

## Chapter 6: Population Growth and Stormwater Pollution

Utilizing the combined results of different model outputs, stakeholder input, and field surveys of Spring Lake Watershed conditions, the Rein in the Runoff project team developed forecasts of future land use and land cover change related to population growth and projected development in the Spring Lake Watershed. These forecasts were then used to model the results of such development on the pollutant loads to Spring Lake as a result of stormwater runoff. Ecological forecasts such as these can help assist planning and decision-making, but they do come with some level of uncertainty (Clark et al. 2001). For such ecological forecasts to be useful, the underlying scientific information must be as accurate as possible, and its communication to the public must be effective. These technical and resource constraints may be large, but not insurmountable (Nilsson et al. 2003).

Accordingly, this chapter examines the forecasted effects of continued population growth and the accompanying land use changes in the Spring Lake Watershed. The project team applied PLOAD model runs (see Appendix A) to the results of the Population Allocation Model (PAM) analysis, the technical details of which are described in Appendix K. These combined results provide one potential future for the Spring Lake Watershed, assuming no change – or “business as usual”. Obviously, changes in policies or practices by the watershed stakeholders – including the widespread implementation of stormwater best management practices (BMPs) – would lead to different future outcomes.

### **POTENTIAL LAND USE CHANGES RESULTING FROM CONTINUED POPULATION GROWTH IN THE SPRING LAKE WATERSHED**

Assuming that there is no change in current conditions, the model outputs from the PAM analysis conducted by the project team graphically show how the Spring Lake Watershed stakeholders could possibly develop and populate their watershed into the future. The population and allocation spatial data generated by PAM for 2010, 2020, 2030, and 2040 utilized the current population growth rate of 1.76% (PAM Scenario 1). These were then converted to land use and land cover GIS (geographic information system) data layers, and used to update the 2006 land use and land cover data for the watershed (Figure 6-1). This analysis focused on the increase in residential lands, but Figure 6-1 makes the concurrent loss of other land uses and land covers quite evident.

