Professional

Engineering

Services

Stormwater Quality Management Plan

Part 2 of 5

Report

City of

La Crosse, WI

August 2024

STRAND ASSOCIATES®

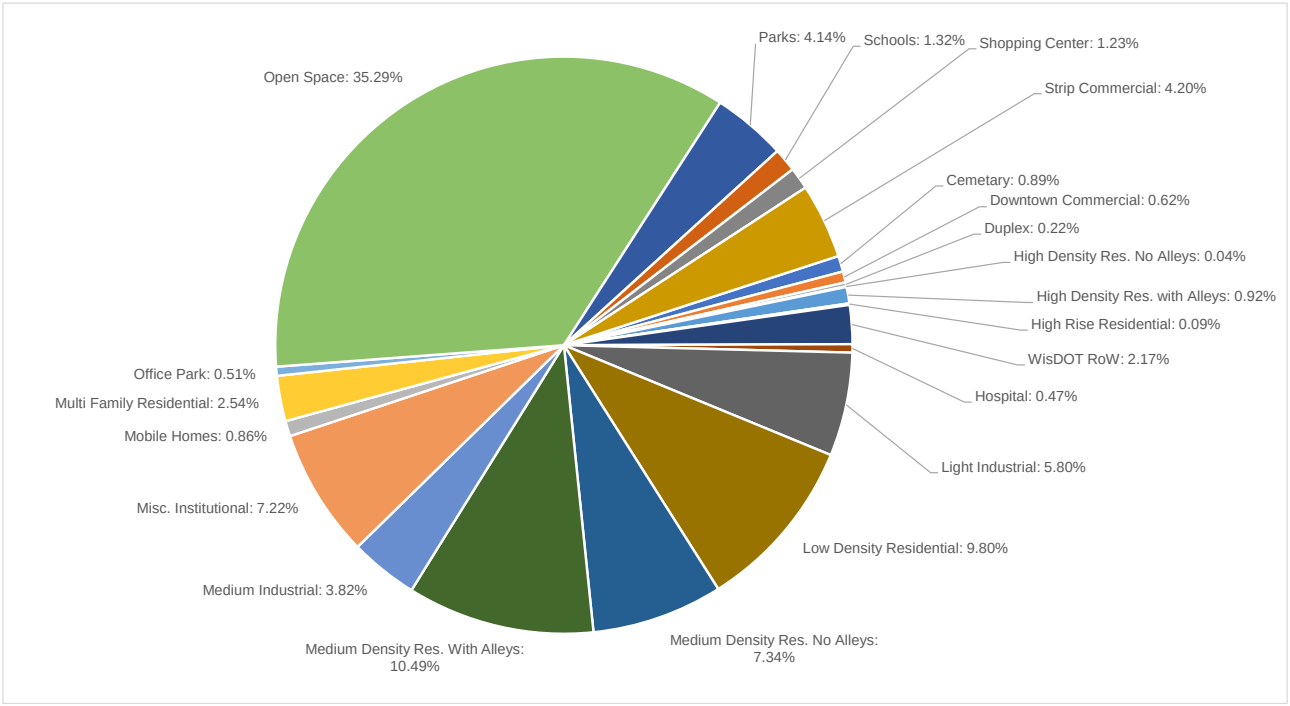
SECTION 2
CONTRIBUTING WATERSHED CHARACTERISTICS

2.01 WATERSHED DESCRIPTION

This section describes land characteristics in the City that impact stormwater runoff. Stormwater runoff and nonpoint pollutant loading from a watershed depend on physical characteristics such as watershed size and topography, land use, soil types, degree of saturation, and type of drainage system (storm sewers, open channels). Figures 2.01-1 and 2.01-2 show the drainage system and drainage basin boundaries in the City and storm sewer, detention ponds, floodplains, parks, public facilities, and outfalls.

A. Population and Land Use

The total municipal area of the City is 21.45 square miles with a Year 2020 population of 52,647. Existing land use in the City is shown in Figure 2.01-3 and graphically summarized in Figure 2.01-4. Detailed land use for each watershed is included in Appendix A. Existing land use is based on geographic information system (GIS) data provided by the City and La Crosse County and supplemented by field investigation.



Notes: Res.=Residential
WisDOT=Wisconsin Department of Transportation
ROW=right-of-way
Misc.=miscellaneous

Figure 2.01-4 Phase 2 Designated Area General Land Use Classification

Lake Onalaska

Black River

Mississippi River

La Crosse River

Legend

Existing BMPs

BMP Type

- Biocell
- Bioretention
- Grass Swale
- Rain Garden
- Rain Garden and Rain Barrel
- Rain Barrel
- Dry Detention Pond
- Wet Detention Pond
- Porous Pavement
- Street Narrowing
- Underground Storage
- Hydrodynamic Separator
- Drainage Basins
- Municipal Limits
- UW La Crosse Boundary
- Parcels

City Storm Sewer

- Storm Sewer Outfalls
- Storm Sewer Liftstations
- Storm Sewer Manholes
- Storm Sewer Catchbasins
- Storm Sewer Mains

N
W E
S

0 0.25 0.5 1
Miles

Aerial Source: Wisconsin Regional Orthoimagery Consortium. (2020).
WROC Aerial Mosaic (WTM) La Crosse County, WI 2020.

