Official Guidance Maps for Appropriate Application of Hydric Soil Field Indicator F21 – Red Parent Material: National and Regional User Notes

DEPARTMENT OF ENVIRONMENTAL SCIENCE & TECHNOLOGY

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ABSTRACT

Hydric soil Field Indicator, F21 - Red Parent Material (RPM), is approved for nationwide testing for identification of problematic red soils (derived from certain parent materials) that are resistant to redox-induced color changes typically associated with hydric soils. Because the morphological requirements of the indicator are relatively minimal (7.5YR or redder hues; 10% redox concentrations and depletions in combination), suspected red soils must "qualify" as being resistant to color change by having Color Change Propensity Index (CCPI) values less than 30. Currently, there is no glossary of problematic RPM soils and parent materials confirmed by CCPI analyses as required by the indicator, and therefore formal guidance regarding where appropriate use of the F21 - RPM indicator is lacking. For these reasons, an effort was coordinated between the UMD, USDA-NRCS, USACE, and KSSL to collect and identify (via CCPI analysis) all problematic RPM soils and their derivative parent materials across the country to generate guidance maps for the appropriate application of the F21 - RPM indicator. From CCPI analyses of more than 1,200 individual soil samples (correlated with USDA-NRCS gSTATSGO2 and relevant USGS datasets), a variety of lithology and soil groups from four major regions (Northeast & Mid-Atlantic, Great Lakes, South-Central, and Desert Southwest and Rocky Mountains) have been mapped which identify areas where problematic RPM likely exists and application of the F21 – RPM indicator is appropriate. Based on this effort, it appears that the problematic RPM occurs in association with lithified, sedimentary, "red bed" deposits rich in the mineral hematite, and in the alluvial, colluvial, and glacial materials derived from them. This poster will present F21 - RPM guidance maps for each of the regions where problematic RPM occurs, as well as indicator "user notes."

INTRODUCTION

The F21 – Red Parent Material (developed from the original TF2) Field Indicator, can be used nationwide for testing in problematic red soils that are resistant to developing redox features typically used to ID hydric soils **(Figure 1)**. Evidence suggests that these soils are resistant to redox-induced color changes via mineralogical characteristics inherited from their parent materials (Elless & Rabenhorst, 1994), and therefore occur in association with particular lithologies. As the F21 – RPM indicator currently reads, morphological requirements (7.5YR or redder hues, 10% redox features as concentrations and/or depletions) for application are minimal, the Glossary lacks a defined list of red parent materials where F21 - RPM can be applied; and User Notes require suspected RPM soils to "qualify" as problematic with Color Change Propensity Index (CCPI) values less than 30 (USDA-NRCS, 2016). For these reasons, a national effort was established between the Univ. of MD, U.S. Army Corp of Engineers (USACE), USDA-Natural Resource Conservation Service (USDA-NRCS), and Kellogg Soil Survey Laboratory (KSSL) to generate guidance maps (via CCPI analysis) for the appropriate application of the F21 - RPM indicator to eliminate potential erroneous hydric soil (and therefore wetland) delineations using F21.

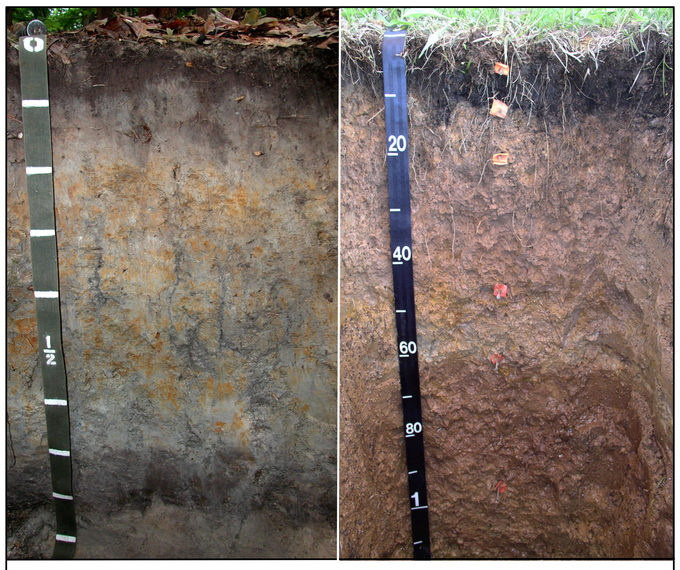

Figure 1. Hydric soils derived from problematic red parent materials (right) demonstrate far weaker expression of redoximorphic features than typical hydric soils (left).

