COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

May 15, 2015

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Celebrating our 50th Year

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1.0 INTRODUCTION

This report presents the results of the Comprehensive Beaver Management Plan prepared by GZA GeoEnvironmental, Inc. (GZA) for the Town of Merrimack, New Hampshire. GZA was retained by the Town of Merrimack Conservation Commission to assess known beaver (*Castor canadensis*) conflict areas and develop both short-term and long-term solutions for minimizing conflicts with beaver. GZA completed field work and analyses during the period of July 2014 April through September of 2014.

View of beaver damming at a culvert associated with Hanson Drive.

Various departments and entities in the Town of Merrimack have invested significant financial resources and personnel time on an individual basis to mitigate conflicts with beaver. The Highway Division of the Public Works Department is responsible for local road maintenance. Beaver dams constructed at and near culvert crossings can reduce the capacity of culverts and result in flooding of roads, infrastructure, and private property. The Highway Division often contends with frequent culvert maintenance at active beaver dam sites. The Merrimack Village District Water Works is responsible for maintaining and operating a water system that provides drinking water for over 85% of the Town's population. This water system is associated with some of the largest open water wetlands in Town that provide ideal beaver habitat. The Merrimack Wastewater Division is responsible for maintaining sewer lines. There are a number of examples where sewer lines cross wetlands in Town, and flooding by beaver limits access to these sewer lines. The Town of Merrimack Conservation Commission manages conservation easements and is frequently contacted by the public for beaver activity complaints on and near Town conservation properties.

To coordinate review of conflicts created by beaver, the Town established a Beaver Management Policy (2002). Although the policy created guidance for reviewing beaver conflicts, the current policy does not provide clear guidance on how to address and minimize beaver conflicts, and it does not provide a system to clarify when routine

maintenance is allowed without review by the Conservation Commission. The following Management Plan is designed to identify known beaver conflict sites and measures to minimize hazards and property damage caused by beaver, while protecting beaver colonies and associated natural resources to the greatest extent practical.

As part of this study, GZA completed the following:

- Assessed beaver activity levels at over 30 known problem areas. Beaver dams, lodges, and food caches where observed were mapped with a handheld GPS unit on foot, via canoe, and with the use of a drone over Town-owned properties to prioritize areas for possible management actions;
- Developed a GIS database of known problem areas;
- Identified both short-term and long-term management strategies for minimizing conflicts with beaver;
- Monitored the installation of water-level control devices at three high priority areas during the fall of 2014;
- Developed a GIS-based model to identify areas with moderate and high beaver habitat suitability and predict potential future problem areas; and
- Provided recommendations on long-term data management to streamline data sharing among residents and Town departments.

It is our understanding that documentation from this effort will be used to develop an updated Beaver Management Policy that streamlines management activities and provides a framework for prioritizing sites and addressing conflicts. This report is subject to the Limitations in **Appendix A**.

2.0 PROJECT DESCRIPTION

2.1 SCOPE OF WORK

Professional services provided by GZA within the work area described below included a desktop and field evaluation of over 30 known beaver problem areas, as identified by the Town of Merrimack. Problem areas are known locations of previous tree cutting, damming or flooding by beaver, as monitored by the Town of Merrimack. Problem areas were generally identified by Town staff in regular infrastructure maintenance or were brought to the attention of the Town as complaints from impacted residents. Known problem areas are distributed throughout the Town (see **Figure 1**, Site Locus).

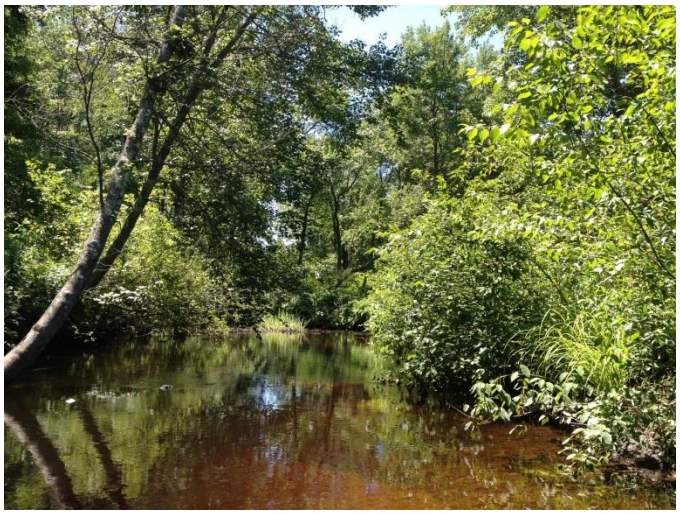
Concurrent with the assessment of current beaver activity levels, GZA also developed a GIS database to identify significant natural resources in the vicinity of potential management areas and predict areas of high beaver habitat suitability. The database

includes existing natural resource data available through GRANIT including 2010 aerial photography, National Wetlands Inventory data, and NH Wildlife Action Plan data published by the NH Fish and Game Department (NHF&G). In addition, habitat data in the Town of Merrimack Biodiversity Conservation Plan and species and community data available through the NH Natural Heritage Bureau was incorporated into the assessment to assess potential impacts to significant natural resources.

The mapping of current beaver activity levels was conducted by New Hampshire Certified Wetland Scientists (CWS) Ms. Tracy L. Tarr (CWS No. 281) and Mr. James H. Long (CWS No. 007) during July through September 2014. Ms. Tarr is also a Certified Wildlife Biologist and Mr. Long is a Licensed Forester. Construction monitoring of approved management activities was completed by Ms. Tarr and Mr. Matthew Savard during November 2014. Development of the GIS database was completed by Ms. Aimee Mountain, Certified Geographic Information Systems Professional (GISP).

2.2 DESCRIPTION OF WORK AREA

The project included a GIS-based assessment of the entire town. The Town of Merrimack spans approximately 33.5 square miles (21,412 acres) and is located in southern New Hampshire in the coastal plain.



View of Baboosic Brook looking easterly from Wire Road.

The Town includes extensive lowland river floodplains associated with the Merrimack River on the eastern border of the Town and the Souhegan River in the central portion of the Town. The northern and southern sections of the Town also include extensive wetland complexes associated with Baboosic Brook, Naticook Brook, and Pennichuck Brook.

2.3 BEAVER ECOLOGY

The beaver (*Castor canadensis*) is the largest rodent in North America and one of only a few species known to actively and regularly construct its habitat. Beavers are herbivorous and eat a variety of plant material including the bark of deciduous trees, as well as grasses, sedges, and aquatic plants when seasonally available. Aspen and alder are preferred food sources as they are highly digestible and have higher levels of protein compared to other trees and shrubs (Doucet and Ball 1994). However, beaver will utilize less preferred resources when preferred tree and shrub species are depleted. When food availability significantly declines, beaver often disperse and colonize new habitats.

View of beaver observed near Madison Lane.

Beaver live in family groups known as colonies which actively work together to maintain pond sites and store (cache) food for winter use. Beavers dam areas with running water (e.g. streams) to create pond habitats. In addition, beavers construct lodges (i.e. den sites) out of wood and store (cache) cut wood for winter use. Dams are created with a combination of mud and cut vegetation, and members of the colony check and repair dams on a daily basis before ice out. The entire colony engages in dam construction, lodge construction, and food storage.

In the northeast, beaver require habitats with ponded water greater than 4 feet deep to provide underwater access to lodges in the winter, when ponds are frozen at the surface. The lodge provides thermal protection in the winter, protection from predators, and serves as the focal point of the colony. As a stream is dammed, the lodge site is built up with woody material, and often reaches a height of at least 5 to 6 feet above water, and 20 to 30 feet across. On average, the interior chamber is 6 to 8 feet wide and roughly 2 feet high, just above the water level. The lodge has one or more underwater entrances, which provide important access points in the winter. Food is stored under water near the lodge for winter consumption. Beaver kits (young) are born and raised in the lodge.

Individual beavers often disperse from their natal colony in their second year, when they become sexually active. Colonies are discreet family units, and generally only have one breeding pair, in addition to generations of offspring. Young beaver may disperse as far as five to ten miles or more from their natal colony to find suitable habitat (Olson and Hubert 1994 In Degraaf and Yamasaki 2001). As a result, new colonies may be forming in a region every year.

Depending on habitat quality, a colony may occupy approximately 0.4 to 0.6 miles of stream length (Novak 1987 In Degraaf and Yamasaki 2001) and multiple colonies may occupy different portions of a stream system. Due to the nature of beaver dispersal, beaver ponds are highly dynamic systems, and long-term management plans must take into account the dispersal characteristics of beaver colonies.

3.0 METHODOLOGY

3.1 BEAVER ACTIVITY FIELD ASSESSMENT

GZA completed a field assessment of 35 areas with known or suspected previous beaver activity (i.e. "problem areas") from July through September 2014 (see **Figure 2**, Known Problem Areas). Areas were generally accessed by foot or via canoe. Where possible, access was obtained along existing Town right-of-ways, Town properties, or Town conservation easements. Verbal permission was also sought and obtained where access was required near existing homes. In select instances, public properties were evaluated using an unmanned aerial vehicle (UAV) to photograph beaver impoundments and assess the presence of dams in remote areas. As required by State law, the UAV was not operated over dwellings or people. The operator maintained visual contact with the unit at all times during operation.

To assess beaver activity levels and document significant natural resources near beaver colonies, GZA developed a project-specific Beaver Habitat Assessment Data Sheet (see **Appendix B**) based on known beaver habitat preferences and behaviors (see habitat preferences in Allen 1982 and Muller-Schwarze and Sun 2003). The data sheet provides documentation of seven types of beaver activities including the presence of cut trees, beaver scent mounds, food piles, lodges, dams, and evidence of active dam construction. Finally, the data sheet documents beaver conflict type and well as the potential for future beaver activity.

The approximate locations of observed beaver dams, lodges, and food caches were mapped using a hand-held GPS unit, with an approximately accuracy of three to five meters. Each assessment area was photo documented. Dominant vegetation within each assessed area was documented to describe general habitat conditions. Vegetation dominance was based on the following standards:

- *National List of Plant Species That Occur in Wetlands: 1988 New Hampshire*. United States Department of the Interior. Fish and Wildlife Service. NERC-88/18.29;
- *Classification of Wetlands and Deepwater Habitats of the United States*. December 1979. United States Department of the Interior. Fish and Wildlife Service. FWS/OBS-79/31.

3.2 NATURAL RESOURCE EVALUATION

Natural resources that may be affected by beaver dam removal or dam creation were also assessed as part of the project (see **Figure 3**, Critical Natural Resources and **Figure 4**, Conservation/Public Lands). The goal of the project was to take a comprehensive approach to natural resource evaluation in the area of potential beaver management activities. The areas with known locations of rare fish species were considered important fisheries for the purposes of assessing impacts from potential management activities. In addition, areas with semi-aquatic rare species or rare aquatic communities were considered sensitive to dam removal. Areas with documented vernal pools or deer wintering areas are considered resources that are sensitive to new dam construction.

Rare species data was obtained primarily from the New Hampshire Natural Heritage Bureau. Due to the sensitivity of rare species locations, the NH NHB does not allow the dissemination of exact rare species locations. As a result, the data was used in the development of management recommendations, but is not provided in the attached GIS data. Information on known vernal pools and heron rookeries was obtained from the Town of Merrimack Biodiversity Plan developed by Moosewood Ecological, LLC. Information on important regional wildlife habitats was obtained from the NHF&G Wildlife Action Plan maps.

3.3 GIS DATABASE DEVELOPMENT

The framework of the Town of Merrimack Beaver Habitat Suitability model was based on habitat criteria developed by the U.S. Fish and Wildlife Service (Allen 1982). Seven factors associated with high quality beaver habitat as described by Allen 1982 were incorporated into the model including stream length, land cover, slope, presence of connected lakes/ponds, and presence of wetlands located adjacent to streams. GZA developed a point ranking system and completed a Union Analysis in ArcGIS to assess "low", "moderate", and "high" habitat suitability areas. GZA also completed a data sheet for each assessed area to provide site-specific data for the development of a GIS model. At assessment areas, dominant vegetation, presence of muddy ponds, and general stream gradient was documented to verify overall habitat suitability. In addition, the statewide hydrography layer was corrected at assessment sites where stream distribution was known to be more extensive than depicted on statewide GIS data. The primary goal of the model was to predict areas with high habitat suitability to assess the location of potential "problem" areas requiring management.

3.4 DEVELOPMENT OF MANAGEMENT RECOMMENDATIONS

GZA worked with stakeholders in the community (e.g., Conservation Commission, Public Works Department, and interested citizens) to identify management recommendations that reduced flooding impacts of beaver, while maintaining existing beaver colonies and the significant natural resources known to occur near or within beaver habitats. Management strategies that serve to limit future infrastructure maintenance, limit flooding/property damage (by beaver), promote wildlife passage (in existing culverts), avoid impacts to rare species, and promote coexistence with beavers were prioritized over other methods.

Prior to engaging stakeholders, GZA completed a literature review of possible management options including the installation of flow devices (see Boyles 2006, Brown et al. 2001, Hardisky 2010, Langlois and Decker 2004, Laramie and Knowles 1997, Nolte et al. 2003, and Taylor and Singleton 2013, Tippie 2010). Skip Lisle of Beaver Deceivers International and Mike Callaghan of Beaver Solutions also provided valuable input on the design of water flow devices. Potential management recommendations were then presented at Conservation Commission meetings, and voted on by the Conservation Commission in order to focus efforts and further prioritize sites.

4.0 RESULTS

4.1 BEAVER ACTIVITY FIELD ASSESSMMENT

A total of 35 primary locations (i.e. "Areas" as described below) were evaluated to document current beaver activity, assess the presence of significant natural resources, and identify potential management options for areas with property damage caused by beaver activities. The following section documents current beaver activity at known problem areas (see **Table 1**, Summary of Beaver Assessment Areas and **Figure 2**, Known Problem Areas).

4.1.1 Area 1

Area 1 is a culvert location on Amherst Road situated west of Meetinghouse Road. The culvert structure consists of a large 9-foot wide concrete box, and serves an unnamed perennial stream. The upstream wetland at the culvert is a wet meadow that is classified as a palustrine, emergent system that is seasonally and semi-permanently flooded (PEM1E/F). The downstream wetland consists of a forested perennial channel with an unconsolidated bottom (R2UB). Based on Town records, the crossing was more regularly dammed by beaver prior to the installation of the larger box culvert.

View of Upstream side of culvert at Area 1.

View of wet meadow.

The surrounding landscape is comprised of light residential development and the brook is bordered by upland forest communities dominated by eastern hemlock (*Tusga canadensis*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*). Herbaceous plants present in the wet meadow include jewelweed (*Impatiens capensis*), broad-leaved cattail (*Typha latifolia*), and a variety of sedges (*Carex* spp.). Invasive palnts such as purple loosestrife (*Lythrum salicaria*) are present in the area. The downstream herbaceous layer located outside of the stream channel is dominated by cinnamon fern (*Osmunda cinnamomea*), New York fern (*Thelypteris noveboracensis*), white oak (*Quercus alba*), and partridgeberry (*Mitchella repens*). Area 1 is located in large perennial stream corridor that has areas of intense beaver activity. However, Area 1 does not currently have any observed beaver activity. This area represents a potential future colonization site due to the location of nearby colonies. This area should be monitored at least annually to determine current activity. The high profile of the road may serve to limit future flooding by beaver, but the area has high Beaver Habitat Suitability (see **Figure 5**, Beaver Habitat Suitability Model).

