Probabilistic Mapping

Soils Project Phase 2:
A new way to use soils data at WDNR

Presented by Nicole Jacobsen
Manager of Scientific Consultation
HCP and Scientific Consultation Section
Forest Resources Division
WA Department of Natural Resources
office: 360.902.1788
cell: 360.790.9356

NOTES

- This presentation was originally given to Forest Resource Division management in 2014
- It wasn't changed at all for the NWFSC meeting [I have since removed the "quiz" since it's not relevant here]
- No work has been done on this idea… yet…
- Let me know if you want to collaborate!!

Soil Survey and Interpretation

- 'Soil association-in-polygon' data model is suitable for small-scale large-area assessments

  (PFLG interpretations are tied to this model)
- Can be applied at many scales

  Provided that polygons are characterized by an optimal composition matrix (usually not the case)

Soil Survey and Interpretation

- DNR dataset is ‘soil association-in-polygon’; requires averaging
  - Standardizing soil classification units ignores range of variability of properties
  - Optimizing composition of associations disregards environmental factors

This diminishes the reliability of the map and ability to be combined with other data sources

Probabilistic Mapping

- Soil bodies already mapped in SSURGO
- **A predictive model is needed to map the probability of soil property occurrence**
  - Empirical quantitative prediction of **Soil = *f*(cl, o, r, p, t, …)**
  - "Hot spot approach"

Probabilistic Mapping

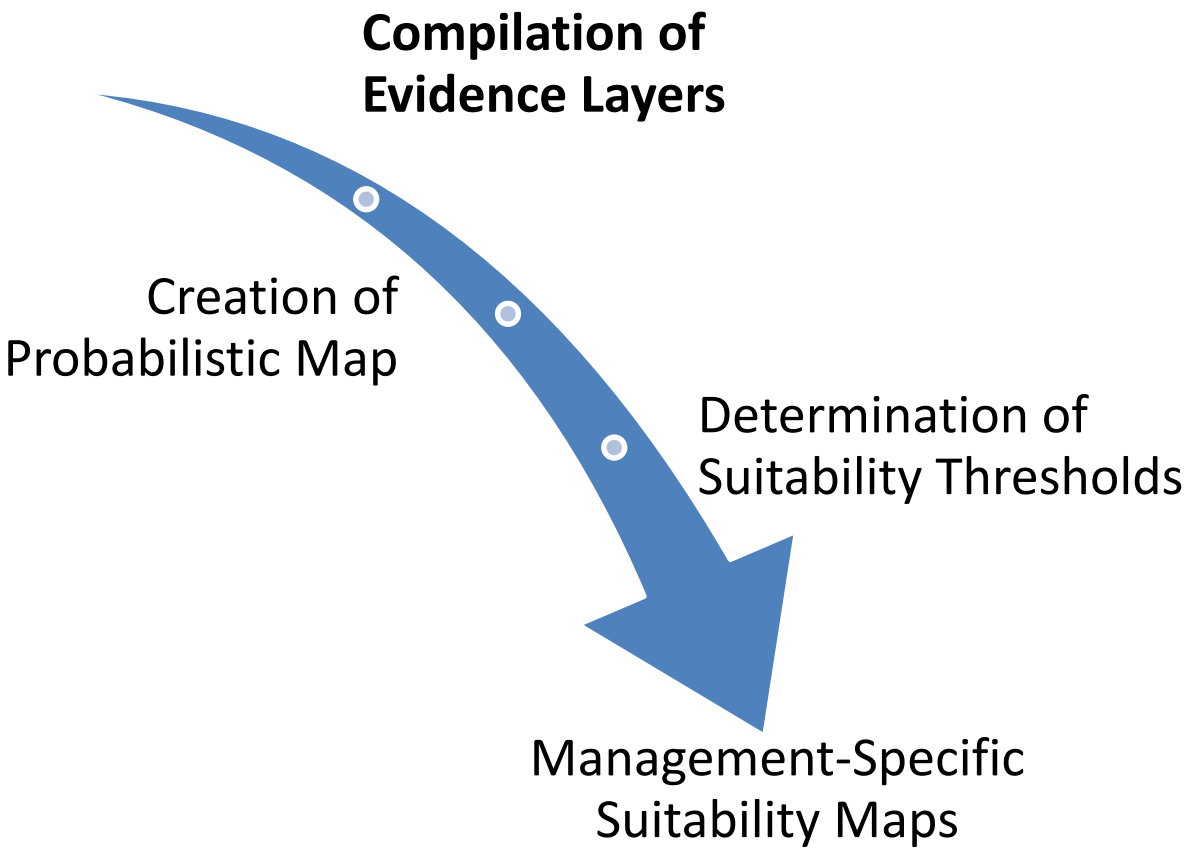
- Highlight areas to avoid based on undesirable environmental impacts
  - **"Forest Soil Management Interpretations"**
  - Rapid screening tool using GIS and remote sensing
  - Map unsuitability
- Direct management decisions to suitable areas
  - Based on detailed soil characterization
  - Using probabilistic out-scaling
  - Map suitability
    - Yakama long-term NSO planning
    - USFS RFRS planning

