City Practice

- Singapore Biodiversity Index: **Lena Chan**, Senior Director, International Biodiversity Conservation Division at the National Parks Board of Singapore
- City of Edmonton, Canada: **Grant Pearsell**, Director of Urban Analysis
- City of Sao Paulo, Brazil: **Rodrigo Ravena**, Chief of Staff of the Secretariat for Green and the Environment

THE SINGAPORE INDEX ON CITIES' BIODIVERSITY: SHARING 10 YEARS OF APPLICATION BY CITIES GLOBALLY

Lena Chan

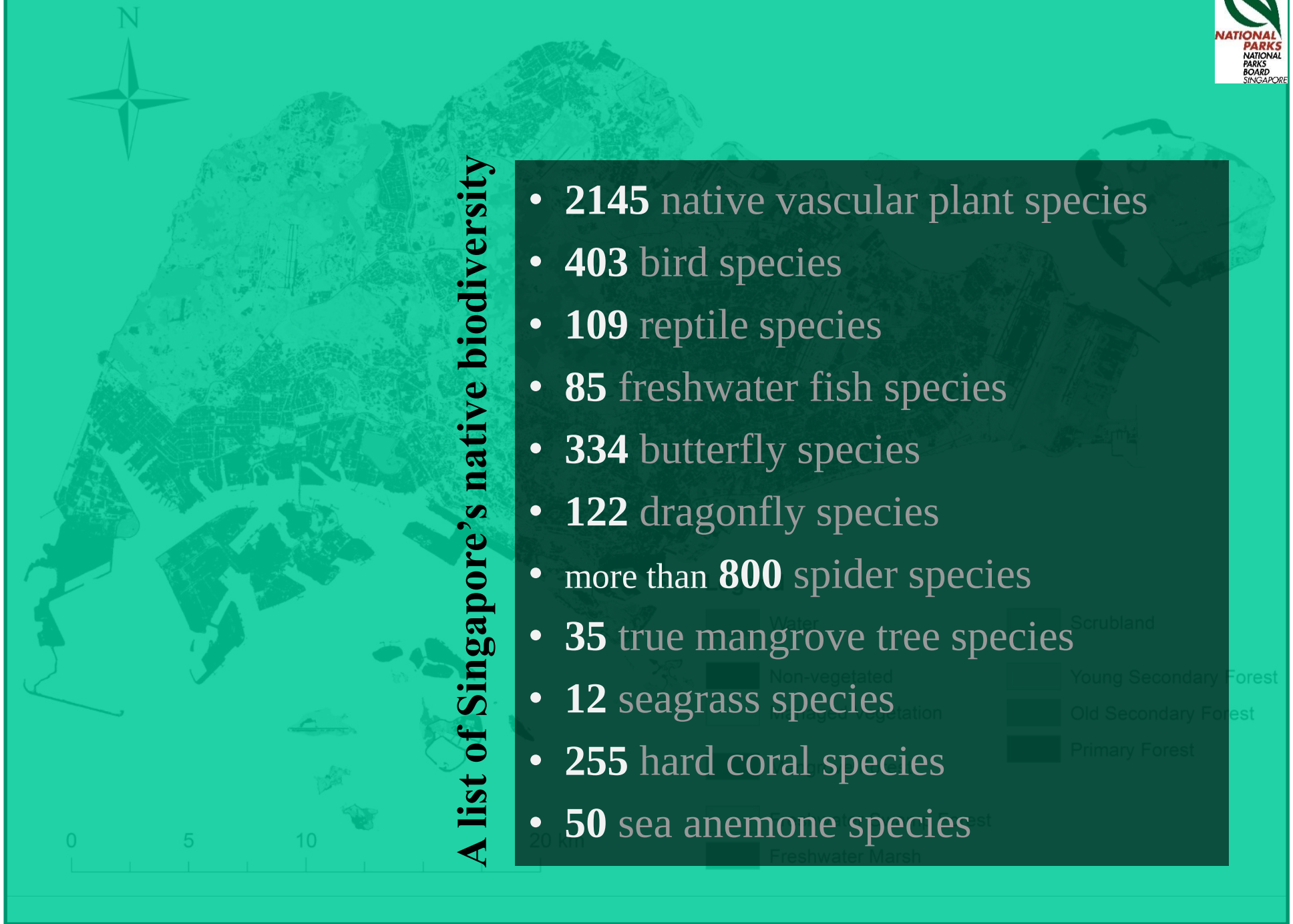
Senior Director, International Biodiversity Conservation Division,
National Parks Board

Global Platform for Sustainable Cities
World Bank Headquarters, Washington DC

8 May 2019

Why is there a need for a Biodiversity Index for Cities?

- 2008: > 50% of people live in cities
- 2050: > 70% will live in cities
- 2025: 29 megacities with population of > 10 million each



A list of Singapore's native biodiversity

- **2145** native vascular plant species
- **403** bird species
- **109** reptile species
- **85** freshwater fish species
- **334** butterfly species
- **122** dragonfly species
- more than **800** spider species
- **35** true mangrove tree species
- **12** seagrass species
- **255** hard coral species
- **50** sea anemone species

WE NEED A TOOL TO MEASURE HOW WELL OUR BIODIVERSITY CONSERVATION EFFORTS IN CITIES HAVE SUCCEEDED

WSSD 2010 Target

In April 2002, the Parties to the Convention committed themselves **to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth.**

GLOBAL BIODIVERSITY OUTLOOK 3

Global Biodiversity Outlook 3 reported that the target agreed by the world's Governments in 2002, "to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth", has not been met.

Limitations of Current Indices

- Environmental Sustainability Index (ESI)
- Environmental Performance Index (EPI)
- Cities of Opportunity
- European Green City Index

Why is there a need for a Biodiversity Index for Cities?

In Jan 2008, the then Executive Secretary of the CBD, Dr. Ahmed Djoghlaf called for cities to share and pool knowledge and develop new approaches, methods and tools.

Why is there a need for a Biodiversity Index for Cities?

In May 2008, Singapore proposed that CBD Parties collaborate in developing a CBD-led “city biodiversity index” (CBI); also known as the Singapore Index on Cities’ Biodiversity (SI)

Singapore's Response

- Singapore hosted with the SCBD the 1st Expert Workshop on the Development of the CBI from 10-12 Feb 2009
- 17 experts from 10 countries
- **Technical Task Force:**
  - Dr. Nancy Holman, London School of Economics
  - Mr. Peter Werner, Institute of Housing and Environment, Darmstadt, Germany
  - Professor Thomas Elmqvist, Stockholm Resilience Centre
  - Mr. Andre Mader, ICLEI-Local Government for Sustainability
  - Ms. Elisa Calcaterra, IUCN
  - Mr. Oliver Hillel, Secretariat of the CBD
  - Dr. Lena Chan, NParks

How did the SI develop?

- Workshop objectives are to develop a CBI to:
  - Assist national governments and local authorities in **benchmarking** their **biodiversity conservation efforts** in the urban context
  - Help **evaluate progress** in reducing the rate of biodiversity loss in urban ecosystems
- Proposed index:
  - a self-assessment tool
  - easy to apply
  - scientifically credible
  - objective and fair

How did the SI develop?

Profile of the City

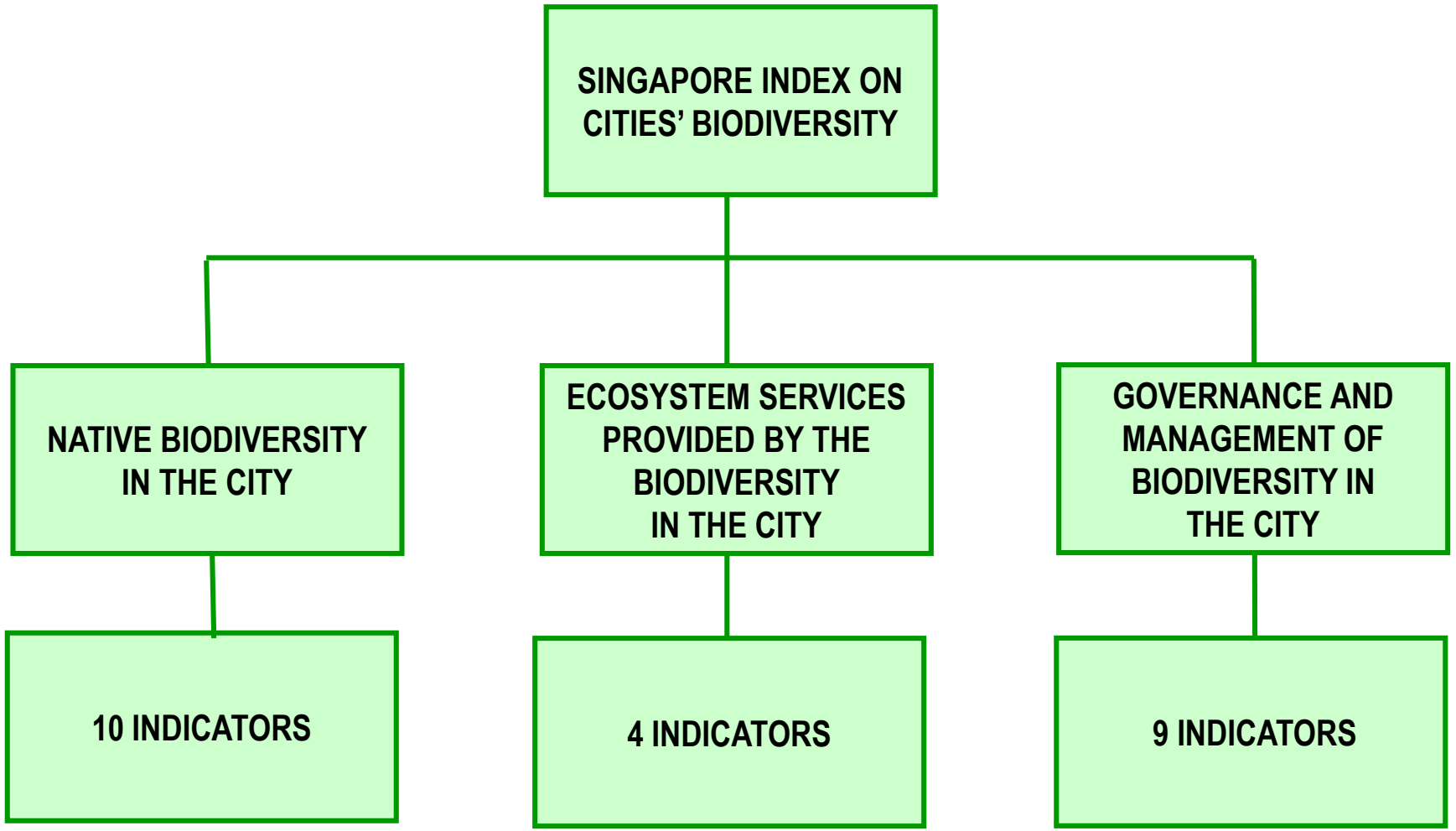
- Ecosystems found in the city
- Species found in the city
- Quantitative data on populations of key biodiversity indicators
- Other relevant biodiversity data

How did the SI develop?

3 components for the Index:

- Native biodiversity in the city
- Ecosystem services provided by native biodiversity in the city
- Governance and management of native biodiversity in the cities

Singapore Index On Cities' Biodiversity (SI)



How did the SI develop?

- The 3rd Expert Workshop on the development of the CBI was held in Singapore from 11-13 October 2011.
- 26 experts from 11 countries participated.

The Singapore Index - Biodiversity (10 Indicators)

1. Proportion of natural areas in the city
2. Connectivity measures or ecological networks to counter fragmentation
3. Native biodiversity in Built-up Areas (Bird species)

4 – 8. Change in number of Native Species – Plants, Birds, Butterflies and 2 other species

9. Proportion of protected natural areas
10. Proportion of invasive alien species

Nagoy

The Singapore Index - Ecosystem Services

(4 Indicators)

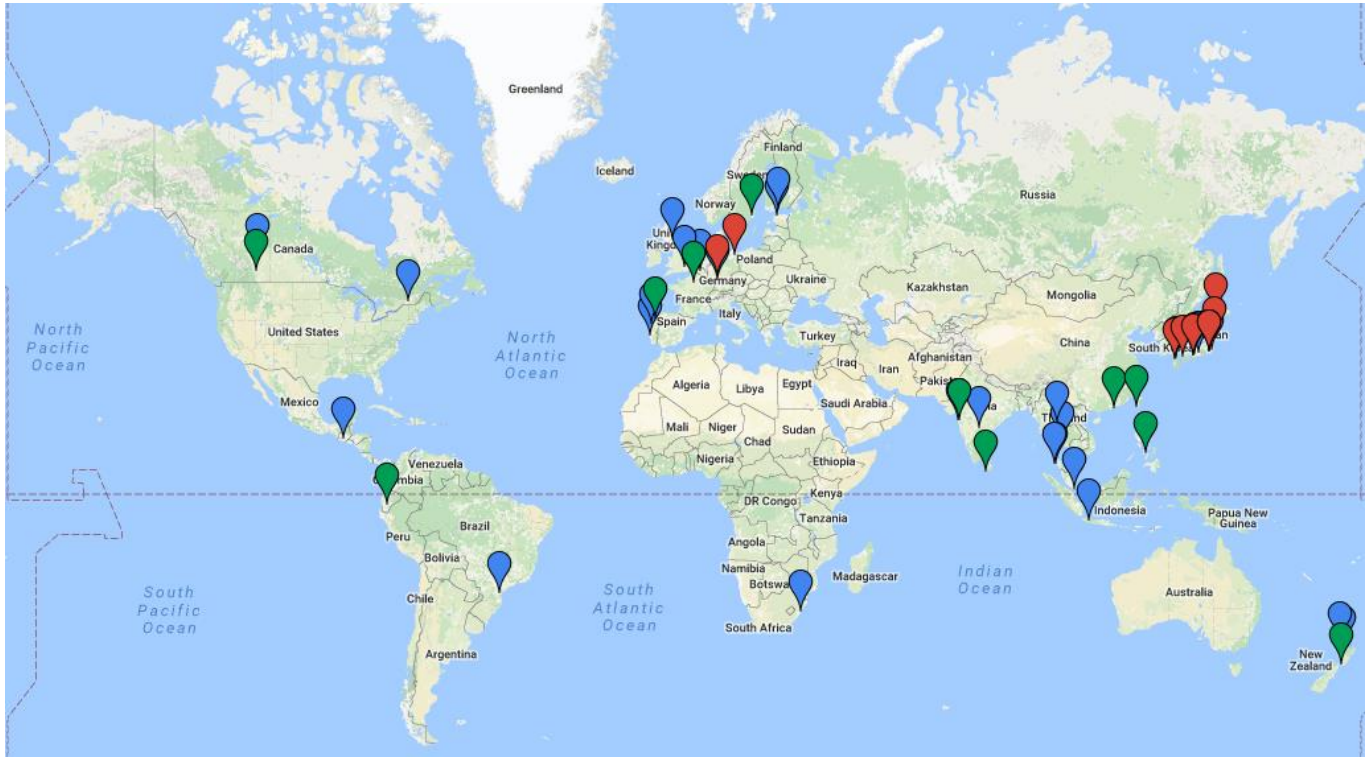
11. Regulation of Quantity of Water
12. Climate regulation: Carbon storage and cooling effect of vegetation
13. Area of parks with natural areas and protected natural areas per 1000 population in city
14. Number of educational visits to parks or protected areas per year

The Singapore Index - Governance and Management (9 Indicators)

