Water Withdrawal Reporting Program
2002-2003 Annual Report

Report to the
Joint Standing Committee on Natural Resources

Submitted by
The Maine Department of Environmental Protection
Bureau of Land and Water Quality

January 29, 2004

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Introduction

This is the first annual report of the Water Withdrawal Reporting Program. Maine's Water Withdrawal Reporting Program, which is found at Title 38, Sections 470-A through 470-G, requires water users who withdraw quantities in excess of the thresholds contained in the statute to provide public information about their annual water withdrawals from public water resources. September 30, 2003, marked the end of the first "water year" subject to reporting under the Water Withdrawal Reporting Program. Reports of withdrawals made from October 1, 2002 to September 30, 2003 were to be submitted to DEP by December 1, 2003, and then reported to the Legislature by January 15.

The DEP recognizes contributions and assistance in assembling this report received from the Maine Geological Survey (MGS), the Department of Agriculture, Food and Rural Resources, the Maine Drinking Water Program, the Public Utilities Commission, the Land Use Regulation Commission, and the US Geological Survey (USGS). The data base of the Water Withdrawal Program is maintained by the Maine Geological Survey and the agricultural water use database is maintained by the Maine Department of Agriculture. The DEP also recognizes the financial support provided by the US Environmental Protection Agency.

While data has continued to come in from various sources after the December 1 deadline, preliminary estimates indicate that nearly 250 water users will be represented in this first year of data. Title 38, Section 470-G calls for this report to compare cumulative water use and availability of water in watersheds and to assess water use issues and priorities on a watershed basis. The DEP, MGS and the Department of Agriculture will be working over the next several months to accomplish this analysis on the data from this first year. We will be trying to identify watersheds that may be under stress in low-flow conditions, and applying the latest low-flow modeling techniques developed by MGS and USGS to compare water use and availability. The results of this analysis will be reported when it is accomplished, and also included in next year's annual report.

The largest group in terms of number of users represented are the public water supplies which report through the long established programs administered by the Public Utilities Commission and the Department of Human Services, Drinking Water Program, which are sharing their data with the Water Withdrawal Reporting Program. The 156 water utilities in this database reported annual production of approximately 34 billion gallons, in 2002. This data is reported annually and complete data for 2003 will be available in April, 2004. The second largest group in terms of number of users represented are agricultural water users. Agricultural water users are reporting through a new reporting program established by the Department of Agriculture, Food and Rural Resources. The 77 agricultural water users in this database reported 853 million gallons for the reporting year. The Department of Agriculture is condensing this data on a watershed basis to protect the confidentiality of the water users, and is sharing this condensed data with the Water Withdrawal Reporting Program. The Department of Agriculture reports a high level of cooperation with the new program.

The DEP also conducted targeted outreach to two major industrial water use sectors in this first year: ski areas and forest products manufacturing facilities, and found a high level of cooperation in both of these sectors as well. The DEP plans to continue this outreach in the second year of the program, to reach out to other types of water users, such as golf courses.

It should be noted that Maine received substantially more rainfall during the latter part of this first reporting year than in the past few years. Accordingly some of the data collected during these relatively wet conditions are not necessarily representative of withdrawals which would have been observed during the previous years of relative drought. The lessening of drought conditions in 2003 may have reduced the number and size of reportable water withdrawals, particularly for uses where withdrawals are necessary to supplement natural precipitation. The end of the drought also increased the water available for remaining needs, thereby reducing the risk of conflict among water uses and the potential stress on water resources.

Recommendations for the Coming Year

Continue Water Withdrawal Reporting Programs

The DEP plans to continue providing support to the Department of Agriculture for the Agricultural Water Management Program, and to continue the partnership with the Maine Geological Survey to jointly administer the Water Withdrawal Reporting Program. The DEP also plans to focus additional targeted outreach efforts to other potentially reportable water users, such as golf courses.

Integrate Data into Maine-Specific New England Water Use Data System

Beginning in 1997, the U.S. Geological Survey (USGS) has coordinated development of the New England Water Use Data System (NEWUDS), a database that would store existing water-use data and allow for analysis and retrieval of this data. NEWUDS was developed to store water-use data that allows water to be tracked from a source location (aquifer, rivers, lakes etc.) to a delivery point (user). The Maine Geological Survey has begun to utilize NEWUDS for the Water Withdrawal Reporting Program. The MGS is attempting to streamline the regional NEWUDS program to become a more Maine-specific program, by "populating" the database with current and more detailed data that is beginning to be collected through the Water Withdrawal Reporting Program. As time progresses, NEWUDS will become fully integrated into the water use data collection process in Maine, which will allow detailed analysis of water availability and utilization within watersheds. The MGS will be working on this analysis over the coming months, and will be reporting its findings as they are developed, as well as in next year's report. This work may also provide valuable information for the Water Use Standard rulemaking process to be undertaken by the DEP pursuant to Title 38, Section 470-E.

Begin Rulemaking on Water Use Standards

Title 38, Section 470-E directs the Board of Environmental Protection to establish water-use standards for maintaining instream flows by 2005. Standards are to be based on the natural variation of flows and water levels. The DEP will give consideration to the first year of data from the Water Withdrawal Reporting Program, as well as the recent work done by USGS and

MGS on estimating low-flow conditions. The DEP plans to commence the rulemaking process called for in Title 38, Section 470-E this winter.

