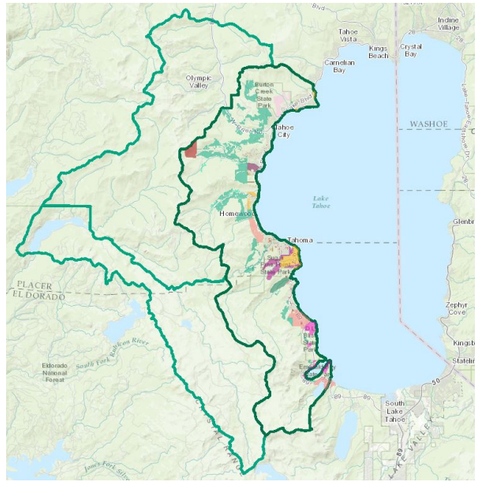
0.861 Dorian Fougères

We developed this vision for a Data Management System in the Lake Tahoe West Restoration Partnership with the Sitka Technology Group, which redesigned and currently manages the existing Lake Tahoe Info site for the Tahoe Regional Planning Agency. The aim is to start thinking early about how modeling outputs and eventually monitoring data from the initiative can be integrated in the existing basin-wide data management system, and the types of analyses and automated work flows that the system could produce.

Data Management Strategy Broadsheet for Lake Tahoe West – Background, Objectives, Personas Introduced

Background

The goal of the Lake Tahoe West Restoration Partnership (Lake Tahoe West or LTW) is to restore the resilience of the west shore's forests, watersheds, recreational opportunities, and communities. The landscape includes 153,249 acres of federal, state, local, and private lands, from Emerald Bay to Squaw Valley.



Four public agencies—the California Tahoe Conservancy, the U.S. Forest Service's Lake Tahoe Basin Management Unit and Pacific Southwest Research Station, California State Parks, and the Tahoe Regional Planning Agency—are joining with the Tahoe Fire and Fuels Team and National Forest Foundation to lead the Partnership.

Purpose of this Document

This broadsheet lays out a strategy for meeting LTW's data management needs. It is the second and final deliverable of an initial consulting contract between NFF and Sitka Technology Group. It is informed by conversations, interviews, a set of Data Management Use Cases for LTW, documents provided by NFF, and Sitka's systems design experience — notably on Lake Tahoe Info, laketahoeinfo.org. This broadsheet has the following components:

- Data Management Goal & Objectives
- User Personas
- Design Principles
- Alternatives Analysis

Data Management Goal

The LTW Partnership calls for "eight critical elements to increase pace and scale of restoration in the Sierra Nevada." A knowledge infrastructure for the Partnership would ideally support all eight elements; however a more targetted goal statement will better guide initial investments in such an infrastructure.

GOAL

Elevate agency planning, permitting, and implementation of multi-party conservation and restoration programs by providing open access to the best available science for local decision making and communication.

Data Management Objectives

To reach that goal, the following objectives have been identified:

- Accelerate discussions and selection of regional priorities across agencies.
- Inform decision making with best available science.
- Support connecting outputs (or "actions") to outcomes, including clear communication of risks and tradeoffs.
- Enable a performance-based framework for monitoring, evaluation, and improvement of results.
- Lower the cost (effort) to answer management questions.
- Provide open access to regional data.
- Support data access via web-based and programming-based (API) methods.

User Persona Summary

Within the Partnership, there is a range of personas. Personas, or user types, are helpful abstractions of real people for a couple of reasons: 1) people come and go, but the functions they serve typically do not, and 2) consolidating goals/tasks under as small a set of personas as possible makes it easier to keep them firmly in mind when designing a system. Said another way, personas help technologists and designers stay focused on the main point: people, not widgets or features.

Each of these persona have different goals, needs, and expectations. Each will interact with LTW data in unique ways. The five personas below are the focus of this Data Management Strategy. Other personas identified include: Regulator, Community Advocate, Environmental Activist, and Landowner.

