

Impervious Cover (SOOE Extended)

Methods & Data Sources

Data for the 52 town PREP footprint (see Figure 1.1) retrieved from the NH GRANIT Clearinghouse (granit.unh.edu) were used as the basis for mapping the 2021 impervious cover (IC). The primary data source used to update the 2015 IC consisted of 2021 60-cm resolution, 4-band National Agriculture Imagery Program (NAIP) orthophotography for both New Hampshire and Maine. Older vintage orthophotography (2015) was used for reference.

The updated IC coverage was derived by displaying the 2015 impervious cover data set for the project area, visually interpreting the 2021 source imagery, and manually digitizing changes to IC features visible in the imagery. Data were initially displayed at a minimum scale of 1:2,000 to identify features to be digitized. The scale was typically increased to 1:1,000 (or greater) when actively digitizing features. Processing was conducted on a town-by-town basis to expedite the editing process and make the overall control of the task more efficient and manageable. Changes to the digitized features included adding new IC features, identifying features that were removed since 2015, and correcting any previous errors of omission or commission (e.g., missing features and false positives). Occasional errors were identified due to differences in tree canopy or lighting in the imagery; comparison of multiple imagery collections allowed for more accurate digitizing.

After a comprehensive review of the data, the IC polygons were processed to derive the final data set for distribution. This involved merging individual town-based datasets into the final, region-wide layer that was used to derive acreage summaries by town and HUC 12 watershed units.

The primary source data for the project comprised 2021 60-centimeter resolution, 4-band orthophotography acquired from the National Agricultural Imagery Program (NAIP) and existing 2015 impervious cover (IC) feature data sets. Older vintage orthophotography (2015) was also used for reference.

Additional Discussion

In some locations, there was a visible shift of the roadways and angle of building lean (as well as other features) between the 2015 high resolution imagery and the 2021 iteration. This is not unexpected, given the 6-year gap in the image collection cycle, the different sensors that were used, the different processing techniques, etc. As a result, there are instances of 2015 IC features that do not appear to overlay precisely on the 2021 imagery. In these cases, the 2015 data was left intact for the 2021 iteration. In general, for the New Hampshire data, where misalignments or questionable features occurred, the 2015 data was presumed correct because it was derived from a higher resolution data source. Conversely, this presumption was not necessarily used for the Maine features, since both the 2015 and 2021 features were derived from NAIP orthophotography.

This project represents the second iteration of mapping the entire 52-town PREP footprint using high resolution (HR), 1-foot/60-cm orthoimagery. Prior to 2015, the PREP IC mapping relied on medium resolution (MR), 30-meter satellite imagery (Justice and Rubin, 2011) As noted in an

earlier report (Justice and Rubin, 2017), there are marked differences between impervious cover estimates generated by the two approaches. This is in part due to the significant difference in the spatial resolution of the source data (1-foot vs. 30-meter, respectively), and in part due to the different processing methodologies used (screen interpretation vs. subpixel automated classification, respectively).

As mentioned in our previous report (Justice and Rubin, 2015), we found that HR impervious cover can be derived using orthophotography at resolutions of 1-meter and greater. It should be noted however that using leaf-on data (i.e., NAIP, 60-centimeter resolution) makes processing slower and less refined. In addition, it should be realized that only major changes in the landscape will be recognized. Despite the shortcomings of the coarser resolution NAIP orthophotography, we feel that this data source is suitably resolved to identify IC at the mapping scales from which these were derived. It is clear, however, that leaf-off photography is preferred and that the NAIP imagery should only be used as a substitute when higher resolution, leaf-off data are not available. It is anticipated that orthophoto data sources such as regularly acquired NAIP imagery can be used as base data from which to delineate significant changes in IC.

Additional Data, Tables, and Graphs

The primary result of this project is a high resolution (HR) impervious cover data set capturing features for the year 2021 within the 52 town PREP footprint. Figure 1.3 displays the distribution of impervious cover mapped throughout the study area. Figure 1.4 presents a large-scale example of the mapping for a small subdivision in the study area. Figures 1.5 and 1.6 graphically show percent impervious cover by town and subwatershed. Tables 1.1 and 1.2 summarize the impervious cover by town and subwatershed.

Note that Figure numbers have been continued from the State of Our Estuaries Report, which contains Figures 1.1 and 1.2.

