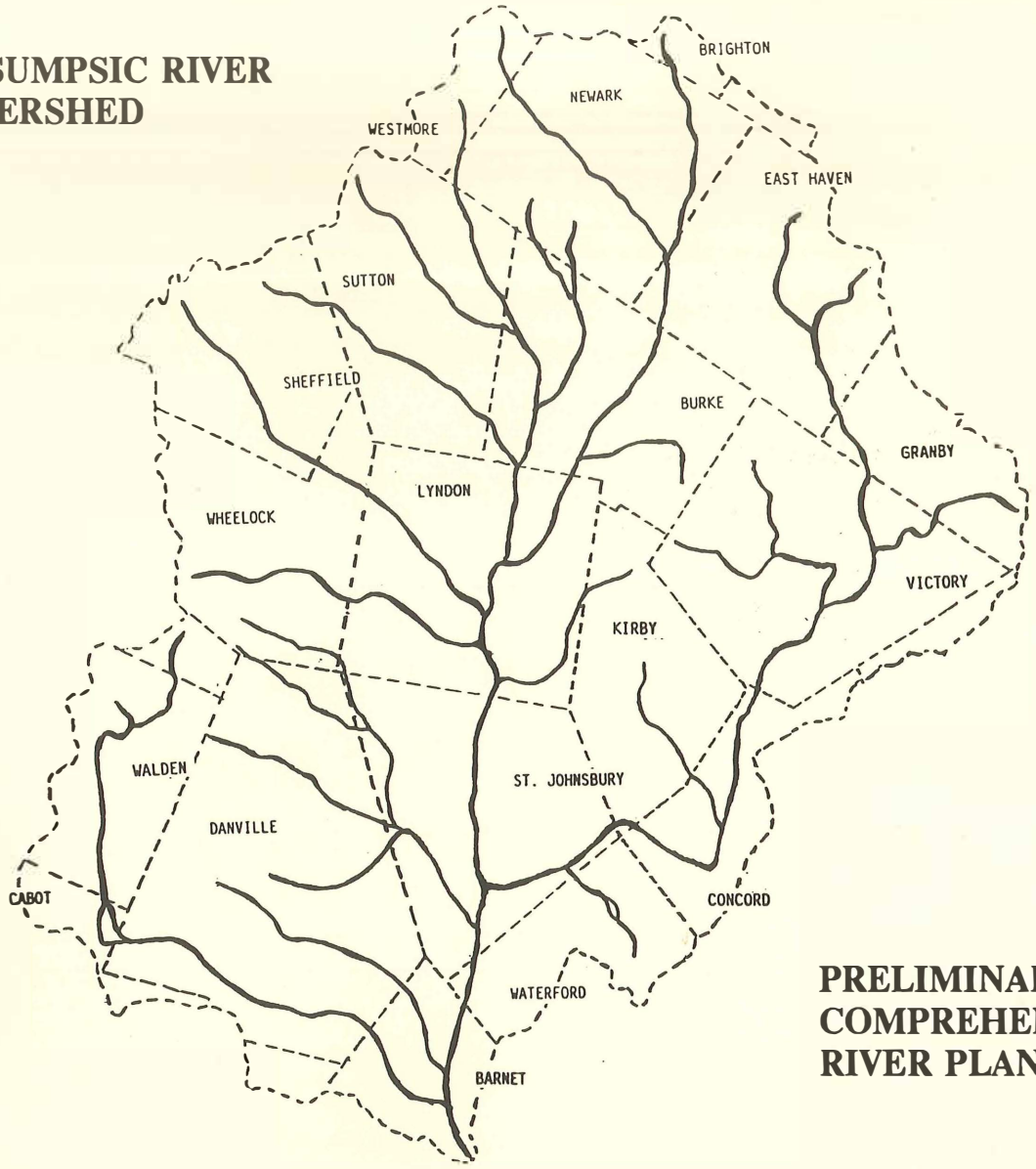
PASSUMPSIC RIVER WATERSHED



PRELIMINARY COMPREHENSIVE RIVER PLAN

prepared by:

Vermont
Department of Environmental Conservation
Water Quality Division
103 South Main Street
Waterbury, Vermont 05671-0408

August 1991

The Preliminary Comprehensive River Plan

for the

Passumpsic River Watershed

Vermont

August 1991

This Preliminary Comprehensive River Plan

Was Prepared By The

Vermont Agency of Natural Resources
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With Assistance From

Residents and Visitors
Of The Passumpsic River Watershed

RESOLUTION
OF
CITIZENS ADVISORY COMMITTEE
FOR
VERMONT COMPREHENSIVE RIVER PLANNING

WHEREAS: The citizens of Vermont whose interests include agriculture, silviculture, fisheries, boating, hydropower, alpine skiing, real estate development, water quality, environmental conservation, and municipal, regional, state and federal natural resource and recreation planning and management are represented on the Citizens Advisory Committee through appointment by the Secretary of the Agency of Natural Resources;

WHEREAS: A comprehensive river planning process for involving the citizenry, whose interests we represent in the Passumpsic River Watershed, in an inventory of river uses, values, management goals and actions was adopted by the Citizens Advisory Committee on June 15, 1989;

WHEREAS: This process was carried out in the Passumpsic River Watershed. Those citizens whose interests we represent were invited to participate in the planning process, and comments made by those citizens were accurately incorporated into this preliminary plan for the Passumpsic River Watershed;

NOW THEREFORE: We respectfully submit this preliminary comprehensive river plan for the Passumpsic River Watershed to the Secretary of the Agency of Natural Resources.

The above resolution, having been read and discussed in an open meeting by the Citizens Advisory Committee for Vermont Comprehensive Rivers Planning on 17 July 1991 at Waterbury State Office Complex, Waterbury, VT was adopted.

Tom Lauricella
Chairman

July 17, 1991
Date

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES, continued

LIST OF TABLES

INTRODUCTION

The Vermont Comprehensive Rivers Program

The Vermont Comprehensive Rivers Program is an effort by the Department of Environmental Conservation to provide leadership and assist the public in the development of river use plans. Most importantly, the Comprehensive Rivers Program hopes to build and strengthen the local interest necessary to establish an ongoing river planning and management process.

With this in mind, the present report and the work leading up to it represent a new opportunity to create a partnership among those who use and value the rivers and streams of the Passumpsic River Basin. Balanced river conservation policies can only be created by addressing the full complexity of issues related to river uses and values. The Passumpsic River watershed with its diversity of natural and cultural settings, requires a river planning process including those interested in:

1) water quality,
2) hydropower,
3) flatwater and whitewater boating,
4) fish and wildlife communities,
5) gorges, rapids, waterfalls, and other scenic features,
6) domestic and industrial water supply,
7) agriculture,
8) silviculture,
9) natural river corridors,
10) housing and commercial development,
11) wastewater assimilation,
12) public areas accessible for fishing, boating, swimming, and passive enjoyment,
13) rare and irreplaceable areas including habitat for threatened and endangered species,
14) free-flowing river segments,
15) wild, remote, and undeveloped river segments,
16) archeological and historical sites, and
17) floodplains and floodwater discharge.

(Appendix A lists those individuals and organizations contacted for involvement in the Passumpsic River Project)

Recognizing rivers as a finite resource, the Passumpsic River Project has taken a basin-wide approach in exploring existing or potential opportunities to fulfill the needs of the broadest range of river interests. River use conflicts exist, however, and the goal of this planning process is to establish agreements between the various interests that will guide local, state, and federal decisions concerning the management of Passumpsic River resources.

Without a planning process that involves local residents; that inventories river uses and values; and then sets clear goals for maintaining those uses and values, we often find ourselves faced with situations where one use grows to the exclusion of others. The Passumpsic River Project is the beginning of a cooperative effort with concerned citizens to develop a comprehensive river management plan for the Passumpsic River and its tributaries. The plan will document final agreements to resolve certain conflicts that have been on the "front burner" in recent years and may uncover new issues for which suggested actions will be offered that focus attention on the needs of different river interests. In addition, the plan will establish a public record of comments made by those who use and value the Passumpsic. People will have ready access to this record while making decisions that affect the river.

Of particular interest at this time is the scheduled relicensing in 1993 by the Federal Energy Regulatory Commission of four hydroelectric facilities owned by Central Vermont Public Service Corporation on the mainstem of the Passumpsic River. Decisions made during this relicensing process will dictate, in part, how the river will be used for the next 30 years. The Passumpsic River Project was recognized by a 20 member Citizens Advisory Committee to the Vermont Comprehensive Rivers Program as vitally important to the state in providing a unique opportunity for public involvement in a federal regulatory process.

Overview of Planning Process

Beginning in the fall of 1989, the Passumpsic River Project sought input from people living in or near the watershed. Through public workshops, mailed surveys, radio talk shows, newspaper articles, personal interviews and telephoning, people were asked to tell or write of their "likes", "dislikes", and "visions of the future" for the Passumpsic River and its tributaries. In so doing, local residents expressed what they valued about the Passumpsic, their perception of river use conflicts, and what they would consider a desirable outcome of future attempts to balance river uses and values.

In March 1990, a public workshop was held to review the Passumpsic River use and value inventory and discuss nine different river use goals and issues that had been addressed by the public to date:

Goal		Issue
1. Clean Rivers and Streams	→	Wastewater Discharges
2. Clean Rivers and Streams	→	Siltation and Streambank Erosion
3. Clean Rivers and Streams	→	Sluggish and Reduced Flows
4. Hydropower Generation	→	Environmental Regulation/Enhancement
5. Restore Scenic Qualities	→	Landfills, Graveling Scars, etc.
6. Improved Fisheries	→	Impacted Habitat and Fish Migration
7. Recreation Opportunities	→	Boating Portages and Public Access
8. Riverbank Vegetation	→	Removal of Riverbank Vegetation
9. Undeveloped Corridors	→	Stream Alterations and Development

Those present at the workshop discussed issues of concern, recommended certain actions to resolve problems, and identified any potential conflicts these actions might create with other river interest groups. In many cases, local residents expressed a need for more information concerning existing river conditions. Appendix B contains workshop comments offered by a **Water Quality/River Use Group** and a **Recreation/River Corridor Values Group.**

During the following year, a detailed inventory of Passumpsic River uses and values was compiled by the staff of the Vermont Division of Water Quality emphasizing those topic areas that seemed high on the public priority list. For instance, over half of the people participating in the process expressed interest and concern for the water quality of the basin. For this reason, a larger effort was made to systematically describe all known water quality conditions and issues for watercourses of the Passumpsic River basin.

Generally, the main sources of information utilized in drafting this Preliminary Comprehensive Plan were existing data, reports, and files at the Agency of Natural Resources and public interviews. It is recognized that much of the information originates from qualitative evaluations or from data that is only cursory in nature. The inventory is meant to represent the state of our present knowledge of the river resource. In many cases this may be all that is necessary to take meaningful actions with respect to river conservation. In other cases, the inventory will serve as a starting place for the more detailed assessments deemed necessary to solve specific river use issues or conflicts.

The final section of this preliminary plan is a set of Study Conclusions summarizing all the Watershed Opportunities, Current Issues, and Recommended Goals and Actions that were identified through the inventory. Specific management recommendations were made only where the necessary information is available and for those actions where the State has a regulatory mandate. Other actions identified are those calling for the completion of studies that may provide a more specific basis for making management decisions. General goals and actions stemming from comments made by the local residents concerning municipal and private landowner authorities were also included.

Further resource management recommendations which consider the complexity and diversity of identified issues and goals have <u>not</u> been included in the Preliminary Comprehensive Plan primarily due to the unavailability of results from technical studies now being conducted by Central Vermont Public Service Corporation (CVPSC) as part of their hydropower facility relicensing efforts.

People who have participated in the Passumpsic River Project and other interested parties have had the opportunity to review this preliminary plan and provide input as to whether there are gaps in the inventory and whether all public goals and recommended actions have been adequately addressed (Appendix E contains comments made during the June 26, 1991 public workshop in St. Johnsbury, Vermont). A public hearing was also be held in the Passumpsic River basin to give local residents ample opportunity to comment (Appendix F contains comments made at the August 8, 1991 public hearing and the responses to those comments).

Once a variety of water quality, fisheries, and recreation studies are completed and study results become available, the Final Comprehensive Plan for the Passumpsic River will contain balanced resource management recommendations largely affecting hydroelectric facility operations and desired recreational uses on utility-owned project lands but also useful to the protection and conservation of river uses and values in other areas of the Passumpsic River basin not owned or managed by the utility.

The final plan resulting from this cooperative effort will be available for distribution to basin towns, the regional planning commission, area businesses and organizations, and other interested groups and individuals to increase awareness of the rivers and streams in the Passumpsic River basin for the many uses and values these waters serve; to initiate special projects to further this awareness; to encourage partnerships between businesses, towns and organizations to protect the Passumpsic River and its tributaries. A large watershed map consisting of U.S.G.S. topographic maps and showing river use and value inventory information has been put on file at the Northern Vermont Development Association (NVDA) in St. Johnsbury for use by the public.

The Agency of Natural Resources will also be filing a copy of the plan with the Federal Energy Regulatory Commission (FERC), the entity responsible for relicensing four of the facilities owned by CVPSC in the Passumpsic River basin. Recent amendments to the Federal Power Act require for the first time that FERC consider the extent to which the facility is consistent with a comprehensive plan (where one exists) for "improving, developing, or conserving a waterway or waterways" affected by the facility. These plans must be prepared by an agency established under Federal law that has the authority to prepare such a plan or the State in which the facility is or will be located.

SECTION II

WATER QUALITY INVENTORY

OF THE

PASSUMPSIC RIVER BASIN

WATER QUALITY OF THE PASSUMPSIC RIVER BASIN

INTRODUCTION

The continued usefulness of Passumpsic Basin rivers and streams for drinking water, swimming, agriculture and fish and wildlife habitat relies on our efforts to protect and enhance water quality. This study will attempt to give the status of existing river uses and the prospect of enjoying those uses in the future by evaluating point and nonpoint sources of pollution and the water quality impacts they are known to cause.

A longer narrative of the Passumpsic watershed's natural and cultural setting and water quality issues is followed by a summary to help identify key issues and areas where more work may be needed. Based on river tributaries, population centers, and town boundaries, the Passumpsic River watershed has been described under three sub-basins including the Upper, Middle and Lower Passumpsic River watersheds. Larger tributary streams and their basins are described separately, and smaller tributaries, where information is available, are discussed with the Passumpsic mainstem segment to which they drain.

Setting

Each water quality discussion is preceded by a brief description of the tributary stream or mainstem corridor setting. The information sources used to characterize natural and cultural settings include road maps, topographic maps, National Wetland Inventory (NWI) maps, and field visits. The purpose of including a description of watershed setting is to provide information pertinent to the water quality assessments.

Watershed size, river gradient and extent of wetland coverage help to characterize the physical setting of a watershed. These factors are relevant to a discussion on water quality in that they describe river size and hydrology. An understanding of river volume, flow fluctuations and the extent of instream riffles and pools is useful when assessing impacts to aquatic habitats and the river's ability to cleanse itself following pollution events. The extent and type of riparian vegetation will influence runoff chemistry and river hydrology. Wetlands and wooded buffers along watercourses are more effective in maintaining water quality and riverine habitats than more open areas such as fields, cropland, pasture and urban areas.

Road descriptions including size, surface type (e.g., paved or gravel), use level, and proximity to streambanks are relevant cultural setting factors with respect to water quality. The encroachment of roads and buildings towards rivers and the presence of different land uses including gravel mining, logging, and agriculture affect pollutant runoff and streambank stability. Transportation networks within river valleys and along lake shorelands also indicate potential growth areas and the need to address growth's inherent wastewater issues.

Water Quality

The following definitions of water quality classifications and point and nonpoint pollution sources are included as a reference for reviewing the more specific pollution sources in the Passumpsic River watershed.

All surface waters of the state are classified under the Water Pollution Control Statute (10 V.S.A. Chapter 49) as "A", "B", or "C" waters by the Water Resources Board. Each classification has water quality goals for maintaining river uses and values. Vermont Water Quality Standards have protective criteria (e.g., pH and turbidity) designed to uphold uses such as fishable or swimmable waters or values such as habitat for aquatic biota.

Class A Waters - Valued as high quality waters of uniformly excellent character. May be used as a source of public water supply with disinfection and, when compatible, for the enjoyment of water in its natural condition. All watersheds above 2500 feet in elevation are Class A. The Board may designate two kinds of Class A watersheds:

1. Pristine Streams - Those found to be ecologically significant waters.

2. Public Water Supplies - Those used as surface drinking water with filtration.

Class B Waters - Consistently exhibit good aesthetic value and provide high quality habitat for aquatic biota, fish, and wildlife. Prescribed uses include public water supply with filtration and disinfection; contact recreation; irrigation and other agricultural uses.

Class C Waters - Valued as habitat suitable for aquatic biota, fish, and wildlife. Prescribed uses include non-contact recreation, irrigation of crops not used for consumption without cooking, and compatible industrial uses. Class C zones are designated by the Board to receive and assimilate effluent from wastewater treatment plants.

Watershed size also has statutory significance. Under the Stream Alteration Statute (10 V.S.A. Chapter 41):

Watersheds greater than 10 Square Miles - A person shall not alter the course or current of any watercourse with a drainage area greater than ten square miles either by movement, fill or by excavation of 10 cubic feet or more in any year, unless they have a State permit.

POLLUTION SOURCES & THEIR EFFECTS ON WATER QUALITY

River classifications express water quality goals and do not necessarily reflect existing conditions and the status of river uses and values. Existing water quality in the Passumpsic River Basin may be defined by the point and nonpoint pollution sources that impair or threaten river uses and values.

Point Source Pollution - discharged from a pipe, conduit, or other discrete source. Point sources are typically recognized as domestic or industrial wastewater treatment facilities requiring a federal discharge permit.

Table 1.

Point Sources	Potential Effects on Water Quality
Wastewater Treatment Facilities (dependent on treatment level)	1. May contribute organic matter and nutrients and result in an increase in biological activity depleting the oxygen levels and threatening oxygen-sensitive species such as trout; 2. May emit chlorine levels toxic to aquatic life: 3. May contain untreated hazardous wastes originating from household and commercial sources; 4. Effluent may contain bacteria and pathogens resulting in health threats to swimmers; 5. Industrial discharges may raise water temperatures or contain toxic chemicals and heavy metals.
Combined Sewer Overflows (CSOs)	1. Contribute untreated domestic wastewater during high flow periods and may affect water quality as outlined in # 1-4 above.

Nonpoint Source Pollution - caused by diffuse sources that are not regulated as point discharges. Nonpoint pollution is associated with precipitation, land runoff, subsurface leachate, water withdrawals and flow regulation.

Table 2.

Nonpoint Sources	Potential Effects on Water Quality
Dams, Diversions, Hydropower Projects, Stream Alterations	1. Aquatic habitat may be lost or altered by fluctuating, reduced or impounded flows and impoundment cycling; 2. The natural cycle of sediment transport in the watershed is altered resulting in turbidity and sedimentation at low flow periods when the river can not clean itself and the fisheries and other aquatic organisms are ill-adapted to cope with these problems; 3. Where reduced flows occur, the river's ability to assimulate wastewater is decreased effecting aquatic habitat and other human uses. 4. Loss of aquatic habitat due to channelization.
Silvicultural Runoff, Construction Erosion, Sand/Gravel Pits	1. May increase siltation, turbidity and downstream sedimentation resulting in the loss or alteration of aquatic habitat; 2. May discharge oil and grease; 3. With loss of streambank trees, cold water species are threatened by temperature increases and loss of available oxygen.
Agricultural Runoff (from cropland, pasture, feedlots, manure storage and animal holding areas)	1. May cause nutrient and organic enrichment increasing the oxygen stress on aquatic biota; 2. May contribute fecal matter and pathogens that result in health threats to swimmers; 3. May increase siltation, turbidity, and downstream sedimentation resulting in a loss or alteration of aquatic habitat; 4. May contain toxic pesticides and herbicides.

Table 2 continued.

Nonpoint Source	Potential Effects on Water Quality
Storm Sewers, Urban Runoff	1. May discharge oil and grease; 2. May increase siltation, turbidity and downstream sedimentation resulting in a loss or alteration of aquatic habitat.
Landfill/Waste Sites, Septic Systems, Underground Storage Tanks	1. May discharge toxic organic and metal leachates; 2. May contribute untreated wastewater and elevate nutrient, organic and pathogen levels.
Salt Storage and Road Salt Application	1. May change the salinity of aquatic habitat which has toxic effects on fish and other aquatic biota.

PUBLIC COMMENTS AND INVOLVEMENT

From October, 1989 through March, 1991, people living in the Passumpsic River watershed indicated the following concerns and ideas with respect to water quality and the land and river uses that affect water quality:

Wastewater Discharges

* I don't like local wastes impacting downstream.
* People take the river for granted - its a sink. (2 people)
* There are wastewater problems downstream of population centers.

* I like the river because it is there but it needs some cleaning up. I would like to see clean streams.
* I dislike the pollution of local rivers and streams and motorized craft found along them.
* I like the sound and cleanliness of local rivers and streams, however I feel that they could be even cleaner.
* Poor water quality is my main concern.

* Get the raw sewage out of the river. (4 people)
* I don't like the Passumpsic's water quality/sewage, litter and trash on the banks. One day (I'd like to see that) the Passumpsic will add to the Connecticut River water quality.
* The rivers are the lifeline of a bigger picture. There is too much dumping of sewage into the Passumpsic.
* I don't like the leachfield owned by Burke Mtn. Enterprises in the esker next to the East Branch of the Passumpsic and the proximity of the Darling Hill Toxic Waste Dump to the confluence of the East and West Branches.

* I dislike the sewage and pollution discharged by local towns.
* I dislike raw sewage from homes & septic systems. Water quality should be improved.
* Septic problems exist in Lyndonville and below East St. Johnsbury.
* Straight pipes and failed septic systems are a very prevalent problem throughout the Passumpsic and Moose River watersheds. The resulting raw seepage is a nuisance and a health hazard.
* I think there may be failed septics near Dish Mill Brook in Burke.
* Sewage is not as big a water quality problem as toxic chemicals that the river can't handle.

* We need clean water throughout the basin. (7 people)
* We should improve water quality. (8 people)
* There is a lack of water quality monitoring.
* We should check to make sure we have clean water.

* The river is in good enough condition to still be saved.
* There are public misperceptions about river's cleanliness.
* The river has been ignored and neglected.
* I don't like the lack of public concern/appreciation. (4 people)

* Possible ways to increase public awareness of the rivers are to have a river display at the Fairbanks Museum and conduct a river photo contest at the local schools.
* We need to increase appreciation and awareness. (3 people)
* The river is a educational resource to teach nature in schools.
* I would like to see the establishment of a Passumpsic River Watershed *Council* and public monitoring of water quality. (2 people)

Sedimentation

* High siltation in runoff is impacting the river.
* We should seek nonpoint source pollution reduction from farming and development - we must find new ways. (2 people)
* I am concerned that streambank erosion is adversely affecting water quality.
* It appears to us (SCS, St. Johnsbury) that only the major (eroding streambank) sites are threatening the important uses of the river. The other major contributor of sediment to the river is runoff from town roads. It may very well dwarf the contribution from streambank erosion.
* There are bad logging and construction (erosion control) practices.

Sluggish Flows

* There are water quality problems especially when the water stagnates from low flow conditions in the summer.
* I don't like it that the river is no longer free-flowing.
* What I don't like about the Passumpsic is sluggish flows.
* I dislike the reduced water flows because of dams.

* We should have true run-of-river hydro operations (no cycling).
* I would like to see constant flows.
* Regarding dislikes, water quality needs improvement, and free-flowingness needs to be enhanced.
* Power Companies should pay for their water use by improving fishing and boating.

River Usage

* The Passumpsic River is a working river.
* I like the working river aspect of the Passumpsic. (2 people)
* I like local rivers and streams in their present use for many needs and local control. I don't like over reaction to environmental issues that restrict practical usage.
* The river dilutes wastewater.
* We need improved flood control. (3 people)

* We have to have hydro projects because the local economy depends on them.
* Hydropower is an alternative to nuclear power.
* There is not enough power generation. (2 people)
* We need to get local people to a hydropower facility so they can better understand what their benefits and environmental impacts are.
* We need to appreciate the river for the multitude of uses it serves. Hydropower is an important source of energy.

Watershed Setting and River Corridor Land Use

* I like the clean and wild nature of local rivers and streams.
* I like the semi-wilderness near a population center.
* I like the low population density in the basin - few large villages.
* The Passumpsic has many beautiful tributaries.
* The Passumpsic has many smaller feeder streams.

* The basin has a rural atmosphere.
* Existing human structures are harmonious with the river.
* We should preserve the Vermontness of Passumpsic basin.
* I like the rural atmosphere of the area. I like the mix of farms, villages and wilderness. (8 people)
* Local rivers and streams flows through a relatively undeveloped corridor, Danville is very threatened in places yet has great wilderness in others and is worth attention before this disappears. I like that many local rivers and streams are scenic and undeveloped, wind their way through diverse wetlands, beaver meadows, gorges, and forests; and that some are bordered by vast tracts of open farmland and look serene and productive. I dislike that floodplains are being used for inappropriate building and activities where there should be farmlands and scenery; that the pace of residential development will encroach on our scenic and wilderness values as streamside, walking access, and habitat are replaced by private ownership and posting; and that buffer zones are not a matter of course in all towns.

* I don't like indiscriminate filling of floodplains.
* I don't like adjacent farms and mountains being subdivided and developed.
* I don't like changing the river course/channelizing to enhance developments (roads, etc).
* Rivers are dependent on their watersheds. I do not like what we are doing to the watershed.
* I dislike the lack of riparian vegetation, more is needed.
* Certain riverbank areas are being stripped of vegetation.
* I dislike the pollution and development along some local rivers and streams.

* Maintain/repair/improve natural riverbank and corridor vegetation. (3 people)
* We need vegetated buffer strips along the river. (3 people)
* I would like to see a greenway and protection of the river banks from development.
* I would like to see the watershed maintained and continue through the centuries with its healthy mix of farms, villages and wilderness.

* Regarding visions, there should be no business - building along rivers or residential development sprawling out from towns.
* Riverways should not become dumping areas, but should be bordered by parks and greenways. Undeveloped roads, ridges, and habitat (including source ponds and upland bogs) that border nice streams and rivers should be, where possible, considered public lands or granted easements and tax incentives. Floodplains should remain open for farming, but no spraying or chemical use allowed where it would affect water quality.

At a public workshop in March 1990, local residents agreed that the first step in resolving many of their concerns would be to seek more specific information on Passumpsic River water quality and the perceived sources and causes of pollution. Since that time, the National River Watch Network, Connecticut River Watershed Council, and the Vermont Agency of Natural Resources have been cooperating to help local citizens and schools begin a Passumpsic River Watch Program.

A goal of the Passumpsic River Watch Program is to assist local citizens in educating themselves through the collection of water quality and watershed information. This information will help people make decisions as they work to protect the Passumpsic River watershed to the benefit of all, while at the same time using the river and adjacent lands to best serve landowners and local communities.

Concord High School, Lyndon Institute, and St. Johnsbury Academy will participate in the Passumpsic River Watch Program. Each school will focus on different portions of the watershed. Once a year, the three schools will hold a Water Congress to jointly share their river study information with parents and other local residents. Teachers plan to use a multi-disciplinary approach including science, math, social studies and english.

To begin the Program, a pilot project was completed in the summer of 1990. More than two dozen local residents collected river samples at 26 locations throughout the Passumpsic River watershed (Table 3). The samples were analyzed for bacteria concentrations by the Northeastern Vermont Regional Hospital. The results of this pilot project, included in the following pages, were presented on November 14, 1990 at the Fairbanks Museum in St. Johnsbury.

The data should be considered preliminary, providing "snapshots" of the bacteria concentrations in the Passumpsic and its tributaries on four different dates. This information will be very useful in designing more specific water quality studies for the Passumpsic River Watch Program. Sample site locations described below are depicted on the following watershed map (Figure 1). The river flow hydrographs, from the Passumpsic River below the Village of Passumpsic and from the Moose River above its confluence with the Passumpsic River, show cubic feet per second flows for the month and a half that includes the four sampling dates. Referencing the hydrograph (Figure 2) when interpreting the bacteria concentration data is very important. For example the large rain storm on September 7 and the consequent rise in the hydrograph largely explains the higher bacteria counts found on September 8th.

Throughout the following water quality inventory of the Passumpsic River basin, references were made to the River Watch bacteria data where possible.

Table 3. Passumpsic Watershed Sampling Site Locations
1990 Bacteria Testing Pilot Project

Site #	River/Stream	Location	Site #	River/Stream	Location
P10	Passumpsic	East Barnet	P70	Passumpsic	above St. Johnsbury
J10	Joes Brook	mouth	P80	Passumpsic	above St. Johnsbury Center
P20	Passumpsic	below Barnet Landfill	P90	Passumpsic	below Lyndonville WWTP
W10	Water Andric	mouth	P100	Passumpsic	above Lyndonville WWTP
P30	Passumpsic	above Barnet Landfill	ML10	Miller Run	mouth
		below Vill. of Passumpsic	ML20	Miller Run	below Wheelock/Sheffield
P40	Passumpsic	above Vill. of Passumpsic	WP10	West Branch	mouth
P50	Passumpsic	below St. Johnsbury WWTP	C10	Calendar Brook	mouth
SL10	Sleepers River	mouth	WP20	West Branch	below West Burke
P60	Passumpsic	above St. Johnsbury WWTP	WP30	West Branch	above West Burke
MS10	Moose River	mouth	EP10	East Branch	mouth
MS20	Moose River	below E. St. Johnsbury	EP20	East Branch	below East Burke
MS30	Moose River	above E. St. Johnsbury below Concord	EP30	East Branch	above East Burke
MS40	Moose River	above Concord			

On September 18, samples were collected by the Department of Environmental Conservation at the P40 and P70 sampling locations and analyzed at the State Microbiology Laboratory in Waterbury, Vermont for E. coli bacteria concentrations per 100 ml. The results, 72 and 60 organisms/100 ml respectively, were nearly identical to the concentration found in samples collected by citizens and analyzed at the Northeastern Vermont Regional Hospital (70 and 60 organisms/100 ml).

Why sample bacteria: Certain bacteria may cause people and farm animals to get sick. Where bacteria are present, there is a probability that viruses that make people and animals sick are also present. Where water is used for drinking and contact recreation such as swimming, knowing the concentration of bacteria in the water indicates the level of health risk in using the water. The bacteria Escherichia coli (E. coli) is used by health officials and water quality specialists as a health risk indicator. E. coli itself will not make you sick, but it is known to be present with bacteria that will and is easier and less expensive to test. The State of Vermont uses the standard of 77 E. coli organisms / 100 ml. Waters with concentrations above this standard are believed to pose an unacceptable health risk to people.

Sources of bacteria: Microscopic bacteria are present everywhere in our environment and thrive particularly well in or on other organisms whether they be living or dead. Total bacteria concentrations found in surface waters such as rivers, originate from direct discharges of wastewater or from diffuse runoff that comes in contact with human or animal wastes. Pastureland runoff, manure pits, large and small septic systems, and wastewater treatment plant discharges are major source of bacteria. Erosion of soils, especially those with high organic content, are another potential source to consider. E. coli is a bacteria that has shown a higher correlation with human waste sources.

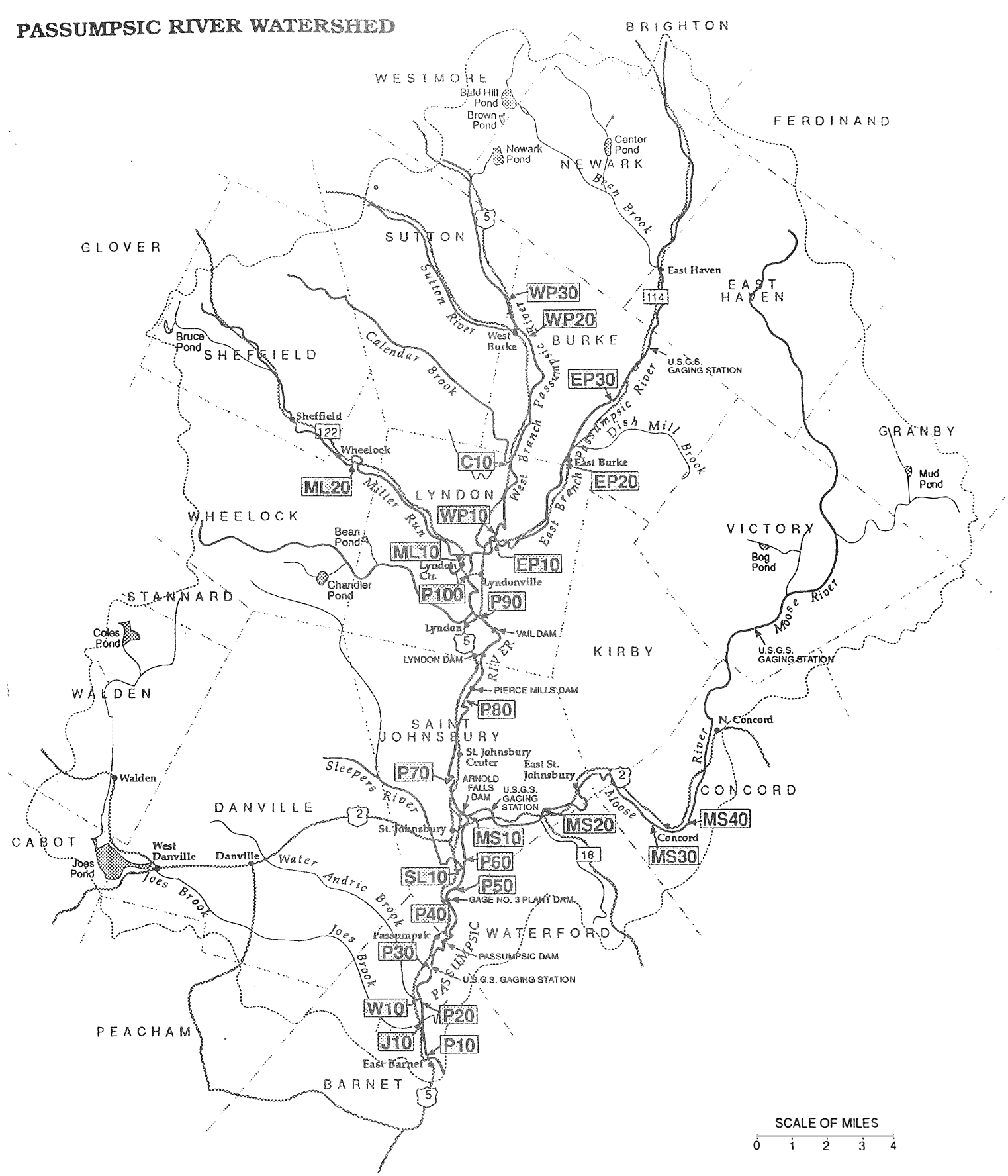

PASSUMPSIC RIVER WATERSHED
BRIGHTON
WESTMORE
Bald Hill Pond
Brown Pond
Newark Pond
Center Pond
NEWARK
FERDINAND
Bean Brook
GLOVER
SUTTON
Sutton River
East Haven
EAST HAVEN
WP30
WP20
114
Bruce Pond
SHEFFIELD
Calendar Brook
West Burke
Passumpsic River
BURKE
U.S.G.S. GAGING STATION
EP30
Sheffield
122
Wheelock
C10
Dish Mill Brook
GRANBY
Mud Pond
ML20
Miller Run
LYNDON
West Branch
East Burke
EP20
WP10
WHEELOCK
Bean Pond
ML10
EP10
VICTORY
Bog Pond
Lyndon Ctr.
Lyndonville
Chandler Pond
P100
P90
STANNARD
Moose River
Coles Pond
Lyndon
5
VAIL DAM
LYNDON DAM
RIVER
KIRBY
U.S.G.S. GAGING STATION
WALDEN
PIERCE MILLS DAM
P80
N. Concord
SAINT JOHNSBURY
St. Johnsbury Center
East St. Johnsbury
P70
Sleepers River
ARNOLD FALLS DAM
U.S.G.S. GAGING STATION
Moose River
CONCORD
Walden
DANVILLE
2
St. Johnsbury
MS10
MS20
MS40
Concord
CABOT
West Danville
Danville
Water
Andric Brook
18
MS30
Joes Pond
Joes Brook
SL10
P60
P50
GAGE NO. 3 PLANT DAM
P40
Passumpsic
WATERFORD
Joes Brook
P30
PASSUMPSIC DAM
PASSUMPSIC
U.S.G.S. GAGING STATION
W10
P20
PEACHAM
J10
P10
East Barnet
BARNET
5
SCALE OF MILES
0 1 2 3 4

Figure 1.

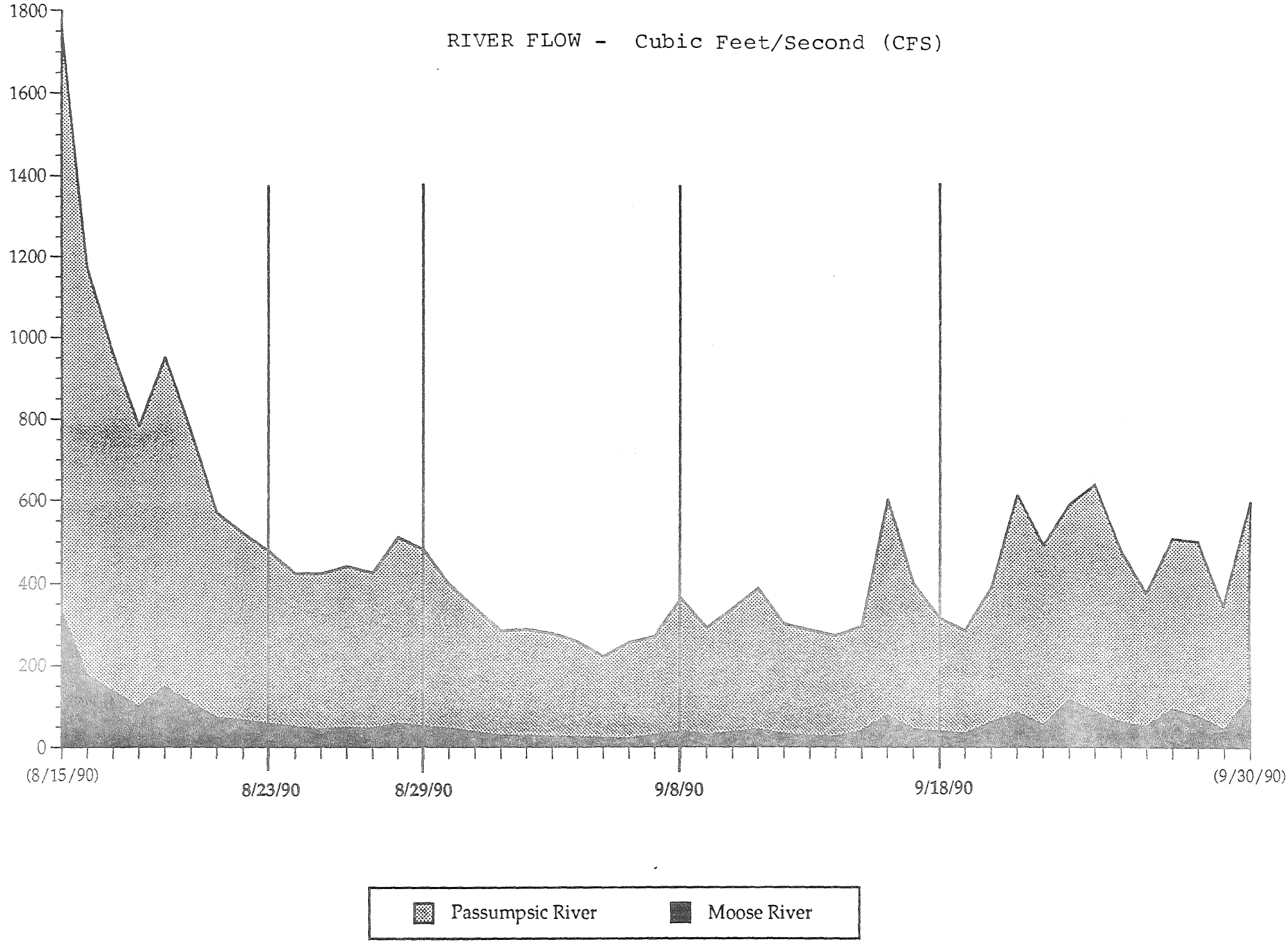

RIVER FLOW - Cubic Feet/Second (CFS)
1800
1600
1400
1200
1000
800
600
400
200
0
(8/15/90)
8/23/90
8/29/90
9/8/90
9/18/90
(9/30/90)
Passumpsic River
Moose River

Figure 2.

Passumpsic River Watch Network – 1990
E Coli results on the Passumpsic River main stem

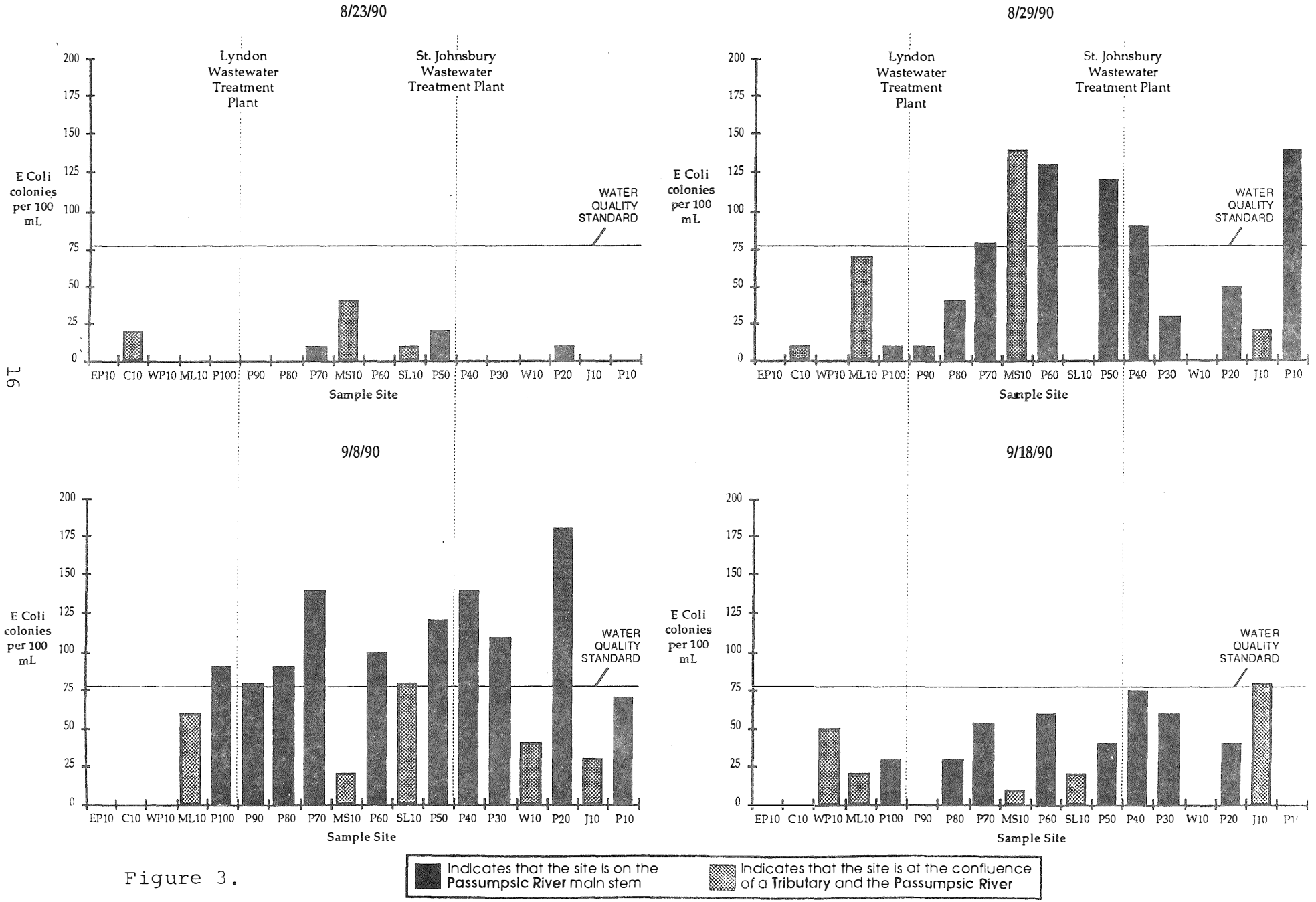


Figure 3.

Passumpsic River Watch Network – 1990

Total Coliform results on the Passumpsic River main stem

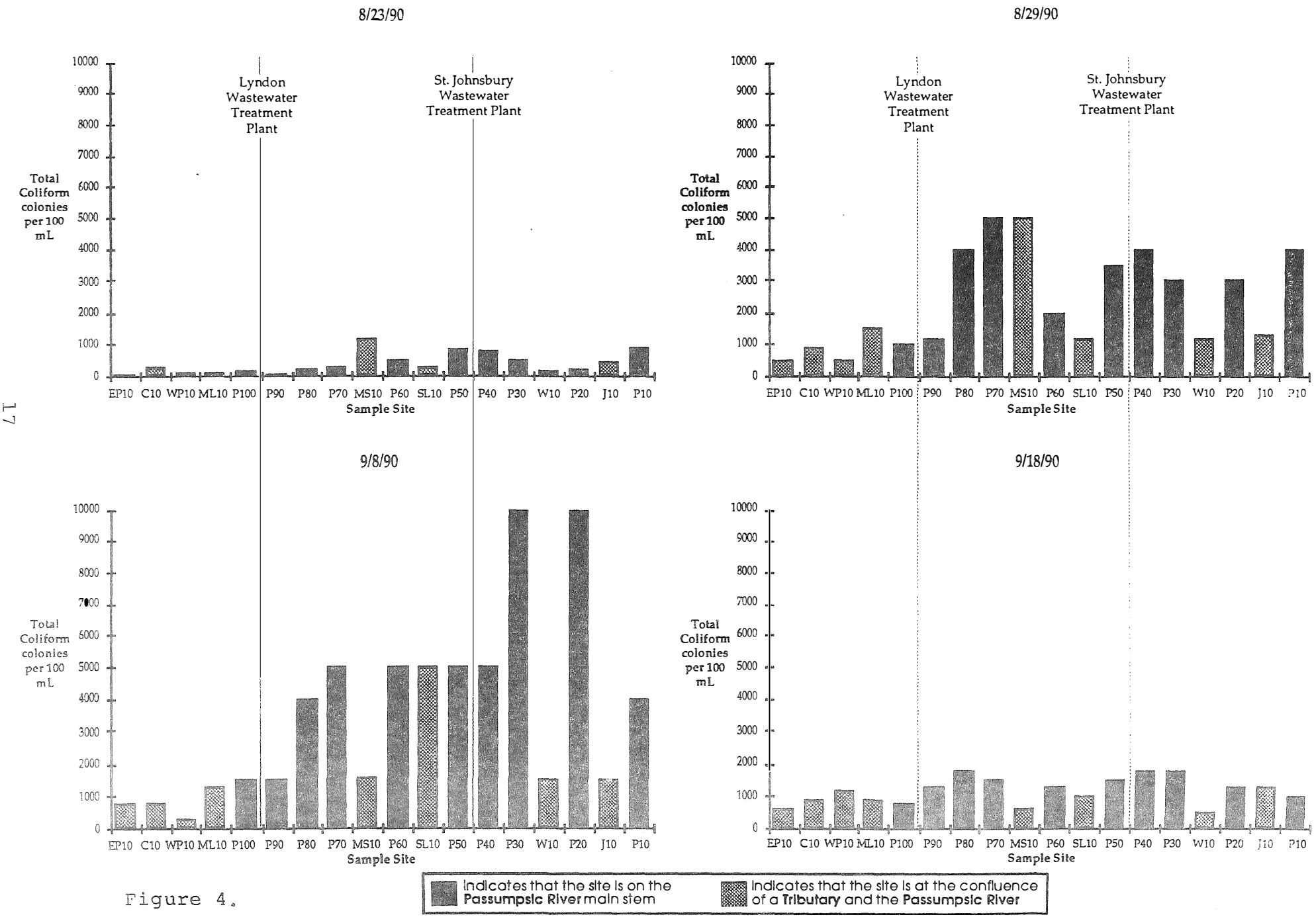
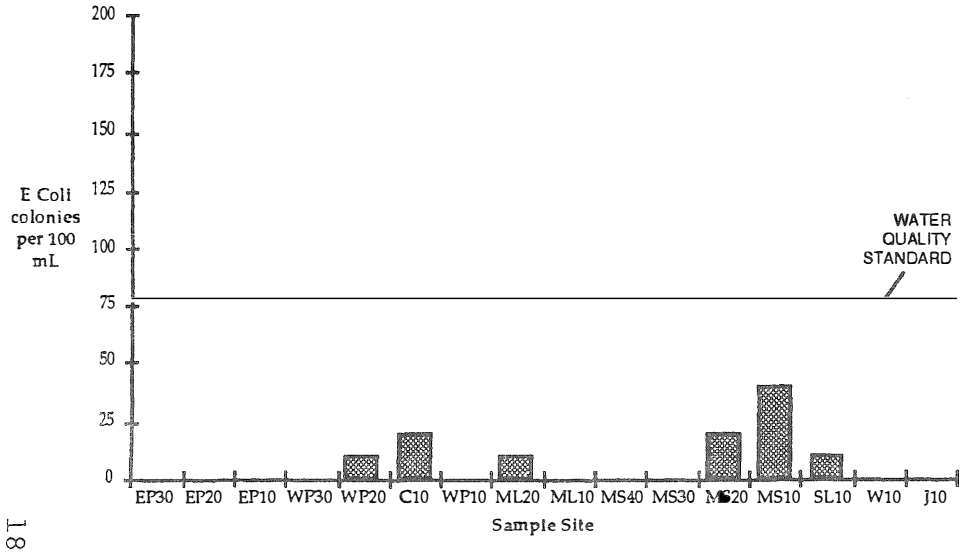


Figure 4.

