

# Phosphorus Source Identification Report

Merrimack River

Town of Andover, Massachusetts

June 30, 2022

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# Phosphorus Source Identification Report

## Town of Andover

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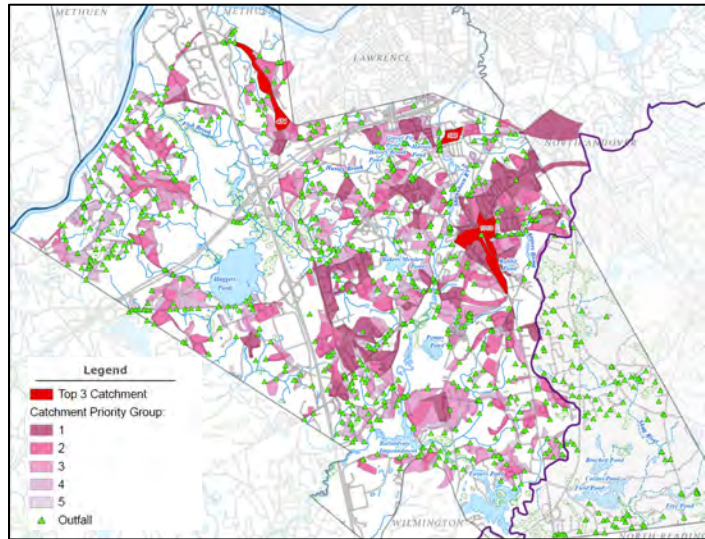
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# Executive Summary

Under the Environmental Protection Agency’s (EPA’s) 2016 National Pollutant Discharge and Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, regulated communities that discharge to certain water quality limited waters are required to meet additional requirements as outlined in Appendix H of the MS4 Permit. The Town of Andover must address the discharge of phosphorus from its MS4 to the Merrimack River.



*Priority catchment areas in the Merrimack River watershed in Andover, MA*

As part of these requirements, Andover must develop a Phosphorus Source Identification Report within four years of effective date of the permit (*by June 30, 2022*). The overall goal of this plan is to determine specific areas of the MS4 that may be contributing higher concentrations of phosphorus to the impaired watershed.

## **Phosphorus Source Identification Report Requirements**

This Phosphorus Source Identification Report includes the following elements as required under the MS4 Permit:

1. Calculation of the MS4 area draining to the water quality limited segment and its tributaries (“Phosphorus Source Area”). Drainage areas were delineated for each MS4 outfall.
2. All screening and monitoring results for outfalls in the Phosphorus Source Area.
3. Calculation of the impervious area and directly connected impervious area (DCIA) for each catchment in the Phosphorus Source Area.
4. Identification, delineation and prioritization of potential catchments with high phosphorus loading.
5. Identification of potential retrofit opportunities or opportunities for the installation of structural BMPs during redevelopment including the removal of impervious area. This focuses on municipally-owned parcels.

A summary of the assessment findings is provided in the table below.

**Summary of Phosphorus Source Identification Report Findings for the Merrimack River,  
Andover, MA**

<b>Phosphorus Source Identification Report Requirement</b>	<b>Merrimack River <i>Phosphorus Impairment</i></b>
Merrimack River Watershed in Urbanized Area (UA)	17,014 acres
Total Number of Outfalls in Merrimack River Watershed in UA	739
Catchment Area for 739 outfalls (Source Area)	5,433 acres
Impervious Area	1,198 acres
DCIA	27 acres
Priority Outfalls Identified in Source Area	Outfall 1013 Outfall 454 Outfall 598
Total Phosphorus Load from Source Area	2,394 lbs P/year
Reduction from Potential Retrofits	14.8 lbs P/year

**Next Steps**

Within five years of the permit effective date (by June 30, 2023), a listing of planned structural BMPs and a plan and schedule for implementation must be developed. One structural BMP, targeting a high phosphorus load area, must be designed and installed as a demonstration project within six years of the permit effective date (by June 30, 2024). The remainder of the structural BMPs must be installed in accordance with the developed schedule.

Next steps to be completed by June 30, 2023 include:

1. Evaluate high-ranking outfall catchment areas for additional BMP opportunities. Include review of existing street right-of-ways, outfalls, and municipal properties that have not yet been assessed, such as undeveloped municipal properties, where opportunities may exist to treat stormwater runoff from the MS4.
2. Evaluate the schedule for planned infrastructure, resurfacing or redevelopment activity planned for any municipal properties where potential retrofits were proposed.
3. Evaluate the engineering and regulatory feasibility of redevelopment or retrofit BMPs.
4. Develop a schedule for implementation of retrofits considering the above criteria.

Next steps to be completed by June 30, 2024 include:

4. Install a demonstration BMP, targeting a high phosphorus load area.

The remaining proposed BMPs shall be implemented in accordance with the developed schedule (item 3 above).

# 1 MS4 Permit Impaired Waters Requirement

Under the EPA's 2016 NPDES MS4 Permit, regulated communities that discharge to certain water quality limited waters are required to meet additional requirements as outlined in Appendices F and H of the MS4 Permit. Water quality limited waters are any waterbodies that do not meet applicable water quality standards, including waterbodies listed in Categories 4a and 5 on the Massachusetts Integrated List of Waters, also known as the "303(d) List." These impaired waters fall into one of two categories as described in Section 2.2 of the 2016 MS4 Permit (as amended):

- Impaired waters with an approved Total Maximum Daily Load (TMDL) (subject to requirements in Appendix F of the MS4 Permit); or
- Impaired waters without an approved TMDL (subject to requirements in Appendix H of the MS4 Permit).

The Town of Andover must address the discharge of phosphorus from its MS4 to the Merrimack River as outlined in Appendix H, Section II of the 2016 MS4 Permit. These requirements include the development of a Phosphorus Source Identification Report for the contributing MS4 area to the Merrimack River within four years of the effective date of the permit (*by June 30, 2022*). The Report must include:

1. Calculation of the MS4 area draining to the water quality limited segment and its tributaries ("Phosphorus Source Area").
2. All screening and monitoring results for outfalls in the Phosphorus Source Area.
3. Calculation of the impervious area and directly connected impervious area (DCIA) for each catchment in the Phosphorus Source Area.
4. Identification, delineation, and prioritization of catchments in the Phosphorus Source Area with high nutrient loading.
5. Identification of potential retrofit opportunities or opportunities for the installation of structural BMPs during redevelopment.

This Phosphorus Source Identification Report was developed to satisfy these requirements as summarized in table below. In addition to these requirements, information regarding potential funding sources and a summary of next steps are provided at the end of this document. This document will be updated as needed as new information becomes available.

### Location of the Source Identification Report Permit Requirements

MS4 Permit Requirement	Location in Report
Phosphorus Source Area	Section 2.3
Outfall Screening and Monitoring Results	Section 3.2
Calculation of Impervious Area	Section 3.2
High Nutrient Loading Catchment Evaluation	Section 3.2
Retrofit Opportunities	Section 4.1

## 2 Phosphorus Source Area

As part of the 2016 MS4 Permit requirements for water quality limited waters, the Town of Andover must define the MS4 area draining to the Merrimack River, also known as the “Phosphorus Source Area.” This is defined as the MS4 drainage area located within the urbanized area (UA) of Andover and within the Merrimack River watershed.

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### 2.1 Urbanized Area in Andover, MA

Andover’s regulated MS4 area is defined as the MS4 located within the Town’s Urbanized Areas (UAs). UAs generally constitute the largest and most dense areas of settlement in the region. The Bureau of the Census determines UAs by applying a detailed set of published UA criteria to the latest decennial census data. The entire Town of Andover is considered to be in the Urbanized Area (Figure 1).

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### 2.2 Merrimack River Watershed

The Merrimack River is a 117-mile-long river that begins at the confluence of the Pemigewasset and Winnepesaukee rivers in Franklin, New Hampshire, flows south through Manchester, New Hampshire towards Massachusetts, and then northeast where it empties into the Gulf of Main in Newburyport, Massachusetts. The Merrimack River flows along the northwest edge of the town and forms the border with Methuen and Dracut. The Merrimack River watershed is approximately 3,204,212 acres in size with approximately 17,014 acres within the Town of Andover. Over 83% of the town lies within the watershed with a small portion in the southeast corner of the town that does not. In total, the Town of Andover occupies less than 1% of the entire Merrimack River watershed (Figure 2).

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### 2.3 Phosphorus Source Area in Andover, MA

The Phosphorus Source Area is limited to the area of town discharging to the Merrimack River watershed through its regulated MS4. 17,014 acres of the Merrimack River watershed are located within Andover’s UA. Within the 17,014 acres, stormwater from approximately 5,433 acres is directed to catch basins that discharge through one of 739 MS4 outfalls. Runoff from the other 11,581 acres within this area either flows as surface runoff or is directed to a non-municipal drainage network (Table 1, Figure 3). As MS4 maps are updated, catchment areas will be updated and expanded if necessary.

**Table 1: Phosphorus Source Area, Andover, MA**

Land Area used to Determine the Phosphorus Source Area	Acres
Merrimack River Watershed	3,204,212
Merrimack River Watershed in Andover UA Catchment Areas for 739 Outfalls in the Merrimack River Watershed in Andover UA Urbanized Area Outside of Catchment Area	17,014 5,433 11,581
<b>Phosphorus Source Area</b>	<b>5,433</b>

## 3 Phosphorus Source Area Evaluation

An evaluation of the Phosphorus Source Area was performed to determine the contribution of phosphorus from each outfall to the Merrimack River and to prioritize outfalls and catchments with high phosphorus loading.

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### 3.1 Catchment Analysis

Outfall catchment areas comprising the Phosphorus Source Area were evaluated for the following:

- Screening and monitoring results;
- Impervious area (IA);
- Directly connected impervious area (DCIA) is determined using the Small MS4 Permit Technical Support Document, Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for Massachusetts Small MS4 Permit, April 2014 (Appendix A);
- Receiving water impairments;
- Distance to receiving water; and
- Annual phosphorus load.

#### 3.1.1 Illicit Discharge Screening

As part of the Town of Andover's Illicit Discharge Detection and Elimination (IDDE) Program, the catchment areas to all outfalls in the town have been delineated and an outfall screening and monitoring program has been developed and implemented as described in part 2.3.4 of the 2016 MS4 Permit and in the Town of Andover's IDDE Plan (June 30, 2019). Dry weather screening has been performed at all outfalls as described in Section 6 of the IDDE Plan.

The phosphorus results from the dry weather screening, where available, are shown in Table 2 at the end of the report.

#### 3.1.2 Source Area Phosphorus Loads

Annual phosphorus loads for each of the 739 outfall catchment areas were calculated in accordance with Appendix F, Attachment 3 of the 2016 MS4 Permit as follows:

1. The total drainage area (acres) to the outfall was measured.

2. The outfall catchment area was distributed into impervious and pervious subareas by land use as defined in Tables 3-1 and 3-2 in Appendix F, Attachment 3 of the 2016 MS4 Permit.
3. The phosphorus load for each land use-based impervious and pervious subarea was calculated by multiplying the subarea by the appropriate nutrient load export rate provided in Tables 3-1 and 3-2 in Appendix F, Attachment 3 of the 2016 MS4 Permit.
4. The phosphorus load to each outfall was determined by summing the calculated impervious and pervious subarea phosphorus loads.

The total phosphorus load from each of the 739 outfalls was calculated to be 2,394 lbs P /year (Table 2 at the end of the report). Tables detailing the catchment area land use and calculations for phosphorus loads are provided in Appendix B.

Impervious area, DCIA, and phosphorus loads calculated for each outfall are shown in Table 2 at the end of the report.

### 3.1.3 Catchment Prioritization Criteria

Based on the outfall catchment analysis, a ranking system was developed to further prioritize catchments with high phosphorus loading. Each catchment was ranked first by annual phosphorus load (highest to lowest). Catchments were then sorted into five prioritization groups based on percentile (20% increments). Each prioritization group was then sorted based on whether the outfall discharges directly to an impaired waterbody and the distance from a waterbody.

The full catchment area analysis for the Phosphorus Source Area is shown in Table 2 at the end of the report. In addition to the above information, other information about the catchment areas is noted including the presence of any existing BMPs or municipally-owned properties. This information will be considered when selecting sites for potential municipal retrofits.

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## 3.2 Catchment Area Prioritization

The 739 outfalls were grouped into one of five ranking groups, with Group 1 representing the highest priority areas and Group 5 representing the areas of a lesser priority. In addition to the five groups, the top three priority catchments are identified. A summary of the prioritization groups of each outfall catchment area is shown in Table 3.

The full catchment area analysis for the Phosphorus Source Area is shown in Table 2 at the end of the report and Figure 4. Outfall 1013 is the highest ranked outfall catchment area. This outfall discharges approximately fifteen feet from a waterbody and has a phosphorus load of 106 lbs P/year. This outfall catchment area, along with Outfalls 454 and 598, the other top-ranked outfalls, should be prioritized for remediation (Table 2, Figure 4).

**Table 3: Catchment Area Prioritization Groups**

Prioritization Group	TP range (lbs P/year)	No. of Catchment Areas
<b>Group 1</b>	> 10 - 106	40
<b>Group 2</b>	> 5-10	81
<b>Group 3</b>	> 2.5 - 5	142
<b>Group 4</b>	> 1 – 2.5	242
<b>Group 5</b>	0 - 1	234
<b>Total</b>		<b>739</b>

## 4 Potential Phosphorus Reductions

An inventory of town-owned properties was performed to identify existing and potential phosphorus reduction opportunities.

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### 4.1 Municipal Retrofit Survey

Under the MS4 permit, regulated communities such as Andover are required to complete an inventory and priority ranking of town-owned properties and existing stormwater infrastructure that could be retrofitted with stormwater (BMPs) designed to reduce the frequency, volume, and pollutant loads of stormwater discharges to the MS4. A separate memo (Municipal Property Retrofit Memo dated June 2022) describes the assessment process and the priority ranking process in detail and is included in Appendix C.

In summary, approximately 28 town-owned properties were assessed in the Fall of 2021. The potential for retrofits or the installation of new BMPs were assessed in the field and the results of these assessments, including potential BMP options, estimated phosphorus load reductions and estimated costs for all properties, where applicable, are described in detail in the Municipal Property Retrofit Memo (Appendix C). A summary of the top six identified BMP retrofit opportunities is included in Table 4.

The South Elementary School site has the potential to reduce 4.96 pounds of phosphorus per year. This site is located in the Merrimack River Phosphorus Source Area.

**Table 4: BMP Retrofit Locations**

Location		Proposed BMP(s)		Estimate Costs	TP Reduction		MS4 Catchment Area in Merrimack River Watershed <sup>1</sup>
Facility Name	Address	Type	Estimated Size	Construction & Engineering	Lbs / Yr	\$ / Pound	
<b>Andover Water Treatment Plant</b>	10 Geneva Road	Water Quality Swale	100' x 20' x 2'	\$44,200	0.50	\$88,400	1007, 1228, 1229
		Infiltration Basin	70' x 30' x 3'	\$69,600	0.87	\$80,000	
<b>Andover Fire Station West</b>	200 Greenwood Road	Bioretention Basin	45' x 35' x 3'	\$152,400	0.43	\$354,600	199
<b>Andover Police and Fire</b>	32 North Main Street	Rain Garden	40' x 25' x 3'	\$97,400	0.25	\$469,400	584
		Porous Pavement	2100 SF	\$19,900			
<b>Bancroft Elementary School</b>	15 Bancroft Road	Infiltration Island	230' x 12' x 2'	\$61,100	2.65	\$41,100	539
		Infiltration Island (2)	90' x 12' x 2' (2)	\$47,700			
		Bioretention Basin	70' x 40' x 3'	\$230,000	0.65	\$353,840	
<b>South Elementary School</b>	55 Woburn Street	Infiltration Island	215' x 20' x 2'	\$95,000	1.42	\$66,900	812
			160' x 20' x 2'	\$70,800	3.54	\$20,000	
<b>Pomps Pond Beach</b>	147-163 Abbot Street	Riprap Swale	270 LF	\$21,900	0.57	\$286,100	N/A
		Bioretention Island	75' x 15' x 2'	\$61,600			
		Infiltration Basin	80' x 30' x 3'	\$79,600			
<b>Total</b>				<b>\$888,100</b>	<b>10.3</b>	<b>--</b>	<b>--</b>

<sup>1</sup> Treatment totals include all BMPs located in outfall catchment areas.

## 5 Potential Funding Sources

The design and implementation of stormwater BMPs will be dependent on available funding. Potential funding sources may include a local stormwater utility and/or loans and grants offered at the state and federal level. A summary of potential state and federal funding sources is listed in Table 5. Additional resources can be found on the [MassDEP Grant Program Directory webpage](#).

**Table 5. Summary of Potential Funding Programs**

Funding Program	Description
<b>Planning and Implementation Programs</b>	
MassDEP Stormwater MS4 Municipal Assistance Grant Program	The MassDEP Stormwater MS4 Municipal Assistance Grant program is available for Massachusetts municipalities, Regional Planning Agencies, stormwater coalitions, and non-profit organizations for innovative projects that will assist multiple communities in meeting the requirements of the MS4 permit. Eligible projects include assessment tools for prioritizing retrofit sites, tracking tools for regional stormwater retrofits, development of templates, formation of new regional stormwater coalitions, and other tasks that benefit multiple Massachusetts municipalities in seeking compliance with their MS4 permit.
MassDEP Clean Water State Revolving Fund	The SRF Clean Water program provides a low-cost financing method to help communities meet water quality standards. The program addresses issues such as watershed management priorities, stormwater management, and green infrastructure. SRF also supplies financial assistance to address communities with septic systems.
MassDEP Watershed Assistance Grants	Water Quality Planning and 604(b) grants are available for water quality planning purposes. Other eligible projects include development of preliminary designs and implementation plans to address water quality impairments, and the development of green infrastructure projects. MassDEP also provides funding appropriated through the USEPA under Section 319 of the Clean Water Act to support local initiatives to restore impaired waters or protect high quality waters. 319-grant funds are targeted toward implementation of completed watershed-based plans. A minimum of 40% non-federal match is required for these grants. While 319 funds may not be used to fund work that is specifically required in the MS4 permit, work in the non-regulated area of town is eligible for these funds.

Funding Program	Description
<b>Climate Resiliency Programs</b>	
Massachusetts Executive Office of Energy and Environmental Affairs (EEA) Municipal Vulnerability Preparedness (MVP) Grant Program	The MVP grant program provides support for cities and towns in Massachusetts to being the process of planning for climate change resiliency and implementing priority projects. The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans. Communities who complete an MVP planning grant become certified as an MVP community and are eligible for MVP Action Grant funding and other opportunities.
<b>Habitat Improvement Programs</b>	
Massachusetts Division of Ecological Restoration (DER) Grant Programs	<p>The Culvert Replacement Municipal Assistance Grant Program is for municipalities interested in replacing an undersized, perched, and/or degraded culvert located in an area of high ecological value. This funding is to encourage municipalities to replace aging culverts with better designed crossings that meet improved structural and environmental design standards and flood resiliency criteria.</p> <p>The Restoration and Revitalization Priority Projects Program selects projects that restore and protect Massachusetts rivers, wetlands, and watersheds for the benefit of people and the environment. The Priority Projects Program selects ecological and urban stream revitalization projects that present significant benefits to Massachusetts. Eligible applicants include restoration project site landowners, non-profit and/or non-governmental organizations, regional planning organizations, municipalities, and state and federal agencies. Current project focus is on cranberry bog wetland restoration, stream restoration, and urban stream and river revitalization.</p>
NOAA Community-Based Restoration Program Partnership	Grant funding provided for stream barrier removal projects that help restore riverine ecosystems, enhance public safety and community resilience, and have clear and identifiable benefits to diadromous fish populations.
National Fish and Wildlife Foundation (NFWF) Grant Programs	<p>NFWF Five Star and Urban Waters Restoration Program provides funds to local partnerships for wetland, forest, riparian and coastal habitat restoration, with a focus on urban waters and watersheds. Funds approximately \$1,500,000 annually, with average grants between \$25,000 to \$35,000 and 1:1 match requirement.</p> <p>NFWF New England Forests and Rivers Fund dedicated to restoring and sustaining healthy forests and rivers that provide habitat for diverse native bird and freshwater fish populations in New England. Annually awards grants ranging from \$50,000 to \$200,000 each.</p>

Funding Program	Description
<b>Recreation and Trail Programs</b>	
Fields Pond Foundation	Funds trail making and other enhancement of public access to conservation lands, land acquisitions for conservation, and establishing funds for stewardship. Funding levels: \$25,000 maximum, \$2,000 - \$10,000 typical.
National Park Service – Rivers and Trails Program	Funds projects focused on protection of natural resources and enhancement of outdoor recreational opportunities.
<b>Agricultural Programs</b>	
Natural Resource Conservation Service (NRCS) Grant Programs	<p>Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers to address natural resources concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion, and improved wildlife habitat.</p> <p>Conservation Stewardship Program (CSP) is the largest conservation program in the United States with a goal of enhancing natural resources and improving agricultural operations. The program helps agricultural operations build on existing conservation efforts while strengthening their operations. The program focuses on improving grazing conditions, increasing crop yields, developing wildlife habitat, and increasing resilience to weather extremes.</p>

## 6 Summary and Next Steps

### Summary

High priority outfalls have been identified and potential retrofits have been initially identified. A summary of the Phosphorus Source Identification Report components is provided in Table 6.

**Table 6: Summary of Phosphorus Source Identification Report Requirements for the Merrimack River, Andover, MA**

Phosphorus Source Identification Report Requirement	Merrimack River <i>Phosphorus Impairment</i>
Merrimack River Watershed in Urbanized Area (UA)	17,014 acres
Total Number of Outfalls in Merrimack River Watershed in UA	739 (#)
Catchment Area for 739 outfalls (Source Area)	5,433 acres
Impervious Area	1,198 acres
DCIA	27 acres
Priority Outfalls Identified in Source Areas	Outfall 1013 Outfall 454 Outfall 598
Total BMP Load from Outfalls in Source Area	2,394 lbs P/year
Reduction from Potential Retrofits	14.8 lbs P/year

### Next Steps

The Town of Andover should begin working towards reducing the amount of phosphorus in the Phosphorus Source Area. Within five years of the permit effective date (by June 30, 2023), a listing of planned structural BMPs and a plan and schedule for implementation must be developed. One structural BMP, targeting a high phosphorus load area, must be designed and installed as a demonstration project within six years of the permit effective date (by June 30, 2024). The remainder of the structural BMPs must be installed in accordance with the developed schedule.

Next steps to be completed by June 30, 2023 include:

1. Evaluate high-ranking outfall catchment areas for additional BMP opportunities. Include review of existing street right-of-ways, outfalls, and municipal properties that have not yet been assessed, such as undeveloped municipal properties, where opportunities may exist to treat stormwater runoff from the MS4.
2. Evaluate the schedule for planned infrastructure, resurfacing or redevelopment activity planned for any municipal properties where potential retrofits were proposed.

3. Evaluate the engineering and regulatory feasibility of redevelopment or retrofit BMPs.
4. Develop a schedule for implementation of retrofits considering the above criteria.

Next steps to be completed by June 30, 2024 include:

1. Install a demonstration BMP, targeting a high phosphorus load area.

The remaining proposed BMPs shall be implemented in accordance with the developed schedule (item 3 above).

**Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area**

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
1013	106.36	Unnamed Stream	15	122.07	0.87	61.31	1.51			x	1
454	37.00	Unnamed Stream	11	74.15	0.50	14.90	0.19			x	1
598	24.98	Shawsheen River	0	22.92	1.09	13.49	1.03				1
964	23.78	Shawsheen River	0	23.84	1.00	13.61	0.37			x	1
985	23.07	Unnamed Stream	22	56.94	0.41	9.59	0.11				1
301	15.40	Rogers Brook	37	22.68	0.68	6.76	0.12				1
594	13.46	Unnamed Stream	33	39.53	0.34	7.12	0.09				1
474	13.30	Unnamed Stream	19	29.47	0.45	5.71	0.07				1
310	13.11	Hussey Brook	9	27.63	0.47	8.34	0.14			x	1
584	12.99	Shawsheen River	0	10.54	1.23	8.43	0.29			x	1
690	12.63	Rogers Brook	43	22.66	0.56	5.40	0.08				1
94	12.42	Fish Brook	12	23.21	0.54	7.16	0.13			x	1
599	12.41	Shawsheen River	18	14.93	0.83	8.07	0.21				1
1019	12.08	Rogers Brook	6	26.64	0.45	6.27	0.09				1
298	12.00	Unnamed Stream	3	38.86	0.31	6.85	0.08				1
920	11.25	Unnamed Stream	21	21.35	0.53	5.50	0.09				1
720	11.23	Unnamed Stream	31	28.26	0.40	6.46	0.09				1
1179	11.22	Fish Brook	18	24.36	0.46	4.04	0.05				1
199	10.00	Unnamed Stream	7	29.09	0.34	2.77	0.02			x	1
67	17.30	Unnamed Stream	97	47.49	0.36	8.78	0.11				1
521	16.35	Hussey Brook	135	38.44	0.43	10.20	0.16			x	1

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
194	12.14	Unnamed Stream	52	37.55	0.32	3.53	0.03				1
608	83.21	Unnamed Stream	374	118.54	0.70	38.21	0.69				1
233	32.75	Unnamed Stream	401	77.20	0.42	13.89	0.17				1
604	15.55	Unnamed Stream	222	43.57	0.36	9.44	0.13				1
198	14.79	Unnamed Stream	297	33.67	0.44	6.67	0.09				1
930	14.29	Hussey Pond Brook	152	25.52	0.56	6.39	0.10				1
101	13.95	Shawsheen River	214	42.60	0.33	6.42	0.07	0			1
648	12.18	Unnamed Stream	178	24.41	0.50	5.81	0.09				1
1138	10.87	Unnamed Wetland	172	18.25	0.60	7.40	0.16			x	1
266	10.81	Unnamed Stream	379	28.79	0.38	5.62	0.07				1
561	10.48	Unnamed Pond	181	27.11	0.39	6.86	0.10				1
261	41.57	Unnamed Stream	679	55.01	0.76	22.24	0.47				1
638	20.24	Unnamed Stream	664	49.47	0.41	8.16	0.09				1
539	12.08	Rogers Brook	538	21.63	0.56	6.31	0.11			x	1
344	11.37	Unnamed Stream	567	19.84	0.57	5.62	0.09				1
837	33.67	Shawsheen River	1159	51.41	0.65	17.72	0.34				1
69	23.65	Unnamed Stream	1584	39.81	0.59	13.48	0.25				1
825	15.76	Unnamed Stream	1960	38.95	0.40	7.20	0.01				1
812	14.72	Unnamed Pond	1338	45.08	0.33	8.99	0.12			x	1
903	8.66	Unnamed Stream	4	21.39	0.40	3.47	0.04				2
71	8.52	Unnamed Stream	10	17.79	0.48	5.14	0.09				2
780	8.04	Rogers Brook	9	10.60	0.76	5.48	0.14			x	2

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
84	7.90	Fish Brook	0	16.23	0.49	2.73	0.03				2
1105	7.86	Shawsheen River	22	5.97	1.32	4.06	1.50	0			2
1088	7.66	Unnamed Stream	30	16.17	0.47	3.57	0.05				2
688	7.24	Rogers Brook	18	11.96	0.61	4.34	0.09			x	2
12	6.32	Unnamed Pond	40	26.45	0.24	3.77	0.04				2
1116	6.07	Unnamed Stream	4	7.38	0.82	2.58	0.84				2
1351	6.06	Shawsheen River	49	12.49	0.49	3.16	0.05				2
927	5.84	Haggets Pond	2	12.94	0.45	3.50	0.06				2
110	5.38	Unnamed Pond	29	14.74	0.36	1.91	0.02				2
290	5.37	Unnamed Stream	13	11.69	0.46	2.69	0.04				2
525	5.25	Gravel Pit Pond	47	12.77	0.41	3.19	0.05				2
1151	5.18	Unnamed Stream	47	11.41	0.45	1.96	0.02				2
1252	5.10	Unnamed Stream	6	16.52	0.31	1.87	0.02				2
1147	9.37	Unnamed Stream	123	26.97	0.35	4.81	0.06				2
252	8.88	Unnamed Stream	114	27.23	0.33	3.28	0.03				2
475	7.49	Unnamed Stream	78	21.26	0.35	3.36	0.04			x	2
1098	6.93	Unnamed Stream	133	24.55	0.28	3.33	0.03				2
979	6.64	Unnamed Stream	80	15.92	0.42	3.45	0.05				2
1108	6.14	Ballardvale Impoundment	132	37.84	0.16	1.35	0.00			x	2
236	5.24	Unnamed Pond	118	11.36	0.46	2.08	0.03				2
758	9.58	Unnamed Stream	270	18.36	0.52	4.17	0.06				2
275	8.65	Unnamed Stream	476	18.70	0.46	3.30	0.04				2

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159	8.53	Unnamed Wetland	279	16.64	0.51	3.48	0.05				2
704	8.19	Unnamed Stream	309	14.47	0.57	3.45	0.05				2
1341	8.17	Ames Pond	328	23.35	0.35	2.99	0.03				2
230	8.16	Unnamed Stream	401	15.78	0.52	3.05	0.04				2
1360	7.92	Unnamed Stream	424	9.75	0.81	5.51	0.15		x	x	2
966	7.89	Unnamed Stream	234	7.68	1.03	5.56	0.18				2
418	7.65	Unnamed Stream	198	23.46	0.33	2.59	0.02				2
621	7.32	Unnamed Stream	427	27.93	0.26	1.90	0.00				2
514	6.87	Unnamed Pond	355	15.89	0.43	2.08	0.02				2
781	6.70	Unnamed Wetland	401	13.36	0.50	2.28	0.03				2
1188	6.51	Ballardvale Impoundment	399	6.08	1.07	3.75	0.29				2
103	6.50	Unnamed Stream	409	15.36	0.42	2.58	0.03				2
755	6.47	Unnamed Stream	492	13.45	0.48	3.28	0.05				2
1090	6.39	Unnamed Stream	335	5.75	1.11	3.79	0.31				2
637	6.22	Unnamed Wetland	191	12.58	0.49	2.91	0.04				2
1193	6.07	Shawsheen River	457	15.21	0.40	2.59	0.11				2
1359	6.00	Unnamed Stream	269	8.32	0.72	4.08	0.10			x	2
268	5.92	Unnamed Stream	460	15.16	0.39	2.70	0.03				2
442	5.60	Unnamed Stream	238	11.30	0.50	2.53	0.04				2
787	5.59	Unnamed Stream	497	10.88	0.51	2.25	0.03				2
26	5.56	Unnamed Pond	258	14.97	0.37	3.54	0.05				2
484	5.55	Unnamed Stream	452	14.20	0.39	1.87	0.02				2

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332	5.49	Unnamed Stream	357	12.70	0.43	2.63	0.04				2
1203	5.39	Unnamed Stream	277	12.55	0.43	3.04	0.05				2
631	5.15	Unnamed Stream	316	15.64	0.33	3.34	0.05				2
1070	5.02	Unnamed Stream	497	10.83	0.46	1.63	0.02				2
118	5.01	Ballardvale Impoundment	413	16.63	0.30	1.93	0.02				2
195	9.53	Unnamed Stream	831	20.16	0.47	4.06	0.05				2
471	9.28	Unnamed Stream	892	25.25	0.37	2.64	0.02				2
739	8.63	Unnamed Pond	586	30.60	0.28	3.58	0.03				2
719	7.70	Unnamed Pond	717	21.72	0.35	4.20	0.01				2
1365	7.62	Merrimack River	960	9.47	0.81	3.13	1.00				2
977	6.85	Unnamed Wetland	817	10.54	0.65	2.90	0.15				2
450	6.47	Unnamed Stream	947	15.96	0.41	2.86	0.03				2
550	6.18	Fish Brook	514	15.96	0.39	3.18	0.04				2
1059	6.08	Unnamed Stream	720	13.53	0.45	2.98	0.04				2
846	5.96	Shawsheen River	937	6.50	0.92	3.38	0.09				2
161	5.84	Fish Brook	722	13.03	0.45	2.46	0.03				2
951	5.65	Unnamed Stream	899	15.43	0.37	1.77	0.02				2
1008	5.52	Unnamed Wetland	993	11.53	0.48	3.93	0.23	0		x	2
174	5.27	Unnamed Stream	649	12.01	0.44	2.17	0.03				2
96	5.22	Unnamed Pond	672	13.87	0.38	2.42	0.03				2
798	5.17	Unnamed Stream	518	17.34	0.30	2.52	0.03				2
282	5.17	Unnamed Stream	690	21.00	0.25	2.91	0.03				2

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653	9.22	Unnamed Stream	1033	20.97	0.44	4.11	0.05				2
645	8.89	Bakers Meadow Pond	1150	28.33	0.31	4.59	0.05				2
839	8.32	Shawsheen River	1161	11.79	0.71	3.53	0.06				2
INT-27	7.81			7.50	1.04	4.64	0.13			x	2
783	7.44	Rogers Brook	1756	15.27	0.49	2.81	0.03				2
276	7.34	Unnamed Stream	1507	20.79	0.35	2.41	0.02			x	2
792	6.09	Skug River	1163	14.48	0.42	1.76	0.02				2
1182	5.93	Unnamed Stream	2101	9.70	0.61	3.11	0.06				2
841	5.82	Hussey Brook	1339	12.84	0.45	2.32	0.03				2
452	5.81	Fish Brook	1337	12.90	0.45	1.50	0.01				2
INT-22	5.43			12.26	0.44	3.17	0.05			x	2
874	5.39	Unnamed Stream	1468	18.47	0.29	3.20	0.04				2
1162	4.67	Rogers Brook	41	13.52	0.35	2.22	0.03				3
59	4.55	Unnamed Stream	46	7.23	0.63	2.18	0.04				3
1119	4.41	Gravel Pit Pond	29	14.57	0.30	2.73	0.03				3
651	4.37	Unnamed Pond	28	6.71	0.65	2.63	0.05				3
48	4.26	Unnamed Stream	8	15.16	0.28	2.24	0.02				3
729	4.17	Shawsheen River	30	9.20	0.45	2.74	0.05				3
601	3.99	Unnamed Stream	21	4.94	0.81	2.16	0.05				3
68	3.91	Fish Brook	19	9.17	0.43	1.11	0.01				3
124	3.91	Unnamed Stream	10	11.69	0.33	1.88	0.02				3
369	3.84	Unnamed Stream	20	9.91	0.39	2.49	0.04				3

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478	3.57	Unnamed Stream	43	9.45	0.38	1.50	0.02				3
309	3.56	Fish Brook	28	8.99	0.40	0.84	0.01				3
193	3.54	Unnamed Stream	22	9.46	0.37	2.24	0.03				3
410	3.40	Unnamed Stream	45	7.97	0.43	1.37	0.02				3
503	3.20	Unnamed Stream	25	8.38	0.38	1.61	0.02				3
231	3.19	Unnamed Stream	32	5.25	0.61	1.73	0.03				3
390	3.04	Fish Brook	28	5.55	0.55	1.51	0.02				3
495	3.02	Unnamed Stream	29	10.63	0.28	1.13	0.01				3
709	2.85	Unnamed Stream	6	8.21	0.35	0.89	0.01				3
1010	2.81	Rogers Brook	11	12.54	0.22	1.03	0.03			x	3
958	2.81	Unnamed Stream	1	7.51	0.37	1.24	0.01				3
307	2.79	Hussey Brook	18	5.15	0.54	1.65	0.03				3
336	2.77	Unnamed Stream	2	7.42	0.37	0.65	0.00				3
1086	2.73	Unnamed Stream	7	7.66	0.36	0.79	0.03				3
287	2.71	Unnamed Pond	34	23.00	0.12	1.28	0.01				3
655	2.62	Shawsheen River	26	7.16	0.37	1.54	0.02				3
1379	2.59	Shawsheen River	0	6.05	0.43	1.64	0.03				3
568	2.57	Unnamed Stream	22	8.13	0.32	1.25	0.01				3
339	4.84	Ballardvale Impoundment	61	15.73	0.31	1.82	0.02				3
107	4.78	Unnamed Stream	116	15.03	0.32	3.02	0.04				3
630	4.41	Unnamed Stream	101	12.27	0.36	2.73	0.04				3
111	4.32	Ballardvale Impoundment	113	16.20	0.27	2.61	0.03				3

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203	4.07	Shawsheen River	133	12.58	0.32	2.48	0.03				3
105	3.87	Haggets Pond	60	14.45	0.27	1.38	0.01				3
1109	3.85	Unnamed Stream	50	12.69	0.30	2.42	0.03				3
809	3.77	Ballardvale Impoundment	59	26.51	0.14	0.92	0.00			x	3
1347	3.74	Hussey Brook	89	12.75	0.29	1.98	0.02				3
558	3.70	Unnamed Stream	120	8.07	0.46	1.85	0.03				3
553	3.59	Unnamed Pond	107	6.97	0.52	2.42	0.05				3
192	3.44	Unnamed Stream	93	7.36	0.47	2.17	0.04				3
520	3.33	Hussey Pond Brook	111	10.12	0.33	1.58	0.02				3
476	3.29	Shawsheen River	141	4.14	0.79	2.02	0.05				3
185	3.27	Ballardvale Impoundment	56	16.44	0.20	1.68	0.01				3
500	3.24	Unnamed Stream	74	9.03	0.36	1.46	0.02				3
923	3.13	Unnamed Stream	142	10.56	0.30	1.36	0.01			x	3
163	2.96	Unnamed Stream	79	11.49	0.26	1.16	0.00				3
611	2.85	Unnamed Wetland	77	5.88	0.49	1.42	0.02				3
168	2.78	Unnamed Stream	138	9.29	0.30	1.15	0.01				3
414	2.76	Unnamed Stream	132	6.44	0.43	1.11	0.01				3
133	2.70	Unnamed Stream	93	6.12	0.44	1.10	0.01				3
698	2.62	Unnamed Stream	148	5.82	0.45	1.03	0.01				3
490	2.56	Unnamed Stream	77	8.33	0.31	1.59	0.02				3
732	4.76	Unnamed Stream	356	10.84	0.44	2.30	0.03			x	3
248	4.56	Shawsheen River	273	12.88	0.35	2.67	0.04				3

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1184	4.49	Ballardvale Impoundment	389	19.56	0.23	1.60	0.01				3
1187	4.20	Ballardvale Impoundment	372	6.89	0.61	2.31	0.04				3
216	4.20	Unnamed Stream	174	8.23	0.51	1.64	0.02				3
436	4.14	Unnamed Stream	321	10.04	0.41	1.69	0.02				3
441	4.12	Unnamed Stream	153	10.16	0.41	1.74	0.02				3
884	4.00	Shawsheen River	389	8.88	0.45	2.16	0.03				3
667	3.84	Unnamed Stream	469	7.52	0.51	1.58	0.02				3
577	3.84	Fish Brook	475	7.68	0.50	2.13	0.03				3
373	3.83	Unnamed Stream	219	9.35	0.41	2.23	0.03				3
330	3.81	Unnamed Pond	205	9.67	0.39	2.16	0.03			x	3
186	3.63	Shawsheen River	280	6.43	0.57	2.01	0.04				3
7	3.62	Unnamed Stream	382	8.25	0.44	1.78	0.02				3
400	3.55	Unnamed Stream	433	7.22	0.49	1.53	0.02				3
1191	3.44	Shawsheen River	479	4.61	0.75	2.01	0.13				3
178	3.42	Unnamed Wetland	486	14.28	0.24	1.08	0.00				3
72	3.38	Fish Brook	164	6.17	0.55	1.48	0.02				3
524	3.34	Merrimack River	334	7.23	0.46	1.56	0.02				3
428	3.29	Hussey Brook	285	9.19	0.36	1.73	0.02				3
58	3.27	Unnamed Stream	421	10.74	0.30	2.06	0.03				3
506	3.22	Unnamed Stream	211	10.28	0.31	1.51	0.02				3
963	3.18	Shawsheen River	495	6.14	0.52	1.87	0.03				3
477	3.08	Unnamed Stream	303	5.96	0.52	2.06	0.04				3

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622	3.07	Unnamed Stream	385	6.89	0.45	1.97	0.03				3
42	3.05	Unnamed Stream	400	8.13	0.38	1.95	0.03				3
968	3.01	Unnamed Pond	233	7.09	0.42	1.42	0.02				3
1417	2.96	Unnamed Stream	434	5.92	0.50	1.40	0.02				3
726	2.79	Shawsheen River	189	4.04	0.69	1.93	0.05	0		x	3
32	2.77	Unnamed Stream	410	9.86	0.28	1.42	0.01				3
1238	2.68	Unnamed Stream	157	10.59	0.25	0.58	0.00				3
394	2.66	Unnamed Stream	467	7.21	0.37	0.62	0.00				3
566	2.60	Unnamed Stream	374	6.67	0.39	1.62	0.02				3
956	2.58	Unnamed Stream	281	14.45	0.18	0.69	0.00				3
407	2.52	Unnamed Stream	467	7.26	0.35	0.72	0.01				3
901	2.51	Shawsheen River	189	6.47	0.39	1.37	0.00			x	3
880	4.89	Unnamed Stream	793	10.03	0.49	2.02	0.03				3
570	4.72	Unnamed Stream	549	14.41	0.33	2.89	0.04			x	3
196	4.40	Bakers Meadow Pond	739	10.97	0.40	2.75	0.04				3
1247	4.33	Shawsheen River	606	11.80	0.37	2.39	0.00			x	3
794	4.21	Unnamed Stream	871	12.87	0.33	2.54	0.03			x	3
753	4.21	Unnamed Stream	886	8.89	0.47	1.27	0.01				3
786	4.10	Pomps Pond	665	9.51	0.43	2.42	0.01			x	3
528	3.90	Unnamed Stream	698	13.27	0.29	1.48	0.01				3
560	3.78	Meadow Brook	994	9.99	0.38	1.48	0.02				3
750	3.70	Unnamed Stream	734	10.14	0.37	1.29	0.01				3

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151	3.64	Unnamed Stream	754	4.77	0.76	1.52	0.03				3
197	3.59	Bakers Meadow Pond	565	9.69	0.37	2.31	0.03				3
596	3.52	Hussey Pond Brook	950	6.98	0.50	2.33	0.04				3
128	3.48	Unnamed Stream	540	7.99	0.44	1.42	0.02				3
1190	3.44	Shawsheen River	788	5.11	0.67	1.81	0.11				3
1207	3.34	Unnamed Stream	617	9.29	0.36	2.07	0.03				3
27	3.26	Unnamed Stream	507	8.35	0.39	2.11	0.03				3
670	3.25	Unnamed Wetland	968	6.06	0.54	1.42	0.02				3
510	3.21	Hussey Brook	935	6.05	0.53	1.79	0.03				3
1403	3.18	Unnamed Stream	634	8.62	0.37	1.32	0.01				3
805	3.08	Unnamed Stream	595	6.54	0.47	0.91	0.01				3
827	2.96	Unnamed Stream	526	6.78	0.44	1.75	0.03				3
278	2.84	Unnamed Stream	763	10.64	0.27	1.19	0.01				3
40	2.80	Unnamed Stream	631	8.97	0.31	1.45	0.02				3
625	2.76	Unnamed Pond	716	7.32	0.38	1.29	0.02				3
574	2.75	Shawsheen River	621	11.11	0.25	1.32	0.01				3
656	2.71	Unnamed Pond	980	5.18	0.52	1.78	0.03				3
136	2.71	Unnamed Stream	662	4.69	0.58	1.20	0.02				3
245	2.68	Unnamed Stream	894	6.49	0.41	1.74	0.03				3
1692	2.67	Hussey Brook	784	8.52	0.31	1.70	0.02				3
718	2.61	Unnamed Stream	775	6.21	0.42	1.70	0.03				3
483	2.59	Unnamed Stream	918	7.67	0.34	0.96	0.01				3

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Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
INT-40	4.97			11.54	0.43	1.37	0.01				3
INT-24	4.89			12.14	0.40	2.98	0.04				3
353	4.85	Unnamed Pond	1592	8.13	0.60	2.96	0.06				3
740	4.75	Unnamed Pond	1142	19.20	0.25	1.80	0.00				3
623	4.57	Hussey Brook	1206	11.94	0.38	2.34	0.03			x	3
INT-23	4.57			8.92	0.51	2.28	0.04				3
229	4.25	Unnamed Pond	1219	8.85	0.48	1.89	0.03				3
INT-43	3.93			2.74	1.43	1.55	0.55		x		3
840	3.84	Hussey Brook	1330	7.47	0.51	1.61	0.02				3
1131	3.82	Shawsheen River	1170	14.27	0.27	1.92	0.00			x	3
346	3.81	Shawsheen River	1057	7.06	0.54	1.76	0.03				3
1011	3.58	Rogers Brook	1062	2.37	1.51	2.00	0.18				3
1376	3.52	Unnamed Stream	1711	7.26	0.48	1.99	0.03			x	3
699	3.43	Rogers Brook	1001	5.55	0.62	1.51	0.02				3
INT-44	3.29			1.87	1.76	1.37	0.51				3
INT-31	3.28			7.98	0.41	1.12	0.01				3
17	3.05	Fosters Pond	1222	10.75	0.28	1.41	0.01				3
973	3.03	Unnamed Pond	1000	7.19	0.42	1.05	0.01				3
542	2.91	Hussey Brook	1413	7.25	0.40	1.09	0.01				3
1009	2.81	Shawsheen River	1184	3.90	0.72	1.99	0.05			x	3
620	2.80	Unnamed Stream	1137	5.71	0.49	1.65	0.03				3
255	2.50	Unnamed Wetland	1051	4.61	0.54	1.00	0.01				3

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Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
502	2.46	Unnamed Stream	26	5.90	0.42	1.62	0.03				4
904	2.44	Rogers Brook	2	3.87	0.63	1.19	0.02				4
49	2.42	Unnamed Stream	41	7.30	0.33	1.52	0.02				4
77	2.41	Unnamed Stream	13	2.10	1.15	1.05	0.37				4
991	2.39	Unnamed Stream	4	5.54	0.43	1.43	0.02				4
905	2.35	Rogers Brook	29	2.63	0.89	1.62	0.05			x	4
1074	2.33	Shawsheen River	0	3.93	0.59	1.52	0.03				4
378	2.31	Unnamed Wetland	27	6.50	0.35	1.00	0.01				4
555	2.29	Unnamed Stream	34	6.18	0.37	1.34	0.02				4
465	2.21	Unnamed Pond	35	6.96	0.32	1.41	0.02				4
1229	2.10	Haggets Pond	6	3.03	0.69	1.30	0.08			x	4
877	2.10	Shawsheen River	0	1.42	1.48	1.09	0.42				4
424	2.05	Unnamed Stream	27	6.67	0.31	1.15	0.01				4
182	2.05	Unnamed Stream	15	5.80	0.35	0.89	0.01				4
181	2.01	Unnamed Stream	9	7.45	0.27	1.02	0.01				4
467	1.98	Shawsheen River	34	4.89	0.41	1.15	0.02				4
617	1.93	Shawsheen River	17	4.39	0.44	1.18	0.02				4
850	1.92	Unnamed Wetland	17	3.94	0.49	1.09	0.02				4
811	1.89	Unnamed Stream	9	4.56	0.41	1.09	0.02				4
1065	1.89	Unnamed Stream	24	5.09	0.37	1.01	0.01				4
838	1.87	Shawsheen River	0	1.58	1.18	1.05	0.09				4
581	1.86	Unnamed Stream	43	4.23	0.44	1.21	0.02				4

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1718	1.83	Unnamed Stream	5	5.20	0.35	1.03	0.01				4
326	1.82	Unnamed Stream	26	4.78	0.38	1.05	0.01				4
384	1.81	Unnamed Pond	1	4.40	0.41	0.86	0.01				4
92	1.81	Unnamed Stream	4	4.65	0.39	0.99	0.00			x	4
328	1.78	Unnamed Stream	20	3.69	0.48	1.15	0.02				4
402	1.75	Unnamed Pond	34	4.32	0.40	0.80	0.01				4
1385	1.73	Shawsheen River	29	2.96	0.58	1.07	0.02				4
419	1.68	Unnamed Stream	7	4.94	0.34	0.87	0.01				4
1205	1.68	Unnamed Stream	4	2.74	0.61	1.09	0.02				4
1007	1.68	Haggets Pond	30	3.77	0.45	0.97	0.01			x	4
912	1.58	Unnamed Stream	43	5.44	0.29	0.96	0.01				4
533	1.56	Unnamed Stream	46	2.85	0.55	0.69	0.01				4
488	1.52	Unnamed Stream	3	4.07	0.37	0.97	0.01				4
551	1.49	Fish Brook	33	3.84	0.39	0.94	0.01				4
1093	1.49	Unnamed Stream	44	1.38	1.08	0.88	0.07				4
1099	1.48	Unnamed Stream	17	1.38	1.08	1.00	0.03			x	4
606	1.47	Hussey Pond	48	3.41	0.43	0.60	0.17				4
848	1.46	Shawsheen River	27	1.13	1.29	0.80	0.03				4
247	1.44	Unnamed Stream	37	6.26	0.23	0.84	0.01				4
766	1.44	Unnamed Stream	42	4.64	0.31	0.39	0.00				4
949	1.43	Unnamed Stream	8	3.73	0.38	0.62	0.01			x	4
1257	1.40	Unnamed Stream	3	3.25	0.43	0.81	0.00				4

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607	1.39	Shawsheen River	14	2.99	0.47	0.83	0.01				4
513	1.39	Unnamed Stream	8	4.73	0.29	0.62	0.00				4
522	1.38	Shawsheen River	27	1.92	0.72	0.83	0.02				4
480	1.33	Unnamed Wetland	0	3.73	0.36	0.69	0.01				4
177	1.33	Unnamed Stream	21	3.29	0.40	0.81	0.01				4
818	1.31	Fish Brook	25	2.41	0.54	0.66	0.01				4
4	1.29	Unnamed Wetland	0	3.94	0.33	0.85	0.01				4
120	1.25	Unnamed Wetland	39	2.53	0.49	0.75	0.01				4
876	1.24	Unnamed Stream	2	5.90	0.21	0.74	0.01				4
368	1.21	Unnamed Stream	6	4.45	0.27	0.75	0.01				4
1482	1.08	Shawsheen River	30	2.97	0.36	0.55	0.01				4
149	1.07	Hussey Brook	46	4.45	0.24	0.66	0.01				4
380	1.07	Unnamed Stream	34	3.05	0.35	0.40	0.00				4
1228	1.02	Haggets Pond	18	0.97	1.06	0.65	0.05			x	4
30	1.00	Hussey Pond Brook	6	1.13	0.88	0.72	0.02				4
166	1.00	Unnamed Stream	11	2.06	0.48	0.57	0.01				4
254	2.48	Unnamed Stream	147	5.53	0.45	1.32	0.02				4
175	2.47	Unnamed Stream	50	7.62	0.32	1.60	0.02				4
1141	2.44	Unnamed Wetland	146	4.23	0.58	1.60	0.03			x	4
57	2.39	Unnamed Stream	55	5.82	0.41	0.94	0.01				4
970	2.36	Fish Brook	52	6.01	0.39	1.28	0.02				4
834	2.36	Unnamed Pond	106	6.21	0.38	0.81	0.03				4

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1121	2.33	Fish Brook	78	6.74	0.35	1.48	0.02				4
280	2.31	Shawsheen River	141	7.81	0.30	1.42	0.02				4
1712	2.16	Unnamed Stream	82	8.24	0.26	0.71	0.01				4
496	2.10	Unnamed Pond	138	4.85	0.43	1.37	0.02				4
210	2.07	Unnamed Stream	61	4.07	0.51	1.39	0.03				4
242	2.00	Unnamed Stream	104	6.57	0.30	1.27	0.02				4
654	1.87	Unnamed Stream	110	6.15	0.30	1.04	0.01				4
52	1.85	Unnamed Stream	124	6.64	0.28	0.80	0.01				4
1687	1.83	Fish Brook	94	3.76	0.49	0.94	0.01				4
575	1.80	Fish Brook	131	7.43	0.24	0.79	0.01				4
446	1.71	Unnamed Stream	87	4.44	0.38	0.64	0.01				4
333	1.67	Haggets Pond	95	4.77	0.35	1.06	0.01				4
200	1.63	Unnamed Stream	84	2.63	0.62	0.75	0.01				4
209	1.48	Unnamed Stream	58	3.81	0.39	0.82	0.01				4
2	1.46	Fosters Pound	53	4.79	0.30	0.92	0.01				4
171	1.42	Unnamed Stream	72	3.93	0.36	0.74	0.01				4
881	1.38	Unnamed Pond	142	3.51	0.39	0.86	0.01				4
878	1.38	Unnamed Pond	72	2.69	0.51	0.92	0.02				4
395	1.34	Unnamed Pond	104	3.43	0.39	0.41	0.00				4
167	1.33	Unnamed Stream	122	4.04	0.33	0.80	0.01				4
292	1.31	Unnamed Stream	68	8.68	0.15	0.61	0.00				4
396	1.29	Unnamed Pond	81	2.29	0.57	0.68	0.01				4

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112	1.29	Ballardvale Impoundment	67	2.58	0.50	0.61	0.01				4
116	1.24	Shawsheen River	91	3.83	0.32	0.79	0.01				4
1	1.17	Fosters Pond	51	4.18	0.28	0.74	0.01				4
36	1.16	Unnamed Stream	50	2.25	0.51	0.47	0.01				4
636	1.13	Unnamed Stream	104	2.31	0.49	0.54	0.01				4
340	1.07	Ballardvale Impoundment	92	1.52	0.70	0.63	0.01				4
869	1.05	Unnamed Stream	111	2.44	0.43	0.39	0.00				4
86	1.04	Bakers Meadow Pond	103	2.57	0.41	0.69	0.01				4
925	1.04	Unnamed Stream	134	3.58	0.29	0.40	0.00			x	4
835	1.03	Unnamed Stream	58	2.67	0.39	0.61	0.01				4
383	1.01	Unnamed Stream	120	2.82	0.36	0.48	0.01				4
727	2.29	Shawsheen River	171	11.22	0.20	0.72	0.00				4
329	2.26	Unnamed Wetland	429	5.16	0.44	1.33	0.02				4
1140	2.25	Unnamed Wetland	174	1.68	1.34	1.68	0.07			x	4
334	2.22	Haggets Pond	216	6.01	0.37	1.42	0.02				4
1073	2.20	Unnamed Stream	417	5.32	0.41	1.24	0.02				4
131	2.20	Unnamed Wetland	247	3.66	0.60	1.00	0.02				4
385	2.17	Unnamed Stream	296	7.61	0.29	0.91	0.01				4
1139	2.17	Unnamed Wetland	171	2.51	0.86	1.60	0.05			x	4
984	2.12	Unnamed Stream	160	8.98	0.24	0.87	0.01				4
324	2.09	Ballardvale Impoundment	201	5.78	0.36	1.34	0.02				4
374	2.09	Ballardvale Impoundment	325	3.37	0.62	1.13	0.02				4

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640	2.02	Unnamed Stream	171	4.40	0.46	1.28	0.02				4
50	2.00	Bakers Meadow Pond	306	5.70	0.35	1.17	0.02				4
187	1.99	Unnamed Stream	410	5.49	0.36	1.30	0.02				4
639	1.98	Unnamed Pond	250	7.58	0.26	1.19	0.01				4
479	1.97	Unnamed Stream	344	4.85	0.41	1.31	0.02				4
1048	1.95	Ballardvale Impoundment	371	9.62	0.20	1.14	0.01				4
108	1.93	Unnamed Stream	268	4.29	0.45	1.18	0.02				4
610	1.92	Shawsheen River	206	1.72	1.11	0.97	0.35				4
15	1.92	Merrimack River	430	3.73	0.52	1.24	0.02				4
145	1.91	Merrimack River	243	3.96	0.48	0.76	0.01				4
1211	1.86	Unnamed Stream	271	5.35	0.35	1.04	0.01				4
556	1.81	Unnamed Wetland	418	5.50	0.33	0.99	0.01				4
952	1.73	Fish Brook	464	3.15	0.55	0.84	0.01				4
405	1.72	Merrimack River	244	3.75	0.46	0.77	0.01				4
401	1.68	Unnamed Stream	165	4.56	0.37	1.00	0.01				4
1152	1.65	Unnamed Stream	461	6.83	0.24	0.60	0.00				4
900	1.65	Shawsheen River	358	2.54	0.65	0.93	0.02			x	4
1006	1.64	Unnamed Stream	392	6.75	0.24	0.97	0.01				4
494	1.64	Unnamed Stream	276	3.03	0.54	0.96	0.02				4
976	1.63	Unnamed Stream	438	5.11	0.32	0.21	0.00				4
515	1.60	Unnamed Pond	230	5.89	0.27	0.65	0.01				4
403	1.59	Unnamed Stream	199	5.06	0.31	0.63	0.01				4

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56	1.59	Unnamed Stream	417	4.18	0.38	0.95	0.01				4
430	1.58	Unnamed Wetland	280	4.76	0.33	1.00	0.01				4
180	1.57	Unnamed Stream	224	4.16	0.38	1.02	0.02				4
657	1.56	Unnamed Pond	246	4.39	0.36	0.67	0.01				4
549	1.52	Unnamed Pond	460	6.68	0.23	0.39	0.00				4
1346	1.51	Unnamed Stream	299	6.22	0.24	0.44	0.00				4
981	1.51	Unnamed Stream	365	8.16	0.19	0.39	0.00				4
511	1.50	Unnamed Stream	267	3.90	0.38	0.79	0.01				4
443	1.50	Unnamed Stream	168	4.57	0.33	0.95	0.01				4
115	1.49	Unnamed Wetland	211	6.09	0.24	0.79	0.01				4
137	1.44	Unnamed Stream	258	2.33	0.62	0.69	0.01				4
1411	1.43	Unnamed Stream	247	2.27	0.63	0.79	0.01				4
530	1.42	Unnamed Stream	334	3.31	0.43	0.90	0.01				4
404	1.41	Unnamed Pond	378	4.17	0.34	0.91	0.01				4
170	1.40	Unnamed Stream	291	6.32	0.22	0.48	0.00				4
493	1.37	Shawsheen River	263	4.88	0.28	0.51	0.00				4
44	1.36	Hussey Pond Brook	208	2.88	0.47	0.90	0.02				4
389	1.35	Merrimack River	303	3.72	0.36	0.75	0.01				4
1364	1.28	Unnamed Stream	240	8.48	0.15	0.21	0.00				4
1233	1.27	Unnamed Stream	433	2.76	0.46	0.54	0.01				4
28	1.23	Unnamed Stream	324	3.59	0.34	0.79	0.01				4
1248	1.21	Unnamed Wetland	415	3.27	0.37	0.66	0.00			x	4

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250	1.19	Hussey Brook	193	3.56	0.33	0.59	0.01				4
504	1.17	Unnamed Stream	346	2.20	0.53	0.58	0.01				4
327	1.14	Unnamed Stream	161	2.74	0.42	0.76	0.01				4
517	1.14	Merrimack River	461	2.07	0.55	0.64	0.01				4
135	1.13	Unnamed Stream	206	2.73	0.41	0.73	0.01				4
1412	1.09	Unnamed Stream	468	3.35	0.32	0.52	0.00				4
31	1.09	Unnamed Stream	306	2.46	0.44	0.37	0.00				4
1167	1.05	Unnamed Stream	218	2.89	0.36	0.33	0.00				4
597	1.05	Unnamed Wetland	338	1.52	0.69	0.53	0.01				4
338	1.03	Unnamed Stream	294	3.25	0.32	0.48	0.01				4
1102	1.03	Unnamed Stream	365	2.37	0.43	0.61	0.01				4
1135	1.02	Unnamed Stream	235	3.00	0.34	0.59	0.01				4
1018	1.02	Unnamed Stream	188	2.06	0.50	0.66	0.01				4
936	2.48	Unnamed Stream	641	7.33	0.34	0.86	0.01				4
1155	2.47	Unnamed Wetland	693	5.50	0.45	0.95	0.01				4
505	2.42	Unnamed Stream	862	6.65	0.36	1.23	0.02				4
312	2.35	Unnamed Stream	769	7.85	0.30	1.35	0.02				4
372	2.35	Shawsheen River	627	4.24	0.55	1.59	0.03				4
548	2.32	Unnamed Stream	697	5.33	0.43	0.99	0.01				4
917	2.32	Shawsheen River	626	2.67	0.87	1.36	0.03				4
692	2.28	Rogers Brook	594	3.77	0.61	1.48	0.03				4
435	2.25	Unnamed Stream	566	5.37	0.42	0.96	0.01				4

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100	2.24	Shawsheen River	559	9.15	0.25	1.20	0.01	0.06		x	4
409	2.10	Unnamed Stream	514	3.02	0.70	1.15	0.02				4
208	2.09	Unnamed Pond	768	4.20	0.50	0.92	0.01				4
274	2.09	Unnamed Stream	577	4.74	0.44	0.70	0.01				4
882	2.02	Unnamed Pond	876	6.30	0.32	1.25	0.02				4
157	1.97	Unnamed Stream	592	4.96	0.40	0.89	0.01				4
538	1.96	Hussey Brook	526	4.64	0.42	0.75	0.01				4
217	1.92	Fish Brook	766	4.48	0.43	0.63	0.01				4
1240	1.85	Unnamed Pond	676	3.26	0.57	0.95	0.02				4
826	1.82	Unnamed Stream	594	5.84	0.31	0.69	0.00				4
491	1.81	Shawsheen River	621	4.64	0.39	0.80	0.01				4
707	1.77	Unnamed Stream	918	3.71	0.48	0.74	0.01				4
264	1.77	Unnamed Stream	767	3.80	0.47	1.17	0.02				4
624	1.77	Unnamed Pond	961	4.43	0.40	0.92	0.01				4
269	1.74	Unnamed Stream	772	3.68	0.47	1.07	0.00			x	4
285	1.72	Fosters Pond	843	5.23	0.33	0.71	0.01				4
331	1.69	Skug River	983	3.02	0.56	0.74	0.01				4
362	1.63	Unnamed Stream	772	5.48	0.30	1.00	0.01				4
605	1.57	Unnamed Stream	845	4.36	0.36	0.57	0.01				4
1064	1.55	Unnamed Stream	668	6.42	0.24	0.71	0.01				4
489	1.53	Unnamed Wetland	684	3.00	0.51	0.63	0.01				4
5	1.48	Unnamed Stream	529	4.03	0.37	0.96	0.01				4

