Town of Lincoln, MA Landfill

Solar Site Assessment and Habitat Evaluation

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FOREWARD

This report was prepared at the request of the Town of Lincoln Conservation Commission, acting as administrator of a Municipal Energy Technical Assistant Grant awarded to the Green Energy Technology Committee (GETC) by the Massachusetts Department of Energy Resources. The purpose of this study was to investigate the existing ecological functions and values of the Town's capped landfill and to assess potential impacts to these functions and values should a solar array be constructed on it. The site has been previously dedicated as Article 97 conservation land and is now protected and managed for recreation and open space purposes. The potential change in use of the site to a solar energy generating facility requires an assessment and comparison of the natural resources value of the parcel under current and proposed conditions. This information can then be used by the Town to determine what if any functions and values should be replaced to avoid a net loss of Article 97 open space.

1.0 INTRODUCTION

The project site is a 7.1 acre municipal landfill that was closed and capped over 20 years ago. It is maintained as open field and mowed annually in the fall. In 1995 Town Meeting voted to place the land under Article 97 protection as conservation land with the intention of managing it for passive recreation and open space. In keeping with the current Massachusetts Department of Environmental Protection policy of promoting green infrastructure, and specifically of targeting previously developed sites such as capped landfills for solar farms, the Green Energy Technology Committee (GETC) is investigating the potential for utilizing 5.8 acres of the site for installation of a 650-970 KW DC solar array. The project, should it go forward, would contribute to the GETC goal of qualifying for the Commonwealth of Mass. Green Communities designation through reductions in energy consumption and promotion of greenhouse gas reduction.

Implementation of such a project requires a change in the Article 97 status of the land and an obligation to demonstrate there is no net loss of open space within the community. To assist in this determination, the Town has requested that all important natural resource values the site currently provides be identified and that an assessment be conducted to evaluate what effect construction of a solar array would have on such values. This information will then be used to determine whether the loss of ecological value is significant and whether such losses can be acceptably mitigated or restored either on site or on other Town lands.

Rimmer Environmental Consulting conducted an ecological assessment during the fall and winter of 2015 and spring of 2016 to provide baseline information on the project site, the results of which are included herein. The assessment includes detailed vegetative community mapping, an inventory of flora and fauna and identification of important wildlife habitat characteristics and values that presently exist on the site. Also included is an evaluation of likely short and long-term effects construction of a solar array would have on these habitat characteristics and values.

On October 20 and October 30, 2015 REC conducted site inspections to assess site conditions, map existing habitat types, conduct plant and animal inventories and inspect surrounding land uses prior to the annual mowing that occurs in the late fall. A winter inspection was conducted following snowfall on January 24, 2016 to observe winter wildlife and note tracks of wildlife utilizing the site and a spring inspection was conducted on May 2, 2016 to investigate potential vernal pools near the project site. A hand-held GPS unit was used to map vegetative communities and important structural features.

Photo 1: View southeast from access drive, October 2015

2.0 EXISTING CONDITIONS

2.1 PROJECT LOCUS

The project site is a 7.1 acre parcel located on the west side of Mill Street that contains the capped landfill as shown in Figure 1 below. It is contained within a larger 36.61 acre Town-owned parcel incorporating the Transfer Station and surrounding woodland areas. The larger parcel borders the Ricci Field Conservation Area to the west, Minuteman National Historical Park to the north, Minuteman Technical High School to the east and residential land to the south. Virtually the entire conservation parcel within the larger Town-owned parcel consists of the capped landfill which is maintained as open field.

