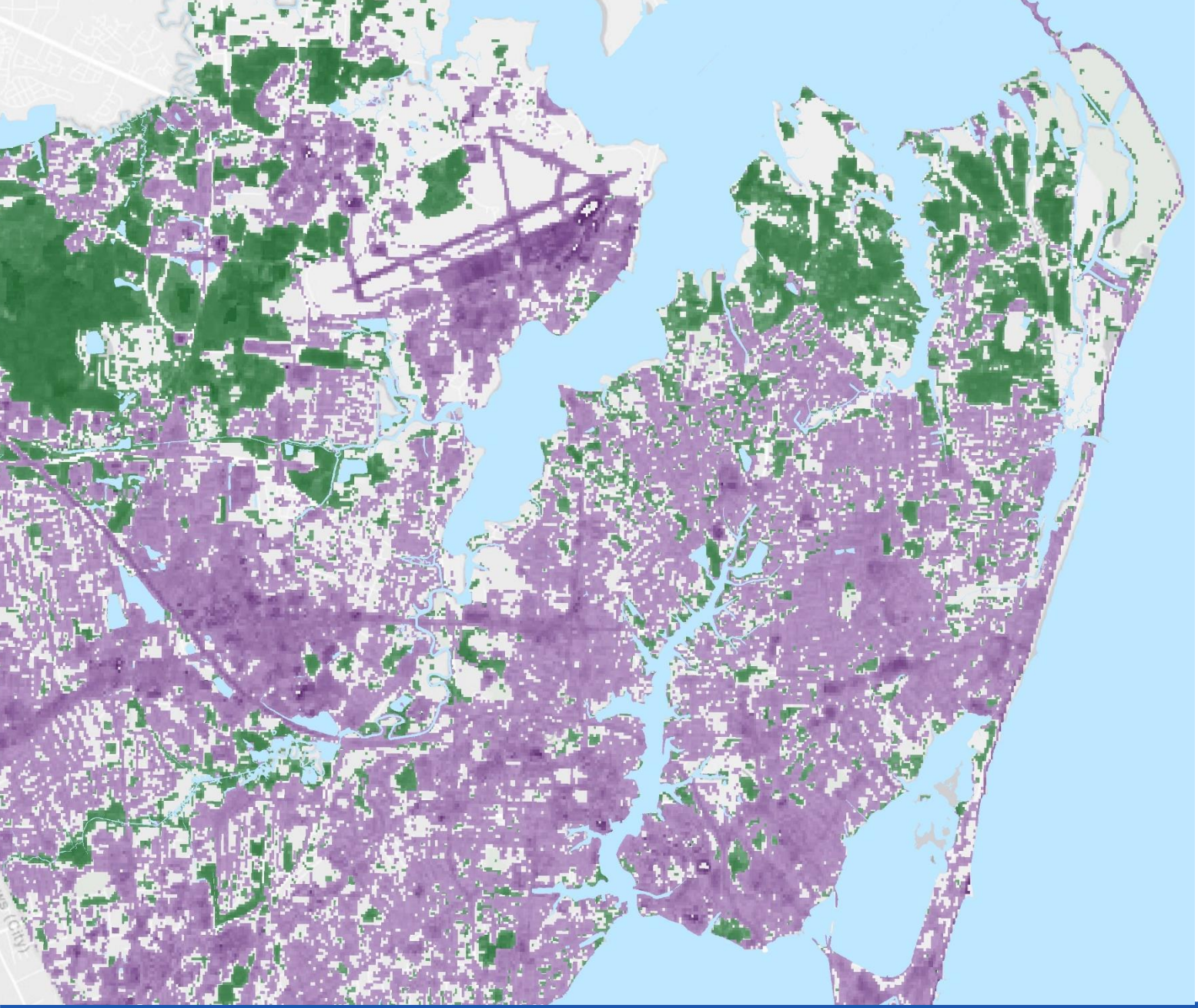


National Aeronautics and Space Administration

HAMPTON ROADS URBAN DEVELOPMENT II

Assessing Urban Tree Canopy and Impervious Surface Distribution to Inform Urban Planning in Hampton, Virginia