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
1082	1.46	Unnamed Stream	991	3.36	0.44	0.49	0.01				4
918	1.46	Unnamed Stream	660	7.68	0.19	0.64	0.00				4
156	1.46	Unnamed Stream	615	2.75	0.53	0.88	0.02				4
14	1.44	Unnamed Stream	661	5.53	0.26	0.70	0.01				4
469	1.42	Unnamed Stream	910	4.03	0.35	0.30	0.00				4
576	1.29	Unnamed Stream	576	3.35	0.39	0.72	0.01				4
148	1.16	Merrimack River	762	3.09	0.38	0.52	0.01				4
306	1.14	Rogers Brook	532	2.49	0.46	0.33	0.00				4
486	1.13	Unnamed Wetland	560	2.19	0.51	0.46	0.01				4
1049	1.10	Unnamed Stream	552	4.60	0.24	0.31	0.00				4
408	1.09	Unnamed Stream	681	2.26	0.48	0.46	0.01				4
158	1.08	Unnamed Stream	509	2.77	0.39	0.45	0.01				4
289	1.05	Unnamed Stream	689	3.86	0.27	0.67	0.01				4
191	1.05	Unnamed Stream	554	2.06	0.51	0.66	0.01				4
472	1.00	Unnamed Stream	654	1.52	0.66	0.64	0.01				4
INT-38	2.32			3.55	0.65	1.46	0.03				4
INT-32	2.30			5.81	0.40	1.51	0.02				4
355	2.07	Bakers Meadow Pond	1114	5.29	0.39	1.18	0.02				4
1467	2.07	Unnamed Stream	1133	4.01	0.52	0.94	0.01				4
1080	2.03	Unnamed Pond	1332	5.44	0.37	1.09	0.01				4
INT-11	1.98			4.63	0.43	1.19	0.02			x	4
INT-3	1.93			3.76	0.51	1.16	0.02				4

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Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
563	1.76	Unnamed Stream	1119	4.43	0.40	0.95	0.01				4
INT-12	1.76			2.99	0.59	1.20	0.03				4
INT-15	1.75			3.27	0.54	1.17	0.02				4
INT-26	1.56			4.60	0.34	1.03	0.01				4
38	1.55	Unnamed Stream	1412	2.97	0.52	0.98	0.02				4
613	1.49	Unnamed Stream	1198	3.06	0.49	1.00	0.02				4
347	1.46	Shawsheen River	1009	2.76	0.53	0.81	0.01				4
559	1.45	Unnamed Pond	1201	6.42	0.23	0.72	0.01				4
426	1.44	Unnamed Pond	1029	2.59	0.56	0.57	0.01				4
33	1.41	Unnamed Stream	1131	3.43	0.41	0.89	0.01				4
70	1.36	Rogers Brook	1507	2.11	0.64	0.75	0.01				4
689	1.28	Rogers Brook	1507	2.73	0.47	0.43	0.00				4
1107	1.24	Unnamed Stream	1047	2.96	0.42	0.79	0.01				4
INT-21	1.23			4.21	0.29	0.77	0.01				4
INT-4	1.23			2.13	0.58	0.75	0.01				4
749	1.13	Rogers Brook	1211	2.32	0.49	0.59	0.01				4
153	1.11	Merrimack River	1025	3.68	0.30	0.41	0.00				4
1336	1.10	Unnamed Stream	1025	2.07	0.53	0.48	0.01				4
540	1.07	Unnamed Stream	1222	2.20	0.49	0.35	0.00				4
41	1.05	Unnamed Stream	1577	3.49	0.30	0.64	0.01				4
1249	1.04	Shawsheen River	1171	1.14	0.91	0.77	0.02			x	4
INT-8	1.02			2.67	0.38	0.66	0.01				4

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416	0.98	Unnamed Wetland	14	2.04	0.48	0.64	0.01				5
587	0.98	Shawsheen River	19	2.16	0.45	0.56	0.17				5
98	0.92	Unnamed Stream	19	1.67	0.55	0.60	0.01			x	5
844	0.90	Unnamed Stream	30	3.25	0.28	0.23	0.01				5
162	0.87	Ballardvale Impoundment	35	1.96	0.44	0.58	0.01				5
342	0.84	Unnamed Stream	1	2.45	0.34	0.53	0.01				5
785	0.83	Ballardvale Impoundment	32	2.01	0.41	0.56	0.01				5
78	0.82	Rogers Brook	18	1.40	0.59	0.39	0.01				5
281	0.80	Unnamed Stream	42	2.32	0.34	0.53	0.01				5
911	0.79	Unnamed Stream	31	1.54	0.51	0.54	0.01				5
554	0.77	Unnamed Stream	17	1.88	0.41	0.49	0.01				5
1223	0.75	Shawsheen River	0	0.57	1.32	0.44	0.01				5
176	0.73	Unnamed Stream	24	1.66	0.44	0.49	0.01				5
931	0.71	Hussey Brook	28	1.93	0.37	0.40	0.01				5
453	0.71	Unnamed Stream	23	0.60	1.18	0.51	0.02				5
422	0.70	Unnamed Stream	16	2.27	0.31	0.44	0.01				5
439	0.66	Unnamed Stream	11	1.46	0.45	0.39	0.02			x	5
257	0.65	Unnamed Stream	13	3.17	0.20	0.22	0.00				5
728	0.64	Shawsheen River	0	1.59	0.40	0.40	0.01				5
908	0.63	Unnamed Stream	14	1.19	0.53	0.31	0.00				5
916	0.60	Unnamed Stream	3	1.56	0.38	0.38	0.01				5
978	0.56	Haggets Pond	5	1.36	0.41	0.36	0.01				5

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81	0.52	Rogers Brook	48	0.96	0.54	0.28	0.00				5
165	0.52	Unnamed Stream	10	1.43	0.37	0.26	0.00				5
271	0.52	Fish Brook	2	0.99	0.52	0.31	0.01				5
243	0.51	Unnamed Stream	16	1.68	0.31	0.28	0.00				5
508	0.50	Unnamed Stream	25	1.18	0.43	0.29	0.00				5
1016	0.48	Unnamed Stream	46	0.74	0.65	0.29	0.01				5
421	0.48	Unnamed Wetland	0	1.50	0.32	0.29	0.00				5
125	0.48	Unnamed Stream	8	0.83	0.58	0.31	0.01				5
1063	0.46	Unnamed Stream	31	0.78	0.58	0.29	0.01				5
801	0.44	Haggets Pond	0	1.01	0.43	0.29	0.00				5
114	0.44	Unnamed Wetland	28	1.21	0.36	0.29	0.00				5
843	0.38	Unnamed Stream	32	1.95	0.20	0.00	0.00				5
990	0.38	Unnamed Stream	6	0.34	1.11	0.28	0.01				5
173	0.37	Unnamed Stream	2	1.19	0.31	0.17	0.00				5
588	0.37	Shawsheen River	25	0.54	0.68	0.25	0.01				5
1000	0.36	Unnamed Stream	9	1.04	0.35	0.21	0.00				5
1150	0.34	Unnamed Stream	3	2.12	0.16	0.18	0.00				5
1208	0.34	Fish Brook	38	1.13	0.30	0.22	0.00				5
272	0.33	Fish Brook	13	0.52	0.64	0.21	0.00				5
512	0.33	Unnamed Stream	5	1.35	0.24	0.13	0.00				5
586	0.33	Shawsheen River	11	0.42	0.79	0.20	0.00				5
829	0.29	Shawsheen River	27	0.29	1.01	0.17	0.00				5

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379	0.27	Unnamed Wetland	36	0.38	0.70	0.16	0.00				5
1058	0.23	Unnamed Stream	16	0.75	0.30	0.06	0.00				5
902	0.22	Unnamed Stream	11	0.24	0.92	0.11	0.04				5
11	0.19	Unnamed Stream	9	0.56	0.34	0.06	0.00				5
382	0.18	Unnamed Stream	24	0.23	0.77	0.12	0.00				5
706	0.11	Rogers Brook	8	0.55	0.20	0.06	0.00			x	5
102	0.11	Unnamed Stream	3	0.28	0.38	0.05	0.00				5
589	0.08	Shawsheen River	12	0.10	0.80	0.06	0.00				5
1401	0.07	Shawsheen River	0	0.06	1.07	0.05	0.00				5
1071	0.06	Shawsheen River	0	0.06	1.00	0.05	0.00				5
265	0.05	Shawsheen River	0	0.04	1.26	0.03	0.00				5
849	0.04	Shawsheen River	44	0.06	0.68	0.03	0.00				5
184	0.96	Unnamed Stream	53	2.98	0.32	0.62	0.01				5
1713	0.95	Unnamed Stream	92	2.34	0.41	0.46	0.00				5
322	0.88	Ballardvale Impoundment	140	1.38	0.64	0.50	0.01				5
806	0.85	Fish Brook	53	2.00	0.42	0.50	0.01				5
444	0.84	Hussey Brook	96	2.21	0.38	0.55	0.01				5
75	0.80	Unnamed Stream	102	3.06	0.26	0.48	0.01				5
113	0.80	Unnamed Stream	108	2.23	0.36	0.51	0.01				5
29	0.79	Hussey Pond Brook	82	1.05	0.76	0.54	0.01				5
1126	0.77	Unnamed Stream	79	2.27	0.34	0.35	0.00				5
164	0.77	Unnamed Stream	98	3.41	0.22	0.47	0.00				5

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498	0.76	Unnamed Wetland	109	1.31	0.58	0.45	0.01				5
367	0.75	Ballardvale Impoundment	55	2.17	0.34	0.25	0.00				5
432	0.74	Unnamed Stream	74	0.81	0.91	0.48	0.01				5
172	0.73	Unnamed Wetland	111	2.64	0.28	0.39	0.00				5
437	0.66	Unnamed Stream	137	1.39	0.48	0.45	0.01			x	5
251	0.65	Hussey Brook	138	1.80	0.36	0.33	0.00				5
438	0.61	Unnamed Stream	100	1.67	0.37	0.38	0.01			x	5
122	0.61	Unnamed Stream	73	1.15	0.53	0.36	0.01				5
980	0.56	Unnamed Stream	64	0.80	0.70	0.39	0.01				5
933	0.56	Unnamed Stream	100	1.33	0.42	0.36	0.01				5
501	0.55	Unnamed Stream	121	2.02	0.27	0.24	0.00				5
557	0.52	Unnamed Stream	112	0.88	0.58	0.30	0.01				5
417	0.43	Fish Brook	83	0.72	0.60	0.30	0.01				5
423	0.43	Unnamed Stream	116	0.75	0.57	0.26	0.00				5
1185	0.42	Ballardvale Impoundment	144	1.30	0.32	0.23	0.00				5
376	0.40	Unnamed Wetland	141	0.81	0.50	0.26	0.00				5
37	0.40	Unnamed Stream	50	0.66	0.61	0.21	0.00				5
733	0.38	Unnamed Stream	53	0.49	0.78	0.22	0.00				5
121	0.37	Unnamed Wetland	114	0.53	0.69	0.23	0.01				5
1688	0.33	Fish Brook	146	0.65	0.51	0.22	0.00				5
16	0.32	Merrimack River	117	0.42	0.75	0.22	0.01				5
572	0.29	Ballardvale Impoundment	63	0.54	0.54	0.19	0.00				5

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123	0.28	Unnamed Stream	74	0.60	0.46	0.19	0.00				5
1362	0.26	Unnamed Stream	66	0.72	0.36	0.13	0.01			x	5
341	0.26	Unnamed Wetland	78	0.94	0.28	0.16	0.00				5
1112	0.21	Unnamed Stream	106	1.02	0.20	0.13	0.00				5
1256	0.19	Unnamed Stream	64	0.22	0.87	0.14	0.00				5
445	0.04	Gravel Pit Pond	78	0.36	0.10	0.02	0.00				5
602	0.98	Unnamed Stream	446	1.85	0.53	0.40	0.01				5
273	0.97	Unnamed Stream	224	1.95	0.50	0.49	0.01				5
516	0.96	Merrimack River	191	1.49	0.65	0.62	0.01	0.09			5
53	0.96	Unnamed Stream	221	3.27	0.29	0.35	0.00				5
134	0.96	Unnamed Stream	205	2.04	0.47	0.64	0.01				5
941	0.96	Unnamed Stream	383	1.97	0.48	0.63	0.01				5
890	0.92	Unnamed Stream	301	1.72	0.53	0.61	0.01				5
397	0.90	Unnamed Stream	276	1.40	0.64	0.51	0.01				5
1122	0.89	Shawsheen River	291	1.07	0.83	0.55	0.01				5
832	0.89	Hussey Brook	283	1.74	0.51	0.60	0.01				5
377	0.85	Unnamed Stream	261	2.53	0.34	0.50	0.01				5
595	0.84	Unnamed Stream	492	2.19	0.38	0.56	0.01				5
1136	0.84	Unnamed Stream	234	1.76	0.48	0.55	0.01				5
387	0.82	Unnamed Stream	485	1.74	0.47	0.43	0.01				5
1389	0.80	Unnamed Stream	202	2.82	0.28	0.15	0.00				5
569	0.79	Unnamed Stream	174	1.74	0.45	0.42	0.01				5

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323	0.77	Ballardvale Impoundment	283	1.61	0.48	0.45	0.01				5
1081	0.77	Unnamed Stream	286	1.56	0.49	0.32	0.00				5
361	0.76	Unnamed Stream	177	2.40	0.32	0.48	0.01				5
464	0.75	Fish Brook	321	1.50	0.50	0.31	0.00				5
325	0.74	Unnamed Stream	315	2.00	0.37	0.49	0.01				5
906	0.72	Unnamed Stream	326	1.77	0.41	0.29	0.00				5
668	0.71	Unnamed Stream	434	1.05	0.67	0.38	0.01				5
541	0.68	Merrimack River	349	1.74	0.39	0.44	0.01				5
1642	0.68	Unnamed Stream	261	2.31	0.29	0.24	0.00				5
932	0.68	Unnamed Stream	292	2.52	0.27	0.17	0.00				5
21	0.67	Unnamed Stream	237	1.45	0.46	0.32	0.00				5
644	0.67	Unnamed Stream	183	2.19	0.31	0.43	0.01				5
154	0.67	Merrimack River	445	1.91	0.35	0.34	0.00				5
337	0.66	Unnamed Stream	165	0.82	0.80	0.43	0.01				5
1363	0.64	Unnamed Stream	406	1.27	0.51	0.35	0.01				5
429	0.63	Unnamed Stream	425	0.86	0.73	0.35	0.01				5
1361	0.63	Unnamed Stream	337	5.05	0.12	0.00	0.00			x	5
942	0.61	Unnamed Stream	313	1.73	0.35	0.36	0.00				5
117	0.60	Ballardvale Impoundment	372	2.12	0.28	0.31	0.00				5
6	0.59	Unnamed Stream	392	2.08	0.29	0.29	0.00				5
234	0.59	Shawsheen River	495	1.30	0.45	0.33	0.01				5
996	0.58	Shawsheen River	344	3.38	0.17	0.27	0.00				5

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492	0.57	Unnamed Stream	441	1.39	0.41	0.34	0.01				5
481	0.55	Unnamed Stream	205	0.90	0.61	0.35	0.01				5
259	0.54	Unnamed Stream	498	1.22	0.45	0.34	0.01				5
119	0.54	Unnamed Wetland	369	1.46	0.37	0.28	0.00				5
564	0.54	Unnamed Stream	247	0.95	0.57	0.29	0.01				5
1705	0.51	Unnamed Stream	261	2.27	0.22	0.06	0.00				5
1691	0.50	Unnamed Stream	207	1.47	0.34	0.25	0.00				5
989	0.49	Unnamed Stream	441	1.04	0.47	0.24	0.00				5
1408	0.47	Unnamed Stream	406	0.71	0.66	0.26	0.01				5
1196	0.46	Unnamed Pond	497	0.67	0.69	0.32	0.01				5
686	0.45	Unnamed Stream	398	0.67	0.68	0.26	0.01				5
1067	0.45	Unnamed Stream	344	1.02	0.44	0.26	0.00				5
267	0.41	Unnamed Stream	223	1.02	0.40	0.22	0.00				5
375	0.41	Ballardvale Impoundment	454	2.93	0.14	0.00	0.00				5
1410	0.40	Unnamed Stream	342	0.62	0.65	0.25	0.01				5
214	0.40	Unnamed Stream	337	0.31	1.28	0.30	0.01				5
1154	0.40	Unnamed Stream	301	0.99	0.40	0.21	0.00				5
961	0.39	Unnamed Pond	258	0.85	0.46	0.24	0.00				5
1146	0.39	Unnamed Stream	182	1.59	0.24	0.19	0.00				5
603	0.38	Unnamed Wetland	375	1.00	0.38	0.07	0.00				5
431	0.37	Unnamed Stream	191	0.30	1.23	0.27	0.01				5
619	0.35	Shawsheen River	188	0.28	1.26	0.24	0.01				5

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
13	0.35	Unnamed Wetland	236	1.00	0.35	0.22	0.00				5
420	0.35	Unnamed Stream	150	0.94	0.37	0.23	0.00				5
1358	0.33	Unnamed Stream	254	0.57	0.58	0.21	0.00			x	5
351	0.29	Unnamed Pond	358	0.66	0.45	0.20	0.00				5
1222	0.24	Unnamed Stream	356	0.74	0.33	0.12	0.00				5
992	0.23	Unnamed Stream	307	0.41	0.57	0.11	0.00				5
1342	0.22	Ames Pond	251	1.44	0.15	0.07	0.00		x		5
993	0.17	Unnamed Pond	258	0.54	0.31	0.07	0.00				5
935	0.16	Unnamed Stream	243	0.16	1.01	0.11	0.00				5
953	0.15	Fish Brook	464	0.21	0.69	0.10	0.00				5
1234	0.14	Fish Brook	211	0.21	0.69	0.09	0.00				5
937	0.14	Unnamed Stream	482	0.15	0.97	0.10	0.00				5
1001	0.08	Bakers Meadow Pond	162	0.64	0.12	0.02	0.00				5
1231	0.07	Fish Brook	396	0.11	0.67	0.05	0.00				5
87	0.04	Shawsheen River	358	0.13	0.30	0.02	0.00				5
55	0.95	Pomps Pond	609	3.13	0.30	0.45	0.00			x	5
468	0.91	Unnamed Stream	607	1.48	0.62	0.57	0.01				5
547	0.91	Merrimack River	793	2.60	0.35	0.57	0.01				5
147	0.83	Hussey Brook	665	2.20	0.38	0.48	0.01				5
945	0.83	Hussey Brook	925	2.35	0.35	0.38	0.00				5
64	0.79	Ballardvale Impoundment	517	2.09	0.38	0.46	0.01				5
1062	0.79	Unnamed Stream	945	1.98	0.40	0.44	0.00			x	5

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
22	0.77	Unnamed Wetland	592	1.12	0.69	0.43	0.01				5
350	0.75	Unnamed Stream	772	2.60	0.29	0.37	0.00				5
189	0.71	Unnamed Stream	534	1.45	0.49	0.47	0.01				5
284	0.67	Unnamed Stream	962	3.04	0.22	0.16	0.00				5
260	0.67	Unnamed Stream	681	0.80	0.83	0.43	0.01				5
460	0.66	Fish Brook	511	1.32	0.50	0.31	0.00				5
146	0.65	Merrimack River	821	1.47	0.44	0.35	0.01				5
127	0.64	Unnamed Stream	863	1.69	0.38	0.35	0.00				5
1407	0.43	Unnamed Stream	569	0.67	0.63	0.22	0.00				5
543	0.38	Merrimack River	721	0.72	0.53	0.17	0.00				5
1079	0.33	Shawsheen River	539	0.29	1.16	0.24	0.01				5
1118	0.31	Unnamed Stream	517	0.89	0.35	0.16	0.00				5
1654	0.29	Unnamed Stream	543	1.20	0.24	0.12	0.00				5
386	0.28	Unnamed Wetland	536	0.64	0.43	0.19	0.00				5
545	0.24	Merrimack River	607	0.31	0.77	0.16	0.00				5
183	0.21	Shawsheen River	756	0.51	0.42	0.14	0.00				5
1406	0.21	Unnamed Stream	582	0.20	1.04	0.13	0.00				5
CEI-OUT-1	0.20	Fish Brook	614	0.40	0.50	0.12	0.00				5
190	0.17	Unnamed Stream	592	1.66	0.10	0.08	0.00				5
1404	0.11	Unnamed Stream	640	0.42	0.27	0.02	0.00				5
764	0.11	Unnamed Stream	974	0.27	0.42	0.05	0.00				5
INT-16	0.98			0.99	1.00	0.41	0.14				5

Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
722	0.94	Unnamed Stream	1274	2.49	0.38	0.61	0.01				5
INT-2	0.94			1.06	0.88	0.65	0.02				5
INT-13	0.90			3.95	0.23	0.51	0.02				5
1440	0.89	Unnamed Stream	1357	1.93	0.46	0.56	0.01				5
152	0.88	Unnamed Stream	1051	1.64	0.54	0.39	0.01				5
360	0.86	Unnamed Stream	1142	2.45	0.35	0.54	0.01				5
573	0.86	Unnamed Stream	1181	3.71	0.23	0.10	0.00				5
INT-17	0.86			0.42	2.02	0.36	0.14				5
497	0.85	Unnamed Stream	1149	1.67	0.51	0.43	0.01				5
763	0.77	Unnamed Stream	1125	4.82	0.16	0.26	0.00				5
283	0.75	Unnamed Stream	1014	2.90	0.26	0.20	0.00				5
INT-41	0.73			0.77	0.94	0.45	0.03				5
INT-5	0.71			1.56	0.46	0.38	0.01				5
INT-45	0.64			0.33	1.97	0.27	0.11				5
INT-19	0.63			2.53	0.25	0.33	0.00				5
INT-33	0.63			1.00	0.63	0.38	0.02				5
INT-7	0.61			1.08	0.57	0.25	0.00				5
562	0.56	Unnamed Stream	1094	1.19	0.47	0.24	0.00				5
INT-25	0.54			1.23	0.44	0.36	0.01				5
INT-34	0.54			1.52	0.35	0.21	0.00				5
INT-1	0.49			0.36	1.34	0.36	0.01				5
INT-9	0.46			0.75	0.61	0.29	0.01				5









Table 2: Catchment Area Analysis for Outfalls in the Phosphorus Source Area

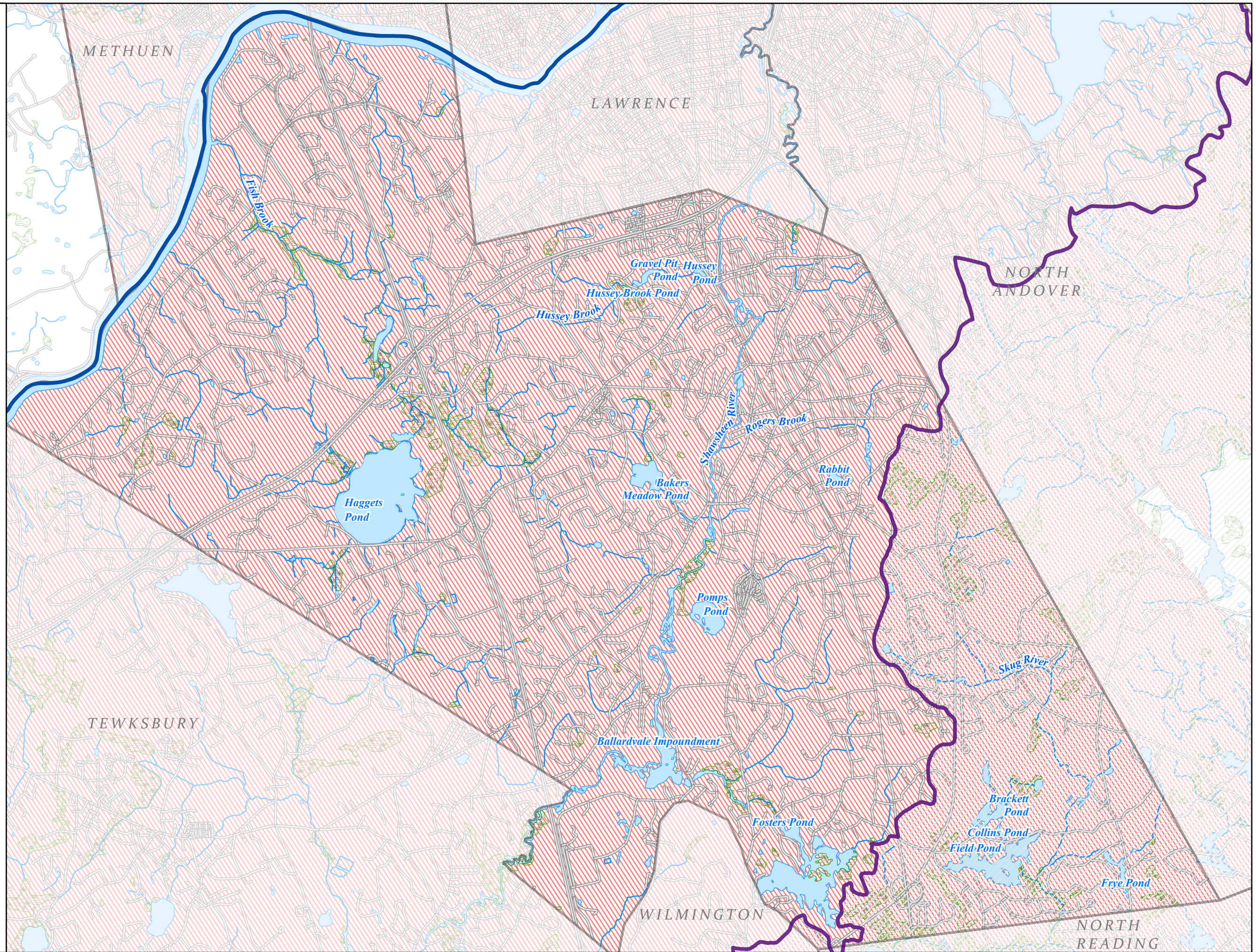
Catchment ID	TP Load (lbs P/year)	Receiving Water	Distance to Receiving Water (ft)	Catchment Area (Acres)	TP Load per acre (lbs/acre/yr)	Impervious Area in Catchment (acres)	DCIA in Catchment (acres)	Phosphorus (mg/L) <i>if sample was taken</i>	Existing BMP in Catchment	Municipal Properties in Catchment	Prioritization Group
39	0.43	Unnamed Stream	1704	0.75	0.57	0.28	0.01				5
INT-29	0.40			0.42	0.95	0.27	0.01				5
INT-14	0.37			1.34	0.27	0.22	0.01				5
65	0.36	Unnamed Stream	1127	1.20	0.30	0.19	0.00				5
34	0.34	Unnamed Stream	1244	0.72	0.48	0.23	0.00				5
INT-18	0.30			0.41	0.73	0.18	0.00				5
INT-30	0.29			0.22	1.32	0.21	0.01				5
INT-28	0.21			0.48	0.45	0.14	0.00				5
INT-6	0.20			0.50	0.39	0.11	0.00				5
391	0.18	Merrimack River	1022	0.41	0.44	0.09	0.00				5
INT-10	0.16			0.27	0.58	0.10	0.00				5
INT-37	0.13			0.27	0.48	0.08	0.00				5
INT-20	0.10			0.12	0.85	0.07	0.00				5
974	0.08	Unnamed Stream	1079	0.24	0.32	0.01	0.00				5
<b>Total</b>	<b>2394</b>			<b>5433</b>		<b>1198</b>	<b>27</b>				

**Figure 1-  
Andover, MA  
Urbanized Area**



**Legend**

-  Merrimack River
-  Merrimack River Watershed
-  Roads
-  Lake, Pond, Reservoir
-  Wetland, Marsh, Swamp
-  Stream, Brook
-  Urbanized Area
-  Other Watershed





**New  
Hampshire**

**Massachusetts**



**Figure 2-  
Merrimack River Watershed**



Data Sources: MassGIS, Town of Andover, CEI

**Legend**

- |                           |                 |
|---------------------------|-----------------|
| Town Of Andover           | Pond, Reservoir |
| Merrimack River           | Swamp, Marsh    |
| Merrimack River Watershed | Stream, River   |







**Figure 3- Phosphorus Source Area in Andover, MA**

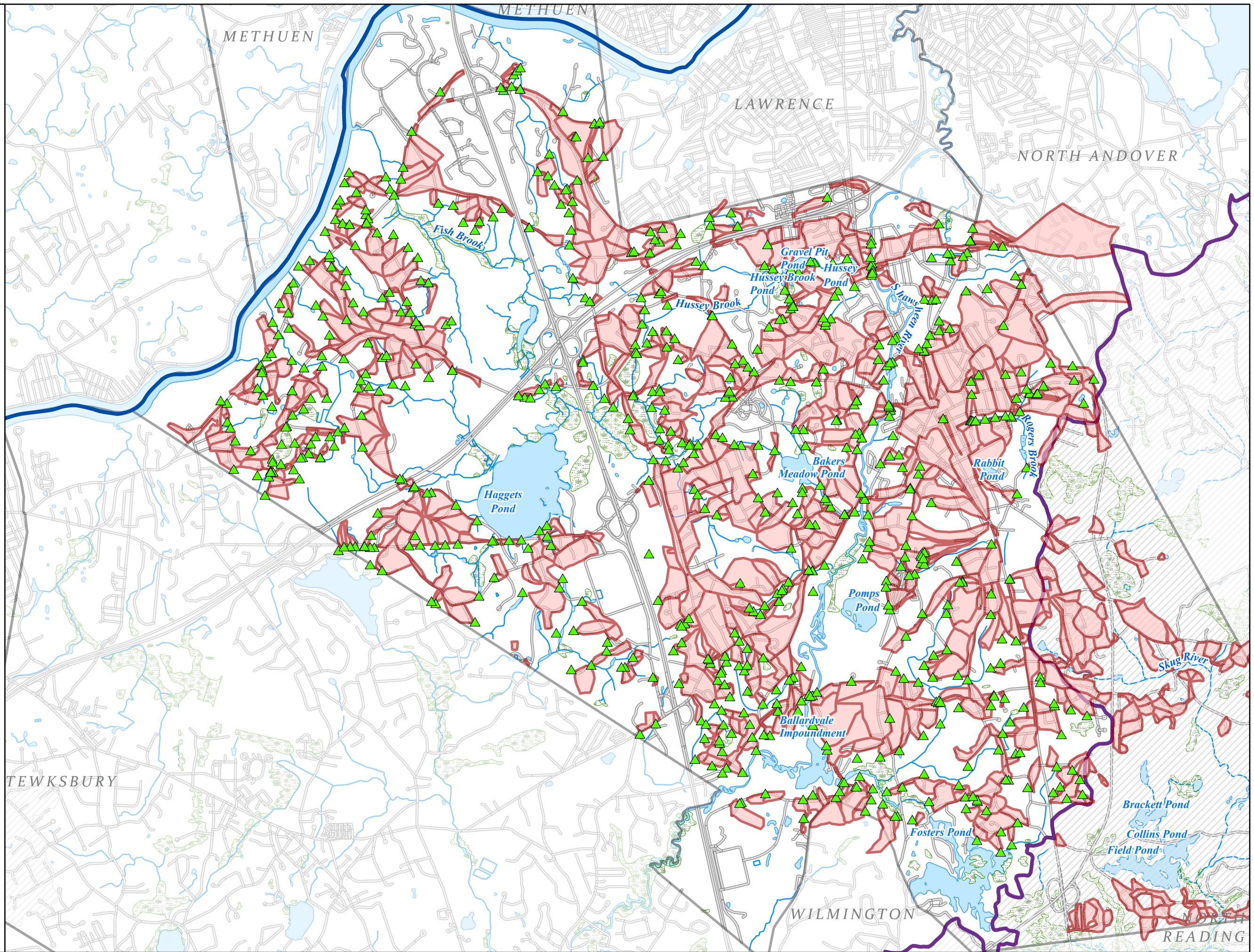


Comprehensive Environmental Incorporated



**Legend**

-  Outfall
-  Andover BMP
-  Private BMP
-  P Source Area
-  Merrimack River Watershed
-  Merrimack River
-  Other Watershed
-  Roads
-  Lake, Pond, Reservoir
-  Wetland, Marsh, Swamp
-  Stream, Brook



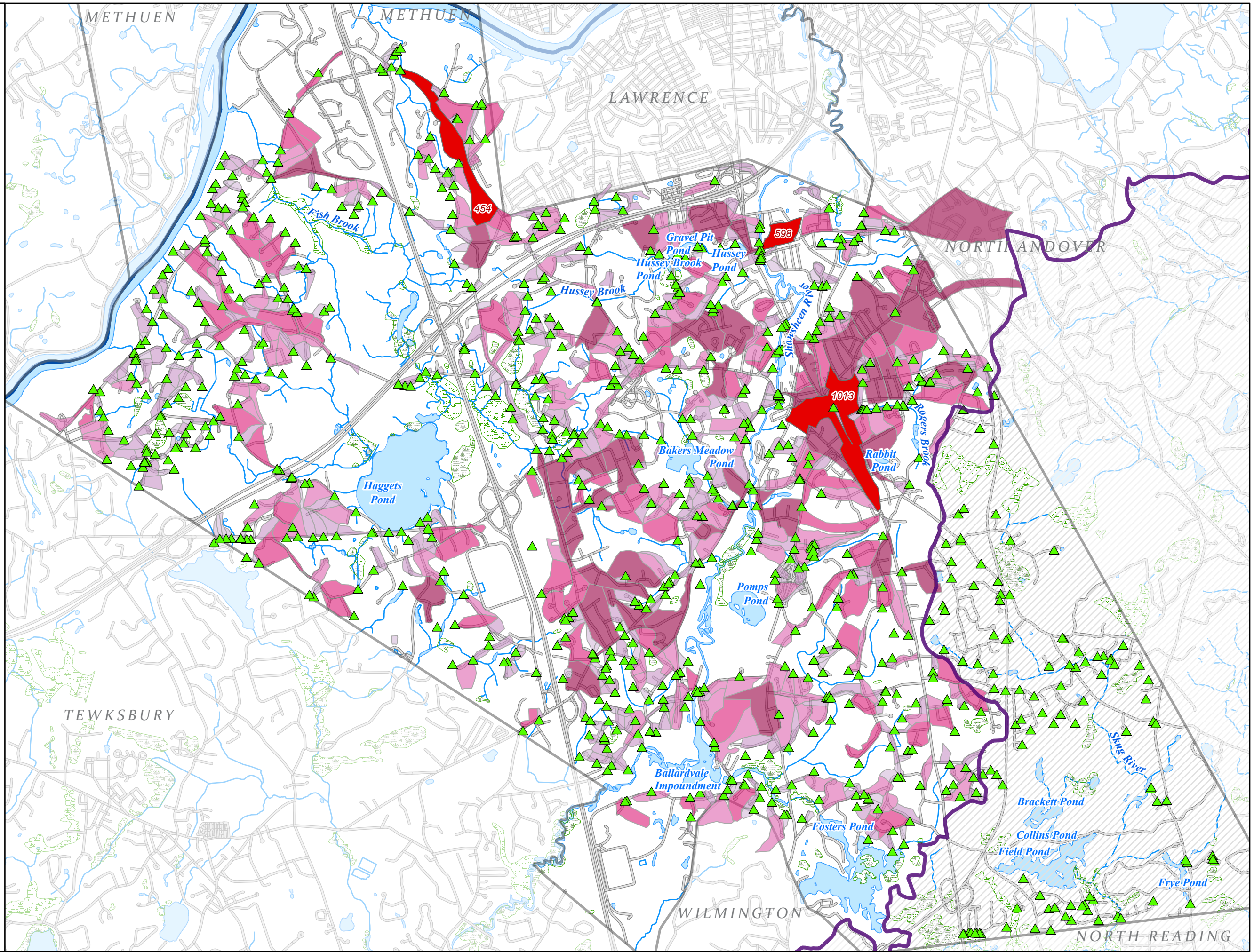
Data Sources: MassGIS, Town of Andover, CEI

**Figure 4- Merrimack River Phosphorus Source Area Catchment Prioritization Andover, MA**



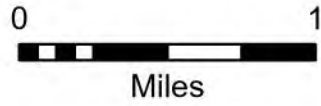
**Legend**

- Top 3 Catchment
- Catchment Priority Group:
- 1
- 2
- 3
- 4
- 5
- Outfall
- Merrimack River
- Merrimack River Watershed
- Other Watershed
- Lake, Pond, Reservoir
- Wetland, Marsh, Swamp
- Stream, Brook
- Roads



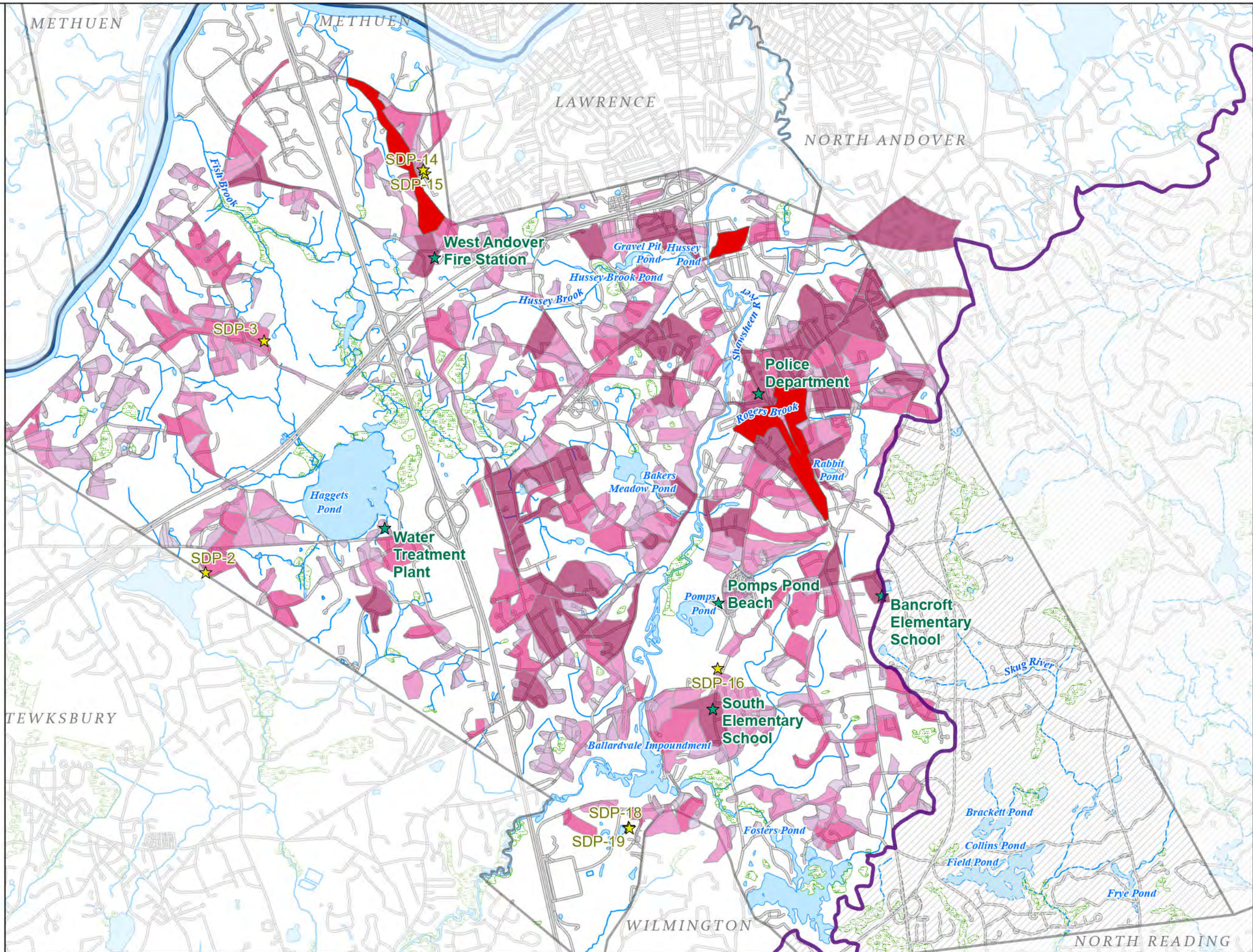
Data Sources: MassGIS, Town of Andover, CEI

**Figure 5- Andover, MA  
Potential Retrofits  
in the Merrimack River  
Phosphorus Source Area**



**Legend**

- ★ Proposed BMP
- ★ Existing BMP
- Top 3 Catchment
- Catchment Priority Group:
- 1
- 2
- 3
- 4
- 5
- 🟪 Merrimack River Watershed
- 🟩 Other Watershed
- 🟦 Merrimack River
- 🛣️ Roads
- 🟩 Lake, Pond, Reservoir
- 🟨 Wetland, Marsh, Swamp
- 🟦 Stream, Brook



# **Appendix A**

## DCIA Calculation Methodology



# Estimating Change in Impervious Area (IA) and Directly Connected Impervious Areas (DCIA) for Massachusetts Small MS4 Permit

Small MS4 Permit Technical Support Document, Revised April 2014 (Original Document, April 2011)

## Draft NPDES Permit Focuses on DCIA

The 2010 NPDES Small MS4 draft permits for Massachusetts require regulated communities to estimate the number of acres of **impervious area (IA)** and **directly connected impervious area (DCIA)** that have been added or removed each year due to development, redevelopment, and or retrofitting activities (Draft North Coastal Permit Section 2.4.6.9). Beginning with the second year annual report, IA and DCIA estimates must be provided for each subbasin within your regulated MS4 area. This technical support tool outlines accepted methods for estimating and reporting IA and DCIA in three steps:



## What does DCIA really mean?

Impervious surfaces such as roadways, parking lots, rooftops, sidewalks, driveways, and other pavements impede stormwater infiltration and generate surface runoff. Research has shown that total watershed IA is correlated with a number of negative impacts on our water resources such as increased flood peaks and frequency, increased sediment, nutrient, and other pollutant levels, channel erosion, impairments to aquatic biota, and reduced recharge to groundwater (Center for Watershed Protection, 2003). Typically watersheds with 4-6% IA start to show these impacts, though recent work has found lower % IA threshold values for sensitive species (Wenger et al., 2008). Watersheds exceeding 12% IA often fail to meet aquatic life criteria and narrative standards (Stanfield and Kilgore, 2006).

For the purposes of the MS4 permit, DCIA is considered the portion of IA with a direct hydraulic connection to the permittee’s MS4 or a waterbody via continuous paved surfaces, gutters, drain pipes, or other conventional conveyance and detention structures that do not reduce runoff volume. DCIA does not include:

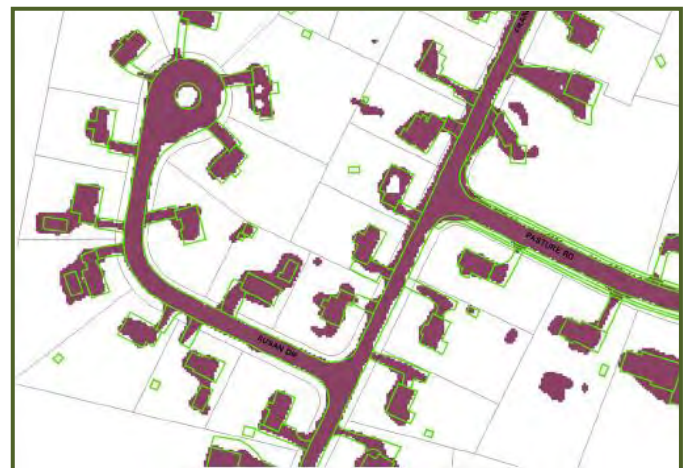
- IA draining to stormwater practices designed to meet recharge and other volume reduction criteria.
- Isolated IA with an indirect hydraulic connection to the MS4, or that otherwise drain to a pervious area.
- Swimming pools or man-made impoundments, unless drained to an MS4.
- The surface area of natural waterbodies (e.g., wetlands, ponds, lakes, streams, rivers).

## Accepted Methods for Estimating IA & DCIA

**Step 1.**  
Establish  
Baseline  
IA/DCIA

Use the estimates of existing IA and DCIA provided by EPA to establish the baseline acreage from which future additions or reductions of impervious cover can be tracked and measured.

For each regulated municipality in Massachusetts, EPA will provide graphical and tabular estimates of IA/DCIA ordered by land use type and subbasin. **Permittees may simply use these baseline estimates as is, or develop more accurate estimates when justified.** This may include using local data to refine EPA’s estimates or the direct measure of IA (**Figure 1**). If the EPA estimates are not used for the baseline, permittees must provide in the annual report a description of the alternative methodology used.



**Figure 1.** EPA will use IA extrapolated from 2005, 1-meter orthoimagery provided by MassGIS (upper). A comparison of a MassGIS-derived IA estimate (shown in purple) vs. a refined direct measurement (shown in green) by the Town of Reading, MA illustrates differences in precision (lower).

Once IA has been established, DCIA can be estimated using empirical formulas developed by Sutherland as a function of IA for various watershed types (CWP, 2000). **Table 1** summarizes appropriate equations to apply for *average, highly connected, totally connected, somewhat connected, and mostly disconnected* watersheds. EPA will provide each municipality with DCIA estimates based on land use and assumed watershed conditions; however, **permittees may opt to refine these estimates to better reflect actual basin conditions where justified.**

**Step 2.**  
Calculate  
Annual  
Change

Once baseline IA/DCIA is established for each subbasin, permittees must annually track the change in IA and DCIA acreage from development, redevelopment, and retrofit projects completed that year.

To account for the estimated annual change in DCIA, permittees will need to determine how much IA and DCIA have been added or removed as a result of individual development, redevelopment, or retrofit projects completed during the reporting period.

**Table 1.** Sutherland Equations to Determine DCIA (%)

Watershed Selection Criteria	Assumed Land Use	Equation (where IA(%) ≥ 1)
Average: Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	Commercial, Industrial, Institutional, Open land, and Med. density residential	$DCIA=0.1(IA)^{1.5}$
Highly connected: Same as above, but residential rooftops are connected	High density residential	$DCIA=0.4(IA)^{1.2}$
Totally connected: 100% storm sewered with all IA connected	--	$DCIA=IA$
Somewhat connected: 50% not storm sewered, but open section roads, grassy swales, residential rooftops not connected, some infiltration	Low density residential	$DCIA=0.04(IA)^{1.7}$
Mostly disconnected: Small percentage of urban area is storm sewered, or 70% or more infiltrate/disconnected	Agricultural; Forested	$DCIA=0.01(IA)^2$

The acres of DCIA for each project will be based on two factors: **(1) the amount of site IA, and (2) the effectiveness of stormwater best management practices (BMPs)** employed to reduce associated runoff. Practices that reduce runoff volume will lower DCIA. Note that practices that remove stormwater pollutants but do not provide runoff reduction benefits are not considered effective at reducing DCIA.

This information must be obtained from site plans and verified by as-built drawings or site inspection upon project completion. For all completed projects:

- (1) Determine the former and new IA for each site.
- (2) Determine the number and type of existing and/or new BMP(s) used, and calculate the amount of IA removed, managed, and unmanaged draining to each BMP.
- (3) For each BMP designed in accordance with specifications provided in MassDEP’s Stormwater Handbook (v.2, chp.2), select the appropriate “disconnection” multiplier from **Table 2**.

For infiltration trenches or basins, determine appropriate runoff volume reduction using **Table 3** depending on site-specific soil infiltration rates and runoff depth captured as derived from the EPA 2010 BMP Performance Curves. Use **Equation 1** to generate the BMP “disconnection” multiplier.

**Eq. 1** Multiplier = 1 - % Runoff Reduction Volume/100

- (4) Calculate DCIA for each BMP using **Equation 2** if adding newly created IA at new construction or redevelopment site, OR by using **Equation 3** if reducing existing IA in a retrofit or redevelopment scenario.

**Eq. 2** Added  $DCIA_{BMPi} = IA_{BMPi} * \text{BMP Multiplier}$

**Eq. 3** Reduced  $DCIA_{BMPi} = IA_{BMPi} * (1 - \text{BMP Multiplier})$

- (5) Calculate DCIA for entire project site draining to BMPs by summing DCIA for individual BMPs using **Equation 4**.

**Eq. 4** Site  $DCIA_{added} = \sum_{i=1}^n DCIA_{BMPi} + \text{New Unmanaged IA}$

### Why Quantify Your IA & DCIA?

New construction, redevelopment, and restoration activities can change existing IA and DCIA – potentially exacerbating or reducing existing watershed impairments. Understanding watershed imperviousness is important for communities because it:

- Informs management of impaired waterbodies and prioritization of watershed restoration efforts;
- Facilitates investigation of existing chronic flooding and stormwater drainage problems, and avoidance of new problems;
- Indicates potential threats to drinking water reservoirs/aquifers; commercial fisheries, and recreational waters;
- Demonstrates progress toward achieving future **Total Maximum Daily Load (TMDL)** allocations based on impervious cover thresholds;
- Serves as an educational tool for encouraging environmentally sensitive land use planning and **Low Impact Development (LID)**;
- Facilitates equitable derivation of possible stormwater utility fees based on parcel-specific impervious cover; and
- Provides guidance for directing stormwater retrofit efforts.

**Table 2.** Determining DCIA based on Interim Default BMP Disconnection Multipliers or EPA's Infiltration Curves

BMP Description	% Runoff Volume Reduction <sup>1</sup>	BMP Disconnection Multiplier <sup>2</sup>
Removal of pavement; restoration of infiltration capacity	100%	0
Redirection of rooftop runoff to infiltration areas, rain gardens or dry wells	85%	0.15
Permeable pavement, bioretention practices, dry/vegetated water quality swales	75%	0.25
Disconnection to qualified pervious area <sup>3</sup>	50%	0.50
Infiltration trenches	15-100%	0.85-0
Infiltration basins	13-100%	0.87-0
Non-runoff reduction practices (i.e., detention ponds, wetlands, sand filters, hydrodynamic separators, etc)	0%	1.0

<sup>1</sup> Interim default values for % runoff reduction based on Schueler 2009 and are subject to change as more data becomes available. Values for infiltration trenches and basins are based on soil infiltration rates and depth of runoff treated. See Tables 3 and 4 to determine the site specific values to apply.

<sup>2</sup> BMP multiplier = 1 - %Runoff Volume Reduction/100

<sup>3</sup> Areas given MassDEP LID Site Design Credits per the MA Stormwater Standards (Vol. 3, Chapter 1) are assigned % reduction values based on upper estimates of rooftop disconnection to pervious area as reported by Chesapeake Stormwater Network (2009).

**Table 3.** Percent Runoff Reduction based on EPA's 2010 Infiltration Curves

Storage Capacity: Runoff Depth from DCIA (inches)	Soil Infiltration Rate (in/hr)					
	0.17	0.27	0.52	1.02	2.41	8.27
<b>Infiltration Trench</b>						
0.1	15%	18%	22%	26%	34%	54%
0.2	28%	32%	38%	45%	55%	76%
0.4	49%	55%	62%	68%	78%	93%
0.6	64%	70%	76%	81%	88%	97%
0.8	75%	79%	84%	88%	93%	99%
1.0	82%	85%	89%	92%	96%	100%
1.5	92%	93%	95%	97%	99%	100%
2.0	95%	96%	97%	98%	100%	100%
<b>Infiltration Basin</b>						
0.1	13%	16%	20%	24%	33%	55%
0.2	25%	30%	36%	42%	54%	77%
0.4	44%	51%	58%	66%	78%	93%
0.6	59%	66%	73%	79%	88%	98%
0.8	71%	76%	81%	87%	93%	99%
1.0	78%	82%	87%	91%	96%	100%
1.5	89%	91%	94%	96%	99%	100%
2.0	94%	95%	97%	98%	100%	100%

### Example Subbasin DCIA Calculations

Baseline conditions for subbasin #54203 were estimated to include 100 acres IA and 50 acres DCIA. By the second year of NPDES reporting, two construction projects were completed that resulted in an overall change in the amount of subbasin IA and DCIA as follows:

**Project 1:** New 5-acre residential townhome complex with 4 acres of new IA, of which, 0.9 acres drain to a bioretention facility, 3 acres drain to an infiltration basin, and 0.1 acres drain untreated to the main road. The infiltration basin is designed based on a soil infiltration rate of 0.52 in/hr and 0.8 inches of runoff captured.

**Step 1. Establish new IA to add to baseline = 4.0 ac**

**Steps 2 -4. Determine DCIA per BMP**

Eq. 3  $Multiplier_{inf. basin} = 1 - 81/100 = 0.19$

Eq. 4  $DCIA_{bioretention} = 0.9 ac * 0.25 = 0.23 ac$   
 $DCIA_{inf. basin} = 3.0 ac * 0.19 = 0.57 ac$

**Step 5. Sum DCIA for entire site**

Eq. 6  $Total Project DCIA = 0.23 ac + 0.57 ac + 0.1 ac_{unmanaged} = 0.9 ac DCIA to add to baseline$

**Project 2:** Redevelopment of an 8-acre retail outlet with 5.5 acres of existing IA. After redevelopment, there are now 6.0 acres total IA. 3.0 acres of IA continues to drain to an existing detention pond, but 1.0 acre of overflow parking was converted to pervious pavement. A new bioretention retrofit now captures 0.7 acres of IA that used to drain to the pond, as well as 0.5 acres of newly added IA. The remaining 0.8 acre of site IA remains untreated.

**Step 1. Establish new IA to add to baseline = 6.0 ac - 5.5 ac = 0.5 ac**

**Steps 2-4. Determine DCIA per BMP to be added or subtracted from baseline.**

Eq. 4  $Added DCIA_{bioretention-new IA} = 0.5 ac * 0.25 = 0.13 ac$

Eq. 5  $Reduced DCIA_{porous pavement} = 1 ac * (1-0.25) = 0.75 ac$   
 $Reduced DCIA_{drypond} = 3.0 ac * (1-1.0) = 0 ac$   
 $Reduced DCIA_{bio-existing IA} = 0.7 ac * (1-0.25) = 0.53 ac$

**Step 5. Sum DCIA for entire site.**

Eq. 6  $Total Project Added DCIA = 0.13 ac + 0 ac_{new unmanaged IA} = 0.13 ac DCIA to add to baseline$

Eq. 6  $Total Reduced DCIA = 0.75 ac + 0 ac + 0.53 ac = 1.28 ac DCIA to subtract from baseline$

#### End of Year Report: Totals for Subbasin #54203:

**IA** = 100 ac<sub>baseline</sub> + 4.0 ac<sub>project 1</sub> + 0.5 ac<sub>project 2</sub>  
 = 104.5 ac (net gain of 4.5 ac)

**DCIA** = 50 ac<sub>baseline</sub> + 0.9 ac<sub>project 1</sub> + 0.13 ac<sub>project 2</sub> - 1.28 ac<sub>project 2</sub>  
 = 49.75 ac DCIA (net reduction of 0.25 ac)

**Step 3.**  
Report Net  
Change in IA  
& DCIA

Starting in year 2, permittees must include a summary of net changes in IA/DCIA by subbasin and document methodology in its annual report.

Permittees will be required to summarize IA and DCIA estimates for all completed construction, redevelopment, and retrofit projects within each subbasin. **EPA will provide a tracking spreadsheet to each community to assist in the calculation and tracking of this information.** For individual BMPs at each site, permittees will need to track the type of practice, the IA captured, and the % runoff reduction and “disconnection” multiplier assigned to that practice. Consider incorporating these DCIA accounting elements into your program’s existing BMP tracking database.

### Checklist of What to Expect EPA to Provide

EPA will provide all regulated MS4 communities in Massachusetts with the following information:

- Delineation of subbasin boundaries.
- Baseline estimates of IA for each subbasin in your regulated area in tabular and GIS formats (i.e., as an impervious area map layer).
- Baseline estimate of DCIA for each subbasin (tabular format).
- DCIA calculation and tracking spreadsheet.

### What are the Costs of Annual DCIA Tracking?

The cost will vary depending on the size of the regulated area, amount of existing IA, sophistication of existing GIS, number of new projects requiring tracking, and the level of effort required to obtain information for each site. Refining the EPA-provided baseline estimates of IA and DCIA may require collecting new data, purchasing new software/GIS, and additional staff time. This effort may not be worth the cost if the annual **net change** in IA and DCIA is the true measure of interest. Factors adding to overall effort may include:

- Refining EPA’s baseline estimates, particularly if local IA mapping doesn’t already exist.
- Over-complicating the analysis by refining given equations.
- Not easily obtaining required IA and BMP information from proposed site plans. Determine the most efficient method to obtain this information as soon as possible – changing applicant reporting requirements may be a solution.
- Verifying as-built conditions with individual site visits. Consider alternatives (e.g., occupancy certifications).
- Maintaining an updated impervious and stormwater infrastructure layer in GIS, particularly if new projects have to be hand-digitized. Possibly require applicants to submit plans electronically.
- Not integrating effort with other existing programs (i.e., plan review, building inspection, or stormwater utility).

### How Does LID Influence IA and DCIA?

Incorporating LID techniques into site design can reduce IA & DCIA, protect natural areas, and minimize alterations to existing hydrology on site. The use of BMPs that maximize runoff reduction benefits (e.g., practices with low BMP multipliers in **Table 2** and those shown in **Figure 2**) can result in a higher “disconnection” factor than when using traditional detention ponds. Your community can help reduce total IA and DCIA by:

- Adopting LID design requirements for new development projects.
- Providing for LID Site Design Credits per MassDEP’s Stormwater Management Standards.
- Requiring documentation of design methods used to minimize site IA and to disconnect IA.
- Requiring site designers to calculate and submit %IA and %DCIA for each site.
- Retrofitting existing, unmanaged impervious areas.



**Figure 2.** BMPs such as the bioretention, porous pavers, and infiltration trenches seen here are designed to provide water quality treatment and maximize runoff reduction through improved infiltration, evapotranspiration, and plant uptake. These are effective practices for reducing DCIA.

### Are we Required to Follow This Protocol?

Permittees are encouraged to refine DCIA baseline estimates where local data is more accurate; however the general methodology for calculating annual change in

DCIA should be applied. Deviations from the methodology are subject to review by EPA and must be described in the annual report.

### Where Can I go for More Information?

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For more information regarding the new permit requirements for Massachusetts and for the North Coastal Small MS4s specifically, go to [www.epa.gov/ne/npdes/stormwater/index.html](http://www.epa.gov/ne/npdes/stormwater/index.html) and [www.epa.gov/ne/npdes/stormwater/draft\\_manc\\_sms4gp.html](http://www.epa.gov/ne/npdes/stormwater/draft_manc_sms4gp.html), respectively. Here you will find links to relevant permit documents; community-specific mapping and statistics for baseline IA and DCIA estimates; detailed descriptions of methods used to calculate IA and DCIA estimates; and the calculation and tracking spreadsheet template.

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**EPA’s Methodology to Calculate Baseline Estimates of  
Impervious Area (IA) and  
Directly Connected Impervious Area (DCIA)  
for Massachusetts Communities**

This document presents EPA’s methodology for calculating baseline estimates of impervious area (IA) and directly connected impervious area (DCIA) to support and provide guidance for relevant provisions of the Massachusetts North Coastal Small MS4 General Permit (“General Permit”). Baseline estimates are available for each Massachusetts municipality in a Microsoft Excel format, titled “IC Stats” on the following EPA website: <http://www.epa.gov/ne/npdes/stormwater/ma.html>.

EPA also provides maps showing the extent of impervious cover within each community, also available on the above-mentioned website. The “IC Maps” display subbasins, impervious area (IA), and the portion of each community subject to the Permit as defined by 2000 Census urbanized areas (“Regulated/Urbanized Area”). The methodology used by EPA to develop the estimates is presented here to provide the user with an understanding of the basis for the estimates, and to facilitate refinements to the estimates by the user where desired.

**Step 1: Aggregation of the MassGIS Land Use 2005 Datalayer into 10 Land Use Codes**

EPA aggregated the forty (40) land use categories included in the Commonwealth’s Office of Geographic and Environmental Information (MassGIS) Land Use 2005 datalayer (available at url: <http://www.mass.gov/mgis/lus2005.htm>) into ten (10) commonly used land use categories. The EPA Code, Code Definition, and corresponding MassGIS 2005 Land Use Codes for these land uses are shown in below in Table 1.

**Table 1: EPA Aggregation of MassGIS 2005 Land Use Codes**

<u>EPA Code</u>	<u>Code Definition</u>	<u>MassGIS 2005 Land Use Codes</u>
1	Commercial	15
2	Industrial	16, 18, 19, 29, 39
3	Low Density Residential	13, 38
4	Medium Density Residential	12
5	High Density Residential	10, 11
6	Urban Public/Institutional	7, 8, 31
7	Agriculture	1, 2, 35, 36
8	Forest	3, 40
9	Open Land	5, 6, 9, 17, 24, 26, 34
10	Water	4, 14, 20, 23, 25, 37

For communities required by the General Permit to implement a Phosphorus Control Plan, please note: the *Final TMDL for Nutrients in the Lower Charles River Basin, Massachusetts (CN 301.0)* presents annual phosphorus loadings based on land cover area (shown in Table 6-4 in the TMDL). The TMDL aggregated the twenty-one (21) land use

categories included in the Commonwealth's Office of Geographic and Environmental Information (MassGIS) Land Use 1999 datalayer (available at url: <http://www.mass.gov/mgis/lus.htm> ) into eight (8) commonly used land use categories.

Because EPA's aggregation for the IA and DCIA baseline estimates uses the MassGIS Land Use 2005 datalayer, the categories shown in Table 1, above, do not perfectly match the land cover areas identified in Table 6-4 of the TMDL. For further clarification, please refer to the Phosphorus Control Plan (PCP) Information on EPA's website at url: [http://www.epa.gov/region1/npdes/stormwater/draft\\_manc\\_sms4gp.html](http://www.epa.gov/region1/npdes/stormwater/draft_manc_sms4gp.html)

Table 1A, at the end of this document, shows the MassGIS 2005 Land Use Codes, the descriptions, and the EPA aggregations.

## **Step 2: Identification of Subbasins**

EPA selected the "Massachusetts Nested Subbasins" presented in "Local and Cumulative Impervious Cover of Massachusetts Stream Basins," U.S. Geological Survey Data Series 451, developed by Sara L. Brandt and Peter A. Steeves in cooperation with the U.S. Environmental Protection Agency, for use in the IA-DCIA analysis. This document is available at url: <http://pubs.usgs.gov/ds/451/>. The Massachusetts Nested Subbasins datalayer is available at url: [http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451\\_subbasins.xml](http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451_subbasins.xml)

The hydrology of the Cape Cod and Plymouth-Carver Regions of Massachusetts is dominated by groundwater flow. Subbasins in these areas cannot be delineated by surface topography, but are instead defined by groundwater elevation and flow direction. For the following municipalities, the area of one or more subbasins is based on "Groundwater Contributing Area":

- Barnstable
- Bourne
- Brewster
- Carver
- Chatham
- Dennis
- Duxbury
- Eastham
- Falmouth
- Halifax
- Harwich
- Kingston
- Marion
- Marshfield
- Mashpee
- Middleborough
- Orleans
- Pembroke
- Plymouth
- Plympton
- Rochester
- Sandwich
- Wareham
- Yarmouth

The Massachusetts Groundwater Contributing Areas are available at url: [http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451\\_gwcontrib\\_areas.xml](http://water.usgs.gov/GIS/metadata/usgswrd/XML/ds451_gwcontrib_areas.xml)

### Step 3: Calculation of Impervious Area in each Subbasin for each EPA Land Use Code

Using its GIS, EPA estimated the area and relative percentage of IA (both within the entire subbasin and only within the Regulated/Urbanized Area) for each EPA Land Use Code within the Massachusetts Nested Subbasins in each community. The IA estimates were generated using the MassGIS 2005 Impervious Surface 1-meter datalayer (available at url: [http://www.mass.gov/mgis/impervious\\_surface.htm](http://www.mass.gov/mgis/impervious_surface.htm)).

The Regulated/Urbanized Area is equivalent to the urbanized area as defined by the 2000 Census. EPA provided urbanized area maps to all regulated communities and web-published the maps at url: <http://www.epa.gov/ne/npdes/stormwater/2003-permit-archives.html>. The Urbanized Area datalayers are available from MassGIS at url: [http://www.mass.gov/mgis/eot\\_layers.htm](http://www.mass.gov/mgis/eot_layers.htm).