View of downstream channel.

View of downstream side of Area 1 culvert.

4.1.2 Area 2

Area 2 is a culvert location on Baboosic Lake Road. The culvert consists of a 36-inch plastic pipe and the stream width ranges from approximately 5 to 7 feet wide in the immediate vicinity of Baboosic Lake Road. The downstream side of the wetland is classified primarily as a palustrine forested system dominated by deciduous trees, in association with riverine perennial stream channel (R2UB). The tree layer of the wetland is dominated by red maple and American elm (*Ulmus americana*), in association with black cherry (*Prunus serotina*). The herbaceous layer consists of a variety of species including cinnamon fern, poison ivy (*Toxidodendron radicans*), false nettle (*Boehmeria cylindrica*), jewelweed, tall meadow rue (*Thalictrum pubescens*), arrow-leaved tearthumb (*Polygonum sagittatum*), and tussock sedge (*Carex stricta*). In this area, the stream is bordered by conservation land, as well as by dense residential development.

View of Area 2 looking downstream

View of Area 2 culvert outlet.

Area 2 contained many tree stumps cut by beaver. Most of the stumps appeared to be older cuttings. There was no evidence of current dams, lodges, or food piles directly downstream of Area 2. However, this area is located in close vicinity to five other known problem areas, four of which exhibited recent beaver sign. Area 2 is located within a high habitat suitability area and should be monitored at least annually as part of road maintenance activities.

View of cut tree stump in Area 2.

4.1.3 Area 3

Area 3 is associated with a large metal arch culvert located on Bean Road. The culvert is serves Baboosic Brook, and is located in close proximity to residential development and conservation land. Baboosic Brook has a wide floodplain in the vicinity of Area 3. The stream channel is classified as lower perennial riverine system dominated by an unconsolidated bottom (R2UB). The floodplain adjacent the channel is forested and dominated by red maple, white pine (*Pinus strobus*), black cherry, and white oak. Shrubs present include highbush blueberry (*Vaccinium corymbosum*) and sheep laurel (*Kalmia angustifolia*). Slow sections of the brook contain aquatic plants including pickerelweed (*Pontederia cordata*). The forested floodplain is dominated largely by royal fern (*Osmunda regalis*) and cinnamon fern, in association with Canada mayflower (*Maianthemum canadense*) in the drier portions of the floodplain.

View of Area 3 looking upstream at the culvert.

View of Area 3 floodplain looking upstream.

Area 3 is a previous location of beaver damming activity. In addition, the site has evidence of flooding and tree damage. During 2014, there was no evidence of current damming by beaver near the culvert. However, the floodplain contained old tree cuttings created by beaver. Area 3 is located in a High Habitat Suitability Area. Although the high dominance of white pine in the area might reduce the likelihood of this area serving as a core habitat area, Area 3 is located in a stream corridor with existing beaver populations. Similar to other sites, this area should be reviewed annually to determine current beaver activity over time.

View of the low floodplain near residences.

View of old tree cuttings started by beaver.

4.1.4 Area 4

Area 4 is associated with a large concrete bridge on Baboosic Brook, located on McGraw Bridge Road near Bel Air Avenue. The wetland is primarily classified as a lower perennial riverine system with an unconsolidated bottom in this area (R2UB). Tree species observed adjacent to the brook include white pine, American elm, and red maple.

View of McGraw Bridge Road.

View of Baboosic Brook at Area 4.

4.1.5 Area 5

Area 5 is located on Baboosic Brook, directly adjacent to dense residential development to the southeast. Existing yards along the brook are located in the active floodplain, and are subject to potential flooding and tree damage. The Town was originally notified of beaver activity in this area by a resident.

The brook is a large lower perennial riverine system dominated by an unconsolidated bottom (R2UB). The dominant tree species growing along the river are white pine and red maple. Plant species present in the shrub layer include red oak, witch hazel (*Hamamelis virginiana*), lowbush blueberry. Burning bush, an invasive plant, is also present. The herbaceous layer includes royal fern and cardinal flower (*Lobelia cardinalis*).

Area 5 contained a series of old beaver dams but lacked new tree cuttings or fresh mud on old dams during the summer of 2014. Based on landowner testimony, there was no obvious beaver activity in this area during the spring of 2014. Although there are no current conflicts, this area functions as a possible recolonization site.

View of Babboosic Brook at Area 5.

View of old beaver dams at Area 5.

4.1.6 Area 6 (6A and 6B)

Area 6 is located within a large wetland complex, in a sewer line easement off of Level Street. The wetland complex is associated with a perennial stream that drains into Baboosic Brook. The wetland system is classified primarily as a semi-permanently flooded, palustrine emergent system (PEM1F). The wetland is dominated by broad-leaved cattail but contains a diversity of emergent and floating plants including bur-reed, watershield, white water lily, swamp milkweed, cinnamon fern, lurid sedge, fringed sedge, soft rush, mannagrass (*Glyceria canadensis*), jewelweed, false nettle, sensitive fern, royal fern, cinnamon fern, and New York fern.

The edges of the wetland contains inclusions of scrub-shrub wetland dominated by speckled alder, silky dogwood (*Cornus amomum*), winterberry holly (*Ilex vreticillata*), northern arrowwood (*Viburnum recognitum*), and meadowsweet. The adjacent uplands are

primarily forested and dominated by white pine and red maple, in association with white birch and yellow birch. Invasive plants including reed canary grass (*Phalarus arundinacea*) and glossy buckthorn (*Frangula alnus*) are also present on the wetland edge.

View of Beaver Pond near Level Street.

Both Area 6A and 6B had evidence of active beaver use. Multiple dams were observed near Level Street and near Cathy Street. The activity near 6A (Level Street) was not impacting nearby residences during the 2014 growing season. However, 6B is in the vicinity of a sewer manhole and a large beaver dam had flooded the manhole location during 2014.

4.1.7 Area 7

Area 7 is associated with the outlet of the Stump Pond Dam located off of Craftsman Lane, on the southwestern border of the Town. The existing man-made dam is supporting a large pond on the northern side of the dam. The downstream side of Area 7 consists of a short section of stream channel before transitioning into a large cattail marsh. The upstream pond is classified as a palustrine, aquatic bed system that is permanently flooded (PABH). The downstream marsh is classified as a semi-permanently flooded emergent system (PEM1F). The uplands surrounding the pond are dominated by white pine. Downstream, adjacent uplands and wetlands also contain red maple and American elm. The pond is dominated by white water lily (*Nymphaea odorata*), in association with watershield, pickerel weed, bur-reed, and water-milfoil (*Myriophyllum* spp.). The downstream marsh is dominated by broad-leaved cattail. Other species present in the herbaceous layer include lurid sedge (*Carex lurida*), common arrowhead (*Sagittaria latifolia*), and royal fern. Three invasive plants including purple loosestrife, common reed (*Phragmites australis*), and bittersweet (*Celastrus orbiculatus*) were observed in the downstream portions of the wetland near Milford Road.

View of Stump Pond from Craftsman Lane.

View of the Stump Pond spillway.

A small (10-foot-long by 2-foot-wide) beaver dam was observed at the concrete spillway of the Stump Pond Dam. Currently, beaver activity does not appear to be causing significant flooding or maintenance concerns. Additionally, during the summer, the outlet stream had very little flow and was essentially stagnant.

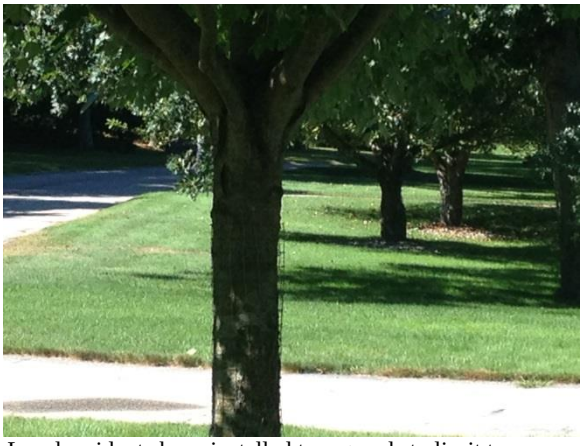
The relative low abundance of preferred food sources may limit overall beaver populations in the area. However, the presence of water lily upstream of the dam provides late spring and summer food to beaver. This area warrants annual monitoring but does not require any current management.

4.1.8 Area 8

Area 8 is located off of French Court, and is associated with Baboosic Brook. This section of brook is part of a Town of Merrimack conservation easement. However, the easement is narrow and directly bordered by residences and yards. The brook channel is classified as a riverine, lower perennial system (R2UB). The channel is bordered by floodplain forest dominated by white pine and red maple. The edges of the channel contain dense scrub-shrub cover consisting primarily of maleberry, silky dogwood, and northern arrowwood. The herbaceous layer is dominated by royal fern, false nettle, cardinal flower, bur-reed, and grape.

No active dam building was observed in this area. However, based on landowner testimony, numerous trees had been felled by beaver in previous years. A nearby residence had installed screening on trees to prevent beaver chewing. Although beaver activity is currently low, this area represents a potential recolonization site. During annual conservation easement monitoring, it would be advisable to conduct beaver activity monitoring at the same time.

View of brook at Area 8.

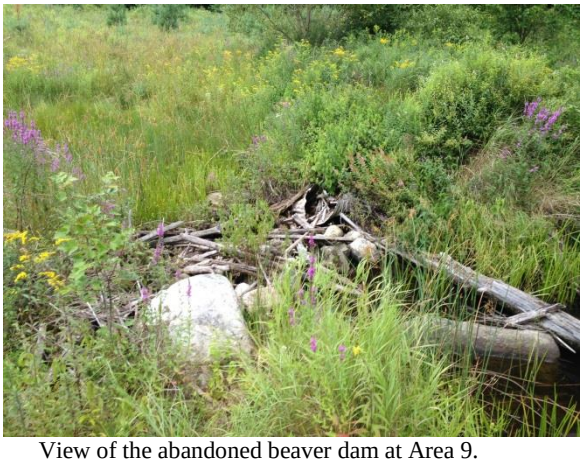


Local residents have installed tree guards to limit tree cutting and damage by beaver.

4.1.9 Area 9

Area 9 is located in the Grater Woods Conservation Area. The area is a previous beaver pond. The failure and breaching of a small beaver dam (approximately 12-feet long by 4-feet wide) led to the complete draining of the prior pond. The area currently consists of a small stream meandering through a wet meadow. The wet meadow is classified as a palustrine emergent system that is seasonally saturated (PEM1E). The upland forest surrounding the wet meadow is dominated by white pine, in association with red maple. The dominant plant species in the herbaceous layer are wool grass, goldenrod (Solidago spp.), and broad-leaved cattail. Other species present include meadowsweet, false nettle, dark green bulrush, and rattlesnake grass. Small areas of yellow spadderdock and bur-reed are also present along the stream. Purple loosestrife, an invasive plant, is also present.

View of the previous beaver pond location.



View of the abandoned beaver dam at Area 9.

4.1.10 Area 10

Area 10 is located adjacent to Greens Pond Road and is associated with a drop inlet structure located in a regulated water supply area. The water supply area is part of Greens Pond, which is classified as palustrine unconsolidated bottom and aquatic bed system that is permanently flooded (PUB/ABH). The wetland is dominated by white water lily,

watershield, pickerelweed, arrow-arum, and broad-leaved cattail. The wetland drains across Greens Pond Road into Naticook Brook. Dominant vegetation in Naticook Brook includes white pine, red maple, highbush blueberry, winterberry holly, tussock sedge, fringed sedge, sensitive fern, royal fern, grape, and cardinal flower. Wildlife observed in the area included great blue heron (*Ardea herodias*), American goldfinch (*Spinus tristis*), American crow (*Corvus brachyrhynchos*), and eastern wood pewee (*Contopus virens*).

The drop inlet associated with the Greens Pond Road showed evidence of previous management. Two abandoned beaver dams were also observed in Naticook Brook, downstream and northeast of Greens Pond Road. As beaver activity increases again in this area, a protective device will likely be needed at the drop inlet to prevent weekly regular maintenance.

View of the Greens Pond drop inlet from Greens Pond Rd.

View of stream channel upstream with no flow.

4.1.11 Area 11

Area 11 is located to the southeast of Hitchin Post Lane, in Town of Merrimack conservation land. During 2014, beaver activity was observed including dam maintenance and tree cutting. One large dam was located near the back property line of residences associated with Hitchin Post Lane. During the assessment, the observed dam was greater than 100-feet long and measured approximately 10 feet wide. The dam is comprised of sticks and mud and was approximately 4 feet high during the assessment. This large beaver dam is supporting the hydrology of a large and diverse beaver pond in the conservation easement.

The pond is classified as a palustrine aquatic bed system that is permanently flooded (PAB1F). In addition to water lily, dominant vegetation in the beaver pond includes broad-leaved cattail, false nettle, royal fern, and bristly dewberry. The pond is bordered by dense scrub-shrub habitat and dominant shrubs in the wetland include speckled alder, silky dogwood, and meadowsweet. Multiflora rose, an invasive species, was also observed. The pond is bordered by forested upland comprised primarily of white pine, red maple, black birch, and eastern hemlock. Wildlife observed near the beaver dam included gray

treefrog (*Hyla versicolor*), American goldfinch, black-capped chickadee (*Poecile atricapillus*), and common yellowthroat (*Geothlypis trichas*). The pond is part of an area identified by the NHF&G as "Highest Ranked Habitat in the Biological Region."

During 2014, the current pond level did not appear to be impacting residents. However, the water level was rising and located in close vicinity to an active wood lot operation. As a result, further pond expansion by beaver has the potential to flood an area being actively used by neighboring residents. The installation of a water flow device in the dam could limit potential for flooding of the adjacent yards, while still maintaining the current water level of the beaver pond and the diverse functions and values of the adjacent beaver pond.

4.1.12 Area 12

Area 12 is associated with a culvert crossing on Hansom Drive in the southwestern portion of Town. The culvert is bordered by a naturalized detention pond that was created in an intermittent stream, as part of adjacent residential development. The stream flows northerly, making two road crossings on Hanson Drive, before exiting via a 24" concrete pipe on the second crossing on the northern side of the detention pond. Although the area is a drainage feature, the pond has aesthetic and habitat value that is valued by adjacent residents.

View of stormwater pond at Area 12.

View of culvert damming at Hanson Drive.

The pond is classified as a palustrine emergent and aquatic bed system that is permanently flooded (PEM/AB1H). The shrub layer is dominated by speckled alder. Multiflora rose, an invasive species, is also present. Plant species present in the herbaceous layer include white waterlily, broad-leaved cattail, lurid sedge, false nettle, cardinal flower, jewelweed, and sphagnum moss. The tree layer bordering the pond consists primarily of gray birch, red pine, red maple, and American elm. Wildlife species observed at Area 12 including beaver, spring peeper (*Pseudacris crucifer*), tufted titmouse (*Baeolophus bicolor*), downy woodpecker (*Dryobates pubescens*), American goldfinch, and broad-winged hawk (*Buteo platypterus*).

