Riparian Buffer Delineation Model

RBDM v3.5

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Introduction

- Riparian areas occupy less than 10% of total landscape and provide numerous ecosystems services to wildlife, fish, water, recreation and other values.
- Riparian areas provide connectivity with different landscapes, plant and animal habitat, native plant and animal species, bank stability, water quality, aesthetic qualities and recreation, and natural filtering and trapping of sediments.
- Riparian areas are dynamic, transitional ecosystems between aquatic and terrestrial ecosystems with well defined vegetation and soil characteristics.
- Riparian areas acts as buffers to protect surface water quality.
- Riparian vegetation reduces pollutants by plant uptake also recycles entrapped nutrients providing permanent habitat for many types of fauna.
- Riparian vegetation reduces streams temperature.
- Riparian areas provides biodiversity also provides food source for plants and animals.

Forest Service

- Develop a national context inventory of riparian areas and their condition within national forests and rangelands.
- The resulting product will supplement information in the FS Terrestrial Condition Assessment and the FS Watershed Condition Classification. The product will provide a multi-scale framework to discuss land management opportunities with partners.
- Freely available data will be used to inventory and delineate riparian areas base maps.

New Methodology

- A new simple practical mapping approach utilizing available open source geospatial data and the geospatial capabilities of python language under ArcGIS Desktop.
- The model utilizes multiple 50 year flood height values per stream type and stream order.
- The model accounts for river/stream watercourse and its associated floodplain.
- Optional data inputs provides extended riparian mapping and attributes such as riparian wetlands, riparian soil type, and riparian land cover classes.
- The model is independent of landform.
- The model is an ArcGIS toolbox with a simple interface that can be easily added, shared, and used by a non GIS expert.
- The model results can be easily shred and results can be replicated.

objectives

1) Where are riparian areas?
   1) How many acres/hectares of riparian areas.
   2) What is the physical extent of riparian boundaries?
   3) Area & type of wetlands/riparian wetlands within riparian areas?
   4) What is the soil profile of riparian areas?
   5) What is the general composition of riparian areas land cover?

2) Multi scale approach to provide a national and regional report map. Create a product for managers to easily understand where to apply the information at various scales.

3) Provide a framework and an end product to stakeholders and apply the information into management actions and strategies.

4) Ensure relevancy to management decisions. Effective monitoring program management are critical to accomplishing the goals of this assessment.

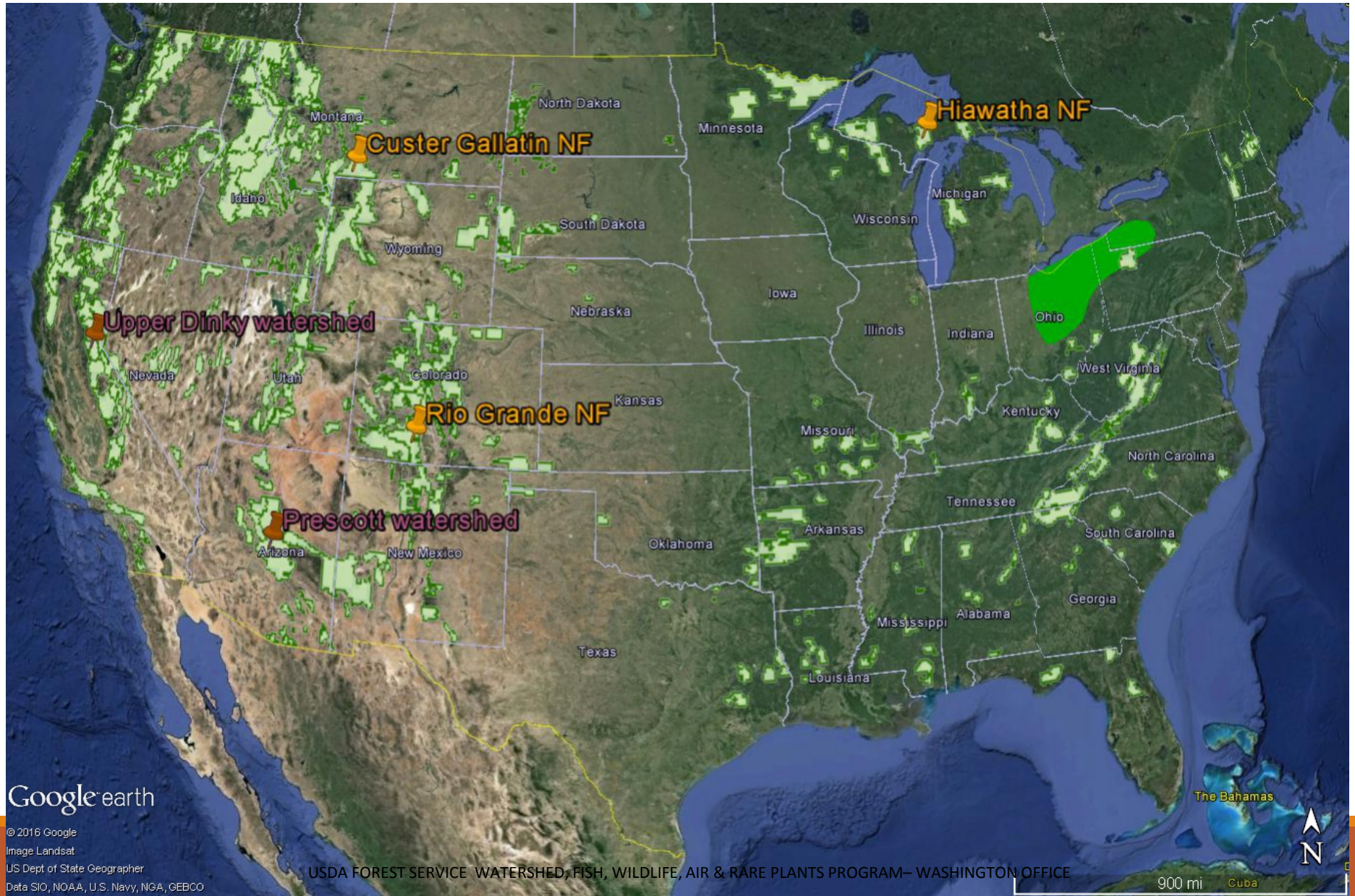
5) Incorporate and connect to agency and partner efforts to assess national conditions. Consider how this can inform fs WCC, TCA or fs national hierarchy. Make use of existing efforts to produce a unified product.

Model Inputs

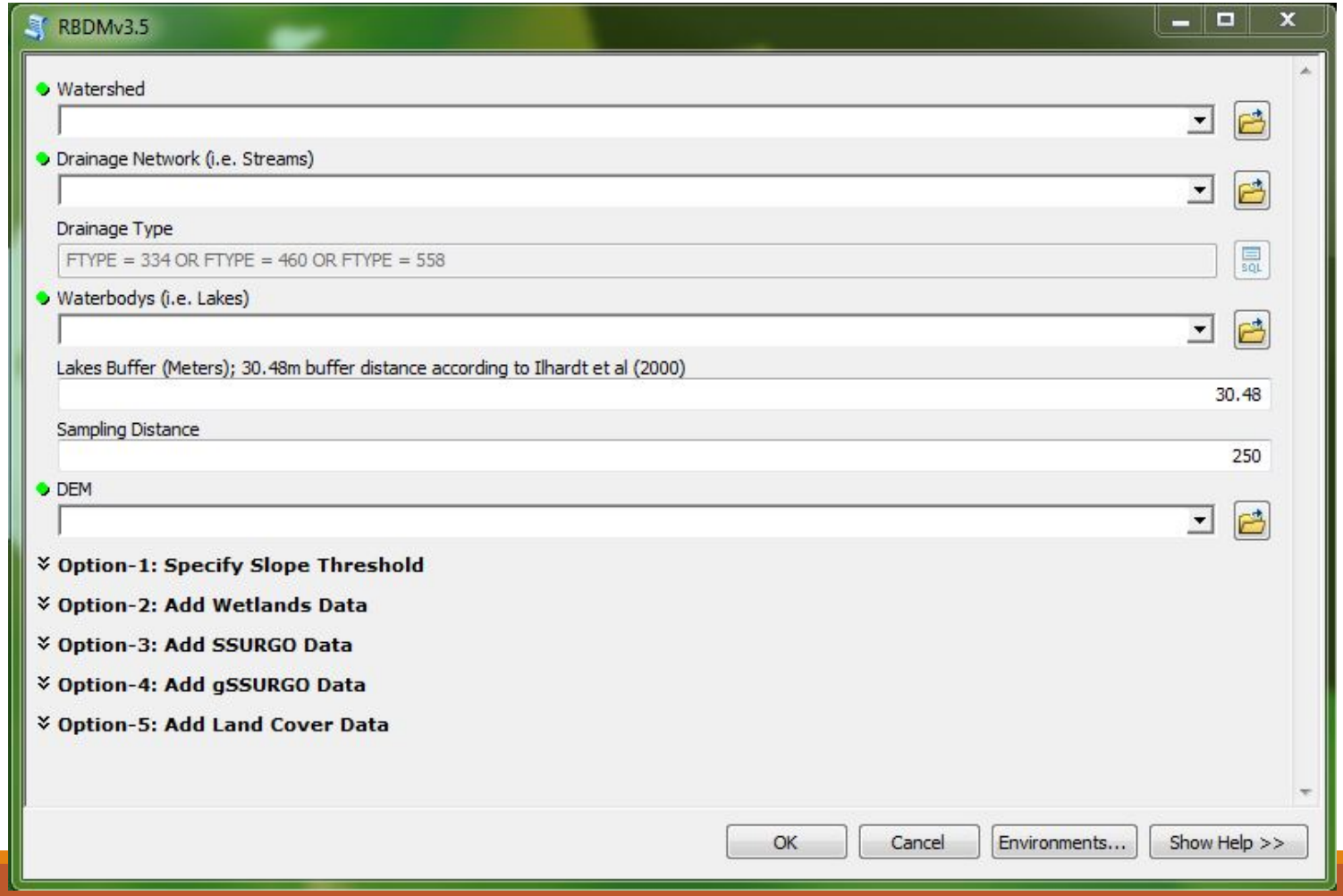
Input Data	Sources
Streams, Lakes, and Watersheds	USGS National Hydrology Dataset (NHD) http://nhd.usgs.gov/
50 year Flood Height	Calculated utilizing Masson (2007)
Wetlands	National Wetlands Inventory (NWI) http://www.fws.gov/wetlands/Data/Data-Download.html
Soil	Natural Resources Conservation Service (NRCS) http://soildatamart.nrcs.usda.gov/ or http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm
Elevation	National elevation Dataset http://ned.usgs.gov/
Land Cover	National Land Cover Database http://www.mrlc.gov/ Corp land Data Layer http://www.nass.usda.gov/research/Cropland/SARS1a.htm