"Paula" Policy Maker	Executive Directors or Administrators, Senior Policy Analysts, some are attorneys and politicians
"Marcus" Program Manager	Managers of portfolios of projects, often with science background and then promoted into management
"Sally" Science Stakeholder	Scientists who often serve on science panels and are with an academic or research institution
"Andrew" Agency Scientist	Scientists within an agency who often have a more narrow scope and contribute to specific programs
"James" Data Manager	Data or GIS Analysts, some database administrators and IT professionals; aka Data Scientists

Interviews with real people serving in these roles/functions helped identify the goals and character sketches on the following page.

Each of these persona have different goals, needs, and expectations. Each will interact with LTW data in unique ways. Interviews with real people serving in these roles/functions helped identify the goals and character sketches below. Interviews were conducted in April 2017 with the following people: Mike Vollmer and Mason Bindl of Tahoe Regional Planning Agency, Patrick Wright of California Tahoe Conservancy, Sue Britting of Sierra Forest Legacy, Randy Striplin of USFS - LTBMU, Tamara Sasaki of CA State Parks, and Shana Gross of USFS - PSW. Input was also received from Jonathan Long of USFS - PSW and Jane Freeman of California Tahoe Conservancy.

"Paula"
Policy Maker

Paula has broad responsibilities for conservation and restoration in the basin. She has many years of experience creating and adapting policy that requires balancing the needs of various stakeholders and interests. She uses best available science when making decisions but laments that it is often tough to access or just unavailable, and thus relies on expert opinion of her trusted colleagues. Paula regularly communicates progress and plans to citizens, legislature, and funders. When it comes to performance measures she strives to balance the output (acres treated) conversation with outcomes (abundance of a key species). She wishes agencies the communities they serve were more aligned in their priorities, yet is hopeful LTW will directly help with this.

GOAL: Increase scale and pace of conservation while balancing benefits, risks, and tradeoffs.

"Marcus"
Program Manager

Increasingly Marcus must answer a wide range of questions about invasive species, trail access, carbon sequestration, and related climate change considerations. It is both challenging and fun; it appeals to his science / technical background and training. However he wishes he could spend more time outdoors and less time at the computer wrangling data and responding to information requests. Having data in various places is not a big deal, as long as it is accessible, current, and of reasonable quality. Marcus also oversees monitoring activities; he is always in pursuit of the "right" level of monitoring. He would also like to see action performance measures coupled with qualitative ones - he's been reading about "defined impact scale" measures and appreciates that they can avoid pitfalls of simply counting widgets.

GOAL: Define, execute, and adapt programs based on the "right" level of monitoring.

"Sally"
Science Stakeholder

Whether she is developing a forest plan, identifying best management practices, or helping set regional priorities, Sally relies on publicly-available data every day. She believes in adaptive management and has come to appreciate the value of good storytelling for affecting change. A scientist by training with many years of experience, she is comfortable leveraging data from others and advocates for open access to data. For example, she works a lot with monitoring data from US Forest Service. Sally is comfortable communicating quantitatively or qualitatively and often uses maps and charts to summarize information. For Christmas she really wants a performance-based framework for multi-party monitoring, evaluation, and synthesis to help inform decisions.

GOAL: Ensure policy and resource decisions are made using best available science.

"Andrew"
Agency Scientist

As an educated and experienced scientist, Andrew really appreciates that monitoring programs can greatly improve understanding of the nuances of biological and social responses. Over the years, Andrew has seen great progress in access to the basin's natural resources but unfortunately cannot say the same about access to the basin's scientific knowledge. While he would love if it the various data he needs were centralized, he has resolved himself to the fact that data is spread out. He feels strongly that you cannot just collect data – real learning comes only after analyzing, synthesizing, deliberating, and presenting.

GOAL: Advance the state of scientific knowledge of the basin's ecosystems.

"James"
Data Manager

James works in a support function — some days in fire-drill mode, other days he makes progress on initiatives to help make information more available to his wide range of customers. James has a range of technical skills that include data analysis, GIS, data querying, data transformation, reporting, and basic systems administration. While he may dabble, he relies on colleagues for programming, systems design, information design, visual design, and reporting. James cares about data security and redundancy. He would love more data standards that make it easier and quicker to compile and aggregate data.

GOAL: Enable open and easy access to data to better inform management decisions.

See "Data Management Use Cases for Lake Tahoe West" for more complete narratives of these personas including their needs, wants, and dreams… at least in the context of how they use, access, and create data in their day jobs.