15. Budget allocated to biodiversity projects
16. No. of biodiversity projects implemented by the city annually
17. Rules, regulations and policy (LBSAP)
18. No. of essential biodiversity-related functions
19. No. of city or local government agencies involved in inter-agencies cooperation pertaining to biodiversity matters
20. Existence of a public consultation process
21. Existence of partnerships
22. Incorporation of biodiversity into the school curriculum
23. No. of outreach programmes and public awareness events

Monitoring our efforts

Singapore Index – Application World-wide



Singapore Index – Application World-wide

26 city governments have applied the SI:

Auckland/Waitakere	Krabi
Bandung/West Java	La Antigua Guatemala
Bangkok	Lisbon
Brussels	London
Chiang Mai	Mira-Bhayandar
Curitiba	Montreal
Durban	Nagoya
Edinburgh	Phuket
Edmonton	Porto
Hamilton	Singapore
Heidelberg	Tallinn
Helsinki	Vitoria-Gasteiz
Hyderabad	Los Angeles

Singapore Index – Application World-wide

12 cities in the process of applying:

Calgary	Iloilo
Costa Rica	Ourense
Cuenca	Paris
Galle City	Stockholm
Hong Kong	Thane
Kaoshiung	Wellington

SI applied by academics to 14 cities:

Chiba	Kyoto
Frankfurt	Neubrandenburg
Fukuoka	Osaka
Hiroshima	Sapporo
Kawasaki	Sendai
Kitakyusyu	Tokyo
Kobe	Yokohama

Other Applications of the SI

- Guidelines on how to enhance native biodiversity
- Provision of biodiversity inputs into the master planning of cities
- Basis for calculation of economic value of biodiversity and ecosystem services
- As the biodiversity component of other indices

New Impetus for Biodiversity Indicators

- Decision 14/3: Mainstreaming of biodiversity in the energy and mining, infrastructure, manufacturing and processing sectors
  - Annex 1, paragraph 5. The Executive Secretary should
    - (h) Identify possible mechanisms to monitor the implementation of actions to advance the mainstreaming of biodiversity at the national, subnational and local levels, such as, for the local level, the Singapore Index on Cities' Biodiversity

- Decision 14/28: Tools to evaluate the effectiveness of policy instruments for the implementation of the Strategic Plan for Biodiversity 2011-2020

SINGAPORE, A GREEN & BLUE BIOPHILIC CITY IN A GARDEN

by

THANK YOU

lena_chan@nparks.gov.sg

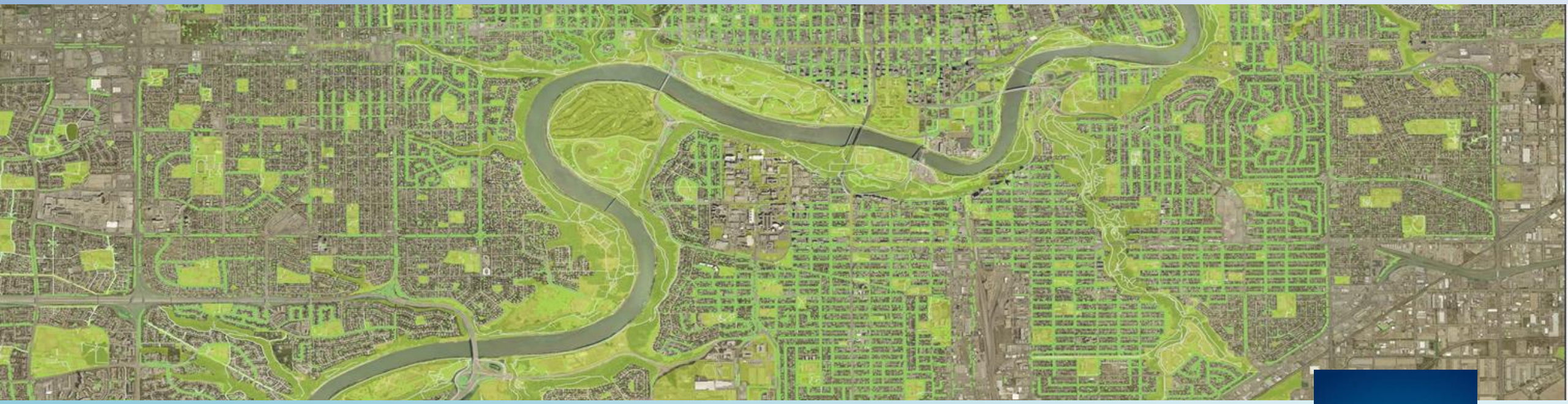
Green Urban Development: Biodiversity, Natural Capital Accounting and Nature-Based Solutions for Cities

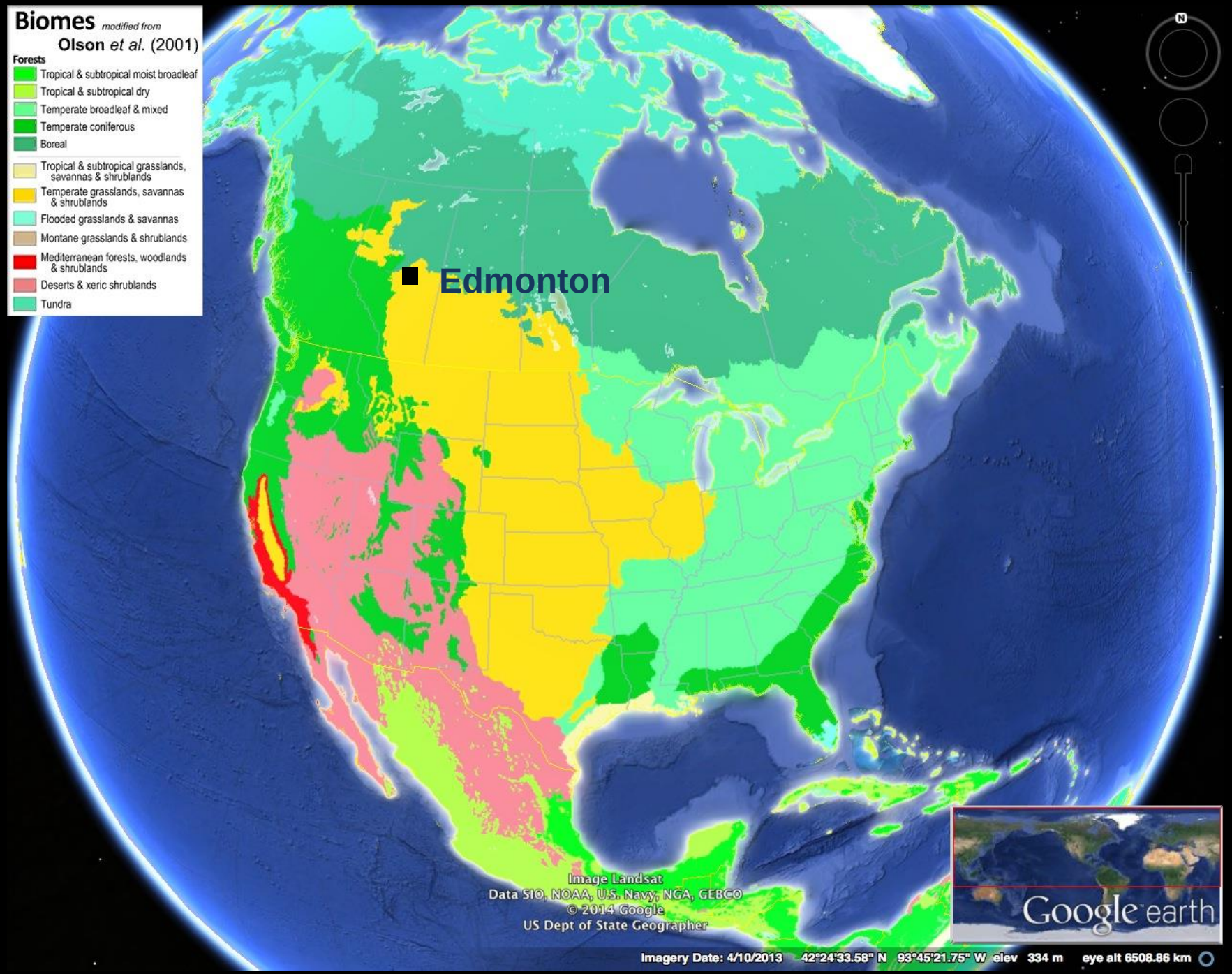
Working Group Meeting
8 – 10 May 2019
Global Platform for Sustainable Cities

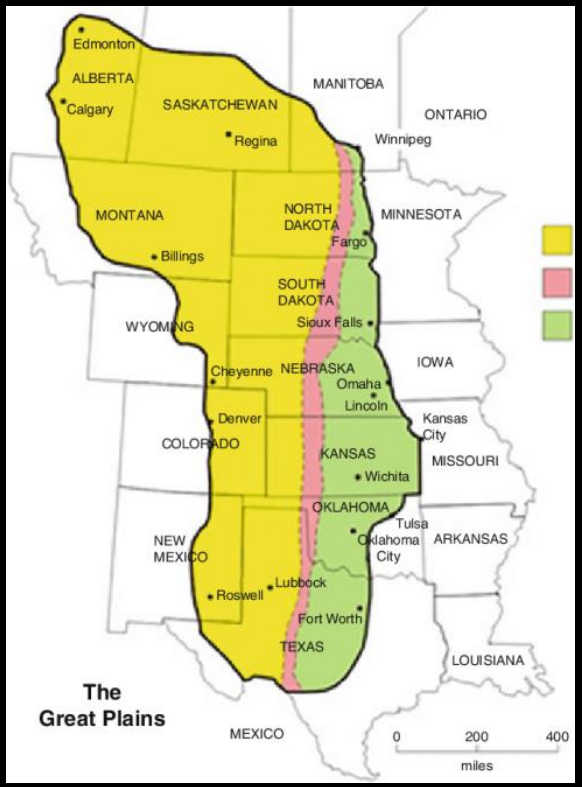
The World Bank Headquarters The World Bank C Building
Room 2-150 1225 Connecticut Ave NW, Washington, DC 20036

Natural Asset Mapping: One of the City of Edmonton's Tools for Biodiversity Planning and Protection

Session 3: City Biodiversity
Grant Pearsell
May 8, 2019




Biomes modified from Olson et al. (2001)
Forests
Tropical & subtropical moist broadleaf
Tropical & subtropical dry
Temperate broadleaf & mixed
Temperate coniferous
Boreal
Tropical & subtropical grasslands, savannas & shrublands
Temperate grasslands, savannas & shrublands
Flooded grasslands & savannas
Montane grasslands & shrublands
Mediterranean forests, woodlands & shrublands
Deserts & xeric shrublands
Tundra
Edmonton
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2014 Google
US Dept of State Geographer
Google earth
Imagery Date: 4/10/2013 42°24'33.58" N 93°45'21.75" W elev 334 m eye alt 6508.86 km


Edmonton
ALBERTA
Calgary
SASKATCHEWAN
Regina
MANITOBA
Winnipeg
ONTARIO
MONTANA
NORTH DAKOTA
Fargo
MINNESOTA
Billings
SOUTH DAKOTA
Sioux Falls
WYOMING
IOWA
Cheyenne
NEBRASKA
Omaha
Lincoln
Denver
Kansas City
COLORADO
KANSAS
MISSOURI
Wichita
OKLAHOMA
Tulsa
Oklahoma City
ARKANSAS
NEW MEXICO
Lubbock
Roswell
Fort Worth
TEXAS
LOUISIANA
The Great Plains
MEXICO
0 200 400
miles


The Boreal Forest
Boreal Forest biome, Canada
Boreal Forest biome, around the world
JAPAN
CHINA
PACIFIC OCEAN
Bering Sea
ASIA
RUSSIA
Gulf of Alaska
Alaska
ARCTIC OCEAN
Beaufort Sea
SIBERIA
NORTH POLE
CANADA
Greenland Sea
FINLAND
Baffin Bay
GREENLAND
SWEDEN
Hudson Bay
Norwegian Sea
NORWAY
U. S. A.
ICELAND
EUROPE
U. K.
ATLANTIC OCEAN
IRELAND
FRANCE
SPAIN
AFRICA
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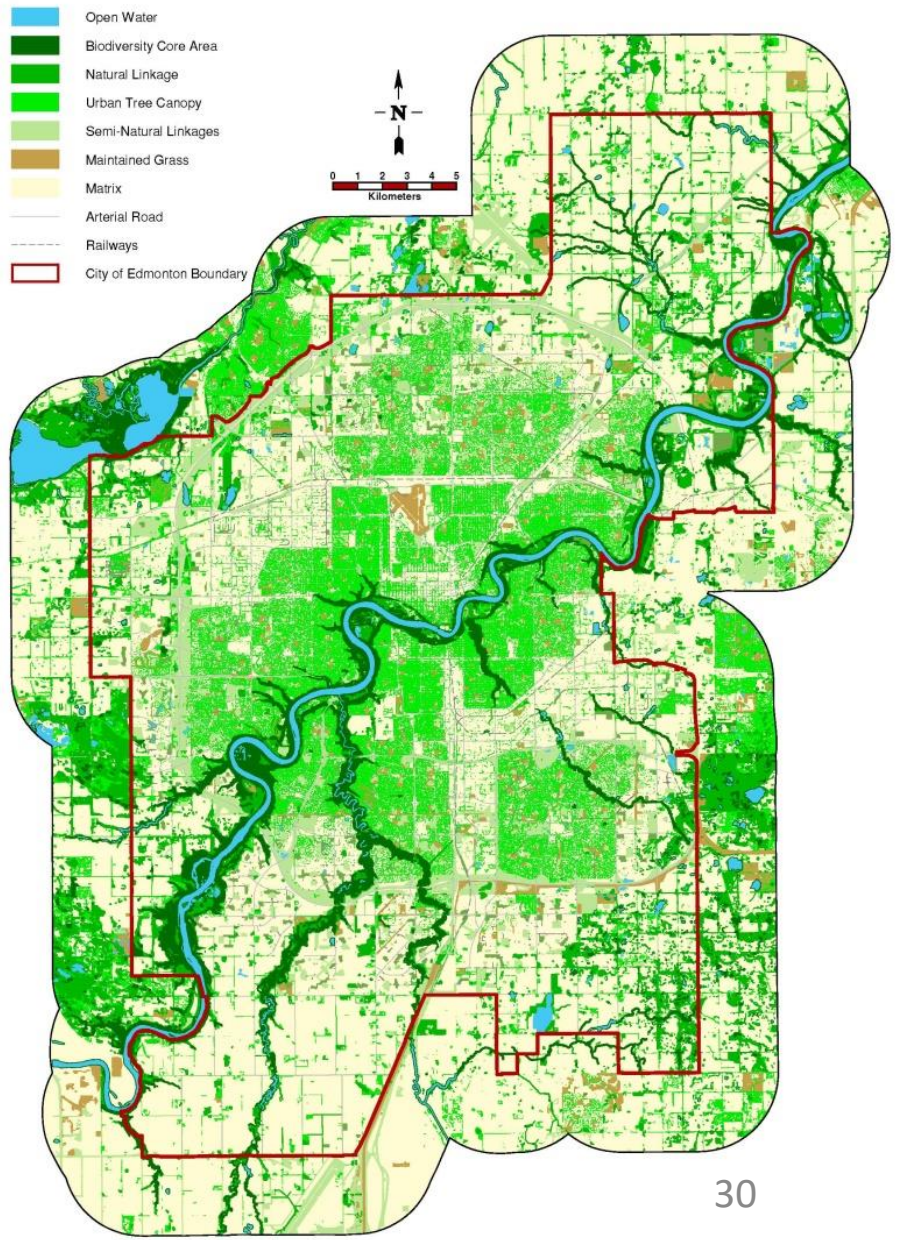

