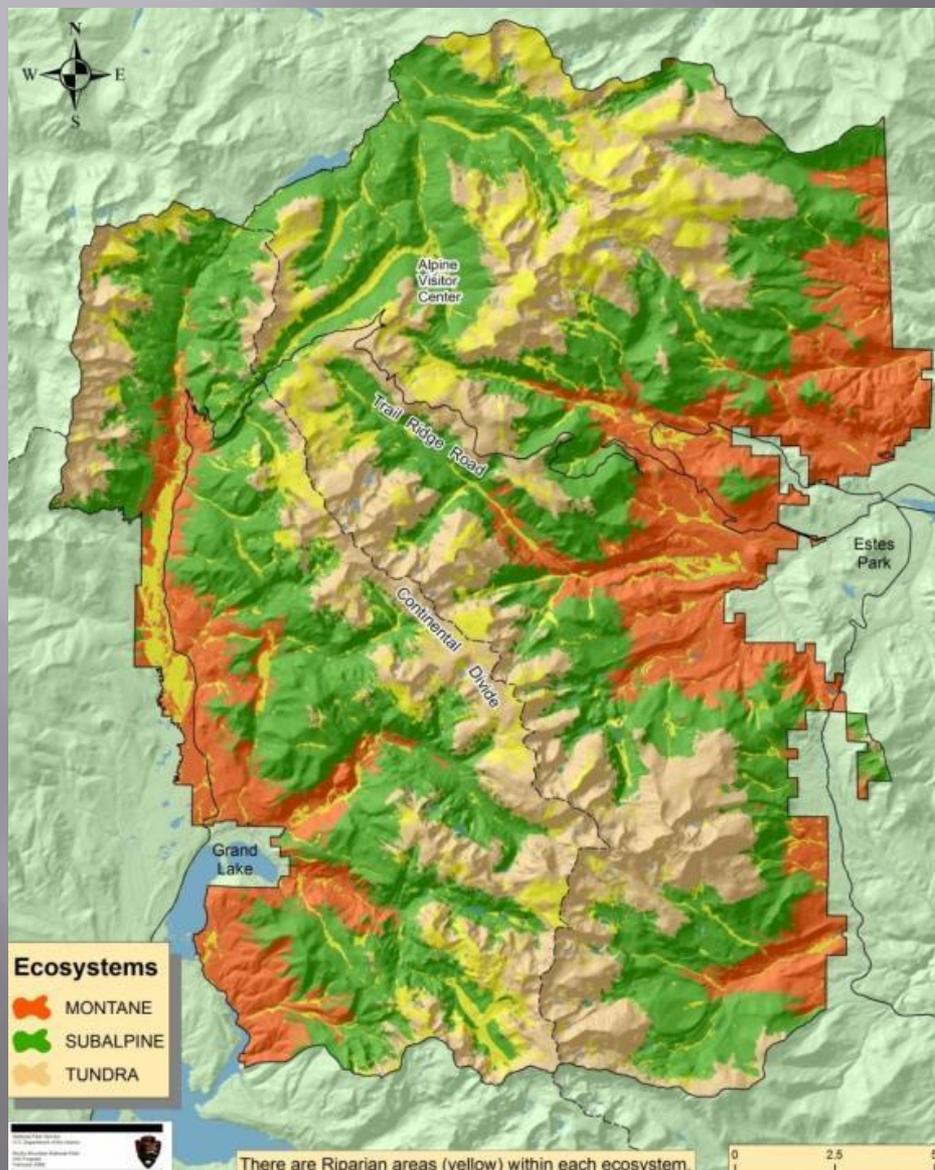




THE ROCKY MOUNTAIN NATIONAL PARK AIR QUALITY INITIATIVE: AIR QUALITY CONTROL COMMISSION ANNUAL BRIEFING

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RMNP AQ Initiative: Background



- ❑ Interagency effort addresses air pollution issues in RMNP
 - Focus on nitrogen deposition trends
- ❑ CDPHE, EPA, NPS
- ❑ Nitrogen Deposition Reduction Plan (2007)
- ❑ Contingency Plan (2010)
- ❑ 2012 Milestone Report (2014)

