To:	Moira Homann, DEP; Woo-Jun Kang, DEP; Chandler Keenan, DEP; Tony Tomalewski, DEP; Diana Turner, DEP
From:	Tetra Tech
Date:	March 30, 2026
Subject:	Task 5. ArcNLET-Py Model Development

1.0 INTRODUCTION

The Florida Department of Environmental Protection (DEP) contracted with Tetra Tech to develop the St. Lucie River Hydrological Simulation Program – FORTRAN (HSPF) Model with a simulation period from January 1, 2008– December 31, 2023. As part of this development, the septic system inputs into the HSPF model are being developed with a comprehensive separate ArcGIS-based Nutrient Load Estimation Toolbox in Python (ArcNLET-Py) Model of the entire St. Lucie River and Estuary Watershed. This memo documents the development, parameterization, calibration, and output processing of this model.

2.0 ARCNLET-PY MODEL DESCRIPTION AND INPUTS

ArcNLET-Py is an analytical, GIS-integrated model originally developed by Florida State University for DEP to simulate nitrogen—and, in its 2023 Python/ArcGIS Pro rewrite, phosphorus—transport from onsite sewage treatment and disposal systems (OSTDS), commonly referred to as septic systems. It couples a simple one-dimensional advection-dispersion-decay framework for both the vadose and saturated zones with closed-form solutions, enabling rapid, catchment-wide estimates of contaminant mass flux from thousands of point sources without the need for a full numerical groundwater model (Core et al, 2023).

This toolkit has been successfully applied to estimate nitrate (NO_3) loads from OSTDS in the City of Port St. Lucie, City of Stuart, and Martin County (Ye et al., 2013); Indian River Lagoon (Sayemuzzaman et al., 2015); City of Vero Beach (Tetra Tech, 2022); St. Lucie County (Tetra Tech, 2020); Indian River County (Tetra Tech, 2023); and Caloosahatchee River and Estuary (Tetra Tech, 2025). The 2023 update ported the code to Python for ArcGIS Pro integration and added a phosphorus module, which was leveraged in this St. Lucie River and Estuary Watershed application to produce spatially explicit nitrogen and phosphorus load estimates for integration into the regional HSPF model.

For the St. Lucie River and Estuary Watershed modeling, the core GIS inputs comprised a high-resolution digital elevation model (DEM) to derive flow directions and depth-to-water-table; hydrography layer delineating rivers, streams, and lakes; Soil Survey Geographic Database (SSURGO)-based soil porosity and saturated hydraulic conductivity rasters, and comprehensive OSTDS point database. Calibration used groundwater level time series from monitoring wells to adjust smoothing factors and NO_3/phosphate (PO_4) concentration data to tune first-order decay and attenuation parameters. Subsections 2.1 through 2.6 that follow describe each dataset's source, projection and processing steps, and its role within the ArcNLET-Py workflow.

For this application, all inputs except OSTDS locations (DEM, waterbodies, soils) were clipped to a one-kilometer buffer around the existing HSPF model boundary to prevent edge artifacts during model runs.

2.1 ELEVATION DATA

Topography for the St. Lucie River and Estuary Watershed was built from the one-meter 2018–2020 Florida Peninsular (National Oceanic and Atmospheric Administration [NOAA] Inport 75872) U.S. Geological Survey (USGS) Light Detection and Ranging (LiDAR) data. Figure 1 shows the original data spatial extent. Select raster tiles from the dataset were reprojected to UTM Zone 17N in meters and mosaicked into a seamless surface. To balance spatial detail with computational efficiency, the merged DEM was resampled to a 10-meter resolution. All model inputs and outputs use metric units. The final 10-meter DEM (Figure 2), referenced to North American Vertical Datum of 1988 (NAVD 88), provides the elevation base for ArcNLET-Py's derivation of groundwater flow directions and depth-to-water-table estimates.

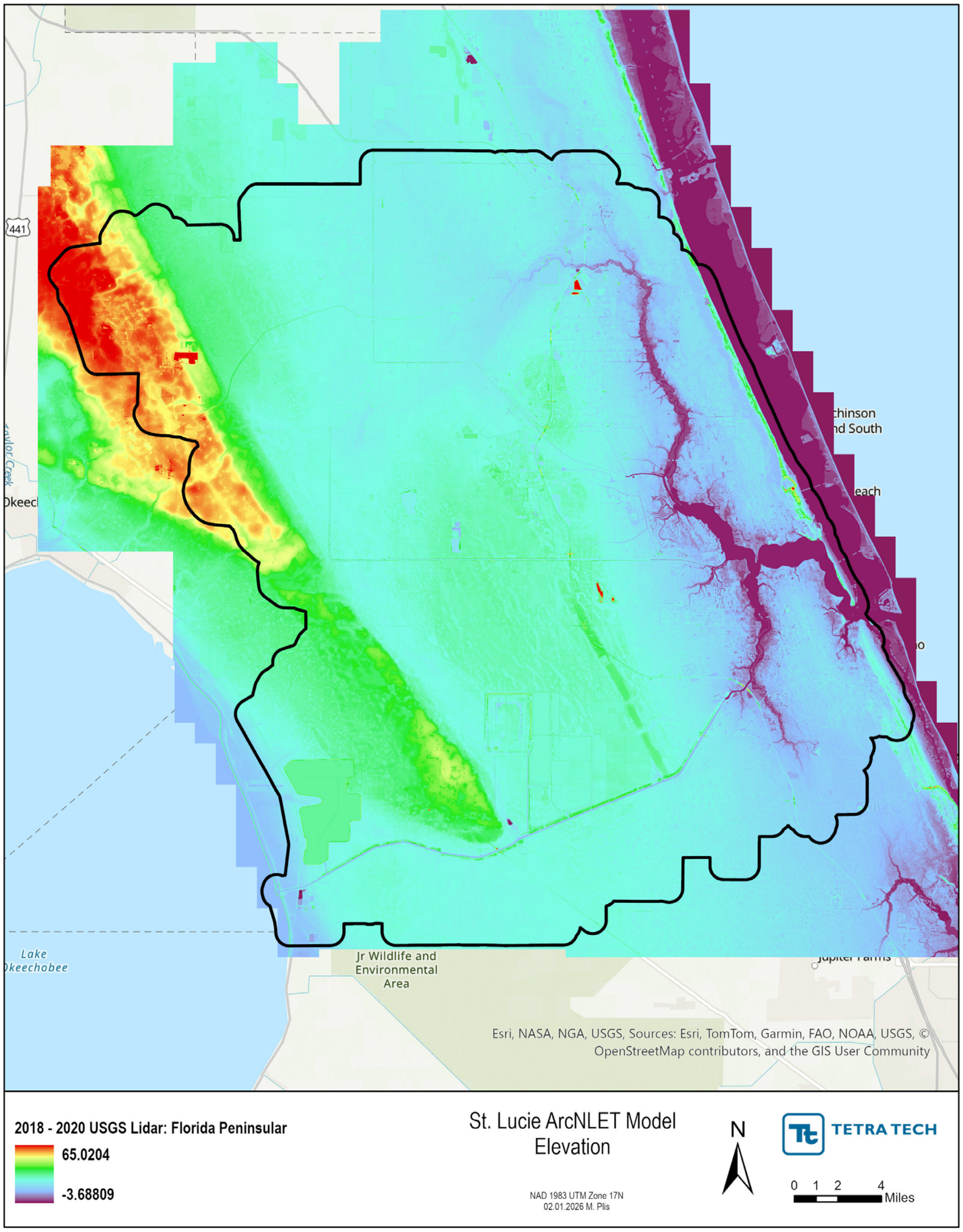

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Figure 1. Initial Elevation Datasets

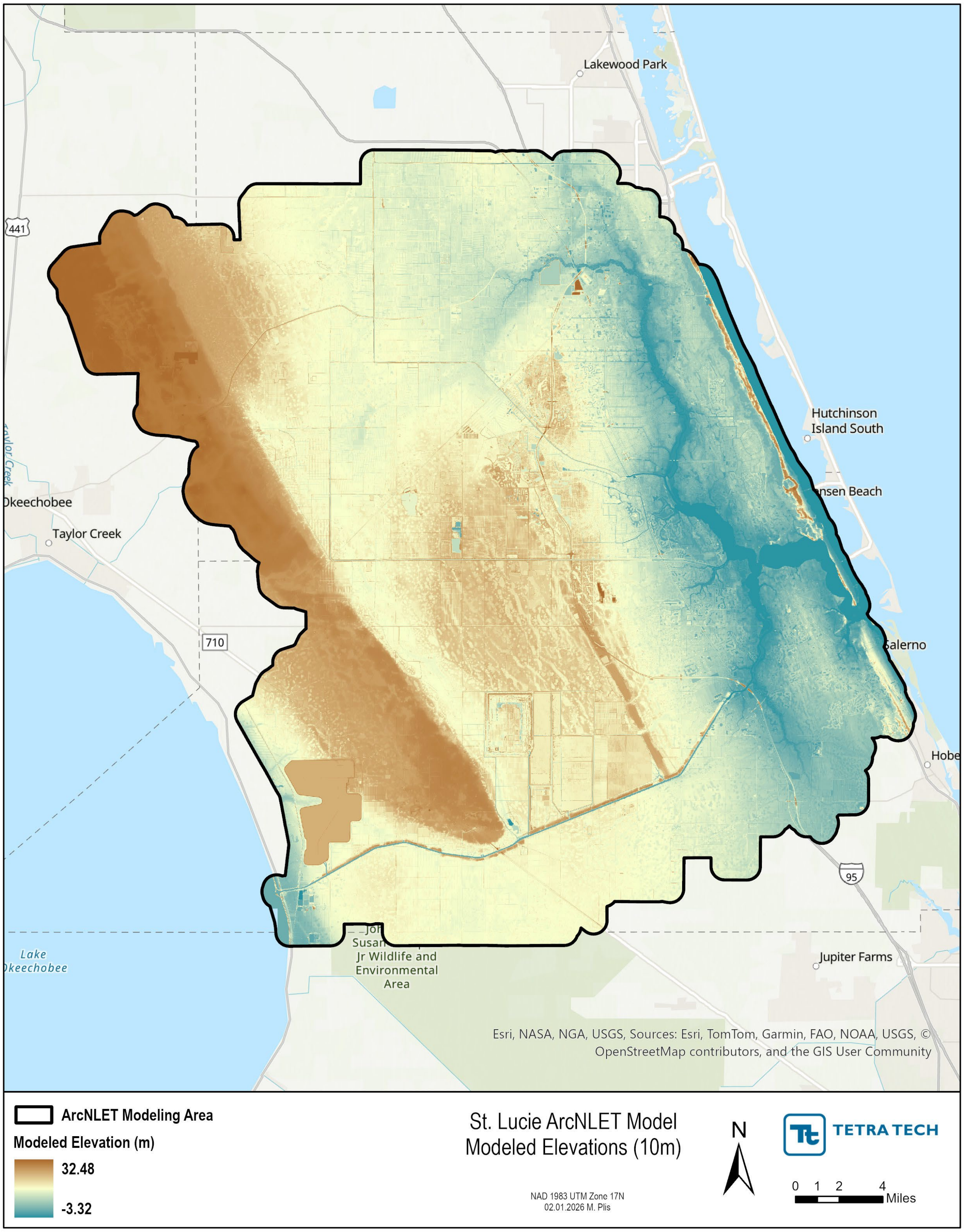

Figure 2. Modeled 10-meter DEM

2.2 WATERBODIES

No single hydrography layer provided the detail required for ArcNLET-Py; therefore, Tetra Tech combined three primary datasets: South Florida Water Management District's (SFWMD) Arc Hydro Enhanced Database (AHED), U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI), and USGS National Hydrography Dataset High-Resolution (NHD HR). Polygon waterbodies and wetlands from AHED and NWI were used directly; AHED and NHD flowlines were buffered by six meters (to capture narrow canals in ArcNLET-Py's particle-tracking algorithm), then converted to polygons. All layers were reprojected to UTM Zone 17N and merged into a seamless waterbody coverage.