STORM SEWER SYSTEM
NORTHERN PORTION OF CITY

STORMWATER MANAGEMENT PLAN UPDATE
CITY OF LA CROSSE
LA CROSSE COUNTY, WI

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FIGURE 2.01-1
4638.002

Path: S:\MAD\4600--4699\4638\002\Drawings\GIS\Figures\Figure 2.01-1 Storm Sewer System Map North 22x34.mxd User: danielj Date: 7/3/2024 Time: 11:01:59 AM

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Black River
Mississippi River
La Crosse River
Pammel Creek

Legend

- Drainage Basins
- Downtown Area
- Municipal Limits
- Parcels
- UW La Crosse Boundary

City Storm Sewer

- Storm Sewer Outfalls
- Storm Sewer Liftstations
- Storm Sewer Manholes
- Storm Sewer Catchbasins
- Storm Sewer Mains

Existing BMPs

- Biocell
- Bioretention
- Grass Swale
- Rain Garden
- Rain Garden and Rain Barrel
- Rain Barrel
- Dry Detention Pond
- Wet Detention Pond
- Porous Pavement
- Street Narrowing
- Underground Storage
- Hydrodynamic Separator

N W E S

0 0.25 0.5 1
Miles

Aerial Source: Wisconsin Regional Orthoimagery Consortium. (2020). WROC Aerial Mosaic (WTM) La Crosse County, WI 2020.

FIGURE 2.01-2
4638.002

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STORM SEWER SYSTEM
SOUTHERN PORTION OF CITY

STORMWATER MANAGEMENT PLAN UPDATE
CITY OF LA CROSSE
LA CROSSE COUNTY, WISCONSIN

Path: S:\MAD\4600--4699\4638\002\Drawings\GIS\Figures\Figure 2.01-3 Land Use 22x34.mxd

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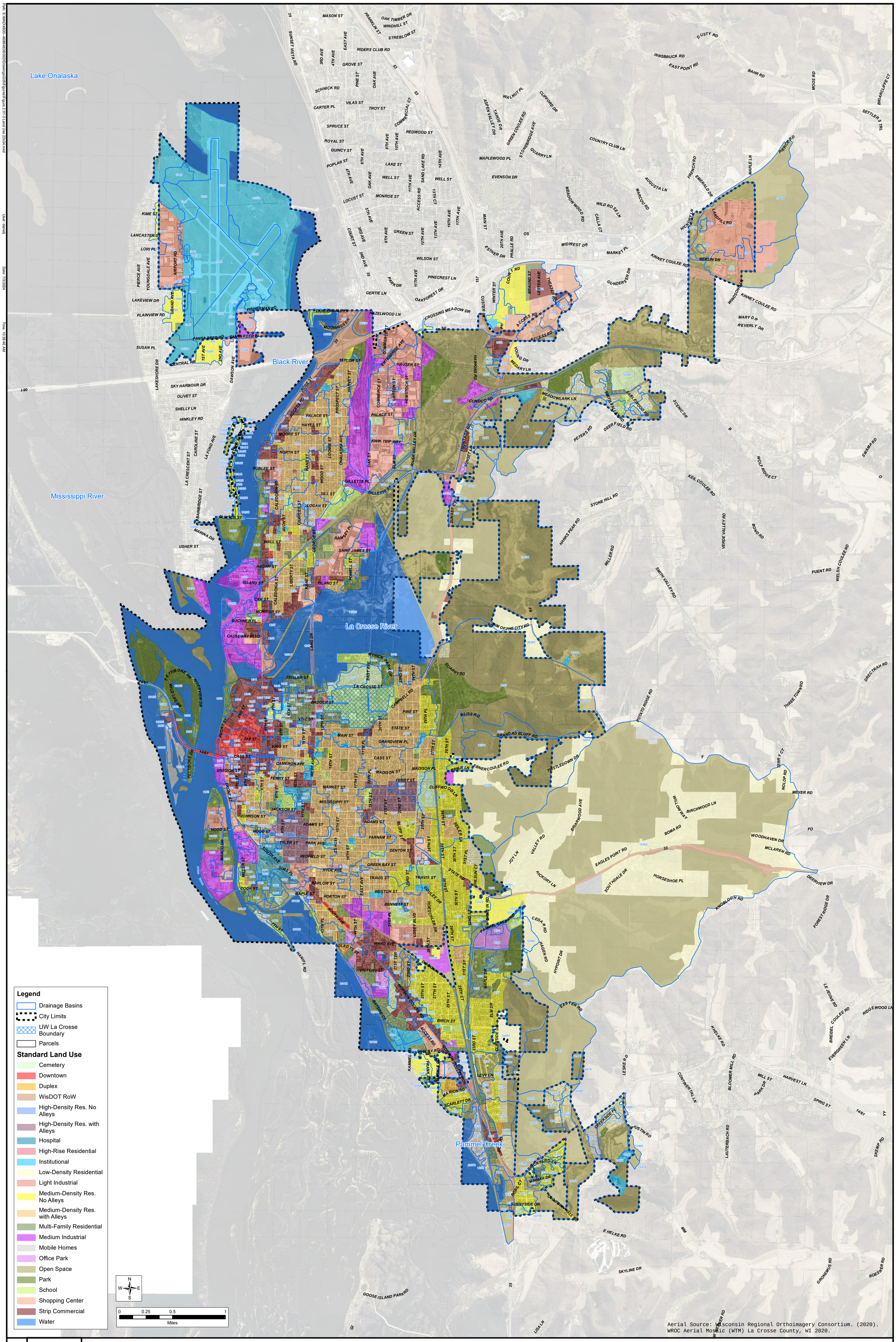