Continue Agricultural Water Management Planning at DAFRR

For agriculture, this year has been successful in implementing the requirements for water reporting by large water users. In the coming year the Department of Agriculture will be seeking additional funds to continue the water management planning technical assistance and help identify any potential areas where conflicts may occur with other water users. The Department of Agriculture also recommends funding for the Aroostook Water and Soil Management Board in order to continue to help potato farmers identify water use conflicts, apply the low-flow studies to practical needs, and continue implementing the low-flow policy of the Board.

Support Recommendations of Blaine House Conference on Natural Resource-based Industries

The Blaine House Conference on Natural Resource-based Industries was held on Monday, November 17, 2003 with nearly 700 participants. Conference participants made recommendations to Governor Baldacci on ways to help grow Maine's agriculture, aquaculture, marine fisheries, forestry, and tourism/recreation industries. A number of recommendations made at the conference related to agricultural water use. Some of these recommendations may be brought forward by the Governor in legislative proposals.

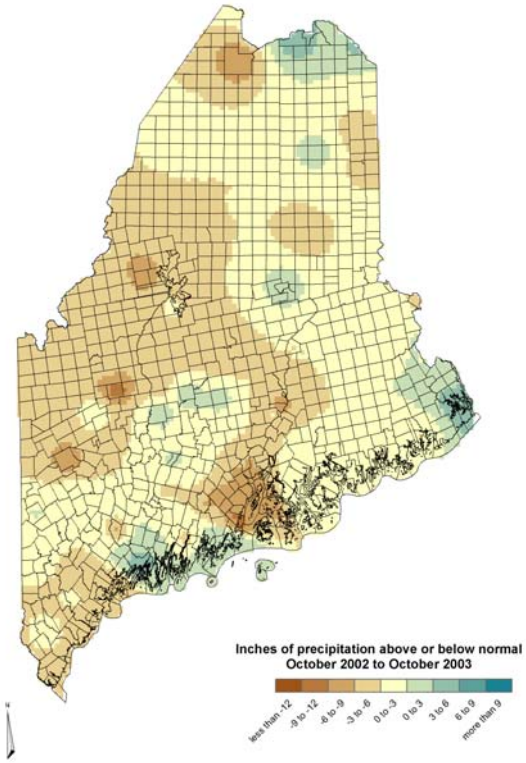
Summary of Water Resources Conditions for October 2002 to October 2003

Maine began the first year of the Water Withdrawal Reporting Program at the end of the summer of 2002 with the entire state in moderate to severe drought conditions. Precipitation through most of the year was normal to below normal, but heavy rains in October 2003 mitigated much of the deficit in eastern and northern Maine and portions of mid-coastal Maine. However, the Penobscot Bay region and the northwestern mountains still had precipitation deficits of over nine inches of rain at the end of the period (see map below).

With respect to drought conditions (as shown by the U.S. Drought Monitor maps on the next page), precipitation in late 2002 eased conditions slightly in coastal Maine, but below normal precipitation in early 2003 returned the State to abnormally dry/moderate drought conditions from the perspective of ground-water levels. (The letter "H" on the U.S. Drought Monitor maps on the following page indicates dry or drought conditions.)

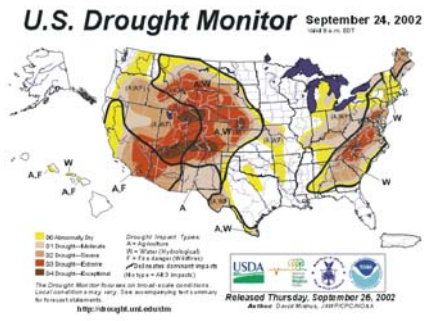
The heavy rains in October 2003 eliminated the last traces of drought in the state. This is in spite of the fact that much of western Maine still showed a precipitation deficit of over six inches for the period, with some parts of the western mountains and coastal Maine showing a precipitation deficit of over nine inches (see map below). Part of this inconsistency may be due to the differences in scale between the National Weather Service observer stations and the data used in compilation of the Drought Monitor. Parts of western Maine may still be abnormally dry from a hydrologic perspective, but not be showing on the national map.

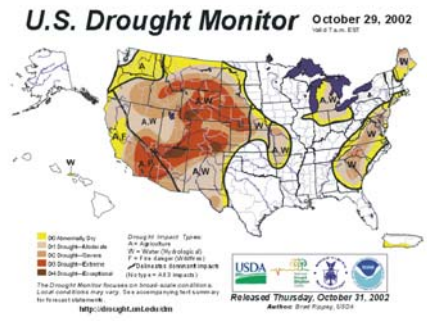
A similar pattern can be seen in the ground-water levels and surface-water runoff reported at U.S. Geological Survey observation wells and gaging stations (see monthly maps pages 6 - 8). Ground-water levels and surface-water runoff were in the normal or above normal range in October 2003 except for a small area in extreme southern Maine where ground-water levels still remained within the lowest 25-percent of recorded measurements.

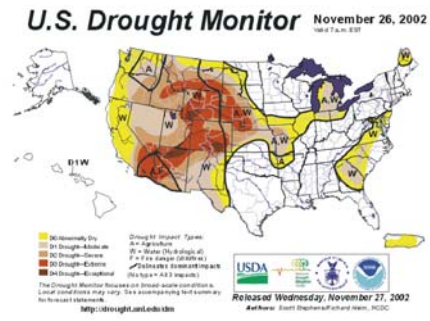


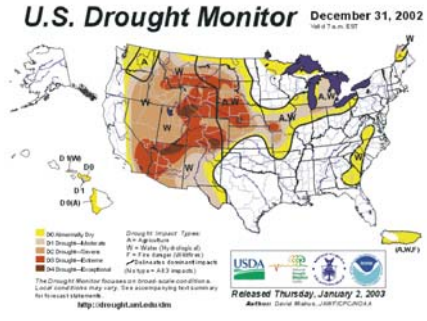
Inches of precipitation above or below normal for the period October 2002 through October 2003.

