California Regional Haze Plan 2014 Progress Report

California Environmental Protection Agency

Air Resources Board

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EXECUTIVE SUMMARY

The landscapes of California include some of the most beautiful and dramatic national parks, forests, wilderness areas, mountains, deserts, and seashores in the United States. Twenty-nine of these California locations were designated Class 1 Areas by those who manage them, to support national goals of improving visibility at these treasured public lands. California continues to reduce emissions of pollutants that result in regional haze, and visibility is improving at these unique places. State residents and visitors from all over the world have access to these special areas, making the short- and long-term goals of visibility improvement a worthwhile effort for everyone's benefit.

There are many ways to measure visibility improvements; human visual perception is only one of them. Particles scatter and absorb light in the atmosphere, causing haze, which impairs the clarity of scenic vistas and views. The nationwide visibility monitoring program measures particles in the air as a way to track and compare variations in the amount of haze particles near the nation's Class 1 Areas. Analyzing relative changes in concentrations of specific pollutant species over time helps identify potential sources, or causes of haze, at different times, seasons, and locations. These sources are both natural and man-made. The monitoring record in California now illustrates both short and long-term trends for most areas of the State. Overall, the record shows visibility has improved.

The California Regional Haze Plan addresses visibility goals and describes a strategy for controlling air pollution from man-made emission sources, including rigorous controls for stationary, area, and mobile sources. The State also supports initiatives to incentivize the development and use of innovative pollution control technology. The benefit of this concerted effort is more days of pristine air for viewing the magnificent landscapes of Class 1 Areas in California and in neighboring states. In fact, visibility at the Class 1 Areas in Southern California, nearest the most densely populated areas, has improved the most from emissions reductions.

This Progress Report examines the visibility data to show that reductions of precursor emissions are on track for meeting our visibility goals. California strategies for reducing oxides of nitrogen (NOx) have lowered nitrate particle concentrations and reduced haze levels throughout the State. Average visibility on the worst haze days is improving, although natural wildfire smoke continues to be the strongest driver of reduced visibility on worst days, at areas where progress is slower.

The California Regional Haze Plan control strategy is working to reduce emissions to reach short-term goals for 2018, as required. Reducing haze is a regional effort and California continues to work with the other western states and the federal land managers to plan for the required 2018 revision of State Implementations Plans for Regional Haze. The states are focusing on strategies for continued reduction of controllable emissions. Quantification of the impacts of wildfire smoke and other sources beyond State regulatory jurisdiction will continue, for the purposes of defining the burden these sources place on achieving visibility goals.

The long-term trends for Worst Days averages show visibility improving at every monitoring site, in the absence of very high wildfire years. Current Best Days are all better or the same as those of the baseline period. As evidenced by reductions in anthropogenic source emissions in California and the concurrent improvement in visibility at all of California's Class 1 Area IMPROVE monitors, California determines the current RH plan strategies are sufficient for California and its neighboring states to meet their 2018 RPGs. In accordance with the requirements of the RHR, California has determined that no further substantive revision of the RH Plan is warranted at this time in order to achieve the 2018 RPGs for visibility improvement.

1. Background and Overview of Progress Report Requirements

Congress recognized the importance of visibility in our national parks and wilderness areas by amending the Clean Air Act (Act) in 1977 to include a goal for "prevention of any future, and the remedying of any existing, impairment of visibility."[1] In order to implement this provision of the Act, the U.S. Environmental Protection Agency (U.S. EPA) established the Regional Haze Rule (RHR)[2] in 1999, specifying how states must work towards this visibility improvement goal. The RHR requires that states identify and implement pollution control strategies to make continuous progress towards a goal of "natural conditions"[3] state of visibility by 2064.

Progress towards natural conditions visibility is expected by reducing or eliminating man-made impairment of visibility at the 156 Class 1 Areas in the United States. These public areas are national parks, forests, monuments, seashores, and wilderness areas managed by federal land management agencies. The RHR requires that continuous progress towards visibility improvement goals be evaluated at periodic checkpoints, with State Implementation Plans (SIPs) required every 10 years, and interim progress reports every five years.

The Air Resources Board (ARB or Board) adopted the California Regional Haze Plan (RH Plan) in January 2009 and transmitted it to U.S. EPA in March 2009. U.S. EPA approved the RH Plan in June 2011. The RH Plan described visibility conditions for the baseline years 2000-2004 and included the State strategy for reaching the first Reasonable Progress Goals (RPGs) in 2018. The 2018 RPGs are interim visibility improvement benchmarks on a path to the ultimate, long-term goal of natural background conditions. The 2018 RPGs were developed by ARB for each Class 1 Area in California, in consultation with other affected states and the federal land managers.

This first Progress Report (Report) evaluates progress made towards the 2018 RPGs and addresses the following:

- Status of RH Plan State strategy;
- Emissions reductions from RH Plan control strategies;
- Visibility progress;
- Emission trends;
- Assessment of changes impeding visibility progress;
- Assessment of current strategy;
- Review of visibility monitoring strategy;
- RH Plan adequacy determination; and
- Federal Land Manager comments.

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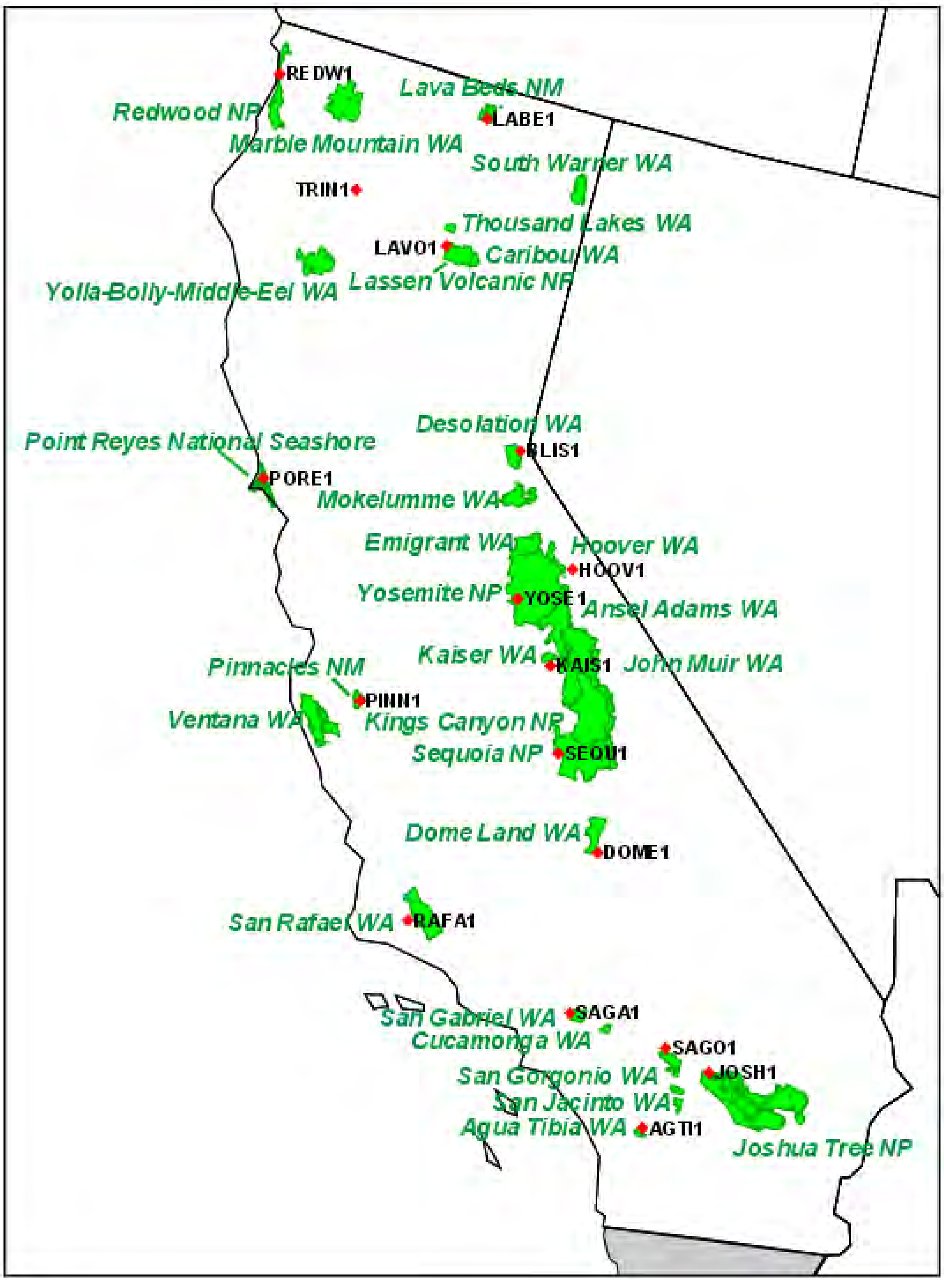
[1] Section 169A of the Clean Air Act.
[2] CFR 40 Part 51 Regional Haze Regulations; Final Rule, July 1, 1999
[3] Note that "default" natural conditions as defined by the U.S. EPA are subject to revisions. States can extend the period of time needed to achieve natural conditions, beyond the nominal 2064 in the RHR, defining and defending new interim reasonable progress rates and adjusting the 2064 end year as needed (see CFR Section 51.308).

