Appendix 9.8 Wastewater Report

Engineering Report

SILO RIDGE
RESORT COMMUNITY

SEQRA Wastewater Concept

Town of Amenia

Dutchess County, New York

August 15, 2006

Revised October 5, 2007

THE Chazen COMPANIES

Prepared for:

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Management Co., LLC
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EXECUTIVE SUMMARY

This wastewater concept report has been prepared to support the Environmental Impact Statement (EIS) portion of the State Environmental Quality Review (SEQR) process required to develop a residential community and golf course in Dutchess County, New York. For the purpose of this document, this property is referred to as the Silo Ridge Resort Community property ("the project"). An on-site wastewater collection and treatment system will serve the residences and community structures. This on-site system will replace an existing septic system, which is undersized and not adequate to serve the needs of the proposed project.

It is recommended that on-site wastewater collection and treatment be accomplished with an on-site sewer system and a wastewater treatment plant (WWTP) to be built by the project sponsor. The WWTP will treat wastewater by a combination of biological processes and filtration before final surface water discharge. The anticipated WWTP outfall location will be to an unclassified on-site intermittent stream that drains to on-site Class C irrigation ponds. These ponds then overflow off-site to Amenia Brook, a Class C_t Stream, which ultimately is tributary to Wassaic Creek and the Housatonic River. By discharging to on-site irrigation ponds, rather than directly to nearby Amenia Brook, the treated effluent can supplement the irrigation supply system and further the project sponsor's goal of responsible environmental development.

Given the proximity of adjacent properties, the WWTP will implement numerous odor control measures. The entire WWTP process will be fully enclosed in a dedicated building, and appropriate aeration and ventilation measures will prevent the generation or dissemination of nuisance odors.

The capacity of the wastewater collection and treatment system will be based on peak seasonal flows and full occupancy corresponding to the primary home scenario as submitted in the Draft Environmental Impact Statement (DEIS).

This document presents the proposed wastewater concepts for two development alternatives for the property; The DEIS Proposed Action, and an alternate plan referred to as the Traditional Neighborhood Alternative (TNA). The proposed general approach and technology will be the same for either alternative, but the average daily flow rates and the proposed WWTP locations will differ. Where divergent wastewater designs are called for, they will be discussed separately in this report. This includes two sewer flow rate tables, and two alternate site plan layouts reflected in the figures.

1.0 INTRODUCTION

Higher Ground Country Club Management Co. L.L.C. is proposing the improvement of the existing 668 (+/-) acre Silo Ridge Country Club into a resort community which will include town home and condominium units, single-family residences, a resort hotel, banquet space, restaurants, conference space, a spa and wellness center as well as improved golf course facilities. The proposed project is a master planned community complex incorporating recreational amenities, community facilities, up-scale hotel and spa and a range of residential housing types, which will be designed, developed and operated with sensitivity to environmental resources and in keeping with the character of the area and local community. A variety of housing configurations will be oriented to various lifestyles using architectural themes compatible with the natural setting of the site and consistent with the character of the local community. The project will include all necessary infrastructure, including an on-site central water supply system, sanitary sewer system, drainage facilities and extensive natural resource conservation, protection and enhancement areas. This report summarizes the wastewater facilities that will be needed to serve the development under two different development scenarios; the DEIS Proposed Action, and a Traditional Neighborhood Alternative.

The existing sanitary wastewater system consists of an on-site septic system with subsurface disposal via leach field. The system operates under New York State Pollution Discharge Elimination System (SPDES) permit number NY0234966, with a permitted flow rate of 0.0126 MGD and a permit expiration date of 2025. The proposed improvements will increase wastewater flows more than ten-fold, rendering this system inadequate. A new sewer collection system and wastewater treatment plant (WWTP) with surface water discharge is proposed as the preferred alternative.

The sanitary sewer system will accommodate sanitary flows only, with all stormwater conveyed separately to stormwater management ponds. Although it is expected that some residents will be full-time, the resort nature of the community will create weekly and seasonal fluctuations in population as well as fluctuating wastewater flows. The development will include the construction of several thousand linear feet of sanitary sewer lines, consisting of low pressure sewers, gravity sewers, and forcemains. The sanitary sewer lines will terminate at a proposed on-site wastewater treatment plant that will treat the wastewater, and discharge treated effluent to the on-site ponds for irrigation reuse. This privately-owned community wastewater system will require a transportation corporation for its ownership, operation, and maintenance. Design and operation of the system will be in accordance with "Design Standards for Wastewater Treatment Works - 1988" by the New York State Department of Environmental Conservation (NYSDEC), and the "Recommended Standards for Wastewater Facilities" by the Great Lakes Upper

Mississippi River Board of State Public Health & Environmental Managers, also known as "Ten States Standards for Wastewater".

The Dutchess County Department of Health (DCDOH) has approved of the methodology used to predict the average wastewater flows for the project. The NYSDEC has issued preliminary effluent standards to which wastewater must be treated prior to discharge. DCDOH and NYSDEC will share review and approval authority for the wastewater design, and NYSDEC will issue a SPDES permit for surface water discharge. An Environmental Assessment Form (EAF), Conceptual Site Plan, and Site Plan Application were submitted in June 2005 to the Town of Amenia, which declared itself Lead Agency and issued a Positive Declaration. Detailed site development plans and transportation rates will require approval from the Town of Amenia.

2.0 WASTEWATER FLOW AND CHARACTERISTICS

2.1 Wastewater Flow Rates

The sewer system and WWTP must be designed to accommodate the anticipated flow rate of wastewater produced on the property, including all residences, hotel facilities, the Homeowner Association, and Golf Club structures expected to be connected to the system. Table 2.1-1 summarizes the anticipated daily average flow rate for the DEIS Proposed Action, and Table 2.1-2 summarizes the flows for the Traditional Neighborhood Alternative (TNA). The Dutchess County Department of Health (DCDOH) reviewed the flow calculation methodology used for both the DEIS Proposed Action and the TNA, and issued a Flow Confirmation Letter (included in Appendix A) approving of the methodology. It should be noted that the development program (i.e. room count) shown in this Flow Confirmation Letter has since changed for both development scenarios. However, the methodology remains unchanged. As the tables show, either development alternative results in approximately 200,000 gallons per day (gpd) +/- 10% average daily flow.

The final total average daily flow rate has been selected as the *design flow* for the proposed wastewater system when fully constructed. Generally, the NYSDEC protocol used to calculate these numbers is fairly conservative, and a wastewater system designed to meet this demand is conservatively sized. The notes below the table provide a detailed description of how these calculations were performed and what assumptions were made.

At times, actual property flow rates will be substantially lower than the design flow due to phases of construction, midweek vs. weekend occupancy, and seasonal occupancy patterns. Consequently, the sewer and WWTP will be designed to efficiently handle the lowest anticipated flow rates caused by seasonal and weekly fluctuations in occupancy. Full build-out flow rates are not expected to drop below 15% of the final design rates. Because it is anticipated that it will take several years for full property build-out to occur, the system must be able to operate at this reduced flow rate essentially indefinitely. A detailed description of construction schedule, and how the WWTP will accommodate the full range of flow rates, is contained in Section 5.3 of this report. The WWTP also will be designed to handle periodic high flow days that *exceed* the average daily flow, while maintaining effluent quality that does not violate SPDES permit requirements.

Table 2.1-1: Projected Wastewater Flow (Proposed Action)

Land Use	Unit	Unit Qty	Generation Rate [1] (gpd/unit)	Flow Reduction Credit [2]	Avg Daily Flow with Credit [3] (gpd)	Peak Hour Head-Count [4]
Hotel Rooms [5]						
A - Studio / One Bath	1-BR apt.	38	120	20%	3,648	38
B - One BR / One Bath	1-BR apt.	88	150	20%	10,560	88
C - Two BR / Two Bath	2-BR apt.	104	300	20%	24,960	208
D - Three BR / Two Bath	3-BR apt.	90	400	20%	28,800	270
Condominiums	3-BR home	328	400	20%	104,960	984
Single Family	4-BR home	41	475	20%	15,580	164
Maintenance Facilities	Ea.	1	400	0%	400	2
Golf Clubhouse						
Banquet Hall	Person	375	20	10%	6,750	188
Restaurant	Seats	100	35	10%	3,150	50
Retail/Office	SF	2,000	0.1	20%	160	25
Golfers [8]	Ea.	160	3	20%	384	80
Hotel General						
Banquet Hall	Person	200	20	10%	3,600	100
Conference Areas	Seats	200	10	20%	1,600	100
Restaurant [6]	Seats	125	35	10%	3,938	63
Spa [7]	SF	15,000	0.4	10%	5,400	25
Retail store & shop	SF	2,000	0.1	20%	160	25
Swimming Pool	Swimmer	333	10	0%	3,330	50
WWTP	Workers	2	25	20%	40	2
Infiltration & Inflow [9]	Total	1.0	1,600	0%	1,600	0
PROJECT TOTAL AT FULL BUILD-OUT (gpd):					**219,020**	2,461
Ten States Peaking Factor (for 2,300 population):					3.6	
Peak Hourly Flow (gpd):					788,470	
Peak Hourly Flow (gpm):					548	

[1] Wastewater rates from NYSDEC Design Standards for Wastewater Treatment Works 1988 unless noted.
[2] NYSDEC allows for up to 20% reduction in flows to account for use of low flow plumbing fixtures.
[3] Average Daily Flow assumes full occupancy of all residences and commercial facilities.
[4] Peak Hour Headcount is used to select peak hourly wastewater multiplier from Ten States Standards. Headcounts for public facilties have been reduced by 50% assuming that 1/2 the patrons are under "Residences" or "Hotel".
[5] Hotel rooms and residences assume 1 person per bed for purposes of calculating peak hourly flow.
[6] Retail, restaurant, and other commercial numbers include emplyee contribution unless otherwise noted.
[7] Spa wastewater generation is estimated at 4X the wastewater generation of conventional retail space.
[8] A maximum of 160 golfers assumed per day, based on 4 golfers every 15 minutes for 10 hours. Flow rate of 3 gpd/golfer based on 1988 NYSDEC standards for airport passengers.
[9] An estimated 15,000 LF of sewer line is anticipated, with 5,000 LF (1 mile) of that as 8" gravity pipe. Ten States Standards allows max 200 gal / in dia / mile / day for push-on SDR35 PVC piping. (200 x 8 in. x 1 mile = 1600 gpd)

Table 2.1-2: Projected Wastewater Flow (Traditional Neighborhood Alt.)

Land Use	Unit	Unit Qty	Generation Rate [1] (gpd/unit)	Flow Reduction Credit [2] (%)	Avg Daily Flow with Credit [3] (gpd/unit)	Peak Hour Head-Count [4]
Single Family Homes	3-Bedroom	18	400	20%	5,760	54
	4-Bedroom	17	475	20%	6,460	68
	5-Bedroom	6	550	20%	2,640	30
Golf Villas	3-Bedroom	13	400	20%	4,160	39
	4-Bedroom	6	475	20%	2,280	24
Townhouse	3-Bedroom	146	400	20%	46,720	438
Flats	2-Bedroom	153	300	20%	36,720	306
Resort Hotel [5]	Room/Suite	300	202	20%	48,412	600
Hotel Amenities/Spa						
Restaurant/Dining/Café	seat	180	35	20%	5,040	90
Spa & Fitness Center (8)	sf	81,490	0.30	20%	19,558	200
Indoor Lap Pool (6,000 sf) (5)	swimmer	400	10	20%	3,200	200
Winery	seat	80	20	20%	1,280	40
Golf Clubhouse/Halfway Grill						
Dining/Lounge/Bar	seat	120	35	20%	3,360	60
Golf shop	sf	1,355	0.10	20%	108	20
Golfers	golfer	160	3	20%	384	80
Banquet Facilities	person	300	20	20%	4,800	150
Conference/Meeting Rooms	theater seat	145	10	20%	1,160	73
Retail store & shop	sf	18,700	0.10	20%	1,496	200
Outdoor Pool (3,000 sf) (5)	swimmer	200	10	20%	1,600	100
Wastewater Treatment Facilities	employee	2	25	20%	40	2
Maintenance Facilities	each	1	400	0%	400	10
Infiltration & Inflow [9]	each	1	1,600	0%	1,600	0
PROJECT TOTAL AT FULL BUILD-OUT (gpd):					**197,178**	2,784
Ten States Peaking Factor (for 2,800 population):					3.5	
Peak Hourly Flow (gpd):					690,123	
Peak Hourly Flow (gpm):					479	

[1] Wastewater rates from NYSDEC Design Standards for Wastewater Treatment Works 1988 unless noted.

[2] NYSDEC allows for up to 20% reduction in flows to account for use of low flow plumbing fixtures.

[3] Average Daily Flow assumes full occupancy of all residences and commercial facilities.

[4] Peak Hour Headcount is used to select peak hourly wastewater multiplier from Ten States Standards. Headcounts for public facilties have been reduced by 50% assuming that 1/2 the patrons are under "Residences" or "Hotel".

[5] Hotel is assumed to be 300 bedrooms, with an average of 1.5 bedrooms per rental unit. Mix of restructed and unrestricted averages to 202 gpd/unit.

[6] Retail, restaurant, and other commercial numbers include emplyee contribution unless otherwise noted.

[7] Spa wastewater generation is estimated at 4X the wastewater generation of conventional retail space.

[8] A maximum of 160 golfers assumed per day, based on 4 golfers every 15 minutes for 10 hours. Flow rate of 3 gpd/golfer based on 1988 NYSDEC standards for airport passengers.

[9] An estimated 15,000 LF of sewer line is anticipated, with 5,000 LF (1 mile) of that as 8" gravity pipe. Ten States Standards allows max 200 gal / in dia / mile / day for push-on SDR35 PVC piping. (200 x 8 in. x 1 mile = 1600 gpd)

2.2 Wastewater Characteristics

Table 2.2-1 contains a summary of the estimated characteristics of the influent raw wastewater that will be generated on the property, and the estimated quality of treated effluent the WWTP must achieve for surface water discharge.

2.2.1 Raw Wastewater Characteristics

The composition of the raw wastewater is assumed to be medium-strength domestic wastewater, typical of residential communities with light to moderate commercial activity (*Wastewater Engineering*, Metcalf & Eddy, Third Edition, 1991). This composition is independent of population, although smaller populations are prone to more drastic fluctuations from the average. At Silo Ridge, commercial sources such as restaurants will generate higher strength wastewater, but these sources account for only about 25% of total property wastewater flow after Phase II, and only 10% of total property wastewater flow after Phase III (full property build-out). This allows the medium-strength assumption. The system also will be designed with the flexibility to treat higher strength wastewater during periods when commercial facilities comprise a higher percent of total wastewater flow.

2.2.2 Required Effluent Quality

The proposed WWTP outfall location will be an unclassified on-site intermittent stream that drains to on-site Class C irrigation ponds. These ponds then overflow off-site to Amenia Brook, a Class C_t Stream which ultimately is tributary to Wassaic Creek and the Housatonic River. Figure 1 (Wastewater Master Plan) of this report shows this effluent route. The required effluent quality is determined by three primary criteria, and summarized below in Table 2.2-1:

- *SPDES Limits*: The values in this column constitute only preliminary guidance from DEC, not final permit values. The goal of these limits is to maintain the quality of the receiving streams. Final values are calculated by NYSDEC from a waste assimilative capacity (WAC) analysis based on receiving stream characteristics and anticipated effluent flow rates. Preliminary effluent limits communicated by NYSDEC for this project are included in this report as *Appendix B: NYSDEC Preliminary Effluent Limits*.

- *Reuse Limits*: NYSDEC, in conference with NYSDOH, will issue guidance for the safe reuse of effluent as irrigation water. Based on previous projects in New York State seeking to reuse effluent for irrigation, these standards tend to focus on reuse practices, not effluent quality. The exception to this is effluent disinfection efficiency, as measured by fecal coliform concentrations. Reuse guidelines recommended by NYSDOH to NYSDEC for a similar project are included in this report as *Appendix C: NYSDOH Effluent Reuse Guidelines*.

- *Operational Considerations*: Unlike the first two criteria in this list, these considerations are voluntary. The property sponsor has a vested interest in maintaining high water quality in the irrigation ponds to prevent eutrophication, odor, and other aesthetic problems. Ponds tend to have less mixing and/or dilution than the streams or larger lakes that are typical outfall locations. Ponds therefore are more prone to serve as a concentration point for effluent constituents that enter it, even at low levels.

The "Design Target" column of Table 2.2-1 lists the effluent quality that the WWTP will be designed to meet in order to satisfy the more stringent of the two values dictated by SPDES limit and Reuse limit. Where the Design Target exceeds either of these guidelines, it is because a more stringent quality is deemed prudent to satisfy voluntary operational considerations such as maintaining irrigation pond quality.

