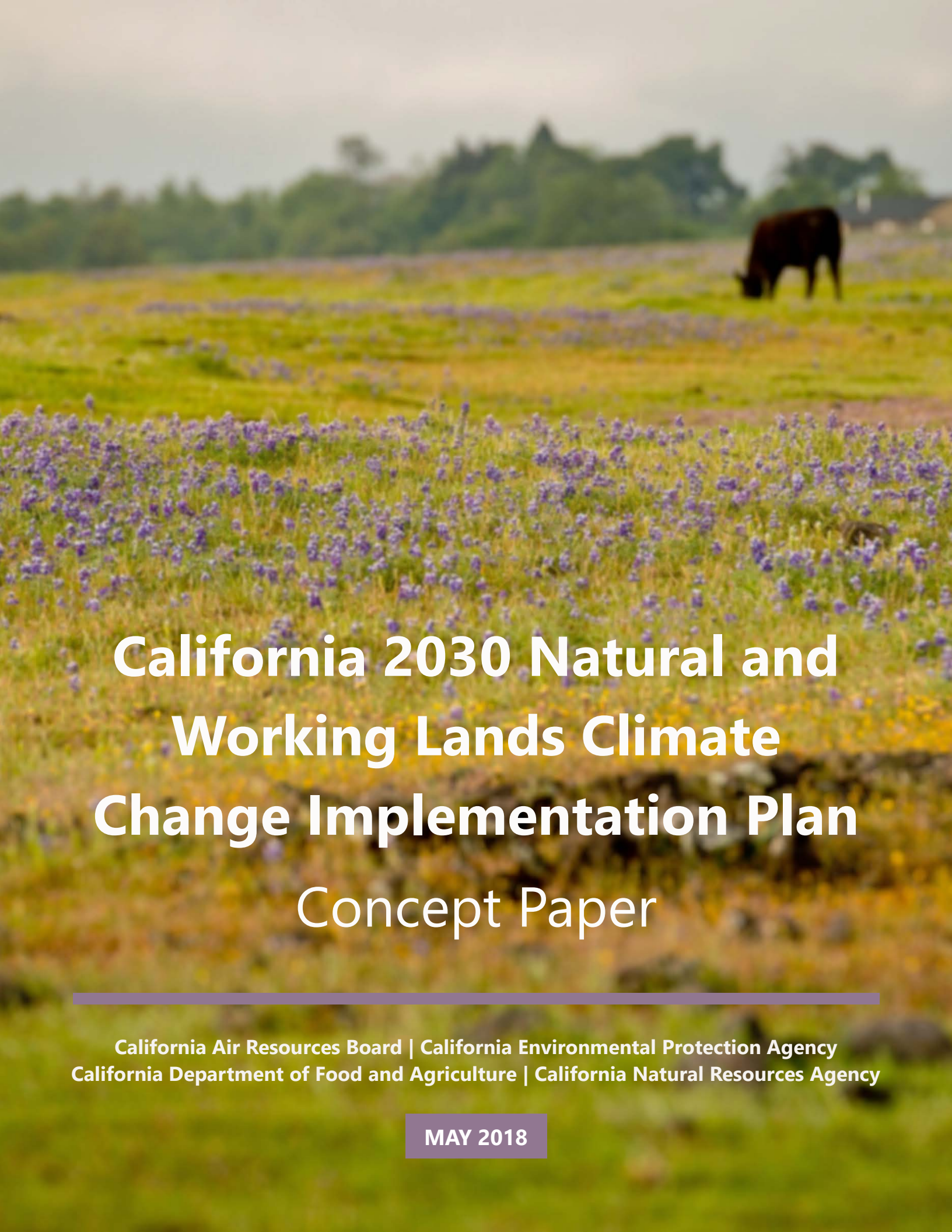

California 2030 Natural and Working Lands Climate Change Implementation Plan

Concept Paper

California Air Resources Board | California Environmental Protection Agency
California Department of Food and Agriculture | California Natural Resources Agency

MAY 2018

FOREWORD

This Concept Paper provides a proposed outline for the California Natural and Working Lands Climate Change Implementation Plan with the aim of gathering feedback and discussion from the public to inform the final Plan. It describes:

A. The **directive** to create an Implementation Plan as outlined in the *2017 Scoping Plan Update: The strategy for achieving California's 2030 greenhouse gas target*;
B. The **scope** of the Implementation Plan;
C. The tools to be used for **setting a 2030 GHG reduction goal**; and
D. The framework and process for **developing, implementing, and tracking progress on** the Implementation Plan and its associated goals.

An **Appendix** outlines the proposed **conservation, restoration, and management activities** that will be employed through state-funded investments to sequester carbon on natural and working lands, and the California Department of Agriculture (CDFA), California Environmental Protection Agency (CalEPA), and the California Natural Resources Agency (CNRA) programs that may contribute to these activities by 2030.

Comments on this concept paper can be submitted by June 15, 2018 to the California Air Resources Board Natural and Working Lands webpage, https://arb.ca.gov/cc/natandworkinglands/natandworkinglands.htm.

OVERVIEW

The Natural and Working Lands Implementation Plan (Implementation Plan) sets California on an ambitious path forward for using forests, farmland, ranchland, grasslands, wetlands, and urban land to mitigate climate change while enhancing their resilience to worsening climate change impacts. Although natural and working lands can remove carbon dioxide from the atmosphere and sequester it in soil and vegetation, disturbances such as severe wildfire, land degradation, and conversion can cause these landscapes to emit more carbon dioxide than they store. The Implementation Plan will identify the scope and scale of activities that California can undertake to mitigate these disturbances and enhance the resilience of natural and working lands, increasing their ability to sequester carbon and provide health, social, economic, and environmental benefits.

The final Implementation Plan will identify an ambitious but achievable 2030 greenhouse gas (GHG) reduction goal for natural and working lands and will provide a blueprint to achieve this goal by building capacity through State-funded conservation, restoration, and management activities. The activities described in the Implementation Plan will include State-supported conservation, restoration, and management efforts implemented through programs at CalEPA, CDFA, and CNRA and their boards, departments, and conservancies. Implementation will occur on state-owned lands or be funded with State dollars on private, federal, and other public lands, and will require collaboration with all interested parties.

