# On-Site Wastewater Treatment System Management Plan for the Township of West Milford

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# Executive Summary

In 2006, the Township of West Milford, Passaic County, New Jersey received a grant of $108,217.00 under the federal Clean Water Act program 604(b) to create an "Onsite Wastewater Treatment Systems (OWTS) Management Plan" for the New Jersey Portion of Greenwood Lake. The three main objectives for this project were to utilize existing GIS and other data to conduct an environmentally-based categorization assessment to identify those parcels in the highest need of some type of OWTS management; collect site-specific water quality data from immediately down gradient of a OWTS leachfield to revise the OWTS total phosphorus (TP) load entering Greenwood Lake and link this revised load to the lake's established TMDL; and develop a detailed set of non-structural and structural management recommendations to comply with the TMDL and improve local water quality.

For the GIS analysis a Zone of Influence (ZOI) was identified around Greenwood Lake and all associated waterways. The ZOI is the average distance in which a septic system leachfield can directly impact the water quality of a receiving waterway. For this analysis the ZOI was established at 100 meters (330 feet). A variety of environmental factors were compiled in a GIS format for both the ZOI as well as the Targeted Zone, which are the three sub-watersheds within the New Jersey end of the watershed that generate the highest TP loads. The environmental factors included soils and their associated properties, the presence of wetlands, slopes, depth to water table and depth to bedrock. In turn, these data were layered over existing municipal parcel data, as well as available data on a specific feature of the existing OWTSs, which was the age of the system.

Unfortunately, due to some data gaps in the existing historical database, there was some type of documentation for only 60% of the the OWTSs within the ZOI and 42% within the Targeted Area. Therefore, this discrepancy was taken into account in the development of the GIS-based categorization process and the resulting analysis does identify those parcels in the highest need of management. In turn, these parcels should be considered for future rehabilitation or retrofit projects (see below).

A Quality Assurance Protection Plan (QAPP) was developed for the installation of sampling wells up and down gradient of an existing OWTS to quantify how these systems can impact the water quality of surface waterways. The QAPP was initially submitted to NJDEP for review in 2007 and was approved in 2010. The sampling wells were installed in 2011 and subsequently samples were collected in August and September of 2011. While a variety of parameters were analyzed, the one of primary interest was TP, since it is the primary limiting nutrient for Greenwood Lake and the pollutant of concern for its TMDL. The OWTS selected for the monitoring program was the one that serves the Township's municipal building. The median TP concentration down gradient of the OWTS's leachfield was 0.62 mg/L, while the median TP concentration adjacent to the leachfield was only 0.075 mg/L. These data indicate that a functioning OWTS can still be a large contributor of TP for surface waterways. Using the data collected from this study, as well as more up-to-date census information, the TP loading coefficient from OTWSs was 0.165 kg of TP / capita / yr. This value was slightly higher than the value that has been widely used in Phase I lakes studies throughout northern New Jersey of 0.115 kg of TP / capita / yr.

Using the revised coefficient, the annual TP load originating from OWTSs within the New Jersey end of the watershed was 508 kg. The TMDL requires a 43% reduction in the annual TP load so the targeted TP load from OWTSs in New Jersey should be 290 kg. Thus, the existing TP load originating from New Jersey OWTSs should be reduced by 218 kg (480 lbs) in order to comply with the TMDL.

In order to comply with the reduction from OWTSs in the New Jersey end of the watershed, as required in the TMDL, a series of both non-structural and structural management measures were reviewed, quantified and discussed in the Management Plan. The first non-structural management measure is pumping out each septic system at least once every three (3) years. Since the Township passed an on-site wastewater Ordinance in 2008, it is now necessary for all residents who own / operate an OWTS to have their septic tanks pumped-out once every three years and have a State-certified contractor conduct a general inspection of the system at that time to obtain a license of operation from the Township. Thus, these mandatory pump-outs were calculated to remove 73 kg of TP on an annual basis.

The other two major non-structural management measures recommended for the Township were the wide spread use of non-phosphorus automatic dishwasher detergents, expected to remove 76 kg of TP, and the installation of water conservation devices, expected to remove 38 kg. In contrast to three year pump-outs, these two non-structural measures are not mandatory, so an active public education / outreach program must be developed by the Township to ensure residents know the value and importance of implementing these measures.

With the three non-structural management measures implemented, there would be another 62 kg to be removed from the New Jersey OWTS annual TP load to be in compliance with the TMDL (includes safety factor). Thus, to attain the targeted TP load, a set of structural management measures were recommended for implementation. There are a variety of alternative OWTS technologies that could be considered for rehabilating or retrofitting existing OWTSs to reduce the TP load and an alternative OWTS technologies manual was developed that provides information on these alternative OWTS technologies. However, for the sake of this Management Plan, those technologies that focus primarily on retrofitting rather than rehabilitating (replace) existing OWTSs were considered. In addition, technologies that were moderately priced, required a low to moderate amount of maintenance, required a relatively small amount of space, and were currently approved by the State, were preferred.

In order for the Township to be in compliance with its portion of the OWTS TP load, it was estimated that about 240 OWTSs would need to be rehabilitated or retrofitted. Of these selected systems it was recommended that most (200 of the 240) of them be considered to be retrofitted with a peat filter to enhance their ability to remove phosphorus. Approximately 40 existing OWTSs should be replaced with an alternative OWTS technology such as intermittent sand filters. However, the actual technology selected should be based on site specific conditions and initial / long-term costs. In addition, Effluent screens or filters should be considered by all operators of OWTSs to reduce the amount of particulate material that enters the drain field.

The Plan concludes by providing guidance on the development and distribution of public education / outreach material to ensure people know what should be done to contribute toward protecting the Township's water resources. Estimated budgets for the implementation of all management measures were provided as well as information on potential sources of funding.

# 1.0 Background

Greenwood Lake is located in the Passaic Watershed Management Area #3 and straddles the New Jersey-New York border (Figure 1, Appendix A). Greenwood Lake is a 1,920 acre waterbody located in both Passaic County, New Jersey and Orange County, New York (Figure 1 in Appendix A). The lake is highly valued as an ecological, recreational, and high quality water resource for both States. Given the high ecological and recreational value of the lake, it has a substantially positive impact on the local economies of both States. In addition, the lake serves as a headwater supply of potable water, which flows into the Monksville Reservoir and eventually into the Wanaque Reservoir, where it supplies over 2.3 million people with drinking water.

In response to identified and confirmed water quality impacts, New Jersey Department of Environmental Protection (NJDEP) drafted a Total Maximum Daily Load (TMDL) analysis for Greenwood Lake to address one specific impairment – elevated phosphorus conditions. In 2004, NJDEP also designated the lake as a high priority to address impairments from low dissolved oxygen, and a medium priority to address impairments from sedimentation. In 2006, NJDEP designated the Lake as impaired for dissolved oxygen, TSS, and mercury. In 2008, the NJDEP delisted Greenwood Lake for TSS and dissolved oxygen, but received a medium ranking for impairment from mercury. The 2004, 2006 and 2008 Integrated Reports indicated that Greenwood Lake met the recommended levels for fecal coliform bacteria, indicating that it was safe for swimming. However, recent monitoring data identified elevated levels of fecal coliform in Belchers Creek, the major tributary to Greenwood Lake.

As indicated by the lake's TMDL, in addition to fecal coliform, total phosphorus is another pollutant of concern. It is the primarily limiting nutrient in Greenwood Lake; even a small increase in the phosphorus load can result in a substantial increase in the amount of algal and aquatic plant growth. Given the water quality, ecological, aesthetic and economic impacts of nuisance algal blooms and aquatic vegetation, the control and reduction of phosphorus loading has been extremely important for Greenwood Lake.

The phosphorus TMDL for the Greenwood Lake watershed was developed and completed by NJ DEP in 2004 and subsequently reviewed and also approved by New York Department of Environmental Conservation (NYS DEC), who completed a Total Maximum Daily Load (TMDL).

Based on the findings of the TMDL, the single largest source of total phosphorus (TP) for Greenwood Lake originates from internal loading, which accounts for 42% of the annual TP load (Table 1). However, stormwater-based surface runoff and on-site wastewater treatment systems (i.e. septic systems) together accounted for over half of the lake's annual phosphorus load (Table 1). Of the surface runoff load, low density residential, high density residential, and commercial / industrial / transportation land types accounted for the highest, second, and third highest sources of stormwater-based TP, respectively. Combined, these three land types accounted for approximately 64% of the total surface runoff load.

**Table 1**
**Annual Total Phosphorus (TP) Load Entering**
**Greenwood Lake, NJ-NY**

| Source of Pollutant | TP Load (kg) | Percent Contribution |
|---|---|---|
| Surface Runoff | 1,580 | 38 |
| Septic Systems | 710 | 17 |
| Internal Loading | 1,739 | 42 |
| Point Sources | 70 | 2 |
| Atmospheric Sources | 53 | 1 |
| **Total** | **3,088** | **100** |

**Table 2**
**Greenwood Lake Phosphorus TMDL**
**Stormwater Contribution and Analysis**

| Scenario | Load |
|---|---|
| Existing Annual Stormwater TP Load (NJ) | 980 kg |
| Existing Annual Stormwater TP Load (NY) | 600 kg |
| **Total Watershed Existing Annual Stormwater TP Load** | **1,580 kg** |
| | |
| **Total Watershed Targeted Annual Stormwater TP Load** | **1,088 kg** |
| | |
| **Total Watershed Required Reduction to Attain the Targeted Stormwater TP Load** | **492 kg** |
| | |
| Required Reduction to Attain the Targeted Stormwater TP Load (NJ) | 305 kg |
| Required Reduction to Attain the Targeted Stormwater TP Load (NY) | 187 kg |
| **Total Required Reduction to Attain Targeted Stormwater TP Load** | **492 kg** |

According to NJ DEP's phosphorus TMDL, the existing surface runoff TP load entering Greenwood Lake is 1,580 kg while the targeted surface runoff TP load should be 1,088 kg (NJ DEP, 2004). Thus, in order to attain the targeted TP load, the required reduction is 492 kg. To assign these reductions in an objective, fair and equitable manner, the TP load targeted for reduction was divided based on the area of land covered within each State's watershed. New Jersey accounts for 62% of the total watershed, while New York accounts for 38%. Thus, New Jersey should reduce its existing surface runoff load by 305 kg, while New York should reduce its existing surface runoff load by 187 kg (Table 2).

A Stormwater Implementation Plan was developed by Princeton Hydro for the New Jersey end of Greenwood Lake (West Milford Township, Passaic County, New Jersey). The development of the Plan was conducted as part of a Non-Point Source (NPS) 319 grant awarded to the Township of West Milford in State Fiscal Year 2004.

Based on the analysis associated with the Plan, the New Jersey sub-watersheds were prioritized and ranked based on the highest "developed" phosphorus loading from residential or commercial use. The results of this analysis were used to identify specific sites and potential stormwater implementation projects. Proposed project sites focused primarily on the most highly ranked sub-watersheds relative to "developed" phosphorus loads. The highest ranked sub-watersheds were those that surround Belchers Creeks. This Stormwater Implementation Plan was reviewed and approved by NJDEP in April 2006.

A similar Non-Point Source (NPS) 319 grant was awarded to the stakeholders of the New York end of the watershed (Town of Warwick / Village of Greenwood Lake, Orange County, New York). Thus, a Stormwater Implementation Plan was also developed for the New York end of the lake as outlined in the phosphorous TMDL (Table 2).

While the Stormwater Implementation Plans address the phosphorus loading originating from surface runoff / stormwater, phosphorus loading from on-site wastewater treatment systems (OWTS) also has to be addressed in order to achieve long-term compliance with the lake's TMDL. While OWTSs are the third largest source of phosphorus for Greenwood Lake and only account for 17% of the lake's annual TP load, as per the TMDL, the form of phosphorus entering the lake from OWTSs can exert a larger impact on water quality relative to other sources. Unlike many of sources of phosphorus such as the erosion of streambanks, stormwater or surface runoff where a large portion of the phosphorus is in a particulate form, most of the phosphorus coming from septic systems is in a dissolved form that is easily assimilated by algae and aquatic plants (Greene, 2001). Thus, while OWTSs are not the dominant source of phosphorus for Greenwood Lake, reducing their contribution would certainly reduce the amount of available phosphorus for resident algae and aquatic plants, in turn, improving water quality.

Given the environmental impacts of phosphorus and the health-related impacts of fecal coliform / E. coli, an OWTS Management Plan was needed for the Greenwood Lake watershed. Specifically, the Plan developed under this 604(b) grant focuses primarily on the OWTSs within Belcher Creek sub-watersheds, on the New Jersey end of the Greenwood Lake watershed. However, the recommendations made in the Plan can be applied to other parts of the watershed and possibly even throughout the Township, Passaic County and parts of the New Jersey Highlands.

This OWTS Management Plan will serve as a critical document for the Township of West Milford since the majority of the residential properties are on OWTSs. Additionally, since homeowners are typically responsible for the operation and maintenance of their individual OWTS, it is vital to provide the necessary information and / or training on the proper operation, maintenance of their septic systems. Furthermore, the passing of a set of septic ordinances by the Township provides an excellent opportunity to educate property owners on their responsibility in operating and maintenance an OWTS. Thus, the OWTS Management Plan will be used as a planning, management and educational tool for the Township, directly linking its implementation to the eventual, long-term compliance with the lake's phosphorus TMDL.

An important step in managing OWTSs is identifying their location, type, condition, and number. This information will be helpful for determining how to best manage and prioritize the OWTSs. The benefits of having an OWTS management program include: reduced costs for repairs, operation, maintenance, and replacement; longer system life; improved system performance, increase reliability; and higher property values. Also, it is important to review and understand the current regulatory powers and management to assure program compliance.