Table 2.2-1: Preliminary Discharge Standards

Parameter	Raw Influent	NYSDEC SPDES Limit	NYSDOH Reuse Limit	Design Target	Standards Met by Recommendation
Biochemical Oxygen Demand (BOD_5) – mg/L	220	5	N/A	5	Intermittent Stream Stds
Total Suspended Solids (TSS) – mg/L	220	10	N/A	10	Intermittent Stream Stds
Settleable Solids – ml/L	10	0.1	N/A	0.1	Intermittent Stream Stds
Dissolved Oxygen – mg/L	0	7.0	N/A	7.0	Intermittent Stream Stds or Class C_t / C_{ts} standards
pH	6-9	6.5 - 8.5	N/A	6.5 - 8.5	Intermittent Stream Stds
Ammonia (winter/summer) - mg/L	25	2.2/1.5	N/A	2.2/1.5	Intermittent Stream Stds
Phosphorous (total) – mg/L	8	0.5	N/A	0.5	Lake/Pond Discharge (limits range from 0.5 – 1.0 mg/L for flows >50,000 gpd)
Fecal Coliform count (30-day geometric mean)	10^8	N/A	200	200	DOH recommendation. DEC Class A Discharge (200)
Fecal Coliform count (7-day geometric mean)	10^8	N/A	200	200	DOH recommendation. DEC Class A Discharge (400)

3.0 COLLECTION SYSTEM ALTERNATIVES

3.1 Summary of Preferred Alternative

The preferred alternative for the Silo Ridge on-site wastewater collection system is a combination of low pressure sewers and gravity sewers. Because of their reliability and relatively low cost, gravity sewers have been selected in areas where they are practical. Low pressure sewers have been selected in areas where widely varying topography makes gravity sewers impractical. In the low pressure sewer areas of the collection network, each served building or house will be equipped with a grinder pump station that will convey wastewater to a low pressure collection trunk. All low pressure sections of the system will ultimately empty into a gravity section or into a pump station. Because of site topography, wastewater from most of the site will be pumped via forcemain to a final length of gravity pipe that will terminate at the WWTP.

Figure 1A and 1B (Wastewater Master Plan) show the layout of the preferred technology alternative for the collection system for the two property development scenarios, including collection pipe layout, pump station locations, and direction of flow. Detailed design of these site features will be submitted for review and approval during the Town's site plan review process. Section 3.2 below contains a description of the practical alternatives that were evaluated to arrive at this preferred alternative.

3.2 Comparison of Practical Alternatives

In order to arrive at the preferred alternative described above, an evaluation of all practical alternatives was performed. A description of each alternative is listed below; including pros and cons relative to this specific project site, and a comparison of alternatives is summarized in Table 3.2-1.

3.2.1 Individual Systems

Rather than a community-wide collection system, this option would involve providing individual treatment systems for each home (usually septic tanks) with subsurface disposal via leach fields. Typically, developments of 50 lots or larger are required by NYSDOH Rules and Regulations (10-NYCRR-Part 74.4) to provide a community sewerage system, although waivers can be obtained where community water is provided.

However, providing Silo Ridge with individual systems is technically impractical, as siting the septic tanks and leach fields would unreasonably drive community layout and design. The total land area for disposal fields capable of accommodating 0.2

MGD is infeasible, and would be unconventionally large for a subsurface system. Individual systems therefore are not considered a practical or feasible alternative for this project.

3.2.2 Standard Gravity Sewers

Modern gravity sewers serving small communities tend to be constructed of 8-inch pipe made of PVC plastic. Each sewer section is a straight pipe with a sufficient downward angle to encourage rapid sewage flow. Changes in direction or slope occur at manholes. Advantages include inexpensive and reliable operation. Disadvantages include difficulties in creating steep enough pipe slopes in areas with flat topography, inability to convey water uphill without frequent pump stations, and the high expense incurred when flat terrain requires deep excavation in order to attain sufficient pipe slope over long distances.

Conventional gravity sewers have been selected as the preferred alternative for some areas at Silo Ridge where practical. However, because of site topography, the use of gravity sewers requires the installation of a community pump station to convey wastewater from the gravity lines to the WWTP in the northeast corner of the site. The practically of gravity sewers is further enhanced by the lack of shallow rock at the site, making deeper excavation more practical.

3.2.3 Small Diameter Gravity Sewers

These systems utilize local solids removal (usually a septic tank) so that only the liquid component of the wastewater is collected and conveyed to a central treatment plant. Septic effluent flows out of the septic tank by gravity into the sewer, which carries it to the WWTP. The absence of solids in the sewer allows it to be less than the standard 8-inch minimum diameter, saving cost on sewer pipe. Periodic solids removal must occur at all of the local septic tanks. This system is most cost effective when retrofitting existing septic/leaching systems to be connected to a central WWTP, with existing septic tanks decreasing overall project cost. However, for projects without previously existing septic tanks, the cost of installing them makes this a less attractive option than conventional gravity sewer pipe, assuming that adequate slope can be achieved.

Because the Silo Ridge project consists of all new construction, building a small diameter gravity system with local septic tanks is less feasible than other options. Another undesirable feature is that all the septic tanks would require periodic solids pump-out; potentially a noisy and odorous process when occurring next to residences.

3.2.4 Low Pressure Sewers

Low pressure sewers are small diameter (<8 inches) systems in which local pumps convey the wastewater through the system under pressure. These systems utilize a buried pump basin located at each building, which accepts that building's wastewater via gravity. A grinder pump then grinds the wastewater solids while it pumps out the basin for easier conveyance of solids and liquid through the common sewer. Flow throughout the length of common pipe is accomplished by the pumping force of these grinder pumps. A disadvantage of low pressure systems is that because they do not drain by gravity, they are full of water during down-time and more prone to freezing. Care must be taken to provide sufficient ground cover to prevent line freezing and bursting in winter. Another disadvantage is that because each building requires a pump, provisions must be made to continue sewer operation during power outage. The primary advantages are that these systems operate independent of pipe slope and topography, and can convey water uphill. Additionally, they are extremely scalable, with a new local pump station being built for each new building, allowing sewer construction to be easily phased with site development.

Low pressure sewers have been selected as the preferred alternative for Silo Ridge wherever gravity sewers are impractical because of site topography. Each pump station will be equipped with a generator receptacle, allowing for the connection of an emergency generator if required.

3.2.5 Vacuum Sewers

Vacuum sewer systems are a relatively new but proven technology that uses centralized vacuum pump stations to pull, rather than push, wastewater through the collection system. Wastewater from each home or building drains by gravity to a small local collection basin. When liquid levels in the basin reach a high point, a float valve opens the vacuum pipe in that basin, pulling the wastewater into the main collection line which is always under vacuum. Vacuum sewers are an excellent alternative in areas of flat topography where gravity sewers are impractical, and where the available head of low pressure pumped sewers is unnecessary. Vacuum systems are less mechanically complex and normally less costly than low pressure sewers because only a few vacuum stations are required, versus a large number of widely distributed pump basins. This has emergency operations benefits as well, since it is technically feasible to provide backup generators to a small number of vacuum pump stations to maintain operation of the entire sewer system during power outages. The primary technical disadvantage of vacuum systems is that they have limited vertical lift (approximately 20 ft), and are therefore of limited practicality in areas with widely varying topography. The primary cost disadvantage is that they are not as readily "scalable" as low pressure systems, since large vacuum stations must be purchased up-front to operate even a small percent of the final planned number of homes in a community. This requires a large initial capital investment.

The use of vacuum sewers is not considered a preferred alternative at Silo Ridge because of widely varying topography, and because the practicality of using gravity sewers at so much of the site. Additionally, because the Silo Ridge property will be built over several years, the large up-front cost makes vacuum sewers a less feasible option than other equally practical alternatives, such as low pressure sewers.

Table 3.2-1: Sewerage Alternatives Matrix

Application	**Standard Gravity Sewers**	**Small Diameter Gravity Sewers**	**Low Pressure Sewers**	**Vacuum Sewers**
Highly variable terrain	2	2	1	3
Rocky soils (able to bury lines shallow)	3	2	2	1
Flat terrain	2	2	1	1
Mechanical complexity	1	1	2	2
Minimize infiltration	2	2	1	2
Minimize exfiltration	2	2	2	1
Dependability	1	2	2	2

Note: "1" ranking indicates above-average applicability for the application, "2" indicates average, and "3" indicates below-average applicability for this project.

4.0 WASTEWATER TREATMENT ALTERNATIVES

4.1 Summary of Preferred Alternative

The preferred alternative to treat wastewater from Silo Ridge is the construction of a new, privately owned and operated WWTP on the property. A wastewater transportation corporation, encompassing the extents of the project, would own and operate both the wastewater collection system and the WWTP. The preferred alternative for treatment technology is a sequencing batch reactor (SBR) with tertiary filtration. This is the preferred alternative discussed in detail in Section 5.0 of this report.

The likely alternate to the preferred SBR option is a membrane bioreactor (MBR). Both technologies use the same biological process to treat wastewater, and differ primarily in their final filtration method. Final selection of the treatment technology will be confirmed in later design phases of the project and subject to DCDOH and NYSDEC approval. There is no substantive difference in site or environmental impact between the SBR and MBR technologies, making the choice between these options outside the scope of SEQRA.

The WWTP is proposed to be located in the northeastern corner of the property, and would consist of advanced biological treatment, gravity settling of solids, advanced filtration to remove residual solids, and disinfection prior to surface water discharge. The proposed WWTP outfall location is an unclassified on-site intermittent stream that drains to on-site Class C irrigation ponds. These ponds then overflow off-site to Amenia Brook, a Class C_t Stream which is ultimately is tributary to Wassaic Creek and the Housatonic River.

The plant will include a comprehensive odor control strategy, including full enclosure in a dedicated building, appropriate ventilation, and aeration of various process tanks to prevent septic conditions.

Figures 1A and 1B (Wastewater Master Plan) show the layout of the preferred wastewater approach for the two property development alternatives (DEIS Proposed Action vs. TNA), including location, major site features, and the route that treated effluent will travel between the WWTP and the receiving streams. Figures 2A and 2B (Wastewater Treatment Plant Site Layout) show a smaller scale site layout of each of the proposed WWTP areas for the two development alternatives. Section 4.2 below contains a description of the feasible alternatives that were evaluated to arrive at the preferred alternative.

4.2 Comparison of Conceptual Alternatives

4.2.1 Onsite vs. Offsite Treatment

The existing sanitary wastewater system consists of an on-site septic system with subsurface disposal via leach field. The system operates under New York State SPDES permit number NY0234966, and is permitted at a flow rate of 0.0126 MGD. The Silo Ridge improvements will increase wastewater flows more than ten-fold, rendering this system inadequate.

The remaining alternatives are to construct an on-site WWTP, or to convey wastewater off-site to an existing WWTP. No nearby or practical existing WWTP exists, leaving on-site treatment as the only practical option. The Town of Amenia is considering construction of a community WWTP along Route 22, just east of the Silo Ridge property. However this concept is not yet fully developed, has not yet received public approval or funding, and may progress on an unpredictable schedule.

An additional disadvantage to off-site treatment and disposal of wastewater is that it would then be unavailable for recovery and reuse to supplement the Silo Ridge irrigation system. Consequently, the preferred conceptual alternative is to treat wastewater at an on-site WWTP built and owned by the project sponsor.

4.2.2 Subsurface vs. Surface Water Disposal

After the wastewater has been treated to appropriate standards, the WWTP effluent will be discharged to the environment. Surface water discharge is the only practical disposal alternative. Subsurface disposal is impractical, given the land area required for a disposal field capable of passing 200,000 gallons per day (+/- 10%), which would be an unconventionally and excessively large subsurface system. The surface water disposal strategy involves conveying treated effluent to on-site irrigation ponds to supplement the irrigation system. This beneficial reuse will reduce irrigation demand on groundwater supplies, and will further the project sponsor's goal of responsible environmental development. This is considered an environmentally superior alternative to directly discharging to nearby Amenia Brook. Excess volume in the irrigation ponds will overflow to Amenia Brook, contributing to stream flow during periods of low irrigation demand.

4.2.3 General Types of Treatment Evaluated

The most efficient and common method of treating sanitary domestic wastewater in the United States is biological treatment. Individual home systems (septic tanks) are anaerobic process, creating an environment in which wastewater is biologically degraded without oxygen (anaerobic). Septic tanks are then followed by leach fields; an oxygen-using (aerobic) process where the septage flows through a shallow sand filter for additional treatment. This is an inefficient process for larger community plants, which overwhelmingly utilize faster aerobic (oxygen-using) biological processes. All of the technology alternatives evaluated for this project involve the use of various aerobic biological technologies to treat wastewater. A general description of biological treatment theory, and how these systems accomplish their treatment goals, is described below.

Untreated wastewater contains compounds that are degraded by bacteria in the water. These bacteria consume oxygen when degrading these compounds, creating a biochemical oxygen demand (BOD). High BOD in surface water depletes dissolved oxygen and destroys aquatic life. All of the treatment options below utilize aerobic biological processes to treat the wastewater by reducing its BOD before discharging to surface water. If the receiving stream has special dissolved oxygen (DO) concerns, the treated water may be subjected to a "post-aeration" step prior to discharge, in which air is injected to boost DO and eliminate a potential "DO sag" that can occur after biological treatment.

An added benefit to aerobic biological processes is the oxidation of ammonia (found in all domestic wastewater) to nitrate in a process called nitrification. Ammonia is a source of BOD and is toxic to aquatic life at elevated concentrations. Aerobic biological treatment oxidizes ammonia to nitrate; a less toxic compound that exerts no BOD.

Another advantage to biological treatment is the degradation of phosphorous, a nutrient that encourages undesirable plant and algae growth in water bodies. Although nitrate is also a plant nutrient, phosphorous tends to be the limiting nutrient in most water bodies, and controlling it is often the key to controlling water body eutrophication. Although some phosphorous is removed by standard biological treatment, strict effluent limits require chemical addition to precipitate dissolved phosphorous as a solid that can be removed by filtration.

The final process in many treatment systems is disinfection by either chlorination/dechlorination or by ultraviolet radiation prior to discharge. Requirements for disinfection are driven by the intended use of the receiving stream. Class A water bodies (drinking water supply) require year-round disinfection, whereas Class B water bodies (seasonal contact recreation) require warm month disinfection.

4.3 Comparison of Technology Alternatives

Once it was determined that on-site biological wastewater treatment was the preferred option, an evaluation was performed of all practical treatment technologies that could be utilized in an on-site WWTP. A description of each alternative is listed below; including pros and cons relative to this specific project site, and a comparison of alternatives is summarized in Table 4.3-1. These alternatives describe only the core biological aspect of each treatment technology, and not ancillary portions of the treatment process such as primary screening and disinfection.

4.3.1 Continuous-Flow Suspended-Growth Aerobic Systems

Continuous-flow suspended-growth aerobic systems (CFSGAS) are the most common form of *suspended growth* technology. This technology fosters the growth of bacteria that are suspended in and mixed with the wastewater. Bacteria and other solids are removed from the treated wastewater as sludge, and the clarified effluent is discharged from the WWTP. Sometimes this sludge is recycled back to the treatment process in order to maintain a high bacteria concentration. Because the sludge is biologically active, suspended technologies are also referred to as *activated sludge* systems. Variations of the CFSGAS technology include conventional plug flow, contact stabilization, extended aeration, and oxidation ditch.

These systems are referred to as *continuous flow* because they continuously receive wastewater into an aeration tank, where the mixing, aeration, and biological activity occur. Wastewater flows into the top of this tank at one end and overflow the top of the tank at the other end. As a result, the retention time of wastewater in the tank is determined by the influent flow rate. High flow rates result in less treatment time, and low flow rates can lead to excessive aeration and mixing times until new influent water displaces the old water from the tank.

In addition to an aeration tank, each CFSGAS system requires a flow equalization tank and a clarifier tank. The equalization tank receives short-lived influent flow surges so that wastewater can be pumped to the aeration tank at a constant flow to increase treatment efficiency. The clarifier tank receives treated water from the aeration tank so that solids (activated sludge) can settle out via gravity and clarified water can be discharged.

Because treatment time in a CFSGAS (in both aeration tank and clarifier) is determined by influent flow rates, not by operator preference, these systems are inappropriate for applications subject to large daily or seasonal variations in flow rate. This technology therefore was not selected as the preferred alternative for the Silo Ridge project.

4.3.2 Sequencing Batch Reactor

The Sequencing Batch Reactor (SBR) is a suspended growth technology that combines all steps of the activated sludge process into a single tank that treats wastewater in discrete batches. Screened wastewater flows into the SBR tank, where it is equalized for flow, treated, clarified, and discharged. A typical SBR system consists of two alternating reactor tanks, so that while one is engaged in the treatment process (and is shut off to incoming wastewater) the second is receiving wastewater from the sewer system.

Because SBR is a batch process with adjustable treatment duration, this technology is ideal for situations with variable wastewater loadings and flows, such as a seasonal golf resort community. An SBR plant is designed so that high flows can be treated by shorter cycle times, and low flows can be treated with longer cycle times. Although an SBR system contains two treatment tanks (as opposed to a single aeration tank), the system can be built with a very compact footprint due to the elimination of a separate equalization tank and clarifier tank.

One perceived disadvantage of an SBR system is the mechanical and controls complexity needed to adjust treatment cycle times in response to influent flow rate. However, advances in the simplicity and reliability of programmable controls and instrumentation essentially nullify this argument. An SBR system is a reliable technology which is extremely flexible and adaptable to changing flow conditions. This is particularly valuable for a project where large flow fluctuations are anticipated with daily and seasonal variations in occupancy. As a result, this technology is considered the optimal choice for the Silo Ridge project.

4.3.3 Membrane Bio-Reactor

A membrane bioreactor (MBR) is a suspended growth, activated sludge technology that is able to eliminate the gravity clarifier by using submerged filtration membranes to extract clarified effluent from the mixed wastewater. The membranes have pore sizes in the nano- to micro- filtration range (approximately 1 nanometer), and are capable of leaving nearly all suspended solids and bacteria behind in the aeration tank, yielding a very high quality effluent.

