WATERSHED ANALYSIS OF THE CHARLES RIVER WATERSHED

TASK 3D TECHNICAL REPORT
CHARLES RIVER WATERSHED ENVIRONMENTAL JUSTICE ANALYSIS

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Prepared by:

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1 INTRODUCTION

The highly developed Charles River Watershed drains into Boston Harbor and faces multiple water quality impairments primarily from phosphorus and pathogens from human activity and urban development. These impairments are evidenced by algal blooms and macrophyte growth which contribute to anoxic bottom waters that do not support aquatic life, reduce water clarity, degrade the aesthetic quality of the river, and impair designated uses such as fishing and boating. Total Maximum Daily Loads (TMDLs) for the Charles River were published in 2007 and 2011 and provide an approach to manage phosphorus pollution to improve water quality and attain water quality standards in the Lower and Middle/Upper portions of the watershed, respectively (MassDEP, 2007) (MassDEP, 2011). The TMDLs identify stormwater runoff as the main source of phosphorus loads within the watershed and calculated that a 65% reduction of stormwater total phosphorus (TP) loadings from high-intensity land uses is required. On May 9, 2019, the U.S. Environmental Protection Agency (EPA) received a residual designation petition from the Conservation Law Foundation (CLF) and the Charles River Watershed Association (CRWA) for the Charles River Watershed (Conservation Law Foundation, Charles River Watershed Association, 2019). The petition requests that EPA permit stormwater from commercial, industrial, institutional, and multi-family residential (CIIM) properties of one acre or greater under the National Pollutant Discharge Elimination System (NPDES) program to meet water quality standards (WQS) in Boston Harbor.

Several communities in areas with environmental justice (EJ) concerns are located within the Charles River Watershed. These communities need further evaluation to better understand the effects of increased stormwater control requirements based on EPA Region 1's potential permitting decisions. This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater TP loading (Paradigm Environmental, 2023a) by further evaluating parcels within areas with environmental justice concerns. Key information presented in this report includes a description of the factors used to define areas with environmental justice concerns, an analysis of census tracts in areas with environmental justice concerns, and an analysis of the parcels, particularly CIIM parcels, within areas with environmental justice concerns. The approximate TP loads from parcels in areas with environmental justice concerns are quantified based on varying thresholds of impervious cover (IC) area; these loads and the number of parcels impacted are put in the context of the broader watershed to support decision-making on additional stormwater permitting.

2 APPLICABLE ENVIRONMENTAL JUSTICE FACTORS

For the analyses presented in this report, areas with environmental justice concerns were defined by three different factors as identified by EPA Region 1 for this analysis based on data from the Climate and Economic Justice Screening Tool (CEJST). CEJST, available at https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5[1], is a national tool that was developed to help federal agencies locate and identify environmentally and economically disadvantaged communities. CEJST uses census tracts, which are a small unit of geography defined by the U.S. Census Bureau, giving users access to high-resolution information. The tool uses datasets, primarily from the 2010 census, as indicators of burdens. The burdens are organized into categories.

The three criteria used to identify areas with environmental justice concerns within the Charles River Watershed for this analysis, as identified by US EPA Region 1, are:

- *Low Median Household Income*: Any census tract with greater than or equal to the 80th percentile for low median household income as a percent of area median income,
- *Linguistic Isolation*: Any census tract with greater than or equal to the 80th percentile for households in linguistic isolation,
- *Disadvantaged:* Any census tract defined as "Disadvantaged" in CEJST.

2.1 Definitions

Definitions of specific terms used in CEJST, and for the selected criteria, are given below. These, and additional information, can be found at https://screeningtool.geoplatform.gov/en/methodology#3/33.47/-97.5 or the provided link.

Burden categories: there are several different burden categories, including, climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Census tracts: are small units of geography. Census tract boundaries for statistical areas are determined by the U.S. Census Bureau once every ten years. The tool utilizes the census tract boundaries from 2010. This was chosen because many of the data sources in the tool currently use the 2010 census boundaries.

Disadvantaged: A community is highlighted as disadvantaged on the CEJST map if it is in a census tract that is: (1) at or above the threshold for one or more environmental, climate, or other burdens, and (2) at or above the threshold for an associated socioeconomic burden. In addition, a census tract that is surrounded by disadvantaged communities and is at or above the 50% percentile for low-income is also considered disadvantaged.

Linguistic Isolation: is defined as "the share of households where no one over age 14 speaks English very well." https://screeningtool.geoplatform.gov/en/methodology#ling-iso

Low Median Household Income: is defined as the percentage of a census tract's population in households where household income is at or below 200% of the Federal poverty level, not including students enrolled in higher education. https://screeningtool.geoplatform.gov/en/methodology#low-income

[1] Additional information on CEJST can be found at: https://screeningtool.geoplatform.gov/en/downloads#3/33.84/-76.34 (see links to the Technical Support Document and Instructions to Federal Agencies On the Use of CEJST).

3 ENVIRONMENTAL JUSTICE DATA ANALYSES

The census tracts in areas with environmental justice concerns meeting the criteria specified in Section 2 were mapped and the area within the Charles River Watershed was evaluated. The breakdown of parcel types and loads within these areas is shown in Section 3.2 and the CIIM subset is shown in Section 3.3. Spatial analyses of areas with environmental justice concerns with other datasets is shown in Section 3.4.

3.1 Watershed Overview

Within the Charles River Watershed, there are 109 census tracts identified as having environmental justice concerns based on the criteria specified in Section 2, out of the 212 total census tracts in the watershed. Figure 3-1 shows that these areas are concentrated in the lower, more urbanized, portions of the watershed; this figure also shows the overlap of the different criteria. The census tracts in areas with environmental justice concerns are within nine of the thirty-five municipalities in the watershed. Table 3-1 provides the breakdown of the areas with environmental justice concerns by criteria for each municipality. Linguistic isolation is the predominant factor covering 95% of all tracts in areas with environmental justice concerns, 34% of tracts in areas with environmental justice concerns are Disadvantaged, and 24% meet the Low Median Household Income threshold. Eighteen percent of the tracts in areas with environmental justice concerns meet all three of the criteria.

For municipalities where Linguistic Isolation makes up more than 5% of the tracts in areas with environmental justice concerns, the other languages spoken were evaluated using data available at: https://mass-eoeea.maps.arcgis.com/apps/MapSeries/index.html?appid=535e4419dc0545be980545a0eeaf9b53. The data from this tool is based on the Census Bureau's 2015 American Community Survey and represents the percentage of a census tract's population that does not speak English well. This information was aggregated by municipality for tracts within the Charles River Watershed that were identified as having environmental justice concerns as shown in Table 3-2. Spanish Creole is the dominate language for these populations in many of these tracts, with Portuguese Creole, Chinese, and Arabic also being common.

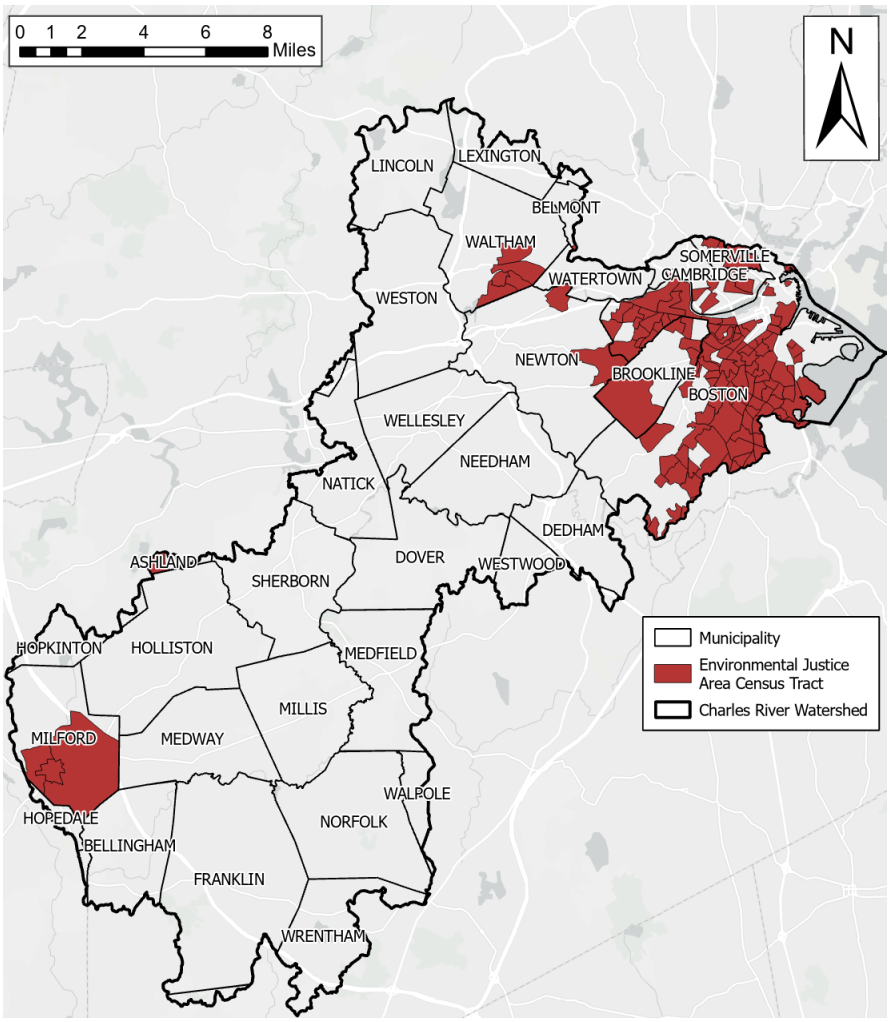

Figure 3-1. Map of census tracts in areas with environmental justice concerns by criteria.

