Appendix J-3
Nitrogen Loading and Mitigation Evaluation

Zebb Environmental Solution Inc.

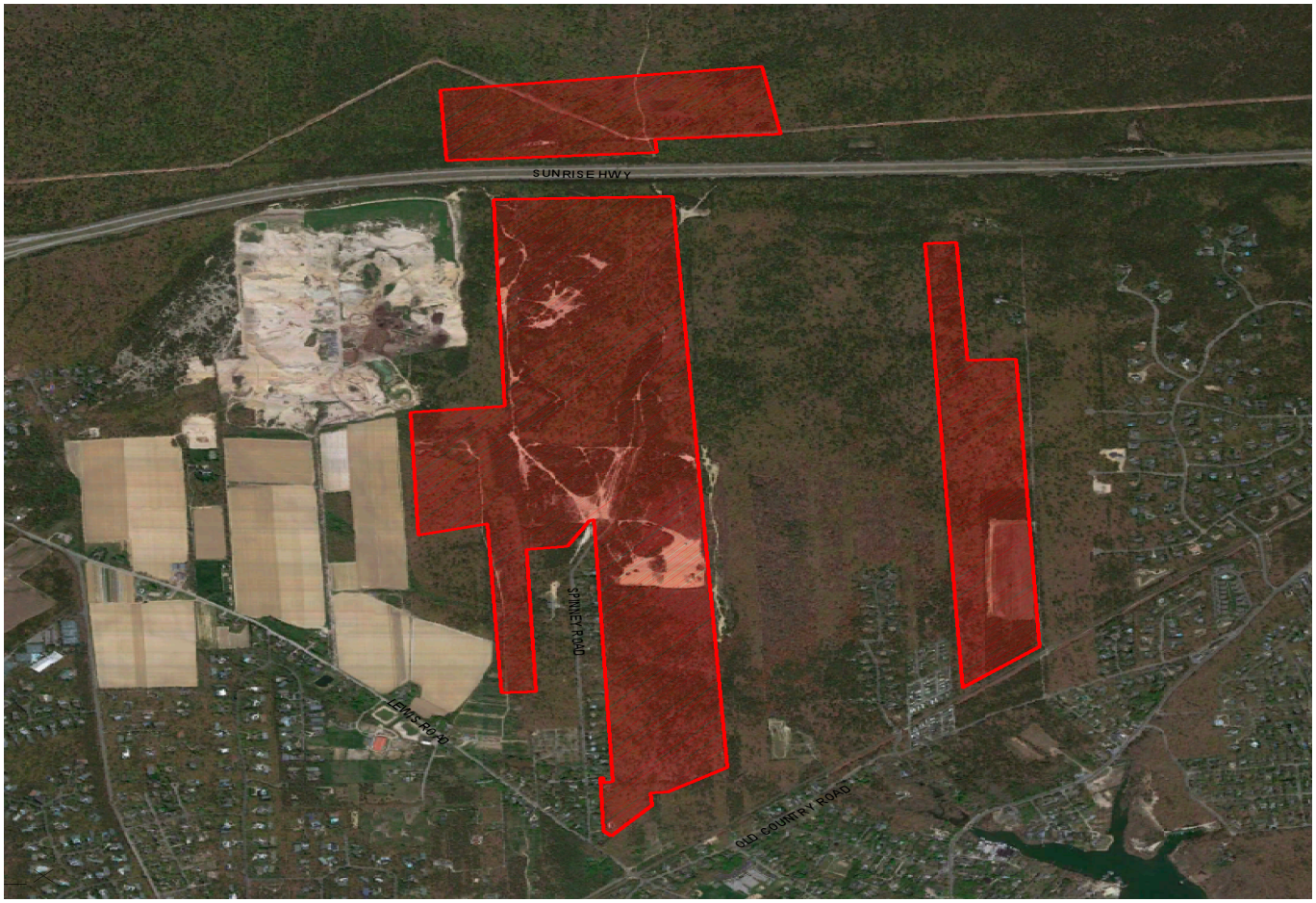
June 28, 2017

NELSON POPE & VOORHIS, LLC
ENVIRONMENTAL • PLANNING • CONSULTING

Nitrogen Loading and Mitigation Evaluation

The Hills at Southampton Planned Development District

East Quogue, New York



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June 28, 2017

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EXECUTIVE SUMMARY

ZEB Environmental Solutions, Inc. (ZEB) has prepared this report to provide a professional and unbiased evaluation of potential nitrogen loading resulting from the proposed Hills at Southampton Planned Development District (PDD), along with an evaluation of the proposed mitigation techniques. In order to provide an unbiased evaluation, ZEB has reviewed the following documents:

- Draft Environmental Impact Statement for The Hills at Southampton, prepared by NP&V dated September 2017
- Comments on the DEIS of the Hills PDD: Effects of Surface and Groundwater Quality, prepared by Christopher J. Gobler, PhD of Stony Brook University, dated March 2017
- A Review of the DEIS of The Hills at Southampton, prepared by Legette, Brashears, and Graham, Inc. for the Group of the East End, dated November 7, 2016
- The Hills – Water Resources Technical Meeting Minutes, prepared by Charles Voorhis, Martin Petrovic, Christopher Gobler, Paul Grosser, and Robert Grover, for the Town of Southampton dated February 1, 2017
- The Hills – Water Resources Technical Meeting Minutes, prepared by Charles Voorhis, Martin Petrovic, Christopher Gobler, Paul Grosser, Robert White, and Robert Grover, for the Town of Southampton dated March 17, 2017

In addition, We have personally attended several public hearings on the DEIS, informational meetings held by the developer, and meetings held by the East Quogue Civic Association.

The quality of the groundwater beneath the subject site has been very well documented and contains elevated concentrations of nitrate and perchlorate from historic agricultural uses in the area. All parties agree to this fact, however there has been some disagreement on the quantity of nitrogen loading resulting from this proposed project. The developer states that total nitrogen loading will be approximately 2,000 lbs/year. Many opponents of this project disagree with this nitrogen loading rate, and suggest that the quantity should be slightly higher.

We believe that it is more important to focus on the nitrogen mitigation/remediation components of this proposed project rather than loading rates. The developer has proposed several components of this project to prevent nitrogen from further impacting groundwater. These include greens and tee boxes lined with impervious materials to capture infiltration, the construction of bioswales and rain

gardens to capture and treat runoff and water from greens and tee boxes, minimal fertilization plans, and the use of state of the art sewage treatment. In addition, the developer has proposed using a Suffolk County Water Authority Well (SCWA) in the area that requires blending with other SCWA wells due to excessive nitrogen and using this well for irrigation purposes. This will act as a pump and treat system to remove the nitrogen from the already impacted aquifer and be used as fertigation.

1.0 EXISTING GROUNDWATER CONDITIONS

As a result of many years of improper agricultural practices on this property and adjacent properties, the groundwater beneath the site has been impacted with elevated concentrations of nitrate along with other metals and pesticides.

Groundwater quality data was available for the immediate area of the parcel which was obtained from the Suffolk County Water Authority who maintains a well field at the northern end of Spinney Road. The data provided consists of untreated raw water withdrawn from the Upper Glacial aquifer. Review of the data revealed the presence of several inorganic compounds. In addition, several pesticide compounds were detected and include aldicarb sulfoxide, aldicarb sulfone and DCPA diacid which are probably related to agricultural land use in the area upgradient of the site. The detections of aldicarb sulfoxide and aldicarb sulfone were found to exceed their respective NYSDEC TOGS 1.1.1 ambient water quality standards for class GA groundwater. Also of note are the detections of nitrate which was found at concentrations ranging from 9.22 to 15.22 mg/L and exceeds its respective NYSDEC TOGS 1.1.1 ambient water quality standards for class GA groundwater. A complete copy of the SCWA well data is included as **Appendix A**.

In addition, to SCWA groundwater data, site specific data was collected from four well points installed on the subject property. The water samples were taken from the groundwater interface using fully screened wells with 15 feet of screen 5 feet above the water table and 10 feet into the water table. Samples were extracted from the groundwater interface after purging with dedicated hand bailers. Review of the data revealed the presence of three inorganic compounds (iron, lead and manganese) that were above their respective NYSDEC TOGS 1.1.1 ambient water quality standards for class GA groundwater and are likely the result of natural sources related to geologic deposits. Total nitrogen was detected in concentrations that ranged from ND to 29 mg/l indicating substantially elevated nitrogen concentrations in areas downgradient of agricultural areas. A summary of the site specific groundwater quality data is provided in Table below.

TABLE 1-1

Existing Groundwater Quatlity

Constituent	MW-1	MW-2	TW-1	TW-2	NYSDEC TOGS 1.1.1
Volatile Organics			None Detected		
Semi-volatile Organics			None Detected		
Metals	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/kg**
Barium	NA	NA	ND	0.12	1
Copper	0.05	0.03	ND	ND	0.2
Iron	43.6	30	0.18	1.87	0.3
Lead	0.064	ND	ND	ND	0.025
Manganese	3.16	2.63	0.02	0.34	0.3
Zinc	0.13	0.08	ND	ND	2
Nitrogen Parameters	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
Total Nitrogen	2.00	ND	**29.00**	4.65	10
Total Organic Nitrogen	ND	ND	ND	ND	
Total Kjeldahl Nitrogen	1.2	ND	1.5	ND	
Chloride	7.86	7.49	24.70	11.10	250
Nitrate	0.80	0.65	27.50	4.65	10
Nitrite	ND	ND	ND	ND	1
Sulfate	7.89	6.19	31.60	19.30	250
Total Phosphorus	0.398	0.584	ND	ND	NS
Ammonia	1.30	ND	ND	ND	2

2.0 LINED GREENS AND BIOSWALES

2.1 Lined Greens

According to the DEIS the 2.62 acres of greens will be fertilized at a similar rate as the fairways, but due to the drainage qualities of these greens, it is advisable to provide a means to capture and treat recharge. Specifically, each of the 18 greens on the golf course will be lined with an impervious material (30 mil thick high density polyethylene, HDPE), to capture the stormwater infiltrating through these surfaces as it passes into the subsoil. Due to runoff, it is estimated that approximately 50% of the water will be collected from the green liners.

The recharged water from these surfaces will be directed into bioswales/rain gardens which will ensure that 70% of the nitrogen is absorbed by plant uptake and/or through denitrification processes. The rain garden/bioswale system provides a mulch layer and a restrictive soil medium to increase the residence time of the runoff from the greens within the rain garden media. The longer residence time provides an anaerobic state within the soil media that results in increased fixation of nitrogen within the media. Recent studies show overall nitrate-nitrite retention of 70-80% depending upon more mulch content and anaerobic conditions.

The Figures on the following pages provide a schematic of the lined greens, water collection system, and rain gardens/bioswales.

WATER QUALITY VOLUME AS PER THE CURRENT NEW YORK STATE STORMWATER MANAGEMENT DESIGN MANUAL'S 90% DESIGN STORM RULE = 1.5" FOR THE SITE

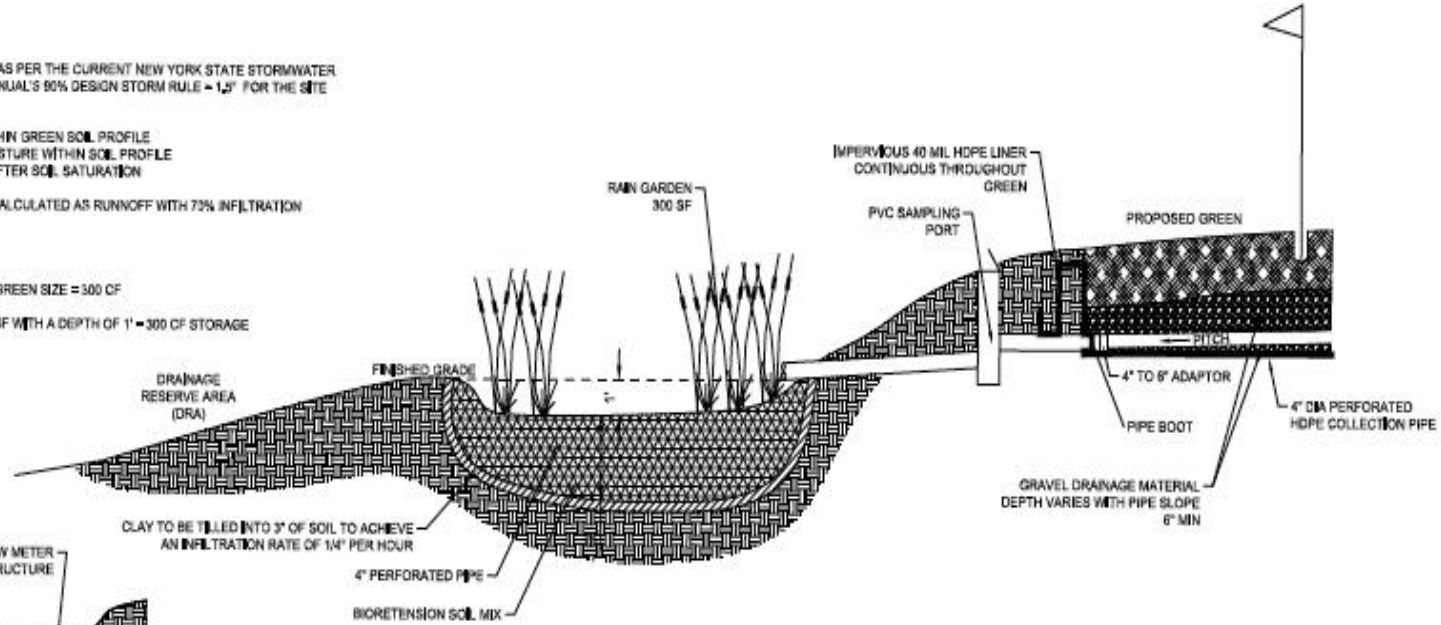
1.5" = 90% RULE
-0.75" = STORAGE WITHIN GREEN SOIL PROFILE
+0.18" = RESIDUAL MOISTURE WITHIN SOIL PROFILE
0.93" = REMAINDER AFTER SOIL SATURATION

-0.28" = 30% OF 0.93" CALCULATED AS RUNNOFF WITH 70% INFILTRATION
0.65" INFILTRATION

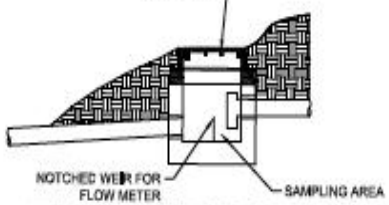
0.65" / 12" = 0.05'

0.05' X 6,000 SF AVERAGE GREEN SIZE = 300 CF

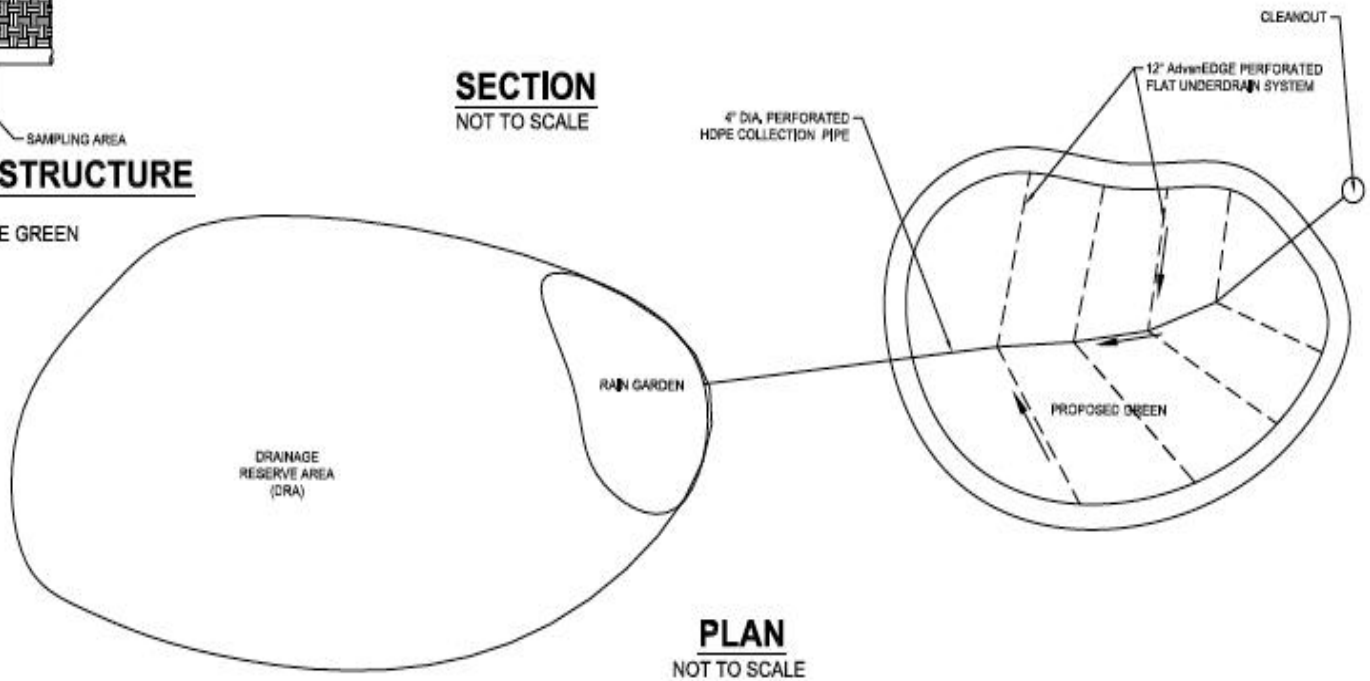
RAINGARDENS TO BE 300 SF WITH A DEPTH OF 1' = 300 CF STORAGE



SECTION
NOT TO SCALE



FLOW METER STRUCTURE
NOT TO SCALE
TO BE INSTALLED ON ONE GREEN



PLAN
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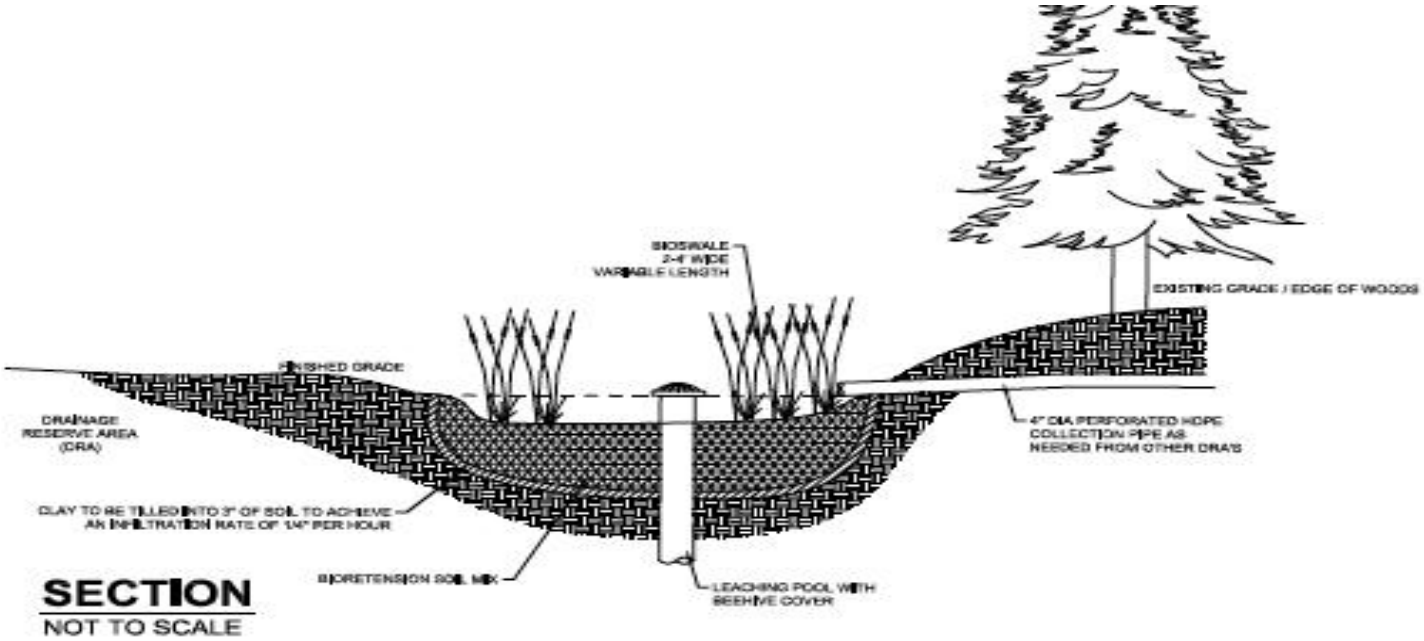
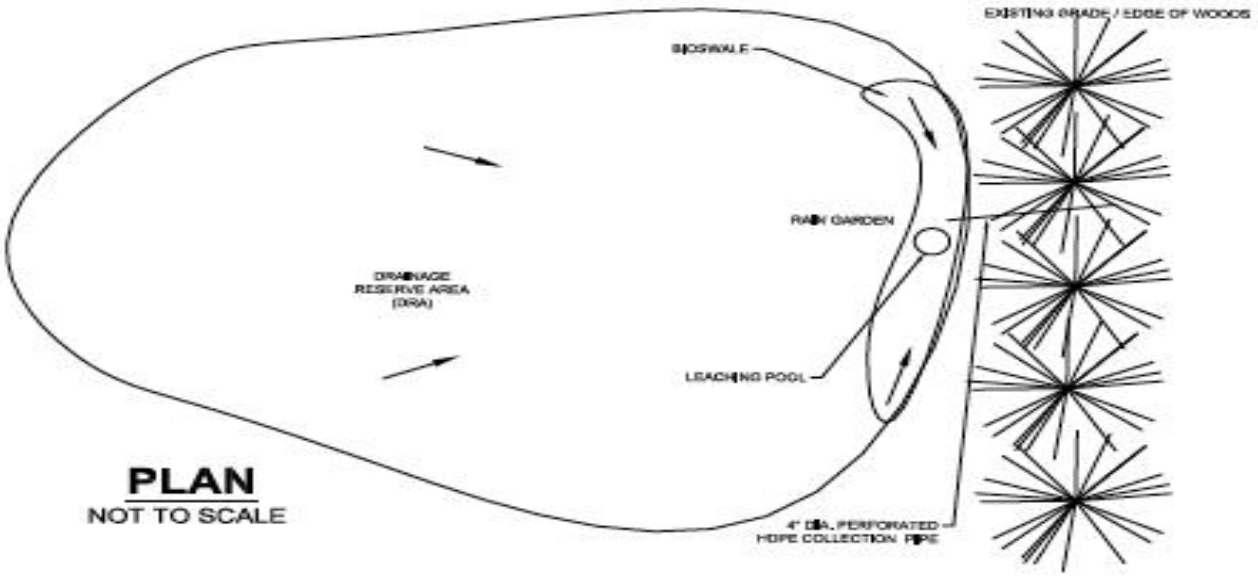

BIOSWALE
2-4' WIDE
VARIABLE LENGTH
EXISTING GRADE / EDGE OF WOODS
FINISHED GRADE
DRAINAGE
RESERVE AREA
(DRA)
4" DIA PERFORATED HDPE
COLLECTION PIPE AS
NEEDED FROM OTHER DRA'S
CLAY TO BE TILLED INTO 3" OF SOIL TO ACHIEVE
AN INFILTRATION RATE OF 1/4" PER HOUR
BIORETENSION SOIL MIX
LEACHING POOL WITH
BEEHIVE COVER
SECTION
NOT TO SCALE


EXISTING GRADE / EDGE OF WOODS
BIOSWALE
RAIN GARDEN
DRAINAGE
RESERVE AREA
(DRA)
LEACHING POOL
4" DIA. PERFORATED
HDPE COLLECTION PIPE
PLAN
NOT TO SCALE

2.2 Bioswales

Natural systems use vegetated depressions, wetlands, marshes, etc. to clean storm water runoff by removing sediments, turbidity, heavy metals, and other pollutants. This is accomplished by vegetation uptake, some by natural flocculation from decomposing vegetation, some by just slowing the flow down enough for sedimentation to occur, and some by biota consumption and ionic attraction around the root structure remove some pollutants. Runoff can pick up suspended solids, metals, organic material, etc. Without a vegetated area to slow and collect the particles in the flowing water, contaminated water will flow into larger water bodies contributing to their degradation. Bioswales and are an ideal natural solution for collecting and storing large amounts of runoff. Three main components are essential for an effective bioswale: Soil, Microorganisms, and Vegetation.

Constructed wetlands, phytofiltration, and bioswales can be successfully built and operated in most soil types provided the subsoil in the area of the biofilter is optimized for the maximum benefit of the biofilter. The subsoil can include soil, sand, gravel, rock, and organic materials such as compost or composted biosolids. Sediments, naturally settled suspended solids and colloidal suspensions (turbidity) will accumulate in the biofilter from the low velocity of water flow, natural flocculation, bioactivity, and decaying vegetation to add to the substrate (bottom) where vegetative uptake can make use of it. The substrate is important and should be uncompacted because:

- It has a higher permeability to allow the movement of water through the biofilter.
- Higher porosity giving the subsoil a higher water storage capacity.
- Biologically, uncompacted soil promotes good root development and ample conditions for microorganisms development.

It is assumed that, along with the vegetation, the soil will act as a filtering media for suspended particles such as nitrogen. The following properties must be considered to maximize filtration efficiency: Cation Exchange capacity, Anion Exchange capacity, pH, Electrical conductivy, and present organic matter. The retention of heavy metals and nutrients is influenced by the pH of the soil. The pH of the soil should be between 6.5 and 8.5 for optimal results. Organic material, clays, and loam have the highest ion exchange capacity and should therefore be utilized for all the constructed bioswales/ rain gardens associated with this property. Per the EIS, a soil survey was conducted by the US Department of Agriculture in 1975 identifying thirteen (13) soil types throughout the subject property. The soil present on the site meets the drainage characteristics necessary for a healthy wetland subsoil. Specifically, the Plymouth Loamy Sand, which occupies a large portions of the southern parcel, may be used as a sub surface soil. The Gravel pits, occupying approximately 36.8 acres (according to the

EIS), can be used for constructing the bioswale water channels. The Riverhead Sandy Loam can be used in combination with fertilizer/compost as a surface soil. Typical mixture ratios for fertilizer to soil should be around 1:3 fertilizer to existing soil.

The establishment and maintenance of a healthy biological colony may be the most important aspect of the construction and continuing viability of the biofilter. The right biota for the biofilter is important because it is the microorganisms to a great extent, which capture and convert pollutants and nutrients into a form, which can be easily consumed by the vegetation. Many pollutants are in an insoluble form, which vegetation cannot use. The biological food chain converts these nutrients and pollutants from their stable insoluble form into ones, which are easily consumed by the vegetation established in the biofilter. The microorganisms work in a symbiosis with the plants to capture and uptake the pollutants and nutrients in the storm water runoff. Endomycorrhiza or arbuscular mycorrhizae fungi help the vegetation root structure bring in water and nutrients.

The establishment of health soil biota can be accomplished through the tilling of compost into the soil of the biofilter during construction or through the preparation of the biofilter soil by the addition of a carbon source, compost, material to loosen the soil, and commercially available biological organisms. Again the soil must remain uncompacted for the micro biota to thrive and to promote successful root development.

Vegetation is the most crucial component of a bioswale. Native plant species are a must for use in biofilter design. Proper selection of native species can provide year-round vegetative cover without need for supplemental irrigation or fertilization. Vegetation chosen for bioswales must provide dense cover of the bioswale area, a strong root system to prevent erosion, and must stand upright in order to provide maximum residence time and pollutant removal. Furthermore, native species usually provide high habitat value for indigenous birds and other animals. Exotic non-native species can become invasive if allowed to proliferate. Local municipal agencies, like the New York Department of Environmental Conservation and Suffolk County Department of Health, can provide lists of acceptable and non-acceptable herbaceous plants and grasses. Selection of turf or woody plants depends on the desired capacity and residence time of the storm water and pollutants in the biofilter. When considering plant species composition it is important to consider the contaminants of concern. For this specific property nitrogen uptake and TSS (Total Suspended Solids) are of concern and bioswales associated with this project should have a plant community that thrives in both drought and inundated setting with a high root density and a high nutrient uptake rate. **Appendix B** contains fourteen (14) plant species fact sheets that would be ideal for this project. The species selected will

stabilize the soil and contain a dense root network capable of filtering the contaminants associated with this project. The selected plants will require minimal maintenance after successful germination. Prior to germination, it is important that the vegetation be planted in the correct elevation to maximize success of each of the species. Selected native species that may thrive in a local bioswale are listed below:

Table 2-1 – Effective Bioswale Species

Low Marsh	Middle to High Marsh
New York Aster(Symphyotrichum novi-belgii)	Red Fescue (Festuca rubra)
Red Fescue (Festuca rubra)	Broomsedge Bluestem (*Andropogon virginicus)*
Fowl Mannagrass (Glyceria melicaria)	Swamp Milkweed (*Asclepias incarnate*
Arrow Arum *(Peltandra virginica)*	Black Eyed Susan (*Rudbeckia hirta)*
Blue Flag (*Iris versicolor)*	Redosier Dogwood (*Cornus sericea)*
Swamp Milkweed (*Asclepias incarnate)*	Canada Goldenrod (*Solidago Canadensis)*
Hard Stem Bulrush *(Scirpus acutus)*	Coastal Sweet Pepperbush (*Clethra alnifolia)*
Weak Rush (*Juncus debilis)*	Common Buttonbush (Cephalanthus occidentalis)

It usually takes at least two years to effectively establish the bioswale vegetation unless compost amendment of the subsurface soil occurs. This means that to prevent erosion and loss of vegetation during the first year, some method must be used to protect the seeds, if seeding is used, other vegetation planted, and provide for the soil isolation and armoring from the water flow. The use of biodegradable geotextiles laid over seeds or the use of a liner through which vegetation can grow from the top down will provide the necessary isolation and armoring needed. The main ingredient needed to provide the isolation and armoring is complete soil coverage and good anchoring of the material.

