Using Satellite-Derived PM$_{2.5}$
Concentrations & US EPA's Emissions Modeling Platform for Improved PM$_{2.5}$ Network Assessment

Weld County Department of Public Health and Environment

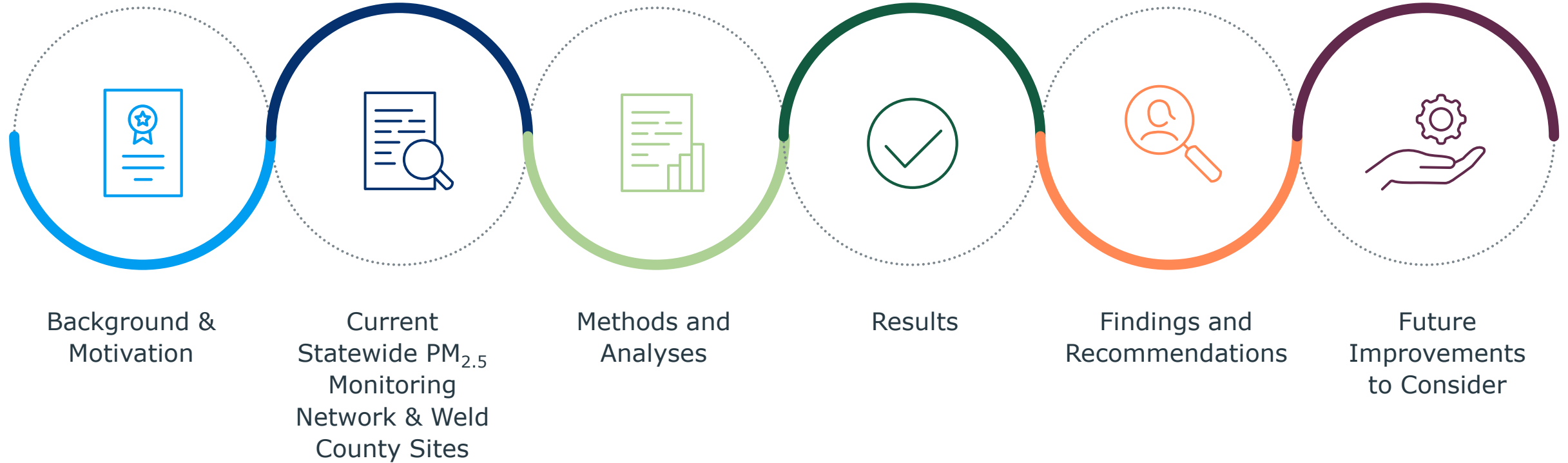Board of County Commissioners of Weld County (BOCC)

August 14, 2024

Kaitlyn Elkind, Abraham Dearden, Blake Himes, Liji David, Jean Guo, Dan Cooke, Courtney Taylor

RAMBOLL

Bright ideas.
Sustainable change.

WELD COUNTY

Overview

Background & Motivation

Current Statewide $PM_{2.5}$ Monitoring Network & Weld County Sites

Methods and Analyses

Results

Findings and Recommendations

Future Improvements to Consider

Background and Motivation

This analysis evaluated the priorities and locations for future PM$_{2.5}$ monitoring sites in the Weld County Air Quality Monitoring Program that would support their overall monitoring goals

Ensure adequate spatial coverage of measurements throughout Weld County to fill gaps in the existing air monitoring network

