Water Resources Research Institute

Annual Technical Report

FY 1999

Introduction

ABSTRACT The FY 1999 Oregon Water Resources Research Institute (OWRRI) program included four research projects funded by the USGS: · Mitigation of High Stream Temperatures in the Tualatin River Basin: an opportunity for pollution credit trading · Source Identification of Fecal Pollution in the Long Tom Watershed · Long-Term Willamette River Restoration Possibilities and Impacts of Physical Activities on River Processes · Oregon Coastal Lakes: Water Quality Status and Management Implications Based on Nutrient Loading OWRRI sponsored several Key Issue Teams to investigate issues related to · Watershed Education · Oregon Lakes · The Willamette River · Effluent Credit Trading OWRRI also sponsored several workshops and seminar series, a graduate minor in water resources, developed a graduate concentration in water resources for the new Environmental Sciences Graduate Program, and sponsored two water resource education websites and a related publication presentation. Due to funding shifts and a need to diversify water interests, much of the year was also spent redesigning OWRRI into a Center for Water and Environmental Sustainability (CWESt). This shift took place on July 1, 2000 and focused water resource efforts into three areas: 1. Water Resources: Supporting water resources research and education 2. TOSC/TAB: Promoting community owned solutions to address public health concerns related to contaminated groundwater and surface water 3. Environmental Sustainability: Encouraging Oregon universities, government, businesses and individuals to promote sustainability as a way of life, in an effort to sustain our water resources and promote the concept that water is a precious resource. WATER PROBLEMS AND ISSUES OF OREGON Major water-related problems in Oregon are related to use exceeding availability in numerous watersheds, flooding during winter storm events, water quality degradation of both surface and groundwaters, and impacted streams resulting in reduced salmonid populations. Watersheds with salmon and related species listed as threatened or endangered under the Endangered Species Act cover 50 percent of Oregon. Both water quality and quantity are of concern to the State of Oregon; in 1999, water quality problems prevailed. Water quality degradation results primarily from non-point sources and increased temperature resulting from inadequate riparian zones. Several hundred streams in Oregon are water quality limited because of high summertime temperatures. A major issue in competition among water users during the past few years has been the allocation of increased streamflows and watershed enhancement efforts to reverse the declining salmon stocks in Pacific Northwest streams. A major issue relates to the listing of coastal coho salmon as endangered species by the US National Marine Fisheries Service. A wide variety of management tools and recovery projects are being conducted to increase stocks so as to avoid listing of species under the Endangered Species Act. Water supply throughout the State is regulated by an extensive network of storage reservoirs primarily built for flood control. Dams on the Columbia and Snake Rivers are major generators of electrical power and support a rapidly growing population and economy. However, the impacts of the dam/reservoir system upon salmon populations have become increasingly visible. Many natural resource experts are beginning to challenge the compatibility of the dam/reservoir systems and natural salmon populations. During 1999, there was intense dialog about the removal of dams from streams in Oregon and the Columbia and Snake River systems. Since access to salmon harvests is protected by treaties between the US government and various tribes, many water use issues will be controlled by outcomes of complex legal battles. Water resource management activities such as water rights adjudication, groundwater resources assessment, contaminated water and soil remediation, and interdisciplinary multi-focus