Erosion control fabrics are usually classified into mulches; organic, biodegradable, andnon-biodegradable blankets and netting; and soil-filled turf reinforcement mats. The use of tackified mulches should only be considered for low-velocity swales or bioswales planted early in the summer and irrigated for vegetation establishment. Note that mulches will add to the nutrient load in the bioswale until it is consumed and may be subject to increased erosion until the vegetation is fully established. Erosion control blankets and netting can be made completely of or in combinations of

jute, coconut fibers, straw, excelsior, and various plastics, and are usually installed stapled or staked into the ground or weighted down with rock or gravel. A seed mixture may be installed in the mat or they may be installed over the seed. Biodegradable blankets or nets degrade thus stabilizing the swale over the short term but providing no longterm protection. Turf reinforcement mats (TRMs) are flexible, synthetic mats filled with soil. They provide long-term channel and vegetation stabilization at water velocities in the range of fourteen to twenty feet per second.

The following are common problems encountered during construction, which result in problems for the best effective bioswale vegetation establishment.

- Crews unfamiliar with the concept behind bioswales;
- Timing of the construction of the bioswale is delayed;
- Compaction of the bioswale subsoil and subsequent failure to correct the problem;
- Poor timing of bioswale construction, such that the bioswale is inundated with sediment-laden runoff, seeding is washed off by the first rains, or erosion occurs in the bioswale and turbidity laden waters are discharged ;
- Cost cutting occurs in the selection and planting of the vegetation; and
- Poor preparation of the swale channel to accept flows, i.e. check dams are not installed

Obtainable reductions of pollutants in bioswales are:

- Total Suspended Solids – 83 to 92%
- Turbidity (with 9 minutes of residence) – 65%
- Lead – 67%
- Copper – 46%
- Total Phosphorus – 29 to 80%
- Aluminum – 63%
- Total Zinc - 63%
- Dissolved Zinc – 30%
- Oil/Grease – 75%
- Nitrate-N – 39 to 89%

These results can be obtained for a bioswale at least 200 feet in length with a maximum runoff velocity of 1.5 ft./sec., a water depth of from one to four inches, a grass height of at least 6 inches, and a minimum contact (residence) time of 2.5 minutes. It is important to maintain a diverse plant community so that the distinct uptake rates of each plant species can be used in combination as an effective biofilter.

2.3 Rain Gardens

A rain garden is a planted depression allows rainwater runoff from impervious urban areas, like roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be absorbed. This reduces rain runoff by allowing storm water to slowly infiltrate into the subsurface.

Native and adapted plants are recommended for rain gardens because they are more tolerant of the local climate, soil, and water conditions; have deep and variable root systems for enhanced water infiltration and drought tolerance; habitat value and diversity for local ecological communities; and overall sustainability once established. The plants, a selection of vegetation tolerant to a variety of environments, such as wildflowers, sedges, rushes, ferns, shrubs and small trees, take up excess water flowing into the rain garden. Water filters through soil layers before entering the groundwater system. Root systems enhance infiltration, maintain or even augment soil permeability, provide moisture redistribution, and sustain diverse microbial populations involved in biofiltration. Also, through the process of transpiration, rain garden plants return water vapor to the atmosphere. A more wide-ranging definition covers all the possible elements that can be used to capture, channel, divert, and make the most of the natural rain and snow that falls on a property. The whole garden can become a rain garden, and each component of the whole can become a small-scale rain garden in itself.

Appendix C contains several plant species fact sheets that would be ideal for this project. The species selected will stabilize the soil and contain a dense root network capable of filtering the contaminants associated with this project. The selected plants will require minimal maintenance after successful germination. Prior to germination, it is important that the vegetation be planted in the correct manner to maximize the growth of the plants. Selected native species that may thrive in a local rain garden are listed below:

Table 2-2 – Effective Rain Garden Species

Species Name (*Scientific name*)
Sweet Fern (*Comptonia peregrina*)
Little Blue Stem(*Schizachyrium scoparium*)
Big Blue Stem (*Andropogon gerardii*)
Black Eyed Susan (*Rudbeckia hirta*)
Woodland Sunflower (*Helianthus divaricatus*)
Wild Indigo (*Baptisia australis*)

3.0 FERTIGATION

Fertigation is the injection of fertilizers, soil amendments, and other water-soluble products into an irrigation system. Fertigation is practiced extensively in commercial agriculture and horticulture. Fertigation is also increasingly being used for landscaping as dispenser units become more reliable and easier to use. Fertigation is used to add additional nutrients or to correct nutrient deficiencies detected in plant tissue analysis. It is usually practiced on high-value crops such as vegetables, turf, fruit trees, and ornamentals.

The Fertigaiton technique proposed for this project will use the nitrate laden groundwater contained beneath the site for irrigation of the greens and tees and other landscaped areas. This will both remediate nitrogen-impacted groundwater beneath the site and will also provide a source of fertilizer for irrigated vegetation. This will also reduce the quantity of additional fertilizers that will need to be applied on the property.

4.0 ALTERNATIVE WASTEWATER TREATMENT

The Developer is proposing to install a Baswood BioVore wastewater treatment system, a modular unit manufactured by Baswood Corporation in Allen, Texas. This system can handle up to 90,000 gallons of wastewater daily—more than double what the development is expected to generate each day during the summer months, the peak occupation time for the seasonal community. If the Baswood BioVore wastewater treatment system, which is now being reviewed by the Suffolk County Health Department, is eventually installed in East Quogue, up to several dozen nearby single-family homes, as well as the hamlet's elementary school, also eventually could be connected to the plant, further improving groundwater quality.

The Baswood BioVore system features three vessels, or compartments, that contain different "environments," each relying on different natural chemical reactions to break apart the components of wastewater. In each vessel, bacteria grow and digest contaminants, primarily nitrogen, and remove them from the wastewater stream. In total, all waste would be broken down nine times—three times per vessel—before exiting the enclosed system and being released into the groundwater via an field of leaching pools. If any solids remain after the multiple digestion processes, they will be returned to the original digestion chambers for further breakdown. The Basewood BioVore system has been implemented at similar locations and show reduction rates of 54% for total nitrogen and 69% for total suspended solids (TSS). Energy requirements for this wastewater system are minimal (up to 50% lower than competing wastewater systems) and limited operational oversight translates to a lower life cycle costs and less environmental impacts. More information regarding the Baswood BioVore wastewater treatment system is contained In **Appendix D.**

5.0 CONCLUSIONS

It is well know that experts have been disagreeing over nitrogen loading rates for this project and whether the proposed PDD would be more beneficial that the as-of-right development scenario. Based on the mitigation measures proposed, it is clear that these measures, mainly the fertigation techniques, the lined greens, and creation of bioswales and rain gardens will offset nitrogen loads created by the development. In addition, the fertigation measures (pump and treat) will ultimately improve groundwater quality beneath the site. Finally, it is important to note that this project is over 1,500 feet from surface waters (Weesuck Creek). Given this distance, surface waters can only be impacted via groundwater intrusion and not by runoff. The Sections above discuss in detail the measure that will be put in place to prevent nitrogen and other contaminants from reaching groundwater. Further, the fertigation Section discusses how this pump and treat process will remove nitrogen from the already compromised groundwater.

6.0 SIGNATURE OF ENVIRONMENTAL PROFESSIONAL

I declare that I am a Professional Geologist (License No 000130) certified by the New York State Education Department. A copy is included as **Appendix E**. I have the specific qualifications based on education, training and experience to assess a property of the nature, history and setting of the subject property.

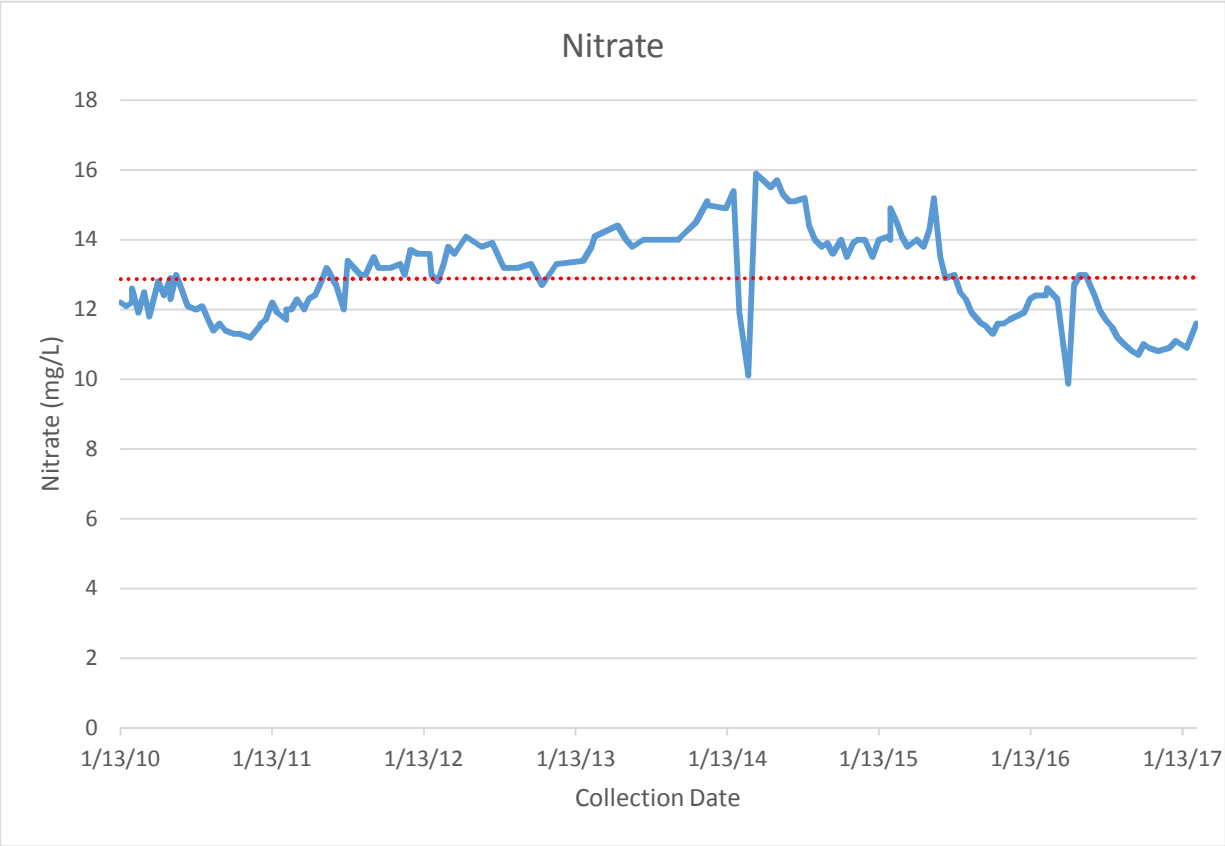
Zeb Youngman
President

Report Completion Date: June 28, 2017

APPENDIX A

EXISTING GROUNDWATER DATA

SCWA - Spinney Road Well # 2 - Nitrate Sample Results



AVG	12.90
MAX	15.90
MIN	9.88

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
01/12/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.19**	<0.200	**41.0**
01/12/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.3**	<0.200		**8.18**	<0.200	**42.0**
01/27/10	0600	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.6**	<0.200		**8.63**	<0.200	**40.6**
01/27/10	0600	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**8.57**	<0.200	**40.9**
02/10/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**8.51**	<0.200	**41.2**
02/10/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.9**	<0.200		**8.63**	<0.200	**41.6**
02/23/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.1**	<0.200		**7.95**	<0.200	**40.3**
02/23/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**8.05**	<0.200	**40.4**
03/09/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.8**	<0.200		**8.09**	<0.200	**38.9**
03/09/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.30**	<0.200	**39.6**
03/24/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**13.9**	<0.200		**7.67**	<0.200	**37.2**
03/24/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.3**	<0.200		**7.91**	<0.200	**38.4**
04/14/10	0620	0 + 30	2208	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.1**	<0.200		**8.49**	<0.200	**37.8**
04/14/10	0620	0 + 30	2208	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**8.45**	<0.200	**39.9**
04/27/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.4**	<0.200		**8.19**	<0.200	**39.0**
04/27/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**8.43**	<0.200	**39.8**
05/11/10	0130	1 + 0	2009	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**15.3**	<0.200		**8.52**	<0.200	**38.3**
05/11/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.6**	<0.200		**8.16**	<0.200	**39.3**
05/11/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.6**	<0.200		**8.73**	<0.200	**39.4**
05/25/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.9**	<0.200		**7.98**	<0.200	**39.8**
05/25/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.7**	<0.200		**8.42**	<0.200	**40.2**
06/09/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**8.56**	<0.200	**43.8**
06/09/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**8.70**	<0.200	**44.5**
06/22/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.25**	<0.200	**44.2**
06/22/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.1**	<0.200		**8.24**	<0.200	**44.3**
07/14/10	0920	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.8**	<0.200		**8.52**	<0.200	**45.8**
07/14/10	0920	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.38**	<0.200	**45.5**
07/27/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.0**	<0.200		**8.53**	<0.200	**42.5**
07/27/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**13.9**	<0.200		**8.03**	<0.200	**41.9**
08/10/10	0045	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.5**	<0.200		**8.59**	<0.200	**42.5**
08/10/10	0045	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.3**	<0.200		**8.27**	<0.200	**41.9**
08/25/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.4**	<0.200		**8.02**	<0.200	**41.5**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested

Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
08/25/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.4**	<0.200		**7.87**	<0.200	**41.2**
09/21/10	0130	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**13.8**	<0.200		**7.85**	<0.200	**40.2**
09/21/10	0130	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**13.6**	<0.200		**7.80**	<0.200	**39.6**
10/13/10	0040	0 + 30	2141	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**8.53**	<0.200	**41.0**
10/13/10	0040	0 + 30	2141	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.1**	<0.200		**8.35**	<0.200	**40.8**
10/24/10	1150	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.5**	<0.200		**8.03**	<0.200	**38.7**
11/21/10	1500	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**13.7**	<0.200		**8.78**	<0.200	**35.0**
11/21/10	1500	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.9**	<0.200		**8.56**	<0.200	**38.9**
12/12/10	1450	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.0**	<0.200		**9.95**	<0.200	**40.5**
12/12/10	1450	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**9.26**	<0.200	**39.0**
12/15/10	1045	0 + 30	1847	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**15.5**	<0.200		**8.88**	<0.200	**37.6**
12/26/10	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**8.17**	<0.200	**37.5**
12/26/10	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.6**	<0.200		**8.81**	<0.200	**38.6**
01/10/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.36**	<0.200	**35.8**
01/10/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**8.48**	<0.200	**37.0**
01/23/11	1440	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.94**	<0.200	**38.4**
01/23/11	1440	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**9.28**	<0.200	**38.9**
02/14/11	1445	0 + 30	2147	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**15.5**	<0.200		**9.56**	<0.200	**36.7**
02/27/11	1440	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**9.18**	<0.200	**37.0**
02/27/11	1440	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**9.27**	<0.200	**37.9**
03/13/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.1**	<0.200		**9.09**	<0.200	**37.0**
03/13/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.3**	<0.200		**9.56**	<0.200	**38.9**
04/10/11	1455	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.3**	<0.200		**9.45**	<0.200	**39.1**
04/10/11	1455	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.9**	<0.200		**9.40**	<0.200	**38.1**
04/25/11	1450	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.9**	<0.200		**9.17**	<0.200	**35.7**
04/25/11	1450	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**8.88**	<0.200	**36.9**
05/11/11	1440	0 + 45	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.3**	<0.200		**9.08**	<0.200	**37.0**
05/11/11	1440	0 + 45	1847	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.4**	<0.200		**9.49**	<0.200	**37.3**
05/22/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**9.87**	<0.200	**38.5**
05/22/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.0**	<0.200		**9.79**	<0.200	**38.4**
06/15/11	0940	0 + 40	1847	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**8.73**	<0.200	**40.2**
06/15/11	0945	0 + 45	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.2**	<0.200		**8.62**	<0.200	**39.9**

Kevin P. Durk, Director
NY Lab ID No: 10311
EPA Lab code: NY00014

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested

Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
06/29/11	0945	0 + 45	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.9**	<0.200		**8.90**	<0.200	**42.1**
06/29/11	0945	0 + 45	1847	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.0**	<0.200		**8.92**	<0.200	**42.5**
07/10/11	1030	0 + 30	2233	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.9**	<0.200		**8.82**	<0.200	**42.9**
07/10/11	1030	0 + 30	2233	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.0**	<0.200		**8.84**	<0.200	**43.2**
07/24/11	1455	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.7**	<0.200		**8.67**	<0.200	**39.3**
07/24/11	1455	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.8**	<0.200		**8.73**	<0.200	**39.8**
08/11/11	0920	0 + 45	1847	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**15.1**	<0.200		**8.57**	<0.200	**39.5**
08/11/11	0920	0 + 45	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.4**	<0.200		**8.84**	<0.200	**40.6**
08/11/11	0920	0 + 45	1847	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**8.91**	<0.200	**41.3**
08/21/11	1450	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.0**	<0.200		**8.48**	<0.200	**40.1**
08/21/11	1450	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**14.9**	<0.200		**8.68**	<0.200	**40.1**
09/11/11	1455	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**14.7**	<0.200		**8.69**	<0.200	**37.8**
09/11/11	1455	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.1**	<0.200		**9.06**	<0.200	**39.8**
09/25/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**9.48**	<0.200	**40.8**
09/25/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**9.10**	<0.200	**40.5**
10/10/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**9.47**	<0.200	**40.4**
10/10/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.1**	<0.200		**9.48**	<0.200	**42.3**
10/23/11	1445	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.1**	<0.200		**9.72**	<0.200	**42.1**
10/23/11	1445	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**9.34**	<0.200	**40.7**
11/17/11	0130	0 + 45	2300	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.5**	<0.200		**9.87**	<0.200	**38.4**
11/17/11	0130	0 + 45	2300	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.2**	<0.200		**9.55**	<0.200	**39.6**
11/28/11	0120	0 + 45	2300	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.8**	<0.200		**9.64**	<0.200	**40.0**
11/28/11	0120	0 + 45	2300	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**15.7**	<0.200		**9.40**	<0.200	**40.2**
12/12/11	0100	0 + 45	2141	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.4**	<0.200		**9.90**	<0.200	**41.0**
12/12/11	0100	0 + 45	2141	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.2**	<0.200		**9.77**	<0.200	**40.3**
12/28/11	0100	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.4**	<0.200		**10.1***	<0.200	**38.8**
12/28/11	0100	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.2**	<0.200		**9.42**	<0.200	**38.4**
01/11/12	0110	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.1**	<0.200		**10.7***	<0.200	**36.3**
01/11/12	0110	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**16.6**	<0.200		**9.97**	<0.200	**37.1**
01/25/12	0110	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.4**	<0.200		**11.7***	<0.200	**34.6**
01/25/12	0110	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.2**	<0.200		**11.0***	<0.200	**36.2**
02/15/12	0110	1 + 0	2009	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**16.0**	<0.200		**11.1***	<0.200	**30.2**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
02/15/12	0110	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**15.6**	<0.200		**12.3***	<0.200	**30.4**
02/29/12	0110	1 + 0	2009	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**16.7**	<0.200		**12.0***	<0.200	**32.8**
02/29/12	0110	1 + 0	2009	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.0**	<0.200		**11.3***	<0.200	**34.6**
03/12/12	0130	0 + 30	2141	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.3**	<0.200		**11.6***	<0.200	**34.4**
03/12/12	0130	0 + 30	2141	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.2**	<0.200		**11.5***	<0.200	**34.9**
03/29/12	1510	0 + 30	1885	GAC A EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.2**	<0.200		**10.8***	<0.200	**34.8**
03/29/12	1510	0 + 30	1885	GAC A INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.4**	<0.200		**11.1***	<0.200	**35.7**
08/14/12	0930	1 + 0	1885	RAW/HOP N/A	PROD	Q	<0.100	<0.100	**15.0**	<0.200		**8.37**	<0.200	**37.7**
08/27/12	0910	1 + 0	1885	GAC A EFF RAW N/A	PROD	M	<0.100	<0.100	**14.8**	<0.200		**8.21**	<0.200	**36.2**
08/27/12	0910	1 + 0	1885	GAC A INF RAW N/A	PROD	M	<0.100	<0.100	**14.9**	<0.200		**8.29**	<0.200	**36.5**
10/25/12	1500	1 + 0	1885	GAC A EFF RAW N/A	PROD	M	<0.100	<0.100	**15.3**	<0.200		**8.71**	<0.200	**36.5**
10/25/12	1500	1 + 0	1885	GAC A EFF RAW N/A	PROD	M	<0.100	<0.100	**15.4**	<0.200		**8.68**	<0.200	**36.7**
10/25/12	1500	1 + 0	1885	GAC A INF RAW N/A	PROD	M	<0.100	<0.100	**15.4**	<0.200		**8.14**	<0.200	**36.9**
10/25/12	1500	1 + 0	1885	GAC A INF RAW N/A	PROD	M	<0.100	<0.100	**15.4**	<0.200		**8.23**	<0.200	**36.9**
11/12/12	1510	0 + 25	1885	RAW/HOP N/A	PROD	Q	<0.100	<0.100	**15.5**	<0.200		**9.06**	<0.200	**35.9**
11/27/12	1455	0 + 30	1885	GAC A EFF RAW N/A	PROD	M	<0.100	<0.100	**15.4**	<0.200		**9.23**	<0.200	**35.0**
11/27/12	1455	0 + 30	1885	GAC A INF RAW N/A	PROD	M	<0.100	<0.100	**15.5**	<0.200		**9.28**	<0.200	**35.5**
01/29/13	1405	0 + 45	2184	GAC A INF RAW N/A	PROD	M	<0.100		**16.5**	<0.200		**9.80**	<0.200	**33.3**
01/29/13	1410	0 + 50	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**16.6**	<0.200		**9.82**	<0.200	**33.0**
02/26/13	1405	0 + 45	2184	RAW/HOP N/A	PROD	Q	<0.100		**16.7**	<0.200		**10.5***	<0.200	**34.2**
02/26/13	1420	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**17.4**	<0.200		**11.1***	<0.200	**35.4**
02/26/13	1420	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**17.3**	<0.200		**10.7***	<0.200	**35.5**
03/27/13	0945	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**15.4**	<0.200		**9.90**	<0.200	**31.7**
03/27/13	0950	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**16.2**	<0.200		**10.2***	<0.200	**32.8**
04/21/13	1430	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**16.5**	<0.200		**9.22**	<0.200	**34.2**
04/21/13	1430	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**16.7**	<0.200		**9.65**	<0.200	**34.8**
05/12/13	1410	1 + 0	2184	RAW/HOP N/A	PROD	Q	<0.100		**16.2**	<0.200		**9.70**	<0.200	**33.4**
05/28/13	1420	0 + 30	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**15.9**	<0.200		**8.60**	<0.200	**35.5**
05/28/13	1425	0 + 30	2184	GAC A INF RAW N/A	PROD	M	<0.100		**15.9**	<0.200		**8.96**	<0.200	**35.7**
06/23/13	1430	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**15.8**	<0.200		**8.83**	<0.200	**39.0**
06/23/13	1430	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**15.9**	<0.200		**8.97**	<0.200	**39.4**
07/21/13	1000	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**15.4**	<0.200		**8.60**	<0.200	**37.7**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
07/21/13	1005	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**15.6**	<0.200		**8.65**	<0.200	**38.0**
08/11/13	0930	24 + 0	2184	RAW/HOP N/A	PROD	Q	<0.100		**15.1**	<0.200		**8.20**	<0.200	**34.4**
08/11/13	0940	24 + 0	2184	STA TRE N/A	PROD	M	<0.100		**15.8**	<0.200	**7.80**	**7.96**	<0.200	**34.2**
08/11/13	0940	24 + 0	2184	STA TRE N/A	PROD	Q	<0.100		**16.0**	<0.200		**8.25**	<0.200	**34.5**
08/25/13	0945	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**16.2**	<0.200		**8.57**	<0.200	**34.9**
08/25/13	0945	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**16.2**	<0.200		**8.68**	<0.200	**34.8**
09/23/13	1015	0 + 45	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**16.7**	<0.200		**8.34**	<0.200	**36.1**
09/23/13	1015	0 + 45	2184	GAC A INF RAW N/A	PROD	M	<0.100		**16.4**	<0.200		**8.59**	<0.200	**35.4**
10/27/13	0935	0 + 40	2184	GAC A INF RAW N/A	PROD	M	<0.100		**16.8**	<0.200		**9.69**	<0.200	**37.2**
10/27/13	0940	0 + 45	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**17.2**	<0.200		**9.27**	<0.200	**38.3**
11/12/13	1515	0 + 45	2273	RAW/HOP N/A	PROD	Q	<0.100		**17.3**	<0.200		**9.94**	<0.200	**37.9**
11/24/13	0940	0 + 50	2184	GAC A INF RAW N/A	PROD	M	<0.100		**17.8**	<0.200		**10.5***	<0.200	**38.1**
12/02/13	1435	0 + 45	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**18.4**	<0.200		**12.0***	<0.200	**38.3**
12/22/13	0940	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**17.8**	<0.200		**10.7***	<0.200	**37.9**
12/22/13	0940	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**17.8**	<0.200		**10.8***	<0.200	**38.5**
01/26/14	0950	1 + 0	2184	GAC A EFF RAW N/A	PROD	M	<0.100		**18.0**	<0.200		**10.9***	<0.200	**38.0**
01/26/14	0950	1 + 0	2184	GAC A INF RAW N/A	PROD	M	<0.100		**17.8**	<0.200		**10.9***	<0.200	**37.8**
02/09/14	0930	0 + 40	2184	RAW/HOP N/A	PROD	BA	<0.100		**18.7**	<0.200		**11.1***	<0.200	**39.3**
02/24/14	1040	0 + 45	2421	GAC A EFF RAW N/A	PROD	M	<0.100		**18.4**	<0.200		**11.3***	<0.200	**39.7**
02/24/14	1040	0 + 45	2421	GAC A INF RAW N/A	PROD	M	<0.100		**17.0**	<0.200		**10.9***	<0.200	**37.0**
03/24/14	1130	0 + 30	2170	GAC A EFF RAW N/A	PROD	M	<0.100		**18.2**	<0.200		**11.2***	<0.200	**38.3**
03/24/14	1130	0 + 30	2170	GAC A INF RAW N/A	PROD	M	<0.100		**18.4**	<0.200		**11.1***	<0.200	**38.6**
04/21/14	1425	0 + 45	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200		**10.3***	<0.200	**39.9**
04/21/14	1425	0 + 45	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.1**	<0.200		**10.6***	<0.200	**40.1**
05/14/14	1350	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**10.7***	<0.200	**39.5**
05/14/14	1350	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**10.7***	<0.200	**40.0**
05/26/14	1440	0 + 25	2395	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**9.51**	<0.200	**37.9**
05/26/14	1440	0 + 25	2395	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.0**	<0.200		**10.1***	<0.200	**39.3**
06/11/14	0908	0 + 30	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.9**	<0.200		**10.1***	<0.200	**40.8**
06/11/14	0909	0 + 30	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.1**	<0.200		**9.97**	<0.200	**40.9**
06/22/14	1400	0 + 45	2142	GAC A EFF RAW N/A	PROD	N/A	<0.100		**17.6**	<0.200		**9.73**	<0.200	**41.6**
06/22/14	1400	0 + 45	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.4**	<0.200		**9.16**	<0.200	**40.3**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
07/16/14	0915	0 + 45	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.4**	<0.200		**9.52**	<0.200	**41.1**
07/16/14	0915	0 + 45	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.0**	<0.200		**9.60**	<0.200	**39.8**
07/27/14	1345	0 + 45	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.1**	<0.200		**9.30**	<0.200	**40.3**
07/27/14	1345	0 + 45	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.3**	<0.200		**9.37**	<0.200	**40.6**
08/11/14	0915	0 + 30	2142	RAW/HOP N/A	PROD	BA	<0.100		**17.2**	<0.200		**9.22**	<0.200	**39.9**
08/11/14	0915	0 + 30	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.6**	<0.200		**9.20**	<0.200	**40.6**
08/26/14	0910	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.3**	<0.200		**9.16**	<0.200	**39.8**
08/26/14	0910	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**9.17**	<0.200	**40.2**
09/08/14	0930	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.0**	<0.200		**9.34**	<0.200	**40.4**
09/08/14	0930	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.1**	<0.200		**9.35**	<0.200	**40.6**
09/23/14	0915	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**9.06**	<0.200	**39.5**
09/23/14	0915	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**9.14**	<0.200	**39.5**
10/15/14	0935	0 + 35	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.4**	<0.200		**9.19**	<0.200	**40.3**
10/15/14	0935	0 + 35	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**9.39**	<0.200	**40.6**
10/26/14	1405	0 + 30	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.6**	<0.200		**9.31**	<0.200	**41.0**
10/26/14	1405	0 + 30	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.7**	<0.200		**9.52**	<0.200	**41.3**
11/11/14	1330	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.7**	<0.200		**9.29**	<0.200	**41.2**
11/11/14	1330	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200		**9.54**	<0.200	**41.3**
11/24/14	1335	0 + 40	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200		**9.62**	<0.200	**41.5**
11/24/14	1335	0 + 40	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200		**9.82**	<0.200	**41.6**
12/21/14	1420	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**11.7***	<0.200	**42.6**
12/21/14	1420	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**10.7***	<0.200	**42.5**
01/11/15	1400	0 + 30	2142	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200		**10.3***	<0.200	**42.9**
01/11/15	1400	0 + 30	2142	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**10.2***	<0.200	**42.4**
01/28/15	1535	0 + 30	1885	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.2**	<0.200		**10.7***	<0.200	**38.9**
01/28/15	1535	0 + 30	1885	GAC A INF RAW N/A	PROD	2-W	<0.100		**19.0**	<0.200		**10.8***	<0.200	**42.7**
02/08/15	1500	0 + 30	2147	RAW/HOP N/A	PROD	BA	<0.100		**18.3**	<0.200		**10.5***	<0.200	**41.7**
02/08/15	1500	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**10.5***	<0.200	**41.5**
02/08/15	1500	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**10.4***	<0.200	**42.1**
02/23/15	1415	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.6**	<0.200		**10.1***	<0.200	**41.7**
02/23/15	1415	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.3**	<0.200		**9.88**	<0.200	**41.2**
03/11/15	1245	0 + 45	2100	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**10.5***	<0.200	**42.9**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:27 PM