City of Edmonton
Ecological Network (2018)
Open Water
Biodiversity Core Area
Natural Linkage
Urban Tree Canopy
Semi-Natural Linkages
Maintained Grass
Matrix
Arterial Road
Railways
City of Edmonton Boundary
N
0 1 2 3 4 5
Kilometers

Why track our natural assets?
Ecosystem Services

- They are a valuable part of Edmonton's landscape
- Are the richest ecosystems within the City of Edmonton

BIODIVERSITY BENEFITS

Habitat for indigenous plants and wildlife
Soil formation
Nutrient cycling

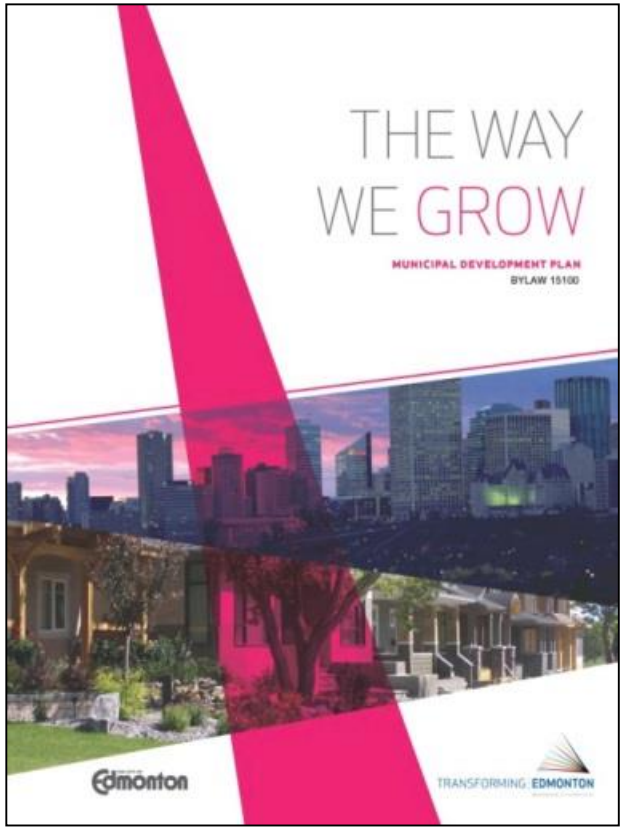
OTHER SERVICES

Clean water
Storage of water (minimize drought)
Climate regulation
Erosion control
Flood reduction
Groundwater recharge

COMMUNITY BENEFITS

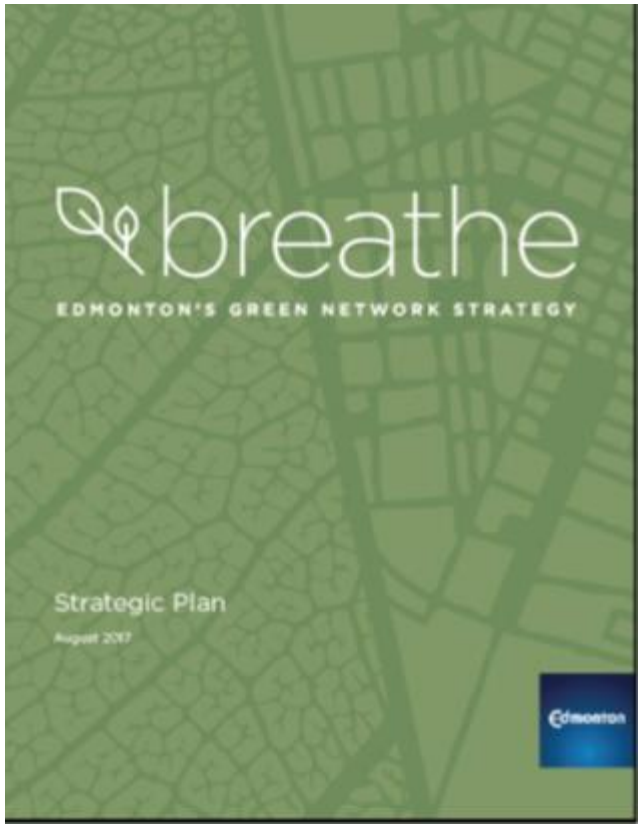
Mental and physical health
Research and education
Increased property values
Research and education
Recreational opportunities
Tourism

Why track our natural assets?
Strategic Direction for Edmonton's Biodiversity Goals



The Way We Grow

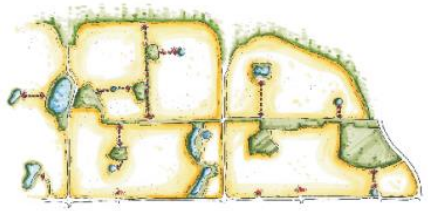
The Way We Green



Breathe

Why track our natural assets?
Regional to Neighbourhood Connectivity:

- Allow for both local and regional understanding of ecological connectivity;
- Promote a common framework that helps the City and its stakeholders to consider the sustainability of natural assets in future planning and land development decisions



Neighbourhood/ Site

City

Regional

Provincial

National

Continental

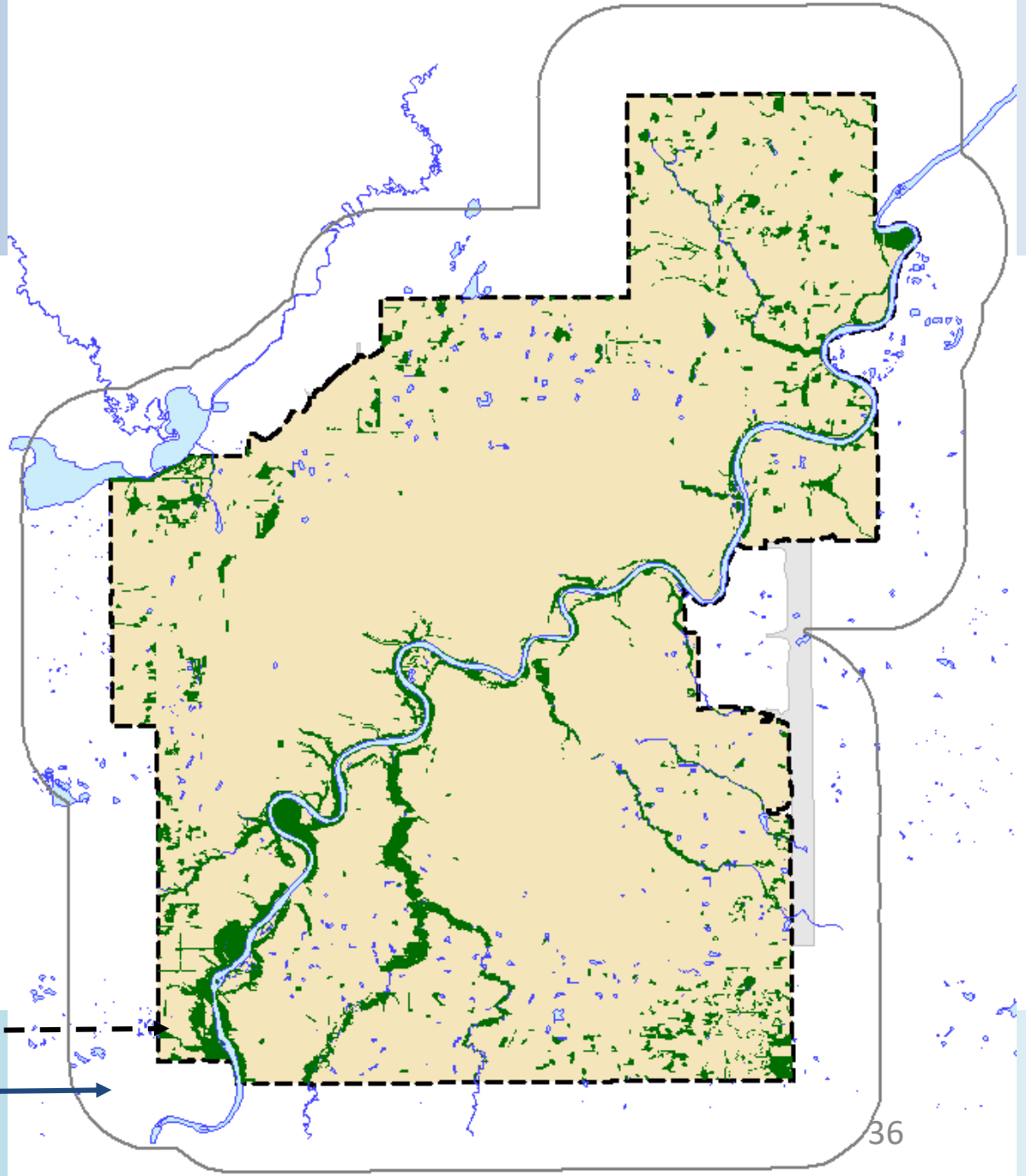
NETWORK SCALE

Why track our natural assets?
Land Planning

Our Approach to Natural Asset Mapping:

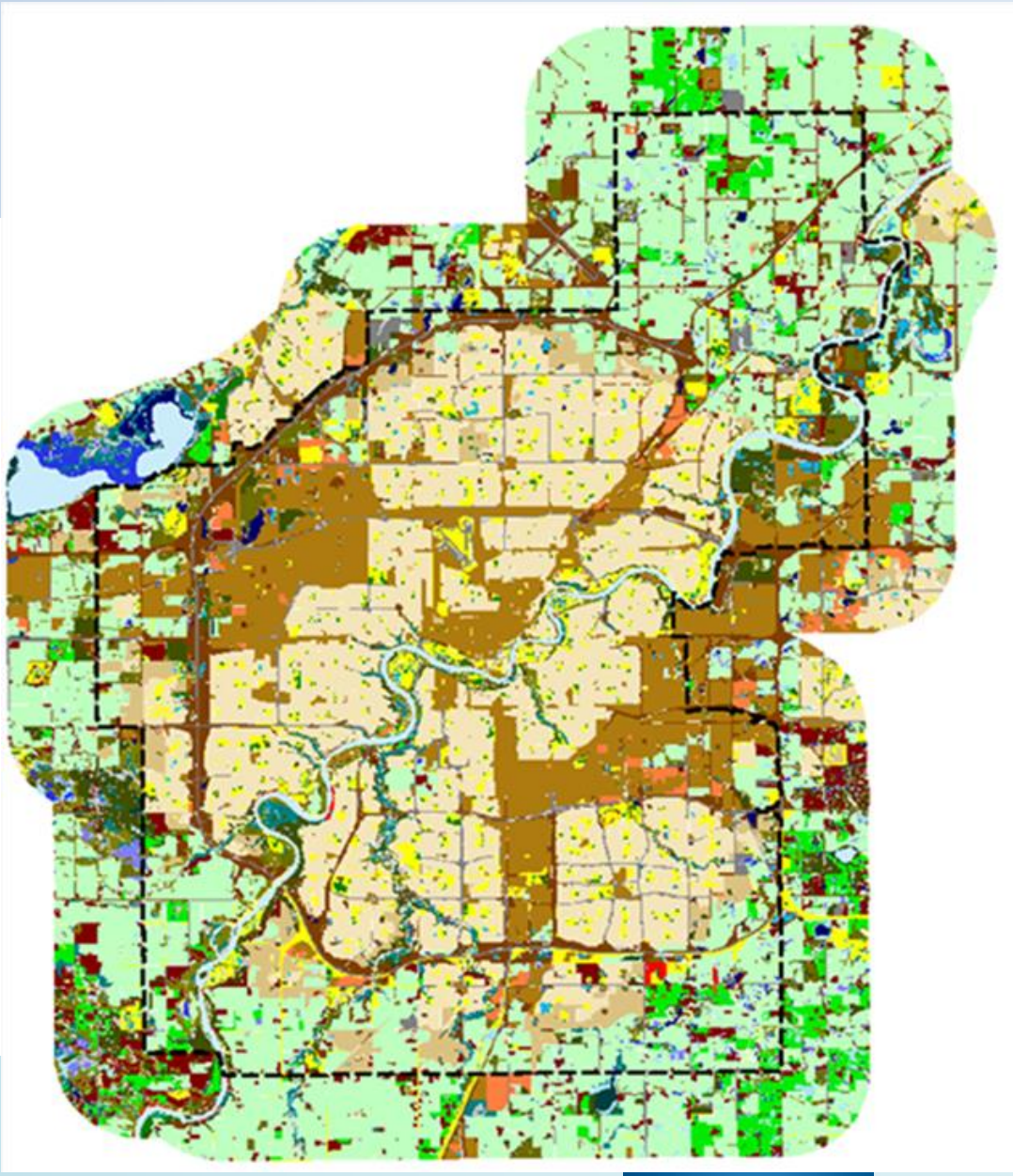
Natural Asset Mapping (Pre-2013): Presence/Absence

- Simple presence (there)/absence (not there) of Natural Areas (green polygons)
- 1130 polygons total
- Coverage: 6,004 ha
- No information on semi-natural areas
- No information on land use types that may be a threat to natural and semi-natural areas
- No information in inter-municipal buffer

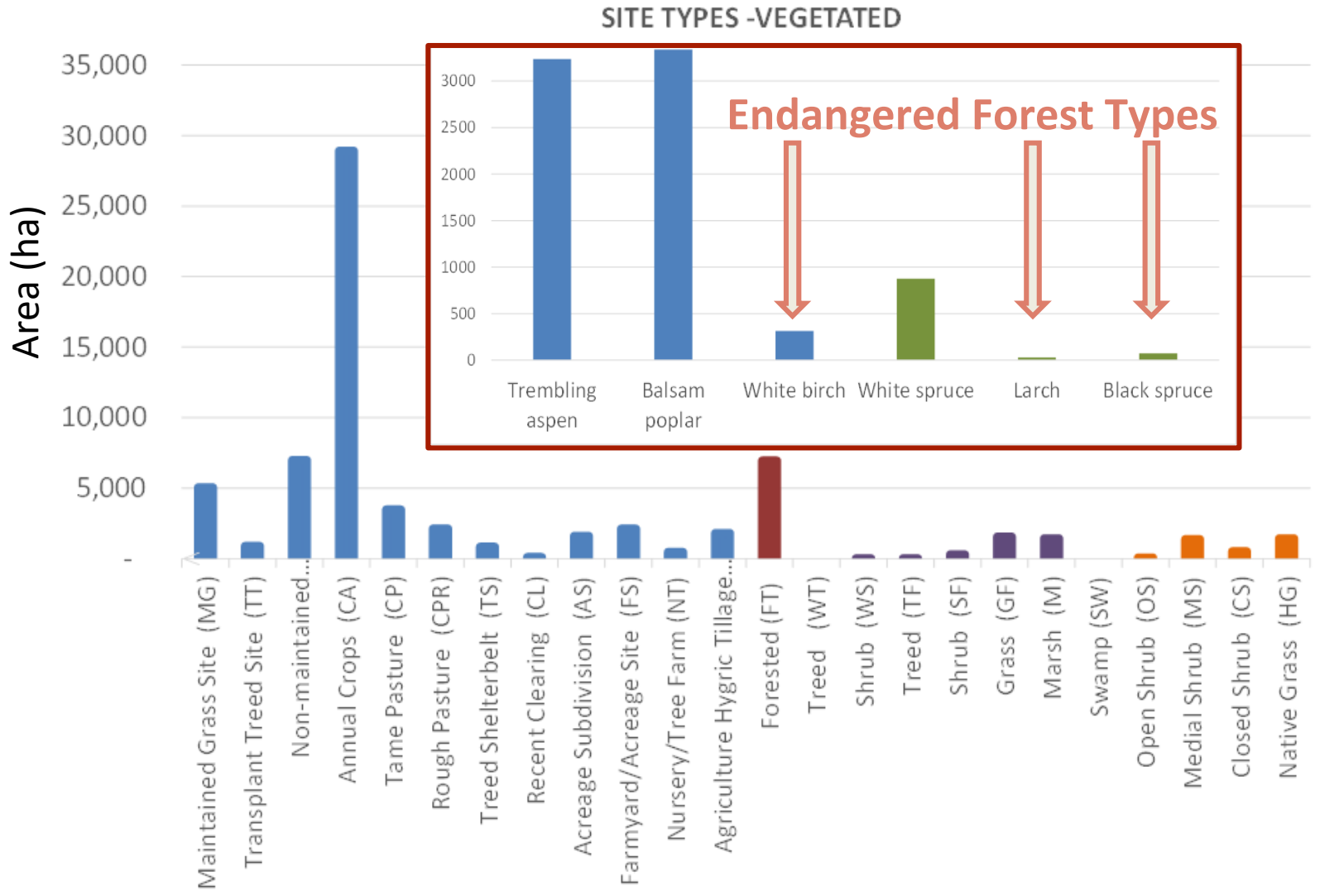


Natural Asset Mapping (Post-2013) uPLVI

- Urban Primary Land and Vegetation Inventory
- A detailed ecological inventory with attributes in each mapping polygon
- 37 natural, semi-natural, and other site types with main level of classification aligned with provincial ecosite mapping
- 14,215 polygons
- Coverage: 128,696 ha
- Detailed information in inter-municipal buffer



What did we learn?