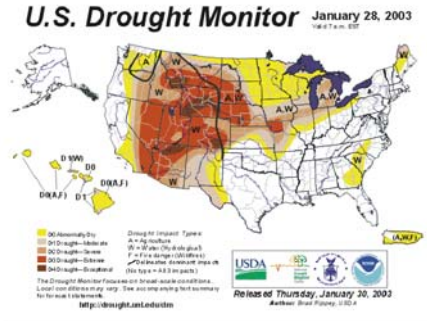
Data from National Weather Service stations and the National Weather Service cooperative observer network

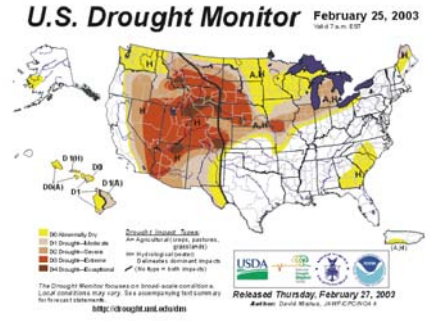


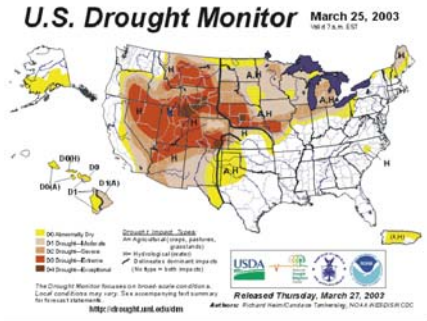


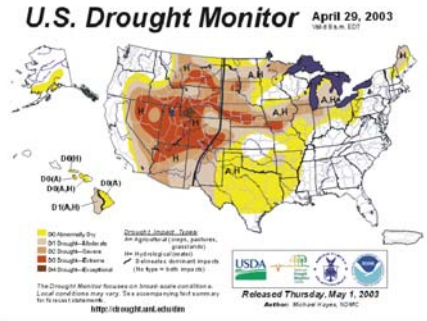


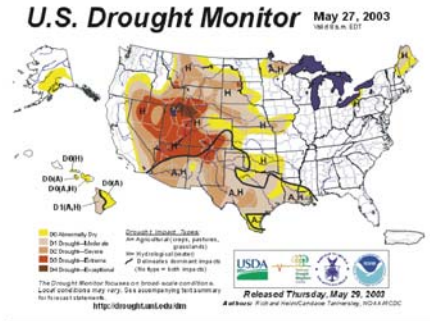


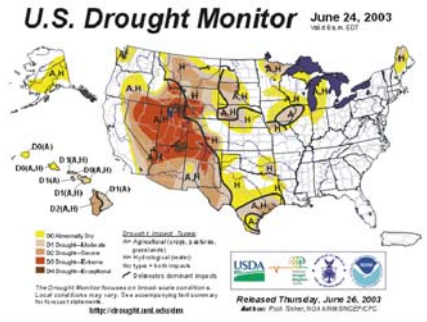


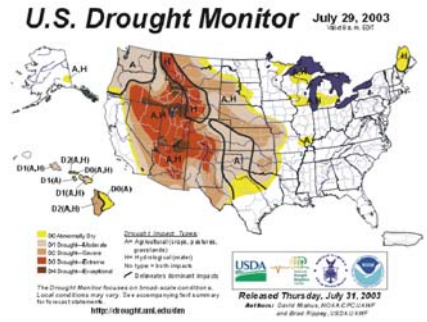


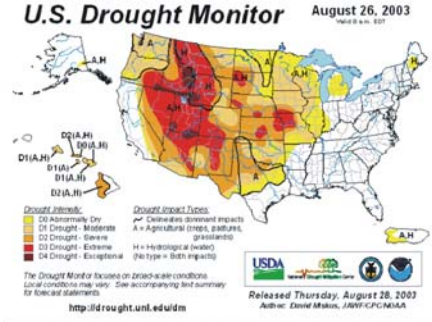


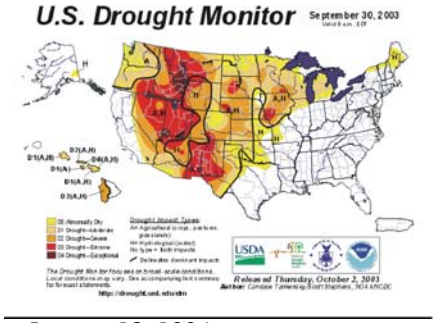


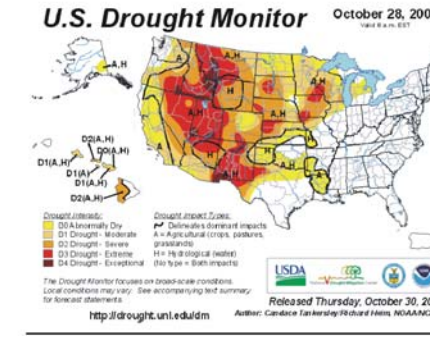




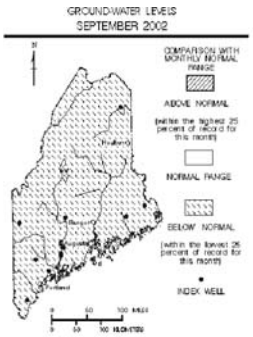


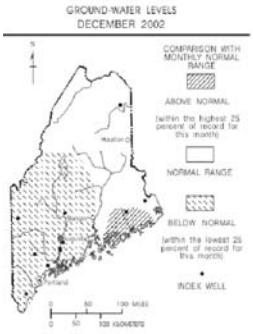


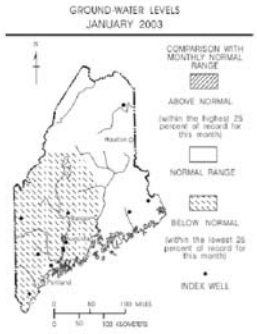


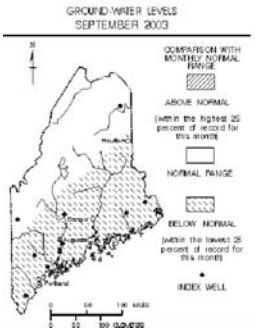


Month-end U.S. Drought Monitor maps. In the Northeast, drought conditions gradually improved through 2002 and 2003. Early fall rains eliminated the last traces of drought conditions in October, 2003.

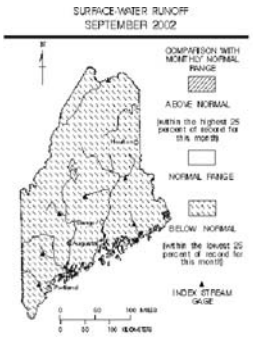


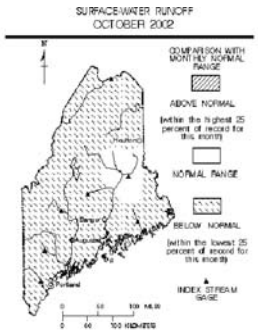


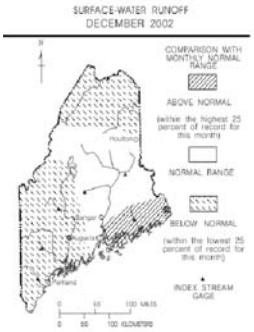


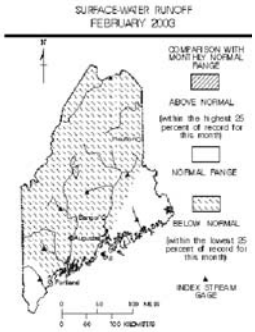


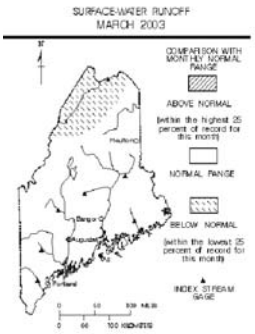
Month-end summary maps of ground-water levels from the U.S. Geological Survey current hydrologic conditions reports for Maine. Ground-water conditions gradually improved throughout late 2002 and 2003. Early fall rains produced ground-water levels much above normal in northern, eastern, and northwestern Maine, and left only a small portion of extreme southern Maine with below normal levels.

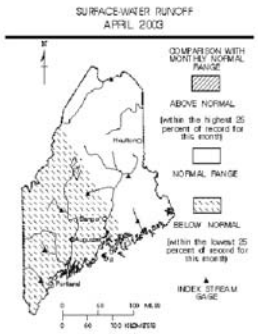


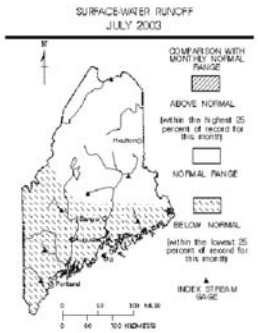


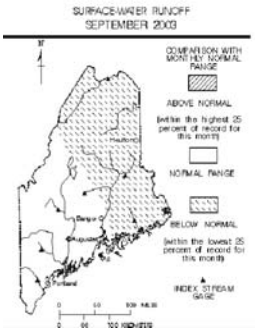


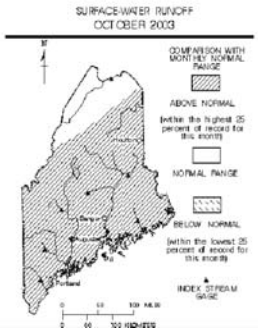












