

# OZONE ANALYSIS AND PLANNING EFFORTS ON THE FRONT RANGE OF COLORADO



**NOVEMBER 6, 2025**  
**WESTAR/WRAP**

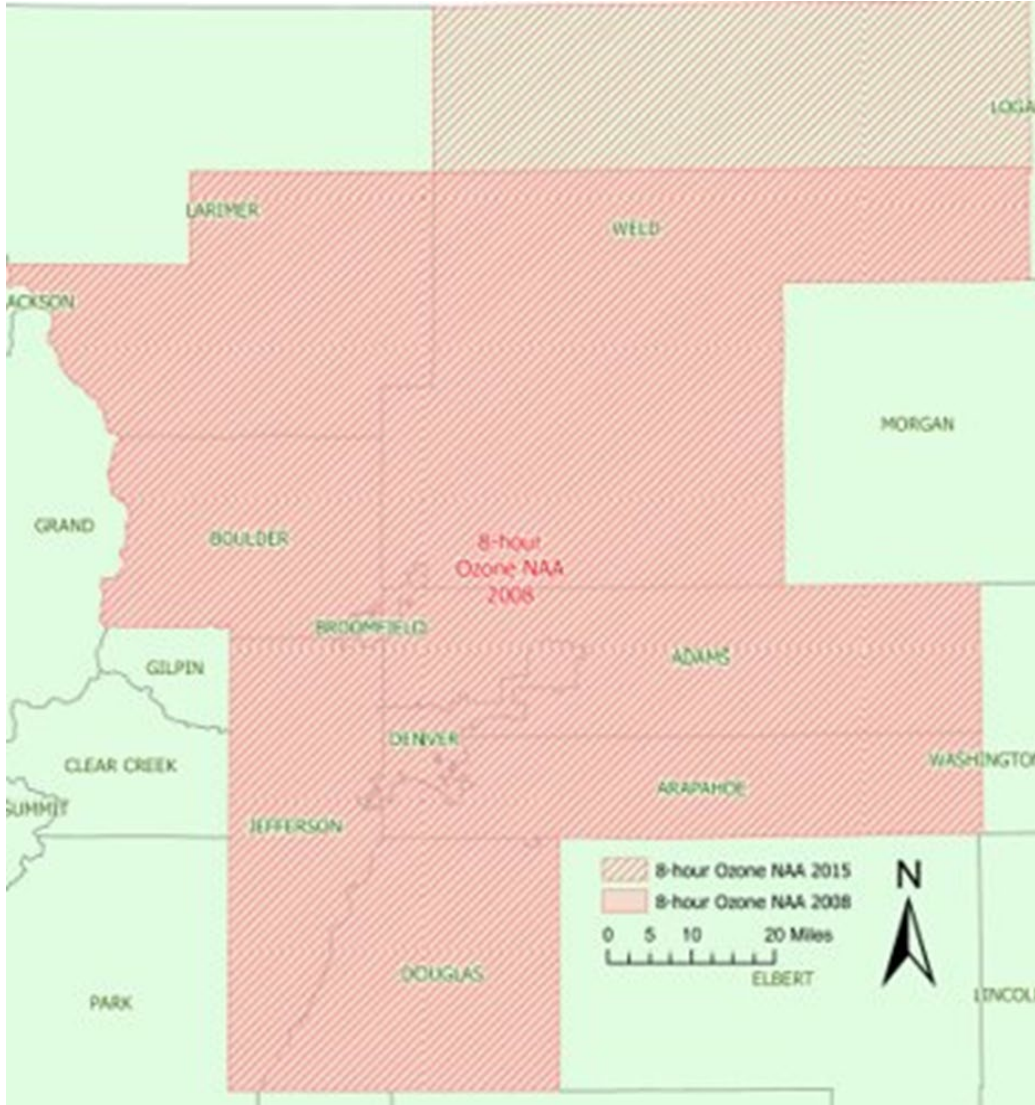
**RAQC is the lead planning agency for the Denver Metro/North Front Range Ozone Nonattainment Area.**

- Governor appoints 30-member Board.

**Brings together ideas for analysis and strategies to include in specific programs, regulations, and plans to address the regional ozone nonattainment problem.**

**Requires defining the problem(s) to address and analyzing solutions.**

**Develops solutions to improve regional air quality for the greater Denver Metro and North Front Range region everyday.**



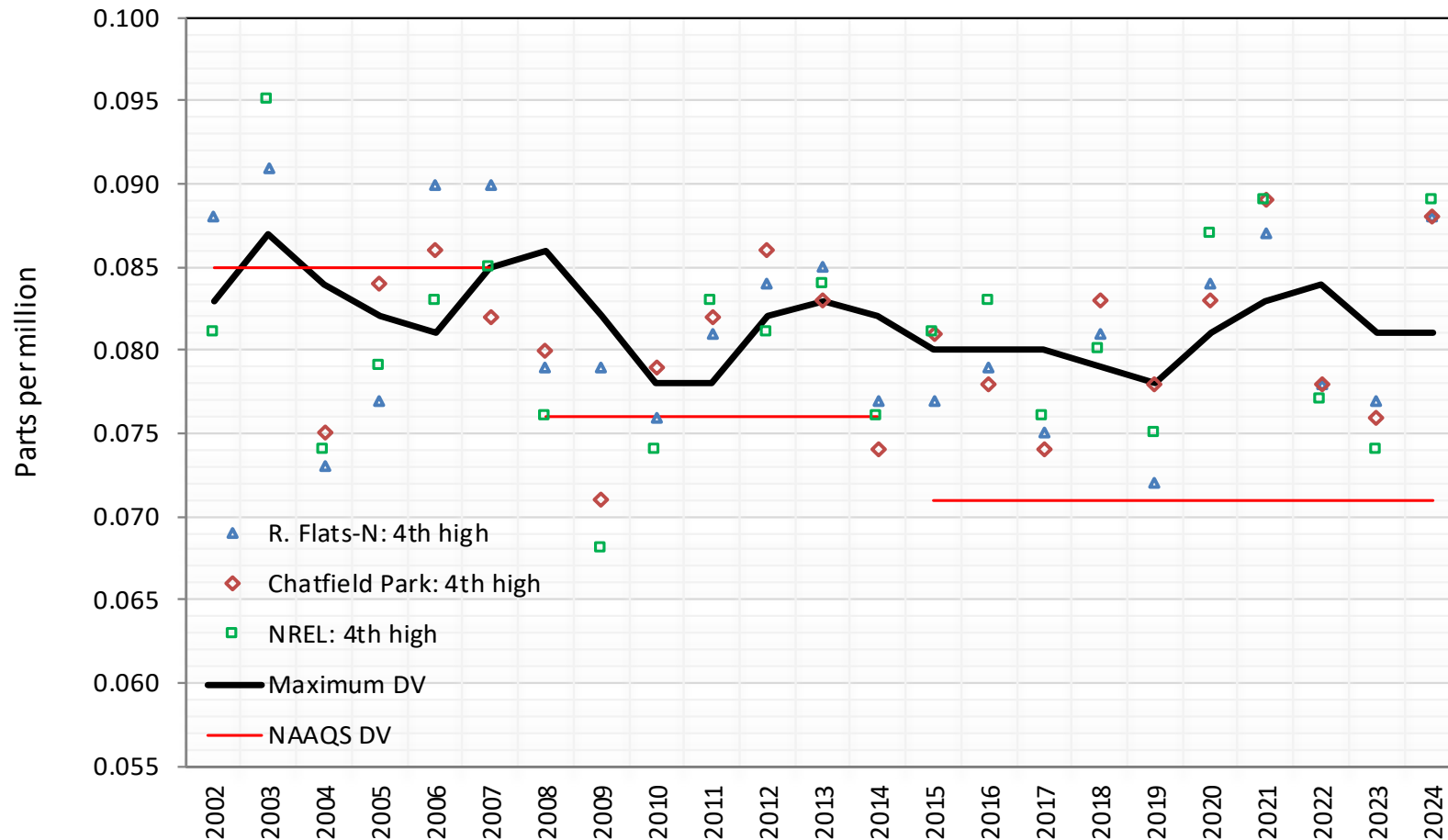
# Attainment Deadlines for Denver Metro / North Front Range 2008 and 2015 Ozone NAAQS Nonattainment Areas