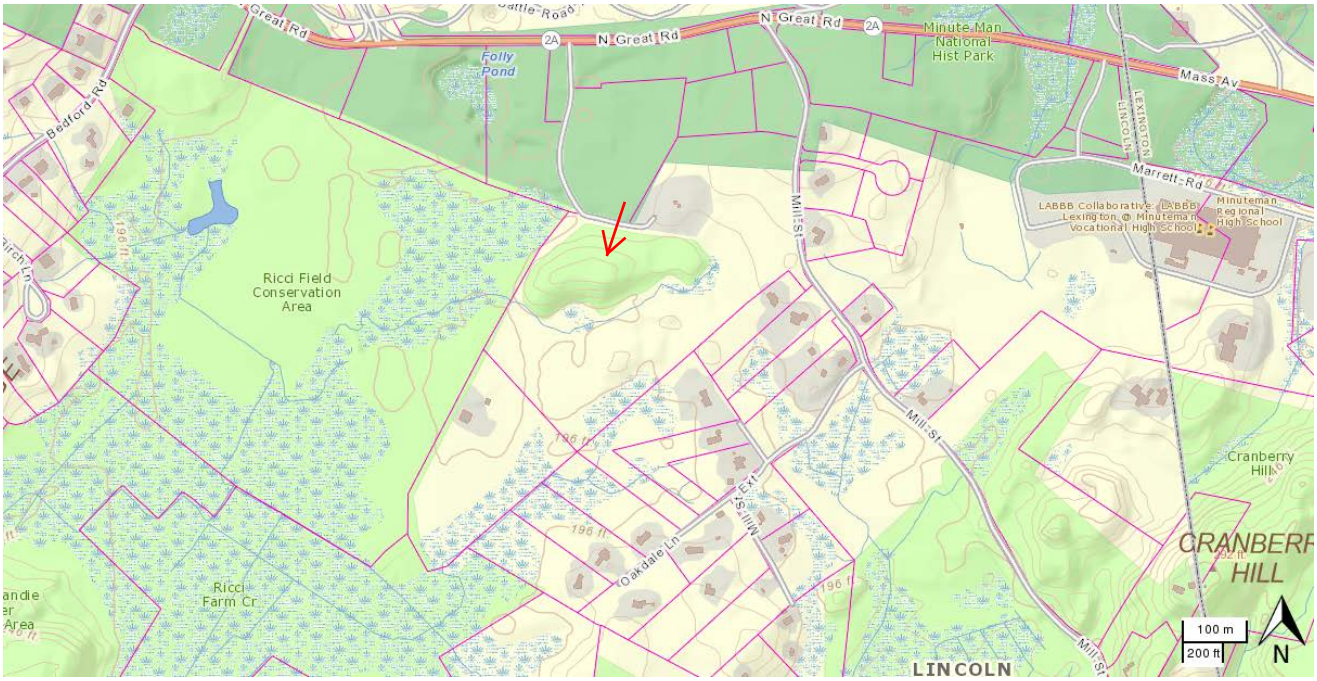

Figure 1: Site Locus (MassGIS)

2.2 TOPOGRAPHY AND SITE DRAINAGE

The site consists of an oblong mound running east to west. It rises gently in elevation approximately 30 feet from Mill Street to the top of the capped landfill then slopes steeply back down to the wetlands on the west and south sides with more gradual slopes extending toward the forested land to the east. The site drains from the top of the cap in all directions. Drainage from this site contributes to the Cambridge Reservoir watershed.

Figure 2: USGS Topographic Quadrangle

2.3 WETLANDS

Most of the project site is upland but there is a narrow band of wet meadow at the base of the north and east slopes, extending parallel to the paved access drive and along the fenced portion of the transfer station. On the south side of the landfill is a small pond/emergent marsh and forested wetland. The ponded area contains a confirmed vernal pool. Wooded wetlands exist off the eastern end of the site and an extensive wooded wetland is located on the Ricci Conservation land to the west. An unnamed intermittent stream passes south along the landfill site connecting the eastern wetland and the pond and extending into the Ricci Conservation Area. Wetlands on the south side of the project site are more extensive than shown on the MassGIS overlay indicated as Figure 3 below. Therefore, much of the perimeter of the landfill is within the 100-foot buffer zone to wetlands regulated under the Massachusetts Wetlands Protection Act (MGL Ch. 131 S. 40) and the Town of Lincoln Wetlands Protection Bylaw.