Month-end summary maps of surface-water runoff from the U.S. Geological Survey current hydrologic conditions reports for Maine. Surface-water conditions gradually improved throughout late 2002 and 2003. Early fall rains produced surface-water runoff much above normal in all except extreme northern, where runoff was in the normal range.

Conditions Observed by Public Water Supplies

The Department of Human Services Drinking Water Program reports that public water supplies observed conditions in 2003 that generally marked a return to more nearly normal water availability. The easing of the drought, followed by significant fall rains, reduced the number of systems that had to seek supplemental sources or restrict water use significantly. A number of coastal public water systems annually experience late-summer demand peaks, which coincide with seasonal ground and surface water lows. Conservation was required in several communities. These systems continue to work to develop supplemental sources. This is often difficult along Maine's rocky coast and often complicated by regulatory constraints.

Conditions Observed by Agricultural Water Users

The Department of Agriculture, Food and Rural Resources reported that year 2003 was a good water year for most Maine farmers, with limited agricultural drought conditions in July and late August. Water availability was good for early season frost control and broccoli germination. Most areas received adequate rainfall in early June, but conditions remained hot and dry from early July through the last week of July, requiring turf, some potato, and blueberry irrigation. August irrigation was limited to later in the month and the first week in September. Late October and early December water availability was adequate for cranberry harvest and winter flooding.