### Step 4: Application of Sutherland Equations to Estimate DCIA %

Using the percent IA estimates calculated in Step 3, EPA applied the “Sutherland Equations” taken from Sutherland, R.C., "[Methodology for Estimating the Effective Impervious Area of Urban Watersheds](#)", Watershed Protection Techniques, Vol. 2, No. 1, fall 1995, to calculate DCIA %. Table 2 shows the EPA Land Use Class and Land Use Name, the watershed selection criteria, and the Sutherland Equation applied to each EPA Code. The Sutherland Equations are only valid where IA % is greater than 1; therefore, EPA assumed DCIA % to be zero where the IA % within a given land use is less than one.

**Table 2: EPA Land Use Classes and Corresponding Sutherland Equations**

<u>EPA Code</u>	<u>Land Use</u>	<u>Watershed Selection Criteria</u>	<u>Sutherland Equation (where IA(%) &gt;1)</u>
1	Commercial	<u>Average</u> : Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	$DCIA\% = 0.1(IA\%)^{1.5}$
2	Industrial	<u>Average</u> : Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	$DCIA\% = 0.1(IA\%)^{1.5}$
3	Low Density Residential	<u>Somewhat connected</u> : 50% not storm sewered, but open section roads, grassy swales, residential rooftops not connected, some infiltration	$DCIA\% = 0.04(IA\%)^{1.7}$
4	Medium Density Residential	<u>Average</u> : Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	$DCIA\% = 0.1(IA\%)^{1.5}$
5	High Density Residential	<u>Highly connected</u> : Same as above, but residential rooftops are connected	$DCIA\% = 0.4(IA\%)^{1.2}$
6	Urban Public/ Institutional	<u>Average</u> : Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	$DCIA\% = 0.1(IA\%)^{1.5}$
7	Agriculture	<u>Mostly disconnected</u> : Small percentage of urban area is storm sewered, or 70% or more infiltrate/disconnected	$DCIA\% = 0.01(IA\%)^2$

<u>EPA Code</u>	<u>Land Use</u>	<u>Watershed Selection Criteria</u>	<u>Sutherland Equation (where IA(%) &gt;1)</u>
8	Forest	<u>Mostly disconnected</u> : Small percentage of urban area is storm sewered, or 70% or more infiltrate/disconnected	$DCIA\% = 0.01(IA\%)^2$
9	Open Land	<u>Average</u> : Mostly storm sewered with curb & gutter, no dry wells or infiltration, residential rooftops not directly connected	$DCIA\% = 0.1(IA\%)^{1.5}$
10	Water	n/a	n/a

### Step 5: Estimation of DCIA Area

EPA used the DCIA % calculated in Step 4 to estimate the acres of DCIA, for each EPA land use class, within each subbasin, within each community.

For Total Area, (including Un-Regulated Areas), calculation is as follows:

$$DCIA \text{ (acres)} = DCIA \% \text{ of Total Area (\%)} * \text{Total Area (acres)} / 100$$

For the Urbanized/Regulated Area Only, calculation is as follows:

$$DCIA \text{ (acres)} = DCIA \% \text{ of Urbanized/Regulated Area (\%)} * \text{All Urbanized/Regulated Area (acres)} / 100$$

### Step 6: Summation of Total Area, IA, and DCIA for each Subbasin within Massachusetts Communities

EPA summed the IA and DCIA areas of all land use classes over each subbasin, and recalculated IA % and DCIA % based on these summations.

**Table 1A: MassGIS Land Use Codes and Descriptions, and EPA Codes**

<u>MassGIS Land Use Code</u>	<u>MassGIS Land Use Description</u>	<u>MassGIS Detailed Definition</u>	<u>EPA Code</u>
1	Cropland	Generally tilled land used to grow row crops. Boundaries follow the shape of the fields and include associated buildings (e.g., barns). This category also includes turf farms that grow sod.	7
2	Pasture	Fields and associated facilities (barns and other outbuildings) used for animal grazing and for the growing of grasses for hay.	7
3	Forest	Areas where tree canopy covers at least 50% of the land. Both coniferous and deciduous forests belong to this class.	8
4	Non-Forested Wetland	<a href="#">DEP Wetlands (1:12,000) WETCODEs 4, 7, 8, 12, 23, 18, 20, and 21.</a>	10

<u>MassGIS Land Use Code</u>	<u>MassGIS Land Use Description</u>	<u>MassGIS Detailed Definition</u>	<u>EPA Code</u>
5	Mining	Includes sand and gravel pits, mines and quarries. The boundaries extend to the edges of the site's activities, including on-site machinery, parking lots, roads and buildings.	9
6	Open Land	Vacant land, idle agriculture, rock outcrops, and barren areas. Vacant land is not maintained for any evident purpose and it does not support large plant growth.	9
7	Participation Recreation	Facilities used by the public for active recreation. Includes ball fields, tennis courts, basketball courts, athletic tracks, ski areas, playgrounds, and bike paths plus associated parking lots. Primary and secondary school recreational facilities are in this category, but university stadiums and arenas are considered Spectator Recreation. Recreation facilities not open to the public such as those belonging to private residences are mostly labeled with the associated residential land use class not participation recreation. However, some private facilities may also be mapped.	6
8	Spectator Recreation	University and professional stadiums designed for spectators as well as zoos, amusement parks, drive-in theaters, fairgrounds, race tracks and associated facilities and parking lots.	6
9	Water-Based Recreation	Swimming pools, water parks, developed freshwater and saltwater sandy beach areas and associated parking lots. Also included are scenic areas overlooking lakes or other water bodies, which may or may not include access to the water (such as a boat launch). Water-based recreation facilities related to universities are in this class. Private pools owned by individual residences are usually included in the Residential category. Marinas are separated into code 29.	9
10	Multi-Family Residential	Duplexes (usually with two front doors, two entrance pathways, and sometimes two driveways), apartment buildings, condominium complexes, including buildings and maintained lawns. Note: This category was difficult to assess via photo interpretation, particularly in highly urban areas.	5
11	High Density Residential	Housing on smaller than 1/4 acre lots. See notes below for details on Residential interpretation.	5
12	Medium Density Residential	Housing on 1/4 - 1/2 acre lots. See notes below for details on Residential interpretation.	4

<b>MassGIS Land Use Code</b>	<b>MassGIS Land Use Description</b>	<b>MassGIS Detailed Definition</b>	<b>EPA Code</b>
13	Low Density Residential	Housing on 1/2 - 1 acre lots. See notes below for details on Residential interpretation.	<b>3</b>
14	Saltwater Wetland	<a href="#">DEP Wetlands (1:12,000) WETCODEs 11 and 27.</a>	<b>10</b>
15	Commercial	Malls, shopping centers and larger strip commercial areas, plus neighborhood stores and medical offices (not hospitals). Lawn and garden centers that do not produce or grow the product are also considered commercial.	<b>1</b>
16	Industrial	Light and heavy industry, including buildings, equipment and parking areas.	<b>2</b>
17	Transitional	Open areas in the process of being developed from one land use to another (if the future land use is at all uncertain). Formerly identified as "Urban Open".	<b>9</b>
18	Transportation	Airports (including landing strips, hangars, parking areas and related facilities), railroads and rail stations, and divided highways (related facilities would include rest areas, highway maintenance areas, storage areas, and on/off ramps). Also includes docks, warehouses, and related land-based storage facilities, and terminal freight and storage facilities. Roads and bridges less than 200 feet in width that are the center of two differing land use classes will have the land use classes meet at the center line of the road (i.e., these roads/bridges themselves will not be separated into this class).	<b>2</b>
19	Waste Disposal	Landfills, dumps, and water and sewage treatment facilities such as pump houses, and associated parking lots. Capped landfills that have been converted to other uses are coded with their present land use.	<b>2</b>
20	Water	<a href="#">DEP Wetlands (1:12,000) WETCODEs 9 and 22.</a>	<b>10</b>
23	Cranberry bog	<a href="#">Both active and recently inactive cranberry bogs and the sandy areas adjacent to the bogs that are used in the growing process. Impervious features associated with cranberry bogs such as parking lots and machinery are included. Modified from DEP Wetlands (1:12,000) WETCODE 5.</a>	<b>10</b>
24	Powerline/Utility	Powerline and other maintained public utility corridors and associated facilities, including power plants and their parking areas.	<b>9</b>
25	Saltwater Sandy Beach	<a href="#">DEP Wetlands (1:12,000) WETCODEs 1, 2, 3, 6, 10, 13, 17 and 19</a>	<b>10</b>

<u>MassGIS Land Use Code</u>	<u>MassGIS Land Use Description</u>	<u>MassGIS Detailed Definition</u>	<u>EPA Code</u>
26	Golf Course	Includes the greenways, sand traps, water bodies within the course, associated buildings and parking lots. Large forest patches within the course greater than 1 acre are classified as Forest (class 3). Does not include driving ranges or miniature golf courses.	<b>9</b>
29	Marina	Include parking lots and associated facilities but not docks (in class 18)	<b>2</b>
31	Urban Public/Institutional	Lands comprising schools, churches, colleges, hospitals, museums, prisons, town halls or court houses, police and fire stations, including parking lots, dormitories, and university housing. Also may include public open green spaces like town commons.	<b>6</b>
34	Cemetery	Includes the gravestones, monuments, parking lots, road networks and associated buildings.	<b>9</b>
35	Orchard	Fruit farms and associated facilities.	<b>7</b>
36	Nursery	Greenhouses and associated buildings as well as any surrounding maintained lawn. Christmas tree (small conifer) farms are also classified as Nurseries.	<b>7</b>
37	Forested Wetland	<a href="#">DEP Wetlands (1:12,000) WETCODEs 14, 15, 16, 24, 25 and 26.</a>	<b>10</b>
38	Very Low Density Residential	Housing on > 1 acre lots and very remote, rural housing. See notes below for details on Residential interpretation.	<b>3</b>
39	Junkyard	Includes the storage of car, metal, machinery and other debris as well as associated buildings as a business.	<b>2</b>
40	Brushland/Successional	Predominantly (> 25%) shrub cover, and some immature trees not large or dense enough to be classified as forest. It also includes areas that are more permanently shrubby, such as heath areas, wild blueberries or mountain laurel.	<b>8</b>

## **Appendix B**

Phosphorus Load Calculations – Merrimack River

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

Outfall ID	Catchment Area (acres)	Total Impervious Area (acres)	Land Use	Hydric Soil Group	Impervious Area (acres)	Pervious Area (acres)	TP Load (lbs P/year)	Total Outfall Load (lbs P/year)
1	4.18	0.74	Forest	A		0.19	0.02	1.17
			Highway	A	0.46		0.61	
			LDR	A	0.29	3.09	0.53	
			Open	A		0.15	0.00	
2	4.79	0.92	Forest	A		0.18	0.02	1.46
			Highway	A	0.57		0.76	
			LDR	A	0.35	3.25	0.64	
			LDR	B		0.09	0.01	
			Open	A		0.11	0.02	
4	3.94	0.85	Forest	A		0.12	0.02	1.29
			Highway	A	0.58		0.77	
			LDR	A	0.27	2.88	0.50	
			Open	A		0.09	0.00	
5	4.03	0.96	Forest	A		0.12	0.02	1.48
			Highway	A	0.52		0.70	
			LDR	A	0.43	2.66	0.73	
			LDR	B/D	0.02	0.03	0.03	
6	2.08	0.29	Open	A		0.26	0.01	0.59
			Ag	A		0.00	0.00	
			Ag	C/D		0.04	0.02	
			Forest	A		0.36	0.05	
			Forest	A/D		0.18	0.02	
			Forest	C/D		0.01	0.00	
			Highway	A	0.08		0.11	
			Highway	A/D	0.18		0.24	
			LDR	A		0.67	0.02	
			LDR	A/D	0.04	0.38	0.13	
7	8.25	1.78	Open	A/D		0.00	0.00	3.62
			Forest	A		0.09	0.01	
			Forest	B		0.62	0.08	
			Forest	C/D		0.88	0.11	
			Highway	A	0.16		0.21	
			Highway	B	0.14		0.18	
			Highway	C/D	0.96		1.28	
			Highway	D	0.00		0.00	
			LDR	A	0.00	1.02	0.03	
			LDR	B	0.11	1.26	0.32	
11	0.56	0.06	LDR	C/D	0.42	2.34	1.31	0.19
			Open	A		0.01	0.00	
			Open	B	0.00	0.03	0.00	
12	26.45	3.77	Open	C/D	0.00	0.21	0.06	6.32
			Highway	C	0.01		0.02	
			LDR	C	0.05	0.50	0.17	
			Open	C		0.00	0.00	
			Forest	A		0.60	0.08	
13	1.00	0.22	Highway	A	1.57		2.11	0.35
			Industrial	A		3.13	0.09	
			Industrial	B/D		0.69	0.14	
			LDR	A	2.20	17.79	3.88	
14	5.53	0.70	Open	A		0.47	0.01	1.44
			Forest	A		0.16	0.02	
			Highway	A	0.17		0.23	
			LDR	A	0.05	0.53	0.10	
			Open	A		0.08	0.00	
14	5.53	0.70	Forest	A		0.25	0.03	1.44
			Forest	B/D		0.01	0.00	
			Highway	A	0.32		0.43	
			Highway	B/D	0.02		0.03	
			LDR	A	0.30	3.06	0.55	
			LDR	B/D	0.06	1.47	0.40	
Open	A		0.03	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

15	3.73	1.24	Forest	A		0.03	0.00	1.92
			Forest	B		0.11	0.01	
			HDR	B	0.01	0.08	0.04	
			Highway	A	0.40		0.54	
			Highway	B	0.25		0.34	
			LDR	A	0.33	1.53	0.54	
			LDR	B	0.25	0.52	0.44	
			Open	A		0.16	0.00	
16	0.42	0.22	Forest	A		0.01	0.00	0.32
			Highway	A	0.18		0.24	
			Highway	B	0.02		0.03	
			LDR	A	0.02	0.08	0.03	
			LDR	B	0.01	0.06	0.02	
			Open	A	0.00	0.04	0.00	
17	10.75	1.41	Open	B		0.01	0.00	3.05
			Forest	A		1.49	0.19	
			Forest	B		0.71	0.09	
			Forest	D		0.97	0.13	
			Highway	A	0.87		1.17	
			Highway	B	0.26		0.35	
			LDR	A	0.08	1.65	0.17	
			LDR	B	0.19	3.53	0.71	
			LDR	D		0.15	0.06	
			LDR			0.81	0.17	
21	1.45	0.32	Open	A	0.01	0.02	0.02	0.67
			Open	B	0.00	0.00	0.00	
			Forest	C/D		0.53	0.07	
			Forest	D		0.05	0.01	
			Highway	C/D	0.24		0.32	
			Highway	D	0.07		0.10	
			LDR	C/D	0.00	0.49	0.14	
22	1.12	0.43	LDR	D		0.03	0.01	0.77
			Open	C/D	0.01	0.03	0.02	
			Open	D	0.01		0.01	
			Forest	A		0.01	0.00	
			Forest	D		0.09	0.01	
			Highway	A	0.04		0.06	
			Highway	D	0.35		0.47	
26	14.97	3.54	LDR	A	0.01	0.09	0.02	5.56
			LDR	D	0.03	0.40	0.19	
			Open	A		0.03	0.00	
			Open	D		0.07	0.03	
27	8.35	2.11	Open	A		0.04	0.08	3.26
			Forest	A		0.93	0.12	
			Highway	A	1.42		1.90	
			LDR	A	2.08	9.89	3.46	
28	3.59	0.79	Open	A	0.04	0.61	0.08	1.23
			Forest	A		0.29	0.04	
			Highway	A	0.86		1.16	
			LDR	A	1.24	5.73	2.06	
			LDR	B		0.00	0.00	
29	1.05	0.54	Open	A		0.22	0.01	0.79
			Forest	A		0.42	0.05	
			Highway	A	0.52		0.69	
			LDR	A	0.27	2.34	0.48	
30	1.13	0.72	Open	A	0.00	0.05	0.00	1.00
			Forest	A		0.10	0.01	
			Highway	A	0.34		0.46	
			LDR	A	0.20	0.34	0.32	
30	1.13	0.72	Open	A		0.06	0.00	1.00
			Forest	A		0.30	0.04	
			Highway	A	0.71		0.96	
			LDR	A	0.00	0.07	0.00	
30	1.13	0.72	Open	A	0.00	0.04	0.00	1.00

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

31	2.46	0.37	Forest	C/D		0.10	0.01	1.09
			Highway	C/D	0.27		0.36	
			LDR	B	0.04	0.11	0.07	
			LDR	C/D	0.07	1.86	0.64	
			Open	C/D		0.01	0.00	
32	9.86	1.42	Forest	A		2.78	0.36	2.77
			Forest	A/D		0.45	0.06	
			Forest	B		0.31	0.04	
			Forest	B/D		0.01	0.00	
			Highway	A	0.59		0.80	
			Highway	A/D	0.18		0.24	
			LDR	A	0.62	3.97	1.06	
			LDR	A/D	0.03	0.63	0.17	
			LDR	B	0.00	0.11	0.01	
			Open	A	0.00	0.12	0.01	
			Open	A/D	0.00	0.06	0.02	
			33	3.43	0.89	Forest	A	
HDR	A	0.03				0.08	0.07	
Highway	A	0.30					0.41	
LDR	A	0.55				2.32	0.90	
Open	A	0.01				0.12	0.02	
34	0.72	0.23	Forest	A		0.14	0.02	0.34
			Highway	A	0.17		0.23	
			LDR	A	0.06	0.30	0.10	
			Open	A		0.05	0.00	
36	2.25	0.47	Forest	C/D		0.04	0.01	1.16
			Forest	D		0.02	0.00	
			Highway	C/D	0.27		0.37	
			Highway	D	0.07		0.10	
			LDR	B		0.02	0.00	
			LDR	C/D	0.12	1.62	0.65	
37	0.66	0.21	LDR	D	0.00	0.08	0.03	0.40
			Forest	C/D		0.09	0.01	
			Forest	D		0.03	0.00	
			Highway	C/D	0.15		0.21	
			Highway	D	0.03		0.04	
			LDR	C/D	0.03	0.26	0.12	
			LDR	D		0.04	0.02	
			Open	C/D		0.02	0.00	
38	2.97	0.98	Open	D		0.01	0.00	1.55
			Forest	A		0.02	0.00	
			Forest	B		0.13	0.02	
			Forest	B/D		0.02	0.00	
			Highway	A	0.24		0.32	
			Highway	B	0.32		0.43	
			Highway	B/D	0.03		0.04	
			LDR	A	0.20	0.74	0.33	
			LDR	B	0.18	0.87	0.38	
			LDR	B/D		0.11	0.02	
			Open	A	0.00	0.07	0.00	
			Open	B		0.03	0.00	
39	0.75	0.28	Open	B/D		0.01	0.00	0.43
			Forest	A		0.13	0.02	
			Forest	B/D		0.05	0.01	
			HDR	A	0.00	0.03	0.00	
			Highway	A	0.18		0.24	
			Highway	B/D	0.07		0.10	
			LDR	A	0.02	0.15	0.04	
			LDR	B/D	0.00	0.08	0.02	
Open	A	0.00	0.02	0.00				
Open	B/D		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

40	8.97	1.45	Forest	A		0.49	0.06	2.80
			Forest	B/D		1.17	0.15	
			Highway	A	0.45		0.60	
			Highway	B/D	0.47		0.63	
			LDR	A	0.34	3.57	0.63	
			LDR	B/D	0.18	1.84	0.65	
			Open	A	0.00	0.22	0.01	
41	3.49	0.64	Open	B/D	0.01	0.23	0.06	1.05
			Forest	A		0.45	0.06	
			Highway	A	0.29		0.39	
42	8.13	1.95	LDR	A	0.32	2.14	0.55	3.05
			Open	A	0.02	0.26	0.04	
			Forest	A		0.61	0.08	
			Highway	A	0.90		1.20	
44	2.88	0.90	LDR	A	1.04	5.12	1.74	1.36
			Open	A	0.01	0.45	0.03	
			Forest	A		0.25	0.03	
			Highway	A	0.54		0.72	
48	15.16	2.24	LDR	A	0.37	1.59	0.61	4.26
			Open	A		0.14	0.00	
			Forest	A		0.23	0.03	
			HDR	A	0.11	0.46	0.27	
			HDR	A/D		0.36	0.08	
			Highway	A	0.53		0.72	
			LDR	A	1.53	9.48	2.61	
49	7.30	1.52	LDR	A/D	0.06	2.19	0.55	2.42
			Open	A		0.19	0.01	
			Forest	A		0.72	0.09	
			Highway	A	0.74		0.99	
50	5.70	1.17	LDR	A	0.78	4.87	1.33	2.00
			Open	A	0.00	0.18	0.01	
			Forest	A		1.59	0.21	
			Highway	A	0.42		0.56	
52	6.64	0.80	LDR	A	0.76	2.84	1.23	1.85
			Open	A		0.10	0.00	
			Forest	A		0.85	0.11	
			Forest	B		1.95	0.25	
			Forest	B/D		0.00	0.00	
			Highway	B	0.54		0.73	
			Highway	B/D	0.00		0.00	
53	3.27	0.35	LDR	B	0.26	3.03	0.76	0.96
			LDR	B/D		0.00	0.00	
			Open	B	0.00	0.01	0.00	
			Ag	A		0.00	0.00	
			Ag	C/D		0.15	0.07	
			Forest	A		1.11	0.14	
			Forest	C/D		0.05	0.01	
			Highway	A	0.16		0.21	
55	3.13	0.45	LDR	A	0.09	0.76	0.15	0.95
			LDR	C/D	0.10	0.41	0.26	
			LDR	D	0.01	0.23	0.10	
			Open	A	0.00	0.21	0.01	
			Forest	A		0.72	0.09	
			Forest	B		0.46	0.06	
			Forest	B/D		0.43	0.06	
			Highway	A	0.17		0.23	
56	4.18	0.95	Highway	B	0.20		0.27	1.59
			Highway	B/D	0.07		0.10	
			Open	A		0.10	0.00	
			Open	B		0.67	0.08	
			Open	B/D		0.30	0.06	
56	4.18	0.95	Forest	A		0.17	0.02	1.59
			Forest	B		0.02	0.00	
			Highway	A	0.33		0.44	
			Highway	B	0.03		0.05	
			LDR	A	0.32	1.90	0.54	
56	4.18	0.95	LDR	B	0.27	1.00	0.54	1.59

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Open	A		0.15	0.00	
57	5.82	0.94	Forest	C		0.12	0.02	2.39
			Highway	C	0.31		0.41	
			LDR	C	0.64	4.63	1.94	
			Open	C		0.13	0.03	
58	10.74	2.06	Forest	A		1.09	0.14	3.27
			Highway	A	1.31		1.76	
			LDR	A	0.75	7.43	1.37	
			Open	A		0.16	0.00	
59	7.23	2.18	Forest	C/D		0.56	0.07	4.55
			Highway	C/D	0.76		1.02	
			LDR	C/D	0.87	4.12	2.52	
			Open	C/D	0.55	0.37	0.94	
64	2.09	0.46	Forest	A		0.15	0.02	0.79
			Highway	A	0.34		0.46	
			LDR	A	0.05	0.93	0.10	
			LDR		0.07	0.49	0.21	
			Open	A		0.06	0.00	
65	1.20	0.19	Highway	A	0.06		0.08	0.36
			LDR	A	0.13	0.71	0.22	
			LDR	C		0.29	0.06	
			Open	A		0.01	0.00	
67	47.49	8.78	Forest	A		0.56	0.07	17.30
			Forest	A/D		0.03	0.00	
			Forest	B		1.48	0.19	
			Highway	A	0.64		0.86	
			Highway	A/D	0.28		0.38	
			Highway	B	2.61		3.49	
			LDR	A	0.71	5.95	1.26	
			LDR	A/D	0.15	1.87	0.63	
			LDR	B	4.36	24.35	9.55	
			LDR	B/D	0.02	3.44	0.76	
			Open	A		0.11	0.00	
68	9.17	1.11	Forest	C/D		0.20	0.03	3.91
			Forest	D		0.01	0.00	
			Highway	C/D	0.36		0.48	
			Highway	D	0.15		0.20	
			Industrial	C/D	0.04	0.77	0.29	
			LDR	C/D	0.57	6.97	2.88	
			LDR	D		0.05	0.02	
			Open	C/D		0.00	0.00	
69	39.81	13.48	Commercial		0.57	0.12	1.04	23.65
			Forest	A		2.00	0.26	
			Forest	B		5.45	0.71	
			Forest	B/D		0.16	0.02	
			Forest			0.31	0.04	
			HDR	A	0.04	0.54	0.10	
			HDR	B	0.67	0.71	1.64	
			HDR	B/D	0.28	0.75	0.80	
			HDR		0.18	0.21	0.47	
			Highway	A	1.73		2.32	
			Highway	B	3.77		5.06	
			Highway	B/D	0.40		0.53	
			Highway		0.41		0.55	
			LDR	A	0.66	2.65	1.08	
			LDR	B	2.08	7.76	4.09	
			LDR	B/D	0.35	1.41	0.82	
			LDR		0.06	0.08	0.11	
			Open	A		0.47	0.01	
			Open	B	0.00	2.79	0.34	
			Open	B/D		0.09	0.02	
Open		2.28	0.82	3.64				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

70	2.11	0.75	Forest	B		0.01	0.00	1.36
			Forest	C/D		0.09	0.01	
			Forest	D		0.00	0.00	
			Highway	B	0.08		0.10	
			Highway	C/D	0.26		0.35	
			Highway	D	0.01		0.01	
			LDR	B	0.14	0.54	0.27	
			LDR	C/D	0.26	0.67	0.59	
			LDR	D	0.00	0.00	0.00	
			Open	B		0.02	0.00	
Open	C/D		0.02	0.01				
71	17.79	5.14	Forest	A		1.04	0.14	8.52
			Forest	A/D		0.06	0.01	
			Forest	B		1.40	0.18	
			HDR	A	0.34	0.49	0.81	
			HDR	A/D	0.04	0.07	0.11	
			HDR	B		0.24	0.03	
			Highway	A	2.32		3.10	
			Highway	A/D	0.12		0.16	
			Highway	B	0.19		0.25	
			LDR	A	1.87	6.67	3.05	
			LDR	A/D		0.00	0.00	
			LDR	B	0.25	2.30	0.65	
			Open	A	0.00	0.35	0.01	
Open	A/D	0.00	0.01	0.00				
Open	B	0.00	0.01	0.00				
72	6.17	1.48	Commercial	C/D		0.07	0.02	3.38
			Forest	C/D		0.38	0.05	
			Highway	C/D	0.97		1.29	
			LDR	C/D	0.51	4.09	1.97	
			Open	C/D		0.16	0.04	
75	3.06	0.48	Forest	A		0.29	0.04	0.80
			Highway	A	0.19		0.25	
			LDR	A	0.29	2.06	0.51	
			Open	A		0.23	0.01	
77	2.10	1.05	Forest	B		0.07	0.01	2.41
			Forest	C		0.04	0.00	
			Forest	C/D		0.21	0.03	
			HDR	C/D	0.76	0.46	1.91	
			Highway	C/D	0.27		0.37	
			LDR	C/D	0.01	0.02	0.02	
			Open	C/D		0.26	0.07	
78	1.40	0.39	Forest	C		0.15	0.02	0.82
			Forest	D		0.13	0.02	
			HDR	C	0.08	0.12	0.22	
			Highway	C	0.15		0.21	
			Highway	D	0.01		0.01	
			LDR	C	0.14	0.57	0.34	
			LDR	D		0.01	0.00	
			Open	C		0.03	0.01	
81	0.96	0.28	Forest	C		0.05	0.01	0.52
			Forest	D		0.04	0.01	
			Highway	C	0.14		0.18	
			Highway	D	0.06		0.08	
			LDR	C	0.07	0.51	0.22	
			LDR	D	0.01	0.02	0.02	
			Open	C		0.06	0.01	
			Open	D		0.00	0.00	
84	16.23	2.73	Forest	C/D		0.79	0.10	7.90
			Forest	D		0.97	0.13	
			Highway	C/D	1.23		1.65	
			Highway	D	0.27		0.36	
			Industrial	C/D	0.12	1.73	0.71	
			LDR	C/D	0.68	5.48	2.63	
			LDR	D	0.44	4.34	2.27	
			Open	C/D		0.17	0.05	
Open	D		0.03	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

86	2.57	0.69	Forest	A		0.14	0.02	1.04
			Highway	A	0.42		0.56	
			LDR	A	0.27	1.71	0.47	
			Open	A		0.03	0.00	
87	0.13	0.02	Forest	A/D		0.00	0.00	0.04
			HDR	A	0.00	0.00	0.00	
			LDR	A	0.01	0.06	0.02	
			LDR	A/D	0.00	0.05	0.02	
92	4.65	0.99	Forest	B		2.82	0.37	1.81
			Forest	C/D		0.66	0.09	
			Highway	B	0.87		1.16	
			Highway	C/D	0.13		0.17	
94	23.21	7.16	Open	B	0.00	0.17	0.02	12.42
			Forest	A		0.78	0.10	
			Forest	A/D		0.01	0.00	
			Forest	B		0.10	0.01	
			Forest	C		1.30	0.17	
			Highway	A	1.46		1.96	
			Highway	A/D	0.00		0.00	
			Highway	B	0.14		0.19	
			Highway	C	3.20		4.28	
			LDR	A	0.43	3.32	0.75	
			LDR	A/D		0.01	0.00	
			LDR	B	0.10	0.39	0.20	
			LDR	C	1.83	8.26	4.51	
			Open	A	0.00	0.87	0.03	
			Open	B		0.04	0.00	
			Open	C		0.97	0.20	
96	13.87	2.42	Forest	A		0.12	0.02	5.22
			Forest	A/D		0.12	0.02	
			Forest	B		0.01	0.00	
			Highway	A	0.48		0.64	
			Highway	B	0.00		0.00	
			LDR	A	1.02	2.91	1.64	
			LDR	A/D	0.31	3.04	1.11	
			LDR	B	0.51	2.52	1.07	
			LDR	B/D	0.10	2.69	0.72	
98	1.67	0.60	Open	A		0.01	0.00	0.92
			Open	A/D		0.04	0.01	
			Forest	A		0.34	0.04	
			Forest	B/D		0.12	0.02	
			Forest	C/D		0.24	0.03	
			Highway	A	0.29		0.39	
			Highway	B/D	0.10		0.14	
			Highway	C/D	0.20		0.27	
100	9.15	1.20	LDR	A		0.01	0.00	2.24
			Open	A		0.25	0.01	
			Open	B/D		0.10	0.02	
			Open	C/D		0.01	0.00	
			Forest	A		0.64	0.08	
			Forest	A/D		0.36	0.05	
			HDR	A	0.12	0.37	0.30	
			Highway	A	0.71		0.95	
101	42.60	6.42	Highway	A/D	0.04		0.05	13.95
			LDR	A	0.33	2.96	0.60	
			LDR	A/D		0.64	0.13	
			Open	A		2.97	0.09	
			Open	A/D		0.00	0.00	
			Forest	A		12.16	1.58	
			Forest	C		3.06	0.40	
			HDR	A	0.09	0.69	0.22	
101	42.60	6.42	Highway	A	2.32		3.11	13.95
			Highway	C	0.96		1.29	
			LDR	A	1.47	8.26	2.48	
			LDR	C	1.58	11.50	4.82	
			Open	A	0.00	0.32	0.01	
			Open	C		0.18	0.04	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

102	0.28	0.05	LDR	A	0.02	0.12	0.04	0.11
			LDR	A/D	0.03	0.10	0.07	
103	15.36	2.58	Forest	B		0.08	0.01	6.50
			Forest	C		0.29	0.04	
			Forest	C/D		0.50	0.06	
			Highway	B	0.27		0.36	
			Highway	C	0.65		0.88	
			Highway	C/D	0.44		0.60	
			LDR	B	0.00	1.03	0.12	
			LDR	C	0.62	6.94	2.40	
			LDR	C/D	0.60	3.58	1.95	
			Open	B		0.03	0.00	
			Open	C		0.23	0.05	
105	14.45	1.38	Open	C/D		0.11	0.03	3.87
			Forest	A		0.30	0.04	
			Forest	B		0.70	0.09	
			Forest	C/D		1.70	0.22	
			Highway	A	0.39		0.52	
			Highway	B	0.18		0.24	
			Highway	C/D	0.11		0.15	
			LDR	A	0.29	1.04	0.47	
			LDR	B	0.39	6.85	1.41	
			LDR	C/D	0.02	2.32	0.70	
			Open	A		0.11	0.00	
107	15.03	3.02	Open	B		0.04	0.00	4.78
			Open	C/D	0.01	0.01	0.01	
			Forest	A		0.88	0.11	
			Highway	A	1.49		1.99	
			Industrial	A	0.00	0.25	0.01	
108	4.29	1.18	LDR	A	1.54	10.65	2.65	1.93
			LDR	B	0.39	6.85	1.41	
			LDR	C/D	0.02	2.32	0.70	
			Open	A		0.11	0.00	
			Open	B		0.04	0.00	
			Open	C/D	0.01	0.01	0.01	
			Forest	A		0.09	0.01	
			Forest	B		0.11	0.01	
			Highway	A	0.47		0.63	
			Highway	B	0.42		0.56	
			110	14.74	1.91	LDR	A	
LDR	B	0.02				0.69	0.12	
LDR	C					0.01	0.00	
LDR	C/D	0.08				0.46	0.26	
Open	A					0.04	0.00	
Open	B					0.04	0.00	
Open	C					0.00	0.00	
Forest	B/D					0.05	0.01	
Forest	C					1.91	0.25	
Forest	C/D					0.60	0.08	
111	16.20	2.61				Highway	B/D	0.03
			Highway	C	0.96		1.29	
			Highway	C/D	0.23		0.31	
			LDR	B/D	0.00	0.01	0.00	
			LDR	C	0.48	7.48	2.30	
112	2.58	0.61	LDR	C/D	0.20	2.14	0.93	1.29
			Open	C	0.00	0.19	0.04	
			Open	C/D		0.44	0.13	
			Forest	A		2.26	0.29	
113	2.23	0.51	Highway	A	1.52		2.04	0.80
			LDR	A	1.04	10.99	1.91	
			Open	A	0.05	0.34	0.08	
			Forest	A		0.10	0.01	
112	2.58	0.61	Highway		0.29		0.39	1.29
			LDR	C	0.06	0.69	0.24	
			LDR		0.27	0.94	0.60	
113	2.23	0.51	Open			0.23	0.05	0.80
			Forest	A		0.24	0.03	
			Highway	A	0.29		0.38	
			LDR	A	0.22	1.46	0.38	
113	2.23	0.51	Open	A		0.02	0.00	0.80

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

114	1.21	0.29	Forest	A		0.10	0.01	0.44
			Forest	B/D		0.05	0.01	
			Highway	A	0.23		0.30	
			Highway	B/D	0.00		0.01	
			LDR	A	0.06	0.71	0.11	
115	6.09	0.79	Open	A		0.06	0.00	1.49
			Forest	A		0.98	0.13	
			Forest	B/D		0.15	0.02	
			Highway	A	0.36		0.49	
			Highway	B/D	0.06		0.08	
			LDR	A	0.28	3.62	0.54	
			LDR	B/D	0.08	0.50	0.23	
116	3.83	0.79	Open	A		0.05	0.00	1.24
			Open	B/D		0.01	0.00	
			Forest	A		0.10	0.01	
			Highway	A	0.36		0.48	
117	2.12	0.31	LDR	A	0.43	2.87	0.74	0.60
			Open	A		0.07	0.00	
			Forest			0.09	0.01	
			Highway	A	0.01		0.02	
			Highway		0.20		0.27	
			LDR	A	0.05	1.19	0.11	
			LDR	C		0.03	0.01	
118	16.63	1.93	LDR		0.05	0.44	0.17	5.01
			Open	A		0.00	0.00	
			Open			0.06	0.01	
			Forest	A		0.03	0.00	
			Forest	B		4.35	0.57	
			Forest	C		1.85	0.24	
			Forest			0.12	0.02	
			Highway	A	0.40		0.54	
			Highway	C	0.01		0.01	
			Highway		0.43		0.58	
119	1.46	0.28	LDR	A	0.44	1.77	0.71	0.54
			LDR	C	0.22	2.36	0.83	
			LDR		0.43	3.87	1.47	
			Open	A		0.18	0.01	
120	2.53	0.75	Open	C		0.02	0.00	1.25
			Open			0.15	0.03	
			Forest	B		0.05	0.01	
			Highway	B	0.17		0.23	
			LDR	B	0.11	1.08	0.29	
			Open	B		0.05	0.01	
			121	0.53	0.23	Forest	A	
Forest	B					0.07	0.01	
Highway	A	0.30					0.41	
Highway	B	0.14					0.19	
LDR	A	0.01				0.25	0.03	
LDR	B	0.28				1.35	0.59	
Open	A	0.01				0.03	0.01	
122	1.15	0.36	Open	B		0.01	0.00	0.61
			Forest	A		0.02	0.00	
			Forest	C		0.08	0.01	
			Highway	A	0.03		0.05	
			Highway	C	0.17		0.23	
			LDR	A		0.01	0.00	
			LDR	C	0.02	0.14	0.07	
122	1.15	0.36	Open	A	0.00	0.00	0.00	0.61
			Open	C	0.00	0.05	0.01	
			Forest	A		0.13	0.02	
			Forest	C		0.07	0.01	
			Highway	A	0.22		0.29	
			Highway	C	0.03		0.04	
			LDR	A	0.00	0.19	0.01	
122	1.15	0.36	LDR	C	0.11	0.33	0.23	0.61
			Open	A	0.00	0.05	0.00	
			Open	C		0.01	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

123	0.60	0.19	Forest	A		0.01	0.00	0.28
			Forest	C		0.01	0.00	
			Highway	A	0.13		0.17	
			Highway	C	0.01		0.01	
			LDR	A	0.05	0.35	0.09	
124	11.69	1.88	Open	A		0.04	0.00	3.91
			Forest	A		0.05	0.01	
			Forest	B		0.70	0.09	
			Forest	B/D		0.04	0.00	
			Highway	A	0.19		0.26	
			Highway	B	0.41		0.54	
			Highway	B/D	0.13		0.18	
			LDR	A	0.33	2.55	0.57	
			LDR	B	0.63	3.97	1.44	
			LDR	B/D	0.15	0.28	0.28	
			LDR	D		0.01	0.00	
			LDR		0.05	2.12	0.51	
			Open	A		0.02	0.00	
			Open	B		0.04	0.00	
Open	B/D		0.04	0.01				
125	0.83	0.31	Forest	A		0.08	0.01	0.48
			Forest	B/D		0.06	0.01	
			Forest			0.02	0.00	
			Highway	A	0.11		0.14	
			Highway	B/D	0.06		0.08	
			Highway		0.10		0.13	
			LDR	A	0.01	0.19	0.02	
			LDR	B/D	0.00	0.00	0.00	
			LDR		0.03	0.16	0.08	
127	1.69	0.35	Open	A		0.00	0.00	0.64
			Open			0.02	0.00	
			Forest	B		0.94	0.12	
			Highway	B	0.30		0.40	
128	7.99	1.42	LDR	B	0.04	0.37	0.11	3.48
			Open	B	0.00	0.03	0.01	
			Forest	C		0.41	0.05	
			Forest	D		0.02	0.00	
			Highway	C	0.62		0.83	
			Highway	D	0.16		0.22	
			LDR	B	0.00	0.10	0.02	
			LDR	C	0.49	5.02	1.79	
131	3.66	1.00	LDR	D	0.15	0.71	0.49	2.20
			Open	C		0.24	0.05	
			Open	D		0.07	0.03	
			Forest	C/D		0.39	0.05	
			Forest	D		0.03	0.00	
			Highway	C/D	0.51		0.69	
			Highway	D	0.05		0.06	
133	6.12	1.10	LDR	C/D	0.33	1.28	0.87	2.70
			LDR	D	0.12	0.79	0.47	
			Open	C/D		0.10	0.03	
			Open	D		0.07	0.02	
			Forest	B		0.12	0.02	
			Forest	C/D		0.10	0.01	
			Forest	D		0.01	0.00	
			Highway	B	0.17		0.23	
			Highway	C/D	0.22		0.30	
			Highway	D	0.00		0.01	
			LDR	B	0.30	2.05	0.71	
LDR	C/D	0.39	2.13	1.21				
LDR	D	0.01	0.40	0.17				
Open	B		0.08	0.01				
Open	C/D		0.10	0.03				
Open	D		0.03	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

134	2.04	0.64	Forest	A		0.28	0.04	0.96
			Highway	A	0.49		0.65	
			LDR	A	0.16	1.06	0.27	
			Open	A		0.05	0.00	
135	2.73	0.73	Forest	A		0.26	0.03	1.13
			Highway	A	0.34		0.46	
			LDR	A	0.39	1.72	0.64	
			Open	A		0.03	0.00	
136	4.69	1.20	Forest	C/D		0.14	0.02	2.71
			Forest	D		0.33	0.04	
			Highway	C/D	0.44		0.58	
			Highway	D	0.26		0.35	
			LDR	C/D	0.49	2.05	1.33	
			LDR	D	0.02	0.83	0.33	
			Open	C/D		0.08	0.02	
137	2.33	0.69	Forest	C/D		0.06	0.01	1.44
			Forest	D		0.01	0.00	
			Highway	C/D	0.36		0.48	
			Highway	D	0.09		0.13	
			LDR	C/D	0.24	1.32	0.74	
			LDR	D	0.00	0.01	0.00	
			Open	C/D		0.17	0.05	
145	3.96	0.76	Open	D		0.09	0.03	1.91
			Forest	C		0.00	0.00	
			Forest	C/D		0.14	0.02	
			Highway	C	0.00		0.00	
			Highway	C/D	0.42		0.56	
			LDR	C	0.08	0.96	0.33	
			LDR	C/D	0.26	1.99	0.97	
146	1.47	0.35	Open	C		0.01	0.00	0.65
			Open	C/D		0.10	0.03	
			Forest	A		0.07	0.01	
			Forest	C		0.18	0.02	
			Highway	A	0.07		0.10	
			Highway	C	0.19		0.25	
			LDR	A	0.05	0.25	0.08	
147	2.20	0.48	LDR	C	0.04	0.52	0.17	0.83
			LDR	A/D	0.04	0.43	0.16	
			Open	A		0.00	0.00	
			Open	A/D		0.03	0.01	
			Forest	A		0.01	0.00	
			Forest	A/D		0.05	0.01	
			Highway	A	0.09		0.12	
148	3.09	0.52	Highway	A/D	0.10		0.14	1.16
			LDR	A	0.24	1.20	0.41	
			LDR	B	0.26	1.78	0.61	
			LDR	C/D	0.03	0.43	0.18	
			Open	B		0.06	0.01	
149	4.45	0.66	Forest	B		0.06	0.01	1.07
			Highway	B	0.19		0.25	
			LDR	A/D	0.03	0.24	0.10	
			LDR	B	0.26	1.78	0.61	
			LDR	C/D	0.03	0.43	0.18	
			Open	B		0.06	0.01	
			Open	A		0.07	0.01	
Forest	A/D		0.03	0.00				
Highway	A	0.26		0.35				
Highway	A/D	0.11		0.14				
LDR	A	0.27	3.56	0.51				
LDR	A/D	0.02	0.07	0.05				
Open	A		0.06	0.00				
Open	A/D		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

151	4.77	1.52	Forest	A/D		0.02	0.00	3.64
			Forest	C/D		0.56	0.07	
			HDR	A/D	0.01	0.01	0.02	
			HDR	C/D	0.71	0.38	1.76	
			Highway	C/D	0.47		0.63	
			LDR	A/D		0.16	0.03	
			LDR	C/D	0.32	2.01	1.08	
			Open	C/D		0.11	0.03	
152	1.64	0.39	Forest	C		0.03	0.00	0.88
			Forest	C/D		0.01	0.00	
			Highway	C	0.19		0.26	
			Highway	C/D	0.10		0.13	
			LDR	C	0.01	0.08	0.03	
			LDR	C/D	0.09	0.96	0.42	
			LDR	D		0.04	0.01	
			Open	C		0.08	0.02	
153	3.68	0.41	Forest	A/D		0.97	0.13	1.11
			Forest	B		0.24	0.03	
			Forest	C/D		0.03	0.00	
			Highway	A/D	0.16		0.21	
			Highway	B	0.13		0.18	
			Highway	C/D	0.02		0.02	
			LDR	A/D	0.00	1.03	0.22	
			LDR	B	0.09	0.73	0.22	
154	1.91	0.34	LDR	C/D	0.01	0.25	0.08	0.67
			Open	A/D		0.01	0.00	
			Open	B		0.02	0.00	
			Forest	A		0.00	0.00	
			Forest	A/D		0.04	0.00	
			Forest	B		0.05	0.01	
			Highway	A	0.00		0.00	
			Highway	A/D	0.02		0.02	
156	2.75	0.88	Highway	B	0.09		0.12	1.46
			LDR	A	0.04	0.29	0.07	
			LDR	A/D		0.01	0.00	
			LDR	B	0.20	1.16	0.44	
			Open	A/D		0.00	0.00	
			Open	B		0.03	0.00	
			Forest	B		0.14	0.02	
			Forest	B/D		0.19	0.03	
157	4.96	0.89	Highway	B	0.36		0.48	1.97
			Highway	B/D	0.40		0.53	
			LDR	B	0.11	1.11	0.30	
			LDR	B/D	0.01	0.37	0.09	
			Open	B		0.07	0.01	
			Open	B/D		0.00	0.00	
			Forest	B		0.06	0.01	
			Forest	B/D		0.09	0.01	
158	2.77	0.45	Highway	B	0.10		0.13	1.08
			Highway	B/D	0.35		0.47	
			LDR	B	0.18	1.49	0.46	
			LDR	B/D	0.25	2.21	0.85	
			Open	B		0.03	0.00	
			Open	B/D		0.20	0.04	
			Forest	B		0.02	0.00	
			Forest	B/D		0.03	0.00	
158	2.77	0.45	Highway	B	0.07		0.09	1.08
			Highway	B/D	0.07		0.10	
			LDR	B	0.16	0.76	0.34	
			LDR	B/D	0.15	1.49	0.54	
			Open	B		0.01	0.00	
			Open	B/D		0.00	0.00	
			Open	B/D		0.00	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

159	16.64	3.48	Forest	B		0.05	0.01	8.53
			Forest	C/D		0.93	0.12	
			Highway	B	0.11		0.15	
			Highway	C/D	1.95		2.61	
			LDR	B	0.05	0.25	0.11	
			LDR	C/D	1.36	11.38	5.37	
			Open	B		0.01	0.00	
			Open	C/D	0.00	0.54	0.16	
161	13.03	2.46	Forest	B		0.21	0.03	5.84
			Forest	C		0.08	0.01	
			Forest	C/D		0.44	0.06	
			Highway	B	0.30		0.41	
			Highway	C	0.28		0.37	
			Highway	C/D	0.79		1.06	
			LDR	B	0.43	3.12	1.03	
			LDR	C	0.07	0.71	0.26	
			LDR	C/D	0.58	5.74	2.54	
			Open	B		0.04	0.00	
162	1.96	0.58	Forest	A		0.15	0.02	0.87
			Forest	C		0.00	0.00	
			Highway	A	0.43		0.57	
			Highway	C	0.01		0.01	
			LDR	A	0.15	1.11	0.26	
			LDR	C		0.00	0.00	
163	11.49	1.16	Open	A		0.10	0.00	2.96
			Forest	B		4.19	0.54	
			Forest	D		0.36	0.05	
			Forest			2.06	0.27	
			Highway	B	0.64		0.86	
			LDR	B	0.52	3.62	1.23	
164	3.41	0.47	Open	B		0.09	0.01	0.77
			Forest	A		0.15	0.02	
			Forest	B		0.01	0.00	
			Highway	A	0.20		0.27	
			Highway	B	0.05		0.06	
			LDR	A	0.22	2.65	0.41	
			LDR	B	0.00	0.01	0.00	
			Open	A		0.14	0.00	
165	1.43	0.26	Open	B		0.00	0.00	0.52
			Forest	B		0.05	0.01	
			Forest	B/D		0.04	0.00	
			Highway	B	0.09		0.12	
			Highway	B/D	0.08		0.11	
			LDR	B	0.07	0.91	0.21	
			LDR	B/D	0.02	0.11	0.06	
			Open	B		0.04	0.00	
166	2.06	0.57	Open	B/D		0.01	0.00	1.00
			Forest	B		0.11	0.01	
			Forest	B/D		0.03	0.00	
			Highway	B	0.32		0.43	
			LDR	B	0.25	1.25	0.52	
			LDR	B/D	0.01	0.04	0.02	
167	4.04	0.80	Open	B		0.06	0.01	1.33
			Forest	A		0.02	0.00	
			Forest	B		0.22	0.03	
			Highway	A	0.21		0.28	
			Highway	B	0.33		0.44	
			LDR	A	0.13	1.92	0.25	
			LDR	B	0.13	0.97	0.32	
			Open	A		0.08	0.00	
Open	B		0.03	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

168	9.29	1.15	Forest	A		0.67	0.09	2.78
			Forest	B		0.70	0.09	
			Forest	B/D		0.03	0.00	
			Forest			3.14	0.41	
			Highway	B	0.23		0.31	
			Highway	B/D	0.45		0.61	
			LDR	B	0.31	2.06	0.71	
			LDR	B/D	0.16	1.15	0.49	
			LDR			0.20	0.04	
			Open	B		0.07	0.01	
Open	B/D		0.11	0.02				
170	6.32	0.48	Forest	B		0.75	0.10	1.40
			Highway	B	0.21		0.28	
			LDR	B	0.27	4.44	0.94	
			Open	B		0.65	0.08	
171	3.93	0.74	Forest	B		1.21	0.16	1.42
			Highway	B	0.56		0.76	
			LDR	B	0.17	1.88	0.49	
			Open	B	0.01	0.09	0.02	
172	2.64	0.39	Forest	A		0.27	0.03	0.73
			Forest	B		0.00	0.00	
			Highway	A	0.12		0.16	
			Highway	B	0.00		0.00	
			LDR	A	0.19	1.19	0.32	
			LDR	B	0.08	0.76	0.22	
Open	A		0.02	0.00				
173	1.19	0.17	Forest	A		0.01	0.00	0.37
			Forest	B		0.15	0.02	
			Forest	C		0.04	0.01	
			Highway	A	0.03		0.04	
			Highway	B	0.05		0.07	
			Highway	C	0.06		0.08	
			LDR	A	0.00	0.16	0.01	
			LDR	B	0.02	0.39	0.07	
			LDR	C	0.01	0.22	0.06	
			Open	A		0.01	0.00	
Open	B		0.02	0.00				
Open	C		0.01	0.00				
174	12.01	2.17	Forest	C		1.04	0.13	5.27
			Highway	C	0.97		1.30	
			Highway	C/D	0.00		0.00	
			LDR	C	0.97	6.71	2.89	
			LDR	C/D	0.23	2.01	0.93	
Open	C		0.09	0.02				
175	7.62	1.60	Forest	A		0.22	0.03	2.47
			Highway	A	0.91		1.22	
			LDR	A	0.69	5.52	1.21	
			Open	A	0.00	0.27	0.01	
176	1.66	0.49	Forest	A		0.14	0.02	0.73
			Forest	B		0.00	0.00	
			Forest	B/D		0.04	0.00	
			Highway	A	0.40		0.53	
			Highway	B	0.01		0.01	
			Highway	B/D	0.02		0.02	
			LDR	A	0.07	0.90	0.13	
			LDR	B		0.00	0.00	
			LDR	B/D		0.01	0.00	
			Open	A		0.07	0.00	
Open	B		0.00	0.00				

Phosphorus Load Calculations - Merrimack River, Andover, MA

177	3.29	0.81	Forest	A		0.19	0.02	1.33
			Forest	B		0.10	0.01	
			Forest	B/D		0.00	0.00	
			Highway	A	0.36		0.49	
			Highway	B	0.27		0.36	
			Highway	B/D	0.04		0.06	
			LDR	A	0.08	0.99	0.16	
			LDR	B	0.05	0.83	0.17	
			LDR	B/D	0.00	0.15	0.04	
			Open	A		0.15	0.00	
			Open	B		0.06	0.01	
Open	B/D		0.01	0.00				
178	14.28	1.08	Forest	A		1.02	0.13	3.42
			Forest	B		0.21	0.03	
			Forest	B/D		0.01	0.00	
			Forest	C/D		4.83	0.63	
			Forest	D		1.88	0.24	
			Highway	A	0.39		0.53	
			Highway	B	0.13		0.17	
			Highway	B/D	0.01		0.01	
			LDR	A	0.36	2.54	0.62	
			LDR	B	0.00	0.30	0.04	
			LDR	B/D		0.00	0.00	
			LDR	C/D	0.19	1.34	0.68	
			LDR	D		0.06	0.02	
			Open	A		0.03	0.00	
Open	B	0.00	0.00	0.00				
Open	C/D		0.62	0.18				
Open	D		0.35	0.13				
180	4.16	1.02	Forest	A		0.32	0.04	1.57
			Forest			0.00	0.00	
			Highway	A	0.68		0.92	
			Highway		0.00		0.00	
			LDR	A	0.34	2.60	0.60	
			LDR		0.00	0.08	0.02	
181	7.45	1.02	Open	A		0.13	0.00	2.01
			Forest	A		1.57	0.20	
			Forest	A/D		0.10	0.01	
			Forest	C		0.16	0.02	
			Forest			0.01	0.00	
			Highway	A	0.36		0.48	
			Highway	A/D	0.35		0.47	
			Highway		0.00		0.00	
			LDR	A	0.18	1.71	0.32	
			LDR	A/D	0.08	0.75	0.28	
			LDR		0.05	0.21	0.12	
Open	A	0.00	1.74	0.05				
Open	A/D		0.11	0.02				
Open	C		0.09	0.02				
Open			0.00	0.00				
182	5.80	0.89	Forest	B		0.09	0.01	2.05
			Forest	C		0.44	0.06	
			Highway	B	0.28		0.38	
			Highway	C	0.26		0.34	
			LDR	B	0.21	2.17	0.58	
			LDR	C	0.14	2.09	0.64	
			Open	B		0.02	0.00	
Open	C	0.01	0.11	0.04				
183	0.51	0.14	Forest	A		0.11	0.01	0.21
			Highway	A	0.10		0.13	
			LDR	A	0.04	0.26	0.07	
184	2.98	0.62	Open	A		0.00	0.00	0.96
			Forest	A		0.17	0.02	
			Highway	A	0.35		0.46	
			LDR	A	0.27	2.10	0.48	
Open	A		0.09	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

185	16.44	1.68	Forest	A		3.74	0.49	3.27
			HDR	A	0.05	0.18	0.13	
			Highway	A	0.81		1.09	
			LDR	A	0.81	10.47	1.55	
			Open	A	0.00	0.36	0.01	
186	6.43	2.01	Forest	A		0.34	0.04	3.63
			Forest	C		0.89	0.12	
			HDR	A	0.49	0.94	1.16	
			Highway	A	0.82		1.10	
			Highway	C	0.02		0.03	
			LDR	A	0.58	1.57	0.93	
			LDR	C	0.11	0.41	0.25	
			Open	A		0.24	0.01	
187	5.49	1.30	Open	C		0.03	0.01	1.99
			Forest	A		0.10	0.01	
			Highway	A	0.70		0.94	
			LDR	A	0.60	3.89	1.03	
			LDR	B/D		0.03	0.01	
189	1.45	0.47	Open	A		0.18	0.01	0.71
			Forest	A		0.08	0.01	
			Highway	A	0.27		0.36	
			LDR	A	0.21	0.83	0.34	
190	1.66	0.08	Open	A		0.07	0.00	0.17
			Forest	A		0.02	0.00	
			Highway	A	0.01		0.02	
			Highway	B/D	0.00		0.00	
			LDR	A	0.07	1.56	0.15	
191	2.06	0.66	Open	A		0.01	0.00	1.05
			Forest	A		0.00	0.00	
			Forest			0.02	0.00	
			Highway	A	0.06		0.08	
			Highway		0.23		0.30	
			LDR	A	0.29	1.08	0.47	
			LDR	C		0.00	0.00	
			LDR		0.09	0.23	0.19	
192	7.36	2.17	Open	A		0.01	0.00	3.44
			Open			0.06	0.01	
			Forest	A		0.52	0.07	
			Forest	B/D		0.05	0.01	
			Forest	C		0.00	0.00	
			Highway	A	0.65		0.87	
			Highway	B/D	0.07		0.10	
			LDR	A	1.39	3.87	2.23	
193	9.46	2.24	LDR	B/D	0.03	0.28	0.11	3.54
			LDR	C	0.02	0.09	0.05	
			Open	A	0.00	0.37	0.01	
			Open	B/D		0.01	0.00	
			Forest	A		0.82	0.11	

Phosphorus Load Calculations - Merrimack River, Andover, MA

194	37.55	3.53	Forest	A		1.24	0.16	12.14
			Forest	A/D		0.03	0.00	
			Forest	C		4.87	0.63	
			Forest	D		0.23	0.03	
			Forest			0.00	0.00	
			Highway	A	0.23		0.31	
			Highway	A/D	0.18		0.25	
			Highway	C	0.78		1.05	
			Highway	D	0.10		0.13	
			Highway		0.05		0.06	
			LDR	A	0.25	1.66	0.43	
			LDR	A/D	0.16	1.08	0.48	
			LDR	C	1.19	12.17	4.36	
			LDR	D	0.35	4.87	2.33	
			LDR		0.08	0.16	0.15	
			Open	A	0.12	0.62	0.20	
			Open	A/D		0.04	0.01	
Open	C	0.04	6.95	1.52				
Open	D		0.09	0.03				
Open		0.00	0.02	0.00				
195	20.16	4.06	Forest	C		0.80	0.10	9.53
			Forest	C/D		0.02	0.00	
			Forest	D		0.31	0.04	
			Highway	C	1.64		2.20	
			Highway	C/D	0.25		0.34	
			Highway	D	0.48		0.64	
			LDR	C	1.36	10.62	4.30	
			LDR	C/D	0.17	2.08	0.86	
			LDR	D	0.16	1.99	0.98	
			Open	C		0.23	0.05	
Open	C/D		0.05	0.01				
Open	D		0.00	0.00				
196	10.97	2.75	Forest	A		0.39	0.05	4.40
			Forest	B		0.19	0.03	
			Forest			0.19	0.03	
			HDR	A	0.10	0.15	0.23	
			Highway	A	1.31		1.75	
			Highway	B	0.13		0.17	
			LDR	A	1.18	6.14	1.98	
			LDR	B	0.04	0.60	0.14	
			LDR			0.03	0.01	
			Open	A		0.41	0.01	
			Open	B		0.04	0.00	
Open			0.06	0.01				
197	9.69	2.31	Forest	A		0.40	0.05	3.59
			Forest	B		0.07	0.01	
			Forest	B/D		0.03	0.00	
			Highway	A	1.12		1.51	
			Highway	B	0.00		0.00	
			Highway	B/D	0.01		0.02	
			LDR	A	1.17	6.54	1.97	
			LDR	B		0.05	0.01	
			LDR	B/D		0.06	0.01	
Open	A	0.00	0.24	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

198	33.67	6.67	Forest	A		0.36	0.05	14.79
			Forest	B		0.31	0.04	
			Forest	C		0.35	0.05	
			Forest	D		0.49	0.06	
			Highway	B	0.96		1.28	
			Highway	B/D	0.00		0.00	
			Highway	C	1.13		1.52	
			Highway	D	0.42		0.57	
			LDR	A	0.12	1.58	0.24	
			LDR	B	1.06	6.94	2.44	
			LDR	B/D	0.00	0.01	0.00	
			LDR	C	2.56	13.48	6.73	
			LDR	D	0.41	2.98	1.72	
			Open	A		0.04	0.00	
			Open	B		0.14	0.02	
			Open	B/D		0.00	0.00	
Open	C		0.28	0.06				
Open	D		0.05	0.02				
199	29.09	2.77	Ag	C		0.00	0.00	10.00
			Ag	C/D		5.34	2.40	
			Forest	A		0.09	0.01	
			Forest	C		4.40	0.57	
			Forest	C/D		5.17	0.67	
			Forest			2.75	0.36	
			Highway	C	1.09		1.46	
			Highway	C/D	0.80		1.07	
			Industrial	C	0.00	0.08	0.02	
			Industrial	C/D	0.00	3.15	0.92	
			LDR	C	0.02	0.37	0.11	
			LDR	C/D	0.07	0.66	0.30	
			Open	C	0.11	0.29	0.23	
			Open	C/D	0.13	0.04	0.21	
Open		0.55	3.98	1.67				
200	2.63	0.75	Forest	C		0.18	0.02	1.63
			Forest	C/D		0.21	0.03	
			HDR	C	0.01	0.01	0.03	
			HDR	C/D	0.16	0.47	0.50	
			Highway	C	0.14		0.19	
			Highway	C/D	0.26		0.35	
			LDR	C	0.10	0.51	0.26	
			LDR	C/D	0.08	0.42	0.24	
			Open	C		0.07	0.01	
Open	C/D		0.02	0.01				
203	12.58	2.48	Forest	A		1.40	0.18	4.07
			Highway	A	0.97		1.30	
			LDR	A	1.43	8.28	2.43	
			LDR	A/D	0.07	0.21	0.15	
			Open	A		0.21	0.01	
208	4.20	0.92	Forest	C/D		0.23	0.03	2.09
			Highway	C/D	0.60		0.81	
			LDR	C	0.09	1.49	0.44	
			LDR	C/D	0.23	1.45	0.77	
			LDR	D		0.08	0.03	
			Open	C/D		0.03	0.01	
209	3.81	0.82	Forest	A		0.39	0.05	1.48
			Forest	A/D		0.28	0.04	
			Forest	B/D		0.03	0.00	
			HDR	A	0.00	0.03	0.00	
			Highway	A	0.28		0.37	
			LDR	A	0.46	1.45	0.74	
			LDR	A/D	0.04	0.72	0.21	
			Open	A	0.04	0.09	0.07	
Open	A/D		0.00	0.00				
210	4.07	1.39	Forest	A		0.38	0.05	2.07
			HDR	A		0.00	0.00	
			Highway	A	0.93		1.25	
			LDR	A	0.46	2.15	0.76	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Open	A		0.15	0.00	
214	0.31	0.30	Highway	A	0.22		0.29	0.40
			Highway	D	0.07		0.10	
			Industrial	A	0.01	0.02	0.01	
			Open	A		0.00	0.00	
216	8.23	1.64	Forest	C		0.06	0.01	4.20
			Forest	C/D		0.12	0.02	
			Forest	D		0.03	0.00	
			Highway	C	0.26		0.34	
			Highway	C/D	0.29		0.39	
			Highway	D	0.11		0.15	
			LDR	C	0.22	1.92	0.74	
			LDR	C/D	0.58	3.06	1.77	
			LDR	D	0.17	1.28	0.74	
			Open	C		0.03	0.01	
			Open	C/D		0.06	0.02	
			Open	D		0.04	0.01	
			217	4.48	0.63	Forest	C	
Forest	C/D					0.01	0.00	
Highway	C	0.21					0.28	
Highway	C/D	0.08					0.11	
LDR	C	0.08				0.98	0.33	
LDR	C/D	0.26				2.69	1.18	
Open	C					0.06	0.01	
Open	C/D					0.00	0.00	
229	8.85	1.89	Forest	C		0.35	0.05	4.25
			Forest	C/D		0.38	0.05	
			Forest	D		0.10	0.01	
			Highway	C	0.81		1.08	
			Highway	C/D	0.10		0.13	
			Highway	D	0.07		0.09	
			LDR	C	0.72	4.43	2.02	
			LDR	C/D	0.17	1.09	0.57	
			LDR	D	0.03	0.38	0.19	
			Open	C	0.00	0.13	0.03	
			Open	C/D	0.00	0.09	0.03	
230	15.78	3.05	Open	D	0.00		0.00	8.16
			Forest	C/D		0.42	0.05	
			Forest	D		0.17	0.02	
			Highway	C/D	0.91		1.22	
			Highway	D	0.29		0.38	
			LDR	C/D	1.52	9.88	5.18	
			LDR	D	0.33	1.71	1.13	
			Open	C/D		0.44	0.13	
231	5.25	1.73	Open	D		0.13	0.05	3.19
			Forest	A/D		0.09	0.01	
			Forest	C		0.12	0.02	
			Forest	C/D		0.09	0.01	
			Highway	A/D	0.40		0.53	
			Highway	C	0.42		0.56	
			Highway	C/D	0.19		0.25	
			LDR	A/D	0.18	0.44	0.36	
			LDR	C	0.50	2.29	1.24	
			LDR	C/D	0.05	0.27	0.15	
			Open	A/D		0.08	0.02	
			Open	C		0.13	0.03	
			Open	C/D		0.01	0.00	
			Forest	A		7.44	0.97	
			Forest	B		1.79	0.23	
			Forest	C/D		1.57	0.20	
			Forest	D		0.88	0.11	
			Forest			2.58	0.33	
			HDR	A	0.18	1.12	0.44	
			HDR	B	0.00	0.08	0.01	
			HDR	C/D	0.39	3.49	1.92	
HDR	D	0.00	0.36	0.13				
Highway	A	0.41		0.55				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

