Section V.I.

Groundwater Resources

This inventory chapter updates and builds on data in similar chapters in the 1987 Islesboro Growth Management Action Plan, 1994 Town of Islesboro Comprehensive Plan, and 2002 Islesboro Comprehensive Plan and are adopted herein by reference.

I. Groundwater Resources

Twelve small high yield aquifers are located in Islesboro. Four are UpIsland, two within the loop formed by Main and Meadow Pond roads, one immediately south of Meadow Pond, and one just south of Bluff Road. Six are located DownIsland, one in the vicinity of the old Islesboro Village, one near Mill Creek, one in the vicinity of the Town Center, one along Babbidge Road, and one east of the intersection of the road that leads to Shattuck Point and Pendleton Point Road.

Three locations are identified as groundwater recharge areas. The largest is located UpIsland within the loop road formed by Main and Meadow Pond roads. It surrounds one of the high yield aquifers noted above. The other two are considerably smaller and are located DownIsland – one is south of the emerging Town Center and the other is east of the intersection of the road that leads to Shattuck Point and Pendleton Point Road, surrounding the high yield aquifer noted above.

II. Drinking Water Supplies

All residents of Islesboro draw drinking water from bedrock wells (86%, based on 1994 survey of residents), dug wells, or springs for household use. There is one community well located in Ryder Cove that serves 9 residences.[1]

Islesboro has 5 water systems that the state defines as "non-transient non-community" or "community" public water systems[2]. They provide water for the Islesboro Central School (2 wells), Tarratine Yacht Club, Dark Harbor Shop, Tarratine Golf Restaurant, and Warren Island State Park. All are bedrock wells, drilled to depths from 20 to 80 feet, in the three cases where overburden thickness is known. The Maine Drinking Water Program identifies contamination risk for these water systems based on:

- well type and site geology (thickness of overburden);

[1] Gerber, Robert G. Inc. Islesboro Ground Water Resource Evaluation. Prepared for the Islesboro Comprehensive Plan Implementation Project. Freeport, Maine. August 1995.
[2] Maine Title 22, Chapter 601, defines any publicly or privately owned water conveyance system which "has at least 125 service connections, or regularly serves an average of at least 25 individuals daily for at least 60 days out of the year."

- existing and future risk of acute contamination from bacteria, nitrates, septic systems, and animal feedlot or manure piles; and
- existing and future risk of chronic chemical contaminants or significant sources of contamination from parking lots, fuel storage tanks, landfills, or industrial waste disposal sites.

In general, two wells are at “moderate” and three are at “low” risk of contamination.

The Islesboro Central School wells are identified as having moderate risk:

- based on site geology because the overburden thickness is unknown;
- for existing risk of acute contamination because there is a septic system within 300 feet of the wells;
- for existing risk of chronic contamination because cadmium has been detected and three potential sources of contamination are located within the well-head protection area, the closest being a parking lot; and
- for future risk of chronic contamination because of lack of legal control of the area within 2500 Phase II/V Waiver.

The Dark Harbor Shop well is identified as having moderate risk:

- based on site geology because the overburden thickness is unknown and
- for future risk for acute contamination because the status of land ownership is unknown or it has been determined that the proprietor does not own or control all the land within 300 feet of this water supply source.

III. Hydrologic Studies

A. 1995 Groundwater Resource Evaluation

The purpose of the 1995 study was to "compile well data collected by volunteers of the Town, analyze maps and aerial photographs, evaluate the present state of ground water and recommend future methods for groundwater protection."[3] The evaluation was based on available hydrogeologic literature, including the results of a townwide well questionnaire. The analysis included determination of bedrock aquifer yield potential through photo linear analysis, salt water intrusion potential within about 600 feet of the coast through photolinear interpretation, and statistical examination and review of well questionnaire data.

The results of the survey indicated that median well yields and bedrock well yields were above average (8 gpm and 16 gpm, respectively), and median and mean bedrock well depths were about average, when compared to other coastal settings. About 7% of respondents indicated that iron was a problem, 2% indicated that lime was a problem, and 1% indicated that manganese, bacteria, sulfur, salt and odors were a problem. One residence cited gasoline and two cited nitrates issues with their wells.

High yield bedrock aquifers and recharge areas were delineated as part of the analysis, which also indicated that very few locations in the community would support a public water supply in the event of contamination or depletion and demonstrated a need for the Town to protect recharge areas through managed growth and the proper handling of chemicals, petroleum, and septic systems.