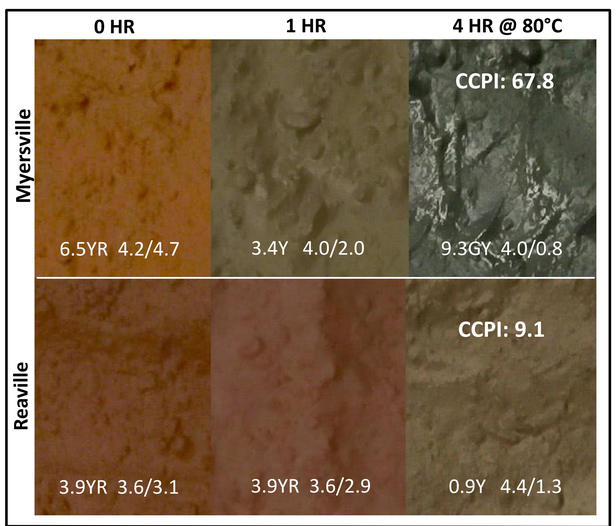

Figure 2. Example soil color and CCPI results of Bt samples from the Myersville (top) and Reaville (bottom) series. For CCPI, soils are incubated with sodium dithionite (reducing agent) in a citrate buffer solution, and then their color is measured: 1) immediately following saturation with no sodium dithionite at 25°C (0 HR); 2) with sodium dithionite after 1 hour @ 25°C (1 HR); and 3) with sodium dithionite after 4 hours @ 80°C (4 HR). Colors measured are used to calculate a CCPI value indicative a soil's resistance to change color/form redoximorphic features. Reaville soils are more resistant to color change than Myersville soils and qualify as "problematic."

SAMPLE ACQUISITION AND IDENTIFICATION OF RPM

- Suspected RPM soils were solicited from government agencies (USDA-NRCS, USACE), the KSSL, universities, and private sector soil/wetland scientists. Initial contact was made through USDA MLRA and USACE wetland delineation regions.
- Pedon descriptions, GPS coordinates, soil series sampled, and any geological context (formation name, age, rock/parent material type, etc.) were requested to accompany samples.
- Samples were be identified as problematic using a Color Change Propensity Index (CCPI) (Rabenhorst & Parikh, 2000) **(Figure 2)**. Soil color was determined using a Konica-Minolta digital colorimeter, measured 3 times per sample. Munsell hue, value, and chroma was recorded to the nearest 0.1 unit **(Figure 3)**.
- CCPI was calculated for each sample and grouped into classes of "problematic" if CCPI < 30, "non-problematic" if CCPI > 40, and "questionable" if CCPI is between 30 and 40 **(Figure 4).**
- Soil series and their derivative parent materials identified as "problematic" (via CCPI analyses) were investigated to compile a "list" of all associated red soils and parent materials (as lithologies) using scientific literature, reports from project participants, geology maps, soil series extent maps, OSDs and NRCS block diagrams **(Figure 5)**.
- Lithologies and soil series identified as problematic RPM were tied to USDA-NRCS gSTATSGO2 and geological map units (from relevant USGS datasets) to produce guidance maps for the possible occurrence of problematic RPM and the appropriate application of the F21 - RPM indicator nationwide.

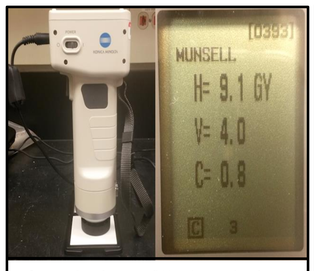

Figure 3. Photo of Konica-Minolta digital colorimeter (left) and measurement screen (right) used to determine soil color of samples. Munsell hue is converted to a number on a continuous scale calculation. The CCPI equation is a composite of a hue index calculated using changes in Munsell hue and a chroma index based on changes in Munsell chroma.