233	77.20	13.89	Highway	B	2.17		2.90	32.75
			Highway	C/D	3.20		4.28	
			Highway	D	0.50		0.67	
			LDR	A	0.56	5.62	1.03	
			LDR	B	2.66	13.73	5.69	
			LDR	C/D	3.18	18.15	10.09	
			LDR	D	0.64	4.86	2.78	
			Open	A		0.10	0.00	
			Open	B		0.44	0.05	
			Open	C/D		0.98	0.29	
			Open	D		0.12	0.05	
234	1.30	0.33	Forest	B		0.09	0.01	0.59
			Highway	B	0.17		0.23	
			LDR	B	0.16	0.79	0.33	
236	11.36	2.08	Open	B		0.09	0.01	5.24
			Forest	C		0.40	0.05	
			Forest	C/D		0.31	0.04	
			Highway	C	0.45		0.61	
			Highway	C/D	0.39		0.52	
			LDR	C	0.48	4.12	1.60	
			LDR	C/D	0.75	4.20	2.36	
			Open	C		0.14	0.03	
242	6.57	1.27	Open	C/D		0.12	0.04	2.00
			Forest	A		0.50	0.07	
			Forest	A/D		0.00	0.00	
			Highway	A	0.77		1.03	
			LDR	A	0.49	4.72	0.89	
243	1.68	0.28	Open	A	0.00	0.07	0.01	0.51
			Open	A/D		0.00	0.00	
			Forest	A		0.18	0.02	
			Forest	A/D		0.01	0.00	
			Highway	A	0.03		0.04	
			Highway	A/D	0.10		0.14	
			LDR	A	0.15	0.95	0.26	
			LDR	A/D	0.00	0.17	0.04	
245	6.49	1.74	Open	A		0.02	0.00	2.68
			Open	A/D		0.06	0.01	
			Forest	A		0.26	0.03	
			Forest	B		0.00	0.00	
			Highway	A	0.76		1.02	
			Highway	B	0.00		0.01	
			LDR	A	0.91	4.23	1.51	
247	6.26	0.84	LDR	B	0.06	0.06	0.09	1.44
			Open	A		0.20	0.01	
			Open	B		0.00	0.00	
			Forest	A		0.12	0.01	
			Forest	B		0.05	0.01	
			Highway	A	0.28		0.38	
			Highway	A/D	0.02		0.02	
			Highway	B	0.17		0.23	
			LDR	A	0.21	4.32	0.45	
248	12.88	2.67	LDR	B	0.16	0.69	0.33	4.56
			Open	A		0.15	0.00	
			Open	A/D		0.00	0.00	
			Open	B		0.09	0.01	
250	3.56	0.59	Forest	A		3.81	0.50	1.19
			Forest	B		0.43	0.06	
			Highway	B	0.39		0.52	
			LDR	B	0.19	2.21	0.55	
			LDR	B/D	0.01	0.06	0.03	
			Open	B		0.03	0.00	
251	1.80	0.33	Forest	B		0.07	0.01	0.65
			Highway	B	0.21		0.28	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

2.51	1.00	0.33	LDR	B	0.13	1.31	0.35	0.33
			Open	B		0.09	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

252	27.23	3.28	Forest	B		0.09	0.01	8.88
			Forest	B/D		7.10	0.92	
			Forest			0.95	0.12	
			Highway	B	0.44		0.60	
			Highway	B/D	0.57		0.77	
			LDR	B	0.52	3.31	1.19	
			LDR	B/D	1.43	8.59	3.97	
			LDR		0.32	3.70	1.26	
			Open	B		0.09	0.01	
Open	B/D		0.11	0.02				
254	5.53	1.32	Forest	A		0.15	0.02	2.48
			Forest	C		0.00	0.00	
			Forest			0.00	0.00	
			Highway	A	0.58		0.78	
			Highway	C	0.00		0.00	
			Highway		0.01		0.02	
			LDR	A	0.36	1.49	0.59	
			LDR	C	0.35	2.24	1.00	
			LDR		0.02	0.16	0.06	
			Open	A		0.15	0.00	
Open	C		0.00	0.00				
Open			0.01	0.00				
255	4.61	1.00	Forest	C/D		0.09	0.01	2.50
			Highway	C/D	0.35		0.46	
			LDR	C/D	0.66	3.42	1.99	
			Open	C/D		0.10	0.03	
257	3.17	0.22	Forest	A		1.57	0.20	0.65
			Forest	C		0.40	0.05	
			Highway	A	0.17		0.23	
			LDR	A		0.27	0.01	
			LDR	C	0.03	0.35	0.12	
			Open	A	0.01	0.36	0.03	
Open	C		0.00	0.00				
259	1.22	0.34	Forest	A		0.02	0.00	0.54
			Forest	C		0.00	0.00	
			Forest			0.02	0.00	
			Highway	A	0.16		0.22	
			Highway	C	0.01		0.02	
			Highway		0.10		0.13	
			LDR	A	0.05	0.57	0.10	
			LDR	C	0.02	0.03	0.03	
			LDR		0.00	0.17	0.04	
			Open	A		0.04	0.00	
Open			0.02	0.00				
260	0.80	0.43	Forest	C/D		0.07	0.01	0.67
			Highway	C/D	0.42		0.56	
			LDR	C/D	0.01	0.25	0.09	
			Open	C/D		0.05	0.01	
261	55.01	22.24	Forest	C/D		4.18	0.54	41.57
			Forest	D		2.66	0.35	
			HDR	C/D	0.47	1.09	1.41	
			HDR	D	1.44	4.07	4.85	
			Highway	C/D	8.28		11.09	
			Highway	D	7.65		10.25	
			LDR	C	0.21	1.82	0.70	
			LDR	C/D	1.95	6.84	4.95	
			LDR	D	0.60	3.21	2.10	
			Open	C/D	0.77	5.72	2.83	
Open	D	0.87	3.19	2.50				
264	3.80	1.17	Forest	A		0.02	0.00	1.77
			Highway	A	0.45		0.60	
			LDR	A	0.72	2.52	1.17	
			Open	A		0.09	0.00	
265	0.04	0.03	Forest	A		0.00	0.00	0.05
			Highway	A	0.02		0.03	
			Highway		0.00		0.00	
			Industrial	A	0.00	0.00	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Industrial		0.00		0.00		
266	28.79	5.62	Forest	A			0.82	0.11	
			Forest	C			0.11	0.01	
			Forest				0.01	0.00	
			HDR	A	0.12		0.54	0.30	
			HDR	C	0.05		0.51	0.21	
			Highway	A	1.74			2.33	
			Highway	C	0.33			0.44	
			Highway		0.48			0.65	
			LDR	A	1.59	11.24		2.76	
			LDR	C	0.72	6.53		2.47	
			LDR		0.59	2.81		1.48	
			Open	A			0.47	0.01	
			Open	C			0.04	0.01	
Open				0.08	0.02				
267	1.02	0.22	Forest	C			0.05	0.01	
			Highway	C	0.14			0.19	
			LDR	A	0.03	0.34		0.05	
			LDR	C	0.05	0.40		0.16	
268	15.16	2.70	Open	C			0.02	0.00	
			Forest	A			0.72	0.09	
			Forest	B			0.25	0.03	
			Forest	C/D			1.10	0.14	
			Highway	A	0.47			0.63	
			Highway	B	0.47			0.63	
			Highway	C/D	0.64			0.86	
			LDR	A	0.18	2.34		0.34	
			LDR	B	0.40	2.91		0.96	
			LDR	C/D	0.53	4.64		2.15	
			Open	A	0.01	0.18		0.02	
			Open	B		0.14		0.02	
			Open	C/D		0.18		0.05	
269	3.68	1.07	Forest	A			1.33	0.17	
			Forest	B			0.85	0.11	
			Highway	A	0.54			0.72	
			Highway	B	0.53			0.71	
			Open	A			0.23	0.01	
271	0.99	0.31	Open	B			0.21	0.02	
			Forest	B			0.03	0.00	
			Forest	B/D			0.03	0.00	
			Highway	B	0.19			0.25	
			Highway	B/D	0.08			0.10	
			LDR	B	0.04	0.44		0.12	
			LDR	B/D	0.00	0.10		0.02	
			Open	B			0.04	0.00	
272	0.52	0.21	Open	B/D			0.04	0.01	
			Forest	A			0.01	0.00	
			Forest	B/D			0.04	0.01	
			Highway	A	0.01			0.02	
			Highway	B/D	0.15			0.21	
			LDR	A	0.03	0.09		0.04	
			LDR	B/D	0.02	0.11		0.05	
273	1.95	0.49	Open	A			0.00	0.00	
			Open	B/D			0.05	0.01	
			Forest	C			0.49	0.06	
			Highway	C	0.24			0.32	
274	4.74	0.70	LDR	C	0.26	0.92	0.58		
			Open	C			0.04	0.01	
			Forest	C			0.02	0.00	
			Forest	D			0.19	0.02	
			Highway	C	0.03			0.04	
			Highway	D	0.27			0.37	
			LDR	C	0.26	1.79		0.78	
			LDR	C/D	0.03	0.89		0.31	
			LDR	D	0.10	1.11	0.56		
			Open	C			0.01	0.00	
			Open	D			0.03	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

275	18.70	3.30	Forest	C		0.50	0.07	8.65
			Forest	C/D		0.32	0.04	
			Forest	D		0.20	0.03	
			Highway	C	0.62		0.83	
			Highway	C/D	0.37		0.50	
			Highway	D	0.67		0.90	
			LDR	C	0.79	5.99	2.46	
			LDR	C/D	0.70	6.70	3.01	
			LDR	D	0.14	1.51	0.77	
			Open	C		0.13	0.03	
			Open	C/D		0.02	0.00	
			Open	D		0.03	0.01	
276	20.79	2.41	Forest	C		4.18	0.54	7.34
			Forest	C/D		0.15	0.02	
			Forest	D		1.36	0.18	
			Highway	C	0.90		1.20	
			Highway	C/D	0.14		0.19	
			Highway	D	0.26		0.34	
			LDR	C	0.92	8.62	3.20	
			LDR	C/D	0.01	0.34	0.12	
			LDR	D	0.19	2.91	1.37	
			Open	C		0.75	0.16	
278	10.64	1.19	Forest	A		0.60	0.08	2.84
			Forest			1.31	0.17	
			Highway	A	0.45		0.60	
			Highway		0.15		0.20	
			LDR	A	0.41	3.89	0.74	
			LDR		0.18	3.64	1.04	
280	7.81	1.42	Open	A	0.00	0.00	0.00	2.31
			Forest	A		0.68	0.09	
			Highway	A	0.58		0.77	
			LDR	A	0.83	5.41	1.43	
281	2.32	0.53	LDR		0.01	0.00	0.01	0.80
			Open	A		0.30	0.01	
			Forest	A		0.06	0.01	
			Highway	A	0.36		0.49	
282	21.00	2.91	LDR	A	0.16	1.58	0.30	5.17
			Open	A		0.15	0.00	
			Forest	A		1.14	0.15	
			Highway	A	1.69		2.26	
			LDR	A	1.04	12.74	1.96	
			LDR	B	0.18	3.21	0.66	
283	2.90	0.20	LDR			0.58	0.12	0.75
			Open	A		0.42	0.01	
			Forest	B/D		0.72	0.09	
			Forest	C		0.04	0.01	
			Forest			0.20	0.03	
			Highway	B/D	0.09		0.12	
			Highway	C	0.05		0.07	
			LDR	A		0.12	0.00	
			LDR	B		0.02	0.00	
			LDR	B/D	0.00	0.40	0.09	
284	3.04	0.16	LDR	C	0.00	0.04	0.01	0.67
			LDR		0.06	1.15	0.33	
			Open	B/D	0.00		0.00	
			Open	C		0.02	0.00	
			Forest	A		0.02	0.00	
			Forest	B/D		0.51	0.07	
			Forest			0.34	0.04	
			Highway	B/D	0.04		0.05	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

285	5.23	0.71	Forest	A		0.00	0.00	1.72
			Forest	C		0.08	0.01	
			Highway	A	0.02		0.03	
			Highway	C	0.41		0.55	
			LDR	A	0.17	1.18	0.30	
			LDR	B/D		0.01	0.00	
			LDR	C	0.00	0.40	0.09	
			LDR		0.10	2.71	0.72	
			Open	A		0.07	0.00	
Open	C		0.08	0.02				
287	23.00	1.28	Forest	A		1.13	0.15	2.71
			Highway	A	0.02		0.02	
			LDR	A	1.27	20.54	2.54	
			Open	A		0.05	0.00	
289	3.86	0.67	Forest	A		0.19	0.02	1.05
			Highway	A	0.45		0.60	
			LDR	A	0.22	2.94	0.43	
			Open	A		0.06	0.00	
290	11.69	2.69	Forest	B		0.28	0.04	5.37
			Forest	B/D		0.19	0.03	
			Forest	D		0.05	0.01	
			Highway	B	0.80		1.07	
			Highway	B/D	0.44		0.59	
			Highway	D	0.14		0.19	
			LDR	B	0.77	3.66	1.61	
			LDR	B/D	0.49	4.26	1.64	
			LDR	C		0.00	0.00	
			LDR	D	0.05	0.19	0.15	
			Open	B		0.28	0.03	
Open	B/D		0.07	0.01				
Open	D		0.00	0.00				
292	8.68	0.61	Forest	A		1.54	0.20	1.31
			Highway	A	0.10		0.14	
			LDR	A	0.51	6.44	0.96	
			Open	A		0.08	0.00	
298	38.86	6.85	Forest	A		2.95	0.38	12.00
			Forest	A/D		0.22	0.03	
			HDR	A	0.09	0.34	0.21	
			Highway	A	2.03		2.72	
			Highway	A/D	0.74		0.99	
			LDR	A	3.31	23.78	5.74	
			LDR	A/D	0.63	3.70	1.74	
			LDR	B/D	0.01	0.23	0.07	
			Open	A	0.05	0.62	0.09	
Open	A/D		0.17	0.04				
301	22.68	6.76	Forest	C		0.00	0.00	15.40
			Forest	C/D		0.59	0.08	
			Forest	D		0.43	0.06	
			HDR	C	0.00	0.00	0.00	
			HDR	C/D	0.48	1.23	1.46	
			HDR	D	0.45	1.94	1.75	
			Highway	C	0.00		0.00	
			Highway	C/D	1.53		2.05	
			Highway	D	0.81		1.08	
			LDR	C	0.28	1.24	0.69	
			LDR	C/D	1.70	6.50	4.46	
			LDR	D	1.41	3.58	3.47	
			Open	C/D	0.01	0.27	0.09	
Open	D	0.10	0.15	0.21				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

306	2.49	0.33	Forest	B/D		0.09	0.01	1.14
			Forest	D		0.11	0.01	
			Highway	B	0.01		0.01	
			Highway	B/D	0.07		0.09	
			Highway	D	0.21		0.28	
			LDR	B		0.04	0.00	
			LDR	B/D	0.00	0.30	0.06	
			LDR	D	0.05	1.52	0.64	
			Open	B		0.00	0.00	
			Open	B/D		0.03	0.01	
307	5.15	1.65	Open	D		0.07	0.02	2.79
			Commercial	A	0.00	0.17	0.01	
			Commercial	B/D		0.01	0.00	
			Forest	A		1.03	0.13	
			Forest	B/D		0.06	0.01	
			HDR	A	0.35	1.08	0.84	
			Highway	A	1.12		1.50	
			Highway	B/D	0.09		0.13	
			LDR	A	0.09	0.80	0.16	
			LDR	B/D		0.04	0.01	
309	8.99	0.84	Open	A	0.00	0.29	0.01	3.56
			Open	B/D		0.03	0.01	
			Forest	C/D		0.17	0.02	
			Highway	C/D	0.34		0.45	
			LDR	C/D	0.50	7.94	3.07	
310	27.63	8.34	LDR	D		0.03	0.01	13.11
			Open	C/D		0.01	0.00	
			Commercial	A		2.31	0.07	
			Commercial	B		0.95	0.11	
			Commercial	B/D		0.04	0.01	
			Forest	A		1.30	0.17	
			Forest	B		1.69	0.22	
			Forest	B/D		0.13	0.02	
			HDR	A	0.00	0.19	0.01	
			HDR	B		0.02	0.00	
			Highway	A	6.33		8.48	
			Highway	B	0.74		0.99	
			Highway	B/D	0.02		0.03	
			LDR	A	0.03	1.52	0.09	
			LDR	B	0.83	3.69	1.70	
LDR	B/D	0.05	0.97	0.28				
LDR	D		0.50	0.19				
Open	A	0.17	5.56	0.43				
Open	B	0.14	0.41	0.26				
Open	B/D	0.03	0.00	0.05				
312	7.85	1.35	Forest	A		0.51	0.07	2.35
			Forest	B		0.05	0.01	
			Forest	B/D		0.18	0.02	
			Highway	A	0.53		0.71	
			Highway	B	0.16		0.21	
			LDR	A	0.54	3.84	0.93	
			LDR	B	0.12	1.72	0.39	
			Open	A		0.16	0.00	
Open	B		0.05	0.01				
322	1.38	0.50	Open	B/D		0.03	0.00	0.88
			Forest			0.02	0.00	
			Highway		0.34		0.46	
			LDR		0.16	0.72	0.39	
323	1.61	0.45	Open			0.13	0.03	0.77
			Forest	A		0.09	0.01	
			Forest	C		0.08	0.01	
			Highway	A	0.13		0.17	
			Highway	C	0.27		0.36	
			LDR	A	0.03	0.32	0.06	
			LDR	C	0.02	0.57	0.15	
Open	A		0.07	0.00				
Open	C	0.00	0.03	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

324	5.78	1.34	Forest	A		0.52	0.07	2.09
			Highway	A	0.70		0.94	
			LDR	A	0.64	3.75	1.08	
			Open	A		0.18	0.01	
325	2.00	0.49	Forest	A		0.12	0.02	0.74
			Highway	A	0.38		0.51	
			LDR	A	0.11	1.26	0.21	
			Open	A		0.12	0.00	
326	4.78	1.05	Forest	A		0.10	0.01	1.82
			Forest	B		0.23	0.03	
			Highway	A	0.27		0.36	
			Highway	B	0.58		0.77	
			LDR	A	0.14	0.99	0.24	
			LDR	B	0.06	2.05	0.34	
			LDR	D	0.01	0.07	0.04	
			Open	A		0.06	0.00	
327	2.74	0.76	Forest	A		0.10	0.01	1.14
			Highway	A	0.42		0.57	
			LDR	A	0.33	1.77	0.56	
			Open	A		0.11	0.00	
328	3.69	1.15	Forest	A		0.33	0.04	1.78
			Forest	B/D		0.21	0.03	
			Highway	A	0.48		0.64	
			Highway	B/D	0.06		0.08	
			LDR	A	0.61	1.95	0.99	
			Open	A	0.00	0.05	0.00	
329	5.16	1.33	Open	B/D	0.00		0.00	2.26
			Forest	A		0.19	0.02	
			Forest	B		0.12	0.02	
			Highway	A	0.22		0.30	
			Highway	B	0.54		0.73	
			Industrial	B	0.00	0.66	0.08	
			Industrial	D		0.00	0.00	
			LDR	A	0.05	0.92	0.10	
330	9.67	2.16	LDR	B	0.51	1.83	0.99	3.81
			Open	A		0.03	0.00	
			Open	B		0.08	0.01	
			Forest	A		0.37	0.05	
			Forest	B/D		0.01	0.00	
			HDR	A	0.57	3.03	1.41	
331	3.02	0.74	Highway	A	1.12		1.50	1.69
			LDR	A	0.48	3.84	0.84	
			LDR	B/D		0.00	0.00	
			Open	A	0.00	0.26	0.01	
332	12.70	2.63	Forest	C/D		0.17	0.02	5.49
			Highway	C/D	0.38		0.52	
			LDR	C/D	0.35	1.99	1.12	
			Open	C/D		0.13	0.04	
			Forest	A		0.23	0.03	
			Forest	B		0.40	0.05	
			Forest	C/D		0.07	0.01	
			HDR	B	0.00	0.16	0.02	
			HDR	C/D	0.26	1.55	1.04	
			HDR	D		0.18	0.07	
			Highway	A	0.36		0.48	
			Highway	B	0.72		0.96	
			Highway	C/D	0.18		0.24	
			Industrial	D	0.01	0.08	0.05	
LDR	A	0.32	1.36	0.53				
LDR	B	0.78	5.40	1.83				
LDR	C/D	0.01	0.49	0.16				
Open	A		0.03	0.00				
Open	B	0.00	0.09	0.01				
Open	C/D		0.03	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

333	4.77	1.06	Forest	A		0.20	0.03	1.67
			Highway	A	0.41		0.55	
			LDR	A	0.65	3.37	1.09	
			Open	A		0.14	0.00	
334	6.01	1.42	Forest	A		0.19	0.02	2.22
			Highway	A	0.48		0.64	
			LDR	A	0.93	4.17	1.55	
			Open	A	0.00	0.23	0.01	
336	7.42	0.65	Forest	B		0.03	0.00	2.77
			Forest	D		0.07	0.01	
			HDR	B		0.21	0.03	
			HDR	C		0.21	0.04	
			HDR	D	0.01	0.53	0.22	
			Highway	B	0.01		0.02	
			Highway	D	0.20		0.27	
			LDR	B	0.09	0.82	0.24	
			LDR	C	0.20	2.29	0.78	
			LDR	D	0.14	2.52	1.14	
			Open	B		0.01	0.00	
			Open	D		0.08	0.03	
337	0.82	0.43	Forest	B		0.01	0.00	0.66
			Highway	B	0.25		0.33	
			Highway	C/D	0.06		0.08	
			LDR	B	0.11	0.29	0.20	
			LDR	C/D	0.01	0.03	0.03	
			Open	B		0.04	0.00	
338	3.25	0.48	Open	C/D	0.00	0.02	0.01	1.03
			Forest	A/D		0.00	0.00	
			Forest	B		0.85	0.11	
			Forest	C		0.35	0.04	
			Highway	A/D	0.00		0.00	
			Highway	B	0.29		0.40	
			LDR	A/D		0.00	0.00	
			LDR	B	0.14	1.35	0.38	
			LDR	C	0.04	0.15	0.10	
			Open	A/D		0.00	0.00	
339	15.73	1.82	Open	B		0.07	0.01	4.84
			Forest	A		0.03	0.00	
			Forest	B		3.99	0.52	
			Forest	C		2.64	0.34	
			Forest	D		0.59	0.08	
			Forest			0.03	0.00	
			Highway	A	0.21		0.28	
			Highway		0.50		0.67	
			LDR	A	0.08	0.60	0.13	
			LDR	C	0.06	1.25	0.36	
			LDR		0.97	4.33	2.38	
			Open	A		0.18	0.01	
			Open	C		0.00	0.00	
			Open			0.30	0.06	
340	1.52	0.63	Forest			0.14	0.02	1.07
			Highway		0.37		0.49	
			LDR		0.27	0.65	0.54	
			Open			0.10	0.02	
341	0.94	0.16	Forest	A		0.21	0.03	0.26
			Forest	B/D		0.00	0.00	
			Highway	A	0.11		0.15	
			LDR	A	0.04	0.53	0.08	
			Open	A	0.00	0.04	0.00	
342	2.45	0.53	Forest	A		0.28	0.04	0.84
			Highway	A	0.30		0.40	
			LDR	A	0.24	1.54	0.41	
			Open	A		0.10	0.00	

Phosphorus Load Calculations - Merrimack River, Andover, MA

344	19.84	5.62	Forest	C		1.55	0.20	11.37
			Forest	D		0.20	0.03	
			Highway	C	1.78		2.38	
			Highway	D	0.71		0.96	
			LDR	C	2.22	9.60	5.39	
			LDR	D	0.91	2.53	2.32	
			Open	C		0.19	0.04	
			Open	D		0.14	0.05	
346	7.06	1.76	Forest	B		0.00	0.00	3.81
			Forest	C/D		0.15	0.02	
			HDR	A	0.03	0.08	0.08	
			HDR	B	0.01	0.02	0.04	
			HDR	C/D	0.05	0.35	0.23	
			Highway	B	0.00		0.00	
			Highway	C/D	0.78		1.04	
			LDR	A	0.13	1.04	0.23	
			LDR	B	0.05	0.17	0.09	
			LDR	C/D	0.71	3.42	2.07	
			Open	B		0.00	0.00	
Open	C/D		0.07	0.02				
347	2.76	0.81	Forest	C/D		0.07	0.01	1.46
			Highway	C/D	0.36		0.48	
			LDR	A	0.01	0.86	0.03	
			LDR	B	0.21	0.23	0.35	
			LDR	C/D	0.24	0.77	0.58	
			Open	C/D		0.01	0.00	
350	2.60	0.37	Forest	A		0.18	0.02	0.75
			Forest	B		0.58	0.08	
			HDR	A	0.01	0.04	0.02	
			HDR	B	0.03	0.05	0.07	
			Highway	A	0.00		0.00	
			Highway	B	0.12		0.16	
			LDR	A	0.15	0.98	0.26	
			LDR	B	0.06	0.38	0.14	
			Open	A		0.01	0.00	
Open	B		0.01	0.00				
351	0.66	0.20	Forest	A		0.11	0.01	0.29
			Highway	A	0.18		0.24	
			LDR	A	0.02	0.33	0.04	
			Open	A		0.02	0.00	
353	8.13	2.96	Forest	A		0.20	0.03	4.85
			Forest	B		0.21	0.03	
			HDR	A	0.00	0.00	0.00	
			HDR	B	0.20	0.43	0.52	
			Highway	A	0.74		1.00	
			Highway	B	0.51		0.69	
			LDR	A	0.75	2.18	1.21	
			LDR	B	0.74	1.81	1.33	
			Open	A		0.16	0.00	
			Open	B	0.01	0.19	0.03	
355	5.29	1.18	Forest	A		0.24	0.03	2.07
			Forest	B/D		0.01	0.00	
			Highway	A	0.43		0.58	
			Highway	B/D	0.04		0.05	
			LDR	A	0.48	2.36	0.79	
			LDR	B		0.37	0.04	
			LDR	B/D	0.23	1.00	0.55	
			Open	A		0.09	0.00	
Open	B/D		0.04	0.01				
360	2.45	0.54	Forest	A		0.23	0.03	0.86
			Forest	D		0.01	0.00	
			Highway	A	0.42		0.56	
			Highway	D	0.02		0.03	
			LDR	A	0.10	1.46	0.20	
			LDR	D		0.12	0.04	
Open	A		0.09	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

361	2.40	0.48	Forest	A		0.24	0.03	0.76
			Highway	A	0.27		0.36	
			LDR	A	0.21	1.64	0.37	
			Open	A		0.04	0.00	
362	5.48	1.00	Forest	A		0.67	0.09	1.63
			Highway	A	0.49		0.65	
			LDR	A	0.51	3.79	0.89	
			Open	A		0.02	0.00	
367	2.17	0.25	Forest			0.08	0.01	0.75
			Highway		0.16		0.22	
			LDR	A	0.00	0.02	0.00	
			LDR		0.09	1.73	0.50	
368	4.45	0.75	Forest	A		0.21	0.03	1.21
			Highway	A	0.35		0.47	
			Highway	B/D	0.00		0.00	
			LDR	A	0.40	3.36	0.71	
369	9.91	2.49	Open	A		0.12	0.00	3.84
			Forest	A		1.05	0.14	
			Highway	A	1.53		2.05	
			LDR	A	0.96	6.17	1.64	
372	4.24	1.59	Open	A		0.20	0.01	2.35
			Forest	A		0.29	0.04	
			Forest	C		0.01	0.00	
			Highway	A	1.02		1.37	
373	9.35	2.23	LDR	A	0.53	1.97	0.86	3.83
			LDR	C	0.04	0.04	0.07	
			Open	A	0.00	0.34	0.01	
			Forest	A		0.56	0.07	
			Forest	A/D		0.00	0.00	
			Forest	C		0.02	0.00	
			Highway	A	0.27		0.36	
			Highway	C	0.31		0.42	
			LDR	A	1.28	4.85	2.09	
			LDR	A/D	0.00	0.02	0.01	
374	3.37	1.13	LDR	B/D	0.00	0.02	0.01	2.09
			LDR	C	0.36	1.34	0.83	
			Open	A	0.00	0.20	0.01	
			Open	A/D	0.00		0.00	
			Open	C		0.12	0.02	
			Forest	B		0.01	0.00	
			Forest	C		0.19	0.02	
			Forest			0.07	0.01	
375	2.93	0.00	Highway	C	0.02		0.02	0.41
			Highway		0.44		0.60	
			LDR	C	0.25	0.67	0.52	
376	0.81	0.26	LDR		0.42	1.05	0.86	0.40
			Open	C		0.00	0.00	
			Open			0.24	0.05	
			Forest	B		0.86	0.11	
			Forest	C		1.71	0.22	
377	2.53	0.50	LDR	C		0.36	0.08	0.85
			Forest	A		0.10	0.01	
			Highway	A	0.14		0.18	
			LDR	A	0.10	0.41	0.17	
			LDR	B	0.02	0.02	0.04	
			LDR	D		0.00	0.00	
			Open	A		0.01	0.00	
Forest	A		0.04	0.00				
Forest	C		0.06	0.01				
Highway	A	0.05		0.07				
Highway	C	0.23		0.30				
LDR	A	0.19	1.51	0.33				
LDR	C	0.04	0.31	0.13				
Open	A		0.01	0.00				
Open	C		0.10	0.02				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

378	6.50	1.00	Forest	B		0.16	0.02	2.31
			Forest	C		0.58	0.07	
			Highway	B	0.20		0.27	
			Highway	C	0.33		0.44	
			LDR	B	0.34	2.43	0.81	
			LDR	B/D	0.02	0.52	0.14	
			LDR	C	0.11	1.75	0.54	
			Open	B		0.01	0.00	
379	0.38	0.16	Open	C		0.05	0.01	0.27
			Forest	B/D		0.00	0.00	
			Forest	C		0.01	0.00	
			Forest	D		0.12	0.02	
			Highway	B/D	0.02		0.03	
			Highway	C	0.02		0.02	
			Highway	D	0.12		0.17	
			LDR	C		0.02	0.00	
380	3.05	0.40	LDR	D		0.07	0.03	1.07
			Forest	B		0.32	0.04	
			Forest	C		0.00	0.00	
			Forest	D		0.18	0.02	
			Highway	B	0.10		0.14	
			Highway	D	0.13		0.18	
			LDR	B	0.09	1.37	0.29	
			LDR	C		0.04	0.01	
382	0.23	0.12	LDR	D	0.07	0.68	0.37	0.18
			Open	B		0.03	0.00	
			Open	D		0.03	0.01	
			Forest	B		0.06	0.01	
			Forest	D		0.05	0.01	
383	2.82	0.48	Highway	B	0.08		0.11	1.01
			Highway	D	0.04		0.06	
			Open	B	0.00		0.00	
			Forest	A		0.03	0.00	
			Forest	B		0.11	0.01	
			Forest	B/D		0.03	0.00	
			Forest	D		0.01	0.00	
			Highway	A	0.03		0.04	
			Highway	B	0.19		0.25	
			Highway	D	0.00		0.00	
			LDR	A	0.00	0.05	0.00	
			LDR	B	0.22	1.59	0.52	
			LDR	B/D	0.03	0.45	0.15	
LDR	D		0.00	0.00				
Open	A		0.01	0.00				
Open	B	0.00	0.07	0.01				
Open	D		0.00	0.00				
384	4.40	0.86	Open	D		0.00	0.00	1.81
			Forest	B		0.01	0.00	
			Forest	B/D		0.02	0.00	
			Forest	D		0.04	0.01	
			Highway	B	0.25		0.33	
			Highway	B/D	0.02		0.02	
			Highway	D	0.05		0.06	
			LDR	B	0.30	2.05	0.70	
			LDR	B/D	0.26	1.33	0.67	
			LDR	D		0.02	0.01	
			Open	B		0.05	0.01	
			Open	B/D		0.02	0.00	
Open	D		0.00	0.00				
Water	B		0.00	0.00				
Water	B/D		0.00	0.00				
385	7.61	0.91	Water	B		1.24	0.16	2.17
			Forest	B		0.08	0.01	
			Forest	B/D		0.08	0.01	
			Highway	B	0.34		0.45	
			Industrial	B		2.06	0.25	
			LDR	B	0.55	2.87	1.19	
LDR	B/D	0.01	0.40	0.10				
Open	B	0.00	0.06	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

386	0.64	0.19	Forest	A		0.02	0.00	0.28
			Highway	A	0.18		0.24	
			LDR	A	0.01	0.37	0.03	
			Open	A		0.05	0.00	
387	1.74	0.43	Forest	B		0.02	0.00	0.82
			Forest	B/D		0.50	0.06	
			Highway	B	0.03		0.04	
			Highway	B/D	0.22		0.30	
			LDR	B	0.10	0.16	0.17	
			LDR	B/D	0.08	0.57	0.24	
			Open	B		0.02	0.00	
			Open	B/D		0.05	0.01	
389	3.72	0.75	Forest	A		0.35	0.05	1.35
			Forest	A/D		0.01	0.00	
			Forest	B		0.10	0.01	
			Highway	A/D	0.00		0.00	
			Highway	B	0.32		0.43	
			LDR	A	0.12	1.05	0.21	
			LDR	A/D		0.00	0.00	
			LDR	B	0.31	1.31	0.62	
			Open	A/D		0.01	0.00	
Open	B		0.14	0.02				
390	5.55	1.51	Forest	C		0.21	0.03	3.04
			Forest	C/D		0.07	0.01	
			Highway	C	0.62		0.84	
			Highway	C/D	0.32		0.43	
			LDR	C	0.43	2.48	1.17	
			LDR	C/D	0.14	1.05	0.51	
			Open	C		0.17	0.04	
Open	C/D		0.06	0.02				
391	0.41	0.09	Forest	B		0.01	0.00	0.18
			Highway	B	0.02		0.03	
			LDR	A/D	0.00	0.12	0.03	
			LDR	B	0.05	0.16	0.10	
			LDR	C/D	0.01	0.02	0.03	
			Open	B		0.01	0.00	
394	7.21	0.62	Forest	C		0.01	0.00	2.66
			Forest	C/D		0.70	0.09	
			Highway	C	0.10		0.14	
			Highway	C/D	0.15		0.20	
			LDR	C	0.24	0.38	0.44	
			LDR	C/D	0.13	5.41	1.76	
			Open	C		0.03	0.01	
			Open	C/D		0.06	0.02	
395	3.43	0.41	Forest	C		0.01	0.00	1.34
			Forest	C/D		0.59	0.08	
			Forest	D		0.00	0.00	
			Highway	C	0.08		0.11	
			Highway	C/D	0.00		0.00	
			Highway	D	0.04		0.05	
			LDR	C	0.17	0.50	0.37	
			LDR	C/D	0.11	1.86	0.71	
			LDR	D		0.02	0.01	
			Open	C		0.03	0.01	
			Open	C/D		0.00	0.00	
Open	D		0.01	0.00				
396	2.29	0.68	Forest	C		0.03	0.00	1.29
			Forest	C/D		0.07	0.01	
			Highway	C	0.37		0.50	
			Highway	C/D	0.21		0.28	
			LDR	C	0.09	1.00	0.35	
			LDR	C/D	0.00	0.32	0.10	
			Open	C		0.12	0.03	
Open	C/D	0.01	0.07	0.03				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

397	1.40	0.51	Forest	C		0.04	0.01	0.90
			Forest	D		0.00	0.00	
			Highway	C	0.36		0.48	
			Highway	D	0.02		0.02	
			LDR	C	0.14	0.62	0.35	
			LDR	D		0.00	0.00	
			Open	C		0.20	0.04	
			Open	D		0.01	0.00	
400	7.22	1.53	Forest	C		0.25	0.03	3.55
			Forest	C/D		0.19	0.02	
			Highway	C	0.31		0.42	
			Highway	C/D	0.53		0.71	
			LDR	A	0.01	0.06	0.02	
			LDR	C	0.29	2.29	0.93	
			LDR	C/D	0.39	2.78	1.40	
			Open	C		0.09	0.02	
Open	C/D		0.02	0.01				
401	4.56	1.00	Forest	A		0.35	0.05	1.68
			Forest			0.06	0.01	
			Highway	A	0.44		0.59	
			Highway		0.18		0.24	
			LDR	A	0.30	2.24	0.52	
			LDR		0.08	0.62	0.26	
			Open	A		0.22	0.01	
			Open			0.06	0.01	
402	4.32	0.80	Forest	A		1.41	0.18	1.75
			Forest			0.28	0.04	
			Highway		0.40		0.54	
			LDR		0.40	1.57	0.93	
			Open	A		0.01	0.00	
			Open			0.25	0.05	
403	5.06	0.63	Forest	A		1.88	0.24	1.59
			Forest			0.34	0.04	
			Highway		0.38		0.51	
			LDR		0.25	1.50	0.69	
			Open	A		0.28	0.01	
			Open			0.43	0.09	
404	4.17	0.91	Forest	A		0.08	0.01	1.41
			Highway	A	0.45		0.60	
			LDR	A	0.46	3.13	0.80	
			Open	A		0.05	0.00	
405	3.75	0.77	Forest	C		0.21	0.03	1.72
			Forest	C/D		0.06	0.01	
			Highway	C	0.33		0.44	
			Highway	C/D	0.17		0.23	
			LDR	C	0.19	2.17	0.75	
			LDR	C/D	0.08	0.43	0.24	
			Open	C		0.05	0.01	
			Open	C/D		0.07	0.02	
407	7.26	0.72	Ag	C/D		0.12	0.05	2.52
			Forest	C		0.28	0.04	
			Forest	C/D		1.02	0.13	
			Highway	C	0.38		0.51	
			Industrial	C/D		0.41	0.12	
			LDR	C	0.33	2.42	1.01	
			LDR	C/D		2.16	0.63	
			Open	C		0.13	0.03	
Open	C/D		0.01	0.00				

Phosphorus Load Calculations - Merrimack River, Andover, MA

408	2.26	0.46	Forest	C		0.01	0.00	1.09
			Forest	C/D		0.14	0.02	
			Forest	D		0.01	0.00	
			Highway	C	0.24		0.32	
			Highway	C/D	0.04		0.05	
			LDR	C	0.11	0.63	0.29	
			LDR	C/D	0.09	0.87	0.38	
			LDR	D		0.00	0.00	
			Open	C		0.11	0.02	
			Open	C/D		0.02	0.01	
409	3.02	1.15	Open	D		0.00	0.00	2.10
			Forest	C		0.06	0.01	
			Forest	C/D		0.03	0.00	
			Highway	A	0.02		0.03	
			Highway	C	0.70		0.94	
			Highway	C/D	0.13		0.18	
			LDR	C	0.26	0.87	0.58	
			LDR	C/D		0.08	0.02	
			LDR	D	0.03	0.75	0.33	
			Open	A		0.04	0.00	
410	7.97	1.37	Open	C		0.03	0.01	3.40
			Open	C/D		0.01	0.00	
			Forest	C		1.19	0.15	
			Forest	C/D		0.02	0.00	
			Forest	D		0.17	0.02	
			Highway	C	0.33		0.44	
			Highway	C/D	0.20		0.27	
			LDR	C	0.56	3.59	1.61	
			LDR	C/D	0.24	0.96	0.64	
			LDR	D	0.04	0.34	0.19	
414	6.44	1.11	Open	C		0.23	0.05	2.76
			Open	C/D		0.08	0.02	
			Forest	B		0.07	0.01	
			Forest	C		0.13	0.02	
			Forest	D		1.45	0.19	
			Highway	C	0.49		0.66	
			Industrial	B	0.03	0.24	0.08	
			Industrial	C	0.05	0.32	0.16	
			Industrial	D	0.04	0.15	0.12	
			LDR	C	0.49	1.81	1.12	
416	2.04	0.64	LDR	D	0.01	0.92	0.36	0.98
			Open	C		0.25	0.05	
			Forest	A		0.10	0.01	
			Forest	B		0.06	0.01	
			Highway	A	0.27		0.36	
			Highway	B	0.18		0.24	
			LDR	A	0.11	0.70	0.19	
			LDR	B	0.08	0.39	0.16	
			Open	A		0.14	0.00	
			Open	B		0.02	0.00	
417	0.72	0.30	Open	C		0.08	0.02	0.43
			Open	C/D		0.01	0.00	
			Forest	A		0.16	0.02	
			Forest	B		0.01	0.00	
			Highway	A	0.28		0.37	
			Highway	B	0.00		0.00	
			LDR	A	0.01	0.15	0.03	
			LDR	B		0.04	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

418	23.46	2.59	Forest	A		0.13	0.02	7.65
			Forest	C		8.07	1.05	
			Forest	C/D		0.17	0.02	
			Forest	D		0.04	0.01	
			Highway	A	0.47		0.63	
			Highway	C	0.44		0.59	
			Highway	C/D	0.40		0.53	
			Highway	D	0.23		0.30	
			Industrial	C	0.01	0.28	0.08	
			LDR	A	0.29	1.55	0.49	
			LDR	C	0.27	4.00	1.25	
			LDR	C/D	0.22	2.44	1.04	
			LDR	D	0.26	2.35	1.26	
			Open	A		0.14	0.00	
			Open	C		1.54	0.32	
Open	C/D		0.10	0.03				
Open	D		0.07	0.03				
419	4.94	0.87	Forest	A		0.11	0.01	1.68
			Forest	B/D		0.61	0.08	
			Highway	A	0.31		0.42	
			Highway	B/D	0.17		0.23	
			LDR	A	0.31	1.94	0.53	
			LDR	B/D	0.08	1.38	0.40	
			Open	A		0.01	0.00	
Open	B/D		0.02	0.00				
420	0.94	0.23	Forest	A		0.12	0.02	0.35
			Highway	A	0.21		0.28	
			LDR	A	0.02	0.58	0.05	
			LDR	B/D		0.00	0.00	
Open	A		0.01	0.00				
421	1.50	0.29	Forest	A		0.15	0.02	0.48
			Highway	A	0.20		0.27	
			LDR	A	0.08	0.83	0.14	
			LDR	B/D	0.01	0.18	0.05	
			Open	A		0.05	0.00	
422	2.27	0.44	Forest	A		0.32	0.04	0.70
			Highway	A	0.37		0.50	
			LDR	A	0.07	1.49	0.15	
			Open	A		0.02	0.00	
423	0.75	0.26	Forest	A		0.01	0.00	0.43
			Forest			0.04	0.01	
			Highway	A	0.04		0.06	
			Highway		0.19		0.26	
			LDR	A	0.00	0.10	0.01	
			LDR		0.02	0.31	0.09	
Open			0.02	0.00				
424	6.67	1.15	Forest	A		0.86	0.11	2.05
			Forest	B		0.51	0.07	
			Highway	A	0.51		0.68	
			Highway	B	0.12		0.16	
			LDR	A	0.29	2.82	0.53	
			LDR	B	0.23	1.33	0.51	
Open	B		0.00	0.00				
426	2.59	0.57	Forest	B		0.01	0.00	1.44
			Forest	C/D		0.02	0.00	
			Forest	D		0.04	0.00	
			Highway	B	0.07		0.10	
			Highway	C/D	0.06		0.08	
			Highway	D	0.08		0.11	
			LDR	B	0.00	0.03	0.01	
			LDR	C		0.01	0.00	
			LDR	C/D	0.30	1.22	0.82	
			LDR	D	0.04	0.65	0.31	
			Open	B		0.02	0.00	
			Open	C		0.00	0.00	
Open	C/D		0.01	0.00				
Open	D		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

428	9.19	1.73	Forest	A		0.09	0.01	3.29
			Forest	B		0.22	0.03	
			Forest			0.04	0.01	
			Highway	A	0.18		0.24	
			Highway	B	0.47		0.63	
			Highway		0.24		0.32	
			LDR	A	0.25	2.04	0.44	
			LDR	B	0.42	3.81	1.10	
			LDR		0.17	1.17	0.50	
			Open	A		0.01	0.00	
			Open	B		0.01	0.00	
429	0.86	0.35	Open			0.08	0.02	0.63
			Forest	C/D		0.05	0.01	
			Highway	C/D	0.24		0.32	
			LDR	C/D	0.11	0.39	0.29	
430	4.76	1.00	Open	C/D		0.07	0.02	1.58
			Forest	A		0.10	0.01	
			Highway	A	0.38		0.50	
			LDR	A	0.63	3.53	1.06	
431	0.30	0.27	Open	A		0.13	0.00	0.37
			Forest	A		0.00	0.00	
			Forest	D		0.00	0.00	
			Highway	A	0.17		0.23	
			Highway	D	0.10		0.14	
			Open	A		0.01	0.00	
			Open	D		0.02	0.01	
432	0.81	0.48	Open	A		0.03	0.00	0.74
			Forest	A		0.08	0.01	
			HDR	A	0.06	0.08	0.14	
			Highway	A	0.32		0.44	
			LDR	A	0.10	0.13	0.16	
435	5.37	0.96	Open	C		0.33	0.04	2.25
			Forest	C		0.33	0.04	
			Highway	C	0.61		0.82	
			LDR	C	0.35	4.06	1.38	
436	10.04	1.69	Open	C		0.02	0.00	4.14
			Forest	B		0.32	0.04	
			Forest	C/D		0.02	0.00	
			Forest	D		0.26	0.03	
			Highway	B	0.71		0.95	
			Highway	C/D	0.05		0.07	
			Highway	D	0.06		0.08	
			LDR	B	0.58	4.79	1.46	
			LDR	C/D		0.03	0.01	
			LDR	D	0.29	2.83	1.49	
437	1.39	0.45	Open	B		0.10	0.01	0.66
			Commercial	A		0.57	0.02	
			Forest	A		0.13	0.02	
			Highway	A	0.38		0.51	
			LDR	A	0.04	0.17	0.06	
438	1.67	0.38	Open	A		0.04	0.06	0.61
			Commercial	A	0.06	0.50	0.13	
			Forest	A		0.10	0.01	
			Highway	A	0.18		0.24	
			LDR	A	0.13	0.62	0.21	
439	1.46	0.39	Open	A		0.01	0.01	0.66
			Commercial	A	0.23	0.77	0.44	
			Forest	A		0.07	0.01	
			Highway	A	0.15		0.20	
			LDR	A	0.00	0.19	0.01	
			Open	A		0.04	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

441	10.16	1.74	Forest	B		0.12	0.02	4.12
			Forest	C		0.32	0.04	
			Forest	C/D		0.40	0.05	
			Highway	B	0.17		0.23	
			Highway	C	0.83		1.12	
			Highway	C/D	0.27		0.36	
			LDR	B	0.00	0.24	0.03	
			LDR	C	0.47	7.03	2.19	
			LDR	C/D	0.00	0.27	0.08	
			Open	B		0.00	0.00	
			Open	C		0.02	0.00	
442	11.30	2.53	Open	C/D		0.01	0.00	5.60
			Forest	A/D		0.07	0.01	
			Forest	B		0.00	0.00	
			Forest	C		0.34	0.04	
			Forest	C/D		0.40	0.05	
			Highway	A/D	0.42		0.56	
			Highway	B	0.09		0.11	
			Highway	C	0.44		0.59	
			Highway	C/D	0.72		0.97	
			LDR	A/D	0.09	1.07	0.37	
			LDR	B	0.01	0.09	0.03	
			LDR	C	0.42	3.06	1.28	
			LDR	C/D	0.34	3.47	1.52	
			Open	A/D	0.00	0.10	0.02	
Open	B		0.00	0.00				
Open	C		0.04	0.01				
Open	C/D		0.12	0.04				
443	4.57	0.95	Forest	A		0.34	0.04	1.50
			Forest	B		0.02	0.00	
			Highway	A	0.36		0.49	
			Highway	B	0.20		0.26	
			LDR	A	0.37	2.94	0.65	
			LDR	B	0.01	0.09	0.03	
			Open	A		0.17	0.00	
Open	B		0.07	0.01				
444	2.21	0.55	Forest	A		0.22	0.03	0.84
			Highway	A	0.34		0.45	
			LDR	A	0.21	1.40	0.36	
			Open	A		0.04	0.00	
445	0.36	0.02	Forest	A		0.02	0.00	0.04
			Highway	A	0.01		0.01	
			LDR	A	0.01	0.33	0.03	
446	4.44	0.64	Open	A		0.00	0.00	1.71
			Forest	C		0.10	0.01	
			Highway	C	0.31		0.42	
			LDR	C	0.33	3.70	1.28	

Phosphorus Load Calculations - Merrimack River, Andover, MA

450	15.96	2.86	Forest	A		0.77	0.10	6.47
			Forest	A/D		1.83	0.24	
			Forest	B		0.01	0.00	
			Forest	B/D		0.03	0.00	
			Forest	C		0.44	0.06	
			Forest	C/D		0.41	0.05	
			Forest	D		0.00	0.00	
			Highway	A	0.23		0.31	
			Highway	A/D	0.03		0.04	
			Highway	B	0.18		0.25	
			Highway	B/D	0.23		0.31	
			Highway	C	0.39		0.52	
			Highway	C/D	0.56		0.76	
			Industrial	A	0.28	0.25	0.50	
			Industrial	B/D	0.11	0.05	0.20	
			Industrial	C/D	0.37	1.05	0.96	
			Industrial	D	0.08	0.22	0.23	
			LDR	A	0.03	1.71	0.10	
			LDR	A/D		0.29	0.06	
			LDR	B	0.10	1.86	0.37	
			LDR	B/D		1.31	0.28	
			LDR	C	0.00	1.23	0.26	
			LDR	C/D	0.25	0.96	0.66	
			LDR	D		0.31	0.11	
			Open	A		0.01	0.00	
Open	A/D	0.01		0.01				
Open	B		0.00	0.00				
Open	B/D		0.03	0.01				
Open	C	0.01	0.19	0.06				
Open	C/D		0.14	0.04				
452	12.90	1.50	Commercial	C/D	0.15	0.33	0.37	5.81
			Commercial	D	0.08	0.83	0.46	
			Forest	C/D		0.11	0.01	
			Forest	D		0.01	0.00	
			HDR	C/D	0.01	0.08	0.03	
			Highway	C/D	0.40		0.53	
			Highway	D	0.17		0.23	
			Industrial	C/D	0.36	1.59	1.11	
			Industrial	D		0.17	0.06	
			LDR	C/D	0.26	6.85	2.38	
			LDR	D	0.07	1.23	0.56	
			Open	C/D		0.15	0.04	
Open	D		0.05	0.02				
453	0.60	0.51	Forest	A		0.01	0.00	0.71
			Forest	A/D		0.01	0.00	
			Forest	C/D		0.03	0.00	
			HDR	A		0.00	0.00	
			HDR	A/D		0.00	0.00	
			HDR	C/D		0.03	0.01	
			Highway	A	0.11		0.14	
			Highway	A/D	0.12		0.16	
Highway	C/D	0.28		0.38				
LDR	A/D	0.01	0.00	0.01				

Phosphorus Load Calculations - Merrimack River, Andover, MA

454	74.15	14.90	Ag	C/D		0.67	0.30	37.00
			Forest	A		0.06	0.01	
			Forest	A/D		0.04	0.01	
			Forest	C		2.63	0.34	
			Forest	C/D		5.18	0.67	
			Forest	D		3.80	0.49	
			HDR	C	0.36	1.78	1.22	
			HDR	C/D	0.31	1.39	1.11	
			HDR	D		1.76	0.65	
			Highway	A	0.29		0.39	
			Highway	A/D	0.14		0.19	
			Highway	C	2.29		3.07	
			Highway	C/D	5.67		7.60	
			Highway	D	0.07		0.09	
			LDR	A/D	0.01	0.06	0.02	
			LDR	C	1.04	3.87	2.39	
			LDR	C/D	4.44	30.72	15.66	
			LDR	D	0.21	4.63	2.03	
			Open	A		0.39	0.01	
			Open	A/D	0.00		0.00	
Open	C	0.05	0.44	0.17				
Open	C/D	0.00	1.74	0.51				
Open	D	0.02	0.09	0.07				
460	1.32	0.31	Forest	C		0.09	0.01	0.66
			Forest	C/D		0.01	0.00	
			Highway	C	0.26		0.34	
			Highway	C/D	0.03		0.04	
			LDR	C	0.01	0.52	0.12	
464	1.50	0.31	LDR	C/D	0.02	0.36	0.14	0.75
			Open	C		0.03	0.01	
			Forest	C/D		0.07	0.01	
465	6.96	1.41	Highway	C/D	0.26		0.35	2.21
			LDR	C/D	0.04	1.03	0.36	
			Open	C/D		0.09	0.03	
			Forest	A		0.73	0.10	
467	4.89	1.15	Highway	A	0.91		1.22	1.98
			LDR	A	0.50	4.54	0.89	
			Open	A		0.29	0.01	
			Forest	A		0.25	0.03	
			Forest	B		0.08	0.01	
			HDR	A	0.01	0.03	0.03	
			Highway	A	0.41		0.55	
			Highway	B	0.00		0.00	
			LDR	A	0.52	1.67	0.83	
468	1.48	0.57	LDR	B	0.21	1.65	0.52	0.91
			Open	A		0.04	0.00	
			Open	B		0.02	0.00	
			Forest	A		0.03	0.00	
			Forest	B		0.06	0.01	
			Forest	D		0.07	0.01	
			Highway	A	0.00		0.00	
Highway	B	0.39		0.52				
469	4.03	0.30	LDR	A		0.00	0.00	1.42
			LDR	B	0.17	0.70	0.35	
			LDR	D		0.05	0.02	
			Forest	A		0.02	0.00	
			Forest	C		0.51	0.07	
			Forest	C/D		0.11	0.01	
			Forest	D		0.13	0.02	
			HDR	C	0.05	0.64	0.26	
			Highway	A/D	0.07		0.09	
			Highway	C	0.10		0.13	
			LDR	A/D		0.04	0.01	
469	4.03	0.30	LDR	C		0.02	0.00	1.42
			LDR	C/D	0.08	1.76	0.64	
			LDR	D		0.51	0.19	
			Open	C		0.00	0.00	
			Open	C		0.00	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

471	25.25	2.64	Forest	C		3.48	0.45	9.28
			Forest	C/D		0.18	0.02	
			Forest	D		1.08	0.14	
			HDR	C	0.05	0.23	0.16	
			HDR	C/D		0.06	0.02	
			Highway	C	0.55		0.74	
			Highway	C/D	0.87		1.17	
			LDR	C	0.55	7.10	2.32	
			LDR	C/D	0.57	6.66	2.80	
			LDR	D	0.05	3.52	1.38	
			Open	C		0.12	0.02	
Open	C/D	0.00	0.18	0.05				
472	1.52	0.64	Forest	B		0.07	0.01	1.00
			Highway	B	0.44		0.59	
			LDR	A/D		0.02	0.00	
			LDR	B	0.20	0.74	0.39	
474	29.47	5.71	Open	B		0.05	0.01	13.30
			Forest	C		0.87	0.11	
			Forest	D		0.17	0.02	
			Highway	C	2.58		3.46	
			Highway	D	0.47		0.63	
			LDR	C	2.57	20.64	8.25	
			LDR	D	0.09	1.46	0.68	
			Open	C		0.51	0.11	
Open	D		0.11	0.04				
475	21.26	3.36	Forest	B		0.72	0.09	7.49
			Forest	C		0.24	0.03	
			Highway	B	1.64		2.19	
			Highway	C	0.59		0.79	
			LDR	B	0.69	10.36	2.30	
			LDR	C	0.42	6.07	1.92	
			LDR	C/D	0.02	0.40	0.15	
			Open	B		0.03	0.00	
Open	C		0.08	0.02				
476	4.14	2.02	Commercial	A	0.15	0.06	0.26	3.29
			Forest	A		0.14	0.02	
			HDR	A	0.36	0.48	0.84	
			Highway	A	0.99		1.33	
			LDR	A	0.52	1.34	0.83	
			Open	A	0.00	0.11	0.01	
477	5.96	2.06	Forest	A		0.13	0.02	3.08
			Highway	A	0.99		1.32	
			LDR	A	1.07	3.49	1.73	
			Open	A		0.29	0.01	
478	9.45	1.50	Forest	B		0.26	0.03	3.57
			Forest	C		0.17	0.02	
			Forest	C/D		0.12	0.02	
			Highway	B	0.46		0.61	
			Highway	C	0.11		0.15	
			Highway	C/D	0.21		0.28	
			LDR	B	0.49	4.23	1.25	
			LDR	C	0.08	0.91	0.31	
			LDR	C/D	0.16	2.20	0.88	
			Open	B		0.00	0.00	
			Open	C		0.00	0.00	
Open	C/D		0.04	0.01				
479	4.85	1.31	Forest	A		0.48	0.06	1.97
			Forest			0.01	0.00	
			Highway	A	0.91		1.22	
			Highway		0.01		0.02	
			LDR	A	0.38	2.97	0.67	
Open	A		0.09	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

480	3.73	0.69	Forest	B		0.34	0.04	1.33
			Forest	C		0.02	0.00	
			Highway	B	0.48		0.64	
			Highway	C	0.07		0.10	
			LDR	A	0.00	0.11	0.01	
			LDR	B	0.13	2.29	0.47	
			LDR	C	0.01	0.24	0.06	
			Open	B		0.04	0.00	
481	0.90	0.35	Forest	A		0.00	0.00	0.55
			Forest	B/D		0.02	0.00	
			Highway	B/D	0.08		0.11	
			LDR	A	0.22	0.34	0.35	
			LDR	B	0.04	0.15	0.08	
			LDR	B/D	0.00	0.03	0.01	
483	7.67	0.96	Open	B/D		0.02	0.00	2.59
			Forest	C		2.79	0.36	
			Forest	C/D		0.03	0.00	
			Highway	C	0.43		0.58	
			Highway	C/D	0.04		0.06	
			Industrial	C	0.12	0.72	0.36	
			LDR	C	0.36	2.68	1.11	
			LDR	C/D		0.03	0.01	
484	14.20	1.87	Open	C		0.48	0.10	5.55
			Forest	C/D		0.27	0.04	
			Forest	D		0.07	0.01	
			Highway	C/D	0.79		1.06	
			Highway	D	0.15		0.20	
			LDR	B		3.91	0.47	
			LDR	C/D	0.93	7.69	3.64	
			LDR	D	0.00	0.27	0.10	
486	2.19	0.46	Open	C/D		0.10	0.03	1.13
			Open	D		0.01	0.00	
			Forest	C/D		0.19	0.02	
			Highway	C/D	0.27		0.36	
488	4.07	0.97	LDR	C/D	0.19	1.50	0.72	1.52
			Open	C/D		0.04	0.01	
			Forest	A		0.17	0.02	
			Forest	B		0.03	0.00	
			Highway	A	0.37		0.50	
			Highway	B	0.09		0.13	
			LDR	A	0.48	2.67	0.81	
			LDR	B	0.03	0.11	0.06	
489	3.00	0.63	Open	A		0.10	0.00	1.53
			Open	B		0.02	0.00	
			Forest	C/D		0.41	0.05	
			Highway	C/D	0.27		0.36	
			LDR	C/D	0.36	1.84	1.08	
490	8.33	1.59	LDR	D		0.02	0.01	2.56
			Open	C/D		0.11	0.03	
			Forest	A		0.52	0.07	
			Highway	A	0.60		0.81	
491	4.64	0.80	LDR	A	0.99	6.02	1.68	1.81
			Open	A		0.20	0.01	
			Forest	A		0.08	0.01	
			Forest	C		0.85	0.11	
			Highway	A	0.20		0.27	
			Highway	C	0.27		0.36	
			LDR	A	0.04	0.26	0.07	
			LDR	C	0.29	2.50	0.96	
492	1.39	0.34	Open	A		0.06	0.00	0.57
			Open	C		0.08	0.02	
			Forest	A		0.03	0.00	
			Forest	C		0.03	0.00	
			Highway	A	0.25		0.34	
LDR	A	0.09	0.57	0.16				
LDR	C		0.34	0.07				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

