

-- PROJECT SUMMERY --**Project Title: RIO GRANDE NATIONAL FOREST RIPARIAN INVENTORY****Submitted by:**

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Abstract:

Riparian areas are dynamic, transitional ecotones between aquatic and terrestrial ecosystems with well-defined vegetation and soil characteristics. Riparian areas offer wildlife habitat, stream water quality, bank stability and protection against erosions. Riparian areas provide aesthetics and recreational value, and other numerous valuable ecosystem functions. Quantifying and delineating riparian areas is an essential step in riparian monitoring, riparian management/planning and policy decisions, and in preserving its valuable ecological functions. Previous approaches to riparian areas mapping have primarily utilized fixed width buffers. However, these methodologies only take the watercourse into consideration and ignore critical geomorphology, associated vegetation and soil characteristics. Other approaches utilize remote sensing technologies such as aerial photos interpretation or satellite imagery riparian vegetation classification. Such techniques requires expert knowledge, high spatial resolution data, and expensive when mapping riparian areas on a landscape scale. The goal of this study is to map the geographic extent and composition of riparian areas within the Rio Grande National Forest boundary utilizing the Riparian Buffer Delineation Model (RBDM) v3.0 and open source geospatial data. This approach recognizes the dynamic and transitional natures of riparian areas by accounting for hydrologic, geomorphic and vegetation data as inputs into the delineation process and the results would suggests incorporating functional variable width riparian mapping within watershed management planning to improve protection and restoration of valuable riparian functionality and biodiversity.



Potential Objectives:

- Delineate variable width riparian areas extent and composition. Riparian composition would be according to the National Land Cover Database (www.mrlc.gov) land cover classification 2001, 2006, and 2011 (see RBDM Defined Query).
- Delineate variable width riparian areas utilizing optional input data such as National Wetlands Inventory (NWI) and SSURGO database
- Prepare a detailed riparian inventory and maps, area in Hectares, number and type of wetlands, type of riparian soil, and riparian land cover for the years 2001, 2006, and 2011 (source: NLCD) and for the years 2010, 2011, 2012, 2013, 2014 (source: CDL).
- Perform riparian from to change index analysis between 2001 to 2011 & 2006-2011 and highlight the change in riparian composition classes within the delineated variable width riparian boundaries.

Study Area:

The Rio Grande National Forest total area is 783798.3ha figures 1. The study area overlaps with 221 HUC-12 watersheds and 59 HUC-10 watersheds.