Location: SPINNEY RD #1 S-23184

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate Analyzer mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
03/11/15	1245	0 + 45	2100	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**10.4***	<0.200	**43.0**
03/22/15	1500	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.0**	<0.200		**10.2***	<0.200	**41.8**
03/22/15	1500	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100		**19.4**	<0.200		**10.7***	<0.200	**45.0**
04/12/15	1500	0 + 30	2147	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**11.2***	<0.200	**41.2**
04/12/15	1500	0 + 30	2147	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.6**	<0.200		**10.7***	<0.200	**42.3**
04/27/15	1400	0 + 45	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.4**	<0.200		**10.5***	<0.200	**43.2**
04/27/15	1400	0 + 45	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**10.5***	<0.200	**43.9**
05/13/15	1307	0 + 45	1847	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.7**	<0.200		**9.61**	<0.200	**42.4**
05/13/15	1309	0 + 45	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.6**	<0.200		**8.78**	<0.200	**41.8**
05/25/15	1103	8 + 0	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200		**9.31**	<0.200	**43.8**
05/25/15	1104	8 + 0	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200		**8.91**	<0.200	**44.1**
06/08/15	1406	0 + 45	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**18.0**	<0.200		**9.08**	<0.200	**43.4**
06/08/15	1412	0 + 45	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200		**8.66**	<0.200	**43.2**
06/22/15	0851	5 + 0	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200		**9.17**	<0.200	**43.8**
06/22/15	0852	5 + 0	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.3**	<0.200		**8.89**	<0.200	**42.7**
07/13/15	1137	0 + 45	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200		**8.81**	<0.200	**43.6**
07/13/15	1138	0 + 45	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.6**	<0.200		**8.68**	<0.200	**43.8**
07/29/15	1540	0 + 40	1847	GAC A EFF RAW N/A	PROD	2-W	<0.100		**16.9**	<0.200		**8.52**	<0.200	**41.5**
07/29/15	1540	0 + 40	1847	GAC A INF RAW N/A	PROD	2-W	<0.100		**16.9**	<0.200		**8.52**	<0.200	**41.6**
08/10/15	1025	10 + 0	2333	RAW/HOP N/A	PROD	BA	<0.100		**17.2**	<0.200		**7.98**	<0.200	**41.3**
08/10/15	1025	10 + 0	2333	GAC A EFF RAW N/A	PROD	2-W	<0.100		**17.2**	<0.200		**8.29**	<0.200	**41.0**
08/24/15	1755	0 + 30	2464	GAC A EFF RAW N/A	PROD	2-W	<0.100		**16.9**	<0.200		**7.95**	<0.200	**39.7**
08/24/15	1755	0 + 30	2464	GAC A INF RAW N/A	PROD	2-W	<0.100		**17.0**	<0.200		**8.09**	<0.200	**39.8**
09/14/15	1931	0 + 45	2273	GAC A INF RAW N/A	PROD	2-W	<0.100		**16.8**	<0.200		**7.89**	<0.200	**38.0**
09/14/15	1936	0 + 45	2273	GAC A EFF RAW N/A	PROD	2-W	<0.100		**16.7**	<0.200		**7.90**	<0.200	**37.9**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Kevin P. Durk, Director
NY Lab ID No: 10311
EPA Lab code: NY00014

N/A = Not Applicable
**Highlighted Components indicate changes from prior year.*

Components and Reporting Limits Jan 1, 2013 to Present*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	N/A	N/A
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Sulfate	2.50	mg/l

Components and Reporting Limits Jan 1, 2008 to Dec 31,2012*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	0.100	mg/l
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Specific Conductance	2	umho/cm
Sulfate	2.50	mg/l

Components and Reporting Limits July 1, 2005 to Dec 31, 2007*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	0.100	mg/l
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Specific Conductance	2	umho/cm
Sulfate	2.50	mg/l

Components and Reporting Limits from January 1, 2005 to June 30, 2005*:

Component	RL	Units
Bromide	0.10	mg/l
Chloride	2.0	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.20	mg/l
Nitrite	0.20	mg/l
Sulfate	2.5	mg/l

Components and Reporting Limits from January 1, 2003 to December 31, 2004*:

Component	RL	Units
Bromide	0.05	mg/l
Chloride	2.0	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.20	mg/l
Nitrite	0.20	mg/l
Sulfate	2.5	mg/l
Ortho Phosphate (as PO4)	N/A	N/A

Components and Reporting Limits from January 1, 2000 to December 31, 2002:

Component	RL	Units
Bromide	0.05	mg/l
Chloride	0.5	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.10	mg/l
Nitrite	0.10	mg/l
Sulfate	0.5	mg/l
Ortho Phosphate (as PO4)	0.10	mg/l

Kevin P. Durk, Director
NY Lab ID No: 10311
EPA Lab code: NY00014

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
01/13/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**12.2***	<0.200	**42.9**
01/13/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**12.2***	<0.200	**42.4**
01/26/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.2**	<0.200	**11.9***	<0.200	**41.6**
01/26/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**12.1***	<0.200	**42.3**
02/09/10	0130	1 + 0	2005	RAW/HOP N/A	PROD	Q	<0.100	<0.100	**18.5**	<0.200	**12.2***	<0.200	**41.8**
02/09/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.3**	<0.200	**12.7***	<0.200	**44.0**
02/09/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.3**	<0.200	**12.6***	<0.200	**43.6**
02/24/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.8***	<0.200	**40.7**
02/24/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**11.9***	<0.200	**40.8**
03/10/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**12.5***	<0.200	**42.2**
03/10/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**12.5***	<0.200	**42.0**
03/23/10	0615	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.1**	<0.200	**11.4***	<0.200	**42.2**
03/23/10	0615	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.8***	<0.200	**42.0**
04/13/10	0540	0 + 30	2208	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**13.2***	<0.200	**43.0**
04/13/10	0540	0 + 30	2208	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**12.8***	<0.200	**43.3**
04/28/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.4**	<0.200	**12.0***	<0.200	**39.5**
04/28/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.0**	<0.200	**12.4***	<0.200	**42.1**
05/12/10	0130	1 + 0	2009	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**18.4**	<0.200	**12.9***	<0.200	**41.5**
05/12/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.7**	<0.200	**11.6***	<0.200	**40.6**
05/12/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**12.3***	<0.200	**40.8**
05/26/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**12.2***	<0.200	**43.6**
05/26/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**13.0***	<0.200	**44.4**
06/08/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.1**	<0.200	**12.5***	<0.200	**45.0**
06/08/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.0**	<0.200	**12.6***	<0.200	**45.0**
06/23/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**12.2***	<0.200	**45.3**
06/23/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**12.1***	<0.200	**45.4**
07/13/10	0730	6 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.3**	<0.200	**12.0***	<0.200	**43.5**
07/13/10	0730	6 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.3**	<0.200	**12.0***	<0.200	**43.5**
07/28/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**12.2***	<0.200	**45.3**
07/28/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**12.1***	<0.200	**46.2**
08/11/10	0045	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.1**	<0.200	**12.1***	<0.200	**42.8**
08/11/10	0045	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**11.7***	<0.200	**42.4**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
08/24/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.4***	<0.200	**42.7**
08/24/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.4***	<0.200	**42.8**
09/08/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**11.7***	<0.200	**41.8**
09/08/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.6***	<0.200	**42.1**
09/22/10	0130	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.7**	<0.200	**11.3***	<0.200	**42.6**
09/22/10	0130	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.4***	<0.200	**43.0**
10/13/10	1010	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.6**	<0.200	**11.0***	<0.200	**40.9**
10/13/10	1010	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.7**	<0.200	**11.3***	<0.200	**41.6**
10/26/10	1105	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**17.8**	<0.200	**12.0***	<0.200	**41.2**
10/26/10	1105	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**17.9**	<0.200	**11.3***	<0.200	**41.3**
11/21/10	1415	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.4**	<0.200	**13.6***	<0.200	**42.6**
11/21/10	1415	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.2**	<0.200	**11.2***	<0.200	**41.1**
12/13/10	1445	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.2**	<0.200	**12.3***	<0.200	**38.1**
12/13/10	1445	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.5**	<0.200	**11.5***	<0.200	**40.8**
12/16/10	1345	0 + 30	2147	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**18.4**	<0.200	**11.6***	<0.200	**41.1**
12/29/10	1010	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	**0.103**	**0.277**	**19.2**	<0.200	**11.5***	<0.200	**41.9**
12/29/10	1010	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.2**	<0.200	**11.7***	<0.200	**39.4**
01/13/11	1110	0 + 40	1534	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**12.0***	<0.200	**43.3**
01/13/11	1110	0 + 40	1534	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.2**	<0.200	**12.2***	<0.200	**42.7**
01/25/11	1430	0 + 30	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**11.9***	<0.200	**42.0**
01/25/11	1445	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**11.8***	<0.200	**42.0**
02/15/11	1450	0 + 40	1847	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**19.0**	<0.200	**11.7***	<0.200	**41.7**
02/15/11	1450	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**12.1***	<0.200	**42.6**
02/15/11	1450	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	**0.141**	<0.100	**19.7**	<0.200	**12.0***	<0.200	**43.1**
02/28/11	1445	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**12.6***	<0.200	**44.1**
02/28/11	1445	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**12.0***	<0.200	**41.2**
03/14/11	1445	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**20.2**	<0.200	**13.3***	<0.200	**45.1**
03/14/11	1445	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.5**	<0.200	**12.3***	<0.200	**42.5**
03/30/11	1040	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.0**	<0.200	**11.6***	<0.200	**42.9**
03/30/11	1040	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**12.0***	<0.200	**41.7**
04/11/11	1040	0 + 30	2208	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**12.6***	<0.200	**44.6**
04/11/11	1040	0 + 30	2208	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**12.3***	<0.200	**42.3**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
04/26/11	1445	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**12.3***	<0.200	**43.3**
04/26/11	1445	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**12.4***	<0.200	**42.5**
05/12/11	1455	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.7**	<0.200	**13.3***	<0.200	**42.8**
05/12/11	1455	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.7**	<0.200	**12.8***	<0.200	**42.8**
05/23/11	1500	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**12.6***	<0.200	**41.4**
05/23/11	1500	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.4**	<0.200	**13.2***	<0.200	**43.2**
06/16/11	1030	0 + 35	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**12.7***	<0.200	**43.5**
06/16/11	1035	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.5**	<0.200	**12.7***	<0.200	**43.1**
07/04/11	0900	6 + 0	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.3**	<0.200	**11.9***	<0.200	**42.2**
07/04/11	0900	6 + 0	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**12.0***	<0.200	**43.3**
07/13/11	0900	7 + 0	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**13.3***	<0.200	**45.1**
07/13/11	0900	7 + 0	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.4**	<0.200	**13.4***	<0.200	**42.4**
08/14/11	1440	0 + 30	2147	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**19.0**	<0.200	**13.0***	<0.200	**42.2**
08/14/11	1440	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**13.0***	<0.200	**42.3**
08/25/11	0945	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.6**	<0.200	**13.0***	<0.200	**41.7**
08/25/11	0945	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**13.0***	<0.200	**42.0**
09/14/11	0920	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.5**	<0.200	**13.3***	<0.200	**43.2**
09/14/11	0920	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**13.5***	<0.200	**43.6**
09/26/11	0930	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**13.0***	<0.200	**41.6**
09/26/11	0930	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.8**	<0.200	**13.2***	<0.200	**42.0**
10/24/11	1450	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**18.7**	<0.200	**13.3***	<0.200	**41.0**
10/24/11	1450	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**18.9**	<0.200	**13.2***	<0.200	**42.6**
11/17/11	0230	0 + 45	2300	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.0**	<0.200	**13.4***	<0.200	**42.3**
11/17/11	0230	0 + 45	2300	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.2**	<0.200	**13.3***	<0.200	**42.3**
11/28/11	0215	0 + 45	2300	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.0**	<0.200	**15.2***	<0.200	**44.7**
11/28/11	0215	0 + 45	2300	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**13.0***	<0.200	**43.6**
12/12/11	0200	0 + 40	2141	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.4**	<0.200	**13.9***	<0.200	**42.2**
12/12/11	0200	0 + 40	2141	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.8**	<0.200	**13.7***	<0.200	**44.2**
12/29/11	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**20.4**	<0.200	**13.6***	<0.200	**45.3**
12/29/11	0110	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**20.1**	<0.200	**13.6***	<0.200	**44.5**
01/12/12	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**20.1**	<0.200	**14.8***	<0.200	**45.8**
01/12/12	0110	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**13.6***	<0.200	**43.1**

Kevin P. Durk, Director
NY Lab ID No: 10311
EPA Lab code: NY00014

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested

Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
01/26/12	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**21.6**	<0.200	**17.8***	<0.200	**51.5**
01/26/12	0110	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.6**	<0.200	**13.6***	<0.200	**43.2**
01/31/12	1040	0 + 15	1389	EFF RAW N/A	PROD	N/A	<0.100	<0.100	**19.6**	<0.200	**16.4***	<0.200	**45.0**
01/31/12	1040	0 + 15	1389	INF RAW N/A	PROD	N/A	<0.100	<0.100	**19.0**	<0.200	**13.0***	<0.200	**41.4**
01/31/12	1310	0 + 15	1389	EFF RAW N/A	BTW	N/A	<0.100	<0.100	**12.6**	<0.200	**8.14**	<0.200	**22.3**
01/31/12	1310	0 + 15	1389	INF RAW N/A	BTW	N/A	<0.100	<0.100	**19.2**	<0.200	**13.0***	<0.200	**42.1**
01/31/12	1325	0 + 30	1389	EFF RAW N/A	BTW	N/A	<0.100	<0.100	**15.4**	<0.200	**11.0***	<0.200	**32.8**
01/31/12	1350	0 + 15	1389	EFF RAW N/A	PROD	N/A	<0.100	<0.100	**16.6**	<0.200	**11.4***	<0.200	**35.1**
02/16/12	0110	1 + 0	2009	RAW/HOP N/A	PROD	BA	<0.100	<0.100	**19.1**	<0.200	**12.8***	<0.200	**41.5**
02/16/12	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.4**	<0.200	**15.2***	<0.200	**41.5**
03/01/12	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**12.8***	<0.200	**40.9**
03/01/12	0110	1 + 0	2009	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.3**	<0.200	**13.3***	<0.200	**42.1**
03/12/12	0215	0 + 30	2141	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**20.0**	<0.200	**12.6***	<0.200	**43.3**
03/12/12	0215	0 + 30	2141	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.9**	<0.200	**13.8***	<0.200	**43.0**
03/27/12	1530	0 + 30	1885	GAC B EFF RAW N/A	PROD	2-W	<0.100	<0.100	**19.1**	<0.200	**13.0***	<0.200	**40.1**
03/27/12	1530	0 + 30	1885	GAC B INF RAW N/A	PROD	2-W	<0.100	<0.100	**19.5**	<0.200	**13.6***	<0.200	**41.6**
04/23/12	0050	0 + 40	2141	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.5**	<0.200	**13.3***	<0.200	**40.5**
04/23/12	0050	0 + 40	2141	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.6**	<0.200	**14.1***	<0.200	**40.9**
05/30/12	0110	1 + 0	2009	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**20.1**	<0.200	**14.3***	<0.200	**45.8**
05/30/12	0110	1 + 0	2009	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.0**	<0.200	**13.8***	<0.200	**42.2**
06/25/12	0920	0 + 40	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.9**	<0.200	**13.9***	<0.200	**44.7**
06/25/12	0920	0 + 40	1885	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.9**	<0.200	**13.9***	<0.200	**44.9**
07/23/12	0910	1 + 0	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.4**	<0.200	**13.1***	<0.200	**43.8**
07/23/12	0910	1 + 0	1885	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.3**	<0.200	**13.2***	<0.200	**43.9**
08/13/12	0950	0 + 30	1885	RAW/HOP N/A	PROD	BA	**0.120**	<0.100	**19.2**	<0.200	**13.2***	<0.200	**42.5**
08/27/12	0945	0 + 30	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.5**	<0.200	**12.9***	<0.200	**42.1**
08/27/12	0945	0 + 30	1885	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.5**	<0.200	**13.2***	<0.200	**41.8**
09/26/12	0050	0 + 30	2141	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.2**	<0.200	**13.3***	<0.200	**44.0**
10/08/12	1500	0 + 30	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**21.5**	<0.200	**15.9***	<0.200	**50.9**
10/24/12	1515	0 + 30	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.1**	<0.200	**13.9***	<0.200	**42.5**
10/24/12	1515	0 + 30	1885	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.7**	<0.200	**12.7***	<0.200	**44.1**
11/27/12	1410	0 + 30	1885	GAC B EFF RAW N/A	PROD	M	<0.100	<0.100	**19.4**	<0.200	**13.0***	<0.200	**43.5**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
11/27/12	1410	0 + 30	1885	GAC B INF RAW N/A	PROD	M	<0.100	<0.100	**19.1**	<0.200	**13.3***	<0.200	**42.5**
01/30/13	1405	0 + 45	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**19.5**	<0.200	**12.7***	<0.200	**41.1**
01/30/13	1405	0 + 45	2184	GAC B INF RAW N/A	PROD	M	<0.100		**19.8**	<0.200	**13.4***	<0.200	**41.4**
02/19/13	1400	0 + 40	2184	RAW/HOP N/A	PROD	BA	<0.100		**19.2**	<0.200	**13.8***	<0.200	**41.2**
02/27/13	1425	1 + 0	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**19.9**	<0.200	**13.1***	<0.200	**43.0**
02/27/13	1425	1 + 0	2184	GAC B INF RAW N/A	PROD	M	<0.100		**19.6**	<0.200	**14.1***	<0.200	**42.0**
04/23/13	1415	0 + 45	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**20.7**	<0.200	**13.6***	<0.200	**43.8**
04/23/13	1415	0 + 45	2184	GAC B INF RAW N/A	PROD	M	<0.100		**20.5**	<0.200	**14.4***	<0.200	**43.7**
05/14/13	1405	1 + 0	2184	RAW/HOP N/A	PROD	Q	<0.100		**19.6**	<0.200	**14.0***	<0.200	**41.7**
05/29/13	1405	0 + 50	2184	GAC B INF RAW N/A	PROD	M	<0.100		**19.7**	<0.200	**13.8***	<0.200	**41.7**
05/29/13	1410	0 + 55	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**19.7**	<0.200	**13.3***	<0.200	**41.4**
06/25/13	0940	0 + 50	2184	GAC B INF RAW N/A	PROD	M	<0.100		**19.8**	<0.200	**14.0***	<0.200	**43.5**
06/25/13	0945	1 + 0	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**19.8**	<0.200	**13.4***	<0.200	**43.7**
09/17/13	0935	0 + 50	2184	RAW/HOP N/A	PROD	Q	<0.100		**20.5**	<0.200	**14.0***	<0.200	**41.7**
09/23/13	0940	1 + 0	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**20.7**	<0.200	**14.1***	<0.200	**43.2**
09/23/13	0940	1 + 0	2184	GAC B INF RAW N/A	PROD	M	<0.100		**20.6**	<0.200	**14.1***	<0.200	**43.2**
10/28/13	0935	0 + 35	2184	GAC B INF RAW N/A	PROD	M	<0.100		**19.9**	<0.200	**14.5***	<0.200	**41.0**
10/28/13	0940	0 + 40	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**17.3**	<0.200	**15.8***	<0.200	**35.1**
11/25/13	0925	0 + 45	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**17.5**	<0.200	**14.4***	<0.200	**34.2**
11/25/13	0925	0 + 45	2184	GAC B INF RAW N/A	PROD	M	<0.100		**20.9**	<0.200	**15.1***	<0.200	**41.8**
11/26/13	0940	0 + 45	2184	RAW/HOP N/A	PROD	Q	<0.100		**21.2**	<0.200	**15.0***	<0.200	**42.7**
12/26/13	0145	0 + 30	2141	GAC B EFF RAW N/A	PROD	M	<0.100		**19.8**	<0.200	**15.1***	<0.200	**36.0**
01/09/14	0605	0 + 25	2141	GAC B EFF RAW N/A	PROD	M	<0.100		**20.9**	<0.200	**12.8***	<0.200	**42.9**
01/09/14	0605	0 + 25	2141	GAC B INF RAW N/A	PROD	M	<0.100		**20.8**	<0.200	**14.9***	<0.200	**43.0**
01/27/14	0945	0 + 50	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**20.9**	<0.200	**14.6***	<0.200	**42.3**
01/27/14	0945	0 + 50	2184	GAC B INF RAW N/A	PROD	M	<0.100		**21.3**	<0.200	**15.4***	<0.200	**43.2**
02/10/14	1015	0 + 45	2421	RAW/HOP N/A	PROD	Q	<0.100		**18.8**	<0.200	**11.9***	<0.200	**35.4**
03/04/14	0920	0 + 45	2184	GAC B EFF RAW N/A	PROD	M	<0.100		**9.31**	<0.200	**10.9***	<0.200	**13.2**
03/04/14	0920	0 + 45	2184	GAC B INF RAW N/A	PROD	M	<0.100		**16.6**	<0.200	**10.1***	<0.200	**29.8**
03/23/14	1050	0 + 30	2142	GAC B EFF RAW N/A	PROD	M	<0.100		**22.2**	<0.200	**14.7***	<0.200	**44.5**
03/23/14	1050	0 + 30	2142	GAC B INF RAW N/A	PROD	M	<0.100		**22.1**	<0.200	**15.9***	<0.200	**44.3**
04/27/14	1400	0 + 35	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.1**	<0.200	**15.1***	<0.200	**43.1**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
04/27/14	1400	0 + 35	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.3**	<0.200	**15.5***	<0.200	**43.7**
05/12/14	1410	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.4**	<0.200	**14.6***	<0.200	**43.6**
05/12/14	1410	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.3**	<0.200	**15.7***	<0.200	**43.3**
05/27/14	1400	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**14.5***	<0.200	**42.5**
05/27/14	1400	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.0**	<0.200	**15.3***	<0.200	**43.4**
06/10/14	0910	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.7**	<0.200	**15.5***	<0.200	**43.1**
06/10/14	0910	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.7**	<0.200	**15.1***	<0.200	**43.0**
06/23/14	1350	0 + 45	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**13.7***	<0.200	**42.4**
06/23/14	1350	0 + 45	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.6**	<0.200	**15.1***	<0.200	**42.8**
07/17/14	0910	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.0**	<0.200	**14.9***	<0.200	**44.6**
07/17/14	0910	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.0**	<0.200	**15.2***	<0.200	**44.2**
07/28/14	0940	0 + 45	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**14.4***	<0.200	**43.3**
07/28/14	0940	0 + 45	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**14.4***	<0.200	**44.0**
08/12/14	0920	0 + 40	2142	RAW/HOP N/A	PROD	BA	<0.100		**20.4**	<0.200	**14.0***	<0.200	**43.7**
08/12/14	0920	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**14.1***	<0.200	**43.7**
08/28/14	0905	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**13.7***	<0.200	**43.2**
08/28/14	0905	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**13.8***	<0.200	**43.1**
09/09/14	0930	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.6**	<0.200	**13.9***	<0.200	**43.4**
09/09/14	0930	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.4**	<0.200	**13.9***	<0.200	**42.7**
09/24/14	0920	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.9***	<0.200	**42.2**
09/24/14	0920	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.2**	<0.200	**13.6***	<0.200	**42.4**
10/14/14	0940	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.6***	<0.200	**43.1**
10/14/14	0940	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.2**	<0.200	**14.0***	<0.200	**43.4**
10/27/14	1405	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.5**	<0.200	**13.2***	<0.200	**42.1**
10/27/14	1405	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.6**	<0.200	**13.5***	<0.200	**42.4**
11/12/14	1345	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.4***	<0.200	**43.4**
11/12/14	1345	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**13.9***	<0.200	**43.8**
11/24/14	1415	0 + 35	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**14.6***	<0.200	**43.4**
11/24/14	1415	0 + 35	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.2**	<0.200	**14.0***	<0.200	**43.6**
12/10/14	1335	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.0**	<0.200	**13.5***	<0.200	**42.0**
12/10/14	1335	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.4**	<0.200	**14.0***	<0.200	**43.0**
12/28/14	0950	0 + 30	1928	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.0**	<0.200	**13.5***	<0.200	**43.6**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
01/12/15	1415	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.7***	<0.200	**44.8**
01/12/15	1415	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.9**	<0.200	**14.0***	<0.200	**45.0**
02/04/15	1215	0 + 45	2451	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.9**	<0.200	**13.9***	<0.200	**44.5**
02/04/15	1215	0 + 45	2451	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.8**	<0.200	**14.1***	<0.200	**44.2**
02/09/15	1155	0 + 50	2451	RAW/HOP N/A	PROD	BA	<0.100		**20.4**	<0.200	**14.0***	<0.200	**43.5**
02/09/15	1155	0 + 50	2451	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.3**	<0.200	**14.3***	<0.200	**48.3**
02/09/15	1155	0 + 50	2451	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.4**	<0.200	**14.9***	<0.200	**48.4**
02/24/15	1100	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.0**	<0.200	**14.1***	<0.200	**44.5**
02/24/15	1100	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.8**	<0.200	**14.5***	<0.200	**44.2**
03/09/15	1015	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**14.3***	<0.200	**44.7**
03/09/15	1015	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**14.1***	<0.200	**44.3**
03/23/15	1500	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.9**	<0.200	**13.5***	<0.200	**43.2**
03/23/15	1500	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.8***	<0.200	**44.0**
04/13/15	1445	0 + 30	2147	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.9**	<0.200	**13.0***	<0.200	**42.6**
04/13/15	1445	0 + 30	2147	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.2**	<0.200	**14.0***	<0.200	**43.1**
04/30/15	1415	0 + 40	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.9**	<0.200	**13.6***	<0.200	**42.9**
04/30/15	1415	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.8***	<0.200	**43.4**
05/14/15	1445	0 + 40	1847	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**14.3***	<0.200	**44.5**
05/14/15	1450	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.3**	<0.200	**13.6***	<0.200	**43.8**
05/25/15	1144	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**21.5**	<0.200	**15.2***	<0.200	**46.3**
05/25/15	1146	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**21.2**	<0.200	**14.7***	<0.200	**45.6**
06/10/15	1020	0 + 40	2131	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.5**	<0.200	**13.7***	<0.200	**45.9**
06/10/15	1020	0 + 40	2131	GAC B INF RAW N/A	PROD	2-W	<0.100		**20.1**	<0.200	**13.5***	<0.200	**45.1**
06/22/15	0906	5 + 0	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.7**	<0.200	**12.9***	<0.200	**43.6**
06/22/15	0908	5 + 0	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.0**	<0.200	**13.1***	<0.200	**44.2**
07/13/15	1225	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**20.7**	<0.200	**13.0***	<0.200	**47.4**
07/13/15	1225	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.9**	<0.200	**13.0***	<0.200	**44.9**
07/27/15	1307	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200	**12.5***	<0.200	**43.5**
07/27/15	1308	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.7**	<0.200	**12.5***	<0.200	**43.4**
08/10/15	1027	10 + 0	2333	RAW/HOP N/A	PROD	BA	<0.100		**19.6**	<0.200	**12.3***	<0.200	**43.5**
08/10/15	1054	10 + 0	2333	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.4**	<0.200	**12.2***	<0.200	**42.6**
08/24/15	1755	0 + 30	2464	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.9**	<0.200	**11.9***	<0.200	**42.0**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
08/24/15	1755	0 + 30	2464	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.1**	<0.200	**11.9***	<0.200	**42.3**
09/16/15	1027	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200	**11.6***	<0.200	**41.4**
09/16/15	1028	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.6**	<0.200	**11.5***	<0.200	**41.4**
09/28/15	1044	0 + 30	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**11.5***	<0.200	**40.8**
09/28/15	1046	0 + 30	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**11.4***	<0.200	**40.7**
10/14/15	1105	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.4**	<0.200	**11.5***	<0.200	**41.3**
10/14/15	1105	0 + 45	1847	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.7**	<0.200	**11.3***	<0.200	**41.5**
10/26/15	1320	0 + 30	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**11.6***	<0.200	**41.4**
10/26/15	1321	0 + 30	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.9**	<0.200	**11.5***	<0.200	**40.5**
11/09/15	1410	0 + 30	2483	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.7**	<0.200	**11.4***	<0.200	**40.3**
11/09/15	1410	0 + 30	2483	GAC B INF RAW N/A	PROD	2-W	<0.100		**17.9**	<0.200	**11.6***	<0.200	**40.9**
11/23/15	1019	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.4**	<0.200	**11.7***	<0.200	**41.8**
11/23/15	1021	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.4**	<0.200	**11.3***	<0.200	**41.8**
12/28/15	1145	0 + 45	2483	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**11.2***	<0.200	**42.5**
12/28/15	1145	0 + 45	2483	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**11.9***	<0.200	**42.5**
01/11/16	0908	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.2**	<0.200	**12.6***	<0.200	**42.2**
01/11/16	0908	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.2**	<0.200	**12.3***	<0.200	**42.3**
01/27/16	0945	0 + 45	2483	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200	**12.2***	<0.200	**42.3**
01/27/16	0945	0 + 45	2483	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200	**12.4***	<0.200	**42.4**
02/18/16	1353	0 + 45	1847	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.1**	<0.200	**12.4***	<0.200	**43.0**
02/18/16	1354	0 + 40	1847	RAW/HOP N/A	PROD	BA	<0.100		**19.4**	<0.200	**12.4***	<0.200	**43.6**
02/22/16	1307	0 + 45	2273	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.7**	<0.200	**12.6***	<0.200	**43.1**
02/22/16	1308	0 + 45	2273	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.8**	<0.200	**13.1***	<0.200	**43.4**
03/17/16	0945	0 + 30	2483	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.3**	<0.200	**12.1***	<0.200	**42.2**
03/17/16	0945	0 + 30	2483	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.5**	<0.200	**12.3***	<0.200	**43.0**
04/12/16	0910	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.4**	<0.200	**10.0***	<0.200	**43.3**
04/12/16	0910	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.1**	<0.200	**9.88**	<0.200	**42.7**
04/27/16	1355	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.2**	<0.200	**12.7***	<0.200	**43.5**
04/27/16	1355	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.2**	<0.200	**12.7***	<0.200	**43.6**
05/10/16	1335	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.5**	<0.200	**12.5***	<0.200	**44.8**
05/10/16	1335	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.4**	<0.200	**13.0***	<0.200	**44.5**
05/24/16	1314	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.5**	<0.200	**12.3***	<0.200	**45.1**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/1003/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
05/24/16	1316	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.5**	<0.200	**13.0***	<0.200	**45.0**
06/14/16	0925	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.9**	<0.200	**12.2***	<0.200	**45.4**
06/14/16	0925	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200	**12.4***	<0.200	**45.2**
06/27/16	0920	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**19.1**	<0.200	**11.9***	<0.200	**43.6**
06/27/16	0920	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**19.1**	<0.200	**12.0***	<0.200	**43.7**
07/13/16	0905	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.7**	<0.200	**11.7***	<0.200	**42.6**
07/13/16	0905	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.7**	<0.200	**11.7***	<0.200	**42.8**
07/27/16	0900	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200	**11.5***	<0.200	**42.4**
07/27/16	0900	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200	**11.5***	<0.200	**42.4**
08/09/16	0903	0 + 45	2142	RAW/HOP N/A	PROD	BA	<0.100		**18.6**	<0.200	**11.2***	<0.200	**43.1**
08/09/16	0903	0 + 45	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.6**	<0.200	**11.1***	<0.200	**43.1**
08/24/16	0920	0 + 45	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**11.0***	<0.200	**41.8**
08/24/16	0920	0 + 45	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**11.0***	<0.200	**41.9**
09/13/16	0859	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.0**	<0.200	**10.8***	<0.200	**42.0**
09/13/16	0900	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.1**	<0.200	**10.9***	<0.200	**42.1**
09/27/16	1400	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200	**10.6***	<0.200	**41.6**
09/27/16	1400	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.4**	<0.200	**10.7***	<0.200	**41.8**
10/11/16	1800	0 + 40	2462	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.6**	<0.200	**11.0***	<0.200	**40.6**
10/11/16	1805	0 + 45	2462	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.2**	<0.200	**10.3***	<0.200	**37.4**
10/24/16	1340	0 + 35	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**10.5***	<0.200	**40.1**
10/24/16	1340	0 + 35	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.5**	<0.200	**10.9***	<0.200	**40.5**
11/14/16	1440	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**12.3***	<0.200	**39.8**
11/14/16	1440	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**10.8***	<0.200	**40.1**
12/12/16	1140	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.6**	<0.200	**10.9***	<0.200	**40.0**
12/12/16	1141	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.8**	<0.200	**7.90**	<0.200	**40.0**
12/27/16	1020	0 + 35	2462	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.3**	<0.200	**11.1***	<0.200	**40.0**
12/27/16	1025	0 + 40	2462	GAC B EFF RAW N/A	PROD	2-W	<0.100		**18.2**	<0.200	**11.3***	<0.200	**39.4**
01/11/17	0930	0 + 40	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**8.30**	<0.200	**3.22**	<0.200	**7.05**
01/11/17	0930	0 + 40	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**8.71**	<0.200	**0.615**	<0.200	**8.80**
01/23/17	1415	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.8**	<0.200	**6.83**	<0.200	**38.2**
01/23/17	1415	0 + 30	2142	GAC B INF RAW N/A	PROD	2-W	<0.100		**18.1**	<0.200	**10.9***	<0.200	**39.3**
02/15/17	0906	0 + 30	2142	GAC B EFF RAW N/A	PROD	2-W	<0.100		**17.5**	<0.200	**10.6***	<0.200	**41.2**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Results for Components Listed Below