Table 3-1. Summary of tracts in areas with environmental justice concerns by municipality and environmental justice criteria*

Municipality	Any Criteria[1]		Linguistic Isolation		Low Median Household Income		Disadvantaged		All Criteria[2]	
	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage	Area (ac)	Percentage
ASHLAND	190.8	0.9%	190.8	0.9%	0.0	0.0%	0.0	0.0%	0.0	0.0%
BOSTON	10,606.3	50.8%	9,473.7	45.4%	4,999.2	24.0%	5,922.9	28.4%	3,656.2	17.5%
BROOKLINE	2,159.9	10.3%	2,159.9	10.3%	0.0	0.0%	0.0	0.0%	0.0	0.0%
CAMBRIDGE	692.4	3.3%	692.4	3.3%	36.4	0.2%	75.8	0.4%	36.4	0.2%
MILFORD	4,420.8	21.2%	4,420.8	21.2%	0.0	0.0%	838.9	4.0%	0.0	0.0%
NATICK	1.8	0.0%	1.8	0.0%	0.0	0.0%	0.0	0.0%	0.0	0.0%
NEWTON	1,089.8	5.2%	1,089.8	5.2%	0.0	0.0%	0.0	0.0%	0.0	0.0%
SOMERVILLE	342.8	1.6%	342.8	1.6%	0.0	0.0%	342.8	1.6%	0.0	0.0%
WALTHAM	1,366.5	6.5%	1,366.5	6.5%	0.0	0.0%	0.0	0.0%	0.0	0.0%
TOTAL	**20,871.0**	**100.0%**	**19,738.4**	**94.6%**	**5,035.6**	**24.1%**	**7,180.4**	**34.4%**	**3,692.6**	**17.7%**

* A darker color gradient represents increasing value within a column.
[1]Any Criteria: at least one of the environmental justice criteria is met within a census tract.
[2]All Criteria: all three environmental justice criteria are met within a census tract.

Table 3-2. Top three languages for populations (%) in census tracts in areas with environmental justice concerns that do not speak English well by municipality

Municipality	> 5% of Tracts with Environmental Justice Concerns are Linguistic Isolation	Arabic	Chinese	French Creole	Japanese	Korean	Mon Khmer Cambodian	Other Indic	Portuguese Creole	Russian	Spanish Creole	Urdu
ASHLAND	Yes	3.2%	--	--	--	--	--	--	6.0%	--	--	1.5%
BOSTON	Yes	--	3.9%	1.7%	--	--	--	--	--	--	6.9%	--
BROOKLINE	Yes	--	4.0%	--	1.9%	--	--	--	--	1.5%	--	--
CAMBRIDGE	Yes	--	1.5%	1.7%	--	--	--	--	--	--	2.9%	--
MILFORD	Yes	--	--	--	--	--	0.4%	--	5.5%	--	4.6%	--
NATICK	Yes	4.6%	0.9%	--	--	--	--	--	2.4%	--	--	--
NEWTON	Yes	--	2.6%	--	--	0.7%	--	--	--	1.1%	--	--
SOMERVILLE	Yes	--	--	--	--	--	--	5.3%	7.3%	--	11.2%	--
WALTHAM	Yes	--	1.7%	--	--	--	--	--	--	0.8%	10.8%	--

3.2 Parcel Analysis

Pollutant load and other attributes for parcels in areas with environmental justice concerns are presented in this section based on the analysis conducted for the entire watershed (Paradigm Environmental, 2023a). Parcels in areas with environmental justice concerns are defined as any parcel within or overlapping a census tract with environmental justice concerns. For these parcels, the annual average TP loads from private and public properties based on the parcel Use Group are quantified over the 2007-2016 period as reported by EPA in the 2024 Charles River Parcel Level Report. The total watershed baseline TP load from unattenuated stormwater for this period is 100,444 lb/yr; a watershed-wide 65% required reduction in TP load is specified in the TMDLs. These values and analyses exclude parcels within combined sewer areas (i.e., areas where stormwater is assumed to be treated already).

A total of 60,792 parcels were identified as being within census tracts in areas with environmental justice concerns. The parcels are predominately Multifamily and Single Family Residential, which represent 67% of all parcels in areas with environmental justice concerns by count but only 21% by land area. Private commercial, industrial, and institutional make up 23% of parcels in areas with environmental justice concerns. Figure 3-2 illustrates the distribution of summary attributes by Public/Private designation for all parcels in areas with environmental justice concerns. Private parcels account for 95% of parcels and 45% of the total parcel area. Fifty percent of total parcel area is impervious cover. In terms of phosphorus loading, private parcels contribute 55% of the total TP. Loading from IC within private parcels amounts to 92% of the total TP. Table 3-3 provides additional details on the parcel count, parcel area, IC area and load by source (i.e., impervious or pervious) for all parcels in areas with environmental justice concerns by Use Group and Private/Public designation for.

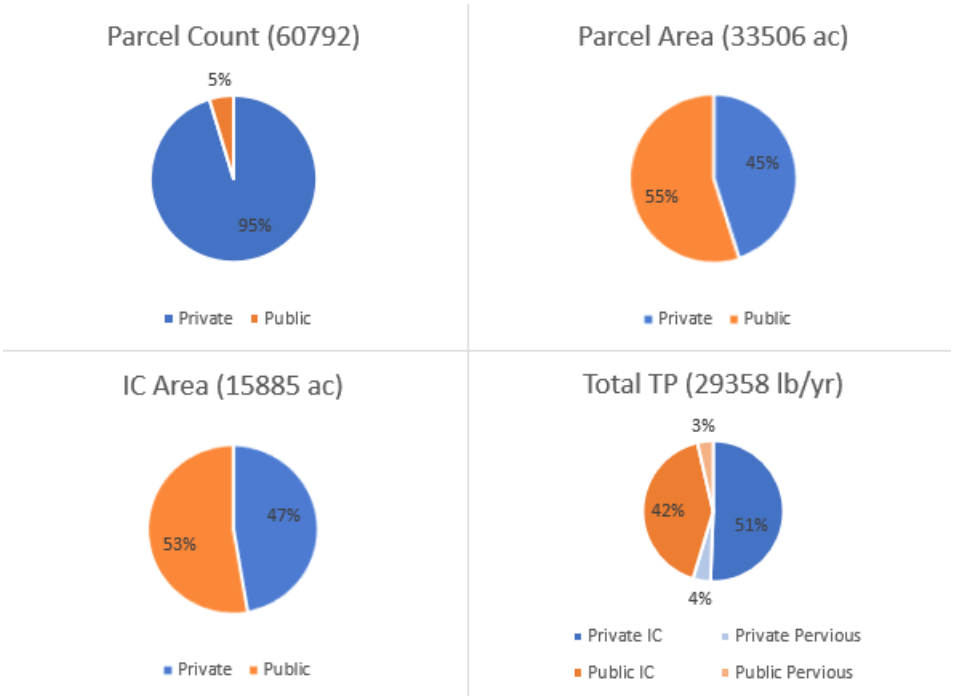

Figure 3-2. Private/Public summaries for all parcels in areas with environmental justice concerns within the Charles River Watershed.

Table 3-3. Summary of attributes for all parcels in the Charles River Watershed in areas with environmental justice concerns by Use Group and Public/Private designation with TP*

Public/ Private	Use Group	Count	Count (%)	Total Area (ac)	Total Area (%)	IC Area			TP Load (lb/yr)				
						Acre	%	Parcel Avg. (ac)	IC	Pervious	Total	Total (%)	Parcel Total Avg.
Private	Agriculture	37	0.1%	11	0.0%	10	89.2%	0.27	17	0	18	0.1%	0.48
	Commercial	12,468	20.5%	5,473	16.3%	3,327	60.8%	0.27	6,293	350	6,643	22.6%	0.53
	Industrial	143	0.2%	153	0.5%	104	67.7%	0.72	185	8	193	0.7%	1.35
	MultiFamily Residential	23,425	38.5%	3,554	10.6%	2,080	58.5%	0.09	4,715	240	4,954	16.9%	0.21
	Open Land	2,820	4.6%	1,129	3.4%	181	16.1%	0.06	301	155	456	1.6%	0.16
	Private Institutional	1,391	2.3%	1,250	3.7%	679	54.3%	0.49	1,222	90	1,312	4.5%	0.94
	Public Institutional	-	0.0%	-	0.0%	-	-	-	-	-	-	0.0%	#DIV/0!
	Right-of-Way	124	0.2%	58	0.2%	42	71.9%	0.34	58	2	60	0.2%	0.49
	Single Family Residential	17,525	28.8%	3,476	10.4%	1,095	31.5%	0.06	2,073	337	2,409	8.2%	0.14
	Water	-	0.0%	-	0.0%	-	0.0%	-	-	-	-	0.0%	#DIV/0!
	Subtotal	57,933	95.3%	15,104	45%	7,518	50%	0.13	14,863	1,182	16,045	55%	0.28
Public	Agriculture	-	0.0%	-	0.0%	-	-	-	-	-	-	0.0%	#DIV/0!
	Commercial	3	0.0%	11	0.0%	0	0.5%	0.02	0	0	0	0.0%	0.16
	Industrial	-	0.0%	-	0.0%	-	0.0%	-	-	-	-	0.0%	#DIV/0!
	MultiFamily Residential	-	0.0%	-	0.0%	-	0.0%	-	-	-	-	0.0%	#DIV/0!
	Open Land	8	0.0%	51	0.2%	0	0.0%	0.00	0	3	3	0.0%	0.32
	Private Institutional	-	0.0%	-	0.0%	-	-	-	-	-	-	0.0%	#DIV/0!
	Public Institutional	2,603	4.3%	6,417	19.2%	1,550	24.2%	0.60	2,645	740	3,386	11.5%	1.30
	Right-of-Way	228	0.4%	8,705	26.0%	6,748	77.5%	29.60	9,517	296	9,814	33.4%	43.04
	Single Family Residential	-	0.0%	-	0.0%	-	0.0%	-	-	-	-	0.0%	#DIV/0!
	Water	17	0.0%	3,218	9.6%	69	2.1%	4.07	94	16	110	0.4%	6.46
	Subtotal	2,859	4.7%	18,402	55%	8,367	45%	2.93	12,257	1,056	13,313	45%	4.66
EJ Total		60,792	100.0%	33,506	100%	15,885	47%	0.26	27,120	2,238	29,358	100%	-
Watershed Total		227,644	100.0%	207,364	100%	45,494	22%	0.20	80,268	20,176	100,444	100%	-

* A darker color gradient represents increasing value within a column.