RMNP AQ Initiative: Background

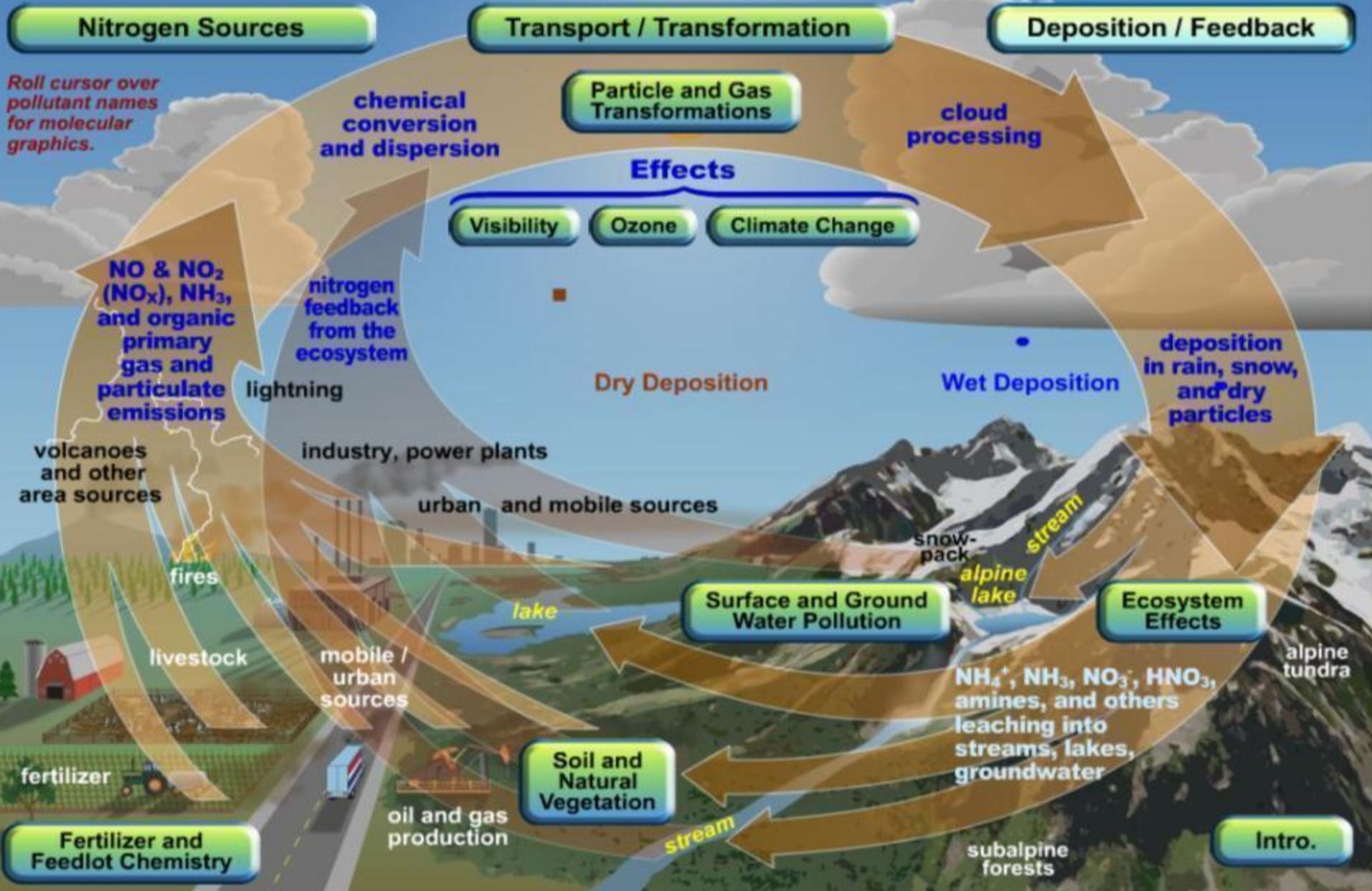


- Agencies support collaborative, preventative approach in lieu of legal/regulatory mechanisms that could be triggered
 - Air Quality Related Values (AQRV) impairment declaration
 - Prevention of Significant Deterioration Increment consumption
- Stakeholder review of research, identified information needs and discussed options for improving conditions
- “Weight of the evidence” approach considers:
 - Monitoring/trends
 - Attribution studies
 - Planned reductions

Nitrogen Cycle

Roll cursor over source areas to reveal pollutant species and percent of contribution.

Roll cursor over pollutant names for molecular graphics.