Implementation will aim to achieve the State's **vision** for the Natural and Working Lands sector to:

- **Protect** land from conversion to more intensified uses by increasing conservation opportunities and pursuing local planning processes that avoid greenfield development;
- **Enhance** the resilience of and potential for carbon sequestration on lands through management and restoration, including expansion and management of green space in urban areas, and reduce GHG and black carbon emissions from wildfire and management activities; and
- **Innovate** biomass utilization such that harvested wood and excess agricultural and forest biomass can be used to advance statewide objectives for renewable energy and fuels, wood product manufacturing,

agricultural markets, and soil health, increasing the resilience of rural communities and economies and avoiding GHG emissions relative to traditional utilization pathways through these activities.

The Implementation Plan will rely on using identified activities (interventions) to contribute to the GHG reduction goal for natural and working lands. This intervention-based approach enables the State to set an achievable GHG reduction goal and to specify the extent of quantifiable activities that will be used to meet it. This approach offers flexibility, as the identified activities are scalable efforts that can be adjusted as natural ecosystem processes and the effects of climate change continue to shape our landscapes.

The Plan will introduce methods for tracking project and program implementation and performance monitoring for carbon sequestration, which is necessary to demonstrate the role natural and working lands play in meeting climate policy goals in the coming decades. While non-state funded strategies taken by federal agencies, local jurisdictions, and private entities are also important, methods to track these efforts have not yet been developed and are not within the scope of this Plan.

The goals established in the Implementation Plan will be one key step toward connecting our efforts on natural and working lands with the broader state climate strategy. Information collected through implementation of the Plan will be used to inform the next California Climate Change Scoping Plan, which will include activities on natural and working lands and identify relationships between land-based strategies and other approaches including energy-sector strategies.

The Implementation Plan will:

- Include a final statewide intervention-based sequestration goal, expressed in million metric tons (MMT) CO_2e, to be achieved through state-funded activities through 2030;
- Be informed by projections of GHGs emitted or sequestered from natural and working lands under different state-funded conservation, management, and restoration scenarios;
- Identify the statewide scope and scale of state-funded conservation, improved management and restoration treatments necessary to reach the carbon sequestration goal and potential regional goals, as well as the anticipated carbon sequestration benefits of these activities;
- Describe the process for Plan implementation at CNRA, CDFA, and CalEPA;
- Outline potential policy changes that may be leveraged as the State strives towards its 2030 intervention-based goal and the objective that natural and working lands act as a net carbon sink; and
- Describe activities necessary to incorporate natural and working lands into the State's long-term climate strategy and Scoping Plan.

INTRODUCTION

California will use an "all lands" approach for carbon sequestration and GHG reduction on natural and working lands that encompasses conservation, improved management, and restoration of wildland and urban forests, farms and ranches, grasslands, coastal and tidal wetlands, and subtidal habitat. This climate change strategy builds on California's long-standing conservation and resource management efforts and significant investments in programs and projects that yield climate benefits from natural and working lands.

Historically, voter-approved water, habitat, flood, and conservation bonds have funded multiple benefit projects and programs on natural and working lands, including Proposition 12 in 2000, Proposition 50 in 2002, Proposition 84 in 2006, and Proposition 1 in 2014, among others. These bonds leveraged investments in watershed, coastal, and riparian restoration; forest and agricultural land protection and management; and local and regional parks that resulted in water supply, biodiversity, health, and community benefits. Many of these bond-funded programs advanced strategies that increased carbon storage on and the resilience of natural and working lands, even if carbon sequestration was not their explicit goal.

California's natural and working lands climate change strategy is also an evolution from early inclusion of forest and agricultural lands in greenhouse gas (GHG) reduction strategies in the form of compliance offsets used in the cap-and-trade program within the CARB Compliance Offsets Program and in broader Scoping Plan policy. GHG reduction and carbon sequestration has been part of the Compliance Market Offset Program since 2011, when the first protocols were developed for forest management, urban forests, and livestock digester projects. CARB has developed and approved land-based protocols for rice cultivation and additional forest practices. As of May 9, 2018, California forest offset projects have sequestered a total of 19,340,603 $MTCO_2e$; these offset projects are expected to continue to sequester carbon beyond baseline levels for many decades to come.

In 2014, the state added funding from California Climate Investments for natural and working lands. These direct climate investments funded by the Cap-and-Trade program total more than $600 million over the past four years, about 10% of total California Climate Investment appropriations **(Box 1)**. Implemented projects to date are expected to reduce an estimated 4.27 MMT CO_2e over project lifetimes and additional benefits will come from projects funded but not yet implemented. These programs fund conservation easements on forests, farms and ranches; wetland restoration in the Sacramento-San Joaquin Delta and along the coast; meadow restoration in the Sierra foothills; active forest management to restore forest health and mitigate the risk of catastrophic wildfire; agricultural practices to increase soil carbon; and urban forestry and other urban greening activities, including parks and trails to encourage active transportation. In addition to protecting lands, removing GHGs from the atmosphere, and sequestering carbon, these programs deliver other benefits by restoring lands that have been degraded by fragmentation, over-grazing, topsoil loss, severe forest fires, and other processes; creating new green space in cities; keeping farmland in production; and helping ecosystems adapt to changing climate conditions.

BOX 1 – California Climate Investments for Natural and Working Lands

More than $600 million in California Climate Investments have been invested in natural and working lands across programs including but not limited to:

- CAL FIRE's Forest Health Program
- The Sustainable Agricultural Lands Conservation Program through the Strategic Growth Council and Department of Conservation
- CDFA's Healthy Soils Program
- The Wildlife Conservation Board's Climate Adaptation Program
- CNRA's Urban Greening Grant Program
- The Department of Fish and Wildlife's Wetland Restoration for Greenhouse Gas Reduction Program
- The Coastal Conservancy's Climate Ready Program

CARB, CNRA, CDFA and other partnering agencies will measure and track both the estimated benefits of these management, restoration, and conservation programs from all current and future funding sources as well as program or project performance through expected GHG reductions. To achieve this, agencies will leverage existing quantification and reporting structures and utilize new tools and internal reporting systems to simplify and standardize the tracking progress with a consistent and cost-effective monitoring regime.