Initial Designation/Classification		2008 NAAQS	2015 NAAQS
		July 2012	August 2018
Classification	# Years to Attain	Attainment Date	Attainment Date
Marginal	3	2015	2021
Moderate	6	2018	2024
Serious	9	2021	August 2027
Severe-15	15	July 2027	2033
Severe-17	17	2029	2035
Extreme	20	2032	2038

- Nonattainment classification was based on % monitoring data is above standard at the time of initial designation.
- Areas are reclassified (i.e., “bumped-up”) to the next highest classification within 6-months of failing to attain by the attainment date.
- **Compliance monitoring period for both NAAQS is the 2024-26 ozone seasons.**

[Basics of SIP Requirements | US EPA www.epa.gov/green-book/ozone-designation-and-classification-information](https://www.epa.gov/green-book/ozone-designation-and-classification-information)

Ground level ozone is a major concern in the Denver Metro North Front Range area, from Douglas County on the south to the Wyoming border, including Larimer and Weld Counties - *little to no trend in reducing ozone*



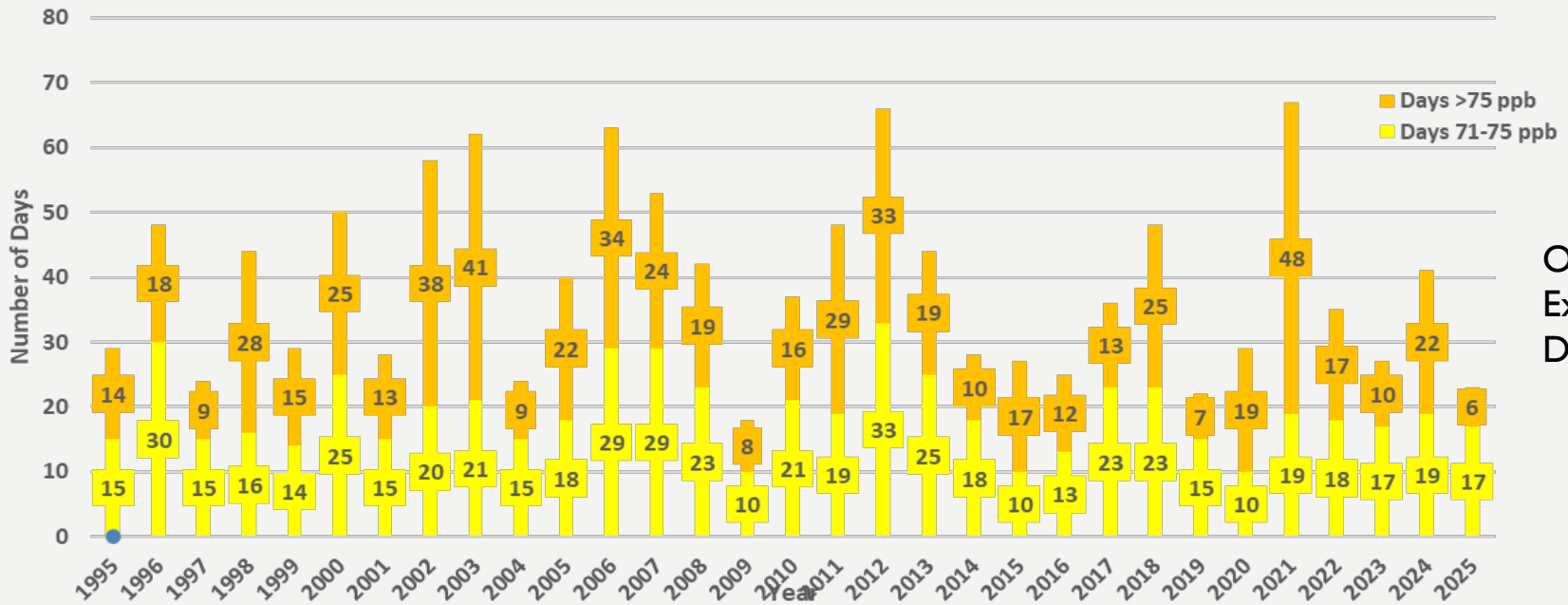
Long-term trends in rolling 3-year 4<sup>th</sup> high MDA8 ozone maximum average DVs (ppm) used for EPA compliance in the DM/NFR NAA (black line), annual maximum 4<sup>th</sup> highest ozone values (colored symbols) at the historically highest ozone monitoring sites (Rocky Flats North [RFNO], Chatfield Reservoir [CHAT], and National Renewable Energy Lab [NREL]) in the NAA from 2002 through 2024, compared with 1997, 2008 and 2015 ozone NAAQS (red lines).