3.3 Commercial, Industrial, Institutional, and Multi-Family Parcels

Private Commercial, Industrial, Institutional, and Multi-Family parcels make up 62% of all parcels in areas with environmental justice concerns in the Charles River Watershed (Table 3-5). The vast majority of CIIM parcels in areas with environmental justice concerns are multifamily residential parcels (63%). On average, however, these parcels have the lowest IC area and total TP loads. Industrial parcels have the highest average IC and load values, followed by Commercial and Institutional. The totals shown in Table 3-5 represent i) the CIIM parcels in areas with environmental justice concerns as a percentage of all parcels in areas with environmental justice concerns ("Environmental Justice Total"), ii) the CIIM parcels in areas with environmental justice concerns as a percentage of all private CIIM parcels ("All Private CIIM"), and iii) the CIIM parcels in areas with environmental justice concerns as a percentage of all parcels within the watershed ("Watershed Total"). For example, CIIM parcels in areas with environmental justice concerns represent 47% of all private CIIM parcels and 16% of all parcels in the watershed but makeup 14% of the total IC area and 16% of the total TP from all IC.

Table 34. Summary of private commercial, industrial, institutional, and multifamily parcel attributes in areas with environmental justice concerns*

Use Group	Count	Total Area (ac)	IC Area			TP Load (lb/yr)		
			Acre	% IC of Total Area	Parcel Avg. (ac)	IC	Pervious	Total Avg.
Commercial	12,471	5,483.65	3,327.41	61%	0.27	6,293.0	350.8	0.53
Industrial	143	153.10	103.62	68%	0.72	185.2	7.6	1.35
MultiFamily Residential	23,425	3,553.78	2,079.71	59%	0.09	4,714.6	239.7	0.21
Private Institutional	1,391	1,250.39	679.16	54%	0.49	1,221.8	90.3	0.94
Subtotal	**37,430**	**10,441**	**6,190**	**59%**	--	**12,414**	**688.06**	--
Environmental Justice Total (%)	**61.6%**	**31.2%**	**39.0%**	**--**	--	**45.8%**	**30.7%**	--
All Private CIIM (%)	**46.6%**	**19.1%**	**36.7%**	**--**	--	**37.2%**	**13.0%**	--
Watershed Total (%)	**16.4%**	**5.0%**	**13.6%**	--	--	**15.5%**	**3.4%**	--

* A darker color gradient represents increasing value within a column.

3.3.1 *Analysis of CIIM Parcels by IC Area*

The relationship between the number of parcels, the amount of IC area within a parcel, and the total load was evaluated for private CIIM parcels in areas with environmental justice concerns by varying thresholds of IC area as shown in Figure 3-3 (Appendix A presents similar plots by individual parcel use group). These plots show that while the IC threshold is > 0.1 ac, the number of parcels identified is relatively small, but accounts for approximately 60% of the private CIIM total load from parcels in areas with environmental justice concerns. As the IC threshold decreases, the number of parcels identified sharply increases. An IC threshold of ≥ 0.1 ac exhibits a large increase in the number of parcels identified because more multifamily residential parcels are included (these parcels have an average IC area of 0.1 ac, as shown in Table 3-5).

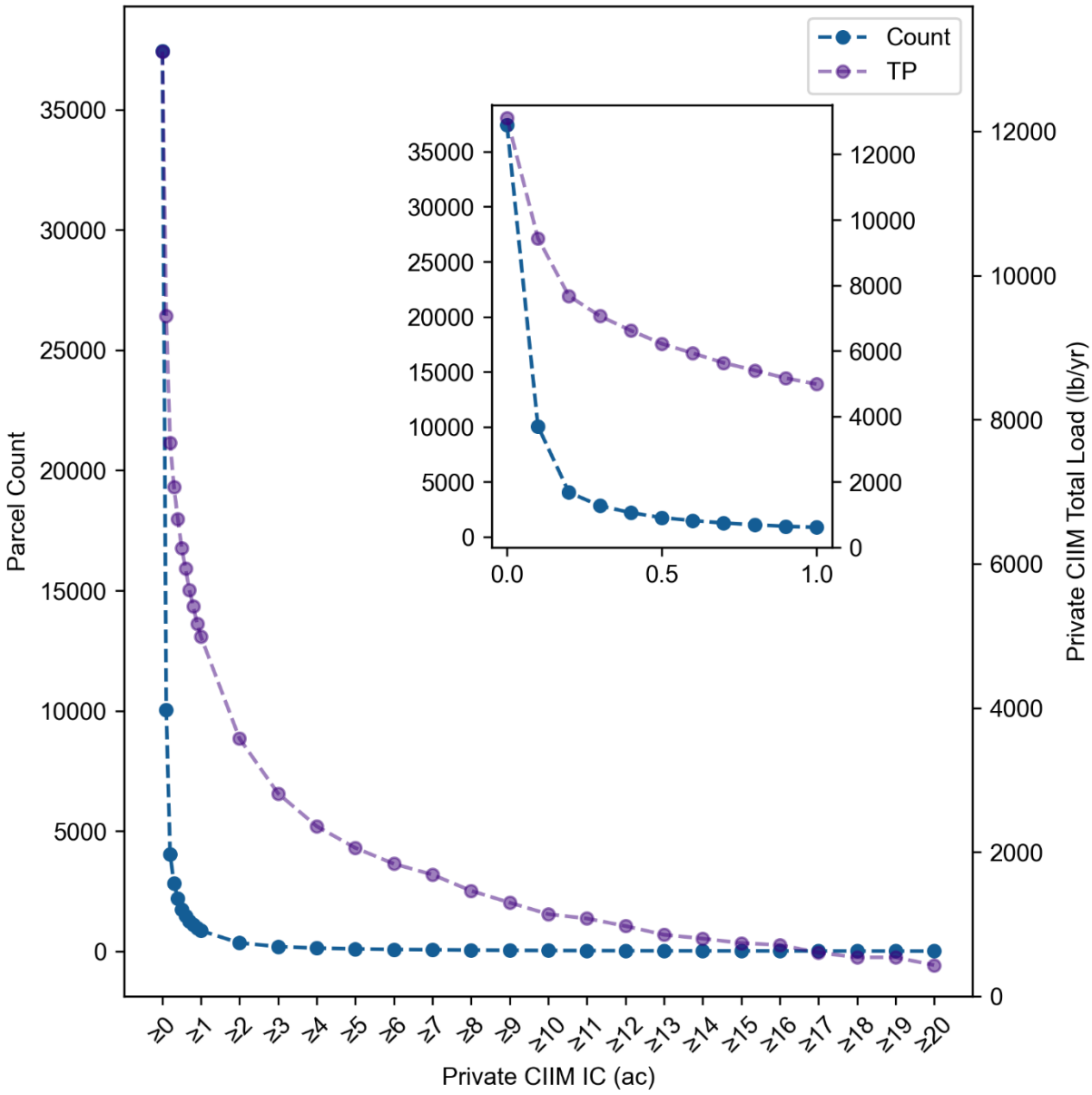

Figure 3-3. Count and total TP load for private CIIM parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private CIIM parcels in areas with environmental justice concerns.

The parcel count, load, and IC relationship was further analyzed for IC thresholds of 0.25 ac, 0.5 ac, 0.75 ac, 1 ac, 2 ac, and 5 ac as shown in Table 36 to Table 311. These tables provide key summary information on the number of parcels in areas with environmental justice concerns impacted by a given IC threshold. For example, with an IC threshold of 0.25 ac (Table 36), 3,295 parcels in areas with environmental justice concerns would have to install additional stormwater controls. These parcels are 5% of the total parcels in areas with environmental justice concerns, 38% of all private CIIM parcels meeting the IC threshold, 4% of all private CIIM parcels, and 1.4% of all parcels within the Charles River Watershed. While parcels in areas with environmental justice concerns make up nearly 38% of all private CIIM parcels, using an IC threshold greater than 0.1 ac helps lower the percentage of impacted parcels in areas with environmental justice concerns, primarily by excluding multifamily residential parcels (the average parcel IC area for multifamily residential parcels is 0.1 ac).

Table 3-5. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.25ac in the Charles River Watershed*

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	2,271	3,789.02	2,528.50	66.73%	4,695.53	198.98	4,894.50
Industrial	77	116.43	96.06	82.50%	172.05	3.74	175.79
MultiFamily Residential	577	909.35	446.31	49.08%	1,004.85	94.71	1,099.57
Private Institutional	370	1,082.97	599.07	55.32%	1,078.40	79.17	1,157.58
Subtotal	**3,295**	**5,897.78**	**3,669.94**	**62.23**	**6,950.83**	**376.61**	**7,327.44**
Environmental Justice Total (%)	**5.4%**	**17.6%**	**23.1%**	--	**25.6%**	**16.8%**	**25.0%**
All Private CIIM (%)	**4.1%**	**10.8%**	**21.8%**	--	**20.8%**	**7.1%**	**19.0%**
Watershed Total (%)	**1.4%**	**2.8%**	**8.1%**	--	**8.7%**	**1.9%**	**7.3%**

* A darker color gradient represents increasing value within a column.

Table 3-6. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.5ac in the Charles River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	1,222	3,309.86	2,155.71	65.13%	3,995.08	181.91	4,176.99
Industrial	42	97.68	84.39	86.39%	151.36	1.95	153.30
MultiFamily Residential	259	726.37	334.50	46.05%	749.38	79.82	829.21
Private Institutional	220	1,009.17	546.99	54.20%	985.29	76.32	1,061.61
Subtotal	**1,743**	**5,143.08**	**3,121.58**	**60.69**	**5,881.10**	**340.01**	**6,221.11**
Environmental Justice Total (%)	**2.9%**	**15.3%**	**19.7%**	--	**21.7%**	**15.2%**	**21.2%**
All Private CIIM (%)	**2.2%**	**9.4%**	**18.5%**	--	**17.6%**	**6.4%**	**16.1%**
Watershed Total (%)	**0.8%**	**2.5%**	**6.9%**	--	**7.3%**	**1.7%**	**6.2%**

* A darker color gradient represents increasing value within a column.

