Groundwater Modeling of Septic System Discharge in Miami-Dade County

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BACKGROUND

- Septic systems are a major part of Miami-Dade county's wastewater system.
- Sea level rise elevates coastal groundwater levels which can cause Septic systems to malfunction potentially contaminating groundwater.
- This is important as this contamination from septic systems can cause public health and environmental hazards such as polluting drinking water or contributing to algal blooms.
- The goal of this project is to identify discharge locations and simulate the movement of groundwater contaminated by septic systems.

METHODS

1. Simulation results from the Urban Miami-Dade county groundwater model by USGS and Miami-Dade Water and Sewer Department were used.
2. The model has a grid size of 101 rows by 189 columns with three layers and a cell size of 500 meters.
3. Septic System return fluxes (m/day) were used as inputs to the model.
4. In areas where nutrient fluxes are above 0 one particle was released .
5. Miami-Dade county waterways were added such as the canal system, bay, and ocean.
6. The model was ran in ModelMuse and represents a period of 30 years (1996-2026) under the scenario of current sea level.
7. GIS was used to create maps of model results.
8. SGeMS was used for informed interpolation then excel was used to perform statistical analysis comparing different groundwater nutrient sample concentrations for Miami-Dade County to particle flow.

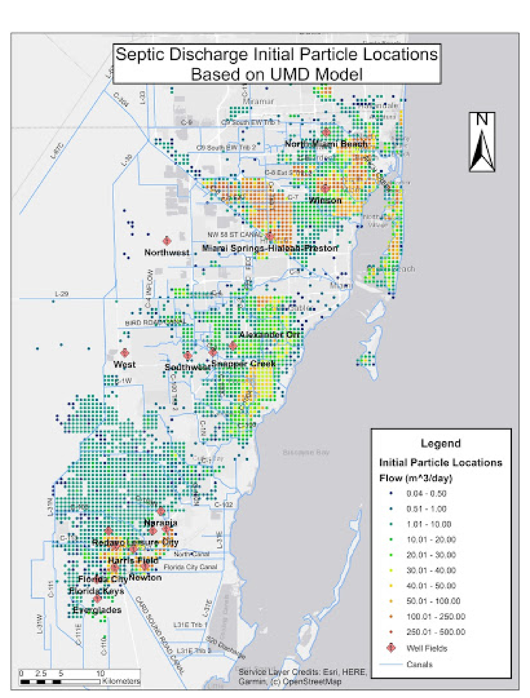
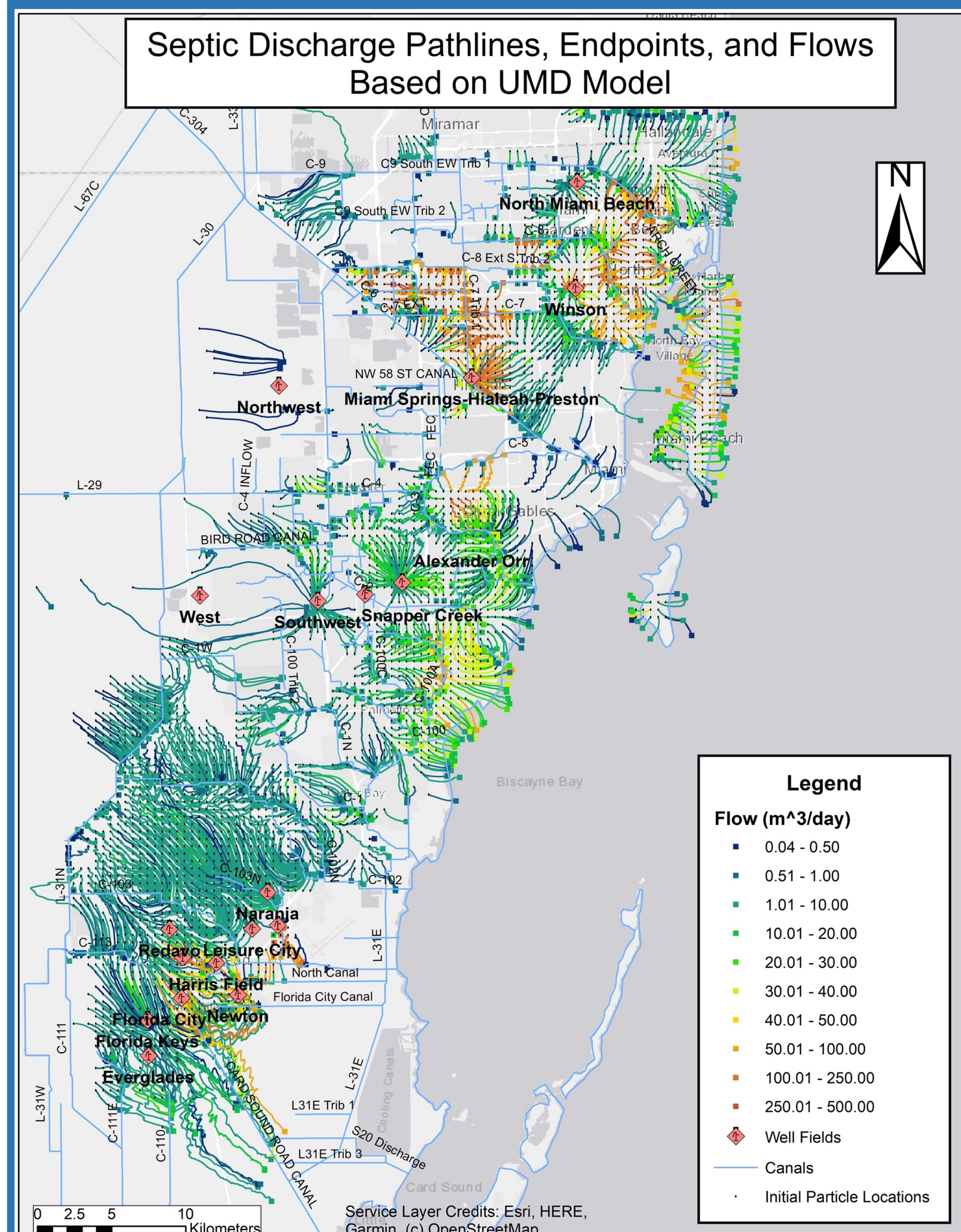
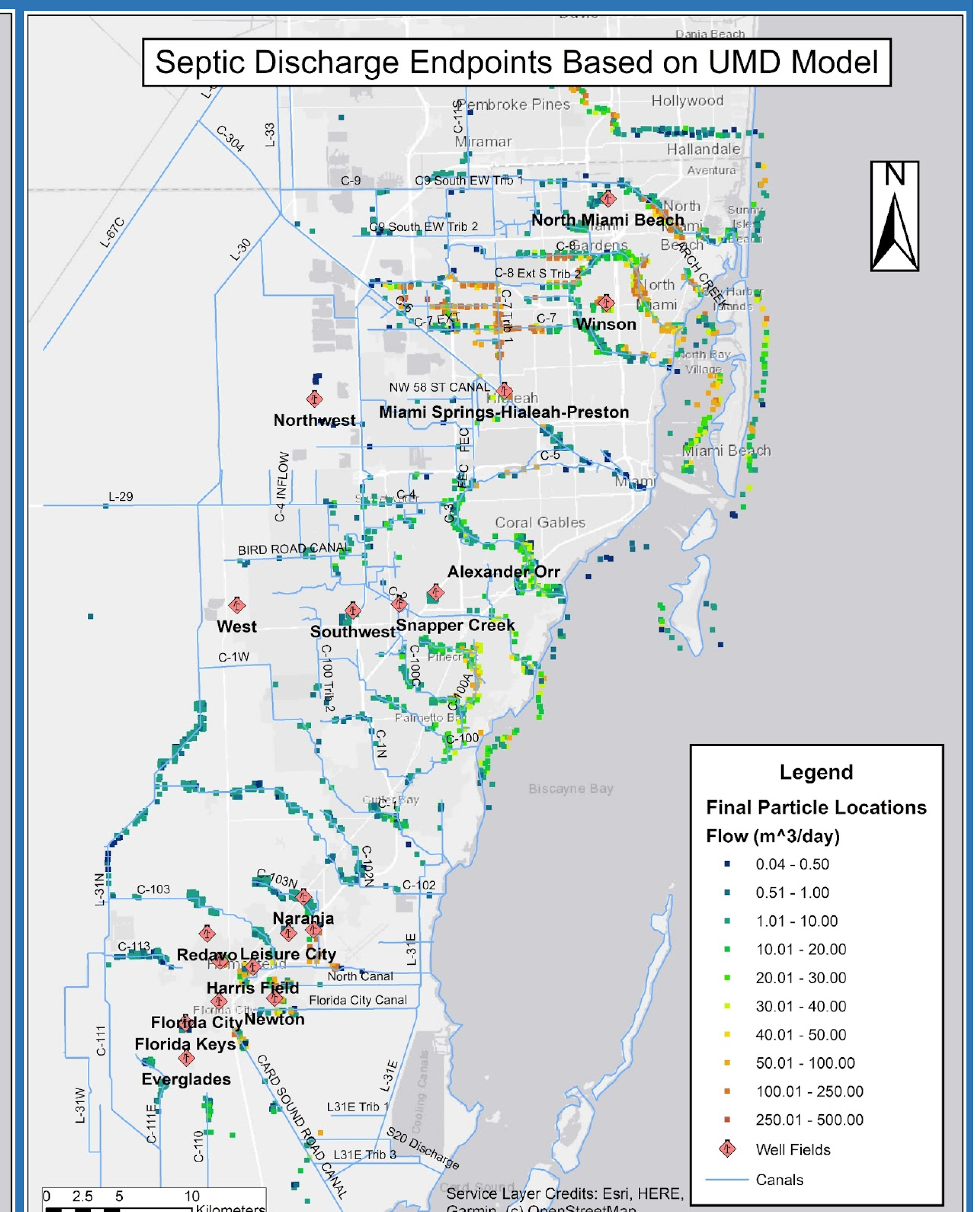


