THE CENTER FOR TRANSPORTATION AND THE ENVIRONMENT
NORTH CAROLINA STATE UNIVERSITY

AQUATIC ORGANISM PASSAGE AT ROAD-STREAM CROSSINGS

PREPARED BY CTE INFORMATION SERVICES
MARCH 2002

The Center for Transportation and the Environment (CTE) is a university research institute funded by the US Department of Transportation and the North Carolina Department of Transportation, and located at The Institute for Transportation Research and Education, North Carolina State University. CTE's mission is to conduct programs of research education and technology transfer which mitigate the impacts of surface transportation on the environment.

This search is in response to a request for research in progress on aquatic organism passage at road-stream crossings. The areas covered include stream simulation, culvert hydrolics, aquatic organism movement or migration, baffles, fishways, culvert or stream crossing design, and fish passage performance standards. The results of the search are divided into sections on hydrology, culverts, habitat and fish passage.

TABLE OF CONTENTS

LIST OF DATABASES SEARCHED

Federal Research in Progress
TRIS-RIP
World Wide Web

HYDROLOGY

TRIS Accession No.:
00818622
Title:
RESEARCH FOR AASHTO STANDING COMMITTEE ON HIGHWAYS. TASK 146. DEVELOPMENT OF SOFTWARE VERIFICATION PROTOCOL FOR THE HYDROLOGIC AND HYDRAULIC MODELS FOR HIGHWAY PLANNING AND DESIGN
Language:
English
Source:
National Cooperative Highway Research Program
Funding Organization:
National Cooperative Highway Research Program
Transportation Research Board, 2101 Constitution Avenue, NW
Washington, DC 20418- USA
Responsible Individual:
Hess, Timothy G
Phone:
202-334-2049
Funding Organization 2:
American Association of State Highway & Transp. Office
444 North Capitol Street, NW, Suite 249
Washington, DC 20001 USA
Funding Organization 3:
Federal Highway Administration
400 7th Street, SW
Washington, DC 20590 USA
Contract:
Project 20-07, Task 146
Funding Type:
NCHRP
Status:
Proposed
Notice Date:
June 30, 2001
Total Dollars:
$100,000.00
Abstract:
The proposed study will develop a protocol for the verification and validation of software available for watershed, hydrologic and hydraulic modeling for highway planning and design studies.
Notes:
Contract to a Performing Organization has not yet been awarded.
Index Terms:
Hydrologic cycle; Hydraulics; Highway planning; Software; Design; Research projects; National Cooperative Highway Research Program

TRIS Accession No.:
00806002
Title:
UPDATE AND EVALUATE NEW METHODS FOR ESTIMATING THE PEAK FLOW CHARACTERISTICS OF UNGAGED STREAMS IN WYOMING
Language:
English
Source:
Wyoming Department of Transportation
Performing Organization:
Wyoming Department of Transportation
P.O. Box 1708, 5300 Bishop Boulevard
Cheyenne, WY 82002-9019 USA
Investigator:
Miller, Kirk
Phone:
307-778-2931
Funding Organization:
Wyoming Department of Transportation
P.O. Box 1708, 5300 Bishop Boulevard
Cheyenne, WY 80002-9019 USA
Responsible Individual:
Bailey, Bill
Phone:
307-777-4045
Contract:
RS05(199)
Funding Type:
Contract
Status:
Active
Notice Date:
November 02, 2001
Start Date:
June, 1999
Est. Completion Date:
May, 2002
Total Dollars:
$51,100.00
Abstract:
The objective of this research project is to update the regression equations for estimating peak streamflows at ungaged sites in Wyoming. These relations to estimate streamflows will help the Wyoming DOT design bridges, culverts and other crossings in a more cost effective manner.
Index Terms:
Streambeds; Peak discharge; Flow; Streams; Regression analysis; Research projects; Wyoming

TRIS Accession No.:
00802406
Title:
VERIFICATION OF ROUGHNESS COEFFICIENTS
Language:
English
Source:
Alaska Department of Transportation and Public Facilities
Performing Organization:
Alaska Department of Transportation and Public Facilities
3132 Channel Drive
Juneau, AK 99801-7898 USA
Investigator:
Adler, C
Phone:
907-451-5321
Funding Organization:
Alaska Department of Transportation and Public Facilities
3132 Channel Drive
Juneau, AK 99801-7898 USA
Funding Organization 2:
Federal Highway Administration
400 7th Street, SW
Washington, DC 20590 USA
Funding Type:
HP&R
Status:
Active
Notice Date:
November 14, 2000
Start Date:
October 01, 2000
Est. Completion Date:
September 30, 2002
Total Dollars:
$88,000.00
Abstract:
This project continues the work done under 99-19, Stream Flow Modeling. both projects are aimed at figuring out flood heights and the volume of water during spring runoff and flood conditions. The end result of high velocity and volume is that culverts and bridges wash out, or so much scour happens that eventually culvert and bridge installations have to be restabilized. The ideas is to prevent or reduce washouts and scour in the first place. The project will start with field data based on conditions, which are admittedly different from much of the rest of the United States. Roughness coefficients were developed in Lower 48, mostly in the southeastern United States, where there are a few large cross- sections of steeper streams to observe. Alaska has cascading-flow and boulder-cobble streams, particularly the southeast and south- central areas, as well as on the Dalton Highway up to Atigun Pass. To date, Alaskan designers have had to extrapolate roughness coefficients from the Lower 48 data, and experience shows that doing so isn't sufficient to protect our culverts and bridges. Developing and improving Alaska's road means designing bridges or culverts for many stream crossings. There is very limited hydrologic data to use for hydraulics, which means that designers typically have to estimate streamflow and scour computations. A critical parameter for modeling flood flows is channel roughness. Accurately knowing roughness (friction) coefficients will improve streamflow modeling. Southeast Alaska presented good research opportunities this past year, with higher than normal stream flows. This allowed stream flow modeling researchers to do some calibration and verification of channel roughness. The objectives of this research are to: (1) derive better flood heights and stream volumes; (2) design more cost- effective bridges and culverts based on being better able to predict what the water flow will do, especially during spring runoff and flood conditions; (3) able to put bridges and culverts in places with reduced

scour (for newer construction); and (4) greatly reduce the number of washouts that occur, especially in the mountainous areas of the state.
Index Terms:
Roughness coefficient; Streambeds; Floods; Channels (Waterways); Culverts; Bridges; Flood damage; Research projects; Alaska

TRIS Accession No.:
00802400
Title:
DESIGN DISCHARGE FOR JUVENILE SALMON
Language:
English
Source:
Alaska Department of Transportation and Public Facilities
Performing Organization:
Alaska Department of Transportation and Public Facilities
3132 Channel Drive
Juneau, AK 99801-7898 USA
Investigator:
Connor, B
Phone:
907-451-4579
Funding Organization:
Alaska Department of Transportation and Public Facilities
3132 Channel Drive
Juneau, AK 99801-7898 USA
Funding Organization 2:
Federal Highway Administration
400 7th Street, SW
Washington, DC 20590 USA
Funding Type:
HP&R
Status:
Active
Notice Date:
November 14, 2000
Start Date:
October 01, 2000
Est. Completion Date:
September 30, 2002
Total Dollars:
$60,000.00
Abstract:
The Alaska Department of Fish and Game uses criteria specifically for Arctic grayling to determine stream discharges that are then used to design culverts for fish passage. While this application is certainly appropriate where Arctic grayling exist, blind application of designs developed for grayling results in potentially inappropriate designs for other species. This can be both costly and inefficient. It is know that juvenile salmon use the boundary layer along the culvert walls to pass through the culvert. Unfortunately, a lack of understanding exists about the velocities of the flow near the culvert walls. Culvert inlets represent a major barrier to fish passage. Researchers will investigate methods to remove this barrier. The objectives of this research are to: (1) better understanding how inlet and culvert velocities affect swimming of specific fish species; (2) develop reasonable criteria to determine design discharges to more closely match geography and fish species; and (3) culvert installations that are neither over- nor under-designed.

