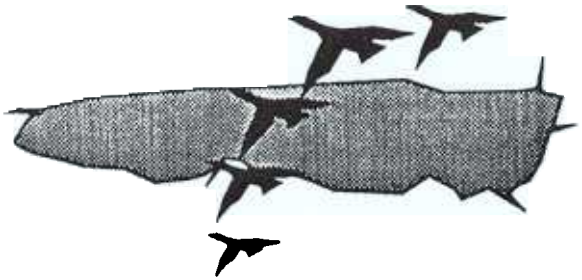
Daniel Steele

ONONDAGA WETLANDS PLAN



A NATURE ORIENTED VISION FOR THE COMMUNITY

6-10-92

PROBLEM

High BOD, biological & nutrient loading generate low dissolved oxygen levels and high turbidity. These factors combined with spurious contaminantion reduce the quality of Onondaga Lake water to well below desirable standards.

COMBINED SEWER OVERFLOW (CSO) Generate direct dumping of contaminants during periods of high runoff (sanitary + drainage area combined)

CONTAMINATED INFLOWS BOD, SS, Nitrogen, Phosphorus, and other nutrient inflows occur on an excessive and steady basis from existing facilities and non point sources

OTHER Mud boils and toxic industrial contamination

SOLUTION

A well designed amalgamation of constructed natural processes, physical structures and management practices which when taken together exceed minimum standards at a fraction of the cost of conventional treatment.

CSO MANAGEMENT By wetland buffering and filtering all CSOs followed by 1 year maximum storm surge capacities integrated with Jewell Process.

CONTAMINENT REDUCTION By employing Jewell Process in conjunction with constructed wetlands, combined with longer term influent reductions via new sewer technology.

OTHER By the capture of all mud boil water in a constructed wetland area. By the physical removal of "hot spots" of industrial residue.

No single component represents the entire solution

CURRENT DRIVERS

BACKGROUND **Current Actions are Driven from Several Aspects:**

ATLANTIC STATES SUIT The Atlantic Suit has forced a Plan to correct treatment deficiencies at the Metropolitan Treatment Plant. Metro is currently operating under a Consent Order - a Waiver initiated by the correction plan.

PLAN The Plan of Record is based upon the availability of funding levels of up to $1 Billion and includes:

1) Distributed Storage of CSO.

2) Treatment Plant Upgrades to Reduce Nutrients & BOD.

3) Piping of Treated Effluent to Seneca River to Bypass Lake

ALLIED SUIT The Allied Suit has forced Allied Corp. to perform extensive Water Quality and Sediment Contamination Analysis in preparation for litigation. The Resolution of this Industrial Contamination Issue is Likely to take Many Years and involve Significant Legal Costs.

DEVELOPERS Apeals being made by local govt for major developments.

A PHASED DEVELOPMENT PLAN

PHASE I INITIAL WETLANDS INSTALLATION

PHASE II PILOT TREATMENT FACILITY & SEPARATED SANITARY SEWER DEVELOPMENT

PHASE III FULL SCALE TREATMENT FACILITY DEVELOPMENT

PHASE IV FULL SCALE SEPARATED SEWER IMPLEMENTATION

MAJOR ISSUES IN PHASE I

PHASE I produces a direct a low cost improvement in Lake quality independent of the incorporation of treatment facility upgrades and the implementation of Phases II through IV.

The costs of industrial "hot spot" cleanup, in preparation of the wetlands site, are borne by separate TBD monies.

WETLANDS POLISH for all major inflows into the Lake via the formation of a "virtual river" within the wetlands itself.

MUD BOIL MITIGATION at the Wetland entrance from Onondaga Creek - not yet addressed in reference to any other plan.

CSO MANAGEMENT:

The isolation of overflow contamination from the Lake.

The filtering of overflow contamination within the Wetlands.

The temporary storage of overflow via the inherent storage capacity of Wetlands design.

MAJOR ISSUES IN PHASE II

PHASE II offers an opportunity for developing fundamental improvements in wastewater treatment (Jewell Process) as well as the reduction in the sources of inflow to the treatment process itself.

This Phase is a relatively low cost risk reduction precursor to later full scale developments.

JEWELL PROCESS PILOT to refine the design for suitable full scale development in Phase III.

SEWER SEPARATION PILOT to refine the design for suitable full scale development in Phase IV.

WETLANDS IMPROVEMENT to optimize nutrient removal and wildlife habitat.

MAJOR ISSUES IN PHASE III

PHASE III implements a **full scale Jewell Process** for improved wastewater treatment.

The Jewell Process provides the following advantages:

INTEGRATED STORM WATER SURGE STORAGE to capture and ultimately treat all CSO water, present during this period.

A HIGHLY EFFICIENT PROCESS both in terms of energy efficiency and in the lower ratios of sludge produced.

A HIGH QUALITY PROCESS providing tertiary treated water quality as release to the Wetlands.

MAJOR ISSUES IN PHASE IV

PHASE IV addresses the significant reductions in inflows to the treatment system, by large scale separation of sanitary sewer and storm drain coupled with incentivization of sanitary sewer inflows.

Note: Inflow reductions are not yet referenced with respect to any other plan.

COMPLETE SEPARATION OF SANITARY AND STORM to remove a large ongoing cost associated with currently projected loads.

INCENTIVIZATION of the input to the separated sanitary sewer system to further reduce the continuous level of inflow to the treatment process. (Lowering the cost and increasing the quality of treatment)

GRAY WATER SEPARATION opportunities exist as a further reduction in the continuous level of inflow, potentially a great step in overall reduction.

PHASE I WETLANDS

WETLANDS BORDER Initial Wetlands Installation to Intercept & Filter Existing Major Inflows into Onondaga Lake

METRO PLANT	Outflows from Current Metro Treatment Facility
ONONDAGA CREEK	CSOs into Onondaga Creek Mud Boils into Onondaga Creek
HARBOR BROOK	CSOs into Harbor Brook
LEY CREEK	CSOs into Ley Creek
NINE MILE CREEK	Runoff from Industrial Residuals

Wetlands Filter All Major Sources of Flow into Onondaga Lake

PHASE I CSO ABATEMENT

CSO MANAGEMENT **Installation of Weir & Swirl Separation and Routine Street Washdowns to Minimize Effects of CSOs**

WEIR Installation of a Weir along Onondaga Creek, **Forming a Canal to** Capture CSO and Mud Boil Outflows and **duct them directly to** the Mouth of the Creek.

SWIRL SEPARATION The Installation of Two Swirl Separators
- One at the Mouth of Onondaga Creek ("Canal" Outflow)
- Second at the Mouth of Harbor Brook.

Swirl Separation Utilized to Effectively Remove Solids & Floatables from CSO Prior to Entry into Wetland Area

STREET WASHDOWNS A Routine of Pre-CSO Washdowns of All City Streets thereby Removing Significant Contaminations During CSO Activity (Note: Washdown Water is treated at Metro)

Straightforward and Direct Measures to reduce CSO effects

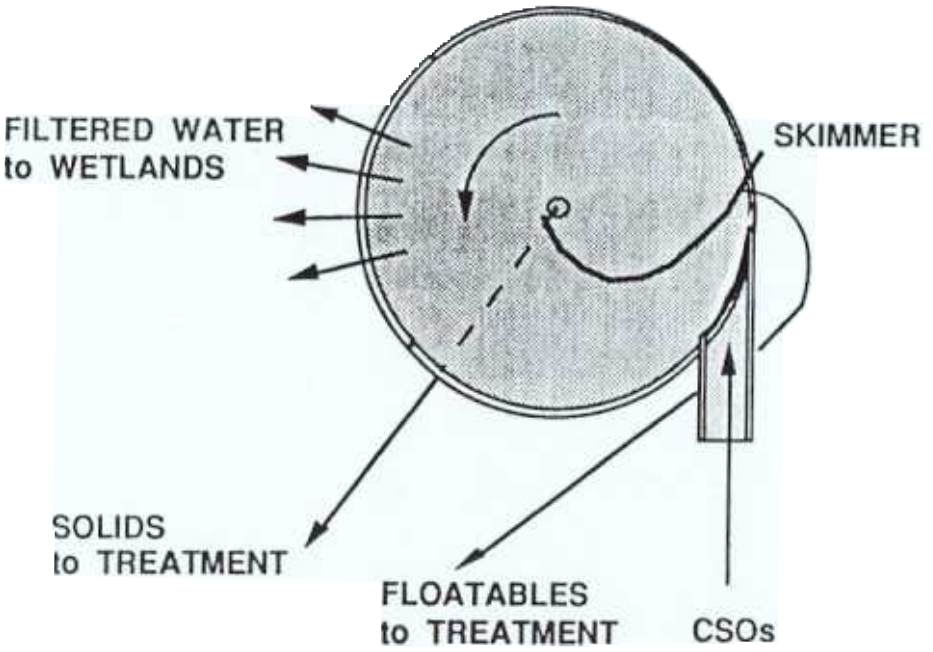
PHASE I SWIRL SEPARATION

SWIRL SEPARATION

Large volume low velocity Swirl Separation is a proven technique for removing Suspended Solids and Floatables from CSO Water