*Also most of the data mentioned above can be downloaded at http://datagateway.nrcs.usda.gov/ or http://viewer.nationalmap.gov/basic/?howTo=true

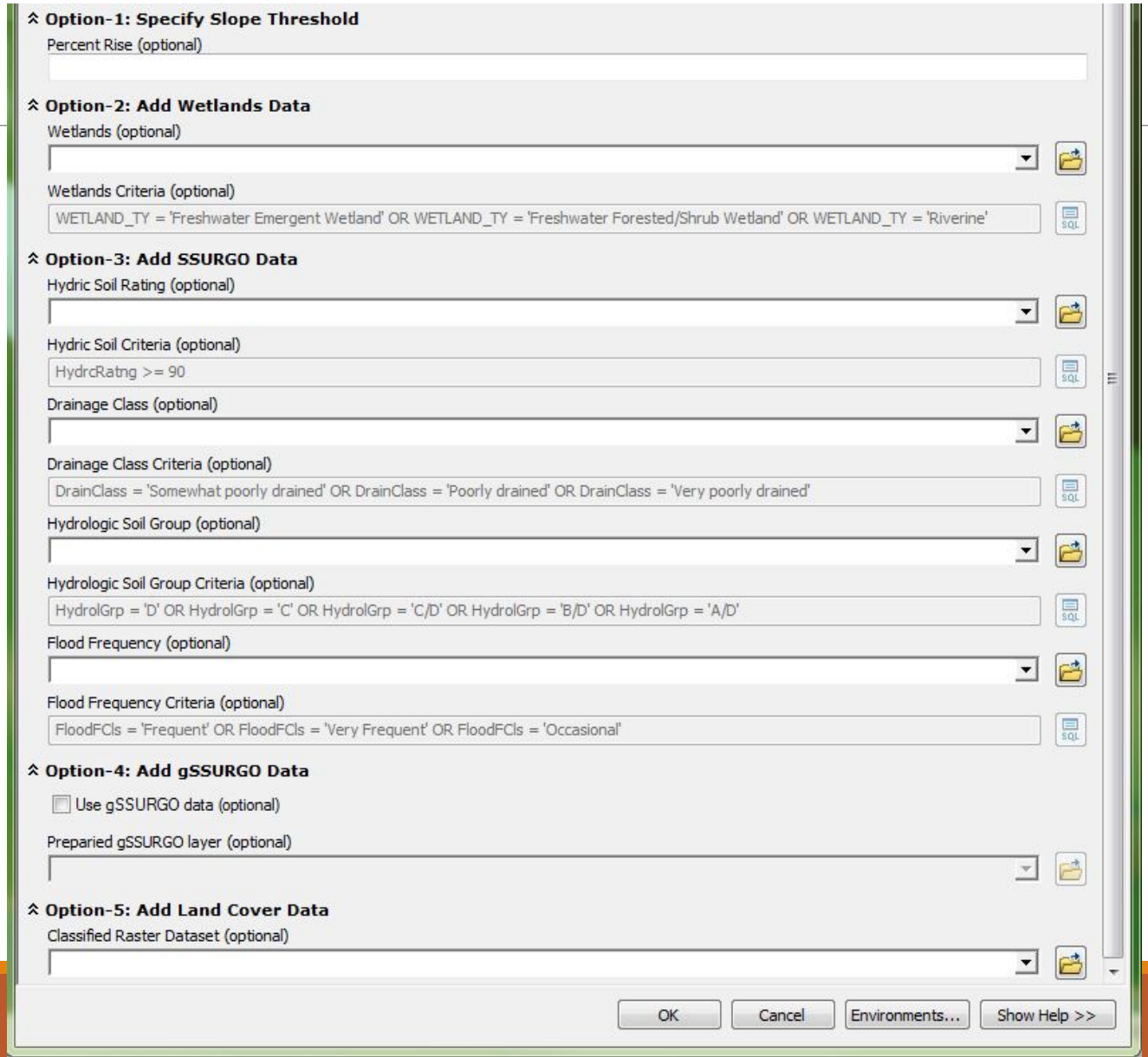
Pilot studies



RBDMv3.5 GUI


RBDMv3.5
Watershed
Drainage Network (i.e. Streams)
Drainage Type
FTYPE = 334 OR FTYPE = 460 OR FTYPE = 558
Waterbodys (i.e. Lakes)
Lakes Buffer (Meters); 30.48m buffer distance according to Ilhardt et al (2000)
30.48
Sampling Distance
250
DEM
Option-1: Specify Slope Threshold
Option-2: Add Wetlands Data
Option-3: Add SSURGO Data
Option-4: Add gSSURGO Data
Option-5: Add Land Cover Data
OK
Cancel
Environments...
Show Help >>

RBDMv3.5 GUI


Option-1: Specify Slope Threshold
Percent Rise (optional)
Option-2: Add Wetlands Data
Wetlands (optional)
Wetlands Criteria (optional)
WETLAND_TY = 'Freshwater Emergent Wetland' OR WETLAND_TY = 'Freshwater Forested/Shrub Wetland' OR WETLAND_TY = 'Riverine'
Option-3: Add SSURGO Data
Hydric Soil Rating (optional)
Hydric Soil Criteria (optional)
HydrcRatng >= 90
Drainage Class (optional)
Drainage Class Criteria (optional)
DrainClass = 'Somewhat poorly drained' OR DrainClass = 'Poorly drained' OR DrainClass = 'Very poorly drained'
Hydrologic Soil Group (optional)
Hydrologic Soil Group Criteria (optional)
HydrolGrp = 'D' OR HydrolGrp = 'C' OR HydrolGrp = 'C/D' OR HydrolGrp = 'B/D' OR HydrolGrp = 'A/D'
Flood Frequency (optional)
Flood Frequency Criteria (optional)
FloodFCls = 'Frequent' OR FloodFCls = 'Very Frequent' OR FloodFCls = 'Occasional'
Option-4: Add gSSURGO Data
Use gSSURGO data (optional)
Preparied gSSURGO layer (optional)
Option-5: Add Land Cover Data
Classified Raster Dataset (optional)
OK
Cancel
Environments...
Show Help >>

Updates

The ability to utilize multiple 50 year flood height values per each stream type and stream order.

Slope threshold to eliminate steep slopes.

The ability to use SSURGO and gSSURGO data.

Highlighting riparian soil units using one parameter or four parameters approach.

Faster performance.

Updates

Verry et al. 2004 and Palik et al. 2004

Digital Soil Data - Hydric Soil Rating (optional)

hydricrating1

Hydric Soil Rating Selection Criteria (optional)

HydrcRatng >= 80

Digital Soil Data - Drainage Class (optional)

drianageclass1

Dianage Class Selection Criteria (optional)

DrainClass = 'Poorly drained'

Digital Soil Data - Hydrologic Soil Group (optional)

hydrologicsoilgroup1

Hydrologic Soil Group Selection Criteria (optional)

HydrolGrp = 'D' OR HydrolGrp = 'C' OR HydrolGrp = 'C/D' OR HydrolGrp = 'B/D' OR HydrolGrp = 'A/D'

Digitall Soil Data - Flooding Frequency

floodfrequency1

Flooding Frequency Selection Criteria

FloodFCls = 'Frequent' OR FloodFCls = 'Occasional'

Data Preparation
Hydrological Estimation

The 50-year floodplain value is the optimal hydrologic descriptor of riparian ecotone along moving watercourse as determined by Ilhardt et al. (2000).

This flood recurrence was selected because in most cases the 50-year flood height intersects the first terrace or other upward sloping surface and supports the same microclimate and geomorphology as the stream channel.

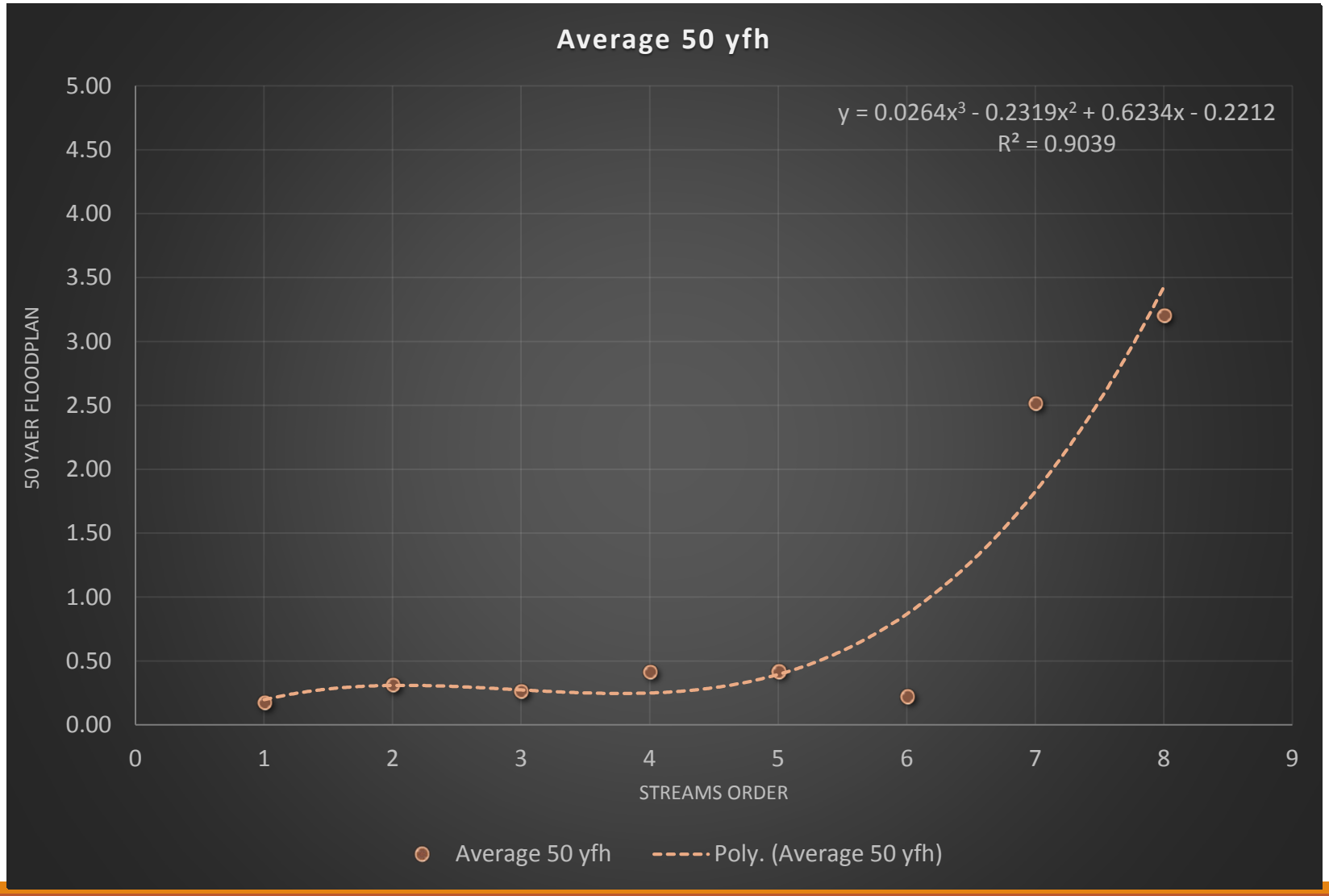
There are many methods to calculate the 50 year flood height.