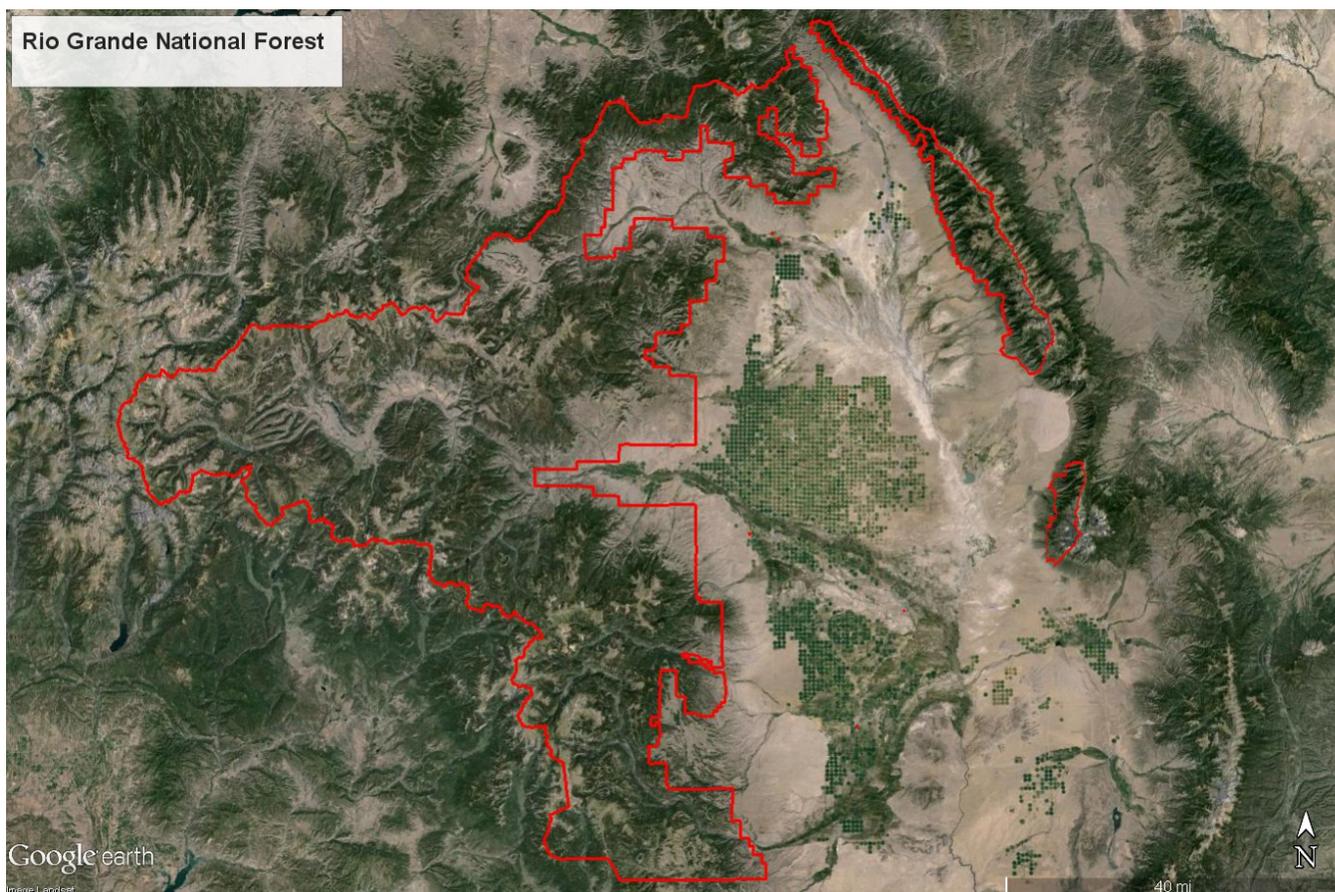


Figure 1. Western Rio Grande National Forest administrative boundary (red).

Methodology:

The Riparian Buffer Delineation Model (RBDM) v3.0 will be used to delineate variable width riparian areas. RBDM is an ArcGIS toolbox developed by Abood et al. (2011) to map variable width riparian ecotones utilizing the 50 year-flood height value and open source available geospatial data. Table 1 illustrates the type and sources of the RBDM inputs.

Table 1. RBDM 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/ GIS Data Depot http://data.geocomm.com/
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/	



50-year flood height:

The 50-year flood height is the optimal hydrological descriptor of riparian ecotones a long moving water courses as determined by Ilhardt et al. (2000). There are 10 operational gauges within the Rio Grande National Forest (Table 1 and Figure 2) Also 5 USGS gauges around the Rio Grande National Forest table 2.

Table 1. Within Rio Grande National Forest.

Gage	50-year flood height, ft	50-year flood height, m	Status
ALATERCO	1.36	0.41	
CARLAGCO	0.63	0.19	
CHECRECO	0.5	0.15	
COCRESO	0.62	0.19	
CONMOGCO	1.87	0.57	Maximum
GARVILCO	0.47	0.14	
GOOWAGCO	0.95	0.29	
KERVILCO	0.6	0.18	
LAGLAGCO	0.8	0.24	
MAJVILCO	0.36	0.10	Minimum



Figure 2. Gauges locations within the Rio Grande National Forest.

Table 2. From USGS gauging stations.

Gage	50-year flood height, ft	50-year flood height, m	Status
09118450	1.65	0.50	Maximum
09358000	1.46	0.44	
09358550	0.78	0.24	Minimum
09359010	1.21	0.37	
09359020	1.35	0.41	

50 year floodplain values in Table 1 were utilized as an input to the RBDM Modelv3.0 to delineate variable width riparian areas at two different extents minimum and maximum.



Project Flowchart:**Downloading data ():**

downloading data from www.datagateway.nrcs.usda.gov
 Status: Ready

Data preparation ():

- Calculating the 50-year flood height according to Mason 2007, Status: ready.
- manually correcting streams in positional inaccuracies within the project study area, Status: in process.
- preparing file geodatabase for each watershed.

Variable width riparian delineation ():

- Run the RBDM tool according to a defined query. see the next section.

Riparian inventory ():

- prepare variable width riparian inventory and maps.
- field data collection for riparian area.
- riparian map accuracy if field data available.
- 2001 to 2011 & 2006 to 2011 land cover from to change index.
- road density within riparian areas.
- DEM spatial resolution assessment and its impact on riparian delineation.



RBDM Defined Query:

This criterion will be applied for all watersheds on the Rio Grande National Forest.

- **Streams:** the model will run on all streams FTypes within the project study area. FCode 33400, 3360, 42000, 42003, 42800, 42807, 46000, and 46007 (highlighted in grey, total mileage 4401.19) were removed from the streams network.

FType	Description	FCode	Type	Miles
334	Connector: a known but specific invisible connection between two nonadjacent network segments	33400	Feature type only no attributes	1.68
336	CanalDitch: an artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water or to serve as a waterway for watercraft	33600	Feature type only no attributes	29.82
		33601	Canal ditch type-aqueduct	1.18
420	A set of naturally occurring subsurface drainage channels formed from the dissolution of soluble rocks in Karst terrain or in terrain similar to karst but formed in nonsoluble rocks, as by melting of permafrost or ground ice, collapse after mining, and by outflow of liquid lava from beneath its solidified crust. Not a named feature.	42000	Feature type only no attributes	0.95
		42003	Positional accuracy approximate	0.02
428	A close conduit, with pumps, valves and control devices, for conveying fluids, gases, or fluids divided solids.	42800	Feature type only no attributes	0.01
		42807	Product-water; pipeline type-general case; relationship to surface-underwater	1.7
460	A body of flowing water: intermittent, perennial, and ephemeral	46000	Feature type only no attributes	0.16
		46003	Hydrographic category - intermittent	4841.35
		46006	Hydrographic category - perennial	1819.46
		46007	Hydrographic category - ephemeral	4365.83
558	Artificial Path: a surrogate for general flow direction in NHDWaterbodies and NHDAreas	55800	Feature type no attributes	248.97



