1st Edition • August 2009

# NEWSLETTER

## Decentralized Wastewater Demonstration Project

**Newsletter Highlights!**



**Photo: Algae Bloom in Greenwood Lake**

*Welcome to the first edition of the Greenwood Lake Decentralized Wastewater Demonstration project newsletter. The purpose of this newsletter is to provide information and educate stakeholders and interested parties of the New York portion of the Greenwood Lake Watershed about the Orange County Water Authority's Decentralized Wastewater Demonstration Project.*

## Greenwood Lake Decentralized Wastewater Demonstration Project

The Orange County Water Authority (OCWA) is conducting this project to demonstrate practices and technologies capable of reducing phosphorus pollution from septic systems in the New York portion of the Greenwood Lake watershed (the "study area"). The other primary goal is utilizing technologies that minimize electricity consumption. Therefore, the treatment approaches we use will not include big pumps, blowers, or other energy-intensive technologies. Instead we will demonstrate reliable, low-energy wastewater technologies that can help improve water quality, with an overall goal of developing relatively affordable options that can be used more widely in Greenwood Lake and other communities. The project is funded by the US Environmental Protection Agency with a grant obtained through Senator Charles Schumer's office, by the New York State Energy Research and Development Authority (NYSERDA), and by the OCWA. The Village of Greenwood Lake, Town of Warwick and the County Planning have provided valuable information and in-kind support. This project will provide a real-world demonstration of several management options that may be part of a sustainable wastewater strategy for the community, and a plan to provide guidance for local leaders and residents about next steps for implementation of system upgrades and other management steps. After the demonstration systems are installed, they will be monitored for one year and the final report and plan are expected to be completed by the end of 2010.

Why is phosphorus important? Excess phosphorus acts as fertilizer and causes blooms of algae and excessive growth of nuisance vegetation in Greenwood Lake that impair its use as a recreational resource and scenic amenity (see article "P Soup"). In downstream areas in New Jersey, where water originating in Greenwood Lake is part of the region's drinking water supply, excess plant growth can result in a need for higher chlorination levels in drinking water, and cause other impacts with direct human health implications. Under the requirements of the federal Clean Water Act, the states of New York and New Jersey have classified the water quality of Greenwood Lake as impaired due to excess total phosphorus concentrations. These agencies have concluded that stormwater runoff and septic systems are the primary causes of the high phosphorus concentrations in Greenwood Lake. A Total Maximum Daily Load (TMDL) – a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality goals — has been developed to provide a target for reduction of phosphorus in the watershed. According to this TMDL, a 43% reduction in phosphorus loading from septic systems located within 200 meters of the lake is needed to meet water quality standards.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

OCWA

NYSERDA
New York State Energy Research and Development Authority

Like many small communities in the U.S., the Village of Greenwood Lake and adjoining areas in the Town of Warwick contain older, onsite septic systems installed before the existence of wastewater regulations. A typical system consists of a septic tank that discharges settled wastewater to a leach field or seepage pit. Cesspools are also in use. Older systems may be undersized for current uses, in part because they were built when most homes were only used in the summer, but are now being utilized year round. Effective treatment of wastewater requires enough contact with soils to remove key pollutants, and a thin soil layer above bedrock or groundwater is not adequate. These older systems, therefore, may be effective in getting wastewater under the ground, but may do little to treat it because of shallow soils over bedrock or groundwater close to the surface (and sometimes both). The wastewater then flows downhill toward Greenwood Lake. This incomplete treatment of wastewater is believed to be an important cause of water quality degradation in the lake. This demonstration project is designed to develop comprehensive solutions for effective wastewater management at the community and watershed level.

Interpreting Soil Properties

The OCWA has retained a consulting team including Stone Environmental, Inc. of Montpelier, VT and Fuss & O'Neill, Inc. of Manchester, CT for this project. The overall scope includes a wastewater needs assessment for the watershed (see related Needs Assessment article) and design and construction management for two innovative onsite wastewater treatment systems in Greenwood Lake. Another consultant to the OCWA who's based in Orange County, Simon Gruber, worked on obtaining the project funding and is coordinating public outreach, education and several upcoming related training workshops. At the end of this project, a wastewater management plan for the New York portion of the Greenwood Lake watershed will be produced with the demonstration project results, as well as other treatment options, and including discussion of potential next steps for meeting the wastewater treatment needs of the Village of Greenwood Lake and Town of Warwick.

