DRINKING WATER AND SANITARY SEPTIC STUDY UPDATE HARPSWELL, MAINE

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1.0 INTRODUCTION AND BACKGROUND

The Town of Harpswell is a growing coastal community in Cumberland County situated along Casco Bay and south of Brunswick. Harpswell consists of a long, narrow peninsula (Harpswell Neck), three large islands (Great, Orr's, and Bailey Islands), and over 80 smaller islands. Harpswell encompasses approximately 24 square miles of land area and approximately 216 miles of coastal shoreline.

The Town of Harpswell has historically been comprised of fishing villages along the shoreline and farmland and forest land within the Town's interior. The natural beauty and character of the coastal community has attracted a continuously increasing number of summer vacationers, retirees, and new residents in more recent years, resulting in the development of additional year-round and seasonal homes. Approximately 20 years ago, the Town's demographics started changing from a fishing community to one where local jobs and businesses are primarily related to the fishing/marine industry, but the majority of Harpswell residents are retirees or upper middle class professionals who commute to jobs in other communities.

Shoreline properties have been and continue to be the desired location for developers of large seasonal or year-round homes. Inland areas are generally developed into year-round house lots. According to Harpswell's 2005 Comprehensive Plan Update, the projected growth of Harpswell over the next ten years is approximately 500 more people and an estimated 400 new homes (approximately 340 year-round and 48 seasonal homes). The development of these new homes could consume up to 1,000-acres of currently undeveloped land (approximately seven percent of the Town's total land area). Refer to the Zoning Map (Map 1) for the location and general land features of Harpswell including the current zoning and parcel outlines.

Harpswell residents and businesses rely solely on groundwater wells for their drinking water supply and individual septic systems for wastewater disposal (with the exception of approximately 96 properties that currently utilize overboard discharge systems). Public water and wastewater systems are generally perceived to be cost-prohibitive due to the geography and geology of Harpswell. The physical setting of the Town, including the jagged coastline, hills, valleys, shallow bedrock, and the spread of developed regions cause the transportation of water and wastewater to be very expensive.

Harpswell's groundwater resources are limited to subsurface bodies (lenses) of freshwater, which are supplied and recharged by rainwater. The groundwater is primarily located and transported through fractures in bedrock. No significant sand and gravel aquifers have been identified in Harpswell, and there are no surface water bodies capable of being utilized as a public reservoir. Saltwater surrounds Harpswell's land area and also underlies the freshwater lenses.

Given the limited and sensitive supply of Harpswell's drinking water as well as the continuous development of the shorelines, neighborhoods, and village districts, the Town of Harpswell has completed previous evaluations of groundwater availability and quality as well as the condition and impact of wastewater systems. Robert Gerber and John Rand completed a Ground Water Resource Analysis in 1982 (Gerber/Rand Report) for the Town that evaluated the bedrock and surficial geology in Harpswell and how it relates to available water and wastewater resources. In 2001, Wright-Pierce completed a Drinking Water and Sanitary Septic Study for the Town to evaluate drinking water resources, well capacities, water quality, and sanitary septic system conditions.

The following report presents the findings of a Drinking Water and Sanitary Septic Study Update for the Town of Harpswell completed by Ransom Environmental Consultants, Inc. (Ransom) in conjunction with CES Inc. and Town of Harpswell staff. The purpose of this study is to evaluate drinking water resources and sanitary septic conditions in an effort to responsibly plan for the residential and commercial development within the Town of Harpswell. Data and figures from the previous study were updated to include current conditions and new information; however, some data from the previous report largely could not be independently verified by Ransom.

1.1 OBJECTIVES

The objective of this study was to compile available information regarding the factors that impact Harpswell's development process, and present this information in a geographic information system (GIS) format that can be easily utilized and maintained by the Town of Harpswell. A GIS system dynamically links information in a database to geographic mapping of the Town. The information gathered and presented throughout this study includes the following:

- Harpswell's current land use;
- Bedrock and surficial geology;
- Natural development constraints such as wetlands, flood plains, and wildlife;
- Governmental development constraints such as shoreland zoning, municipal ordinances, and limited/restricted use properties;
- Sites or natural resources impacted by environmental, septic system, or road salt contaminants;
- Public and private wells and their associated capacities and qualities; and
- Public and private septic systems and overboard discharges.

A series of resource maps have been developed to display the information outlined above. The information has been arranged within a GIS platform that can be utilized, manipulated, and maintained by the Town of Harpswell. The GIS platform is intended to be used by the Town as a tool in their ongoing planning process.

This comprehensive report summarizes the findings of this study based on the historic and updated information compiled and evaluated. Section 8 of this report presents conclusions regarding this data and our analysis.

2.0 CURRENT LAND USE

The Zoning Map (Map 1) depicts the Town's established zones, including the Commercial Fishing, Resource Protection, Shoreland Business, Shoreland Residential, and Tower District zones. The intent of Harpswell's zoning guidelines is to direct specific development to designated regions appropriate for that type of development. The zoning information presented on Map 1 was obtained from the Town of Harpswell and represents the Town's established zones as of 2007. Harpswell's established zones are primarily located along the extensive shorelines of the Town. Shoreland Protection zones encompass areas surrounding watercourses and wetlands located within the interior portions of Harpswell's larger land masses. A significant portion of the Town's inland areas are currently not located within an established zone, however, these areas are categorized with a specific land use classification (refer to Map 2).

As shown on Map 2, land use within the Town of Harpswell is categorized as commercial, residential, agricultural, institutional, recreational, land cover, and conservation land. The Land Use Map was developed from 2004 data provided by the Greater Portland Council of Governments.

Land use categories are further divided into several different classifications that identify the current use of regions within the Town. For example, residential land use includes single-family or multi-family residential properties. Harpswell's land use categories are discussed in the following sub-sections.

2.1 COMMERCIAL

Commercial land in Harpswell is comprised of several different classifications that include marine and fishing-related properties, restaurants, lodging, retail businesses, service businesses and other miscellaneous businesses. Land designated for commercial use is primarily located in the vicinity of the Town villages, including Bailey Island, South Harpswell, West Harpswell, Harpswell Center, East Harpswell, and Cundy's Harbor, as well as along the major roads through Town, including Route 123 and Route 24.

2.2 RESIDENTIAL

Residential properties in the Town of Harpswell are further categorized as parcels comprised of single-family/two-family or multi-family homes. Residential properties are located throughout Harpswell with village clusters formed primarily along the shorelines of Harpswell Neck, throughout the majority of Bailey Island, within the northern and southern regions of Orr's Island, throughout developed coastal regions of Great Island, including Gun Point Cover, Dyer Cove, East Harpswell, Cundy's Harbor, and Ridley Cove, and along the major roads, Route 123, Route 24, and Mountain Road. Locations of residential land uses are depicted on Map 2.

2.3 AGRICULTURE

Agricultural land in Harpswell is classified as hay fields, pastures, or orchards. There are only a select few properties designated for agricultural use in the Town, and these sites are depicted on Map 2. Agriculture was historically prominent in Harpswell, but has nearly disappeared as a full-time occupation. Agricultural properties are primarily limited to regions within North Harpswell.

2.4 RECREATION

Harpswell's recreation land includes landings, ball fields, tennis courts, and Mitchell Field. There are approximately 12 landings located along the coastline of Harpswell, primarily within the regions of Harpswell Center, South Harpswell, Bailey Island, Hen Cove, and Cundy's Harbor. These landings provide public access to the ocean for residents, visitors, and fisherman. Ball fields and tennis courts are primarily associated with the Town's schools.

Mitchell Field is located in West Harpswell along Middle Bay, and encompasses approximately 119 acres of prominent coastal land within the Town. Mitchell Field historically was a U.S. Navy Fuel Depot, providing fuel to the Brunswick Naval Air Station from the 1950s to 1991, at which time the Navy determined it would be more economical to truck fuel into Brunswick from Searsport. The Town of Harpswell acquired the property in 2001 and formed the Mitchell Field Committee to oversee the Master Planning process for the future use of the site. The site is currently comprised of a deep-water pier, a dock, a 100,000-gallon water tank, historic buildings, wooded areas, and open space. Future land use for Mitchell Field is proposed to include open space, hiking trails, recreation fields, public access to the waterfront including a public boat launch, a cluster housing development for mixed-income families, opportunities for marine-related businesses, and public parking.

2.5 LAND COVER

Properties in Harpswell categorized as land cover are forested land or open land. One aspect of Harpswell's natural beauty and appeal is the forest land and open space that surrounds the residential and commercial properties throughout the majority of the Town. As depicted on Map 2, the majority of land throughout interior portions of Harpswell Neck and Great Island is forest land with intermittent areas of open land. The central eastern region of Orr's Island is comprised of forest land and limited open land. Bailey Island is highly developed with residential, commercial and institutional properties; therefore, the amount of forest land and open space is limited.

2.6 CONSERVATION LAND

Conservation land in Harpswell is comprised of conservation land and resource protection areas. Select properties located in North Harpswell, the northern portion of Orr's Island, and western portions of Great Island are designated as conservation land or resource protection areas, as depicted on Map 2. Several of the smaller islands that comprise Harpswell also consist of designated conservation land, including, but not limited to, Whaleboat Island, Upper Flag Island, Little Birch Island, Jaquish Island, Pond Island, Ram Island, Yarmouth Island, and portions of Upper Goose Island and Birch Island.

3.0 CURRENT LAND USE CONSIDERATIONS AND CONTROLS

The intent of Harpswell's zoning guidelines is to direct and plan for specific development in designated regions appropriate for that type of development. The majority of properties located within the inland areas of Harpswell's land masses are currently not zoned for distinct land uses. Regions in Harpswell are classified with a specific land use category, whether or not the parcels are located within an established zone. In addition to zoning guidelines and land use categories, Harpswell enforces several protective ordinances discussed below to guide development in accordance with Harpswell's Comprehensive Plan. The Comprehensive Plan is an advisory document that defines the community's goals for the future as well as the policies and programs necessary to help the Town achieve the goals. The Comprehensive Plan was updated in 2005 through significant public involvement and is the foundation for building the Town's land use controls while balancing anticipated growth with the community's values.

In addition to the Town's zoning and protective ordinances, there are land use controls and limitations regarding public land, conservation easements, open space and historical features. Each of these land use controls and limitations are discussed below.

3.1 ORDINANCES

3.1.1 Basic Land Use Ordinance

Harpswell enforces a Basic Land Use Ordinance (amended on March 10, 2007) with the following purpose, as stated in the ordinance:

"The purpose of this Ordinance is to provide for reasonable and orderly development within all areas of the Town while protecting the health, safety, and welfare of its citizens. This Ordinance seeks to preserve the character of Harpswell as a residential, fishing, and vacation community with clean waters, healthy wetland functions and wildlife habitats, scenic attractiveness and a sense of openness. It seeks also to preserve to the maximum extent possible, traditional rights of landowners to use their lands as they desire, while at the same time protecting nearby residential owners from excessive conflicting uses that might degrade property values and damage the attractiveness of the community to the detriment of all."

The Basic Land Use Ordinance applies to all dwellings, accessory structures, and all land uses in Harpswell that are not subject to the Shoreland Zoning Ordinance (discussed in the following section). This Ordinance regulates the use of properties throughout Town, including the construction or change of structures on lots, the location of structures in relation to adjacent water bodies, roads, and neighboring properties, the creation of new lots and minimum lot size, and the required permits and approvals from the Code Enforcement Office and the Planning Board for new development.

3.1.2 Shoreland Zoning Ordinance

Harpswell enforces a Shoreland Zoning Ordinance (amended on March 10, 2007) with the following purpose, as stated in the ordinance:

"The purposes of this Ordinance are to further the maintenance of safe and healthful conditions; to prevent and control water pollution; to protect fish spawning grounds, aquatic life, bird and other wildlife habitat; to protect buildings and lands from flooding and accelerated erosion; to protect archaeological and historic resources; to protect commercial fishing and maritime industries; to protect freshwater and coastal wetlands; to control building sites, placement of structures and land uses; to conserve shore cover, and visual as well as actual points of access to inland and coastal water; to conserve natural beauty and open space; and to anticipate and respond to the impacts of development in Shoreland areas of Harpswell."

The Shoreland Zoning Ordinance applies to all properties within 250 feet (horizontal distance) of the maximum high water line of any great pond or salt water body; within 250 feet (horizontal distance) of the upland edge of a coastal wetland, the upland edge of a freshwater wetland greater than ten contiguous acres, or the upland edge of a freshwater wetland less than ten contiguous acres and adjacent to a surface water body, excluding any tributary stream, such that the combined surface area is greater than ten acres; and within 75 feet (horizontal distance) of the maximum high water line of a stream. This Ordinance also applies to any structure built on, over, or abutting another structure extending beyond the maximum high water line of a body of water or within a coastal or freshwater wetland.

The areas subject to the Shoreland Zoning Ordinance are divided into the five following districts:

- Resource Protection: includes areas in which development would adversely affect water quality, productive habitat, biological ecosystems, or scenic and natural values.
- Shoreland Residential: includes areas suitable for residential and recreational development.
- Shoreland Business: includes areas of light commercial and residential uses.
- Commercial Fishing: includes areas limited to 75 feet inland from maximum high water mark (Commercial Fisheries I district) as well as the remaining 175 foot zone beyond the Commercial Fisheries I district and extending to 250 feet inland from the maximum high water mark (Commercial Fisheries II district).

These districts are depicted on the Zoning Map (Map 1).

3.1.3 Floodplain Ordinance

Harpswell enforces a Floodplain Ordinance (amended on March 8, 2008) with the following purpose, as stated in the ordinance:

"Certain areas of the Town of Harpswell, Maine are subject to periodic flooding, causing serious damages to properties within these areas. Relief is available in the form of flood insurance as authorized by the National Flood Insurance Act of 1968.

Therefore, the Town of Harpswell, Maine has chosen to become a participating community in the National Flood Insurance Program, and agrees to comply with the requirements of the National Flood Insurance Act of 1968 (P.L. 90-488, as may be amended from time to time) as delineated in this Floodplain Management Ordinance.

It is the intent of the Town of Harpswell, Maine to require the recognition and evaluation of flood hazards in all official actions relating to land use in the floodplain areas having special flood hazards.

The Town of Harpswell has the legal authority to adopt land use and control measures to reduce future flood losses pursuant to 30-A MRSA, § 3001-3007, 4352, 4401-4407, and Title 38 MRSA, Section 440, as may be amended from time to time.

The National Flood Insurance Program, established in the aforesaid Act, provides that areas of the Town of Harpswell having a special flood hazard be identified by the Federal Emergency Management Agency and that floodplain management measures be applied in such flood hazard areas. This Ordinance establishes a Flood Hazard Development Permit system and review procedure for development activities in the designated flood hazard areas of the Town of Harpswell, Maine.

The areas of special flood hazard, Zones A1-30, AO, and V1-30 are identified by the Federal Emergency Management Agency in a report entitled "Flood Insurance Study—Town of Harpswell, Maine, Cumberland County," dated January 3, 1985, with accompanying "Flood Insurance Rate Map" dated July 20, 1998, which are hereby adopted by reference and declared to be a part of this Ordinance."

The Floodplain Ordinance applies to properties identified in areas with mapped flood hazards. Harpswell's floodplains are depicted on the attached Flood Zones Map (Map 3) based on data from the Flood Insurance Rate Maps database maintained by the Federal Emergency Management Agency (FEMA). That data is current as of 1996. Areas with identified flood hazards include areas of shallow flooding and areas of special flood hazard. Areas of shallow flooding include properties with a one percent or greater chance of flooding each year to an average depth of one to three feet, where a defined channel does not exist and the path of flooding is unpredictable. Areas of special flood hazard include properties in a floodplain having a one percent or greater chance of flooding in any given year. Flood plains within the Town of Harpswell are discussed further in Section 4.5.

3.1.4 Subdivision Ordinance

Harpswell enforces a Subdivision Ordinance (amended on March 10, 2007) with the following purpose, as stated in the ordinance:

"The purpose of this Ordinance is to further the intent of Harpswell's Comprehensive Plan in protecting the safety, health, and quality of the environment, including groundwater resources, and the future quality of life in the Town, and to encourage use of the best planning by private developers. This Ordinance also seeks to establish an orderly, equitable, and expeditious procedure for reviewing subdivision applications and to provide clear standards that encourage orderly growth in the community. To this end the Planning Board shall follow the procedures and criteria in this Ordinance when reviewing subdivision applications and before granting approval shall find that the provisions of this Ordinance and State rules and regulations have been met."

This Ordinance applies to all parcels of land in the Town of Harpswell that are associated with a proposed subdivision. The Ordinance establishes requirements regarding the application and review of subdivision plans by the Planning Board, a public hearing, Planning Board approval, and subdivision standards including aesthetic design, water and sewer services, landscaping, minimum lot size, erosion control and stormwater management. The results of this study may impact decisions made by the Planning Board pertaining to water and sewer services and minimum lot size requirements.

3.1.5 Site Plan Review Ordinance

Harpswell enforces a Site Plan Review Ordinance (amended on March 10, 2007) with the following purpose, as stated in the ordinance:

"The site plan review provisions set forth in this Ordinance are intended to protect the public health and safety, promote the general welfare of the community, and conserve the environment by assuring that nonresidential and multifamily development is designed and developed in a manner which assures that adequate provisions are made for traffic and pedestrian safety and access; emergency access; water supply; sewage disposal; management of stormwater, erosion, and sedimentation; protection of the groundwater; protection of the environment, wildlife habitat, fisheries, and unique natural areas; protection of historic and archaeological resources; minimizing the adverse impacts on adjacent properties; and fitting the development harmoniously into the fabric of the community."

The Site Plan Review Ordinance establishes the requirement of Planning Board review and approval of development activities in Harpswell, including the construction or expansion of non-residential structures, the conversion of an existing structure from residential use to non-residential use, the conversion of a site from non-residential use to another non-residential use of a different nature, applicable construction or expansion of paved areas or other impermeable surfaces for non-residential use, the construction or expansion of structures for animal husbandry, and the construction or expansion of a residential structure with three or more dwelling units.