FIGURE 2.01-3
4638.001

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CITY STANDARD LAND USE
2004 DEVELOPMENT CONDITIONS

STORMWATER MANAGEMENT PLAN UPDATE
CITY OF LA CROSSE
LA CROSSE COUNTY, WISCONSIN

B. Watershed Description

The City is primarily located in the Bad Axe-La Crosse River watershed, which drains portions of Crawford, La Crosse, Monroe, and Vernon Counties. The City is bounded on its western edge by the Mississippi and Black Rivers. The La Crosse River flows through the City from the east and divides the urbanized areas into northern and southern portions. Extensive undeveloped marshy areas are located along the La Crosse River. Steep hills and bluffs bound the City on its eastern edge. Pammel Creek drains portions of the southern part of the City. Commercial, industrial, and downtown areas tend to be located on the western portion of the City, while residential areas tend to be located in the central and eastern portions. The majority of the City is drained by City curb and gutter and storm sewer. Stormwater pumping stations serve multiple areas throughout the City to facilitate stormwater drainage during high river conditions. The eastern and southern portions of the City drain to the La Crosse River by City curb and gutter, storm sewer, and stormwater conveyance ditches.

The Black River, La Crosse River, and Mississippi River are included on the state's 303(d) list of impaired waters. A waterbody is considered impaired if the current water quality does not meet the numeric or narrative criteria in a water quality standard, or if the designated use that is described in WAC is not being achieved. The impaired waters relevant to the City are listed in Table 2.01-1 which is derived from data available on the WDNR Surface Water Data Viewer. Typically, the WDNR will follow the process to create a TMDL for 303(d)-Listed Waters as a plan to "clean up" the water and eventually remove it from the 303(d) list. It is our understanding that the WDNR does not have a timeline for when a TMDL for either the Black River, La Crosse River, or Mississippi River will be completed.

Table 2.01-1 303d Listed Impaired Waters

Water Body	Major Watershed	Current Use	Attainable Use	Designated Use	303(d) Impairment/Pollutant Sources	303(d) Priority
La Crosse River	Lower La Crosse River	FAL	FAL	FAL	Impairment: Unknown Pollutants include: ▪ TP	Low
Black River	Lower Black River	FAL	FAL	Default FAL	Impairment: ▪ Mercury Contaminated Fish Tissue ▪ PCBs Contaminated Fish Tissue ▪ Unknown Pollutants Include: ▪ Mercury ▪ PCBs ▪ TP	Low
Mississippi River–Reach 3	Lower La Crosse River	WWSF	WWSF	WWSF	Impairment: Unknown Pollutants include: ▪ Mercury ▪ PCBs ▪ TP	Low
La Crosse River Marsh	Lower La Crosse River	FAL	FAL	FAL	Impairment: Lead contaminated sediments	Low

Notes: FAL=Fish and Aquatic Life Community
WWSF=Warm Water Sport Fishery
TP=Total Phosphorus
PCB=Polychlorinated Biphenyls

2.02 LOCAL SOURCE AREAS AND OUTFALLS

A. Pollutant Source Areas

In addition to land use, pollutant loading from urban areas is dependent on the characterization of "source areas." Various urban source areas will contribute different quantities of runoff and associated pollutants depending on their characteristics. For instance, impervious areas such as roadways and parking lots will generally generate more runoff and pollutants than pervious areas such as lawns and gardens, especially for smaller, more frequent storms. However, pervious areas will contribute a larger portion of the runoff and pollutants as storm events get larger. For the smallest of rainfall events, almost all runoff and pollutants will be generated by impervious area. Rooftops contribute to increased runoff volumes but tend to contribute fewer pollutants than parking lots or streets.

Impervious cover in a watershed can be organized into two main categories:

1. Rooftops–created by buildings, homes, garages, stores, warehouses, and other buildings.

2. Transport systems–impervious cover created by roads, sidewalks, driveways, and parking lots.

For modeling purposes all impervious surface area is described in two basic ways, total impervious area or effective impervious area. The total impervious area in a watershed includes all impervious cover, including rooftops and transport systems. The effective impervious area is the portion of total impervious cover that is directly connected to the storm drain network. Roof drains are often directed to lawns or other pervious surface, allowing some stormwater runoff to infiltrate, which removes these rooftops as effective impervious area.

B. Stormwater Drainage System

1. Description of Drainage System

The main drainage systems consist of curb and gutter with overland flow that discharges to either the La Crosse River, Pammel Creek, or Black River with ultimate discharge to the Mississippi River.

Historically, stormwater management in the City has focused on draining stormwater from developed areas as quickly as possible. BMPs are primarily focused on construction of engineered drainage systems consisting of curb and gutter, graded ditches, and storm sewer. More recently, the City has required construction of detention basins in new developments to minimize increases in stormwater runoff and provide stormwater quality treatment. Basins are a mix of privately owned/maintained ponds (serving areas developed before 2004) and City-owned and maintained ponds.

2. Outfall Locations

There are currently 386 storm sewer system outfalls (ditches or culverts) in the City. Outfalls are defined as ditches or culverts that discharge either to a water of the state or to an adjacent MS4. Outfall locations are identified in Figures 2.01-1 and 2.01-2.

