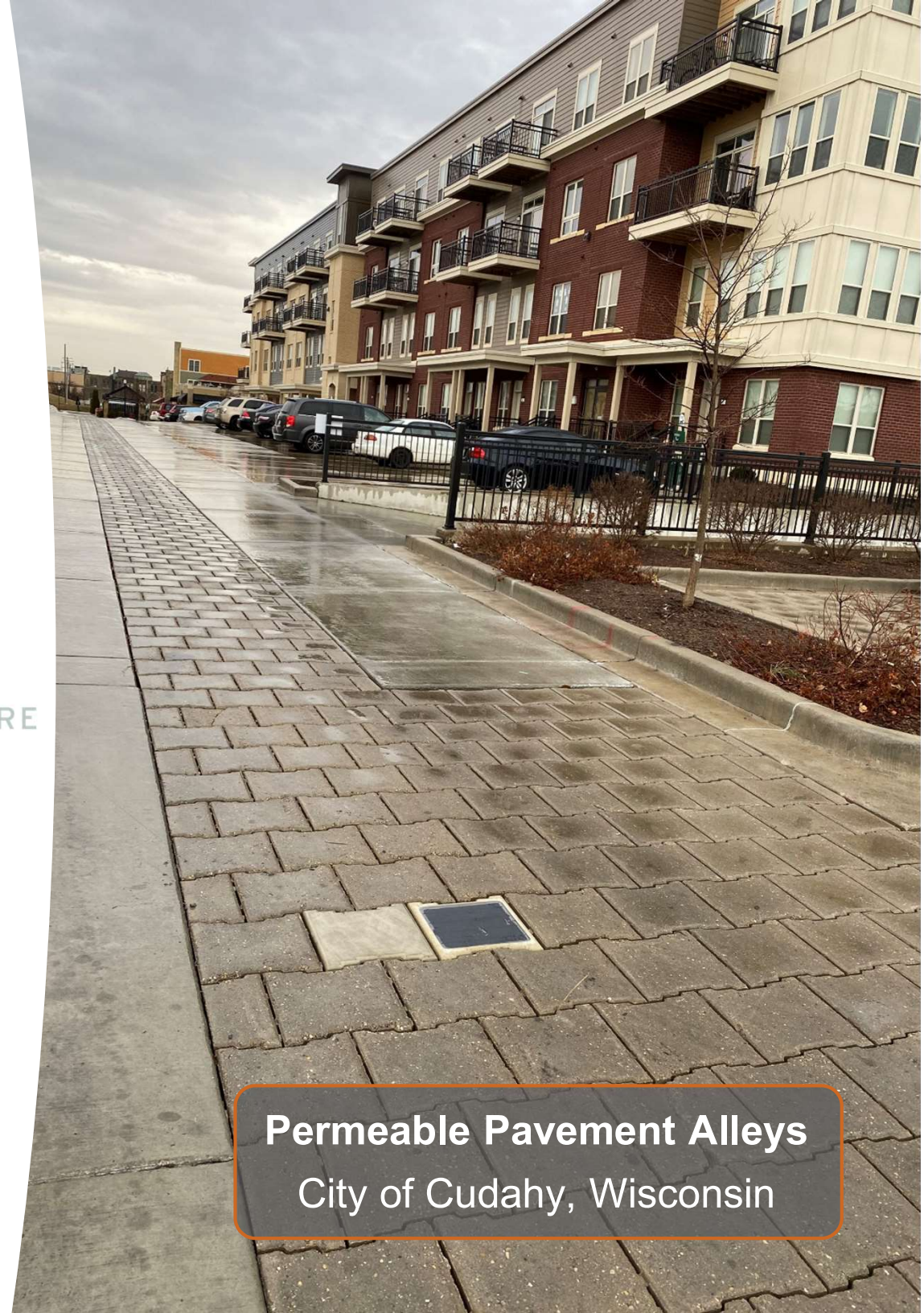
P4 INFRASTRUCTURE



Permeable Pavement Alleys

City of Cudahy, Wisconsin

Introduction

Background

Customer Need

P4 Solution

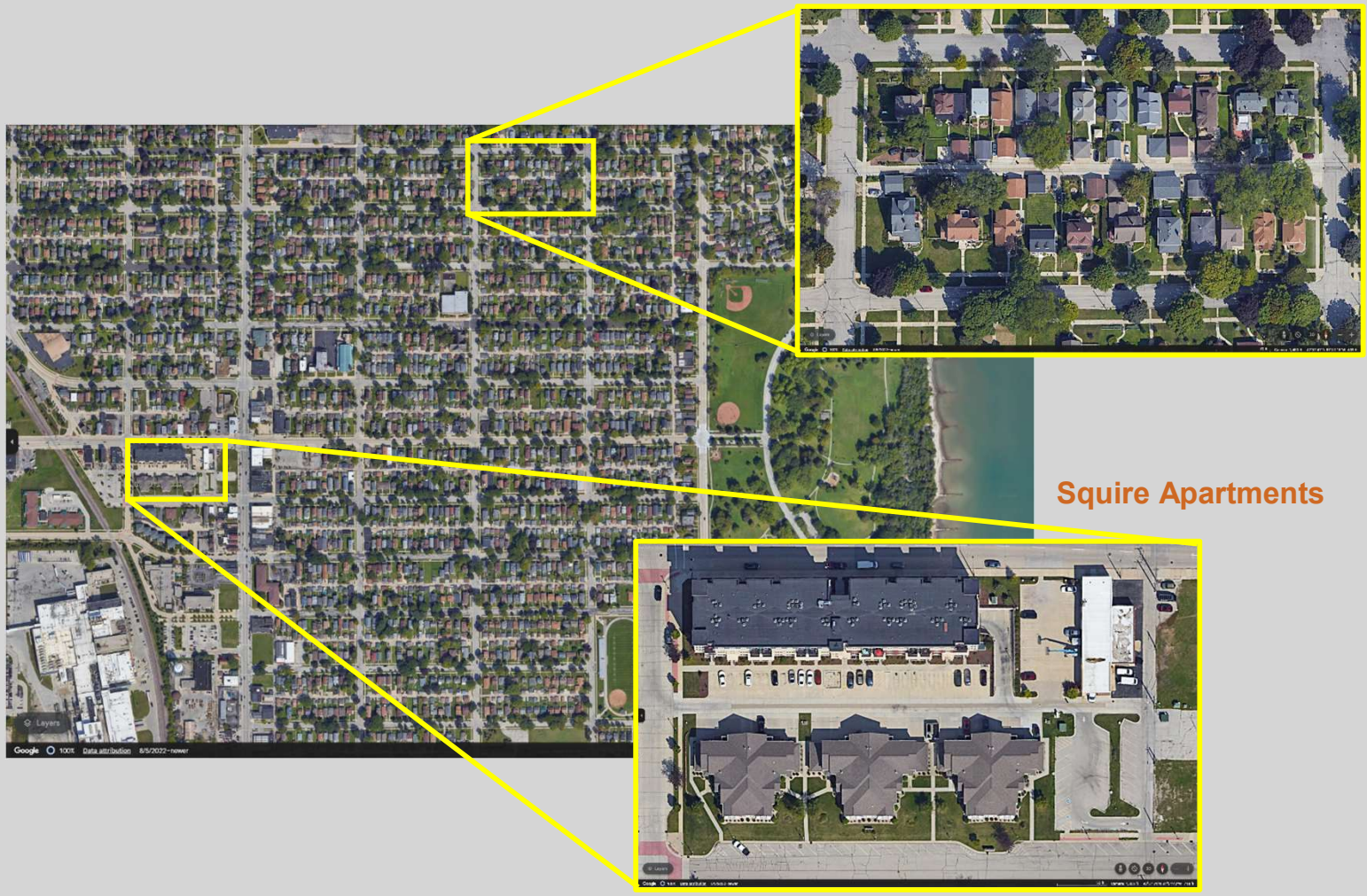
City of Cudahy, WI

Western Shore of Lake Michigan – Milwaukee Suburb

Permeable Pavement Alley Program

Blast-furnace Slag as Storage Gallery Media

Van Norman Alley



Squire Apartments

Van Norman Alley

Customer Needs

Collect Stormwater Runoff for Water Quality Testing (when to collect)