1.1. California Class 1 Areas

California has 29 Class 1 Areas, more than any other state. Progress towards better visibility is calculated from data collected at the Interagency Monitoring of Protected Visual Environments (IMPROVE) network. There are 17 IMPROVE monitors representing one or more of the Class 1 Areas in California. Class 1 Areas in California with their respective IMPROVE monitor names and locations are shown in Figure 1.

Figure 1
Map of Class 1 Areas and IMPROVE monitors



◆ *IMPROVE monitor* *WA = Wilderness Area* *NP = National Park* *NM = National Monument*

1.2. Measuring Visibility

Measuring visibility is complex. Particle and aerosol pollution in the air causes haze (light extinction) by extinguishing and absorbing light. The haze-causing particles and aerosols in the air are ammonium nitrates (nitrates), ammonium sulfates (sulfates), organic carbon matter aerosols (OMC), elemental carbon (EC), fine soil (FS), coarse mass (CM), and sea salt (SS). There is also natural light scattering by gases, Rayleigh scattering, with a constant light extinction value based on elevation. Reducing the concentrations of the pollutant species means their contribution to light extinction lessens, and visibility improves.

The IMPROVE monitors measure the concentration of each haze-causing pollutant every three days. Since each pollutant species has a different capacity to extinguish light, a mathematical formula was created to add up the light extinction caused by constant Rayleigh scattering and the different concentrations of pollutants on each measurement day. This formula, called the Haze Algorithm, converts the total light extinction calculated for each day into units of visibility called "deciviews".[4] One deciview (dv) unit corresponds with the minimum visibility change detectable to the human eye. As deciview levels decrease, visibility improves.

The RHR requires that assessments of visibility progress must be based on five-year averages of the deciview values for the annual haziest (Worst) and clearest (Best) days at each IMPROVE monitor. The Worst Days measurement is the average of the deciview levels for the 20 percent of the sampling days with the highest visibility impairment each year. The Best Days measurement is the annual average of the lowest 20 percent deciview days.

The 2018 RPGs are the projected deciview levels for the Worst Days averages at each monitor in 2018, after implementing the RH Plan's State strategy. U.S. EPA approved the 2018 RPGs when they approved the RH Plan. Worst Days deciview levels should be decreasing as they progress towards the 2018 RPGs. The RHR also specifies that Best Days averages should not degrade from the baseline period (2000-2004).

1.3. Source Impacts on Visibility

A better understanding of visibility improvement emerges from relating reductions in precursor emissions in and near the Class 1 Areas to changes in concentrations of haze species measured at the monitors. Also important is the change in each haze species' contribution to light extinction, as the mix of precursor emissions changes. Emissions from both natural sources and from man-made activities (anthropogenic sources) affect visibility. These sources can be located within California, but long-range transport also brings visibility-impairing pollutants from out-of-State and international sources into

[4] *Appendix A of the initial RH Plan explains further how deciviews are calculated from measurements of mass concentrations of haze species at each IMPROVE monitor.*

California's atmosphere. California's emissions control strategy focuses on sources within the State's regulatory jurisdiction.

The fact that "uncontrollable" natural and anthropogenic sources affect visibility is not neglected in this analysis. For example, visibility progress in western states is slowed by the increased frequency and intensity in wildfires during the summer. Smoke originating from wildfires within and outside California generates enormous concentrations of organic carbon aerosols that form far-reaching plumes impacting many visibility monitors before dissipating. Depending on the wildfire location, smoke impacts different monitors from year-to-year. Another annual event occurring beyond California's borders are spring windstorms in the Gobi Desert, which have detectable but minor haze consequences in California at this time. Every year these seasonal windstorms send natural geologic material, coated with industrial emissions from Asia, into the jet stream which deposits dust at IMPROVE monitors in California and other western states.[5]

Uncontrollable emissions sources add to the atmospheric mix of visibility-impairing pollutants produced by anthropogenic sources in California, all detected but not differentiated by the IMPROVE monitors. Seasonal inversions, sea breezes, and humidity enhance the impact of these variable emissions. California's coastal location, complicated topography, and complex meteorology, may result in somewhat uneven year-to-year deciview progress at some sites, despite steady reductions of emissions. The Progress Report appendices describe localized and regional situations where uncontrollable emissions intensify the impacts on visibility progress.

1.4. Initial Reporting Requirements

In this first Progress Report, the RHR requires all states to report on the implementation status for emission control measures implemented within the state for achieving reasonable progress towards the 2018 goals for Class I Areas within and outside the state. California's first Progress Report is due to U.S. EPA in the Spring of 2014. In April 2013, U.S. EPA issued Guidance[6] that states evaluate visibility improvement using the most recent monitoring data available for the initial Progress Reports. At the time of preparation of this Progress Report for the required review by the Federal Land Managers, the most recent monitoring data was available through 2011 at all but one of the seventeen IMPROVE monitors.[7]

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[5] *VanCuren, R., and T. Cahill (2002), Asian aerosols in North America: Frequency and concentration of fine dust, J.Geophys. Res., 107(D24), 4804, doi:10.1029/2002JD002204.*

[6] *"General Principles for the 5-Year Regional Haze Progress Reports for the Initial Regional Haze State Implementation Plans (Intended to Assist States and EPA Regional Offices in Development and Review of the Progress Reports)", U.S. EPA, Office of Air Quality Planning Standards, April 2013.*

[7] *The IMPROVE monitor SAGA, serving the San Gabriel Wilderness and the Cucamonga Wilderness, was destroyed in the summer wildfire called the Station Fire of 2009. SAGA was reestablished at the same location in the fall of 2011. Therefore data from the years 2005-2008 comprise the "current period" evaluated for SAGA in this Progress Report. The years 2009-2011 have incomplete deciview day data at SAGA so that Worst and Best Days annual deciview averages for those years do not exist.*

In this Progress Report, “current” conditions are the five-year averages of 2007-2011 visibility data, which is compared with “baseline” conditions, 2000-2004, from the initial California Regional Haze Plan. While some years may not have enough deciview days statistically to calculate the annual Worst and Best Days values, good information is still available for extensive parts of the year. Analyzing all the data gives a better understanding of seasonal patterns and long-term trends in visibility improvement.