Two beaver dams were documented at Area 12, including an actively maintained 5-foot long dam at the first culvert crossing and a second 10-foot long abandoned dam at the second (northerly) culvert crossing. Although abandoned, fresh beaver tracks were observed at the second crossing. At the time of the assessment, the second culvert lacked flow. Over the course of the summer, beaver activity increases at the southerly culvert crossing, which contained a grate to prevent complete damming of the culvert. This area was targeted as a potential area for a water flow device due to the weekly culvert maintenance required at this crossing.

4.1.13 Area 13

Area 13 is located adjacent to Heidi Lane in the eastern section of Town, and is associated with the lower portion of Naticook Brook. During site assessments, Area 13 was posted and could not be accessed. However, basic wetland observations were made from the Heidi Lane right-of-way.

View of Heidi Lane neighborhood.

View of wetland located behind Heidi Lane residences.

Heidi Lane borders a large palustrine emergent and unconsolidated bottom wetland system that is permanently flooded (PEM1F/PUB). In the vicinity of Area 13, the wetland is dominated by broad-leaved cattail and milfoil (*Myriophyllum* spp.). Two invasive plant species, purple loosestrife and reed canary grass, were also observed. Due to the presence of vegetated deep water, the wetland has high value to a variety of semi-aquatic wildlife species. Painted turtle and green frog were observed. Due to the direct adjacency of this wetland, residences on the northern side of Heidi Lane have high potential to be flooded. However, there were no current beaver conflicts known in this area during 2014.

4.1.14 Area 14

Area 14 is located on the Wildcat Falls Trail in the Currier Road Conservation Area. The Currier Road Conservation Area borders the Souhegan River and is located in the northecentral portion of Town. Area 14 is accessed off of Hemlock Lane and is a culvert located on Wildcat Falls Trail. The culvert connects a large palustrine forested and

scrub-shrub wetland system to an adjacent detention pond known as Area 30. During 2014, no beaver activity was observed at the Area 14 culvert, although beaver activity was observed nearby in Area 30.

View of Area 14 culvert and protective grate.

View of Wildcat Falls Trail between Area 14 and 30.

4.1.15 Area 15

Area 15 is a wetland located adjacent to Continental Boulevard Extension, near Joey Road, and is associated with Area 23 (the Continental Boulevard Extension culverts). Area 15 is located in the conservation area known as the Naticook Estates Green Area, and consists of a series of documented beaver dams. The wetland associated with Area 15 is classified primarily as a palustrine emergent wetland that is semipermanently flooded (PEM1F). Dominant vegetation in the wetland includes broad-leaved cattail, bur-reed, bearded sedge (*Carex comosa*), fringed sedge, soft rush, blue vervain, arrowhead, halberd-leaved tearthumb, royal fern, and cinnamon fern. Two invasive plant species, purple loosestrife and common reed, were also observed in the wetland. Area 15 contains a well-developed shrub layer on the edges of the wetland, comprised principally of speckled alder, highbush blueberry, northern arrowwood, and silky dogwood. The western side of the wetland has a well-developed tree canopy dominated by red maple, white pine, eastern hemlock, and red oak. The eastern side of the wetland is bordered by residential development. The wetland has diverse cover and a variety of wildlife species were observed. White-tailed deer sign was observed in the forested border to the wetland and green frog, catbird, American goldfinch, mallard, and red-winged blackbird were observed in the wetland. Area 15 is part of a larger area mapped by the NHF&G Department as "Highest Ranked Habitat in New Hampshire."

View of primary beaver dam in Area 15.

View of beaver pond, which has high waterfowl use.

Two actively maintained beaver dams, one old dam, and one lodge and associated food pile were documented in Area 15. The longest dam measures approximately 70 feet long and was approximately 3-feet high. The second dam measured approximately 55 feet long and was up to 5-feet tall. A third older dam was located over an existing sewer easement near Continental Boulevard Extension. Area 15 had high beaver activity during 2014. The Town anticipates coordinating with nearby property owners in the future to address potential management activities in this area.

4.1.16 Area 16

Area 16 is located on Lyons Road and is associated with a stream and large beaver pond located on Reeds Ferry School property. Upstream of the school itself, beaver have established three dams which have established a large beaver pond, and a smaller sub-pond. The sub-pond, located near the school recreation trail, had evidence of recent beaver maintenance. Two smaller dams, one located at the Lyons Road culvert and the second located downstream between the culvert and sub-pond, were not being maintained by beaver at the time of the assessment. The northern-most dam establishing the sub-pond varied from 4 to 5 feet high.

View of Lyons Road culvert and grate.

View of upper beaver pond located near the school.

The overall wetland is classified as a palustrine emergent and scrub-shrub system that is dominated by broad-leaved deciduous vegetation and varies from being semipermanently flooded above the school, to seasonally saturated conditions near Lyons Road. The herbaceous layer is extremely diverse and includes broad-leaved cattail, narrow-leaved cattail, sensitive fern, fox sedge, fringed sedge, soft rush, American bur-reed, arrowhead, rattlesnake grass, boneset, and verbena. The ponded portions of the wetland contain bladderwort, yellow waterlily, and pondweed. Shrubs present in the wetland include silky dogwood, speckled alder, and elderberry. The tree layer consists primarily of red oak, white pine, black cherry, apple, and quaking aspen. Three invasive plant species (autumn olive, purple loosestrife, and reed canary grass) were also observed. Wildlife species observed included song sparrow (*Melospiza melodia*), northern cardinal (*Cardinalis cardinalis*), red-winged blackbird (*Agelaius phoeniceus*), and American bullfrog (*Lithobates catesbeiana*).

The concrete culvert at Lyons Road measures approximately 4.5 feet wide and has a grate, which had been maintained in the past. Although beaver activity was low at the culvert, the presence of a deep sub-pond should be reviewed by Town staff for overall safety considerations. A water flow device may be desirable in the primary dam to maintain water depths and protect the downstream culvert associated with Lyons Road. A device may be warranted at Lyons Road if beaver activity increases again at the culvert. The existing grate, although in disrepair during the site assessment, has the potential to limit overall wildlife passage in the stream channel when it is installed.

4.1.17 Area 17

Area 17 is located on Mast Road in the southeastern portion of Town and is associated with a ditch and culvert crossing on the road. One beaver dam is located just upstream of the road, within the road right-of-way, and has raised water level by approximately 3 feet above the road grade. This dam is approximately 10 feet long by approximately 3 feet wide.

View of dam located directed adjacent to Mast Road.

View of beaver pond located directly adjacent to Mast Road.

The wetland associated with Area 17 is classified as a palustrine aquatic bed and unconsolidated bottom system that is semipermanently flooded (PAB/UBF). This wetland area is dominated by broad-leaved cattail, jewelweed, boneset, water-shield, bur-reed, bearded sedge, tussock sedge, skunk cabbage, and northern arrowhead. The open water system transitions into a large palustrine forested system (PFO1/4E) that borders a large extent of Mast Road. The canopy of the adjacent forested wetland is dominated by gray birch, red maple, and white pine. The shrub layer is dominated by glossy buckthorn, an invasive species. Speckled alder was observed in the sapling layer.

Although nearby road culverts do not have signs of recent beaver activity, the presence of a beaver dam directly adjacent to Mast Road is causing flooding at a utility pole and represents a potential hazard to the road, should the dam fail. A water flow device may be necessary to control the water elevation of the pond near the road. The presence of a second channel located west of Area 17 presents another possible future conflict area.

View of culvert and stream located on Mast Road that function as potential beaver dam sites.

4.1.18 Area 18

Area 18 is located off of Mayflower Road in Meadowwood Pond. The majority of the pond is bordered by residential development. A Town-maintained sewer line forms a dam to the southern border of the pond. The sewer line forms the outlet to a small stream which has been the location of intense beaver activity. The sewer line contains a drop inlet and interceptor. Area 18 contains a large beaver dam above the sewer line and the sewer line interceptor and both the drop inlet and interceptor has been regularly plugged by beaver damming activities. The western edge of the pond contains a large beaver lodge.

View of sewer line area looking towards Mayflower Road.

View of pond looking upstream of beaver dams.

The wetland associated with Area 18 is classified as a palustrine aquatic bed system that is permanently flooded. Dominant vegetation in the wetland includes white water lily and jewelweed. The pond is bordered by a band of white pine, red maple, and red oak. Despite dense residential development, and relatively limited forested cover, the presence of water lily and other aquatic plants provides high quality summer forage for beaver.

View of plugged drop inlet at sewer line.

View of primary beaver dam.

Area 18 has been the source of concern for residents bordering the pond. Dam construction by beaver has caused flooding in at least one yard, and beaver have felled large trees in adjacent yards. One owner requested immediate action to limit impacts to her property and the Dam Bureau directed the Town to prevent damage by beaver to the sewer line. Although the Town had installed a “beaver pipe” to maintain water flow in the primary dam, the pipe was routinely plugged by beaver and was not functioning. Due to landowner concerns, as well as a need to protect the sewer line infrastructure, Area 18 was considered a high priority area for management activities. A proper water flow device, as well as a protective fence for the drop inlet structure was installed at Area 18 during 2014.

4.1.19 Area 19

Area 19 is located on Merrymeeting Drive near dense residential development in the northwestern portion of the Town. The area is the location of a 36-inch culvert and grate. The upstream portion of the culvert is classified as a palustrine emergent wetland that is semi-permanently flooded. The downstream portion of the wetland is a palustrine broad-leaved deciduous wetland that is seasonally and semi-permanently flooded. The dominant vegetation in the ponded portion of the wetland included broad-leaved cattail, tussock sedge, and white water lily. Green frog, American toad, gray catbird, American goldfinch, gray squirrel, and broad-winged hawk were observed in the wetland.

Some minor beaver activity was observed at the culvert in the form of packed mud, suggesting the creation of a new dam. More intense activity had been previously observed by the Town at the culvert, and in nearby residential yards before trapping conducted in 2012. Based on the presence of appropriate habitat, it is likely that beaver will recolonize the pond and increase damming activities. At this time, a water flow device may be required at the culvert to prevent weekly maintenance of the culvert grate.

View of wetland located at Merrymeeting Road.

View of Merrymeeting Road culvert.

4.1.20 Area 20

Area 20 is located near Carrie Drive and Madistone Drive, on the southern edge of the Mitchell Drive Town Forest. This area has dense residential development and has been the location of extensive beaver damming activity. Due to the low streambank slopes and adjacency of yards, the beaver dams caused flooding in residential yards and were impacting the preformance of septic systems located in the area. One 40-foot long by ten foot wide breached beaver dam was located in this area as well as a series of small dams across small tributary flows.

View of inactive breached beaver dam at Area 20.

View of tree damage caused by beaver.

The wetland located in the vicinity of Area 20 is a riverine lower perennial system (R2UB) that transitions into a large palustrine scrub-shrub wetland system near the Mitchell Drive Town Forest boundary. The canopy of the wetland is dominated by red maple, white pine, eastern hemlock, American elm, and red oak. The shrub layer is dominated by American elm, eastern hemlock, musclewood, winterberry holly, witch hazel, speckled alder, and spicebush. The herbaceous layer includes a diversity of species including fringed sedge, jewelweed, cinnamon fern, sensitive fern, lurid sedge, partridgeberry, Indian pipe, starflower, arrowhead, and poison ivy. Wildlife observed in the area included mallard (*Anas platyrhynchos*), white-tailed deer (*Odocoileus viginianus*), and raccoon (*Procyon lotor*).

Due to the multiple conflicts with residential uses, Area 20 was heavily trapped in the fall of 2013. This resulted in relatively minimal beaver activity in the immediate area during 2014. However, due to the high habitat value of the site, it is likely that Area 20 will be recolonized by nearby colonies (e.g., Area 35) where beaver were observed during 2014. As a result, flow devices may be needed in primary beaver dams when activity increases again in this area.

View of low floodplain and close proximity of residences to Area 20.

4.1.21 Area 21

Area 21 is located off of Ingham Road and is associated with Naticook Dam on Naticook Brook. This area is part of a conservation area known as Wasserman Park located adjacent to Naticook Lake. Four beaver dams were located in Naticook Brook ranging from 15 to 20 feet wide and two to four feet tall.

View of Naticook Dam looking toward Naticook Lake.

View of Naticook Brook looking upstream.

Naticook Brook is classified as a riverine lower perennial unconsolidated bottom system (R2UB). The tree layer of the brook is dominated by white pine, eastern hemlock, black birch, red maple, and oak. Species present in the shrub layer included sweet pepperbush, witch hazel, highbush blueberry, and chestnut. Wild sarsaparilla and cardinal flower dominated the herbaceous layer. Wildlife species observed in the stream include American goldfinch, pickerel frog (*Lithobates palustris*), and broad-winged hawk.

Although beaver activity was observed, current activity levels did not appear to be impacting the existing dam or nearby residential yards to a great degree. As a result, this area does not require any management activities based on current beaver activity levels. Due to the presence of conservation land, it would be efficient to conduct annual beaver activity monitoring during regular conservation easement monitoring.

4.1.22 Area 22

Area 22 is located adjacent to Naticook Road across from Greens Pond Road. This location is part of a large extensive beaver marsh that is hydrologically connected to Greens Pond. Multiple beaver lodges and food piles can be observed from Naticook Road. During 2014, beaver activity was high in this area. Due to the presence of dense emergent vegetation near wooded areas, this area will likely continue to have high habitat suitability for beaver well into the future.

The marsh associated with Area 22 is classified as a palustrine emergent system that is semipermanently flooded (PEM1F). Dominant vegetation in the marsh includes broad-leaved cattail and tussock sedge. The marsh is bordered by undeveloped upland dominated by red maple and white pine.

Area 22 contains a drop inlet to a culvert under Naticook Road that eventually drains to Greens Pond. The existing inlet is regularly plugged by beaver, which has resulted in road flooding in the past. The Highway Department has had to complete regular maintenance in Area 10 to maintain the road. A protective fence and water flow device was installed at this location during 2014.

View of Area 22.
The metal grate in the foreground is repeatedly plugged by beaver.

4.1.23 Area 23

Area 23 is located on Naticook Road Extension, near Joey Road and Area 15 (see Area 15 above for habitat information). Area 23 consists of double three foot wide concrete culverts. Due to ongoing beaver dam activities, the Highway Department maintains a grate on the culvert to prevent complete culvert blockage. This area was considered a high priority item by the Highway Department due to excessive maintenance of the culvert grate. However, the presence of an upstream beaver dam over the sewer line, partially located on private property, has triggered the need for long-term planning with multiple land/easement holders.

View of plugged culverts at Continental Blvd.

View of beaver pond located upstream of Continental Blvd.

