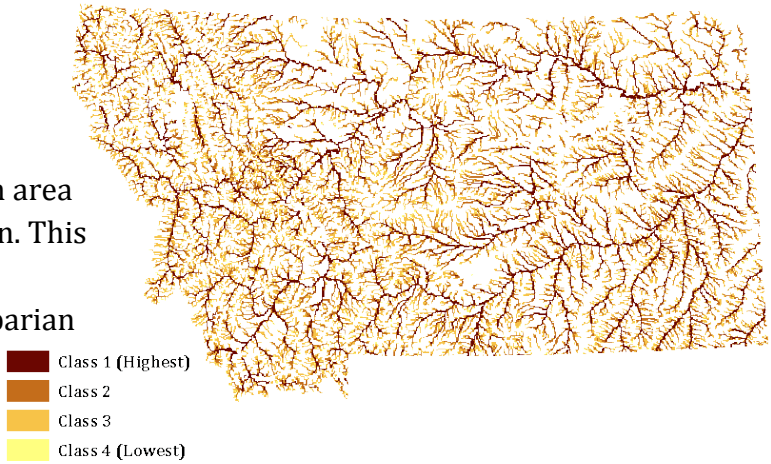
RIPARIAN AREAS



SUMMARY: The purpose of this layer is to represent total riparian area in Montana by square-mile section. This layer does not represent riparian condition or health, only area. Riparian areas serve as important sources of biodiversity and are not captured well in remotely-sensed data due to their size. We represented riparian corridors separately using this layer to capture the biodiversity that these unique habitats represent.

DATA SOURCES
- Survey data – counts or estimates
- Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- Extrapolation based on expert opinion

DATA SOURCE(S) / QUALITY: FWP streams layer (based on National Hydrologic Dataset 1:100,000) and riparian mapping conducted by Montana Natural Heritage (MTNHP) program for submission to the National Wetlands Inventory (NWI).

METHODS: Streams with Strahler order > 1 were extracted from the FWP streams layer. A stratified random sample (order = stratum) of streams was examined relative to detailed riparian mapping from preliminary NWI data mapped by MTNHP. Using this sampling technique mean riparian buffer widths were determined for each Strahler stream order. Buffers were applied to all FWP streams in the hydrologic network to produce a layer of riparian corridors statewide. The riparian corridor layer was intersected with the Montana PLSS section layer to calculate total riparian area for each section in Montana. The metric presented is total riparian area per section. Riparian condition was not considered in this analysis.

CLASS	RANGE OF VALUES (acres)	PERCENT OF STATE
1 (Highest)	29 to 366	7 %
2	6.4 to 29	11 %
2	1.0 to 6.3	15 %
4 (Lowest)	0.1 to 0.9	3 %
No Class		63 %

FINAL CATEGORIZATION: Raw scores (total riparian area for section) were assigned into four categories by finding natural breaks in the data.

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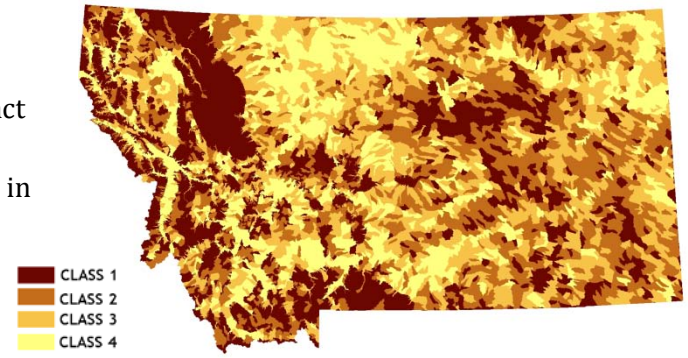
DATE MODIFIED: April 15, 2010 – Version 1.0

WATERSHED INTEGRITY



SUMMARY: We characterized the level of human impact on streams and river basins by creating a score of watershed integrity for each river basin and sub-basin in Montana. Watershed Integrity (WI) is a summation of human impacts that contribute to the impairment of streams and watersheds. The 13 variables are supported by literature as best predictors of watershed health in Pacific Northwest and Rocky Mountain streams and include impacts that are likely to affect water quality, water quantity, watershed connectivity, stream function, and the overall health of stream systems. Variables include: 1) % urban, 2) % riparian buffer as urban, 3) % cultivated cropland, 4) % riparian buffer as cultivated cropland, 5) road density, 6) road density in riparian buffer, 7) # producing oil / gas wells, 8) # unique points of irrigation diversion, 9) # surface / placer mines, 10) # dams with storage >20 surface acres, 11) presence of large in-stream reservoirs, 12) presence of impaired streams (303d listed by Dept of Environmental Quality), 13) # of Wetland Modification Project Permits (Army Corps of Engineer 404 permits).