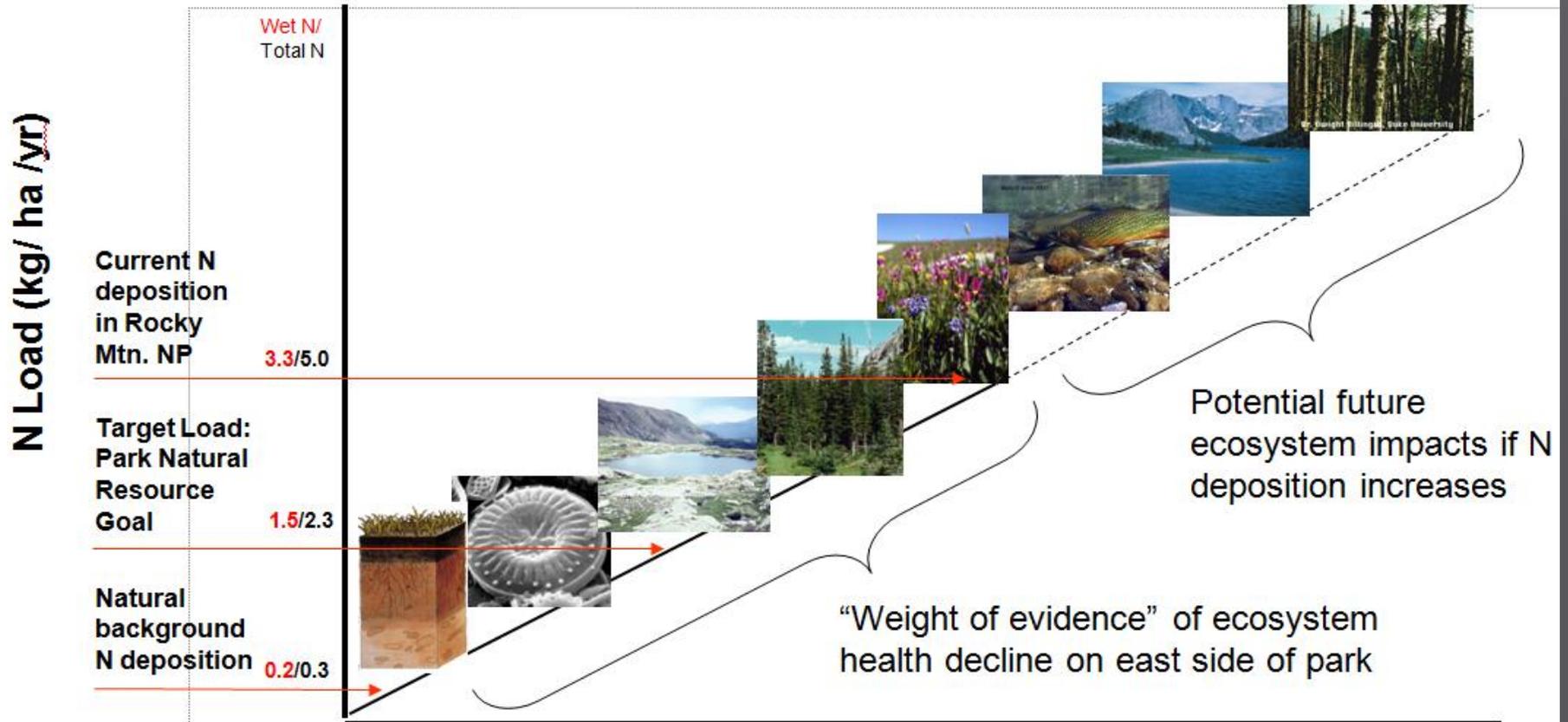


Critical Load

- Large body of evidence indicates nitrogen deposition has affected and continues to cause harmful effects on sensitive ecosystems within the park.
 - Current wet deposition monitored at ~3.3 kg N/hectare/year (rolling 5-year average - 2010-2014)
 - Natural background estimated at 0.2 kg N/hectare/year
- Specific, published (peer-reviewed) research has shown that wet deposition levels at the time harmful effects started to occur was ~1.5 kg N/ha/yr.



Rocky Mountain National Park: Continuum of Impacts to Ecological Health



Change in alpine plant species
CL = 3.0 kg/ha/yr total N

Increases in “weedy” lichen species
CL = 3.1 kg/ha/yr total N

Effects on aquatic animals (episodic acidification) begins
CL = 4.0 kg/ha/yr total N

Change in aquatic plant species composition
CL = 1.5 kg/ha/yr **wet N**

Soil N saturation/ leaching
CL = 4.0 kg/ha/yr total N

Forest decline (acidification effects on trees)
CL = 8.0 kg/ha/yr total N

NPS-ARD
2015

Solid line text box = observed effects; Dotted line text box = potential effects

Nitrogen Deposition Reduction Plan & Contingency Plan

- Original NDRP endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on August 16, 2007

- 1) Management approach based on collaborative process
- 2) Voluntary approach, no mandatory requirements or standards
- 3) Sets long-term (25-year) resource management goal
- 4) Sets timeline and interim (5-year) milestone goals intervals to achieve nitrogen reduction goal by 2032
- 5) Strategies to achieve goal
- 6) Identifies options that can be implemented on a voluntary basis



- Contingency Plan endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on June 22, 2010

- ❖ Adaptive management approach consisting of 5 elements
 - 1) Data Tracking Plan
 - 2) Triggering Mechanism
 - 3) Recommending & Implementing Contingency Measures
 - 4) List of Potential Contingency Measures
 - 5) Public Outreach & Participation



2012 Milestone Report: Weight of the Evidence Approach & Conclusions

- ▣ Assessment of multiple evidence types
- ▣ Two identified questions:
 - 2012 Nitrogen Deposition Interim Milestone met? No.
 - Will the RMNP Nitrogen Deposition Contingency Plan be triggered? No.
- ▣ Quantitative and Qualitative Factors
- ▣ *Therefore, the MOU agencies conclude that the 2012 interim milestone has not been achieved. However, the RMNP Nitrogen Deposition Contingency Plan shall not be triggered at this time.*