3.1.6 Wireless Telecommunications Facilities Ordinance

Harpswell enforces a Wireless Telecommunications Facilities Ordinance (amended on March 10, 2007) with the following purpose, as stated in the ordinance:

"The purpose of this ordinance is to provide a process and a set of standards for the construction of wireless telecommunications facilities in order to:

- *Implement a municipal policy concerning the provision of wireless telecommunications services, and the siting of their facilities;*
- *Establish clear guidelines, standards and time frames for the exercise of municipal authority to regulate wireless telecommunications facilities;*
- *Allow competition in telecommunications service;*
- *Encourage the provision of advanced telecommunications services to the largest number of businesses, institutions and residents of Harpswell;*
- *Permit and manage reasonable access to the public rights of way of Harpswell for telecommunications purposes on a competitively neutral basis;*
- *Ensure that all telecommunications carriers providing facilities or services within Harpswell comply with the ordinances of Harpswell;*
- *Ensure that Harpswell can continue to fairly and responsibly protect the public health, safety and welfare;*

- *Encourage the co-location of wireless telecommunications facilities, thus helping to minimize adverse visual impacts on the community;*

- *Enable Harpswell to discharge its public trust consistent with rapidly evolving federal and state regulatory policies, industry competition and technological development;*

- *Further the goals and policies of the comprehensive plan, while promoting orderly development of the town with minimal impacts on existing uses; and*

- *Protect the scenic and visual character of the community."*

This Ordinance applies to the construction and expansion of wireless telecommunications facilities within the Town of Harpswell. The Tower District in Harpswell has been established in the approximate center of Town, adjacent to the north of Mountain Road (refer to Map 1–Zoning).

3.2 PUBLIC LAND, CONSERVATION EASEMENTS, AND OPEN SPACE

Several properties throughout the Town of Harpswell have been designated as public land, open space, or land protected from development by conservation easements. Maintaining public land and open space in Harpswell is important to protect water resources, natural habitats, recreational access and scenic views. The Town of Harpswell, with input from residents, is currently finalizing an Open Space Plan to include long-term strategies to establish and protect their key open spaces. Information regarding public land and conservation areas was provided by the Town's Open Space Committee and the Greater Portland Council of Governments. The land use data is current as of 2004.

Locations of public land and conservation land are depicted on the attached Land Use Map (Map 2). Currently there are approximately 3,000-acres of land in Harpswell designated as conservation land. This represents approximately 19 percent of the total land of Harpswell. Nearly 600-acres are designated as public land that consists of cemeteries, churches, community buildings, municipal offices, schools, and libraries, to name a few.

3.3 HISTORICAL FEATURES

Proposed land use activities in the Town of Harpswell are regulated to protect archeological and historic sites that have been identified in the Town's Comprehensive Plan, by the Maine Historic Preservation Commission, or by the National Park Service. Information regarding sites listed in the National Register of Historic Places, the inventory of Maine Historic Archaeological Sites in Harpswell, and prehistoric archaeological sensitivity maps are included in Appendix A.

As part of the 2001 Drinking Water and Sanitary Septic Study, the Maine Historic Preservation Commission provided an inventory of Maine Historic Archaeological Sites in Harpswell, a map depicting properties with standing structures listed in the National Register, and prehistoric archaeological sensitivity maps (dated 1995). As part of this update, the Maine Historic Preservation Commission was contacted again to review their information on file for the Town of Harpswell and provide an updated inventory of historical features within Harpswell. The Maine Historic Preservation Commission provided a map dated April 2008 depicting known archeological sites and areas sensitive for prehistoric archaeology in Harpswell.

There are five types of prehistoric archeological sites identified by the Maine Historic Preservation Commission, including habitation (camp or village) and workshop sites, lithic quarries, cemeteries, rock art, and waterlogged sites preserving wood or other perishables. Of the estimated 6,000 sites in Maine's prehistoric archaeological survey inventory, habitation and workshop sites comprise over 95 percent. The Maine Historic Preservation Commission indicates that these sites are located adjacent to canoe-navigable waters, such as the coastline of Harpswell.

The information pertaining to areas sensitive for prehistoric archeology presented in the April 2008 map was largely similar to what was presented in the 1995 maps. These sensitive areas are primarily located along several sections of the shorelines of Harpswell Neck, Great Island, Bailey Island, Orr's Island, and coastlines of several of the smaller surrounding islands, including Upper Goose Island, Lower Goose Island, Whaleboat Island, Yarmouth Island, and Rogue Island, to name a few. As depicted on the April 2008 map, areas sensitive for prehistoric archeology encompass several mapped prehistoric archeological sites.

In addition to areas sensitive for prehistoric archeology depicted on the April 2008 map, areas with mapped historic archeological sites are also depicted on the map. Historic archaeological sites include structures (settlements and forts) of the period of about 1600 and on. According to the Maine Historic Preservation Commission, these sites may be associated with past events or people of significance in Maine's history. The Maine Historic Preservation Commission provided a map dated 1857 that identifies historic structures in Harpswell. The historic structures identified on the 1857 map are located throughout Harpswell, including South Harpswell, along Route 123 in Harpswell Neck, within the southwestern region of Orr's Island, and scattered throughout Great Island.

The 2001 Drinking Water and Sanitary Septic Study included an inventory of 21 historic archeological sites. The April 2008 map depicts approximately 27 known historic archeological sites that should be recognized as part of planning and development activities. Mapped historic archeological sites in Harpswell are primarily located along several of the coves and peninsulas throughout Harpswell, including regions of North Harpswell, the southern point of South Harpswell, Bailey Island, the southern portion of Orr's Island, and southern regions of Great Island, as well as several of the Town's smaller islands. The April 2008 map is included in Appendix A.

The National Register of Historic Places is administered by the National Park Service and the Maine Historic Preservation Commission, and is a list of sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. Twelve properties in Harpswell were listed in the National Register of Historic Places in the 2001 Drinking Water and Sanitary Septic Study, including the Merriconegan Farm, Elizah Kellog House, Union Church, Deacon Andrew Dunning House, Elijah Kellog Church, Harpswell Meetinghouse, Auburn-Harpswell Association Historic District, East Harpswell Free Will Baptist Church, Union Hotel, Bailey Island Cobwork Bridge, Eagle Island, and Halfway Rock Light Station. Since the previous study, one new property (the Tarr-Hackett House located at 906 Harpswell Neck Road) has been added to the National Register of Historic Places.

4.0 NATURAL RESOURCES

Several natural resources in the Town of Harpswell are significant to the Town's water supply and sanitary wastewater management. Natural resources evaluated as part of this study include surficial and bedrock geologic features, slopes, wetlands, floodplains, wildlife, and plant life, and are discussed further in the following sub-sections. Natural resources in Harpswell are often protected by Town land use regulations or by State regulations; however, other natural resources may not be protected and are subject to proposed development. Development constraints exist regarding natural resources, including the impacts new development would have on the natural environment as well as safety concerns for future site occupants and structures (for example, flood hazards). Natural resources are recognized by the Town of Harpswell in their Comprehensive Plan as valuable land features that should be protected and preserved.

4.1 SURFICIAL GEOLOGY

Information regarding the surficial geology of Harpswell has been collected through everal investigations. Robert Gerber and John Rand completed a Groundwater Resource Analysis for the Town of Harpswell in 1982 (Gerber/Rand Report). The Gerber/Rand Report included an in-depth evaluation of surficial geologic deposits in Harpswell. Based on their review of available information, observations, and field mapping, a map of the surficial geology for Harpswell was created and provided to the Town. This map was subsequently updated to include information provided by the Maine Geological Survey (MGS) in 1999. As part of the previous Drinking Water and Sanitary Septic Study completed in 2001, available information pertaining to Harpswell's surficial geology was transferred into the Town's GIS system. There have been no changes to the 2001, and this information is presented on the attached Surficial Geology and Soil Thickness Map (Map 4).

Surficial geology in the Town of Harpswell primarily consists of glacial till and exposed bedrock in portions of Harpswell Neck and most of Orr's Island, Bailey Island, Great Island, and several of the smaller islands, glaciomarine clay-silt in portions of Harpswell Neck with limited regions throughout the remainder of the Town, and lodgment till throughout Harpswell Neck and Bailey Island, as shown on Map 4. Small regions consisting of reworked glacial till are located in West Harpswell, on Orr's Island, and in Great Island near Lombos Hole, Orr's Cove, and within East Harpswell. According to MGS, no significant sand and gravel aquifers have been identified in the Town of Harpswell.

Three potential areas were identified by Robert Gerber and John Rand (1982) with surficial geology comprised of thick glacial till overlying possible artesian aquifers of buried sand and gravel deposits. Two of these areas are located within populated regions on Bailey Island and in South Harpswell. The third region is situated east of Harpswell Center. The three areas of thick glacial till are identified on the attached Water Supply and Bedrock Geology Map (Map 5).

4.2 BEDROCK GEOLOGY

Bedrock in the Town of Harpswell is of significant importance because it comprises Harpswell's primary source for drinking water. Harpswell's groundwater resources are limited to subsurface freshwater lenses located and transported through fractures in bedrock. The freshwater lenses are supplied and recharged by rainwater.

Information pertaining to bedrock geology in the Town of Harpswell was obtained from MGS. The bedrock geology data provided by MGS is current as of 1995 and is presented on the attached Water Supply and Bedrock Geology Map (Map 5). Updated information pertaining to Harpswell's drinking water wells was provided by the Maine Drinking Water Program (DWP) and the MGS. The Maine DWP provided groundwater quality data for public wells located in the Town of Harpswell that is current as of 2007. MGS provided data pertaining to locations, casing lengths, and well yields of private wells in the Town of Harpswell. Well data from the 2001 Drinking Water and Sanitary Septic Study and data compiled by MGS from 2000 through 2008 are presented on Map 5.

The various bedrock stratigraphic units underlying the Town of Harpswell are categorized as Ordovician deposits of the Precambrian Z age. The bedrock formation varies from region to region throughout the Town. The bedrock underlying the smaller islands along the western perimeter of Harpswell are comprised of the Cushing Formation. The bedrock underlying Harpswell Neck is categorized as Cushing Formation or mafic volcanic member of the Cushing Formation along the northwestern region of the peninsula. The majority of the remaining portions of the peninsula are underlain with bedrock of the Cape Elizabeth Formation. Bedrock underlying South Harpswell is categorized as Scarboro and Diamond Island Formations, Spring Point Formation, or Spurwink Limestone. Bailey Island is generally underlain by glacial till or bedrock of the Cape Elizabeth or Spring Point Formation. Bedrock underlying Orr's Island and western portions of Great Island is primarily comprised of the Cape Elizabeth Formation. Remaining portions of Great Island are underlain by bedrock categorized as Cushing Formation mafic volcanic member or sulfidic pelite.

Bedrock geology in Harpswell directly impacts groundwater resources in the Town. Water supply wells are drilled into the bedrock, and well yields depend on the amount of bedrock fractures and recharge rates in the specific drilled locations. Locations of the water supply wells are depicted on Map 5 along with their corresponding well yields provided by MGS. Several of the wells did not have any corresponding well yield data. The majority of the developed properties within Harpswell have an individual water supply well; therefore, the locations of the wells are primarily within the highly developed Town villages and along the coastlines and major roads. Areas of multiple wells with relatively high yields (approximately 10 to 50 or more gallons per minute) are considered to be located over a high yield well aquifer.

Map 5 also shows the locations of topographic lineaments and tabular diabase dikes mapped by Robert Gerber and John Rand (1982). These features are commonly associated with higher yielding bedrock aquifers and are discussed in Section 5.1.3.

4.3 STEEP SLOPES

Slope is a measurement of the steepness or incline of the land surface. A higher slope value indicates a steeper incline. Slope measures the change in a surface elevation over a given distance, and is expressed as a percentage.

The Town of Harpswell is comprised of many areas of steep slopes along its shorelines as well as inland areas that are considered valuable natural landscape features. In many cases, the Town of Harpswell aims to protect and preserve these natural features. The existence of steep slopes within regions of proposed development should be evaluated in the planning and development of Harpswell. There are several impacts involved with developing or disturbing steep slopes that should be considered, including erosion, stormwater runoff, natural topography and drainage patterns, and surface water impacts. Additionally, steep slope sites limit the amount of rainwater infiltration that may occur which will affect the groundwater availability.

The 2001 Drinking Water and Sanitary Septic Study states that according to the National Resource Conservation Service (NRCS), slopes greater than eight to 15 percent significantly constrain the construction of water management measures, buildings, and roads for most soil types.

4.4 WETLANDS

Rural areas of Harpswell, including numerous offshore islands, are primarily comprised of undeveloped forest land and wetlands. Freshwater and coastal wetlands are considered important natural resources for the Town of Harpswell for several reasons. Wetlands act as a detention basin to collect surface water runoff and allow the recharge of groundwater. In addition, wetlands also cleanse the surface water runoff, provide sediment and floodwater retention, and are a natural habitat for a variety of plant and wildlife species. Coastal wetlands are equally important to the Town of Harpswell as they provide habitat for the fisheries which are an important part of the community's socioeconomic fabric.

Because of their significance, wetlands are protected under state and federal regulations as well as local ordinances. Data provided in Harpswell's Comprehensive Plan states that from 1998 to 2003, the Town issued over 300 building permits for new residential construction, encompassing an estimated 600 acres of undeveloped land. As the Town continues to grow and develop, maintaining the protection of the wetlands and other natural resources will be important.

Information on wetlands in the Town of Harpswell has been compiled by the National Wetlands Inventory Program of the U.S. Fish and Wildlife Service and was provided through "Beginning with Habitat" for this study. Beginning with Habitat is a program affiliated with the U.S. Fish and Wildlife Service. Information pertaining to wetland locations in Harpswell was provided by Beginning with Habitat and is current as of 2007.

The Zoning Map (Map 1) depicts the wetland areas identified within the Town of Harpswell. Wetland areas are located within the Town's shoreland zones. The shoreland zones encompass areas of wetlands, waterbodies, and watercourses, as well as a 250-foot border around these natural resource areas.

The wetland areas included in the 2001 Drinking Water and Sanitary Septic Study were delineated by Woodlot Alternatives in 1996. Wetlands identified in the 2001 study remain in the current inventory of mapped wetlands within Harpswell. Since 2001, additional areas have been classified as wetlands, including many small regions scattered throughout the interior portions of the Town's larger land masses as well as many coastal areas Harpswell Neck, Great Island, Orr's Island, Bailey Island, and the surrounding smaller islands.

4.5 FLOOD PLAINS

Flood plains (flood zones) are areas with identified flood hazards, including areas of shallow flooding and areas of special flood hazard. Areas of shallow flooding include properties with a one percent or greater chance of flooding each year to an average depth of one to three feet, where a defined channel does not exist and the path of flooding is unpredictable. Areas of special flood hazard include properties in a floodplain having a one percent or greater chance of flooding in any given year.

Within the Town of Harpswell, the flood plains generally overlap with the Town's shoreland zones. In particular, the 50-year and 100-year flood zones are primarily located within the 250-foot shoreland zone. Select areas outside the shoreland zones are located within a 500-year flood zone; however, these are generally limited to wetland areas or riverbeds. Flood zones within the Town of Harpswell are depicted on the Flood Zones Map (Map 3), which was created based on data from the Flood Insurance Rate Maps database maintained by the Federal Emergency Management Agency (FEMA). The flood zone data is current as of 1996, and no changes in Harpswell's floodplains have been identified since the previous Drinking Water and Sanitary Septic Study.

Harpswell's Floodplain Ordinance applies to properties located in regions with identified flood hazards. This Ordinance establishes a Flood Hazard Development Permit system and review procedure for development activities in mapped flood hazard areas with the intent of recognizing and evaluating flood hazards relating to land use in Harpswell's floodplain areas. Development of land within a known 50-year or 100-year flood plain puts future occupants as well as any new structures at significant risk. Insurance costs relating to development within a flood plain and the potential future flood risks often prohibit construction in these areas.

4.6 WILDLIFE HABITAT AND BOTANICAL FEATURES

As the Town of Harpswell continues to develop, one of the goals established in Harpswell's Comprehensive Plan is to ensure that new development does not encroach upon critical natural areas or essential wildlife habitats. Harpswell's future growth will likely impact select undeveloped regions. The future development of these regions will require responsible planning to minimize the impacts to the Town's valuable natural resources. The locations of new developments and associated roads will need to be managed in order to minimize habitat fragmentation or wildlife travel corridors, for example. Wildlife habitats and botanical features in the Town of Harpswell have been evaluated and inventoried by State and federal agencies.

The Gulf of Maine Coastal Program established by the U.S. Fish and Wildlife Service works to build partnerships to identify, protect and restore nationally important fish and wildlife habitat in the Gulf of Maine watershed. Since the 2001 Drinking Water and Sanitary Septic Study was completed, the Coastal Program compiled a list of 91 priority species within the Gulf of Maine watershed habitats in 2007. The priority species list includes 75 species of birds such as the bald eagle, the osprey, and the common loon, nine species of fish such as the Atlantic salmon, four species of plants, the Canada lynx, the horseshoe crab, and the Plymouth redbelly turtle. The list of priority species cataloged by the Coastal Program is included in Appendix B.

Beginning with Habitat is affiliated with the U.S. Fish and Wildlife Service, and is a statewide effort that compiles and prioritizes high value habitat identified by the U.S. Fish and Wildlife Service, the Maine Natural Areas Program (MNAP), the Maine Department of Inland Fisheries and Wildlife (IF&W), and the Maine Audubon Society. The intent of Beginning with Habitat is to support land protection and town planning efforts. As part of this study, Beginning with Habitat provided available information pertaining to the region of Harpswell. This information is current as of 2007 and has been presented on the attached Ecological Resources Map (Map 6).

The Ecological Resources Map (Map 6) identifies areas of essential fish, wildlife, and plant habitats in the Town of Harpswell. Map 6 depicts areas essential to the 91 priority species for the Gulf of Maine identified by the Coastal Program (high value animal points), shorebird areas, seabird nesting islands, eagle essential habitats, inland and tidal waterfowl and wading bird habitats, roseate tern essential habitats, areas of rare or exemplary botanical features (high value plant areas), natural communities, and regions categorized as high value habitat by the U.S. Fish and Wildlife Service. Essential wildlife habitats have been identified by the Maine Department of Inland Fisheries and Wildlife as regions historically or currently providing habitat essential to the conservation of endangered or threatened species. Essential habitats in Harpswell include documented existing or suitable areas for nesting, feeding, breeding, wintering, and roosting for eagles and roseate terns.

A riparian buffer (vegetated zone for the protection of water quality) established by MNAP includes a 250-foot zone along the coastline, rivers, streams, and wetlands in Harpswell. This riparian buffer primarily overlaps the Town's established shoreland zone and is depicted on Map 6. A significant portion of the coastline of Harpswell is also identified as tidal waterfowl and wading bird habitat. The majority of Casco Bay and the harbors, coves, and sounds in the region of Harpswell are categorized by the U.S. Fish and Wildlife Service as high value habitat. Essential habitats for eagles in Harpswell include Bombazine Island, Pond Island, and a couple smaller islands adjacent to the shore of Great Island. Also on Great Island, near Quahog Bay, is a region designated as a high value animal point. Several of Harpswell's smaller islands are designated seabird nesting islands.

As part of the 2001 Drinking Water and Sanitary Septic Study, MNAP (formerly referred to as the Maine Department of Conservation's Natural Areas Program) provided information on rare or exemplary botanical features identified within the Town of Harpswell. MNAP was contacted to review the information in their databases and provide an updated inventory for the Town of Harpswell. Information available from MNAP is provided to and maintained by Beginning with Habitat. Rare or exemplary botanical features are depicted on the Ecological Resources Map (Map 6).