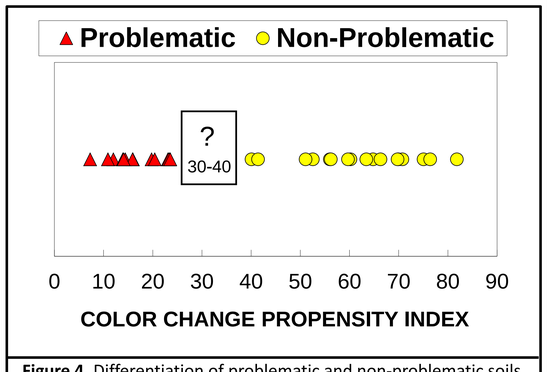

Figure 4. Differentiation of problematic and non-problematic soils using a CCPI index published by Rabenhorst & Parikh, 2000. Problematic soils (red) plot below 30 and non-problematic soils (yellow) plot above 40. Soils within the "questionable" range between 30 and 40 were be grouped with scrutiny. Soils used to develop the CCPI methodology were sampled within the Mid-Atlantic Coastal Plain & Piedmont and Ridge and Valley Provinces.

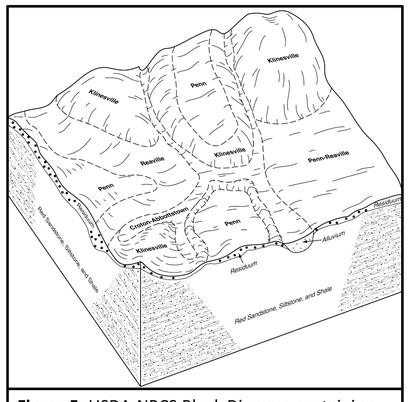

Figure 5. USDA-NRCS Block Diagram containing the Reaville series. Note all series pictured in the diagram are derived from the same red sandstones, siltstones, and shales. Geological maps and datasets were used to correlate this soils information to geological formation.

RESULTS AND GUIDANCE MAPS

- A total of 1,247 individual samples were analyzed for CCPI, resulting in four major regions where problematic RPM can be found throughout the country **(Figure 6)**. The four major regions where the F21 – RPM indicator is appropriate are: the Northeast & Mid-Atlantic **(Figure 7a)**; Great Lakes **(Figure 7b)**; South-Central **(Figure 7c)**; and Desert Southwest & Rocky Mountains **(Figure 7d)**. All problematic RPM has been found to be associated with sedimentary, hematite-rich, "red bed" formations, and the alluvial, colluvial, and glacial materials derived from them.