Hydrological Estimation
USGS Water Data

Calculate the 50-year floodplain using the Hydrologic Estimation.xlsm file developed according to Mason (2007) and Bedient & Huber (2002).

1					Coefficients			Year	
2	USGS Station #		Equation-1	c	b		1	50	
3	13336500		y = 923.49ln(x) + 2824.3 R^2 = 0.8897	923.49	2824.3		2824.3	6437.014125	
4	Latitude	Longitude							
5			Equation-2	c2	c1	b			
6	Ftype	Stream Level	y = -2E-06x2 + 0.146x + 481.79 R^2 = 0.9823	-0.000002	0.146	481.79	878.184459	1338.723761	
7									
8	County	State	Equation-3	c	b				
9			y = 25.485ln(x) + 103.46 R^2 = 0.5286	25.485	103.46		276.193677	286.9385445	
10	Hydrologic Unit								
11									
12	Drainage area	square miles				Flood Height (ft)	3.18	4.67	
13						Flood Height (meter)	0.97	1.42	
14			Calculate Equation-1				Calculate Equation-2	Calculate Equation-3	
15									
16		Annual Statistics	Delete Equation-1			Field Measurments	Delete Equation-2	Delete Equation-3	
17									
18		Annual Flow (ft3/s)	Year	Rank	Recurrence Interval (Years)	Channel Discharge (ft3/s)	Channel Width (ft)	Channel Cross Sectional Area (ft2)	
19		6159	6159	1	84	493	257	423	
20		5653	5653	2	42	510	256	436	
21		5453	5453	3	28	755	266	575	
22		5273	5273	4	21	395	265	451	
23	Clear Data	5099	5099	5	16.8	514	258	492	
24		5045	5045	6	14	697	266	582	
25		4958	4958	7	12	723	263	578	
26		4939	4939	8	10.5	1040	268	659	
27		4926	4926	9	9.333333333	17200	304	2290	
28		4890	4890	10	8.4	5630	285	1310	
29		4877	4877	11	7.636363636	936	268	622	
30		4796	4796	12	7	1260	270	710	
31		4791	4791	13	6.461538462	4570	280	1180	
32		4776	4776	14	6	14900	303	2080	
33		4748	4748	15	5.6	21900	310	2600	
34		4745	4745	16	5.25	977	266	632	
35		4595	4595	17	4.941176471	683	262	543	

Hydrological Estimation
multiple gauges per stream order



Hydrological Estimation regression equations

SUPPLEMENT 1: Regression equations and standard errors of intercept (SE_I) and slope (SE_S) for the Physiographic Divisions and Provinces

Physiographic Division	Physiographic Province	Bankfull width			Bankfull depth			Bankfull cross-sectional area		
		Equation	SE_I	SE_S	Equation	SE_I	SE_S	Equation	SE_I	SE_S
LUP		**$4.15DA^{0.308}$**	**2.294**	**0.143**	**$0.31DA^{0.202}$**	**2.170**	**0.133**	**$1.27DA^{0.509}$**	**4.370**	**0.253**
APL		**$2.22DA^{0.363}$**	**1.098**	**0.021**	**$0.24DA^{0.323}$**	**1.118**	**0.024**	**$0.52DA^{0.680}$**	**1.190**	**0.038**
AHI		**$3.12DA^{0.415}$**	**1.037**	**0.008**	**$0.26DA^{0.287}$**	**1.037**	**0.008**	**$0.82DA^{0.704}$**	**1.056**	**0.012**
	Appalachian Plateaus	$3.18DA^{0.430}$	1.050	0.012	$0.26\ DA^{0.290}$	1.050	0.012	$0.82\ DA^{0.720}$	1.074	0.017
	Blue Ridge	$3.77DA^{0.390}$	1.449	0.080	$0.25\ DA^{0.310}$	1.369	0.068	$0.98\ DA^{0.700}$	1.631	0.106
	New England	5.90DA								
	Piedmont	2.84DA								
	Valley and Ridge	2.79DA								
IPL		**2.56DA**								
	Central Lowland	2.98DA								
	Great Plains	0.92DA								
	Interior Low Plateaus	$2.68DA^{0.420}$	1.093	0.023	$0.18\ DA^{0.420}$	1.084	0.021	$0.48\ DA^{0.850}$	1.139	0.034
IHI		**$23.23DA^{0.121}$**	**1.754**	**0.089**	**$0.27DA^{0.267}$**	**2.074**	**0.115**	**$6.28DA^{0.387}$**	**2.685**	**0.156**
	Ozark Plateaus	$14.56DA^{0.180}$	1.481	0.058	$0.05\ DA^{0.510}$	2.245	0.119	$0.67\ DA^{0.690}$	1.775	0.087
RMS		**$1.24DA^{0.435}$**	**1.084**	**0.015**	**$0.23DA^{0.225}$**	**1.079**	**0.014**	**$0.20DA^{0.688}$**	**1.215**	**0.037**
	Middle Rocky Mountains	$0.82DA^{0.520}$	1.558	0.074	$0.33\ DA^{0.200}$	2.256	0.138	---	---	---
	Northern Rocky Mountains	$1.20DA^{0.440}$	1.095	0.017	$0.23\ DA^{0.240}$	1.083	0.015	$0.17\ DA^{0.740}$	1.229	0.040
	Southern Rocky Mountains	$1.85\ DA^{0.340}$	1.219	0.037	$0.19\ DA^{0.200}$	1.127	0.022	$0.32\ DA^{0.530}$	1.551	0.075
	Wyoming Basin	$0.73\ DA^{0.500}$	2.092	0.102	$0.11\ DA^{0.300}$	1.826	0.084	---	---	---
IMP		**$1.11DA^{0.415}$**	**1.259**	**0.035**	**$0.07DA^{0.329}$**	**1.219**	**0.030**	**$0.07DA^{0.751}$**	**1.493**	**0.061**
	Basin and Range	$3.75\ DA^{0.280}$	1.255	0.034	$0.20\ DA^{0.190}$	1.199	0.027	$0.56\ DA^{0.500}$	1.483	0.059
	Colorado Plateaus	$0.98\ DA^{0.330}$	1.439	0.067	$0.03\ DA^{0.390}$	1.443	0.067	$0.03\ DA^{0.720}$	1.685	0.096
	Columbia Plateau	$0.55\ DA^{0.530}$	1.459	0.048	$0.23\ DA^{0.210}$	1.461	0.048	$0.05\ DA^{0.820}$	4.668	0.197
PMS		**$2.76DA^{0.399}$**	**1.273**	**0.035**	**$0.23DA^{0.294}$**	**1.346**	**0.043**	**$0.87DA^{0.652}$**	**1.599**	**0.068**
	Cascade-Sierra Mountains	$4.08\ DA^{0.340}$	1.613	0.066	$0.19\ DA^{0.300}$	1.591	0.064	$0.77\ DA^{0.640}$	2.248	0.112
	Pacific Border	$2.20\ DA^{0.440}$	1.324	0.042	$0.21\ DA^{0.330}$	1.448	0.056	$0.71\ DA^{0.710}$	1.775	0.087
USA		**$2.70DA^{0.352}$**		**1.039**	**0.007**	**$0.30DA^{0.213}$**	**1.039**	**0.007**	**$0.95DA^{0.540}$**	**1.082**	**0.015**

DEVELOPMENT AND EVALUATION OF BANKFULL HYDRAULIC GEOMETRY RELATIONSHIPS FOR THE PHYSIOGRAPHIC REGIONS OF THE UNITED STATES[1]

Katrin Bieger, Hendrik Rathjens, Peter M. Allen, and Jeffrey G. Arnold[2]

Data Preparation
Hydrological Estimation

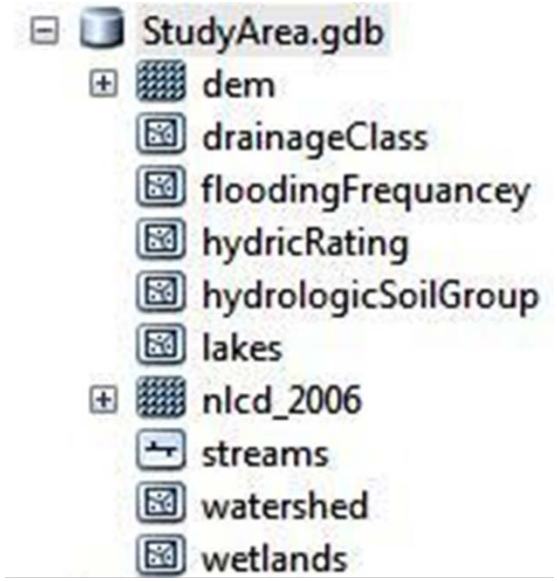
GEP_Cum	GEP	GEP_DEL	Strm_Name	RdWEPP_Yld	RdWEPP_Cum	GRAIP	GRAIPCum	Shape_Length	DEPTH_	FType	StreamLeve	FloodData
2476.2406	3565.109	224.5031	Grayling Creek	0	0	0	0	21.533486	0.71617	12	5	0.72
2383.5144	248.9231	11.8761	Grayling Creek	0	0.69	0	4799.3	8.894084	0.60990	39	5	0.61
2383.5704	2054.2172	98.0066		0	0.69	0	4799.3	103.834705	0.60989	39	5	0.61
2383.8095	1949.0806	90.3188		0	0.69	0	4799.3	93.453225	0.60984	39	5	0.61
2383.8912	1206.6056	59.6149		0	0.69	0	4799.3	96.935419	0.60979	39	5	0.61
2384.1299	938.9327	42.9324		0	0.69	0	4799.3	104.107354	0.60976	39	5	0.61
2384.3556	1537.0211	65.2663		0	0.69	0	4799.3	103.091967	0.60974	39	5	0.61
2384.7108	2243.2329	106.4657		0	0.69	0	4799.3	106.543131	0.60968	39	5	0.61
2384.7863	2920.86	161.6414		0	0.69	0	4799.3	106.671788	0.60948	39	5	0.61
2384.2002	3148.285	252.8743		0	0.69	0	4799.3	100.105336	0.6093	39	5	0.61
2383.755	2825.0974	264.7701		0	0.69	0	4799.3	95.496237	0.60916	39	5	0.61
2382.7694	3124.3855	254.4288		0	0.69	0	4799.3	95.107927	0.60894	39	5	0.61
2382.3484	2822.1178	234.9807		0	0.69	0	4799.3	102.811382	0.60880	39	5	0.61
2380.3892	2807.9161	281.3543		0	0.69	0	4799.3	97.448277	0.60854	39	5	0.61
2380.584	3297.5383	350.0571		0	0.69	0	4799.3	95.321917	0.60828	39	5	0.61
2378.3956	3684.2353	338.6246		0	0.69	0	4799.3	98.005421	0.60807	39	5	0.61
2375.675	4426.7515	441.3511		0	0.69	0	4799.3	95.287661	0.60757	39	5	0.61
2374.6683	4188.9915	573.0495		0	0.69	0	4799.3	95.241099	0.60748	39	5	0.61
2372.5499	4554.8083	840.3705		0	0.69	0	4799.3	95.234527	0.60734	39	5	0.61
2370.6884	4383.2562	952.8818		0	0.69	0	4799.3	93.095582	0.60714	39	5	0.61
2368.7265	4154.4795	907.0916		0	0.69	0	4799.3	94.362381	0.60702	39	5	0.61
2364.7688	4191.742	893.7616		0	0.69	0	4799.3	99.155357	0.60681	39	5	0.61
2363.2258	4598.878	972.2786		0	0.69	0	4799.3	104.190755	0.60662	39	5	0.61
2357.5234	4705.8153	935.5497		0	0.69	0	4799.3	103.880257	0.60636	39	5	0.61
2355.5916	4512.5419	864.4717		0	0.69	0	4799.3	106.490904	0.60618	39	5	0.61
2352.7763	4426.3478	862.8358		0	0.69	0	4799.3	106.746804	0.60593	39	5	0.61
2348.8743	4696.0956	937.3444		0	0.69	0	4799.3	100.328515	0.60567	39	5	0.61
2346.6502	4560.0546	776.8407		0	0.69	0	4799.3	105.19835	0.6055	39	5	0.61
2343.9563	3795.0375	652.0683		0	0.69	0	4799.3	106.987234	0.60530	39	5	0.61
2327.653	3712.1993	793.205		0	0.69	0	4799.3	99.419516	0.60316	39	5	0.6
2326.1024	5264.6627	1309.6176		0	0.69	0	4799.3	100.345639	0.60304	39	5	0.6

