Chapter IV. Integrated restoration

How is the Forest Service conducting integrated restoration? Could we link Forest Service partners to integrated restoration?

In a period of increased focus on effective landscape restoration efforts, understanding how restoration occurs across the landscape and how different activities are spatially related can better link agency work to communities and conditions surrounding the forests. Specifically, understanding how Forest Service’s accomplishments on the forests relate to communities with high social vulnerability and/or isolation can link both ecological priorities with social and economic realities, with the potential to inform management and planning.

Finding new and creative ways to represent complex management through available and routinely collected data would help both the Forest Service and their partners understand and articulate where and how agency work links to communities.

This chapter is the most exploratory part of this project to date, documenting our analysis and exploration of spatial Forest Service accomplishment measures, to understand: 1) if we could identify and understand the idea of “integrated restoration” from a performance reporting angle, and 2) if information gleaned from this exploration could be used in the future to link social and economic conditions on the landscape (e.g. Chapter 2), or link to agency partners (e.g. Chapter 3), to create clear linkages between agency work and impacts to communities. Because of the exploratory nature of these analyses, this chapter provides documentation of the process and lessons learned in examining whether and how integrated restoration is taking place in forests using the accomplishment measures that became spatially explicit in FY 2015. These measures are listed in Table 4.1, at right.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Abbreviation</th>
<th>Description (areas in acres)</th>
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<tr>
<td>Forest vegetation established</td>
<td>FOR-VEG-EST</td>
<td>Forest vegetation established</td>
</tr>
<tr>
<td>Forest vegetation improved</td>
<td>FOR-VEG-IMP</td>
<td>Forest vegetation improved</td>
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<tr>
<td>Fuel treatment outside wildland urban interface</td>
<td>FP-FUELS-NON-WUI</td>
<td>Fuel treatment outside wildland urban interface</td>
</tr>
<tr>
<td>Fuel treatment inside wildland urban interface</td>
<td>FP-FUELS-WUI</td>
<td>Fuel treatment inside wildland urban interface</td>
</tr>
<tr>
<td>Terr habitat</td>
<td>HBT-ENH-TERR</td>
<td>Territal habitat restored</td>
</tr>
<tr>
<td>Noxious weeds treated on NFS lands</td>
<td>INVPRT-NXWD-FED-AC</td>
<td>Nox weed</td>
</tr>
<tr>
<td>Rangeland vegetation improvement</td>
<td>RG-VEG-IMP</td>
<td>Range veg</td>
</tr>
<tr>
<td>Water protection/enhancement</td>
<td>S&amp;W-RSRC-IMP</td>
<td>Water</td>
</tr>
<tr>
<td>Harvest-related woody fuels treatment</td>
<td>TMBR-BRSH-DSPSL</td>
<td>Woody fuels</td>
</tr>
<tr>
<td>Forest land treatment (using timber sales)</td>
<td>TMBR-SALES-TRT-AC</td>
<td>Timber treat</td>
</tr>
<tr>
<td>Stream restoration*</td>
<td>HBT-ENH-STRM</td>
<td>Stream</td>
</tr>
<tr>
<td>Lake habitat</td>
<td>HBT-ENH-LAK</td>
<td>Lake</td>
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*Measured in miles
Data used in Chapter IV: Integrated restoration