For further analysis on a regional scale, California joined with fourteen other states to prepare the Western Regional Air Partnership (WRAP) Regional Summary Report included in Appendix A. The WRAP Summary Report was released in June 2013 and includes a comprehensive analysis of both measured visibility changes at the IMPROVE monitors and changes in emissions inventories between the baseline period and the five following years (2005-2009) to meet some of the RHR reporting requirements. California’s Progress Report goes further to update the Regional Summary Report with the 2007-2011 California-specific data.

The 2012 visibility data became available at the end of February 2014, during the Federal Land Managers review period. The timing of the data does not allow for an extensive analysis to be done in this Progress Report. However, the 2012 data is provided in Appendix C in summary format and mentioned in the Appendix D Case Studies. The 2012 summary data continues to illustrate progress in visibility improvement and does not change the conclusions of this Progress Report.

2. Control Strategy Status and Emissions

In California, nitrate and organic carbon aerosols are the primary drivers of poor visibility on Worst Days. Sulfates can also play a role. Therefore, reductions in the precursors for these pollutants, NOx, ROG and SOx, along with directly-emitted PM2.5 support improvements in visibility throughout the State. In the RH Plan Control Strategy, California addressed all three precursors along with directly-emitted PM2.5.

Mobile Sources are the primary contributor to NOx emissions, a precursor to nitrate. They also contribute SOx emissions, a precursor to sulfates; ROG emissions, a precursor to organic carbon aerosols; and PM2.5, a direct-emitter of organic carbon aerosols. Statewide control measures have been effective in driving all three of these types of emissions downward. Light-duty passenger vehicles, heavy-duty diesel-powered trucks, and off-road equipment were the three largest sub-category sources of all NOx emissions in 2000.

2.1. Status of Control Strategies in the RH Plan

The RH Plan Control Strategy relied upon already adopted ARB control measures for mobile sources and consumer products that reduce precursors of haze pollutants: NOx, SOx, ROG, and PM2.5. California's aggressive and innovative control measures go beyond the federal requirements and defined a comprehensive and long-term basis for setting the 2018 RPGs. By regulating fuel and product formulations as well as mobile source equipment and pollution control technology, California's control measures continue to provide significant emission reductions through 2018. Integrated programs addressing Diesel Risk Reduction, Goods Movement, and Smoke Management are designed to cover multiple source categories. California's Smoke Management Program, certified by U.S. EPA in August 2003, continues to manage the occurrence of prescribed fires and smaller agricultural burns, by coordinating private, local, State, and federal actions. The Smoke Management Program requires that Class 1 Areas be identified as sensitive receptors. California also continues to supplement regulatory programs with financial incentives to accelerate early emission reductions and promote new technologies.

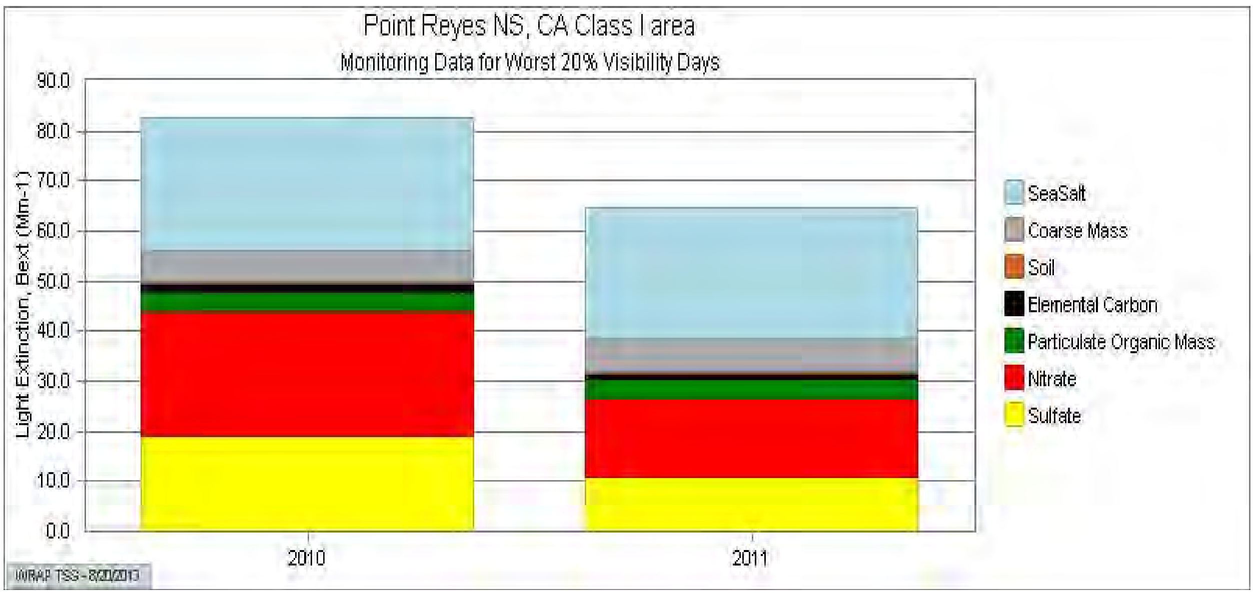
2.2. BART Requirement

In the RH Plan, Best Available Retrofit Technology (BART) was required for one source, the Main Stack at the Valero refinery in Benicia, California. The new control equipment was installed and operating by February 2011, prior to the 2013 compliance deadline. The BART determination concluded that the Main Stack and its contributing sources would be rebuilt to reduce emissions of SO2, NOx, and PM10. A fluidized coker, a fluidized catalytic cracker unit, and two CO boilers feed to the Main Stack.

The RH Plan BART determination described a technically feasible control system for the components that also produced a beneficial reduction in deciview levels modeled at the nearest Class 1 Area, Point Reyes National Seashore. A regenerative amine scrubber and a pre-scrubber were used for SO2 removal. The pre-scrubber also removes PM10. NOx is removed by selective catalytic reduction. Low NOx-burners are used for the CO boilers. With the installation of the improvements to the Main Stack as summarized in the RH Plan, reductions of 0.65 tpd NOx, 15.7 tpd SOx, and 0.06 tpd PM10 were achieved.

Point Reyes National Seashore is the primary Class 1 Area affected by emissions from the Valero Refinery. Deciview and light extinction data from 2010 and 2011 are available for comparison prior to and after installation of the retrofit equipment. Figure 2 shows the drop in light extinction, especially from nitrates and sulfates, at the PORE IMPROVE monitor. The corresponding deciview level for the Worst Days annual average went from 22 dv in 2010 to 20.2 dv in 2011.

Figure 2
Comparison of Light Extinction at the PORE Monitor



2.3. New Control Strategies

In the RH Plan, California committed to give an update on new control strategies not included in the RH Plan. Due to the nonattainment challenges in California, ARB and local districts are regularly revising rules to account for new technologies. ARB research, coupled with incentives, provides the bridge to develop these new innovative technologies. The RH Plan reflected emissions from strategies adopted through 2004. Since the RH Plan was developed, ARB has adopted additional control measures. Table 1 includes a list of these control measures and appropriate implementation dates that were adopted by ARB and not reflected in the RH Plan Control Strategy. These control measures further reduced forecasted emissions in 2018 beyond what was in the RH Plan. Since these control measures were not used to set the 2018 RPGs, they will provide additional emission reduction benefits to help California reach the 2018 RPGs.