## 2.0 Project Goal and Objectives

The ***goal*** of this project is to develop a comprehensive yet flexible Management Plan for the OWTSs within the New Jersey end of the Greenwood Lake watershed, with the focus being the three sub-watersheds (G, H and I) that immediately drain into Belchers Creek (Target Zone), the lake's main inlet (Figure 2, Appendix A). In addition, the Plan will be an integral component of Greenwood Lake's phosphorus TMDL Restoration Plan, as well as provide guidance in reducing fecal coliform loads.

***Objectives*** **–** The objectives of the proposed project are listed below and closely follow the eight minimum components identified by NJDEP.

1. Develop a GIS-based process to collect and compile site-specific information on the OWTSs within the study area. This same process will also be used to track and document long-term developments / changes associated with the OWTSs (Component 1).

2. Update the estimated annual phosphorus load entering Greenwood Lake from OWTSs located in the New Jersey end of the watershed.

3. Collect site-specific water quality data to assist in quantifying the phosphorus loads entering the lake from New Jersey OWTSs.

4. Develop and apply an objective prioritization scheme to identify and rank the operation and maintenance concerns of the OWTS (Component 2).

5. Through the findings of the prioritization scheme, identify management measures and recommendations that should be implemented to best address site-specific OWTS concerns (Component 3).

6. Establish a set of protocols to provide short-term and long-term monitoring, operation, maintenance, replacement and upgrades of OWTS (Component 4).

7. Identify the technical resources and the fiscal budget needed to implement the OWTS Management Plan. Sources of both technical and financial assistance will be identified (Component 5). As part of the required assistance in implementing the Plan, an OWTS Management entity would be established to oversee and administer the plan (Component 7).

8. Establish an aggressive and pro-active educational and outreach program that will provide information to watershed stakeholders, owners / operators of OWTSs and the public on both the need and value of implementing the management measures identified in the plan (Component 6).

9. Establish a comprehensive yet flexible implementation schedule for the management measures identified in the plan. The actual implementation of the plan will obviously be dependent upon potential sources of funding and the agreed upon version of the plan. However, with such additional factors in mind, an implementation plan will be developed (Component 8).

Finally, for clarification, a few terms that will be used throughout the Plan will be formally defined here.

The <u>Planning Area</u> is the portion of the Township of West Milford, Passaic County, NJ located within the Greenwood Lake watershed. The Planning Area is essentially the New Jersey end of the Greenwood Lake watershed.

In contrast, the <u>Targeted Zone</u> includes the three sub-watersheds that drain directly into Belcher Creek, the main inlet of Greenwood Lake that originates from Pinecliff Lake. On Figure 2 in Appendix A these sub-watershed are identified as Sub-watersheds G, H and I.

The <u>Zone of Influence (ZOI</u>) is the area of land approximately 330 ft. (100 meters) around Greenwood Lake and its associated waterways (streams, ponds and wetlands) within its watershed. The zone of influence is the average distance in which septic systems can influence waterbodies; the value of 100 meters is the estimated distance that is generally accepted by New Jersey Department of Environmental Protection (NJDEP) and United States Environmental Protection Agency (US EPA) within the context of Clean Lakes Projects. For this analysis, land parcels within this buffer zone were focused on. It should be noted that the GIS parcel layers used for this analysis were clipped to the ZOI.

## 3.0 Basic Information on the Planning Area

West Milford Township is an 80+ square mile municipality located in Passaic County, New Jersey, totally within the Preservation Area of New Jersey's Highlands. A large proportion of its residents, over 5,000 homes, are located along the many lakes distributed throughout the municipality, including Greenwood Lake, which boarders New Jersey and New York (Figure 1, Appendix A). The Township clearly recognizes the importance and value of the aesthetic and natural resources of the Highlands, coupled with the availability of a variety of recreational activities including hiking, boating and fishing. For example, a small section of the Appalachian Trail crosses into the Township in its northwest corner. These recreational opportunities, coupled with its location within the northeast corridor of the United States, make the Township of West Milford an attractive area to visit and reside. Such conditions have prompted the need for the Township to develop holistic management plans that preserve and protect its natural resources.

Greenwood Lake is a 1,920 acre waterbody and is one of the primary natural resources within the Township of West Milford that is open to the public. In fact, the lake is highly valued as an ecological, water quality and recreational resource for both New Jersey and New York. Given its high ecological and recreational value, the lake has a substantially positive impact on the local economies of both States. In addition, the lake serves as a headwater supply of potable water that flows into the Monksville Reservoir and eventually into the Wanaque Reservoir, where it supplies over 2.3 million people with drinking water. Thus, a large component of the OWTS Plan focuses on minimizing the water quality impacts the OWTSs can have on Greenwood Lake. Similar to the stormwater efforts, the primary pollutant of concern for Greenwood Lake is total phosphorus (TP), which is the primary limited nutrient for the lake. Elevated phosphorus loads entering the lake stimulate nuisance levels of algal and aquatic plant growth.

In addition to phosphorus, fecal coliform is another important pollutant of concern that will be addressed in the OWTS Plan. A number of residents within West Milford rely on individual private wells as a source of potable water. In fact, of the 2,392 homes within the Highland's designed Planning Area, 2,063 homes (86%) are on private wells. Additionally, it should be recognized that 2,210 (92%) of the 2,392 homes within the Planning Area have some type of OWTS. Such conditions within the Planning Area emphasize the need for an OWTS Management Plan that addresses the long-term ecological and health-related impacts associated with OWTSs.

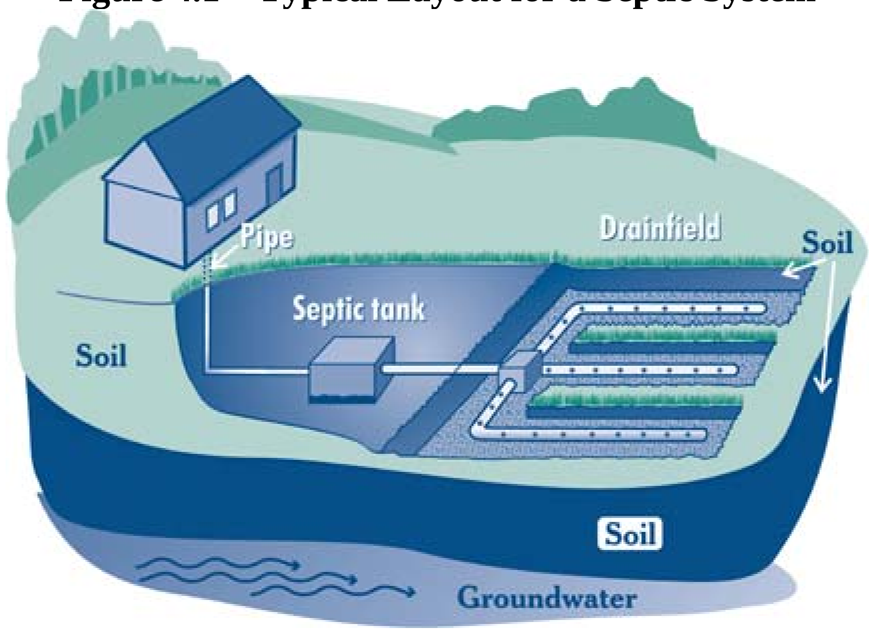
As previously described, the Planning Area is the New Jersey end of the Greenwood Lake watershed (Figure 2, Appendix A). However, relative to the development of this OWTS Management Plan, the ZOI land, approximately 330 ft. (100 meters) around Greenwood Lake and its associated waterways (streams, ponds and wetlands), is the primary area of concern. The Plan focuses on the ZOI since, in general, any older (at least 15 years old) septic system drainfield within 330 ft. of an associated waterway is more than likely a contributing source of phosphorus. Thus, with the use of Geographic Information Systems (GIS) Software, Princeton Hydro identified the ZOI within the entire Planning Area (Figure 3, Appendix A). The ZOI within the Targeted Zone is the primary area of focus for the OWTS Management Plan (Section 5.0).

For the GIS data analysis portion of this Management Plan, Princeton Hydro used ESRI's GIS products. Specifically, this product was ArcGIS 10.0, plus the 3-D Modeling and Spatial Analyst extensions. ESRI's GIS products are run on Dell Precision Workstations (various models) with at least two gigabytes of DDR Ram, dual Xeon processors and Nvidia Quadro 128 megabyte dual monitor video cards.

## 4.0 Septic System Basics

The first step in this Management Plan is to specifically define and describe what this Plan is designed to manage. On-site Wastewater Treatment Systems (OWTSs) are wastewater systems that are designed to treat and dispose of effluent on the same property that generates the wastewater. Thus, unlike sewering, OWTSs do not convey the wastewater to a central / communal facility where it is treated and disposed of collectively. One of the most common types of OWTS is the traditional septic system, or the soil absorption system (Figure 4.1).

**Figure 4.1 – Typical Layout for a Septic System**




***From: A Homeowner's Guide to Septic Systems (US EPA, 2005).***

### 4.1 Soil Absorption System

Soil absorption systems (septic systems) are the most popular OWTS; they consist of a septic tank, which receives the home's wastewater and a drainfield (also known as a leachfield). The tank allows solids to settle and separate from the liquid; this allows for the decomposition of organic matter and storage of solids. The liquid is passed on for further treatment and disposal in the drainfield. Soil absorption systems rely on the gradual seepage of wastewater into the surrounding soils. For effective wastewater treatment, soils should be permeable and should remain unsaturated for several feet below the system. Where impermeable soils exist, fill systems and sand-lined trenches can be used.

A wide variety of parameters dictate how effective an OWTS leachfield is in removing pollutants from the wastewater effluent. Some of these parameters include soil type, slope, drainage rate through soil, depth to bedrock, depth to the water table, the age of the system, its initial design and is current usage (Green, 2001). However, the primary processes of removing phosphorus from the OWTS effluent is adsorption and mineralization.

When maintained and managed properly, OWTS are often less expensive than having a centralized plant. Properly managing OWTS can result in lower replacement and repair costs and increase property value. Furthermore, these systems can be installed as needed, thus decreasing large upfront capital costs associated with centralized sewage treatment plants. Additionally, OWTSs can aid in recharging groundwater aquifers and maintaining dry season flow in streams.

Therefore, the proper management of OWTS is important for the system, health of the environment, and human health. For these reasons, establishing effective management programs would increase awareness of OWTS management and help ensure that the OWTS are being managed properly.

## 5.0 Development of Categorization Scheme

A categorization scheme was developed in order to identify and rank the operation and maintenance concerns for on-site wastewater treatment systems within the Target Zone in West Milford Township. As described below, a number of environmental factors and other criteria were used in the development of the categorization scheme. The following text outlines the Geographic Information System (GIS) methodology that was utilized in determining this categorization. Please note that the term “categorization” is used rather than “prioritization” based on the lack on site-specific septic system data (age of the system).

### 5.1 Identification of the Zone Of Influence (ZOI)

A zone of influence (330 ft. or 100 m) was constructed around Greenwood Lake and its associated lakes, streams, and wetlands within its watershed (Figure 3, Appendix A). The zone of influence is the average distance in which septic systems can influence waterbodies; the value of 100 meters is the estimated distance that is generally accepted by New Jersey Department of Environmental Protection (NJDEP) and United States Environmental Protection Agency (US EPA) within the context of Clean Lakes Projects. For this analysis, land parcels within the ZOI were the primary focus. It should be noted that the parcel layer was clipped to the ZOI as shown in Figure 5 (Appendix A).

### 5.2 Environmental Factors

In order to manage and reduce pollutant loading from OWTSs, an objective and rational categorization analysis was conducted. Based on this analysis, land parcels with the lowest categorization values will be targeted over those with higher categorization values. The following section will describe how the various environmental factors were categorized relative to land parcels within the within the ZOI and later the Targeted Zone.

**Soils**: Using Passaic County data from the Soil Survey Geographic Database (SSURGO) and New Jersey Administrative Code N.J.A.C. 7:9A, land parcels were categorized based on soil suitability. SSURGO soil data were clipped to the zone of influence and were designated with an N.J.A.C. 7:9A soil suitability code. Under N.J.A.C 7:9A, soil suitability is classified using three Roman numerals (I, II, and III) in which III represents the least suitable (or most severe) soil for septic systems. Furthermore, there are six criteria for septic suitability, which are defined by N.J.A.C 7:9A:

- **Fractured rock or excessively coarse substrata** (Sc): A rock substratum which contains an adequate number of open and interconnected fractures to allow unimpeded absorption of applied wastewater and transmission of this wastewater away from the disposal area.
- **Massive rock or hydraulically restrictive substrata** (Sr): A rock substratum which does not contain an adequate number of open and interconnected fractures to allow unimpeded absorption of applied wastewater and transmission of this wastewater away from the disposal area.
- **Hydraulically restrictive horizon, permeable substratum** (Hr): A substratum below the soil profile which slows or prevents the downward or lateral movement of water and which extends beyond the depth of profile pits or borings or to a massive substratum. A substratum which has a saturated permeability less than 0.2 inch per hour or a percolation rate slower than 60 minutes per inch is hydraulically restrictive.
- **Excessively coarse horizon** (Hc): A horizon of limited thickness with the soil profile which provides inadequate treatment of septic tank effluence due to a high coarse fragment content, excessively coarse texture, and/or excessively rapid permeability.
- **Zone of saturation, regional** (Wr): A layer within or below the soil profile which is saturated with groundwater either seasonally or throughout the year, which extends vertically without interruption below the depth of soil borings and profile pits.
- **Zone of saturation, perched** (Wp): A layer within or below the soil profile which is saturated with groundwater either seasonally or throughout the year, which occurs immediately above a hydraulically restrictive horizon and which is underlain by permeable horizons or substrata which are not permanently or seasonally saturated.

When classifying soil suitability, the classifications were based on soil series, which are a group of similar soil types that have major horizons with similar important characteristics. If the soil series had more than one of these criteria, multiple suitability classes were identified. For example, the soil series Hibernia is classified as III Hr and III Wp.