Where aerial imagery revealed missing or misaligned features, canals and ponds were added, adjusted, or removed manually to improve accuracy. Figure 3 illustrates the combined waterbody layer used in the model. All waterbody polygons serve as the endpoints for nitrogen and phosphorus plumes in the ArcNLET-Py simulation.

2.3 OSTDS LOCATIONS

Tetra Tech obtained the 2024 parcel layer for Martin, Okeechobee, and St. Lucie counties from the Florida Department of Health Florida Water Management Inventory (2024) and selected all parcels identified as "Known Septic" or "Likely Septic." Tetra Tech then calculated each parcel centroid to serve as the ArcNLET-Py point source location (Figure 4). Because some centroids initially fell within mapped waterbody polygons—resulting in zero-length flow paths and model errors—Tetra Tech applied an automated script to shift points lying closer than six meters from a waterbody edge. This adjustment resolved most conflicts. The remaining points (four total) were removed from the dataset as they showed parcels in a marina, possibly houseboats. All OSTDS location coordinates are projected to UTM Zone 17N. Table 1 summarizes the number of OSTDS by county.

Table 1: OSTDS Counts per County

County	Number of Known or Likely OSTDS
Martin	16,453
Okeechobee	97
St. Lucie	27,204
Total	***43,754***

2.4 SOIL POROSITY AND SATURATED HYDRAULIC CONDUCTIVITY

The ArcNLET-Py preprocessing module automatically retrieves SSURGO datasets, extracts various soil properties including porosity and saturated hydraulic conductivity, and generates both shapefiles and rasters for model input. However, SSURGO often does not have these values for open water or some urban land (Figure 5). The soil coverage is not as detailed as some of the shorelines, creating voids. These voids are often adjacent to waterbodies and create problems as particle paths and plumes would stop there without terminating at a waterbody. To fix these problems and produce continuous inputs, these gaps were infilled by assigning each empty polygon the value of its nearest valid neighbor, and the corrected rasters were rebuilt. The resulting soil porosity and conductivity surfaces (Figure 6 and Figure 7) provide the spatially explicit parameters for the ArcNLET-Py model.

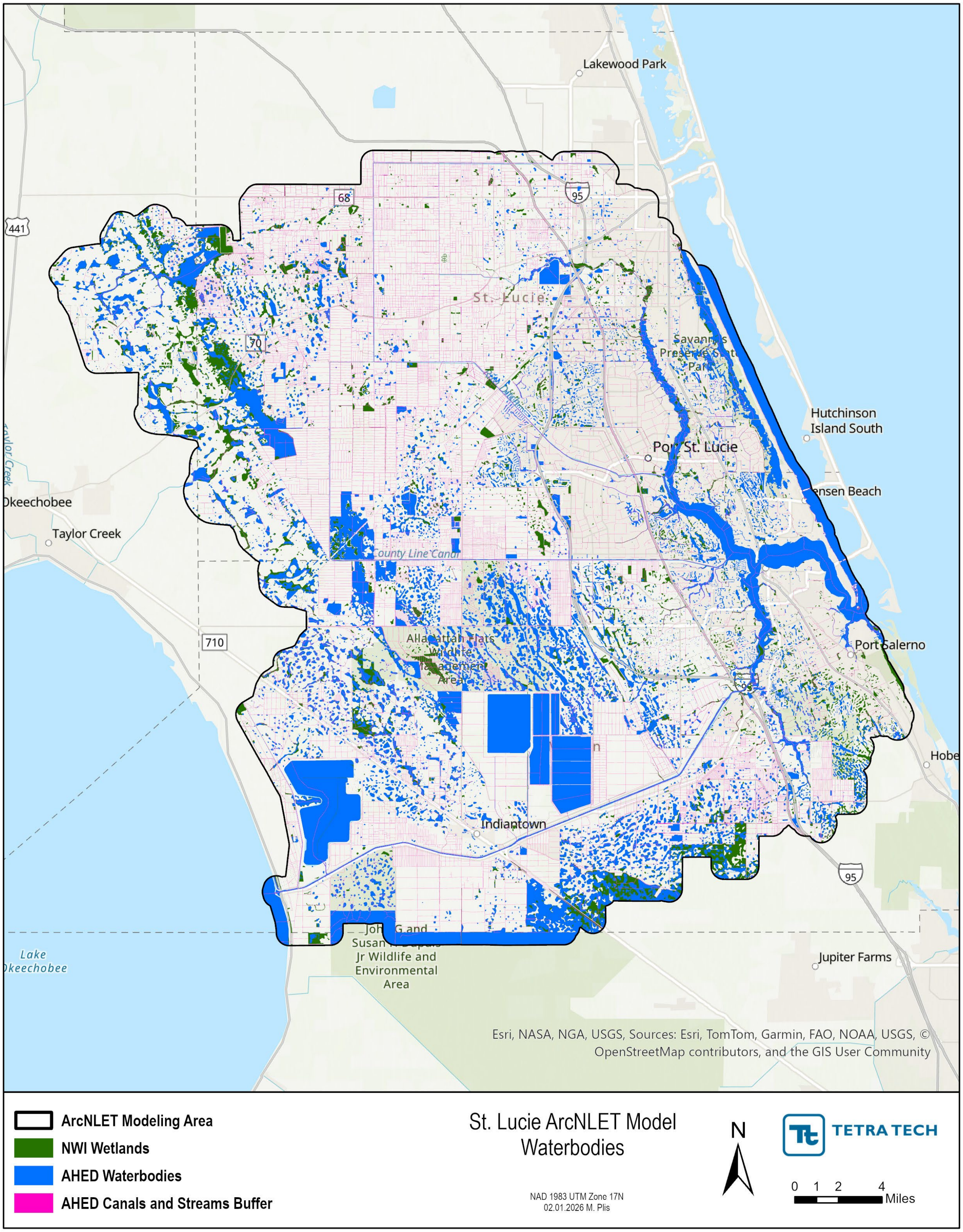

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Figure 3. Modeled Waterbodies and Sources