# PAM Analysis: Projected Residential Growth for 2010, 2020, 2030 and 2040

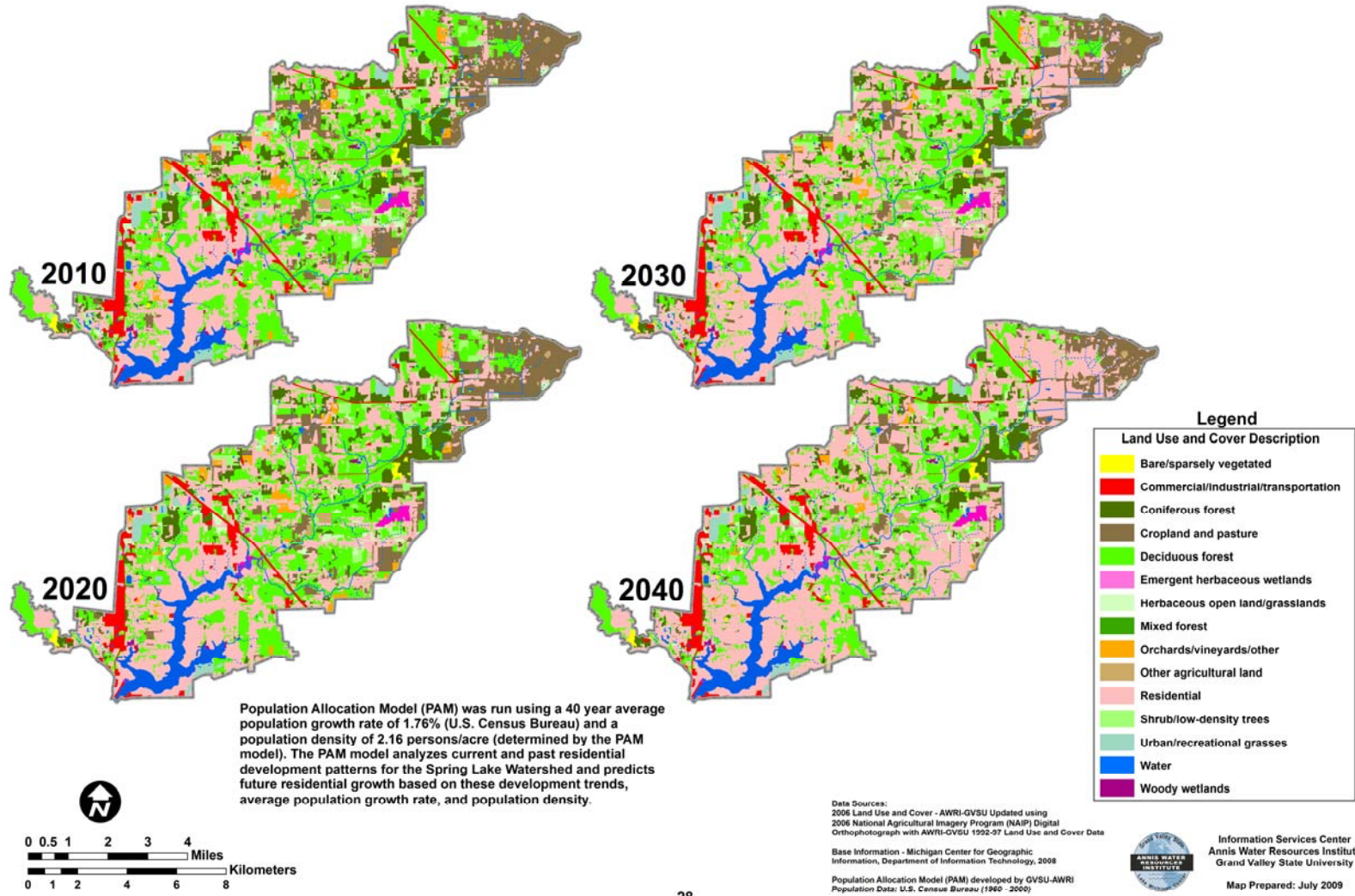


Figure 6-1. Projected land use and land cover changes in the Spring Lake Watershed in 2010, 2020, 2030, and 2040, based on the Population Allocation Model's (PAM) projected residential growth and population allocation.

## EFFECTS OF FUTURE DEVELOPMENT ON POLLUTANT LOADS TO SPRING LAKE

The Rein in the Runoff project team then ran PLOAD on these projected future Spring Lake Watershed land use and land cover data for 2010, 2020, 2030, and 2040, to determine how this future residential growth might affect the pollutant loadings throughout the watershed. (For a detailed discussion of the PLOAD methodology utilized by the Rein in the Runoff project team, please see Appendix A.) The resulting linked model outputs showed projected increases in pollutant loads from 2010 – 2040 of 29% for Total Nitrogen (TN), 34% for Total Phosphorus (TP), and 25% for Total Suspended Solids (TSS) (Table 6-1). Although PAM projected residential growth throughout the entire Spring Lake Watershed, the highest pollutant loads were again seen in the sub-basins closest to Spring Lake for TN (Figure 6-2), TP (Figure 6-3), and TSS (Figure 6-4).