Mapping Suitability

- Compilation of secondary data (climate, terrain, vegetation, etc.) – **TBD**
- Analysis of geologic maps and stratigraphy
- GIS integration of suitability thresholds **("Forest Soil Management Interpretations")**
- In-field soil assessment (Phase 3)

GOAL: New base map for management decisions

Overview of Process



Evidence Layers

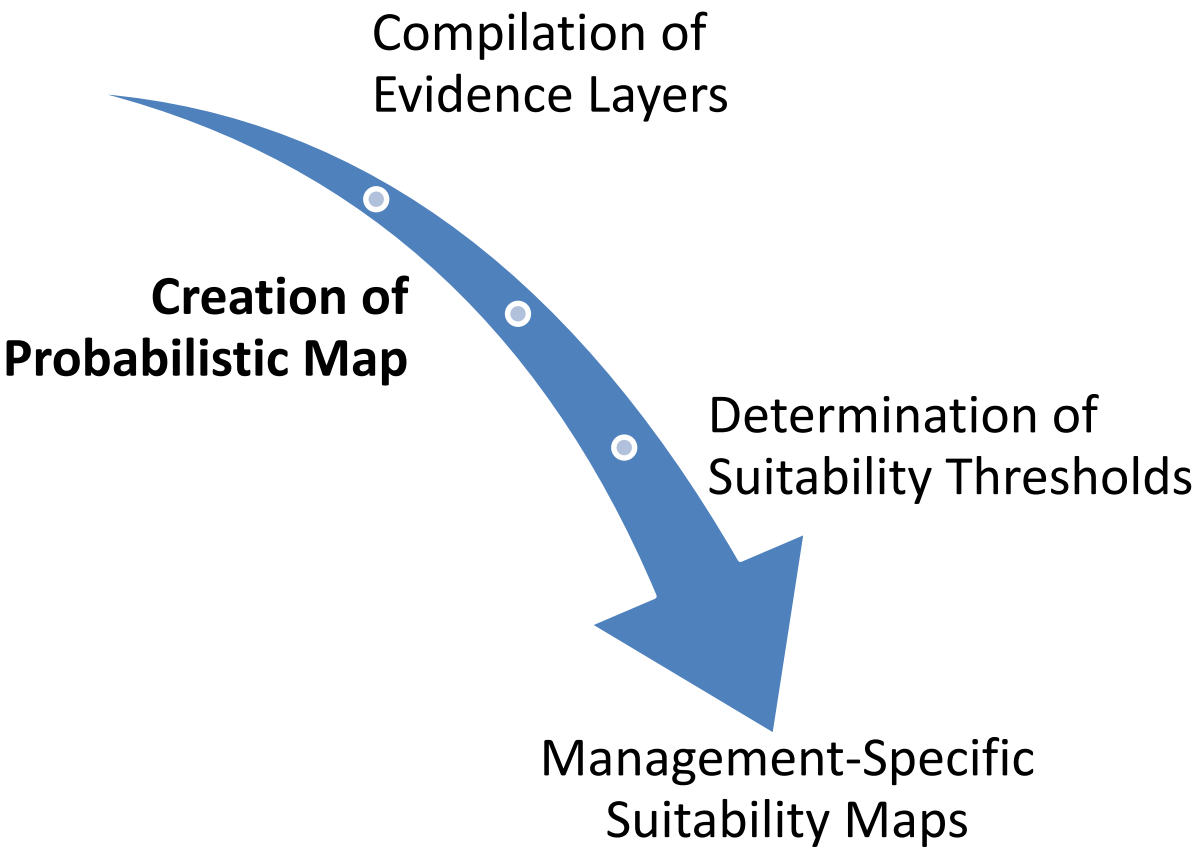
- Map **soil properties** instead of soil bodies
- Highlight relationships with environmental variables (elevation, rainfall, slope, etc.)
- Mapping of individual soil properties is **probabilistic**, leading to fuzzy instead of crisp classifications