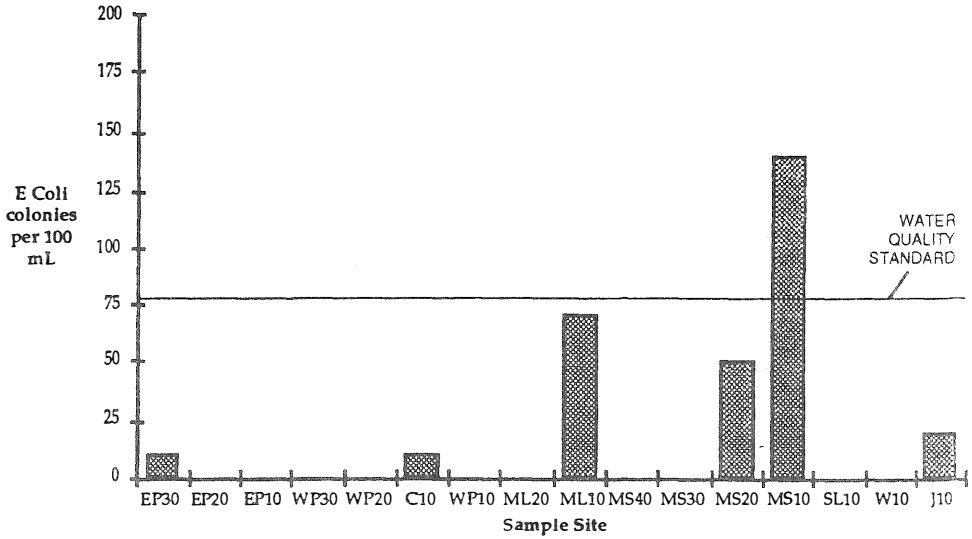
Passumpsic River Watch Network – 1990

E Coli results on Tributary Sites in the Passumpsic River Watershed

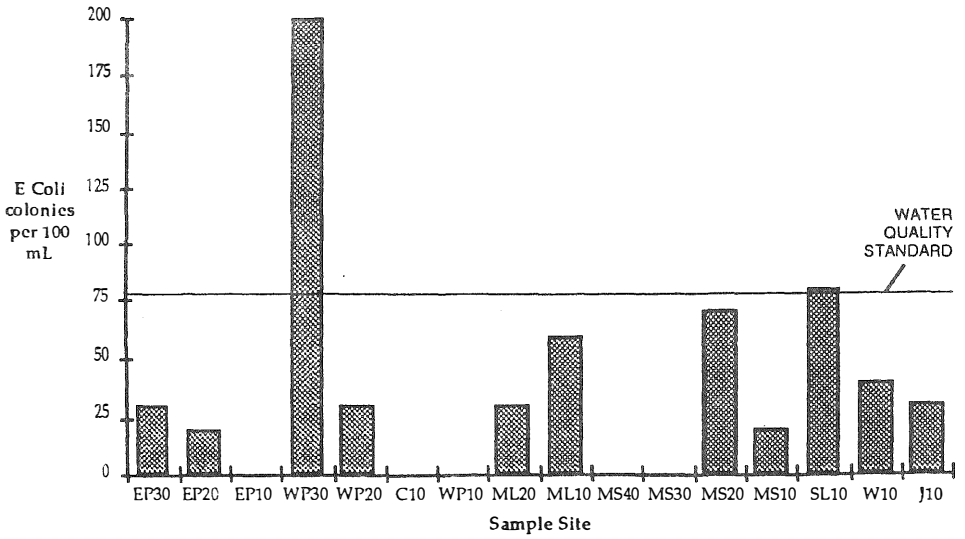
8/23/90



8/29/90



9/8/90



9/18/90

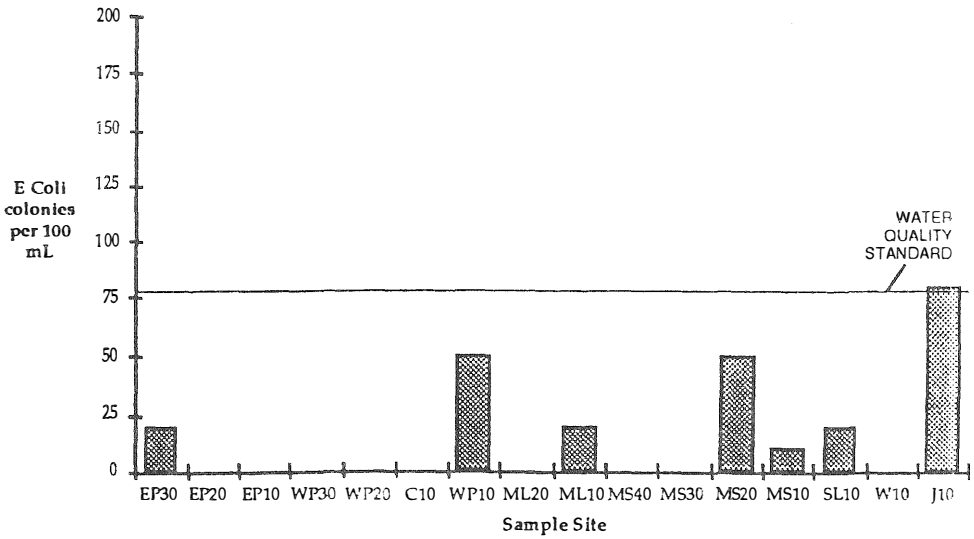
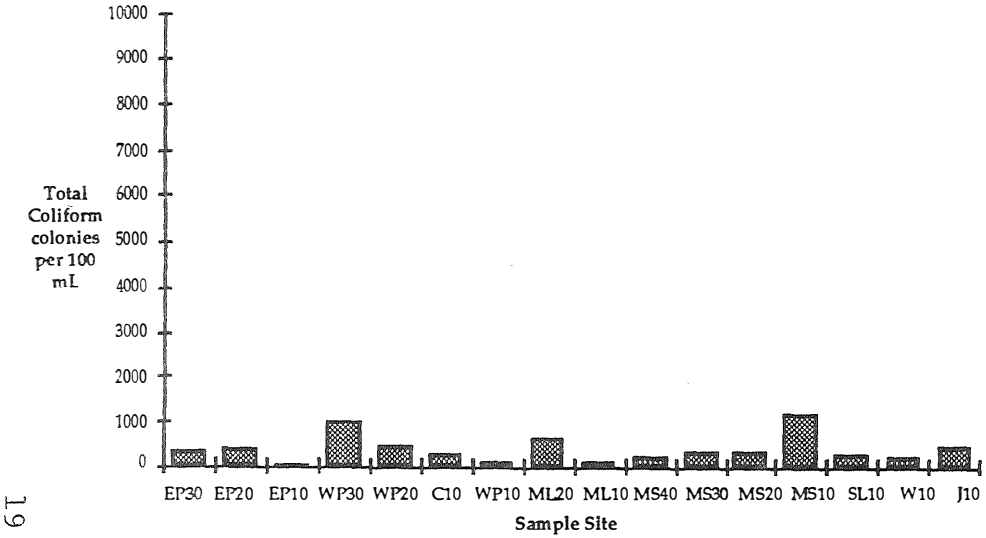


Figure 5.

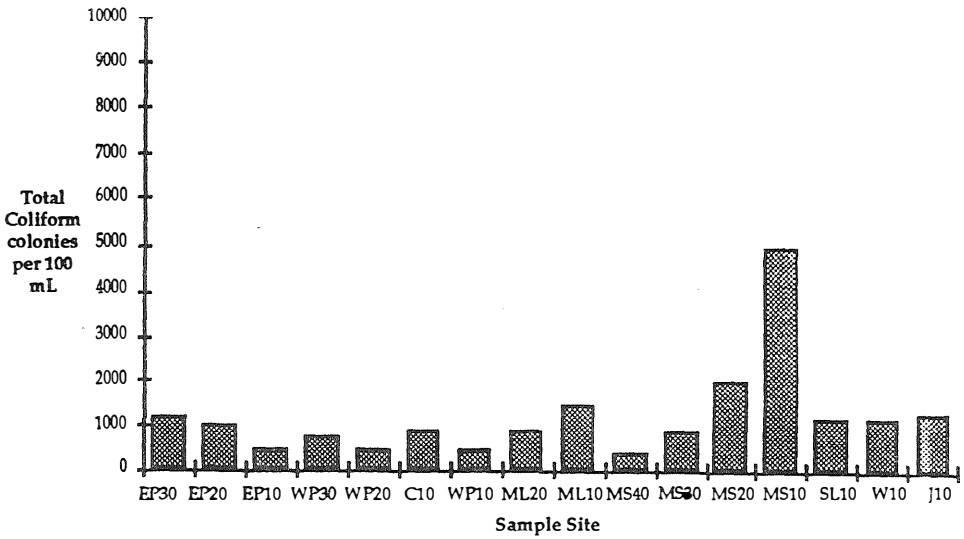
Passumpsic River Watch Network – 1990

Total Coliform results on Tributary Sites in the Passumpsic River Watershed

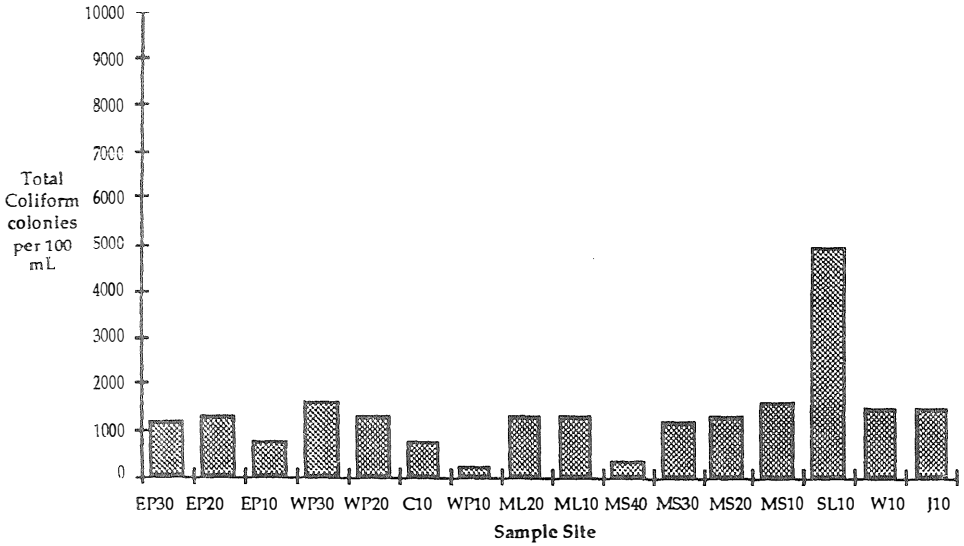
8/23/90



8/29/90



9/8/90



9/18/90

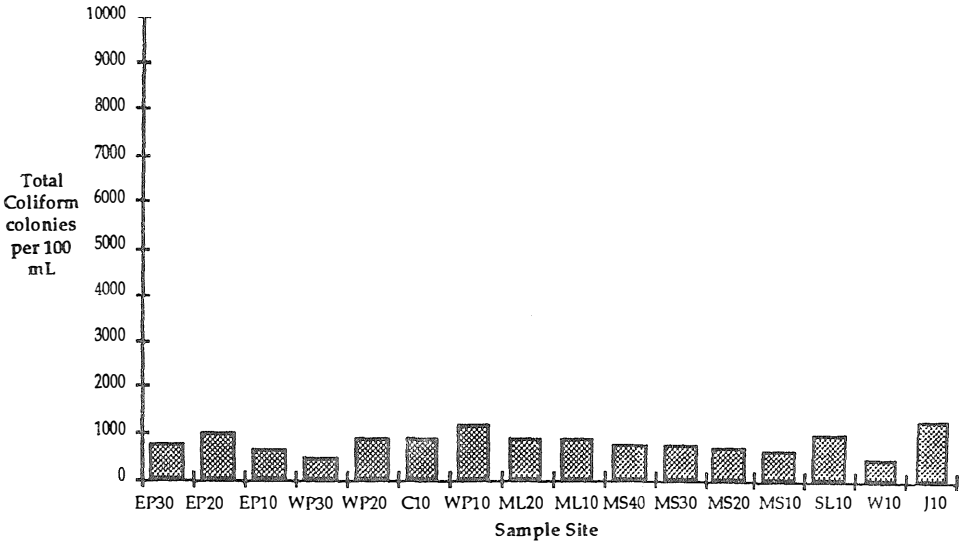


Figure 6.

PASSUMPSIC RIVER WATERSHED

E Coli / 100 ml — 8/23/90

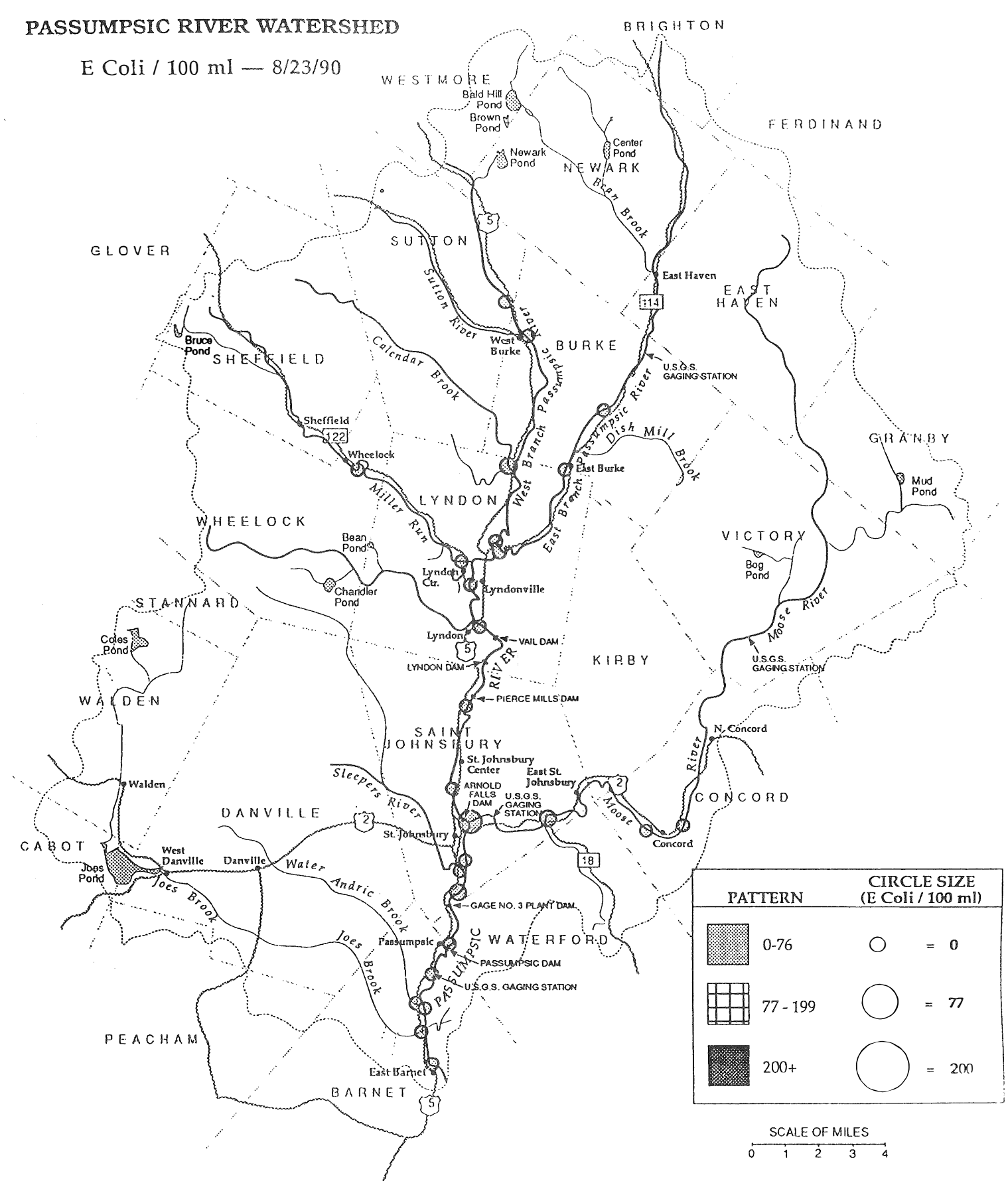


Figure 7.

PASSUMPSIC RIVER WATERSHED

Total Coliform / 100 ml — 8/23/90

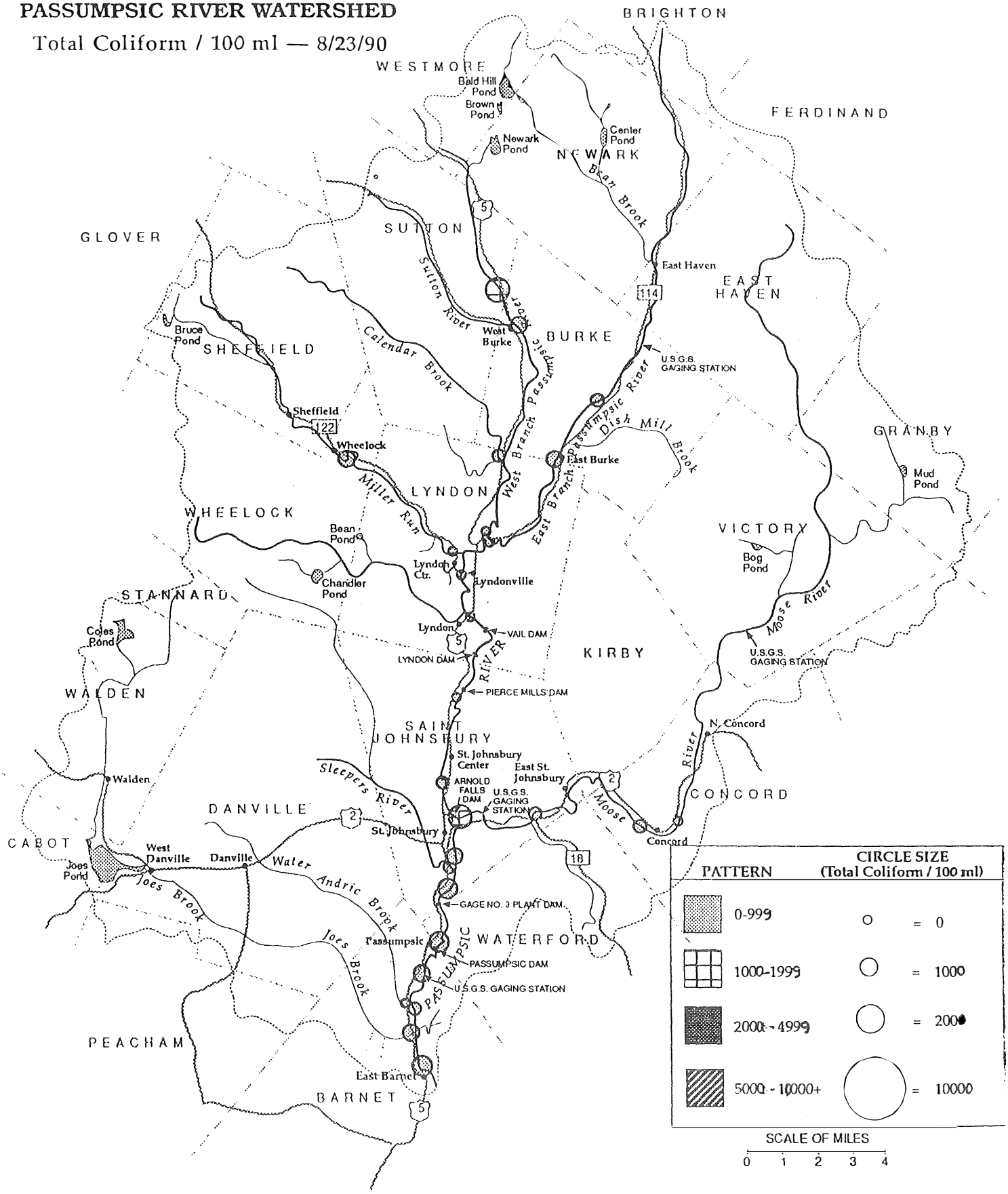


Figure 8.

PASSUMPSIC RIVER WATERSHED

E Coli / 100 ml — 8/29/90

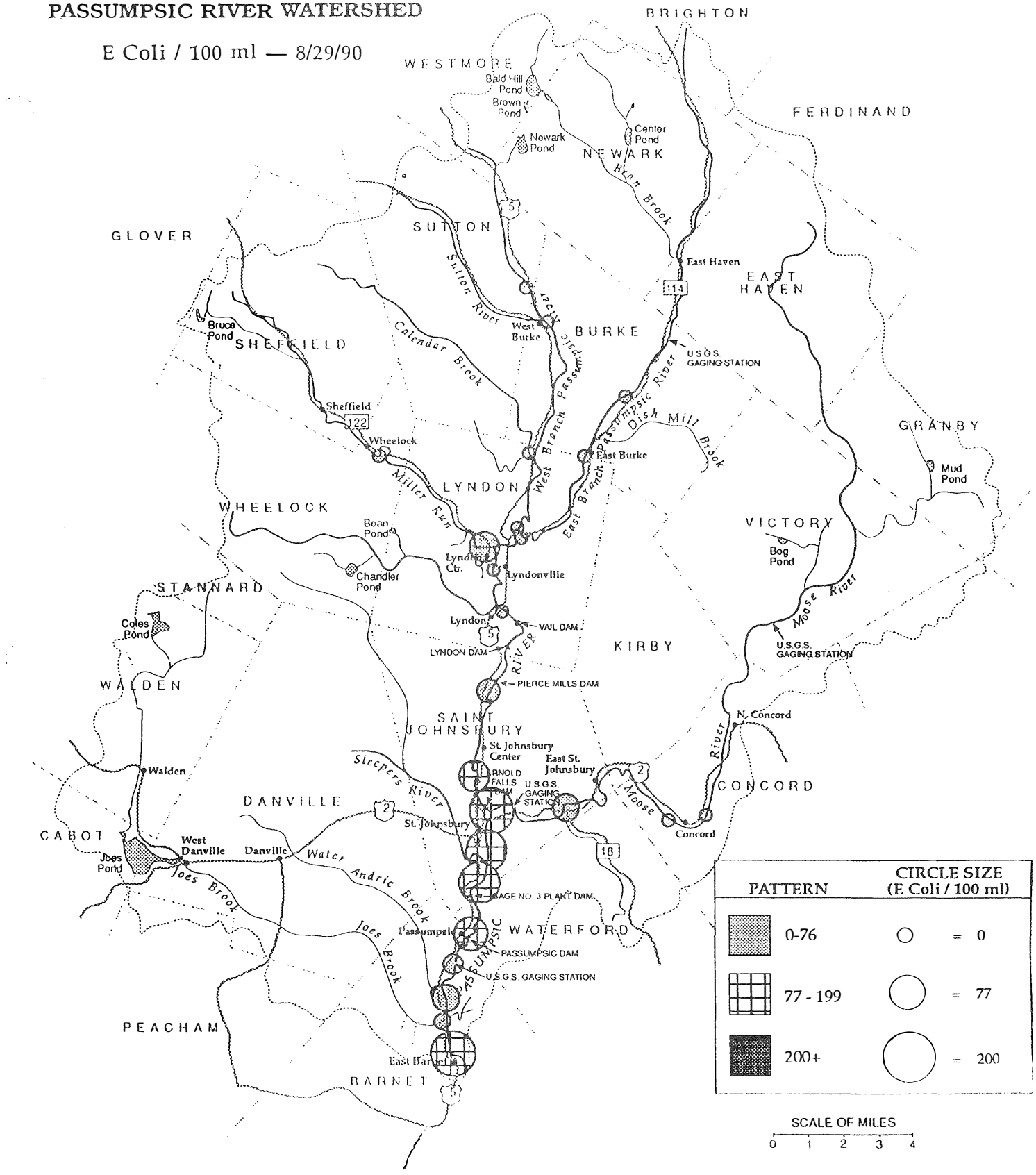


Figure 9.

PASSUMPSIC RIVER WATERSHED

Total Coliform / 100 ml — 8/29/90

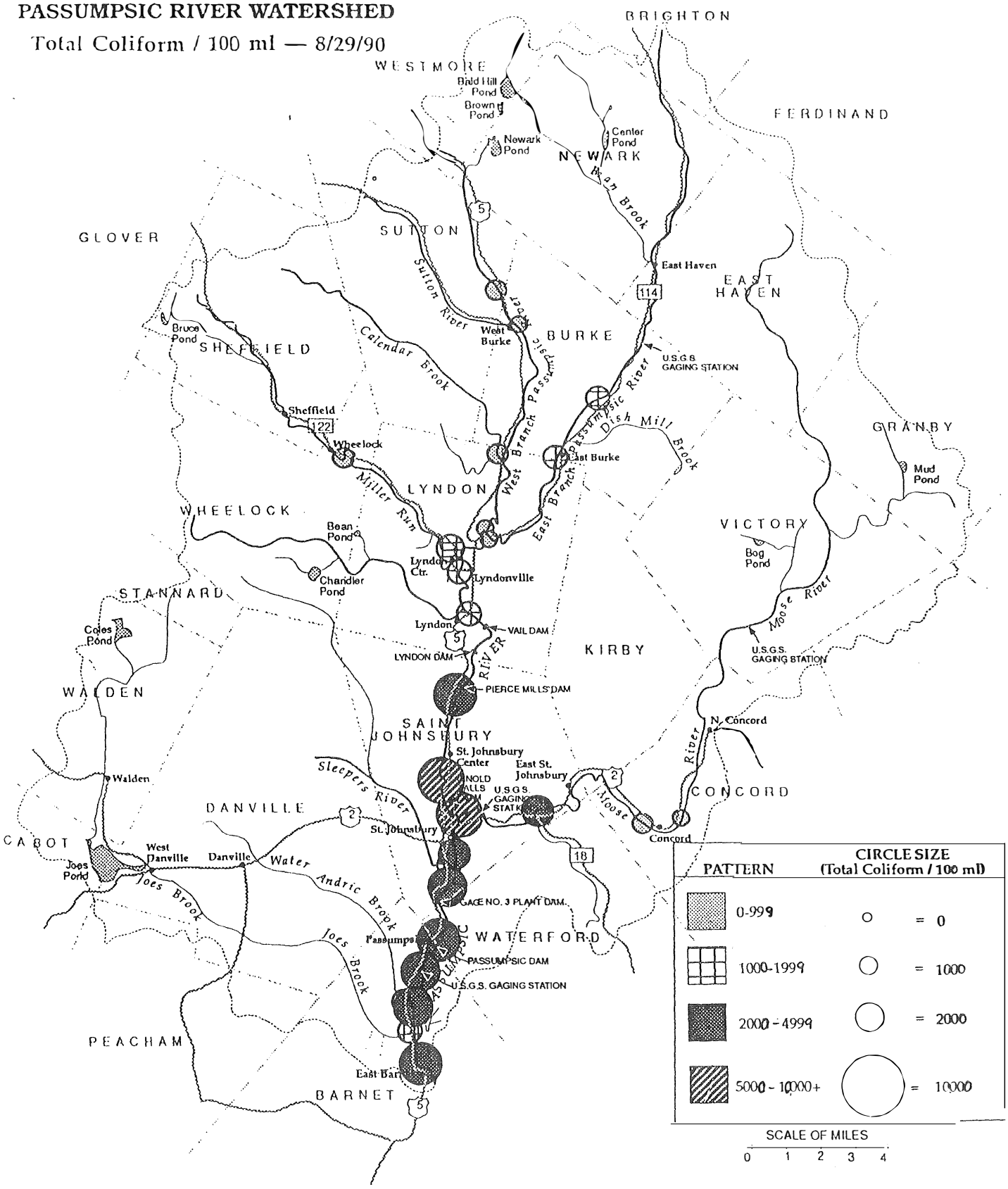


Figure 10.

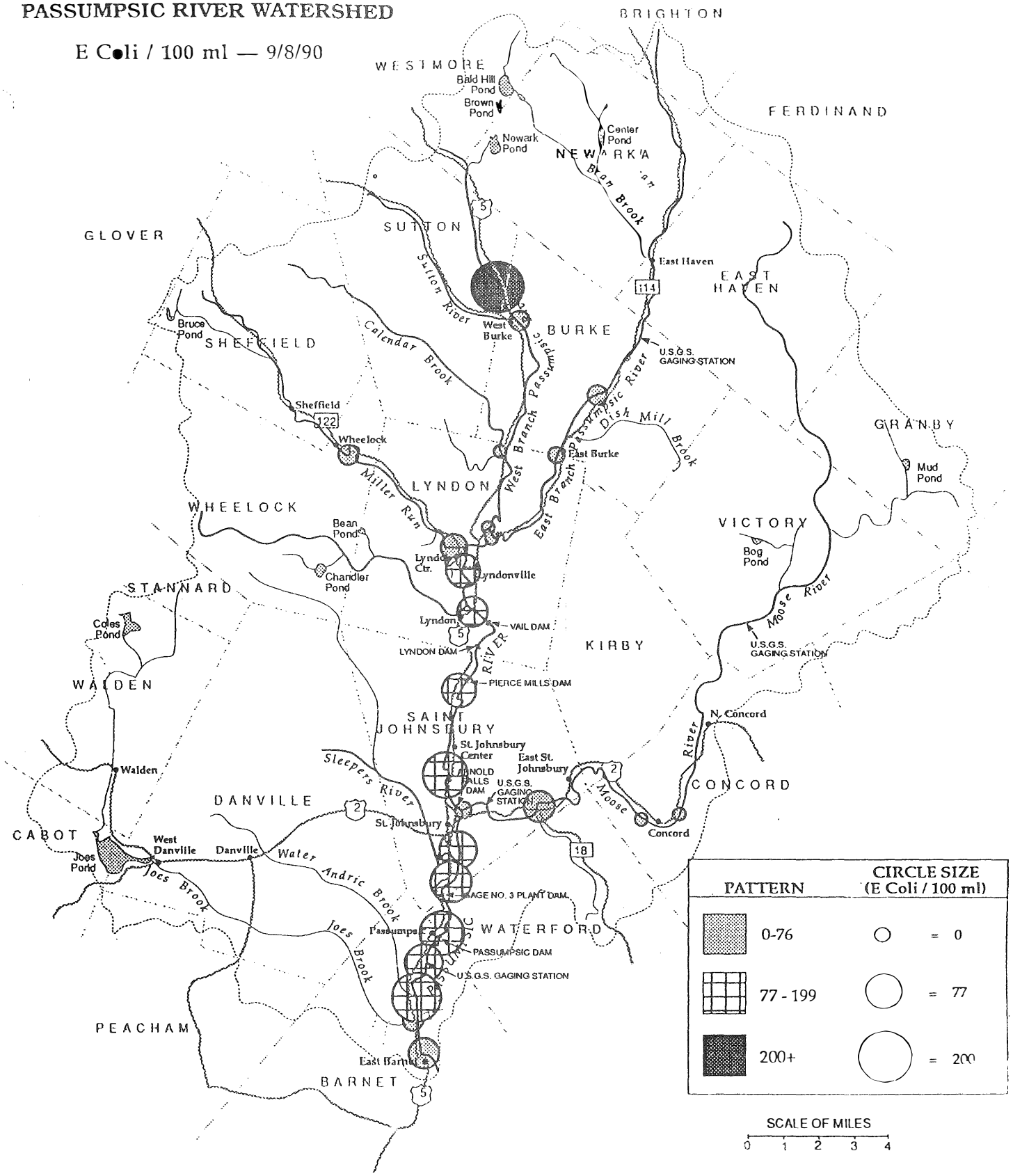

PASSUMPSIC RIVER WATERSHED
E Coli / 100 ml — 9/8/90
BRIGHTON
WESTMORE
Bald Hill Pond
Brown Pond
Nowark Pond
Center Pond
FERDINAND
NEWARK
Burn Brook
GLOVER
SUTTON
Sutton River
East Haven
EAST HAVEN
Bruce Pond
SHEFFIELD
Calendar Brook
West Burke
BURKE
Passumpsic River
U.S.G.S. GAGING STATION
Sheffield
122
Wheelock
West Branch Passumpsic
East Burke
Dish Mill Brook
GRANBY
Mud Pond
Miller Run
LYNDON
WHEELOCK
Bean Pond
Chandler Pond
VICTORY
Bog Pond
Moose River
STANNARD
Coles Pond
Lyndon Ctr.
Lyndonville
Lyndon
VAIL DAM
LYNDON DAM
KIRBY
U.S.G.S. GAGING STATION
WALDEN
PIERCE MILLS DAM
SAINT JOHNSBURY
N. Concord
St. Johnsbury Center
East St. Johnsbury
ARNOLD FALLS DAM
U.S.G.S. GAGING STATION
Sleepers River
Walden
DANVILLE
CONCORD
Moose River
Concord
St. Johnsbury
CABOT
West Danville
Danville
Joes Pond
Joes Brook
Water
Andric Brook
PAGE NO. 3 PLANT DAM
WATERFORD
Passumpsic
PASSUMPSIC DAM
U.S.G.S. GAGING STATION
PEACHAM
East Barnet
BARNET
PATTERN
CIRCLE SIZE (E Coli / 100 ml)
0-76
= 0
77 - 199
= 77
200+
= 200
SCALE OF MILES
0 1 2 3 4

Figure 11.

PASSUMPSIC RIVER WATERSHED

Total Coliform / 100 ml — 9/8/90

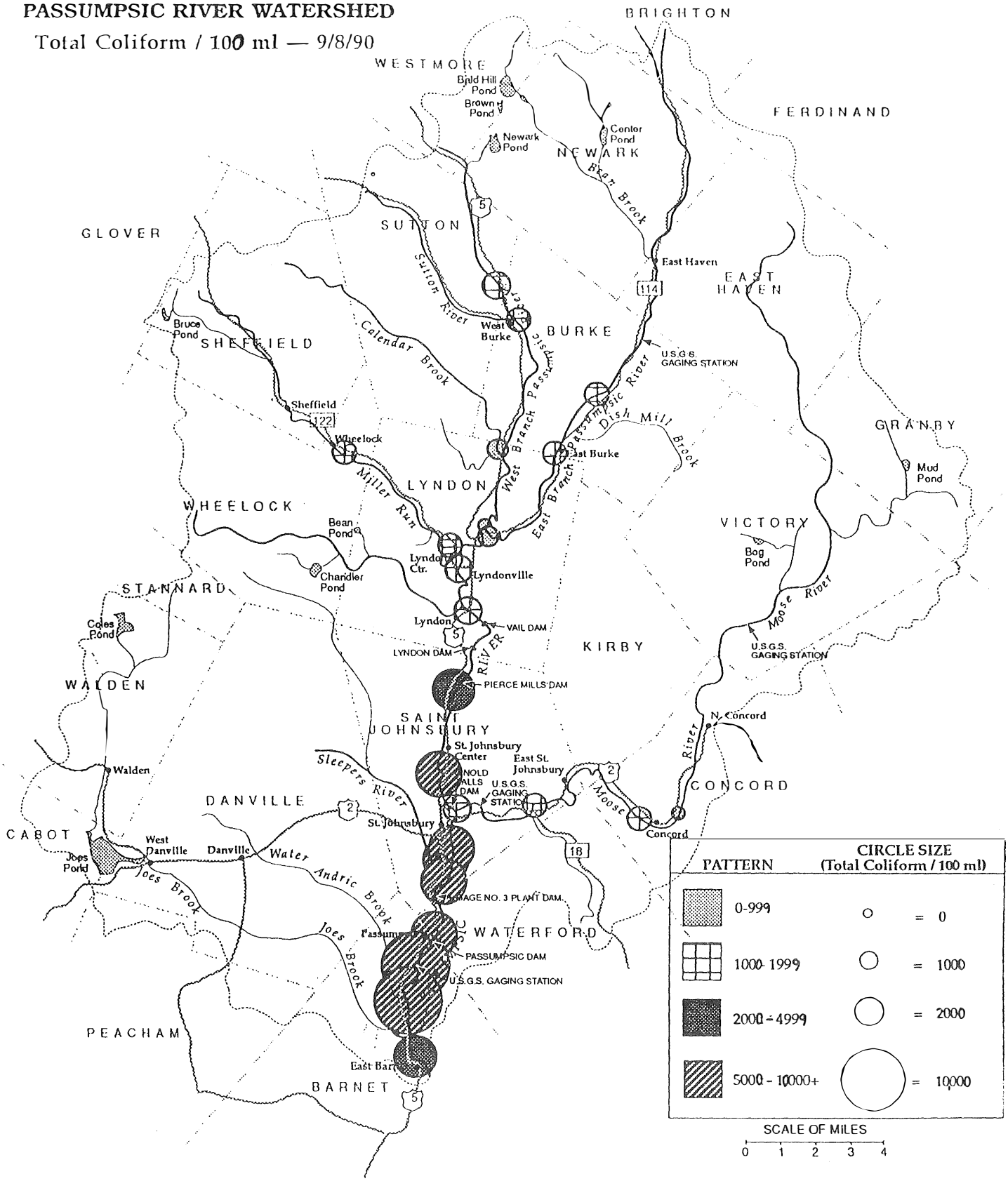


Figure 12.

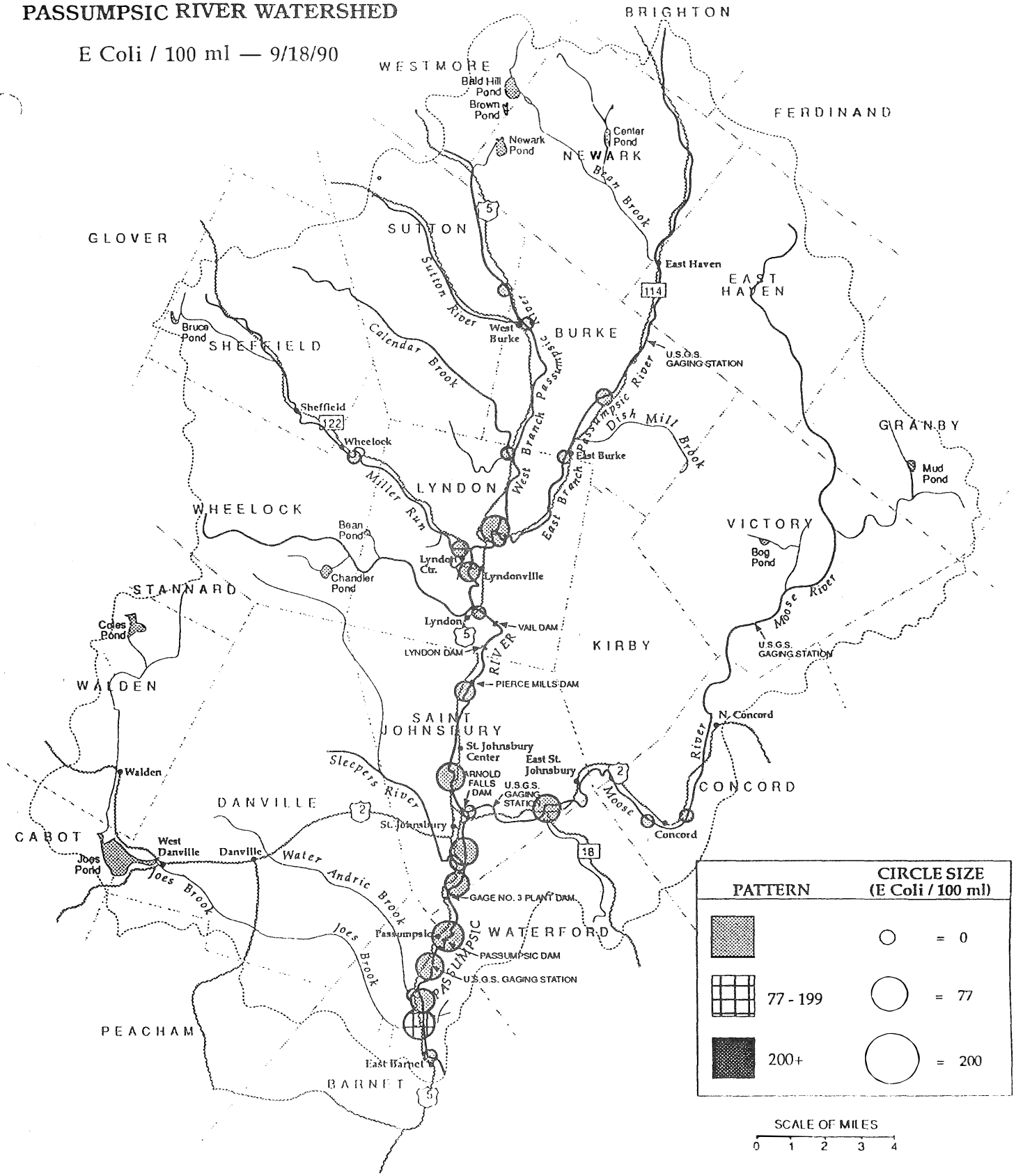

PASSUMPSIC RIVER WATERSHED
E Coli / 100 ml — 9/18/90
BRIGHTON
WESTMORE
Bald Hill Pond
Brown Pond
Newark Pond
Center Pond
NEWARK
FERDINAND
Bean Brook
GLOVER
SUTTON
Sutton River
East Haven
EAST HAVEN
114
Bruce Pond
SHEFFIELD
Calendar Brook
West Burke
BURKE
U.S.G.S. GAGING STATION
Passumpsic River
Sheffield
122
Wheelock
Miller Run
West Branch Passumpsic
East Burke
Dish Mill Brook
GRANBY
Mud Pond
LYNDON
WHEELOCK
Bean Pond
Lyndon Ctr.
Lyndonville
Chandler Pond
VICTORY
Bog Pond
STANNARD
Coles Pond
Lyndon
VAIL DAM
LYNDON DAM
Moose River
U.S.G.S. GAGING STATION
KIRBY
WALDEN
PIERCE MILLS DAM
SAINT JOHNSBURY
N. Concord
St. Johnsbury Center
East St. Johnsbury
Walden
Sleepers River
ARNOLD FALLS DAM
U.S.G.S. GAGING STATION
Moose River
CONCORD
DANVILLE
St. Johnsbury
Concord
CABOT
West Danville
Danville
Water
Andric Brook
Joes Pond
Joes Brook
18
GAGE NO. 3 PLANT DAM
Passumpsic
WATERFORD
PASSUMPSIC DAM
U.S.G.S. GAGING STATION
PEACHAM
East Barnet
BARNET
PATTERN
CIRCLE SIZE (E Coli / 100 ml)
0
77 - 199
77
200+
200
SCALE OF MILES
0 1 2 3 4

Figure 13.

PASSUMPSIC RIVER WATERSHED

Total Coliform / 100 ml — 9/18/90

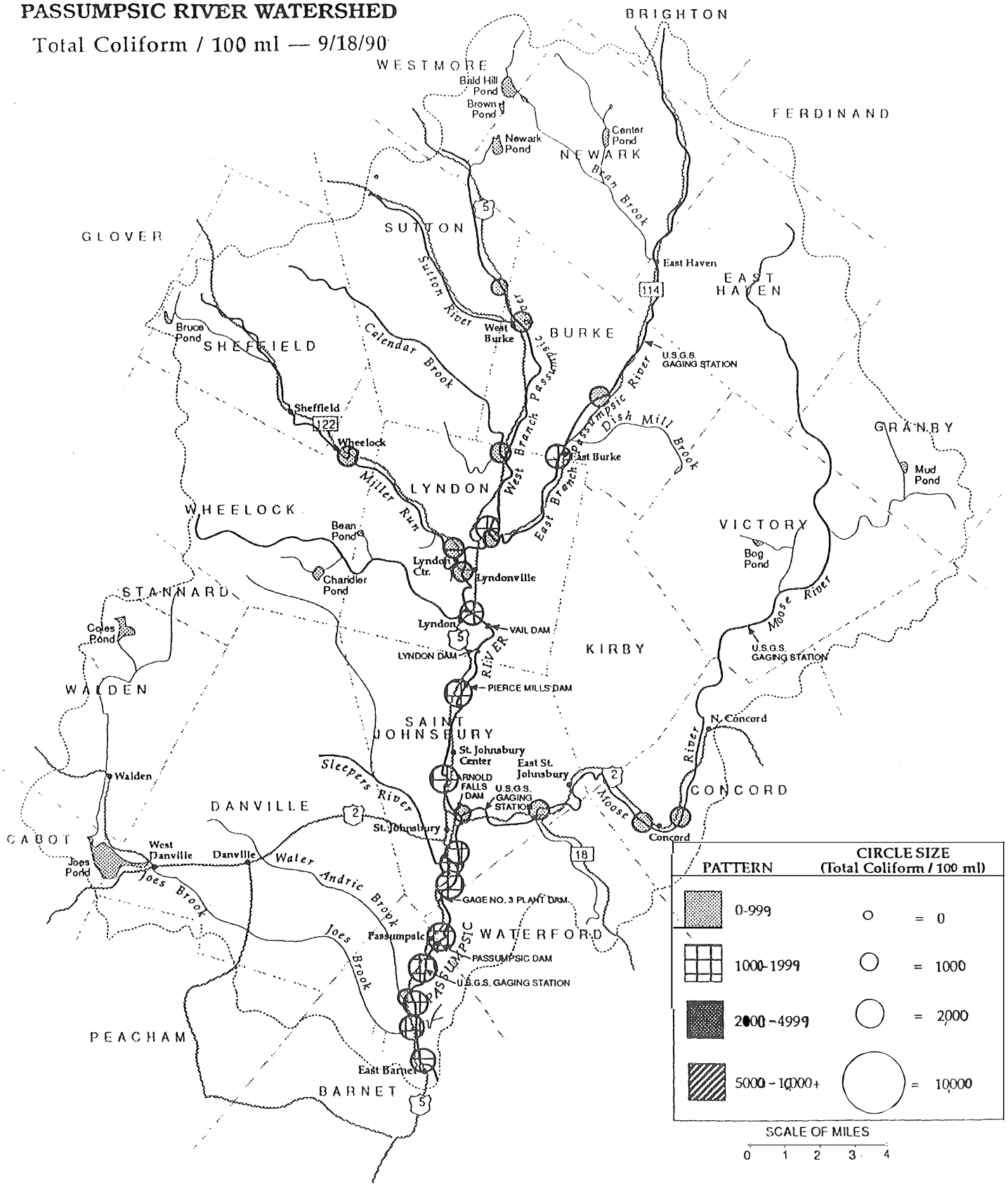


Figure 14.

UPPER PASSUMPSIC RIVER WATERSHED

The Upper Passumpsic River Watershed is defined, for the purposes of this study, as all drainages that enter the Passumpsic River upstream of the townline between Lyndon and St. Johnsbury and includes five major tributaries, the West Branch, East Branch, Miller Run, South Wheelock Branch and Sheldon Brook.

West Branch of the Passumpsic River

SETTING

The West Branch originates at the height of land just south of Lake Willoughby and flows 15 miles draining a watershed of 68 square miles in the towns of Westmore, Sheffield, Newark, Sutton, Burke and Lyndon (Figure 15). Within just two miles of its headwaters at 2400 feet in elevation, the West Branch drops 1200 feet (at a 11.4% grade) and then, with the exception of a quick drop through the village of West Burke, the river meanders more slowly through a wooded floodplain at a 0.5% grade.

The Sutton River and Calendar Brook enter the West Branch from the west, each draining over 10 square miles, at 21 and 11.4 square miles respectively. Roundy Brook is the only other large tributary to the West Branch. Entering from the east, it drains a watershed just under 10 square miles.

The West Branch and its three largest tributaries are paralleled by roads. Paved state highways, Route 5 and 5A, are heavily travelled in the West Branch and Sutton River valleys. The roads along Roundy Brook are all gravel surface roads. A paved secondary highway closely follows the lower half of Calendar Brook. There are many connecting gravel roads with scattered residences throughout the watershed. The Canadian Pacific railroad closely follows the West Branch into West Burke and then with Route 5, parallels the Sutton River. The only concentrated population centers through which these streams flow are the small villages of West Burke on the West Branch and Burke Hollow and Newark Street on Roundy Brook. Newark Pond, 163 acres in size located in the northern corner of the West Branch watershed in the town of Newark, has over 40 seasonal camps located along its shoreline.

The villages and roads represent a small amount of human encroachment along these drainages. The West Branch watershed is predominately wooded with open fields and pasture on the higher tablelands and rural residential areas in the valleys. The upper reaches of both the West Branch and Sutton Rivers flow through long narrow bands of wetlands (500-1000 feet wide) that buffer them from encroachment.