A. DIRECTIVE

In his 2015 State of the State address, Governor Brown established 2030 targets for GHG emission reductions and called for policies and actions to reduce GHG emissions from natural and working lands, including forests, rangelands, farms, wetlands, and soils. In 2016, these policy objectives were codified through passage of Senate Bill (SB) 32 (Pavley, Chapter 249, Statutes of 2016) and SB 1386 (Wolk, Chapter 545, Statutes of 2016). SB 32 commits California to reducing emissions 40 percent below 1990 levels by 2030, and SB 1386 identifies the protection and management of natural and working lands as a key strategy towards meeting this ambitious GHG reduction goal. Specifically, SB 1386 directs state agencies to consider the carbon sequestration potential of natural and working lands when revising, adopting, or establishing policies, regulations, expenditures, or grant criteria relating to their protection and management.

Consistent with this direction, the 2017 Scoping Plan Update restates that reducing GHG emissions from and increasing carbon sequestration in natural and working lands is crucial in the State's long-term climate change strategy. It outlines climate objectives for natural and working lands: to maintain them as a resilient carbon sink (i.e., net zero or even negative GHG emissions) and sets a preliminary goal to reduce GHG emissions by at least 15 – 20 MMT CO_2e by 2030. CARB Resolution 17-46 further directs the CARB Executive Officer to work with the CNRA, CDFA, CalEPA, and other agencies to reevaluate the 15 – 20 MMT CO_2e 2030 quantitative goal by September 30, 2018 and determine if the goal should be adjusted in light of ongoing analyses to estimate the GHG mitigation potential of natural and working lands.

Agencies will report to the Board on their reconsideration of the goal and any adjustments made to as part of the annual update on the implementation of the Scoping Plan in 2018. To accomplish these objectives, both the 2017 Scoping Plan and CARB Resolution 17-46 direct CNRA, CDFA, CalEPA, and CARB, to complete the Natural and Working Lands Climate Change Implementation Plan by November 2018. The final Implementation Plan and the 2030 NWL intervention-based goal will orient many state funded conservation and restoration activities towards an ambitious but achievable GHG emission reduction goal. The Plan will facilitate integration of California's land base into California's comprehensive climate change strategy and the next Scoping Plan update.

B. PLAN SCOPE

The Natural and Working Lands Plan will seek to increase carbon sequestration and reduce GHG emissions in and on California's forests, farms, ranches, grasslands, wetlands, sub-tidal habitats and cities, while enhancing their resilience to threats including worsening climate change impacts. The conservation, management and restoration activities the State will promote as part of this strategy are listed in **Table 1** and are further described in the **Appendix,** *Proposed Management Activities*. The scope of the 2030 Plan will focus on demonstrated practices that sequester carbon and are currently funded by State agencies. Implementation will also seek to include land management activities not currently included in modeling efforts and activities for which the carbon flux science is still emerging. These practices will be integrated into the Natural and Working Lands strategy on an ongoing basis.

TABLE 1 – Proposed Management Activities. The Implementation Plan will describe the targeted extent of the following conservation, restoration, and management activities for carbon sequestration and other benefits.

Land or Ecosystem Type	Conservation, restoration, and management activities
Cultivated lands	Soil conservation practices including cover cropping, reduced-till, no-till, mulching and compost application; riparian area restoration; conversion to herbaceous or woody cover
Rangelands	Compost amendment; prescribed grazing; riparian area restoration
Forests	Fuel reduction; understory treatment; prescribed burning; less-intensive forest management; partial cut (thinning); reforestation; enhanced biomass utilization
Coastal areas and the Sacramento San-Joaquin Delta	Coastal marsh restoration; seagrass restoration; Delta wetland restoration
Ecological restoration on other lands	Mountain meadow restoration; oak woodland restoration; forest expansion
Urban areas	Urban forest expansion; urban greening
All land types	Protection of land from conversion

The scope of the natural and working lands GHG reduction goal associated with the Implementation Plan will correspond generally with the scope of CARB's Natural and Working Lands Greenhouse Gas Emissions Inventory (NWL Inventory), which estimates the carbon contained in ecosystems at points in time and the GHG flux associated with changes in carbon stocks (described in **Section C,** *Tools to set a 2030 Goal).* Both the NWL inventory and the GHG goal account for soil carbon, above-and below-ground live biomass, standing and downed dead wood, and carbon stored in durable wood products, as well as carbon dioxide and methane emissions from wildfire events and forest management activities and methane emissions associated with coastal wetlands restoration activities. The Implementation Plan will also account for carbon sequestration resulting from additional State-supported activities not included in NWL Inventory, such as sediment carbon and seagrass restoration, in achieving GHG goals.

That said, the success of reaching carbon sequestration goals for natural and working lands overlaps and interacts with other sectors as defined in the CARB GHG Emission Inventory for transportation, electricity, commercial/residential, industrial, agricultural, and waste management sectors. For example, carbon sequestration is inherently tied to land use and development decisions that affect both the permanence of forest or agricultural lands and the emissions associated with the transportation sector and built environment. Active management practices intended to increase the resilience and volume of carbon sequestration in forests statewide will generate biomass that may interact with and generate emissions in the energy, transportation fuels, and waste sectors. Gaining a better understanding and accounting for these interactions will be part of the complete integration of natural and working lands into climate strategy and the next Scoping Plan update.

C. TOOLS TO SET A 2030 GOAL

The final goal for sequestration and emissions from natural and working lands, expressed in MMT CO_2e, will be informed by both CARB NWL Emission Inventory data and expected GHG benefits of various State-funded conservation, restoration, and management activities. Projections for expected GHG benefits of targeted conservation, restoration, and management activities will be developed through CALAND, an integrated stock-change carbon and GHG accounting model and the COMET-Planner tool for agricultural land management practices. These tools are described below, and the technical makeup and results of inventory and projection analyses will be described in the Implementation Plan.