planning are continuing. However, these efforts both within the State and through OWRRI do not meet all the demands placed on the State's water resources. Inadequate information is available on both quantity and quality of water resources, and the use of water resources to meet various demands. Better management will require a more complete base of information and greater public involvement. Several imaginative processes have been adopted in Oregon to meet these needs. The Oregon Watershed Enhancement Board (OWEB) has mobilized considerable local activity directed to specific watershed improvements for communities. OWRRI is helping supporting the public efforts by hosting workshops and developing proposals to address water information needs in Oregon and supporting watershed councils with technical expertise and information. Surface and groundwater withdrawals and total water consumption are rising steadily driven by Oregon's population and economic growth. Water competition and threats to environmental quality have become increasing critical. Increased efforts need to be made to protect, conserve, recycle, and develop production systems with fewer negative externalities. The need for expanded municipal water supplies has become a major political issue. Beyond the high-public-attention areas of water policy and management, important unsolved technical questions related to water resource management remain unanswered. The main problem areas and specific problems identified by the OWRRI include: Inadequate seasonal instream flows (adverse effects on aquatic habitat, waste dilution and assimilation, recreation, downstream needs); Contamination of ground and surface waters (sources, control, cleanup, protection of drinking water supplies); Declining groundwater levels (poor knowledge of aquifer conditions, excessive withdrawals, need for management); Management for grazing to protect streams in rangelands; Inefficiency of water use (agriculture, industry, municipal and domestic systems); Inter-connectivity of surface waters and groundwater (inter-connectedness, joint management, water yield, interstate use); Deterioration and loss of aquatic/riparian habitat especially wetlands; High summer temperatures in streams that are habitat for cold water fish; Management for protection of forested streams; Protection of bay, estuarine and wetland resources (processes, impacts of nearby development); (reservoir impacts, alternatives, seasonal and geographic problems, floods, water shortages, land use, management); Competition for available water (shifting priorities, alternative sources, valuation); Planning and management for water-related resources (implementation of state-of-the-art technologies and methodologies); Effect of long term global weather patterns on water resource management in Oregon; Water institutions and institutional arrangements (laws, rights, pricing, reuse, competition); and Technology/information transfer to effectively disseminate information from researchers to users. PROGRAM GOALS AND PRIORITIES Goals and Objectives The Institute's overall long-range goal is to assist in the sound management, sustained use, and protection of the State's waters and water-dependent resources. Specific long-range goals of OWRRI are to analyze and clarify the major water resources problems and issues in the state, and help to solve these problems through research, education, and technology transfer activities. The objectives of the Oregon Water Resources Research Institute, similar to those originally formulated in 1959, are to: understand Oregon's current and future water resource needs; identify areas where research, education, and technology transfer are required; set priorities for OWRRI programs; assure recognition of capabilities of water resources research and education; initiate multidisciplinary research in areas of need; provide information on water resources to decision makers through reports and workshops; and promote and support multi-disciplinary graduate education programs in water resources. Water resources problems in Oregon have quantity, quality, ecological, economic, institutional and social aspects. Therefore, the physical, biological, socio-economic and related sciences are all viewed as essential contributors to solutions of these problems. The Institute activities emphasize multi-disciplinary, problem-oriented research and encourage interdisciplinary activities in support of that research. Priorities OWRRI periodically establishes research priorities for solving critical water-related problems. Research priorities are set for both State and regional needs and have served to guide the development of the FY 1999 program. The FY 1999 Oregon Water Resources Research Institute Program has focused on protection of surface water, and influence of physical characteristics of streams upon salmonid productivity. Projects were directed towards protecting both water quality and ecosystems and investigating stream restoration potential. The projects included in the FY 1999 Oregon WRRI Program all addressed issues related to the Oregon and Pacific Northwest OWRRI priority plans. Several are high-public attention issues and relate to problems that continue to receive legislative attention. The USDI Water Resources Research Institute program has been of utmost importance in maintaining an active multi-disciplinary, problem-solving water research program in Oregon. The USDI program is also an important catalyst