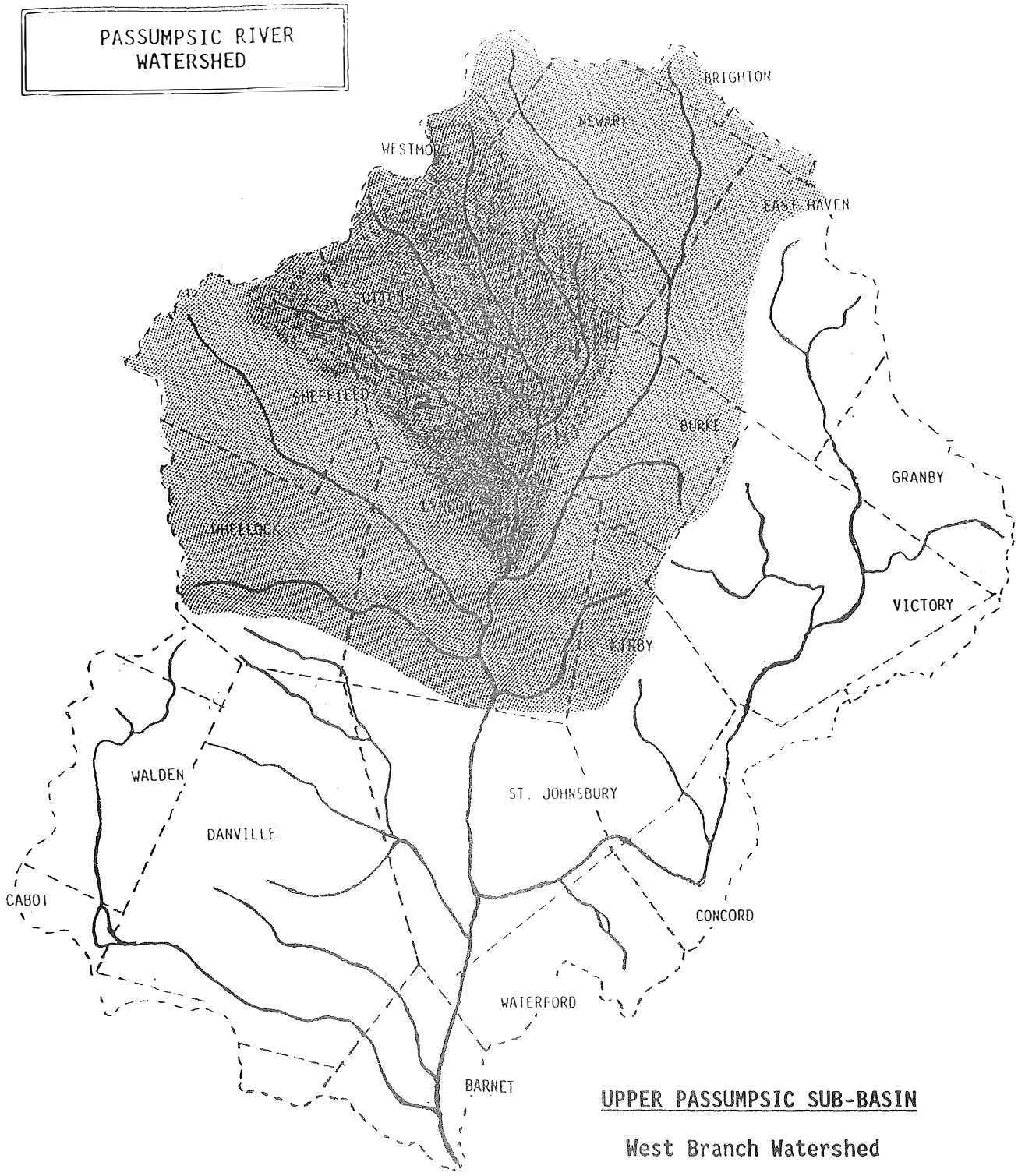

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
UPPER PASSUMPSIC SUB-BASIN
West Branch Watershed
1. West Branch mainstem
2. Calendar Brook
3. Sutton River
4. Roundy Brook

Figure 15.

WEST BRANCH WATER QUALITY

No water quality monitoring (sampling and testing) is being conducted in the West Branch at this time. Of the 42.8 miles of river and streams evaluated, the fishable/swimmable goals of the Federal Clean Water Act are attained throughout the West Branch watershed. Threats to 1.7 miles of river may exist as a result of lumber treatment sites, a junkyard, a landfill and alledgedly failed septic systems. Evaluations were made on the basis of land uses, known pollution sources, citizen input and interviews with fisheries personnel (Vermont Water Quality Assessment, 1990).

Classifications and Drinking Water Supplies

There are presently no Class A watersheds in the West Branch drainage as there are no lands above 2500 feet in elevation, no surface water drinking sources, and no waters designated ecologically significant. Four subsurface drinking water supplies are designated as Wellhead Protection Areas (WHPAs):

Table 4.

WHPA #	Type	Owner	Town	Drainage
5555	bedrock well	West Burke Village	Burke	West Branch
5464	gravel well	Burke Mobile Estates	Sutton	Roundy Brook
5048	bedrock well	Sutton Water System	Sutton	Calendar Brook
5041	bedrock well	Lyn Haven Ind.	Lyndon	West Branch

No Class C zones have been designated to receive treated wastewater effluent. Therefore, all streams and rivers of the West Branch watershed are managed as Class B waters.

Domestic Wastewater

No domestic sewage collection systems and wastewater treatment facilities are located in the West Branch watershed. All domestic sewage is disposed of using septic systems at individual dwellings or commercial sites. Some septic systems in the Village of West Burke are very close to the river. Suspected failure of these systems threatens the river's use for swimming near the village.

Industrial Wastewater

There are no manufacturers in the watershed which produce wastewater in an industrial process requiring treatment and direct discharge (via a pipe) into the West Branch or one of its tributaries.

Hazardous Wastes

Two sites historically used for chemical treatment of lumber products, may continue to threaten river segments in the vicinity of West Burke. A creosote dipping operation, at what was the Mt. View Lumber Company on the Sutton River near West Burke, may have created contaminated soils as a result of creosote spills. The company, now called Burke Lumber under new management, has not continued creosote dipping and has moved all creosote storage tanks off the site. There is local citizen concern that creosote dipping occurred at different areas on the overall site and that previously used areas may still present hazards to water quality of the Sutton River. Another potentially hazardous site may exist in the Village of West Burke where railroad ties were chemically treated in the past.

Threats to Calendar Brook, near the West Branch confluence are posed by possible leachate from a junkyard situated on the banks of the brook. Concerns for aquatic biota have been expressed by state fisheries biologists. Waste petroleum products may also pose threats to the ground and surface waters of the Sutton River drainage. Local residents are concerned about diesel fuel spills at Burke Lumber and numerous junk cars near the banks of the lower Sutton River.

The Darling Hill solid waste dump is located near the confluence of the East and West Branches of the Passumpsic River. The dump is located 300' above the east bank of the West Branch, but due to the complex geology of the area, ground and surface waters of the East Branch drainage are more directly impacted by leachate from the dump. Industrial wastes placed in the dump include water soluble coolant oils, alkali degreasers, barium chloride, oil-soaked debris, sodium cyanide, sodium hydroxide, waste oils, mineral spirits, TCE sludge and laminate production clean-up debris. The dump is on the National EPA Superfund list of hazardous waste sites. A two year Remedial Feasibility Study is currently underway to determine what type of remediation actions are necessary. It has been determined that ground water is contaminated (although below the EPA maximum allowable contaminate levels), and a water treatment system is being required to treat drinking water supplies.

Other Wastewater and Nutrient Sources

Land use activities that may result in organic and nutrient loading are not extensively practiced adjacent to the West Branch and its tributaries. Almost no cropland or pasture exists near the streambanks in the watershed. Agricultural activity is more prevalent on the higher tablelands that lie between the drainages. Logging is not occurring near streambanks, but is common on the steeper slopes of the headwaters and just above the valley floors. How much, if any, soil erosion impacts occur from these areas is not known, presently.

Erosion and Sedimentation

There are seven gravel pits along the West Branch. Four are located within a mile downstream of the village of West Burke. The other three are scattered further downstream.

The U.S. Soil Conservation Service (SCS) reports that various streambank sites, totalling an estimated 1500 feet, along the West Branch are eroding resulting in an average discharge of 169 tons of sediment per year. It is unknown whether aquatic habitats in West Branch drainages have been impacted by erosion and sedimentation.

Flow Modification

All streams and rivers of the West Branch watershed are free-flowing. There are no hydroelectric facilities and all village mill sites are no longer in operation.

East Branch of the Passumpsic River

SETTING

The East Branch originates in the southern part of Brighton and flows 19 miles south to southwest draining a watershed of 77 square miles in the towns of Brighton, Westmore, Newark, East Haven, Burke and Lyndon (Figure 16). Within four miles of its headwaters at 2000 feet elevation, the East Branch drops 900 feet at a 5% grade. In the remaining 15 miles, the East Branch drops much more slowly at a 0.4% grade.

Bean Brook, a 5.5 mile stream draining 22 square miles (mostly in the town of Newark), enters the East Branch from the west at the village of East Haven. The East Branch watershed narrows at this point with the only tributary of any size being Dish Mill Brook draining 6.5 square miles and entering the East Branch at the village of East Burke. All other tributaries drain areas less than 4 square miles.

The mainstem of the East Branch and Dish Mill Brook are paralleled by paved roads. State highway 114 is a main travel route between Lyndonville and Island Pond, Vermont. The East Branch is visible from Route 114 along a number of river segments, but, as with tributary streams in the West Branch watershed, the watercourse is generally well buffered from paved and gravel roads. Residences are located along Route 114, with slightly higher housing densities in the East Burke and East Haven areas. A larger number of residences and businesses in the village of East Burke are adjacent to the lower end of Dish Mill Brook. The developments associated with Burke Mountain Ski Resort - seasonal homes, condominiums, lodge facilities and associated parking areas - are located in the upper Dish Mill Brook watershed. A dozen or so seasonal residences are clustered along the shorelines of Bald Hill Pond and Center Pond in the Bean Brook watershed, which is otherwise very sparsely populated.

The northern and eastern portions of the East Branch watershed are remote, mountainous forestlands. Most of the East Branch watershed population and the open-lands associated with residences and business are located in the southern half of the drainage in Burke and Lyndon. Expansion plans submitted in spring of 1990 for Burke Mountain Resort set proposals that would increase the urbanization of the Dish Mill Brook drainage area. These plans, as of Spring, 1991, are being redone to address environmental concerns related to critical bear habitat, wetlands, water quality and streamflows. The southern East Branch watershed, though not as remote as areas to the north, is predominately woodland with rural residential areas.

EAST BRANCH WATER QUALITY

Limited water quality monitoring is being conducted in the East Branch at this time. Monthly river samples are required for the operation of leach fields treating wastewater from the Burke Mountain Ski Resort. The East Branch is sampled monthly at locations upstream and downstream of the

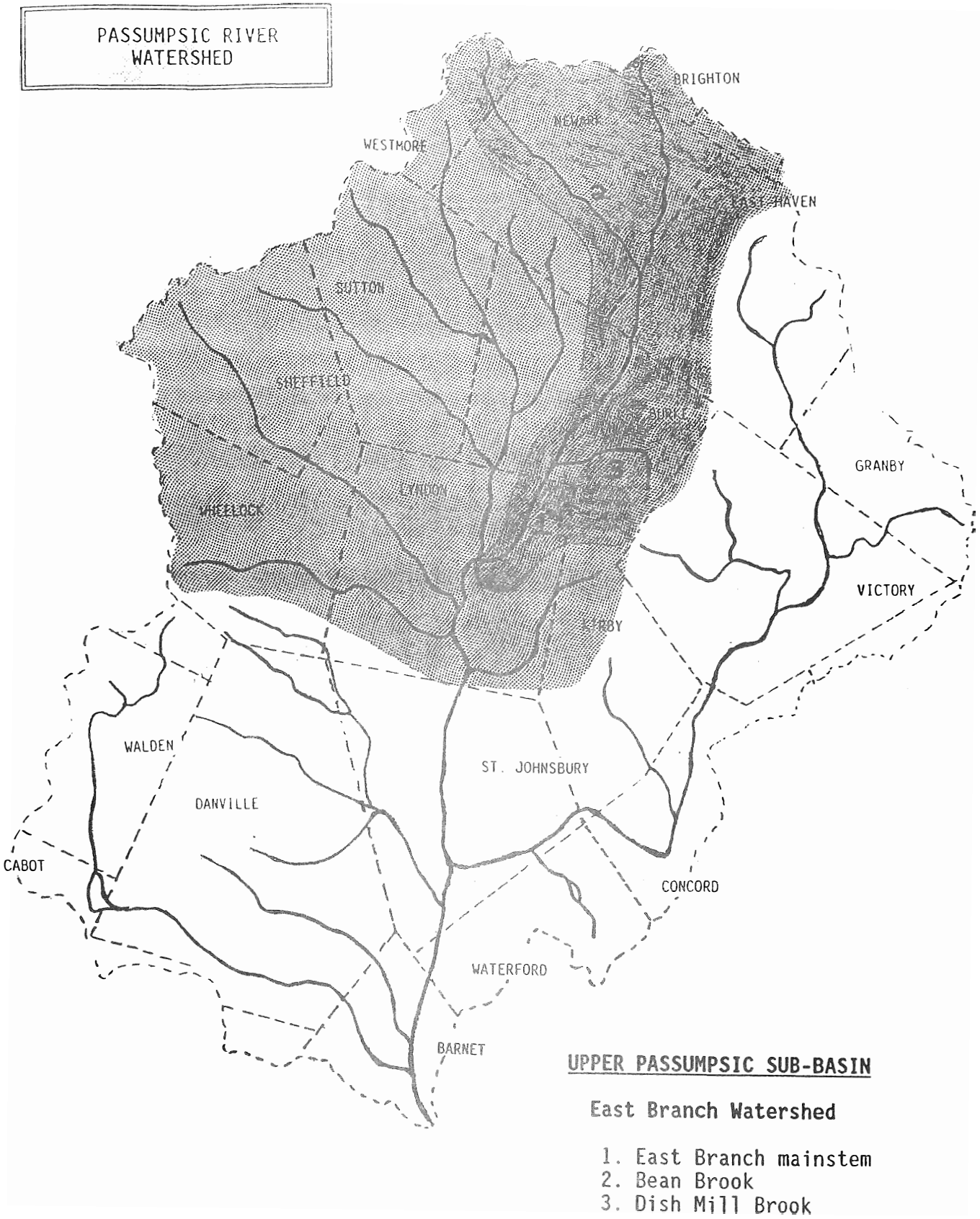

PASSUMPSIC RIVER WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
UPPER PASSUMPSIC SUB-BASIN
East Branch Watershed
1. East Branch mainstem
2. Bean Brook
3. Dish Mill Brook

Figure 16.

discharge and analyzed for nitrogen, phosphorus, chlorides, bacteria, pH, alkalinity, dissolved oxygen, and turbidity.

The Vermont 1990 Water Quality Assessment does not address this site specific data, and all East Branch pollution sources and impacts are evaluated on the basis of field observations. Of the 38.6 miles of rivers and streams evaluated for attainment of Clear Water Act Goals, the fishable goal is supported in 12.1 miles, partially supported in 24.5 miles and not supported in 2.0 miles. The swimmable goal is fully supported in all waters where it is a designated use. A 1.2 mile segment below Hartwellville receives treated wastewater, designated as a Class C zone and not for swimming use. Threats to aquatic habitat and fisheries have resulted primarily from sedimentation and erosion allegedly caused by logging and land development activities (Vermont Agency of Natural Resources, 1990). Nutrient runoff from agricultural fields below East Burke is also suspected as a threat to aquatic habitat.

Water Classifications and Drinking Water Supplies

Watersheds above 2500 feet in elevation on Bald, Jobs, Bull, Seneca, East, East Haven and Burke mountains have Class A surface waters. There are presently no streams designated Class A on the basis of drinking water use or ecologically significant habitat. Five subsurface drinking water supplies are designated as wellhead protection areas (WHPA) in the East Branch basin:

Table 5.

WHPA#	Type	Owner	Town	Drainage
5109	Bedrock well	East Haven	East Haven	East Branch
5110	Gravel well	Coffey - Teachout	East Haven	East Branch
5503	2 springs/2 wells	Burke Mount. Ent.	Burke	Dish Mill Brook
5033	Spring	East Burke	Burke	East Branch
5040	Gravel well	Lyndonville	Lyndon	East Branch

A 1.2 mile Class C zone of the East Branch extends from the outfall of the Hartwellville wastewater treatment plant to the confluence of Flower Brook. Contact recreation is not a recommended use in this river segment. All other streams and river miles in the East Branch watershed (except those above 2500 feet in elevation) are managed as Class B waters.

Domestic Wastewater

The small community of Hartwellville, formerly a U.S. Air Force housing development, is now 30-40 private residences with a sewer collection system and a 15,000 gallon per day (GPD) wastewater treatment plant discharging to

the East Branch. The trickling filter "package" plant installed in 1958 has failed and raw sewage is entering the East Branch. A replacement wastewater system is presently under review for a State Indirect Discharge Permit. The proposed project involves two 6,000 gallon septic tanks and a leachfield percolation system. The new system would eliminate the direct discharge of domestic wastes and the need for a Class C zone.

Burke Mountain Ski Resort operates an in-ground leachfield wastewater treatment system with a present design capacity of 72,000 GPD at a site one-quarter mile upstream of the Dish Mill Brook confluence. The current flow and indirect discharge from the system is not at design capacity levels, however, resort owners anticipating future developments and expansion of their project have applied for an indirect discharge permit to discharge 100,000 GPD. The Department of Environmental Conservation issued the permit (11/89) determining that the sand/gravel esker would effectively treat flows of an expanded system and no significant alteration of aquatic biota would occur in the East Branch. Local residents and adjacent landowners have expressed much concern over the large leachfield system and its effects on private drinking water wells and the East Branch.

All other domestic sewage is disposed of using septic systems at individual dwelling or commercial sites. Suspected septic system failures have been reported in the upper Dish Mill Brook watershed. These systems have not been investigated to date.

Industrial Wastewater

There are no manufacturers in the East Branch watershed producing wastewater in an industrial process requiring treatment and direct discharge into the East Branch or one of its tributaries.

Hazardous Wastes

The Darling Hill Dump, near the confluence with the West Branch, is a monitored hazardous waste site and a threat to the East Branch. See the site description under the West Branch "Hazardous Wastes" section. Underground fuel storage tanks at the Burke View Garage, approximately 3/4 mile upstream of the West Branch confluence in Lyndon, are suspected of leaking. This site is currently under study by the U.S. Environmental Protection Agency.

Other Wastewater and Nutrient Sources

The 1990 Water Quality Assessment Report (DEC) contains information on suspected nutrient loading to the East Branch from Lyndonville to East Burke from agricultural activities adjacent to the river. No river monitoring or biological assessments have been completed to verify threats to aquatic biota. The northern half of the East Branch watershed has generally steeper slopes

and valleys less suitable for agriculture. At this time there is no evidence of nutrient loading in the upper reaches of the East Branch and its tributaries.

Water quality analyses performed as part of the permit process underway for the fish hatchery on Bean Brook showed low ammonia, no toxics, and similarly low nutrient levels above and below the facility. It was noted during field visits that the sawdust and mill shavings at an inactive sawmill site above the hatchery may be an ongoing threat to Bean Brook water quality.

Erosion and Sedimentation

There are 26.5 miles of rivers and streams in the East Branch watershed reported as not supporting or only partially supporting the fishable goal of the Clean Water Act. The aquatic biota in these streams or river segments are impacted or threatened by erosion and sedimentation. The SCS reports that various streambank sites, totalling an estimated 2000 feet, along the East Branch are eroding an average discharge of 270 tons of sediment per year.

In an unnamed tributary entering the East Branch in the town of East Haven, two miles of stream has been heavily sedimented and spawning habitat has been impaired due to a logging road washout. The aquatic biota, fishing, and aesthetics of high quality waters in the East Branch headwaters in East Haven and Newark are reportedly threatened by streambank erosion and sedimentation from logging, logging roads and land development (Vermont Agency of Natural Resources, 1990). Four mile river segments: one on the mainstem from East Burke to the East Haven town line and a second on Flower Brook in Burke have also been allegedly threatened in recent years by erosion from logging activities. Sedimentation caused by gravel mining is suspected as a threat to aquatic habitat in the lower two miles of the East Branch above its confluence with the West Branch. These water quality assessments are based primarily on public comments and field observations by state and federal resource managers.

Land development at the Burke Mountain Resort has caused high turbidity and impacts to aquatic biota in a small stream adjacent to the access road due to high sand loading into the stream that has embedded most of the stream's substrate habitat. Fish community studies (1989) were performed by the Department of Environmental Conservation in Dish Mill Brook. A Brook Trout/Sculpin fishery at expected densities was found, however, habitat assessments suggested that erosion from land disturbances on Burke Mountain is threatening aquatic habitat in five miles of Dish Mill Brook.

While eroding banks and gullies and turbid runoff have frequently been observed in the East Branch watershed, it is unknown to what extent the aquatic biota of the East Branch mainstem have been impacted. Preliminary macroinvertebrate data from a site located near the Burke/Lyndon town line indicates a "healthy" aquatic insect community. Fish communities in the East Branch mainstem have not been sampled recently.

Flow Modification

The fish hatchery withdraws water from the Bean Brook tributary leaving Sawdust Pond. The facility is being re-permitted by DEC in 1991 with a minimum stream flow requirement. All other streams and rivers of the East Branch watershed are free-flowing. A breached dam in the Village of East Burke does not fluctuate lows or create a stream by-pass segment but does backup or impound the East Branch. The small reservior that is formed is used as a water supply for the East Burke Fire Brigade. There are no hydroelectric facilities and all village mill sites are no longer in operation.

The Vermont Agency of Transportation has prioritized an upgrade of the access road to Burke Mountain. To do so they have proposed relocating 0.8 miles of the Dish Mill Brook channel to avoid reconstructing two bridges. Anticipated impacts to aquatic habitat at and below the proposed project are unknown at this time but may be substantial in a small high gradient stream such as Dish Mill Brook (refer to the stream alteration discussion on page 49).

Miller Run

SETTING

The Miller Run watershed originates on the highlands of Wheelock and Granby Mountains and flows 12 miles in a southeasterly direction draining 48.5 square miles in the towns of Sheffield, Wheelock, Sutton and Lyndon (Figure 17). Between the headwaters and Sheffield Village (4 miles) the stream drops steeply at a 7.5% gradient. From Sheffield through Wheelock, Miller Run moderates to a 1.3% gradient and flattens to a 0.1% gradient in the last four miles before entering the Passumpsic River in Lyndonville.

The Oregon and Square Brook tributaries converge a mile above Sheffield Village to form Miller Run, draining 8.7 and 4 square miles respectively. On its remaining course to the Passumpsic, Miller Run picks up Fall Brook (draining 5.5 square miles) from the south and smaller tributaries, Squabble Hollow and Mathewson Brook, from the north.

The proximity of roads to stream courses in the watershed is limited to stream crossings and Route 122 which closely parallels Miller Run, Oregon Brook and Trout Brook. Interstate 91 follows Route 122 through the watershed; however, there are only a few locations where the Interstate comes within a quarter mile of the river. Only one set of exit ramps for Interstate 91, in Lyndonville, are located near Miller Run, limiting local use of the Interstate highway. Streams in the Miller Run watershed are generally well buffered from dirt and gravel roads.

Open farmland and residences are scattered along the length of Miller Run off Route 122. The river flows through the villages of Sheffield and Wheelock. Lands adjacent to the mainstem of Miller Run are well settled, whereas, outlying areas along tributary streams are remote woodlands. There are no lakes with concentrations of seasonal camps in the Miller Run Watershed. The lower Miller Run valley is one of the most intensive agricultural areas in the Passumpsic River watershed.

MILLER RUN WATER QUALITY

Assessments of surface water quality in the Miller Run watershed are based primarily on field observations rather than ongoing water quality monitoring programs. Of the 40.5 miles of rivers and streams evaluated, the Clean Water Act fishable goal is supported in 31 stream miles and only partially supported in 9.5 miles (from Sheffield village to the mouth). Threats to aquatic habitat, fishing use and aesthetics have resulted primarily from streambank erosion and siltation. Causes of streambank slumping are both natural and human induced through pasturing of livestock close to the river. No threats to swimming use have been reported (Vermont Water Quality Assessment, 1990).

A hazardous waste site also threatens aquatic biota in a 0.1 mile segment. Contaminants from the Marden Industries site have not been detected in river samples; however, organics and metals were found in groundwater.

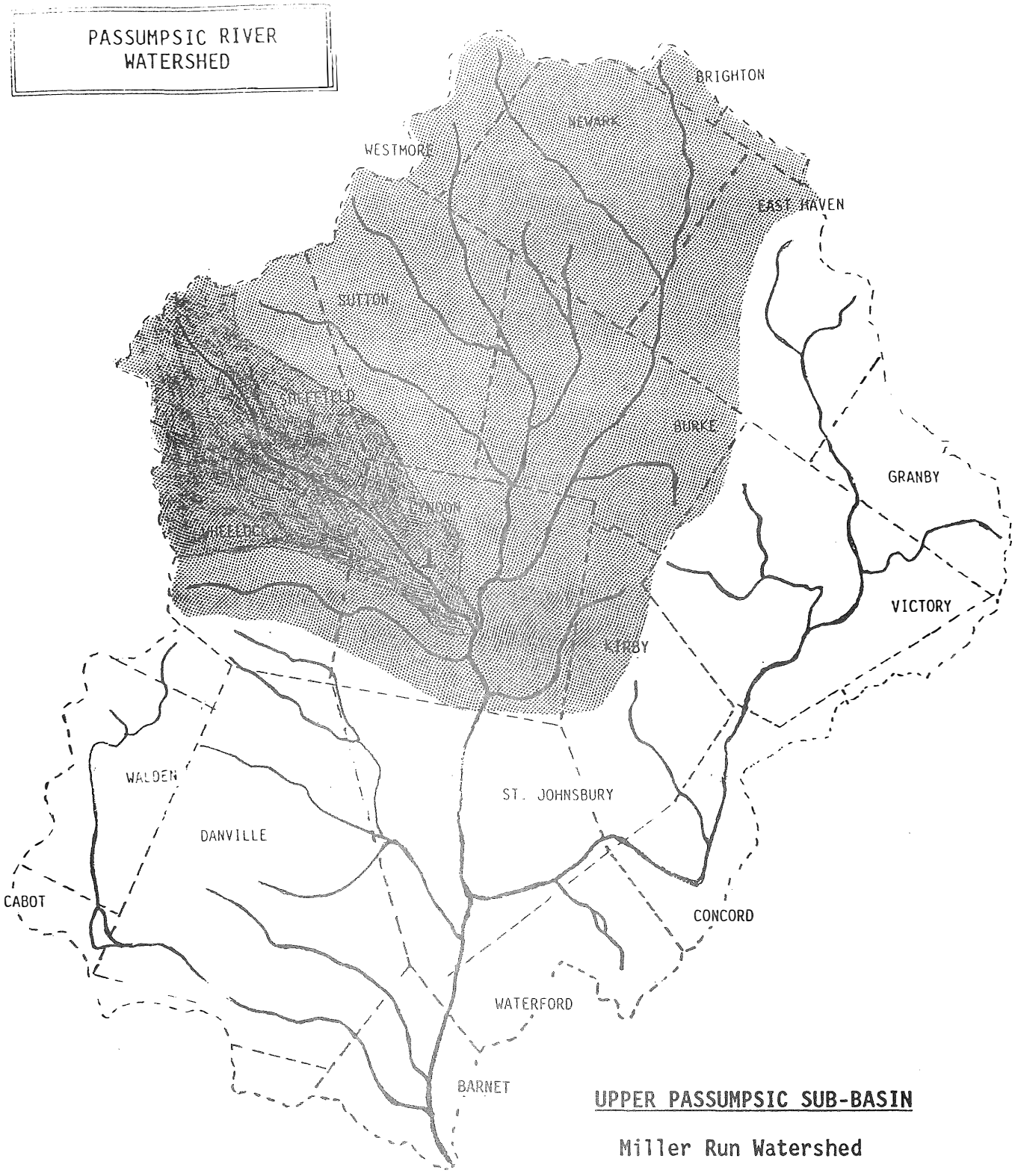

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
UPPER PASSUMPSIC SUB-BASIN
Miller Run Watershed
1. Miller Run

Figure 17.

Water Classifications and Drinking Water Supplies

Within the Miller Run watershed, the only Class A watershed designated as pristine waters above 2500 feet in elevation is on Wheelock Mountain. A Class A watershed designated for Lyndonville as a drinking water supply includes the upper reaches of Squabble Hollow Brook down to and including Mathewson Reservoir. The Sheffield Village Water Company uses a spring (WHPA # 5048) northwest of the village as a subsurface water supply.

No stream or river segments in the Miller Run watershed are designated Class C to receive wastewater point source discharges. All other streams and the entire length of the mainstem of Miller Run are managed as Class B waters.

Domestic Wastewater

There are no sewer collection and wastewater treatment systems that discharge into watercourses of the Miller Run watershed. All domestic wastewater is treated through individual septic tanks and leachfields. No reports of system failures have been made and the status of human wastewater impacts to Miller Run is not known at this time. Wastewaters from houses and businesses in Lyndonville near the lower reaches of Miller Run are collected and treated at the Lyndonville Municipal Wastewater Treatment Plant which discharges to the mainstem of the Passumpsic River.

Industrial Wastewater

There are no manufacturers discharging treated wastewater directly to streams and rivers in the Miller Run watershed. Marden Industries on Route 122 pipes treated metal plating rinsewater to the Lyndonville Wastewater Treatment Facility, which discharges to the mainstem of the Passumpsic River.

Hazardous Wastes

Mardon Industries, a machineshop one half mile northwest of the Passumpsic River confluence along Route 122, operated a subsurface disposal system and dumped hazardous waste over a 9 year period approximately 460 feet from Miller Run. Dumping is no longer being done at the site. Analysis of river and ground water samples, did not detect contaminants in the river; however, toxic organics and metals were found in groundwater samples. The Marden Industries site will be monitored for 30 years. A sediment sampling and clean-up plan has been developed.

Other Wastewater and Nutrient Sources

Surface runoff with elevated phosphorus and nitrogen concentrations is suspected from manure and exposed soils of the extensive pastureland along the Miller Run. Water quality monitoring to determine the levels of nutrient loading in the watershed has not been completed.

Erosion and Sedimentation

The lower half of the Miller Run watercourse is similar to that of Passumpsic River mainstem with respect to surficial geology. The river flows through an area that has deep layers of sand and fine gravel sediments deposited as the last glacial period came to an end. Natural erosion, as the river carves its way back and forth through these layers of sand, commonly occurs in places along the lower Miller Run. The rate at which the river carves through its sandy banks is hastened in a few places by the lack of streambank vegetation and the weight of livestock that have access to the steep, sandy banks. Aquatic habitat is threatened in the lower Miller Run from excessive sedimentation. At present, the U.S. Soil Conservation Service is working with farmers and landowners to stabilize streambanks. SCS estimates that 3000 feet of Miller Run streambank are eroding, resulting in an average discharge of 810 tons of sediment per year.

A gravel pit operation, approximately 2.5 miles from the mouth of Miller Run, is directly adjacent to the river. It is not known whether erosion from this site is impacting the river.

Flow Modification

All streams and rivers of the Miller Run watershed are free-flowing. There are no hydroelectric facilities and all village mill sites are no longer in operation.

Upper Passumpsic River

SETTING

An upper six-mile segment of the Passumpsic River mainstem is described for the purposes of this study as the Lyndon segment, or that portion of the river from the confluence of the East and West Branches to the Lyndon - St. Johnsbury town line (Figure 18). Five of the Passumpsic River's nine major tributaries (those draining 10 or more square miles) enter the mainstem in the town of Lyndon. The Passumpsic River drops approximately 100 feet in the Lyndon segment. Nearly 80 feet of that descent occurs in the last 1.5 miles at the Vail and Lyndon dam sites.

In addition to the East and West Branches and the Miller Run already discussed, Sheldon Brook and South Wheelock Branch are large tributary streams entering the Upper Passumpsic just below Lyndonville. The headwaters of these streams are in the Kirby and Wheelock mountains respectively. Other smaller streams entering the Upper Passumpsic drain lands solely within Lyndon.

As the upper six miles of the Passumpsic is a confluence of rivers and streams, draining nearly half of the entire Passumpsic watershed, the town of Lyndon is a confluence of people. Lyndonville is the second largest population center in the basin. Businesses, schools, commercial areas and other community functions serve 1400 Lyndonville residents as well as people from surrounding towns coming into the upper valley via Interstate 91 and Routes 5, 122, and 114.

South Wheelock Branch, Sheldon Brook, and its tributary Hawkins Brook are paralleled by paved and gravel roads. The lower one mile segment of South Wheelock Branch flows through the village of Lyndon with little natural buffer between buildings and the stream. The small villages of East Lyndon and Red Village are in the Sheldon Brook valley. The predominately open farmland settings of these streams might be characterized as rural residential/ agricultural.

Watersheds of Chandler Pond (65 acres) and Bear Pond (24 acres) drain into South Wheelock Branch. Chandler Pond is part of the Lyndonville Water Supply system, the level of which is controlled by a dam structure. The shorelands of both ponds are undeveloped. There are no large ponds (greater than 20 acres) in the Sheldon Brook watershed.

South Wheelock Branch, like Miller Run to its north, has very little acreage of wetlands in the bottom lands along the stream mainstem. There is a little higher percentage of wetland in the Sheldon Brook watershed. Larger wetlands occur along northern Sheldon Brook tributaries.

In contrast with other urban segments of the Passumpsic mainstem in the City of St. Johnsbury and St. Johnsbury Center, the river segment in Lyndonville is well buffered from roads, buildings and parking lots. The Passumpsic flows one to two tenths of a mile west of Lyndonville through wetlands and open fields that are either fallow or used for agriculture.

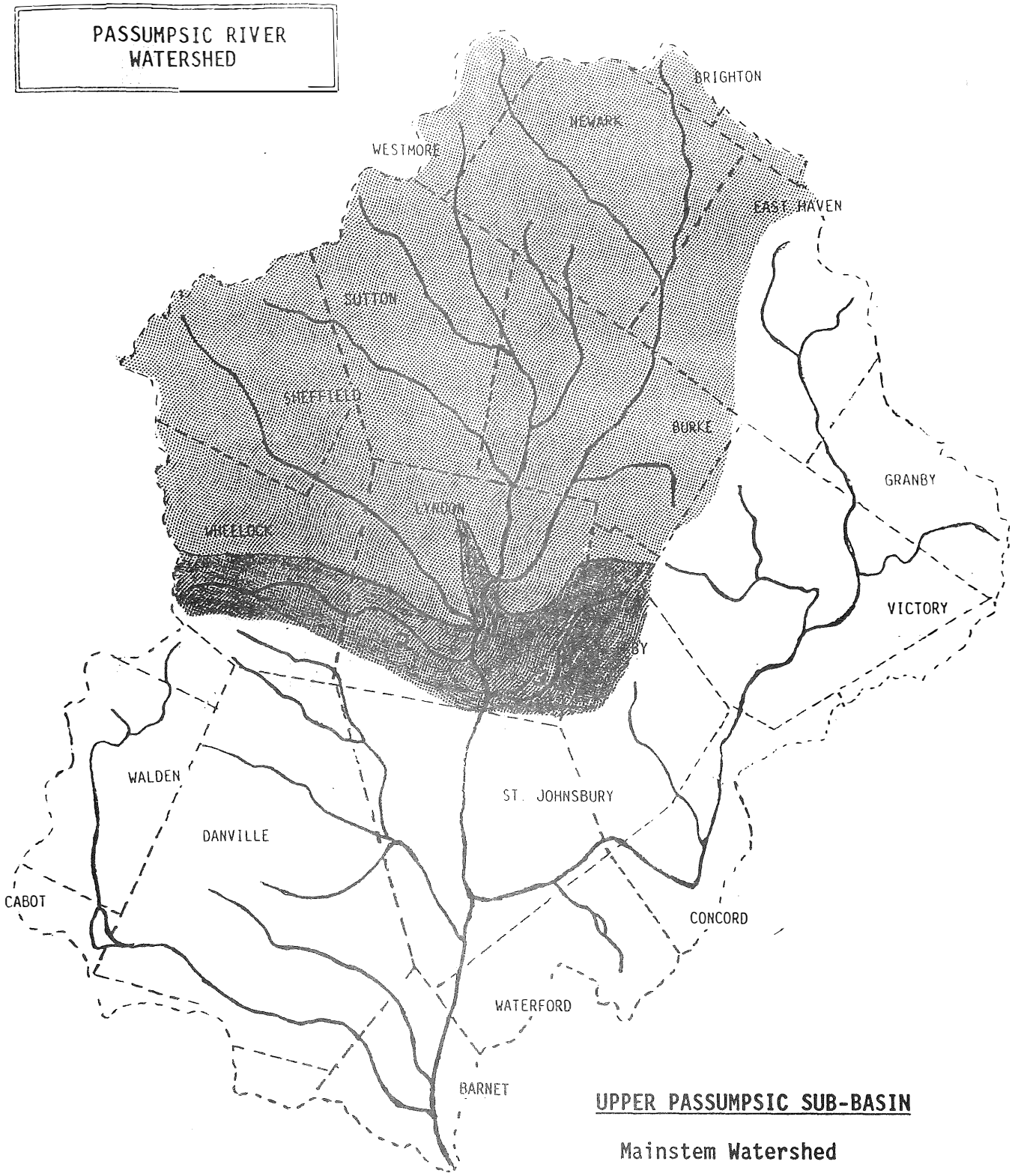

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
UPPER PASSUMPSIC SUB-BASIN
Mainstem Watershed
1. Upper Passumpsic mainstem
2. South Wheelock Branch
3. Sheldon Brook

Figure 18.

UPPER PASSUMPSIC WATER QUALITY

Water quality evaluations of streams tributary to the Upper Passumpsic are based on field observations rather than chemical analyses. No threats to water quality have been observed by fishery personnel in the Sheldon Brook and South Wheelock Branch drainages. The fishable and swimmable goals for these streams are reported as being fully supported (Vermont Water Quality Assessment 1990).

The unnamed outlet stream of Lily Pond, entering the Passumpsic River from the east, is threatened due to leachate from industrial wastes dumped at the Parker Landfill. Surface water testing revealed the presence of both E.P.A. priority organic compounds and metals.

The 1990 Vermont Water Quality Assessment reports impairment to aquatic habitat in the entire six mile Upper Passumpsic mainstem segment. From the East/West Branches confluence to the Lyndonville Wastewater Treatment Plant (WWTP), the aquatic habitat is impacted by sedimentation as a result of eroding banks and urban stormwater runoff. The 1.5 mile segment from the WWTP to Vail Dam is impacted by organic enrichment and sedimentation from the WWTP discharge and combined sewer/stormwater overflows. The remaining mileage of the Passumpsic to the Lyndon/St. Johnsbury town line is partially impaired by flow modifications associated with the Vail and Great Falls hydroelectric plants and sedimentation as a result of gravel mining and erosion from a road washout. Vermont District Fisheries Biologists are the source of information concerning habitat impairments in the Upper Passumpsic.

Classifications and Drinking Water Supplies

Small land areas above 2500 feet in elevation on Wheelock and Kirby mountains have Class A surface waters protected as pristine, ecologically sensitive waters. Three streams and their watersheds tributary to the Upper Passumpsic are designated Class A as drinking water supplies serving Lyndonville as back-up emergency supplies:

1) Quimby Brook - Copeland Reservoir to headwaters.
2) South Wheelock Branch Tributary - Chandler Pond to headwaters.
3) South Wheelock Branch Tributary - Woodworth Reservoir to headwaters.

No designated Wellhead Protection Areas (WHPA) occur in the Upper Passumpsic mainstem drainage.

The river segment from the upper (or northern) village limits of Lyndonville to the Great Falls dam, near the Lyndon - St. Johnsbury town line, is designated as a Class C zone. The Class C segment, approximately 4.4 miles long, was designated on the Passumpsic to receive a treated wastewater discharge from the Lyndonville Wastewater Treatment Plant. A shortening of

this "C" zone has been proposed. The 1.5 miles of river above the Lyndonville plant receives combined sewer overflow (CSO) discharges but would be a candidate for reclassification to Class B, should the CSOs be eliminated. Three miles of Class C zone below the treatment facility may be excessive in that the facility is designed to treat wastewater at a secondary level (biological nutrient removal and disinfection). Sheldon Brook, South Wheelock Branch and all other small tributaries to the Upper Passumpsic mainstem (not already described as Class A waters) are managed as Class B waters.

Domestic Wastewater

The Village of Lyndonville has a secondary wastewater collection and treatment facility with the capacity to treat 750,000 gallons a day. The treatment plant uses extended aeration tanks to biologically remove carbonaceous wastes and a chlorination unit to remove bacteria before discharging to the Upper Passumpsic River at a point just south of the Village. At present, the plant treats an average of 550,000 gallons a day.

Since December 1989, notable improvements have been made to the sewer and treatment plant facilities in Lyndonville. A project has been completed to repair broken or leaking sewer lines in the village, and overflow valves have been added to discharge pipes at the plant so that back-flows of river water from impounding at the Vail hydroelectric plant will not enter the plant and mix with untreated wastes. Sewer pipes in Lyndonville are combined with four different stormwater drainage pipes. During rain storms, raw sewage may be flushed directly into the Passumpsic. These CSOs are on the State priority list for sewage/stormwater separation.

The 1988 and 1990 Vermont Water Quality Assessments reported that EPA chlorine levels have been exceeded in the effluent discharged from the Lyndonville WWTP. Acceptable chlorine concentration levels are set by EPA to protect aquatic life from toxic chlorine concentrations. In December 1989, a dechlorination unit was added to the waste treatment process to correct the problem. Significant treatment improvements were also accomplished through recent rehabilitation of treatment plant equipment.

Smaller villages, residences and commercial buildings in the South Wheelock Branch and Sheldon Brook watersheds are served by individual septic tank and leachfield systems. Concern for septic system failures in Lyndonville have been expressed by local citizens. No specific location information or river impacts have been documented at this time.

Industrial Wastewater

The Lyndonville WWTP receives treated industrial wastewater from three local industries. Vermont Tap and Die Company has a state permit to treat and discharge (to the WWTP) rinse water from alkaline cleaning and heat treating operations. Northeast Tool pretreats metal plating wastes. The third

Lyndonville industry discharging to the WWTP is Vermont Flexible Tubing, which pretreats wastewater from an ion-exchange unit regeneration operation and rinse water from umbrella washing and metal plating operations. There are no industries that have a state permit to discharge treated wastewater directly into the Upper Passumpsic River in Lyndon.

Hazardous Wastes

The Parker Landfill southeast of Lyndonville, is less than 1/2 mile east of the Passumpsic River mainstem. In February 1990, the Parker Landfill was added to the federal Superfund list of hazardous waste sites. Over a twelve year period (1972-1983), industrial solvents, sludges and oils were poured onto the ground or into unlined pits and lagoons on the site. The Vermont Department of Environmental Conservation is completing surface and ground water analyses near the site. The unnamed outlet stream of Lily Pond is threatened due to the presence of low levels of toxic organic compounds, lead levels that exceed EPA Freshwater Chronic Criteria Levels, and tichloroethene levels that exceed EPA Water and Fish Ingestions and Fish Consumption criteria levels. Toxic chemicals were also found in four private wells located a half mile away. The site is presently used as a municipal landfill but not for hazardous waste disposal. A Remedial Feasibility Study is currently underway to determine the types of clean up actions necessary. Surface water quality monitoring will continue.

Other Wastewater and Nutrient Sources

Urban runoff from Lyndonville is suspected of impacting the aquatic habitat in the Upper Passumpsic mainstem. Stormwater runoff from roads, buildings and parking areas may contain nutrients, sediments, oxygen-demanding wastes, oil, grease and toxic pollutants often found in stormwater. Once in the river, biological activity to consume these organic wastes will utilize available oxygen supplies.

Cropland and pastureland exist along the Upper Passumpsic, South Wheelock Branch and Sheldon Brook. It is not known at this time if runoff from agricultural fields is impacting the water quality of these rivers.

Erosion and Sedimentation

Aquatic biota and aesthetics of the Upper Passumpsic River are affected by siltation caused by eroding river banks. The U.S. Soil Conservation Service has identified the following bank erosion sites on the Passumpsic mainstem and Sheldon Brook:

Table 6.

Location of Slumping Streambank	Length (ft)	Av. Tons/Year
Locations on Sheldon/Hawkins Brooks	800	2160
Mouth of Sheldon Brook	200	45
Pass. R. btwn I-91 exit and Rt. 122	1400	252
Pass. R. just upstream of Rt. 122	600	162
Pass. R. above mouth of Miller Run	1600	576

Aquatic habitat in the lower one mile of the Upper Passumpsic River has been moderately impacted by sediments from a road washout and runoff from an adjacent gravel pit operation.

Flow Modification

There are two hydroelectric facilities on the lower one mile of the Upper Passumpsic River:

Vail Station:

Vail Station hydroelectric facility, owned and operated by Lyndonville Electric, has a generating capacity of 350 kilowatts. The project includes a 15 foot concrete dam with 16" flashboards that impounds 3 miles of river, creating a 25 acre reservoir. No by-passed river segment is created due to the proximity of the powerhouse to the dam.

A 401 Water Quality Certificate was issued in March 1980 and a FERC license was granted January 1981. The 401 certificate requires a run-of-river operation, meaning that releases below the facility equal river inflow to the facility. Lyndonville complies with its license with the use of an automatic float control that monitors constant pond height at the dam, the level of intake to the generators, and ultimately the inflow and outflow from the facility. Anglers reported at an April 1991 meeting that river flows are constant below Vail Station.

Great Falls:

The Great Falls hydroelectric facilities is located one mile downstream of the Vail Station project and two miles upstream of Pierce Mills hydroelectric project. Great Falls is also owned and operated by Lyndonville Electric and has a generating capacity of 1,200 kw. Project features include a 160' long and 32' high dam creating a 12 acre reservoir that impounds 1.1 miles of river. Other features include a canal intake and penstock that delivers water to a powerhouse bypassing 200 feet of riverbed (DesMueles and Parks, 1988).

A 401 Water Quality certificate was issued in February, 1984, and the FERC license granted in June 1979 and amended March 1985. The project is licensed to operate on a run-of-river basis. Automated float control units used at Vail Station are also used at Great Falls to ensure constant flows. An opening in the dam passes 10 CFS of flow into the by-pass river segment for fisheries habitat needs as required by the operating license. The river in this area is designated as a cold water fish habitat.

At times Lyndonville Electric finds it more efficient to operate the Great Falls facility using smaller turbines rather than the single larger unit. These smaller units must be operated manually. To ensure run-of-river compliance during manual operation, Lyndonville Electric has installed an alarm system. The operator must reset the alarm every one-half hour. Failure to do so will set off the alarm at the station and a warning is dailed out by phone automatically to two different locations. A low-low water relay has also been installed on the single large unit which will trip the unit off line if the water level drops more than two inches below the top of the flashboards. If this occurs during the hours the facility in unmanned, an alarm is dailed to the operator's home.

Lyndonville Electric reports that its Passumpsic River projects qualify only as run-of-river type operations. Due to the narrow elevation band where a height for dropping the water and getting an effective generating head is achieved and the extent of siltation that has filled much of the reservoirs, a "ponding-type" operation that stores water for generating at peak power production times is not feasible (Kenneth Mason, Manager, Lyndonville Electric Department, 9/7/90 letter to Doug Graham, CVPSC).

A more detailed description of Passumpsic River real or potential threats and impairments resulting from the seven mainstem hydroprojects has been outlined under the "Flow Modification" section for the Middle Passumpsic River discussed below.

The broad floodplain adjacent to Lyndonville lies between bedrock-controlled valley constrictions below and steep-sloped watersheds above. The combination of these factors result in frequent flooding (Federal Emergency Management Agency, 1988). Lyndonville Electric dams are located at these "bedrock-controlled valley constrictions" and may increase flood frequency in the floodplains above.

The Upper Passumpsic River has been channelized with rip-rap in the segment between Lyndonville and Lyndon Center and more rip-rapping has been proposed. Application for a 404 Permit was made to the U.S. Army Corps of Engineers in December 1990 by Lyndon Institute to rip-rap a 600 foot segment of the right bank of the Passumpsic River to protect its recreation field from further erosion. This project would start at the downstream end of the existing rip-rap. The following hydrology and biological considerations are made in the review of stream alteration projects of this kind:

* Unless stream length is maintained and large boulders are used to absorb river currents, the erosive power being avoided in the rip-rapped segment may be intensified and result in greater land losses downstream.

* In river segments where the bottom substrate habitat is not of the rubble/boulder consistency that provides mid-channel refuges for fish and other aquatic biota, the available habitat is concentrated along riverbanks at undercuts and vegetative overhangs. Rip-rapping may eliminate instream habitat and riverbank trees and shrubs that keep water temperatures cooler and provide cover for wildlife.

* Vegetated buffer zones maintained along the riverbank anchors soil and decreases the need for bank stabilization with rip-rap.

A State stream alteration permit (10 V.S.A., S.1021) has been issued for the Lyndon Institute project. Approval was given on the basis that this segment of the Passumpsic has nearly a flat grade (the area floods 1-3 times annually) and aquatic habitat has been lost as a result natural erosion which is occurring at a rate where bank vegetation can not re-establish itself. The project has been designed to maintain bank roughness for river current absorption and the applicant has agreed to make plantings on the rip-rap to improve aesthetics and habitat values.

The South Wheelock Branch and streams in the Sheldon Brook watershed are free-flowing. All village mill sites are no longer in operation.

MIDDLE PASSUMPSIC RIVER WATERSHED

A Middle Passumpsic River Watershed is defined, for the purpose of this study, as all drainages that enter the Passumpsic River in the town of St. Johnsbury including two major tributaries, the Moose and Sleepers Rivers.

Moose River

SETTING

The Moose River is the largest Passumpsic River tributary, draining one quarter of the Passumpsic watershed. Steep mountains, 2000 feet in elevation encircle the northern, wilderness half of the Moose River watershed in the towns of East Haven, Gramby, Kirby and Victory. The Moose then runs through Concord and into St. Johnsbury to meet the Passumpsic River (Figure 19).

Running at a 2.8% grade for the first ten miles, the Moose River drops more gradually than Upper Passumpsic tributaries. As the Moose enters the town of Victory, it flows through one of the largest wetland complexes in Vermont, meandering at a 0.5% gradient. The lower ten miles of the Moose River, in Concord and St. Johnsbury, pick up in gradient and provide some of the best boatable whitewater in the Passsumpsic basin.