The goals of the recommended groundwater management plan laid out in the report included:

1. Preserving Groundwater Quantity. Staying within bedrock aquifer safe yields, enhancing groundwater recharge, and controlling residential subdivision and commercial developments by:

    - Minimizing the amount of impervious cover that prevents rain water from entering the earth to become groundwater.
    - Encouraging infiltration of storm water from new development.

[3] Op cit page 2.

- Preventing excessive pumping or reduction in recharge that can lower the groundwater table through conservation and management of new development.
- Limiting coastal development to at least one dwelling unit per acre.
- Adding new well data to the Town's groundwater database.
- Making educational material available.

2. Preserving Groundwater Quality. Controlling all types of waste disposal, managing nonpoint source pollution, and controlling development and water quality monitoring by:

- Balancing the need for growth with groundwater quality protection, by using federal maximum contaminant levels (MCL's) for public drinking water supplies as a guideline for private water supplies.
- Not pumping groundwater at a rate that exceeds the rate at which groundwater is recharged by precipitation.
- Establishing minimum lot sizes based on soil carrying capacity to manage nitrate loading from septic systems.
- Setting water quality performance standards for all development under subdivision or site plan review.
- Directing waste disposal to groundwater discharge areas.
- Monitoring salt water intrusion.
- Defining the personnel and equipment available to respond in the event of a chemical or petroleum spill.
- Managing potential nonpoint sources of pollution (i.e., subsurface sewage disposal systems, petroleum storage tanks, material stock piles, sand/salt piles, abandoned wells, golf courses, airports).
- Continuing to collect and tabulate well data, water levels, and soil thicknesses.

B. Groundwater Resource Protection Monitoring

In 1999, the Town was granted federal Environmental Protection Agency "sole source aquifer" status and embarked on a program that relies on the voluntary cooperation of householders, development of recommendations for corrective action, and the preparation and distribution of educational materials.

From 2001 to 2003, the Town's Groundwater Protection Committee conducted annual water testing and water level monitoring of a network of wells to establish a reasonable foundation of information on groundwater characteristics. The same year, Wright-Pierce tied the elevation of well casings to sea level to aid efforts to determine base ground water levels. Each year in August the Committee also tested for water quality.

In 2001, 8 wells satisfactorily met the Federal Safe Drinking Water standards; 9 did not. The Committee recommended that all island well owners have their wells tested and decided to focus future efforts on identifying wells that are vulnerable to contamination.

In 2002, 60% of test wells tested positive for coliform bacteria, but no test wells exceeding the federal standards for metals. The Committee recommended that Islanders test their wells annually and made test kits available at the Town Office. It continued its program of identifying potential and existing sources of pollution to island aquifers, primarily septic systems and sources of petroleum.

In 2003, 20% fewer test wells tested positive for coliform bacteria. The Committee continued to recommend annual testing for Islanders wells, cautioned about potential impacts from malfunctioning septic systems and pesticides, and noted that more than 100 junked cars had been removed from the island that year. It also began a program of studying the effects of pesticide and fertilizer usage on groundwater.

In 2003 based on its annual testing of well water levels, the Committee was able to report that it appeared that groundwater levels decline each summer (low of 18 feet in August), but recover by the following spring (8 feet in April). The annual water quality testing included two wells on property where pesticides and fertilizers were normally used, which did not show any contamination. Coliform bacteria continued to be found in 40% of the wells tested, approximately twice the average figure for the state as a whole. Two wells also tested positive for E.coli; two others slightly exceeded arsenic standards and well owners were advised to contact the Maine Department of Human Resources

(DHS). The Committee continued to encourage islanders to test annually and to conserve.

In 2004, based on the recommendation of its consultant, Stratex, LLC, the Committee decided to investigate several areas of particular interest, including the integrity of well casings and the regulatory files and water quality associated with the Town's landfill, as well as a revision of its water monitoring program. The result of a study of well casings revealed seal failures that allow potentially contaminated surface and shallow groundwater from soil to enter the well. In August 2004, Stratex prepared a summary of the findings from the annual water level measurements and water quality testing of the network of wells.