2.03 TOPOGRAPHY, SOILS, AND PRECIPITATION

A. Topography

Topographic features, particularly slope steepness, have a direct bearing on the potential for soil erosion and the sedimentation of surface waters. Slope steepness affects the velocity and, accordingly, the erosive potential of runoff. As a result, steep slopes may place limitations on urban development and contribute to high levels of nonpoint source (NPS) pollution associated with construction sites.

The primary drainage features in the City are La Crosse River, Black River, Pammel Creek, and Mississippi River. For the most part, land within the City drains toward these waterways. Elevations range from 630 to 1,290 feet above sea level.

B. Soils

The amount of stormwater runoff produced by a storm event is impacted by the types of soil underlying the watershed. Soils having a high percentage of sand and gravel will infiltrate a higher percentage of stormwater runoff than will soils having high clay content. This means that sandy soil generally produces less runoff than clayey soil.

The Natural Resource Conservation Service (NRCS) classifies soil types in categories known as Hydrologic Soil Groups (HSG). Group A soils consist of sandy soils having low runoff potential. Group B soils have moderately fine to moderately coarse textures and moderate runoff potential. Group C soils are typically sandy clay loam soils having moderately fine to fine textures and a high runoff potential. Examples of Group D soils are clays, soils with a permanent high water table, and shallow soils over nearly impervious material.

As shown in Table 2.03-1 and Figure 2.03-1, local soils are primarily silty loams and sand. These soils are classified by the NRCS as mainly HSG Group A and Group B. Group D soils are primarily located in wetland areas along the La Crosse River and Mississippi River.

Approximately 60 percent of the soils within the municipal limits are classified as “Urban land, valley terrain.” In previous iterations of NRCS soils maps, these areas have been classified as sandy soils. During routine maintenance of stormwater facilities, City staff have not observed evidence of saturated soils, standing water, or dead vegetation that would indicate the presence of restrictive soil layers. City staff have also observed wide-spread sandy soils during previous construction projects throughout the City. Previous soil borings indicate wide-spread sandy soils are present, as well. These observations corroborate previous soil mapping that indicates the urban lands within the City are composed of sandy soils. WDNR has confirmed in an e-mail, dated February 6, 2023, that the urban soils within the City may be considered sandy and HSG A. This correspondence is included in Appendix G.

FIGURE 2.03-1
4638.002

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SOIL TEXTURES

STORMWATER MANAGEMENT PLAN UPDATE
CITY OF LA CROSSE
LA CROSSE COUNTY, WI

Table 2.03-1 Soil Types

Symbol	Soil Name	HSG	Infiltration Rate[1] (in/hr)	Area (acres)	Percent of Total Area
2002	Udorthents, earthen dams	A	3.6	0.2	0.0%
2013	Pits, gravel	A	3.6	30.8	0.2%
2014	Pits, quarry, hard bedrock	B	0.13	109.2	0.6%
2020	Urban land, valley trains	A[2]	3.6	11,012.9	59.8%
2030	Udorthents and Udipsamments, cut or fill	B	0.13	1,062.0	5.8%
2050	Landfill	A	3.6	117.4	0.6%
11600	Churchtown silt loam, 20 to 30 percent slopes, moderately eroded	B	0.13	519.7	2.8%
16300	Elbaville silt loam, 20 to 30 percent slopes, moderately eroded	C	0.07	44.5	0.2%
25400	Norden silt loam, 20 to 30 percent slopes, moderately eroded	C	0.07	43.6	0.2%
110D3	Timula silt loam, knolls, 12 to 20 percent slopes, moderately eroded	B	0.13	17.2	0.1%
1125F	Dorerton, very stony-Elbaville complex, 30 to 60 percent slopes	B	0.13	1,017.3	5.5%
1145F	Gaphill-Rockbluff complex, 30 to 60 percent slopes	A	3.6	12.3	0.1%
114B2	Mt. Carroll silt loam, 2 to 6 percent slopes, moderately eroded	B	0.13	10.0	0.1%
115vC2	Seaton silt loam, driftless valley, 6 to 12 percent slopes, moderately eroded	B	0.13	50.5	0.3%
115vD2	Seaton silt loam, driftless valley, 12 to 20 percent slopes, moderately eroded	B	0.13	27.5	0.1%
115vE2	Seaton silt loam, driftless valley, 20 to 30 percent slopes, moderately eroded	B	0.13	7.8	0.0%
116C2	Churchtown silt loam, 6 to 12 percent slopes, moderately eroded	B	0.13	62.8	0.3%
116D2	Churchtown silt loam, 12 to 20 percent slopes, moderately eroded	B	0.13	247.7	1.3%
126B	Barremills silt loam, 1 to 6 percent slopes	B	0.13	64.0	0.3%
132B2	Brinkman silt loam, 2 to 6 percent slopes, moderately eroded	B	0.13	1.2	0.0%
132C2	Brinkman silt loam, 6 to 12 percent slopes, moderately eroded	B	0.13	65.5	0.4%
133B2	Valton silt loam, 2 to 6 percent slopes, moderately eroded	C	0.07	3.4	0.0%
133C2	Valton silt loam, 6 to 12 percent slopes, moderately eroded	C	0.07	16.4	0.1%
133D2	Valton silt loam, 12 to 20 percent slopes, moderately eroded	C	0.07	239.6	1.3%
1658A	Algansee-Kalmarville complex, river valleys, 0 to 3 percent slopes, frequently flooded	A/D	0.07	1,287.9	7.0%
1743F	Council-Elevasil-Norden complex, 30 to 60 percent slopes	B	0.13	47.9	0.3%
202C2	Lambeau silt loam, 6 to 12 percent slopes, moderately eroded	B	0.13	1.8	0.0%
20A	Palms and Houghton mucks, 0 to 1 percent slopes	A/D	0.07	96.8	0.5%
21A	Palms muck, 0 to 1 percent slopes, frequently flooded	A/D	0.07	369.6	2.0%
253D2	Greenridge silt loam, 12 to 20 percent slopes, moderately eroded	B	0.13	6.3	0.0%
312B2	Festina silt loam, 1 to 6 percent slopes, moderately eroded	B	0.13	36.3	0.2%
318A	Bearpen silt loam, 0 to 3 percent slopes, rarely flooded	B/D	0.07	9.9	0.1%
326B2	Medary silt loam, 0 to 6 percent slopes, moderately eroded	D	0.07	90.0	0.5%
326F	Medary silt loam, 15 to 45 percent slopes	D	0.07	57.5	0.3%
336B	Toddville silt loam, 1 to 6 percent slopes	B	0.13	39.9	0.2%
424B	Merit silt loam, 1 to 6 percent slopes	B	0.13	58.5	0.3%
424D2	Merit silt loam, 12 to 20 percent slopes, moderately eroded	B	0.13	6.4	0.0%
424E	Merit silt loam, 20 to 45 percent slopes	B	0.13	37.2	0.2%
434B	Bilson sandy loam, 1 to 6 percent slopes	A	3.6	34.0	0.2%
434C2	Bilson sandy loam, 6 to 12 percent slopes, moderately eroded	A	3.6	9.2	0.1%
446A	Merimod silt loam, 0 to 3 percent slopes	B	0.13	90.7	0.5%
483B2	Brice loamy fine sand, 2 to 6 percent slopes, moderately eroded	A	3.6	17.9	0.1%
501A	Finchford loamy sand, 0 to 3 percent slopes	A	3.6	231.3	1.3%
502B2	Chelsea fine sand, 2 to 6 percent slopes, moderately eroded	A	3.6	233.3	1.3%
502C2	Chelsea fine sand, 6 to 15 percent slopes, moderately eroded	A	3.6	86.0	0.5%
511B	Plainfield loamy sand, river valley, 1 to 6 percent slopes	A	3.6	11.1	0.1%