The Moose River watershed can easily be divided in terms of setting. Route 2, a major east/west New England regional highway, runs along the lower segment of the river. At North Concord, Route 2 turns east and the Moose continues north. Only gravel/dirt roads follow it through Victory and into East Haven. The Moose River watershed covers approximately 127 square miles, with about two-thirds of this area above North Concord.

A dirt/gravel road traverses east to west through the upper Moose watershed, north of the Victory wetland complex, from Guildhall near the Connecticut River to Route 114 near East Burke. The small villages of Granby and Gallup Mills, and scattered residences located along this road represent the near total population of the 80 square mile upper Moose River watershed. Nearly three-quarters of this area is owned by either the State of Vermont or private timber companies. The Upper Moose watershed is part of the largest continuous tract of public/private forest holdings in Vermont extending north in Essex County to the Canadian border. The Northern Forest Land Study (U.S. Forest Service, 1989) reports fewer than 15 people/square mile, a large percentage of whom are involved in the timber products industry.

After cascading off Seneca Mountain and the East Haven Range in the north, the Moose River enters Victory Basin which is a large lowland area with a 3.5 square mile wetland complex including Victory Bog. Outside of the Lake Champlain and Memphremagog shorelands, the Victory wetland complex, extending up both Bog and Granby Brooks, is one of Vermont largest wetland areas. The State owns and manages the Victory wetlands as a Wildlife Management Area. One of the largest deer wintering yards in Vermont is located in the basin.

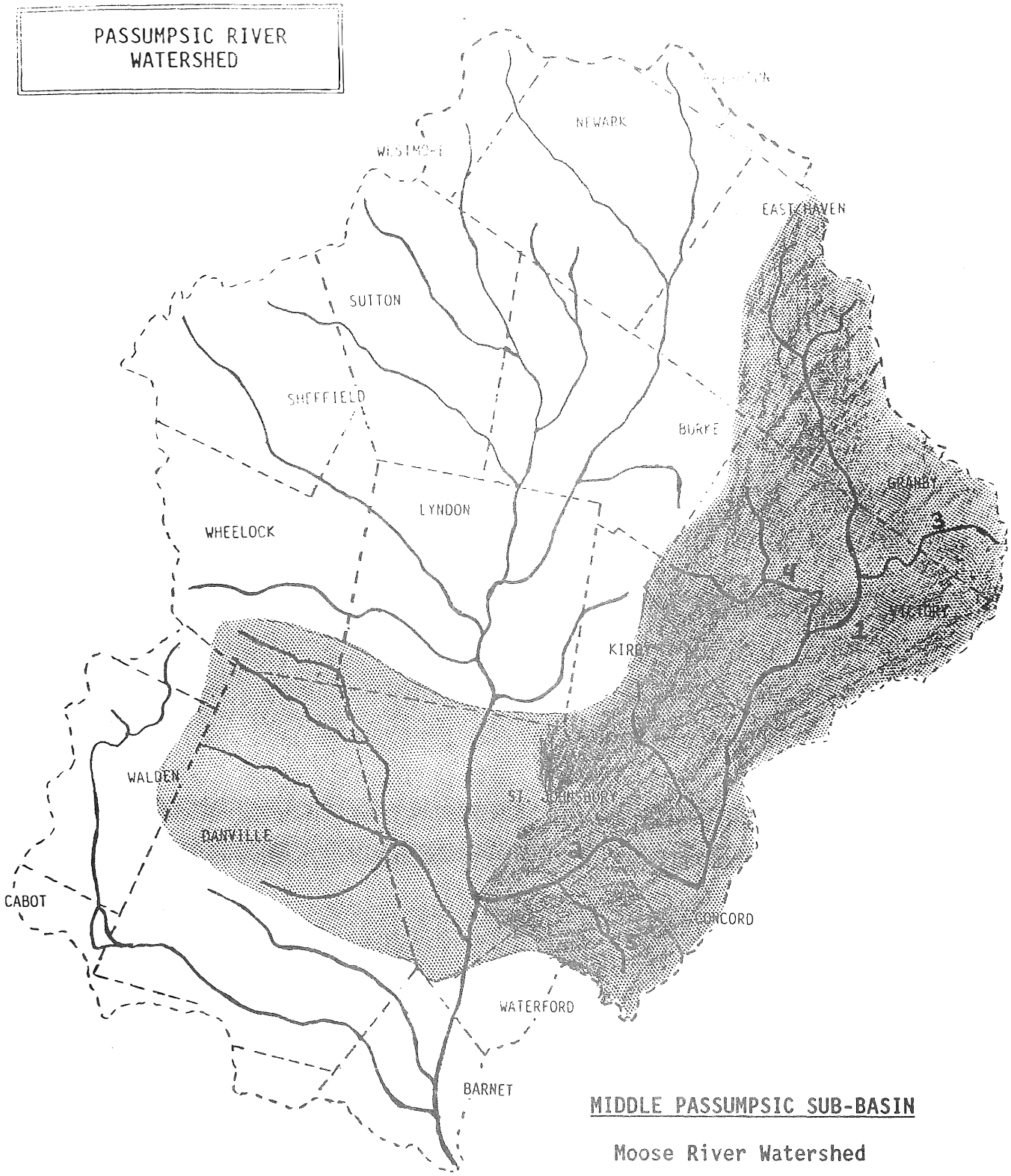

PASSUMPSIC RIVER
WATERSHED
NEWARK
EASTCHAVEN
SUTTON
SHEFFIELD
BURKE
LYNDON
WHEELOCK
GRANBY
VICTORY
KIRK
WALDEN
DANVILLE
CONCORD
CABOT
WATERFORD
BARNET
MIDDLE PASSUMPSIC SUB-BASIN
Moose River Watershed
1. Upper Moose River
2. Lower Moose River
3. Rogers Brook
4. Bog Brook
5. Stiles Brook

Figure 19.

At North Concord where the Moose River meets U.S. Route 2, the river valley changes from a wilderness/forestland setting to a rural residential/ agricultural setting. The lower two miles of the Moose flows through an urban commercial area in the City of St. Johnsbury.

Between North Concord and the East St. Johnsbury area, three larger streams Kirby Brook, Chesterfield Valley Brook and Stiles Brook (7-9 sq. mile watersheds) enter the Moose River. An unpaved, gravel road parallels Kirby Brook through the Town of Kirby into the Hawkins Brook drainage in Lyndon. The Chesterfield Valley is a paved travel route between Concord and Lydonville through the town of St. Johnsbury. In the Stiles Brook watershed, Route 18 and Interstate 93 are travel routes through the Town of Waterford. Residential development along these routes has been increasing over the past 20 years (U.S.G.S., 1988).

The Concord/East St. Johnsbury segment of the Moose River and its tributary streams are associated with extensive wetlands in their immediate corridors. For this reason, these watercourses are relatively buffered from roads, highways and other developments. The noteable exceptions would be the village of Concord through which the Moose River flows and lower Stiles Brook area at the I-93 Interchange.

Stiles Pond, a 146 acre artificially controlled lake, is located on Stiles Brook. Route 18 is on the eastern shoreline of the lake, while the western shoreline is undeveloped and inaccessible. Stiles Pond is utilized as a public water supply.

MOOSE RIVER WATER QUALITY

Of a total 60 stream miles evaluated in the Moose River watershed for the 1990 Vermont Water Quality Assessment, all but the lower two miles of the Moose River are reported as having water quality that will support both fishing and swimming uses. However, there are sources of pollution that threaten the high quality waters of the upper Moose River and its tributaries.

Streambank erosion and sedimentation caused by logging and farming practices allegedly threaten aquatic habitats of the Moose River; however impairments have not been reported (Vermont Agency of Natural Resources, 1990). The possible exception may be the sedimentation of an unnamed tributary to Johnson Pond in Kirby due to a 1200 acre clearcut. Above and below the Victory wetland complex, the Moose is a clear running river with very little evidence of embedded sediments in the river's boulder and rubble substrate. Silt and sand in the bedload of the upper Moose River are likely to be trapped in the flatter meanders within Victory basin.

From Victory Bog to the Passumpsic River confluence, the Moose River is naturally tannic or tea colored as a result of the dissolved organic acids decomposing from the wetland peat mats. Langdon (1985) studied the chemistry and biology of 18 Vermont streams, including the Moose River, believed to be

Hazardous Wastes

A lagoon, used for 13 years by Colt Industries to hold metal plating process water, was filled with gravel in 1981 and is no longer used for dumping. The site is adjacent to the Moose River approximately 2.5 miles from the river's mouth and is considered a hazardous waste site by Vermont DEC due to the presence of heavy metals. Threat to surface water supplies, swimming and aquatic biota of the Moose River below the site are not considered high due to the river's size and, therefore, no water quality monitoring is being conducted at this time.

Other Wastewater and Nutrient Sources

The St. Johnsbury water treatment plant, located near the mouth of Stiles Pond, has been discharging filter backwash water directly to Stiles Brook. The backwash water contains high particulate levels, including the alum used in the water treatment process. This causes high turbidity levels and other sedimentation impacts to aquatic biota in Stiles Brook and the Moose River. Construction began, in 1990, on a new water treatment plant that will supply St. Johnsbury with water meeting federal safe drinking water standards and adequately treat backwash water. Treatment will be accomplished by pumping backwash water to two large lagoons that will settle out solid particles before being discharged to Stiles Brook.

Erosion and Sedimentation

Agricultural activities and to a larger extent logging activities are, in addition to natural erosion, suspected as the causes of streambank erosion in an eight mile Moose River segment between Stiles Brook and North Concord (Vermont Agency of Natural Resources, 1990). No scientific analysis has been completed and the extent of impacts due to sedimentation in this segment is not known at this time. The wetlands adjacent to the Moose River in the area would tend to lessen or minimize erosion. The SCS reports a streambank erosion site behind the Fairbanks-Morse Plant approximately 600 feet long and discharging an average of 1890 tons of sediments per year.

A steeper segment of the Moose River above Gallup Mills in Granby and East Haven is also reportedly threatened by erosion impacts. The upper watershed is largely owned by paper companies and logging activity is the primary land use. Local residents have complained about turbidity levels in the Moose; however, extensive sedimentation in the upper Moose is not evident at this time.

Flow Modification

A dam on Stiles Brook, above the St. Johnsbury water treatment plant, regulates stream flow and diverts water into the plant. The water treatment plant improvements currently underway include dam rehabilitation. The dam permit issued in October 1990 includes erosion and silt control provisions and minimum flow requirements.

All other streams and rivers in the Moose River drainage are free-flowing. There are no hydroelectric facilities and all village mill sites are no longer in operation.

Only a handful of rivers in Vermont are as large or larger than the Moose River and remain free-flowing, meaning there are no hydroelectric or flood control dams that have the capacity to regulate flows. The Black, Barton, and Nulhegan Rivers are other Northeast Kingdom rivers that are still free-flowing.

Sleepers River

SETTING

A ridge of mountains running north/south through Stannard and along the town line of Walden and Danville form the headwaters of the Sleepers River watershed. Draining approximately 44 square miles, the Sleepers River watershed lies mainly in the northern half of the town of Danville and runs through the west side of St. Johnsbury before entering the Passumpsic River just south of the city (Figure 20). The Sleepers River drops at a fairly constant gradient (3.5% - 5.0% grade) over the first 8 miles before slowing to a 0.5% grade in the last few miles of its course.

Burroughs Brook, Morrill Brook, North Brook and Roy Brook are the major tributaries of the Sleepers River. Only the Burroughs Brook watershed draining the northern part of the basin is over 10 square miles. The Sleepers River begins at the confluence of North Brook and Morrill Brook in the village of North Danville.

When compared with other rural agricultural areas in the Passumpsic Basin, the Sleepers River watershed is more populated. Excluding the lower portion of the drainage in the City of St. Johnsbury, however, there are no sizeable commercial districts. People working or carrying out business in Danville and St. Johnsbury have sought rural living in the North Danville area. Encroachment of buildings and roads on tributary streams is minimal, whereas, the Sleepers River mainstem is very closely paralleled by the paved/gravel road to North Danville. After the road turns south to meet Route 2, the river goes over Emerson Falls and is then severely channelized where an I-91 / Route 2 interchange was constructed over it. The Sleepers River runs its last mile through an urban/industrial area of St. Johnsbury before its confluence with the Passumpsic River immediately below the wastewater treatment plant outfall.

SLEEPERS RIVER WATER QUALITY

Assessments of surface water quality in the Sleepers River watershed are based primarily on field observations rather than any ongoing water quality monitoring programs. Of the 47.0 miles of rivers and streams evaluated, the "fishable waters goal" of the Federal Clean Water Act (CWA) is attained in 36.2 tributary stream miles and only partially supported in the 10.7 mile Sleepers River mainstem. Both fishing and swimming uses have reportedly been impaired in a 0.1 mile segment at the Emerson Falls hydroelectric facility due to flow diversions that bypass water around pools below the falls (Vermont Water Quality Assessment, 1990).

Of the 36.2 miles reported as fully supporting the CWA goals, 13.2 stream miles are threatened primarily from sedimentation of aquatic habitat caused by natural erosion and logging and agricultural activities. In the City of St. Johnsbury, a 0.2 mile segment of the Sleepers River is threatened by wastes previously dumped at the old Fairbanks Morse Foundry. Iron wastes

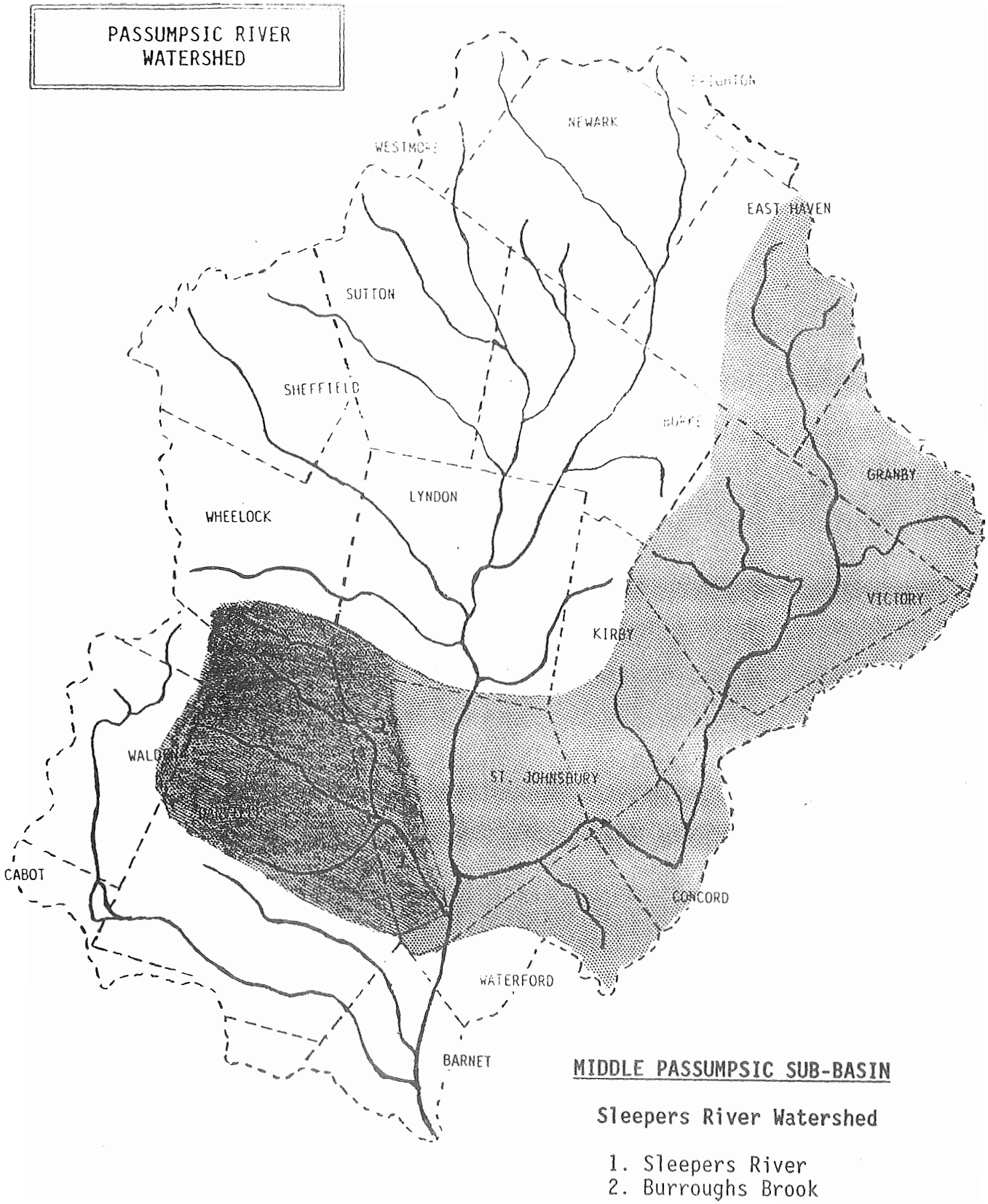

PASSUMPSIC RIVER
WATERSHED
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
LYNDON
WHEELOCK
GRANBY
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
CABOT
CONCORD
WATERFORD
BARNET
MIDDLE PASSUMPSIC SUB-BASIN
Sleepers River Watershed
1. Sleepers River
2. Burroughs Brook

Figure 20.

dumped at the old Fairbanks Morse Foundry. Iron wastes were dumped into the river and coat bottom habitat, and oil sheens on the river have been observed.

A potential threat not mentioned in the 1990 Vermont Water Quality Assessment is the old St. Johnsbury municipal dump operated until 1976 adjacent to the Sleepers River, 0.5 miles downriver of the old foundry site. An EPA Screening Site Inspection (SSI) has determined a potential for groundwater and surface water contamination.

Classifications and Drinking Water Supplies

There are presently no Class A watersheds in the Sleepers River drainage as no lands are above 2500 feet in elevation and no surface drinking water sources have been designated. No Class C zones have been designated to receive treated wastewater effluent. Therefore, all streams and rivers of the Sleepers River watershed are Class B waters.

All drinking water supplies for residents of the drainage are taken from small private wells. No Wellhead Protection Areas (WHPA) have been designated.

Domestic Wastewater

Sewage is collected in the St. Johnsbury City portion of the Sleepers River watershed. This domestic wastewater is piped to the St. Johnsbury wastewater treatment plant which discharges to the Passumpsic River mainstem immediately upstream of the Sleepers River confluence. No direct discharges of treated sewage are being made to streams and rivers in the Sleepers River watershed at this time.

Combined sewer overflow (CSO) pipes discharge to the Sleepers River - two at Fairbanks Village, one off Mt. Vernon Street and another off Western Avenue. During storm events, raw sewage mixes with storm water and enters the river directly. All CSOs in St. Johnsbury are presently under engineering study for sewer/stormwater pipe separation by October 1993. The sewer pipes will be connected to the St. Johnsbury wastewater treatment plant collection systems. Two private residents that were straight piping sewage to the Sleepers River in St. Johnsbury were connected to the collection system during the summer of 1990.

All domestic sewage, outside the City of St. Johnsbury, is disposed of using septic systems at individual dwelling or commercial sites. Alleged straight pipes or failed systems have been reported in the village of North Danville and just above Emerson Falls. These potential nutrient/pathogen sources contribute to the impacts on aquatic biota, aesthetics and swimming reported for the 10.7 mile segment of the Sleepers River mainstem in the 1990 Vermont Water Quality Assessment.

Industrial Wastewater

Fairbanks Morse Foundry adjacent to the Sleepers River in St. Johnsbury, approximately one mile from the Passumpsic River confluence, is no longer in operation. However, fuel oil spills at the site, both surface and subsurface, were running into the Sleepers River. By state order, a resource recovery unit was placed at the site to pump and treat groundwater for fuel oil related hydrocarbons. At present, Colt Industries - Fairbanks Inc. is discharging up to 8,500 gallons per day of treated groundwater to the Sleepers River and will do so until the subsurface contamination is no longer a threat to surface waters and drinking water supplies. There are no active manufacturers in the watershed which produce wastewater in an industrial process requiring treatment and direct discharge (via a pipe) into the Sleepers River or one of its tributaries.

Hazardous Wastes

Within the City of St. Johnsbury, there are two sites from which hazardous wastes may be entering the Sleepers River and potentially impacting aquatic habitat. Along the lower 1.1 mile segment are the Fairbanks Morse Foundry and the St. Johnsbury dump, both of which are no longer in operation.

The defunct Fairbanks Morse Foundry created wastes from etching and plating processes which probably included heavy metals, acids, solvents and paint wastes. These toxic materials may have entered the Sleepers River via floor drains. Iron wastes from the foundry were dumped into the river and now coat the bottom habitat for approximately 0.2 mile. Macroinvertebrate (bottom dwelling insect) numbers are reduced but organism diversity has not been impaired. A major oil spill occurred and has soaked into soils at the site. An oil sheen has been observed on the Sleepers River. Clean-up efforts to flush and remove petroleum from soils is ongoing (described above under Industrial Wastewater).

From sometime before 1962 until 1975, the City of St. Johnsbury operated a landfill on approximately four acres of land along the Sleepers River, less than 0.5 mile southeast of Western Avenue. Until 1976, all wastes generated by Fairbanks Morse were transported to the St. Johnsbury Dump, including: paint sludges, water soluble coolants and electroplating sludges. Metal wastes included zinc, cadmium, chromium, copper and lead. In addition to municipal solid wastes there is potential that industrial wastes from other sources were also brought to the dump. When the dump was closed, it was revegetated. The Sleepers River is located 0 to 10 feet east of the toe of the landfill and receives runoff from the landfill via gullies and smaller rill channels. The gullies on the site may be partly due to runoff from I-91 stormwater pipes. Exposed wastes can be seen in these gullies, and runoff has the potential to carry contaminants from the gully to the river. During an EPA Screening Site Inspection, organic compounds and metals were detected above background levels in both soils and groundwater. The site is presently under consideration by the EPA for a more detailed investigation.

Other Wastewater and Nutrient Sources

In St. Johnsbury, three stormwater pipes drain urban areas of the city and discharge to the Sleepers River. Urban runoff waters may affect aquatic habitat due to the oil, grease, road salts and sediments. Land use activities that may result in organic and nutrient loading are not extensive at this time. Scattered cropland and pasture along the Sleepers River are reported as a source of nutrients during overland runoff events (Vermont Water Quality Assessment, 1990).

Erosion and Sedimentation

Threats to aquatic biota due to erosion from logging and agricultural practices have been reported for Houghton Brook (9.5 mile segment). A 3.5 mile segment of Whiteman Brook is threatened by erosion of sediments from logging areas. The Sleepers River mainstem from Whiteman Brook to North Danville has been heavily impacted by natural sloughing of clay banks. Noticeable erosion occurred throughout the 1980's, and heavy rain storms during the summer of 1990 eroded large sections of river bank in this area. SCS estimates that a 200 foot segment one half mile east of North Danville discharges an average of 270 tons of sediment per year, and a 300 foot segment above Emerson Falls discharges an average of 81 tons of sediment annually. The 1990 Vermont Water Quality Assessment reports that aquatic habitat is impaired in this segment due to sedimentation.

Flow Modification

A one mile segment of the Sleeper River between the Emerson Falls hydro power site and the defunct Fairbanks Morse Foundry has been severely channelized due to I-91 construction in the late 1970's. The river flows through six large concrete highway box culverts that have eliminated aquatic habitat. Remaining portions of the natural channel have been straightened and all river bank vegetation in the area has been removed. Other flow modifications result from two hydroelectric facilities on the Sleepers River:

Fairbanks Mills:

The Fairbank Mills hydroelectric facility is located on the Sleepers River in North Danville and is owned and operated by Robert and Linda Desrochers. The project is a reconstruction of a former dam site. Project features include a concrete headworks, without flashboards, that impounds 200,000 cubic feet of water. A 50 foot long penstock diverts water from the streambed to the powerhouse. A 401 Water Quality Certificate, issued by the DEC in August 1982, conditions the project to operate in a run-of-river mode with minimum instream flow requirements set at 3 cfs in the bypass stream segment.

Emerson Falls:

The Emerson Falls hydroelectric facility is located on the Sleepers River in St. Johnsbury, 2.5 miles above the Passumpsic River confluence. It is owned and operated by Emerson Falls Hydro Inc. and has a generating capacity of 230 kw. The Emerson Falls hydroproject was constructed at a former fish hatchery site. Project features include a 200 foot wide concrete spillway that impounds 0.05 acres. A 42" diameter buried penstock runs 390 feet bypassing water from the stream to a powerhouse below the dam. Below the powerhouse, a 60 foot long tailrace diverts flows back to the river. A 401 Water Quality Certificate was issued by the DEC for Emerson Falls in September 1984 and conditions minimum flows set at 15 cfs in the by-pass stream segment for aquatic habitat and aesthetics/recreation purposes. The project is licensed to operate in a run-of-river mode, and equipment will be installed to record minimum flows and headpond elevations to ensure compliance.

The stream area is designated as a Class B cold water segment and supports rainbow and brook trout populations. Emerson Falls, one of the ten largest cascades in Vermont, is found below the dam site. Due to good water quality and its proximity to St. Johnsbury, the site is popular for fishing, swimming, and picnicking (ANR, Hydro files). Use of the falls have been impaired, however, due to the diversion of the river around both the falls and the pools immediately above and below the falls. A study to determine the minimum flow needed to maintain aesthetics and recreational use for the by-pass is to be completed in 1991.

River use enhancements that have come about as a result of the hydro facilities and their operation include:

* Excellent fish habitat provided in the intake cannel and tailrace areas,
* Improved parking and access for people using the site, and
* Closer supervision and control regarding littering, drinking parties, and other abuses. (7/2/91 letter from Rober F. Desrochers, President, Emerson Falls Hydro, Inc.)

All other streams of the Sleepers River watershed are free-flowing. All village mill sites are no longer in operation.

UVM's School of Natural Resources and the U.S. Army Corps of Engineers' Cold Regions Research and Engineering Laboratory are presently continuing a thirty-plus year data collection effort using the Sleepers River watershed to study the hydrology of a small watershed in the north-temperate latitudes. The Sleepers River studies will attempt to model seasonal watershed discharges especially as they relate to snowpack accumulation and freeze/thraw rates. Long-term stream discharge data of this nature is very rare.

Middle Passumpsic River

SETTING

A nine mile segment of the Passumpsic River mainstem is described for the purposes of this study as the St. Johnsbury segment or that portion of the river from the northern St. Johnsbury townline to the southern townline with Waterford (Figure 21). Two of the Passumpsic River's nine major tributaries, the Moose and Sleepers Rivers, enter the mainstem within the St. Johnsbury segment. The river drops approximately 85 feet within the segment. The river segment is basically flat water as most of this descent occurs at three dam sites.

Aside from the Moose and Sleepers Rivers discussed above, only small brooks with watersheds smaller than 10 square miles are tributary to the St. Johnsbury segment. The drainages of these smaller streams lie almost completely within the Town of St. Johnsbury with the exception of the upper most portion of the Stark Brook watershed in Lyndon.

The Middle Passumpsic River valley is an urban setting, more highly developed than any other area of the Passumpsic watershed. As described for Lyndonville, St. Johnsbury is also a crossroads with a heavily travelled commercial, business and manufacturing district serving many people from surrounding towns. Roads and buildings encroach on one or both sides of the river for the nearly entire nine miles of the segment.

Although the Middle Passumpsic River corridor may be generally characterized as urban-developed, there are a number of segments where the encroachment is limited to less travelled dirt roads and a wider buffer of natural vegetation on the riverbank providing a greater sense of privacy. As with other Vermont rivers, the Passumpsic River in St. Johnsbury provides the most immediate access to a natural or semi-natural setting for people living in the city.

The eastern third of the valley, toward Mt. Pisgah and the Moose River watershed, is higher terrain and small streams, including Roberts Brook, flow through wooded, more remote areas. In contrast, the Stark Brook drainage, west of the Passumpsic mainstem, is a more open watershed with residential and agricultural areas.

MIDDLE PASSUMPSIC WATER QUALITY

The 1990 Vermont Water Quality Assessment reports impairments to aquatic habitat in the entire nine mile Middle Passumpsic mainstem segment. Flow modification at or below hydropower stations and nutrient enrichment below the St. Johnsbury wastewater treatment plant are observed as the primary reasons for the loss of habitat. Very low and fluctuating flows below Pierce Mills and Gage hydrodams have resulted in habitat loss, reduced channel area, temperature increases and a reduction in the wastewater assimilative capacity of the river. Operation of the Arnold Falls dam results in some habitat loss

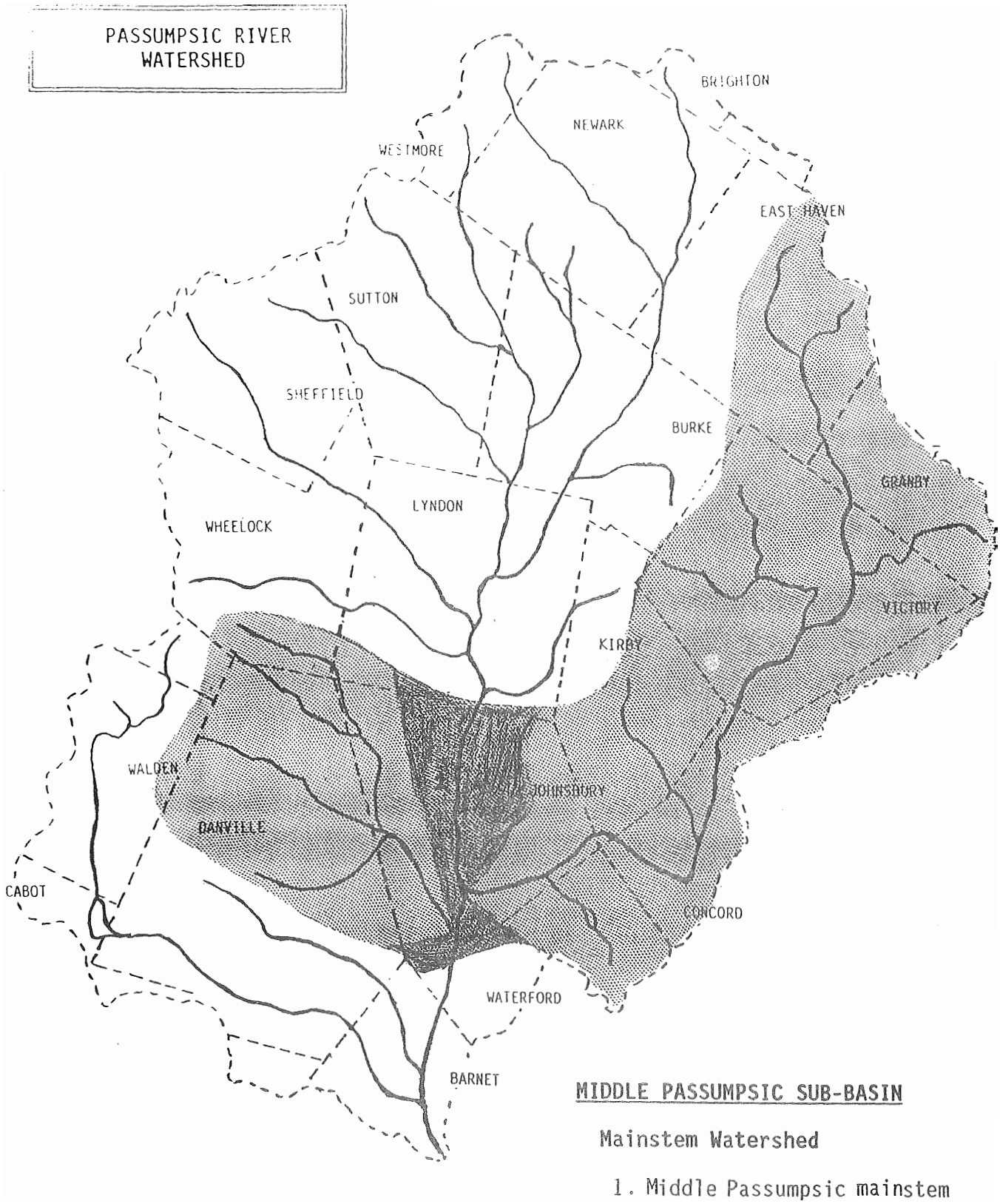

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
MIDDLE PASSUMPSIC SUB-BASIN
Mainstem Watershed
1. Middle Passumpsic mainstem

Figure 21.

in a by-passed segment of the river, but flow modification impacts are partially mitigated by the inflow of the Moose River 100 yards below the powerhouse. Low and fluctuating flows through the City of St. Johnsbury and the resulting high water temperatures reduce dissolve oxygen levels and exacerbate the impacts of nutrient loading from the City's combined sewer overflows and primary wastewater treatment plant. Sedimentation from gravel pit operations are also observed as threats to aquatic habitat.

Preliminary macroinvertebrate studies initiated in the Passumpsic River below hydropower projects during the summer of 1990 show organic enrichment in the river below St. Johnsbury. Below the Gage Dam, high densities of fly larvae (dipterans) were found. Many species in this insect order are pollution tolerant, generalist feeders that rely on algae and decaying organic matter for food. Insect communities sampled above St. Johnsbury have higher percentages of species less tolerant of organic enrichment. The high river flows of 1990 did not give biologists the chance to optimally sample the Passumpsic under habitat conditions stressful to aquatic communities (i.e., typical summer low flow conditions). Ongoing macroinvertebrate studies would provide information on a wider range of factors limiting water quality and document anticipated improvements.

Classification and Drinking Water Supplies

There are no land areas in the middle Passumpsic River corridor above 2500 feet in elevation and therefore no surface waters were automatically designated Class A due to their ecological significance when the Pristine Streams Act passed the State Legislature in 1986. Similarly, no tributary watersheds in the corridor have been designated Class A for domestic water supply. The City of St. Johnsbury relies primarily on surface waters from the Stiles Brook watershed for drinking water. The City does have a emergency well (WHPA #5045), and the St. Johnsbury Fire District #1 relies on a bedrock well (WHPA #5046) in St. Johnsbury Center.

Two segments of the middle Passumpsic River mainstem are classified as Class C waters. A 0.9 mile segment from the EHV Weidmann industrial plant to Stark Brook is Class C water to receive the discharge from the 0.35 MGD industrial wastewater treatment plant at EHV Weidmann. A second 4.8 mile segment, from the upstream city limits of St. Johnsbury to the Passumpsic Dam, receives 0.9 MGD of wastewater from the St. Johnsbury treatment plant. The Class C zone above the sewage treatment plant is presently needed to receive CSO discharges from the City. With the treatment plant upgrade from primary to secondary and the elimination of CSOs by 1993, portions of the St. Johnsbury C zone may be a candidate for reclassification to Class B. All other surface waters in the Middle Passumpsic River corridor basin are managed as Class B waters.

Domestic Wastewater

The City of St. Johnsbury has a domestic sewage collection and treatment system. Through 1990, the wastewater treatment plant, located immediately above the Sleepers River confluence, was a primary treatment operation. The primary treatment process included screening, clarifiers (settling tanks) and chlorination for disinfection. The average daily discharge from the St. Johnsbury WWTP into the Passumpsic River is 0.9 MGD. Solids and bacteria have been reduced in the effluent, however, the plant discharged a considerable organic load to the river. Fine suspended solids increased turbidity. Dissolved nitrogen, phosphorous and carbon as nutrients increased biological activity in the river causing a depletion of dissolved oxygen to toxically low levels. Aquatic habitat in the Passumpsic has been impaired especially during summer low flow periods when the hydropower facilities further reduce flows. Shallow waters are heated rapidly and warm water holds less dissolved oxygen than cold water. Nitrogen in the form of ammonia has been reported as a source of stress on aquatic biota below the plant. During low flow periods, the danger of toxic chlorine levels entering the Passumpsic from the plant was also high.

In 1989, construction began on a new secondary plant at the existing site. The new facility is going on-line in 1991. The new 1.9 MGD capacity, secondary treatment process will include larger primary works plus rotating biological contactors (RPCs), chlorination and dechlorination works. The RBC units contain bacteria which consume organic and nutrients or change them to a chemical state less available for consumption by organisms in the Passumpsic River. Large secondary clarifiers settle out a greater percentage of solids reducing turbidity. The new plant also has a complete laboratory testing facility.

Sewer pipes in St. Johnsbury are combines with twelve different storm water drainage pipes discharging to the Passumpsic River. During rainstorms, raw sewage may be flushed directly into the river. The CSOs in St. Johnsbury are scheduled for separation by October, 1993. At this time, all domestic sewage in St. Johnsbury will receive treatment before discharge to the river.

A large percentage of St. Johnsbury homes and businesses are served by individual septic systems. Local residents have expressed concern for alleged system failures in St. Johnsbury Center along the Middle Passumpsic mainstem.

Industrial Wastewater

Colt Industries, located along the Moose River pretreats metal finishing process water and pipes it to the St. Johnsbury WWTP for further treatment before discharge to the Middle Passumpsic River. Small manufacturers and commercial operations in the City of St. Johnsbury that periodically handle or work with larger volumes of materials containing potentially toxic compounds ship hazardous wastes for treatment and disposal outside the Passumpsic River basin. Any disposal of untreated toxic compounds into the City's domestic

sewage collection system poses threats to the RBC biological treatment units of the new WWTP and ultimately to the Passumpsic river.

North of St. Johnsbury Center, EHV Weidmann Industries operates a 0.35 MGD wastewater treatment plant and discharges directly to the Middle Passumpsic River. The wastewater generated is from a fiberboard mill process. Similar to paper manufacturing, this process results in a wastewater high in organic mater. EHV Weidmann uses a lagoon / filtration system to biologically process dissolved organics and physically remove suspended and particulate organic matter. EHV Weidmann discharges a high quality effluent to the Passumpsic River and received a new five year discharge permit in 1990.

Hazardous Wastes

Hazardous waste sites along the Moose and Sleepers Rivers near their respective confluences with the Passumpsic in St. Johnsbury may impact aquatic habitat in the Middle Passumpsic River, however, this has not been tested for or documented at this time. There are no other known hazardous waste sites in the Middle Passumpsic River corridor area.

Other Wastewater and Nutrient Sources

Stormwater discharges containing urban runoff are the primary source of other wastewaters and nutrient sources entering the Middle Passumpsic River. The Town of St. Johnsbury holds state permits for 13 stormwater discharges into the Passumpsic, most of which also carry domestic sewage during storm events. The Vermont Agency of Transportation holds state permits for five stormwater discharges and Ames Department Store near St. Johnsbury Center has three stormwater discharges to the Middle Passumpsic River. Stormwater runoff from roads, buildings and parking areas may contribute nutrients, sediments, oxygen-demanding wastes, oil, grease and toxic pollutants to the river. The 1990 Vermont Water Quality Assessment does not report urban stormwater runoff as a suspected cause of aquatic habitat impairment in the Middle Passumpsic River. This is not to say that urban runoff is not contributing to the water quality problems in the Passumpsic. The impacts of urban runoff may be over shadowed or masked by the aquatic habitat impacts attributed to hydropower flow modifications, sewage discharges and erosion.

Erosion and Sedimentation

Sand and siltation of the bottom substrate habitat in the mainstem of the Passumpsic River is a major limiting factor to trout fisheries due to the loss of physical habitat (embedded gravels and rubble) and food production. Bank erosion, road washouts, construction-related erosion, hydro impoundment and desilting practices, sand/gravel pit runoff and sediment loads from tributary streams add up to a high degree of sedimentation throughout the 21 mile length of the Passumpsic River.

Due to the surficial geology in the basin, the Passumpsic River is more naturally a sandy-bottomed river compared with other Connecticut River tributaries. Two features related to the glacial history of the basin contribute to a prevalence of fine sediments in the river. An esker, which is a ridge composed of glacial outwashed sand and gravel, extends from the West Burke-East Haven area to approximately two miles north of the mouth of the Passumpsic River. Along the lower portions of the river beginning about three miles north of St. Johnsbury the esker is overlain by glacial lake sediments consisting of silt, clay, sand and gravel. As the Passumpsic River meanders back and forth across the valley, it cuts into the esker and glacial lake sediments, easily eroding these materials into the watercourse.

Over the past century, the St. Johnsbury/Lyndonville area has been recognized statewide as a commercial source of sand and gravel. Mining activities along the river have exposed portions of the esker to erosion. Several gravel pits north of St. Johnsbury predated the Act 250 requirement that exposed sediments be sloped toward the center of the pit and not toward surface waters. Erosion from gravel pits along the Middle Passumpsic River is suspected as a cause of aquatic habitat impairment.

The availability of sand and gravel in the area, make them an inexpensive material of choice for fill at road and construction projects. Being highly susceptible to erosion, exposed sandy grades may be difficult to stabilize before a storm or flood event washes a construction site into the Passumpsic River. A road washout between Great Falls and Pierce Mills dams and floodplain filling in places along the northern half of the Middle Passumpsic River threaten aquatic habitat.

The seven hydropower dams on the Passumpsic mainstem also create sedimentation problems. Sediment loads in the river drop in the back waters of the dam impoundments. Deep layers of silt and sand on the impoundment banks are extremely susceptible to slumping when reservoir heights are lowered rapidly to generate electricity at peak demand times or to repair head works and flash boards on the dam. The river can be observed as muddy during these times. Impoundment desilting to maintain adequate water storage volume is particularly a problem for hydropower projects on the Passumpsic.

The Passumpsic River basin, because of its surficial geology, has a higher propensity for sedimentation of river bottom habitat. The presence of erodible silt, sand and gravel near or along the river floodway and a high level of land and river use activity provide a difficult challenge to minimize the degree to which these activities intensify erosion and sedimentation of Passumpsic River habitats.

Bank stabilization projects along "naturally" sandy Passumpsic River segments should also be pursued with caution. Critical instream habitat in sandy runs, along bank undercuts and grass/shrub/tree overhangs, may be lost with accessive use of rip-rap.

Flow Modification

There are three hydroelectric facilities located on the Middle Passumpsic River within the Town of St. Johnsbury:

Pierce Mills:

Pierce Mills hydroelectric facility is owned and operated by Central Vermont Public Service Corporation and has a generating capacity of 250 kw. Project features include a 30' long concrete dam topped with 18" flashboards. This structure impounds 200 feet of river forming a 25 acre reservoir. A 246 foot penstock carries water to the powerhouse. Total stream bypass is 300 feet, and this bypass section which is a large cascade/riffle area, may receive only leakage flows from the flashboards during low flow periods.

A FERC license was issued in June of 1969 and expires in December 1993. License conditions stipulate that the project operate to enhance power and recreational purposes. No minimum flows are assigned. Central Vermont Public Service reports operation of the project in a run-of-river mode, however, water may be impounded at low flow periods. Operation at Pierce Mills is affected by the Great Falls project upstream.

The site is designated as a cold water fishery with Class B waters. There are native populations and stocking of trout in the project area. The impoundment is used for fishing and swimming. (DesMueles and Parks, 1988)

Arnold Falls:

The Arnold Falls hydroelectric facility is located 5.4 miles downstream of Pierce Mills and 4.0 miles upstream of the Gage Station project. It is owned and operated by Central Vermont Public Service and has a generating capacity of 350 kw. Project features include a timber crib dam, 255 feet long and 18 feet high topped with 18" flashboards, creating a 7.2 acre impoundment. The dam is in two sections separated by an island. About 100 feet of rocky streambed is bypassed to reach the powerhouse.

A FERC license was issued in June of 1969 and expires in December of 1993. CVPS reports that the project operates on a run-of-river basis, however some impounding occurs. The license has no minimum in-stream requirements. Flows at Arnold Falls are dependent on operation of upstream projects.

The stream is designated as a cold water fishery in this stretch and there are populations of brown, brook, and rainbow trout. The river above and below the dam is designated Class C. (DesMueles and Parks, 1988)

Gage Station:

The Gage Station hydroelectric facility is located four miles downstream of Arnold Falls and 1.7 miles upstream of the Passumpsic Station project, just below the confluence with the Sleepers River. It is owned and operated by Central Vermont Public Service Corporation and has a generating capacity of 700 kw. Project features include a concrete dam in two sections with flashboards that impound the river into a 15 acre reservoir; a 90 foot long intake canal; and a powerhouse with two generators. Streambed bypass is 90 feet.

Upstream of the dam, the river is designated Class C to receive discharge from the St. Johnsbury WWTP which is about one mile upstream. The river downstream of the project is Class B. The river is designated as a cold water fishery and supports trout species. (DesMueles and Parks, 1988)

The CVPSC and Lyndonville hydroelectric facilities are believed to result or contribute to the following threats and impairments of the Passumpsic River:

1. Flow regulation reduces the assimulative capacity of the river to recieve wastewater discharges from EHV Weidmann and the municipal treatment plants in Lyndonville and St. Johnsbury. Higher water temperatures and lower dissolved oxygen concentrations are stressful to fisheries and other aquatic biota.

2. Ponding behind the dams reduces river flow to leakage from the cracks between flashboards. Aquatic habitat in the river during these periods may be severely limited.

3. Flucuations in pond height impairs aquatic habitat and aesthetics both in the impoundment and downstream as a result of increased turbidity from slumping banks behind the dams. Pond desilting practices may also increase sedimentation of downstream habitat.

4. Lack of spillage into bypassed river segments results in a dewatering of some of the best rocky/cascade type habitat in the Passumpsic which is important to fisheries and macroinvertebrate production, as well as, aesthetics and recreational use of the river. Water re-aeration is also lost in these segments.

5. The number of dams poses a formidable obstruction to upstream and downstream fish passage and recreational boating on the Passumpsic River.

Aquatic habitat studies are being performed by CVPSC during the 1990 and 1991 summer seasons. The DEC Biomonitoring and Aquatic Studies Unit has also performed aquatic habitat studies on the Passumpsic, including eight years of macroinvertebrate community assessments below the Gage #3 dam. This data is now being analyzed and will be useful in ascertaining past and present aquatic habitat impariments and provide a baseline for future assessments.

As part of CVPSC efforts to relicense hydroelectric facilities at Pierce Mills, Arnold Falls, Gage Station, and Passumpsic Dam, the utility has offered to operate its Passumpsic River projects under a true instantaneous run-of-river mode with constant pond heights. Remediation of the problems stated in #1-3 above will be facilitated greatly with these changes. Minimum flows in the river bypass segments to minimize habitat, water quality and aesthetic concerns are presently under study by the utility. CVPSC has also offered to construct boating portage facilities at dam sites to help recreational use of the river.

LOWER PASSUMPSIC RIVER WATERSHED

A Lower Passumpsic River Watershed is defined, for the purposes of this study, as all drainages entering the Passumpsic River in the Towns of Waterford and Barnet including two major tributaries, the Water Andric and Joes Brook.

Joes Brook

SETTING

The headwaters of Joes Brook are primarily formed by the tributary streams of Steam Mill Brook draining approximately thirteen square miles on the southern flank of Stannard Mountain before meeting Joes Brook in the Town of Walden. The Joes Brook drainage, consisting of 52 square miles in the towns of Walden, Cabot, Stannard, Danville and Barnet, forms the southwest corner of the Passumpsic River watershed (Figure 22). Joes Brook drops throughout its length at fairly even 2% gradient. A mid-course segment of Joes Brook, between the villages of Walden and West Danville, slows considerably as the stream flows through a large wetland and Joes Pond.

The northern third of the Joes Brook watershed, above the village of Walden, is mostly a wooded, roadless area in the Steam Mill Brook Wildlife Management Area owned by the State of Vermont. A gravel/dirt road traverses the upper basin from west to east. Leaving Hardwick on the west, a gravel road enters the Steam Mill Brook watershed and continues to the southern end of Coles Pond. This road serves as an access road for the thirty-four camps on Coles Pond. The road continues eastward into Danville as an unimproved dirt road with only a couple residences along it. The Steam Mill Brook Wildlife Management Area is a steep remote basin with numerous ponds and wetlands along the tributary streams.

The segment of Joes Brook from the village of Walden through Joes Pond to the village of West Danville is the most developed portion of the basin. Running east from Hardwick, Route 15 enters the watershed at Walden Four Corners and follows the brook into Walden and southward to Joes Pond. Route 15 encroaches near the banks of Joes Brook at a few locations, however, the highway and residences along it are for the most part set back from the brook. Pasture, hay field and open meadow are the predominate land uses in the stream corridor from Walden to the large wetland complex at the north end of Joes Pond. Local residents are presently involved in a concerted effort to conserve the values of the Joes Pond inlet wetland complex. Around the shoreline of Joes Pond there are over 225 seasonal camps and year-round residences. Joes Pond is a regional recreation center, highly visited for fishing, swimming and boating.

