Field Operations

Fresh Kills

Fresh Kills Preferred
Utility Scenario

DRAFT 1

Field Operations

Fresh Kills

Fresh Kills Preferred Utility Scenario

December 2007

Ove Arup & Partners Consulting Engineers PC
155 Avenue of the Americas,
New York NY 10013
Tel +1 212 229 2669 Fax +1 212 229 1056
www.arup.com

Job number 131730

ARUP

Document Verification

Job title	Fresh Kills	Job number 131730
Document title	Fresh Kills Preferred Utility Scenario	File reference
Document ref		

Revision	Date	Filename	Preferred development scenario 12.18.07.doc		
Draft 1	12/17/07	Description	First draft		
			Prepared by	Checked by	Approved by
		Name	CT		
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			

Issue Document Verification with Document ✓

Contents

1 Introduction

This report presents a preferred development scenario for utility development in Fresh Kills Park. The preferred scenario was selected by the New York City Department of Parks and Recreation (NYCDPR) project development team as an ambitious yet realistic way forward to develop utilities in the park. This report expands on the scenario and provides more detail on the potential locations of individual technologies. The preferred scenario was selected from four scenarios which were loosely defined as:

1. Conventional utility supply i.e. 100% grid connected with no sustainable technologies
2. 20% more sustainable
3. 50% more sustainable
4. 100% sustainable or “off grid”

The third scenario was selected as the preferred scenario and can be summarized as: integrating green building principles into all buildings and integrating technologies that can supply some, but not all, of the required utilities and rely less on municipal or private services providers. With some exceptions this scenario still recommends that the park be grid connected for all utilities.

This report is the fourth in a series of reports which has described alternative utility options for Fresh Kills Park. The previously issued reports are:

1. Applied Sustainable Energy Technologies
2. Applied Sustainable Water and Waste Technologies
3. Fresh Kills Utility Development Scenarios

All of these reports should be consulted for information on specific technologies, the approach that was taken to calculate the demand for utilities and the various assumptions that were made in those calculations.

After NYCDPR has reviewed this report, Arup will develop the preferred scenario into a utility Implementation Plan for Fresh Kills. The Implementation Plan will contain goals and strategies which will inform and guide the integration of sustainable technologies into the design and construction, focusing on resource conservation, but also suggesting technologies in the longer term.

1.1 Scenario Development

This report does not provide a detailed methodology describing how the scenario was developed, as this was provided in the earlier report *Fresh Kills Utility Development Scenarios.* However, due to the ongoing development of the program for the park, certain data has changed which was used in the earlier report. This is principally related to the downsizing of certain elements of the park. As the scenario is essentially a strategic approach it does not significantly affect this development scenario. However, the revised baselines calculations are presented in Table 1. These represent the first scenario i.e. demand for utilities under a conventional build scenario assuming no sustainable technologies or green design principles.

Table 1 - Baseline Calculations for utility consumption

	Program Built Years	
Utility	**2016 (Phase 1)**	**2036 (Phase 2)***
Energy (kWh/day)	12,258	30,589
Water (gallons per day)	90,938	283,958
Wastewater (gallons per day)	65,000	170,000
Waste (tons per day)	3.3	8.5

*2036 phase includes all of phase 1

The revised calculations in Table 1 are important as all scenarios were developed from this baseline through reduction strategies. Therefore, the utility demand calculations presented for scenario three in the *Fresh Kills Utility Development Scenarios* report have also been revised and are presented in Table 2. The calculations represent how much energy and water will be needed and the volume of waste and wastewater that would need to be processed by municipal or private services.

Table 2 - Scenario 3 utility consumption

	Program Built Years	
Utility	**2016 (Phase 1)**	**2036 (Phase 2)**
Energy (kWh/day)*	4,830	9,378
Water (gallons per day)	39,359	148,668
Wastewater (gallons per day)	19,500	51,000
Waste (tons per day)	1	2.6

The utility demand calculations presented in Table 2 also reflect the two phased development approach which will enable the park to be built over time. The calculations take into account which buildings and structures will be built within each phase.