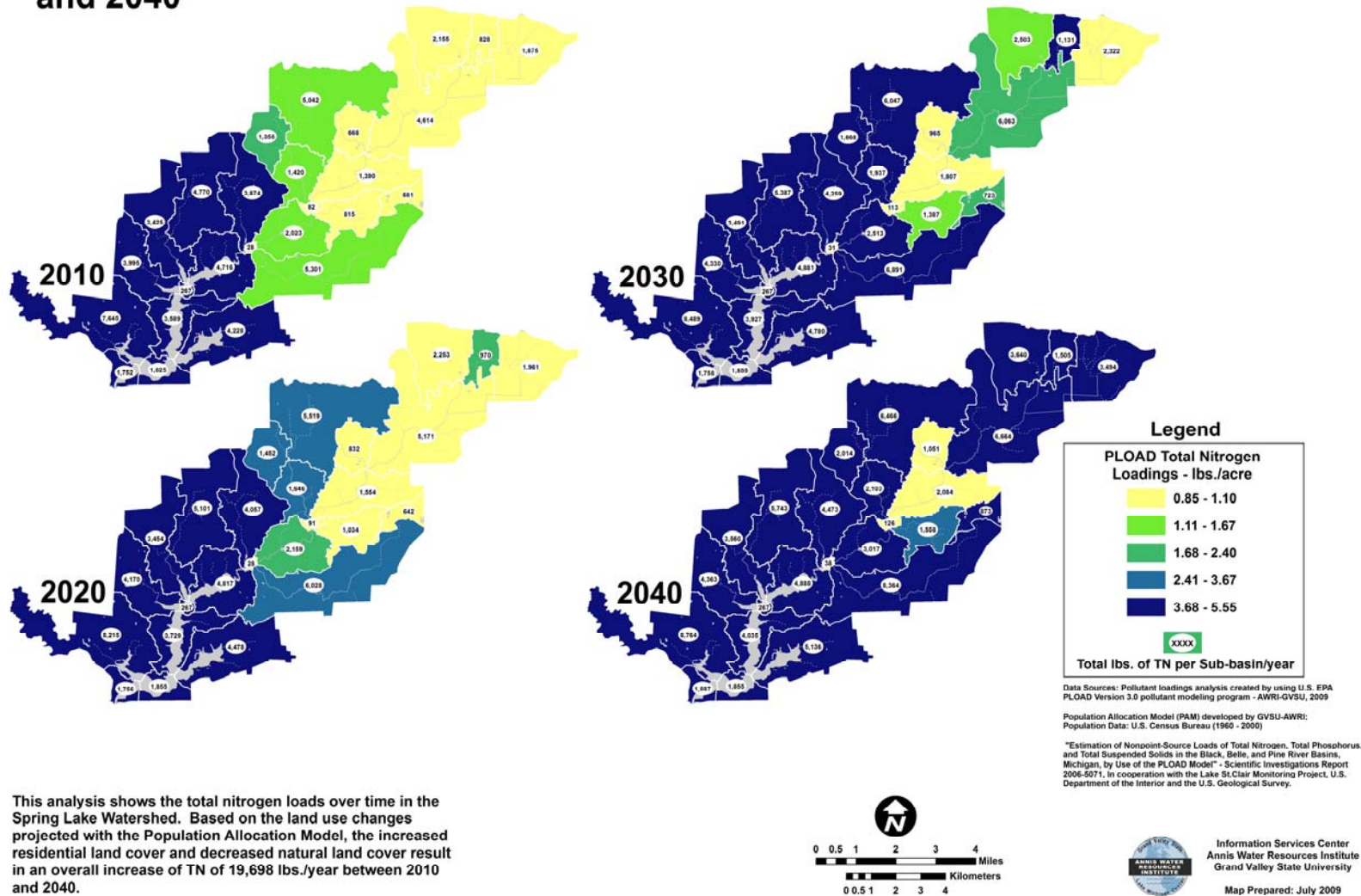
Table 6-1. PLOAD Results for Pollutant Loads from the Spring Lake Watershed based on the Population Allocation Model's (PAM) Forecasted Residential Growth and Patterns of Development in 2010, 2020, 2030, 2040.

Year	Residential Land Use and Land Cover		Total Nitrogen (lbs/yr)	Total Phosphorus (lbs/yr)	Total Suspended Solids (lbs/yr)
	Acres	% of Watershed			
2010	10,532.06	31.14	68,268	13,456	851,146
2020	12,248.19	36.22	73,239	14,639	904,040
2030	14,415.62	42.62	79,524	16,113	971,524
2040	17,218.64	50.89	87,966	18,090	1,062,751
<b>Change from 2010 - 2040:</b>	<b>6,586.58</b>	<b>19.75</b>	<b>19,698</b>	<b>4,634</b>	<b>211,605</b>

These patterns of development assumed that population growth would remain steady at the current rate of 1.76% (U.S. Census Bureau 2009), and were based on the current zoning ordinances and other regulations currently in effect throughout the Spring Lake Watershed. Certainly, if development continues unchecked, without proper stormwater BMPs to help control these pollutant loads to Spring Lake, the water quality in the lake and adjoining waterways will worsen. However, the implementation of stormwater BMPs – in particular Low Impact Development (LID) strategies – for new development will help limit the impact of increased pollutant loads associated with continued residential growth.