for initial contacts for water research by federal and state agencies, and for bringing research to the university campuses and the academic departments. Use of FY 1999 Grant to Develop and Implement Program In an effort to meet OWRRI's goals and objectives, and improve upon process, the institute's activities focused on three areas, 1) Supporting Key Issue Teams, 2) Continuing and improving upon Technology Transfer and Education, and 3) Developing new Center for Water and Environmental Sustainability (CWESt) to accommodate funding shifts and better serve diverse water needs. 1. Facilitated Key Issue Teams (KITs) to promote interdisciplinary research on topics such as watershed education, the Willamette River, Effluent Credit Trading, and Oregon Lakes. 2. Developed Watershed Restoration Education Initiative Proposal (Appendix 1) 3. Developed and delivered Conservation Reserve Enhancement Program workshop 4. Initiated documentation of water related entities working on Willamette River issues. 5. Established research priorities to map physical and biological habitat and identify land most viable to reestablish natural ecosystem function, if purchased for reserve. 6. Conducted pilot survey detailing citizen's perspectives on needs in the next century. Delivered findings at regional conference. 7. Engineers, Water and Political Scientists, and Agricultural Economists came together to explore the innovative concept of using effluent credit trading in Oregon basins. Established basis for funding future Tualatin Basin research. 8. Brought interdisciplinary researchers together to establish consensus on priority issues and build research partnerships. 9. Documented priority basins based on amphibian sensitivity to water quality issues 10. Technology Transfer and Education (detailed in Information Transfer activities) a. Delivered workshops, seminars, and conferences b. Developed interactive web pages c. Providing a graduate minor in Water Resources in three subdisciplines: 1.Hydrology 2.Water Resource Planning and Management 3.Water Quality d. Provided telephone outreach and referral on water related issues to Oregon citizens e. Writing proposals to support watershed research and education needs 11. Due to funding shifts and a need to diversify water interests, much of the year was spent redesigning OWRRI into a Center for Water and Environmental Sustainability (CWESt). This shift took place on July 1, 2000 and focused water resource efforts into three areas: 1. Water Resources: Supporting water resources research and education 2. Technical Outreach Services to Communities: Promoting community owned solutions to address public health concerns related to contaminated groundwater and surface water 3. Environmental Sustainability: Encouraging Oregon universities, government, businesses and individuals to promote sustainability as a way of life, in an effort to sustain our water resources and promote the concept that water is a precious resource. The proposal is included in Appendix 2.

Research Program

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Mitigation of High Stream Temperatures in the Tualatin River Basin: an opportunity for pollution credit trading
Project Number	01
Start Date	04/01/1999
End Date	09/30/2000
Research Category	Water Quality
Focus Category #1	Surface Water
Focus Category #2	None

Focus Category #3	None
Lead Institution	Oregon State University

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Marshall English	Professor	Oregon State University	01

Problem and Research Objectives

According to the 303(d) list for Oregon, exceedance of temperature standards has been identified as a problem in approximately 700 Oregon streams with the Tualatin River Basin having the highest priority for mitigation of temperature problems. Given the dispersed nature of many sources of heat-loading, this is a problem in non-point source pollution. This project is investigating two issues, the technical feasibility of measures for mitigating high stream temperatures, and the possibility of using a strategy of effluent credit trading to promote and finance the mitigation measures. Specific project objectives are to: 1. Conduct an engineering analysis of an exchange of irrigation water for municipal effluent as a tool for effluent credit trading. 2. Propose an analytical framework for credit trading based on this strategy. 3. Conduct a public information program dealing with both effluent credit trading and management of thermal pollution.

Methodology

Technical feasibility will be assessed by a program of data collection and modeling. The modeling effort will have two parts; (1) an analysis of the local effects of the mitigation strategy in terms of rates, temperatures and timing of discharges into the Tualatin River and its tributaries, and (2) an analysis of temperature patterns in one reach of the Tualatin River main stem. An existing model of temperature dynamics in streams, calibrated for the Tualatin River is being used to estimate the temperature-related credits which should be assigned to a seller for undertaking given mitigation measures. Ultimately, this model will be the basis for a dynamic trading system in which buyers and sellers can easily identify costs and benefits of trading based on the proposed mitigation measure and the location on the river. OSU efforts have focused on (1) identification of sources of heated effluent, (2) measurement of ground water temperatures in a study area adjacent to the Tualatin River, and (3) use of an ODEQ model to analyze withdrawals of water from the river by the Tualatin Irrigation district and discharges into the river by the principal source of heated effluent, the Unified Sewerage Agency. OSU will also address the potential for effluent credit trading in general, and its use as a strategy for mitigating high stream temperatures in particular. Effluent credit trading is a cost-effective strategy advocated by EPA for engaging stakeholders in combating non-point source pollution.