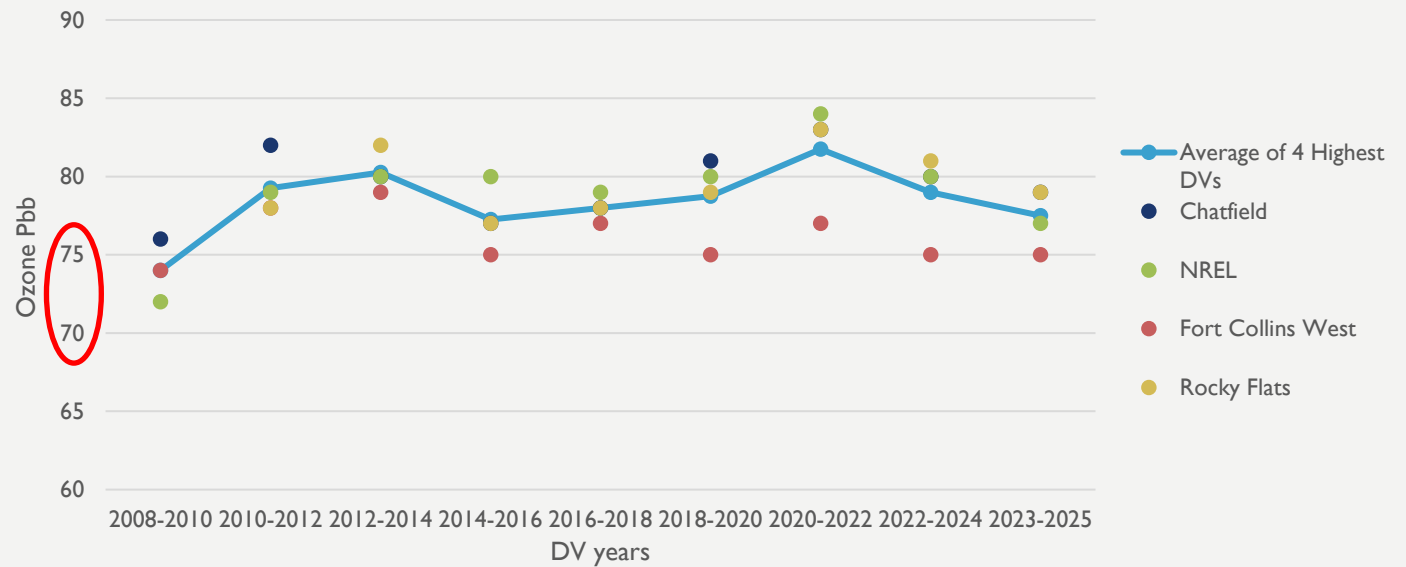
## 2024 Ozone Season



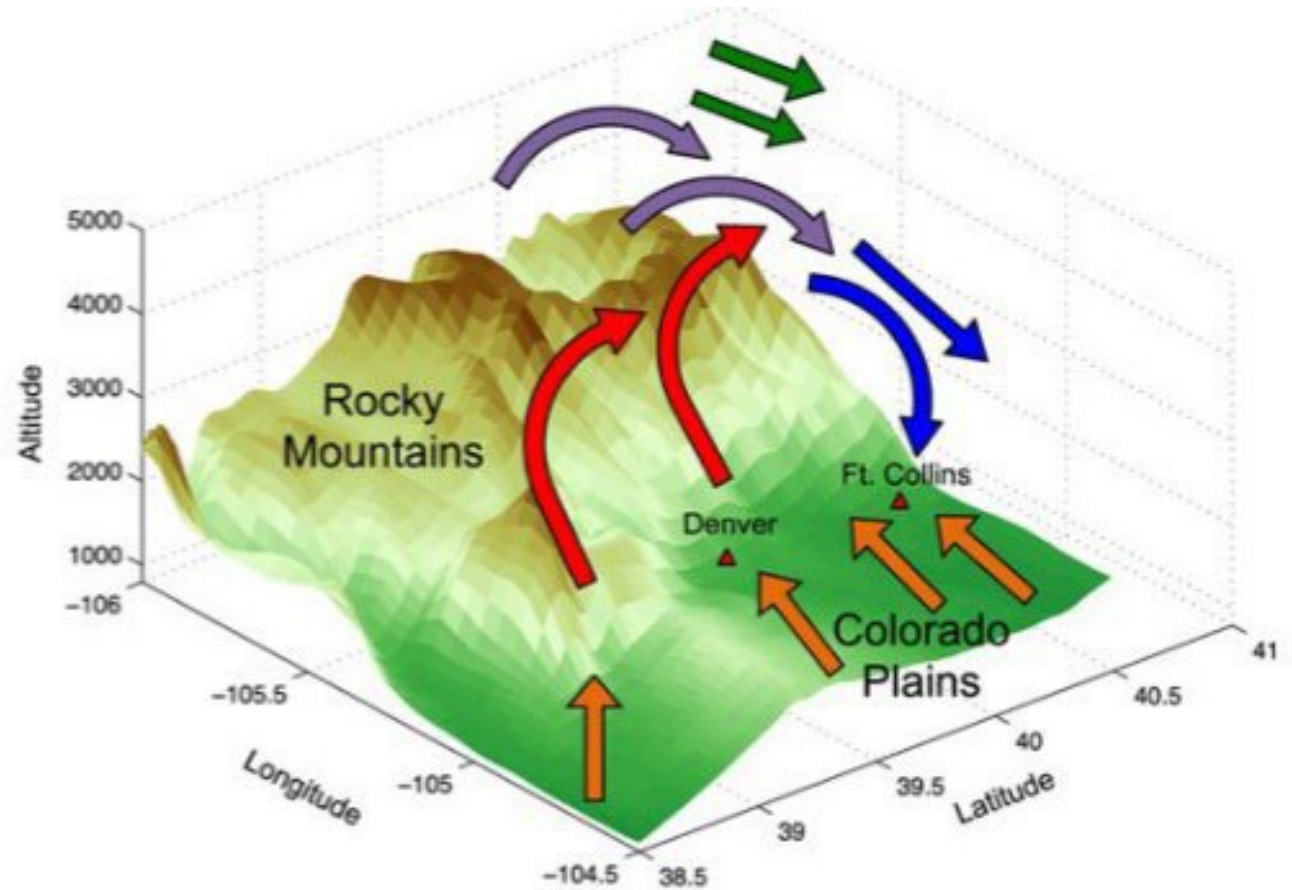
# OZONE NAAQS ATTAINMENT STATUS – MONITORING DATA