Table 1
Control Strategies

Category Program	Actions	Implementation
Passenger Vehicles		
Transit Bus Rule Additions	2005	2010
Zero Emission Bus Rule Amendments	2006	2010
Smog Check Improvements	2007-2009	2008-2010; 2013
Expanded Vehicle Retirement (AB 118)	2007	2009
Modifications to Reformulated Gasoline Program	2007	2010
Trucks		
Heavy-Duty Sleeper Truck Idling Technology	2005	2010
Public and Utility Diesel Truck Fleet Rule	2005	2010
Border Truck Inspection Program Protocol Improvements	2006	2006
Cleaner In-Use Heavy-Duty Trucks	2007, 2008, 2010	2011-2015
Goods Movement Sources		
Diesel Cargo Handling Equipment Rule	2005	2010
Ship Auxiliary Engine Cleaner Fuel Requirements	2005	2010
Auxiliary Ship Engine Cold Ironing & Other Clean Technologies	2007, 2008	2010
Cleaner Main Ship Engines and Fuel	2008-2011	2009-2015
Port Truck Modernization	2007,2008, 2010	2008-2020
Accelerated Introduction of Cleaner Line-Haul Locomotives	2008	2012
Clean Up Existing Harbor Craft	2007, 2010	2009-2018
Off-Road Equipment		
Forklifts and Other Spark-Ignition Equipment Regulation	2006	2010
Off-Highway Recreational Vehicle Regulation Amendments	2006	2010
Cleaner In-Use Off-Road Equipment	2007, 2010	2009
Other Off-Road Sources		
In-Use Diesel Agricultural Engine Requirements	2006	2012
Enhanced Vapor Recovery for Above-Ground Storage Tanks	2008	2009-2016
Additional Evaporative Emission Standards	2009	2010-2012
Areawide Sources		
Portable Fuel Container Requirements	2005	2015
Consumer Product Lower Emission Limits	2006	2010
Consumer Products Program	2008-2011	2010, 2013-2014

In California, local air districts implement stationary source and indirect source control programs. This also includes the New Source Review and Prevention of Significant Deterioration permit programs. The Districts also utilize local and pass-through funds to incentivize reductions. Some local air districts encourage residential improvements that reduce emissions, such as swap-outs, to battery-powered lawnmowers or to U.S. EPA-certified wood-pellet stoves. These programs have localized benefits for meeting the federal and State criteria pollutant standards. They also decrease emissions transported from populated areas to the more remote Class 1 Areas.

2.4. Emission Inventory

California's control measures discussed above are reflected in the Statewide emission inventories shown in Table 2. This inventory is ARB's latest inventory used for the 2013 Almanac and is based on information developed for the daily PM2.5 standard SIPs recently sent to U.S. EPA. The table includes both past and forecasted inventory years in five-year increments and includes years, 2000, 2005, 2010, 2015, and 2020. The ARB inventory is different from that of the WRAP Summary Report in Appendix A since ARB has more recently updated the inventory to reflect revised emission factors and new assumptions for growth along with the units. ARB reflects the inventory in an annual tons per day unit which can be multiplied by 365 in order to get the WRAP tons per year unit. Appendix B includes additional information on the ARB emission inventory.

Table 2
California Statewide Inventory Summary (Tons Per Day)

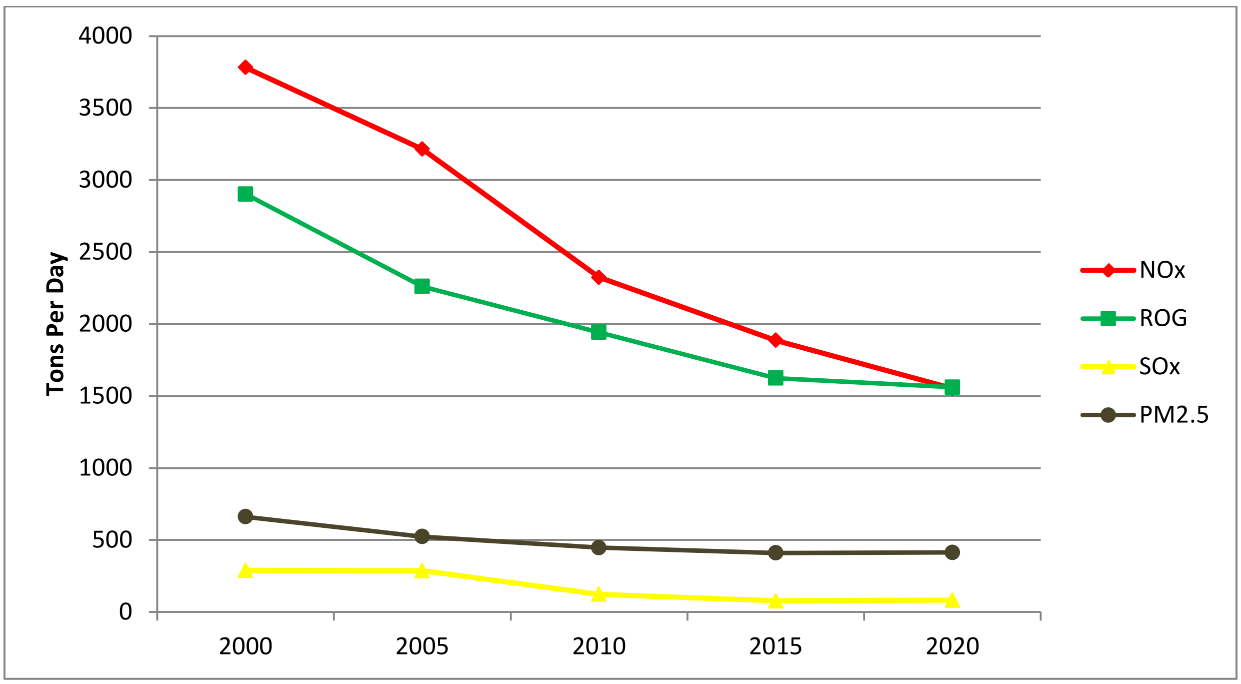
POLLUTANT	CATEGORY	2000	2005	2010	2015	2020
NOx	STATIONARY SOURCES	584	402	313	288	291
NOx	AREAWIDE SOURCES	96	85	75	74	74
NOx	MOBILE SOURCES	3,103	2,727	1,935	1,525	1,188
NOx	GRAND TOTAL STATEWIDE	3,782	3,214	2,324	1,887	1,553
ROG	STATIONARY SOURCES	564	416	417	401	425
ROG	AREAWIDE SOURCES	783	713	655	611	630
ROG	MOBILE SOURCES	1,555	1,133	871	613	506
ROG	GRAND TOTAL STATEWIDE	2,902	2,261	1,943	1,624	1,561
SOx	STATIONARY SOURCES	132	97	64	54	55
SOx	AREAWIDE SOURCES	9	7	7	6	6
SOx	MOBILE SOURCES	148	182	52	18	21
SOx	GRAND TOTAL STATEWIDE	289	287	123	78	82
PM2.5	STATIONARY SOURCES	92	91	82	65	69
PM2.5	AREAWIDE SOURCES	445	309	275	277	281
PM2.5	MOBILE SOURCES	123	124	90	68	64
PM2.5	GRAND TOTAL STATEWIDE	661	524	447	410	414

2013 Almanac
SOURCE: http://www.arb.ca.gov/aqd/almanac/almanac13/chap313.htm

2.5. Control Measure Emission Reductions

California emissions have declined for all precursors since 2000 as shown in Figure 3. Between 2000 and 2020, mobile source NOx, ROG, and PM2.5 emissions are projected to be reduced by about 60, 65, and 50 percent, respectively. Stationary sources are also projected to decline for all precursors. Areawide sources also decline but not at the rate of mobile and stationary sources. Overall, between 2000 and 2020, NOx, ROG, SOx, and PM2.5 emissions decline almost 40 percent. These emission reductions reflect the maturity of California's emission control program.