MEASUREMENT UNIT: Upper and lower portions of 6th Code HUCs (4,271 in State)

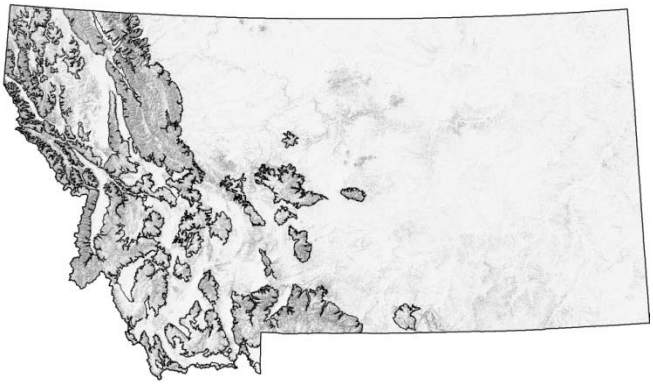
DATA SOURCE(S) / QUALITY: Montana Department of Natural Resources and Conservation: **water rights & points of diversion**; Montana Department of Environmental Quality: **303d list of impaired waterbodies**; Army Corps of Engineers: **404 Permits (Wetland Modification Project Permits);** US Census: **TGR Roads 2000**; Montana Natural Heritage Program: **land use**; Montana Natural Resource Information System: **mines, dams, oil and gas wells**. Montana Department of Revenue: **Farm Land Use-Type (FLU)**. All data sets used were current (within one year) at the time of publication and contained statewide coverage.

DATA SOURCES
- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- Extrapolation based on expert opinion

METHODS: Variables were summarized by 6th Code HUC and each HUC was given a score based on density, frequency or presence of each variable. In HUCs west of the lower Yellowstone and Missouri basins, HUCs were split into valley and mountain portions to account for differences in land use management and stream gradient. Valley segments of watersheds are generally lower in gradient, have a different suite of native species present, and have different ownership characteristics than mountainous stream reaches that are generally high gradient and publicly owned.

Variables used to represent watershed integrity were selected from literature as best explaining the variability seen in watershed health throughout Pacific Northwest and high elevation prairie streams. Variables presence, density, or frequency were summarized by 6th Code HUCs in prairie systems (lower Missouri and Yellowstone), and by sub-basin (upper and lower) for streams west of the lower Missouri and Yellowstone ecoregions. The elevation contour that best explained the division between valley and mountain topography was selected as the division between upper and lower portions of most western HUCs.



Map showing elevation contours used to divide HUCs into mountain and valley sub-basins

HUC scores for each variable ranged from 0 to 30 with five categories possible for most variables. Scoring breaks for each variable were made using the Natural Breaks (Jenks) Method of categorization. Variables shown by literature as being highly correlated to watershed health (% cultivated cropland, road density, % urban) received more weight than others. Calculations for riparian buffers are based on increasing buffer widths for stream orders 2 – 8, with buffers 5 to 246 meters, respectively. Each 6 th Code HUC score was calculated by adding scores for each variable and dividing by possible points, such that: WI Score = HUC total / total possible.

FINAL CATEGORIZATION: Scores for watershed integrity were normally distributed. We created four categories of watershed integrity based on quartiles that represented a gradient of integrity from highest to low. Perfect score for a watershed was 1.00, whereas the lowest scoring HUC was 0.48

CLASS	RANGE OF VALUES	SQUARE MILES (% of State)
1	0.901 - 1.00	40,669 (24%)
2	0.831 – 0.90	49,476 (29%)
3	0.766 – 0.83	42 265 (25%)
4	0 - 0.765	35,754 (21%)