"We were impressed with the level of interest residents showed in the project..."

## Two Properties Selected as Wastewater Demonstration Sites

Two different advanced onsite wastewater treatment systems will be installed at two properties around Greenwood Lake: the Grace Evangelical Lutheran Church on Waterstone Road and a private residence on Grove Street. At the Church, the treatment system will also treat wastewater from the adjacent parsonage and sexton's house on the church property, and therefore is called a cluster system. A single use or individual system will be installed at the Grove Street residence.

Performing a Percolation Test

This summer, the project consultants are evaluating innovative technologies available for treating phosphorus and designing a wastewater system for each property that will provide a high level of treatment while minimizing electricity consumption. They will monitor the systems for one year to evaluate the performance of these technologies, and this information will be used to develop recommendations to community leaders and property owners about how they may be used on other residential and commercial properties in the Greenwood Lake watershed.

Last year, the project team solicited applications from property owners in the Village of Greenwood Lake and the Town of Warwick interested in hosting a demonstration system. OCWA described the project and distributed application materials at public meetings in the Village of Greenwood Lake and the Town of Warwick. The Greenwood Lake News published an announcement as well. More than 30 property owners interested in being considered submitted applications.

David Church, Executive Director of OCWA, said, “We were impressed with the level of interest residents showed in the project and in their appreciation of the importance of improving water quality in Greenwood Lake. We only wish the project’s funding allowed for installation of more demonstration systems.” Dave Braun, Project Manager at Stone Environmental, noted “It was difficult to pass over promising sites, but we believe we ultimately selected the two sites that will most fully achieve the goals of the demonstration project.”

The process used to select the demonstration sites was objective and rigorous, and included consideration of background information obtained through a community-wide wastewater needs assessment (see related article in this newsletter.) From the applications received, the 12 most promising sites were inspected by the project consultants. They studied site conditions and verified application information. In consultation with the OCWA, they reviewed them based on how closely each site matched the following requirements:

- Property must be occupied year-round (by two or more people for residential properties)
- Site and soil conditions must be suitable for obtaining permits from the Orange County Dept. of Health and local government
- Site and soil conditions must be suitable for construction of an advanced wastewater treatment and dispersal system, including monitoring devices
- Access to electricity and suitable available power must be available to reliably operate the demonstration system
- Access to the property must be unrestricted during the site evaluation, system construction, and the subsequent one-year monitoring period
- Existing wastewater system, or a component thereof, must not meet current regulations
- Property must be located within the Greenwood Lake Watershed, ideally within 200 meters of the lake
- Property must not have a separate system for graywater (water from sinks, showers and laundry)
- Applicable setback distances to drinking water wells must be met by any new demonstration system

**Digging Test Pits**

(Operator: Fran Reichal, Town of Warwick)

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**Site Selection Criteria:**

- Occupied year-round by 2 or more people
- Conditions suitable for permitting with OC Health Dept & Construction needs
- Electric accessibility & reliability
- Etc: See article for more criteria