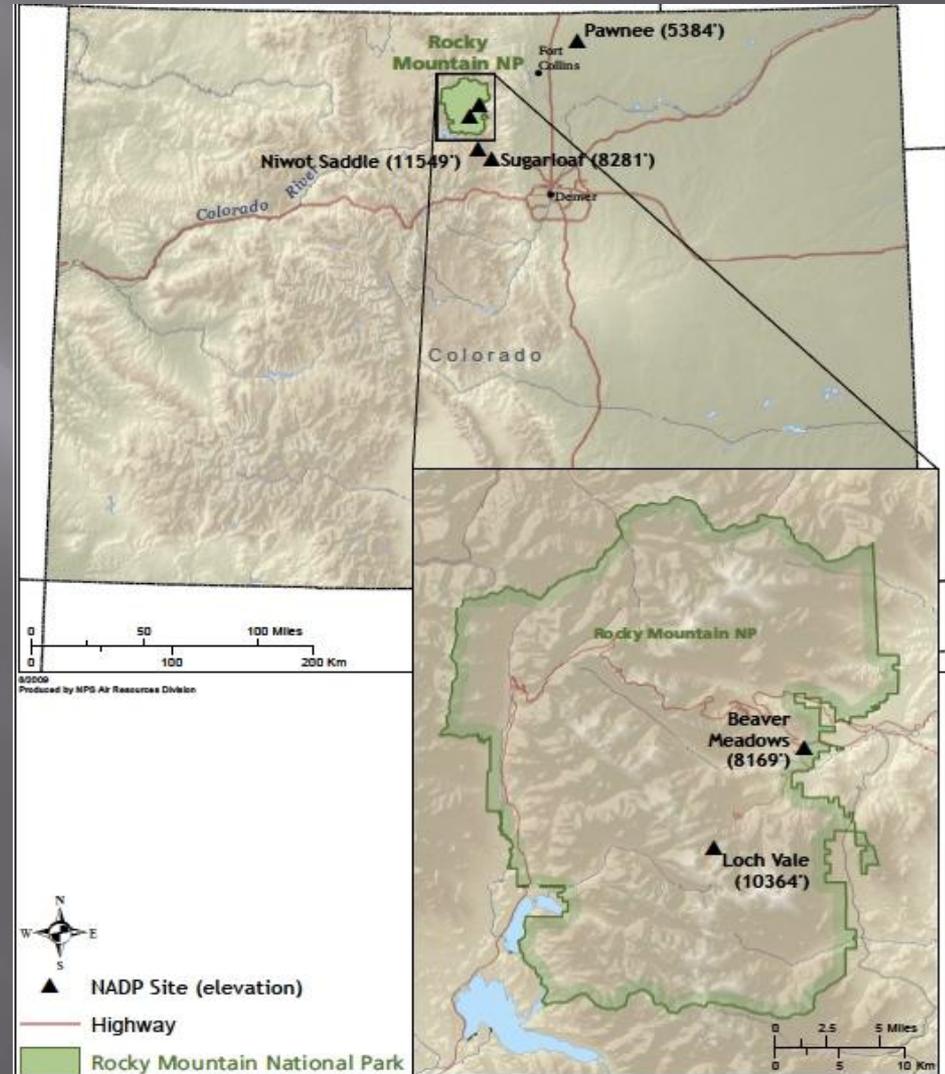
Monitoring & Tracking

- ▣ Has nitrogen deposition decreased at RMNP or other sites in the region?
 - Long-Term Statistical Trend (1984-2014):
 - No trend in wet nitrogen deposition (went from increasing to stable) as of 2010
 - Ammonium is increasing at 4 out of 5 sites
 - No trend in nitrate
 - Short-Term 5 or 7 year Statistical Trends (2010-2015 or 2008-2015):
 - Wet nitrogen deposition is increasing at 1 out of 5 sites
 - No trend in ammonium
 - No trend in nitrate
 - Co-located site (2009 - 2013)
 - Passive ammonia samplers