IF&W provided a Wildlife Habitats Map for the Town of Harpswell in 2001. The 2001 map depicted areas of eider habitat and rookery islands, primarily in southern regions of Harpswell. As part of this study update, IF&W was requested to review the information available for Harpswell and provide any updates. Data compiled and maintained by IF&W was incorporated in the data provided by Beginning with Habitat and is included on Map 6. Since 2001, several new areas for tidal waterfowl/wading bird habitat protection were identified along Harpswell's extensive coastline. In addition, three new inland waterfowl/wading bird habitat protection areas were identified on Great Island, and one new inland waterfowl/wading bird habitat protection area was identified on Harpswell Neck, north of West Harpswell. One new high value animal area was also identified on Great Island, adjacent to Quahog Bay.

5.0 GROUNDWATER AND SURFACE WATER

5.1 GROUNDWATER

The Town of Harpswell seeks to provide its residents a safe and adequate water supply. Harpswell's bedrock aquifers are the primary source for drinking water for Harpswell residents and visitors, and therefore, are of significant importance to the Town. Most properties within Harpswell consist of individual drinking water well and sanitary septic systems.

The Town's groundwater resources are very sensitive to contamination, and must be protected from identified environmental concerns and future threats involved with development. Concerns regarding the groundwater in Harpswell include sanitary septic contaminants, environmental contaminants, and road salt contaminants, which are discussed in the following subsections. In addition, salt water surrounds Harpswell's land area, resulting in salt water intrusion in some water supply sources.

5.1.1 Water Supply Wells

Each property in the Town of Harpswell generally has an individual water supply well and sanitary septic system. Locations of water supply wells are identified on the Water Supply and Bedrock Geology Map (Map 5). The amount of water available at any given property depends upon the degree of bedrock fracturing in the bedrock underlying that site and the specific recharge of the fractured zone. Reported well yields in Harpswell range from less than one gallon of water per minute to greater than 50 gallons per minute.

The analysis of water quality data is essential in identifying areas in Harpswell with existing or potential future problems, such as contamination or inadequate yield. Data pertaining to water supply wells that have been installed in Harpswell from 2000 to the present was provided by MGS for this study. Information pertaining to water quality testing of private wells conducted from 2000 to present was provided by the Maine Health and Environmental Testing Laboratory (HETL). Water quality test results for public wells that have been conducted from 2005 to 2007 were provided by the Maine DWP. The analysis of the water quality data is presented in Section 7 of this report.

Existing public wells are identified on the Water Supply and Bedrock Geology Map (Map 5). A public water system is defined by the Maine DEP as any publicly or privately owned system of pipes or other constructed conveyances, structures and facilities through which water is obtained for or sold, furnished or distributed to the public for human consumption if such a system has at least 15 service connections, regularly serves an average of at least 25 individuals daily at least 60 days out of the year, or bottles water for sale.

There are approximately 27 mapped public water supply wells in Harpswell, including wells that are maintained by Auburn Colony Dining Hall, Bailey Island Grille, Birch Island Water System, Blackbird Café, Block and Tackle, Cooks Island View Motel, Cundy's Harbor Community Hall, Dipper Cove Association, Dolphin Marina and Restaurant, Driftwood Inn, Estes Lobster House, Giant Stairs Seafood Grill, Great Island Lobster Barn, Lombos Peninsula Owners Associations, Millstone Apartments, the Harpswell Island School System and West Harpswell School System (MSAD 75), and Orr's Island Campground. This represents a 28 percent increase in mapped public water supply wells from the 2001 Drinking Water and Sanitary Septic Study.

According to State primary and secondary drinking water regulations, all public water systems are required to conduct water testing to identify contaminants which may have an adverse effect on human health and welfare. Upon identification of contaminants that exceed levels no less stringent than the National Primary Drinking Water Regulations, one or more treatment techniques are required to reduce the contaminant level to protect human health.

5.1.2 Soil Thickness

Well data for private wells installed in Harpswell from 2000 to 2008 was provided by MGS. Geologic characteristics provided by MGS, including well casing length and well yield, present information pertaining to the depth to bedrock and the groundwater withdrawal capability of the bedrock aquifers in Harpswell. Well casing is typically an approximately 6-inch diameter pipe that is driven through the soil and into bedrock. The casing keeps the soil from falling into the well during the drilling, minimizes the amount of sediment that enters the well during its use, and seals the well from potential surface water runoff. The length of well casing is an approximation of soil thickness in that specific area, and well yield is an indication of the bedrock aquifer yield. Soil thickness and aquifer yield are significant characteristics to evaluate problem areas and to aid in future planning for groundwater use in Harpswell.

The thickness and type of the soil overlying bedrock have direct impacts on the sustainability of Harpswell's water supply systems. Harpswell's drinking water sources are primarily limited to bedrock aquifers, and the bedrock aquifers are recharged with rainwater. Surficial geologic conditions that likely promote the recharge of bedrock aquifers include thicker and more permeable soils overlying bedrock. Available information pertaining to the approximate soil thicknesses at well locations for properties in Harpswell, based on well casing lengths, was provided by MGS (2000 to 2008) and is depicted on the attached Surficial Geology and Soil Thickness Map (Map 4). To simplify the data, Map 4 shows two categories of casing length: greater than ten feet, indicating relatively thick soils; and less than ten feet, indicating shallow soils.

Clusters of wells with deeper casing lengths represent areas in Harpswell with a thicker layer of soil overlying bedrock. These areas have the potential to provide higher well yields and more effectively manage wastewater generated by site occupants in the area. In addition, areas of thicker soils may have the potential to be further developed in the future.

Regions comprised of several wells with deeper casing lengths (greater than ten feet) were identified located within areas of South Harpswell, along Basin Cove, in North Harpswell, in western Great Island north of Mountain Road, in East Harpswell, and near Cundy's Harbor. Many of the well clusters with greater soil depths are located within or near areas of high yield well aquifers and high yield well buffer regions.

A significant portion of the wells that serve the coastal areas and the village centers of Harpswell have shallow casing lengths (less than ten feet). Clusters of wells with shallow casing lengths indicate a thin soil layer overlying the bedrock in that region. Areas in Harpswell with limited soil thickness can often represent future development limitations. Adequate soil thickness is necessary in order to provide a sufficient water supply and wastewater handling capacity for each developed property.

Areas comprised of a thin soil thickness include the southern point of South Harpswell, the majority of Bailey Island, the southern region of Orr's Island around Lowell Cove, northern areas of Orr's Island surrounding Long Cove, western regions of Great Island near Card Cove and Dyer Cove, northern areas of Great Island along Gurnet Strait, areas in the vicinity of East Harpswell, regions adjacent to Cundy's Harbor and Ridley Cove, and several other areas along the coastlines of Harpswell. Many, if not most, of these areas represent village areas with dense existing development. Well locations and corresponding casing lengths are identified on Map 4.

Soil thickness and soil type can impact the efficiency of wastewater disposal systems and the carrying capacity of the land. Wastewater disposal in the Town of Harpswell primarily relies on individual sanitary septic systems, and each property on which a sanitary septic system is located must have adequate carrying capacity to manage the wastewater generated on that site. The Gerber/Rand Report and the 2001 Drinking Water and Sanitary Septic Study delineated the carrying capacity of the Town's land based on surficial geologic limitations, including soil type and thickness. The 2001 Drinking Water and Sanitary Septic Study included an analysis utilizing GIS to identify properties with inadequate land area to properly manage their wastewater based on the carrying capacity of the onsite soils. Ransom, in conjunction with the Town of Harpswell, has updated the Town's carrying capacity model in order to evaluate development opportunities in regard to water and wastewater limitations for areas throughout the Town. The updated carrying capacity assessment is discussed herein in section 6.1.

5.1.3 Aquifer Yield

Harpswell's primary source for drinking water is groundwater from bedrock aquifers. Bedrock aquifers consist of geologic deposits with numerous fractures that are saturated with water. Water supply wells are drilled into the bedrock, intercepting the fractures, allowing water to flow into the well. The bedrock aquifers are replenished with precipitation that falls on the ground surface and infiltrates through the overlying soils, recharging the bedrock aquifer.

Soil type and permeability as well as thickness of the overburden layer directly impact the recharge potential of the bedrock aquifers. Thick subsurface materials, such as sand and gravel, have a high degree of void space and interconnectivity along with a variety of grain sizes, making the overlying soil layer more permeable for water to flow, resulting in higher recharge rates for the aquifer. Subsurface materials with smaller grain sizes and little void space and interconnectivity result in lower recharge rates for the aquifer.

Maine regulations require that the driller report certain well information to the State for new wells. This data includes an estimate of the yield for the new well, and this information is maintained by MGS. Well yield data for Harpswell was evaluated as part of the 2001 Drinking Water and Sanitary Septic Study. More recent well data was provided by MGS, including casing length and well yield for wells installed in Harpswell since the previous 2001 Study. Locations of water supply wells in Harpswell and information regarding well yields are mapped on the Water Supply and Bedrock Geology Map (Map 5).

Wells yields were assigned to three categories. The first category is less than one gallon per minute (gpm). Wells that yield less than one gpm are considered marginal and are typically only adequate for development when they also maintain substantial borehole or tank storage. The second category (one to ten gpm) is for wells considered to have moderate yields and typically provide adequate yield for most developments. Wells with yields of 10 to 50 gpm (third category) and yields of greater than 50 gpm (fourth category) are considered high yields and may represent high yield aquifer zones.

The majority of the water supply wells in Harpswell are categorized as yielding zero to one gallon per minute or one to ten gallons per minute of water. However, there are 408 wells throughout Harpswell that yield 10 to 50 or more gallons of water per minute.

Areas of multiple wells with relatively high yields (approximately 10 to 50 or more gallons per minute) were identified as potential high yield aquifer zones. The potential high yield zones were further analyzed for regional physical properties as well as soil type and thickness in order to determine whether the potential high yield could be sustained. Areas with estimated sustainable high yields are considered to be potential high yield well aquifers. Locations of potential high yield well aquifers are depicted on the Water Supply and Bedrock Geology Map (Map 5). The boundaries of these high yield well aquifers and recharge areas were interpolated using a GIS application based on individual well yield data.

Potential high yield well aquifers have been identified in North Harpswell near Wilson Cove, Widgeon Cove, and along Route 123, in Harpswell Center along Route 123 and near Merriman Cove, in central regions of West Harpswell, in South Harpswell along Harpswell Sound, on Bailey Island adjacent to Mackerel Cove, on the southern point of Orr's Island near Lowell Cove, in the central region of Orr's Island, and throughout Great Island near Lombos Hole, Doughty Cove, Orr's Cove, Dyer Cove, along Quahog Bay, and near Dingley Island.

Map 5 also shows topographic lineaments and tabular diabase dikes that may correspond with higher yielding aquifer zones (Gerber/Rand report). Topographic lineaments, identified by faint lines on aerial photographs, are sometimes associated with bedrock fracture zones and high well yields. Diabase dikes are intrusive volcanic rocks that often caused fracturing of the surrounding rock; these fractures may comprise zones of high well yield. Several topographic lineaments and two diabase dikes have been mapped in Harpswell. The dikes are located south of Harpswell Center and on East Harpswell.
A number of the high yielding wells on Map 5 are located along, or in the vicinity of, the topographic lineaments and diabase dikes.

The State of Maine recommends a wellhead protection zone consisting of a 1,000-foot radius around high yield public water supply wells. Source water protection areas for small public systems are scaled based on the population served by the system. The minimum protection area covers a circle of land with a 300-foot radius from the public water supply well. The minimum size protection areas are applicable for water supply wells that provide drinking water to a population of less than 240 people. The majority of the public water supply wells in Harpswell have a State-recommended source protection area with the minimum 300-foot radius. However, a few of the public water supply wells have recommended source protection areas that extend approximately 1,000-feet or more from the well. These wells service a larger population (for example, 400 to 600 people). Public well buffers for wells in the Town of Harpswell are identified on the Water Resources Protection Map (Map 7). Map 7 shows both the 1,000-foot wellhead protection zone and the population-based source protection areas around the small public water systems.

5.2 SURFACE WATER

Harpswell is comprised of one peninsula, three large islands, and many smaller islands situated north of Casco Bay, surrounded by Middle Bay, Harpswell Sound, Quahog Bay, New Meadows River, and numerous smaller bays, coves, and harbors. The land area comprising Harpswell also encompasses several small ponds, streams, and wetlands dispersed throughout the Town. According to the U.S. Census Bureau (Census 2000), Harpswell encompasses 83.9 square miles of total area. Of the total area, only 24.1 square miles consist of land area.

There are approximately ten ponds that exceed one acre in surface area and several small freshwater ponds in Harpswell (less than one acre). According to the 2001 Drinking Water and Sanitary Septic Study, only one pond, Ice Pond, has been identified as having a surface area greater than ten acres, making it a great pond.

No surface water bodies capable of being a public reservoir for the Town of Harpswell have been identified. However, protecting the surface water quality is of significant importance to the Town because surface water is tied to groundwater. Surface water quality directly impacts quality of the drinking water supplied to Harpswell's occupants. Protecting the surface water in Harpswell is also important to conserve suitable habitats for fish, wildlife, and plant life.

6.0 WASTEWATER DISPOSAL SYSTEMS

The Town of Harpswell continues to rely on individual sewage disposal systems for wastewater disposal and treatment. Individual septic systems typically consist of a traditional septic tank and a leach field. In a traditional septic system, wastewater enters a septic tank where solids settle to the bottom and grease and oils rise to the top. Within the tank, bacteria decompose or mineralize the solid waste in an anaerobic environment. The liquid wastewater then flows into a disposal field and is further treated within the soil.

During recent years an increasing number of properties have elected to install innovative wastewater disposal systems. Since 2000, Harpswell has issued approximately 1,000 septic system permits with one third of these permits being for innovative systems. Innovative systems used within Harpswell include Eljin Mantis systems, Geoflow subsurface drip systems, Presby Environmental Enviro-Septic leaching systems, and Aeration Systems OxyPro systems. These innovative systems provide enhanced treatment of wastewater compared to traditional septic systems. Many of these systems include fabric wraps or the addition of air to encourage bio-growth and bio-activity. Other treatment methods are available to de-nitrify the effluent.

6.1 CARRYING CAPACITY

Generally, wastewater disposal in the Town of Harpswell includes individual sanitary septic systems. The effects of wastewater disposal on Harpswell's drinking water and other natural resources are a significant concern and require adequate land area and carrying capacity of the surficial soils.

Wastewater disposal systems are a limiting factor for planning and development of regions in Harpswell. The Gerber/Rand Report and the 2001 Drinking Water and Sanitary Septic Study delineated the carrying capacity of the Town's land based on surficial geologic limitations, including soil type and thickness. The 2001 study included an analysis utilizing GIS to identify properties with inadequate land area to properly manage their wastewater based on the carrying capacity of the onsite soils. Ransom, in conjunction with the Town of Harpswell, updated the Town's carrying capacity model in order to evaluate development opportunities in regard to water and wastewater limitations for areas throughout the Town. This updated analysis is based on the J.J. Trela and L.A. Douglas Dwelling Density Model (modified Trela-Douglas Model) to further delineate areas of the Town with development limitations or opportunities. The Trela-Douglas Model was developed in 1978 and calculates minimum lot size requirements for septic systems based on septic systems, soil types, and recharge rates. Documentation for the Town of Harpswell carrying capacity model is provided under separate cover.

The carrying capacity model indicates a number of areas with relatively favorable soil conditions for septic systems. These areas include modeled regional carrying capacities of one to two acres on Bailey Island, North Harpswell, Harpswell Center, and a broad area between West Harpswell and South Harpswell. Less favorable soils are apparent based on carrying capacities of greater than ten acres on Birch and White Islands, and the north end and east side of North Harpswell. The majority of the soils in Harpswell warrant or support carrying capacities of three to four acres, including large tracts on Great Island and East Harpswell, among many others. The carrying capacity model results presented herein are for planning purposes only; site-specific testing would be required to accurately determine the carrying capacity of any parcel proposed for development.

6.2 SYSTEM FAILURES

Data maintained by the Town of Harpswell indicates that there were 478 replacement system permits issued between 2000 and 2007. This number is not a surprise given the number of systems in Harpswell and the age of some of the systems. A well designed and maintained septic system has a projected life span of 20 years, but some septic systems can fail prematurely. There are a variety of reasons for failure including, but not limited to, the following:

- Inappropriate soil conditions or excessively compacted soils around the leach field;
- Excessive dumping of oils, grease, or use of a garbage disposal for food waste that can overwhelm a system or clog inlet drains;
- Excess water due to poor drainage or spring melting that can flood a system;
- Roots from trees and shrubs situated too close to a system that can clog or rupture a system;
- Flushing non-biodegradable products into a system that can rapidly overload it;
- Old age of the septic system; and
- Failure to periodically pump solids from the septic tank.

6.3 OVERBOARD DISCHARGES

Overboard discharges (OBDs) are systems that discharge wastewater into rivers streams, lakes or the ocean. These systems were installed on properties that could not effectively manage a septic system, such as properties with poor soil conditions or small lot sizes. OBDs are a concern in many areas because of their risks to the marine environment and especially shell fishing areas.

The 2001 Drinking Water and Sanitary Septic Study reported that there were 127 active OBDs in Harpswell at that time. As of May 2008, the number of OBDs has dropped to 91 with approximately 11 more in the process of being removed. The 91 existing OBDs are identified on the Septic Features Map (Map 8). OBDs are primarily located in North Harpswell near Ewin Narrows, in Harpswell Center near Clark Cove, on the southern point of South Harpswell, throughout Bailey Island, on the southern border of Orr's Island near Lowell Cove, on the eastern border of Bailey's Island along Gun Point Cove, on the southern point of Great Island near Gun Point Cove, in the western region of Great Island along Quahog Bay, and on the eastern region of Great Island around Cundy's Harbor. Two OBDs are also located on Dingley Island and Great Mark Island.

Shellfish beds are impacted by the existence of OBDs, and nearly all of the existing OBDs are located adjacent to shellfish closure areas. Current information pertaining to shellfish closures was provided by the Town of Harpswell for this study. Areas of shellfish closures are identified on Map 8. Shellfish closures are depicted along various shoreline areas of Harpswell Neck near Harpswell Center and South Harpswell, surrounding the shorelines of Bailey Island and Orr's Island, and bordering the southern shorelines of Great Island within Quahog Bay and Cundy's Harbor. Shellfish beds surrounding Upper Flag Island, Eagle Island, Haskell Island, and Great Mark Island are also identified as closed.