Recall that LID techniques attempt to mimic presettlement hydrology – or at least to maintain the hydrologic status quo. Although the project team did not re-run these linked model results with the suite of BMPs implemented in the high priority areas identified for the Spring Lake Watershed (see Figure 4-2 in Chapter 4), earlier model results showed that even without more development, the nutrient loads to Spring Lake will need to be controlled (see Table 4-2 in Chapter 4). The implementation of LID BMPs in new development projects would keep the stormwater runoff problem from worsening; however, these practices also need to be incorporated into already existing developed areas throughout the watershed.

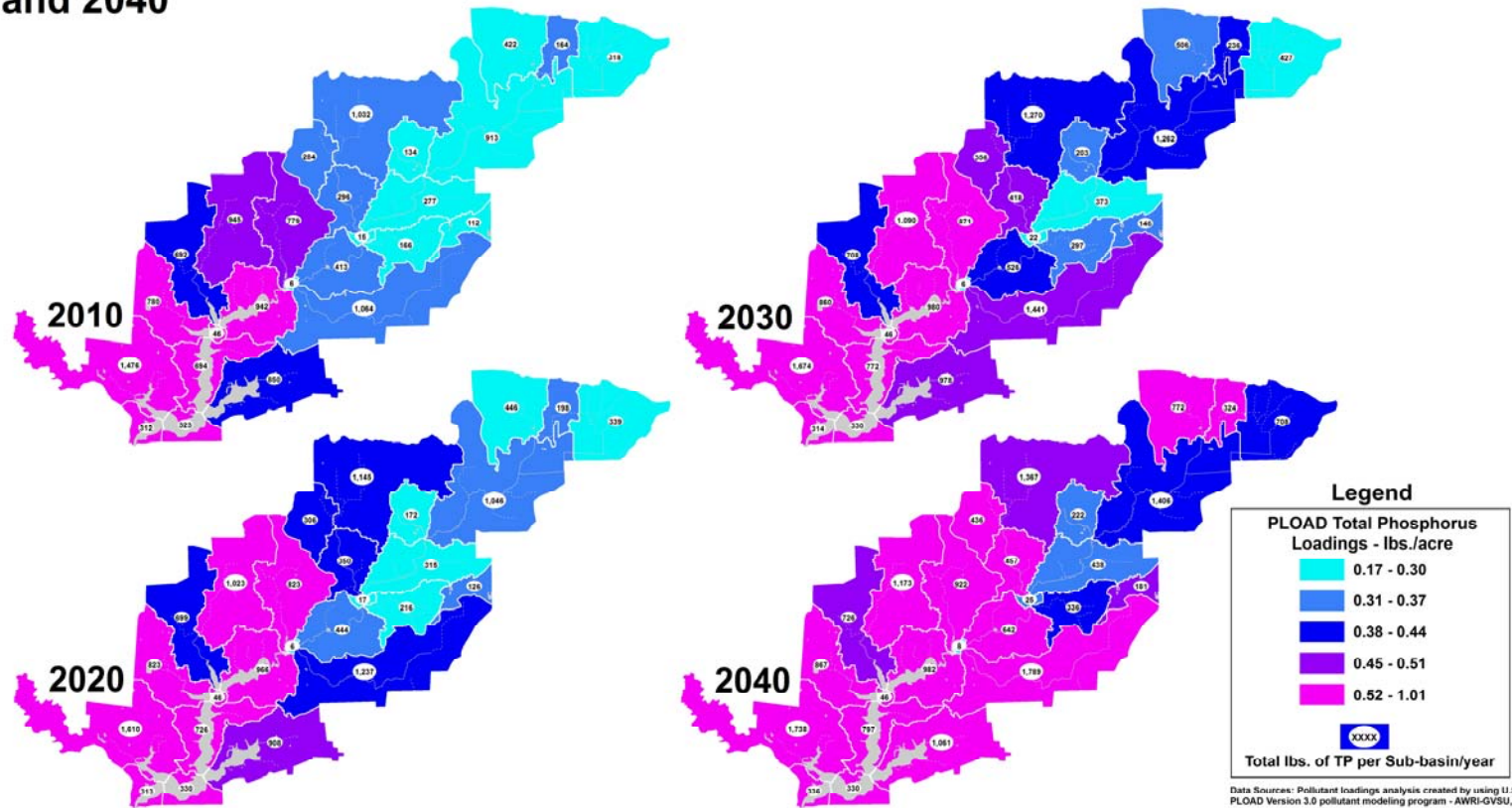
# PAM Analysis: Projected Results for Total Nitrogen Loading for 2010, 2020, 2030, and 2040