Data Preparation

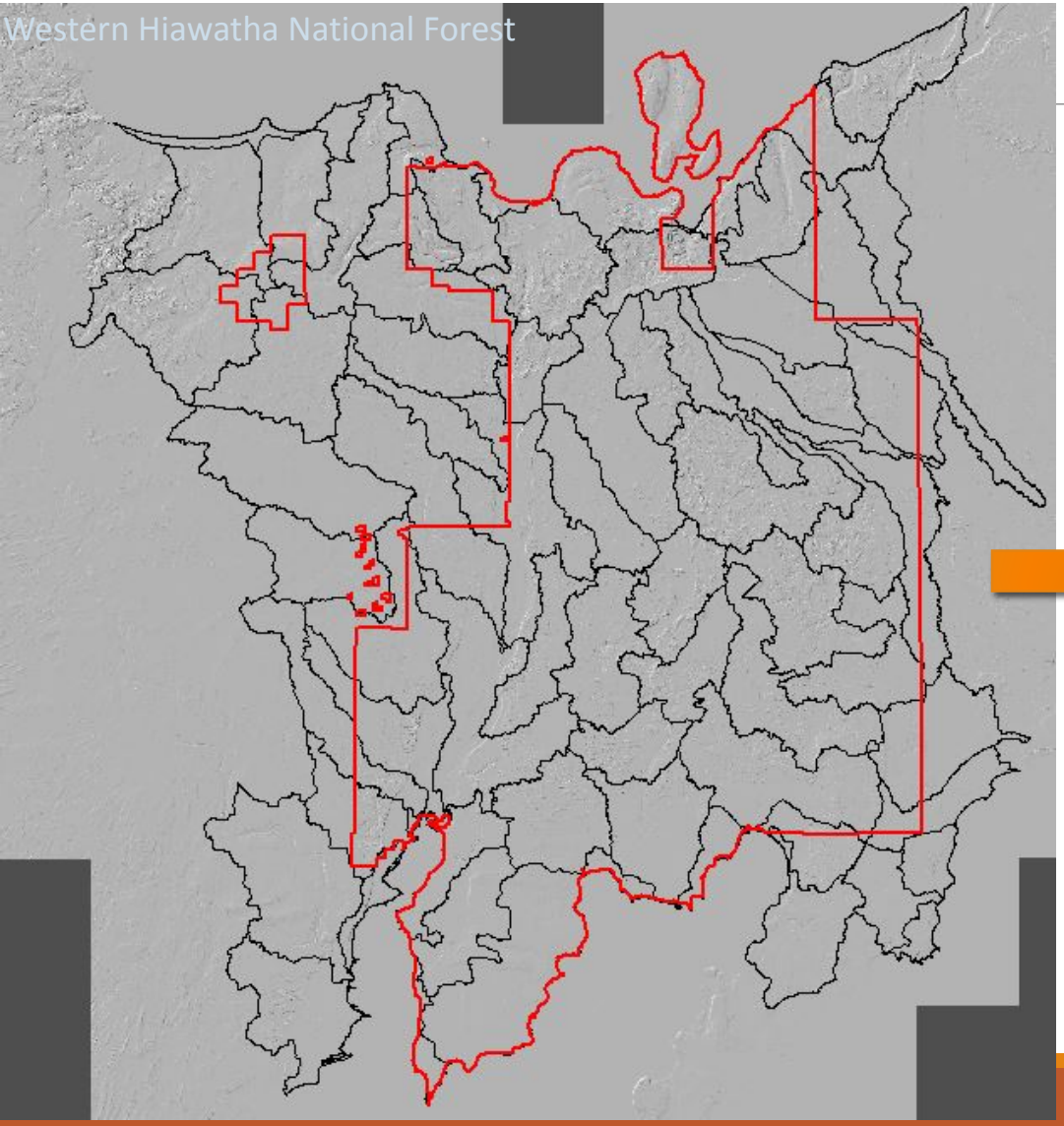
Streams positional inaccuracies and streams attributes.

Prepare soils data.

Prepare the model file geodatabase (last step).



Riparian Inventory



- AlamosaRiver_1.gdb
- AlderCreekRioGrande_1.gdb
- BellowsCreek_1.gdb
- CarneroCreek_1.gdb
- ChavezCreekRioChama.gdb
- CityofAlamosaRioGrande_1.gdb
- ClearCreek.gdb
- ClearCreek_1.gdb
- ConejosRiverHeadwaters_1.gdb
- DeadmanCreekSanLuisCreek.gdb
- EmbargoCreek_1.gdb
- FordCreekSaguacheCreek.gdb
- GarnerCreekSanLuisCreek.gdb
- GooseCreek.gdb
- HeadwatersRioGrande_1.gdb
- HeadwatersSaguacheCreek_1.gdb
- HeadwatersSanLuisCreek.gdb
- KerberCreek.gdb
- LaGaritaCreek_1.gdb
- LaJaraCreek.gdb
- MiddleCreekSaguacheCreek.gdb
- MinersCreek_1.gdb
- NavajoRiver.gdb
- OutletConejosRiver.gdb
- PinosCreek_1.gdb
- RedMountainCreek.gdb
- RiodelLosPinos.gdb
- RioSanAntonio.gdb
- RockCreek_1.gdb

Results

Hiawatha National Forest	% Riparian Areas
Eastern	43 (87,523 Ha)
Western	42 (139,140 Ha)

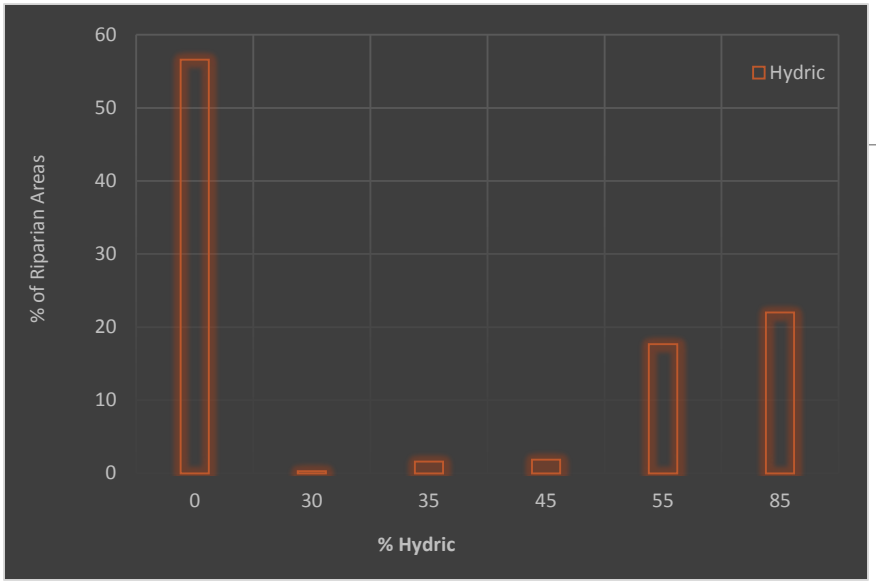
Rio Grande National Forest	Ha	% Riparian Areas
Variable width riparian areas	45808	5.85