Agricultural producers did not report any water use and availability conflicts in 2003. The Department of Agriculture and DEP toured areas that had the potential for water use problems based on experience in 2002. In many cases the farmers have worked voluntarily with DEP to resolve issues. In some cases a new water source would take care of any future needs and the Department of Agriculture has encouraged farmers to apply to the water source cost share development program.

Water Use Conflict Enforcement Actions

Neither the DEP nor the Land Use Regulation Commission reported any enforcement actions due to excessive withdrawals from resources during the reporting year.

Summary of Water Withdrawal Data

The Water Withdrawal Reporting Program has sliding-scale reporting thresholds for rivers/streams and lakes, essentially designed to limit the reporting burden to withdrawals that are relatively large in comparison to the water available in the resource. While those withdrawing below the various reporting thresholds are not required to file under the program, over the course of the past year the DEP has received numerous contacts, particularly from commercial and industrial water users on Maine's larger rivers, indicating that many of these users fall below the established thresholds. However, the DEP still feels the reporting thresholds are sufficiently restrictive that the unreported uses do not hamper the state's ability to assess impacts from all water withdrawals. The program also contains exemptions for various types of water uses, such as non-consumptive uses, household uses, public emergencies, and withdrawals from certain storage ponds.

Public Water Systems

There are approximately 2,200 Public Water Systems (PWS) in Maine, of these, 400 are community water systems with 25 or more users. Data for these systems, including location, source, and population served, are maintained in a GIS database by the Department of Human Services, Division of Health Engineering as part of their Drinking Water Program.

Production/consumption data for 156 of the larger water utilities is compiled in an existing reporting program at the Public Utilities Commission (PUC). The water utilities report to the PUC on a calendar year basis, with data due by April of the following year. The production/withdrawal data is broken down into monthly segments, and is also further divided into source, either groundwater or surface water. For calendar year 2002, 123 (79%) of these water utilities have reported. Total water utilities reported annual production for 2002 was 33.8 billion gallons, or 2.8 billion gallons a month, or 92.5 million gallons a day. Using the average daily usage value, and recalculating the unreported utilities, the total water utilities usage would be approximately 42.8 billion gallons (bg). Of the total usage, approximately 24% (10.3 bg) was from groundwater and 76% (32.5 bg) was from surface water. The highest consumption rates are directly related to the higher populated regions of the state.

Agricultural Water Use

The Department of Agriculture received 98 water use responses with 77 reporting use, 14 not needing to report and 7 exemptions from reporting. Based on a previous 2002 survey of water use, the Department had calculated that approximately 94 farmers out of 540 irrigating would need to report under the program. For the 77 sources from which water was withdrawn, the total use was 853 million gallons or 2,600 acre feet[1] of water. The largest use by county was in Washington County (582 million gallons) for blueberry and cranberry production. One producer accounted for 85% of that amount. York County was second (77 million gallons), primarily for mixed vegetables, Aroostook was third (69 million gallons) primarily for potatoes and broccoli, and Cumberland was forth (49 million gallons), primarily for mixed vegetables and turf production. Other county totals were: Kennebec (27 million gallons), Penobscot (23 million gallons), Androscoggin (14 million gallons) and Oxford (7.5 million gallons). All other counties

[1] One acre foot equals the volume of water necessary to cover one acre to a depth of one foot, or 325,851 gallons.

reported less than a million gallons of use. Rivers made up 33 of the sources, followed by 18 from manmade ponds, 12 from wells, and 12 from natural ponds.