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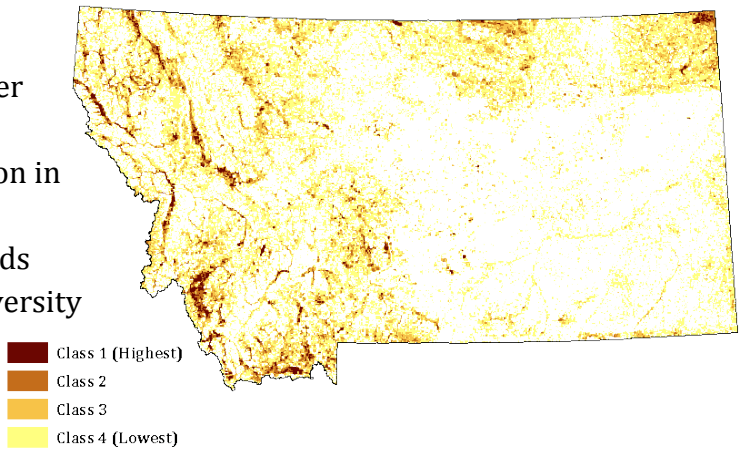
DATE MODIFIED: April 10, 2010 – V 1.2

WETLAND AREAS



SUMMARY: The purpose of this layer was to represent maximum wetland area or count in each one-mile section in Montana. This layer does not reflect wetland condition or health. Wetlands serve as important sources of biodiversity and are not captured well in remotely-sensed data due to their size. We represented wetlands separately using this layer to capture the biodiversity that these unique habitats represent. The metric presented is a score that represents the greater of two measures: 1) total wetland area per one-mile section divided into four classes, and 2) total count of wetlands per one-mile section divide into four classes. The metric also takes into account the amount of flooded irrigation in a one-mile section.

MEASUREMENT UNIT: One-mile section

DATA SOURCES
- Survey data – counts or estimates
- Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- ✓ None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- Extrapolation to habitat unit (e.g. stream section)
- Extrapolation based on expert opinion

DATA SOURCE(S) / QUALITY: National Hydrologic Dataset (NHD) 1:24,000 scale waterbodies, USFWS National Wetlands Inventory (NWI), Montana Land Cover (MLC), USDA/ERS Major Land Use (MLU), and Montana PLSS Sections. NHD waterbodies were digitized by 24K quad therefore results vary across Montana (both and amount and categorization of wetlands). USFWS National Wetlands Inventory was completed in the 1980's for much of the northern glaciated plains in Montana (north of Hwy-2 east of the Continental Divide), however completion of other parts of the state are subject to specific project funding. Coverage of Montana by the NWI is patchy but detailed where complete. Montana Landcover is based on satellite data and is comprehensive; however, small wetlands are not well represented by this layer. USDA MLU for Montana was digitized using aerial imagery and has complete statewide coverage.

METHODS: NHD waterbody features were available for Montana by hydrologic basin. NHD waterbody data for each basin was clipped to the extents of the Montana state boundary. All NHD basin waterbodies were merged to form a single layer. *Ice Mass* and *Reservoir* waterbody categories were removed from the NHD layer leaving *Lake/Pond*, Swamp/*Marsh*, and *Playa* wetland categories. To remove wetlands that are highly altered, we selected all wetlands from the NWI that included the word "impounded" in the wetland description. All wetlands in the NHD layer that intersected "impounded" NWI wetlands were removed. All wetland land cover classes from the Montana Landcover dataset were combined into a single wetland raster layer. Patches of wetland were identified from this layer and converted to simplified polygons. We overlaid the NHD wetlands described above with the Montana Landcover wetlands to arrive at unique wetland boundaries for all overlapping polygons.

	% OF SECTION IN WETLANDS		COUNT OF WETLANDS IN SECTION		
CLASS	MAXIMUM VALUE	MEAN VALUE	MAXIMUM VALUE	MEAN VALUE	PERCENT OF STATE
1 (Highest)	100	18.1	183	57	1%
2	58.7	8.1	164	28	2%
3	46.1	3.0	42	11	7%
4 (Lowest)	17.3	0.4	20	3	30 %
No Class					59 %

FINAL CATEGORIZATION: We calculated the total wetland area and total count of distinct wetland by one-mile section. We converted each of these two metrics to four classes by finding natural breaks in the data. One-mile sections with no wetlands were given a score of zero. To calculate a single wetland score for each one-mile section we took the highest score from the total wetland area and total wetland count scores. Finally, we penalized all one-mile sections by one class (unless a section was already a "zero" or was in the lowest wetland class) if the amount of flooded agriculture in the one-mile section exceeded twenty-five percent.

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DATE MODIFIED: April 15, 2010 – Version 1.0