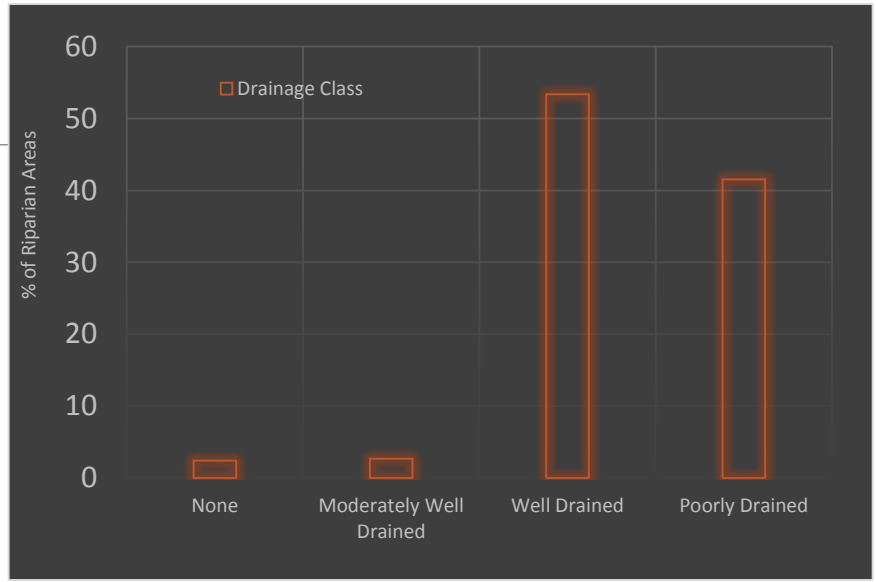
Results
Wetlands

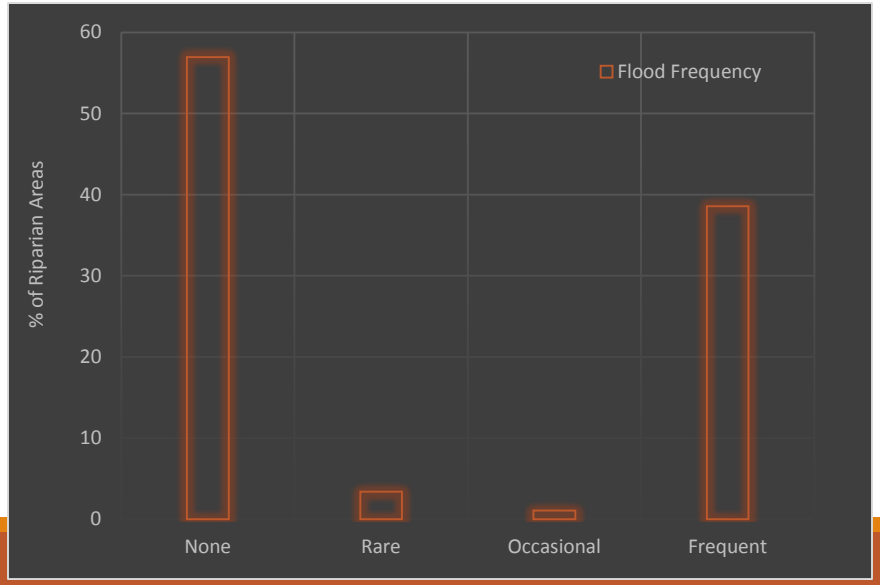
Hiawatha NF	wetlands	
	Ha	% of riparian areas associated with wetlands
East	66,195.66	75.63
West	107,097.55	76.97

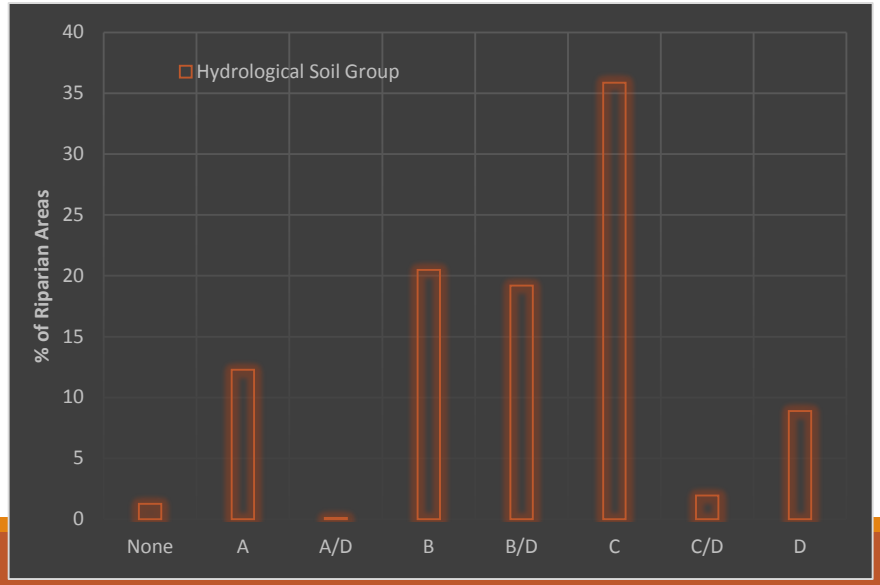
Rio Grande NF	Ha	% of riparian areas associated with wetlands
Variable width riparian areas	15963.5	34.85

Results
Soils









Hiawatha National Forest	% Riparian Areas
Eastern	43 (87,523 Ha)
Western	42 (139,140 Ha)

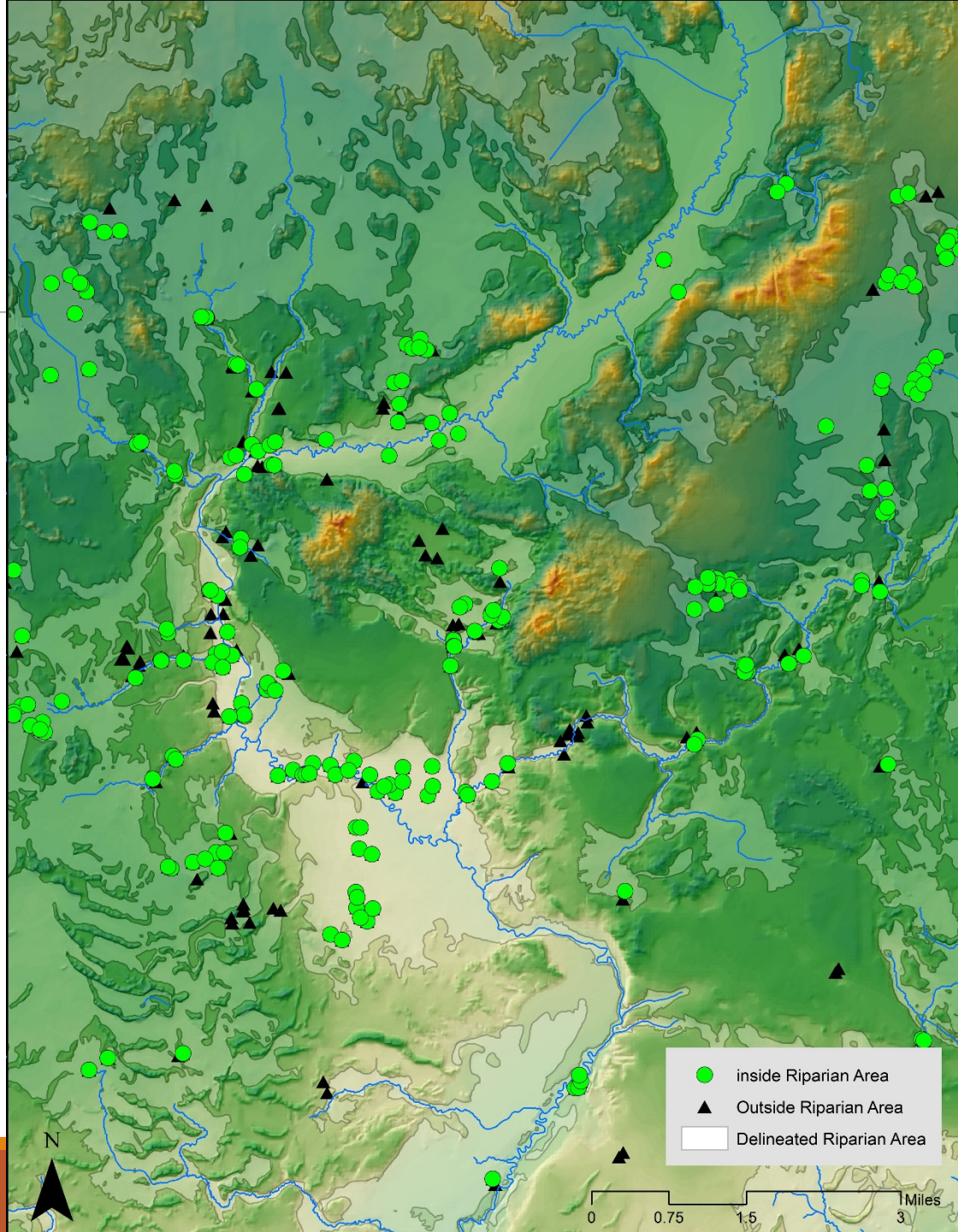
		Reference	
	HNF West	Riparian	Upland
Map	Riparian	300	6
	Upland	37	15