Index Terms:
Wildlife; Salmon; Fishes; Culverts; Water; Streams; Flow; Velocity; Research projects

TRIS Accession No.:
00795895
Title:
METHODS FOR DETERMINING BANKFULL DISCHARGE AND OTHER FLOOD DISCHARGES FOR UNGAGED SITES IN WESTERN MONTANA BASED ON CHANNEL MORPHOLOGY
Language:
English
Source:
Montana Department of Transportation
Performing Organization:
United States Geological Survey
3162 Bozeman Avenue
Helena, MT 59601- USA
Investigator:
Parrett, Charles
Phone:
406-457-5928
Funding Organization:
Montana Department of Transportation
2701 Prospect Avenue, P.O. Box 201001
Helena, MT 59620-1001 USA
Responsible Individual:
Sillick, Susan C.
Phone:
406-444-7693
Funding Type:
Contract
Status:
Active
Notice Date:
November 02, 2001
Start Date:
July 01, 2000
Est. Completion Date:
September 30, 2003
Total Dollars:
$79,370.00
Abstract:
State and Federal land and water management agencies require credible scientific information to evaluate and design various channel restoration projects at impaired stream reaches throughout Montana. In addition, these agencies require methods for reliably estimating peak discharges at ungaged sites throughout Montana in order to economically design hydraulic structures such as culverts, bridges, and drainage facilities. This project will provide the hydrologic data required to evaluate and design stream restoration projects and will produce improved equations for estimation of peak discharge in western Montana.
Index Terms:
Floods; Channel flow; Channel stabilization; Restoration ecology; Hydraulic structures; Streams; Research projects; Montana

TRIS Accession No.:
00769000
Title:
WATERSHED DRAINAGE
Language:
English
Source:
Maine Department of Transportation
Performing Organization:
Maine Department of Transportation
Transportation Building, State House Station 16
Augusta, ME 04330-0016 USA
Investigator:
Carter, B
Phone:
207-287-2055
Performing Organization 2:
United States Geological Survey
N/A, USA
Investigator 2:
Hodkins, G
Phone:
207-287-2055
Funding Organization:
Maine Department of Transportation
Transportation Building, State House Station 16
Augusta, ME 04330-0016 USA
Funding Organization 2:
United States Geological Survey N/A USA
Contract:
00-5
Funding Type:
SP&R
Status:
Active
Notice Date:
March 09, 2001
Total Dollars:
$102,400.00
Abstract:
Based on a 1981 U.S. Water Resources Council study current methods to predict peak flows for small drainage watersheds are grossly inaccurate. When current methods were compared to actual gauged (true) flows errors ranging from 55% to 75% four underestimation and 105% to 310% overestimation were determined. Clearly this could lead to under- and over- sizing culverts. The costs associated with materials is significant. However the cost associated with flood event damage can be enormous. This study will gage 30 diverse watersheds geographically spread across the state. Peak flow data will be compared to current prediction methods and results analyzed. This three year study will provide an indication of the accuracy of the models.
Index Terms:
Drainage; Water supply and distribution structures; Water resources; Culverts; Model basins; Peak discharge; Flow; Research projects

TRIS Accession No.:
00759930
Title:
HYDRAULICS OF SLOPE-TAPERED CONCRETE PIPE CULVERTS
Language:
English
Source:
Iowa Department of Transportation
Performing Organization:
Federal Highway Administration
400 7th Street, SW
Washington, DC 20590 USA
Investigator:
Jones, JS
Performing Organization 2:
GKY and Associates
N/A, ZZ USA
Funding Organization:
Iowa Department of Transportation
Capitol Building, 1007 East Grand Avenue
Des Moines, IA 50319 USA
Responsible Individual:
N/A
Phone:
N/A
Contract:
HR-398
Funding Type:
Contract
Status:
Active
Notice Date:
February, 1999
Start Date:
January 17, 1997
Est. Completion Date:
December 13, 1997
Total Dollars:
$33,832.00
Abstract:
The objective of this research project is to verify the hydraulic design details of slope tapered pipe culverts. The results of the research show that both the slope tapered inlet configuration and the typical precast concrete pipe apron (IDOT) Standard Road Plant RF-3) are more hydraulically efficient than assumed. Also, in the slope taper section, the number of reducer sections required in IDOT' s design guidelines can be decreased by one reducer without adversely affecting hydraulic efficiency of the inlet. In general, the research verified assumptions in IDOT's design guidelines for slope tapered concrete culverts.
Index Terms:
Concrete pipe; Culverts; Hydraulic structures; Slopes; Research projects

TRIS Accession No.:
00759922
Title:
COLLECTION AND ANALYSIS OF STREAM FLOW DATA
Language:
English
Source:
Iowa Department of Transportation
Performing Organization:
U.S. Geological Survey
Iowa City Office, Water Resources Division
Iowa City, IA 52244- USA
Investigator:
Middlemis-Brown, R.
Phone:
319-358-3600
Funding Organization:
Iowa Department of Transportation
800 Lincoln Way
Ames, IA 50010 USA
Responsible Individual:
Barrett, B.C.
Phone:
N/A
Contract:
HR-140
Funding Type:
Contract
Status:
Active
Notice Date:
November 02, 2001
Est. Completion Date:
September 30, 1999
Total Dollars:
$143,000.00
Abstract:
The objective of this project are to obtain information about the flow of water in Iowa streams with particular emphasis on the magnitude and frequency of floods and to compile and analyze this information for use by highway engineers engaged in the design of bridges, culverts and embankments.
Notes:
A summary report of magnitude and frequency of Iowa floods is prepared annually.
Index Terms:
Streams; Flow measurement; Floods; Culverts; Embankments; Research projects; Iowa

Dialog Accession No.:
00262502
Sponsor ID No.:
0161777
Title:
HYDROLOGY OF SOUTHWESTERN WETLANDS AND RIPARIAN AREAS
Language:
English
Performing Organization:
UNIVERSITY OF ARIZONA, RENEWABLE NATURAL RESOURCES, TUCSON, ARIZONA 85721
Investigator:
Guertin, D. P.
Abstract:
The objective of this proposed research is to investigate the hydrological and vegetation relations of southwestern riparian and wetland systems. At selected sites recording and non-recording water table observation well and/or piezometers will be installed. Streamflow will also be monitored at some sites. The wells locations and elevations will be surveyed. Vegetation measurements, including composition, canopy cover, density, size and age class, and recruitment will be taken at each site. The field data will be analyzed using standard statistical procedures, as well as, used to develop models to simulate the interaction between hydrology and vegetation dynamics.PR ; investigate and management southwestern riparian systems, especially to address the influence of watershed condition. The project linked models and field data to geographic information systems (GIS) to better represent the spatial variability of a watershed and relation watershed and riparian characteristics. Individual studies completed during the project include: (1) Heller used a hydrologic model to assess the potential impact of stock tanks on water availability to downstream riparian areas. The results indicated that on small watersheds stock tanks can decrease downstream water yield by as much as 20%; (2) Miller et al. and Levick investigated the use of remote sensing to develop GIS; theme layers and parameterize hydrologic models; (3) Martinez and Miller et al. examined the sensitivity of hydrologic models to different levels of complexity; (4) Guertin et al. developed a GIS-based tool to integrated watershed and livestock allotment planning; (5) Miller et al. used a GIS to gain better understanding of the geomporhic processes in a semiarid watershed in southeastern Arizona. Relationships were derived between channel shape variables and watershed characteristics. Channel cross-sectional area and channel width were found to be correlated to channel order, watershed area, and maximum contriduting flow length; (6)Danzer developed relationships ; between vegetative and environmental characteristics for high elevation riparian areas. The study found elevation and channel gradient were important variables for predicting riparian vegetation characteristics; and (7) Youberg related GIS derived variables to channel characteristics in the White Mountains, Arizona. The study developed significant multiple regresssion relationships (R-square > 0.7) for channel cross-sectional area and substrate D50 particile size. Grazing and geology were found to be important independent variables.PB elevation riparian communities in the mountains of southeastern Arizona. Unpublished Ph.D. Dissertation, School of Renewable Natural ; Resources, The University of Arizona.PB Geographic Information System Based Tool for Integrated Allotment and Watershed Management. In: Rangeland Management and Water Resources, Proceedings, AWRA Specialty Conference, D.F. Potts (editor), American Water Resources Association, Herdon, VA. pp. 35-44.PB recharge on the Arivaca Creek Watershed. Unpublished M.S. Thesis, School of Renewable Natural Resources, The University of Arizona.PB watershed assessment: Integrating spatial and tabular data to derive parameters for a hydrologic simulation model (ASDBSN). In 1999 ESRI User Conference Proceedings, San Diego, CA, July 1999. URL: www.esri.comPB Green-Ampt effective hydraulic conductivity ; for rangelands. Journal of Rangeland Management 50: 290-299.PB Linking a hydrologic model with remote sensing and GIS. Unpublished M.S. Thesis, School of Renewable Natural Resources, The University of Arizona.PB watershed discretization schemes using ARDBSN hydrological model and GIS. Unpublished Ph.D. Dissertation, School of Renewable Natural Resources, The University of Arizona. Mehramiz, M.R. 1998. Nutrient content of three Atriplex species(Atriplex cancensces, Atriplex lineraris, and Atriplex Polycarpa) under different management practices and site conditions. Unpublished.
Index Terms:
hydrology wetlands riparian sites vegetation plant communities water tables piezometers stream flow species composition plant ecologyplant canopy plant size plant density recruitment simulation models statistical analysis field studies

CULVERTS

TRIS Accession No.:
00821372
Title:
FISH PASSAGE THROUGH CULVERTS
Language:
English
Source:
Texas Transportation Institute
Performing Organization:
Oregon State University, Corvallis
Department of Fisheries and Wildlife, 104 Nash Hall
Corvallis, OR 97331 USA
Investigator:
Gregory, Stan
Phone:
541-737-1951
Funding Organization:
Oregon Department of Transportation
200 Hawthorne SE, Suite B-240
Salem, OR 97301-5192 USA
Responsible Individual:
Sposito, Brett
Phone:
503-986-2847
Contract:
325
Funding Type:
Contract
Status:
Active
Notice Date:
December 06, 2001
Start Date:
July 01, 1999
Est. Completion Date:
June 30, 2003
Total Dollars:
$180,977.00
Abstract:
As part of the Oregon Plan for Salmon and Watersheds, highway culverts that are barriers to fish passage must be retrofitted or replaced in order to pass fish. It is unknown whether the culverts that have been retrofitted or constructed are effective. This project will evaluate the extent of fish movement and test various types and placements baffles to develop recommendations for the design of culverts for maximum fish passage.
Index Terms:
Fishes; Culverts; Salmon; Watersheds; Retrofitting; Barriers (Roads); Research projects; Oregon