493	4.88	0.51	Open	A		0.08	0.00	1.37
			Forest	B		0.67	0.09	
			Forest	B/D		0.06	0.01	
			Forest	C		0.22	0.03	
			Highway	B	0.21		0.29	
			Highway	B/D	0.09		0.13	
			LDR	B	0.16	2.07	0.49	
			LDR	B/D	0.04	0.91	0.25	
			LDR	C		0.43	0.09	
			Open	B	0.00	0.01	0.01	
494	3.03	0.96	Open	B/D		0.01	0.00	1.64
			Forest	B		0.11	0.01	
			Highway	B	0.53		0.72	
			LDR	B	0.43	1.61	0.85	
495	10.63	1.13	LDR	C	0.00	0.22	0.05	3.02
			Open	B	0.00	0.12	0.01	
			Forest	A		0.72	0.09	
			Forest	A/D		0.05	0.01	
			Forest	C		1.62	0.21	
			Highway	A	0.23		0.31	
			Highway	A/D	0.30		0.41	
			Highway	C	0.02		0.02	
			LDR	A	0.15	1.10	0.26	
			LDR	A/D	0.18	0.61	0.41	
496	4.85	1.37	LDR	C	0.24	2.02	0.79	2.10
			Open	A		1.12	0.03	
			Open	A/D		0.09	0.02	
			Open	C		2.16	0.45	
497	1.67	0.43	Forest	A		0.37	0.05	0.85
			Highway	A	0.66		0.89	
			LDR	A	0.70	2.97	1.16	
498	1.31	0.45	Open	A		0.14	0.00	0.76
			Forest	C		0.09	0.01	
			Highway	C	0.33		0.44	
			LDR	C	0.10	1.08	0.37	
			Open	C		0.07	0.01	
			Forest	A		0.04	0.01	
			Forest			0.07	0.01	
500	9.03	1.46	Highway	A	0.10		0.13	3.24
			Highway		0.24		0.32	
			LDR	A	0.00	0.16	0.01	
			LDR		0.11	0.48	0.27	
			Open	A		0.03	0.00	
			Open			0.08	0.02	
			Forest	A		0.08	0.01	
			Forest	B		0.16	0.02	
			Forest	C		1.23	0.16	
			Highway	A	0.18		0.24	
501	2.02	0.24	Highway	B	0.27		0.36	0.55
			Highway	C	0.29		0.38	
			Industrial	C		0.51	0.11	
			LDR	A	0.29	1.29	0.49	
			LDR	B	0.17	0.75	0.35	
			LDR	C	0.27	3.02	1.04	
			Open	A		0.09	0.00	
Open	B		0.13	0.02				
502	5.90	1.62	Open	C		0.30	0.06	2.46
			Forest	A/D		0.01	0.00	
			Forest	B		0.01	0.00	
			Highway	A/D	0.01		0.01	
			Highway	B	0.12		0.16	
502	5.90	1.62	LDR	B	0.12	1.75	0.39	2.46
			Open	B		0.01	0.00	
			Forest	A		0.16	0.02	
			Forest	C		0.03	0.00	
502	5.90	1.62	Highway	A	0.82		1.10	2.46
			Highway	C	0.02		0.02	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			LDR	A	0.78	3.93	1.30	
			Open	A	0.00	0.15	0.01	
503	8.38	1.61	Forest	B		0.27	0.04	3.20
			Forest	C/D		0.14	0.02	
			Forest	D		0.16	0.02	
			Highway	B	0.65		0.87	
			Highway	C/D	0.17		0.23	
			Highway	D	0.22		0.29	
			LDR	B	0.55	5.53	1.49	
			LDR	C/D	0.01	0.32	0.11	
			LDR	D	0.01	0.20	0.09	
			Open	B		0.04	0.01	
			Open	C/D		0.05	0.01	
			Open	D		0.06	0.02	
			504	2.20	0.58	Forest	C	
Forest	C/D					0.02	0.00	
Highway	C	0.32					0.42	
Highway	C/D	0.06					0.08	
LDR	C	0.12				1.16	0.43	
LDR	C/D	0.08				0.27	0.20	
Open	C					0.06	0.01	
505	6.65	1.23	Open	C/D		0.03	0.01	2.42
			Forest	B		0.22	0.03	
			Highway	B	0.56		0.75	
			LDR	B	0.67	5.10	1.63	
506	10.28	1.51	Open	B		0.10	0.01	3.22
			Forest	B		0.80	0.10	
			Highway	B	0.79		1.06	
			LDR	B	0.72	7.95	2.05	
508	1.18	0.29	Open	B	0.00	0.01	0.00	0.50
			Forest	A		0.10	0.01	
			Forest	A/D		0.00	0.00	
			Highway	A	0.16		0.22	
			Highway	A/D	0.02		0.03	
			LDR	A	0.08	0.40	0.14	
			LDR	A/D		0.00	0.00	
			LDR		0.02	0.32	0.10	
510	6.05	1.79	Open	A		0.06	0.00	3.21
			Open	A/D		0.00	0.00	
			Forest	B		0.29	0.04	
			Forest	B/D		0.39	0.05	
			Highway	B	0.62		0.84	
			Highway	B/D	0.43		0.58	
			LDR	B	0.48	1.86	0.96	
			LDR	B/D	0.22	1.62	0.68	
511	3.90	0.79	LDR	D	0.02	0.04	0.05	1.50
			Open	B		0.02	0.00	
			Open	B/D	0.00	0.05	0.01	
			Forest	B		0.34	0.04	
512	1.35	0.13	Highway	B	0.43		0.58	0.33
			LDR	B	0.36	2.70	0.87	
			Open	B		0.06	0.01	
			Forest	B		0.97	0.13	
513	4.73	0.62	Highway	B	0.13		0.17	1.39
			LDR	B		0.25	0.03	
			Open	B	0.00	0.01	0.00	
			Forest	B		2.40	0.31	
			Highway	B	0.42		0.56	
			LDR	B	0.20	1.61	0.50	
			Open	B		0.09	0.01	

Phosphorus Load Calculations - Merrimack River, Andover, MA

514	15.89	2.08	Forest	B		0.17	0.02	6.87
			Forest	C		0.00	0.00	
			Forest	C/D		0.45	0.06	
			Forest	D		0.81	0.11	
			Highway	B	0.19		0.25	
			Highway	C	0.01		0.01	
			Highway	C/D	0.24		0.32	
			Highway	D	0.23		0.31	
			LDR	B	0.29	2.17	0.70	
			LDR	C	0.15	1.02	0.44	
			LDR	C/D	0.35	2.72	1.32	
			LDR	D	0.63	6.30	3.29	
			Open	B		0.02	0.00	
			Open	C		0.00	0.00	
Open	C/D		0.08	0.02				
Open	D		0.05	0.02				
515	5.89	0.65	Forest	B		0.36	0.05	1.60
			Forest	D		0.70	0.09	
			Highway	B	0.39		0.52	
			LDR	B	0.25	3.91	0.85	
			LDR	D	0.01	0.12	0.06	
			Open	B		0.10	0.01	
Open	D		0.04	0.01				
516	1.49	0.62	Forest	A		0.01	0.00	0.96
			Forest	B		0.01	0.00	
			Highway	A	0.08		0.10	
			Highway	B	0.35		0.46	
			LDR	A		0.04	0.00	
			LDR	B	0.20	0.69	0.38	
			Open	A		0.03	0.00	
Open	B		0.10	0.01				
517	2.07	0.64	Forest	B		0.00	0.00	1.14
			Highway	B	0.36		0.49	
			LDR	B	0.28	1.02	0.55	
			LDR	C/D		0.34	0.10	
Open	B		0.06	0.01				
520	10.12	1.58	Commercial			0.39	0.08	3.33
			Forest	A		0.03	0.00	
			Forest			0.11	0.01	
			HDR	A		1.07	0.03	
			HDR			1.09	0.23	
			Highway	A	0.15		0.20	
			Highway			0.45	0.61	
			LDR	A	0.46	3.02	0.79	
			LDR			0.52	2.59	
			Open	A		0.10	0.00	
Open			0.14	0.03				
521	38.44	10.20	Forest	A		4.04	0.52	16.35
			Forest	B		0.14	0.02	
			HDR	A	0.54	2.25	1.32	
			HDR	B	0.10	0.05	0.24	
			HDR	B/D	0.03	0.23	0.11	
			Highway	A	5.84		7.83	
			Highway	B	0.35		0.46	
			LDR	A	3.05	17.97	5.17	
			LDR	B	0.30	1.27	0.61	
			Open	A		2.25	0.07	
Open	B		0.03	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

522	1.92	0.83	Commercial		0.16	0.03	0.29	1.38
			Forest	A		0.02	0.00	
			Forest	B		0.14	0.02	
			Forest			0.04	0.01	
			HDR	A	0.02	0.15	0.05	
			HDR	B		0.01	0.00	
			Highway	B	0.13		0.17	
			Highway		0.09		0.11	
			LDR	A	0.08	0.19	0.13	
			LDR	B	0.09	0.45	0.19	
			LDR		0.02	0.05	0.04	
			Open	A	0.21	0.00	0.31	
			Open	B	0.00	0.00	0.00	
Open		0.04	0.00	0.06				
524	7.23	1.56	Forest	A		0.01	0.00	3.34
			Forest	B		0.13	0.02	
			Forest	C/D		0.10	0.01	
			Forest			0.01	0.00	
			Highway	A	0.13		0.18	
			Highway	B	0.35		0.47	
			Highway	C/D	0.24		0.32	
			Highway		0.08		0.10	
			LDR	A	0.04	0.19	0.06	
			LDR	B	0.43	2.36	0.94	
			LDR	C/D	0.28	2.47	1.15	
			LDR		0.00	0.11	0.02	
			Open	A		0.03	0.00	
Open	B		0.12	0.01				
Open	C/D		0.08	0.02				
Open			0.05	0.01				
525	12.77	3.19	Forest	A		0.92	0.12	5.25
			Forest			0.01	0.00	
			Highway	A	1.35		1.81	
			Highway		0.13		0.18	
			LDR	A	1.55	6.48	2.54	
			LDR		0.16	1.54	0.57	
Open	A	0.00	0.59	0.02				
Open			0.05	0.01				
528	13.27	1.48	Forest	A		0.12	0.02	3.90
			Forest	B		0.17	0.02	
			Forest	B/D		1.18	0.15	
			Forest	C		0.58	0.08	
			Forest	C/D		0.02	0.00	
			Highway	A	0.40		0.53	
			Highway	B	0.19		0.26	
			Highway	C	0.06		0.08	
			LDR	A	0.20	1.09	0.34	
			LDR	A/D	0.04	0.04	0.07	
			LDR	B	0.17	4.10	0.75	
			LDR	B/D	0.37	3.05	1.20	
			LDR	C		0.15	0.03	
LDR	C/D		0.55	0.16				
Open	A		0.08	0.00				
Open	B		0.07	0.01				
Open	B/D		0.51	0.11				
Open	C	0.05	0.08	0.09				
530	3.31	0.90	Forest	A		0.93	0.12	1.42
			Forest	B		0.07	0.01	
			Highway	A	0.69		0.92	
			Highway	B	0.10		0.13	
			LDR	A	0.11	0.56	0.19	
			LDR	B		0.00	0.00	
Open	A		0.51	0.02				
Open	B		0.34	0.04				
533	2.85	0.69	Forest	C/D		0.23	0.03	1.56
			Highway	C/D	0.42		0.56	
			LDR	C/D	0.27	1.84	0.95	

Phosphorus Load Calculations - Merrimack River, Andover, MA

538	4.64	0.75	Open	C/D		0.09	0.03	1.96
			Forest	B		0.00	0.00	
			Forest	B/D		0.25	0.03	
			Forest	D		1.14	0.15	
			Highway	B/D	0.34		0.46	
			Highway	D	0.07		0.09	
			LDR	B/D	0.27	1.24	0.68	
			LDR	D	0.06	1.18	0.54	
			Open	B/D		0.05	0.01	
Open	D		0.03	0.01				
539	21.63	6.31	Forest	A		0.21	0.03	12.08
			Forest	C/D		3.98	0.52	
			Forest	D		0.00	0.00	
			Forest			0.50	0.06	
			HDR	C/D		0.37	0.11	
			Highway	A	0.54		0.72	
			Highway	C/D	2.63		3.53	
			Highway	D	0.01		0.02	
			Highway		2.83		3.79	
			LDR	C/D	0.30	4.95	1.89	
			LDR	D		0.00	0.00	
			LDR			0.15	0.03	
			Open	A		0.27	0.01	
			Open	C/D		4.30	1.25	
Open	D		0.00	0.00				
Open			0.58	0.12				
540	2.20	0.35	Forest	C/D		0.01	0.00	1.07
			HDR	C/D	0.05	0.21	0.19	
			Highway	C/D	0.21		0.28	
			LDR	C/D	0.09	1.52	0.58	
			Open	C/D		0.11	0.03	
541	1.74	0.44	Forest	A		0.17	0.02	0.68
			Highway	A	0.25		0.34	
			LDR	A	0.19	1.06	0.32	
			Open	A		0.06	0.00	
542	7.25	1.09	Forest	A		0.20	0.03	2.91
			Forest	B/D		0.22	0.03	
			Forest	C/D		0.68	0.09	
			Highway	A	0.25		0.34	
			Highway	B	0.02		0.02	
			Highway	B/D	0.38		0.51	
			Highway	C	0.00		0.00	
			LDR	A	0.03	0.21	0.05	
			LDR	B/D	0.11	1.40	0.47	
			LDR	C	0.10	0.26	0.20	
			LDR	C/D	0.20	2.91	1.15	
			Open	A		0.19	0.01	
Open	B		0.00	0.00				
Open	B/D		0.07	0.01				
Open	C/D		0.00	0.00				
543	0.72	0.17	Forest	A/D		0.01	0.00	0.38
			Forest	C/D		0.07	0.01	
			Highway	A/D	0.03		0.04	
			Highway	C/D	0.09		0.12	
			LDR	A/D		0.01	0.00	
			LDR	C/D	0.05	0.46	0.20	
			Open	C/D		0.00	0.00	
545	0.31	0.16	Forest	A/D		0.02	0.00	0.24
			Forest	B		0.03	0.00	
			Highway	A/D	0.08		0.11	
			Highway	B	0.08		0.10	
			LDR	A/D		0.06	0.01	
			LDR	B		0.02	0.00	
LDR	C/D	0.00	0.01	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

547	2.60	0.57	Forest	A		0.10	0.01	0.91
			Forest	A/D		0.01	0.00	
			Highway	A	0.25		0.34	
			Highway	A/D	0.01		0.01	
			LDR	A	0.31	1.81	0.52	
			LDR	A/D	0.00	0.06	0.01	
			LDR	C		0.01	0.00	
			Open	A		0.03	0.00	
548	5.33	0.99	Open	A/D		0.01	0.00	2.32
			Forest	C		0.24	0.03	
			Highway	C	0.44		0.59	
			LDR	C	0.55	4.05	1.69	
549	6.68	0.39	Open	C		0.05	0.01	1.52
			Forest	B		0.06	0.01	
			Forest	B/D		0.00	0.00	
			Forest	C		0.30	0.04	
			Highway	B	0.16		0.21	
			Highway	B/D	0.01		0.01	
			Highway	C	0.10		0.13	
			LDR	B	0.00	3.05	0.37	
			LDR	C	0.11	1.67	0.51	
			LDR	D	0.02	0.01	0.03	
			Open	B		0.45	0.05	
			Open	B/D		0.00	0.00	
			Open	C		0.75	0.16	
550	15.96	3.18	Open	C		0.01	0.00	6.18
			Forest	B		0.87	0.11	
			Forest	C/D		1.19	0.16	
			Highway	B	1.62		2.17	
			Highway	C/D	0.55		0.73	
			LDR	B	0.88	9.35	2.46	
			LDR	C/D	0.12	1.09	0.50	
			Open	B	0.01	0.27	0.04	
551	3.84	0.94	Open	C/D		0.01	0.00	1.49
			Forest	A		0.07	0.01	
			Forest	B/D		0.01	0.00	
			Highway	A	0.54		0.73	
			LDR	A	0.37	2.22	0.63	
			LDR	B/D	0.02	0.38	0.11	
			LDR			0.00	0.00	
			Open	A		0.21	0.01	
553	6.97	2.42	Open	B/D		0.00	0.00	3.59
			Forest	A		0.76	0.10	
			Highway	A	1.63		2.19	
			LDR	A	0.79	3.47	1.30	
554	1.88	0.49	Open	A		0.33	0.01	0.77
			Forest	A		0.17	0.02	
			Forest	A/D		0.02	0.00	
			Highway	A	0.28		0.38	
			Highway	A/D	0.01		0.02	
			LDR	A	0.19	0.89	0.32	
			LDR	A/D		0.10	0.02	
			Open	A		0.22	0.01	
555	6.18	1.34	Open	A		0.22	0.01	2.29
			Forest	A		0.19	0.02	
			HDR	A	0.21	0.57	0.49	
			Highway	A	0.46		0.61	
			LDR	A	0.68	3.87	1.15	
556	5.50	0.99	Open	A		0.21	0.01	1.81
			Forest	A		0.06	0.01	
			Forest	B/D		0.00	0.00	
			Highway	A	0.38		0.51	
			Highway	B/D	0.10		0.13	
			LDR	A	0.40	2.96	0.70	
			LDR	B/D	0.02	0.08	0.05	
			LDR		0.09	1.28	0.40	
Open	A		0.11	0.00				
Open	B/D		0.02	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

557	0.88	0.30	Forest	C		0.09	0.01	0.52
			Highway	C	0.28		0.37	
			LDR	C	0.02	0.43	0.11	
			Open	C		0.07	0.02	
558	8.07	1.85	Forest	A		0.02	0.00	3.70
			Forest	C		0.12	0.02	
			Highway	A	0.62		0.83	
			Highway	C	0.46		0.62	
			LDR	A	0.33	1.42	0.54	
			LDR	C	0.41	3.45	1.35	
			LDR	C/D	0.03	0.93	0.32	
			Open	A		0.21	0.01	
			Open	C		0.07	0.02	
			559	6.42	0.72	Forest	A	
Forest	B					0.03	0.00	
Forest						0.01	0.00	
Highway	A	0.30					0.40	
Highway	B	0.07					0.10	
LDR	A	0.13				2.42	0.27	
LDR	B	0.22				2.07	0.59	
Open	A					0.64	0.02	
Open	B					0.03	0.00	
Open						0.03	0.01	
560	9.99	1.48	Forest	C		0.67	0.09	3.78
			Highway	C	0.79		1.06	
			LDR	B	0.01	0.76	0.10	
			LDR	C	0.68	6.81	2.46	
561	27.11	6.86	Open	C		0.27	0.06	10.48
			Forest	A		1.15	0.15	
			Highway	A	3.66		4.91	
			LDR	A	3.03	15.60	5.07	
562	1.19	0.24	Open	A	0.16	3.51	0.35	0.56
			Open	B		0.04	0.00	
			Forest	C		0.04	0.00	
			Highway	C	0.03		0.04	
563	4.43	0.95	LDR	C	0.21	0.89	0.51	1.76
			Open	C		0.03	0.01	
			Forest	B		0.39	0.05	
			Highway	B	0.57		0.76	
564	0.95	0.29	LDR	B	0.38	3.02	0.94	0.54
			Open	B		0.07	0.01	
			Forest	C		0.02	0.00	
			Highway	C	0.21		0.28	
566	6.67	1.62	LDR	C	0.08	0.62	0.25	2.60
			Open	C		0.02	0.00	
			Forest	A		0.58	0.07	
			Highway	A	0.39		0.52	
568	8.13	1.25	LDR	A	1.22	4.42	1.99	2.57
			Open	A	0.00	0.05	0.01	
			Forest	A		0.03	0.00	
			Forest	A/D		0.17	0.02	
			Forest	B		0.03	0.00	
			Highway	A	0.25		0.33	
			Highway	A/D	0.30		0.41	
			Highway	B	0.26		0.35	
			LDR	A	0.11	0.66	0.19	
			LDR	A/D	0.09	0.48	0.24	
			LDR	B	0.23	5.27	0.98	
			Open	A		0.05	0.00	
Open	A/D	0.00	0.02	0.01				
Open	B		0.16	0.02				
569	1.74	0.42	Forest	B		0.09	0.01	0.79
			Forest	C		0.09	0.01	
			Highway	B	0.28		0.38	
			Industrial	B		0.13	0.02	
			Industrial	C		0.14	0.03	
			LDR	B	0.14	0.66	0.30	
			LDR	C		0.21	0.04	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

570	14.41	2.89	Open	B		0.01	0.00	4.72
			Forest	A		2.34	0.30	
			Highway	A	1.36		1.82	
			LDR	A	1.53	8.25	2.57	
572	0.54	0.19	Open	A	0.00	0.93	0.03	0.29
			Forest	A		0.19	0.02	
			Forest			0.01	0.00	
			HDR	A		0.00	0.00	
			Highway	A	0.19		0.26	
			LDR	A	0.00	0.06	0.00	
			LDR			0.02	0.00	
573	3.71	0.10	Open	A	0.00	0.07	0.00	0.86
			Forest	A		0.00	0.00	
			Highway	A	0.05		0.07	
			LDR	A	0.02	0.22	0.04	
			LDR	C	0.02	3.38	0.74	
574	11.11	1.32	Open	A		0.02	0.00	2.75
			Forest	A		1.10	0.14	
			Forest	B/D		1.67	0.22	
			Highway	A	0.54		0.73	
			LDR	A	0.72	5.39	1.26	
			LDR	B/D	0.06	1.41	0.39	
			Open	A		0.15	0.00	
575	7.43	0.79	Open	B/D		0.06	0.01	1.80
			Ag	A		0.01	0.00	
			Ag	B		0.07	0.03	
			Forest	A		0.17	0.02	
			Forest	B		0.02	0.00	
			Highway	A	0.13		0.18	
			Highway	B	0.45		0.60	
			LDR	A		2.08	0.06	
			LDR	B	0.21	3.44	0.73	
			LDR	B/D	0.00	0.77	0.16	
576	3.35	0.72	Open	A		0.01	0.00	1.29
			Open	B		0.07	0.01	
			Forest	A		0.23	0.03	
			Forest	B		0.16	0.02	
			Highway	A	0.11		0.15	
			Highway	B	0.34		0.46	
			LDR	A	0.01	0.48	0.03	
577	7.68	2.13	LDR	B	0.26	1.72	0.60	3.84
			Open	A		0.00	0.00	
			Open	B		0.03	0.00	
			Forest	A		0.80	0.10	
			Forest	A/D		0.09	0.01	
			Forest	B		2.00	0.26	
			HDR	A	0.07	0.19	0.18	
			HDR	B	0.16	0.37	0.41	
			Highway	A	0.17		0.23	
			Highway	A/D	0.12		0.17	
			Highway	B	1.15		1.54	
			LDR	A	0.04	0.21	0.07	
581	4.23	1.21	LDR	A/D		0.04	0.01	1.86
			LDR	B	0.14	1.14	0.34	
			Open	A		0.02	0.00	
			Open	A/D		0.18	0.04	
			Open	B	0.28	0.50	0.49	
			Forest	A		0.77	0.10	
			Forest	A/D		0.06	0.01	
			Highway	A	0.75		1.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

584	10.54	8.43	Commercial	B	0.02		0.04	12.99
			Commercial		1.44	0.14	2.60	
			Forest	A		0.15	0.02	
			Forest			1.21	0.16	
			HDR	A	0.05	0.02	0.11	
			HDR		0.39	0.11	0.92	
			Highway	A	0.27		0.36	
			Highway	B	0.10		0.14	
			Highway		4.52		6.06	
			LDR	A	0.02	0.00	0.02	
			LDR		0.15	0.12	0.25	
			Open	A	0.02	0.02	0.03	
			Open		1.45	0.33	2.27	
586	0.42	0.20	Forest			0.10	0.01	0.33
			HDR		0.01	0.08	0.05	
			Highway		0.15		0.20	
			Open		0.04	0.03	0.06	
587	2.16	0.56	Forest	A		0.01	0.00	0.98
			HDR	A	0.16	1.15	0.40	
			Highway	A	0.30		0.40	
			LDR	A	0.10	0.43	0.17	
			Open	A		0.01	0.00	
588	0.54	0.25	Forest	A		0.01	0.00	0.37
			HDR	A	0.00	0.08	0.01	
			Highway	A	0.14		0.19	
			LDR	A	0.11	0.18	0.17	
			Open	A		0.02	0.00	
589	0.10	0.06	Forest	A		0.02	0.00	0.08
			Highway	A	0.06		0.08	
			Industrial	A		0.00	0.00	
			Open	A		0.02	0.00	
594	39.53	7.12	Forest	A		0.34	0.04	13.46
			Forest	B		1.99	0.26	
			HDR	A	0.10	0.57	0.26	
			HDR	B	0.04	0.15	0.10	
			Highway	A	0.39		0.52	
			Highway	B	2.55		3.42	
			LDR	A	0.68	8.79	1.30	
			LDR	B	3.33	20.14	7.48	
			LDR	B/D		0.00	0.00	
			Open	A		0.13	0.00	
Open	B	0.03	0.31	0.08				
595	2.19	0.56	Forest	A		0.02	0.00	0.84
			Highway	A	0.29		0.39	
			LDR	A	0.27	1.54	0.45	
			Open	A		0.08	0.00	
596	6.98	2.33	Forest	A		0.32	0.04	3.52
			Highway	A	1.08		1.44	
			LDR	A	1.25	4.14	2.03	
			Open	A		0.19	0.01	
597	1.52	0.53	Forest	C/D		0.09	0.01	1.05
			Forest	D		0.01	0.00	
			Highway	C/D	0.19		0.26	
			Highway	D	0.06		0.09	
			LDR	C/D	0.26	0.74	0.61	
			LDR	D	0.01	0.15	0.07	
Open	C/D		0.01	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

598	22.92	13.49	Commercial		10.03	4.15	18.72	24.98
			Forest	B		1.81	0.23	
			Forest			0.85	0.11	
			HDR	B	0.04	0.03	0.09	
			HDR		0.59	0.70	1.52	
			Highway	B	0.04		0.05	
			Highway		2.24		3.01	
			Industrial		0.16	0.15	0.31	
			LDR	B	0.02	0.27	0.06	
			LDR		0.36	0.71	0.69	
			Open	B		0.00	0.00	
Open		0.01	0.76	0.18				
599	14.93	8.07	Commercial	A	0.10	0.09	0.17	12.41
			Commercial		1.29	0.08	2.31	
			Forest	A		1.14	0.15	
			Forest	B		0.05	0.01	
			Forest			0.14	0.02	
			HDR	A	0.21	0.47	0.51	
			Highway	A	2.11		2.83	
			Highway	B	0.06		0.08	
			Highway		2.25		3.01	
			LDR	A	1.26	3.81	2.02	
			LDR		0.77	0.17	1.21	
Open	A	0.01	0.80	0.03				
Open	B	0.01	0.01	0.01				
Open		0.03	0.08	0.06				
601	4.94	2.16	Commercial	A/D	0.00	0.01	0.00	3.99
			Commercial	C/D	0.00	0.00	0.00	
			Forest	A		0.12	0.02	
			Forest	A/D		0.06	0.01	
			Forest	C/D		0.33	0.04	
			HDR	A/D	0.12	0.18	0.32	
			HDR	C/D	0.33	0.57	0.93	
			Highway	A	0.21		0.28	
			Highway	A/D	0.26		0.34	
			Highway	C	0.00		0.00	
			Highway	C/D	0.96		1.28	
			LDR	A	0.13	0.22	0.20	
			LDR	A/D	0.08	0.51	0.23	
			LDR	C/D	0.08	0.36	0.23	
Open	A		0.04	0.00				
Open	A/D		0.10	0.02				
Open	C		0.00	0.00				
Open	C/D		0.29	0.09				
602	1.85	0.40	Commercial	C/D		0.00	0.00	0.98
			Forest	C		0.00	0.00	
			Forest	C/D		0.35	0.05	
			HDR	C		0.01	0.00	
			HDR	C/D	0.04	0.29	0.18	
			Highway	C	0.00		0.00	
			Highway	C/D	0.13		0.17	
			LDR	C/D	0.23	0.78	0.58	
Open	C		0.00	0.00				
Open	C/D		0.01	0.00				
603	1.00	0.07	Forest	C/D		0.01	0.00	0.38
			Forest	D		0.01	0.00	
			Highway	C/D	0.00		0.01	
			Highway	D	0.04		0.05	
			LDR	C/D	0.01	0.80	0.25	
			LDR	D	0.02	0.11	0.07	
Open	C/D		0.00	0.00				
Open	D		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

604	43.57	9.44	Forest	A		2.04	0.26	15.55
			Forest	B		0.96	0.12	
			HDR	A	0.16	0.59	0.40	
			HDR	B/D		0.00	0.00	
			Highway	A	3.28		4.39	
			Highway	B	0.72		0.97	
			LDR	A	4.35	24.38	7.34	
			LDR	B	0.92	4.81	1.98	
			LDR	B/D		0.10	0.02	
			Open	A		0.97	0.03	
Open	B		0.29	0.03				
605	4.36	0.57	Forest	A		0.45	0.06	1.57
			Forest	C/D		0.25	0.03	
			Highway	C/D	0.31		0.41	
			LDR	A	0.05	0.90	0.10	
			LDR	C/D	0.21	2.09	0.92	
Open	C/D	0.01	0.10	0.05				
606	3.41	0.60	Forest	A		0.42	0.05	1.47
			HDR	A	0.55	2.03	1.33	
			Highway	A	0.00		0.00	
			LDR	A	0.02	0.30	0.04	
			Open	A	0.03	0.07	0.04	
607	2.99	0.83	Forest	A		0.62	0.08	1.39
			HDR	A	0.10	0.19	0.24	
			Highway	A	0.43		0.58	
			LDR	A	0.30	1.31	0.49	
			Open	A		0.04	0.00	
608	118.54	38.21	Commercial	B	1.75	0.24	3.15	83.21
			Commercial	C/D	4.51	0.85	8.27	
			Forest	B		0.83	0.11	
			Forest	C		1.68	0.22	
			Forest	C/D		4.89	0.64	
			Forest	D		0.85	0.11	
			Forest			0.08	0.01	
			HDR	B		0.02	0.00	
			HDR	C	0.07	0.37	0.24	
			HDR	C/D	3.10	10.40	10.22	
			HDR	D	2.62	4.93	7.90	
			Highway	B	1.34		1.80	
			Highway	C	5.24		7.03	
			Highway	C/D	7.79		10.43	
			Highway	D	1.45		1.94	
			LDR	B	0.20	0.23	0.33	
			LDR	C	2.55	12.57	6.52	
			LDR	C/D	5.03	24.43	14.74	
			LDR	D	2.46	9.28	7.17	
			LDR			0.05	0.01	
Open	B	0.07	0.15	0.13				
Open	C	0.01	2.21	0.48				
Open	C/D	0.01	5.67	1.66				
Open	D		0.29	0.11				
Water	C/D		0.00	0.00				
Water	D		0.06	0.00				
Water			0.25	0.00				
610	1.72	0.97	Forest	A		0.08	0.01	1.92
			HDR	A	0.46	0.21	1.06	
			HDR	A/D	0.06	0.33	0.22	
			Highway	A	0.44		0.59	
			Highway	A/D	0.00		0.00	
			LDR	A	0.01	0.02	0.02	
			LDR	A/D		0.11	0.02	
			Open	A		0.01	0.00	
Open	A/D		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

611	5.88	1.42	Forest	A		0.19	0.02	2.85
			Forest	B/D		0.06	0.01	
			HDR	A	0.71	2.11	1.72	
			HDR	B/D		0.01	0.00	
			Highway	A	0.30		0.40	
			Highway	B/D	0.12		0.17	
			LDR	A	0.27	1.83	0.47	
			LDR	B/D		0.24	0.05	
613	3.06	1.00	Open	A	0.00	0.02	0.01	1.49
			Forest	A		0.42	0.05	
			Highway	A	0.73		0.98	
			LDR	A	0.27	1.56	0.45	
617	4.39	1.18	Open	A		0.08	0.00	1.93
			Commercial	B	0.07	0.02	0.13	
			Forest	A		0.95	0.12	
			Forest	B		0.24	0.03	
			Highway	A	0.17		0.22	
			Highway	B	0.69		0.93	
			LDR	A	0.04	0.60	0.08	
			LDR	B		0.06	0.01	
619	0.28	0.24	Open	A		0.82	0.02	0.35
			Open	B	0.21	0.51	0.39	
			Forest	A		0.00	0.00	
			HDR	A	0.02	0.00	0.04	
620	5.71	1.65	Highway	A	0.17		0.23	2.80
			LDR	A	0.06	0.03	0.09	
			Open	A		0.00	0.00	
			Forest	A		0.25	0.03	
			Forest	B		0.36	0.05	
			HDR	B	0.04	0.17	0.12	
			Highway	A	0.06		0.08	
			Highway	B	0.63		0.84	
621	27.93	1.90	LDR	A	0.42	1.21	0.67	7.32
			LDR	B	0.50	1.82	0.98	
			Open	A		0.00	0.00	
			Open	B		0.24	0.03	
			Forest	A		0.12	0.02	
			Forest	C/D		11.11	1.44	
			Forest	D		8.37	1.09	
			Highway	C/D	0.64		0.86	
622	6.89	1.97	Highway	D	0.07		0.10	3.07
			LDR	A		0.00	0.00	
			LDR	C/D	1.04	4.33	2.84	
			LDR	D	0.15	1.83	0.90	
623	11.94	2.34	Open	C/D		0.27	0.08	4.57
			Open	D		0.01	0.00	
			Forest	A		1.16	0.15	
			Highway	A	1.03		1.38	
			LDR	A	0.94	3.41	1.53	
			Open	A		0.35	0.01	
			Forest	A		1.11	0.14	
			Forest	A/D		2.08	0.27	
			Forest	B/D		0.59	0.08	
			HDR	A		0.08	0.00	
			Highway	A	1.20		1.60	
Highway	A/D	0.19		0.25				
Highway	B/D	0.03		0.03				
LDR	A	0.32	1.13	0.52				
LDR	A/D		0.31	0.06				
LDR	B/D	0.42	2.61	1.19				
Open	A	0.18	1.27	0.31				
Open	A/D		0.09	0.02				
Open	B/D	0.01	0.32	0.08				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

624	4.43	0.92	Forest	A		0.22	0.03	1.77
			Forest	A/D		0.17	0.02	
			Forest	B/D		0.05	0.01	
			Highway	A	0.30		0.41	
			Highway	A/D	0.11		0.15	
			Highway	B/D	0.00		0.00	
			LDR	A	0.46	1.36	0.74	
			LDR	A/D	0.00	1.47	0.32	
			LDR	B/D	0.03	0.20	0.09	
			Open	A		0.04	0.00	
Open	B/D		0.00	0.00				
625	7.32	1.29	Forest	A		0.10	0.01	2.76
			Forest	B		0.01	0.00	
			Forest	B/D		0.14	0.02	
			Highway	A	0.25		0.34	
			Highway	B	0.02		0.02	
			Highway	B/D	0.48		0.65	
			LDR	A	0.15	1.85	0.29	
			LDR	B	0.02	0.27	0.06	
			LDR	B/D	0.36	3.01	1.18	
			LDR	D		0.42	0.16	
Open	A		0.08	0.00				
Open	B		0.01	0.00				
Open	B/D		0.13	0.03				
630	12.27	2.73	Forest	A		1.69	0.22	4.41
			Forest	B/D		0.05	0.01	
			Highway	A	1.34		1.79	
			Highway	B/D	0.10		0.14	
			LDR	A	1.29	6.91	2.16	
			LDR	B/D	0.00	0.28	0.06	
			Open	A		0.60	0.02	
Open	B/D	0.01		0.01				
631	15.64	3.34	Forest	A		0.53	0.07	5.15
			Forest	B		0.02	0.00	
			HDR	A	0.05	0.53	0.13	
			Highway	A	2.09		2.80	
			Highway	B	0.07		0.09	
			LDR	A	1.13	10.48	2.03	
			Open	A		0.74	0.02	
Open	B		0.00	0.00				
636	2.31	0.54	Forest	C		0.09	0.01	1.13
			Highway	C	0.29		0.39	
			LDR	C	0.25	1.53	0.70	
			Open	C		0.16	0.03	
637	12.58	2.91	Forest	A		0.07	0.01	6.22
			Forest	C		0.90	0.12	
			HDR	C	0.16	0.34	0.45	
			Highway	A	0.42		0.56	
			Highway	C	0.94		1.26	
			LDR	A	0.07	0.20	0.12	
			LDR	C	1.32	7.89	3.67	
			Open	A	0.00	0.08	0.00	
Open	C		0.18	0.04				
638	49.47	8.16	Forest	A		0.00	0.00	20.24
			Forest	C		1.80	0.23	
			Highway	C	3.88		5.19	
			LDR	A		0.01	0.00	
			LDR	C	4.22	38.31	14.45	
			Open	A		0.00	0.00	
Open	C	0.07	1.18	0.36				
639	7.58	1.19	Forest	A		0.31	0.04	1.98
			Highway	A	0.38		0.51	
			LDR	A	0.76	5.77	1.33	
			LDR	B/D		0.04	0.01	
Open	A	0.05	0.28	0.08				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

640	4.40	1.28	Forest	A		0.36	0.05	2.02
			HDR	A	0.07	0.15	0.17	
			Highway	A	0.62		0.83	
			LDR	A	0.58	2.44	0.96	
			Open	A	0.00	0.17	0.01	
644	2.19	0.43	Forest	A		0.05	0.01	0.67
			Highway	A	0.17		0.23	
			LDR	A	0.25	1.62	0.43	
			Open	A		0.10	0.00	
645	28.33	4.59	Forest	A		1.04	0.14	8.89
			Forest	B		0.36	0.05	
			Forest	B/D		0.07	0.01	
			Highway	A	0.87		1.16	
			Highway	B	0.88		1.18	
			Highway	B/D	0.20		0.26	
			LDR	A	1.37	7.80	2.32	
			LDR	B	1.01	8.62	2.57	
			LDR	B/D	0.27	3.36	1.11	
			Open	A		2.31	0.07	
			Open	B		0.15	0.02	
			Open	B/D		0.01	0.00	
648	24.41	5.81	Forest	C		0.78	0.10	12.18
			Highway	C	2.78		3.72	
			LDR	A	0.00		0.00	
			LDR	C	3.04	17.26	8.24	
			LDR	D	0.00	0.00	0.00	
			Open	C		0.56	0.12	
651	6.71	2.63	Forest	A		0.23	0.03	4.37
			Forest	C		0.24	0.03	
			HDR	A	0.41	0.52	0.97	
			Highway	A	1.11		1.48	
			LDR	A	1.05	2.39	1.67	
			LDR	C	0.01	0.38	0.10	
653	20.97	4.11	Open	A	0.05	0.31	0.08	9.22
			Forest	A		0.56	0.07	
			Forest	C		0.36	0.05	
			Forest	C/D		0.07	0.01	
			Highway	A	0.88		1.18	
			Highway	C	0.60		0.81	
			Highway	C/D	0.56		0.75	
			LDR	A	0.20	2.21	0.36	
			LDR	C	0.92	8.90	3.26	
			LDR	C/D	0.94	4.06	2.61	
			LDR	D	0.02	0.02	0.03	
654	6.15	1.04	Open	A		0.36	0.01	1.87
			Open	C		0.15	0.03	
			Open	C/D		0.17	0.05	
			Forest	A		1.56	0.20	
			Forest	B		0.04	0.01	
			Highway	A	0.29		0.38	
			Highway	B	0.19		0.25	
655	7.16	1.54	LDR	A	0.44	2.76	0.75	2.62
			LDR	B	0.13	0.49	0.26	
			Open	A	0.00	0.20	0.01	
			Open	B		0.07	0.01	
			Forest	A		0.36	0.05	
			Forest	B		0.08	0.01	
			HDR	A	0.05	0.11	0.11	
			HDR	B	0.02	0.14	0.06	
			Highway	A	0.48		0.64	
Highway	B	0.20		0.27				
LDR	A	0.65	3.45	1.09				
LDR	B	0.11	1.43	0.33				
Open	A	0.04	0.03	0.06				
Open	B		0.02	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

656	5.18	1.78	Forest	A		0.38	0.05	2.71
			Forest	B		0.25	0.03	
			Highway	A	1.04		1.39	
			Highway	B	0.58		0.78	
			LDR	A	0.14	0.50	0.23	
			LDR	B	0.01	0.23	0.04	
			Open	A	0.00	0.76	0.03	
			Open	B		1.29	0.16	
657	4.39	0.67	Ag	B		0.01	0.00	1.56
			Forest	B		0.02	0.00	
			Highway	B	0.30		0.41	
			LDR	A/D		0.13	0.03	
			LDR	B	0.32	1.98	0.72	
			LDR	B/D	0.05	1.54	0.40	
667	7.52	1.58	Open	B		0.05	0.01	3.84
			Forest	B		0.02	0.00	
			Forest	C/D		0.25	0.03	
			Highway	B	0.08		0.11	
			Highway	C/D	0.78		1.04	
			LDR	B	0.11	0.49	0.23	
			LDR	C/D	0.61	4.87	2.34	
			Open	B		0.03	0.00	
668	1.05	0.38	Open	C/D	0.00	0.27	0.08	0.71
			Forest	C/D		0.10	0.01	
			Highway	C/D	0.27		0.37	
			LDR	C/D	0.11	0.46	0.30	
670	6.06	1.42	Open	C/D		0.10	0.03	3.25
			Forest	C/D		0.10	0.01	
			Forest	D		0.12	0.01	
			Highway	C/D	0.64		0.86	
			Highway	D	0.10		0.14	
			LDR	C/D	0.47	2.76	1.52	
			LDR	D	0.20	0.49	0.49	
			Open	C/D		0.32	0.09	
686	0.67	0.26	Open	D		0.07	0.03	0.45
			Forest	C		0.02	0.00	
			Highway	C	0.18		0.24	
			LDR	C	0.09	0.36	0.21	
688	11.96	4.34	Open	C		0.02	0.01	7.24
			Forest	A		0.60	0.08	
			Forest	B		1.11	0.14	
			Forest	B/D		0.77	0.10	
			Forest	D		0.01	0.00	
			Forest			1.01	0.13	
			HDR	A	0.01	0.00	0.02	
			HDR	B	0.15	0.17	0.37	
			HDR	B/D	0.01	0.43	0.11	
			Highway	A	0.14		0.19	
			Highway	B	0.30		0.40	
			Highway	B/D	0.89		1.20	
			Highway	D	0.04		0.05	
			Highway		2.64		3.54	
			LDR	A	0.02	0.06	0.04	
			LDR	B	0.09	0.46	0.19	
			LDR	B/D	0.02	1.09	0.26	
			689	2.73	0.43	Open	A	
Open	B					0.03	0.00	
Open	B/D					0.48	0.10	
Open		0.00				1.32	0.28	
Forest	C/D					0.02	0.00	
Highway	C/D	0.11		0.14				
LDR	B		0.20	0.02				
LDR	C/D	0.29	1.92	1.01				
Open	C/D		0.01	0.00				

Phosphorus Load Calculations - Merrimack River, Andover, MA

690	22.66	5.40	Forest	C		0.33	0.04	12.63
			Forest	C/D		0.79	0.10	
			Forest	D		3.34	0.43	
			HDR	C	0.06	0.15	0.16	
			HDR	C/D	0.35	0.96	1.10	
			HDR	D	0.01	0.19	0.10	
			Highway	C	0.91		1.22	
			Highway	C/D	0.59		0.79	
			Highway	D	0.49		0.66	
			LDR	C	0.93	2.45	1.92	
			LDR	C/D	1.21	4.02	3.00	
			LDR	D	0.84	4.40	2.91	
			Open	C		0.25	0.05	
			Open	C/D	0.00	0.14	0.04	
Open	D		0.24	0.09				
692	3.77	1.48	Forest	B		0.82	0.11	2.28
			Forest	B/D		0.10	0.01	
			Highway	B	1.32		1.77	
			Highway	B/D	0.15		0.20	
			Open	B	0.00	1.28	0.15	
Open	B/D	0.01	0.08	0.03				
698	5.82	1.03	Forest	C		0.17	0.02	2.62
			Forest	C/D		0.01	0.00	
			Highway	C	0.28		0.37	
			Highway	C/D	0.07		0.10	
			LDR	C	0.65	3.55	1.73	
			LDR	C/D	0.04	0.10	0.09	
			LDR	D	0.00	0.81	0.30	
			Open	C		0.09	0.02	
			Open	C/D		0.00	0.00	
Water	C		0.01	0.00				
Water	D		0.05	0.00				
699	5.55	1.51	Forest	B		0.00	0.00	3.43
			Forest	C/D		0.16	0.02	
			Forest	D		0.05	0.01	
			HDR	B	0.05	0.18	0.14	
			HDR	C/D		0.00	0.00	
			HDR	D	0.15	0.43	0.52	
			Highway	B	0.10		0.13	
			Highway	C/D	0.25		0.34	
			Highway	D	0.14		0.19	
			LDR	B	0.37	0.99	0.68	
			LDR	C/D	0.36	1.07	0.86	
			LDR	D	0.07	1.06	0.50	
			Open	B		0.01	0.00	
Open	C/D		0.06	0.02				
Open	D		0.02	0.01				
704	14.47	3.45	Forest	A		0.00	0.00	8.19
			Forest	C		0.04	0.00	
			Forest	C/D		0.58	0.08	
			Forest	D		0.04	0.01	
			HDR	C		0.00	0.00	
			HDR	C/D	0.09	0.31	0.30	
			Highway	C	0.22		0.30	
			Highway	C/D	0.85		1.15	
			Highway	D	0.14		0.19	
			LDR	A		0.76	0.02	
			LDR	C	0.18	0.30	0.34	
			LDR	C/D	1.61	5.73	4.11	
			LDR	D	0.32	2.84	1.53	
			Open	C	0.03	0.04	0.05	
Open	C/D	0.00	0.31	0.09				
Open	D		0.08	0.03				
706	0.55	0.06	Forest	A		0.01	0.00	0.11
			LDR	A	0.06	0.47	0.11	
			LDR		0.00	0.00	0.00	
			Open	A		0.00	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

707	3.71	0.74	Forest	C/D		0.27	0.03	1.77
			Forest	D		0.69	0.09	
			Highway	C/D	0.29		0.39	
			LDR	A	0.00	0.13	0.01	
			LDR	C/D	0.44	1.44	1.09	
			LDR	D	0.00	0.41	0.16	
709	8.21	0.89	Open	C/D		0.03	0.01	2.85
			Forest	A		0.88	0.11	
			Forest	C/D		0.07	0.01	
			Forest	D		2.81	0.37	
			HDR	C/D	0.04	0.16	0.13	
			Highway	C/D	0.08		0.10	
			Highway	D	0.08		0.10	
			LDR	A		0.49	0.01	
			LDR	C/D	0.61	1.56	1.37	
			LDR	D	0.10	1.25	0.61	
718	6.21	1.70	Open	C/D		0.08	0.02	2.61
			Open	D		0.02	0.01	
			Forest	A		0.48	0.06	
			Highway	A	0.90		1.21	
			LDR	A	0.79	3.84	1.32	
719	21.72	4.20	LDR	A/D	0.00	0.02	0.01	7.70
			Open	A		0.17	0.01	
			Forest	A		4.88	0.63	
			Forest	B		2.82	0.37	
			Forest	B/D		2.42	0.31	
			Forest	C/D		0.43	0.06	
			Forest	D		0.93	0.12	
			Highway	A	1.14		1.53	
			Highway	B	2.18		2.92	
			Highway	B/D	0.39		0.52	
			Highway	C/D	0.11		0.15	
			Highway	D	0.37		0.50	
			LDR	B		0.00	0.00	
			Open	A		3.10	0.09	
			Open	B		1.93	0.23	
Open	B/D		0.58	0.12				
Open	C/D		0.31	0.09				
Open	D		0.11	0.04				
720	28.26	6.46	Commercial	A	0.65	0.04	1.15	11.23
			Forest	A		4.13	0.54	
			Forest	B/D		0.04	0.00	
			HDR	A	0.83	1.29	1.96	
			Highway	A	3.06		4.10	
			Industrial	A	0.20	0.01	0.36	
			LDR	A	1.71	15.67	3.07	
			Open	A	0.02	0.62	0.04	
722	2.49	0.61	Open	B/D		0.00	0.00	0.94
			Forest	A		0.12	0.02	
			Highway	A	0.29		0.39	
			LDR	A	0.32	1.60	0.53	
726	4.04	1.93	Open	A		0.16	0.00	2.79
			Forest	A		0.41	0.05	
			Forest	A/D		0.12	0.02	
			Forest			0.10	0.01	
			Highway	A	1.18		1.58	
			Highway	A/D	0.03		0.04	
			Highway		0.62		0.84	
			LDR	A	0.09	1.00	0.17	
			LDR	A/D		0.04	0.01	
			LDR		0.01	0.00	0.01	
727	11.22	0.72	Open	A		0.18	0.01	2.29
			Open			0.27	0.06	
			Forest	A		9.05	1.18	
			HDR	A	0.09	0.31	0.22	
			Highway	A	0.52		0.69	
			LDR	A	0.10	1.14	0.19	

Phosphorus Load Calculations - Merrimack River, Andover, MA

728	1.59	0.40	Open	A	0.00	0.00	0.01	0.64
			Forest	A		0.48	0.06	
			Forest	B/D		0.03	0.00	
			Highway	A	0.26		0.35	
			Highway	B/D	0.09		0.12	
			LDR	A	0.05	0.63	0.10	
			Open	A		0.04	0.00	
729	9.20	2.74	Open	B/D		0.00	0.00	4.17
			Forest	A		0.69	0.09	
			Highway	A	1.37		1.84	
732	10.84	2.30	LDR	A	1.36	5.53	2.23	4.76
			Open	A	0.01	0.25	0.02	
			Forest	A		0.29	0.04	
			Forest	A/D		0.07	0.01	
			Forest	B		0.09	0.01	
			Forest	B/D		0.04	0.01	
			Forest	C/D		0.02	0.00	
			Highway	A	0.53		0.71	
			Highway	A/D	0.16		0.22	
			Highway	B	0.23		0.30	
			Highway	B/D	0.15		0.20	
			Highway	C/D	0.06		0.08	
			LDR	A	0.17	0.87	0.28	
			LDR	A/D	0.31	2.30	0.96	
			LDR	B	0.29	1.35	0.60	
			LDR	B/D	0.34	2.93	1.14	
			LDR	C/D	0.06	0.22	0.15	
			Open	A		0.08	0.00	
			Open	A/D		0.07	0.01	
			Open	B		0.10	0.01	
Open	B/D		0.10	0.02				
Open	C/D		0.00	0.00				
733	0.49	0.22	Open	C/D		0.01	0.00	0.38
			Forest	C/D		0.01	0.00	
			Highway	C/D	0.05		0.07	
			LDR	B	0.02	0.08	0.04	
739	30.60	3.58	LDR	C/D	0.14	0.18	0.27	8.63
			Forest	A		4.57	0.59	
			Forest	B		1.20	0.16	
			Forest	B/D		1.14	0.15	
			Forest	C		3.28	0.43	
			Forest	C/D		3.00	0.39	
			HDR	A	0.02	0.12	0.04	
			Highway	A	1.25		1.67	
			Highway	B	0.95		1.27	
			Highway	B/D	0.68		0.91	
			Highway	C	0.11		0.14	
			LDR	A	0.49	4.16	0.87	
			LDR	B	0.03	1.69	0.25	
			LDR	B/D		0.41	0.09	
			LDR	C		0.15	0.03	
			LDR	C/D		3.11	0.90	
			LDR	D		0.31	0.11	
			Open	A	0.03	0.15	0.04	
			Open	B	0.01	3.06	0.39	
			Open	B/D		0.23	0.05	
Open	C	0.03	0.22	0.09				
Open	C/D		0.22	0.06				

Phosphorus Load Calculations - Merrimack River, Andover, MA

740	19.20	1.80	Forest	A		0.04	0.01	4.75
			Forest	B		4.73	0.62	
			Forest	B/D		0.85	0.11	
			Forest	C		0.48	0.06	
			Forest	C/D		3.65	0.47	
			Forest	D		1.23	0.16	
			Highway	A	0.01		0.01	
			Highway	B	1.19		1.59	
			Highway	B/D	0.00		0.00	
			Highway	C	0.03		0.05	
			Highway	C/D	0.48		0.65	
			Highway	D	0.08		0.11	
			LDR	C		0.05	0.01	
			LDR	C/D	0.00	0.24	0.07	
			Open	A		0.85	0.03	
			Open	B		4.22	0.51	
			Open	B/D		0.04	0.01	
Open	C		0.00	0.00				
Open	C/D		1.02	0.29				
749	2.32	0.59	Forest	B		0.10	0.01	1.13
			Forest	B/D		0.03	0.00	
			Highway	B	0.15		0.20	
			Highway	B/D	0.08		0.11	
			LDR	B	0.23	0.85	0.46	
			LDR	B/D	0.12	0.70	0.34	
			Open	B		0.05	0.01	
Open	B/D		0.01	0.00				
750	10.14	1.29	Forest	B/D		0.17	0.02	3.70
			Highway	B/D	0.44		0.59	
			LDR	B	0.01	0.64	0.09	
			LDR	B/D	0.84	7.79	2.91	
			LDR	D	0.00	0.21	0.08	
Open	B/D		0.04	0.01				
753	8.89	1.27	Forest	B/D		0.06	0.01	4.21
			Forest	C/D		0.01	0.00	
			Forest	D		0.04	0.01	
			Highway	B/D	0.19		0.26	
			Highway	C/D	0.03		0.04	
			Highway	D	0.13		0.18	
			LDR	B/D	0.34	2.83	1.11	
			LDR	C/D	0.00	0.03	0.01	
			LDR	D	0.58	4.59	2.58	
			Open	B/D		0.01	0.00	
			Open	C/D		0.01	0.00	
Open	D		0.06	0.02				
755	13.45	3.28	Forest	B		0.50	0.06	6.47
			Forest	B/D		0.42	0.05	
			Highway	B	0.75		1.00	
			Highway	B/D	0.81		1.09	
			LDR	B	0.92	3.15	1.78	
			LDR	B/D	0.80	5.88	2.45	
			Open	B		0.10	0.01	
Open	B/D		0.13	0.03				
758	18.36	4.17	Forest	B/D		0.48	0.06	9.58
			Forest	C/D		0.21	0.03	
			Forest	D		0.02	0.00	
			HDR	B/D	0.29	0.75	0.82	
			Highway	B/D	1.08		1.45	
			Highway	C/D	0.37		0.50	
			Highway	D	0.09		0.12	
			LDR	B	0.07	0.30	0.15	
			LDR	B/D	1.67	8.13	4.25	
			LDR	C/D	0.55	3.11	1.74	
			LDR	D	0.05	0.77	0.36	
			Open	B/D	0.00	0.23	0.05	
Open	C/D		0.15	0.04				
Open	D		0.04	0.02				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

763	4.82	0.26	Forest	A		0.88	0.11	0.77
			Forest			1.70	0.22	
			Highway	A	0.18		0.24	
			LDR	A	0.08	1.90	0.18	
			LDR			0.04	0.01	
764	0.27	0.05	Open	A	0.00	0.04	0.00	0.11
			Forest	C/D		0.08	0.01	
			Highway	C/D	0.05		0.06	
			LDR	C/D		0.14	0.04	
766	4.64	0.39	Open	C/D		0.00	0.00	1.44
			Forest	B		0.10	0.01	
			Highway	B	0.21		0.28	
			LDR	B	0.18	1.94	0.51	
			LDR	C/D	0.00	2.18	0.64	
780	10.60	5.48	Open	B		0.03	0.00	8.04
			Forest	A		0.13	0.02	
			Forest	B		0.05	0.01	
			Forest	B/D		0.83	0.11	
			Forest			0.15	0.02	
			Highway	A	0.14		0.19	
			Highway	B/D	0.05		0.07	
			Highway		5.06		6.78	
			LDR	A	0.02	0.05	0.03	
			LDR	B	0.08	0.25	0.15	
			LDR	B/D	0.13	1.04	0.42	
			LDR		0.00	0.01	0.00	
			Open	A		1.62	0.05	
			Open	B		0.02	0.00	
Open	B/D		0.52	0.11				
781	13.36	2.28	Open			0.45	0.09	6.70
			Forest	C/D		0.51	0.07	
			Forest	D		0.32	0.04	
			Highway	C/D	0.86		1.16	
			Highway	D	0.20		0.27	
			LDR	C/D	0.74	4.99	2.57	
			LDR	D	0.47	4.29	2.30	
783	15.27	2.81	Open	C/D		0.89	0.26	7.44
			Open	D		0.09	0.03	
			Forest	B		0.10	0.01	
			Forest	C/D		0.35	0.04	
			Forest	D		2.02	0.26	
			HDR	B	0.38	1.77	1.10	
			HDR	C/D	0.08	0.47	0.32	
			Highway	B	0.07		0.09	
			Highway	C/D	0.55		0.74	
			Highway	D	0.01		0.02	
			LDR	B	0.10	0.74	0.24	
785	2.01	0.56	LDR	C/D	1.55	5.40	3.93	0.83
			LDR	D	0.06	1.55	0.66	
			Open	B		0.01	0.00	
			Open	C/D		0.07	0.02	
			Forest	A		0.04	0.00	
			Highway	A	0.40		0.53	
			Highway		0.00		0.00	
			LDR	A	0.16	1.28	0.29	
786	9.51	2.42	LDR	C		0.00	0.00	4.10
			LDR			0.00	0.00	
			Open	A		0.12	0.00	
			Open			0.00	0.00	
			Forest	A		1.92	0.25	
			Forest	B		2.74	0.36	
			Forest	B/D		0.51	0.07	
			Highway	A	1.21		1.62	
786	9.51	2.42	Highway	B	1.04		1.40	4.10
			Highway	B/D	0.17		0.22	
			Open	A		0.82	0.02	
			Open	B		0.78	0.09	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Open	B/D		0.31	0.07	
			Forest	C/D		0.76	0.10	
			Forest			0.01	0.00	
787	10.88	2.25	Highway	C/D	1.06		1.43	5.59
			LDR	C/D	1.13	7.28	3.83	
			LDR		0.05	0.24	0.13	
			Open	C/D		0.35	0.10	
			Ag	C/D		0.00	0.00	
792	14.48	1.76	Forest	C/D		0.49	0.06	6.09
			Highway	C/D	1.05		1.41	
			LDR	C/D	0.71	12.08	4.58	
			Open	C/D		0.15	0.04	
			Forest	A		3.30	0.43	
			Forest	B		0.03	0.00	
794	12.87	2.54	Highway	A	1.65		2.21	4.21
			Highway	B	0.09		0.11	
			LDR	A	0.76	5.69	1.32	
			LDR	B	0.06	0.11	0.10	
			Open	A		1.19	0.04	
			Forest	A		0.72	0.09	
			Forest	B		0.07	0.01	
			Forest	C/D		0.00	0.00	
			Forest	D		0.15	0.02	
			Highway	A	0.70		0.94	
			Highway	C/D	0.07		0.10	
			Highway	D	0.15		0.20	
798	17.34	2.52	LDR	A	0.75	7.28	1.36	5.17
			LDR	B	0.37	4.16	1.06	
			LDR	C/D	0.32	1.73	1.00	
			LDR	D	0.02	0.12	0.07	
			LDR		0.03	0.58	0.17	
			Open	A	0.01		0.01	
			Open	D	0.09		0.14	
			Forest	A		0.25	0.03	
801	1.01	0.29	Forest	B		0.00	0.00	0.44
			Highway	A	0.29		0.39	
			LDR	A	0.00	0.47	0.02	
			LDR	B		0.00	0.00	
			Forest	C/D		0.17	0.02	
			Highway	C/D	0.39		0.52	
805	6.54	0.91	LDR	C/D	0.49	3.40	1.74	3.08
			LDR	D	0.03	1.98	0.79	
			Open	C/D		0.08	0.02	
			Open	D		0.00	0.00	
			Forest	A		0.01	0.00	
			Forest	B		0.14	0.02	
806	2.00	0.50	Highway	A	0.00		0.00	0.85
			Highway	B	0.22		0.30	
			LDR	A	0.18	0.66	0.30	
			LDR	B	0.10	0.58	0.22	
			Open	A		0.00	0.00	
			Open	B		0.10	0.01	
			Forest	A		14.47	1.88	
			Forest	A/D		0.26	0.03	
			HDR	A	0.00	0.19	0.01	
			Highway	A	0.13		0.18	
809	26.51	0.92	Highway	A/D	0.20		0.27	3.77
			LDR	A	0.53	9.47	1.09	
			LDR	A/D	0.06	0.94	0.29	
			Open	A	0.00	0.20	0.01	
			Open	A/D	0.00	0.05	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

811	4.56	1.09	Forest	B		0.56	0.07	1.89
			Forest	D		0.10	0.01	
			Highway	B	0.63		0.85	
			Highway	D	0.11		0.15	
			LDR	A	0.13	0.77	0.23	
			LDR	B	0.21	1.90	0.54	
			LDR	C/D	0.01	0.00	0.01	
			LDR	D	0.00	0.07	0.03	
			Open	B		0.07	0.01	
Open	D		0.00	0.00				
812	45.08	8.99	Forest	A		11.78	1.53	14.72
			HDR	A	0.03	0.62	0.08	
			Highway	A	6.76		9.06	
			LDR	A	2.19	19.44	3.92	
			Open	A	0.01	4.26	0.14	
818	2.41	0.66	Forest	C		0.24	0.03	1.31
			Forest	C/D		0.00	0.00	
			Highway	C	0.31		0.42	
			LDR	C	0.33	1.25	0.77	
			LDR	C/D	0.02	0.15	0.07	
			Open	C		0.09	0.02	
Open	C/D		0.00	0.00				
825	38.95	7.20	Forest	A		2.04	0.26	15.76
			Forest	C/D		11.52	1.50	
			Forest	D		6.17	0.80	
			HDR	A		0.17	0.00	
			HDR	C/D	0.13	0.79	0.53	
			Highway	C/D	4.69		6.28	
			Highway	D	0.35		0.47	
			LDR	A	0.14	1.80	0.26	
			LDR	C/D	1.65	6.15	4.30	
			LDR	D	0.17	0.74	0.53	
Open	C/D	0.04	2.23	0.70				
Open	D	0.04	0.16	0.11				
826	5.84	0.69	Forest	C		0.29	0.04	1.82
			Forest	C/D		3.01	0.39	
			Highway	C	0.34		0.46	
			Highway	C/D	0.05		0.07	
			LDR	C	0.30	1.57	0.78	
			LDR	C/D		0.04	0.01	
			Open	C		0.02	0.00	
Open	C/D		0.21	0.06				
827	6.78	1.75	Commercial	A	0.34	0.16	0.61	2.96
			Commercial	C/D	0.03	0.01	0.05	
			Forest	A		0.37	0.05	
			Forest	C/D		0.13	0.02	
			HDR	A	0.00	0.31	0.01	
			Highway	A	0.57		0.76	
			Highway	C/D	0.03		0.04	
			LDR	A	0.67	3.59	1.13	
			LDR	C/D	0.10	0.39	0.27	
			Open	A	0.00	0.05	0.01	
Open	C/D		0.02	0.01				
829	0.29	0.17	Commercial	B	0.12	0.00	0.21	0.29
			Forest	B		0.02	0.00	
			Highway	B	0.05		0.06	
			Open	B		0.10	0.01	
832	1.74	0.60	Forest	A		0.11	0.01	0.89
			Highway	A	0.44		0.59	
			LDR	A	0.16	0.91	0.28	
			Open	A		0.12	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