Data Management Strategy Broadsheet for Lake Tahoe West – Design Principles

The following design principles are a blend of concepts raised explicitly or implied during interviews as well as best practices for public-sector data management systems. As such, these can be considered high-level requirements for the LTW data management system. However please note these requirements aren't specific enough to begin building a system. A good next step would be to discuss each in more detail and then rank them.

Open Access - data must be easily accessible not just for the personas identified, but for the global scientific and policy making community. The LTW Partnership is obligated to make its data, analyses, deliberations, and decisions transparent and available to the public. There may be some necessary exceptions such as landowner details, locations of cultural artifacts, or locations of sensitive species/habitats.

Answer Essential Management Questions - data management systems, and the monitoring & evaluation programs they support, must always "remember" they are in service of answering important questions. The LTW Partnership — with support from its Stakeholder Science Committee (SSC), the Interagency Design Team, and the Executive Team — will work through a series of EMQs to help manage Tahoe West's natural resources through its assessment, strategy, and planning phases. This design principle is to track and share monitoring information associated with the implementation of projects.

Store or Link Datasets - many excellent data repositories already exist, are well-maintained, and provide efficient ways to extract their data. LTW must not engage in a battle for eyeballs or pursue a "One Ring to Rule Them All" strategy. Instead it must excel at integration and partnering with critical external sources such as: DRI's TahoeClim, WestMap, Western Regional Climate Center, NOAA's Earth System Research Laboratory, National Fire and Aviation's WFDSS, USFS and US DOI's LandFire, and USFS's FAMWEB. Pursuing this principle aggressively could result in a federated architecture that pulls data from existing databases.

Storytelling and Visualizations - with databases galore and metrics to match, LTW personas and the audiences they need to reach can get overwhelmed by quantitative information. This design principle balances tabular data with narratives and "visual projections" as Paula said. Data management systems should heed an old Indian proverb: "Tell me a fact, and I'll learn. Tell me a truth, and I'll believe, but tell me a story and it will live in my heart forever." However systems cannot craft great stories - they can only make information readily available to storytellers.

Relate Outputs to Outcomes - in Lake Tahoe Info, the Tahoe region has already invested in workflow-assisted, timely tracking of high-confidence outputs (aka actions). While this regional system also affords sharing of outcomes, it lacks the subsystems and workflows to automate the tracking of their details. For example it does not track the hourly air or weekly water quality observations which measure physical response and thus the efficacy of treatments. This principle is perhaps the most challenging to realize, but one that must be pursued in order to achieve landscape-scale results.

Acknowledge Risks, Benefits and Tradeoffs - in a multi-party, multi-stakeholder world with sometimes competing interests, a humble data management system must openly document risks, benefits, and tradeoffs of decision scenarios. Achieving reasonable balance and broad support is tough, but it is close to impossible without transparency.

Analysis and Deliberation - to answer management questions data collection and assemblage is often required, yet to gauge the confidence of the answer, analysis and deliberation are essential. As Andrew said, "real learning comes only after analyzing, re-analyzing, synthesizing, and presenting." Following this principle might mean the LTW data system equally invests in access to "raw" data and tools for analysis or simply in access to the results of analysis.

Self Service - some of the principles above emphasize the importance of summarizing and visualizing information, however it is equally important to ensure all LTW Personas - Paula, Marcus, Sally, Andrew, and James - can access data directly, in self-service fashion. These personas, no matter how exalted their position, demand the option for direct access. This principle also ensures LTW Data Management remains a "white box" and establishes a healthy feedback loop on data quality.

Web Services - all modern systems must provide ways for non-technical people to access information, and for technical people to access data. For Paula, Marcus, and Sally, web browsers and spreadsheets are the way. For Andrew and James, tapping into web services can be far more efficient and powerful. Web Services are functions that can be accessed over the web (using the http protocol), designed to be consumed by software or programs rather than humans. More generically, they are a type of Application Programming Interface (API). The intent of web services is to facilitate coordination and information sharing between agencies, interested parties, and the public.