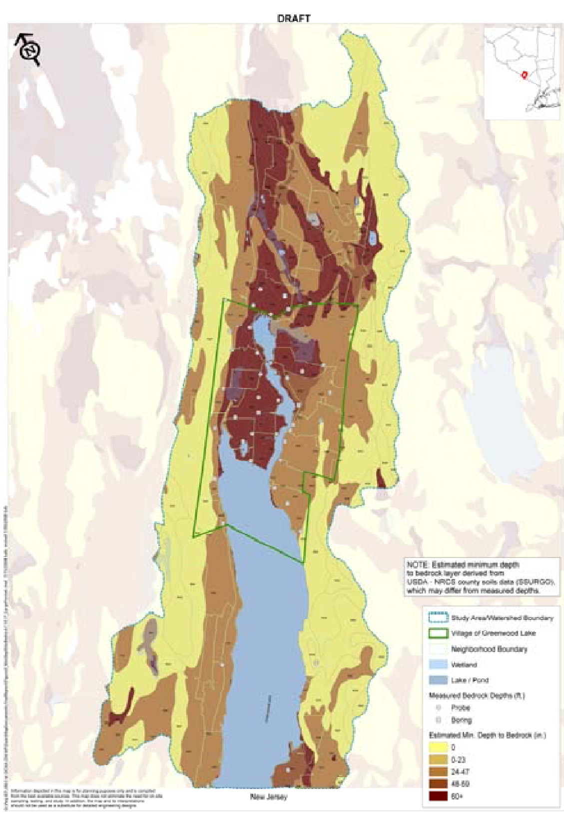



**FIGURE 3. MINIMUM DEPTH TO BEDROCK BY SOIL MAP UNIT**
Orange County Decentralized Wastewater Demonstration Project
Village of Greenwood Lake and Town of Warwick, New York

Sources: Hydrography (lakes/ponds), Stone 2008; Roads, OCGIS; Wetlands, NYS DEC; Parcel Boundaries, OCGIS; Neighborhood Boundaries, Stone 2008. Soils (Estimated Minimum Depth to Bedrock), NRCS SSURGO, Probe/Boring Data, 2001, Malcolm Pirnie.

STONE ENVIRONMENTAL INC

Following this screening, project scientists and engineers characterized soils at the three highest ranked sites, which as it happened were all located in the Village of Greenwood Lake. At each site, they interpreted soil properties in deep test pits, performed percolation tests to measure how fast water drains into the soil, and collected soil samples to characterize the phosphorus binding potential of the soils. According to soil scientist and engineer Bruce Douglas of Stone Environmental, “We wanted to understand the suitability of the soils for infiltration and treatment of wastewater. Two of the sites tested will showcase the phosphorus treatment technologies very well, while a third would have required significant modifications to make it suitable.”

Based on this detailed site characterization, the Grace Evangelical Lutheran Church on Waterstone Road and a private residence on Grove Street were selected for installation and monitoring of demonstration systems. These systems will incorporate phosphorus removal and energy efficiency technologies. Following final design of these systems and after required permits are obtained, systems will be installed in the Fall of 2009 and monitored for one year. Results of the monitoring and overall performance, costs and other information will be shared with local leaders and residents in Greenwood Lake, as well as other agencies and organizations working to implement sustainable, cost effective wastewater solutions elsewhere in the region.

# Greenwood Lake Watershed Wastewater Needs Assessment

The first step in the overall project was to complete a wastewater needs assessment. A key tool used in this process is a geographic information system, or GIS, consisting of digital mapping and database information that enables visualization and analysis of geographic data and other information. Analysis of properties in the study area, which was conducted to define the scope of the wastewater treatment challenge, has found that site conditions limit conventional options for onsite wastewater disposal in most areas. The results of this analysis have guided the selection of properties for installation of advanced wastewater treatment demonstration systems (see article "Two Properties Selected as Wastewater Demonstration Sites") and will be used in developing a comprehensive wastewater management plan for Greenwood Lake, this project's final product.

By analyzing existing mapped data using the GIS, the team considered four scenarios to assess limitations for safely disposing of wastewater via individual or cluster septic systems. Generally, the Greenwood Lake watershed is characterized by steep slopes, shallow bedrock, and/or shallow groundwater, conditions that are not conducive to effective wastewater treatment by conventional septic systems over the long term.

*Photo: Greenwood Lake Shoreline*

Scenario 1 - The team identified those properties suitable for septic systems after excluding required regulatory setbacks, which are horizontal distances from features such as water bodies, wetlands, buildings, property boundaries, and drinking water wells. Areas with slopes greater than 15% were also excluded. Under these constraints, approximately 33% of all developed parcels have less than 200 square feet of land area available for onsite wastewater treatment and disposal. The options for onsite wastewater treatment are very limited on these parcels.

Scenario 2 - The team identified those properties suitable for septic systems after considering the Scenario 1 setbacks plus required isolation distances between a private water supply well and a leachfield. When onsite well isolation requirements are considered for properties with water supply wells, the percentage of parcels with less than 200 square feet of available area increases to approximately 45%.