Report Range From: 01/01/10 to 03/01/17

* exceeds MCL
** exceeds SCWA MCLG
Blank Line - Not Tested
Report run on: March 1, 2017 2:41 PM

Location: SPINNEY RD #2 S-53593

Coll Date	Coll Time	Hrs + Min Op	Coll By	Coll Point	Status	Freq	Bromide mg/l	Chlorate mg/l	Chloride mg/l	Fluoride mg/l	Nitrate mg/l	Nitrite mg/l	Sulfate mg/l
02/15/17	0907	0 + 30	2142	RAW/HOP N/A	PROD	BA	<0.100		**17.9**	<0.200	**11.6***	<0.200	**42.2**

Water Quality Data
Inorganic Anions
E.P.A. Method 300.0

Kevin P. Durk, Director
NY Lab ID No: 10311
EPA Lab code: NY00014

N/A = Not Applicable
**Highlighted Components indicate changes from prior year.*

Components and Reporting Limits Jan 1, 2013 to Present*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	N/A	N/A
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Sulfate	2.50	mg/l

Components and Reporting Limits Jan 1, 2008 to Dec 31,2012*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	0.100	mg/l
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Specific Conductance	2	umho/cm
Sulfate	2.50	mg/l

Components and Reporting Limits July 1, 2005 to Dec 31, 2007*:

Component	RL	Units
Bromide	0.100	mg/l
Chlorate	0.100	mg/l
Chloride	2.00	mg/l
Fluoride	0.200	mg/l
Nitrate	0.200	mg/l
Nitrite	0.200	mg/l
Specific Conductance	2	umho/cm
Sulfate	2.50	mg/l

Components and Reporting Limits from January 1, 2005 to June 30, 2005*:

Component	RL	Units
Bromide	0.10	mg/l
Chloride	2.0	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.20	mg/l
Nitrite	0.20	mg/l
Sulfate	2.5	mg/l

Components and Reporting Limits from January 1, 2003 to December 31, 2004*:

Component	RL	Units
Bromide	0.05	mg/l
Chloride	2.0	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.20	mg/l
Nitrite	0.20	mg/l
Sulfate	2.5	mg/l
Ortho Phosphate (as PO4)	N/A	N/A

Components and Reporting Limits from January 1, 2000 to December 31, 2002:

Component	RL	Units
Bromide	0.05	mg/l
Chloride	0.5	mg/l
Conductivity	2.0	umho/cm
Fluoride	0.2	mg/l
Nitrate	0.10	mg/l
Nitrite	0.10	mg/l
Sulfate	0.5	mg/l
Ortho Phosphate (as PO4)	0.10	mg/l

LONG ISLAND ANALYTICAL LABORATORIES INC.

"TOMORROWS ANALYTICAL SOLUTIONS TODAY"

Laboratory Report

NYSDOH ELAP# 11693
USEPA# NY01273
CTDOH# PH-0284
AIHA# 164456
NJDEP# NY012
PADEP# 68-2943

LIAL# 6052002

May 20, 2016

Nelson, Pope & Voorhis
Steve McGinn
572 Walt Whitman Road
Melville, NY 11747

Re: Then Hills @ East Quogue

Dear Steve McGinn,

Enclosed please find the laboratory Analysis Report(s) for sample(s) received on May 19, 2016. Long Island Analytical laboratories analyzed the samples on May 20, 2016 for the following:

SAMPLE ID	ANALYSIS
TW-1	Nitrate, Nitrite and TKN Analysis, Total Nitrogen
TW-2	Nitrate, Nitrite and TKN Analysis, Total Nitrogen
KMW-1	Nitrate, Nitrite and TKN Analysis, Total Nitrogen
KMW-2	Nitrate, Nitrite and TKN Analysis, Total Nitrogen
KMW-3	Nitrate, Nitrite and TKN Analysis, Total Nitrogen
KMW-4	Nitrate, Nitrite and TKN Analysis, Total Nitrogen

Samples received at 1.7 ° C

If you have any questions or require further information, please call at your convenience. Long Island Analytical Laboratories Inc. is a NELAP accredited laboratory. All reported results meet the requirements of the NELAP standards unless noted. Report shall not be reproduced except in full without the written approval of the laboratory. Results related only to items tested. Long Island Analytical Laboratories would like to thank you for the opportunity to be of service to you.

Best Regards,

Long Island Analytical Laboratories, Inc.

Michael Veraldi - Laboratory Director

Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 14:55	Sample ID: TW-1
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-01
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 15:26	Calculation	1.60	28.7	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 15:09	EPA 300.0 Rev. 2.1	0.50	28.7	mg/L	3.E
Nitrite as N	05/20/2016 12:25	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	4.G

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 13:05	Sample ID: TW-2
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-02
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 15:26	Calculation	1.20	2.54	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 12:40	EPA 300.0 Rev. 2.1	0.10	2.54	mg/L	
Nitrite as N	05/20/2016 12:40	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 15:58	Sample ID: KMW-2
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-04
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 15:54	Calculation	1.20	4.94	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 15:54	EPA 300.0 Rev. 2.1	0.10	4.94	mg/L	
Nitrite as N	05/20/2016 15:54	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 16:25	Sample ID: KMW-3
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-05
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 16:09	Calculation	1.20	2.40	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 16:09	EPA 300.0 Rev. 2.1	0.10	2.40	mg/L	
Nitrite as N	05/20/2016 16:09	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 17:00	Sample ID: KMW-4
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-06
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 15:26	Calculation	1.20	<1.20	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 13:40	EPA 300.0 Rev. 2.1	0.10	0.19	mg/L	
Nitrite as N	05/20/2016 13:40	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

Data Qualifiers Key Reference:

3.E Compound reported at a dilution factor.

4.G Spike recovery out of range due to matrix interference.

MDL Minimum Detection Limit

LOQ Limit of Quantitation

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23

CHAIN OF CUSTODY / REQUEST FOR ANALYSIS DOCUMENT

CLIENT NAME/ADDRESS: NPV, 572 Walt Whitman Rd., Melville N.Y. 11747

CONTACT: Steve McGin

PHONE: 427-5865

EMAIL:

PROJECT LOCATION: The Hills @ East Quogue

SAMPLER (SIGNATURE):

SAMPLER NAME (PRINT): Jonathan McGin

SAMPLE(S) SEALED: YES / NO

CORRECT CONTAINER(S): YES / NO

6052002

SAMPLES RECEIVED AT: 1.7 °C

TERMS & CONDITIONS: Accounts are payable in full within thirty days, outstanding balances accrue service charges of 1.5% per month. Tendering of samples to LIAL for analytical testing constitutes agreement by buyer/sampler to LIAL's Standard terms

LABORATORY ID # (For Laboratory Use Only)	MATRIX	TYPE	pH	RES. CHLORINE	PRES.	DATE	TIME	SAMPLE # LOCATION	ANALYSIS REQUIRED: TKN / Nitrate	# OF CONTAINERS
1. 6052002-01	WW	G			1	5/19/16	2:55	TW-1	X	2
2. 02	WW	G			1		1:05	TW-2	X	2
3. 03	WW	G			1		2:00	KMW-1	X	2
4. 04	WW	G			1		3:58	KMW-2	X	2
5. 05	WW	G			1		4:25	KMW-3	X	2
6. 06	WW	G			1		5:00	KMW-4	X	2
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										

M

RUSH!

MATRIX: S=SOIL; SL=SLUDGE; DW=DRINKING WATER; A=AIR; W=WIPE; PC=PAINT CHIPS; BM= BULK MATERIAL, O=OIL, WW=WASTE WATER
TYPE: G=GRAB; C=COMPOSITE; SS=SPLIT SPOON
PRES: (1) ICE; (2) HCL; (3) H_2SO_4; (4) NAOH; (5) $NA_2S_2O_3$; (6) HNO_3; (7) OTHER

TURNAROUND REQUIRED: ☐ NORMAL ☑ STAT
BY 5 / 20 / 16

COMMENTS / INSTRUCTIONS: 24 HR TAT

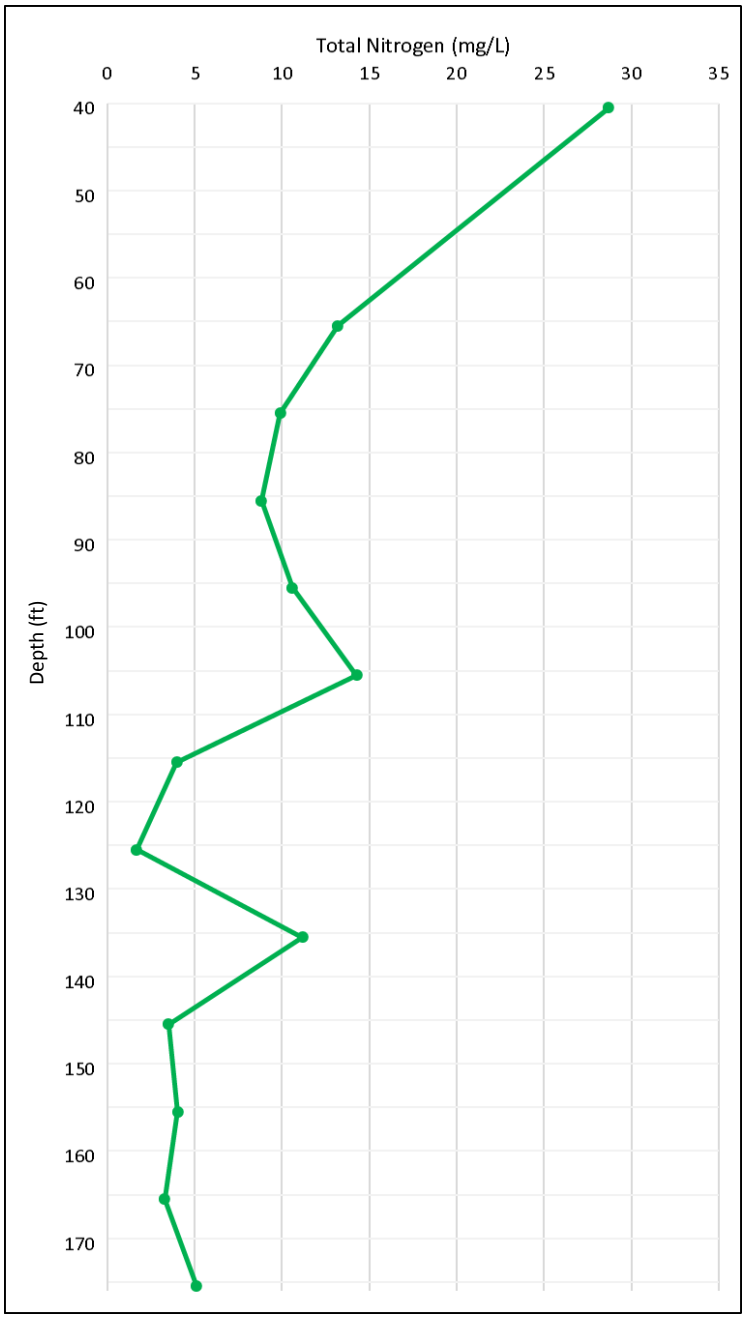
RELINQUISHED BY (SIGNATURE)	DATE 5/19/16 TIME 6:00	PRINTED NAME Jonathan McGin	RECEIVED BY (SIGNATURE)	DATE 5/19/16 TIME 18:07	PRINTED NAME Mike D. Veraldi
RELINQUISHED BY (SIGNATURE)	DATE TIME	PRINTED NAME	RECEIVED BY SAMPLE CUSTODIAN	DATE 5-19-16 TIME 922A	PRINTED NAME Ben Lamberson

WHITE - OFFICE / CANARY - CLIENT

Hills Vertical Profile Well Results	
Depth Interval (ft)	**Total Nitrogen (mg/L)**
40	28.7
65	13.20
75	9.92
85	8.85
95	10.60
105	14.30
115	4.00
125	1.71
135	11.20
145	3.52
155	4.06
165	3.29
175	5.13

Average* = 14.26

*Based on depths of 40-105 ft.



Client: Nelson, Pope & Voorhis	Client ID: Then Hills @ East Quogue
Date (Time) Collected: 05/19/2016 14:00	Sample ID: KMW-1
Date (Time) Received: 05/19/2016 18:01	Laboratory ID: 6052002-03
Matrix: Non-Potable Water	ELAP: #11693

General Chemistry Parameters

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Kjeldahl Nitrogen	05/20/2016 15:26	ASTM D3590-02(06) (A)	1.00	<1.00	mg/L	

Date Prepared: 05/20/2016 Preparation Method: SM4500-Norg B

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Total Nitrogen	05/20/2016 15:26	Calculation	1.20	6.29	mg/L	

Date Prepared: 05/20/2016 Preparation Method: [CALC]

Parameter	Date Analyzed	Method	LOQ	Result	Units	Flag
Nitrate as N	05/20/2016 12:55	EPA 300.0 Rev. 2.1	0.10	6.29	mg/L	
Nitrite as N	05/20/2016 12:55	EPA 300.0 Rev. 2.1	0.10	<0.10	mg/L	

Date Prepared: 05/20/2016 Preparation Method: IC Preparation

APPENDIX B

EFFECTIVE BIOSWALE PLANT SPECIES

Plant Guide

NEW YORK ASTER

Symphyotrichum novi-belgii (L.) Nesom var. *novi-belgii*

Plant Symbol = SYNON

Contributed by: USDA NRCS National Plant Data Center

© Don Kurz @ PLANTS

Alternative Name
Michaelmas daisy, *Aster novi-belgii*

Uses
Landscape: New York aster is an excellent upright perennial for a mixed bed or border. This species provides a color accent, bringing autumn color to the garden.

Wildlife: New York aster is known for attracting butterflies and moths to areas where it is found growing. This is a good bee plant providing nectar in the autumn. Most species in this genus seem to be immune to the predictions of rabbits (Thomas 1990).

Status
Please consult the Plants Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status, and wetland indicator values.

Description
General: Aster family (Asteraceae). New York aster is an upright, native perennial that grows between one and a half to five feet tall. The leaves are elliptic to linear, smooth to scabrous above and glabrous beneath (Radford, Ahles & Bell 1968). The disc flowers are red to yellow. The flowers are hermaphrodite (having both male and female organs) and are pollinated by bees, butterflies, flies, beetles and moths.

Distribution: New York aster ranges from Newfoundland and Nova Scotia south to Georgia, apparently to Alabama, chiefly near the coast (Tiner 1987). For current distribution, please consult the Plant profile page for this species on the PLANTS Web site.

Adaptation
New York aster is found growing in slightly brackish and tidal fresh marshes, occasionally borders of salt marshes; inland marshes, shrub marshes, shores and other moist areas (Tiner 1987). This plant requires well-drained soil and prefers sandy, loamy and clay soils. It can grow on nutritionally poor soil, in semi-shade or no shade but prefers a sunny location.

Establishment
Propagation by Seed: New York aster seeds should be sown fresh in the fall or spring (Heuser 1997). Pre-chill spring sown seeds to improve germination. When the seedlings are large enough to handle, place them into individual pots and plant them out in the summer. Division of this species should be done in the spring. Large divisions can be planted into their permanent positions whereas smaller clumps should be kept in a cold frame until they are growing well.

Management
Divisions of New York aster should be done in the spring every three years to maintain vigor (Heuser 1997). Regular spraying is recommended for this species because it is prone to mildew and attack from pests.

Cultivars, Improved and Selected Materials (and area of origin)
Available through some native plant seed sources. Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under "United States Government." The Natural Resources Conservation Service will be listed under the subheading "Department of Agriculture."

References
Gleason, H.A. & A. Cronquist 1991. *Manual of the vascular plants of northeastern United States and*

adjacent Canada. 2nd ed. The New York Botanical Garden, Bronx, New York.

Heuser, C.W. 1997. *The complete book of plant propagation*. The Taunton Press, Newtown, Connecticut.

Huxley, A. 1992. *The new RHS dictionary of gardening*. MacMillan Press, New York, New York.

Radford, A.E., H.E. Ahles, & C. Bell 1968. *Manual of the vascular flora of the Carolinas*. The University of North Carolina Press, Chapel Hill, North Carolina.

Thomas, G.S. 1990. *Perennial garden plants*. J.M. Dent & Sons, London

Tiner, R.W., Jr. 1987. *A field guide to the coastal wetland plants of the northeastern United States*. The University of Massachusetts Press, Amherst, Massachusetts.

Prepared By
Lincoln M. Moore
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Species Coordinator
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USDA, NRCS, National Plant Data Center, c/o Plant Sciences Dept., Davis, California

Edited: 19jun02 jsp; 04jun03 ahv; 060817 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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Plant Fact Sheet

RED FESCUE

Festuca rubra L.

Plant Symbol = FERU2

Contributed by: USDA NRCS Plant Materials Program

Robert H. Mohlenbrock
USDA NRCS 1995
Northeast Wetland Flora
@USDA NRCS PLANTS

Alternate Names
Please consult PLANTS for infraspecific taxa.

Uses
Erosion control: Red fescue is an excellent soil binder and used extensively for stabilizing waterways, slopes, banks, cuts, and fills.

Recreation and beautification: This grass is used as a turf for lawns, athletic fields, golf courses, and playgrounds.

Crop: It is used as a cover crop in orchards.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Festuca rubra L., red fescue, is a cool season, sod-forming grass. Leaves of red fescue are bright green, wiry, and narrow. They are pressed together in a "V" shape and appear nearly round. Stems are usually bent at the reddish or purplish base and grow about 2 feet tall. The panicle seedhead is contracted or narrow.

Adaptation and Distribution
This grass is hardy, wear-resistant, and shade tolerant. It is drought resistant after establishment, and adapted to sandy and acid soils. It prefers well-drained soils, but requires ample moisture for establishment. Its prime area of use in the Northeast consists of New York, Ohio, West Virginia, Pennsylvania, and the New England states. In the other states of the Northeast region, the grass is adapted to the cooler zones. In areas of high temperatures and humidity, the grass may turn brown or deteriorate during the summer. It will generally recover in the fall when temperature and moisture conditions are more favorable.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Red fescue is rarely seeded in pure stands. Instead, it is used with grasses and legumes for specific purposes, such as lawns, erosion control, or recreational areas. Seedbed preparation, fertilizing, liming, rate and dates of seeding, and weed control requirements are generally governed by the companion grasses in the mixture. When red fescues are added to a mixture they usually constitute 25 to 60 % of the mixture by weight. In shaded areas, red fescue is often the key grass in the mixture.

Management
To maintain stand vigor and density on lawns and recreational areas, apply fertilizers at the recommended rate annually. For critical erosion areas, less frequent use of fertilizers may be satisfactory. When red fescue dominates a stand, mowing consistently below 1-1/2 inches can cause severe damage to the stand.

Pests and Potential Problems
There are no serious pests of red fescue.

Cultivars, Improved, and Selected Materials (and area of origin)
'Illahee' (England), 'Pennlawn' (Europe), 'Rainier', and 'Trinity'. The common varieties are readily available from commercial sources.

Prepared By & Species Coordinator:
USDA NRCS Plant Materials Program

Edited: 05Feb2002 JLK; 25may06jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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Plant Fact Sheet

FOWL MANNAGRASS

Glyceria striata (Lam.) Hitchc.

Plant Symbol = GLST

Contributed by: USDA NRCS Plant Materials Center, Corvallis, Oregon

Photo by Dale Darris, USDA NRCS Corvallis PMC.

Alternative Names

Alternate Common Names: tall mannagrass
Alternate Scientific Names: *Glyceria elata, Glyceria nervata, Glyceria striata* ssp. *stricta, Glyceria striata* var. *stricta, Panicularia nervata, Panicularia striata*

Uses

Fowl mannagrass is a rapidly establishing native species suitable for restoration of swamps, the edges of marshes, ponds, and streams, and other wetland plant communities where an herbaceous understory is desired. It has versatility for use along creeks and ditch bottoms where exposure may vary from full sun to dense shade, thereby improving soil stability beyond the use of woody plants alone. Where this species dominates, herbage production is high. Palatability of *G. striata* is rated good to very good for cattle and horses which consume both flower stems and leaves. It is rated fair to good for sheep which tend to use only the leaves. The seed is food for waterfowl and birds while the foliage and tall stems provide good wildlife cover. Foliage is seasonally grazed at a light to heavy rate by deer, muskrat, and bears. Elk can make minor use of it as well. Fowl mannagrass may be applicable to seeding mixtures targeted to improve species richness and exclude reed canarygrass (*Phalaris arundinacea*) prior to its invasion. It is occasionally planted as an ornamental in and around backyard ponds.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation

In the Pacific Northwest, fowl mannagrass is a long-lived, cool season perennial bunchgrass with somewhat succulent stems (culms) that reach a height of 100 to 180 cm. The form is erect, robust, and clumpy despite the production of slow growing rhizomes or underground stems. Rate of spread may vary among populations. Leaf blades are soft, ribbon-like, 6 to 12 mm wide and 15 to 25 cm long. The flowerhead (panicle) is loose, broad, pyramid-like, and 8 to 27 cm long with spreading and drooping branches. Populations previously described for *G. striata* include plants that are shorter and tougher with smaller leaves (2 to 5 mm wide) and flower heads that are more closed. *G. striata* occurs across most of North America.

Fowl mannagrass distribution from USDA-NRCS PLANTS Database.