Foster Community, Conversation, and Collaboration - simply providing a friendly interface to an information system can welcome the community and encourage collaboration. A further step to consider: design for promoting online conversations in the form of blogs, forums, or commenting. Consider allowing interested parties to comment on datasets, maps, charts, or other information products. Note that the technical implementation cost to do this is a pittance compared to the cost of supporting and curating these conversations over time. If citizens take their time to converse with the Partnership, the Partnership has an obligation to respond in a timely manner.

TECH STUFF

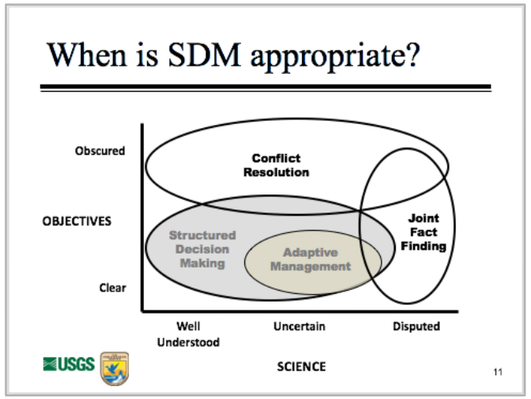
There are important technical considerations when building out a data management system. Nowadays, any competent technology partner knows to manage and deliver on these requirements. Briefly, they are: Security, Permissions, Auditability, Redundancy and Failover, Backup, Performance, and Maintainability.

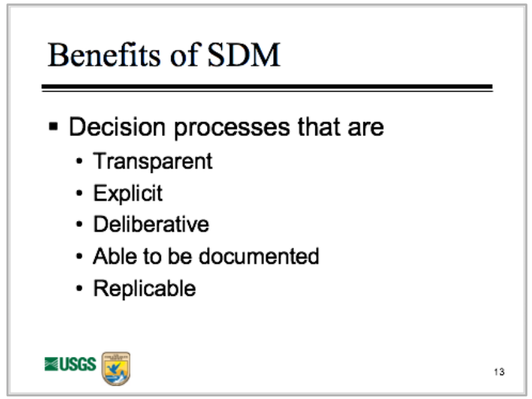
Data Management Strategy Broadsheet for Lake Tahoe West – Concepts Introduced

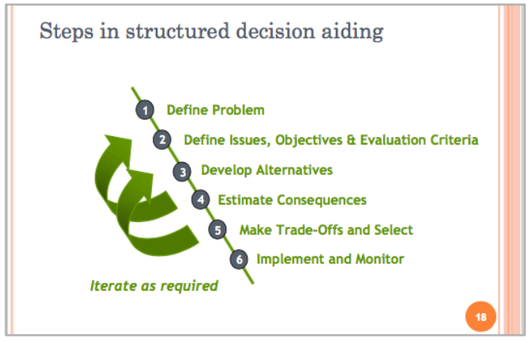
The following concepts inform the Alternatives Analyses on the following page.

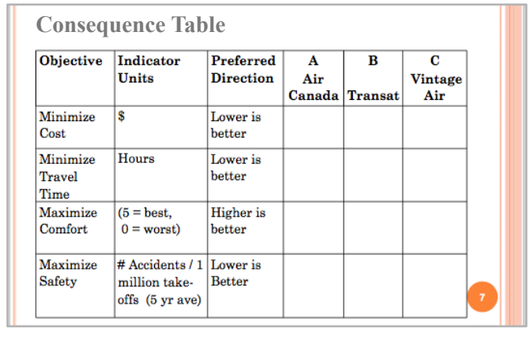
Structured Decision Making

"A formal application of common sense for situations too complex for the informal use of common sense." (R. Keeney)









Consequence Table

Objective	Indicator Units	Preferred Direction	A Air Canada	B Transat	C Vintage Air
Minimize Cost	$	Lower is better			
Minimize Travel Time	Hours	Lower is better			
Maximize Comfort	(5 = best, 0 = worst)	Higher is better			
Maximize Safety	# Accidents / 1 million take-offs (5 yr ave)	Lower is Better			

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Based on materials and conversations with leaders and team members, it seems the LTW Partnership is already familiar with these concepts, and practicing some of these techniques.

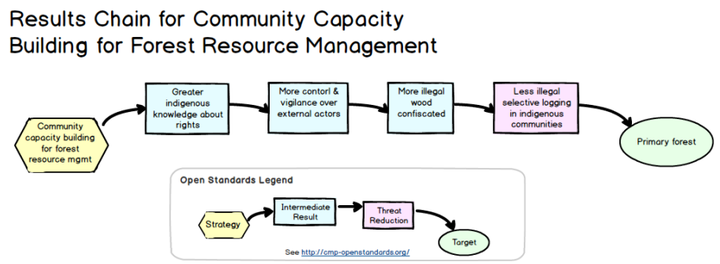
One the alternatives discussed on the next page leverages the SDM approach and framework, and provides explicit systems support for implementing it efficiently and effectively.

Sources

- "Structured Decision Making." Michael C. Runge, USGS Patuxent Wildlife Research Center. Apr/May 2012. https://training.fws.gov/courses/ALC/ALC3176/resources/pdfs/sdm_reoccuring_handout.pdf
- "Structured Decision Making: A Practical Guide to Environmental Management Choices." Gregory, Failing, Harstone, Long, McDaniels, Olhson. Mar 2012. http://www.structureddecisionmaking.org/
- "What is Structured Decision Making?" Gregory. Presentation to US Fish & Wildlife Service, 2013. https://www.fws.gov/habitatconservation/windpower/Past_Meeting_Presentations/Robin_Gregory.pdf

Open Standards and Results Chains

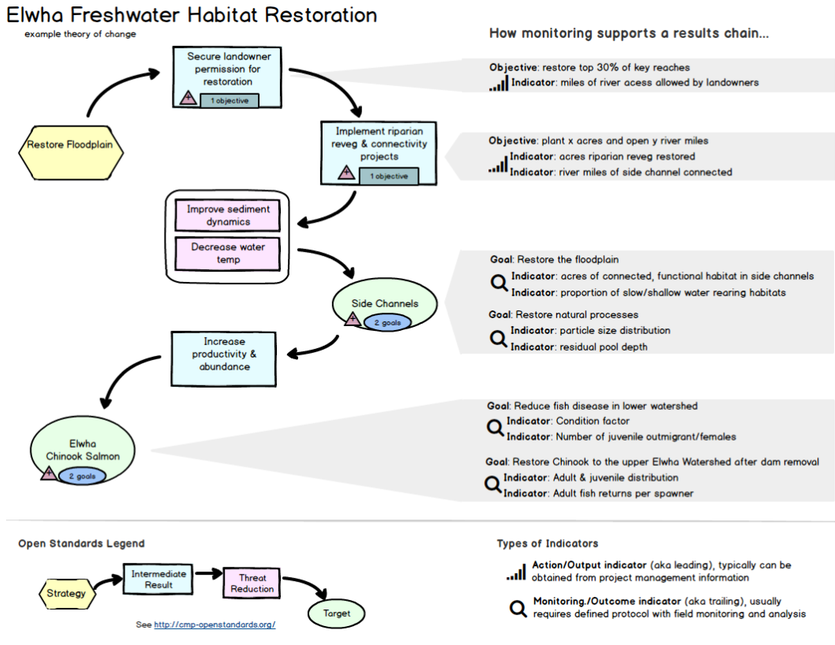
"The Open Standards for the Practice of Conservation help teams be systematic about planning, implementing, and monitoring their conservation initiatives so they can learn what works, what does not work, and why — and ultimately adapt and improve their efforts."



Results Chains, also known as Theories of Change, visually and logically describe how your **Strategies** implement specific **Actions** (aka Intermediate Results and Thread Reductions) in order to realize a **Target**.

Each element can/should have **Goals** or **Objectives**, which in turn have Indicators - either **Implementation/ Output Indicators** (e.g. acres treated) or **Monitoring/Outcome Indicators** (e.g. abundance of a key species).

Many organizations and programs have adopted the Open Standards: Puget Sound Partnership (2010), The Nature Conservancy (2003), California Dept of Fish & Game (2012), Disney (2015), US AID (2011), etc.



Sources

- "Open Standards for the Practice of Conservation." Apr 2013. http://cmp-openstandards.org/download-os/

Data Management Strategy Broadsheet for Lake Tahoe West – Alternatives Analysis

After considering the personas, data management principles, and existing platforms/systems, the following alternatives for meeting the LTW Data Management goal and objectives were identified. Except for Alternative 1, these alternatives assume a data management system that leverages the work done in earlier phases of LTW, specifically the products of the Ecosystem Management Decision Support (EMDS) currently being developed.

