DRAFT - SUMMARY
JOINT STAKEHOLDER SCIENCE COMMITTEE AND STAKEHOLDER COMMUNITY COMMITTEE MEETING
LAKE TAHOE WEST RESTORATION PARTNERSHIP

Tuesday, December 5, 10:00 am to 3:30 pm
Lake Tahoe Basin Management Unit, 35 College Drive, South Lake Tahoe, CA 96150

All meeting materials are publicly available on the Lake Tahoe West website http://nationalforests.org/laketahoewest. For questions please contact the program manager/facilitator Sarah Di Vittorio at sdivittorio@nationalforests.org or (530) 902-8281.

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Meeting Synopsis

The Stakeholder Science Committee (SSC) and Stakeholder Community Committee (SCC) met jointly on December 5, 2017 from 10am to 4pm at the Lake Tahoe Basin Management Unit as the group transitions from Phase I to Phase II of the Lake Tahoe West collaborative project process. The main objectives of the meeting were to: (1) Learn about and discuss key findings of the Landscape Resilience Assessment (LRA), Version 1; (2) Consider what LRA findings mean for the goals of Lake Tahoe West; (3) Seek the SSC's recommendation to Executive Team on approval of the LRA, Version 1; and (4) Provide general updates on the Lake Tahoe West project. The next Stakeholder Science Committee meeting will be a webinar on January 9, 2018 from 1pm to 3pm.

Contents

Action Items and Next Steps

- **Sue Britting** will send suggested LRA edits to Ms. Di Vittorio.
- **Sarah Di Vittorio** will follow up SSC members not present at the meeting to seek comments and approval.
- **Shana Gross** will send Sue Britting the draft paper on climatic water deficit that the Design Team used to develop the resilience classes for that indicator.

Welcome, Agenda Review, and Introductions

Sarah Di Vittorio began the meeting with welcoming remarks and provided time for introductions. Teresa McClung, Forest Service Lake Tahoe Basin Management Unit, provided opening comments, and reflected back on passing the one year milestone for the Lake Tahoe West Collaborative.

Randy Striplin announced that he will be moving to work for the Regional Office, and will be reducing his role in the Lake Tahoe West initiative.

There were no interested party comments.

1. Refresher on Phase 1, Phase 2, and Lake Tahoe West Process

Ms. Di Vittorio began the first agenda item of the meeting with providing context for where the group is in the Lake Tahoe West project process. The project is at a transition point between wrapping up Phase I (The LRA) and beginning work on Phase II (Landscape Restoration Strategy). The next phases will be: Phase III (Restoration Project Planning and Documentation), Phase IV (Permitting), and Phase V (Implementation, Monitoring, Performance Measurement and Improvement).

Ms. Di Vittorio provided introductory comments on the Landscape Resilience Assessment, noting that the Assessment sought to use the best available, existing data. The LRA is a powerful framework, as it integrates across resource areas, and social and ecological values. However, it is important to note that the LRA is a data driven assessment tool, and not a project prioritization or planning tool, in and of itself. The final LRA released now is Version 1, and the group plans to have a Version 2 ready by the end of Phase II.

2. Landscape Resilience Assessment: Key Findings

Jen Greenberg presented the details and process of the LRA. The LRA process worked to: (1) define resilience, (2) determine the disturbances to resilience, (3) determine the indicators of these disturbances, and (4) analyze the landscape for the least resilient areas. The assessment used 31 indicators: 16 ranked, 3 proportional (over- or under- represented), 2 visual overlays, and 10 composite indicators (rollups of original 19 indicators – 16 ranked and 3 proportional). A large scale was used to observe impact and implications for management actions across the landscape. See attached slides for further detail.

Brian Garrett presented the results of the LRA, Version 1, which may be found in the Executive Summary. Refinements are being considered for Version 2, including the addition of “removed” or new indicators (dependent on data availability), the weighting of indicators, and the development of new composite indicators. See attached slides for further detail.

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Forest Schafer reviewed the main takeaways from the Ms. Greenberg's and Mr. Garrett's presentations, and proposed next steps for the LRA. The LRA will be used to inform development of potential and final "Landscape Restoration Strategies" in Phase II. Phase II includes modeling to assess the effectiveness of different landscape restoration strategies in the context of a changing climate. See attached slides for further detail.

Ms. Di Vittorio opened up conversation to the group, prefaced with the following questions: (1) What stands out to you as major findings? (2) New insights for Lake Tahoe West landscape? (3) Refinements for Version 2?

Discussion followed:

Q: How did you develop classes for Climatic Water Deficit?

- Climatic Water Deficit classes were based on research (draft paper), and partitioned where data showed spikes in mortality.
- **ACTION ITEM: Shana Gross** will send Sue Britting the draft paper on climatic water deficit that the Design Team used to develop the resilience classes for that indicator.

Q: Was species composition considered (white fir, etc.)?

- Species composition can be view as an overlay, but the layer only identifies the dominant species type. This made it difficult to use this as an indicator in the LRA. If better LiDAR data can be obtained, it will be integrated into LRA.
- The group recognized the importance of species composition. Species composition will be examined at the project level.

Q: Any surprises from the results?

- The human access indicator was surprising. With 75% of land within a ¼ mile of trials, roads, etc., it seemed to indicate that we may not need to open new roads or reopen ghost roads.
- The aquatic findings were startling: 80% of streams are impassable, 50% of streams have more non-native than native species.
- Horizontal/vertical structural diversity was higher than expected.
- Diversity may have been lost in categorizing seral stages - the landscape is more than just a homogeneous forest.
    - There is a lot of possible diversity within seral classes. Most of these areas are places that were cut at the same time, but came back at different rates.
    - This is an inherited landscape. Though it has had a lot of time to recover, there is plenty of opportunity to move the landscape in a different direction.
    - The group recognized that seral stage data may need more thinking/interpretation.
- Meadow refugia status did not appear to take into account connectivity status.
    - Connectivity was not a factor in determining which meadows were refugia.
    - Connectivity is still a beneficial feature for meadows, as it could help facilitate movement to refugia.

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The group recommended edits for the LRA Version 1, and suggested improvements for the LRA Version 2, detailed below:

Version 1 Edits:

- Include a paragraph about who the Design Team is, and describe the collaborative effort involved in the LRA in the Executive Summary/Preamble/About.
- Include web links in the document that direct readers towards project website (and/or supplementary documentation).
- Add a sentence to Executive Summary stating the LRA "highlights points the group feels may have a management implication."
- Include Mike Vollmer in citation.
- **ACTION ITEM: Sue Britting** will send suggested LRA edits to Ms. Di Vittorio.

Version 2 Edits:

- Include thematic composites (ex. PACs).
- If possible, integrate thematic composites/LRA locations/treatment prioritization into LANDIS modeling.
    - The foundation is currently being laid for this in Science Team meetings.
- Consider more opportunities for aquatic restoration.
- Q: Call out composite indicators more in Executive Summary?
    - Lack of emphasis on composite indicators in Executive Summary is a reflection of the role of composites in the LRA.
    - The last bullet has conclusions about composites.

3. SSC Recommendation on Landscape Resilience Assessment Approval

Ms. Di Vittorio performed a formal query to seek approval from the SSC to finalize the Version 1 of the LRA.

Agreement: By consensus of the five present 5 SSC members, the group agreed to recommend the document as a finalized account of the LRA, Version 1.

- **ACTION ITEM: Sarah Di Vittorio** to follow up SSC members not present at the meeting to seek comments and approval.

Ms. Di Vittorio wrapped up the conversation for a lunch break and recognized the group for their hard work in putting together the LRA, Version 1.

4. Small Group Discussion: Lake Tahoe West Goals

The main focus for the afternoon was to think about the Lake Tahoe West general landscape restoration goals. Sarah provided context for how the Draft General Goals were developed from the EMQs and how more refined goals will be used in the process moving forward.

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- Comment: Terminology (goals, objectives, etc.) is important. There is a need to standardize terms (Forest Service: goals, objectives, desired conditions).

Meeting attendees separated themselves into small groups and were asked to think about the following 3 questions:

1. How well do the DRAFT General Goals translate the Essential Management Questions? What additions or revisions would you suggest?
2. Based on the LRA findings, would you change or further refine any of the DRAFT General Goals?
3. In Phase II, we will aim to develop a consensus Landscape Restoration Strategy. What do you expect to be key tensions or trade-offs among the General Goals?

Group #	Question 1: How well do Draft General Goals translate the EMQs?
1	* Draft General Goals captured EMQs fairly well. * Thinking has changed - we are thinking about the landscape differently (socioecological vs. purely ecological). * Water quality needs more. * There should be a goal specifically for recreation - "maintain/restore rec benefits." * Cultural landscapes need representation.
2	* Missing some of the intricacies of the EMQs * Draft General Goals need to be more explicit. * Missing meadows, culturally/tribally significant areas, and aquatic habitat. *Goal 3: Needs more specificity on species composition. * Goal 4: Include more reference to reinforcing native species. * Goal 6: Carbon dynamics needs specificity.
3	* Goals lacked depth and texture of EMQs. * Take each of the EMQs, decompose them into goals, refine to reduce repetition. * Missing riparian, recreation.

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4	* Innovative tools and tradeoffs missing. * Need specificity (only included fire). * Timing of treatments? (short vs. long term). * Goal 1: When *a disturbance* (not just fire) occurs on a landscape, we want the landscape to be resilient. * Goals 5 & 6: Don't relate well to EMQs. Too nebulous, need more specificity. * Goal 7: "Recreation and community" should talk about community and cultural significance. * Need to address invasive species.
5	* Draft General Goals and EMQs translated fairly well. * Water quality wasn't emphasized enough. * Include "native" species in species composition and wildlife goals. * Include "upland" and "aquatic" species where necessary. * Streamlined, innovative, adaptive process is an important goal.

Group	Question 2: Based on LRA, changes or refinements to Draft General Goals?
1	* Key point - we don't have all the data to assess goals.
2	
3	* Some goal statements were not in the LRA (ex. use innovative tools). Had to figure out ways to include and identify usable metrics.
4	* "Improve," rather than "restore" heterogeneity. * Missing: aquatic, SEZ, meadows, soil health. * Human access result – what does that mean for our goals? * Soil health (tied into C dynamics, could be more specific).
5	* Need to determine how we track success into the future.

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Group	Question 3: Key tensions or tradeoffs among General Goals?
1	* Smoke/air quality vs. prescribed fire. * Recreation vs. restoration. * Only 25% of landscape isn't within a ¼ mile of a road/trail. Perhaps these areas need to be protected. * Build in future recreation.
2	* Smoke/Carbon/fire regimes
3	* Treatments vs. recreation. * Air quality vs. recreation. * Innovative tools vs. comfort in implementation. * Restoring fire vs. species management
4	* Fire resilience and other treatments vs. wildlife habitat. * Treatments vs. water quality.
5	* Fire vs. air quality. * Restoring vegetative structure vs. habitat, species, & carbon dynamics.

Discussion followed:

- Q: There is a lot of interest in recreation as a goal, but the Executive Team provided direction not to include recreation as a main goal of Lake Tahoe West – how should this be reconciled?
    - The group agreed that trail access and trail improvements should not be included in the restoration strategies, but that the strategies need to consider the impact of treatments to recreation, and specifically how to minimize the impact. There may also be complementarities between Lake Tahoe West projects and recreation improvements.
- Q: How many goals are too many?
    - The group needs to consider how the goals will be input into EMDS.
    - Are there some goals that should move to the forefront? Are there some goals that should be documented elsewhere (e.g. restoration goals versus operational goals)?
- The goals should consider the temporal impacts (short term vs. long term).
- The group needs to be careful about framing air quality in the goals. If prescribed fire is used, it will affect air quality. Goal to "minimize impacts to/from air quality?"
- The group needs to acknowledge that there will be tensions.
- Modeling should be used to help resolve some of the tensions.

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- The goals need to be measurable and interpretable, so that Lake Tahoe West can show that it is accomplishing what it set out to do.
- There may be discomfort in the lack of certainty in some of the data, especially in the context of public education.

5. General Business

To be responsive to modeling efforts and maximize the efficiency of the iteration process, Ms. Di Vittorio proposed the possibility of having more flexible SSC meeting dates in 2018. No objections were voiced.

Ms. Di Vittorio proposed the possibility of moving the upcoming 2018 Field Visit dates, since Conservancy staff have meetings on the first Wednesday of every month (when prior field visits were scheduled). Sarah proposed either first Mondays (before the stakeholder meeting) or second Tuesdays. Either option was acceptable to stakeholders.

Closing Remarks

Ms. Di Vittorio thanked everyone for a productive meeting, calling attention to the engagement, commitment, hard work and focus of the group as a whole.

There were no interested party comments.

Meeting Attendees

<u>Organizing and Participating Agencies</u>
CTC – California Tahoe Conservancy
NFF – National Forest Foundation
State Parks – California State Parks
TFFT – Tahoe Fire and Fuels Team
USFS LTBMU – U.S. Forest Service Lake Tahoe Basin Management Unit
USFS PNW – U.S. Forest Service Pacific Northwest Research Station
USFS PSW – U.S. Forest Service Pacific Southwest Research Station

Stakeholder Science Committee Members
1. Jeff Brown
2. Jennifer Quashnick
3. Matt Freitas
4. Sue Britting
5. Roland Shaw

Staff

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6. Beth Kenna,
7. Doug Barr,
8. David Reichel,
9. Maria Mircheva,
10. Savannah Rudroff,
11. Amy Jirka, TFFT
12. Kim Caringer, TRPA
13. Shana Gross, USFS LTBMU
14. Mason Bindl, TRPA
15. Pat Manley, USFS PSW
16. Kim Carr, NFF
17. John Warpeha, Washoe Tribe
18. Brian Garrett, USFS LTBMU
19. Daniel Shaw, State Parks
20. Forest Schafer, TFFT
21. Jason Vasques, CTC
22. Jen Greenberg, CTC
23. Randy Striplin, USFS LTBMU
24. Sarah Di Vittorio, NFF
25. Evan Ritzinger, NFF
26. Stephanie Coppeto, USFS LTBMU
27. Whitney Brennan, CTC
28. Mike Vollmer, TRPA