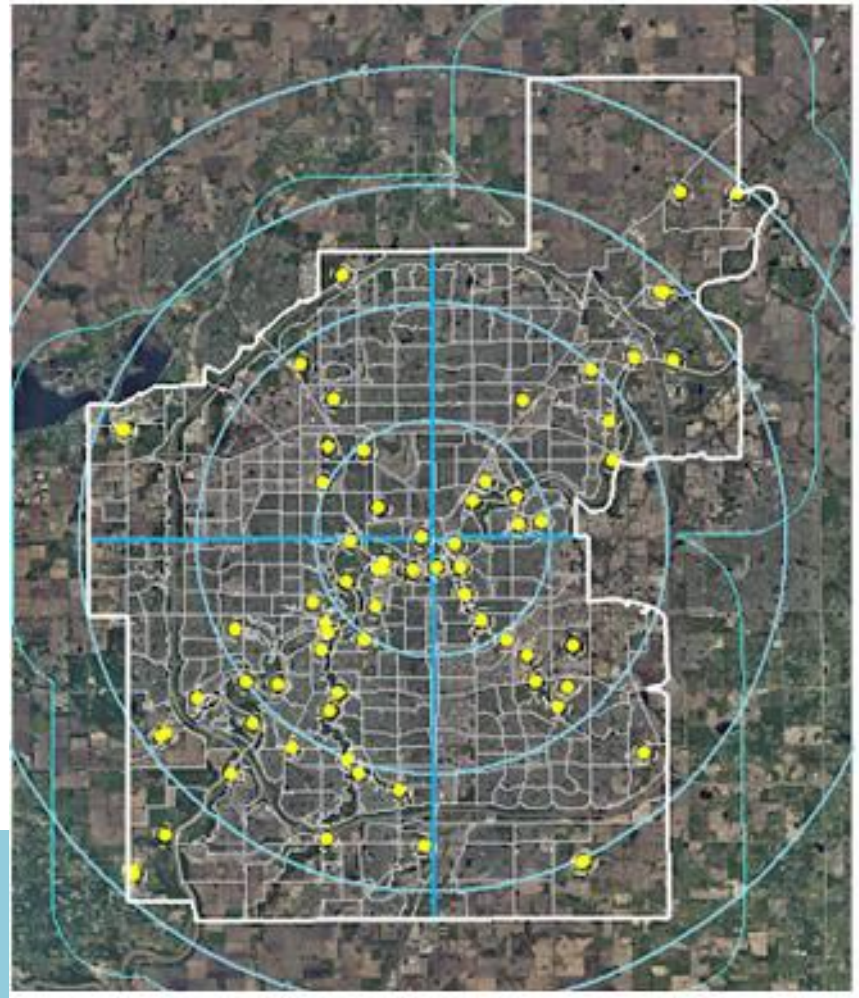


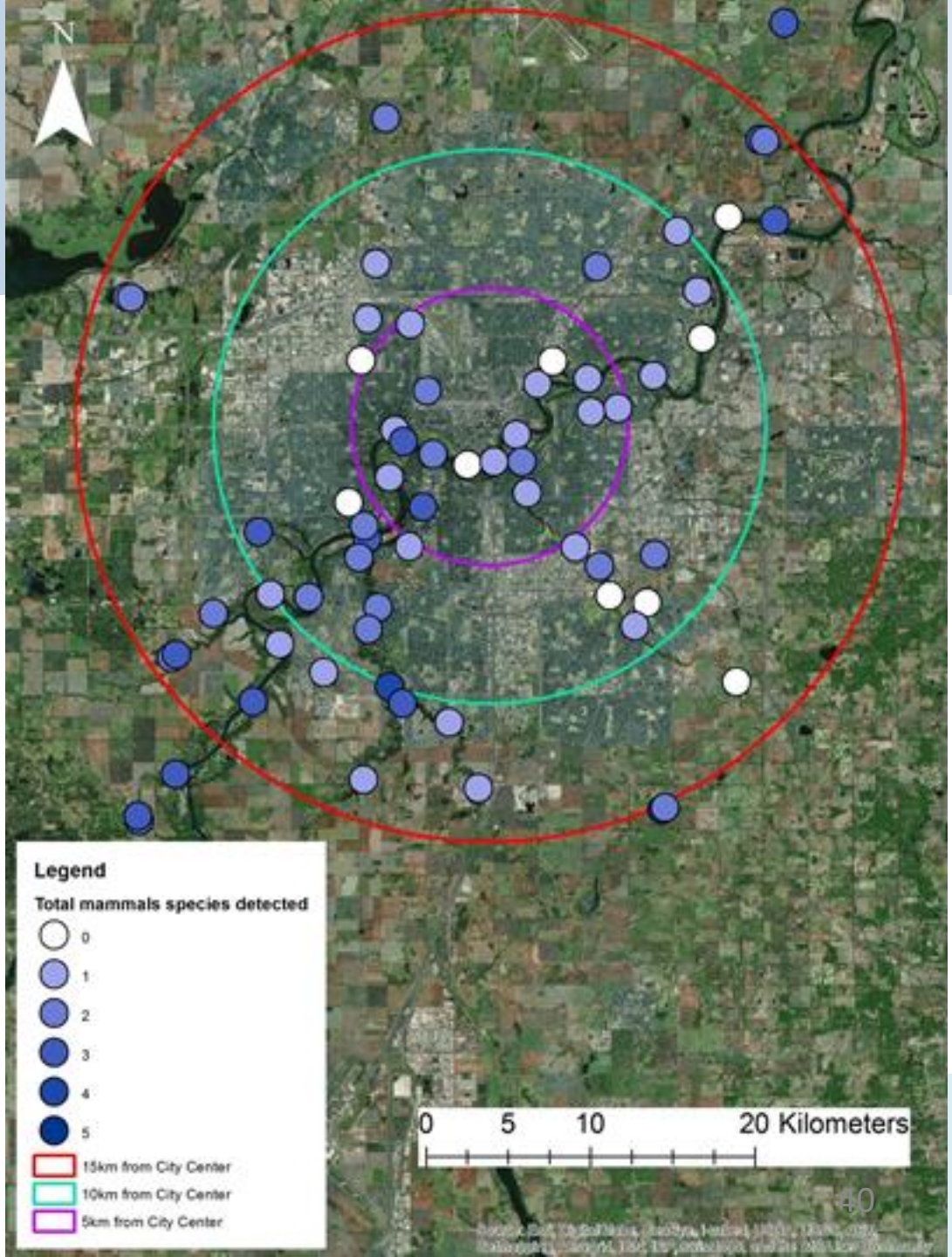
After over 100 years of land use planning, we now know:

- what our most endangered forest communities are;
- that they cover <0.001% of the City; and
- where they are

How we use these data

Wildlife monitoring





Environmental Sensitivity Mapping

Products are publically available through open data portal:

https://data.edmonton.ca/stories/s/pswc-e52d

Natural Assets

-

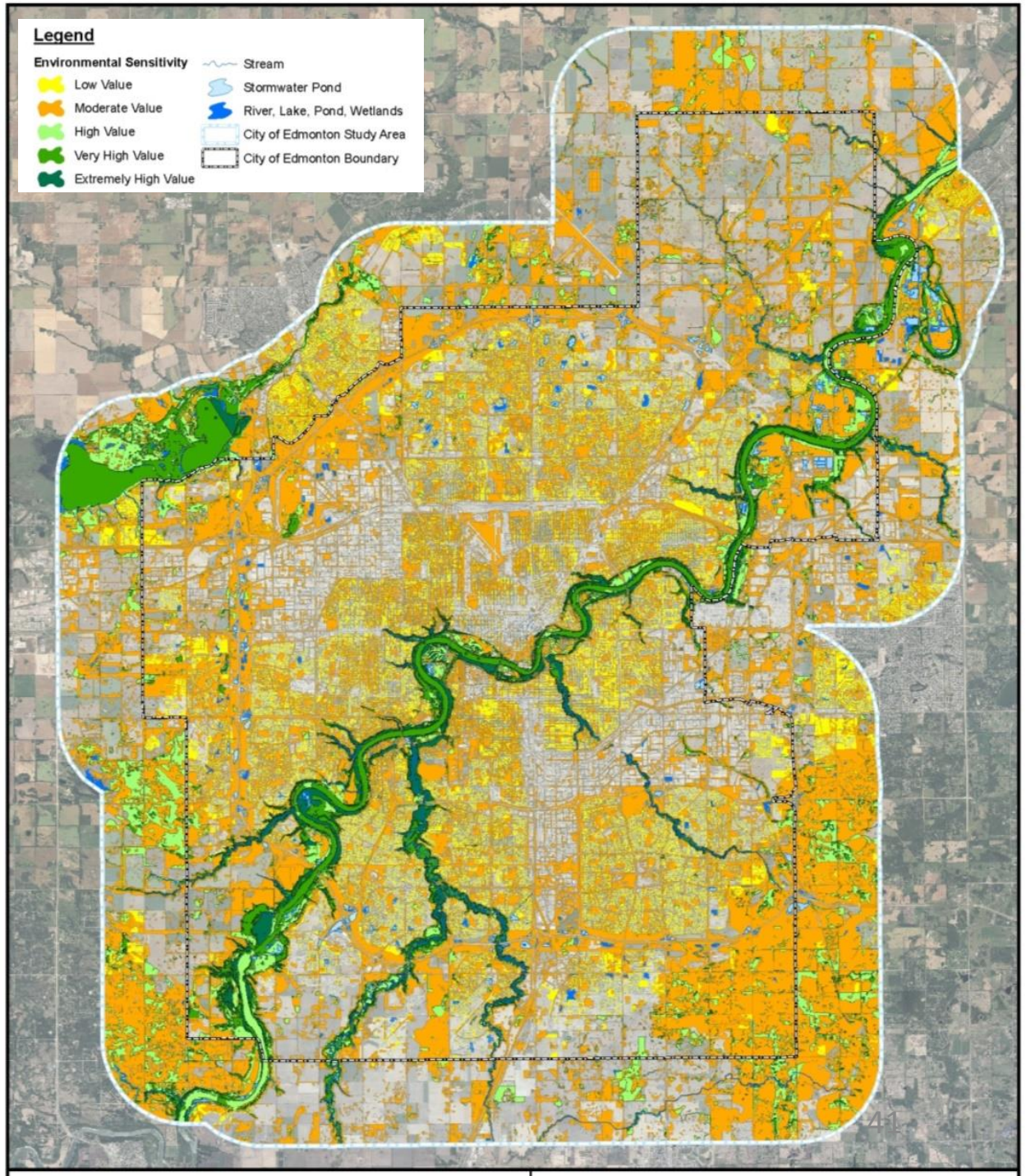
Threats

+

Planning Constraints

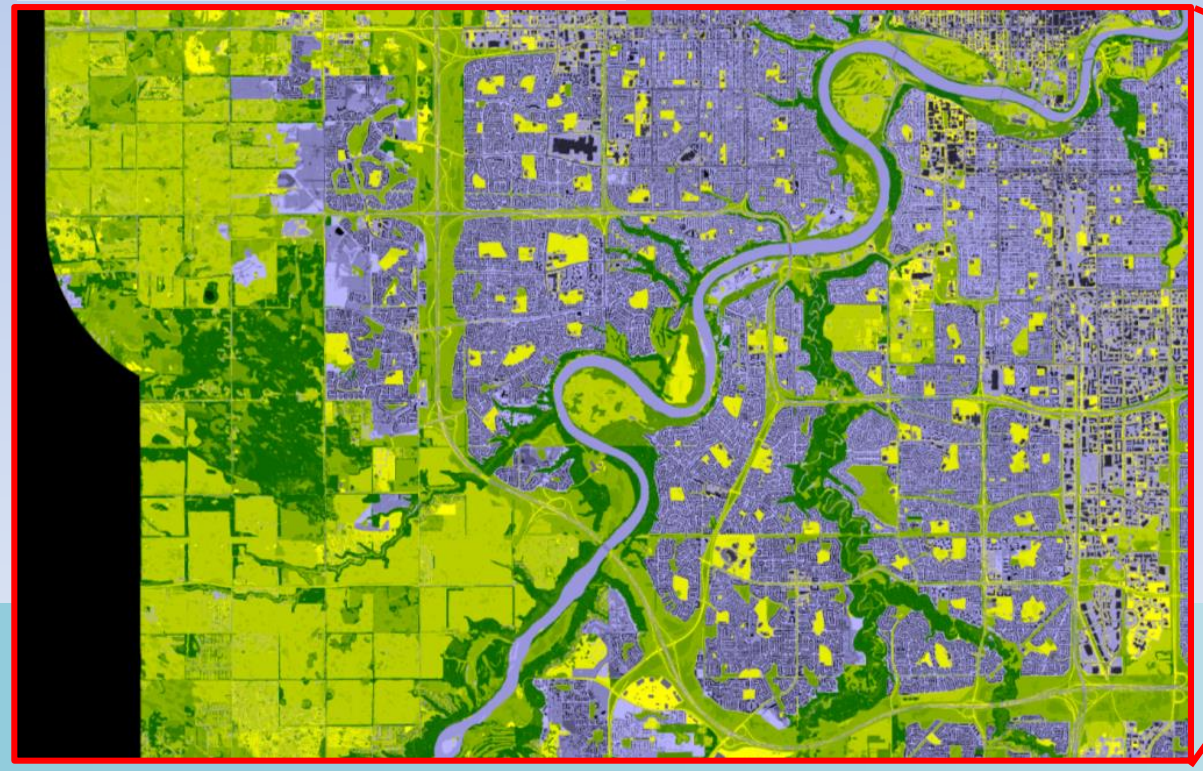
=

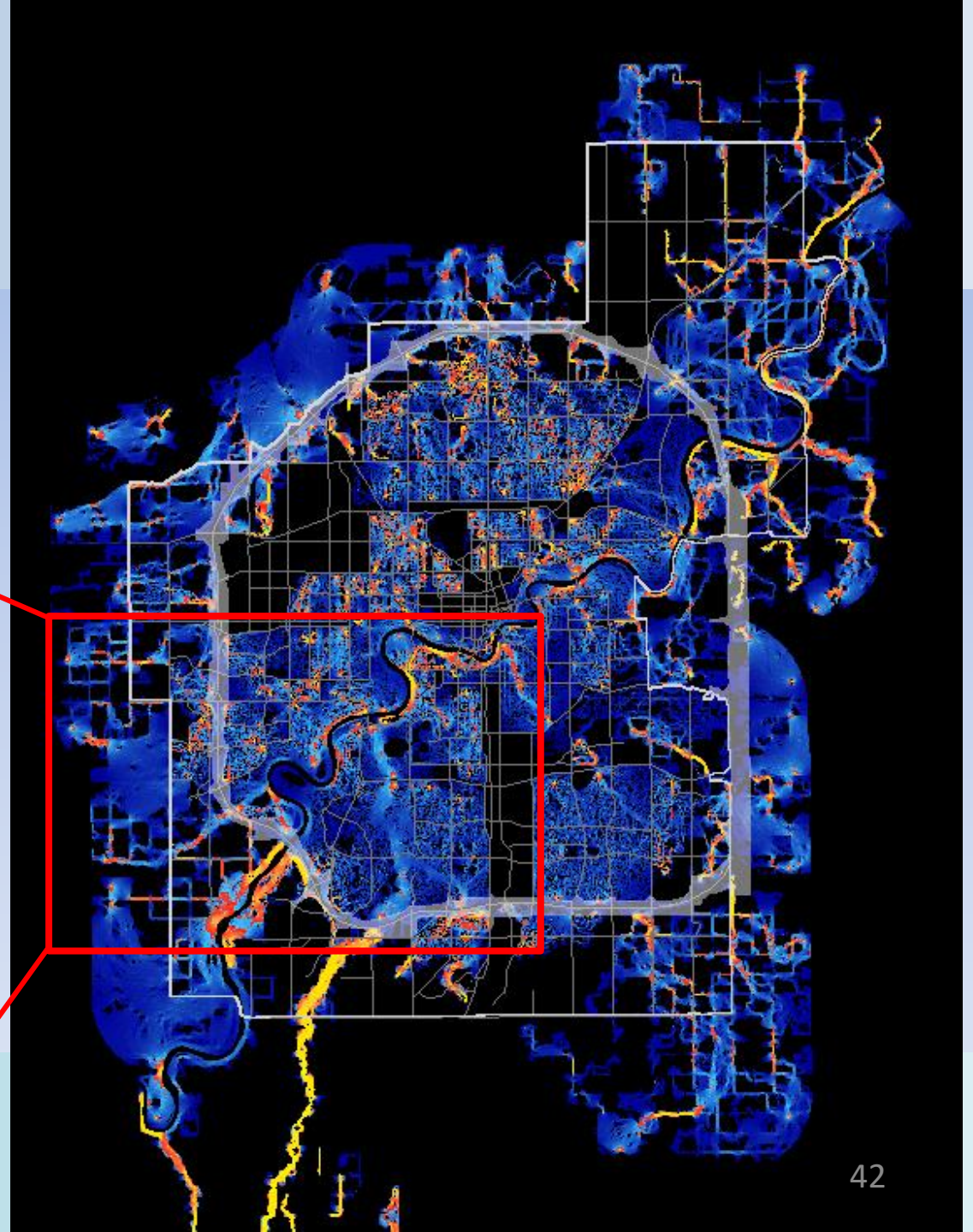
Environmental Sensitivity



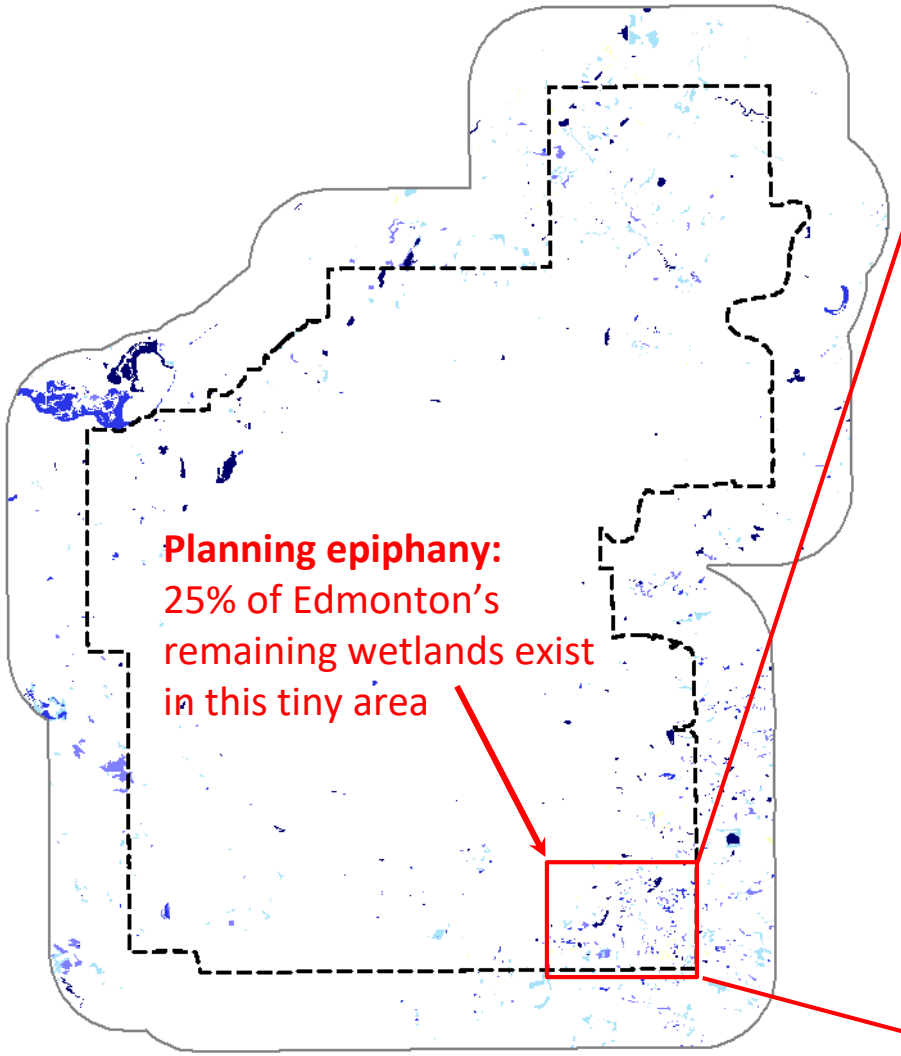
Natural Systems Connectivity Mapping

A birds eye view:
Chickadee
Resistance Map



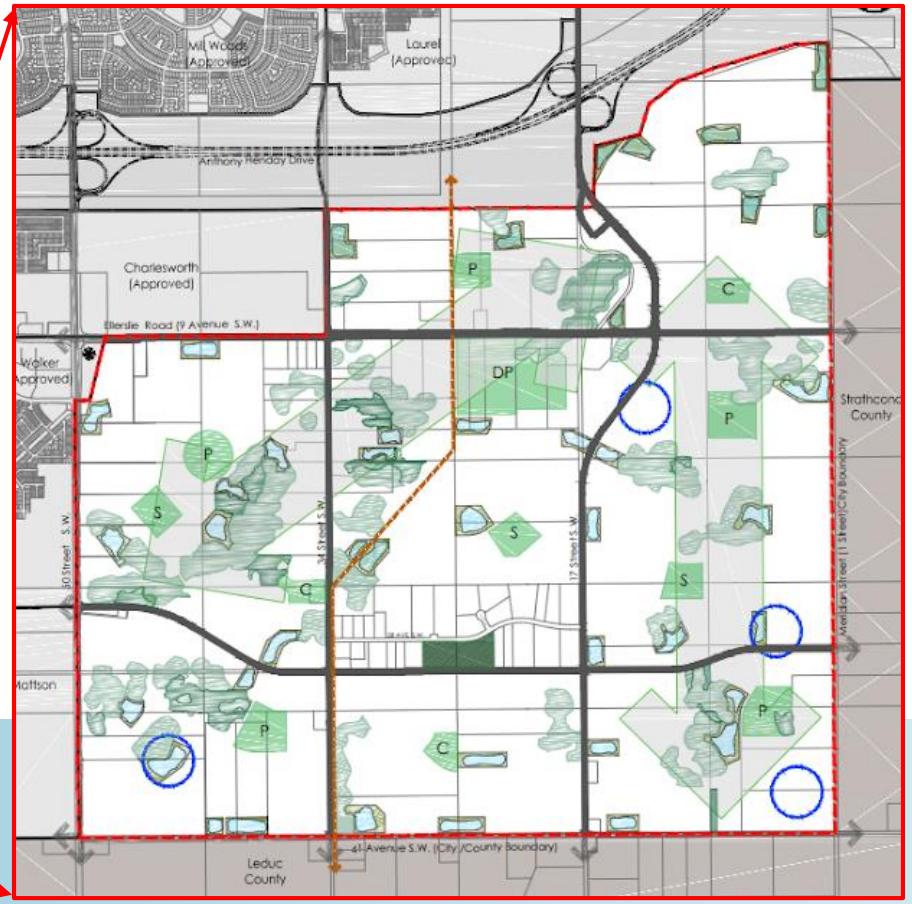


Wetland Conservation



Decoteau Area Structure Plan

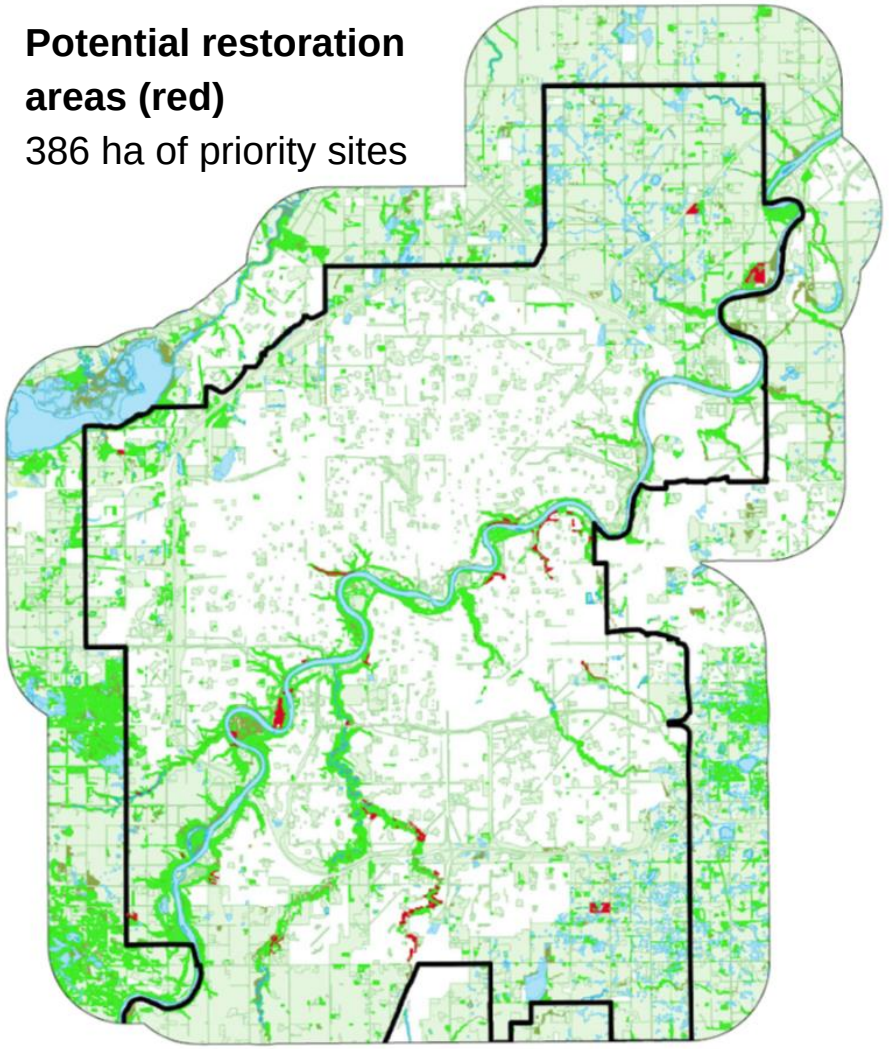
198 ha of Council approved wetland retention (2015)

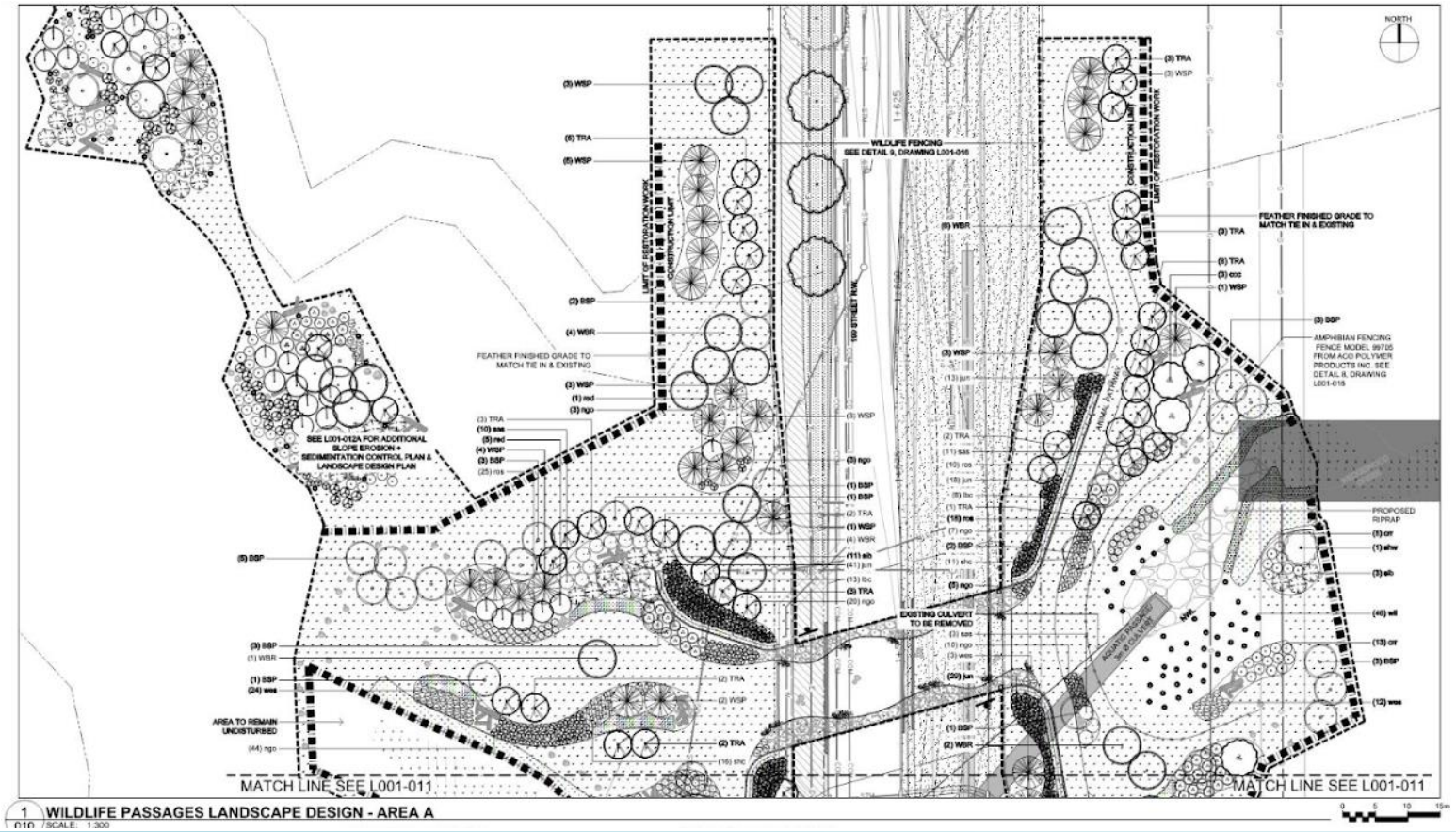


Areas planned prior to having access to the City's natural asset tools, see historically less than 10 % wetland conservation. Now >50% retention.