Principal Findings and Significance

A search of 180 discharge permits indicated a total of 14 discharging cooling water, and one major discharge source of municipal effluent at higher than ambient temperatures. The warm effluent from two Unified Sewerage Agency (USA) treatment plants offer a good opportunity for a credit trading program with the USA as a buyer of credits. One likely source of marketable credits would be the Tualatin Irrigation District (TID), which withdraws water from the Tualatin River at the Spring Hill Pumping

Plant, upstream from the USA discharge point. A second source of credits might be the USA itself. The USA could spread heated effluent on a USA 300 acre field at rates that would recharge ground water in the area of that property in order to enhance return flows of cooler ground water to the river during periods of low flow. Other alternatives considered for investigation under this project were to exchange warm effluent from the waste water treatment plants for instream flows which the Tualatin Irrigation District normally withdraws during the summer. Specific alternatives were detailed.

Descriptors

Stream temperatures, temperature standards, effluent credit trading, mitigation, TMDL planning, point source and non-point source pollution

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

One presentation was made on this project at the Vomocil Water Quality Conference in 1999.

Other Publications

A graduate student has been involved in this project at the masters degree level. She is now employed part time by ODEQ in the Tualatin Basin and will be pursuing the balance of the project objectives from that position.

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Long-Term Willamette River Restoration Possibilities and Impacts of Physical Activities on River Processes
Project Number	03
Start Date	06/01/1999
End Date	02/28/2000
Research Category	Climate and Hydrologic Processes
Focus Category #1	Surface Water
Focus Category #2	Hydrology
Focus Category #3	None

Lead Institution	Oregon State University

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Peter Klingeman	Associate Professor	Oregon State University	01
Josh Wyrick	Student	Oregon State University	02

Problem and Research Objectives

Human use of the Willamette River (WR) in western Oregon has included activities to straighten, narrow, deepen, fill, block, line, and otherwise encroach upon the river channels. Multi-purpose federal reservoirs have altered downstream seasonal and shorter-term river flows. As a result, much of the channel system has become simplified, stabilized in position, disconnected from part of the historical stream meander corridor and floodplain, and subject to stabilized streamflows that have lost part of their high-flow and low-flow variability. These physical alterations, according to stream biologists, have had an impact on the associated natural ecosystem and native biota that evolved and depended upon natural conditions. Past efforts to “enhance” local aquatic habitat usually have not been adequate to halt general ecosystem decline and species losses. The Willamette is large -- the 12th largest river in the lower 48 states, based on annual discharge (USGS 1987) -- and the extent of change has been commensurate. The specific research objectives were: 1. Review past and on-going physical alterations of the river corridor for riverbank erosion control (revetments, dikes), dredging (gravel mining, channel alignment, navigation), and local structures (bridge crossings, waterfront development), including the longer-term impacts of such alterations on physical processes. 2. Determine the physical possibilities for alleviating channel encroachment, re-establishing floodplain floodwater storage, and restoring channel complexity (in terms of planform features and channel morphology), while protecting population centers and vital facility crossings. 3. Assess the relations of reservoir regulation, flood-water releases, and low-flow augmentation with present and potentially altered physical features of the river corridor. The broad goal of this research was to explore the impacts of past and on-going physical alterations of the Willamette River channel and its streamflow with respect to possibilities for long-term restoration of natural river physical processes.

Methodology

The research methods identified the requirements, in terms of river space and physical processes, to successfully restore 60 miles of the upper mainstem Willamette River between Eugene and Albany, OR. Research methods emphasized physical analyses of streamflows and channel conditions – river hydrology, river hydraulics, river sediment transport, and channel morphology. Past physical alterations of the river corridor were identified. The impacts of past activities on channel changes were also evaluated by comparisons of streambed elevations at several locations. Maps and aerial photographs were used to characterize the present active river corridor and the land immediately adjacent to this corridor. This included channel bars and low floodplain lands. Possibilities for restoring some natural floodplain functions were examined. The present regulated streamflow regime of the Willamette River was compared with the pre-reservoir flow regime. Flood frequency analyses, annual and monthly flow patterns, flow duration analyses, and high-flow frequencies were evaluated. All were compared over time and for split records. The effects of seasonal flow augmentation on low-flow conditions were also

examined.