Table 3-7. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 0.75ac in the Charles River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	827	2,977.08	1,912.78	64.25%	3,545.01	166.49	3,711.51
Industrial	35	92.44	79.74	86.25%	143.06	1.83	144.89
MultiFamily Residential	154	568.93	271.41	47.71%	605.40	64.43	669.82
Private Institutional	152	947.50	505.75	53.38%	910.62	72.94	983.55
Subtotal	**1,168**	**4,585.96**	**2,769.68**	**60.39**	**5,204.09**	**305.69**	**5,509.78**
Environmental Justice Total (%)	**1.9%**	**13.7%**	**17.4%**	--	**19.2%**	**13.7%**	**18.8%**
All Private CIIM (%)	**1.5%**	**8.4%**	**16.4%**	--	**15.6%**	**5.8%**	**14.3%**
Watershed Total (%)	**0.5%**	**2.2%**	**6.1%**	--	**6.5%**	**1.5%**	**5.5%**

* A darker color gradient represents increasing value within a column.

Table 3-8. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 1ac in the Charles River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	614	2,741.62	1,728.41	63.04%	3,209.67	159.42	3,369.08
Industrial	28	85.83	73.42	85.54%	131.76	1.77	133.54
MultiFamily Residential	100	497.75	224.85	45.17%	499.60	59.85	559.45
Private Institutional	116	900.50	475.29	52.78%	855.57	69.26	924.83
Subtotal	**858**	**4,225.70**	**2,501.96**	**59.21**	**4,696.60**	**290.30**	**4,986.90**
Environmental Justice Total (%)	**1.4%**	**12.6%**	**15.8%**	--	**17.3%**	**13.0%**	**17.0%**
All Private CIIM (%)	**1.1%**	**7.7%**	**14.8%**	--	**14.1%**	**5.5%**	**12.9%**
Watershed Total (%)	**0.4%**	**2.0%**	**5.5%**	--	**5.9%**	**1.4%**	**5.0%**

* A darker color gradient represents increasing value within a column.

Table 3-9. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 2ac in the Charles River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	261	1,990.90	1,229.96	61.78%	2,284.45	125.38	2,409.84
Industrial	8	51.17	43.52	85.05%	78.25	1.15	79.40
MultiFamily Residential	33	355.24	135.31	38.09%	300.87	50.11	350.98
Private Institutional	47	707.39	374.72	52.97%	675.26	57.52	732.77
Subtotal	**349**	**3,104.70**	**1,783.52**	**57.45**	**3,338.82**	**234.16**	**3,572.98**
Environmental Justice Total (%)	**0.6%**	**9.3%**	**11.2%**	--	**12.3%**	**10.5%**	**12.2%**
All Private CIIM (%)	**0.4%**	**5.7%**	**10.6%**	--	**10.0%**	**4.4%**	**9.2%**
Watershed Total (%)	**0.2%**	**1.5%**	**3.9%**	--	**4.2%**	**1.2%**	**3.6%**

* A darker color gradient represents increasing value within a column.

Table 3-10. Summary of private commercial, industrial, institutional, and multifamily parcels in areas with environmental justice concerns with IC ≥ 5ac in the Charles River Watershed *

Use Group	Count	Total Area (ac)	IC Area		TP Load (lb/yr)		
			Acre	% IC of Total Area	IC	Pervious	Total
Commercial	70	1,134.25	668.97	58.98%	1,225.10	70.71	1,295.81
Industrial	1	25.58	21.39	83.63%	38.50	0.58	39.08
MultiFamily Residential	5	102.14	52.76	51.66%	119.42	8.95	128.37
Private Institutional	25	532.96	309.19	58.01%	554.67	39.13	593.81
Subtotal	**101**	**1,794.93**	**1,052.31**	**58.63**	**1,937.70**	**119.37**	**2,057.07**
Environmental Justice Total (%)	**0.2%**	**5.4%**	**6.6%**	--	**7.1%**	**5.3%**	**7.0%**
All Private CIIM (%)	**0.1%**	**3.3%**	**6.2%**	--	**5.8%**	**2.3%**	**5.3%**
Watershed Total (%)	**0.0%**	**0.9%**	**2.3%**	--	**2.4%**	**0.6%**	**2.0%**

* A darker color gradient represents increasing value within a column.

Figure 35 further illustrates the tradeoff between pollutant reduction and the number of private CIIM parcels with IC area ranging from ≥20 ac to ≥0 ac (i.e., all private CIIM parcels and private CIIM parcels in areas with environmental justice concerns) that would have to manage stormwater. This figure assumes that runoff from IC within a parcel would be treated by stormwater controls sized to achieve the required load reduction target of 65%. The "knee" of the curve, where the slope begins to flatten, indicates the IC threshold where the fewest number of parcels can provide the greatest benefit in terms of TP reduction. For the Charles River Watershed, this appears to lie between parcels with ≥0.2 ac and ≥0.75 ac of IC. As an example, if 0.25 ac IC is chosen as a threshold, approximately 8,600 private CIIM parcels would need to be permitted, nearly 3,300 of those parcels are in areas with environmental justice concerns, and the potential reduction in the watershed TP load would be 17%. Appendix B presents similar plots by individual parcel use group.

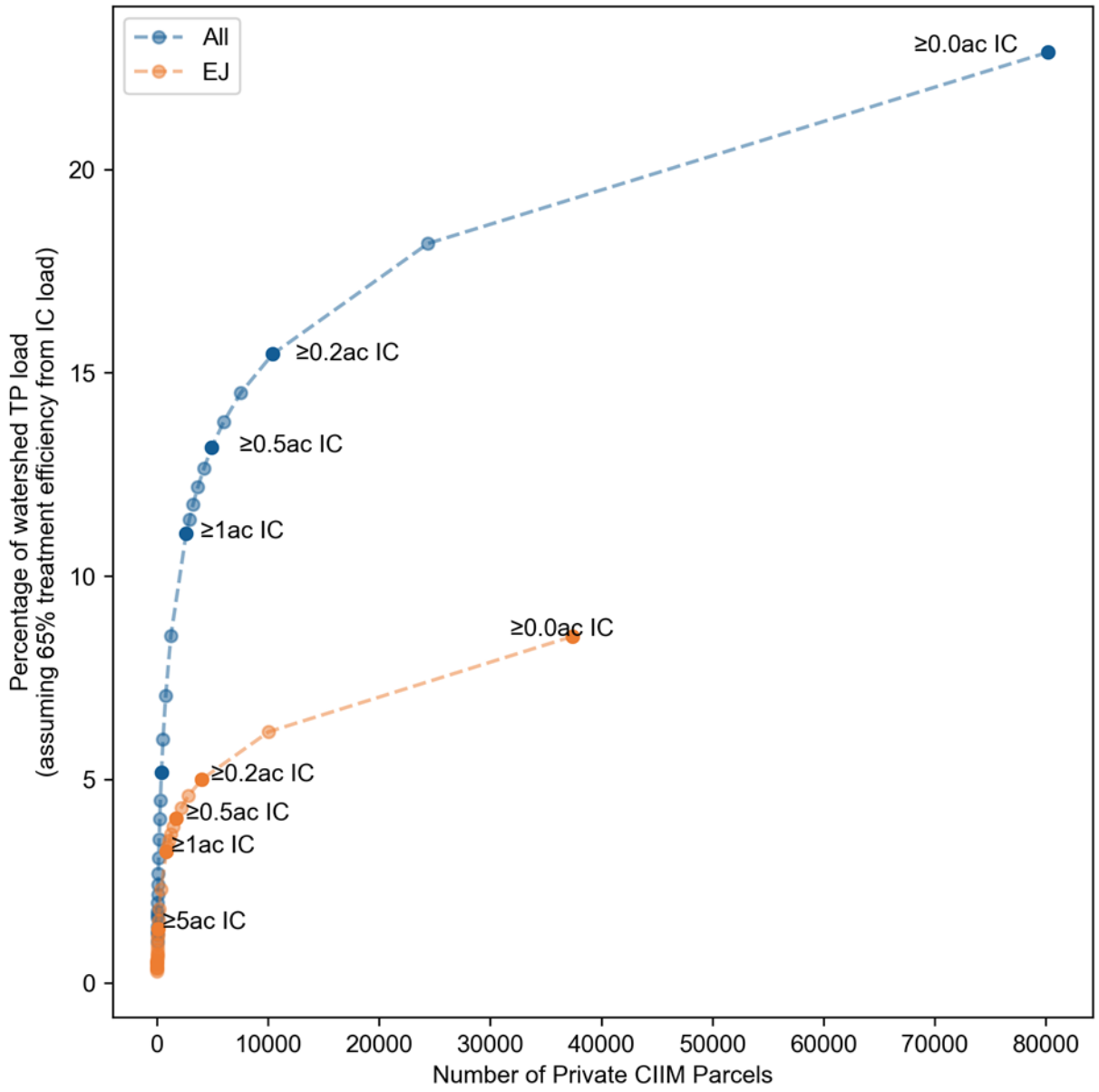

Figure 3-4. Percentage of watershed TP load that can be captured from IC runoff, assuming a 65% treatment efficiency, and the corresponding number of private CIIM parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

3.3.2 *Additional Benefits*

In the Charles River Watershed, nearly half of the CIIM parcels that could be subject to a residual designation stormwater permit are concentrated within the quarter of the watershed comprised of areas with environmental justice concerns. Implementation of additional SCMs by CIIM property managers in these areas should prove effective in addressing the stormwater-related impacts and risks experienced by local residents of areas with environmental justice concerns. Existing commercial, industrial, and large institutional properties can implement SCMs that disconnect rooftop and parking lot stormwater runoff to the storm drain system and instead reroute stormwater to bioretention and infiltration cells that filter the water before slowly recharging groundwater aquifers. Commercial and industrial property managers may also be able to install green rooftops or other green infrastructure elements when buildings are periodically renovated or redeveloped. Similarly, pervious pavement, green swales, and additional stormwater retention cells can be installed when parking areas are refurbished.