Soils within the zone of influence were then ranked based on the six aforementioned criteria for septic suitability. A total of six soil suitability categories were identified:

| Category/Ranking | Soil Suitability |
|---|---|
| 1 | Soils with at least three severe codes (III) of the six criteria |
| 2 | Soils with a severe code (III) for two of the six criteria |
| 3 | Soils with a severe code (III) for one criterion |
| 4 | Soils with a moderate code (II) for one criterion |
| 5 | Unclassified |
| 6 | Water |

The results of the soil suitability analysis for the ZOI are shown in Figure 4 (Appendix A).

As mentioned above, the land parcel data were layered over the ZOI for the various environmental factors. In the event that a parcel of land contains multiple ranking for a given environmental factor, such as soil, the lowest ranking (high priority) value was selected. To better demonstrate how this may impact the categorization process the septic soils suitability data layer of Figure 4 was layered over the parcel data and re-ran for the categorization. These two mapped data layers are shown together on Figure 5 (Appendix A) for comparative purposes. Obviously, this moved substantial portions of the ZOI into a lower rank value, which in turn gives these lands a higher level of need relative to addressing soil-related septic limitations (Figure 5 in Appendix A).

**Wetlands:** If a parcel contained a NJDEP mapped wetland, a value of 1 was SUBTRACTED from the soils ranking. For example if the soil suitability for a parcel was “1” and there was a wetland the score, based on these two factors, would be “0”, and thus would have worse environmental conditions for septic systems than a parcel with a soil suitability of “1” and no wetland “0” (total score “1”). The results of layering the wetland data onto the septic soil suitability and land parcel data are shown in Figure 6 (Appendix A).

**Slope:** Slope data were obtained from the Township of West Milford’s own GIS database. Data were divided into three categories (0-10, 10-20, and >20%) based on township guidelines.

| Ranking | Percent Slope |
|---|---|
| 1 | >20% |
| 2 | 10-20% |
| 3 | 0-10% |

The raw slope data within the ZOI are displayed in Figure 7 (Appendix A), while the raw slope data layered with the land parcel data are shown in Figure 8 (Appendix A). Similar to septic soil suitability, layering the slope data over the parcel data lowered the categorization value, thus increasing limitations associated with septic systems in many areas within the ZOI.

**Depth to Groundwater**: Depth to groundwater (also known as depth to water table) data were obtained from SSURGO soils data layer. Depth to groundwater ranged from 0 to 76 cm (0 to 2.5 ft.). Three categories were generated: 0 to 31 cm, 31 to 61 cm, and > 61 cm and were given the scores 1 2 and 3, respectively.

| Ranking | Depth to Groundwater (cm) |
|---|---|
| 1 | 0-31 |
| 2 | 31-61 |
| 3 | >61 |

The raw depth to water table data within the ZOI are displayed in Figure 9 (Appendix A), while the raw depth to water table data layered with the land parcel data are shown in Figure 10 (Appendix A). Similar to the other environmental factors, layering the depth to water table data over the parcel data lowered the categorization value, thus increasing limitations associated with septic systems in many areas within the ZOI.

**Depth to Bedrock:** Depth of bedrock data were also obtained from the SSURGO soil data layer. Based on the data there were three different depths: 0, 152, and 217 in. Rankings of 1, 2, and 3 were assigned, respectively.

| Ranking | Depth to Bedrock (in) |
|---|---|
| 1 | 0 |
| 2 | 152 |
| 3 | 217 |

The raw depth to bedrock data within the ZOI are displayed in Figure 11 (Appendix A), while the raw depth to bedrock data layered with the land parcel data are shown in Figure 12 (Appendix A). Similar to the other environmental factors, layering the depth to bedrock data over the parcel data lowered the categorization value, thus increasing limitations associated with septic systems in many areas within the ZOI.

**Other Factors to Consider:** In addition to the five environmental factors listed above, several others were identified for consideration in conducting the categorization analysis. Specifically, these factors include the identification of preserved and/or protected lands. Such lands are unlikely to have high densities of septic systems either now or in the future. Thus, the identification of preserved and/or protected lands (Figure 13, Appendix A) will aid in removing specific sections within both the Planning Area and Targeted Zone for analysis.

Site specific information on the existing OWTS within the ZOI was included in the analysis as well. The Township reviewed the Department of Public Health's historical paperwork on exiting

OWTS throughout ZOI and, unfortunately, the data was limited in scope. Of the information that could be obtained on the existing OWTS, the one piece of information that would provide the most amount of information is the age of the OWTS. All other factors being equal, an older system should be prioritized for upgrades or replacement relative to younger systems simply due to wear and tear, improvements in septic technology, and a better understanding on how such system operation and impact receiving waterways.

Unfortunately, site-specific data on existing OWTSs was extremely limited and to demonstrate this, those parcels with any amount of available information on the existing OWTSs are shaded a darker blue, while those parcels with no available information on the existing OWTSs are a lighter blue (Figure 14, Appendix A). There are a total of 3,195 parcels within the ZOI; 1,632 of these parcels have OWTSs but only 976 of these have documented information on the OWTSs. In contrast are a total of 1,486 parcels within the Targeted Area; 1,373 of these parcels have OWTSs but only 439 of these have documented information. Thus, relative to total number of existing OWTSs, approximately 60% have some type of documented information in the ZOI and 42% have some type of documented information in the Targeted Area. The absence of data for some of the parcels had to be taken into account in the categorization analysis, as described in detail below.

It should be noted that the GIS-based data on the existing OWTSs for the Township of West Milford is slightly dated (2008) and should be updated on a routine basis. Such updates could be easily integrated into the Township's recently passed mandatory pump-out and inspection program. For example, with the 2008 data the number of permits filed for OWTS was slightly higher than the number of actual OWTSs. This more than likely represents the fact that some of the OWTSs were in the process of being designed or installed in 2008. Updating the existing GIS-database would account for such changes.

## Environmental Factors within the Targeted Zone

The categorization analysis and associated data layers (Figures 4-14, Appendix A) focus on the ZOI for the New Jersey end of the Greenwood Lake watershed. The ZOI is a 330 ft. (100 meter) buffer that was established along all waterways within the watershed. A categorization analysis was conducted for each environmental factor within the ZOI. However, the OWTS Plan focuses on the Targeted Zone or those three sub-watersheds known to generate the largest NPS pollutant loads. Specifically, these three sub-watersheds cover the land that drains directly into Belchers Creek and exclude lands that drain first into Pinecliff Lake. Thus, the Targeted Zone sub-watersheds include Sub-watershed G, H and I (Figure 2, Appendix A).

To re-direct the categorization analysis to focus on the Targeted Zone, an additional set of GIS maps were generated that categorize the environmental factors by parcel within the three sub-watersheds of concern and include:

- Figure 15 – Septic Soils Suitability by Parcel within the Targeted Zone
- Figure 16 - Septic Soils Suitability and Wetlands by Parcel within the Targeted Zone
- Figure 17 – Slopes by Parcel within the Targeted Zone

- Figure 18 – Water Table Depth by Parcel within the Targeted Zone
- Figure 19 – Depth to Bedrock by Parcel within the Targeted Zone

**Final Environmental Categorization**

These environmental factors (Soils with wetlands criteria, Percent Slope, Depth to Groundwater, and Depth to Bedrock) were summed. Values ranged from 3 to 11 and were reclassified into an 'Environmental Rank' as follows:

| Environmental Factors Sum | Environmental Rank |
|---|---|
| 3-4 | 1 |
| 5-6 | 2 |
| 7-8 | 3 |
| 9-11 | 4 |

The results of this categorization of the parcels based on the environmental factors was compiled based on the Environmental Ranking described above and is shown in Figure 20 (Appendix A). Based on environmental factors, Sub-watershed H has the largest amount of OWTS-limiting lands. That is, of the three sub-watersheds, based on environmental factors alone, any future planning that involves the use of innovative OWTSs should generally prioritize sites within Sub-watershed H relative to the other two.

### 5.3 Site Specific Information

The last component to this categorization assessment was to include site specific information on the OWTSs within the Township of West Milford. As a partial in-kind match toward the 604(b) grant, the Township had compiled specific information on the OWTSs from the historical records found in the Department of Public Health. It should be noted that data were only obtained from land parcels within the ZOI in the Targeted Zone. While the quality of the data varied based on a number of factors, age was one of the primary factors dictating the quality, value and application of the data. Essentially, the younger the OWTS, the more usable data was available on that system.

It is widely accepted that all factors being equal, the older an OWTS, the more likely it will experience operational problems and/or have a reduced capacity to effectively treat wastewater and, in particular, remove phosphorus. For example, over time, the bonding sites for phosphorus in a septic leachfield will be depleted over time. Additions to the hydrologic load to the leachfield, say through expanding the size of a house and its bathrooms but not the leachfield itself, can put additional stress on the OWTS. Over time these factors will reduce the OWTS's capacity to remove phosphorus. It is generally thought that even under acceptable environmental conditions, the phosphorus removing efficiency of an OWTS will decline after 35-50 years. In turn, older OWTSs should be ranked higher in need of repair, management and/or replacement when compared to young systems. Thus, the site specific OWTS factor that was used in this categorization analysis was the age of the system.

As previously mentioned, the Township compiled data on the age of the septic systems on a parcels basis. These data were ranked by blocks of decades with the exceptions being the 1950's since the oldest available information was from 1957, and the 2000's, since the analysis was conducted in 2008. These decadal blocks were then ranked from oldest to youngest. Unfortunately, only a percentage of parcels had any information on the existing septic systems so an additional category, called "Date Unknown" was added to the analysis. The result of this categorization of existing OWTSs based on age is provided in Figure 21 (Appendix A).

The parcels within each Septic Age category were then ranked using the results of the Environmental Factor analysis; the results of this analysis are provided in Figure 22 (Appendix A). This resulted in a series of 22 individual categorizes, excluding unknown parcel data; such a dataset would be difficult to utilize in the development of long-term planning. In addition, one of the goals of this categorization analysis is to integrate some site-specific information on the OWTSs into the Environmental Database. Therefore, the Septic Age rankings in Figure 21 were added to the Environmental Factor rankings, with unknown parcels separated from the parcels with information on the age of the systems. The result of this analysis is shown in Figure 23 (Appendix A).

To make the categorization and subsequent use of the database very accessible, the unknown parcels were separated from known parcels. The known parcel data were then ranked similar to Environmental Factors (Figure 20) with those parcels having the lowest values receiving the highest priority in terms of requiring some degree of repair, management and/or replacement. This final categorization analysis is shown in Figure 24 (Appendix A). In this final analysis, the categorization was as follows: value of 1 is highest priority; value of 2 is high priority; value of 3 is moderate priority and value of 4 is lowest priority (Figure 24 in Appendix A).

A number of statements can be made relative to the final categorization analysis of the OWTSs within the Targeted Area of this study. First, the highest and high priority parcels are fairly well scattered over the Targeted Area. While there were a large number of high ranking parcels in Sub-watershed H for Environmental factors only analysis (see Figure 20), such a large cluster was not observed in the final categorization (Figure 24). This was primarily due to the fact that many of the parcels did not have any data of OWTSs that may be present.

While no large-scale patterns were observed in the final analysis, some small clusters were observed. Most notable were the number of highest ranked parcels along the southwestern shoreline of Greenwood Lake. Smaller clusters of highest ranked parcel are also observed along Eisenhower Drive and Rutgers Avenue, with another small cluster around the Mountain Circle residential area. However, as previously mentioned, not one location within the Targeted Area was dominated with highest ranked parcels. Therefore, while specific sites may be identified for specific replacement or demonstration projects, a more watershed / community-wide approach needs to be taken for the long-term management of OWTSs within the New Jersey end of the Greenwood Lake watershed, which is entirely located in the Township of West Milford.

## 6.0 OWTS and Phosphorus Relationship

Unlike properly functioning and placed OWTS, malfunctioning and/or OWTS in unsuitable conditions are capable of contributing nutrients to nearby water supplies, which in turn can increase nuisance plant and algal densities (Princeton Aqua Science 1983). The percolation of wastewater through a drainfield is an importance component of a septic system because percolation allows nutrients and pollutants in wastewater to be absorbed prior to entering adjacent waterways. Wastewater percolation can be reduced by over-saturation of the drainfield due to seasonal elevation of water table height, hydraulic overloading caused by overcrowding of homes and conversion of vacation properties to year-round residences, and/or formation of clogging mats in the drainfield (Princeton Aqua Science 1983). These conditions reduce the soils' ability to effectively remove nutrients by sedimentation, absorption, and filtration.

Furthermore, unsuitable soil conditions such as poor absorptive qualities can cause phosphorus to migrate into adjacent waterways. However as discussed in Section 5.0, some of the more common OWTS treatment limitations for the Greenwood Lake watershed include a shallow depth to bedrock, high slope (8 – 15%), and/or a high water table. Other factors such as soil type, age of system, relative degree of usage, distance to closest waterway and frequency of maintenance will also directly impact the ability of an OWTS to assimilate and remove pollutants such as phosphorus and fecal coliform.

Finally, it should be emphasized that the relationship between an operating OWTS and its assimilation of phosphorus is not as simple as has been established between OWTS and bacteriological parameters such as fecal coliform and *E. coli*. Typically, an OWTS is defined as "failing" if it can no longer remove microbial contaminants and thus poses a health hazard to nearby water supplies. However, it has been clearly established that a septic system does not have to be failing in the microbial sense to be a substantial source of phosphorus (Baker, et.al., 1998; Ptacek, 1998; Zanini, et.al., 1998). Thus, Health Department records on failing septic systems cannot be used as a means of identifying those OWTSs that are net contributors of phosphorus.