7.0 WATER QUALITY PROBLEM AREAS AND SOLUTIONS

The Town of Harpswell's groundwater resources are limited and vulnerable to contamination. Protecting the Town's groundwater resources as well as identifying problem areas is important because Harpswell residents and businesses depend on the groundwater for their fresh water needs each day. Groundwater quality concerns include contamination due to both naturally-occurring (e.g., arsenic) and man-made contaminants (e.g., volatile organics in petroleum and solvents), septic system contaminants, and road salt contaminants, as discussed in the following subsections.

According to State drinking water regulations, public water systems are required to conduct water testing to identify contaminants which may have an adverse effect on human health and welfare. Water quality data from public water systems in the Town of Harpswell were provided by the Maine DWP. The public well data provided by the State was limited to water tests completed from 2005 through 2007 for Harpswell's public wells, but should be representative of trends beyond the three years of data available from the State. Upon identification of contaminants that exceed levels the more stringent concentration of the Environmental Protection Agency's (EPA's) National Primary Drinking Water Standards Maximum Contaminant Levels (MCLs) or the Maine Center for Disease Control Maximum Exposure Guidelines (MEGs), public water systems are required to implement one or more treatment techniques to reduce the contaminant level to protect human health. Copies of the EPA MCLs and Maine MEGs are included in Appendix C.

Unlike public water systems, private water supply well owners are not required to conduct water testing. Private well owners perform water testing on a voluntary basis and are able to select from many commercial laboratories or the Maine HETL to perform the water testing. The Maine HETL is often utilized by private well owners. Information pertaining to water quality testing of private wells conducted since 2000 was provided by Maine HETL. Private laboratories are not allowed to release water quality information from private well sampling. The data utilized in the 2001 Drinking Water and Sanitary Septic Study was from the Maine HETL and includes data maintained in the lab's database for the ten years prior to 2001. However, this raw data was not available for this report.

Available water quality data for public and private wells were compared to Maine MEGs to identify areas of potential concern within the Town of Harpswell. For water quality parameters that do not have an established Maine MEG, the test results were compared to the corresponding EPA's MCLs.

7.1 GROUNDWATER CONTAMINANTS

Both public and private wells in Harpswell are periodically tested for numerous water quality parameters. Compounds that have been identified in water supply wells in Harpswell since 2001 include arsenic, chloride, copper, fluoride, iron, lead, manganese, sodium, uranium, petroleum compounds, and septic system contaminants (septic system contaminants are discussed in the following section). Summary tables of public and private well test data are included at the end of this section.

A total of 33 water samples were collected from public wells from 2005 through 2007 and analyzed for metals including arsenic, copper, iron, lead, manganese, mercury, or silver. One out of the five water samples analyzed for iron had an elevated iron concentration exceeding the corresponding Maine MEG. One out of five water samples analyzed for manganese had an elevated manganese concentration exceeding the corresponding Maine MEG. No elevated concentrations of arsenic, copper, lead, mercury, or silver were identified in the public well water samples.

A total of 71 water samples were collected from public wells from 2005 to 2007 and analyzed for petroleum contaminants, including benzene, ethylbenzene, methyl tert-butyl ether (MTBE), naphthalene, toluene, and xylenes. No elevated concentrations of these petroleum constituents were identified in the public well water samples.

A total of 1,103 metals analyses were conducted on water samples from private water supply wells within the Town of Harpswell by Maine HETL from 2000 to 2008. Analytes included arsenic, copper, iron, lead, manganese, mercury, silver, uranium, and fluoride. According to the data provided by the State, 7 out of 164 (approximately 4.3 percent) water samples analyzed for arsenic indicated concentrations that exceeded the corresponding Maine MEG. A total of 57 out of 162 (approximately 35.2 percent) water samples analyzed for iron had elevated iron concentrations exceeding the corresponding Maine MEG. A total of 22 out of 118 (approximately 18.6 percent) water samples analyzed for lead had elevated lead concentrations exceeding the corresponding Maine MEG. A total of 9 out of 197 (approximately 4.6 percent) water samples analyzed for copper had elevated copper concentrations exceeding the corresponding Maine MEG. A total of 15 out of 160 (approximately 9.4 percent) water samples analyzed for manganese had elevated manganese concentrations exceeding the corresponding Maine MEG. A total of 4 out of 190 (approximately 2.1 percent) water samples analyzed for fluoride had elevated fluoride concentrations exceeding the corresponding Maine MEG. Elevated levels of uranium above the Maine MEG were identified in 7 out of 96 (approximately 7.3 percent) water samples analyzed for uranium. No exceedances of mercury or silver above their respective guidelines were identified in samples collected from the private wells since 2000.

Elevated levels of certain compounds such as arsenic, iron, manganese, and uranium in water samples may be representative of naturally occurring background conditions in the State of Maine. Elevated lead and copper concentrations in the drinking water samples are likely due to naturally occurring aggressive water leaching lead and/or copper from household plumbing pipes and fixtures. The locations of private wells with identified exceedances are shown on the Groundwater Quality Concerns Map (Map 9). Locations of 31 wells that had exceedances were not geo-coded (assigned a geographical location identifier, such as a street address or latitude and longitude coordinates) and could not be located due to the address in the data base being a postal box or out of town address.

From 2000 to 2008, 98 samples were collected from private wells in Harpswell for analysis of petroleum contaminants, including benzene, diesel range organics (DRO), ethylbenzene, gasoline range organics (GRO), MTBE, naphthalene, toluene, and xylenes. Of the analyses, DRO concentrations for two samples were equal to the Maine MEG of 50 parts per billion (ppb). One of the private wells with the identified elevated DRO level is shown on Map 9; however, the other well was not geo-coded and could not be located. Elevated DRO concentrations are likely due to historic petroleum releases within the Town. No exceedances of benzene, ethylbenzene, GRO, MTBE, naphthalene, toluene, and xylenes were identified above their respective Maine MEGs.

Releases of oil and/or hazardous materials in the State of Maine are required to be reported to the MDEP. The MDEP maintains a GIS database of locations of mapped spill sites within the State. Spill sites in Harpswell that are included in the MDEP's GIS database are identified on Map 9. It is important to note that many additional MDEP reported spills have occurred within Harpswell that have not or could not be assigned a geographical location in the MDEP's database.

According to the 2001 Drinking Water and Sanitary Septic Study, approximately 46.4 percent of the water samples tested during the 10 years prior to 2001 demonstrated elevated levels of iron, and approximately 49.5 percent of the tests demonstrated elevated manganese levels. Elevated arsenic levels were identified in nine of cases. Elevated lead levels were detected in five of the water samples included in the 2001 Study. A total of 47 out of 470 (approximately 10 percent) of the private well water samples tested for petroleum constituents, including MTBE, GRO, fuel oil constituents, and total hydrocarbons from 1990 to 2000 resulted in elevated concentrations.

Growth in areas with identified contaminants must take into consideration the potential for encountering contaminated groundwater. If development is proposed in an area of known contamination, review of water quality data should be conducted to identify risk and to assure safe drinking water can be provided. Residents in Harpswell located within an area of identified groundwater contamination should be made aware of the potential contamination and be provided with the guidance necessary to effectively manage their individual water and wastewater systems.

The Town of Harpswell, in conjunction with the State of Maine, should provide guidance to residents on the required proper oil tank installation, maintenance, and inspection policies. In addition, given Harpswell's geographical setting, residents and visitors should be made aware of proper spill prevention, control, and countermeasure policies to prevent releases of oil and hazardous materials within the Town as well as immediately respond to any releases to reduce or eliminate groundwater impacts.

7.2 SEPTIC SYSTEM CONTAMINANTS

Septic system contaminants have been identified in samples collected from water supply wells in Harpswell since 2000. A total of 546 water samples were collected from public wells from 2005 through 2007 and analyzed for possible septic system contaminants including total coliform, Escherichia coli (E. coli), nitrate-nitrogen, and nitrite-nitrogen. A total of 41 out of 205 (approximately 20 percent) of the samples contained positive levels of total coliform. One out of 180 public well water samples contained E. coli. None of the 161 public well water samples tested for nitrate-nitrogen or nitrite-nitrogen resulted in concentrations exceeding the respective Maine MEG.

A total of 1,475 water samples were collected from private wells in Harpswell from 2000 to 2008 to be analyzed for fecal coliform, total coliform, E. coli, nitrate-nitrogen, and nitrite-nitrogen. None of the five water samples analyzed for fecal coliform resulted in a detection of fecal coliform. A total of 133 out of 470 (approximately 28.3 percent) of the water samples analyzed for total coliform resulted in detections of total coliform. E. coli was detected in 12 out of 450 (approximately 2.7 percent) water samples analyzed for E. coli. Of the 550 water samples analyzed for nitrate-nitrogen or nitrite-nitrogen, no elevated concentrations exceeding the corresponding Maine MEGs were identified. Locations of the public and private wells in Harpswell with identified elevated concentrations of septic system contaminants are identified on Map 9. Locations of select wells were not geo-coded and could not be located.

The presence of E. coli in water samples may be indicative of septic system impacts as this bacteria lives in the digestive tract. Detection of total coliform bacteria may indicate septic system impacts, but this bacteria is common on skin, in soils on plant matter, among others; therefore, if sampling is not conducted carefully, such as disinfecting the faucet before sampling and wearing gloves, total coliform may be detected even if the water has not been impacted by a septic system. Recognizing the size of many lots within the village areas of Harpswell, it is surprising that no nitrate exceedances were reported within the State data.

Groundwater contamination due to septic systems in Harpswell may be due to several factors. Aged and failed septic systems, inappropriate use or lack of maintenance of septic systems, and poor soil conditions for septic systems contribute to groundwater contamination.

Harpswell has been highly successful in eliminating overboard discharges where possible and continues to accomplish this program. Continuing to reduce to number of OBDs will have a direct positive impact on groundwater and shellfish beds along the coastline of Harpswell. Ninety-one overboard discharges are currently active in the Town of Harpswell.

7.3 ROAD SALT

Based on the 2001 Drinking Water and Sanitary Septic Study, groundwater in the Town of Harpswell was perceived to have been potentially impacted by the application of salt to the roads during the winter months. In addition, given Harpswell's geographic setting, salt water intrusion is a naturally-occurring source for environmental contamination of water supply wells.

Since 2001 (according to the analytical data obtained from the State laboratory), four water samples were collected from public wells in Harpswell to be analyzed for sodium, and five water samples were collected to be analyzed for chloride to evaluate the potential existence of road salt contaminants in the groundwater. All of the four samples analyzed for sodium resulted in sodium concentrations that exceeded the Maine MEG. Of the five public well water samples analyzed for chloride, no elevated levels of chloride exceeded the EPA Secondary Drinking Water Standard of 250,000 pbb. Secondary Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects.

A total of 211 water samples were collected from private wells to be analyzed for sodium and chloride since 2001. A total of 37 out of 52 (approximately 71.2 percent) of the samples analyzed for sodium resulted in levels that exceeded the corresponding Maine MEG. A total of 11 out of 159 (approximately 6.9 percent) of the samples that were analyzed for total chloride resulted in levels that exceeded the EPA Secondary Standard. Elevated levels of sodium and chloride exceeding the corresponding Maine MEGs in water samples collected from drinking water wells in Harpswell represent an environmental concern for the Town.

According to the 2001 study, water quality test data from 1990 to 2000 indicated that groundwater had been potentially impacted by the application of road salt. The 2001 Study stated elevated concentrations of sodium and chloride were identified in water samples collected from wells in Harpswell. A total of 24 out of 38 (approximately 63.1 percent) of the samples analyzed for sodium resulted in sodium levels that exceeded the corresponding Maine MEG. A total of 55 out of 113 (approximately 48.7 percent) of the samples that were analyzed for total chloride resulted in levels of total chloride that exceeded 20,000 ppb (this was the regulatory guideline referenced in the 2001 study and is not consistent with the current EPA guideline which is 250,000 ppb). The 2001 report did not include the raw data so the number of samples that exceeded the EPA Secondary Standard is unknown but is likely significantly less than presented in the 2001 report.

The Town of Harpswell has made an effort to minimize the amount of salt applied to the roads during the winter. The Town's continued efforts will help reduce potential impacts to the groundwater, in particular in the areas where road salt is still needed for driver safety during the winter months.

The Town of Harpswell is actively looking into where it would be effective to modify its procedures for applying road salt or other de-icing methods. In addition, the Town is completing a road salt study under separate cover to identify areas in Harpswell that may be more likely to be impacted by road salt, such as areas with steep hills or curved roads, and develop a plan for eliminating this potential source of groundwater contamination.

SUMMARY OF PUBLIC WELL TEST DATA

ANALYTE	NUMBER OF SAMPLES	NUMBER OF EXCEEDANCES
Water Quality Parameters		
Arsenic	5	0
Copper	5	0
Fluoride	7	0
Iron	5	1
Lead	5	0
Manganese	5	1
Mercury	4	0
Silver	4	0
Septic System Contaminants		
Coliform, E. coli	180	1
Coliform, Total	205	41
Nitrate Nitrogen	104	0
Nitrite Nitrogen	57	0
Petroleum Contaminants		
Benzene	11	0
Ethylbenzene	11	0
Methyl Tert-Butyl Ether	9	0
Naphthalene	9	0
o-Xylene	9	0
Toluene	11	0
Xylene, Meta and Para	11	0
Salt Water/Road Salt		
Chloride	5	0

ANALYTE	NUMBER OF SAMPLES	NUMBER OF EXCEEDANCES
Sodium	4	4
Other Parameters		
1,2,3-Trichloropropane	11	0
Nitrobenzene	9	0
Toxaphene	1	0
Vinyl Chloride	11	0

SUMMARY OF PRIVATE WELL TEST DATA

ANALYTE	NUMBER OF SAMPLES	NUMBER OF EXCEEDANCES
Water Quality Parameters		
Arsenic	164	7
Copper	197	9
Fluoride	190	4
Iron	162	57
Lead	118	22
Manganese	160	15
Mercury	8	0
Silver	8	0
Uranium	96	7
Septic System Contaminants		
Coliform, Fecal	5	0
Coliform, Total	470	133
E. coli	450	12
Nitrate Nitrogen	277	0
Nitrite Nitrogen	273	0
Petroleum Contaminants		
Benzene	22	0
DRO	2	2

ANALYTE	NUMBER OF SAMPLES	NUMBER OF EXCEEDANCES
Ethylbenzene	8	0
GRO	14	0
m,p-Xylenes	6	0
Methyl Tert-Butyl Ether	22	0
Naphthalene	8	0
o-Xylene	6	0
Toluene	8	0
Xylenes	2	0
Salt Water/Road Salt		
Chloride	159	11
Sodium	52	37
Other Parameters		
1,2,3-Trichloropropane	8	8
1,2-Dibromo-3-chloropropane	8	8
1,2-Dibromoethane	6	6
1,2-Dichlorobenzene	16	2
Dibromochloromethane	6	1
Nitrobenzene	8	8
Toxaphene	1	1
Vinyl Chloride	8	8

8.0 CONCLUSIONS

This Drinking Water and Sanitary Septic Study Update was completed for the Town of Harpswell with the purpose of evaluating drinking water resources and sanitary septic conditions. The intent of this study is to assist the Town of Harpswell in responsibly planning and managing their future growth and development. The conclusions of this study are presented below.

- The natural beauty and character of Harpswell has attracted a continuously increasing number of summer vacationers, retirees, and new residents in more recent years, resulting in the development of additional year-round and seasonal homes, as well as the conversion of seasonal homes to year-round residences. The projected growth of Harpswell over the next ten years is approximately 500 more people and an estimated 400 new homes (approximately 340 year-round and 48 seasonal homes).
  The development of these new homes could consume up to 1,000-acres of currently undeveloped land (approximately seven percent of the Town's total land area).
  From 2000 to 2008, approximately 963 new wells have been installed in Harpswell to accommodate the recent growth and development.

- Although Harpswell's groundwater supply presents a protection constraint that should be considered for future development activities, groundwater availability is not expected to be a major constraint on development. Drillers have had reasonable success developing a substantial number of moderate to high yield wells throughout the Town. As with any bedrock aquifer, subsurface conditions are highly variable and adequate water supply for any location cannot be guaranteed. A hydrogeologic assessment should be conducted during the planning of any high demand developments, such as a food processing facility, golf course, or car wash.

- Water quality data from private and public well water samples collected from 2000 to 2008 indicates groundwater has been impacted at a number of locations throughout Harpswell. Groundwater impacts are due to naturally-occurring metals or metals from household plumbing, petroleum constituents from historic oil releases, septic system contaminants, and road salt contaminants, including arsenic, copper, fluoride, iron, lead, manganese, uranium, total coliform, E. coli, DRO, chloride, sodium, 1,2,3-trichloropropane, 1,2-dibromo-3-chloropropane, 1,2-dibromoethane, dibromochloromethane, nitrobenzene, toxaphene, and vinyl chloride. With the exception of the more densely populated areas of the Town where groundwater may have been impacted by septic systems, there does not appear to be specific regions in Town with significant contamination (i.e., with a high number of contaminated drinking water wells in one area).

- While shallow depth to bedrock and low permeability soils limit the carrying capacity of soils in Harpswell, Ransom did not identify evidence of widespread septic system impacts on groundwater quality. Available water quality data from 2000 to 2008 indicated no concentrations of nitrate, a primary indicator of septic waste impacts, which exceed drinking water guidelines. Water quality testing identified coliform bacteria and E. coli bacteria in a number of wells suggesting the possibility of septic system impacts. However, some of the bacteria may be detected as a result of improper sampling techniques.