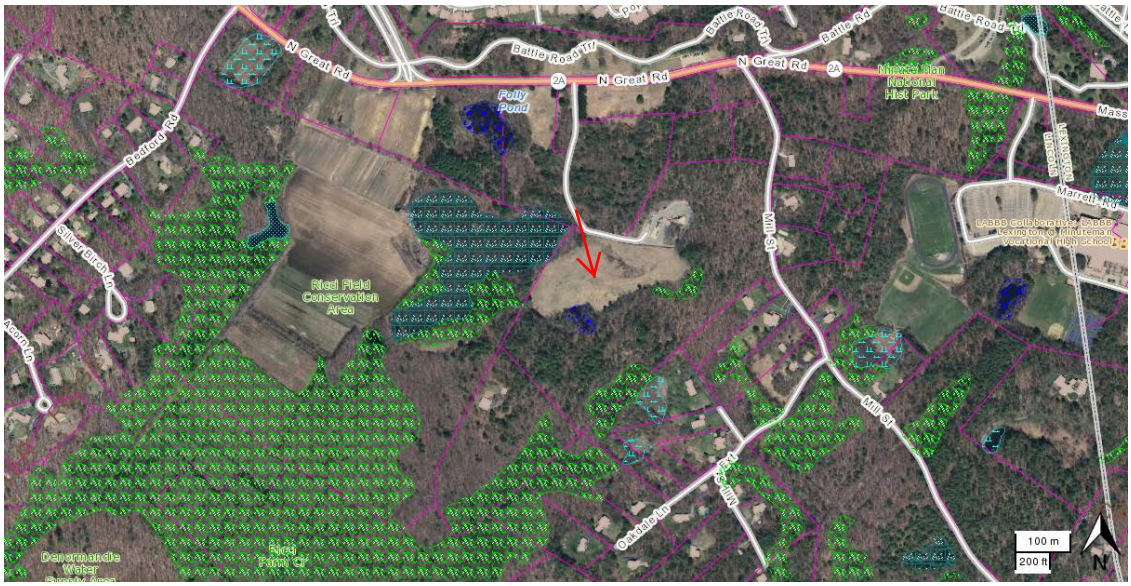

Figure 3: Wetlands Mapping, MassGIS

2.4 FLOODPLAIN

The west and south perimeter of the landfill are subject to a 0.2% annual chance of flooding, or 500 year floodplain as indicated by FEMA and depicted in Figure 4 below. The main portion of the site is not within mapped floodplain.

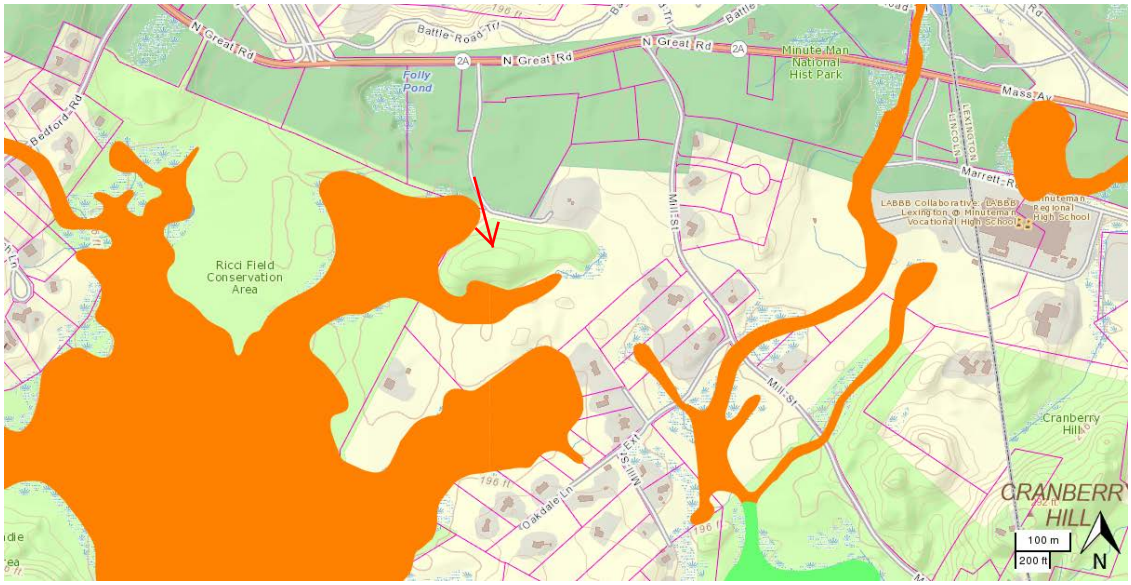

Figure 4: FEMA 500-year Flood Boundary, MassGIS

2.5 SOILS

The soils on the site are mapped as Udorthents with a refuse substratum according to the Middlesex County Soil Survey. This urban soil classification is based upon the post-capped landfill. Field inspection of the surface soil was conducted by REC with a hand-held soil auger at several locations. Results indicate only 1-5 inches of sandy loam atop a dense gravel pack that forms part of the landfill cap with the somewhat deeper topsoil on the lower slopes.

2.6 VEGETATIVE COMMUNITIES

The entire site is maintained as open field through annual mowing. Within the field four vegetative sub-communities were identified that have developed based upon differences in slope, exposure, and depth of soil. The margins of these communities were mapped by GPS and are depicted in Figure 5. Those communities are described generally as follows, with a more complete list of plant species in each community provided in Appendix 1:

1. Upland Grassland: This is the dominant vegetative community, encompassing 5.27 acres on the upper slopes of the landfill site. It is dominated by three non-native species: sheep fescue (*Festuca ovina*), Queen Anne's lace (*Daucus carota* and smooth brome (*Bromus ienermis*) with a mix of other grasses and forbs as described in Appendix 1. The sod-forming grasses were likely installed following the landfill closure as they provide soil stability and are somewhat drought tolerant. A mix of other grasses and forbs are present, providing a good variety, though again much of the species composition is non-native.

Photo 2: Upland Grassland view looking east from summit

2. Bluestem/Moss Area: Approximately 0.5 acres on the eastern slope consists of very shallow and sandy areas with less dense vegetative cover. The area contains upland mosses and little bluestem, which are typical tolerant species and could provide evidence of a small fire in this area. Other species include mouse-eared chickweed, English plantain, red clover and goldenrods which occur throughout the site.