Interested Parties from the Public

29. Meredith Cowart, CONCUR Inc.
30. Jonathon Jansen, Placer County

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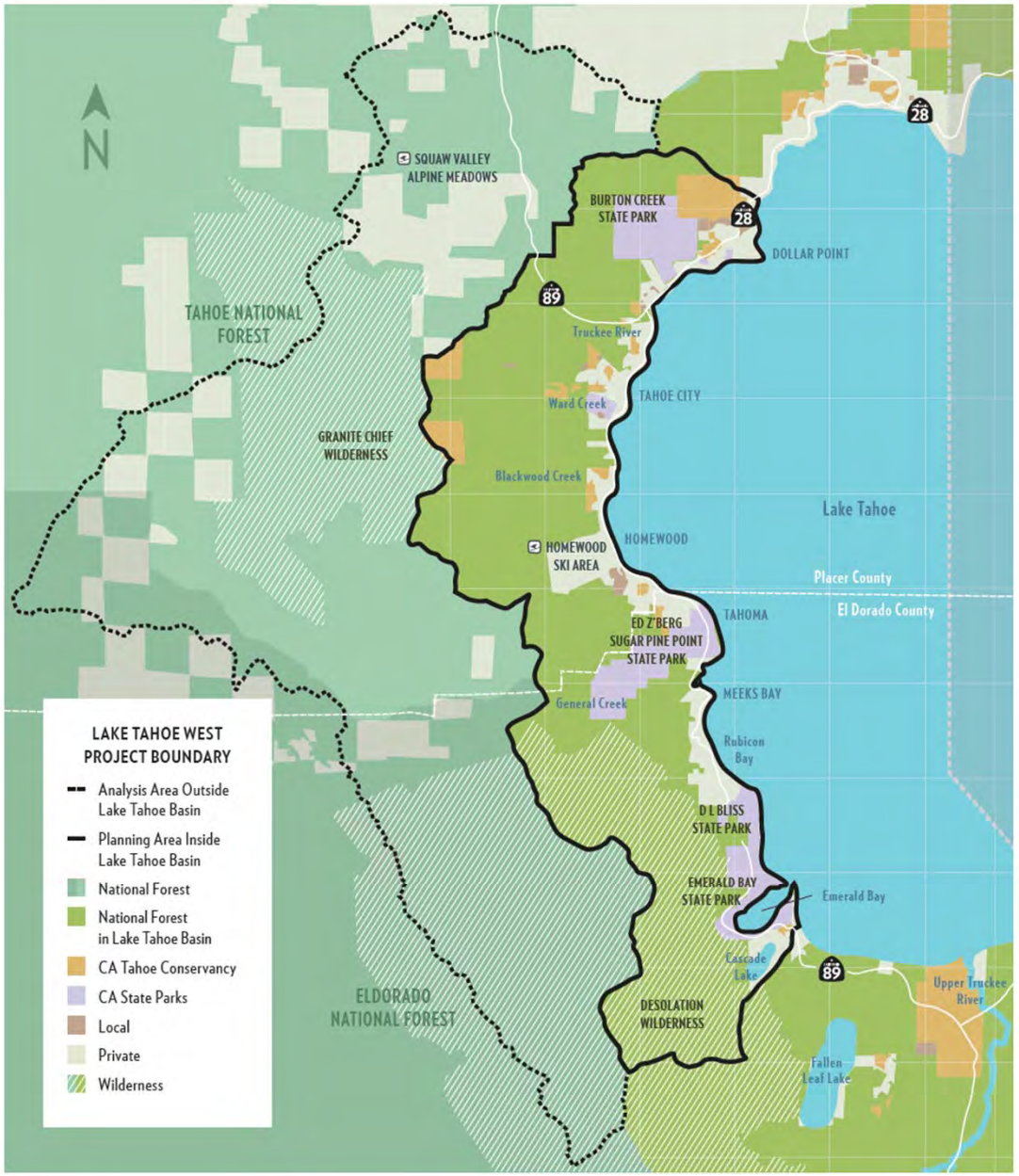
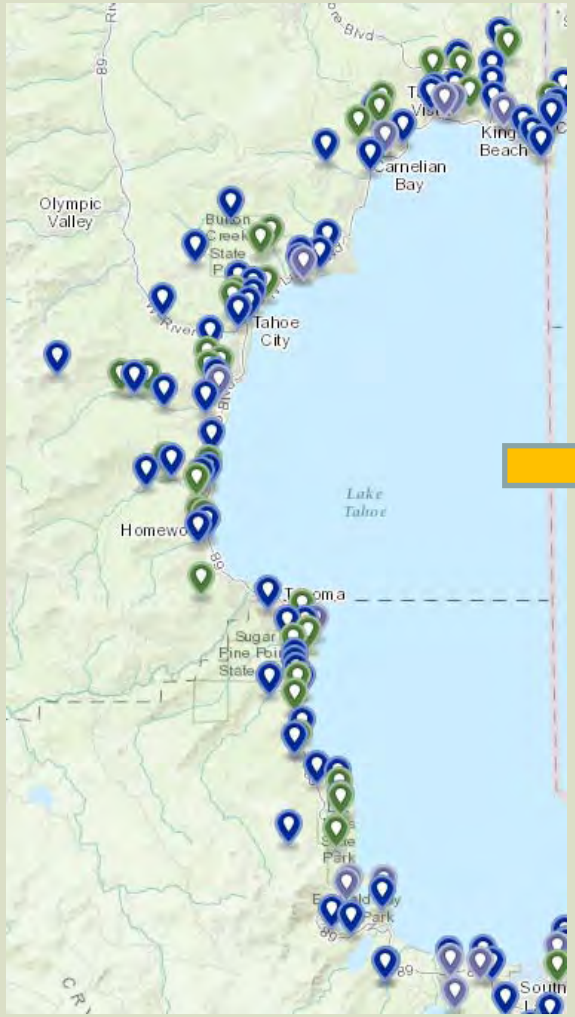

N
SQUAW VALLEY
ALPINE MEADOWS
BURTON CREEK
STATE PARK
28
DOLLAR POINT
89
TAHOE NATIONAL
FOREST
Truckee River
TAHOE CITY
Ward Creek
GRANITE CHIEF
WILDERNESS
Blackwood Creek
Lake Tahoe
HOMEWOOD
HOMEWOOD
SKI AREA
Placer County
El Dorado County
TAHOMA
ED Z'BERG
SUGAR PINE POINT
STATE PARK
MEEKS BAY
General Creek
Rubicon
Bay
D L BLISS
STATE PARK
EMERALD BAY
STATE PARK
Emerald Bay
Cascade
Lake
Upper Truckee
River
ELDORADO
NATIONAL FOREST
DESOLATION
WILDERNESS
Fallen
Leaf Lake
LAKE TAHOE WEST
PROJECT BOUNDARY
Analysis Area Outside
Lake Tahoe Basin
Planning Area Inside
Lake Tahoe Basin
National Forest
National Forest
in Lake Tahoe Basin
CA Tahoe Conservancy
CA State Parks
Local
Private
Wilderness

Project Approach

- Collaborative through all phases
- Integrates science from the start
- All-lands approach
- Scale of solution matches scale of problems

Project-by-project focus



Landscape project focus

Lake Tahoe West Restoration Partnership
Phasing Diagram
February 7, 2017

PHASE 1

Landscape Resilience Assessment

What would resilient forests and watersheds look like 20, 50, or 100 years in the future?

What elements and/or areas of the landscape are furthest from resilient conditions — are most "out of whack"?

July 31, 2017

PHASE 2

Landscape Restoration Strategy

If restored, what elements and/or areas would yield the greatest benefit for the landscape's resilience?

What are the greatest barriers to restoring the resilience of these elements and/or areas?

What are the most effective ways to accomplish this restoration?

June 30, 2018

PHASE 3

Restoration Project Planning & Documentation

How do we operationalize the strategy on the ground?

How do we sequence the project activities (or projects) in space and over time?

February 28, 2019 - *Stakeholder Science Committee Recommendation*

March 31, 2020 - *Record of Decision*

PHASE 4

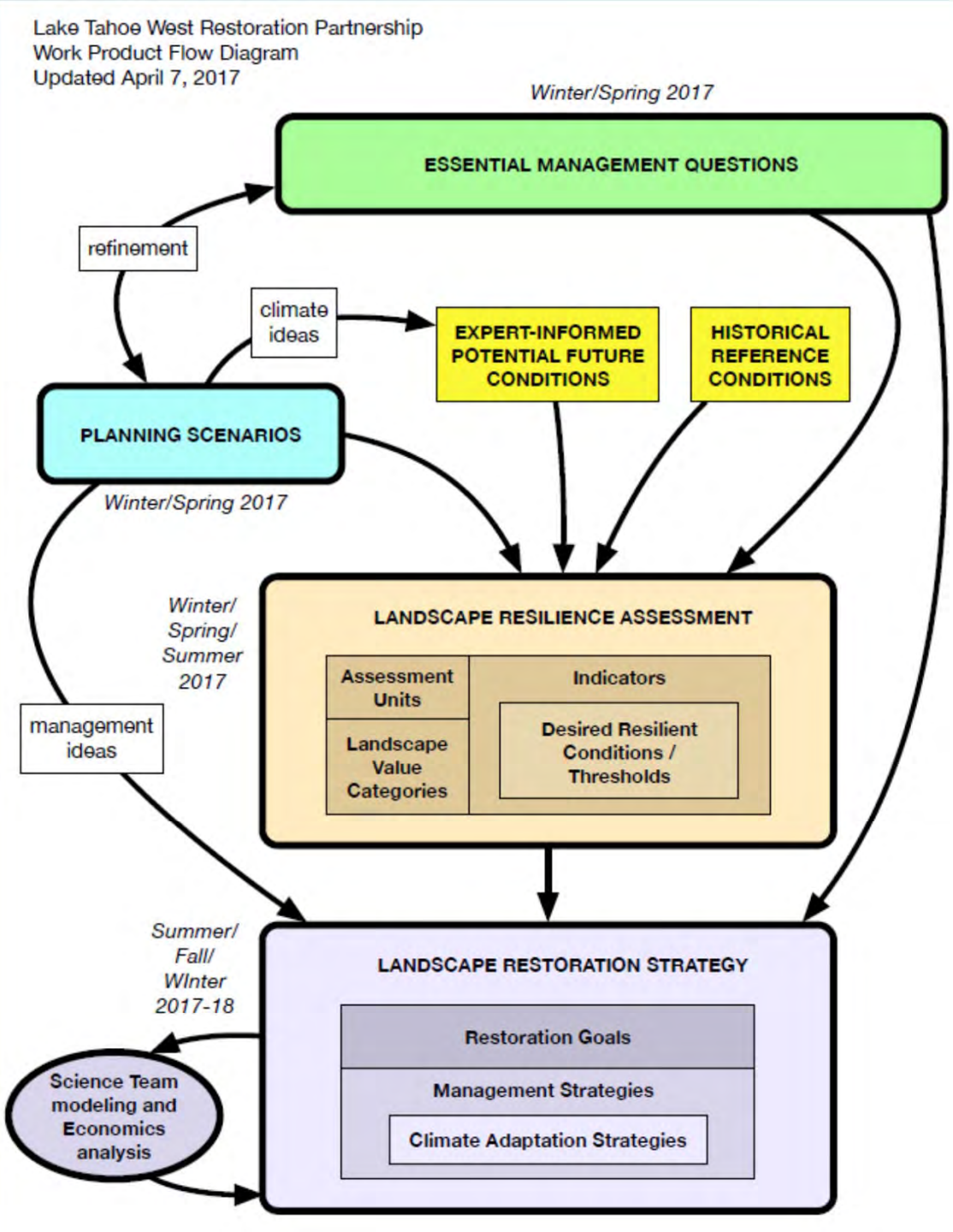
Permitting

June 30, 2020

PHASE 5

Implementation, Monitoring & Performance Measurement, and Improvement

Ongoing through August 31, 2025 and beyond


Lake Tahoe West Restoration Partnership
Work Product Flow Diagram
Updated April 7, 2017
Winter/Spring 2017
ESSENTIAL MANAGEMENT QUESTIONS
refinement
climate ideas
EXPERT-INFORMED POTENTIAL FUTURE CONDITIONS
HISTORICAL REFERENCE CONDITIONS
PLANNING SCENARIOS
Winter/Spring 2017
Winter/ Spring/ Summer 2017
LANDSCAPE RESILIENCE ASSESSMENT
Assessment Units
Indicators
Landscape Value Categories
Desired Resilient Conditions / Thresholds
management ideas
Summer/ Fall/ Winter 2017-18
LANDSCAPE RESTORATION STRATEGY
Restoration Goals
Management Strategies
Climate Adaptation Strategies
Science Team modeling and Economics analysis

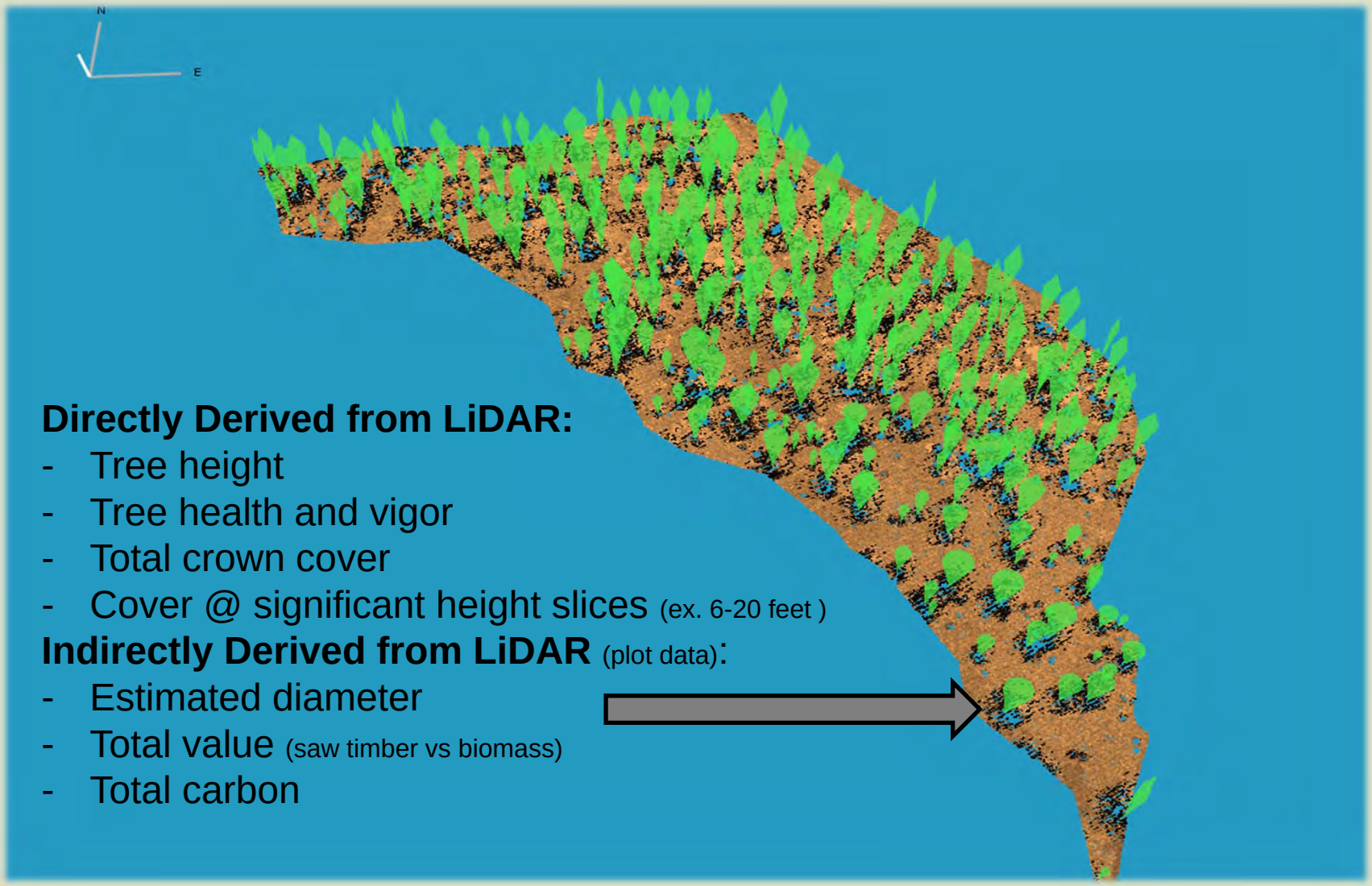
Indicators of Resilience

16 ranked	• Translate data sources into assessments of resilience
3 proportional	• Assess current vs desired proportions across the landscape
2 visual overlays	• Provide additional information
10 composite	• Resilience to disturbances • Resilience of landscape values and services

