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## ***Watershed Condition Classification Attribute Assessments: A summary 2010 to 2018***

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### **INTRODUCTION**

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The U.S. Department of Agriculture's Forest Service (Forest Service) is currently exploring opportunities for updating the Watershed Condition Classification (WCC) to make it more cost-effective, better leverage readily available datasets across scales, provide the potential for regular updates, and better reflect the current capabilities and needs of the agency. The aim of this document is to summarize WCC data stored in the Forest Service corporate database, Watershed Classification Assessment Tracking Tool (WCATT), to provide a snapshot of the temporal and spatial distribution of watershed condition assessments. This summary covers WCC assessments conducted between 2010 and 2018 by the Forest Service.

The WCC is summarized in the Watershed Condition Classification Technical Guide (Potyondy and Geier 2011) and is the first step of the six-step Forest Service Watershed Condition Framework (WCF; USDA 2011). The framework is used to help prioritize restoration activities to protect the integrity of Nation Forest System (NFS) water and soil resources. It was introduced in 2010 and fully implemented in 2011. The WCC includes 12 aquatic and terrestrial biophysical indicators, each of which have one or more measurable attributes. In total, the WCC includes 24 attributes, which are rated as a 1, 2, or 3, signifying functioning properly, functioning at risk, and impaired function.

Condition assessments are done for Hydrological Unit Code 12 (HUC12) watersheds at the Forest level by interdisciplinary teams of natural resource specialists. These teams enter completed condition assessments into the Forest Service's Natural Resource Manager (NRM) application, WCATT. Retrieving these data requires a database query from a separate NRM application, called Watershed Improvement Tracking (WIT).

The WCC Technical Guide suggests that the Forest Service conduct reassessments annually, concentrating on:

- those watersheds thought to have dramatically changed in condition,
- priority watersheds with implemented treatment activities,
- and those watersheds that have experienced large fires or other natural or man-made disturbances.

In addition, the WCC Technical Guide suggests a full reassessment of condition on HUC12 watersheds that contain greater than 5% NFS land at least every five years. However, it is likely that limited workforce capacity in Forest Service has prohibited this level of reassessment effort.

There are four levels of condition measures in the WCC: attribute class, indicator class, indicator score, and overall condition class (Potyondy and Geier 2011). Only the attribute class is assessed by the interdisciplinary teams, while all other levels are aggregates of these classes.



Previous work by Steel and Podschwit (2012) reviewed the statistical design of the WCC and made a number of recommendations for improving the tool. The analysis here builds on that work but focuses on summarizing the watershed condition data that has been entered into WCATT. In particular, this document focuses on watersheds for which multiple condition assessments have been made and differentiates between those with and without changing condition. The intent is to introduce different spatial and temporal summaries of existing watershed condition that may be useful in the ongoing effort to update the WCC or in novel applications of this Forest Service classification.

## WATERSHED CONDITION ASSESSMENTS: 2010 TO 2018

The complete set of WCC assessments stored in the WCATT database was gathered using the WIT query “WCATT Attribute Ratings by Assessment Year - SAQ” (query ran on 03/29/2018).

Between the years 2010 and 2018, 18934 HUC12 watershed assessments were conducted by the Forest Service and entered into WCATT (Table 1). The majority of these assessments took place in two years – in 2010 there was a Forest Service-wide expectation that a complete census of all watersheds in the NFS was to be carried out to serve as a baseline-of-condition, and in 2015 there was Forest Service direction encouraging units to do watershed reassessments, but this direction left it as optional.

**Table 1:** Number of assessments of watersheds, by year from WCATT (total number of assessments as of 03/29/2018 is 18934).

Assessment Year	# of Assessments
2010	15081
2011	216
2012	145
2013	24
2014	14
2015	2749
2016	540
2017	157
2018	8

In the period 2010 to 2018, according to WCATT data, 11621 watersheds were assessed a single time, while more than 3000 watersheds were assessed two or more times (Table 2). Similarly, the majority of regions have revisited a small number of watersheds three or more times. Watersheds with multiple assessments may be particularly useful in, for example, validating remote sensing tools detecting trends over time in watershed condition. In Table 3, the number of watershed assessments per region entered into WCATT is further broken down by year and differentiated by whether the assessment was a reassessment or a first-time assessment.