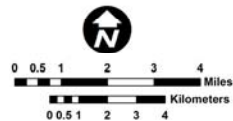
This analysis shows the total nitrogen loads over time in the Spring Lake Watershed. Based on the land use changes projected with the Population Allocation Model, the increased residential land cover and decreased natural land cover result in an overall increase of TN of 19,698 lbs./year between 2010 and 2040.

Figure 6-2. Linked model results from PAM and PLOAD for Total Nitrogen (TN) mapped to the ArcSWAT sub-basins for the Spring Lake Watershed based on projected residential growth and development in 2010, 2020, 2030, and 2040.

# PAM Analysis: Projected Results for Total Phosphorus Loading for 2010, 2020, 2030, and 2040



This analysis shows the total phosphorus loads over time in the Spring Lake Watershed. Based on the land use changes projected with the Population Allocation Model, the increased residential land cover and decreased natural land cover result in an overall increase of TP of 4,634 lbs./year between 2010 and 2040.

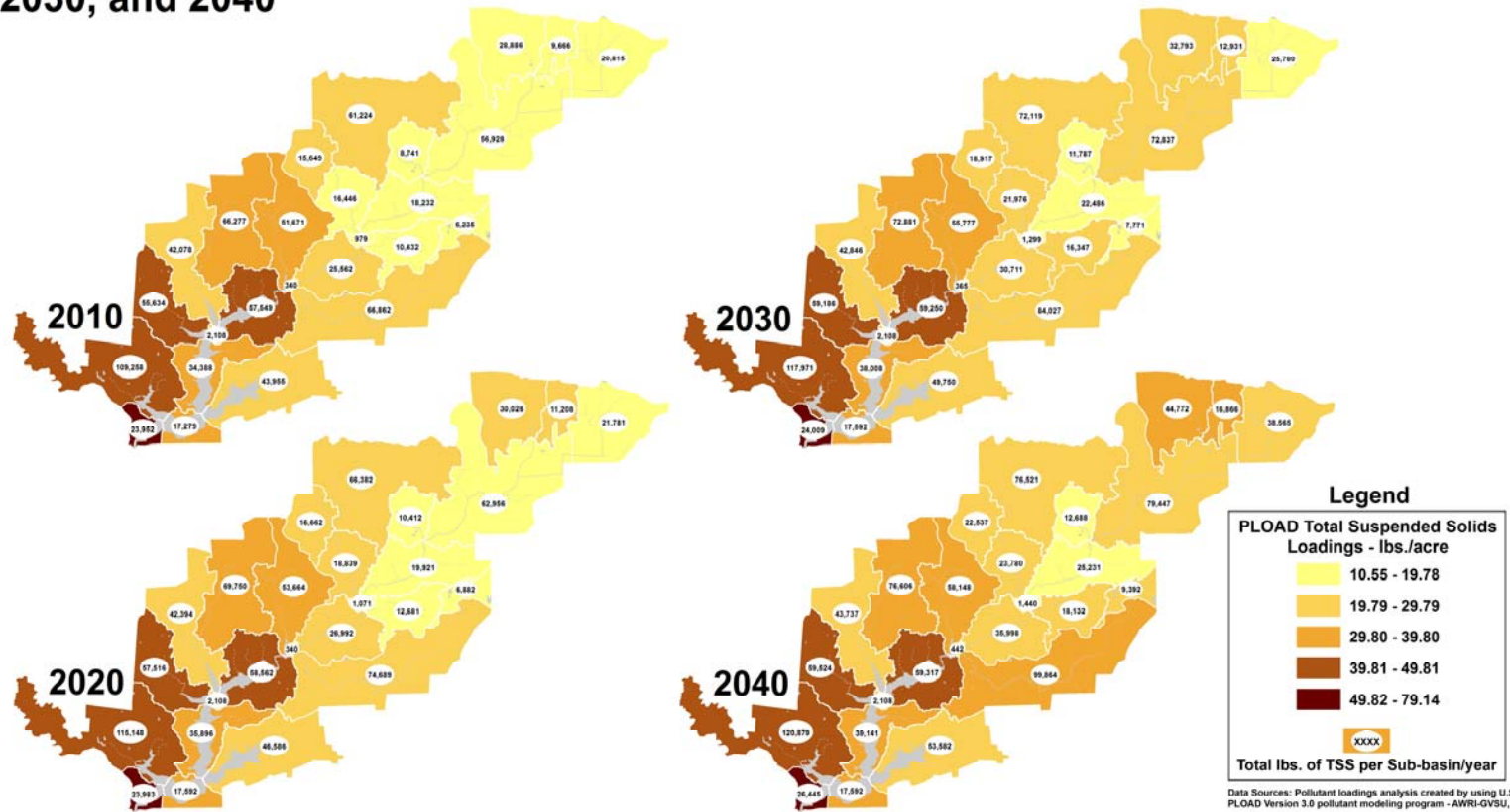


Data Sources: Pollutant loadings analysis created by using U.S. EPA PLOAD Version 3.0 pollutant modeling program - AWRI-GVSU, 2009  
 Population Allocation Model (PAM) developed by GVSU-AWRI;  
 Population Data: U.S. Census Bureau (1960 - 2000)  
 \*Estimation of Nonpoint-Source Loads of Total Nitrogen, Total Phosphorus, and Total Suspended Solids in the Black, Belle, and Pine River Basins, Michigan, by Use of the PLOAD Model\* - Scientific Investigations Report 2006-5071, in cooperation with the Lake St. Clair Monitoring Project, U.S. Department of the Interior and the U.S. Geological Survey.