EcObject

EcObject

EcObject



Directly Derived from LiDAR:

- Tree height
- Tree health and vigor
- Total crown cover
- Cover @ significant height slices (ex. 6-20 feet)

Indirectly Derived from LiDAR (plot data):

- Estimated diameter
- Total value (saw timber vs biomass)
- Total carbon

EcObject

Resilient Conditions

Fire Severity		
Patch Size (All Veg Types)	Resilience Rank	Description
≤ 40 acres	0	Resilient
> 40 acres	1	Least Resilient

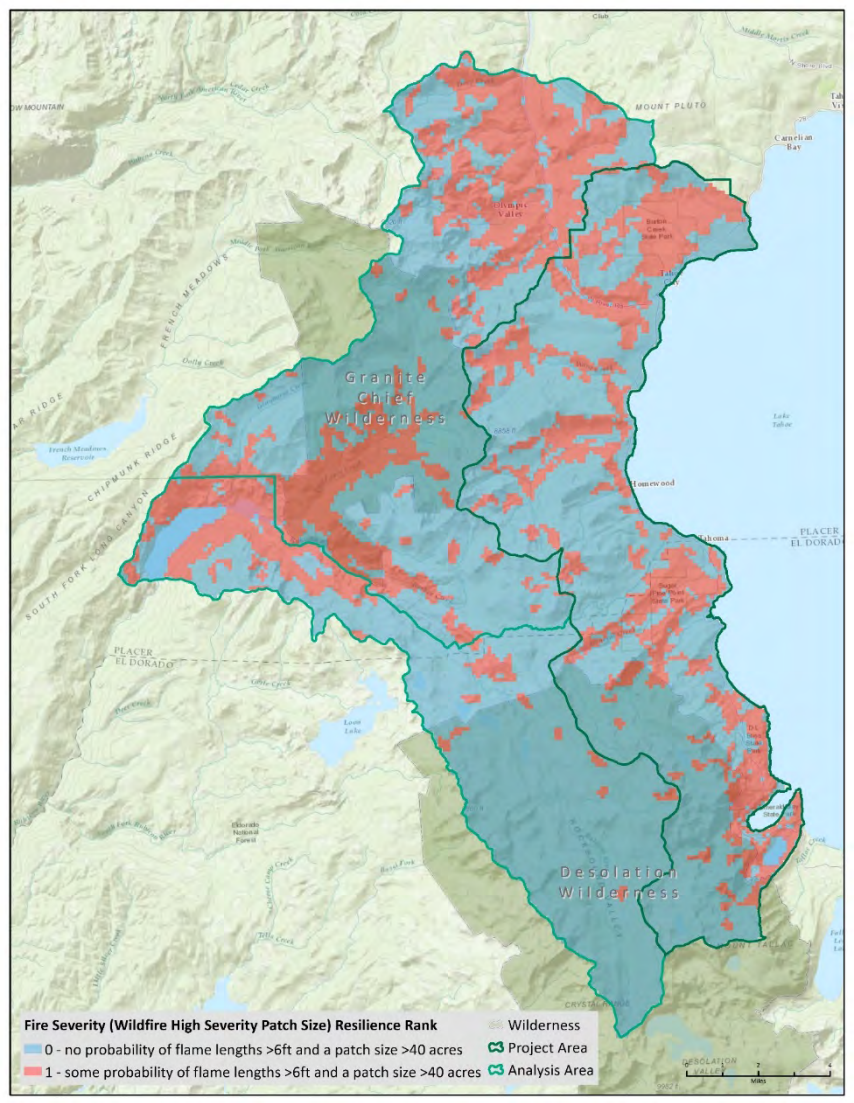
Aquatic Organism Passage		
Sculpin Passage	Resilience Rank	Description
No man-made barrier or sculpin can pass barrier	0	Resilient
Barrier that sculpin cannot pass	1	Least Resilient
Data for this indicator were based on the 2010 and 2011 Aquatic Organism Passage Assessment (USDA 2010 and 2011).		

	Resilient Condition		
Seral Stage[1]	Yellow Pine	Mixed Conifer	Red fir
EDO	5-15%	5-20%	3–20%
EDC	0%	0%	0%
MDO	8-25%	1-15%	0-15%
MDC	0-10%	0-15%	12-30%
LDO	29–50%	6-50%	2-15%
LDC	5–31%	7-79%	25–70%

[1] Seral stage refers to overstory tree DBH (inches) and overstory tree canopy from above. Early development (ED): ≥5" & <25%; Mid development open (MDO): 5-19.9" & <40%; Mid development moderate (MDO): 5-19.9" & 40-70%; Mid development closed (MDC): 5-19.9" & >70%; Late development open (LDO): >20" & <40%; Late development moderate (LDM): >20% & 40-70%; Late development closed (LDC): >20" & >70%.

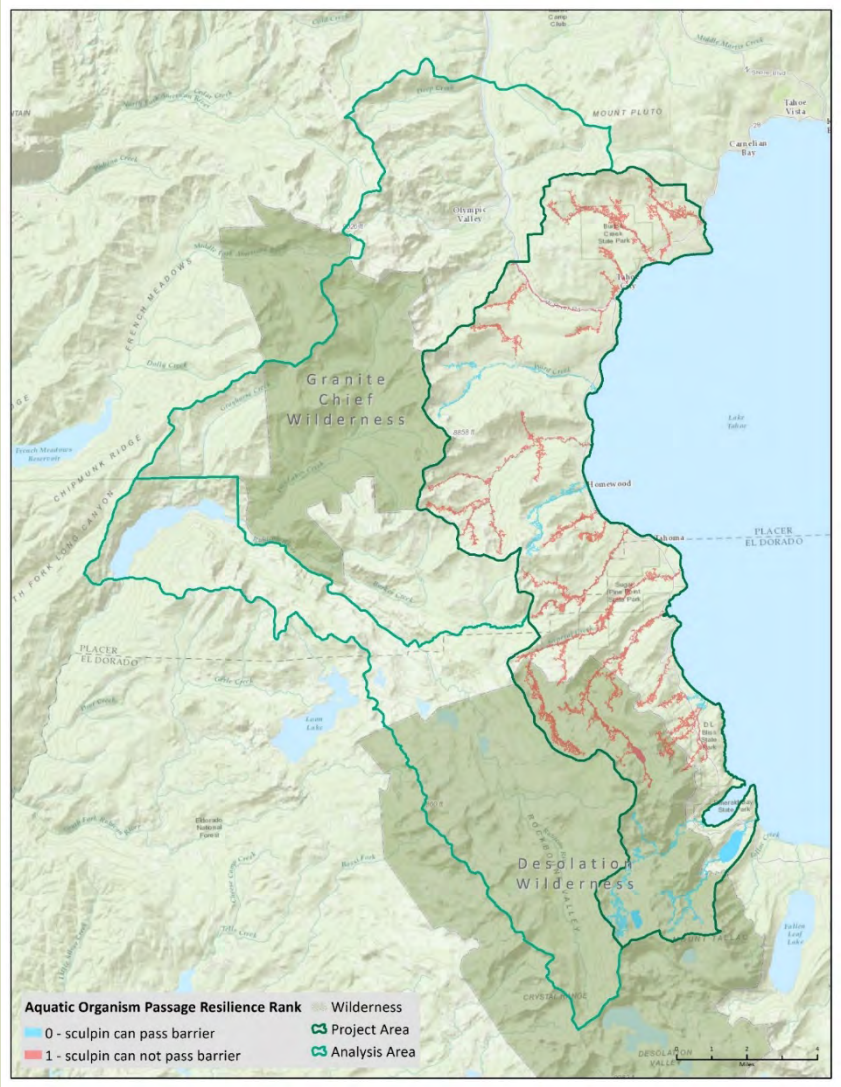
Resilience Rank

Which elements are least resilient?



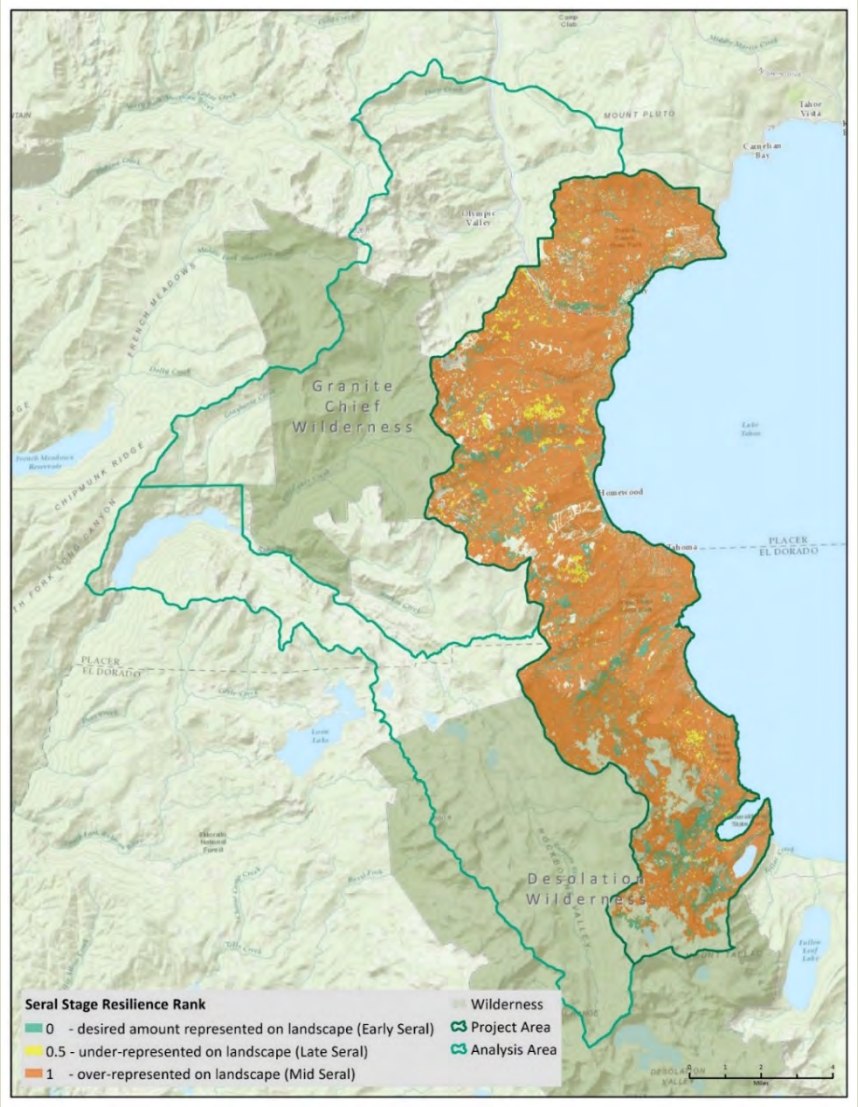
Resilience Rank

Which elements are least resilient?



Resilience Rank - Proportional

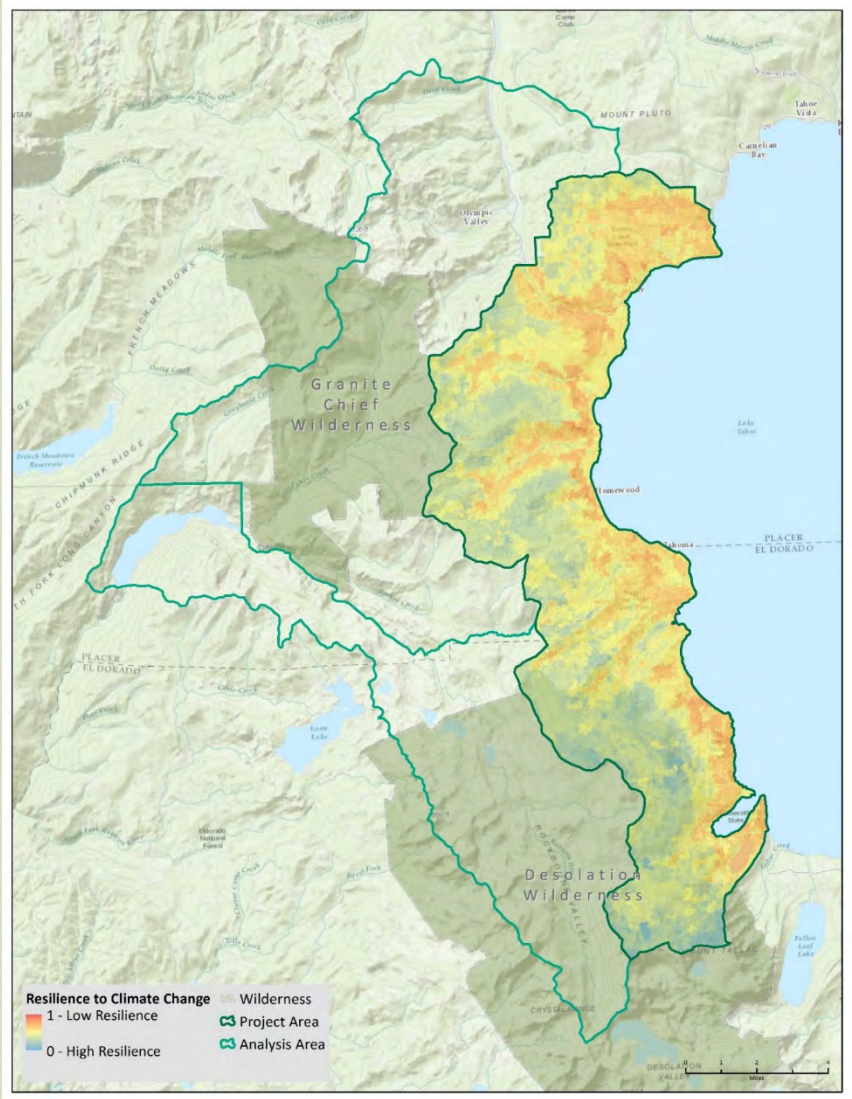
Which elements are least resilient?