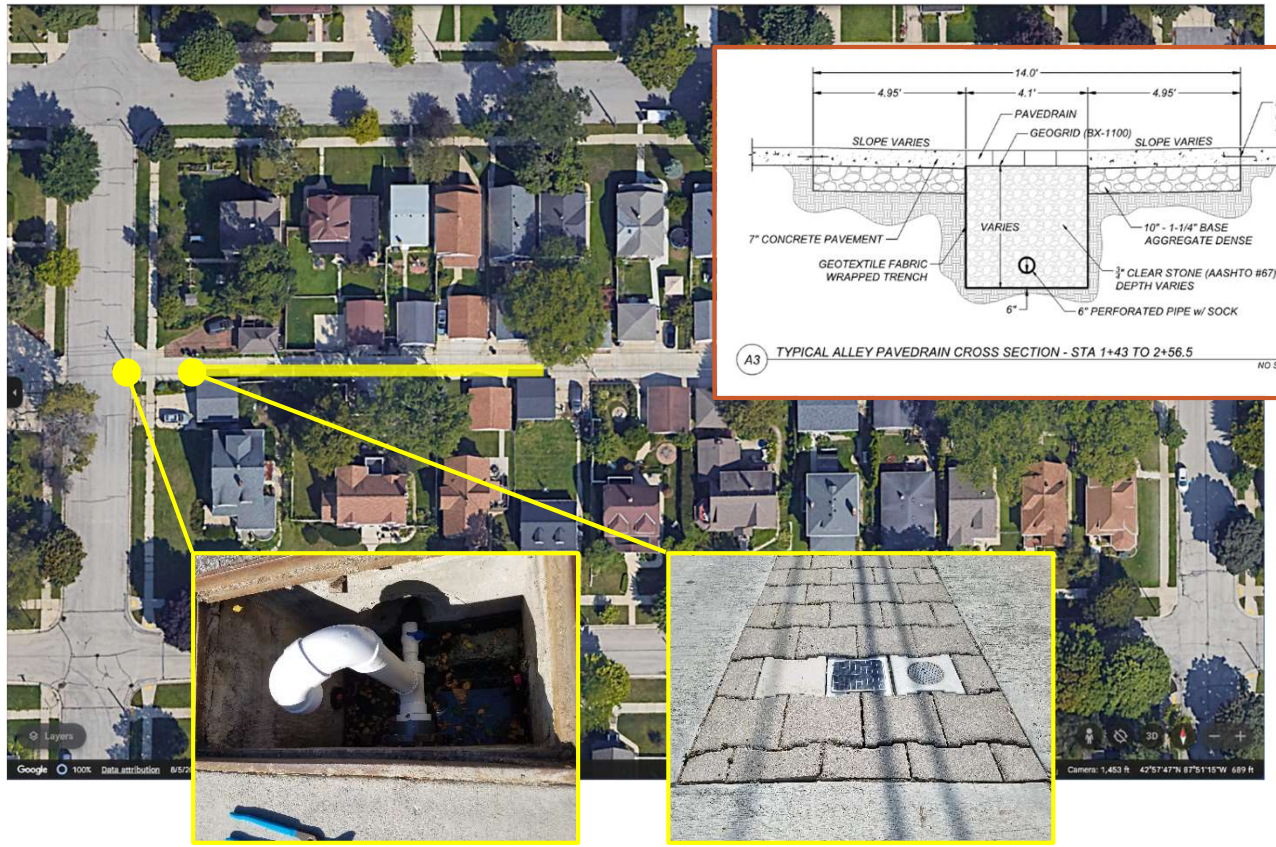
Assess Lack of Underdrain Discharge

Understand System Performance

P4 Solution

Rain-mX

INFIL-Tracker



Flow-RTC

INFIL-Tracker

Squire Apartments

Customer Needs

Collect Stormwater Runoff for Water Quality Testing (when to collect)