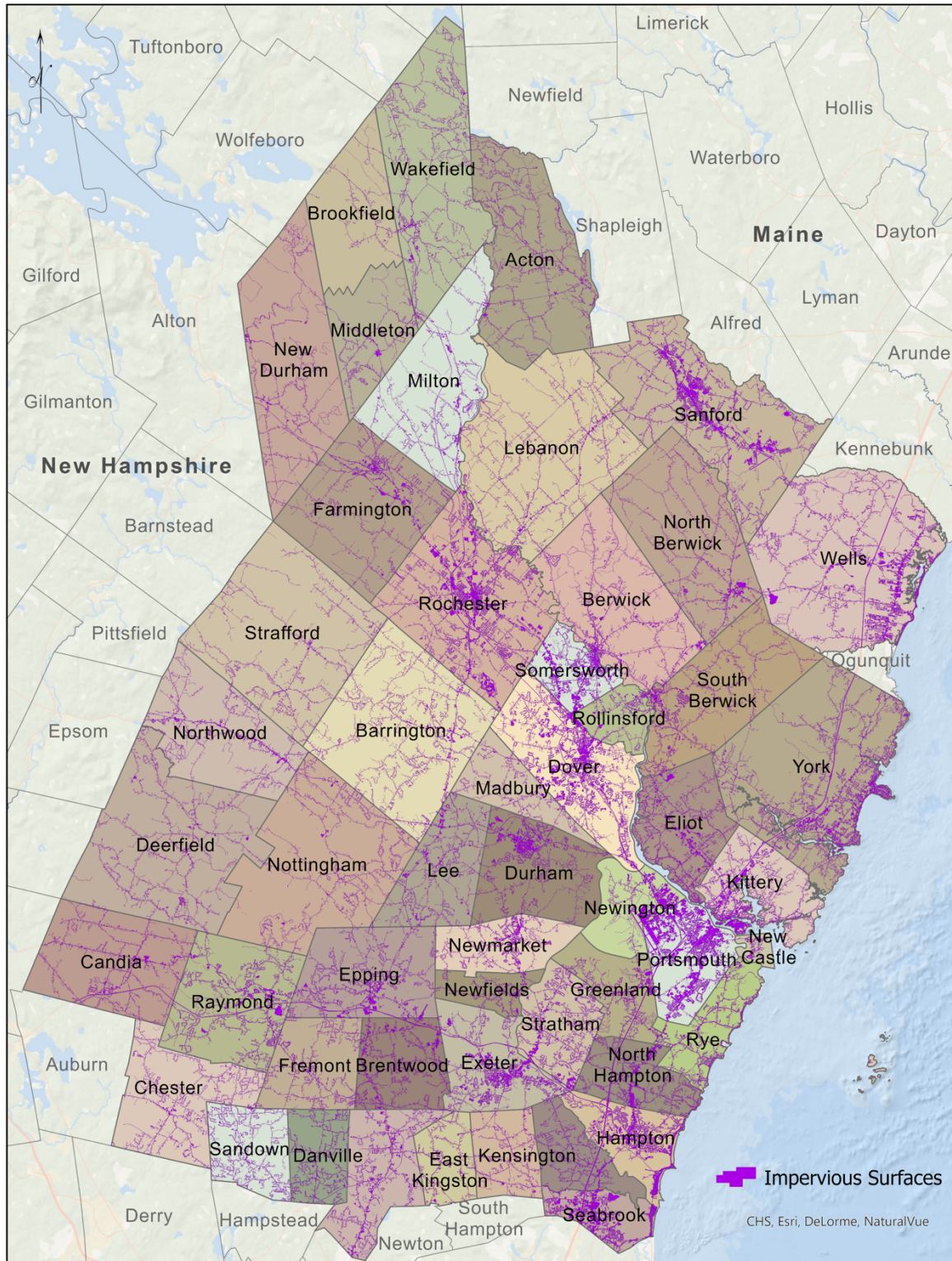


Figure 1.3. Distribution of 2021 impervious cover (purple features) in the project study area.



Figure 1.4. Large-scale example showing impervious cover features.