TRIS Accession No.:
00813652
Title:
EXPERIMENTAL EVALUATION OF SPIRAL CORRUGATED HIGH-DENSITY POLYETHYLENE PIPES FOR CULVERTS AND STORM DRAINS
Language:
English
Source:
Florida Department of Transportation
Performing Organization:
Consultants Sotres Incorporated
5902 Place Villiers
Quebec J4W 1X7, ZZ Canada
Investigator:
Chaallal, Omar
Phone:
514-396-8852
Funding Organization:
Florida Department of Transportation
605 Suwannee Street
Tallahassee, FL 32399-0450 USA
Responsible Individual:
El-Saad, Adnan
Phone:
850-414-4665
Contract:
BC758
Funding Type:
Contract
Status:
Active
Notice Date:
June 20, 2001
Start Date:
July 12, 2000
Est. Completion Date:
July 11, 2001
Total Dollars:
$80,000.00
Abstract:
The objective of this research is to develop/verify reliable test methods for determine the material properties of HDPE pipes.
Index Terms:
Spiral flow tests; Culverts; Storm sewers; Pipe; High density; Experiments; Research projects

TRIS Accession No.:
00810477
Title:
MONITORING ANIMAL USE OF MODIFIED DRAINAGE CULVERTS ON THE LOLO SOUTH PROJECT
Language:
English
Source:
Montana Department of Transportation
Performing Organization:
University of Montana
Division of Biological Sciences
Missoula, MT 59812- USA
Investigator:
Foresman, Kerry R.
Phone:
406-243-5113
Funding Organization:
Montana Department of Transportation
2701 Prospect Avenue, P.O. Box 201001
Helena, MT 59620-1001 USA
Responsible Individual:
Sillick, Susan C.
Phone:
406-444-7693
Contract:
8117-15
Funding Type:
Contract
Status:
Active
Notice Date:
October 08, 2001
Start Date:
December 18, 2000
Est. Completion Date:
August 31, 2001
Total Dollars:
$24,468.00
Abstract:
tHighways present a barrier to animal movement, particularly when they bisect wildlife corridors or unique habitats such as wetland communities. The current highway expansion between Lolo and Hamilton in west-central Montana raises this issue since a wider (4- lane) highway surface is being constructed and many sections will further separate existing wetlands. Attempts have been made within the first phase of construction to mitigate such impacts by providing modified drainage culverts have been placed under the reconstructed section of Highway 93. These 48" diameter culverts have a 25" wide galvanized grate mounted to one side at mid-height, running the length of the culvert and accessed by a ramp. When thes4 culverts are water-free, animals are able to walk either on the floor of the culvert or along the grate from one side to the other. As water flows through, the opportunity still exists to use the suspended grate, and even when water overflows the grate, semi- aquatic species are able to move from one riparian zone to the other. The primary objectives of this research are to document the species of animals using these culverts and the extent to which they use them seasonally. Use of these modified culverts will be compared to use of standard culverts located in adjacent sections of the highway.
Index Terms:
Drainage; Culverts; Animals; Animal behavior; Wetlands; Wildlife; Highway corridors; Expansion; Research projects

TRIS Accession No.:
00809159
Title:
SNAP-TITE CULVERT LINING SYSTEMS
Language:
English
Source:
Connecticut Department of Transportation
Performing Organization:
Connecticut Department of Transportation
2800 Berlin Turnpike, P.O. Box 317546
Newington, CT 06131-7546 USA
Investigator:
Calin, Veronica M.
Phone:
860-594-2078
Funding Organization:
Connecticut Department of Transportation
2800 Berlin Turnpike, P.O. Box 317546
Newington, CT 06131-7546 USA
Responsible Individual:
Sime, James M.
Phone:
860-258-0309
Contract:
CT 98-01
Funding Type:
Contract
Status:
Active
Notice Date:
April 01, 2001
Start Date:
April, 1998
Est. Completion Date:
October, 2001
Total Dollars:
$315,000.00
Abstract:
The objective of this research project is to evaluate the performance, effectiveness and quality of lining culverts with the Snap-Tite Culvert Lining System.
Index Terms:
Culverts; Linings; Performance evaluations; Performance tests; Quality assurance; Research projects

TRIS Accession No.:
00797367
Title:
BROKEN-BACK CULVERT
Language:
English
Source:
Nebraska Department of Roads
Performing Organization:
Hotchkiss, Rollin
P.O. Box 642910
Pullman, WA 99164-2910 USA
Investigator:
Hotchkiss, Rollin
Phone:
509-335-1927
Funding Organization:
Nebraska Department of Roads
1500 Nebraska Highway 2, P.O. Box 94759
Lincoln, NE 68509-4759 USA
Responsible Individual:
Donahoo, Kevin
Phone:
402-479-4725
Funding Type:
Contract
Status:
Active
Notice Date:
November 02, 2001
Total Dollars:
$10,000.00
Abstract:
The Nebraska Department of Roads (NDOR) uses a unique kind of culvert termed broken back in situations of steep topography where excavation costs would be very high to install a traditional culvert. The researchers developed a computer software called Broken-Back Culvert Analysis Program (BCAP) to evaluate the hydraulic performance of these culverts. However, 4%-5% of the time when extreme conditions are being evaluated, an error occurs. This supplement would be to debug the program, periodically upgrade it and provide maintenance.
Index Terms:
Culverts; Topography; Excavation; Costs; Software; Computers; Hills; Research projects; Broken back culvert

TRIS Accession No.:
00796864
Title:
EXPERIMENTAL AND ANALYTICAL EVALUATION OF FLEXIBLE PIPES FOR CULVERTS AND STORM SEWERS
Language:
English
Source:
Florida Department of Transportation
Performing Organization:
Florida Atlantic University
777 Glades Road
Boca Raton, FL 33431 USA
Investigator:
Arockiasamy, Madasamy
Phone:
561-297-3434
Funding Organization:
Florida Department of Transportation
605 Suwannee Street
Tallahassee, FL 32399-0450 USA
Responsible Individual:
Shahawy, Mohsen
Phone:
850-414-2966
Contract:
BC-775
Funding Type:
Contract
Status:
Active
Notice Date:
July 05, 2001
Start Date:
August 30, 2000
Est. Completion Date:
August 14, 2002
Total Dollars:
$540,174.00
Abstract:
The major objective of this research is to provide answers to the many lingering questions concerning the use of flexible pipes for Florida culverts and sewer applications.
Index Terms:
Culverts; Storm sewers; Flexibility; Pipe; Evaluation and assessment; Research projects

HABITAT

TRIS Accession No.:
00821468

Title:

ASSESSMENT OF STREAM HABIT AND BIOLOGICAL COMMUNITIES ASSOCIATED WITH BRIDGES AND CULVERTS

Language:
English

Source:
University of Tennessee Center for Transportation Research

Performing Organization:
Tennessee Technological University
Box 96-B
Cookeville, TN 38505 USA

Investigator:
Cook, S. Bradford; Combs, Daniel L.

Funding Organization:
Tennessee Department of Transportation
James K. Polk Building, Fifth and Deaderick Street
Nashville, TN 37243-0349 USA

Contract:
Cut 149

Funding Type:
Contract

Status:
Active

Notice Date:
December 13, 2001

Start Date:
October 01, 1996

Est. Completion Date:
December 31, 2004

Total Dollars:
$645,865.00

Abstract:
The objective of this project is to provide further progress towards a comprehensive analysis of affected streams across the entire State of Tennessee by examining the ecoregions in western Tennessee that are characterized by low-gradient streams with surrounding row-crop land-use practices. The following objectives will also be addressed: identify the immediate (short-term) habitat and biological community alterations resulting from bridge culvert placement; determine the length of time required for habitat and biological recovery at each construction site; and investigate long- term effects of bridge/culvert placement on stream fish communities in western Tennessee ecoregions.

Index Terms:
Streams; Habitat (Ecology); Biological control; Land use; Bridges; Culverts; Location; Research projects; Tennessee

TRIS Accession No.:
00814978
Title:
ASSESSMENT OF STREAM HABITAT BIOLOGICAL COMMUNITIES ASSOCIATES WITH BRIDGES AND CULVERTS IN TENNESSEE
Language:
English
Source:
University of Tennessee Center for Transportation Research
Performing Organization:
Tennessee Technological University
Cookeville, TN 38505 USA
Investigator:
Cook, S. Bradford; Combs, Daniel D.
Funding Organization:
Tennessee Department of Transportation
900 James K. Polk Building
Nashville, TN 37243-0334 USA
Responsible Individual:
Presley, Mike
Funding Type:
Contract
Status:
Active
Notice Date:
August 07, 2001
Start Date:
October 01, 1996
Est. Completion Date:
December 31, 2001
Total Dollars:
$357,375.00
Abstract:
The objectives of this project are: (1) to determine the length of time required for streams to recover from construction activities associated with bridge or culvert replacement; (2) to ensure that the replacement of the bridge or culvert has not affected the intended use of the stream, its biological communities, and its chemical and physical features.
Index Terms:
Construction of specific facilities; Bridges and culverts; Streams; Length; Time periods; Biological control; Research projects; Tennessee