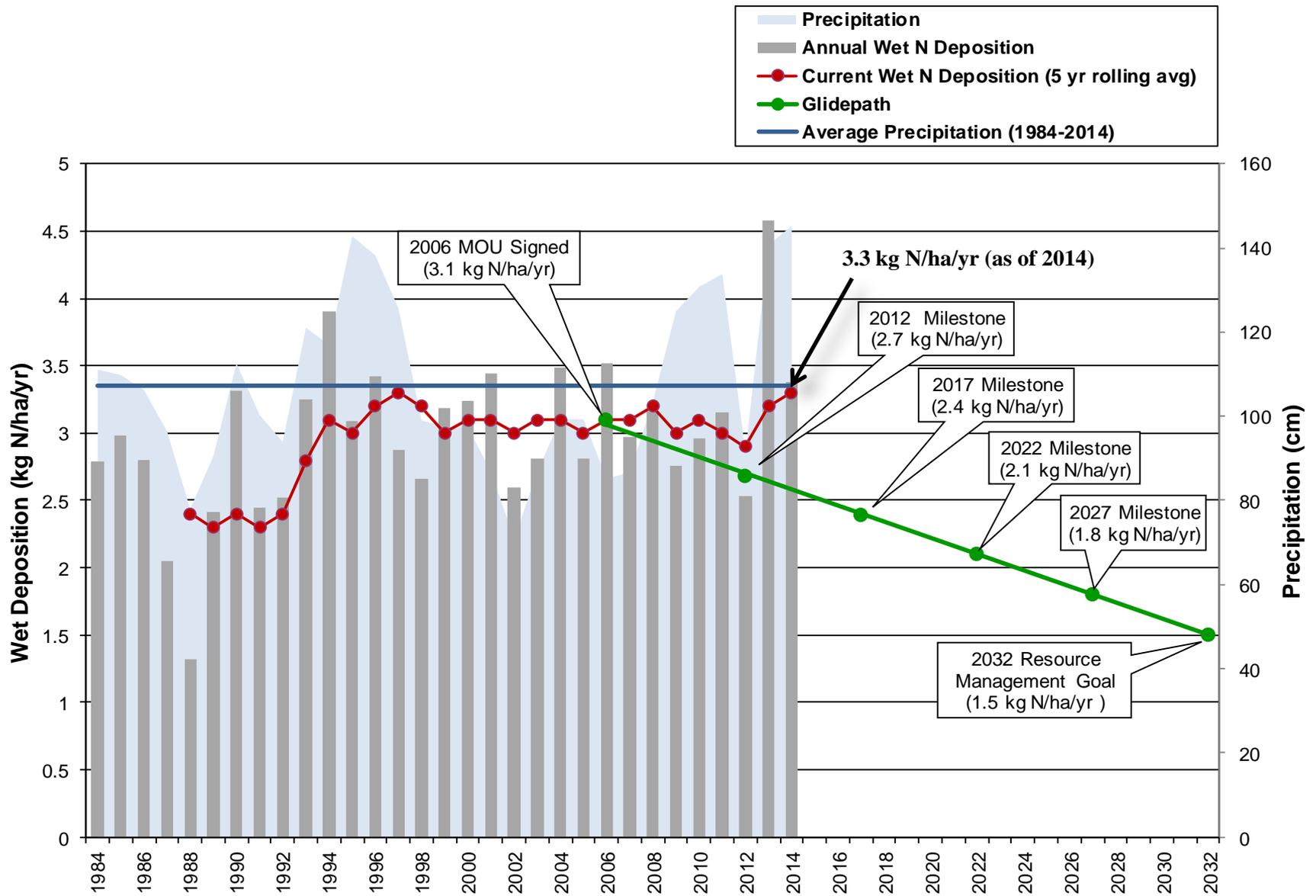


Deposition Trends through 2014

- Historically, nitrogen deposition increased at the park largely due to increasing ammonium.
- Some Good News
 - Long-term trend in nitrogen deposition shifted from increasing to stable at Loch Vale.
 - Short-term trends in nitrate are stable (at a lower level) after several years of decreases.
 - General short-term trends in ammonium are stable in the region.
- Challenges
 - Nitrogen deposition is not yet decreasing and is departing further from glidepath.
 - Ammonium continues to increase over the long-term.



RMNP Loch Vale Nitrogen Deposition & NDRP Glidepath



Nitrogen Source Areas & Transport Patterns

- ▣ Substantial portion of deposited nitrogen originates in Colorado
 - Greater than 50% ammonia (NH_3) from Colorado
 - Less than 50% nitrogen oxides (NO_x) from Colorado
- ▣ During spring and fall upslope weather events, high concentrations of both types of nitrogen move from eastern urban & agricultural areas of Front Range to RMNP.
- ▣ Regular summer upslope transport from mountain valley convection
- ▣ Local sources of ammonia not significant contributors to deposition in RMNP.



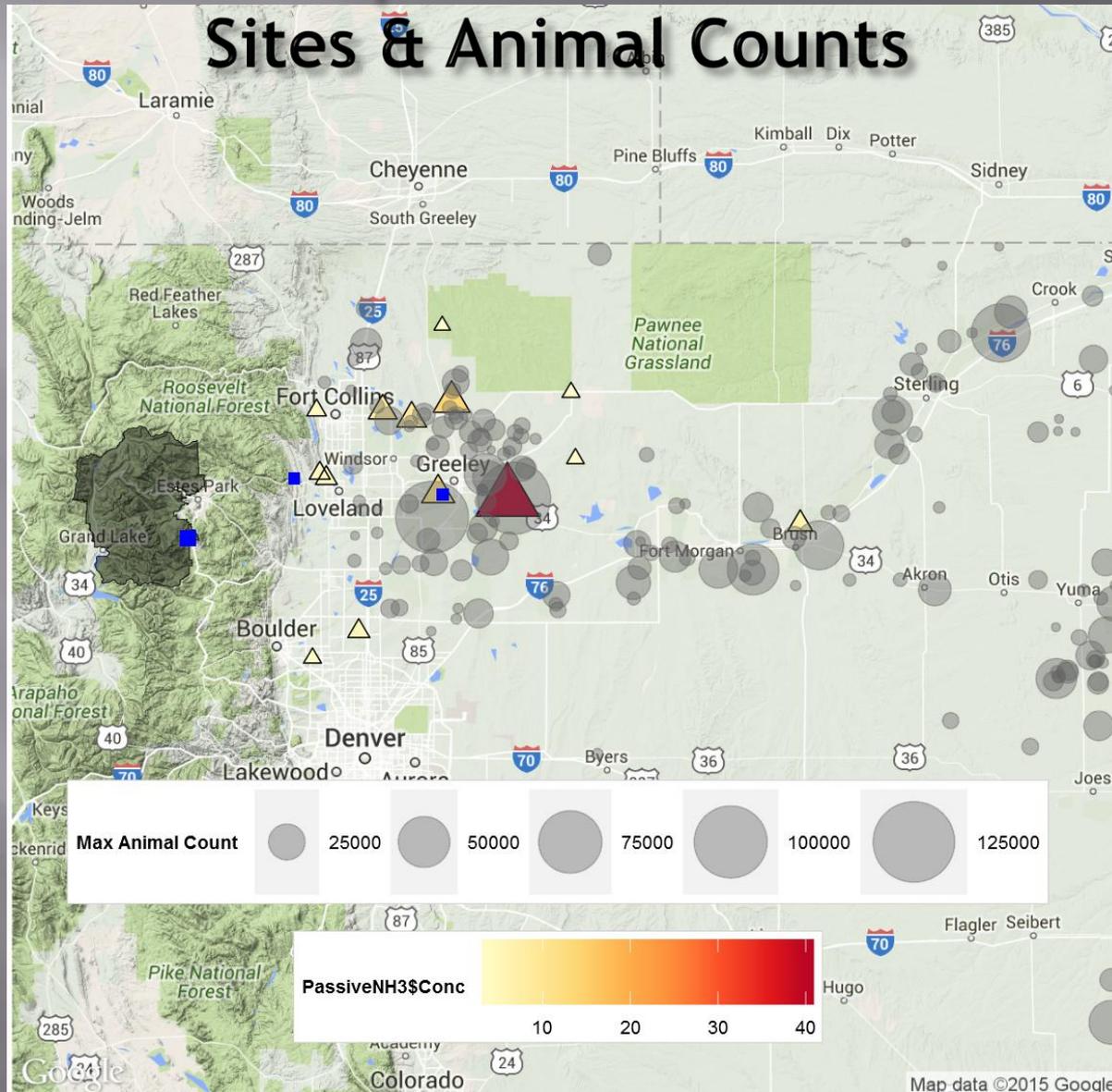
2013 Deposition Spike

- ▣ April had the highest recorded month of N deposition (by a combination of high ammonium concentrations and high precipitation)
- ▣ September flood rain contributed but low ammonium concentrations resulted in a lower deposition event.
- ▣ Back trajectory analysis shows that the frequency of transport through eastern Colorado (a known source area of ammonium) was greater than average in April 2013.