# 7.0 OWTS Phosphorus Model for the Planning Area of West Milford Township

As identified in the TMDL, the annual TP load originating from OWTSs used methodology that was used in the development of the original Phase I Diagnostic / Feasibility study for Greenwood Lake and its Watershed (Princeton Aqua-Science, 1983). The methodology used to estimate the annual phosphorus load originating from OWTSs is a five-step procedure, as outlined in the *Lake Management Handbook: A Guide to Quantifying Phosphorus Inputs to Lakes* (Windham Regional Planning Agency, 1982). This was the modeling methodology used to quantify the phosphorus load originating from OWTSs in the original Greenwood Lake Phase I study (Princeton Aqua-Science, 1983) and it is also used for the TMDL (NJDEP, 2004).

Essentially, the NJDEP analysis updated the original septic load TP calculation by using 2000 census data and estimating that there are a total of 2,075 housing units within 200 meters of the lake's shoreline. In addition, the calculation included a mean family estimate of three persons per dwelling. The analysis also used the septic TP loading coefficient used in the Phase I study of 0.114 kg TP / capita / yr to calculate the resulting 710 kg TP per year (NJDEP, 2004). The TMDL then established a targeted TP load originating from OWTSs to be 405 kg / yr, indicating that the existing TP load should be reduced by 305 kg or 43% (NJDEP, 2004).

Princeton Hydro refined the estimated TP load originating from OWTSs, primarily to reflect local conditions within the New Jersey end of the watershed. This refinement included a number of modifications, which are summarized below:

1. The refined model re-established the "zone of influence", defined as the average distance when a septic drainfield will have a measurable impact on an adjacent waterway to 100 meters, as described by Reckhow (1976) and USEPA (1980).
2. The model was run only for housing units within the New Jersey end of the watershed; the New York end of the watershed was not included in the analysis since the OWTS Management Plan focuses only on the West Milford portion of the watershed.
3. In addition, the New Jersey housing units included in the model were not limited to those along the lake shoreline. The established 100 meter zone of influence was expanded to include all housing units adjacent to streams and wetlands, as well as the lake's shoreline.
4. Based on a review of the existing soils (see Section 5.0 for details), the soil retention coefficient for the Greenwood Lake watershed was categorized as "somewhat poor" and was given a value of 0.3.
5. Those septic system drainfields located within 100 meters of a wetland included a phosphorus uptake coefficient.
6. Finally, some water quality monitoring of sub-surface groundwater was conducted to directly measure the phosphorus concentrations immediately down gradient of a septic

drainfield to provide some site-specific data. In turn, these data were used to re-calculate the OWTS-based phosphorus load from the Study Area.

Princeton Hydro then re-ran the OWTS phosphorus model for the Planning Area with these modifications. In turn, the results of the refined model were linked to the established goals of the phosphorus TMDL and then used to prioritize locations within the Planning Area in need of OWTS management.

### 7.1 Sub-Soil Leachate Water Quality Monitoring Program

In order to refine the OWTS phosphorus model, Princeton Hydro developed and submitted a Quality Assurance Protection Plan (QAPP), which was submitted to NJDEP for review and approval. This QAPP provided details on the protocol associated with the installation of wells up and down gradient of the leach field for the Township building's municipal septic system. The QAPP underwent a series of reviews and was approved in May 2010 (Appendix B). Once approved, a concerted effort was made to manually install the sampling well in July 2010 and November 2010. After these attempts were unsuccessful, a sub-contractor was hired to drill and install four sampling wells, which was conducted in late June 2011.

As outlined in the QAPP (Appendix B), four sampling wells were installed to collect sub-surface water. Two of the sampling wells (SW-1 and SW-2) were immediately down gradient of the Township's septic leachfield, while two other sampling wells (SW-3 and SW-4) were installed adjacent to but not receiving any treated septic leachate from the Township's leachfield. Originally the idea was to install SW-3 and SW-4 upgradient of the leachfield, however, the upgradient area would be receiving septic leachate from the library's septic system. Therefore, these two sampling wells were placed nearby the Township's leachfield but not down gradient where they would receive treated leachate (Figure 3, Appendix A).

In addition to the sampling wells, the closest down gradient waterway was also sampled at the same time, for the same parameters. This surface water sampling site was located along the streambank of Belcher's Creek and is the lake's main inlet (L-1). The Township's septic tank itself was also sampled during each event (SEP); field replicates and blanks were collected as well.

During a set of four specific sampling events in August and September 2011, sub-surface soil samples were collected from the sampling wells and analyzed for a variety of water quality parameters. The raw water quality data are provided in Appendix C. The methodology used to collect water samples from the sub-surface soils were based on previous studies conducted in New York and Canada (Ptacek, 1998; Meehan, unpublished) and are described in detail in the QAPP (Appendix B).

### 7.2 Results of the Sub-Soil Leachate Water Quality Monitoring Program

As mentioned above, water quality sampling of the installed wells were conducted in August and September of 2011. Some parameters were measured on site (called *in-situ*), which others involved the collection of samples to be transported to a laboratory for analysis. For convenience a very brief interpretation of the data is provided here, comparing the down gradient sampling well data to those adjacent to the leachfield.

**Temperature –** Not surprising, the temperature of the surface water station (L-1) and in the septic tank were higher relative to the well samples. However, the difference between the stations was lower in the September events relative to August.

**Conductivity –** This parameter can be used to measure the amount of dissolved substances in the water. Again, as was expected, the septic tank had the highest conductivity values while the surface water station had the lowest. It is interesting to note that the conductivity of the down gradient well stations were typically lower than the well stations not down gradient of the leachfield.

**Dissolved Oxygen –** The septic tank had the lowest amount of dissolved oxygen (DO), varying between < 1.0 and 3.47, while the surface water station (L-1) had the highest values, varying between 5.98 and 10.0 mg/L. The sampling wells down gradient of the Township's leachfield typically high lower DO concentrations (between 1.55 and 4.78 mg/L) relative to the adjacent wells (between 1.97 and 7.92 mg/L). This is an impact of the soils treating the leachate at SW-1 and SW-2.

**pH –** The pH of groundwater in the northeast portion of the United States typically varies between 6.0 and 8.5. All well samples were within this typical range with the down gradient samples varying between 6.03 and 7.06, while adjacent samples varying between 6.27 and 6.64. The surface water station pH values were between 7.20 and 8.60; these alkaline values probably reflected elevated primarily productivity due to algae and/or aquatic vegetation.

**Fecal Coliform –** These bacteria are indicator organisms for pathogenic micro-organisms and surface water densities greater than 200 colonies per 100 mLs filtered are considered unacceptable for direct contact recreation and/or potable use. The down gradient sampling wells had fecal coliform counts between 90 and 120,000 colonies per 100 mLs filtered with values typically greater than the 200 col. / 100 mLs threshold. In contrast, the sampling wells adjacent the leachfield had fecal coliform counts ranging from less than the detectable limit to 224 col. / 100 mLs. Only one sample exceeded the 200 col. / 100 mLs threshold. The surface water station had counts between 92 and 1,280 col. / 100 mLs, with one sample being greater than the 200 col. / 100 mLs threshold. As would be excepted, fecal coliform counts in the septic tank were extremely high, varying between 110,000 and 740,000 col. / 100 mLs.

**E. coli –** *E. coli* is a bacterial commonly found in the intestines of warm blooded animals and can directly impact the health of humans. The NJDEP surface water criteria for *E. coli* is 126 colonies per 100 mLs for a geometric mean and 235 colonies per 100 mLs for a single sample. Similar to the fecal coliform counts, down gradient *E. coli* densities were generally higher than those adjacent to the leachfield. Two of the four SW-2 samples were greater than the single sample criteria, while at the surface water sampling station (L-1), the single sample criteria was exceeded during the 20 September 2011 well sampling vent. All in-tank E. coli counts were high, varying between 76,000 and 550,000 colonies per 100 mLs.

**Nitrate-N –** Nitrate-N is a nutrient that stimulates algal and plant growth and its drinking water / health criteria is 10 mg/L. None of the well samples exceeded the criteria but the SW-1 sample from 12 August 2011 was 9.4 mg/L. The down gradient samples generally had higher nitrate-N concentration relative to the other samples during the August sampling events. In contrast, samples collected during the September sampling events were similar among all four well stations.

**Phosphorus –** Three forms of phosphorus were measured as part of this study and included soluble reactive phosphorus (SRP), total dissolved phosphorus (TDP) and total phosphorus (TP). The Greenwood Lake TMDL focuses on TP as the pollutant of concern so the TP concentrations were used to calculate the OWTS contribution to the lake's annual TP load (Section 7.3). Down gradient (SW-1 and SW-2) TP concentration were higher than other sampling wells during three of the four events. In contrast, there was some overlap among the four sampling wells during the 20 September 2011 event. However, the median TP concentration for all of the samples collected down gradient of the leachfield (n = 8) was 0.62 mg/L, while the median for all samples collected adjacent but out of the leachfield (n = 8) was 0.075 mg/L.

### 7.3 Verification and/or Calibration the OWTS Phosphorus Model

The resulting sampling well water quality data were used to calibrate and / or verify the results of the modeled phosphorus contribution of the OWTS for the Planning Area. Specifically, the resulting down gradient TP data were integrated into the OWTS model to revise the annual TP load originating from OWTSs located in the New Jersey end of the watershed.

Based on the design of the well sampling program, a total of eight data points of TP concentrations down gradient of the municipal OWTS's drainfield were collected (four monitoring events, two wells for a total of eight data points). Given the small sampling size and the numerous variables (i.e. distance from drainfield to sampling well, soil and slope characteristics, and variation in sub-surface phosphorus concentrations) the median down gradient TP concentration was calculated. The down gradient median TP concentration was 0.62 mg/L while the median TP concentration for the sampling wells adjacent to the drainfield (SW-3 and SW-4) was 0.075 mg/L.

In the absence of any OWTS contamination, groundwater TP concentrations are expected to general be below the limit of detection (Ptacek, 1998). The concentrations for the sampling wells adjacent to the drainfield varied between below the detection limit to 0.19 mg/L. However, as identified above, the median value was a little over an order of magnitude higher than the down gradient TP median. Therefore only the TP concentrations collected at the down gradient wells (SW-1 and SW-2) were used to represent groundwater contaminated with septic leachate.

Using a hydrologic coefficient selected for water uses in an office or commercial building setting of 49 liters per person per day (US EPA, 2002), the average number of people who work at the Township's municipal building per day and the total of work days being 236, the annual hydrologic load for the Township's septic tank was calculated to be 716,968 liters (189,423 gallons) per year.

Using the median TP concentration of 0.62 mg/L for soils immediately down gradient of a septic leachfield, and the annual hydrologic load, it is estimated that the Township's septic system can generate approximately 0.44 kg of TP per year. Dividing this number by the mean number of people within a household in the Township, which is 2.7 per capita based on US Census data (2000), generated a loading coefficient of 0.165 kg of TP / capita / yr. This value is slightly higher than then septic-based TP loading coefficient of 0.114 kg of TP / capita / yr used by

NJDEP in the TMDL for Greenwood Lake (2004), which in turn originated from the Phase I Diagnostic / Feasibility study (PAS, 1983).

Using this revised TP loading coefficient, which is based on the data collected during the sub-surface, well sampling monitoring program of August – September 2011, and the number of OWTSs known to be within 100 meters of any waterway within the New Jersey end of the watershed (1,632 units), the annual TP load originating from OWTSs is estimated to be 508 kg per year. Based on the existing soils and other environmental factors (i.e. slopes, depth to water table, and depth to bedrock) throughout the watershed, a soil phosphorus retention efficiency of 30% was included in the model.

Based on this analysis, the New Jersey end of the Greenwood Lake watershed generates approximately 508 kg of TP per year from OWTSs. Based on the Stormwater Implementation Plan, the New Jersey end of the watershed generates approximately 980 kg of TP per year from stormwater and surface runoff. Combined, these two human-based sources of TP generate 1,488 kg per year; stormwater accounts for approximately 66% of this total, while OWTSs account for 34%.

Based on the TMDL (NJDEP, 2004), the annual TP loads from stormwater and OWTSs for the entire watershed were 1,580 and 710 kg, respectively. The percent contributions of these two human-based sources, 69% for stormwater and 31% for OWTSs, were similar to our analysis of the New Jersey end of the watershed.

# 8.0 The OWTS Management Plan for the Belcher Creek Sub-Watersheds, Township of West Milford, Passaic County, New Jersey

Sections 1.0 through 7.0 provided background information on OWTSs in general, conducted a categorization analysis of the existing OWTS within the ZOI and the Targeted Zone, and revised the annual TP load originating from OWTSs with the aid of site-specific water quality data. The results of these previous Sections are now integrated into a OWTS Management Plan which focuses on the three sub-watersheds that account for Belchers Creek, the main inlet of Greenwood Lake (Figure 2, Appendix), also known as the Targeted Zone. The subsequent sections of this document are the actual Management Plan which provides the numerical analysis and associated strategy to attaining the 43% reduction in the OWTS TP load as per the TMDL, addresses the maintenance, operation and rehabilitation of existing systems and provides information on alternative on-site wastewater technologies for future systems.

Table 3 is a breakdown of the TMDL analysis for OWTSs within the New Jersey end of the Greenwood Lake watershed. As shown, the existing annual TP load is estimated to be 508 kg. The TMDL requires a 43% reduction in the annual TP load so, for the OWTSs contribution, this would result in a targeted load of 290 kg per year (Table 3). Therefore, existing annual OWTS TP load needs to be reduced by 218 kg to attain the targeted TP load originating from OWTSs.

**Table 3**
**Greenwood Lake Phosphorus TMDL**
**OWTS Contribution and Analysis (NJ end of watershed only)**

| Scenario | Load |
|---|---|
| **Existing Annual OWTS TP Load (NJ only)** | **508 kg** |
| | |
| **Targeted Annual OWTS TP Load (targeted reduction of 43%)** | **290 kg** |
| | |
| **Required Reduction to Attain the Targeted OWTS TP Load** | **218 kg** |
| | |

In order to reduce the existing OWTS TP load and attain the targeted load, both non-structural and structural management measures were considered for the Township's OWTS Management Plan. The non-structural measures focus on educating the residents of West Milford on behavioral changes that should be made in order to maintain or rehabilitate existing OWTSs. It should be noted that a large component of the non-structural recommendations are based on the Township's General Ordinances for "Individual Subsurface Sewage Disposal System Management" (Ordinances No. 2008 – 050 and 2009 – 019). A complete copy of the Ordinances is provided in Appendix E.