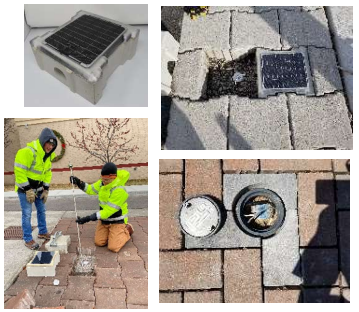
Assess Lack of Underdrain Discharge

Understand System Performance

P4 Solution

Rain-mX

INFIL-Tracker



INFIL-Tracker

Flow-RTC

Measured Data

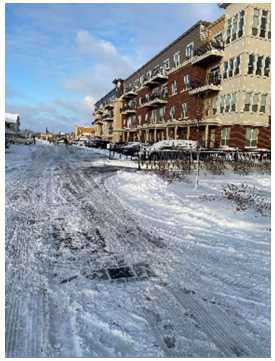
System Performance

Maintenance Assessment

Alley Program Value

Long-Term Value

Squire Apartments


May-September 2022 - Volume Calculations - Squire		
24 Hr Rainfall Event	Rainfall	Volume Captured
No.	(in)	(gal)
1	0.8	0
2	0.77	90
3	0.25	0
4	1.8	4609
5	0.34	747
6	0.72	4962
7	1.51	10257
8	0.77	0
9	1.75	12847
10	0.34	1434
11	0.54	3916
12	1.03	7490
13	1.51	9600
14	0.43	1340
15	5.69	19568
Totals	**18.25**	**76860**

Pollutant Removal & Runoff Elimination – Summer 2022

Blended Residential Land Use

76,860 Gallons of Runoff Captured & Infiltrated (no underdrain discharge)

TSS Removed: 75.7 lbs

TP Removed: 0.21 lbs

Treatment Volume Reduced by 76,860 gallons.

Maintenance Assessment

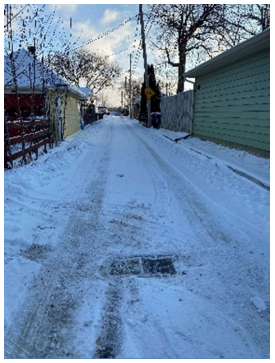
Review of Gallery Water Level Rise

Events in 2022 Caused Water Level Rise Consistent with Similar Events in 2020

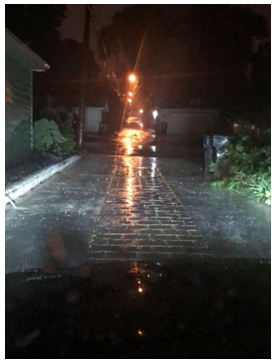
Surface Infiltration Unchanged

Visual Inspections are Misleading (NO maintenance in two years – NO degradation)

Van Norman Alley



January 2020



August 2022

August 2022

May-September 2022 - Volume Calculations - Van Norman		
24 Hr Rainfall Event	Rainfall	Volume Captured
No.	(in)	(gal)
1	0.8	1932
2	0.77	1780
3	0.25	149
4	1.8	3128
5	0.34	413
6	0.72	1033
7	1.51	5511
8	0.77	2250
9	1.75	5090
10	0.34	505
11	0.54	778
12	1.03	2391
13	1.51	3417
14	0.43	202
15	5.69	8500
Totals	**18.25**	**37078**

Pollutant Removal & Runoff Elimination – Summer 2022

Blended Residential Land Use

37,078 Gallons of Runoff Captured & Infiltrated (no underdrain discharge)

TSS Removed: 36.5 lbs

TP Removed: 0.10 lbs

Treatment Volume Reduced by 37,000 gallons.