TRIS Accession No.:
00764072
Title:
TECHNOLOGY FOR REDUCING WATER QUALITY IMPACTS FROM FOREST ROAD STREAM CROSSINGS
Language:
English
Source:
Center for Transportation and the Environment, NCSU
Performing Organization:
Auburn University
Auburn, AL 36830 USA
Investigator:
Taylor, SE
Funding Organization:
Department of Agriculture
Independence Avenue, Between 12th and 14th Streets, SW
Washington, DC 20250 USA
Contract:
CRIS 0175872
Funding Type:
Contract
Status:
Active
Notice Date:
December 31, 1998
Start Date:
October 01, 1997
Est. Completion Date:
September 30, 2000
Abstract:
The research objectives are to quantify and compare the water quality impacts resulting from both traditional and alternative types of stream crossings; quantify net sediment production resulting from the road approaches to stream crossing sites; and document life-cycle costs for each of the crossings studied. Several ford, culvert, and temporary bridge stream crossings will be installed on forest roads and then monitored to determine the quantity of sediment introduced into streamflow by each crossing throughout the life of the crossing. Tests also will be conducted on new stream crossing alternatives such as portable bridge systems, pipe fascine systems, and constructed fords. Automated equipment will be used to collect water samples at locations upstream and downstream from the crossings. Then water samples will be analyzed to determine sediment production at the crossing. Also, devices will be installed at the crossings to measure sediment produced by the road approaches. When using the information on sediment production from road approaches is compared with stream crossing sediment production, we can determine whether more efforts should be devoted to reducing sediment production from the crossing structure itself or >from the road approaches to the crossing, In addition to gathering information on sediment production, the researchers will document life-cycle costs of each of the stream crossings studied.
Index Terms:
Streams; Sediments; Water quality; Forest roads; Bridges and culverts; Research projects

Dialog Accession No.:
00276565
Sponsor ID No.:
0185495
Title:
EFFECTS OF AGRICULTURAL AND FORESTRY PRACTICES ON STREAM ECOSYSTEM: Environmental factors
Language:
English
Performing Organization:
WEST VIRGINIA UNIVERSITY, FORESTRY, MORGANTOWN, WEST VIRGINIA 26506
Investigator:
Petty, J. T.
Abstract:
Characterize spatial and temporal variation in stream ecosystem processes, including hydrologic regime, habitat structure, sedimentation, productivity and temperature in mountainous streams of West Virginia. Identify the effects of these processes on the spatial distribution, dispersal, and stability of stream fish populations. Identify the effects of human activities, including agriculture, forestry, surface mining, and urbanization on stream ocosystem processes and fish metapopulation dynamics. Develop landscape scale models to predict fish metapopulation responses to human activities that disrupt natural stream processes. Use models to identify critical ; areas within drainage basins for protection and restoration to ensure the persistence and long term productivity of stream fish populations. This project will use a combination of long term observational field studies, experimentation, and simulation modeling to examine the effects of agricultual and forestry practices on stream ecosystem processes and fish metapopulation dynamics. Field studies are directed at providing information on relationships among environmental variation, land use, stream processes, and fish demographics. Particular emphasis will be placed on identifying links between land use, stream flow variability and fish population stability. I also will; focus on the effects of various land use activities on fish dispersal among stream reaches within a particular watershed. The final product of this project will be a simulation model that can be used to assess the impacts of alternative land use scenarios on fish metapopulation dynamics and long term productivity.PR Creek watersheds that summarizes current land use activities, water and habitat quality, and fish diversity profiles. Much of this information came from data sets obtained by various state and federal agencies over the past several years. Land use data was obtained from the Natural Resource Analysis Center (NRAC). Water quality data came from the WV DEP and the US EPA.; Fish community data was obtained from the WV DNR and the USFS. Our compilation of this data identified important gaps in our current knowledge. I ran preliminary statistical analyses to assess the interactive effects of forestry, agriculture, and acid mine drainage on fish communities in the lower Cheat basin. These analyses indicated three patterns. First, like most watersheds, there is a consistent relationship between stream order and fish diversity; species richness increases as stream order increases. Second, the direct effect of AMD on fishes is severe; species richness is zero in streams directly impacted by AMD, regardless of stream order. Third, a significant ; amount of the variation in species richness among streams in this watershed is neither explained by stream order nor by the direct effects of AMD. Much of this "unexplained" variation can be explained by the interactive effects of forestry, agriculture, and AMD in the watershed. I began a long-term stream sampling approach that will be used to assess the interactive effects of forestry and agriculture on stream ecosystems and fish metapopulations dynamics. Results from this research will be used to develop landscape scale models to predict stream community responses to changes in land use patterns within a watershed.
Index Terms: agriculture environmental impact forestry cultural practices streams aquatic ecosystems fish population population dynamics dispersal hydrology watershed management spatial variability temporal distribution fish habitats habitat characteristics wildlife human relations mining land use long term simulation models environmental factors

Dialog Accession No.:
00275542
Sponsor ID No.:
0184121
Title:
Stream community responses to watershed urbanization biomonitoring
Language:
English
Performing Organization:
PURDUE UNIVERSITY, FORESTRY & NATURAL RESOURCES, WEST LAFAYETTE,INDIANA 47907
Investigator:
Spacie, A.
Abstract:
The overall goal is to develop a better understanding of the causal relationships between land-use change in urbanizing Midwestern watersheds and consequent alterations of their stream ecosystems.
Specific objectives of the project are: (1) to develop predictive relationships among flow regime, channel stability, and stream community structure and function across a regional gradient of land uses in agricultural and urbanizing watersheds; (2) to identify and test key factors limiting stream community structure and function; and (3) to formulate design criteria for protection of stream biota in urbanizing areas based on land use, hydrology, and channel ; characteristics. The first objective, development of predictive relationships, will be accomplished by examining extensive current and historic data sets available for a range of urbanizing watersheds in the central cornbelt ecoregion of Indiana. Recent field collections of fish, macro- invertebrates, and periphyton as well as stream flow and channel measurements have been made on twelve 3rd order streams in this region. The data will be examined using multivariate statistics to determine significant correlations among land use, channel stability, and various metrics characterizing stream community structure and function (e.g. percent omnivorous insects). Emphasis will be placed on; those factors that relate flow to habitat perturbations. For the second objective, significant correlations identified in the first phase of the project from regional data sets will be directly tested to examine causal relationships. This will be accomplished by intensive sampling within areas of high and low flow variability and by experimental manipulation of the substrate in small stream reaches. For example, periphyton can be quantified in areas of known stream flow before and after spates that cause scour and substrate movement to determine the direct effects of such disturbances on species composition and productivity. The focus will be on testing non-linearities in ; responses. Current theory suggests that urbanizing streams degrade in a non-linear way when certain critical flows are exceeded. If so, this will have important implications for urban planning and design. The final phase of the project will be to translate significant flow-biota relationships into design criteria useful to engineers,urban planners, and policy-makers. These will typically take the form of flow exceedence curves or critical design flows that can be used to calculate acceptable runoff characteristics and stormwater discharge rates.PR rates. As forest and farmland is converted to residential and commercial uses, the imperviousness of the watershed typically ; increases, changing the hydrologic response of streams draining the area. This project focuses on the relationship between urban hydrology and stream community structure and function, with stream channel characteristics as the linking factor. Specific objectives of the project are: (1) to develop predictive relationships among flow regime, channel stability, and stream community structure and function across a gradient of land uses in agricultural and urbanizing watersheds; (2) to identify and test key factors limiting stream community structure and function; and (3) to formulate design criteria for protection of stream communities in urbanizing areas based on land use, hydrology, and ; channel characteristics. The first objective has been accomplished by examining recent data sets on land use, stream channel morphology, water quality, invertebrates, and algae for a range of urbanizing watersheds in the eastern cornbelt ecoregion of Indiana (Tippecanoe and Marion Counties). The data are being tested using multivariate statistics to determine significant correlations among land use (as percent imperviousness), channel stability (shear stress, median substrate size, probability of exceedence of critical flow), and various metrics characterizing stream community structure.
Index Terms:
urbanization channel stability substrate stability shear stress stream power stream productivity stream community benthic production periphyton dissolved oxygen macroinvertebrates bioindicator biomonitoring

FISH PASSAGE

TRIS Accession No.:
00821428
Title:
FISH PASSAGE AT ROAD CROSSINGS IN MONTANA WATERSHEDS PROVIDING BULL AND CUTTHROAT TROUT HABITAT
Language:
English
Source:
Texas Transportation Institute
Performing Organization:
Montana State University, Bozeman
205 Cobleigh Hall, P.O. Box 173900
Bozeman, MT 59717 USA
Investigator:
Sillick, Susan C.
Phone:
406-444-7693
Funding Organization:
Montana Department of Transportation
2701 Prospect Avenue, P.O. Box 201001
Helena, MT 59620-1001 USA
Responsible Individual:
Cahoon, Joel
Phone:
406-994-5961
Contract:
8160
Funding Type:
Contract
Status:
Active
Notice Date:
December 06, 2001
Start Date:
October 01, 2001
Est. Completion Date:
February 28, 2004
Total Dollars:
$119,571.00
Abstract:
The primary objective of this study is to examine the extent to which road crossings of streams and rivers fragment fish populations across a large drainage basin or basins in Montana. The goal is to pick one or two basins that are home to one or more migratory fish species that have high management interest. Specific sub-objectives are to determine the hydraulic passage limitations for bull trout, to refine the currently limited knowledge base concerning passage criteria for cutthroat trout, and identify physical and biological factors that relate to previously identified barriers to fish passage.
Index Terms:
Fishes; Habitat (Ecology); Streams; Rivers; Hydraulics; Research projects