Rolling 3-year Design Value trend at 4 highest sites in the nonattainment area

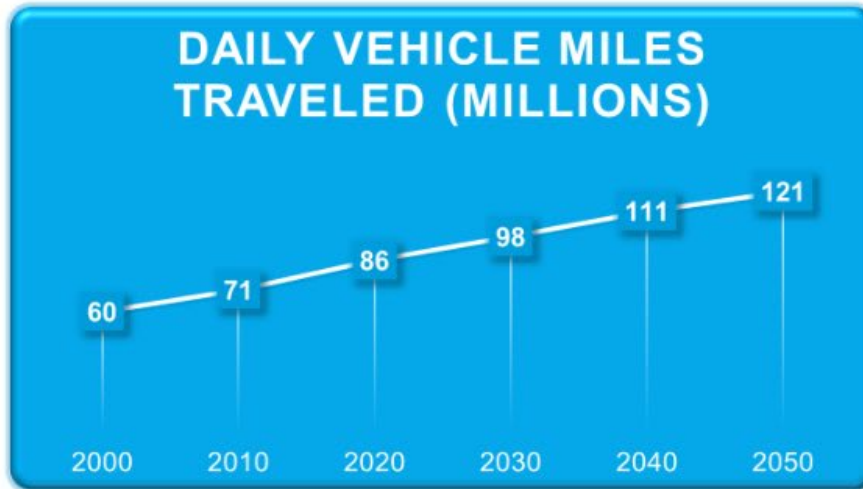
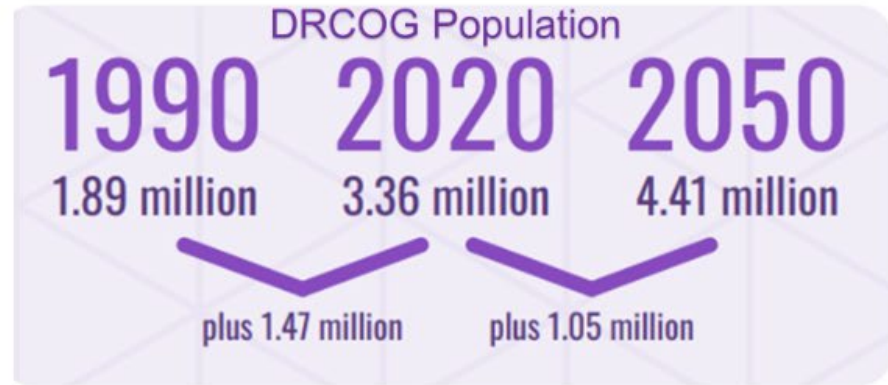


*Our complex meteorology is natural and conducive to the buildup of pollutants.*



Source: Sullivan et al., (2016)

# Population Change in 7-county urbanized Denver Metro area



# Ozone NAAQS Current Attainment Status from Monitoring Data

Future 4th highest max readings allowable to monitor 75 pbb NAAQS attainment compliance in the 2024-26 timeframe			
Monitor	2024 4th Max	2025 4th Max	2026 allowable
Aurora East	81	70	76
Blackhawk	79	66	82
Boulder Reservoir	84	69	74
CAMP	79	70	78
La Casa	84	71	72
Chatfield	88	73	66
Evergreen	85	73	69
Fossil Crk	84	68	75
Fort Collins - CSU	82	68	77
Fort Collins West	83	72	72
Greeley Weld County	81	71	75
Highlands	73	62	92
NREL	86	71	70
Mehaf Park*	NA	70	87
LaSalle Twr	79	69	79
Rocky Flats North	88	72	67
Timnath	78	73	76
Welby	83	69	75

**Forecast of monitored 4<sup>th</sup> high 2026 values at each site needed to average at or below the standard to achieve NAAQS compliance for 2024-26**

**75 ppb standard (left)**

**70 ppb standard (right)**

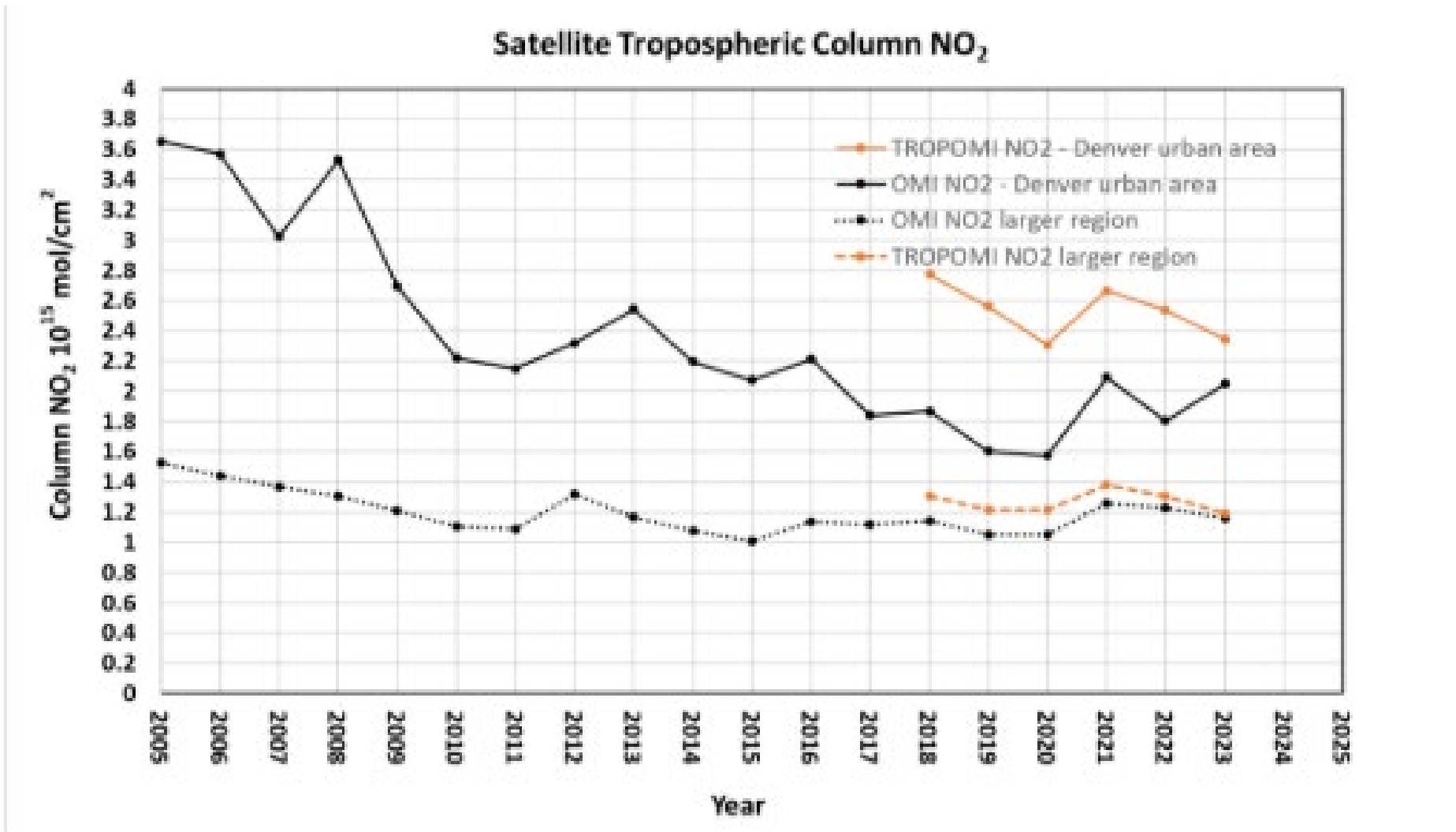
Future 4th highest max readings allowable to monitor 70 pbb NAAQS attainment compliance in the 2024-26 timeframe			
Monitor	2024 4th Max	2025 4th Max	2026 allowable
Aurora East	81	70	62
Blackhawk	79	66	68
Boulder Reservoir	84	69	60
CAMP	79	70	64
La Casa	84	71	58
Chatfield	88	73	52
Evergreen	85	73	55
Fossil Crk	84	68	61
Fort Collins - CSU	82	68	63
Fort Collins West	83	72	58
Greeley Weld County	81	71	61
Highlands	73	62	78
NREL	86	71	56
Mehaf Park*	NA	70	73
LaSalle Twr	79	69	65
Rocky Flats North	88	72	53
Timnath	78	73	62
Welby	83	69	61