Figure 1: Map showing the initial particle locations obtained from septic system returns described in the Urban Miami-Dade Groundwater Model

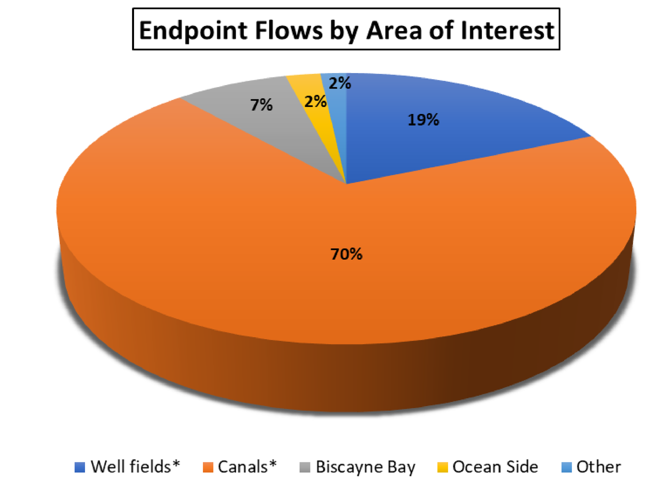
A 30-year simulation shows septic system discharge ends up primarily in canals followed by well fields, Biscayne Bay, and the ocean.





Figures 2 and 3: Map showing a 30-year simulation of particle motion from septic discharge locations described in Urban Miami-Dade Groundwater Model; Most particles terminate at canals, in Biscayne Bay, and well fields.

RESULTS



Endpoint Flows by Area of Interest		
Location	Number of particles	Flow (m^3/day)
Well fields*	422	14066
Canals*	2317	52830
Biscayne Bay	236	5696
Ocean Side	80	1747
Other	49	1303
Totals	3104	75642

*500 m from cell/object

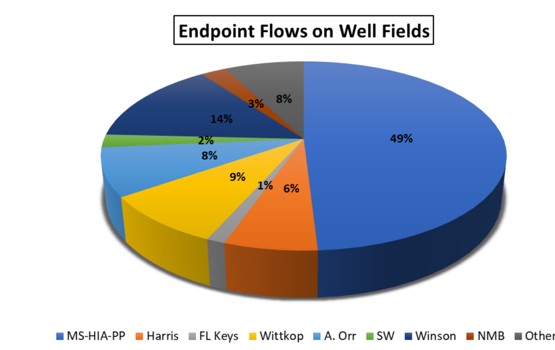
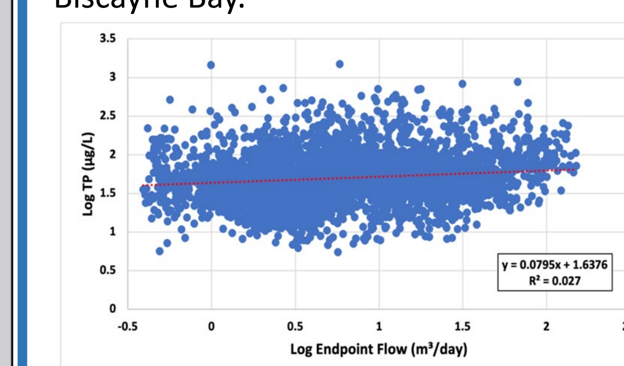
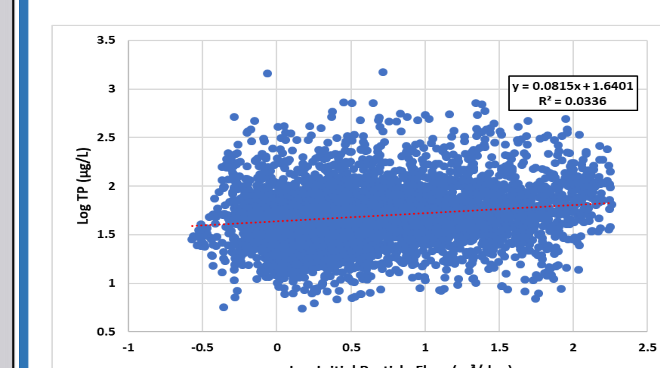


Figure 4:This chart shows the discharge fate of groundwater flows from septic systems for each major area. It tells how many particles are found in each major area and what the total flow is. Most flows end up in the canals with eventual discharge to Biscayne Bay.



Log Endpoint Flows vs Log TP		
Correlation	p-value	Alpha
0.16	2.13E-43	0.05



Log Initial Particle Flow vs Log TP		
Correlation	p-value	Alpha
0.18	9.84E-54	0.05

Figure 5:The geostatistical software SGeMS was used for informed interpolation allowing for comparison between nutrients and particle flow. Log total phosphorus shows a significant weak correlation with both log initial particle flow and log endpoint flow.

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