834	6.21	0.81	Ag	C	0.00	0.29	0.13	2.36
			Forest	C		0.66	0.09	
			Highway	C	0.66		0.88	
			Industrial	C	0.00	2.86	0.61	
			Industrial	C/D	0.02	1.06	0.34	
			LDR	C	0.00	0.40	0.08	
			LDR	C/D		0.06	0.02	
			Open	C	0.12	0.08	0.20	
835	2.67	0.61	Forest	A		0.09	0.01	1.03
			Highway	A	0.28		0.37	
			LDR	A	0.33	1.44	0.55	
			LDR			0.47	0.10	
837	51.41	17.72	Open	A		0.07	0.00	33.67
			Forest	A		0.15	0.02	
			Forest	B		2.29	0.30	
			Forest	C/D		0.97	0.13	
			HDR	A	0.13	0.38	0.32	
			HDR	B	0.67	0.61	1.63	
			HDR	C/D	1.52	2.90	4.37	
			Highway	A	0.61		0.82	
			Highway	B	3.71		4.97	
			Highway	C/D	2.62		3.51	
			LDR	A	0.92	1.16	1.44	
			LDR	B	4.96	14.17	9.25	
			LDR	C/D	2.56	9.17	6.56	
			Open	A		0.06	0.00	
			Open	B	0.01	1.04	0.13	
			Open	C/D		0.79	0.23	
838	1.58	1.05	Commercial	A		0.05	0.00	1.87
			Commercial		0.88	0.17	1.61	
			Forest	A		0.07	0.01	
			Forest			0.00	0.00	
			Highway		0.13		0.17	
			LDR	A	0.00	0.12	0.01	
			LDR		0.00	0.09	0.02	
			Open	A		0.04	0.00	
839	11.79	3.53	Open		0.03		0.05	8.32
			Commercial		0.06	0.00	0.10	
			Forest	A		0.03	0.00	
			Forest	B		0.04	0.00	
			Forest	C/D		0.05	0.01	
			HDR	B	0.52	0.81	1.30	
			HDR	C/D	0.91	2.22	2.76	
			HDR		0.03	0.01	0.06	
			Highway	A	0.14		0.18	
			Highway	B	0.15		0.21	
			Highway	C/D	0.08		0.10	
			LDR	A	0.20	0.07	0.30	
			LDR	B	0.85	2.16	1.55	
			LDR	C/D	0.60	2.80	1.72	
LDR		0.00	0.01	0.01				
Open	A		0.02	0.00				
Open	B		0.05	0.01				
840	7.47	1.61	Ag	C/D		0.31	0.14	3.84
			Forest	A		0.02	0.00	
			Forest	C		0.09	0.01	
			Forest	C/D		0.96	0.13	
			Highway	A	0.04		0.06	
			Highway	C	0.19		0.26	
			Highway	C/D	0.38		0.51	
			LDR	A	0.00	0.05	0.00	
			LDR	C	0.11	0.65	0.30	
			LDR	C/D	0.84	3.48	2.28	
			Open	C		0.03	0.01	
Open	C/D	0.04	0.26	0.14				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

841	12.84	2.32	Forest	A		0.13	0.02	5.82
			Forest	C/D		0.80	0.10	
			HDR	A	0.03	0.09	0.06	
			Highway	A	0.43		0.57	
			Highway	C/D	0.82		1.10	
			LDR	A	0.12	1.41	0.23	
			LDR	C/D	0.93	7.83	3.68	
			Open	A		0.06	0.00	
843	1.95	0.00	Open	C/D		0.19	0.06	0.38
			Forest	A/D		0.09	0.01	
			Forest			0.23	0.03	
844	3.25	0.23	Open			1.63	0.34	0.90
			Forest	A/D		0.15	0.02	
			Forest			1.00	0.13	
			Open	C	0.02		0.03	
846	6.50	3.38	Open		0.22	1.86	0.72	5.96
			Commercial		0.15	0.01	0.27	
			Forest	A		0.18	0.02	
			Forest	B		0.27	0.03	
			Forest			0.00	0.00	
			HDR	A	0.19	0.43	0.45	
			HDR	B	0.74	0.73	1.81	
			Highway	A	0.21		0.29	
			Highway	B	0.90		1.20	
			Highway		0.24		0.32	
			LDR	A	0.26	0.56	0.41	
			LDR	B	0.62	0.50	1.01	
			LDR		0.06	0.02	0.10	
			Open	A		0.10	0.00	
848	1.13	0.80	Open	B		0.29	0.04	1.46
			Open			0.04	0.01	
			Commercial		0.17	0.06	0.32	
			Forest			0.00	0.00	
			HDR		0.22	0.26	0.56	
849	0.06	0.03	Highway		0.28		0.38	0.04
			Open		0.13	0.00	0.19	
			Forest			0.03	0.00	
			Highway		0.03		0.04	
850	3.94	1.09	Forest	A		0.00	0.00	1.92
			Forest	A/D		0.10	0.01	
			Forest	B		0.12	0.02	
			Highway	A	0.03		0.05	
			Highway	A/D	0.15		0.20	
			Highway	B	0.19		0.26	
			LDR	A	0.18	0.63	0.30	
			LDR	A/D		0.44	0.09	
			LDR	B	0.48	1.50	0.91	
			Open	A	0.05	0.03	0.08	
869	2.44	0.39	Open	A/D		0.01	0.00	1.05
			Open	B		0.02	0.00	
			Forest	C/D		0.05	0.01	
			Highway	C/D	0.10		0.14	
			LDR	C	0.20	1.31	0.58	
			LDR	C/D	0.08	0.66	0.31	
874	18.47	3.20	LDR	D		0.00	0.00	5.39
			Open	C/D		0.03	0.01	
			Forest	A		0.79	0.10	
			Forest	B		0.00	0.00	
			HDR	A	0.00	0.23	0.01	
			HDR	A/D		0.22	0.05	
			Highway	A	1.35		1.81	
			Highway	B	0.00		0.00	
			LDR	A	1.75	12.02	3.02	
LDR	A/D	0.02	0.73	0.18				
LDR	B	0.07	0.73	0.20				
Open	A		0.53	0.02				
Open	B		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

876	5.90	0.74	Forest	A		0.08	0.01	1.24
			Highway	A	0.27		0.36	
			LDR	A	0.47	5.00	0.87	
			Open	A		0.08	0.00	
877	1.42	1.09	Forest	A		0.00	0.00	2.10
			Forest			0.09	0.01	
			HDR	A	0.02	0.02	0.05	
			HDR		0.57	0.20	1.35	
			Highway	A	0.08		0.11	
			Highway		0.41		0.55	
			LDR	A	0.02		0.03	
			Open	A		0.00	0.00	
			Open			0.00	0.00	
			Open			0.00	0.00	
878	2.69	0.92	Forest	A		0.24	0.03	1.38
			Forest			0.00	0.00	
			Highway	A	0.71		0.95	
			Highway		0.00		0.00	
			LDR	A	0.21	1.26	0.36	
			LDR		0.00	0.14	0.03	
			Open	A	0.00	0.13	0.00	
880	10.03	2.02	Forest	C/D		1.01	0.13	4.89
			Forest	D		0.06	0.01	
			Highway	C/D	0.92		1.23	
			Highway	D	0.04		0.06	
			LDR	B	0.16	1.61	0.43	
			LDR	C/D	0.71	3.89	2.20	
			LDR	D	0.20	1.28	0.78	
			Open	C/D		0.12	0.03	
			Open	D		0.03	0.01	
881	3.51	0.86	Forest	A		0.18	0.02	1.38
			Forest	B		0.06	0.01	
			Highway	A	0.35		0.46	
			Highway	B	0.04		0.05	
			LDR	A	0.46	1.76	0.75	
			LDR	B	0.02	0.42	0.08	
			Open	A		0.21	0.01	
			Open	B		0.03	0.00	
882	6.30	1.25	Forest	A		0.37	0.05	2.02
			Highway	A	0.46		0.61	
			LDR	A	0.75	4.32	1.27	
			LDR	B	0.04	0.16	0.08	
			Open	A		0.20	0.01	
884	8.88	2.16	Forest	B		0.09	0.01	4.00
			HDR	B	0.03	0.00	0.08	
			Highway	B	0.64		0.86	
			LDR	B	1.49	6.30	3.02	
			Open	B		0.33	0.04	
890	1.72	0.61	Forest	A		0.19	0.02	0.92
			Highway	A	0.37		0.49	
			LDR	A	0.25	0.77	0.40	
			Open	A		0.15	0.00	
900	2.54	0.93	Forest	A		0.22	0.03	1.65
			Forest	A/D		0.55	0.07	
			HDR	A	0.25	0.38	0.59	
			Highway	A	0.48		0.65	
			Highway	A/D	0.06		0.08	
			LDR	A	0.13	0.38	0.21	
			LDR	A/D	0.01	0.01	0.02	
			Open	A		0.07	0.00	
901	6.47	1.37	Forest	A		3.96	0.52	2.51
			Forest	B/D		0.21	0.03	
			Forest			0.17	0.02	
			Highway	A	0.67		0.89	
			Highway		0.67		0.90	
			LDR	A	0.03	0.02	0.04	
			LDR		0.00	0.00	0.00	
			Open	A		0.28	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Open		0.00	0.46	0.10	
902	0.24	0.11	Forest	C		0.02	0.00	0.22
			Forest	D		0.01	0.00	
			HDR	C	0.04	0.07	0.11	
			HDR	D		0.02	0.01	
			Highway	C	0.04		0.06	
			Highway	D	0.03		0.04	
903	21.39	3.47	Forest	C		3.89	0.51	8.66
			Forest	C/D		0.15	0.02	
			Forest	D		0.09	0.01	
			HDR	D	0.00	0.06	0.03	
			Highway	C	1.14		1.52	
			Highway	C/D	0.45		0.60	
			Highway	D	0.24		0.33	
			LDR	C	1.10	9.17	3.60	
			LDR	C/D	0.42	2.50	1.36	
			LDR	D	0.11	0.35	0.30	
			Open	C		1.55	0.33	
			Open	C/D		0.10	0.03	
			Open	D		0.05	0.02	
904	3.87	1.19	Forest	A		0.13	0.02	2.44
			Forest	B		0.03	0.00	
			Forest	C/D		0.06	0.01	
			Forest	D		0.03	0.00	
			HDR	B	0.27	0.64	0.69	
			HDR	C/D	0.00	0.01	0.00	
			HDR	D	0.01	0.25	0.11	
			Highway	A	0.10		0.13	
			Highway	B	0.13		0.18	
			Highway	C/D	0.18		0.24	
			Highway	D	0.01		0.02	
			LDR	B	0.47	1.05	0.84	
			LDR	C/D	0.01	0.09	0.03	
			LDR	D	0.01	0.29	0.12	
			Open	A	0.00	0.01	0.00	
			Open	B		0.03	0.00	
Open	C/D	0.02	0.05	0.04				
Open	D		0.01	0.00				
905	2.63	1.62	Forest	A		0.03	0.00	2.35
			Forest			0.25	0.03	
			Highway	A	0.53		0.72	
			Highway		1.07		1.43	
			LDR	A	0.01	0.00	0.02	
			LDR		0.00	0.00	0.00	
			Open	A	0.00	0.07	0.00	
Open			0.66	0.14				
906	1.77	0.29	Forest	C		0.08	0.01	0.72
			Highway	C	0.14		0.18	
			LDR	C	0.16	1.34	0.52	
			Open	C		0.05	0.01	
908	1.19	0.31	Highway	C	0.12		0.16	0.63
			LDR	C	0.19	0.84	0.46	
			Open	C		0.04	0.01	
911	1.54	0.54	Commercial	A	0.07	0.11	0.12	0.79
			Forest	A		0.04	0.01	
			Highway	A	0.44		0.58	
			LDR	A	0.03	0.72	0.07	
			Open	A		0.13	0.00	
912	5.44	0.96	Forest	A		0.29	0.04	1.58
			Forest	A/D		0.04	0.01	
			Forest	B		0.00	0.00	
			Highway	A	0.35		0.47	
			Highway	A/D	0.15		0.20	
			LDR	A	0.41	3.87	0.74	
			LDR	A/D	0.02	0.22	0.08	
			LDR	B	0.03	0.05	0.05	
Open	A	0.00	0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

			Open	A/D		0.01	0.00	
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**Phosphorus Load Calculations - Merrimack River, Andover, MA**

916	1.56	0.38	Forest	A		0.28	0.04	0.60
			Forest	B/D		0.02	0.00	
			Highway	A	0.23		0.31	
			Highway	B/D	0.02		0.03	
			LDR	A	0.13	0.83	0.22	
			LDR	B/D		0.02	0.00	
917	2.67	1.36	Open	A		0.03	0.00	2.32
			Commercial	A	0.04	0.00	0.08	
			Forest	A		0.07	0.01	
			Forest	B		0.02	0.00	
			Highway	A	0.05		0.07	
			Highway	B	0.13		0.17	
			Industrial	A	0.18	0.02	0.32	
			Industrial	B	0.38	0.66	0.75	
918	7.68	0.64	Open	A	0.57	0.37	0.88	1.46
			Open	B	0.01	0.17	0.03	
			Forest	A		1.77	0.23	
			Forest	B		1.15	0.15	
			Highway	A	0.20		0.27	
			Highway	B	0.26		0.35	
			Industrial	B	0.01	0.00	0.02	
			LDR	A	0.13	3.38	0.30	
920	21.35	5.50	LDR	B		0.72	0.09	11.25
			Open	A	0.04	0.01	0.06	
			Open	B	0.00	0.01	0.01	
			Forest	B		0.18	0.02	
			Forest	B/D		1.66	0.22	
			Forest	D		0.01	0.00	
			HDR	B/D	0.47	1.56	1.43	
			Highway	B	0.34		0.46	
			Highway	B/D	2.07		2.78	
			Highway	D	0.11		0.15	
			LDR	B	0.51	2.63	1.09	
			LDR	B/D	1.99	9.06	4.93	
923	10.56	1.36	LDR	D		0.12	0.04	3.13
			Open	B		0.05	0.01	
			Open	B/D		0.56	0.12	
			Open	D		0.03	0.01	
			Forest	B		2.04	0.27	
			Forest	C/D		0.16	0.02	
			Highway	B	0.65		0.87	
925	3.58	0.40	Highway	C/D	0.15		0.20	1.04
			LDR	B	0.57	6.34	1.62	
			LDR	C/D		0.35	0.10	
			Open	B		0.19	0.02	
			Open	C/D		0.11	0.03	
			Ag	A		0.02	0.01	
			Forest	A		0.55	0.07	
			Forest	C		0.26	0.03	
			Forest	C/D		0.92	0.12	
			Highway	A	0.07		0.09	
			Highway	C	0.07		0.09	
Highway	C/D	0.27		0.36				
LDR	C		0.28	0.06				
LDR	C/D	0.00	0.54	0.16				
Open	A	0.00	0.47	0.01				
Open	C		0.00	0.00				
Open	C/D		0.13	0.04				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

927	12.94	3.50	Forest	A		0.88	0.11	5.84				
			Forest	B		0.02	0.00					
			HDR	A	0.06	0.17	0.14					
			Highway	A	1.97		2.64					
			Highway	B	0.07		0.09					
			Highway	B/D	0.10		0.13					
			Industrial	A	0.04	0.04	0.08					
			Industrial	B/D	0.01	1.63	0.35					
			Industrial	D		0.49	0.18					
			LDR	A	1.24	5.79	2.06					
			LDR	B	0.01	0.04	0.03					
			Open	A	0.00	0.30	0.01					
			Open	B/D		0.08	0.02					
930	25.52	6.39	Commercial	A	0.78	1.49	1.43	14.29				
			Commercial		3.32	5.83	7.13					
			Forest	A		0.51	0.07					
			Forest			0.19	0.02					
			HDR	A	0.55	5.95	1.46					
			HDR		1.10	2.90	3.16					
			Highway	A	0.00		0.01					
			Highway		0.31		0.42					
			LDR	A	0.32	2.03	0.55					
			LDR			0.04	0.01					
			Open			0.21	0.04					
			931	1.93	0.40	Forest	B			0.05	0.01	0.71
						Highway	B		0.24		0.32	
Highway	B/D	0.01					0.01					
LDR	A					0.39	0.01					
LDR	B	0.15				1.07	0.36					
LDR	B/D	0.00				0.00	0.00					
Open	B					0.02	0.00					
Open	B/D		0.00	0.00								
932	2.52	0.17	Forest	A		0.01	0.00	0.68				
			Forest	B/D		0.21	0.03					
			Forest	D		0.28	0.04					
			Highway	A	0.05		0.07					
			Highway	D	0.10		0.13					
			LDR	A		0.65	0.02					
			LDR	B/D		0.53	0.11					
			LDR	D		0.66	0.24					
			Open	A	0.00	0.00	0.00					
			Open	A/D	0.00		0.00					
Open	D	0.02		0.03								
933	1.33	0.36	Forest	A		0.01	0.00	0.56				
			Forest	D		0.00	0.00					
			Highway	A	0.19		0.26					
			Highway	D	0.01		0.01					
			LDR	A	0.16	0.91	0.27					
			LDR	D		0.04	0.02					
			Open	A		0.01	0.00					
Open	D		0.00	0.00								
935	0.16	0.11	Forest	D		0.02	0.00	0.16				
			Highway	B	0.05		0.06					
			Highway	D	0.05		0.07					
			LDR	B	0.01	0.01	0.01					
			LDR	D	0.01	0.00	0.01					
Open	B		0.01	0.00								
936	7.33	0.86	Forest	B		0.07	0.01	2.48				
			Highway	B	0.40		0.54					
			LDR	B	0.18	3.90	0.74					
			LDR	C/D	0.24	1.84	0.89					
			LDR	D	0.04	0.64	0.30					
Open	B		0.02	0.00								
937	0.15	0.10	Highway	B	0.07		0.09	0.14				
			LDR	B	0.03	0.04	0.05					
			Open	B		0.01	0.00					

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

941	1.97	0.63	Forest	A		0.11	0.01	0.96
			Highway	A	0.28		0.38	
			LDR	A	0.35	1.23	0.56	
			Open	A		0.00	0.00	
942	1.73	0.36	Forest	A		0.02	0.00	0.61
			Forest	C		0.00	0.00	
			Highway	A	0.18		0.24	
			Highway	C	0.02		0.03	
			LDR	A	0.14	1.01	0.25	
			LDR	C	0.02	0.27	0.08	
			Open	A		0.03	0.00	
			Open	C		0.04	0.01	
945	2.35	0.38	Forest	A		0.18	0.02	0.83
			Forest	B		0.81	0.11	
			Forest	B/D		0.03	0.00	
			Forest	D		0.17	0.02	
			Highway	B	0.06		0.09	
			Highway	B/D	0.06		0.08	
			Highway	D	0.11		0.15	
			LDR	B	0.03	0.58	0.12	
			LDR	B/D	0.02	0.02	0.04	
			LDR	D	0.09	0.16	0.20	
			Open	B		0.00	0.00	
949	3.73	0.62	Forest	B		0.20	0.03	1.43
			Forest	C/D		0.04	0.01	
			Highway	B	0.20		0.26	
			Highway	C/D	0.07		0.09	
			LDR	B	0.18	1.19	0.42	
			LDR	C	0.15	1.59	0.56	
			LDR	C/D	0.02	0.08	0.06	
Open	B		0.00	0.00				
Open	C/D		0.01	0.00				
951	15.43	1.77	Forest	B		0.05	0.01	5.65
			Forest	C		0.00	0.00	
			Forest	C/D		0.37	0.05	
			Highway	B	0.13		0.17	
			Highway	C/D	0.57		0.77	
			LDR	B	0.25	2.99	0.75	
			LDR	C	0.31	3.65	1.24	
			LDR	C/D	0.50	6.56	2.66	
Open	B		0.00	0.00				
Open	C/D		0.04	0.01				
952	3.15	0.84	Commercial	C/D	0.00	0.64	0.19	1.73
			Commercial	D	0.09	0.15	0.21	
			Forest	C/D		0.62	0.08	
			Forest	D		0.17	0.02	
			Highway	C/D	0.52		0.70	
			Highway	D	0.19		0.25	
			Industrial	D		0.00	0.00	
			LDR	C/D	0.04	0.51	0.20	
			LDR	D		0.03	0.01	
			Open	C/D		0.12	0.03	
Open	D		0.06	0.02				
953	0.21	0.10	Forest	C/D		0.07	0.01	0.15
			Forest	D		0.03	0.00	
			Highway	C/D	0.08		0.11	
			Highway	D	0.02		0.02	
Open	C/D		0.01	0.00				
956	14.45	0.69	Forest	A		0.32	0.04	2.58
			Forest	B		0.13	0.02	
			Highway	A	0.42		0.56	
			Highway	B	0.18		0.24	
			LDR	A	0.01	3.14	0.10	
			LDR	B	0.08	8.58	1.16	
			LDR	C/D		1.58	0.46	
Open	A		0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

958	7.51	1.24	Forest	A		0.07	0.01	2.81
			Forest	B		0.07	0.01	
			Forest	C/D		0.47	0.06	
			Highway	A	0.11		0.15	
			Highway	B	0.24		0.32	
			Highway	C/D	0.54		0.73	
			LDR	B	0.21	3.73	0.77	
			LDR	C/D	0.13	1.91	0.75	
			Open	A		0.00	0.00	
			Open	B		0.01	0.00	
961	0.85	0.24	Open	C/D		0.01	0.00	0.39
			Forest	A		0.15	0.02	
			Highway	A	0.09		0.13	
963	6.14	1.87	LDR	A	0.15	0.41	0.24	3.18
			Open	A		0.05	0.00	
			Forest	B		0.65	0.08	
964	23.84	13.61	Highway	B	0.95		1.27	23.78
			LDR	B	0.81	3.55	1.66	
			Open	B	0.11	0.07	0.17	
			Commercial	A		0.07	0.00	
			Commercial		2.16	0.58	3.96	
			Forest	A		0.66	0.09	
			Forest	B		0.00	0.00	
			Forest			0.64	0.08	
			HDR	A	0.77	2.91	1.88	
			HDR	B	1.05	0.92	2.55	
			HDR		1.40	0.88	3.44	
			Highway	A	0.24		0.32	
			Highway	B	0.04		0.05	
			Highway		5.75		7.71	
			Industrial		0.03		0.06	
966	7.68	5.56	LDR	A	0.44	1.75	0.73	7.89
			LDR	B	0.39	0.54	0.66	
			LDR		0.51	0.44	0.87	
			Open	A		0.23	0.01	
			Open	B		0.02	0.00	
			Open		0.83	0.57	1.38	
			Open		0.01		0.01	
968	7.09	1.42	Commercial	B/D	0.01		0.01	3.01
			Forest			0.20	0.03	
			Highway	B/D	0.39		0.52	
			Highway		5.17		6.92	
			Open	B/D	0.00	0.14	0.03	
			Open			1.78	0.37	
			Ag	A/D		0.00	0.00	
			Ag	B		0.02	0.01	
			Ag	B/D		0.00	0.00	
			Forest	A/D		0.34	0.04	
			Forest	B		0.02	0.00	
			Forest	B/D		0.03	0.00	
			Forest	C		0.25	0.03	
			HDR	A/D	0.01	0.07	0.04	
			HDR	C	0.07	0.11	0.19	
			Highway	A/D	0.63		0.85	
			Highway	B	0.11		0.15	
			Highway	C	0.35		0.47	
LDR	A/D	0.10	1.78	0.53				
LDR	B	0.13	1.72	0.40				
LDR	B/D		0.38	0.08				
LDR	C	0.01	0.23	0.06				
Open	A/D		0.46	0.10				
Open	B		0.10	0.01				
Open	C		0.17	0.04				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

970	6.01	1.28	Forest	A		0.30	0.04	2.36
			Forest			0.33	0.04	
			Highway	A	0.47		0.63	
			Highway		0.32		0.43	
			LDR	A	0.13	2.05	0.26	
			LDR		0.36	1.87	0.94	
			Open	A		0.09	0.00	
973	7.19	1.05	Forest	C		0.03	0.00	3.03
			Forest	C/D		1.11	0.14	
			Highway	C	0.40		0.54	
			Highway	C/D	0.06		0.08	
			LDR	C	0.10	1.00	0.36	
			LDR	C/D	0.49	3.84	1.86	
			Open	C	0.00	0.12	0.03	
974	0.24	0.01	Open	C/D		0.04	0.01	0.08
			Highway	C	0.01		0.01	
			LDR	C		0.07	0.01	
			LDR	C/D	0.00	0.06	0.02	
			LDR	D		0.10	0.04	
976	5.11	0.21	Open	C		0.01	0.00	1.63
			Forest	C/D		0.82	0.11	
			HDR	C/D		0.66	0.19	
			HDR	D		0.38	0.14	
			Highway	C/D	0.08		0.11	
			LDR	C/D	0.13	3.03	1.08	
977	10.54	2.90	Open	C/D		0.02	0.00	6.85
			Commercial	B	0.25	1.06	0.58	
			Commercial	C	2.23	1.53	4.28	
			Commercial	C/D		0.00	0.00	
			Commercial	D		0.51	0.19	
			Forest	C		0.18	0.02	
			Forest	C/D		0.07	0.01	
			Forest	D		1.22	0.16	
			HDR	C		0.13	0.03	
			HDR	C/D		0.00	0.00	
			HDR	D		1.42	0.53	
			Highway	C	0.04		0.06	
			Highway	C/D	0.14		0.18	
			Highway	D	0.08		0.11	
			LDR	B	0.09	0.16	0.15	
LDR	C/D	0.08	0.79	0.35				
LDR	D		0.50	0.19				
978	1.36	0.36	Open	C/D		0.06	0.02	0.56
			Forest	A		0.21	0.03	
			Highway	A	0.25		0.34	
			LDR	A	0.11	0.77	0.19	
979	15.92	3.45	Open	A		0.01	0.00	6.64
			Forest	A		0.03	0.00	
			Forest	B		0.31	0.04	
			Forest	B/D		0.60	0.08	
			Forest	D		0.03	0.00	
			Highway	A	0.30		0.40	
			Highway	B	0.51		0.69	
			Highway	B/D	0.94		1.26	
			Highway	D	0.07		0.09	
			LDR	A	0.42	2.74	0.72	
			LDR	B	0.43	3.69	1.09	
			LDR	B/D	0.77	4.45	2.11	
			LDR	D	0.01	0.20	0.09	
			Open	A		0.03	0.00	
Open	B		0.15	0.02				
Open	B/D		0.22	0.05				
Open	D		0.01	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

980	0.80	0.39	Commercial	A	0.03	0.00	0.05	0.56
			Commercial	B/D		0.00	0.00	
			Forest	A		0.05	0.01	
			Forest	B/D		0.01	0.00	
			Highway	A	0.26		0.35	
			Highway	B/D	0.04		0.05	
			LDR	A	0.06	0.34	0.10	
			LDR	B/D		0.00	0.00	
981	8.16	0.39	Open	A		0.01	0.00	1.51
			Forest	B		4.12	0.54	
			Highway	B	0.27		0.37	
			LDR	B	0.11	3.64	0.61	
984	8.98	0.87	Open	B	0.00	0.01	0.00	2.12
			Forest	B		0.18	0.02	
			Forest	C/D		0.38	0.05	
			Highway	B	0.06		0.09	
			Highway	C/D	0.26		0.35	
			LDR	A	0.08	1.82	0.18	
			LDR	B	0.41	5.47	1.28	
			LDR	C/D	0.04	0.25	0.14	
985	56.94	9.59	Open	C/D	0.00	0.02	0.01	23.07
			Forest	A		0.05	0.01	
			Forest	A/D		0.03	0.00	
			Forest	B		0.78	0.10	
			Forest	B/D		0.07	0.01	
			Forest	C		0.40	0.05	
			Forest	D		0.06	0.01	
			HDR	A/D	0.02	0.08	0.06	
			HDR	C	0.11	0.06	0.26	
			HDR	D	0.04	0.19	0.17	
			Highway	A	0.33		0.45	
			Highway	A/D	0.13		0.18	
			Highway	B	2.26		3.03	
			Highway	B/D	0.30		0.41	
			Highway	C	0.97		1.30	
			Highway	D	0.45		0.60	
			LDR	A	0.34	2.19	0.59	
			LDR	A/D	0.10	0.56	0.26	
			LDR	B	2.12	17.08	5.27	
			LDR	B/D	0.12	1.14	0.42	
LDR	C	1.61	15.09	5.62				
LDR	D	0.68	7.94	3.97				
LDR			0.01	0.00				
Open	A		0.04	0.00				
Open	A/D		0.00	0.00				
Open	B		0.79	0.09				
Open	B/D		0.11	0.02				
Open	C		0.50	0.10				
Open	D		0.21	0.08				
989	1.04	0.24	Forest	C		0.06	0.01	0.49
			Highway	C	0.22		0.29	
			Highway	D	0.00		0.00	
			LDR	C	0.02	0.54	0.14	
			LDR	D		0.05	0.02	
			Open	C		0.15	0.03	
990	0.34	0.28	Open	D		0.00	0.00	0.38
			Forest	B		0.05	0.01	
			Forest	B/D		0.01	0.00	
			Highway	B	0.26		0.35	
Highway	B/D	0.02		0.03				
Open	B		0.01	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

991	5.54	1.43	Ag	A	0.03	0.16	0.11	2.39
			Forest	A		0.18	0.02	
			Forest	B/D		0.12	0.02	
			Forest	C/D		0.03	0.00	
			Highway	A	0.76		1.02	
			Highway	B/D	0.01		0.02	
			Highway	C/D	0.15		0.20	
			LDR	A	0.44	3.01	0.76	
			LDR	C/D	0.01	0.01	0.01	
			LDR	D	0.01	0.42	0.17	
			MDR	A	0.03	0.11	0.07	
			Open	A		0.07	0.00	
			Open	C/D		0.01	0.00	
992	0.41	0.11	Forest	A		0.01	0.00	0.23
			Forest	D		0.02	0.00	
			Highway	A	0.03		0.04	
			Highway	D	0.02		0.03	
			LDR	A	0.01	0.06	0.02	
			LDR	D	0.04	0.20	0.13	
			Open	A		0.01	0.00	
Open	D		0.00	0.00				
993	0.54	0.07	Forest	B		0.00	0.00	0.17
			LDR	A	0.02	0.27	0.04	
			LDR	B		0.03	0.00	
			LDR	B/D	0.00	0.04	0.01	
996	3.38	0.27	LDR	D	0.05	0.13	0.12	0.58
			Forest	A		0.81	0.10	
			HDR	A		0.08	0.00	
			Highway	A	0.03		0.04	
			LDR	A	0.24	1.19	0.40	
1000	1.04	0.21	Open	A		1.04	0.03	0.36
			Forest	A		0.27	0.03	
			Forest	A/D		0.14	0.02	
			Highway	A	0.11		0.14	
			Highway	A/D	0.10		0.13	
			LDR	A	0.00	0.33	0.01	
1001	0.64	0.02	LDR	A/D	0.00	0.09	0.02	0.08
			Open	A/D		0.01	0.00	
			Forest	A		0.26	0.03	
1006	6.75	0.97	LDR	A	0.02	0.35	0.05	1.64
			Open	A		0.01	0.00	
			Forest	A		0.93	0.12	
			Highway	A	0.51		0.68	
1007	3.77	0.97	LDR	A	0.46	4.71	0.84	1.68
			Open	A		0.15	0.00	
			Forest	A		1.24	0.16	
			Forest	B		0.20	0.03	
			Highway	A	0.24		0.32	
			Highway	B	0.04		0.05	
			LDR	A	0.05	0.67	0.09	
			LDR	B		0.02	0.00	
			Open	A	0.28	0.33	0.44	
Open	B	0.36	0.34	0.58				
1008	11.53	3.93	Forest	A		0.18	0.02	5.52
			Highway	A	3.88		5.20	
			LDR	A	0.05	0.02	0.07	
			Open	A		7.40	0.22	
1009	3.90	1.99	Forest	A		0.71	0.09	2.81
			Forest	B		0.02	0.00	
			Highway	A	1.96		2.63	
			LDR	A		0.03	0.00	
			LDR	B	0.03	0.11	0.05	
			Open	A		1.02	0.03	
Open	B		0.02	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1010	12.54	1.03	Forest	A		0.84	0.11	2.81
			Forest	B/D		0.56	0.07	
			HDR	B/D	0.13	0.24	0.36	
			Highway	A	0.16		0.21	
			LDR	A	0.00	0.00	0.00	
			LDR	B/D	0.66	3.53	1.74	
			Open	A	0.08	6.32	0.32	
			Open	B/D		0.01	0.00	
1011	2.37	2.00	Commercial		1.17	0.17	2.12	3.58
			Forest			0.04	0.01	
			HDR	B	0.01	0.07	0.03	
			HDR		0.24	0.06	0.57	
			Highway		0.21		0.28	
			Open		0.38	0.02	0.58	
1013	122.07	61.31	Commercial	A	0.74	0.30	1.32	106.36
			Commercial	B	1.53	0.55	2.79	
			Commercial	B/D	0.01	0.00	0.01	
			Commercial	C/D	1.47	0.25	2.68	
			Commercial		9.22	0.68	16.55	
			Forest	A		9.17	1.19	
			Forest	B		7.03	0.91	
			Forest	B/D		2.77	0.36	
			Forest	C/D		0.44	0.06	
			Forest			1.75	0.23	
			HDR	A	0.93	0.90	2.19	
			HDR	B	1.83	3.13	4.63	
			HDR	B/D	1.41	1.48	3.59	
			HDR	C/D	2.04	2.72	5.52	
			HDR		1.33	0.73	3.23	
			Highway	A	4.84		6.49	
			Highway	B	9.41		12.60	
			Highway	B/D	2.69		3.60	
			Highway	C/D	1.96		2.62	
			Highway		10.88		14.58	
			Industrial		0.43	0.04	0.76	
			LDR	A	0.20	0.72	0.33	
			LDR	B	2.15	5.61	3.94	
			LDR	B/D	1.91	4.67	3.88	
			LDR	C/D	1.34	2.65	2.81	
			LDR		0.69	0.40	1.13	
Open	A	0.21	4.63	0.46				
Open	B	0.21	5.89	1.02				
Open	B/D	0.16	2.59	0.79				
Open	C/D	0.04	0.48	0.20				
Open		3.69	1.19	5.86				
1016	0.74	0.29	Forest	A		0.04	0.01	0.48
			Forest	B/D		0.12	0.02	
			HDR	A	0.07	0.15	0.17	
			Highway	A	0.09		0.13	
			Highway	B/D	0.12		0.16	
			LDR	A		0.13	0.00	
			Open	A		0.01	0.00	
			Open	B/D	0.00		0.00	
1018	2.06	0.66	Forest	A		0.33	0.04	1.02
			Highway	A	0.33		0.44	
			LDR	A	0.33	0.98	0.53	
			Open	A		0.09	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1019	26.64	6.27	Commercial	B	0.72	0.78	1.37	12.08
			Forest	A		3.03	0.39	
			Forest	B		3.89	0.51	
			Forest	B/D		5.13	0.67	
			HDR	B/D	0.03	0.01	0.07	
			Highway	A	0.04		0.05	
			Highway	B	2.54		3.41	
			Highway	B/D	1.13		1.52	
			LDR	A	0.00	0.00	0.00	
			LDR	B	0.40	1.79	0.83	
			LDR	B/D	1.27	4.59	2.89	
			Open	B		0.93	0.11	
			Open	B/D	0.14	0.21	0.26	
1048	9.62	1.14	Forest	A		0.50	0.07	1.95
			Highway	A	0.51		0.68	
			LDR	A	0.63	7.83	1.20	
			Open	A		0.14	0.00	
1049	4.60	0.31	Forest	B		0.17	0.02	1.10
			Forest	C/D		3.15	0.41	
			Highway	B	0.09		0.12	
			Highway	C/D	0.14		0.18	
			LDR	B	0.00	0.26	0.03	
			LDR	C/D	0.09	0.70	0.33	
1058	0.75	0.06	Open	C/D		0.01	0.00	0.23
			Forest	C		0.17	0.02	
			Highway	B/D	0.00		0.00	
			LDR	B/D	0.00	0.12	0.03	
1059	13.53	2.98	LDR	C	0.06	0.40	0.17	6.08
			Forest	B		0.52	0.07	
			Forest	B/D		0.53	0.07	
			Forest	C		0.15	0.02	
			Highway	B	0.50		0.67	
			Highway	B/D	0.62		0.83	
			Highway	C	0.29		0.38	
			LDR	B	0.49	3.41	1.15	
			LDR	B/D	0.49	3.11	1.40	
			LDR	C	0.60	2.26	1.38	
			Open	B		0.15	0.02	
1062	1.98	0.44	Open	B/D		0.21	0.04	0.79
			Open	C		0.20	0.04	
			Forest	A		0.63	0.08	
			Forest	B		0.85	0.11	
			Highway	A	0.18		0.24	
			Highway	B	0.26		0.35	
1063	0.78	0.29	Open	A		0.06	0.00	0.46
			Open	B		0.00	0.00	
			Forest	B		0.05	0.01	
			Highway	B	0.24		0.33	
1064	6.42	0.71	LDR	B	0.04	0.39	0.11	1.55
			LDR	B	0.04	0.39	0.11	
			Open	B		0.05	0.01	
			Forest	A		0.14	0.02	
			Forest	B/D		0.03	0.00	
			Highway	A	0.07		0.09	
			Highway	B/D	0.11		0.15	
			LDR	A	0.49	3.78	0.85	
1065	5.09	1.01	LDR	B/D	0.04	1.74	0.43	1.89
			LDR	B/D	0.04	1.74	0.43	
			Open	A		0.00	0.00	
			Open	B/D		0.00	0.00	
			Forest	A		0.14	0.02	
			Forest	B		0.42	0.05	
			Forest	C		0.32	0.04	
Highway	B	0.56		0.75				
Highway	C	0.34		0.45				
LDR	B	0.05	1.98	0.32				
LDR	C	0.01	0.11	0.03				
Open	B	0.06	1.22	0.23				
Open	C		0.03	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1067	1.02	0.26	Forest	A		0.18	0.02	0.45
			Forest	B		0.01	0.00	
			Highway	A	0.15		0.20	
			LDR	A	0.01	0.09	0.02	
			LDR	B	0.10	0.48	0.21	
1070	10.83	1.63	Open	A	0.00	0.02	0.00	5.02
			Forest	B		0.01	0.00	
			Forest	D		0.33	0.04	
			Highway	B	0.03		0.05	
			Highway	D	0.57		0.76	
			LDR	B	0.01	0.08	0.02	
			LDR	C	0.44	3.95	1.50	
			LDR	C/D	0.02	0.15	0.08	
1071	0.06	0.05	LDR	D	0.55	4.61	2.55	0.06
			Open	D		0.07	0.03	
			Forest	A		0.01	0.00	
			Highway	A	0.04		0.06	
			Highway		0.00		0.00	
			LDR	A	0.00	0.01	0.01	
			LDR		0.00	0.00	0.00	
			Open	A		0.00	0.00	
1073	5.32	1.24	Water	A		0.00	0.00	2.20
			Water			0.00	0.00	
			Forest	A		0.20	0.03	
			Forest	B		0.22	0.03	
			Highway	A	0.22		0.29	
			Highway	B	0.33		0.45	
			LDR	A	0.33	1.61	0.55	
			LDR	B	0.29	1.64	0.64	
1074	3.93	1.52	LDR	D	0.07	0.25	0.20	2.33
			Open	A		0.02	0.00	
			Open	B		0.13	0.02	
			Forest	A		1.27	0.16	
			Highway	A	1.06		1.42	
1079	0.29	0.24	Industrial	A	0.07	0.02	0.13	0.33
			LDR	A	0.37	1.03	0.59	
			Open	A	0.02	0.10	0.03	
			Forest	A		0.02	0.00	
1080	5.44	1.09	Highway	A	0.23		0.31	2.03
			LDR	A		0.00	0.00	
			Open	A	0.01	0.02	0.02	
			Forest	B		2.23	0.29	
			Forest	B/D		0.36	0.05	
			Highway	B	1.04		1.40	
1081	1.56	0.32	LDR	B	0.05	0.36	0.12	0.77
			Open	B		1.38	0.17	
			Open	B/D		0.01	0.00	
			Forest	C/D		0.31	0.04	
1082	3.36	0.49	Highway	C/D	0.14		0.18	1.46
			LDR	C/D	0.18	0.87	0.53	
			Open	C/D		0.06	0.02	
			Forest	A/D		0.05	0.01	
			Forest	C		0.17	0.02	
			Forest	C/D		0.10	0.01	
			Forest	D		0.06	0.01	
			HDR	C		0.00	0.00	
			Highway	A/D	0.20		0.27	
			Highway	C/D	0.04		0.06	
			LDR	A/D	0.00	0.21	0.05	
LDR	C		0.09	0.02				
LDR	C/D	0.20	1.92	0.86				
LDR	D	0.04	0.27	0.15				
Open	A/D	0.01		0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1086	7.66	0.79	Forest	A		0.14	0.02	2.73
			Forest	A/D		0.03	0.00	
			Forest	C/D		0.16	0.02	
			HDR	C/D	0.04	0.78	0.31	
			HDR	D		0.00	0.00	
			Highway	A	0.20		0.27	
			Highway	A/D	0.03		0.04	
			Highway	C/D	0.29		0.39	
			Industrial	A	0.00	0.69	0.02	
			Industrial	C/D	0.00	3.29	0.96	
			Industrial	D	0.01	0.10	0.05	
			LDR	A	0.04	0.62	0.08	
			LDR	A/D		0.09	0.02	
			LDR	C/D	0.17	0.93	0.53	
Open	A		0.01	0.00				
Open	C/D		0.04	0.01				
1088	16.17	3.57	Forest	B		0.37	0.05	7.66
			Forest	C/D		0.23	0.03	
			Highway	B	1.37		1.84	
			Highway	C/D	1.00		1.35	
			LDR	B	0.39	5.16	1.22	
			LDR	C/D	0.77	6.37	3.03	
			LDR	D	0.03	0.15	0.10	
			Open	B		0.19	0.02	
Open	C/D		0.12	0.04				
1090	5.75	3.79	Forest	A		0.05	0.01	6.39
			Highway	A	0.96		1.28	
			Industrial	A	2.83	1.79	5.09	
			Open	A		0.13	0.00	
1093	1.38	0.88	Forest	A		0.13	0.02	1.49
			Highway	A	0.24		0.33	
			Industrial	A	0.64	0.35	1.14	
			Open	A		0.02	0.00	
1098	24.55	3.33	Forest	A		0.94	0.12	6.93
			Forest	B		0.38	0.05	
			Forest	B/D		0.14	0.02	
			Forest			0.42	0.05	
			HDR	A	0.20	0.04	0.48	
			HDR	B	0.12	0.13	0.28	
			Highway	A	0.86		1.15	
			Highway	B	0.31		0.42	
			Highway	B/D	0.38		0.50	
			LDR	A	0.81	4.16	1.36	
			LDR	B	0.52	3.08	1.15	
			LDR	B/D	0.14	1.26	0.48	
			LDR		0.00	0.11	0.03	
			Open	A		6.61	0.20	
Open	B		2.05	0.25				
Open	B/D	0.00	0.08	0.02				
Open			1.82	0.38				
1099	1.38	1.00	Forest	A		0.01	0.00	1.48
			Highway	A	0.44		0.59	
			Highway	D	0.49		0.66	
			Industrial	A	0.00	0.06	0.00	
			Industrial	D	0.07	0.23	0.21	
			Open	A		0.02	0.00	
			Open	D		0.07	0.02	
1102	2.37	0.61	Forest	A		0.00	0.00	1.03
			Forest	B		0.12	0.02	
			Highway	B	0.39		0.52	
			LDR	A	0.07	0.53	0.13	
			LDR	B	0.15	0.99	0.35	
			Open	A		0.02	0.00	
Open	B		0.10	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1105	5.97	4.06	Commercial	A	0.23	0.08	0.42	7.86
			Forest	A		0.05	0.01	
			HDR	A	2.10	1.00	4.90	
			Highway	A	1.27		1.70	
			Industrial	A	0.43	0.00	0.77	
			Open	A	0.03	0.76	0.07	
1107	2.96	0.79	Forest	A		0.46	0.06	1.24
			Forest	B/D		0.00	0.00	
			Highway	A	0.42		0.56	
			LDR	A	0.37	1.60	0.61	
			LDR	A/D	0.00		0.00	
			LDR	B/D	0.00	0.03	0.01	
			Open	A		0.08	0.00	
Open	B/D		0.00	0.00				
1108	37.84	1.35	Forest	A		30.61	3.98	6.14
			Forest	A/D		0.03	0.00	
			Highway	A	0.49		0.66	
			Highway	A/D	0.05		0.06	
			LDR	A	0.79	5.51	1.37	
			LDR	A/D	0.01	0.08	0.03	
			Open	A	0.02	0.24	0.03	
			Open	A/D		0.02	0.00	
1109	12.69	2.42	Commercial	A	0.05	0.15	0.10	3.85
			Forest	A		0.64	0.08	
			Highway	A	1.17		1.57	
			Industrial	A	0.01	0.04	0.01	
			LDR	A	1.16	8.57	2.03	
			Open	A	0.02	0.87	0.06	
1112	1.02	0.13	Forest	A		0.08	0.01	0.21
			Highway	A	0.12		0.16	
			LDR	A	0.01	0.76	0.03	
			LDR	B		0.00	0.00	
			Open	A		0.05	0.00	
1116	7.38	2.58	Forest	A		0.02	0.00	6.07
			HDR	A	2.29	2.25	5.39	
			HDR	A/D		0.36	0.07	
			Highway	A	0.00		0.00	
			LDR	A	0.29	1.58	0.48	
			LDR	A/D		0.59	0.12	
1118	0.89	0.16	Forest	B		0.08	0.01	0.31
			HDR	B	0.00	0.39	0.05	
			Highway	B	0.12		0.16	
			LDR	B	0.04	0.26	0.09	
1119	14.57	2.73	Forest	A		0.55	0.07	4.41
			Forest	B		0.16	0.02	
			HDR	A		0.20	0.01	
			Highway	A	0.96		1.28	
			Highway	B	0.10		0.13	
			LDR	A	1.63	10.19	2.78	
			LDR	B	0.04	0.34	0.11	
			Open	A		0.37	0.01	
			Open	B		0.02	0.00	
1121	6.74	1.48	Forest	A		0.49	0.06	2.33
			Forest			0.01	0.00	
			Highway	A	0.93		1.25	
			Highway		0.06		0.08	
			LDR	A	0.38	4.17	0.70	
			LDR		0.11	0.27	0.23	
			Open	A		0.32	0.01	
			Open			0.00	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1122	1.07	0.55	Commercial	B/D	0.01	0.02	0.02	0.89
			Commercial	C	0.06	0.09	0.13	
			Forest	B/D		0.03	0.00	
			Forest	C		0.25	0.03	
			Highway	B/D	0.07		0.10	
			Highway	C	0.32		0.43	
			Industrial	C	0.04	0.12	0.10	
			Open	B/D	0.00		0.00	
1126	2.27	0.35	Open	C	0.04	0.02	0.07	0.77
			Forest	A/D		0.09	0.01	
			Forest	B		0.01	0.00	
			Forest	C		0.15	0.02	
			Highway	A/D	0.13		0.18	
			Highway	B	0.08		0.10	
			LDR	A/D	0.00	0.25	0.06	
			LDR	B	0.14	1.21	0.36	
1131	14.27	1.92	LDR	C	0.00	0.15	0.03	3.82
			Open	A/D		0.05	0.01	
			Open	B		0.00	0.00	
			Forest	A		7.12	0.92	
1135	3.00	0.59	HDR	A	0.02	0.08	0.04	1.02
			Highway	A	1.10		1.48	
			LDR	A	0.78	4.18	1.31	
			Open	A	0.02	0.97	0.06	
			Forest	A		0.45	0.06	
1136	1.76	0.55	Highway	A	0.26		0.34	0.84
			Highway	C	0.02		0.03	
			LDR	A	0.28	1.63	0.48	
			LDR	C	0.03	0.33	0.12	
			Open	A		0.00	0.00	
			Forest	A		0.12	0.02	
			Forest	C		0.01	0.00	
1138	18.25	7.40	Highway	A	0.25		0.34	10.87
			Highway	C	0.00		0.00	
			LDR	A	0.28	0.99	0.46	
			LDR	C	0.01	0.02	0.02	
			Open	A		0.07	0.00	
			Open	C		0.01	0.00	
			Forest	A		1.49	0.19	
			Forest	B		0.33	0.04	
			Forest	B/D		0.02	0.00	
			Forest			0.01	0.00	
			Highway	A	6.38		8.55	
			Highway	B	0.37		0.49	
1139	2.51	1.60	Highway		0.11		0.15	2.17
			LDR	A	0.16	0.69	0.26	
			LDR	B	0.36	0.90	0.65	
1140	1.68	1.68	LDR		0.02	0.09	0.05	2.25
			Open	A	0.01	5.85	0.19	
			Open	B		0.09	0.01	
1141	4.23	1.60	Open			1.38	0.29	2.44
			Forest	A		0.00	0.00	
			Highway	A	1.60		2.14	
1140	1.68	1.68	Open	A		0.91	0.03	2.25
			Forest	A		0.00	0.00	
			Highway	A	1.68		2.25	
1141	4.23	1.60	Open	A		0.00	0.00	2.44
			Forest	A		2.09	0.27	
			Highway	A	1.60		2.15	
1141	4.23	1.60	Open	A		0.54	0.02	2.44

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1146	1.59	0.19	Forest	A		0.07	0.01	0.39
			Forest	B		0.01	0.00	
			Forest	B/D		0.00	0.00	
			Highway	A	0.15		0.20	
			Highway	B	0.01		0.01	
			Highway	B/D	0.00		0.00	
			LDR	A	0.01	0.45	0.03	
			LDR	B	0.03	0.86	0.14	
			Open	A		0.01	0.00	
Open	B		0.00	0.00				
1147	26.97	4.81	Forest	A		1.07	0.14	9.37
			Forest	B		0.22	0.03	
			Forest	B/D		0.02	0.00	
			Forest			0.06	0.01	
			HDR	A	0.00	0.08	0.01	
			Highway	A	1.12		1.50	
			Highway	B	0.98		1.32	
			Highway	B/D	0.03		0.03	
			Highway		0.15		0.20	
			LDR	A	1.00	6.16	1.70	
			LDR	B	1.13	9.81	2.90	
			LDR	B/D	0.01	0.03	0.02	
			LDR		0.39	4.13	1.45	
			Open	A	0.00	0.23	0.01	
Open	B		0.34	0.04				
Open			0.00	0.00				
1150	2.12	0.18	Commercial	A/D	0.00		0.00	0.34
			Forest	A		0.02	0.00	
			Forest	A/D		0.01	0.00	
			Forest	B/D		0.01	0.00	
			Forest			0.00	0.00	
			Highway	A	0.11		0.15	
			Highway	A/D	0.05		0.07	
			LDR	A	0.00	1.71	0.05	
			LDR	A/D		0.00	0.00	
			LDR	B/D		0.16	0.03	
			LDR	D		0.01	0.00	
			Open	A	0.01	0.01	0.01	
Open	A/D	0.01	0.01	0.02				
Open			0.00	0.00				
1151	11.41	1.96	Forest	C		0.57	0.07	5.18
			Forest	C/D		0.32	0.04	
			Forest	D		0.75	0.10	
			Highway	C	0.99		1.33	
			Highway	C/D	0.27		0.37	
			Highway	D	0.01		0.02	
			LDR	B		0.07	0.01	
			LDR	C	0.24	2.04	0.80	
			LDR	C/D	0.44	3.96	1.81	
			LDR	D	0.01	1.64	0.62	
			Open	C		0.07	0.01	
			Open	C/D		0.03	0.01	
Open	D		0.00	0.00				
1152	6.83	0.60	Forest	B		0.03	0.00	1.65
			Highway	B	0.19		0.26	
			LDR	B	0.41	6.02	1.35	
			LDR	C/D		0.15	0.04	
Open	B		0.02	0.00				
1154	0.99	0.21	Forest	B		0.28	0.04	0.40
			Forest	C/D		0.11	0.01	
			Highway	B	0.19		0.26	
			Highway	C/D	0.01		0.01	
			LDR	B	0.01	0.31	0.05	
			LDR	C/D	0.00	0.07	0.02	
			Open	B	0.00	0.00	0.00	
Open	C/D	0.00	0.00	0.00				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1155	5.50	0.95	Forest	B		0.16	0.02	2.47
			HDR	B		0.04	0.00	
			HDR	D		0.21	0.08	
			Highway	B	0.39		0.52	
			Industrial	D	0.09	0.40	0.31	
			LDR	B	0.44	2.23	0.93	
			LDR	D	0.03	1.46	0.59	
1162	13.52	2.22	Open	B		0.05	0.01	4.67
			Forest	A		0.98	0.13	
			Forest	C		4.05	0.53	
			Forest	C/D		0.09	0.01	
			Forest	D		0.19	0.03	
			Highway	A	0.47		0.63	
			Highway	C	0.66		0.89	
			Highway	D	0.00		0.00	
			LDR	A	0.21	2.84	0.40	
			LDR	C	0.73	1.91	1.52	
1167	2.89	0.33	LDR	C/D	0.14	0.91	0.48	1.05
			Open	A	0.00	0.06	0.00	
			Open	C		0.26	0.06	
			Ag	C/D		0.14	0.06	
			Forest	A		0.31	0.04	
			Forest	C/D		0.82	0.11	
			Forest	D		0.04	0.01	
			Highway	A	0.12		0.17	
			Highway	C/D	0.11		0.15	
			Highway	D	0.00		0.00	
1179	24.36	4.04	LDR	A	0.00	0.02	0.01	11.22
			LDR	C/D	0.06	1.06	0.40	
			LDR	D	0.01	0.18	0.08	
			Open	A	0.01		0.02	
			Open	C/D	0.00	0.00	0.00	
			Open	D	0.00		0.00	
			Commercial	C/D		0.14	0.04	
			Forest	C/D		2.48	0.32	
			Forest	D		0.04	0.00	
1182	9.70	3.11	Highway	C/D	2.21		2.96	5.93
			Highway	D	0.31		0.41	
			Industrial	C/D	0.09	6.55	2.06	
			LDR	C/D	1.39	10.59	5.19	
			LDR	D	0.02	0.27	0.14	
			Open	C/D	0.01	0.23	0.08	
			Open	D	0.00	0.02	0.01	
			Commercial	A		0.01	0.00	
			Commercial	B	0.18	0.81	0.42	
			Commercial	C/D	0.01	0.48	0.16	
			Commercial		1.21	1.41	2.44	
			Forest	A		0.24	0.03	
			Forest	B		1.48	0.19	
			Forest	C/D		0.05	0.01	
			Forest			0.38	0.05	
			Highway	A	0.10		0.13	
			Highway	B	0.59		0.79	
Highway	C/D	0.10		0.13				
Highway		0.73		0.97				
Industrial	B	0.04	0.06	0.07				
Industrial	C/D	0.03	0.37	0.17				
LDR	B	0.12	0.79	0.28				
LDR	C/D		0.04	0.01				
Open	A		0.19	0.01				
Open	B	0.01	0.13	0.03				
Open	C/D		0.09	0.03				
Open			0.06	0.01				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1184	19.56	1.60	Forest	A		12.54	1.63	4.49
			Forest	B		3.15	0.41	
			Forest	C		1.64	0.21	
			Highway	A	1.40		1.87	
			Highway	B	0.05		0.06	
			Industrial	A	0.02	0.23	0.05	
			LDR	A	0.02	0.08	0.03	
			LDR	C	0.09	0.25	0.20	
			Open	A	0.02	0.07	0.03	
			Open	B	0.00		0.00	
			Open	C		0.00	0.00	
1185	1.30	0.23	Forest	A		0.02	0.00	0.42
			Forest	B		0.01	0.00	
			Forest	C		0.12	0.02	
			Highway	A	0.15		0.21	
			LDR	A	0.08	0.63	0.14	
			LDR	C		0.27	0.06	
			Open	A		0.01	0.00	
1187	6.89	2.31	Forest	A		1.65	0.21	4.20
			Highway	A	0.29		0.39	
			Industrial	A	1.06	1.25	1.92	
			Industrial		0.62		1.11	
			LDR	A	0.17	1.66	0.31	
			Open	A	0.17	0.01	0.25	
1188	6.08	3.75	Forest	A		0.02	0.00	6.51
			Forest			0.18	0.02	
			Highway	A	0.07		0.10	
			Highway		1.17		1.56	
			Industrial	A	0.08	0.43	0.15	
			Industrial		2.42	1.18	4.56	
			LDR	A		0.07	0.00	
			LDR		0.01	0.33	0.09	
			Open	A		0.02	0.00	
			Open			0.09	0.02	
1190	5.11	1.81	Commercial	A		0.00	0.00	3.44
			Commercial		0.44	0.41	0.87	
			Forest			0.78	0.10	
			Highway		0.52		0.70	
			Industrial	A	0.64	1.00	1.17	
			Industrial		0.20	0.79	0.51	
			Open		0.01	0.31	0.08	
1191	4.61	2.01	Forest	A		0.72	0.09	3.44
			Forest			0.09	0.01	
			Highway	A	0.56		0.76	
			Highway		0.09		0.12	
			Industrial	A	1.31	1.47	2.38	
			Industrial			0.04	0.01	
			Open	A	0.04	0.28	0.07	
1193	15.21	2.59	Forest	A		0.82	0.11	6.07
			Forest	B/D		0.01	0.00	
			Highway	A	0.22		0.29	
			Industrial	A	2.06	5.62	3.84	
			Industrial	B/D	0.22	6.04	1.67	
			Industrial		0.07	0.08	0.13	
			Open	A	0.02	0.06	0.03	
1196	0.67	0.32	Commercial	A	0.04	0.27	0.08	0.46
			Forest	A		0.02	0.00	
			Forest			0.00	0.00	
			Highway	A	0.20		0.27	
			Highway		0.06		0.08	
			Industrial	A	0.01	0.04	0.03	
			Open	A		0.00	0.00	
			Open			0.01	0.00	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1203	12.55	3.04	Forest	A		1.24	0.16	5.39
			Forest	B		0.21	0.03	
			Forest	C/D		0.04	0.00	
			Forest	D		0.01	0.00	
			Forest			0.28	0.04	
			Highway	A	0.70		0.94	
			Highway	B	0.44		0.59	
			Highway	C/D	0.03		0.03	
			Highway	D	0.02		0.02	
			Highway		0.15		0.20	
			LDR	A	0.77	3.48	1.27	
			LDR	B	0.20	1.41	0.47	
			LDR	C/D	0.04	0.15	0.10	
			LDR	D		0.10	0.04	
			LDR		0.71	1.69	1.43	
			Open	A		0.58	0.02	
Open	B		0.19	0.02				
Open	D		0.01	0.00				
Open			0.11	0.02				
1205	2.74	1.09	Forest	A		0.08	0.01	1.68
			Forest	A/D		0.27	0.03	
			Highway	A	0.59		0.79	
			Highway	A/D	0.10		0.13	
			LDR	A	0.31	0.89	0.49	
			LDR	A/D	0.09	0.39	0.22	
			Open	A		0.02	0.00	
Open	A/D		0.02	0.00				
1207	9.29	2.07	Forest	A		1.31	0.17	3.34
			Forest	B		0.06	0.01	
			Highway	A	1.10		1.48	
			Highway	B	0.31		0.41	
			LDR	A	0.35	4.26	0.67	
			LDR	B	0.31	0.94	0.58	
			Open	A		0.55	0.02	
Open	B		0.10	0.01				
1208	1.13	0.22	Forest	A		0.11	0.01	0.34
			Highway	A	0.21		0.28	
			LDR	A	0.02	0.77	0.05	
			Open	A		0.03	0.00	
1211	5.35	1.04	Forest	A		0.10	0.01	1.86
			Forest	A/D		0.03	0.00	
			Forest	B/D		0.03	0.00	
			HDR	A	0.13	0.57	0.32	
			HDR	A/D		0.05	0.01	
			Highway	A	0.37		0.50	
			Highway	A/D	0.12		0.16	
			Highway	B/D	0.09		0.11	
			LDR	A	0.27	2.78	0.49	
			LDR	A/D	0.07	0.47	0.20	
			LDR	B/D	0.00	0.20	0.05	
			Open	A		0.07	0.00	
			Open	A/D		0.01	0.00	
Open	B/D		0.00	0.00				
1222	0.74	0.12	Forest	B		0.15	0.02	0.24
			Highway	B	0.12		0.16	
			LDR	B	0.00	0.46	0.06	
1223	0.57	0.44	Forest	A		0.01	0.00	0.75
			HDR	A	0.14	0.07	0.33	
			Highway	A	0.11		0.15	
			Highway		0.05		0.06	
			LDR	A	0.04	0.05	0.06	
Open	A	0.09	0.00	0.14				
1228	0.97	0.65	Forest	B		0.06	0.01	1.02
			Open	B	0.65	0.26	1.02	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1229	3.03	1.30	Forest	A		0.87	0.11	2.10
			Forest	B		0.06	0.01	
			Highway	A	0.23		0.31	
			LDR	A	0.06	0.24	0.10	
			Open	A	0.57	0.32	0.87	
			Open	B	0.44	0.24	0.69	
1231	0.11	0.05	Forest	C		0.06	0.01	0.07
			Highway	C	0.05		0.06	
1233	2.76	0.54	Forest	C		0.07	0.01	1.27
			Forest	D		0.12	0.02	
			Highway	C	0.06		0.09	
			Highway	D	0.08		0.11	
			LDR	C	0.35	1.87	0.93	
			LDR	D	0.05	0.13	0.12	
1234	0.21	0.09	Open	C		0.02	0.00	0.14
			Forest	C		0.06	0.01	
			Highway	C	0.09		0.12	
1238	10.59	0.58	Open	C		0.05	0.01	2.68
			Forest	B		0.02	0.00	
			Forest	C/D		0.57	0.07	
			Forest	D		1.54	0.20	
			Highway	B	0.06		0.08	
			Highway	C/D	0.08		0.11	
			Highway	D	0.18		0.24	
			LDR	B	0.01	4.19	0.52	
			LDR	C/D	0.25	3.61	1.43	
LDR	D	0.00	0.08	0.03				
1240	3.26	0.95	Open	D	0.00		0.01	1.85
			Forest	C		0.24	0.03	
			Highway	C	0.39		0.52	
			LDR	C	0.57	2.01	1.28	
			LDR	D		0.04	0.01	
1247	11.80	2.39	Open	C		0.02	0.00	4.33
			Forest	A		2.78	0.36	
			Forest	B/D		5.60	0.73	
			Highway	A	2.39		3.21	
1248	3.27	0.66	Open	A		1.03	0.03	1.21
			Forest	A		0.43	0.06	
			Forest	B/D		2.02	0.26	
			Highway	A	0.66		0.89	
			Open	A		0.15	0.00	
1249	1.14	0.77	Open	B/D		0.00	0.00	1.04
			Forest	A		0.00	0.00	
			Highway	A	0.77		1.03	
1252	16.52	1.87	Open	A		0.37	0.01	5.10
			Forest	B		0.72	0.09	
			Forest	C		6.24	0.81	
			Highway	B	0.66		0.89	
			Highway	C	0.32		0.43	
			Industrial	C	0.06	0.82	0.27	
			LDR	B	0.03	1.10	0.18	
			LDR	C	0.70	5.44	2.20	
			Open	B		0.05	0.01	
Open	C	0.10	0.28	0.22				
1256	0.22	0.14	Open	C		0.10	0.22	0.19
			Forest	A		0.04	0.01	
			Forest	B		0.02	0.00	
			Highway	A	0.11		0.14	
			Highway	B	0.03		0.04	
1257	3.25	0.81	Open	A		0.02	0.00	1.40
			Open	B		0.01	0.00	
			Forest	A		1.30	0.17	
			Forest	B		0.95	0.12	
			Highway	A	0.63		0.84	
			Highway	B	0.18		0.24	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1336	2.07	0.48	Forest	D		0.04	0.00	1.10
			Highway	D	0.19		0.25	
			LDR	C	0.17	1.14	0.50	
			LDR	D	0.12	0.36	0.32	
			Open	D		0.05	0.02	
1341	23.35	2.99	Forest	A		0.05	0.01	8.17
			Forest	B		0.05	0.01	
			Forest	C		0.28	0.04	
			Forest	C/D		0.03	0.00	
			Highway	A	0.77		1.03	
			Highway	B	0.24		0.33	
			Highway	C	0.34		0.46	
			Highway	C/D	0.19		0.25	
			LDR	A	0.11	4.42	0.30	
			LDR	B	0.26	2.18	0.65	
			LDR	C	0.51	4.10	1.64	
			LDR	C/D	0.57	8.75	3.41	
			Open	A	0.00	0.26	0.01	
			Open	B		0.11	0.01	
Open	C		0.05	0.01				
Open	C/D		0.07	0.02				
1342	1.44	0.07	Forest	A		0.81	0.11	0.22
			LDR	A	0.06	0.37	0.11	
			Open	A	0.00	0.20	0.01	
1346	6.22	0.44	Forest	C		4.07	0.53	1.51
			Highway	C	0.22		0.29	
			Industrial	C		0.03	0.01	
			LDR	C	0.22	1.62	0.67	
			Open	C	0.00	0.05	0.01	
1347	12.75	1.98	Forest	A		0.06	0.01	3.74
			Forest	B		0.27	0.03	
			Forest			0.07	0.01	
			Highway	A	0.26		0.35	
			Highway	B	0.48		0.64	
			Highway		0.35		0.47	
			LDR	A	0.53	5.70	0.98	
			LDR	B	0.20	2.87	0.64	
			LDR		0.15	1.48	0.55	
			Open	A		0.03	0.00	
Open	B		0.06	0.01				
Open			0.23	0.05				
1351	12.49	3.16	Forest	A		0.24	0.03	6.06
			Forest	B		0.22	0.03	
			Forest			0.01	0.00	
			HDR	A	0.30	0.23	0.70	
			HDR	B	0.22	1.57	0.69	
			HDR		0.01	0.02	0.03	
			Highway	A	0.66		0.89	
			Highway	B	0.40		0.53	
			Highway		0.02		0.02	
			LDR	A	0.48	0.71	0.75	
			LDR	B	0.96	5.90	2.17	
			Open	A	0.11	0.12	0.17	
			Open	B		0.31	0.04	
Open		0.00	0.00	0.00				
1358	0.57	0.21	Forest	B		0.27	0.03	0.33
			Highway	B	0.21		0.29	
			Open	B		0.09	0.01	
1359	8.32	4.08	Forest	B		1.94	0.25	6.00
			Highway	B	4.08		5.47	
			Open	B		2.29	0.27	
1360	9.75	5.51	Forest	B		2.48	0.32	7.92
			Highway	B	5.51		7.38	
			Open	B		1.76	0.21	
1361	5.05	0.00	Forest	B		2.29	0.30	0.63
			LDR	B		0.04	0.00	
			Open	B		2.72	0.33	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1362	0.72	0.13	Forest	B		0.02	0.00	0.26
			Forest	C/D		0.14	0.02	
			Highway	B	0.13		0.18	
			Open	B		0.36	0.04	
			Open	C/D		0.07	0.02	
1363	1.27	0.35	Forest	B		0.17	0.02	0.64
			Forest	C		0.01	0.00	
			HDR	B	0.01	0.43	0.08	
			HDR	C	0.02	0.09	0.08	
			Highway	B	0.13		0.17	
			Highway	C	0.06		0.08	
			Highway	C/D	0.00		0.00	
			LDR	B	0.12	0.19	0.21	
			Open	B	0.00	0.04	0.01	
1364	8.48	0.21	Open	C		0.00	0.00	1.28
			Forest	B		0.42	0.05	
			Highway	B	0.21		0.27	
1365	9.47	3.13	LDR	B	0.00	7.85	0.95	7.62
			Forest	B		0.56	0.07	
			Forest	C/D		0.01	0.00	
			HDR	B	0.04	0.36	0.13	
			HDR	C		0.06	0.01	
			HDR	C/D	1.45	2.10	3.98	
			HDR	D	0.41	1.27	1.41	
			Highway	B	0.77		1.03	
			Highway	C/D	0.33		0.44	
			LDR	B	0.12	0.79	0.28	
			LDR	C/D		0.15	0.04	
			LDR	D		0.00	0.00	
			Open	B	0.01	0.56	0.08	
1376	7.26	1.99	Open	C/D		0.47	0.14	3.52
			Forest	A		0.26	0.03	
			Forest	C		0.54	0.07	
			Forest	D		0.45	0.06	
			Highway	A	1.76		2.36	
			Highway	C	0.07		0.09	
			Highway	D	0.00		0.00	
			LDR	C	0.17	2.20	0.71	
			Open	A		1.09	0.03	
1379	6.05	1.64	Open	C		0.70	0.15	2.59
			Open	D		0.04	0.01	
			Forest	A		0.87	0.11	
			HDR	A	0.02	0.07	0.04	
			Highway	A	0.79		1.05	
			Industrial	A	0.02	0.25	0.04	
1385	2.96	1.07	LDR	A	0.82	2.87	1.33	1.73
			Open	A		0.34	0.01	
			Forest	A		0.19	0.02	
			HDR	A	0.17	0.46	0.40	
			Highway	A	0.62		0.83	
			Industrial	A	0.01	0.01	0.02	
1389	2.82	0.15	LDR	A	0.26	1.13	0.42	0.80
			Open	A	0.02	0.09	0.03	
			Forest	A		0.01	0.00	
			Forest	B/D		0.10	0.01	
			Forest	D		0.06	0.01	
			Highway	A	0.08		0.11	
			Highway	D	0.02		0.03	
			LDR	A		0.81	0.02	
			LDR	B/D		0.51	0.11	
			LDR	D		1.17	0.43	
1401	0.06	0.05	Open	A	0.04	0.00	0.06	0.07
			Open	A/D	0.00		0.00	
			Open	D	0.01		0.01	
			Forest			0.01	0.00	
			HDR		0.00	0.00	0.00	
					0.00		0.00	
			Highway		0.05		0.07	