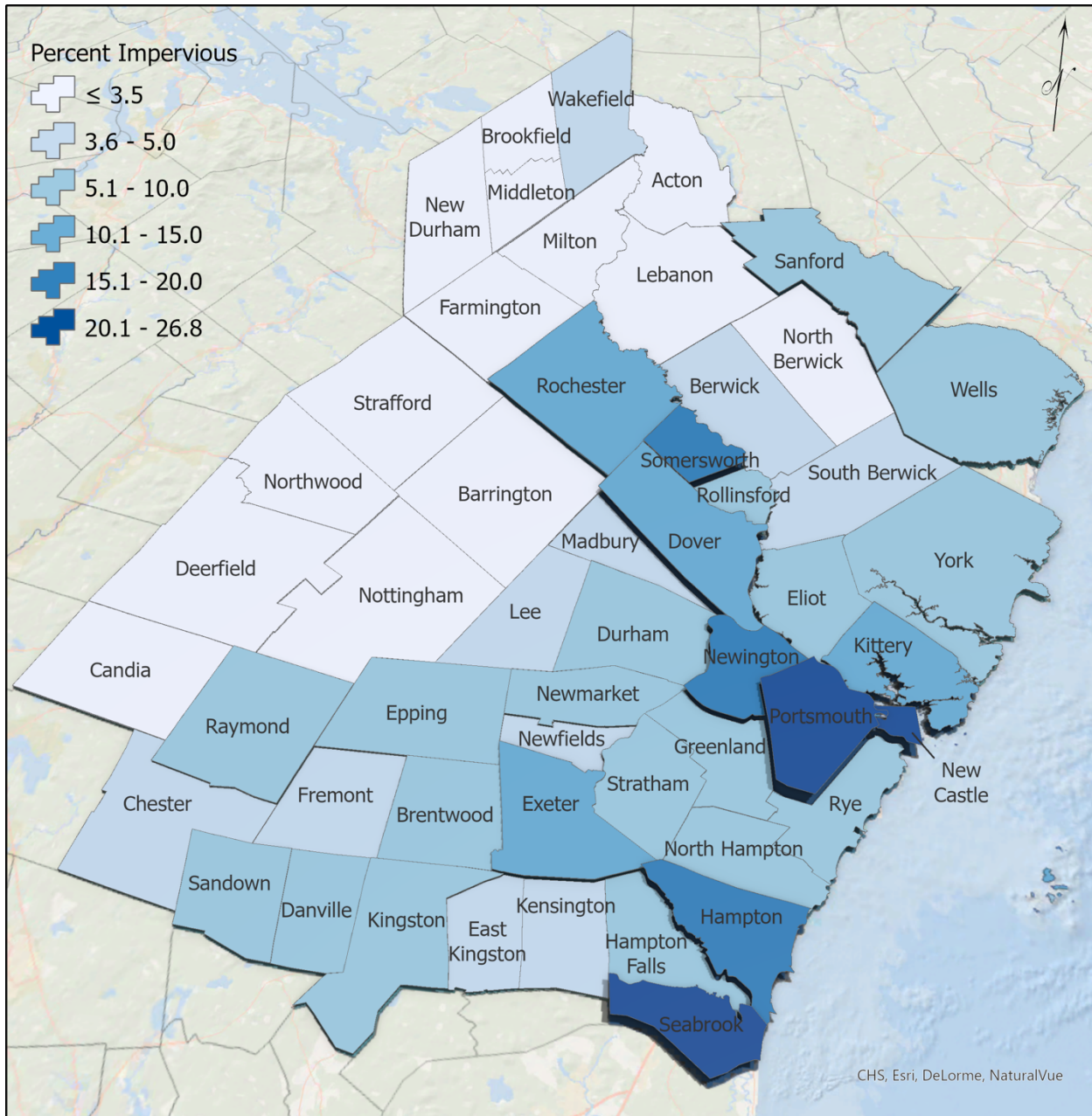


Figure 1.5. Percent impervious cover by town, 2021.