In considering the possible use of structural measures in reducing the TP loads originating from OWTSs, a series of alternative technologies were assessed and an "Alternative OWTS Technologies" Manual was developed. This Manual for OWTSs is provided in Appendix E and focused on technologies that were applicable in a lakefront setting and/or would be acceptable for installation in New Jersey. In some instances, State approval may be required to install some of the recommended technologies, particularly those that are community-based systems. It is strongly recommended in this Management Plan that wherever possible those alternative OWTS technologies identified for use by NJDEP (Bureau of Nonpoint Pollution Control, Alternative Treatment Systems; www.state.nj.us/dep/dwq/owm_ia.htm ) be seriously considered for implementation.

As will be described in more detail below, structural recommendations will focus primarily on those measures that need little to no State guidance; however County and/or local, Department of Health approvals may still be required. For example, retrofitting an existing OWTS to increase its capacity to remove phosphorus, while not altering its ability to treat waste, could be an effective means of minimizing State requirements. However, such a strategy would still require local Department of Health approvals of the retrofitted technology.

In the consideration of the OWTS Management Plan, four problems or issues will consistently arise that should be taken into consideration in the implementation of any portion of the Plan.

These issues include:

- Public Involvement and Education
- Support from Elected Officials
- Financial Support
- Addressing State, County and Local Approvals or Permits

While each issue cited above may present some type of obstacle in implementing components of the Management Plan, they can also serve as “vehicles of implementation”. For example, with enough public involvement and education, many of the general maintenance recommendations can be implemented on a grass roots level and have a cumulative impact on improving / protecting local water quality and natural resources. Additionally, financial support in the form of grants or low interest loans may be obtained through the support of elected officials and thus, make acquiring approvals or permits a more tangible goal, particularly for the private property owner. Such integrated strategies have been very successful in implementing other environmental issues, such as recycling.

The support from elected officials is absolutely critical in moving forward with the implementation of any community-based plan, including the management of OWTSs. The Township of West Milford has made significant progress in addressing this issue with the passing of their Septic Ordinances late in 2009 and early in 2010.

As described in more detail below, local involvement and participation for some of the recommended management measures are mandatory for all property owners within the Township, due to the passing of the ordinances (Appendix E). However, an aggressive, grass roots, educational outreach program needs to be implemented to ensure property owners know and understand their responsibilities, particularly in regards to pump-outs and inspections. Such outreach programs will also be extremely useful in promoting other components of the Management Plan, such as the use of non-phosphorus dishwashing detergents and the installation of water conservation devices.

Using some relatively simple models and establishing some conservative parameters, which are discussed in detail below, the strategy in attaining the targeted TMDL TP load for OWTSs is outlined in Table 4. Essentially, the Plan involves the implementation of both mandatory and, for now, voluntary non-structural measures that depend on the actions and behavior of the property owner, as well as the installation of alternative OWTS technologies or retrofitting existing OWTSs. Each component of the Plan is discussed in detail below.

## Table 4
## Proposed Breakdown of Attaining the Targeted TP Load for OWTSs on the New Jersey end of the Greenwood Lake Watershed

| Scenario | Load |
|---|---|
| **Required Reduction to Attain the Targeted OWTS TP Load** | **218 kg** |
| | |
| **Non-structural Management Measures** | |
| Mandatory pump-outs for all OWTSs (once every three years) | 73 kg |
| Use of non-P dishwasher detergents for all homes with dishwashers | 76 kg |
| Water conservation devices installed for at about 25% of the homes | 38 kg |
| | |
| **Structural Management Measures**<br>Installation of alternative OWTSs or retrofitting existing OWTSs<br>While 31 kg of TP needs to be removed for the structural management measures to be in compliance with the TMDL, this targeted reduction was increase to 62 kg as a safety factor to partially address future development.<br><br>(Based on the remaining amount of TP to be removed, 240 properties of the 1,632 parcels within the ZOI, or 15% of the total, should include some type of structural management measure) | 62 kg |
| | |
| **Combined amount of TP removed with non-structural and structural management measures** | **259 kg** |

### Mandatory Pump-Outs for all OWTS

As stated in Ordinance No. 2008 – 050 (Appendix E), the Township established a Management Program for OWTSs “in order to ensure the proper operation and maintenance of such systems.” A key component of this Program is that all OWTSs be pumped out at least once every three (3) years in order to minimize future malfunction. Removing the accumulated sludge from a septic tank on a regular basis will minimize the amount of particulate material that flows into the drainfield. In addition, a substantial portion of the phosphorus in the wastewater entering a septic system is adsorbed onto or integrated within particulate material. For example, almost half of the phosphorus entering a septic system settles and is retained within the tank (Gold, 2006). Thus, removing particulate material from the tank on a routine basis prevents the associated phosphorus from entering the drainfield and flow into adjacent waterways.

Particulate material in the drainfield severely reduces its capacity to properly treat wastewater and remove pollutants such as phosphorus. Also, as mentioned above, particulate material entering the drainfield will carry with it phosphorus that can then in turn impact associated waterways. Thus, regular pump-outs of a septic tank are a very cost effective means of maximizing an existing system's ability to remove pollutants, including phosphorus.

While the Township's ordinance pertains to all operating OWTSs, the OWTS Management Plan focuses only on those systems within the established Zone of Influence (ZOI; Figure 3) as previously discussed. Based on the Township's GIS database, there are 1,632 OWTSs within the ZOI; approximately 84% of these systems are within the Targeted Zone (sub-watersheds G, H, and I; Figure 2). It should be noted the ordinance pertains to all OWTSs since a system can still have undesirable impacts related to local health (i.e. contamination of wells).

Pumping out the OWTSs within the ZOI should contribute toward reducing the TP load entering the waterways within the New Jersey end of the Greenwood Lake watershed. In order to quantify this for the TMDL, a number of studies were reviewed. For example, it has been stated that a properly functioning septic tank retains up to 48% of the phosphorus that enters the tank (Gold, 2006). However, studies conducted in the Cannonsville Reservoir watershed, New York, have estimated that between 20 - 30% of the TP from raw wastewater is separated out as sludge, which accumulates in the bottom of the septic tank (Day, 2011). Thus, for the OWTS Management Plan, a conservative removal rate of 10% per tank was used to calculate how much TP would be removed from the annual load once all tanks are pumped out on a routine schedule of at least once every 3 years. The removal rate was lowered to 10% for two reasons. First, there are large data gaps in the OWTSs database and many of the existing systems are known to be at least 35 to 50 years old. In the absence of an extensive database, it is prudent to assume that many of these systems are operating on a sub-optimal capacity and lowering the removal rate to 10% will account for some of this in the model. Second, lowering the removal rate to 10% also contributes toward accounting for an implicit margin of safety for the TMDL analysis.

Since, as per the Township's ordinance, all septic tanks are required to be pumped out at least once every three years, with subsequent proof of action through certification, it was assumed that all OWTSs within the ZOI will participate in this management action. As described in Section 7.3, the median TP concentration down gradient of the municipal septic leachfield and estimated water consumption were used to calculate a median per tank load of 0.44 kg of TP per year. In turn, this loading rate was multiplied by the number of OWTSs within the ZOI and then by 0.1 to calculate how much TP would be removed on an annual basis once all of the residents are in compliance with the three year mandatory pump-outs. The resulting annual removal rate was 73 kg (Table 4).

It should be noted that an additional means of increasing the efficiency of mandatory pump-outs is to install an effluent filter in the existing OWTS. The application of an effluent filter, in conjunction with mandatory septic tank pump-outs will result in a 40% reduction in the amount of particulate material that flows into the drainfield (NJDEP, personal communication). Thus, the individual operator of an OWTS can increase the removal efficiency of particulate material, and associated phosphorus, by including such an effluent filter. However, for the sake of this Plan and development of the model, the conservative phosphorus removal rate of 10% per tank was used.

**Use of Non-P Dishwasher Detergents**

In the 1970's it was well documented that phosphorus is frequently the primary limiting nutrient in freshwater ecosystems (Schindler, 2008), particularly in the Northeast portion of the United States. Elevated phosphorus loading results in higher amounts of algal and aquatic plant biomass and, in turn, a decline in water quality. It was also identified that the phosphorus in laundry detergents was a major source of this nutrient. Thus, bans on phosphorus in laundry detergents were passed and declines of phosphorus in wastewater effluent were documented. For example, it was documented that such a ban resulted in a 40% reduction in effluent phosphorus concentrations from waste water treatment facilities in Vermont (Van Benschoten and Smeltzer, 1981). Similar reductions were documented nationwide (Litke, 1999). However, while the bans established in the 1970's covered most forms of detergents, they did not include those products used in automatic dishwashers. In the 1970's automatic dishwashers were not common but by the beginning of the 21$^{st}$ century it has been estimated that between 50 and 75% of homes have an automatic dishwasher (Hanrahan and Winslow, Jr., 2004). Thus, substantially more people use automatic dishwashers relative to back in the 1970s.

Studies conducted in the Chesapeake Bay watershed have estimated that 7 to 12% of the phosphorus entering sewage plants originated from automatic dishwasher detergents, while a study in Massachusetts estimated that 8 to 34% of the phosphorus in municipal wastewater may originate from automatic dishwashers (Organization for Assabet River Watershed, 2001). Additionally, automatic dishwasher detergents may have up to 8% phosphorus by weight, representing a substantial source of phosphorus for receiving waterbodies (Burnside and McDowell, 2001).

Both PA and NY have State-wide bans on automatic dishwasher detergents (ADDs) that contain phosphorus. However, such a ban has not been established in New Jersey. Therefore, in order to determine how a community-wide effort to eliminate the use of ADDs that contain phosphorus would contribute toward compliance with the TMDL, some modeling was conducted based on methodology developed by Hanrahan and Winslow, Jr. (2004). First, a small survey of ADDs in New Jersey supermarkets was conducted and most products already have minimal amounts of phosphorus. In response to the State-wide bans - at least 17 have been implemented as of 2011 - many manufacturers already began to minimize the amount of phosphorus in their products. For the sake of this analysis, any ADD that claims to contain no phosphorus was deemed to have 0.5% phosphorus. Of sub-sampling of various ADDs in New Jersey, 9 out of 11 products contained no phosphorus (0.5%), while one had 4% and another had 6%.

Using the weight of ADD products and their percent phosphorus values, a mean amount of phosphorus in grams per tablespoon of ADD was calculated as per Hanrahan and Winslow, Jr. (2004). This value was 0.208 grams per TBSP of ADD. It was then estimated that 62.5% of the OWTSs within the ZOI for the New Jersey end of Greenwood Lake had automatic dishwashers. This estimate is the mean of 50% and 75%, the range of homes that have automatic dishwashers (Hanrahan and Winslow, Jr., 2004).

Using the methodology and assumptions of dishwasher use developed by Hanrahan and Winslow, Jr. (2004), as well as the loading rate of 0.208 grams per TBSP of ADD, it was estimated that automatic dishwashers within the ZOI of West Milford, contribute 116 kg of TP per year. In contrast, if all ADDs available for purchase within the Township contained no phosphorus, again using a value of 0.5%, this would result in a loading rate of 0.071 grams per TBSP of ADD. In turn, if all homes that used automatic dishwashers within the ZOI used non-phosphorus ADD products (0.5% phosphorus), the resulting contribution would be 40 kg of TP per year. Thus, a shift from the estimated existing load of 116 kg to a targeted load of 40 kg, as a result of eliminating the use of ADDs that contain phosphorus, is estimated to remove 76 kg of TP from the annual TP load originating from OWTSs (Table 4).

**Water Conservation**

Another way of maximizing the effectiveness of the ability of an OWTS to remove pollutants is to minimize the amount of water flowing through the system. A situation that has occurred in the past (prior to the 1970's), before the oversight of land development and the installation of WOTSs by the local, County and State regulatory agencies, was the increased size of lakefront homes but not the treatment capacity of the existing OWTSs. The result for these older OWTSs that have not yet been modified or replaced has been they are undersized for operation, primarily due to the fact that the drainfield remains saturated and does not have an opportunity to periodically aerate. Keeping the drainfield saturated can result in a depletion of oxygen within the soils and the release and subsequent movement of phosphorus to a receiving waterway as a "plume". Thus, minimizing the amount of water that flows through the OWTS's drainfield will allow for the soils to aerate and more effectively retain / remove phosphorus.

On an additional site note, it should be emphasized that it is currently illegal within the State of New Jersey to expand on the existing sites of any residential dwelling, without upgrading and/or expanding the size of the existing OWTSs. In fact, the potential expansion of an existing dwelling, particularly those within the ZOI should be considered as a potential opportunity to upgrade the existing OWTS to increase its capacity to remove phosphorus.

It has been estimated that the average person uses approximately 70 gallons (265 liters) of water per day (US EPA, 2002). Using the Township's per capita rate of 2.7 persons per home, the mean annual water load per home is about 261,158 liters per year. Pennsylvania State University (Penn State) conducted a detailed assessment on the use of water in an average household and how water conservation can reduce amount of water being used (Sharpe and Swistock, 2008). Essentially, the study compiled the daily use of a home without any water conservation devices to be 68.3 gallons per person per day, which is close to the 70 gallons per person per day estimate provided by US EPA (2002). The sources of water use in the study included toilets, showerheads, faucets, washing machines and dishwasher.