**Table 2:** The number of watersheds reporting single and multiple assessments from WCATT, by region.

# Assessments	R1	R2	R3	R4	R5	R6	R8	R9	R10	Overall
1	1664	1627	1022	2162	1229	679	1367	1233	638	11621
2	285	176	515	264	228	1076	98	10	479	3131
3	9	17	10	4	17	192	3	1	69	322
4	0	0	0	0	10	1	0	0	4	15
5	0	0	0	0	5	0	0	0	0	5



**Table 3:** Number of watersheds assessed by year and region, where the first number is the number of watersheds assessed for the first time and the number in parenthesis is the number of re-assessed watersheds for the given year and region (data source: WCATT).

Year	R1	R2	R3	R4	R5	R6	R8	R9	R10	Overall
2010	1958 (0)	1810 (0)	1547 (0)	2429 (0)	1489 (0)	1947 (0)	1467 (0)	1244 (0)	1190 (0)	15081 (0)
2011	0 (1)	0 (5)	0 (0)	0 (2)	0 (21)	0 (181)	0 (2)	0 (1)	0 (3)	0 (216)
2012	0 (2)	0 (4)	0 (44)	0 (9)	0 (15)	0 (1)	0 (2)	0 (0)	0 (68)	0 (145)
2013	0 (7)	0 (1)	0 (2)	0 (1)	0 (8)	0 (3)	0 (1)	0 (0)	0 (1)	0 (24)
2014	0 (3)	0 (5)	0 (1)	0 (0)	0 (0)	0 (2)	0 (1)	0 (1)	0 (1)	0 (14)
2015	0 (7)	10 (174)	0 (406)	1 (255)	0 (214)	1 (1118)	0 (5)	0 (6)	0 (552)	12 (2737)
2016	0 (277)	0 (14)	0 (46)	0 (4)	0 (36)	0 (153)	1 (7)	0 (2)	0 (0)	1 (539)
2017	0 (6)	0 (4)	0 (36)	0 (1)	0 (17)	0 (5)	0 (83)	0 (1)	0 (4)	0 (157)
2018	0 (0)	0 (3)	0 (0)	0 (0)	0 (1)	0 (0)	0 (3)	0 (1)	0 (0)	0 (8)

## Overall Watershed Condition Trends

To understand how watershed condition has changed over time across the NFS, a basic question is how many watersheds display a change in overall condition class, for the period 2010-2018? To answer this question it is important to note that Steel and Podschwit (2012) found that WCC overall condition class can be insensitive to changes in inputs (i.e. changes in indicator class, indicator score, or attribute class). Indeed, WCC allows for overall condition class to be changed by “overriding” an un-changing overall condition class when it is judged that watershed treatments warrant a change. In the period 2010-2018, of the 3475 watersheds with multiple assessments in WCATT, nearly 450 watersheds show some change in overall condition, of which 95 were instances of the override being used (Table 4). Conversely, there are 3027 watersheds with multiple assessments and no change in watershed condition class. Note that because change in condition class was calculated by subtracting the watershed condition class corresponding to the last year of assessment from the first year, the calculation does not detect intermediate years watershed condition in the case of more than two assessments occurring for the same watershed.

**Table 4:** For those watersheds with more than one assessment for the years 2010 through 2018, the change in overall watershed condition class, and the corresponding number of watersheds. The first number does not include class overrides, while the number in parenthesis does. A +2 indicates a 2 class improvement in WCC, 0 indicates no change in WCC, and -2 indicates a 2 class degradation in WCC, etc. (data source: WCATT).

Change in WCC Condition Class	# watersheds (# including overrides)
-2	11 (11)
-1	174 (175)
0	3027 (2992)
1	259 (293)
2	2 (2)

## Attribute Class Trends

While the overall condition class is typically the reported measure for the WCC, tracking and summarizing the attribute class data provides additional specific information on ecological condition of the assessed watersheds. To understand which watershed attributes changed the most over the period 2010-2018, for each attribute, the number of watersheds with improved, degraded, or unchanged attribute status is calculated (Table 5). This revealed that, from the total number of watersheds with more than one assessment and non-empty attribute values (n = 3161), for the period 2010-2018, the Insects and Disease and Proximity to Water attributes showed the most change overall. Ozone, on the other hand, is nearly never adjusted (Table 5).