Inform the spatial extent and boundaries of any nonattainment areas (NAA)
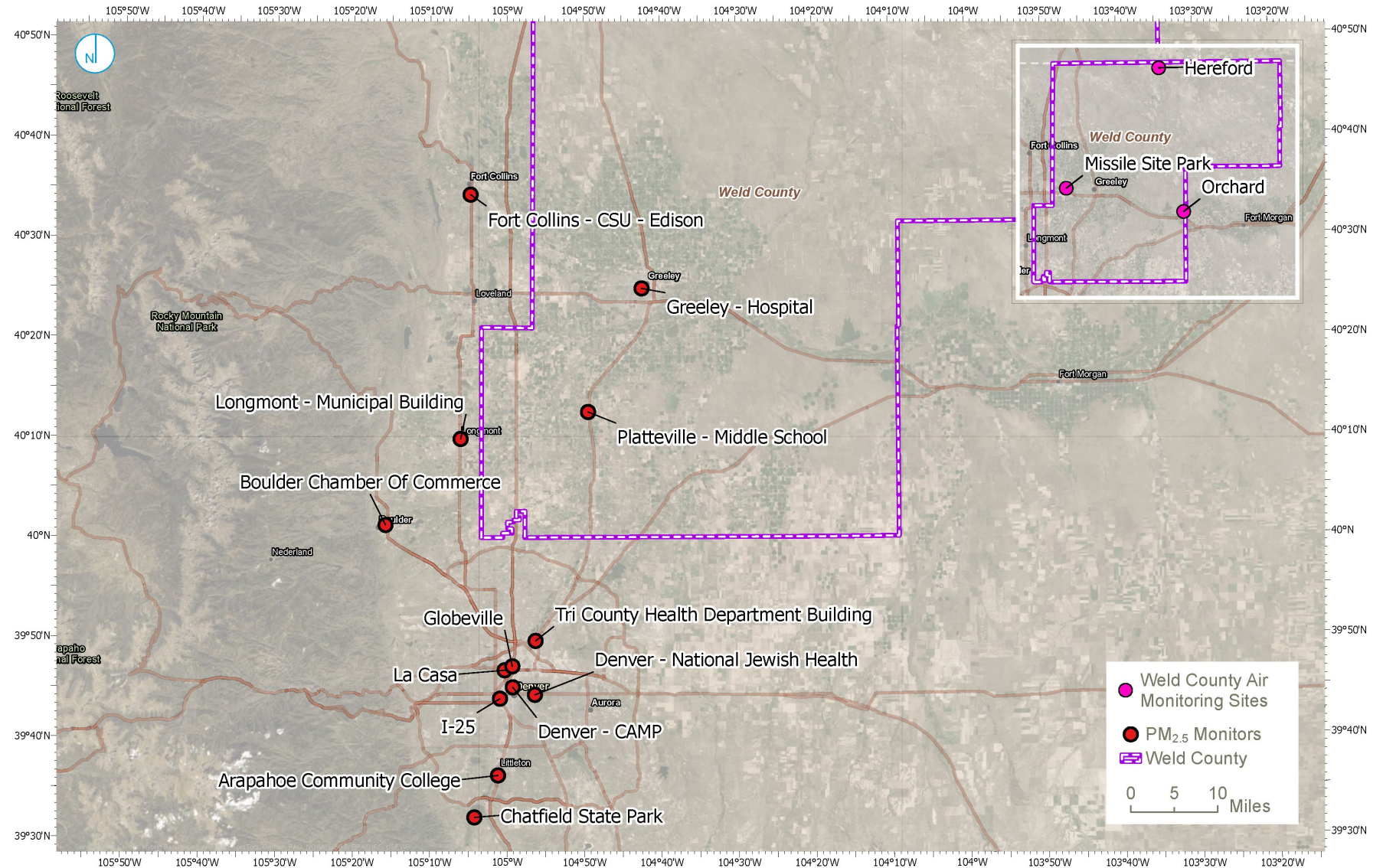
Track trends in concentrations

Quantify changes in concentrations as a result of regulatory and economic changes

Improve efforts to quantify sources and transport of pollutants throughout the ozone NAA or any NAA
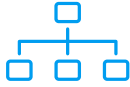
Quantify background concentrations entering Weld County

Support the needs of local businesses to conduct analyses required for air permit applications

Current Statewide PM₂.₅ Monitoring Network & Weld County Sites

Methods and Analyses

	Temporal Analysis	Spatial Analysis	Emissions Modeling Analysis
Utility	• To evaluate how the primary $PM_{2.5}$ design value has changed over recent years	• To investigate spatial patterns	• To better refine areas of interest for monitoring
Method	• Time series plots for nearby monitors in Colorado	• Inverse Distance Weighted (IDW) interpolation • Satellite data	• 2016 emissions modeling platform (EMP)[5]
Technical Information	• Design values for the 7 most recent three-year periods[1] • 2014-2016 to 2020-2022 • All monitors in the Colorado Front Range area	• 2022 Design Values[2] • 2019-2021 Surface $PM_{2.5}$ estimates for North America[3] • Colorado EnviroScreen Scores[4] • Showing DICs with EnviroScreen scores > 70th percentile	• MOtor Vehicle Emission Simulator (MOVES3)[6] • 2017 National Emissions Inventory (NEI) nonpoint inventory[7] • 2019 NEI point source inventory[8] • Western Regional Air Partnership oil and gas inventory[9]