Habitat Restoration for the benefit of improved ecological connectivity

Potential restoration areas (red)
386 ha of priority sites





Example of Restoration Plan in Environmental Impact Assessment
199th street crossing of Wedgewood creek (Wildlife passage landscaping)

Innovation: GHG Emissions Monitoring due to land use change

Used to estimate land-cover change over two periods of time: 2005 and 2012-2015

Annual average was applied to Alberta-based emission factors to estimate GHG emissions from land-use changes.

Table 24 2012-2015 GHG Emissions from Land-Use Change (tCO_2e)

Category	Forestland	Cropland	Grassland	Wetlands	Settlements	Other	Total
Forestland	3	14	12	0	(5,121)	-	(5,093)
Cropland	10	226	436	6	(132,438)	(4,646)	(136,406)
Grassland	2	171	1,457	6	(51,807)	(49)	(50,219)
Wetlands	(0)	(20)	(11)	42	(2,375)	-	(2,364)
Settlements	13	78	632	8	-	-	732
Other	-	539	41	-	-	-	580
Total	28	1,008	2,567	63	(191,740)	(4,694)	(192,769)

NOTES:

Negative values are carbon losses.

Wetland conversion means a loss in carbon as wetlands have the highest natural capital compared to other land classes.

The bottom total (in orange) represents the total GHG emissions (tCO_2e) for each class, as of the 2012 reporting year.

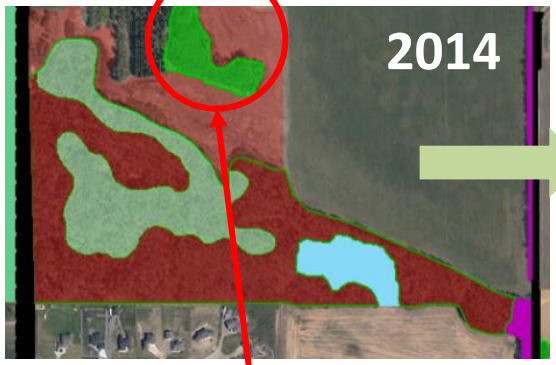
The right outermost column total (in green) represents the total GHG emissions (tCO_2e) for each class, as of the 2015 reporting year.

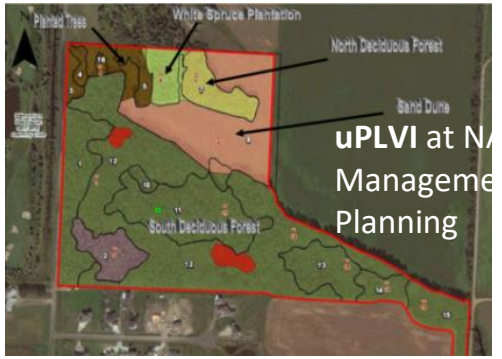
The data within the table (white cells) represent the change in land use between 2012 and 2015.

More information is available at:

dashboard.edmonton.ca (Community Greenhouse Gas Emissions)

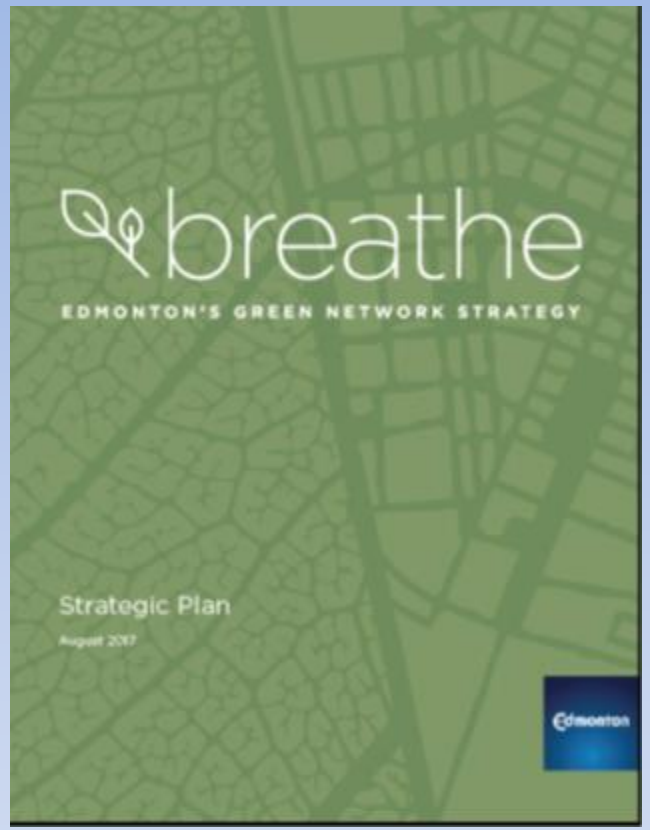
Land Planning and Management





Unique vegetation/geologic feature never before mapped (Edmonton's only protected sand dune)

Ability to capture more detailed ecological information at every step of the Municipal Land Use planning process.



CSLA | AAPC
Canadian Society of Landscape Architects
Association des architectes paysagistes du Canada

EDMONTON'S **GREEN NETWORK**

The green network is part of a connected network of open spaces and corridors providing multiple services to humans and the environment, which bring the following benefits in networks across the city:

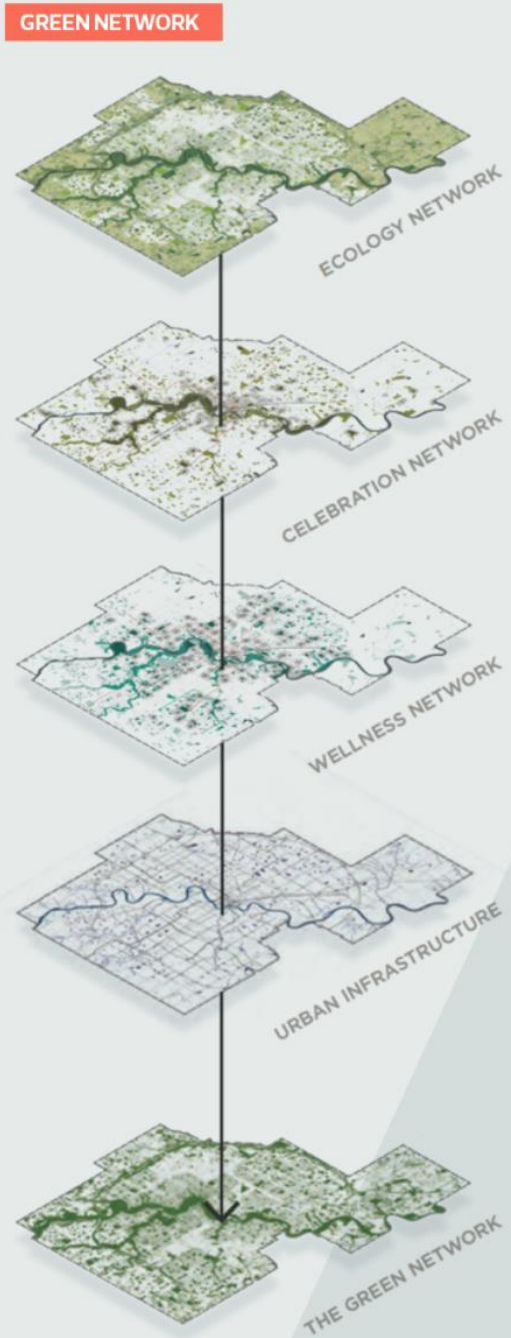
ECOLOGY
Supports and enhances the environment by sustaining healthy and resilient ecosystems.

CELEBRATION
Connects people to one another and builds a sense of place by providing places for communities to thrive, gather and celebrate.

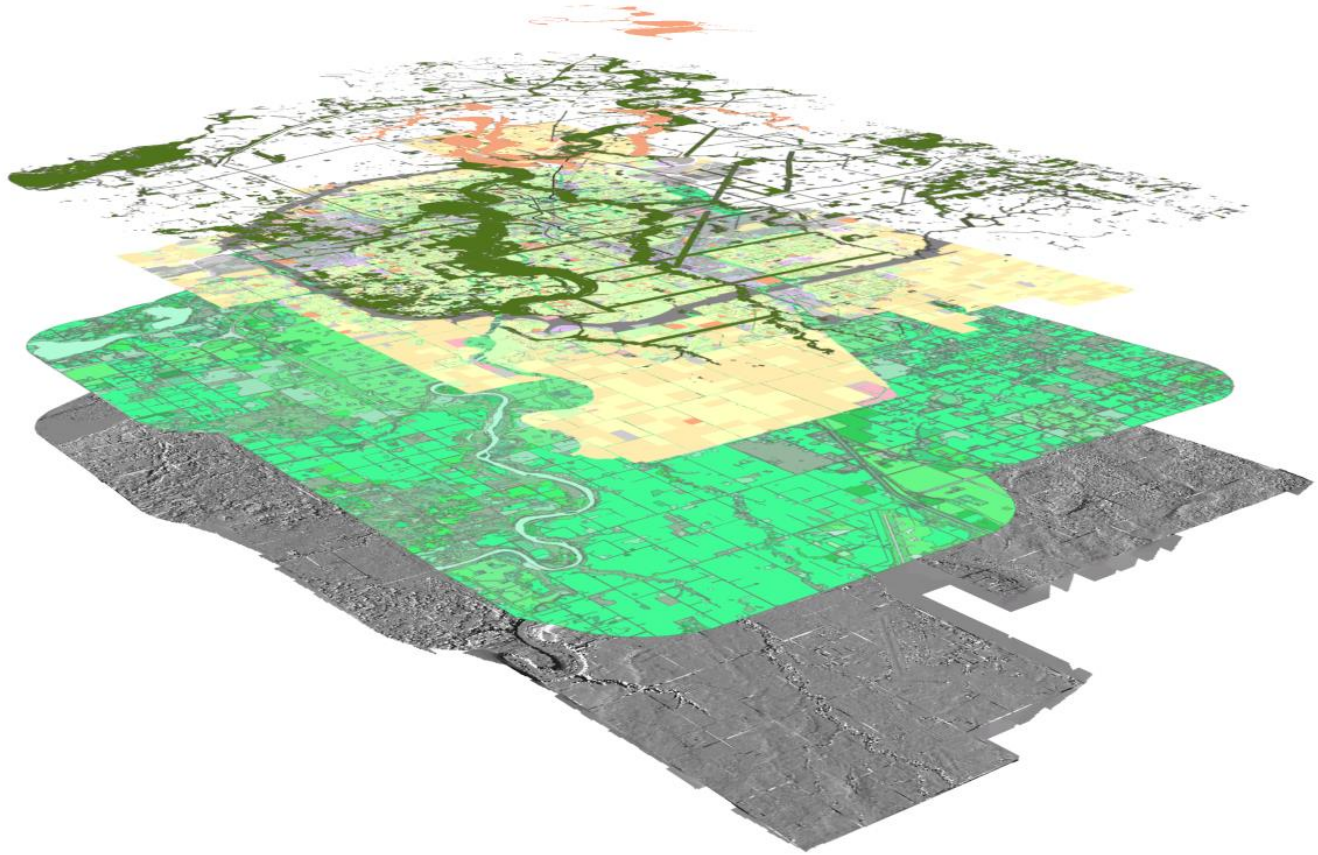
WELLNESS
Promotes healthy living and fosters wellbeing through diverse kinds of recreation, mobility and environments.

Understanding our green network means moving beyond a focus on the total amount of open space, and instead focusing on a **well-connected set of multifunctional open spaces**.

BREATHE's strategies consider the **distribution, quality, diversity, and supply** of open space in recognition that multifunctionality makes the most efficient use of public land as a scarce but valuable civic resource.



THE CITY PLAN



https://data.edmonton.ca

Apps | Active Holds | Edm... | Inbox (8) - grant.pe... | Leadership Portal -... | Sustainable Develo... | City Planning Branc... | Delegation of Auth... | LearnFlex - login ar... | Process and Inform... | SD Project Manage... | Executive Leadershi... | New folder | Apps

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City of Edmonton's Open Data Portal

Your data. Connect, download, analyze.
Please click here to review our Terms of Use.

Open Data 101
Tips & Tricks for using this site

Catalogue
Access our open data catalogue

Stories
Stories about data? Access them here!

+1 / Suggest A Dataset
+1 / Suggest A New Dataset : Why Not Do Both?

Citizen Dashboard
Access our Citizen Dashboard

EPS Dashboard
Access Edmonton Police Service's Dashboard

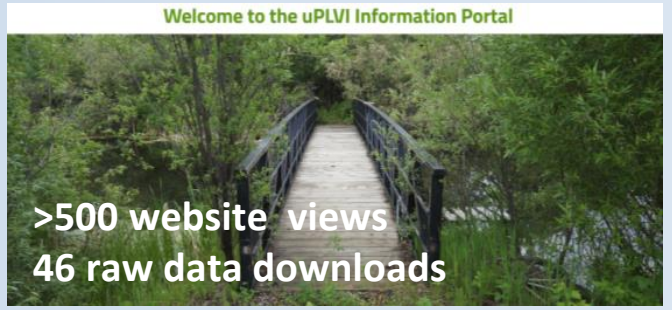
Open Budget
Access our Open Budget web application

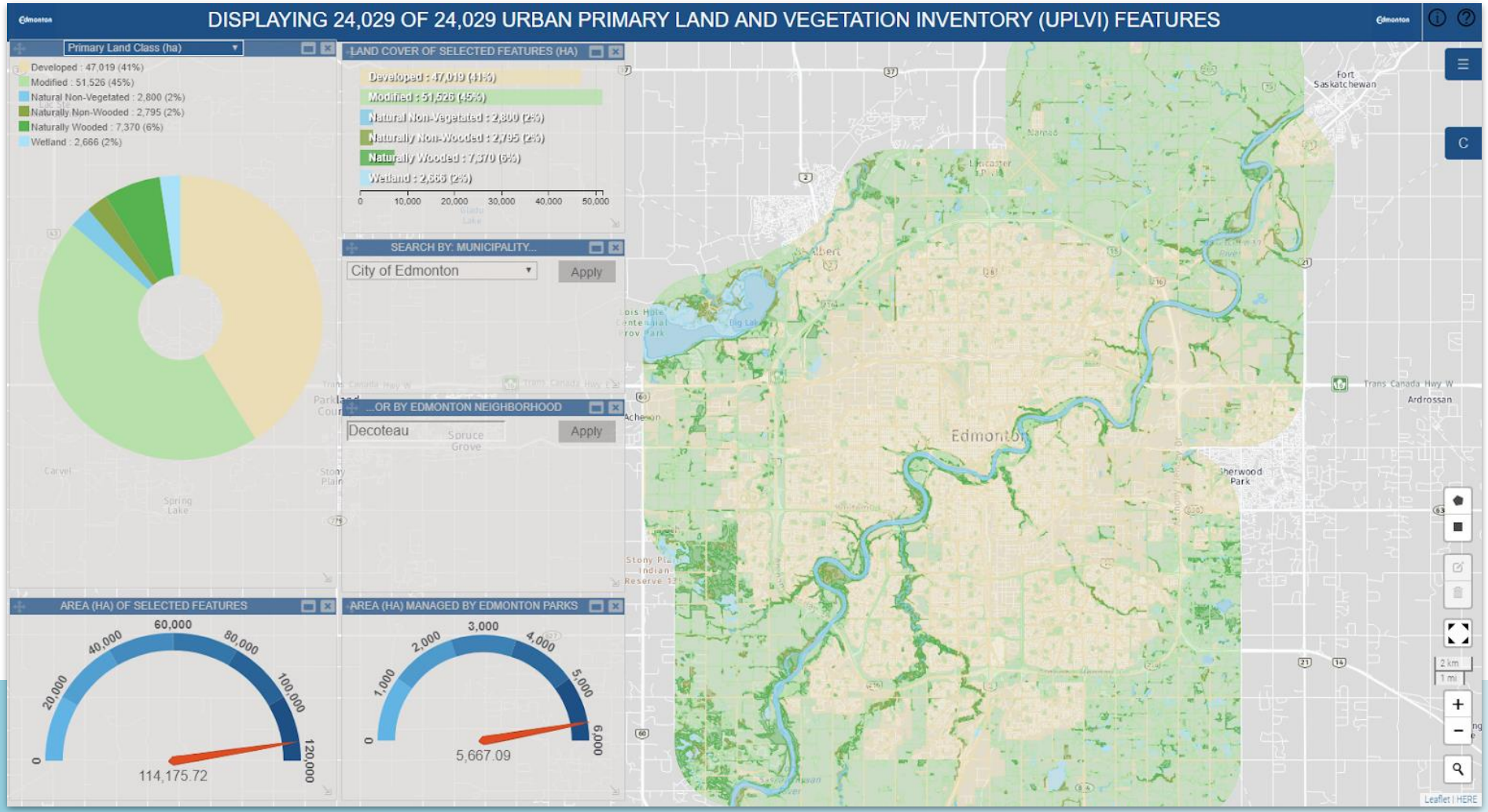
Open Data Toolkit
Access our Toolkit. Check out how we got to where we are today!