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Figure 6-3. Linked model results from PAM and PLOAD for Total Phosphorus (TP) mapped to the ArcSWAT sub-basins for the Spring Lake Watershed based on projected residential growth and development in 2010, 2020, 2030, and 2040.

# PAM Analysis: Projected Results for Total Suspended Solids Loading for 2010, 2020, 2030, and 2040



**Legend**

**PLOAD Total Suspended Solids Loadings - lbs./acre**

- 10.55 - 19.78
- 19.79 - 29.79
- 29.80 - 39.80
- 39.81 - 49.81
- 49.82 - 79.14

XXXX

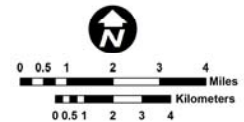
**Total lbs. of TSS per Sub-basin/year**

Data Sources: Pollutant loadings analysis created by using U.S. EPA PLOAD Version 3.0 pollutant modeling program - AWRI-GVSU, 2009

Population Allocation Model (PAM) developed by GVSU-AWRI: Population Data: U.S. Census Bureau (1960 - 2000)

\*Estimation of Nonpoint-Source Loads of Total Nitrogen, Total Phosphorus, and Total Suspended Solids in the Black, Betis, and Pine River Basins, Michigan, by Use of the PLOAD Model\* - Scientific Investigations Report 2006-5071, in cooperation with the Lake St. Clair Monitoring Project, U.S. Department of the Interior and the U.S. Geological Survey.

This analysis shows the total suspended solids loads over time in the Spring Lake Watershed. Based on the land use changes projected with the Population Allocation Model, the increased residential land cover and decreased natural land cover result in an overall increase of TSS of 211,605 lbs./year between 2010 and 2040.



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Figure 6-4. Linked model results from PAM and PLOAD for Total Suspended Solids (TSS) mapped to the ArcSWAT sub-basins for the Spring Lake Watershed based on projected residential growth and development in 2010, 2020, 2030, and 2040.