Figure 3
California Statewide Inventory Trends



3. Visibility Progress

The RHR requires each state to assess visibility conditions and changes, using the Worst Days and Best Days metrics. The RHR requires states to assess current visibility, the change compared to baseline, and change over the past five years for both Worst Days and Best Days. For this initial Progress Report, the current conditions are the 2007-2011 period; the baseline period and past five years are the same, 2000-2004.

Table 3 compares Current and Baseline Worst Days and Best Days including the visibility changes as required by the RHR. Table 3 also compares Worst Days current conditions with the U.S. EPA approved 2018 RPG at each monitoring site, to show the percent progress achieved since the baseline, using the 2007-2011 five-year average. Visibility is improving on the Best Days at all monitoring sites meeting the RHR requirement that Best Days should not degrade. At nine monitoring sites, the current conditions already meet the 2018 RPGs. Visibility improvement at all but three of the monitoring sites indicates that by the end of 2011, progress exceeds 50 percent of that needed to reach the 2018 goals. Appendix C contains the Worst Day record since the baseline period. Looking at just 2011, all sites recorded values below the 2018 RPGs.

The three monitoring sites with the least progress, using the 2007-2011 five-year averages, are the LAVO, BLIS, and REDW IMPROVE monitors. Further analysis of trends in haze-causing pollutant concentrations and their contributions to light extinction at these three monitors reveals the cause of the limited progress. In the western U.S., wildfire smoke can elevate Worst Days values at particular monitors in a single year, as well as skew subsequent five-year averages. In 2008 and 2009, wildfire smoke caused unusually high deciview Worst Day values with the first and third highest Worst Day value in 23 years of monitoring at the LAVO monitoring site. Wildfire smoke also impacted the BLIS monitoring site in 2007 and 2008 and caused the highest and second highest Worst Days annual averages in 16 years of deciview calculations at that location. In 2008, wildfire smoke also impacted the REDW monitoring site. As mentioned later, in Section 4, wildfire smoke can significantly impact visibility and mask improvements from emission controls. Appendix D examines the composition and timing of the Worst Day values in detail for these three monitoring sites.

Offshore emissions from ocean-going vessels (OGV) contribute to sulfate formation, impacting visibility at monitoring sites closest to the coast. California has near-shore controls on OGV SOx emissions, however, sulfates are long-lasting once formed in the atmosphere. The coastal REDW, PINN, and RAFA monitoring sites may also be affected more by offshore sources, because they are located in remote areas with few other large SOx-emitting sources nearby. The current visibility at PINN and RAFA, while over 50 percent towards the 2018 RPG since the baseline period, are not improving as quickly as some of the other sites in California. No further analysis is included for RAFA and PINN because their current conditions years also include Worst Day values with high wildfire contributions in 2007 and 2008. In contrast, visibility improvement at PORE is progressing more quickly, because it is much closer to emissions reductions in a highly urbanized area.

Table 3

*(See **Table 3a** for technical corrections to "Best Days 2007-2011" and "Visibility Change" on Best Days)*

Statewide 2018 Reasonable Progress Goal Summary

IMPROVE Monitor	California Class I Area(s)	Best Days Baseline (dv)	Best Days (2007-2011) (dv)	Visibility Change (dv)	Worst Days Baseline (dv)	Worst Days (2007-2011) (dv)	Visibility Change (dv)	2018 RPG (dv)	Progress to 2018 RPG by 2011
NORTHERN CALIFORNIA									
TRIN	Marble Mountain W. Yolla Bolly-Middle Eel W.	3.4	3.2	0.2	17.4	**15.2**	2.1	**16.4**	210%
LABE	Lava Beds N.M. South Warner W.	3.2	2.8	0.4	15.1	**13.0**	2.1	**14.4**	300%
LAVO	Lassen Volcanic N.P. Caribou W. Thousand Lakes W.	2.7	2.5	0.2	14.1	**15.6**	-1.5	**13.3**	-188%
SIERRA CALIFORNIA									
BLIS	Desolation W. Mokelumne W.	2.5	2.2	0.3	12.6	**13.0**	-0.4	**12.3**	-133%
HOOV	Hoover W.	1.4	1.3	0.1	12.9	**11.5**	1.4	**12.5**	350%
YOSE	Yosemite N.P. Emigrant W.	3.4	2.9	0.5	17.6	**16.0**	1.6	**16.7**	178%
KAIS	Ansel Adams W. Kaiser W. John Muir W.	2.3	1.6	0.2	15.5	**14.9**	0.6	**14.9**	100%
SEQU	Sequoia N.P. Kings Canyon N.P.	8.8	7.9	0.9	25.4	**22.3**	3.1	**22.7**	115%
DOME	Dome Lands W.	5.1	5.1	0	19.4	**18.3**	1.1	**18.1**	85%
COASTAL CALIFORNIA									
REDW	Redwood N.P.	6.1	5.6	0.5	18.5	**18.5**	0	**17.8**	0%
PORE	Point Reyes N.S.	10.5	9.1	1.4	22.8	**21.6**	1.2	**21.3**	80%
PINN	Pinnacles W. Ventana W.	8.9	8.0	0.9	18.5	**17.5**	1.0	**16.7**	56%
RAFA	San Rafael W.	6.4	5.5	0.9	18.8	**18.0**	0.8	**17.3**	53%
SOUTHERN CALIFORNIA									
SAGA	San Gabriel W. Cucamonga W.	4.8	4.5	0.3	19.9	**18.0** ***(2005-2008)***	1.9	**17.4**	76% by 2008
SAGO	San Gorgonio W. San Jacinto W.	5.4	4.5	0.9	22.2	**18.7**	3.5	**19.9**	152%
AGTI	Agua Tibia W.	9.6	7.4	2.2	23.5	**19.8**	3.7	**21.6**	195%
JOSH	Joshua Tree N.P.	6.1	5.3	0.8	19.6	**16.1**	3.5	**17.9**	206%

W = Wilderness N.M. = National Monument N.P. = National Park N.S. = National Seashore

Table 3a (Errata Sheet)

(Revised with technical corrections for "Best Days 2007-2011" and "Visibility Change" for Best Days)

Statewide 2018 Reasonable Progress Goal Summary

IMPROVE Monitor	California Class I Area(s)	Best Days Baseline (dv)	Best Days (2007-2011) (dv)	Visibility Change (dv)	Worst Days Baseline (dv)	Worst Days (2007-2011) (dv)	Visibility Change (dv)	2018 RPG (dv)	Progress to 2018 RPG by 2011
NORTHERN CALIFORNIA									
TRIN	Marble Mountain W. Yolla Bolly-Middle Eel W.	3.4	3.0	0.4	17.4	**15.2**	2.1	**16.4**	210%
LABE	Lava Beds N.M. South Warner W.	3.2	2.9	0.3	15.1	**13.0**	2.1	**14.4**	300%
LAVO	Lassen Volcanic N.P. Caribou W. Thousand Lakes W.	2.7	2.3	0.4	14.1	**15.6**	-1.5	**13.3**	-188%
SIERRA CALIFORNIA									
BLIS	Desolation W. Mokelumne W.	2.5	2.1	0.4	12.6	**13.0**	-0.4	**12.3**	-133%
HOOV	Hoover W.	1.4	1.3	0.1	12.9	**11.5**	1.4	**12.5**	350%
YOSE	Yosemite N.P. Emigrant W.	3.4	2.5	0.9	17.6	**16.0**	1.6	**16.7**	178%
KAIS	Ansel Adams W. Kaiser W. John Muir W.	2.3	1.5	0.8	15.5	**14.9**	0.6	**14.9**	100%
SEQU	Sequoia N.P. Kings Canyon N.P.	8.8	7.6	1.2	25.4	**22.3**	3.1	**22.7**	115%
DOME	Dome Lands W.	5.1	4.9	0.2	19.4	**18.3**	1.1	**18.1**	85%
COASTAL CALIFORNIA									
REDW	Redwood N.P.	6.1	5.8	0.3	18.5	**18.5**	0	**17.8**	0%
PORE	Point Reyes N.S.	10.5	8.6	1.9	22.8	**21.6**	1.2	**21.3**	80%
PINN	Pinnacles W. Ventana W.	8.9	7.8	1.1	18.5	**17.5**	1.0	**16.7**	56%
RAFA	San Rafael W.	6.4	5.2	1.2	18.8	**18.0**	0.8	**17.3**	53%
SOUTHERN CALIFORNIA									
SAGA	San Gabriel W. Cucamonga W.	4.8	4.5 *(2005-2008)*	0.3	19.9	**18.0** ***(2005-2008)***	1.9	**17.4**	76% by 2008
SAGO	San Gorgonio W. San Jacinto W.	5.4	4.0	1.4	22.2	**18.7**	3.5	**19.9**	152%
AGTI	Agua Tibia W.	9.6	7.1	2.5	23.5	**19.8**	3.7	**21.6**	195%
JOSH	Joshua Tree N.P.	6.1	4.8	1.3	19.6	**16.1**	3.5	**17.9**	206%