ONONDAGA CREEK SWIRL SEPARATOR
CAPACITY = 4 M cubic feet, 28 M gallons / Event
EST. SIZE = 125 feet diameter X 20 feet deep

HARBOR BROOK SWIRL SEPARATOR
CAPACITY = 1 M cubic feet, 7 M gallons / Event
EST. SIZE = 50 feet diameter X 10 feet deep

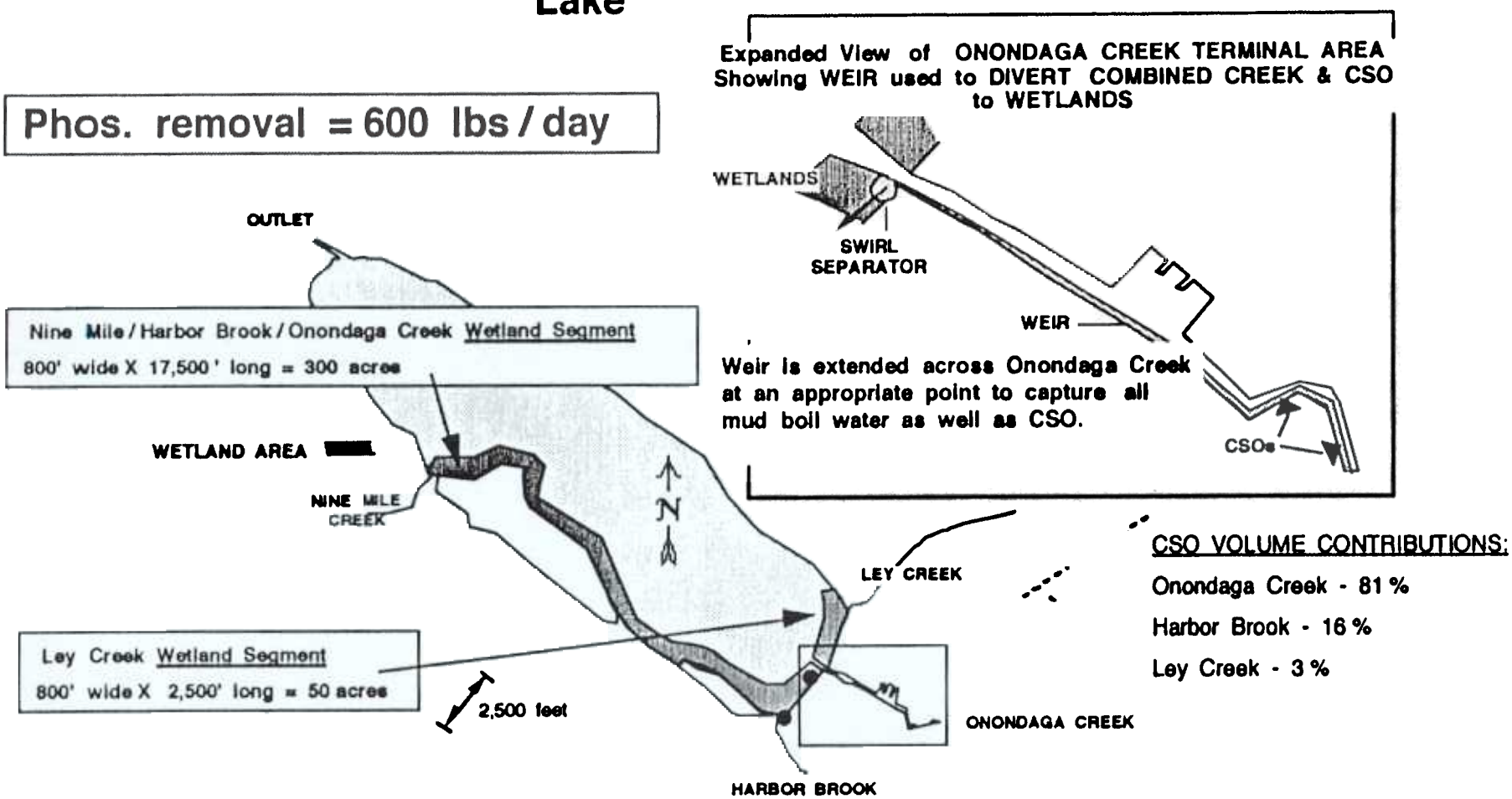


The use of two large Swirl Separators located near Treatment reduces Cost and Siting difficulties while Protecting Wetlands

PHASE I WETLANDS BORDER

WETLANDS BORDER Intercepts, Stores and Filters Flows into Onondaga Lake

Phos. removal = 600 lbs / day



CSO VOLUME CONTRIBUTIONS:

Onondaga Creek - 81 %

Harbor Brook - 16 %

Ley Creek - 3 %

Immediate and low cost improvement in lake water quality.

Quotations taken from - "Artificial Wetlands - An Alternative to Conventional Wastewater Treatment"

John C. P. Kristof, Ecoplans Ltd, Waterloo, Ontario Canada

BOD removal efficiencies were 89% and 88% respectively for two consecutive summers. The winter removal rate was found to be 67%.

High Nitrogen removal efficiencies were noted when an artificial wetland was supplanted with a carbon source (mulched plant biomass); removal efficiencies of 97% and 94% can be attained for both total inorganic Nitrogen (TIN) and total Nitrogen (TN). (Gersberg et al, 1984)

The number of faecal bacteria reduced was found to approach 99%.

In the case of 95% Phosphorous removal, all the wastewater penetrated the soil and the soil was characterized by a high organic content.

Quotations taken from - "Artificial Wetlands and Urban Lakefill Policy"
Walter H. Kelm, University of Guelph, Ontario Canada

All waterfront development projects and existing open space areas, including Harbourfront, should be reviewed in terms of their potential to create sustainable plant and animal wildlife habitats.

Ecological planning is as important as recreational planning;

for it would seem obvious that people want to return to waterfronts, but only if they are non-poluted, alive with healthy natural environments, and refreshing because of their diverse landscape qualities.

Quotations taken from - "Urban Stormwater Management and Artificial Marshes; The Ontario Perspective" Thomas J. Carlisle and George Mulamootil, University of Waterloo, Ontario Canada

The retardation of urban stormwater is a basic objective of any watershed or master drainage plan. The strategy to retard stormwater runoff in attenuating peak flows associated with stormwater discharges, and to reduce water quality problems downstream, includes permanent or temporary storage of precipitation through the use of retention and detention ponds.

Additional advantages of constructed wetlands include

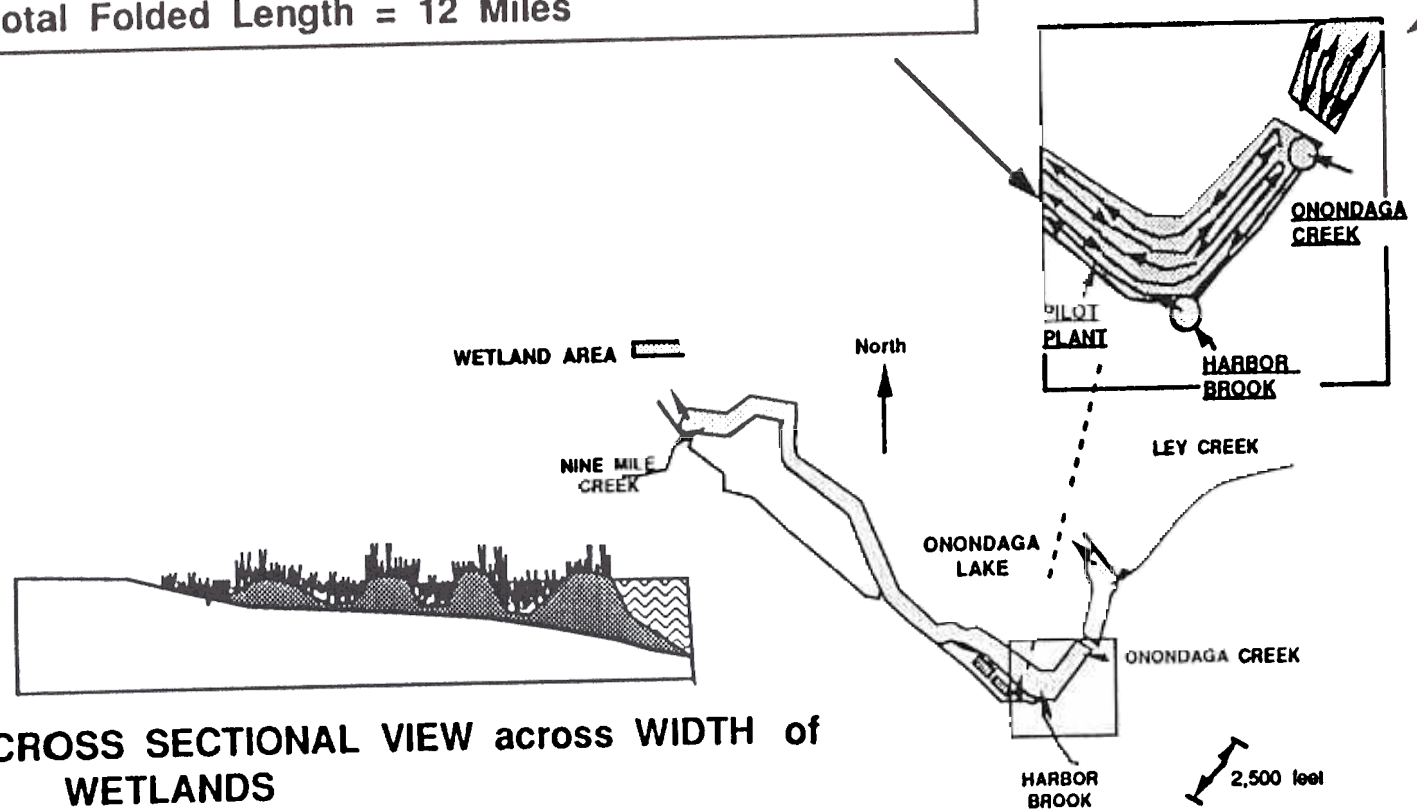
1) Flexibility in site location 2) Optimum size for projected stormwater runoff 3) Construction of topographic features such as channels, shallow bars, islands and levees to improve polutant removal and facilitate maintenance. 4) Exemption from rigorous influent criteria if a wetland is considered part of a treatment system