2 Energy

This section describes how the demand for and provision of energy could be potentially managed at Fresh Kills Park. The scenario comprises two strategies to deliver a more sustainable approach to energy use at the site which are:

- The reduction of energy within buildings and infrastructure
- The use of renewable energy technologies to supply a share of the park's energy

Table 3 presents calculations for how dependency on the grid would be reduced by implementing the various strategies described in the rest of this section. The calculations provide an energy value for each strategy. The final rows in the table present the energy required from the grid after all the strategies are implemented.

Table 3 - Energy Reduction Calculations

	Energy (kWh/day)	
	2016 (Phase 1)	**2036 (Phase 2)**
Baseline scenario energy demand from grid	**12,258**	**30,589**
Strategies/technologies for reducing demand from grid		
LEED®/ Green building principles	8,581	21,412
Powering all outdoor lights with PV's*	6,069	11,997
Powering 10% of remaining utility demand with wind turbines	5,348	11,277
Powering 10% of remaining utility demand with PV's	4,830	9,378
Total energy demand from grid after implementation of all reduction strategies	**4,830**	**9,378**

*Excludes sports fields floodlights

2.1 Energy demand reduction

As a public project it is likely that the Park will need to comply with Local Law 86 as projects that receive City funding over $2 million must become LEED® accredited or meet green building standards equivalent to LEED® Silver. As discussed in previous reports, integrating green building practices can significantly reduce energy demand by approximately 30% and often more. Indeed, this strategy would require that the energy code, ASHRAE 90.1 2004 would be exceeded by 30%. This is quite achievable for new buildings in the New York area. Table 3 shows that total energy required from the grid after this scenario is implemented would be 8,581 kWh/day for 2016 and 21,412kWh for 2036.

The previous reports suggested active and passive technologies to achieve this energy reduction. The feasibility and economic viability of these strategies and technologies would be determined after detailed, site-specific analysis is undertaken and as building designs are further developed.

2.2 Energy supply technologies

After reducing the site energy load requirements by at least 30%, a series of distributed renewable technologies should be installed, which would further reduce the park's reliance on grid-supplied energy. In most cases, these distributed sources will be backed up by the grid, primarily for reliability purposes, but also to sell any excess power to the grid. In order to receive grants for renewables, two-way metering is often a pre-requisite.

Solar power and wind power are the most widely used renewable technologies apart from hydro electric, which is not a feasible energy source at Fresh Kills. Solar power can be easily integrated into buildings by installing photovoltaic panels (PVs) on roofs, using solar powered lighting and to heat water for direct use or heating. This development scenario proposes three measures to use renewable energy technologies on site:

- All outdoor lighting except floodlights are powered by PVs and are not grid connected (approximately 50% of energy demand)
- Approximately 10% of the remaining energy demand is met by PV installations
- Approximately 10% of the remaining energy demand is met by wind turbines

2.2.1 Solar Power

Solar Powered lights

Implementing this scenario would entail powering all its outdoor lights powered by PVs as independent units. This would include all outdoor lighting except where floodlights are required e.g. sports fields. This would account for approximately 20 - 30% of baseline calculations i.e. 2,500kWh in Phase 1 (2016) and 9,500kWh in Phase 2 (2036). Specific lighting products will need to be sourced and their specifications will need to meet with NYCDPR standards where applicable. The cost of lights powered by PVs is generally more than conventional lights, but it is expected that this will be offset by reduced infrastructure installation and operational costs.

Photovoltaics for other uses

Preliminary evaluation of the site conditions and proposed buildings indicate that PVs have greater potential to be integrated into the park program than wind turbines. The site is constrained by poor wind and restrictive foundation conditions and obstructions, therefore, installing turbines to produce a significant amount of energy would be hard to achieve. PVs can be easily integrated into the significant amount of roof area in the park and, are compatible with rainwater recycling systems.

Table 4 presents conservative calculations using 10% of the roof area in Phase 1 (2016) and 15% for Phase 2 (2036) for PV panels. This would deliver approximately 10% of the entire energy demand for the site in 2016 and slightly more (15%) in 2036. The slightly higher percentage in 2036 is to make up for the deficit in wind energy production (see below).