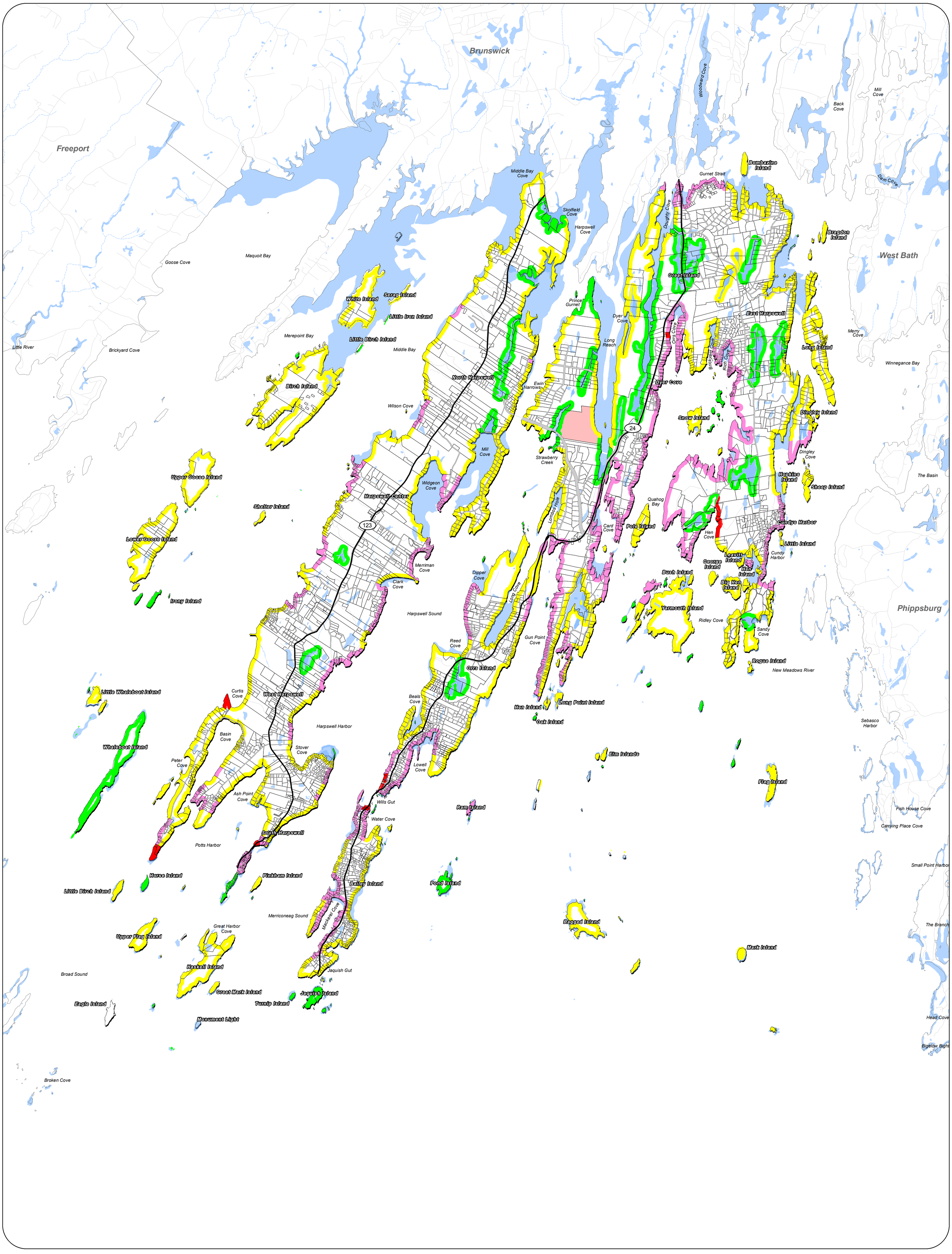
- Future development in Harpswell is constrained due to wetlands, flood zones, riparian buffers, and shoreland zones, among others. Conservation land and resource protection areas are located throughout numerous peripheral and interior regions of Harpswell and also include the smaller islands that surround the Town. Ecological resources such as high value plant and animal habitats as well as essential habitats for eagles and roseate tern restrict land use and development activities in the majority of Harpswell's coves, tidal regions, and smaller islands. This coupled with the relatively thin soil cover (for groundwater recharge as well as septic wastewater treatment) limit the areas of potential growth in the community.

- The carrying capacity assessment for Harpswell indicates that the majority of the Town has soils with relatively poor carrying capacity. This is not surprising given the thin soil cover and low permeability soil deposits in many parts of the Town. While a few areas appear to support carrying capacities of one to two acres, a number of areas have soils that appear to support carrying capacities of greater than three acres. Practically speaking, carrying capacities of greater than five acres are generally not required given the substantial attenuation of nitrate on the scale of several acres. The carrying capacity results presented herein are for planning purposes only; site specific testing is required for accurate determination of carrying capacity for a given parcel. In addition, proper controls on septic systems should be implemented and maintained in order to protect groundwater quality. The quantity of Harpswell's groundwater supply does not appear to represent a development limitation; however, the carrying capacity of the soils and proper septic system practices should be considered in future development activities in order to protect groundwater quality.

- Map 11 attached to this report is a synthesis of the key development constraints discussed herein. The synthesis mask consists of regions with development limitations and was created with the following sets of data: conservation land, flood zones, wetlands, relevant zoning (Resource Protection, Commercial Fishing, Shoreland Business, and Shoreland Residential), high value animal and plant habitats, riparian buffers, and wellhead protection areas. Despite such constraints as wetlands, conservation land and flood risk, large tracts within the Town are available for development. Areas with favorable development characteristics include interior regions of Harpswell Neck and Harpswell's larger islands. The synthesis map is underlain by the carrying capacity results, allowing consideration of housing density as areas for future development are contemplated.

9.0 REFERENCES

1. 2005 Update of the Harpswell Comprehensive Plan
2. Beginning with Habitat, 2007
3. Drinking Water and Sanitary Septic Study—Phase I, Wright-Pierce, February 2001
4. Federal Emergency Management Agency
5. Greater Portland Council of Governments, 2004
6. Ground Water Resource Analysis, Robert G. Gerber & John R. Rand, April 5, 1982
7. Inland Fisheries and Wildlife
8. Maine Department of Environmental Protection
9. Maine Drinking Water Program
10. Maine Geological Survey
11. Maine Health and Environmental Testing Laboratory
12. Maine Historic Preservation Commission
13. Maine Natural Areas Program
14. Town of Harpswell Municipal Offices



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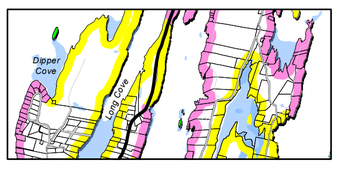
Data Source:
Features and Information on this map appear as currently represented in the Town of Harpswell data holdings for spatial and geographic information. Additional data sources include: Beginning with Habitat 2008, Maine Office of GIS.

N W E S

0 0.5 1 Miles

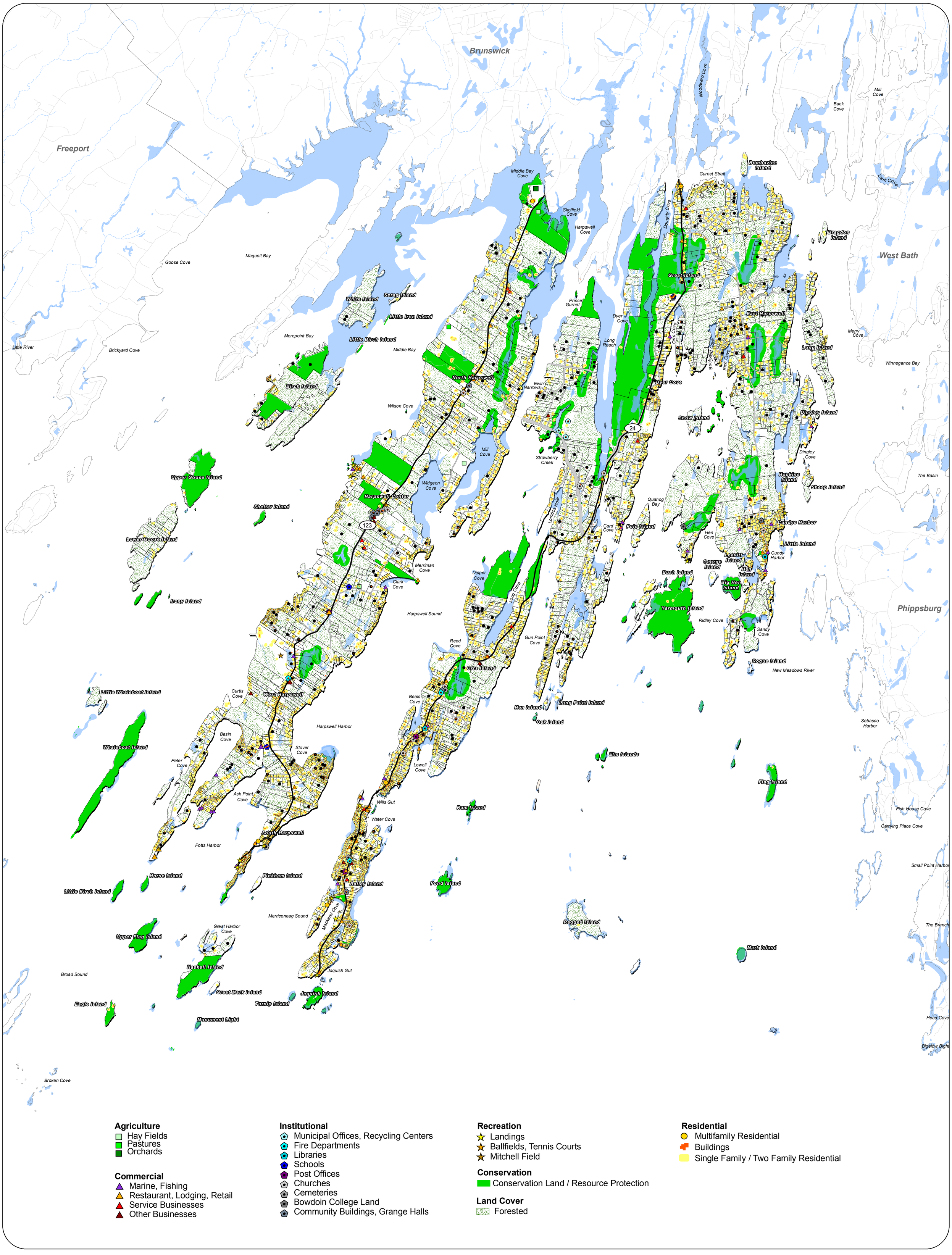
1 inch = 0.5 miles

Zoning (2007)



- Commercial Fishing
- Resource Protection
- Shoreland Business
- Shoreland Residential
- Tower District
- Property Boundary
- Wetland
- River, Stream, Brook
- Major Road
- Local Road

MAP 1



Agriculture
- Hay Fields
- Pastures
- Orchards

Commercial
- Marine, Fishing
- Restaurant, Lodging, Retail
- Service Businesses
- Other Businesses

Institutional
- Municipal Offices, Recycling Centers
- Fire Departments
- Libraries
- Schools
- Post Offices
- Churches
- Cemeteries
- Bowdoin College Land
- Community Buildings, Grange Halls

Recreation
- Landings
- Ballfields, Tennis Courts
- Mitchell Field

Conservation
- Conservation Land / Resource Protection

Land Cover
- Forested

Residential
- Multifamily Residential
- Buildings
- Single Family / Two Family Residential

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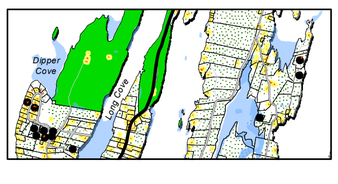
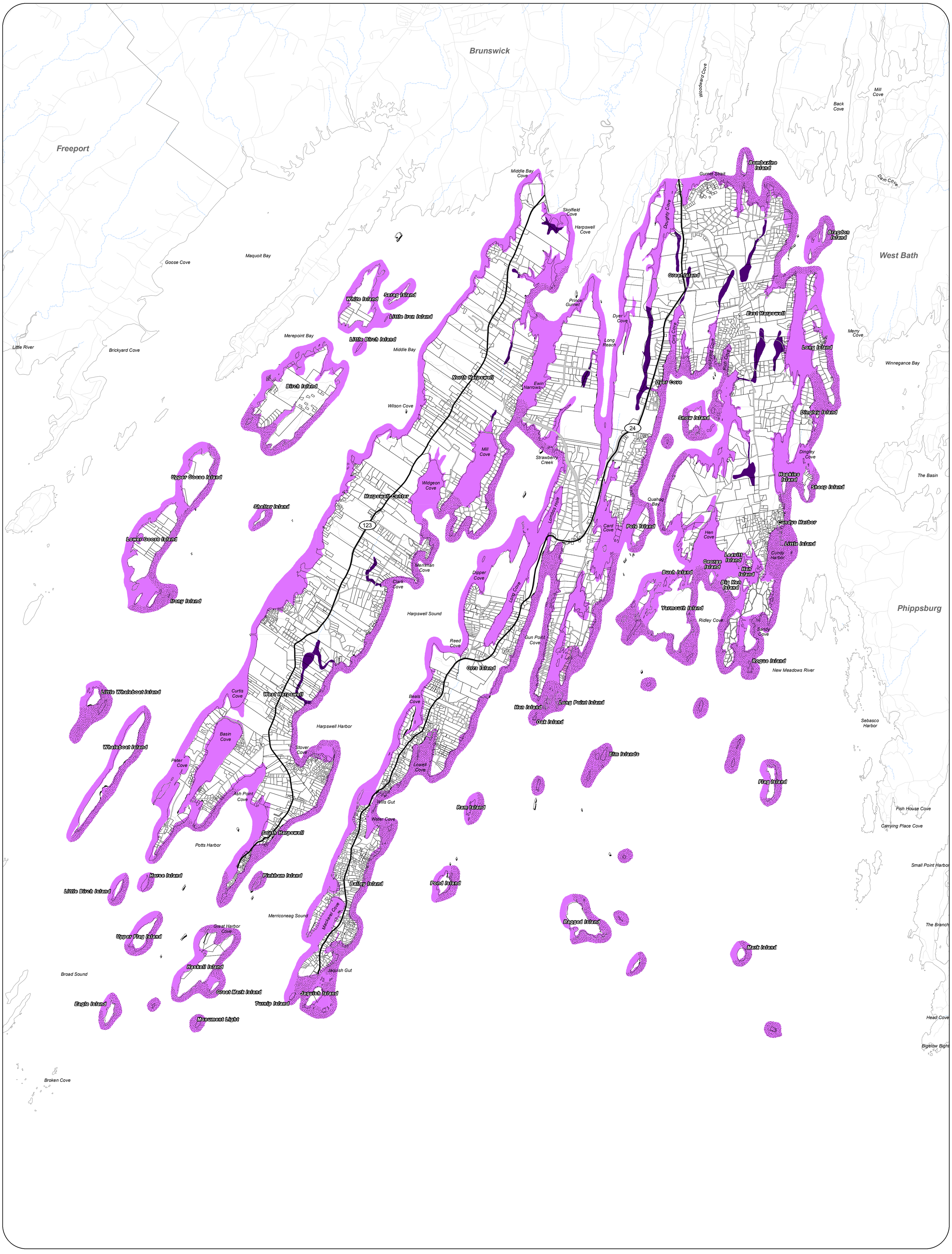
Land Use (2004)



- New Residential Permits (1998-2003)
- River, Stream, Brook
- Property Boundary
- Major Road
- Wetland
- Local Road

MAP 2



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N W E S

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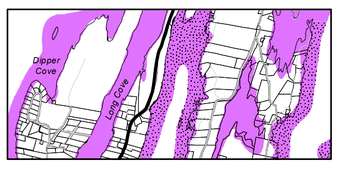
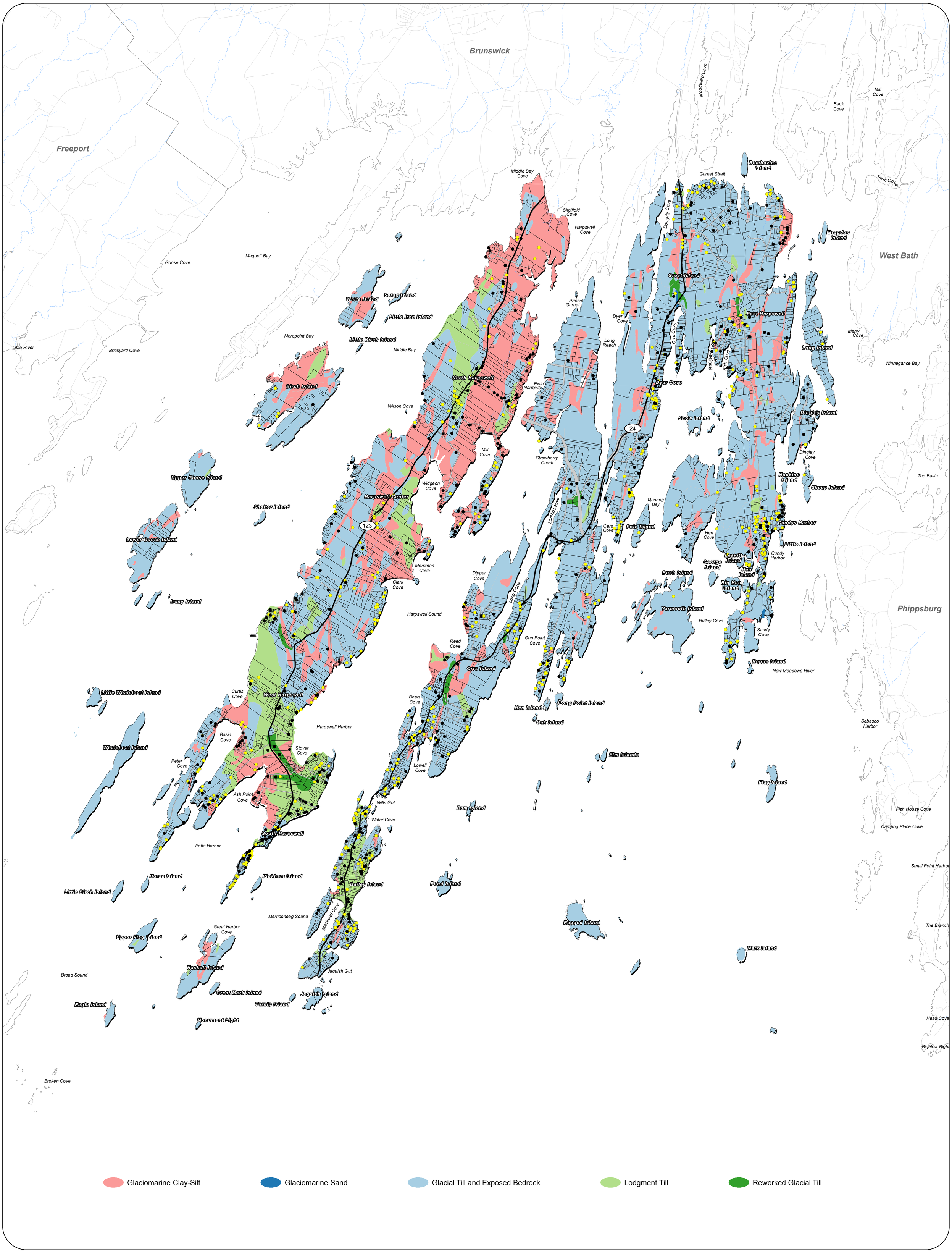
Flood Zones (1996)



- Zone AE (100 Year Flood Zone)
- Zone AO (100 Year Flood Zone) (Sheet Flow Impacts)
- Zone VE (100 Year Flood Zone) (Velocity Impacts)
- Zone X500 (500 Year Flood Zone)
- Property Boundary
- River, Stream, Brook
- Major Road
- Local Road

