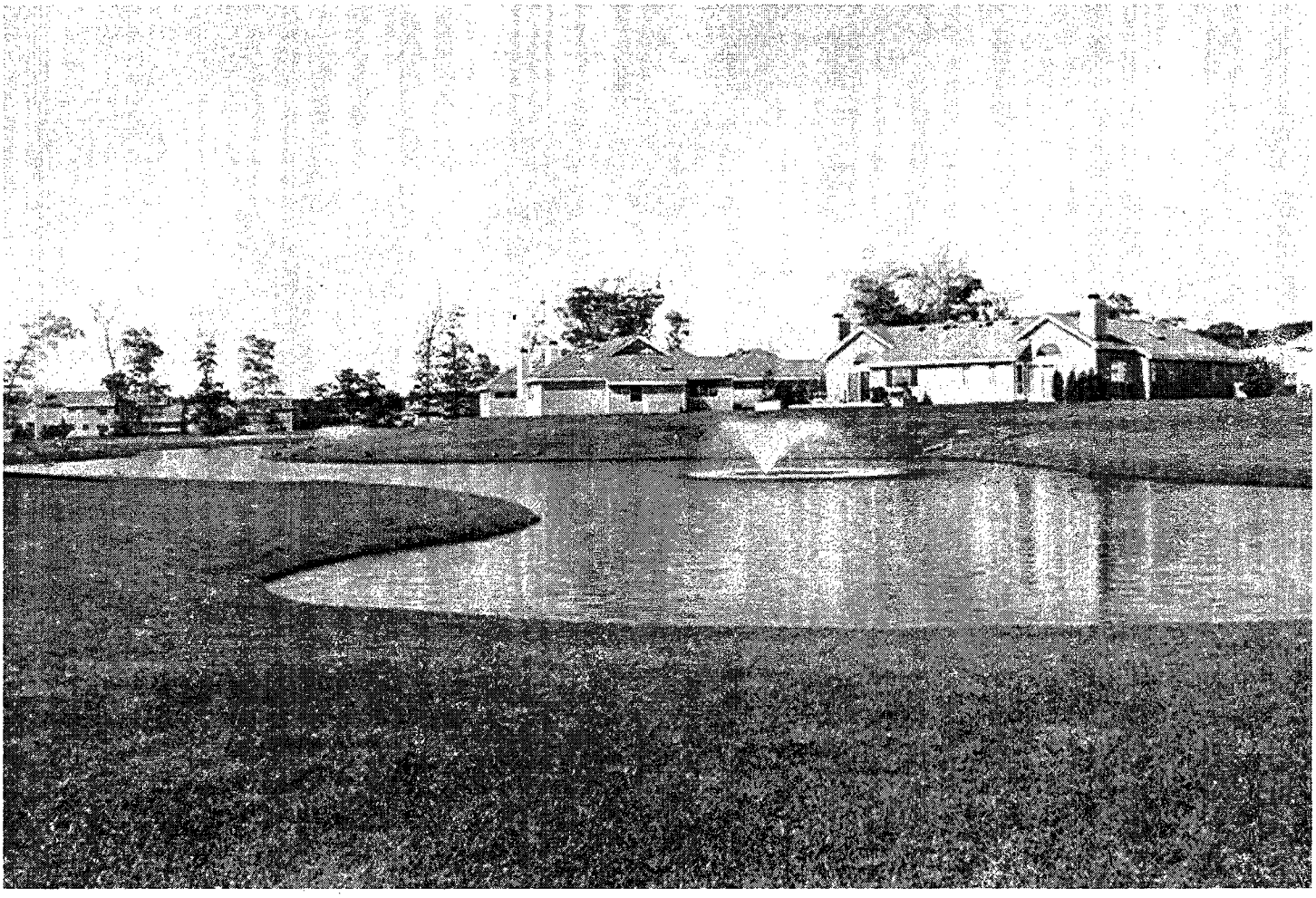
Study of
Man-made Ponds
in Suffolk County
New York



Prepared by:
Suffolk County Planning Department
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M A N-M A D E P O N D S
in
S U F F O L K C O U N T Y

Suffolk County Planning Department

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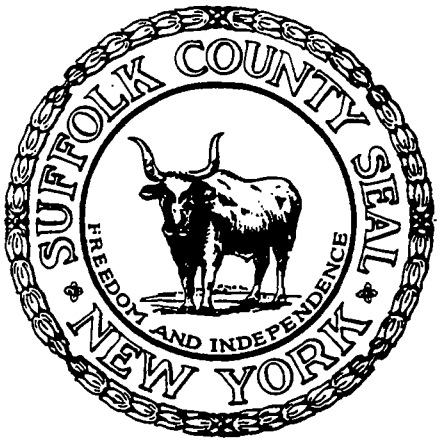

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I. INTRODUCTION

Man has been constructing dams, building reservoirs and diverting streams and rivers for many years. The primary reasons for this included providing irrigation for crops and drinking water for people and livestock. Later on, man began to harness the energy of flowing water for his mills. By the middle of the twentieth century many dams were constructed for electrical production all over the world and many large reservoirs covering many square miles were holding water for large municipalities.

For the most part, little or no study had been done to consider the impacts of these structures on the environment. Because these projects provided essential energy and drinking water for large populations, the economic benefits were considered to outweigh any loss of natural environment or the elimination of any species which could not adapt to the drastic changes in their environment.

Today most people are much more environmentally conscious and most large projects are carefully reviewed to ensure that any environmental disruption will be mitigated. Small individual ponds however, were never considered to be a great threat to the environment, and therefore have been permitted with little limitation.

There has been an increase in the number of these small man-made ponds recently and the cumulative impact of these ponds on our environment has never been seriously studied. As development sweeps across Suffolk County and into the precious groundwater recharge areas, it was felt that some study should be considered, especially of that development which impacts the ground water below, our sole source of drinking water here on Long Island.

This report will look into the man-made ponds and their impact. Discussion will include the existing man-made ponds, their problems and benefits. In order to better understand the dynamics of these ponds, we will consider natural ponds and see how they work.

Like many processes within the ecosystems of the environment, ponds are a constantly changing and evolving "organism". A natural pond is created, it grows, and it dies. This process is a complex one that many individuals do not fully understand. Like the shifting sands of the barrier beach, ponds are not meant to remain permanently unchanged. There are different types of ponds in different successions of their growth period.

The birth of a natural pond starts with the change of an ecosystem through a natural "catastrophe". The pond, once created, will encourage new species to proliferate and others to be eliminated. As the biomass accumulates, the water will rise, and certain vegetation will give way to different species which are more readily adapted to the new ecosystem. Sediment or peat on the bottom will continue to collect, eventually raising the height of the pond to what is referred to as a bog or marsh area. What we see and identify as marshland today may have been ponds several hundred years ago. This is the natural succession of certain ponds. These processes take place naturally without the intervention of man and have been doing so for thousands of years.

This is a very simplified version of what is taking place. There is limited knowledge on the intricacies of the dynamics. There are all kinds of biological interactions which interface with the hydrology and geology of the site.

We may be able to predict what will happen during the first few years of the life of an artificial pond based on past experiences. But we must constantly be looking back to past projects to see where others have erred so that we can avoid their mistakes. Many of the questions and concerns on man-made ponds have been addressed in a report by the United States Department of Agriculture entitled "Ponds-Planning, Design, Construction", June 1982. Therefore, in an effort to conserve resources we have not spent much time or energy reiterating the topics discussed in that report. It is felt, however, that a copy of that report be acquired as a supplement because it does contain much useful information. This report was issued by the U.S.D.A. because they realized the importance of ponds for agricultural uses. In response to the need for information, the Soil and Conservation Service provides engineering expertise in the form of brochures and publications such as the U.S.D.A. report.

II. TYPES OF PONDS

For the purpose of our study we will divide the types of ponds into two categories; Perched ponds and Interface ponds. Perched ponds are those which are situated above the groundwater table, usually on a clay lens. The impervious layer obstructs the natural percolation of the water through the soil. Interface ponds are those which occur in low lying areas where the topography of the land dips below the groundwater level.

Both types of ponds occur naturally and can be constructed artificially. In the case of the perched pond, the developer will create a liner of clay or bentonite. Bentonite is a substance which expands 12 to 20 times its size when it comes in contact with water. When wet, it becomes impervious. It has become a standard in the industry, replacing the conventional clay liner which has been used for many years. Plastic or PVC liners have also been used with much success.

Man made interface ponds can only be constructed where the water table is very close to the surface. The developer must dig down into the groundwater itself to create such a pond. One of the main problems or concerns with interface ponds is the fact that the groundwater can fluctuate a significant amount. An example of problems resulting from the drastic change in groundwater involves the homes that were built during the 1960's in low lying areas of Smithtown . The weather had been dry for several years and the groundwater was unusually low when the houses were constructed. After a decade without incident, precipitation increased and the groundwater rose to a higher level. Many of the homes

were found to have basements constructed beneath the average groundwater level. This, of course, caused homeowners much expense to remedy the situation.

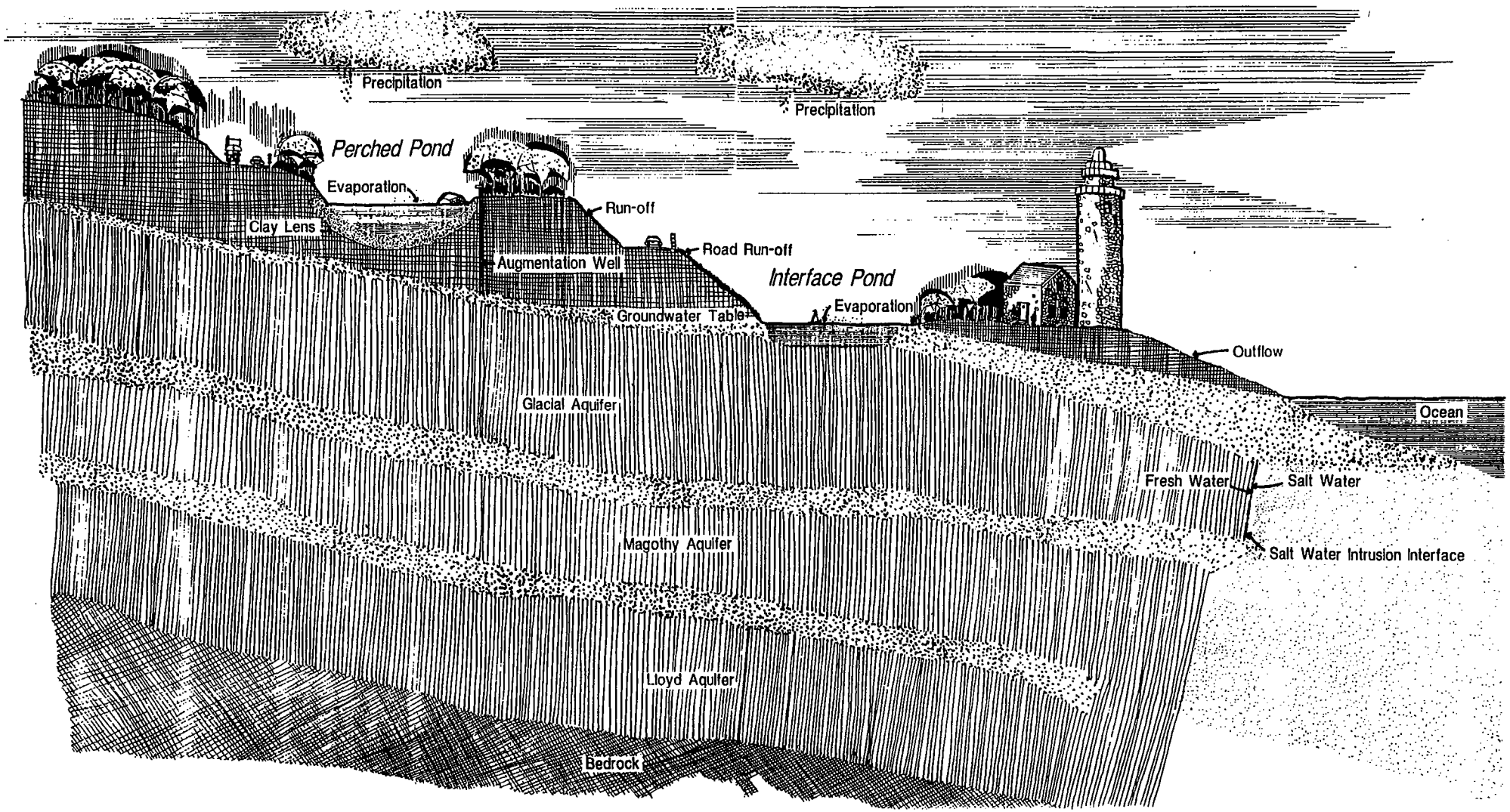
Another concern of interface ponds is the increased vulnerability of the aquifer once the soil cover has been removed. Several studies have demonstrated the soils ability to trap or contain contaminants which would otherwise infiltrate the aquifer and undermine water quality.