W = Wilderness N.M. = National Monument N.P. = National Park N.S. = National Seashore

4. Assessment of Changes Impeding Visibility Progress

As discussed in the RH Plan, in California, there are three factors, largely beyond State control, that can interfere with progress towards improved visibility in Class 1 Areas: wildfire smoke, offshore shipping emissions, and Asian dust. These factors are either from natural sources (wildfire smoke), uncontrollable sources (shipping emissions beyond California's jurisdiction), or both (Asian dust, a combination of anthropogenic and natural sources beyond California's control.)

Each factor can produce a spike in the sampling record measuring concentrations of each haze species. Whether wildfire smoke originates in California or is transported from out of state, the signature appears as elevated organic carbon concentrations that can last for several consecutive sampling days or weeks, depending on the size of the fire.

Pacific offshore shipping emissions from vessels burning sulfur-containing fuels, have increased dramatically in the last decade due to shifts in the global economy. These SOx emissions form sulfates, with higher levels near the California coastline, likely due to the higher humidity along the shoreline enhancing sulfate formation. Sulfates are normally elevated during the summer at all California monitors. They can be the secondary driver of haze at some monitors on Worst Days when elevated organic carbon is the primary driver. California has controlled both in-port and near-port shipping emissions with recently adopted measures. These controls have dampened the impact of shipping emissions, but cannot offset the changes beyond the State's jurisdiction. The RH Plan estimated that more than 50 percent of the sulfate measured at the California coastal monitors was beyond the State's control.

Asian dust, which has been identified by small amounts of marker soil elements at high elevation IMPROVE monitors, has the most visible influence in the spring. At that time, seasonal windstorms in the Asian deserts load the atmosphere with geologic dust. As these strong winds move across eastern Asia, the natural dust combines with, and is coated by, industrial pollution. These pollution-laden winds enter the jet stream crossing the Pacific Ocean and their plumes are visible in satellite photos. Asian dust is detected at the IMPROVE monitors as episodes of coarse mass and fine soils on single days, March through May, when these two haze species spike at the same time at many monitors in a region. Depending on other sources affecting a particular monitor, Asian dust events may elevate normal measurements sufficiently to cause occasional Worst Days in California. The WRAP Summary Report has more information about these regional transported dust episodes.

Wildfires are occurring more frequently. The largest wildfires in California, measured in acreage burned since 1950, occurred in the first decade of the 21st century. Figure 4 illustrates this increase.[8,9]

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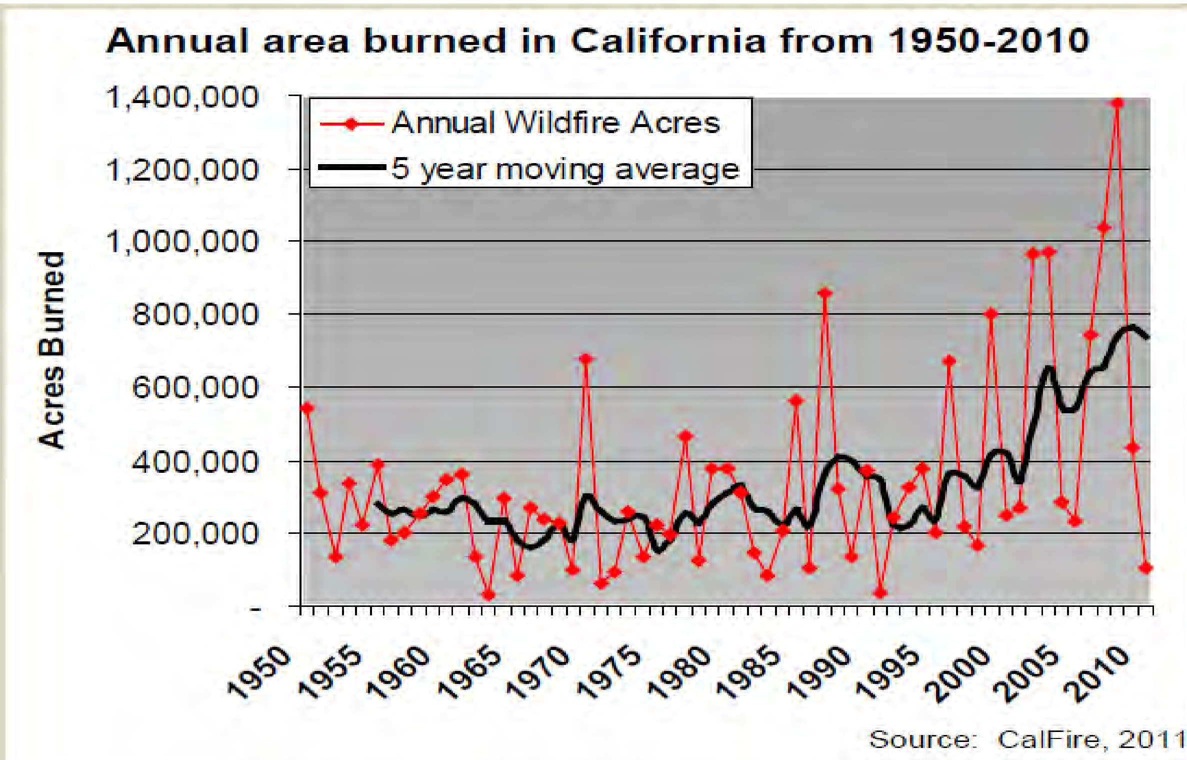
[8] *http://oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsReport2013.pdf, p. 137.*
[9] *http://frap.fire.ca.gov/assessment/assessment2010/document.html, 2010 graph.*