Principal Findings and Significance

· The Willamette River remains dynamic in its physical processes. · Floods and meander belts are key factors to limiting human encroachment on the river and for maintaining options for river restoration. · Floods continue to provide a 'disturbance regime.' · 'Stable', silty-clay, 20-60 foot bluffs erode 10's of feet over a decade. · Water surface elevations and slopes are critical parameters for restoration design. · Floodplain water storage can be incrementally increased by restoration projects. · River restoration activities should acknowledge the need for instabilities and changes to occur and should be designed so that instabilities and changes may happen. · Space must be provided to let larger-scale natural processes function. These include hydrologic 'disturbances' and space for channel and floodplain complexity to evolve, leading to a more viable and sustainable ecosystem. Boundaries of human encroachment must be limited. · Floodplain gravel pond restoration has potential to add channel complexity. TRAINING: One Ph.D. student (Wyrick, PhD-CE) was directly supported. Eight other students received training on the hydrologic and engineering evaluations required for WR restoration evaluations (Ahsan, MS-CE; Baker, PhD-F&WL; Blume, MS-BRE; Knapp, MS-CE; Lenart, MS-EnvE; Morrissette, MS-FE; Prock, BS-CE; Taylor, MS-F&WL).

Descriptors

Willamette River, channel processes, erosion, bank protection, revetments, streamflow regulation, reservoir regulation, river slopes, restoration, river restoration, stream corridor restoration.

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Source Identification of Fecal Pollution in the Long Tom Watershed
Project Number	02
Start Date	07/01/1999
End Date	06/30/2000
Research Category	Water Quality
Focus Category #1	Management and Planning

Focus Category #2	Non Point Pollution
Focus Category #3	Surface Water
Lead Institution	Oregon State University

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
John Bolte	Associate Professor	Oregon State University	01
James Moore	Professor	Oregon State University	02
Cindy Theiman	Unknown	Oregon State University	03

Problem and Research Objectives

This proposed study addresses the subject area of managing water quality in the Long Tom (LT) watershed which is subject to multiple uses. Complex interactions of both natural processes and anthropogenic influences determine present LT lake water quality. The relative effects on water quality of these watershed processes and uses, and trends or changes that may have occurred, are not known. This study surveyed the water quality and trophic state of two Long Tom coastal lakes. Current water quality was established for these lakes through a program of sampling and laboratory determinations. Areas under various types of land uses in the watersheds of these lakes was quantified. Best estimates of areal loading rates from different types of land uses was used to estimate loadings of nutrients to the lakes. The calibrated lake mass-balance model was used to relate phosphorus loadings to average phosphorus concentration in each lake and to predict the resultant effect on lake trophic state and water quality.

Methodology

Several related tasks were required to apply the nutrient mass-balance model. The limiting nutrient nonpoint source loadings from the watershed and from direct point sources was measured. Watershed land use areas and lake physical and hydrological characteristics, including mean depth, surface area, and detention time, were documented. Documentation included lake physical and hydrological characteristics, water quality/water chemistry data, and selected biological indicators. Watershed characteristics summarized included land use by area, number of residences, soil classification, geological and topographical descriptions, and hydrological information (annual precipitation, evaporation, and runoff). Lake chemical and biological characteristics were used to confirm the trophic state and limiting nutrient concentration as predicted by the mass-balance model. Field work was required to obtain current, consistent, and comprehensive water quality/chemistry data for the study lakes. Two study lakes were sampled approximately monthly to determine temporal variations and annual average conditions. Samples were taken at the maximum depth point of each lake in both the epilimnion and hypolimnion during the period of thermal stratification. An additional sample was taken at each lake outlet. In situ profiles of temperature, dissolved oxygen, conductivity, and transparency (Secchi depth) were also made at the maximum depth sampling point. Laboratory determinations of chemical and biological water quality parameters were made in the Environmental Engineering laboratories at O.S.U. Chemical parameters included nutrients (nitrogen as nitrate, ammonia, and TKN; phosphorus as total and ortho-P), major cations and anions (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, HCO_3^{-}), pH, alkalinity, TOC, and conductivity. Biological parameters included chlorophyll a and algal

identification. Algal growth tests were used to verify the limiting nutrient for each lake.