Symbol	Soil Name	HSG	Infiltration Rate[1] (in/hr)	Area (acres)	Percent of Total Area
511C	Plainfield sand, river valley, 6 to 15 percent slopes	A	3.6	4.8	0.0%
511F	Plainfield sand, river valley, 15 to 60 percent slopes	A	3.6	66.8	0.4%
561F	Tarr sand, 15 to 60 percent slopes	A	3.6	38.2	0.2%
576B	Tintson sand, 1 to 6 percent slopes	A	3.6	5.5	0.0%
601C	Beavercreek cobbly fine sandy loam, 3 to 12 percent slopes, occasionally flooded	A	3.6	17.1	0.1%
625A	Arenzville silt loam, channeled, 0 to 2 percent slopes, occasionally flooded	B	0.13	27.9	0.2%
626A	Arenzville silt loam, 0 to 3 percent slopes, occasionally flooded	B	0.13	33.2	0.2%
628A	Orion silt loam, 0 to 3 percent slopes, occasionally flooded	B/D	0.07	194.0	1.1%
629A	Ettrick silt loam, 0 to 2 percent slopes, frequently flooded	C/D	0.07	134.9	0.7%
656A	Scotah loamy fine sand, 0 to 3 percent slopes, occasionally flooded	A	3.6	153.1	0.8%
676A	Kickapoo fine sandy loam, 0 to 3 percent slopes, occasionally flooded	B	0.13	27.3	0.1%
N1155G	Brodale-Bellechester-Rock outcrop complex, 60 to 90 percent slopes	B	0.13	61.1	0.3%
W	Water	NA	0.0	2,796.6	15.2%
TOTAL				**18,406.6**	**100.0%**

Note:
in/hr=inches per hour
[1]Infiltration Rate Based on Table 2 of the WDNR Site Evaluation for Stormwater Infiltration (1002) Technical Standard
[2]Soils were modeled as Sandy or Silty based on City experience as shown in Figure 2.03-1.

C. Precipitation

Expected rainfall depths for the City from National Oceanic and Atmospheric Administration (NOAA) Atlas 14, for storm events of various frequencies are summarized in Table 2.03-2. These rainfall totals are used in conjunction with the applicable Bulletin 71 distribution to estimate peak storm discharges.

Recurrence Interval and Depths (inches)						
Storm Duration	**2 Years**	**5 Years**	**10 Years**	**25 Years**	**50 Years**	**100 Years**
30 Minutes	1.11	1.39	1.62	1.95	2.20	2.46
60 Minutes	1.45	1.83	2.15	2.59	2.95	3.31
2 Hours	1.79	2.26	2.67	3.24	3.70	4.16
3 Hours	2.01	2.54	3.01	3.68	4.22	4.78
6 Hours	2.36	2.98	3.54	4.38	5.07	5.80
12 Hours	2.68	3.37	4.00	4.98	5.82	6.72
24 Hours	3.01	3.76	4.47	5.57	6.53	7.57
48 Hours	3.40	4.24	5.02	6.22	7.23	8.34

Table 2.03-2 Expected Rainfall Depths from NOAA Atlas 14

2.04 CURRENT STORMWATER PRACTICES AFFECTING STORMWATER QUALITY

This section summarizes existing programs that impact stormwater runoff in the study area. Information in this section is intended to identify existing conditions for stormwater pollutant load modeling.

