or even boulders depending on the specific configuration and orientation of the rock. In any case, bedrock does not usually conform to the shape of the channel as the flow would deform it if it were surfaced with mobile material. The resistance offered by bedrock is a function of its texture and form, which cannot be equated to the resistance offered by bed particles without a great deal of difficulty. Bedrock is best thrown into the bin of the sorts of form resistances (large woody debris, bank protrusions, car bodies, etc.) that confound quantifying channel roughness.

In the end, how you handle bedrock depends how you intend to apply the data. Resolution of the issue, therefore, requires critical thinking on your part (see Table Below).

In closing, you generally won't encounter many instances in which bedrock counts will be more than a footnote in your field notebook. If you are shooting for 100 counts and you have 80 as pebbles and 20 on bedrock, you'd better find 20 more pebbles.

Questions for Doctor Hydro should be sent in written form, on the Data General if possible, to STREAM:S28A, addressed to subject *Ask Doctor Hydro*. With each issue of STREAM NOTES, we will select at least one question of widespread interest and provide an answer.

Data Application	Use Bedrock?
1. To characterize bed composition	Yes
2. To characterize bed roughness	Maybe
3. To characterize size distribution of material available for sediment transport	No

Catalog of Continuing Education Courses in Hydrology and Watershed Management

A catalog of courses that support continuing education and skill development for forest hydrologists and other water resource related professionals is now available in a public file on the Forest Service's Data General computer network.

The catalog represents a joint effort involving BLM and Forest Service personnel. It was developed in response to needs identified by Regional Watershed Directors and addresses the maintenance and development of technical and program management skills in hydrology and watershed management.

The catalog was produced through the dedicated efforts of Shelly Witt, USFS Fish Habitat Relationships Group, Logan, Utah; Jim Fogg, BLM Service Center, Denver, Colorado; Ken Roby, Pacific Southwest/R-5 Liaison, Albany, California; Bruce McCammon, Region 6, Portland, Oregon; Harry Parrot, Region 9, Milwaukee, Wisconsin; and Bill Putnam, Region 1, Missoula, Montana.

Course information is available through the Forest Service Training Information Center **(TRN)**. TRN is designed to allow individuals to request Service-wide and inter-Regional training announcements using the Data General short message facility.

Courses follow a format compatible with the national training catalog effort led by Keith Namock. Each individual training announcement contains information about:

1. Course title and location;
2. Responsible program office;
3. Course length;
4. Course objectives;
5. Target audience;
6. Costs; and
7. Key contact person for more information on the course.

Instructions for basic accessing of TRN are detailed on the next page. More complete information about TRN access and procedures are available from your local Systems Information Manager. Should you experience any difficulties using this system, please contact your Systems Information Manager.

A hard copy notebook version of this information will be available later this spring. We plan to revise the catalog periodically and welcome your suggestions about courses that could be added to the catalog.

Computers and Math Coprocessors: *If you are planning to purchase a desktop or personal computer, be sure to buy one with a math coprocessor. We recently ran across several computer programs that require math coprocessors to run. As programs get progressively more sophisticated computationally, coprocessors will become increasingly essential. A common misconception exists that all 486 computers have built-in math coprocessors. This is not true. Only 486s with the 486DX chip have built-in coprocessors; the 486SX chip does not.*

TRAINING INFORMATION SERVICE
TRN ACCESS INFORMATION

INSTRUCTIONS TO LOG ON AND MAIL A TRN DOCUMENT TO YOUR LOCAL DG INBOX

1. Log onto your Data General in the usual manner.

2. Press INTERRUPT, the (F5) function key.

3. Press 7 for the "User Applications" menu item and NEW LINE.

4. Some users may be asked if they are doing this from public or private domain. If asked, Select 2, "Public Domain," and then NEW LINE. Most users will be asked to "Select an Application." Enter INFO_CENTER and then press NEW LINE twice.

5. A menu of Forest Service Information Centers will appear. Enter the menu number for OTHER, "Additional Information Centers" followed by NEW LINE. This is usually the last menu item.

6. You will be asked to enter the Center Name. Enter TRN and then NEW LINE.

7. "Calling Information Center" will appear in the lower left corner. Once connected, a standard folder menu will appear. You are now connected to a computer in the Washington Office in Drawer: TRN and will see a list of Folders. Navigate through this as you would your own CEO filing system. Look in Folder WATERSHED & AIR for most of the catalog listings. You may also wish to look in folder WILDLIFE & FISHERIES that is immediately below it for some of the courses.

8. View documents as you normally would in your personal DG space. When you find the document you want, use menu item 9, "Mail," at the bottom of the screen, to mail the document to yourself. Enter your name with host ID (for example, J.SMITH:R08F12a), the name of the document on the Subject line, and mail it like you would any document.

9. Be sure to properly logoff the system when done to break the phone connection. Log off by depressing CANCEL/EXIT, the (F11) function key as often as needed (be patient and give the system time to respond) until you see the message "Do you want to exit?" Answer Y and NEW LINE. You will see "Clearing the Connection" in the upper right corner, then the INFO_CENTER menu. You are now back to your local DG system. Depress the CANCEL/EXIT, (F11) function key as needed to return to the main menu of CEO.

Editorial Policy

To make this newsletter a success, we need **voluntary contributions** of relevant articles or items of general interest. YOU can help by taking the time to share innovative approaches to problem solving that you may have developed.

Please submit typed, single-spaced contributions limited to two pages. Include graphics and photos that help explain ideas.

We reserve editorial judgments regarding appropriate relevance, style, and content to meet our objectives of improving scientific knowledge. Send all contributions to: Stream Systems Technology Center, Attention: STREAM NOTES Editor.

Please share copies of STREAM NOTES with your friends and associates. We mail a copy of the newsletter to each Forest Service hydrologist and fisheries biologist using lists provided by the Regional Offices. You may have noticed a new format for our mailing labels. **Please check your address and notify us of any corrections if you do not like the way your mailing label is addressed.**

Anyone wishing to be added to our mailing list or requiring a change of address should send their name and street mailing address via DG to STREAM:S28A or write to our mailing address at USDA Forest Service, Stream Systems Technology Center, Rocky Mountain Station, 240 West Prospect, Fort Collins, CO 80525.

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