4.1.24 Area 24

Area 24 is located on South Baboosic Lake Road on the northwestern corner of the Town, just northeast of Beebe Lane. The area is associated with triple 36-inch culverts that provide hydrologic connectivity to a large marsh system. The wetland is classified as a palustrine emergent and scrub-shrub system that is semipermanently flooded. The shrub layer of the wetland is dominated by red maple in association with speckled alder, red-osier dogwood, and common elderberry. The herbaceous layer is heavily dominated by broad-leaved cattail. Wool grass, duckweed, sensitive fern, and poison ivy is also present. Purple loosestrife, and invasive plant, was observed in the wetland. The wetland system is densely vegetated. Channels located within the wetland contain approximately two to three feet of standing water. During site assessments, American toad (*Anaxyrus americanus*), American goldfinch, and painted turtle (*Chrysemys picta*) was observed. The wetland has high habitat value and is likely utilized by a diversity of turtle species, as well as wading birds and species associated with shrub habitats.

No beaver activity was observed during 2014. However, the culverts present on the road represent potential dam sites. If damming is observed in the future, culvert protective fences could be installed to prevent culvert blockage, while maintaining the important habitat features of the adjacent marsh. Any protective fences utilized in this area should be designed to provide passage to turtles.

View of large emergent wetland complex at Area 24.

View of culvert at Area 24.

4.1.25 Area 25

Area 25 is located on Summitt Road and is associated with a six foot wide CMP culvert and grate, and six, six inch plastic corregated pipes extending out of the CMP pipe. Summitt Road separates a large wetland complex. The northern side of the wetland is classified as a palustrine emergent wetland that is semi-permanently flooded (PEM1F). The southern side of the wetland is classified as a palustrine forested system that is dominated by broad-leaved deciduous vegetation and is seasonally saturated (PFO1E). The tree layer of the wetland is dominated by red maple, and includes white pine and white ash. The shrub layer is dominated by speckled alder. The herbaceous layer of the marsh contains pondweed, broad-leaved cattail, bur-reed, jewelweed, halberd-leaved tearthumb,

and duckweed. GZA observed green frog (*Lithobates clamitans*), catbird (*Dumetella carolinensis*), American goldfinch, raccoon (tracks), downy woodpecker, and mallards in the wetland system. The wetland also has high habitat value to a diversity of turtle species.

View of culverts installed on Summitt Road to prevent plugging by beaver. These limit flow and wildlife passage.

View of mallards in the Summitt Road marsh.

The culvert is the location of a small intermittent stream. Although beaver activity has been observed in the past, there was no new damming observed during 2014. One abandoned dam, measuring approximately five feet long by two feet wide was observed at the culvert structure. The presence of a grate and multiple pipes within the primary pipe suggests that the culvert was altered in the past to limit culvert plugging. However, the current pipe limits both wildlife passage and stream flow. If beaver activity increases in this area, a properly designed culvert fence is recommended to replace the six smaller plastic pipes in the primary culvert structure.

4.1.26 Area 26

Area 26 is located on Watkins Road in the eastern-central portion of Town. Watkins Road contains a 24-inch concrete pipe. This area is hydrologically connected to Merrill Road, which is located to the west of Watkins Road and contains three concrete pipes. A man-made dammed pond is located to the east of Watkins Road.

The dammed pond located adjacent to Watkins Road is bordered by red maple, white pine, red oak, and gray birch, near light residential development and associated agricultural uses. The shrub layer is dominated by speckled alder and American elm. The herbaceous layer contains milfoil, jewelweed, duckweed, marsh fern, hayscented fern, royal grass, wood reed grass, and arrow-leaved tearthumb. Painted turtles, mallards, and otter (*Lontra canadensis*) sign was observed in the pond. Otter activity was high as evidenced by otter latrines and scat, as well as piled turtle shells near the otter latrines.

During 2014, no beaver activity was observed at the Watkins or Merrill Road culverts. However, activity was observed at the dammed pond located adjacent to Watkins Road. The pond is created by a concrete dam located east of Watkins Road. Beaver damming is

clogging the intake of the concrete dam. There are no known complaints or property impacts from this activity during 2014. As a result, no management is currently recommended at this area. Should activity increase at the culverts, the culverts could be protected with properly designed fence systems.

View of pond located upstream of Watkins Road.

View of otter latrine. The pond provides habitat to a variety of species.

4.1.27 Area 27

Area 27 is located on West Thornton Road, near House #26, in the southern portion of Town. Two culverts (one 12-inch CMP and one two foot concrete pipe and metal grate) connect the Pennichuck Brook wetland system located to the south to wetlands located on the north side of West Thornton Road. In the immediate vicinity of Area 27, the large wetland system is classified primarily as a permanently flooded palustrine aquatic bed/unconsolidated bottom system (PAB/UBH). White pine and red maple border the wetland. Shrubs present outside of flooded areas include white oak, red oak, white pine, and common elderberry. The herbaceous layer includes tussock sedge, watershield, white water lily, pickerel weed, arrow arum, pondweed, bladderwort, sensitive fern, and New York fern. GZA observed white-breasted nuthatch (*Sitta carolinensis*), American crow, and blue jay (*Cyanocitta cristata*) adjacent to the wetland. However, public access is restricted from a majority of the wetland due to the use of the area as part of the Water Works system.

GZA observed old beaver activity at the two foot culvert and grate. However, no new dams were observed. If activity increases, a culvert protective fence in this area might serve to limit frequent maintenance and provide enhanced aquatic passage.

View of Pennichuck Brook wetland system.

View of road culvert requiring period maintenance.

4.1.28 Area 28

Area 28 is located at Whispering Pines Road, a discontinued road associated with the historical Twin Bridges sites. This area is part of Baboosic Brook and is classified as a riverine, lower perennial unconsolidated bottom system (R2UB). The tree layer bordering the brook channel is diverse and includes American elm, red maple, Eastern hemlock, white pine, gray birch, red oak, black cherry, and shagbark hickory. The shrub layer includes witch hazel, common elderberry, honeysuckle, silky dogwood, and northern arrowwood. Multiflora rose, an invasive species, was also observed. The herbaceous layer includes fringed sedge, cinnamon fern, pickerelweed, bur-reed, royal fern, sensitive fern, and Virginia creeper.

View of old granite bridge known as "Twin Bridges."

View looking upstream at Twin Bridges.

Twin Bridges consists of old stone bridge abutments. In one location, where the abutments have become dilapidated, beaver have started construction of a 25-foot long by three foot wide stick dam. Due to the steep grades in this location, and relatively far distance to nearby houses, no management is recommended in this area. Should beaver activity increase, and pose unacceptable impacts, a properly designed water flow device could be installed in the dam.

During site assessments, beaver sign and red fox (*Vulpes vulpes*) scat was observed in the area. Area 28 is ranked by the NH Fish and Game Department as Highest Ranked Habitat in the Biological Region and multiple rare species are known in this area.

View of the start of a beaver dam at Twin Bridges.

View of wetland located upstream of Twin Bridges.

4.1.29 Area 29

Area 29 is a large marsh complex located off of Queens Way and Regal Drive, located near Horse Hill. Near Queens Way, the wetland is classified as a palustrine emergent and aquatic bed system that is semi-permanently flooded (PEM/AB1F). To the east, the wetland transitions into a riverine system. The tree layer is dominated by white pine and red maple. Species present in the shrub layer include highbush blueberry, yellow birch, and maleberry. The herbaceous layer is dominated by broad-leave cattail, in association with white water lily, royal fern, marsh fern, jewelweed, woolgrass, and sphagnum moss. Purple loosestrife, an invasive plant, is also present. GZA observed green frog, red-winged blackbird (*Agelaius phoeniceus*), mallard, beaver (sign), and mourning dove (*Zenaida macroura*) in the wetland. Rare species are known in the area.

View of Queens Way marsh.

View of beaver lodge located in the marsh.

Two beaver dams and a large beaver lodge were located in the wetland. The dams varied from approximately 50 to 60 feet long and were approximately five to ten feet wide. Both dams are located in an area used for archery, and do not appear to be impacting infrastructure. However, the Queens Way residences directly border the pond and future dam activity has the potential to cause flooding in these yards. Annual monitoring may be necessary in this area.

4.1.30 Area 30

Area 30 is located off of the Wildcat Falls Trail in the Currier Road Conservation Area, near Area 14 (see habitat information above under Area 14). The Currier Road Conservation Area borders the Souhegan River and is located in the northcentral portion of Town. Area 30 is accessed off of Hemlock Lane and is a detention pond constructed to provide treatment for a nearby parking area. During 2014, the outlet of the detention pond was plugged with cut cattail stems. Because beaver typically use mud and sticks to create dams, while muskrat tend to utilize cattail to create bank lodges, it is likely that muskrat are plugging the outlet of the detention pond, in addition to beaver. A properly designed protective fence will likely be needed at this outlet to minimize repeated maintenance. However, due to the small size of muskrat, a smaller mesh will likely be needed to construct the protective fence. Because this "dam" is located in a man-made detention fence, this is not expected to impact wildlife. Rare species are known from the area but are more likely to be associated with the nearby wetland complex, as opposed to the detention pond.

View of plugged inlet.

Overall view of detention pond.

4.1.31 Area 31

Area 31 is located on and off of Wire Road, and is associated with a portion of Baboosic Brook, upstream of Area 28. In this location, Baboosic Brook is classified as a riverine, lower perennial uncultivated bottom system (R2UB). The stream contains a well-developed forested floodplain dominated by red maple. The lower floodplain contains a dense shrub layer comprised of buttonbush, speckled alder, silky dogwood, northern arrowwood, and willow. The herbaceous layer is dominated by bur-reed, dark green

bulrush, royal fern, and cinnamon fern. GZA observed white tailed deer sign in the upper floodplain, as well as beaver activity. Rare species are also known to occur in Baboosic Brook.

View of Wire Road Bridge.

View of Baboosic Brook located downstream from the bridge.

In previous years, beaver dammed the large metal culvert located at Wire Road. During 2014, no new dams were located at the culvert. However, four individual beaver dams of varying sizes were located east of Wire Road and two additional dams were observed west of Wire Road in McQuade Brook, which drains into Baboosic Brook. East of Wire Road, the dams were only partially formed, varying from 45 to 75 feet long and covered approximately 70% to 95% of the channel width of Baboosic Brook. In McQaude Brook, dams ranged from 15 to 25 feet long and covered 100% of the channel.

View of old and newly created beaver dams on Baboosic Brook.

Based on observations during 2014, beaver activity is high at Area 31 but is not currently impacting infrastructure such as culverts. If activity becomes more excessive, and threatens property, flow devices may be required in one or more of the dams.

4.1.32 Area 32

Area 32 is located off of Brookside Drive, upstream of Area 5, in a portion of Baboosic Brook. Unlike Area 31, Area 32 is bordered by dense residential development to the south. The tree layer is dominated by white pine and red maple. The upper floodplain contains red oak, witch hazel, lowbush blueberry, in the shrub layer. Burning bush, an invasive species, is also present. The herbaceous layer is dominated by royal fern and cardinal flower. This portion of Baboosic Brook is mapped by the NH Fish and Game Department as Highest Ranked Habitat in the Ecological Region. Upland rare species are also known to occur in the general vicinity.

Two breached beaver dams were observed near Area 32, one totaling 30 feet long and the second consisting of two separate seven foot long segments on each side of the stream. GZA polled nearby residents on Brookside Drive. Although beaver activity has been high in previous years, the owners did not recall seeing beaver activity during 2014.

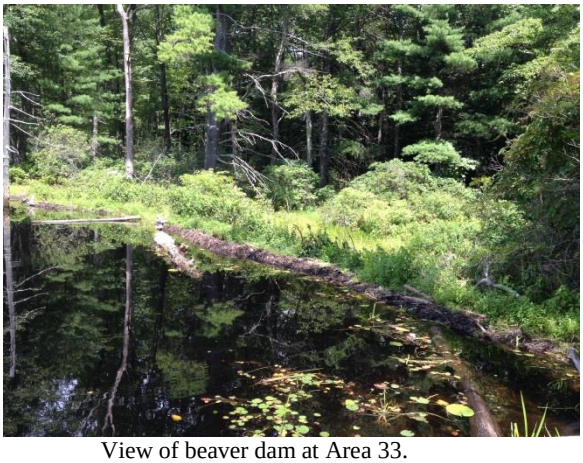
The presence of maintained backyards in the floodplain of the brook presents potential flooding conflicts. If activity increases in subsequent years, flow devices may be required in dams.

4.1.33 Area 33

Area 33 is an active beaver pond located in the Grater Woods Conservation Area. The beaver pond is classified as a palustrine aquatic bed and unconsolidated system that is semi-permanently flooded (PAB/UBF). The pond is surrounded by forest cover dominated by white pine, eastern hemlock, and red oak. Species present in the shrub layer include red maple and rhododendron. The herbaceous layer of the pond is diverse and includes white water lily, bur-reed, false nettle, wool grass, broad-leaved cattail, lurid sedge, three-way sedge, rattlesnake grass, St. Johns Wort and sensitive fern. A few scattered purple loosestrife plants (an invasive species) are also present. GZA observed wood duck (*Aix sponsa*), green frog, and beaver activity during site assessments. The area is mapped by NHFG as Highest Ranked Habitat and rare wetland species are known in the vicinity of the project. One large beaver dam measuring approximately 60 feet long by seven feet tall is located at the outlet to the pond.

Because this is a large conservation area located upstream of additional conservation land maintained by the Town, no management activities are recommended. This area represents an ideal location in town to allow natural dynamics of beaver pond succession. The site is already used as an outdoor classroom by the nearby middle school, and the maintenance of beaver in this pond supports a variety of wildlife species.

View of beaver pond and beaver lodge at Area 33.



View of beaver dam at Area 33.

4.1.34 Area 34

Area 34 is located in the Grater Woods Conservation Area, near Area 33. Similar to Area 33, this area provides an ideal location to allow the natural colonization and abandonment by beaver. Rare species are known to occur in the larger wetland complex and these species benefit from the presence of beaver and beaver ponds.

4.1.35 Area 35

Area 35 is known as the Mitchell Drive Conservation Area (i.e. Mitchell Woods). The area is located downstream of Area 20, and beaver activity in Area 35 has the potential to impact residences near Area 20. This area is a know "Greenway" connecting across Baboosic Lake Road to the Grater Woods Forest. This wildlife corridor supports deer, wild turkey, bear, Virginia opossum, moose and bobcat. The wetland is classified predominantly as a palustrine emergent system that is semi-permanently flooded (PEM1F). The wetland is bordered by forest dominated by red maple and white pine. The shrub layer contains steeplebush as well as autumn olive, an invasive plant. The herbaceous layer is dominated by broad-leaved cattail in association with spadderdock, pickerelweed, sedge, milfoil, and duckweed. Purple loosestrife, an invasive plant, is also present in the herbaceous layer.

This wetland contains a series of dams. During 2014, beaver activity was extremely high at one dam, totaling approximately 60 feet long by 10 feet wide. Activity at this dam was causing noticeable flooding in upstream residences. As a result, a flow device and protective fence was installed at the primary dam.

View of Mitchell Woods wetland complex.

View of large beaver dam and area of old underwater culverts and associated carriage road.