How a Natural Pond Works

In order to better understand the workings of a man made pond, it is important to understand how a natural pond works. We must keep in mind that a pond is a living organism which is a part of the ecosystem. It is created, it grows, it matures, and it dies. Sometimes this process takes hundreds of years, and sometimes it takes several decades. Its origin, water source, pH, surrounding ecosystems, size, etc. are all factors that influence the life of the pond.

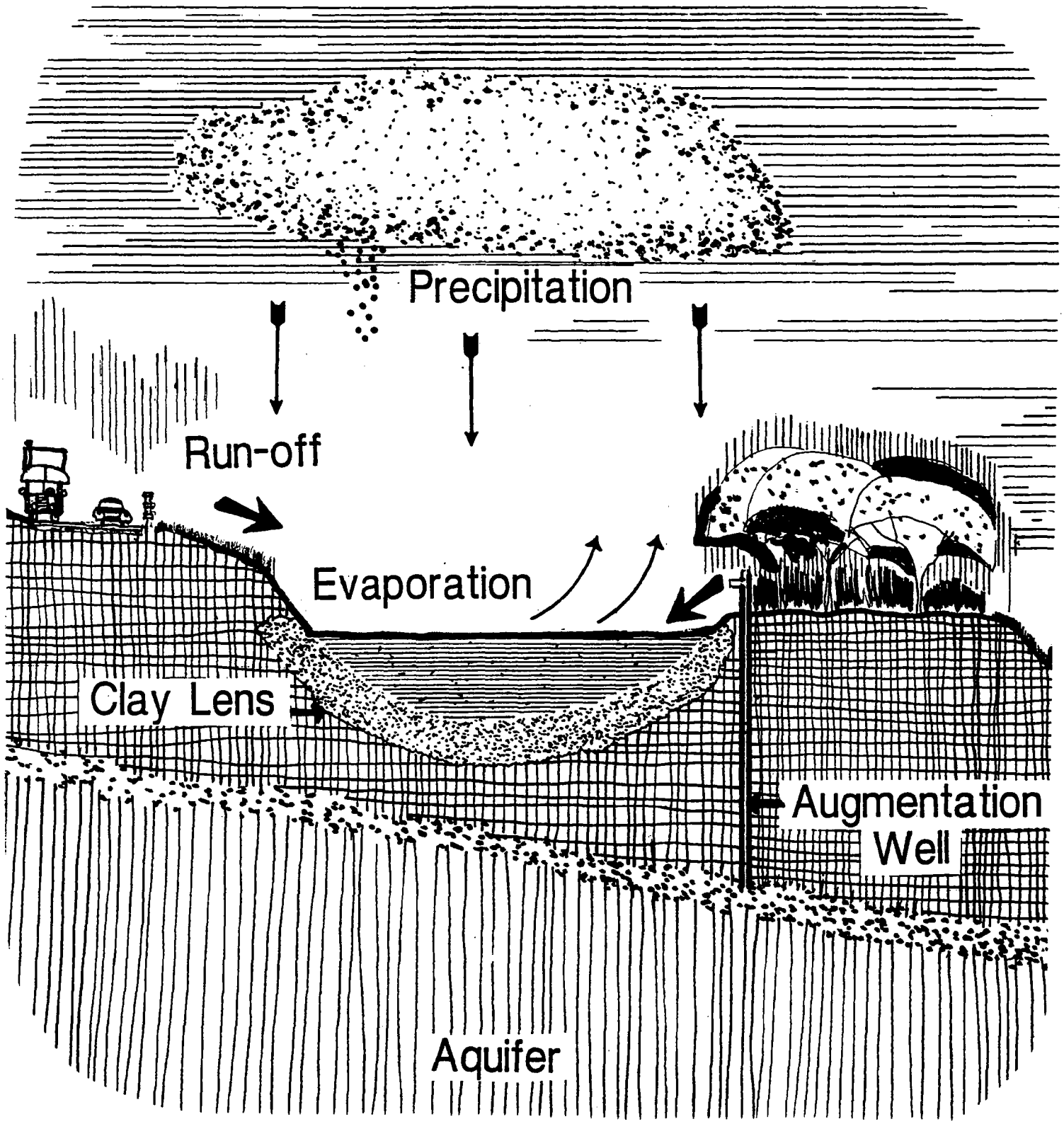
The origins of new ponds are many. A river or stream can be blocked up naturally, by a landslide or a beaverdam. Likewise, kettleholes can collect water, rivers can change course, soluble rock can dissolve to create a depression, or shifting tidal sands can trap water behind the dunes. Man can intentionally or unintentionally create ponds as he develops the landscape, builds roads and residential developments or clears land for agricultural use.

A new pond will alter part of the existing ecosystem to create a niche for itself. Large trees that may have been standing for hundreds of years can drown and die. A new succession of life will always fill in as long as the right conditions exist. The pH, nutrient level, oxygen level, temperature, and water flow will all help to determine what type

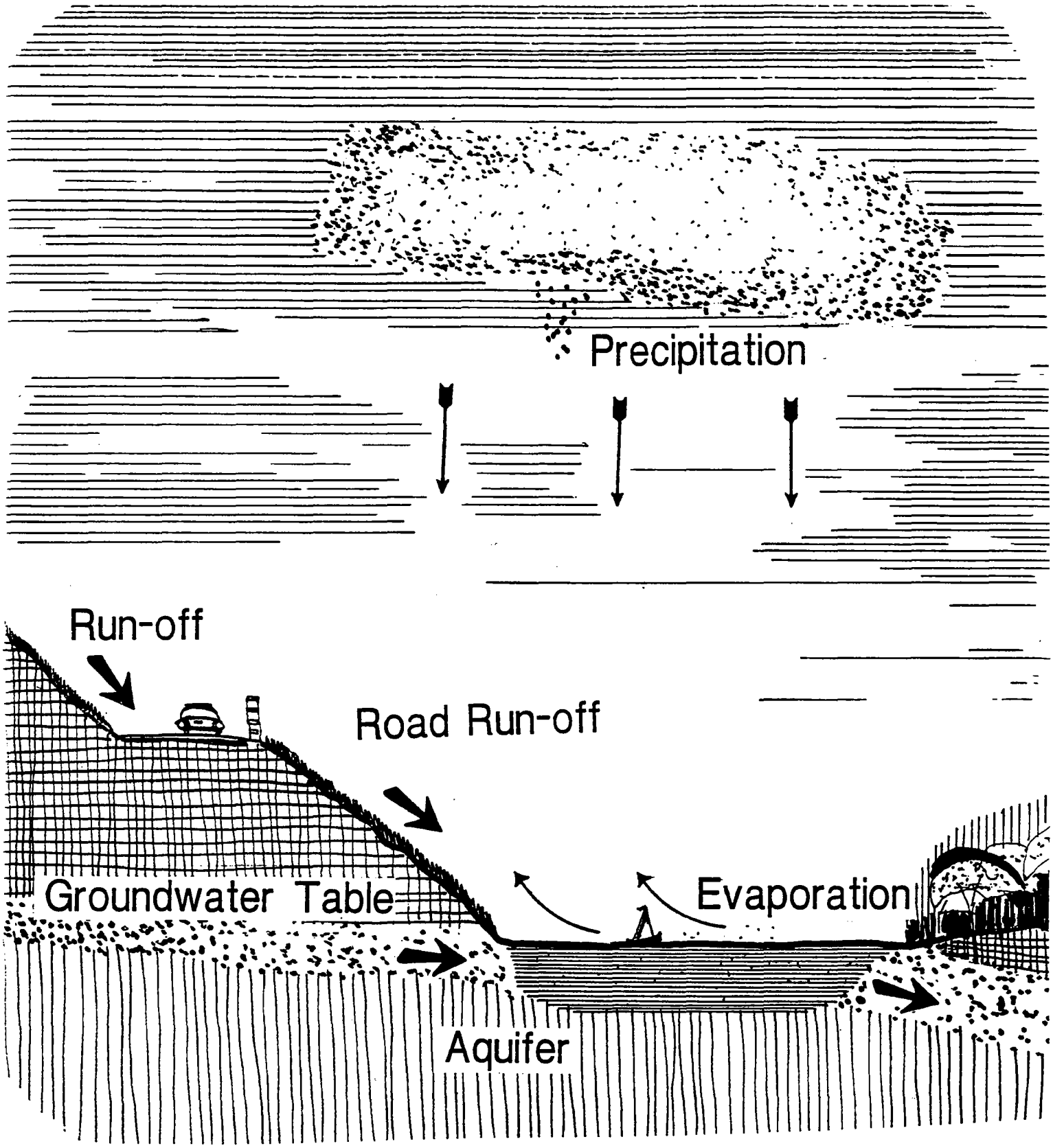


Types of Ponds

Perched Pond



Interface Pond



of vegetation will start or pioneer the chain of succession. As one species dominates, it will change some or several of these features to permit another species to take hold. Before long, the pond should attract all types of species of plants, reptiles, insects, birds and mammals to form an intricate food web which in turn changes the factors that determine the ecosystem. All this time, the biomass will be building up in the system.

The source of the energy for all ecosystems is eventually traced back to the sun. The sun provides energy for plants through the process of photosynthesis. The plants, in turn, are eaten by the herbivores. The herbivores are eaten by the carnivores. Eventually, all of the organisms are eaten or decay and wind up on the bottom of the pond to be digested by micro organisms and bottom feeders. As the silt or sediment builds up as peat, the pond becomes shallower. If the pond is nutrient and mineral rich, this process will be relatively quick.

If the hydrology of the pond is such that the biomass can be carried out of the system by a stream, the pond can continue for hundreds of years. Many ponds are not flushed and will eventually turn to marsh land and die. That is not to say all life will cease. The ecosystem will change to one which is perceived to be less desirable for man, since the marshland has little obvious use to most people. (It should be noted that a marshland is beneficial to mankind as a rich and diverse natural habitat as well as a water purification system.)