1. Groundwater Levels. Water levels were measured quarterly from 2001 to 2004, monthly for 2002 and 2003, then quarterly in 2004. Despite relatively high groundwater levels in 2004, cumulative annual precipitation since 2001 was consistently less than average annual precipitation levels. Stratex concluded that, "it is possible that groundwater levels in 2004 are still less than the long-term average (i.e., 30 years) levels."[4]

2. Water Quality Testing. The 2004 water quality sampling focused on specific parameters, including pH, specific conductance, sodium, chloride, hardness, radon, and total coliform counts.

The pH values were generally within the range of values measured during other sampling events, with the average pH at 7.41 (median at 7.38).

In general, Stratex observed that elevated values for specific conductance were consistent with Islesboro's coastal and geologic setting (i.e., more dissolved components of limestone bedrock units).

[4] Stratex, LLC. 2004 Ground Water Resource Protection Monitoring, Islesboro, Maine. November 17, 2004.

Concentrations of sodium, hardness, and chloride were similar to previous measurements and elevated in several wells, possibly due to impacts from road salt, salt water intrusion, water softeners, and/or wastewater.

Testing revealed radon in concentrations that generally exceeded EPA maximum contaminant level, but were below the alternative maximum contaminant level for small community water systems (several were very close to the standard). However, indoor air levels were comparable to outdoor levels. Because samples were collected by the Groundwater Committee, the DHS recommended retesting by a Maine Registered Radon Service Provider to verify results and advised homeowners to contact the Maine Radiation Control Program for additional information.

"The presence of total coliform [bacteria] has been a persistent problem in Islesboro wells."[5] To explore potential causes, the Committee checked the integrity of well seals and performed additional testing, including an expanded suite of coliform parameters for a subset of wells. Bacterial counts from four wells were very high and suggested contamination from surface water. In general, the type and quantity of bacteria found suggest "well integrity issues common in older wells (> 50 years old)"[6] and point to the need for public education regarding land use activities near wellheads and the need for regular testing. The results support the need for a well casing inspection program.

Based on the 2004 water monitoring program, Stratex recommended that the Committee:

- Establish a well database and GIS mapping system.
- Require registration and proof of potable water for new wells through the building permit process.
- Educate the public about the value of regular water quality testing and the importance of eliminating pet waste from ground surface near wells.
- Review water quality test data from the Maine Health and Environmental Testing Laboratory for the past 10 years.

[5] Op cit page 6.
[6] Ibid.

- Review the Town's land use regulations for measures aimed at protecting groundwater.
- Establish a groundwater monitoring program for the landfill.
- Continue inspecting well casings.
- Evaluate potential causes of elevated sodium, hardness, and chloride by meeting with public works to gain an understanding of road salting activities, compiling information on use of water softeners, and checking separation distances between septic system leachfields and water supply wells.

In 2005, eight of the nineteen well tested, tested positive for coliform bacteria, though none tested positive for E.coli. One tested positive for fecal coliform from an animal source. These results continued to suggest well integrity issues, which was confirmed when two of the four well casings inspected were found to be leaking badly. Based on these results, the Committee decided to continue its well casings program the following year. Stratex indicated that well water level monitoring results now provided sufficient data to indicate that ground water quantities were adequate for Islesboro's present population and for anticipated growth. The Committee advised Islanders to continue annually well testing and care with potential sources of contamination.

2007 testing indicated no significant change in water quality. The Town's consultant, Robinson Resources made a joint presentation to the Groundwater and Comprehensive Plan committees and recommended that the Town adopt a groundwater protection ordinance that requires a minimum 200 foot distance between wells and septic systems and a 500 foot setback from the shoreline to prevent salt water intrusion.

In 2008, well monitoring continues.

C. Soil Carrying Capacity

Geologic Soil Type	Average Natural Recharge Rate % of PPTN	Average Natural Recharge Rate gpm/acre	Average Natural Recharge Rate inches/year	A Allowable Dwellings per Acre	1/A Allowable Acres per Dwelling	Drought Recharge Rate gpm/acre	Drought A Allowable Dwellings per Acre	Drought 1/A Allowable Acres per Dwelling
sand and gravel	50%	1.23	23.9	1.6	0.6	0.74	1.0	1.0

thin sandy till	25%	0.62	11.9	0.8	1.2	0.37	0.5	2.1
silty till	15%	0.37	7.2	0.5	2.1	0.22	0.3	3.5
exposed rock and glaciomarine silt	10%	0.25	4.8	0.3	3.1	0.15	0.2	5.2
glaciomarine clay silt	5%	0.12	2.4	*0.2	*5.0	0.07	*0.2	*5.0
Notes: 1) * Glaciomarine clay-silt soils are not only limiting in their ability to treat residential wastewater, but they also have limitations relating to other site engineering issues such as slope stability, drainage and siltation potential. Ongoing research suggests clays may have the capability of denitrifying wastewater more effectively than typically assumed. 2) Drought conditions assume that precipitation is reduced to 60% of the average rainfall.								
Source: Robinson Resources, LLC. Soil Carrying Capacity, Islesboro, Maine. December 22, 2006.								