  (e.g. maps showing the probability of depth class 0-25 cm, 25-50 cm, 50-100 cm in pixel x instead of pixel x= class 0-25)

Evidence Layers

- Based on the **weights of evidence method**, first proposed by Bonham-Carter and Agterberg (1990) and modified by Corner et al. (2002) in the **Expector software**
  - Application in GIS of Bayesian statistics
  - Includes local and expert knowledge
  - Hypothesis expressed as a soil attribute class

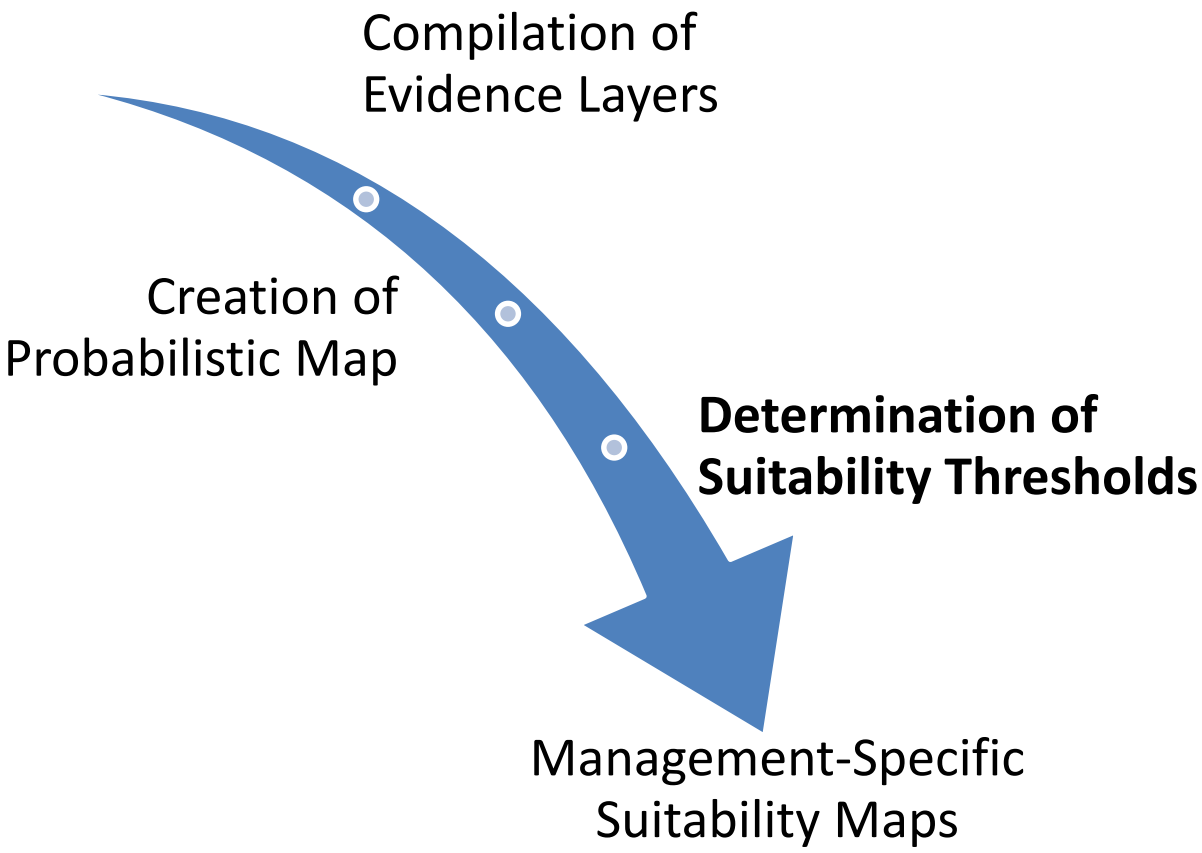
Overview of Process



Probabilistic Map

- Map hypothesis (i.e., soil attribute class)
- Guide suitability threshold discussions
- **Examples**:
  - Steve Wangemann, soil scientist at Yakama Nation, is doing this to **plan future NSO reserves**
  - Mike Brown, geologist with USFS in eastern OR, is attempting to do this to **address riparian forest buffer management issues**