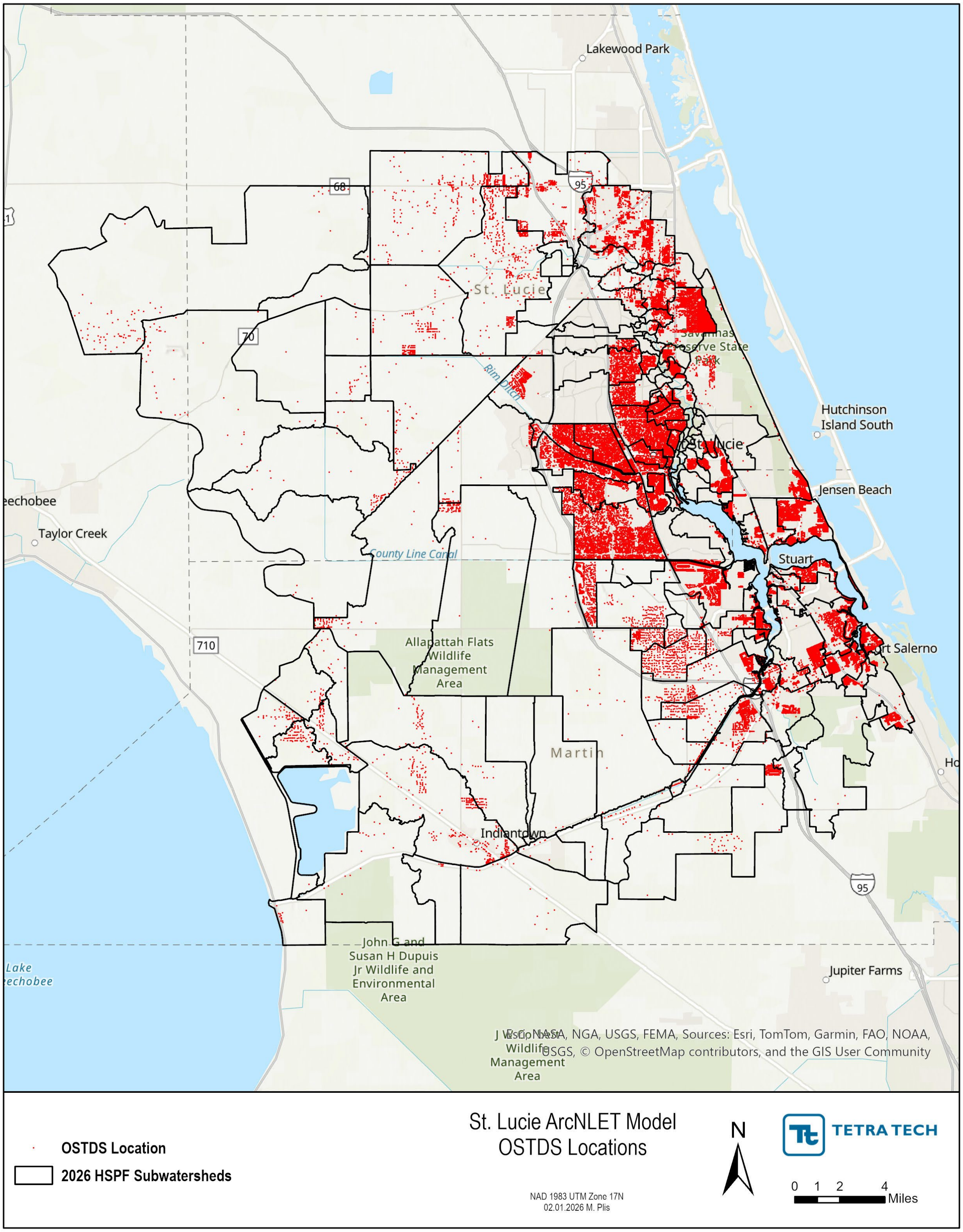


Figure 4. OSTDS Locations in the ArcNLET-Py Model

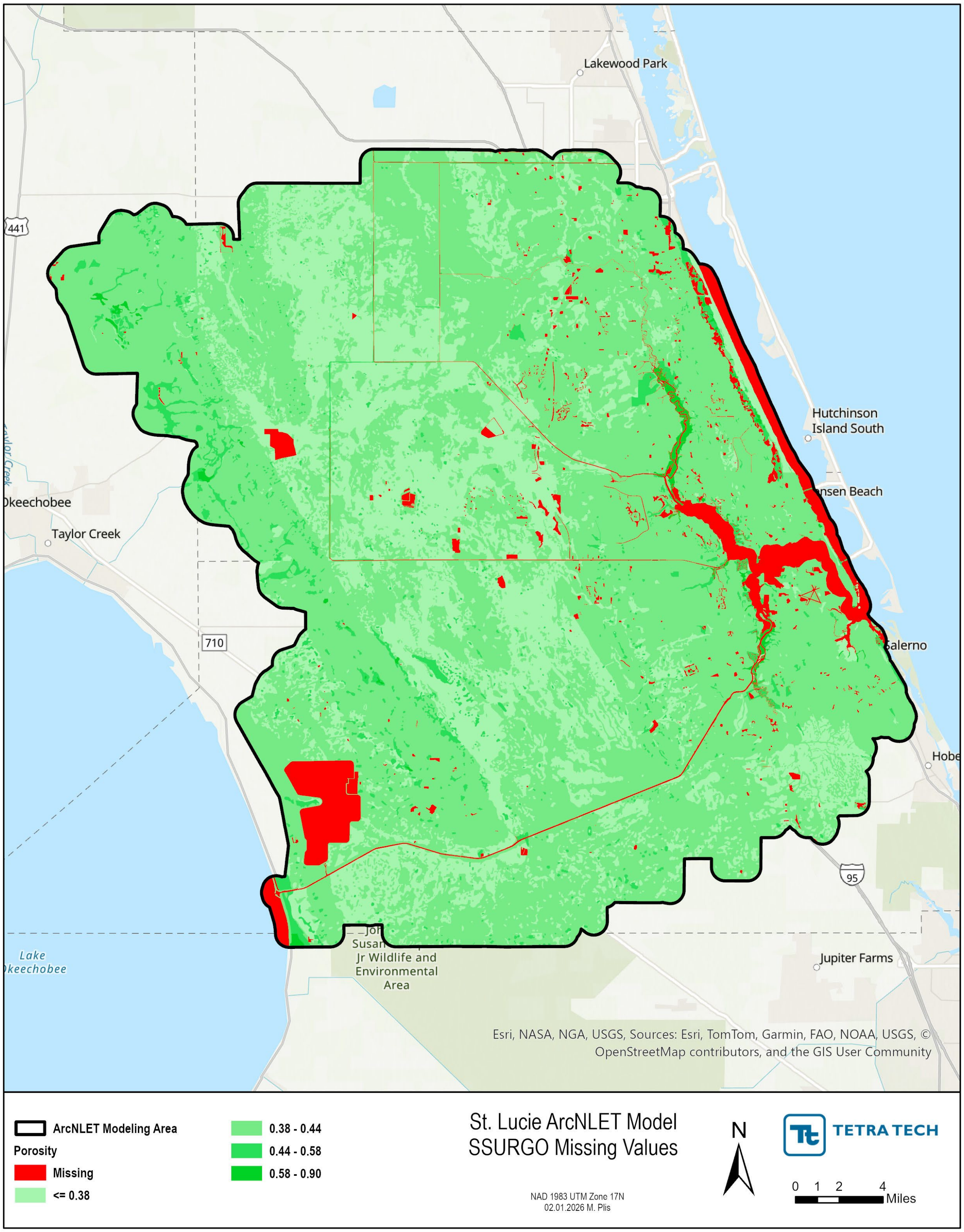
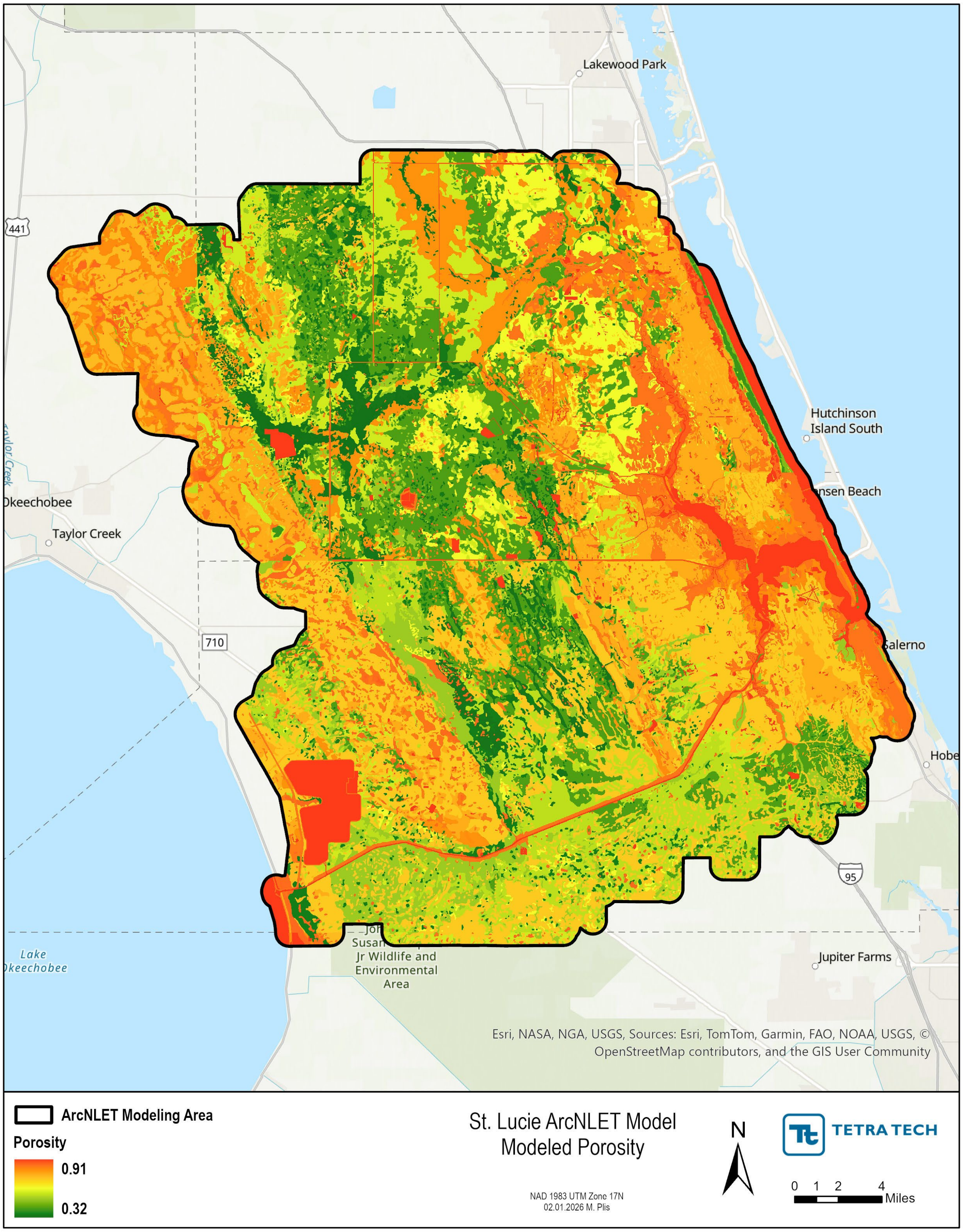


Figure 5. Preprocessing SSURGO Data



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NAD 1983 UTM Zone 17N
02.01.2026 M. Plis

Figure 6. Modeled Porosity

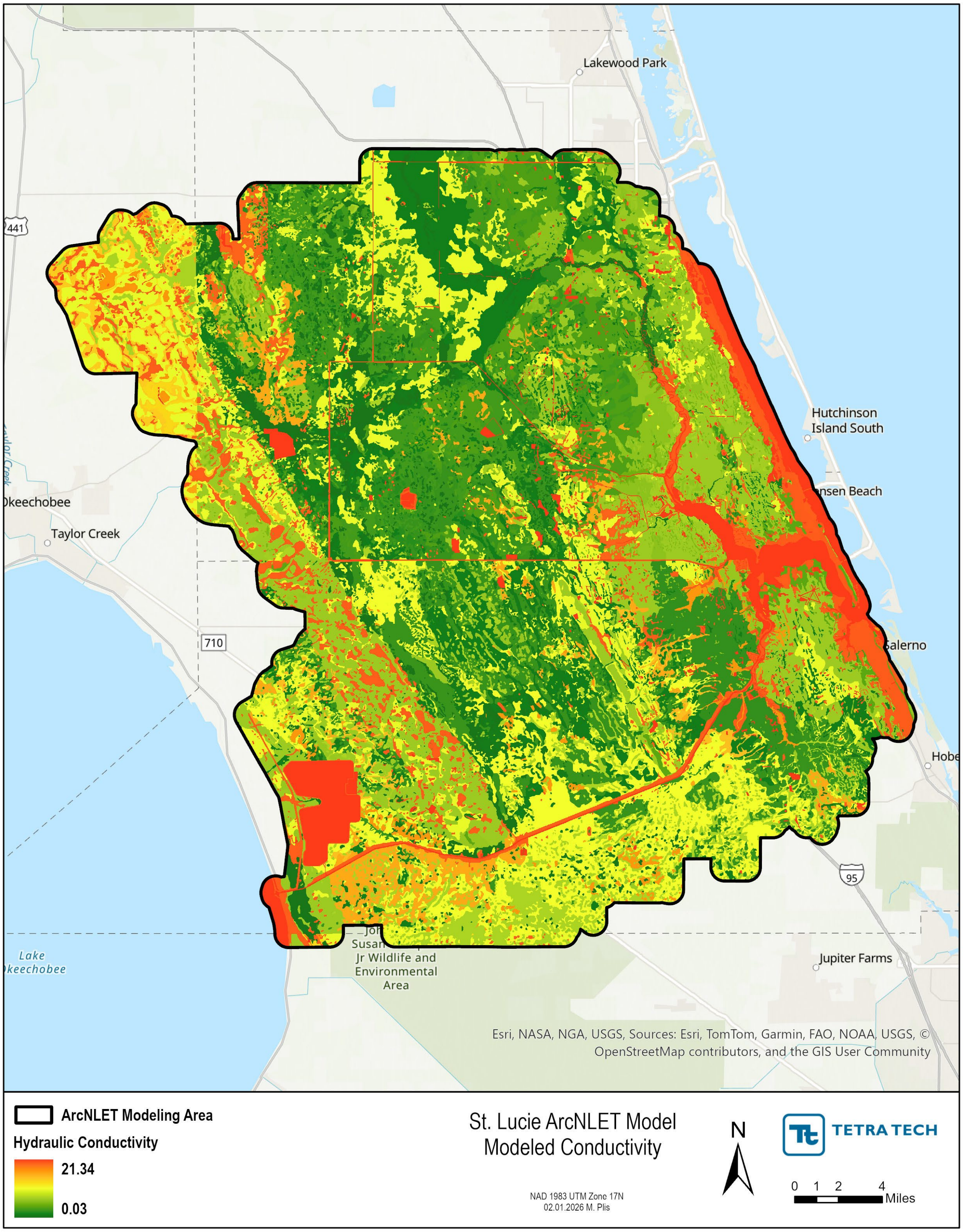

Figure 7. Modeled Conductivity

2.5 GROUNDWATER LEVELS

Tetra Tech acquired groundwater well measurements from USGS and SFWMD's DBHYDRO databases, data for the 2014–2024, 11-year modeling period were used. After screening for wells that measure the unconfined surficial aquifer, 19 wells were selected for hydrologic calibration. All well locations were reprojected to UTM Zone 17N and their average water level elevations were calculated and converted to meters relative to NAVD88. Figure 8 maps the calibration wells, and Table 2 lists each site's average water level elevation.