The availability of phosphorous is the limiting factor for algal growth in freshwater,[1] just as the limiting factor in saltwater is the availability of nitrogen[2] the higher the concentration of the limiting nutrient, the greater the growth of the algae.

> "Assuming that phosphorus is the limiting nutrient for primary productivity, control of undesirable algal blooms necessarily implies a control of phosphorus. Major sources of phosphorus likely include the overfertilization of residences within the immediate drainage shed of (the pond) as well as fertilizer and sediment runoff from adjacent farmland. . . any increase in natural vegetative buffers surrounding (the pond) may serve to reduce nutrification to the pond, thereby enhancing water quality. Additionally, increasing natural adjacent buffers would also serve to enhance wildlife habitat. Nearby residents should be encouraged to reduce or eliminate the use of fertilizers in the interest of enhancing pond quality."[3]

As the concentration of algae increases, the turbidity of the water will increase and prevent light from getting down to the other plant species. As the algae dies, it will drop to the bottom and begin to decay. The decomposition process will utilize much oxygen and will cause the level to diminish. This lower level of oxygen will sometimes result in the death of fish and other species, which depend on oxygen for survival. In order to avoid the acceleration of this process, we must limit the phosphorus in freshwater and also limit the nitrogen in saltwater. Phosphates are a major source of phosphorous. Phosphates are usually introduced into the pond system by overland runoff. (We know that

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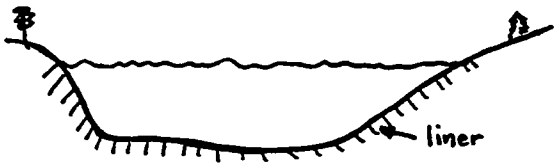
[1] Wetzel, Robert G. Limnology. p. 215

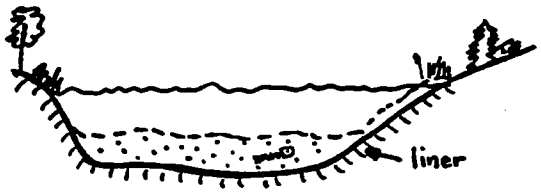
[2] USEPA, Status Report and Interim Plan for Hypoxea Management (Draft). p.15

[3] Southampton Department of Planning and Natural Resources. A Study of Eight Select Town Freshwater Ponds. p.23

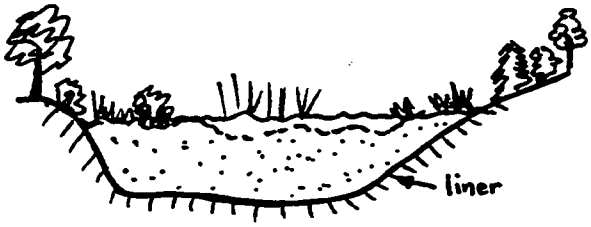
THE AGING OR EUTROPHICATION OF A POND



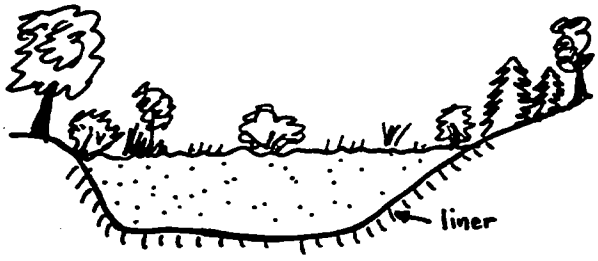
NEWLY CREATED POND



POND BECOMES SHALLOWER



MARSHLAND



COMPLETE CONVERSION

Source: Earthscape, J.O. Simonds.

phosphates can not travel very far through the soil).[4] For this reason it has always been the policy to limit fertilized vegetation within 100 feet of surface water. Another source of the phosphates is stormwater runoff from the roads which can carry phosphates and other nutrients from nearby lawns, gardens or farmland. Again the policy has always been to avoid the direct discharge of stormwater runoff directly into surface waters. It should make no difference whether those waters are natural or artificial.

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[4]Wetzel, Robert G. Limnology p.220

III. GROUNDWATER IMPACT

When considering the impacts of man-made ponds on the environment, there is great concern regarding the groundwater. Both quality and quantity of the groundwater is at issue here, since the aquifer is our sole source of drinking water.

Quantity

According to the Suffolk County Comprehensive Water Resources Management Plan, water quantity is not a problem in Suffolk County, "except for a few insular areas". This assessment is based upon projected water requirements for the year 2020. The report designates certain areas where the water may be stressed due to the threat of salt water intrusion.

Thirteen specific locations are mentioned in the report and a management plan is outlined for water use in these areas. The areas include Lloyd Neck, Eatons Neck, Gilgo, Oak Beach, Fire Island, Westhampton Beach, Nassau Point, Great Hog Neck, Orient, Plum Island, North Haven, Montauk, Shelter Island and Fishers Island. The report mentions general and area specific recommendations for these insular areas in an effort to protect the existing water supply and deter any saltwater intrusion or upconing which may result from excessive pumping in the future.

The recommendations include limiting residential density, monitoring water quality and improving distribution systems by extending mains and providing water quality treatment districts. Proposals for new ponds in these areas should be discouraged due to potential negative impacts on the groundwater quantity and quality.

In all cases, developers should be required to demonstrate the differences in recharge before and after construction. When all factors are considered, the difference in recharge can and should be minimized. Some models have demonstrated increased recharged rates due to the increase in impervious surface areas and the decrease in loss through evapotranspiration.

TABLE 1
Annual Precipitation Totals (in inches)
for Eight Sites in Suffolk County, New York
1979-1987

Site	1979	1980	1981	1982	1983	1984	1985	1986	1987
Belmont Lake	52.37	35.69	40.29	38.14	52.83	51.62	31.53	38.81	34.28
Vanderbilt Museum	–	42.98	38.95	38.22	59.66	–	–	43.98	36.10 *
Patchogue	–	38.68	41.61	47.26	66.18	62.80	40.15	46.79	40.85
Medford	50.59	27.84	30.68	35.80	52.83	50.70	32.68	33.36	35.91
Setauket	53.71	41.93	37.92	43.80	52.49 *	54.34 *	37.02	42.02	40.17
Riverhead	51.67	31.98	38.17	46.19	62.82	53.92	36.50 *	43.77	41.20
Bridgehampton	51.42	33.83	39.69	46.69	64.05	46.06	38.85	45.42	50.10
Greenport	50.22	35.31	40.99	48.72	64.92	50.62	39.30	47.71 *	40.15
Average	51.66	36.03	38.54	43.10	59.47	33.92	36.50	42.73	39.85

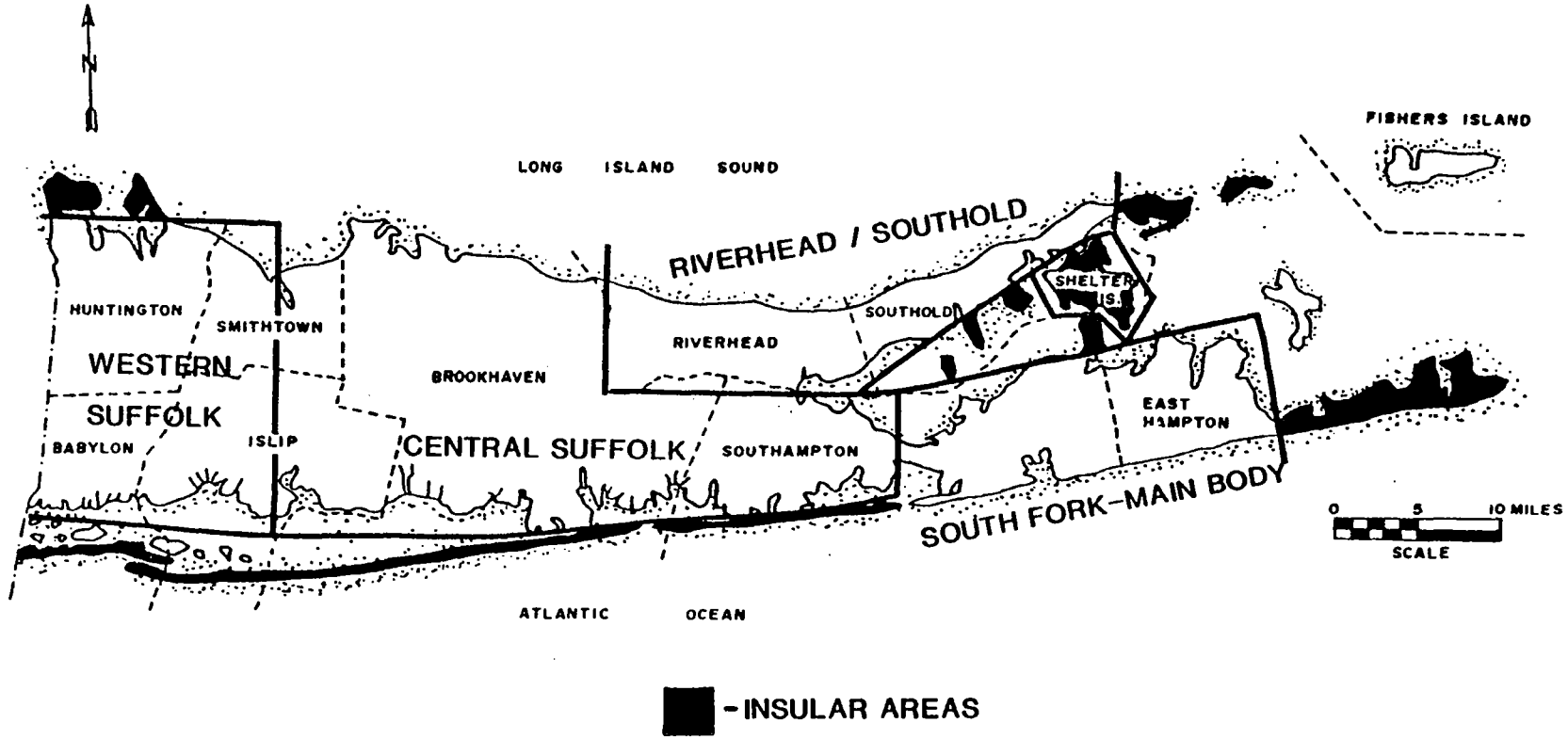
Note: Suffolk County annual average approximately 44.5 inches.
– = Data Not Recorded or Available.
* = Monthly Data Missing.

Source: 1988 Annual Environmental Report to the Suffolk County Legislature.

Table I demonstrates that during a typical year, rainfall averages 44.5 inches in Suffolk County. The U.S. Weather Bureau has calculated evaporation rates on lakes and ponds to average 28-30 inches per year. Assuming these figures to be correct, the net gain to the pond will be 16.5 to 18.5 inches per year. This excess water is usually permitted to spill over into the groundwater. In an area where the pond is acting as a collection point for a tributary or water shed area, the "excess" or overflow will be even greater.