Phosphorus Load Calculations - Merrimack River, Andover, MA

			Open			0.00	0.00	
1403	8.62	1.32	Forest	B		0.28	0.04	3.18
			Forest	B/D		0.72	0.09	
			Forest	C		1.65	0.22	
			Forest	C/D		1.16	0.15	
			Highway	B	0.12		0.16	
			Highway	B/D	0.20		0.27	
			Highway	C	0.12		0.16	
			Highway	C/D	0.01		0.01	
			LDR	B	0.45	0.96	0.80	
			LDR	B/D	0.03	0.30	0.10	
			LDR	C		0.03	0.01	
			LDR	C/D	0.14	1.60	0.68	
			Open	B	0.19	0.14	0.30	
			Open	B/D	0.00	0.25	0.06	
Open	C	0.06	0.19	0.13				
Open	C/D		0.00	0.00				
1404	0.42	0.02	Forest	B/D		0.00	0.00	0.11
			Highway	B/D	0.01		0.02	
			LDR	B/D	0.01	0.39	0.09	
			Open	B/D		0.01	0.00	
1406	0.20	0.13	Highway	B/D	0.01		0.01	0.21
			LDR	B/D	0.12	0.07	0.19	
			Open	B/D		0.00	0.00	
1407	0.67	0.22	Highway	B/D	0.03		0.04	0.43
			LDR	B/D	0.19	0.45	0.39	
			Open	B/D		0.01	0.00	
1408	0.71	0.26	Highway	B	0.01		0.02	0.47
			LDR	B	0.21	0.17	0.34	
			LDR	B/D	0.03	0.28	0.11	
			Open	B		0.00	0.00	
1410	0.62	0.25	Forest	B		0.01	0.00	0.40
			Highway	A/D	0.00		0.00	
			Highway	B	0.12		0.15	
			LDR	A/D		0.02	0.00	
			LDR	B	0.13	0.27	0.23	
			LDR	B/D		0.00	0.00	
			LDR	C/D	0.00	0.00	0.01	
			Open	A/D		0.00	0.00	
Open	B		0.07	0.01				
1411	2.27	0.79	Forest	B		0.00	0.00	1.43
			Forest	C		0.00	0.00	
			Forest	C/D		0.84	0.11	
			Forest	D		0.01	0.00	
			Highway	B	0.13		0.18	
			Highway	C/D	0.01		0.01	
			LDR	B	0.09	0.12	0.16	
			LDR	C/D	0.55	0.39	0.96	
			Open	B		0.09	0.01	
			Open	C/D		0.04	0.01	
1412	3.35	0.52	Forest	B		0.20	0.03	1.09
			Forest	C		0.74	0.10	
			Forest	C/D		1.36	0.18	
			Highway	B	0.35		0.47	
			Highway	B/D	0.01		0.01	
			Highway	C	0.07		0.09	
			LDR	B	0.08	0.23	0.15	
			LDR	B/D		0.00	0.00	
			LDR	C/D	0.01	0.01	0.02	
			Open	B	0.00	0.21	0.03	
			Open	B/D		0.00	0.00	
Open	C		0.04	0.01				
Open	C/D		0.04	0.01				
1417	5.92	1.40	Forest	C		0.18	0.02	2.96
			Highway	C	0.58		0.77	
			LDR	C	0.82	4.23	2.14	
			Open	C		0.12	0.03	

Phosphorus Load Calculations - Merrimack River, Andover, MA

1440	1.93	0.56	Forest	A		0.01	0.00	0.89
			Forest	C/D		0.00	0.00	
			Highway	A	0.29		0.39	
			Highway	C/D	0.09		0.13	
			LDR	A	0.17	0.98	0.30	
			LDR	C/D	0.00	0.20	0.06	
			Open	A		0.14	0.00	
			Open	C/D		0.05	0.01	
1467	4.01	0.94	Forest	C		0.02	0.00	2.07
			Forest	C/D		0.08	0.01	
			Forest	D		0.01	0.00	
			Highway	C	0.20		0.27	
			Highway	C/D	0.12		0.16	
			Highway	D	0.11		0.15	
			LDR	C	0.36	2.10	0.98	
			LDR	C/D	0.10	0.59	0.33	
			LDR	D	0.05	0.21	0.15	
			Open	C		0.03	0.01	
			Open	C/D		0.00	0.00	
1482	2.97	0.55	Forest	B		0.11	0.01	1.08
			HDR	A	0.13	0.70	0.32	
			HDR	B		0.01	0.00	
			Highway	B	0.19		0.26	
			LDR	A	0.12	0.55	0.20	
			LDR	B	0.11	1.03	0.28	
			Open	B	0.00	0.01	0.00	
1642	2.31	0.24	Forest	B		0.14	0.02	0.68
			Forest	C/D		0.00	0.00	
			Forest	D		0.12	0.02	
			Highway	B	0.04		0.06	
			Highway	C/D	0.00		0.00	
			Highway	D	0.02		0.03	
			LDR	B	0.06	1.34	0.25	
			LDR	C/D	0.11	0.47	0.31	
1654	1.20	0.12	Forest	B		0.12	0.02	0.29
			Highway	A	0.01		0.01	
			Highway	B	0.10		0.14	
			LDR	B	0.01	0.96	0.13	
1687	3.76	0.94	Forest	B/D		0.00	0.00	1.83
			Forest	C		1.20	0.16	
			Highway	B/D	0.04		0.06	
			Highway	C	0.48		0.65	
			LDR	B/D	0.01	0.09	0.03	
			LDR	C	0.23	1.16	0.60	
			Open	C	0.17	0.37	0.34	
1688	0.65	0.22	Forest	A		0.08	0.01	0.33
			Forest	B/D		0.01	0.00	
			Highway	A	0.17		0.22	
			Highway	B/D	0.03		0.04	
			LDR	A	0.00	0.30	0.01	
			Open	A	0.01	0.04	0.02	
1691	1.47	0.25	Open	B/D	0.02	0.00	0.03	0.50
			Forest	A		0.02	0.00	
			Forest	B		0.29	0.04	
			Highway	A	0.00		0.01	
			Highway	B	0.16		0.21	
			LDR	A		0.01	0.00	
			LDR	B	0.09	0.82	0.24	
1692	8.52	1.70	Open	A		0.01	0.00	2.67
			Open	B		0.07	0.01	
			Forest	A		0.57	0.07	
			Highway	A	0.95		1.27	
			LDR	A	0.75	5.98	1.32	
			Open	A		0.28	0.01	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

1705	2.27	0.06	Forest	A		0.03	0.00	0.51
			Forest	C/D		0.16	0.02	
			Highway	A	0.04		0.06	
			Highway	C/D	0.01		0.02	
			LDR	B		1.09	0.13	
			LDR	C/D	0.01	0.94	0.28	
1712	8.24	0.71	Forest	A		0.05	0.01	2.16
			Forest	B		0.21	0.03	
			Forest	B/D		0.03	0.00	
			Forest	C/D		0.34	0.04	
			Forest			0.05	0.01	
			Highway	A	0.03		0.04	
			Highway	B	0.12		0.16	
			Highway	B/D	0.01		0.02	
			Highway	C/D	0.06		0.08	
			Highway		0.05		0.07	
			LDR	A	0.15	2.93	0.32	
			LDR	B	0.00	0.98	0.12	
			LDR	B/D		0.01	0.00	
			LDR	C/D	0.24	2.73	1.16	
LDR		0.04	0.21	0.11				
Open	C/D		0.00	0.00				
1713	2.34	0.46	Forest	A		0.08	0.01	0.95
			Forest	B		0.81	0.11	
			Forest	B/D		0.17	0.02	
			Forest	C/D		0.00	0.00	
			Forest			0.25	0.03	
			Highway	A	0.04		0.05	
			Highway	B	0.14		0.19	
			Highway	B/D	0.04		0.05	
			Highway	C/D	0.08		0.10	
			Highway		0.06		0.08	
			LDR	C/D	0.06	0.24	0.16	
			LDR		0.05	0.23	0.12	
			Open	B	0.00		0.00	
			Open	B/D	0.00		0.00	
Open	C/D		0.05	0.02				
Open			0.06	0.01				
1718	5.20	1.03	Forest	A		0.26	0.03	1.83
			Forest	B		0.18	0.02	
			Highway	A	0.56		0.75	
			Highway	B	0.25		0.34	
			LDR	A	0.07	1.08	0.14	
			LDR	B	0.15	2.52	0.54	
			Open	A		0.08	0.00	
Open	B		0.04	0.00				
CEI-OUT-1	0.40	0.12	Forest	C		0.28	0.04	0.20
			Highway	C	0.12		0.16	
INT-1	0.36	0.36	Commercial		0.00	0.00	0.01	0.49
			Highway		0.36		0.48	
INT-10	0.27	0.10	Forest	B		0.06	0.01	0.16
			Highway	B	0.06		0.09	
			LDR	B	0.03	0.06	0.06	
			Open	B		0.05	0.01	
INT-11	4.63	1.19	Forest	A		0.57	0.07	1.98
			HDR	A	0.14	0.75	0.34	
			Highway	A	0.51		0.69	
			LDR	A	0.50	1.99	0.81	
			Open	A	0.04	0.13	0.07	
INT-12	2.99	1.20	Forest	A		0.03	0.00	1.76
			Highway	A	0.68		0.91	
			LDR	A	0.52	1.48	0.83	
			Open	A	0.00	0.28	0.01	
INT-13	3.95	0.51	Forest	A		0.42	0.05	0.90
			Highway	A	0.14		0.18	
			Open	A	0.38	3.01	0.67	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

INT-14	1.34	0.22	Forest	A		0.23	0.03	0.37
			Highway	A	0.14		0.18	
			LDR	A	0.03	0.11	0.05	
			Open	A	0.05	0.77	0.11	
INT-15	3.27	1.17	Forest	A		0.03	0.00	1.75
			Forest	B		0.01	0.00	
			Highway	A	0.50		0.66	
			Highway	B	0.20		0.27	
			LDR	A	0.37	1.51	0.61	
			LDR	B	0.10	0.33	0.19	
			Open	A		0.14	0.00	
			Open	B		0.08	0.01	
INT-16	0.99	0.41	Commercial	B		0.01	0.00	0.98
			Forest	B		0.03	0.00	
			HDR	B	0.15	0.32	0.39	
			HDR	C	0.20	0.14	0.49	
			LDR	B	0.06	0.09	0.10	
INT-17	0.42	0.36	HDR	B	0.04	0.00	0.09	0.86
			HDR	C	0.32	0.05	0.76	
INT-18	0.41	0.18	Forest	C/D		0.10	0.01	0.30
			Highway	C/D	0.16		0.22	
			Open	C/D	0.02	0.13	0.07	
INT-19	2.53	0.33	Forest	A		0.10	0.01	0.63
			Highway	A	0.15		0.19	
			LDR	A	0.07	1.03	0.13	
			LDR	B	0.11	0.99	0.29	
			Open	A		0.09	0.00	
INT-2	1.06	0.65	Forest	A		0.21	0.03	0.94
			Highway	A	0.44		0.59	
			LDR	A	0.18	0.20	0.27	
			Open	A	0.03	0.01	0.04	
INT-20	0.12	0.07	Forest	A		0.04	0.01	0.10
			Highway	A	0.07		0.10	
			LDR	A		0.00	0.00	
			Open	A		0.01	0.00	
INT-21	4.21	0.77	Forest	A		0.43	0.06	1.23
			HDR	A		0.89	0.03	
			Highway	A	0.46		0.61	
			LDR	A	0.29	0.79	0.47	
			Open	A	0.02	1.34	0.07	
INT-22	12.26	3.17	Commercial	A	0.36	1.10	0.67	5.43
			Forest	A		2.14	0.28	
			Forest	B		0.42	0.05	
			HDR	A	0.21	0.59	0.51	
			Highway	A	2.33		3.13	
			Highway	B	0.03		0.04	
			LDR	A		1.19	0.04	
			LDR	B	0.23	2.80	0.69	
INT-23	8.92	2.28	Open	A	0.00	0.85	0.03	4.57
			Forest	B		0.16	0.02	
			Forest	C/D		0.88	0.11	
			HDR	B	0.01	0.01	0.02	
			HDR	C/D	0.02	0.20	0.11	
			Highway	B	0.76		1.02	
			Highway	B/D	0.07		0.09	
			Highway	C/D	1.10		1.47	
			LDR	B	0.08	0.49	0.18	
			LDR	B/D	0.00	0.07	0.02	
			LDR	C/D	0.23	2.04	0.94	
			Open	B		1.40	0.17	
Open	B/D		0.03	0.01				
Open	C/D		1.36	0.39				

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

INT-24	12.14	2.98	Forest	A		0.71	0.09	4.89
			Forest	A/D		0.21	0.03	
			Forest	B		0.25	0.03	
			Forest	B/D		0.00	0.00	
			Highway	A	1.37		1.83	
			Highway	A/D	0.17		0.23	
			Highway	B	0.36		0.48	
			LDR	A	0.89	5.21	1.51	
			LDR	A/D	0.09	0.84	0.32	
			LDR	B	0.10	1.67	0.35	
			LDR	B/D		0.06	0.01	
			Open	A		0.20	0.01	
			Open	A/D		0.01	0.00	
Open	B		0.01	0.00				
INT-25	1.23	0.36	Forest	A		0.01	0.00	0.54
			Forest			0.00	0.00	
			Highway	A	0.18		0.24	
			Highway		0.12		0.17	
			LDR	A	0.06	0.66	0.11	
			LDR		0.00	0.07	0.02	
			Open	A		0.11	0.00	
Open			0.01	0.00				
INT-26	4.60	1.03	Forest	A		0.16	0.02	1.56
			Highway	A	0.72		0.96	
			LDR	A	0.32	3.34	0.58	
			Open	A		0.07	0.00	
INT-27	7.50	4.64	Commercial		0.01		0.01	7.81
			Forest			0.67	0.09	
			HDR		0.69	0.76	1.76	
			Highway		1.89		2.54	
			LDR		0.25	0.51	0.49	
Open		1.80	0.93	2.93				
INT-28	0.48	0.14	Highway	A	0.09		0.12	0.21
			Highway	C	0.04		0.05	
			LDR	A	0.00	0.25	0.01	
			LDR	C	0.01	0.04	0.03	
			Open	A		0.04	0.00	
Open	C		0.01	0.00				
INT-29	0.42	0.27	Highway	C	0.26		0.35	0.40
			LDR	C	0.01	0.10	0.03	
			Open	C		0.04	0.01	
INT-3	3.76	1.16	Forest	A		1.02	0.13	1.93
			HDR	A	0.14	0.21	0.32	
			Highway	A	0.62		0.83	
			LDR	A	0.40	1.24	0.65	
			Open	A	0.00	0.14	0.00	
INT-30	0.22	0.21	HDR	B/D	0.00		0.01	0.29
			HDR		0.01	0.01	0.01	
			Highway	B/D	0.08		0.10	
			Highway		0.12		0.17	
			Open	B/D		0.00	0.00	
			Open			0.01	0.00	
INT-31	7.98	1.12	Forest	C		0.26	0.03	3.28
			Forest	C/D		0.09	0.01	
			Highway	C	0.54		0.72	
			Highway	C/D	0.08		0.10	
			LDR	C	0.24	2.71	0.94	
			LDR	C/D	0.26	3.22	1.33	
			Open	C		0.47	0.10	
Open	C/D		0.11	0.03				
INT-32	5.81	1.51	Forest	A		0.25	0.03	2.30
			Highway	A	0.79		1.05	
			LDR	A	0.71	3.81	1.20	
			Open	A	0.01	0.23	0.02	

**Phosphorus Load Calculations - Merrimack River, Andover, MA**

INT-33	1.00	0.38	Forest	B/D		0.07	0.01	0.63
			Highway	B	0.16		0.22	
			Highway	B/D	0.22		0.29	
			Open	B		0.03	0.00	
			Open	B/D		0.52	0.11	
INT-34	1.52	0.21	Ag	A		0.48	0.22	0.54
			Highway	A	0.10		0.13	
			LDR	A	0.11	0.77	0.19	
			Open	A		0.06	0.00	
			Forest	A		0.01	0.00	
INT-37	0.27	0.08	Highway	A	0.05		0.06	0.13
			LDR	A	0.00	0.14	0.01	
			LDR	B	0.03	0.03	0.06	
			Open	A	0.00	0.00	0.00	
			Forest	A		0.08	0.01	
INT-38	3.55	1.46	Highway	A	0.53		0.71	2.32
			Industrial	A	0.45	0.69	0.83	
			LDR	A	0.28	1.09	0.46	
			Open	A	0.20	0.23	0.31	
			Forest	A		0.35	0.05	
INT-4	2.13	0.75	HDR	A	0.08	0.03	0.20	1.23
			Highway	A	0.29		0.39	
			LDR	A	0.34	0.84	0.55	
			Open	A	0.03	0.17	0.05	
			Forest	C/D		0.46	0.06	
INT-40	11.54	1.37	Forest	D		0.08	0.01	4.97
			Highway	C/D	0.36		0.48	
			Highway	D	0.03		0.04	
			LDR	C/D	0.87	8.36	3.74	
			LDR	D	0.12	1.16	0.61	
			Open	C/D		0.10	0.03	
			Commercial	A	0.26	0.27	0.47	
INT-41	0.77	0.45	Forest	A		0.04	0.00	0.73
			Highway	A	0.18		0.25	
			Open	A		0.02	0.00	
			HDR	C/D	1.55	1.20	3.93	
INT-43	2.74	1.55	HDR	B	0.04	0.07	0.09	3.29
			HDR	C	0.96	0.28	2.29	
			HDR	C/D	0.10	0.07	0.25	
			HDR	D	0.27	0.09	0.65	
INT-44	1.87	1.37	HDR	C	0.27	0.06	0.64	0.64
			Forest	A		0.09	0.01	
			Forest	B/D		0.08	0.01	
			Highway	A	0.08		0.11	
INT-5	1.56	0.38	Highway	B/D	0.25		0.33	0.71
			LDR	A	0.03	0.19	0.05	
			LDR	B/D	0.02	0.78	0.19	
			Open	A		0.01	0.00	
			Open	B/D		0.03	0.01	
			Forest	A		0.33	0.04	
			Forest	A		0.52	0.07	
INT-6	0.50	0.11	Highway	A	0.11		0.15	0.20
			Open	A		0.06	0.00	
			Forest	A		0.20	0.30	
			Highway	A	0.06		0.07	
INT-7	1.08	0.25	Open	A		0.00	0.00	0.61
			Forest	A		0.52	0.07	
			HDR	A	0.20	0.30	0.47	
			Highway	A	0.06		0.07	
INT-8	2.67	0.66	Open	A		0.33	0.01	1.02
			Forest	A		0.52	0.07	
			Highway	A	0.55		0.74	
			LDR	A	0.11	1.16	0.20	
INT-9	0.75	0.29	Open	A		0.33	0.01	0.46
			Forest	B		0.21	0.03	
			Highway	B	0.23		0.31	
			LDR	A		0.00	0.00	
			LDR	B	0.06	0.14	0.11	
<b>Total</b>	<b>5433.01</b>	<b>1198.41</b>						<b>2394.05</b>

# **Appendix C**

Municipal Property Retrofit Memo



# MUNICIPAL PROPERTY BMP RETROFITS

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**To:** Town of Andover  
**From:** Rebecca Balke, P.E., Comprehensive Environmental Inc.  
**Date:** June 30, 2022  
**Subject:** Municipal Property BMP Retrofits

## Permit Requirements and Project Background

Under the Environmental Protection Agency's (EPA's) 2016 National Pollutant Discharge and Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit, as amended (Permit), the Town of Andover is required to complete an inventory and priority ranking of Town-owned properties and existing stormwater infrastructure that could be retrofitted with stormwater Best Management Practices (BMPs) designed to reduce the frequency, volume and pollutant loads of stormwater discharges to its MS4 through the mitigation of impervious area. At a minimum, Andover must consider municipal property with significant impervious area that could be mitigated, existing street right-of-ways, outfalls and conventional stormwater conveyances and controls that could be readily modified or retrofitted.

The potential for retrofitting particular properties must consider factors such as maintenance access; subsurface geology; depth to water table; proximity to aquifers and subsurface infrastructure including sanitary sewers and septic systems; and opportunities for public use and education. Sites must be priority ranked based on factors such as schedules for planned capital improvements to storm and sanitary sewer infrastructure and paving projects as available; current storm sewer level of service (if known); and control of discharges to impaired or critical receiving waters, first or second order streams, public swimming beaches, drinking water supply sources and shellfish growing areas.

Andover must maintain a minimum of five sites for retrofits within its inventory, until such time as when it has less than five sites remaining for improvements. Beginning with the fifth year MS4 annual report and in each subsequent annual report, Andover must report on those permittee-owned properties and infrastructure inventoried that have been retrofitted with BMPs to mitigate impervious area and associated water quality impacts.

This memorandum outlines activities completed by Comprehensive Environmental Inc. (CEI) to assist the Town of Andover with meeting the above Permit requirements, with a focus on potential retrofit opportunities on developed municipal parcels. Analysis of open space and undeveloped land available to mitigate stormwater runoff from nearby areas should be evaluated under a future effort.

## Municipal Parcel Retrofits

### Desktop and Field Analysis

Twenty-eight Town-owned facilities were identified within the MS4 regulated area. These parcels were advanced for additional desktop and field analysis as outlined further in the next section. CEI



# MUNICIPAL PROPERTY BMP RETROFITS

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first developed a series of parcel maps for each facility to be used for recording existing conditions and field notes. Parcel maps typically showed an aerial view of each facility, along with property lines, topography data, available drainage information, and other relevant information. CEI also reviewed the Merrimack Valley Stormwater Collaborative, MassDEP MS4 Municipal Assistance Grant Report prepared by the Merrimack Valley Planning Commission, dated June 30, 2021. Within this report, MVPC identified five sites for implementation of BMPs to reduce the volume of stormwater discharge, and recommended BMPs for two of these sites.

Noah Parent of CEI conducted field assessments of all 28 facilities in spring 2022. The goal was to evaluate opportunities to reduce pollutant loads discharging to the MS4 or surface water bodies from the site through reduction or treatment of stormwater runoff from impervious surfaces

A map of all 28 facilities is provided as **Figure 1** at the end of this memorandum. A summary of the existing conditions for each site is included as **Table 1**, with proposed retrofit conditions provided as **Table 2** the end of this memorandum.

## Proposed BMP Selection

Proposed conceptual BMPs have been selected based largely on available space, soil types within the area, and proximity to wetland areas. For planning, pollutant removal, and cost estimating purposes, locations with larger areas available for implementation were assigned BMPs with larger footprints such as infiltration basins, extended detention basins, or constructed wetlands, whereas smaller areas were assigned to rain gardens, trenches, or swales. Implementation areas with soils classified primarily as HSG C or D were assigned non-infiltrating BMP types such as extended detention basins. Areas located in close proximity to wetlands are assumed to have relatively high groundwater, and thus were assigned BMP types such as constructed wetlands.

For the purposes of this initial screening effort, BMP selection focused on surface BMPs that could be installed in existing available spaces with little disturbance to existing paved surfaces, as a typical surface BMP is less expensive on a pounds of pollutant removed than a subsurface system installed below a parking lot or ball field. More expensive underground infiltration BMPs (e.g., subsurface infiltration) will be considered for proposed redevelopment projects where demolition, reconstruction and/or repaving are proposed to minimize the costs of installation. The use of subsurface infiltration BMPs would significantly increase treatment costs, as they can cost up to 4-10 times more than surface BMPs. Other BMPs that disturb pavement, including leaching catch basins and porous pavement will also be evaluated during redevelopment projects.

BMPs were identified for 12 sites and include the top sites identified by MVPC (**Table 2**). Actual BMP types and sizes are expected to be refined as part of future designs and in consideration of the cost benefit (e.g., cost per pound of removal).

## BMP Unit Costs

Costs for BMP design and construction were estimated based on a memorandum from EPA titled "Methodology for developing cost estimates for Opti-Tool" (**Attachment A**). This memorandum built on multiple previous studies dating as far back as 2010 to estimate total implementation costs for multiple types of stormwater BMPs on a dollars per cubic foot of constructed volume in 2016



# MUNICIPAL PROPERTY BMP RETROFITS

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dollars, which also assumed that 35% of the construction cost would go towards engineering design and other contingencies. For the purposes of this memorandum, 2016 dollars were then converted to 2022 dollars by adding 18% to the total cost in order to account for inflation over the preceding six years.

Additionally, the Opti-Tool memorandum notes that cost adjustment factors may be incorporated to more accurately account for BMP site constraints associated with installation in urban environments as follows:

- Undeveloped areas: 1.0;
- Partially developed areas: 1.5;
- Developed areas: 2.0; and
- Highly urban setting: 3.0.

Based on current development conditions, a cost adjustment factor of 1.5 was applied to all potential BMPs. A summary of costing data is provided in **Table 3** at the end of this memorandum.

Actual engineering costs depend on many factors, and engineering for larger projects generally consist of a lower total percent of the construction cost, with the inverse being true for smaller projects (e.g., a \$250,000 construction project may have a \$50,000 engineering cost or 20% of construction, whereas a \$50,000 construction project may have a \$25,000 engineering cost or 50% of construction). Costs outlined in this memorandum are for guidance and comparison purposes only, and future design phases will further refine costs associated with all BMPs.

## **Pollutant Removal and Cost Summary**

Based on calculations from the BATT calculator, implementation of all stormwater BMPs outlined in **Table 2** will remove a total of 15.33 pounds of phosphorus for a total engineering and construction cost of approximately \$1,353,500 at an average cost of \$88,300 per pound of phosphorus. Pre-conceptual designs for six sites have been prepared and are included as **Attachment B**.

## **Roadway Improvement Projects**

Roadway improvement projects such as pavement resurfacing, reclamation, and/or roadway widening serve as an opportunity for the Town to coordinate drainage improvements with roadway improvements. It also provides an opportunity to incorporate water quality BMPs, however, such opportunities are often restricted to areas located within, or immediately adjacent to, the roadway. Example roadway intersection improvements for Town to consideration are provided in **Attachment C**, however, other alternative designs may also be considered depending on site-specific conditions. Implementation of such BMPs requires evaluation on a case-by-case basis in



# MUNICIPAL PROPERTY BMP RETROFITS

consideration of the size of the ROW, soil type, surrounding drainage infrastructure and location of other utilities.

## Recommendations and Next Steps

It is recommended that the Town move forward with design of BMPs at the top six sites outlined in **Table 4** below. Pre-conceptual designs for each of these sites have been prepared and are included as **Attachment B**.

**Table 4 – Top BMP Locations**

Location		Proposed BMP(s)		Estimate Costs	TP Reduction	
Facility Name	Address	Type	Estimated Size	Construction & Engineering	Lbs / Year	Dollars / Pound
Andover Water Treatment Plant	10 Geneva Road	Water Quality Swale	100' x 20' x 2'	\$44,200	0.50	\$88,400
		Infiltration Basin	70' x 30' x 3'	\$69,600	0.87	\$80,000
Andover Fire Station West	200 Greenwood Road	Bioretention Basin	45' x 35' x 3'	\$152,400	0.43	\$354,600
Andover Police and Fire	32 North Main Street	Rain Garden	40' x 25' x 3'	\$97,400	0.25	\$469,400
		Porous Pavement	2100 SF	\$19,900		
Bancroft Elementary School	15 Bancroft Road	Infiltration Island	230' x 12' x 2'	\$61,100	2.65	\$41,100
		Infiltration Island (2)	90' x 12' x 2' (2)	\$47,700		
		Bioretention Basin	70' x 40' x 3'	\$230,000	0.65	\$353,840
South Elementary School	55 Woburn Street	Infiltration Island	215' x 20' x 2'	\$95,000	1.42	\$66,900
			160' x 20' x 2'	\$70,800	3.54	\$20,000
Pomps Pond Beach	147-163 Abbot Street	Riprap Swale	270 LF	\$21,900	0.57	\$286,100
		Bioretention Island	75' x 15' x 2'	\$61,600		
		Infiltration Basin	80' x 30' x 3'	\$79,600		

Note: These are top sites based on impervious area and available space to implement a functional surface BMP.

The Town should also consider investigating, and implementing where feasible, water quality treatment BMPs as part of drainage improvements during roadway improvement projects. The cost and amount of phosphorus removed from these systems will vary based on the size of the BMP and contributing drainage area.

If you have any further questions or would like additional information, please feel free to contact me at 800.725.2550 x308 or [rbalke@ceiengineers.com](mailto:rbalke@ceiengineers.com). Thank you.



# MUNICIPAL PROPERTY BMP RETROFITS

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## **Attachments:**

- Table 1: Summary of Existing Conditions
- Table 2: Proposed Improvements
- Table 3: BMP Costing Information
- Figure 1: Municipal Properties visited
- Attachment A: Memorandum report on Methodology for developing cost estimates for Opti-Tool; February 20, 2016
- Attachment B: Pre-Conceptual Designs for Top Locations
- Attachment C: Example Roadway and Intersection BMP Improvements

Table 1 - Summary of Existing Conditions

Description	Address	CEI Map ID	Parcel Area		Existing Conditions Description	Watershed	Direct or Near-Direct Discharge	BMPs Present?	Soil Type	Hydric Soil Group	Soil Area (acres)
			Total (acres)	Impervious (acres)							
Andover Water Treatment Plant	10 GENEVA RD	W2	7.5	2.8	Site consists of treatment plant buildings and associated parking areas. Existing drainage observed throughout the site.	Merrimack River	Yes (Haggetts Pond)	No	Hinckley loamy sand	A	4.28
									Sudbury fine sandy loam	B	3.21
									Water	N/A	0.00
Andover Fire Station West	200 GREENWOOD RD	FD2	6.1	0.3	A mostly wooded parcel bound by Chandler Road, Greenwood Road and Ledge Road. Fire station exists on the northeastern corner of the parcel. No drainage observed within the parcel. Existing drainage observed on Greenwood Road.	Merrimack River	No	No	Montauk fine sandy loam	C	4.05
									Woodbridge fine sandy loam	C/D	2.08
Andover Police and Fire	32 NORTH MAIN ST	PD1, FD1	1.4	1.2	Parcel includes the Andover police station and main fire station. The parcel is bound by Lewis Street, North Main Street and Pearson Street. Mapping identified potential underground storage for site drainage but no cleanout or access ports were observed. Site is mostly impervious, with a small grass area in the northeastern corner.	Merrimack River	No	No	Urban land	N/A	1.44
Bancroft Elementary School	15 BANCROFT RD	S2	20.9	4.6	Parcel is relatively flat with existing drainage flowing towards Bancroft Road. An existing BMP was observed on the southern portion of the parcel adjacent to the school access road.	Merrimack River and Ipswich River	No	Yes	Ridgebury fine sandy loam	D	0.23
									Udorthents	A	0.01
									Urban land	N/A	3.84
								Woodbridge fine sandy loam	C/D	16.78	
South Elementary School	55 WOBURN ST	S8	20.2	5	Site consists of the school, parking areas and sports fields. Wooded areas exist in the west and southwestern portions of the Site. Existing drainage exists around the building and in the parking areas east of the building.	Merrimack River	No	No	Windsor loamy sand	A	20.23
Pomps Pond - Beach	147-163 ABBOT ST	P2	10.3	0.8	A town beach with parking area at the end of Pomps Pond Road. Steep slope decreasing from east to west across the wooded portion of the parcel. The western portion of the parcel abuts Pomps Pond.	Merrimack River	No	No	Hinckley and Windsor soils	A	9.26
									Hinckley loamy sand	A	1.04
									Water	N/A	0.03
Municipal Parking Lot	51 PARK ST	TP1	1.6	1.4	Large municipal parking area off of Bartlet Street and Park Street. Existing drainage exists near the southern end of the parking lot. Multiple raised mulch beds observed throughout.	Merrimack River	No	No	Urban land	N/A	1.61
Old Town Hall	20 MAIN ST	EH1	0.6	0.6	Old town hall now home to the town house welcome center and post office. Large parking area to the east of the building.	Merrimack River	No	No	Urban land	N/A	0.57
West Middle School and Andover High School	70 SHAWSHEEN RD	S1, S10	89	24.1	Large parcel containing both the West Middle School and High School with associated parking areas. Multiple sports fields observed throughout the site. A Large wooded area with mapped wetlands exists in the southwestern portion of the site.	Merrimack River	Yes (Wetlands)	Yes	Canton fine sandy loam	B	0.05
									Freetown muck	B/D	20.76
									Hinckley and Windsor soils	A	5.21
									Hinckley loamy sand	A	7.69
									Udorthents	A	50.05
									Urban land	N/A	4.16
									Walpole fine sandy loam	A/D	0.97
									Wareham loamy sand	A/D	0.11
Andover Housing Authority	256 NORTH MAIN ST	H2	4.9	2.3	Community of apartment style buildings owned by the town surrounded by Frye Circle. Noticeable decrease in elevation from west to east across the site. Existing drainage observed throughout.	Merrimack River	No	No	Merrimack fine sandy loam	A	1.27
									Udorthents	A	3.62
Bald Hill	288-302 HIGH PLAIN RD	D3	76.2	0.1	Expansive wooded area with steep slopes bound by High Plain Road and I-495. Over 100 feet of elevation change over the parcel. Bald Hill Composite Site and the Andover Dog Park both exist on the parcel.	Merrimack River	Yes (Unnamed Stream)	No	Canton fine sandy loam	B	5.07
									Hinckley loamy sand	A	0.20
									Paxton fine sandy loam	C	27.49
									Swansea muck	B/D	7.00
									Udorthents	A	8.71
									Windsor loamy sand	A	12.58
									Woodbridge fine sandy loam	C/D	15.16
									High Plain Elementary School	11 CROSS ST	S4, S5
Woodbridge fine sandy loam	C/D	2.07									
Sanborn School	90 LOVEJOY RD	S6	41.7	4	Large wooded parcel with the school building, parking areas and sports fields taking up roughly half of the site. Multiple BMPs observed around the school including porous pavement and concrete. Existing drainage infrastructure also observed throughout.	Merrimack River	No	Yes	Montauk fine sandy loam	C	3.33
									Ridgebury and Leicester fine sandy loams	D	4.99
									Scituate fine sandy loam	C	24.74
									Udorthents	A	6.97
									Whitman fine sandy loam	D	1.62
Shawsheen School	18 MAGNOLIA AV	S7	4.6	1.5	Site consists of the school, parking areas and small sports field. Noticeable decrease elevation from north to south across the parcel.	Merrimack River	No	No	Hinckley and Windsor soils	A	2.22
									Hinckley loamy sand	A	2.41
Pomps Pond - Fields	165-183 ABBOT ST	P1	21.9	1.9	Recreational areas off of Recreation Park Road. Areas include tennis courts, pickleball courts, baseball field and walking trails. The western portion of the parcel abuts Pomps Pond.	Merrimack River	No	No	Hinckley and Windsor soils	A	14.36
									Hinckley loamy sand	A	0.69
									Pipstone loamy sand	A	0.52
									Pits	N/A	2.64
									Water	N/A	0.01
Windsor loamy sand	A	3.68									

Description	Address	CEI Map ID	Parcel Area		Existing Conditions Description	Watershed	Direct or Near-Direct Discharge	BMPs Present?	Soil Type	Hydric Soil Group	Soil Area (acres)
			Total (acres)	Impervious (acres)							
Andover Housing Authority	0 MORTON ST	H1	2.1	0.9	Community of apartment style buildings owned by the town. Noticeable decrease in elevation from south to north. Site bound by Rogers Brook to the north. Existing drainage observed throughout.	Merrimack River	No	No	Sutton fine sandy loam	B/D	1.06
									Udorthents	A	0.44
									Urban land	N/A	0.57
Andover Housing Authority	12-18 MEMORIAL CI	H3	3.8	1.7	Community of apartment style buildings owned by the town. Noticeable decrease in elevation from south to north. Site bound by Rogers Brook to the north. Existing drainage observed throughout.	Merrimack River	No	No	Urban land	N/A	3.03
									Whitman fine sandy loam	D	0.02
									Sutton fine sandy loam	B/D	0.77
Andover Housing Authority	0 GRANDVIEW TR	H4	1.1	0.6	Community of apartment style buildings owned by the town. Noticeable decrease in elevation from south to north. Site bound by Rogers Brook to the north. Existing drainage observed throughout.	Merrimack River	No	No	Sutton fine sandy loam	B/D	0.56
									Urban land	N/A	0.54
Andover Housing Authority	0 CHESTNUT ST	H5	2.3	1.1	Community of apartment style buildings owned by the town. Noticeable decrease in elevation from south to north. Site bound by Rogers Brook to the north. Existing drainage observed throughout.	Merrimack River	No	No	Urban land	N/A	1.13
									Whitman fine sandy loam	D	1.13
									Urban land	N/A	0.02
Doherty Middle School	50 BARTLET ST	S3	16.6	7.1	School building is connected to other municipal offices and buildings. Multiple parking areas were observed within the parcel as well as multiple sports fields and the Cormier Youth Center. Multiple existing BMPs were observed throughout the parcel.	Merrimack River	Yes (Rogers Brook)	Yes	Charlton fine sandy loam	B	0.09
									Sutton fine sandy loam	B/D	0.51
									Udorthents	A	6.45
									Urban land	N/A	9.51
West Elementary School	60 BEACON ST	S9	11.8	6.7	Portions of the site are currently under construction for future renovations and replacement of the existing school.	Merrimack River	No	No	Hinckley loamy sand	A	0.46
									Sudbury fine sandy loam	B	0.20
									Sutton fine sandy loam	B/D	0.43
									Udorthents	A	10.71
									Wareham loamy sand	A/D	0.01
Andover Highway Maintenance	11 LEWIS ST	D2	2.0	1.8	Old DPW building and associated parking and storage areas. Miscellaneous storage throughout.	Merrimack River	No	No	Urban land	N/A	2.01
Ballardvale Fire Station	163 ANDOVER ST	FD3	0.2	0.1	New construction/renovation of fire station and surrounding area. Drainage improvements observed throughout site including porous pavement, catch basins and subsurface separators.	Merrimack River	No	Yes	Hinckley loamy sand	A	0.05
									Udorthents	A	0.12
Memorial Hall Library	2 NORTH MAIN ST	L1	1	0.8	Large library on the corner of North Main Street and Essex Street. Noticeable decrease in elevation from east to west across the site was observed. Existing drainage on both Essex and North Main Street was observed. Small grassed areas and parking surround the building.	Merrimack River	No	No	Urban land	N/A	0.95
TOPS School	30 WHITTIER CT	SC1	0.2	0.2	School building is connected to other municipal offices and buildings. Multiple parking areas were observed surrounding the parcel as well as multiple sports fields and the Cormier Youth Center.	Merrimack River	No	No	Urban land	N/A	0.25
Andover Town Offices	36 BARTLET ST	TH1, W1	0.3	0.2	Town office building is attached to multiple other town owned buildings including the Doherty Middle School and TOPS School. Multiple parking areas were observed surrounding the parcel as well as multiple sports fields and the Cormier Youth Center.	Merrimack River	No	No	Urban land	N/A	0.25
Spring Grove Cemetery	124 ABBOT ST	C1	46.6	7.5	Large cemetery between Spring Grove Road and Abbot Street with multiple outfalls and a piped stream crossing through the most northern portion of the site.	Merrimack River	Yes (Unnamed Stream)	No	Canton fine sandy loam	B	24.09
									Hinckley and Windsor soils	A	0.24
									Hinckley loamy sand	A	15.09
									Sutton fine sandy loam	B/D	5.27
									Whitman fine sandy loam	D	0.53
									Woodbridge fine sandy loam	C/D	1.41
Department of Public Works	5 CAMPANELLI DR	D1	16.2	0	New DPW building, parking and garage areas. Site also includes a large wetland area with stream to the west of the building. Drainage infrastructure observed throughout new parking area.	Merrimack River	Yes (Unnamed Stream)	Yes	Canton fine sandy loam	B	2.78
									Charlton-Rock outcrop-Hollis complex	A	0.35
									Deerfield loamy fine sand	A	3.27
									Paxton fine sandy loam	C	2.72
									Scarboro mucky fine sandy loam	A/D	3.68
									Udorthents	A	0.00
									Woodbridge fine sandy loam	C/D	3.43

1. All soils data obtained from GIS sources.

= Included in the MVPC Grant Report with recommendations  
 = Included in MVPC Grant Report

Table 2 - Proposed Improvements

Description	Address	CEI Map ID	Recommendations and Conclusions	Treatment Area		Pollutant Loading <sup>1</sup>			Proposed BMP(s)		Pollutant Reduction Estimates <sup>2</sup>			BMP Implementation Costs <sup>3</sup>				Dollars per Pound of Removal		
				Total (acres)	Impervious (Acres)	Impervious Area TP Load (lbs/yr)	Impervious Area TN Load (lbs/yr)	Impervious Area TSS Load (lbs/yr)	Proposed BMP(s)	Estimated Size	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)	TSS Reduction (lbs/yr)	Unit Construction Cost per SF, CF or LF	Estimated Construction Costs	Estimated Engineering Costs	Total BMP Cost (Design & Construction)	TP Reduction (\$\$/lb)	TN Reduction (\$\$/lb)	TSS Reduction (\$\$/lb)
Andover Water Treatment Plant	10 GENEVA RD	W2	Recommend separating any potential plant effluent from stormwater drainage. Install infiltration basin with sediment forebay in eastern grassed area to treat water from catch basins near Geneva Road and eastern plant access road. Install water quality swale in grassed area between plant entrance off Lowell Street and the plant parking area to treat and convey the 4 catch basins on entrance road.	1.37	0.38	0.51	3.86	562.45	Water Quality Swale	100' x 20' x 2'	0.50	3.87	562.45	\$8.18	\$32,700	\$11,500	\$44,200	\$88,400	\$11,400	\$80
				1.43	0.66	0.88	6.71	976.89	Infiltration Basin	70' x 30' x 3'	0.87	6.71	976.89	\$8.18	\$51,500	\$18,100	\$69,600	\$80,000	\$10,400	\$70
Andover Fire Station West	200 GREENWOOD RD	FD2	Recommend the installation of curbing and catch basins to convey stormwater runoff to a small bioretention basin in the small grassed area near the station entrance off of Greenwood Road. An overflow structure can be utilized and connected to the small stream south of the station.	1.1	0.51	0.68	5.19	754.87	Bioretention Basin	45' x 35' x 3'	0.43	2.08	754.87	\$20.27	\$95,800	\$33,600	\$129,400	\$354,600	\$73,300	\$200
									Catch Basin (3)	N/A				\$5,690	\$17,070	\$6,000	\$23,000			
Andover Town Police & Fire Station	32 NORTH MAIN ST	PD1, FD1	Recommend installing two shallow sump catch basins to capture water from the fire engine garage bay parking area and discharge it to an infiltration basin in the adjacent grassed area. Overflow from the basin can be tied back into the drainage system on North Main Street.	0.32	0.29	0.39	2.95	429.24	Rain Garden	40' x 25' x 3'	0.25	1.18	429.24	\$20.27	\$60,800	\$21,300	\$82,100	\$469,400	\$99,400	\$300
									Catch Basin (2)	N/A				\$5,690	\$11,380	\$4,000	\$15,300			
									Porous Pavement	2100 SF				\$6.98	\$14,658	\$5,200	\$19,900			
Bancroft Elementary School	15 BANCROFT RD	S2	Recommend sinking parking lot island to accept drainage from adjacent catch basins and potential sheet flow via curb cuts. Recommend large bioretention basin in grassed area in the northwestern corner of the site. Intercept drainage from existing pipe flowing towards Bancroft Road. Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	3.98	1.99	2.67	20.24	2945.46	Infiltration Island	230' x 12' x 2'	2.65	20.34	2945.46	\$8.18	\$45,200	\$15,900	\$61,100	\$41,100	\$5,300	\$40
									Infiltration Island (2)	90' x 12' x 2' (2)				\$8.18	\$35,300	\$12,400	\$47,700			
									Bioretention Basin	70' x 40' x 3'				0.65	3.13	1139.70	\$20.27			
South Elementary School	55 WOBURN ST	S8	Recommend lowering parking lot island east of the school building to allow for infiltration of stormwater runoff. Select catch basins can be redirected to discharge into the infiltration islands. Curb cuts can also be installed to allow for sheet and gutter flow to enter the system.	1.31	1.07	1.43	10.88	1583.74	Infiltration Island	215' x 20' x 2'	1.42	10.88	1583.74	\$8.18	\$70,300	\$24,700	\$95,000	\$66,900	\$8,700	\$60
				4.52	2.8	3.75	28.48	4144.36		160' x 20' x 2'	3.54	27.95	4144.36	\$8.18	\$52,400	\$18,400	\$70,800	\$20,000	\$2,500	\$20
Pomps Pond - Beach	147-163 ABBOT ST	P2	Recommend installing a riprap conveyance swale along the northern side of the parking lot to capture runoff from steep wooded slope. Recommend repaving parking lot to promote positive drainage away from Pomps Pond and towards a bioretention island and the riprap conveyance swale. An infiltration basin should also be constructed south of the parking lot to accept overflow from the parking lot island and from the riprap swale.	1.29	0.44	0.59	4.47	651.26	Riprap Swale	270 LF	0.57	4.47	651.15	\$60.00	\$16,200	\$5,700	\$21,900	\$286,100	\$36,500	\$300
									Bioretention Island	75' x 15' x 2'				\$20.27	\$45,600	\$16,000	\$61,600			
									Infiltration Basin	80' x 30' x 3'				\$8.18	\$58,900	\$20,700	\$79,600			
Municipal Parking Lot <sup>4</sup>	51 PARK ST	TP1	MVPC study indicated redevelopment was planned for this site. Recommend proposed design plans include stormwater BMPs like bioretention basins or infiltration trenches to capture and treat runoff from parking lot.	1.51	1.42	1.90	14.44	2101.78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Old Town Hall <sup>4</sup>	20 MAIN ST	EH1	Given the proximity to the municipal parking lot, it is unclear whether this site is part of the proposed redevelopment indicated by MVPC. Recommend following a similar design to what should be implemented into the new construction of the municipal parking lot (TP1).	0.4	0.4	0.54	4.07	592.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
West Middle School and Andover High School	70 SHAWSEEN RD	S1, S10	Recommend retrofitting multiple parking lot islands throughout the site into infiltration island. Select catch basins can be redirected to discharge into the infiltration islands. Curb cuts can also be installed to allow for sheet and gutter flow to enter the system. Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	2.36	2.1	2.81	21.36	3108.27	Infiltration Island	60' x 20' x 2'	1.65	14.33	2185.31	\$8.18	\$19,600	\$6,900	\$26,500	\$16,100	\$1,800	\$10
										30' x 20' x 2'	0.55	4.78	728.44	\$8.18	\$9,800	\$3,500	\$13,300	\$24,200	\$2,800	\$20
Andover Housing Authority	256 NORTH MAIN ST	H2	Slope on site is not conducive for BMPs. Recommend the installation of porous pavement/pavers for future walkway and sidewalk improvements.	3.74	2.27	3.04	23.09	3359.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bald Hill	288-302 HIGH PLAIN RD	D3	A combination of swales and basins should be implemented at the Bald Hill Composting Facility to stop runoff from leaving the site and flowing down the side of High Plain Road.	2.13	0.52	0.70	5.29	769.67	Infiltration Basin	60' x 20' x 2'	0.68	5.18	769.66	\$8.18	\$19,600	\$6,900	\$26,500	\$39,000	\$5,100	\$30
High Plain Elementary School	11 CROSS ST	S4, S5	Recommend installing an infiltration trench along the toe of the slope, south of the school access road. Subdrain piping can connect to an existing manhole in the access road. Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	1.11	0.01	0.01	0.10	14.80	Infiltration Trench	200' x 2' x 1'	0.1	0.1	14.8	\$16.38	\$6,600	\$2,400	\$9,000	\$90,000	\$90,000	\$610

Description	Address	CEI Map ID	Recommendations and Conclusions	Treatment Area		Pollutant Loading <sup>1</sup>			Proposed BMP(s)		Pollutant Reduction Estimates <sup>2</sup>			BMP Implementation Costs <sup>3</sup>			Dollars per Pound of Removal			
				Total (acres)	Impervious (Acres)	Impervious Area TP Load (lbs/yr)	Impervious Area TN Load (lbs/yr)	Impervious Area TSS Load (lbs/yr)	Proposed BMP(s)	Estimated Size	TP Reduction (lbs/yr)	TN Reduction (lbs/yr)	TSS Reduction (lbs/yr)	Unit Construction Cost per SF, CF or LF	Estimated Construction Costs	Estimated Engineering Costs	Total BMP Cost (Design & Construction)	TP Reduction (\$\$/lb)	TN Reduction (\$\$/lb)	TSS Reduction (\$\$/lb)
Sanborn School	90 LOVEJOY RD	S6	Recommend the installation of a bioretention pond in the grassy area southwest of the school. Existing drainage can be intercepted and discharged into pond. Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	5.12	2.05	2.75	20.85	3034.27	Bioretention Basin	60' x 40' x 3'	1.43	6.64	2999	\$20.27	\$145,900	\$51,100	\$197,000	\$137,800	\$29,700	\$70
Shawsheen School	18 MAGNOLIA AV	S7	Recommend the installation of a water quality swale along the northern side of Anns Lane to intercept water running down grassed slope and gutter flow running down school access road. The swale can be connected to the existing catch basin at the corner of Anns Lane and Sherbourne Street.	0.78	0.27	0.36	2.75	399.64	Water Quality Swale	200' x 6' x 1'	0.01	0.42	332.36	\$8.18	\$9,800	\$3,500	\$13,300	\$1,330,000	\$31,700	\$40
Pomps Pond - Fields	165-183 ABBOT ST	P1	Recommend installing a water quality swale or infiltration trench along the northern and western sides of the tennis court. This will capture water running off of the tennis courts and prevent it from flowing down the steep slope to Pomps Pond.	1.8	0.63	0.84	6.41	932.48	Water Quality Swale	250' x 6' x 1'	0.03	0.98	443.22	\$8.18	\$12,300	\$4,400	\$16,700	\$556,700	\$17,000	\$40
Andover Housing Authority	0 MORTON ST	H1	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Andover Housing Authority	12-18 MEMORIAL CI	H3	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Andover Housing Authority	0 GRANDVIEW TR	H4	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Andover Housing Authority	0 CHESTNUT ST	H5	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Doherty Middle School	50 BARTLET ST	S3	Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
West Elementary School	60 BEACON ST	S9	Recommend including stormwater BMPs in design plans for school renovations and new school building.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Andover Highway Maintenance	11 LEWIS ST	D2	No room for BMP retrofits.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ballardvale Fire Station	163 ANDOVER ST	FD3	Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Memorial Hall Library	2 NORTH MAIN ST	L1	Very limited room for BMPs. Recommend the installation of porous pavement in the parking areas west of the building. Possibility for rooftop gardens if roof is flat and can structurally accommodate them. Overflow piping can be tied into existing roof leader system.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOPS School	30 WHITTIER CT	SC1	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Andover Town Offices	36 BARTLET ST	TH1, W1	No room for BMP retrofits within parcel boundaries.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spring Grove Cemetery	124 ABBOT ST	C1	No Room for BMP retrofits.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Department of Public Works	5 CAMPANELLI DR	D1	Recommend routine maintenance of existing BMPs and drainage infrastructure on site.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Total</b>											<b>15.33</b>	<b>113.04</b>	<b>20660.65</b>		<b>\$1,001,708</b>	<b>\$351,900</b>	<b>\$1,353,500</b>	<b>\$88,300</b>	<b>\$12,000</b>	<b>\$66</b>

  = Included in the MVPC Grant Report with recommendations

  = Included in MVPC Grant Report

1. Pollutant loading calculated for impervious areas only using the land use loading rates provided in the BATT calculator for "Highway". Rates are as follows, in pounds per acre per year: 1.34 pounds of Total Phosphorus; 10.17 pounds of Total Nitrogen; 1,480.13 pounds of Total Suspended Solids

2. Pollutant reduction estimates calculated through EPA's BATT calculator

3. Information on BMP costing is attached as Attachment A.

4. The MVPC study indicated redevelopment was planned for the municipal parking lot. Given the proximity to the old town hall parking areas, it was assumed the town hall parking may also be a part of the proposed redevelopment. Due to the possibility of design plans already existing or in progress, these sites were not advanced to estimate potential BMP implementation costs and removals.

**Table 3 - BMP Costing Information**

<b>Stormwater BMP Type</b>	<b>Unit</b>	<b>OptiTool BMP Estimates, 2016<sup>1,2</sup></b>	<b>OptiTool BMP Estimates, 2022<sup>3</sup></b>	<b>Adjusted BMP Estimate, 2022<sup>4</sup></b>	<b>Adjusted Construction Estimate<sup>4</sup></b>	<b>Adjusted Engineering/Contingency Estimate<sup>5</sup></b>
<b>Bioretention / Rain Garden</b>	per CF	\$15.46	\$18.24	\$27.36	\$20.27	\$7.09
<b>Constructed Wetlands</b>	per CF	\$6.80	\$8.02	\$12.04	\$8.92	\$3.12
<b>Dry Detention Basin</b>	per CF	\$6.80	\$8.02	\$12.04	\$8.92	\$3.12
<b>Gravel Wetland</b>	per CF	\$8.78	\$10.36	\$15.54	\$11.51	\$4.03
<b>Infiltration Basin</b>	per CF	\$6.24	\$7.36	\$11.04	\$8.18	\$2.86
<b>Infiltration Trench</b>	per CF	\$12.49	\$14.74	\$22.11	\$16.38	\$5.73
<b>Porous Pavement</b>	per CF	\$5.32	\$6.28	\$9.42	\$6.98	\$2.44
<b>Sand Filter</b>	per CF	\$17.94	\$21.17	\$31.75	\$23.52	\$8.23
<b>Wet Detention Basin</b>	per CF	\$6.80	\$8.02	\$12.04	\$8.92	\$3.12
<b>Subsurface Infiltration/Detention System (aka Infiltration Chamber)</b>	per CF	\$67.85	\$80.06	\$160.13	\$118.61	\$41.51

1. Memorandum on Methodology for developing cost estimates for Opti-Tool is provided as Attachment A.
2. Total includes cost of construction, engineering, and contingencies.
3. 2022 Estimate assumes a 18% markup from 2016 Estimate due to inflation.
4. Adjustment factor of 1.5 is applied to account for construction in developed areas.
5. Engineering/Contingency Estimate is 35% of the Construction Estimate.





# BMP Retrofit Site Inspection Map Andover, MA

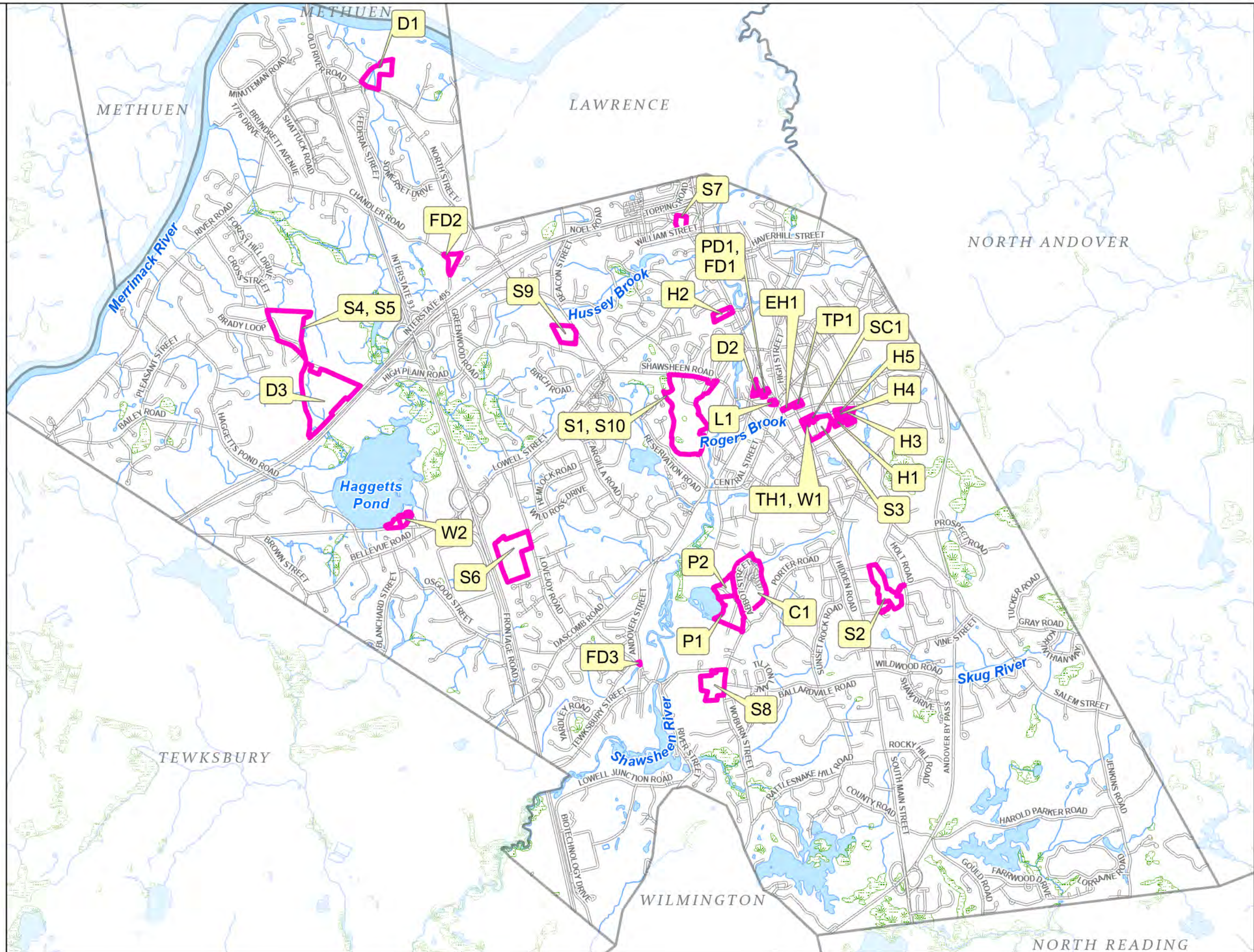


Comprehensive  
Environmental  
Incorporated



## Legend

-  Municipal Property
-  Lake, Pond, Reservoir
-  Wetland, Marsh, Swamp
-  Stream, Brook



**Attachment A:**

BMP costing table and memorandum report on  
Methodology for developing cost estimates for Opti-Tool;  
February 20, 2016

## MEMORANDUM

**DATE:** February 20, 2016  
**TO:** Opti-Tool TAC  
**FROM:** Karen Mateleska, EPA Region- I  
**SUBJECT:** Methodology for developing cost estimates for Opti-Tool

### Introduction

EPA – Region I offered to provide TetraTech with BMP cost information for the New England Stormwater Management Optimization Tool (Opti-Tool). The goal was to include the latest available information that would accurately reflect capital costs for select BMPs installed in the New England region. This document describes the approach used to determine these values.