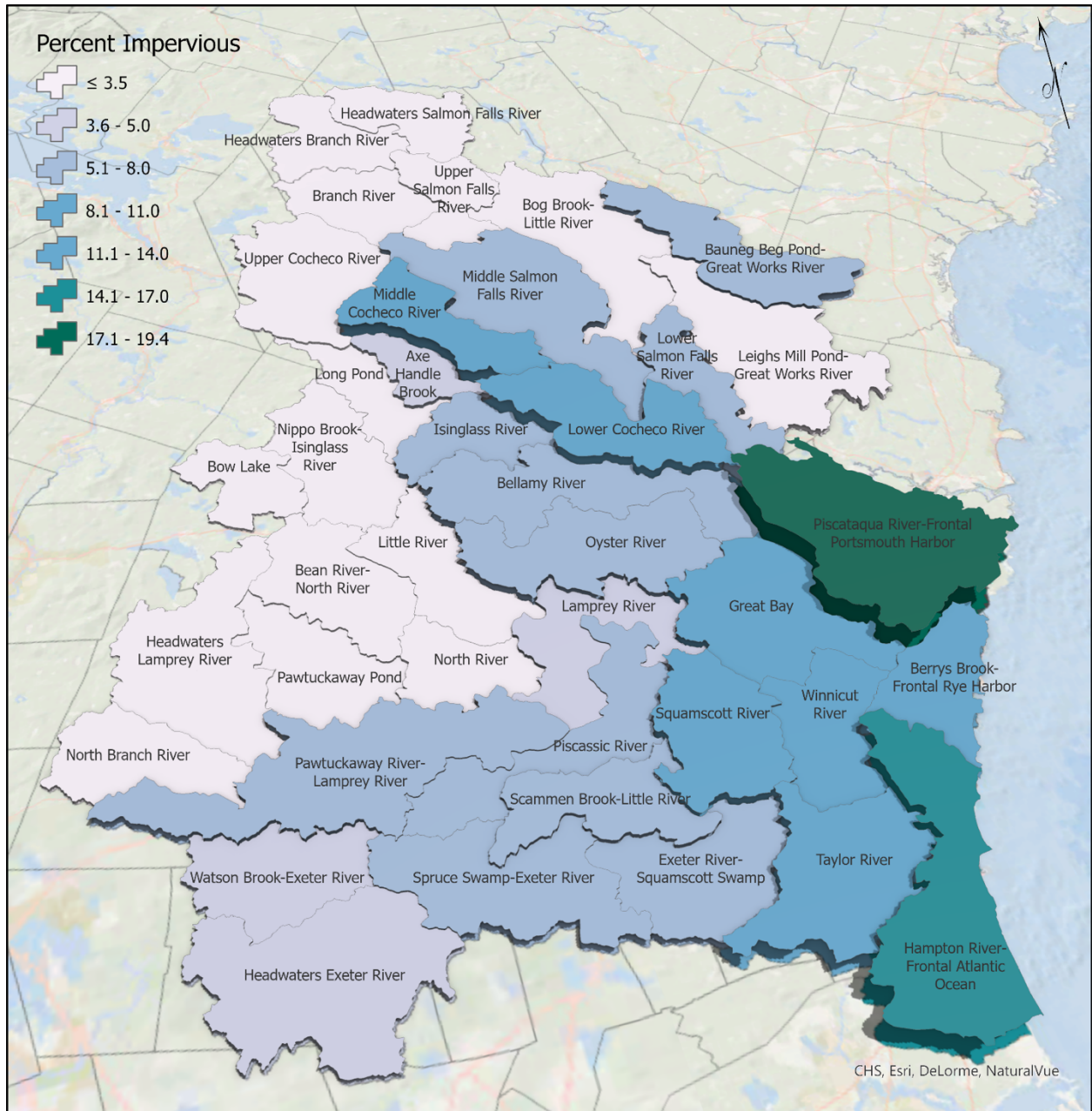


Figure 1.6. Impervious cover by HUC watershed.