[1]USEPA, Air Quality Design Values. Available at https://www.epa.gov/air-trends/air-quality-design-values. Accessed 7/19/2024.
[2]Id.
[3]Washington University, Atmospheric Composition Analysis Group, Satellite-derived PM2.5. Available at https://sites.wustl.edu/acag/datasets/surface-pm2-5/. Accessed 7/19/2024.
[4]Colorado Enviroscreen Tool. Available at teeo-cdphe.shinyapps.io/COEnviroScreen_English/. Accessed 7/23/2024.
[5]USEPA, 2014-2016 Version 7 Air Emissions Modeling Platforms. Available at https://www.epa.gov/air-emissions-modeling/2014-2016-version-7-air-emissions-modeling-platforms. Accessed 7/19/2024.
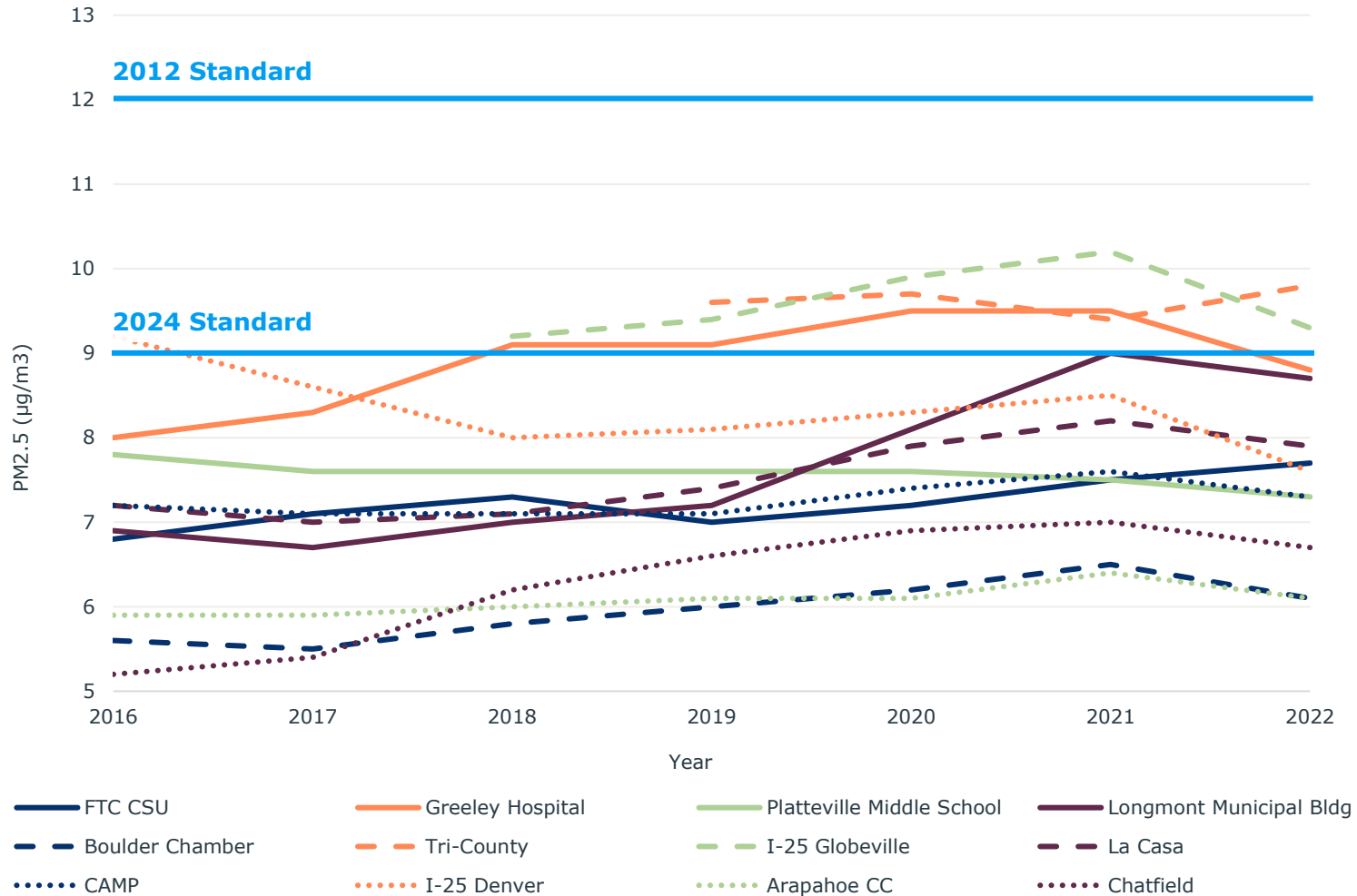[6]USEPA, MOVES Versions in Limited Current Use. Available at https://www.epa.gov/moves/moves-versions-limited-current-use. Accessed 7/19/2024.
[7]USEPA, National Emissions Inventory. Available at https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. Accessed 7/19/2024.
[8]Id.
[9]Western Regional Air Partnership, Regional Emissions Data and Analyses. Available at https://www.westar.org/emissions/. Accessed 7/19/2024.

Annual PM$_{2.5}$ Design Value Trends

Results: Temporal Analysis of Design Value Trends

2012 Standard

2024 Standard

PM2.5 (µg/m3)

Year

- FTC CSU
- Greeley Hospital
- Platteville Middle School
- Longmont Municipal Bldg
- Boulder Chamber
- Tri-County
- I-25 Globeville
- La Casa
- CAMP
- I-25 Denver
- Arapahoe CC
- Chatfield

- Short downward trend from 2021 to 2022

- DVs have increased over the past 5 years

- Tri-County and I-25 Globeville exceeded the new standard for 2022 DV, other sites near threshold

Conclusion

- Potential long term compliance issue for the region

[1]USEPA, Final Rule to Strengthen the National Air Quality Health Standard for Particulate Matter, Fact Sheet. Available at https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-overview.pdf. Accessed 7/19/2024.