Composite Indicators

	LANDSCAPE VALUES & SERVICES - *WHAT WE WANT TO BE RESILIENT*										
	Upland Ecosystems including vegetation, wildlife*, water quality (lake clarity), water supply, soils, and carbon	Meadow / Riparian Ecosystems including vegetation, wildlife, water quality (lake clarity), water supply, soils, and carbon			Aquatic Ecosystems incl. wildlife, water quality (lake clarity), water supply	Public Health and Safety			Cultural Landscapes includes ecosystems, archaeological sites, as well as associations with places	Recreation Including Winter as well as Summer	Composite Indicators - Measure of resilience to individual disturbance (note: does not incorporate indicators labeled as (O) or (R))	# of Indicators included
	Forests including shrub communities	Meadows and Marshes	Aspen Forests	Riparian Areas	Streams and Lakes	Life and Property	Water Quality and Supply (municipal use, fire-fighting)	Air Quality				
A. Fire, including fire-related smoke *affects the following values: vegetation, wildlife, water quality (lake clarity), soils and carbon, as well life & property, water quality & supply, air quality, and recreation*	Mean condition class Fire severity Trees per acre Seral stage (P) Vertical & Horizontal heterogeneity (P) Vegetation type (O) Treatment type (O) (R) Terrestrial wildlife connectivity	Mean condition class Fire severity Roads & trails linked to water channels Human access	Mean condition class Fire severity Trees per acre (desire primarily aspen)	Fire severity Trees per acre Seral stage (P)	Not primary disturbance for the above value	Fire risk index	Fire risk index Water quality	(R) Air quality	*to be developed with the Washoe Tribe*	Fire severity Fire risk (R) Air quality	Resilience to Fire: Mean condition class; Fire Severity; Trees per acre; Fire risk index; Roads & trails linked to water channels; Human access; Water quality; Seral stage (P); Vertical Heterogeneity (P); Horizontal heterogeneity (P)	10
B. Flood *affects vegetation, wildlife, water quality (lake clarity), water supply, soils, carbon, life & property, water quality & supply, and recreation*	Not primary disturbance for the above value	Roads & trails linked to water channels Floodplain condition	Not primary disturbance for the above value	Roads & trails linked to water channels Floodplain condition (R) Stream channel stability	Floodplain condition (R) Stream channel stability	Roads & trails linked to water channels Floodplain condition	Water quality Floodplain condition	Not primary disturbance for the above value	*to be developed with the Washoe Tribe*	Roads & trails linked to water channels Human access	Resilience to Flood: Roads & trails linked to water channels; Water quality; Floodplain condition	5
C. Drought (linked to Tree Mortality) *affects vegetation, wildlife, water supply, water quality & supply, and recreation*	Trees per acre Climatic water deficit Snowpack Bark beetle predators Seral stage (P) Treatment type (O) (R) Terrestrial wildlife connectivity	Meadow refugia Meadow connectivity Climatic water deficit Snowpack Floodplain condition Vegetation type (O)	Trees per acre Snowpack Floodplain condition Vegetation type (O)	Trees per acre Snowpack Floodplain condition Vegetation type (O) (R) Stream channel stability (R) Stream complexity	Snowpack Floodplain condition Aquatic organism passage Native fish diversity (R) Stream channel stability (R) Stream temperature	Not primary disturbance for the above value	Snowpack	Not primary disturbance for the above value	*to be developed with the Washoe Tribe*	Snowpack	Resilience to Drought: Trees per acre; Meadow refugia; Meadow connectivity; Climatic water deficit; Snowpack; Aquatic organism passage; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P)	10
D. Insects and Disease (linked to Tree Mortality) *affects vegetation, life & property, and recreation*	Trees per acre Climatic water deficit Bark beetle predators Seral stage (P) Treatment type (O) Vegetation types (O)	Not primary disturbance for the above value	Trees per acre Climatic water deficit Seral stage (P)	Trees per acre Climatic water deficit Seral stage (P)	Not primary disturbance for the above value	Trees per acre (large amt. of hazard trees)	Not primary disturbance for the above value	Not primary disturbance for the above value	*to be developed with the Washoe Tribe*	Trees per acre (large amt. of hazard trees)	Resilience to Insects and Disease: Trees per acre; Climatic water deficit; Bark beetle predators; Seral stage (P)	6
E. Climate Change (other than A,B,C; so warming temperatures and changes in the timing and form of precipitation) ***affects vegetation, wildlife, and recreation***	**Fire severity Trees per acre Thermal tolerance Climatic water deficit Snowpack Bark beetle predators Seral stage (P) Treatment type (O) Vegetation type (O) (R) Terrestrial wildlife connectivity**	**Meadow refugia Meadow connectivity Thermal tolerance Climatic water deficit Snowpack Floodplain condition**	**Thermal tolerance Snowpack Floodplain condition**	**Thermal tolerance Snowpack Floodplain condition (R) Stream channel stability (R) Stream complexity**	**Snowpack Floodplain condition Native fish diversity (R) Stream channel stability (R) Stream complexity (R) Stream temperature**	**Not primary disturbance for the above value**	**Not primary disturbance for the above value**	**Not primary disturbance for the above value**	***to be developed with the Washoe Tribe***	**Human access (R) Air quality**	**Resilience to Climate Change: Fire severity; Trees per acre; Meadow refugia; Meadow connectivity; Thermal tolerance; Climatic water deficit; Snowpack; Human access; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P)**	**12**
F. Erosion (other than B, so												
(improperly sited or inadequate mechanical road & trails and mechanically vegetation treatments) affects water quality (lake clarity), soils, carbon, and recreation	Water quality	Roads & trails linked to water channels Human access Floodplain condition	Not primary disturbance for the above value	Roads & trails linked to water channels Human access Floodplain condition	Roads & trails linked to water channels Human access	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	*to be developed with the Washoe Tribe*	Roads & trails linked to water channels Human access	Resilience to Erosion: Roads & trails linked to water channels; Human access; Water quality; Floodplain condition	4
G. Air Pollution (other than A (e.g., smoke) affects vegetation, air quality, and recreation	No current indicator, needs future investigation	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	No current indicator, needs future investigation	*to be developed with the Washoe Tribe*	No current indicator, needs future investigation	Resilience to Air Pollution: TBD	TBD
H. Human Presence and Activity (other than A and B, such as, vegetation manipulation, & invasive species) affects wildlife and recreation	Human access (R) Terrestrial wildlife connectivity	Human access Floodplain condition	Human access Floodplain condition	Human access Floodplain condition	Roads & trails linked to water channels Human access	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	*to be developed with the Washoe Tribe*	Not primary disturbance for the above value	Resilience to Human Presence: Roads & trails linked to water channels; Human access; Floodplain condition	3
I. Built Environment as it affects entire suites of management objectives and activities	TBD the threshold throughout the acceptable resilient conditions for relevant indicators (e.g., fire risk, water quality), and Wildland Urban Interface Defense Zone will possibly constitute an "overlay" in the region. Will also be focus of fine-scale analysis during Phases 2 and 3 (Landscape Restoration Strategy, Restoration Project Planning).											
Composite Indicators - Measure of landscape value/service resilience (note: does not incorporate indicators labeled as (O) or (R))	Resilience of Ecosystems: Mean condition class; Fire severity; Trees per acre; Meadow refugia; Meadow connectivity; Thermal tolerance; Climatic water deficit; Snowpack; Roads & trails linked to water channels; Human access; Water quality; Aquatic organism passage; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P); Vertical heterogeneity (P); Horizontal heterogeneity (P)					Resilience of Public Health and Safety: Trees per acre; Snowpack; Fire risk index; Roads & trails linked to water channels; Water quality; Floodplain condition			TBD	Resilience of Recreation: Fire severity; Trees per acre; Snowpack; Fire risk index; Roads & trails linked to water channels; Human access		
# of Indicators Included	18					6			TBD	6		

Composite Indicators

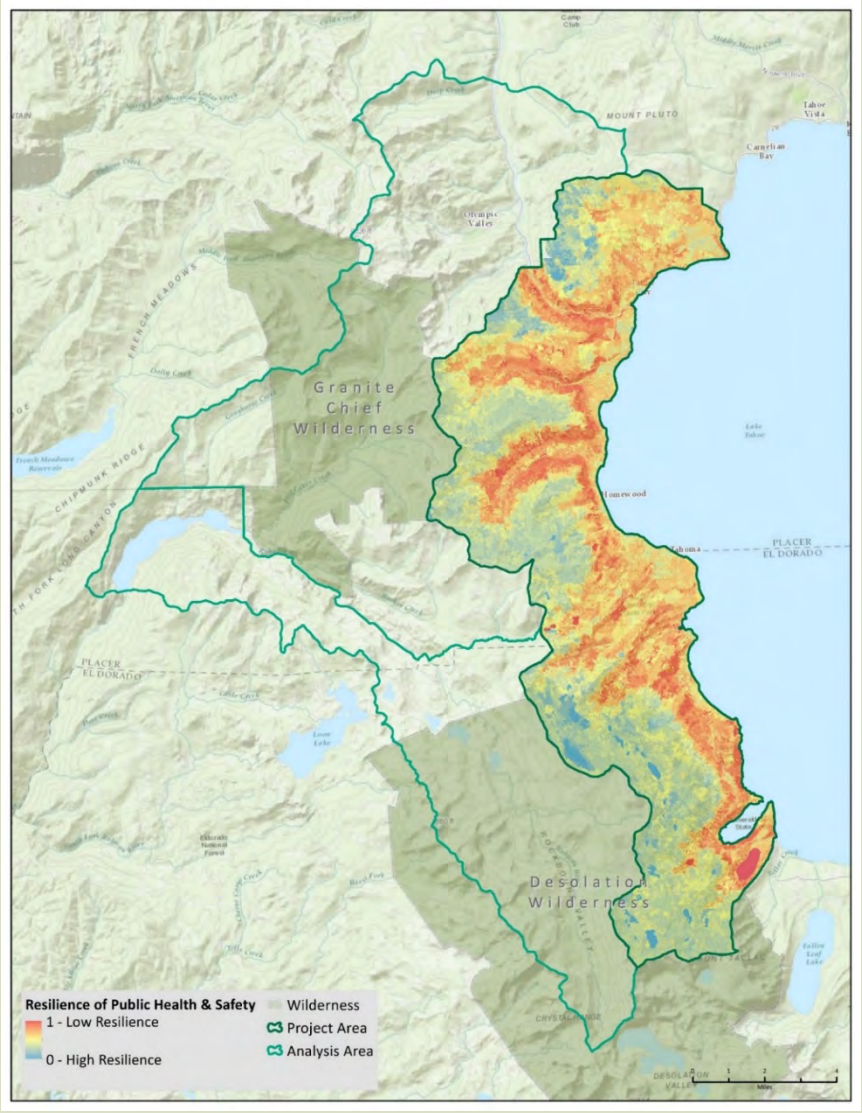


Which *areas* are least resilient to disturbances and for values/services

Composite Indicators

	LANDSCAPE VALUES & SERVICES - WHAT WE WANT TO BE RESILIENT										
	Upland Ecosystems: including vegetation, wildlife*, water quality (lake clarity), water supply, soils, and carbon	Meadow / Riparian Ecosystems: including vegetation, wildlife, water quality (lake clarity), water supply, soils, and carbon			Aquatic Ecosystems: incl. wildlife, water quality (lake clarity), water supply	Public Health and Safety			Cultural Landscapes: includes ecosystems, archaeological sites, as well as associations with places	Recreation: Including Winter as well as Summer	Composite Indicators - Measure of resilience to individual disturbance (note: does not incorporate indicators labeled as (O) or (R))	# of Indicators included
	Forests: including shrub communities	Meadows and Marshes	Aspen Forests	Riparian Areas	Streams and Lakes	Life and Property	Water Quality and Supply (municipal use, fire-fighting)	Air Quality				
DISTURBANCE TYPE - WHAT WE WANT VALUES & SERVICES TO BE RESILIENT TO: A. Fire, including fire-related smoke: affects the following values: vegetation, wildlife, water quality (lake clarity), soils and carbon, as well life & property, water quality & supply, air quality, and recreation	Mean condition class Fire severity Trees per acre Seral stage (P) Vertical & Horizontal heterogeneity (P) Vegetation type (O) Treatment type (O) (R) Terrestrial wildlife connectivity	Mean condition class Fire severity Roads & trails linked to water channels Human access	Mean condition class Fire severity Trees per acre (desire primarily aspen)	Fire severity Trees per acre Seral stage (P)	Not primary disturbance for the above value	Fire risk index	Fire risk index Water quality	(R) Air quality	to be developed with the Missoula Tribe	Fire severity Fire risk (R) Air quality	Resilience to Fire: Mean condition class; Fire Severity; Trees per acre; Fire risk index; Roads & trails linked to water channels; Human access; Water quality; Seral stage (P); Vertical Heterogeneity (P); Horizontal heterogeneity (P)	10
B. Flood: affects vegetation, wildlife, water quality (lake clarity), water supply, soils, carbon, (life & property, water quality & supply, and recreation	Not primary disturbance for the above value	Roads & trails linked to water channels Floodplain condition	Not primary disturbance for the above value	Roads & trails linked to water channels Floodplain condition (R) Stream channel stability	Floodplain condition (R) Stream channel stability	Roads & trails linked to water channels Floodplain condition	Water quality Floodplain condition	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Roads & trails linked to water channels Human access	Resilience to Flood: Roads & trails linked to water channels; Water quality; Floodplain condition	3
C. Drought (linked to Tree Mortality): affects vegetation, wildlife, water supply, water quality & supply, and recreation	Trees per acre Climatic water deficit Snowpack Bark beetle predators Seral stage (P) Treatment type (O) (R) Terrestrial wildlife connectivity	Meadow refugia Meadow connectivity Climatic water deficit Snowpack Floodplain condition Vegetation type (O)	Trees per acre Snowpack Floodplain condition Vegetation type (O)	Trees per acre Snowpack Floodplain condition Vegetation type (O) (R) Stream channel stability (R) Stream complexity	Snowpack Floodplain condition Aquatic organism passage Native fish diversity (R) Stream channel stability (R) Stream temperature	Not primary disturbance for the above value	Snowpack	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Snowpack	Resilience to Drought: Trees per acre; Meadow refugia; Meadow connectivity; Climatic water deficit; Snowpack; Aquatic organism passage; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P)	10
D. Insects and Disease (linked to Tree Mortality): affects vegetation, life & property, and recreation	Trees per acre Climatic water deficit Bark beetle predators Seral stage (P) Treatment type (O) Vegetation types (O) (R) Terrestrial wildlife connectivity	Not primary disturbance for the above value	Trees per acre Climatic water deficit Seral stage (P)	Trees per acre Climatic water deficit Seral stage (P)	Not primary disturbance for the above value	Trees per acre (large amt. of hazard trees)	Not primary disturbance for the above value	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Trees per acre (large amt. of hazard trees)	Resilience to Insects and Disease: Trees per acre; Climatic water deficit; Bark beetle predators; Seral stage (P)	4
E. Climate Change (other than A,B,C, as warming temperatures and changes in the timing and form of precipitation): affects vegetation, wildlife, and recreation	Fire severity Trees per acre Thermal tolerance Climatic water deficit Snowpack Bark beetle predators Seral stage (P) Treatment type (O) Vegetation type (O) (R) Terrestrial wildlife connectivity	Meadow refugia Meadow connectivity Thermal tolerance Climatic water deficit Snowpack Floodplain condition	Thermal tolerance Snowpack Floodplain condition	Thermal tolerance Snowpack Floodplain condition (R) Stream channel stability (R) Stream complexity	Snowpack Floodplain condition Native fish diversity (R) Stream channel stability (R) Stream complexity (R) Stream temperature	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Human access (R) Air quality	Resilience to Climate Change: Fire severity; Trees per acre; Meadow refugia; Meadow connectivity; Thermal tolerance; Climatic water deficit; Snowpack; Human access; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P)	12
F. Erosion (other than B, so improperly engineered or maintained roads & trails and mechanical vegetation treatments): affects water quality (lake clarity), soils, carbon, and recreation	Water quality	Roads & trails linked to water channels Human access Floodplain condition	Not primary disturbance for the above value	Roads & trails linked to water channels Human access Floodplain condition	Roads & trails linked to water channels Human access	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Roads & trails linked to water channels Human access	Resilience to Erosion: Roads & trails linked to water courses; Human access; Water quality; Floodplain condition	4
G. Air Pollution other than A (e.g., ozone): affects vegetation, air quality, and recreation	No current indicator, needs future investigation	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	*No current indicator, needs future investigation*	to be developed with the Missoula Tribe	No current indicator, needs future investigation	Resilience to Air Pollution: TBD	TBD
H. Human Presence and Activity (other than A and F, so noise, vegetation manipulation, & invasive species): affects wildlife and vegetation	Human access (R) Terrestrial wildlife connectivity	Human access Floodplain condition	Human access Floodplain condition	Human access Floodplain condition	Roads & trails linked to water channels Human access	Not primary disturbance for the above value	Not primary disturbance for the above value	Not primary disturbance for the above value	to be developed with the Missoula Tribe	Not primary disturbance for the above value	Resilience to Human Presence: Roads & trails linked to water channels; Human access; Floodplain condition	3
I. Bulk Environment as it affects entire suites of management objectives and activities	Will be threaded throughout the acceptable resilient conditions for relevant indicators (e.g., fire risk, water quality), and Wildland Urban Interface Defense Zone will possibly constitute an "overlay" in this regard. Will also be focus of finer-scale analysis during Phases 2 and 3 (Landscape Restoration Strategy, Restoration Project Planning).											
Composite Indicators - Measure of landscape value/service resilience (note does not incorporate indicators labeled as (O) or (R))	Resilience of Ecosystem: Mean condition class; Fire severity; Trees per acre; Meadow refugia; Meadow connectivity; Thermal tolerance; Climatic water deficit; Snowpack; Roads & trails linked to water channels; Human access; Water quality; Aquatic organism passage; Floodplain condition; Bark beetle predators; Native fish diversity; Seral stage (P); Vertical heterogeneity (P); Horizontal heterogeneity (P)					Resilience of Public Health and Safety: Trees per acre; Snowpack; Fire risk index; Roads & trails linked to water channels; Water quality; Floodplain condition			TBD	Resilience of Recreation: Fire severity; Trees per acre; Snowpack; Fire risk index; Roads & trails linked to water channels; Human access	
# of Indicators Included	18					6			TBD	6		