- **Lake Buffer:** this parameter will be set to 30 meter according to Ilhardt et al. 2000 recommendations.
- **Length of Transects Vector:** this parameter will be set to 250 or 500 meter.
- **DEM Dataset:** this parameter will be set to 10 meter spatial resolution DEM.
- **50-Year Flood Height:** the model will run for the minimum and maximum 50 year flood heights in the western part. The model will run for the minimum and maximum respectively 50 year flood heights in the eastern part
- **NWI Criteria:** this parameter will be set to Freshwater Emergent wetland, Freshwater Forested/Shrub wetland, or Riverine.
- Digital Soil Criteria: this will be as follows;

Soil Layer	Criteria
Hydric Soil Rating Selection Criteria	More or equal to 80% Hydric
Drainage Class Selection Criteria	Poorly drained, Somewhat poorly drained, or very poorly drained
Hydrologic Soil Group Selection Criteria	Groups C, D, A/D, B/D, or C/D
Flood Frequency	Frequent or occasional

The soil mapping unit (polygon) will be highlighted as a riparian soil when the four criteria above are fulfilled.

- **Classified Raster Layer 1:** NLCD land cover classes can be used to present riparian land cover at 2001, 2006, and 2011 utilizing NLCD land cover attributes.
- **Classified Raster Layer 2:** CDL data can be used to present riparian land cover at 2010, 2011, 2012, 2013, and 2014 utilizing CDL attributes aggregated in six new land cover classes;
 1. Crops
 2. Developed and Roads
 3. Barren Land
 4. Grass/Pasture
 5. Forests
 6. Shrubland
 7. Wetlands
 8. Open Water



Results

Riparian Area:

The results are categorized in two different criteria. Riparian_Minimum represents delineated variable width riparian areas utilizing national wetlands inventory, digital soil data (SSURGO), and minimum 50 year floodplain values (10 & 20cm). Riparian_Maximum represents delineated variable width riparian areas utilizing national wetlands inventory, digital soil data (SSURGO), and maximum 50 year floodplain values (40 & 60cm).

Riparian Areas	Acres	% riparian areas Of Rio Grande NF
Riparian_Minimum	113,194.01	5.85
Riparian_Maximum	127,853.95	6.60

Wetlands:

According to the U.S. Fish and Wild Life Services National Wetlands Inventory (NWI) database there are 48,450.0 acres of wetlands within the administrative boundary of the Rio Grande National Forest. 81-81.5% of existing wetlands are associated with delineated riparian areas. 30-34.85% of delineated riparian areas are wetlands. The major wetlands system within delineated riparian area is "Fresh Water Emergent Wetlands" at a 61% (Figure 3).

Riparian Areas	Acres of Wetlands	% of delineated riparian areas are wetlands
Riparian_Minimum	39,351.85	30.85
Riparian_Maximum	39,446.77	34.85

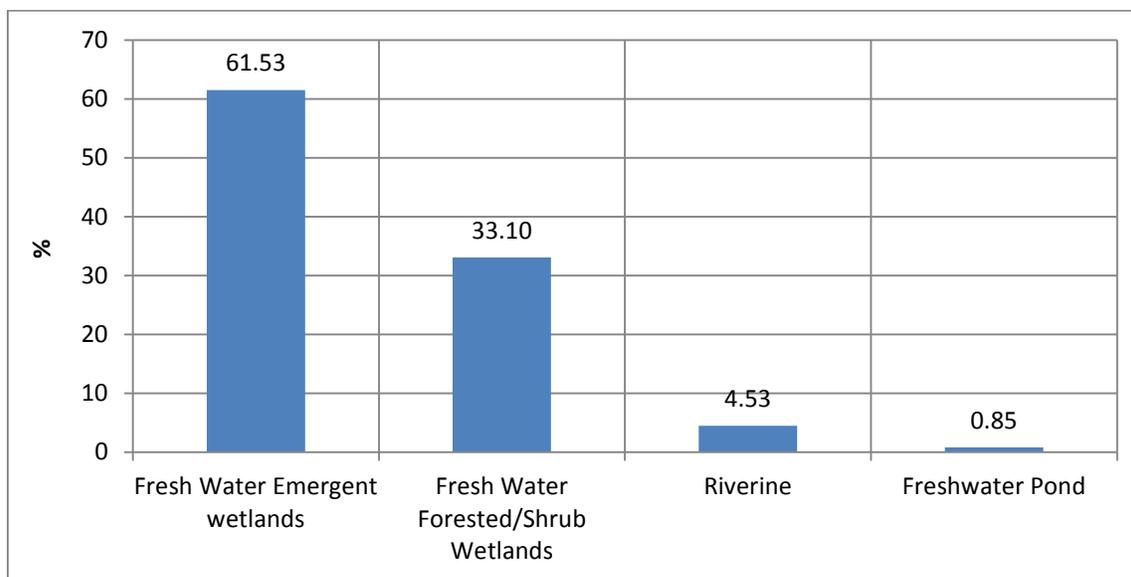


Figure 3. wetlands type distribution within delineated riparian areas.