A. Street Sweeping

Street sweeping, while historically conducted primarily for aesthetic and maintenance purposes, is an effective stormwater management practice. However, in rural road sections drained by grass-lined drainage swales, this practice is not practical because of the lack of curb and gutter. The City is primarily drained by curb and gutter, making street sweeping an effective practice. The City currently performs street sweeping every two weeks citywide, and weekly in downtown areas using a mechanical sweeper. Street sweeping material is generally taken to the landfill.

B. Inlet and Catch Basin Sumps

Catch basin sumps are located throughout the City as shown on Figure 2.04-1. During a rain event, sumps allow sediment and debris to settle out of runoff within the storm sewer system. The City's standard depth of a sump is 1.5 feet below the invert elevation of the outlet pipe. Based on discussions with the City, catch basin cleaning is distributed annually such that each catch basin is cleaned once every five years.

Path: S:\MAD\4600--4699\4638\002\Drawings\GIS\Figures\Figure 2.04-1 Catchbasin Locations 22x34.mxd

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Legend

- Drainage Basins
- Municipal Limits
- UW La Crosse Boundary
- Parcels
- Modeled Catch Basins

N W E S

0 0.25 0.5 1 Miles

Aerial Source: Wisconsin Regional Orthoimagery Consortium. (2020). WROC Aerial Mosaic (WTM) La Crosse County, WI 2020.

CITY CATCH BASINS

STORMWATER MANAGEMENT PLAN UPDATE
CITY OF LA CROSSE
LA CROSSE COUNTY, WI

FIGURE 2.04-1
4638.002

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C. Stormwater Detention Basins

The WDNR allows dry stormwater detention basins to be included as a stormwater BMP if it is modeled in WinSLAMM as a wet pond with a starting water depth of 0.01 feet or as a biofilter of grassed swale if site-specific soils data are available. As discussed in Section 2.03 B, City staff have not observed evidence of saturated soils, standing water, or dead vegetation within dry detention basins that would indicate the presence of restrictive soil layers. Additionally, City staff have observed wide-spread sandy soils throughout the City and provided soil borings from previous projects that indicate wide-spread sandy soils are present. Therefore, dry detention basins were included in WinSLAMM modeling as biofilters using a "book value" infiltration rate for sandy soils of 3.6 in/hr, as defined in Table 2 of WDNR Technical Standard 1002.

D. Grass-Lined Ditches and Swales

The WDNR gives stormwater quality credit to areas drained by grass-lined ditches. There are six areas drained in this manner in the City that are included in existing conditions modeling. Similar to the infiltration rates used for dry detention basins, a sandy soil texture was assumed based on previously obtained soils data and City observations. The static infiltration rates specified in Table 2 of WDNR Technical standard 1002 were divided by two to obtain the dynamic infiltration rate for swales in the modeling. Swales are inspected on a regular basis and maintained as needed.

E. Additional Stormwater Practices

While not as widespread as the stormwater management practices discussed above, the City has also incorporated porous pavement, street narrowing, underground storage, rain barrels, and rain gardens to treat stormwater runoff. Private facilities have maintenance agreements on file certifying the practice will be maintained in accordance with WDNR guidance. These practices are discussed further in Section 3.06.

SECTION 3
STORMWATER QUALITY MODELING

3.01 INTRODUCTION

A. General

Water quality analysis for the City was completed using WinSLAMM v10.4.1. WinSLAMM is a computer model approved by the WDNR to address requirements of WAC NR 151 that analyzes NPS pollution abatement. WinSLAMM has been calibrated using extensive water quality data throughout the United States. As this model is used for regulatory purposes, the results can be compared to other past and ongoing studies. WinSLAMM is regularly updated to include additional water quality monitoring data to further refine its predictive capabilities.

WinSLAMM is a planning-level tool that enables municipalities to make decisions regarding BMPs necessary to achieve NPS runoff standards described in WAC NR 151. WinSLAMM specifically analyzes control practices including street sweeping, wet detention ponds, catch basin and inlet sumps, infiltration devices, porous pavements, and grass swales. WinSLAMM also predicts relative pollutant contributions from “source areas” including rooftops, parking lots, driveways, streets, sidewalks, and pervious space.

B. Regulatory Requirements

The City’s stormwater permit requires assessment of compliance with WAC NR 151 pollutant reduction goals through completion of a pollutant loading analysis using WinSLAMM or other equivalent pollutant loading model. At a minimum, the City must estimate average annual TSS loads for the cumulative discharge from all outfalls for the “no controls/baseline” and “controls/existing” conditions. For the no controls condition, the modeling must estimate the theoretical annual average mass of TSS generated for the entire area served by the City’s stormwater management system with no controls or BMPs applied. The controls condition must estimate the City’s current level of pollutant reductions based on current City practices such as street sweeping, wet detention basins, catch basins with sumps, and swale drainage. The controls condition must be judged against the no controls condition to determine the percent of TSS reduction.