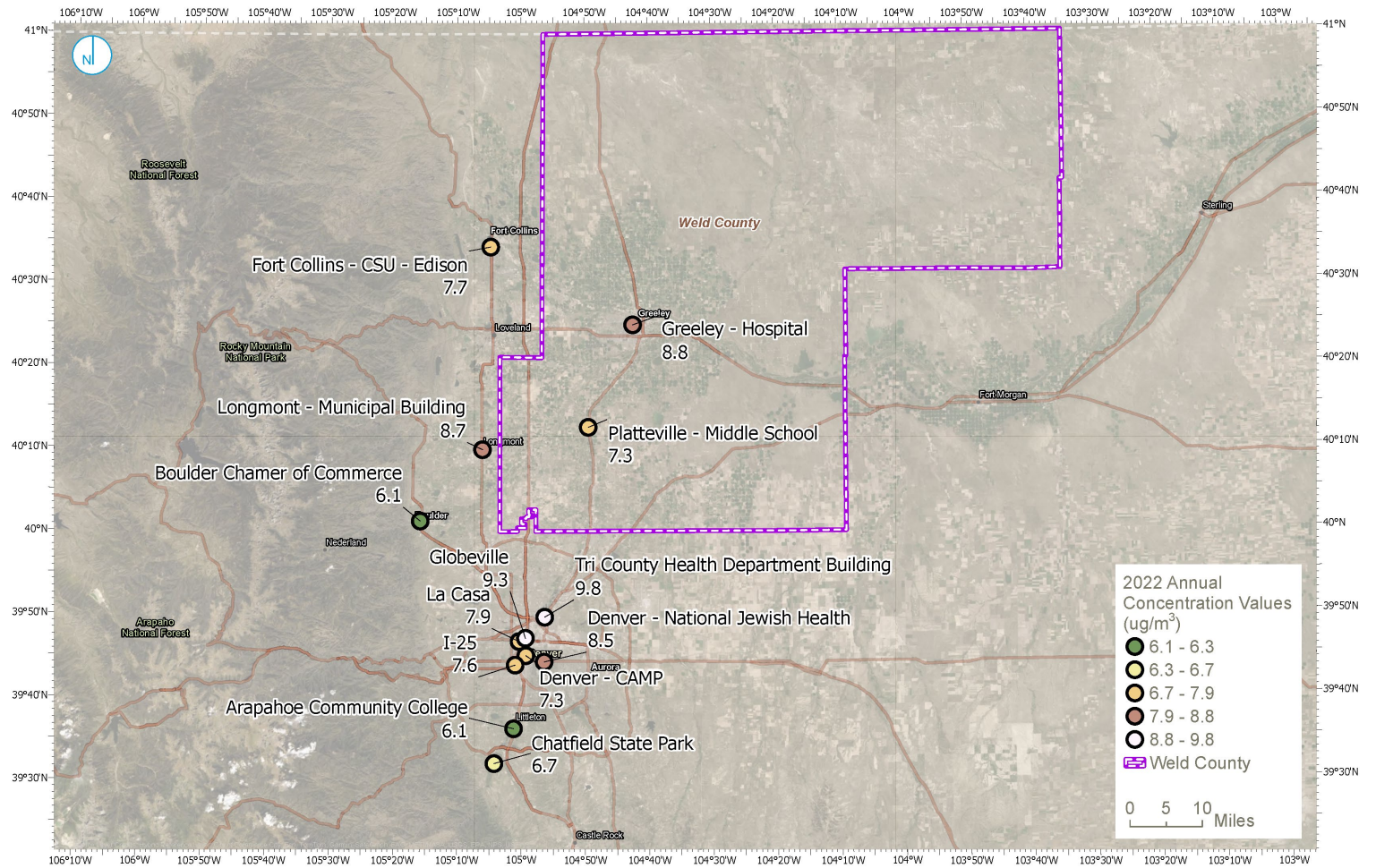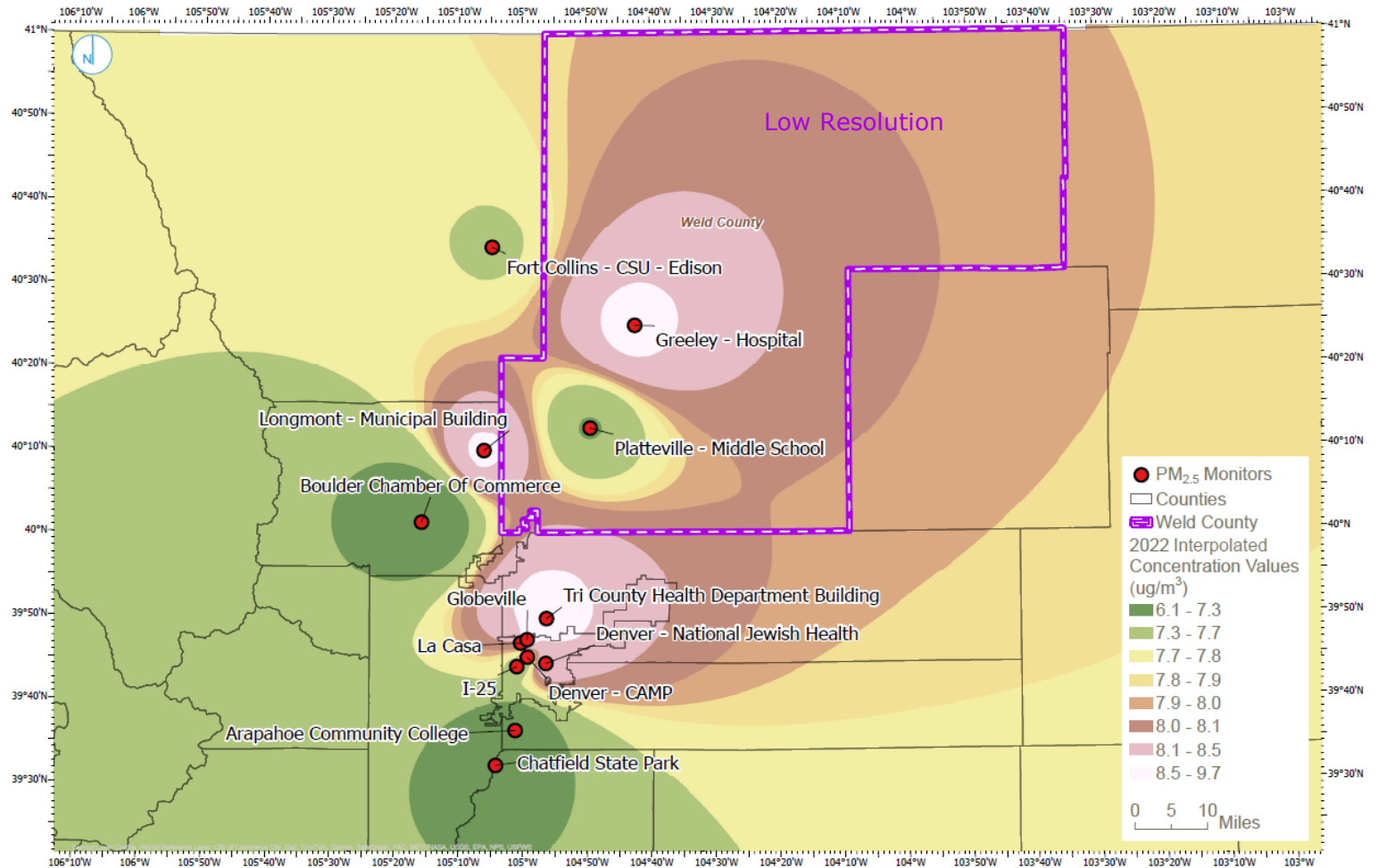# 2022 Results: Spatial Analysis Using Inverse Distance Weighted (IDW) Interpolation