Alternative	Pros	Cons	Principles Achieved	Cost Estimate
1 **Status Quo** *Live with existing approach to data management*	+ No new investment required	*Most Design Principles will not be achieved, a few worth emphasizing:* – Uncoordinated approach does not promote cross-agency alignment – Significant human labor expended on low order activities – Linking outputs to outcomes continues to be a manual process		$0
2 **Off the Shelf** *Use collection of off-the-shelf tools such as Sharepoint or other generic portal to share datasets, maps, and analyses*	+ Limited investment (at least lower up-front capital costs) + Flexibility to use diff. tools for diff. aspects of data mgmt + Large install base likely means regular updates	– No intrinsic knowledge of how one dataset relates to another – Requires significant process / org. change; adoption is unsure – High operational costs due to manually moving data between tools – Likely no workflow support; expensive to adapt, still not "yours"	 Storytelling & Vizualizations  Self Service	$50 - 100k
3 **LT Info - LTW as Monitoring Program** *Support LTW as a "**monitoring program**" with multiple **monitoring datasets** (static upload or link; some dynamic); browse tabular data and simple charting; modify some existing Indicators and add some new LTW-specific indicators; create an **LTW Dashboard***	+ Limited investment + Leverages existing platform, builds on what is familiar + Extends platform for the benefit of all by enhancing the "Monitoring Program" area, coordinating/organizing datasets, enabling easier "discovery", and promoting open access	– Does not explicitly and transparently list management questions – Does not empower analysis, deliberation, visualization – More narrow platform that could limit scaling to meet additional/ emergent needs	  Store/Link Data  Open Access  Web Services	$100 - 300k
4 **LT Info - Structured Decision Making** *Everything in Alt 3, plus: explicit and transparent tracking of **management questions** and associating monitoring datasets to each; let users define **objectives** and **evaluation criteria**; let users build and compare **scenarios**; add **monitoring projects** under monitoring programs; enable community involvement with **online commenting/forums**; to summarize: elevate "tough conversations & decisions" by using a shared tool for coordination and communication*	*Same as Alt 3 plus:* + Tackles management questions head-on, and grounds monitoring datasets in them. + Promotes community and new level of communication + Closer to traditional program management techniques; makes explicit decision making processes used today + Leverages "Structured Decision Making" approach already adopted by US DOI and others	*Same as Alt 3 plus:* – Requires modest level of commitment (time, willingness to change) – Some people will be challenged by the additional rigor – Increases complexity of LT Info	  Management Questions  Community  Risks, Benefits, Tradeoffs	$300 - 600k
5 **LT Info - Open Standards Based Landscape Conservation Planning** *Everything in Alt 4, plus: improved/**visual scenario building**; track **risks, benefits** , and **tradeoffs**; let users diagram their **theory of change** with explicit outputs and outcomes; associate indicators to each output and outcome for real-time viewing of real-time progress*	*Same as Alt 4 plus:* + End-to-end adaptive management to model and measure actions/outputs to outcomes + Makes explicit LTW's "Theories of Change" + Leverages "Open Standards for Practice of Conservation" and global community for rapid learning	*Same as Alt 4 plus:* – Requires hight level of commitment (time, willingness to change) – Larger investment, may be tough to pull together funding up front – Many people will be challenged by the additional rigor	  Outputs to Outcomes  Analysis & Deliberation	$800 - 1200k

Recommendation: LT Info - Structured Decision Making

This alternative firmly places monitoring data and projects in service of management questions, directly supports balancing of risks and benefits, and enables very real conversations about tradeoffs. It avoids the mistakes of most environmental information systems that have come before it that only track monitoring data and indicators and provide no real support for scenario analysis and arriving at good decisions.

While this approach will still not provide LTW with automated linking of actions to outcomes and direct support for deliberation, it will deliver a system that can evolve to accommodate these final two principles. Tapping into the global community using the Open Standards and ensuring theories of change are explicit in everything LTW does would do great service to Lake Tahoe and the global conservation and science community, but doing so comes at more than double the up-front cost and higher degree of executive commitment and process change.