The pollutant loading analysis will be used by the WDNR to evaluate compliance with mandated pollutant reduction goals. As discussed in Section 1, the City must implement SMPs so that the controls condition results in a 20 percent TSS reduction compared to the no controls condition. The reduction comparison was completed using the developed areas of the city using 2004 conditions in order to evaluate compliance with the City’s stormwater permit. All existing BMPs evaluated were either constructed before 2004, constructed to serve areas developed before 2004, or constructed to serve redeveloped areas after 2004.

C. Analysis Methodology

Areas within the City were classified as either residential, institutional, industrial, commercial, open space, or freeway land use based on existing City zoning and land use data. Ultimately, all areas were assigned 1 of the 31 standard land uses available in WinSLAMM. These classifications contain representative proportions of pervious and impervious source areas such as rooftops, driveways, parking lots, streets, sidewalks, lawns, landscaped areas, etc. that can be expected in a given land use. While this method does not capture the specific details of all source areas present, it provides an accurate representation of the pollutant loading potential of the land use as a whole. The assumed distributions of total pervious and impervious areas, source areas of impervious areas, and source areas of pervious areas are shown in Tables 3.01-1, 3.01-2, and 3.01-3, respectively.

Table 3.01-1 Source Area by Land Use

Class	Land Use	Roof (percent)	Driveway (percent)	Sidewalk (percent)	Paved Parking/ Storage (percent)	Unpaved Parking/ Storage (percent)	Playground (percent)	Large Landscaped (percent)	Undeveloped (percent)	Small Landscaped (percent)	Other Pervious (percent)	Isolated Water Body (percent)	Directly Connected Impervious (percent)	Partially Connected Impervious (percent)	Street Area (percent)	Total (percent)
Residential	High Density Residential with Alleys (<1/4-acre lots)	24.20	0.70	6.40	0.40	0.00	0.00	0.00	0.30	41.50	6.30	0.00	0.00	0.00	20.20	100.00
	High Density Residential Without Alleys (<1/4-acre Lots)	21.40	14.10	4.0	0.00	0.00	0.00	0.00	0.00	41.00	5.90	0.10	0.00	0.00	13.50	100.00
	Medium Density Residential (1/4- to 1/2-acre lots)	15.00	7.50	2.20	0.20	0.00	0.00	0.20	0.40	57.50	4.00	0.20	0.00	0.00	12.80	100.00
	Low Density Residential (>1/2-acre lots)	8.00	4.50	0.70	0.10	0.00	0.00	0.00	4.40	74.80	0.20	0.20	0.10	0.00	7.00	100.00
	Duplex	16.54	5.31	3.96	0.00	0.00	0.00	0.00	0.00	60.88	0.00	0.00	0.00	0.00	13.31	100.00
	Multifamily	20.70	2.80	4.20	10.80	0.50	0.10	1.40	3.00	38.00	3.80	0.10	0.00	0.00	14.60	100.00
	Mobile Home	16.90	12.30	1.00	13.40	0.60	0.00	0.00	4.50	44.70	0.00	1.00	2.00	0.00	3.60	100.00
Commercial	Commercial	9.44	0.00	2.28	26.31	0.00	0.00	58.66	0.00	0.00	0.00	0.00	0.00	0.00	3.31	100.00
	Commercial Downtown	40.73	1.48	8.35	22.61	0.00	0.00	0.00	0.00	3.56	0.62	0.00	0.00	0.08	22.17	99.60
	Shopping Center	21.61	1.81	0.54	60.68	0.34	0.00	0.00	2.93	4.53	0.82	0.00	0.35	0.00	6.39	100.00
	Strip Commercial	23.40	2.00	4.30	40.90	1.40	0.00	0.00	0.20	5.80	1.90	0.00	0.00	0.00	20.10	100.00
Institutional	Institutional	14.41	3.00	2.20	27.21	0.00	3.40	5.34	1.83	26.55	2.65	0.00	0.00	1.33	12.08	100.00
	School	15.00	1.98	2.91	10.65	0.00	17.33	22.09	0.42	17.43	2.19	0.00	0.00	1.35	8.65	100.00
Industrial	Light Industrial	25.35	2.56	1.28	32.94	6.34	0.00	3.51	4.34	9.86	2.77	0.00	0.00	0.21	10.84	100.00
	Medium Industrial	23.11	2.80	0.90	34.09	14.61	0.00	2.81	5.37	4.00	4.53	0.00	0.00	0.23	7.55	100.00
Other Urban	Cemetery	1.10	7.67	0.06	2.24	0.07	0.00	86.40	0.48	0.23	0.00	0.28	0.00	0.03	1.44	100.00
	Open Space	0.55	0.00	0.58	0.00	0.00	0.00	0.59	94.54	0.00	0.00	0.00	0.00	0.00	3.74	100.00
	Park	0.46	1.21	0.49	4.19	0.22	1.80	77.95	0.00	0.85	0.00	7.08	0.00	2.48	3.27	100.00