Highest Concentrations

- Denver Metropolitan Area (DMA)

Lower Concentrations

- Denver suburbs, especially to the south & northern Colorado

Fort Collins - CSU - Edison
7.7

Greeley - Hospital
8.8

Longmont - Municipal Building
8.7

Platteville - Middle School
7.3

Boulder Chamer of Commerce
6.1

Globeville
9.3

Tri County Health Department Building
9.8

La Casa
7.9

Denver - National Jewish Health
8.5

I-25
7.6

Denver - CAMP
7.3

Arapahoe Community College
6.1

Chatfield State Park
6.7

2022 Annual Concentration Values (ug/m³)

- 6.1 - 6.3
- 6.3 - 6.7
- 6.7 - 7.9
- 7.9 - 8.8
- 8.8 - 9.8
- Weld County

0   5   10 Miles

2022 Results: Spatial Analysis Using Inverse Distance Weighted (IDW) Interpolation

↑

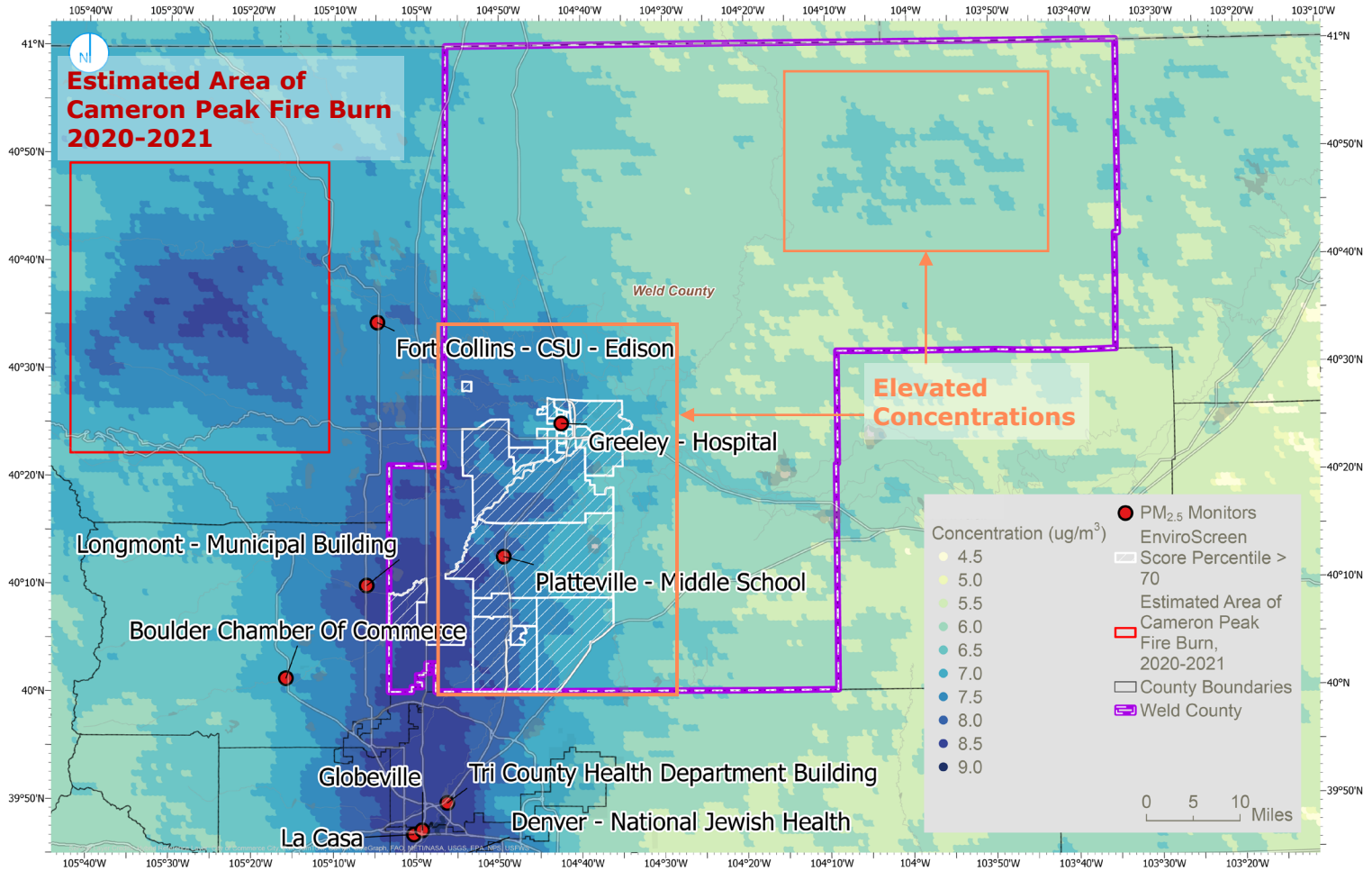## Highest Concentrations

- Denver Metropolitan Area (DMA)

↓

Lower Concentrations

- Denver suburbs, especially to the south & northern Colorado

EnviroScreen Score Percentiles >70 are only shown for Weld County

Results: Spatial Analysis Using Satellite Derived Concentrations

↑

Highest Concentrations

- Denver Metropolitan Area (DMA)
- Southwestern Weld County

↓

Lower Concentrations

- Northern Colorado
- Eastern Weld County

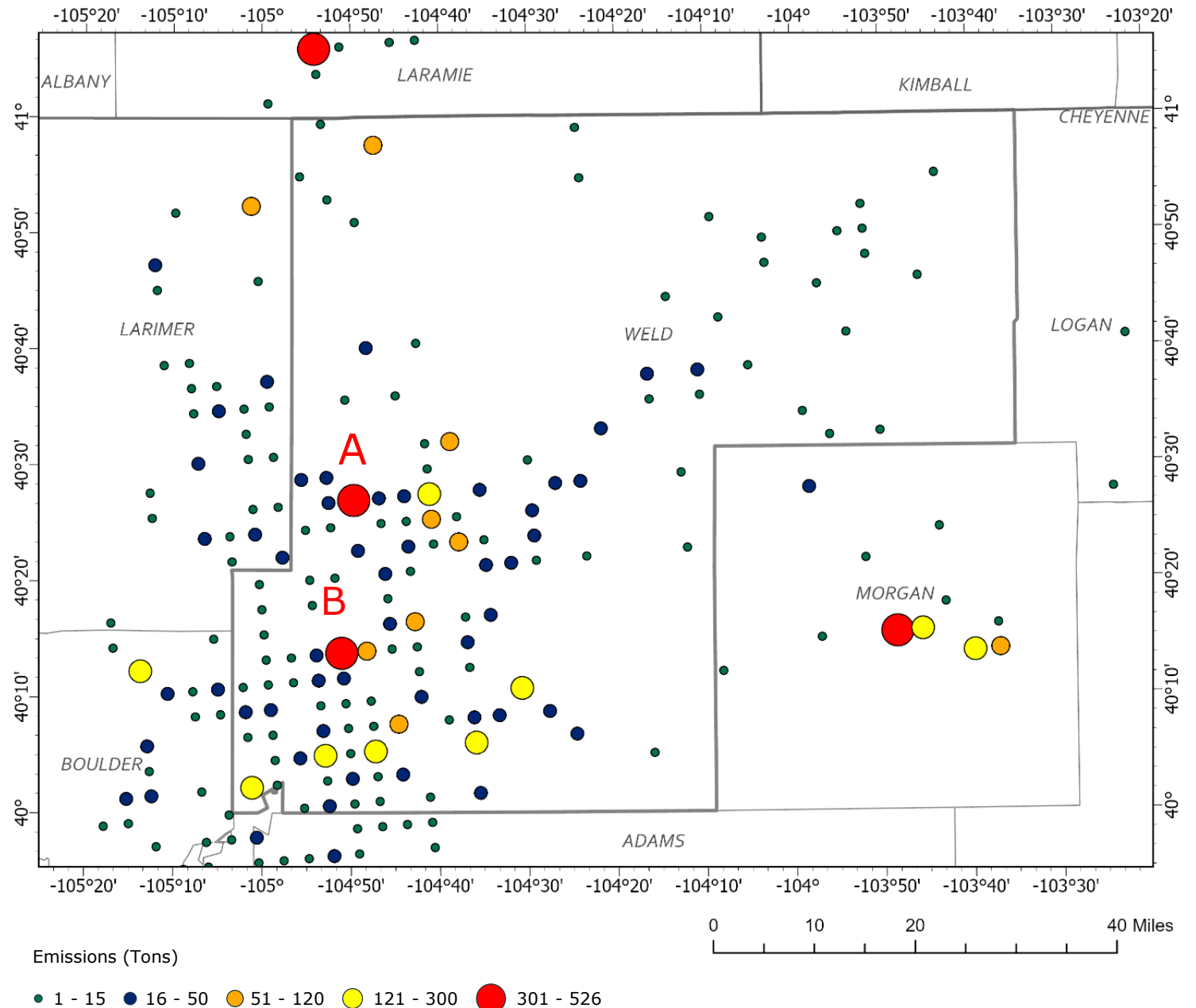# Results: Emission Modeling Analysis for Point Sources