Stephanie Kealy

Sophie Barrowman

Paige Haley

Alina Schulz

PARTNERS

Image Credit: City of Hampton

STUDY AREA

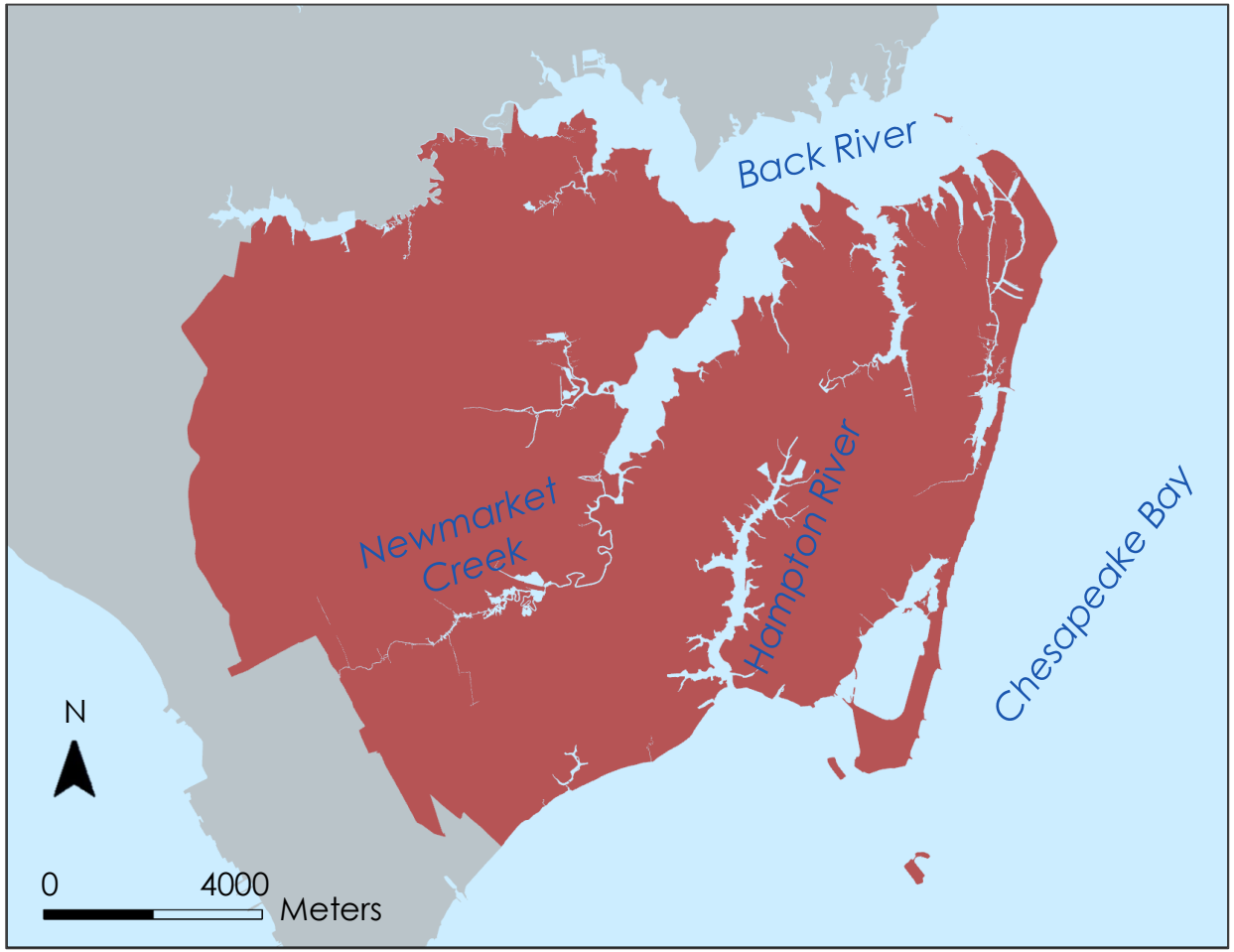
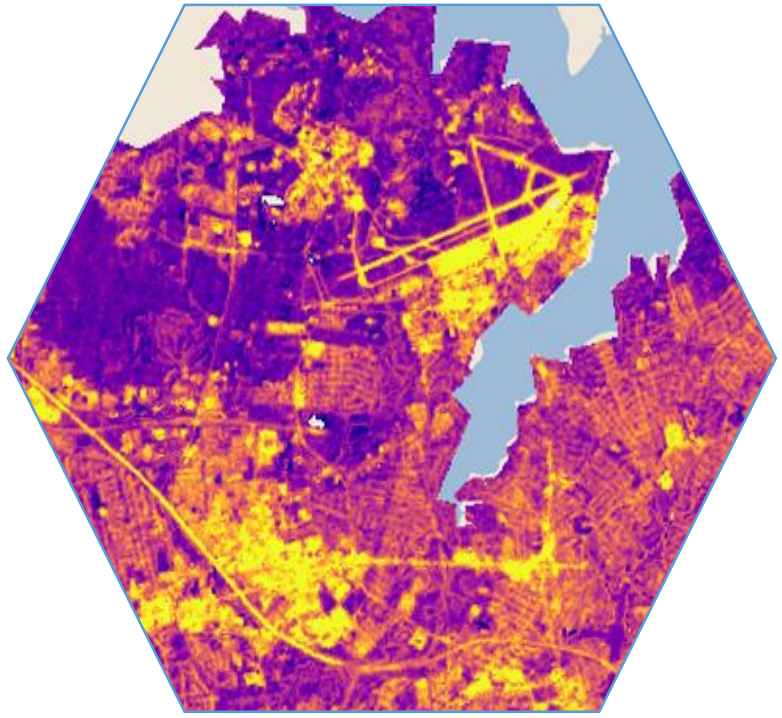


Image Credit: DEVELOP Team

OBJECTIVES

Utilize NASA Earth observations to…

- **Identify** zones susceptible to flooding



- **Map** distribution of impervious surface and tree canopy cover

- **Empower** city officials and residents to work together

Image Credits: City of Hampton, DEVELOP Team

COMMUNITY CONCERNS

- Recurring flooding
- Extreme weather and sea-level rise
- Blocked infrastructure and water damage