Key to identification: Fowl mannagrass can be easily confused with reed mannagrass (*Glyceria grandis*), which has smoother leaves and lacks its slightly rough texture. Others mannagrasses are easier to distinguish, but a botanical key should be consulted.

Line drawing of fowl mannagrass reprinted with permission, University of Washington Press.

Relative abundance in the wild: Seed ripens in July or August and retention within the flower head is fair to good. Collections can be readily made along wet forest road ditches, but access can be difficult along streams or in denser, swampy brush where this species is commonly found.

Adaptation: Fowl mannagrass occurs widely in bogs**,** seeps, wet woods, thickets or swampy areas, shaded ditches, and along or in streams. It may occasionally be found growing in full sun on summer damp soils as well as in standing water. Reportedly, this species is best adapted to freshwater, semi-aquatic habitats (*G. elata*) or those that are irregularly to seasonally flooded and saturated for up to 25% of the growing season (*G. striata*). However, some plants have been observed to thrive and flower under continuous inundation (1-10 cm) for several years. Fowl mannagrass tolerates open areas but prefers shady habitats. It may occur as single plants, small colonies, or larger stands that dominate the understory of ash swales as well as willow, aspen, and other wetland forest or shrub communities. Soils range from organic to mineral with a pH of 4 (acidic) to 8 (slightly alkaline). This species does not tolerate salinity and needs moderately good fertility. This species is very shade tolerant, similar to reed mannagrass, yet it can be grown in full sun to produce substantial seed.

Establishment

The presence of seed dormancy, if any, may vary among populations. Seeds can germinate within two to three weeks without treatment, but 14 to 30 days of cold moist stratification (moist pre-chilling) has resulted in faster germination, although not necessarily higher rates. Others report the need for 150 days of stratification in cold water. Fall sowing is preferred if dormancy is known or uncertain. Seed hulls readily detach but removal is unnecessary. There are approximately 1,600,000 seeds per pound with hulls intact. A seeding rate of one pound pure live seed per acre will result is about 37 live seeds per square foot. Seeding rates depend on methods used, objectives, and site conditions.

Management

Sites where fowl mannagrass occurs are typically too wet for grazing when the herbage is most succulent. Therefore, access must be deferred until late in the season when soils are drier and quality has declined somewhat. Tolerance to fire and heavy grazing is not well documented. Fowl mannagrass can be grown for seed on upland sites with medium to fine textured soils if regular irrigation is applied in summer and fall.

Pests and Potential Problems

Glyceria striata is susceptible to fungal pathogens such as *Epichloe glyceriae*, which causes floral castration, and *Ustilago striiformis*, better known as stripe smut. Fungicides may be needed for control. Consult with your local Extension Service agent, plant disease control handbook, or other experts for advice.

Environmental Concerns

Some strains or populations of *G. striata* may contain cynogenetic compounds. Cyanide poisoning has been reported in cattle from both fowl and reed mannagrass, so caution is advised for livestock utilization. Other species of mannagrass are described as weedy in certain crops or wet areas, but concerns for fowl mannagrass are not widely known.

Cultivars, Improved, and Selected Materials (and area of origin)

Seed sources and plants are regularly available throughout much of the United States.

Prepared By:

Dale Darris, USDA NRCS Plant Materials Center, Corvallis, Oregon

Citation

Darris, D. 2005. Plant fact sheet for fowl mannagrass (*Glyceria striata)*. USDA-Natural Resources Conservation Service, Plant Materials Center, Corvallis, OR.

Published January 2005

Edited: 21Mar2006 jsp, 17Sep2008 dcd; 19Sep2008 jsp; 17Feb2012 aym

For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>

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Plant Fact Sheet

BROOMSEDGE BLUESTEM *ANDROPOGON VIRGINICUS* L.

Plant Symbol = ANVI2

Contributed by: USDA NRCS East Texas Plant Materials Center

Melinda Brakie, USDA NRCS East Texas Plant Materials Center

Alternate Names
broomsedge, yellowsedge bluestem, Virginia bluestem, whiskey grass

Uses
Livestock: Broomsedge bluestem is not considered important cattle forage. It provides grazing in spring and early summer. However, nutritional quality and palatability quickly decrease as the summer progresses.

Wildlife: Small birds utilize the seed in winter when other food supplies are limited. Broomsedge bluestem provides cover for ground nesting birds such as quail and turkeys. It is a larval host for the Zabulon Skipper butterfly (*Poanes zabulon*).

Ornamental: Broomsedge bluestem is used as an ornamental plant. It is recommended for golf courses and residential landscaping because it requires low amounts of water. In the fall, the foliage turns a reddish orange and retains this color during winter dormancy, thereby adding color to the winter landscape.

Status
Please consult the PLANTS Web site (http://plants.usda.gov) and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation
Broomsedge bluestem is a native warm season perennial bunchgrass that grows 2 to 4 feet tall. The leaves are flat to partly folded 10 to 15 inches long and approximately 1/8 inch wide. The fringed ligule is 1/16 inch long. The flattened basal leaf sheaths are colorless or yellow. The rest of the plant is a pale greenish yellow. Broomsedge bluestem produces many seeds on the upper half of the plant that are distributed by the wind. At a distance the inflorescence may appear silvery in the sunlight.

Broomsedge bluestem grows where average rainfall is greater than 25 inches. It is found throughout the eastern portion of the United States. The grass is found in open areas such as abandoned fields, overgrazed pastures, cut-over timber sites, and rights of way. Broomsedge grows on a wide variety of soils, preferring loose, sandy, moist sites with low fertility and is an indicator of low phosphorus soils. It also is a shallow rooted plant.

Distribution: Please consult the Plant Profile page for this species on the PLANTS Web site.

Establishment
Broomsedge bluestem can be established by direct seeding or transplanting. Direct seeding is the preferred method of establishing a broomsedge bluestem stand. Prepare a firm, weed free seedbed by discing and cultipacking. The site may be prepared by treating the planting area in the spring with a nonselective herbicide such as glyphosate to kill existing vegetation then using a no-till type drill to plant.

The best time to plant broomsedge bluestem seeds is in the spring when soil temperature is at least 55°F or greater. The seed should be planted no more than ¼ inch

deep. Broomsedge bluestem seeds germinate well and readily begin growing on exposed soil. Two methods for planting the seed are drilling and broadcast planting. A drill is the preferred method due to proper seed placement and spacing. The drill should be capable of planting light, fluffy seed at a planting rate of 8 pounds of pure live seed (PLS) per acre. When broadcast planting the seed, increase the planting rate to 12 PLS per acre. It will be necessary to add a carrier material to the broomsedge bluestem seed when broadcast planting is done. Carriers include rice hulls, sand, or sawdust. Without an accompanying carrier material, the broomsedge bluestem seed will not flow well through the broadcaster and be unevenly distributed in the field. After broadcast planting, run a cultipacker or roller over the planting to ensure seed to soil contact.

Broomsedge seedlings grow quickly. In a North Carolina study, first-year seedlings averaged five inches in height. One and two year old plants averaged 40 inches in height and 3 inches in basal circumference (Keever, 1950). Seed production begins when plants reach two to three years of age.

Transplants of broomsedge bluestem are best used for small areas and high visibility sites. Transplants are usually more costly than direct seeding. Professional installations may cost between $1.00 per square foot for small plants and up to $10.00 per square foot for gallon pots. To produce transplants, divide larger plant crowns into smaller plants. Divide plant crowns so that each small plant includes healthy, viable stems. The best time for transplanting is in the spring. Dig a hole just large enough to accommodate plant roots without bunching, and then fill in around the plant with soil. After planting, water the transplants so they will have adequate moisture and the soil will settle around the roots. Prevent weed seed germination by applying a pre-emergent herbicide or mulch, after planting.

Management

Native grasses grow slowly and require two to three years to fully establish. Mowing is an effective method for controlling weeds. Mow above the tops of the broomsedge bluestem to reduce weed competition. Mowing only the tops keeps from covering up the small grass seedlings.

Weeds can also be controlled by selective herbicides. Imazapic herbicides will control broadleaf weeds and is labeled for use on most warm season grasses. Apply imazapic herbicides in the spring using a boom sprayer after the broadleaf weeds have begun growing.

In certain situations, broomsedge bluestem is considered a pasture weed. It increases in plant numbers as more desirable vegetation is selectively grazed by livestock. If left uncontrolled, broomsedge bluestem can become the dominant grass in abused, overgrazed range and pastures. Avoid overgrazing of desirable grasses by managing the number of animals, the duration of their grazing, and amount of herbage that is removed from the pasture. Do not rely on calendar days to determine the number of days for animals to graze a pasture, instead schedule grazing based on plant growth of key species and available forage. If warm season grasses are the desirable species, remove grazing animals when the grasses have 6 to 8 inches of stubble height remaining. Contact your local USDA-NRCS field office for assistance in planning a prescribed grazing plan.

Vegetative growth of broomsedge bluestem begins in early spring. To reduce the amount of broomsedge bluestem in a pasture, heavily graze it in early spring when the grass is most palatable and then defer grazing for 60 to 90 days. Increase the soil fertility by adding nitrogen, phosphorus, and potassium based upon soil tests and fertilizer recommendations. Fertilizing the desirable species will help them compete successfully with the broomsedge.

Pests and Potential Problems

On infertile soils, broomsedge is a long-lived competitor. Broomsedge bluestem has allelopathic chemicals which adversely affected other plants (Rice, 1972).

Environmental Concerns

Broomsedge bluestem was inadvertently introduced to the Hawaiian Islands in 1932. It is considered noxious there because it invades native Hawaiian plant communities and alters the fire and hydrology regimes (Diggs, et al., 2006).

Control

By itself, prescribed burning has little detrimental effect on broomsedge bluestem and is not an effective means of control. The aboveground biomass is removed; in response, the plant quickly begins new vegetative growth after a burn. However, the new vegetative growth can be treated with herbicides.

Glyphosate herbicides are an effective chemicals to use for control of broomsedge bluestem. Glyphosate herbicides are non-selective. Broadcast spraying of a glyphosate herbicide will result in killing both broomsedge bluestem and desirable vegetation. Therefore, broadcast spraying is not recommended for established stands of desirable vegetation. If a complete canopy kill is the objective, apply the herbicide using a boom sprayer. Apply the herbicide when the plants are actively growing. A follow-up application may be needed.

Selective application of glyphosate, such as wicking or spot treatment is recommended in established pastures. When using a wick, raise it above the desired vegetation and sweep the top of the broomsedge bluestem. If the treatment site is smaller with isolated broomsedge

colonies, a backpack sprayer is a feasible option to apply herbicide. Make herbicide applications when the broomsedge bluestem plants are actively growing.

For all chemical control methods, always read and follow label and safety instructions. Consult your extension weed specialist or county agent for recommended herbicides. Control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Cultivars, Improved, and Selected Materials (and area of origin)
Currently, the cultivar 'Silver Beauty' is commercially available. Locally harvested material may be available from local seed dealers.

Prepared By
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Species Coordinator
R. Alan Shadow, USDA NRCS East Texas Plant Materials Center

References:
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Keever, C. 1950. Causes of succession on old fields of the Piedmont, North Carolina. Ecological Monographs. 20 (3):229-250.

Rice, E.L. 1972. Allelopathic effects of *Andropogon virginicus* and its persistence in old fields. Amer. J. Bot. 59:752-755.

Edited: 22Sep09 mws

Published: September 2009

For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>

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Plant Fact Sheet

ARROW ARUM

Peltandra virginica (L.) Kunth.

Plant Symbol = PEVI

Contributed by: USDA NRCS Plant Materials Program

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Uses

Expansive stands of arrow arum often develop in the marginal waters it inhabits. The foliage and stems in these stands create a wave deflecting or buffering barrier, while the root masses knit together and stabilize the submerged sediments. The roots and shoots translocate methane from the substrate. Arrow arum fruit is a preferred food of wood ducks, and is also eaten by muskrats and rails. The foliage is seldom damaged, providing good cover to waterfowl, wading birds, insects, and aquatic mammals.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

The bright green, smooth, succulent, arrow- to heart-shaped leaves of arrow arum (*Peltandra virginica*) emerge annually from perennial bulbs. The bulbs are tufted with thick fibrous roots. The 4 to 30 inch long ascending leaves are 3 to 8 inches wide, and have three prominent veins with an abrupt, sharp tip.

Arrow arum is monoecious, with both male and female parts contained in a partially closed 4 to 8 inch green spathe. It blooms from May to July. As the fruit matures the entire flowering stem curves downward, immersing the spathe. The green berry-like fruit is up to 1/2 inch long, and usually contains one seed. Upon separation from the flowering stem, this floatable fruit begins to turn black.

Adaptation and Distribution

The native range of arrow arum is from Maine to Ontario and Michigan, south to Florida, Louisiana, and Missouri. It commonly inhabits shallow water areas of marshes, bogs, swamps, stream and river bottoms, lakes, ponds, and ditches. This emergent requires unconsolidated silty or organic sites, which are open, and saturated or inundated up to 1 foot. It will tolerate pHs of 3.0 to 9.5, and salinity up to 2 ppt.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

Arrow arum predominantly relies on its seed production for re-establishment and population distribution, but it can be propagated vegetatively. There are an average of 500 cleaned seeds per pound. When the fruit of this species falls into or is stored in water, the fruit coating swells and ruptures. The seed separates, sinks, then begins to germinate if site conditions are adequate. This same seedling development process can easily be replicated in cultivated fields or in greenhouses.

Vegetative propagation is by root bulb divisions. The bulbs form in layers around a root mass, which may be as deep as 8 inches. Once dug, the bulbs are broken from the root mass, then either directly planted or transplanted into containers or production beds. One mature plant may produce up to ten of these planting units.

Management

If planted into soils with low organic contents, arrow arum responds well to applications of commercial fertilizer. Only marginal effect is expected with the

addition of fertilizers on adequate sites. To sustain good vigorous plant growth, soils must be deep and maintained at the saturation point, or inundated to a depth shallower than the leaves. Once established, this species tolerates partial shade, but young seedlings need direct sunlight. If managing for seed production, timely harvest is necessary, since ripe fruit are readily consumed by wood ducks and muskrats. No other damaging pests have been documented or observed.

In the Northeast, arrow arum grows in association with facultative wetland trees and shrubs, wild rice, woolgrass, burreeds, and soft rush. In shallower open water it often is over topped by aggressive rhizomatous species.

Cultivars, Improved, and Selected Materials (and area of origin)

No known varieties are available, but wetland nurseries carry local or regional ecotypes.

Prepared By & Species Coordinator:

USDA NRCS Northeast Plant Materials Program

Edited: 05Feb2002 JLK; 060802 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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Read about Civil Rights at the Natural Resources Convervation Service.

Plant Fact Sheet

BLUE FLAG

Iris versicolor L.

Plant Symbol = IRVE2

Contributed by: USDA NRCS Plant Materials Program

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MD-National Capital Park &
Planning Commision
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Uses
This species is primarily utilized for its brightly colored floral display. The root mass of established colonies provides good shoreline protection. Although the seed is large and kernel-like, there is no documentation of wildlife consumption; the root stock is fed upon by aquatic rodents.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Blueflag's sword-like leaves emerge from thick horizontal root stock (corm) which are covered with fibrous roots. This emergent will grow to heights of four feet in spreading clumps. The individual leaves are somewhat shorter than the entire plant. This species will radially grow less than 2 feet per year.

From the nearly straight flowering stems emerge large blue to violet-blue showy flowers. They bloom from May to July. The three petaled flowers are often finely variegated with yellow, green, and white. The flower develops a three celled capsule which is about 1 1/2 inches long and 3/4 of an inch in diameter. Within each cell, two rows of flattened round seeds form. There are an average of 18,000 seeds per pound.

Adaptation and Distribution
The native distribution of blue flag spans from Newfoundland to Manitoba, south to Florida and Arkansas. It is typically encountered in marshes, swamps, wet meadows, along shorelines, and in forested wetlands. It performs best on sites with unconsolidated soils high in organic content, in direct sunlight. It will tolerate moderately brackish water, partial shade, and permanent inundation up to 6 inches deep.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Like many wetland species, this perennial emergent can be effectively established using vegetative and seed techniques. To propagate wild iris by vegetative means, single corms or bulbs can be divided or cut from the parent root system. These propagules are then potted or directly field planted before the end of July. Plant along the water line.

To field or nursery grow seedlings, the seeds should be stratified in moist peat moss for at least three months at 36 to 0 degrees Fahrenheit. Naturally the seed will shatter from their pods in fall; wash on land at the soil/water interface and over winter at that location; then, germinate in spring. Fall seeding can be considered, but is often met with less success than with nursery transplants.

This plant is easily established and increased under nursery conditions. With organic soils, minimal fertilization, and good water depth control, this perennial will thrive.

Management
Under proper hydric environment and soil organic levels, this flowering plant thrives without the addition of commercial fertilizers. There are no known insects or diseases which negatively impact this species, but muskrats will eat the root. Blueflag

is easily over-topped by aggressive rhizomotous emergents.

Cultivars, Improved, and Selected Materials (and area of origin)

This wild iris has been utilized to develop certain ornamental bulbs that are commercially available. Seedlings or divisions of locally or regionally collected ecotypes are available from wetland plant nurseries.

Prepared By & Species Coordinator:

USDA NRCS Northeast Plant Materials Program

Edited: 05Feb2002 JLK; 060801 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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Natural Resources Conservation Service

Plant Fact Sheet

SWAMP MILKWEED

Asclepias incarnata L.

Plant Symbol = ASIN

Contributed by: USDA NRCS, Norman A. Berg National Plant Materials Center, Beltsville, MD

Jennifer Anderson. IA, Scott Co., Davenport, Nahant Marsh. January 2, 2002

Alternate Names
Rose milkweed
Pleurisy Root
White Indian hemp

Warning: Swamp milkweed may be toxic when taken internally without sufficient preparation.

Uses

Conservation: Swamp milkweed is a native, colonizing, perennial wildflower useful for wetland rehabilitation. It is a good component of a wildlife seed mixture when seeded with native grasses and wildflowers. It prefers moisture retentive to damp soils in full sun to partial shade.

Wildlife: Swamp milkweed is a favored food of monarch butterfly (*Danaus plexippus*) larva (shown in the picture above). Swamp milkweed is also an important food source for the queen butterfly (*Danaus glippus*) larva. Various other butterflies and hummingbirds consume nectar from the flowers.

Ethnobotanical: The Chippewa and Iroquois have used an infusion of the roots externally to strengthen the body and heal babies' navels. The Iroquois and Meskwaki have also used a decoction of the roots and/or aerial portions of the plant as an emetic, diuretic, and anthelmintic (de-worming agent). The common name, Pleurisy Root, comes from its once common use to treat lung problems. Swamp milkweed is toxic when taken in large doses. The tough stringy stem fibers have been used to make twine, rope and rough textiles.

The downy parachutes (comas) that are attached to each seed are six times more buoyant that cork and five times warmer than wool. Large quantities of milkweed were grown for use as stuffing in pillows and lifejackets during World War II.

Landscape: Swamp milkweed is a tall plant with fragrant, showy clusters of pink and light purple flowers. It does well in landscape plantings with moist soil and in plantings near bodies of water. Unlike many ornamentals, swamp milkweed tolerates heavy clay soils and is very deer-resistant. It is a more cultivated alternative to common milkweed that is also attractive to egg-laying Monarchs.

Livestock: The bitter leaves of swamp milkweed do not appeal to livestock; sheep are especially susceptible to the poisonous compounds in swamp milkweed, and sheep fatalities have been reported after consuming the plant.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Description and Adaptation

Swamp milkweed distribution from USDA-NRCS PLANTS Database.

Description: Swamp milkweed is a native, perennial, wildflower growing three to six feet tall. It gets its common name from its white sap, although it has less sap than many of its relatives. The genus was named in honor of Aesculapius, Greek god of medicine, undoubtedly because some species have long been used to treat a variety of ailments. The Latin species name means flesh-colored. It has long, narrow, lance-shaped leaves that progress in pairs up the stem. Bright pink, white and purple clusters of flowers appear in summer at the tops of the stems. In the fall, blooms give way to distinctive tear-shaped five-inch seed pods that are green when unripe, but harden to brown. The individual seeds are attached to fluffy hairs that allow the seeds to drift on the wind. Swamp milkweed also spreads through rhizomes (roots that grow horizontally from the original plant).

Adaptation and distribution: Swamp milkweed is widely distributed across the U.S. and Canada from Quebec and Maine south to Florida and Texas and west to Nevada and Idaho. It prefers neutral to slightly acidic soil, although it will tolerate a pH up to 8.0. Its moisture requirements are high, and it is primarily found in moist habitats such as wet meadows, floodplains, riverbanks, pond shores, stream banks, wet woods, swamps, and marshes, although it will also grow in drier areas such as prairies, fields, and roadsides. Swamp milkweed needs full sun or partial shade to flourish. It is insect-pollinated and self-fertilizing

Establishment

Propagation by seeds: Collect seeds in the fall, when the brown pods are dry and have begun to split. Crack the pods open completely allowing the seeds to dry for one to two weeks in paper bags. Several weevil larvae prey on developing seeds, so look for signs of damage including small entry holes in the pod exuding latex. Once they are dry, place the seeds into plastic bags filled with moist perlite or vermiculite and store them in a cold place, approximately 35 to 38 degrees Fahrenheit, for at least 4 to 12 weeks (stratification). Good germination results have been reported without stratification by soaking the seed. Soak the seed in hot water (190 degrees Fahrenheit) for 12 hours. Repeat this process two additional times for expected seed germination of 50%. Seed can be placed in cold storage for up to three years.

To grow plants, use germination trays with cells two inches wide and four inches deep. Fill the cells with a commercial seedling mixture or a mix of sphagnum peat moss and vermiculite and moisten well. Press the seed gently into the soil, three seed per cell, and cover with a very thin layer of soil. Keep the soil moist during germination by spraying or misting. Ambient temperatures should remain between 65 and 75 degrees Fahrenheit. Swamp milkweed seed requires light for germination. Germination is poor at temperatures higher than 85 degrees Fahrenheit. Seedlings should not be transplanted until they have at least one set of true leaves. Allow 4 to 8 weeks inside growing time for seedlings before moving to a cold frame or transplanting outside. Plants can be moved outside once the danger of frost has passed.

Management

Swamp milkweed spreads through rhizomes; established plants can be divided in late spring. Swamp milkweed is a relatively long-lived (and slow-growing) herbaceous perennial.

Pests and Potential Problems

Swamp milkweed attracts the orange milkweed aphid. If plants begin to look unhealthy, spray them with a soap solution or high-pressure blasts of water.

Environmental Concerns

None at this time.

Cultivars, Improved, and Selected Materials

The cultivars ‘Ice Ballet’ and ‘Cinderella’ can be found at many native plant nurseries.

Prepared By

Samantha Kirk and Shawn Belt, USDA-NRCS, Norman A. Berg National Plant Materials Center, Beltsville, MD.

Citation

Kirk, S. and Belt, S. 2011. Plant fact sheet for swamp milkweed (*Asclepias incarnata)*. USDA-Natural Resources Conservation Service, Norman A. Berg National Plant Materials Center. Beltsville, MD 20705.

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Plant Fact Sheet

BLACK-EYED SUSAN

Rudbeckia hirta L.

Plant Symbol = RUHI2

Contributed by: USDA NRCS Plant Materials Program

USDA NRCS National Plant Materials Center
Beltsville, MD

Uses

Erosion control: Black-eyed Susan is an important component in critical area treatment plantings along with grasses, legumes, and other forbs when used along road cuts, hillsides, and other areas subject to erosion.

Wildlife: This plant offers protection and food to several song and game birds.

Recreation and beautification: Black-eyed Susan can be used for landscaping and in wildflower gardens.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

Rudbeckia hirta L., black-eyed Susan, is a biennial forb about 1 m tall with yellow ray flowers and dark brown spherical centers. After germination, the seedling grows into a rosette with oblong leaves. Sometimes flower stalks will appear in the first summer, but typically black-eyed Susan blooms from June to September of the second year. After flowering and seed maturation, the plants die. The seed is very small (1,746,000 per pound) and black, about 2 mm long and 0.5 mm in diameter.

Adaptation and Distribution

Black-eyed Susan is naturalized in most of the states east of Kansas and the bordering areas of Canada. It is adapted throughout the Northeast on soils with a drainage classification range from well-drained to somewhat poorly drained. It will perform acceptably on droughty soils during years with average or above rainfall, but best growth is achieved on sandy, well drained sites. It is winter hardy in areas where low temperatures are between -30 ° and -20 °F.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

Black-eyed Susan is easily established with most critical area seeding techniques. Generally ½ lb. of seed per acre is sufficient in mixes with conservation grasses, legumes, and other forbs. Where the intent is to maximize the impact of the forb component, utilize bunchgrasses rather than aggressively spreading grasses such as reed canarygrass or bromegrass. Once established, new seedlings will be produced from the preceding crop; the stand may perpetuate itself indefinitely.

Management

After establishment, competing perennial vegetation should be controlled through the use of mechanical or chemical practices. If competing vegetation is not controlled, one will observe a decrease in the number of black-eyed Susan plants.

Pests and Potential Problems

There are no major insect or disease pests of black-eyed Susan. Stands can be reduced by powdery mildew and damping-off organisms.

Cultivars, Improved, and Selected Materials (and area of origin)

'Golden Jubilee' black-eyed Susan was released by the Big Flats Plant Materials Center in 1985. It is typical of the species except slightly shorter in height with a longer bloom period. It was not selected for its flower size or color. 'Golden Jubilee' is the only cultivar of black-eyed Susan that has proven adaptation throughout the Northeast for conservation

REDOSIER DOGWOOD

Cornus sericea L.

Plant Symbol = COSE16

Contributed By: USDA NRCS National Plant Data Center & Carlinville (IL) Field Office

Robert H. Mohlenbrook
USDA, NRCS, Wetland Science Institute
@ PLANTS

Alternative Names

American dogwood, red willow, redstem dogwood, *Cornus sericea* ssp. *sericea*; *Cornus stolonifera* var. *nevadensis* Jepson and *Cornus stolonifera* Michaux (Hickman 1993). A subspecies, *Cornus sericia* spp. *occidentalis* (Torr. & Gray) Fosberg is known as western dogwood.

Uses

Ethnobotanic: Native Americans smoke the inner bark of redosier dogwood in tobacco mixtures used in the sacred pipe ceremony. Dreamcatchers, originating with the Potawotami, are made with the stems of the sacred redosier dogwood. Some tribes ate the white, sour berries, while others used the branches for arrow-making, stakes, or other tools. In California, peeled twigs were used as toothbrushes for their whitening effect on teeth (Strike 1994). Bows and arrows were made from *Cornus* shoots. The inner bark is used for tanning or drying animal hides.

The Apache, Cheyenne, Dakota, Montana Indians, Ojibwa, Potawatomi, Omaha, Ponca, and Thompson Indians all use the inner bark in a tobacco mixture for smoking the sacred pipe (Moerman 1986). The leaves and/or inner bark of redosier dogwood are also used as a smoking mixture by the Okanagan-Colville,

the Flathead, the Kootenay, and the Blackfeet peoples in the western United States and Canada (Hellson 1974, Hart 1976, Turner 1978, Turner et al. 1980, Johnston 1987). The Navaho-Kayentaf and Navaho-Ramah used the plant ceremonially as a Mountain-top-way emetic (Moerman 1986). An infusion of redosier dogwood bark was used as an anti-diarrheal by the Chippewa and the Potawatomi, an antidote for weak kidneys by the Shuswap, and a pediatric aid for children who wet the bed by the Shuswap. The Chippewa used an infusion of the bark for eruptions caused by poison ivy. The Chippewa and the Micmac used a decoction of redosier dogwood root for sore eyes and catarrh. The Okanagan and the Thompson Indians took a decoction of the leaves. Other remedies treated by redosier dogwood included headaches, sore throats, a wash for ulcers, a substitute for “larb”, and a decoction of bark was taken as an antidote for weakness.

The Maidu of Northern California used redosier dogwood as a tonic, a laxative, emetic, and cathartic (Strike 1994). Maidu women took a dogwood decoction after childbirth.

The Indians of the Missouri region (Densmore 1974) ate the fruits. The berries are known to be tart and bitter, but were nonetheless eaten by all of the southern Interior peoples of British Columbia, including the Nlaka’pamux, Lillooet, Okanagan-Colville, Shuswap, Kootenay, Blackfeet, and the Flathead of Alberta and Montana (Kuhnlein and Turner 1991). The fruits were gathered from August to October and eaten fresh, a few at a time, or, more commonly, were pounded and mixed with other fruits, such as chokecherries (*Prunus virginiana*) or Saskatoons (*Amelanchier almifolia*). Some people mashed the berries and dried them in cakes; others dried and stored them. Eating a few raw fruits was considered to be a good tonic among the Nlaka’pamux and the Okanagan-Colville, who ate them raw as a kind of “relish” (Turner 1978; Turner et al. 1990).