Table 2: Groundwater Level Data Availability

Well ID	USGS ID	Aquifer Confinement	Average Water Level (meters NAVD88)
M-1004	USGS-270835080105801	Unconfined	0.78
M-1048	USGS-270124080280202	Unconfined	8.39
M-1255	USGS-270913080284901	Unconfined	7.38
M-1261	USGS-270609080163401	Unconfined	2.56
M-1369D	USGS-265839080365201	Unconfined	3.32
M-1369I	USGS-265839080365202	Unconfined	3.54
PG-26	-	Unconfined	3.33
STL-125	USGS-272524080242801	Unconfined	4.99
STL-172	USGS-272313080182701	Unconfined	3.89
STL-175	USGS-271755080153001	Unconfined	2.30
STL-176	USGS-271755080153002	Unconfined	3.96
STL-185	USGS-271413080311201	Unconfined	7.25
STL-213	USGS-272427080240201	Unconfined	3.16
STL-214	USGS-271618080245801	Unconfined	6.08
STL-269	-	Unconfined	4.43
STL-270	-	Unconfined	0.39
STL-286	USGS-272603080324901	Unconfined	5.81
STL-295	-	Unconfined	4.95
STL-313	USGS-272138080374103	Unconfined	7.87

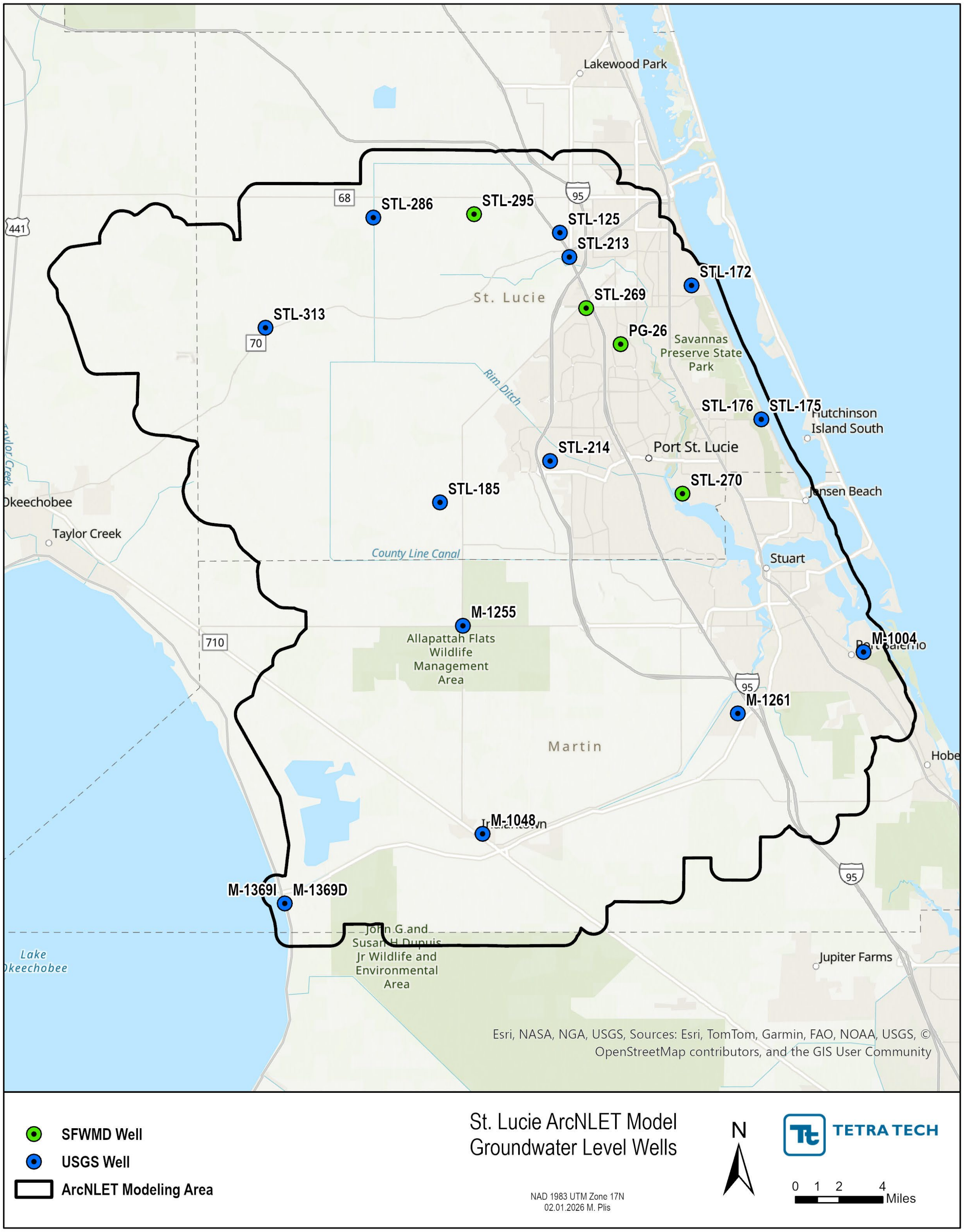

Figure 8. Wells Used in the Hydrology Calibration

2.6 GROUNDWATER WATER QUALITY

DEP provided Tetra Tech with groundwater quality measurements from the Watershed Information Network (WIN) database. Tetra Tech screened available samples for NO_3, ammonia (NH_4), PO_4 and total phosphorus (TP), retaining only those wells in the unconfined surficial aquifer. There were no PO_4 measurements; therefore, TP measurements are used in the calibration. For each of the 24 selected sites with available nutrient data, Tetra Tech computed a mean concentration across all samples. Figure 9 shows the spatial distribution of these calibration wells and Table 3 summarizes the available measurements. Notably, well 5452 exhibited a high TP concentration (1.5 milligrams per liter [mg/L]), and well 52179 had a large NO_3 concentration (1.6 mg/L), which were above all other calibration sites.

Table 3. Calibration Wells Used in the ArcNLET-Py Model

DEP_ID	Aquifer Confinement	Average NO_X (mg/L)	Average NH_4 (mg/L)	Average TP (mg/L)
3232	Unconfined	0.087	0.470	0.110
3443	Unconfined	0.010	0.408	0.018
3444	Unconfined	0.005	0.420	0.004
3462	Unconfined	0.004	0.990	0.033
5243	Unconfined	0.004	0.590	0.036
5251	Unconfined	0.004	0.220	0.006
5258	Unconfined	0.004	0.400	0.240
5299	Unconfined	0.130	0.420	0.005
5452	Unconfined	0.004	0.240	1.500
5982	Unconfined	0.004	0.355	0.255
5990	Unconfined	0.110	0.550	0.290
24120	Unconfined	0.006	0.610	0.076
39128	Unconfined	0.005	0.470	0.980
43243	Unconfined	0.008	0.758	0.004
43250	Unconfined	0.004	0.571	0.002
44742	Unconfined	0.017	0.330	0.082
45006	Unconfined	0.011	0.526	0.007
52179	Unconfined	1.600	0.160	0.340
52863	Unconfined	0.006	0.715	0.004
52865	Unconfined	0.004	0.555	0.005
52867	Unconfined	0.009	0.690	0.004
52873	Unconfined	0.004	0.492	0.003
54595	Unconfined	0.340	0.960	0.160
59688	Unconfined	0.004	0.063	0.030

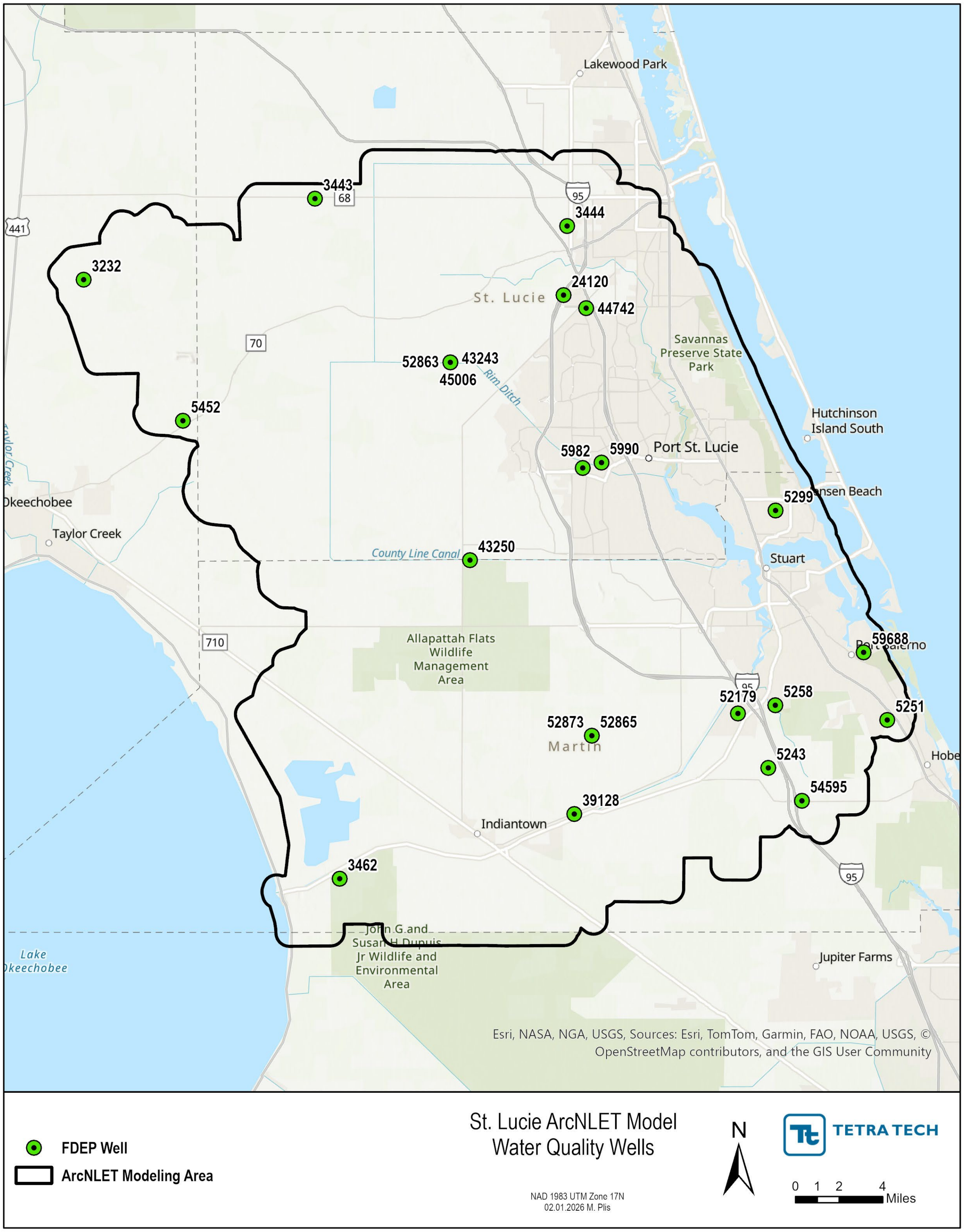

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Figure 9. Wells Used in Nitrogen and Phosphorus Calibration

3.0 ARCNLET-PY MODEL CALIBRATION

The ArcNLET-Py model was calibrated in four sequential modules – groundwater flow, vadose zone model, particle tracking, and reactive nitrogen and phosphorus transport – under a steady state assumption.

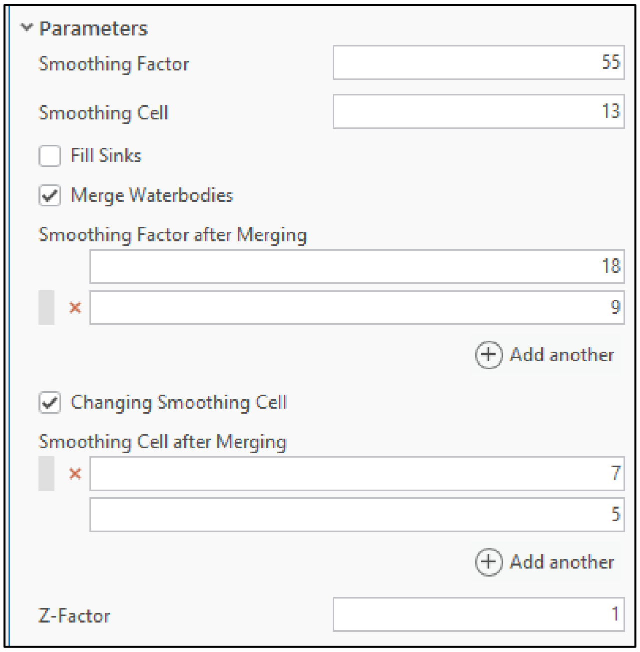
3.1 GROUNDWATER FLOW CALIBRATION

ArcNLET-Py's groundwater flow module relies on a smoothed DEM surface to approximate the steady state water table and to calculate both hydraulic gradients and flow directions. Calibration therefore centers on selecting an appropriate smoothing parameter that minimizes the difference between modeled heads (smoothed DEM) and measured groundwater levels, while also yielding realistic flow path geometries when used in the subsequent particle tracking routine. This is an iterative process. Tetra Tech evaluated a series of smoothing factors ranging from 10 to 150 applied to the 10 meter DEM. For each candidate smoothing factor, Tetra Tech:

- Generated the smoothed DEM surface.
- Extracted modeled head values at the 19 calibrations well locations and performed a linear regression against the observed mean heads. Computed the slope, intercept, R^2, and root-mean-square error (RMSE).
- Ran the particle tracking algorithm using the smoothed surface and inspected the resulting flow lines in ArcGIS Pro, verifying that flow directions radiated smoothly downslope without abrupt reversals or inflection points and terminated at the mapped waterbodies rather than terminating inland or crossing ridges.