State	Town	Total Area (acres)			IC (acres)			Percent IC (Land Area)	
		Land	Inland Water	Total	2015	2021	Change	2015	2021
Maine	Acton	24,216.3	2,191.7	26,408.0	747.0	781.4	34.4	3.1%	3.2%
	Berwick	23,779.6	447.1	24,226.7	893.8	946.0	52.2	3.8%	4.0%
	Eliot	12,609.4	150.6	12,759.9	894.0	957.8	63.8	7.1%	7.6%
	Kittery ¹	11,548.0	168.2	11,716.1	1,325.8	1,358.8	33.0	11.5%	11.8%
	Lebanon	34,957.8	675.8	35,633.6	1,018.0	1,050.5	32.5	2.9%	3.0%
	North Berwick	24,265.1	157.6	24,422.7	759.2	792.6	33.4	3.1%	3.3%
	Sanford	30,314.8	890.3	31,205.1	2,453.9	2,521.0	67.1	8.1%	8.3%
	South Berwick	20,468.8	243.1	20,711.8	761.7	802.3	40.6	3.7%	3.9%
	Wells	36,427.3	125.1	36,552.3	2,195.8	2,355.9	160.1	6.0%	6.5%
	York	34,913.8	685.0	35,598.8	2,204.7	2,295.6	90.9	6.3%	6.6%
Total		253,500.6	5,734.4	259,235.0	13,253.9	13,861.9	608.0	5.2%	5.5%
New Hampshire	Barrington	29,719.0	1,398.3	31,117.3	1,003.8	1,037.1	33.3	3.4%	3.5%
	Brentwood	10,728.1	134.9	10,863.0	688.1	722.0	33.9	6.4%	6.7%
	Brookfield	14,593.0	287.3	14,880.4	133.7	138.3	4.6	0.9%	0.9%
	Candia	19,328.9	228.2	19,557.2	645.0	679.8	34.8	3.3%	3.5%
	Chester	16,606.2	111.6	16,717.8	566.1	604.4	38.3	3.4%	3.6%
	Danville	7,438.7	130.7	7,569.4	400.5	421.5	21.0	5.4%	5.7%
	Deerfield	32,575.7	772.1	33,347.8	697.1	723.4	26.3	2.1%	2.2%
	Dover	17,036.9	1,555.2	18,592.1	2,441.7	2,551.0	109.3	14.3%	15.0%
	Durham	14,251.1	1,601.2	15,852.3	922.7	952.6	29.9	6.5%	6.7%
	East Kingston	6,318.0	62.8	6,380.8	274.2	278.2	4.0	4.3%	4.4%
	Epping	16,476.6	299.1	16,775.7	929.7	996.9	67.2	5.6%	6.1%
	Exeter	12,540.6	272.3	12,812.9	1,226.6	1,272.7	46.1	9.8%	10.1%
	Farmington	23,213.0	427.0	23,640.0	781.2	798.2	17.0	3.4%	3.4%
	Fremont	11,033.1	109.3	11,142.4	425.6	446.6	21.0	3.9%	4.0%
	Greenland	6,722.5	1,801.4	8,523.9	586.1	613.0	26.9	8.7%	9.1%
	Hampton	8,287.3	785.5	9,072.8	1,404.9	1,437.5	32.6	17.0%	17.3%
	Hampton Falls	7,719.6	358.4	8,078.0	402.9	415.0	12.1	5.2%	5.4%
	Kensington	7,616.4	51.4	7,667.8	287.6	298.0	10.4	3.8%	3.9%
	Kingston	12,494.3	955.9	13,450.3	784.6	814.6	30.0	6.3%	6.5%
	Lee	12,685.0	242.2	12,927.3	597.8	633.0	35.2	4.7%	5.0%
	Madbury	7,383.6	415.5	7,799.1	266.6	274.4	7.8	3.6%	3.7%
	Middleton	11,559.0	284.0	11,843.0	269.4	277.5	8.1	2.3%	2.4%
	Milton	21,088.6	847.3	21,935.9	694.9	704.6	9.7	3.3%	3.3%
New Castle	506.2	841.4	1,347.6	101.5	103.7	2.2	20.0%	20.5%	
New Durham	26,345.5	1,708.5	28,054.0	534.4	549.6	15.2	2.0%	2.1%	
Newfields	4,540.8	105.9	4,646.7	213.6	219.5	5.9	4.7%	4.8%	

Newington	5,214.5	2,702.2	7,916.8	886.5	903.7	17.2	17.0%	17.3%
Newmarket	8,034.5	1,045.8	9,080.3	579.4	597.4	18.0	7.2%	7.4%
North Hampton	8,861.8	61.0	8,922.8	732.6	759.2	26.6	8.3%	8.6%
Northwood	17,965.0	1,391.9	19,357.0	611.0	629.3	18.3	3.4%	3.5%
Nottingham	29,839.7	1,157.0	30,996.7	657.0	687.6	30.6	2.2%	2.3%
Portsmouth	10,003.5	759.9	10,763.4	2,674.8	2,679.1	4.3	26.7%	26.8%
Raymond	18,438.3	505.2	18,943.6	1,147.5	1,208.2	60.7	6.2%	6.6%
Rochester	28,329.2	751.5	29,080.7	2,858.9	3,013.8	154.9	10.1%	10.6%
Rollinsford	4,681.3	161.5	4,842.8	281.6	291.3	9.7	6.0%	6.2%
Rye ¹	8,464.7	411.3	8,876.0	666.0	682.2	16.2	7.9%	8.1%
Sandown	8,888.5	343.3	9,231.8	500.4	522.4	22.0	5.6%	5.9%
Seabrook	5,664.7	496.6	6,161.3	1,133.8	1,177.3	43.5	20.0%	20.8%
Somersworth	6,219.2	179.1	6,398.3	1,015.4	1,032.8	17.4	16.3%	16.6%
Strafford	31,151.8	1,627.1	32,778.9	562.5	582.6	20.1	1.8%	1.9%
Stratham	9,655.1	246.5	9,901.6	874.2	926.7	52.5	9.1%	9.6%
Wakefield	25,264.0	3,453.2	28,717.2	878.5	908.7	30.2	3.5%	3.6%
Total	585,483.6	31,080.9	616,564.5	33,340.4	34,565.4	1,225.0	5.7%	5.9%
Study Total	838,984.2	36,815.3	875,799.5	46,594.3	48,427.3	1,833.0	5.6%	5.8%