WETLANDS DESIGN

Wetlands designed as a continuous folded path to optimize total length and filtering action

Nine Mile / Harbor Brook / Onondaga Creek Segment
Total Folded Length = 12 Miles

Ley Creek Segment
Total Folded Length = 1.5 Miles



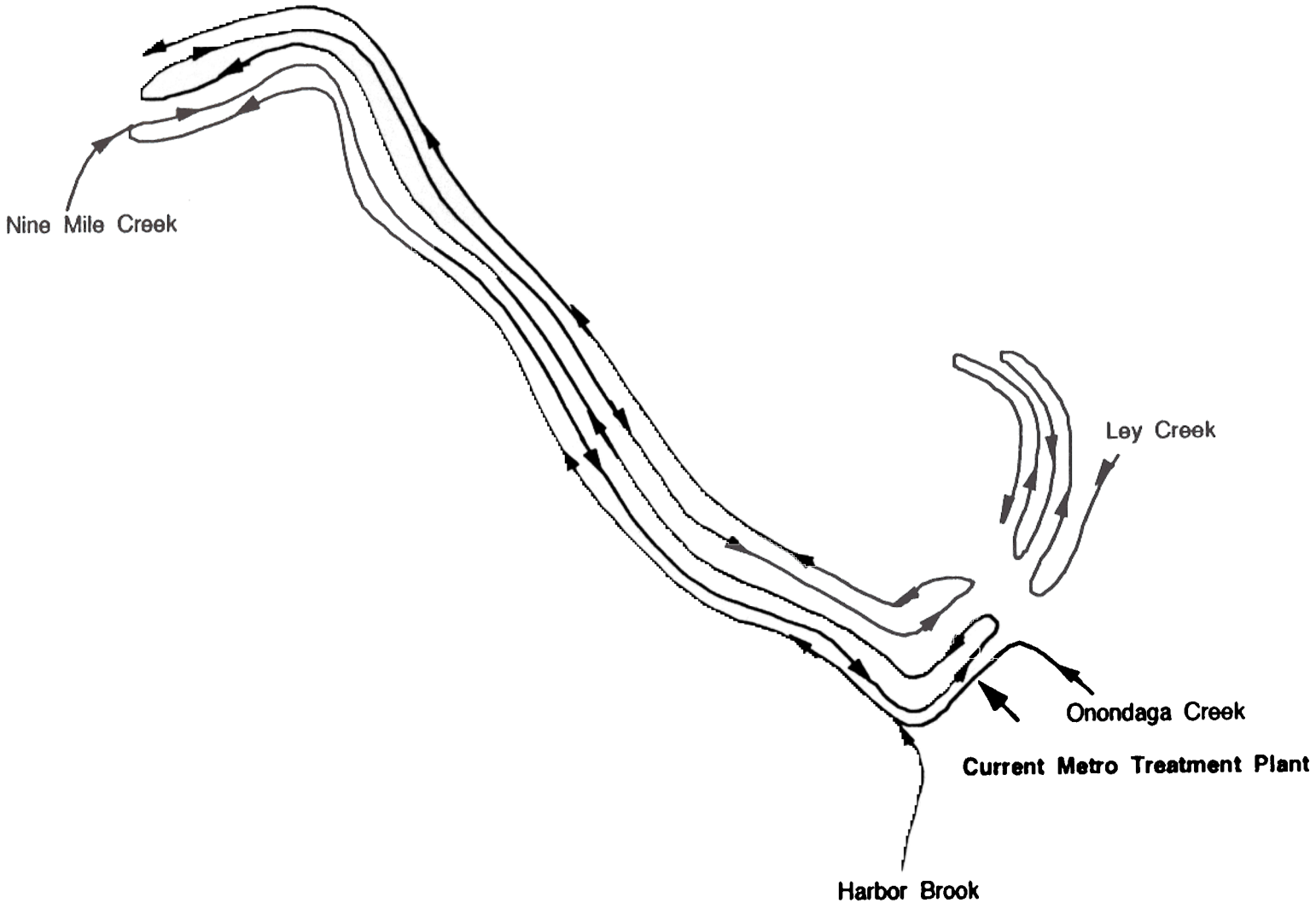
CROSS SECTIONAL VIEW across WIDTH of WETLANDS

Onondaga Wetlands Plan

FOLDED PATHS

5/92

DWS-08A



WETLAND FEATURES

BENEFITS Implementation of a Wetland Buffer System provides advantages beyond the reduction of Nutrient and BOD flows into the Lake.

INHERENT STORAGE for storm water surges. It is reasonable to store upwards of 300 million gallons, given reef heights of 3 feet above lake level. Flooding beyond 3 feet results in "graceful" overflows, reef area by reef area, to the Lake.

RIVER & POND SYSTEM is a natural outgrowth of the wetland system, providing for a wide diversity of wildlife habitat. Canoe navigation through portions of this varied system would be a further attraction.

WALKING TRAILS can be constructed along the tops of designated reefs to increase recreation and enhance the community's exposure to wildlife.

WETLAND CONSTRUCTION

NATURAL CONSTRUCTION **The use of Natural Wetland Materials such as Tree and Brush Trimmings provides for Low Cost and Nature Compatable Construction. It will be very Important to secure Community Ownership of this Project through Direct Involvement of Local - People, Organizations, and Companies throughout All phases of Wetland Development.**

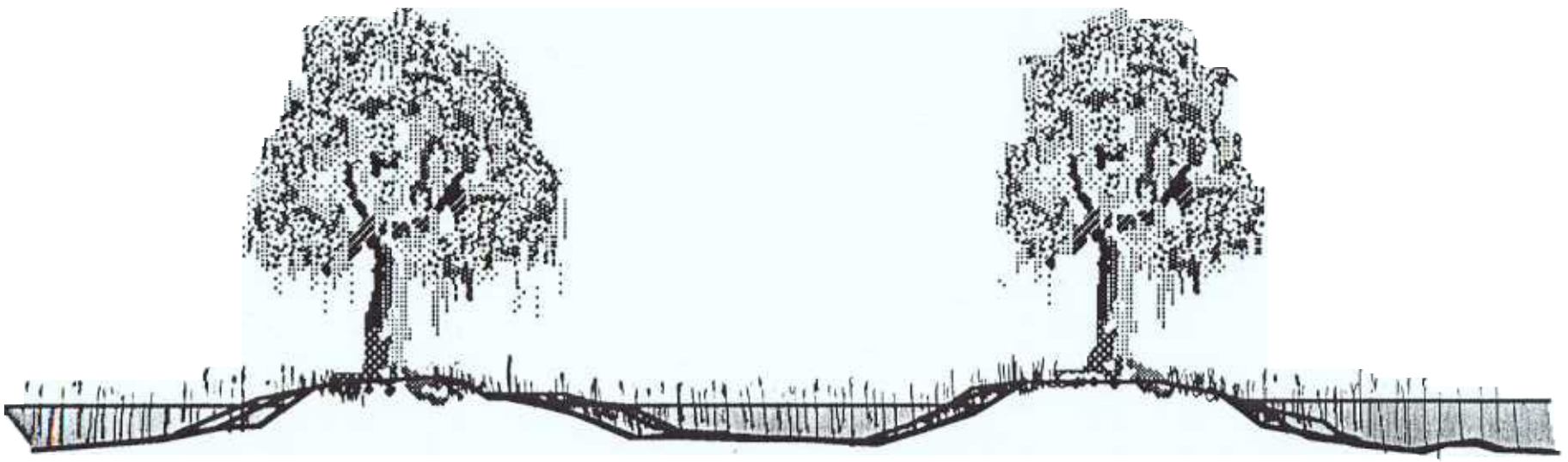
TREE & BRUSH SUBSTRATE provides a stable base for subsequent plant growth. Initial construction would be carried out over a 3 year period, during which several layers of wood material would be layed down. Tree and Brush material normally destined for Landfill would be put into place with suitable amounts of volunteer and public works labor and equipment.