Of the multiple smoothing scenarios, a combination approach was the best fit. Tetra Tech applied an iterative three-step smoothing procedure re-imposing waterbody elevations between each pass to strike the right balance between statistical fit to observed heads and realistic flow-line geometry. First, a focal-mean smoothing was run with a 15-cell window and smoothing weight factor of 55, then the original waterbody elevations were merged back into the surface to ensure mapped sinks remained true to their known depths. Second, Tetra Tech repeated the smoothing at the weight factor of 18 over a 9-cell window, again restoring waterbody elevations. Finally, Tetra Tech applied a lighter smoothing (weight factor 7 over a 5-cell window) to remove residual high-frequency noise without undermining the overall gradient. Parameters are shown in Figure 10.

Comparison between the modeled and measured water level values show a good correlation. The final surface produced a regression slope of 0.91, intercept of +1.64 meters, R^2 of 0.93, the results are presented in Figure 11. Particle tracking lines comprised gently curving streamlines that consistently converged on river and canal polygons, with no spurious flow reversals or dead ends (Figure 12).



Parameters

Smoothing Factor: 55

Smoothing Cell: 13

☐ Fill Sinks

☑ Merge Waterbodies

Smoothing Factor after Merging: 18, 9

☑ Changing Smoothing Cell

Smoothing Cell after Merging: 7, 5

Z-Factor: 1

Figure 10. Parameterization of the Groundwater Flow Module

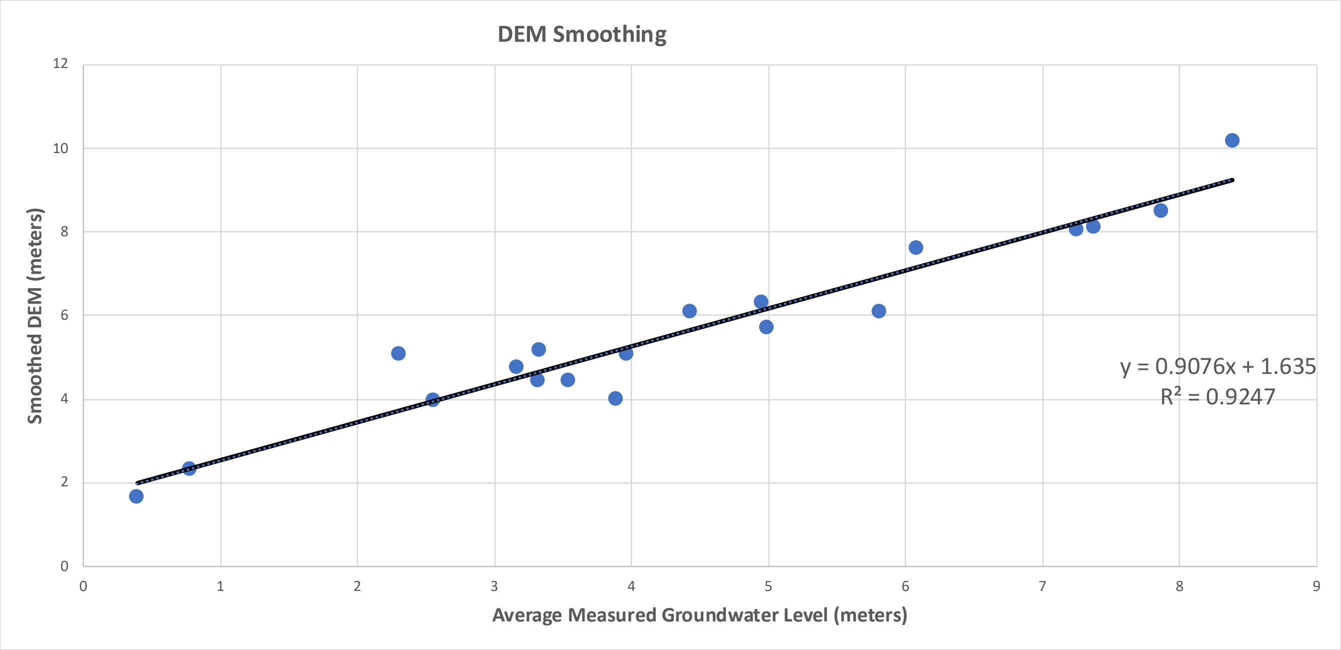


Figure 11. Model Result of the Groundwater Flow Module

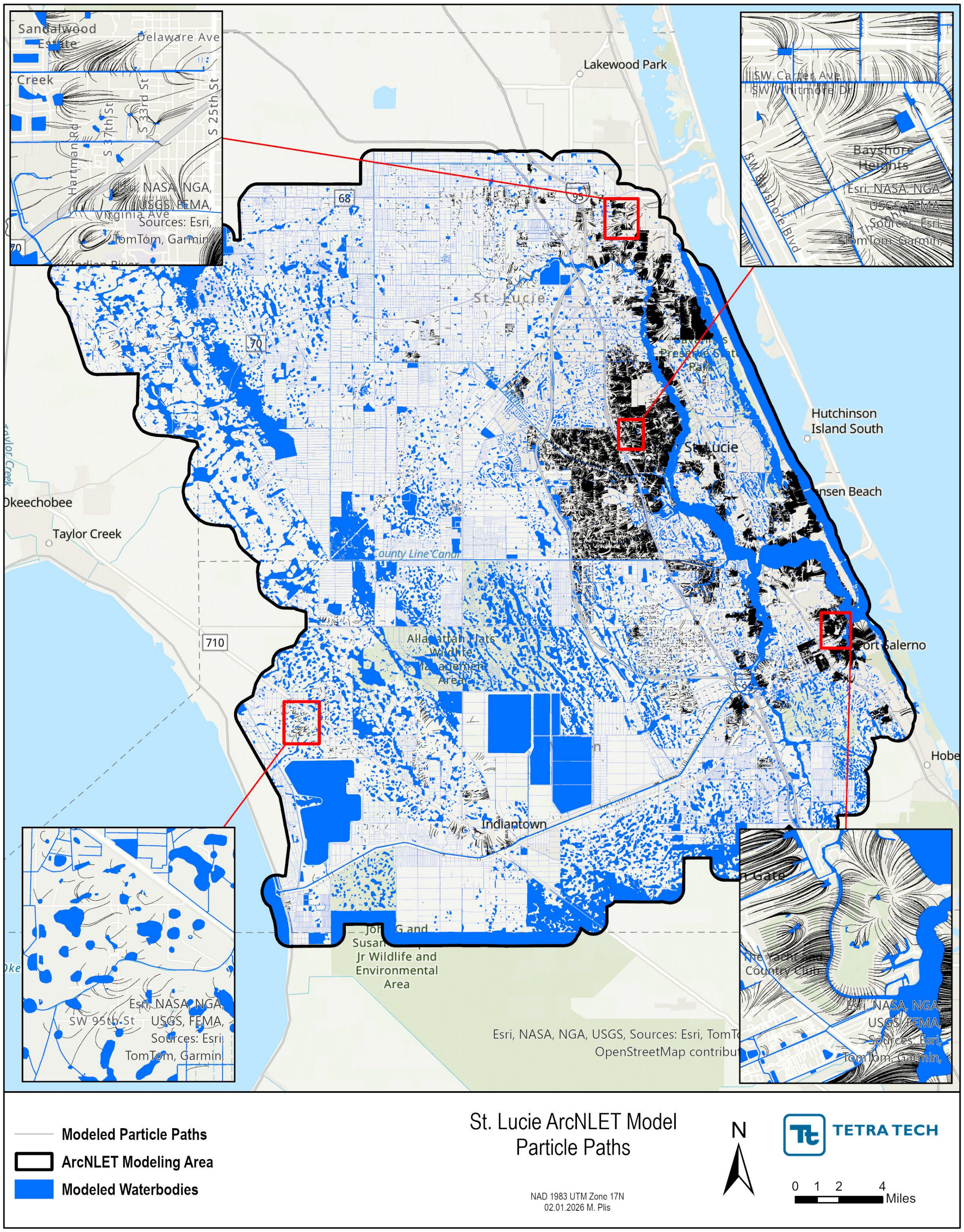


Figure 12. Modeled Particle Paths

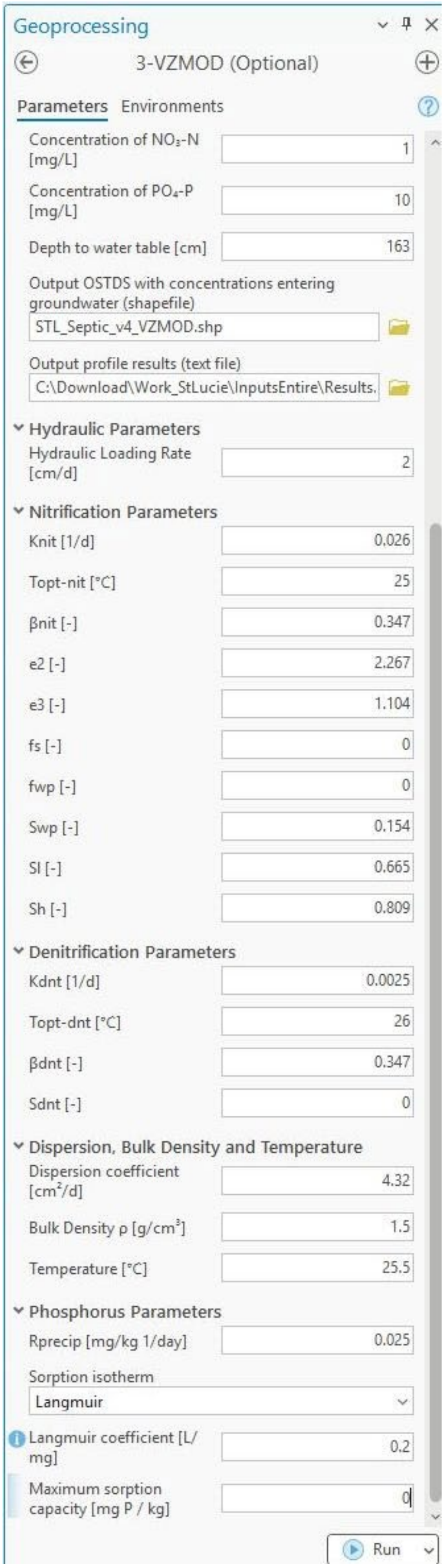
3.2 NITROGEN TRANSPORT CALIBRATION

Of the 24 surficial aquifer wells with DEP water quality data, only six (DEP_IDs 5251, 5258, 5299, 5982, 5990, and 52179) were located downgradient of OSTDS. Those six wells formed the calibration set.

OSTDS nitrogen inputs were set at 27.5 grams of total nitrogen (TN)/day/tank, based on the U.S. Environmental Protection Agency's (USEPA) 11.2 grams of TN/day/person and an average household size of 2.46 between Martin and St. Lucie counties. Consistent with Toor et al. (2011), Tetra Tech applied a 35% removal of TN in the septic tank and drainfield, resulting in 17.9 grams of TN/day/tank entering the groundwater. Tetra Tech then used the Vadose Zone Model (VZMOD) module of ArcNLET-Py to simulate the transformation and vertical transport of NH_4, NO_3, and PO_4 in the vadose zone beneath the OSTDS drainfield. Heterogeneous soil hydraulic parameters, including soil textures, porosity, and hydraulic conductivity rasters, were used in the model. This resulted in a varied per OSTDS groundwater concentrations of 2.5 – 47.1 mg/L NO_3 and 12.7 – 58.4 mg/L NH_4. Final VZMOD transport parametrization is shown on Figure 13.