Table 1.1. Acreage and percent impervious cover by town.

¹Acreage values for the towns of Kittery, ME and Rye, NH include the Isles of Shoals.

HUC 12 ID	HUC 12 Name	Total Area (acres)			Mapped Area (acres)			IC (acres)			Percent IC (Mapped Land Area)	
		Land	Inland Water	Total	Land	Inland Water	Total	2015	2021	Change	2015	2021
010600030602	Axe Handle Brook	7,028.2	368.8	7,397.0	7,028.2	368.8	7,396.9	256.5	267.1	10.6	3.6%	3.8%
010600030401	Bauneg Beg Pond-Great Works River	23,127.6	392.6	23,520.1	23,127.5	392.6	23,520.0	1,152.1	1,188.1	36.0	5.0%	5.1%
010600030705	Bean River-North River	14,795.8	276.0	15,071.8	14,795.7	276.0	15,071.7	371.3	378.9	7.6	2.5%	2.6%
010600030903	Bellamy River	20,335.0	1,276.8	21,611.8	20,334.9	1,276.8	21,611.7	1,443.8	1,514.0	70.2	7.1%	7.4%
010600031002	Berrys Brook-Frontal Rye Harbor	10,284.6	333.4	10,618.0	10,281.8	331.6	10,613.4	948.0	963.7	15.7	9.2%	9.4%
010600030505	Bog Brook-Little River	34,702.3	169.6	34,871.9	34,362.6	169.1	34,531.7	788.1	813.4	25.3	2.3%	2.4%
010600030604	Bow Lake	7,885.2	1,239.6	9,124.9	7,881.6	1,239.6	9,121.2	205.4	217.2	11.8	2.6%	2.8%
010600030502	Branch River	17,268.4	235.4	17,503.7	17,268.3	235.4	17,503.7	358.1	361.5	3.4	2.1%	2.1%