Large point sources

Point Source A

• Industrial other than O&G or EGU's

Point Source B

• EGU's – Likely St. Vrain Power Station

Emissions (Tons)

● 1 - 15 ● 16 - 50 ● 51 - 120 ● 121 - 300 ● 301 - 526
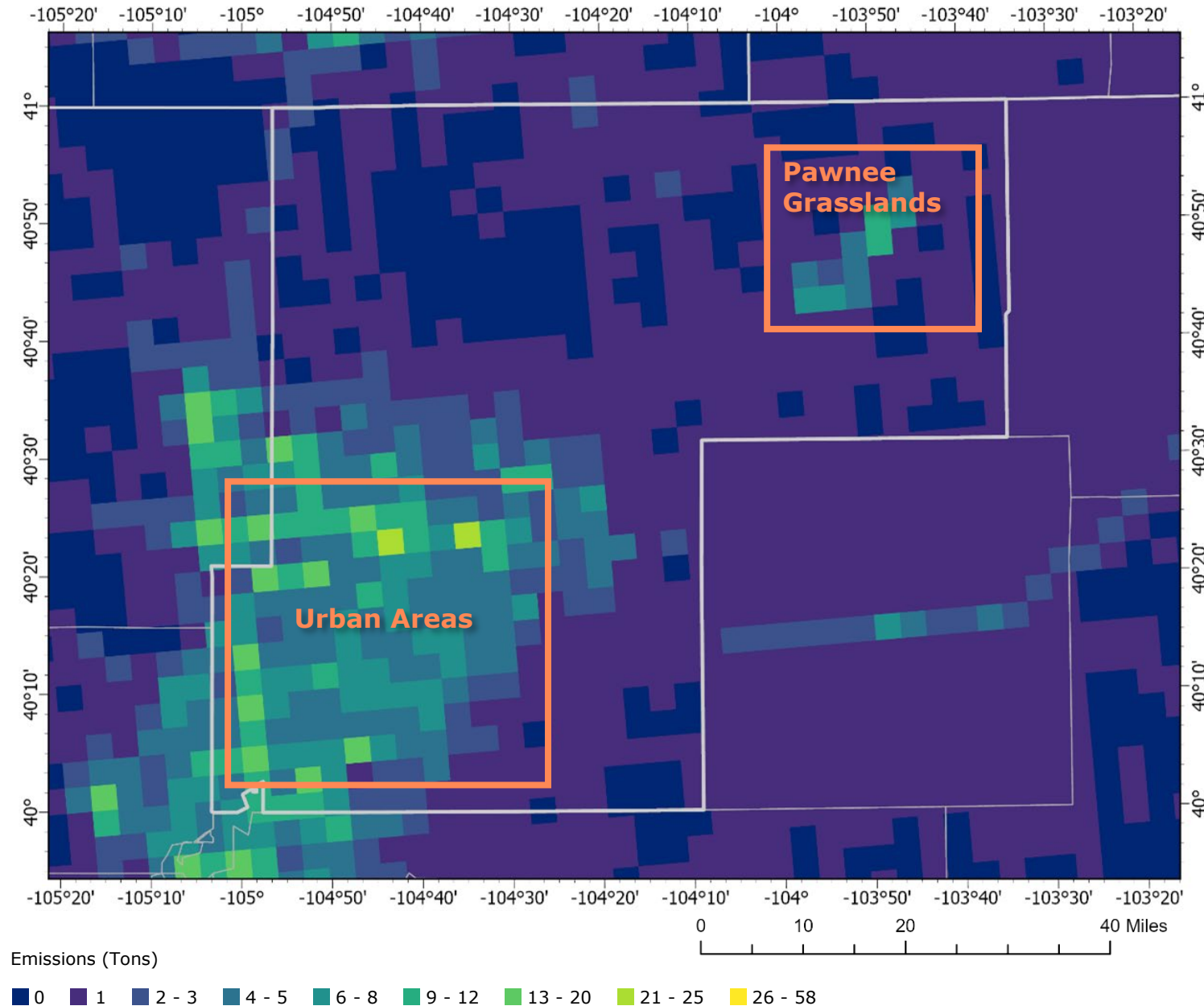
Results: Emission Modeling Analysis for Area Sources

Important sources

- Agriculture (Ag)
- Mobile on-road (on-road)
- Oil and Gas (np_og)