Table 4 - PV Potential

	Program Built Years	
	2016 (Phase 1)	2036 (Phase 2)*
Roof area (ft^2)	11,893	43,518
Potential Energy Produced (kWh/day)	518	1,899

Costs for panels are approximately $146 per square foot for materials and installation. However, this cost be reduced significantly by subsidies, grants and discounts. A layout plan for proposed technologies is appended in Appendix A. The layout plan presents potential locations for PV arrays chosen matched with buildings i.e. where there are large energy users there are more PV arrays. Remote sites, including all independent comfort stations, also have PV arrays for dusk and dawn lighting needs.

Solar thermal technologies are also recommended throughout the site where there is a demand for hot water and heating. Solar thermal technologies contribute to reducing energy use from heating water and are compatible with PV installations. Large comfort stations, restaurants and cafes are all well suited applications for solar exchangers.

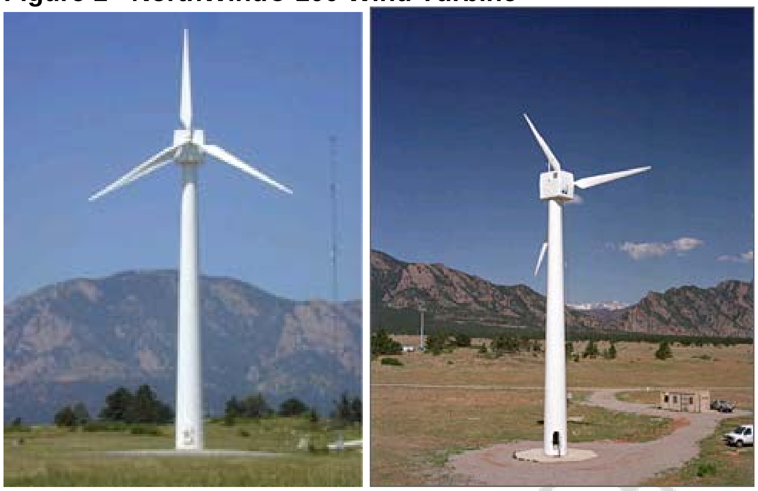
2.2.2 Wind power

As stated above there is potential for wind technology on the site but the locations are not ideal. The *Applied Sustainable Energy Technologies* report discussed various wind technology benefits and constraints. This scenario proposes that approximately 10% of total site demand would come from wind energy. Therefore, this scenario recommends two mid-sized turbines. Mid-size turbines (100 ft to hub) offer a compromise between generating a significant amount of energy without being overly imposing. Smaller sized turbines were evaluated for delivering energy to the site, but it is considered that they would be less effective than using mid-sized turbines. Smaller turbines are less efficient and produce less energy. Approximately 10 small turbines would be required to supply the same energy as two mid-sized turbines. Due to site constraints, it is considered that having more efficient energy producers using less surface area would be preferable.

A recommended wind turbine is the NorthWind® 100 Wind Turbine, which is approximately 100ft to the hub with a 60ft diameter rotor. The wind turbines would be located in off-mound areas and where there will be high energy demand to reduce infrastructure costs from cabling. A potential site for the turbines would be in the Point area of the Confluence, see plan in Appendix A. There is a high energy demand in this area from restaurant uses and sports field lighting. This location is one of the more exposed areas to the prevailing winds and is less obstructed than other areas with high energy demand, such as Owl Hollow or Creek Landing. There may also be more stable foundations in this area as it is on the periphery of the landfill site. Both turbines should be installed in Phase 1 (2016) of the park's development.

An evaluation of site conditions using RETScreen software revealed that each turbine could generate approximately 360kWh/day under conservative conditions (15% capacity). Therefore, two turbines will not meet 10% of the energy demand in Phase 2 (2036) but they will contribute to the overall reduced dependency on the grid. The shortfall in meeting the 20% of demand from renewables could be met by increased PVs (see previous section). Building another turbine is possible but more detailed work would need to be done to determine a suitable location.