Source: WinSLAMM Standard Land Use Files

Table 3.01-2 Distribution of Impervious Source Areas by Land Use Class

Class	Land Use	Pitched Roofs		Flat Roofs		Driveways		Sidewalks		Parking/Storage		Unpaved Parking/Storage		
		Connected (percent)	Unconnected (percent)	Connected (percent)	Unconnected (percent)	Connected (percent)	Unconnected (percent)	Connected (percent)	Unconnected (percent)	Connected (percent)	Unconnected (percent)	Connected (percent)	Unconnected (percent)	Total (percent)
Residential	High Density Residential with Alleys (<1/4-acre lots)	42.9	33.4	0.0	0.0	2.2	0.0	10.1	10.1	1.3	0.0	0.0	0.0	100.0
	High Density Residential Without Alleys (<1/4-acre lots)	26.0	28.1	0.0	0.0	35.7	0.0	5.1	5.1	0.0	0.0	0.0	0.0	100.0
	Medium Density Residential (1/4- to 1/2-acre lots)	18.1	42.2	0.0	0.0	22.5	7.6	4.4	4.4	0.8	0.0	0.0	0.0	100.0
	Low Density Residential (>1/2-acre lots)	14.3	45.9	0.0	0.0	24.1	9.8	2.6	2.6	0.8	0.0	0.0	0.0	100.0
	Duplex	17.4	46.7	0.0	0.0	20.6	0.0	15.3	0.0	0.0	0.0	0.0	0.0	100.0
	Multifamily	36.2	8.2	8.7	0.0	4.9	2.3	5.4	5.4	27.7	0.0	1.3	0.0	100.0
	Mobile Home	0.0	0.0	38.2	0.0	27.8	0.0	1.1	1.1	30.3	0.0	0.0	1.4	100.0
Commercial	Commercial	2.0	0.0	12.4	10.5	0.0	0.0	6.0	0.0	69.2	0.0	0.0	0.0	100.0
	Commercial Downtown	0.0	0.0	55.7	0.0	2.0	0.0	11.4	0.0	30.9	0.0	0.0	0.0	100.0
	Shopping Center	0.0	0.0	25.4	0.0	2.1	0.0	0.6	0.0	71.4	0.0	0.4	0.0	100.0
	Strip Commercial	5.1	0.0	27.4	0.0	2.8	0.0	6.0	0.0	56.8	0.0	0.0	1.9	100.0
Institutional	Institutional	18.0	1.2	11.5	0.0	6.4	0.0	4.7	0.0	58.1	0.0	0.0	0.0	100.0
	School	0.0	0.0	49.1	0.0	6.5	0.0	9.5	0.0	34.9	0.0	0.0	0.0	100.0
Industrial	Light Industrial	3.8	0.0	30.0	3.3	3.7	0.0	1.9	0.0	48.1	0.0	0.0	9.3	100.0
	Medium Industrial	2.5	0.0	22.3	5.9	2.4	1.3	0.6	0.6	45.2	0.0	0.0	19.4	100.0
Other Urban	Cemetery	0.0	4.9	4.9	0.0	68.9	0.0	0.5	0.0	20.1	0.6	0.0	0.0	100.0
	Open Space	0.0	0.0	48.7	0.0	0.0	0.0	51.3	0.0	0.0	0.0	0.0	0.0	100.0
	Park	1.7	3.8	1.5	0.0	18.4	0.0	7.5	0.0	63.8	0.0	0.0	3.4	100.0

Source: WinSLAMM Standard Land Use Files

Table 3.01-3 Distribution of Pervious Source Areas by Land Use Class

Class	Land Use	Playground		Pervious Areas							
		Connected (percent)	Unconnected (percent)	Large Landscaped Area (percent)	Undeveloped (percent)	Small Landscaped Area (percent)	Other Pervious (percent)	Isolated Water Body (percent)	Other Partially Connected (percent)	Other Directly Connected (percent)	Total (percent)
Residential	High Density Residential with Alleys (<1/4-acre lots)	0.0	0.0	0.0	0.6	86.3	13.1	0.0	0.0	0.0	100.0
	High Density Residential Without Alleys (<1/4-acre lots)	0.0	0.0	0.0	0.0	87.2	12.6	0.2	0.0	0.0	100.0
	Medium Density Residential (1/4- to 1/2-acre lots)	0.0	0.0	0.3	0.6	92.3	6.4	0.3	0.0	0.0	100.0
	Low Density Residential (>1/2-acre lots)	0.0	0.0	0.0	5.5	93.9	0.3	0.3	0.1	0.0	100.0
	Duplex	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
	Multifamily	0.0	0.2	3.0	6.5	81.9	8.2	0.2	0.0	0.0	100.0
	Mobile Home	0.0	0.0	0.0	8.6	85.6	0.0	1.9	0.0	3.8	100.0
Commercial	Commercial	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0
	Commercial Downtown	0.0	0.0	0.0	0.0	83.6	14.6	0.0	1.9	0.0	100.0
	Shopping Center	0.0	0.0	0.0	34.0	52.5	9.5	0.0	0.0	4.1	100.0
	Strip Commercial	0.0	0.0	0.0	2.5	73.4	24.1	0.0	0.0	0.0	100.0
Institutional	Institutional	4.1	4.1	13.0	4.5	64.6	6.5	0.0	3.2	0.0	100.0
	School	28.5	0.0	36.3	0.7	28.7	3.6	0.0	2.2	0.0	100.0
Industrial	Light Industrial	0.0	0.0	17.0	21.0	47.7	13.4	0.0	1.0	0.0	100.0
	Medium Industrial	0.0	0.0	16.6	31.7	23.6	26.7	0.0	1.4	0.0	100.0
Other Urban	Cemetery	0.0	0.0	98.8	0.6	0.3	0.0	0.3	0.0	0.0	100.0
	Open Space	0.0	0.0	0.6	99.4	0.0	0.0	0.0	0.0	0.0	100.0
	Park	1.0	1.0	86.5	0.0	0.9	0.0	7.9	2.8	0.0	100.0

Source: WinSLAMM Standard Land Use Files