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<th>Data</th>
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<th>Analysis</th>
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<tr>
<td>Spatial data for gPAS</td>
<td>USFS gPAS from Ryan Gregg and David Green, Washington Office, Strategic Planning, Budget, and Accountability, USFS</td>
<td>Obtained March 2016</td>
<td>Mapped all spatially explicit accomplishments, then counted acres where accomplishments overlapped spatially. Used overlap threshold of 10% (i.e., two polygons need to overlap by at least 10% to be considered).</td>
<td>Limited findings with only one year of data and only a few measures. Overlap could be due to how data was entered and drawn, or conducting a phased project because activities are not necessarily independent accomplishments.</td>
</tr>
<tr>
<td>Tabular data for gPAS measures</td>
<td>USFS Accomplishment acres by HUC 12 Watershed from John Mana, Washington Office, Business Operations, Strategic Planning, Budget and Accountability.</td>
<td>Obtained February 2016</td>
<td>We removed Invasive/Noxious Spp from Management Accomplishments because it was unreliable. Missing and incomplete records were removed from the dataset prior to calculating summaries; the majority of these HUCs likely bordered Region 6, with headwaters outside of the region. For the final set of analysis looking at the concentration and frequency of treatment, we only used HUCs with management activity in them.</td>
<td>Invasive/Noxious Spp from Management Accomplishments is unreliable data (spatially off by 200%+). Unreliable measures impacted ability to use all measures for analysis.</td>
</tr>
<tr>
<td>Watershed Condition Class and priority</td>
<td>Watershed Condition Framework USFS online database</td>
<td>Downloaded April 2016</td>
<td>Counts of watershed condition class and identified HUCs with priority watershed classification. Linked watershed condition class and presence/absence of priority watershed classification to each HUC 12 watershed in tabular gPAS data.</td>
<td>Both datasets contained missing data. WCF online data contained incomplete and outdated information on priority watersheds. Used second set of data to address missing data issues. This resulted in a more complete list of watershed condition class and priority by HUC 12 identifiers, but still had missing data. Missing data were watersheds on the border with another region (e.g., watersheds in the Fremont-Winema that included some portion of Region 5). This may be due to how these data were sorted and deleted for our data request.</td>
</tr>
<tr>
<td>Case study example</td>
<td>TIM FPDS FACTS</td>
<td>Obtained 2016, used for FY 2015</td>
<td>Located timber sales by location information in timber sale description. Attempted to locate restoration-related service contracts by description of where and how work was conducted. Had limited success in finding physical locations for recorded service contract work. Attempted to link accomplishments from FACTS to location of timber sales and service contract work, to see where projects aligned with reported accomplishments.</td>
<td>Linking proved to be unfeasible. Timber data is reported with enough information about location of sale that the majority of timber sales could be linked. However, the majority of service contract work could not be linked to the reported accomplishments, as demonstrated in maps 4.3 and 4.4.</td>
</tr>
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4.1. Developing an Accomplishments Explorer to understand accomplishment overlap

We used two different strategies for measuring integration. First, we calculated the spatial overlap of accomplishments by identifying places where two or more reported accomplishments overlapped by at least 10 percent with another on the landscape. Second, we calculated the diversity of accomplishments within the same watershed at the same spatial scale as the Watershed Condition Framework (HUC 12) scale.

To explore the overlap of accomplishments, we created an interactive web-based “explorer” tool that allowed us to calculate the spatial overlap between the eleven different accomplishment measures (the 12th measure was only used in the watershed analysis discussed later on). This tool allowed us to see what treatments overlapped most often and zoom in to their locations on the landscape.

Of the eleven accomplishments used, ten were measured in acres. They totaled 59,766 acres in FY2015 across national forests in Oregon and Washington. Of these acres, 273 different accomplishments overlapped, representing 9,800 acres, or approximately 16 percent of the total treatment acres. The remaining accomplishment, measured in miles of stream, included 3,237 feet of overlap with other treatments. Treatments that overlapped the most were non-WUI fuels treated and acres of harvest-related woody fuels treated (Figure 4.1, right). That is, the most common overlaps were different types of non-WUI fuels treatments occurring in the same location. Acres of improved forest vegetation also overlapped with non-WUI fuels treated. Acres of forestland treated using timber sales and acres of fuels treated in WUI also overlapped with acres of harvest-related woody fuels treated. These five measures all contained the highest number of acres overlapping other treatments.

An example of this overlap in accomplishments is shown in Figure 4.2 (page 49). The area shown in Figure 4.2a shows a functioning-at-risk watershed on the Umatilla National Forest where harvest-related woody fuels were treated through low intensity underburns with both WUI and non-WUI fuels treatments. Another example is shown in Figure 4.2b in a functioning-at-risk watershed in the Fremont-Winema. The selected area includes acres of woody fuels treated (TIMBR-BRUSH-DISPOSAL), in which both burning of piled materials and fuel inventory were conducted on 47 acres. The same 47 acres were also listed as an accomplishment for acres of non-WUI fuels treated (FP-FUELS-NON-WUI).