TABLE 1
Summary of Beaver Assessment Areas

Assessment Area	Location	Documented Current and Previous Beaver Activity Types				2014 Activity Level
		Dam Construction (Flooding)	Culvert Plugging	Tree Damage	Septic Failure	
1	Amherst Rd		X			None
2	Baboosic Rd		X	X		None
3	Bean Rd	X	X	X		None
4	McGaw Bridge Rd near Bel Air Ave					None
5	Brookside Dr	X		X		None
6A	Level St	X		X		Moderate
6B	Cathy Street	X	X			High
7	Craftsman Lane		X			Moderate
8	French Ct	X		X		None
9	Greater Woods Conservation Area	X				None
10	Greens Pond Rd		X			High
11	Hitchin Post Lane		X			High
12	Hanson Dr		X			High
13	Heidi Lane	X				Moderate
14	Wildcat Falls Trail culvert off Hemlock Dr		X			None
15	Continental Blvd, Joey Rd			X		High
16	Lyons Rd	X	X			Low
17	Mast Rd	X	X			High
18	Mayflower Rd	X	X	X		High
19	Merrymeeting Dr		X			Moderate
20	Carrie Dr/Madison Ln	X		X	X	Moderate
21	Naticook Dam, Ingham Rd	X				Moderate
22	Naticook Rd	X	X			High
23	Naticook Rd Ext	X	X			High
24	S. Baboosic Lake Rd		X			Low

Assessment Area	Location	Documented Current and Previous Beaver Activity Types				2014 Activity Level
		Dam Construction (Flooding)	Culvert Plugging	Tree Damage	Septic Failure	
25	Summitt Rd		X			Low
26	Watkins Ln/Merrill Rd		X	X		High
27	West Thornton Rd		X			Moderate
28	Whispering Pines (Twin Bridges)	X		X		Moderate
29	Queens Way/Regal Dr	X				Moderate
30	Wildcat Falls Trail SW pond off Hemlock Dr		X			High
31	Wire Rd	X				High
32	Brookside Dr	X		X		None
33	Grater Woods Conservation Area	X		X		Moderate
34	Grater Woods Conservation Area 3	X				Moderate
35	Mitchell Woods, Profile Dr	X				High

4.2 NATURAL RESOURCES

The Town of Merrimack hosts a diversity of natural resources, which are in part, supported by the wide extent and distribution of beaver ponds in the municipality (see **Figure 3**, Critical Natural Resources). In total, 28 of the 35 (80%) assessed problem areas are located within the vicinity of known semi-aquatic rare species locations. It is important to note that not all areas in Town have been surveyed and additional rare species locations are likely present. Semi-aquatic rare species known to occur in Town include Blanding's turtle (*Emydoidea blandingii*), spotted turtle (*Clemmys guttata*), wood turtle (*Glyptemys insculpta*), and bald eagle (*Haliaeetus leucocephalus*).

The Town is in a unique position to support rare species on a town-wide scale through the proper selection and execution of appropriate beaver management practices. As part of the development of this Plan, GZA consulted with the NH Fish and Game Department to obtain input on rare species considerations. The Nongame & Endangered Program recommended that the Town avoid destroying and removing existing beaver dams as turtles including the State Endangered Blanding's turtle will overwinter in beaver dams. In addition, beaver ponds and marshes often provide ideal habitat structure and hydrology for both spotted turtle, a State Threatened species and Blanding's turtle. In addition, beaver ponds support a high diversity of waterfowl, wading birds, songbirds, semi-aquatic mammals, and aquatic species such as fish. As a result, the complete dewatering of beaver ponds is not generally desirable from a natural resource management perspective.

View of painted turtle in Merrymeeting Marsh.

TABLE 2
Summary of Significant Natural Resources Located Near Beaver Assessment Areas.

Assessment Area	Location	Natural Resource						
		Semi-aquatic Rare Species	Fisheries (rare)	Heron Rookery	Significant Wildlife Action Plan Habitats	Exemplary Community	Mapped Vernal Pools	Upland Rare Species
1	Amherst Rd	X		X			X	
2	Baboosic Rd	X			X		X	
3	Bean Rd	X	X		X			
4	McGaw Bridge Rd near Bel Air Ave	X	X			X		
5	Brookside Dr	X	X		X			X
6A	Level St							
6B	Cathy Street							
7	Craftsman Lane	X	X		X			
8	French Ct	X	X		X			
9	Greater Woods Conservation Area	X			X		X	
10	Greens Pond Road	X					X	X
11	Hitchin Post Lane			X				
12	Hanson Dr							
13	Heidi Lane	X						
14	Wildcat Falls Trail culvert, off Hemlock Dr	X					X	
15	Continental Blvd, Joey Rd				X			
16	Lyons Rd							
17	Mast Rd	X			X			
18	Mayflower Rd	X						
19	Merrymeeting Dr	X			X		X	
20	Carrie Dr/Madison Ln				X		X	
21	Naticook Dam, Ingham Rd	X						

Assessment Area	Location	Natural Resource						
		Semi-aquatic Rare Species	Fisheries (rare)	Heron Rookery	Significant Wildlife Action Plan Habitats	Exemplary Community	Mapped Vernal Pools	Upland Rare Species
22	Naticook Road	X					X	X
23	Naticook Rd Ext	X	X		X			
24	S. Baboosic Lake Rd	X		X	X		X	X
25	Summitt Rd	X					X	
26	Watkins Ln/Merrill Rd	X						
27	West Thornton Rd	X			X			X
28	Whispering Pines (Twin Bridges)	X	X		X			
29	Queens Way/Regal Dr	X		X			X	
30	Wildcat Falls Trail SW pond off Hemlock Dr	X					X	
31	Wire Rd	X	X					
32	Brookside Dr	X	X		X			X
33	Grater Woods Conservation Area				X		X	
34	Grater Woods Conservation Area 3	X		X	X		X	X
35	Mitchell Woods, Profile Dr	X	X		X		X	

The Town also contains important fisheries and 10 of the assessed areas are located near known rare fish populations. Swamp darter (*Etheostoma fusiforme*), banded sunfish (*Enneacanthus obesus*), sea lamprey (*Petromyzon marinus*), and American eel (*Anguilla rostrata*) are State listed and known to occur in Town. In general, fish are benefited by culverts that maintain appropriate aquatic passage and maintain safe flows during both low and high water conditions. Culverts that are "perched" above the normal water elevation often restrict fish movement and genetic diversity of fish populations by limiting dispersal and emigration to and from individual wetlands. Management practices for beaver that avoid additional culvert restrictions (e.g., small grates, smaller culverts placed within larger culverts) are preferred especially where sensitive fish species have been documented.

In addition to the presence of aquatic species, the Plan also considered the presence of rare upland species to determine the potential impacts of new dam creation. In total, seven of the assessed sites are located within the vicinity of rare upland species including late purple American aster (*Symphyotrichum patens*), blue corporal (*Ladona deplanata*) and northern black racer (*Coluber constrictor constrictor*). However, all sites are existing ponds and marshes. In addition, 18 of the assessed areas are located within or near Tier 1 and Tier 2 Wildlife Action Plan habitats and one is located near an exemplary community. These represent locations where drastic changes in habitat condition (via beaver dam alteration) may not be desirable.

4.3 GIS MODEL OF HABITAT SUITABILITY

Of the 35 assessment areas, 34 were accurately predicted as "high habitat suitability" areas in the GIS model. The remaining area was rated as a "moderate habitat suitability" area and has no current beaver activity or current conflicts with infrastructure. As a result, the GIS model provides a tool for predicting potential future conflict areas to guide land management decisions. The model is not intended to be used to predict where beavers won't occur, but provides a framework for understanding where beaver activity is likely or has a higher probability of occurring. The model is particularly useful for a species such as beaver, which may abandon and then recolonize individual areas over time developing on food availability and other factors (see **Figure 5**, Beaver Habitat Suitability Model).

4.4 MANAGEMENT RECOMMENDATIONS

As described above, the Town desired management recommendations that limited frequent maintenance of infrastructure, reduced overall management costs over the long-term, avoided impacts to natural resources, and promote co-existence with beavers (see **Table 3**). Beaver dam removal and trapping are often the first or primary tools used to address management conflicts. However, removal of beaver dams is generally a poor management choice because the alteration of dams often triggers immediate dam repairs by beaver and may even stimulate the construction of additional dams by beaver. Dam construction also alters pond depths, which may impact both common and rare aquatic and semi-aquatic species. For these reasons, full-scale dam removal is often not successful and may even exacerbate a problem. Trapping in one year is always a temporary measure as beaver disperse from natal colonies every year and trapping represents a temporary solution. As a result, trapping is not a preferred or long-term method to addressing beaver conflicts. Overtrapping can also stimulate breeding at a younger age, and is not an ideal management tool. Considering both the immediate expense of trapping, and long-term costs, trapping should only be considered in specific scenarios. Boyles (2006) recommends trapping during the first year of water flow device installation to acclimate a beaver colony to a new desired water level. However, water level changes of less than one foot may be very successful without trapping (pers. Comm. Mike Callaghan, Beaver Solutions). Live trapping was not considered a viable alternative for this Plan as live-trapping often relocates a problem, or leads to conflicts with existing established beaver colonies.

In many cases, existing beaver conflicts are associated with flooding and infrastructure maintenance. Culvert grates have been utilized by the Town but require extensive maintenance, can reduce aquatic passage, and generally limit the hydraulic capacity of culverts as they become plugged during storms. The installation of properly designed water flow devices can often address beaver conflicts in many scenarios, and is the primary management tool identified in this Plan. Flow devices may be installed in beaver dams, or in infrastructure such as culverts and drop inlets to maintain flow and limit flooding. At the request of the Town of Merrimack, GZA identified the Top 10 highest priority conflict areas and provided recommendations for these areas. GZA also developed a decision matrix for addressing conflicts in other areas in Town.

Table 3. Summary of management recommendations prepared to address flooding and other impacts created by beaver activities at known problem areas in the Town of Merrimack during 2014.

Area	Location	2014 Activity Level	Residential Conflict Potential	Rare Species Impact Potential	Priority	Recommendation
1	Amherst Rd	None	Low	High	Low	Maintain culvert Larger new box has experienced less conflict
2	Baboosic Rd	None	Moderate	Moderate	Low	Maintain culvert
3	Bean Rd	None	High	High	Low to Mod	Maintain culvert, devices not recommended due to presence of sensitive fish species
4	McGaw Bridge Rd	None	Low	High	Low	None (monitor)
5	Brookside Dr (Associated with: Area 32)	None	High	Moderate	Low	None (monitor)
6A	Level St	Moderate	Low (now)	Low	Low	None (monitor)
6B	Cathy Street	High	High	Low	Mod to High	Assess activity during Spring 2015 and consider installation of a Flexible Pond Leveler
7	Craftsman Lane	Moderate	Low	High	Low to Mod	Consider Beaver Deceiver if management becomes excessive; sensitive fish present
8	French Ct	None	Moderate	High	Moderate	None (monitor)
9	Greater Woods Conservation Area (Associated with: Areas 33 and 34)	None	Low	Moderate	Low	Presence of conservation land likely precludes future management needs
10	Greens Pond Rd (Associated with: Area 22)	High	Low	Moderate	High	Consider protective fence and pipe device
11	Hitchin Post Lane	High	Mod to High	Low	Mod to High	Consider Flexible Pond Leveler in large dam to maintain water level, contact adjacent land owner
12	Hanson Dr	High	High	Low	Moderate	Consider a Beaver Deceiver
13	Heidi Lane	Moderate	High	High	Low	None (monitor)
14	Wildcat Falls Trail culvert (Associated with: Area 30)	None	Low	High (with dam removal)	Low	Maintain culvert
15	Continental Blvd, Joey Rd	High	Moderate	Low	Moderate	Consider a Flexible Pond Leveler
16	Lyons Rd	Low	Low	Low	Moderate	Consider a Beaver Deceiver at Lyons Road and a Flexible Pond Leveler in the Primary Dam
17	Mast Rd	High	Low	Moderate	Moderate	Consider a Flexible Pond Leveler in the dam adjacent to the road at Beaver Deceivers at the road culverts
18	Mayflower Rd	High	High	Moderate	High	Consider a Flexible Pond Leveler, protective fence at the Interceptor and tree guards
19	Merrymeeting Dr	Moderate	High	Moderate	Low	Maintain culvert, consider devices that do not limit turtle movement
20	Carrie Dr/Madison Ln (Associated with Area 35)	Moderate	High	Moderate	High	Consider a Flexible Pond Leveler if activity increases again
21	Naticook Dam, Ingham Rd	Moderate	Low	Low	Low	Maintain Naticook Dam outlet, lower beaver dams not impacting residents at this time
22	Naticook Road (Associated with: Area 10)	High	Low	Moderate	High	Consider a protective fence and pipe system at the drop inlet if maintenance becomes excessive
23	Naticook Rd Ext	High	High	Moderate	Moderate	Consider a Beaver Deceiver to promote fisheries and limit maintenance. The current grate limits flows.
24	S. Baboosic Lake Rd	Low	Low	High (with dam removal)	Low	Maintain culvert
25	Summitt Rd	Low	Low	High	Low to Mod	Maintain culvert, consider different culvert retrofit to benefit rare turtles

Table 3. Summary of management recommendations prepared to address flooding and other impacts created by beaver activities at known problem areas in the Town of Merrimack during 2014.

Area	Location	2014 Activity Level	Residential Conflict Potential	Rare Species Impact Potential	Priority	Recommendation
26	Watkins Ln/Merrill Rd	High	Moderate	Moderate	Low to Mod	Dam maintenance (private) may be needed
27	West Thornton Rd	Moderate	Moderate	High	Low to Mod	Maintain culvert, species present not likely impacted by culvert maintenance, consider culvert protective device if maintenance is excessive
28	Whispering Pines (Twin Bridges)	Moderate	Low	High	Low	None (upstream area is largely undeveloped)
29	Queens Way/Regal Dr	Moderate	Moderate	High	Low	None (monitor, future dams have high potential to cause conflicts with residents)
30	Wildcat Falls Trail SW pond (Associated with: Area 14)	High	Low	High	Moderate	Consider a protective fence at the stormwater pond outlet for exclusion
31	Wire Rd	High	Low	High	Low	Maintain culverts (upstream areas may require Flexible Pond Levelers in the future)
32	Brookside Dr (Associated with: Area 5)	None	High	Moderate	Low	None (monitor)
33	Grater Woods Conservation Area – Mid Pond (Associated with: Areas 9 and 34)	Moderate	Low	Moderate	Low	None (presence of conservation land precludes management need)
34	Grater Woods Conservation Area 3 – Upper Pond (Associated with: Areas 9 and 33)	Moderate	Low	Moderate	Low	None (presence of conservation land precludes management need)
35	Mitchell Woods, Profile Dr (Associated with: Area 20)	High	High	Moderate	High	Consider a Flexible Pond Leveler due to association with Area 20 and prior septic system failure

Current State of New Hampshire law (RSA 210:9) allows a landowner or municipal official to conduct common beaver management activities without a permit. According to RSA 210:9, "A landowner, landowner agent, or any municipal official or employee may destroy beaver, remove beaver dams, or install beaver pipes or beaver fences on property under their supervision without a permit under RSA 482-A if machinery does not enter the water and filling or dredging in or immediately adjacent to surface water, wetlands, or their banks does not occur. Removal shall be done in a gradual manner so as not to cause erosion, siltation, or a safety hazard." Under RSA 210:9, beaver pipes do not require a state permit if they consist of no more than three temporary structures with the widest pipe no larger than 15 inches placed in a dam. The flow devices recommended in this Plan were developed to fall under the criteria of RSA 210:9.