FIRST GROWTH during the first 3 years of installation would concentrate upon plants designed to stabilize reef areas and upon plant populations within waterways designed to remove nutrients and BOD.

SECOND GROWTH during the subsequent 5 years of Wetland Construction would concentrate upon implementing targeted species - designed to optimize the diversity of Wildlife Habitat.

WETLAND LANDSCAPE

VARIED LANDSCAPE The development of a diverse Wetland Landscape is not only pleasing to the eye but increases its value as a wildlife habitat.



PHASE II JEWELL PILOT

JEWELL PILOT Creation of a Pilot Facility to Evaluate & Optimize the Jewell Process

PROCESS SCALING utilizing an Appropriate Subset of Full Scale Components to Implement a Complete Process String.

PROVIDES OPTIMIZATION of:

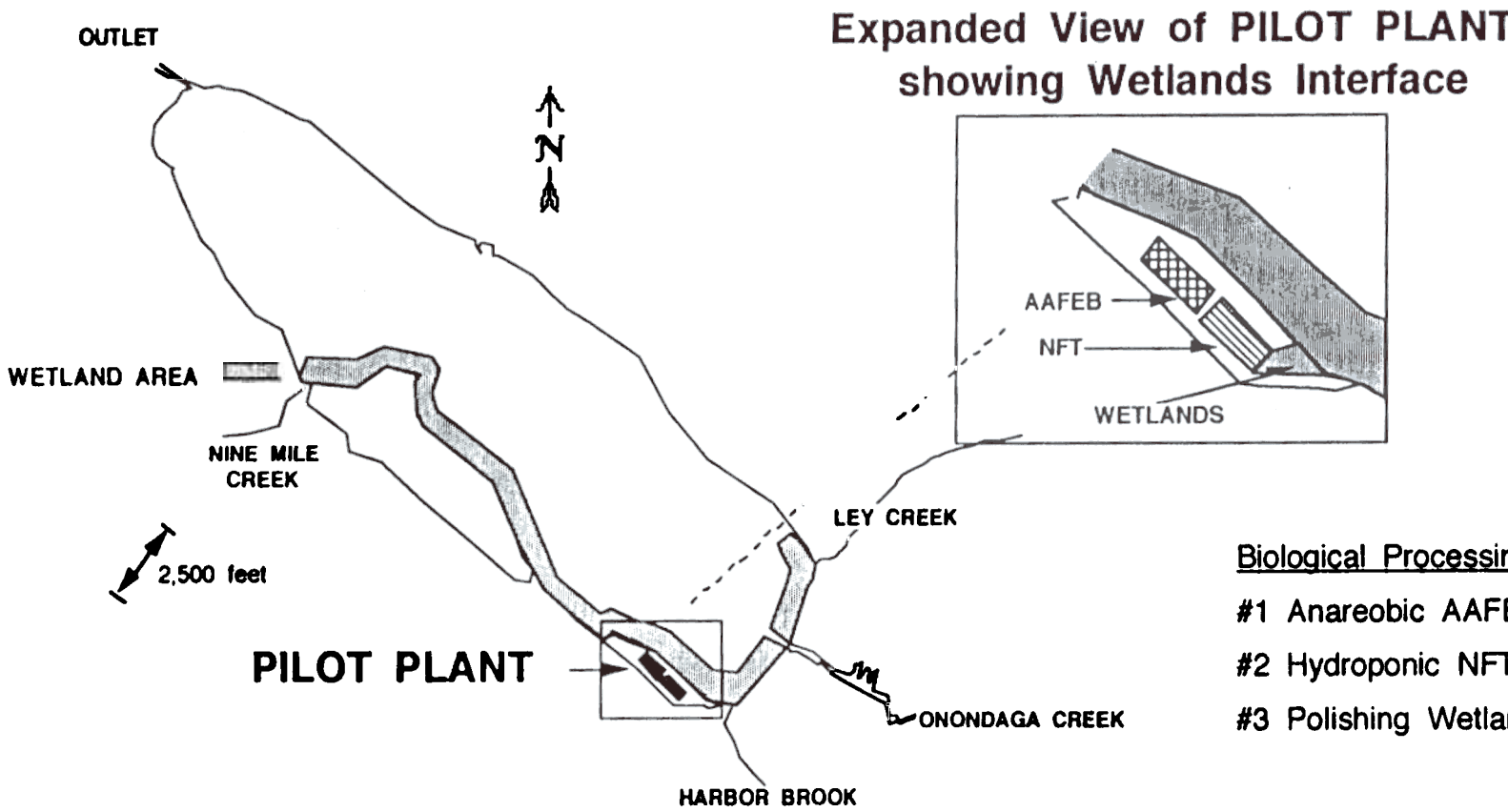
- Implementation Costs
- Maintenance Procedures
- Methane Production Rates
- Year Round Performance
- Phosphorous and Nitrogen Removal

LONG TERM BENEFIT following Phase III as a county wide leachate and toxics processing facility.

Reduce RISKS and COSTS of FULL SCALE DEVELOPMENT

PHASE II JEWELL PILOT SITE

JEWELL PILOT PLANT Optimizes Jewell Process for Full Scale Development



Biological Processing:

#1 Anareobic AAFEB

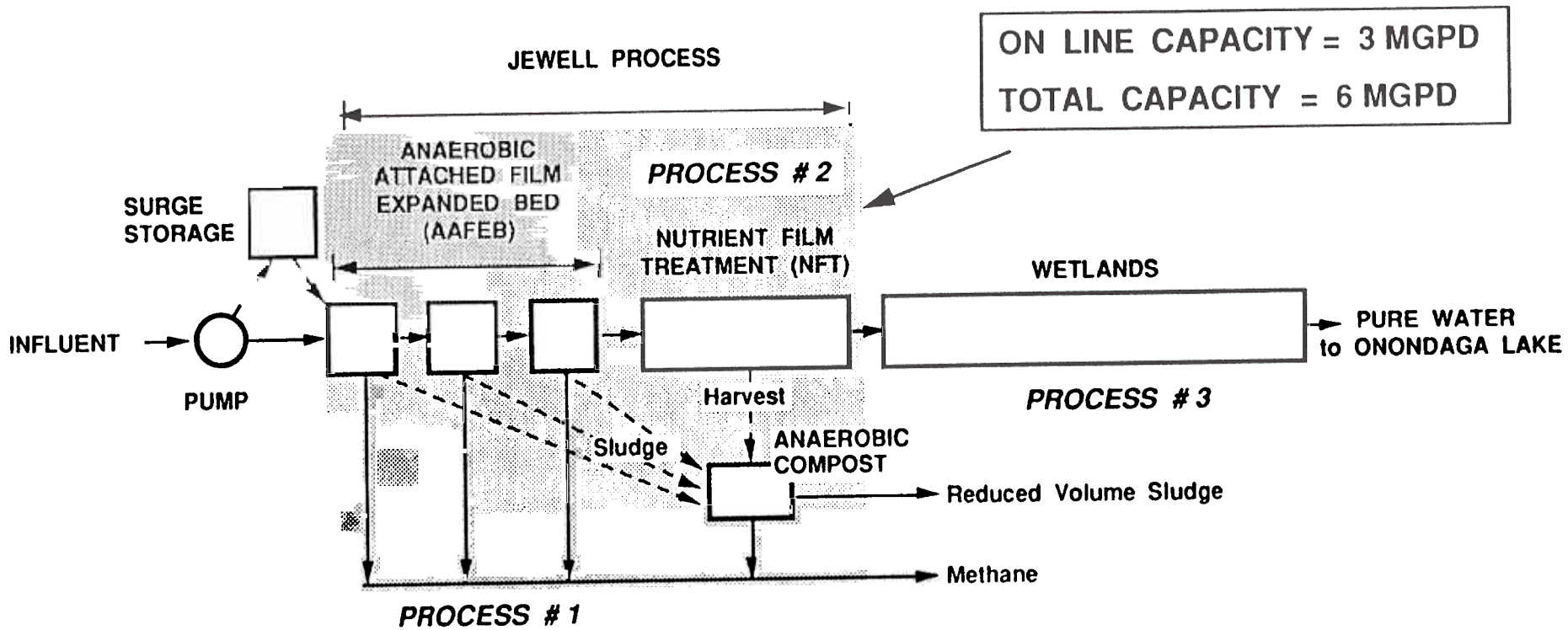
#2 Hydroponic NFT

#3 Polishing Wetlands

Minimize development risks and cost

PHASE II PILOT SCHEMATIC

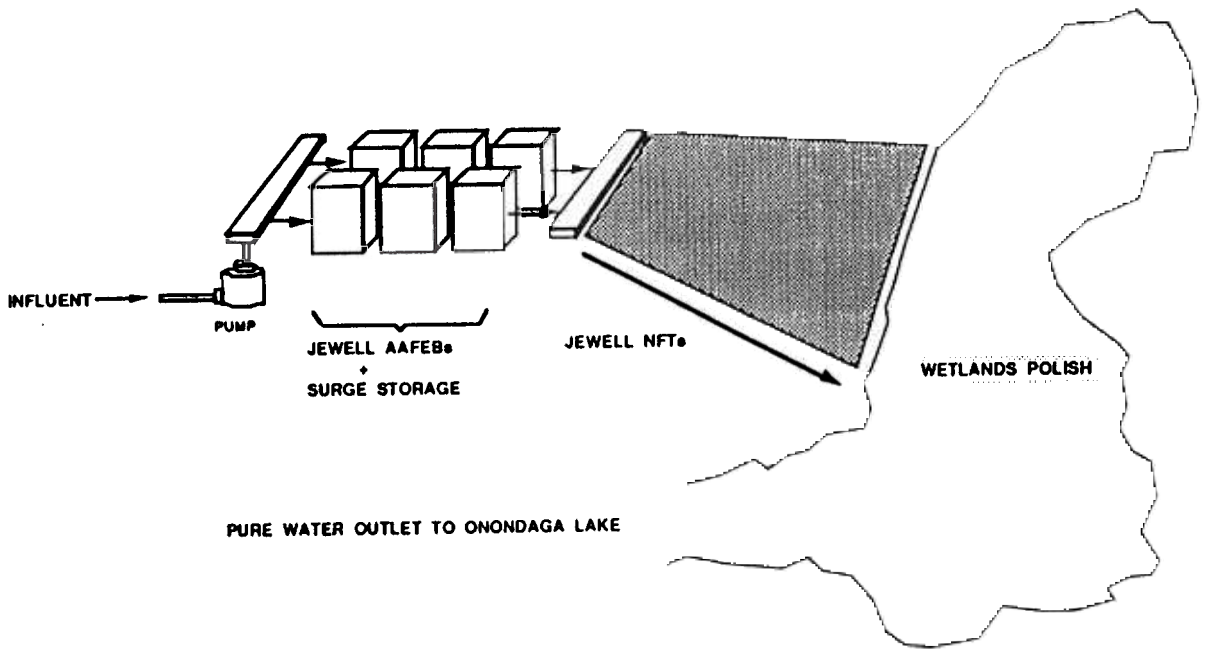
SCHEMATIC Cascade of Three **Biological Processes - Jewell AAFEB, Jewell NFT, and Wetlands**



PHASE II TREATMENT PROCESS

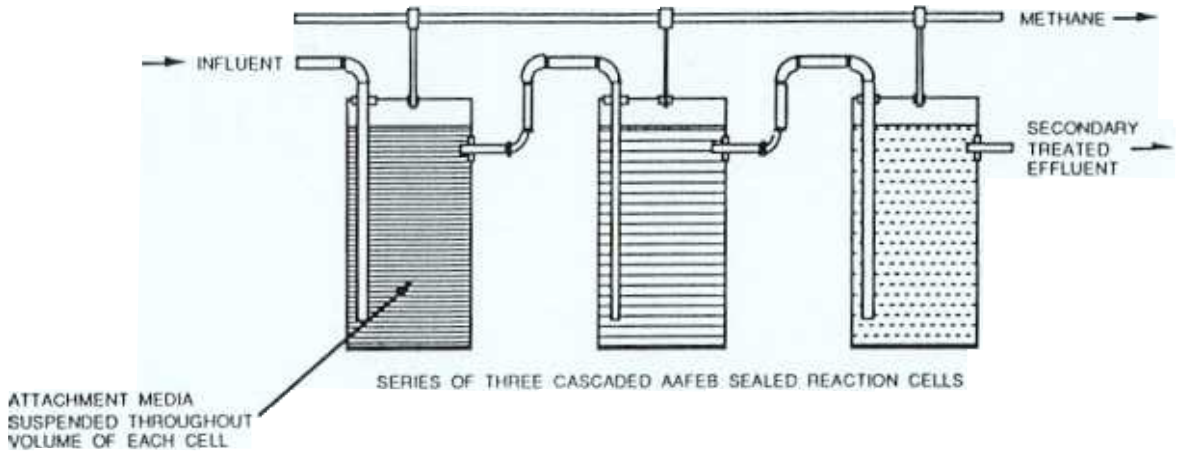
PHASE II TREATMENT

High Purity Effluent
Wildlife Refuge for Increased Quality of Life within the Community
Robust and Straightforward System
Significant Sludge Reduction over Conventional Treatment
Energy Generation through Methane Production



PHASE II AAFEB

High Quality Secondary **Quality Effluent Low in Sulfides**
Up to 20 Times Sludge **Reductions over Conventional Treatment**
High Rates of Methane **Production**



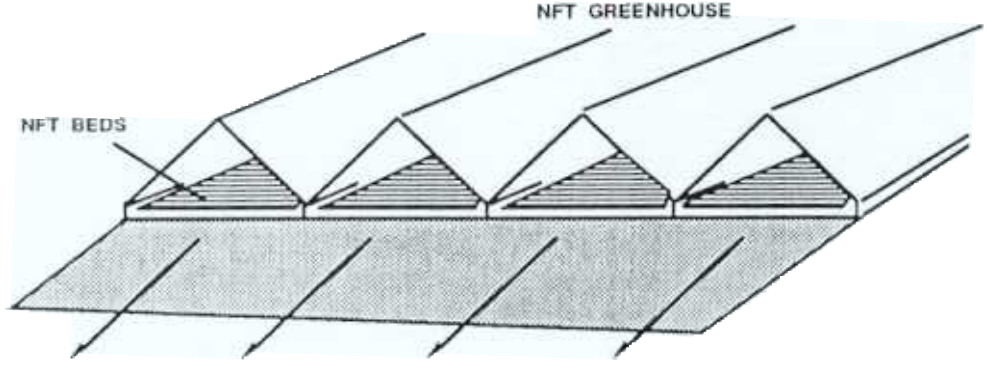
CAPACITY	**=**	**3 MGPD**
TOTAL HRT	**=**	**2 DAYS**
HRT / CELL	**=**	**16 Hours**

PHASE II NFT PILOT

NUTRIENT FILM TECHNIQUE
NFT)

P ov de year round eff c en Nu r en
remova

CAPACITY	=	3 MGPD
HRT	=	1 DAY
AREA	=	4 ACRES



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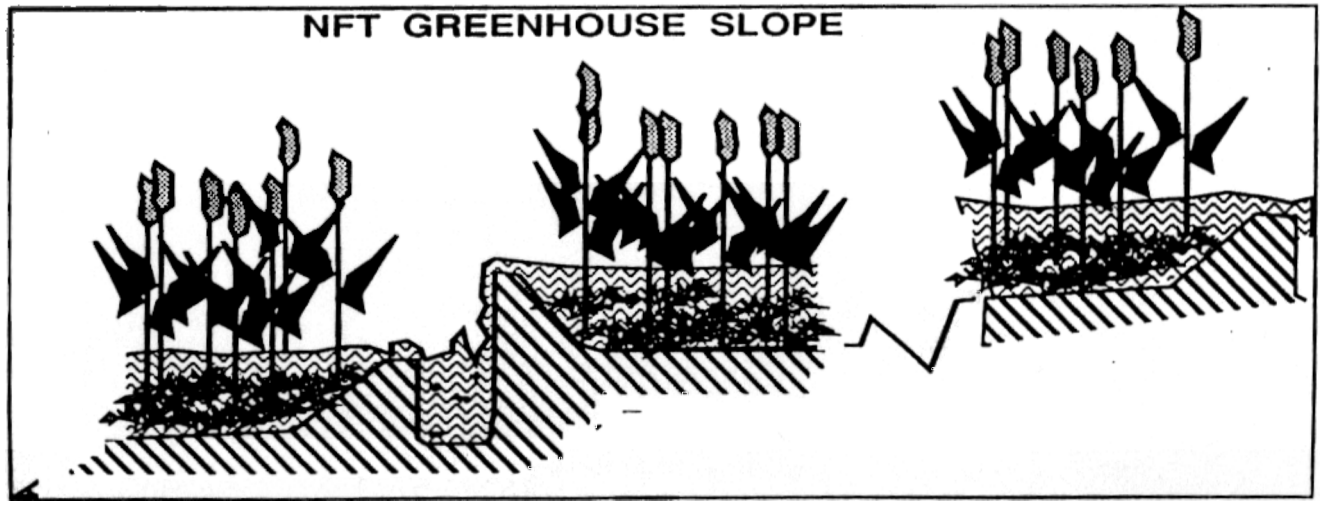


PHASE II CSO SEPARATION PILOT

CSO SEPARATION PILOT A Pilot Project which Targets the Installation of Vacuum Sewers in an Appropriate Drainage Area

ISSUES:

CSO REDUCTION - targeted for a significant local improvement

COST REDUCTION - evaluation of installation & maintenance

INCENTIVIZATION - implementation of a fair billing system

TREATMENT OPTIMIZATION - gray water separation to reduce dilution of sanitary treatment

Reduce RISKS and COSTS of PHASE IV FULL SCALE DEVELOPMENT

PHASE II SEWER PILOT SITE

SEWER PILOT Implementation of a Pilot Vacuum Sewer both reduces CSO and enhances treatment while providing valuable experience.