Principal Findings and Significance

Based upon land uses determined from aerial photographs and data obtained from field measurements and sampling, it was possible to estimate phosphorus export coefficients for forested land and the dunal aquifer. Phosphorus loading from rangeland did not appear to be significant. Phosphorus loading from the dunal aquifer was found to be relatively low, due to the absence of significant vegetation and human activity. Forested land was found to be the largest source of phosphorus. Phosphorus loading into Mercer Lake was primarily due to the forested lands within the watershed, suggesting that a large amount of forest activity could significantly alter the amount of phosphorus entering the lake. Phosphorus export to Clear Lake was divided fairly equally among Collard Lake, the surrounding forested lands and the atmospheric input. The dunal aquifer appears to have very little impact on the phosphorus loading into Clear Lake. The phosphorus export coefficient for forested land in the Clear and Mercer Lake watersheds was estimated to be 40 kg/km2-yr. The phosphorus export coefficient for the dunal aquifer was estimated to be 2.7 kg/km2-yr. Estimated phosphorus export coefficients for rangeland, residential land, and clear-cut forest land were unattainable with the collected data. Phosphorus loading into Clear Lake was estimated as 66 kg/yr and phosphorus loading into Mercer Lake was estimated as 950 kg/yr. These results will be useful for predicting nutrient loading and subsequent effects on water quality for the coastal lakes of Oregon, and further as an aid in land use management decisions.

Descriptors

Nutrients, watersheds, fecal coliform, streams, water quality

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications

Basic Project Information

Basic Project Information	
Category	**Data**
Title	Oregon Coastal Lakes: Water Quality Status and Management Implications Based on Nutrient Loading
Project Number	04
Start Date	07/01/1999
End Date	12/29/2000

Research Category	Water Quality
Focus Category #1	Nutrients
Focus Category #2	Non Point Pollution
Focus Category #3	None
Lead Institution	Oregon State University

Principal Investigators

Principal Investigators			
Name	**Title During Project Period**	**Affiliated Organization**	**Order**
Peter Nelson	Associate Professor	Oregon State University	01

Problem and Research Objectives

This study addresses managing water quality in lakes with watersheds subject to multiple uses such as residential development, recreational activities, forestry practices, and as water supply sources. Coastal lakes vary in water quality from that characteristic of oligotrophic lakes (low nutrient enrichment, pristine water quality) to that of eutrophic lakes (high nutrient enrichment, poor water quality). Complex interactions of both natural processes and anthropogenic influences determine present lake water quality. The relative effects on water quality of these watershed processes and uses, and trends or changes that may have occurred, are not well understood. In this study, an annual survey of nutrients in two Oregon coastal lakes and their tributaries was performed through a program of monthly sampling. The limiting nutrient for plant growth was established as phosphorus based on the nutrient survey, concurrent biological assays, and previous studies. The survey quantified the temporal and spatial distributions of total phosphorus concentration and loading in the two lakes and their tributaries. A mass-balance model of phosphorus in the lakes, based on estimates of areal loading rates from different types of land uses in their watersheds, was used to predict the lakes' mean annual total phosphorus concentrations and compared to the survey results. Current water quality was classified for these lakes in terms of nutrient loading and trophic state.

Methodology

The conceptual framework of this study is based on the Vollenweider-type (VT) nutrient load-eutrophication response model for lakes. The average nutrient concentration in the lake is estimated by the amount of nutrient loading to the lake, the amounts of nutrient lost by sedimentation and lake outflow, and diluted by the volume of the lake. The average nutrient concentration correlates strongly with the lake's trophic state. To apply the VT model, the limiting nutrient nonpoint source loadings from the watershed and from direct point sources and physical and hydrological characteristics were noted. Lake chemical and biological characteristics were used to confirm the trophic state and limiting nutrient concentration as predicted by the mass-balance model. Chemical and biological data are very limited and not recent for most Oregon coastal lakes. These tasks were accomplished by a combination of literature survey and field trips to state and local regulatory or environmental control agencies. These included

collecting information on lake physical and hydrological characteristics, water quality/water chemistry data, and watershed characteristics, including land use by area, number of residences, soil classification, geological and topographical descriptions, and hydrological information (annual precipitation, evaporation, and runoff). Two lake samples were also collected monthly from Mercer and Clear Lakes, one at three feet below the surface (epilimnion) and the other at five feet above the lake bottom (hypolimnion).