Figure 4. Shows wetlands attribute distribution within delineated riparian areas according to Cowardin et al., 1979 classification. The dominant wetlands attributes are (PEMB, PSSB, and PEMC) at 45.32%, 20.47%, and 12.05% respectively. 4.52% represents wetlands with less than 1% of the total wetlands attributes.



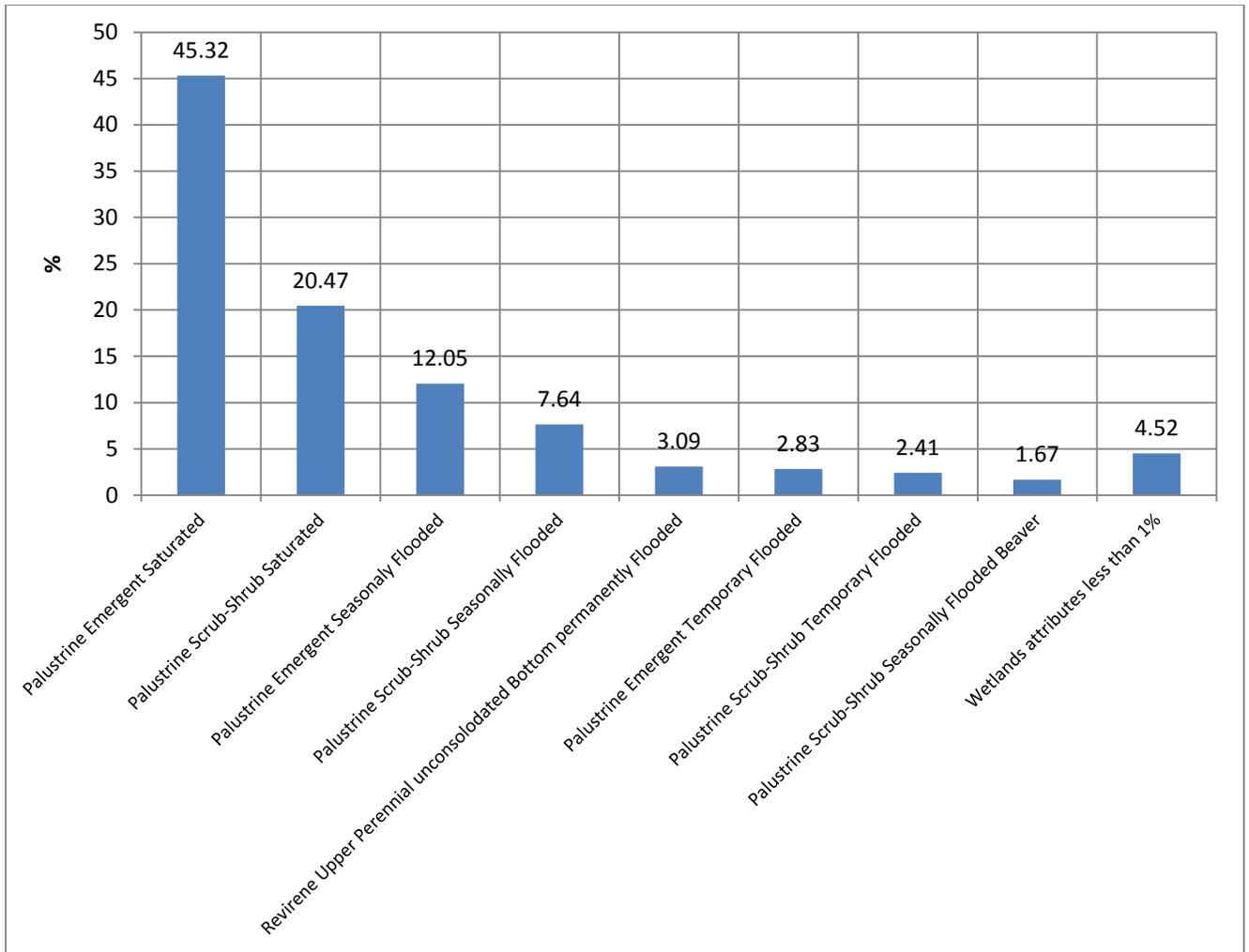
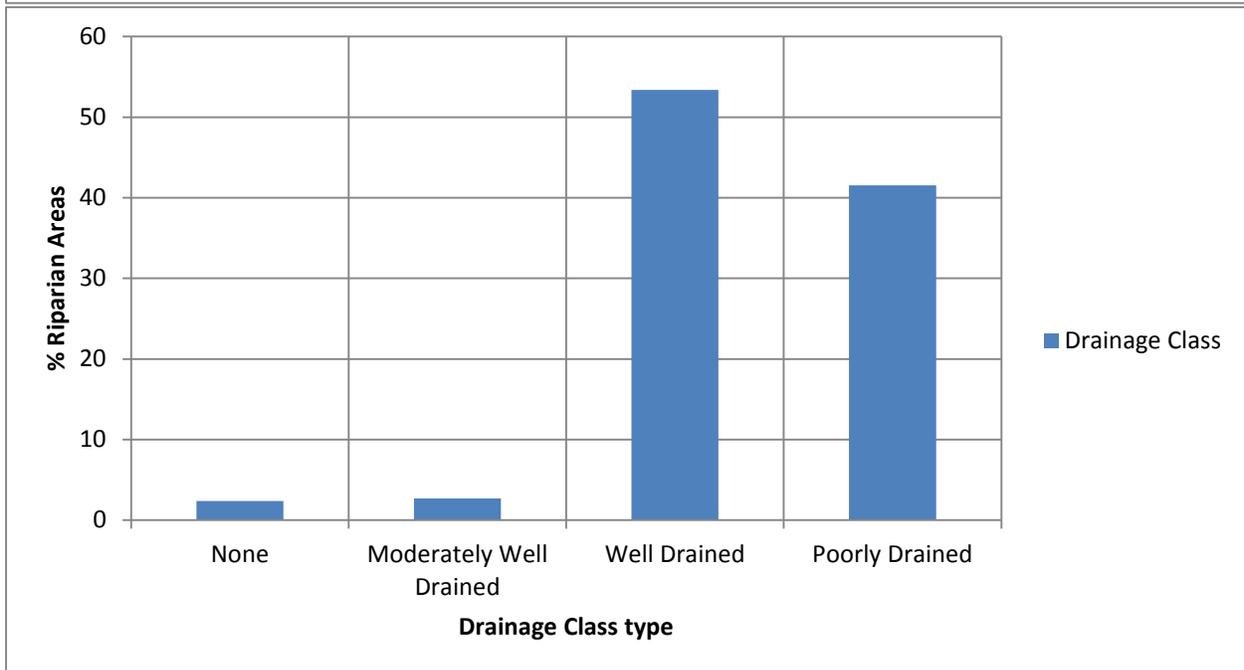
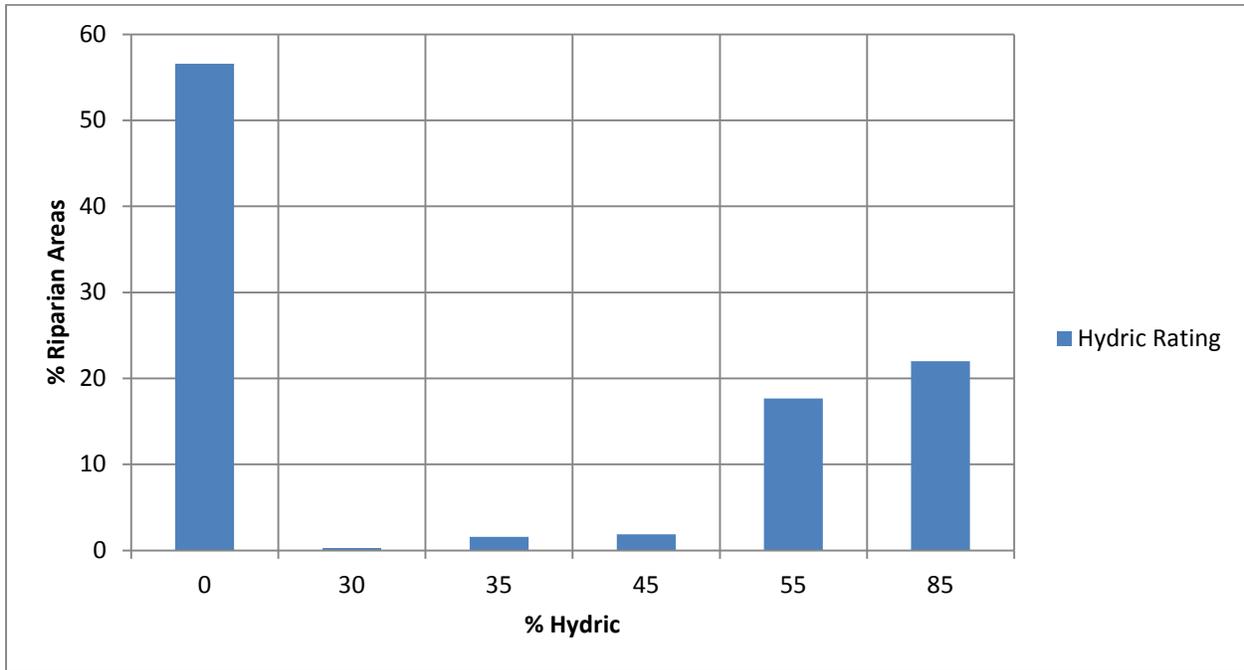