The actual overflow will not be this great however, if the pond has a fountain for aeration. These fountains will increase the amount of evaporation but it is unclear exactly how much. The evaporation rate is

SUFFOLK COUNTY WATER MANAGEMENT AREAS

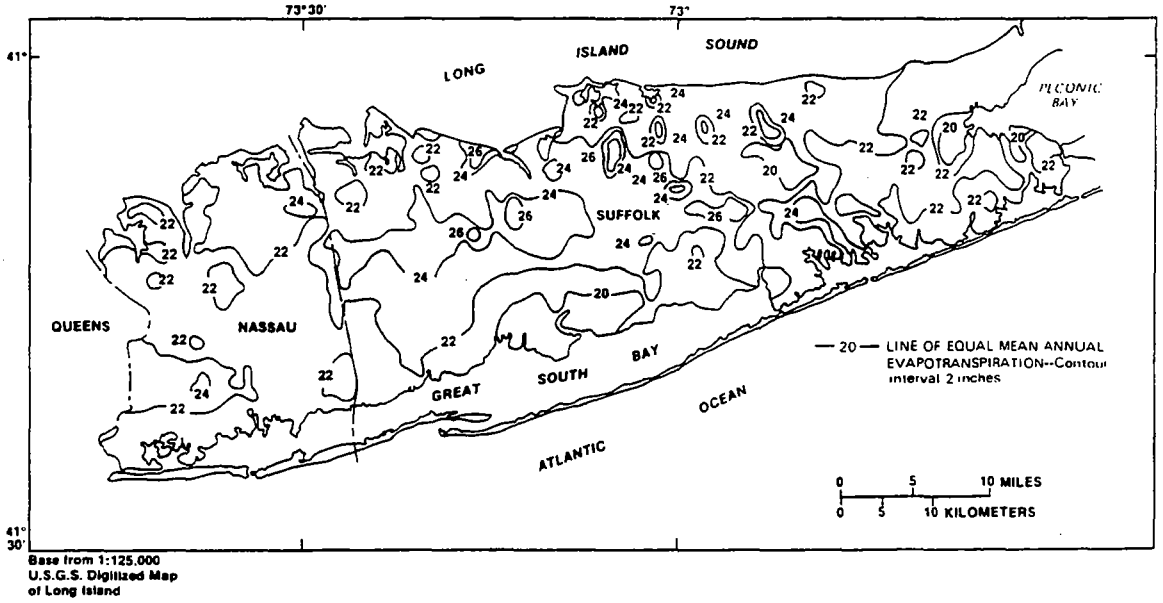


SUFFOLK COUNTY

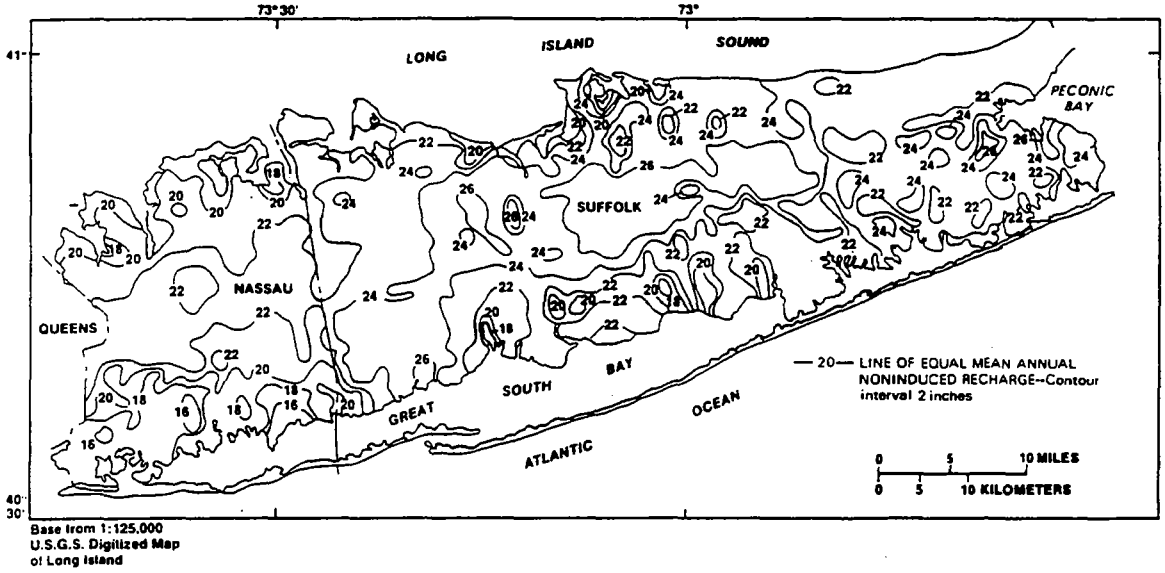
WATER RESOURCES MANAGEMENT PLAN

FIGURE 1 - 1

Source: Suffolk County Comprehensive Water Resources Management Plan, S.C.D.H.S.



Mean long-term annual evapotranspiration in Nassau and Suffolk Counties.



Mean long-term annual recharge in Nassau and Suffolk Counties.

Source: Groundwater-Recharge Rates in Nassau and Suffolk Counties, New York, D.S. Peterson.

dependent upon many factors in addition to water temperature. A typical pond will loose more water to evaporation on a cool, windy day with a relative low humidity, compared to a hot, humid, calm day. The reason for this is the fact that on humid days, the air is saturated. On a windy day, as the water evaporates into the air, it is carried off quickly.

The depth of the pond should be such that there is a relatively low surface to volume ratio. This ratio will help keep relative water loss down and make temperature variations less dramatic. A depth of at least six (6) feet is recommended for this latitude to keep that ratio low and to permit pond life to survive through a cold winter.

Quality

It is imperative to retain certain standards for the water quality of the ponds. The Suffolk County Planning Commission has standards for subdivisions which include or are adjacent to natural wetlands and there should be the same type of standards for artificial ponds which are interfacing with the groundwater. It has been an established policy that no stormwater runoff from roads should be permitted to enter directly into natural wetlands. This is due to the fact that the runoff from a development carries many pollutants. The range and amount of pollutants have been quantified in the National Urban Runoff Program authorized by the Environmental Protection Agency. If these pollutants are permitted to be carried into a wetlands area which interfaces with the groundwater, the groundwater could be directly contaminated.

Likewise, if a pond is created which interfaces with the groundwater, the same results are possible. On the other hand, many of the proposed ponds are lined with either a plastic (P.V.C.) or bentonite

liner which prevents the water from percolating down to the groundwater below. These ponds are designed with some sort of overflow mechanism which permits some of the water to percolate down to the aquifer when the water level is higher than desired. In most cases, by the time the water reaches the overflow, there have been several opportunities for the sediments to settle out. The only impurities that usually get into the groundwater are those water soluble pollutants (salts, nitrates, etc.) which have had an opportunity to settle out and become less concentrated.

"A well designed basin can trap 80 to 100 percent of suspended sediments, remove 60 to 80 percent of total phosphorus and 40 to 60 percent of total nitrogen, and stabilize 60 to 80 percent of trace metals."[5]

The problem with the "well designed basin" is that it may not necessarily be the one that is being designed by a developer whose goal is to create an amenity at the least possible cost. Remembering the natural succession of ponds, we must consider the impacts of these nutrients on the biomass of the system. As the phosphates and nitrates are absorbed by the natural processes, the succession is accelerated. The "growth" within the pond will eventually cause a build up in sedimentation which must be removed or the system will evolve into a marshland/swamp.

Dredging the pond to keep the system stable is a costly process which may cause injury to the integrity of the liner. Unless properly done, it may contaminate the groundwater. The contractor commissioned to

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[5]Tourbier and Westmacott. "Looking Good: The Use of Natural Methods to Control Urban Runoff", Urban Land Magazine. April 1989. p.33

remove the sediments should be required to deposit the material in a lined landfill so as to prevent the concentrated contaminants from leaching down into the groundwater.

HIDDEN PONDS AT SMITHTOWN

It will be difficult to maintain an acceptable water level in groundwater interface ponds during times of drought. Because these ponds have no liner, water level is dependent upon the ground water supply.

IV. EXAMPLES OF PONDS

There are few places on Long Island that have not been affected by the presence of man. Many of the natural features have been altered by the construction of roads, buildings, farms, residential developments, sand pits, etc. Natural waterways have been altered through the changes in the land topography. Ponds were created by farmers as they constructed dams to focus water to power their mills. Others were filled in or moved as roads were constructed.

Over the years, nature will take back the environment so it becomes difficult to decipher what is natural and what is artificial. For the purpose of our study, we will look at only a few of the many ponds which occur here on Long Island. We will concentrate on those constructed recently within subdivisions or condominium complexes.

We should understand however, that there are other types of man-made ponds besides these mentioned. Many of the golf courses contain artificial water hazards and many private estates have "garden ponds" which range in size from the smaller cement basins for goldfish to large extensive ponds with elaborate waterfalls.

In the past several years, there has been an increase in the number of planned residential developments (PRD) which have artificial ponds. In many cases the purpose of these ponds, is twofold: primarily as an alternative to the conventional recharge basin and secondly as an aesthetic amenity.

In an effort to enhance these units in a competitive marketplace, new and more imaginative amenities have been finding their way into the designs. Tennis courts and swimming pools have become standards so developers must do one better if they want to compete. Water front

property has always been a popular commodity, however, there is a limited supply. Today, with the use of prefabricated liners and refined engineering techniques, more and more people have the opportunity to have the waterfront property they desire, even if it is only a pond.

Sterile Ponds

There are many examples of sterile ponds created here on Long Island. Eagle Chase, located off Exit 46 of the Long Island Expressway in Woodbury, provides an excellent example. The 5 acres of ponds within this exclusive development have a depth of only 2 feet. The introduction of a dye to inhibit algal growth, along with constant filtering, will not permit the establishment of plant life within the water. Constructed for aesthetic as well as recharge purposes, the ponds have a bentonite liner on the bottom to retain a minimum level of water. A free board or rip rap border above the bentonite provides for the recharge of excess runoff. Turf surrounds the ponds and the developer has placed many rocks and boulders over the inlet and outlets to provide a more natural look. Much of the runoff includes that from the road system on site. Supplemental water must augment these ponds during dry spells. The volume of augmentation is said to be well below that of the recharge from the free board areas.

Several fountains propel the water into the air for aeration purposes. A large pump situated in the club house of the development controls the circulation and filtering. The cost of the system and operation is absorbed by the residents of the development. It is felt these residents can readily absorb the cost of pond maintenance since the development has been marketed to a wealthier clientele. Units were selling for $450,000 according to a representative of the developer.

Honey Hollow Condominium, located on Old Willets Path just south of Veterans Memorial Highway in Hauppauge, is a good example of what could go wrong in an area of high groundwater. The design showed a pond surrounded by condominiums. Source of water for the pond is runoff from the road system and surrounding fertilized turf. The development is relatively new and the only problem associated so far is flooding on Old Willets Path. Swale areas and dry wells were designed to accept the overflow from the pond. Although the groundwater is very close to the surface, the developer opted for a bentonite liner. Dry wells were situated below the average groundwater level however, and their capacity is insufficient due to poor drainage in wet periods. A private management company has been hired to handle day to day operations.

The 14.8 acre site includes 88 dwelling units, a swimming pool and tennis court in addition to the half acre pond. The design submitted by the developer shows no trash traps or sedimentation chambers between the stormwater drains in the street and the pond itself. In addition, the pond is surrounded by a fertilized lawn area which slopes down to the pond. These two features, left uncorrected, will contribute to sediment accumulation and nutrient buildup with every rainfall. And due to the fact that water depth is only 2-3 feet, there should be a relatively short time before dredging and relining is necessary. The high cost of such operations may be prohibitive. If it is, this pond will give way to an alternate stormwater management structure within the next decade.