Image Credits: Jamie Chapman, Velva Goodman

IMPERVIOUS SURFACE & TREE CANOPY

Impervious surfaces increase runoff

- roads, parking lots, driveways and buildings

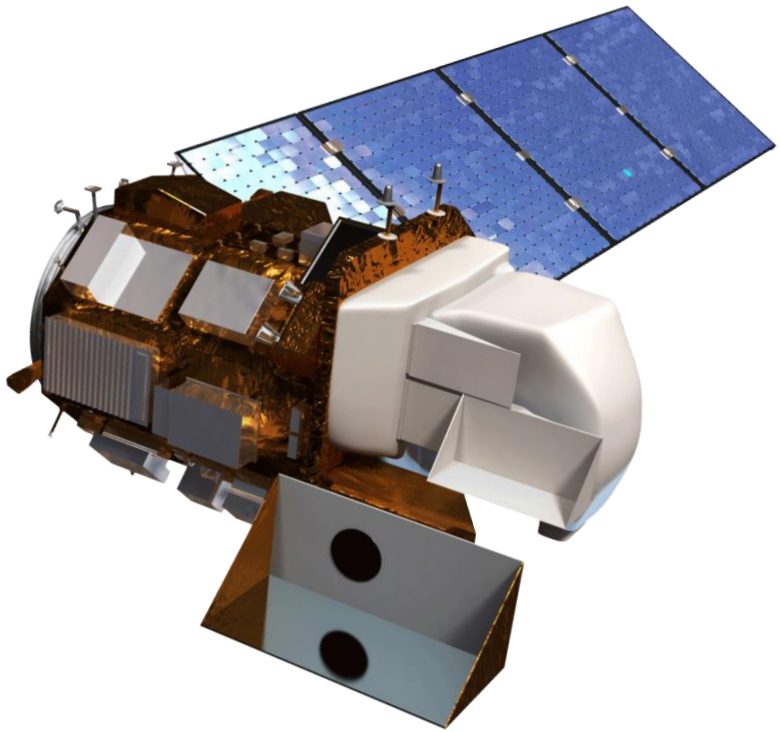
Trees reduce runoff

- catch rainfall
- slow raindrops
- absorb groundwater

Image Credit: PNGIMG.com, DEVELOP Team

NASA EARTH OBSERVATIONS

Landsat 8 OLI



Landsat 5 TM

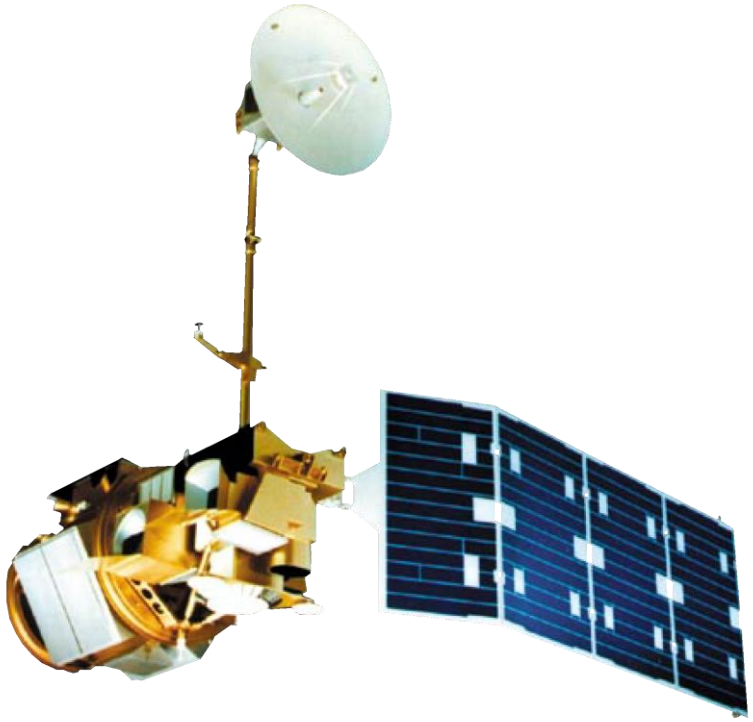
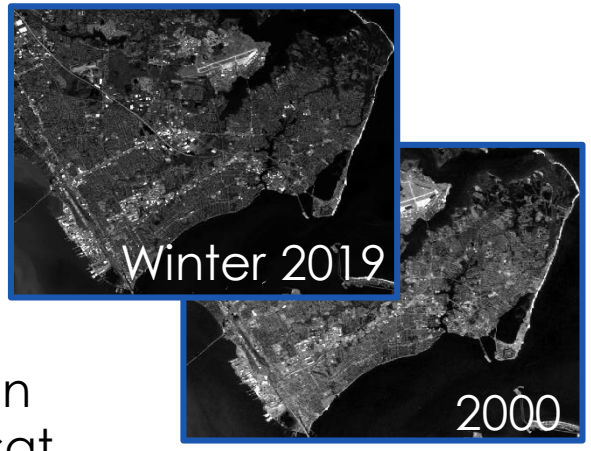