We found the explorer tool useful for spatial analysis and for understanding where and how certain measures overlapped with each other. However, our findings made it clear that understanding overlap was not enough. The infrequent spatial overlap suggested that either there was very little integrated restoration going on, or, as likely, that integration was occurring at a different spatial scale. Consequently, we discovered that we also needed to look at how work was being performed in close proximity within watersheds.
Figure 4.2  Forest Treatment Overlap Explorer and pull-outs

Displays the amount of overlap, with darker shading representing more overlap.

Locations where selected accomplishment types overlap.

Umatilla National Forest

Fremont-Winema National Forest

Names of accomplishments
4.2. Watershed analysis to understand the proximity of Forest Service accomplishments

We investigated the number and types of treatments performed watershed by watershed. We conducted this analysis at the HUC-12 watershed level, which is the scale used for the Watershed Condition Framework. This analysis did not allow us to provide acreage numbers due to data limitations and the challenges posed by avoiding double (or triple) counting acres where similar sets of accomplishments were linked to the same polygons. Instead, we analyzed the frequency of the eleven accomplishment measures, along with an additional measure for acres of lake habitat enhanced.

Frequency of accomplishments

Of the 1,947 HUC-12 level watersheds in the National Forest System in Oregon and Washington, at least one of the twelve accomplishment types occurred in 1,601 (82 percent) of the region’s watersheds in FY 2015 based upon the Spatial Accomplishments dataset. However, upon reviewing spatial data for accuracy, we determined that Noxious Weed Removal, the single most common management accomplishment, was recorded at scales larger than individual HUCs and was found to be unreliable, and we removed it from the management accomplishments. With this activity removed, we found that at least 1,234 (63 percent) of all watersheds received one or more treatments. Accomplishments are widespread, not concentrated in certain watersheds, as might have been expected given the focus on prioritizing particular watersheds for treatments.

Of the watersheds that received treatments, 33 percent of watersheds benefited from a single management accomplishment, while 67 percent of HUCs received management activities with two or more benefits. Fully one-third of watersheds benefited from three, four, or five accomplishments, with only a handful of HUCs receiving integrated treatments that resulted in more accomplishments.

Frequency of accomplishments in the same watershed

The series of figures presented on the right (Figure 4.3) demonstrate how different accomplishments were linked to each other; in other words, they reveal where different accomplishments were listed most frequently in the same watersheds. The thickness of the lines between treatments in these figures shows the relative frequency of which different activities occurred in the same watershed. As one might expect, accomplishments fell into different categories: fuels-related accomplishment measures most frequently occurred with other fuels measures, watershed and water related measures most frequently occurred together, and vegetation treatment formed the third group of accomplishments. Within the fuels measures, woody fuels, non-WUI, and WUI fuels occurred together in the same watershed the most frequently. In the watershed measures group, lake and stream accomplishments were nearly always conducted together in the same watershed (note that the total number of lake measures was relatively small). In the vegetation group, forest vegetation improved and rangeland vegetation improved occurred most frequently in the same watersheds. Although we do not have sufficient data to know for certain, these connections and groupings suggest that related measures are still occurring most frequently in the same watershed(s), which raises questions about if and how accomplishments should be varied or combined in different ways.
Figure 4.3  Frequency of accomplishments in the same watershed

Count of reported accomplishments

- Fuel treatment frequency
  - 1,665
  - 1,640
  - 4,363
  - Total: 12,306

- Vegetation treatment frequency
  - 347
  - 930
  - 1,772
  - Total: 3,049

- Watershed treatment frequency
  - 130
  - 1,831
  - 3,195
  - 5,172
  - Total: 10,328

- Fuel treatment connections*
- Vegetation treatment connections*
- Watershed treatment connections*

Key
1 - Stream
2 - Forest veg estb.
3 - Forest veg imp.
4 - Fuel (non-WUI)
5 - Fuel (WUI)
6 - Terr habitat
7 - Nox weed
8 - Range veg
9 - Water
10 - Woody fuels
11 - Timber treat
12 - Lake

Region total: 25,683 reported accomplishments

* Thickness of line represents relative frequency of accomplishments reported
Accomplishments linked to watershed condition