Willow Ridge, Twisting Hills, Indian Ridge and Indian Terrace are all developments in Smithtown, which had originally proposed man-made ponds, but later opted for recharge basins to avoid potential problems with high groundwater.

Groundwater Interface Ponds

Hidden Ponds at Smithtown, located on Rte. 347, is an example of a groundwater interface pond system constructed in a condominium development. The plans for the 56.5 acre parcel, which included 300 units in addition to the three ponds, were reviewed by the Planning Commission in February, 1985. A layout was filed with the County Clerk in August of 1985 and construction began soon after.

The proximity of wetlands is clearly evident on aerial photographs taken in March of 1986. These pictures show construction was well underway. Several natural ponds are located to the south of the project. These ponds are protected by surrounding woodlands. A streambed runs northerly just easterly of the development. The wetlands and surrounding woodlands have been protected from future development through acquisition by the town and county governments.

Test hole data, accumulated prior to construction, showed the groundwater to be pitched toward the nearby streambed. Groundwater contours ranged from 49 ft. in the west, 47 ft. at the location of the second pond and 44 ft. at a site northeast of pond #3. (This well was adjacent to proposed units with a first floor elevation of 50.7 ft. i.e. 6 feet above ground water at that time and 2.9 feet above the projected high water line of pond #3)

The pond design was simple. The Plan showed no plastic or bentonite liner to contain water. The design permits storm water runoff from the streets and fertilized lawns to discharge directly into the ponds. No retention basins or sedimentation chambers (to trap trash or to permit solubles to settle out) were indicated on the design.

The overflow provision for Pond #1 allows water to flow into Pond #2 via a 3" hole in a catch basin and a 12" culvert. In the event that the water level reaches the maximum, a cast iron grate at the top of the catch basin will allow water to flow much more rapidly.

Pond #2 will overflow into Pond #3 and Pond #3 will overflow into the adjacent wetlands.

The two concerns with this type of design is: 1) groundwater contamination and; 2) ground water fluctuation. There are no provisions in the original design to mitigate or compensate for these concerns.

The Ponds created are nothing more than the underlying groundwater being exposed. Runoff from roads and lawns permit immediate contamination due to the fact that pollutants such as nutrients, oils, heavy metals, gasoline, asbestos from brake linings, etc. are being directly introduced into the groundwater.

Secondly during times of drought as the groundwater drops the level of water in the ponds will also. Augmentation will be in vain due to the fact that the ponds have no liner.

Perched Pond Systems

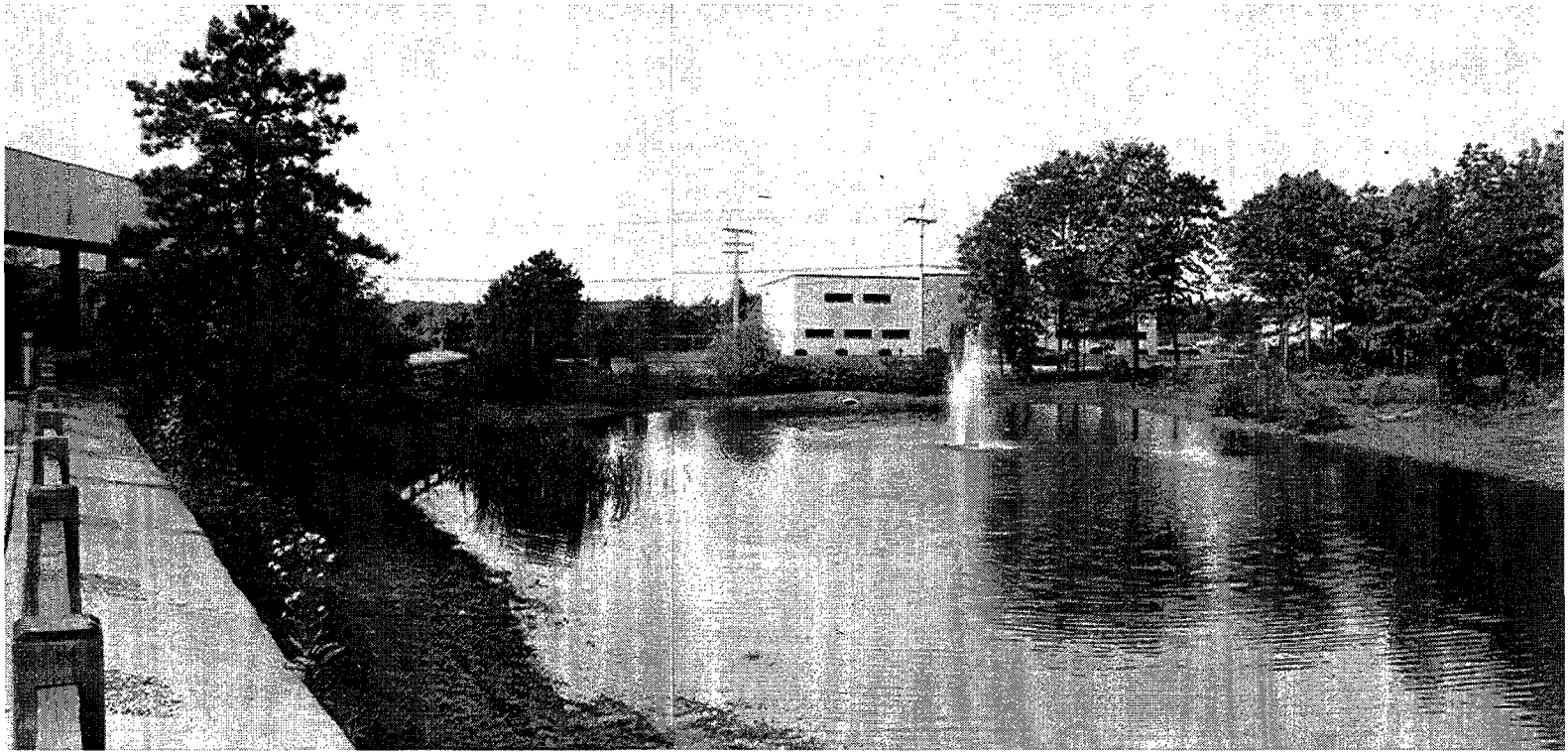
In the Town of Brookhaven there are two examples of perched ponds that will be discussed. The first, The Waterways at Bay Pointe, is located in Moriches on the Forge River. Plans for this residential condominium/homeowners association development were approved by the County Planning Commission in May, 1987, after construction of the first section of condominium units was completed. The Town of Brookhaven approved the plans for this development prior to its increased emphasis on review of man-made ponds.

The second artificial perched pond system we will look at in Brookhaven, is The Stony Brook Technology Park, located on the easterly side of Terminal Road. Final plans for this industrial development were submitted to the County Planning Commission in November of 1986. According to town officials, this development has artificial retention ponds which meet the new criteria of man-made ponds. The plans were more vigorously reviewed before approval.

The two projects have several differences beyond land use and setting. The Waterways project is located between Ely Creek and the Forge River on a peninsula with elevations ranging from sea level to approximately 25 feet above sea level. Groundwater is very close the surface. Any adverse environmental impact would directly affect the nearby Great South Bay.

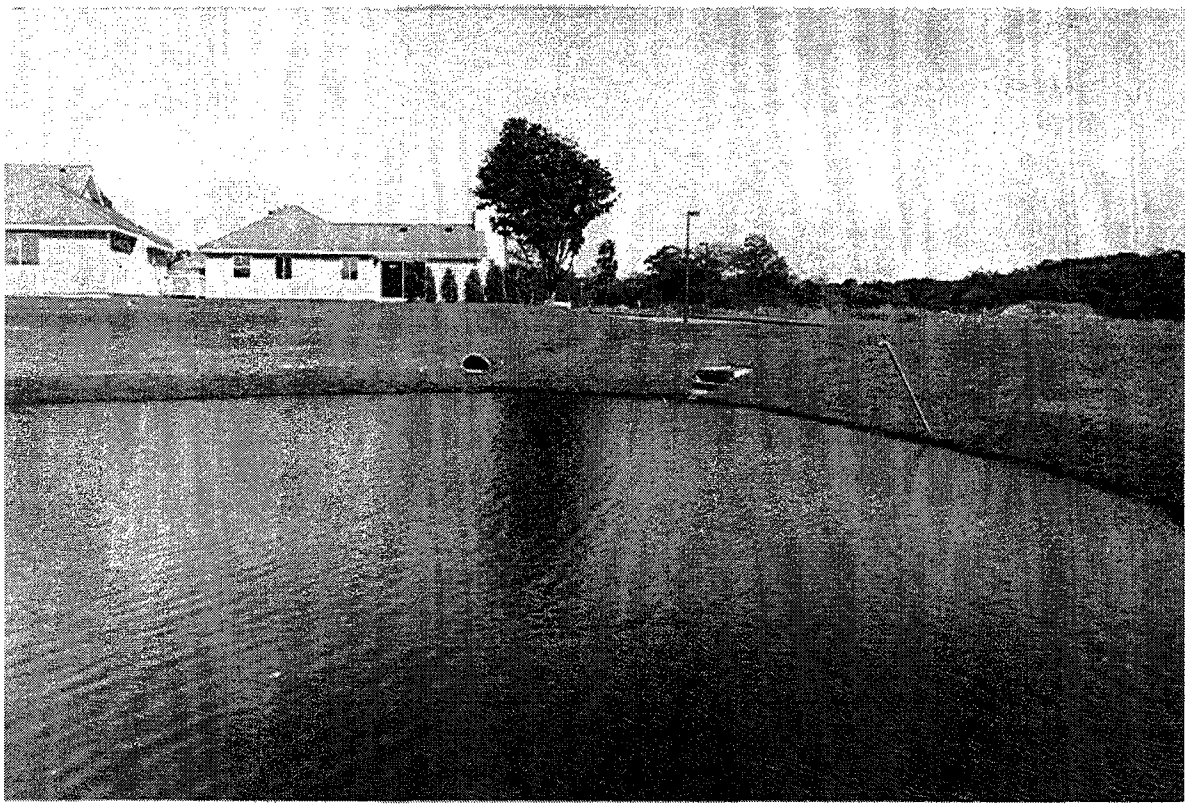
Stony Brook Technology Park, on the other hand, is situated within the South Setauket Special Groundwater Protection Area. Elevations for this site range from 121± feet to 153± feet above sea level with groundwater 70 to 100 feet below the surface. This area is also located within the Pine Barrens Zone. Any adverse environmental impact would affect the underlying acquifers.

Both designs include lined ponds which act to retain water at a certain predetermined level (NWL). They also include an overflow provision which permits excess water to leach through a higher pervious zone (which works like a conventional recharge basin). This brink of the pond, which slopes down at a 4 on 1 slope and ranges from 4 to 6 feet in width, is lined with rip rap. This rip rap is comprised of rocks and is usually about 1 foot thick. The rocks will act to control erosion during times of fluctuation.



Stonybrook Technology Park

Ponds with required plantings afford a much more scenic vista (above) compared with those which are surrounded with nothing but lawn (below).



Waterways at Bay Pointe

If the water level should rise past the top of the rip rap (HWL) an auxiliary overflow mechanism will carry excess water (via gravity) away from the ponds to underground leaching basins designed to recharge the water.