At the mouth of Joes Pond in West Danville, Route 15 joins Route 2 and heads east into Danville. Here, Joes Brook begins flowing in a southeast direction. The valley steepens again to about a 2% gradient. Overall, the lower Joes Brook valley is rural residential in a woodland setting with some

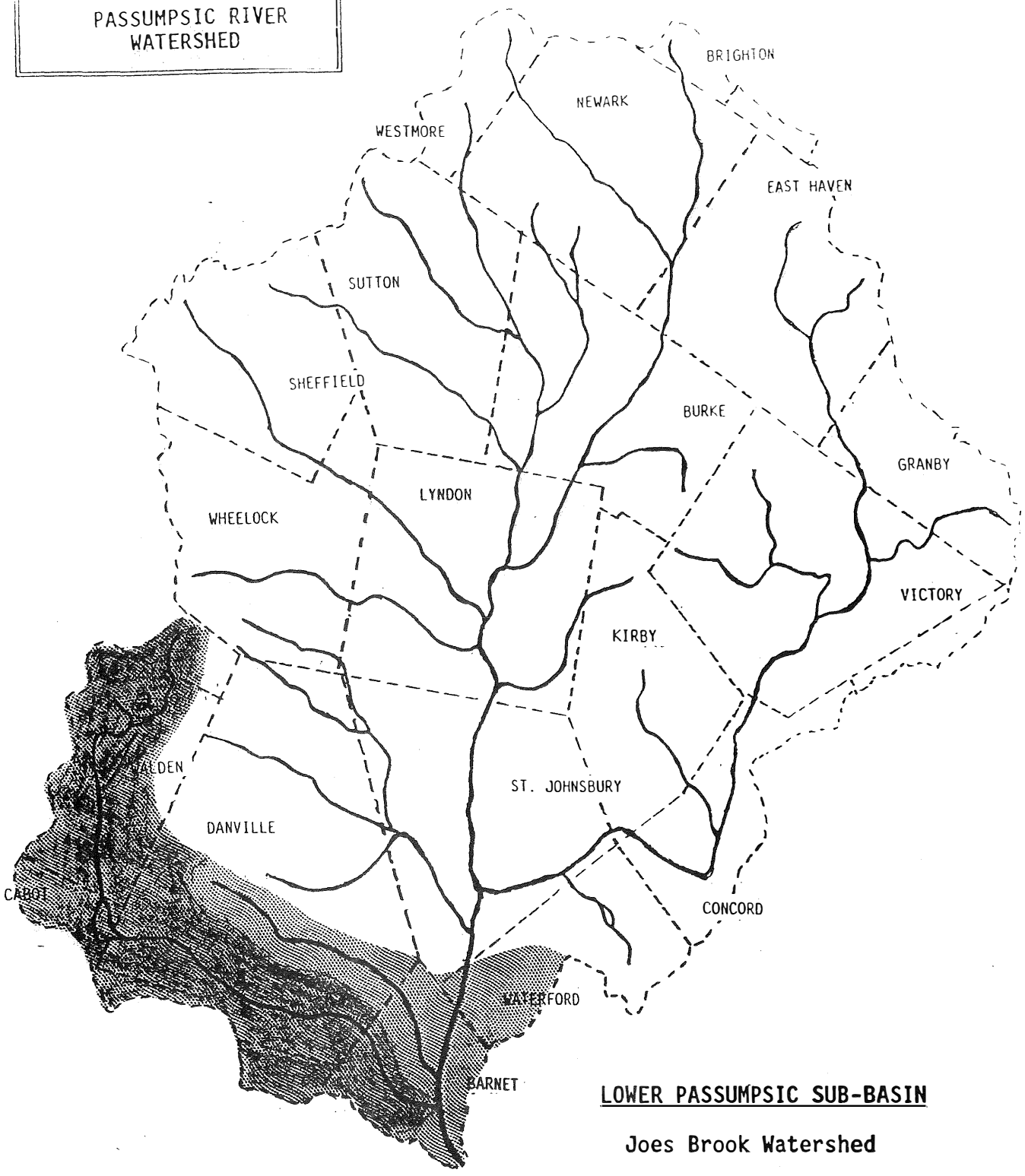

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
LOWER PASSUMPSIC SUB-BASIN
Joes Brook Watershed
1. Joes Brook
2. Steam Mill Brook

Figure 22.

open agricultural land along the brook just above its confluence with the Passumpsic River. A couple stream segments over a mile in length are remote in that no roads or structures come within a quarter mile of the brook.

Brown Brook, Sawyer Brook and Rake Factory Brook flow into the lower Joes Brook drainage. All of these tributaries have watersheds less than 10 square miles in size. In terms of setting, their valleys are very similar to that described for the lower Joes Brook. Brown Brook has a number of large wetlands associated with it, and Sawyer Brook flows through both wetlands and Keiser Pond.

JOES BROOK WATER QUALITY

For the 1990 Vermont Water Quality Assessment, 40 stream miles in the Joes Brook Watershed were evaluated. Water quality of an 8 mile segment of Joes Brook below Joes Pond is reported as impaired in that fisheries are less abundant to non-existent due to hydropower flow modifications. Aquatic habitat in the lowest two miles of Joes Brook is impacted by agricultural runoff and natural streambank erosion. The remaining upstream 30 stream miles in the watershed are reported as having high quality water, fully supporting fisheries and swimming use.

Monitoring of Coles Pond and Joes Pond have produced results showing both lakes to have high quality water supporting all surface water uses. However, threats to lake water quality have been reported. Erosion associated with new housing construction was observed near the inlet on the north and northwest sections of Coles Pond. Joes Pond, with its intensely developed shoreline, is threatened by runoff containing materials similar to those found in urban runoff from buildings, parking areas, etc. Cottage septic systems are, in many cases, close to the lake. System failures may result in nutrient loading and higher bacteria counts in the lake. Some camp owners have complained of aquatic plant growth. According to DEC aquatic biologists' reports, these growths have not reached a "nuisance" level but do merit further monitoring. Joes Pond has a relatively short water residency period meaning water enters and leaves the lake rapidly. This physical phenomenon is thought to be a positive factor in keeping Joes Pond clean.

Classifications and Drinking Water Supplies

There are lands above 2500 feet in elevation in the Joes Brook watershed on Stannard Mountain. However, these land areas are small and no Class A perennial streams exist at these elevations on the mountain. A watershed designated Class A as a municipal water supply is located on the headwaters of Brown Brook. Approximately two miles of stream above the Danville Reservoir and its tributaries form this Class A watershed. A Wellhead Protection Area (WHPA #5037) is located within the Brown Brook Class A watershed and consists of two springs. The Danville Fire District #1 utilizes both the reservoir and

springs as water supplies. No Class C waters are designated within the Joes Brook watershed, therefore, all other streams, lakes and ponds are managed as Class B waters.

Domestic Wastewater

A domestic sewage collection system is used in the Village of Danville which straddles the Brown Brook and Water Andric watersheds. The Danville sewage treatment plant discharges to the Water Andric and will be discussed later in the Lower Passumpsic River section. All other domestic sewage is disposed of using septic systems at individual dwelling or commercial sites. Septic systems at camps and residences around Joes Pond are very close to surface waters. Possible failure of these systems threatens use of the lake for contact recreation.

Industrial Wastewater

There are no manufacturers in the watershed which produce wastewater in an industrial process requiring treatment and direct discharge (via a pipe) into Joes Brook or one of its tributaries.

Hazardous Wastes

There are no active or inactive commercial, industrial or landfill sites in the Joes Brook watershed where hazardous wastes are known to be threatening surface or ground waters.

Other Wastewater and Nutrient Sources

Organic enrichment of a two mile segment of Joes Brook just above its confluence with the Passumpsic River, as a result of manure pit runoff, has been reported in the 1990 Vermont Water Quality Assessment. Due to the lack of water quality or biomonitoring data from the lower Joes Brook segment, it is not known at this time what level of impact, if any, has occurred in aquatic habitats. The steep gradient of Joes Brook creates riffle areas that replenish the dissolved oxygen levels that may become low as a result of biological activity being fed by organic and nutrient enrichment.

Erosion and Sedimentation

Natural streambank erosion along the lower two mile segment of Joes Brook is suspected of impacting aquatic habitat. The steeper gradient in this segment minimizes the direct impact to Joes Brook. Sediments deposited in the lower segment are scoured and transported into the Lower Passumpsic River. It is not known at this time whether logging, agriculture or gravel mining taking

place in the Joes Brook watershed are resulting in any appreciable erosion impacts to surface waters. Construction activities around the basin's lakes and ponds have resulted in erosion and sedimentation.

Flow Modification

There is one hydroelectric facility on Joes Brook that modifies the flow of the stream:

West Danville:

The West Danville project is located at the outlet of Joes Pond. The project is owned and operated by Green Mountain Power and has a generating capacity of 1,000 kw. Project features include a 50 foot dam and a 33' long spillway. Flashboards create an impoundment of 219 acres, and a 2,002" penstock extends from the intake to the powerhouse. The stream bypass is over 2,000 feet long.

Application for a license was dismissed by FERC in May of 1979, and according to Green Mountain Power's license application of August 1965, operation of the dam is subject to a 1926 agreement between Eastern Vermont Public Utilities Corporation and Joes Pond Association. Power generation is limited to morning hours and generally ceases during the summer under low flows. During drier seasons, leakage flows through the flashboards are the only flows that reach the natural streambed bypassed by the penstock.

Joes Pond supports a variety of lake fisheries, and the brook downstream of the powerhouse supports trout species. The outlet brook is designated as a Class B water. (ANR, Hydro Files).

A 0.4 mile segment of Joes Brook below the dam is severely impacted. Were it not for leakage flows at the dam, this segment would be completely dewatered during drier periods when power is being generated. Beginning at the powerhouse to a distance 7.6 miles downstream, aquatic habitat is also reported to be degraded due to low and fluctuating flows (DesMueles and Parks, 1988).

Lower Passumpsic River

SETTING

A lower six mile segment of the Passumpsic River mainstem in the towns of Waterford and Barnet begins at the St. Johnsbury/Waterford townline and ends at the Passumpsic's confluence with the Connecticut River (Figure 23). The Passumpsic River flows as nearly flatwater, dropping only 60 feet in elevation throughout this lower segment. A majority of this drop occurs between the two hydropower dams, one each in the villages of Passumpsic and East Barnet.

In addition to Joes Brook already discussed, the Water Andric and Simpson Brook are tributary streams of the Lower Passumpsic River. The Simpson Brook watershed (five square miles) is located almost entirely in the town of Waterford and meets the Passumpsic just as the river enters Barnet in the village of Passumpsic. The Water Andric watershed (13 square miles) begins in the town of Danville and flows nine miles to confluence with the Passumpsic River in the Town of Barnet.

The River Road and Route 5 highway closely parallel the Passumpsic River on the east and west, respectively, and Interstate 91 follows the Passumpsic River valley on the east. The Canadian Pacific Railroad also follows the river valley, crossing the river a total of eight times before entering the City of St. Johnsbury. Unlike the Upper and Middle portions of the mainstem valley, the Lower Valley is a busy travel corridor but does not have a large population center such as Lyndonville or St. Johnsbury. Two villages, Passumpsic and East Barnet, are near the banks of the Passumpsic at river cascades that were first developed as mills and now as hydropower sites.

The Lower Passumpsic valley is relatively narrow between steep wooded hills. Within wider meanders of the river there are fertile flood plains where farming is practiced. When driving along the Lower Passumpsic River, the feel is that of a rural agricultural setting. The roads encroach on the river banks in many locations; however, in places where the valley narrows, the river corridor is a more wooded, natural setting. The lowest quarter mile of the Passumpsic leaves East Barnet and enters the Nine Islands wetland complex on the Connecticut River.

The Water Andric begins in open rural residential areas just north and east of the Village of Danville. After crossing under Route 2, the stream drops steeply through a 7.5 mile forested valley. Dirt roads follow the Water Andric in places, but encroachment is limited and the stream corridor is only sparsely inhabited.

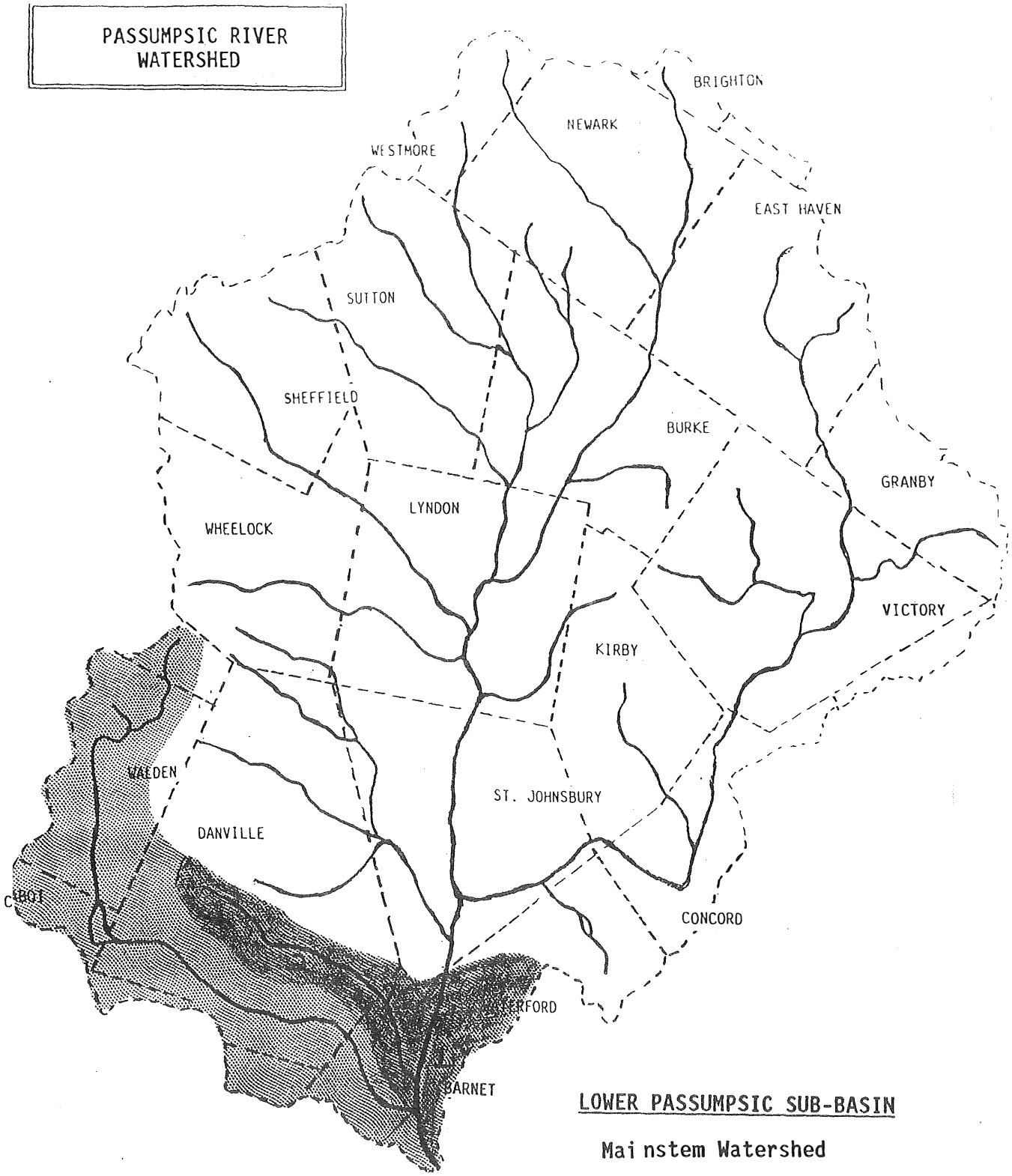

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WAEDEN
ST. JOHNSBURY
DANVILLE
CONCORD
BARNET
LOWER PASSUMPSIC SUB-BASIN
Mainstem Watershed
1. Lower Passumpsic mainstem
2. Water Andric

Figure 23.

LOWER PASSUMPSIC WATER QUALITY

The Vermont Department of Environmental Conservation has completed a biomonitoring assessment of aquatic habitat in Water Andric and found that the stream supports a good macroinvertebrate community. The study was completed to assess the impacts of the Danville wastewater treatment plant located immediately below Route 2. The 1990 Vermont Water Quality Assessment does not report impacts or loss of habitat in Water Andric and gives no information on Simpson Brook.

The entire six mile mainstem segment of the Lower Passumpsic River is impacted by nonpoint sources of pollution. From Gage Dam to the East Barnet Dam, aquatic habitat and fisheries populations are impaired due to low and fluctuating flows below the hydropower projects. Channel area is reduced during low flow periods, temperatures increase, assimilation of other wastewaters is reduced and impoundment drawdowns result in the entrainment of large quantities of silt. Some improvement in these conditions occur below the East Barnet dam where a minimum flow release is required for the operation of the hydropower project. Other sources of nonpoint pollution to the Lower Passumpsic include runoff from pastureland and the Barnet landfill. The landfill is also a gravel mining operation so that leaching of toxic organics is a concern, as well as erosion and sedimentation (Vermont Water Quality Assessment, 1990).

Classifications and Drinking Water Supplies

No Class A surface drinking water supplies are taken from the Lower Passumpsic, the Water Andric or their smaller tributaries. Residents and businesses of Danville, Waterford and Barnet in the watershed utilize ground water for drinking supplies. The village of Passumpsic is served by three springs and two gravel wells (WHPA #5031) which are privately held by Passumpsic Aqueduct System Inc., which serves 35 customers. Unsafe levels of coliform bacteria and nitrates have been found in this water supply necessitating boiling the water before use. Nearby septic systems, agricultural land and state highways are suspected sources of the contaminants. The water users are presently seeking an economically feasible solution to comply with an EPA compliance order.

The Water Andric, from the Danville Municipal Wasterwater Treatment Plant outfall to Lime Brook, a distance of approximately 3.8 miles, is a designated Class C zone. This C zone was established before the WWTP was constructed and is now being recommended for shortening to one mile in length due to the fact that the Danville Plant provides a secondary (high) level of treatment. All other surface waters in the Lower Passumpsic corridor and Water Andric watershed are managed as Class B waters.

Domestic Wastewater

The Village of Danville has a 0.06 MGD wastewater collection and treatment facility. The wastewater treatment plant consists of two aerated lagoons in series and biologically treats wastewater to a "secondary" level. Water leaving the lagoons is disinfected of bacteria with an ultraviolet light system before being discharged to the Water Andric. Danville is permitted to discharge from October through April and then on the basis of adequate flows monitored in the Water Andric during the low flow season. Operation and maintenance reports indicated that the Danville WWTP is operating as designed. No known industrial wastewaters that may contain toxic organic or inorganic substances are being discharged to the WWTP.

All other domestic wastewater in the Water Andric and Lower Passumpsic River corridor are being treated and disposed of using individual septic tank and leachfield systems. Local residents have alleged that septic system failures in and around the village of Passumpsic may be impacting the river.

Industrial Wastewater

There are no manufacturers in the Water Andric watershed or Lower Passumpsic River corridor which produce wastewater in an industrial process requiring treatment and direct discharge (via a pipe) into the Lower Passumpsic or one of its tributaries.

Hazardous Wastes

The Barnet landfill has been serving the towns of Waterford and Barnet since 1969. Solid wastes are dumped into a mined gravel pit area approximately 250 feet from the Passumpsic River. The road used for transporting wastes to the fill area is much closer to the river, separated only by a 20-30 foot dirt berm. An EPA Preliminary Assessment involving ground water test monitoring wells was completed in 1989. Leachate in one of the wells was discovered to contain an EPA priority organic compound. Continued monitoring and an EPA site investigation will be pursued in the future. Due to the small volumes of hazardous materials known to have been dumped, the Barnet landfill has not become a high priority site. Continued use of the Barnet landfill is not expected past 1992. At that time the dump will be "capped" and revegetated. Closure will decrease infiltration and leaching of hazardous materials toward the river and groundwater supplies.

Other Wastewater and Nutrient Sources

Pastureland runoff from farms is noted in the 1990 Water Quality Assessment as contributing to the impairment of aquatic habitat in the Lower Passumpsic River. Organics and other biological nutrients such as nitrogen and phosphorous are leaching from animal wastes, ultimately creating a greater

oxygen demand on the aquatic ecosystem of the river. Lower oxygen levels increase the stress on fisheries, especially trout species. Temperature modifications resulting from flow regulation, domestic waste discharges and nonpoint sources of nutrients such as farm and logging runoff, all have the potential to increase the oxygen demand in surface waters. Quite often it is accumulative effects of these pollution source which result in the impairments documented in fisheries assessments.

Erosion and Sedimentation

As with other large rivers in Vermont, the river bottom of the Lower Passumpsic is a natural depository of sediments that have been eroded from points higher in the watershed. Where the flows flatten in velocity, the bedload entrained in the water column falls out. For this reason, it is more difficult to assess increases in sedimentation of river bottom habitats in large rivers. The stormwater runoff from highways and dirt roads following the Lower Passumpsic are suspected sources of sediments in the river. The U.S. Soil Conservation Service has identified the following bank erosion sites on the Lower Passumpsic mainstem:

Table 7.

Location of Slumping Streambank	Length (ft)	Av. Tons/Year
Near the of Joes Brook Road	200	45
Across & upstream of Joes Bk. mouth	800	432
Just upstream of the previous site	800	180
Just below Passumpsic Village	200	36
Above Passumpsic Dam	1200	324
LaMothe Meadow	600	162
Below Gage Power Station	300	20

The hydropower projects may not increase the amount of sediments moving through the river drainage system, however, wave action due to fluctuations in pond height disturbs silts and sands deposited on the banks of the impoundments keeping them entrained in the water column. This results in very high levels of turbidity in the river when the river would normally be quiet and clear. Power company operations to desilt the reservoirs behind their dams at times when the river can not hydrologically "clean" itself is an extreme situation affecting aquatic habitat.

Flow Modifications

The Gage hydropower dam is located approximately 1200 feet upstream of where the Lower Passumpsic River segment begins and, therefore, the facility impacts both the Middle and Lower Passumpsic. Two hydroelectric facilities are located on the Lower Passumpsic River:

Passumpsic Dam:

The Passumpsic Dam is in Barnet in the village of Passumpsic, 1.7 miles downstream of Gage Station. It is owned and operated by CVPSC and has a generating capacity of 700 kw. Project features include a concrete dam, 258' long with two spillway sections creating an 18.3 acre reservoir. An 87 foot canal diverts flows to the powerhouse. The project bypasses about 500 feet of a cascade/riffle segment of riverbed. A FERC license was issued in February 1970 and expires in December, 1993. CVPSC reports the project is operated in a run-of-river mode; however overnight ponding of the river does occur. The Passumpsic Dam is dependent on operation of upstream projects (DesMueles and Parks, 1988).

East Barnet:

The East Barnet facility is owned and operated by CVPSC and has a generating capacity of 2,200 kw. This facility is a reconstruction of a former mill site and impounds 2 miles of river into a 24 acre reservoir. There are no flashboards. Below the powerhouse, a 300 foot long tailrace diverts flows back to the river. A 401 Water Quality Certificate was issued in March 1982 and conditions the project to be operated in a run-of-river mode. Under low flow conditions, minimum flows of 100 cfs are required. The stream area is designated as a cold water fishery. There are populations of rainbow, brook, and brown trout, as well as smallmouth bass. (ANR Hydro Files)

See the "Flow Modification" section for the Middle Passumpsic River for a more detailed description of threats and impairments resulting from the seven Passumpsic River hydropower projects.

The Water Andric and all other small tributaries entering the Lower Passumpsic River are free-flowing.

PASSUMPSIC RIVER WATER QUALITY SUMMARY

The 1990 Vermont Water Quality Assessment has been cited throughout the preceding discussion on existing water quality threats and impairments in the Passumpsic River watershed. The Assessment contains the most complete evaluation available on the use of 340 miles of rivers and streams in the basin for fisheries habitat and swimming.

Overall, a majority of rivers and streams in the Passumpsic River basin have high quality waters that meet the goals of the Clean Water Act. The fishable goal is met in 76% of Passumpsic basin watercourses. Headwater streams are in very good condition, whereas, pollution sources have either partially or completely impaired aquatic habitat in lower reaches including the entire mainstems of the Passumpsic and Sleepers Rivers and lower segments of the East Branch, Moose River, and Joes Brook.

There are 16.2 miles of Class C waters in the basin which by definition are not designated for contact recreation. Of the remaining Class A and B waters, only a half mile of swimmable waters are recreationally impaired due to lack of flows below hydroelectric dams.

A Passumpsic River basin map which follows (Figure 24) shows the status of aquatic habitat. Swimming use impairments are not included because only 0.5 mile of the stream miles desnated for swimming use are known to be unusable for swimming. Segments are marked showing where habitat is impaired, where they are thought to be only partially impaired, and where fisheries are presently supported but aquatic habitat is threatened. Unmarked river and stream segments are thought to have high quality habitat for aquatic biota and there are no known threats or impairments.

Following the basin map is a summary table showing the sources of water quality threats and impairments in the Passumpsic Basin. All streams with a watershed greater than 10 square miles are shown on the table regardless of whether there are known water quality problems. Roundy, Dish Mill and Stiles brooks were also included. Streams and rivers were placed along the top of the table in the order they were discussed in the previous text, which follows a hydrological order from upstream to downstream in the watershed.

Without information obtained through river monitoring programs, it is difficult to determine the actual magnitude of pollution problems. For this reason, only a relative assessment was made based on field observations by local residents and State and Federal resource managers involved with the Passumpsic River. The status assessment included in the table ascertains what is currently being done to improve the usefulness of Passumpsic waters and what actions might be targeted in the future.

The water quality summary discussions that follow group stream and river segments by size, looking at issues related to headwater streams, large tributaries and the Passumpsic mainstem. Based on the status of corrective actions either suggested or currently underway, a list of unresolved water quality issues is offered along with possible ways to remediate known problems and investigate those where the level of impact is unknown.

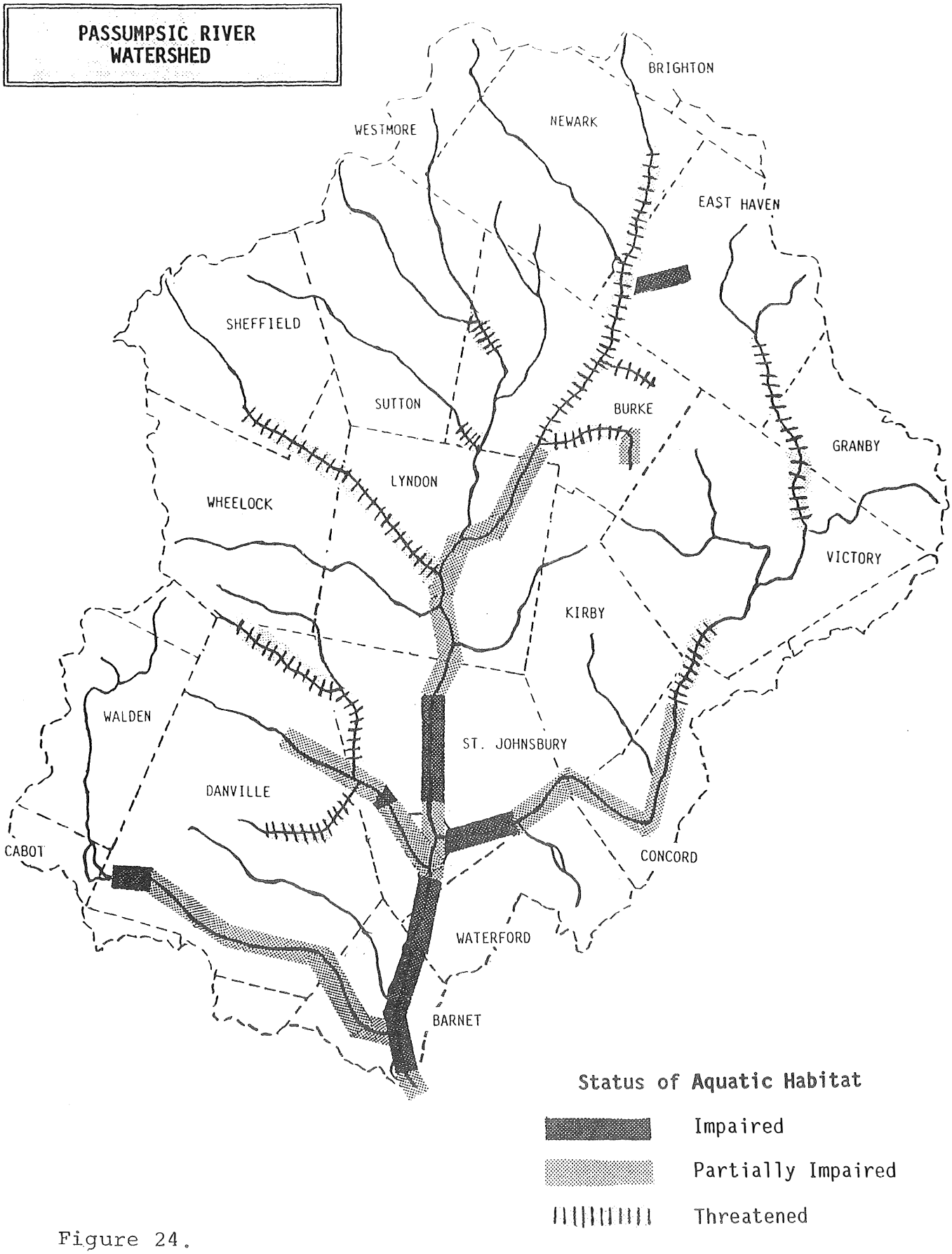

PASSUMPSIC RIVER WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SHEFFIELD
SUTTON
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
Status of Aquatic Habitat
Impaired
Partially Impaired
Threatened

Figure 24.

Headwaters of the Passumpsic River

Some of Vermont's most pristine waters are found in the headwater regions of the Passumpsic River watershed. These streams flow through wildland areas that are predominately woodlands and wetlands with only sparse settlement or other land uses that might contribute pollution. Some headwater streams may one day be more susceptible to impacts in that roads systems provide ready access to future development. In the same vain, some of Vermont's vast roadless areas include Passumpsic headwaters areas. Tributaries of the East and West branches, the Moose and Sleepers rivers and Joes Brook are notable examples.

Developments associated with the Burke Mountain Ski Resort threaten Dish Mill Brook and its tributaries. Studies conducted in Dish Mill indicate a healthy aquatic ecosystem and a good brook trout fishery. However, continued urbanization of this small watershed may necessitate an ongoing program to monitor water chemistry and sedimentation of aquatic habitats.

Although little scientific analysis has been completed, logging, and to a lesser extent farming practices, are percieved as threats to Passumpsic headwater streams. Logging, which is a chief industry throughout northeastern Vermont, is the predominant livelihood in the mountain woodlands of the Passumpsic Basin. Some headwater areas are farmed but not to the extent seen lower in the major tributary valleys. Above-normal turbidity and stream sedimentation have been observed below logging jobs in Passumpsic woodlands and at times severe washouts occur resulting in longer term impacts (Vermont Agency of Natural Resources, 1990). It is unknown to what extent the removal of streamside vegetation is occurring.

Vermont's Forestry Department has adopted 24 Acceptable (forestry) Management Practices (AMPs), which if followed on a logging job will protect water quality. Vermont Timber Truckers and Producers Association (VTTPA), State foresters, and State water quality investigators have worked out a cooperative agreement for voluntary AMP compliance monitoring. A VTTPA representative, who attended the March 1990 Passumpsic Issues/Actions Workshop in St. Johnsbury, offered the following procedure should a logging related problem be identified in the Passumpsic River basin:

* identify the location of the logging operation,
* identify the logger involved (if possible),
* identify the land owner,
* a VTTPA representative and State forester will visit the site and work with the logger to implement AMPs and eliminate the discharge,
* follow up visit to see if problem(s) are resolved,
* State water quality investigators will only be called in if the logger refuses to implement AMPs and the discharge continues.

A few small tributary streams enter larger rivers in villages that may have sewage or solid waste problems. The Sutton River and South Wheelock Branch are examples. Very short stream segments of these small tributaries

may be affected before the pollution is diluted in the larger rivers; however, the proximity to population centers makes these waters especially important. Safe, clean water in the "village" segments of small streams is a priority due to the high use of swimming holes in or near village centers.

Major Tributaries of the Passumpsic River

The **East and West branches** in the towns of Burke and Lyndon; **Miller Run** in Sheffield, Wheelock, and Lyndon; **Moose River** in Concord, Kirby, and St. Johnsbury; **Sleepers Rivers** in Danville and St. Johnsbury; and **Joes Brook** in Danville and Barnet are described as major tributary segments of the Passumpsic River. Generally, the setting for each of these rivers is described as rural residential/agricultural. Each flows through one or more small villages and all but Joes Brook enters the Passumpsic River in the urban settings of either Lyndonville or the City of St. Johnsbury.

The West Branch of the Passumpsic River is perhaps the least impacted major tributary in the basin in terms of known pollution sources. The village of West Burke is the only population center along its banks. Encroachment is minimal along the West Branch due in part to the extensive wetlands along the stream corridor. The bacteria data collected by citizens indicates possible septic system problems in the West Burke area. Sampling should continue to find and correct problems that might affect use of the West Branch for swimming.

Domestic wastewater discharges may also be a problem for other major Passumpsic tributaries, but to differing degrees. Raw sewage from Hartwellville has been entering the East Branch since the failure of the development's treatment plant. This problem is currently being corrected with the emplacement of a new system. Combined sewer overflows discharging raw sewage to the Moose and Sleepers Rivers in St. Johnsbury are also in the process of being corrected. Construction was completed in summer 1990 on pipes entering both these tributaries. All are slated for separation by October 1993.

Straight pipes and failed leachfields adjacent to the Moose River have been reported from Concord village to St. Johnsbury. Several corrections have been made; however, domestic wastewater discharges, especially in the East St. Johnsbury area, continues to be one of the largest pollution problems in the lower Moose. The aquatic habitat in the lower two miles of the Moose River is reported as impaired due to high temperatures and wastewater assimilation problems. Some of the highest bacteria counts found at major tributaries sites by the 1990 citizens sampling project were those of the lower Moose River. Citizen's data also indicates high bacteria counts in the Miller Run, Sleepers River, and Joes Brook. Further study is recommended before drawing conclusions on the existence of specific wastewater discharges and the potential threats they may pose to these rivers.

Municipal landfills, junkyards, or buried waste dumps pose threats to all major tributaries of the Passumpsic River except Joes Brook. Large hazardous wastes sites adjacent to rivers in Lyndonville and St. Johnsbury may pose serious threats to water quality. All sites are under study by the Vermont Department of Environmental Conservation and the Federal Environmental Protection Agency. No actions to correct these problems are currently underway, with the exception of the fuel oil recovery project at the Fairbanks Morse site along the Sleepers River in St. Johnsbury.

Nutrient loading from agricultural runoff is the suspected cause of aquatic habitat impacts in the East Branch, Millers Run, Sleepers River, and Joes Brook. The extent of pastureland adjacent to the Miller Run from Sheffield to Lyndonville may be particularly troublesome to aquatic life and fisheries due to the lack of streamside vegetation that may lead to higher turbidity and sedimentation rates and lower oxygen levels from increased temperatures and waste assimilation conflicts. The U.S. Soil Conservation Service in St. Johnsbury is active with local farmers in stabilizing streambanks. Further implementation of Accepted Agricultural Practices (AAPs) as defined by the Vermont Department of Agriculture will greatly reduce the pollution threats posed by farming in the Passumpsic River Basin. The AAPs call for storing manure away from watercourses and providing vegetated buffer strips along streams to reduce nutrient runoff and erosion.

Erosion and sedimentation are the among the greatest impediments to maintaining high quality aquatic habitat in the Passumpsic River Basin. This may be especially true in major tributaries where there are courser gravels and rubble used for fish spawning and food production, now clogged with fine silts and sands. Comparing major tributaries, the Miller Run and Moose and Sleepers rivers experience the greatest streambank erosion. In all three rivers, natural bank slumpage is exacerbated by land use activities such as livestock grazing or the removal of streambank vegetation.

Gradient and watershed hydrology are significant factors in determining the ability of a river to "cleanse" itself of accumulated sediments. The lower Moose River is free-flowing, has greater flows and is relatively steep in gradient. This is perhaps why sedimentation of river bottom aquatic habitat is not apparent in the lower Moose River.

The Miller Run has nearly a flat gradient, and although bank slumpage may be no more severe than that seen along the Moose River, accumulated sediments are not transported as readily. The Miller Run is threatened by excessive sedimentation. The Sleepers River in recent years has been naturally eroding several very steep banks. It is not known at this time whether hydroelectric dams, logging activities or increased development in the basin have had any hydrological effects influencing the rate of erosion.

Joes Brook and the Sleepers River have altered flows. All other major Passumpsic River tributaries are free-flowing, which is significant in that nearly every village in the basin at one time had a mill powered by the river. In the Joes Brook watershed, flow modifications at the Green Mountain Power

hydroelectric facility at Joes Pond are the greatest source of water quality and aquatic habitat impacts. Low flows in the long bypass stream segment below the dam are suspected of causing an undue adverse effect to the aquatic biota and fisheries. If verified, this would constitute a violation of the Vermont Water Quality Standards. Water releases may be negotiated under the authority of State stream flow statute, 10 V.S.A. S.1003.

The hydroelectric projects on the Sleepers River are both operated as run-of-river projects with minimum flow requirements in the by-pass stream segments. The remaining issue is that of providing sufficient flows in the by-pass at Emerson Falls for aesthetics and recreational uses. A study involving demonstration flows at the Falls will be completed in 1991. The results will be used to amend the State 401 Certificate and modify operation of the project to meet the FERC requirements.

Mainstem of the Passumpsic River

The entire 22 miles of the Passumpsic River mainstem is assessed as having impaired aquatic habitat to the degree that fish populations are either limited or non-existent. The problems facing the Passumpsic River fall under all six pollution source categories discussed earlier. However, several sources stand out as major problems, and the status of corrective measures must be studied to understand what future water quality issues are expected.

Untreated or partially treated domestic sewage has been the nemesis of the Passumpsic River for decades. In comparison with other major Vermont rivers that flow through large population centers it is one of the last to have these problems fully addressed. Treatment plants inefficient at removing nutrients and combined sewer overflows entering the river have justifiably given the Passumpsic a reputation as a "dirty" river. Urban and agricultural runoff have also been cited as sources of nutrients and pollutants affecting the Passumpsic River mainstem. The problems associated with high oxygen-demanding wastes have been made more severe by the low flows, higher temperatures and lowered reaeration caused by flow regulation at the seven hydroelectric dams along the length of the river.

Major improvements in the water quality of the Passumpsic River mainstem are anticipated in the next five years. Improvements in the Lyndonville WWTP, enlargement and upgrading of the St. Johnsbury WWTP and the correction of all combined sewer overflows by 1993 have and will continue to dramatically reduce the waste loading into the Passumpsic. With Central Vermont Public Service Corporation's offer to relicense (in 1993) its Pearce Mills, Arnold Falls, Gage Dam, and Passumpsic Dam facilities with a true instantaneous run-of-river operating mode, all seven Passumpsic mainstem hydropower projects will then be anticipated to release the same amount of flow below the powerhouses that enter at the head of the impoundments. Lower waste loads and more constant flows will equate to improved wastewater assimilation, a "cleaner" river and better prospects for additional use of the river for swimming and aquatic habitat.

Uses and values associated with the short river segments between the dams and the powerhouse tailraces, known as "by-pass" segments, include habitat for fish and other aquatic biota and riffle/cascade areas valued for water aesthetics and re-oxygenation. By-passes at Pierce Mills and the Gage Dam have relatively high fisheries value. The Agency of Natural Resources has requested that CVPSC complete habitat studies in these by-passes to determine what minimum flows will be spilled over the crest of the dam to improve and then maintain fisheries values.

The by-passes at Arnold Falls and Passumpsic Dam also have habitat values. However, the amount of useable habitat in these segments, due to short length or steepness, does not warrant the level of study asked for at Pierce Mills and Gage Dam. In lieu of any studies at Arnold Falls and Passumpsic Dam, State fisheries managers have recommended 7Q10 flow values for setting minimum spillage flows. These are equal to the lowest mean flow measured for seven consecutive days having a 10% chance of occurring in any given year in the Passumpsic River. The Agency has agreed to accept the use of flow demonstrations at Arnold Falls and Passumpsic Dam to determine the adequacy of flows even lower than 7Q10 for habitat needs should other studies demonstrate that these lower flows maintain the aesthetics and reaeration values of the river.

The Passumpsic River mainstem was referred to by native americans as the "clear sandy-bottomed river". The glacial and post-glacial history of the basin explains the deep layers of fine sediments through which the Passumpsic carves its way enroute to the Connecticut River. There are long segments of the Passumpsic that are shallow sandy runs or have become sand-filled impoundments behind dams. Therefore, those places in the river where the gradient is a little steeper and the bottom substrate is gravel and rubble-size rocks are extremely valuable as habitat for fish and other aquatic biota. Increased sediments from road washouts, floodplain filling, construnction-related erosion, bank slumpage, and dam operations have resulted in a loss of aquatic habitat in the Passumpsic River mainstem. With improvements in wastewater treatment and flow modifications, the sedimentation of pools and riffles and the loss of habitats associated with undercuts lost through riverbank slumpage may become the next greatest limiting factors to biotic productivity of the Passumpsic River.

In accordance with the Vermont Water Quality Standards, appropriate desilting practices are requested as a license condition for the operation of CVPSC and Lyndonville Electric hydropower facilities on the Passumpsic River. Timing the removal of accumulated sediments from behind dams in relationship with the river's hydrological capability to transport a higher sediment bedload is critical in avoiding undue adverse affects to aquatic habitats. Maintenance of riverbank vegetation and erosion controls practices for logging, road maintenance, and construction projects are recommended to minimize river sedimentation.

Two EPA Superfund hazardous waste sites are near the Upper Passumpsic River mainstem and buried industrial waste dumps are located along several major tributaries near their confluence with the Passumpsic. These sites are being monitored for both surface and subsurface water quality impacts. Remedial Feasibility Studies to treat hazardous leachates are underway for the Darling Hill and Parker landfills in Lyndon.

Perhaps the most recently identified water quality problem for the Passumpsic River is that of public perception. The river has improved from the days when it truly was a "dirty" river, and it is getting better. The Passumpsic has the capacity to keep on working, as well as become a place to visit and enjoy.

SECTION III

RECREATIONAL AND CULTURAL RESOURCES INVENTORY

OF THE

PASSUMPSIC RIVER BASIN

RECREATIONAL AND CULTURAL RESOURCES OF THE PASSUMPSIC RIVER BASIN

INTRODUCTION

The following inventory of recreational uses and cultural resources in the basin includes boating and fishing, as well as the scenic, historic and natural areas where the individual or classroom can go to observe rivers, the wildlife that lives there, and places that show how people coexisted with the river in the past. A listing and description of public access areas to streams and rivers of the Passumpsic basin is included to assess the different kinds of opportunities people have to see and use the river.

This section also addresses issues local residents have expressed concerning the lack of recreation opportunities in the Passumpsic watershed and what might be done to improve the situation. The same sub-basin format used in the water quality section is used here, where appropriate, to better understand the issues and conflicts often involved with different river uses and values.

PUBLIC COMMENTS

Scenery and Aesthetics

* I like the river because it is there.
* I like the rivers because they're beautiful to look at.
* I like the aesthetic quality of the rivers in the Burke area.
* I just like to look at the river, including Arnold Falls. I like to check out Emerson Falls in the spring.
* The river banks are cleaner than those of rivers in other states.
* Surface waters provide important aesthetic value.
* The river and its tributaries are lovely. Its like our communities.

* I don't like trash especially around towns, on the banks and in the river. (3 people)
* I don't lie the Barnet town dump along the river. (3 people)
* I don't like rubbish on riverbanks.
* I don't like the land fills.
* Trash removal is needed.

* The river has interesting geology.
* I don't like that the falls and cataracts are dammed.
* I don't like the loss of geologic features.
* I don't like the graveling scars.

* Restore scenic aspects. (2 people)
* Restore the scenic aspects of the river. Cleanup the Barnet dump and restore the site.

* I don't think that many people comprehend what a treasure we have in the town of Barnet. The stretch of river from the East Barnet dam to the confluence with the Connecticut, and on down to the dam in McIndoe Falls is one of the finest in New England in terms of scenic beauty, challenging canoeing,

and historical significance. With the singular exception of a recent gazebo, the banks are unencumbered by structures. The waters are cleaner than ever, and offer trophy trout and smallmouth. The geology alone is remarkable in places. I almost always see osprey here, and bald eagles frequent the place. The perspective given at the scenic overlook is grand, and yet there are no roads close to the river banks to spoil the quiet splendor of so much water moving towards the sea. And finally, there are the tracks of the Canadian Pacific, which make a perfect parallel footpath.

Public Access, Boating, River Parks, and Swimming

* We need more access points along the river. (4 people)
* We need more public use/access for recreation. (2 people)
* I like being able to access rivers.

* I like canoeing and the canoe race.
* Local Boy Scouts like to use the river for canoeing.
* I dislike the lack of public access for boating. (3 people)
* We need canoeing portages/access.
* What I don't like about the Passumpsic River is limited access for canoeing and limited recreational use.
* We need better public access for boating. (2 people)
* I don't like the lack of access to the river.

* I like swimming.
* I like local rivers and streams for swimming.
* We need better public access for swimming.

* I would like to see more parks and nature walks along the river. (2 people)
* I would like to see river-related (linear) parks. (5 people)

* The Passumpsic ties us to the Connecticut River and to the sea. (2 people)
* The river is a network: towns to each other and towns to wilderness.
* The Passumpsic River is a common thread between 19 communities. (2 people)

Fisheries/Aquatic Habitat

* I like fishing and the possibility of salmon someday.
* I like local rivers and streams for fishing.
* I like the fact that local rivers and streams represent untapped resources, specifically for trout habitat, in the midst of town.

* I don't like the Passumpsic's lack of fish.
* Fishing in the Moose River use to be better. Fish stocking doesn't seem to help.
* There are many fisherman that either live in or visit the area. Fishing is going downhill mainly because the state hasn't been stocking. Lots of fish are being taken out but none are being put back in. More people fish in the lakes than in the rivers. Local streams have good brook trout fisheries.
* We need more fish and improved habitat.
* There are not enough fish. The rivers could be stocked to draw more tourists. We need to have fish ladders at all dams.
* Improve fish and wildlife.

* I'd like to see the trout "old-timers" return to small brooks.

* We need fish ladders at the dams so that salmon and trout can migrate. There should be more fish stocking in the river.

* The better fishing places are in the Moose River and fish are caught each year in the Passumpsic below the confluence with the Moose.
* I would like to see a high biological diversity in the river.
* A fish ladder is needed in East Barnet. Rainbow trout pool up below the dam, unable to reach spawning waters in the Passumpsic above.
* We must stock more trout if the dams are hampering the fish population ...they should stock annually (or at least bi-annually). Upstream and downstream fish passage facilities should be a must.

Natural Areas

* I like Victory Bog.
* The river provides habitat for migrating birds.
* I like the Passumpsic River for its wildlife.
* I like the wildlife habitat along the river.
* Our local rivers and streams are a vital resource for wildlife, and clean, clear water is important to all life.
* I like the semi-wilderness near a population center.
* I like the low population density in the basin - few large villages.

* Rivers flow through a relatively undeveloped corridor, Danville is very threatened in places yet has great wilderness in others and is worth attention before this disappears. I like that many local rivers and streams are scenic and undeveloped, wind their way through diverse wetlands, beaver meadows, gorges, and forests; that some of them have old roads and trails worth preserving for walking, skiing, and even snowmobiles; and that some are bordered by vast tracts of open farmland and look serene and productive. I dislike that floodplains are being used for inappropriate building and activities where there should be farmlands and scenery; that the pace of residential development will encroach on our scenic and wilderness values as streamside, walking access, and habitat are replaced by private ownership and posting; and that buffer zones are not a matter of course in all towns.

* Riverways should not become dumping areas, but should be bordered by parks and greenways. Undeveloped roads, ridges, and habitat (including source ponds and upland bogs) that border nice streams and rivers should be, where possible, considered public lands or granted easements and tax incentives. Floodplains should remain open for farming, but no spraying or chemical use allowed where it would affect water quality.

* I believe that rivers and streams represent a good natural resource for local communities to enjoy.
* I like the Passumpsic River for its recreational possibilities, aesthetic impacts, education opportunities.
* We enjoy seeing and hearing local rivers and streams; also the birds, wildlife viewing, and canoeing and hiking opportunities they provide. We don't like trash disposal along streambanks.
* My vision is that rivers and streams should be clean, fishable, and boatable - usable by all.

SCENIC AREAS AND CULTURAL RESOURCES

This topic is closely related to the watershed setting and river corridor land use discussions offered under the Water Quality section of this study. A set of comments made by local residents included under the Water Quality Public Comments section bears repeating here:

* Existing human structures are harmonious with the river.
* We should preserve the Vermontness of Passumpsic basin.
* I like the rural atmosphere of the area. I like the mix of farms, villages and wilderness. (8 people)

Scenic Areas

One element of the quality of life in the Passumpsic River basin is the feelings people have for the aesthetic qualities of their natural/cultural surroundings. The viewscapes of the river from the perspective of travelling river corridor roads is an important part of people's daily lives. The list of bridges described as river access points are also commonly enjoyed as scenic vistas of the Passumpsic River or one of its tributaries meandering through a rural valley. Views of the river in cultural settings are very popular. For instance, the view of the the Passumpsic River through St. Johnsbury from the perspective of Fred Mold Park is classic New England scenery equal to any in Vermont.

Geologic features exposed by the cutting power of rivers and streams are perhaps among the most interesting river scenes. Access to Emerson Falls, described in more detail under the Natural Features discussion for the Sleepers River, was preserved when the site was re-developed for hydropower, and many people continue to visit the cascade for its scenic value.

Howard Reed in an opening address at a Passumpsic River Project meeting (11/89) concerning the history of the river, reported that by 1824, there were over 150 mills in Caledonia County on the 180 stream miles of the Passumpsic River Basin. Most of these were saw mills, grist mills, and tanneries. Not only does this point out the close historical relationship people have had with the river and its smaller tributaries, but it tells of the scores of small cascades or segments of falling water that exist in the basin. It is likely that all the older villages in the basin were developed around mill sites, and residents now enjoy the scenic waterfalls that were once the workhorses of their predecessors. The beautiful 20 foot cascade in the village of Wheelock is a good example.

The small cascades in the by-pass segments below Arnold Falls and Passumpsic Dams are also scenic geologic features in village settings. Other falls and cascades were lost through hydropower development. Dams constructed over geologic features can themselves be attractive at times when water is spilled over the dams.

The most commonly expressed concerns for activities that visually impact the Passumpsic River are gravel mining and landfill dumping at sites adjacent to the mainstem. The gravel pits north of St. Johnsbury Center and the

Landfill just south of the village of Passumpsic are commonly mentioned as sites needing restoration.