A variety of flow devices have been designed by others for use in beaver dams, to allow the passage of water and maintain beaver pond levels at a specific desired level. Flexible Pond Levelers, Clemson Beaver Pond Levelers, and "beaver boxes" are all variations of potential flow devices that may be installed in beaver dams. This Plan identified the installation of Flexible Pond Levelers as the primary water flow device, as Flexible Pond Levelers are relatively easy to maintain, allow for site specific placement of an outlet, and have a proven track record of working in similar watersheds. Clemson Pond Levelers are not recommended as part of this plan as they lack the versatility of Flexible Pond Levelers, are generally limited to small watersheds, and can be more expensive and complicated to construct.

A variety of fence systems may be employed at culverts and drop inlet to prevent plugging from dam construction. Fence systems may be trapezoidal, triangular, rectangular/square, or round in construction. The actual shape of the fence system is often influenced by site conditions including channel width and depth. The use of a "double filter system" may be used to extend the feel of flowing water away from the drainage structure being replaced, to encourage damming away from the critical infrastructure.

4.4 MANAGEMENT IMPLEMENTATION

During November 2014, five devices were installed in three areas (Area 18, Area 35, and Area 22) to address the areas of highest priority, as determined by the Conservation Commission. Beaver Solutions, LLC was hired by the Town of Merrimack to complete the final design and installation of devices at these sites. GZA completed construction monitoring during the installation of devices.

Area 18 (Meadowwood Pond)

A Flexible Pond Leveler and 15" ADS pipe were installed in the beaver dam located upstream of the sewer line. The leveler was designed to replace a dysfunctional beaver box that was plugged and no longer functioning. Beaver Solutions LLC installed the leveler with assistance from the Town of Merrimack Highway Division. The Leveler was installed at an elevation to effectively reduce the pond level at the dam by approximately one foot. This depth reduction was designed to address private property impacts caused by

the rising pond levels, reduce flooding risks to the adjacent sewer line, and to maintain appropriate water depths in the pond to continue to support beaver. In addition, water level changes of more than one foot can be associated with an increase in damming activity by behavior, so the water level change was considered an appropriate compromise between the desire to maintain private property and municipal infrastructure, while maintaining important natural features associated with Meadowwood Pond.

View of construction of Flexible Pond Leveler.

View of protective fence installed at the inlet to Meadowwoods Dam.

To limit repeated maintenance at the existing drop inlet, a fence and pipe flow device were installed at the inlet. The goal of the installation was to reduce the need for weekly maintenance by the Highway Department, and to protect water flow through Meadowwood Dam. This indirectly also serves to protect the base flows of the associated stream, which were limited by repeated damming.

The Highway Department assisted with site preparation.

View of installed devices. The Flexible Pond Leveler in the main beaver dam is submerged.

Area 35 (Mitchell Woods)

Area 35 is the location of large and actively maintained beaver dam which was contributing to residential flooding at Area 20. On November 25, 2014, Beaver Solutions, LLC installed a Flexible Pond Leveler and approximately 40 feet of associated 15" ADS pipe in the primary dam in the Mitchell Woods Conservation Area. A 10-foot pipe

extension and exclusion fence was also installed at the outlet of the leveler to provide protection of the flow device at the outlet, where reduced water depths were present. The devices were installed at a height in the dam to achieve an approximately one foot drop in the pond level. During installation, old culverts were discovered buried in the beaver dam, above the elevation of an old carriage road. The intent of the devices was to avoid the constant need for maintenance of the beaver dam to limit impacts on residents. Town volunteers were conducting weekly maintenance evaluations of the dam in the conservation area to assess impacts to nearby residents.

View of Flexible Pond Leveler prior to submersion.

View of pipe outlet installed in beaver dam.

Area 22 (Naticook Road)

Area 22 contains a submerged drop inlet that is repeatedly plugged by beaver. The drop inlet connects to a culvert under Naticook Road that provides hydraulic connectivity to a stream. When not maintained, the plugging of the drop inlet results in flooding of Naticook Road. Beaver Solutions, LLC installed a culvert protective fence and pipe device at the drop inlet, consisting of a Flexible Pond Leveler pipe system and 15-inch pipe connected to the fence protecting the drop inlet. The inclusion of the Flexible Pond Leveler pipe system allows beaver to dam at the drop inlet while still allowing flow through the leveler pipe. Water flow was restored to the drop inlet at the completion of construction of the pipe and fence system.

View of Constructed Flexible Pond Leveler just prior prior to installation at the drop inlet.

View of protective fence and outlet of the Flexible Pond Leveler at the drop inlet after installation.

General Construction Procedures

All of the devices were constructed on site by Beaver Solutions, LLC and the construction and installation of the devices was monitored by GZA. Fences were constructed from 6 gauge steel panels, typically used for concrete work. The fences were cut to shape, rolled by hand, and attached together using metal fasteners. Three panels were used to construct the main body of the protective fences, and to form the top and bottom of the fences. The fences were approximately 5.75 feet wide and 3.75 ft. tall, and are designed to encircle and protect the inlet of the installed pipe. The wide circumference limits the amount of flow felt by beaver at inlet of the pipe.

High Density Polyethylene (HDPE) Pipe (15-inch) was obtained by ADS. Double-walled pipe was selected to provide additional protection from chewing by beaver. To insert the pipe, 1.5 ft. wide by 1.5 ft. tall openings are cut in the base of the fence. A few holes are drilled into the pipes to allow gases to escape and the pipes are weighed down with small concrete blocks.

Six gauge steel panels are used to construct protective panels.

The panels are cut, rolled, and bent to form an approximate 5.75 foot wide and 3.75 foot wide protective fence to surround the inlet of an HDPE pipe.

4.5 LONG-TERM MONITORING AND DECISION MAKING

4.5.1 Beaver Management Decision Matrix

The following protocols are designed to assist the Town of Merrimack in making consistent decisions relative to management activities at areas with problematic beaver activity. It is recognized that at least six different Town entities (Private Property owners, Merrimack School District, Town of Merrimack Highway Division, Town of Merrimack Stormwater Division, Town of Merrimack Wastewater Division, and Town of Merrimack Conservation Commission) are responsible for providing management activities at properties under their prevue and are involved in maintaining infrastructure that may be affected by beaver activity. The following protocols are designed to facilitate routine maintenance activities, while providing continuity in management approaches, data gathering, and cost sharing. Currently, it is anticipated that the Conservation Commission will oversee the GIS database of beaver activity, however it is expected that all departments involved in beaver activity will have a role in contributing and sharing data on management activities and following the decision matrix, once formally accepted by the Town. The Town Conservation Commission will, on an annual basis, confirm the current local and state regulations relative to beaver device installation and adjust this matrix as necessary, based on changes in relevant regulations (e.g., NH RSA 210:9).

I. General Procedures

a. Upon receipt of a complaint or report of beaver activity, the contacted entity (e.g., Public Works or Conservation Commission) will determine the location of beaver activity and assess whether the activity is occurring on Town-owned properties or right-of-ways.

b. Once the ownership of the beaver activity is determined, the appropriate Town entity (e.g., Conservation Commission for conservation properties and Highway Division for public roads) will be contacted within 48 hours of a public complaint, if feasible.

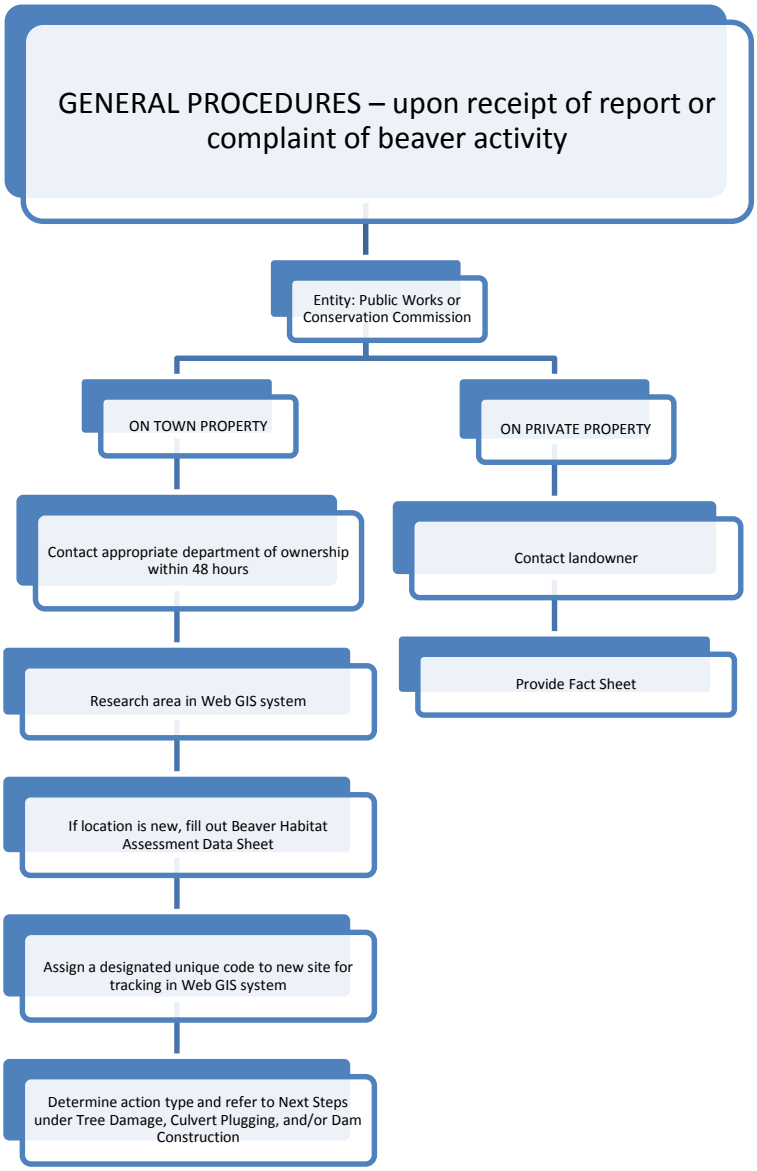
c. If the activity is located on private property, the Town will provide a fact sheet to the affected landowner and complainant, if relevant. Landowner permission is required for any management activities on their land.

d. The activity area will be reviewed by the appropriate entity as described below and then logged into the anticipated Web GIS system for beaver activity (see attached data sheet and map of known beaver activity areas).

e. Each activity area will be assigned a designated unique code for tracking in the Web GIS system.

f. It is expected that the cost of any management activities will be borne by the relevant landowner or easement holder, if the relevant property owner requests and approves of the management activities.

g. Costs for management activities (e.g., device installation, regular maintenance and abatement activities) should be tracked in the Web GIS system.



II. Specific Procedures Based on Beaver Activity Type

Culvert Plugging

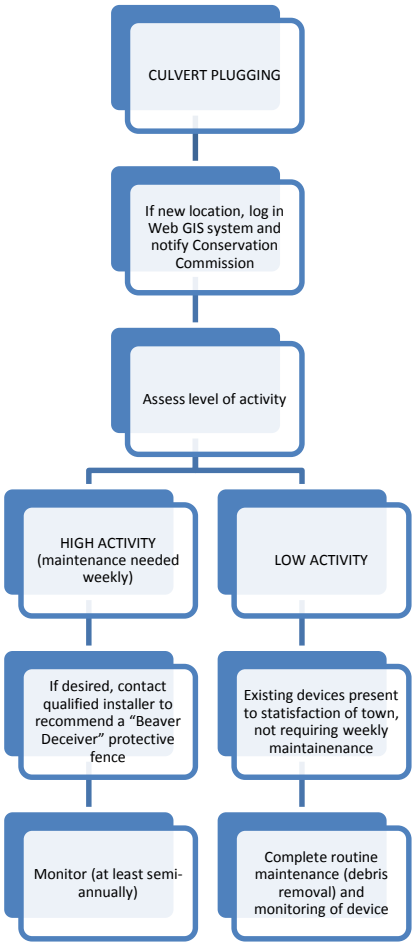
a. If existing public road culverts or drainage inlets are plugged by beaver activity, the structures may be cleaned and maintained, according to local and state regulations, to maintain public safety. Currently, beaver fences installed at culverts do not trigger state wetland permitting requirements (see NH RSA 210:9).

b. The maintenance activity shall be logged into the Web GIS system.

c. Areas subject to routine plugging by beaver likely warrant the installation of culvert fences (e.g., "Beaver Deceivers").

d. The installation of devices is favored over trapping, as young beaver disperse annually from existing colonies.

e. The Conservation Commission does not need to be consulted prior to device installation, but should be notified of activities to ensure that the location is properly logged into the database. A qualified professional (e.g., water flow device installer with experience in beaver management) should be consulted to determine the appropriate design of the "Beaver Deceiver" or similar device.



Dam Construction (e.g., along sewer and water easements)

a. If beaver dams are causing unacceptable flooding, the dam location/s should be reviewed utilizing the Beaver Habitat Assessment Field Sheet to determine the presence of sensitive natural resources (e.g., rare species, exemplary communities, important fisheries, heron rookeries, or Tier 1-3 Wildlife Action Plan Habitats). Data required for this assessment will be maintained in the

WebGIS system. The Town may also wish to obtain a report from the NH Natural Heritage Bureau to determine the presence of rare species, as these data are updated by the State of New Hampshire on a regular basis. The Conservation Commission will assist with these assessments.

b. Prior to management activities, the relevant Town entity should assess and document damage and flooding by beaver to infrastructure or properties with photographs.

c. If infrastructure/property damage is documented, the reviewing entity should assess the feasibility of installing water level control devices in the dam/s. It is highly recommended to consult an experienced device installer. Experienced installers consider factors such as the nature of the site (i.e. water depth and watershed size) in the sizing and design of appropriate devices.