Other Water Uses

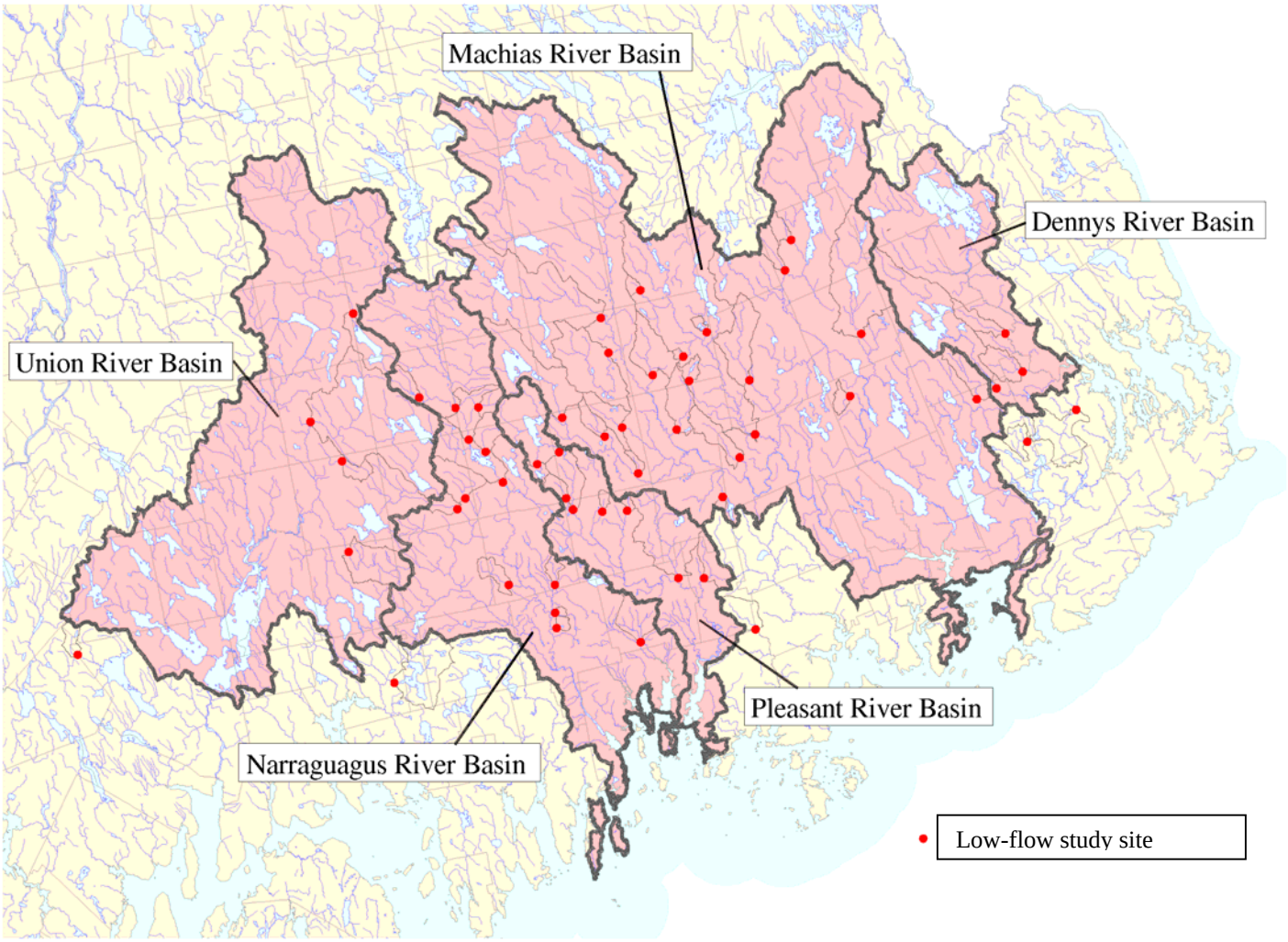
Other data sets from the Water Withdrawal Reporting Program database illustrate the varied types and amounts of water use taking place in Maine. The Maine bottled water producers estimated 2002 water usage was 364.5 million gallons, or 30.4 million gallons per month. There were 15 Maine ski areas with snowmaking capabilities during the 2002 - 2003 ski season. Eight of these areas reported a total of approximately 590 million gallons of water used for snow making during the 2002 - 2003 ski season. As noted above, many commercial and industrial facilities turned out to be exempt from reporting requirements, but analysis of waste water discharge volumes from ten paper mills indicates that they used approximately 40 billion gallons of water. These facilities are located on Maine's largest rivers and most of the water is discharged back to the river after use and treatment.

Regional Water Use Management Efforts

Eastern Maine Rivers Low-flow Study

The Maine Geological Survey and the U.S. Geological Survey are conducting a 5-year study of low-flow conditions on eastern Maine rivers in order to understand base flow conditions critical to aquatic habitat and to support permitting of water withdrawals. This project directly supports the Atlantic Salmon Conservation Plan. The final year of the project began in October 2003. The project is a collaborative effort with funding from DOC, DOT, SPO, DEP, DARR, IFW, ASC, and USGS. With the assistance of stakeholders, 25 partial-record sites were selected in 1999 for low-flow measurements. Since that time, two low-flow measurements have been made each summer at each site with a total of 10 independent low-flow measurements completed on all sites by the end of the summer, 2003. These data will be used to develop regression equations to estimate low-flow statistics at any ungaged, unregulated site in eastern Maine by calculating topographic, climatic, and geologic characteristics. A final report will be available in 2004.

Eastern Rivers Low-Flow study area



Aroostook Water and Soil Management Board

The Aroostook Water and Soil Management Board (AWSMB) developed a policy in 1996 for water use during low-flow periods in Aroostook County to ensure that farmers had adequate resources to maintain yields and quality of agricultural crops while protecting the environment from excessive draw-down of lakes, rivers and streams. This policy states that site-specific aquatic base flow (ABF) withdrawal limits will be implemented where drawdown is causing damage to fish and wildlife. It also states that state and federal agencies will help to establish these low-flow withdrawal limits. The Department of Agriculture secured support in the legislature to allow the AWSMB to fund a long-term study with USGS. The USGS recently published a report under this agreement, providing a method to estimate August median streamflow for small basins in Aroostook County, which can be used to help resolve low flow issues under the Low Flow Policy of the AWSMB.

Streamflow Statistics for Ungaged Streams

Better equations to estimate low-flow statistics, including August median streamflows, are an important step in establishing streamflow standards. The U.S. Geological Survey, in cooperation with state, local, and other federal agencies, is in the process of developing methods that can be used by hydrologists, engineers, and managers to estimate characteristic stream flows based on measured hydrologic and climatic basin characteristics such as drainage area, wetland area, precipitation, elevation, and surficial geology. Complementing the eastern river and Aroostook low-flow studies, a statewide study provides a means for estimating mean and median monthly flows, and 7Q10 in all parts of the state on medium to large basins. An attached USGS fact sheet outlines recent and ongoing work to develop streamflow statistics, and guides water resource managers in the selection of the most appropriate equation to use depending on the streamflow statistic of interest and the basin size.