MAP 3



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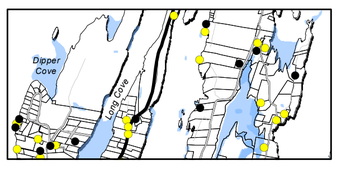
N W E S

0 0.5 1 Miles

1 inch = 0.5 miles

Surficial Geology and Soil Thickness



- Casing Length < = 10 feet
- Casing Length > 10 feet
- Property Boundary
- Wetlands
- River, Stream, Brook
- Major Road
- Local Road

MAP 4

Brunswick
Freeport
West Bath
Phippsburg
Woodward Cove
Mill Cove
Back Cove
Dam Cove
Bombazine Island
Gurnet Strait
Middle Bay Cove
Skolfield Cove
Harpswell Cove
Bragdon Island
Great Island
Goose Cove
Maquoit Bay
White Island
Seraig Island
Little Iron Island
Merepoint Bay
Little Birch Island
Middle Bay
Little River
Brickyard Cove
Prince Gurnet
Dyer Cove
Long Reach
Orrs Cove
East Harpswell
Merry Cove
Long Island
Winnegance Bay
Birch Island
North Harpswell
Ewin Narrows
Wilson Cove
Snow Island
Dingley Island
Mill Cove
Strawberry Creek
Dingley Cove
Upper Goose Island
Widgeon Cove
Hopkins Island
Sheep Island
The Basin
Harpswell Center
Shelter Island
Quahog Bay
Lombos Hole
Cundys Harbor
Pole Island
Hen Cove
Lower Goose Island
Little Island
Cundy Harbor
Leavitt Island
George Island
Hen Island
Merriman Cove
Bush Island
Big Hen Island
Dipper Cove
Clark Cove
Long Cove
Irony Island
Yarmouth Island
Harpswell Sound
Ridley Cove
Sandy Cove
Gun Point Cove
Reed Cove
Rogue Island
Orrs Island
New Meadows River
Little Whaleboat Island
Curtis Cove
West Harpswell
Beals Cove
Long Point Island
Hen Island
Oak Island
Harpswell Harbor
Sebasco Harbor
Basin Cove
Whaleboat Island
Stover Cove
Peter Cove
Elm Islands
Lowell Cove
Flag Island
Ash Point Cove
Wills Gut
Ram Island
Fish House Cove
Water Cove
Carrying Place Cove
South Harpswell
Potts Harbor
Small Point Harbor
Horse Island
Pinkham Island
Little Birch Island
Bailey Island
Pond Island
Merriconeag Sound
Mackerel Cove
Ragged Island
The Branch
Great Harbor Cove
Upper Flag Island
Mark Island
Haskell Island
Broad Sound
Jaquish Gut
Great Mark Island
Jaquish Island
Eagle Island
Turnip Island
Head Cove
Monument Light
Bigelow Bight
Broken Cove

Devonian granite
Ordovician - Precambrian Z Cape Elizabeth Formation
Ordovician - Precambrian Z Cushing Formation
Ordovician - Precambrian Z Cushing Formation mafic volcanic member
Ordovician - Precambrian Z Cushing Formation sulfidic pelite
Ordovician - Precambrian Z Jewell Formation
Ordovician - Precambrian Z Scarboro and Diamond Island formations
Ordovician - Precambrian Z Spring Point Formation
Ordovician - Precambrian Z Spurwink Limestone

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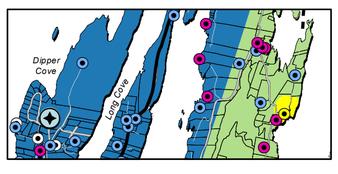
N W E S

0 0.5 1 Miles

1 inch = 0.5 miles

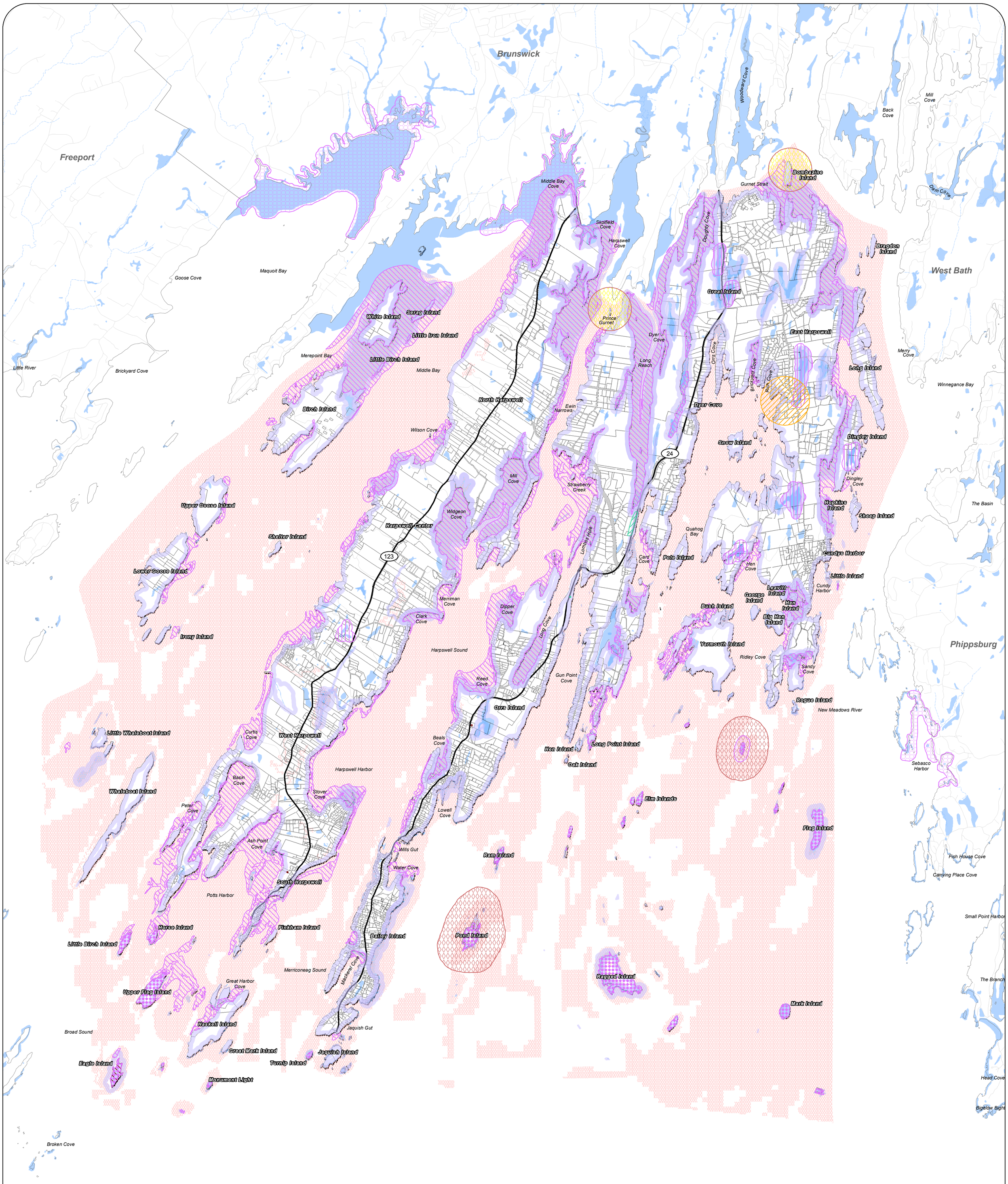
Water Supply and Bedrock Geology



Private Well Yield (gpm)

- 0 - 1
- 1 - 10
- 10 - 50
- > 50
- Public Well
- Topographic Lineament
- Tabular Diabase Dike
- Property Boundary
- River, Stream, Brook
- Major Road
- Local Road
- Area of Thick Glacial Till
- Potential High Yield Aquifer Area

MAP 5



High Value Animal Area
Seabird Nesting Island
Inland Waterfowl / Wading Bird Habitat
Roseate Tern Essential Habitat
Natural Community
Shorebird Area
Eagle Essential Habitat
Tidal Waterfowl / Wading Bird Habitat
High Value Plant Area
USFWS High Value Habitat

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Fax: 207-772-3248

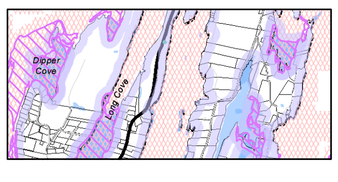
Data Source:
Features and Information on this map appear as currently represented in the Town of Harpswell data holdings for spatial and geographic information. Additional data sources include: Beginning with Habitat 2008, Maine Office of GIS.

N W E S

0 0.5 1 Miles

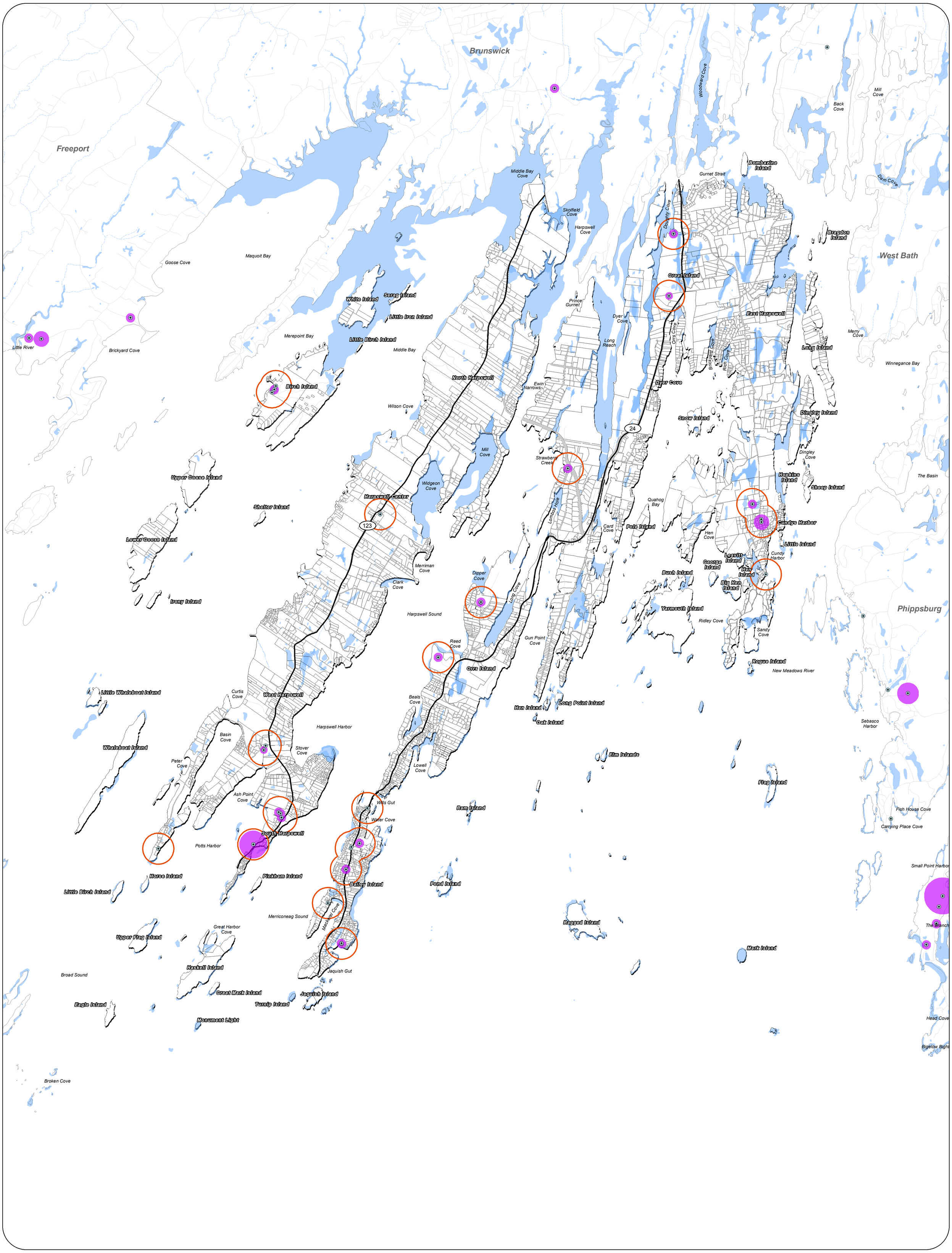
1 inch = 0.5 miles

Ecological Resources (2007)



Riparian Buffer
Property Boundary
Wetland
River, Stream, Brook
Major Road
Local Road

MAP 6



RANSOM Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Phone: 207-772-2891
Fax: 207-772-3248

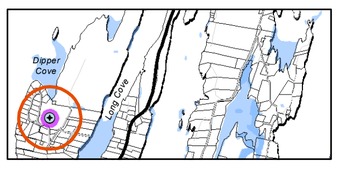
Data Source:
Features and Information on this map appear as currently represented in the Town of Harpswell data holdings for spatial and geographic information. Additional data sources include: The Maine Drinking Water Program, Maine Office of GIS.

N W E S

0 0.5 1 Miles

1 inch = 0.5 miles

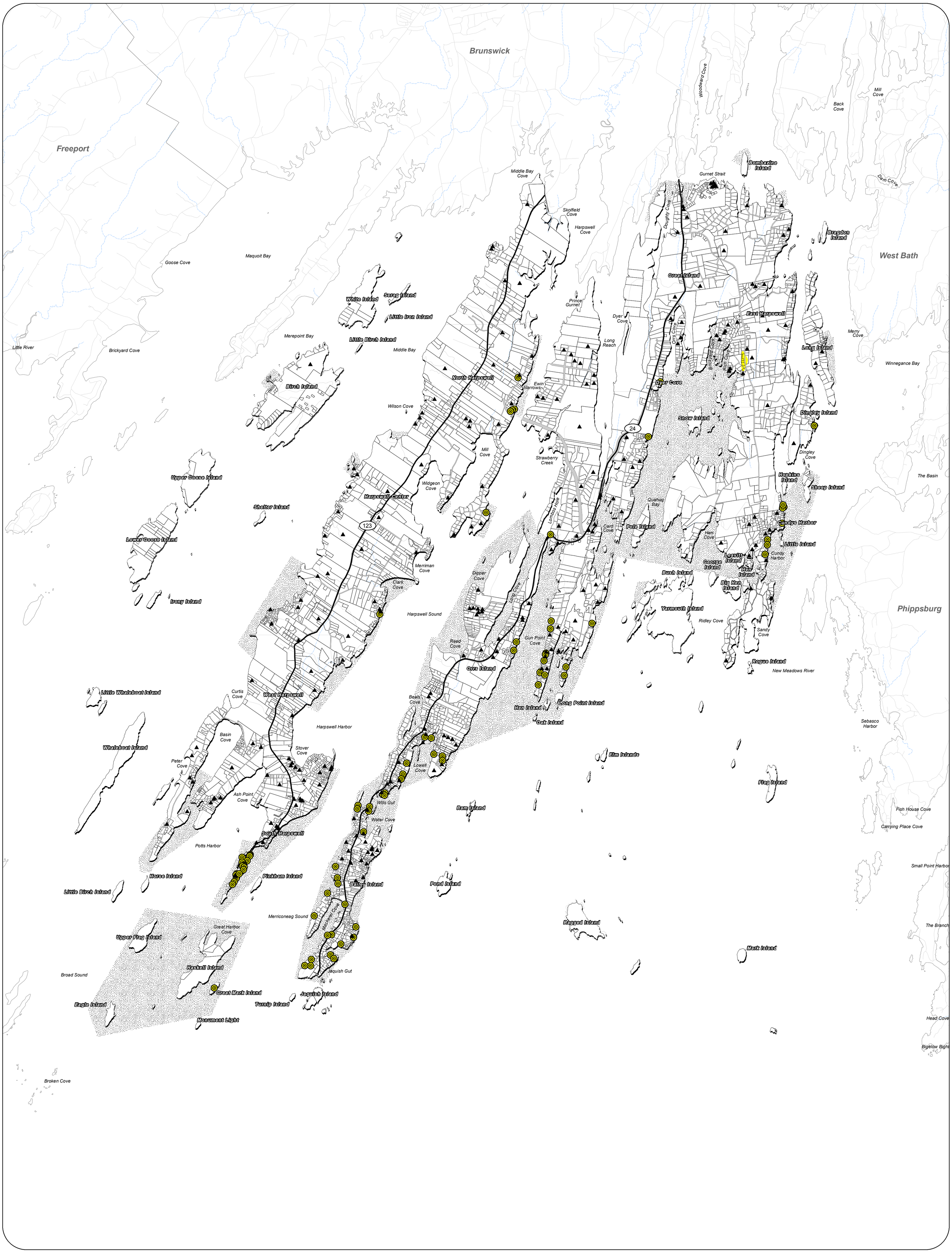
Water Resource Protection



- Public Well
- Public Well 1000 Ft Buffer
- Source Protection Area *
- Property Boundary
- Wetland
- River, Stream, Brook
- Major Road
- Local Road

* Maine Drinking Water Program Population-Based Model

MAP 7



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Fax: 207-772-3248

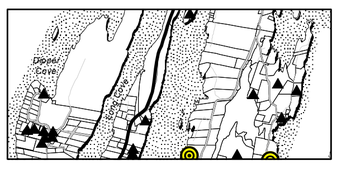
Data Source:
Features and Information on this map appear as currently represented in the Town of Harpswell data holdings for spatial and geographic information. Additional data sources include: Gerber / Rand 1982, Maine Office of GIS.