Table 4 summarizes the measured versus modeled steady state concentrations of NO_3 and NH_4 at the six calibration wells. At the calibration wells, measured NO_3 concentrations ranged from the detection limit (0.004 mg/L at four sites) up to 1.6 mg/L. The model tended to overpredict NO_3 at sites with low observed concentrations and underpredict at the highest observed site. The overprediction of NO_3 likely reflects the model's assumption of continuous nitrification of NH_4 in groundwater, which may not fully capture local attenuation or variability. In contrast, modeled NH_4 concentrations were generally in good agreement with observed values across all sites, with most predictions closely matching measurements. Overall, simulated NO_3 and NH_4 concentrations remained within an order of magnitude of observations, indicating a reasonable calibration for NH_4 and highlighting the importance of site-specific data for NO_3.

Final nitrogen transport parametrization is shown on Figure 14 and the resulting NO_3 and NH_4 plumes in Figure 15 and Figure 16.



Concentration of NO_3-N [mg/L]: 1

Concentration of PO_4-P [mg/L]: 10

Depth to water table [cm]: 163

Output OSTDS with concentrations entering groundwater (shapefile): STL_Septic_v4_VZMOD.shp

Output profile results (text file): C:\Download\Work_StLucie\InputsEntire\Results.

Hydraulic Parameters

Hydraulic Loading Rate [cm/d]: 2

Nitrification Parameters

Knit [1/d]: 0.026

Topt-nit [°C]: 25

βnit [-]: 0.347

e2 [-]: 2.267

e3 [-]: 1.104

fs [-]: 0

fwp [-]: 0

Swp [-]: 0.154

Sl [-]: 0.665

Sh [-]: 0.809

Denitrification Parameters

Kdnt [1/d]: 0.0025

Topt-dnt [°C]: 26

βdnt [-]: 0.347

Sdnt [-]: 0

Dispersion, Bulk Density and Temperature

Dispersion coefficient [cm^2/d]: 4.32

Bulk Density ρ [g/cm^3]: 1.5

Temperature [°C]: 25.5

Phosphorus Parameters

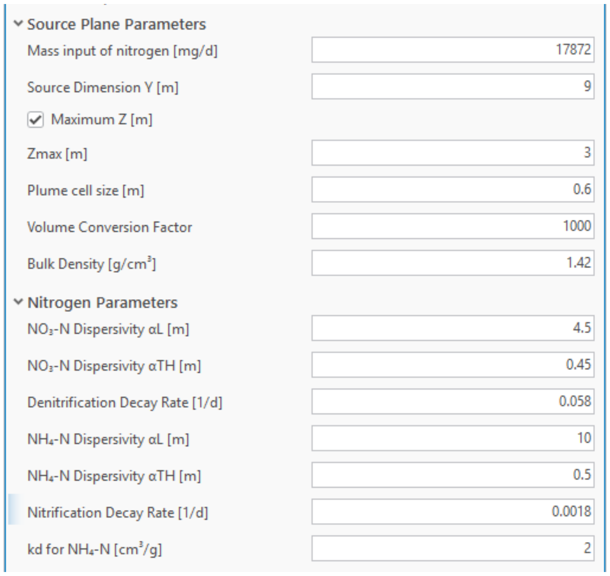
Rprecip [mg/kg 1/day]: 0.025

Sorption isotherm: Langmuir

Langmuir coefficient [L/mg]: 0.2

Maximum sorption capacity [mg P / kg]: 0

Figure 13. Parameterization of the VZMOD Module



Source Plane Parameters

Mass input of nitrogen [mg/d]	17872
Source Dimension Y [m]	9
☑ Maximum Z [m]	
Zmax [m]	3
Plume cell size [m]	0.6
Volume Conversion Factor	1000
Bulk Density [g/cm^3]	1.42

Nitrogen Parameters

NO_3-N Dispersivity αL [m]	4.5
NO_3-N Dispersivity αTH [m]	0.45
Denitrification Decay Rate [1/d]	0.058
NH_4-N Dispersivity αL [m]	10
NH_4-N Dispersivity αTH [m]	0.5
Nitrification Decay Rate [1/d]	0.0018
kd for NH_4-N [cm^3/g]	2