When this analysis is limited to just those watersheds designated as priority under the WCF, the attributes that are most often adjusted are Road Maintenance, Water Quality Problems, Open Road Density, and Proximity to Water (Table 6). For priority watersheds, very few attributes showed a degradation of attribute condition, which aligns with the fact that watershed improvement efforts are concentrated in priority watersheds under the WCF.

The WCC override can be used in two ways: first, the attribute data can be entered into WCATT and, when the overall watershed condition class does not change when the practitioner thinks it ought to, the override may be applied to indicate a changed overall condition class. Alternatively, a practitioner could apply the override without updating the attribute data. In the former, remotely-sensed data or GIS products may be tested against trends in relevant watershed attributes; in the latter, the use of the override would obscure the reasons for the change in overall condition class. Of the 95 watersheds where the override was applied in WCATT (2010-2018), attribute data was updated in 91 cases.

**Table 5:** Number of watersheds with improved (positive change), degraded (negative change), or unchanged attribute values over the period 2010-2018 from WCATT. Absolute (Any) change is also provided. The number of watersheds are expressed as a percent of the Total # of Watersheds and as the actual number. The Total # Watersheds column provides the total number of assessed watersheds, by attribute\*. Categories of change calculated by subtracting the attribute class corresponding to the last year (final) from the first year (initial).

WCC Attribute	Any change	Positive Change	Negative Change	No Change	Total # Watersheds
Insects Disease	19% (591)	6% (198)	12% (393)	81% (2570)	100% (3161)
Proximity Water	13% (409)	12% (372)	1% (37)	87% (2752)	100% (3161)
Channel Shape Func	11% (361)	5% (166)	6% (195)	89% (2800)	100% (3161)
Soil Erosion	11% (357)	2% (79)	9% (278)	89% (2804)	100% (3161)
Impaired Waters	11% (346)	6% (185)	5% (161)	89% (2815)	100% (3161)
Forest Cover	10% (319)	3% (86)	8% (233)	90% (2757)	100% (3076)
Water Qual Probs	10% (314)	6% (177)	4% (137)	90% (2847)	100% (3161)
Road Maintenance	10% (311)	5% (150)	5% (161)	90% (2850)	100% (3161)
Riparian Veg Cond	9% (294)	4% (142)	5% (152)	91% (2867)	100% (3161)
Soil Productivity	9% (291)	2% (70)	7% (221)	91% (2870)	100% (3161)
Large Woody Debris	11% (278)	6% (145)	5% (133)	89% (2238)	100% (2516)
Hab Fragmentation	8% (253)	5% (170)	3% (83)	92% (2908)	100% (3161)
Native Species	7% (207)	4% (127)	3% (80)	93% (2954)	100% (3161)
Flow Characteristics	6% (196)	3% (104)	3% (92)	94% (2965)	100% (3161)
Open Road Density	6% (190)	4% (142)	2% (48)	94% (2971)	100% (3161)
Life Form Presence	5% (157)	4% (119)	1% (38)	95% (3004)	100% (3161)
Aq Invas Species	5% (144)	2% (60)	3% (84)	95% (3017)	100% (3161)
Extent SpreadRate	3% (98)	1% (16)	3% (82)	97% (3063)	100% (3161)
Mass Wasting	3% (70)	2% (42)	1% (28)	97% (2050)	100% (2120)
Range Veg Condition	3% (65)	2% (44)	1% (21)	97% (2028)	100% (2093)
Soil Contamination	2% (58)	1% (32)	1% (26)	98% (3103)	100% (3161)
Wildfire Effects	10% (36)	9% (33)	1% (3)	90% (322)	100% (358)
Ozone	0% (6)	0% (4)	0% (2)	100% (3155)	100% (3161)

\* Note that some attributes were not assessed for some watersheds (e.g. Wildfire Effects and Large Woody Debris).