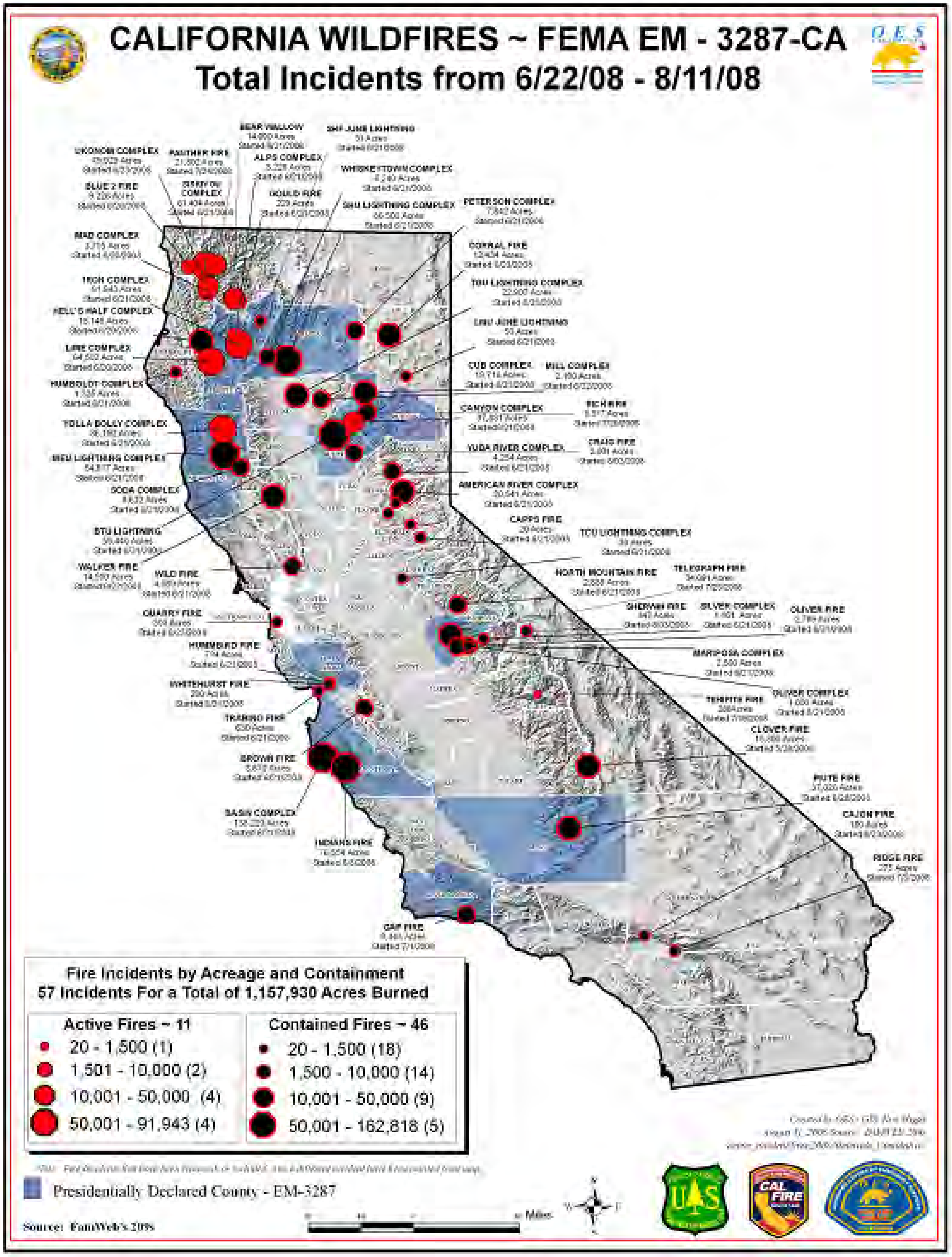
Figure 4
Wildfire Acreage Burned in California



Wildfires cause organic carbon concentrations to increase significantly on days when wildfire smoke reaches a Class 1 Area, often remaining high for several consecutive days or even weeks. Organic carbon is the largest contribution to light extinction on those days, sometimes making the deciview level high enough to skew the annual Worst Days average. Further analysis of which haze species cause the Worst Days, and their timing, clearly implicates wildfire smoke as a challenge that impacts California on a regular basis.

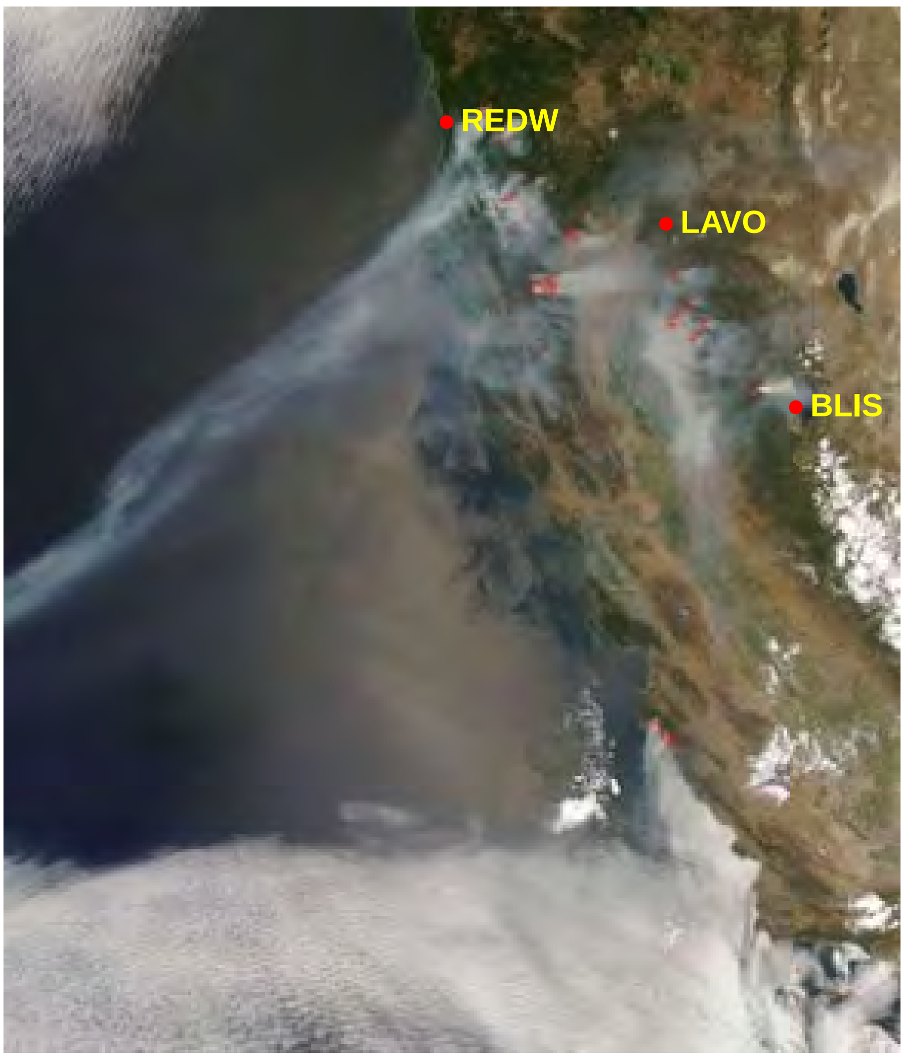
In 2008, Northern, Sierra, and Coastal California were particularly affected by a large number of wildfires known collectively as the 2008 Lightning Strike Complex. Wildfire smoke began June 22 and did not die out until after the last ignition in August. Figure 5 shows the name, location, and size of these fires, many of which burned and smoldered beyond their containment date. This smoke directly impacted the Class 1 Areas and had an overwhelming impact on visibility progress at many monitoring sites throughout California and the west.