Figure 14. Parameterization of the Nitrogen Transport Module

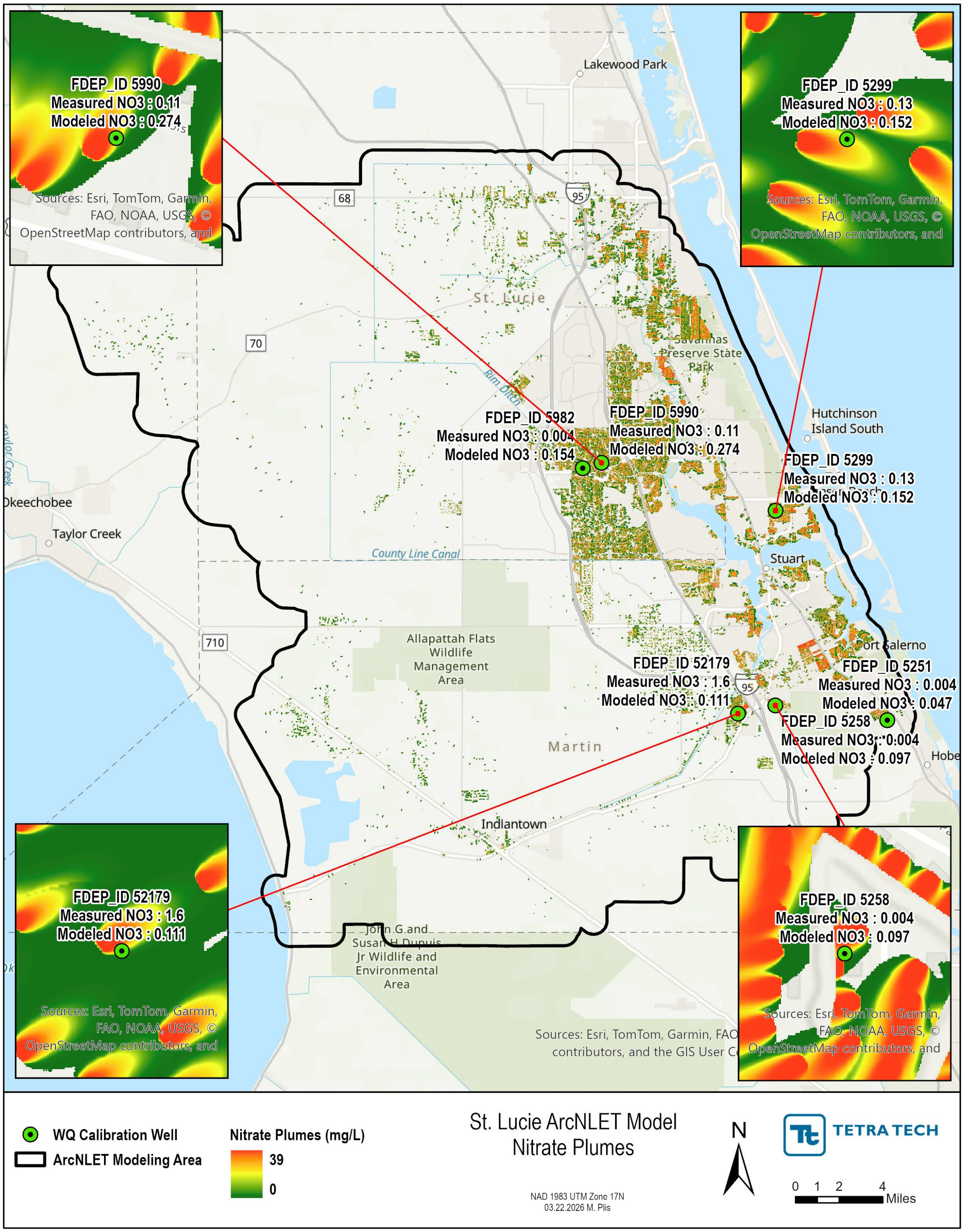


Figure 15. Calibrated NO_3 Plumes Compared to Measured Values

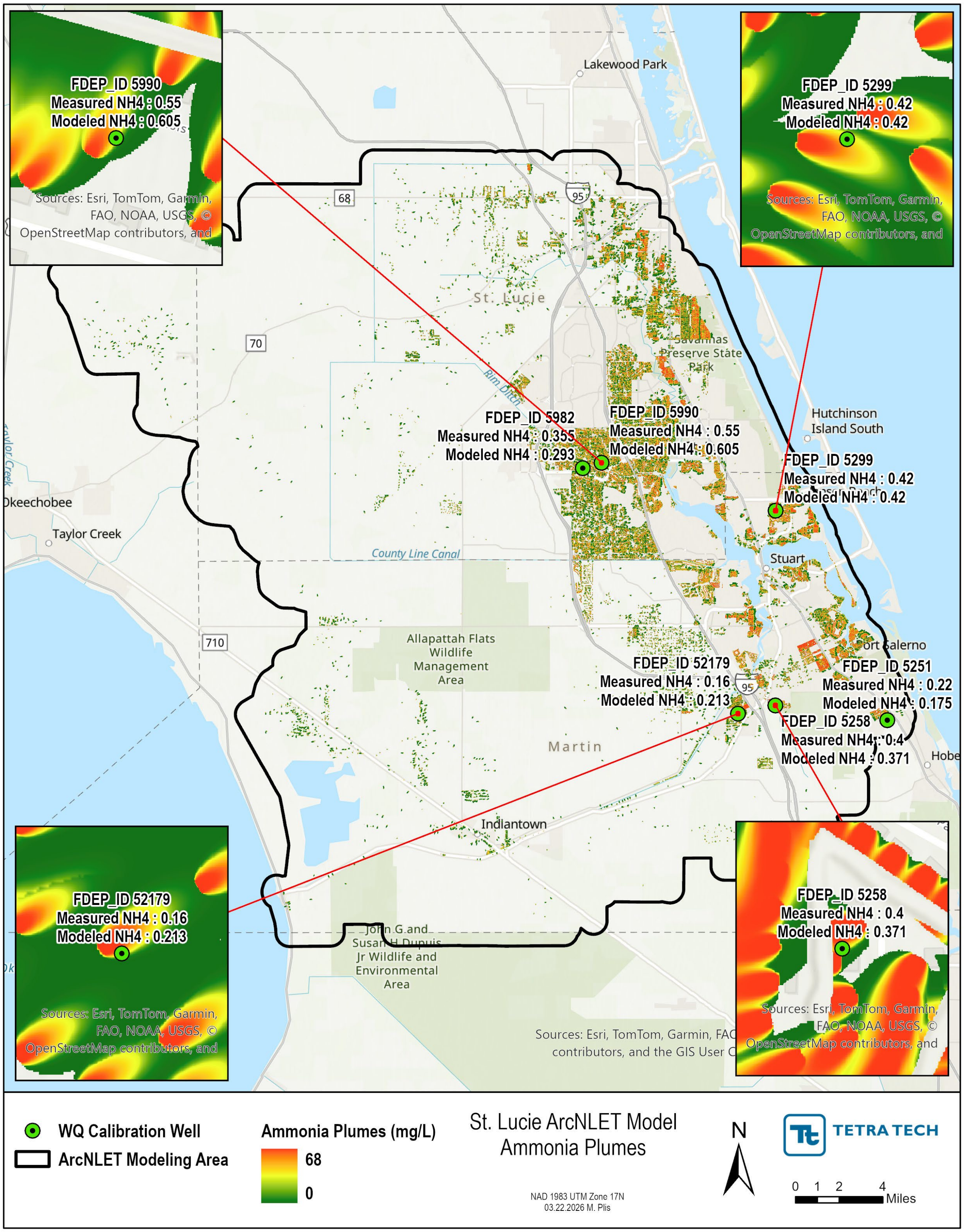


Figure 16. Calibrated NH_4 Plumes Compared to Measured Values

Table 4. Comparison of Measured and Modeled Nitrogen

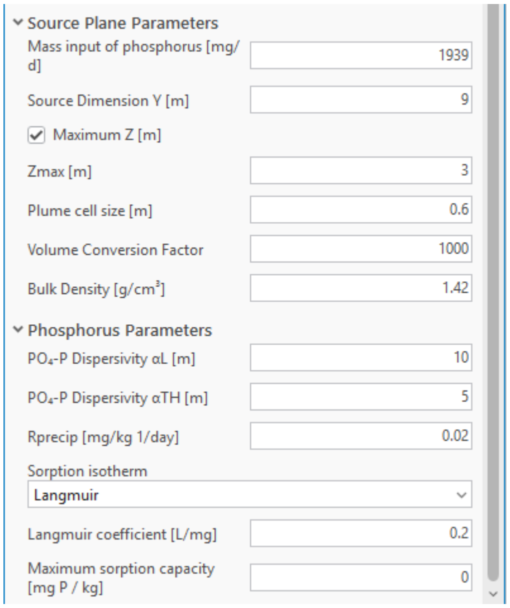
DEP_ID	Measured NO_3 (mg/L)	Modeled NO_3 (mg/L)	Measured NH_4 (mg/L)	Modeled NH_4 (mg/L)
5251	0.004	0.047	0.220	0.175
5258	0.004	0.097	0.400	0.371
5299	0.130	0.152	0.420	0.420
5982	0.004	0.154	0.330 – 0.380	0.293
5990	0.110	0.274	0.550	0.605
52179	1.600	0.111	0.160	0.213

3.3 PHOSPHORUS TRANSPORT CALIBRATION

OSTDS phosphorus inputs were based on an USEPA estimate of 2.7 grams/day/person phosphorus load. Using an average household size of 2.46 persons, this yields 6.6 grams of phosphorus/day/tank. Based on Toor et al. (2011) Tetra Tech accounted for in-tank sludge settling (assumed 25% loss) and rapid phosphorus precipitation in the drainfield (61% removal), resulting in a net groundwater phosphorus input of 1.9 grams of phosphorus/day/tank. VZMOD module of ArcNLET was again used to estimate the initial concentrations at the water table, which resulted in values of 2.7 – 7.2 mg/L applied at each point source.

The OSTDS layer included a free-text “WW_SRC_NAM” field that often contained either a construction-approval date or the date of the last repair, plus a generic “2009 Inventory” and “DEP SepticTankParcels_20130927 related to St Lucie River study” tag for OSTDS with no later record. Tetra Tech ran a parser to pull out the year of each OSTDS’ most recent interaction, which showed that 51% of OSTDS had their last recorded date more than six years before the 2025 model run, 3% had a date within the past six years, and 45% had no date. Based on Mechtensimer and Toor (2016), which shows that a year of effluent loading saturates 18% of a drainfield’s phosphorus sorption capacity, and given that most local systems exceed six years of service, Tetra Tech assumed full sorption capacity exhaustion in the surrounding soils. Final phosphorus parameterization is shown on Figure 17.

Of the six wells downgradient of OSTDS (DEP_IDs 5251, 5258, 5299, 5982, 5990, and 52179), no dissolved PO_4 data were available; therefore, TP measurements were used as the calibration target. Table 5 compares the observed TP concentrations against the modeled PO_4 values. Simulated PO_4 generally falls within the same order of magnitude as measured TP and slightly overpredicts at wells 5251 and 5299. Given the inherent uncertainties in soil sorption rates and the use of TP in lieu of PO_4, the model’s performance is acceptable for estimating watershed-wide OSTDS derived phosphorus loads.



Source Plane Parameters

Mass input of phosphorus [mg/d]	1939
Source Dimension Y [m]	9
☑ Maximum Z [m]	
Zmax [m]	3
Plume cell size [m]	0.6
Volume Conversion Factor	1000
Bulk Density [g/cm^3]	1.42

Phosphorus Parameters

PO_4-P Dispersivity αL [m]	10
PO_4-P Dispersivity αTH [m]	5
Rprecip [mg/kg 1/day]	0.02
Sorption isotherm	Langmuir
Langmuir coefficient [L/mg]	0.2
Maximum sorption capacity [mg P / kg]	0

Figure 17. Parameterization of the Phosphorus Transport Module

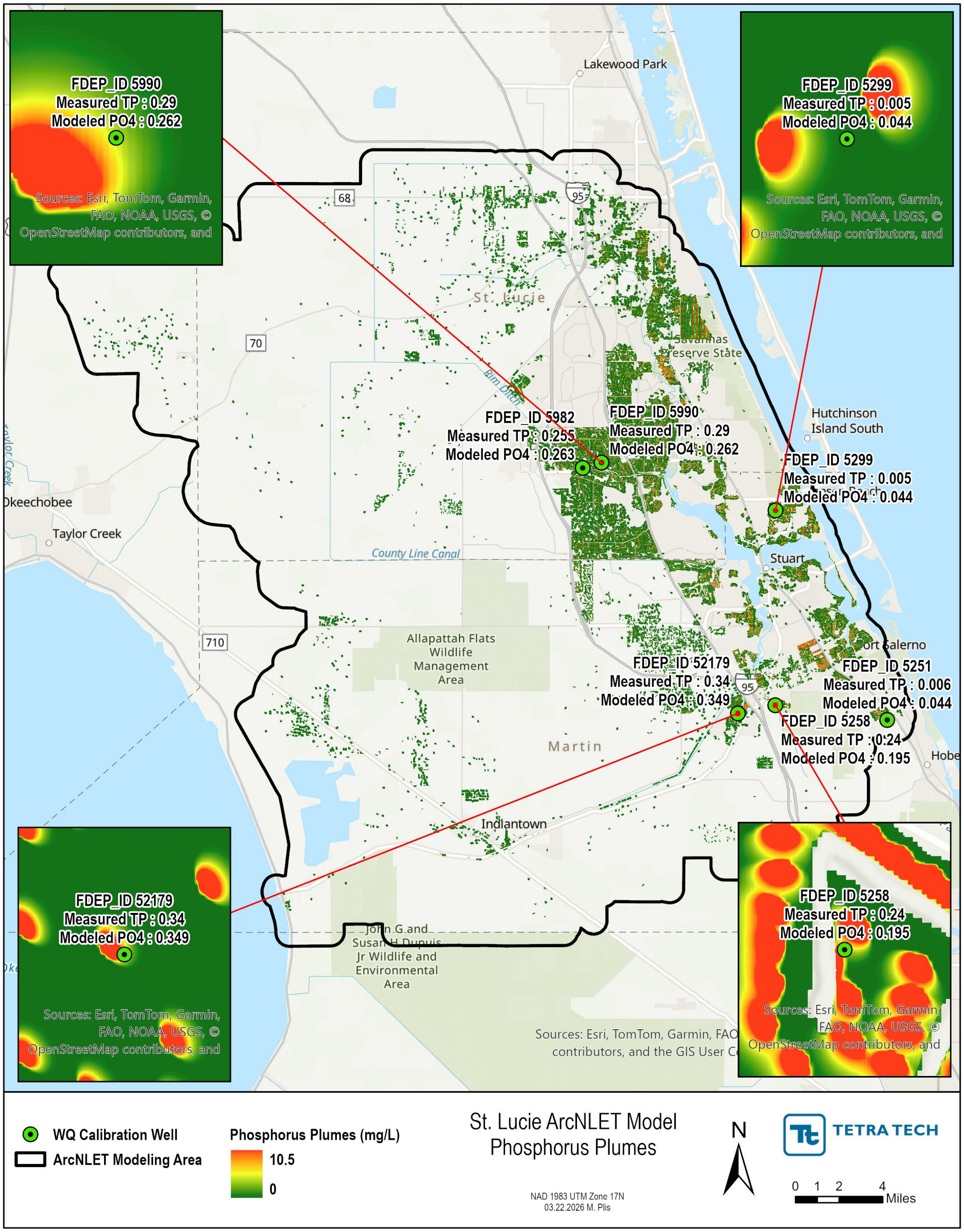


Figure 18. Calibrated Phosphorus Plumes Compared to Measured Values

Table 5. Comparison of Measured and Modeled Phosphorus

DEP_ID	Measured TP (mg/L)	Modeled PO_4 (mg/L)
5251	0.006	0.044
5258	0.240	0.195
5299	0.005	0.044
5982	0.255	0.263
5990	0.290	0.262
52179	0.340	0.349

4.0 MODEL RESULTS AND OUTPUT LOADS

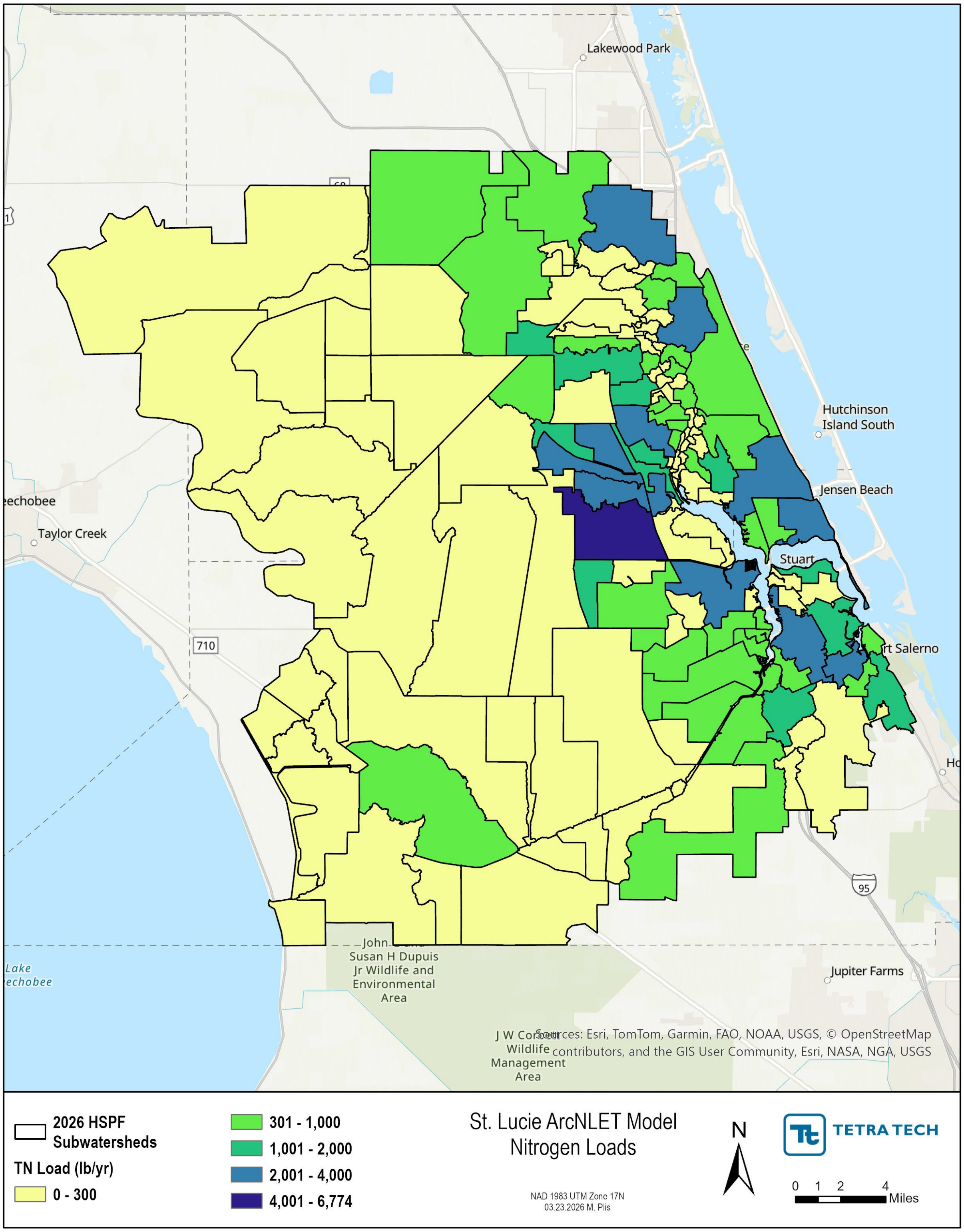
Once calibration was complete, Tetra Tech ran ArcNLET-Py for all 43,754 OSTDS across the modeling domain. The model produced rasters of NO_3, NH_4, and PO_4 as well as point shapefiles containing loads. Using GIS, each OSTDS output was joined to its associated HSPF subwatershed polygon. Within each subwatershed, the individual loads were summed to derive TN and TP loads for that HSPF model reach.