Based on the Penn State study, about 30% of a person's daily water use is used to flush toilets. In addition, a leaky toilet can waste as much as 200 gallons a day (Sharpe and Swistock, 2008). Therefore, the toilet should be the first component of a household's water consumption to be considered for any efforts to implement water conservation. In the Penn State study, replacing each of the five categories of water use previously listed with a water saving device would reduce the amount of water used per person per day by approximately 45% (Sharpe and Swistock, 2008). For the Township's OWTS Management Plan, it is proposed that homeowners within the ZOI replace three of the five uses with water saving devices. Specifically, it is proposed that the toilets, showerheads and faucets all be replaced by low-flow devices. If these three water uses are upgraded to low-flow devices, the daily water use per person per day is expected to be reduced by 32%.

Using the previous household estimate of 261,158 liters of water used per year, a 32% reduction would result in an annual water use of 177,587 liters per household. Using the median TP concentration of 0.62 mg/L and the low-flow devices reduced water load results in an annual TP loading rate of 0.110 kg of TP per tank. For the sake of the TMDL, a participation rate of 25% was used for residents within the ZOI who would install the three low-flow water devices. After the mandatory pump-outs and use of non-P dishwasher detergents, the installation of low-flow water devices, under the described scenario, is estimated to remove approximately 38 kg of TP per year (Table 4).

It should be noted that mechanisms behind the expected reduction in phosphorus associated with reducing the hydrologic load flowing through the OWTS is twofold. First, a larger flow will result in less settling of the particulate material (and associated phosphorus) in the septic tank and can also increase the re-suspension of already settled material in the tank. The net result is a higher concentration, and thus loads, of phosphorus leaving the tank and entering the drainfield. Second, as previously mentioned, a lower flow through the drainfield will increase the soil's capacity to retain / remove phosphorus. A drainfield that is constantly saturated will result in a depletion of dissolved oxygen within the soil matrix and the subsequent mobilization of dissolved phosphorus to adjacent waterways. For example, in studies conducted by Ptacek, it was demonstrated that phosphate (dissolved phosphorus) concentrations were above the background concentrations in soils with low dissolved oxygen concentrations as far as 60 meters (almost 200 ft) from the septic tank (Ptacek, 1998). Thus, water conservations efforts to reduce the magnitude of the hydrologic load through an OWTS will contribute toward reducing the pollutant load, particularly phosphorus, leaving the septic tank and entering the drainfield.

### Structural Management Measures

After the three non-structural management measures are implemented, another 31 kg of TP needs to be removed in order for the OWTS portion of the annual TP load to be in compliance with the TMDL for the New Jersey end of the Greenwood Lake watershed. Thus, structural management measures are recommended and considered to address the remaining 31 kg of TP. However, in order to at least partially address the concerns of future development, a safety factor was incorporated into remaining TP load to be address through structural measures. Thus, the targeted reductions for structural measures were established at 62 kg of TP (Table 4).

With an estimated annual TP loading rate of 0.44 kg per tank, approximately 240 OWTSs would need to be replaced or retrofitted with some type of technology to enhance their capacity to remove phosphorus. It should be noted that the 240 OWTSs account for 15% of the systems within the ZOI or 17.5% of the systems within the Targeted Area.

While more detail will be provided in Section 10 as to why, the preferred alternative OWTS technologies recommended for implementation under this Plan are peat biofilters and, to a lesser degree, intermittent sand filters. Based on the scientific literature the removal rate of TP from peat biofilters varies from 50 to 75% (Kangsepp, et.al., 2008; Patterson, 2004), so for the sake of this analysis the TP removal rate of peat biofilters is estimated to be 62.5%. With a mean TP load of 0.44 kg per tank, this means installing a peat biofilter would remove 0.275 kg per tank. This does not take into account any non-structural measures to minimize the OWTS phosphorus load. If 200 OWTSs are retrofitted with a peat biofilter, this would remove approximately 55 kg of the 62 kg TP load targeted for removal; this represents approximately 89% of the amount of TP targeted for removal by structural measures. The remaining 7 kg of TP could be reduced through the design and implementation of other alternative OWTS measures (Appendix E). For the sake of this analysis, the selective alternative is the intermittent sand filter. This alternative OWTS structure has documented TP removal rates of around 50% (US EPA, 2002). Using this TP removal rate and the loading rate of 0.44 kg of TP per tank, it is estimated that approximately 40 OWTS would need to be upgraded to remove the remaining 7 kg of TP.

As part of this Management Plan, a "Best Management Practices" manual of OWTS technologies that would increase a system's capacity to remove phosphorus is included in Appendix E. Section 10 provides guidance and more detail on some of these technologies and which ones would be good candidates for implementation in West Milford. As previously cited, OWTSs ranked highest in need of rehabilitation or retrofitting are fairly well scattered over the Targeted Area. A few clusters of highest ranked parcels were identified along the southwestern shoreline of Greenwood Lake, along Eisenhower Drive and Rutgers Avenue, with another small cluster around the Mountain Circle residential area. Thus, these areas, as well as other highly ranked parcels, should be prioritized over others for the implementation of structural measures. This would ensure that those systems having the highest need for rehabilitation or retrofits, particularly relative to their contribution to the phosphorus load, would be considered for implementation before other lower ranked parcels. Such a strategy would maximize the cost efficiency of any implemented project. The exception to this approach may be to install a retrofit at the municipal building to enhance its capacity to reduce phosphorus as a demonstration.

### Data Gaps in the Development of the OWTS Management Plan

Finally, it should be noted that while the development of this OWTS Management Plan incorporated site-specific digital (GIS database) and water quality (well sampling) information, there are still some large data gaps that should be at least partially address over the long-term implementation of the Plan. These data gaps fall into two major categories and include site-specific information on existing OWTSs and more quantitative data on phosphorus loading from additional OWTSs.

As previously noted, a substantial number of the parcels with OWTSs have little to no data on these systems. Thus, one of the long-term objectives of the Township should be to collect and compile data on existing and future OWTSs in a digital database that can be accessed through GIS. Another data gap is the collection of more data on the phosphorus concentrations immediately down gradient of OWTSs. The water quality well data collected from the municipal building represents only one OWTS within the Township. In addition, it is not a residential system and is fairly young in age (< 10 years). Thus, the results may not accurately represent the TP loading originating from a residential, lakefront OWTS that is older than 50 years. The resulting TP loading coefficient during the municipal data was 0.165 kg of TP / capita / year, which is slightly higher than the coefficient that has been used in the past by US

EPA and NJDEP (0.115 kg of TP / capita / year) to quantify the phosphorus loads originating from OWTSs (PAS, 1983). Nevertheless, additional well sampling of older, residential OWTSs should be conducted to verify if the municipal OWTS calculation can be used to represent the entire ZOI.

In addition to data gaps associated with the existing TP loading rate of OWTSs, empirical data on the removal rates for phosphorus are scant, particularly when compared to other pollutants such as fecal coliform and nitrogen. This is evident in the OWTS Manual (Appendix E) where no percent removal rates are provided for a number of the alternative OWTS technologies. Site specific data on the operation of existing alternative OWTS technologies within the Township of West Milford or northern New Jersey in general is minimal as well. However, the Township's Department of Health has approved and is familiar with a number of such alternative OWTS technologies that have been installed in the Township. Based on conversations during the the January 2012 public meeting, several peat biofilters and an aerobic / drip irrigation system have already been installed in the Township. Thus, if possible, the Township should collect some water samples from the inflow and outflow of these systems, at least for the analysis of TP, to quantify the pollutant removal capacity of these systems.

# 9.0 Identification of OWTS Management and Maintenance Measures

The proper maintenance and management of an OWTS is of utmost importance for maximizing the efficiency and life of the system. The following describes the basic maintenance and management measures that should be employed to ensure proper septic system function and to avoid unnecessary system failures and associated human and environmental health risks. As previously noted, the Township of West Milford recently adopted an OWTS ordinance (Ordinance No. 2008-050) which addresses many of the maintenance and management measures discussed in the following sections. A complete copy of the Ordinance is provided in Appendix D.

The maintenance of an OWTS, such as soil absorption systems, is important for proper functioning of the system. Properly managing OWTS can result in lower replacement and repair costs and increase property value. Thus, the proper management of an OWTS is important for the continued functioning of the system, environmental health, and human health. For these reasons, establishing effective management programs can increase awareness of septic management and thus ensure that the OWTS are being managed properly. The USEPA (2003) has identified four maintenance activities to ensure the proper functionality of the septic system. At a minimum, each property owner who owns and operations an OWTS should be conducting these maintenance activities. Some of these activities are now mandatory (i.e. pump-outs once every three years with associated inspections), while others are more voluntary (i.e. actions associated with water conservation). However, as outlined in the Ordinance, the implementation of all such non-structural measures will require some degree of public outreach / education conducted by the Township.

Firstly, the septic system (OWTS) should be regularly inspected and pumped out by a State-licensed contractor. Unless a large-scale failure of a system is apparent, such as unpleasant odors or ponds of water over the leachfield, inspections should be conducted at the same time the system is pumped out. After the inspection is complete, the Township's Department of Health or authorized designee will provide the property owner with a license to operate the OWTS. Details on what is involved with the inspection process and the factors that may result in the Department of Health considering a more frequent licensing renewal or pumping / inspection schedule are listed in the Ordinance and include, but is not limited to:

- Limited size of the septic tank / drainfield relative to the dwelling
- Whether the existing system a true septic system or it is a cesspool
- Age of the system
- Past history of malfunctions or other non-compliance
- Location of the existing system in a particularly sensitive location relative to environmental resources
- Proximity of the system to a well or receiving waterway

In addition to describing the inspection and pump-out procedure, the Ordinance also outlines a set of standard uses and limitations that should be following in operating an OWTS within the Township of West Milford. For convenience, these standards are outlined below:

- The OWTS shall be used only for the disposal of wastes as approved the original engineering design of the system
- No permanent or temporary connection shall be made to any other sources other than what the system was designed for
- Drainage from basement floors, footings or roofs shall not enter the system and shall be diverted away from the leachfield
- Any sewage system cleaner containing any restricted chemical material shall not be added to the system
- Materials containing any toxic substances, such as but not limited to waste oil, oil based or acrylic paints, varnishes, photographic solutions, pesticides, insecticides, paint thinners, organic solvents or degreases and drain openers, shall not be disposed of in the OWTS
- Inert or non-biodegradable substances, such as but not limited to disposable diapers containing plastic, cat box litter, coffee grounds, cigarette filters, sanitary napkins, facial tissues and wet-strength paper towels, shall not be disposed of in the OWTS
- No cooking greases or fats shall be disposed of into an OWTS not equipped with a grease trap; details on the maintenance and inspection of a properly designed OWTS grease trap are provided in the Ordinance (see Appendix D).
- Plumbing leaks shall be repaired promptly to prevent hydraulic overloading of the OWTS
- Vehicle traffic and parking shall be kept away from the OWTS
- The leachfield of the OWTS should be kept free of encroachments from decks, pools, sprinkler systems, driveways, patios, accessory buildings, additions to existing structures, and trees / shrubbery whose roots may cause clogging or damage to the OWTS
- Grading shall be maintained to promote run-off of rainwater and prevent ponding
- All drainage from roofs, footing drains, ditches or swales shall be diverted away from the leachfield
- Vegetation [grasses and low lying herbaceous plants with small root systems] shall be maintained to prevent soil erosion

The Ordinance also provides additional guidance for abandoned OWTSs and other aspects of the program (Appendix D), however, listed above are a series of non-structural measures that should be promoted through an aggressive public outreach program to the residents of West Milford. Some select public outreach and educational material has been included in Appendix F for use by the Township.

As discussed in the outlined strategy for complying with the TMDL (Table 4), reducing the amount of water entering the septic system will prolong its life and maximize its capacity to reduce / remove phosphorus. One of the specific long-term goals associated with complying with the TMDL is to get approximately 25% of the population within the ZOI to utilize low-flow devices such as low-flush toilets (1.5 – 3 gallons per flush), low-volume showerheads (2.5 gallons per minute) and low-volume faucets (approximately 1.5 gallons per minute). However, in general, the more people within the watershed who implement such actions, even at least partially, the lower the OWTS-related impacts will be relative to both phosphorus (pollutant) loading and potential impacts on human health (pathogens).

As previously recognized, it is well established that the average indoor water use per person in a typical single-family home is approximately 70 gallons (USEPA 2001). Any measures to reduce the amount of water being used on a daily basis should be encouraged. Thus, beyond the three low-flow devices described above as part of complying with the TMDL, a number of other actions can be taken to reduce the hydraulic load to an OWTS. Some of these actions include:

- Running the water only went it is needed. For example, turn the water off while brushing teeth or shaving
- Running full loads of laundry and dishes
- Doing a house-wide inventory and addressing any leaky pipes / toilets
- Consider the purchase of energy efficient washing machines and automatic dishwashers

Relative to washing machines and automatic dishwashers, new models are generally more energy efficient and require less water than older models. For example, an older top loading washing machine typically used 50 – 60 gallons per load, while newer models used about 40 gallons per load. In addition, newer front loading washing machines use only 17 – 28 gallons per load. For automatic dishwashers, those built before 1994 used more than 10 gallons of water per load. In contrast, dishwashers made after 2004 typically use between 8 and 14 gallons per load but those that earn the Energy Star rating since August 2008 are required to use 5.8 gallons or less. Most of these models typically use 3 – 4 gallons per load. Thus, by simply replacing an old washing machine and automatic dishwasher with newer models, the hydraulic load from both machines could be reduced by approximately 38 gallons, or approximately 59%, if each machine ran one load.