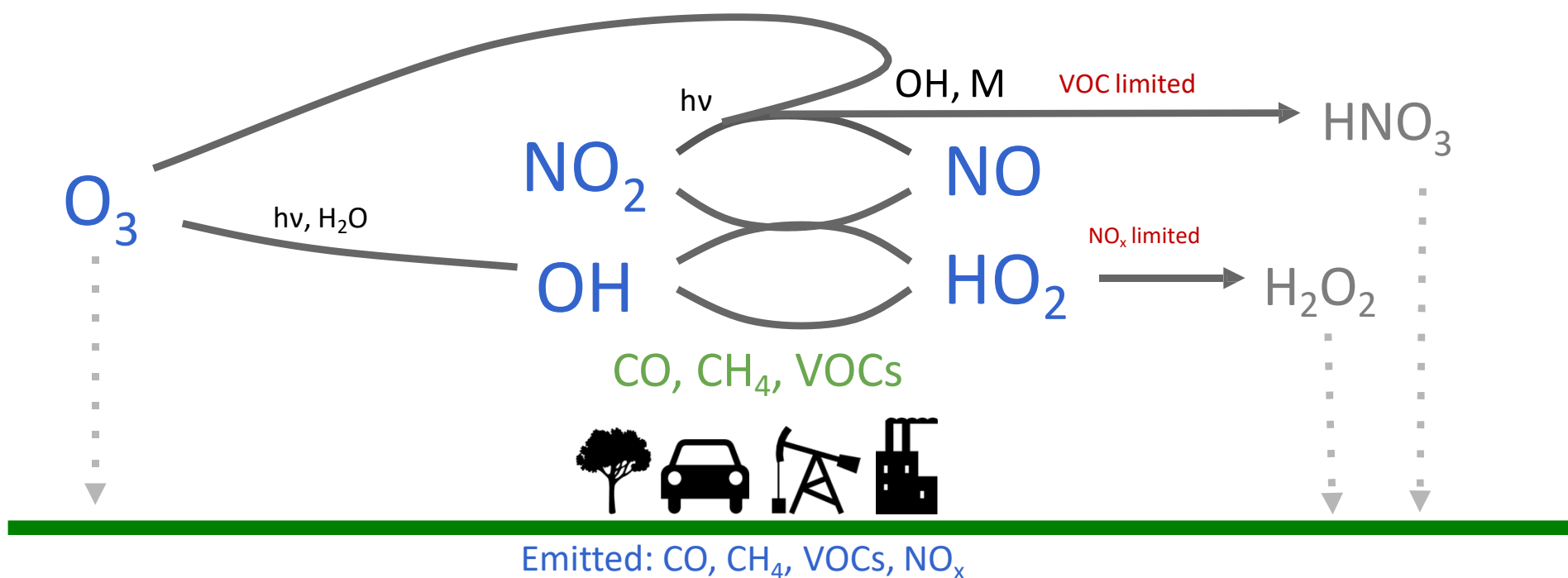
**NEEDED RESEARCH:**

**Front Range Ozone  
Experiment (FROZÉ)**

# Maybe recent NOx emissions aren't on the decline as our inventories suggest...

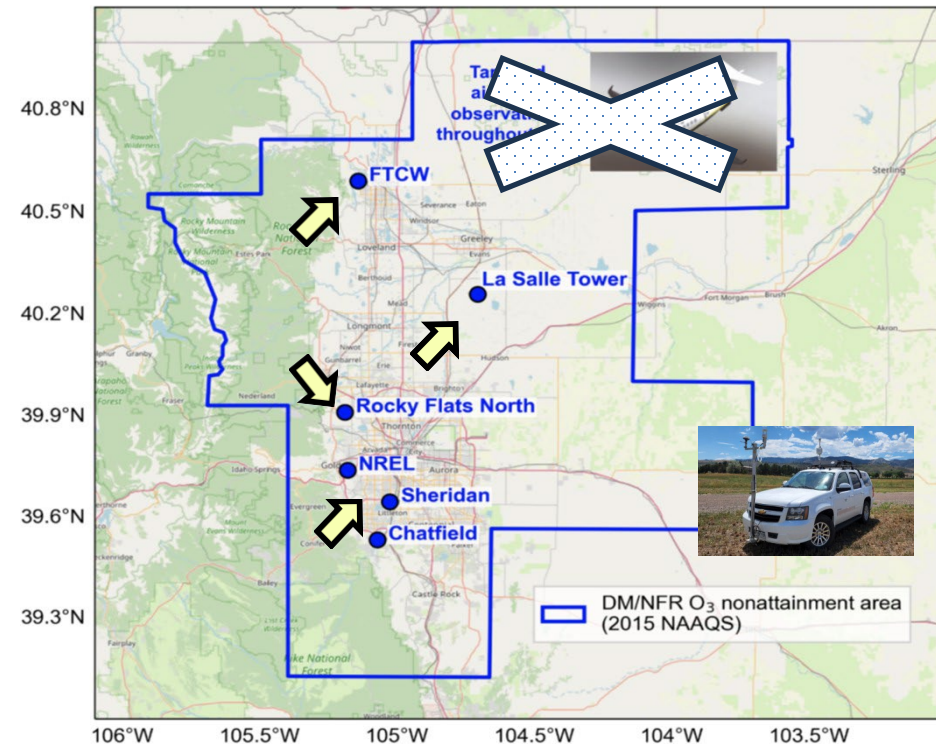


To understand  $O_3$ , we need to observe its precursors.