CARB Natural and Working Lands Emissions Inventory (NWL Inventory)

The NWL Inventory provides a retrospective estimate of carbon stocks, stock-change, and resulting GHG flux associated with stock change in California's natural and working lands, and attributes stock changes to disturbances. CARB is updating the NWL Inventory and will publish a draft for public review in fall 2018. The updated inventory will indicate the overall natural and working lands GHG flux, which will help show whether and how much recent GHG emissions from the land base differ from the long-term objective of maintaining this sector as a net sink of carbon. If the NWL Inventory indicates that lands are currently a net source of emissions, then the focus of the Implementation Plan must be on making up for losses by establishing a land base that can sequester more carbon in the future, avoiding GHG emissions in sector, and protecting the existing carbon stock.

If the NWL Inventory indicates that lands are currently a net sink, then the focus of the Implementation Plan can be protecting the existing carbon stock and increasing sequestration to set a path for the deeper reductions needed by 2050. This deeper GHG goal would reflect that natural and working lands' ability to generate negative emissions, or net sequestration, is essential in achieving those broader climate goals. In setting the intervention-based natural and working lands goal, agencies will thus assess the potential for increasing sequestration over a long-time horizon as part of the State's GHG reduction targets. A zero or negative emissions goal for NWL would be guided by existing ecosystem and resource management needs and objectives, including biodiversity, water quality and supply, and agricultural viability.

Because the NWL Inventory cannot currently run projections, the CALAND model, which utilizes initial carbon state and land cover types derived from NWL Inventory data and other sources, and COMET-Planner will be utilized; they are described below.

California Natural and Working Lands Carbon and Greenhouse Gas Model (CALAND)

The California Natural and Working Lands Carbon and Greenhouse Gas Model (CALAND) is an empirically based landscape-scale carbon accounting model that assesses the projected GHG benefits of certain conservation, restoration, and management activities on California's natural and working lands. It is a database carbon accounting model that quantifies the changes in landscape carbon dynamics (stock and flux) resulting from different levels of management, land use and land cover changes, and potential climate change scenarios. Version 1 of the model was developed from August 2016 to December 2016 and Version 2 through October 2017; Version 3 will be completed in July 2018.

Rather than showing absolute GHG emissions, CALAND compares the difference in expected GHG emissions that result from alternative land use and management scenarios. The scenarios represent different input levels of state-funded conservation, restoration, and management activities that are not included in the baseline case. Constructing alternative scenarios to run in comparison to the BAU requires identifying the management activities to be implemented **(Table 1; Appendix)** and the scale of implementation for each activity (e.g., acres under a given management practice or acres of avoided conversion).

At least three scenarios will be run through the model using aggregated potential acreages of implementation for each management and restoration practice, and assumptions for avoided anthropogenic land use change:

- ***Baseline scenario (no-intervention)****:* This scenario represents avoided GHG emissions and sequestration resulting from no additional State conservation, restoration, and management beyond mandatory regulations and policies, such as compliance with California Forest Practice Rules.
- ***Business-as-usual alternative scenario (maintaining California's current track)****:* This scenario will simulate avoided GHG emissions and sequestration if existing State-funded activities are assumed to

continue at current levels through 2030. It is based on projecting out current and recent historic levels of conservation, restoration, and management with state dollars on public and private land.

- ***Ambitious alternative scenario****:* This scenario will represent a more aggressive approach than the business-as-usual scenario, requiring additional funding for existing programs and planned activities as well as new programs and policies.

The planned process for developing the acreage targets for the business-as-usual and ambitious alternative scenarios to run through the CALAND model is described below, in Section **D-1**. The outputs for CALAND's business-as-usual and ambitious scenarios will be compared against the no-intervention baseline to determine the potential change in sequestration and emissions resulting from state-funded conservation, restoration, and management activities. This information will help agencies evaluate what may be feasible to accomplish with state interventions in the natural and working lands sector.

The business-as-usual and ambitious scenarios land use and management scenarios will include activities implemented through 2030, and the model will run to 2100. State agencies may consider applying management practices after the 2030 timeframe to assess the longer-term impact of ongoing management, as the duration of impact of alternative land management and restoration practices is not assumed to be indefinite. These additional model runs will be important in determining the long-term potential of these practices to continue to reduce emissions and increase resilient carbon sequestration over time.

CALAND will output the expected GHG benefits, expressed in MMT CO_2e, resulting from implementation of given alternative land use and management scenario. The results will be compared to the draft emission reduction goal in the Scoping Plan (15 – 20 MMT CO_2e) to determine whether the scale of implementation can be expected to yield GHG benefits above or below that draft goal. This comparison will indicate whether the scale of implementation needs to be more aggressive, and whether the mix of management and restoration activities should be modified. This information will help evaluate what may be feasible to accomplish with State interventions in the NWL sector.

COMET-Planner

COMET-Planner was developed by the United States Department of Agriculture and University of Colorado to estimate GHG emissions and carbon sequestration of different management practices. It is a tool used to assess the net climate benefits of a suite of management practices on cultivated land and grazing land, including some restoration and vegetative cover activities. CDFA and CARB have worked with COMET-Planner developers to fine-tune a California version of the tool for use in CDFA's Healthy Soils Program. For the purposes of the Natural and Working Land Implementation Plan, COMET-Planner can provide projections for a number of agricultural practices that are under consideration to help the state meet climate targets. A process similar to the one described above for CALAND will be used for COMET-Planner practices to compare carbon sequestration and avoided GHG emissions from a business-as-usual and ambitious management and restoration scenario.

D. PROCESS FOR NATURAL AND WORKING LANDS IMPLEMENTATION PLAN DEVELOPMENT AND IMPLEMENTATION

This section describes the process for setting the 2030 GHG goal and developing, implementing, and tracking progress towards the Implementation Plan. It outlines how the CARB NWL Inventory, CALAND model, and COMET-Planner described above will be used together to develop the Implementation Plan and associated goals and to monitor progress.