Maintenance Assessment

Review of Gallery Water Level Rise

Events in 2022 Caused Water Level Rise Consistent with Similar Events in 2020

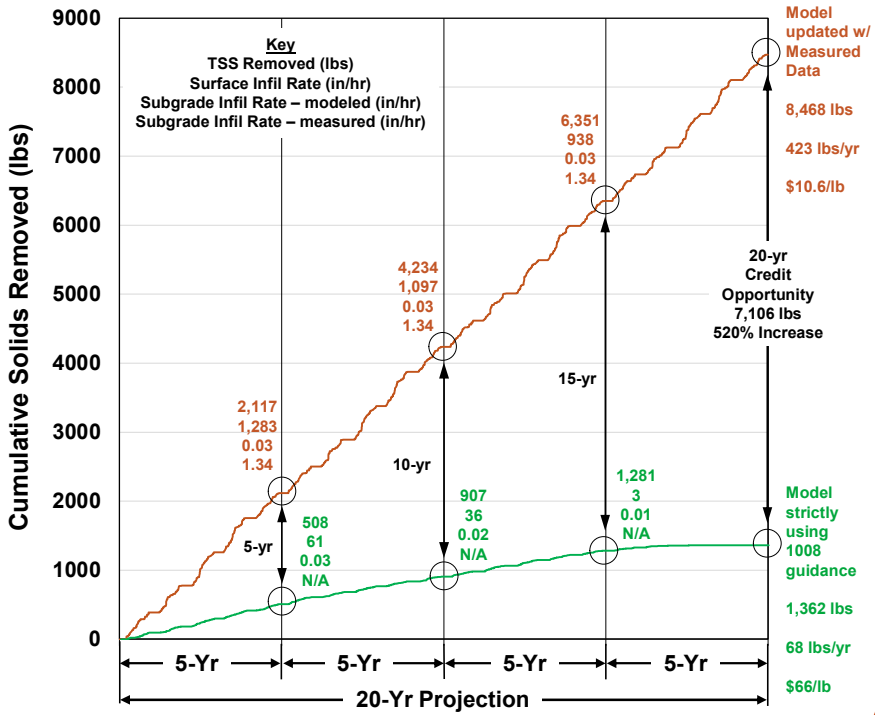
Surface Infiltration Unchanged

Visual Inspections are Misleading (NO maintenance in two years – NO degradation)

Van Norman Alley Estimated Pollutant Removal

BMP Area for Van Norman Alley:

4200 sf (0.096 acre)



Pollutant Removal By the Numbers

423 lbs/year removed if modeled using data measured by P4.

4,406 lbs/BMP-acre removal efficiency

TSS Removal Cost: $10.60/lb

68 lbs/year removed if Van Norman is modeled strictly following 1008 guidance.

708 lbs/BMP-acre removal efficiency

TSS Removal cost: $66/lb

Example TMDL Implementation Study with Estimated Costs

TMDL - Permeable Pavement Program

Cudahy Basins Draining to Kinnikinic River Watershed

KK River Watershed Goals:

Remove 80% TSS and 88% TP

Focusing on TSS:

North Basin No Controls:
233,654 lbs TSS

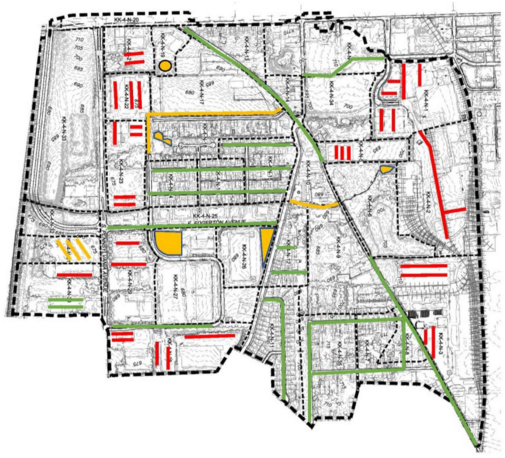
80% TSS Removal Goal:
186,923 lbs

Central Basin No Controls:
142,873 lbs TSS

80% TSS Removal Goal:
114,298 lbs

Propose to use Permeable Pavement Alleys and Parking Lanes Similar to Van Norman Level Removals

North Basin



Estimated Cost of Permeable Pavement BMP:

$933,000/BMP-acre

North Basin Watershed Area: 590 Acres

BMP Area Required using 5:1 Run-On: 118 Acres
Estimated Cost: $110.1M

Area Required using Instrumentation: 13.3 Acres
Estimated Cost: $12.4M

Central Basin

Central Basin Watershed Area: 351 Acres

BMP Area Required using 5:1 Run-On: 70 Acres
Estimated Cost: $65.3

Area Required using Instrumentation: 8.1 Acres
Estimated Cost: $7.6M

Notes:

1. 5:1 Run-on areas required by 1008 guidance (118 acres in North Basin and 70 acres in Central Basin) are not physically available for permeable pavement construction.
2. BMP areas proposed using instrumentation (13.3 acres in North Basin and 8.1 acres in Central Basin) are shown in green on maps.
3. Ask P4 how to get DNR acceptance of run-on violations.

The End

Let P4 show you how digitalization of stormwater infrastructure can change the game.

P4 INFRASTRUCTURE


P4 INFRASTRUCTURE
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Brown Deer, WI
53223
414-446-4145