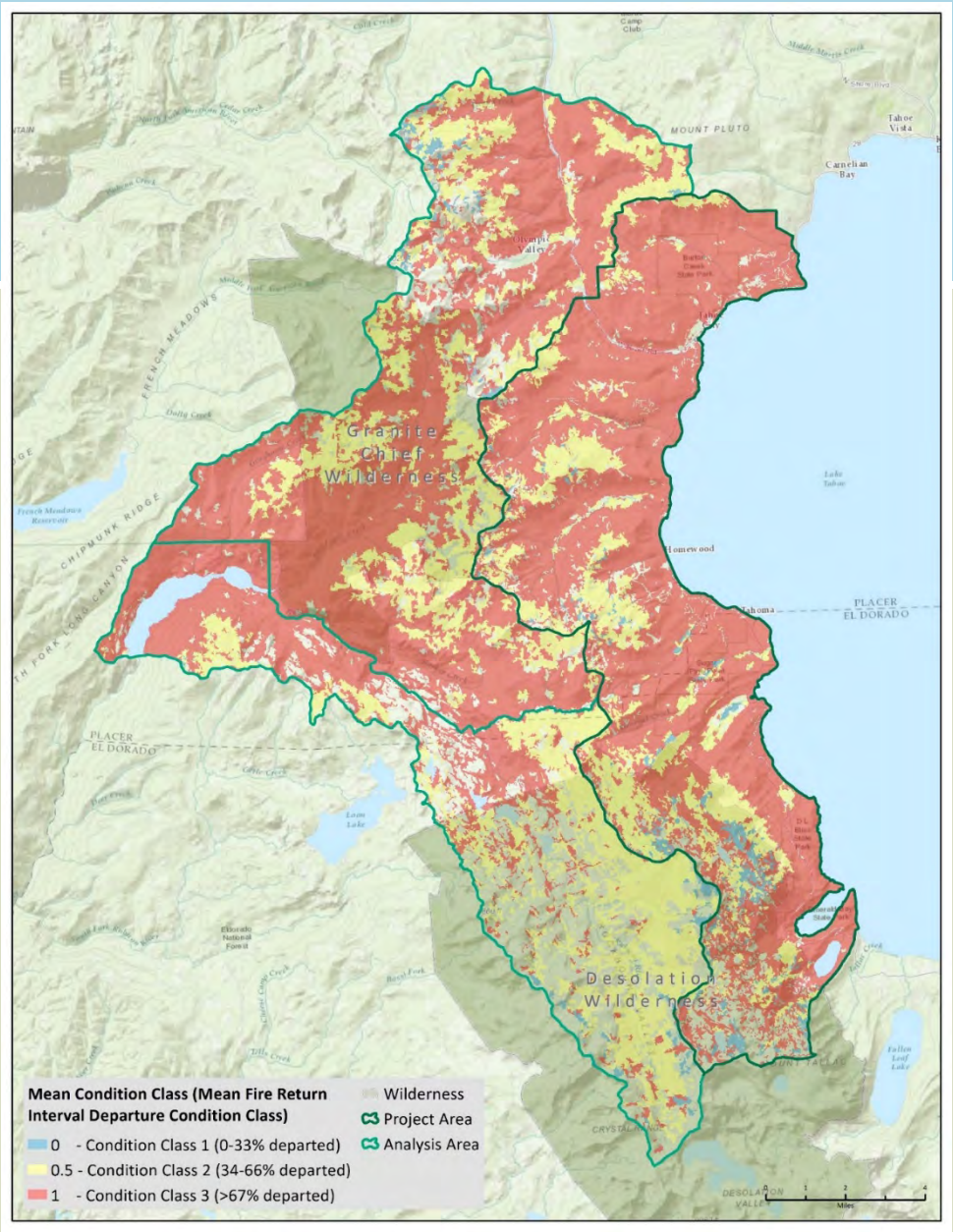
Composite Indicators

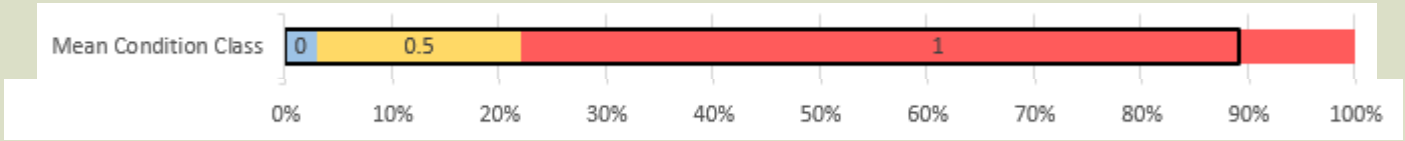


Which *areas* are least resilient?

Results

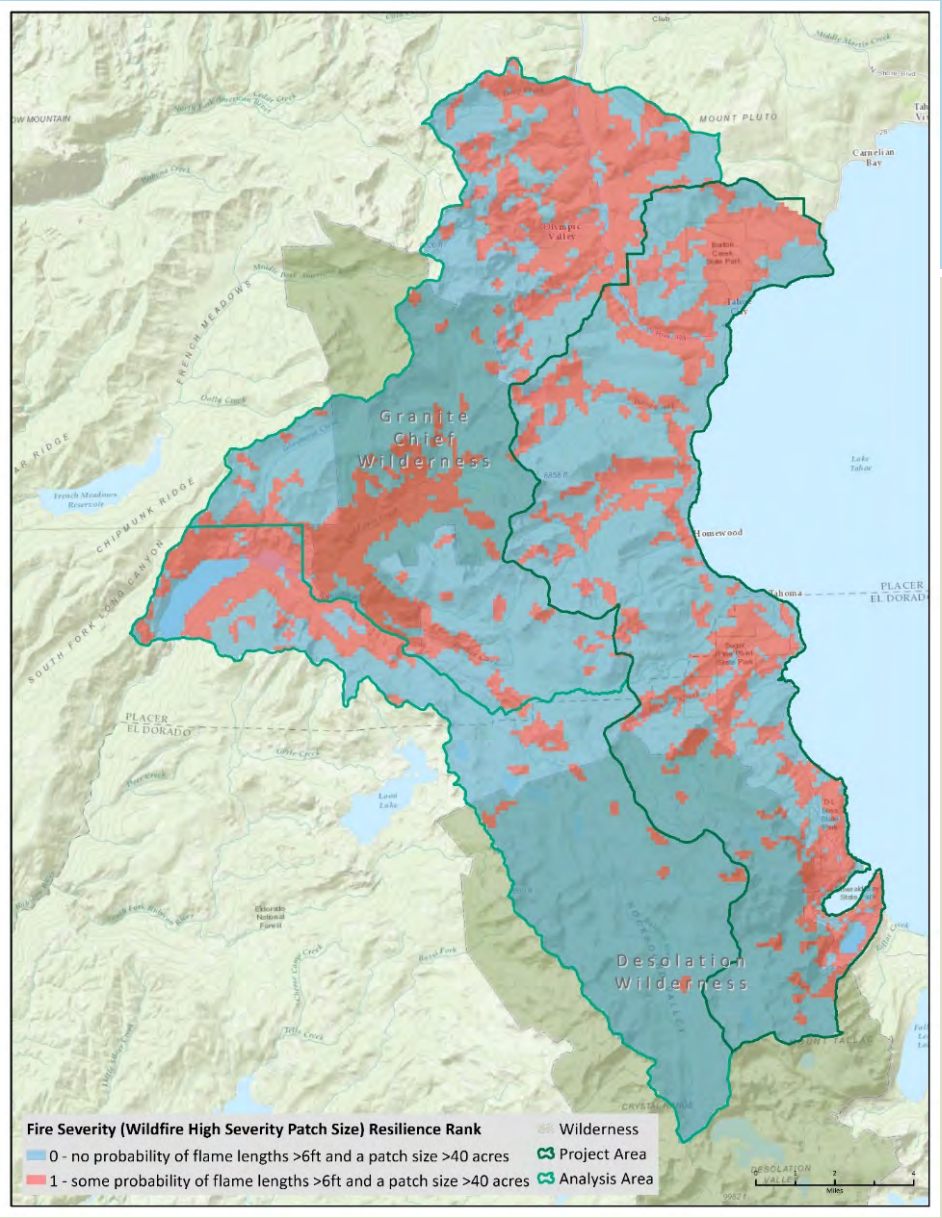
Over 75% of landscape highly departed from pre Euro-American settlement fire return intervals

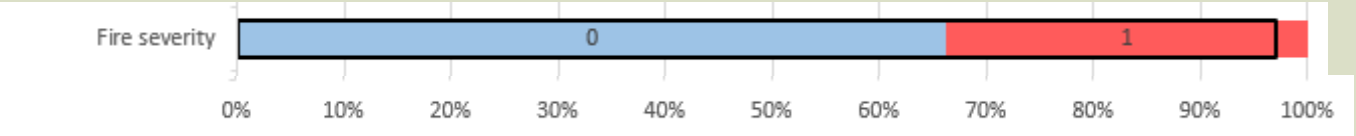




Results

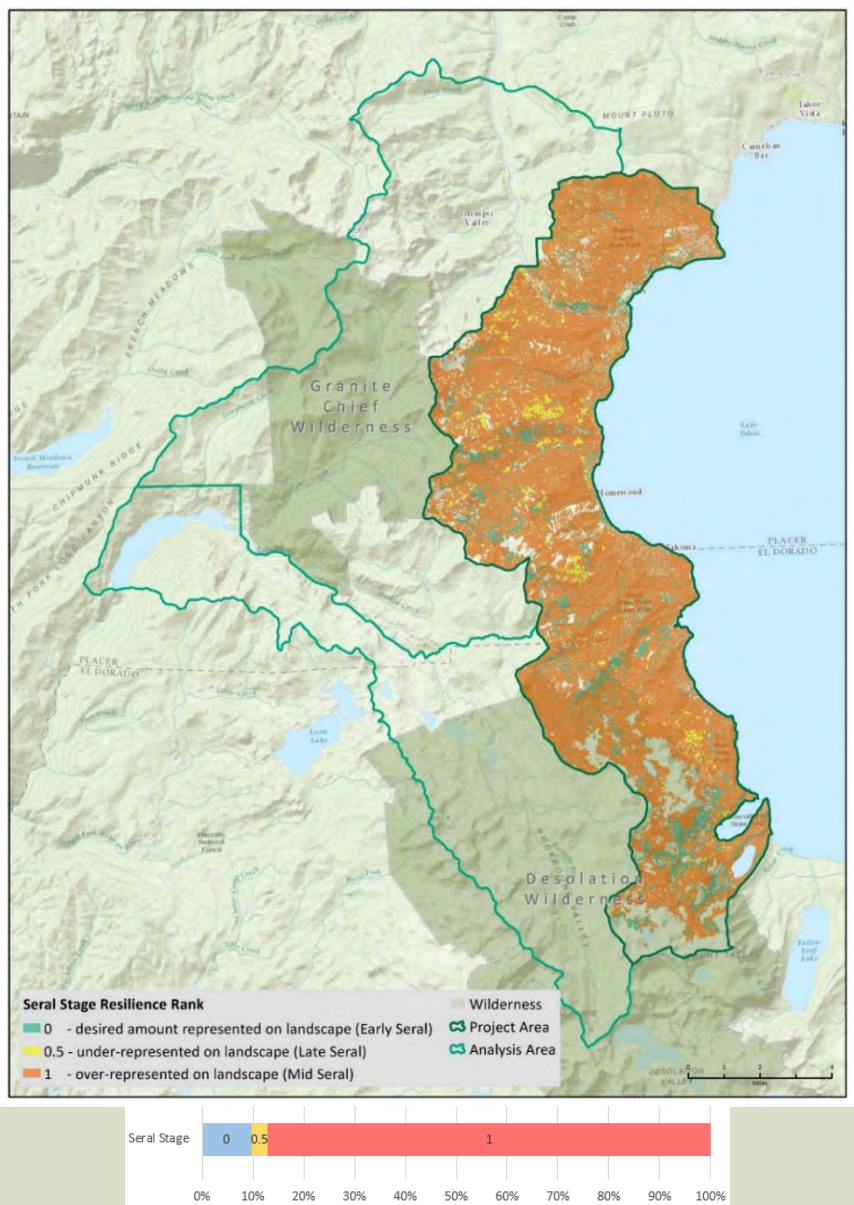
Almost 1/3 of landscape is least resilient to large high severity fires