If a residual designation permit is to apply to multi-family residential properties, it will be unlikely to create new stormwater control requirements for smaller residential properties. However, there are some large residential properties located in areas of the Charles River Watershed with environmental justice concerns that may be regulated. For example, if an IC threshold of 1 ac is used for permitting, 100 multi-family residential parcels in areas with environmental justice concerns would be included (Table 3-9). A variety of effective SCM options are available to these properties, some of which can be retrofitted to the existing building and associated impervious surface areas, and others which can be implemented when buildings and impervious areas are refurbished. Many of the same types of SCMs discussed above for use by commercial, industrial, and institutional property managers are also appropriate for use in multi-family residential parcels. These include rooftop disconnection and bioretention/infiltration cells that have been widely demonstrated effective in reducing stormwater flows to local streams and rivers.

Many residential and institutional properties have a greater amount of existing surrounding green spaces as compared with commercial and industrial land uses. Additional SCM options are available to utilize and refurbish even small green spaces around residential and institutional properties to improve their ability to collect and absorb polluted stormwater before it recharges groundwater, and reduce flows to storm drains. At locations near existing streams and rivers, SCM projects incorporating treatment wetlands have proven highly effective in reducing pollutant loads while creating additional green space and aquatic habitat. Residential and institutional parcel managers may have a wider range of SCM options available to help them meet their permit obligations while generating additional local benefits.

The types of green infrastructure approaches available to CIIM property managers can yield a range of additional benefits, including contributing to flood risk reduction by reducing rapid stormwater flow to over-burdened storm drain systems and increasing tree canopy and green spaces, which helps reduce urban heat island effects. Similar projects installed in other highly urbanized areas have successfully created additional neighborhood amenities and recreational spaces that are highly valued in areas with little existing green space or parklands. SCM projects that increase retention and filtering of stormwater before it is infiltrated to groundwater or slowly released to surface waters have proven effective in ensuring flows of clean water to adjacent surface wetlands and streams. Stormwater recharge SCMs also help ensure that clean groundwater resources are protected, which may become more important in the future if surface sources of water supply become less reliable and as populations grow. The SCMs to be implemented in the Charles River watershed will likely vary substantially in size and type. While the benefits of implementing individual, often small-scale distributed SCMs to the community as a whole may seem difficult to detect, their implementation in many locations within a community overtime can yield substantial cumulative benefits.

There are also opportunities to coordinate planning and implementation of SCMs by newly-regulated CIIM properties with the stormwater management planning of other property owners and municipal governments. Many communities in the Charles River watershed are planning and implementing projects to revitalize areas of their communities, refurbish and improve transportation corridors, and reduce flooding, urban

heating, and other climate-related risks. These initiatives present opportunities for CIIM properties to collaborate with their neighbors and with government agencies to devise SCM solutions that efficiently address stormwater runoff and complement other project objectives, while leveraging investments in stormwater projects to extract maximum benefits. Through cooperative project planning, there may also be opportunities to address stormwater runoff from several CIIM properties through investment in larger scale SCM projects that more efficiently control stormwater pollution and potentially yield greater collateral benefits than can be realized solely through smaller-scale SCM controls at each CIIM parcel.

4 CONCLUSIONS

This report builds on the methodology and results of watershed-wide analyses of parcel-level stormwater TP loading in the Charles River Watershed (EPA, 2024) by identifying and further evaluating parcels within areas with environmental justice concerns. Taken together, findings from these reports may be used by EPA Region 1 to support decisions regarding the control of stormwater runoff from certain private properties to meet watershed TMDL goals and WQS. Findings from these analyses include:

1. One-hundred and nine census tracts were identified as areas with environmental justice concerns based on linguistic isolation, low median household income, or disadvantaged. Hotspot areas that meet all environmental justice criteria represent 18% of the areas with environmental justice concerns.
2. Within the watershed, 27% of parcels are in areas with environmental justice concerns but these parcels represent 35% of the watershed IC area and 29% of the total TP load.
3. Private properties contribute nearly three-quarters (68%) of the watershed's total TP load, with 29% of the total coming from private parcels in areas with environmental justice concerns.
4. The majority of TP from private properties is generated from impervious cover (79% of load from private properties and 54% of the watershed total load).
5. Private commercial, industrial, institutional, and multi-family residential (CIIM) properties make up 35.3% of all parcels, but have relatively high percentages of IC and therefore contribute a large proportion of the watershed IC TP load (42%)
6. Selecting private CIIM parcels based on their IC area (which is proportional to the amount of TP generated) can minimize the number of parcels installing stormwater controls, while providing the greatest TP reduction benefit (Table 4-1).
7. Nearly half (47%) of all private CIIM parcels are in areas with environmental justice concerns. However, the majority of these parcels are multifamily residential and are largely avoided with IC thresholds greater than 1.0 ac (the average multi-family residential parcel IC area is 0.1 ac).

Installation of additional SCMs in areas of the Charles River Watershed with environmental justice concerns should prove particularly effective in reducing key pollutant loadings while yielding additional community benefits. As discussed in this report, while about one quarter of the parcels in the watershed are in areas with environmental justice concerns, about one third of all impervious surfaces and nearly one third of the total phosphorus pollutant loads are associated with these areas. Additionally, depending on permitting decisions by EPA R1, nearly half of the CIIM parcels that could be subject to a residual designation stormwater permit are concentrated within the quarter of the watershed comprised of areas with environmental justice concerns. As a result, these areas are particularly important contributors to stormwater-related problems. These areas are also particularly vulnerable to the impacts of polluted stormwater runoff, which adversely affects the quality of urban streams and rivers, harms aquatic ecosystems, and reduces recreational and swimming opportunities for area residents.

The findings from the watershed-wide report indicate that the WQS goals for TP in the Charles River cannot be met without additional reduction of stormwater runoff and pollutant loads from private parcels. A portion of those reductions will have to come from parcels within areas with environmental justice concerns. These areas are disproportionately impacted by polluted stormwater and disproportionately vulnerable to associated risks including urban flooding, heat island effects, and threats to groundwater quality. It is clear

that substantial additional stormwater controls are needed to address water quality impairments in the Charles River Watershed. Implementation of these controls presents a tremendous opportunity for the watershed communities to move toward restoration of polluted urban waters while creating a wide range of additional community benefits. While this report presents an initial broad-scale evaluation of areas with environmental justice concerns within the Charles River Watershed, engaging these communities in outreach and further planning efforts will be essential to understanding their unique needs and ensuring the best localized and watershed-wide outcomes from any residual designation permitting decisions.

Table 4-1. Summary of private CIIM parcels installing stormwater controls based on parcel IC area, the count and percentage of parcels in areas with environmental justice concerns, and the potential reduction achieved in watershed total TP load

IC Threshold (ac)	Parcel Count	Parcels in areas with environmental justice concerns		Total TP Load (lb/yr)	IC TP Load (lb/yr)	Total TP Treated (%)*
		Count	%			
≥0 (All)	80,280	37,430	47%	38,682	33,377	22%
≥0.25	8,631	3,295	38%	24,490	21,752	14%
≥0.5	4,938	1,743	35%	21,529	19,215	12%
≥0.75	3,446	1,168	34%	19,496	17,463	11%
≥1	2,628	858	33%	18,009	16,117	10%
≥2	1,252	349	28%	13,924	12,457	8%
≥5	403	101	25%	8,374	7,545	5%

* Percentage calculated as IC load times a 65% treatment efficiency divided by the watershed total TP load of 100,444 lb/yr.

5 REFERENCES

Conservation Law Foundation, Charles River Watershed Association. (2019). *Charles River Watershed RDA Petition.* Boston: CLF & CRWA.

EPA. (2024). *Task 3C Technical Report Charles River Watershed Property Parcel Analysis.*

MassDEP. (2007). *Total Maximum Daily Load for Nutrients In the Lower Charles River Basin, Massachusetts .*

MassDEP. (2011). *Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River, Massachusetts .*

APPENDIX A

See the accompanying Excel workbook for the data used to create these plots.