# Front Range OZone Experiment (FROZÉ)

- RAQC – CSU - APCD
- June-August 2025 field study complete
- Data analysis and publications 2026-27
- Colorado Air Quality Enterprise funding
- Field measurements
  - Core ground monitoring sites ( $O_3$ , VOCs,  $NO_x/NO_y$ ) - Fort Collins West (FTCW) to south Denver
  - CSU and UoMT Mobile monitoring ( $O_3$ ,  $NO_x$ ,  $CH_4$ , VOCs/air toxics)
  - TEMPO Satellite  $NO_2$  and HCHO with special operational periods

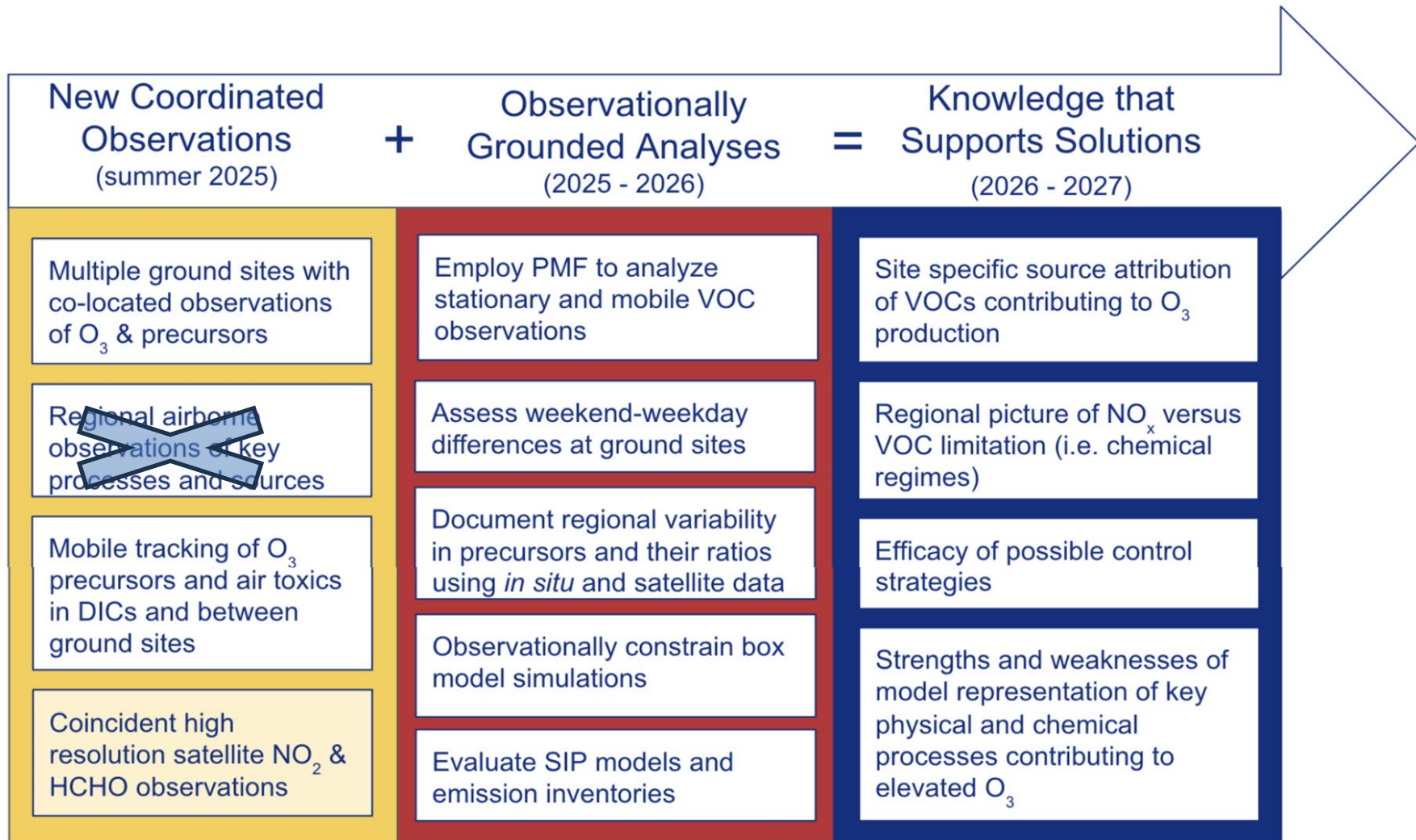


New  $NO_x/NO_y$  measurements to be maintained long-term by APCD at FTCW, NREL, and Chatfield post-campaign



**COLORADO STATE UNIVERSITY**

# FROZÉ Study Overview





**WILL WE BE ABLE TO  
SHOW ATTAINMENT  
IN SIP MODELING ?**

# Flashback:

No sites modeled an exceedance of 75 ppb by 2026 (2023 Severe O<sub>3</sub> Plan)  
5-year Baseline DVs were from 2014-18

Natl. Renewable Energy Lab,  
Chatfield State Park, Fort Collins  
West, and Rocky Flats North are  
historically the 4 highest ozone  
sites in the nonattainment area

Anthropogenic 2016 and 2026 NO<sub>x</sub> and VOC  
emissions in the 9-county nonattainment area

Tons per Day Source Sector	NO <sub>x</sub>		VOC	
	2016	2026	2016	2026
EGU Point	21.3	8.4	0.5	0.5
Non-EGU Point	20.9	17.2	26.4	29.3
O&G Point	13.6	17.0	11.0	15.2
O&G Area	45.3	58.7	180.1	85.5
Non-Point	12.9	13.0	83.3	93.2
Non-Road	27.8	18.6	36.6	37.5
On-Road	70.7	22.2	42.4	22.3
Airports	6.3	9.0	2.5	2.6
Rail	5.8	4.5	0.3	0.2
<b>Total Anthro</b>	<b>224.5</b>	<b>168.7</b>	<b>383.0</b>	<b>286.4</b>
<b>Percent Reduction</b>		<b>-24.8%</b>		<b>-25.2%</b>

Ozone design values in purple exceed 75 ppb 2008 NAAQS

Blue highlighted 2026 projections exceed 70 ppb NAAQS

Site	County	5-year Baseline Monitored Average Design Values	Modeled RRFs	2026 Projection of Monitored Design Values
NREL	Jefferson	79.3	0.9415	74.6
CHAT	Douglas	77.3	0.9256	71.5
FTCW	Larimer	75.7	0.9451	71.5
RFNO	Jefferson	77.3	0.9206	71.1
HIGH	Arapahoe	73.0	0.9268	67.6
WELC	Jefferson	73.0	0.9249	67.5
WELD	Weld	70.0	0.9534	66.7
FTCO	Larimer	69.0	0.9506	65.5
CASA	Denver	68.7	0.9516	65.3
RMNP	Larimer	69.3	0.9404	65.1
CAMP	Denver	67.7	0.9528	64.5
ASNP	Jefferson	70.0	0.9207	64.4
AURE	Arapahoe	67.7	0.9476	64.1
WELB	Adams	67.0	0.9457	63.3