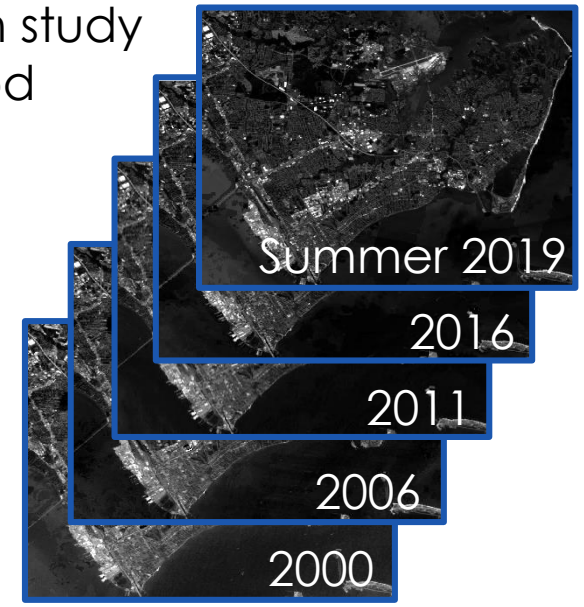
Image Credits: NASA

2000 to 2019

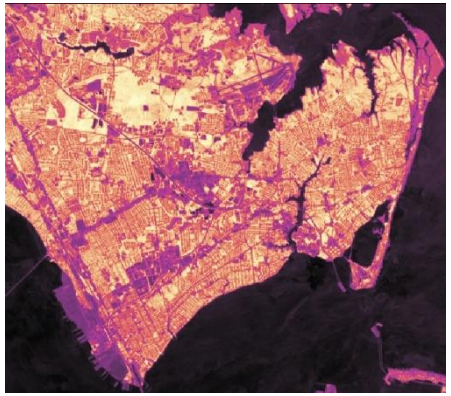
METHODOLOGY



Obtain Landsat imagery for each study period



Calculate % land cover



Calculate NDVI

SUMMARY OUTPUT

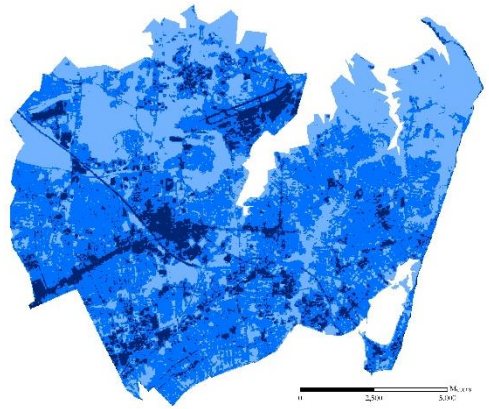
Regression Statistics	
Multiple R	0.627575948
R Square	0.393851571
Adjusted R Square	0.33746567
Standard Error	0.251616858
Observations	95

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	8	3.537785682	0.44222321	6.984930061	4.61751E-07
Residual	86	5.444749734	0.063311043		
Total	94	8.982535416			