We explored how these activities related to the Forest Service’s Watershed Condition Framework (WCF), which classifies watersheds into three categories based on a suite of 12 physical and biological indicators. We focused our assessment on 1,234 watersheds in Oregon and Washington that occur in whole or in part on national forests, and that had reported accomplishments. Region wide, more than one-third of these watersheds (39 percent) are designated as functioning properly (Class 1), 58 percent are at risk (Class 2), and 2 percent are impaired function (Class 3) which we further broke down by national forest (Figure 4.4, right). This figure shows the number of total watersheds per forest, broken into: 1) watersheds with at least one of the eleven reliable accomplishment measures reported (divided by condition class); 2) watersheds that we identified as not having any of the eleven management actions reported, and 3) watersheds that had inaccurate or missing data (only reported noxious weed removal or were missing from data we received).

The Wallowa-Whitman National Forest, which borders the Snake River, has 18 Class 3 watersheds, the most of any forest. In contrast, 13 of the forests contained no Class 3 watersheds. In addition to the WCF classes, watersheds may be prioritized by the Regional and Washington Offices for special, focused attention for restoration. In the Pacific Northwest Region, 70 watersheds are designated as Priority, with every forest containing at least one Priority watershed and some having as many as 13. Priority and WCF can be used together to identify watersheds in need of acute restoration. Fifty-five priority watersheds are coded as Class 2 and 15 are coded as Class 1. No Class 3 watersheds are currently designated as a Priority, suggesting the WCF framework is focused on improving the watersheds with the greatest chance of returning them to ecological function and health and keeping Class 1 watersheds from degrading.
More than four hundred watersheds received only one type of activity, but the majority of treated watersheds had two or more types of activities. Figure 4.5 (right) shows the number of different activity types reported within the same watershed, with watersheds broken into the three classes. Only a handful of watersheds received more than five management activities, and no watershed had more than nine of the 12 different performance measures. Higher-risk watersheds tended to have a greater diversity of accomplishments in them, suggesting management activities are benefiting multiple objectives in terms of ecological restoration. Watersheds designed as priority primarily contained two to five types of accomplishments, which was more than non-priority watersheds.

Relating to management activity and accomplishments, a larger proportion of watersheds in more at-risk classifications (e.g. Class 2 or 3) were linked to larger numbers of different accomplishment measures. Watersheds rated as Class 2 and 3 accounted for 60 percent of the accomplishments. In other words, the watersheds of higher ecological risk tended to have accomplishments linked to them more frequently, suggesting concentration of activity and restoration intensity. All priority watersheds received at least one type of management treatment, based upon available data. These data seem to broadly align with the intent of the Watershed Condition Class and Priority designation for directing restoration and management activities. Restoration activities in these data are more likely to be centered on Class 1 and 2 which is in alignment with the new paradigm of the watershed condition framework: to remove risk factors that may threaten the integrity of a watershed, not to treat the “worst” watersheds first.

Our analysis finds that at-risk watersheds are generally receiving more attention—both in the number of watersheds linked to accomplishments and the diversity of accomplishments within the watersheds. Although the underlying data is not complete, the analysis of available data serves as a likely indicator of broader trends of ecologically prioritized watersheds and the manner in which land management actions are conducted. This work raises questions about the degree to which integrated, concentrated, and targeted restoration occurs across the region broadly, as well as within individual forests.
**4.3. Linking activities and contractors: Which businesses perform what work?**

**Case example of potential for linking accomplishments to contractors**

In continuing the theme of data exploration in this chapter, we explored if we could better estimate how far contractors travel to perform forest and watershed restoration activities. We originally intended to conduct a full case study to link contractor home locations with work they are doing on the forests. However, we were limited in how far we could connect data, and it became clear that such an analysis would require a more in-depth and concentrated look in a project-by-project manner. For now, we provide a summary of our efforts and lessons learned to provide some possible discussion points if such a direction were to be pursued in the future.

At the Ecosystem Workforce Program, we have investigated the location of forest and watershed restoration contracts and timber sales in relation to national forests in order to understand how these opportunities flow to communities near national forests. One limitation of this work has been that we have not been able to connect the actual work location to contractor locations, making estimates of how far contractors travel to perform work a rough estimate at best. Here, we hoped to improve these estimates of work location, of how these techniques could be applied to other Forest Service partners, and also of where and how they connect to work in the forests (e.g. volunteers and trail restoration, natural resource agreements with NGOs).