TRIS Accession No.:
00762604
Title:
LOW LIGHT IMPEDIMENT OF FISH MIGRATION WITH PARTICULAR EMPHASIS ON RIVER HERRING
Language:
English
Source:
North Carolina Department of Transportation
Performing Organization:
University of North Carolina, Wilmington
Center for Marine Science Research, 7205 Wrightsville Avenue
Wilmington, NC 28403- USA
Investigator:
Moser, M.
Phone:
910-395-3905
Funding Organization:
North Carolina Department of Transportation
P.O. Box 25201, 1 South Wilmington Street
Raleigh, NC 27611 USA
Responsible Individual:
Mustafa, M.B.
Phone:
919-715-2462
Funding Organization 2:
Strategic Highway Research Program
N/A
National Research Council, 2101 Constitution Avenue, NW
Washington, DC 20418- USA
Responsible Individual 2:
N/A
Phone:
N/A
Contract:
98-3
Funding Type:
SHRP
Status:
Active
Notice Date:
November 02, 2001
Start Date:
July 01, 1997
Est. Completion Date:
September 30, 1999
Total Dollars:
$205,263.00
Abstract:
This study will investigate whether anadromous fish migration is impeded by low light conidtions in highway culverts. If culverts are determined to pose a light related barrier to fish (river herring) migration, this study will investigate the type of culverts that are most likely to block fish migration from a light related standpoint, and it will investigate improvements or modifications to culvert design that will facilitate fish passage.
Index Terms:
Fishes; Culverts; Migration; Research projects

Dialog Accession No.:
00279706
Sponsor ID No.:
0189459
Title:
Water resources engineering in riparian settings fish passage
Language:
English
Performing Organization:
MONTANA STATE UNIVERSITY, AGRI ENGINEERING, BOZEMAN, MONTANA 59717
Investigator:
Cahoon, J. E.
Abstract:
The objectives of this project are to advance engineering methods for design and analysis in riparian settings where sensitive ecologies or habitats occur. Items of specific concern are irrigation diversions,
stream rehabilitation structures or techniques, road crossings and interfaces between agricultural operations and natural waterways. A variety of field-based and modeling projects will be used to accomplish
the overall goals of this project. Specific examples are a critical examination of the impacts of modifications to hydraulic structure at the MSU/UM Bandy Ranch, basin-wide studies of impairments to fish passage and mobility, and field evaluations of a streambank remediation; techniques using temporary removable structures.
Index Terms:
river engineering riparian irrigation diversion fish passage

The Washington Department of Fish and Wildlife Washington (WDFW) and Department of Transportation (WSDOT)

Juvenile Fish Passage Research
Salmon Research

The declines in salmonids in Washington and surrounding states have caused extreme concern among fish managers, fishing interests, business and development interests, environmental groups and tribes. . Virtually every geographic region of Washington State will be affected by the listings. California, Oregon, Idaho and other coastal states have similar problems with managing declining fish populations.
Salmon migrate between fresh water and saltwater with some species spending several years in fresh water systems as part of their life cycle. While adult access throughout a river system to reach spawning areas is essential, it is also critical that juvenile salmon have access to a variety of habitats to meet their needs during various times of the year. Resident fish species which do not migrate to the sea also must move through different parts of river systems at different life stages and seasons.
Human caused fish passage barriers include poorly designed or poorly maintained road culverts. Removing these barriers and maintaining unobstructed fish passage corridors for salmon and resident fish is crucial to the long range recovery of these species.
Transportation research will play a major role in solving fish passage problems due to culverts. This is one of the most direct and cost effective measures that can be taken to increase available habitat, and the knowledge gained will also benefit other states, cities, counties and private efforts to open up habitat.

Scope of Problem

The implications of obstructed fish passages is significant. The Washington State Department of Fish & Wildlife (WDFW) estimates that road crossings block about 3000 miles of spawning and rearing areas in Washington. Fifty percent of these blockages occur on State and local roads managed by WSDOT, cities and counties. The remaining fifty percent are attributed to federal ownership, tribal and/or privately held.
Factors involved in a fish barrier correction effort include:

- A better understanding of juvenile salmonid migration patterns, timing and needs and abilities enabling them to pass through culverts;
- An inventory of passage deficiencies necessary to plan and prioritize correction work;
- Trained personnel with expertise necessary to organize and conduct fish passage inventory, prioritization, design and construction work;
- Coordination and consistent methodology for inventory efforts, data collection and monitoring outcome and success.

Clearly, partnerships must be created to solve this problem, but the key is to provide, through research, the techniques, knowledge and methods to accomplish these tasks.
There are significant benefits from this work. WDFW projects a 4 to 1 benefit for every dollar spent in fish passage correction. Coordinated efforts among various parties can leverage even more substantial gains.
The WSDOT Research Office and Environmental Affairs Office has put together a committee of fisheries experts that has worked to develop a **strategic plan** for salmon research. Alaska, Oregon, and Canada have been represented, and several opportunities for partnerships and joint efforts have surfaced.
Initial research, conducted by Dr Tom Quinn and Tom Kahler, University of Washington School of Fisheries, is providing specific direction for research efforts. The full text of that research report is available in PDF format by **clicking here**.
It is important to initiate research programs that will seek solutions to questions related to fish passage and culverts. Successful, reliable, and cost effective designs must be developed and applied to meet the needs of fish populations in Washington. Upcoming lists of salmon under the Endangered Species Act could have a substantial impact on all current and new stream crossing activities. It is essential that we find ways to make the transportation system compatible with the needs of the fish**.**

- We need to know more about the extent and timing of juvenile salmon movements in the watershed during the year.
- We need a better understanding of the interaction between the swimming capacities and behavioral tendencies of salmon and the design of culverts.
- What are the swimming and jumping abilities of different species and sizes of fish?
- What influences do boundary layers, turbulence, baffles, roughness, and other hydraulic features have on the use of culverts by the fish?
- Can culverts be designed to pass fish, or are bridges the only solution? .

WSDOT Contacts:

For information on the juvenile salmon research project, contact Jim Schafer.

For information on barrier inventory and ongoing correction programs, contact Paul Wagner.

For information on the barrier correction grant program administered by WSDOT, contact Cliff Hall.

Washington State Fish Passage Research

The Washington Department of Fish and Wildlife Washington (WDFW) and Department of Transportation (WSDOT) have jointly focused on needs in fish passage research on culvert analysis and design for both adult and juvenile salmonids. As a result of recent workshops and information from other west coast states related to ongoing research, the following highest priority research projects were determined to be essential, urgent and critical transportation research. These agencies are currently undertaking these research tasks. Some of the work is either under way or completed. Research proposals are currently being developed for the remaining topics. For more information on them, contact Jim Schafer, Research Manager at WSDOT jschafer@wsdot.wa.gov or Ken Bates, Chief Environmental Engineer at WDFW bateskmb@dfw.wa.gov .

Stream Simulation in Culverts

A new approach to road culvert design for fish passage is being developed in Washington State where natural stream channels are constructed or allowed to develop inside a culvert. The design criteria for the culvert is focused more on channel stability as opposed to channel velocity. To date about 10 have of these projects been designed and constructed with variable success. WDFW currently has a design process for this at http://www.wa.gov/wdfw/hab/engineer/cm/toc.htm.

An initial research project has been completed at Washington State University in Pullman Washington, where equations were developed for accessing bed stability (WEB site). This research is currently being tested and compared to existing sites.

The project developed design tools to build stable channels in culverts; a hydraulic flume was used to simulate a stream with different sediment types and sizes and has resulted in design parameters being developed for use in roadway culverts. Stable and unstable flow regimes were determined for various slopes, roughness and channel profiles.

Future research in this area needs to focus on the parameters which affect fish passage. Since the roughness is very high and the Q/A velocities low the main concern is turbulence. Turbulent stresses and intensities need to be measured for different channel configurations.

Juvenile Salmon Movement Timing

The scope of work for this project is currently under development, and will be a biological field evaluation of timing of major juvenile salmon movements associated with hydrology and other environmental parameters. The study will look at spring and fall movements for coho and chinook in Eastern and Western Washington. Existing upstream migrant trap data will be examined, and this study will try to coordinate locations with past work and ongoing studies. This project will be important in designing culvert options for streamcrossings, as critical passage timing can then be related to streamflow conditions.

A Study of Fish Passage Through Modified Culverts: Flume Study

This work will be primarily under controlled conditions in a constructed flume, where baffles, bed material, flows and culverts can be evaluated for fish passage. Information from past work relating to stable channels will also be biologically evaluated.

Initial work will be done in a flume to test a variety of bed and culvert conditions, flows, and slopes. Turbulence measurements will be made and related to passage success of different species and sizes of fish, with important information about fish capabilities to be developed which can be incorporated into effective designs.

We are in the process of developing the scope of work for this project at this time.

Modeling Hydrology for the Design of Fish Passage

While fish passage design flow prediction models exist for Western Washington, no models exist for Eastern Washington. Attempts in the past (Powers, USGS, etc) developed regression equations relating fish passage design flows to drainage area and precipitation. Evaluation of these models by WDFW has shown varied results, with a clear need for further development.