Ammonia Monitoring & Research Projects

- ▣ Continuous ammonia monitors in Greeley (summer 2014) and Loveland (summer 2015) (NPS/CSU/NRCS/CDPHE)
- ▣ Additional monitor in RMNP (July 2014) (NPS/EPA)
 - Continuous ammonia, 3x/week wet dep of oxidized, reduced, and organic N
- ▣ USDA funded summertime ammonia network
- ▣ Testing improved instrumentation
 - Trace-level measurements
 - Bi-directional fluxes
- ▣ Direction ammonia sources from monitors (CSU)
- ▣ Comparison with Satellite Observations (CSU)
- ▣ Comparison with CAMx Model Simulations (CSU)

Research: Map of Ammonia Monitoring Sites & Animal Counts



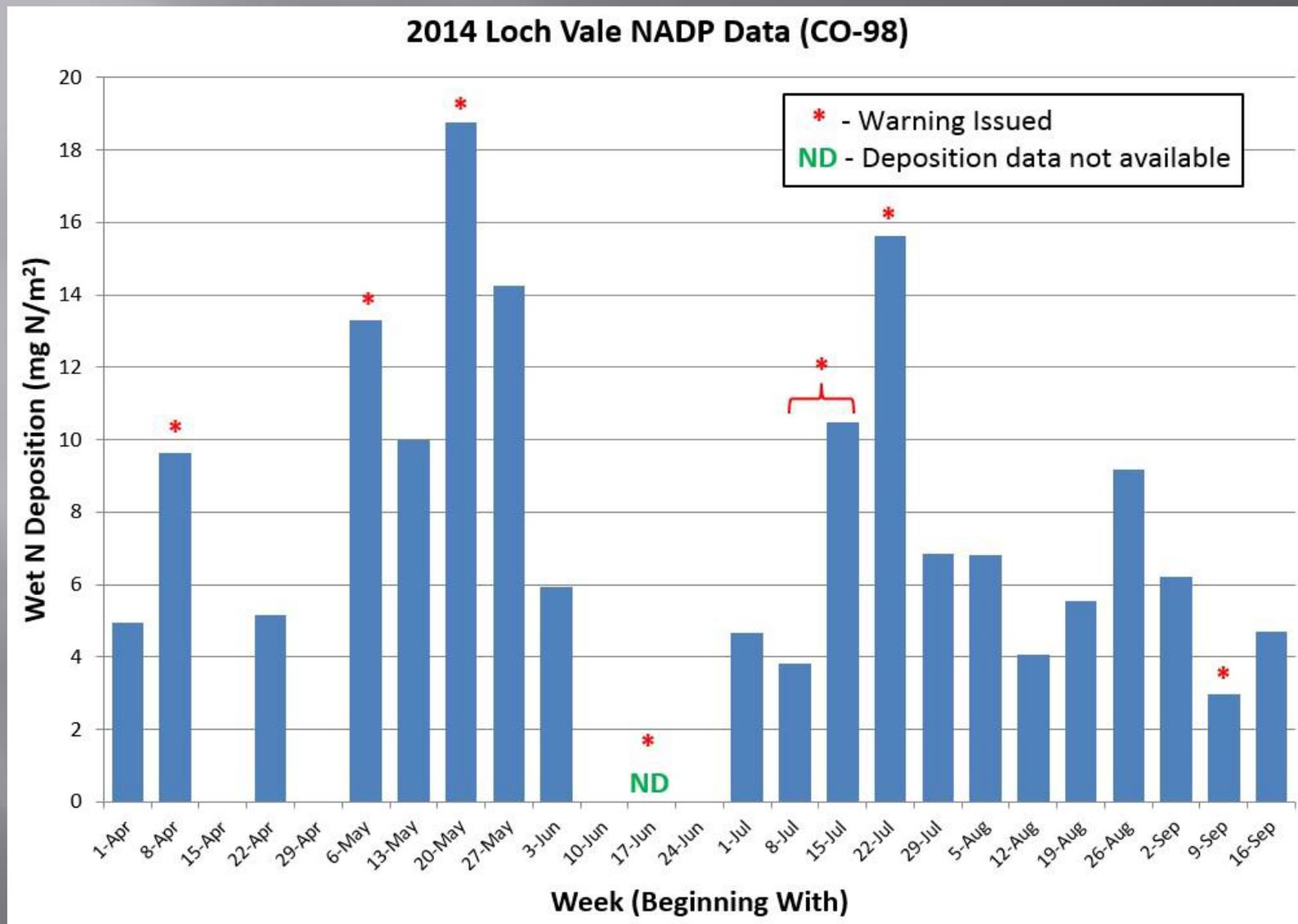
June - August
2010 - 2014

Benedict et. al, 2015

Early Warning System/ Agricultural Pollution Prevention Project

- Goal: demonstrate effectiveness of pilot-scale “early warning system” that alerts agricultural producers in advance of upslope weather event likely to transport ammonia & reactive nitrogen into RMNP
 - Producers alter or delay farm or manure management practices until weather event elapsed
- Agricultural producer participants: 53
- Non-producer participants tracking warnings: 25
- Number of meteorological warnings
 - 2014: 10 events total (majority in July/Sept) (13 days total)
 - 2015: 14 events so far (majority in April/Oct) (30 total days)
- Response rates ranged from 30 - 69% of affected producers
 - 58% of respondents changed practices for full warning period
 - Additional 16% changed for portion of warning period