OPTIMUM TARGET for the Pilot Sewer project would be within the Ley Creek Sanitary District.

PRIMARY OBJECTIVE would be to significantly reduce or eliminate CSO discharges into Ley Creek. These discharges, although small compared with the total Onondaga Lake CSO, are very significant to Ley Creek.

SECONDARY OBJECTIVE would be to prepare for full scale implementation of Vacuum Sewers during Phase IV.

PHASE II VACUUM SEWERS

VACUUM SEWER

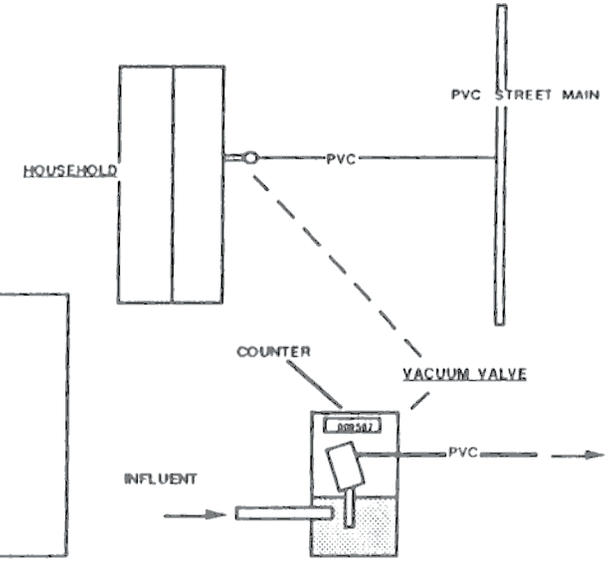
Small Size

Flexible Installation

Half the Cost of Conventional Sewers **$4 M / MGD**
for small installations (installed)

Provides for Direct Billing

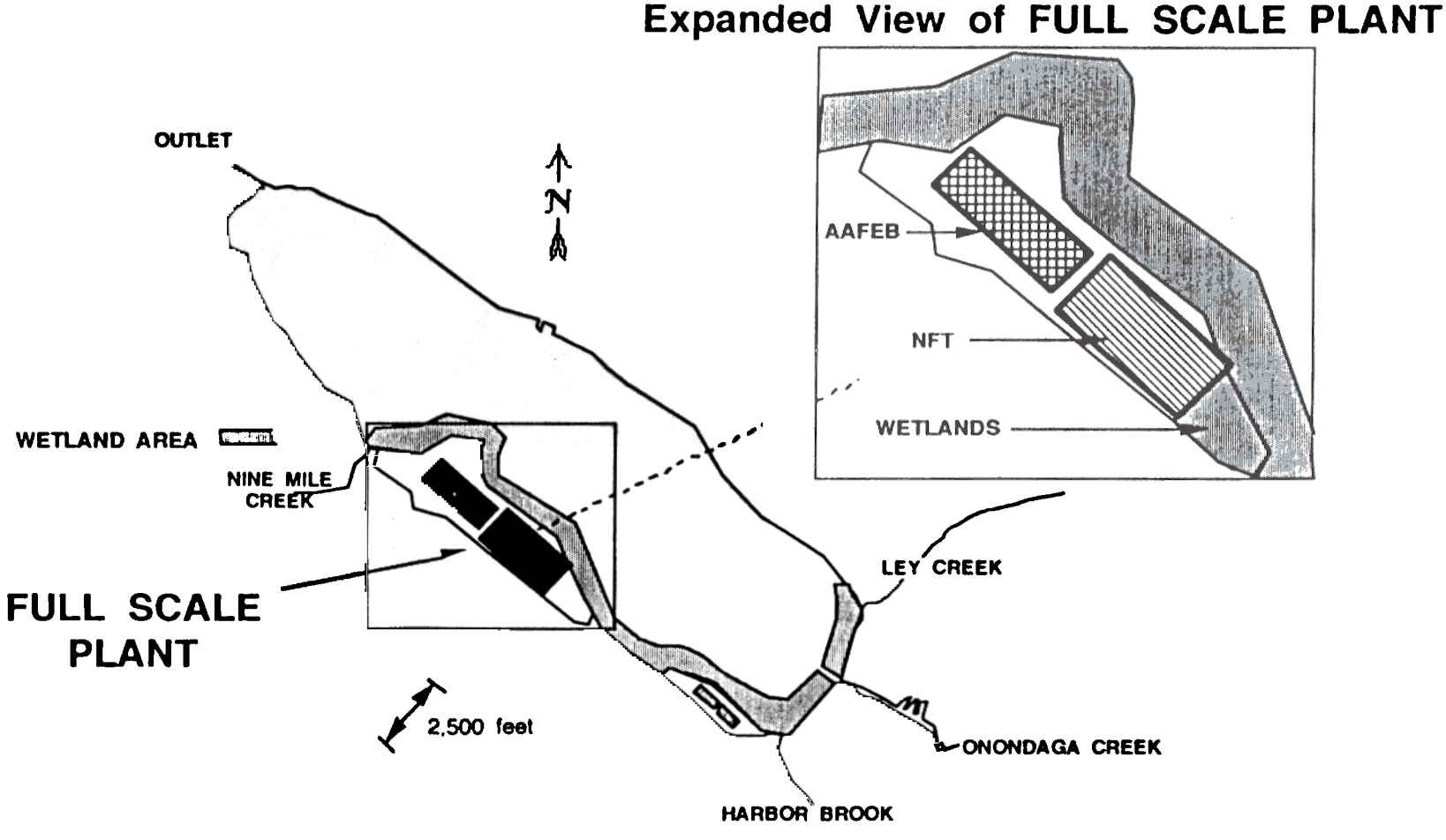
Provides Possibilities for Gray Water Separation



TOTAL CAPACITY	= 1.5 MGPD
EST. USER FEE	= $25 / month
EST. INSTALLATION	= $2500 / Household

PHASE III JEWELL FSD SITE

JEWELL FSD Full Scale Development of the Jewell Process



Consistently high quality treatment via a series of biological processes

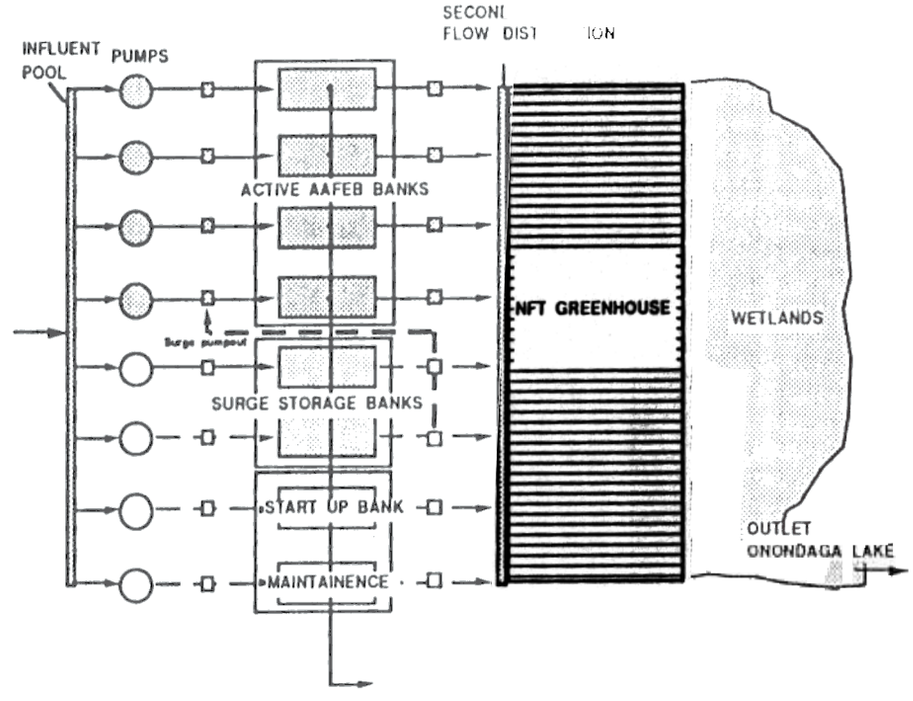
Onond g W nd P n

PHASE FSD D AGRAM

DW 20

JEWELL FSD DIAGRAM

Fea ure n gra d Ye r S orm Surge S orag nd Ma n n nc Ro on o AAFEB Bank



TOTAL CAPACITY	=	260 MGPD
NORMAL CAPACITY	=	110 MGPD
HRT @ 110 MGPD	=	3 DAYS (TOTAL)