This research will gather flow data and develop reliable models for small streams throughout the state. Models would use watershed and climate characteristics; they would consider hydrologic provinces where appropriate, and high and low elevation and urban and rural watersheds.

Currently, WSU has developed a detailed proposal for this work.

Pool and Chute Fishways and New Channel Design

Detailed design standards will be developed for the design of new channels intended for fish passage and pool and chute fishways. Characteristics of channels will include hydrology, natural channel dimensions, slope, bedload, bed material, fish passage, and whether the bed is to be alluvial or fixed. Pool and chute fishways are an important style for retrofit for impassable culverts that are otherwise costly and difficult to repair. Capability of juvenile salmon to pass chute jumps will be addressed.

Pool and chute fishways are a recently developed hybrid fishway design mainly applicable to retrofitting existing culverts. New channel designs are used where culverts are removed and replaced with steep constructed channels. The program currently has no proposals for this work.

Fish Passage Research Underway

http://www.wsdot.wa.gov/ppsc/research/Environment/FishPass.htm

Overview:

Timing, Hydrology & Hydraulics of Juvenile Salmon Culvert Passage

As pacific salmon become a major focus of the Endangered Species Act (ESA), WSDOT will need to evaluate all aspects of Department programs that may effect salmon or salmon habitat and correct situations where impacts exist. Throughout the state, over 2500 culverts block access over 3000 linear miles of stream habitat. Much has been done to restore passage for adult salmon, but the passage needs for juvenile steel head and Coho are not well understood. This research area is directed at fish passage through culverts; Fish have been observed passing through velocities and turbulence that should have been impassable under standard models. Velocity and turbulence do not always block fish passage under natural conditions.

This work would look at the limits of their abilities in the field, and analyze observed juvenile swimming capabilities where turbulence and velocity are present; baffles and roughened pipes should be included in the study. Observed abilities would be replicated in a controlled setting, and the hydraulics quantified. New technology with marking fish, videography and observation make this type of research productive today.

Project:

Culvert Passage Factors For Juvenile Salmon - Biological Study

The focus of this project is to determine what triggers movement and relocation of juvenile salmon in the spring and fall. There are times during the year when mass movement occurs, especially from large mainstem rivers into small streams or off channel habitats. The timing of these movement is critical in the design of fish passage structures. Westside coho and Eastside chinook are the target for this work being done at the University of Washington by Susan Bolton, Center for Streamside Studies.

Project:

Modeling Hydrology for Design of Fish Passage Structures

If fish passage is required for juveniles all year, more information is needed to model appropriate flows in all watersheds. To design for peak juvenile movement in May and peak adult movement in January, considerable information is needed. Existing models need to be expanded; there is virtually no information for eastern Washington.

Practical methods utilizing modeling is essential. It would take 10-20 years to obtain the data from stream gauging. A model based on analysis of basin or watershed characteristics may work, and such a method may be in use today. The product of this research would be an expansion of models currently used by WDFW to predict fish flows, where gauged data is not available. The information from such a model would be the basis for design of stream passage facilities, increasing certainty that fish passage efforts will be successful.

Project:

New Channel Design for Fish Passage

This project involves developing design information related to initial installations where new channels or new culverts will be used, emphasizing juvenile salmon. Issues to be addressed include structures, bed design, design flows, low flows, sealing, surface flow issues, size slope and hydrology factors that have to do with fish passage and bed stability. This includes evaluation and hydraulic design of countersunk culverts. Methods include laboratory simulation, modeling and collection of hydrologic data from natural streams.

For questions on Projects contact Jim Schafer
Phone: 360-705-7975

Washington State Department of Transportation

Juvenile Salmon: Completed, Current and Needed Research 1999-2001
http://www.wsdot.wa.gov/ppsc/research/Environment/FishPassPage.htm

Juvenile and Resident Salmon Movement and Passage Through Culverts - stream dwelling salmonid juveniles are highly mobile; upstream movement was common in all species ages and seasons. There are variations both between and within river systems. **Completed project.**

Stable Channel /Stream Simulation in Culverts - Using a tilted water recirculating flume 70' long and 3' wide that can be tilted 14%, this project identified bed size requirements for a stable bed in a steep channel culvert setting under different flow conditions. 2", 4" and 6" sediments sizes were used . The spacing and nature of pools was determined. **Completed project.**

Juvenile Salmon Timing and Movement Study - This projectwill investigate what motivates movement and relocation of juvenile salmon in the spring and fall. There are mass distributions of fish within the watershed during the year. This movement could be related to food supply, water temperature, rearing needs or accessible flows.. This study will verify the timing of the movements, and the motivation (trigger) causing the movement. Once the timing of movements is identified, flow regime can be estimated, and appropriate design criteria applied to culvert installations. **Ongoing Research**

Juvenile Salmon Capability/Flume Study - This project will use a flume 60-70' long, and live juvenile salmon, to determine the ability of the fish to negotiate system designs at various conditions and slopes. We will investigate passage through baffles, weirs and fishways of various configurations. We will also verify passage using the sediment design sizes we have developed in an ongoing research project for developing stable channels in culverts. Turbulence measurements will be made and related to passage success of different species and sizes of fish. This will verify the ability of the fish to pass designed systems under controlled conditions.
It has been observed that fish can negotiate high turbulence and velocity barriers in a natural channel - we hope to be able to find and measure this phenomenon, and document how to duplicate it.

Hydrology Model for Ungaged Watersheds in Washington - Once migration timing and fish life stage has been determined, the design flows need to be calculated. Fish passage design flow prediction models exist for Western Washington though they are not very reliable. No models exist for Eastern Washington; hydrological equipment will be installed at 20 critical stream locations to gather data..

This data will be used to develop reliable models for small streams throughout the state for predicting the 10% excedance flow. Models would use watershed and climate characteristics; they would consider hydrologic provinces where appropriate, and high and low elevation and urban and rural watersheds. **Ongoing research.**

Pool and Chute Fishways and New Channel Design - Detailed design standards will be developed for the design of new channels intended for fish passage and pool and chute fishways. Characteristics of channels will include hydrology, natural channel dimensions, slope, bedload, bed material, fish passage

WSDOT Research Program Manager: Jim Schafer
360-705-7403
Washington State Department of Transportation
Research Office
PO Box 47370
Olympia, Washington 97504-7370

NORTHWEST FISHERIES SCIENCE CENTER

http://www.nwfsc.noaa.gov/issues/issuesTOC.html#fe

NWFSC Issue Paper FE 6302 (HQ ID 306)

Problem Statement

As they migrate downstream, five to fifteen percent of juvenile salmon die at each of the eight dams along the Snake and Columbia rivers.

Critical factors

• The Columbia Basin Fish and Wildlife Authority has set a long-term goal of diverting seventy percent of subyearling chinook salmon and eighty percent of yearling chinook salmon into safe bypass routes around the turbines at each dam along the Snake and Columbia Rivers.

• Most of the bypass systems at lower Snake and Columbia River dams cannot meet those longterm goals.

Status of research

The Northwest Fisheries Science Center (NWFSC) has worked with the U.S. Army Corps of Engineers to develop and evaluate the effectiveness of diversion screens at most of the Columbia and lower Snake River dams. NWFSC scientists will assess the condition of the fish that are diverted, evaluate the survival rates associated with various spill patterns and volumes, and recommend modifications in the diversion system to the U.S. Army Corps of Engineers.

Future considerations

Researchers must continue to evaluate the efficiency of collection and bypass systems, and to monitor mortality rates at each dam. The NMFS will use these research results as a basis for making and modifying bypass screens and will evaluate the performance of any new bypass systems.

Key Players

Fish Ecology (FE) Division, NWFSC
Bonneville Power Administration
Columbia Basin Fish & Wildlife Authority
Columbia River Inter-Tribal Fish Commission
Oregon Department of Fish & Wildlife
Washington Department of Fish & Wildlife
Idaho Department of Fish & Game
Northwest Power Planning Council
U.S. Army Corps of Engineers
U.S. Fish & Wildlife Service

Contact: Dr. Michael Schiewe, Director, FE Division (206/860-3270)

Wetland Research & Monitoring

Australian Landscape Trust

Fish Passage Project

IMPROVING FISH PASSAGE THROUGH WETLAND STRUCTURES AND CONTRIBUTING TO NATIONAL GUIDELINES

This 2 year project addresses a major gap in our knowledge of wetland rehabilitation projects, and addresses community concerns about exclusion of all large fish from wetlands through the use of flow control structures with fish screens.

The project examines the requirements / ability for adult fish to move into & out of wetlands with fish and flow control structures present, and aims to produce wetland specific guidelines on how to better manage existing fish control structures for the benefit of native fish access to wetlands.

It complements a New South Wales Fisheries project that is specifically looking at fish movement through road crossings. Results >from these projects will collaboratively form the scientific basis for National Guidelines for the construction of "fish and flow friendly control structures".

Although there is a general belief that most fish need to move onto the floodplain for feeding and breeding during floods, exactly when that occurs (at what flows / at day or night), and how they move is not known. This is especially so for movement through wetland inlets structures - some structures may form a barrier to movement (eg pipes), yet others may not (eg box culvert/grid top box culverts).

Currently recommendations are based on interstate "preliminary findings" which have indicated that pipes are inhibitive to movement of some native fish species, due to their reluctance to move through a darkened passage. Based on this limited information recommendations are made to construct grid-top box culverts, using a "lit and open passage is best" approach.