In 2006, the Comprehensive Plan Committee hired Robinson Resources, LLC to perform a soil carrying capacity analysis to evaluate the capacity of soils to treat wastewater from residential septic systems and as a potential tool to protect groundwater resources. Based on the analysis of soil types, whose potential recharge rate varies from about 2-5% for clay to 50% for sand and gravel, the recommended allowable dwellings per acre ranged from a high of 1.6 dwellings per acre to a low of 0.2 dwelling units per acre. Expressed differently, the recommended allowable acres per dwelling ranged from 0.6 to 5 acres per dwelling.

Four small areas appropriate for higher densities are located UpIsland; one is located DownIsland in the vicinity of the emerging Town Center. Areas that would support slightly higher densities than are currently required are located in the northern parts UpIsland, north and west of and within the Narrows, on portions of Grindle Point, along Charlottes Cove, and other scattered locations DownIsland. Much of the rest of the Island is highly constrained and would warrant a reduction in density, much of it significantly lower than currently allowed, using traditional on-site septic systems.

The analysis was based on the ability of the land to dilute residential wastewater, with nitrate-nitrogen as the primary contaminant of interest. Robinson Resources reviewed soil types and assigned recharge rates as the percent of average annual precipitation likely to infiltrate the ground. After recharge rates were assigned, the number of housing units per acre was calculated for each soil type, assuming the dilution of wastewater with groundwater.[7] A second set of calculations were prepared to reflect drought conditions. The consultant recommended that wells and septic systems be separated by at least 200 feet to protect against pathogens. Robinson Resources noted the limitations of local variations in geology, soils, or septic system design, installation, and operation as well as accuracy of data collected by others, and recommended that individual site and project design should be subject to field verification.

IV. Potential Sources of Contamination

A number of potential threats to groundwater have been identified; a number of which are clustered together.

UpIsland, along Meadow Pond Road, between two high yield aquifers and the largest groundwater recharge area, are the municipal transfer station, the Town's sand and salt pile, a septage spreading location, a remediation site that requires no further action, and an automobile repair facility. The municipal landfill is located north of the groundwater recharge area. Near Meadow Pond are two registered out-of-service underground oil tanks. In the vicinity of the old North Islesboro Village, there are one registered underground oil tank, four leaky aboveground oil tanks, and three surface spills.

DownIsland, in the vicinity of the old Islesboro Village, there was a leaking aboveground storage tank. In the vicinity of the emerging Town Center north of one of the groundwater recharge areas are a bulk fuel storage facility, an automobile repair facility, a gas station, two registered underground storage tanks, and a leaking underground oil tank. In Dark Harbor, are a wastewater treatment plant and outfall, a leaking aboveground oil tank, two leaking underground oil tanks, a marina, and two registered out-of-service underground storage tanks. An engineered solid waste disposal facility is located nearby at the Tarratine Yacht Club. One registered aboveground oil tank is located near Pendleton Point.

[7] Robinson Resources, LLC. Soil Carrying Capacity, Islesboro, Maine. December 22, 2006.

Offshore on Seven Hundred Acre Island are a marina, a spill response, and a remediation site that requires no further action.

Spill responses were also noted at the old Islesboro Village, Northeast Point, Pripet, and in the Eastern Bay.

Two active overboard discharges are located at Fire Island and Ryder Cove. Eighteen overboard discharges have been removed – two UpIsland, thirteen DownIsland, one in the Narrows, and one each on Seven Hundred Acre and Minot islands.

V. State Regulations

In 2000, the Legislature adopted PL 761 to give pubic water suppliers “abutter status” for certain proposed activities that require a permit within a given source protection area, including automobile recycling facilities or junkyards, expansion of structures using subsurface waste disposal systems, conditional and contract zoning, subdivisions, and other land use projects. In 2008, the Legislature directed the Department of Defense, Veterans and Emergency Management, Maine Emergency Management Agency, in coordination with the Department of Public Safety, Office of the State Fire Marshall and the Department of Environmental Protection, to review and make recommendations on improving the current framework for registering aboveground oil storage facilities.

