1.0 EXECUTIVE SUMMARY

Otis Reservoir covers 985 acres in the Towns of Otis and Tolland, excluding islands and contiguous emergent wetlands. It has a mean depth of 17.5 ft and a maximum depth of 48 ft, resulting in a full volume of 17,188 acre-feet or about 5.6 billion gallons of water. Recreational opportunity and habitat value are high. The watershed of Otis Reservoir includes 8,814 acres of largely (79%) forested land, mostly in two state forests, and 11% residential land, much of it adjacent to the reservoir. The low watershed:lake area ratio (<9:1) minimizes both pollutant and water flow through the system. Otis Reservoir receives enough water annually to replace the full volume just over one time, with inflow from the Twentyfive Mile River from Big Pond comprises 49% of total inflow. Other tributaries provide 33% of the flow, while precipitation provides 18%. Water leaves the reservoir as surface outflow (89%) or evaporation (11%), with fall-winter drawdown, spring refill, and summer water level maintenance yielding an extremely variable outlet discharge pattern for Otis Reservoir. Spring refill requires nearly all of the inflow between mid-March and late May, evaporation matches inflow during dry summers, and drawdown yields very high outflows in October.

Water quality in Otis Reservoir and its tributaries is generally acceptable for designated uses. Oxygen is naturally low near the sediment-water interface and in part of the bottom water layer during summer stratification, but no human uses are impaired as a result. Nutrient levels are generally low, and the calculated loads are near the level below which algal blooms and related problems are rare. Water quality in tributaries draining developed areas is better than that of typical developed areas in MA, but still threaten long-term water quality. The natural features of the landscape lead to inputs of humic substances, slightly acidic pH and slightly elevated color in the waters of tributaries and Otis Reservoir.

Except for a few areas of low bottom slope, annual drawdown over many years has prevented soft sediment accumulation in areas of water depth <8 ft (18% of the reservoir area), resulting in a cobbly peripheral zone. Chemical testing of the muck sediments revealed no contaminants in excess of either the detection limit or guidelines for human health and ecological integrity.

Phytoplankton in Otis Reservoir reflect the low nutrient, slightly acidic waters, with low to moderate biomass appropriate to multi-purpose aquatic system. Water clarity is sufficient for recreational uses, but productivity is adequate to sustain a viable fishery. Zooplankton biomass is also generally low. Benthic invertebrates are rare in the deep water areas, apparently as a consequence of low oxygen, and are potentially impacted by drawdown, predation and low food supply in shallow water. Fish include a wide range of warmwater and coldwater species, largely as a product of a long history of

stocking. Largemouth bass, smallmouth bass, yellow perch, white perch and rainbow trout are the primary game species, but no comprehensive survey of the Otis Reservoir fishery has been completed since 1978.

Rooted plants are sparse in Otis Reservoir, restricted mainly to a peripheral band in 8 to 15 ft of water by coarse substrate in shallower water and low light in deeper water, and to shallow areas of low slope and substantial muck accumulation such as Dismal Bay. Common plant species include *Nitella* (actually an advanced form of algae), pondweeds, naiads, bladderwort, bur-reed, spikerush, pipewort and arrowhead, all native submergent species indicative of low nutrient waters. Drawdown clearly inhibits plant growths in shallow water in Otis Reservoir, and this is perceived by many as a benefit to both human users and overall aquatic habitat value. Examination of the two larger wetlands contiguous with Otis Reservoir revealed a very diverse plant community with a few introduced and potentially invasive species. Drawdown could be a factor in the establishment of the introduced plant species, but habitat value remains very high. Permanent plots were set up for continued monitoring.

Evaluation of motorized watercraft use and impact on Otis Reservoir indicates that boating density can exceed the estimated safe limit on sunny summer weekends, but is well below that limit during most of the year and on summer weekdays. Although day-use boating contributes significantly to overall density, there are ten times more boats moored seasonally in the reservoir that are the primary source of occasional crowding. Water and sediment quality investigations revealed no boat-induced contamination in excess of either detection limits or guidelines for human and ecological health. Noise levels were generally not excessive in an absolute sense, but the variability in noise creates annoyance levels on busy weekends.

Otis Reservoir was placed on the Section 303D list for lakes with use impairment based on water quality and biological conditions. Based on this investigation, alleged water quality and biological problems do not exist at a level severe enough to cause use impairment and the lake should be removed from the 303D list. Protection of the desirable qualities of Otis Reservoir is warranted, and management of user groups and reservoir features is advisable to maximize recreational opportunity and aquatic habitat value. Otis Reservoir requires no rehabilitation at this time, as its condition is suitable for all designated and desired uses. Some improvements might be made, depending upon a clear statement of goals and priorities.