# Comparing recent attainment modeling for 2008 75 ppb NAAQS and 2015 70 ppb NAAQS with increasing ozone design values

## 2023 Severe SIP for 2008 Ozone NAAQS

- 2016 Base Year and 2026 Future
- **Modeling used 25% NOx and 25% VOC Reductions from 2016 to 2026**
- 2026 Ozone DVF = RRF x Ozone DVB<sub>2014-2018</sub>
- RRF = Model Ozone<sub>2026</sub> / Model Ozone<sub>2016</sub>
  - Max 2026 O<sub>3</sub> DVF = 74.6 < 76.0 → Attainment

2024 Serious SIP			2014-2018	2026	Difference
75 ppb 2008 ozone NAAQS			Ozone DVB	Ozone DVB	DVB - DVB
AIRS ID	Station	County	(ppb)	(ppb)	(ppb)
80350004	CHAT	Douglas	77.3	71.5	-5.8
80590006	RFNO	Jefferson	77.3	71.1	-6.2
80590011	NREL	Jefferson	79.3	74.6	-4.7
80690011	FTCW	Larimer	75.7	71.5	-4.2
80310002	CAMP	Denver	67.7	64.5	-3.2

## 2026 Planning for 2015 Ozone NAAQS

- 2022 Base Year and 2026 Future Year
- **Modeling used 9% NOx and 2% VOC Reductions from 2022 to 2026**
- 2026 Ozone DVF = RRF x Ozone DVB<sub>2020-2024</sub>
  - **DVB<sub>2020-2024</sub> > DVB<sub>2016-2018</sub>**
  - **Screening analysis of each site-day in the ozone DVB<sub>2020-2024</sub> data with influences from stratospheric ozone and/or wildfire smoke was applied to make 2026 ozone projections (previous slide)**

			2014-2018	2020-20224	Difference
AIRS ID	Station	County	DVB	DVB	DVB
80350004	CHAT	Douglas	77.3	81.3	4.0
80590006	RFNO	Jefferson	77.3	81.3	4.0
80590011	NREL	Jefferson	79.3	81.3	2.0
80690011	FTCW	Larimer	75.7	76.0	0.3
80310002	CAMP	Denver	67.7	73.0	5.3



# OZONE NAAQS ATTAINMENT STATUS - 2026 OZONE PROJECTIONS

2020-24 average base ozone Design Value (DVB) and projected 2026 future ozone Design Value (DVF) by site with no screening (Default) and with DVB screened to eliminate days identified as being influenced by stratospheric ozone intrusion or wildfires (STWF)

AQS Number	Site Name	Default DVB		DVB Screened STWF	
		2020-2024 DVB	2026 DVF	2020-2024 DVB	2026 DVF
80013001	Welby	75.7	74.2	73.7	72.3
80050002	Highland Reservoir	76.7	74.9	74.3	72.6
80050006	Aurora - East	73.7	72.4	70.3	69.0
80130014	Boulder Reservoir	75.3	73.7	72.3	70.8
80310002	CAMP	73.0	71.7	70.7	69.4
80310026	La Casa	75.7	74.3	73.0	71.7
80350004	Chatfield State Park	81.3	79.4	79.0	77.2
80410013	U.S. Air Force Academy	71.0	69.5	71.0	69.5
80410016	Manitou Springs	72.7	71.2	72.7	71.2
80450012	Rifle - Health Dept.	60.0	59.2	60.0	59.2
80590006	Rocky Flats - N.	81.3	79.6	78.0	76.4
80590011	NREL	81.3	79.6	78.3	76.6
80590014	Evergreen Rocky Mountain NP	76.0	74.0	75.0	73.1
80690007		71.0	69.9	71.0	69.9
80690011	Fort Collins - West	76.0	74.9	74.3	73.2
80691004	Fort Collins - Mason	71.7	70.7	68.7	67.7
80770020	Palisade Water Treatment	63.7	62.9	63.7	62.9
80830006	Cortez - Health Dept.	62.3	61.3	62.3	61.3
81230009	Greeley - Weld Tower	72.0	70.9	71.0	70.0
81230013	Platteville Observatory	70.7	69.5	70.7	69.5

**11 sites do not attain 70 ppb NAAQS in 2026 with no data screening**

WESTAR/WRAP Ozone Nonattainment in the West Panel  
November 6, 2025

**9 sites do not attain 70 ppb NAAQS in 2026 with data screening**



## Reducing ozone for 70 ppb NAAQS Planning (**from 2016- based 2023 attainment modeling**)

Anthropogenic NAA emissions: **15 to 20 ppb contribution at highest ozone sites**

[2023 Local Source Apportionment Results](#) – April 2021

Highest modeled ozone site in **2023 Severe Plan analysis shows 74.6 ppb by 2026**

3 other sites model >71 ppb ([2026 Attainment Demo DM-NFR 2023 Severe-O3-Plan.pdf](#) - Sept. 2023)

For 70 ppb Ozone planning, must **reduce max of 74.6 by ~4 ppb**

- All sites must model 70.9 ppb or less to demonstrate attainment in 2026
- Modeled 2026 ozone for 70 ppb planning needs to be >6% less than modeled in 2023 Severe Plan

**4 ppb / 20 ppb = 20% reduction needed in modeled 2026 ozone caused by local emissions**

## Reducing ozone for 70 ppb NAAQS Planning (**from 2022- based 2026 attainment modeling**)

Anthropogenic NAA emissions: **~18 ppb average contribution across NAA ozone sites**

[2026 Source Apportionment Results](#) – October 2025

Highest modeled ozone site in current **70 ppb NAAQS analysis shows 77.2 ppb by 2026**

7 other sites model >71 ppb ([2026 Ozone Projections using the 2022v1 Platform](#) - Sept. 2025)

For 70 ppb Ozone planning, must **reduce max of 77.2 by ~6.5 ppb**

- All sites must model 70.9 ppb or less to demonstrate attainment in 2026
- Modeled 2026 ozone for 70 ppb planning needs to be ~9% less than current 2026 modeled estimates