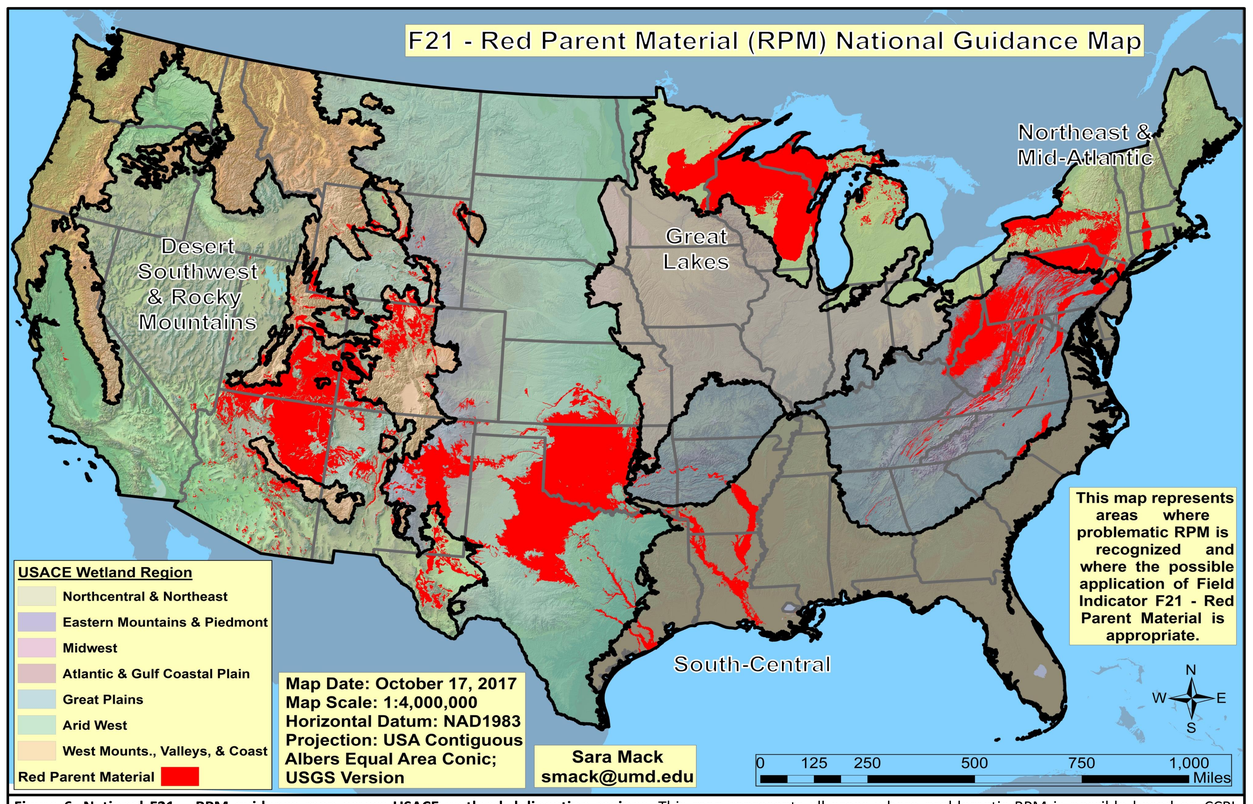

Figure 6. National F21 – RPM guidance map across USACE wetland delineation regions. This map represents all areas where problematic RPM is possible based on CCPI analyses of soil samples (not other factors relating to hydric soils such as climate, hydrology, etc.); and is a composite of both USDA-NRCS gSTATSGO2 soils and USGS geological datasets. No problematic RPM was identified in HI, AK, or Puerto Rico.

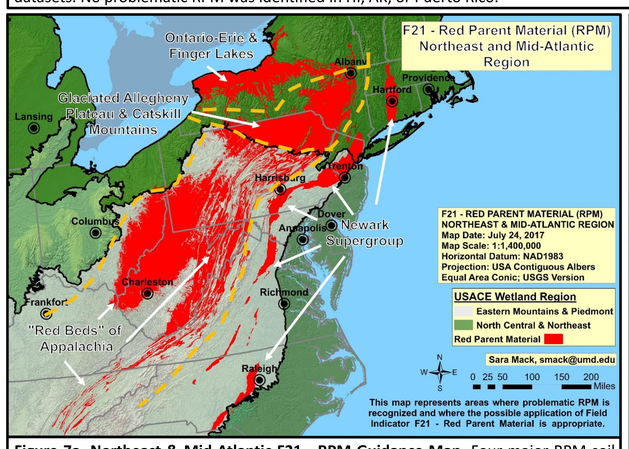

Figure 7a. Northeast & Mid-Atlantic F21 - RPM Guidance Map. Four major RPM-soil groups in this region are: the Paleozoic "Red Beds" of Appalachia; the (Triassic/Jurassic) Newark Supergroup; Pleistocene-aged glacial deposits associated with the Glaciated Allegheny Plateau and Catskill Mountains, & Pleistocene-aged till and (glacio)lacustrine deposits of the Erie-Ontario Lowlands & Finger Lakes region.