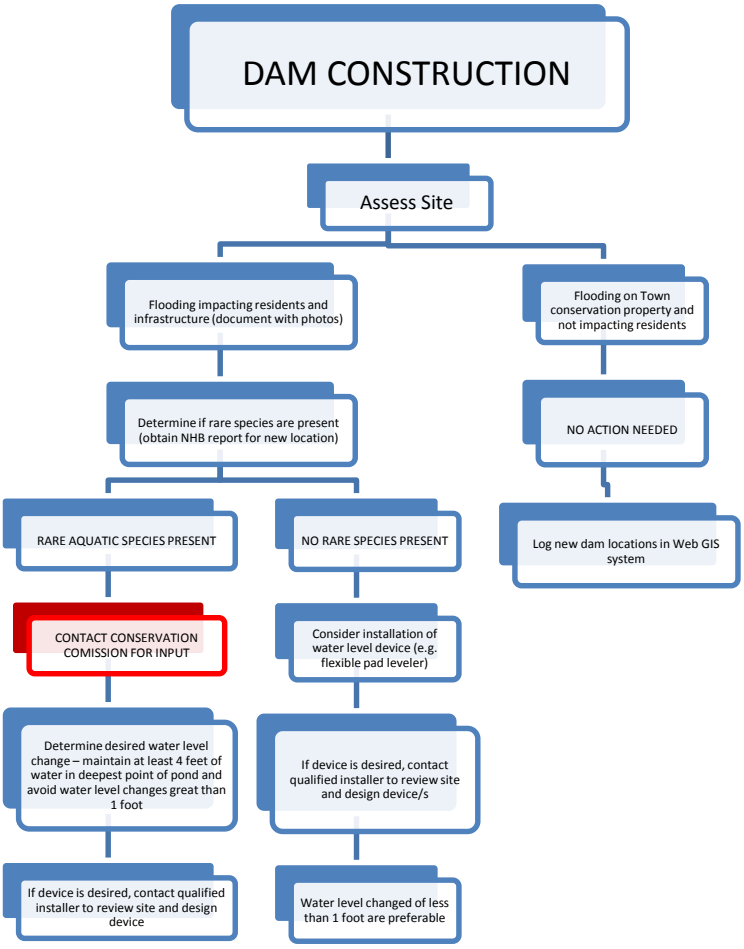
d. The relevant entity should assess whether local or state permits are required. Currently, a landowner may install up to three temporary "beaver pipes" in a beaver dam without machinery, as long as the individual pipes do not exceed 15 inches in diameter.

e. The presence of sensitive natural resources should be noted and utilized to help guide decisions relative to desired water level. It is preferable to maintain at least four feet of water in portions of beaver ponds, to provide appropriate winter habitat for beaver and other semi-aquatic and aquatic wildlife. Generally, where allowable, it is best to not lower ponds by more than 1 foot, as excessive water level changes can trigger the construction of new dams in new locations. ***The Conservation Commission should be consulted where water level changes greater than one foot are required or where water level devices will result in less than four feet of water in the deepest part of a beaver pond, to provide for an adequate assessment of sensitive natural resources and aquatic habitat.***

f. The installation of devices is favored over trapping, as young beaver disperse annually from existing colonies. Trapping is considered as a last option when and only if appropriately designed and installed water control devices fail and the installation of new devices in other locations does not address flooding concerns. Trapping should only be considered with the input of the Conservation Commission.

g. In general, beaver dams should never be completely removed at active beaver colonies, as this often triggers new dam construction. In addition, rare turtle species may overwinter in dams. The Conservation Commission should be consulted when dam removal is believed to be required.

h. Input from the Conservation Commission should be sought for installation of devices where rare species, exemplary communities, important fisheries, heron rookeries, or Tier 1-3 Wildlife Action Plan Habitats are known to occur (based on the then current WebGIS system).

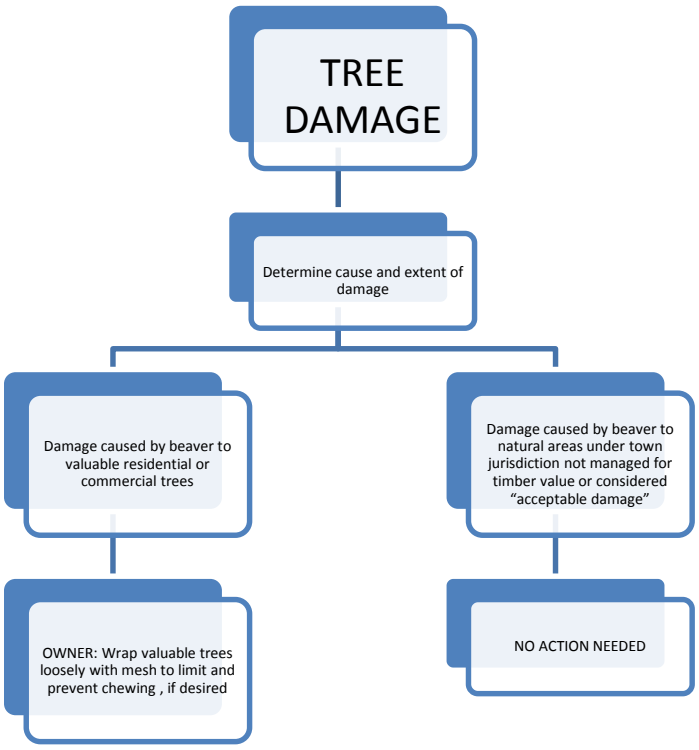


Tree Damage

a. Areas within 100 feet of a known beaver pond are generally at risk for damage from beaver. In addition, beavers may forage up to approximately 300 feet away from a pond when food is scarce. Trees may be protected (loosely wrapped)with wire mesh to limit and prevent chewing.

b. No local approvals are required for tree protection. However, tree protection should only be installed with landowner permission.

c. The Conservation Commission does not need to be consulted prior to installation.



4.5.2 Monitoring

GZA recommends that the Town implement regular monitoring to evaluate the success of water control devices, and monitor beaver activity at known problem areas. Monitoring is currently scheduled to be completed by Beaver Solutions, LLC quarterly at the sites where devices were installed. During monitoring, the protective fences and pipes will be visually evaluated for damage (e.g., plugged pipes, chew damage). The devices will be cleared of obstructing debris and minor repairs will be made to devices as necessary. GZA recommends that the Town log maintenance activities into the WebGIS system for each individual site. This will allow the Town to track the status of sites over time and prepare budgets for future work and maintenance activities.

In addition to monitoring of device areas, it will be beneficial to the Town to complete a minimum of annual monitoring of known problem areas during the growing season (May – October). Monitoring could occur at Town conservation properties during routine annual monitoring already occurring at these sites. In addition, it may be of interest to engage local school and youth groups (e.g., Girl Scouts, Boy Scouts) to assist with monitoring on conservation areas. It is anticipated that the Highway Department will routinely address problem areas on public roads, and update the Conservation Commission at least annually, on the locations of sites with new devices or ongoing maintenance.

4.5.3 Estimated Costs

For proper assessment and management, it is recognized that multiple departments will need to budget for anticipated device installation and maintenance of properties under their jurisdiction. During 2014, GZA assessed known problem areas and calculated the approximate estimated costs to address known problem areas during 2014 and 2015 (see **Table 4**, Summary of Current and Future Estimated Management Costs at Problem Areas) based on costs provided by contractors. In addition, GZA included expected maintenance costs through 2017, based on the number of known problem areas. As devices are installed, it is anticipated that total costs for management activities will decrease over time, at least at the ten current known problem areas. Costs were based on 2014 installation/maintenance costs and may increase over time. However, the costs provide a general framework for budgeting. During 2014, individual flow devices cost approximately $2,000 for materials, delivery, construction, and on-site installation.

5.0 FINDINGS AND CONCLUSIONS

GZA has completed beaver activity assessment field work, evaluation of natural resources near beaver sites, GIS database development, management recommendation development, and construction monitoring at 2014 installation sites. The following is a summary of our findings and conclusions:

- Beaver activity was assessed at 35 known problem areas by canoe, on foot, and with the use of a UAV. Observed beaver dams, lodges, and food caches were mapped with a handheld GPS unit.
- Of the total number of sites, 27 had some level of beaver activity during 2014 including dam construction, culvert plugging, and tree removal.
- Areas without current beaver activity often were sites of recent culvert/bridge replacements (to larger structures) or were sites of previous beaver trapping. As a result, sites without activity during 2014 may be recolonized by beaver over time.
- Of the assessed areas, approximate 80% of the sites are located near known locations of semi-aquatic rare species. In addition, 29% are near important fisheries and 40% are located within important Wildlife Action Plan habitats. As a result, devices installed to prevent flooding should often consider aquatic passage and rare species protection.
- As requested, GZA developed management recommendations for the top ten priority sites where moderate to high beaver activity was observed during 2014. Management recommendations that address flooding impacts while maintaining beaver colonies and important natural resources (e.g., rare species) were prioritized for implementation.
- Device recommendations were focused on Flexible Pond Levelers for dam sites and protective fences (“Beaver Deceivers) for culvert locations.

Table 4 Summary of Current (2014) and Future Estimated Management Costs at Problem Areas.

Area	Location	Activity Type	Recommended Management Type	Responsible Party	2014 Device Cost	2015 Estimated Cost	2016 Estimated Cost	2017 Estimated Cost
6B	Cathy Street	Dam construction and pipe plugging (flooding)	Assess activity Spring 2015 and consider installation of a Flexible Pond Leveler	Public Works working with landowners	N/A	$2,000	$210	$210
11	Hitchin Post Lane	Culvert plugging, flooding	Consider Flexible Pond Leveler in large dam to maintain water level, contact adj owner	Conservation Commission	N/A	$2,000	$210	$210
12	Hansom Dr	Culvert plugging	Maintain culvert/grate, consider a Beaver Deceiver at Hansom Road due to high activity	Association working with Public Works	N/A	$2,000	$210	$210
15	Continental Blvd, Joey Rd	Tree damage	Consider a Flexible Pond Leveler in the primary dam if flooding is impacting residents	Public Works	N/A	$2,000	$210	$210
16	Lyons Rd	Culvert plugging, dam construction	Consider a Beaver Deceiver at Lyons Rd, and a Flexible Pond Leveler in the primary dam to protect school property	Public Works	N/A	$2,000	$210	$210
17	Mast Rd	Dam construction, culvert plugging	Consider a Flexible Pond Leveler immediately in the dam adjacent to Mast Road and Beaver Deceivers at the culvert inlets if activity increases	Public Works	N/A	$4,000	$420	$420
18	Mayflower Rd	Dam construction, outlet plugging, flooding, tree damage	Consider a Flexible Pond Leveler in the dam, a protective fence at the Interceptor, and tree guards	Public Works	$3,760	$450	$420	$420
20	Carrie Dr/Madison Ln	Dam construction, flooding, septic failure, tree damage	Consider a Flexible Pond Leveler in the major dam if activity shifts back to the dams in this area	Conservation Commission	N/A	N/A	$2,000	$210
22	Naticook Road	Culvert plugging	Consider Culvert Protective Fence and Pipe Device	Public Works	$1,980	$225	$210	$210
23	Naticook Rd Ext	Culvert plugging	Consider a Beaver Deceiver to promote fisheries and limit maintenance. The current grate limits flows.	Public Works	N/A	$2,000	$210	$210
30	Wildcat Falls Trail SW pond off Hemlock Dr	Plugging of outlet	Consider a protective fence at the stormwater pond outlet for exclusion	Conservation Commission	N/A	$2,000	$210	$210
35	Mitchell Woods - Profile Dr	Dam construction	Consider a Flexible Pond Leveler and Round Fence in the primary dam due to septic system failure	Conservation Commission	$2,230	$225	$210	$210
				Total Estimated Costs	**$7,970**	**$18,900**	**$6,730**	**$2,940**

- Devices installed in this study typically allow for passage of fish and rare turtles (e.g., due to the presence of 6-inch squares in fences), while the smaller grates utilized at some existing crossings likely preclude aquatic passage.
- The Town hired Beaver Solutions, LLC to install five devices at the three top priority sites during 2014. GZA monitored device construction and installation. Proper device design and installation is critical to ensure long-term success of projects.
- The devices were installed in a manner to maintain at least four feet of water in the deepest part of each beaver pond and avoid water level changes greater than approximately one foot. Maintaining deep water provides for appropriate winter habitat for beaver and other aquatic life and avoiding changes greater than one foot may serve to limit the construction of new dams at active beaver colonies.
- Device construction and installation costs totaled $7,970 in 2014. If devices are installed at the remaining top ten priority areas and formal maintenance is completed, total costs are expected to be approximately $18,900 in 2015. However, total costs are expected to decline rapidly in 2016 and 2017 as costs will be related primarily to long-term maintenance of devices. This will reduce both the staffing burden on the Highway Department and the burden by volunteers to maintain culverts and dam sites on a weekly basis.
- GZA developed a decision matrix to assist the Town with determining actions at beaver problem areas in the future. The matrix is designed to facilitate routine maintenance while ensuring proper review for sites with known rare species.
- Of the 35 original known problem areas identified in the study, all sites were accurately modeled as high or moderate habitat suitability (to beaver). As existing problem areas, all assessed sites are known to have supported beaver currently or in the recent past. This demonstrates that the Beaver Habitat Suitability Model can be used to help predict potential future conflict areas. Infrastructure installed in high habitat suitability areas may result in lower maintenance if such infrastructure incorporates water flow devices and practices designed to coexist with beaver.

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FIGURES

2014 Monitoring Locations

Site #	Site Name
1	Amherst Rd near Meetinghouse
2	Baboosic Lake Road by Bishop Field
3	Bean Rd
4	Bel Air Drive & McGaw Bridge Rd
5	Brookside Drive (start)
6	Cathy St. / Waterville Dr / Level St.
7	Craftsman Ln/Stump Pond Dam
8	French Ct
9	Grater Woods conservation area 1
10	Greens Pond Road
11	Hamlet Circle / Hitchinpost Ln
12	Hansom Drive
13	Heidi Ln (behind Cinemagic)
14	Hemlock
15	Joey Rd
16	Lyons Road
17	Mast Road
18	Meadowwoods Pond / Dam
19	Merrymeeting
20	Mitchell Woods/Jakes Ln/Madison (start)
21	Naticook Dam
22	Naticook Rd at Greens Pond
23	Naticook Rd Extension
24	S. Baboosic Lake Road
25	Summit Road
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27	West Thornton Rd
28	Whispering Pines
29	White pine swamp
30	Wildcat falls entrance
31	Wire Rd
32	Brookside Drive (end)
33	Grater Woods conservation area 2
34	Grater Woods conservation area 3
35	Mitchell Woods/Jakes Ln/Madison (end)

Legend

- 2014 Monitoring Locations

N W E S

0 750 1,500 3,000 4,500

SCALE IN FEET

SOURCE NOTES:

THIS MAP CONTAINS THE ESRI ARCGIS ONLINE USA TOPOGRAPHIC MAP SERVICE, PUBLISHED DECEMBER 12, 2009 BY ESRI ARCIMS SERVICES AND UPDATED AS NEEDED. THIS SERVICE USES UNIFORM NATIONALLY RECOGNIZED DATUM AND CARTOGRAPHY STANDARDS AND A VARIETY OF AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS

COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

SITE LOCUS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MERRIMACK, NH

PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 1
DESIGNED BY: TLT	DRAWN BY: ADM	SCALE:1 INCH = 1,500 FT	
DATE: 03-31-2015	PROJECT NO. 04.0190085.00	REVISION NO.	

2014 Monitoring Locations

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Legend

- 2014 Monitoring Locations
- Streams
- Wetlands

2014 Field Data

- Culvert
- Dam
- Food Pile
- Lodge
- Vernal Pool
- Fence and Pipe Flow Device
- Flexible Pond Leveler
- Flexible Pond Leveler with Pipe Extension and Exclusion Device
- Culvert Protective Fence and Pipe Device

N W E S

0 750 1,500 3,000 4,500

SCALE IN FEET

SOURCE NOTES:

1 Field data points were mapped using a hand-held GPS unit with the GIS Program iCMTGIS II, with an approximate accuracy range of three to five meters.

2 Roads (NH DOT) and Hydrography (USGS) data were obtained from NH GRANIT and represent the efforts of the contributing agencies. The parcel data was obtained from the Town of Merrimack during July 2014. GZA GeoEnvironmental, Inc. does not make any claims to the accuracy, reliability, or uses of these data.