Figure 1 - NorthWind® 100 Wind Turbine



3 Water

The baseline for water demand and reductions under this scenario are presented in Table 5. Water demand is based on water use for irrigation and all other purposes (human consumption, cooking, bathroom use etc). This scenario assumes that a grid connected potable water supply is still needed to supply the water needs that cannot be met onsite.

Table 5 - Water demand calculations

	Water (gallons/day)	
	2016 (Phase 1)	2036 (Phase 2)
Baseline scenario water demand from grid*	**90,938***	**283,958***
Strategies/technologies for reducing demand from grid		
LEED®/ Green building principles	66,244	219,375
Greywater systems	46,744	168,375
Rainwater harvesting	39,359	148,668
Total water demand from grid after implementation of all reduction strategies	**39,359**	**148,668**

*Irrigation demand is 25,938 for 2016 and 113,958 for 2036.

This scenario would implement the following strategies (also shown in Table 5) to reduce water demand and maximize water use in the park:

- Waterless urinals and composting toilets in remote comfort stations (no water supplied)
- Water conservation measures and low flow fixtures throughout
- Grey water recycling systems in larger buildings
- Rainwater harvesting on buildings

All of the above technologies have been discussed in previous reports and are therefore not discussed here. Many of them would need to be implemented to achieve LEED® certification for the buildings. Below are a series of calculations which demonstrate how each technology or measure can contribute to reducing water demand and dependency on the municipal supply. The examples given are for Phase 2 (2036) but the same principles would be applied to Phase 1 (2016).

Table 6 provides a comparison of water use using conventional technologies and low flow fixtures. These measures alone account for a water use reduction of approximately 40%.

Table 6 - Low flow fixture potential

Parameter	Conventional		Low flow fixtures	
Visitors	17,000	visitors per day	17,000	visitors per day
Assume each visitor uses the bathroom	17,000	uses per day	17,000	uses per day
Showers use (1%)	170	shower use per day	170	shower use per day
Assume 3 trip female water closet	40,800	gal/day	28,050	gal/day
Assume 2 trip male urinal, 1 trip male water closet	30,600	gal/day	22,950	gal/day
Assume 3 uses of the faucet	31,875	gal/day	6,375	gal/day
Shower use	2,125	gal/day	1,530	gal/day
Total water use in bathrooms	105,400	gal/day	58,905	gal/day
Food preparation, etc.	64,600	gal/day	46,512	gal/day
TOTAL WATER USE	**170,000**	**gal/day**	**105,417**	**gal/day**

Rainwater harvesting can be achieved through the use of the building's roof to collect rainwater. In calculating rainwater harvesting potential, remote (off-grid) comfort stations were not included as they will not be using water. It is assumed that it would be possible to capture 80% of the rainwater from buildings under normal circumstances. This equates to 7,385 gal/day for Phase 1 (2016) and 19,707 gal/day for Phase 2 (2036). This water could be used for irrigation, toilet flushing, maintenance, and other custodial uses.

Greywater systems should also be implemented in larger buildings and larger comfort stations. By using faucet wastewater, shower water and kitchen water (oil and grease traps and filters are necessary at each sink), 54,417 gal/day can be reused in Phase 2 (2036). The water uses would be the same as those for using rainwater.

These measures and technologies should be implemented in Phases 1 (2016) and 2 (2036). Their cumulative effect would reduce water demand from the municipal supply by approximately 50%.

4 Wastewater

Wastewater is linked to water use. By reducing water demand, the amount of wastewater produced is significantly reduced. Table 7 presents a summary of solutions and values for reducing wastewater processed offsite.

Greywater treatment is part of the solution to managing wastewater; the previous section discussed that potentially 19% of wastewater could be recycled for use within the park for irrigation and other uses. As well as demand reduction, there is the potential to reduce pressure on municipal systems for treatment of used water. The wastewater solution which has the potential to reduce pressure on the municipal wastewater treatment works is constructed wetlands. This is an ambitious solution but it has the potential to work and almost completely closes the loop on processing the remaining 51,000 gals/day of wastewater within the park.

Table 7 - Wastewater reduction calculations

	Wastewater (gallons/day)	
	2016 (Phase 1)	**2036 (Phase 2)**
Baseline scenario wastewater to be processed*	**65,000**	**170,000**
Strategies/technologies for reducing demand from grid		
LEED®/ Green building principles	40,307	105,417
Greywater systems	19,500	51,000
Constructed wetlands	0	0
Total wastewater to be processed after implementation of all reduction strategies*	19,500*	51,000*

*This could be reduced to zero or negligible if constructed wetlands are built.

The location plan in Appendix A proposes locations for two constructed wetland sites. These sites would be designed to manage the wastewater from the Confluence area and South Park where most of the wastewater would come from. The wastewater would still need to be transported to the sites which would require infrastructure. The sites were selected for the proximity to the main watercourse, Arthur Kill and distance from populated areas of the park. The constructed wetlands could potentially treat all remaining wastewater except flows from buildings near Richmond Avenue and Arthur Kill Road which could easily connect to existing sewerage connections.

The reduced flow from water conservation and recycling measures would mean that the constructed wetlands would not need to be more than 10 acres each, and possibly much less.

5 Waste

The waste solutions proposed for the park focuses on three strategies:

- Waste reduction
- Waste recycling
- Composting

All of these strategies and technologies have been discussed in previous reports and with the exception of composting they are straightforward to implement. Together the strategies have the potential to reduce waste from 3.3 tons to 1 ton in Phase 1 (2016) and 8.5 tons to 2.6 tons in Phase 2 (2036). The key action is to develop a Waste Management Strategy which sets a vision for waste management in the park as well as laying policies and management practices for operations within the Park. The Strategy should be developed in conjunction with the Implementation Plan.

Finding a location for the composting site is the major challenge for waste management within the park. Composting sites need a relatively large surface area and have the potential to be an odor nuisance for visitors. Therefore, a location has not been specified as this will need consideration by the Park development team, but suitable locations may include existing onsite DSNY facilities which become vacant. In most cases these facilities are already paved have access roads to transport compostable waste to the site. Table 8 provides a summary of the reduction potential from each waste reduction strategy.

Table 8 - Waste reduction calculations

	Waste (tons/day)	
	2016 (Phase 1)	**2036 (Phase 2)**
Baseline scenario waste produced*	**3.3**	**8.5**
Strategies/technologies for reducing demand from grid		
LEED®/ Recycling and waste strategy	2.3	6
Composting	1	2.6
Total waste to be processed offsite after implementation of all reduction strategies*	1	2.6

6 Summary and recommendations

This report provides more refinement and suggests locations for technologies described in scenario three, which was proposed in the *Fresh Kills Utility Development Scenarios* report. It is not intended to be a comprehensive guide to utility development within the site; it provides an illustration of the potential for developing the park's utilities more sustainably.

As specified in previous reports all calculations are approximate; more data and park program designs are needed to substantiate the calculations.

While this report provides a way forward for identifying measures and technologies for developing the park more sustainably, the consideration of utilities within the park should be approached with flexibility in the future. New technologies are developing quickly, becoming more economical and efficient. NYCDPR should remain open to these emerging technologies and potentially adapt the park program and designs to accommodate new technologies. The consideration of using methane gas from the landfill as an energy source should remain a high priority in considering energy supply.

The next step in this process is to develop an Implementation Plan which will inform and guide the integration of sustainable technologies into the design and construction of the Park. This task will need to be done in close consultation with NYCDPR and the project development team to ensure that the solutions are truly integrated into all aspects of the park.

It is also recommended that the scope of the Implementation Plan is widened to embrace all aspects of sustainability including issues such as transport, community and biodiversity. This plan can build on earlier work completed as part of the Draft Master Plan but will provide one document which can be referred to for guidance on sustainability across the Park.

Appendix A – Location Plan for Sustainable Technologies


LEGEND
REMOTE OFF-GRID COMFORT STATION
PHOTOVOLTAIC ARRAY
WIND TURBINE
CONSTRUCTED WETLAND
NORTH PARK
CONFLUENCE
EAST PARK
SOUTH PARK
WEST PARK
1 mile