Finally, in addition to actions outlined in the Ordinance and water conservation efforts, other changes in behavior maximize the operational efficiency of OWTSs. One, which was already discussed in detail, was the use of non-phosphorus products, particularly automatic dishwater detergents. Some other positive changes in behavior include:

- Reducing or, better yet, eliminating the use of a garbage disposal. Grinding food wastes and allowing them into the septic tank increases the amount of solids and nutrients entering the system. Composting such food wastes would be a more environmentally friendly means of disposing of such material.
- While there are a variety of products, mostly biological in nature, on the market that claim to improve the operation of a septic system, there is no impartial scientific evidence that documents this (Rutgers, 2005). The most cost effective means of maintaining a septic tank is through routine pump-outs as outlined in the Township's Ordinance.

Included in Appendix F are some select public outreach / educational material that the Township can use in moving the non-structural management measures forward for compliance with the TMDL. Specifically, a guide to operating and maintaining a septic system is provided; this guide was originally developed by US EPA and modified for use in New Jersey by NJDEP. In addition, a set of educational brochures were developed by Princeton Hydro for general use by the Township on the operation and maintenance of septic systems and includes many of the recommended actions previously highlighted in this section of the Plan (Appendix F).

# 10.0 OWTS Rehabilitation / Retrofit Measures (Alternative OWTSs Technologies Manual)

As outlined in the management strategy (Table 4), non-structural management measures will address approximately 86% of the TP load reduction. The remaining 14% will be addressed through the installation of alternative OWTS technologies to rehabilitate or retrofit existing systems. For the sake of the Plan, the term rehabilitate refers to the installation of a system that would completely replace the existing OWTS. It may use some of the existing infrastructure but for the most part, it will essentially replace the existing system. Such a project would be reserved for an OWTS that is experiencing large-scale failure that could result in the contamination of nearby wells with pathogenic organisms. Such projects tend to be expensive to design and install, and they may be very difficult to install on small, lakefront lots. Many of the structural measures associated with a rehabilitation project would be far more cost effective to incorporate into new development within the watershed. Thus, it is strongly recommended that the Township direct developers toward these alternative technologies in their plans for future building plans.

In contrast to a rehabilitation project, a retrofit project would involve adding on or slightly modifying an existing OWTS. Such retrofit projects would tend to focus on increasing an OWTS's capacity to remove phosphorus although other pollutants are typically addressed as well. Retrofit projects tend to be lower in cost relative to rehabilitation projects and are more flexible for installation, particularly in the amount of space needed. Thus, the Plan recommended that wherever possible, retrofits should be seriously considered.

There are a number of alternative technologies that can be used to replace conventional OWTSs or improve their operation. Additionally, some of these technologies can be used where more conventional OWTSs are unsuitable due to environmental constraints. Below are brief outlines of a few structural OWTS measures; details of many of these alternative technologies for on-site wastewater disposal are provided in Appendix E.

One of the alternative technologies that has the highest promise relative to retrofitting an existing OWTS is a **peat filter system**. This type of system can be used when preferred permeable soils are not available. The peat filter system consists of a septic tank followed by a subsurface peat bed. Effluent from the septic tank is evenly distributed over an impermeable lined peat bed though a network of pipes. A layer of gravel and underdrain piping installed beneath the peat collects effluence for onsite disposal. In addition, smaller, "package" peat biofilter units can be installed between the septic tank and the leachfield of an existing OWTS. Such a retrofit avoids replacing the whole system by treating the effluent leaving the tank, before it enters the leachfield. However, in order to retrofit an existing system, the OWTS has to be in operation and not in a failed condition. Such retrofits are designed to enhance – not replace – the septic system's treatment of wastewater. Peat systems are known to be very effective at removing solids, nitrate-N and pathogens. Recently the technology has been modified to also enhance the removal of phosphorus as well, with removal rates has high as 80% or greater. However, for the sake of this Plan more conservative TP removal rates, varying between 50 and 75%, were used (Appendix E).

It should also be noted that NJDEP strongly endorses the peat biofilter OWTS for new or expanded construction as well as a means of addressing or retrofitting an existing, malfunctioning system. There are two types of manufactured peat biofilters structures that are generally approved by NJDEP, Puraflo[R] and Eco-Pure[R] Manufactured Treatment Devices (MTDs). As with all alternative OWTS structures, the location and design of it must conform to all provisions of N.J.A.C. 7:9A-1 et seq. and comply with all other applicable Federal, State, County and local rules and regulations.

**Intermittent sand filters** (ISFs) can also be used to remove contaminants in wastewater through physical, chemical, and biological treatment processes and are typically built below grade; they can be gravity or pressure dosed systems. ISFs consist of two basic components: 1) a primary treatment unit such as a septic tank and 2) a sand filter. Following primary treatment, wastewater is intermittently dispersed onto the surface of the sand filter bed where it percolates through the sand to the bottom of the filter. Once the wastewater reaches the bottom of the filter, it is collected in an underdrain and transported to a line for further treatment and disposal. The last phase of treatment and disposal is usually through a leachfield, similar to what one would find in a conventional septic system.

**Effluent screens or filters** can also be placed in a septic tank to prevent large solids from leaving the tank, which improves wastewater quality and extends the life of the drain field. There are little to no data on how these screens or filters enhance the capacity of a septic system to remove phosphorus. However, by preventing large solids and the phosphorus adsorbed onto them from entering the drain field, a reduction in the amount of phosphorus leaving the drain field and flowing into an adjacent waterway will be achieved.

To keep the filter functioning properly it needs to be cleaned out regularly, which could be conducted at the same time the tank is being pumped out. However, in some conditions, the may require cleaning once a year instead of once every three years (Appendix E).

There are various types of toilets that also reduce the amount of waste entering septic systems. For instance, **incinerating toilets** evaporate and burn toilet wastes, thereby, producing ash that can be disposed of with household wastes. The use of incinerating toilets allows for a significant reduction in water consumption. However, there require high energy inputs and some air pollutants may be produced. It should also be noted that incinerating toilets are not within NJDEP jurisdiction and are thus addressed by the local Department of Health.

Another type of toilet is the **composting toilet.** Composting toilets require a separated residential plumbing system where blackwater (water contaminated with food, animal or human waste) is treated in a composting toilet and greywater (water generated from laundry, dishwashing, and bathing) is conveyed outside to another treatment / disposal system. Composting toilets aerobically decompose toilet wastes and produce material that may be used as a fertilizer. Similar to incinerating toilets, compositing toilets are not within NJDEP jurisdiction and are thus addressed by the local Department of Health.

Large alternative OWTSs include **package plants, community wastewater systems, drip irrigation, constructed wetlands** and others. These systems are higher in costs, generally in both initial installation and long-term maintenance, but can be used to treat the on-site wastewater from multiple homes. In many of these systems, each home has its own septic tank and the effluent is temporarily stored and subsequently treated on a collective basis. Such larger alternative OWTS technologies tend to be more cost effective when integrated into a future development, as a means of dealing with additional wastewater loads.

It should be noted that some of the technologies described in the Alternative OWTS Technologies Manual are approved for design and implementation by NJDEP. Specifically, in addition to conventional and mound septic systems, NJDEP has provided approval and listed approved vendors / companies for the following modifications or alternative technologies for the treatment of on-site wastewater:

- Modifications to fill (a manufactured product or gravel alternative)
- Aerobic Treatment systems
- Peat Biofilter Wastewater Treatment Systems
- Drip Dispersal Wastewater Disposal Systems

The first two listed are approved modifications to the basic septic system design (Figure 4.1), that provide the benefits of a standard septic systems where the soils may have severe limitations in septic suitability or limited space for an appropriately size leachfield. Thus, these modifications do not necessarily enhance the capacity to remove phosphorus from the on-site wastewater. The last three listed above are approved alternative technologies for on-site wastewater treatment.

Aerobic treatment systems are a State-approved alternative technology listed in the Alternative OWTS Technologies manual and, while they have good removal efficiencies for fecal coliform and nitrogen, their removal rates for total phosphorus are low at 20% (Appendix E). Thus, while aerobic treatment systems may be an effective alternative to a conventional system that is a net source of fecal coliform for a down gradient well, it is not being recommended for the Township's OWTS since its removal rate of phosphorus is so low.

Peat filters are another State approved alternative technology but unlike aerobic treatment systems, they have relatively high phosphorus removal rates. While the actual phosphorus removal rate for peat filters vary between manufacturer and design, most remove at least 80% of the incoming phosphorus (Appendix E). Thus, peat filters are one of the highest ranked alternative technologies for implementation in West Milford due to their ability to be retrofitted onto an existing septic system, moderate initial and long-term costs, high phosphorus removal rates and State approval.

The last State approved alternative technology listed above is Drip Irrigation Systems. This technology may be applicable in some of the steep slopes / septic limited soils area within the ZOI and Township in general; it tends to require large amounts of land and thus is more cost effective when conducted on a multi-home or community basis. In addition, in New Jersey drip irrigation can only be used along with some type of pre-treatment such as with an aerobic or peat biofilter structure. Finally, there are a limited amount of data on its removal of phosphorus and it is not known if the estimated removal rates provided for fecal coliform (Appendix E) include pre-treatment. Thus, drip irrigation systems are not being highly recommended as a replacement of existing OWTSs. However, such alternative technologies maybe a cost effective means of treating the wastewater from new developments, particularly at locations that have steep slopes and/or severe soil limitation relative to septic.

Finally, it should be noted that a number of alternative technologies are listed in the Alternative OWTS Technologies Manual that have moderate to high phosphorus removal rates (50-100%) but are not currently State approved technologies. Such technologies should still be considered for potential implementation; approval could still be issued by the NJDEP Onsite Wastewater Management Program. Such a State approval is essentially a waiver; however, it also permits the local Health Department to make the final approval. The Instructions for application of such alternative technologies are provided at www.state.nj.us/dep/dwq/owm_permits.htm.

## Estimated Cost for Implementing the Structural Management Measures

As discussed in Section 8.0, if it is assumed that all OWTSs within the ZOI will produce approximately 0.165 kg of TP per capita per year, or 0.44 kg of TP per OWTS per year, then at least 240 OWTSs should be rehabilitated or retrofitted to achieve a TP load reduction of twice the targeted removal as per the TMDL (Table 4). For the sake of the Plan, if we assume that most of these OWTSs, 84%, are operational but need to be retrofitted to enhance their capacity to remove phosphorus, then peat filters may be the dominant alternative technology of choice. Again, there are a number of alternative OWTSs to choose from and factors such as size of property, environmental constraints, age of system and willingness to participate by the property owner will aid in dictating the final choice. However, the peat filters can be installed in relatively small spaces, are lower in cost compared to other OWTS technologies and have lower maintenance requirements as well.

As described above, peat biofilter OWTS structures are the preferred alternative technology, relative to providing effective treatment of wastewater, as well as provide some moderate to high amount of phosphorus removal. Total phosphorus removal rates between 50% (Kangsepp, et. al., 2008) and 75% (Patterson, 2004) have been documented for peat biofilters. Thus, for the sake of developing and initiating this OWTS Management Plan, it is recommended that 84% of the 240 OWTSs proposed for upgrade / modification use peat biofilters. Thus, 200 of the 240 OWTSs would be targeted for upgrades to peat biofilters.

The estimated cost for the design and installation of peat biofilters, as well as the initial installation of the peat, is between $20,000.00 and $40,000.00 per unit (modified but based on US EPA, 2002). It should be emphasized that this cost range does not include additional work that may be required on the existing OWTS to make such a retrofit compatible or bring an older septic system up to code. The actual cost will depend on a number of factors such as size of existing septic tank, hydraulic load through system, whether or not the system will require power for a pump, age of system and amount of material (i.e. piping) required for retrofitting. Thus, depending on site specific conditions, the actual cost of retrofitting an existing OWTS with a peat filter may be substantially more.

Using a mean cost estimate of $30,000.00 per unit and assuming additional work on the existing OWTS is not required for the retrofit, the installation of all 200 peat filters is estimated to cost a total of $6,000,000.00. In addition, the peat will need to be replaced once every 8 to 14 years. The actual frequency of replacement is based primarily on the site-specific hydraulic and pollutant loads. Each replacement of the peat is estimated to cost between $3,000.00 and $4,000.00; again this is a reoccurring cost, once every 8 to 14 years.

The most cost effective alternative OWTSs to consider for the remaining 40 OWTSs in need of structural measures, relative to costs and document phosphorus removal for a residential property, are:

- Intermittent Sand Filters
- Package Plants
- Effluent Screens / Filters (should be considered for conventional septic systems as well)

It should be noted that Incinerating Toilets and Composting Toilets are discussed in this Plan but are not recommended for implementation and consideration for the TMDL. These alternative OWTS technologies may be viable options for local camp or other recreational facilities within the Township. However, these technologies are not within NJDEP jurisdiction and are therefore not included in this Plan since it is based on a TMDL developed by the State.

Again, for the sake of this analysis, the focus for the Plan is on existing OWTSs on individual lots. This essentially includes single-family residential homes or commercial / recreation facilities where multiple toilets feed into one OWTS. Under this scenario 200 of the OWTSs are would be upgraded or modified to include peat biofilters. An addition 40 OWTSs would be proposed to be completely replaced with intermittent sand filters. Again, other alternative OWTSs technologies could and should be considered for use, based on site specific conditions and with guidance provided by the Township's Department of Health. Details on a proposed budget for design and implementation of all of the proposed alternative OWTSs on a per unit basis are provided below in Table 5. The proposed budget for implementation in Table 5 also includes long-term maintenance costs on a 10 year cycle. For convenience, the criteria used to put the cost estimates in Table 5 are provided below:

<u>Peat Filters</u>

- Estimates that over 80% of the OWTS targeted under the TMDL can be retrofitted with peat filter; 200 systems
- The estimated mean cost for design and retrofitting the peat filter (including materials) is $20,000.00; it should be noted this price does not include any additional work that may be required to make the existing OWTS compatible for such a retrofit.
- NJDEP requires that an inspection of the peat biofilter be conducted twice a year, which includes examining and cleaning (if required) the tank filters and raking the top of the peat media. These annual inspection / maintenance activities are estimated to cost $200.00 to $500.00 per year. It should be noted that these services do not include the mandatory pump-outs of the septic tank, required once every three years.
- On average, the peat needs to be replaced in each unit once every 15 - 20 years (based on the State-certified Manufacturers) at a cost of approximately $2,000.00.