The two maps at right (Map 4.1 and 4.2) show our traditional look at the relationship between national forests and contractor and purchaser locations, using the Willamette National Forest. Circles on each map represent the communities where businesses are located that are working with the Willamette National Forest; the size of the circle represents the value of restoration service contracts and timber sales awarded to contractors in those locations.

**Local contractors:**

Contractors whose place of business located within a county which the national forest of interest touches. For the Willamette National Forest, these local counties include: Douglas, Lane, Linn, Marion, and Clackamas.

- Forty-one local businesses performed forest and watershed restoration treatments in the Willamette NF between FY 2011-2015.
- Another 20 businesses in other parts of Oregon have performed forest and watershed restoration treatments in the Willamette NF between FY 2011-2015.
- The total value of restoration contracts from the Willamette (FY 2011-2015) was $8.7 million. Of this, approximately 86 percent ($7.5m) was contracted by businesses outside the state. Businesses from outside the state were from California, Washington, Idaho, Missouri, New York, and Virginia.

- Thirty-two Oregon businesses—timber mills, logging companies and individuals—purchased timber from the Willamette National Forest during FY 2011-2015. Of these, 18 businesses were local to the Willamette.
- The total value of timber sales in Oregon from the Willamette was $30.9 million. Of this, approximately 99 percent ($30.6 million) was purchased by Oregon businesses, and about 1 percent ($391,000) was purchased by businesses in Washington.
- Approximately 89 percent ($27.5 million) of the timber sale value went to local businesses.
The next two maps (Map 4.3 and 4.4, at right) show how our linking of Forest Service timber sale and service contract data to reported accomplishments aligned. The lines denote places where we were able to definitively make a link between contracts in FPDS and timber sales in TIM and accomplishments reported by the agency in FACTS. The remainder of the polygons on the maps shows the accomplishments we were unable to link back to a service contract or timber sale.

Now that we have approached this question from the perspective of database linking, we would propose that any future related work be done by starting at the relevant forest and ranger districts, in order to work with staff and their local knowledge to draw lines between these datasets. Our intent of exploring this from a database angle was to understand if it would be possible to do this linking at a large scale, across multiple years and forests at once, instead of needing the manual labor required to conduct this investigation accomplishment by accomplishment. As more and more measures become spatial and integrated into pPAS, there may be an opportunity to further develop this analysis, although we caution that may still be limited by data reporting on service contracts and timber sales.

Figure 4.6  Type of workforce implementing accomplishments, by acres, FY 2011-2015 (draft)
Data takeaways:

- Tabular data proved more reliable to summarize measure of activity and proximity of activities near each other. Spatial data provides the ability to look at a smaller scale than HUC 12 level, but has its own challenges with data accuracy in reporting.
- Matrix figures show data in relative proportions. So measures that are the most tightly linked are not necessarily the ones occurring the most frequently.
- Other conditions could be linked to watershed classification, such as identifying classes of watersheds by social and economic factors (a combination of demographic conditions and isolation and service access resulting in a ranked system of watershed classification). This could link work accomplished to social and demographic conditions in the respective watersheds.
- Without complete data, or more years of data, we are limited in the conclusions that we can definitively draw from this exercise. We can see that treatments tend to cluster with others in the same management objective family (e.g. fuels, watershed and vegetation). Seeing treatments occurring in all priority watersheds also confirms what we should be observing on the landscape.

Chapter takeaway:

Altogether, our analysis of integrated restoration in each watershed shows considerable variability in the region, with at-risk watersheds generally receiving more attention. It is clear that there is potential to link agency accomplishments not only to ecological risk of watersheds, but also to social and economic risk factors. A larger question still exists, however, about the value and utility of tracking accomplishments on the landscape to understand integrated restoration. Given how agency management priorities and plans are determined, and the varying goals and priorities of different program areas, understanding integration of measures may not be as relevant as other avenues linking work to local social, economic, and ecological conditions, regardless of treatment integration.