N W E S

0 0.5 1 Miles

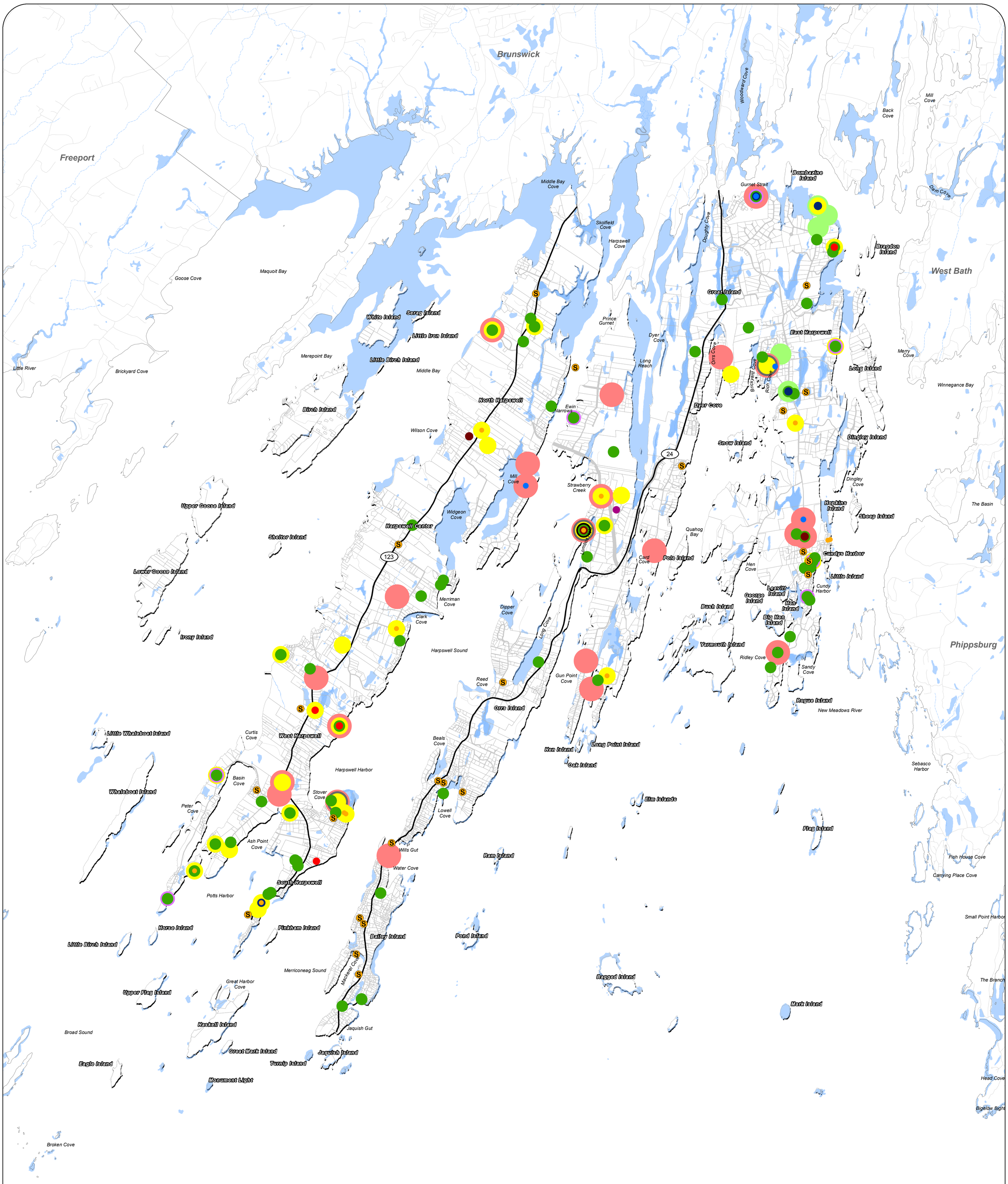
1 inch = 0.5 miles

Septic Features



- Property Boundary
- Shellfish Closure (2008)
- Property With Multiple Septic Permits (1990 - 2008)
- Overboard Discharge (May 2008)
- River, Stream, Brook
- Major Road
- Local Road
- Septic System Impacts (2001)

MAP 8



RANSOM Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Phone: 207-772-2891
Fax: 207-772-3248

Data Source:
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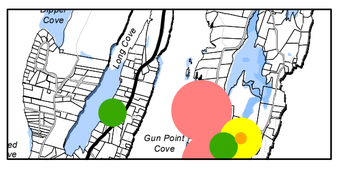
N W E S

0 0.5 1 Miles

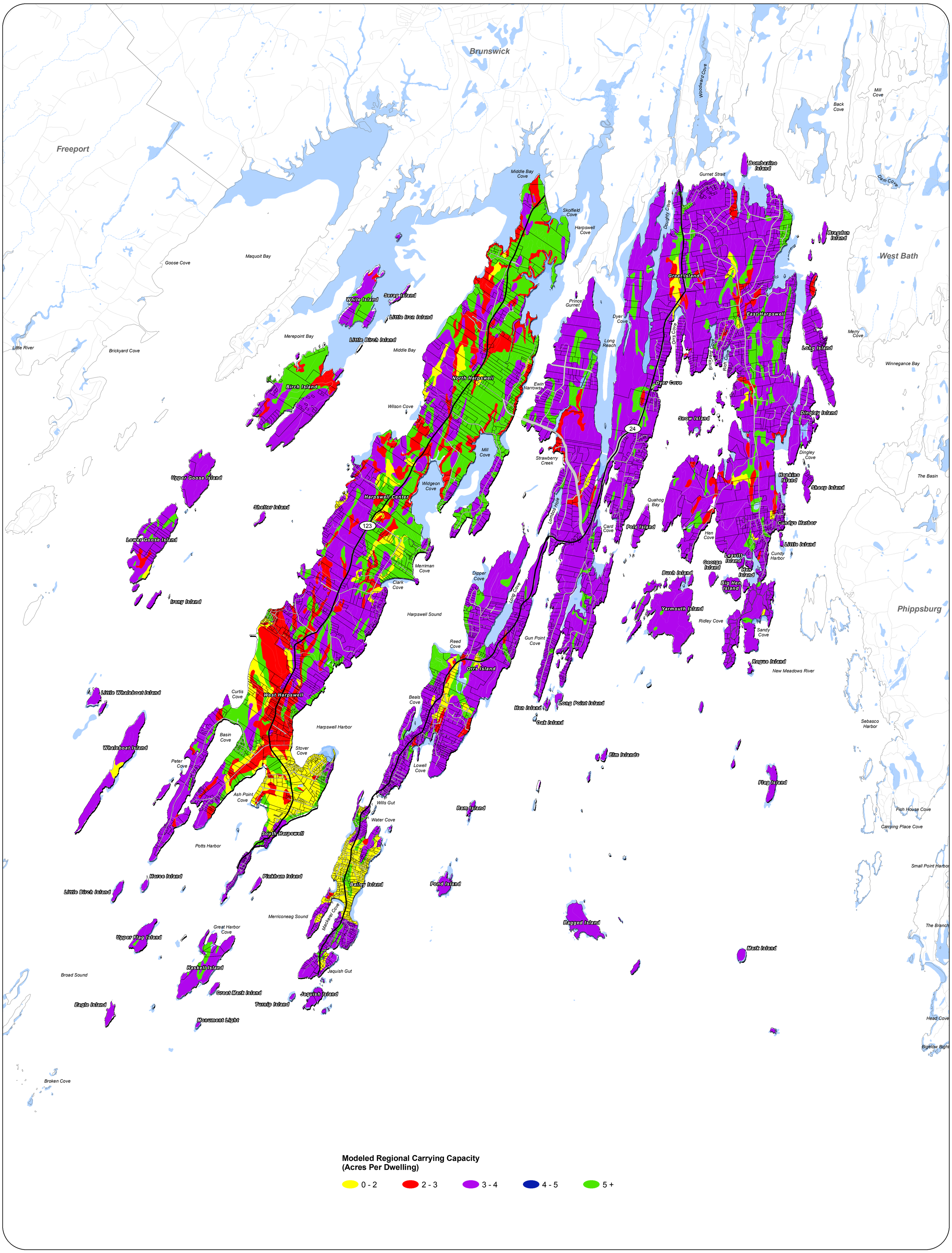
1 inch = 0.5 miles

Groundwater Quality Concerns



Property Boundary
River, Stream, Brook
Wetland
Major Road
Hazardous / Oil Spill Location
Local Road

MAP 9



Modeled Regional Carrying Capacity
(Acres Per Dwelling)

0 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 +

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Data Source:
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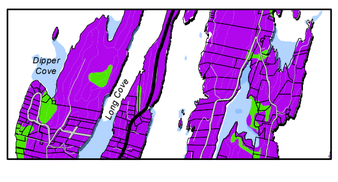
Additional data sources include:
NRCS, Gerber/Rand, Wright Pierce

N W E S

0 0.5 1 Miles

1 inch = 0.5 miles

Carrying Capacity



Property Boundary
Wetland
River, Stream, Brook
Major Road
Local Road

MAP 10

Note:

The synthesis mask consists of regions with development limitations and was created with the following sets of data: conservation land, flood zones, wetlands, relevant zoning (Resource Protection, Commercial Fishing, Shoreland Business, and Shoreland Residential), high value animal and plant habitats, riparian buffers, and wellhead protection areas

Modeled Regional Carrying Capacity (Acres Per Dwelling)

0 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 +

RANSOM Environmental Consultants, Inc.
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Data Source:
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NRCS, Gerber/Rand, Wright Pierce

N W E S

0 0.5 1 Miles

1 inch = 0.5 miles

Synthesis

Property Boundary
Synthesis Mask
River, Stream, Brook
Major Road
Local Road

Harpswell

MAP 11

APPENDIX A

Supplementary Information on Historical Features

Drinking Water and Sanitary Septic
Study Update
Harpswell, Maine

Ransom Environmental Consultants, Inc.
Project 086012

MAINE HISTORIC PRESERVATION COMMISSION
55 CAPITOL STREET
65 STATE HOUSE STATION
AUGUSTA, MAINE
04333

JOHN ELIAS BALDACCI
GOVERNOR

EARLE G. SHETTLEWORTH, JR.
DIRECTOR

June 25, 2008

Ms. Kristin Beaulieu
Project Engineer
Ransom Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101

Project: MHPC #0946-08 - Town of Harpswell; Water and Sanitary Needs Study (previous MHPC # 0644B-00)

Town: Harpswell, ME

Dear Ms. Beaulieu:

In response to your recent request, I have reviewed the information received June 2, 2008 to initiate consultation on the above referenced project pursuant to the requirements of the Town of Harpswell.

Per your request, please find enclosed a new map dated April 2008 which indicates known archaeological sites and areas sensitive for prehistoric archaeology in Harpswell. I have also enclosed a map dated 1857 which indicates areas sensitive for historic archaeology. Regarding above ground resources, the Tarr-Eaton House, 906 Harpswell Neck Road was listed in the National Register of Historic Places in 2001.

Please contact Robin Stancampiano of my staff if you have any questions pertaining to this matter or require additional information.

Sincerely,

Kirk F. Mohney

Kirk F. Mohney
Deputy State Historic Preservation Officer

1857

Sensitive areas for historic Archaeo. are structures shown on this map.

1/2 k square intersecting a known prehistoric archaeological site.

1/2 k square intersecting a known historic archaeological site.

1/2 k square intersecting a known historic archaeological site with an estimated location.

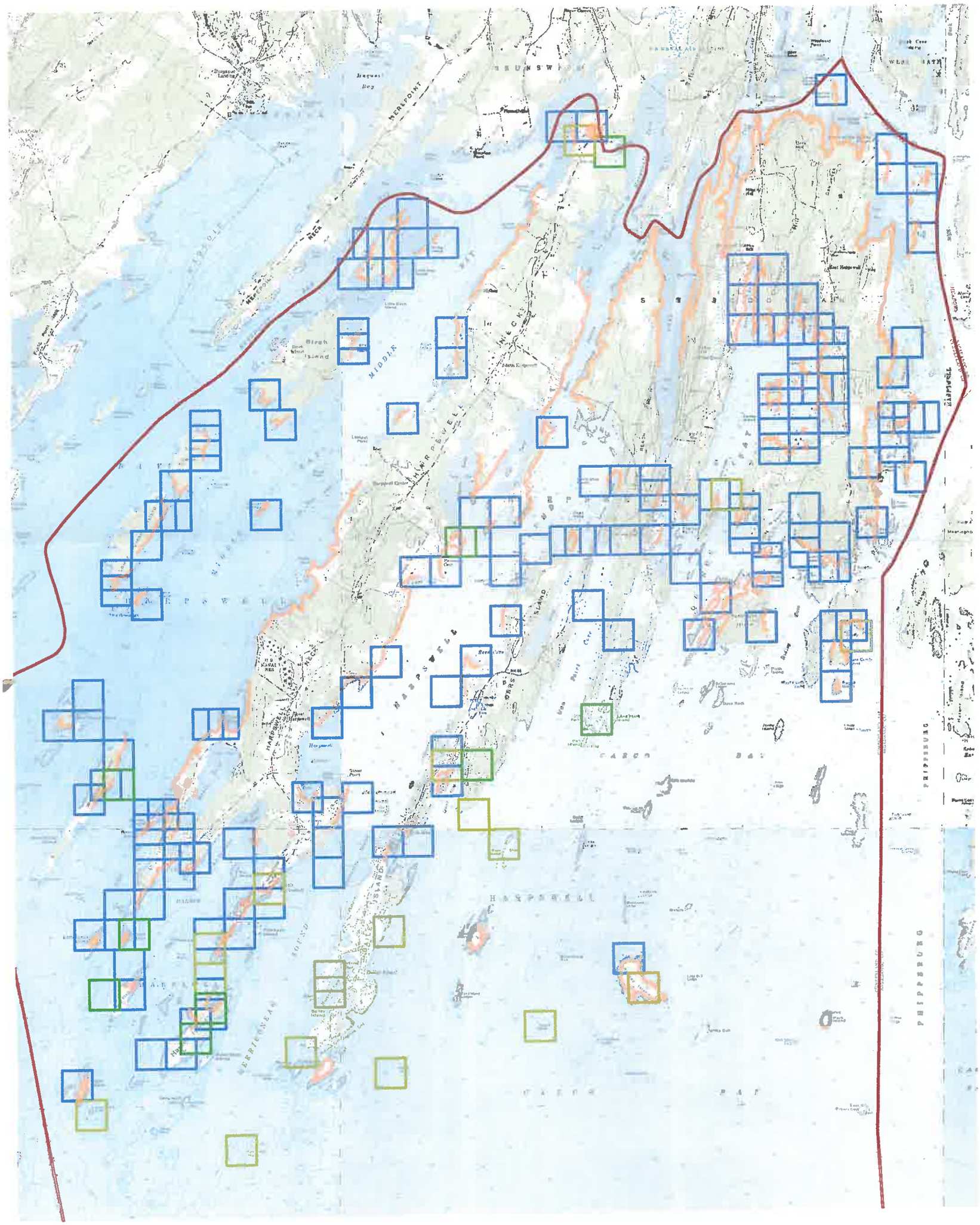
Areas sensitive for prehistoric archaeology

Known Archaeological Sites* and Areas Sensitive for Prehistoric Archaeology* in

Harpswell

information provided by
Maine Historic Preservation Commission
April 2008

*dated material subject to future revision
map 1/1



APPENDIX B

Supplementary Information on Natural Resources

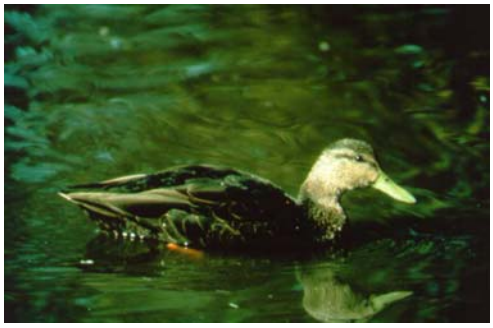
Drinking Water and Sanitary Septic
Study Update
Harpswell, Maine

Ransom Environmental Consultants, Inc.
Project 086012

U.S. Fish and Wildlife Service Update

Gulf of Maine
Coastal Program

Building partnerships to identify, protect and restore nationally important fish and wildlife habitat in the Gul f of Maine watershed



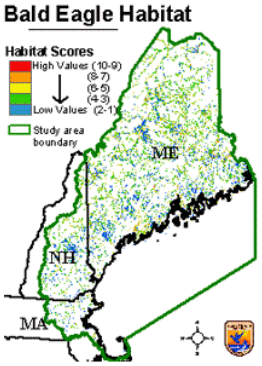
For further information, please contact:

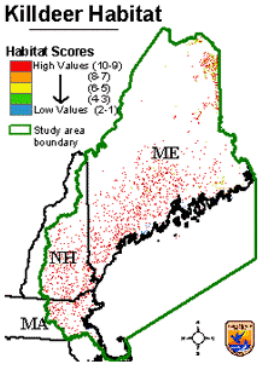
U.S. Fish and Wildlife Service
Gulf of Maine Coastal Program
4R Fundy Road
Falmouth, Maine 04105
Phone: (207) 781-8364
FAX: (207) 781-8369
E-mail: r5es_gomp@fws.gov
http://www.fws.gov/northeast/gulfofmaine

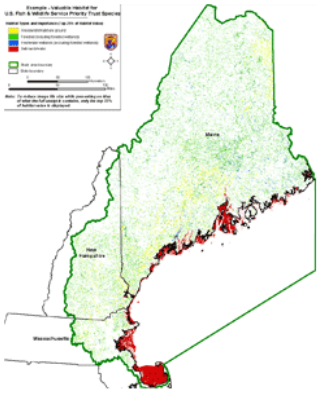
11/07

Identifying, ranking and mapping habitat for priority trust species in the Gulf of Maine watershed

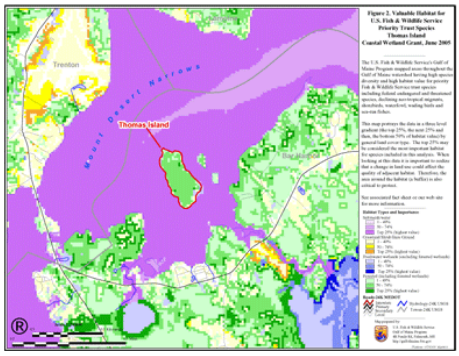
In order to strategically protect fish and wildlife habitat for endangered, threatened, rare or declining trust species in the Gulf of Maine watershed, the U.S. Fish and Wildlife Service's (USFWS) Gulf of Maine Coastal Program identified, mapped and ranked important fish and wildlife habitat for priority species throughout the U.S. portion of Gulf of Maine watershed. Staff biologists first selected 91 species. *All species included in this analysis are listed on the reverse side of this fact sheet.* Next, biologists ranked habitat values for all species -- based on verified sightings and by developing habitat suitability models reflecting the environmental requirements for each species.







Once habitat maps were completed for each species, biologists combined all of the maps to create a composite map identifying priority grassland, forest, freshwater wetland and estuarine habitat. Data can be viewed watershed-wide, and it can also be viewed at a 1:24,000 topographic map scale. The larger scale topographic map scale allows the analysis to be practical for identifying predicted habitat values for all 91 species on individual parcels of land. Gulf of Maine Coastal Program provides this information to help conservationists and town planners focus habitat protection efforts in areas of greatest biological value.



Results of the analysis have been used to help implement on-the-ground conservation initiatives, including:

- catalyzing and supporting hundreds of initiatives to protect high value habitat through federal and state grant programs directed to land trusts, state agencies and National Wildlif Refuges,
- *Beginning with Habitat*, a statewide effort that identifies and prioritizes high value habitat identified by our USFWS office, Maine Natural Areas Program, Maine Dept. of Inland Fisheries and Wildlife and Maine Audubon Society in order to support land protection and planning efforts conducted by state and federal agencies, town officials, non-governmental conservation partners and willing landowners,
- educational/outreach activities with conservation partners and the media,
- comprehensive planning and management activities on National Wildlife Refuges,
- permit and license review by town, state and federal agencies, and
- contaminant and oil spill damage assessment and mitigation.

