Natural Resource Inventory Update

natural resource inventory GIS model

CITY OF PORTLAND
BUREAU OF
PLANNING

Natural Resource Inventory Update

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gis model overview

The Natural Resource Inventory Update project is part of Portland's long-standing investment in conserving the natural resources in the City. Previous inventories produced by the City did not have access to GIS information relating to the location and type of natural resources within the City. The widespread availability of high-quality GIS data makes the development of a standardized, GIS-based model for determining the relative value of these resources possible.

There are several advantages to a GIS-based modeling approach:

- it relies on documented, geographic information that can be distributed and viewed both by both City staff and the public (via www.PortlandMaps.com);
- it applies uniform decision-making across the specified geographic area or areas;
- a GIS-based approach allows for all of the information that determines why things are valued the way they are to be part of the resulting data, allowing people to better understand the decision making process;
- a GIS-based approach is transferable and replicable;
- the inventory resulting from the GIS model is not static – as the inputs to the model change, the inventory can be updated, thus allowing the model to incorporate changes in the landscape, the science, etc., thus making the inventory easy to update and maintain over time.

There are disadvantages to this approach as well:

- the results are only as accurate as the data that goes into the model – with this in mind, the City has made a concerted effort to improve the accuracy and quality of our GIS-based natural resource data such as streams, vegetation, etc.;
- the model is limited to GIS data that currently exists – for example, the City has relatively little data pertaining to the condition of our mapped natural resources.

With these advantages and limitations in mind, the City of Portland, Bureau of Planning has been developing its natural resource inventory models and improving its natural resource GIS data since 2000. The primary goal was to generate results that are easy to interpret, well documented, and contain all of the information needed to understand and replicate the inventory decisions.

The City developed the GIS model tools to evaluate the relative quality of the riparian corridor and wildlife habitat in Portland. The City inventory models are comprised of the same general modeling approach that Metro developed for the regional inventory of riparian corridors and wildlife habitat conducted as part of the 2006 Nature in Neighborhoods project.

The models are actually a series of "scripts" written in Arc Macro Language (AML). The model itself runs in ESRI's ArcInfo Workstation. It is completely automated, requiring roughly 4 hours to evaluate of the areas within Portland's jurisdiction. Figure 1 illustrates the general process:

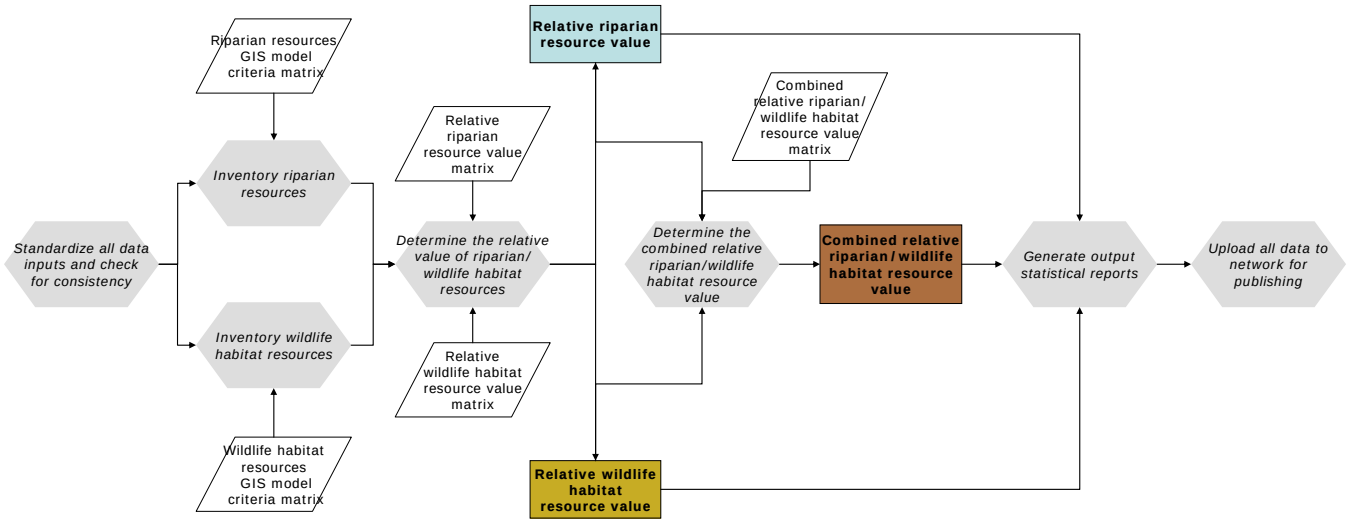


Figure 1. Overview of the Natural Resource Inventory GIS model.

The GIS models evaluate all of the areas within Portland's jurisdiction to determine if they provide significant natural resource functions. The model generates maps of riparian and wildlife habitat resources based on the presence of landscape features including streams, rivers, wetlands and other water bodies, floodplains, steep slopes, and vegetation. These features are associated with a set of riparian or wildlife habitat functions that are individually evaluated by the model.

The relative resource value (high, medium, or low) of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of riparian areas and wildlife habitat. For example, vegetated areas that are relatively close to streams and wetlands have been shown to be more valuable in terms of their ability to maintain healthy riparian function than vegetated areas farther from streams and wetlands. These areas generally receive a "high" relative riparian resource value due to their ability to provide microclimate functions (i.e., shade and temperature regulation), water quality functions (i.e., filtering of sediment and pollution), etc. Large, contiguous areas of forest close to other forested areas and water have been shown to be beneficial wildlife habitat. These areas would generally receive a “high” relative wildlife habitat resource value due to their ability to maintain species diversity, provide movement corridors for seasonal migration, etc.

Once the individual riparian functions and wildlife habitat attributes of each landscape feature are evaluated, a relative resource value is calculated based on both the number of and significance of functions provided by a given area. Each riparian and wildlife habitat resource is assigned a relative resource value of high, medium, or low.

The wildlife values are then "adjusted" for all areas within a designated *special habitat area* (SHA). Special Habitat Areas contain or support special status fish or wildlife species, sensitive/unique plant populations, wetlands, native oak, bottomland hardwood forests, riverine islands, river delta, migratory stopover habitat,

connectivity corridors, grasslands, and other unique natural features. All areas within a designated SHA receive a "high" adjusted wildlife habitat resource relative value.

The *combined relative riparian/wildlife habitat resource value* is determined by comparing the riparian and adjusted wildlife habitat relative resource value of the resources. Where mapped riparian and wildlife habitat resources overlap and the relative resource values differ, the higher of the two becomes the combined relative value for that resource area. For example, those resources with either a "high" riparian or adjusted wildlife relative resource value are assigned a high combined relative value. Of the remaining resource areas, those with a "medium" riparian or adjusted wildlife resource value are assigned a medium combined relative value. The remaining resource areas are assigned a "low" combined relative value.

riparian inventory model description

The Natural Resource Inventory riparian resources GIS model was developed by the City of Portland, Bureau of Planning, to identify riparian resources within the City of Portland jurisdiction and to assign these resources a relative rank based on the functional value that they provide. Figure 2 illustrates the general process:

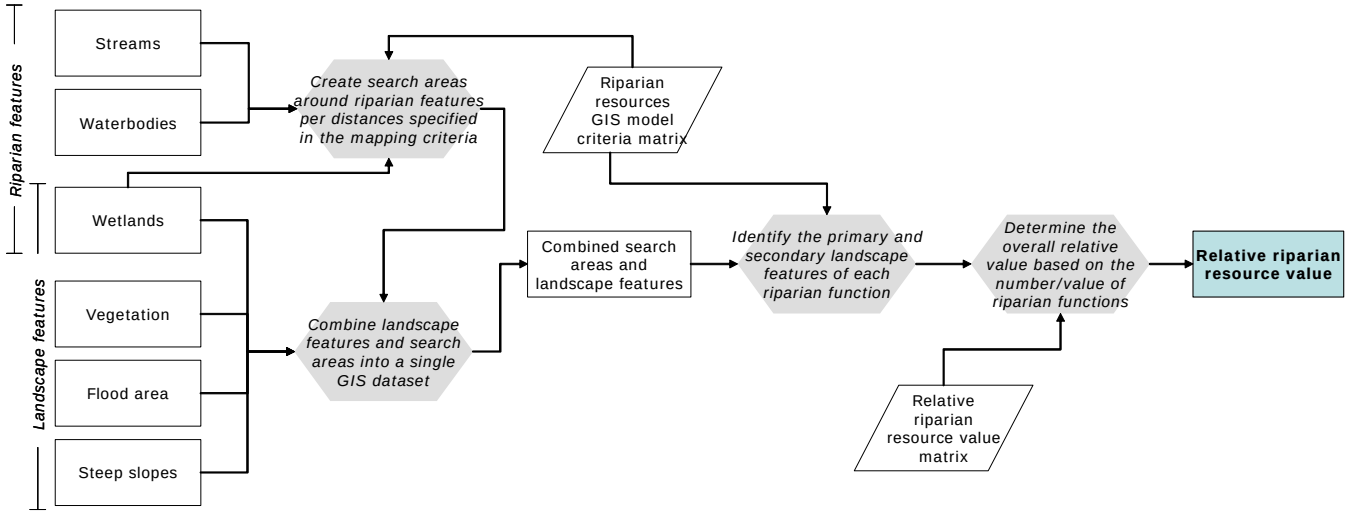


Figure 2. Overview of the Natural Resource Inventory riparian GIS model.

The riparian GIS model assigns scores to natural resources for each of the following riparian functions:

- *Microclimate and shade* – Open water bodies, wetlands, and surrounding trees and woody vegetation are associated with localized air cooling and increased humidity.
- *Bank stabilization and control of sediments, nutrients and pollutants* – Trees, vegetation, roots and leaf litter intercept precipitation, hold soils, banks and steep slopes in place, slow surface water runoff; take up nutrients, and filter sediments and pollutants found in surface water.
- *Stream flow moderation and flood storage* – Waterways and floodplains provide for conveyance and storage of streamflows and floodwaters, while trees and vegetation intercept precipitation and promote infiltration which tempers streamflow fluctuations or "flashiness" that often occurs in urban watersheds.
- *Large wood and channel dynamics* – Streams, riparian wetlands, floodplains and large trees and woody vegetation contribute to the natural changes in location and configuration of stream channels over time.
- *Organic inputs, food web and nutrient cycling* – Water bodies, wetlands and nearby vegetation provide food for aquatic species (e.g., plants, leaves, twigs, and insects) and are part of an ongoing chemical, physical and biological nutrient cycling system.

› *Wildlife habitat/corridors* – Vegetated corridors along waterways, and between waterways and uplands, allow wildlife to migrate and disperse among different habitat areas, and provide access to water.

These riparian functions occur within certain distances of rivers, streams and wetlands depending on the type and extent of the features present. The riparian corridor model assigns primary and secondary scores to landscape features depending on the types of features present and how close the feature is to a river, stream or wetland. “Primary” scores are applied to features that provide the most direct and substantial contribution to a particular riparian function. “Secondary” scores are assigned to features that provide lesser, but still important, riparian functions. Functions with one or more primary features are considered primary functions; functions with no primary features and one or more secondary features are considered secondary functions.

The relative riparian resource value of each area evaluated by the model is determined by the number of primary and secondary riparian functions in a given area. Each area is assigned a relative value of high, medium, low, or no significant value.

The inputs to the riparian inventory GIS model, the model criteria, and the results of the model are discussed in the following sections.

riparian inventory model inputs

The following natural resource feature GIS datasets are used by the riparian inventory GIS model to identify the riparian relative resource value. All of these datasets are available for viewing by street address on the *Natural Resources* maps page of www.PortlandMaps.com. You can report any errors in the datasets using an online form available on the PortlandMaps page. This GIS data is also distributed upon request. For more information, visit the *Maps* section of the Natural Resource Inventory Update project homepage at http://www.portlandonline.com/planning/ index.cfm?c=40437.

1) Rivers, streams and waterbodies

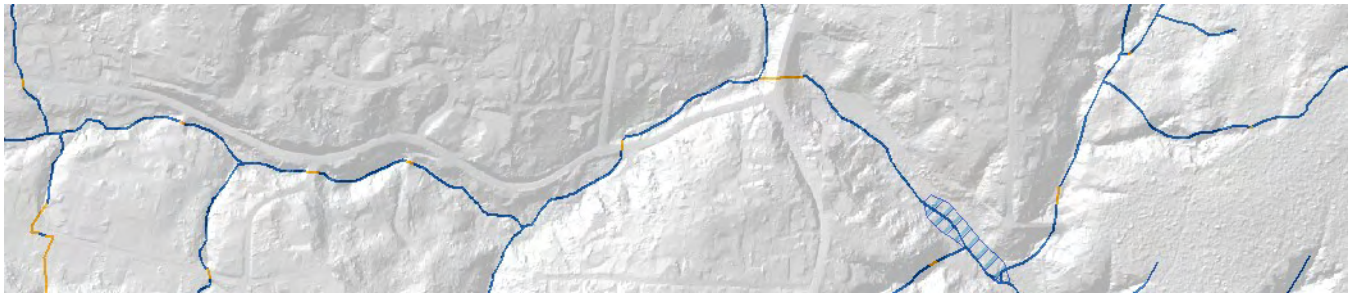
GIS data description: Mapped City of Portland stream centerlines and river and large stream waterbodies (river bank types and beaches are also mapped and used by the GIS model). Original data created by Metro. Updated by the City of Portland, Bureau of Planning, to refine stream centerline geometry, remove erroneously mapped streams, add missing stream centerlines, and route the stream dataset through the City of Portland combined sewer and stormwater network. City of Portland streams are now maintained by the Bureau of Planning. More information about the City of Portland stream mapping project can be found online at http://www.portlandonline.com/shared/cfm/image.cfm?id=106049

GIS Data Metadata: stream centerlines: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52071&Db_type=sde&City_Only= False

water bodies: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52070&Db_type=sde&City_Only= False

Riparian significance: Streams and water bodies provide critical watershed functions, including conveyance and storage of water, groundwater/surface water exchange, and nutrient cycling. These features also provide some of the most valuable habitat for fish and wildlife. Adjacent trees and other vegetation provide cover and nesting or roosting sites as well as migrating pathways for hundreds of species. Adjacent riparian vegetation helps maintain stream functions including water quality and temperature, organic inputs, and microclimate.

2) Wetlands



GIS data description: National Wetland Inventory (NWI) wetlands with revisions made by local governments in the tri-county region. Original data created by Metro. Portland wetlands are updated from an original Metro dataset by City of Portland, Bureau of Planning to refine geometry, remove erroneously mapped wetlands, and add missing wetlands.

GIS Data Metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52608&Db_type=sde &City_Only=False

Riparian significance: Wetlands provide critical watershed functions, including conveyance and storage of water, groundwater/surface water exchange, and nutrient cycling. These features also provide some of the most valuable habitat for fish and wildlife. Adjacent trees and other vegetation provide cover and nesting or roosting sites as well as migrating pathways for hundreds of species. Adjacent riparian vegetation helps maintain wetland functions including water quality and temperature, organic inputs, and microclimate.

3) Vegetation

GIS data description: Vegetation patches larger than 1/2 acre. Vegetation patches are classified as forest, woodland, shrubland, or herbaceous, and as either natural/semi-natural or cultivated. The mapping area includes all land within the City of

Portland and the unincorporated parts of Multnomah County that are administered by the City of Portland. Created and maintained by the City of Portland, Bureau of Planning. Based on information from reference data sources including aerial photos, City of Portland Parks and Recreation "natural area assessments," and vegetation surveys along the banks of the Willamette and Columbia rivers. More information about the City of Portland vegetation mapping project can be found online at http://www.portlandonline.com/shared/cfm/image.cfm?id=106047

GIS Data Metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52135&Db_type=sde&City_Only=False

Riparian significance: Vegetation provides multiple functions throughout the Portland's watersheds. Vegetation intercepts and stores rainwater, reducing and improving the quality of stormwater runoff. Trees, shrubs, and herbaceous plants provide cover, nesting, roosting, and food sources for wildlife species. Vegetation also provides important migration pathways along streams. Trees, shrubs and other tall vegetation located along streams and wetlands provide shade that helps keep riparian areas cool and moist and reduces water temperatures. When water gets too warm, salmon and other aquatic species have problems growing and reproducing, and may die. Plants next to streams and wetlands are also a source of organic material such as leaves and branches that provide food for fish and wildlife.

4) Combined flood area

GIS data description: The combination of the modified FEMA 100-year floodplain and the 1996 flood inundation area. The 100-year floodplain was originally delineated by the Federal Emergency Management Association (FEMA). Digitized by the Portland Office of the Army Corps of Engineers using by registering the flood plain maps to USGS 7.5 minute quadrangle maps. The floodplain has been modified based on local input by the City of Portland and Metro to remove areas that meet FEMA standards for removal from the floodplain. The 1996 flood inundation area was digitized by the Army Corps of Engineers using aerial photos taken during the February 1996 flood. The original Army Corps map was further

modified by Metro remove areas that were later deemed to not be part of the 1996 event.

GIS Data Metadata: modified 100-year floodplain: http://geode.metro-region.org/metadata/display.cfm?Meta_layer_id=463&Db_type=rlislite

1996 flood inundation area: http://geode.metro-region.org/metadata/display.cfm?Meta_layer_id=2056&Db_type=rlislite

Riparian significance: Flood areas provide many functions that benefit the overall health of a watershed. Flood area vegetation and wetlands act like sponges to help soak up water and reduce flood peaks during storms and keep streams flowing during dry periods. Periodic flooding also contributes to the distribution of nutrients between land and water. Undeveloped flood areas allow river and stream channels to migrate and evolve over time which helps to sustain a healthy stream ecosystem. When flood areas are developed these functions are impaired as vegetation and wetlands are replaced with fill, buildings and pavement. However, even developed flood areas can continue to provide periodic flood storage benefits.

5) Steep slopes

GIS data description: Areas with a slope equal to or greater than 25 percent (12 degrees). Slope was mathematically derived by Metro from USGS 10' contours using GIS software.

GIS Data Metadata: http://geode.metro-region.org/metadata/display.cfm?Meta_layer_id=358&Db_type=rlislite

Riparian significance: Steep slopes are common in parts of Portland, especially in the West Hills and parts of the Johnson Creek Watershed. Steep slopes provide important functions relating to watershed hydrology and microclimate. Steep slopes can also be prone to landslides and erosion which pose risks to public healthy and safety, property, and fish and wildlife. Vegetation on slopes anchors soil and helps keep sediments and pollution out of the water. The vegetation on steep

slopes also slows overland flow of water to waterways, reducing in-channel erosion.

riparian inventory model criteria

Riparian resources GIS model criteria matrix:

function	*primary features*	*secondary features*
microclimate and shade	1. river, stream or wetland; 2. forest that is contiguous to and within 100' of a river, stream or wetland; 3. forest within the flood area (except within a drainage district)	1. forest that is contiguous to primary forest vegetation and within 780' of a river, stream or wetland; 2. woodland that is contiguous to and within 100' of a river, stream or wetland; 3. woodland within the flood area (except within a drainage district); 4. shrubland that is contiguous to and within 50' of a stream or wetland
stream flow moderation and water storage	1. river, stream or wetland; 2. vegetation within the flood area (except within a drainage district)	1. forest that is contiguous to primary forest vegetation or starts within 300' of a river, stream or wetland, and is within 780' of a river, stream or wetland; 2. woodland or shrubland within 300' of a river, stream or wetland; 3. herbaceous vegetation within 100' of a river, stream or wetland; 4. where the slope is 25 percent or more, herbaceous vegetation that starts within 100' of a river, stream or wetland, and is within 200' of a river, stream or wetland; 5. non-vegetated land within the flood area (except within a drainage district)

function	*primary features*	*secondary features*
bank stability, sediment, pollution and nutrient control	1. river, stream or wetland (except Willamette River North and Central Reach); 2. land within 50' of a river, stream, or wetland (except hardened river banks in the Willamette River North and Central Reach); 3. forest, woodland or shrubland within 100' of a stream or wetland; 4. where the slope is 25 percent or more, forest, woodland or shrubland within 200' of a stream or wetland; 5. forest and natural/semi-natural woodland or shrubland within 100' of a river; 6. where the slope is 25 percent or more, forest and natural/semi-natural woodland or shrubland within 200' of a river; 7. forest, woodland or shrubland within the flood area (except within a drainage district)	1. Willamette River North and Central Reach; 2. land within 50' of a hardened river bank in the Willamette River North and Central Reach; 3. where the slope is 25 percent or more, forest, woodland or shrubland that is contiguous to primary vegetation (limited to the area of 25 percent slope); 4. herbaceous vegetation within 100' of a river, stream or wetland; 5. where the slope is 25 percent or more, herbaceous vegetation that starts within 100' of a river, stream or wetland, and is within 200' of a river, stream or wetland; 6. vegetation within the flood area (except within a drainage district)
large wood and channel dynamics	1. river, beach, or stream; 2. land within 50' of a river, stream, or wetland (except land within 50' of a river in the Willamette River North and Central Reach); 3. wetland located completely or partially within the flood area or 150' of a river or stream (except within a drainage district); 4. forest within 50' of a river in the Willamette River North and Central Reach; 5. forest that is contiguous to and within 150' of a river or stream (except within a drainage district); 6. forest that is contiguous to and within 150' of a wetland located completely or partially within the flood area or 150' of a river or stream (except within a drainage district); 7. forest within the flood area (except within a drainage district)	1. non-forest land within 50' of a river in the Willamette River North and Central Reach; 2. where the slope is 25 percent or more, forest that is contiguous to primary forest vegetation and is within 260' of a river or stream (except within a drainage district); 3. where the slope is 25 percent or more, forest that is contiguous to primary forest vegetation and within 260' of a wetland located completely or partially within the flood area or 150' of a river or stream (except within a drainage district); 4. within a drainage district, forest that is contiguous to and within 150' of a stream; 5. vegetation within the flood area (except within a drainage district)

function	*primary features*	*secondary features*
organic inputs, food web, and nutrient cycling	1. river, stream or wetland; 2. forest and natural/semi-natural woodland or shrubland within 100' of a river; 3. forest, woodland or shrubland within 100' of a stream or wetland; 4. forest and natural/semi-natural woodland or shrubland within the flood area (except within a drainage district)	1. forest, woodland or shrubland that is contiguous to primary vegetation and is within 170' of a stream or wetland; 2. forest and natural/semi-natural woodland or shrubland that is contiguous to primary vegetation and is within 170' of a river; 3. cultivated woodland or shrubland within 100' of a river; 4. cultivated woodland or shrubland within the flood area (except within a drainage district)
wildlife movement corridors	1. river, stream or wetland; 2. vegetation that is contiguous to and within 100' of a river, stream, or wetland	1. vegetation that is contiguous to primary vegetation and is within 300' of a river, stream or wetland

Relative riparian resource value:

Relative value	*number of functions*
high	4 or more primary functions
medium	1 to 3 primary functions
low	no primary functions; 1 or more secondary functions

Notes:

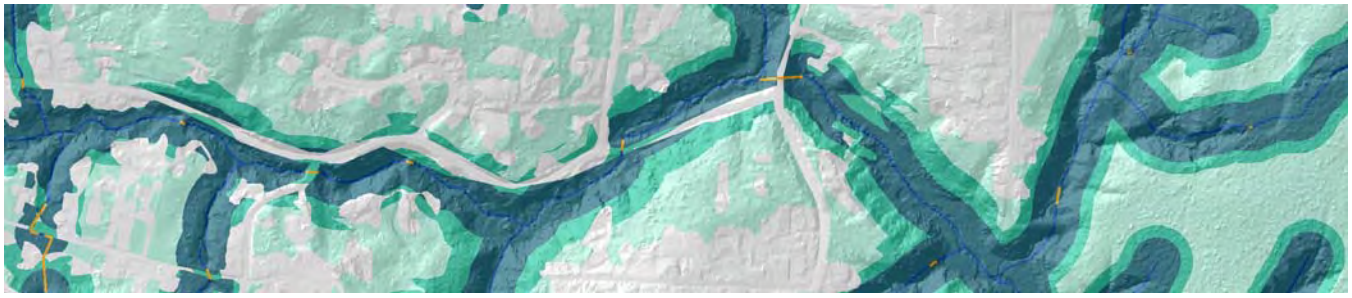
i. All river and stream search distances are measured from either a) the water line where it has been mapped from aerial photos, or b) the stream centerline where the water line has not been mapped.
ii. Pipes and culverts less than 100' in length are considered part of a stream.
iii. "Hardened banks" are defined as seawalls, pilings, and non-vegetated riprap.
iv. "Wetland" refers to all mapped City of Portland wetlands fully or partially within ¼ mile of a river or stream.
v. Vegetation contiguous to a river, stream or wetland is defined as vegetation starting within 10' of the mapped water body or wetland boundary, or within 10' of the mapped stream centerline.
vi. "Flood area" is the combined 100-year floodplain and 1996 flood inundation area. Refer to the *riparian inventory model inputs* section for more detailed information.
vii. Portland-area drainage districts: Peninsula Drainage District #1, Peninsula Drainage District #2, and Multnomah County Drainage District #1.
viii. Riparian functions with one or more primary features are considered primary functions; functions with no primary features and one or more secondary features are considered secondary functions.

riparian inventory model results

The results of the riparian inventory GIS model can be mapped by the overall relative riparian resource value or by the individual riparian functional values.

All of the riparian results are contained in a single GIS dataset – the natural resource inventory relative riparian resource values (a.k.a, the *nri_riparian_resources_pdx* shapefile). This GIS data is distributed upon request. For more information or to request the data, visit the Natural Resource Inventory Update Project website at http://www.portlandonline.com/planning/index.cfm?c=40437

1) Overall relative riparian resource value



GIS data description:

The City of Portland, Bureau of Planning, Natural Resource Inventory Update project GIS model relative riparian resource value. Relative resource values are determined by a GIS model that evaluates all of the areas within Portland's jurisdiction to determine if they provide significant riparian resource functions. The model generates maps of riparian relative resource values based on the presence of landscape features including streams, rivers, wetlands and other water bodies, floodplains, steep slopes, and vegetation. These features are associated with a set of riparian functions that are individually evaluated by the model.

The relative resource value -- high, medium, or low -- of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of riparian areas. For example, vegetated areas that are relatively close to streams and wetlands have been shown to be more valuable in terms of their ability to maintain healthy riparian function than vegetated areas farther from streams and wetlands. These areas generally receive a "high" relative riparian resource value due to their ability to provide microclimate functions (i.e., shade and temperature regulation), water quality functions (i.e., filtering of sediment and pollution), etc. An area farther from a stream or wetland would receive a lower riparian resource value because its ability to provide these same functions would be reduced.

GIS data metadata:

http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52824&Db_type=sde&City_Only=False

General mapping criteria: High value resources – areas with 3 or more primary riparian functions.

Medium value resources – areas with 1 to 2 primary riparian functions.

Low value resources – areas with no primary functions and 1 or more secondary riparian functions.

2) Individual riparian functional values

Each of the individual functions can be mapped based on the functional score. "Primary" scores are applied to features that provide the most direct and substantial contribution to a particular riparian function. "Secondary" scores are assigned to features that provide lesser, but still important, riparian functions. Functions with one or more primary features are considered primary functions; functions with no primary features and one or more secondary features are considered secondary functions.

The following maps illustrate in a very general way; darker colors represent primary functional areas, lighter colors are secondary functional areas.

Note that the generalized criteria provided in the functional descriptions below do not take into account differences in how the criteria are applied to drainage districts. Refer to the *riparian inventory model criteria* section above for more specific information about the mapping criteria for each function. For more detailed information on the scientific rationale behind the riparian mapping criteria, please refer to the Natural Resource Inventory Update Project reports at http://www.portlandonline.com/planning/index.cfm?c=40539.

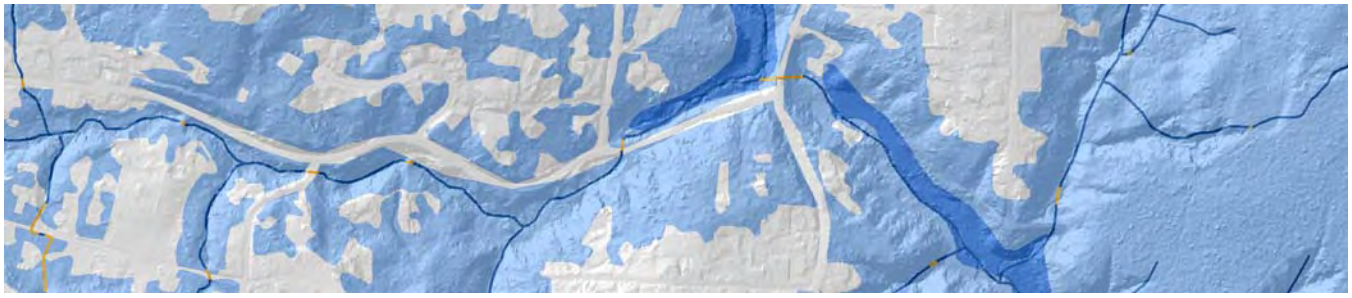
a) Microclimate and shade

Function description: The presence of vegetation and water affects air temperature, humidity, and soil moisture in riparian corridors. The shade provided by riparian vegetation also affects the temperature of water in streams and wetlands. Riparian microclimate effects directly influence ecological processes and metabolic activity. The effectiveness of riparian corridors in producing shade depends on vegetation composition, height, and density; channel width, and channel orientation relative to solar angle. Riparian tree canopy has the greatest shade impact on narrower streams channels.

General mapping criteria: Primary – river, stream and wetland features; forest or woodland vegetation in a flood area or up to 100' from a river, stream or wetland.

Secondary – contiguous forest or woodland vegetation between 100 and 780' from a river, stream or wetland; shrubland up to 50' from a river, stream or wetland.

b) Stream flow moderation and water storage

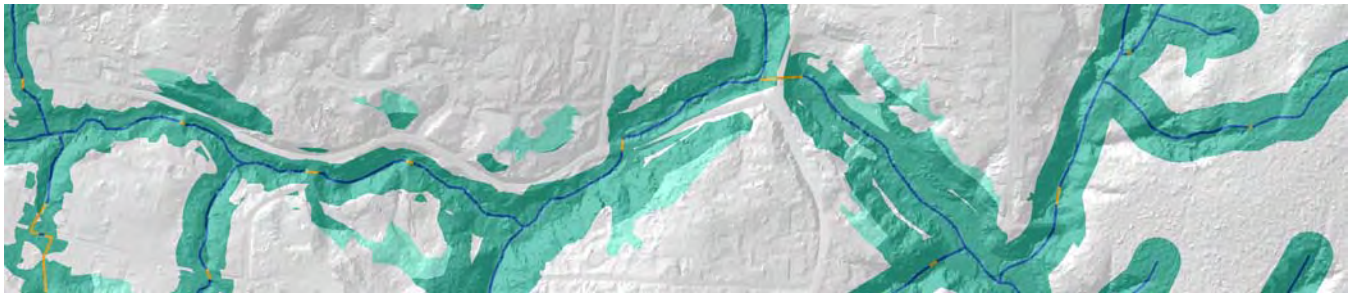


Function description: Variability in streamflow volume, rate, and velocity influences the structure, dynamics, and habitats of rivers and streams. In urbanized landscapes, increases in impervious surfaces prevent infiltration, resulting in more runoff, increased storm flows and flood flows, and decreased dry season flows. Riparian and upland vegetation helps moderate streamflows by intercepting, absorbing and storing rainfall. Plant roots increase soil porosity and help promote infiltration. These areas can also help provide cool groundwater to streams during the dry season. Floodplains and riparian wetlands provide important capacity for storage areas for flood flows. In urban areas such as Portland, floodplains have often been developed with structures and impervious surfaces. Although highly degraded, these areas still contribute to the storage of flood water, which can delay or reduce flood damage downstream.

General mapping criteria: Primary – river, stream and wetland features; vegetated flood area.

Secondary – non-vegetated flood area; contiguous forest or woodland vegetation starting within 300' and extending up to 780' from a river, stream or wetland; herbaceous vegetation up to 100' from a river, stream or wetland, or 200' where the slope is 25% or more.

c) Bank stability, sediment, pollution and nutrient control



Function description: Increased erosion and sedimentation from urbanization and disturbance can negatively impact stream functions and aquatic ecosystems. Streams of all sizes, and especially headwater streams, benefit from the regulating influence that riparian vegetation has on the amount of sediment entering aquatic habitats. The physical structure of standing riparian vegetation and large wood in the stream channel slows water, mechanically filters and stores fine silt and sediment, holds materials in place, and reduces stream channel scouring which is especially important during periods of high streamflow. Riparian vegetation can trap excess nutrients, such as nitrogen and phosphorus found in fertilizers, and pollutants such as herbicides and industrial chemicals carried in surface water. Riparian microbial processes can also help immobilize nutrients and degrade organic pollutants found in overland flows.

General mapping criteria: Primary – river, stream and wetland features; land within 50' of a river, stream or wetland; forest, woodland or shrubland within the flood area or up to 100' from a river, stream or wetland, or 200' where the slope is 25% or more.

Secondary – contiguous extent of forest, woodland or shrubland vegetation starting within 200' where the slope is 25% or more; herbaceous vegetation up to 100' from a river, stream or wetland, or within 200' where slope is 25% or more.

d) Large wood and channel dynamics

Function description: Riparian areas can contribute branches, logs, uprooted trees, and rootwads that help to form channel features and provide instream cover for fish. Large in-channel wood also controls the routing of water and sediment, dissipates stream energy, protects stream banks, stabilizes streambeds, helps retain organic matter, and acts as a surface for biological. Large wood helps form the channel in headwater streams and mid-section stream reaches. Large wood can also provide important habitat functions, such as cover for fish, in large, low-gradient rivers as well as the smaller streams.

Active floodplains and riparian wetlands also contribute to stream channel formation by providing areas for high streamflows to spread out and form new channels. These areas allow high flows to slow down and deposit sediment, which affects channel form over time.

General mapping criteria: Primary – river and streams; wetlands within 150' of a river or stream, or within the flood area; land within 50' of a river or stream; forest within the flood area or up to 150' from a river, stream or wetland within 150' of a river or stream.

Secondary – contiguous extent of forest contiguous to "primary" forest and extending up to 260' from a river or stream.

e) Organic inputs, food web, and nutrient cycling

Function description: Forest ecosystems adjacent to stream corridors provide the majority of energy and carbon sources in aquatic food. Riparian plant communities affect the quantity, quality, and timing of nutrients delivered to the stream channel that are then used by aquatic species. Deciduous and coniferous forests contribute important organic matter to Pacific Northwest stream systems. Leaves, wood, fruit, cones, insects and other types of organic matter can fall directly into the stream channel from the riparian area. Organic matter is also produced within the streams themselves. Many fish, amphibians, reptiles, birds and mammals rely on freshwater macroinvertebrates and fish eggs, fry, live adults and carcasses for food.

General mapping criteria: Primary – river, stream or wetland features; forest, woodland or shrubland within the flood area or up to 100' from a river, stream or wetland.

Secondary – contiguous extent of forest or woodland starting within 100' and extending up to 170' from a river, stream or wetland.

f) Wildlife movement corridors

Function description: In the greater Portland area, 93 percent of terrestrial vertebrate wildlife species regularly use water-associated habitats. The three main water-associated habitat types in the region are open water (rivers, lakes, and streams), herbaceous wetlands (also known as emergent wetlands), and riparian wetlands (includes conifer/hardwood corridors and forested and shrub-scrub wetlands). Each of these habitat types supports a broad array of plant and wildlife species, including a number of species at risk. Riparian vegetation surrounding these features creates a unique microclimate and provides abundant food, cover, and a link to drinking water. In addition, riparian areas provide important movement corridors for wildlife. The linear nature of a riparian corridor allows wildlife to move along and between habitat areas. Riparian corridors provide edge habitat which can promote species diversity, while also having a negative effect on species that rely on interior habitat characteristics or species vulnerable to predators moving along edge habitat.

General mapping criteria: Primary – vegetation contiguous to and no more than 100' from a river, stream or wetland.

Secondary – vegetation contiguous to "primary" vegetation and extending up to 300' from a river, stream or wetland.

wildlife habitat inventory model description

The Natural Resource Inventory wildlife habitat resources GIS model was developed by the City of Portland, Bureau of Planning, to identify wildlife habitat resources within the City of Portland jurisdiction and to assign these resources a relative rank based on the value that they provide. Figure 3 illustrates the general process:

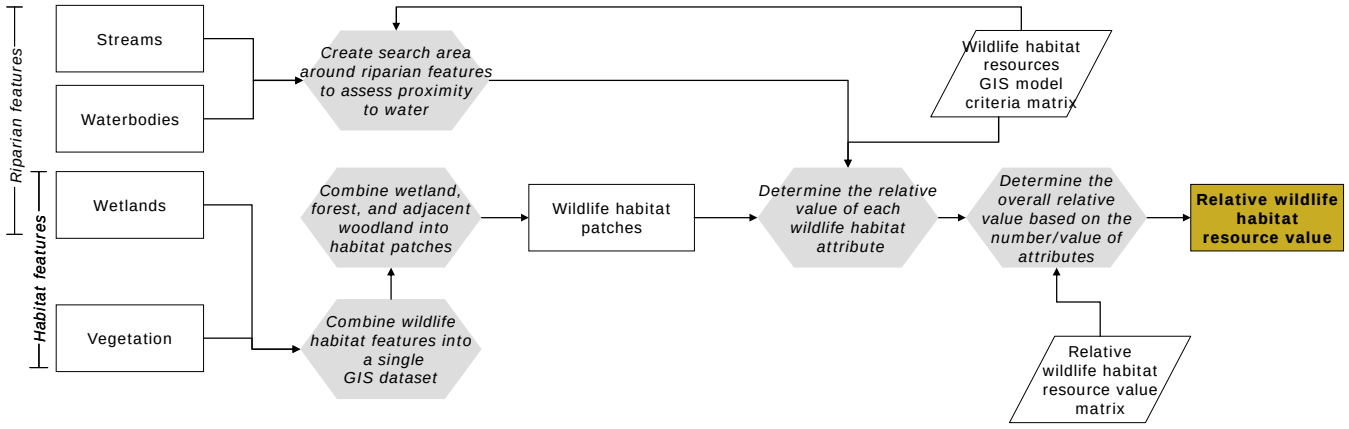


Figure 3. Overview of the Natural Resource Inventory wildlife habitat GIS model.

The wildlife habitat GIS model assigns scores to natural resources for each of the following wildlife habitat attributes:

- *Habitat patch size* – larger patches can support a larger number of individuals and a greater diversity of species, support a wildlife population for a longer time period, and provide greater opportunity for foraging and dispersal.
- *Interior habitat area* – like patch size, interior area plays a key role in maintaining the vitality and the survival of many species.
- *Connectivity between patches* – connected populations are more likely to survive over the long term. Connectivity allows populations to interbreed, maintaining genetic variability. Provides movement corridors for seasonal migration, finding better habitat, finding a mate, dispersal of post-breeding young, and escape routes.
- *Connectivity to water* – habitat patches near water resources have increased diversity of wildlife. Most wildlife species use riparian areas for some aspect of their life history. Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding. Riparian corridors frequently serve as travel routes, especially in urban areas.

A “wildlife habitat patch” is defined as an area of contiguous forest and/or wetland, and any adjacent woodland vegetation, greater than 2 acres in size. The wildlife habitat model assigns a high, medium, or low score to habitat patches depending on their relative size, shape, and connectivity based on the attributes described above.

The overall relative wildlife habitat resource value of each habitat patch is determined the number of high, medium, and low attributes for each patch. Each area is assigned a relative wildlife habitat value of high, medium, low, or no significant value.

The inputs to the wildlife habitat inventory GIS model, the model criteria, and the results of the model are discussed in the following sections.

wildlife habitat inventory model inputs

The following natural resource feature GIS datasets are used by the riparian inventory GIS model to identify the riparian relative resource value. All of these datasets are available for viewing by street address on the *Natural Resources* maps page of www.PortlandMaps.com. You can report any errors in the datasets using an online form available on the PortlandMaps page. This GIS data is also distributed upon request. For more information, visit the *Maps* section of the Natural Resource Inventory Update project homepage at http://www.portlandonline.com/planning/index.cfm?c=40437.

1) Streams and waterbodies

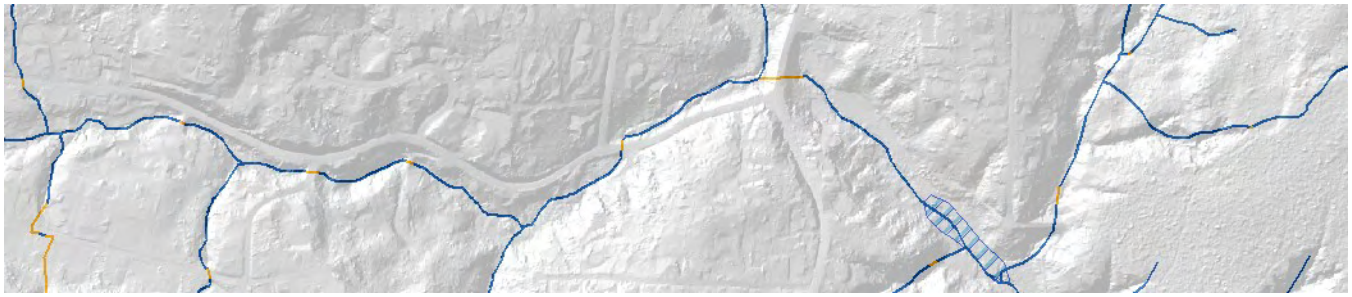
GIS data description: Mapped City of Portland stream centerlines and waterbodies (rivers and large streams). Original data created by Metro. Updated by the City of Portland, Bureau of Planning, to refine stream centerline geometry, remove erroneously mapped streams, add missing stream centerlines, and route the stream dataset through the City of Portland combined sewer and stormwater network. City of Portland streams are now maintained by the Bureau of Planning. More information about the City of Portland stream mapping project can be found online at http://www.portlandonline.com/shared/cfm/image.cfm?id=106049

GIS Data Metadata: stream centerlines: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52071&Db_type=sde&City_Only= False

water bodies: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52070&Db_type=sde&City_Only= False

Habitat significance: Habitat patches near water resources have increased diversity of wildlife. Most wildlife species use riparian areas for some aspect of their life history. Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding. Riparian corridors frequently serve as travel routes, especially in urban areas.

2) Wetlands



GIS data description: National Wetland Inventory (NWI) wetlands with revisions made by local governments in the tri-county region. Original data created by Metro. Portland wetlands are updated from an original Metro dataset by City of Portland, Bureau of Planning to refine geometry, remove erroneously mapped wetlands, and add missing wetlands.

GIS Data Metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52608&Db_type=sde &City_Only=False

Habitat significance: Wetlands support wildlife on a non-incidental basis and are a component of the habitat patches evaluated by the model. Wildlife habitat patches are defined as areas of forest vegetation and/or wetlands, at least two acres in sizes, plus adjacent woodland vegetation.

In addition, habitat patches near water resources have increased diversity of wildlife. Most wildlife species use riparian areas for some aspect of their life history. Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding. Riparian corridors frequently serve as travel routes, especially in urban areas.

3) Vegetation

GIS data description: Vegetation patches larger than 1/2 acre. Vegetation patches are classified as forest, woodland, shrubland, or herbaceous. The mapping area includes all land within the City of Portland and the unincorporated parts of Multnomah County that are administered by the City of Portland. Created and maintained by the City of Portland, Bureau of Planning. Based on information from reference data sources including aerial photos, City of Portland Parks and Recreation "natural area assessments," and vegetation surveys along the banks of the Willamette and Columbia rivers. More information about the City of Portland vegetation mapping project can be found online at http://www.portlandonline.com/shared/cfm/image.cfm?id=106047

GIS Data Metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52135&Db_type=sde&City_Only=False

Habitat significance: Vegetation patches support wildlife on a non-incidental basis and are a component of the habitat patches evaluated by the model. Wildlife habitat patches are defined as areas of forest vegetation and/or wetlands, at least two acres in sizes, plus adjacent woodland vegetation.

wildlife habitat inventory model criteria

Wildlife habitat resources GIS model criteria matrix:

Habitat metric		*high value (3 points)*		*medium value (2 points)*		*low value (1 point)*
habitat patch size	>	forest/wetland/woodland habitat patches containing 585 or more acres of forest or wetland	>	forest/wetland/woodland habitat patches containing 30 to 585 acres of forest or wetland	>	forest/wetland/woodland habitat patches larger than 2 acres containing less than 30 acres of forest or wetland
interior habitat area	>	forest/wetland/woodland habitat patches containing 500 or more acres of forest or wetland interior area	>	forest/wetland/woodland habitat patches containing 15 to 500 acres of forest or wetland interior area	>	forest/wetland/woodland habitat patches containing 2 to 15 acres of forest or wetland interior area
connectivity to other patches	>	forest/wetland/woodland habitat patches larger than 2 acres with a proximity value of 100 or more	>	forest/wetland/woodland habitat patches larger than 2 acres with a proximity value between 30 and 100	>	forest/wetland/woodland habitat patches larger than 2 acres with a proximity value of less than 30
connectivity to water	>	forest/wetland/woodland habitat patches larger than 2 acres where 75% or more of the patch is within 300' of a river, stream or wetland	>	forest/wetland/woodland habitat patches larger than 2 acres where 25% to 75% of the patch is within 300' of a river, stream or wetland	>	forest/wetland/woodland habitat patches larger than 2 acres where less than 25% of the patch is within 300' of a river, stream or wetland

Relative wildlife habitat resource value:

relative value	*total score*
high	9 or more points
medium	5 to 8 points
low	4 or less points

Notes:

i. Forest/wetland/woodland wildlife habitat patches refers to contiguous areas of forested vegetation, any wetland within or adjacent to the forested area, and any contiguous areas of woodland vegetation that is within or adjacent to the forested area.

ii. Interior area is defined as the portion of a vegetation patch that is not within 200' of the habitat patch edge (the habitat patch net a 200' internal "buffer").

iii. Proximity to other patches is calculated using the Fragstats 3.3 proximity index (PROX). The specified search radius is ¼ mile. The proximity index is a dimensionless measure of the relative size and distance of all patches whose edges are within the specified search radius of each vegetation patch. Refer to http://www.umass.edu/landeco/research/fragstats/fragstats.html for more information on Fragstats and the proximity index. The proximity index values were divided by 100,000 to make the numbers more manageable (e.g., a proximity index of 100,000 would have an adjusted proximity value of 100). The proximity value relative value thresholds were determined by identifying "natural breaks" in the distribution of the values using the Jenk's Natural Breaks method, which determines the best arrangement of values into a specified number of classes by comparing and minimizing the sum of the squared differences of values from the means of potential classes.

iv. Proximity to water relative value thresholds were determined by identifying "natural breaks" in the distribution of the values using the Jenk's Natural Breaks method, which determines the best arrangement of values into a specified number of classes by comparing and minimizing the sum of the squared differences of values from the means of potential classes.

wildlife habitat inventory model results

The results of the wildlife habitat inventory GIS model can be mapped by the overall relative wildlife habitat resource value or by the relative value of the individual wildlife habitat patch attributes.

All of the wildlife habitat model results are contained in a single GIS dataset – the natural resource inventory relative wildlife habitat resource values (a.k.a, the *nri_wildlife_resources_pdx* shapefile). This GIS data is distributed upon request. For more information or to request the data, visit the Natural Resource Inventory Update Project website at http://www.portlandonline.com/planning/index.cfm?c=40437

1) Overall relative wildlife habitat resource value

GIS data description: The City of Portland, Bureau of Planning, Natural Resource Inventory Update project GIS model relative wildlife habitat resource value. Relative resource values are determined by a GIS model that generates maps of wildlife habitat relative resource values based on the size, shape, and connectivity of wildlife habitat patches within the City of Portland jurisdiction. Wildlife habitat patches are defined as areas of forest vegetation and/or wetlands, at least two acres in sizes, plus adjacent woodland vegetation.

The relative resource value -- high, medium, or low -- of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of wildlife habitat. For example, large habitat patches have been shown to be more valuable in terms of their ability to support a larger number of individuals and a greater diversity of species. Areas receiving a "high" relative wildlife habitat resource value are generally larger, less narrow, closer to other patches, and closer to water than habitat patches receiving medium or low values.

GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52826&Db_type=sde&City_Only=False

General mapping criteria: High value resources – areas with a wildlife habitat patch score of 9 or more.

Medium value resources – areas with a wildlife habitat patch score of 5 to 8.

Low value resources – areas with a wildlife habitat patch score of 4 or less.

2) Individual wildlife habitat patch attribute values

Each of the individual habitat patch attributes can be mapped based on the attribute value (high, medium, or low). The following maps illustrate in a very general way; darker colors represent high value areas, lighter colors are medium value areas, with the lightest colors representing low value wildlife habitat attribute areas.

Refer to the *wildlife habitat inventory model criteria* section above for more specific information about the mapping criteria for each function. For information on the scientific rational behind the wildlife habitat mapping criteria, please refer to the Natural Resource Inventory Update Project Report at http://www.portlandonline.com/planning/index.cfm?c=40539.

a) Habitat patch size

Attribute description: The size of the patch in acres. Larger patches can support a larger number of individuals and a greater diversity of species, support a wildlife population for a longer time period, and provide greater opportunity for foraging and dispersal.

Mapping methodology: The acreage of the habitat patch is derived from the square footage of the patch as determined by the GIS software.

General mapping criteria: High value – wildlife habitat patches with 585 or more acres of forest or wetland.

Medium value – wildlife habitat patches with 30 to 585 acres of forest or wetland.

Low value – wildlife habitat patches with 30 acres or less of forest or wetland.

b) Interior habitat area

Attribute description: The interior area of the patch in acres. Like patch size, interior area plays a key role in maintaining the vitality and the survival of many species.

Mapping methodology: Interior area is defined as the portion of a vegetation patch that is not within 200' of the habitat patch edge (the habitat patch net a 200' internal buffer). The acreage is derived from the square footage of the interior area of the patch as determined by the GIS software

General mapping criteria: High value – wildlife habitat patches containing 500 or more acres of forest or wetland interior area.

Medium value – wildlife habitat patches containing 15 to 500 acres of forest or wetland interior area.

Low value – wildlife habitat patches containing less than 15 acres of forest or wetland interior area.

c) Connectivity to other patches

Attribute description: The relative proximity of the wildlife habitat patch to all other patches. Connected habitat patches support wildlife populations are more likely to

survive over the long term. Allows populations to interbreed, maintaining genetic variability. Provides movement corridors for seasonal migration, finding better habitat, finding a mate, dispersal of post-breeding young, and escape routes.

Mapping methodology: Proximity to other patches is calculated using the Fragstats 3.3 proximity index (PROX) using a search radius of ¼ mile. The proximity index is a dimensionless measure of the relative size and distance of all patches whose edges are within the specified search radius of each vegetation patch. Refer to http://www.umass.edu/landeco/research/ fragstats/fragstats.html for more information on Fragstats and the proximity index. Note that the proximity index values were divided by 100,000 to make the numbers more manageable (e.g., a proximity index of 100,000 would have an adjusted proximity value of 100).

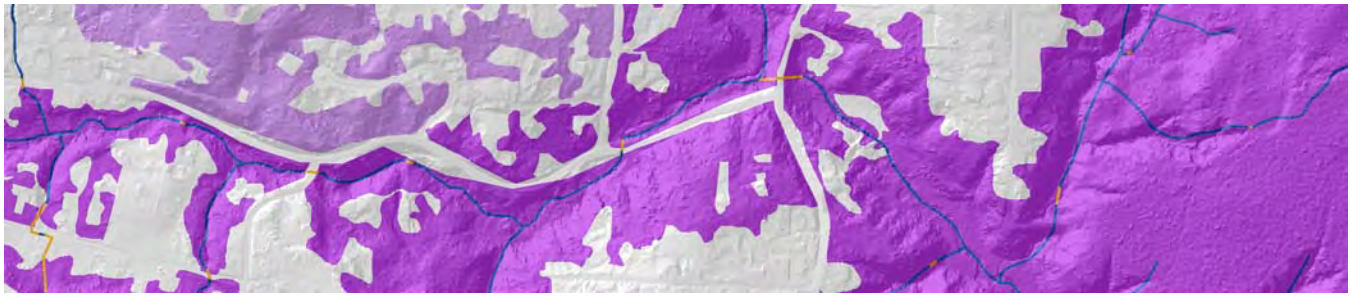
The proximity value relative value thresholds were determined by identifying "natural breaks" in the distribution of the values using the Jenk's Natural Breaks method, which determines the best arrangement of values into a specified number of classes by comparing and minimizing the sum of the squared differences of values from the means of potential classes. For more information, refer to http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=26442.

General mapping criteria: High value – wildlife habitat patches with an adjusted proximity value of 100 or more.

Medium value – wildlife habitat patches with an adjusted proximity value of between 30 and 100.

Low value – wildlife habitat patches with an adjusted proximity value of less than 30.

d) Connectivity to water



Attribute description: The relative proximity of the wildlife habitat patch to water sources (rivers, streams and wetlands). Habitat patches near water resources have increased diversity of wildlife. Most wildlife species use riparian areas for some aspect of their life history. Over 60 percent of mammals in the Northwest use riparian areas for breeding or feeding. Riparian corridors frequently serve as travel routes, especially in urban areas.

Mapping methodology: Proximity to other water is calculated as the percentage of each wildlife habitat patch that is within 300' of a river, stream or wetland.

Proximity to water relative value thresholds were determined by identifying "natural breaks" in the distribution of the values using the Jenk's Natural Breaks method, which determines the best arrangement of values into a specified number of classes by comparing and minimizing the sum of the squared differences of values from the means of potential classes. For more information, refer to http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=26442.

General mapping criteria: High value – wildlife habitat patches where 75% or more of the patch is within 300' or a river, stream or wetland.

Medium value – wildlife habitat patches where 25% to 75% of the patch is within 300' or a river, stream or wetland.

Low value – wildlife habitat patches where less than 25% of the patch is within 300' or a river, stream or wetland.

combined riparian / wildlife habitat inventory model description

The Natural Resource Inventory combined riparian/wildlife habitat resources GIS model was developed by the City of Portland, Bureau of Planning, to identify riparian and wildlife habitat natural resources within the City of Portland jurisdiction and to assign these resources a relative rank based on the value that they provide. Figure 4 illustrates the general process:

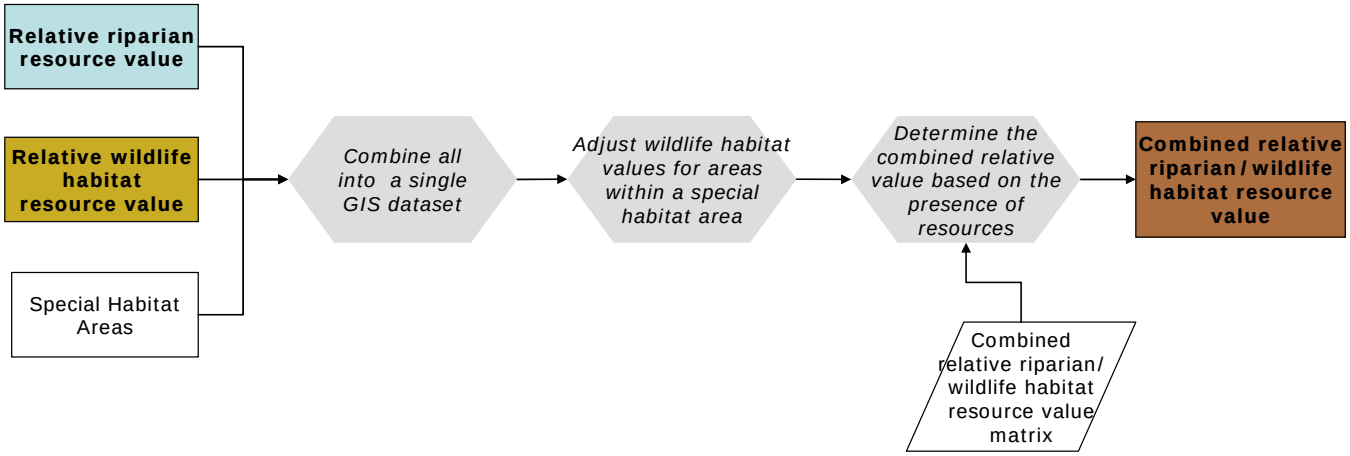


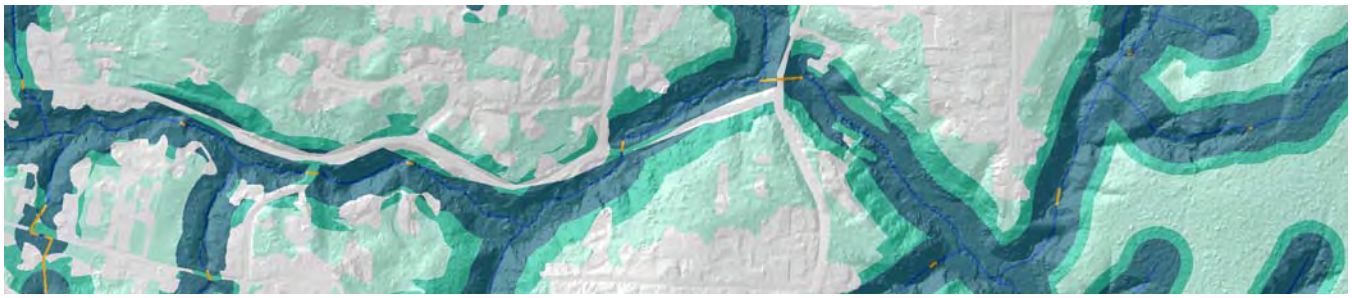
Figure 4. Overview of the Natural Resource Inventory combined riparian/wildlife habitat GIS model.