The ponds at The Waterways are lined with a mix of soil and bentonite which is designed to create an impermeable layer. The designers of Stony Brook Technology Park opted for a Polyethylene liner, ie: Dow Chemical 20 mil (2/100 of an inch) CPE unreinforced liner.

The most obvious difference between the two designs is the surrounding vegetation. The design for The Waterways included no planting and the ponds are presently surrounded with nothing but a large expanse of lawn sloping down into the ponds. Plans for the Stony Brook Technology Park on the other hand, include various types of vegetation to be introduced into the new ecosystem. Field review indicates one of the several ponds actually has the plantings established and growing. Other ponds within the development have not been finished off according to the specifications submitted. It is assumed that the developers are waiting for the ground to settle or possibly preliminary construction inspections to be completed.

Lenox Road Pond System

The Lenox Road ponds in Huntington Station are not man-made, but are a natural perched pond system. There is a large clay or otherwise impervious lens beneath the surface which prevents or significantly delays the flow of water down into the aquifer below. There have been substantial drainage problems in the area and the ponds have been used as a storage basin for road runoff from the local storm water system. In

addition, the ponds are surrounded with well maintained lawns which contribute to the nitrates and phosphate levels in the ponds.

The following is excerpted from a Department of Health Services memo, describing the situation.

> "The ponds appeared to have a slightly green hue, which appeared to worsen near the southern end of the system. Residents noted that the ponds were now relatively clean, and that dense, green, slimy blooms were common in the summertime. They further stated that a milky-white substance was recently visible in the lake and subsided about a week prior to the sampling effort. The only remaining visible algae bloom was a small green slimy area of water at sampling station TP-6 on the eastern part of the south lake; this growth was sampled. In general, residents complained of algae blooms, decreased fish population, an excessive number of dead snails, etc.
>
> Goose and duck waste was quite common, even after recent rains. In addition, lawns and gardens were frequently well-maintained right down to the edge of the lake. The lawns had, in many spots, an extremely spongy consistency, especially near the lake, this may be due in large part to recent rains. Residents on the eastern side of the southern pond claimed that springs underneath their property, which they said are sometimes "visible," were the only source of non-runoff, non-rainfall water to the system.
>
> Unfortunately, access to the spillway at the north end of the property was not obtained. However, the level of the lake was well below the top of the north spillway. On the south end of the system there was visible flow into the southern retention pond. Both the northern sump and the southern retention pond had a dense green growth of algae, which was noticeably denser in the southern retention pond than in the northern sump.

DISCUSSION OF DATA

> Lenox Road Ponds were sampled on September 20, 1989, within 24 hours of a rainfall event. Five points (see SAMPLING STATIONS) were sampled for total and dissolved nutrients (nitrogen and phosphorus) as well as coliform bacteria and

physical parameters including temperature, pH, conductivity, and dissolved oxygen.

Conclusive results are not inferable from one such sampling event. However, it appears that organic nitrogen and, to a lesser degree, total phosphorus and coliform bacteria levels were elevated with respect to data obtained from the Lake Ronkonkoma Clean Lakes Study (Suffolk County Planning Department and Suffolk County Department of Health Services [SCDHS], 1986) and the SCDHS Peconic River monitoring program. Although the Lenox Road Ponds concentrations were slightly high, they were not outside of the range of data obtained at the Peconic River and Lake Ronkonkoma. Meanwhile, ammonia-nitrogen and nitrate-nitrogen concentrations were in the same range as or lower than levels reported for Lake Ronkonkoma and the Peconic River. Conductivity, pH, and dissolved oxygen concentrations were not alarming. The only sample which showed high concentration of contaminants was sample TP-6; however, these concentrations were most likely due to nutrients bound up in the algal biomass present in the localized sampling area and were not representative of the water quality in the lake. Actual values of chemical parameters are contained in the data table "Lenox Road Ponds Sampling Event, September 20, 1989."

It should be noted that the above-described data comparisons are meant only as gross indications of chemical water quality in the absence of detailed site-specific data. Local conditions at Lenox Road Ponds are not directly comparable to conditions at the Peconic River, which is bordered by large tracts of open space, or Lake Ronkonkoma, which is a larger system and which has been highly urbanized. In order to adequately assess the water quality dynamics at the Lenox Road Ponds site, a detailed water quality study would need to be performed. Such a study would include chemical, physical, and biological water quality sampling over different seasons and during different weather conditions. Sampling of stormwater runoff would also be required as part of a water budget modeling effort. This budget would also incorporate a delineation of the stormwater runoff-contributing area to the lake and an approximation of the quantity of runoff generated, an analysis of local hydrogeologic conditions, and an assessment of the effects of direct precipitation. Furthermore, an evaluation of physical characteristics of the surface water system would necessitate a study of spatial and temporal

variations in depth and temperature profiles of the water column.

The algae which was visible in small portions of the Lenox Road Ponds system was identified by SCDHS Bureau of Marine Resources as a locally dense bloom of colonial blue-green algae (of Anacystes). The presence of algae in the summer and early fall is a common occurrence in numerous surface water systems in Suffolk County. The propagation and proliferation of algae is generally dependent upon usable nutrients (nitrogen and phosphorus) and upon favorable light and temperature conditions. While algae may prove to be aesthetically or recreationally objectionable to humans, its presence provides the base of the food chain, and increased or decreased amounts may adversely affect the lake ecosystem.

Dense blooms such as the ones described by residents of the Lenox Road Ponds area may well be due to accelerated eutrophication, which is an increase in the natural and inevitable aging process of a lake because of the activities of man. Causes of excess nutrient loading to a lake may be due to a combination of the following reasons:

* Fertilizers
* Septic systems
* Stormwater runoff
* Direct precipitation

While direct precipitation cannot practically be controlled, the use of fertilizers can be managed to minimize the runoff and leaching of nutrients contained in fertilizer. Land use controls, although frequently called for in the management of valuable or fragile ecosystems and natural resources to limit future fertilizer and septic system contribution, would probably not be very applicable to the immediate vicinity of Lenox Road Ponds because of the high degree of development already present in the area.

Stormwater runoff control measures via the prevention of new sources and the reduction of direct discharges would also limit nutrient input to the surface waters. The benefits to be gained from the elimination of stormwater discharges, however, would have to be weighed against the relatively high cost of retro-fitting existing drainage and discharge systems and the potential for adverse effects on the lake ecosystem due to the possible lowering of existing water levels. Actual estimates of nutrient inputs due to stormwater runoff relative

to other sources could be obtained by the program of study previously outlined."

V. PROS AND CONS OF MAN MADE PONDS

Regulating Agencies

At present, there are no regulating agencies for artificial or man made ponds. Each municipality has its own policy on the design and construction of these structures and until recently there have been no steadfast rules. The D.E.C., which regulates natural wetlands, has no jurisdiction per se on the construction of man made ponds except where they will interfere with nearby natural wetlands (e.g. it is their policy not to permit the overflow from man made ponds, which are storm sewer fed, to be discharged directly into any D.E.C. wetlands.) The D.E.C. also regulates any wells which pump more than 45 gallons per minute. Augmentation wells for the ponds do not usually require such volume.

The N.Y.S.D.E.C. does however, receive a constant flow of calls concerning problems with ponds both man made and artificial. The number of complaints increase with the temperature in the warm summer months. According to officials of the D.E.C., most cases of algal blooms can be attributed to two sources; 1) discharge of stormwater runoff directly into the pond and 2) the ponds are surrounded by fertilized lawns. Runoff from both fertilized lawn and streets carry nutrients which feed the algae. Complainants look for a government agency to solve the problems, most of which are on private property. Many of these problems would require thousands of dollars in capital improvements to rectify.

The D.E.C. does offer several recommendations for artificial ponds.

1. Any construction within 100 feet of a regulated wetland area would require a permit from the D.E.C.

2. It is preferable that any ponds constructed be located as far from wetlands as possible.
3. Ponds should be a minimum depth of 6 feet.
4. No fertilized vegetation should be planted within 100' of the shoreline of the pond.
5. Natural vegetation should be located within 50 to 75 feet of the shoreline of the pond.
6. No stormwater runoff from streets should be permitted to be directly discharged into the pond.

Algacides

Many officials are skeptical of the use of algacides such as Copper Sulfate and blue dyes. Copper Sulfate will suppress algal growth, but it is only a temporary solution. Use of this algacide must be repeated to achieve the desired results and the constant application will cause a build up in the pond sediments, eventually impacting higher organisms such as invertebrates and ultimately fish, amphibians, reptiles, birds and mammals.

The use of copper sulfate and other aquatic herbicides is controlled by the DEC. Only licensed pesticide applicators are permitted to dispense such regulated chemicals. There has been some question as to whether the use of such chemicals is wise in a special groundwater protection area.

Blue dyes, applied to suppress algal growth, work by blocking sunlight and thereby prevent photosynthesis. Although this is only a vegetable dye and harmless to plant and animal life, it is not effective within 2 feet of the surface. For this reason, the dye will be

ineffective in limiting algal growth and bottom growth in areas where the ponds depth is less than 2 feet.

Pond Depth

Many artificial ponds are being designed for ornamental use only. The depth need only be two feet and algal growth is inhibited by Copper Sulfate or a blue dye. These are more like large fountains or swimming pools which must be filtered and the water must be in constant circulation lest it become stagnant. These structures have little in common with their natural cousins due to the fact that they sustain no life.

When designing a pond to replicate the natural, a developer should maintain a depth of 6 feet minimum. The reason for this is the fact that at our latitude, the two foot deep pond will freeze solid. A minimum of 6 feet is required to ensure fish life will survive even through the coldest winter. Many of the pond flora and fauna will drop to the bottom in late fall. This protective instinct will only work if the bottom does not freeze.

Increasing pond depth will decrease the surface to volume ratio, limiting evaporation and stabilizing water temperature during the summer. The developer must be sure to have proper slopes around the sides of the ponds. This and other construction criteria are discussed in the USDA Handbook #592 "Ponds - Planning, Design, Construction".

It should be noted that ponds with a depth less than two feet will permit enough light to generate bottom growth. Such shallow ponds, which allow rooted plants to grow in the middle, may have future problems as the roots can comprise the integrity of an artificial liner.

Water Source

Source of water for all ponds essentially comes from either stormwater or groundwater. Interface ponds are groundwater fed and perched ponds are stormwater fed. If the tributary area for the perched ponds is insufficient, the pond must be supplemented by an augmentation well which draws from the groundwater. The problem with interface ponds is the fact that they cannot be augmented as they have no liner. The depth of the pond is dependent upon the depth of the groundwater which can fluctuate substantially.

Another concern of interface ponds arises when they are used to recharge stormwater runoff. If there are no means to intercept the heavy metals, oils, water soluble pollutants, nitrates and phosphates, they will be discharged directly into the pond (which is essentially the groundwater). When designing ponds and recharge systems, developers should be required to make an effort to place the greatest distance between the direct discharge of stormwater runoff and the groundwater.

It is also unwise to design a lined pond where the groundwater is too close to the bottom of the pond. The fluctuations of the groundwater will place additional stresses on the pond liner which may eventually compromise the integrity of the structure. In addition, when, at some future date, it becomes necessary to dredge the pond of sediments (which may or may not contain contaminants) the dredged material will come into direct contact with the groundwater if the seal is broken.