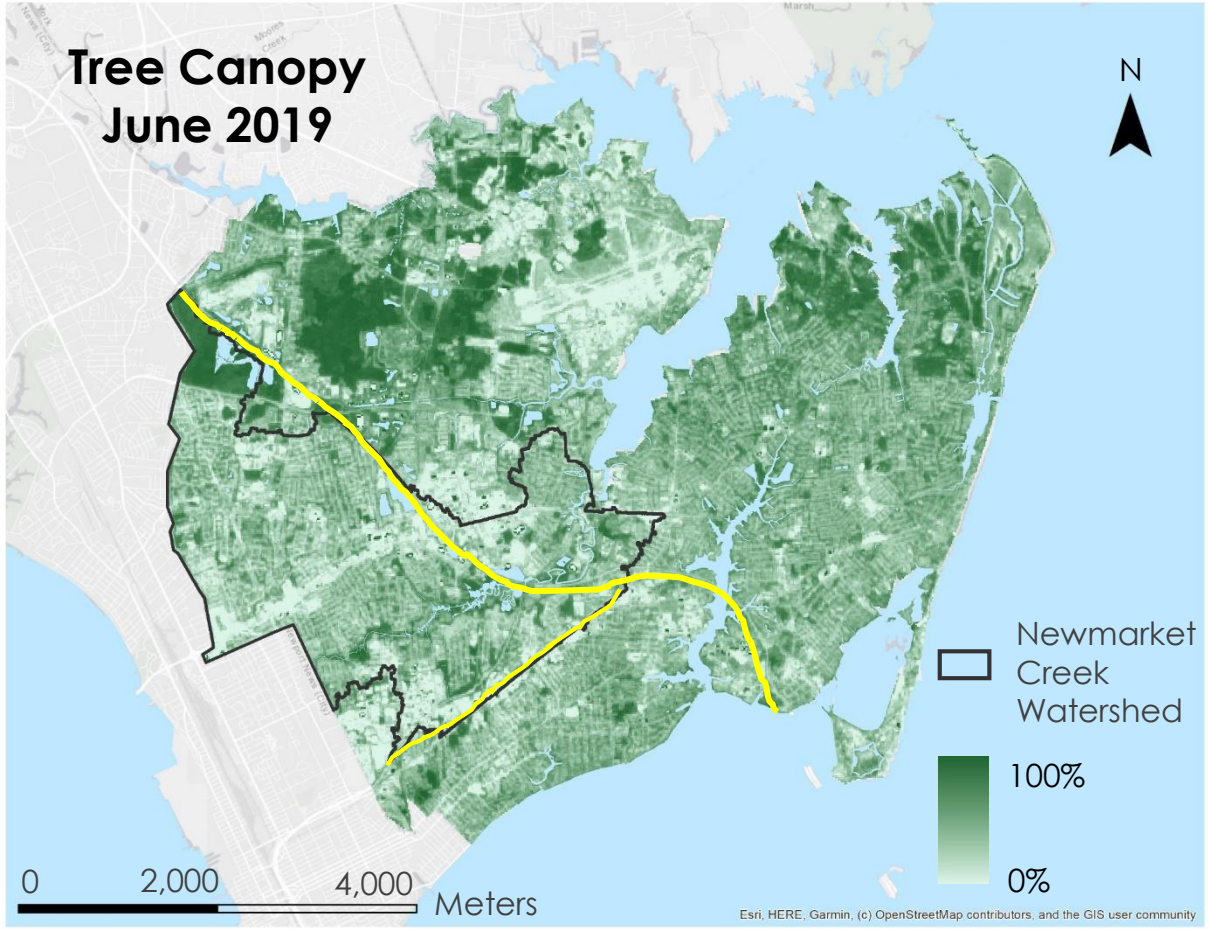
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	6.284441488	6.34474295	0.990495839	0.324710504	-6.328490051	18.89737303	-6.328490051	18.89737303
B1	0.000398899	0.000674193	0.5916687	0.555624627	-0.000941352	0.00173915	-0.000941352	0.00173915
B2	-0.000645473	0.000704648	-0.916021367	0.362217191	-0.002046266	0.000755321	-0.002046266	0.000755321
B3	0.000512626	0.000582061	0.880708518	0.380930243	-0.000644473	0.001669726	-0.000644473	0.001669726
B4	0.000218419	0.000113091	1.93134947	0.056733514	-6.39923E-06	0.000443236	-6.39923E-06	0.000443236
B5	-0.000375988	0.000196918	-1.909359496	0.059550041	-0.000767448	1.54728E-05	-0.000767448	1.54728E-05
B6	-0.002119009	0.002156511	-0.982609766	0.328555847	-0.006406012	0.002167994	-0.006406012	0.002167994
B7	-5.54512E-05	0.000283655	-0.195488427	0.845471738	-0.000619338	0.000508436	-0.000619338	0.000508436
NDVI	0.422991014	0.275037203	1.537941085	0.127734342	-0.12376485	0.969746879	-0.12376485	0.969746879