Breathe_StrategicP....pdf | Breathe_StrategicP....pdf | CoE_NA_lossassess....p... | Geowest_1993_Inv....pdf | Show all

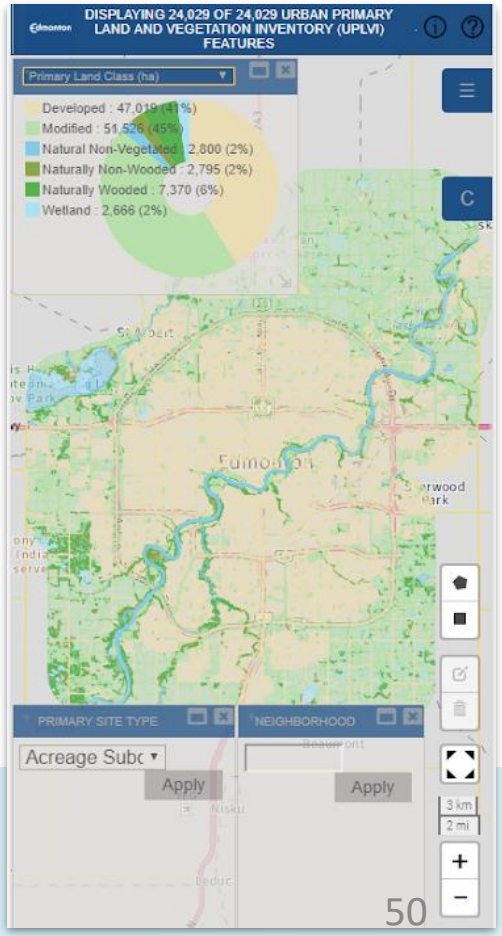
9:33 AM 4/26/2019

Public Education (Interactive Map)



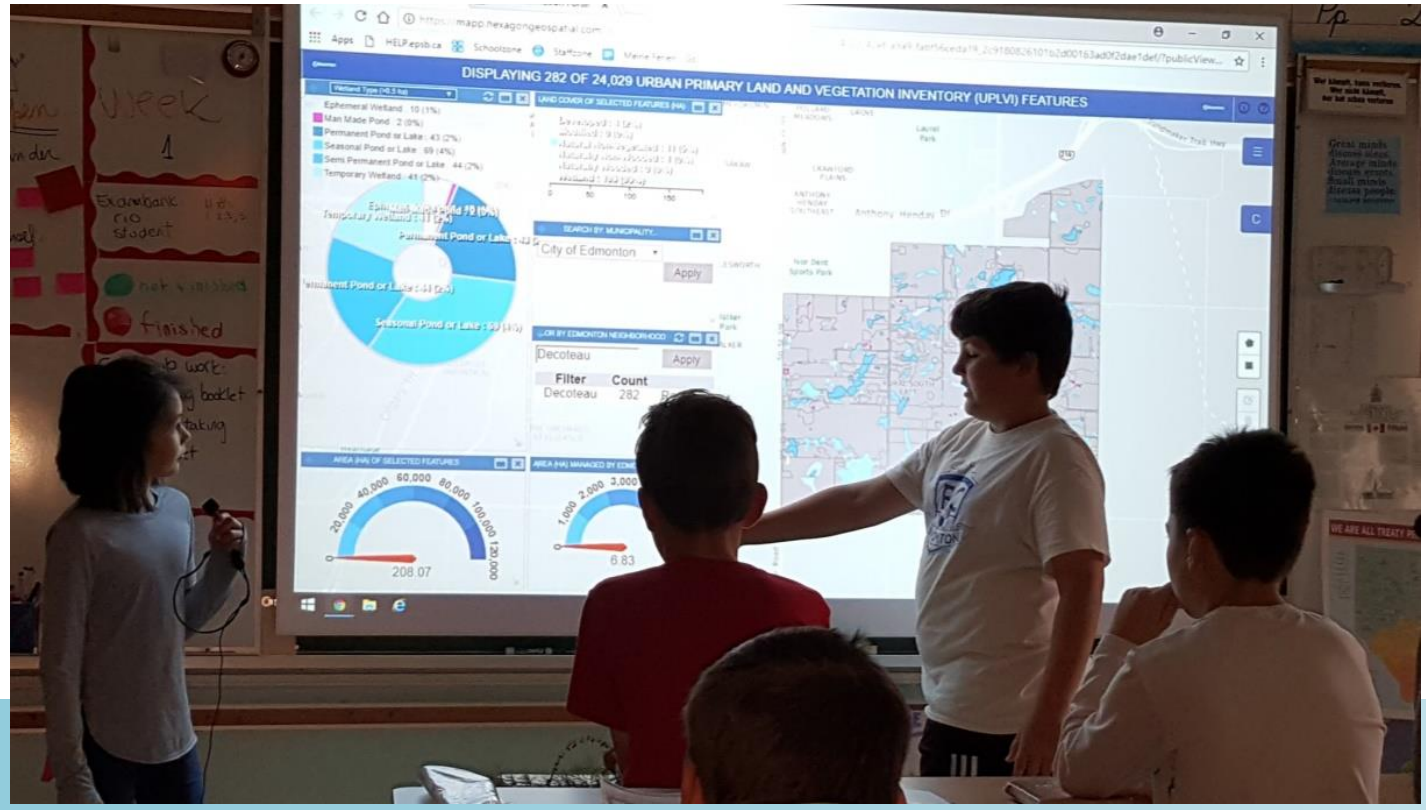


SmartPhone Edition:



Public Education (Elementary to Post Doc Research)

Use of interactive map for a wetlands assignment
Grade 5 Rio Terrace (Edmonton Public) German Bilingual Program



"I am writing to tell you how much we value the uPLVI for our research in human health. We are currently using the natural vegetation categories to associate with the diversity and composition of the infant gut microbiome and in combination with areas that experience more air pollution."

Charlene Nielsen, Post Doc, Pediatric Environmental Health Research Laboratory

Thank you

Grant Pearsell
grant.pearsell@gmail.com

CIDADE DE SÃO PAULO

VERDE E MEIO AMBIENTE

São Paulo, the challenges of SUSTAINABLE development and preservation of biodiversity

1

City of São Paulo Biodiversity

Main stages of preparation:

1. Diagnosis
2. Priority Areas for Conservation and Recovery
3. Action Plan

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1.a

Rain Forest Plan of São Paulo

Diagnosis

Flora

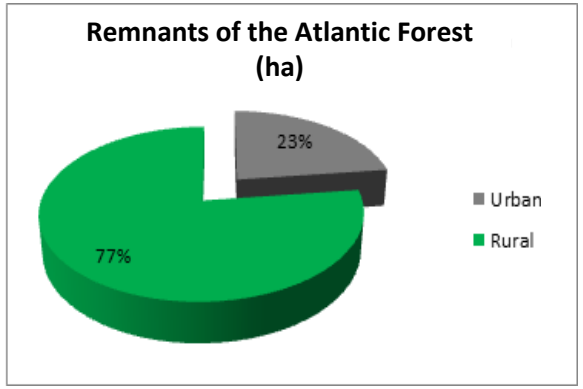
4,426 vascular species / 3,285 native species

Fauna

Class	Number of species
Mammalia	83
Birds	372
Amphibia	45
Reptilia (tortoises, crocodiles, lizards and snakes)	40
Osteichthyes (fishes)	23
Insecta (butterflies and crickets)	126
Arachnida (spiders)	09
Malacostraca (crabs and crayfishes)	02

District	Remnants of the Atlantic Forest Biome (ha)	%
Urban	10.554,25	23%
Rural	35.378,05	77%
Total	**45.906,47**	100,00%

Municipality Area	Remnants of the Atlantic Forest Biome (ha)	%
152.712,00	**45.906,47**	30,06%



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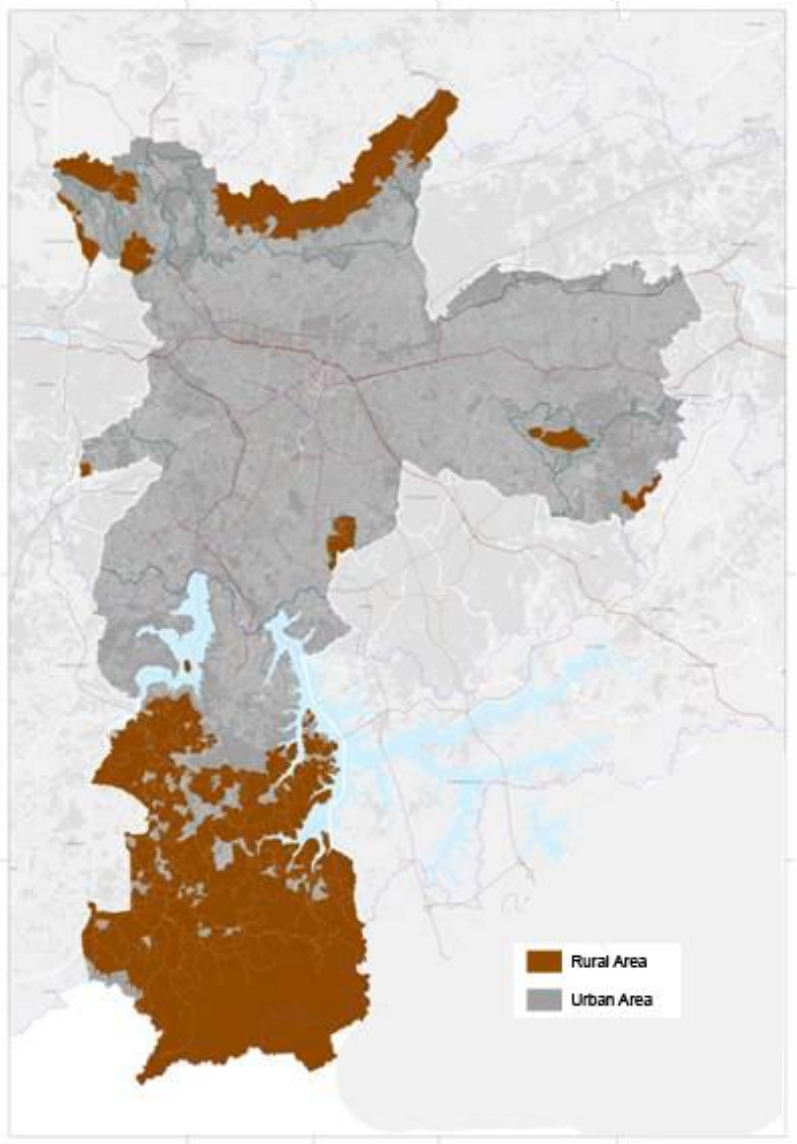
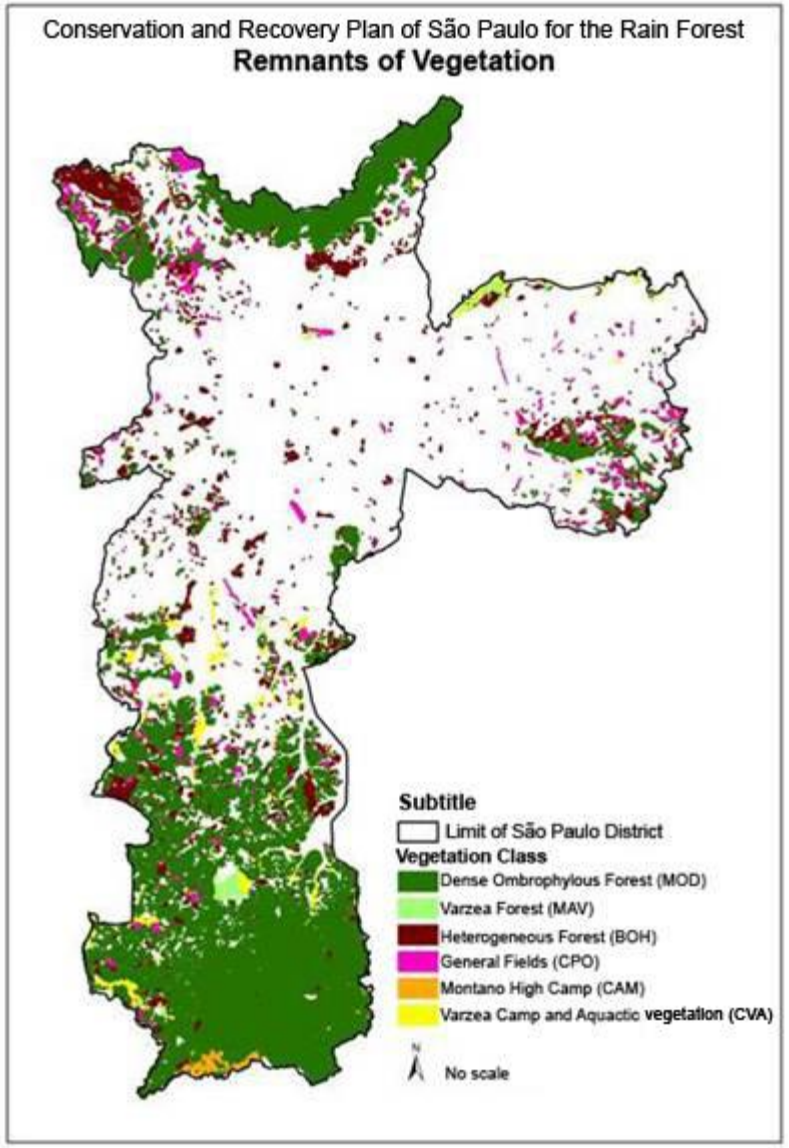
1.b

Rain Forest Plan of São Paulo

Urban Area and Rural Area



Remnants - PMMA



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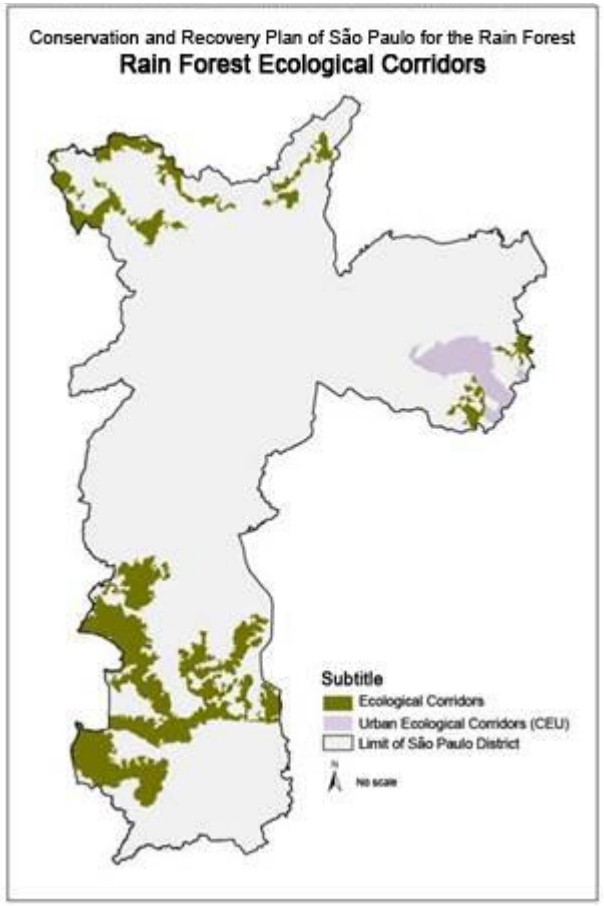
1.c

Rain Forest Plan of São Paulo

Priority Areas: Ecological Corridors

Ecological corridors are areas that have forests ecosystems with great importance and viable for the conservation of the Atlantic Forest Biodiversity, composed by conservation units groups, indigenous lands and interstitial areas. Its function is the effective protection of nature, reducing or preventing the fragmentation of existing forests, through the connection between different modalities of protected areas and other spaces with different uses of the soil.