In addition to better clarification and high effluent quality, advantages of MBR systems include a high mixed liquor suspended solids (MLSS) content in the aeration tank. Conventional activated sludge plants operate at a low MLSS (approximately 3,000 mg/l) because to operate higher would send more solids to the clarifier, compromising effluent quality. Because the MBR membranes can easily remove solids better than a gravity clarifier, MBR systems can operate at a much higher MLSS (>10,000 mg/l), allowing the same level of treatment to be attained in a smaller tank volume. Also contributing to a small MBR plant footprint is the elimination of a clarifier.

MBR systems have significant advantages in situations where the required effluent quality justifies using a membrane filter. However, in situations where membrane filtration is not required, the capital and operating cost associated with membranes can cause a MBR to be less cost competitive. Because membrane filtration is not anticipated to be required for the Silo Ridge project, MBR technology is not considered the most appropriate technology. It is, however, considered a reasonable alternative in the event that the SBR option becomes less desirable for technical or financial reasons later in the design process.

4.3.4 Rotating Biological Contactor

A rotating biological contactor (RBC) is one type of a group of technologies called *fixed film,* which is separate and distinct from the *suspended growth* alternatives discussed above. Fixed film technologies foster the growth of bacteria that are attached as a fixed film to a solid surface (or media) instead of suspended in the wastewater. Because the bacteria are not mixed into the wastewater, the wastewater must be exposed to the media surface (and hence to the fixed film) for treatment to occur. As the fixed film grows too thick to remain attached to the media, it sloughs off into the wastewater and must be removed as sludge. This sludge is disposed of and is not recycled back to the process. It is good practice for fixed film systems to be preceded by flow equalization and some form of primary treatment such as a primary settling tank or influent screen.

In an RBC system, the media is a large cylindrical wheel several feet in diameter that rotates slowly. The RBC is positioned above the wastewater tank, so that the bottom portion is submerged in wastewater. As the RBC rotates, the portion of the fixed film that is submerged treats the wastewater, and then is rotated out of the water for the fixed film bacteria to receive oxygen from the air.

RBCs have the advantages of being easy to operate, and being less sensitive to shock loading and influent strength variability. However, they can require expensive periodic maintenance of the media and rotating mechanisms. They also are very susceptible to cold because of the air exposure required of the media and its fixed film. Susceptibility to cold, however, would not apply to the Silo Ridge project since the WWTP is anticipated to be enclosed in a building.

Additional disadvantages are specific to seasonal communities. An RBC cannot be restarted quickly after a low-flow period during which the fixed film is depleted. Because the fixed film bacteria must grow on the media surface, the system can't be easily seeded from an existing source, as can a suspended biological system. This initial and restart growth period may require several weeks. An additional disadvantage of fixed film systems is that they often require larger secondary settling tanks than activated sludge systems. This combination of disadvantages makes RBC an inappropriate technology for the Silo Ridge project.

4.3.5 Trickling Filter

A trickling filter is *fixed film* technology in which a tower or tank is packed with a media, which historically has been rock but is now more commonly plastic. Wastewater from primary treatment (equalization and clarification) is applied to the top of the packing media, where it flows down through the media by gravity to an underdrain below. The organic content of the wastewater stimulates the growth of a microbial film on the media surface, which then consumes that organic content, reducing its concentration and reducing the wastewater BOD. Oxygen is supplied to the microbial film via direct contact of the media with air as the wastewater intermittently trickles past.

Trickling filters are designed in two configurations; low-rate and high-rate. Low-rate trickling filters receive wastewater at either a lower flow rate or lower organic loading per square foot than do high-rate filters. This difference in loading creates advantages and disadvantages in each. A disadvantage common to both low and high rate trickling filters is that they often require larger secondary settling tanks than activated sludge systems.

Low rate systems have the following advantages. They are able to degrade most of the influent BOD as it trickles down through the top 1-3 feet media. The resulting low organic content of the water in the lower media encourages nitrogenous bacteria to degrade any ammonia and create a highly nitrified effluent. This is advantageous when discharge permitting requires low ammonia limits. Disadvantages of low rate systems include thick slime layers on the media that occasionally slough off and require additional clarification, and the aesthetic nuisance of filter flies that thrive on the media surface. The low flow rate creates areas of media that are infrequently flushed with water, allowing larvae and flies to thrive.

High rate systems have the advantage of creating a thinner bio-film, which leads to less-pronounced sloughing events in the filter effluent. Additionally, they have fewer filter flies because the higher flow rate keeps the media flushed with water, preventing flies and larvae from thriving. Disadvantages include poor nitrification of wastewater, leading to higher levels of ammonia in the effluent.

All trickling filters are very susceptible to cold because of the air exposure required of the media and its fixed film. Addition disadvantages are specific to seasonal communities. A trickling filter cannot be restarted quickly after a long low-flow period during which the fixed film is depleted. Because the fixed film bacteria must grow on the media surface, the system can’t be easily seeded from an existing source, as can a suspended biological system. This initial and restart growth period may require several weeks. This combination of disadvantages makes trickling filters an inappropriate technology for the Silo Ridge project.

4.3.6 Constructed Wetlands

Constructed wetlands use aquatic plants in shallow ponds or channels to treat wastewater by natural microbial, biological, physical, and chemical processes. Although they can be a cost-saving alterative in some applications, the US EPA cautions that the small number of existing constructed wetlands results in limited data availability regarding the design, costs, and operations of wetland treatment systems. In general, the EPA considers regions with inexpensive land available and low availability of experienced WWTP operators as the regions for which a constructed wetland treatment system would be most suitable. Both of these conditions are negated by the rising cost of land in Dutchess County, the limited land at the Silo Ridge property, and the availability of skilled, licensed wastewater operators in the New York / Connecticut area.

Average design parameters published by the EPA indicate that approximately one (1) square foot of wetland area is required for treatment of one (1) gallon of low to medium strength wastewater per day. This parameter is based on empirical data primarily obtained from existing wetland treatment systems located in Louisiana, Mississippi, and other southern states. Additionally, in cold weather climates, a greater wetland treatment area would be required, due to reduced wetland performance during colder periods. A “rule-of-thumb” for constructed wetlands in cold climates is to increase the wetland treatment area by 25%. Additionally, the total area required, including berms, diversion areas, channels, equipment access, etc. would be 1 ½ times the treatment area.

Engineered Wetlands are not considered a preferred alternative for the Silo Ridge project for the following reasons:

- *Approval Process*: The duration of the approval process may be extended by the unique nature of the process. As of 2005, there are no approved constructed wetlands operating in Dutchess County. In the mid-Hudson region, there is currently one operating constructed wetland located in the Town of Lloyd, Ulster County serving a single manufacturing facility. The wetland receives and treats a volume of wastewater less than 1/3 of its design capacity on weekdays, and usually receives no flow on weekends or holidays. Its performance therefore cannot be accurately gauged against its design.

- *Extended Startup Period*: Establishing a constructed wetland may require more than one growing season, and is affected by the season in which planting occurs, the density of the plantings, the type of plants, the type of wetland, and weather conditions. During early phases of plant growth, exposure to wastewater is not recommended. It may take several growing seasons for the wetland to reach an optimal vegetative density.

- *Land Use Requirements*: Using the EPA methodology described above, the minimum land required for constructed wetlands at Silo Ridge (excluding emergency reconstruction area to address bed failure) is:

  (219,000 gpd) x (1 ft^2 area / gpd) x 1.25 x 1.5 = 410,625 ft^2

  This translates to approximately 8 acres of land for a constructed wetland to serve the entire Silo Ridge project. If the wetland were to serve only a portion of the project, its size would decrease proportional to flow. This amount of land is unavailable on the Silo Ridge property for wastewater treatment purposes. Additional land area complications arise because the varying site topography would require extensive grading, terracing, or retaining walls. Attempting to distribute the wetlands across the site in multiple smaller footprints would somewhat diminish this impact. However, the fencing likely required to limit access to untreated wastewater could create a significant visual impact across the property.

- *Technically Impractical*: Effluent quality requirements for the Silo Ridge project are likely higher than a wetland can produce without additional treatment. This is driven by the project sponsor's desire to reuse effluent for irrigation, and the stringent Intermittent Stream Standards that the project may require. At a minimum, constructed wetlands would have to be followed by post-aeration to increase dissolved oxygen level, and by disinfection. Depending on the quality of wetland effluent, addition filtration and ammonia removal may also be required. Adding these engineered processes reduces the appeal of wetlands, and makes a conventional WWTP a more practical choice. Additional mechanical complexity is introduced if the wetlands are distributed across the site, thereby requiring a large piping network and additional pump stations.

4.3.7 Tank-Based Plant Systems

Like constructed wetlands, tank-based plant systems use plant root zones and their bacteria to remove wastewater BOD and nutrients. However, tank-based systems implement mechanical processes such as aeration and mixing to drastically reduce the footprint of the process. In these systems, the plants typically are grown in steel or concrete tanks inside a greenhouse. Tank-based plant systems still require the same equalization and primary settling/screening steps as all of the treatment options described above. These systems have a very limited approval history in New York State, and the systems that have been approved discharge to subsurface or surface locations that require far less stringent effluent quality than what is expected at Silo Ridge. Because these systems offer no significant treatment quality advantage or impact advantage over a conventional treatment system, they are not a preferred alternative for this project.

Table 4.3-1: Wastewater Treatment Alternatives Matrix

	BOD/TSS Removal	Nutrient Removal	Resistant to Off-Season Low Flows	Resistance to Organic Fluctuations	Ease of Operation	Small Footprint
Conventional Continuous-Flow Suspended- Growth	2	2	2	2	2	2
Sequencing Batch Reactor	2	1	1	2	3	1
Membrane Bio-Reactor	1	1	1	2	3	1
Rotating Biological Contactors	2	3	3	1	2	2
Trickling Filter	2	3	3	1	2	2
Constructed Wetlands	3	2	3	3	2	3
Tank-Based Plant Systems	2	2	3	3	3	2

Notes:
“1” relative ranking is very favorable, “2” is average, and “3” is less than average.

5.0 DETAILED DESCRIPTION OF PREFERRED ALTERNATIVE

5.1 Wastewater Collection System

The collection system will conform to appropriate sections of local, state, and federal standards for construction. Design of the collection system will conform to NYSDEC and Ten States Standards. Gravity sewers will be designed at sufficient pitch and diameter to convey solids without accumulation. Manholes will be placed at appropriate intervals in the gravity sewer system, and wherever significant changes in pitch or direction occur. Community pump stations will be equipped with appropriate volume, redundant pumps, run-fail alarms, and emergency power.

Low pressure pumped portions of the collection system will contain at least one small pump station at each residential building. Each single family house will be equipped with one outdoor below-grade pump station, and each multi-family building will be equipped with multiple pump stations; one per residence. These residential pump stations will convey wastewater through the low pressure sewer lines. Each low pressure sewer line empties into a manhole where it then enters the gravity sewer system. Portions of the gravity sewer in lower lying areas will empty into community pump stations, which will convey the wastewater via forcemain to a higher elevation, from where a gravity sewer will carry it to the WWTP. All wastewater entering the WWTP will do so in a single trunk sewer.

DEIS Proposed Action: The sanitary wastewater collection system will contain 26,500 +/- total feet of sewer lines, consisting of 16,000 +/- feet of gravity sewer, 6,000 +/- feet of low pressure sewer, and 4,500 +/- feet of raw sewage forcemains. In addition, there will be a 4,000 +/- foot forcemain conveying treated effluent from the WWTP and its discharge outfall. A site-wide layout of the recommended collection system is shown on Figure 1A – Wastewater Master Plan (Proposed Action).

Traditional Neighborhood Alternative (TNA): The sanitary wastewater collection system will consist of 24,300 +/- total feet of sewer lines, with 18,000 +/- feet of gravity sewer, and 6,300 +/- feet of raw sewage forcemains. There also will be a 4,600 +/- foot forcemain conveying treated effluent from the WWTP and its discharge outfall. A site-wide layout of the recommended collection system is shown on Figure 1B – Wastewater Master Plan (TNA).

5.2 Wastewater Treatment Plant

A sequencing batch reactor (SBR) was selected over other practical alternatives because of its technical feasibility, its ability to meet anticipated effluent quality requirements, and its ability to treat a wide range of wastewater flow rates that will occur due to weekly and seasonal occupancy. This includes its ability to withstand months of low-flow operation, and then ramp up at the start of peak season with minimal acclimation time. A conceptual SBR design has been used to develop the WWTP building size and site layout shown in Figures 2A and 2B – Wastewater Treatment Plant Site Layout. However, a membrane bioreactor (MBR) is considered a reasonable backup alternative in the event that the SBR option becomes less desirable for technical or financial reasons later in the design process. Preliminary evaluations have shown that switching to an MBR as the preferred alternative could be done within the proposed building footprint, and would not change the WWTP site layout or impacts in any substantial way that would affect the DEIS or SEQRA process.

5.2.1 Treatment Process Description

The SBR will be the core treatment process of the WWTP. However, to enhance SBR operation and to meet all anticipated effluent standards listed in Table 2.2-1, numerous other treatment processes will be contained in the WWTP. All wastewater treatment processes anticipated for the plant are listed below in order of flow direction.

- *Primary Treatment*: Primary treatment will consist of grinding, screening, or settling large solids before they reach downstream treatment processes. Because this will occur upstream from any flow equalization, the equipment will be sized for peak hourly flows.

- *Flow Equalization*: Flow equalization will be integral to the SBR tanks themselves, and will not require any additional tanks or pumps.

- *Secondary Treatment*: Aeration and mixing in the SBR tanks will remove biochemical oxygen demand, ammonia, and phosphorous from the wastewater. The two SBR tanks will alternate receiving wastewater. Once an SBR tank is full, the wastewater is treated by aerating and mixing. Each aeration and mix cycle is followed by a "quiet" phase in which solids are allowed to settle to the bottom of the tank and clear water is decanted from the top by a floating decant pipe. The SBR tank is then ready to receive the next batch of wastewater for treatment. While this treatment cycle occurs, the second SBR tank is receiving wastewater. When solids begin to accumulate in the tank after several treatment cycles, a sludge pump conveys them to a dedicated *Sludge Tank*, which is aerated for additional solids treatment and stabilization.

- *Post Equalization*: The clear decant water from each of the two alternating SBR tanks drains to a Post Equalization tank. This tank receives the short-duration high-flow decants, and then pumps them at a lower steady rate to a downstream filter for additional solids removal.

- *Chemical Dosing*: Before clear water reaches the filters, it enters a dedicated mixing chamber where an aluminum-based salt is added that will react with remaining dissolved phosphorous and create an aluminum-phosphorous solid.

- *Filtration*: Tertiary filtration will be performed by a cloth media filter to remove the aluminum-phosphorous salt from the chemical dosing process, as well as residual total suspended solids (TSS) that were inadvertently decanted with the clear water from the SBR tanks. Generally, a cloth filter will effectively remove particle sizes between 1-10 microns (μm) and larger. This effectively removes most fine solids, and will remove a portion of microorganisms in this size range, including Cryptosporidium and Giardia. However, it is not a small enough filter size to assume effective removal of these organisms. This cloth filter has a smaller effective pore space than most rapid sand filters, and therefore produces high quality effluent. Its ability to continue filtration even during a backwash, and its short backwash duration (approximately 3 minutes), make it very resistant to solids fouling and plugging.

  More advanced membrane filtration (0.1 to 1 micron pore size) is not required by this project. However, the WWTP has been designed to accommodate addition of microfiltration at a later time if an increase in effluent quality is required.

- *Disinfection*: Disinfection will be required to inactivate (kill) remaining microorganisms, including viruses that are too small to be substantially removed by tertiary filtration. The effluent will be disinfected either by ultraviolet light (UV) or by a chemical metering system that adds chlorine to kill the organisms and then removes the chlorine for safe environmental discharge of effluent. Any chlorine addition would be done with liquid sodium hypochlorite (similar to household bleach), and not with hazardous chlorine gas.

- *Post-Aeration*: The final processes in the WWTP will be post-aeration to raise the water's dissolved oxygen (DO) before discharge. This is done to help ensure a healthy elevated dissolved oxygen level in the receiving stream. Even if there is no DO requirement in the SPDES permit, discharging effluent with high DO will help maintain the quality of the irrigation ponds.

5.2.2 Physical Plant Description – DEIS Proposed Action

If developing the property under the DEIS Proposed Action, the WWTP will be located in the northeast corner of the project site near Amenia Brook, with its entrance off of West Lake Amenia Road between NYS Route 44 and NYS Route 22. The location of the WWTP relative to the rest of Silo Ridge is shown in Figure 1A –

Wastewater Master Plan (Proposed Action). All treatment processes and features of the plant will be located inside a building with a footprint of approximately 9,000 square feet, preliminarily sized as a rectangle 60ft wide by 150ft long. The proposed layout of the WWTP site is shown in Figure 2A – Wastewater Treatment Plant Site Layout (Proposed Action). The WWTP will share driveway, parking, loading dock, and emergency generator resources with the proposed Silo Ridge water treatment plant. The WWTP is anticipated to be steel-frame, with roof and siding materials selected by the project architect to blend with the surrounding buildings and landscape. Building elevations in Figure 2A show how the building's roof will be eccentrically sloped to follow the hillside, reduce building height, and minimize visual impact. This is only a conceptual building elevation, but the WWTP footprint, height, and access door layout sizing and dimensions are based on actual treatment equipment and tank requirements. The project architect will ultimately select the buildings architecture based on these dimensions.