Run regression



Generate maps

RESULTS



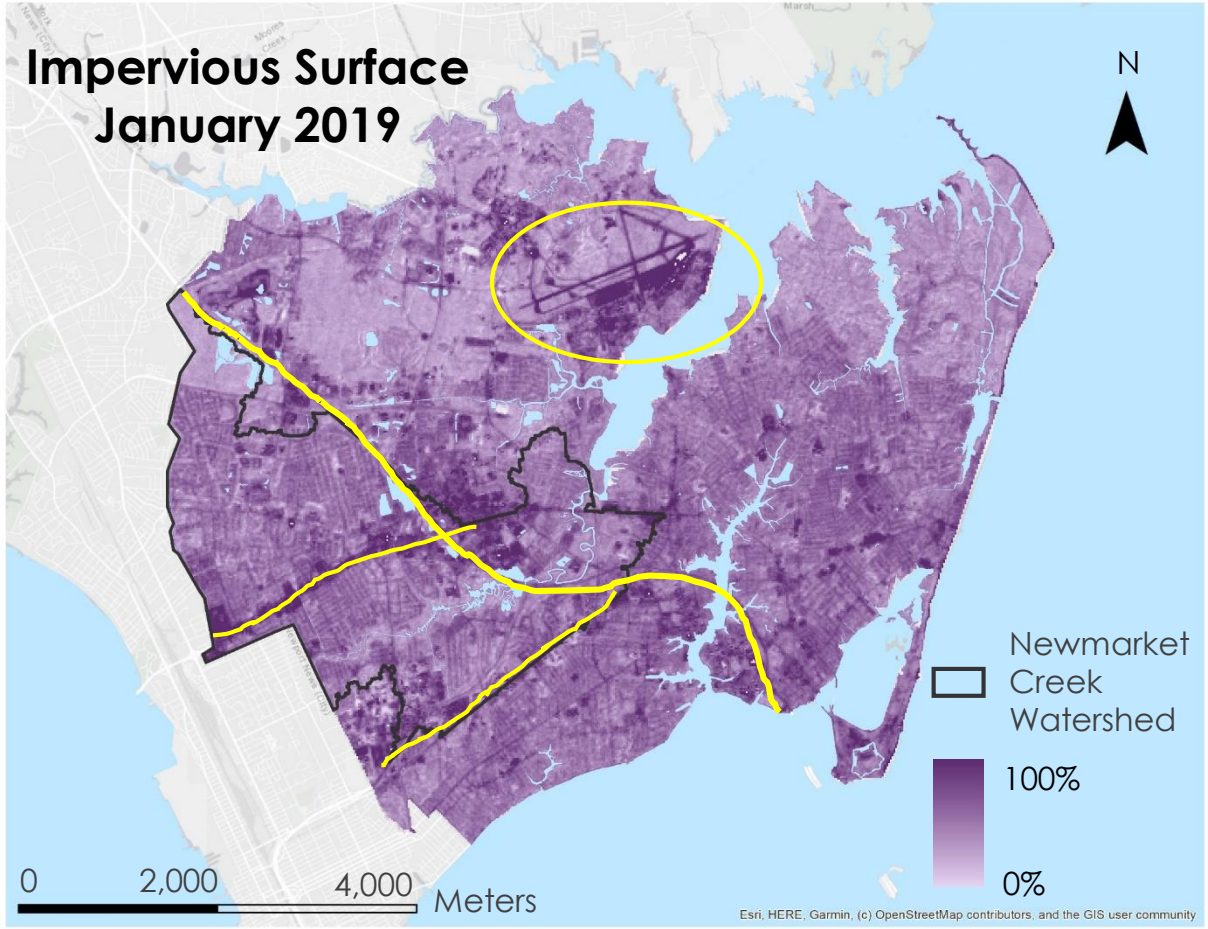