The inputs to the combined riparian/wildlife habitat inventory GIS model, the model criteria, and the results of the model are discussed in the following sections.

combined riparian / wildlife habitat inventory model inputs

The following natural resource value GIS datasets are used by the combined inventory GIS model to identify the riparian/wildlife habitat relative resource value. This GIS data is distributed upon request. For more information, visit the *Maps* section of the Natural Resource Inventory Update project homepage at http://www.portlandonline.com/planning/index.cfm?c=40437.

1) Relative riparian resource value



GIS data description:

The City of Portland, Bureau of Planning, Natural Resource Inventory Update project GIS model relative riparian resource value.
Relative resource values are determined by a GIS model that evaluates all of the areas within Portland's jurisdiction to determine if they provide significant riparian resource functions. The model generates maps of riparian relative resource values based on the presence of landscape features including streams, rivers, wetlands and other water bodies, floodplains, steep slopes, and vegetation. These features are associated with a set of riparian functions that are individually evaluated by the model.

The relative resource value -- high, medium, or low -- of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of riparian areas. For example, vegetated areas that are relatively close to streams and wetlands have been shown to be more valuable in terms of their ability to maintain healthy riparian function than vegetated areas farther from streams and wetlands. These areas generally receive a "high" relative riparian resource value due to their ability to provide microclimate functions (i.e., shade and temperature regulation), water quality functions (i.e., filtering of sediment and pollution), etc. An area farther from a stream or wetland would receive a lower riparian resource value because its ability to provide these same functions would be reduced.

GIS Data Metadata:

http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52824&Db_type=sde&City_Only=False

2) Relative wildlife habitat resource value

GIS data description: The City of Portland, Bureau of Planning, Natural Resource Inventory Update project GIS model relative wildlife habitat resource value.
Relative resource values are determined by a GIS model that generates maps of wildlife habitat relative resource values based on the size, shape, and connectivity of wildlife habitat patches within the City of Portland jurisdiction. Wildlife habitat patches are defined as areas of forest vegetation and/or wetlands, at least two acres in sizes, plus adjacent woodland vegetation.

The relative resource value -- high, medium, or low -- of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of wildlife habitat. For example, large habitat patches have been shown to be more valuable in terms of their ability to support a larger number of individuals and a greater diversity of species. Areas receiving a "high" relative wildlife habitat resource value are generally larger, less narrow, closer to other patches, and closer to water than habitat patches receiving medium or low values.

GIS Data Metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52826&Db_type=sde&City_Only=False

3) Special Habitat Areas (SHAs)

GIS data description:

The City of Portland, Bureau of Planning, Natural Resource Inventory Update project Special Habitat Areas (SHAs). Special Habitat Areas are the updated equivalents of the Portland-area Habitats of Concern that Metro designated for the regional inventory. Special Habitat Areas contain or support special status fish or wildlife species, sensitive/unique plant populations, wetlands, native oak, bottomland hardwood forests, riverine islands, river delta, migratory stopover habitat, connectivity corridors, grasslands, and other unique natural features. The name "Special Habitat Area" was chosen in order to focus on the unique or unusual habitat features and functions, and to avoid implying that all these areas have been officially deemed at-risk by state or federal regulatory agencies.

The Bureau of Planning worked closely with the Bureau of Environmental Services and Portland Parks and Recreation to update and hone the descriptions and boundaries for the Special Habitat Areas. The Special Habitat Areas (SHA) boundaries generally follow the adopted regional Habitat of Concern (HOC) boundaries. However, the boundaries have been updated to reflect more detailed analysis of resource location, incorporate new stream or vegetation information, consider information from more recent studies, and to improve mapping consistency.

GIS Data Metadata:

http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52825&Db_type=sde&City_Only=False

combined riparian / wildlife habitat inventory model criteria

Combined riparian/wildlife habitat resources GIS model criteria matrix:

combined relative value	*criteria*
high	"high" relative riparian resource value OR "high" relative wildlife habitat resource value OR area is within a "Special Habitat Area" (areas with a "high" adjusted relative wildlife habitat resource value)
medium	"medium" relative riparian resource value OR "medium" relative wildlife habitat resource value
low	"low" relative riparian resource value OR "low" relative wildlife habitat resource value

combined riparian / wildlife habitat inventory model results

The results of the combined riparian/wildlife habitat inventory GIS model are contained in a single GIS dataset – the natural resource inventory combined relative riparian/wildlife habitat resource values (a.k.a, the *nri_combined_resources_pdx* shapefile). This GIS data is distributed upon request. For more information or to request the data, visit the Natural Resource Inventory Update Project website at http://www.portlandonline.com/planning/index.cfm?c=40437

1) Combined relative riparian / wildlife habitat resource value

GIS data description:

The City of Portland, Bureau of Planning, Natural Resource Inventory Update project GIS model combined relative riparian and wildlife habitat resource value. Combined relative resource values are determined by a GIS model that evaluates all of the areas within Portland's jurisdiction to determine if they provide significant natural resource functions. The model generates maps of riparian and wildlife habitat resources based on the presence of landscape features including streams, rivers, wetlands and other water bodies, floodplains, steep slopes, and vegetation. These features are associated with a set of riparian or wildlife habitat functions that are individually evaluated by the model.

The relative resource value (high, medium, or low) of the resources is determined using a set of criteria developed from scientific studies and articles describing the role and function of riparian areas and wildlife habitat. For example, vegetated areas that are relatively close to streams and wetlands have been shown to be more valuable in terms of their ability to maintain healthy riparian function than vegetated areas farther from streams and wetlands. These areas generally receive a "high" riparian relative resource value due to their ability to provide microclimate functions (i.e., shade and temperature regulation), water quality functions (i.e., filtering of sediment and pollution), etc. An area farther from a stream or wetland would receive a lower riparian resource value because its ability to provide these same functions would be reduced.

Once each of the individual riparian and wildlife habitat functions of each resource are evaluated, a relative resource value is calculated based on both

the number of and significance of functions provided by a given area. Each riparian and wildlife habitat resource is assigned a relative resource value of high, medium, or low.

The wildlife values are then "adjusted" for all areas within a designated "special habitat area" (SHA). All areas within a designated SHA receive a "high" adjusted wildlife habitat resource relative value.

The combined relative resource value is determined by comparing the riparian and adjusted wildlife habitat relative resource value of the resources. Where mapped riparian and wildlife habitat resources overlap and the relative resource values differ, the higher of the two becomes the combined relative value for that resource area. For example, those resources with either a "high" riparian or adjusted wildlife relative resource value are assigned a high combined relative value. Of the remaining resource areas, those with a "medium" riparian or adjusted wildlife resource value are assigned a medium combined relative value. The remaining resource areas are assigned a "low" combined relative value.

GIS data metadata: http://www.portlandonline.com/cgis/metadata/viewer/display.cfm?Meta_layer_id=52823&Db_type=sde&City_Only=False

General mapping criteria: High value resources – resources with either a high relative riparian resource value, a high relative wildlife habitat resource value, or areas within a designated special habitat area (areas with a high adjusted relative wildlife habitat resource value).

Medium value resources – resources not ranking high with either a medium relative riparian resource value or a medium relative wildlife habitat resource value.

Low value resources – resources not ranking medium or high with either a low relative riparian resource value or a low relative wildlife habitat resource value.

inventory model contacts

For more information about the City of Portland Natural Resource Inventory Update project GIS model, please contact:

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