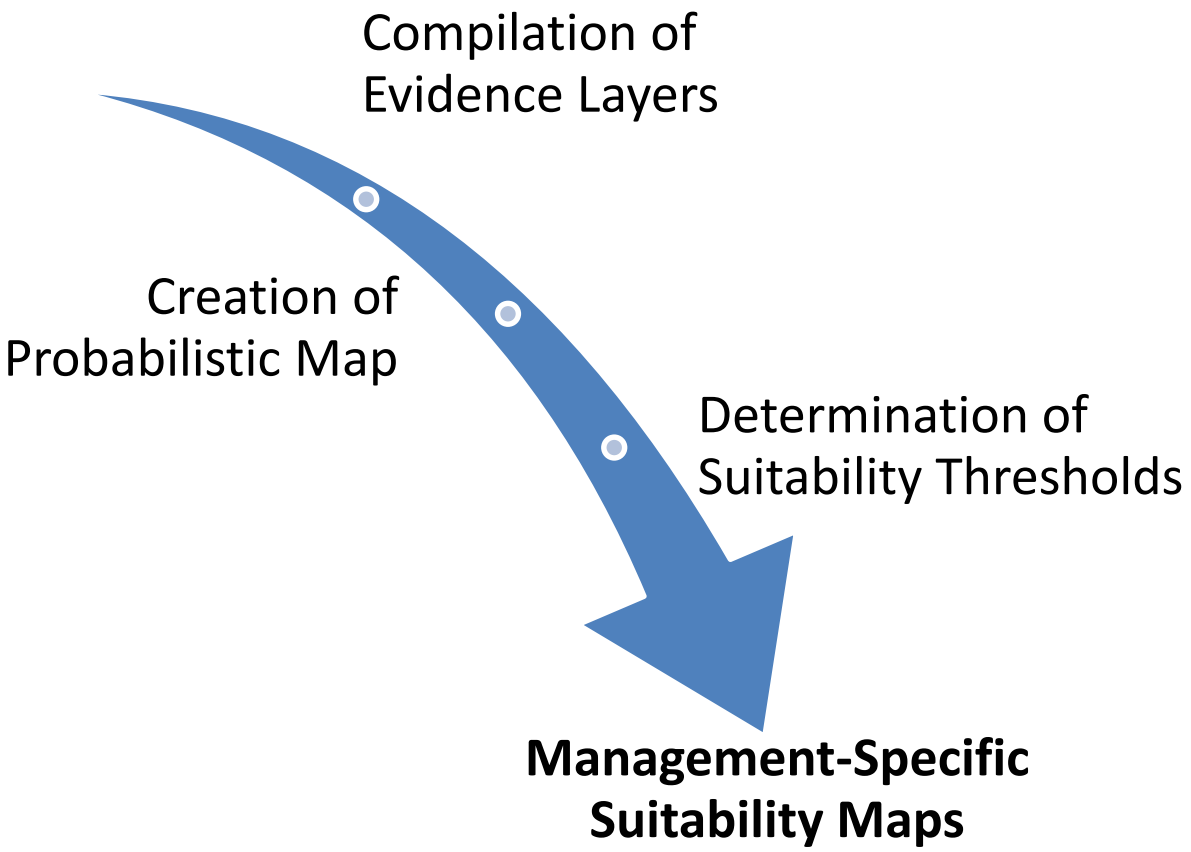
Overview of Process



Suitability Thresholds

- User-defined, may include:
  - Equipment limitations (slope, rockiness, etc.)
  - Environmental criteria (aspect, elevation, etc.)
  - "Operability Classes" (WAC 458-40-530)
- **"Forest Soil Management Interpretations"**
- Based on local and expert knowledge
  - Onsite experience of managers and operators
  - NRCS (NASIS / SSURGO) data
  - Refined with transects

Overview of Process



Suitability Maps

- Integrates all field and technical knowledge
- Highlight:
  - Primary target areas
  - Secondary suitable areas
  - Unsuitable areas
- Examples

Review

- Analyze user needs and management options
- Identify existing data/info/expertise
- Utilize GIS and remote sensing technologies
- Use statistical model to generate pixel-level probabilistic data of relevant soil properties