Image Credits: DEVELOP Team

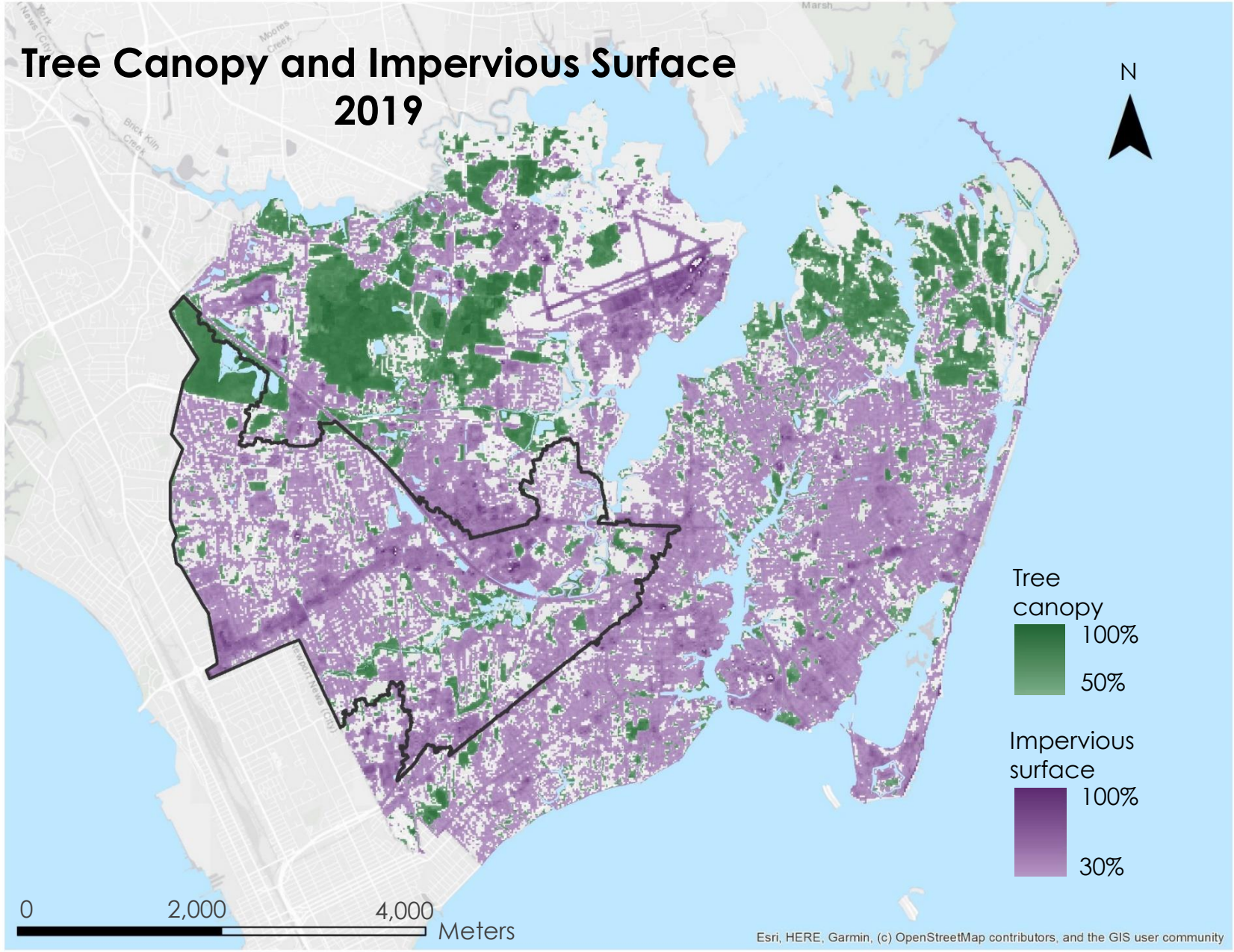
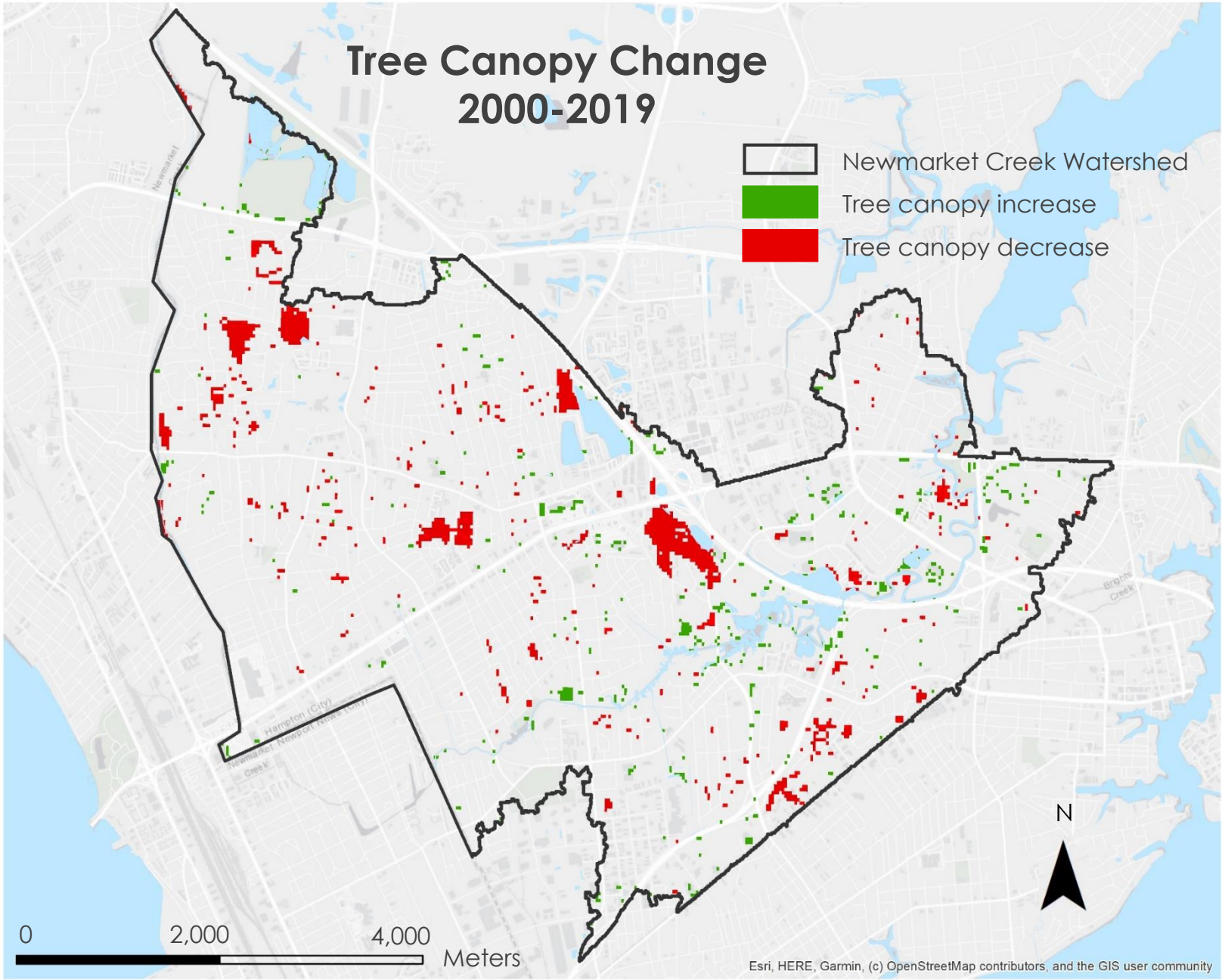