Figure 4. wetlands attributions distribution within delineated riparian areas.

Soils:

Riparian soil properties distribution according to the predefined soil criteria Hydric Rating, Drainage Class, hydrological Soil groups, and Flood Frequency within delineated riparian areas (Figure 5).



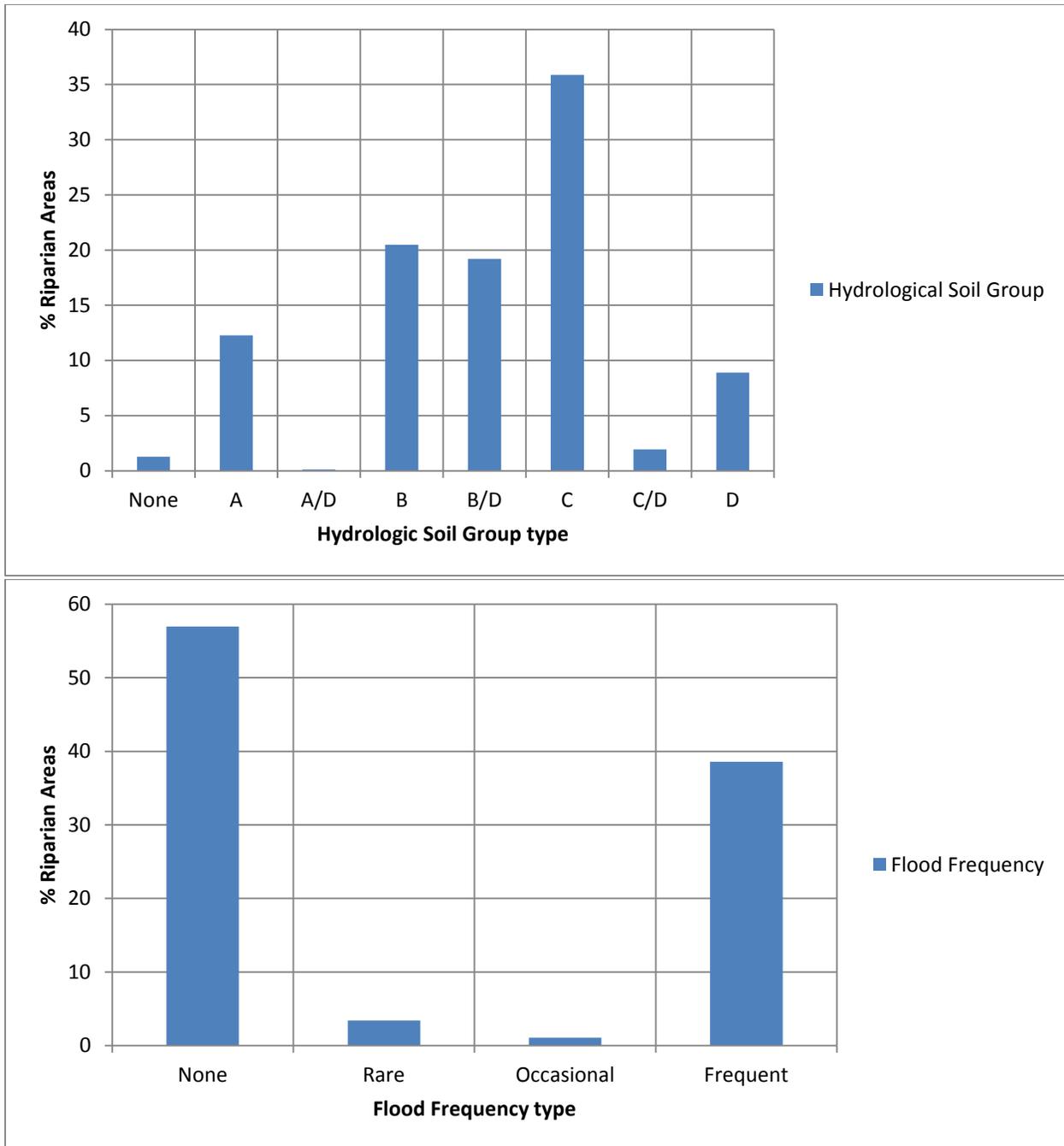


Figure 5. Soils properties within delineated riparian areas.

The RBDM v3.0 identifies riparian soils according to Palik et al., 2004. Each map unit in the digital soil data (SSURGO) database will be considered riparian soils if it has a hydric, drainage class, hydrological soil group, and flood frequency property according to the defined soil criteria. There are 23959.75 Acres of riparian soils which represents 18-21% of delineated riparian areas. 60% of the identified riparian soils belong to wetlands within delineated riparian areas the remaining 40% belongs to with riparian corridors.

Land Cover:

Due to the small difference 1% between the delineated riparian areas utilizing minimum and maximum 50 year floodplain values all the following calculations are based on delineated riparian areas utilizing minimum 50 year floodplain (Riparian_Minimum) as the base layer.

Cropland Data Layer (CDL, <http://www.nass.usda.gov/>) was used to produce classified riparian land cover layers. This land cover database was developed to provide acreage estimates of major commodities throughout the United States and to produce digital crop specific, categorized and geo referenced annual land cover products. The CDL land cover classes were reclassified to (Crops (1), Developed (2), Barren Land (3), Grass/Pasture (4), Forest (5), Shrublands (6), Wetlands (7), and Open Water (8)) to produce a meaningful riparian areas land cover classification for the period between 2010-2014 (Figure 6).