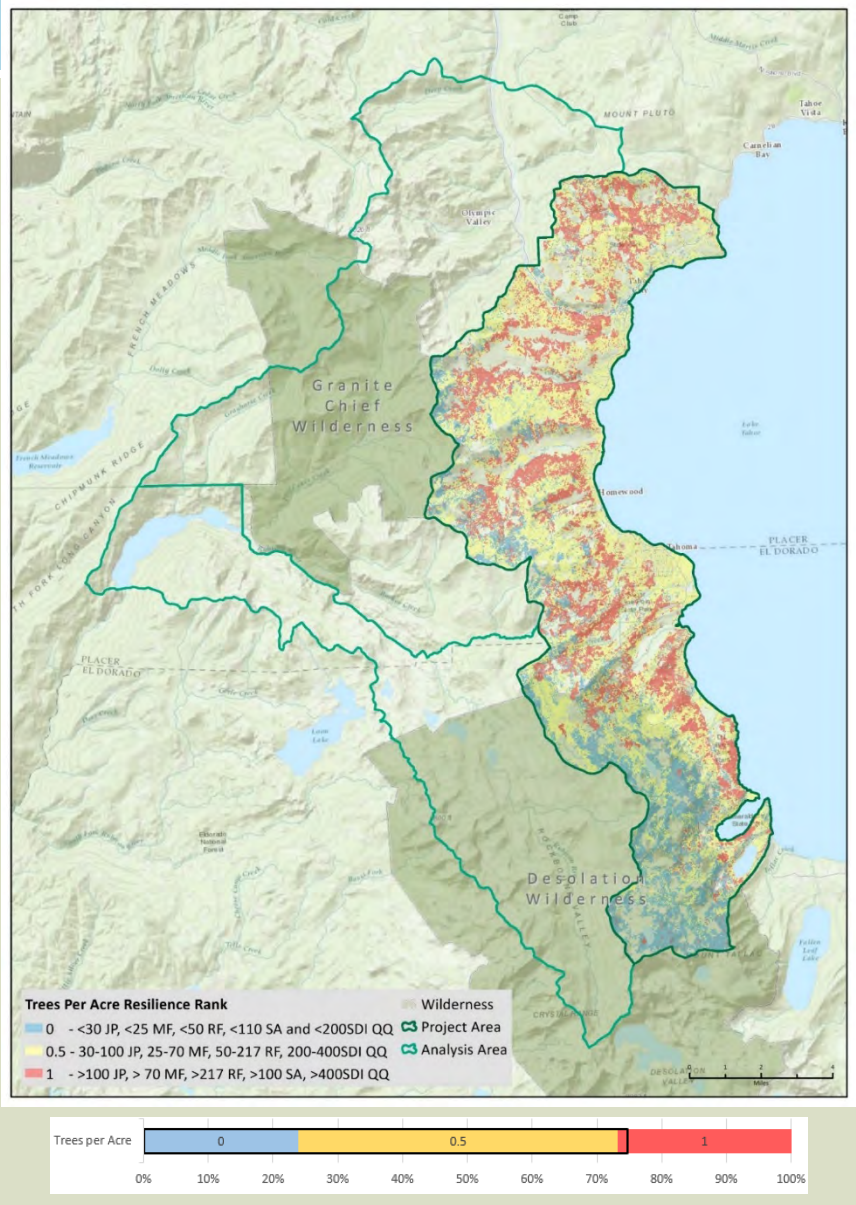




Results

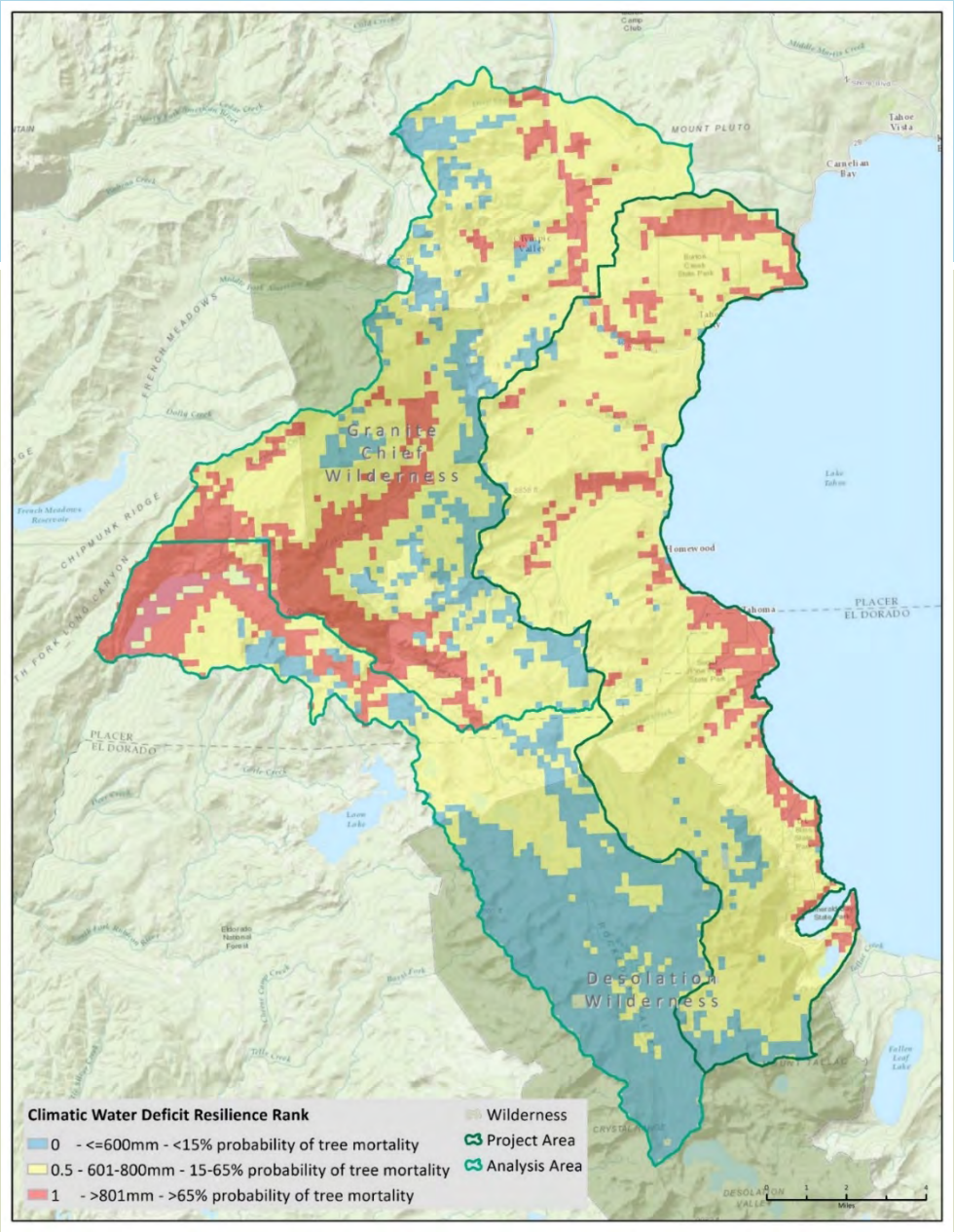
Over-representation of mid-seral, high trees per acre

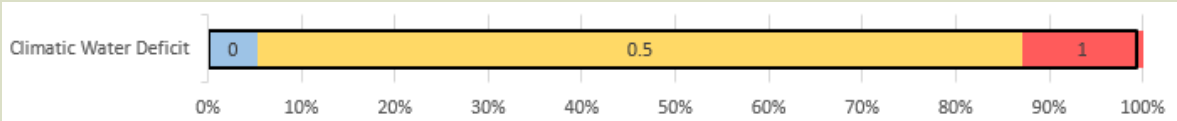




Results

Additional stress on least resilient forest stands

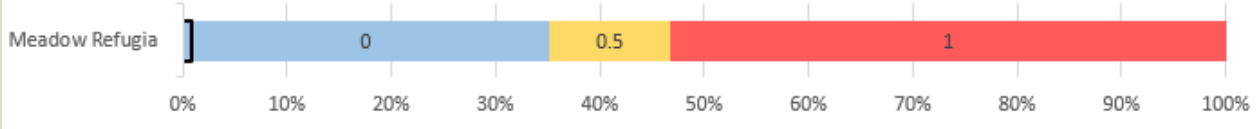




Some indicators cannot be changed through management

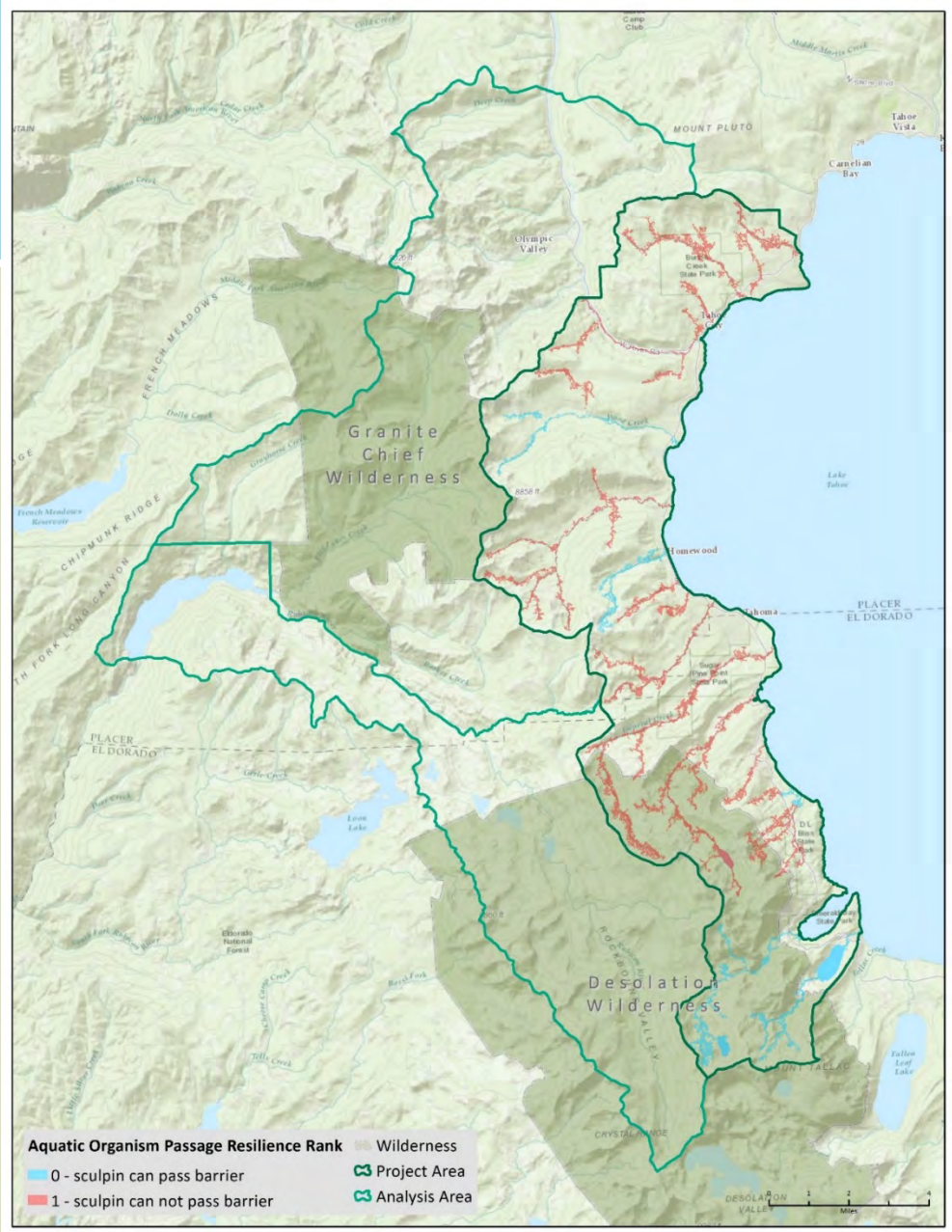
Results

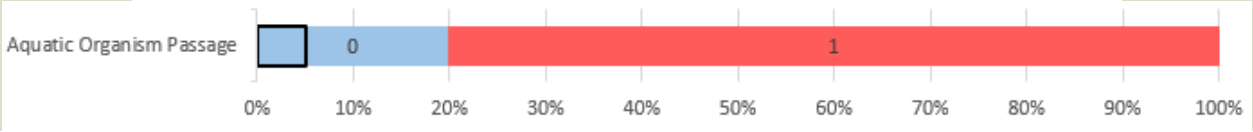
Changing climate is threatening meadow condition



Results

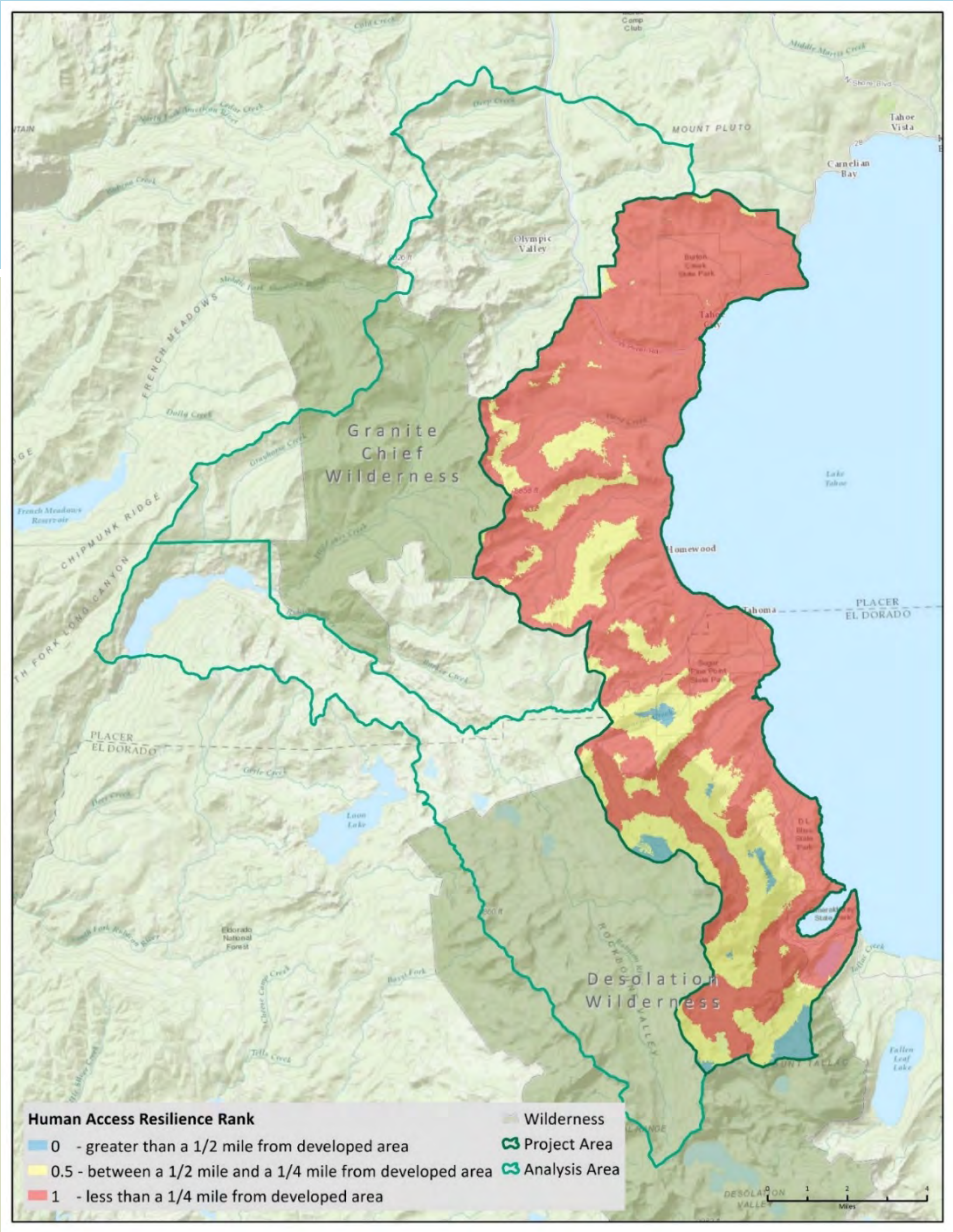
80% of streams are impassable by small fish