Scenario 3 - In reviewing wastewater treatment system designs, the Orange County Department of Health has historically shown flexibility regarding setbacks from buildings and property boundaries, to allow replacement and repair of substandard systems on small lots. In scenario 3, therefore, the required setback between a building and a septic system was reduced from 20 feet to 10 feet and the property boundary setback was reduced from 10 feet to 5 feet. Slopes greater than 15% were excluded, but no onsite well isolation requirements were assumed. Based on these assumptions, the percentage of all developed parcels which have less than 200 square feet of land area available for onsite wastewater treatment and dispersal is 24%.

Scenario 4 - Inadequate vertical distance to seasonal high groundwater and/or bedrock also constrains the available options for onsite wastewater treatment and dispersal on many lots. According to policies of the Orange County Department of Health (which follow the State's codes), conventional leachfields must have at least four feet of well-drained soil. Where bedrock or seasonal high groundwater is within four feet of the ground surface, raised systems or mound systems are typically used. Approximately 24% of developed parcels in the study area have soils that are potentially suitable for traditional in-ground leachfields. Approximately 35% of developed parcels have soils that are potentially suitable for raised systems or mound systems. The remaining approximately 40% of developed parcels have soils that have significant limitations for installing onsite septic systems that meet the existing Department of Health standards.

*Did you know...? From the mine to the lake*

*There is growing concern that known reserves of phosphorus on the planet are running out. Effectively, we have mined deposits of phosphorus and spread it all over the landscape, from whence a portion flows to water bodies in a much diluted state. By one estimate, there is only a 50-100 year supply of phosphorus remaining among all known reserves. Florida produces most of the phosphorus fertilizer sold in the U.S. Concerns about dwindling phosphorus reserves are contributing to a growing interest in developing technologies to capture phosphorus from wastewater in a recyclable form.*

The needs assessment also found that:

1. There are approximately 2,678 developed parcels in the study area that typically use onsite systems for wastewater management.
2. Approximately 78% of properties were developed prior to 1970. Of these, 11% of onsite systems have been repaired or upgraded since 1999.
3. 1483 parcels are served by municipal or community drinking water systems and 1228 parcels are served by onsite wells or seasonal water systems.
4. Approximately 1,513 developed parcels are located within 200 meters of Greenwood Lake (which is the area addressed in the TMDL for the lake – see introductory article).
5. Shallow depths to bedrock and steep slopes dominate the hillside portion of the study area.
6. Shallow depths to groundwater are evident in the lower hillside areas and in low lying areas near the lake, and north of the lake.

The OCWA decentralized wastewater planning and demonstration project will result in a wastewater management plan that will incorporate the needs assessment findings, provide additional background information and analysis about how these findings might guide decision-making by community leaders and property owners, and provide recommendations for next steps towards developing a sustainable wastewater management strategy for the study area.

# "P Soup" - Too Much Phosphorus Impairs Lake Water Quality

Local leaders and many residents are aware that Greenwood Lake suffers from too much phosphorus.  As described elsewhere in this newsletter (see introductory article), excess phosphorus causes overgrowth of algae and other nuisance vegetation in lakes. The question that dominates the discussion is: How can the amount entering the lake be reduced? The answer to this question is surprisingly complex.

Phosphorus (typically abbreviated with the letter P) fuels the biological productivity of lakes in this part of the world. Lakes rich in phosphorus tend to have low water clarity, taste and odor problems. In their bottom layer (the hypoliminion) they have low dissolved oxygen levels, which can result in fish kills.  This is the “P soup” phenomenon.  A lake with these conditions is described by scientists as “eutrophic,” and the process leading to this is called eutrophication. People appreciate phosphorus on land where it is a needed fertilizer, but  we enjoy our lakes most when they are in effect starved of phosphorus.


*Photo: Excessive algae growth from nutrient loading*

Just about all human activities in a watershed, from forestry to agriculture and development, increase the amount of phosphorus draining from a watershed to a receiving water body, such as Greenwood Lake. Phosphorus enters the lake in several forms: 1) dissolved forms, such as from onsite wastewater treatment systems; 2) attached forms bound to and contained in eroded soil particles; 3) and in leaf litter and other plant debris. In a developed watershed, it is practically impossible to reduce the amount of phosphorus entering a lake to levels that existed before humans dominated the landscape.