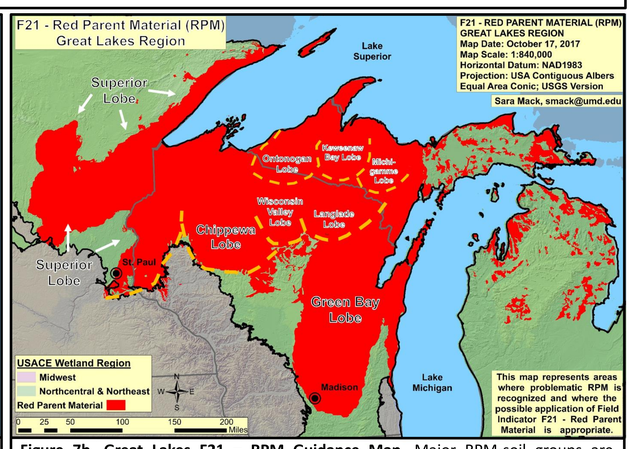

Figure 7b. Great Lakes F21 – RPM Guidance Map. Major RPM-soil groups are associated with "lobes" of the Laurentide ice sheet formed during the Wisconsinan glaciation. Ice "lobes" of the glacier carried and deposited sediments derived from Precambrian-aged red beds (that currently underlie Lake Superior) across the region. Glacial deposits of the ice "lobes" become younger in age from south to north.

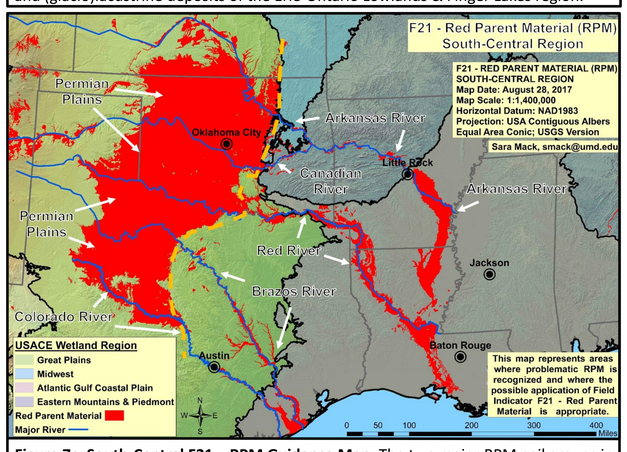

Figure 7c. South-Central F21 – RPM Guidance Map. The two major RPM-soil groups in this region are: 1) the Permian "red beds" of the Central Plains (TX, OK, and KS); and 2) Quaternary–aged alluvium deposited by watershed systems that drain them. The two watersheds that drain the Permian red beds from the Plains are the Arkansas-Red River systems (north-east) and the Brazos-Colorado River systems (south-west).

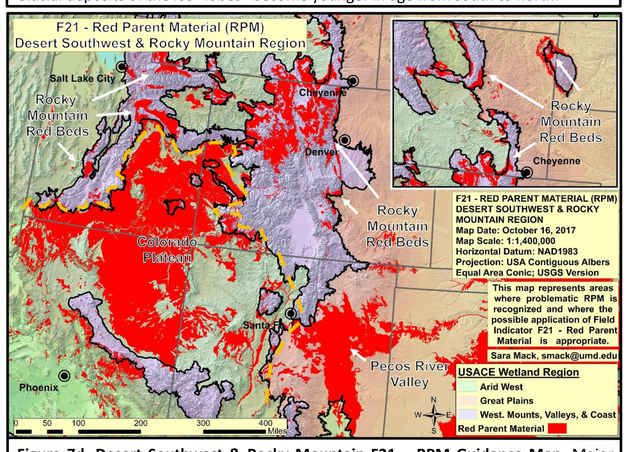

Figure 7d. Desert Southwest & Rocky Mountain F21 – RPM Guidance Map. Major RPM-soil groups are associated with red beds deposited during the Precambrian, Permian, and Mesozoic time periods. RPM-soil groups are sub-divided based on the major area they currently occupy: 1) the Colorado Plateau; 2) the Pecos River Valley, & 3) recently (Cenozoic) uplifted areas within & adjacent to the Rocky Mountains.

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