Historic and Archeologic Resources

There were not many Indian settlements in the Passumpsic River area, as it was between the Algonquin territory to the east and the Iroquois to the west and, therefore, was not a "good place to hang around" (Howard Reed address to the 11/89 public meeting for the Passumpsic River Project). In connection with Indian trade on the Connecticut River, however, the lower Passumpsic River watershed was "pre-historically" inhabited. The Vermont River Study (1986) lists the following archeologically sensitive areas in the Passumpsic Basin:

Archeologic Resources

Table 9.

River	Segment Description	Sensitivity
Passumpsic River	Connecticut River to the mouth of Water Andric Br.	Known moderate/high
	Water Andric Brook to Lyndonville	Expected mod./high
Moose River	Passumpsic River mainstem to Stiles Brook	Expected mod./high
Stiles Brook	Moose River to headwaters	Expected mod./high

The area was settled by people of European descent after the Revolutionary War. Jonathan Arnold, founder of St. Johnsbury, was given the waterfalls of the Passumpsic River which were quickly put to work following Vermont's descension to statehood. The Arnold Falls hydroelectric site reminds us today of the river's history. During the late 1800's and early 1900's when much activity was generated by the Fairbanks Mills, St. Johnsbury became one of the largest industrial centers of Vermont. "Heavy industry" is still an important part of the St. Johnsbury and Lyndonville economies, however, a greater diversity of trades has grown in these population centers along the Passumpsic River. The Vermont River Study lists the following historical resources from State and National Historic Registers within a ¼ mile corridor of the Passumpsic River or one of its tributary streams:

Historic Resources

Table 10.

River	Covered Bridge	Location	Register
West Branch	Centre Bridge	Lyndon	National
East Branch	Burrington Bridge	Lyndon	National
Miller Run	Bradley Bridge	Lyndon	National
South Wheelock Branch	Old Schoolhouse Br.	Lyndon	National
	Chamberlain Mill Br.	Lyndon	National
Joes Brook	Greenbank Hollow Br.	Danville	National

From the mid-1800's on, covered bridges were constructed to enhance the ease of land transport. Today these wooden covered bridges are identifying characteristics of the Vermont landscape (Vermont Agency of Environmental Conservation, 1986).

The following historic districts are also listed on the National Register of Historic Places and/or the Vermont Historic Sites and Structures Survey and are within ¼ mile of a watercourse. These areas have been nominated with the support of local interests and have been reviewed by the Vermont Division for Historic Preservation and the National Park Service:

Historic Resources

Table 11.

River	Historic District	Location	Register
Passumpsic River	St. Johnsbury	St. Johnsbury	National
	Passumpsic Village	Barnet	State
Water Andric	Hill Street	Danville	State
	Railroad Street	Danville	State
	Brainered Street	Danville	State
	Danville Green	Danville	State
Joes Brook	West Danville	West Danville	State
North Brook	North Danville	Danville	State
Sleepers River	Fairbanks House	St. Johnsbury	National
Moose River	Concord Village	Concord	State

"The preservation of Vermont's historic sites provides an important link to the roots of Vermont culture and helps maintain the character of Vermont's river corridors." (Vermont Agency of Environmental Conservation, 1986) It is also true that, the preservation of river corridors is one of the most critical steps in preserving archeological and historic resources in Vermont. These cultural resources help give identity to the river corridor and may be impacted by corridor development and changes in flow regulation.

As part of the FERC relicensing process for the Pierce Mills, Arnold Falls, Passumpsic and Gage Dam hydroelectric facilities on the Passumpsic River mainstem, CVPSC is performing studies, working with the Vermont Division for Historic Preservation to determine the potential impacts of the hydro project on archeological and historic resources. These studies will involve an assessment of whether the hydro facilities themselves are eligible for inclusion in the State and/or National Registers of Historic Places. For instance, the hydroelectric plant at the Gage #3 dam site, constructed in 1919, was recently rehabilitated.

PUBLIC ACCESS

Formal and informal public river access are important ways for people to use the Passumpsic and its tributaries for recreation. For the purposes of this study, public lands such as state and municipal forests provide "formal" public access. Generally, public lands include facilities for parking, boating or picnicking. Highway bridges and corporate lands adjacent to watercouses in the basin fall under the category of "informal" public access. People can use these areas to get to the river, but there may be no nearby parking or other facilities for the recreationists to use.

Outside of the Lyndonville and St. Johnsbury urban corridors, rivers and streams of the Passumpsic River Basin flow through wilderness and rural forestlands and farmlands, mostly in private landownership. Many landowners keep their lands open and, more often, local residents are aware of places from which they can access the rivers. However, there is concern about the lack of access and the need to establish formal public river access areas in the basin. The following tables list the public lands and access areas for each Passumpsic River sub-basin. Private campgrouds and large corporate forest lands are also listed. The purpose of this section is to quantify public access along Passumpsic watercouses and to point out where access is lacking.

West Branch

Public and private lands providing formal access to waters in the West Branch sub-basin includes the following:

Table 12.

Water Frontage	Access Area	Ownership	Acres	Facilities/Use
Newark Pond	Fishing Access Area	VT Fish & Wildlife	.33	Fishing and Boating
Sutton R. tribs West Branch	Willoughby State Forest	VT Forest & Parks	1852	Fishing/Hiking Swimming/ Picnicking
Calendar Brook	Calendar Br. Wildlife Mgt. Area	VT Fish & Wildlife	340	Fishing/Hiking Hunting
Calendar Brook tributary	Sheffield Mun. Forest	Town of Sheffield	200 (est)	Town Forest
West Br. tribs.	Burke Town Forest	Town of Burke	65	Town Forest

Table 12. Cont.

West Branch	Burning Bush Campground	Private		Campground

In West Burke and Newark, Route 5A crosses the upper West Branch at two locations. Route 5 crosses Calendar Brook just above its confluence with the West Branch. State bridges provide informal public access to the river. The Sutton River, Calendar Brook, Roundy Brook, and the West Branch are all paralleled by either state and town roads, the Canadian Pacific railroad and/or the Portland pipeline, each of which may have easements associated with them that provide river access.

East Branch

Public and private lands providing formal access to waters in the East Branch sub-basin include the following:

Table 13.

Water Frontage	Access Area	Ownership	Acres	Facilities/Use
Center Pond	Fishing Access Area	VT Fish & Wildlife	.06	Fishing and Boating
Beck Pond	Fishing Access Area	VT Fish & Wildlife	.80	Fishing and Boating
Dish Mill Brook	Darling State Park	VT Forests and Parks	2000	Fishing/Hiking Camping
Bean Brook Bald Hill Pond Brown Pond	Bald Hill Wildlife Mgt. Area	VT Fish & Wildlife	700	Fishing/Hiking Hatchery
East Branch tribs.	Timber lands in East Haven	Private	3,000 (est)	Timber harvest

From Lyndonville to the East Branch headwaters, Route 114 crosses over the East Branch seven times. The East Burke Fire Brigade has a water supply reservoir and firehouse along the East Branch. The dam is in the village center and the firehouse is approximately one mile downstream. Both areas may provide informal public access to the river.

Millers Run

The headwaters of Mathewson Brook are accessible in the Mathewson State Forest, a 795 acre parcel owned and managed by the VT Forest, Parks and Recreation Department. Mathewson Brook is a small stream (2.3 square miles) entering Millers Run below the village of Wheelock. No other lands in the Miller Run watershed are in public ownership. Route 122 crosses Millers Run seven times from Lyndonville to the headwaters providing informal access at the bridges.

Upper Passumpsic River

Public and private lands providing formal access to waters along the Upper Passumpsic mainstem include the following:

Table 14.

Water Frontage	Access Area	Ownership	Acres	Facilities/Use
Passumpsic R. tributary	Lyndon State Forest	VT Forests and Parks	72	Fishing/Hiking
Passumpsic R. tributary	Lyndon Town Forest	Town of Lyndon	4	Town Forest
Passumpsic R. and trib.	Lyndon Inst.	Private	133	Playfields and Recreation

Within the Town of Lyndon, State highways bridge the Upper Passumpsic mainstem a total of four times: Route 114 - one bridge, Route 122 - one bridge, and Route 5 - two bridges. Access to the Upper Passumpsic mainstem is also possible at the Vail and Lyndon dam sites owned by Lyndonville Electric.

Moose River

Public and private lands providing formal access to waters in the Moose River sub-basin include the following:

Table 15.

Water Frontage	Access Area	Ownership	Acres	Facilities/Use
Moose River Bog Brook Rogers Brook	Victory State Forest	VT Forest and Parks	13,026	Fishing/Hiking Picnicking

Table 15. Cont.

Moose River Bog Brook Rogers Brook	Victory Bog Wildlife Mgt. Area	VT Fish & Wildlife	4,970	Fishing/Hiking Hunting
Moose River	St. Johnsbury Town Forest	Town of St. Johnsbury	150 (est)	Town Forest
Stiles Pond and Brook	St. Johnbury Mun. Forest	Town of St. Johnsbury	1,000	Public Water Supply
Moose River	Moose River Camping Area	Private		Campground
Moose River & tributaries	Timber lands in Granby & East Haven	Private	9,000 (est)	Timber harvest

Between St. Johnsbury and North Concord, Route 2 bridges over the Moose River four times. The Maine Central railroad also parallels this segment of the Moose. On the east side of the village of Concord, a town highway bridge provides access to the river at the site of a small cascade.

Sleepers River

The headwaters of Whiteman Brook are accessible in the 140 acre Danville Municipal Forest. Portions of the Steam Mill Brook Wildlife Management Area (described below under the Joes Brook sub-basin) are in the headwaters region of Sleepers River tributaries along the Kittridge Hills. Within the Town of St. Johnsbury, State Routes 2 and 5 cross the Sleepers River. Access to the River is also possible at the Fairbanks Mills Hydropower Facility in North Danville and the Emerson Falls Hydropower Facility in St. Johnsbury, both owned and operated by Emerson Falls Hydro Associates.

Middle Passumpsic River

North of the City of St. Johnsbury, Route 5 bridges the Passumpsic mainstem two times, another town bridge below E.H.V. Weidmann provides informal access to the river, and the Pierce Mills Hydropower Facility just upstream is another access point. Pierce Mills is owned and operated by Central Vermont Public Service Corporation (CVPSC).

The City of St. Johnsbury owns land on the east side of the Passumpsic, above and below the Moose River confluence. Above the Moose River is the Fred

Mold Park, which is very nicely landscaped with flowers and has great views of the river and the city. Picnic tables are also provided. Below the Moose River confluence are the City recreation fields with two baseball diamonds. The CVPSC Hydro Facility at Arnold Falls just above Fred Mold Park involves steep land adjacent to the river that is difficult to access on foot. Route 2 bridges over the Passumpsic River in the center of the city.

Below St. Johnsbury, the CVPSC Hydro Facility at the Gage #3 Dam is an access point to the Passumpsic mainstem. Finding a place to park a vehicle is the main difficulty here. The Canadian Pacific Railroad parallels the entire Middle Passumpsic segment. Where it crosses this segment under the Interstate 91 overpass is a commonly used informal access point.

Joes Brook

Public lands providing formal access to waters in the Joes Brook sub-basin includes the following:

Table 16.

Water Frontage	Access Area	Ownership	Acres	Facilities/Use
Lyford Pond	Fishing Access Area	VT Fish & Wildlife	.37	Fishing & Boating
Keiser Pond	Fishing Access Area	VT Fish & Wildlife	31.6	Fishing & Boating
Joes Pond	Fishing Access Area	VT Fish & Wildlife	1.97	Fishing & Boating
Steam Brook	Steam Brook Wildlife Mgt. Area	VT Fish & Wildlife	5,744	Fishing/Hiking Hunting
Brown Brook	Danville Fire Dist. Forest	Danville Fire Dist.	20 (est)	Town Water Supply

State Route 15 and U.S. Route 2 cross over Joes Brook in the vicinity of Joes Pond. Route 15 in the village of Walden and Route 2 downstream at the mouth of Joes Pond near the head of the by-pass stream segment associated with the West Danville Hydropower Facility owned and operated by Green Mountain Power (GMP). Joes Brook is also accessible to the public on GMP land dwnstream at the powerhouse. Route 5 bridges over Joes Brook near its confluence with the Lower Paasumpsic River.

Lower Passumpsic River

The Barnet Municipal Forest is a 180 acre parcel on the east bank of the Passumpsic River mainstem. At present, the Town Forest is used as a landfill and gravel pit. The landfill is scheduled for closure by 1993 which may give this public land greater appeal as a place to access the river. A mile upstream in the village of Passumpsic, river access is possible at the CVPSC hydropower facility. This site is the location of the only highway bridge crossing over the Lower Passumpsic. The CVPSC hydro facility at East Barnet also provides river access. Route 5 crosses the Water Andric near its confluence with the Passumpsic. The Canadian Pacific Railway parallels the Lower Passumpsic, crossing it seven times in Waterford and Barnet.

Public Access Summary

Numerous informal public access areas exist on the Passumpsic River and its tributaries. Town road bridges would lengthen this inventory considerably. They were not included because many of them are located in close proximity to private residences. It is not the intent of this study to advertize access areas and create conflicts with abutting landowners where none presently exist. Undoubtedly, some town roads and bridges may provide some of the best informal public river access.

A watershed map (Figure 25) is used to show the approximate size and location of public lands. Most public lands and formal access areas are in the headwater regions of Pussumpsic tributaries providing trails to small upland streams and fishing and boating access facilities to lakes and ponds. Notable exceptions are the State lands in the Town of Victory providing formal access to mid-reaches of the Moose River and the municipal forests and city parks near the Passumpsic and Moose River confluence in St. Johnsbury.

There are conspicuously few public river access areas along the Passumpsic River and its major tributaries. Private corporate lands, including utility lands in the vicinity of hydropower facilities, may provide one of the best opportunities to improve public access and fill the expressed need for river recreation facilities. CVPSC has indicated a willingness to consider improvement of day use facilities at the Pierce Mills, Arnold Falls, Gage #3, Passumpsic Station, and East Barnet hydropower facilities.

An idea generated at the March, 1990 workshop in St. Johnsbury is the enhancement of urban trail systems along the Passumpsic as an amenity to shoppers and city residents and an asset to commercial interests in the downtown area. Mention of this opportunity at the St. Johnsbury Rotary Club brought positive comments from several local business leaders. A similar proposal for a bicycle and jogging path has been included in the Recommendations Section of the Lyndonville Town Plan. The path, called the Stevens Route, is already in use and the plan calls for formalizing the path with signs and pavement lines. The Lyndonville path uses covered bridges that cross the Miller Run and Passumpsic River.

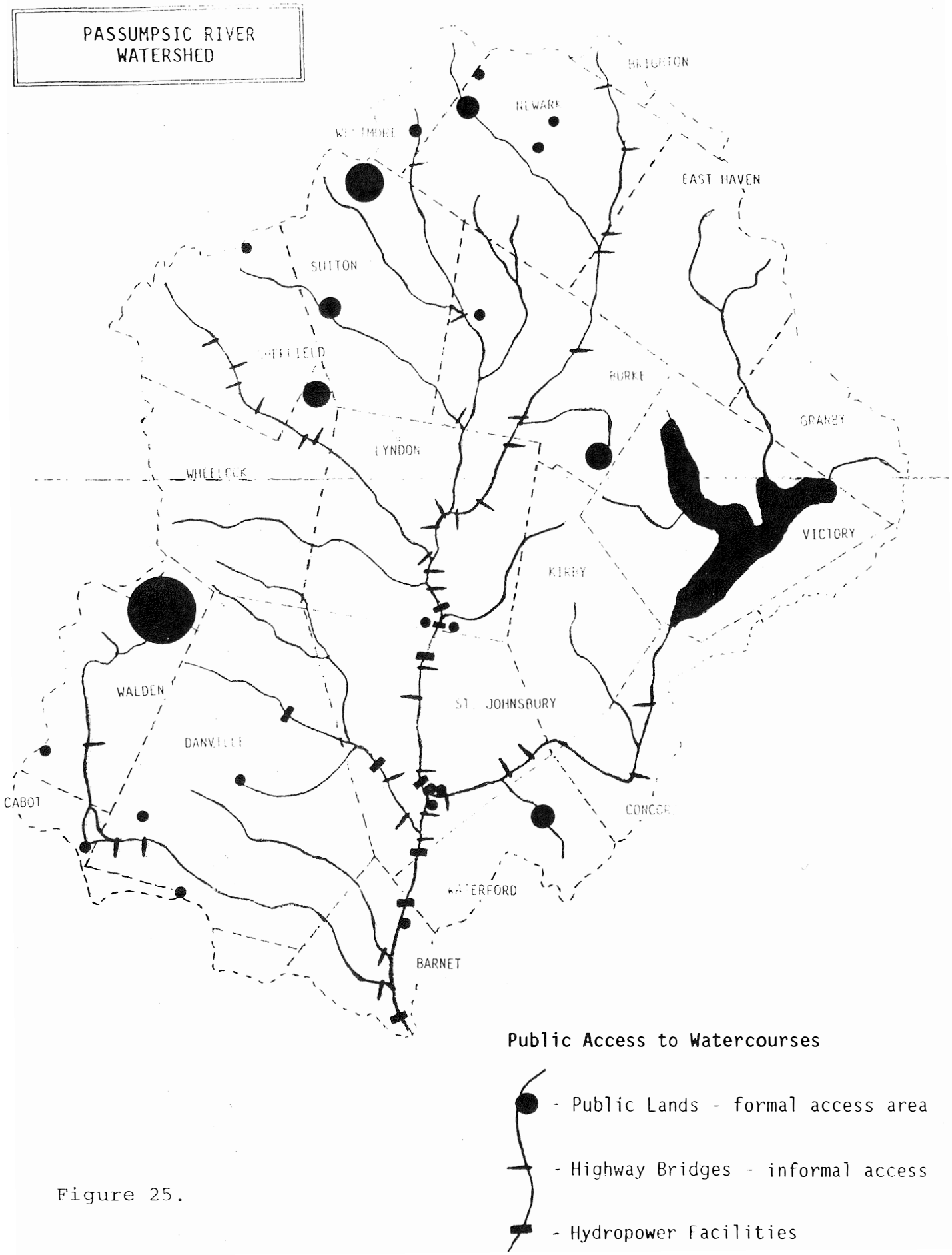

PASSUMPSIC RIVER
WATERSHED
BRIGHTON
NEWARK
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
Public Access to Watercourses
- Public Lands - formal access area
- Highway Bridges - informal access
- Hydropower Facilities

Figure 25.

BOATING

Summaries of published boating inventories are organized below under sub-basin headings:

West Branch

A short three and a half mile segment of quickwater and Class I rapids may be paddled on the lower West Branch. The easiest put-in is at the bridge over Calender Brook which is a short distance above the West Branch. The run to the Passumpsic mainstem in Lyndonville is a pleasant one through a forested corridor. High water during early May is the best time to paddle the West Branch. The amount of use this segment gets by local canoeists is not known at this time. (Applachian Mountain Club, 1989)

East Branch

Eleven miles of Class I-II rapids from East Haven to the confluence with the West Branch of the Passumpsic River. The upper seven miles are mostly wooded and feel wild. The lower four miles are more open through meadows and farmland with some houses. Route 114 parallels the river. The dam at East Burke must be portaged. Directly below the boating interruption is a high Class II or Class III rapid at high water. The run receives local use and is becoming more popular as a result of an annual downriver race that is held on this stretch as a benefit for the East Burke Fire Brigade and Rescue Squad. (Jenkins and Zika, 1989)

Moose River

A fifteen mile stretch from a snowmobile bridge below Victory Bog to the Passumpsic River confluence. The first three miles is in a remote mixed-forest area, rated as one of the two wildest whitewater segments in the state, and having the most continuous rapids in northeastern Vermont. This upper part of the run has a steep rocky channel and abrupt chutes and ledges resulting in two miles of Class II water sandwiched between small stretches of Class III-IV rapids.

The river slows down for two miles and then below the Route 2 bridge there are rocky Class II-III rapids that extend to within two miles of East St. Johnsbury, before the river becomes flatwater again. Along this stretch, to the end of the run, there are more open areas along with Route 2, some village centers, and the City of St. Johnsbury. There is a ledge below the bridge in East St. Johnsbury which must be portaged. From this point to the confluence, there are three miles of fast Class II whitewater with a lot of Class III-IV rapids. It is not well known, but is one of the most difficult ledge runs in Vermont that includes a five foot waterfall drop. There is no artificial flow regulation on the Moose River and whitewater runs are possible during snowmelt and after rains. (Jenkins and Zika, 1989)

Passumpsic River

Historically, the river guides did not describe the Passumpsic in a favorable light because of the domestic and industrial pollution visible in the river. More recently, the Passumpsic is reported to boaters as having an excess number of dams, but nonetheless, it is "an attractive river in a rural area." The drawing card of the Passumpsic is that you can run it when the water is too low to run most other rivers. (Applachian Mountain Club, 1989)

The Passumpsic is flatwater and quickwater with some rapids as high as Class II. The lower 2-3 miles is very scenic. On the total 22 mile boatable length of the Passumpsic mainstem, there are seven dams which must be portaged:

Table 17.

River Mile	Obstruction	Portage - Direction/Distance
5¼	Vail Dam	Right side - 25 yards
6	Lyndon Dam	Right side - 1/4 mile
7¼	Pierce Mills	Left side - 150 yards
13	Arnold Falls	Center Island - 50 yards
15	Gage #3 Dam	Left side - 50 yards
17	Passumpsic Dam	Right side - 100 yards
21½	East Barnet Dam	Left side - 50 yards

Between Pierce Mills and Arnold Falls Dams, there are ledges at 8¼ and 10¼ miles that should likely be portaged by less experienced boaters.

Boating portage issues were raised during the FERC licensing of the Vail Dam and Great Falls hydropower facilities. Lyndonville Electric examined the feasibility of providing canoe portages and found that the steep terrain in the vicinity of the Great Falls project rendered a portage unsafe and impractical. FERC staff investigated the area and reported that the east shoreline is too precipitous for public use. The most feasible upstream access site to a portage trail would be on the west shoreline, near the headworks on the intake canel, but public recreational activity so close to the intake would be hazardous. The west shoreline, except in the vicinity of the headworks, is also precipitous for at least 500 yards above the dam. From this point, a portage trail proceeding downstream along the west shoreline would be dificult to develop safely. For these reasons Lyndonville Electric

was not required to create a portage trail as a license condition. The Great Falls hydro site would provide a public canoe put-in place for paddling downstream of the project.

Hydroelectric projects at Pierce Mills, Arnold Falls, Gage #3, and Passumpsic are owned by Central Vermont Public Service Corporation (CVPSC) and are up for Federal relicensing in 1993. As part of the relicensing process, the Federal Energy Regulatory Commission requires an evaluation of recreation enhancements at hydroelectric facilities. As part of this evaluation, CVPSC has provided the preliminary assessment of the four project areas:

> Pierce Mills: There is good access here for a portage trail beginning upstream of the dam on the left bank of the river. The trail can be graded to meet the existing gravel road above the dam and then be extended from the grassy area by the powerhouse to a point 50 yards or so downstream. The area has good potential for day use as it already serviced by a good road. (Fullerton, 1989)
>
> Arnold Falls: The only feasible portage trail here will run the length of the mid-stream island which is owned by the Town of St. Johnsbury. The access to the island is easy enough for a competent paddler, but the careless or inexperienced boater may be in danger of getting close to the dam. The placement of log booms here will be very important. There seems to be limited day use potential, unless a smooth area is provided on the island. A fireplace and table would be possible here, and would only be accessible by boat. (Fullerton, 1989)
>
> Gage #3 Dam: The site has a very accessible portage area beginning just upstream of the dam, around the bend on the left side of the river and crossing the land enclosed by the river bend to end at the pool below the dam. The trail will need some grading to make it easier to negotiate. This is a good site for river-based camping as it is reachable only by river or by the CVPSC right-of-way. Due to the problems of the railroad crossing and private ownership of the approach, day use would not seem to be feasible. (Fullerton, 1989)
>
> Passumpsic Dam: Portage access here is good above the dam, just under the highway bridge. There is a small cove formed by the bridge pier where the water is shallow and slow. Access below the powerhouse can be included by clearing and grading the existing slope with permission from the current owners. There is a good spot for picnic tables above the dam where the portage trail would begin. (Fullerton, 1989)

Final proposals have not been submitted. There is probable agreement on the need to improve boating portages at the dams, however, CVPSC has expressed concern over providing day use or camping areas at selected sites due to the personnel and maintenance costs associated with vandalism. CVPSC has

commented that those facilities in more populated areas where people can watch over the facilities are less prone to vandalism. CVPSC does not have people stationed at all four facilities; operations are presently based out of the Gage #3 Power Station.

In an attempt to get local public input from those who use waters in the Passumpsic Basin for boating, a survey was taken of those participating in the East Branch Canoe Race (4-29-90). People checked off, yes/no, for three questions on a survey form handed to them as they were registering for the race:

Table 18.

Question	Respondents	Yes	No
I have paddled the mainstem of the Passumpsic River.	24	18	6
I would paddle the Passumpsic River if there were a way to portage the dams.	22	22	0
I am enthusiastic about the proposed portage facilities and would help with their upkeep if constructed.	24	16	8

Of the six respondants that said they do not presently paddle the mainstem, all six said they would use the Passumpsic for boating if there were portages and four of the six said they would help with the upkeep of facilities. Of the total respondents, six were boaters who traveled from northern Vermont and New Hampshire towns outside the basin, the remaining 18 people were from Burke, Lyndon or St. Johnsbury. Specific conclusions can not be drawn from this survey, however, in general:

* People are interested in the Passumpsic mainstem for boating, and

* Most people who would benefit from an upgrade of facilities, recognize the need to participate in their upkeep.

Other flatwater and whitewater river boating opportunities within close driving distance (30-40 min.) for residents of the Passumpsic basin would include segments of the Lamoille, Black, Barton, Clyde, Nulhegan, and Upper Connecticut Rivers. Numerous large ponds and lakes are popular for boating within or near the Passumpsic basin. Must notable are those with formal public access and boat launch facilities, including: Newark Pond, Center Pond, Beck Pond, Lyford Pond, Keiser Pond, and Lake Willoughby.

SPORT FISHERIES

Information pertaining to the sport fishery throughout the basin has been obtained from three sources: fish surveys completed by the Agency of Natural Resources, fish surveys completed by CVPSC at hydroelectric facilities on the Passumpsic, and from interviews with state fisheries managers and local anglers. The discussion following the presentation of existing data will focus on fish habitat and population issues raised by the angling public.

Fish Distribution and Habitat

The following table contains sport fisheries information collected for the Vermont Rivers Study (1986) from population surveys completed by the Vermont Department of Fish and Wildlife and interviews with state fisheries managers responsible for streams and rivers in the Passumpsic River basin.

Table 19.

River	BN	RB	BK	LB	SB	Segment Description
Sutton River			N			West Br. - Headwaters
Calendar Brook			N			West Br. - Headwaters
West Branch	NS	S	NS			Lyndonville - W.Burke
	N		N			W. Burke - Headwaters
Sleeper Brook			N			Bean Br. - Headwaters
Bean Brook	N	S	N			East Br. - Headwaters
Dish Mill Brook			N			East Br. - Headwaters
East Branch	N	S	NS			Pass. R. - E.Burke D.
			NS			East Burke Dam - HW
Miller Run	N		NS			Pass. R. - Headwaters
S. Wheelock Branch			NS			Pass. R. - Headwaters
Sheldon Brook			N			Pass. R. - Headwaters
PASSUMPSIC RIVER	NS	S	N			Vail Dam - E/W Branch

Table 19. Cont.

	BN	RB	BK	LB	SB	Segment Description
Stiles Brook			N			Moose R. - Stiles P.
Moose River	NS	N				Pass. R. - Concord
	NS		N			Concord - Gallup Mill
			NS			Gallup Mills - HW
Sleepers River	N	NS	N			Pass. R. - Emerson F.
		N	N			Emerson F. - North Br
Stark Brook			N			Pass. R. - Headwaters
PASSUMPSIC RIVER	NS	NS	N			Gage Dam - Vail Dam
Bog Brook			N			Steam Mill Bk. - HW
Steam Mill Brook			N			Joes Bk. - Headwaters
Joes Brook	NS	N	N			Pass. R. - Morse Mill
	NS		NS			Morse Mill - Joes P.
	N		N			Joes Pond - Walden
Water Andric			N			Pass. R. - Headwaters
PASSUMPSIC RIVER	NS	NS				Pass. Dam - Gage Dam
	NS	NS				E.Barnet - Pass. Dam
	N	N			N	E. Barnet Dam - CT R.

BN - Brown Trout
RB - Rainbow Trout
BK - Rainbow Trout
LB - Largemouth Bass
SB - Smallmouth Bass

N - naturally sustained fishery
NS - natural fishery enhanced with stocking
S - stocked fishery

Passumpsic River Tributaries

Upland streams of the Passumpsic River Basin have historically been known as some of the most productive native brook trout waters in Vermont. The moderate to steep gradient streams with good gravel and boulder riffles interspersed with pools provide excellent spawning and nursery habitat (Vermont Fish & Wildlife Department 1972). Streams in the watersheds of all major Passumpsic tributaries contain naturally sustained populations of brook trout. Some of the more notable streams are the Sutton River, Calendar Brook, and Steam Mill Brook. Stark Brook, draining directly to the Passumpsic in St. Johnsbury, also has a naturally reproducing brook trout population.

Fish surveys in Bean Brook and Dish Mill Brook in the East Branch watershed were completed by the Department of Environmental Conservation in 1990 and 1989 respectively. In two electrofishing runs on Dish Mill Brook, 80 brook trout were taken. In Bean Brook below Bald Hill Pond, 19 brown trout and 6 brook trout were taken in one electrofishing run.

Major tributaries in the Passumpsic River watershed support naturally sustained brook and brown trout populations. Brook trout flourish in higher altitude reaches, whereas, brown trout are found more frequently in lower reaches taking refuge in larger, deeper pools. Rainbow trout are present in fewer numbers in the lower reaches of most large Passumpsic tributaries, notably in the Moose and Sleepers Rivers.

The fish habitat issues on major tributaries in the Passumpsic basin are high temperatures, obstructions to fish migration, eroding banks, and sedimentation. Hydro dams on the Sleepers River and Joes Brook and a water supply dam on the East Branch impede salmonid spawning migrations. The lower reaches of major tributaries may experience summer high temperatures in access of 70° and 80°F. Optimal temperatures for salmonid species are below 68°F, therefore brook, brown, and rainbow species must seek the deepest holes and take refuge at the mouths of colder small tributaries. Populations may become limited as there is only so much available refuge habitat. Depending on the tributary river in question, erosion and sedimentation may be a temporary and/or long-term problem. A more detailed discussion on this habitat issue is presented under the water quality summary for major tributaries.

Passumpsic River Mainstem

The entire length of the Passumpsic River mainstem is managed as cold water fish habitat as prescribed in the Vermont Water Quality Standards. This means that the total increase in temperature from background conditions due to all discharges and activities shall not at any time exceed 1.0°F except as provided for in special permit conditions and not to have an undue adverse effect on aquatic biota. As with all large Vermont rivers being managed for salmonid species, trout are in an uphill struggle with nature to survive in the summer temperatures of the Passumpsic. Wide and slow moving for most of

its length, the Passumpsic has deeper, colder holes that harbor some trophy size trout. Mostly brown trout. Again, the colder waters entering the mainstem from small tributary streams are important refuge habitats. Towards the mouth of the Passumpsic River and in the reservoirs impounded along its length, warm water sport fish such as small and largemouth bass are found.

The Passumpsic River was historically home to Atlantic salmon. Stolte (1982) reported estimates of 600,000 square yards of salmon nursery habitat in the Passumpsic which is, however, relatively small when compared with other Connecticut River tributaries with similar watershed sizes. The Atlantic Salmon Restoration Program for the Connecticut River Watershed identifies the salmon habitat in the mainstem of the Passumpsic River and its tributaries (along with 15 other Connecticut River drainages) as critical to the success of the restoration effort. At present, the Passumpsic has the potential to serve as rearing habitat for stocked salmon fry. Until fish passage issues are dealt with at Upper Connecticut River dams, upstream passage for adult salmon use of spawning habitat in the Passumpsic River watershed will not be a critical issue.

River flows in approximately half of the 22 mile length of the Passumpsic River mainstem have been altered through impoundment. The slower water behind dams at hydroelectric facilities is a change in habitat and favors those species of aquatic biota more characteristic of lakes and ponds, including fish such as perch and bass. Another related habitat alteration in the Passumpsic River mainstem is the frequent dewatering or extreme low flows in the by-passed river segments between the dams and tailraces, approximately 1500 feet of Passumpsic River is effected in this manner. The only segment of the aquatic habitat in the Passumpsic that does not experience dewatering, impounding, or flow fluctuations from peaking operations at the dams is the five miles of river above Vail Dam in Lyndon.

Flow modifications result in the direct loss of physical habitat by concentrating fish into the deeper holes when flows are lowered. Bottom substrate habitat is altered through the process of sedimentation behand dams causing a loss of the boulder/rubble refuges used by riverine species of fish and aquatic insects. Fish spawning and nursery habitats are directly effected by these modifications and upstream spawning migrations are stopped at the Passumpsic River dams.

Impounded and artificial low flows during summer months increase already critically high water temperatures that may, in more stagnant segments of the river, cause a lowering of dissolved oxygen concentrations. During high flow years there may be ample water to spill over the crest of the dams and higher temperatures and low dissolved oxygen will not be habitat issues. During low flow years or droughts, fish kills and low to nill fish reproductive success are the result.

The increase in nutrients and oxygen-demanding wastes from combined sewer overflows, the St. Johnsbury sewage treatment plant and other sources

have contributed significantly to the low dissolved oxygen problems stated above. These point source pollution problems are also slated for correction. The remaining factors in the temperature/oxygen equation for the Passumpsic River are eroding river banks (discussed earlier in the water quality section) and the loss of bank vegetation which functions to shade waters, especially where the channel is more restricted in width.

Run-of-river dam operation modes and constant pond heights at all Passumpsic River hydroelectric facilities will lessen most of these aquatic habitat issues. Available fish habitat in the by-passes and the minimum flow requirements necessary to maintain the useage of these segments by salmonid species is the focuss of studies being performed by CVPSC as part of the FERC relicensing and 401 Water Quality Certification processes. Pierce Mills and Gage Dam by-passes contain large, deep pools that are considered important trout habitat (Aquatec, 1990). Arnold Falls has two by-pass channels, one on either side of a mid-river island. The left side is very short, whereas, the right side has stair-step pools and cascades that contain sport fish when water is available during high flow periods. Passumpsic Dam is a steeper cascade with little or no fish habitat value. The CVPSC East Barnet project, which is not currently up for relicensing, has a pool up to 20 feet deep at the base of the dam into which the tailrace empties.

ANGLER MEETING AND COMMENTS

The Connecticut River Watershed Council, Trout Unlimited, and the Wheelock-Titcomb Fund transmitted a joint comment letter letter to CVPSC on 1/23/90 concerning fisheries and aquatic habitat, which is contained in Appendix D.

On April 11, 1991, the Agency of Natural Resources facilitated a meeting of anglers from the St. Johnsbury and Lyndonville area. This meeting was held at the request of local residents, who made personal contacts as well as radio and newspaper anouncements to gather Passumpsic River anglers to discuss the sport fishery and habitat issues of local streams and rivers. Half of the 24 people attending the meeting filled out a short survey form. Concerning the Passumpsic River mainstem, the number of respondants fishing at different locations with respect to the hydropower facilities were as follows:

6 - in river impoundments
6 - in river by-passes
12 - at tailraces
12 - below hydroprojects

3 - Vail Dam
2 - Lyndon Dam
9 - Pierce Mills Dam
9 - Arnold Falls Dam
9 - Gage #3 Dam
10 - Passumpsic Dam
9 - East Barnet Dam

Anglers were asked what types of habitat limitations they were aware of or suspected as threats to the life cycles of fish populations in the Passumpsic River:

10 - low flows in the river below hydroelectric impoundments.
7 - low flows and dewatering of by-pass river segments.
6 - unnatural flow fluctuations from hydroproject operations.
8 - bank slumping, erosion and sedimentation.
9 - untreated sewage entering the river.
7 - toxics leaching from landfills or waste dumps.

The bulk of the meeting was spent in facilitated group discussions focussing on fish habitat limitations and fishing access needs. The following comments were made by local anglers:

General Fisheries Comments

* Atlantic salmon were historically taken from the Passumpsic River and the Sleepers River.

* People often say "You shouldn't eat the fish from the Passumpsic" - is there testing? We need testing of fish similar to the check they do for Lake Champlain fish.

* There is probably little brown trout reproduction in most areas of the river - we don't see any small size class fish. Fishing success varies with stocking rates. We don't want only stocked fish; they taste like liver pellets.

* Some of the best fish habitat is in the Upper Passumpsic River mainstem. There are more holes from the East/West Branch confluence through Lyndonville to the Vail Dam than in other segments. Above Vail Dam is reknown for brown trout.

Concerning the Fisheries at Specific Hydroelectric Projects

* There always seems to be water flowing below Great Falls hydro.

* Flows get killed below Pierce Mills. The tailrace is the fish refuge at Pierces Mill.

* Bypass fish habitat is present and should be restored at Pierce Mills.

* From Arnold Falls downstream is better fishing than upstream from Pierce Mills to Arnold Falls.

* Concerning the Arnold Falls bypass:

  - Right side (Concord Ave. side) has good rock habitat - brown trout are seen moving up to the dam when water is present, others see fish move up to the dam in the spring. Fish become pooled up when the water level drops rapidly. Fish and aesthetics are impacted by the lack of bypass flows. Flows over the rocky channel are important for reoxygenation.

  - Left side (Powerhouse side) has deeper holes which are good habitat, this side is hard to access.

  - Bypass habitat is present and should be restored at Arnold Falls.

  - the island between the two bypasses is being sold by the City of St. Johnsbury. This area is important for fishing and boating access.

  - at present fishing is better below the facility closer to Fred Mold Park which is heavily fished in the spring

* Fish and aesthetics are impacted by the lack of bypass flows below the Gage Dam.

* Bypass habitat is present and should be restored at Gage. The Gage bypass is especially important to the river fishery.

* The fishery has been lost at the base of the Passumpsic Station Dam.

Concerning the Operation of All Hydroelectric Facilities on the Passumpsic

* FERC license duration too long - shorten 30 year period.

* There are both anadromous and indigenous salmonid migration needs, both upstream and downstream. Fish ladders or their equivalent should be required. After mention of upstream passage for salmon someday when they reach the Passumpsic, someone responded "why not for rainbows - we need upstream passage for rainbows and browns right now!"

* Prefer wild fish but may not be able to self perpetuate in river environment with dams. Some segments between dams have become isolated from larger tributaries where fish can migrate to spawning areas.

* Power Company should pay for lost fish as a result of hydro generation. CVPSC should pay for stocking.

* The backwaters at all hydro facilities are unproductive.

* There are odors around all the power stations.

* The dams centralize the fish. We need constant flows to spread them out. Sustained water flows are needed to protect fishery needs. Power company has a responsibility to address the public trust.

* All dam bypasses should be required to have minimum flow volumes.

* Compliance flow monitoring of river is necessary to ensure daily flow use and fluctuation to protect against extreme fluctuations and provide adherence to prescribed flow volumes.

* The public needs adequate fishing and boating access at all stations. Including all four CVPSC sites.

* Power company should practice power conservation. There needs to be an increased awareness of the environment by company rather than business first.

Concerning Other Water Quality and Fisheries Issues

* Campground near Aime's restaurant is suspect of discharging camper pump-out station directly into the river.

* St. J. Center gravel pit is a sediment source to the river.

* Anglers suspect logging clear-cuts as the cause for temperature increases and sedimentation in the Moose River. During the drought year of 1988, a Department of Fish & Wildlife temperature study found 90°+ temperatures in the Moose River.

* Toxic groundwater leachate at Darling dump site, Barnet dump, and the old St. Johnsbury wood dump are of concern.

* Sewage treatment is needed to maintain water quality - East St. Johnsbury septics are a serious problem - action is needed.

* Contracts for future snowmaking needs of concern to river users.

Other suggestions for Habitat Improvement

* Habitat for osprey, great blue herons, etc. is in the river buffer strips, we need conservation corridors.

* Referring to rip-rap sites constructed after 1973 flood, the opinion was that channeled areas should have structures such as fish rocks, snags, etc. placed in the stream.

* Conservation fund monies should be set aside for resource needs.

NATURAL AREAS

Over seventy different natural community types have been described in Vermont. This inventory will focus on those water-related communities identified in the Passumpsic River watershed. A commonly used definition for "natural area" is:

> An area of land or water which: 1) either retains or has re-established its natural character, although it need not be completely undisturbed, or which 2) retains unusual flora, fauna, geological or similar features of scientific or educational interest. (Vermont Natural Resources Council, 1976)

The purpose of including a natural areas inventory in this study of the Passumpsic River Basin is to recognize places that are especially unusual biologically or geologically or especially representative of the native plants and animals of Vermont. Natural areas are important recreational opportunities for hikers and others who enjoy outings to see unique wildlife, plant communities or geological sites. High schools, universities and naturalists organizations from throughout Vermont utilize natural areas in the Passumpsic Basin for ecological study and research.

The following information about natural areas and the unique plants and animals within them has been obtained from the Nongame and Natural Heritage Program and the Wetlands Program at the Vermont Agency of Natural Resources (unless otherwise referenced). More detailed information can be obtained by contacting these Programs directly. These programs also help communities and landowners with developing management and protection plans for natural areas.

West Branch

West Branch Cedar Swamps - 2 sites. A small 0.2 acre area at the headwaters of the West Branch is dominated by young northern white cedars. Four rare plant species have been observed here. A second larger cedar swamp extends approximately 2 miles along the upper reaches of the West Branch. At least three rare plant species have been located here.

Sutton River Swamp - a cedar swamp community about 10 to 15 acres in size. Although this site was heavily logged in the past, older trees persist in small clumps. The swamp is seasonally flooded.

Roundy Brook Swamp - A 20 acre cedar swamp at the headwaters of Roundy Brook. Dominant tree species include a mixture of northern white cedar and balsam fir. The cedars measure 8"-12" in diameter at breast height and are approximately 50-70 years old, forming a dense canopy. Huge stumps are evidence of a once spectacular cedar swamp that was once logged over. The shrub and herb understory layers are sparse and seepage is evident. One rare plant species has been found here.

West Burke Bog - peat moss forms a quaking mat including pitcher plants and sundews around a small open water area. The bog is located along the West

Branch in a westerly direction from Burke Hollow. (Vermont Agency of Environmental Conservation, 1986)

West Branch Esker - formed by the receding Pleistocene glaciers along a 1.25 mile segment of the West Branch upstream of the Calender Brook confluence in the Town of Burke.

East Branch

Mill Brook Cascades - located in a dense boreal forest with only a dirt road downstream. The site consists of a long chain of cascades and pools. The total drop is 150-200 feet; the pools are up to 12 feet across, and at various points there are low rock walls up to six feet high. Because the site is remote and distant from population centers, it receives only light use for swimming and fishing (Jenkins and Zika, 1987).

East Branch Esker - glacial deposits along a 4.5 mile segment of the East Branch from East Haven to Est Burke.

Deer Hill Wetland and **Corner Swamp** are in the town of East Haven and were part of the Essex County Natural Areas Inventory completed in 1990. Reports for these areas are on the following pages.

Miller Run

WHeelock Sulfur Spring - a rock sheltered natural spring along a short segment of the Miller Run just downstream of the Village of Wheelock.

Stannard - Wheelock Mountain - wilderness area including Fall Brook and other unnamed tributaries totalling 9,000 acres in the Town of Wheelock. This mountainous area is well forested providing habitat to black bear and other wildlife species. It is also an aquifer recharge area.

Moose River

Appendix C. contains excerpts from the Essex County Natural Areas Inventory describe these pond and wetland areas in the Moose River drainage:

East Haven:	**Mud Pond**
Granby:	**Cow Mountain Pond**
	Mud Pond
Victory:	**Umpire Brook Wetlands**
	Victory Basin
Concord:	**North Concord Bog**

Duck Pond - tributary to Duck Pond Brook which flows into Stiles Pond in the Town of Waterford. The 25 acre site has an open pond with deep marsh and boggy margins. The area provide habitat for waterfowl and beaver. (Vermont Agency of Environmental Conservation, 1986)

Sleepers River

Emerson Falls - located in a rural setting, one-quarter mile from the I-91 right-of-way, with concrete weirs and a gauging station upstream. At the site, the north side of the river is densely wooded and the south bank has grassy slopes and ledges. Below a small concrete dam there is a pool 25 feet in diameter and then a steep cascade, 40 feet wide and 35-40 feet high. The size of this feature qualifies it as one of the fifteen largest cascades in Vermont. Below the main cascade are several low cascades and deep pools. The site is very popular locally for scenery, picnics, swimming and fishing. (Jenkins and Zika, 1987)

Knapp Swamp - A cedar swamp with poplar, balsam fir, and dogwood along its edges with moderately sized northern white cedars requiring wetter habitat in the middle. The understory is dominated by dwarf scouring rush, cotton grass, the rare sheathed sedge, and peat moss. Also located here are some rare orchids.

Middle Passumpsic River

Passumpsic River Esker - exposed in places along a 2.5 mile river segment north of the City of St. Johnsbury. The glacial outwashed sands and gravels form a ridge that have been heavily mined as a commercial resource. Due to erosive processes, the esker has a strong natural influence on the aquatic habitat of the Passumpsic River. (Vermont Agency of Environmental Conservation, 1986)

Joes Brook

Henderson Bog - A kettlehole bog formed as an ice block sloughed off from a receding glacier and formed a crater-like depression. Within this seven acre bowl, peat moss forms a quaking mat. Small cranberries are abundant and bog laurel is the common shrub. Rare plant species habitat is found here. The bog is surrounded by a mixture of birch and coniferous forest.

Stoddard Swamp - a unique plant community with bog and swamp species at the headwaters of Rake Factory Brook. The 12 acre bog forest is dominated by white cedar, black spruce, tamarack, and balsam fir. An open bog heath has many orchids and other typical bog species. Carbon-14 dates on the bog show it is over 11,000 years old. (Vermont Agency of Environmental Conservation, 1986)

Lower Passumpsic River

Barnet Riverside Outcrop Community - found in the lower portions of steep cliffs adjacent to the river. It is an open community due to the affects of floodwaters and ice scour. Alluvial (water-deposited) soil found in rock

cracks provides anchorage for hareball, columbine, goldenrods, and bluegrass plant varieties. The Barnet outcrop is quite small, extending for about 50 meters along a narrow band. A patch of bearberry as well as river thimbleweed and rusty woodsia were also found at this site.

Nine Islands - a large eddy-delta complex covering about three acres at the mouth of the Passumpsic River. The community has been disturbed by logging and flow fluctuations from dams on the Connecticut and Passumpsic Rivers; although a small stand on the mainland west shore is an exception. The latter area is dominated by silver maples averaging about 12" in diameter, with the largest individuals reaching up to 30". Typical of the floodplain forest community, the understory is dominated by ostrich fern with aground layer of grasses and spotted joe-pye weed.

The Northern Vermont Development Association (NVDA) is completing (1990-91) an inventory of undeveloped lake shorelines in the Northeast Kingdom, including those in the Passumpsic River watershed. Undeveloped lake shorelines in Vermont are highly valued natural areas. The NVDA project will:

1. Inventory the lake and ponds over 10 acres in the Northeast Kingdom. The inventory information will be supplied to local planning commissions, regional and state organizations to be used in planning and conservation efforts.

2. Identify sections of undeveloped shoreline greater than 1000 feet.

3. Using established criteria, identify the most important shorelines to protect as undeveloped. These lists will be supplied to local, regional and state organizations to be used in planning and conservation projects.

Central Vermont Public Service Corporation is completing studies of endangered and threatened vascular plants and outstanding natural communities within the hydropower projects areas at Pierce Mills, Arnold Falls, Gage #3, and Passumpsic Dam. The Vermont Nongame and Natural Heritage Program lists 20 different rare plants and animals found in the Passumpsic River watershed. This information is not provided here due to the high sensitivity of these species to habitat perturbations.

SECTION IV

PASSUMPSIC RIVER PROJECT CONCLUSIONS

OPPORTUNITIES

GOALS

ACTIONS

PASSUMPSIC RIVER PROJECT CONCLUSIONS

Water quality discussions, descriptions of natural/cultural settings, and the inventories of river recreation in the Passumpsic River watershed show that, in large part, today's river uses and values remain a function of the settlement patterns established in the last century. The natural "Vermont" constraints on resource use and development found the forest industry and a few farmers in the highlands and located villages and cities progressively lower in the valleys where the ease of transportation aided the prosperity industry and commerce. There are river use concerns and issues people want to resolve, and at the same time, one of the strongest messages heard from the public as part of the present Passumpsic River Project was that people do not want to lose their historic relationship with the land and water. In the Passumpsic River basin there are strong correlations between:

1) land use, land cover,
2) stream size and gradient,
3) existing water quality and aquatic habitat type, and
4) pollution sources.

To aid problem solving with the overall goal of balancing river uses and values, as expressed by local residents, conservation strategies are suggested under the three general watershed settings describing the Passumpsic Basin. The map on the following page approximates these watershed areas described as 1) Forestland and Wildlands, 2) Rural Residential/Agricultural, and 3) the Lyndon and St. Johnsbury Urban Corridor. U.S.G.S. topographic maps (1:24,000 and 1:25,000 scale) were used as the primary source of information pertaining to land use/cover and stream elevation/ gradient.

The purpose of the map is not to provide detail on these topics but to facilitate the reduction of a large volume of information and recognize similar and dissimilar water quality and recreation issues. Management recommendations pertaining to instream issues for the entire Passumpsic River mainstem are included under the "Urban Corridor" discussion.