Principal Findings and Significance

This research compared Secchi disk depths measured on the lake and TP concentrations of the epilimnion of the lake with value ranges reported by researchers in the past two decades. The Vollenweider model TP predictions and measured TP concentrations gave good predictive values of the TP concentration in the two Oregon coastal lakes. The good correlation between measured and predicted lake TP concentrations adds credibility to the phosphorus export coefficients and loadings determined by Giese (1996). The Clear Lake TP concentration prediction was well below measurements of previous studies, which averaged 10.8 mg/L. Mercer lake TP concentration predictions were below previous study measurements, which averaged 19.4 mg/L. Both measured and predicted TP concentrations of each lake were 30-50% below previous study values. This could be attributed to the 40-50% increase in precipitation above average during the study period. If so, it implies the model may be fairly sensitive to changes in annual precipitation amounts, especially in lakes with high flushing rates such as Mercer Lake. It is important to remember that the model is predicting a steady state TP concentration while measurements reveal some of the temporal dynamics of the lake and watershed over shorter time periods (less than annual cycle). These results will be useful for predicting nutrient loading and subsequent effects on water quality for the coastal lakes of Oregon, and further as an aid in land use management decisions. Training: One M.S. students was partially supported on this project.

Descriptors

Phosphorus, nutrient loading, watersheds, export, lakes, water quality

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications

Information Transfer Program

Defining the Objectives The 1999 to 2000 year was unique in that it provided an opportunity to catch the wave of excitement over the new millennium. This year was dedicated to promoting thought about water needs and concerns in the next century and to addressing current issues of concern to Oregonians. To this end, and in spite of

a limited budget and staff, OWRRI sponsored several seminar series and workshops, developed two water resource education websites, and promoted several water resource education programs. Implementing the Program OWRRI increased visibility by participating in and sponsoring several conferences, workshops, and planning meetings at local, statewide, regional, and national levels. These activities were a joint effort by the Director; the water education and technical outreach coordinator, Stephanie Moret; and cooperation from other faculty members. The continuation of seminars, conferences and workshops was identified as a crucial goal for OWRRI during 1999 to enhance the visibility of the Institute to various state and federal agencies. This goal was oriented toward important and timely water issues and demanded extensive amounts of staff time and materials. OWRRI successfully sponsored and co-sponsored the following conferences, seminars and workshops (Appendix 3). Conferences Spring 1999 ‘Crossing Boundaries: Linking People, Policy and Science’, Oregon State University, Corvallis, OR, May 14, 1999. Co-sponsor Environmental Sciences. This conference brought Portland State University, University of Oregon, and Oregon State University graduate students and faculty together to share their research and promote inter-academy relations. Approximately 60 people attended. Fall 1999 Co-sponsor, James Vomocil Water Quality Conference, November 3, 1999. "Water Quality Tools for the New Millennium." Conference topics included: total maximum daily load (TMDL), the role and power of local watershed councils. The annual Vomocil Water Quality Conference at OSU is designed to bring scientists, regulators and citizens into conversation about water quality in Oregon. It was attended by approximately 150 people representing state and local agencies, universities, private sector, students, and land owners. 1999-2000 Co-designed, ‘Water Availability Policy Forum’ for Willamette Valley Council of Governments. The objective of this forum was to inform government decision makers of basin processes and function in an effort to provide a background for understanding water quantity and quality issues; specific to meeting water needs in the next millennium. Approximately 100 elected government representatives attended this weekend workshop in Spring 2000. Seminar Series: Fall 1999 ‘Water in the West: The Challenge for the Next Century”. Oregon State University, Corvallis, OR, Water Resources fall quarter series Spring 1999 ‘The Willamette River Basin: Population, Progress and Protection in the 21st Century’, Oregon State University, Corvallis, OR, Co-sponsor: Environmental Sciences Graduate Program Spring 1999 Tools and Challenges of Hydrologic Analysis for the Next Millennium. Co-sponsor with Engineering and Geosciences Programs at Oregon State University. Training Workshops Winter 1999 ‘Conservation Reserve Enhancement Program (CREP)’ Workshop, Oregon State University, Corvallis, OR, March 5, 1999. The purpose of the workshop was to bring together senior federal and state environmental officials with representatives from the agricultural community; environmental advocates; municipal water managers; water quality scientists; watershed coordinators, and the public. The focus was upon basin function, the process by which streams were listed as water quality limited, the potential responses after listing, and to explain and list the advantages and disadvantages of the Conservation Reserve Enhancement Program. Attendance 100. Spring 1999 ‘Sustainability and the Land Grant University’. Included ‘The Natural Step’ workshop, Oregon State University, Corvallis, OR, May 24, 1999. The objective of this workshop was to stimulate discussion on integrating sustainability into the land grant curriculum in an effort to promote environmental responsibility by balancing economy and ecology. Co-sponsored with Center for Analysis of Environmental Change. Attendance 100. Water Resources Education Water resources minor students and students from across disciplines continue to be involved in OWRRI to obtain information and grow academically. Students are attracted to the Institute by its ongoing programs and the strong teaching and student advocacy skills of Water Resources faculty and staff. During the 1999 to 2000 year, OWRRI: · Sponsored a regularly scheduled, informal discussion hour with graduate students on water related topics incorporating ‘systems theory’. Dr. David Bella, Winter 1999-2000 · Continued to sponsor, advise and promote the graduate minor in Water Resources; with disciplines in Water Quality, Hydrology, and Water Planning and Management. FY1999-2000 efforts focused on increasing women and minority faculty for this program. · Co-developed a Proposed Area of Concentration in Water Resources for the new Environmental Sciences Graduate Program, presented in November 1999; accepted by graduate school and faculty senate in Spring 2000. o The Area of Concentration in Water Resources is designed for students who have a strong natural science background and want to develop an understanding of water resources in relation to environmental issues. Water Resources is the study of spatial and temporal variations and movement of water within and between earth systems, and the physical, chemical, biological, and social processes which affect and accompany the movement of