**6.5 ppb / 18 ppb = 36% reduction needed in modeled 2026 ozone caused by local emissions**



***Back of the envelope calculations***



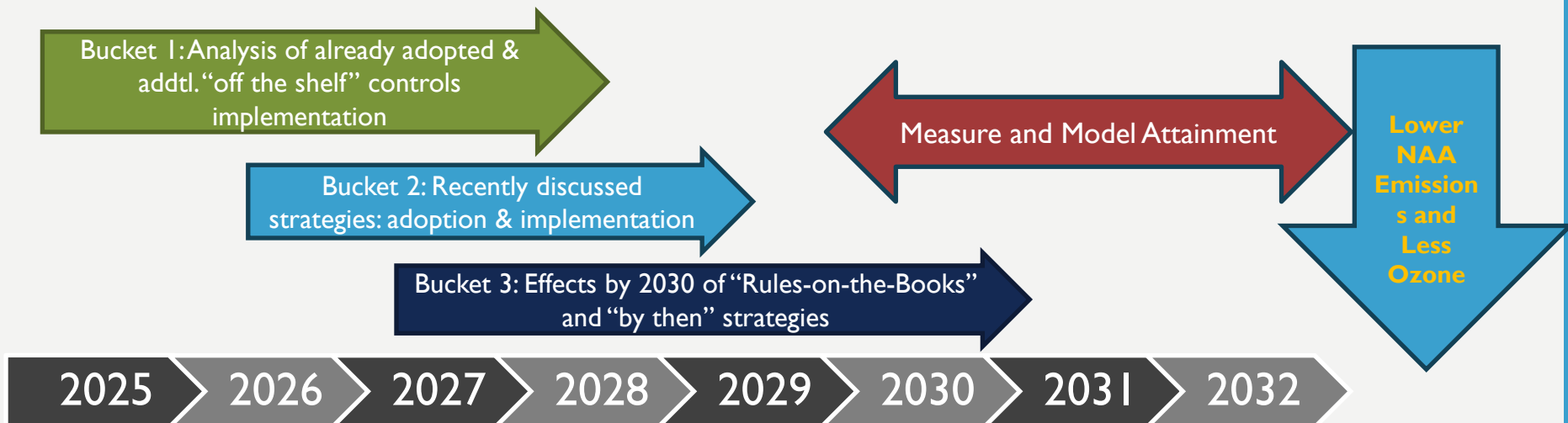
# RAQC CONTROL STRATEGY BLUEPRINT – NEW DIRECTION

## Air Quality Improvement Goal of the Regional Air Quality Council:

***Achieve attainment of the 70 ppb National Ambient Air Quality Standard for ozone in the 2030-32 period, by proposing a viable and sufficient package of emission reduction policies for implementation by 2030.***

# A BLUEPRINT FOR CONTROL STRATEGIES AND ANTHROPOGENIC EMISSION REDUCTIONS: 2025-2029

- A **strategic framework** for the RAQC staff and Board to develop control strategy options and to plan implementation timelines is necessary, aligned with new attainment planning milestones **and** to achieve critical air quality improvement as soon as possible for human health and environmental benefits
- RAQC will develop a set of **control strategy policy recommendations** for Board consideration and AQCC presentation this year that:
  - Recommends a sequence of emission reduction policy actions for implementation during the 2026-2029 timeframe, for the set of potential strategies recently discussed and additional ones to be determined, to result in:
    - **Lower levels of measured peak ozone, to occur less frequently, within the 2029-2032 timeframe, and**
    - **Achieving emission reductions and a plan to achieve the new federal attainment compliance deadline.**





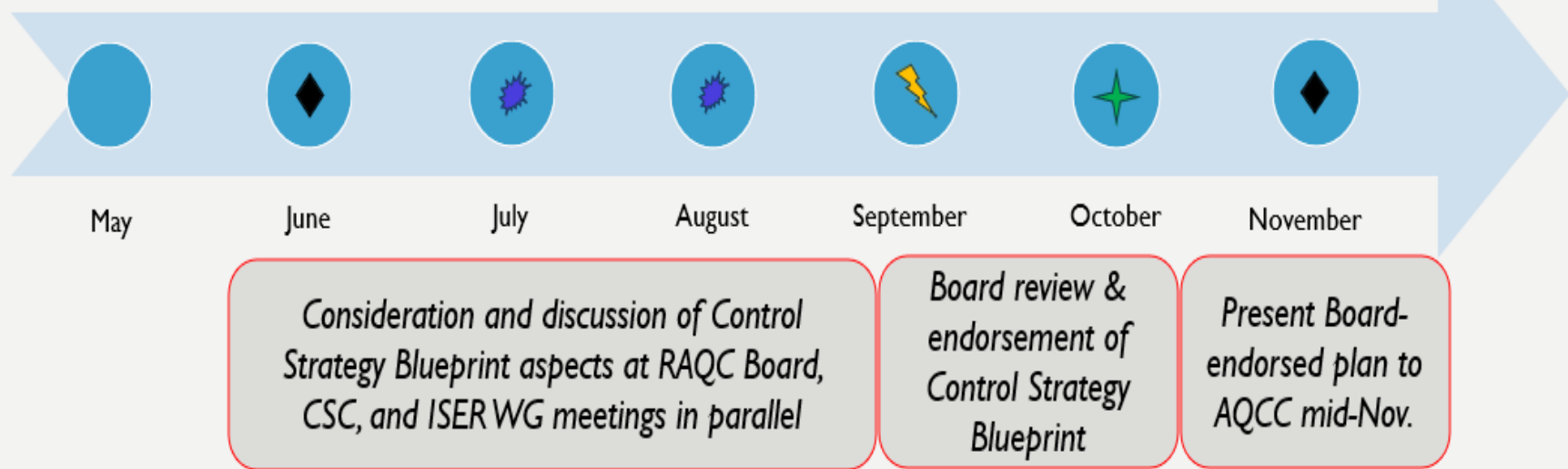
# WHAT'S IN THE FINAL NOVEMBER 7<sup>TH</sup> BLUEPRINT?

- **Background**
  - Efforts Guiding and Supporting Control Strategy Blueprint
  - Acronyms and Terms
  - RAQC's roles and responsibilities
  - Public input on Blueprint
- **Final recommendations**
- **Ozone Air Quality Planning Context for our Region**
  - Trends and Levels of Measured Ozone Air Quality at most polluted sites
  - Emissions causing Ozone
  - Relating Emissions Control Strategies and Monitoring Data toward Attainment
  - Modeling Estimates of Projected Future Regional Ozone
- **Emission Control Strategies**
  - APCD regulatory updates proposed for adoption with the Serious Ozone SIP - Nov. 2025
  - Post-2025 Control Strategy Timing and Consideration in the Blueprint
  - Emission Control Strategies for the Nonattainment Area – brief summaries & overview links
  - Emissions Control Strategy Evaluation
- **Control Strategy Blueprint: Summary for Stakeholder Review**
- **Blueprint Endorsement Consideration Process by the RAQC Board**

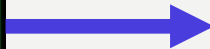


# 2025 CONTROL STRATEGY BLUEPRINT CONSIDERATION TIMELINE

- ◆ Overview at CSC meeting, draft Blueprint and one-page strategy summaries
- 🌟 All-day workshops (July 22<sup>nd</sup> @ DRCOG, August 18<sup>th</sup> @ Fort Collins Senior Center)
- ⚡ CSC and Board review of complete versions of draft Blueprint and summaries
- ✦ Board endorsement
- ◆ AQCC presentation



Just like the



the Blueprint can be a journey to a better place



To change the air quality status quo, we'll need a brain to apply, the wish of the [Scarecrow](#), as well as using our heart and judgement, the wish of the [Tin Man](#); and we will have to have courage and use it, the wish of the [Cowardly Lion](#).

## [RAQC Control Strategy Blueprint](#)