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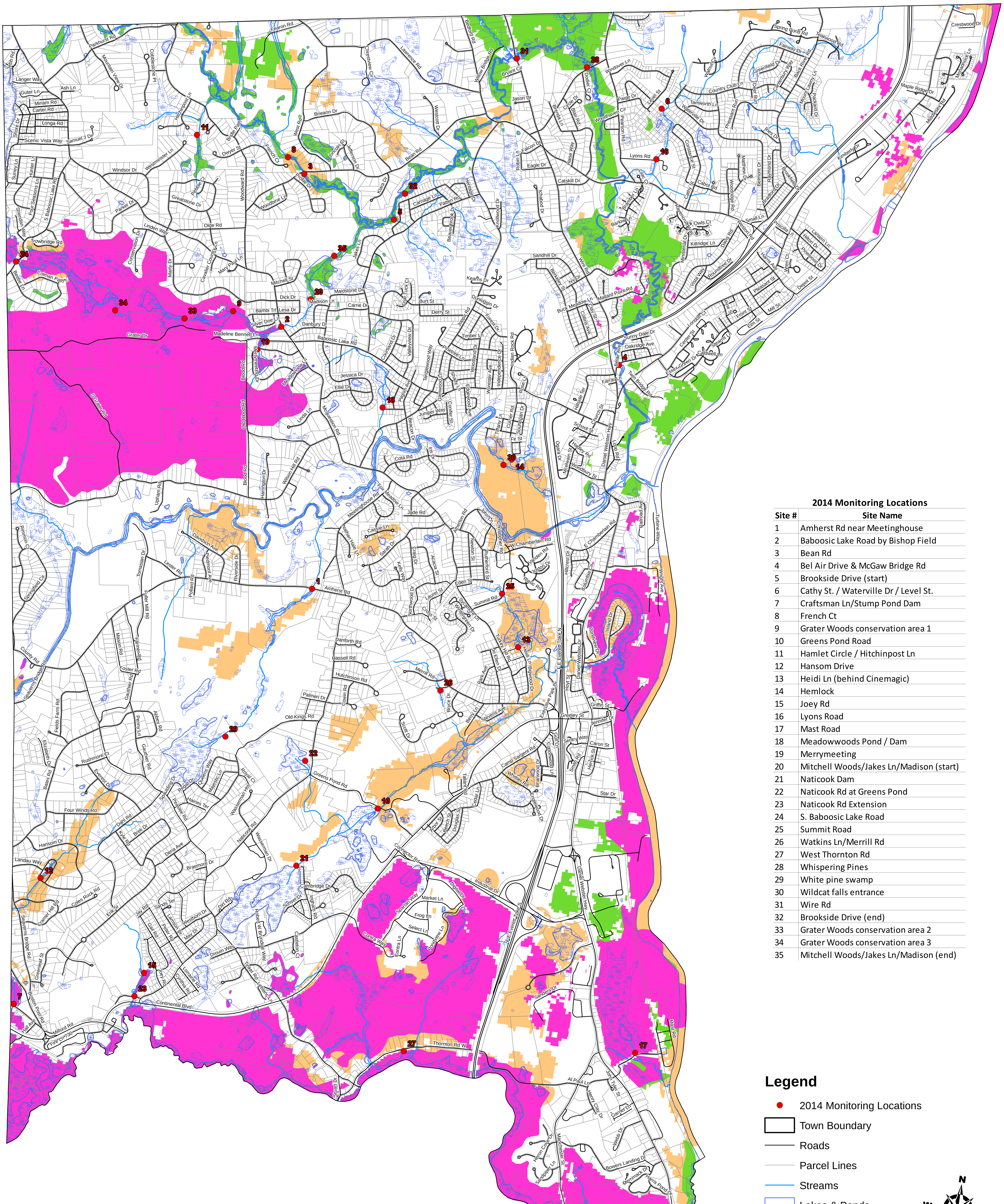
COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

KNOWN PROBLEM AREAS

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
TOWN OF MERRIMACK, NH

PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 2
DESIGNED BY: TLT	DRAWN BY: ADM	SCALE:1 INCH = 1,500 FT	
DATE: 03-31-2015	PROJECT NO. 04.0190085.00	REVISION NO.	



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Legend

- 2014 Monitoring Locations
- Town Boundary
- Roads
- Parcel Lines
- Streams
- Lakes & Ponds
- Rivers
- Wetlands

Wildlife Action Plan

- Highest Ranked Habitat in NH
- Highest Ranked Habitat in Biological Region
- Supporting Landscapes

N W E S

0 750 1,500 3,000 4,500
SCALE IN FEET

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COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

NATURAL RESOURCES

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: TOWN OF MERRIMACK, NH	
PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE
DESIGNED BY: TLT	DRAWN BY: ADM	SCALE: 1 INCH = 1,500 FT	3
DATE: 03-31-2015	PROJECT NO. 04.0190085.00	REVISION NO.	

Conservation Land	
ID	Owner
1	Pennichuck Water Works
2	Boat Access
3	Merrimack Village District Land
4	Woodbury #2 Open Space
5	Sleepy Hollow
6	Watkins Forest
7	Mitchell Drive Town Forest
8	Country Club Estates
9	Town of Merrimack Land
10	Dahl Road Green Area
11	White Pine Swamp
12	Town of Merrimack
13	Dumpling Brook WMA
14	Hidden Forest Common Land
15	Woodbury #1 Open Space
16	Indian Rock Open Space
17	Grogan Easement
18	Birches Open Space
19	Merrimack Village District Land
20	Merrimack Village District Land
21	Bradford Woods Open Space
22	Greenfield Farms Open Space
23	Pheasant Run I - Green Area
24	Town of Merrimack Land
25	Town of Merrimack Land
26	Pennichuck Water Works
27	Town of Merrimack Land
28	Town of Merrimack Land
29	Mitchell Drive Town Forest
30	Harris Pond Open Space
31	Mitchell Drive Conservation Area
32	Acre Ridge Open Space
33	South Grater Road Parcel
34	Pennycook Green - Green Area
35	Pennycook Green - Green Area
36	Pennichuck Water Works
37	Twin Bridges Park
38	Pennycook Green - Green Area
39	Currier Road Conservation Area
40	Horseshoe Fish & Game Club Land
41	Weston Park
42	Turkey Hill Green Area
43	Riverview Park Green Area
44	Brookfield I
45	Horseshoe Fish & Game Club Land
46	Souhegan Boating Access
47	Merrimack Village District Land
48	Wasserman Park
49	Naticook Camps of NH Inc.
50	Merrimack Technology Park
51	Blueberry Island
52	Dahl Road Green Area
53	Town Park
54	Pennichuck Water Works
55	Town of Merrimack
56	Naticook Estates Green Area
57	Tinker Woods
58	Tinker Woods
59	Pennichuck Water Works
60	Pennichuck Water Works
61	Pennichuck Water Works
62	Pennichuck Water Works
63	Pennichuck Water Works
64	Merrimack Village District Land
65	Pennichuck Water Works
66	Pennichuck Water Works
67	Merrimack Village District Land
68	Merrimack Village District Land
69	Pennichuck Water Works
70	Pennichuck Water Works
71	Pennichuck Water Works
72	Pennichuck Water Works
73	Merrimack02-327
74	Merrimack02-327
75	Ackley
76	Woolsey Bequest 2000
77	Grater Road 1992

2014 Monitoring Locations

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Legend

- 2014 Monitoring Locations
- Town Boundary
- Roads
- Parcel Lines
- Streams
- Lakes & Ponds
- Rivers
- Wetlands
- Conservation Land

N W E S

0 750 1,500 3,000 4,500

SCALE IN FEET

COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

CONSERVATION/PUBLIC LANDS

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: TOWN OF MERRIMACK, NH	
PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 4
DESIGNED BY: TLT	DRAWN BY: ADM	SCALE:1 INCH = 1,500 FT	
DATE: 03-31-2015	PROJECT NO. 04.0190085.00	REVISION NO.	

2014 Monitoring Locations

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Legend

- 2014 Monitoring Locations
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- Lakes & Ponds
- Rivers
- Wetlands
- Town Boundary

Beaver Habitat Suitability

- Low
- Moderate
- High

0 750 1,500 3,000 4,500

SCALE IN FEET

N W E S

BEAVER HABITAT SUITABILITY NOTES:

Beaver Habitat Suitability was developed by GZA GeoEnvironmental, Inc. using National Wetlands Inventory (NWI), National Hydrography Dataset (NHD), Digital Elevation Model (DEM), and Land Cover data obtained from NH GRANIT.

Areas within 100 meters from hydrography features were identified as potential beaver habitat. Areas closer to hydrography features were assigned a higher suitability ranking.

Stream features were modified to connect adjacent stream segments together into a continuous line and streams that were visible in the aerial imagery were added. Connected streams of longer lengths were assigned a higher suitability ranking.

NH Land Cover Assessment 2001 was used to determine land cover suitability. Natural land cover, such as forest, were assigned a higher suitability ranking.

The Digital Elevation Model (DEM) was used to identify the slope, or gradient. Streams with lower gradient were assigned a higher suitability ranking.

Wetland areas were identified as being connected or disconnected from streams. Wetlands connected to streams were assigned a higher suitability ranking.

Lakes & ponds were identified as being connected or disconnected from streams. Lakes & ponds connected to streams were assigned a higher suitability ranking.

Suitability rankings from all above criteria were then compiled to determine beaver habitat suitability.

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COMPREHENSIVE BEAVER MANAGEMENT PLAN
MERRIMACK, NEW HAMPSHIRE

BEAVER HABITAT SUITABILITY MODEL

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: TOWN OF MERRIMACK, NH	
PROJ MGR: TLT	REVIEWED BY: JCM	CHECKED BY: DMZ	FIGURE 5
DESIGNED BY: TLT	DRAWN BY: ADM	SCALE:1 INCH = 1,500 FT	
DATE: 03-31-2015	PROJECT NO. 04.0190085.00	REVISION NO.	

APPENDIX A

LIMITATIONS

NATURAL RESOURCE SURVEY AND ASSESSMENT
LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) has prepared this report on behalf of, and for the exclusive use of the Town of Merrimack (''Client'') for the stated purpose(s) and location(s) identified in the report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not identified in the agreement, for any use, without our prior written permission, shall be at that party's risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in the Report and/or proposal, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the data gathered and observations made during the course of our work. Conditions other than described in this report may be found at the subject location(s).

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

Limits to Observations

4. Natural resource characteristics are inherently variable. Biological community composition and diversity can be affected by seasonal, annual or anthropogenic influences. In addition, soil conditions are reflective of subsurface geologic materials, the composition and distribution of which vary spatially.

5. The observations described in this report were made on the dates referenced and under the conditions stated therein. Conditions observed and reported by GZA reflect the conditions that could be reasonably observed based upon the visual observations of surface conditions and/or a limited observation of subsurface conditions at the specific time of observation. Such conditions are subject to environmental and circumstantial alteration and may not reflect conditions observable at another time.

6. The conclusions and recommendations contained in this report are based upon the data obtained from a limited number of surveys performed during the course of our work on the site, as described in the Report. There may be variations between these surveys and other past or future surveys due to inherent environmental and circumstantial variability.

Reliance on Information from Others

7. Preparation of this Report may have relied upon information made available by Federal, state and local authorities; and/or work products prepared by other professionals as specified in the report. Unless specifically stated, GZA did not attempt to independently verify the accuracy or completeness of that information.

Compliance with Regulations and Codes

8. GZA's services were performed to render an opinion on the presence and/or condition of natural resources as described in the Report. Standards used to identify or assess these resources as well as regulatory jurisdiction, if any, are stated in the Report. Standards for identification of jurisdictional resources and regulatory control over them may vary between governmental agencies at Federal, state and local levels and are subject to change over time which may affect the conclusions and findings of this report.

New Information

9. In the event that the Client or others authorized to use this report obtain information on environmental regulatory compliance issues at the site not contained in this report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this work, may modify the conclusions stated in this report.

Additional Services

10. GZA recommends that we be retained to provide further investigation, if necessary, which would allow GZA to (1) observe compliance with the concepts and recommendations contained herein; (2) evaluate whether the manner of implementation creates a potential new finding; and (3) evaluate whether the manner of implementation affects or changes the conditions on which our opinions were made.

APPENDIX B

BEAVER HABITAT ASSESSMENT DATA SHEET

Town of Merrimack Comprehensive Beaver Management Plan
Beaver Habitat Assessment Data Sheet

Site Name/Lot: _____ Date: _____ Weather: _____
Nearest Road: _____ Evaluators: _____ Stream Name/s _____

Beaver Activity Observed:

Beaver	Yes ❑ No ❑	Adults ❑ kits ❑ No. Beaver Observed _____
Beaver Stumps	Yes ❑ No ❑	Recent ❑ Old ❑ Few ❑ Many ❑ Approx No. _____
Beaver Scent Mounds	Yes ❑ No ❑	Describe: _____
Beaver Food Piles	Yes ❑ No ❑	Describe: _____
Beaver Lodges	Yes ❑ No ❑	Describe: _____
Dams Present	Yes ❑ No ❑	No. Dams _____
Active Dam Building?	Yes ❑ No ❑	Describe: _____
Other Activities	Yes ❑ No ❑	Describe: _____

Natural Resources Present in Inundated Areas that could be affected by dam REMOVAL:

Semi-Aquatic Rare species	Yes ❑ No ❑	Species _____ Date Observed _____
Important Fisheries	Yes ❑ No ❑	Describe _____
Heron rookery	Yes ❑ No ❑	Describe _____
WAP Habitats (Aquatic)	Yes ❑ No ❑	Describe _____
Exemplary Community	Yes ❑ No ❑	Describe _____
Other	Yes ❑ No ❑	Describe _____

Natural Resources Present Outside of Inundated Areas that could be affected by dam CREATION:

Vernal Pools	Yes ❑ No ❑	Describe _____
Deer Wintering Areas	Yes ❑ No ❑	Describe _____
Rare Species (Upland)	Yes ❑ No ❑	Describe _____
Peatlands	Yes ❑ No ❑	Describe _____
Other	Yes ❑ No ❑	Describe _____

Observed Beaver Conflicts:

Known Problem Area	Yes ❑ No ❑	Describe: _____
Flooding (Private Property)	Yes ❑ No ❑	Describe: _____
Flooding (Public Roads)	Yes ❑ No ❑	Describe: _____
Culvert Obstructions	Yes ❑ No ❑	Describe: _____
Beaver Devices Present	Yes ❑ No ❑	Describe: _____
Tree Damage Present	Yes ❑ No ❑	Describe: _____

Potential for Future Beaver Activity:

Trees present within 30m (Species/dbh)	Yes ❑ No ❑	Describe: _____ _____
Beaver Colonies Obs. Nearby	Yes ❑ No ❑	Describe: _____
Streams Present	Yes ❑ No ❑	Describe: _____
Culvert Restrictions Present	Yes ❑ No ❑	Describe: _____
Muddy ponds Present	Yes ❑ No ❑	Describe: _____
Stream gradient <6%	Yes ❑ No ❑	Describe: _____
Convoluted shoreline on lakes	Yes ❑ No ❑	Describe: _____

Site Name/Lot: _____ Date: _____

GPS Locations of Important Features:

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Sketch of Evaluation Area and Photo Locations: