

At Risk 2012

The Bay Area Greenbelt

METHODOLOGY

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FEEDBACK / QUESTIONS?

Please direct questions and comments regarding At Risk and the Greenbelt Mapper to the following web address: <http://www.greenbelt.org/greenbelt-mapper/feedback/>

INTRODUCTION

The greenbelt lands surrounding the Bay Area provide the region much of its vitality and identity. The At Risk report seeks to evaluate the 3.6 million acres of open space land surrounding San Francisco Bay Area cities.

The At Risk analysis evaluates three main stories from these lands. Development pressure factors on open space surrounding the region's cities, policy protection measures to protect the land and open space values interweave to tell the story of these greenbelt lands. For the first time, this research measures the cumulative strength of open space policy protection measures, which when compared against development pressure factors provides the At Risk measurement or likelihood of urban development. This assessment measures lands as high risk of urban development in 10 years, medium risk in 20 to 30 years, or low risk as 30 years or more until the land is developed. Additionally, the project shows where vital lands provide clean water, food and wildlife habitat supporting healthy ecosystems based upon best available research.

These layers are made available online for both viewing and download at the Greenbelt Mapper (<http://www.greenbelt.org/greenbelt-mapper/>).

STUDY AREA

The At Risk analysis focuses on San Francisco Bay Area greenbelt lands outside of the continuous urbanized areas, defined by 1 home per 1½ acres in accordance with the California Department of Conservation. The 2012 results focus on the 8 counties, not including San Francisco County, that have remaining greenbelt opens spaces at risk of development. The policy protection analysis limited the review of cities to only those adjacent to large tracts of unprotected open space that exist at some level of risk; cities bordered by other jurisdictions or protected lands with no place to expand were excluded.

METHODS

To understand the story of the landscape around the Bay Area's urban areas, Greenbelt Alliance collected and processed information on development pressure factors, policy protection measures and open space values. In order to derive the final At Risk results, a weighted GIS model was used to directly compare the threat of urban development against the policy measures intended to preserve and protect the landscape. The results of this model help to describe the likelihood of urban development across the wild places and cultivated lands that surround the developed footprint of the Bay Area's cities and towns, the greenbelt. This methodology could be further enhanced by improved measuring of planning timelines of cities, development projects and land protection



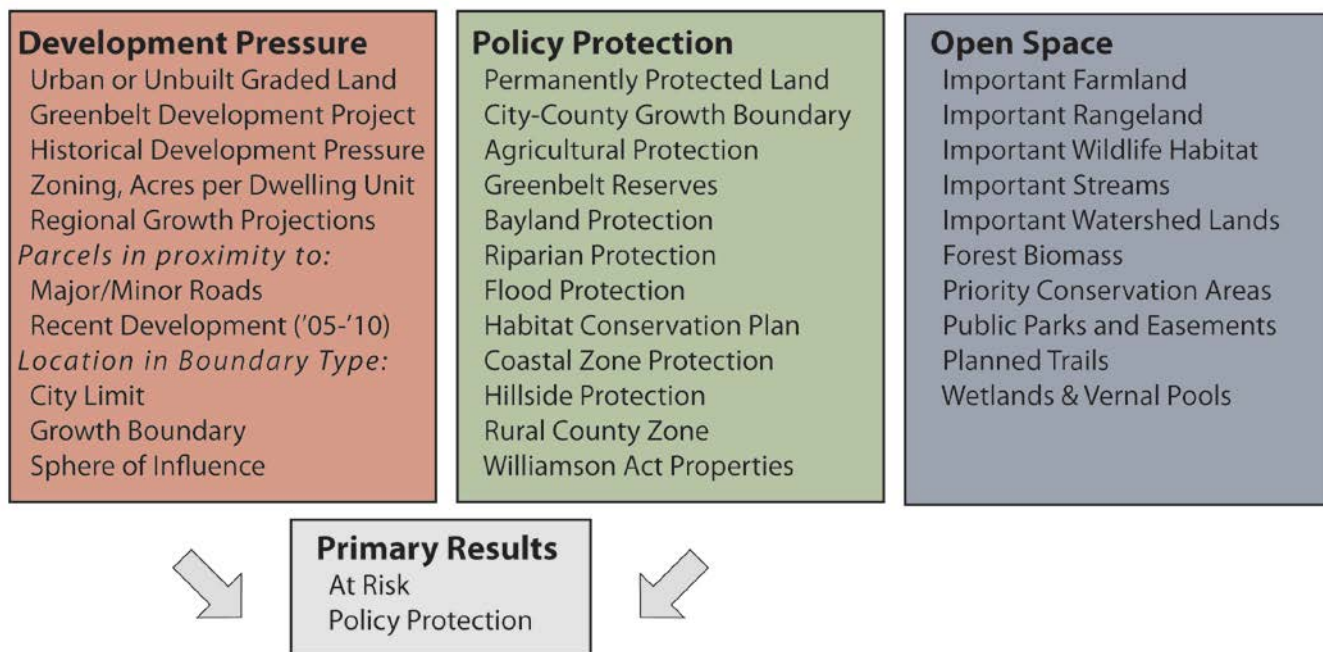
contracts. Please send a request from the Greenbelt Mapper feedback for more detailed technical explanation of these methods.

Software Requirements

In order to process the complete set of At Risk data layers, ArcGIS version 9.3 or higher and the Spatial Analyst extension are required.

Data Sources

These tables list the data layers used in each section. Following the tables are descriptions of each layer. The Risk Evaluation section lists the relative weight of each of these factors.



Development Pressure Factors

Urban or Unbuilt Graded Land

Urban development is recognized as land with more than 1 home or more on a one and a half acre lot according to the California Department of Conservation. This information from their Farmland Mapping and Monitoring Program is used as the basis for the urban footprint of the Bay Area from the 2010 release for all counties except Sonoma County which is from 2008. This urban footprint includes lands that have been graded and prepared for development, but have no buildings constructed yet. These additions were tracked by an aerial analysis.

Greenbelt Development Project

Development proposals and approved projects in the entitlement process of a city or county lying outside of San Francisco Bay Area's contiguous urbanized lands. This information was collected through field interviews by field representatives, updating past At Risk research and jurisdictional county websites that list current development proposals. To facilitate this collection of spatial data, an online mapping tool was designed to generate shapefiles based on research and interviews conducted by

Greenbelt Alliance staff and interns. This mapping tool allowed researchers to draw the area of a specific development proposal and include planning relevant information.

Greenbelt Development Project - Developer Speculation

Lands under consideration for development outside the Bay Area's contiguous urbanized lands, though no official planning proposal has been submitted to a jurisdiction's planning department. This includes a project that was recently proposed in the last five years on greenbelt lands but has since been rescinded from the entitlement process. This data was collected through field interviews by field representatives, updating past At Risk research and using the online mapping tool to generate shapefiles of areas under development speculation.

Historical Development Pressure

Areas consistently identified at High and Medium Risk over the previous three At Risk reports from 1996, 2000 and 2006 are considered to have historical development pressure. Isolated areas below ½ acre were removed from the inventory to show larger parcels and remove slivers.

Zoning

A Bay Area-wide parcel map from 2011 combined with county zoning designations provides an interpretation of how many homes are allowed to be built per acre. County zoning data current through January 2012 was compiled by Greenbelt Alliance staff and interpreted using minimum parcel size and dwelling units per acre to determine consistent measurement of potential levels of development across the Bay Area. Urbanized lands are considered properties with greater density than one house per one and half acres in accordance with the California's Farmland Monitoring and Mapping Program (FMMP) designations. Larger rural ranchette properties could potentially allow up to one home per 1.6-30 acres, while the largest rural estates would allow one home per 31-200 acres.

Regional Growth Projections

The Association of Bay Area Government's Projections for 2009 show existing and projected populations through 2035 by traffic analysis zones, approximate in size to census tracts. To calculate the projected housing growth in a TAZ, parks and easements from California's Protected Areas Database were removed from the corresponding area of each TAZ. The remaining TAZ area was calculated for its projected housing units in 2035 divided by its recalculated acreage, providing projected housing density. Urbanized lands are considered properties with greater density than one house per one and half acres in accordance with the California's Farmland Monitoring and Mapping Program (FMMP) designations. Larger rural ranchette properties could potentially allow up to one home per 1.6-30 acres, while the largest rural estates would allow one home per 31-200 acres.

Parcels in Proximity to Major/Minor Roads and Recent Development (2005 – 2010)

Parcels in close proximity to major roads are much more likely to be developed through their accessibility to local resources. Minor roads are also somewhat more likely to develop. Parcels within a ¼ mile of major roads and 1/8 mile from minor roads were assigned a lower development pressure score relative to actual proposed developments. Additionally, parcels within ¼ mile of recent urban development occurring between 2005 and 2010 based on the FMMP data were assigned a relatively low development pressure score from their potential to urbanize and proximity to resources.

Growth Boundary

A planning boundary of a city and/or county defining where urban growth can and cannot occur. Lands outside a growth boundary are considered to have declining pressure but lands inside a growth boundary

are considered priority for development by policy. Data compiled by Greenbelt Alliance staff and interns based upon current general plan maps and local agency formation commission maps from March 2012.

City Limits

A city's boundary that defines where urban services and utilities are provided. Data compiled by Greenbelt Alliance staff and interns based upon general plan maps and local agency formation commission maps from March 2012.

Sphere of Influence

A city's boundary that defines the future area of a local agency's probable physical boundaries that is regulated by local agency formation commissions. Data compiled by Greenbelt Alliance staff and interns based upon general plan maps and local agency formation commission maps from March 2012.

Policy Protection Measures

Permanently Protected Land

San Francisco Bay Area lands identified in the California Protected Areas Database (<http://www.calands.org/>) in January 2012, including areas permanently protected from development, including most publicly owned lands, land trust properties, and conservation easements.

Agricultural Protection – Voter Approved

Agriculturally-zoned parcels identified as important for protection from urban development and protected by a vote of the people from Napa County's Measure J and Solano County's Orderly Growth Initiative. Napa County includes Watershed designated lands falling under Measure J's protection. A proposed change in zoning to the agricultural designation or non-conforming use of the land must be approved by a vote of the people in the county. Data compiled by Greenbelt Alliance staff and interns in February 2012 based upon counties' general plan, zoning map and 2011 parcel boundaries from Association of Bay Area Governments' shapefile.

City-County Growth Boundary – Voter Approved

Voter-approved agreements for coterminous urban growth boundaries shared by a county and the cities offer a high degree of protection by restricting urban growth to inside the boundary. In other cases where only cities have urban growth boundary, a county may still allow urban development on lands that fall within their county jurisdiction. The Bay Area has two voter-approved shared city-county growth boundaries in Contra Costa County and East Alameda County.

Coastal Zone Protections

The Coastal Zone is the area under regulatory control by coastal management agencies over all federal activities and federally licensed activities that affect coastal resources. The shapefile was acquired in December 2011 and is available by request through the Caltrans GIS data library (<http://www.dot.ca.gov/hq/tsip/gis/datalibrary/gisdatalibrary.html>). This policy could be further enhanced by mapping the Appeal Jurisdiction area which covers land located between the sea and the nearest through public road, land located within 300 feet of a beach, high-tide line or coastal bluff top or within 100 feet of any stream, estuary or wetland in the Coastal Zone.

Baylands Protection

Areas identified as important for protection and conservation falling under the jurisdiction of the Bay Conservation and Development Commission (BCDC). The Commission holds authority over development projects falling within the San Francisco Bay, including Suisun, San Pablo, Honker, Richardson, San Rafael, San Leandro and Grizzly Bays and the Carquinez Strait, certain waterways that flow into the Bay, certain salt ponds or managed wetlands around the Bay, a shoreline band jurisdiction which extends 100 feet inland from the Bay, and the Suisun Marsh. Data compiled by Greenbelt Alliance staff in March 2012 based upon plan maps and jurisdictional coverage description available through San Francisco Bay Plan website (http://www.bcdc.ca.gov/laws_plans/plans/sfbay_plan#5).

Hillside Protection

Hillside areas identified as important for protection or conservation based on city and county general plans. Policies mapped include areas based upon their physical characteristics from a digital elevation model (DEM), including the slope of a hill, the area of a hill above a certain elevation, and the area within a certain vertical or horizontal distance from a ridge line. The slope is calculated using the Slope tool in spatial analyst and selecting those areas that meet the general plan's protected slope percent rise. The protected elevation area is selected above the lowest limit of the defined elevation. Horizontal distance from the ridge is calculated using the Buffer tool, while vertical distance from a ridge is calculated from a raster with elevation data of the vertical drop relative to the height of the closest point on the ridgeline. Data compiled by Greenbelt Alliance staff and interns through March 2012, and processed with assistance from GreenInfo Network and based upon general plan policies, as well as city and county-provided data.

Greenbelt Reserves

Large open space reserves that are set aside permanently or temporarily by a single or among several jurisdictions. Data compiled by Greenbelt Alliance staff and interns based upon general plan maps.

Critical Habitat

Areas identified as essential for the conservation of a threatened or endangered species under the Federal Endangered Species Act that may require special management and protection. These areas are updated from January 2012 data and are available for download from U.S. Fish and Wildlife Service Critical Habitat Portal (<http://criticalhabitat.fws.gov/crithab/>).

Habitat Conservation Plan

Areas identified as important for protection and conservation in the Bay Area's Habitat Conservation Plans (HCP). These areas do not necessarily show the entire HCP boundary, but rather those areas designated for limited or prohibited development. Data compiled by Greenbelt Alliance staff and interns through April 2012 based upon interviews, HCP documents, and HCP-provided shapefiles.

Williamson Act Properties

Williamson Act properties are enrolled in a state program providing relief of property tax to owners of farmland and open-space land in exchange for a ten-year agreement that the land will not be developed or otherwise converted to another use. Data was downloaded from California's Department of Conservation FTP site that includes properties enrolled in 2009 for all Bay Area

counties except San Mateo which is from 2006.

(<ftp://ftp.consrv.ca.gov/pub/dlrp/WA/WA%20GIS%20to%202009/shapefile/>)

Flood Plain Protection

Flood plain areas identified as subject to flooding where development is prohibited. In limited cases, some development may be allowed with a special permit. Data compiled by Greenbelt Alliance staff and interns in February 2012 based upon general plans and 100 year storm flood level from the U.S. Federal Emergency Management Agency.

Riparian Protection

Riparian areas, such as streams and rivers, identified as important for protection or conservation by cities and counties. This policy limits or prohibits new construction with a certain buffered distance from rivers and streams to avoid adverse impacts of urban development. The Buffer tool calculates the distance from centerline of a river based on the general plan's designation. Data compiled by Greenbelt Alliance staff and interns in November 2011 based upon general plans, as well as city and county-provided data.

Rural County Zone

Large continuous areas designated by a county to maintain low density rural development and open space preservation. These areas include Rural Mid-Coast and South Coast of San Mateo County's Rural/Urban Boundary as well as Marin County's Inland Rural and Coastal Corridors. Data compiled by Greenbelt Alliance staff and interns in December 2011 based upon county general plan maps.

Open Space Values

Wetlands & Vernal Pools

Marine and terrestrial wetlands identified in the U.S. Fish and Wildlife Service's National Wetland Inventory (<http://www.fws.gov/wetlands/Data/State-Downloads.html>), vernal pools mapped from the California's Department of Fish and Game California Central Valley Vernal Pool Habitat GIS Data (http://www.dfg.ca.gov/biogeodata/by_program.asp#CWHR), and baylands and wetlands in San Francisco Estuary's Institute's Bay Area Aquatic Resource Inventory. Data compiled by Greenbelt Alliance staff in March 2012.

Important Streams

Streams identified as Critical 1 or Critical 2 for Stream Conservation Targets in the Conservation Lands Network (<http://www.bayarealands.org/gis/>) by the Bay Area Open Space Council, as well as streams identified as Threatened by U.S. Fish and Wildlife Service's Critical Habitat Portal (<http://criticalhabitat.fws.gov/crithab/>). Data compiled by Greenbelt Alliance staff in January 2012.

Important Watershed Lands

Lands identified as important for providing drinking water combining reservoir catchment, groundwater and soil infiltration data. From California's Department Water Resources (DWR) and monitoring data from the State Water Resources Control Board, groundwater basins were classified based on use and vulnerability. Reservoir catchment areas from (DWR) are assigned the

combined volume of all reservoirs within their watershed system according to the average reservoir storage volume. Both DWR layers can be downloaded from the 2010 Forest and Range Assessment as 'Groundwater Basins' and 'Surface Water Storage Watersheds' (<http://frap.cdf.ca.gov/assessment2010/data.html>). To determine where the soil type and landscape characteristics overlap with groundwater basins to allow percolation, the California Basin Characterization Model (BCM) evaluates precipitation, temperature, elevation, geology, and soils to produce surfaces for a wide range of variables, including recharge. Recharge levels are summarized into 4 categories, the upper two labeled 'High' and 'Medium', using a natural breaks classification for the 1971-1999 annual average recharge, with original units in millimeters per year. This data is available by a subscription to California Climate Commons (<http://climate.calcommons.org/>). For the At Risk 2012 report results, watershed lands include reservoir catchment areas with specific areas that overlap between groundwater basins and high and medium groundwater recharge areas. Data compiled by staff from Greenbelt Alliance and The Nature Conservancy in November 2011.

Important Farmland

Land identified important for farming based on all farmland categories from California's Farmland Monitoring and Mapping Program (FMMP) and the Federal Soil Survey Geographic Database (SSURGO). The FMMP data is the primary layer that includes Bay Area county soil type results from 2010, except for Sonoma's which is from 2008 and is available for download through the FTP site (<http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx>). The SSURGO data is the secondary layer that identifies important soils where FMMP data is absent, including important soils with potential for future cultivation and is available for download through the Soil Data Mart or the Geospatial Data Gateway (<http://soils.usda.gov/survey/geography/ssurgo/>). Data compiled by Greenbelt Alliance staff in January 2012.

Important Rangeland

Land identified as important for grazing based on their soil type from the Farmland Monitoring and Mapping Program (FMMP). The FMMP data is the primary layer that includes Bay Area county results from 2010, except for Sonoma which is from 2008 and is available for download through the FTP site (<http://www.conservation.ca.gov/dlrp/fmmp/Pages/Index.aspx>). Data compiled by Greenbelt Alliance staff in January 2012.

Public Parks and Easements

San Francisco Bay Area lands identified in the California Protected Areas Database (<http://www.calands.org/>) as allowing public access on the property in January 2012.

Planned Trails

Regional trail routes that are proposed for the San Francisco Bay Trail (<http://www.baytrail.org/maps.html>), Bay Area Ridge Trail (www.ridgetrail.org) and East Bay Regional Park District based on shapefiles acquired in March 2012. The Bay Trail and Bay Ridge Trail shapefiles were acquired from their respective agencies, while proposed trails from the East Bay Regional Park District are from Priority Conservation Areas from the Association of Bay Area Governments.

Important Habitat

Wildlife areas identified as important for creating an interconnected regional habitat and recommended for protection and conservation by the Bay Area Open Space Council (BAOSC). Data provided by BAOSC as essential, important and fragmented habitat of the Conservation Lands Network and is available for download along with additional habitat information (<http://www.bayarealands.org/gis/>).

Carbon Storage

The above and below ground carbon storage and sequestration on private forested lands. Available for download as 'Forest Biomass and Biomass Potentials' at the 2010 Forest and Range Assessment website (<http://frap.cdf.ca.gov/assessment2010/data.html>).

Priority Conservation Areas

The approximate area identified as a Priority Conservation Area by local jurisdictions (<http://www.bayareavision.org/pca/>). Data provided by the Association of Bay Area Governments in February 2012.

Primary Results

At Risk

The At Risk layers provide a calculated assessment of the likelihood of urban development over the next several decades based on a spatial comparison of development pressure factors against policy protection factors. The probability of development is divided into three categories as high risk of urban development within 10 years, medium risk from 10 to 30 years and low risk as more than 30 years chance of developing. Information for the At Risk 2012 analysis was compiled by Greenbelt Alliance staff and interns.

Policy Protection

Greenbelt lands are covered by policy measures that vary in their efficacy at protecting cultivated or natural resource lands. High policy protection lands are protected by one or more policy measures that prohibit most development on that land. Medium policy protection lands are protected by one or more policy measures where development is intended to be limited but is still possible with a special permit. Low policy protection lands do not fall under any specific protective policy measures. Information for the Policy Protection 2012 analysis was compiled by Greenbelt Alliance staff and interns.

Risk Evaluation

The At Risk 2012 analysis measures the likelihood of urban development over the next 30 years on open space lands around the cities of the San Francisco Bay Area counties. The 2012 At Risk report is based on the analysis of data collected up to April 2012 and builds upon past research. The final At Risk results are calculated using a geographic information system, or GIS model to approximate likelihood of urbanization. It measures development pressure and policy protection of open space using a weighted model to directly compare the relative urgency or significance of a given threat or protection layer. Stronger policy measures, such as areas protected under voter-

approved policies, and strong development pressures, like a housing project given a green light for construction, are given a higher weight. As the strength of the urban development pressure or open space policy protection diminishes, so does the relative weight of that spatial layer. To derive the final At Risk 2012 results, the cumulative weight of the policy protection measures are subtracted from the cumulative weight of the development pressure threats. Thereby, permanently protected areas are given a low score while development proposals receive a high score.

At Risk Model

Development Pressure Factors		Score	Policy Protection Factors		Score
Market Conditions	Unbulit Residential	100	Permanent Protection	Protected Land - Park (Fee)	6000
	Approved or Proposed Greenfield Development	20		Protected Land - Easement	3000
	Developer Speculation	3	High Protection	Agricultural Protection - Voter Approved	6
	Historical Threat of Development	1		City - County Shared UGB - Voter Approved	6
Locational Attributes	Urbanized Land	500	Medium Protection	Flood Plain - Prohibited	4
	Parcels Adjacent to Recent Development	1		Habitat Conservation Plan - Prohibited	4
	Parcels Adjacent to Major Roads	1		Hillside Ordinance - Prohibited	4
	Parcels Adjacent to Local Roads	0.5		Riparian Corridor - Prohibited	4
County Zoning	Open Space Zoned Urban Residential	3		Williamson Act Properties	3
	Open Space Zoned Rural Ranchette	2	Low Protection	Bayland Protection	1
	Opesn Space Zoned Rural Estate	1		Coastal Zone	1
Regional Projections	Open Space Growth Projected Urban Residential	1.5		Flood Plain - By Permit	1
	Open Space Growth Projected Rural Ranchette	1		Greenbelt Reserves	1
	Open Space Growth Projected Rural Estate	0.5		Habitat Conservation Plan - By Permit	1
County & City Planning Boundaries	Inside All Growth Boundaries	2		Hillside Ordinance - By Permit	1
	Inside Growth Boundary but Outside City Limit	1.5		Riparian Corridor - By Permit	1
	Inside City Limits but Outside UGB	1	Rural County Zoning Area	1	
	Sphere of influence	1			

Cumulative Development Pressure Score

minus

Cumulative Policy Protection Score

equals

At Risk Results Score Range

Permanent Protection - Park	-9,014
Urban - Park	-5,879
Permanent Protection - Easement	-5,514
Urban - Easement	-5,477
Low Risk	-5,402
Medium Risk	-2,895
High Risk	-2,511
Urban	-2,480
Low Risk	-26
Medium Risk	2
High Risk	3
Urban	6
Low Risk	7
Medium Risk	25
High Risk	91
Urban	622

Greenbelt Mapper *(provided by GreenInfo Network)*

The Greenbelt Mapper uses a stack of open source tools and custom code to tie it all together. A [PostGIS](#) database stores the datasets; [MapServer](#) renders images of the data ([TileCache](#) and [TileStache](#) cache those images); [OpenLayers](#) powers interactions with the data; JQuery (and other javascript + css) controls much of the user interface.

PHP code and PostGIS functions provide the information for the intersection of a user-defined polygon with each of the datasets. The Google Maps API delivers the satellite imagery and the background streets (using custom style parameters so that the streets info doesn't draw attention away from the Greenbelt data); [GDAL/OGR](#) and bash scripts facilitated the data loading. We designed the map to load using a [RESTful](#) url that facilitates bookmarking and sharing (through email or social media--and for debugging!). We used an amalgam of custom code and wkhtmltopdf to generate the custom pdf reports.

In order to capture user-generated spatial data on development pressures around the Bay Area's greenbelt, researchers used a separate web map (built with a similar open source stack, plus [Geo]Django) to facilitate multi-user, distributed creation and editing of highly localized data which informed the Risk layers.

Click the embedded links to learn more about the open source tools, or take a look at the Open Source Geospatial Foundation ([OSGeo](#)) or its Free and Open Source Software for Geospatial ([FOSS4G](#)) conference. And feel free to contact [GreenInfo Network](#) if you have any other questions about "Information & mapping in the public interest!"