4.1 NITROGEN LOADS

The NO_3 and NH_4 loads were summed and tabulated, summarized, and assigned to each HSPF model reach as a point source inflow. Total load from the entire model showed 78,553.55 pounds per year (lbs/yr) of nitrogen is going into the system. Overall loads spanned between 0.00 and 11.61 lbs/yr/OSTDS, with an average of 1.86 lbs/yr/OSTDS. Figure 19 shows the summed loads to each HSPF reach, and Table 6 shows the per-reach load that is input into the HSPF model.

4.2 PHOSPHORUS LOADS

The PO_4 loads were summed and tabulated, summarized, and assigned to each HSPF model reach as point source inflow. TP load from the entire model showed 34,460.80 lbs/yr of phosphorus is going into the system. Overall loads spanned between 0.00 and 1.44 lbs/yr/OSTDS, with an average of 0.92 lbs/yr/OSTDS. Figure 19 shows the summed loads to each HSPF reach, and Table 7 shows the per-reach load that is input into the HSPF model.



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, NASA, NGA, USGS

Figure 19. Modeled Nitrogen Loads per HSPF Subwatershed

Table 6. Summary of Nitrogen Load to HSPF Reach

HSPF Reach ID	TN Load (lbs/yr)	HSPF Reach ID	TN Load (lbs/yr)	HSPF Reach ID	TN Load (lbs/yr)
100	0.00	211	0.00	404	116.17
101	0.00	212	2.43	405	8.92
102	0.00	213	0.00	406	129.95
103	0.00	214	342.27	407	8.50
104	30.95	215	395.91	408	61.18
105	517.44	216	89.82	500	592.87
106	118.04	217	432.48	501	2,995.56
107	762.49	218	1,824.33	502	768.38
108	243.47	219	2,070.95	503	155.71
109	739.14	220	6,774.22	504	118.30
110	38.15	221	2,322.42	505	422.13
111	0.00	222	2,799.34	506	401.54
112	113.35	223	3,748.45	600	410.35
113	151.34	224	96.83	601	3,185.87
114	604.63	225	1,302.57	602	1,464.89
115	184.94	226	498.22	603	142.85
116	51.99	227	3,127.26	604	1,976.62
117	60.24	228	0.00	605	2,560.20
118	2,011.15	229	370.69	606	540.55
119	442.82	230	971.96	607	1,032.85
120	274.35	231	192.68	608	583.04
121	166.00	232	133.13	700	1,164.78
122	2,631.02	233	586.19	701	0.00
123	364.42	234	14.68	702	53.31
124	656.94	235	1,025.34	703	333.47
125	890.71	236	0.00	704	17.27
126	469.18	237	597.64	705	73.34
127	967.93	238	1,881.93	800	8.45
128	310.29	239	0.00	801	41.37
129	679.12	240	466.65	802	57.57
130	782.87	241	0.00	803	6.28
131	185.62	242	0.00	804	33.73
132	101.92	243	0.00	805	34.16
133	245.03	244	0.00	806	23.19
134	13.99	245	151.29	807	26.76
135	1,245.91	246	60.68	808	35.25
136	15.56	300	1,582.14	809	0.00
137	0.00	301	170.69	810	161.15
138	0.00	302	628.78	811	124.45

HSPF Reach ID	TN Load (lbs/yr)	HSPF Reach ID	TN Load (lbs/yr)	HSPF Reach ID	TN Load (lbs/yr)
200	228.42	303	126.91	812	35.06
201	9.50	304	39.97	813	31.66
202	899.03	305	8.39	814	78.98
203	696.92	306	7.20	815	0.00
204	284.31	307	7.57	816	418.06
205	0.00	308	2.26	817	102.84
206	0.00	309	162.68	818	0.00
207	945.86	400	2.23	819	1.34
208	2,524.55	401	1,149.37	820	87.57
209	337.32	402	39.37	821	20.78
210	2,531.56	403	140.69	-	-

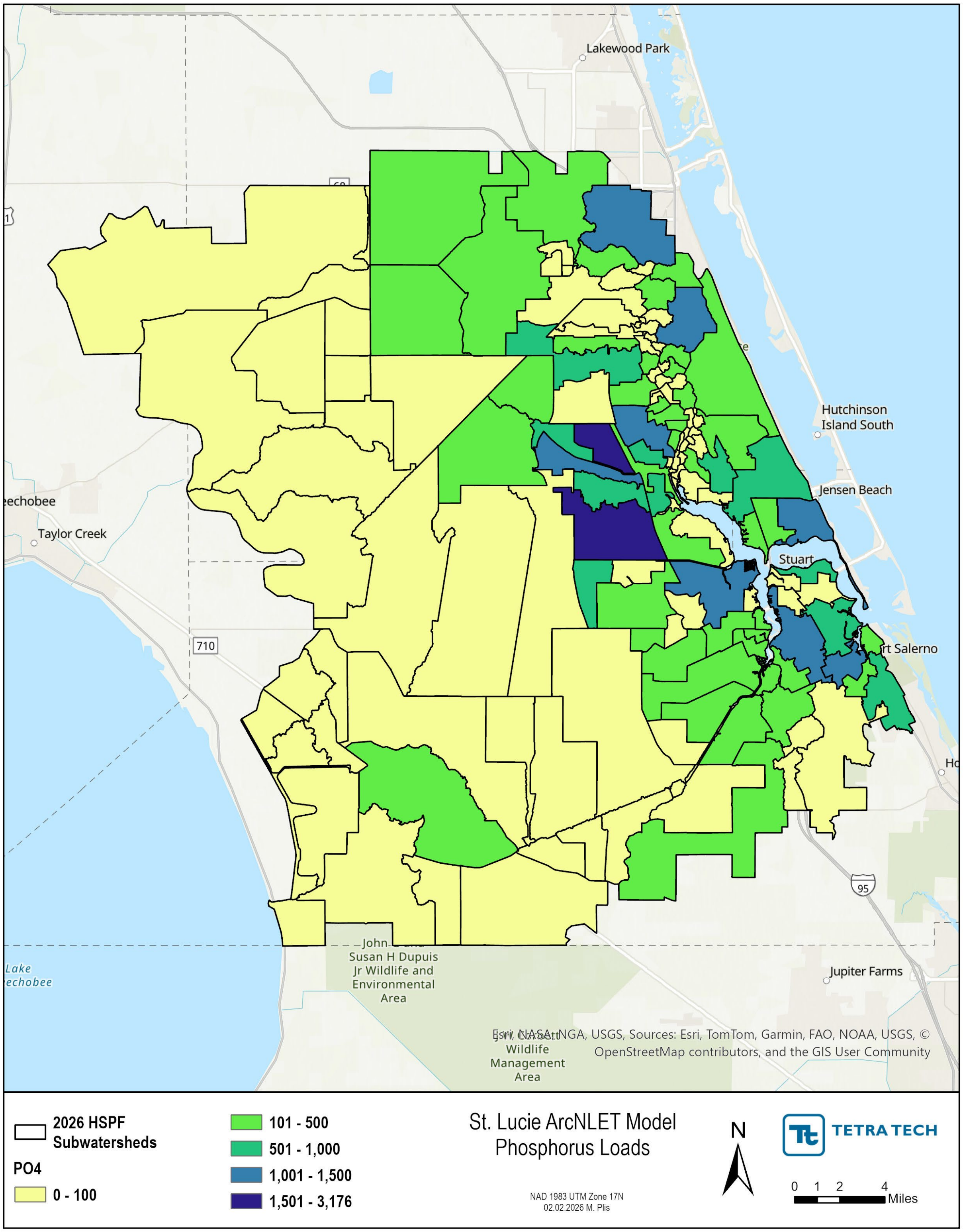


Figure 20. Modeled Phosphorus Loads per HSPF Subwatershed

Table 7. Summary of Phosphorus Load to HSPF Reach

HSPF Reach ID	TP Load (lbs/yr)	HSPF Reach ID	TP Load (lbs/yr)	HSPF Reach ID	TP Load (lbs/yr)
100	0.00	211	0.00	404	51.58
101	0.00	212	1.43	405	2.85
102	0.00	213	0.00	406	70.10
103	0.00	214	175.35	407	4.30
104	12.88	215	167.88	408	24.35
105	205.20	216	40.11	500	245.25
106	34.32	217	179.41	501	1,317.68
107	262.04	218	762.67	502	437.62
108	97.72	219	844.79	503	60.25
109	333.46	220	3,175.61	504	69.98
110	18.64	221	887.42	505	192.05
111	0.00	222	1,258.17	506	169.36
112	62.76	223	1,866.52	600	179.31
113	81.16	224	52.77	601	1,364.61
114	254.78	225	502.50	602	502.49
115	71.45	226	176.89	603	75.76
116	22.96	227	1,490.57	604	901.15
117	27.21	228	0.00	605	1,122.66
118	685.07	229	151.55	606	265.16
119	156.50	230	430.71	607	501.70
120	84.81	231	71.55	608	227.33
121	88.63	232	43.07	700	414.01
122	1,050.24	233	280.62	701	0.00
123	172.69	234	7.17	702	22.99
124	309.49	235	487.69	703	160.49
125	375.12	236	0.00	704	7.11
126	213.68	237	296.05	705	35.86
127	465.61	238	755.16	800	4.31
128	123.28	239	0.00	801	21.51
129	260.19	240	223.70	802	18.52
130	283.89	241	0.00	803	4.29
131	77.27	242	0.00	804	11.58
132	54.14	243	0.00	805	17.12
133	129.85	244	0.00	806	7.19
134	8.54	245	75.69	807	11.44
135	495.83	246	27.05	808	5.75
136	5.73	300	781.80	809	0.00
137	0.00	301	101.45	810	75.89
138	0.00	302	276.80	811	64.37
200	111.33	303	50.17	812	18.61
201	1.44	304	20.10	813	17.09
202	476.84	305	2.89	814	38.58
203	338.34	306	4.31	815	0.00
204	107.49	307	4.31	816	197.18
205	0.00	308	1.43	817	52.92
206	0.00	309	60.28	818	0.00
207	436.95	400	0.00	819	1.42

HSPF Reach ID	TP Load (lbs/yr)	HSPF Reach ID	TP Load (lbs/yr)	HSPF Reach ID	TP Load (lbs/yr)
208	1,066.27	401	568.56	820	41.43
209	141.70	402	17.25	821	8.62
210	1,069.65	403	78.69	-	-

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