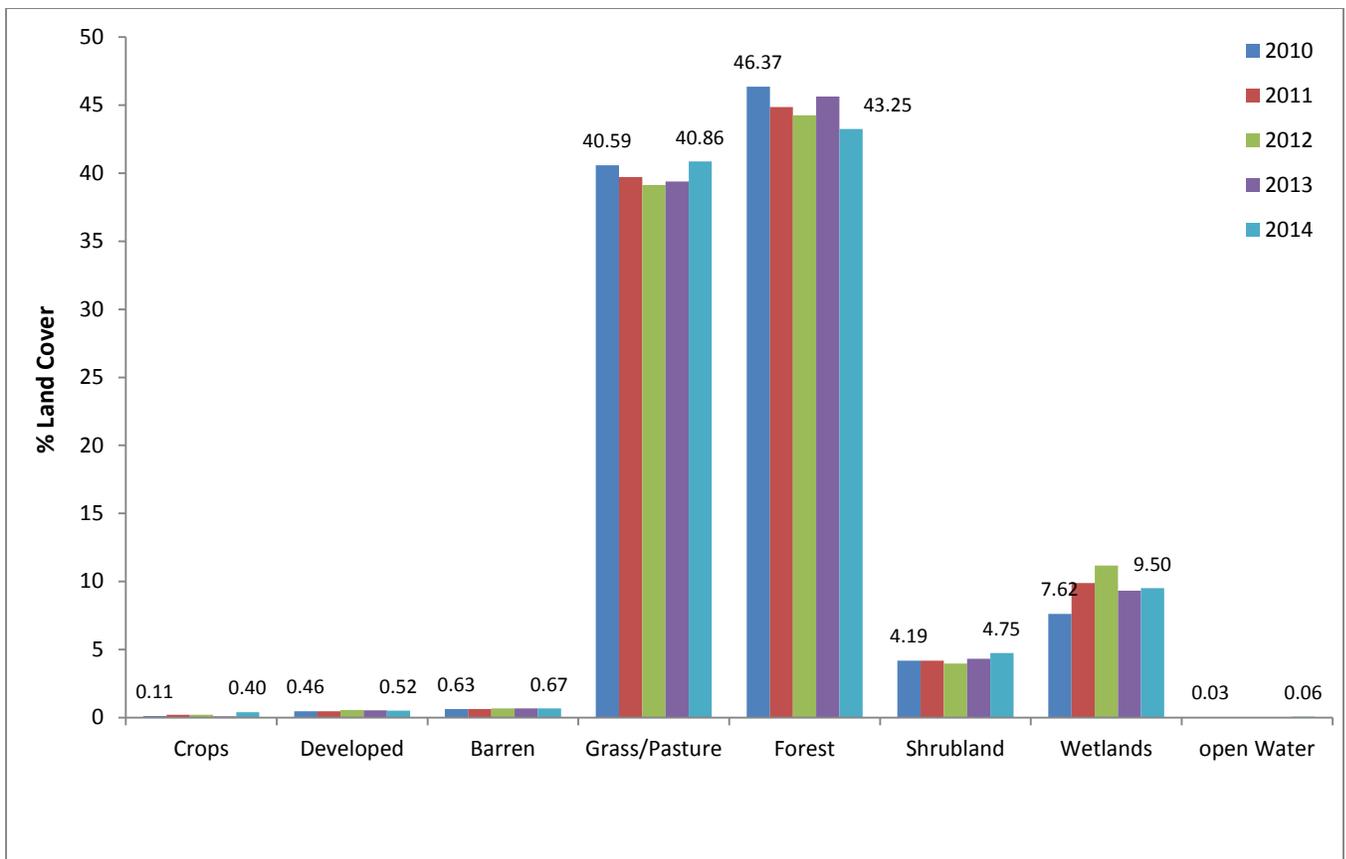


Figure 6. Delineated riparian areas land cover histogram distribution 2010-2014.



Change Analysis (application):

Change analysis was performed on delineated riparian areas between 2010 (from) – 2011 (to). The change matrix has 8 classes and explains the interactions among riparian land cover classes from 2010 to 2014. The matrix diagonal axis represents the unchanged acres/% for all 8 land cover classes from 2010 to 2014. The (yellow) column represents the change in acres/% from 2010 different land cover classes to forests in 2014. For example 5,314 Acres (10.12%) of wetlands in 2010 changed to forests in 2014 while 2,841 Acres (32.9) of forests changed to wetlands within the same period of time. The green highlighted box inside the forest column represents acres (or 84.99%) forests remained unchanged from 2010 to 2014. the highest unchanged riparian land cover classes found from 2010 to 2014 are “Grass/Pasture” and “Forests” 92% and 84.99% respectively. Figure 7 shows the change matrix spatial distribution within delineated riparian areas.