Total	User %	Commission Error
306	98.04	1.96
52	71.15	28.85

Total	337	21
Producer %	89.02	71.43
omission Error %	10.98	28.57

358	
	88

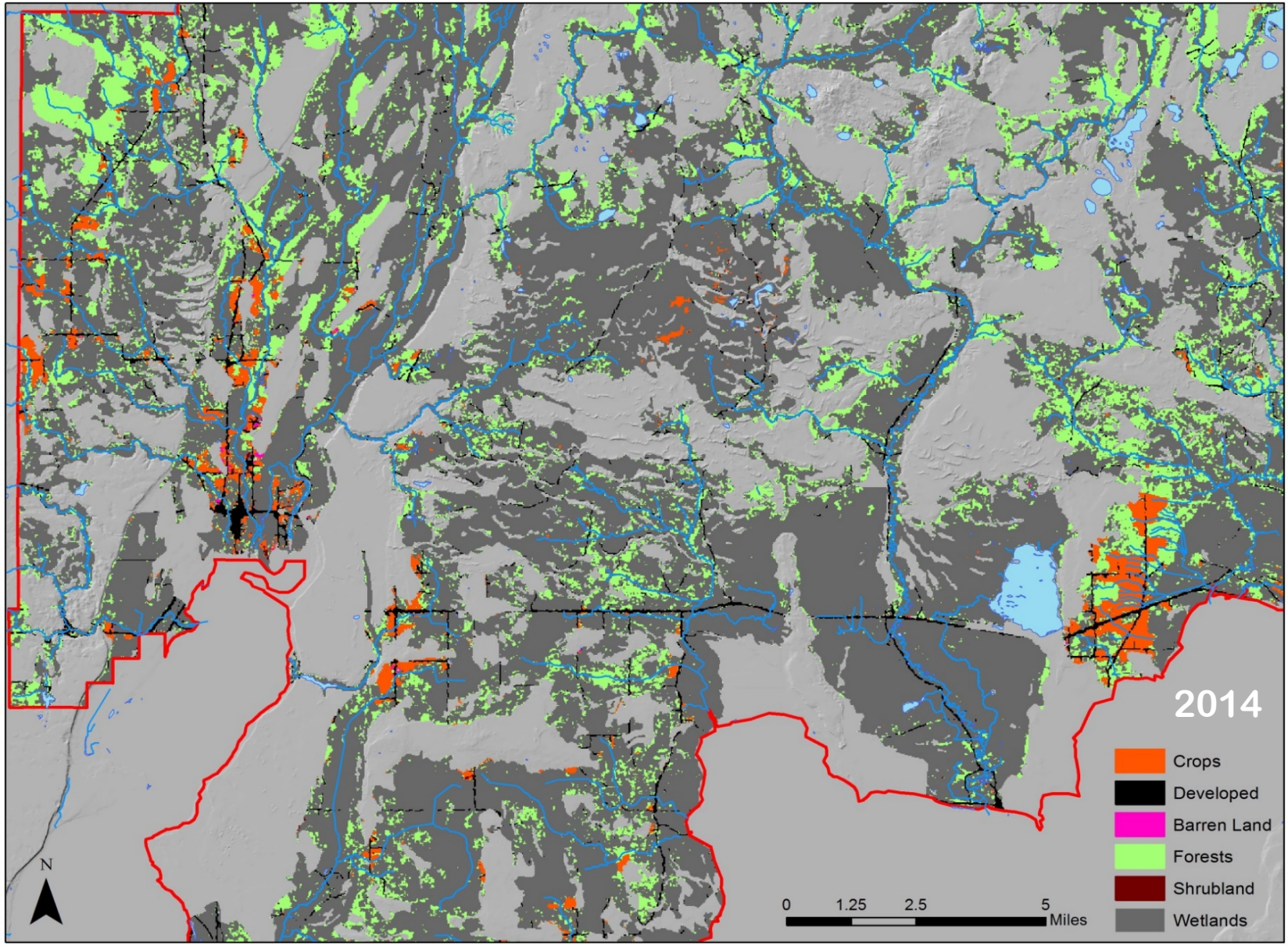
Overall accuracy



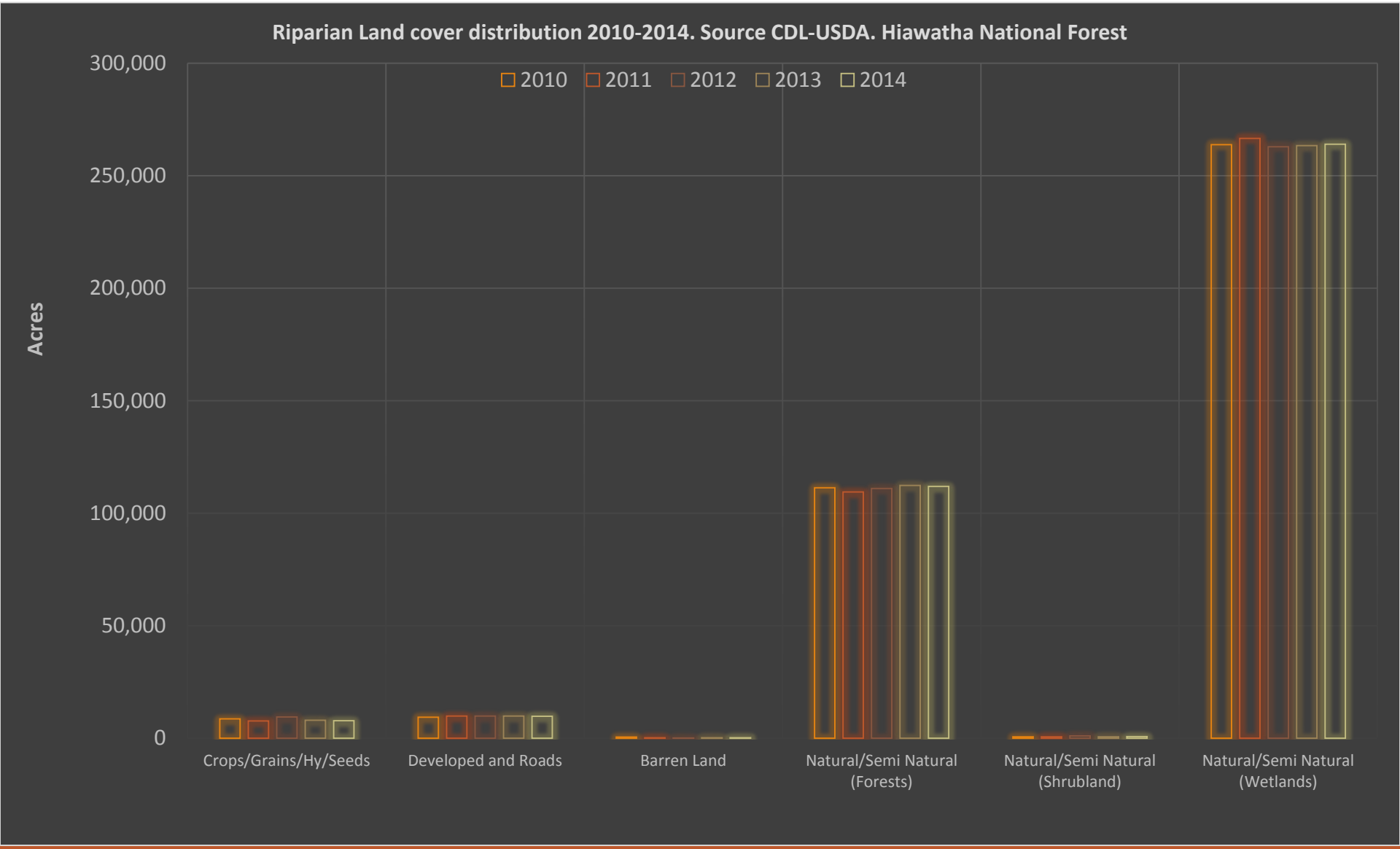
Application-Land Cover Assessment

New land cover classes	Original Land cover classes	Value	Color Map
Crops/Grains/Hay/Seeds	Corn, sorghum, soybeans, sunflower, barley, spring wheat, winter wheat, rye, oats, millet, spletz, alfalfa, other hay/non alfalfa, sugar beets, dry beans, potatoes, clover/wildflowers, sod/grass seed, fallow/idle cropland, cherries, apples, grass/pasture, and celery	1	
Developed and Roads	Developed/ open space, developed/low intensity, developed/med intensity, and developed/high intensity	2	
Barren Land	Barren	3	
Natural/Semi Natural (Forests)	Deciduous Forest, Evergreen Forest, and Mixed Forest	4	
Natural/Semi Natural (Shrubland)	Shrubland	5	
Natural/Semi Natural (Wetlands)	Woody wetlands and herbaceous wetlands	6	