PHASE III JEWELL FSD

JEWELL FSD

FULL SCALE DEVELOPMENT

Full Scale Development of the Jewell Process per Metro and Onondaga Wetlands Requirements

Features:

Minimal CSO via an Integrated Surge Storage Capacity

High Reductions in SS & BOD through the combined actions of AAFEB & NFT Processes

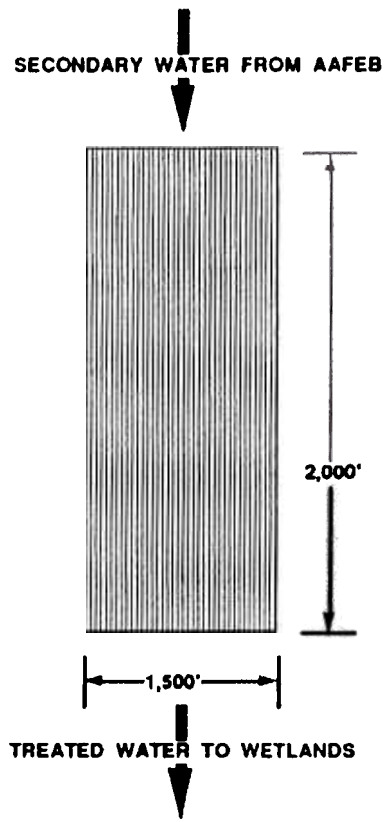
Low Cost of Operation through the use of Natural Processes and Methane Recovery

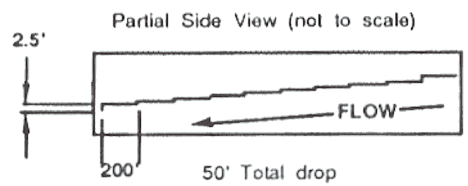
High Reductions in Nitrogen & Phosphorous through the use of an NFT and Wetlands Polish

Wildlife and Recreational Enhancement via the Presence of Extensive Wetlands, Navigable Waterways, and an Abundance of Clean Water

FULL SCALE NFT "A Sheltered Wetlands" Environment

TOTAL AREA	=	140 ACRES
NORMAL CAPACITY	=	110 MGPD
HRT	=	1 DAY
HYD. LOADING	=	200 m3/ha-d
PHOS. REMOVAL	=	300 LBS PD
(from WETLANDS	=	600 LBS PD)
NITROGEN REM.	=	> 90%
SS REMOVAL	=	>90%
BOD REMOVAL	=	>90%





PHASE IV QUALITY IMPROVEMENT

IMPROVEMENT Improvement of the Entire Process through Phased Reductions of Total Inflows

VACUUM SEWER INSTALLATION

Provide Low Volume / High Rate Sewers at relatively low cost

Allow the Direct Metering of Effluent from Individual Sources thereby Providing for Reduction Incentivization via Fair Billing of Service

Provide Opportunities **for Gray** Water Separation at the **Source** and thereby provide low cost Treatment Options

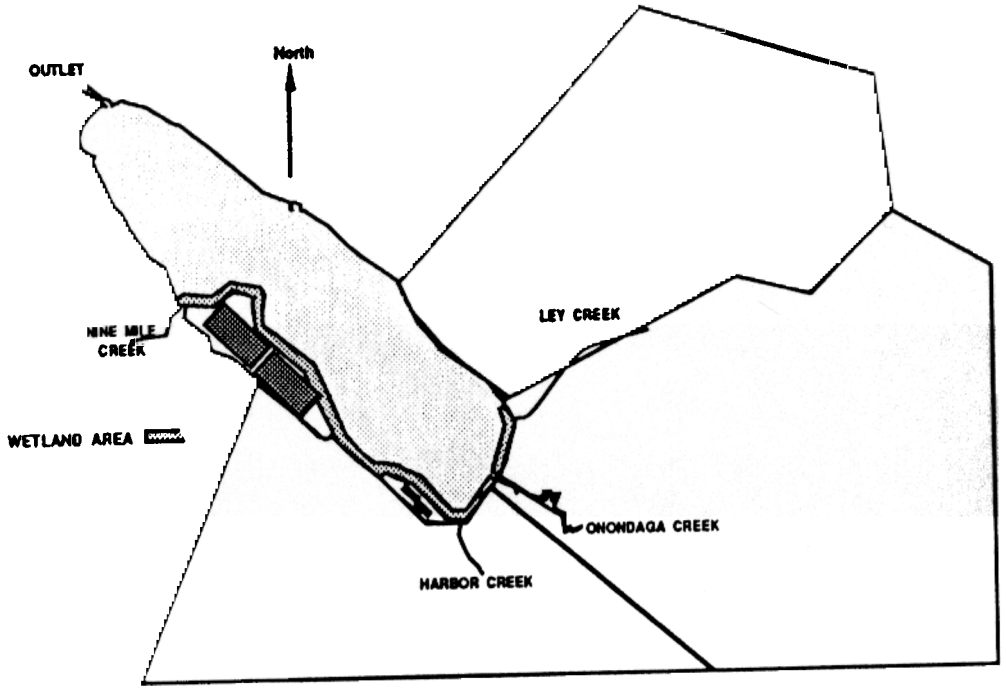
FACILITY BENEFITS

Higher Quality of Treatment lower flows allow for Longer HRTs

Increased Capacity allow both Water Supply and Treatment to Serve Growing Community without Additional Investment

PHASE IV QUALITY EVOLUTION

QUALITY IMPROVEMENT Quality and cost improvements through phased influent reductions



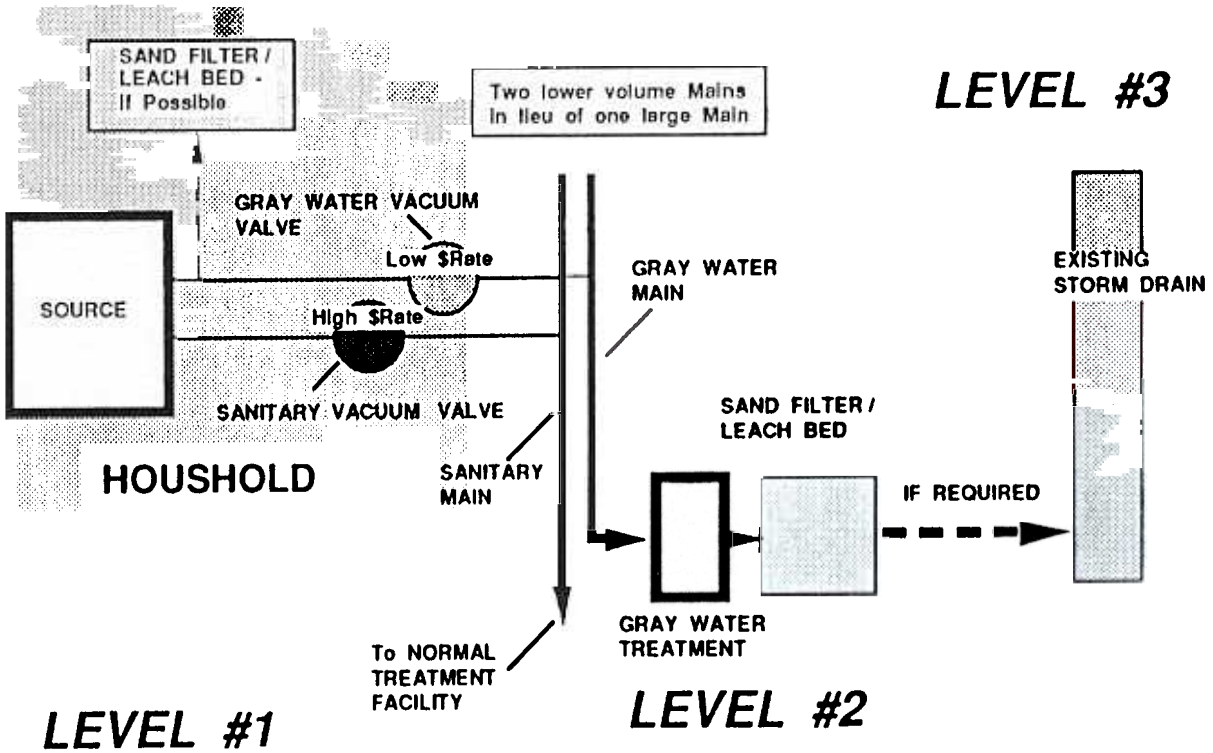
Influent abatement:

Through a phased program of installation of dual - gray water / sanitary vacuum sewers

Reduced inflows produce higher quality treatment at reduced costs

PHASE IV SEWER SEPARATION

SEPARATION The installation of Vacuum Sewers allows for three levels of separation within the treatment system



TOTAL CAPACITY = 110 MGPD

GRAY WATER = 80 MGPD

SANITARY = 30 MGPD

Separation of influent types optimizes treatment resources

SUMMARY OF IMPROVEMENT

IMPROVEMENT GOALS

The Primary Technical Measures of Improvement can be reduced to a measurement of the Reductions from Present Inflows of BOD, SS, Total Phosphorous & Nitrogen into the Lake. The final goal (figure of merit = 100%) is a reduction of >95% for all of these Technical Factors.