		TO 2014							
Acres		Crops	Developed & Roads	Barren Land	Grass/Pasture	Forests	Shrubland	Wetlands	open Water
From 2010	Crops	98.52	1.56	0.00	76.28	26.69	152.56	24.02	0.00
	Developed & Roads	0.22	220.62	0.22	213.28	56.49	78.06	17.12	0.00
	Barren Land	0.00	0.22	422.33	132.77	127.88	1.11	71.17	2.22
	Grass/Pasture	12.90	131.21	195.93	42,367.39	1,146.00	1,218.28	1,226.95	3.56
	Forests	2.89	86.73	71.17	1,061.49	44,634.08	308.68	2,841.09	6.67
	Shrubland	5.78	67.16	5.12	905.37	1,180.69	2,646.27	563.10	8.23
	Wetlands	9.34	14.23	10.90	1,212.72	5,314.12	332.03	3,872.33	4.67
	Open Water	0.22	0.00	3.56	4.89	29.80	5.56	16.01	9.34

Same above change matrix but with % representation instead of acres

		To 2014							
%		Crops	Developed & Roads	Barren Land	Grass/Pasture	Forests	Shrubland	Wetlands	open Water
From 2010	Crops	75.86	0.3	0	0.17	0.05	3.22	0.28	0
	Developed & Roads	0.17	42.28	0.03	0.46	0.11	1.65	0.2	0
	Barren Land	0	0.04	59.55	0.29	0.24	0.02	0.82	6.41
	Grass/Pasture	9.93	25.15	27.63	92.15	2.18	25.69	14.21	10.26
	Forests	2.23	16.62	10.03	2.31	84.99	6.51	32.91	19.23
	Shrubland	4.45	12.87	0.72	1.97	2.25	55.8	6.52	23.72
	Wetlands	7.19	2.73	1.54	2.64	10.12	7	44.86	13.46
	Open Water	0.17	0	0.5	0.01	0.06	0.12	0.19	26.92



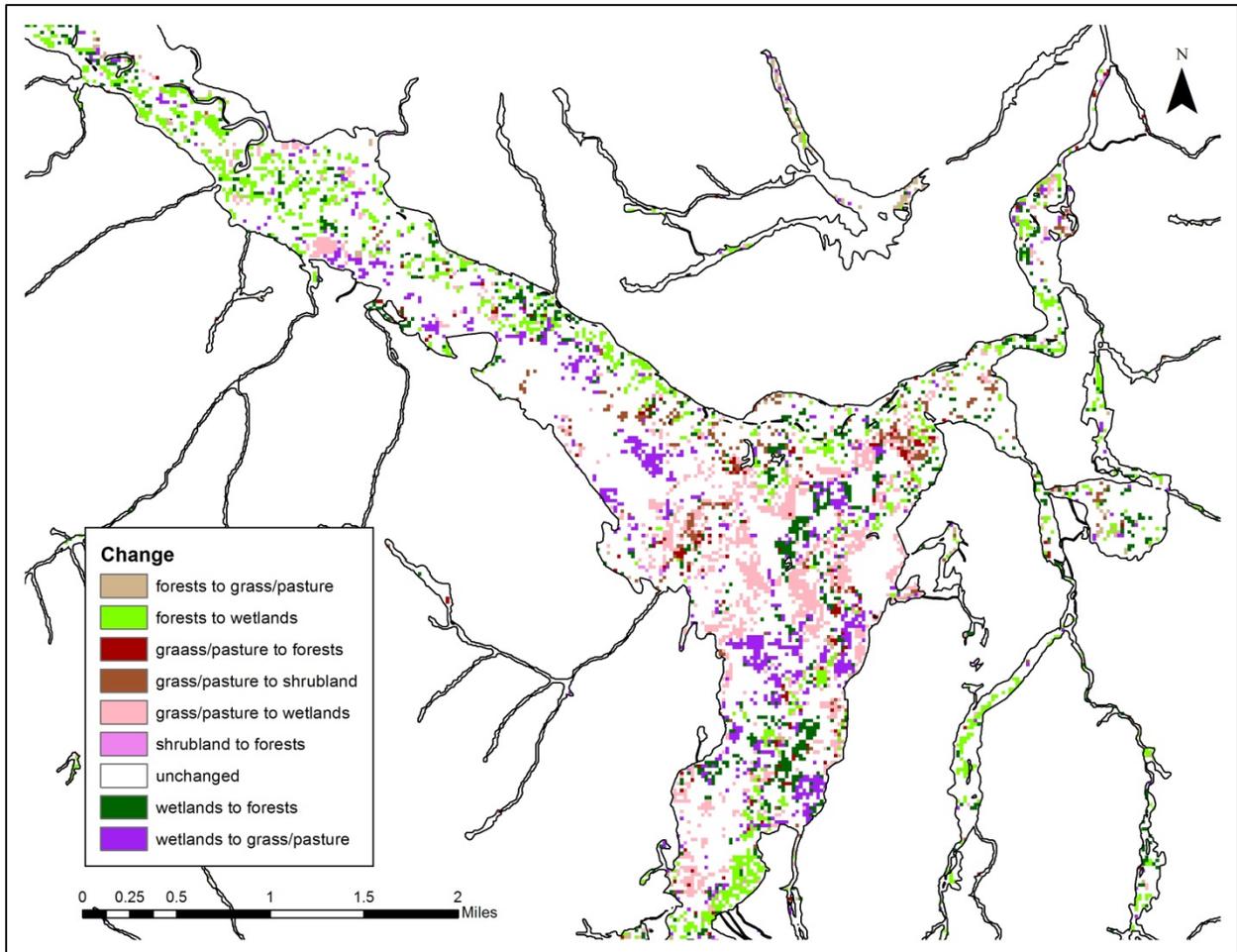


Figure 7. change map within riparian areas.