Enclosing the entire plant inside a building, rather than locating process tanks outside as common practice allows, has been proposed to minimize visual, sound, and odor impacts that might otherwise be significant from a WWTP. Particular processes, such as influent screen or grinders, and the solids holding area, will have a separate enclosure within the building, as well as a dedicated ventilation system to isolate the system. All ventilation systems in the building will be designed to accommodate future addition of off-gas treatment (such as activated carbon or scrubbers) if additional odor control is warranted.

The access drive off of West Lake Amenia Road will be used daily by a small number of water and wastewater treatment operators. Additional traffic will include visits by trucks to remove waste solids from the WWTP. Other than daily operations, additional visitation frequency is anticipated at no more than one day per week. Periodic truck visits may also occur due to deliveries of water and wastewater equipment and supplies.

5.2.3 Physical Plant Description – TNA

For the Traditional Neighborhood Alternative, the WWTP will be located north of NYS Route 44, across the road from the major portion of the development. The driveway to the plant will be directly off of Route 44, near the intersection of Route 44 and West Lake Amenia Road. The location of the WWTP relative to the rest of Silo Ridge is shown in Figure 1B – Wastewater Master Plan (TNA). Locating the plant here raises its elevation respective to Route 44 and surrounding residences. Consequently, enclosing the tanks in a building would no longer be required for aesthetic reasons. Instead, the tanks would be outdoors, with low-profile engineered covers for odor control. A building next to the tanks would contain the tertiary treatment processes (filtration and UV disinfection) and support facilities (office, chemical room, blower room, solids dewatering room, storage, etc.). The overall combined footprint of the building and tanks would still be approximately 9,000 square feet, as with the DEIS Proposed Action. The proposed layout of the WWTP site is shown in Figure 2A – Wastewater Treatment Plant Site Layout (Traditional Neighborhood Alternative). The WWTP is anticipated to be steel-frame, with roof and siding materials selected by the project architect to blend with the surrounding buildings and landscape. The project architect will ultimately select the buildings architecture based on these dimensions.

Enclosing the entire plant inside a building and under tank covers has been proposed to minimize visual, sound, and odor impacts that might otherwise be significant from a WWTP. All ventilation systems in the building will be designed to accommodate future addition of off-gas treatment (such as activated carbon or scrubbers) if additional odor control is warranted.

The access drive off of Route 44 will be used daily by a small number of water and wastewater treatment operators. Additional traffic will include visits by trucks to remove waste solids from the WWTP. Other than daily operations, additional visitation frequency is anticipated at no more than one day per week. Periodic truck visits may also occur due to deliveries of water and wastewater equipment and supplies. The WWTP facility will be required to have sufficient vehicle turn-around space so that exiting vehicles always enter Route 44 in the forward-facing direction.

5.2.4 Effluent Outfall and Irrigation Reuse

Treated effluent from the WWTP will be pumped via an effluent forcemain to the western portion of the Silo Ridge property, where it will exit an outfall into the intermittent stream beneath Bridge #1. From there it will flow downstream through two small ponds, through a larger pond (Island Green Pond), and into the main Irrigation Pond. All of these ponds are Class C water bodies.

Flow in the intermittent stream may be increased by recirculating water from the stream's discharge pond back up to Bridge #1. This would improve the aesthetics of the stream, and will improve mixing and attenuation of treated effluent before it enters the downstream irrigation storage ponds. Additionally, aerators in the receiving ponds will help maintain their quality. The main Irrigation Pond is a spring-fed pond with an approximate depth of 100-ft. Therefore the irrigation system will be fed by spring water, storm water, and treated wastewater effluent.

The Irrigation Pond overflows to DEC Wetlands AM15/AM16, and crosses under NYS Route 22 off-site to Amenia Brook, a Class C_t Stream. Amenia Brook ultimately is tributary to Wassaic Creek and the Housatonic River. The entire effluent discharge routing concept described above is depicted in attached Figures 1A and 1B – Wastewater Master Plan. The effluent outfall location is the same for both the DEIS Proposed Action scenario and the Traditional Neighborhood Alternative scenario.

The WWTP is expected to contribute approximately 219,000 gpd of treated effluent (under Proposed Action scenario) to the irrigation storage ponds. This will off-set 219,000 gpd that would otherwise be required from the groundwater spring or from storm water runoff. This will allow the irrigation system to operate with no additional makeup sources. A detailed description of the irrigation storage and supply system can be found in other sections of the DEIS.

5.3 Construction Schedule

5.3.1 Property Occupancy

The property will be developed in three major phases both under the Proposed Action scenario and the TNA scenario. For the Proposed Action, Phases I and II comprise approximately 50% of the final design flow, with Phase III comprising the remaining 50%. The TNA scenario is more front-loaded, with Phase I comprising approximately 50% of the final design flow, with Phases II and III comprising the remaining 50%. In either case, it may be most economical to construct the main structure of the WWTP (building and tanks) in a single up-front stage, with treatment equipment added in two district stages (initial installation, followed by an expansion of equipment around Phase II of property development). This is the proposed path for WWTP construction. Constructing the WWTP structure up-front will result in higher up-front, but lower overall cost for the owner, and will create far less site disturbance than several major construction phases of the WWTP. This approach translates to the WWTP having an approximate treatment capacity of 100,000 gpd initially, to be expanded to a total of 200,000 gpd (+/- 10%) with the installation of additional equipment.

5.3.2 Collection System

The main trunk portion of the sewer system will be built early in the property development, in conjunction with the roadways under which it will be located. The individual pump station basins and service connections will be built incrementally, when the buildings they serve are constructed.

5.3.3 Wastewater Treatment Plant

For construction and design efficiency, the WWTP will be constructed during Phases I of property development, so it is ready to receive wastewater when the first residences and public use facilities begin their occupation. The sequencing batch reactors will be designed to effectively operate at flow rates as low as 15% of the full design flow. The following design measures will be taken to ensure proper WWTP operation over the course of all property development phases.

- *Flows below 5% of Design Rate*: Because wastewater flows from just the existing sources approximate 6% of the design flow, this condition may never occur. But in the event that it does, a single SBR tank will receive the wastewater and act as an extended aeration system. Wastewater will be aerated and mixed for extended periods. Sludge and some wastewater will be periodically removed from the tank and trucked off-site for disposal at a receptive wastewater facility. During this phase, it is necessary that the process tank structure and associated blowers and pumps be installed. The rest of the WWTP structure and mechanical components can be installed while this temporary system is operating. Effluent discharged to the environment during this phase will meet all quality requirements of the SPDES permit. This reduced flow operation will incorporate appropriate odor control measures such as aeration, ventilation, and enclosure.

- *Flows from 5-15% of Design Rate*: It is expected that the WWTP will begin operation in this mode in the early stages of property development. At this point, the plant will begin operating as an SBR process. One of the SBR tanks will operate as an equalization tank, with the second SBR tank providing aeration and treatment as an SBR. This low level of flow should be fairly short-lived, and will give way to higher flows as the property is developed.

- *Flows above 15% of Design Rate*: The plant will then operate as it would under full flow conditions, with at least two full-size SBR tanks alternating receiving and treating wastewater. This is the expected operating configuration for the rest of the plant's life. It is expected that once the Silo Ridge property is fully developed, that wastewater generation rates will seldom fall below 15% of the design rate for the WWTP.

The WWTP will be designed to accommodate future addition of membrane microfiltration. Although it is unlikely that membrane microfiltration is required at this time, its future addition would treat effluent to extremely high standards, and thus would satisfy virtually any foreseeable increases in effluent standards required by the DEC for surface discharge or for irrigation reuse. This upgrade capacity will be accomplished by providing sufficient open floor space for the microfilter, near the proposed cloth media filter and disinfection equipment. Providing this relatively small amount of upgrade space will have a negligible impact on building size, site impacts, and system cost, and would allow this upgrade to occur quickly with no increase in plant size and no site impacts.

5.4 Impact Mitigation

5.4.1 Surface Water Quality

The wastewater treatment technology for this project will be selected to meet all effluent quality requirements as required by NYSDEC. The anticipated effluent quality values listed in Table 2.2-1 can be readily achieved by the preferred alternative. When met, these stringent standards will help preserve the water quality of the intermittent stream where the outfall is proposed, the downstream Class C irrigation ponds, Amenia Brook (Class Ct), and downstream water bodies. On-site public health will be protected by disinfection of the effluent, and by the fact that the effluent will be diluted in the Irrigation Pond before reuse. The collection system will not have a significant adverse impact on surface water quality.

5.4.2 Groundwater Quality

There is no direct discharge of treated wastewater effluent to groundwater, and it is anticipated that the wastewater system for the project will not have a significant adverse impact on groundwater. In fact, removing the existing leach field from service may produce a marginal improvement in local groundwater quality. The reuse of treated WWTP effluent for golf course irrigation, combined with captured storm water, will eliminate the need to use potable water for irrigation. Since the Silo Ridge project will utilize on-site wells for potable water, this will further reduce impact on the underlying aquifer. It should be noted that the Irrigation Pond is already a spring-fed water body, and some groundwater is therefore used for irrigation in that manner. This usage has a negligible impact on groundwater, however, since unused spring water would continue to flow into the pond and overflow off-site to Amenia Brook in the absence of irrigation demand. The sanitary sewer collection system will be leak-tight, and will not have a significant adverse impact on groundwater quality.

5.4.3 Air Quality

Implementation of this wastewater strategy will not entail discharging any priority air pollutants, and will have no significant negative impact on air quality. The only potential source of air pollutants will be the WWTP emergency backup generator. However, this generator will operate infrequently and will not have a significant adverse impact on air quality. Odors from the wastewater treatment process are discussed below.

5.4.4 Visual Aesthetics

The preferred WWTP alternative will be contained entirely within a building that has been designed to be of similar scale and dimensions as the multi-family condominium buildings proposed for the project. The WWTP will be located uphill from Amenia Brook, with a layout that follows the hillside to minimize building height and visibility. This will allow the project architect to blend the WWTP building into the surrounding area, minimizing its visual impact. The low pressure sewer pump stations will be entirely subsurface, with only an at-grade access hatch for each. The community pump stations will be either entirely below-grade with an access hatch, or will consist of a small above-grade structure containing pumps and controls. Each of the community pump stations also will be equipped with an enclosed emergency generator with appropriate muffling, and will have sufficient landscaping, fencing, or architectural features to allow them to have no significant negative visual impact.

5.4.5 Land Use

As shown by Figure 2 (Wastewater Treatment Plant Site Layout), the proposed WWTP option has been designed to occupy a minimal amount of land area, with the building in which all processes reside occupying approximately 9,000 feet. Furthermore, enclosing it in a building with appropriate ventilation and odor control eases the need for a nuisance buffer around the plant, allowing greater land use flexibility in the surrounding area. Pavement has been kept to a minimum, with enough paved area only to provide truck access and maneuvering for deliveries and solids hauling, and a small number of parking spaces for WWTP operators.

5.4.6 Odor

Odor issues will be mitigated by proper operation of aerated processes and by enclosing the entire treatment process inside a building. The main treatment process tanks will be aerated and mixed to maintain oxygen levels and prevent septic conditions that lead to the generation of most offensive odors. The enclosure of the tanks within the building also will allow additional odor control and ventilation options in the future if the need arises. Within the building, the influent channel and the head works will be located in a dedicated room to allow for special ventilation and odor control as needed. Initially, odor control measures for the headworks room will consist of properly enclosing all processes. The ventilation system of the headworks room will be sufficiently segregated so that a dedicated odor control system could potentially be added at a future time if necessary. Odor control technology options include activated carbon or a scrubber. All other portions of the WWTP process are expected to yield negligible odors and will be subjected simply to standard ventilation and climate control in the building.

Any future equipment used for odor control would be located within the building. All ventilation will conform to Ten States, NFPA, and any other applicable standards. This includes the enclosed room containing the primary screen, which triggers specific ventilation, access, and gas monitoring requirements per Ten States Standards section 61.13.

All pump stations within the site-wide collection system will utilize standard odor control measures, including proper ventilation, and timed pump-down of large pump stations so their contents do not reside in them for extended periods during times of low sewer flow and turn septic. During detailed sewer design, the option of odor control chemicals will be evaluated in addition to the above measures.

5.4.7 Noise

All excessively noisy equipment such as large pumps, blowers, compressors, and generators, will be housed inside buildings, vaults, or noise-reducing enclosures to mitigate the noise effects at neighboring residences and properties. The aeration blowers for the treatment tanks will be the loudest equipment, and will be located either in a dedicated sound-proofed room within the WWTP building, or within individual noise enclosures within the building. All pumps associated with the treatment process will be submersible pumps, and therefore will be submerged in water and relatively quiet when operating. Piping will be designed to minimize noise associated with high velocity pipe flow in the building. The emergency generator for the WWTP will operate only sporadically and will not constitute a significant noise impact. The collection system pump stations will be subsurface and produce no discernible noise.

Current Town of Amenia Code §121-20G(2) restricts noise audible beyond property boundaries. Current code is even more strict if the lot lies within 200 feet of a residential district, and provides a list of acceptable thresholds for a variety of noise types. The Proposed (draft) Code would simplify the noise ordinance to limit all noise to 60 decibels at the property line. Exceptions are made for construction activities and for emergency activities, such as the emergency generator. The WWTP will be designed so that when it starts operation, it will meet all governing noise ordinances.

5.4.8 Separation Distances to Nearby Properties

NYSDEC guidelines recommend a 500-ft separation distance between wastewater aeration tanks and public roadways, places of significant public use, or residential structures. This recommended distance is intended primarily to minimize the WWTP impacts of noise and odor on surrounding properties. Both the preferred technology alternative (SBR) and the likely backup technology alternative (MBR) contain aeration tanks that would trigger these separation requirements. However, this minimum 500-ft separation assumes a conventional WWTP with outdoor tanks, and can be substantially reduced by implementing "engineering measures" such as enclosing the process tanks, implementing appropriate ventilation and odor control measures, and housing all loud equipment in soundproofed enclosures. As described above, the Silo Ridge WWTP will incorporate such measures, allowing it to be less than 500 feet from other structures while not having a significant adverse impact.

Figures 3A and 3B (Parcel Data within 500-ft of WWTP) show the proposed WWTP location for both the DEIS Proposed Action and the TNA alternative. Around the WWTP, a circle shows adjacent properties that lie within 500-ft, triggering the need for special engineering measures for impact mitigation (odor and noise control, etc.).

5.5 Daily Operations

5.5.1 Automated Operations and Controls

Operation of the system will require daily, but not continuous, attendance by a licensed wastewater operator. Most of the processes will be automatic and controlled by an industrial-grade computer called a programmable logic controller (“PLC”). The function of the operator will be to verify proper operation of the control system, to modify the controls as needed, to sample the wastewater to ensure that adequate treatment is being supplied, and to perform routine and preventive maintenance on equipment.

The WWTP will operate in automatic fashion as follows. For a more detailed description of the unit processes, refer to section 5.2.1 Treatment Process Description:

- Raw wastewater will be pumped by the sewer system pump stations to the WWTP. The pumps in these pump stations will be turned on/off by water levels in each station. The control panels for these stations will be equipped with run-fail and high level alarms that will transmit back to the WWTP.

- Raw wastewater will enter the WWTP and pass through a grinder and screen that will remove large solids and reduce the remaining solids to a size and consistency capable of being passed by the downstream pumps.

- Screened wastewater will then pass through the treatment process as described in Section 5.2.1. The control system will be programmed to provide a standard 5-hour treatment cycle for each SBR, with the PLC-based control system triggering the initiation, duration, and termination of all phases within each system (fill, mix, aerate, and decant), as well as the alternation of flow between the two SBR tanks.

- If level sensors in the SBR tanks detect that the tanks are filling exceptionally quickly (indicating a high influent flow condition), then the

PLC will accelerate the treatment cycle to be more frequent that the standard 5-hours. This feature allows the control system to automatically adjust to rare high flow conditions by treating and passing more flow, and thereby preventing an overflow situation from occurring.

- The pumps in the post equalization tank will feed the downstream tertiary filters at a steady rate. When the post equalization tank level falls low, the pumps will turn off. They will reactivate once the tank level rises above an acceptable level.

- The tertiary cloth filter will process water passively without the need for controls. As water enters the filter, it flows by gravity through the filter disks and out the filter discharge. The control system is used only to initiate and run the filter backwash cycle. If the filter begins to foul, it will pass less water and will result in high water levels in the filter housing. A level sensor in the filter housing detects this high level and engages an automated backwash cycle.

- The UV disinfection system will be a flow-paced unit that increases lamp output and UV dose as flow increases. The higher flows will be detected by a flow meter near the UV influent channel that will transmit the flow signal to the UV control panel.

All PLC-based control panels (pump stations, influent grinder/screen, SBRs, tertiary filters, and UV) will be designed to operate as stand-alone systems with their own controls. They all will communicate with a PLC-based Master Control Panel, which will act as the main alarm enunciator, status display, and data collector.

5.5.2 Alarms and Notification

The automated control system will generate alarms to announce the failure of equipment or the existence of unacceptable operating parameters (high water levels, etc.). These alarms will be sounded locally on the control panel, and also will be automatically transmitted to the operator by a auto-dialing feature in the Master Control Panel in the event that the operator is not at the WWTP. The auto-dialing feature will be capable of executing a notification “chain” to several recipients if the first call goes unanswered. The data storage feature of the Master Control Panel will create a historical database of all alarms and when they were acknowledged.