Winter drawdown protects shoreline integrity, permitted shoreline structures and the dam. Drawdown is also largely responsible for the current physical conditions in the reservoir, which provide much desirable habitat and a range of habitat types. Limited vegetation in shallow water is offset by the presence of rocky structure and gravelly substrate, habitat features in short supply throughout Massachusetts. Prevention of

infestation by invasive species and overabundance of aquatic plants is best served by the current drawdown. Drawdown may not need to be as severe or as frequent to maintain these conditions, but maintenance of the existing drawdown is recommended, unless damage to property and the dam are shown to be acceptable at an altered target level. Additional protection from invasive species could be gained by placing boat washing stations at three boat ramps at a cost of up to $20,000 per station, and by posting instructions for recognizing invasive species and eliminating their transport.

Despite the benefits of drawdown, the current water level management program may negatively impact the Fall River, and low spring water level may be responsible for the presence of some atypical species in adjacent wetlands. If the current drawdown of about 8 ft can be reduced by 1 to 3 feet, the target drawdown could be achieved more rapidly in the fall and refill could be accomplished more quickly in the spring, possibly without compromising drawdown benefits. Careful evaluation of the dam and structures around the reservoir are needed to ascertain if any change in drawdown depth is feasible. Release of slightly more water during dry summer periods could improve conditions in the Fall River and is recommended. Reduction in the rate of water release in early October could reduce scour in the Fall River, but would preclude the popular canoeing and kayak events on the Farmington River; this change is not recommended.

Current fishing conditions offer substantial recreational opportunity, and are enhanced by annual stocking. As Otis Reservoir is not an especially fertile system, fishing pressure may be greater than some natural populations can tolerate. Drawdown may negatively impact some species while benefiting others. Lack of recent data inhibits assessment of community status and analysis of impacts of current management practices. Addition of artificial structure to water >15 ft deep might benefit fish, but more recent data for the fish community are needed to evaluate the merits of providing such structure. Loss of fish downstream during drawdown could be eliminated by installing a screen over the intake of the subsurface discharge pipe at a cost of up to $23,000. A clear statement of management goals should be developed cooperatively between the MA DFW, the MA DEM, and various Otis Reservoir user groups. A detailed fishery survey, at a cost of up to $20,000, should be conducted.

Infractions of boating law are minimized at Otis Reservoir by shoreline structures and Environmental Police patrols. Enforcement of a limit on operation above headway speed within 150 ft of shore would effectively eliminate use of Dismal Bay by waterskiers and PWCs, leaving this valuable habitat area as a quiet haven. Solids loads from shoreline erosion can also be minimized by keeping motorized watercraft at least 150 ft from shore. Very limited noise impact and no evidence of any water or sediment contamination precludes recommendation of any further restriction on motorized watercraft access or operation, but it is suggested that the Otis Reservoir Association

work with the MA DEM to evaluate the acceptability of current boating conditions and seek internal resolution of conflicts among reservoir users.

Prevention of algal blooms and maximizing water clarity can be achieved by minimizing watershed inputs that could eventually raise fertility in the reservoir to an undesirable level. Solids loads from tributaries and storm drains, including erosion from dirt roads, should be countered by stabilization methods and detention in the watershed. Actions by towns and the DEM could cost about $100,000, internalized in maintenance budgets over multiple years.

To minimize adverse impacts from development within the watershed and protect the reservoir for future generations, residents should be educated regarding impact-minimizing property management methods, with a focus on maintenance of septic systems and landscaping for minimizing runoff and pollutant escape. At the neighborhood and town levels, education should focus on road and storm water drainage system management for reduced inputs to the reservoir. An appropriate set of brochures could be prepared for about $15,000 and a workshop could be held for about $7,000.

To reduce loading to the reservoir associated with storm water runoff from developed areas, structural improvements to drainage systems should be implemented as opportunities arise and funding allows, with towns and neighborhoods budgeting for gradual enhancement of drainage systems and taking advantage of available funding. As much as $600,000 could be spent on storm water management system improvements over the next decade to address all storm water issues, but considerably less expense could be adequate to protect reservoir condition. A list of potential candidate sites for improvements has been generated, with three priority levels and suggested techniques for each site. Additionally, small detention or infiltration systems would be desirable on properties with direct drainage to the reservoir.

A monitoring plan to track any changes in reservoir condition and to assess progress in water quality management within the watershed should include annual aquatic plant inspection near boat launches, a more complete plant survey every 3 years, similar monitoring of the two established wetland plots, annual water quality monitoring of the reservoir and representative tributaries, and continuation of water level record keeping by the DEM. The cost of this monitoring will average about $7,000 per year. Additionally, the invertebrates and fish of Fall River should be surveyed a year after any change in flow regime is implemented ($2,000) and the fish community of Otis Reservoir should be re-surveyed about once per decade (up to $20,000).

Implementation of recommended actions is expected to extend over about a decade, and some activities would continue indefinitely into the future. Most recommended

activities require either no permits or an Order of Conditions under the Wetlands Protection Act. In a few cases a Chapter 91 License for alterations in a great pond may also be required. The cost of permitting over a decade of management would be about $30,000. The results of management will be manifested primarily as preservation of the highly desirable conditions of Otis Reservoir and extended or enhanced enjoyment of this system for generations to come.