Available in: *http://www.mma.gov.br/areas-protegidas/programas-e-projetos/projeto-corredores-ecologicos*



Atlantic Forest from São Paulo District (%)*	Total Area of Atlantic Forest from São Paulo District (hectare)	Total Area of Atlantic Forest from Ecological Corridors (hectare)
30,06	45.932,30	15.232,35

*Approximately 1/3 is within the Corridors

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1.d

Rain Forest Plan of São Paulo

Main Actions

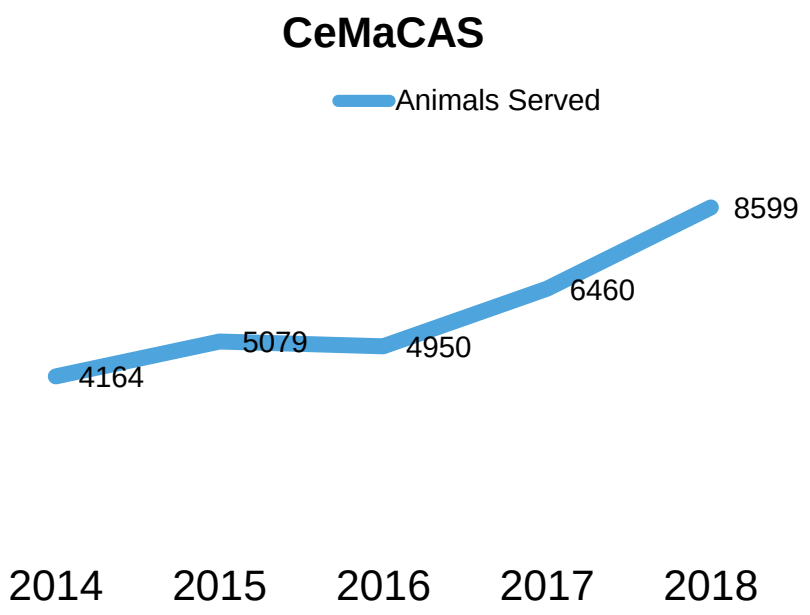
1.To create and implement Ecological Corridors;
2.Propose the creation and / or expansion of UCs, Urban Parks and Linear Parks;
3.To create and implement the Ecological Restoration Program in UCs, urban parks, linear parks and private areas;
4.To create the sustainable management development program for rural areas of the municipality of São Paulo
5.To improve Environmental Inspection in articulation with the State Government;
6.To prepare and implement the PMMA Communication Plan;
7.To apply the incentive instruments for conservation and recovery of remnant Rain Forest, as the PSA. (Payments for Provision of Environmental Services)
8.To raise and systematize studies of vegetation resilience to climate change;
9.To perform a study of the behavior of the regional climate against the change in the use and occupation of the soil in the vegetated areas.
10.To create financial incentives and technical support for the category of Private Natural Heritage Reserve

Technical Division of Veterinary Medicine and Wildlife Management

1.e

Wildlife Care

- The Wildlife Division is prepared to attend the various species of wild animals that live in the city of São Paulo. This service is provided by technicians specialized in the premises of the Technical Division of Veterinary Medicine and Wildlife Management and Conservation of Wild Animals (CeMaCAS).
- From1991 to 2018, 71,754 wild animals were treated.
- The Wildlife Division also conducts the wildlife county inventory. The most recent number (2018) recorded 1,121 species in 135 green areas and 5 water bodies.



2

Biodiversity Planning

System of Protected Areas, Green Areas and Free Spaces (SAPAVEL)

SAPAVEL is comprised of both environmentally sensitive areas such as conservation units and parks, as well as squares, open spaces, green areas of lots, cemeteries. Such system is an important tool to contribute to the environmental agenda of the township.

Payments for Provision of Environmental Services (PSA)

Implementation of a new instrument to reward property owners who knowingly preserve areas that provide relevant environmental services for the city's sustainability, such as water production, organic agriculture, preservation of remnants of the Atlantic Forest and biodiversity.

National Wildlife Management System (SISFAUNA)

The National Wildlife Management System is an electronic system for the management and control of enterprises and activities related to the use and management of wild fauna in carriage in the national territory.

2.a

Biodiversity Planning

Urban Tree Management System (SISGAU)

SISGAU is a web platform tool that assists the tree planting process through the construction of a register of trees, compiling information relevant to the creation of strategies for managing the specimens.

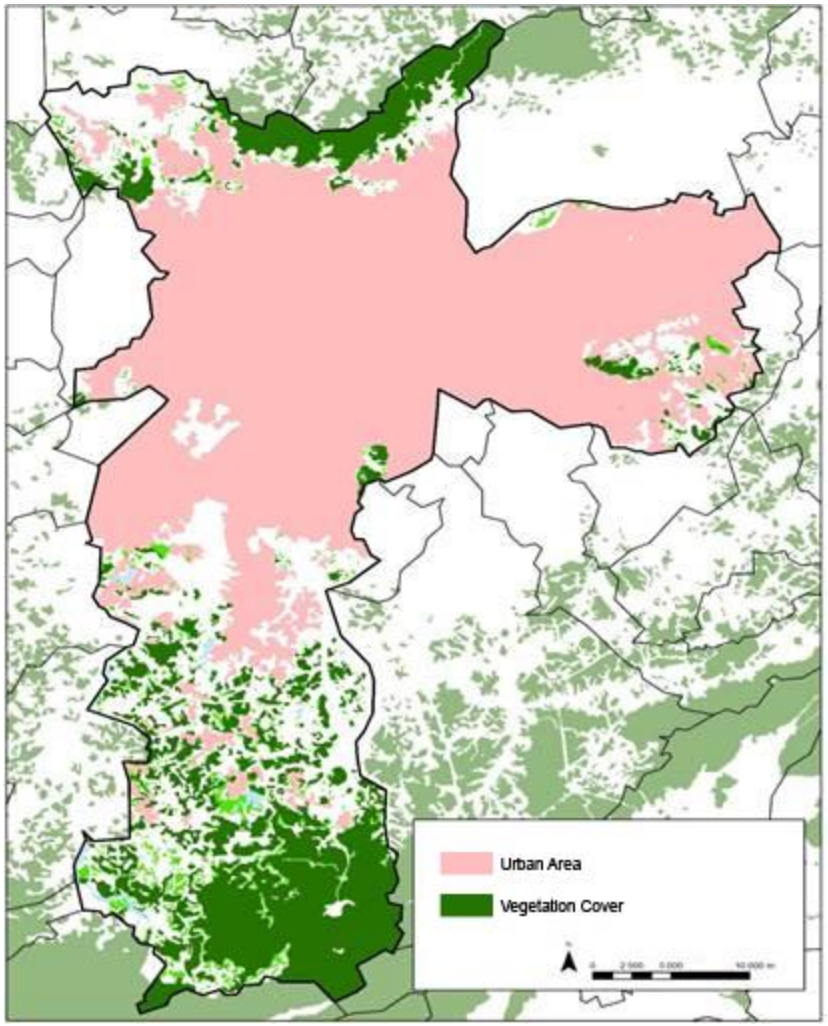
Supervision

SVMA counts on the Coordination of Environmental Surveillance (CFA), which supervises through of denunciations of environmental crimes, mainly using Law 9605/1998, which deals with criminal and administrative sanctions derived from actions harmful to the environment.

3

Indicators for monitoring

Vegetation Cover



Green Area by Inhabitant

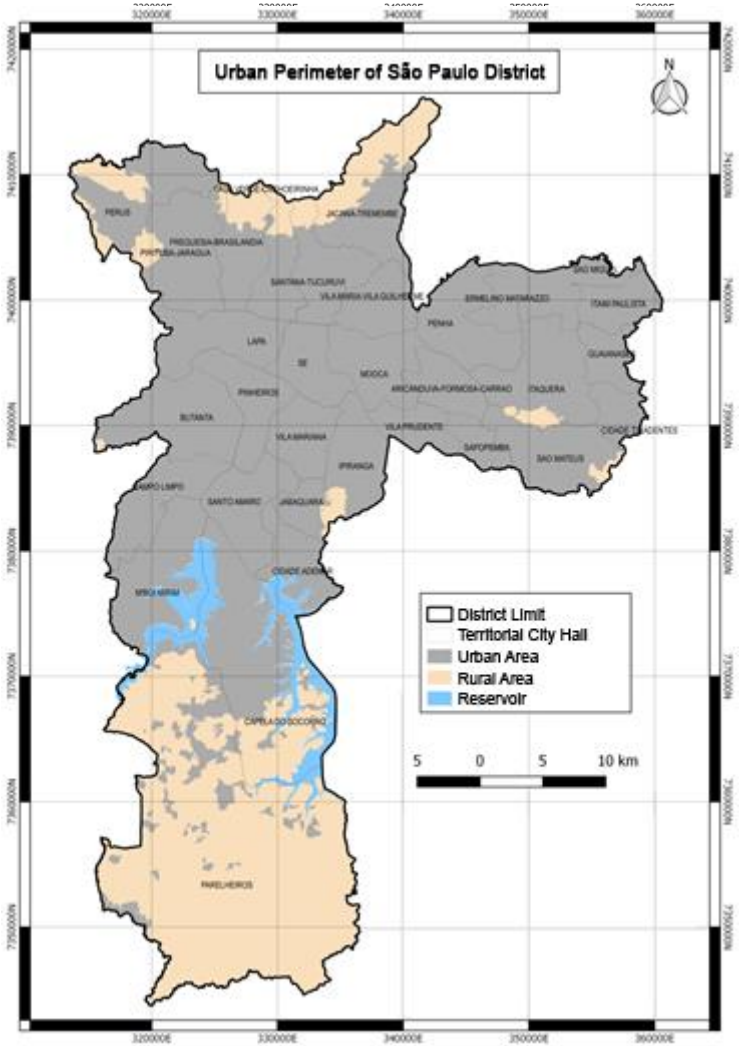
Green public area, in square meters per inhabitant by territorial city hall of São Paulo District

Aricanduva / Formosa / Carrão	4,13
Butantã	5,73
Campo Limpo	2,25
Capela do Socorro	16,23
Casa Verde / Cachoeirinha	17,44
Cidade Ademar	0,77
Cidade Tiradentes	4,89
Ermelino Matarazzo	4,17
Freguesia / Brasilândia	18,54
Guaianases	1,35
Ipiranga	10,7
Itaim Paulista	2,09
Itaquera	12,82
Jabaquara	4,69
Jaçanã / Tremembé	88,58
Lapa	4,71
M'Boi Mirim	6,94
Mooca	2,37
Parelheiros	358,79
Penha	15,1
Perus	63,71
Pinheiros	6,31
Pirituba	12,63
Santana / Tucuruvi	15,07
Santo Amaro	2,27
São Mateus	3,13
São Miguel	2,94
Sé	2,54
Vila Maria / Vilha Guilherme	3,03
Vila Mariana	6,8
Sapopemba	1,54
Vila Prudente	

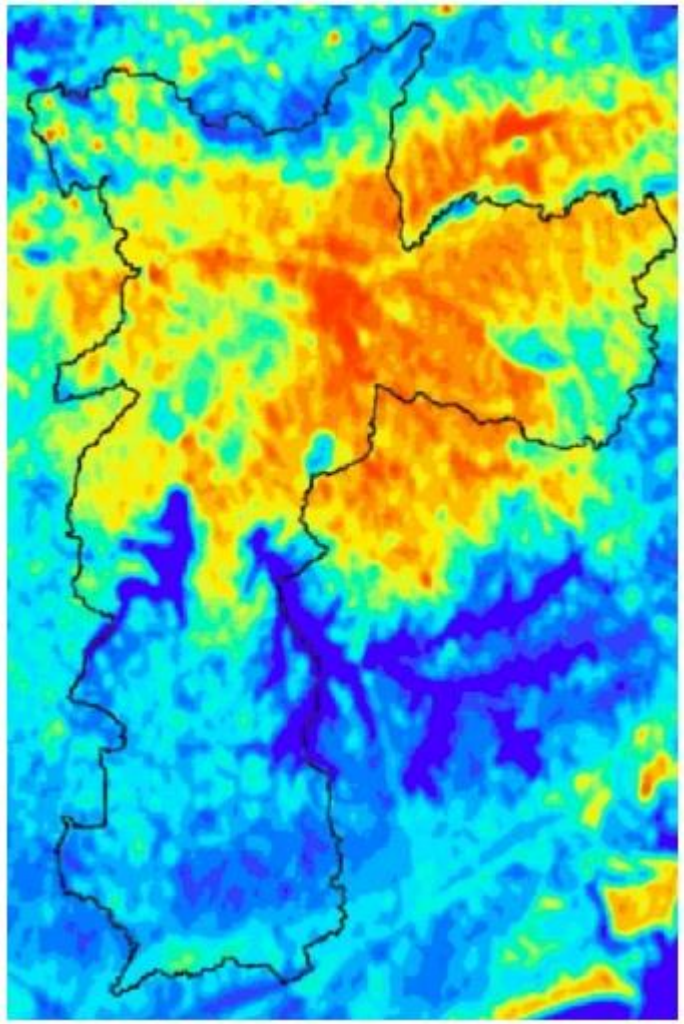
3.a

Indicators for monitoring

Urban Area



Heat Islands



4 Decision Making

The SVMA considers several factors for the decision making that can directly or indirectly impact the life of the citizen, we can mention:

- Encouraging the adoption of sustainable practices in construction, solid waste disposal and environmental preservation;
- Resilience
- Long-Term Planning;
- Strategic Director Plan;

The adoption of solutions based on nature for new constructions with increased permeability, containment of rainwater, ceilings and green walls and the non-incentive to use of automobile.

CIDADE DE SÃO PAULO

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City Practice

Q & A