1. Developing implementation targets for conservation, restoration, and management on natural and working lands for the Implementation Plan

To develop State targets for the extent of implementation of different land management activities, CNRA and CDFA surveyed their programs, departments and conservancies in early 2018 to assess the area of conservation, restoration, and management activities they would expect to complete by 2030 under both current and more ambitious funding levels. The purpose of this task was to set goals that are grounded in existing programmatic efforts for natural and working lands. The potential scale of implementation was estimated for all management activities that will be included in the Implementation Plan **(Table 1; Appendix)** for which the State anticipates funding, regardless of whether the programs that fund these activities have a primary goal of carbon sequestration.

Information was gathered to inform two alternatives to the baseline scenario, as described in the previous section: a business-as-usual scenario and a more ambitious implementation scenario. The business-as-usual scenario reflects the expected scale of implementation to 2030 assuming funding consistent with current levels and expected future funding from bonds, California Climate Investments, and other sources. The more ambitious scenario includes additional acreage that could be accomplished with supplementary resources, including funding and on-the-ground personnel and resource management professionals. Some departments and conservancies based the ambitious scenario on existing resource management and restoration plans or goals such as the Bay Plan, State Wildlife Action Plan, or Sierra Nevada Watershed Improvement Program.

A stakeholder outreach effort will elicit feedback for potential revision of the acreage targets for natural and working lands. This process will seek to engage practitioners, Resource Conservation Districts, land trusts, NGOs, nonprofits, and local, regional, and tribal governments through regional meetings and additional conversations. Stakeholders will be asked to provide feedback on whether the business-as-usual and ambitious scenarios consider regional priorities and conservation, restoration, and management projects on natural and working lands. Additionally, this process will aim to elicit existing regional conservation, restoration, and acreage goals that should be represented, especially in ambitious scenarios for the Implementation Plan. This process will aim to help agencies understand what is needed for successful regional implementation.

CARB, CNRA, and CDFA and other agencies will use projections from CALAND and COMET-Planner derived from finalized acreage targets to better understand the estimated impact state-funded activities could have on meeting the near-term GHG reduction and carbon sequestration goal. These projections will help show the potential aggregate GHG outcomes of management practices pursued by various State agencies and departments through 2030, 2050, and 2100. These projections will provide an outlook of how far State efforts may help California reach its carbon outcomes for natural and working lands, and whether these activities will need to be scaled up to reach 2030 or more ambitious carbon goals. Projections will be compared with cost effectiveness numbers to determine whether the input acreages represented a reasonable suite of strategies.

2. Reassessing the 2030 intervention-based goal for the Implementation Plan

At the December 2017 hearing, the Air Resources Board (Board) directed CARB staff to reassess the preliminary 2030 intervention-based goal of sequestering 15 – 20 MMT by 2030 by September 2018, prior to the release of the Implementation Plan. The Board also suggested that the final goal, and identification of actions for meeting it, should consider the relative contribution to GHG emissions and carbon sequestration of each land type, the available options for land management to reduce GHG

emissions and increase carbon sequestration, and the relative cost and effectiveness of the available land management options. CARB staff will work with CalEPA, CNRA, and CDFA to reevaluate the 2030 goal based on available information including, but not limited to:

- CARB's NWL Inventory: This information will indicate the current status of California's NWL and the magnitude of the source or a sink and allow us to assess the adequacy of the NWL goal, as well as the relative contribution to GHG emissions and carbon sequestration;
- CALAND and COMET business-as-usual and ambitious scenarios: This information will help evaluate what may be feasible to accomplish with identified State interventions in the NWL sector;
- Other published, peer-reviewed academic literature on California's land-based climate mitigation potential;
- Information related to the cost effectiveness of the identified activities collected from various sources including reported data for California Climate Investment projects: This information will provide a total estimated cost of achieving the goal and to determine whether the scenarios represent a reasonable suite of strategies; and
- Public input on approaches and data sources.

3. Developing and releasing a final 2018 Implementation Plan

The final Implementation Plan will be released by November 2018. It will include the extent of restoration, conservation, and management activities needed to reach the revised GHG reduction goal through 2030. The Plan will provide additional context on how actions will be prioritized in the near and long-term, considering non-carbon factors such as other climate benefits, cost-effectiveness, geographic, environmental, social, and economic suitability, health outcomes, and permanence. Additionally, it will discuss other policy changes, beyond the activities funded to reach the intervention-based goal, that the State could leverage to meet long-term goals for net zero or negative GHG emissions.

4. Implementing the Plan and tracking progress

Once the Plan is finalized, CNRA, CDFA, CalEPA, and CARB will work to implement the Plan through existing conservation, management, and restoration programs and new efforts, as needed. Implementation will include the organization of existing, and initiation of additional, State-funded activities on both private and public lands. It will require coordination across multiple policy and regulatory areas, including forest and agricultural lands, water quality, biodiversity conservation, and local and regional development and planning. Departments and programs that are expected to engage directly are listed in **Box 2**.

BOX 2 – Implementation of the Natural and Working Lands climate strategy is anticipated to involve departments and programs including but not limited to:

- CDFA's Healthy Soils Program
- CNRA's Urban Greening, Environmental Enhancement and Mitigation, and California EcoRestore Programs
- CAL FIRE's Forest Health Grant Program, Urban and Community Forestry Grant Program, California Forest Improvement Program, and Fire Prevention Grants
- The Department of Conservation's Sustainable Agricultural Lands Conservation Program; and Williamson Act Program
- Various programs at the Department of Fish and Wildlife, Department of Water Resources, Ocean Protection Council, and Wildlife Conservation Board
- The State Coastal Conservancy's Climate Ready Program

Multiple agencies will coordinate to annually report on progress towards acreage targets identified in the Implementation Plan. The contents of this reporting will be identified in the Implementation Plan, and is expected to include statewide, regional, and land type-specific (e.g., forests, agricultural lands, wetlands)

breakdowns of progress in terms of both acres protected and brought under management, and expected GHG reduction outcomes for implementation. The expected GHG reduction and carbon sequestration outcomes for CNRA programs will be generated using CALAND and other methods, or future versions of CALAND as necessary. CDFA will utilize COMET-Planner and existing quantification methodologies developed as part of California Climate Investments to quantify the expected emissions reductions and sequestration benefits of all funded projects. The expected carbon sequestration outcomes for activities funded through the Greenhouse Gas Reduction Fund will be generated through quantification methodologies used by California Climate Investment programs. Agencies will also seek to report on advancement of carbon co-benefits, including linkages to existing resources management plans like the State Wildlife Action Plan, the California Water Action Plan, and the Forest Carbon Plan.