Figure 5
The 2008 "Lightning Strike Complex"



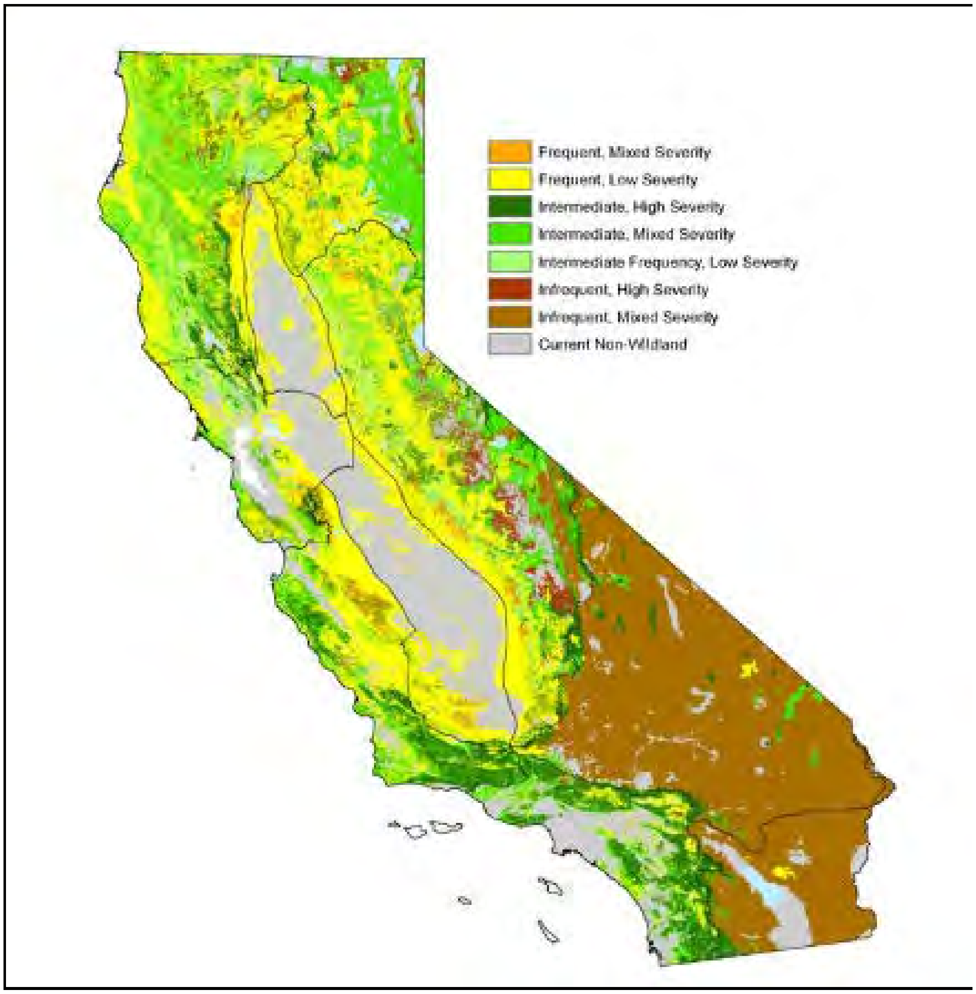
The satellite image in Figure 6 shows the extent of smoke plumes during the summer of 2008, almost three weeks after lightning strikes first ignited the dozens of wildfires throughout the State. The image shows how wildfire smoke can be transported far beyond its origin. The image also shows the wildfire smoke proximity to the REDW, BLIS, and LAVO monitoring sites. These were the only monitors in California, based on 2007-2011 data, where current visibility progress was less than halfway towards reaching the 2018 RPGs. The technical analysis of long-term deciview trends, monitoring data not impacted by wildfires, and anthropogenic emissions, found in Appendix D, demonstrates that visibility is otherwise improving at these locations.

Figure 6
NASA Satellite Photo: July 9, 2008



The California Department of Forestry and Fire Protection (CalFire) estimates that 80 percent of the State is considered wildlands, with a range of fire frequency and severity as shown in Figure 7.[10] California's Class 1 Areas are all susceptible to wildfires. Even Joshua Tree National Park, the only Class 1 Area partially within an area which infrequently burns, is directly downwind of smoke plumes from frequent and severe fires burning in the San Bernardino and San Jacinto Mountains. Depending on when and where they occur, wildfires will continue to be an impediment to reaching natural conditions in the future.

Figure 7
Wildfire Frequency and Intensity



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[10] *California Department of Forestry and Fire Protection, Draft Vegetation Treatment Program Environmental Impact Report, October 30, 2012, Chapter 4 and Figure 4.2.1.*

5. Assessment of Current Control Strategy

The RH Plan Control Strategy is sufficient for meeting California's 2018 RPGs. The recent IMPROVE data year, 2011, shows that all sites for the year 2011 are below the 2018 RPGs. In addition, California continues to strengthen existing control measures due to the severity of the air quality problem. California is currently developing SIPs for the 75 ppb 8-hour ozone standard and the 12 ug/m3 annual PM2.5 standard which are due in the 2016 timeframe. This provides strong evidence that California is on track to meeting the 2018 RPGs throughout the State.

The RH Plan control strategy is also sufficient to lessen California's impact on neighboring states. In the RH Plan, California determined that the State contributed about three percent or less nitrate on Worst Days at Jarbridge Wilderness Area, Kalmiopsis Wilderness Area, Crater Lake National Park, Sycamore Canyon Wilderness Area, and Grand Canyon National Park. In the RH Plan, the NOx emissions were forecast to decrease about 40 percent in California by 2018. Now, California NOx emissions are decreasing by almost 60 percent between 2000 and 2020, exceeding what was in the RH Plan.

6. Visibility Monitoring Strategy

California will continue to rely on the IMPROVE network to collect and analyze the visibility data. During the current reporting period, the SAGA monitor was destroyed by the Station Fire in August of 2009. The site was re-established in October of 2011. The U.S. Forest Service (USFS) and their contractors were able to collect data and calculate light extinction for parts of 2009 and 2011. There was sufficient data for averaging four years, 2005-2008, used as the current reporting period for SAGA without data substitution. There are no current recommendations for changing the monitoring locations.

7. RH Plan Commitments and Continued Consultation

In the RH Plan, California committed to update the 2018 RPGs with the latest WRAP modeling if appropriate. Since submission of the RH Plan, WRAP has not updated the modeling for the California 2018 RPGs. California will continue to examine refinements to the Natural Conditions targets, given the increases in wildfires in California.

ARB staff regularly confers with other western states to discuss mutual concerns and strategies for reducing haze, through the WRAP and the Western States Air Resources Council (WESTAR.) ARB staff participated in the WESTAR Regional Haze Subcommittee, which developed recommendations regarding continued implementation of the Regional Haze Rule. These recommendations were presented to the U.S. EPA in August of 2013. ARB staff also consulted with the other western states, regarding whether anthropogenic sources or controllable activities in California affected the progress towards 2018 RPGs of these states. There is general agreement that smoke emissions from wildfires, especially in 2007, 2008, and 2009, did impact other States.

In turn, smoke emissions from Oregon wildfires sometimes impacted California Class 1 Area monitors. California has determined that absent these natural wildfire smoke impacts, visibility is improving sufficiently due to reduction of anthropogenic emissions, in-state and out-of-state.

ARB staff also meets routinely with the Federal Land Management Agencies (FLMs) with Class 1 Areas in California to review visibility progress, to share technical and research information, and to discuss policies leading to air quality improvement. This occurs at the staff level throughout the year at Interagency Air and Smoke Council meetings and through senior management meetings of ARB, air districts, CalFire, and FLM representatives in the State at the Air and Land Managers meetings. California provided the draft Progress Report to the FLMs sixty days in advance of the public notice of the hearing on the Progress Report, for their review and comments. Appendix E includes their written comments and the responses from ARB staff.

8. Adequacy of Regional Haze Plan

California is making adequate progress overall in improving visibility due to reductions in emissions from RH Plan control strategy. The trends for Worst Days averages show visibility improving at every monitoring site, in the absence of very high wildfire years. Current Best Days are all better or the same as those of the baseline period. As evidenced by reductions in anthropogenic source emissions in California and the concurrent improvement in visibility at all of California's Class 1 Area IMPROVE monitors, California determines the current RH plan strategies are sufficient for California and its neighboring states to meet their 2018 RPGs. In accordance with the requirements of the RHR, California has determined that no further substantive revision of the RH Plan is warranted at this time in order to achieve the 2018 RPGs for visibility improvement.

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