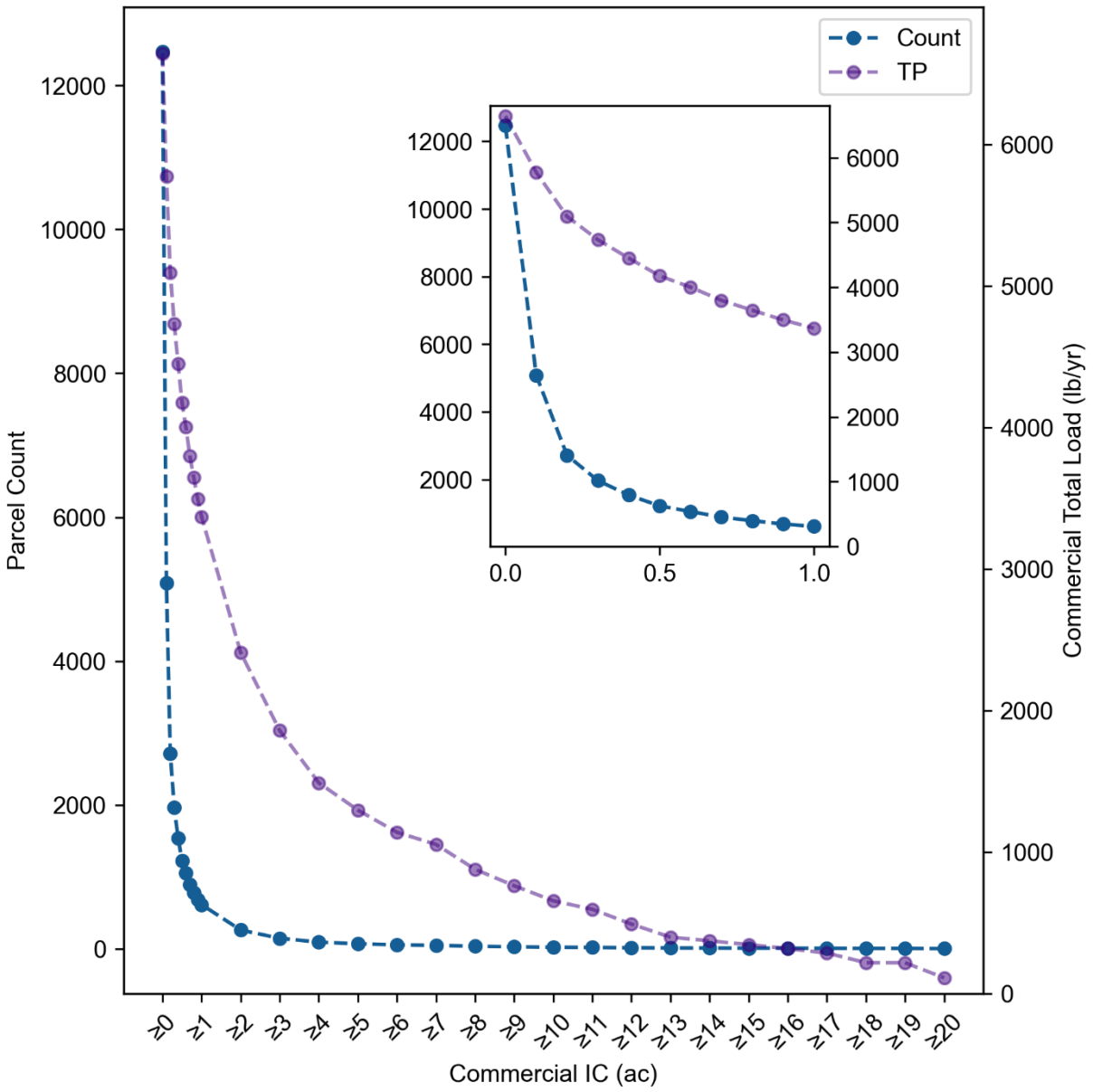

Figure A-1. Count and total TP load for private commercial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private commercial parcels in areas with environmental justice concerns.

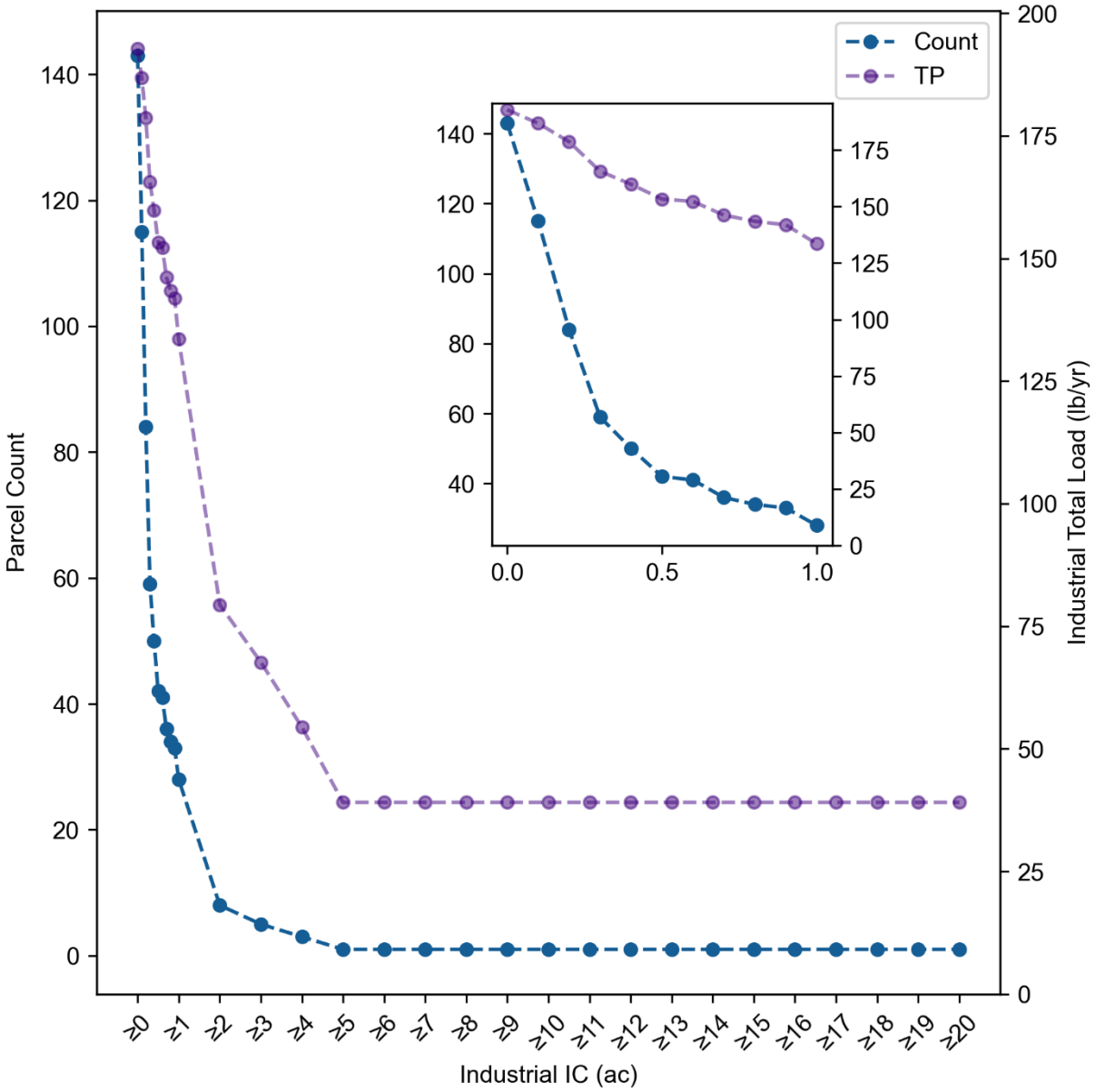

Figure A-2. Count and total TP load for private industrial parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private industrial parcels in areas with environmental justice concerns.

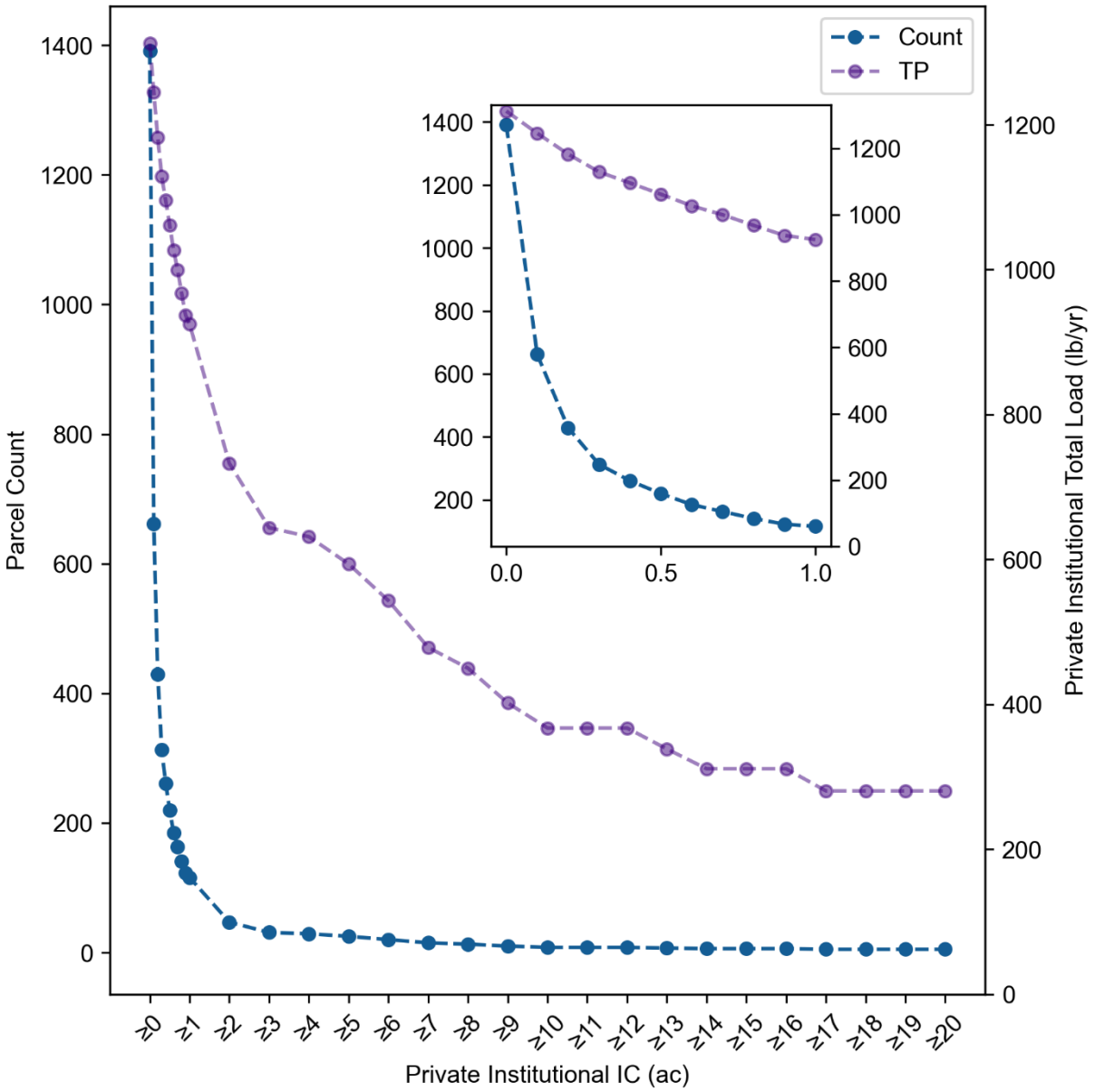

Figure A-3. Count and total TP load for private institutional parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private institutional parcels in areas with environmental justice concerns.