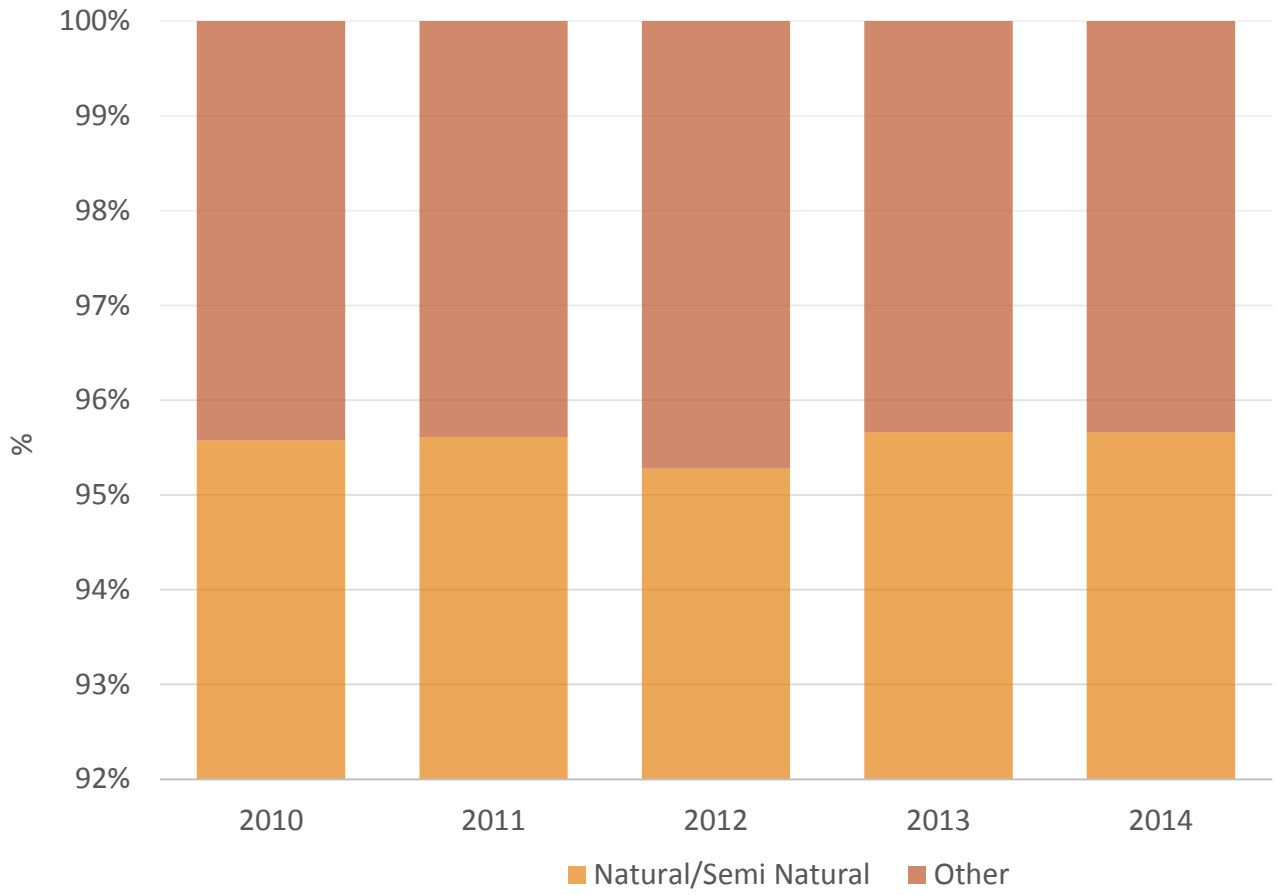
Application-Land Cover Assessment



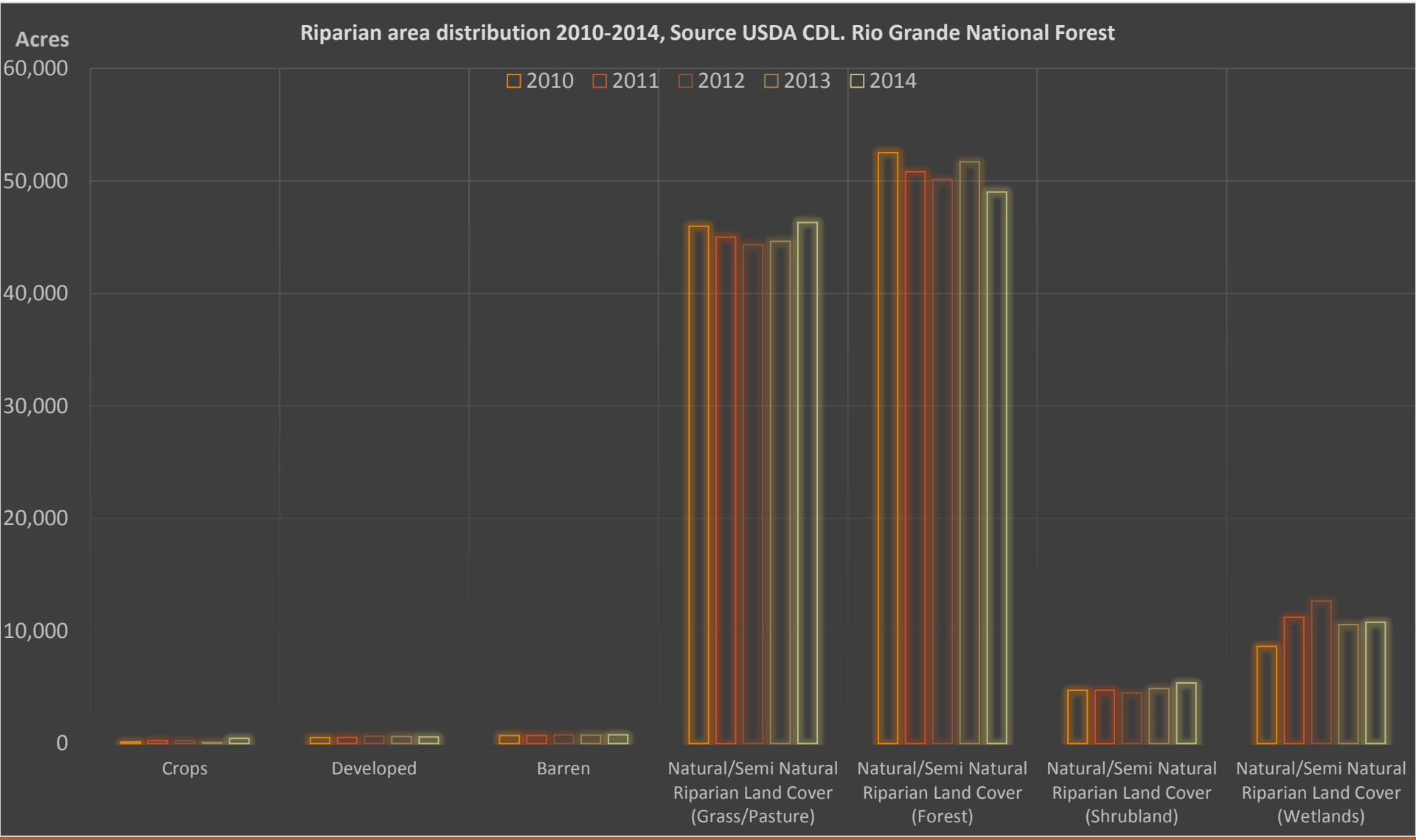
Application
Land Cover Assessment



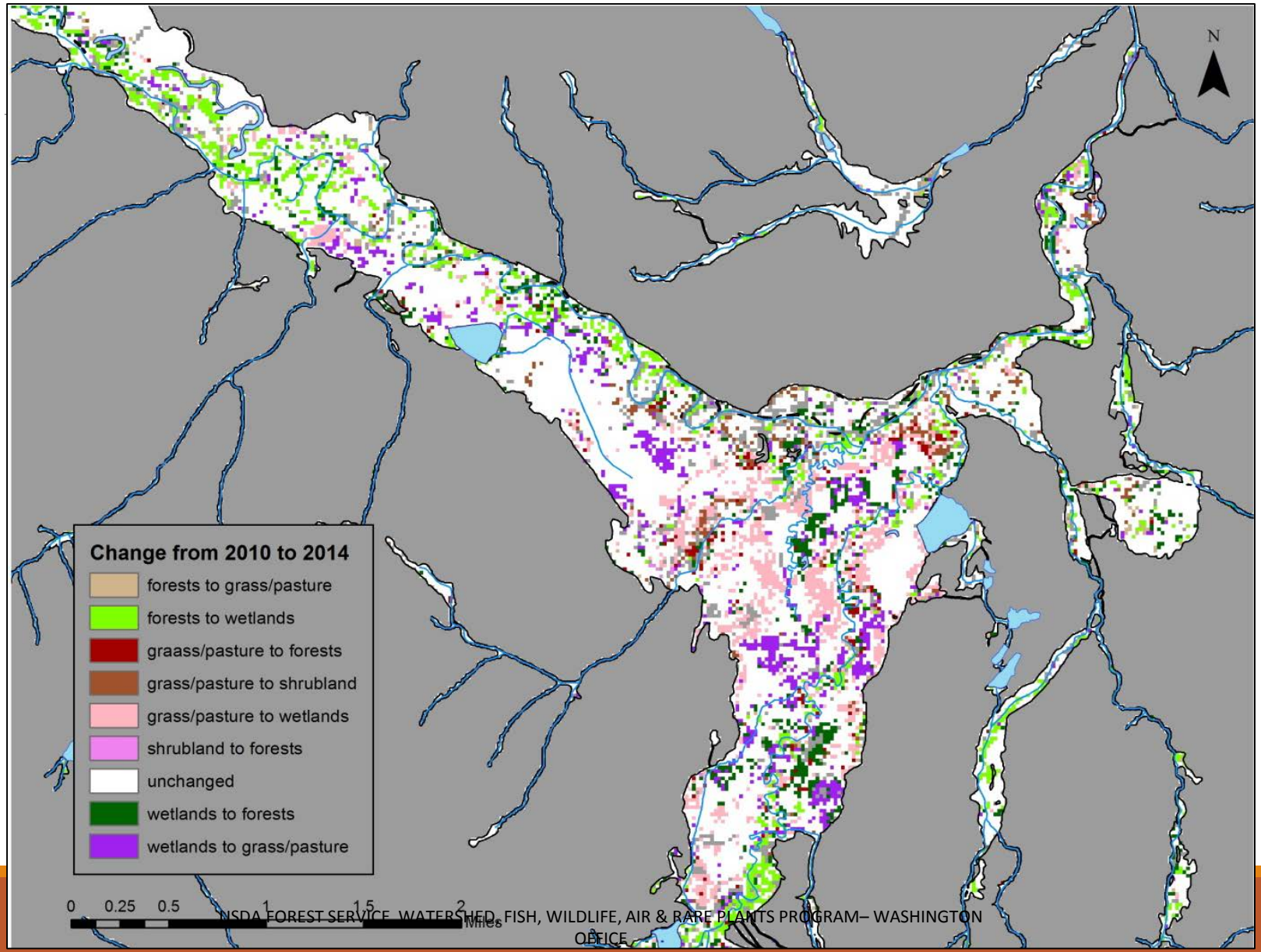
Application
Land Cover Assessment



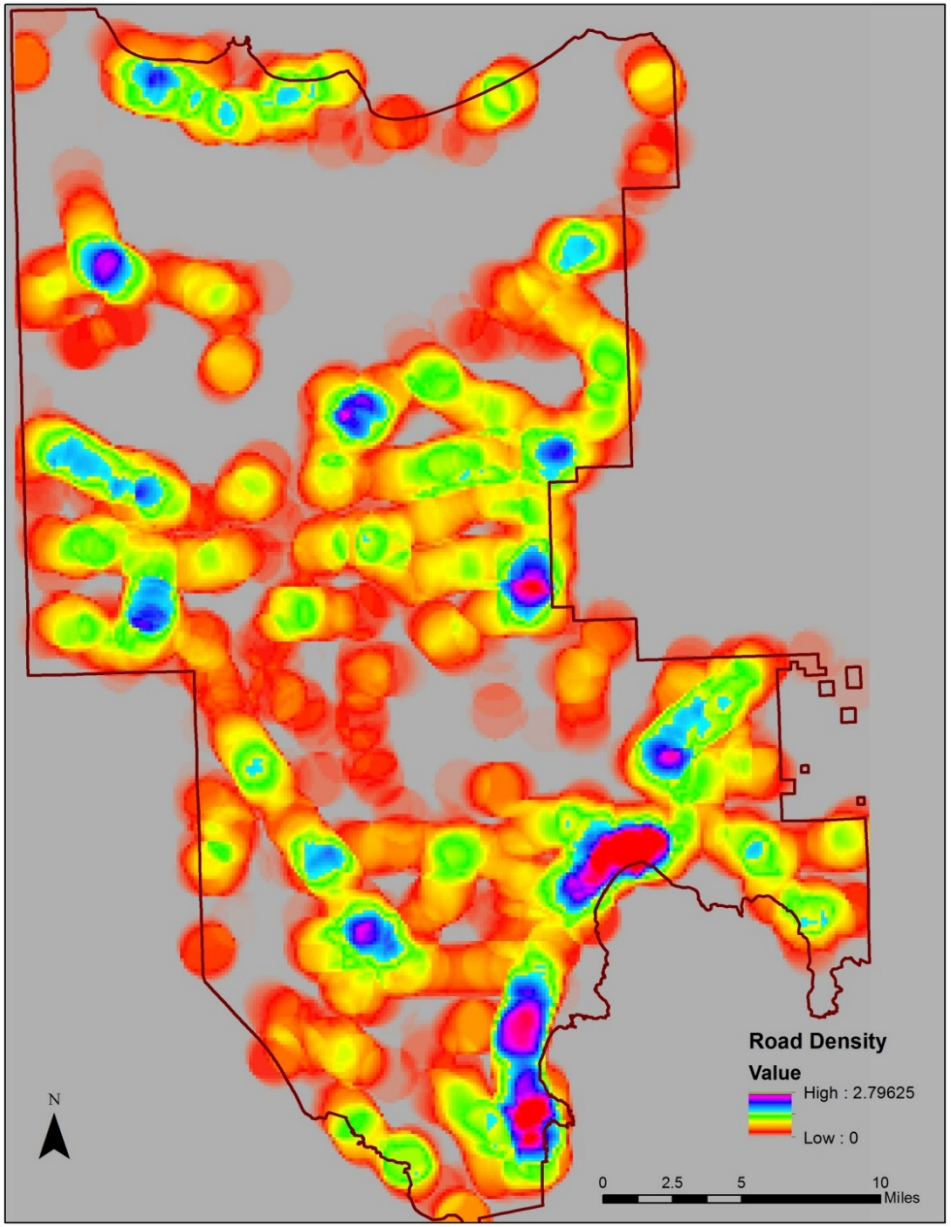
Application
Land Cover time serious



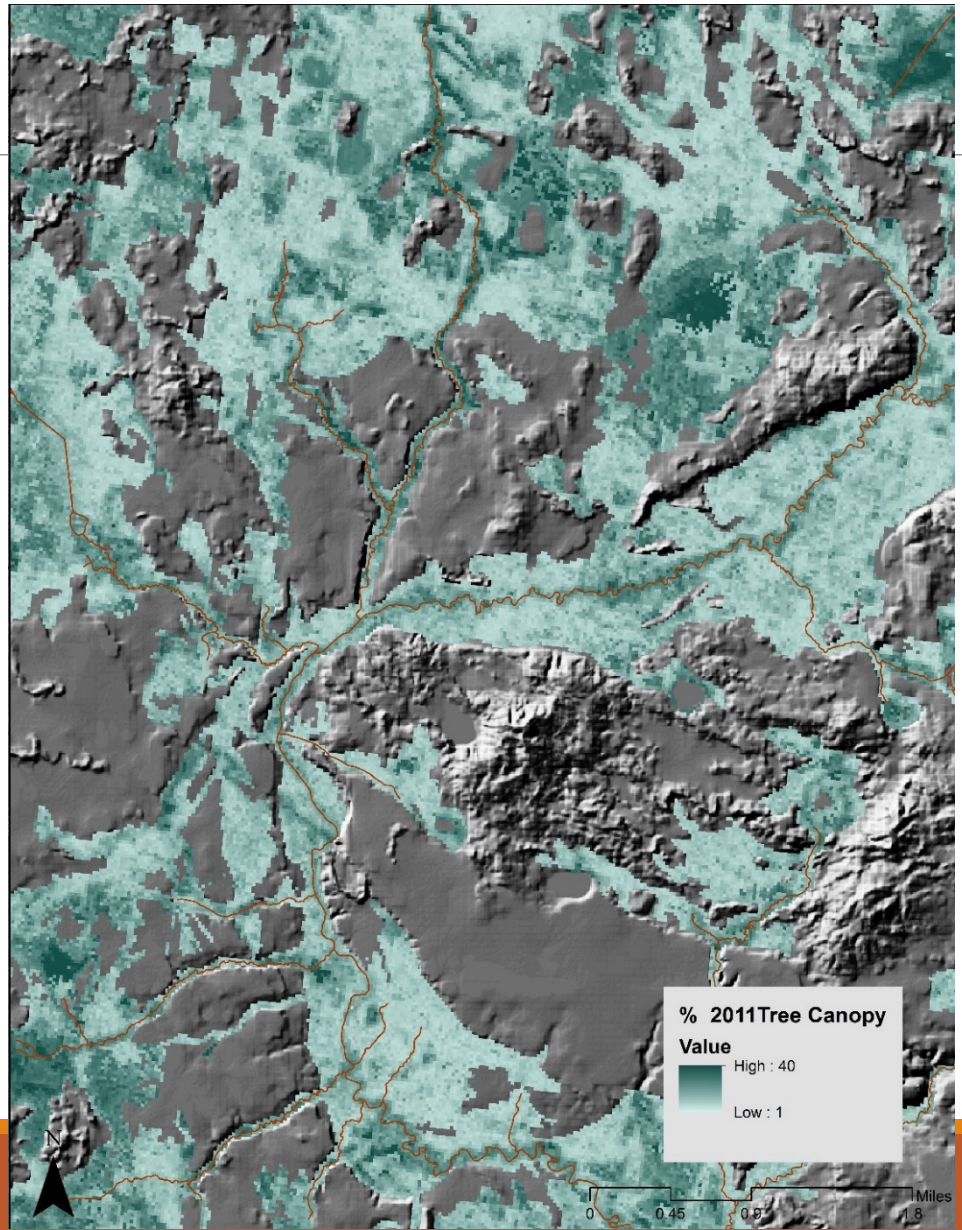
Application
Land Cover Change Matrix



Application
Road Density



Application