The unit cost estimates originally developed as part of a 2010 study were used as the basis/starting-point for the cost estimates for the Opti-Tool. This study, entitled *Stormwater Management Plan for Spruce Pond Brook Subwatershed*, was produced by the Charles River Watershed Association (CRWA). The full report can be viewed at: [http://www.crwa.org/hs-fs/hub/311892/file-636820515-pdf/Our\\_Work/Blue\\_Cities\\_Initiative/Scientific\\_and\\_Technical/CRWA\\_Franklin\\_Plan.pdf](http://www.crwa.org/hs-fs/hub/311892/file-636820515-pdf/Our_Work/Blue_Cities_Initiative/Scientific_and_Technical/CRWA_Franklin_Plan.pdf). This subwatershed in the Town of Franklin (in eastern Massachusetts) was selected, in part, because it represented one of the many communities in the watershed that would be required to reduce nutrient (phosphorus) loads in stormwater runoff as part of EPA's Phase II MS4 General Stormwater Permit and a TMDL for Nutrients in the Upper/Middle Charles River. The cost estimates developed in the study can predominantly be attributed to CRWA and both Rich Claytor and Nigel Pickering of Horsley Witten Group (CRWA *et al.* 2010). The development of these costs was based on a literature review of BMP cost information and Claytor's extensive experience working in this field with Massachusetts communities. These values were originally reported in Appendix B of the aforementioned CRWA document. Those cost estimates have also been used in additional stormwater studies supported by EPA – Region I, including the *Sustainable Stormwater Funding Evaluation for the Upper Charles River Communities of Bellingham, Franklin, and Milford, MA* (2011). (That report can be viewed at: <http://www.epa.gov/region1/npdes/charlesriver/pdfs/20110930-SWUtilityReport.pdf>)

Before simply relying on the CRWA cost estimates, additional research was conducted of publicly available (online) resources to determine if more recent BMP cost information for the New England region was available. These resources included:

- EPA's LID webpage: <http://water.epa.gov/polwaste/green/>
- EPA's 2013 Article: *Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs*: [http://water.epa.gov/polwaste/green/upload/lid-gi-programs\\_report\\_8-6-13\\_combined.pdf](http://water.epa.gov/polwaste/green/upload/lid-gi-programs_report_8-6-13_combined.pdf)

- New England Environmental Finance Center: <http://efc.muskie.usm.maine.edu/>
- UNC Environmental Finance Center's *Catalog of Finance Publications on Green Infrastructure Approaches to Stormwater Management* (This spreadsheet provides a catalog of 46 publications related on green infrastructure for stormwater management that have finance relevance; Several of the sources from the catalog were reviewed for this document) : <http://www.efc.sog.unc.edu/reslib/item/catalog-green-infrastructure-and-stormwater-finance-publications>
- Houle, *et al.* *Comparison of Maintenance Cost, Labor Demands, and System Performance for LID and Conventional Stormwater Management*: [http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/Houle\\_JEE\\_July-2013.pdf](http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/Houle_JEE_July-2013.pdf)
- University of New Hampshire Stormwater Center's *Forging the Link: Linking the Economic Benefits of LID and Community Decisions*: <http://www.unh.edu/unhsc/forging-link-topics>
- Center for Neighborhood Technology's *Green Values Stormwater Tool Box*: <http://greenvalues.cnt.org/> which included the Green Values Calculator: <http://greenvalues.cnt.org/national/calculator.php>
- Water Environment Research Foundation (WERF): User's Guide to the BMP and LID Whole Life Cost Models, Version 2.0: [www.werf.org/bmpcost](http://www.werf.org/bmpcost)
- Low Impact Development Center: <http://www.lowimpactdevelopment.org/>
- ECONorthwest's *The Economics of Low-Impact Development: A Literature Review*: <http://www.econw.com/our-work/publications/the-economics-of-low-impact-development-a-literature-review/>
- Drexel University's Low Impact Development Rapid Assessment (LIDRA Model) <http://www.lidratool.org/home/publications.aspx>

A review of these resources did highlight the multitude of variables that can impact the cost of installing LID BMPs and the variety of cost analysis methods that can be used when assessing the cost effectiveness of various LID storm water controls. For example, many of the resources emphasized that costs tend to be site specific. Costs often differ significantly among different geographical locations, depending upon labor and material expenses and the constraints of a particular site. Unfortunately, most of the aforementioned resources highlighted projects outside of the New England region (with the exception of the articles by Houle of the UNHSC and New England Environmental Finance Center.)

EPA's recent (2013) report entitled *Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs* listed the 7 different types of economic analyses that were represented by the 13 case studies highlighted in the report. These ranged from the simplest form of economic analysis (i.e., the capital cost assessment) to more robust forms, including the life cycle cost assessment. Whole life-cycle costs would provide a more accurate estimate of the cost of installing, operating, maintaining, and replacing a project (i.e., BMP) throughout its expected lifetime. However this type of analysis requires solid estimates for capital, land purchase, O&M, and other related costs.

Ideally, the goal was to include a more advanced economic analysis (i.e. –life cycle costs) in the Opti-Tool while still maintaining some level of simplicity for the end user. However, such a robust economic analysis does not currently appear possible because the literary search for more recent BMP cost estimates, reflective of New England states, was largely unsuccessful. However, the search was not

entirely fruitless. Jamie Houle of the UNHSC did provide extremely valuable information on capital and maintenance costs for various BMPs that have been tested at the UNHSC. Cost estimates for a particular BMP available from *both* the CRWA study and UNHSC were discussed among Mark Voorhees of EPA, Jamie Houle of UNHSC, and Karen Mateleska of EPA, and a best professional judgment decision was made.

The recommendation at this time is to use a combination of the CRWA cost estimates **and** UNHSC costs estimates as the basis for the Opti-Tool BMP cost estimates, and to use a modified capital cost assessment (which includes a fixed percentage for Design and Contingency Costs) as well as a separate field for maintenance hours (from the UNHSC). The details supporting this approach are described below.

### **Overview of Scope and Approach**

According to a draft memo, dated 6/20/14 from Tetra Tech to EPA Region I, the current SUSTAIN BMP Cost function has seven major individual components, using a formula that would likely be useful in a more detailed design mode. For purposes of simplicity, EPA Region I is proposing the following cost function formula for the tool's "planning" mode:

<b>General Cost Function Formula =</b> Storage Volume of BMP* (ft <sup>3</sup> ) X Cost Estimate for BMP (\$/ft <sup>3</sup> ) X Adjustment Factor
---

\* Storage Volume of BMP is more accurately defined as (Design) Physical Storage Capacity of BMP; See Section A below for more details

Initially, the intention was to include the preliminary Operations and Maintenance (O&M) costs in the general formula (page 3) by simply multiplying the formula results by our Preliminary O & M costs. However, such an approach would only include **one year's worth** of operations and maintenance, which could have been misleading because it would not have reflected the true life cycle cost of the BMP (i.e., assume life cycle of 20 years). However, simply including the 20 year life cycle cost (O&M cost \*20) in the above formula would have greatly increased the cost value and perhaps have created misconceptions about BMP use and affordability.

Therefore, the subcommittee decided to include the anticipated operation and maintenance **hours** required for each BMP per year instead. This parameter was included as a completely separate field in the Opti-Tool. The rationale was that Opti-Tool users need to understand that operation and maintenance impact the overall cost-effectiveness of BMPs and should be considered when selecting a BMP. Including O&M hours (instead of costs) as a separate field, would still highlight this important consideration for stormwater managers.

## A. Storage Volume and Proposed Cost Estimate Values

As highlighted above, the general cost function formula used in the Opti-Tool consists of 3 factors: the BMP storage volume, the proposed BMP storage volume cost estimate, and the adjustment factor. The first two factors will be covered together in this memo because they are so closely linked. Table 1 below summarizes the proposed BMP cost estimates for the Opti-Tool.

**Table 1: Proposed BMP Cost Estimates for Opti-Tool**

BMP (From Opti-Tool)	Cost (\$/ft <sup>3</sup> ) <sup>1</sup>	Cost (\$/ft <sup>3</sup> ) – 2016 dollars <sup>6</sup>
Bioretention (Includes rain garden)	13.37 <sup>2,4</sup>	15.46
Dry Pond or detention basin	5.88 <sup>2,4</sup>	6.80
Enhanced Bioretention (aka-Bio-filtration Practice)	13.5 <sup>2,3</sup>	15.61
Infiltration Basin (or other Surface Infiltration Practice)	5.4 <sup>2,3</sup>	6.24
Infiltration Trench	10.8 <sup>2,3</sup>	12.49
Porous Pavement - Porous Asphalt Pavement	4.60 <sup>2,4</sup>	5.32
Porous Pavement - Pervious Concrete	15.63 <sup>2,4</sup>	18.07
Sand Filter	15.51 <sup>2,4</sup>	17.94
Gravel Wetland System (aka-subsurface gravel wetland)	7.59 <sup>2,4</sup>	8.78
Wet Pond or wet detention basin	5.88 <sup>2,4</sup>	6.80
Subsurface Infiltration/Detention System (aka-Infiltration Chamber)	54.54 <sup>5</sup>	67.85

<sup>1</sup> Footnote: Includes 35% add on for design engineering and contingencies

<sup>2</sup> Costs in 2010 dollars

<sup>3</sup> From CRWA Cost Estimates

<sup>4</sup> From UNHSC Cost Estimates; Most of original costs were from 2004 and converted to 2010 dollars using U.S. Department of Labor (USDOL). (2012). Bureau of Labor Statistics consumer price index inflation calculator. [http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm)

<sup>5</sup> From Cost Estimate of MA TT Rizzo Project (2008 Dollars)

<sup>6</sup> 2010 costs were converted to 2016 values to adjust for inflation. The ENR Cost Index Method was used for this conversion.

Table 1 includes all of the BMPs that are included in the Opti-Tool. The unit costs represent the dollar amount (\$) per cubic foot of storage volume (ft<sup>3</sup>), where the storage volume reflects the (design) physical static storage capacity that the relevant BMP can hold. This volume includes the volume of ponding water *and* the volume of water retained in the porous media or subbase materials if applicable. (This storage volume does *not* represent the *treated* volume of stormwater, which may be significantly higher than the physical storage volume of a BMP particularly for systems that are sized dynamically or

by a water quality flow rate as opposed to a water quality volume.) This unit cost per storage volume captured by a BMP differs from other (perhaps more traditional) methods that can be used. By choosing to use the unit cost per storage volume instead of volume of water treated, we are trying to eliminate confusion over what the actual dimensions of the BMP will be for the costs being estimated. Additionally, this use of the unit cost per storage volume is consistent with the approach used in developing the BMP performance curves (used in the Opti-Tool) where the x-axis is the actual **physical storage capacity** to hold water. Lastly, expressing the unit costs in this manner will benefit users who are simply interested in using the unit costs (outside of the Opti-Tool) by eliminating the step of modeling hydrology and routing the water through the BMP, which can yield widely varying results depending on modeling approach and supporting assumptions. Attachment A describes the method used in calculating the design storage volume for each of the selected BMPs.

Also, each unit cost per storage value represents the capital cost of construction/installation of the BMP and includes a 35% design/engineering/contingency (D & E) cost. This 35% fixed percentage of the total construction cost follows a general “rule of thumb,” often used by consulting firms. Based upon a conversation between Mark Voorhees and Jamie Houle (two members of the Opti-Tool cost subcommittee), a decision was made to include this D&E cost. The values in Table 1 do *not* include the cost of purchasing any land, nor does it include any O&M costs (which is discussed in more detail in a subsequent section). Therefore, each unit cost in Table 1 that was based on the CRWA’s 2010 values was calculated by multiplying the relevant BMP cost by 1.35.

Since the CRWA study did not include cost estimates for porous pavement or sand filters, which are BMPs included in the Opti-Tool, relevant data was obtained from Jamie Houle of the University of New Hampshire Stormwater Center (UNHSC). He also provided additional cost estimates (as denoted by Footnote 4 in Table 1) for some of the other BMPs included in the tool. UNHSC can provide valuable data because they have been directly involved with the engineering, design and construction of numerous LID controls, as well as evaluating multiple stormwater treatment systems over multiple years at their primary field research facility in Durham, N.H. Since they could provide cost information for both porous asphalt pavement and pervious concrete, separately, the general category of porous pavement was divided into the aforementioned two sub-categories.

It should be noted that the costs used for the Opti-tool *assume linearity*, which will both allow for *and* incentivize the scaling to smaller-sized systems. For example, EPA has estimated that *smaller* capacity designs for BMPs, rather than large-sized BMPs, can increase both the technical and economic feasibility of installing controls, particularly for retrofits. The assumption of linearity was made for the following reasons: 1) Limited data currently exists on the cost of small capacity systems. Until a larger pool of cost data becomes available which will allow for the development of a non-linear cost curve, the current method is the best available alternative; 2) As the installation of smaller systems becomes more widespread, it is likely that economies of scale will develop and cost savings will occur. For example, if one entity is contracted to install multiple small systems at once, materials can be bought in bulk and the installation process can become more efficient and less expensive; 3) An undersized system built to treat a large area can be a very cost effective approach. As an example, there should not be a significant cost difference between a 1-inch system treating 1 acre and a 1/10-inch-system that treats 10 acres, since the absolute capacity of the system is the same in both cases. This topic of linearity will be revisited in the future when more data is available.

Since UNHSC typically calculates the capital costs per cubic foot (ft<sup>3</sup>) *treated*, using WQv, Jamie Houle converted the costs to represent the capital costs per BMP storage volume (ft<sup>3</sup>). This was necessary so the capital cost data would be consistent with the method used in the Opti-Tool. Also, all of the costs were converted to 2010, and ultimately 2015, dollars. As with the CRWA costs, the UNHSC capital costs were already adjusted to include the 35% design/engineering/contingency (D & E) cost. Details of all of these calculations, and any other assumptions made, are presented in Attachment B.

When developing cost estimates, another topic for consideration was whether or not to address the issue of inflation. CRWA's BMP cost estimates were based on capital costs from 2010. As previously stated, UNHSW's cost estimates have also already been converted to constant 2010 dollars using consumer price index inflation rates [U.S. Department of Labor (USDOL) 2014].<sup>1</sup> Therefore, there was the option of converting all of these 2010 costs to 2016 costs, using the U.S. Department of Labor's consumer price index inflation calculator. However, another suggestion was made to use the ENR Cost Index method to adjust for inflation instead because it more closely tracks construction work. At least one New England state (i.e., Vermont) also uses the ENR Cost Index method, so this could provide some consistency, as well. Therefore, the decision was made to ultimately convert all of the costs to 2016 values using the ENR Cost Index method. These values are reflected in Table 1.

To use the index, one calculates the quotient of the current index number (based on the month and year of *current* date) divided by the index number from a given date (e.g., June of 2010). Since the month was not known for the 2010 costs, the month of June was used as an estimate. This assumption was used because it falls mid-way between the construction season and would likely provide a reasonable estimate. Once the quotient was calculated, it was multiplied by the construction cost (found in the middle column in Table 1, above) to provide the 2016 construction cost value

## **B. Cost Adjustment Factor**

Since the cost of installing a BMP will vary depending on the specific site location, the TAC subcommittee believed it was important for the Opti-Tool to include a scalable cost adjustment factor. The proposed cost estimates for the Opti-Tool (in Table 1) are all based on a Cost Adjustment Factor of 1. However, each Opti-Tool user has the option to choose and enter into the tool a cost adjustment factor that is appropriate for their site. This will adjust the storage volume cost function in the Opti-Tool.

For example, the CRWA report included the cost factors summarized in Table 2.

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<sup>1</sup> Reference: U.S. Department of Labor (USDOL). (2014). Bureau of Labor Statistics consumer price index inflation calculator." ([http://www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm))(Sep. 12, 2014)

**Table 2: Example of Cost Adjustment Factors**

<b>BMP Type</b>	<b>**EXAMPLE** Cost Adjustment Factor</b>
New BMP in undeveloped area	1
New BMP in partially developed area	1.5
New BMP in developed area	2
Difficult installation in highly urban settings	3

(Source: Table 4 of Appendix B of CRWA's Spruce Pond Brook Subwatershed Project for Town of Franklin)

The assumption made was that it would cost more to install a new BMP in a developed area (with more site constraints) than it would cost to install the same BMP in a previously undeveloped area. So in the above example, the cost adjustment factor would be 2 for installing a BMP in a previously developed area versus a cost adjustment factor of 1 for installing a BMP in an undeveloped area.

It should be noted that Table 2 (above) provides just *one example* of adjustment factors. The factor should be flexible enough so that another location (or Opti-Tool user) can adjust it, as needed. For example, the Charles River Watershed (in eastern Massachusetts) used an adjustment factor of 2 for installing a BMP in a developed area, while the State of Vermont uses an adjustment factor of 1.4 to estimate the cost of installing a BMP for existing development.

### **C. Maintenance (O&M) Costs**

Originally, one goal was to include Operation and Maintenance (O&M) costs as part of the cost estimates for the Opti-Tool. These O&M costs would help to provide a more realistic reflection of the long-term expenses of structural storm water controls, which is obviously critical in the practical, real-world implementation of BMPs. However, it is difficult to obtain accurate maintenance costs and they will be highly variable depending on the size, location and equipment needed to perform long-term O&M.

This point was highlighted by a key finding in EPA's recent (2013) publication, *Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs*. The report indicated that only a small percentage of the entities that implement LID and GI approach for stormwater management conduct economic analyses due to the "uncertainties surrounding costs, operation and maintenance (O&M) requirements, budgetary constraints, and difficulties associated with quantifying the benefits provided by LID/GI" and the need "to obtain better estimates of the O&M costs associated with different types of LID/GI projects" was a key finding of the report.

As previously mentioned, one article entitled, *Comparison of Maintenance Cost, Labor Demands, and System Performance for LID and Conventional Stormwater Management* (Houle et al. 2013), did contain relevant information for BMP costs in the New England region. During initial discussions between EPA Region I (Mark Voorhees) and UNHSC (Jamie Houle), there was concern that not enough data existed on O&M costs to propose accurate values for each of the BMPs included in the Opti-Tool. There was also

the concern that the O&M costs were not scaleable. For example, initial O&M costs for each BMP were based on the cost of operation and maintenance per year per acre of IC treated. Scaled differences such as the annual O&M costs for treating 0.5 acres of IC or 2 acres of IC have **not** been evaluated and may or may **not** result in a simple linear relationship. Yet the Opti-Tool costs subcommittee also realized the importance of including some maintenance parameter in order to *initiate* the conversation on the importance of accounting for O&M to maintain the functionality of the BMPs. Therefore Table 3, below, presents these annual maintenance costs (in \$) for select BMPs, as well as the annual maintenance hours. Although the O&M costs have been presented in this memo, only the O&M **hours** will be included (as a separate field) in the Opti-Tool.

**Table 3: Maintenance Costs (\$) and Hours per year for select BMPs – From UNHSC**

<b>BMP</b>	<b>Maintenance Cost (\$) per year</b>	<b>Annual Maintenance Hours</b>
Bioretention	\$1,890.00	20.7
Chamber System	Not Assessed	Not Assessed
Detention Pond	\$2,380.00	24.0
Gravel Wetland	\$2,138.33	21.7
Porous Asphalt	\$1,080.00	6.0
Pervious Concrete	\$1,080.00	6.0
Retention Pond	\$3,060.00	28.0
Sand Filter	\$2,807.50	28.5

\*Note: initial costs based on cost of maintenance per year per acre of IC treated

Annual maintenance strategies were evaluated by directly quantifying hours spent categorizing maintenance activities, and assessing difficulty of those activities. To better illustrate costs and anticipate maintenance burdens, activities were characterized into distinct categories and a standard cost structure was applied. This unit conversion can easily be adapted according to local conditions, current economic climate, and regional cost variations which is why we decided to go with maintenance **hours** as those were directly measured and should remain constant. These maintenance activity categories allow more accurate cost predictions and provide insight into the appropriate assignment of maintenance responsibilities.

Annual maintenance costs were normalized to 2012 dollars and calculated for all SCMs by both dollars and personnel hours per acre of IC treated per system per year. It is important to note that inflation was not considered in life cycle maintenance cost projections.

**Attachment B:**  
Pre-Conceptual Designs for Top Five Locations

# TOWN OF ANDOVER

# MUNICIPAL PROPERTY BMP RETROFIT OPPORTUNITIES

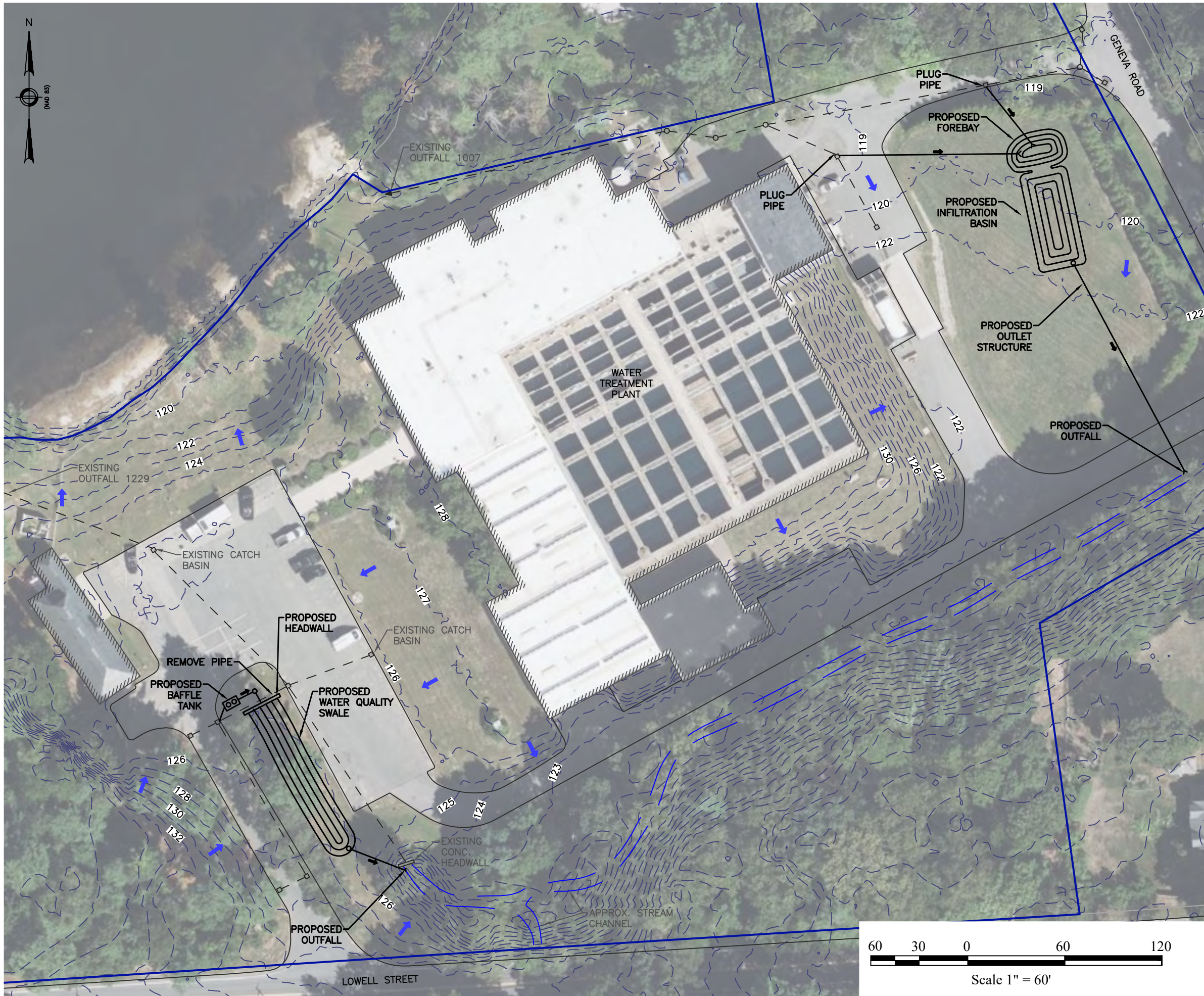
JUNE 2022



LOCUS NOT TO SCALE

<u>SHEET</u>	<u>TITLE</u>
C-1	W2 - WATER TREATMENT PLANT
C-2	FD2 - WEST ANDOVER FIRE STATION
C-3	PD1-FD1 - ANDOVER TOWN FIRE & POLICE STATION
C-4	S2 - BANCROFT ELEMENTARY SCHOOL
C-5	S8 - SOUTH ELEMENTARY SCHOOL
C-6	P2 - POMPS POND BEACH





### GENERAL NOTES

#### LEGEND

- PROJECT PARCEL
- PROPERTY LINE
- EXISTING CONTOUR (1')
- EXISTING DRAIN PIPE
- EXISTING CATCH BASIN
- EXISTING DRAIN MANHOLE
- EXISTING BUILDING
- EDGE OF PAVEMENT
- FLOW DIRECTION ARROW

COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED



41 MAIN STREET  
BOLTON, MA 01740

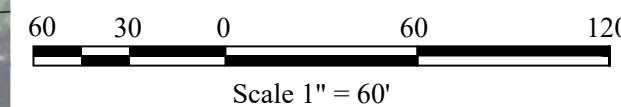
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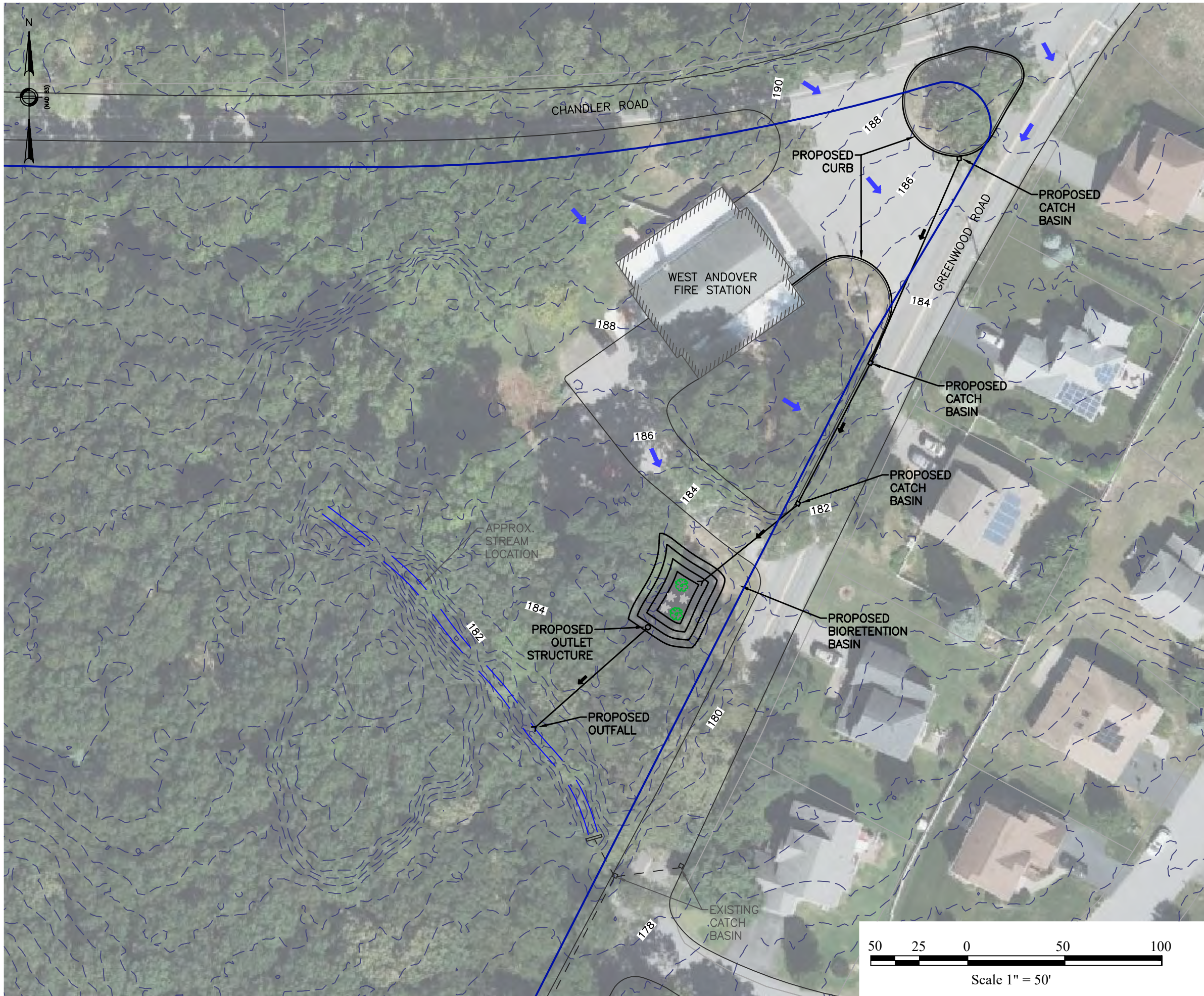
TOWN OF ANDOVER, MA

Project No.: 179  
Date: 6/2/2022  
Drawn By: NP  
Checked By: RB  
Scale: AS SHOWN

Sheet

C-1





### GENERAL NOTES

#### LEGEND

- PROJECT PARCEL
- PROPERTY LINE
- EXISTING CONTOUR (1')
- EXISTING DRAIN PIPE
- EXISTING CATCH BASIN
- EXISTING DRAIN MANHOLE
- EXISTING BUILDING
- EDGE OF PAVEMENT
- FLOW DIRECTION ARROW

COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED



41 MAIN STREET  
BOLTON, MA 01740

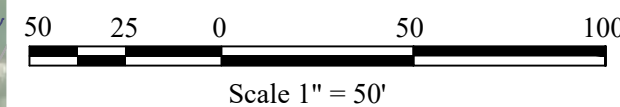
### PROPOSED CONDITIONS WEST ANDOVER FIRE DEPARTMENT PLAN VIEW

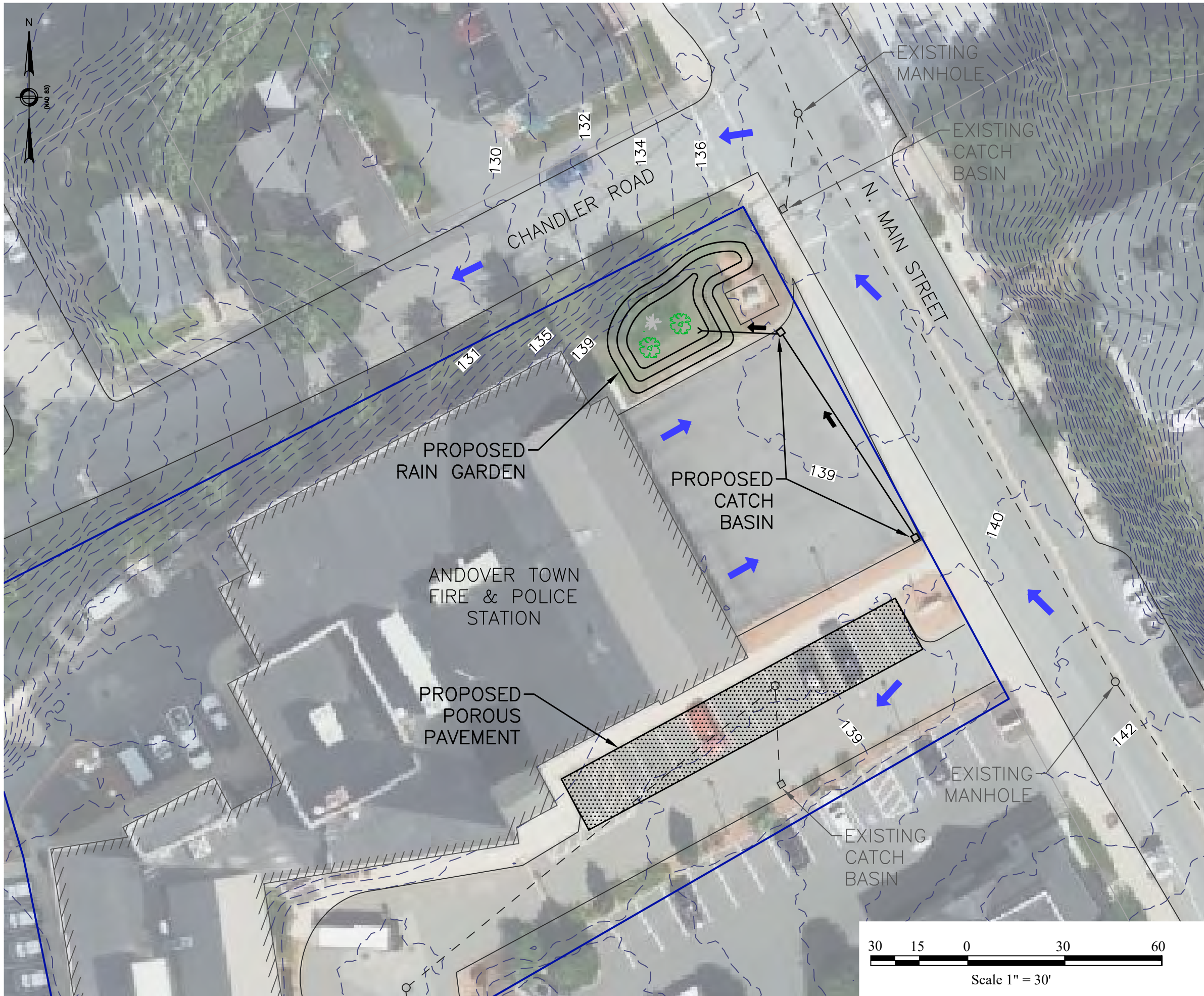
TOWN OF ANDOVER, MA

Project No.: 179  
Date: 6/2/2022  
Drawn By: NP  
Checked By: RB  
Scale: AS SHOWN

Sheet

C-2





**GENERAL NOTES**

**LEGEND**

- PROJECT PARCEL
- PROPERTY LINE
- EXISTING CONTOUR (1')
- EXISTING DRAIN PIPE
- EXISTING CATCH BASIN
- EXISTING DRAIN MANHOLE
- EXISTING BUILDING
- EDGE OF PAVEMENT
- FLOW DIRECTION ARROW

**COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED**



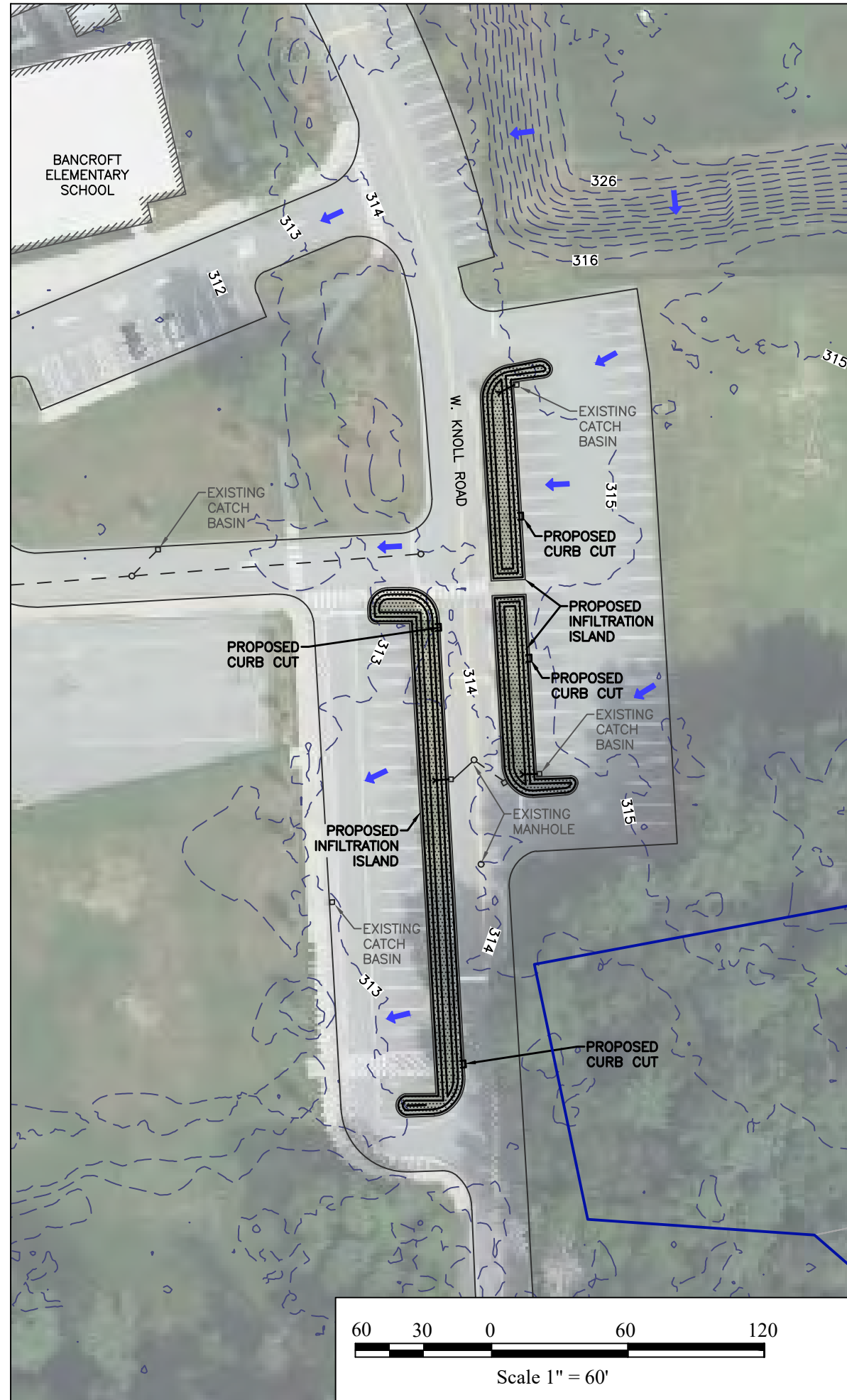
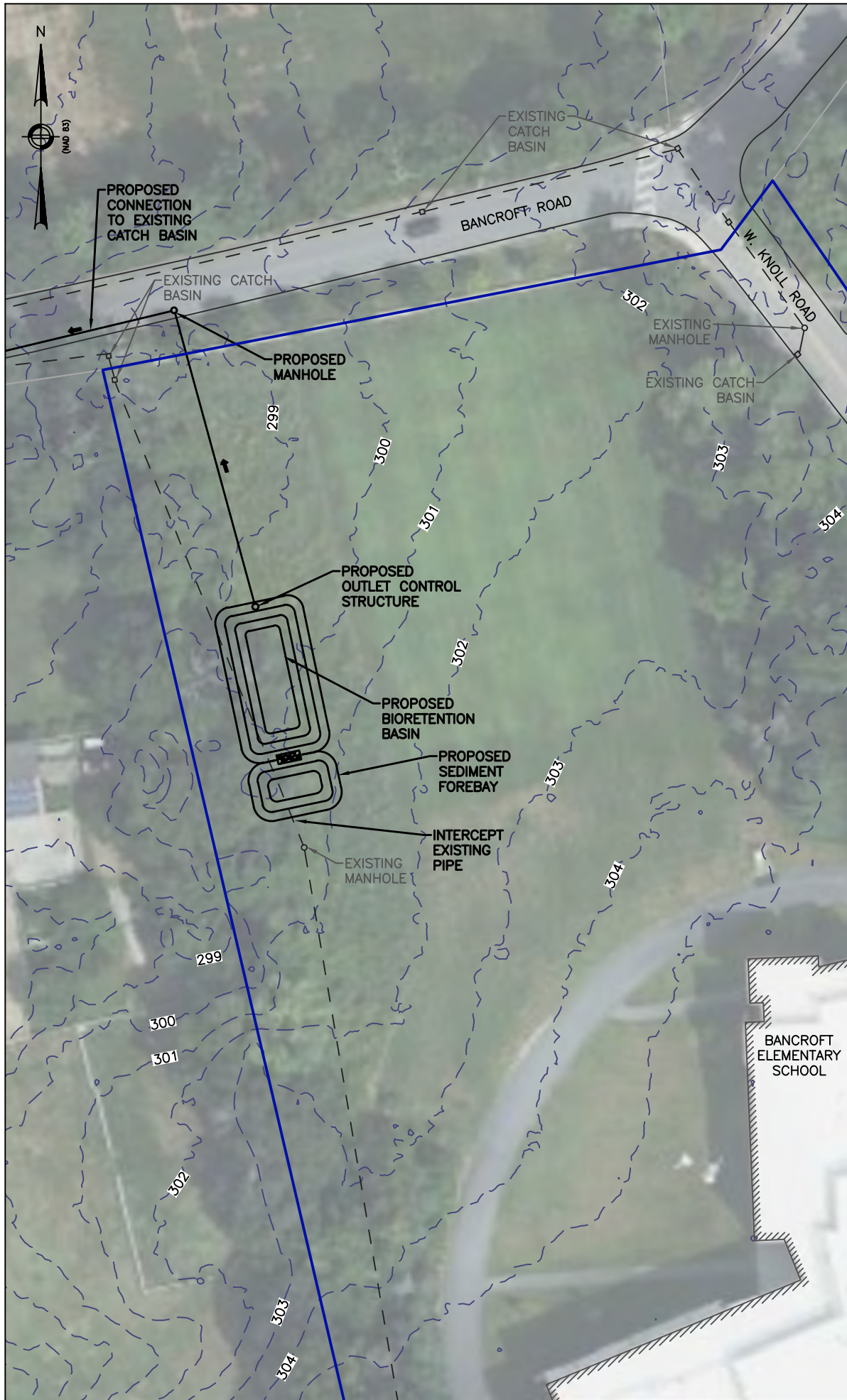
41 MAIN STREET  
BOLTON, MA 01740

**PROPOSED CONDITIONS  
ANDOVER TOWN FIRE & POLICE  
STATION  
PLAN VIEW**

TOWN OF ANDOVER, MA










Project No.: 179  
Date: 6/2/2022  
Drawn By: NP  
Checked By: RB  
Scale: AS SHOWN

Sheet  
**C-3**



**GENERAL NOTES**

**LEGEND**

-  PROJECT PARCEL
-  PROPERTY LINE
-  EXISTING CONTOUR (1')
-  EXISTING DRAIN PIPE
-  EXISTING CATCH BASIN
-  EXISTING DRAIN MANHOLE
-  EXISTING BUILDING
-  EDGE OF PAVEMENT
-  FLOW DIRECTION ARROW

COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED



41 MAIN STREET  
BOLTON, MA 01740

**PROPOSED CONDITIONS  
BANCROFT ELEMENTARY  
SCHOOL  
PLAN VIEW**

TOWN OF ANDOVER, MA

Project No.: 179  
Date: 6/2/2022  
Drawn By: NP  
Checked By: RB  
Scale: AS SHOWN










Sheet

C-4



### GENERAL NOTES

#### LEGEND

-  PROJECT PARCEL
-  PROPERTY LINE
-  EXISTING CONTOUR (1')
-  EXISTING DRAIN PIPE
-  EXISTING CATCH BASIN
-  EXISTING DRAIN MANHOLE
-  EXISTING BUILDING
-  EDGE OF PAVEMENT
-  FLOW DIRECTION ARROW

COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED



41 MAIN STREET  
BOLTON, MA 01740

PROPOSED CONDITIONS  
SOUTH ELEMENTARY SCHOOL  
PLAN VIEW

TOWN OF ANDOVER, MA

Project No.: 179

Date: 6/2/2022

Drawn By: NP

Checked By: RB

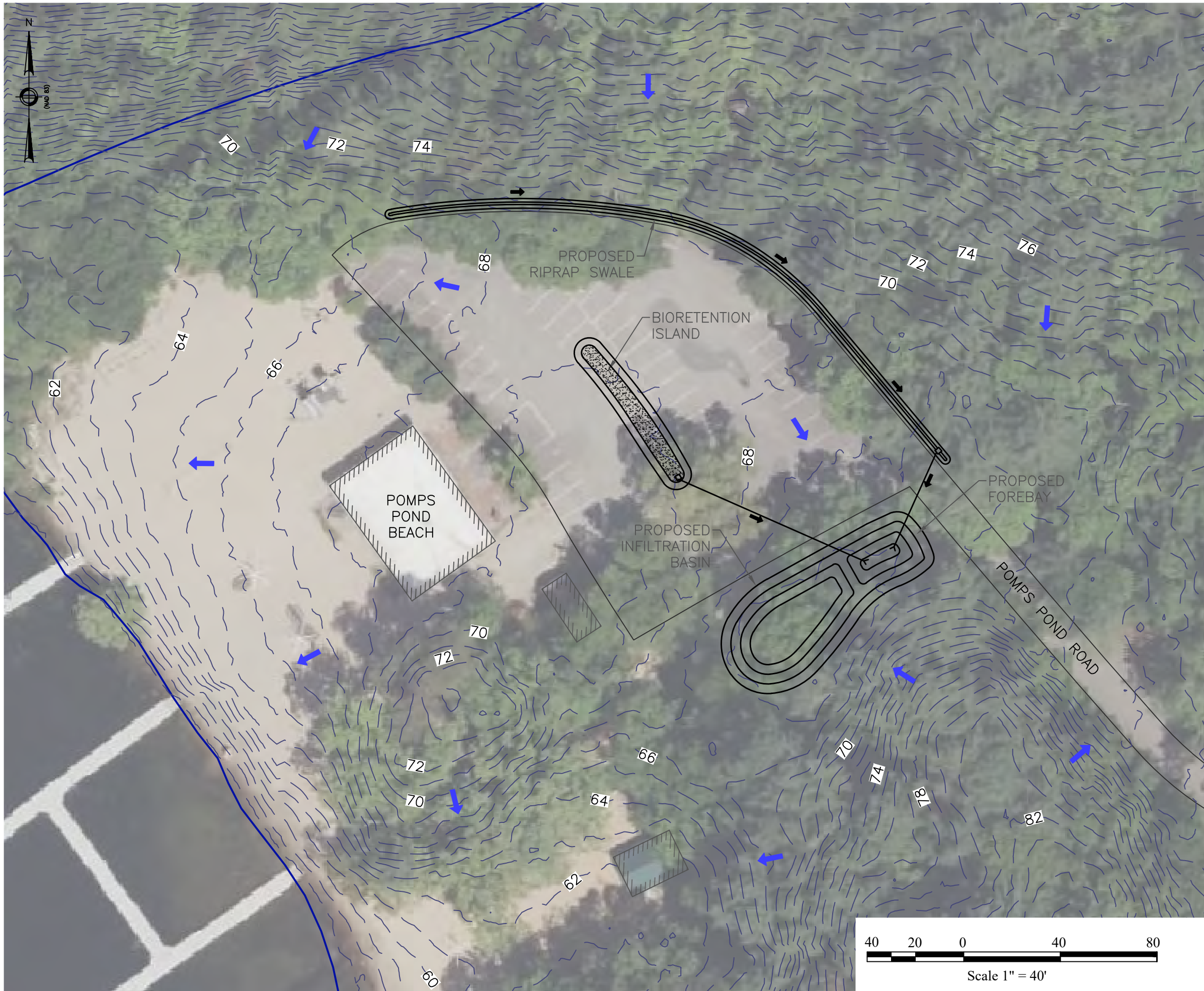
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C-5












Scale 1" = 60'



### GENERAL NOTES

#### LEGEND

-  PROJECT PARCEL
-  PROPERTY LINE
-  EXISTING CONTOUR (1')
-  EXISTING DRAIN PIPE
-  EXISTING CATCH BASIN
-  EXISTING DRAIN MANHOLE
-  EXISTING BUILDING
-  EDGE OF PAVEMENT
-  FLOW DIRECTION ARROW

COMPREHENSIVE ENVIRONMENTAL  
INCORPORATED



41 MAIN STREET  
BOLTON, MA 01740

### PROPOSED CONDITIONS POMPS POND BEACH PLAN VIEW

TOWN OF ANDOVER, MA

Project No.: 179

Date: 6/2/2022

Drawn By: NP

Checked By: RB

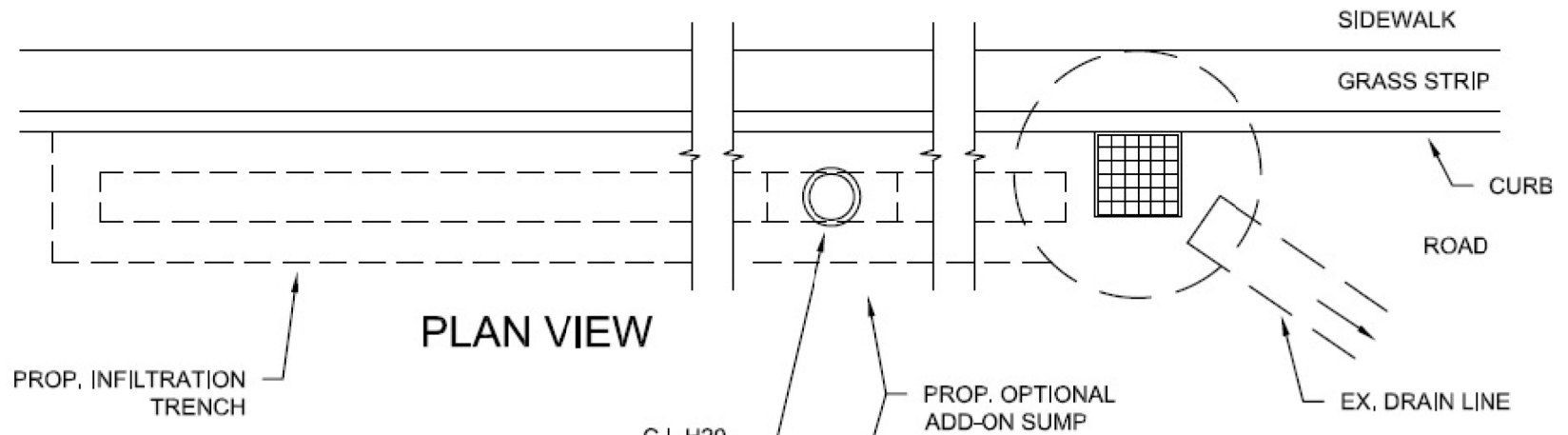
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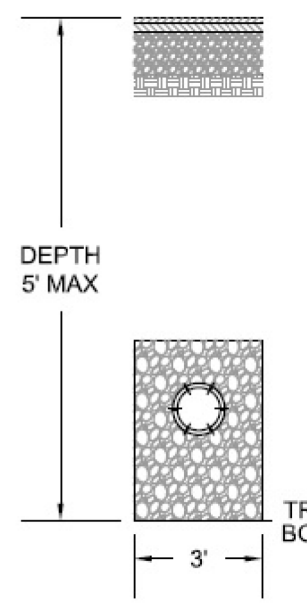
C-6

**Attachment C:**  
Example Roadway and Intersection BMP Improvements

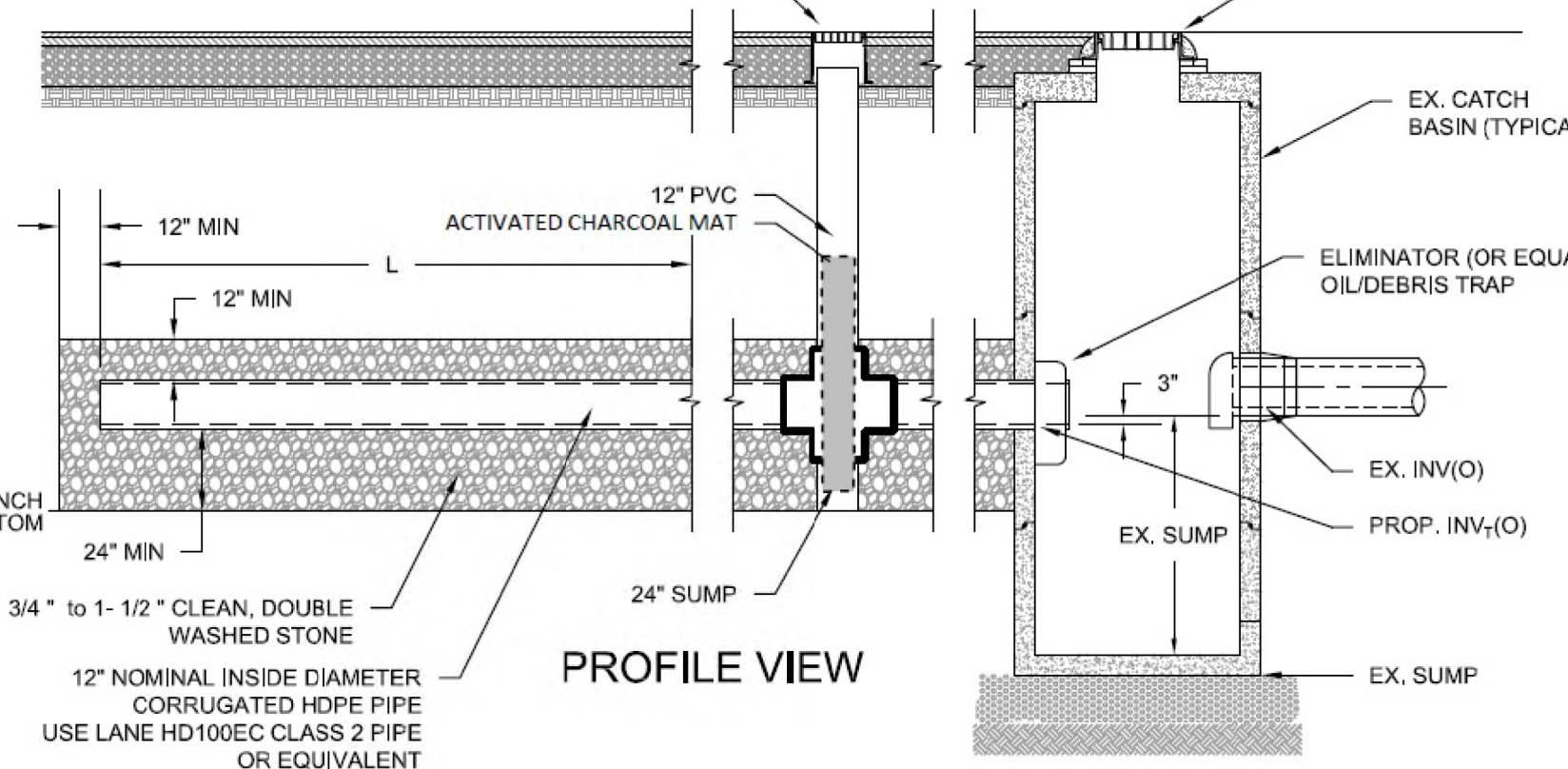
TRENCH ID:
LOCATION:
EX. RIM:
EX. INV(0):
PROP INV <sub>7</sub> (0):
TRENCH BOT:
EX. SUMP:



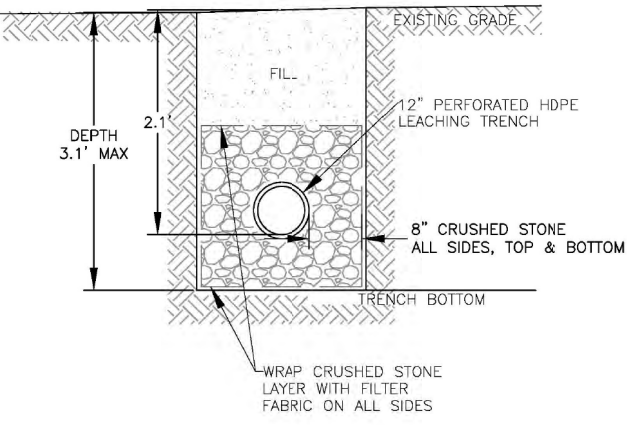
**PLAN VIEW**



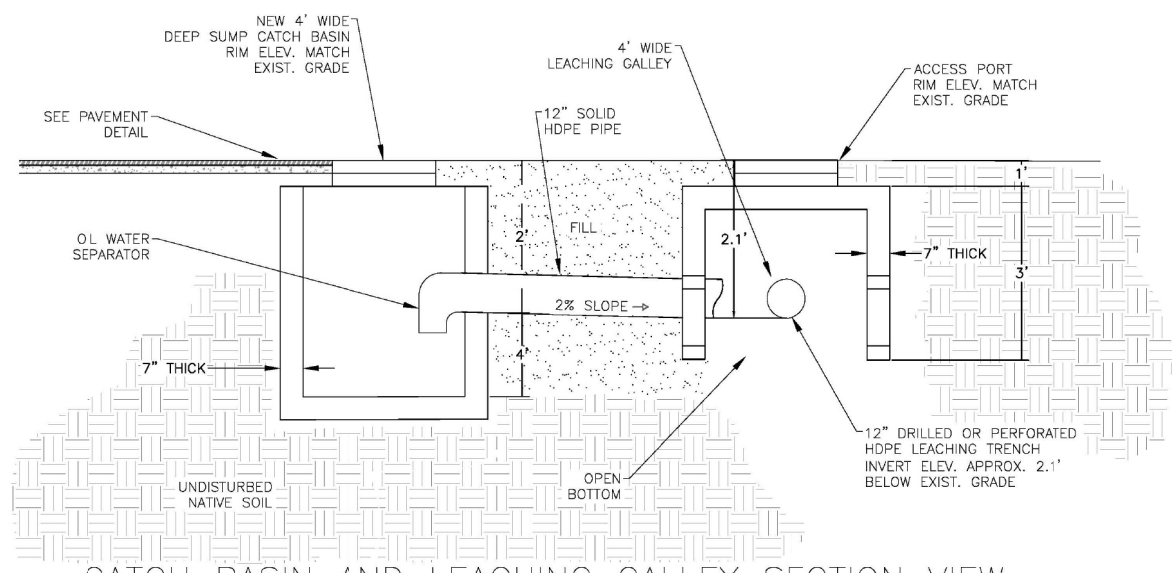
**CROSS SECTION**



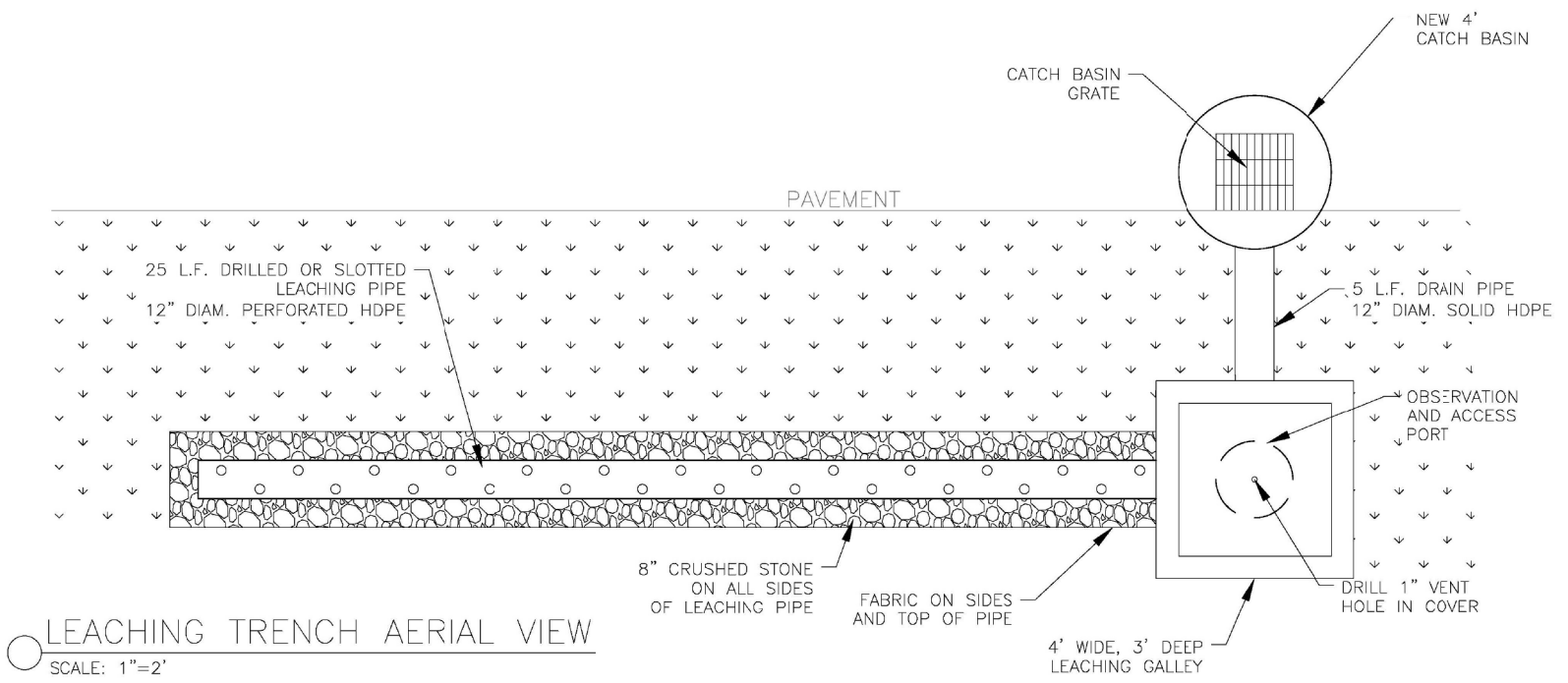
**PROFILE VIEW**



**LEACHING TRENCH SECTION VIEW**  
SCALE: N.T.S.



**CATCH BASIN AND LEACHING GALLEY SECTION VIEW**  
SCALE: 1"=3'



**LEACHING TRENCH AERIAL VIEW**  
SCALE: 1"=2'