5.5.3 Water Quality Analysis

Wastewater and effluent will be sampled from various locations within the WWTP, and analyzed for two purposes:

- *Regulatory Compliance*. These samples will track the quality of effluent as required by the SPDES permit. Some of the simpler analyses such as pH, DO, and settleable solids may be performed on-site by the operator. The more complex analyses such as BOD and fecal coliform are expected to be sent off-site for independent laboratory analysis. The results of these analyses will be reported in the monthly report required to the NYSDEC for SPDES permit compliance.

- *Operational Performance*. These analyses will tell the operator how well the system is operating, and whether adjustments should be made to the control system in order to increase performance and effluent quality. Many of same parameters will be tracked as for SPDES compliance, but will be sampled from different stages in the WWTP process; not just from the plant effluent.

5.6 Emergency Operations

The WWTP will be operated from the electrical power grid for the Property. However, in the event of power outage it is essential that the WWTP be capable of continued operation. Failure to do so could result in accumulation and overflow of untreated wastewater, with environmental and regulatory consequences. Consequently, the WWTP will be equipped with an emergency generator that will be installed when the plant is built. The generator will be sized and fueled to provide at least 24 hours of continuous WWTP operation during power failure. The generator will be fueled by a local tank of diesel, propane, or natural gas. If diesel is used, appropriate containment and spill control measures will be implemented to prevent accidental release. An automatic transfer switch (ATS) will be provided in the electric room of the plant to automatically switch power over to the generator when a power outage occurs.

The community pump stations also will be provided with emergency power from an emergency generator, with an ATS for automatic switch-over in the event of power failure.

The collection system grinder pump stations will be provided with generator receptacles. In the event of an extended power outage, the residents will have the capability to connect a personal generator to this receptacle to maintain pump station operation. In the absence of emergency power, each pump station has sufficient volume to provide a short period of storage capacity before a generator is required.

5.7 Site Security and Safety

The WWTP will be fully enclosed in a secure building or covered tanks, with no significant outdoor operations. The building will be constructed of steel framing and steel exterior panels, or of masonry block in order to be structurally sound and fire resistant. All exterior doors will be industrial-grade, secure, locked, and made of steel. There will be minimal exterior windows, and those provided will be shatter resistant. The Proposed Action WWTP concept will be fully enclosed in a secure building, and may not require further enclosure by a fence. The TNA WWTP concept may include outdoor (albeit covered) tanks that more warrant a perimeter fence around the facility. Given the higher location along Route 44, a fence around the TNA facility would have much less negative visual impact than a fence around the Proposed Action facility.

The building will be equipped with an alarm system that will sound during unauthorized entry, and will be transmitted to the property security personnel or to the wastewater operator.

The WWTP will incorporate fire suppression, protection, and alarming as specified in New York State Building Code and National Fire Protection Association (NFPA) standards.

6.0 ADDITIONAL DOCUMENTS

6.1 Facility Plan

The detailed basis of design for the collection system and WWTP will be summarized in an Engineer's Report and submitted to NYSDEC for review and approval. This report will technically specify how the proposed systems will be designed to meet all regulatory guidelines and requirements. Upon receipt of approval, detailed design of these systems will proceed.

6.2 Construction and Erosion Control

A Project-wide Storm Water Pollution Prevention Plan (SWPPP) will be developed and practiced during all phases and aspects of construction for the entire Silo Ridge Property. Site preparation and construction of the WWTP will be performed in conformance with this document.

6.3 Operation and Maintenance

A detailed Operations and Maintenance (O&M) Plan will be assembled to describe the required operation and maintenance of the proposed on-site WWTP, as well as the collection components of the sewerage system. The plan will at a minimum include technical specification cut sheets of equipment including operations requirements, standard operating procedures for sample collection and analysis of influent and effluent, program for solids and other waste disposal, electrical schematic, and other engineering details. It will also describe the frequency of maintenance for individual pump stations and flushing frequency for the low pressure forcemains. The following components will be included in the O&M Plan.

- Introduction and Organizational Overview
- Permits, Standards, and Regulatory Requirements
- Process Description and Operation of Facilities
- Equipment Maintenance Schedules and Procedures
- Emergency Operation and Response Program
- Sampling, Testing, and Analysis
- Records Keeping
- Organizational Overview and Qualification Requirements
- Personnel
- Safety
- Building Utilities and Communications

7.0 REFERENCES

Design Standards for Wastewater Treatment Works for Intermediate Sized Sewerage Facilities, New York State Department of Environmental Conservation, Division of Water; 1988

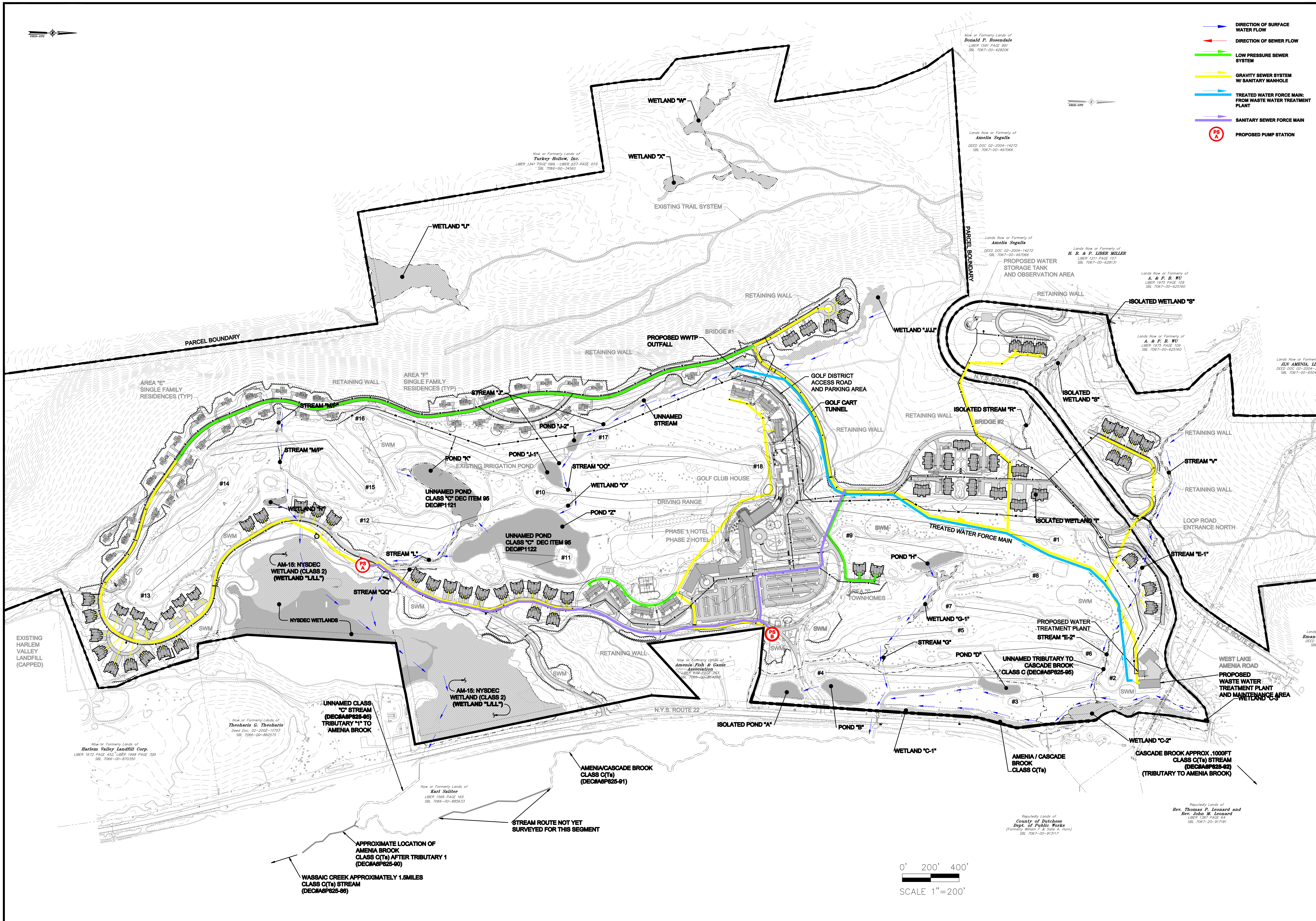
Recommended Standards for Wastewater Facilities, Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers; Health research Inc Publishers; 1997 Edition

Onsite Wastewater Treatment Systems Technology Fact Sheet 2 – Fixed Film Processes, United States Environmental Protection Agency, EPA 625/R-00/008

Wastewater Engineering, Treatment, Disposal, and Reuse; Metcalf & Eddy; McGraw-Hill Publishers, Third Edition, 1991

Constructed Wetlands Treatment of Municipal Wastewaters, EPA Manual, EPA/625/R-99/010, September 2000

Figure 1A: Wastewater Master Plan (Proposed Action)



DEIS SUBMISSION

Silo Ridge
Resort Community

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Devereaux & Associates
ARCHITECTS AND PLANNERS

CANNONDESIGN
2170 Whitehaven Road, Grand Island, New York 14072 716.773.6800
Baltimore • Boston • Buffalo • Chicago • Jacksonville • Los Angeles • New York • St. Louis • Vancouver • Washington DC

0 1 2 3
ORIGINAL SCALE IN INCHES

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Engineers/Surveyors
Planners
Environmental Scientists

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North Country Office: 100 Glen Street, Glens Falls, New York 12801, Phone: (518) 812-0513

rev.	date	description

SILO RIDGE RESORT COMMUNITY

WASTEWATER MASTER PLAN

TOWN OF AMENIA, DUTCHESS COUNTY, STATE OF NEW YORK

drawn	checked
CJB	PR/JAR
date 9/7/06	scale 1"=200'
project no. 10454.01	
sheet no. FIG1A	

Drawing Name: S:\1\10400-10499\10454.00\ENG\DWG\120_PA_FIG1A_10454-00_overall sewer.dwg
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Date Printed: Jun 15, 2007, 1:58pm

Figure 1B: Wastewater Master Plan (TNA)

ISSUED FOR DEIS COMPLETENESS

Silo Ridge Resort Community

ERNIE ELS DESIGN

ROBERT A.M. STERN ARCHITECTS

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rev.	date	description

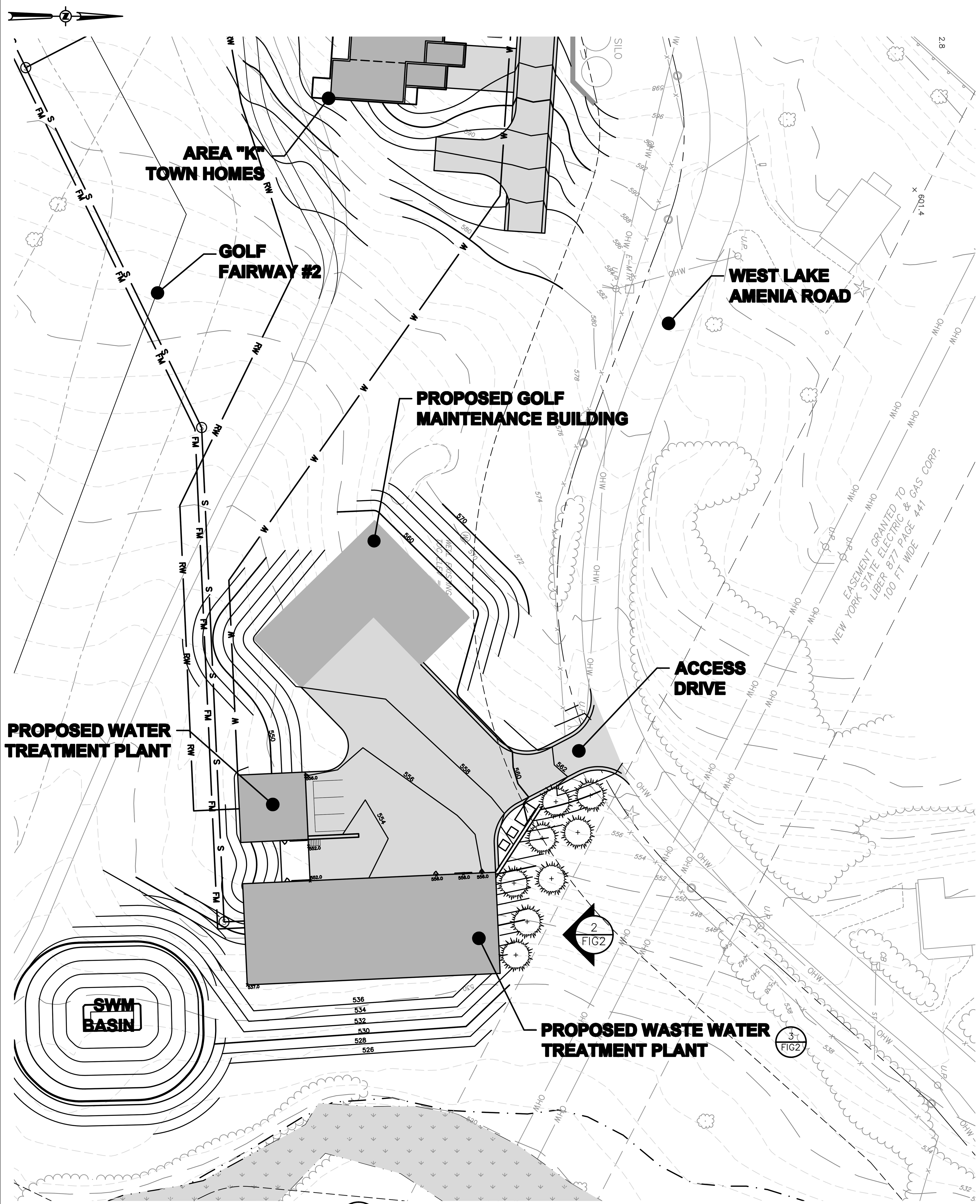
SILO RIDGE RESORT COMMUNITY
TRADITIONAL NEIGHBORHOOD ALTERNATIVE

WASTEWATER MASTER PLAN

TOWN OF AMENIA, DUTCHESS COUNTY, NEW YORK

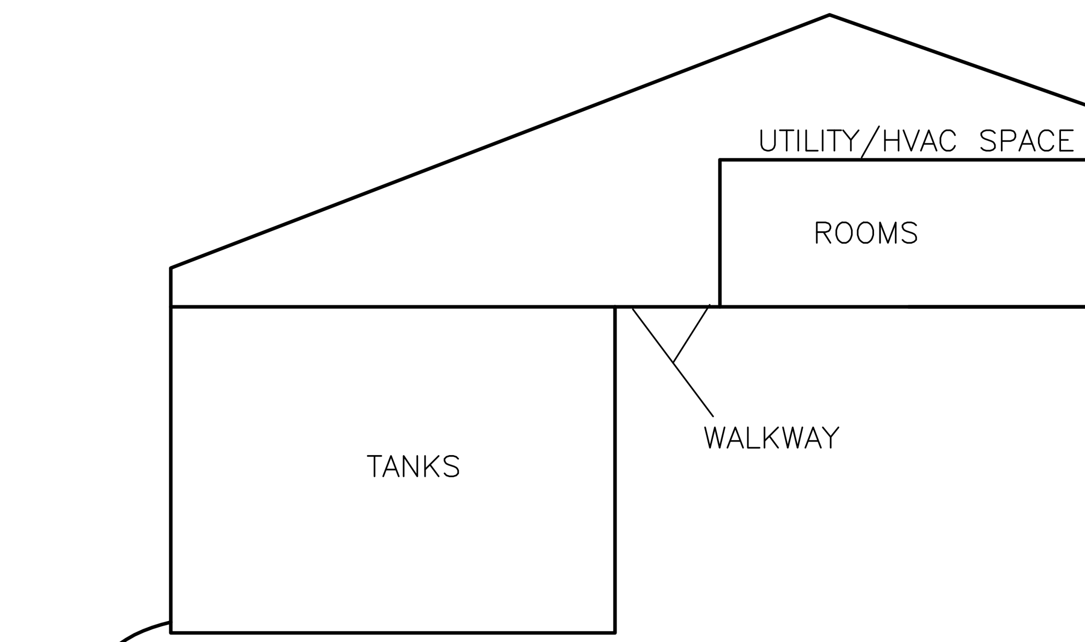
drawn CAM	checked PR/JAR
date 6/21/07	scale 1"=200'
project no. 10454.02	
sheet no. 1B	7 of 8

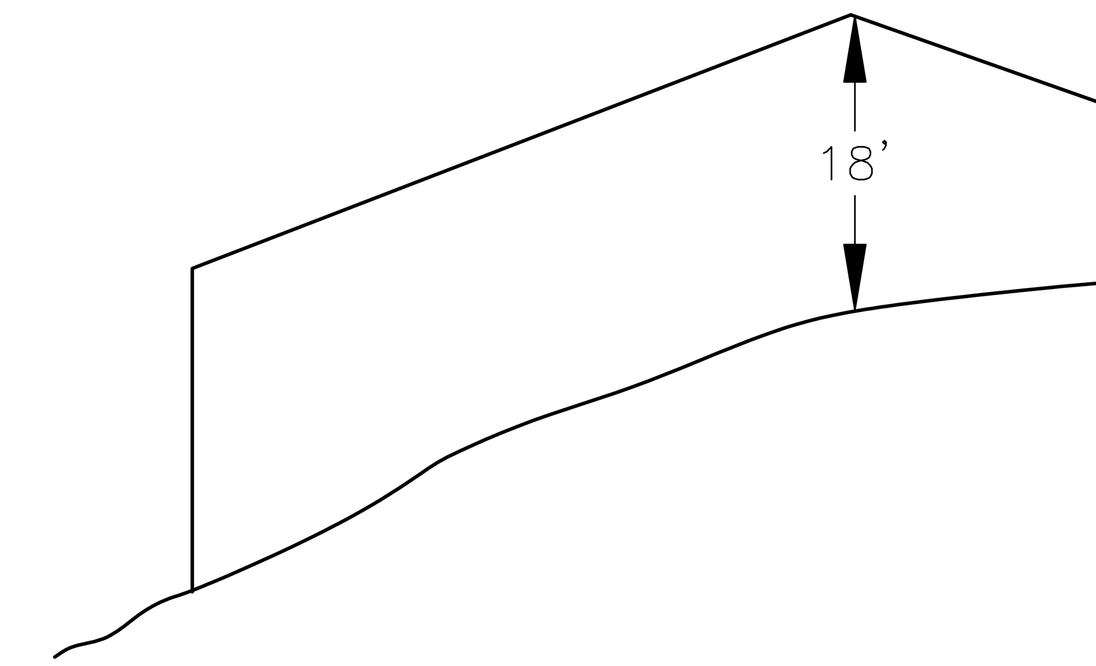
Figure 2A: WWTP Site Layout
(Proposed Action)



1 FIG2A **OVERALL WWTP LAYOUT**
SCALE: 1"=40'

0' 20' 40' SCALE

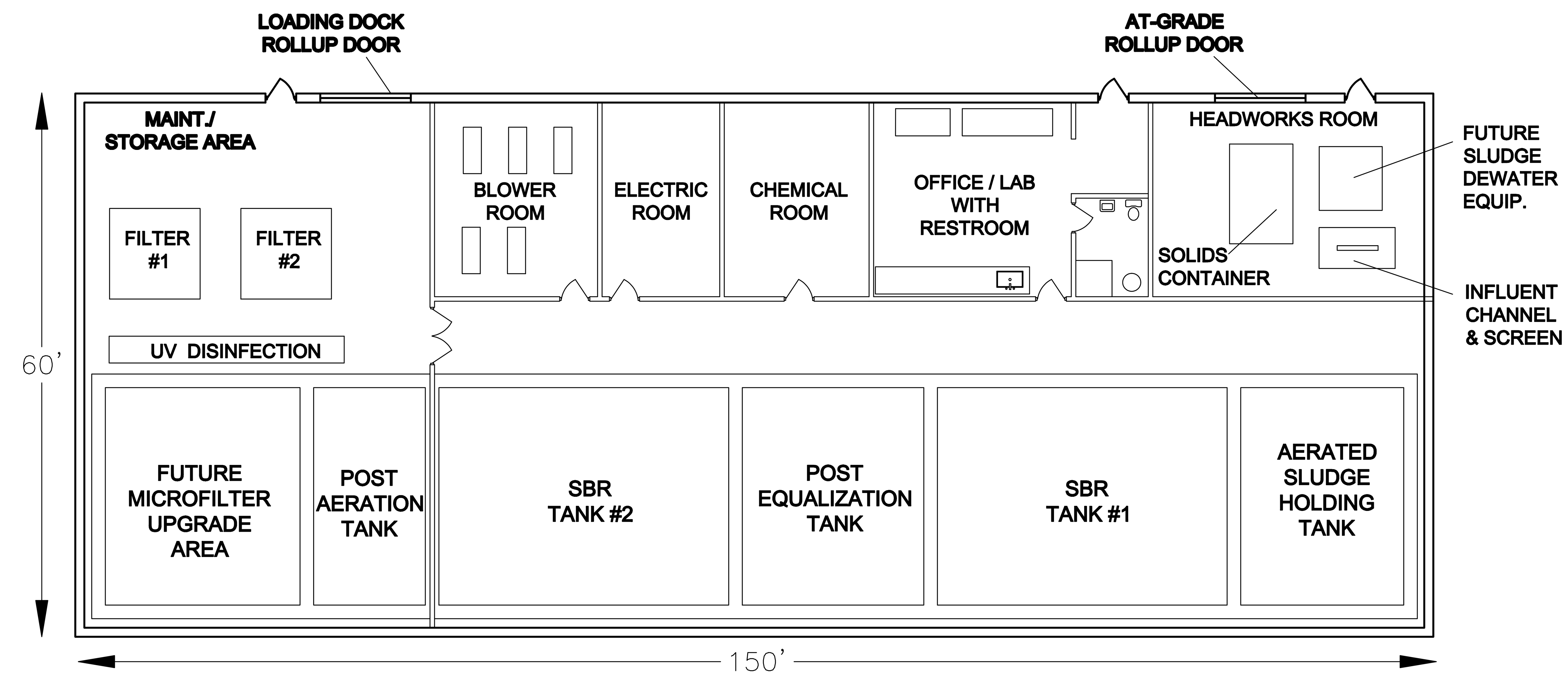




THE BUILDING ELEVATION SHOWN ON THIS SHEET IS REPRESENTATIVE OF THE BUILDING FOOTPRINT, LIKELY INTERNAL HEIGHT REQUIREMENTS, AND SITE TOPOGRAPHY. HOWEVER, IT IS INTENDED ONLY TO SHOW POTENTIAL VISUAL IMPACTS OF THE WWTP. FINAL BUILDING DESIGN WILL BE PERFORMED BY THE PROJECT ARCHITECT DURING THE DESIGN PHASE OF THE PROJECT."

2A FIG2 **WWTP NORTH ELEVATION (INTERIOR), OFFSET ROOF PEAK OPTION**
SCALE: 1"=10'

2B FIG2 **WWTP NORTH ELEVATION (EXTERIOR), OFFSET ROOF PEAK OPTION**
SCALE: 1"=10'



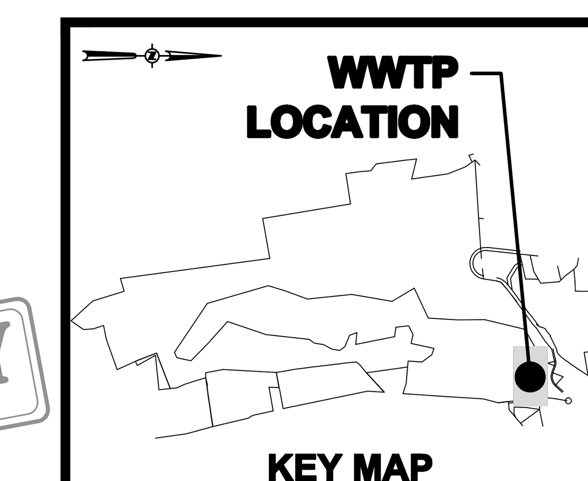
THE FLOOR PLAN SHOWN ON THIS SHEET IS FOR DEMONSTRATION PURPOSES ONLY, AND HAS BEEN SUPPLIED TO JUSTIFY BUILDING SIZE, DIMENSIONS, AND ORIENTATION. THE INTERNAL LAYOUT OF THE WWTP IS BEYOND THE SCOPE OF SEQRA AND WILL BE DETERMINED IN THE DESIGN PHASE OF THE PROJECT.

3 FIG2A **WWTP BUILDING FLOOR PLAN**
SCALE: 1"=10'

LEGEND:

180	PROPOSED 10 FT CONTOUR
178	PROPOSED 2 FT CONTOUR
+ 188.3	PROPOSED SPOT GRADE
— S —	PROPOSED SANITARY SEWER LINE
— FM —	PROPOSED FORCE MAIN
— W —	PROPOSED WATER LINE
	PROPOSED BUILDING
	PROPOSED ROAD

PRELIMINARY DATE:6/7/07



KEY MAP
NOT TO SCALE

PROGRESS PRINTS - FOR SEQR SUBMISSION - NOT FOR CONSTRUCTION

ROBERT A.M. STERN ARCHITECTS

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Engineers/Surveyors
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rev.	date	description

SILO RIDGE RESORT COMMUNITY
PROPOSED ACTION

WASTEWATER TREATMENT PLANT SITE LAYOUT

TOWN OF AMENIA DUTCHESS COUNTY STATE OF NEW YORK

drawn CJB	checked JTB
date	scale AS NOTED
project no. 10454.02	
sheet no. FIG2A	

Drawing Name: S:\1\10400-10499\10454.00\ENG\DWG\120_PA_FIG2A_10454-00.dwg
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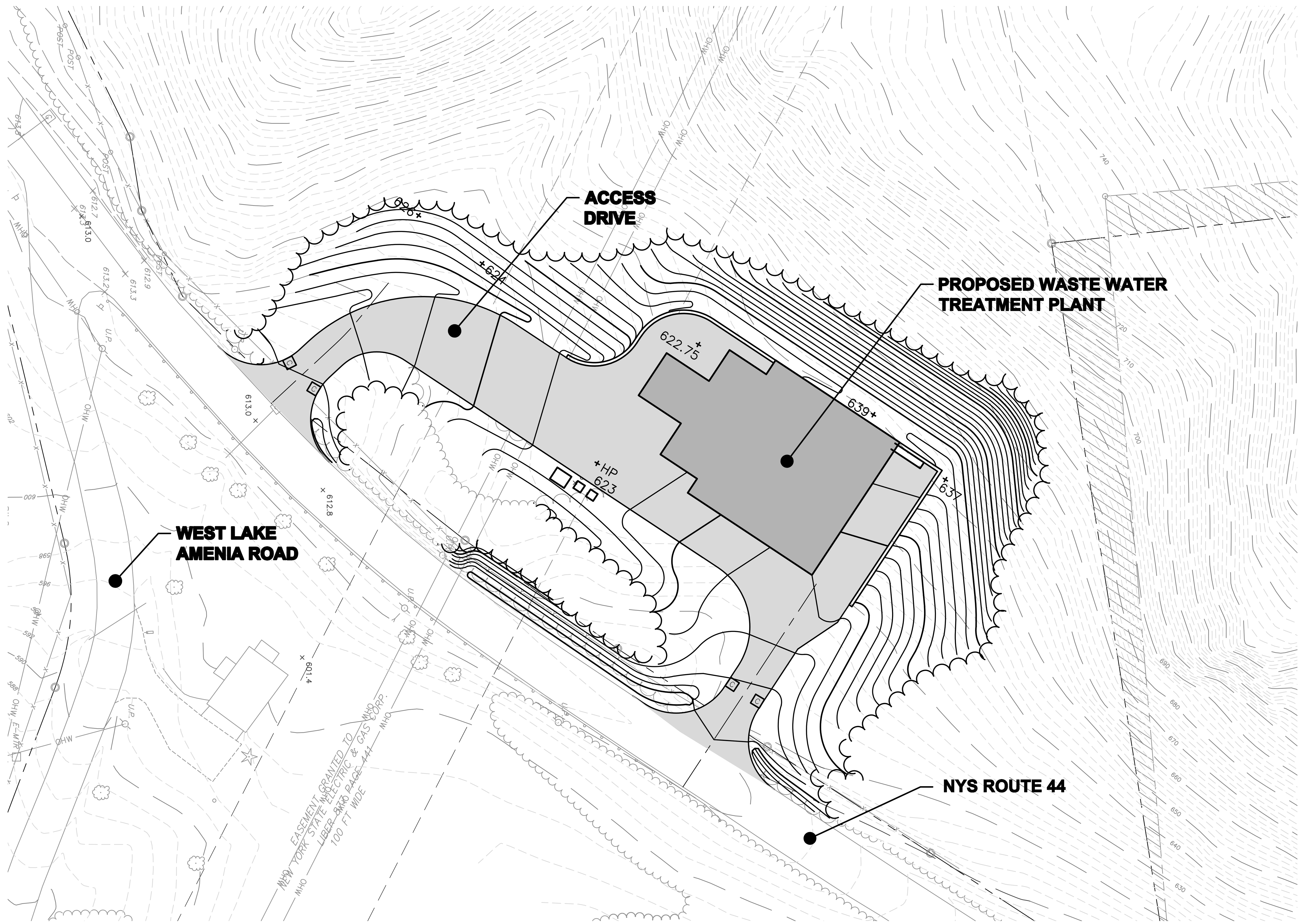
Date Printed: Jun 08, 2007, 10:00am

Figure 2B: WWTP Site Layout (TNA)

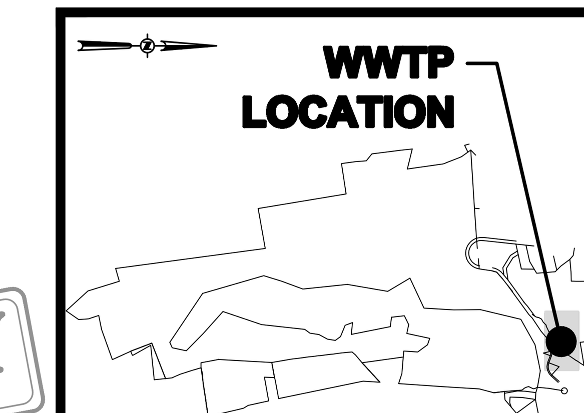
LEGEND:

180	PROPOSED 10 FT CONTOUR
178	PROPOSED 2 FT CONTOUR
+188.3	PROPOSED SPOT GRADE
S	PROPOSED SANITARY SEWER LINE
FM	PROPOSED FORCE MAIN
W	PROPOSED WATER LINE
	PROPOSED BUILDING
	PROPOSED ROAD



1 FIG2B **OVERALL WWTP LAYOUT**
SCALE: 1"=40'

0' 20' 40'
SCALE



KEY MAP
NOT TO SCALE

PRELIMINARY
DATE:6/7/07

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rev.	date	description

SILO RIDGE RESORT COMMUNITY
TRADITIONAL NEIGHBORHOOD ALTERNATIVE

WASTEWATER TREATMENT PLANT SITE LAYOUT

TOWN OF AMENIA DUTCHESS COUNTY STATE OF NEW YORK

drawn	checked
CJB	JTB
date	scale AS NOTED
project no. 10454.02	
sheet no. FIG2B	

Drawing Name: S:\1\10400-10499\10454.00\ENG\DWG\320_TNA_FIG2B_10454-02.dwg
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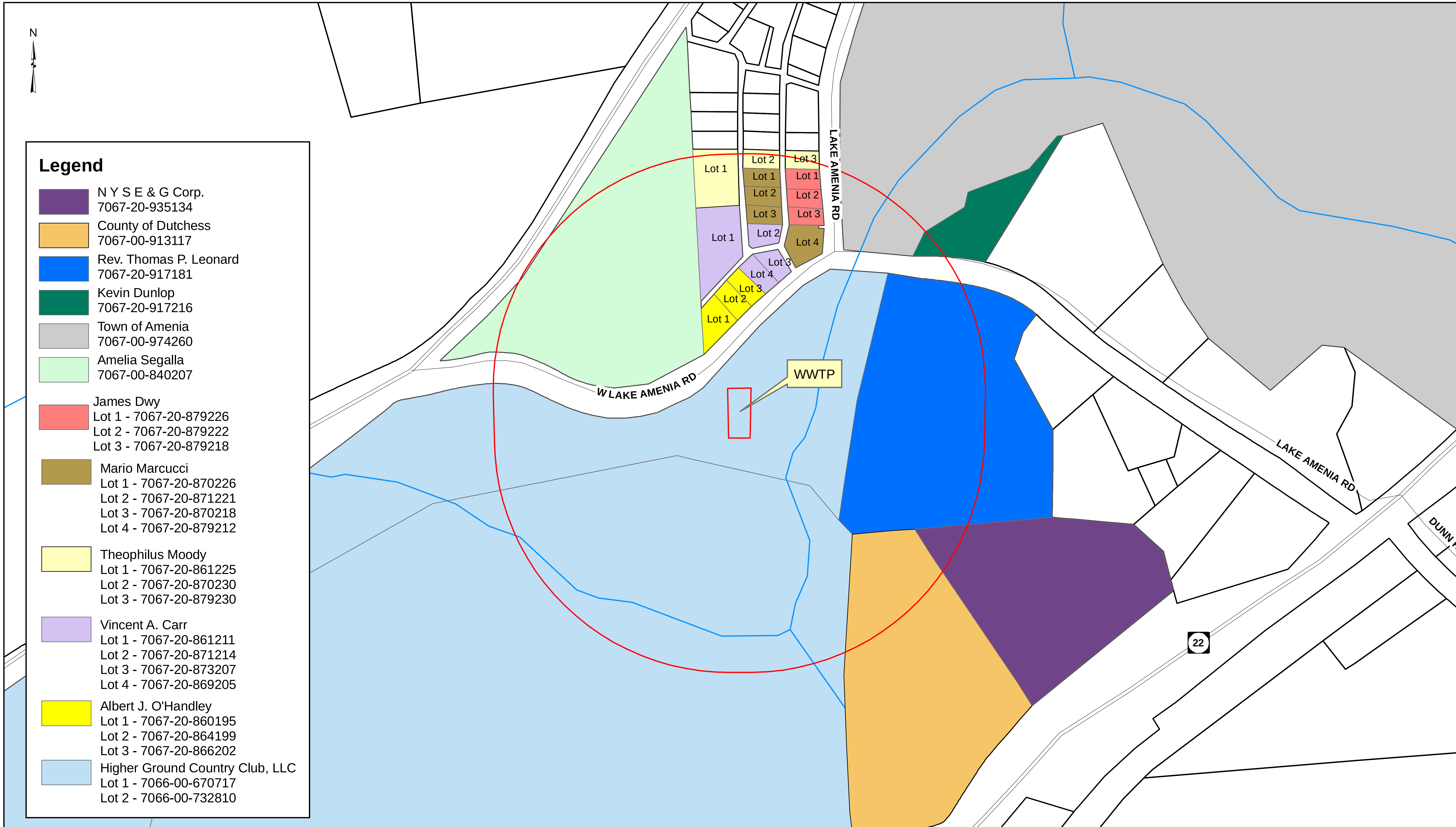
Date Printed: Jun 15, 2007, 1:53pm

Figure 3A: Parcel Data within 500 Feet of WWTP (Proposed Action)



Silo Ridge Resort Community

Parcel Data within 500-ft of WWTP (Proposed Action)

Town of Amenia, Dutchess County, New York

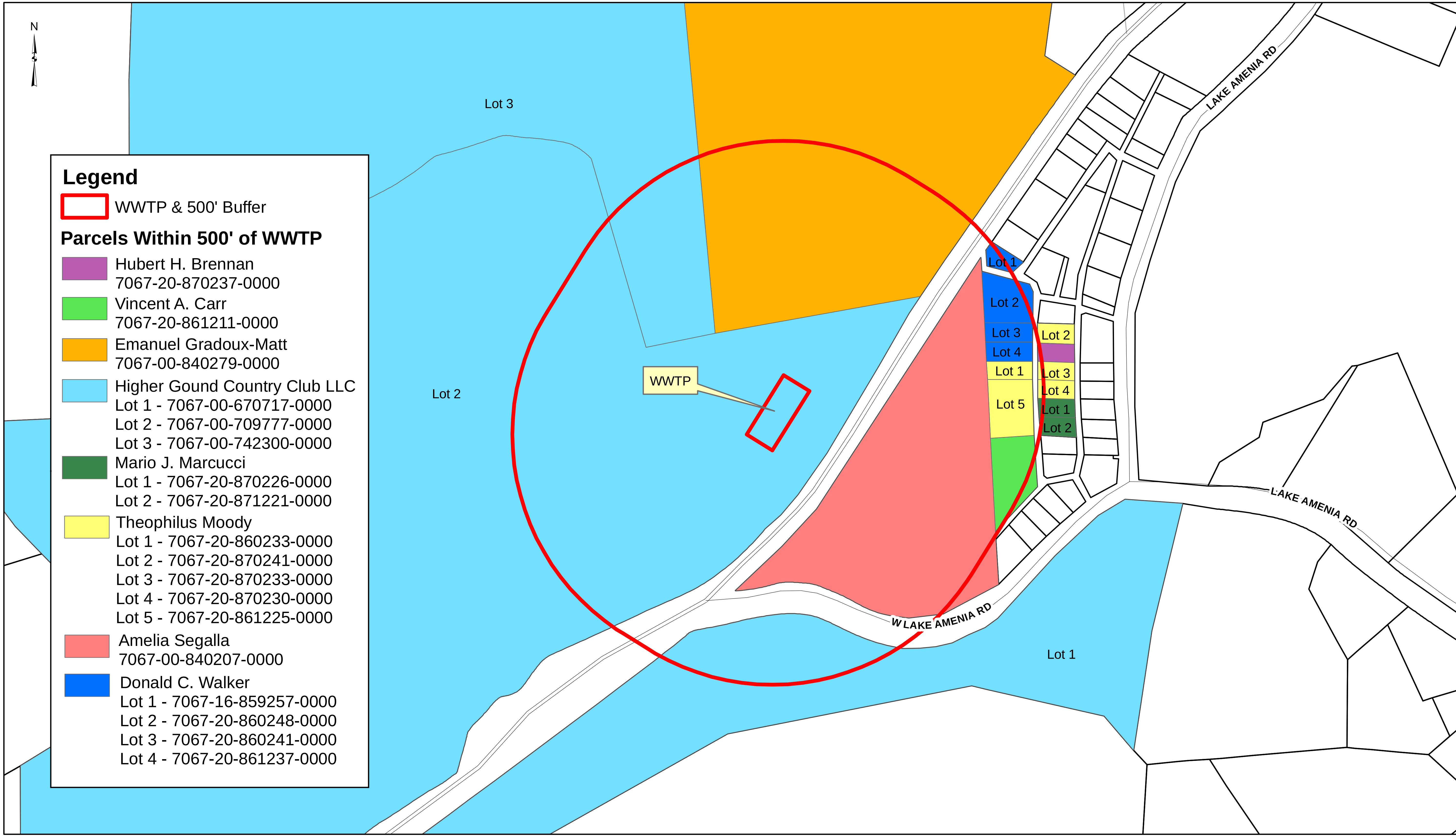
1 inch equals 200 feet

Fig. 3A

Source: Dutchess County Real Property

Drawn by: SEP

Figure 3B: Parcel Data within 500 Feet of WWTP (TNA)



THE Chazen COMPANIES

Silo Ridge Resort Community

Parcel Data within 500-ft of WWTP
(Traditional Neighborhood Alternative)

Town of Amenia, Dutchess County, New York

Source: Dutchess County Real Property Services

SEP/PC

1 inch equals 200 feet

Fig. 3B

Map Document: (R:\GIS_maps\AAA_StaffGISmaps\SaraPolicella\2006\Jim Beninati\WWTP Colored Map-060707.mxd)
6/7/2007 -- 10:07:45 AM

Appendix A:
DCDOH Flow Confirmation

The Chazen Companies
August 15, 2006
Revised October 5, 2007

Dutchess

Dutchess County Department of Health

William R. Steinhaus
County Executive

Michael C. Caldwell, MD, MPH
Commissioner

Environmental Health

387 Main Street
Poughkeepsie
New York
12601
(845) 486-3404
Fax (845) 486-3545

January 10, 2006

James T. Beninati, P.E.
Chazen Engineering & Land Surveying Co., P.C.
547 River Street
Troy, N.Y. 12180

Re: Wastewater Flow Confirmation
Silo Ridge Country Resort Community
Town of Amenia

Dear Mr. Beninati:

This department has reviewed your engineer's submission for confirmation of the wastewater design flow for the above-referenced project and finds as follows:

The proposed design flow of 180,572 gallons per day is acceptable based on the standards/guidelines which are applicable to the project. The proposed project consists of the following:

Land Use	Unit	Unit Qty.	Generation Rate (gpd/unit)	Flow Reduction Credit	Avg. Daily Flow with Credit (gpd)
Single Family	4-BR House	41	475	20%	15,580
Townhouse	3-BR House	328	400	20%	104,960
Phase 1 Hotel					
Rooms	Rooms	120	120	20%	11,520
Banquet Hall	Person	200	20	10%	3,600
Conference Areas	Seats	200	10	20%	1,600
Restaurant	Seats	125	35	10%	3,938
Spa	SF	15,000	.4	10%	5,400
Retail store & shop	SF	2,000	.1	20%	160
Phase 2 Hotel					
Rooms	Rooms	200	120	20%	19,200
Golf Clubhouse					
Banquet Hall	Person	375	20	10%	6,750
Restaurant	Seats	100	35	10%	3,150
Retail/Office	SF	2,000	.1	20%	160
Golfers	Ea.	160	3	20%	384
Swimming Pool	Swimmer	333	10	0%	3,330
WWTP	Employees	2	25	20%	40
Maintenance Facilities	Ea.	1	400	0%	400
Infiltration & Inflow	Lump Sum	1	400	0%	400
Total					**180,572**

It will be necessary for you to submit to the New York State Department of Environmental Conservation an Engineer's report which evaluates the proposed discharge's effect on the receiving waters. Specific information on the content of the report may be discussed with a representative of the New York State Department of Environmental Conservation, Division of Water, Region 3, at (914) 332-1835, ext. 355.

Your submission should include the following:

1. A completed Application Form "D" (original and one copy).
2. A completed Environmental Assessment Form (or other appropriate SEQR documentation).
3. Two (2) copies of a U.S.G.S. quadrangle map showing the property boundaries.
4. Two (2) copies of this letter.
5. Two (2) copies of the site plan for the project, identifying the discharge location and all other proposed site disturbances.

Please send your complete submission to:

Regional Permit Administrator
NYS Department of Environmental Conservation
Region 3
21 South Putt Corners Road
New Paltz, New York 12561

A copy of the SPDES Application (item 1) should be sent to this office at the tiem of submission to the DEC Regional Permit Administrator.

Please recognize that the Department of Environmental Conservation may have additional submission requirements relating to other regulatory programs under which your project may fall. You may wish to contact the Division of Environmental Permits at (845) 256-3059.

Please note that, following permit issuance by N.Y.S.D.E.C. detailed plans and specifications shall be submitted to this office for review and approval. Construction of the sanitary facilities is prohibited prior to this approval.

Should you have any questions concerning this matter, please feel free to contact this office at (845) 486-3404. Thank you for your cooperation.

Very truly yours,

Daniel J. Keeler
Public Health Engineer
Environmental Health Services

cc: file

DJK: tb

CHAZEN ENGINEERING & LAND SURVEYING CO., P.C.

Dutchess County Office
Phone: (845) 454-3980

Orange County Office
Phone: (845) 567-1133

547 River Street, Troy, New York 12180
Phone: (518) 273-0055 Fax: (518) 273-8391
Web: www.chazencompanies.com

North Country Office
Phone: (518) 812-0513

December 23, 2005

Mr. John Glass
Dutchess County Department of Health
387-391 Main Street
Poughkeepsie, NY 12601-3316

Re: *Wastewater Flow Confirmation*
Silo Ridge Country Club Resort Community
Chazen Project # 10454

Dear Mr. Glass;

The Chazen Companies (TCC) is requesting *flow confirmation* from the Dutchess County Department of Health (DOH) regarding a sanitary wastewater treatment plant proposed for a private residential and golf community ("Silo Ridge Country Club and Resort") in the Town of Amenia, Dutchess County, New York. You are already familiar with this project from our November 21st meeting with you requesting DOH guidelines on reusing treated effluent for on-site golf course irrigation. To expedite the project, I would like to pursue *flow confirmation* separately from DOH approvals for irrigation reuse. I understand that flow confirmation does not ensure DOH approval of the project, but it will allow TCC to create a preliminary treatment design that can then be submitted to you for preliminary approval.

Project General Description

TCC is providing wastewater design services for the proposed redevelopment and expansion of the Silo Ridge Country Club near the intersections of Route 22 and Route 44 in the Town of Amenia, Dutchess County, New York. The current site, a 170-acre 18-hole golf course, will be redeveloped as a 210+/- acre community consisting of 41 single-family home, 328 townhome units, two resort hotels, banquet space, two restaurants, a spa, a wellness center, and an improved golf course.

Wastewater Treatment

The WWTP will treat and release approximately 200,000 gallons per day of sanitary wastewater from the Silo Ridge development. The design process is in its preliminary stages and a specific treatment technology has not yet been chosen. It is anticipated that the WWTP will include primary treatment, secondary biological treatment, advanced filtration, and disinfection.

The WWTP will be a privately-owned, on-site facility built by the project sponsor. The property will be developed in phases over several years, but TCC is seeking at this time a flow confirmation for the fully built-out WWTP at full capacity. The WWTP will then be designed to accommodate all ranges of wastewater flow, from low flow periods associated with early development phases to the full plant flow at project completion. Accommodations for plant expansion will include phased mechanical upgrades, and potentially the phased addition of tanks and other structures beyond what is initially constructed.

Current plans are to discharge treated effluent to on-site artificial ponds for reuse in golf course irrigation. During periods of low irrigation demand, the ponds will overflow to nearby surface waters. This project therefore will require guidance from DOH on effluent standards for irrigation water quality, as well as DEC SPDES discharge standards for the effluent that is discharged to surface water bodies of the State. Where the DOH and DEC standards differ from one another, the treatment process will meet the more stringent of the two. Surface discharge from the irrigation ponds will be to Cascade Brook (a Class C stream), which is abutted by DEC wetlands AM15 and AM16 (both Class 2 wetlands). Cascade Brook ultimately is tributary to Ten Mile River.

Table 1: Projected Wastewater Flow summarizes the anticipated sanitary sewer flows that the wastewater plant will be sized to accommodate. Although the SPDES permit will be requested to reflect the average daily flow shown below, the plant will likely be sized slightly larger to accommodate peak flow days.

Table 1 - Projected Wastewater Flows, Silo Ridge Country Club

Land Use	Unit	Unit Qty	Generation Rate [1] (gpd/unit)	Flow Reduction Credit [2]	Avg Daily Flow with Credit [3] (gpd)	Peak Hour Headcount [4]
Single Family	4-BR House	41	475	20%	15,580	164
Townhouse	3-BR House	328	400	20%	104,960	984
Phase 1 Hotel						
Rooms [5]	Rooms	120	120	20%	11,520	180
Banquet Hall	Person	200	20	10%	3,600	100
Conference Areas	Seats	200	10	20%	1,600	100
Restaurant [6]	Seats	125	35	10%	3,938	63
Spa [7]	SF	15,000	0.4	10%	5,400	25
Retail store & shop	SF	2,000	0.1	20%	160	25
Phase 2 Hotel						
Rooms [4]	Rooms	200	120	20%	19,200	300
Golf Clubhouse						
Banquet Hall	Person	375	20	10%	6,750	188
Restaurant	Seats	100	35	10%	3,150	50
Retail/Office	SF	2,000	0.1	20%	160	25
Golfers [8]	Ea.	160	3	20%	384	80
Swimming Pool	Swimmer	333	10	0%	3,330	50
WWTP [9]	Employees	2	25	20%	40	2
Maintenance Facilities	Ea.	1	400	0%	400	2
Infiltration & Inflow [10]	Lump Sum	1	400	0%	400	0
TOTAL:					180,572	2,337
Ten States Peaking Factor (for 2,300 population):					3.6	
Peak Hourly Flow (gpd):					650,057	
Peak Hourly Flow (gph):					27,086	
Peak Hourly Flow (gpm):					451	

Notes:
[1] Wastewater generation rates from NYSDEC Design Standards for Wastewater Treatment Works 1988 unless noted.
[2] NYSDEC allows for up to 20% reduction in flows to account for use of low flow plumbing fixtures.
[3] Average Daily Flow assumes full occupancy of all residences and commercial facilities.
[4] Peak Hour Headcount is used to select peak hourly wastewater multiplier from Ten States Standards. Headcounts for public facilties have been reduced by 50% under the assumption that 1/2 the patrons are under "Residneces" or "Hotel".
[5] Hotel occupancy assumed 1.5 persons per room for peak hourly headcount purposes.
[6] Retail, restaurant, and other commercial numbers include emplyee contribution unless otherwise noted.
[7] Spa wastewater generation is estimated at 4X the wastewater generation of conventional retail space.
[8] A maximum of 160 golfers assumed per day, based on 4 golfers every 15 minutes for 10 hours. Flow rate of 3 gpd/golfer based on 1988 NYSDEC standards for airport passengers.
[9] WWTP flows are only for toilet/sink/shower. Hoses, washing, and processes will use nonpotable recycled water.
[10] An estimated 15,000 LF of sewer line is anticipated, with 5,000 LF (1 mile) of that as 8" gravity pipe. Uni-Bell assumes 50 gal / in dia / mile / day for push-on SDR35 PVC piping. (50 x 8 in. x 1 mile = 400 gpd)

Based on the data in Table 1, TCC anticipates that a treatment plant designed for an average daily flow of 181,000 gpd will sufficiently treat all sanitary wastewater generated by the proposed community. TCC will appropriately design the plant for a higher capacity to accommodate maximum sustained flow days. If you concur with this average daily flow estimate, please forward to me a flow confirmation letter at your earliest convenience. Feel free to direct any questions or comments to me at 518-273-0055. Thank you for your efforts.

Sincerely,

James T. Beninati, P.E.
Senior Engineer

JTB

Enclosures:
Location Map
Site Plan

cc:
Mr. Lenny Meyerson, NYSDEC, Region III Tarrytown Office
File /JTB 1

Appendix B:
NYSDEC Preliminary Effluent Limits

New York State Department of Environmental Conservation
Division of Water
Bureau of Water Assessment and Management, 4th Floor
625 Broadway, Albany, New York 12233-3502
Phone: (518) 402-8179 • **FAX:** (518) 402-9029
Website: www.dec.state.ny.us

Denise M. Sheehan
Acting
Commissioner

TELEFAX TRANSMISSION COVER SHEET

DATE: 2/27/06

TO: Jim Beninati **FAX #:** (518) 273-8391

FROM: Chuck St. Lucia **PHONE #:** (518) 402-8246

NUMBER OF PAGES: 2 **(INCLUDING THIS COVER SHEET)**

SUBJECT: I have reviewed the Silo Ridge Proposal relative to both a stream and pond discharge. Considering the small drainage area involved and the size of the proposed discharge at 0.2 MGD I would recommend intermittent stream effluent limitations (ISEL) for both discharge locations.

If you do not receive the number of pages specified or if you have trouble with the copy transmitted, please call for assistance.

Intermittent Limits as follows:

$CBOD_5$ = 5 mg/l

TSS = 10 mg/l

D.O. ≥ 7 mg/l

NH_3 = 1.5 mg/l (June - Oct.)

NH_3 = 2.2 mg/l (Nov. - May)

pH = 6.5 - 8.5

TRC = 0.1 mg/l (if chlorine is used for disinfection)

Phosphorus = No NYS Ponded Waters downstream but Phos. may be of concern in your irrigation ponds.

I hope this is helpful as you move forward with the Silo Ridge Proposal. I will send an email to Region 3 so they also have my recommendations.

CHAZEN ENGINEERING & LAND SURVEYING CO., P.C.

Dutchess County Office
Phone: (845) 454-3980

Orange County Office
Phone: (845) 567-1133
Phone: (845) 567-1133

547 River Street, Troy, New York 12180
Phone: (518) 273-0055 Fax: (518) 273-8391
Web: www.chazencompanies.com

North Country Office
Phone: (518) 812-0513

January 20, 2006

Lenny Meyerson
NYSDEC Region 3
5th Floor
200 White Plains Road
Tarrytown, NY 10591
P (914) 332-1835, F (914) 332-4670
Email: lsmeyer@gw.dec.ny.us

Re: *Refined Effluent Outfall and Reuse Strategy*
Silo Ridge Country Club Resort Community
Chazen Project # 10454

Dear Mr. Meyerson;

This is a follow-up to my November 30, 2005 letter to you requesting preliminary effluent limits for a proposed 181,000 gpd community wastewater treatment plant (Silo Ridge Country Club) in the Town of Amenia, Dutchess County.

I have attached a new figure ("Wastewater Master Plan – Draft") to clarify the proposed wastewater layout, discharge, and outfall strategy. As shown in this figure, the outfall strategy is to discharge treated effluent to an unmapped on-site stream tributary to several on-site Class C ponds. Flow characteristics of this stream are anecdotal, with the stream apparently running heavy in runoff/rainfall conditions, and reducing substantially in drier summer months. TCC is unsure whether this stream is genuinely intermittent.

One of the mapped on-site Class C ponds ("Irrigation Pond") is the current and proposed future water source for the irrigation pump house serving the golf course. Water from these ponds overflows through NYSDEC wetlands AM15/AM16, off the property under NYS Route 22, and into Amenia Brook at a location where the brook transitions from C_{ts} to C_t.. Amenia Brook is tributary to Wassaic Creek which ultimately is tributary to the Housatonic River.

TCC requests from you preliminary SPDES limits for this proposed outfall and discharge strategy, taking into consideration the classification/use of the receiving streams, that the receiving stream is tributary to ponds, and that ponds in this tributary chain will be used as an irrigation source for the golf course.

Please contact me at your earliest convenience so that we may finalize our DEIS concept. If DEC takes issue with certain aspects of this concept, I will work with you to come to a mutually acceptable resolution. Thank you.

Sincerely,

James T. Beninati, PE
Senior Engineer

Attached Figures:
NYSDEC Stream Classification; Silo Ridge County Club
Wastewater Master Plan – Draft; Silo Ridge Country Club

cc:
John Glass, Dutchess County DOH
Charles St. Lucia (NYSDEC, 625 Broadway, 4th Floor, Albany, NY, 12233-3502)
File/JTB
File/Admin

CHAZEN ENGINEERING & LAND SURVEYING CO., P.C.

Dutchess County Office
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547 River Street, Troy, New York 12180
Phone: (518) 273-0055 Fax: (518) 273-8391
Web: www.chazencompanies.com

North Country Office
Phone: (518) 812-0513

November 30, 2005

Lenny Meyerson
NYSDEC Region 3
5th Floor
200 White Plains Road
Tarrytown, NY 10591
P (914) 332-1835, F (914) 332-4670
Email: lsmeyer@gw.dec.ny.us

Re: Determination of WWTP Effluent Limits
Silo Ridge Country Club Resort Community
Chazen Project # 10454

Dear Mr. Meyerson;

The Chazen Companies (TCC) requests a determination of effluent discharge limits for a planned community wastewater treatment plant. Please review the following information and forward all correspondences to me in our Troy office. We are in the draft DEIS process, and any timely feedback from you on preliminary effluent limits would be immensely helpful.

Overall Project Description

TCC is providing wastewater design services for the proposed redevelopment and expansion of the Silo Ridge Country Club on Route 22 in the Town of Amenia, Dutchess County, New York. The current site, a 170-acre 18-hole golf course, will be redeveloped as a 210+/- acre community consisting of 41 single-family home, 328 townhome units, two resort hotels, banquet space, two restaurants, a spa, a wellness center, and an improved golf course.

The project sponsor will develop a site-wide sanitary sewer system for collecting wastewater from all residences and buildings, and an on-site wastewater treatment plant (WWTP) that will treat and discharge the wastewater into an on-site surface water body.

Outfall and Receiving Water Body Description

Refer to the attached "USGS Map" figure for the proposed layout of wastewater features on the property. The WWTP will be designed with an approximate treatment capacity of 200,000 to 250,000 gpd. Treated effluent will be discharged to unclassified on-site manmade ponds currently used as an irrigation source for the golf course. The precise irrigation/effluent layout is still being formulated as part of the DEIS process. Tentatively, it is anticipated that Pond D will receive treated effluent, and the contents of Pond D will be transferred to Island Green Pond, which is the irrigation source pond. Both Pond D and Island Green Pond overflow to Cascade Brook (a Class C stream), which is abutted by DEC wetlands AM15 and AM16 (both Class 2 wetlands). Cascade Brook ultimately is tributary to Ten Mile River.

Island Green Pond has a surface area of 5.53 acres, a mean depth of 8 feet, and an approximate volume 14,000,000 gallons. Existing contributions to the pond include local storm water and periodic overflow transfers from an adjacent spring-fed deep pond located at its southwest corner. These flows have not yet been quantified. The proposed development will expand contributions to include the WWTP effluent. On a wastewater day of 250,000 gpd, WWTP effluent flow will make a daily contribution of <2% of total lake volume.

The exact wastewater treatment technology has not yet been chosen. TCC is evaluating a variety of standard treatment technologies, with an option for engineered wetlands where they can gain regulatory acceptance for a portion of the wastewater flow. The precise technology choice will be made to satisfy anticipated SPDES limits (based on your response to this letter), and to satisfy the requirements of the Dutchess County Department of Health.

DOH Involvement

On November 21, 2005 TCC met with John Glass at the Dutchess County Department of Health to discuss how the WWTP will discharge to the irrigation ponds. It was unknown at the time of that meeting where DEC will require the outfall's permitted location to be, although a conversation with you the previous week indicated that it may be where the unclassified ponds discharge to Cascade Brook. If that is the case, then the diluted effluent being used for irrigation would be pre-SPDES outfall. It is therefore likely that TCC would have to work out with DOH a methodology to guarantee effluent quality separate from the SPDES sampling program.

Mr. Glass stated that so long as an appropriate level of treatment and disinfection is attained by the WWTP, DOH would not object to the recovery and reuse strategy presented here, assuming that sufficient effluent disinfection is achieved. Consequently, the preliminary effluent standards we are requesting from DEC will govern the effluent quality discharged to Cascade Brook, but separate standards may be required by DOH for when the effluent is being reused as irrigation. TCC will design a system that complies with the more stringent of the two standards.

Summary

At your earliest convenience, please inform me of what parameters and values you would preliminarily anticipate for this WWTP effluent into Cascade Brook. Also, please inform me of whether DEC Region 3 regards engineered wetlands as a feasible technology alternative for this level of treatment (for a portion of the wastewater), or whether all of the wastewater should be directed to the proposed conventional WWTP for more rapid review and approval.

Please do not hesitate to contact me with any questions at 518-273-0055 or jbeninati@chazencompanies.com. Thank you.

Sincerely,

James T. Beninati

James T. Beninati, PE
Senior Engineer

Enclosures:

USGS Map, Figure Z15 (modified to include wastewater features)

cc:
John Glass, Dutchess County DOH
File

Appendix C:
NYSDOH Effluent Reuse Guidelines

The Chazen Companies
August 15, 2006
Revised October 5, 2007

Cross Bel Dec 01.doc

STATE OF NEW YORK
DEPARTMENT OF HEALTH

Flanigan Square, 547 River Street, Troy, New York 12180-2216

Antonia C. Novello, M.D., M.P.H., Dr.P.H.
Commissioner

Dennis P. Whalen
Executive Deputy Commissioner

May 30, 2003

Mr. Peter Freehafer
New York State Department of Environmental Conservation
Office of Environmental Quality – Region 4
1150 North Westcott Road
Schenectady, NY 12306-2014

RE: Golf Course Irrigation, Wildacres Resort.

Dear Peter:

The following material is in response to your request for comments on the golf course irrigation page of the draft SPDES permit for the Wildacres Resort. In addition, included are recommendations related to fecal coliforms in the effluent, a brief literature review on risk and reiterations of parts of our telephone conversations (May 1 and May 30, 2003) that helped clarify some issues for NYSDOH.

A. Effluent Limitiations

1. Regarding the effluent limitations on fecal coliforms - suggestion.

The 30-day average (geometric mean) is suggested as 200 FC/100ml. This office concurs with the ≤200 FC/100 ml standard since the public may come into direct contact with the "lawn" or surface. We would suggest an increased frequency of sampling when the pond actually is in use. The rationale for this suggestion are as follow: Since the waste facility will be tertiary-treated sewage that finished with microfiltration or continuously backwashed upflow dual sand (CBUDS) filters, it seems that the effluent limitations may never be exceeded: [1] If microfiltration units with 0.2 – 0.45 micron cut-offs are used and are functioning properly, then bacteria in the effluent should be non-existent unless the filters are rated "nominal"; [2] If they are rated "absolute" then the filter throughput should be free of bacteria unless there is filter failure; [3] If the filters are designed primarily for *Cryptosporidium*, then they should be 1.0 micron absolute cut-off filters and some bacteria would be expected to pass through the membrane; [4] CBUDS has been found to be equivalent to microfiltration for the purposes of protozoan cyst and oocyst removal. It would be expected that effluent bacterial levels could be relatively high when compared to membrane microfiltration.

The specified 30-day average of 200 FC/100ml is similar to what the World Health Organization (WHO) recommends for Category A treated wastewater for use in agriculture (unrestricted irrigation, including sports fields and public parks): The recommended geometric mean is ≤ 1000 FC/100 ml but WHO also recommends the slightly more stringent standard of ≤200 FC/100 ml in areas of high public traffic.

The most stringent effluent guidelines are those in California and states that follow California's example. The State of California Health Code for unrestricted access sites such as golf courses requires a median value of 23 total coliform/100 ml for a 30-day period. Ohio, specifies in its bulletin 860 a value of 23 MPN/100ml for a 30-day average.

B. Special Conditions

1. Special Condition #4: Application time - reiteration

From our conversations, you noted that irrigation would not be permitted during daylight hours when the public is actually using the course. The spray applications will be at dawn and dusk when patrons are not on the course. The purpose of the dawn and dusk applications is that there can be visual verification of the lack of ponding and run-off. If the applicant can demonstrate the lack of ponding and run-off during controlled overnight applications, then the permit may be modified.

2. Special Condition #3: Irrigation restrictions - reiteration

Special condition #3 was modified to read that irrigation was not permitted if the "daily" rainfall has been, or is expected to be, greater than one tenth of an inch. The original text only restricted rainfall to one tenth of an inch without specifying a time frame.

3. (New) Special Condition #8: Cross Connection Control – recommendation.

Wastewater lines to the irrigation ponds must be separate and distinct from any water line supplying potable water to the irrigation ponds.

C. Effluent parameters and application methods as they relate to risk to the human population – In support of 200 FC/100ml.

The spray application of the wastewater to areas frequented by the public will be a concern for all parties involved. The following bullets are statements related to the disease risk to humans for unrestricted irrigation *of crops for consumption* as summarized in the WHO document listed in the reference. The SPDES effluent conditions meet or exceed most WHO application guidelines. Given that no crop is being consumed at the golf course we would expect that risk factors for increased incidence of disease noted below would be reduced even further.

- When FC guidelines are exceeded by a factor of 10 there is a significant increase in disease but *only* when crops for consumption are involved.

- When crops were spray irrigated with tertiary-treated wastewater with >100 viruses per 100 liters, the risk of infection never was greater than 10^{-4}.
- In another study, when unchlorinated secondary effluent was used food crops the annual risk ranged from 10^{-3} to 10^{-5}; when the effluents were chlorinated the risk was reduced to 10^{-7} to 10^{-9}.
- Analysis of aerosol exposure to wastewater containing 10^3 to 10^4 FC/100 ml does not result in excess infection with enteric viruses. Studies have also shown that the guideline of $\leq 10^5$ FC/100 ml during sprinkler or spray irrigation should be sufficiently protective for the nearby population and farmworkers in direct contact with the aerosol.

The draft SPDES permit for *effluent* is more stringent than the suggested WHO *application* guidelines. The only exception is that WHO uses a guideline that also includes nematode eggs (<≤0.1/ liter) for crops; to the best of our knowledge California does not follow that guideline.

D. References

Blumenthal, U.J., D. D. Mara, A. Peasey, G. Ruiz-Palacios, and R. Stott. 2000. Guidelines for the microbiological quality of treated wastewater used in agriculture: recommendations for revising WHO guidelines. Bulletin of the World Health Organization, 78(9):1104-1116.

Whitmore, Roy W., *Testing Equivalence of Microfiltration and Contiuous-Backwash-Upflow, Dual-Sand Filtration Technologies*, Document #RTI/6922/371-01F, Report submitted to USEPA Office of Research and Development, Quality Assurance Division, by Research Triangle Institute, Research Triangle Park, NC (1998)

NYCDEP, *Village of Stamford Tertiary Wastewater Treatment Demonstration Project Comparing Continuously Backwashed Upflow Dual Sand Filtration and Microfiltration*, http://www.ci.nyc.ny.us/html/dep/pdf/stamford.pdf

State of California, *Wastewater reclamation Criteria*, California Code of Regulations, Title 22, Division 4, Environmental Health, Department of Health Services, Sacramento, California, 1978 .

Reuse of Reclaimed Wastewater Through Irrigation , Bulletin 860, http://ohioline. osu.edu/b860 / b860_14.html

Thank you for your assistance and we hope this information is helpful for this project.

Sincerely,

David M. Dziewulski, Ph.D
Research Scientist
Bureau of Water Supply Protection - NYC Watershed Unit

Copy: J.M. Dunn/C. Hudson

Special Conditions for Golf Course Irrigation

a. Golf course irrigation from the Irrigation Ponds is permitted from April 1 through November 30. Withdrawals may occur outside of this period only for the purposes of maintenance and testing of the lines and sprinkler heads.

b. Irrigation shall be conducted so there is no surface runoff or ponding.

c. Irrigation is not permitted during and immediately following rainfall events.

d. Irrigation is not permitted during any period of upset of the wastewater treatment plant, and cannot resume until fecal coliform and total coliform levels are demonstrated to meet the Effluent Disinfection limits provided on Pages 4 and 5 of 21 of this permit.

e. Irrigation is permitted only at dawn and dusk when patrons are not on the course, and is not permitted during daylight hours and during those hours when the golf course is in use by the public. If the permittee can demonstrate the lack of ponding and run-off during controlled overnight applications, then the permittee can request modification of this permit Special Condition.

f. Irrigation is not permitted within 200 feet of classified surface waters or public roadways, except for near tees, greens and the golf course practice range, unless one or a combination of the following conditions are met:

- In the case of public roadways, the area between the location being irrigated and the public roadway contains a tree line adequate in providing an effective natural barrier for the prevention of wind-borne aerosols from reaching the public roadway, provided such irrigation does not involve direct spraying of trees.

- For areas to be irrigated that are not separated from a surface water or public roadway by tree lines, fixed directional sprinkler heads with spray patterns affecting only the golf course areas intended, are utilized. Such areas utilizing fixed directional sprinkler heads shall have installed swales or utilize other grading measures to prevent runoff from directly entering the adjacent surface water or public roadway.

g. Signs will be prominently posted on the golf course identifying the source of the irrigation water, the SPDES permit number and a Big Indian Plateau and Department contact person. The Department contact person is the Regional Water Engineer, NYSDEC Region 3, 200 White Plains Road, 5th Floor, Tarrytown, NY, telephone (914) 332-1835.

h. Irrigation water monitoring data required by this permit shall be kept up to date and available for public inspection at the golf course.

i. Hose connections shall have signs identifying the source of water and access to these areas shall be limited to maintenance personnel.

i. Wastewater lines to and from the Irrigation Pond must be separate and distinct from any water line supplying potable
water within the facility, including supply to the Irrigation Pond.

j. If using potable water for irrigation, the permittee must ensure that there are no cross-connections to any WWTP effluent line or the Irrigation Ponds.

Excerpted Disinfection Requirements
from Pages 5 and 6 of
Draft SDPES Permit Number NY 027 0679

Effluent Disinfection required: [X] All Year [ ] Seasonal from __________ to										
Coliform, Fecal	30 Day Geometric Mean	200	No./ 100 ml			Monthly	Grab		X	2,5

SPDES PERMIT NUMBER NY 027 0679
6

	EFFLUENT LIMIT					MONITORING REQUIREMENTS				
Coliform, Fecal	7 Day Geometric Mean	[illegible] 400	No./ 100 ml			Monthly	Grab		X	2,5
Coliform, Total	30 Day Geometric Mean	1000	No./ 100 ml			Monthly	Grab		X	2,4
Chlorine, Total Residual *	Daily Maximum	0.1	mg/l			Daily	Grab		X	2,5

* If Chlorine is used for disinfection.