**Table 6:** Number of Priority Watersheds with improved (positive change), degraded (negative change), or un-changed attribute values over the period 2010-2018 from WCATT. Absolute (Any) change is also provided. The number of watersheds is expressed as a percent of the Total # of Watersheds and as the actual number. Total # Watersheds column provides the total number of assessed watersheds, by attribute\*,\*\*. Categories of change calculated by subtracting the attribute class corresponding to the last year (final) from the first year (initial) of assessment.

WCC Attribute	Any change	Positive Change	Negative Change	No Change	Total # Watersheds
Road Maintenance	24% (20)	21% (18)	2% (2)	76% (65)	100% (85)
Water Qual Probs	20% (17)	19% (16)	1% (1)	80% (68)	100% (85)
Open Road Density	19% (16)	18% (15)	1% (1)	81% (69)	100% (85)
Proximity Water	16% (14)	16% (14)	0% (0)	84% (71)	100% (85)
Hab Fragmentation	15% (13)	15% (13)	0% (0)	85% (72)	100% (85)
Channel Shape Func	14% (12)	13% (11)	1% (1)	86% (73)	100% (85)
Riparian Veg Cond	13% (11)	12% (10)	1% (1)	87% (74)	100% (85)
Soil Erosion	12% (10)	8% (7)	4% (3)	88% (75)	100% (85)
Flow Characteristics	9% (8)	9% (8)	0% (0)	91% (77)	100% (85)
Large Woody Debris	11% (8)	8% (6)	3% (2)	89% (63)	100% (71)
Insects Disease	9% (8)	7% (6)	2% (2)	91% (77)	100% (85)
Native Species	6% (5)	6% (5)	0% (0)	94% (80)	100% (85)
Impaired Waters	6% (5)	4% (3)	2% (2)	94% (80)	100% (85)
Life Form Presence	5% (4)	5% (4)	0% (0)	95% (81)	100% (85)
Mass Wasting	6% (4)	6% (4)	0% (0)	94% (58)	100% (62)
Soil Productivity	5% (4)	4% (3)	1% (1)	95% (81)	100% (85)
Forest Cover	5% (4)	2% (2)	2% (2)	95% (77)	100% (81)
Extent SpreadRate	5% (4)	5% (4)	0% (0)	95% (81)	100% (85)
Aq Invas Species	4% (3)	2% (2)	1% (1)	96% (82)	100% (85)
Soil Contamination	2% (2)	2% (2)	0% (0)	98% (83)	100% (85)
Range Veg Condition	2% (1)	2% (1)	0% (0)	98% (52)	100% (53)
Wildfire Effects	0% (0)	0% (0)	0% (0)	100% (8)	100% (8)
Ozone	0% (0)	0% (0)	0% (0)	100% (85)	100% (85)

\* Note that some attributes were not assessed for some watersheds (e.g. Wildfire Effects and Large Woody Debris).

\*\* Priority watersheds are identified from the “WCF Priority Watershed Completed EDW” query from the Watershed Improvement Tracker database. These are the watersheds identified as priority by the Forest that have had their Watershed Restoration Action Plans (WRAP; Step C of the WCF, USDA 2011) completed.

## SUMMARY

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- There are 3473 watersheds identified in the WCATT database that have been assessed more than once (Table 2). These watersheds could be targets for validating remote sensing approaches to measuring watershed condition as they provide a verified instance of changing condition over time.
- Between 2011 and 2018, all Forest Service regions conducted some WCC reassessments; although, to date, no region has conducted a full WCC reassessment for all of the watersheds that were originally assessed in 2010. Region 9 had the lowest number of reassessments (less than 1% of the total number of watersheds) and Region 6 had the highest number, with over 75% watershed reassessed between 2011 and 2018.
- Most reassessments took place in 2015. This fact is attributed to Forest Service (optional) direction that encouraged units to conduct WCC reassessments in this year.
- In 91 out of 95 instances of the WCC condition class override being applied, this analysis confirmed that condition attributes were updated in WCATT. This is a positive indication that, when the override is used, the database is still tracking the attributes that were improved (or degraded).
- For hundreds of watersheds, many of the WCC attributes show variation between reassessments. In priority designated watersheds, the attributes Road Maintenance, Water Quality Problems, Open Road Density, Proximity to Water, and Habitat Fragmentation are the top five most-improved attributes following reassessment.

## REFERENCES

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