- Number of fact sheets developed/distributed: 3

EWS Warnings vs. Nitrogen Deposition (2014)



Credit: Colorado Livestock Association

National Resources Conservation Service (NRCS) Update

- ▣ NRCS National Air Quality Initiative (NAQI)
 - 2008 Farm Bill authorized NRCS to assist producers in addressing agricultural air quality issues
 - NAQI changed in FY2015 to:
 - ▣ Better address true agricultural air quality issues
 - Not just nonattainment
 - States have more flexibility and say
 - ▣ Address regional agricultural air quality issues
 - ▣ Encourage and prioritize partner participation

Recent & Upcoming Activities

- ▣ MOU Agencies Communication Plan
 - EPA Summer Interns
 - ▣ Draft Strategic Proposal (August) with Agency Input
 - ▣ Draft Inventory of State Air Quality Programs (Ammonia Emission Mitigation Strategies)
 - Workshop in January 2016
 - ▣ Agency roles
 - ▣ Data gaps/needs
 - ▣ Potential paths forward
- ▣ Ag Subcommittee
 - Separate plan drafted April 2015
- ▣ Conduct workshops to refine strategy through next milestone, in cooperation with agriculture
- ▣ Work closely with agriculture to fill data gaps
- ▣ Support higher resolution ammonia monitoring
- ▣ Conduct research to better understand deposition factors including conducting source apportionment, transport back trajectories

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Questions?

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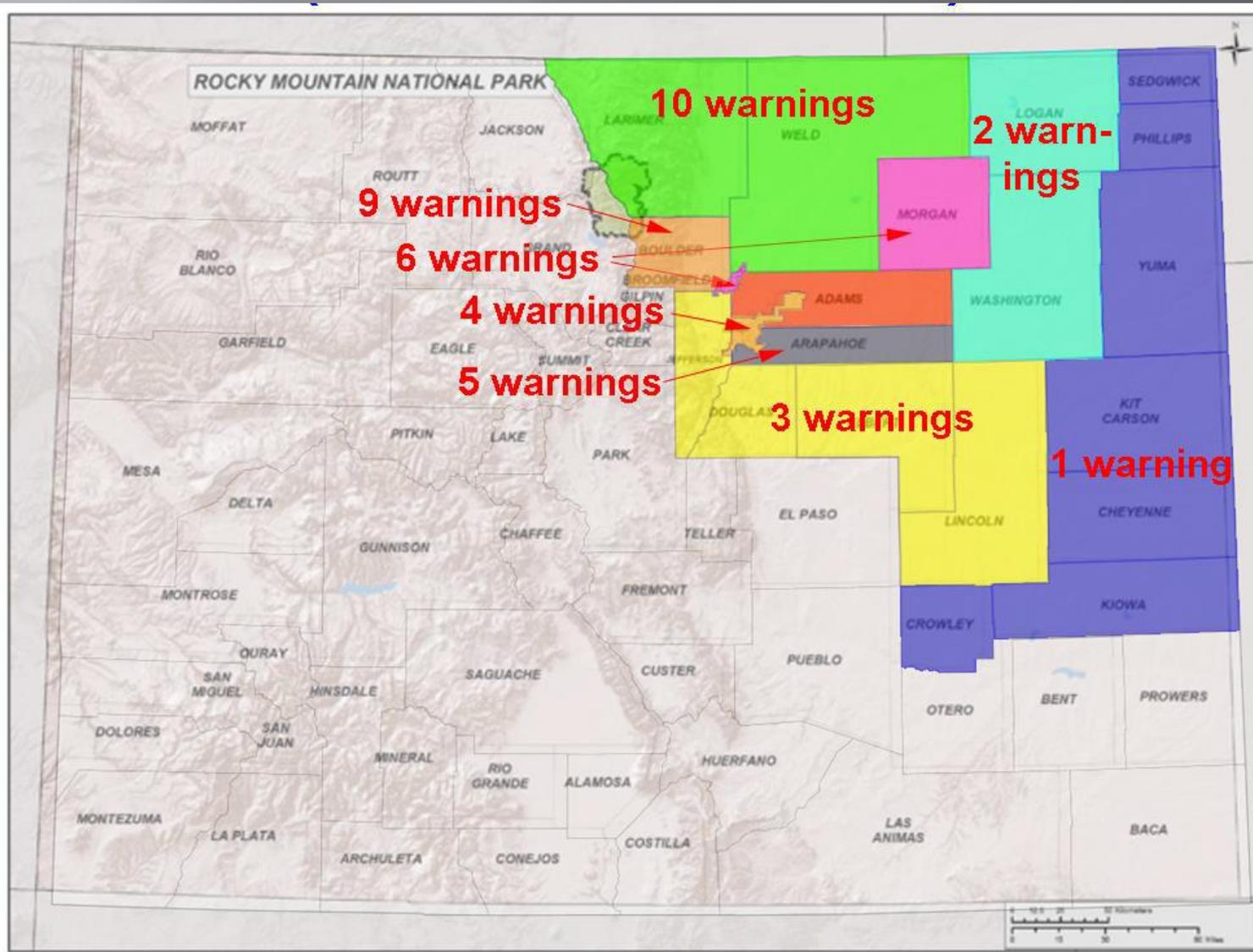
RMNP Website: www.colorado.gov/cdphe/rmnpinitiative