Compiled for the three natural/cultural settings of the watershed are lists of **watershed opportunities** - i.e., existing or potential river uses and values, the **current issues** that may involve conflicts between uses that limit opportunities, and **goals and recommended actions** to resolve issues. These lists were generated from existing water quality and recreation information, recent field observations and input from local residents living in the Passumpsic Basin.

Actions describe projects that are underway or programs and procedures ordinarily used to resolve Vermont water quality and recreation issues. For many issues, the impetus for action must begin with local residents, town government and landowners. Consequently, the recommendations below are based on suggestions made at local forums and through written surveys. They are offered as a starting place for discussion. In action statements for activities for which the Agency has regulatory authority to make specific technical recommendations, the citation "(ANR)" was made.

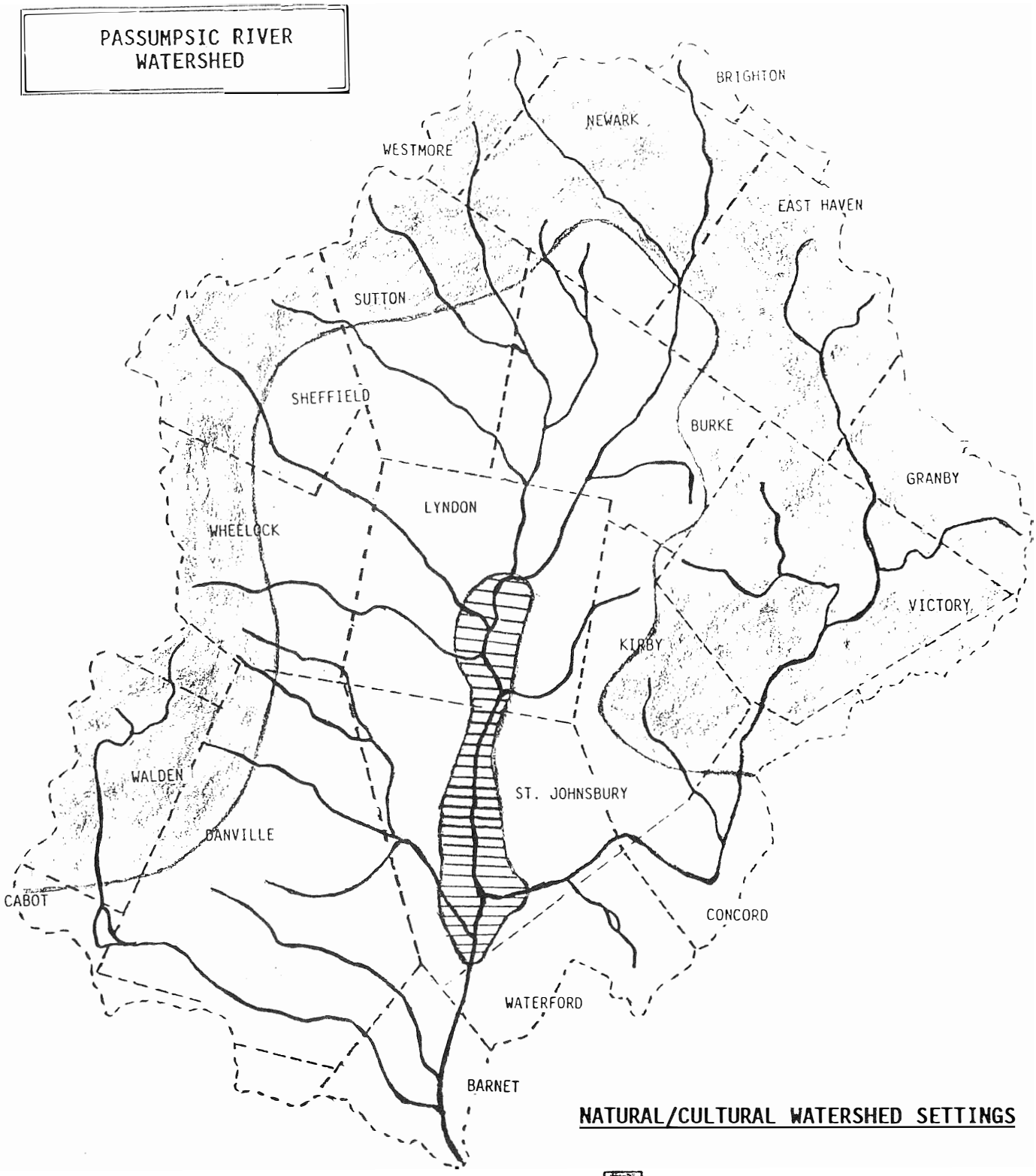

PASSUMPSIC RIVER WATERSHED
BRIGHTON
NEWARK
WESTMORE
EAST HAVEN
SUTTON
SHEFFIELD
BURKE
GRANBY
LYNDON
WHEELOCK
VICTORY
KIRBY
WALDEN
ST. JOHNSBURY
DANVILLE
CABOT
CONCORD
WATERFORD
BARNET
NATURAL/CULTURAL WATERSHED SETTINGS
Forestland and Wildland
Rural Residential/Agricultural and Small Villages
Lyndon and St. Johnsbury Urban Corridor

Figure 26.

FORESTLAND AND WILDLANDS

Watershed Opportunities

★ **Forest Economy** supported by soil conservation in large timberlands.
★ **Pristine Streams** in secluded, roadless areas that contribute cold, clear water to downstream rivers.
★ **Upland Aquatic Habitat** in characteristically high gradient streams with rubble/boulder substrates and high riffle/pool ratios supporting one of the healthiest populations of native brook trout in Vermont.
★ **Swimming Holes** frequented by villagers.
★ **Exceptional Water Resource Values** of statewide significance, especially those of the Upper Moose River.

Current Issues

▸ Erosion and sedimentation from logging sites.
▸ Failed septic systems in villages.
▸ Stream encroachment especially problematic in the Dish Mill watershed.
▸ Lack of effective way to determine pollution impacts and carry out corrective actions.

Goals and Recommended Actions

● Maintain forest economy and protect pristine streams and their upland aquatic habitats.

Action: Local citizens and ANR work more closely with representatives of the Vermont Timber Truckers and Producers Association and the American Forestry Association to ensure forestry AMP implemention when problems are identified.

● Limit encroachment of roads and structures on fragile upland streams.

Action: Local road commissioners improve and maintain erosion control measures and prioritize stream protection in the design and construction of dirt/gravel backroads, especially in the conversion of logging roads to more permanent travel routes. The Local Roads Program centered at St. Michael College in Winooski, Vermont will assist municipalities with management practices to minimize road erosion.

Action: Local citizens and town officials identify appropriate stream setbacks for development projects in upland watershed to protect water quality, fish and wildlife habitat, and the experience of hiking and fishing along wilderness streams.

- Increase watershed stewardship and local interest to maintain clean water, safe for swimming and compatible with other identified stream uses and values.

  Action: Local citizens and schools with the assistance of the Connecticut River Watershed Council, the River Watch Network, and the ANR establish a Passumpsic River Watch Program that will:

  a. Identify stream uses and values (i.e., swimming holes) and suspected pollution threats.
  b. Establish an ongoing water quality monitoring program in local schools to verify stream impacts.
  c. Work with local government and businesses to correct water quality problems at the local level.

RURAL RESIDENTIAL/AGRICULTURAL

Watershed Opportunities

- ★ **Farm, Forest, and Recreation/Tourism Based Economies** benefiting from soil conservation, clean water supply, and productive fisheries.
- ★ **Free-flowing River Segments** popular for boating and critical habitat for fish migration, spawning, and food production. Cascading waters at historic village mill sites are important for scenic value.
- ★ **Segments of Undeveloped River Corridor** with shaded waters and stable streambanks supported by adjacent wetlands and woodlands.
- ★ **Variety of Aquatic Habitats** from low gradient sandy runs to steeper rocky pools and riffles being the most productive waters in the Passumpsic basin.
- ★ **Large Swimming Holes** especially those associated with geologic river features to which people are willing to travel to enjoy.
- ★ **New Class B Managed Waters** on the East Branch and Water Andric

Current Issues

- ▸ Bank slumpage especially problematic on the Miller Run, Sleepers River, and Sheldon Brook and the Lower Passumpsic mainstem in the towns of Waterford and Barnet.
- ▸ Elevated water temperatures harmful to fish populations due to the loss of river bank and corridor vegetation.
- ▸ Nutrient loading, erosion, and sedimentation from adjacent farmland.
- ▸ Impairment of aquatic habitat below Green Mountain Power hydroelectric project in the by-pass and downstream of the powerhouse.
- ▸ Aesthetic and recreational flows at Emerson Falls in the hydroelectric facility by-pass.
- ▸ Health risks associated with raw sewage discharges, especially in the Lower Moose River segment below East St. Johnsbury.

- ► Class C zones that receive no domestic sewage discharges or are longer than need be to adequately protect public safety.
- ► Lack of formal public access to streams and rivers.

Goals and Recommended Actions

- Increase soil conservation to preserve farm and forest economies and protect both low and high gradient aquatic habitats from erosion, sedimentation, and elevated water temperatures.

  Action: Landowners and farmers work voluntarily with the U.S. Soil Conservation Service office in St. Johnsbury. Cost share money and technical assistance are currently being provided to help stabilize streambanks and minimize erosion. Encouraging the growth of riparian trees and shrubs will shade the water in addition to stabilizing soils.

  Action: Local citizens and ANR work more closely with representatives of the Vermont Timber Truckers and Producers Association and the American Forestry Association to ensure forestry AMP implemention when problems are identified.

- Enhance recreation/tourism based economy, preserve historic and archeological resources, and restore the aesthetics and productivity of local rivers and streams.

  Action: Town and regional planning commissioners encourage recreation and conservation greenways by recommending building setbacks and vegetation maintenance for developments proposed along watercourses and seek public access easements from willing landowners. River greenways have been successfully billed as community amenities enhancing local economies throughout the U.S. State programs are available to assist towns and local groups with trails and greenways projects.

- Establish river and stream classifications that reflect the actual water quality and compatible beneficial uses.

  Action: After completion of the East Haven community septic tank/leachfield system (1991), the Class C zone on the East Branch of the Passumpsic River from Hartwellville to Flower Brook should be reclassified to Class B, waters suitable for contact recreation (ANR).

  Action: After separation of sewer and storm pipes in St. Johnsbury (1993), the 1.1 mile Class C zone on the lower Moose River should

be reclassified to Class B, waters suitable for contact recreation (ANR).

Action: The 3.8 mile Class C zone on the Water Andric should be shortened to 1.0 mile starting at the Danville WWTP outfall. A one mile C zone is the stream distance necessary to assimilate the WWTP design capacity discharge and will reclassify 2.8 stream miles to Class B, suitable for contact recreation (ANR).

- Restore aquatic habitat values in the West Danville hydroelectric project by-pass and in Joes Brook downstream of the powerhouse.

  Action: The Vermont DEC should determine the extent of impact on fish populations and habitat due to the curtailment of flow in the by-pass and downstream of the West Danville hydroproject (ANR).

  Action: The Vermont DEC, Green Mountain Power Corporation, and the Joes Pond Association should negotiate minimum flow requirements in the bypass and below the project, and determine stable pond heights behind the dam to enhance fisheries, water quality and aesthetics. The Department should call a 10 V.S.A., Section 1003 conference for these purposes, if necessary (ANR).

- In addition to recreational enhancements presently realized at the Emerson Falls hydro facility, ensure that aesthetic and recreation values of falls and swimming holes in the immediate vicinity of the falls are maintained.

  Action: Emerson Falls Hydro, Inc. should conduct flow demonstration studies with the Agency of Natural Resources (1991) to determine what changes in by-pass minimum flow requirements, if any, should be made to maintain the aesthetic and recreation values of the Falls. A 401 Certificate will be reissued by the State to reflect the final agreement (ANR).

- Reduce the health risks posed by the discharge of domestic wastewater and restore safe recreational use of the Lower Moose River.

  Action: Residents of East St. Johnsbury and the Town of St. Johnsbury should establish and implement a plan to collect and treat septic tank effluents to eliminate direct discharges of wasterwater to the Moose River.

- Increase watershed stewardship and local interest to maintain clean water, safe for swimming and compatible with other identified stream uses and values.

  Action: Local citizens and schools with the assistance of the Connecticut River Watershed Council, the River Watch Network, and the ANR should establish a Passumpsic River Watch Program that will:

  a. Identify stream uses and values (i.e., swimming holes) and suspected pollution threats.
  b. Establish an ongoing water quality monitoring program in local schools to verify stream impacts.
  c. Work with local government and businesses to correct water quality problems at the local level.

URBAN CORRIDOR

Watershed Opportunities

- ★ **Industrial and Service Economies** benefiting by hydropower production, clean water supplies and adequate flows for wastewater assimilation.
- ★ **Constant Natural Flows** from powerhouse tailraces downstream to the head of dam impoundments will improve waste assimilation, water quality aesthetics, scenery, and habitat for aquatic biota.
- ★ **An Aesthetically Pleasing, Swimmable River** attractively clean and clear and without visible domestic sewage, high algal growths, and excessive turbidity.
- ★ **Increased Aquatic Habitat** for fisheries and other aquatic biota in hydropower facility by-passes and in the limited riffle areas of the Passumpsic historically threatened by sedimentation.
- ★ **Urban Parks and Open Space** enjoyed by people living and working in or near Lyndonville and St. Johnsbury as "green" places to visit along the Passumpsic River and its major tributaries.
- ★ **Improved Formal Public Access** at hydropower facilities.
- ★ **A Boatable River** with convenient portage facilities.

Current Issues

- ▸ Untreated domestic sewage entering the Passumpsic, Sleepers, and Moose Rivers via combined sewer/storm water pipes (CSOs) and failed septic systems.
- ▸ Flow regulation at mainstem hydropower facilities affecting upstream flooding, aquatic habitat, water quality and aesthetics in by-pass segments and downstream of the facilities.
- ▸ Landfills and hazardous waste sites adjacent to the river thought of as eyesores and a threat to public health.
- ▸ River encroachments including floodplain filling, construction and road-related erosion, and lack of development setbacks.

- Urban runoff including sediments, petroleum products and household hazardous wastes.
- Lack of formal public access to the Passumpsic River mainstem.
- Dam passage problems for boaters paddling downstream, adult fish moving upstream to spawn and then young fish moving downstream to find deeper refuge habitat.
- Public misperceptions about uses and values of the Passumpsic River.

Goals and Recommended Actions

- Increase the appeal and safety of swimming in the Passumpsic River by eliminating all known sources of untreated domestic wastewater entering the Passumpsic River and major tributaries.

  Action: Maintain 1991-1993 schedule for separating all storm and sewer pipes in Lyndonville and St. Johnsbury.

  Action: Vermont water quality investigators, towns, businesses and homeowners should work together to remediate failed septic systems.

- Continue to use the river for the generation of electricity and to make this use more compatible with other river uses and values.

  Action: Federal Energy Regulatory Commission (FERC) should relicense and the Vermont Agency of Natural Resources (ANR) should reissue 401 Water Quality Certificates for hydropower projects on the Passumpsic River with conditions that achieve the goals below related to hydro facility operations.

- Establish natural river flows between hydropower facilities to improve aquatic habitat, water quality and aesthetics.

  Action: ANR should issue a 401 Water Quality Certification to the Central Vermont Public Service Corporation (CVPSC) facilities at Pierce Mills, Arnold Falls, Gage Dam, and Passumpsic Dam to operate in a true instantaneous run-of-river mode with constant pond heights at all times (ANR).

  Action: FERC should license the same four CVPSC projects to operate in a true instantaneous run-of-river mode with constant pond heights at all times (ANR).

  Action: FERC and ANR should monitor the compliance of run-of-river operations licensed at the two Lyndonville Electric and five CVPSC hydropower facilities on the Passumpsic mainstem.

- Establish minimum flows in the by-pass segments of the Pierce Mills, Arnold Falls, Gage Dam, and Passumpsic Dam hydropower facilities to maintain aquatic habitat, water quality, aesthetic values.

  Action: CVPSC should conduct fisheries studies at Pierce Mills and Gage Dam to determine minimum by-pass flows necessary to improve and maintain aquatic habitat values in these river segments (ANR).

  Action: CVPSC should agree to spill 7Q10 flows in the Arnold Falls and Passumpsic Dam by-passes or conduct dissolved oxygen and aesthetics studies to determine if flows lower than 7Q10 will meet water quality standards and maintain river values (ANR). If these studies show that flows lower than 7Q10 will maintain water quality and aesthetics, CVPSC may avoid quantitative fisheries habitat studies by conducting flow demonstrations for the Vermont Fish and Wildlife Department and the U.S. Fish and Wildlife Service to determine qualitatively if habitat values are lost by spilling flows lower than 7Q10 (ANR).

  Action: ANR should issue a 401 Certificate and FERC should relicense the four CVPSC hydropower facilities to operate with the minimum spillage flows that maintain aquatic habitat, water quality, and aesthetics in the by-pass segments (ANR).

- Enhance the ability of boaters and fish to negotiate passage of hydroelectric dams.

  Action: CVPSC and Lyndonville Electric Department should improve boating portage trails including safe put-in and take-out places along the river where possible (i.e., a Great Falls portage trail is not deemed feasible at this time for public safety reasons).

  Action: As part of FERC relicensing process, downstream fish passage facilities should be provided at all Passumpsic River mainstem hydropower facilities. Due to the high cost of upstream passage facilities, the State will defer its request for upstream passage at this time, and in accordance with provisions made in the East Barnet hydro project, ask CVPSC to construct, operate, and maintain fish-passage facilities for migrating salmonids as becomes necessary to implement the Atlantic Salmon Restoration Project for the Connecticut River Watershed (ANR).

- Increase river water clarity, enhance river aesthetics, and improve habitat for fish, wildlife and other aquatic biota.

  Action: If CVPSC desilts impoundments of Passumpsic River hydroelectric facilities effects on water quality, fisheries, and supporting aquatic life should be minimized (ANR).

Action: In addition to those flood hazard bylaw provisions currently in place in the towns of Burke, Lyndon, St. Johnsbury, Waterford, and Barnet, town and regional planning commissioners should discourage floodplain filling and review site plans for building and road setbacks, vegetation maintenance, and adequate erosion control measures for developments proposed along watercourses. Technical assistance for erosion control and floodplain management are available at the Division of Water Quality.

- Reduce the risks of toxic chemicals affecting the health of people and aquatic life.

  Action: Continue or increase monitoring of surface water and groundwater near the Darling Hill, Parker, St. Johnsbury, and Barnet landfills for E.P.A. priority toxics. Leachates should be collected and treated where health threats exist.

  Action: Local schools and waste disposal programs should expand public education on the need to properly dispose of household hazardous wastes and maintain vehicles to minimize the contamination of surface runoff and groundwater.

- Enhance the desirability to live and conduct business in Lyndonville and St. Johnsbury by making the Passumpsic River a recreational, cultural/historical, and educational amenity in the urban corridor.

  Action: Local businesses, Towns, and landowners as part of ongoing urban renewal efforts, should explore ways to formalize public river access, and incorporate recreation and pedestrian paths, parks, and picnic areas as part of development projects along the Passumpsic River to attract other businesses, visitors, and shoppers.

- Increase watershed stewardship and local interest to maintain clean water, safe for swimming and compatible with other identified stream uses and values.

  Action: Local citizens and schools with the assistance of the Connecticut River Watershed Council, the River Watch Network, and the ANR should establish a Passumpsic River Watch Program that will:

  a. Identify stream uses and values (i.e., swimming holes) and suspected pollution threats.
  b. Establish an ongoing water quality monitoring program in local schools to verify stream impacts.
  c. Work with local government and businesses to correct water quality problems at the local level.

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Appendix A.

CONTACTED RIVER INTERESTS

PASSUMPSIC RIVER

Municipal Planning Commissions/Board of Selectmen
Caledonia Soil Conservation Service
North East Audubon Society
Vermont Trappers Association
Northeast Kingdom Water Quality Monitors
UVM Extension Service
Caledonia Natural Resource Conservation District
Lyndonville Electric
Soil and Water Conservation Society, St. Johnsbury
Ducks Unlimited, Northeast Chapter
St. Johnsbury Academy
Green Mountain Environmental Alliance, Lyndonville
Connecticut River Watershed Council, St. Johnsbury
Lyndon State College
District Fish and Wildlife Department, St. Johnsbury
Fairbanks Museum
Caledonia Forest and Stream Club
Local Sporting Goods Stores
Northern Vermont Canoe Cruisers
Vermont Timber Truckers and Producers Association
St. Johnsbury Historical Society
Three Rivers Canoe Company, Lyndonville
Northeast Woodland Services
State Senators and Representatives
Vermont Timberland Owners Association
Associated Industries of Vermont
Vermont Natural Resources Council
Northern Vermont Development Association, St. Johnsbury
Central Vermont Public Service Corporation
Sleepers River Hydropower Company
Burke Mountain Enterprises
EHV Weidmann Company, St. Johnsbury
Green Mountain Power
Division of Historic Preservation
Agency of Transportation
The Nature Conservancy
Vermont Farm Bureau
Local Residents and Private Landowners

Number of individuals\organizations contacted representing different interests:

Silviculture (6), Agriculture (13), Regional Planning Commission, Municipalities (20), Fisheries (9), Environmental (5), Wildlife (5), Vermont Senators/Representatives (9), Water Quality (16), Boating (5), Development (8), Hydropower (4), Historical (2), Ski Area (1)

State of Vermont

Department of Fish and Wildlife
Department of Forests, Parks and Recreation
Department of Environmental Conservation
State Geologist
Natural Resources Conservation Council

AGENCY OF NATURAL RESOURCES
103 South Main Street
Waterbury, Vermont 05676

Department of Environmental Conservation

WATER QUALITY DIVISION
10 North Building
802-244-6951

PASSUMPSIC RIVER PROJECT

March 19 Workshop Report:

During the workshop, participants divided themselves into two smaller groups:

1. Water Quality/River Use
2. Recreation/River Corridor Values

Based on the river issues and goals identified by area residents, specific actions to achieve goals were identified. In clarifying the actions that were listed, people discovered that visions or goals for the river were easier to formulate than the steps necessary to get there. By the end of the workshop, there was a consensus on the need for more information about the Passumpsic River, its tributaries, and the concerns and attitudes of others, including landowners and municipalities.

The following outline includes action steps, information needs, and potential conflicts identified by people during the workshop. If you have anything to add, please send me your thoughts in a letter or contact me at 244-6951.

Thank you for your interest,

Michael Kline

Michael Kline, Coordinator
Passumpsic River Project

eh

Enclosure

ACTIONS/INFORMATION NEEDS/POTENTIAL CONFLICTS

Water Quality/River Use

1. Reduce organic loading to rivers.

   A. For point sources there should be higher treatment levels applied.

   B. Better storage and management of manure. SCS, Extension Service, and ANR work together to develop more financial incentives for farmers.

   C. Eliminate raw sewage by first implementing local on-site sewage programs then enforcing with fines if necessary.

   D. Sewer/stormwater separation.

   E. Watershed inventory through water quality monitoring and stream walks to find pollution sources.

Information need: ANR and RPC should pull together information on present federal, state, and local regulations.

Information need: Where is raw sewage entering the river--both private and public sources?

Potential Conflicts: The cost of higher treatment levels, manure management and eliminating raw sewage discharges.

2. River education through river trips, slide shows, water quality monitoring, and AMP team activities.

   A. Areas where education is believed to be needed most include: river ecosystems, impacts of pollution, recreational values, importance of river and history.

   B. Those involved with educational projects should include the media, RPC, schools, Connecticut River Watershed Council, colleges, River Watch Network, television, AMP team, Scouts, Extension Service (4-H).

   C. Rivers should be integrated into school curriculum.

Information needs: Watershed inventories should be completed by RPC, ANR, local people, and students. Teams should be built.

Potential Conflicts: Educational projects may be limited by money needs and time constraints in the schools.

3. Towns and landowners should regulate land use activities that impact the rivers.

   A. Don't allow filling of wetlands and flood plains.

   B. Revegetate streambanks. Projects may involve landowners, scouts, garden clubs, schools, youth groups, SCS, tourists, ANR, River Watch Network, Youth Conservation Corps, Extension Service.

4. Find money sources as river protection incentives.

   A. Fines and user fines.

   B. "Kingdom Watch."

5. Green-up days for rivers, sponsored by town conservation committees, ANR.

   A. River celebration.

   B. Canoe races such as the one sponsored by the East Burke Fire Department.

RECREATION/RIVER CORRIDOR VALUES

1. Buffer zones and undeveloped corridors.

   A. ANR and RPC will survey towns to find out how they presently control development in the river corridor. Flood plains, wetlands, filling?

   B. Inventory mile by mile (using standardized field data collection form) the present status of land ownership, land use and corridor vegetation. This could be completed by ANR and resident volunteers utilizing existing information from towns (tax maps), regional planning commissions, and SCS.

   C. Determine what river values are maintained and protected with buffers: water quality, fish and wildlife habitat, public access, screening from hydro projects, and gravel pits?

   D. Create maps and other educational materials including model ordinances (one page) explaining flexible buffers. These materials will be used to work with towns and landowners in corridor/buffer zone protection.

   E. Form conservation commissions and work with land trusts to identify corridor projects and money sources.

Potential Conflict:

a. Property rights versus corridor preservation.
b. Administrative complexity versus flexible buffer.
c. Town values and attitudes vary toward planning and zoning.
d. Additional costs for landowners, gravel pit owners, etc.

2. Recreational opportunities.

   A. Get information on recreational uses of Passumpsic and tributaries from:

   - sporting goods outlets.
   - sporting clubs (go to their meetings).
   - canoeists.
   - Lyndon State College-outing club.
   - high school outing clubs.
   - swimming holes and passive recreation.

B. Identify specific areas used. Do you play in the Passumpsic? Why or why not?

C. Research what the river is or could be as a recreational asset ($) to communities.

D. Enhance urban trail systems along the river as an amenity to commercial interests in downtown area. Reorient St. Johnsbury to the river.

3. State, RPC, environmental groups, and Burke Mountain Enterprises should work together to keep everyone informed about the town and regional impacts associated with the ski resort expansion and associated secondary developments.

Potential Conflicts: Different interests of Burke Mountain Enterprises, town of Burke with neighboring towns, NVDA (RPC), VNRC, and environmental organizations.

Appendix C.

SACHS & DESMEULES

ATTORNEYS AND COUNSELORS AT LAW

THE HARRIET PARTRIDGE HOUSE

POST OFFICE BOX 1090

NORWICH, VERMONT 05055

(802) 649-2001

ERNEST P. SACHS
PETER J. DESMEULES
FRANK H. OLMSTEAD
NICHOLAS E. HEYL

23 January, 1990

Mr. W. William Martinez, P.E.
Environmental Coordinator
Central Vermont Public Service Corporation
77 Grove Street
Rutland, Vermont 05701

Re: Central Vermont Public Service Corporation
Initial State Consultation
Pierce Mills - FERC No. 2396
Arnold Falls - FERC No. 2399
Gage - FERC No. 2397
Passumpsic - FERC No. 2400
Taftsville - FERC No. 2490
Cavendish - FERC No. 2489

Dear Bill:

I am in receipt of a copy of your letter of 12/8/89 to Stephen Sease of the Vermont Agency of Natural Resources in connection with the captioned matter.

On behalf of the Wheelock-Titcomb Fund, the Connecticut River Watershed Council, and Trout Unlimited I would like CVPSC to know that its decision to operate all six sites in question in a true run of the river mode with instantaneous outflow equaling inflow and pond elevations being maintained at a constant level is a welcome one and indicates to us that CV is prepared to transfer its words into action to demonstrate its concern and commitment to a cleaner and healthier environment.

We endorse this decision and hope that it is only the first of many which will be made as we begin the process of restoring our diminished river resources. The Whitcomb Fund, the Connecticut River Watershed Council and Trout Unlimited look forward to working with CV and other responsible corporate citizens to

achieve this goal in the months and years to come.

Although CV's proposals as expressed in your letter certainly get the relicensing process off to a good start, I do have some concerns and questions relative to the mitigation and enhancement measures of which you speak in your letter. They are as follows:

> You state that true run of the river flows will be maintained, however, "Exceptions would be for maintenance purposes and during power pool capacity shortages when we would draw from storage. However, during refill we would maintain a continuous flow below the project."

I am concerned that these exceptions, if not strictly limited and clearly defined as to duration and timing could undo, in one fell swoop, the improvements and benefits brought about by responsible operation.

For instance, a cessation of flow and consequent drying of the riverbed, notwithstanding the arguably legitimate reasons why it might takes place (i.e., maintenance or power pool shortage) would still cause the river's fish, insect, and other aquatic life to suffer the same disastrous consequences. All the more so if this happened to occur during a hot August afternoon! The possibility that this kind of a situation should legally be permitted to occur is unacceptable.

Please let us know if you have some suggestions as to how to avoid this from happening.

Fisheries: I am anxious to have an opportunity to review the conclusions of the fisheries enhancement study commissioned this past year by CV. Missing from your letter is any mention of construction of fish passage facilities (downstream or upstream). At least two of the rivers in question (the Ottauquechee and to a lesser extent the Passumpsic) have migratory strains of Rainbow Trout. It is very important in order to assure a healthy, naturally reproducing trout population (our goal) that these salmonids be able to access their preferred spawning areas in the river headwaters and to later migrate from the spawning and nursery headwater areas to the lower portions of the river without substantial mortality. Water intakes and turbine "fins" have a well deserved reputation for chopping downstream migrants into crawfish bait. We need to identify where this is a problem, select from the available technology how best to prevent its continuing and arrive at a firm time table within which to install preventive devices.

At some of the sites it is important to develop upstream fish passage facilities to enable the existing salmonid populations and, in some cases, small-mouth bass, to access under-utilized and now presently inaccessible spawning habitat. Allowing these

species to do so is, again, in keeping with our long standing goals of restoring, maintaining, and enhancing naturally reproducing/self-sustaining fish populations.

I would welcome the opportunity to discuss with your fisheries consultants the need for such passage facilities at the sites in question.

Erosion/Siltation: I am personally familiar with at least one area along the Ottauquechee's south bank immediately above the Taftsville facility that would benefit substantially from stream bank stabilization work. I am sure there are others. The erosion at the site which I have in mind has, quite obviously, been exacerbated by past frequent and dramatic fluctuations in pool elevation. I think it needs to be addressed.

I would like also to suggest the creation of riffle areas and improvement of instream cover in the reach of river immediately upstream from the upper end of the Taftsville pool. I believe there is significant opportunity in this stretch to substantially increase the river's fish carrying capability.

These are just some of my thoughts and suggestions. I am sure the State people and others who are more familiar with the Black and Passumpsic River system will have additional suggestions and comments.

Again, I would like to say thanks to CV for the real and tangible progress towards restoring fish populations and aquatic life to more natural levels and the resultant improvement in water quality which your voluntary change of operational mode represents.

I look forward to hearing back from you in connection with my comments and questions. Thanks for your help.

Very truly yours,

Peter J. Desmeules

PJD:rk

cc: Jon Conner, Wheelock-Titcomb Fund
Syl Stempel, Trout Unlimited
Peter Richardson, Connecticut River Watershed Council
Michael Kline, Vermont Water Quality
Jim Haimes, Federal Energy Regulatory Commission
Stephen Sease, State of Vermont
Ray Gonda, Vermont Canoe Cruisers
Roderick Wentworth, Vermont Fish and Wildlife

Appendix D.

ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Deer Hill Wetland

SITE CODE: **TOWN:** East Haven

MAPS: Seneca Mountain Quadrangle 7.5' topographic map (1988); East Haven 1:5000 scale Vermont Base Map #200240 (1984).

LOCATION: From Route 114 in East Haven go northeast on Lost Nation Road about 1.2 miles. Park where Mill Brook flows under road, walk up Mill Brook approximately 0.4 mile to wetland.

LATITUDE/LONGITUDE: 44°41'10"/71°51'35"

SIGNIFICANCE: A diverse wetland complex of sedge meadow, shrub swamp and shrub and forested bog - county significance.

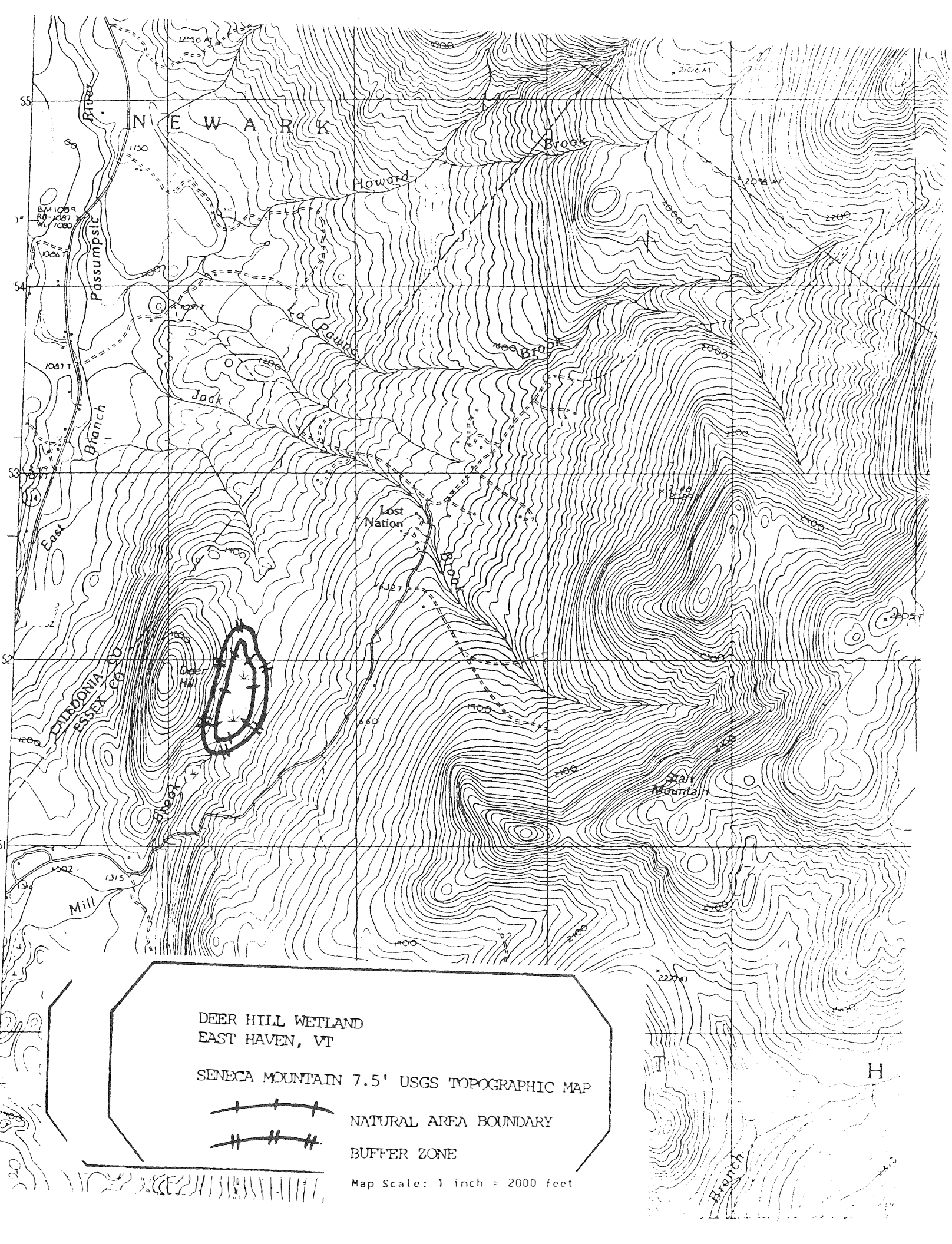
GENERAL DESCRIPTION:

There is open water in most of the central part of this elongate wetland, with a band of sedge meadow above this. The shrub bog is above, and slightly drier than the sedge meadow and grades into the forested bog, which is dominant on the west side of the wetland. This wetland is a peatland that has been flooded by beaver activity. Aerial photos indicate that the beaver dam across Mill Brook at the southern end of the wetland was built between 1942 and 1962. The peatland may have had a typical open mat before flooding. Leatherleaf is more tolerant of flooding than many bog plants, and now dominates in the shrub bog community, which is the largest area of the wetland. The forested bog is dominated by black spruce with a complete groundcover of Sphagnum moss. There is very little evidence of human disturbance in the wetland or adjacent uplands. A pair of black ducks and numerous moose tracks were observed in the wetland.

NATURAL AREA ACREAGE: Wetland complex = 19 acres; entire natural area including buffer = 40 acres.

COMMENTS AND RECOMMENDATIONS:

1. The current owners should be contacted regarding the significance of this site, and they should be encouraged to protect it.
2. A 200 foot buffer zone should be maintained from the edge of the wetland. There should be no disturbance of the soils or the vegetation in the first 100 feet of the buffer zone. From 100 to 200 feet there should be only selective timber harvesting. Clearcutting will have no direct impact on the wetland if done outside the buffer zone.
3. All vehicles should be kept out of the wetland.


NEWARK
Passumpsic River
Howard Brook
La Pauze Brook
Jack Branch
East Branch
Lost Nation Brook
Deer Hill
CALEDONIA CO
ESSEX CO
Mill Brook
Start Mountain
Branch
DEER HILL WETLAND
EAST HAVEN, VT
SENECA MOUNTAIN 7.5' USGS TOPOGRAPHIC MAP
NATURAL AREA BOUNDARY
BUFFER ZONE
Map Scale: 1 inch = 2000 feet

ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Corner Swamp

SITE CODE: **TOWN:** East Haven

MAPS: West Burke Quadrangle 7.5' topographic map (1988); Burke-Newark 1:5000 scale Vermont Base Map #196236 (1983)

LOCATION: In the west corner of East Haven, straddling the boundary between East Haven, Newark and Burke (some of the swamp is thus in Caledonia County). To reach the site, drive south from East Haven village 1.2 miles on VT Route 114, then turn right (west) on a small gravel road. Follow this road WNW for 0.5 miles, then SW about 0.4 miles. Park and walk west through the woods to the swamp.

LATITUDE/LONGITUDE: 44°38'50"/71°54'30"

SIGNIFICANCE:

1. A relatively undisturbed cedar swamp, an uncommon community type in Vermont and a rare community type in Essex County - statewide significance.
2. Potential habitat for rare plants.

GENERAL DESCRIPTION:

Corner Swamp (name assigned by authors) is a gently sloping cedar swamp in which cold calcareous water flows just below the surface of the ground, between mineral soil and a thin layer of organic soil. This cold seepage water carries mineral nutrients into the swamp, providing an unusual combination of habitat features. Swamps of this type are sometimes referred to as "seepage swamps" because of the constant movement of water under the surface. Compared to other cedar swamps where standing water is more the norm, this one is relatively dry at the surface, and in some areas resembles upland forest more than swamp. The vegetation is characteristic of northern Vermont calcareous seepage swamps, with northern white cedar dominating the canopy, and a mossy ground cover. The herbaceous plants of this swamp are mostly boreal plants. Some of them are common in spruce-fir forests of Essex County, while others are restricted to calcareous swamps, but in general they are absent from the warmer hardwood forests. Some common species are blue-bead lily, mountain sorrel, broad-lipped twayblade, creeping snowberry, and naked mitrewort.

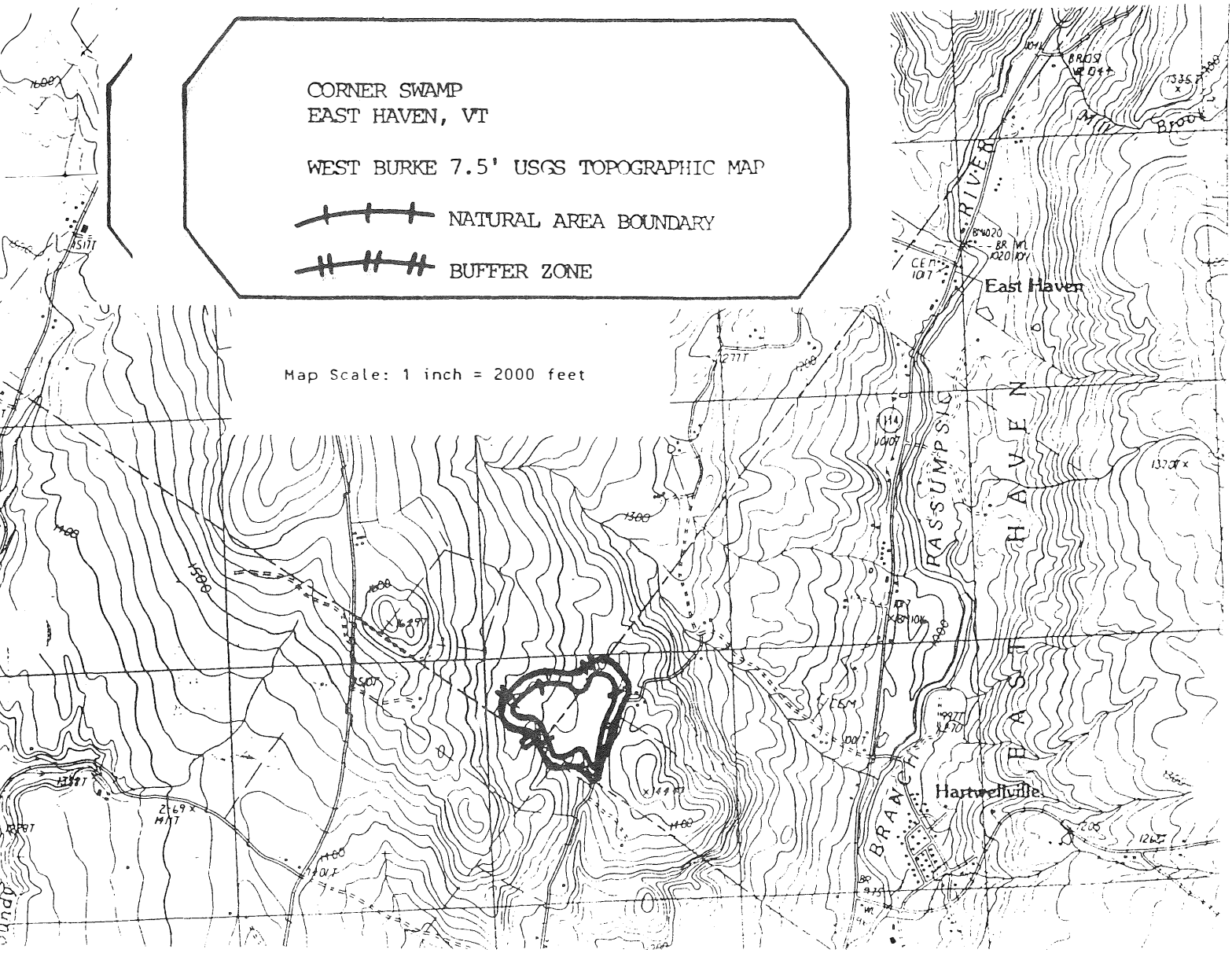
The cedar swamp occupies two topographic plateaus, the westernmost of which is in the town of Newark, in Caledonia County. The swamp is surrounded by a northern hardwood forest dominated by sugar maple.

Cedar swamps of any kind are rare in Essex County, where there is relatively little calcareous bedrock, thus this is an important natural area, worthy of attention and protection.

NATURAL AREA ACREAGE: Approximately 20 acres.

COMMENTS AND RECOMMENDATIONS:

1. The present owners should be contacted regarding the significance of this site, and they should be encouraged to protect it. If the current owners dispose of this property, this swamp should receive permanent protection as a natural area.
2. In order to protect the wetland a 200 foot buffer should be maintained around the wetland edge. There should be only selective removal of trees in the swamp and in the buffer zone. Beyond the buffer zone clearcutting will have no direct impact on the wetland.
3. Vehicles of any kind should be kept out of the wetland.



ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Mud Pond

SITE CODE: **TOWN:** East Haven

MAPS: Gallup Mills Quadrangle 7.5' topographic map (1988); Hobart Ridge North 1:5000 scale Vermont Base Map #204232 (1984).

LOCATION: From Gallup Mills in Victory travel north about 2.0 miles on Champion International road that parallel Moose River. Park at point where unnamed stream from Mud Pond flows through a culvert under the road from the west. Walk upstream to west about 0.5 mile, then follow branch upstream to southwest another 0.5 mile to pond.

LATITUDE/LONGITUDE: 44°35'57"/71°48'57"

SIGNIFICANCE:

A remote, pristine, softwater pond with an undisturbed buffer zone - statewide significance.

GENERAL DESCRIPTION:

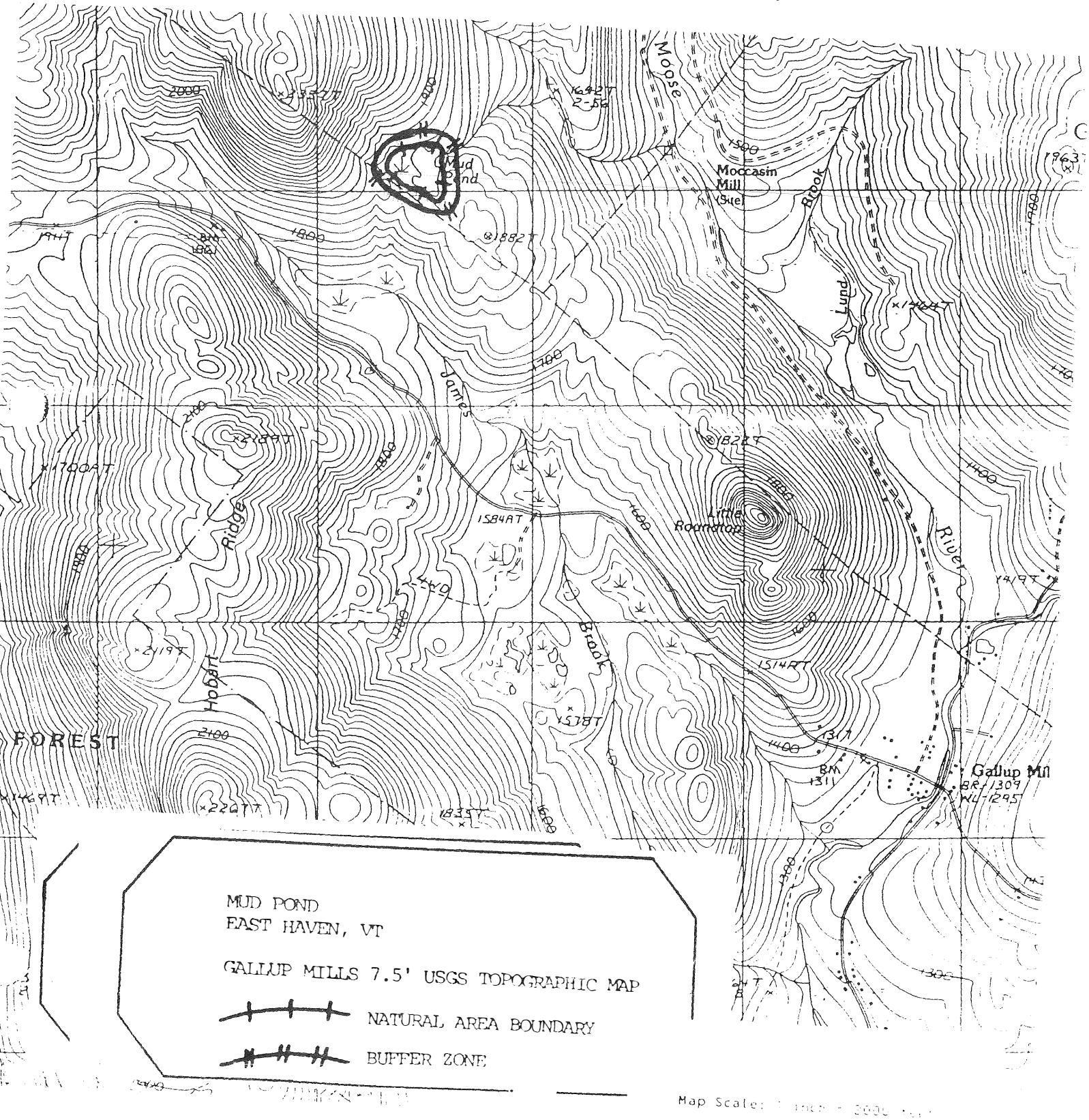
Mud Pond is a small, clear, softwater pond in an undisturbed setting. The pond has a gravel and sand bottom and large boulders present along the shoreline. The depth of the pond is unknown. There is a beaver dam present on the northeastern end of the pond. The water level has been raised by recent beaver activity, but aerial photos (1962, 1974) indicate that the pond is not a result of beaver dams. There is a band of sedge meadow around most of the pond with a leatherleaf dominated shrub border above this. A dense band of spruce-fir forest which is especially thick on the north and east sides, surrounds the pond and wetlands. There are more extensive shrub and sedge meadow wetlands present on the northwest side of the pond. A female common merganser with three young were observed on the pond. There are no camps on the pond and no recent logging in the area.

NATURAL AREA ACREAGE: Pond and associated wetlands = 16 acres; entire natural area including buffer = 30 acres.

COMMENTS AND RECOMMENDATIONS:

1. The current owners should be contacted regarding the significance of this site and, they should be encouraged to protect it. If the present owners dispose of the property, Mud Pond should receive permanent protection as a natural area.

2. A 200 foot protective buffer should be maintained from the edge of the wetland. There should be no disturbance of soils or vegetation in the first 100 feet. From 100 to 200 feet there should be only selective tree removal so as to maintain a visual buffer and to decrease the chance of blowdowns. Beyond the 200 foot buffer zone, clearcutting should have no direct impact on the pond or wetland.
3. All vehicles should be kept out of the wetland.



ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Cow Mountain Pond

SITE CODE: **TOWN:** Granby

MAPS: Stone Mountain Quadrangle 7.5' topographic map (1988); Pond Brook 1:5000 scale Vermont Base Map #212228 (1983).