Image Credits: DEVELOP Team



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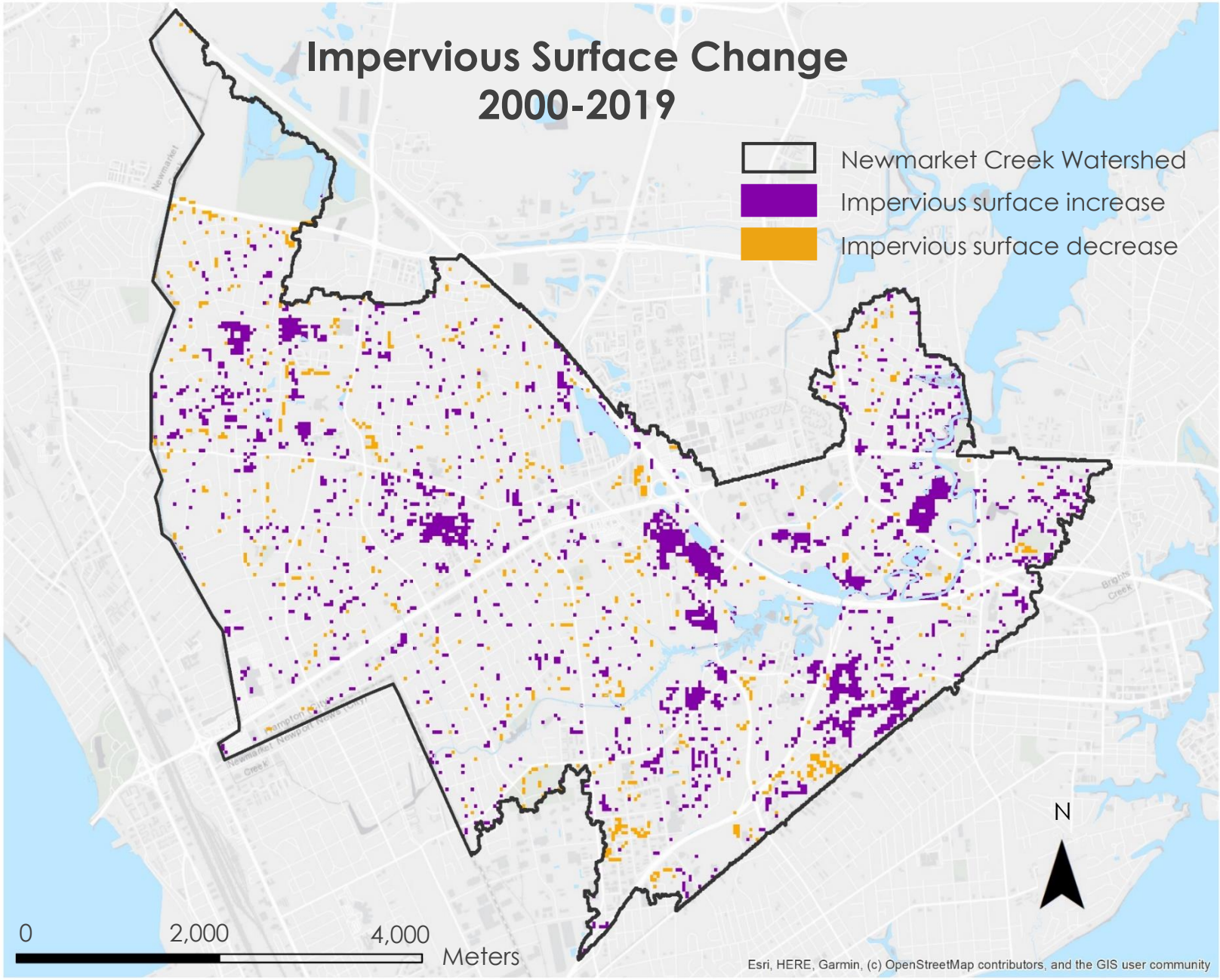
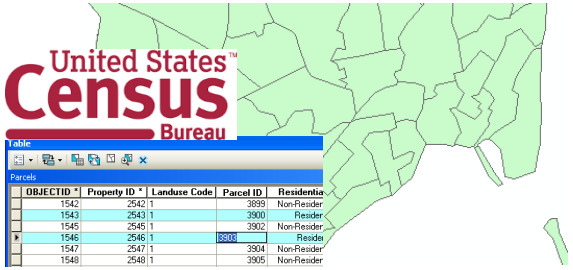


Image Credits: DEVELOP Team

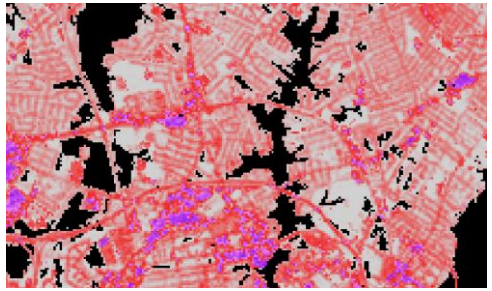
CHANGE RESULTS 2000-2019

	Impervious surface			Tree canopy		
	January 2000	*January 2019*	*Percent Change*	*August 2000*	*June 2019*	*Percent Change*
City of Hampton	53%	61%	**+ 8%**	17%	23%	**+ 6%**
Newmarket Creek Watershed	48%	67%	**+ 19%**	16%	15%	**- 1%**

Inputs



Census Blocks + Pop Data



% Impervious Surface

Fine Res. Land Use Layer

Percent Impervious Surface by Census Block

ISAT Output using High Population Density Scenario

Water Quality
Protected 0-10%
Impacted 10-25%
Degraded 25% +

≤ 20%
≤ 25%
≤ 30%
≤ 35%
≤ 45%
Newmarket Creek Watershed

0 4,000 Meters

N

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Image Credits: DEVELOP Team

CONCLUSIONS

- **All Census Blocks** – degraded water storage capacity
- **Place-based approach** – unique results depending on scale
- **Newmarket Creek watershed** – in need of water quality & infiltration rehabilitation confirmed using NASA Earth observations

ERRORS & UNCERTAINTIES

- Coarseness of Landsat sensors (30 m) increases uncertainty for detecting heterogeneous fine scale phenomena in the urban setting
- Regression results have not been validated

Image Credits: City of Hampton

FUTURE WORK

- Utilize Urban Flood Risk Mitigation Model, a part of Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST), upon release
- Expand study area to all of Hampton Roads

Image Credit: DEVELOP Team

ACKNOWLEDGEMENTS

- City of Hampton: Bruce Sturk, Lucy Stoll, David Imburgia, Alan Lambert
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