water. Within the Water Resources track, students may choose to focus on integrated aspects of aquatic, terrestrial, atmospheric, marine and social systems. · Initiated several meetings to discuss the future of Water Resources graduate programs in the Oregon University System (OUS). This included inviting an American Institute of Hydrology (AIH) representative and several OUS faculty and advanced graduate students to discuss the possibility of implementing a Professional Hydrologist certificate into the water resource graduate programs. Water Resources Education on the Web OWRRI staff worked with graduate students to develop, host, and finance the graphic design of two Water Resources Education websites. The sites took 480 hours to develop and they included cold-fusion technology to enhance the user interface. The sites were so successful that OWRRI sponsored the students to deliver a paper presentation at the AWRA Symposium on Water Resources and the WWW; held in Seattle, WA; December 1999. The paper was entitled: Supporting an Emerging Academic Water Resources Community with the WWW." The abstract is as follows: Research and teaching in water resources are found in multiple science, engineering, and social science departments at Oregon State University (OSU). This diversity provides a strong foundation for a graduate water resources program, but hinders effective flow of information and recognition of water resources as a common career path. Two websites have been created by students to unite and inform the academic hydrology and water resources community at OSU. The first website is focused on the student chapter of AWRA and AIH, and includes narratives of field trips, student profiles, alumni profiles, and chapter business. The second website describes OSU's academic offerings in water resources. An online database common to both websites provides the user with searchable listings of all water resources departments, personnel, and courses, and is a powerful tool for planning degree programs and increasing collaboration. Web forms allow the user community to update information themselves, distributing the maintenance workload and enhancing accuracy. Our approach to unifying information from multiple subdisciplines under water resources can also serve as a model for communicating information in other multidisciplinary fields. The websites have created as well as served demand for increased recognition of water resources as a distinct academic field, and are part of an ongoing effort to gain major degree status for hydrology and water resources at OSU.

USGS Internship Program

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	1	N/A	N/A	N/A	1
Masters	11	N/A	N/A	N/A	11
Ph.D.	2	N/A	N/A	N/A	2
Post-Doc.	N/A	N/A	N/A	N/A	N/A
Total	14	N/A	N/A	N/A	14

Awards & Achievements

Publications from Prior Projects

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications