Siskiyou Streamside Protections Review:
Update on Monitoring Options

1. Introduction

At the June 2019 meeting, the Board provided specific direction to work with the Department of Environmental Quality (DEQ) to further evaluate Total Maximum Daily Load (TMDL) analyses. The Board further discussed a wide range of potential tools to complete this work. A high-level framework for moving forward with this work is discussed below along with a preliminary discussion and investigation of potential tools. In spring 2020 the department will bring the Board monitoring approaches for assessing rule sufficiency including a recommended approach with a scope and timeline developed in collaboration with DEQ (see below). A **Temperature** or **DFC** symbol in the title of each approach refers the rule sufficiency question that approach would address.

2. FPA sufficiency monitoring planning, options, and tools

2.1 FPA sufficiency monitoring plan and further evaluation of DEQ TMDLs **Temperature DFC**

A Memorandum of Understanding was created in 1998 establishing interagency expectations for ODF and DEQ regarding the review of FPA sufficiency to achieve state water quality goals and processes regarding waterbody specific coordination where TMDLs have been established (DEQ/ODF MOU, 1998).

As described in the MOU, for basins where water quality impairment may be attributable to forest management practices, ODF will design and implement a specific monitoring program with the schedule and scope jointly agreed to with DEQ. DEQ and ODF will jointly review monitoring results to assess sufficiency and present them to the Board for their sufficiency decision.

This MOU was created prior to the completion of any TMDLs. Both ODF and DEQ have made considerable progress since this time in the implementation of FPA sufficiency monitoring projects and TMDL analyses and implementation. The rule sufficiency review in the Siskiyou geographic region presents an opportunity to both implement and potentially improve upon this existing MOU.

Some key areas for ODF and DEQ to explore include but are not limited to:

- **Streamside vegetation goals:** DEQ uses system potential vegetation (SPV) as the baseline model of shade against which shade from existing vegetation is compared. How does SPV compare with ODF’s goals for Desired Future Condition (DFC)? Do they set the same vision for streamside forest stands now and into the future?
- **FPA sufficiency reviews and further analysis of TMDLs:** ODF must evaluate FPA rules to determine sufficiency of specific harvest practices (e.g., protections for small and medium fish-bearing streams) for meeting water quality standards. DEQ must also ensure

that state water quality standards are met. Where they are not met, DEQ utilizes TMDLs to set expectations for outcomes based on allocations for (in this case) temperature and shade. ODF and DEQ will explore how to align the FPA sufficiency and TMDL processes.

- Example: Prior to the ODF 'RipStream' study analysis, application of the DEQ Protecting Cold Water Criterion (PCW) to data collected for the purpose of an FPA rule sufficiency analysis had never been done for non-point temperature pollution on forestlands. ODF RipStream data were collected at a reach scale: The PCW criterion is a cumulative effects standard applied at a larger scale. DEQ and ODF staff worked together to establish guidance for evaluating the PCW criterion given these differing scales in order to complete the sufficiency analysis that the Board based a degradation finding on in January 2012. This took considerable time and effort on the part of both agencies to come to a shared understanding of the PCW standard and how it could be applied to a different spatial scale than it was originally designed.

Anticipated products:

- One or more recommended monitoring program(s) with the schedule and scope jointly agreed to with DEQ
- Refinement and clarification of MOU elements, incorporated either (or both) into the monitoring program design and analysis or a revised MOU

2.2 Monitoring Project Options for FPA Sufficiency

2.2.1 Potential Tool: GIS Analysis of Remote Sensing Data DFC

The department will leverage remotely sensed techniques to collect relevant data. This can include but isn't limited to aerial photography or Lidar data collected from Unmanned Aerial Vehicles (UAV, or drone), fixed-wing, or rotary aircraft. Such tools can be used to create surface models of the bare ground and vegetation from which canopy height, closure, shade, and other metrics can be derived. Estimates of metrics such as in-stream shade and cover associated with streamside stands on private ownership at various years post-harvest in comparison to mature stands could be created. Duration, cost, and staff needs are anticipated to be greater for estimating shade than for canopy cover due to the larger analysis required to calculate shade. Also, estimating shade or canopy cover requires extensive correcting of stream location and attributes identified in GIS stream layers. This is essential to accurate data reporting dependent on correct stream location and ultimately increases time needed to complete the project. Additionally, this approach may require quality assessment/quality control which would be conducted through field work (see section on Field Study below).

Current status: Staff are still exploring the feasibility and certainty of this approach. The monitoring unit has been collaborating with the department's GIS Unit and the Southwest Oregon District to discuss possible remote sensing methods. Different test cases are being planned to support a more informed estimate of the time, staff resources, and cost of methods and metrics.

2.2.2 Potential Tool: Field Study **Temperature** and/or **DFC**

Three options for a field study component could be added to test for sufficiency of either stream temperature or DFC:

1. Simplified field study – cover data for quality assessment and quality control of GIS-remote sensing analysis;
2. Moderate field study – Simplified field study + simple temperature recording + riparian management area cruise (metrics of stand structure e.g., basal area, stand density index, species composition) using variables for testing of Groom *et al*. 2011 & 2018 shade models.
3. Intensive field study – Modified field study + Before After Control Impact (BACI) study design to investigate harvest impacts on shade and stream temperature

Table 1. Levels of field study being investigated as approaches to the next phase of the Siskiyou Streamside Protections Review.

Field study	**WQ standards assessed for Temperature[1]**	**Stand metrics assessed for DFC**
Simplified	TMDL shade allocations	Cover (GIS-remote sensing QA/QC)
Moderate	NC, TMDL shade allocations	Shade/cover, basal area, density, diversity, etc.
Intensive	NC, PCW, TMDL shade allocations	Shade/cover, basal area, density, diversity, etc.

[1] Water quality standards for stream temperature: PCW = protecting cold water criterion (OAR 340-041-0028(11)); NC = biologically-based numeric criterion (OAR 340-041-0028(4)).

Current status: More information is needed from the GIS-remote sensing methods described in section 2.2.1 to determine what variables are needed for field study, the degree of QA/QC needed, and how the data from each method would align.

2.2.3 Potential Tool: Integrated Landscape Priority Stream Assessment

This approach seeks to capitalize on currently available data, prioritize locations for field data collection, and to explore the use of the remotely sensed data described above. Using a tiered, multi-method approach, the department would seek to identify and collect field monitoring data at locations according to anticipated risk of stream temperature increase. Collected data would serve as both a quality control tool for remotely sensed data and a stand-alone sufficiency monitoring project should remote sensing tools not meet data quality needs. The elements of this approach are described further below.

Step 1. Landscape Priority Stream Reach Assessment (Current Data – Watershed Scale)

Using currently available data and GIS tools, staff would develop a spatial model to predict risk of stream temperature increase. Parameters are likely to include but are not limited to: FERNS harvest notification polygons (harvest type); topographic shading; aspect; stream channel gradient; etc.

Step 2. Priority Stream Reach Field Data Collection (Current Tools – Local Scale)
Using the stream reach priority assessment from Step 1, specific monitoring locations would be selected across a range of risk categories. At a minimum, stream temperature, shade, and cover data will be collected. The amount and frequency of stream temperature data is still to be determined (one-off or continuous), as is the collection of any riparian stand data.

Step 3. Local Remote Sensing Data Collection (New Tool and Data – Local Scale)
If funds and resources allow, ground or low-elevation remote sensing data would be collected at some or all field data collection sites. An example could include UAV flights to collect high-resolution surface models using Structure from Motion (SfM) techniques sometimes called "phodar". The Department's Southwest Oregon District is currently using phodar technology to monitor goals for canopy cover as part of the Good Neighbor Authority (GNA) treatment program. While Lidar derived data has extensive geographic coverage, it only represents the canopy cover or other metrics on the collection date. A UAV can be used to collect current canopy conditions to help leverage field plot data to the stream reach-scale.

Step 4. Remote Sensing Data Analysis (New Tool and Data – Watershed Scale)
Simultaneous with the development and implementation of steps 1-3, the department could develop a tool to estimate stream and riparian canopy cover using Lidar data. This can create estimates across large areas (watershed, landscape level). The limit is that the data is only relevant to the date the data were collected. Lidar-based canopy estimates can be compared against field data as a qualitative quality check. Lidar can also be used to estimate tree heights in and around RMAs, allowing a landscape level view of a key stand characteristic and a check on DFC. The Lidar-generated canopy estimates can in turn be used to refine the landscape priority reach assessment generated in Step 1.

Developing the Lidar-based canopy tool will require some foundational steps to take place:

- Correction and alignment of current GIS stream line locations with Lidar generated topographic models
- Transfer of FPA stream class and type attributes to corrected stream line locations
- Etc.

Table 2. Proposed monitoring methods for assessing sufficiency of streamside protections for stream temperature and the stand structure and shade components of Desired Future Condition (DFC).

Approach Methods	Sufficiency Questions Addressed	Certainty of method to address question[2]	Considerations
TMDL evaluation — DEQ collaboration ***Directed by the Board	Stream temperature (PCW/NC[1])	TBD	Uncertainty regarding time to complete this work
GIS remote sensing analysis (Lidar)	DFC (cover, possible tree heights)	TBD	Need to correct stream line locations and attributes
GIS remote sensing analysis (Lidar)	DFC (shade, possibly tree heights)	TBD	Would need to compare methods from literature, correct stream line locations and attributes
Landscape Priority Stream Assessment (moderate field study, GIS-remote sensing analysis at different scales)	Stream temperature, DFC (cover/shade, possibly stand structure)	TBD	Landscape assessment used for locating study sites QA/QC needed for remote sensing data analysis and as fail-safe should remote sensing be inadequate Need to correct stream line locations and attributes
Simplified field study	DFC (cover)	Low	Serves as needed QA/QC for GIS-Lidar analysis

Approach Methods	Sufficiency Questions Addressed	Certainty of method to address question[2]	Considerations
Moderate field study	DFC (cover/shade, basal area, density, diversity, etc.)	Moderate	Serves as needed QA/QC for GIS-Lidar analysis
Intensive field study	DFC (cover/shade, basal area, density, diversity, etc.), Temperature(PCW)	High	BACI design

[1]Water quality standards for stream temperature: PCW = protecting cold water criterion (OAR 340-041-0028(11)); NC = biologically-based numeric criterion (OAR 340-041-0028(4)). BACI = Before-after-control-impact design.

[2]Certainty of method to address stream temperature and DFC rule sufficiency questions for the Siskiyou region. Certainty is based on department staff's professional opinion.

3. Next steps on monitoring options for additional information

In spring 2020, we will present to the Board the suite of options for monitoring approaches to answer rule sufficiency questions along with costs, duration, staff resources, and department recommendations.

4. References

Department of Environmental Quality and Oregon Department of Forestry. June 1, 1998. MOU between ODF and DEQ regarding coordination for water quality limited streams on the 303d list. 7 pages. (Available from ODF upon request)

Groom JD, Dent L, Madsen LJ, and J Fleuret. 2011. Response of western Oregon (USA) stream temperatures to contemporary forest management. Forest Ecology and Management 262:1618-1629.

Groom J, Madsen LJ, Jones JE, Giovanini JN. 2018. Informing changes to riparian forestry rules with a Bayesian hierarchical model. Forest Ecology and Management 419-420:17-30.