It does not take much phosphorus to have a dramatic effect. The average phosphorus concentration in Greenwood Lake as recently measured is about 31 parts per billion. At this level all the phosphorus in Greenwood Lake at any given time could fit into the bed of a large pickup truck, but it’s still enough that we expect to see algae blooms and low water clarity at certain times of the year. Water quality would be dramatically better at 10 parts per billion, which is typical of some Adirondack lakes. At 50 parts per billion, we would expect frequent nuisance algae blooms, taste and odor problems, and fish kills due to low dissolved oxygen levels. Avoiding the green “P soup” problem is of utmost importance.

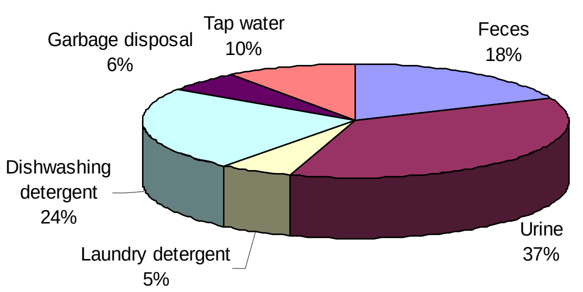
Sources of phosphorus entering Greenwood Lake are many, but the main categories are stormwater and wastewater. Rainfall runoff washes fertilizer off lawns and phosphorus-containing sediments off paved surfaces, and erodes phosphorus-rich soils from stream channels and gullies. The OCWA's decentralized wastewater planning and demonstration project addresses only the wastewater sources. Other work is ongoing to address phosphorus in stormwater, including work by the consulting firm Princeton Hydro, which is working with the Town of Warwick and the Village of Greenwood Lake with state funding to examine ways to reduce phosphorus in stormwater runoff. Direct atmospheric deposition on the lake is also a minor source of phosphorus.

*Photo: Storm Drain*

According to a 2002 report of the USEPA, each person's contribution of phosphorus in bodily wastes is 1-2 grams per day. Of course it depends on what and how much you eat. Urine is the largest source of phosphorus in domestic wastewater. Other important sources include automatic dishwasher detergents, ground up food from garbage disposal units and tap water.

One of the simplest ways for a household to reduce the amount of phosphorus entering its wastewater is to switch to a dishwashing detergent that is phosphorus free. Another key step where they are used is to eliminate garbage disposals, which will not only reduce Phosphorus entering wastewater, but can greatly improve waste treatment in the septic tank. The greatest source reduction can be had by installing unconventional plumbing fixtures, such as a composting toilet or a urine diverting toilet. (Some dairy farms are experimenting with low-phosphorus feeds to reduce phosphorus pollution, but we're not aware of any similar diets for people!)

After wastewater leaves the home, it typically enters a septic tank. In the tank, microbes decompose most of the organic waste and convert organic forms of nitrogen and phosphorus to ammonia and orthophosphate. If a typical tank is pumped every three years is required in the Village of Greenwood Lake since 2001 and in parts of the Town of Warwick since 2008, a small percentage (about 5%) of the phosphorus that has entered the tank since the last pump-out is removed by the septage hauler. Most of the phosphorus is carried in the wastewater flowing from the tank to the dispersal system (typically a leachfield or seepage pit), where it enters the soil. In a well functioning leachfield, phosphorus will become bound to soil particles. However, as onsite systems age the binding potential of soil decreases as it becomes saturated with phosphorus. Phosphorus may migrate through the soil and groundwater and eventually discharge in surface waters, in this case Greenwood Lake. The US Environmental Protection Agency has stated that older onsite systems pose "the potential for serious environmental degradation, as witnessed by the thousands of inland lakes where older, onsite development is increasingly being cited as the primary reason for lake eutrophication."




*Sources of phosphorus in typical domestic wastewater*
The phosphorus contributions among the sources indicated are highly variable. The percentages indicated here assume: 1) The residence is served by a municipal water supply that adds phosphorus for corrosion inhibition (note that the Village of Greenwood Lake adds approximately half the typical amount); 2) A statewide ban limits the content of phosphorus in laundry detergents to 0.5% (as in New York State); 3) An automatic dishwasher is used with a common brand of detergent; and 4) A garbage disposal is used to dispose of kitchen wastes in household plumbing drains.