010600030805	Exeter River-Squamscott River	12,188.8	174.3	12,363.2	12,188.8	174.3	12,363.1	618.1	634.3	16.2	5.1%	5.2%
010600030904	Great Bay	13,102.6	6,121.2	19,223.8	13,102.5	6,121.2	19,223.7	1,111.0	1,125.0	14.0	8.5%	8.6%
010600031005	Hampton River-Frontal Atlantic Ocean	18,059.2	1,341.2	19,400.4	12,930.9	1,229.3	14,160.2	1,935.0	1,999.2	64.2	15.0%	15.5%
010600030501	Headwaters Branch River	17,542.9	839.9	18,382.8	17,101.4	839.9	17,941.4	397.4	411.6	14.2	2.3%	2.4%
010600030801	Headwaters Exeter River	20,208.8	202.1	20,410.9	18,875.1	197.0	19,072.1	842.7	900.1	57.4	4.5%	4.8%
010600030701	Headwaters Lamprey River	21,718.4	208.6	21,927.0	21,718.3	208.6	21,926.9	486.8	508.4	21.6	2.2%	2.3%
010600030503	Headwaters Salmon Falls River	15,178.3	2,555.7	17,734.0	15,179.1	2,555.6	17,734.7	432.3	449.4	17.1	2.8%	3.0%
010600030607	Isinglass River	10,288.6	438.5	10,727.1	10,288.6	438.5	10,727.0	498.5	527.6	29.1	4.8%	5.1%
010600030709	Lamprey River	12,788.5	402.4	13,191.0	12,788.5	402.4	13,190.9	613.3	630.1	16.8	4.8%	4.9%
010600030402	Leighs Mill Pond-Great Works River	31,670.4	269.8	31,940.2	31,670.2	269.8	31,940.0	1,044.5	1,116.5	72.0	3.3%	3.5%
010600030707	Little River	12,585.2	358.7	12,943.9	12,585.1	358.7	12,943.8	375.4	397.7	22.3	3.0%	3.2%
010600030606	Long Pond	9,801.4	351.3	10,152.6	9,801.3	351.3	10,152.6	178.6	188.1	9.5	1.8%	1.9%
010600030608	Lower Cocheco River	19,479.4	583.3	20,062.7	19,479.3	583.3	20,062.6	2,328.4	2,418.8	90.4	12.0%	12.4%
010600030507	Lower Salmon Falls River	13,299.2	567.2	13,866.5	13,299.2	379.6	13,678.7	968.4	1,007.9	39.5	7.3%	7.6%
010600030603	Middle Cocheco River	16,025.2	275.5	16,300.7	16,025.1	275.5	16,300.6	1,585.5	1,657.6	72.1	9.9%	10.3%
010600030506	Middle Salmon Falls River	37,430.2	789.6	38,219.8	37,430.2	787.2	38,217.5	2,152.4	2,213.6	61.2	5.8%	5.9%
010600030605	Nippo Brook-Isinglass River	17,115.9	272.9	17,388.9	17,115.9	272.9	17,388.8	341.9	356.3	14.4	2.0%	2.1%
010600030702	North Branch River	10,900.9	146.2	11,047.0	10,900.8	146.2	11,047.0	334.3	358.2	23.9	3.1%	3.3%
010600030706	North River	8,785.7	65.5	8,851.1	8,785.6	65.5	8,851.1	250.3	273.5	23.2	2.8%	3.1%
010600030902	Oyster River	19,317.5	542.4	19,859.8	19,317.4	542.3	19,859.7	1,357.1	1,412.2	55.1	7.0%	7.3%
010600030704	Pawtuckaway Pond	12,107.0	945.4	13,052.4	12,107.0	945.4	13,052.3	186.8	190.0	3.2	1.5%	1.6%
010600030703	Pawtuckaway River-Lamprey River	25,584.1	637.6	26,221.7	25,584.0	637.6	26,221.6	1,529.8	1,607.3	77.5	6.0%	6.3%
010600030708	Piscassic River	14,407.3	102.9	14,510.1	14,407.2	102.9	14,510.1	783.7	813.6	29.9	5.4%	5.6%
010600031001	Piscataqua River-Frontal Portsmouth Harbor	25,020.4	5,383.2	30,403.6	25,018.5	2,651.8	27,670.2	4,742.0	4,841.5	99.5	19.0%	19.4%
010600030804	Scamen Brook-Little River	10,109.1	38.3	10,147.3	10,109.0	38.3	10,147.3	715.1	758.9	43.8	7.1%	7.5%
010600030803	Spruce Swamp-Exeter River	14,998.9	182.0	15,180.9	14,998.8	182.0	15,180.8	815.8	858.4	42.6	5.4%	5.7%
010600030806	Squamscott River	12,445.2	543.6	12,988.8	12,445.1	543.6	12,988.7	1,186.9	1,245.5	58.6	9.5%	10.0%
010600031003	Taylor River	14,373.8	281.7	14,655.4	14,373.7	281.7	14,655.3	1,475.2	1,520.7	45.5	10.3%	10.6%
010600030601	Upper Cocheco River	27,142.7	514.6	27,657.3	26,787.3	514.3	27,301.6	820.2	838.1	17.9	3.1%	3.1%

010600030504	Upper Salmon Falls River	13,691.6	1,174.3	14,865.9	13,692.7	1,176.7	14,869.4	419.0	434.4	15.4	3.1%	3.2%
010600030802	Watson Brook-Exeter River	10,452.0	122.9	10,574.8	10,451.9	122.9	10,574.8	404.8	434.8	30.0	3.9%	4.2%
010600030901	Winnicut River	11,052.5	99.0	11,151.5	11,052.4	99.0	11,151.4	941.9	990.2	48.3	8.5%	9.0%
Total		664,298.3	30,823.9	695,122.1	656,691.6	27,785.0	684,476.6	37,396.4	38,823.4	1,427.0	5.7%	5.9%

Table 1.2. Acreage and percent impervious cover by HUC 12 subwatershed.

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