PHASE I REDUCTION GOAL > 25% IN ALL COMPONENTS

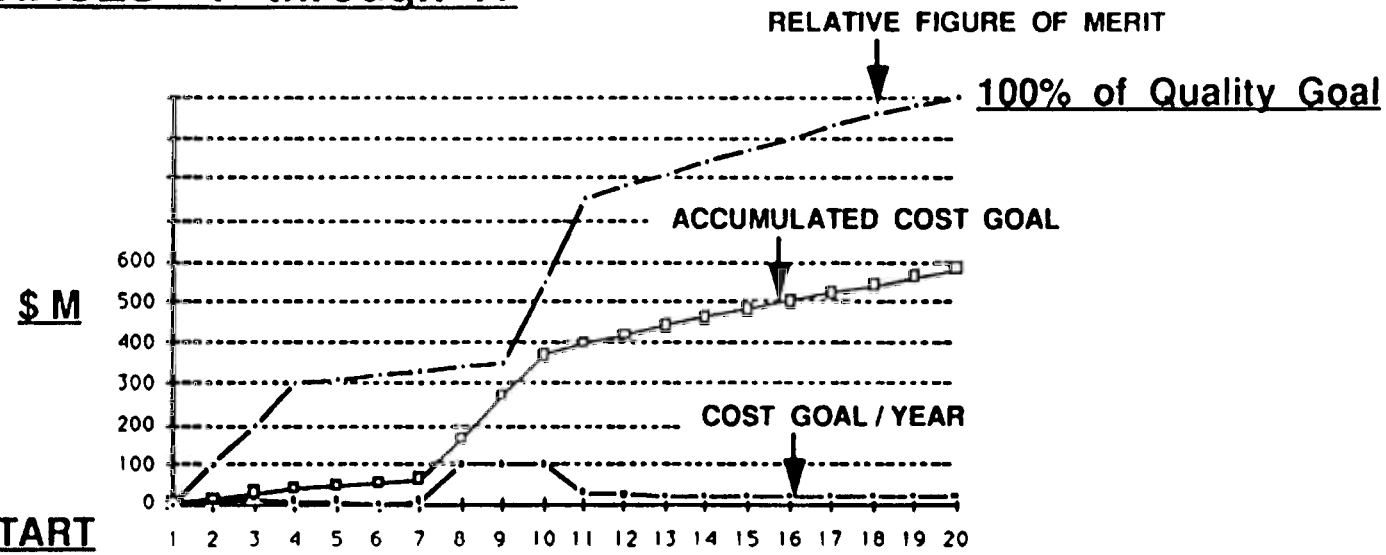
PHASE II REDUCTION GOAL Essentially no change from PHASE I

PHASE III REDUCTION GOAL > 75% IN ALL COMPONENTS

PHASE IV REDUCTION GOAL > 95% IN ALL COMPONENTS

PLAN SCHEDULE & GOALS

PLAN for PHASES I through IV



YEAR from START		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
PHASE I	25	7	1																	
PHASE II	30		6	8	12	2	1	1												
PHASE III	325						10	100	100	100	10	3	2							
PHASE IV	200										20	20	20	20	20	20	20	20	20	20
COST GOAL / Year		7	9	15	8	12	2	11	101	100	100	30	23	22	20	20	20	20	20	20
ACCUMULATED COST GOAL		7	16	31	39	51	53	64	165	265	365	395	418	440	460	480	500	520	540	560	580
Lake quality plot value			100	200	300	310	320	330	340	350	550	750	780	810	840	870	900	930	960	980	1000
LAKE QUALITY GOAL			10	20	30	31	32	33	34	35	55	75	78	81	84	87	90	93	96	98	100

PLAN COST GOALS

COST GOALS

PHASE I

DESIGN		2.5
STREET WASHDOWN EQUIPMENT		.5
INITIAL WETLANDS CONSTRUCTION		9
ONONDAGA WEIR CONSTRUCTION		8
SWIRL SEPARATORS	2 + 3 =	5
		$ 25 M

PHASE II

DESIGN	2
JEWELL PILOT CONSTRUCTION	14
VACUUM SEWER PILOT CONSTR.	6
WETLANDS IMPROVEMENTS	3
	$ 30 M

PHASE III

DESIGN	10
FSD CONSTRUCTION	300
	$ 310 M

PHASE IV

FSD VACUUM SEWERS	200
	$ 200 M

INVALUABLE VALUE

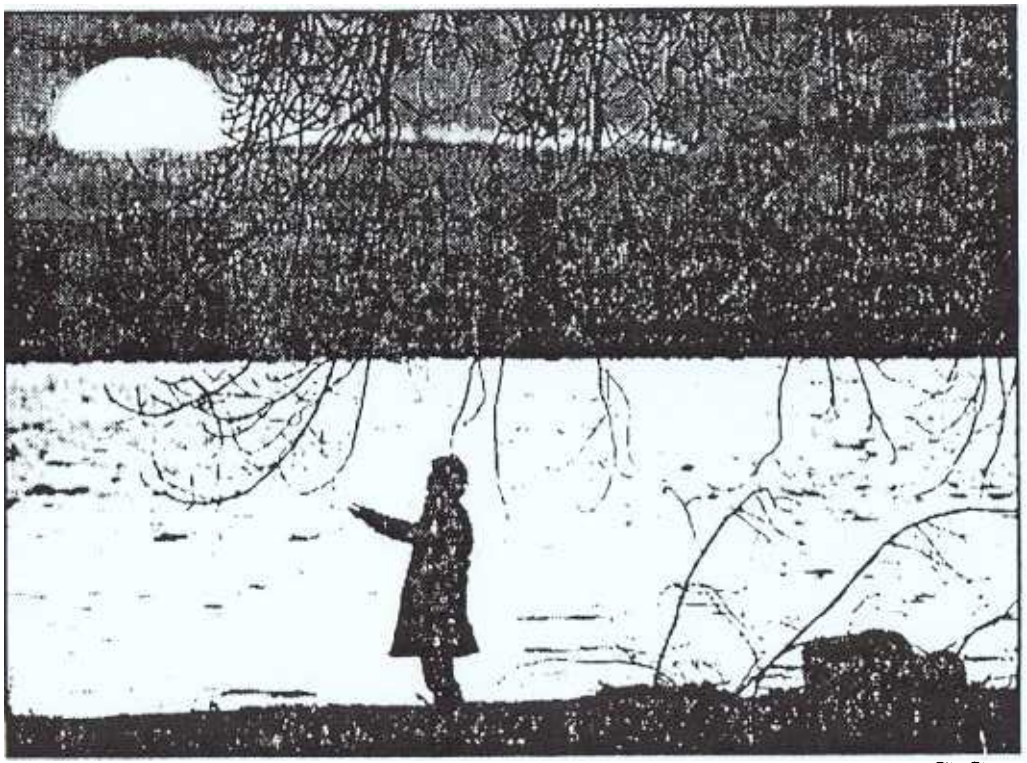
VALUE BEYOND COST and QUALITY of TREATMENT

WILDLIFE The presence of Wildlife in immediate proximity to daily living patterns promotes contact and provides reminders of true value. We are part of Nature and as such we are fundamentally inseparable from it.

EDUCATIONAL RESOURCES Our local community contains two excellent resources for skills key to the Onondaga Wetlands Plan, ESF and Cornell. This plan will provide a core upon which these Institutions can build and consequently promote a reservoir of skills needed to carry out the plan. We are at the forefront of a truly environmentally conscious era, where skills which allow us to work with nature will have high value.

DEVELOPMENT ENRICHMENT A Wetlands environment enhances the atmosphere for other community developments, provides a setting rich in contrast variety and possibility. This diverse setting would become a magnet for the community.

NEXT STEP A comprehensive Engineering Development Plan



POST-STANDARD File Photo

POSSIBLE COUNTY ACTIONS

PROVIDE LOW COST ALTERNATIVES

FUND AN ENGINEERING EVALUATION OF THE WETLANDS PLAN

1) Quantify design, performance, and costs to allow for direct comparisons to the existing plan.

2) Identify possible alternatives within the Wetlands Plan.

3) Seek public input to a final plan - a combination of the two plans may be most acceptable.