Groups such as Wetland Care Australia, are recommending grid top box culverts as a means of allowing fish movement because these provide a lit passage for fish to move through. However, these structures are generally (at their cheapest) about 3 times more expensive than pipes. Therefore, if we can determine that a particular structure allows better passage for native fish, installation costs may be brought down, or (at the very least) recommendations will be made with sound supporting evidence.

This project is investigating the movement of fish at different flow conditions (ie at different water velocities, turbulences, during low flow conditions and flooding flows), and at a range of different structure types currently in use. This will give us an idea of what fish want to move when, and if a particular structure type is less / more effective than another in allowing fish passage.

Environmental engineering students from the University of Adelaide are working with us to determine how fish (specifically carp) react to differing water velocities and turbulences encountered at various flows. The findings >from laboratory based flume experiments will be used in conjunction with field research to develop guidelines for improving management of fish control structures and to establish practical guidelines for altering or designing structures that are 'friendly' to the movement of fish and flow.

http://www.bookmarkbiosphere.org/WetlandResearch/wrm_fishpassage.html

Fish Passage Report

Oregon Dept of Fish and Wildlife
http://www.dfw.state.or.us/ODFWhtml/Research&Reports/RBFAT_Strategic_Plan.htm#_Toc490979652

PLAN OVERVIEW

INTRODUCTION

Native salmonids within the Rogue River Basin (RRB) have historically been at population levels sufficient to provide for sustaining healthy populations while at the same time providing for sport and commercial harvest. Due to a multitude of factors over recent decades, most native salmonid populations have experienced severe declines. Depending on the species, these declines have led to severe constraints on both sport and commercial harvest, leading in several cases to proposals for listing or actual listings under the Endangered Species Act. These constraints have further degraded and altered the economic and social structure of the Rogue River Basin. Many factors contributed to these declines, including construction of man-made barriers, over-harvest, misuse of hatchery stocks, habitat degradation, unscreened water withdrawals, agricultural and timber practices, urban development, and increased predation. Man-made barriers are considered a significant threat to native salmonid population viability, and as one of the more treatable and significant causative factors, are considered a high priority for treatment.

The Rogue Basin Fish Access Team (RBFAT) was organized to prioritize fish passage barriers and to develop a strategic plan for addressing those barriers within the Basin. RBFAT is an advisory committee to the Rogue Basin Coordinating Council (RBCC) and was formed to address the first of the RBCC's priorities, fish passage.

The RBFAT includes representatives from a number of groups actively engaged in watershed and fish health restoration within the Rogue River Basin. These include the Rogue Basin Coordinating Council, the Gravel Pushup Dam Team, the Rogue River Basin Fish Passage Technical Team, the Clean Water Act/Endangered Species Act Pilot Integration Team and the Rogue Basin Technical Team. Two members were volunteered from each of the partner groups making a ten person advisory team. Agencies and other groups represented in these working groups include: Oregon Water Resources Department (OWRD), Oregon Department of Fish & Wildlife (ODFW), Oregon State Police (OSP), Oregon Watershed Enhancement Board (OWEB), Irrigation Districts, Basin Watershed Councils, Soil and Water Conservation District (SWCDs), Oregon Department of Environmental Quality (ODEQ), Natural Resources Conservation Service (NRCS), National Marine Fisheries Service (NMFS), United States Fish & Wildlife Service (USFWS), Bureau of Reclamation (BOR), Environmental Protection Agency (EPA), Bureau of Land Management (BLM) and United States Forest Service (USFS).

SCOPE OF THE PLAN

RBFAT's approach outlined in this document is a process, not a result. It is a voluntary planning tool, not a mandate. The Strategic Plan provides a means through which regional fish passage priorities can be set and collective results measured.

The RBFAT process does not supercede the management plans, implementation strategies or funding priorities of any watershed council or recognized jurisdiction. Nor does it supercede the legal authority of any agency or the rights of landowners. This document offers a tool to provide planning guidance and a yardstick to measure results at a regional level. The watershed councils within the Rogue Basin serve as the primary locus of coordination, habitat assessment, project development, and implementation.

This strategic plan provides a process for improving passage of native salmonids at barriers within the Rogue River Basin. The goals and objectives are the planned outcomes of the project. Critical components considered necessary for creating a basin free of impediments to passage are delineated and described. Components covered within this planning document include: description, classification and prioritization of barriers, removal prioritization process, barrier treatment alternatives, project engineering and construction options, project funding options, monitoring strategy, reporting requirements, and a framework of annual work plan and project work plans incorporating all components. Timelines for various products of the project are also shown in Table 1.

GOALS AND OBJECTIVES

Goal 1

Remove or modify all human-made barriers to fish passage on the Rogue River and its tributaries using a cooperative, coordinated partnership of agencies, organizations and individuals.

GOAL 1 OBJECTIVES

Prioritize all known barriers to native salmonid passage within the Rogue River Basin by March 31, 2000.

Over the 10 year life of the plan, restore or enhance year around access for adults and juvenile salmonids by restoring access to: 12 points by September 30, 2000; 100 additional points by September 30, 2001; and 175 additional points (total 287) by September 30, 2002, for a total of 1740 points over the 10 year life of the plan.

Develop project work plans each year from 2000 to 2010 for the treatment of individual barriers to native salmonid passage within the Rogue River Basin beginning with the first work plan to be completed by May 1, 2000. Complete as many work plans each year as are needed to reach the objective per year.

Goal 2

Secure funding for implementation of projects and develop equitable cost-share methods for implementing projects so that no undue hardships are placed on stakeholders.

GOAL 2 OBJECTIVES

Structure the RBFAT Strategic Plan as an action plan to facilitate applying for grants to fund a group of projects.

For each project, have the stakeholders sign a "cooperative agreement" that details the cost-share arrangement, RBFAT/agency access, and maintenance obligations. A sample "cooperative agreement" is contained in Appendix 8.

Develop a strategic funding plan by April 30th, 2000.

Apply for grants from OWEB and other identified sources by December 31st, 2000 to set up a basin fund for addressing projects over the life of the plan.

Goal 3

Solve fish passage barrier problems and monitor the success of projects by directly involving local stakeholders and watershed councils.

GOAL 3 OBJECTIVES

The RBCC-RBFAT Program Manager will meet with the Rogue Basin Coordinating Council (RBCC), RBFAT member groups and each watershed council to develop tactics for a coordinated effort of problem solving, outreach and project monitoring by December 31st, 2000.

Goal 4

Educate stakeholders and the public on the impacts of fish passage barriers and the variety of methods that can be used to restore fish passage.

GOAL 4 OBJECTIVES

Coordinate with watershed councils to present in each watershed council area one community meeting/presentation per year, beginning in October 2000, on the impacts of fish passage barriers and the variety of methods which may be used to restore fish passage.

The work or results of the RBFAT or educational information about fish passage will be presented (press releases, interviews or articles) to the media at least six times during the Year 2000 starting in May. Information will be released at least three times per year to the media for the life of the project.

PLANNING PROCESS

The planning process for resolving native fish passage barrier issues in the Rogue River Basin involves three levels of planning, strategic, annual and project, with a feedback loop built into the planning update process (through an annual review of work plans, and biannual review of the strategic plan). Below is a description of the three levels, how they are linked and the relationship of the planning update process to the plans.

STRATEGIC PLAN

The planning process includes development of an overall strategic plan with tiered Annual Work Plans and Project Work Plans, which describe long term, annual and site specific work needs for elimination of barriers. The strategic plan provides an overview and context for the Rogue River Basin passage restoration process.

USGS

LEETOWN SCIENCE CENTER
S.O. CONTE ANADROMOUS FISH RESEARCH CENTER
http://www.lsc.usgs.gov/cafl/lsc-afl.htm

With their unique life histories, anadromous fishes require special consideration in understanding their biology and developing management strategies. During the Industrial Revolution, many populations of anadromous fishes were severely depleted or extirpated by damming, pollution or alteration of their migratory or spawning habitats. Some measures were taken in the late 1880s to provide access for anadromous fishes around dams by construction of rudimentary fishways, or by stocking fish into habitats that historically supported large runs. However, without a complete understanding of the ecology, life history and environmental needs of these species, many of these efforts failed to restore naturally reproducing populations within their original ranges. With the passage of the Anadromous Fish Conservation Act of 1965, the federal government took an active role in assisting states in their anadromous fish enhancement efforts. However, the need for information about anadromous fish biology and ecology continues, and is critical to the success of these programs. The S.O. Conte Anadromous Fish Research Center (CAFRC) has been charged to meet this need to perform research directed towards restoration and protection of anadromous fishes. In recent years fishery agency needs have expanded to include provision of fish passage facilities for many riverine species. CAFRC has expanded its mission to include work on any riverine migratory species.

Research Mission and Priorities
CAFRC is a branch of Leetown Science Center, Kearneysville, West Virginia, within the U.S. Geological Survey-Biological Resources Division, Department of the Interior. The focus of research at CAFRC is to perform both basic and applied research relative to biological and management concerns regarding anadromous fish populations and their associated ecosystems. Priorities include research leading to restoration and enhancement of anadromous fishes, environmental and resource consequences from dams or altered ecosystems, and effective fish passage research and development. CAFRC performs research in four major areas, with substantial interaction between scientists in each area to maintain an interdisciplinary approach to solving problems in anadromous fish biology and management.