Weight of the Evidence Summary (as of 2012)



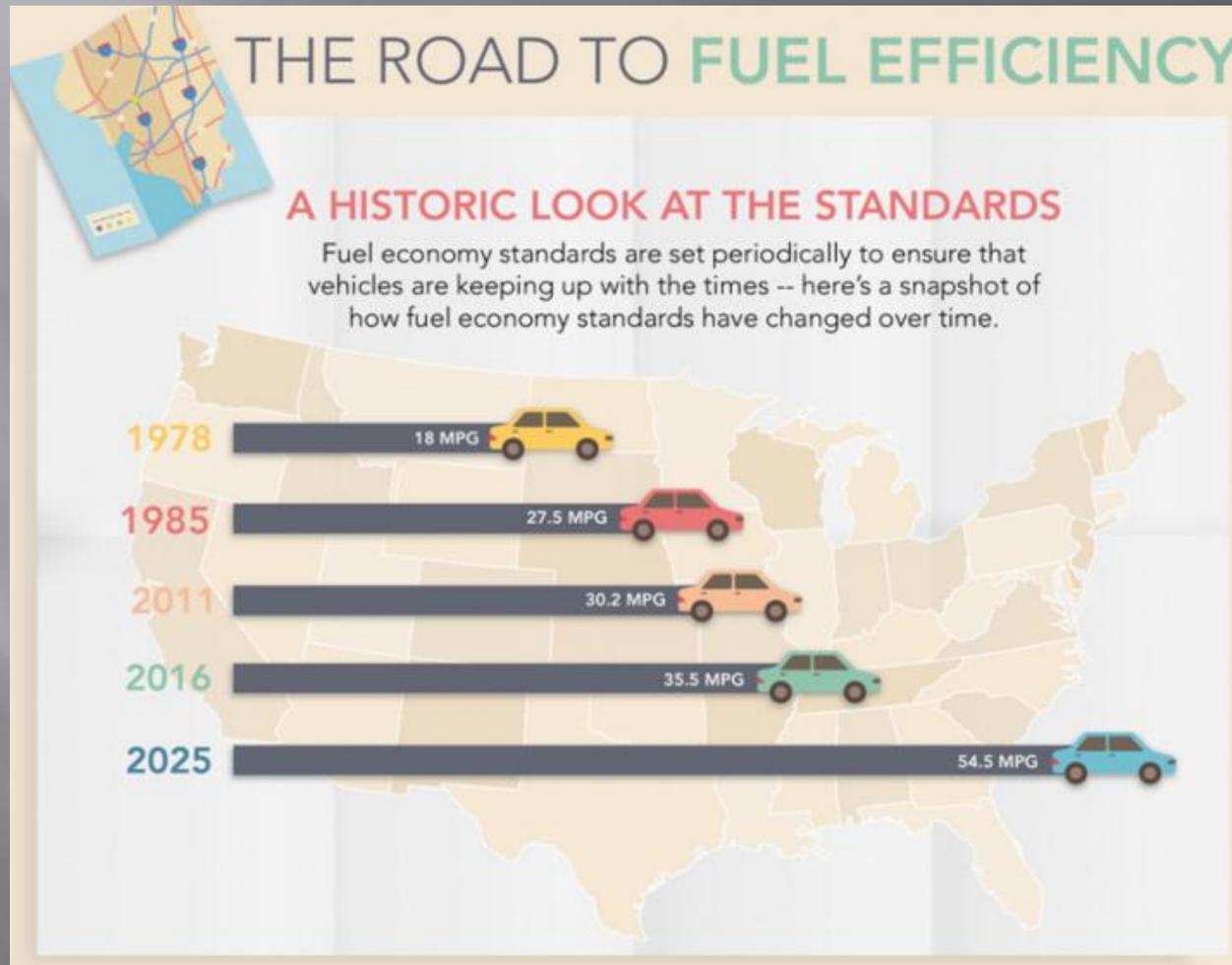
- ▣ Demographic trends show Front Range population and vehicle miles increasing while agricultural counts steady
- ▣ NO_x emissions decreasing nationally and locally while ammonia emissions remain stable
- ▣ Efforts continue to improve Colorado's nitrogen emission inventories
- ▣ Significant NO_x reductions on the horizon expected to contribute to reduced nitrogen deposition in RMNP
- ▣ Ag Subcommittee and multiple ammonia-related research efforts promising
 - 5-year adaptive plan & Early Warning System pilot
- ▣ In-Park emission strategies in place
 - Vehicle transportation systems
 - Increases in fleet efficiency
 - Environmental Management System

EWS Warnings by County Issued 2014



Credit: Colorado Livestock Association

National Vehicle Standards



Source: <http://energy.gov/articles/infographic-road-fuel-efficiency>