Redosier dogwood is used for basketweaving. Sometimes called red willow, both *Salix* species and *Cornus sericea* are used interchangeably. Differences in stem color create a multi-hued design

element. Indian people from the mid-Columbia River used redosier dogwood to make "ribbons" for basket decorations (Schlick 1994). If gathered in the early spring, the bark will retain its deep red color when dried and could be mistaken for cherry. The Hidatsa, Arikara, and Mandan made twill plaited burden baskets with two-toned dark and light designs; these baskets were made of willow (*Salix nigra*), redosier dogwood, and boxelder (*Acer negundo*) splints (Turnbaugh et al. 1986, Hart 1976). Willow and redosier dogwood were used by the Cheyenne, Arapaho, Kiowa, Pawnee, and Teton Sioux to make a coarsely coiled gambling basket for dice.

The Ojibwa and the Chippewa used redosier dogwood bark as a dye. The inner bark was mixed with other plants or minerals and used to make a red dye, a light red dye, a black dye, and an ecru or "khaki" colored dye (Densmore 1974).

Wildlife: The fleshy fruits of dogwoods are very valuable to wildlife, particularly in the Northeast (Martin et al. 1951). The fruit ripens in late summer, and besides being available through the fall, some of the berries may persist on the plants into the winter months. Wildlife browse the twigs, foliage, and fruits. Birds known to eat the fruit include: wood ducks, eastern bluebirds, cardinals, catbirds, long-tailed chats, crows, purple finches, yellow-shafted flickers, crested flycatchers, grosbeaks, kingbirds, American magpies, mockingbirds, crested mynah birds, orioles, robins, yellow-bellied sapsuckers, European starlings, tree swallows, scarlet tanagers, brown thrashers, thrushes, vireos, pine warblers, cedar waxwings, and woodpeckers. Game birds who eat both the fruits and buds include grouse, ring-necked pheasants, band-tailed pigeons, greater prairie chickens, bobwhite quail, and wild turkeys. The shrubs provide excellent nesting habitat for songbirds. Mammals that eat the fruit and foliage include black bear, beaver, mountain beaver, cottontail rabbits, raccoons, eastern skunks, squirrels, chipmunks, mice, and rats. Deer, elk, Mountain goat, and moose browse the twigs and foliage.

Landscaping & ornamental: Redosier dogwood is often planted as an ornamental, both to beautify the landscape and to attract birds. Dogwood is often used for landscaping and as a secondary plant in windbreaks.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status, such as, state noxious status, and wetland indicator values.

Description

General: Dogwood Family (Cornaceae). Redosier dogwood is a woody deciduous shrub generally 1.4-6 m (4.6-20 ft) tall. The bark and twigs are reddish to purple and fairly smooth from autumn to late spring; after the leaves have fallen, the deep burgundy branches add color to the winter landscape. The bark, twigs, and leaves are bright green in spring through summer. The simple, opposite leaves are 5-10 cm (2-4 in) long, dark green above and hairy and lighter-colored below, with smooth margins, rounded bases, pointed tips, and falsely parallel veins. Flowering occurs from June to August. The inflorescence is a cyme, with 2-3 mm (0.08-0.12 in) white to cream-colored flowers. The white berries are smooth on the faces, furrowed on the sides.

Distribution

For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site. Redosier dogwood has a wide distribution from California north to Alaska and throughout the country to the eastern United States south to Mexico. It generally grows at elevations below 2500 m.

Establishment

Adaptation: Redosier dogwood grows in soils that are saturated for at least a portion of the growing season. Redosier dogwood is common on the edges of lakes, ponds, within wetlands, and along streams. Not as tolerant of long-term root saturation as are some other shrubs, dogwood seems to prefer wetland margins where soils are nitrogen-rich, saturated, and shallowly inundated in the spring, and may be completely dry by late summer. It is tolerant of fluctuating water tables. The "osier" in redosier dogwood is derived from French, meaning "willow-like"; it is often called red willow because of its red stems.

Propagation from cuttings: Redosier dogwood can be started easily by division, french layering, and hardwood cuttings. To propagate suckers by division:

- Lift a root with suckers on it without disturbing the parent plant. Check that there are fibrous roots at the base of the suckers.
- Remove the suckering roots by cutting it off close to the parent plant. Firm the soil around the parent plant.
- Cut the main root back to the fibrous roots, then divide the suckers so that each has its own roots. Cut back the top-growth by about half.

- Treat each sucker or hardwood cutting at the base with IBA at 20,000 ppm liquid formulation to promote rooting. Alternatively, treatment with 2 percent IBA talc; this will promote rooting on both suckers and stem cuttings.
- Replant the suckers in open ground in prepared holes with good potting soil. Firm the soil around the suckers and water.
- Before growth starts in the spring, lift the plant. Break the clump into sections, retaining those with vigorous shoots and well-developed roots.
- Prune any damaged roots, and cut back the top-growth by one-third to a half to reduce water loss. Replant the divisions in the open and water in dry weather.
- Ultimately, simply lift a suckering root, sever it from the parent plant, and then replant it in the open.

To ensure survival of cuttings or suckers through the following winter in cold climates, the potted cuttings should be kept in heated cold frames or poly-houses to hold the temperature between 0-7°C (32-45°F). Rooted cuttings that had shoot growth in the fall, but were not given nitrogen, had the best over-winter survival in a cold frame with microfoam.

French layering: Layering is a method where a stem is encouraged to develop roots before being removed from the parent plant.

- In spring, plant a rooted layer or young plant, label it, and grow it for a season. Then, in the dormant season, cut back the stem to within 3 inches (8 cm) of the ground.
- In the following spring, apply a balanced fertilizer at the rate of 2-4-oz/sq yd (60-110 g/sq m). Space the stems evenly again; dropping each into a 2-inch (5-cm) deep trench. Peg down each stem and cover with soil, leaving the shoot tips exposed. Hill up all but 2-3 inches (5-8 cm) of the new shoots as they develop, until the mound is 6 inches (15 cm) high. Water as needed.
- After leaf fall, carefully fork away the soil from around the new shoots until the stems that were laid horizontally are exposed. Cut these flush with the basal area of the stems. Then cut the stems to separate the rooted sections. Pot these or plant them out in the open garden, and label them. The same redosier dogwood basal area may be used to propagate further layers.

Propagation by seed: Redosier dogwood is established easily from seed. The best germination is obtained if the seeds are gathered as soon as the fruit starts to color or ripen, from August to October. If the seeds are allowed to dry out, it is best to remove seeds from the fruit and soak in water.

The best results are obtained from fall sowing of freshly harvested seeds. Fruits collected too late to sow in the fall should be stored, pre-chilled until the next season, and sown outdoors the following fall. To effectively condition the seed for germination, store for two months in moist sand at 5ºC for 90 days. After pre-chilling, expose the seeds to fluctuating temperatures from 12/72ºC for 10 days (Young and Young 1992). With some species, the warm stratification period may be replaced by mechanical scarification or soaking in sulfuric acid. Seeds sown in nursery beds should be covered with 0.25-0.5 in (0.6-1.25 cm) of soil. Fall-sown beds should be mulched during the winter.

Management

Redosier dogwood is often coppiced in late fall after the leaves turn brown and fall off the stem. Cut all stems to approximately 2-3 in (5-8 cm) from the base before growth begins in spring. Apply fertilizer around the shrub to promote new growth, then apply mulch around the base. Coppicing stimulates the growth of new, vigorous stems whose deep burgundy color is especially vivid.

Traditional resource management: Redosier dogwood was traditionally tended by pruning or burning to produce long straight stems.

- Often basket weavers will prune many redosier dogwood stems, sometimes replanting the stems, so there will be nice straight basketry material the following year.
- Before gathering, offerings of thanks and prayers for permission to gather are given. Often tobacco or sage or other offerings are given before beginning to gather.
- Basket weavers process materials with their hands and mouths. Herbicides sprayed along streams have a much higher health risk for humans when they are processed and used for traditional materials.

Overgrazing, especially by livestock and big game, frequently changes plant species composition and growth form, density of stands, vigor, seed production of plants, and insect production. Livestock grazing can cause the replacement of bird and mammal species requiring the vertical vegetation structure of riparian habitat to species, which are ubiquitous in their habitat preferences. Previous heavy cattle grazing changed the bird and small mammal community composition in riparian areas through reduction of shrub and herbaceous cover.

Cultivars, Improved and Selected Materials (and area of origin)
Cultivars: 'Alman's Compacta', 'Allamans', 'Bailey', 'Cardinal', 'Coloradensis', 'Flaviromea', 'Isanti', 'Kelseyi', 'Lutea', 'Ruby', 'Silver' and 'Gold', and 'White Gold' have been planted in the growing range of redosier dogwood.

Consult your local nurseries to choose the right cultivar for your specific landscape.

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For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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use. The original collection area of 'Golden Jubilee' was near Manchester, Vermont. Foundation seed is distributed to commercial producers by the Big Flats PMC in Corning, NY. Black-eyed Susan is readily available from commercial sources.

Prepared By & Species Coordinator:
USDA NRCS Plant Materials Program

Edited: 05Feb2002 JLK; 060809 jsp

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WETLAND PLANT FACT SHEET

INTERAGENCY
RIPARIAN/WETLAND PROJECT
USDA-NRCS
Plant Materials Center
Aberdeen, Idaho 83210

Hardstem Bulrush (*Scirpus acutus*)

Hardstem bulrush is a perennial, heavily rhizomatous wetland plant that is found at low to mid elevations (generally below 7500 ft) in marshes and along lake, reservoir, and pond shorelines. It forms large stands with the young plants on the outside and the older plants on toward the center. It is generally found in areas of standing water ranging from 10 cm to more than 2.5 m in depth. It will not tolerate long periods with very deep water. It will grow and spread on alkaline, saline, and brackish sites. It will grow on soils that range from peat to alkaline and silts to coarse substrates. Hardstem bulrush will resprout after fire. Burning will increase its production and protein content. It will reproduce from seeds and rhizomes. It will spread more than 45 cm in one growing season. Seeds will tend to germinate readily on freshly deposited, fertile, moist soils. Currently accepted name is *Schoenoplectus acutus* var. *acutus* (Muhl. ex Bigelow) A.& D. Love.

DESCRIPTION:

Habit -- Perennial, rhizomatous wetland obligate. May reach 3 m in height and form dense stands.

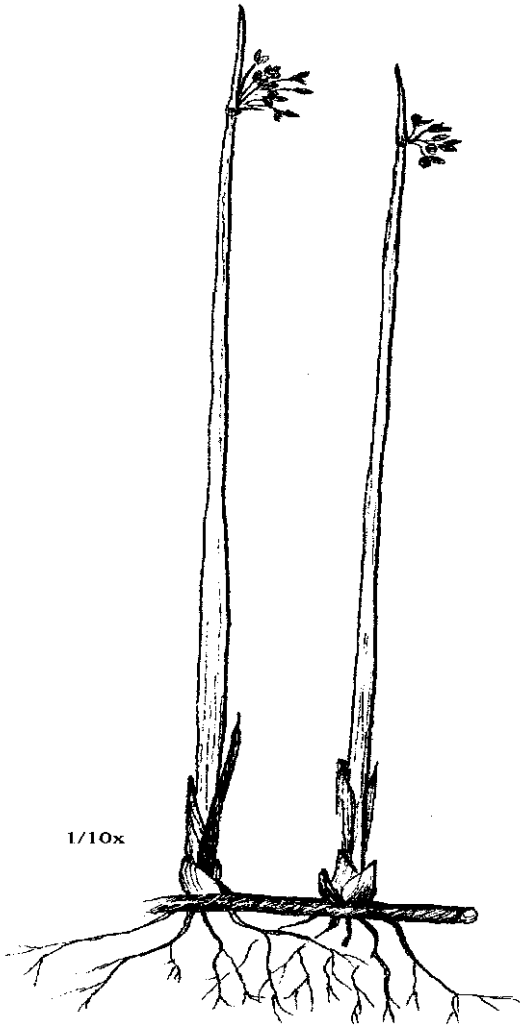
Stems **--** Upright, gray-green to green, round, 1-2 cm thick, 1-3 m high.

Leaves **--** Few and short, found at or near the base, commonly with well-developed sheath.

Panicle **--** Terminal panicle made up of up to 50 or more spikelets. May be on a short pedicel or sessile. Spike exceeded by a 3-10 cm lateral bract.

Fruits **--** Dark brown lenticular achenes up to 2.5 mm long.

Distribution **--** Widespread throughout North America, but most common in the West.



(Drawing by G. Bentrup)

SEED COLLECTION:

Seeds ripen in late August to September. Seeds are not held tightly in the seedhead. High winds, frost, and brushing against the seedhead will cause the seeds to drop out. Seeds may be collected by hand stripping them from the plant or by clipping the seedhead using a pair of hand shears. A handheld power seed harvester may also be used.

CLEANING:

A hammermill is needed to break up coarse debris and knock seeds free from the panicle. Cleaning can be accomplished using a seed cleaner with a No. 12 top screen and a 1/20 inch bottom screen. Screens should be sized so desired seed will fall through and debris and weed seed are removed. Air velocity should be adjusted so chaff is blown away. Air flow and screen size may require adjustment to optimize the cleaning process for each collection.

PROPAGATION:

***Special procedures* --** The germination rate can be enhanced by wet prechilling the seeds in a mixture of water and sphagnum moss at 2°C for 30-75 days. Another option would be using a 10% acid wash for 45 minutes followed by a through washing then wet prechilling the seed for 75 days.

***Greenhouse* --** Seeds need light, moisture, and heat for germination. Place seeds on the soil surface and press in lightly to assure good soil contact. Do not cover the seed. Soil should be kept moist. Greenhouse should be kept hot (35°-38°C). Germination should begin within about 1 week to 10 days. Maintain moisture until plants are to be transplanted.

***Wild transplants* --** Wild plants can be collected and transplanted directly into the desired site. As long as no more than 4 dm^2, 13-15 cm deep, is removed from any 1 m^2 area, the hole will fill in within one growing season. Care should be taken not to collect plants from weedy areas as these weeds can be relocated to the transplant site. In addition, the hole left at the collection site may fill with undesirable species.

ESTABLISHMENT AND MAINTENANCE OF STANDS:

***Establishment* --** Planting plugs (either from the greenhouse or wild transplants) is the surest way to establish a new stand of this species. Plug spacing of 30-45 cm will fill in within one growing season. Soil should be kept saturated. Standing water should be no deeper than 4-5 cm during the first growing season. Larger transplanted plugs can handle more standing water if the stems are cut long enough to ensure they are out of the water. Fluctuating the water level during the establishment period will speed spread. Water levels can be managed to enhance spread and to control weeds.

***Maintenance* --** Water level should be fluctuated from saturated conditions up to a maximum depth of 30 cm of standing water. The plants can handle deeper water, but not for an extended period of time. This species can tolerate periods of drought and total inundation. It will spread into water depths of 1-1.5 m. Water levels can be managed to either enhance or reduce spread as well as to control terrestrial weeds.

Plant Fact Sheet

CANADA GOLDENROD

Solidago canadensis L.

Plant Symbol = SOCA6

Contributed by: NRCS Plant Materials Center, Pullman, WA

***Solidago canadensis.* www.discoverlife.org**

Alternate Names

Canadian goldenrod, meadow goldenrod, common goldenrod, giant goldenrod, tall goldenrod, shorthair goldenrod (*S. canadensis* var. *gilvocanescens*), Hager's goldenrod (*S. canadensis* var. *hargeri*), rough goldenrod (*S. canadensis* var. *salebrosa*).

Uses

Pollinator habitat: Solidago species provide vital sources of pollen and nectar for bees and other insects in the late summer and fall throughout North America.

Rangeland revegetation: Canada goldenrod can be used for revegetation of disturbed areas, for mine spoil reclamation, and soil stabilization.

Forage: This plant is grazed by cattle, sheep, horses, and whitetail deer.

Ethnobotanical: The Iroquois, Okanagan-Colville, Potowatomi, Shuswap, Zuni, Gosiute and Navajo utilized Canada goldenrod for various medical purposes.

Ornamental: Canada goldenrod is not typically planted in a landscaped setting due to its spreading rhizomatous growth. However, it is possible to manage plants by planting in a pot submersed in the ground, or by removing new growth each year. Seed dispersal can be controlled by removing flower heads prior to seed ripening.

Status

Consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Weediness

Goldenrods have a reputation of being weedy due to their aggressive rhizomatous growth. However, in stable rangeland environments they seldom achieve densities that are problematic. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding this plant's status and management.

Description and Adaptation

General: Sunflower family (Asteraceae). *Solidago canadensis* is a native, warm-season, long-lived perennial that spreads by rhizomes and forms large, dense patches. Stems are mostly smooth, covered with fine hairs at the top and are 1 to 7 ft tall. Leaves are sharply toothed, lance-shaped, covered with fine hairs, triple-nerved and 2 to 5 inches long. Flower panicles occur at the end of each stem, and when open, are 10 inches wide. Inflorescences occur mostly on one side of long, drooping panicle branches, have 10 to 17 ray flowers, and bloom July through October. Pollination typically occurs by the aid of insects. Seeds are small and dry with sparse hairs and numerous pale bristles at the tip.

Solidago canadensis can be distinguished from *S. missouriensis* by its taller stature and its larger, more branched, open flower panicles. *S. canadensis* can be distinguished from *S. giganteus* by its hairs on the stems and yellow bracts.

Canada goldenrod is adapted to areas receiving full sun or part shade and 16 to 60 in of annual precipitation. Plants typically grow in moist soil with medium texture and moderate levels of organic matter. They are found in

damp meadows, waterways, and ditches along roadsides and railroads. They may also inhabit dry, open slopes in upland prairies, and deciduous and evergreen forests. Plants are not found on waterlogged sites and only rarely found on very dry sites.

Canada goldenrod grows in all US states except HI, LA, AL, GA, SC and FL, and all Canadian provinces except Nunavut. The plant has five varieties (ecotypes): var. *canadensis* (Canada goldenrod), var. *gilvocanescens* (shorthair goldenrod), var. *hargeri* (Harger's goldenrod), var. *lepida* (Canada goldenrod), and var. *salebrosa* (rough goldenrod). For current distribution of this species and varieties, consult the Plant Profile page on the PLANTS Web site.

Canada goldenrod distribution from the USDA PLANTS Database

Establishment
Plants can be established by seed, seedlings, or rhizomes. Seed should be planted into a firm, weed-free seed bed at a rate of 0.5 lb PLS/ac and at a depth of 0.125 to 0.25 inches. If planted in a mix, the seeding rate should be adjusted according to the proportion of the mix. Seed is non-dormant, and can be planted in the fall or spring.

Plants established by seedlings can be started by sowing seed in containers placed in a greenhouse in January. Seed should be covered lightly with soil and kept moist until germination. A layer of pea gravel can be applied to the soil surface to prevent seeds from floating. Plants should be moved to a cold-frame in late March or early April and hardened off for 2 to 4 weeks prior to transplanting into a prepared field site in early May. Plants should be spaced 1 to 2 ft apart.

Plants can also be established by rhizomes. Sections of rhizomes should be collected from cultivated plants or approved areas, kept moist during transport, and replanted in a prepared field site.

Management
This plant spreads by rhizomes and by seed. Where plant spread is not desired, seedlings should be planted in a large pot or barrel submersed in the soil, or new growth should be cut and removed each year. To prevent seed dispersal, flower heads should be removed prior to seed ripening. Plants will withstand vigorous cutting, and will regrow if cut during the growing season.

Pests and Potential Problems
Solidago canadensis is susceptible to many pathogens and insect pests, which may reduce seed production.

Environmental Concerns
This plant may form dense stands in some habitats, particularly where ground is open and disturbed. To prevent dense stands from forming, seed Canada goldenrod at low densities or plant in small areas.

Control
If control of this species is desired, contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for any control method.

Cultivars, Improved, and Selected Materials (and area of origin)
None. Seed and seedlings, however, are available from multiple vendors.

Prepared By
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Citation
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For more information about this and other plants, please contact your local NRCS field office or Conservation District <http://www.nrcs.usda.gov/>, and visit the PLANTS Web site <http://plants.usda.gov> or the Plant Materials Program Web site <http://plant-materials.nrcs.usda.gov>

USDA IS AN EQUAL OPPORTUNITY PROVIDER AND EMPLOYER

COASTAL SWEET PEPPERBUSH

Clethra alnifolia L.

Plant Symbol = CLAL3

Contributed by: USDA NRCS National Plant Data Center

Ducey, V. 2003.
USF Herbarium Slide Collection.

Alternate Names
Clethra, *Clethra alnifolia* var. *tomentosa*, *Clethra angustifolia*, *Clethra bracteata*, *Clethra incana*, *Clethra michauxii*, *Clethra paniculata*, *Clethra pubescens*, *Clethra pumila*, *Clethra scabra*, *Clethra tomentosa*, poorman's soap, summer sweet, sweet pepper bush, white alder.

Uses
Erosion control: Coastal sweet pepperbush spreads by sending up new shoots, forming a thicket of low bushes. Growth from root suckering will provide moderate erosion control along streams and ponds.

Garden and landscape: The foliage and flowers of coastal sweet pepperbush make it an attractive garden shrub. It can be used in a mixed shrub hedge or border and pruned to maintain a small size. The lush green leaves turn to golden yellow in autumn. The fragrant flowers last up to 6 weeks or more during the middle of summer while other flowering shrubs are not blooming due to the heat.

Utility right of ways: Coastal sweet pepperbush is sometimes used to halt succession of tall trees along pathways. It has been planted following herbicide application along electrical transmission, telephone, railroad, roadside, and pipeline right of ways. Its low stature does not interfere with the general operations around these utility areas.

Wildlife: The fragrant white flowers and nectar of coastal sweet pepperbush attract hummingbirds and butterflies. Deer eat it only when other forage vegetation is limited. Birds eat the fruit and aid in seed dispersal.

Legal Status
Coastal sweet pepperbush is listed as a special concern species in Maine and as threatened in Tennessee. Please consult the PLANTS Web site (http://plants.usda.gov) and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
General: White Alder Family (Clethraceae). Coastal sweet pepperbush is a large deciduous shrub that grows to 2.5 m tall. The bark is smooth, reddish-orange or gray in color, and 2 to 3 mm in diameter. Twigs are reddish-orange covered with dense white hairs. Leaves are alternate, simple, 5 to 8 cm long, and toothed toward their tips. They are medium to dark green, turn golden yellow in the fall and have appressed white hairs along the midvein. Flowers are up to 1 mm long and 0.8 mm wide, composed of 5 white fused petals. Seventeen to one hundred fragrant flowers form the bottlebrush-like inflorescences that are about 10 cm long and 2 cm wide. The fruiting stalk has many miniature oval 3-seeded capsules that are winter-persistent and are good identification features. Coastal sweet pepperbush produces leaves in late spring, flowers in July and August, and sets fruit in September and October. The yellow fall foliage persists for two to four weeks.

Distribution: This is the only species in the genus *Clethra* that is native to North America. It occurs from southern Maine and New Hampshire, south to eastern Texas and Florida. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site (http://plants.usda.gov).

Habitat: Coastal sweet pepperbush is found in wet woods, thickets, marshes, swales and bogs, along

lake and stream edges, and near rocks in water. It is typically not a dominant species in plant communities. Common overstory associates include cypress, Atlantic white cedar, coastal pine species, red maple, magnolias, and beech.

Adaptation

The USDA hardiness zones for coastal sweet pepperbush are 4 to 9. It grows naturally in poorly drained, moist soils and will get larger and produce more suckers if provided plenty of water. Once established, it can also thrive on drier, well-drained soils. The optimum soil pH is approximately 4.5. Coastal sweet pepperbush is moderately salt tolerant and can be grown near, but not directly behind, beaches.

Coastal sweet pepperbush is a shade-tolerant understory shrub that grows under the canopy of old-growth trees. It will grow in full sun, but does best in a light, dappled shade.

Management

Legginess occurs with age among coastal sweet pepperbush plants. Aggressive root suckering also occurs with age, which is an asset if naturalization or moderate erosion control is desired.

Coastal sweet pepperbush can build up and create a fire hazard. It can be controlled with regular prescribed burning. Most fires probably top-kill sweet pepperbush, but the plant can resprout from surviving stolons. Fires severe enough to consume the organic soil may kill stolons.

Pests and Potential Problems

Damage caused by spider mites can be severe on plants in hot, dry locations.

Seeds and Plant Production

Coastal sweet pepperbush can be propagated by seeds, summer cuttings, or sucker division. Seeds are cold stratified for 30 days and germinated under spring temperatures.

Collect 10 cm long softwood cuttings at the end of May or the beginning of June and strip the leaves from the lower two-thirds of the cutting. Wound the lower portion of the stem and apply a powder or liquid root hormone compound. Place cuttings in coarse sand that is 7 to 10 cm deep and lightly water at least every 2 hours. The medium can be any well-drained mixture that does not contain soil. Provide shade to the cuttings for the first 7 to 10 days to allow the cuttings to harden off before exposing them to full sun. For best rooting results, place cuttings in an intermittent misting system.

Cultivars, Improved, and Selected Materials (and area of origin)

The USDA NRCS Plant Materials Program has not released any cultivars of coastal sweet pepperbush for conservation use.

Several ornamental cultivars are available through commercial nurseries. These cultivars include ‘Anne Bidwell,’ ‘Creels Calico,’ ‘Hummingbird,’ ‘Paniculata,’ ‘Pink Spires,’ ‘Ruby Spice,’ ‘September Beauty,’ and ‘Summersweet Clethra.’ These cultivars have been developed for flower size and color, foliage variegation and shine, plant stature, and extended bloom time.

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under ”United States Government.” The Natural Resources Conservation Service will be listed under the subheading “Department of Agriculture.”

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USDA NRCS National Plant Data Center, Baton Rouge, Louisiana

Edited: 24May2004 sbw; 20Oct2004 rln; 06jun06 jsp

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INSECT AND DISEASE PROBLEMS:

Generally not a problem. Aphids will feed on the stems, but generally will not kill the plant. If an insect or disease problem is encountered in the greenhouse, treat as you would for any other plant species.

WILDLIFE AND LIVESTOCK USES:

Livestock rarely use this species when the area is flooded. They will use it as roughage or in the winter under heavy snow cover because the stems stick out of the snow. Waterfowl will feed on the seeds and use the stands for nesting. Muskrats and beaver will eat the rootstocks and young shoots. Muskrats will use the stems for building their houses.

ANTICIPATED CONSERVATION USES:

Constructed Wetland System applications, wildlife food and cover, erosion control, wetland creation and restoration, and for improving plant diversity in wetland and riparian communities. Its dense root mass makes this species an excellent choice for soil stabilization. Its above ground biomass will provide protection from erosive wave action and stream currents that erode shorelines or streambanks. The rhizomes also form a matrix for many beneficial bacteria, making this plant an excellent choice for wastewater treatment.

RELEASED SELECTIONS:

The Interagency Riparian/Wetland Plant Development Project released four performance tested ecotypes for areas within its service area in 1997. The following is a list of those Selected releases:

Camas Selection of Hardstem Bulrush *(Scirpus acutus),* Accession Number 9057643, for Land Resource Region (LRR) B East from Camas National Wildlife Refuge (NWR), just west of the town of Hamer, Jefferson County, Idaho.

Hagerman Selection of Hardstem Bulrush *(Scirpus acutus),* Accession Number 9057597, for Land Resource Region (LRR) B West from Hagerman Wildlife Management Area, just west of the town of Hagerman, Gooding County, Idaho.

Ogden Bay Selection of Hardstem Bulrush *(Scirpus acutus),* Accession Number 9067393, for Land Resource Region (LRR) D South from Ogden Bay Wildlife Management Area, west of the city of Ogden, Weber County, Utah.

Stillwater Selection of Hardstem Bulrush *(Scirpus acutus),* Accession Number 9057634, for Land Resource Region (LRR) D North from Stillwater National Wildlife Refuge, northwest of the town of Fallon, Churchill County, Nevada.

REFERENCES:

Hurd, E.G., N.L. Shaw, and L.C. Smithman. 1992. Cyperaceae and Juncaceae- selected low-elevation species. Proceedings of Symposium on Ecology, Management, and Restoration of Intermountain Annual Rangelands, Boise, ID. May 18-22, 1992. p.380-383.

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Agriculture, Washington, DC, 20250, or call 1-800-245-6340 (voice) or (202) 720-1127(TDD).
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Plant Fact Sheet

COMMON BUTTONBUSH

Cephalanthus occidentalis L.

Plant Symbol = CEOC2

Contributed by: USDA NRCS Plant Materials Program

Robert H. Mohlenbrock
USDA NRCS 1989
Midwestern Wetland Flora
@ USDA NRCS PLANTS

Uses
Buttonbush is an obligate wetland shrub suitable for wetland restoration, created wetlands, and riparian zones. It has exceptional wildlife benefits. The seed is eaten by eight species of waterfowl and the twigs by three species of mammals.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
Buttonbush is a large, multi-stemmed shrub that grows to a mature height of twelve feet. It has opposite, entire leaves 2-6 inches long and 1-3 inches wide. They are glabrous and green above. The flowers occur in dense, round, 1 inch diameter clusters which bloom from June to September. The seed matures in the round clusters that resemble those of the sycamore tree. This plant spreads by seed dispersal and resulting seedling establishment.