To evaluate actual (versus expected) GHG outcomes of projects and assess progress towards meeting the 2030 GHG goal, CNRA seeks to utilize funding authorized in Proposition 68 for GHG emissions program monitoring to develop a consistent approach for monitoring carbon sequestration outcomes available to all bond, and other, funded programs. This will help agencies understand the effectiveness of specific programs in reducing GHG emissions and increasing the volume and resilience of carbon sequestration.

In addition to tracking progress towards the 2030 goal, the Implementation Plan will rely on programs and structures in place to monitor progress towards the long-term objective of net zero or negative emissions. The CARB NWL Inventory will serve as an inventory of record for this sector, tracking progress on the long-term objective. The NWL Inventory will provide a snapshot of the status of California's natural and working lands in recent years. Over time, CARB's retrospective NWL GHG inventory will capture the effects of implemented interventions, along with any impacts from regulatory and policy changes and other gains or losses that occur over the same timeframe.

5. Natural and working lands goals in the next Scoping Plan Update

Experience and information from executing the Implementation Plan will inform goals for natural and working lands in the next Scoping Plan Update. Information may include carbon sequestration and other outcomes of interventions; new data, methods, and practices as they are developed; and new understanding of the interactions among emissions and emission reductions in this and other sectors.

APPENDIX: PROPOSED MANAGEMENT ACTIVITIES FOR THE IMPLEMENTATION PLAN

This section describes the proposed land use, management, and restoration activities the State will leverage to meet the goals of the Implementation Plan. The activities are organized into groupings for similar resources and practices: land protection; management practices on forest lands; management practices on agricultural lands (including cultivated lands and rangelands); restoration of Delta, ocean, and coastal areas; ecological restoration on other natural lands; and management practices in urban areas. CALAND modeling will produce estimated carbon benefits of the activities included in this Concept Paper and included in the 2030 intervention-based goal, as described in the process above. Additional practices for natural and working lands modeled outside of CALAND will be included in the final Implementation Plan with a description of methods that will be used to measure the GHG benefits of these practices.

The practices provide a multitude of ecosystem and societal co-benefits by improving biodiversity, supporting water supply, encouraging climate smart food production, increasing public health, and making available important recreation and education opportunities.

While the practices are listed individually here, CALAND can be used to model the effects of multiple land use and management practices applied to the same area. Layering practices may change the expected duration of and GHG impacts from what is listed for individual practices here. For example, putting in place a conservation easement that mandates one of the listed management or restoration practices would increase the permanence of expected GHG outcomes, since that management practice would be required to be ongoing, rather than a one-time activity. The impacts of layering practices, and permanent land conservation in particular, will be explored through planned sensitivity analyses prior to finalizing Version 3 of CALAND and can also be explored in running alternative scenarios.

The final Implementation Plan will also apply an ecoregional lens to these activities to capture place-based environmental conditions, sequestration opportunities, and collaborations. The State recognizes that success in implementing the Plan and meeting California climate goals will depend on empowering individual landowners to pursue sequestration opportunities, and on supporting new and existing collaborations that advance diversified, landscape-scale efforts.

ECOLOGICAL RESTORATION

Mountain Meadow Restoration	
Activity	Restoration of meadows in mountain regions. This is modeled as a land type change from shrubland, grassland, and savanna to meadow and woodland, which will change carbon dynamics according to the specific land type conversions.
Carbon pool(s) impacted	Above- and below-ground live vegetation, dead biomass, soil carbon
Duration of effect	Net soil carbon accumulation rates for meadow begin in the year following the prescribed implementation year. Any carbon losses and associated GHG emissions accrue in the implementation year. Restored meadow area persists throughout the simulation - area restored does not convert to another land type.
Implementing agencies	Department of Fish and Wildlife (CDFW), Department of Parks and Recreation (DPR), Department of Water Resources (DWR), Wildlife Conservation Board (WCB); Tahoe and Sierra Nevada Conservancies
Oak Woodland Restoration	
Activity	Reestablishment of oak woodlands on grasslands and cultivated lands. This is modeled as establishment of oak woodlands on currently unforested grasslands and cultivated lands.
Carbon pool(s) impacted	Above- and below-ground tree canopy and understory vegetation, soil carbon

Duration of effect	Net carbon accumulation rates for woodland begin in the year following the prescribed implementation year. Any carbon losses and associated GHG emissions accrue in the implementation year. Restored woodland area persists throughout the simulation - area restored does not convert to another land type.
Implementing agencies	DPR; State Coastal and Santa Monica Mountains Conservancies

LAND PROTECTION

Land Protection	
Activity	Reduced conversion of natural and working lands to urbanized land. This is modeled as a reduction in the business-as-usual (BAU) urban area growth rate, for example, by reducing the rate of urbanization to 75% of the BAU. The land types affected differ by region and ownership, and the specific land type areas are converted in proportion to each year's land type area distribution within a given region and ownership. Reduced conversion can also be directed to a specific region and ownership.
Carbon pool(s) impacted	Above- and below-ground live vegetation, dead biomass, soil carbon. If forest is converted in the course of urbanization, the disposition of the removed trees is the same as for even-aged forest management (i.e., full clearing).
Duration of effect	This is determined by the prescribed reduction in urban area growth rate selected for the Alternative Scenario. If the reduction halts growth indefinitely, then no more lands will be converted to urban area, otherwise a specified level of conversion continues. If the growth rate increases during a simulation, then conversion avoided earlier in the simulation will be subject to conversion later in the simulation. Note: this potential future loss of avoided conversion is currently viewed as a gap for improvement within CALAND, since the State also wishes to model direct conservation in alignment with existing land use priorities. Direct conservation will be able to be implemented in CALAND Version 3, but preservation of certain acreages will be manual rather than programmed into the model. This is a priority for addressing in future versions of CALAND.
Implementing agencies	CDFW, Department of Conservation (DOC), Department of Forestry and Fire Protection (CAL FIRE), DPR, DWR, WCB; State Coastal, San Diego, Santa Monica Mountains, Sierra Nevada, and Coachella Conservancies

MANAGEMENT PRACTICES ON AGRICULTURAL LANDS[1]

Soil Conservation on Cultivated Lands	
Activity	Adoption of soil conservation practices - including cover cropping, reduced tillage, no-till, mulching, and compost – on traditionally managed cultivated lands. This suite of practices is modeled using a single factor derived from empirical data for cover cropping, reduced tillage, and compost amendment. The uncertainty range of this single factor captures the output values of all of the soil conservation practices included in the California COMET Planner, thus making it an appropriate proxy for the broader suite of practices.[2]
Carbon pool(s) impacted	Soil carbon

[1] The management practice for conversion to herbaceous or woody cover will be included and further described in the final Implementation Plan.