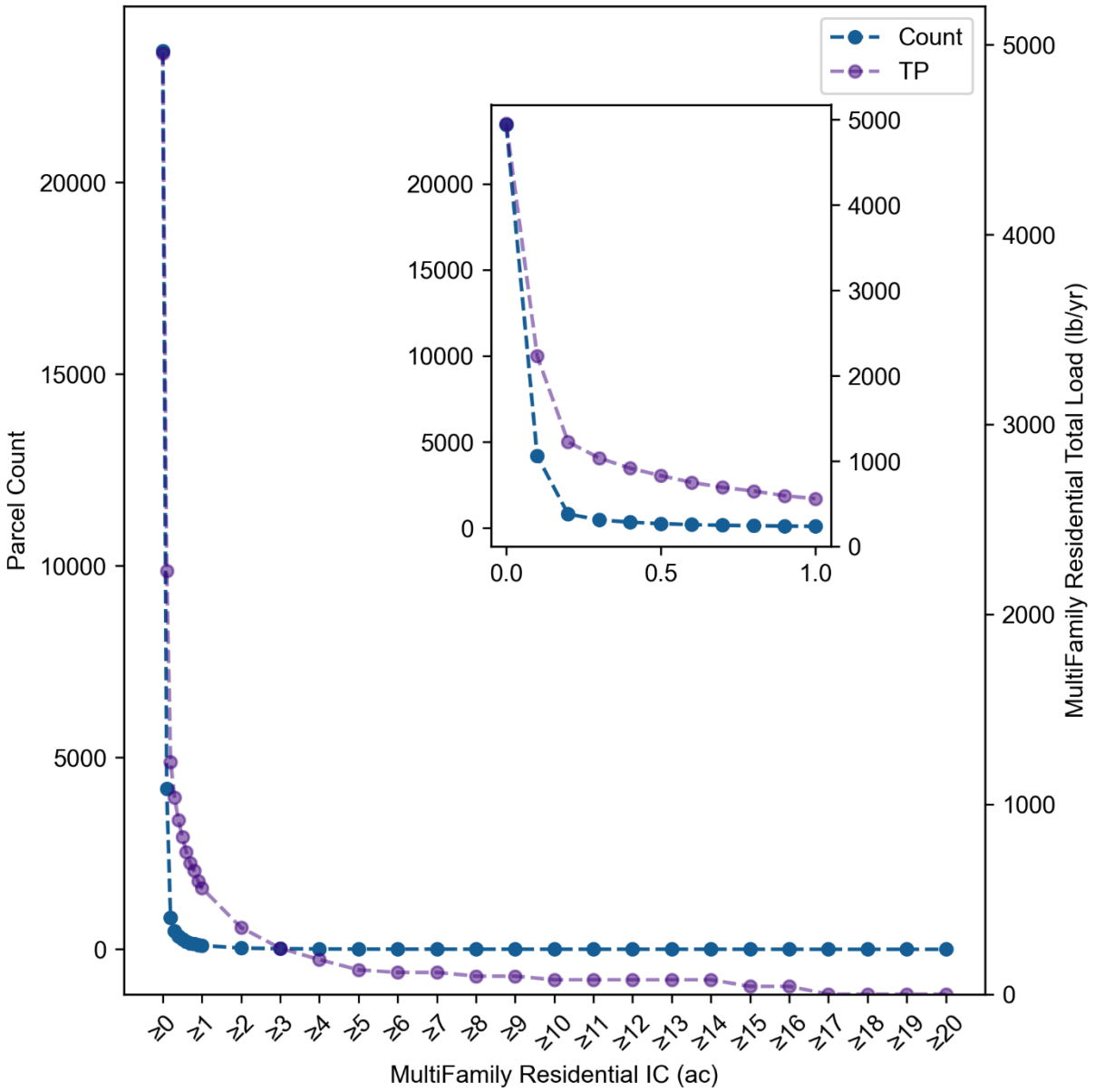

Figure A-4. Count and total TP load for private multi-family residential parcels in areas with environmental justice concerns by parcel IC area. Note that a threshold of ≥ 0ac IC includes all private multi-family residential parcels in areas with environmental justice concerns.

APPENDIX B

See the accompanying Excel workbook for the data used to create these plots.

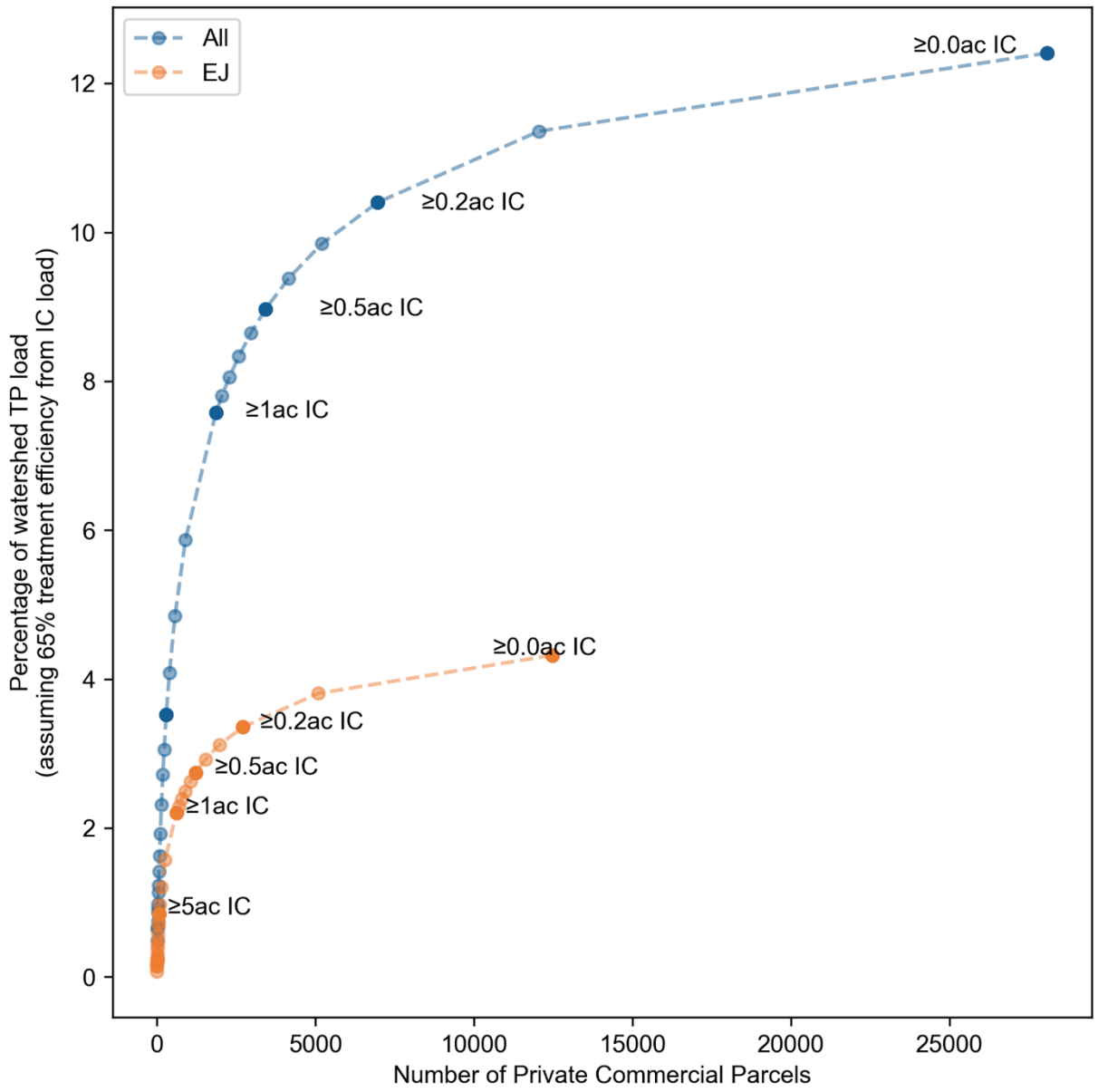

Figure B-1. Percentage of watershed TP load that can be captured from IC runoff, assuming a 65% treatment efficiency, and the corresponding number of private commercial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