Large area sources

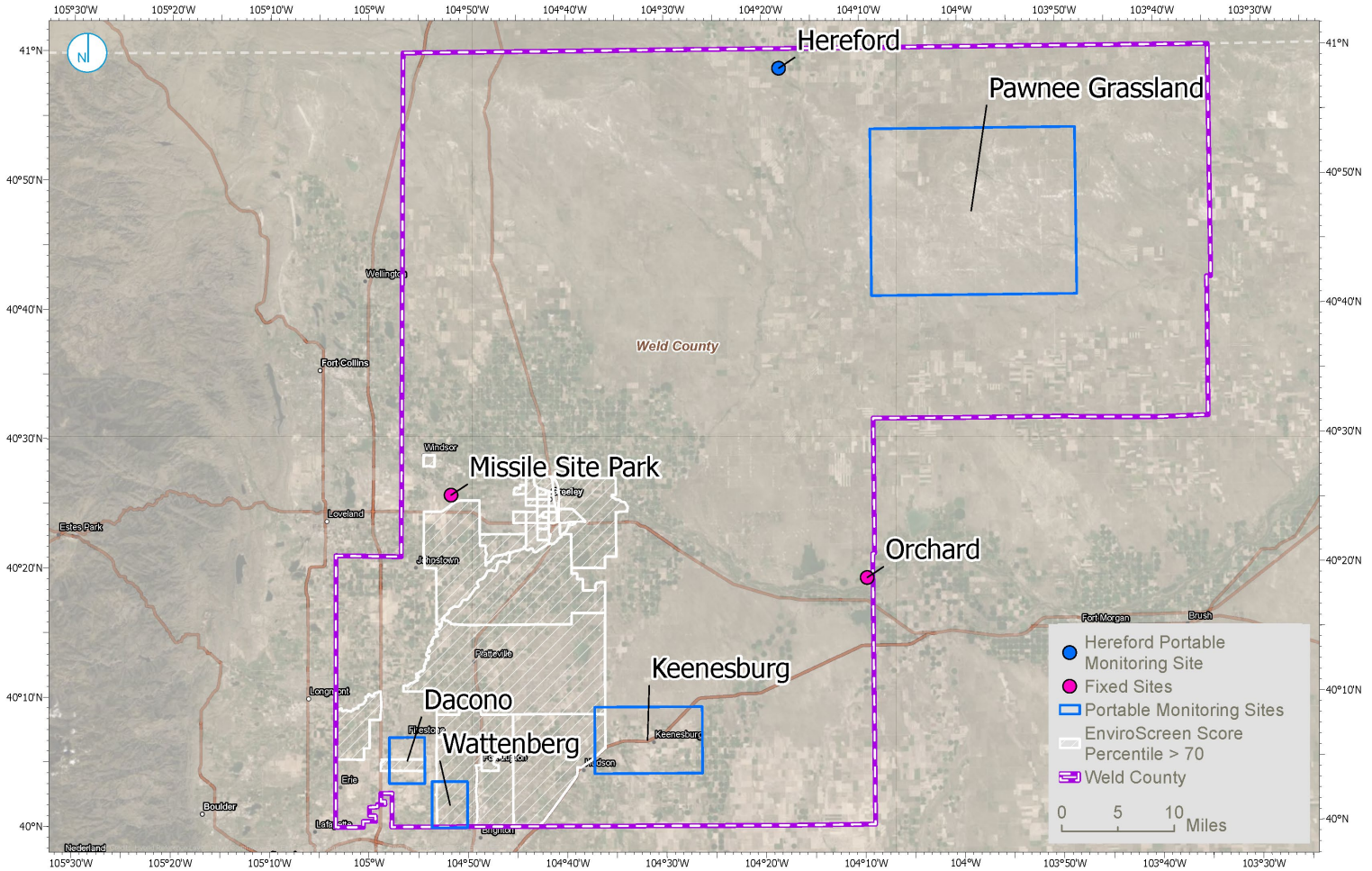- Southwestern Weld – Urban areas
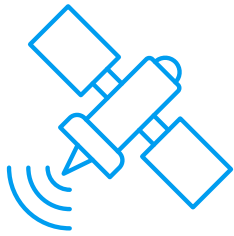- Northeast Weld – Pawnee Grasslands

Emissions (Tons)

0	1	2 - 3	4 - 5	6 - 8	9 - 12	13 - 20	21 - 25	26 - 58

EnviroScreen Score Percentiles >70 are only shown for Weld County

Findings & Recommendations

Portable Monitoring Prioritization

1. Hereford
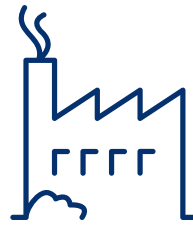2. Dacono
3. Pawnee Grassland
4. Wattenberg
5. Keenesburg

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Future Improvements to Consider

New satellite data (2022) is now available through Washington University[1]

New emissions modelling platforms exist through the EPA (2020-2022)[2]

New national emissions inventory data has been published (2020)[3]

[1]Washington University, Atmospheric Composition Analysis Group, Satellite-derived PM2.5. Available at https://sites.wustl.edu/acag/datasets/surface-pm2-5/. Accessed 7/19/2024.
[2]USEPA, 2020-2022 Air Emissions Modeling Platforms. Available at https://www.epa.gov/air-emissions-modeling/2020-2022-air-emissions-modeling-platforms. Accessed 7/19/2024.
[3]USEPA, 2020 National Emissions Inventory (NEI) Data. Available at https://www.epa.gov/air-emissions-inventories/2020-national-emissions-inventory-nei-data. Accessed 7/19/2024.

Thank you

This study was supported by funding from the Board of County Commissioners of Weld County (BOCC).

Kaitlyn Elkind

Managing Consultant
+1 602-734-7709
kelkind@ramboll.com

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