In 2001, the State passed legislation to protect sensitive geologic areas from oil contamination, which prohibits or modifies the installation of underground storage tank facilities in the proximity of existing public water supplies and private wells and future water supplies associated with significant sand and gravel aquifers. The requirements of the statute apply only to motor fuel and bulk plant underground storage tanks, not to the expansion of underground storage tanks that existed at a site prior to the effective date of the law.

Under the law, tanks cannot be installed:

- within 300 feet of a private well, other than the well used to supply water to the business with the underground storage tank
- within 1,000 feet (or the source water protection area, which ever is larger) of a community water supply
- over a high-yield sand and gravel aquifer
- within 1,000 feet (or the source water protection area, which ever is greater) of a transient (e.g., restaurant, highway rest stop) or non-transient (e.g., school, office park) public water supply
- over a mapped moderate-yield sand and gravel aquifer.

In 2008, a bill was proposed to amend this law to prohibit the installation of aboveground storage facilities, automobile graveyards or recycling businesses, automobile body or other commercial automobile maintenance and repair shops, dry cleaning facilities, metal finishing or plating facilities, or commercial hazardous waste facilities within wellhead protection zones to prevent contamination by oil and hazardous matter and give municipal code enforcement officers the authority to enforce the restrictions. The bill, as adopted, was amended to eliminate provisions that called for administration and enforcement primarily at the local level, the requirement for the registration of aboveground oil storage facilities in wellhead protection zones and over sand and gravel aquifers, and authorization for the Department of Environmental Protection to enjoin the operation of a facility installed in violation of the new siting restrictions and replace it with more comprehensive enforcement language. It also required a number of departments and agencies to review and make recommendations about how to improve the current framework for registering aboveground oil storage facilities.

VI. Islesboro Regulations

In 2000, based on the recommendations of the 1995 groundwater study, the Town adopted a Groundwater Protection Ordinance, which established the Groundwater Protection Committee and charged it with:

- monitoring groundwater quality,

- recommending corrective action to address groundwater pollution in cooperation with the Codes Enforcement Officer and Local Plumbing Inspector,
- developing and publicizing educational and informational material on groundwater protection and conservation,
- requiring adherence to provisions of the Environmental Protection Agency's provisions for sole source aquifers,
- applying for grants and donations to add to Town funds for its purposes,
- preparing an annual budget in cooperation with the Town Manager,
- preparing reports, including one for inclusion in the Town's Annual Report, and
- advising the Planning Board, and other boards and committees, about procedures, rules, or ordinances related to groundwater protection.

Furthermore, the Town's Land Use Ordinance requires applicants for land use permits to supply data on any new well dug or drilled, including the depth and flow rate, to the Codes Enforcement Officer to aid the monitoring of the Town's water supply.

VII. Issues and Implications

1. Is the Town concerned about the moderate existing and potential risk of chronic contamination at the Islesboro Central School? What, if any, steps should it take to reduce this risk?

2. The Groundwater Committee has worked long and hard to inform homeowners about potential threats to their drinking water. What additional educational efforts should the Town undertake? Should the Committee encourage greater water conservation? What steps should the Town encourage householders to take to reduce coliform bacteria in wells?

3. What next steps should the Town take to protect groundwater resources? Should the Town adopt regulations requiring all wells and septic systems to meet environmental compliance standards? Should the Town revise its land use regulations to increase the required distance between wells and septic systems and

between the shore and wells? Should the Town continue and/or expand well monitoring? Should the Town create a database of well, compliance, and monitoring data linked to its GIS mapping system?

4. The 1987 Comprehensive Plan recommends that “future residential and commercial development on or adjacent to high-yielding groundwater aquifers should be encouraged to utilize centralized wells or public water supplies rather than individual wells” and that “sewage disposal in these areas should be limited to public sewage collection systems, and individual septic systems should be limited in density by requiring a minimum lot size of one hundred thousand square feet per system.”

   Should the Town encourage centralized rather than individual wells in some areas? Similarly, should the Town encourage centralized septic rather than individual systems in some areas?

5. What further steps should the Town take to reduce threats to groundwater from identified potential sources of contamination? Should the Town consider acquiring additional land or development rights in the vicinity of identified groundwater recharge areas?