Core Capabilities

- Fish Physiology - Methods for study of osmoregulatory and endocrine systems.
- Fish Behavior - relationship with functional capacity to negotiate passage designs; field behavior as it relates to population sustainability.
- Fish Ecology - Exploring patterns and mechanisms of fish population dynamics, habitat use, genetics, and growth.
- Engineering Research - basic and applied research in hydraulics and fish passage.
- Fish Passage Biology - basic and applied research into fish migration and passage behavior, and the evaluation of passages to enhance upstream and downstream movement of anadromous and migratory species .

WEBSITES FOR OTHER FISH PASSAGE INFORMATION

PACIFIC NORTHWEST FISH & WILDLIFE POLICY ACCESS NETWORK

http://www.newsdata.com/enernet/fishnet/fishlinks.html

NW Fish.Net Links
The following site links and descriptions are to some of the most comprehensive Pacific Northwest regional fish policy information on the Web. Please send additions and corrections to webmaster@newsdata.com.

- Alaska Department of Fish and Game: Check out what our northern neighbor feels about the Pacific Salmon Treaty or how it's dealing with a salmon glut by following legislative updates and press releases, along with in-season salmon harvests by area.

- Bonneville Power Administration's Environment / Fish & Wildlife Group: This web site contains complete information on fish and wildlife prioritization proposals, the squawfish program , Kootenai white sturgeon, and the preliminary conclusions from the PATH process, where the region's modelers have been working together. One of BPA's most useful site continues to be the Technical Management Team page, which provides Bonneville's perspective on activities of the TMT. The page offers historical information on the TMT and information on current TMT activities, including guidelines for 1996. The 1996 water management plan and the 1996 hydro biological opinion requirements are available on this page. Extensive information is provided on the Kootenai white sturgeon recovery program, including flow proposals and biological opinion requirements.

- Columbia Basin Research (CBR): This is the home page for the University of Washington research facility that conducts studies of salmon migration on the Columbia River. It's a joint effort of two research groups through the UW's School of Aquatic and Fishery Sciences.
  The CBR page provides the umbrella for all the information these groups provide on the Web, which includes: DART (Data Access in Real Time) where information can be obtained on adult salmon passage, smolt indices, PIT-tag data, and river environment data. Options allow the user to select specific geographical locations, fish species, time periods and other selections; CRiSP (Columbia River Salmon Passage Model), which describes in detail fish movement, survival and the effects of river operations, calculating and displaying the influences of factors such as hatchery release dates, reservoir levels and water flow rates; and Inseason Forecasts of juvenile salmon migration produced by the RealTime Forecaster and the CRiSP model.
  Also at the CBR site is an alphabetical list of more than 100 fish-related sites, information on the hydroelectric system, climate change, dissolved gas and relevant papers. Specific links are offered to other UW departments and directly affiliated entities such as the National Marine Fisheries Service. In addition, the DART page provides links to the US Army Corps of Engineers and the Pacific States Marine Fisheries Commission (see below). The CBR and DART pages are packed with well-organized information which is updated frequently.

- Columbia River Alliance: The Columbia River Alliance for Fish, Commerce and Communities (CRA) is an industry/utility group that focuses on salmon recovery and other wildlife issues as they relate to federal hydro projects and commerce on the Columbia and Snake rivers. The site is under development, but currently offers weekly newsletters and other information from its monthly bulletin, *Alliance Advocate.*

- Fish Passage Center: The FPC keeps up-to-date information is available on the physical and biological conditions of salmon and steelhead migrating in the Snake and Columbia River basins during the migration season, including dissolved nitrogen gas saturation tables for mainstem dams and in-river sites, data on smolt monitoring for signs of gas bubble trauma, and smolt transportation schedules. The site contains juvenile salmon and steelhead passage index tables, with summaries of daily passage over the previous 14-day period. Also available are hatchery release schedules, and hydro System Operation Requests and the weekly posting of the FPC migration season reports.

- For the Sake of Salmon: This organization was initiated last year by federal, state, local and tribal governments, private and public organizations and citizens, with the goal of protecting and restoring Northwest salmon to healthy sustainable populations. Its focus is habitat restoration and protection of healthy watersheds. It plans a bulletin board service, with information on watershed restoration activities and research. The site currently offers information on FSOS activities, watershed groups in Oregon, Washington and California, watershed-related conferences and seminars and publications (both print and Internet).

- Idaho Department of Fish and Game: This site offers more than 2,000 published documents in its Fisheries Publications Library, utilizing a key word search by topic. Also available are the state's five-year plan for fisheries management, information on current research projects, hatchery activities and fishing reports. The site also offers the complete text of Gov. Phil Batt's Salmon and Steelhead Plan and the governor's draft bull trout plan. F&G commission meeting information, including dates and agendas, can also be accessed. Some of the files are formatted in Portable Document Format and require the Adobe Acrobat Reader to access. Users can download the free reader directly from this site.

- Idaho Rivers United: IRU is an environmental group that focuses on preservation of Idaho's rivers and riparian areas, with an additional focus on salmon recovery. The group's home page is well-organized and information is easily accessed through numerous links. Available at the site are links to information pages on proposed Idaho hydro projects and dam relicensing processes, as well as river-related issues currently before the Idaho legislature. The home page also links to information pages on salmon recovery and river flow issues. Links to Northwest environmental and fish advocate groups are also available.

- The Native Fish Society: This fish advocate group calls itself "an advocate for the conservation, protection and restoration of native fishes in the Northwest." In addition to information on efforts to conserve wild fish, the website offers links to several agencies and groups working in fish recovery. It also offers a guest book, which allows the user direct input into the design and direction of the website.

- Northwest Fisheries Science Center: This research arm of the National Marine Fisheries Service provides information to support NMFS in anadromous fish management. Links are available to the Coastal Zone and Estuarine Studies Division (CZES), which conducts research on salmon and other aquatic life in the Columbia Basin. Links at CZES include information on ecological effects of dams, habitat, fisheries and conservation biology. Also available is a list of publications produced by NWFSC researchers, although most were not available as hot text. These pages are searchable.

- Northwest Power Planning Council: The Council's home page reflects all aspects of their mandate to ensure the region has both a reliable power system and protected enhanced fish and wildlife populations. Press releases, issue papers, and important documents may be downloaded, such as the Independent Scientific Advisory Board's salmon report,*Return to the River*. An upcoming feature will let you download a software program that gives you an idea of what it takes to run the hydro system in a fish-friendly way.

- Oregon Department of Fish and Wildlife (ODFW): The home page offers links to ODFW initiatives such as the coastal salmon restoration plan and the 1995 report on the status of wild fish in the state. The latter document can be accessed by chapter, allowing the user to click directly to the specie of interest. A gopher page offers access to numerous reports and publications. A separate page lists reports on research projects performed by department scientists. The complete text of all volumes of the agency newsletter, News and Views is available, offering articles on a wide variety of fish and wildlife research and issues. For those with sound capabilities, the site even offers the weekly radio report, including archived reports. Finally, the page links to the Northwest Environmental Database, allowing the user to view data on fish, wildlife and habitat, by specific river basin or geographic area.

- Pacific States Marine Fisheries Commission (PSMFC): Representing Oregon, Washington, Idaho, Alaska and California, the PSMFC has no regulatory authority, but serves as a discussion forum in fisheries management and conservation. They have developed a coordinated information system called StreamNet

that compiles data related to Pacific Northwest aquatic resources for use in the region's Fish and Wildlife Program, ESA, and related activities. A new feature is an online database that allows the user to create custom requests for data related to anadromous fish production. Under construction is a map library and interactive GIS capability, an education feature that targets a lay audience.

- Save Our Wild Salmon: Save Our Wild Salmon is a coalition of 44 salmon advocacy and commercial fisher groups, "working to restore the declining numbers of wild salmon in the as well as the complete text of the group's proposed recovery plan. The site also offers e-mail access to several members of the Northwest Congressional delegation and to Northwest governors.

- US Army Corps of Engineers, Northwestern Division: From the North Pacific Division home page. For current data on flows and reservoir status, go to "Water Management Division." The Portland District provides access to historic fish passage data at all federal hydro projects on the Columbia. The Walla Walla District offers a wealth of information on the Corps' activities, including documents the Corps will use to help plan the future of Snake River dams, like the Lower Snake River Juvenile Salmon Migration Feasibility Study, and their own Interim Status Report. The site also contains information on dissolved gas that is updated hourly (April 1-Sept. 1) and reports on gas abatement study.

- US Army Corps of Engineers: Technical Management Team: you can read meeting minutes of the TMT, the group of river managers that meets weekly to plan hydro system operations to benefit fish, check out their online discussion forum of issues under discussion, or access fish passage information, water management data and gas supersaturation, The page contains agendas and minutes of the weekly Wednesday sessions, as well as decisions on project operational parameters.

- US Fish and Wildlife Service, Region 1: General information on endangered species is available here, as is the complete text of the Endangered Species Act. On the Endangered Species Page is a link to a complete list of species protected under the ESA, including anadromous fish. Within the list, individual species are linked, for detailed profiles of status and listing process. These pages are searchable.

- Washington Department of Fish and Wildlife: The state's website includes current information on the Fish and Wildlife Commission and up-to-date news releases