LOCATION: From Granby, travel east toward Guildhall approximately 4 miles. Follow trail south to pond.

LATITUDE/LONGITUDE: 44°33'44"/71°42'08"

SIGNIFICANCE:

1. Pristine wilderness pond - statewide significance.
2. Large population of purple bladderwort, an uncommon aquatic plant species (Heritage rank S2) - statewide significance.
3. Potential nesting site for common loons.
4. Important fishing resource for local residents.

GENERAL DESCRIPTION:

A scenic, undeveloped softwater pond surrounded by spruce-fir forest and cut-over northern hardwoods and spruce-fir in the uplands. The lake shoreline is primarily rocky; virtually no bog vegetation grows around the perimeter. An undisturbed buffer zone of at least 100 feet currently exists between the lake and adjacent logging activities. There are two fire ring/campsite locations at either end of the lake. Jeep trails lead to these campsites from the Granby Road.

The pond is outstanding because of its pristine condition and remoteness.

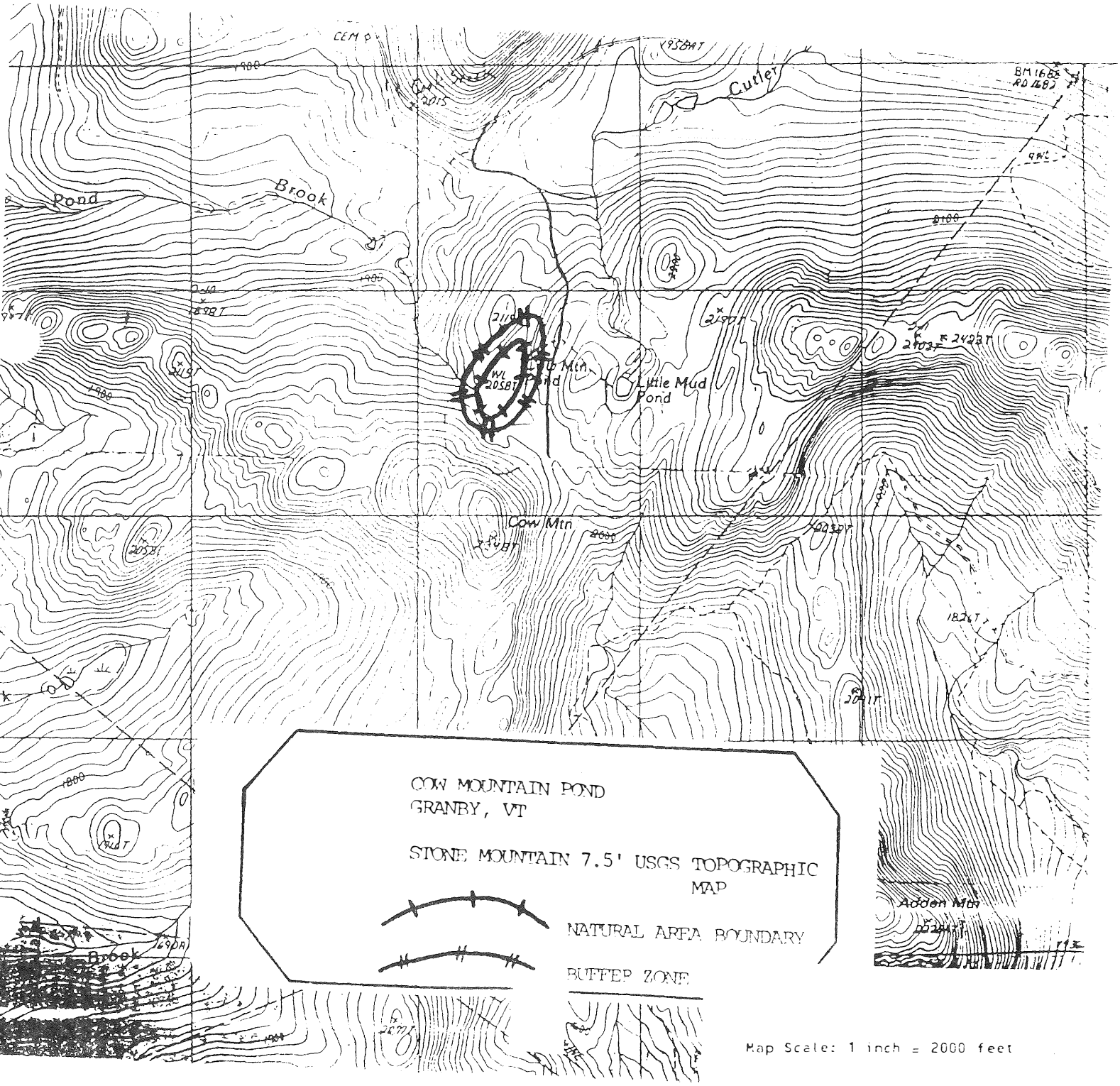
NATURAL AREA ACREAGE: Pond = 11.5 acres; entire natural area would include a 200 ft buffer around the pond (see below).

COMMENTS AND RECOMMENDATIONS:

1. The present owners should be contacted regarding the significance of this site and encouraged to protect it. The boundary of the buffer zone should be permanently marked to prevent damage to the area. If the current owner disposes of the property, Cow Mountain Pond should receive permanent protection as a natural area or recreation area.
2. Current logging practices do not appear to have any adverse effect on the natural area. With adjacent land under timber

management, we recommend that a buffer zone of 200 feet be maintained from the edge of the pond. Within the first 100 feet, the vegetation should be left undisturbed. From 100 to 200 feet there should be only selective tree removal. Beyond this 200-foot buffer clearcutting will have no direct impact on the pond.

3. Vehicles of any kind should be kept out of the natural area, and a buffer zone should be established to prevent shoreline damage and to maintain aesthetic quality. Walking trails should be used for access.



ESSEX COUNTY NATURAL AREAS INVENTORY
Vermont Natural Heritage Program

SITE NAME: Mud Pond

SITE CODE: **TOWN:** Granby

MAPS: Stone Mountain Quadrangle 7.5' topographic map (1988); Pond Brook 1:5000 scale Vermont Base Map # 212228 (1983).

LOCATION: From Granby village travel east approximately 1.4 miles to Granby Brook. Travel north about 0.3 mile on gravel road east of Granby Brook. Park and walk west down slope to pond.

LATITUDE/LONGITUDE: 44°34'45"/71°44'20"

SIGNIFICANCE:

1. A remote and pristine tannic-water pond - statewide significance.
2. Nesting site for northern harriers - statewide significance.
3. A diverse wetland complex providing important wildlife habitat - regional significance.

GENERAL DESCRIPTION:

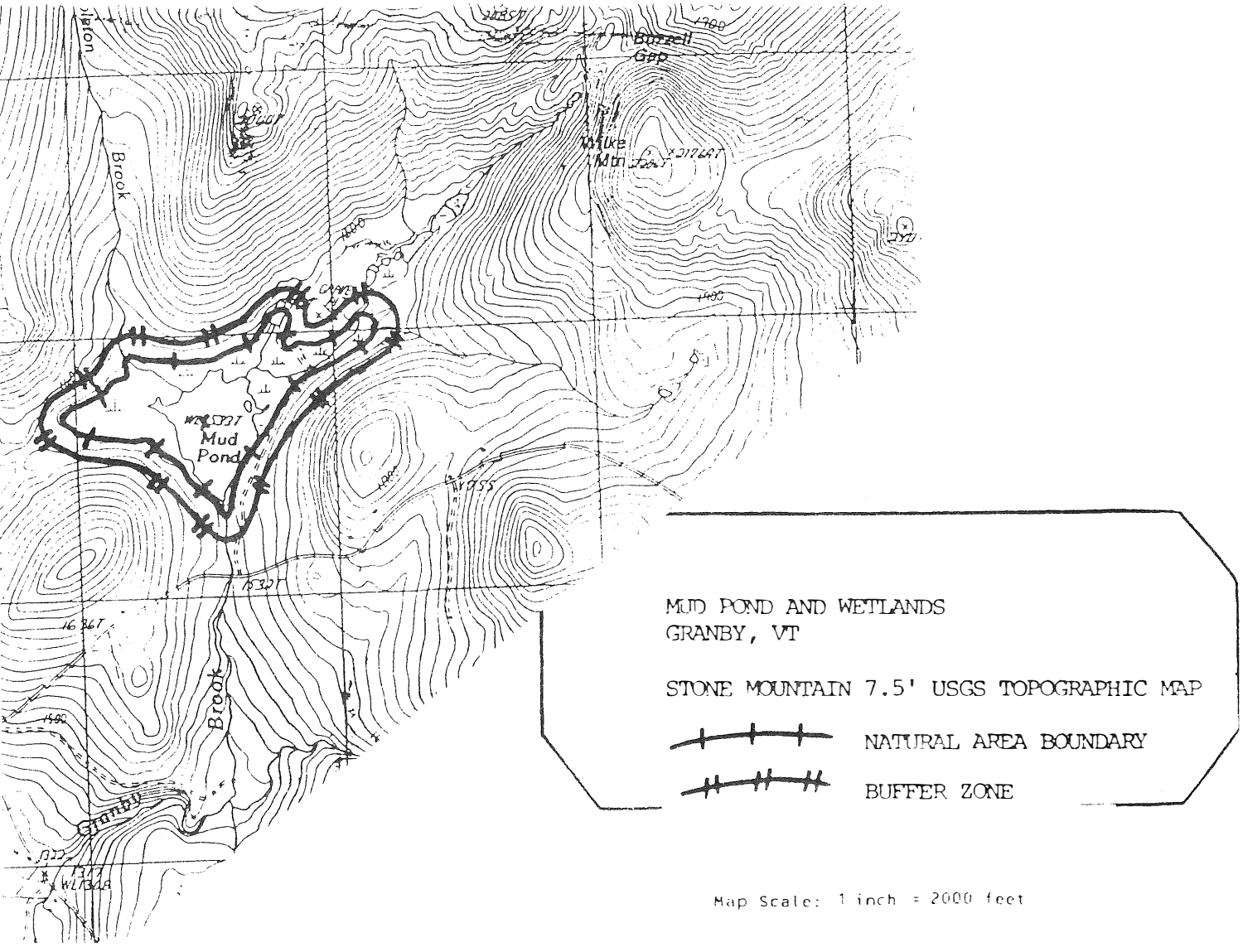
A very shallow, mud and peat-bottomed pond surrounded by unvegetated mud flats, sedge and rush marshes, alder swamp and shrub bog communities. Two streams flow into the pond and wetlands, Appleton Brook from the northwest and an unnamed stream from the northeast. Granby Brook drains the pond to the south. Damming of the pond by beavers in the past would have resulted in water levels rising approximately two feet. The beaver dam is now breached and the water level is down. The extensive mud flats are likely a result of this past beaver activity.

The sedge and rush marshes are located just upgradient of the sparsely vegetated mud flats and are dominated by three-way sedge and soft-stem bulrush. There is a nearly complete groundcover of Sphagnum moss in the shrub bogs on the northeastern and western sides of the pond, and leatherleaf and sweet gale are codominant in the shrub layer. The wetland appears to be heavily used by wildlife: on the day of the site visit two deer were observed, there were abundant moose tracks, three great blue herons were observed feeding in shallow water, a snipe was observed, and a pair of nesting northern harriers was flushed from the shrub bog on the western side of the site. The site is very scenic and the surrounding hills are undisturbed. There is a gravel operation to the northeast of the pond, but it seems to have had very little physical impact on the pond and wetlands.

NATURAL AREA ACREAGE: Pond and associated wetlands = 95 acres; entire natural area including buffer = 140 acres.

COMMENTS AND RECOMMENDATIONS:

1. The current landowners should be contacted regarding the significance of this site, and they should be encouraged to protect it. If possible, this area should receive permanent protection as a natural area.
2. A 200 foot buffer zone should be maintained from the wetland edge in order to protect water quality, wildlife habitat and the scenic and wild character of the pond and the wetlands. There should be no disturbance in the first 100 feet of this buffer zone, and there should be only selective timber harvesting from 100 to 200 feet. Beyond the 200 foot buffer zone, clearcutting will have no direct impact on the pond and wetland.
3. The gravel operation should not expand in the direction of the wetland.
4. Access to the pond should be maintained for foot travel only.
5. Vehicles of any kind should be kept out of the wetland.



MUD POND AND WETLANDS
GRANBY, VT

STONE MOUNTAIN 7.5' USGS TOPOGRAPHIC MAP

NATURAL AREA BOUNDARY

BUFFER ZONE

Map Scale: 1 inch = 2000 feet

ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Umpire Brook Wetlands

SITE CODE: **TOWN:** Victory

MAPS: Gallup Mills Quadrangle 7.5' topographic map (1988); Hobart Ridge South 1:5000 scale Vermont Base Map #204228 (1983).

LOCATION: From Route 114 in Burke travel east on Victory Road (also Burke Road) toward Gallup Mills. Park near the Victory town boundary where there is access to the gas pipeline right-of-way on the south side of the road. Walk southwest along the right-of-way for about 1.8 miles to the point where the pipeline runs along the eastern edge of the large sedge meadow wetland. Site also accessible from south via road north from old Victory village.

LATITUDE/LONGITUDE: 44°34'05"/71°50'25"

SIGNIFICANCE:

1. A mature cedar swamp, a community that is uncommon in Vermont and rare in Essex County - statewide significance.
2. A large and diverse wetland complex - county significance.
3. Potential rare plant habitat.

GENERAL DESCRIPTION:

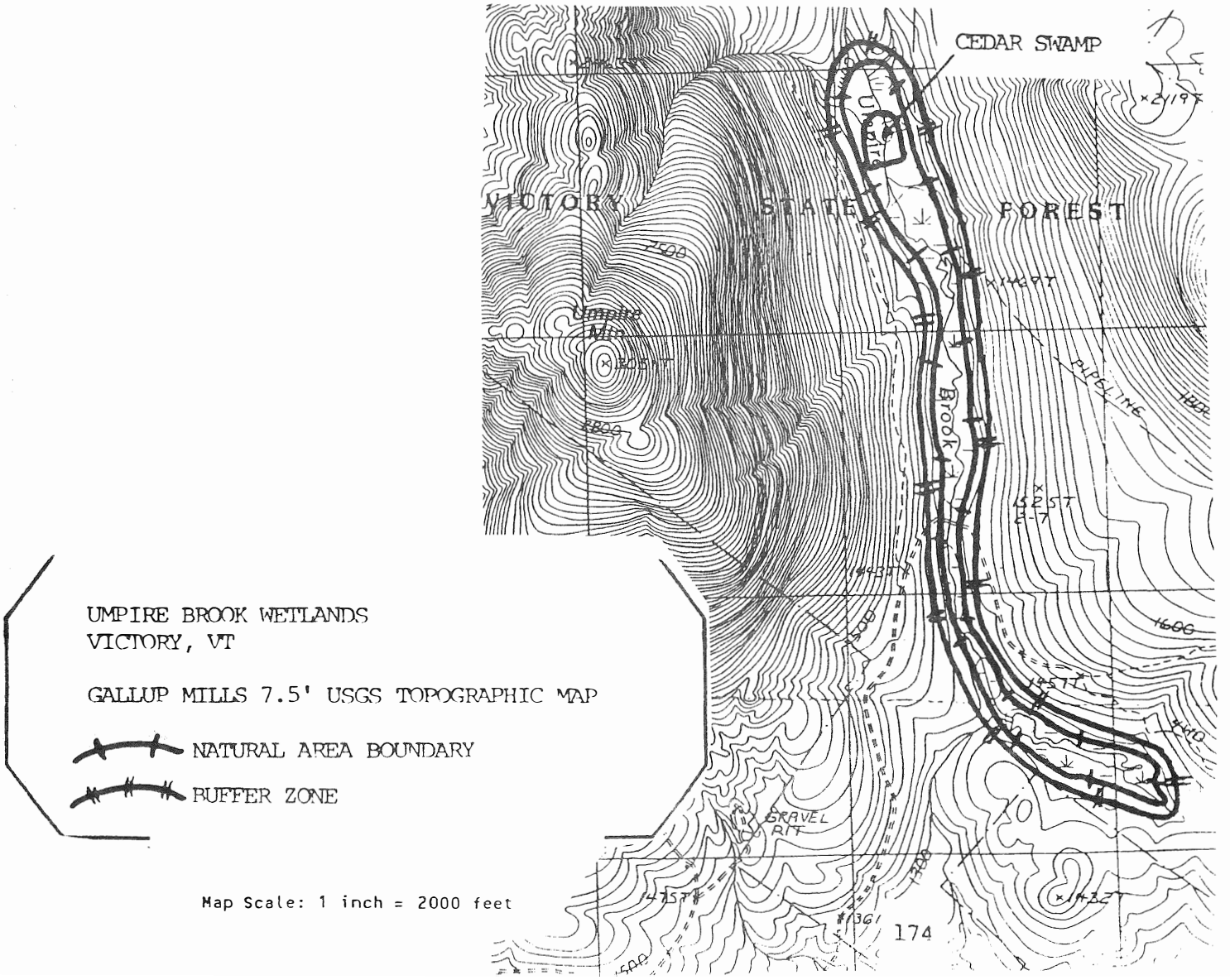
A large and diverse wetland complex of wooded swamp, shrub swamp and sedge marsh in a flat valley floor associated with Umpire Brook. There are numerous, old beaver dams and several active dams along this nearly two mile long wetland. There are a lot of old, dead cedar trees in some of the sedge marshes above the active beaver dams. The largest cedar swamp is located at the upstream end of the wetland and has trees up to 18 inches in diameter. There are plant indicators of calcium-rich conditions in the swamp, such as Sphagnum warnstorfii. There are also calcareous seeps on the nearby pipeline right-of-way with grass-of-parnassus and other species indicative of the local calcium-rich conditions. Glacial activity has likely deposited material rich in limestone in the Umpire Brook valley. The wetland is bordered by a narrow band of upland cedar and red spruce forest which grades into the northern hardwood forests.

A logging road has been built across the wetland near its center, and there has been recent logging near southern portions of the wetland. The gas pipeline runs along the eastern edge of the wetland for approximately 1,500 feet.

NATURAL AREA ACREAGE: Wetland complex = 98 acres; entire natural area including buffer = 186 acres.

COMMENTS AND RECOMMENDATIONS:

1. This site is currently owned by the State of Vermont and managed as part of Victory State Forest.
2. In order to protect the remote and scenic character of this wetland, its water quality and the wildlife habitat it provides, a 200 foot buffer zone should be maintained from the edge of the wetland. There should be no logging or other disturbance in the first 100 feet of this buffer zone. From 100 to 200 feet there should be only selective timber harvesting. This buffer zone should also reduce the likelihood of blowdowns in the natural area.
3. There is an old woods road between the wetland and Umpire Mountain that could be maintained as walking trail access to the area.
4. All vehicles should be kept out of the wetland.
5. Access for hiking or skiing should be limited to the edge of the wetland.



ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: North Concord Bog

SITE CODE: **TOWN:** Concord

MAPS: Miles Pond Quadrangle 7.5' topographic map (1988); Miles Pond West 1:5000 scale Vermont Base Map #204216 (1983)

LOCATION: Between Route 2 and Railroad, ca. 1/2 mile east of North Concord. To reach the bog, drive 0.4 miles east from North Concord on U.S. Route 2. Park and walk southwest, downhill through a clearcut to the bog.

LATITUDE/LONGITUDE: 44°27'57"/71°50'55"

SIGNIFICANCE:

A fine example of a lowland bog, and uncommon natural community in Vermont - statewide significance.

GENERAL DESCRIPTION:

This small bog is located at a watershed divide, in a saddle between two hills. A small area near the center of the peatland is quite open, with very low shrubs and sedges. Characteristic plants in this central area are green-keeled cotton-grass, small cranberry, bog rosemary, bog laurel and the sedge, Carex pauciflora.

Surrounding this bog opening are larger areas of semi-open bog, with more abundant black spruce and tamarack, and taller shrubs (up to 3' tall in places) of labrador tea, leatherleaf and bog laurel. Labrador tea is the most abundant shrub here.

Surrounding this semi-open bog is a narrow band of black spruce and tamarack forest.

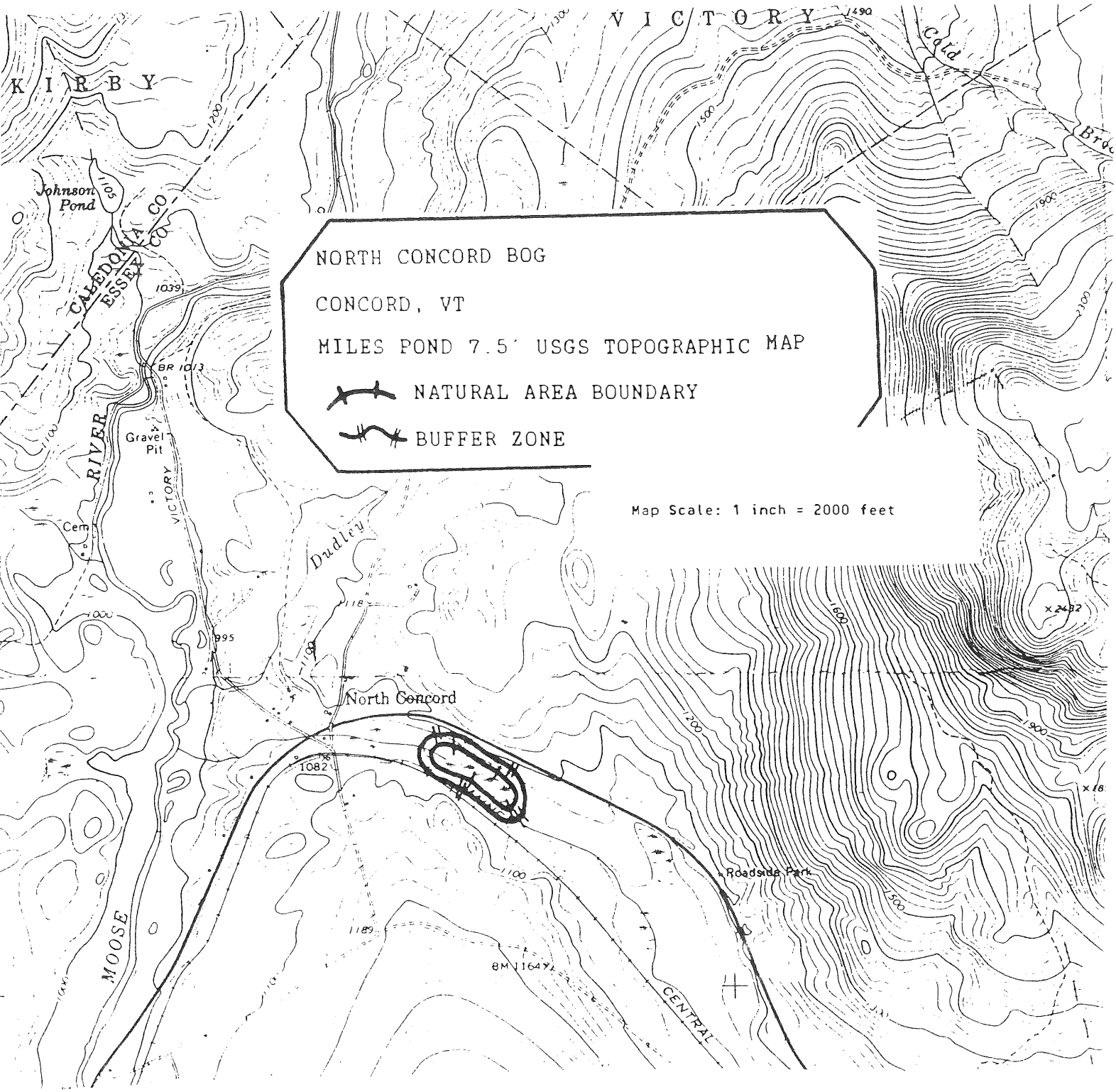
The upland forest surrounding the wetland has been recently clearcut. The effect of the clearcutting on the bog itself is unknown.

NATURAL AREA ACREAGE: Bog and surrounding swamp: approximately 12 acres.

COMMENTS AND RECOMMENDATIONS:

1. The present owners should be contacted regarding the significance of this site, and they should be encouraged to protect it. If the current owners dispose of this property, North Concord Bog should receive permanent protection as a natural area.

2. In order to protect the wetland from future logging activity, a 200 foot buffer should be maintained around the wetland edge. There should be no further logging in the 100 feet of this buffer zone that is closest to the wetland. From 100 to 200 feet there should be only selective removal of trees. Outside the buffer zone clearcutting will have no direct impact on the wetland.
3. Vehicles of any kind should be kept out of the wetland.



ESSEX COUNTY NATURAL AREAS INVENTORY
Nongame and Natural Heritage Program

SITE NAME: Victory Basin

SITE CODE: **TOWN:** Victory

MAPS: Gallup Mills Quadrangle 7.5' topographic map (1988); Damon Crossing #204224 (1983) and Victory-Lees Hill #208224 (1983) 1:5000 scale Vermont Base Maps.

LOCATION: Victory Basin is approximately 5 miles north of North Concord.

LATITUDE/LONGITUDE: 44°31'15"/71°47'26"

SIGNIFICANCE:

1. Outstanding example of a lowland bog; one of best examples in Vermont - statewide significance.
2. Nesting habitat for boreal forest bird species: black-backed woodpecker, gray jay, boreal chickadee, rusty blackbird, and possibly, spruce grouse.

GENERAL DESCRIPTION:

Victory Basin is a large lowland area in the valley of the Moose River, encompassing a variety of wetland types. The large open wetland through which Bog Brook flows and the road passes is not a bog, but a sedge meadow and shrub swamp. The actual bog is east of this open area. Scattered throughout the basin are stands of black spruce, home to several boreal bird species. This is an excellent area to view many wildlife species. Moose are frequently seen here.

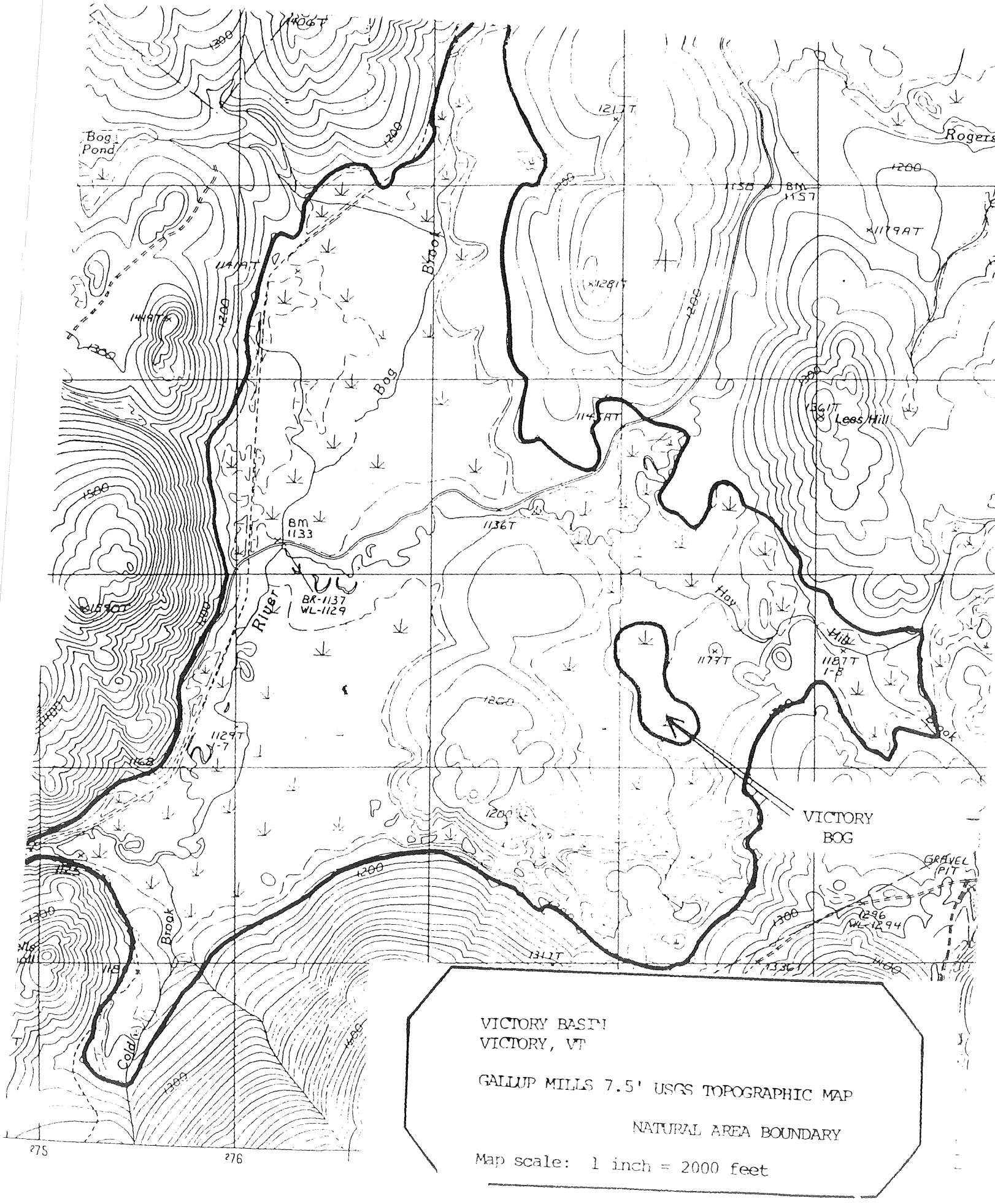
Victory Bog is a classic, boreal open bog - very acidic with low plant diversity. Some small black spruce are scattered on the bog mat, but the peatland is basically dominated by low ericaceous shrubs on tall hummocks elevated above the surrounding water table. There is a more open mat in the southern part of the bog where sedges, such as cottongrass are common. Areas of open water are absent.

The bog is virtually undisturbed, the only sign of human intrusion is a deer stand along the edge. Other portions of Victory Basin have seen more disturbance, such as roads, logging, pipeline construction, and even settlement.

NATURAL AREA ACREAGE: Victory Basin = approximately 2200 acres; Victory Bog = 35 acres.

COMMENTS AND RECOMMENDATIONS:

1. Victory Bog currently receives little use, mostly by hunters and biologists. Low usage is preferable to protect the integrity of the fragile bog mat. Trail development should be confined to the perimeter of the bog.
2. Due to its large size, boreal environment and diversity of habitats, Victory Basin could serve as a location for reintroduction of spruce grouse, and possibly, pine marten.
3. Researchers wishing to conduct studies at Victory Bog should receive prior authorization from the Vermont Fish and Wildlife Department.
4. Vehicles of any kind should be kept out of the wetland.



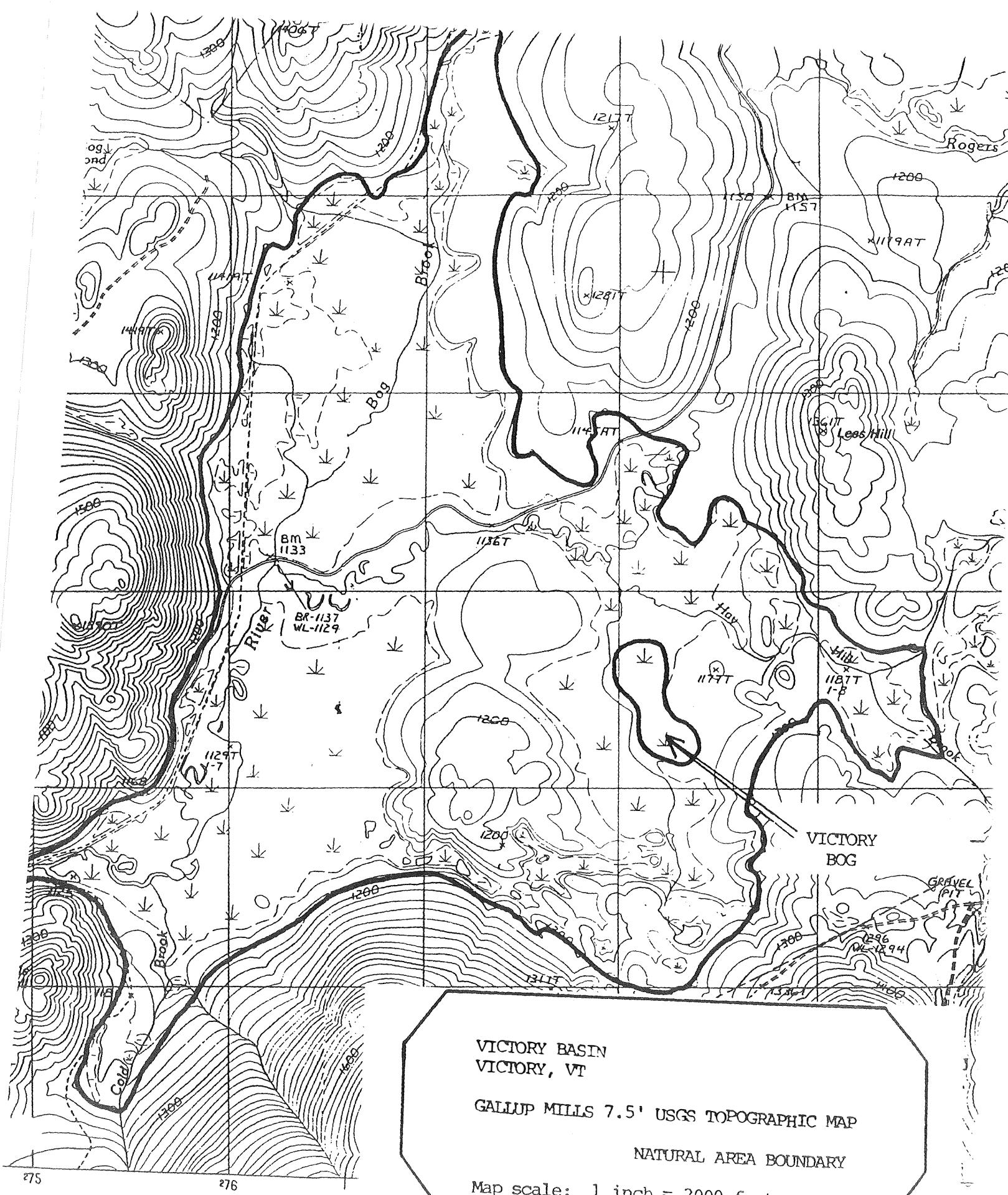
VICTORY BASIN
VICTORY, VT

GALLUP MILLS 7.5' USGS TOPOGRAPHIC MAP

NATURAL AREA BOUNDARY

Map scale: 1 inch = 2000 feet

SCALE 1:24 000



VICTORY BASIN
VICTORY, VT

GALLUP MILLS 7.5' USGS TOPOGRAPHIC MAP

NATURAL AREA BOUNDARY

Map scale: 1 inch = 2000 feet

SCALE 1:24 000

Appendix E.

A public workshop was held on June 26, 1991, 7-9 pm., at the Fairbanks Museum in St. Johnsbury. The purpose of the workshop was to review the river management goals and recommended actions for achieving those goals. People were invited to make comment on any concern they may have and encouraged to add specificity to the goal and action statements. The following comments were made by those in attendance:

1. How is this (plan) going to effect agriculture? Don't create obstacles for agriculture.

2. It wouldn't hurt to keep manure piles a little further back from the streams.

3. John Mullen, Director of Hydro Licensing with Central Vermont Public Service Corporation (CVPSC) made the following comments with respect to actions anticipated by CVPSC as part of the relicensing of their hydropower stations in the basin:
   A. Pierce Mills, Arnold Falls, Gage #3, and Passumpsic Dam hydro facilities will be operated in the run-of-river mode.
   B. CVPSC does not plan to spill 7Q10 flows into all by-pass segments. They propose to spill one inch of water at all sites, which equates to approximately 25-30% of 7Q10 flows.
   C. Concerning the question of reaeration. CV can improve oxygenation. Studies will be completed this summer (1991) to monitor Dissolved oxygen. The State will use these measurements to determine the flows necessary to maintain the river's assimilative capacity. If there are water quality limited times, flows could be increased.
   D. CV is looking into portage routes around all four sites. Some may be more problematic due to land ownership issues. Pierce Mills presents no problems in making a portage and day use picnic site. At Passumpsic Dam, CV is also looking at a day use picnic site. The public will be able to drive into both of these stations in the future. Gage #3 site poses safety hazards, however, a day use picnic site for boaters may be possible. Vandalism is a concern for CV in encouraging public access to their facilities.
   E. CVPSC is studying rare botanical species and wetlands on their project lands this summer (1991).
   F. Last summer (1990) CV completed a macroinvertebrate study. No rare species were found. The macroinvertebrate community below Gage #3 dam in the Passumpsic was found to be in the fair quality range.
   G. Flows will be videotaped at leakage and one inch spill levels to judge aesthetics. A screening study (landscaping) of the substations will be completed this summer.
   H. Pierce Mills and Gage #3 will be studied for fishery habitat in by-pass segments. At Pierce Mills there are plans to improve habitat by placing instream cover such as large rocks, snags, and gabions.
   I. CV will be doing some archeological studies but haven't pinpointed the exact sites at this time.
   J. CV is not doing IFIM (fish habitat) studies this summer. The studies that will be completed are more visual in nature.

K. Before the end of the year, Passumpsic and Gage will have water output readings transmitted hourly to CV's Rutland office. The other two stations will also have gages soon.

4. What hazardous waste studies are ongoing at the Parker landfill? Landfill leachates should be continually monitored. EPA results should be published.

5. When storm water pipes are separated from sewer pipes will stormwater that is presently being treated then go to the river untreated. I am concerned about the possible increased negative impacts of urban runoff. Will storm drains cause petroleum to go into the river like they experience in Burlington?

6. There are a large number of leaking septic systems in the basin. How much of a water quality problem do they cause?

7. CV should double check the archeological studies that were completed in the mile corridor associated with the Interstate highway.

8. We (anglers) are interested in fish ladders at the dams when the salmon return.

9. The Barnet project was supported by the public because they were promised that picnic access would be constructed, but instead there is a chain across the entrance and no picnic tables.

10. Could CV publish the flows in the local newspaper? Gauge readings would have to be translated to flows and a canoeability flow range would have to be provided for the information to be useful to the public.

11. The rivers are no longer being dredged and silt and sand are building up.

12. Access is poor along the river. If you put in at St. Johnsbury there is no way to get out of the river. Formal access could be improved in several places, especially where land is already in public ownership.

13. The Alright spring off the North Danville Road toward St. Johnsbury is not listed.

14. Hydropower is a continued need in balance with other uses.

15. Does electricity from Passumpsic stations stay in the area? (yes)

16. The Passumpsic River Project has been a great service to the St. Johnsbury area people.

Appendix F.

A public hearing was held on August 8, 1991, 7:00 pm., at the St. Johnsbury Municipal Offices. The purpose of the workshop was to receive public comment on the Preliminary Comprehensive River Plan for the Passumpsic River Watershed.

Public Comment: If the preliminary plan is supposed to represent the interests and goals of the public, it seems inconsistent to make specific 7Q10 flow recommendations in an Action statement (page 131) without referencing the Agency as the source of the recommendation. (comment was made by John Mullen, Director of Hydro Licensing, Central Vermont Public Service Corporation)

Agency Response: The goal statement concerning the establishment of minimum flows in the by-pass segments of the Pierce Mills, Arnold Falls, Gage Dam, and Passumpsic Dam was derived from statements made by the public. The actions for achieving this goal were also derived from recommendations made by citizens attending Passumpsic River Project workshops. Specific aspects of these actions (i.e., 7Q10 flows) are restated from Agency positions made in a letter to CVPSC (2/24/91). These specifics were provided at this time (in the Preliminary Report) to begin establishing a range of by-pass flows fitting the public's interest in improving fisheries habitat in the Pierce Mills, Gage Dam, and Arnold Falls by-passes and improving the water quality and aesthetics in the Passumpsic River mainstem.

Those citizens commenting on by-pass segments did not feel fish habitat was an issue in the Passumpsic Dam by-pass. Anglers felt strongly that the pools present in the Pierce Mills and Gage Dam by-passes provide deep holding habitat for adult salmonids. The Arnold Falls by-pass (right side), they suggested, did not have deep pools but provided rocky habitat used by brown and rainbow trout when water was present. Due to the importance of fish habitat in the Pierce Mills and Gage Dam by-passes, the Agency recommends that fish habitat studies be completed in these segments to determine by-pass flows. 7Q10 flows were suggested by the Agency as by-pass flows in the Arnold Falls and Passumpsic Dam by-passes that would be adequate to protect water quality, aesthetics, and habitat values and if offered by CVPSC would preclude the need for additional studies. It is acknowledged by the Agency that CVPSC may want to complete by-pass flow studies to demonstrate that flows less than 7Q10 would be adequate.

During the June 26, 1991 public workshop, CVPSC proposed to spill ½ to 1 inch of water over the crest of each of the four dams which represent approximately 25-30% of the 7Q10 flows. At the Pierce Mills and Gage Dam sites these proposed flows may represent a position different from that expressed by the Agency and public in that no quantitative assessment of habitat gain or loss is provided. Flow demonstrations in the Arnold Falls and Passumpsic Dam by-passes would have to be viewed before a determination can be made as to whether the proposed spillage would protect water quality, aesthetics, and aquatic habitat.

In a follow up letter to the public hearing, CVPSC offered the following relevant comments on the Preliminary Comprehensive Plan:

* The specific actions relevant to each goal (pgs. 130-131) were developed solely by the V.A.N.R. In other words, they were not specific recommendations for actions from the public. As such, the source should be identified as the Agency.

* At the workshop on June 26, a member of the public recommended that hydropower be given recognition as a legitimate use of the river, in viewing pages 129 through 132, there are no changes from the draft report presented at the workshop.

* The FERC relicensing process is supposed to strike a balance between power and non-power uses of the river resource. CVPSC have agreed to modify our operations to run-of-river, provide bypass flows, albeit, not 7Q10, and provide river access. Water quality sampling done this summer under near drought flows has yielded D.O. levels well above standards for both concentration and saturation.

* CVPSC is forwarding a four page summary of CVPSC's position with respect to the various "actions" recommended in the report.

Agency Response:

The explanation provided on the previous page on the source of public goals and actions and the added Agency specificity applies to all goals and actions on pages 130 and 131. Goal and action statements that include Agency recommendations now include a citation.

The second goal statement on page 130, "Continue to use the river for the generation of electricity and to make this use more compatible with other river uses and values" was added in response to public comments made at the June 26th workshop. This goal recognizes hydropower generation as a legitimate use of the river. This goal statement was presented at the hearing on August 8, 1991.

The agreements made by CVPSC to modify their Passumpsic River operations are viewed by the Agency as positive steps toward balancing the power and non-power uses of the river.

The summary of CVPSC's positions with respect to the actions recommended in the preliminary comprehensive plan are provided on the following pages.

Public Comment: Mike Demers of St. Johnsbury wrote and circulated a petition to anglers who fish the Passumpsic River. Mr. Demers sent original copies of the signed petition to the Agency of Natural Resources for inclusion in the Preliminary Comprehensive River Plan for the Passumpsic River Watershed to represent the signers' position on recommended actions related to operation of hydroelectric facilities on the Passumpisic River. Eighty-three (83) people from the towns of St. Johnsbury, Lyndon, Danville, Newark, Sheffield, Burke,

Concord, Newport, Sutton, Wheelock, Waterford, Barnet, Peachum, and Monroe (NH) signed a petition which read:

ATTENTION FISHERMAN

To improve the fisheries and fishing opportunities in the Passumpsic River, the signers of this petition with to have Hydrodams on the Passumpsic do the following:

1. Pass minimum waterflows in the bypass sections and tailraces of all dams to maintain oxygen levels and physical habitat for fish.

2. Monitor flows to ascertain that the above is done.

3. Construct fish ladders once ladders are constructed at McIndoe Falls, VT for salmon migration.

This petition will be presented when the dams come up for relicensing this year.

Agency Response: These recommendations are similar to the goal and action recommendations offered by the 24 anglers who attended the April 11, 1991 Anglers Meeting in St. Johnsbury.

CVPS Position - Goals/Actions
(Reference Pages 130 - 131 Project Report)

(1) Establish natural river flows between hydropower facilities to improve aquatic habitat, water quality, aesthetics

- CV is proposing run-of-river operation at all four plants; implicit to that is a constant pond level. This mode of operation will enhance aquatic habitat, water quality and aesthetics in the 14 miles of river below the four plants. Water quality certification should be contingent only on documented needs, not conjecture.

- To monitor compliance, CV is installing equipment to collect hourly pond level and station output (KW) data at Gage and Passumpsic this year. Similar equipment will ultimately be installed at Arnold Falls and Pierce Mills

(2) Establish minimum flows in the bypass segments of Pierce Mills, Arnold Falls, Gage and Passumpsic hydropower facilities to maintain aquatic habitat, water quality, aesthetic values

- CVPS will spill the equivalent of 1/2 to 1 inch of water over the dams at all four sites to enhance aquatic habitat and aesthetic values in the bypass segments. Comparative flows are being videotaped

- Water quality testing for dissolved oxygen has taken place and will continue this summer. Reaeration coefficients will be developed. Data is being provided to the Department of Environmental Conservation for use in assimilative capacity studies. Of the 140 samples already collected by CVPS and D.E.C., only one showed substandard concentration, i.e. 5.9 milligrams/liter versus the 6.0 state standard.

- If on-going water quality testing dictates a greater spillage during water quality limited periods, that can be accommodated.

- CVPS' proposed spill releases will reduce annual output by 5%. Spillage of 7Q10 would cut output by 22% at a current cost of $75,000 annually.

(3) Enhance the ability of boaters and fish to negotiate passage of the hydroelectric dams.

- CVPS will provide portage routes provided land, or rights-of-way, can be acquired

- Day use picnic areas will be provided at Pierce Mills and Passumpsic. At Gage, a boat accessible picnic area will be provided due to safety concerns with vehicular access on either side of the river and in protection of sensitive wetlands identified by VDFW. Vandalism could be a deterrent to continuance after a trial period

- A professional landscape architect is developing plans for plantings at the sites to screen substations and other prominent civil features

- We are not proposing downstream fish passage at any site since we question both need and effectiveness. Our conclusions are based on lack of upstream Atlantic salmon stocking, low intake velocities - less than salmonid cruising speed, stocked trout are greater than six inches - can avoid impingement, inability to sense passage attractant flows - dams are spilling water about 90% of time in April and May. These considerations, in our opinion, do not support expenditure of $164,000 for downstream passage facilities.

(4) Increase river water clarity, enhance river aesthetics, and improve habitat for fish, wildlife, and other aquatic biota.

- Run-of-river operation and stable pond levels in conjunction with bypass spillage, will enhance aesthetics as well as fish, wildlife and aquatic biota habitat

- During the summer of 1991, CVPS in cooperation with Vermont Fish and Wildlife, will place instream fish cover at six to eight locations above and below Pierce Mills. Similar work is planned at Gage in the next year or two.

- Desilting the impoundments would be prohibitively expensive and could literally

"stir-up" problems for indigenous fish and aquatic biota. Further, since CVPS has agreed to run-of-river operation, there would be no offsetting gain in increased storage capability.

J. J. Mullen
6/26/91

Table 8.

WATER QUALITY SUMMARY OF THE PASSUMPSIC RIVER BASIN

Pollution Source Types

DW - Domestic Wastewater
IW - Industrial Wastewater
HW - Hazardous Wastes
OW - Other Wastewater and Nutrient Sources
ES - Erosion & Sedimentation
FM - Flow Modification

	Sutton River	Calendar Brook	Roundy Brook	West Branch	Bean Brook	Dish Mill Brook	East Branch	Miller Run	South Wheeloch Branch	Sheldon/Hawkins Brooks	UPPER PASSUMPSIC RIVER	Bog Brook	Rogers Brook	Upper Moose River	Stiles Brook	Lower Moose River	Burroughs Brook	Sleepers River	MID. PASSUMPSIC RIVER	Steam Mill Brook	Joes Brook	Water Andric	LOWER PASSUMPSIC RIVER
DW - Sewage Treatment Plant							⊗				○							⊗				○	⊗
DW - Combined Sewer Overflows											◍					⊗		⊗	⊗				⊗
DW - Large Septics > 6500 gal							○																
DW - Small Septic Systems				○		○					○					◍		○	○		○		○
IW - Industrial Discharges																		⊗	○				
IW - Industr. Wastes to WWTP											◯								◯				○
HW - Mun. Landfills/Junkyards	○	○		◍			◍				◍								○				◍
HW - Buried Waste Dumps	○							◍							○		◍		○				
HW - Underground Fuel Tank							◍																
OW - Agricultural Runoff							○	◯	○	○	○						○	○			●		◯
OW - Urban/Stormwater Runoff						○			○		●				●		●	●					
OW - Water Plant Backwash														⊗	⊗								
ES - Gravel Pit Runoff				○			○	○			○								○				○
ES - Road Erosion & Runoff											●								●				○
ES - Construction Sites						●													○		○		
ES - Logging Practices							●					○	○	●		○	●	○					
ES - Farming Practices								◍			○					○	●	●			○		○
ES - Natural Erosion				○				○			○							●	○		○		○
ES - Hydropower Facilities											●								●				●
FM - Bypass River Reaches											●							◍	◍		●		◍
FM - Flow Flucuations					○						◯				⊗			◍	◍		●		◍
FM - River Impoundment											●								●				●
FM - Channelization						○					○							●					

Relative Magnitude of the Problem

○ - Smaller

◯ - Larger

Status of the Pollution Problem

● - Pollution Source Is Known But Remediation Plans or Actions Have Not Occurred

◍ - Problem Currently Under Study/ Remediation Plan Suggested

⊗ - Action To Correct the Problem Is Underway

○ - Suspected/Potential Future Pollution Source