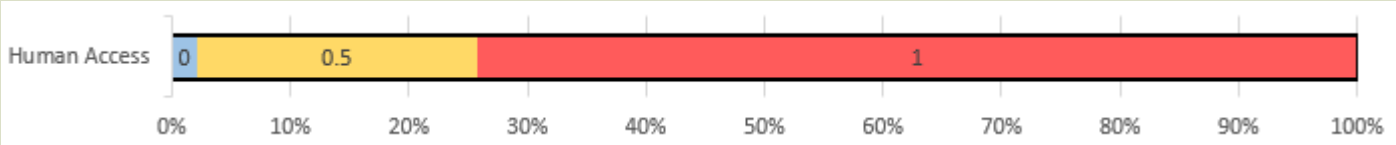




Results

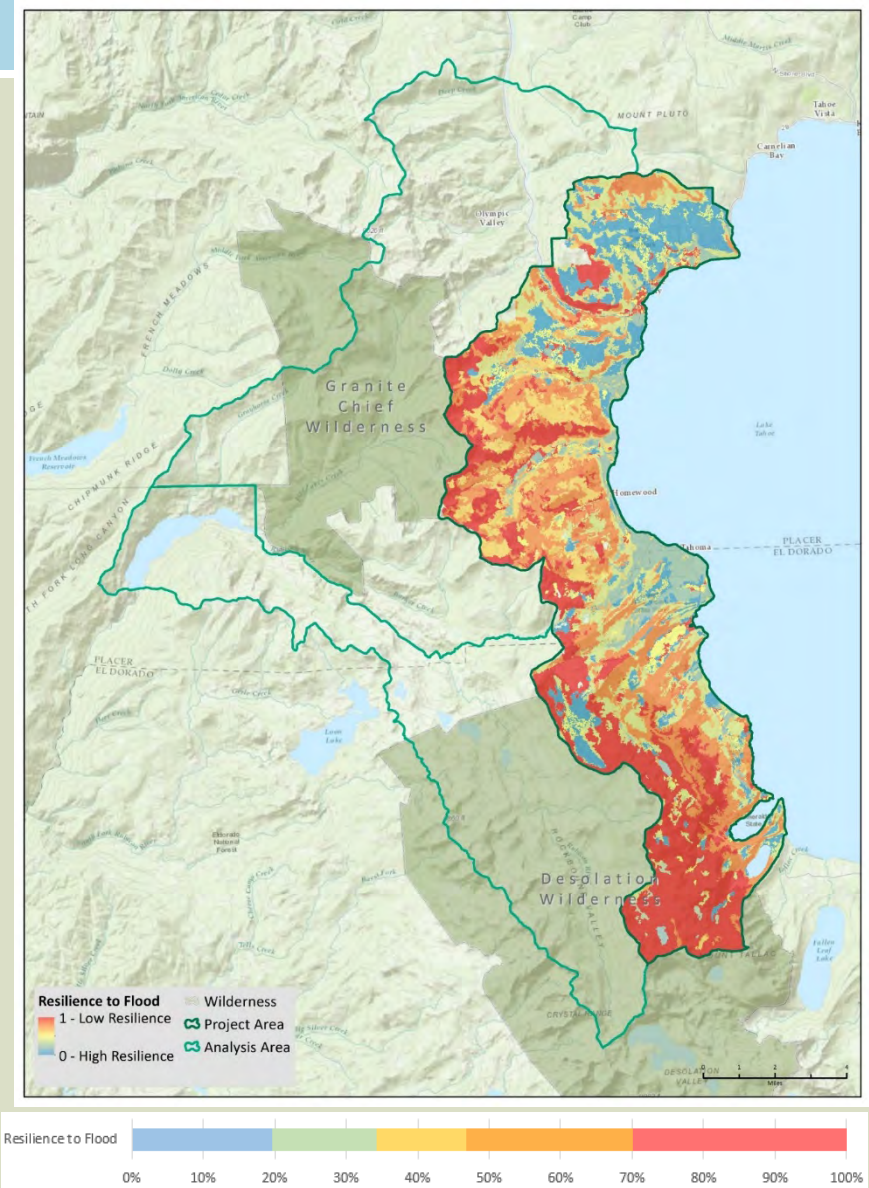
75% of the landscape is within ¼ mile of a road or trail

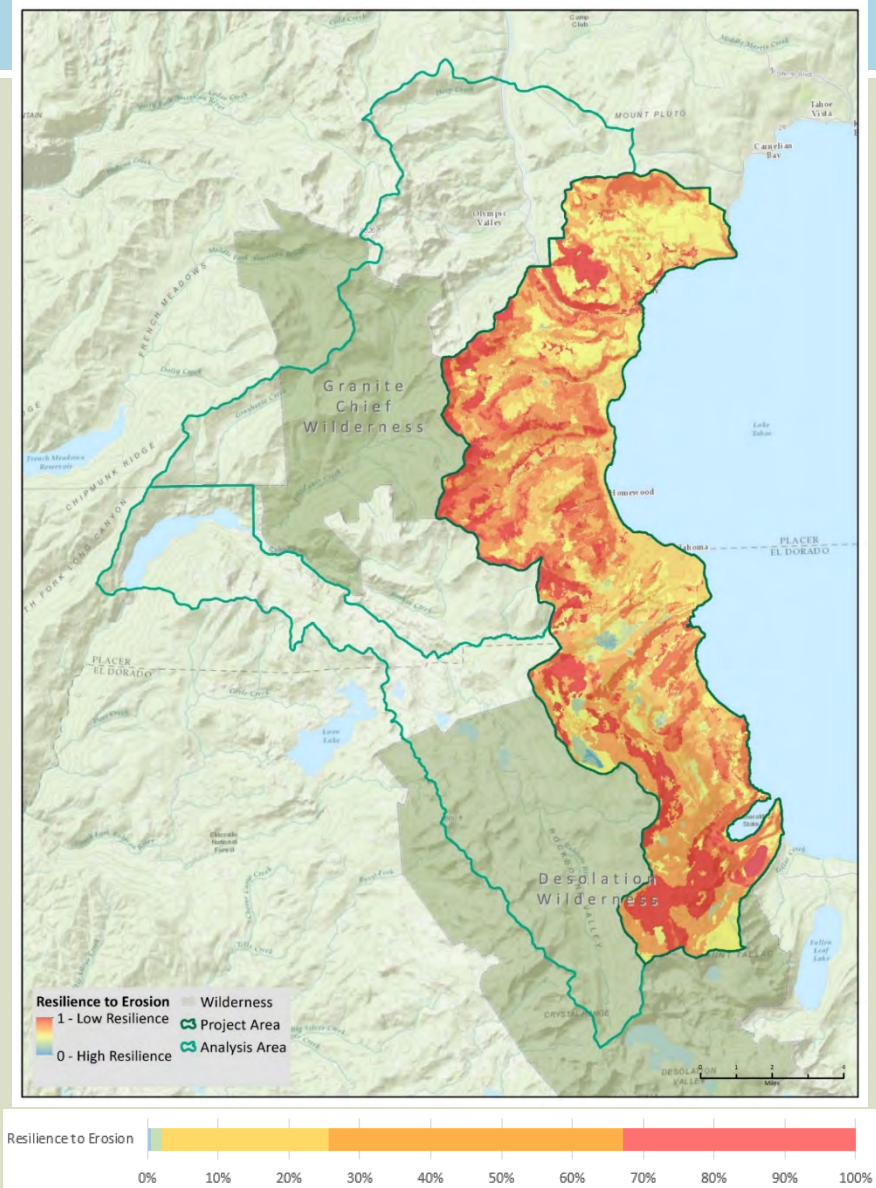




Results

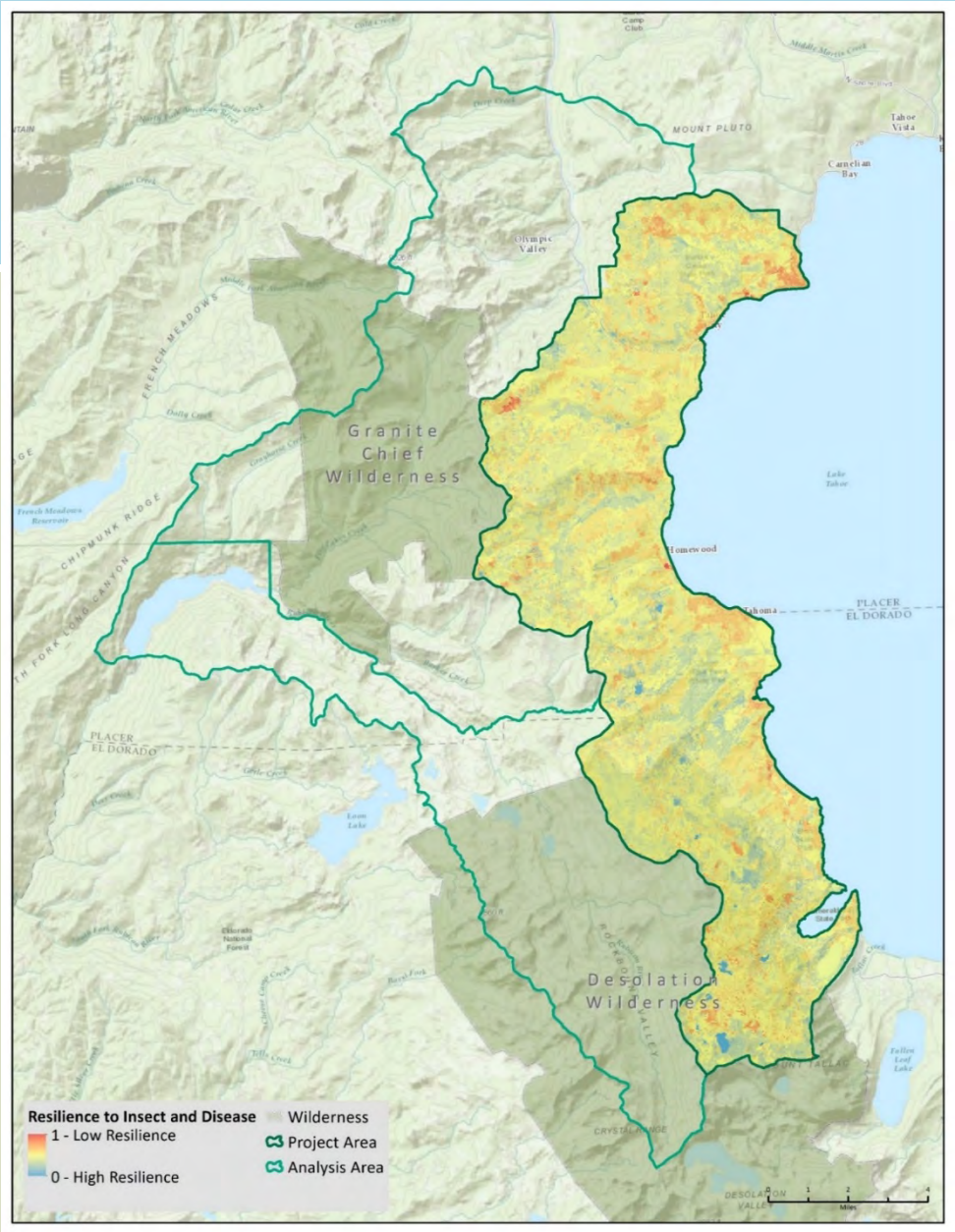
Higher elevations tend to be highly erosive and lead to less flood resilience

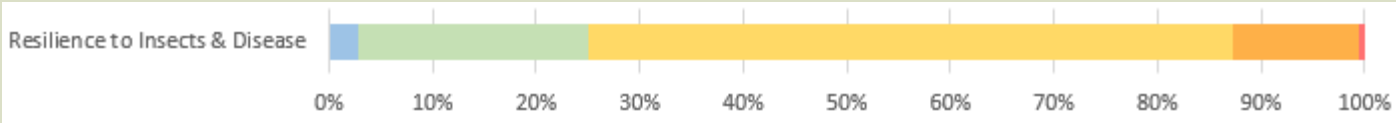




Results

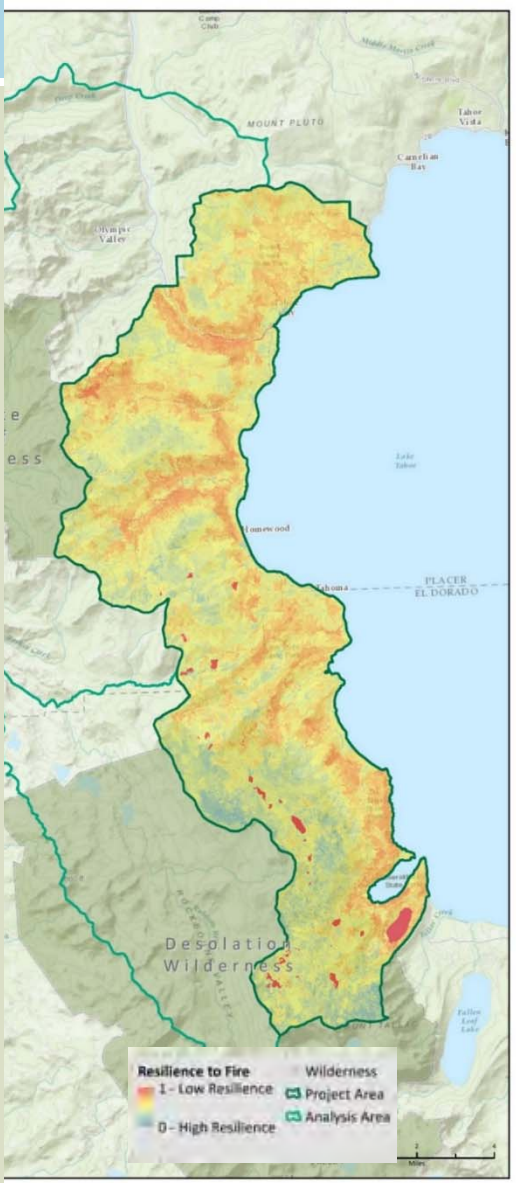
Much of the landscape is susceptible to insect outbreak