[2] The broad suite of practices includes: Add Legume Seasonal Cover Crop to Irrigated Cropland, Add Legume Seasonal Cover Crop to Non-Irrigated Cropland, Add Non-Legume Seasonal Cover Crop to Irrigated Cropland, Add Non-Legume Seasonal Cover Crop to Non-Irrigated Cropland, Add Mulch to Croplands, Intensive Till to No Till or Strip Till on Irrigated Cropland, Intensive Till to No Till or Strip Till on Non-Irrigated Cropland, Intensive Till to Reduced Till on Irrigated Cropland, Intensive Till to Reduced Till on Non-Irrigated Cropland.

Duration of effect	Altered soil carbon flux occurs only in the implementation year, resulting in an enhanced soil carbon accumulation in non-Delta soils and reduced soil carbon loss (GHG emissions) in Delta soils. The resulting increase in soil carbon will persist in non-Delta soils unless it is converted to a land type with lower soil carbon density or one that has a net loss of soil carbon, which may negate the accrued benefits. In contrast, the carbon benefit in Delta soils is primarily due to a reduction in GHG emissions, which would contribute to a long-term, cumulative benefit, barring any subsequent activity that generates more emissions than the reference. Repeated application of compost, or retreatment for soil conservation, would again alter soil carbon flux for the year of implementation.
Implementing agencies	CDFA, DPR, San Diego River Conservancy
Rangeland Compost Application	
Activity	Compost is applied to traditionally managed rangeland (grassland, savanna, and woodland land types in CALAND) and repeated either every 10 years or every 30 years. The base land type is traditionally managed rangeland.
Carbon pool(s) impacted	Soil carbon
Duration of effect	The decrease in annual soil carbon loss is annualized over the specified repeat period, so the scenario prescription needs to include the repeated treatment area at the appropriate interval. At the end of the repeat period the annual benefit ends. This is based on studies showing that the soil carbon benefit of a single compost application diminishes over time, and may eventually disappear over 100 years due to increasing emissions over time.
Implementing agencies	CDFA, State Coastal Conservancy
Prescribed Grazing[3]	
Activity	Managing the harvest of vegetation with grazing and/or browsing animals with the intent to achieve specific ecological, economic, and management objectives.
Carbon pool(s) impacted	Soil carbon
Duration of effect	COMET-Planner estimates assume that grasslands were previously overgrazed, leading to degradation and decreased soil carbon stocks. Prescribed grazing practices are assumed to improve grassland condition and productivity, which is expected to increase soil carbon stocks. Comet-planner models an annual benefit of carbon sequestration and/or emission reduction for each year that the practice is implemented. Eventually these stocks approach a new equilibrium condition and thus carbon dioxide removals do not continue indefinitely. The carbon dioxide reductions reported should be viewed as average values over a 20-year duration.
Implementing agencies	CDFA, DPR
Riparian Restoration	
Activity	Riparian trees, primarily oaks, are established on grassland or cultivated lands. This is modeled as an expansion of woodland area on the impacted acreage.
Carbon pool(s) impacted	Above- and below-ground tree canopy and understory vegetation, soil carbon
Duration of effect	The restored woodland area persists throughout the simulation. Carbon is lost from woodland soils annually, but is offset by greater carbon accumulation in trees and understory. The net ecosystem carbon gain is limited by the same mortality and fire processes as the rest of woodland.

[3] See https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1255132.pdf.

Implementing agencies	CDFA, DOC, DPR, DWR, WCB; Delta, Tahoe Conservancy, and San Diego River Conservancies

MANAGEMENT PRACTICES ON FOREST LANDS

Understory Clearing	
Activity	This activity entails clearing and removal of forest understory to support forest health objectives. It is considered a forest fire risk reduction treatment. This assumes that 50% of understory biomass is scattered as dead debris, and 50% goes into the slash pool, which is then pile burned (25%) or decays rapidly (75%).
Carbon pool(s) impacted	Above-ground live understory vegetation, dead biomass; this may also contribute to wood products and/or bioenergy through the slash removal pathway (see Increased Forest Biomass Utilization)
Duration of effect	The loss of stored carbon that results from this treatment and the GHG emissions from burning and decay accrue in the year of implementation. This practice enhances net forest carbon accumulation and reduces the fraction of high-severity wildfire for 20 years without additional treatment.
Implementing agencies	CAL FIRE, DPR; Tahoe and Sierra Nevada Conservancies
Prescribed Burning	
Activity	Prescribed burning for forest fire fuel reduction and ecological restoration. Prescribed burning can be modeled as in sequence with mechanical thinning if directed in the Alternative Scenario. Prescribed burning is modeled as ladder fuel collection and broadcast burning of understory and piled and/or scattered debris. This assumes burning understory vegetation (55% of total), downed dead material (53%) and litter (60%), and conversion of 45% of the understory to downed dead material. It also assumes 3% mortality of live trees.
Carbon pool(s) impacted	Above-ground live vegetation, dead biomass
Duration of effect	The loss of stored carbon that results from this treatment and the GHG emissions from burning accrue in the year of implementation. This practice enhances net forest carbon accumulation and reduces the fraction of high- severity wildfire for 20 years without additional treatment.
Implementing agencies	CAL FIRE, DPR; Sierra Nevada and Tahoe Conservancies
Partial Cut	
Activity	This activity entails a removal of a portion (20%) of the live canopy and standing dead trees, and is intended to support forest health objectives. It can be considered a forest fire risk reduction treatment. It represents a group of specific practices that require high levels of basal area to remain in the forest, such as uneven-aged management and thinning for fuel reduction, and is parameterized as average commercial thinning. This assumes that 96% of harvested trees are removed and utilized for forest products and bioenergy production, and the remaining 4% of harvested material goes into the slash forest pool, along with 70% of the understory and 42% of downed dead and litter material. The slash pool is assumed to either burn (25%) or decay rapidly (75%). The remaining 30% of understory is transferred to dead biomass pools, 19% of root biomass is transferred to the soil, and 13% and 3% of soil and root biomass decay to the atmosphere, respectively.
Carbon pool(s) impacted	Above- and below-ground live vegetation, dead biomass, soil carbon; this also contributes to wood products and/or bioenergy. Modeling assumes that 20% of the harvested biomass goes to durable wood products, 75% goes to energy, and 1% decays rapidly at the sawmill. Additional slash can be removed and utilized for wood products and/or bioenergy (see Increased Forest Biomass Utilization).