Stagnation

Stagnation was once considered to be a problem in small bodies of water where wind action is limited. The larger the pond in both surface

area and depth, the better the natural circulation. Circulation in the pond is caused by wind motion and currents. Currents occur as one part of the pond heats or cools at a different rate than another. Interface ponds will probably be spring fed and will drain on the opposite side. The currents may not be visible to the eye.

Many people fear that the stagnant water will breed mosquitoes. This is true. For this reason, aeration and circulation devices have been required by local municipalities. While this does effectively limit mosquito breeding as well as algae growth, it will also increase the amount of water lost to evaporation. The extent of this loss has not been determined and would be difficult to calculate as there are many variables. In any event, the fountain sprayers have become a standard in artificial ponds throughout the county and may be useful in natural ponds which have stagnation problems.

Liability

A question of liability arises when one constructs a structure which may be hazardous to small children who wander too close, to ice skaters who fall in, and to unsuspecting bathers. The Town of Brookhaven has established a policy of posting signs around artificial ponds which should not be used for swimming, ice skating, etc. It is felt that this will limit the owner's liability.

Creation of Natural Wetlands

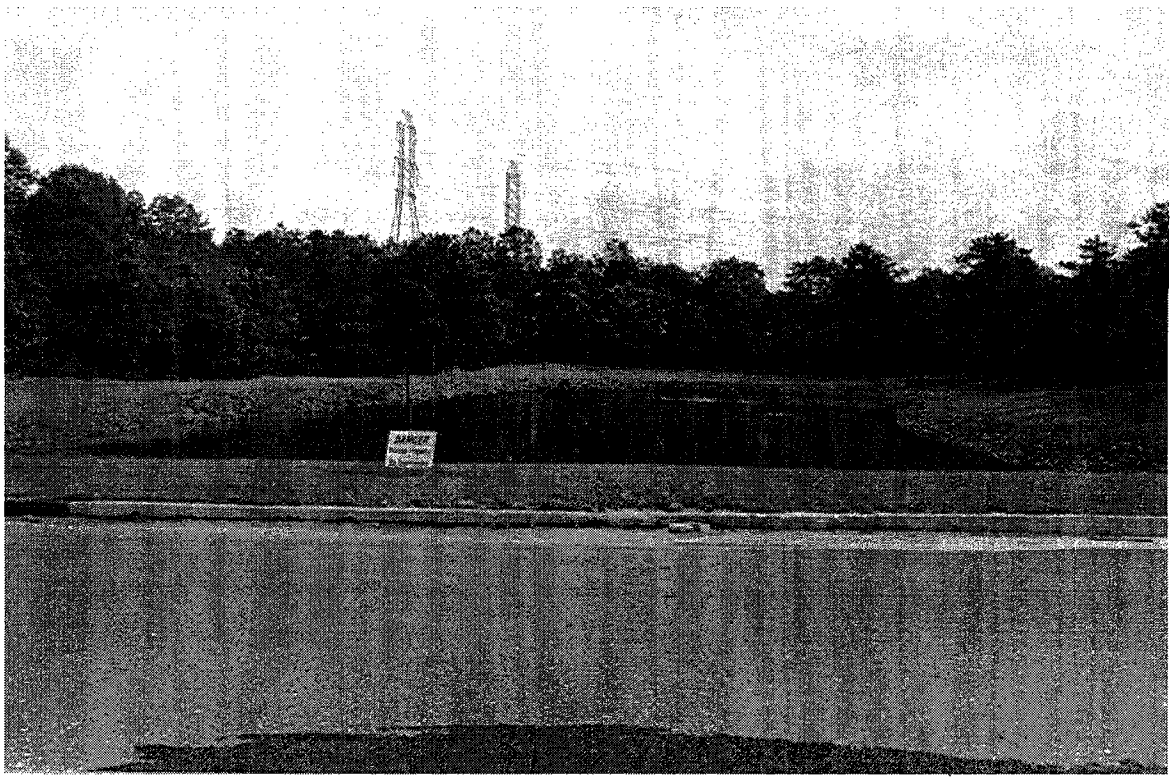
The design of new wetlands is a major undertaking which requires the careful consideration of numerous physical, chemical, biological and hydrological factors. The designers must have a good understanding of the hydrology of the area if there is to be an interface with the groundwater. Even slight changes in hydrology, water chemistry or other

wetland features could result in significant alterations in wetland ecology. What may appear to be an improvement (e.g. an enhanced aesthetic value through the removal of "unsightly" organic material) can actually be an ecological degradation. Important functions of a wetland system include not only flood buffer and water quality control, but it should provide a natural habitat for wildlife and also provide for the proper recycling of organic materials.

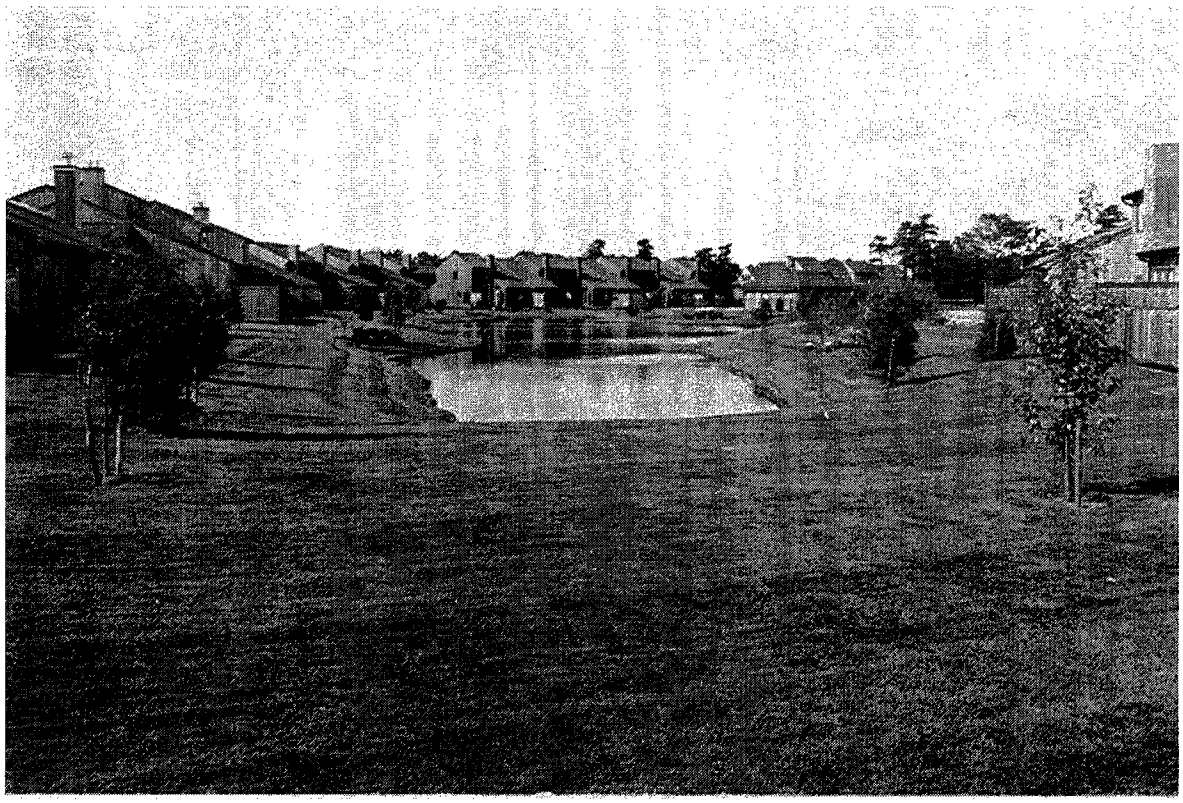
Creation of wetlands will affect non-wetland resources and habitats and should be evaluated for the total environmental impacts. Biologically, the development of new wetlands is a desirable enhancement measure wherever the design will result in a biologically productive wetland. As a general rule, wherever water can be ponded a wetland can develop. However, the amount and kind of biological productivity is dependent upon a variety of factors including water depth, nutrients, species and adjacent vegetation. The design of new wetlands requires that careful attention be given to the type of wetland desired and to the specific parameters which must be controlled. If not suitably located and designed, new wetlands may become a nuisance or health hazard.

Depending upon subsurface geology, hydrology and other physical factors, new wetlands may actually result in a net loss in the amount of available water in an area. Good ecological design should be integrated with good hydrological design and a regional approach to water resource management.

Certain wetland systems function as vernal or pulsed systems which undergo periods of wet and dry conditions. This type of ecosystem is a valuable resource in the overall ecology of the region. Augmenting this type of wetland and creating a year-round pond may be beneficial for the



Brookhaven Officials suggest warning signs to limit potential liabilities



Nutrient build up will invariably occur when large fertilized lawns are permitted to slope towards the pond.

enhancement of the aesthetics and may help to sell homes in an area, but it must be understood that the vernal or pulsed system is a different type of wetland, no less important or significant environmentally speaking. In fact vernal ponds provide an essential habitat for certain salamanders and frogs who thrive in such environments because fish predators cannot survive there. Also, several rare plant speicies can only be found in and around vernal ponds. Elimination of these vernal ponds must be discouraged.

VI. POLICY OPTIONS

Augmentation

Water conservation is mentioned as a well advised management practice which can help to ensure the long term adequacy of the groundwater as a source of water supply. Within the county as a whole, quantity is not a problem as there is an estimated 70 trillion (70,000,000,000,000) gallons. As previously mentioned in the chapter on groundwater impact, however, certain areas of Suffolk County have marginal or poor quality groundwater in the upper glacial aquifer. Due to the need for occasional augmentation in all artificial perched ponds, especially during times of drought, it is recommended that no ponds be permitted in the identified "insular areas".

In the county as a whole it is recommended that, as part of the environmental impact analysis, the developer be required to provide a water budget to demonstrate the differences in water recharge before and after construction. Increase in evaporation due to fountains should be factored.

Pond Ownership

Many municipalities have been wise enough to forfeit any dedication of these structures. Fear of unforeseen maintenance problems and their associated expenses has discouraged Town governments from pursuing the dedication to the municipality. Subdivision and Condominium proposals are structured such that future homeowners are the sole owners of the ponds, thereby forcing them to accept the liabilities as well as the benefits from the ponds.

In most cases a Homeowners Association is set up to control the common areas which will include the man-made ponds. The developers set up the structure of the Homeowners Association such that they maintain control until all of the units are sold. Once all the units are sold, the homeowners are on their own.

The major problem with this scenario is that the builder is never held responsible for potential problems which he may have caused and which surface several years down the road. The builder is not forced to put up a performance bond for any structures that are not dedicated to the municipality, and without that bond it is very difficult to recoup repair costs.

State Law requires the developer to prepare a prospectus on the risks to the future owners. However, there is usually no mention of risks or future expenses of the man made ponds aside from water or electric consumption for day to day operation.

It is felt that some sort of mechanism be put into place to warn future lot or unit owners of the risks and costs involved as owners of the pond. Future lot owners should be given a full disclosure of the man made structure so as to better understand the risks involved. This disclosure should include the type of pond, whether it is lined and what type of lining it has, how deep it is, what type of future maintenance will be required, the need for any chemicals such as copper sulfate, the affects of those chemicals on wildlife, origin of water in the pond, (i.e.: stormwater runoff) depth to groundwater and whether or not the water level in the pond is dependent upon the groundwater remaining constant.