Adaptation and Distribution
The natural range of this shrub is from Florida to Mexico and north to Nova Scotia and Ontario. Buttonbush is best adapted to shorelines and swamps with saturated soil and full sunlight. It will tolerate water depths up to three feet. Flowering is poor in the shade or in dry soils.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
One year old seedlings or rooted cuttings can be established at a two foot spacing for erosion control, or a wider spacing for wetland mitigation or habitat development. Controlling competition during the first growing season is the biggest establishment challenge. Scalp the existing vegetation from a two foot diameter area on which the seedling is being established. Unrooted cuttings can be established by pushing cuttings into the soil one foot apart for erosion control or wider for mitigation or habitat development.

Management
Buttonbush may be fertilized with a slow release fertilizer to enhance flowering and seed production. Plants on areas with fluctuating water levels may need debris cleared out of the canopy.

Cultivars, Improved, and Selected Materials (and area of origin)
'Keystone' (composite from PA, WV, NY) was released by the Big Flats, NY Plant Materials Center.

Prepared By & Species Coordinator:
USDA NRCS Northeast Plant Materials Program

Edited: 01Feb2002 JLK; 01jun06 jsp

For more information about this and other plants, please contact your local NRCS field office or Conservation District, and visit the PLANTS Web site<http://plants.usda.gov> or the Plant Materials Program Web site <http://Plant-Materials.nrcs.usda.gov>

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Plant Fact Sheet

COASTAL PANICGRASS

Panicum amarum Ell. var. *amarulum* (A.S. Hitchc. & Chase) P.G. Palmer

Plant Symbol = PAAMA2

Contributed by: USDA NRCS Plant Materials Program

USDA NRCS National Plant Materials Center
Beltsville, MD

Alternate Names
Panicum amarulum A. S. Hitchc. & Chase, *Panicum amarum* Ell. ssp. *amarulum* (A.S. Hitchc. & Chase) Freckmann & Lelong, bitter panicgrass

Uses
Coastal panicgrass has a deep fibrous root system which has made it a top choice for secondary sand dune stabilization in the mid-Atlantic states. Due to its upright form, this warm-season grass has been recommended for use in developing vegetative wind barriers. Due to its hedges form and winter persistence, coastal panicgrass is popular for wildlife cover on sandy coastal soils and reclaimed minelands. It is also useful as a primary stabilizer of very well or excessively drained sites, such as gravel pits, dikes, and road bank cuts and fills.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description
This grass is deep rooted (±6 feet), robust, long lived where hardy, and grows to heights of 3 to 6 feet. This is a U.S. native grass. The stems may be as thick as 1/2 inch, with bluish green leaves from 8 to 20 inches long and 1/4 to 1/2 inch wide. Although coastal panicgrass grows faster than most warm season grasses, it is slower than cool season grasses. Producing short outwardly spreading rhizomes, it forms clumps or bunches. Like most other species in the genus *Panicum*, coastal panicgrass has a large terminal inflorescence. It is a tightly arranged, densely flowered cluster. Seed dispersal is the primary means of reproduction of this species. There are an average of 350,000 seeds per pound.

Adaptation and Distribution
Coastal panicgrass naturally occurs from Massachusetts to Florida, west to Texas. Like most plants, coastal panicgrass flourishes on fertile, well drained soils, but will perform well on droughty, very sandy sites. When established on sand dunes it will only survive where other species have initially stabilized the location. It will tolerate moderate saline overspray, and pH as low as 5.0. It does not tolerate large deposits of sand. Coastal panicgrass is useful in warm season grass mixtures on sand and gravel pits. There the good seedling vigor helps with initial stand establishment. Inland and north of Massachusetts it will winterkill, but not before helping during the seeding years.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Coastal panicgrass can be propagated by seed or vegetative divisions. It is the only species known to be successfully established on mid-Atlantic sand dunes by direct seeding. It is best to sow from early spring, until May. If sands shift after planting,

covering seed more than 2” deep, emergence will be obstructed. Depending on soil texture and available moisture, seed should be placed 1 (with increased % fines) to 1 1/2 (coarse soils) inches deep. Drilling in rows 10 to 20 inches apart, using 6 to 8 pounds of seed per acre results in the best establishment. In mixtures with other warm season grasses, 3 lb/ac of coastal panicgrass is sufficient. Inland critical areas should be established using standard broad cast seeding, mulching, and fertilization procedures on sand and gravel pits, tracking with a dozer is recommended.

Planting trials on field sites have been established utilizing bare-rooted stem divisions and containerized divisions, with mixed results. Successful sites were on protected locations, while failures were located on exposed, unstable sites. Under nursery conditions, most vegetative techniques work well.

Management

Annual controlled burning often stimulates seed production, recycles nutrients, and suppresses weed growth. At the time of planting 250 pounds per acre of 10-10-10, or the equivalent, should be band applied below the seed. Top or side dressed spring applications of 500 pounds of 10-10-10 fertilizer or the equivalent per acre, in post establishment years, will promote good plant and seed growth.

Cultivars, Improved, and Selected Materials (and area of origin)

Only one cultivar is grown for commercial distribution; that is ‘Atlantic’ (Virginia). ‘Atlantic’ was evaluated and selected for release by the Cape May Plant Materials Center in 1981. Foundation seed of this grass is available from the Cape May Plant Materials Center in New Jersey; certified seed is available from commercial nurseries. Seed distribution is the primary means of propagation.

Prepared By & Species Coordinator:

USDA NRCS Plant Materials Program

Edited: 05Feb2002 JLK; 25may06jsp

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Natural Heritage & Endangered Species Program

www.mass.gov/nhesp

Massachusetts Division of Fisheries & Wildlife

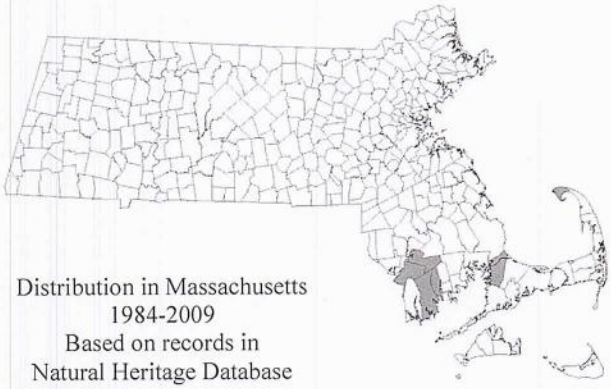
Weak Rush
Juncus debilis
Gray

State Status: **Endangered**
Federal Status: **None**

DESCRIPTION: The Weak Rush (*Juncus debilis*) is a small, inconspicuous, perennial herb from about 3.5 to 10 inches (10 to 25 centimeters) tall. It produces erect tufts of round stems, and its maroon or dark green leaves are also round in cross-section and appear somewhat needle-like. The small, brownish flowers of this plant are borne in clusters or "glomerules" near the tops of the stems.

AIDS TO IDENTIFICATION: The Weak Rush is a "true" rush (unlike plants which share similar common names, such as bulrushes and spike-rushes) and belongs to the rush family (Juncaceae). Rushes in the genus *Juncus* are distinguished by their small, brown or green flowers, which have six tepals (three sepals and three petals that all look alike). They are also characterized by having dry fruit that splits open (a capsule) along three sutures. The Weak Rush belongs to a group of rushes that have round leaves with small cross-partitions (called septae) that can be felt as small bumps when running two fingers up a leaf. The Weak Rush can be distinguished from other members of this group by a combination of characters including its yellow-brown seeds which lack white, tail-like appendages; the elliptic capsule that exceeds (is taller than) the straw-colored tepals of each flower; and by the arrangement of the flowers into terminal clusters that are not round, but rather v-shaped (ob-pyramidal).

Holmgren, Noel H. 1998. *The Illustrated Companion to Gleason and Cronquist's Manual*. New York Botanical Garden.



Distribution in Massachusetts
1984-2009
Based on records in
Natural Heritage Database

SIMILAR SPECIES: Members of this genus are difficult to distinguish from one another, and the Weak Rush superficially resembles many other rushes. A technical manual should be used to identify the different

A Species of Greatest Conservation Need in the Massachusetts State Wildlife Action Plan

Massachusetts Division of Fisheries & Wildlife

1 Rabbit Hill Rd., Westborough, MA; tel: 508-389-6300; fax: 508-389-7890; www.mass.gov/dfw

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www.mass.gov/nhesp

species of rushes. Common rushes that have been observed growing in the same habitat as the Weak Rush include the Canada Rush (*Juncus canadensis*), Soft Rush (*Juncus effusus*), and Pondshore Rush (*Juncus pelocarpus*). Unlike the Weak Rush, the Canada Rush has an inflorescence that often bears nearly globe-shaped heads (vs. ob-pyramidal), and its seeds have white, tail-like appendages under magnification. The Soft Rush is much larger than the Weak Rush (40 to 130 centimeters), and possesses an inflorescence that appears to be emerging from the side of the stem, rather than the top. The Pondshore Rush has round leaves, but they are not cross-septate as they are in the Weak Rush, and its flowers do not grow in heads, but singly, and are often replaced by vegetative propagules called "bulbils."

HABITAT: In Massachusetts, the Weak Rush has typically been found in open, unshaded habitat in seasonally wet, sandy, peaty or mucky substrate along the coastal plain, especially boggy depressions that are inundated in spring but may dry out later in the season. Specific habitat descriptions include a former road in a coastal dune system; along a dry, seasonal pond; and on disturbed, sandy soil in an active gravel pit. The Weak Rush is an early-successional species and hence is adapted to compete well after disturbance. It has been seen to co-occur with the Canada Rush in several Massachusetts locations, and has also been repeatedly found growing with the Slender Goldenrod (*Euthamia tenuifolia*). Other associates include the Brown Beak-rush (*Rhynchospora capitellata*), Yellow-eyed Grass (*Xyris difformis*), Wool-grass (*Scirpus cyperinus*), and Lance-leaved Violet (*Viola lanceolata*).

POPULATION STATUS IN MASSACHUSETTS: The Weak Rush is listed under the Massachusetts Endangered Species Act as Endangered. All listed species are protected from killing, collecting, possessing, or sale and from activities that would destroy habitat and thus directly or indirectly cause mortality or disrupt critical behaviors. All Massachusetts stations of this Endangered species have been discovered since the mid-1980's in Bristol or Barnstable Counties. The Weak Rush is also considered to be rare throughout the New England region. It is rare in our region because it is at the northern extent of its range. The only other New England state known to harbor occurrences of the Weak Rush is Rhode Island.

RANGE: The Weak Rush is primarily found in southeastern North America, with its range extending from Massachusetts west to Missouri, and south to Texas and Florida. It is also known from Mexico and Honduras.

MANAGEMENT RECOMMENDATIONS: As for many rare species, the exact needs for management of the Weak Rush are not known. The following comments are based primarily on observation of populations in Massachusetts. Because the Weak Rush is an early-successional species adapted to open environments, maintenance of surrounding vegetation is an important consideration in the management of this species. If succession is left unchecked, the Weak Rush may eventually be crowded and shaded out. New disturbances may provide alternate habitat for the species, however. Since wet conditions are also critical to the Weak Rush, another important management consideration may be to preserve site hydrology where occurrences of this species are known. Finally, two invasive exotic plant species, Common Reed (*Phragmites australis*) and Purple Loosestrife (*Lythrum salicaria*), have been reported from Weak Rush sites in Massachusetts. Removal of these species from the population area would maintain site integrity and reduce competition at the rare plant locations.

Fruit Present:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Updated 2015

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www.mass.gov/nhesp

APPENDIX C

EFFECTIVE RAIN GARDEN PLANT SPECIES

Plant Fact Sheet

SWEETFERN

Comptonia peregrina L.

Plant Symbol = COPE80

Contributed by: USDA NRCS Plant Materials Program

USDA NRCS National Plant Materials Center
Beltsville, MD

Alternate Names
Comptonia peregrina (L.) Coult. var. *aspleniifolia* (L.) Fern., *Myrica aspleniifolia* L., *Myrica peregrina* (L.) Kuntze

Uses
This nitrogen-fixing plant is used primarily as a ground cover for erosion control and species diversity in sterile, sandy soils. The abundant underground stems, or rhizomes, makes it especially suited to stabilizing steep, sandy banks. It makes a pleasing companion plant in a coastal setting with the low growing junipers, rugosa rose, bayberry, and beach plum.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values). It is considered threatened or endangered in several states.

Description
Bayberry Family (Myricaceae). Sweetfern is a low, loosely branched, mat-forming shrub, 1-3 feet high, with sweet-scented, fern like leaves. The alternate, hair-covered leaves are 2-5 inches long and taper at each end. There is an occasional compound leaf form variation. The leaf blades are deeply cut into 20 or more rounded lobes, dark green above, paler and hair-covered beneath and on the midrib and margin above. Resinous glands cover both surfaces. Leaves are very aromatic when crushed. The flowers are small, inconspicuous catkins that bloom during April and May. Flowers of one or both sexes can be produced on an individual plant. The male catkins are rather long and cylindrical; the female catkins are short and rounded. In winter, the male catkins are prominent and erect. The female catkins become bur-like at maturity and are 1/2 inch in diameter. The seeds are nutlets that mature in August and become available in September and October. About four seeds are found in each fruit. Each seed is about 1/4 inch long, olive brown in color, and shiny.

Adaptation and Distribution
Sweetfern does especially well in open, sterile, sandy soils of woodlands, clearings, and pastures. It prefers acidic soils over limestone soils.

Sweetfern is distributed throughout northeastern United States. For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment
Some nurseries offer wild collected clumps, but it is best established using nursery-grown, containerized plants. Losses of plants from the wild can be considerable. One or two year old liner material is also acceptable.

Management
Little management is needed if planted in an appropriate site. Sweetfern does not tolerate shading well, so removing competing vegetation is important.

Cultivars, Improved, and Selected Materials (and area of origin)
No known varieties of sweetfern exist. Plants are available at nurseries in the Northeast that specialize in coastal plants.

Prepared By & Species Coordinator:
USDA NRCS Northeast Plant Materials Program

Edited: 01Feb2002 JLK; 01jun06 jsp

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LITTLE BLUESTEM

Schizachyrium scoparium (Michx.) Nash

Plant Symbol = SCSC

Alternate Names

Common Names: povertygrass, broom bluestem, broom beardgrass, prairie beardgrass, small feathergrass
Scientific Names: Andropogon scoparius

Description

General: Little bluestem is a tufted (sometimes with short rhizomes), warm-season (C_4), perennial grass broadly distributed and native to the U.S. and Canada. Because of this broad distribution, little bluestem exhibits significant ecotypic variation. Plants vary in height, color, length of leaves, flowering, and clump diameter (USDA, 1983; Uchytil, 1989). It grows from 1 to 3 feet tall with culms slightly flattened. The blades are folded, sometimes rolled inward, and smooth to hairy. They are 2 to 12 inches long, 1.5-6 mm wide, pointed with sheaths keeled and usually smooth. The ligule is a fringed membrane 0.5-2.5 mm long. The culms terminate in a single raceme 1-3 inches long. The pediceled spikelets are 3-6 mm long with pedicels flattened. The awns of the fertile lemmas are 9-16 mm long, bent and twisted. The anthers are 2-4 mm long (Sedivec and Barker, 1997). Seed averages 225,000 to 250,000 bearded seeds per pound (Uchytil, 1989).

Distribution: Little bluestem is found throughout the lower provinces of Canada and all states of the U.S., except Nevada and Washington. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: This midgrass is a tallgrass prairie increaser and mixed prairie decreaser. Little bluestem typically occurs on dry upland sites, especially on ridges, hilltops, and steep slopes. It also occurs on limey subirrigated sites and in prairie fens. It is found in areas receiving 10 to 60 inches of mean annual precipitation and plant hardiness zones 3 to 9.

Adaptation

Little bluestem is adapted to soils ranging from sandy to clay-loam in texture. It begins growth in late spring after cool-season species have already developed (Uchytil, 1989). It has been observed that little bluestem phenology follows a well-defined pattern. Periods of active growth as well as stage of maturity are directly related to the length of the growing season (Miller, 1967; USDA, 1983).

Uses

Pasture/rangeland/prairie restoration: This species provides fair to good forage while young. It is rated fair for cattle and horses, but is usually too coarse for sheep and goats. Ungrazed wolf plants with seed stalks often give the false impression of non-use for the plant community. Shorter plants between the wolf plants have usually been grazed quite extensively. Crude protein is 12 to 14 percent in May, dropping off considerably in July through September to less than 4 percent (Sedivec and Barker, 1997). Little bluestem has been used extensively in prairie restoration projects primarily because of its adaptation to a diversity of sites, drought tolerance, growth habit, and wildlife appeal.

Erosion control: Little bluestem has moderate drought tolerance and broad adaptation to diverse sites. It can form mats from short rhizomes on wetter sites although this species is usually thought of as a bunchgrass (clumps) on dry, upland sites. It is deep-rooted, and somewhat slow to establish from seed.

Wildlife: Little bluestem is one of the best grasses for nesting and roosting habitat. The clump type of growth habit and many fine leaves at the base provide excellent nesting sites. The seeds are consumed by small mammals

and birds, including upland game birds, rosy finches and juncos, as well as chipping, field, and tree sparrows. The seeds are of high value especially as a food source for birds that spend the winter on grasslands, such as prairie chickens and sharp-tailed grouse (Jones, 1963). Meadowlarks nest in areas where little bluestem grows. The dusky skipper butterfly caterpillars overwinter in tube tents above the base of the clumps (Knopf et al., 1997).

Landscaping: Little bluestem is becoming more popular for home landscaping because it is a colorful and easy-care addition. New varieties are being developed that don't lodge (falling over at the base) and are more disease resistant. New growth can be bluish, maturing to a reddish-gold color. The seed develops to a fluffy silver-white. The plumes are showy when seed has matured which adds interest to a cut arrangement. Frost accents the plants and the reddish tint provides color during the winter (Mahr, 2007). This is a prairie grass for the garden that is truly exceptional in mass plantings. Use in full sun.

Ethnobotany: Some tribes used little bluestem switches in ceremonial sweat lodges. The Lakota word means "small red grass". Dried leaves and stems were rubbed into soft fiber for moccasin lining and insulation (Johnson and Larson, 1999).

Status

Please consult the PLANTS web site (http://plants.usda.gov) and your State Department of Natural Resources for this plant's current status (e. g. threatened or endangered species, state noxious status, and wetland indicator values).

Weediness: This plant may become weedy or invasive in some regions or habitats and may displace more desirable vegetation if not properly managed. The seed is light and fluffy, and may spread to the surrounding areas, especially in a garden or landscape setting. Seed is generally dispersed a short distance from the parent plants. The maximum dispersal is only 5 to 6 feet and seedling vigor is weak (Uchytil, 1989). Consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use. Weed information is also available from the PLANTS Web site at http://plants.usda.gov/. Consult the Related Web Sites on the Plant Profile for this species for further information.

Management

Little bluestem begins growth later in the spring after the cool-season species have already developed. It tolerates glyphosate when dormant, and other herbicides as labeled for grasses. Weed control can be accomplished by mowing, especially the first year when the planted grass is short. It is minimally affected by fire if burned dormant and changes little in frequency of occurrence due to fire. Little bluestem is relatively resistant to fire under moist conditions. The growing points (apical meristem) are slightly more than an inch above the soil surface (Uchytil, 1989). Little bluestem in the immature growth phase is considered a nutritional, palatable grass for all classes of livestock in June and early July in studies in North and South Dakota. Palatability is lower than many other native warm-season grasses, especially when seed stalks are present. Proper grazing management is critical to improve grazing efficiency. Little bluestem is an increaser under season long grazing systems. Higher stock densities such as rotational grazing systems will achieve greater use of more plants. Recommended stubble height of 3 to 4 inches is required to assure stand longevity. Although not usually recommended for hay production, little bluestem can make fair to good hay when part of a native hayland mixture (Sedivec et al., 2008). It is a popular species to include in prairie restoration seedings because of its wide adaptation and high wildlife value. Plants will sometimes die from the center out in the clump if the plants become too dry. Burning at the opportune time can help to reduce the population of cool-season competing vegetation, as well as woody species.

Pests and Potential Problems

A leaf spot disease was found to be widespread in a little bluestem nursery established at Mandan, North Dakota, from plants collected in North Dakota, South Dakota, and Minnesota. *Phyllosticta andropogonivora* was consistently isolated from leaves showing leaf spot symptoms. The fungus was also isolated from native prairie plants. The fungus was pathogenic to little bluestem, big bluestem (*Andropogon gerardii*), and sand bluestem (*Andropogon halli*) (Krupinsky and Tober, 1990).

Environmental Concerns

This grass is primarily a bunchgrass that will spread some by seed. The seed is light and fluffy and it will move to adjacent areas. Bare soil may allow seed to germinate, but it is usually not a problem. Random plants in a natural landscape are usually not considered undesirable because it is a native species.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Seeds and Plant Production

Seed into a firm seedbed in early spring for best results. Seed as a solid stand (8 inches or less row spacing) at approximately 4.5 lb/acre (eastern ND rate), or 30 seeds per linear foot of row, or 2.5 lb/acre for 24-inch rows. Glyphosate may be used for weed control immediately

after seeding to kill everything green and growing. Other herbicide weed control options are also available. Consult with the local extension service or Land Grant University for assistance with recommendations on herbicides and application rate. Always read and follow the label directions when applying herbicides. Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. government and does not imply its approval to the exclusion of other products that may also be suitable.

Seed is best harvested from the plant using a commercial stripper at 600 to 800 rpm at the hard dough or mature seed stage. This is because of the light, fluffy seed, and the uneven maturity. Straight combining is another method of harvest when most of the seed has matured. Average dockage of combined seed is 60 percent. Seed should be air dried for a couple of days. Seed for the bin should be dried to 12 percent or less, and sacked seed should be 15 percent or less. Average yield is 200 to 300 lb/acre irrigated and 75 to 150 lb/acre dryland. Processing the seed is fairly difficult because of the fuzziness of individual spikelets. It should be debearded first. A hammermill works well with a 3/16-inch screen at 550 rpm, and then a debearder at 200 rpm for 45 to 60 minutes. Scalping or final cleaning may be done using a 4-screen fanning mill. Post-harvest management requires rotary mowing, rototilling, or cultivating between rows in the fall or spring; or burning on a regular basis in early spring (Smith et al., 1989).

Plants may be grown in the greenhouse using standard greenhouse procedures. Deeper containers (4 inches or more) are recommended because perennial grasses develop extensive root systems. A critical factor in growing little bluestem is day length. A study in North Dakota required 18 hours of artificial light each day for continued growth of seedling little bluestem plants (USDA, 1983) during the winter months.

Little bluestem has high genetic diversity.

Cultivars, Improved, and Selected Materials (and area of origin)

'The Blues', 'Prairie Blues', 'Blue Heaven', 'Carousel', and several other varieties have been developed for landscaping and ornamental use. Sources for conservation planting showing the year of release, and origin include the following:

Coastal Plains Germplasm	2016	TX
STN-176 Germplasm*	2015	TX
STN-461 Germplasm*	2015	TX
Ozark Germplasm	2010	MO
Suther Germplasm	2008	NC
Prairie View Indiana Germplasm	2005	IN
OK Select Germplasm	2003	OK
Spirit Ecovar (Canada)	2003	SK,MB
Southlow Michigan Germplasm	2001	MI
Itasca Germplasm	2001	ND,SD,MN
Taylor Ecovar (Canada)	2000	MB,SK
Southern Iowa Germplasm	1999	IA
Northern Iowa Germplasm	1999	IA
Northern Missouri Germplasm	1999	IA
Central Iowa Germplasm	1997	IA
Badlands Ecotype	1996	ND,SD
'Cimmaron'	1979	KS,OK
'Camper'	1973	NE,KS
'Blaze'	1967	NE,KS
'Aldous'	1966	KS
'Pastura'	1964	NM

*Carrizo Blend is a commercial post-harvest blend of STN-176 Germplasm and STN-461 Germplasm. The blend should contain no more than 50 ± 10% of each of the two germplasms.

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Citation

Tober, D. and N. Jensen. 2013. Plant guide for little bluestem (*Schizachyrium scoparium*). USDA Natural Resources Conservation Service, Plant Materials Center, Bismarck, North Dakota 58501

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For more information about this and other plants, please contact your local NRCS field office or Conservation District at http://www.nrcs.usda.gov/ and visit the PLANTS Web site at http://plants.usda.gov/ or the Plant Materials Program Web site http://plant-materials.nrcs.usda.gov. PLANTS is not responsible for the content or availability of other Web sites.

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Plant Fact Sheet

BIG BLUESTEM

Andropogon gerardii Vitman

Plant Symbol = ANGE

Contributed by: USDA NRCS Plant Materials Program

Robert H. Mohlenbrock
USDA NRCS 1995
Northeast Wetland Flora
@USDA NRCS PLANTS

Uses

Erosion control: Big bluestem is a top choice for erosion control plantings on sites with moderately well drained to excessively well drained soils. Generally, it is planted in combination with other warm season grasses on these sites.

Livestock: Big bluestem is one of the most palatable warm season grasses and is preferred over switchgrass by livestock. Therefore, in pastures, it should be planted alone for best management, especially where continuous or extensive grazing practices are used. It can be mixed with other species for intensive, rotational grazing.

Wildlife: Birds and mammals use big bluestem for nesting and escape cover in summer and winter. It resists lodging under snow cover almost as well as switchgrass, thereby contributing to spring nesting habitat.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

Andropogon gerardii, big bluestem, is a native, perennial, warm season grass that occurs from the short grass prairie region to the Atlantic Ocean. It is tufted, forms sod, and has short, scaly rhizomes. Big bluestem is tall, reaching a height of 6 to 8 feet on most sites where it is protected from grazing. It is very leafy at the base, with some leaves carried up on the stem. The seed heads normally have 3 spikelets that appear like a 'turkey foot.'

Adaptation and Distribution

Big bluestem is climatically adapted throughout the Midwest and Northeast on moderately well drained through excessively well drained soils. It is adapted to a range of other soil limitations such as shallow depth, low pH, and low fertility.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

Big bluestem should be seeded as early in the spring as possible. Conventional tillage should be used where practical. Where no-till must be used due to slope, stoniness, or other reasons, the sod control should be performed in the fall to permit early spring planting. The seeding rate for broadcast or no-till methods should be 7 to 12 pounds PLS per acre. When drills are used to plant, debearded seed must be utilized unless the drill has a chaffy seed box. When the seed is broadcast, a packer should be utilized to firm the seedbed and incorporate the seed 1/4 to 1/2 inch (3/4 inch on very droughty sites) as if alfalfa was being planted. No nitrogen fertilizer should be applied during the establishment year unless no weed competition is expected. If pH is below 5.5, lime is recommended during site preparation or the fall prior to no-till plantings.

Management

No harvest of bluestem during the establishment season should be allowed. During the second growing season, harvesting by controlled pasturing or haying is possible on good stands. The first harvest should not commence until the bluestem is 20 inches tall. It should be grazed (5 days maximum duration) or cut no lower than 8 inches and then protected from use until 20 inches in height is reached again. No cropping should occur below 8 inches or within 1 month of anticipated frosts. After a killing frost, the

area may be grazed to 8 inches, but forage quality is greatly reduced and supplementation is recommended for growing animals.

Big bluestem has relatively weak seedling vigor compared to weeds and cool season grasses; therefore, control of competition is necessary for successful stand establishment. High mowing (above the bluestem seedlings) is a common method of weed control. Selected herbicides may have application when forage harvests are not anticipated during the year. Grazing of competing cool season grasses after frost in the fall and before the bluestem is 1 inch tall in the spring is desirable, unless soil conditions are too wet.

Cultivars, Improved, and Selected Materials (and area of origin)

There are several cultivars available as certified seed, i.e. 'Bison' (ND), 'Bonilla' (SD), 'Champ' (NE, IA), 'Kaw' (KS), 'Earl' (TX), 'Niagara' (NY), 'Pawnee' (NE), and 'Rountree' (IA).

Prepared By & Species Coordinator:

USDA NRCS Plant Materials Program

31Jan2002 JLK; 24may06jsp

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Plant Fact Sheet

BLACK-EYED SUSAN

Rudbeckia hirta L.

Plant Symbol = RUHI2

Contributed by: USDA NRCS Plant Materials Program

USDA NRCS National Plant Materials Center
Beltsville, MD

Uses

Erosion control: Black-eyed Susan is an important component in critical area treatment plantings along with grasses, legumes, and other forbs when used along road cuts, hillsides, and other areas subject to erosion.