For more information on the GIS analysis, go to:
http://www.fws.gov/northeast/gulfofmaine/projects/habitat_analysis.htm

Gulf of Maine watershed habitat analysis: Priority species list

All species included in our GIS habitat analysis regularly inhabit the Gulf of Maine watershed and meet one or more of the following criteria:

- federally endangered, threatened and candidate species,
- migratory birds, diadromous and estuarine fish that are declining nationwide,
- migratory birds, diadromous and estuarine fish that are threatened or endangered in two of the three states in the Gulf of Maine watershed, or
- other birds that have been identified as species of concern by the North American Waterfowl Management Plan, the U.S. Shorebird Conservation Plan, the Colonial Waterbird Plan and Partners in Flight.

Birds (75 species):

American bittern
American black duck
American oystercatcher
American woodcock
Arctic tern
Bald eagle
Baltimore oriole
Bay-breasted warbler
Bicknell's thrush
Black scoter
Black tern
Black-bellied plover
Blackburnian warbler
Blackpoll warbler
Black-throated blue warbler
Blue-winged warbler
Buff-breasted sandpiper
Canada warbler
Cape May warbler
Chestnut-sided warbler
Common loon
Common snipe
Common tern
Eastern meadowlark
Field sparrow
Golden-winged warbler
Grasshopper sparrow
Hudsonian godwit
Killdeer
Least sandpiper
Least tern
Little blue heron
Little gull
Louisiana waterthrush
Marsh wren
Nelson's sharp-tailed sparrow
Northern flicker
Northern goshawk
Northern harrier
Olive-sided flycatcher
Osprey
Peregrine falcon
Pied-billed grebe
Piping plover
Prairie warbler
Purple sandpiper
Razorbill
Red crossbill
Red-headed woodpecker
Red knot
Red-shouldered hawk
Roseate tern
Ruddy turnstone
Saltmarsh sharp-tailed sparrow
Sanderling
Scaup (greater and lesser)
Seaside sparrow
Sedge wren
Semipalmated sandpiper
Short-billed dowitcher
Short-eared owl
Snowy egret
Solitary sandpiper
Spruce grouse
Surf scoter
Tricolored heron
Upland sandpiper
Veery
Whimbrel
Whip-poor-will
White-winged scoter
Wood duck
Wood thrush
Yellow rail

Fish (9 species):

Alewife
American eel
American shad
Atlantic salmon
Atlantic sturgeon
Blueback herring
Bluefish
Shortnose sturgeon
Winter flounder

Plants (4 species):

Eastern prairie fringed orchid
Furbish's lousewort
Robbins' cinquefoil
Small whorled pogonia

Mammal:

Canada lynx

Invertebrate:

Horseshoe crab

Herps:

Plymouth redbelly turtle

APPENDIX C

National Primary Drinking Water Regulations and Maine Maximum Exposure Guidelines

Drinking Water and Sanitary Septic
Study Update
Harpswell, Maine

Ransom Environmental Consultants, Inc.
Project 086012

EPA National Primary Drinking Water Standards

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems;	Added to water during sewage/wastewater increased risk of cancer treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, live problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidneys problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing micro-organisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero

LEGEND

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	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent).

LEGEND

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National Secondary Drinking Water Standards

National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Office of Water (4606M)
EPA 816-F-03-016
www.epa.gov/safewater
June 2003

Maine CDC
Maximum Exposure Guidelines (MEGs) for drinking water

July 21, 2008

Environmental and Occupational Health Program
Center for Disease Control and Prevention

Maximum Exposure Guidelines (MEG) for Drinking Water

Maine Center for Disease Control, Maine Department of Human Services

July 22, 2008

CHEMICALS	CASRN#	MEG STATUS	Maximum Exposure Guideline (ppb)	EPA HEALTH ADVISORY (ppb)	EPA MCL (ppb)
INORGANICS					
Aluminum	7429-90-5	Interim	1430		
Ammonia	7664-41-7	FINAL	30000	30000	
Ammonium sulfamate	7773-06-0	FINAL	1400	2000	
Antimony	7440-36-0	FINAL	3		6
Arsenic	7440-38-2	Interim	10		10
Barium	7440-39-3	FINAL	2000	2000	2000
Boron	7440-42-8	FINAL	1400	600	3000
Cadmium	7440-43-9	FINAL	3.5		5
Chloramine	10599-90-3	Interim	660	3000	
Chlorate	14866-68-3	Interim	7		
Chlorine dioxide	10049-04-4	FINAL	210	800	800
Chlorite	7758-19-2	FINAL	210	800	1000
Chromium (total)	7440-47-3	Interim	40	100	100
Chromium VI	18540-29-9	FINAL	35		
Copper	7440-50-8	FINAL	1300		1300
Cyanide	57-12-5	FINAL	140	200	200
Fluoride	7782-41-4	FINAL	1680		2000
Iodide	20461-54-5	Interim	340		
Lead	7439-92-1	Interim	10		15
Manganese	7439-96-5	FINAL	500		
Mercury (inorganic; mercuric salts)	7487-94-7	FINAL	2	2	2
Molybdenum	7439-98-7	FINAL	35	40	
Nickel (soluble salts)	7440-02-0	FINAL	140	100	
Nitrate (as N)	14797-55-8	FINAL	10000		10000
Nitrite (as N)	14797-65-0	FINAL	1000		1000
Selenium	7782-49-2	FINAL	35		50
Silver	7440-22-4	FINAL	35	100	
Sodium	7440-23-5	Interim	20000		
Strontium	7440-24-6	FINAL	4200	17000	
Thallium (chloride)	7791-12-0	FINAL	0.5	0.5	2
Uranium	7440-61-1	FINAL	20		30
White Phosphorous	7723-14-0	FINAL	0.14	0.1	
Zinc	7440-66-6	FINAL	2000	2000	
ORGANICS					
Acetamiprid	135410-20-7	Interim	497		
Acetochlor	34256-82-1	Interim	14		
Acetone	67-64-1	FINAL	6300		
Aciflurofen	62476-59-9	Interim	3.5		
Acrylamide	79-06-1	FINAL	0.08		
Acrylonitrile	107-13-1	FINAL	0.6		
Alachlor	15972-60-8	FINAL	7		2
Aldicarb	116-06-3	FINAL	7	7	
Aldicarb sulfone	1646-88-4	FINAL	7	7	
Aldrin	309-00-2	FINAL	0.02		
Ametryn	834-12-8	FINAL	60	60	
Asulam	3337-71-1	Interim	35		
Atrazine	1912-24-9	Interim	3	3	3
Azinophos - methyl	86-50-0	Interim	11		
Baygon (propoxur)	114-26-1	FINAL	28	3	
Bentazon	25057-89-0	FINAL	200	200	
Benzene	71-43-2	FINAL	6		5
Benzo (a) pyrene	50-32-8	FINAL	0.05		0.2

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Benzoic Acid	65-85-0	FINAL	28000		
Boscalid	188425-85-6	Interim	152.6		
Bromacil	314-40-9	Interim	70	90	
Bromochloromethane	74-97-5	Interim	10	10	
Bromodichloromethane	75-27-4	FINAL	6		
Bromoform	75-25-2	FINAL	44		
Bromomethane	74-83-9	FINAL	10	10	
Butachlor	23184-66-9	Interim	26		
Butylate	2008-41-5	FINAL	350	350	
Captan	133-06-2	Interim	146		
Carbaryl	63-25-2	FINAL	70	700	
Carbofuran	1563-66-2	FINAL	35	40	40
Carbon disulfide	75-15-0	Interim	600		
Carbon tetrachloride	56-23-5	FINAL	3		5
Carboxin	5234-68-4	FINAL	700	700	
Chloral hydrate (hydrated trichloroacetaldehyde)	75-87-6	FINAL	70	60	
Chloramben (Amiben)	133-90-4	FINAL	105	100	
Chlordane	12789-03-6	FINAL	0.3		2
Chloroform	67-66-3	FINAL	70	70	80
bis-2-Chloroethyl ether	111-44-4	FINAL	0.3		
bis-2-Chloro isopropyl ether	108-60-1	FINAL	300	300	
Chloromethane	74-87-3	Interim	3	3	
Chlorophenol (2-)	95-57-8	FINAL	35	40	
Chlorothalonil	1897-45-6	Interim	45		
Chlorotoluene (2- or ortho-)	95-49-8	FINAL	140	100	
Chlorotoluene (4- or para-)	106-43-4	Interim	140	100	
Chlorpyrifos	2921-88-2	FINAL	20	20	
Cyanazine	21725-46-2	Interim	1.4	1	
Dacthal (DCPA)	1861-32-1	FINAL	70		
Dalapon	75-99-0	FINAL	200	200	200
DDT	50-29-3	FINAL	1		
Di-(2-ethylhexyl)adipate	103-23-1	FINAL	292	400	400
Di-(2-ethylhexyl)phthalate (PAE)	117-81-7	FINAL	25		6
Diallate (Avadex)	2303-16-4	Interim	3.5		
Diazinon	333-41-5	Interim	0.6	0.6	
Dibromo-3-chloropropane (1,2-) (DBCP)	96-12-8	Interim	0.25		0.2
Dibromochloromethane	124-48-1	FINAL	4	60	
Dicamba	1918-00-9	FINAL	200	200	
Dichlorobenzene (1,3- or meta)	541-73-1	Interim	60	600	
Dichlorobenzene (1,2- or ortho)	95-50-1	Interim	63	600	600
Dichlorobenzene (1,4- or para-)	106-46-7	Interim	21	75	75
Dichlorodifluoromethane	75-71-8	FINAL	1400	1000	
Dichloroethane (1,1-)	75-34-3	Interim	70		
Dichloroethane (1,2-)	107-06-2	FINAL	4		5
Dichloroethylene (1,1-)	75-35-4	FINAL	0.6		7
Dichloroethylene (cis-1,2-)	156-59-2	Interim	70	70	70
Dichloroethylene (trans-1,2-)	156-60-5	FINAL	140	100	100
Dichloromethane	75-09-2	FINAL	47		5
Dichlorophenol (2,4-)	120-83-2	FINAL	21	20	
Dichlorophenoxyacetic acid (2,4-)	94-75-7	FINAL	70	70	70
Dichloropropane (1,2-)	78-87-5	Interim	5		5
Dichloropropene (1,3-)	542-75-6	FINAL	4		
Dieldrin	60-57-1	FINAL	0.02		
Diethyl phthalate (PAE)	84-66-2	FINAL	5000	5000	

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Diisopropyl methylphosphonate	1445-75-6	FINAL	500	600	
Dimethrin	70-38-2	Interim	2100	2000	
Dimethylformamide (N,N-)	68-12-2	Interim	700		
Dibutyl phthalate (PAE)	84-74-2	FINAL	700		
Dinitrobenzene (1,3- or meta-)	99-65-0	FINAL	0.7	1	
Dinitrophenol (2,4-)	51-28-5	FINAL	14		
Dinitrotoluene (2,4-)	121-14-2	FINAL	0.5		
Dinitrotoluene (2,6-)	606-20-2	FINAL	0.5		
Dinoseb	88-85-7	FINAL	7	7	7
Dioxane (p-)	123-91-1	FINAL	32		
Diphenamid	957-51-7	FINAL	200	200	
Diphenylamine	122-39-4	FINAL	175	200	
Diquat	85-00-7	FINAL	15	20	20
Disulfoton	298-04-4	FINAL	0.3	0.3	
Dithiane (1,4-)	505-29-3	FINAL	70	80	
Diuron	330-54-1	FINAL	14	10	
Endothall	145-73-3	FINAL	140	100	100
Endosulfan	115-29-7	FINAL	42		
Endrin	72-20-8	FINAL	2	2	2
Epichlorohydrin	106-89-8	Interim	35		
Ethylbenzene	100-41-4	Interim	70	700	700
Ethylene dibromide (EDB)	106-93-4	FINAL	0.2		0.05
Ethylene glycol	107-21-1	FINAL	14000	7000	
Ethylene glycol monobutyl ether	111-76-2	FINAL	3500		
Ethylene thiouria (ETU)	96-45-7	FINAL	0.6		
Fenamiphos	22224-92-6	FINAL	1.8	2	
Fluometuron	2164-17-2	FINAL	90	90	
Fluorotrichloromethane	75-69-4	FINAL	2000	2000	
Folpet	133-07-3	FINAL	100		
Fonofos	944-22-9	FINAL	14	10	
Formaldehyde	50-00-0	Interim	140	1000	
Fuel oil		Interim	50		
Gasoline, unleaded		Interim	50		
Glyphosate	1071-83-6	FINAL	700	700	700
Heptachlor	76-44-8	FINAL	0.08		0.4
Heptachlor epoxide	1024-57-3	FINAL	0.04		0.2
Hexachlorobenzene	118-74-1	FINAL	0.2		1
Hexachlorobutadiene	87-68-3	FINAL	4	1	
Hexachlorocyclopentadiene	77-47-4	FINAL	42		50
Hexachloroethane	67-72-1	FINAL	7	1	
Hexachlorophene	70-30-4	FINAL	2		
Hexane (n-)	110-54-3	Interim	420		
Hexazinone	51235-04-2	FINAL	230	200	
HMX (cyclo-tetramethylenetetranitramine)	2691-41-0	Interim	350	400	
Isophorone	78-59-1	FINAL	370	100	
Isopropylmethylphosphonate	1832-54-8	FINAL	700	700	
Isopropyltoluene (p-cymene)	99-87-6	Interim	70		
Lindane	58-89-9	FINAL	0.2	0.2	0.2
Malathion	121-75-5	FINAL	140	200	
Maleic hydrazide	123-33-1	FINAL	3500	4000	
Mancozeb	8018-01-7	Interim	6		
Maneb	12427-38-2	Interim	6		
MCPA (2-Methyl-4-chlorophenoxyacetic acid)	94-74-6	FINAL	4	10	
Metalexyl	57837-19-1	FINAL	420		

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Methomyl	16752-77-5	FINAL	175	200	
Methoxychlor	72-43-5	FINAL	35	40	40
Methyl ethyl ketone	78-93-3	Final	3600	4000	
Methyl parathion	298-00-0	FINAL	2	2	
Methyl tert butyl ether (MTBE)	1634-04-4	FINAL	35	20-40	35
Methylphenol (3-)	108-39-4	FINAL	35		
Methylphenol (4-)	106-44-5	Interim	3.5		
Metolachlor	51218-45-2	FINAL	100	70	
Metribuzin	21087-64-9	FINAL	175	100	
Monochlorobenzene	108-90-7	FINAL	140	100	100
Naphthalene	91-20-3	FINAL	14	20	
Napropamide	15299-99-7	Interim	840		
Nitrobenzene	98-95-3	FINAL	3.5		
Nitroguanidine	556-88-7	FINAL	700	700	
Nitrophenol (p-)	100-02-7	Interim	60	60	
Norflurazon	27314-13-2	Interim	10.5		
Oxamyl (Vydate)	23135-22-0	FINAL	175	200	200
Paraquat	1910-42-5	Interim	3	30	
Parathion	56-38-2	FINAL	0.2		
PCNB (pentachloronitrobenzene)	82-68-8	FINAL	2		
Pentachlorophenol	87-86-5	FINAL	3		1
Phenol	108-95-2	FINAL	2100	2000	
Phorate	298-02-2	Interim	3.5		
Picloram	1918-02-1	FINAL	500	500	500
Polychlorinated biphenyls (PCBs)	1336-36-3	FINAL	0.5		0.5
Prometon	1610-18-0	FINAL	100	100	
Pronamide	23950-58-5	Interim	23	50	
Propachlor	1918-16-7	FINAL	90	90	
Propanil	709-98-8	FINAL	35		
Propazine	139-40-2	FINAL	14	10	
Propham	122-42-9	FINAL	140	100	
Propiconazole	60207-90-1	FINAL	9		
RDX (1,3,5-trinitro-1,3,5-triazine)	121-82-4	FINAL	3	2	
Resorcinol (1,3-Benzenediol)	108-46-3	Interim	140		
Rotenone	83-79-4	FINAL	28		
Simazine	122-34-9	FINAL	3.5	4	4
Styrene	100-42-5	FINAL	140	100	100
Tebuthiuron	34014-18-1	FINAL	500	500	
Terbacil	5902-51-2	FINAL	90	90	
Terbufos	13071-79-9	Interim	0.35	0.9	
Tetrachlorodibenzo-p-dioxin (2,3,7,8-)	1746-01-6	FINAL	0.000007		0.00003
Tetrachloroethane (1,1,1,2-)	630-20-6	FINAL	13	70	
Tetrachloroethane (1,1,2,2-)	79-34-5	FINAL	1.8		
Tetrachloroethylene	127-18-4	FINAL	7		5
Tetrahydrofuran	109-99-9	Interim	70		
Thiram	137-26-8	FINAL	35		
Toluene	108-88-3	FINAL	1400	1000	1000
Toxaphene	8001-35-2	FINAL	0.3		3
Trichloroethane (1,1,1-)	71-55-6	Interim	200	200	200
Trichloroethane (1,1,2-)	79-00-5	FINAL	6	3	5
Trichloroethylene	79-01-6	Interim	32		5
Trichlorofluoromethane	75-69-4	FINAL	2100		
Trichlorophenol (2,4,6-)	88-06-2	FINAL	32		
Trichlorophenoxyacetic acid (2,4,5-)	93-76-5	FINAL	70	70	

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Trichlorophenoxypropionic acid (2,4,5-)	93-72-1	FINAL	50	50	50
Trichloropropane (1,2,3-)	96-18-4	Interim	0.05	40	
Tricholorobenzene (1,2,4-)	120-82-1	FINAL	70	70	70
Tricholorobenzene (1,3,5-)	108-70-3	Interim	40	40	
Trifluralin	1582-09-8	FINAL	45	5	
Trinitroglycerol (nitroglycerin)	55-63-0	Interim	5	5	
Trinitrophenol (2,4,6-)	88-89-1	Interim	57		
Trinitrotoluene (2,4,6-)	118-96-7	Interm	3.5	2	
Tris (1,3-dichloroisopropyl) phosphate	13674-87-8	Interim	14		
Vinyl Chloride	75-01-4	Interim	0.2		2
Xylenes	1330-20-7	FINAL	1400		10000
Zineb	12122-67-7	FINAL	350		
Ziram / Ferbam	137-30-4	Interim	25		

NOTES:

MEG = Maximum Exposure Guideline
MCL = Maximum Contaminant Level
EPA = U.S. Environmental Protection Agency
ppb = parts per billion, same as micrograms per liter
FINAL MEG STATUS: MEG is based on USEPA IRIS toxicity data and derived following standard USEPA protocols.
INTERIM MEG STATUS: MEG is not based on USEPA IRIS toxicity data and the Bureau of Health has lower confidence in toxicity data.