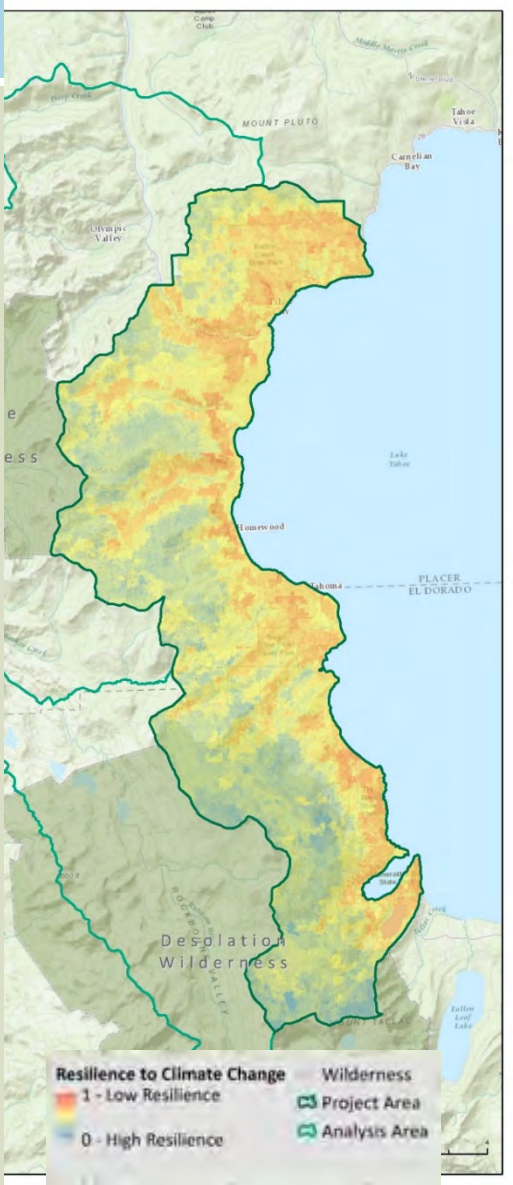


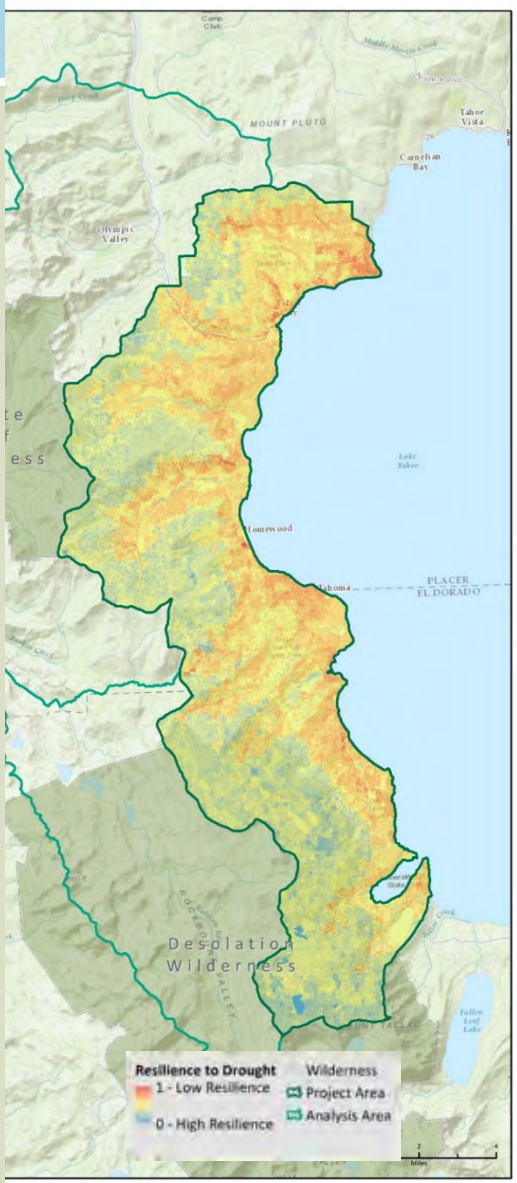


Results

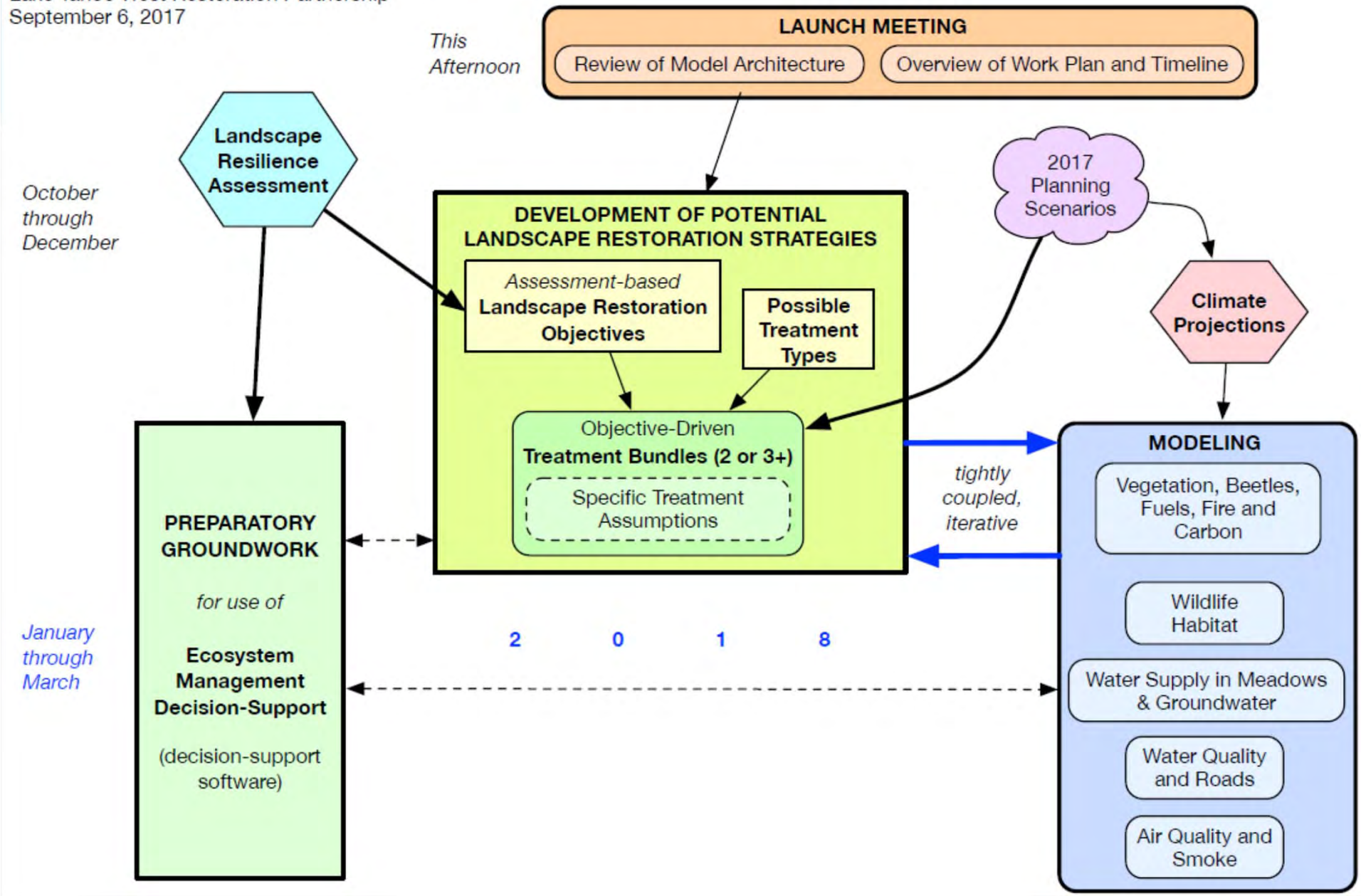
Low elevations and canyons tend to be areas of least resilience



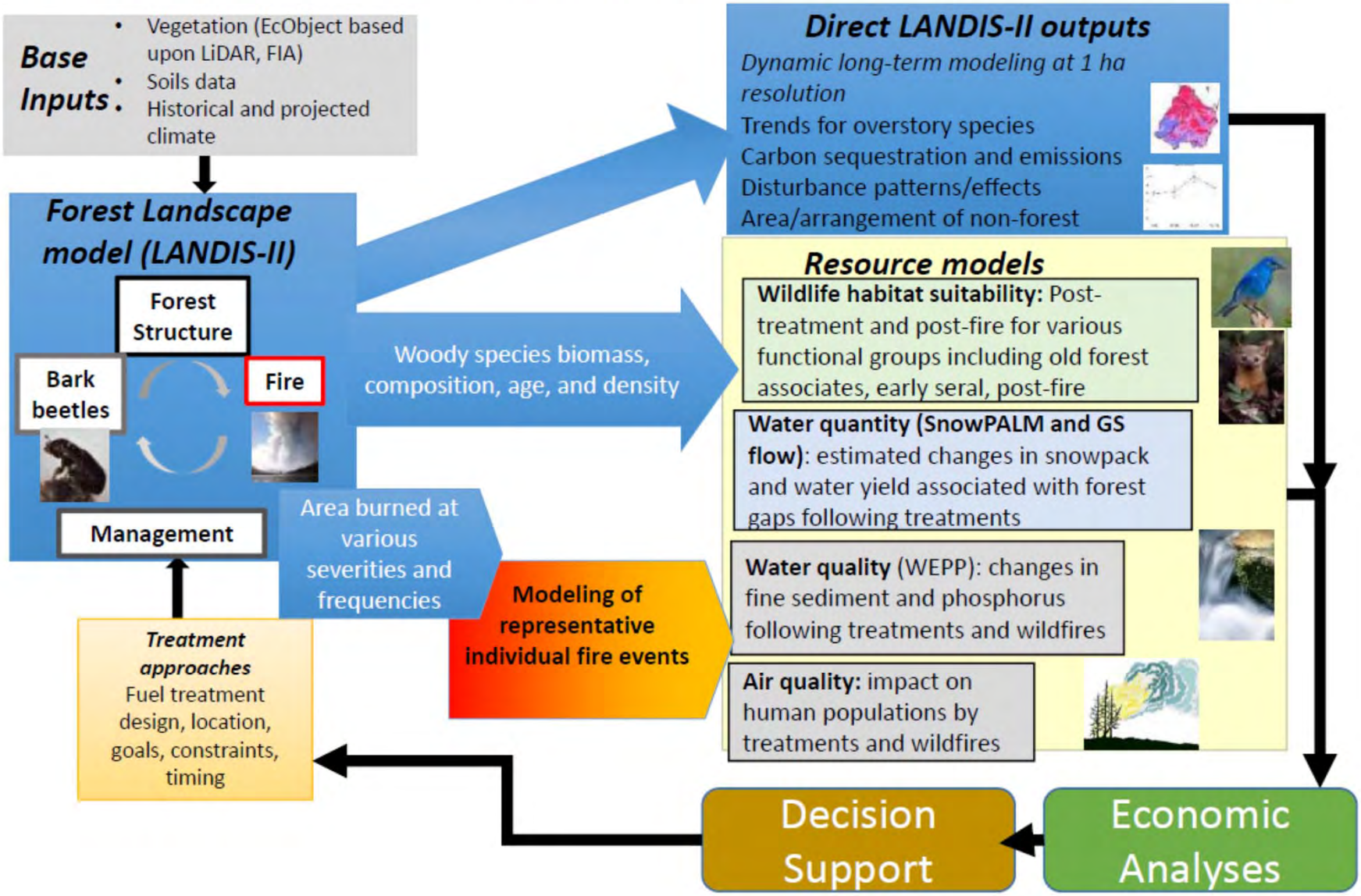




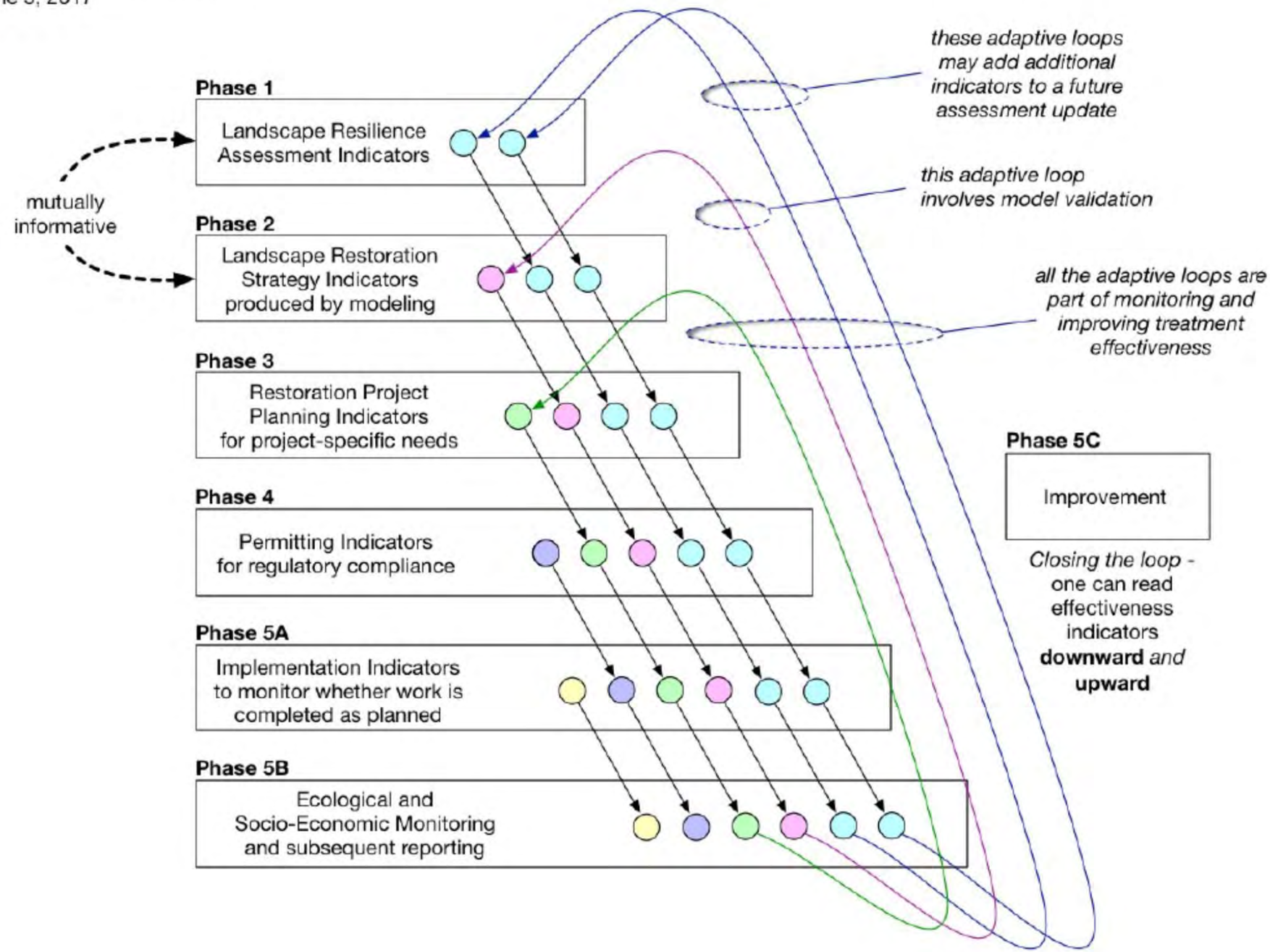
Landscape Restoration Strategy Flow Diagram
Lake Tahoe West Restoration Partnership
September 6, 2017



Lake Tahoe West Integrated Science Modeling



Monitoring Downward-Upward Continuity Diagram
Lake Tahoe West Restoration Partnership
June 5, 2017



Lake Tahoe “Rest”