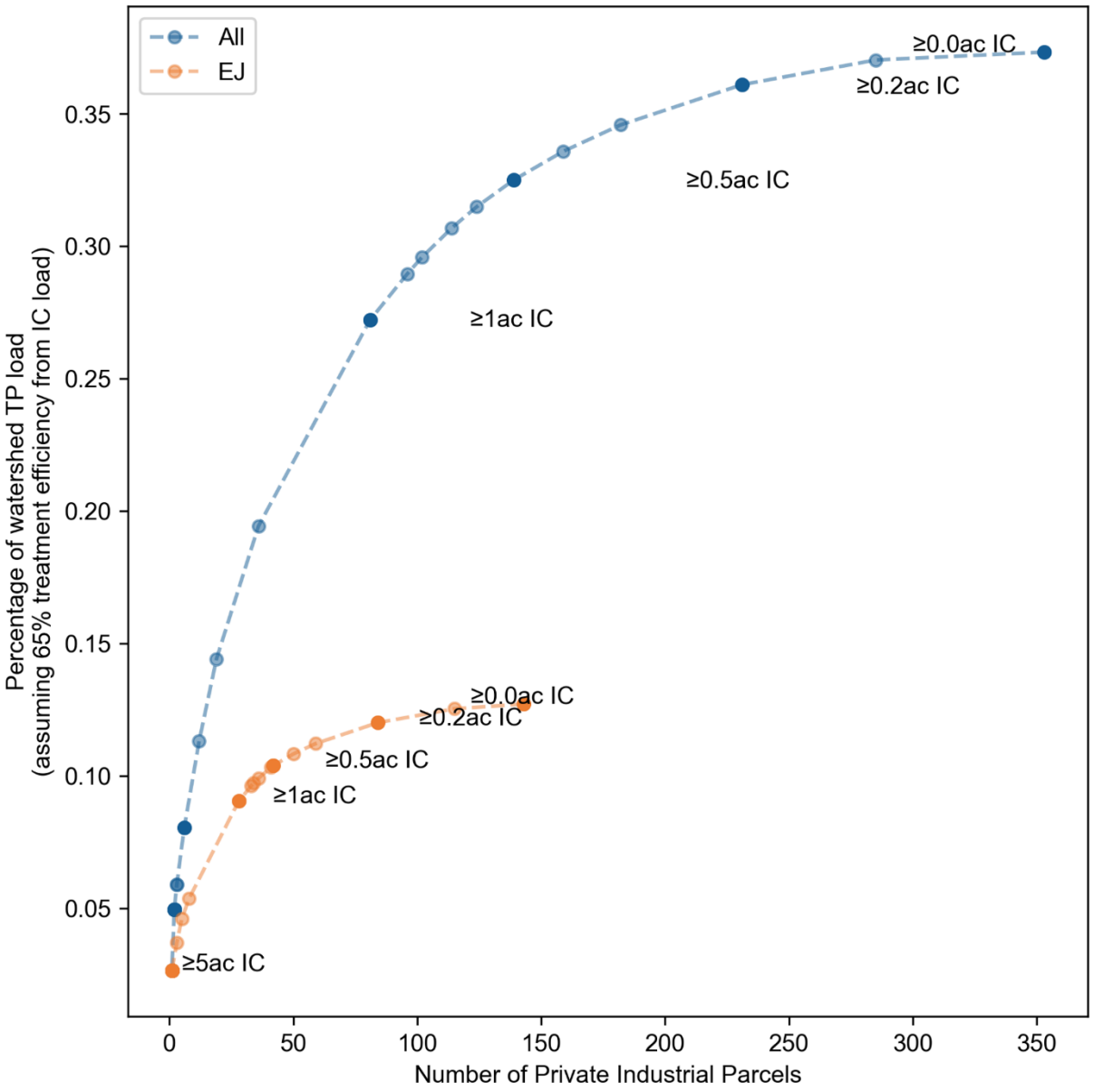

Figure B-2. Percentage of watershed TP load that can be captured from IC runoff, assuming a 65% treatment efficiency, and the corresponding number of private industrial parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

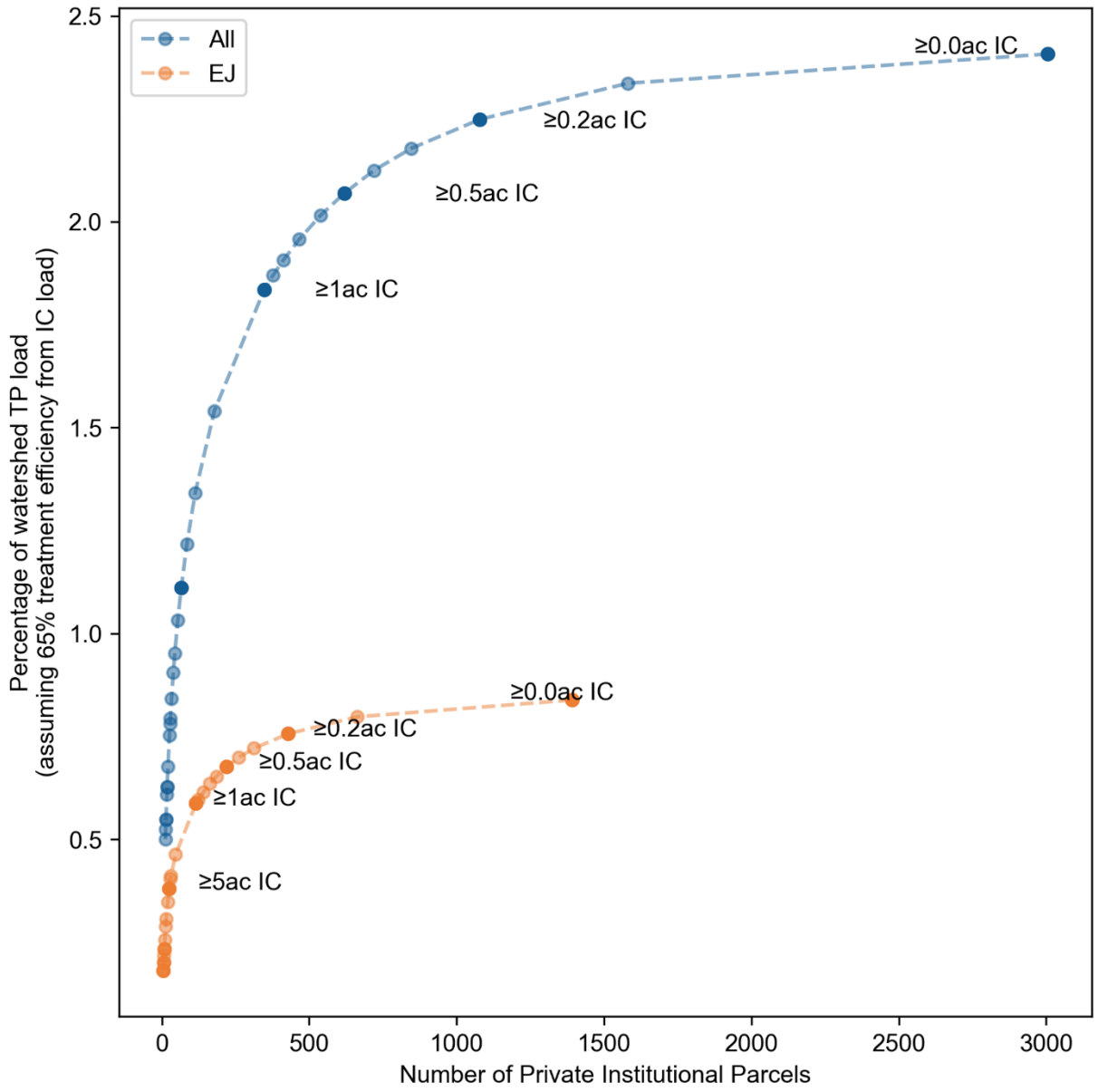

Figure B-3. Percentage of watershed TP load that can be captured from IC runoff, assuming a 65% treatment efficiency, and the corresponding number of private institutional parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.

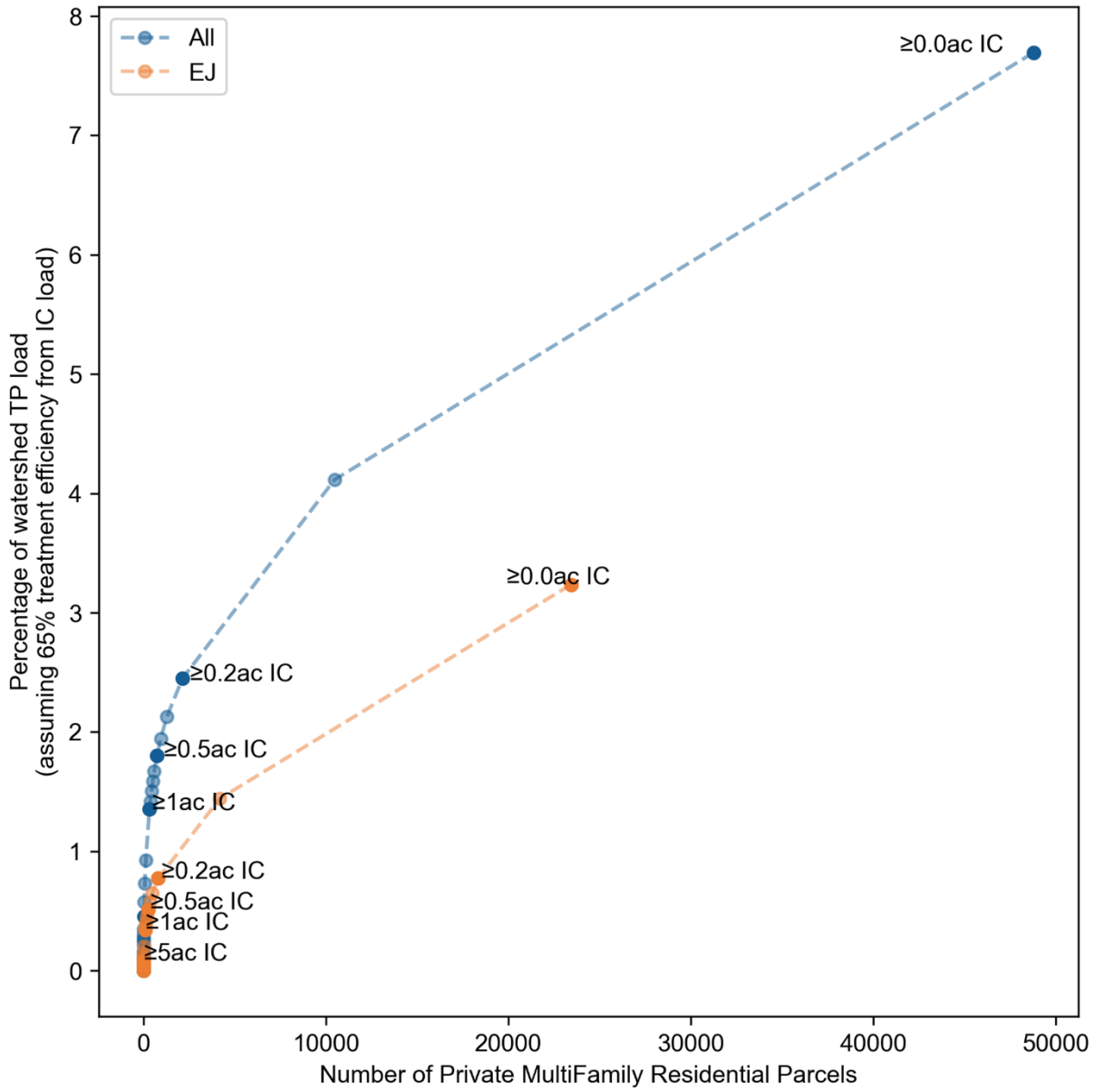

Figure B-4. Percentage of watershed TP load that can be captured from IC runoff, assuming a 65% treatment efficiency, and the corresponding number of private multifamily residential parcels based on IC threshold. Labels for IC thresholds correspond to the bold dots.