In Greenwood Lake, there are many houses built on small lots with shallow depths to bedrock or groundwater. The area available for wastewater dispersal is restricted by steep slopes and required setback distances from private wells, waterbodies, buildings, and property boundaries. In the remaining available area, there may be an inadequate volume of soil to bind the phosphorus from onsite wastewater systems over the long term. If the capacity of the soil to bind phosphorus is exceeded, a phosphorus plume will move toward the lake. One strategy to improve phosphorus treatment in the soil is to disperse wastewater at shallow depths. In a conventional leachfield, effluent is typically dispersed at 2 feet below ground surface. Dispersing wastewater at shallower depths of 6-12 inches below ground surface increases the soil volume available to bind the phosphorus, and generally improves other aspects of treatment as well.

On sites that are not suitable for a traditional onsite wastewater dispersal system with the soils needed to remove phosphorus over the long-term (30+ years), there is a need for advanced treatment. Phosphorus treatment technologies for small wastewater flows are still in the early stages of development. Many technologies and filtration materials are being promoted, but there is limited data to inform selection of technologies and system designs. Most technologies do not have long-term performance data from full-scale systems. Based on the available data, the OCWA's project team evaluated information about 12 filtration materials, as well as chemical additions that have shown some promise for removing phosphorus from wastewater. Filtration materials include engineered filter media, industrial by-products such as various slags from steel manufacturing, fly ash, crushed brick, and natural materials.

The project team is currently considering which phosphorus treatment approaches are most appropriate for the demonstration sites selected in Greenwood Lake. More information on the selected technologies and media will be forthcoming over the next several months. This is a demonstration project and we will continue sharing the findings of our research and demonstration work in a series of newsletters, public meetings, workshops for professionals in the field of onsite wastewater management, and a final report. Please stay tuned!

Did you know? Interesting facts about Phosphorus

- There is growing concern that known reserves of phosphorus on the planet, which are used to support major portions of our agricultural system, are running out. By one estimate, there is only a 50-100 year supply of phosphorus remaining among all known reserves. Florida produces most of the phosphorus fertilizer sold in the U.S. Concerns about dwindling phosphorus reserves are contributing to a growing interest in developing technologies to capture phosphorus from wastewater in a recyclable form.
- While septic tanks remove only a small fraction of phosphorus from sanitary wastewater, periodic pumping is critical because it prevents overloading of the leachfield (or the soil surrounding a seepage pit) with solids and grease. Leachfields overloaded with wastewater solids and grease does not provide effective treatment. The soil can be highly effective at removing phosphorus from septic tank effluent if it is not overloaded. Finer textured soils and soils containing higher amounts of iron and aluminum are generally most effective for phosphorus removal. Regular pumping is therefore critical for effective system performance and can help maximize the natural phosphorus removal capacity of soils in the leachfield.

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*Photos:*

*Septic System Components (tank, pump and filter)*

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**There's phosphorus in my tap water?** Many community drinking water systems in the northeastern U.S., including the Village of Greenwood Lake's, add phosphorus to treated drinking water to minimize corrosion and leaching of lead and copper from household plumbing. Most of this phosphorus passes through the distribution system into your home or business. When you run the tap, shower, or flush the toilet, this phosphorus enters the wastewater stream along with the phosphorus you generate inside the home. Also, when municipal water is flushed down a storm drain, off a dock, or is released due to hydrant flushing, the phosphorus concentration in this water is more than the current average concentration in Greenwood Lake. The Village of Greenwood Lake recently reduced the concentration of phosphorus in its treated water by approximately 50% and is now seeking alternatives to using phosphorus for corrosion inhibition.

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Educational resources:

The National Small Flows Clearinghouse is a good source of educational and technical information about onsite and small community wastewater technologies and management issues for homeowners, local officials, engineers and other audiences. Call (800) 624-8301 or visit http://www.nesc.wvu.edu/wastewater.cfm

The NY State Federation of Lake Associations has information about water quality management and restoration in lakes, including a link to the newly revised Diet for a Small Lake handbook. http://www.nysfola.org/

The Center for Watershed Protection is an educational and research organization with a lot of resources on stormwater management, watershed planning and protection and related issues. http://www.cwp.org/

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