Atlantic Salmon Commission Activities

The Atlantic Salmon Commission is charged with implementing many elements of the Atlantic Salmon Conservation Plan. The Commission oversaw the development of a Water Use Management Plan for eastern Maine salmon rivers and is now implementing that plan. Over the next year, a contractor to the Commission will catalog and assess the quality of existing hydrologic, geologic, habitat, and climatic data relevant to developing coupled surface water-ground water watershed models in the river basins presently identified as significant habitat for Atlantic salmon. The contractor will also evaluate computer models that analyze surface water – groundwater interactions, an essential component to evaluating the impacts of water withdrawals. The compilation of datasets and the model review are significant steps towards analyzing potential water use conflicts statewide. Additional resources will be needed to conduct detailed analysis of these potential conflicts at the watershed level in order to identify solutions.

Agricultural Water Use Management Program

The Department of Agriculture has accessed $150,000 of federal funds to conduct a water use survey and develop an agricultural water use strategic plan in 2003. The water use survey showed that farmers have suffered over $32 million of losses to drought in the past few years and a need exists for over $28 million for new source development and equipment in the next five years. The strategic plan calls for more bond money support for source development, the

development of better, more streamlined regulation for wetland use, and technical assistance to help farmers develop water management plans. The recent Blaine House Conference on Natural Resource-based Industries highlighted water access to be a major need for agriculture.

Water Use Management Planning Assistance

The Department of Agriculture has established a program to help farmers develop water budgets for their farms. In 2003 the Department, working with USDA, developed a water management budget computer program to assist in that effort. Over 60 farmers were assisted in putting together plans. A number of those farms subsequently applied for grants for new source development. In addition, the Maine Potato Board initiated their own cost share grant program to assist potato farmers in developing water budgets. Nine farmers were given grants to develop those plans in 2004.

Water Source Development Grant Program

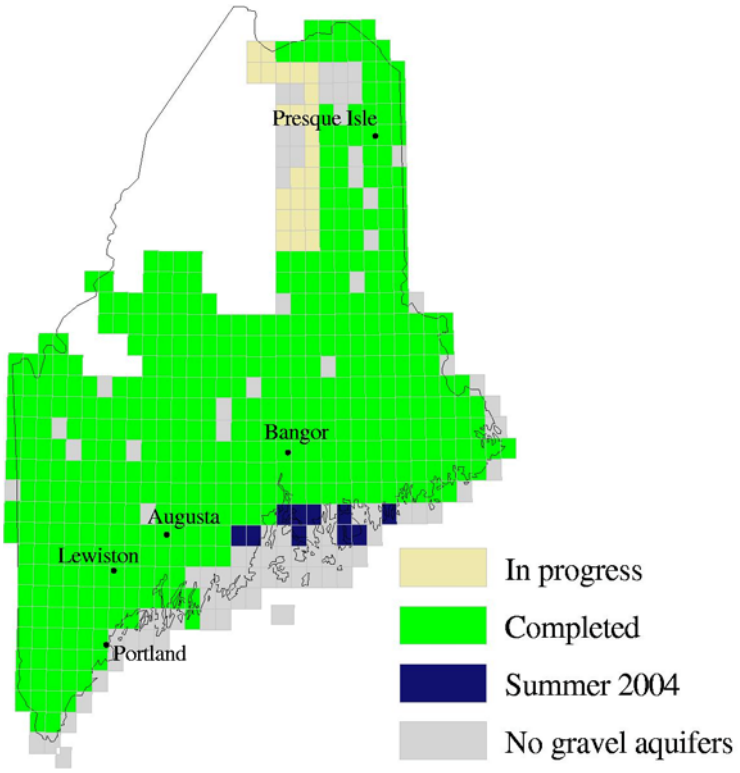
The Department of Agriculture reports that water availability for agriculture is the number one production input that is the hardest to manage and has the most potential to either destroy or improve market quality, yields, and consistent production. Recognizing this, the legislature passed three bond issues in 2001, 2002 and 2003 for $1.95 million to develop new water sources for farms. The Cost Share Program for new source development has issued over $900,000 in grants to 58 farms to build 27 ponds, 36 wells and three impoundments. The new sources will protect over $8.7 million of crop value from drought. At the end of 2003, approximately 36 of the projects had been completed. A number of the projects helped farmers to avoid the use of rivers or streams in the future by building ponds to capture spring runoff and meet the water budget needs of the crops for the summer.

Farmers who know they have a potential problem have come forward to seek grants for new source development, primarily for wells and manmade ponds, or are working on water management plans to develop new sources in the next few years. Of particular interest is the situation in Downeast Maine where the Atlantic Salmon listing as an endangered species may potentially impact water withdrawals directly from streams. In this case, private companies have been investing millions of their own dollars to remove pumps from streams and install wells to tap the high volume aquifers. These aquifers are a much more stable source than direct surface withdrawals. Cherryfield Foods has been a leader in shifting over 60% of its water needs from rivers, streams, and ponds to wells in the past five years. The trend to off-stream water source development for all growers Downeast will accelerate with the continued funding of the Agricultural Water Source Development Grant Program.

Sand and Gravel Aquifer Mapping

Significant sand and gravel aquifers are those that are capable of yielding 10 gallons per minute or more of water to a well. Because of their value as water resources and concerns for maintaining water quality, the Maine Geological Survey has been directed to map significant sand and gravel aquifers statewide. During the summer of 2003, the MGS mapped aquifers in central Aroostook County. With the completion of mapping in 2004 in the central coastal region, all of the state except for portions of western Aroostook and northern Piscataquis and Somerset Counties will be mapped. The value of these sand and gravel deposits as water resources cannot be overstated. In many parts of the state they are frequently developed as municipal water supplies. Where they are available in agricultural areas, they are used extensively for irrigation. Furthermore, the percentage of a watershed that is underlain with sand and gravel aquifers is a significant factor in determining low-flow conditions in streams. This mapping effort provides a valuable basic data layer for analysis of numerous water resource issues.