Wildlife: This plant offers protection and food to several song and game birds.

Recreation and beautification: Black-eyed Susan can be used for landscaping and in wildflower gardens.

Status

Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values).

Description

Rudbeckia hirta L., black-eyed Susan, is a biennial forb about 1 m tall with yellow ray flowers and dark brown spherical centers. After germination, the seedling grows into a rosette with oblong leaves. Sometimes flower stalks will appear in the first summer, but typically black-eyed Susan blooms from June to September of the second year. After flowering and seed maturation, the plants die. The seed is very small (1,746,000 per pound) and black, about 2 mm long and 0.5 mm in diameter.

Adaptation and Distribution

Black-eyed Susan is naturalized in most of the states east of Kansas and the bordering areas of Canada. It is adapted throughout the Northeast on soils with a drainage classification range from well-drained to somewhat poorly drained. It will perform acceptably on droughty soils during years with average or above rainfall, but best growth is achieved on sandy, well drained sites. It is winter hardy in areas where low temperatures are between -30 ° and -20 °F.

For a current distribution map, please consult the Plant Profile page for this species on the PLANTS Website.

Establishment

Black-eyed Susan is easily established with most critical area seeding techniques. Generally ½ lb. of seed per acre is sufficient in mixes with conservation grasses, legumes, and other forbs. Where the intent is to maximize the impact of the forb component, utilize bunchgrasses rather than aggressively spreading grasses such as reed canarygrass or bromegrass. Once established, new seedlings will be produced from the preceding crop; the stand may perpetuate itself indefinitely.

Management

After establishment, competing perennial vegetation should be controlled through the use of mechanical or chemical practices. If competing vegetation is not controlled, one will observe a decrease in the number of black-eyed Susan plants.

Pests and Potential Problems

There are no major insect or disease pests of black-eyed Susan. Stands can be reduced by powdery mildew and damping-off organisms.

Cultivars, Improved, and Selected Materials (and area of origin)

'Golden Jubilee' black-eyed Susan was released by the Big Flats Plant Materials Center in 1985. It is typical of the species except slightly shorter in height with a longer bloom period. It was not selected for its flower size or color. 'Golden Jubilee' is the only cultivar of black-eyed Susan that has proven adaptation throughout the Northeast for conservation

use. The original collection area of 'Golden Jubilee' was near Manchester, Vermont. Foundation seed is distributed to commercial producers by the Big Flats PMC in Corning, NY. Black-eyed Susan is readily available from commercial sources.

Prepared By & Species Coordinator:
USDA NRCS Plant Materials Program

Edited: 05Feb2002 JLK; 060809 jsp

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Plant Guide

BLUE WILD INDIGO

Baptisia australis (L.) R. Br. ex Ait. f.

Plant Symbol = BAAU

Contributed by: USDA NRCS Kansas Plant Materials Center

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Courtesy of Smithsonian Institution
Dept. of Systematic Biology-Botany

Alternate Names
blue false indigo, wild indigo, plains wild indigo, false indigo, baptisia, plains baptisia, rattlepod, rattlebush, rattlebush wild indigo.

Uses
Conservation: It makes good ground cover in sunny locations because of its bushy habit, extensive root systems and perennial life form. It is a native legume, fixes nitrogen in the soil, and can be part of a good wildlife seed mixture when native grasses and forbs are seeded.

Cultural: Presently, *Baptisia australis*, is grown by many as an ornamental in outdoor flower gardens or as a decorative border. It has become popular because it grows well in many areas outside its native range when planted, does well without watering, requires no fertilizer or pesticide treatments and needs no pruning. The pods have been used in dried flower arrangements. When in bloom the brightly colored blue flowers arranged in spikes make it very attractive. However, a bouquet of fresh cut flowers does not last very long. The flowers and stems turn black as soon as they begin to dry.

The Cherokees used the plant as a source of blue dye for their clothes. Early pioneer settlers copied this practice. A common name, false indigo, indicates it is not the true indigo plant (*Indigofera tinctoria* L.) which was introduced from the India subcontinent and cultivated for blue dye by many landowners during the early settlement of America. Some Indian tribes used it for medicinal purposes. The Osage made eyewash from the plant. The Cherokees would make a tea from it. A hot tea was taken as a purgative and a cold tea to prevent vomiting. A pulverized root or hot tea was held over a sore tooth to relieve the pain. Indian children would use the dried pods with the loose seeds inside as rattles.

Status
Please consult the PLANTS Web site and your State Department of Natural Resources for this plant's current status (e.g. threatened or endangered species, state noxious status, and wetland indicator values). This plant is considered threatened in several states.

Description
General: Blue wild indigo is a native, perennial, deep rooted warm season legume which reproduces by seed or rhizomes. The leaves are alternate and trifoliate. The plant is erect, rising from a branched root system which has root tubercles. It branches at the top with the flowers in an erect short terminal raceme at the pinnacle. The stems are stout and glabrous. It may grow up to 5 feet tall and 3 feet wide. Normally, it is about 3 feet tall and 2 feet wide. The flowers are hermaphroditic, about 1 inch long and may range in color from light blue to deep purple. The fruit is an inflated hardened pod from 1 to 3 inches long and from 1/2 to 1 inch in diameter. When mature the pods contain a number of small seeds, which are loose. Depending on the region it may flower from April (in the south) through August

(in the north). It is in leaf approximately one month before flowering to one month after the pods have formed. In the autumn when full maturity is reached the plant turns silvery-gray, and breaks off from the root system at ground level. The pods stay with the plant for some time while the wind tumbles it around to a new location. The leaves and pods turn black upon drying. When it is growing if a leaf is crushed or stem is broken the sap turns a slate blue color when exposed to the air.

Distribution: It occurs from Nebraska to Texas on the west to the eastern seaboard states. It reaches into Canada in its middle range and New Hampshire is the extreme northeast area it occurs as a native. It is rarely found near the Gulf or Atlantic coasts. For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.

Habitat: Larger populations can be found along tree lines, bordering forested riparian areas and in open prairies or native hay meadows. It does not grow well in shaded habitats. It prefers gravelly, sandy or well-drained loamy soils. It withstands prolonged droughts. Like many legumes it can fix nitrogen in the soil.

Adaptation
Blue wild indigo adapts to many areas outside its native habitat. It can withstand freezing temperature extremes of negative 30 degrees Fahrenheit for a short period without any ill effects. It grows between USDA hardiness zones 3 to 10.

Management
Once it has become established blue wild indigo will remain healthy for several years. It requires a minimum of maintenance in a garden or outside setting. It is not shade tolerant, so does not make a good house plant. Herbicides used to control broad-leaf weeds will also kill this plant. Care should be taken whenever a pesticide is used to ensure only the targeted pests are affected.

Pests and Potential Problems
Parasitic weevils normally infest the seedpods in their native habitats. Generally, it takes a large number of seeds when they are harvested from a natural ecosystem to have any success at finding viable seeds.

Environmental Concerns
Toxicity: Some older poisonous plant literature has blamed *Baptisia* species for killing cattle and horses. More modern literature documents this genus as more likely to cause severe diarrhea and anorexia. *Baptisia australis* contains several quinolizidine alkaloids including anagyrine, cystinine, lupaninne, N-methylcystisine, rhombifoline, sparteine, and tinctorine. Alkaloids have a bitter taste and make the plant unpalatable for grazing animals. If other forage is available it is unlikely any detrimental effects from *Baptisia* will be seen. No poisonings of people or pets have been recorded. Recent German research indicates some *Baptisia* species may act as stimulants to the human immune system.

Blue wild indigo is unlikely to become weedy or invasive in most regions or habitats and rarely displaces desirable vegetation.

Seeds and Plant Production
Collected seeds from plants growing in a native setting have an extremely low germination rate due to predation by weevils. The pods should be treated for insects before bringing them into a greenhouse or the seeds sorted prior to bringing them inside. If these precautions are not taken it is likely several dozen weevils will immediately escape when the pod is opened. Like many other legumes it has a hard seed coat. The seeds must be scarified if germination is to occur within an artificial setting. Also, studies involving stratification and soaking the seeds a full day prior to planting show more success than scarification alone. The seeds normally germinate when the soil temperature nears 50 degrees Fahrenheit. After seedlings emerge they can be divided and further propagated.

Cultivars, Improved, and Selected Materials (and area of origin)
USDA lists no named cultivars, or genetically improved varieties. There are three recognized naturally occurring varieties of *Baptisia australis* (L.) R. Br. ex Ait. f.:
variety *aberrans* (Larisey) M. Mendenhall
variety *australis*
variety *minor* (Lehm.) Fern.

Contact your local Natural Resources Conservation Service (formerly Soil Conservation Service) office for more information. Look in the phone book under ”United States Government”. The Natural Resources Conservation Service will be listed under the subheading “Department of Agriculture.”

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Helianthus divaricatus

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More Images

Tried and Trouble-free
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Species Native to Missouri

Common Name: sunflower

Type: Herbaceous perennial

Family: Asteraceae

Native Range: Eastern United States, Oklahoma, Canada

Zone: 3 to 8

Height: 2.00 to 6.00 feet

Spread: 1.00 to 3.00 feet

Bloom Time: July to September

Bloom Description: Yellow rays with darker yellow center disk

Sun: Part shade

Water: Dry to medium

Maintenance: Low

Suggested Use: Naturalize

Flower: Showy, Good Cut

Attracts: Birds, Butterflies

Tolerate: Deer, Drought

Garden locations

Culture

Easily grown in average, dry to medium, well-drained soil in part shade. Tolerant of wide range of soil conditions. Spreads over time by creeping rhizomes to form colonies. Divide every 3-4 years to control spread and maintain vigor.

Noteworthy Characteristics

Helianthus divaricatus is a Missouri native plant that occurs in open rocky woodlands and thickets in eastern Missouri. Features 2" wide sunflowers with bright yellow rays and slightly darker yellow center disks atop rigid stems typically growing 2-6' tall. Smooth stems and sessile or short-stalked leaves (to 6") are the distinguishing characteristics of this species. Blooms from mid summer to fall. Good fresh cut flower.

Genus name comes from the Greek words *helios* meaning sun and *anthos* meaning flower.

Specific epithet means spreading in a straggling manner.

Problems

No serious insect or disease problems. Taller plants may need staking.

Garden Uses

Partially shaded border, wild or native plant garden, or naturalized planting.

APPENDIX D

BASEWOOD BIOVORE SYSTEM

BASWOOD

Baswood BioVore™

Advanced Technology for Municipal Wastewater and Biosolids Management

About Baswood

Baswood delivers innovative, technology-based solutions that provide effective wastewater treatment and biosolids management for a wide range of municipal applications. Baswood offers biological systems using patented technologies that provide a unique combination of increased solids retention and decreased hydraulic retention in a small footprint, resulting in efficient removal of organic contaminants, while minimizing biosolids production.

BioVore™ Advantages

The Baswood BioVore™ provides cost effective, reliable municipal wastewater treatment and biosolids/sludge management within a stable, fixed film biological system. Advantages of the Baswood municipal wastewater solution include the following:

- Low life-cycle costs providing a rapid return on investment
- Sequential, fixed media biotechnology provides highly efficient BOD digestion and improved effluent quality
- Patented Aerobic/Anaerobic Integrated Media System (AIMS) integrated media maintains high food to mass (F/M) ratio, resulting in a robust biomass in a system that can handle fluctuating organic loads
- Superior biosolids digestion consistently reduces sludge handling and disposal requirements
- Patented Dry Cycle Aerobic/Anaerobic Digestion (DCAD™) process manages the biomass character in the reactors
- Unique vertical configuration of treatment zones allows for system to be constructed with a reduced footprint
- No internal moving parts within the reactors reduces equipment maintenance costs and potential for equipment failure

Baswood Innovation

Baswood's AIMS™ is a patented hybrid process incorporating aerobic and anoxic (oxygen depleted) environments that maximize biological treatment efficiency and provide optimal BOD digestion and biosolids reduction. Waste is fed sequentially through a series of mixed environment biological fixed film reactors. Within each reactor are three treatment zones that provide sequential biological treatment, resulting in accelerated BOD digestion, as well as biological nutrient removal.

The most significant innovation of AIMS technology is Baswood's proprietary DCAD™ process. During the DCAD™ process, one of the reaction vessels is taken off line for the purpose of 'pruning' the biomass. Removing the food source and altering the environment in the vessel stresses the ecosystem, causing the healthy bacteria to feed upon weaker/older bacteria, as well as retained residual biosolids. In addition to increasing the digestion capacity of the system, the pruning action of the DCAD™ process manages the hydraulic flow characteristics through the biomass-laden media. The reactor vessels are cycled through the DCAD™ process without taking the system offline, one of the reactor vessels may be in the DCAD™ process at any time.

Baswood's systems achieve treatment goals with a reduced hydraulic retention and increased solids retention. These factors, along with the efficiency of our DCAD™ technology, result in a smaller physical footprint, reduced volume requirement, and effective sludge reduction. Baswood's systems also require significantly less operational horsepower compared to other similar sized aerobic technologies.

Operational Simplicity

The following features minimize operational oversight and system maintenance requirements:

- No internal moving parts
- Internal self-buffering reduces chemical use
- Use of commercial off the shelf (COTS) components reduces costs and facilitates simplified maintenance
- Proprietary Supervisory Control and Data Acquisition (SCADA) with remote monitoring capability

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The BioVore™ Process

The Baswood BioVore™ process provides for enhanced digestion of BOD and superior biosolids reduction with minimal operator oversight and low maintenance costs. The system is comprised of four reactors, each with three distinct treatment zones in a unique, vertical alignment that provides a relatively small footprint.

The verticality of the system takes advantage of air's natural tendency to rise through liquids. Air is supplied to the biomass to meet its respiratory needs, rather than as the medium to maintain the mass or the media in suspension As a result, the Baswood system uses a fraction of the energy required by competing technologies to maintain an aerobic environment.

As wastewater passes between three distinct treatment zones in each of four reactors, it is treated a total of 12 times during an 8-hour period. This repetitive exposure to different environments results in accelerated BOD digestion, as well as biological nutrient removal.

At the top of the reactor, wastewater is distributed across the surface and travels downward through the following treatment zones:

Zone 1: Trickling Filter

Aerobic treatment using passive aeration, providing BOD reduction and denitrification

Zone 2: Facultative Zone

Anoxic treatment layer at the interface between the Trickling Filter and Submerged Zone, providing additional denitrification and overcoming the uncontrolled sloughing of the trickling filter

Zone 3: Submerged Zone

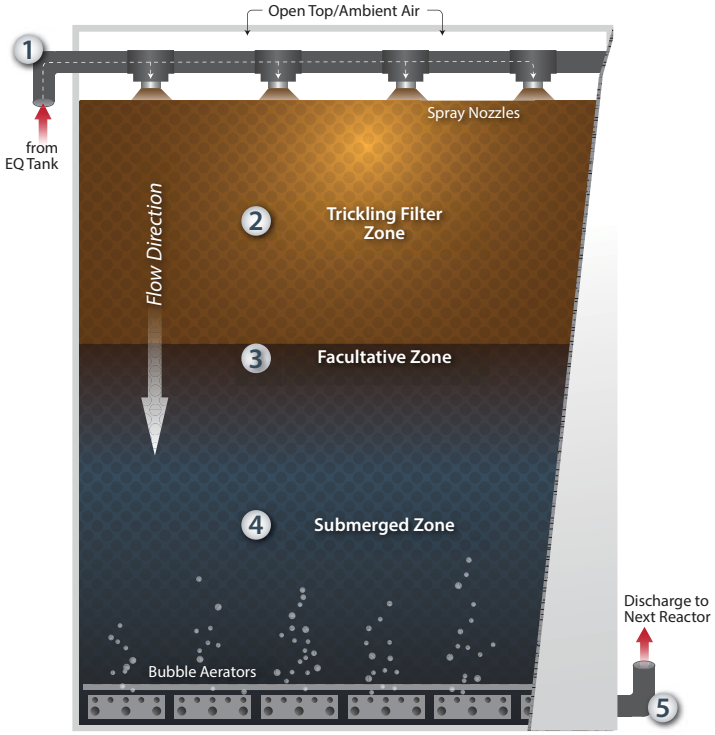
Submerged attached growth to the fixed media increases solids retention time (SRT) and provides a platform for aerobic treatment below the reactor's water line where aggressive BOD reduction occurs

Wastewater is piped from the base of the one reactor to the top of the next reactor, where the treatment process is repeated in sequence. The same treatment process is used as the water flows through each of the four reactors, then it is sent to a clarifier prior to discharge or tertiary treatment.

The Baswood BioVore™ produces an effluent that meets the requirements for discharge and reuse, while producing less residuals solids that meet Class B Criteria. The BioVore™ can be combined with proven technologies from existing partners for tertiary treatment if needed.

Baswood BioVore™ Process Utilizing Patented AIMS™ Technology

1. Wastewater enters the BioVore™ through a series of nozzles that distributes flow evenly across the top of the reactor. Wastewater flows by gravity through a series of three treatment zones.
2. Zone 1, Trickling Filter: Water cascades over biofilm-coated media using passive aeration, enhancing BOD reduction and denitrification.
3. Zone 2, Facultative Zone: As solids are sloughed off from the Trickling Filter, they collect at the interface with the Submerged Zone providing additional denitrification
4. Zone 3, Submerged Zone: The solids enter the submerged zone and the naturally occurring hydrophilic bacteria attach to the fixed media, extending the solids retention time (SRT). Respiratory oxygen is supplied to the reactor though an aeration system creating a robust treatment environment below the water line in each reactor.
5. Treated wastewater is piped out from the base of the reactor and into the next reactor in the series, where the three zone treatment process is repeated. A series of four reactors make up the BioVore™ system.



Energy Efficiency

The characteristics of the BioVore™ system that contribute to energy efficiency, as compared to other wastewater treatment systems, include:

- Efficient aeration process uses less energy than traditional aerobic systems
- As a fixed media system, no energy is required to keep either the solids or media in suspension

Efficiency comparison of Baswood BioVore™ to other technologies

Technology	Kw/Hr Annual	Baswood Benchmark	Water Reuse Opportunities
Packaged Plant High Rate Aerobic	38,108	-114%	Sometimes
MBR	20,835	-71%	Always
Activated Sludge	17,422	-43%	Rarely
MBBR	15,717	-29%	Rarely
Baswood BioVore™	**12,184**		**Always**

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Patent Nos. 7,144,507 B2 and 7,387,733

Case Study: Biosolids Management for Municipal Wastewater Treatment Facility, Glasgow, KY

Innovative Process Improves Digestion and Reduces Energy Demand

In 2005, Baswood installed its proprietary BioVore™ biosolids reduction system at the Glasgow Water Company (GWC), treating the waste activated sludge (WAS) from the facility's activated sludge wastewater treatment system. The system has an average biosolids digestion rate of 60%. Utilizing Baswood's patented Aerobic/Anaerobic Integrated Microbial Succession (AIMS) technology and innovative 'Dry Cycle' process, the system maximizes digestion with limited energy demand. Installed as part of a technology demonstration project championed by the State of Kentucky, the system soon became an active part of GWC's treatment works. The BioVore™ has effectively treated more than 12 million gallons of biosolids to date.

Process Overview

The Baswood BioVore™ was seamlessly integrated into GWC's existing plant to improve the biosolids management practices of the facility. A series of fixed film reaction vessels with aerobic, facultative, and anaerobic zones promote maximum biological digestion. The high quality clarified effluent can be discharged to tertiary treatment and any residual solids are suitable for land application.

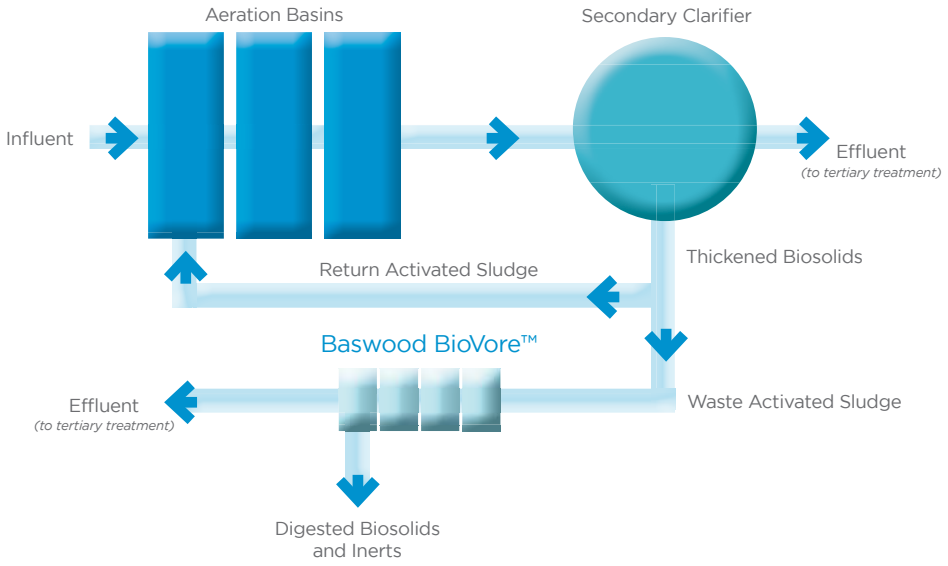
The innovative AIMS biological process has proven to be more effective for digestion of WAS, when compared to the facility's existing aerobic digestion system. The BioVore™ uses less than 50% of the required power and has a hydraulic retention time (HRT) of less than 24 hours.

In addition, any biosolids discharged from the BioVore™ have improved dewatering characteristics. Installation of a belt press would further reduce the net volume of material requiring disposal.

The system utilizes Baswood's patented 'Dry Cycle' process that increases solids retention, reduces hydraulic retention, and maximizes biological digestion. The overall treatment process is reliable and has a low cost of operation and maintenance. A proprietary SCADA control system provides automated operation and remote monitoring/operating capabilities and requires minimal operator training.

The BioVore™ can be sized to process the biosolids produced by a 0.5 mgd – 8 mgd wastewater treatment system. It is modular and scalable in design, requiring minimal capital investment if expansion is needed to accommodate growth in existing plant capacity.

The BioVore™ easily integrates into existing wastewater treatment facilities



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Performance

PARAMETER	INFLUENT (mg/l)	EFFLUENT (mg/l)*	REDUCTION
VSS	6,187	1,920	69.0%
COD	10,144	2,540	75.0%
TKN	394	181	54.0%
Phosphorus	340	102	70.1%

**prior to clarification*

Settling tests show the effectiveness of the BioVore™ WAS digestion and clarification

Influent *Post Digestion* *Post Clarification*

Advantages/Benefits

The Baswood BioVore™ has unique advantages over other systems:

- Superior digestion rates compared to other treatment options (60%+), translating to less material to manage and lower transportation and disposal costs
- Low HRT (<24 hours) allows for more biosolids to be processed in a smaller footprint
- An efficient, scalable process that can be quickly mobilized to decrease the cost of biosolids processing and handling or eliminate existing "bottle necks"
- A breakthrough biological process that is robust, with low energy requirements (>50% less) and limited operational oversight, translating to lower life cycle costs and less environmental impact
- Low to no odor process that eliminates community concerns and the added cost of odor treatment equipment
- High quality clarified effluent that can be blended with treatment system discharge

About Baswood

Baswood offers an environmentally responsible, lower cost alternative to biosolids management. In addition, our proven, patented technologies provide effective treatment of municipal and industrial wastewater streams. Founded in 2004, the company delivers innovative, technology-based solutions that are economically and environmentally sound. Our systems are compact, customizable, and require less energy and manpower to operate.

The Baswood AIMS technology has a wide range of municipal, industrial, and agricultural applications, particularly where issues with cost, capacity, or energy exist.

For additional information

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BASWOOD

Patent Nos. 7,144,507 B2 and 7,387,733

APPENDIX E

PROFESSIONAL GEOLOGIST CERTIFICATION

(Zeb Youngman)

To: Licensee/Registrant

- Please review the Registration Certificate below to be sure the information on it is correct.
- If any of the information is not correct, please contact us at OPREGFEE@mail.nysed.gov or (518) 474-3817, Ext. 410.
- If the information is correct, sign above the Licensee/Registrant block and please destroy any previous Registration Certificates you may have, as certificates with incorrect information are not valid and should not be kept.
- Should your address or name change, please notify us as described on the reverse and a new certificate will be issued.

UPON RECEIPT OF THIS REGISTRATION CERTIFICATE YOUR PREVIOUSLY ISSUED REGISTRATION CERTIFICATE IS NULL AND VOID. PLEASE DESTROY THE PREVIOUSLY ISSUED REGISTRATION CERTIFICATE.

SEE BACK FOR IMPORTANT INFORMATION

The University of the State of New York
Education Department
Office of the Professions

REGISTRATION CERTIFICATE

Do not accept a copy of this certificate

License Number: 000130-1 Certificate Number: 9711799

YOUNGMAN ZEB
STE E6
188 W MONTAUK HWY
HAMPTON BAYS NY 11946-0000

is registered to practice in New York State through 03/31/2020 as a(n)
PROFESSIONAL GEOLOGIST

LICENSEE/REGISTRANT

EXECUTIVE SECRETARY

COMMISSIONER OF EDUCATION

DEPUTY COMMISSIONER
FOR THE PROFESSIONS

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What is this document?

This is your REGISTRATION CERTIFICATE, not a license (a New York State license is issued once and does not expire). If you are practicing in New York State, your registration **must be renewed periodically**. Practice without current registration violates the Education Law and may subject you to disciplinary action.

Should I display this REGISTRATION CERTIFICATE?

You must display a current REGISTRATION CERTIFICATE in each office where you practice. If your practice is not in an office, have a current REGISTRATION CERTIFICATE available for inspection at all times.

What do I do when my address or name changes?

When your address or name changes, Education Law requires that you report this within 30 days. When your record(s) have been updated, we will send you a replacement REGISTRATION CERTIFICATE.

- Address changes can be made by providing all required information in the checklist below via ***E-mail*** to op4info@mail.nysed.gov, ***Telephone*** 518-474-3817, ***Fax*** 518-474-1449 or ***Mail*** to Professional Licensing Services - Records and Archives, 89 Washington Avenue, Albany NY 12234-1000.
- Name changes must be made in writing to the address above with all information detailed in the checklist that follows. You will receive a new REGISTRATION CERTIFICATE in your new name. **OPTIONAL:** To receive a new LICENSE PARCHMENT, please request this in your letter and we will send fee information and a customized form.

Address Change	Name Change	*Checklist Items*
X	X	1. Full name currently on record (i.e., how your name now appears on your license and registration)
	X	2. New name exactly as you wish it to appear
X	X	3. Date of birth
X	X	4. Social Security Number
X	X	5. Daytime phone number
X	X	6. Profession(s) - list all professional licenses you hold in New York State
X	X	7. License Number(s) - for each of the professional licenses you list in item 6 above
X		8. Complete address currently on record
X		9. Complete new address
	X	10. Supporting legal documentation
	X	11. Original signature

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X	X	3. Date of birth
X	X	4. Social Security Number
X	X	5. Daytime phone number
X	X	6. Profession(s) - list all professional licenses you hold in New York State
X	X	7. License Number(s) - for each of the professional licenses you list in item 6 above
X		8. Complete address currently on record
X		9. Complete new address
	X	10. Supporting legal documentation
	X	11. Original signature

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THE STATE EDUCATION DEPARTMENT / THE UNIVERSITY OF THE STATE OF NEW YORK / ALBANY, NY 12234
State Board for Engineering, Land Surveying & Geology
Telephone: 518-474-3817 Ext. 140
Fax: 518-473-6282
E-mail: geology@nysed.gov

Professional Geologist

Important Resources and Information
Please Read and Keep for Future Reference

Congratulations on licensure as a professional geologist! This letter accompanies your License Parchment (this does not expire) and your Registration Certificate (see expiration date on this document). In order to practice you must maintain your registration and notify the Department within 30 days of a change in address or name.

For information on obtaining an **optional licensed professional photo identification card,** please visit our Web site at www.op.nysed.gov/photoid.htm.

The Office of the Professions' home page (www.op.nysed.gov) provides access to information about:

- online registration and address changes;
- online verification of licensees in over 50 professions;
- disciplinary actions taken by the Board of Regents;
- meetings of over 30 state boards and committees for the professions; and
- frequently asked questions about licensure and registration.

You can access information about practicing as a professional geologist on our Web site at www.op.nysed.gov/prof/geo/. Much of this information is only available on-line. This page includes links to information about:

- online registration renewal;
- laws, rules and regulations that define practice as a licensed professional;
- professional geology seal/stamp requirements;
- practice issues;
- information on corporate entities permitted to practice engineering in New York State and Certificates of Authorization;
- frequently asked questions about Geology; and,
- definitions of unprofessional conduct under Regents Rules.

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Welcome to the community of nearly 900,000 licensed and currently registered professionals in New York State.

Sincerely,

Jane W. Blair, PE
Executive Secretary

12/16