Duration of effect	The loss of stored carbon that results from this treatment and the GHG emissions from burning and decay accrue in the year of implementation. This practice enhances net forest carbon accumulation and reduces the fraction of high-severity wildfire for 20 years without additional treatment.
Implementing agencies	CAL FIRE, DPR, DWR
Less Intensive Forest Management	
Activity	This activity entails a change in forest management practices to a less intensive harvest regime, from even-aged management to uneven-aged management (partial cut) or areas of no harvest (reserve areas). It is modeled by moving acreage undergoing even-aged management in the BAU scenario to partial cut in the Alternative scenario, along with some areas of even-aged and partial cut to no harvest (reserves). Extending harvest rotation period can also be modeled as a reduction in annual harvest area (for either even-aged management or partial cut).
Carbon pool(s) impacted	Above- and below-ground live vegetation, dead biomass, soil carbon, wood products and/or bioenergy
Duration of effect	This is determined primarily by the prescribed scenario. Reducing forest management intensity in a given year likely reduces emissions and/or enhances carbon storage for that year, which may have some persistent effects, but the reduction needs to continue over time to ensure longer-term carbon and GHG benefits. If management intensity increases after a period of lower intensity, the previous benefits may be negated.
Implementing agencies	CAL FIRE, DPR, State Coastal Conservancy
Increased Forest Biomass Utilization	
Activity	Increase in the amount (percentage) of slash material diverted to bioenergy and wood products, away from pile burning and decay.
Carbon pool(s) impacted	Wood products
Duration of effect	These are one-time diversions and therefore impacts are one-time and permanent for each year in which increased utilization is implemented. Material diverted to wood products and bioenergy follows the respective storage to decay emission pathways.
Implementing agencies	CAL FIRE; Tahoe and Sierra Nevada Conservancies
Forest Area Expansion/ Reforestation	
Activity	Establishing forest on shrubland or grassland. Modeled as an increase in forest area. May include reforestation of non-regenerated forest area post-wildfire; this is being assessed in sensitivity analyses.
Carbon pool(s) impacted	Above- and below-ground live vegetation, dead biomass, soil carbon
Duration of effect	Net carbon accumulation rates for forest begin in the year following the prescribed implementation year. Any carbon losses and associated GHG emissions accrue in the implementation year. Restored forest area persists throughout the simulation - area restored does not convert to another land type.
Implementing agencies	CAL FIRE, DPR, Sierra Nevada Conservancy, WCB

RESTORATION OF COASTAL AREAS AND THE SACRAMENTO SAN-JOAQUIN DELTA

Delta Managed Fresh Wetland Restoration	
Activity	Conversion of cultivated lands to fresh managed wetlands in the Sacramento-San Joaquin Delta.

Carbon pool(s) impacted	Above-ground main canopy vegetation, soil carbon
Duration of effect	Net soil carbon accumulation rates for fresh wetland begin in the year following the prescribed implementation year. Note that net carbon accumulation includes losses due to methane emissions. Any carbon losses and associated GHG emissions accrue in the implementation year. Restored fresh wetland area persists throughout the simulation - area restored does not convert to another land type.
Implementing agencies	CDFW, DWR, Sacramento San-Joaquin Delta Conservancy, WCB
Coastal Marsh Restoration	
Activity	Creation of saline tidal wetlands on cultivated in coastal regions.
Carbon pool(s) impacted	Above-ground main canopy vegetation, soil carbon
Duration of effect	Net soil carbon accumulation rates for coastal marsh begin in the year following the prescribed implementation year. Note that there are no methane emissions for saline wetlands. Any carbon losses and associated GHG emissions accrue in the implementation year. Restored coastal marsh area persists throughout the simulation - area restored does not convert to another land type.
Implementing agencies	CDFW, DPR, DWR, State Coastal Conservancy, WCB
Seagrass Restoration	
Activity	Creation of sub-tidal seagrass beds where none previously existed.
Carbon pool(s) impacted	Above-ground main canopy vegetation, soil carbon (ocean sediment)
Duration of effect	Net sediment carbon accumulation rates for seagrass begin in the year following the prescribed implementation year. Restored seagrass area persists throughout the simulation. In reality, seagrass beds tend to be ephemeral, so the increase of acreage covered by seagrass beds in an Alternative scenario is meant to represent an increase in statewide coverage, above the BAU level, rather than consistent establishment at any given locale.
Implementing agencies	Ocean Protection Council, State Coastal Conservancy

URBAN FORESTS

Urban Forest Expansion	
Activity	Increase in the urban tree canopy above BAU level. This activity is limited to urbanized areas. Modeling includes mortality and disposal of urban trees as well as planting of new trees.
Carbon pool(s) impacted	Main canopy vegetation
Duration of effect	More urban forest area equates to greater net annual carbon accumulation in urban area, with accumulation limited by the prescribed mortality rate. The accrued carbon is retained unless urban area is converted to another land type with lower vegetation carbon density.
Implementing agencies	CAL FIRE, CNRA; San Diego and Santa Monica Mountains Conservancies