Future owners should be made aware that their Home Owners Association will be responsible for future maintenance of the ponds and will be liable for the costs associated therewith. Maintenance could include but may not be limited to draining, dredging, relining and installation of aeration and filtering devices. The alternative to such maintenance would be to allow the natural succession of the pond to take place.

Siting

When developing a parcel, it must be determined weather or not it is practical or ecologically sound to create a pond or wetland on the site. As mentioned previously, depth to groundwater is crucial. Proximity to natural wetlands should also be considered important. Ponds should never be permitted to intercept the natural flow of water to an existing wetland if it will adversely affect the natural ecosystem. Use of the pond could determine its proximity to natural wetlands. (i.e.: stormwater runoff storage ponds are not permitted to overflow directly into D.E.C. wetlands.)

Another major factor in siting a pond is determining whether or not the subject parcel is large enough to include a pond. Just as clearing standards have been set within the Pine Barrens, the Planning Commission may want to determine whether or not standards should be set on pond sizes. This would be an effective planning tool for mitigating some negative impacts of the ponds. Minimum lot size should be based upon the areas ability to act as a water shed or tributary. This should also be used to determine the maximum percentage of the site which could be used as pond area.

Algacides

The use of algacides, specifically copper sulfate, may be detrimental to groundwater. As mentioned previously, copper sulfate is "a strong poison". According to the N.Y.S. D.O.T., "Copper based pesticides are poisonous; may be fatal if inhaled, swallowed or absorbed through the skin. Contact may cause burn to skin and eyes. . .dilution water may cause pollution." The concentration at which Copper sulfate becomes non-toxic is unclear. The Suffolk County Department of Health Services has established drinking water guidelines for maximum concentration levels for both copper and sulfate (1.0 mg/1 and 250 mg.1 respectively).

It is feared that repeated applications of such herbicides will create a buildup of the chemicals in the sediment. This concentration of copper can be released later, if the pH of the sediment is changed, causing an increase in the concentration of copper in the water column. Too high a concentration will cause a fish kill.

VII. CONCLUSIONS & RECOMMENDATIONS

Ponds can be constructed in such a way that the benefits are enhanced and the liabilities are mitigated. This section will discuss in detail those recommendations neccesary to enhance the quality of artificial ponds in Suffolk County. The recommendations are broken down into three categories: 1) Specific Design Criteria; 2) Pond Ownership/ Management; and 3) Specific Site Restrictions.

The Planning Commission reserves the right to waive any or all of these requirements if a qualified applicant can demonstrate his ability to design, construct and maintain an artificial pond or wetland system which can emulate a natural system and have no negative impacts on the environment.

A. Specific Design Criteria

Design Criteria for the ponds must be established to ensure that all ponds function properly and do not adversely affect the adjacent ecosystems. These policies and standards are based upon this study as well as standards accepted by the Town of Islip. They apply to any artificial ponds greater than 1300 s.f. constructed within Suffolk County.

1. No artificial ponds shall be permitted within 175' of existing wetlands or within an area which would impound the natural flow of runoff into a wetland area.

2. No artificial ponds shall be permitted within 15 feet of existing groundwater.

3. All ponds shall maintain a minimum depth of six (6) feet to allow freshwater species to survive through the winter. This depth should help to

maintain proper temperatures, oxygenation, photosynthetic regimes and winter ice cover without destruction of the organisms.

4. Pond slopes should be established at a minimum of 1 on 4 for the first 12' from the edge and then be increased to 1 on 3 to the bottom elevation. This will avoid an extremely sharp slope in the event an individual is exploring the edge of the pond and falls.

5. No direct discharge of stormwater runoff shall be permitted into the ponds. Stormwater shall be directed into a leaching pool or sedimentation chamber system to remove suspended solids. These chambers must be designed such that they can be accessed for sediment removal.

6. The use of fertilizers and pesticides shall not be permitted within 100' of the edge of the pond except where the grade slopes away from the pond, such that no runoff enters the pond, and then a minimum 15' buffer must be maintained.

7. The roto-tilled bentonite method of pond liners is unacceptable as it requires almost continuous on-site inspection and may not provide a uniform seal for the bottom of the pond which will create long-term maintenance problems.

8. *Bentonite mat is acceptable and is the preferred method of pond lining. - "Environmat" - Salomen (Distributor's) Covered with a minimum of one foot of clean sand and installed per manufacturer's specifications.

*PVC is unacceptable as it deteriorates when exposed to sunlight. This exposure risk to ultra-violet light may create problems with installation and maintenance.

*36 mil reinforced CPE or HYPALON is acceptable covered with a minimum of one foot of clean sand and installed to manufacturer's specs.

*30 mil HDPE is acceptable covered with a minimum of one foot of clean sand and installed to manufacturer's specs.

*NOTE: All liners should be installed by manufacturer's crews, as installation specs. are very specific and should not be attempted by unskilled laborers.

9. Any liabilities that may be incurred by Suffolk County by permitting these ponds, must be reviewed by the County Attorney.

10. Ponds must contain aeration and circulation systems as a component of their design.

11. Additional designs and standards may be at the discretion of the Planning Commission.

B. Pond Ownership/Management

An artificial pond should only be constructed where there is a clear indication that it will be maintained properly and at no cost to the general public. A Homeowners Association must be established to maintain control over the pond as well as other common areas within the development (i.e.: tennis courts, swimming pools, etc.). A prospectus or offering is required by the Attorney Generals Office to ensure that future homeowners will be fully informed of the benefits and liabilities that are included with home ownership in the development.

In addition, to be an informational document, the offering designates how the Homeowners Association will be run and managed. As a condition of approval, the Planning Commission can require that additional information, pertaining to the pond and its future maintenance, be included in that offering. These requirements will ensure that concerns of the Planning Commission will be addressed long after the review process is complete.

1. That developers be required to post a performance/construction bond (i.e.: in much the same way one is required by a municipality) with the Homeowners Association for two years after the control of the association is transferred to the residents.

2. The construction and operating cost of the pond shall be detailed and certified.

3. Construction techniques and design of the pond shall be detailed along with a water budget demonstrating water sources and sedimentation or filtering chambers ensuring water standards.

4. Maintenance practices and their associated costs shall be outlined to ensure the pond and/or system will be properly maintained (i.e.: cleaning out sedimentation chambers).

5. The pond system and water quality shall be monitored by an independent professional engineer on a regular basis (i.e.: biannually).

6. Future risks shall be outlined and mitigated to minimize the potential for pond failure or premature eutrophication. Costs associated with pond failure shall also be included. (i.e.:conversion to recharge basin, replacing liner, dredging pond).

7. No potenially harmful chemicals, such as copper sulfate, shall be utilized to control algal growth.

C. Specific Site Restrictions

Pine Barrens Zone

The Pine Barrens Review Commission has established policies and standards for rezonings and subdivision applications that are subject to their review. The purpose of these policies and standards is to ensure the protection of the natural resources within the Pine Barrens including but not limited to groundwater, wetlands, surface waters, rare and endangered species, native vegetation and geographic features.

A section of that policy statement which deals with runoff water discusses briefly the creation of artificial ponds. The following is excerpted from that report.

> "The Pine Barrens Review Commission may discourage the construction of large excavated recharge basins and may encourage the use of alternative natural recharge areas and/or drainage system designs that will cause less disturbance of the site. Such alternatives include, but are not

limited to, the use of natural swales and depressions and/or the installation of perforated pipe, vertical drains or dry wells.

The Pine Barrens Review Commission may recommend disapproval of a proposal if all stormwater runoff originating from development on the property is not recharged on site. Ponds should only be created in place of recharge basins, not for aesthetic purposes. They should be constructed and planted to create a shallow marsh habitat to filter runoff to the maximum extent possible. A management plan should be developed which requires minimal augmentation and attempts to balance evaporation with size limitation of the pond."

This statement gives a general outline for review of artificial ponds. It is felt that the Planning Commission should set more specific guidelines for the review of artificial ponds in the Pine Barrens Zone.

It is not unreasonable to require that ponds be fed with stormwater runoff. This does not have to contradict earlier statements that no direct discharge of stormwater runoff be permitted to enter the pond. Stormwater runoff must go through a cleansing process to remove the maximum amount of sediments, floatables, oils, nutrients, and deleterious materials possible before being discharged into the pond. In addition, no overland runoff should be permitted to enter directly into the pond.

This filtering process could be accomplished by a series of sedimentation chambers, which should be properly maintained. Construction of a shallow marsh habitat for filtering runoff can be effective in removing nutrients, fertilizer, and organic compounds. However, trash and floatables must be removed mechanically. There is also some concern over the design constraints of the shallow marsh habitat due to the area they occupy. They should be considered an option, but should not be a requirement.

A delineated management plan minimizing augmentation should be spelled out in a water budget prepared during the design stage of the pond. Augmentation of the ponds, especially during times of drought, is a particular concern which should be addressed up front. The developers must be required to provide augmentation sources and expected requirements prior to approval of any plan.

Requirements of stormwater filtering and of a water budget should be required county wide, not only within those areas of the Pine Barrens Zone. Ponds within the Pine Barrens Zone, however, should have a dual purpose and should not be created for aesthetic purposes only.

Insular Areas

Man made ponds should be prohibited in those specific geographic areas where they would pose a threat to the quantity or quality of the groundwater. Of the 13 specific insular areas discussed in the Suffolk County Comprehensive Water Resource Management Plan, only one, Lloyd Neck, is mentioned as having, "No water quality problems...experienced or anticipated." This is at least partially due to the fact that approximately 60 percent of the area is in publicly-owned open space. While ponds are not restricted in this area, caution should be exercised.

Eaton's Neck (inclusive of the Village of Asharoken) is predominantly served by S.C.W.A. mains. Burdening this system with artificial pond augmentation should not be permitted. Private wells for augmentation should not be permitted. It should be a policy that no artificial ponds be created in this area.

Gilgo-Oak Beach, Fire Island, and Westhampton Beach have environmentally fragile ecosystems and should be protected against the construction of man made ponds. The barrier beaches do not have the

proper characteristics to be good sites for artificial ponds. Poor soils and the close proximity to wave action tend to make the cost for construction of man-made ponds prohibitive in most cases. It should be an established policy that no ponds be permitted in these areas.

Nassau Point and Great Hog Neck - Both quantity and quality of groundwater appear to be a problem in these areas. Since the Comprehensive Water Resources Management Plan recommends the establishment of water quality treatment Districts, extension of mains and creation of new supply wells (South Fork) will try to compensate for increased future demands. It should be a policy that no artificial ponds be created in these areas.

Plum Island - This island is used as an Animal Disease Center for the U.S. Department of Agriculture. As there is no potential for development, there is no need to recommend any restrictions.

North Haven residents presently rely primarily on private wells. Water quality problems are expected to increase with an increase in development. The recommended improvements necessary to provide public water to 600 homes is estimated to cost $2.5 million. It should be a policy that no artificial ponds be created in this area.

Shelter Island - Groundwater on Shelter Island is limited and chloride levels in shoreline wells have been problematic. The location of the freshwater-saltwater interface is continuously shifting "in response to fluctuations in recharge and groundwater withdrawal, moving...landward with increased withdrawals." Since the bulk of the Island is located within either the Water Supply Problem Zone or Marginal Water Supply Zone, it is recommended that no artificial ponds be created within the Town of Shelter Island.

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