Riparian areas % tree canopy



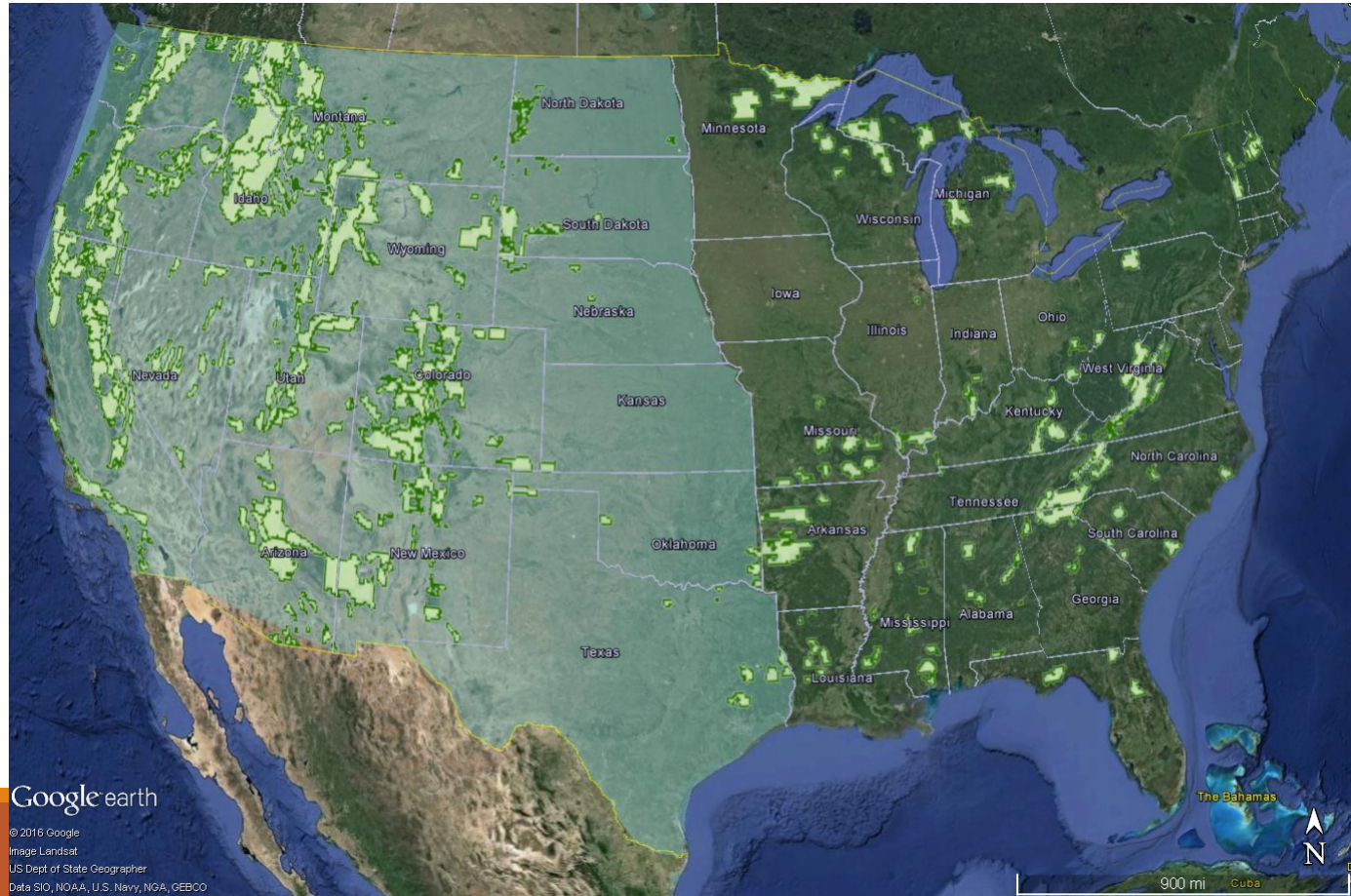
Model Parameters

- Hydrological estimation (50 year flood height).
- NHD positional inaccuracies.
- DEM spatial resolution.

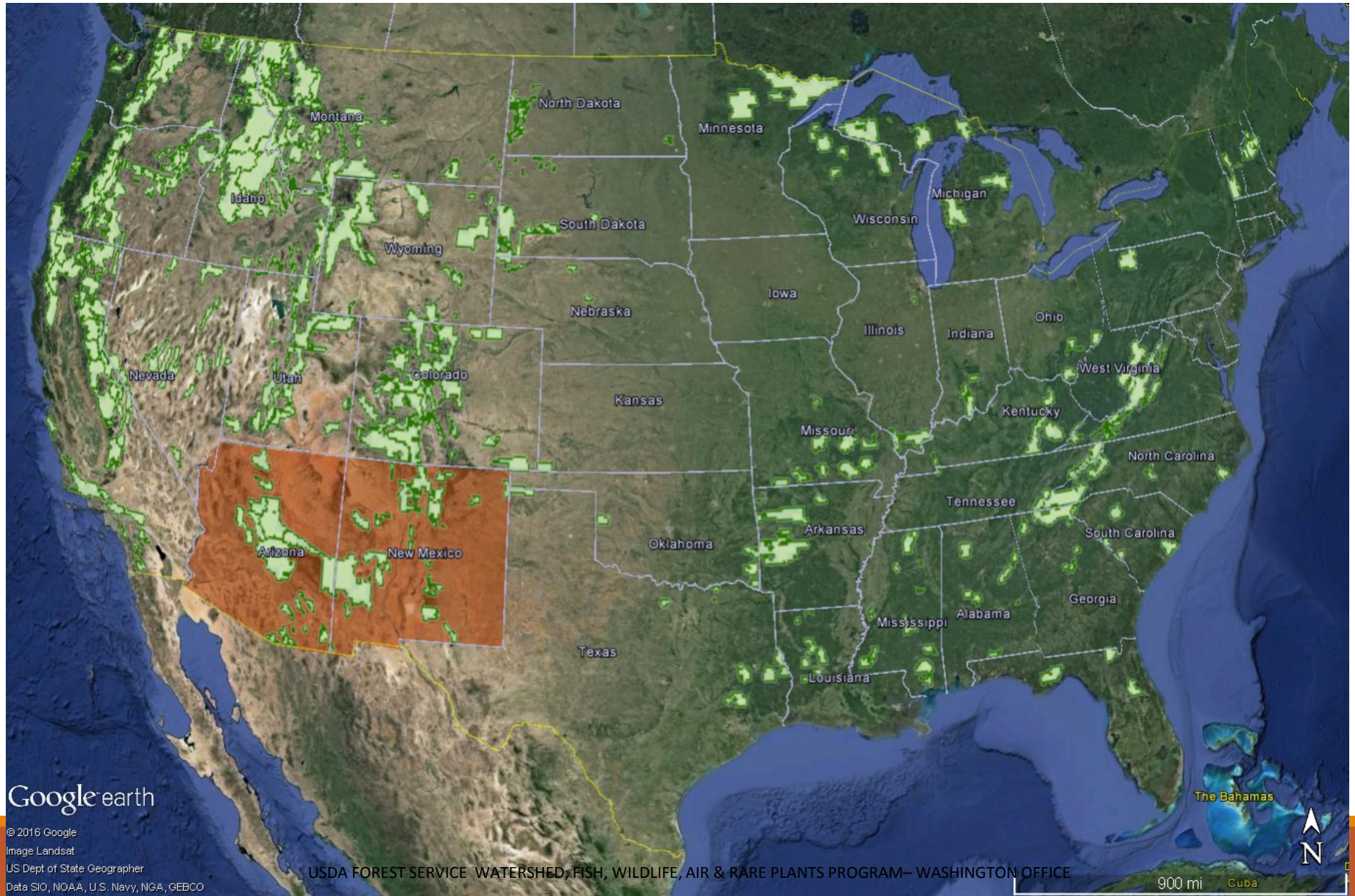
Current Projects

National Riparian Inventory & Assessment.

Rangelands Riparian Inventory &Assessment.



Potential projects



Questions

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