Intermittent Sand Filters

- For single family residence but with more land available for installation of sand filter
- The remaining 40 OWTSs identified for structural OWTS alternative technologies will use intermittent sand filters
- System will be designed to have a septic tank with the capacity to be pumped out once every three years
- Unlike the peat biofilters, the intermittent sand filter is not a retrofit but a complete rehabilitation (replacement) of an existing OWTS
- If properly sized, operation and maintenance (O+M) of intermittent sand filters is not excessive (US EPA, 2002). The influent, effluent and the associated infrastructure should be inspected every three months.
- The most important maintenance component of the intermittent sand filter is associated with the filter media. The surface of the media needs to be raked on an as needed basis. This may involve removing the top 1" layer of media once every 3 to 12 months.
- If the surface begins display signs of heavy incrusting, it should be removed and replaced with fresh media. Typically, the replacement media does not occur until the total filter depth falls below 18". In addition, any vegetation on the media should be removed and monitoring for potential ice sheeting is required.
- Annual O+M costs, which include electricity for pumping / dosing, as well as 4 – 12 hours of semi-skilled labor for system oversight, is estimated to cost between $350.00 and $400.00 per year.

## Table 5
## Estimated Costs (per unit) for the Installation and Maintenance of Alternative OWTS Technologies for Treating On-Site Wastewater within the Township of West Milford, Passaic County, New Jersey

| Selected Alternative OWTS | Initial Cost (per unit installed) | Long-term (Maintenance) Cost | Cost over 10 years |
|---|---|---|---|
| **Peat filter retrofitted onto an OWTS** | **$30,000.00 per peat filter** | **Approximately $400.00 per year for O+M**<br><br>**$3,500.00 every 8-14 years to replace peat** | **$37,500.00** |
| **Rehabilitation of an OWTS to an Intermittent Sand Filter** | **$50,000.00 per intermittent sand filter plus media** | **$350.00 to $400.00 per year**<br><br>**Approximately $3,000.00 for complete media replacement per 10-15 years** | **$57,000.00** |

## 11.0 Establishment of Protocol for the Maintenance and Inspection Actions

A set of protocol have already been established by the Township for the general maintenance and inspection of OWTSs within the New Jersey portion of the watershed and are outlined in the OWTS Ordinance (Appendix D). Every OWTS currently in operation must be pumped out once every three years and include an inspection conducted by a State-certified, Township approved contractor. As listed in the Ordinance (Appendix D), a State-certified contractor will inspect various components of the system during the pump-out. Once complete, the operators (homeowner) of the system will be issued a certificate of compliance for the OWTS, which is valid until the next pump-out / inspection, after another three years.

In addition to standard pump-outs and inspections of existing individual and non-individual OWTS, the Department of Health will issue a license to operate an OWTS under one or more of the following events as stated in § 300-40 A.1: a) Issuance of a certificate of compliance for a new system; b) Issuance of a certificate of compliance for the alteration of a system; or c) Upon the sale or transfer of a premises.

The Ordinance also gives authority to the Department of Health to suspend a license if a septic system malfunctions, the owners do not comply with the proper operation and maintenance of the system, or they are denied access to the property. In addition, the Department of Health can modify the duration of the license based on, but not limited to, limited size of tank or disposal field, age of system, or past history of malfunctioning.

This Ordinance also includes general maintenance and management measures (standards) for OWTSs as outlined in § 300-41. Many of these measures have already been discussed in Section 8.0 of this Plan. In addition to the 3-year required septic tank pumping, these standards include those substances and materials that are prohibited from entering the system, such as waste oil, pesticides, drain openers, non-biodegradable materials, coffee grounds and cigarette filters. In addition to the disposal field standards mentioned in Section 8 of this report, this ordinance also prohibits encroachment on the disposal field from new construction such as decks, pools, building additions, and driveways. The ordinance also outlines the protocol for action in the event that it is necessary to abandon an OWTS, such as when upgrading from a cesspool or replacing and relocating the system.

## 12.0 Establishment of Protocol for Rehabilitation and Retrofitting of Existing OWTSs

In order to comply with the TMDL, at least 240 OWTSs need to participate in a structural management measure, which specifically involves the rehabilitation or retrofitting of an existing OWTS. Through the public education / outreach program, it is hoped that the Township will hear from residents who are interested in participating in such projects. Again, the primary focus will be to increase an existing system's ability to remove phosphorus from its wastewater effluent, so the first anticipated structural measure considered will be retrofitting peat filters onto existing systems. The recommended protocol for moving forward on such activities is as follows:

1. Anyone who installs a State-approved alternative OWTS, such as peat filters, to increase their capacity to remove phosphorus from their wastewater should have the $100.00 Township issuance of license fee waived. The operator of the retrofitted OWTS is still required to have the septic tank pumped out and submit an inspection report every three years to obtain Township certification. However, the $100.00 fee associated with this activity should be waived for anyone retrofitting an existing OWTS with State-approved technology to enhance phosphorus uptake.

2. Anyone who installs an alternative OWTS, such as compositing toilets or intermittent sand filters, to increase their capacity to remove phosphorus from their wastewater should have the $100.00 Township issuance of license fee waived. However, this is provided that the alternative technology received approval by the State and the Department of Health. The operator of the retrofitted OWTS is still required to have the septic tank pumped out and submit an inspection report every three years to obtain Township certification. However, the $100.00 fee associated with this activity should be waived for anyone installing OWTS technology to enhance phosphorus uptake.

3. The Township should develop a contact list of residents who would be interested in participating in projects to rehabilitate / retrofit their existing OWTS to enhance phosphorus uptake, with a preference given to those lots that have lakefront property. Thus, if and when the Township has funding available to dedicate toward the design and installation of alternative OWTSs, a list of potential project sites has already been established.

4. The Township should look into additional means of encouraging homeowners to retrofit existing OWTSs. Technical assistance in the form of survey services, obtaining State approval for an alternative technology or design services, financial assistance, and tax incentives should be considered.

5. The Township should also encourage the installation of water conservation devices and, depending on the extent of devices installed, consider providing tax incentives to those homeowners who participate. At a minimum, the Township should educate homeowners on how such devices will maximize the live and effectiveness of their OWT as well as result in-home water use.

6. Finally, the Township should encourage developers to integrate alternative OWTS technologies and water conservation actions that provide high rates of phosphorus removal into future structures. The Township may also want to consider crafting an Ordinance requiring that some high phosphorus removing OWTS (alternative or otherwise) is included in any OWTS with a leachfield located within the ZOI.

# 13.0 Public Education / Outreach, Implementation Budget and Identification of Technical Assistance

The Township role in the implementation of this OWTS Management Plan is largely two-fold. First, the Township is responsible for documenting, overseeing and enforcing the on-site wastewater management Ordinance that was recently passed (Appendix D). This includes overseeing a program that tracks the general status of existing OWTSs and issues licenses to for their operation. As part of this confirmation septic tank pump-outs, conducted at least once every 3 years, needs to be confirmed. Second, the Township is responsible to educate and provide public outreach to the homeowner so they are informed on the individual's role and responsibility in operating an OWTS, as well as what other efforts can be done to maximize the efficiency of the OWTS. In turn, this will contribute toward protecting the quality of local drinking wells, as well as receiving surface waterbodies such as Greenwood Lake.

To aid in covering the costs associated with these activities, a $100.00 flat fee is to be paid by the OWTS operator (homeowner) during each license period (once every 3 years). Thus, in addition to the general oversight and enforcement of the OWTS program, these funds will also be used to develop and/or distribute educational material to the homeowners on many of the topics described in this Management Plan (i.e. the use of non-P dishwater detergents, water conservation, and the value of frequent pump-outs). The distribution of educational material can include, but not be limited to, mailing flyers / brochures, placing material on the Township's website, public presentations, and local radio / television campaigns.

Public educational and outreach material should also provide basic information on how a septic systems works (Appendix F) and provide much of the "housekeeping" actions that should be implemented by everyone to maximize the operation of their systems (see Sections 8.0 and 9.0 and Appendix F). One of the most important components of this should include convincing homeowners to buy and use only those automatic dishwashing deterrents that have no phosphorus. Such products are relatively common and can be easily obtained in local supermarkets.

The costs associated with the installation of various alternative OWTSs were outlined in Table 5 on a per unit basis. However, this operating budget did not include some of the costs associated with the non-structural BMPs and did not provide a total cost for the initial installation of the structural alternative OWTSs that are recommended for the 240 parcels. Thus, Table 6 accounts for these additional costs.

As previously mentioned, the $100.00 fee every three years will pay for the Township's requirements as outlined in the Ordinance. Specifically, this includes oversight of the licensing program and public education / outreach. However, the Township should also seek other sources of funding to augment the program oversight and public outreach. In particular, funds should be pursued for possible partnerships between the Township and private property owners who are interested in installing one of the alternative OWTSs on their parcels. Potential sources of such funding are discussed in Section 14.0 but the first step in such funding should be to obtain funds to implement at least one of the recommended alternative OWTSs at the municipal building to assist in reducing its phosphorus load contribution to the TMDL.

Although the Township's OWTS is not failing from a health perspective (removal of pathogens), it does contribute a substantial amount of phosphorus (see Section 7.0). Thus, the Township's OWTS would certainly benefit from being retrofitted with a peat filter and/or the installation of alternative toilets (Appendix E). At a minimum, the Township should seriously consider the installation of water conservation devices (i.e. low-flow toilets and faucets), if such devices have not already been installed within the municipal building. Similar projects could be implemented at other Township buildings. The goal of such projects will be to contribute toward reducing the existing TP load originating from OWTSs, as well as demonstrate to local property owners how such structures work and benefit the local environmental resources. Therefore, relative to any funding that is obtained for the installation of alternative OWTSs, it is recommended that the Township's OWTSs be the first on the list for implementation.

## Table 6
## Estimated Costs for Implementation of the OWTS Management Plan for the New Jersey end of the Greenwood Lake Watershed, Township of West Milford, Passaic County, New Jersey

| Management Measure | Initial Cost | Long-Term Cost | Notes |
|---|---|---|---|
| **Non-Structural BMPs** | | | |
| Mandatory pump-outs and inspections | $100.00 for Township license every 3 years | $250.00 for pump-out every 3 years | To be paid for by the property owner |
| Use of non-P dishwashing detergents | Nominal costs | Nominal costs | To be paid for by the property owner |
| Installation of water conservation devices (low flow toilets, showerheads and faucets) | Approximately $3,100.00 per home | none | To be paid for by the property owner |
| Public Education / Outreach | $5,000.00 | Approximately $2,000.00 per year | Cover costs of printing and distributing material to residents |
| **Structural Alternative OWTSs** | | | |
| Retrofitting a total of 200 existing OWTS with peat filters | $6,000,000,00 | $3,500.00 per unit, once every 10 years<br><br>$400.00 per unit for annual O+M | Possibly obtain grant funds or low interest loans but long-term costs to be paid by individual homeowner |
| Replacing 40 existing OWTSs with Intermittent Sand Filters | $2,000,000.00 | $3,000.00 per unit, once every 10 years<br><br>$350.00 - $400.00 per unit for annual O+M | Possibly obtain grant funds or low interest loans but long-term costs to be paid by individual homeowner |
| Effluent Screens or Filters | Between $100.00 and $400.00 per OWTS | Between $50.00 and $200.00 for annual O+M | To be paid for by the property owner |

Please note all prices are estimates, originally derived from US EPA (2002), adjusted for inflation, and will vary depending on site specific conditions.

## 14.0 Funding

Funding for rehabilitating or retrofitting existing OWTS with alternative technologies could possibly be obtained through the Clean Water State Revolving Fund (CWSRF). This program offers low interest rate loans to fund on-site wastewater projects; this program provides over $4.5 billion annually for projects relating to wastewater treatment, non-point source pollution control, and watershed and estuary management. Funding is administered through the State; in New Jersey CWSRF resources are provided by the New Jersey Environmental Infrastructure Financing Program (EIFP).

Every year, the New Jersey Department of Environmental Protection (NJ DEP) develops a “Proposed Priority System, Intended Use Plan, and Project Priority List”; this document is required by the US EPA. The Priority System described the ranking methodology for the municipal water pollution control projects that are eligible for financing, the Intended Use Plan provides information on funds available through the clean water component of the EIFP, and the Priority List identified the estimated total eligible building costs under the appropriate project category. Due to the recent curtailments in the budget, traditional OWTS projects are given higher priority. However it may still be possible to obtain funds for the implementation of alternative technologies, such as those that have been approved by the NJDEP Onsite Wastewater Management Program.

There are also grants, which were established in August 2005, under the Highlands Council. One example of such a grant program is the, the Municipal Partnership Pilot Projects (MP$^3$) grant. This grant’s purpose is to initiate important elements of the Regional Master Plan such as, but not limited to, septic management for lake communities, redevelopment, eco-tourism, and economic development. Thus far, there were 10 MP3 grants approved; this provided communities within the New Jersey Highlands with $405,290.00 (New Jersey Highlands Council 2007). However, such funds may not be available as of early 2012. This possible source of funding should be investigated by the Township in more detail.

It is also possible that the Township may be able to obtain funds through the State’s NJDEP Non-Point Source (NPS; Section 319(h)) Pollutant program for the implementation of alternative OWTSs. While the NPS program focuses almost exclusively on sources of pollution originating from surface runoff and stormwater, pollution from OWTS is another form of NPS pollution may possibly be considered for future funding.

Finally, funding through State or Federal Environmental Education grants may be obtained to develop and distribute additional outreach material, coordinate and host public meetings and possibly expand the Township’s existing OWTS database to reduce the number of unknown parcels in the ZOI. Such education or outreach project may also be eligible for funds through County or local grant programs.

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