Figure below shows current status of sand and gravel aquifer mapping and project area for summer of 2004.



Methods for Estimating Streamflow Statistics for Ungaged Streams in Maine

Figure 1. Flood on the Kennebec River at Augusta, Maine, April 1987.

Introduction

Streamflow statistics such as flood peak flows, monthly means and medians, and 7-day 10-year low flows (7Q10) are used for a variety of purposes, including the design of bridges, culverts, and flood-control structures; the management and regulation of flood plains and reservoirs; and the allocation of limited water resources during seasonal low flows and droughts.

Although a number of rivers in Maine have long-term continuous gaging stations with up to 100 years of streamflow record, it often is necessary for hydrologists and water-resource managers to estimate flows on ungaged rivers, at ungaged locations on gaged rivers, or on gaged rivers with insufficient periods of record. To provide simple methods to estimate flow statistics at ungaged sites in Maine, the U.S. Geological Survey (USGS), in cooperation with State, local, and other Federal agencies, has developed methods that can be used by hydrologists, engineers, and managers to estimate characteristic flows based on measured hydrologic and climatic basin characteristics such as drainage area, wetland area, precipitation, elevation, and surficial geology.

Peak Streamflows

Regression equations to estimate peak flows with 2- to 500-year recurrence intervals in basins with drainage areas from 1 to 1,650 square miles are presented in U.S. Geological Survey Water-Resources Investigations Report 99-4008 (Hodgkins, 1999). Guidelines provided in this report assist water-resource managers in choosing the most appropriate equation to apply. Guideline criteria include evaluating the amount of development in the basin, the degree of regulation at the site of interest, the proximity of the

Table 1. Methods for estimating streamflow statistics for ungaged basins by basin size.

Streamflow statistic	Basin size		
	0 to 1 square miles	1 to 10 square miles	10-1,500 square miles
Peak flow	Under development	Hodgkins (1999)	Hodgkins (1999)
Annual mean/median	Not available	Not available	Dudley (written commun., 2003)
Monthly mean/median	Not available	Not available	Dudley (written commun., 2003)
August median—Aroostook County	Lombard and others (2003)	Lombard and others (2003)	Dudley (written commun., 2003)
August median—Downeast	Under development	Under development	Dudley (written commun., 2003)
7Q10—Statewide	Not available	Not available	Dudley (written commun., 2003)
Flow duration	Not available	Not available	Not available

site of interest to a gaging station, and the degree of accuracy compared to the ease of application. Statewide equations are derived to calculate the 2-, 5-, 10-, 50-, 100- and 500-year recurrence interval peak flows based on the drainage area of the basin and the percentage of wetlands in the basin. A simplified technique using only drainage area is quicker and easier to apply, but results in estimates of peak flows that are less accurate.

Estimating peak flows for small basins (less than 1 square mile) often is done with models such as the Rational method and the National Resources Conservation Service TR-20 model. A crest-stage gaging network currently is in operation on 15 small basins throughout Maine, which will allow the accuracy of the models to be evaluated.

Mid-Range Streamflows

The USGS has recently developed improved statewide regression equations to estimate annual and monthly mean and median streamflows at ungaged streams with drainage areas from 10 to 1,420 square miles (R.W. Dudley, U.S. Geological Survey, written commun., 2003). The new equations supersede those derived by the USGS 25 years ago (Parker, 1978). The new equations will take advantage of 25 years of additional flow data and basin characteristics calculated with a Geographic Information System (GIS).

The statewide regression equations will estimate annual and monthly mean and median flows using drainage basin characteristics including drainage area, surficial geology, precipitation, and distance from the coast.

Figure 2. 100-year drought at Piscataquis River at Dover-Foxcroft, Maine, August 2001.

Low Streamflows

A method to estimate the August median flow for ungaged basins in eastern Aroostook County is described in U.S. Geological Survey Water-Resources Investigations Report 03-4225 (Lombard and others, 2003). New generalized least-squares regression equations are applicable to small drainage basins from 1 to 40 square miles. Basin characteristics, including drainage area and mean elevation, are used to estimate August median flow. A similar study for small drainage basins in Washington and Hancock Counties currently is underway.

New regression equations to estimate the 7Q10 low-flow statistic and summer monthly means and medians also have recently been developed (R.W. Dudley, U.S. Geological Survey, written commun., 2003).

Future Directions

In U.S. Geological Survey Water-Resources Investigations Report 99-4008 (1999), Hodgkins indicated that very steep watersheds may behave differently than other watersheds with regards to peak flows. Work to investigate peak flows on steep watersheds has been proposed.

References

Hodgkins, G.A., 1999, Estimating the magnitude of peak flows for streams in Maine for selected recurrence intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p.

Lombard, P.J., Tasker G.D., and Nielsen, M.G., 2003, August median streamflow on ungaged streams in eastern Aroostook County, Maine: U.S. Geological Survey Water-Resources Investigations Report, 03-4225, 20 p.

Parker, G.W., 1978, Methods for determining selected flow characteristics for streams in Maine: U.S. Geological Survey Open-File Report 78-871, 25 p.

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