GOAL: maps highlighting areas of suitability for various management options

Soil Survey / Assessment

Soils Project Phase 3:
Ground-truthing Phase 2 predictions

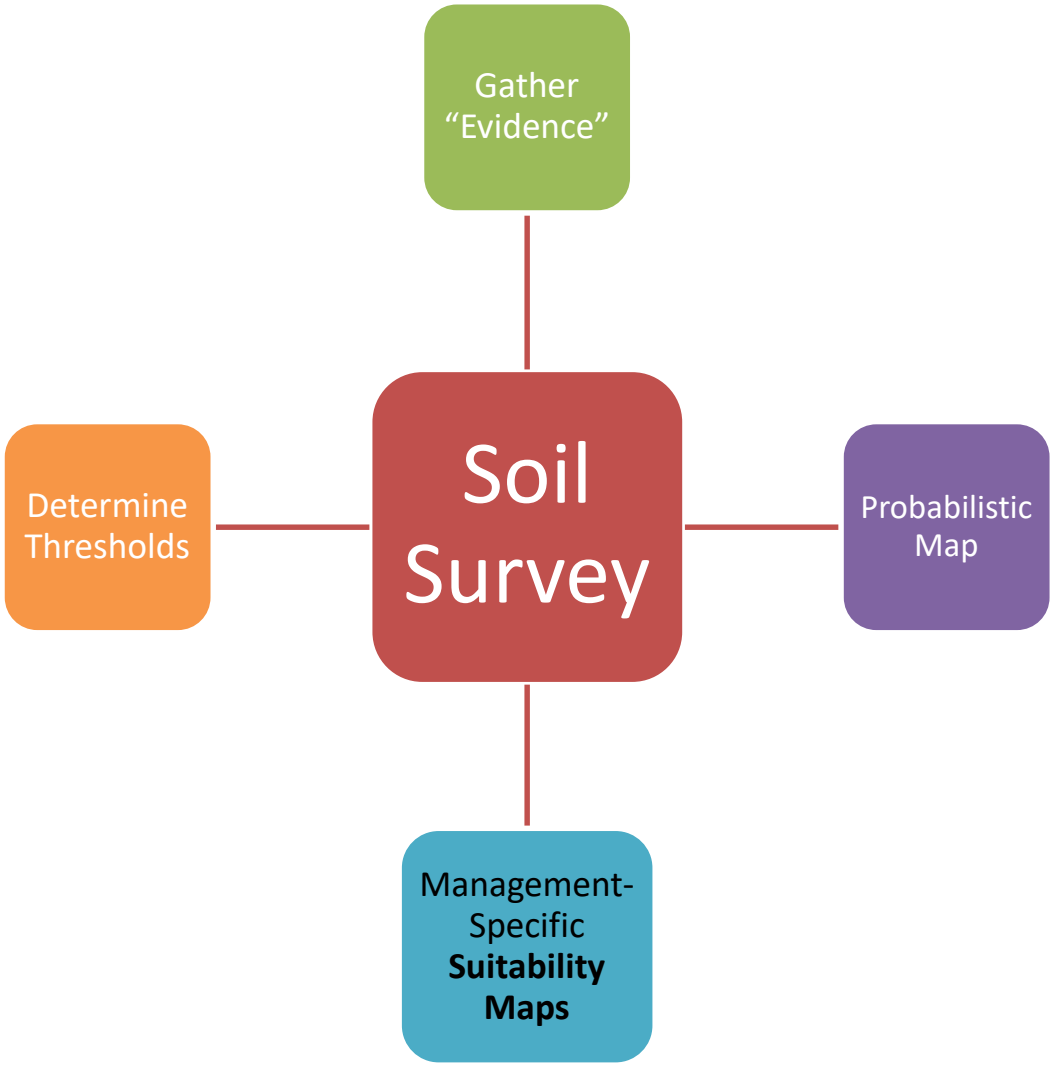
Overview

Soil survey/assessment

1. Consult with NRCS re: field methodology
2. Select survey areas
3. Recruit summer intern(s)
4. Summer fieldwork
5. Repeat steps 2-4 *ad infinitum*

Soil survey/assessment is an ONGOING effort to the refine dataset and build local knowledge

Why Continuous Soil Surveys?



REMEMBER:

Soil is the key to improving natural resource management decisions!

- Western WA soils are very highly productive; degradation may currently be masked
- Need long-term planning tools to maintain productivity in times of
  - Climate change
  - Increased demand

Notes

- **Thanks to Sabra** Hull, the original squeaky wheel for this project!
- Thanks to Steve Campbell, NRCS West Technical Center, for providing comments!

This DRAFT presentation was developed using the outline and ideas in an FAO presentation: "From Polygon-Based Soil Unit Mapping to Probabilistic Maps of Soil Properties in the West Asia-North Africa Region" by E. De Pauw and P. Hawinkel