Photo 3: Bluestem/Moss Area view looking northeast

3. Goldenrod Pasture: This 1.2 acre habitat is located primarily along the lower slopes between the bluestem/moss area and the wet meadow described below. Its lower position in the landscape provides wetter soil conditions allowing for a greater diversity and density of plant species. It is dominated by goldenrods, but also contains other wildflowers such as queen anne's lace, aster, tansy and milkweed. Some woody stemmed vegetation, including glossy buckthorn, multiflora rose, lowbush blueberry and crabapple seedlings were also noted in this sub-community.

Photo 4: Goldenrod Pasture, view looking southeast

4. Wet Meadow: This small area includes approximately .09 acres along the base of the north and east slopes where drainage from the landfill mound collects near the access road. It is dominated by reed canary grass, purple loosestrife, goldenrods, sedges and rushes, pussy willow, timothy grass, foxtail grass and woolgrass.

Photo 5: Wet Meadow View from Access Drive

Vegetation within the field is managed by the Conservation Department including an annual late fall mowing to control growth of woody vegetation that might adversely affect the landfill cap. The Conservation Department has also made efforts to control invasive species, especially black swallowwort (*Cynanchum louiseae*) while encouraging species with high wildlife value like common milkweed.

The immediately adjacent woodland areas along the field edges provide opportunities for woody species to become established along the perimeter of the landfill. White pine, black oak, grey birch, and black cherry are all common along the field edge. Non-native vegetation is particularly prevalent in this zone, including asiatic bittersweet, multiflora rose, and honeysuckle.

TOWN OF LINCOLN LANDFILL
Vegetative Community Mapping 2016

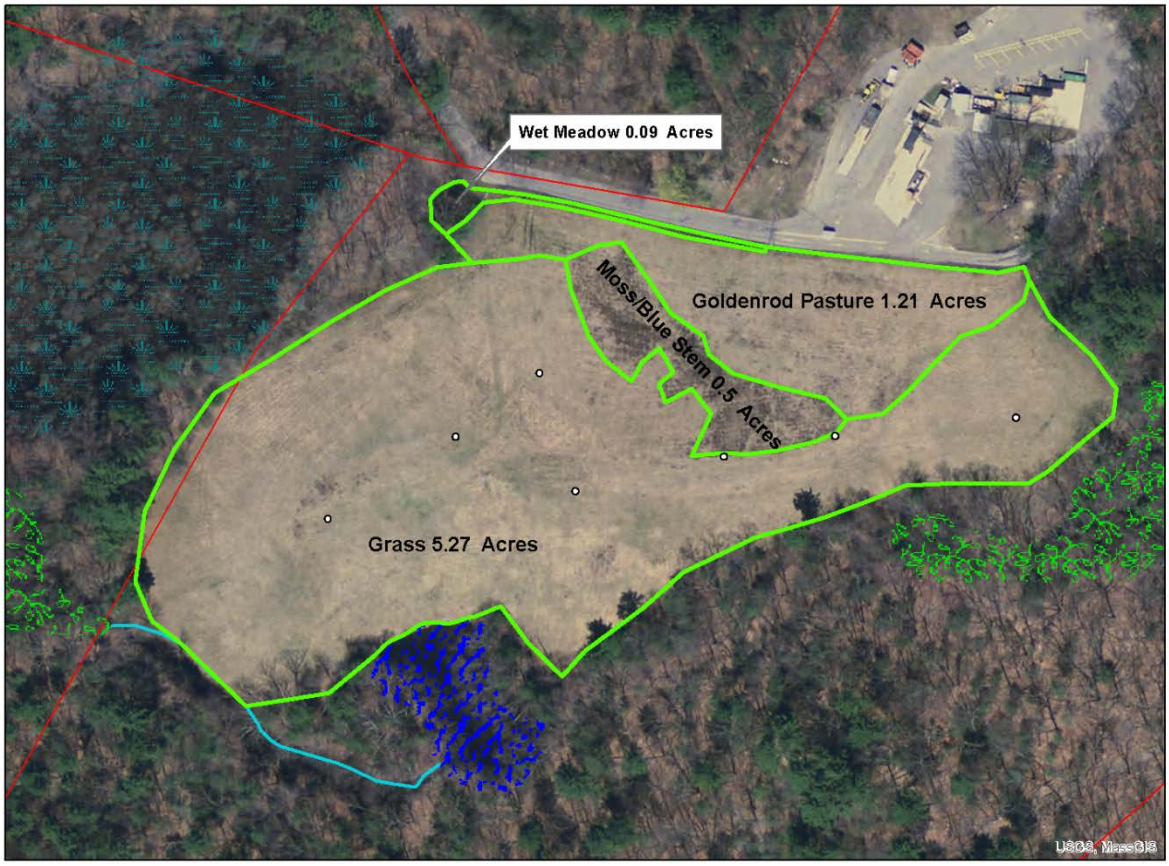

Figure 5

2.7 WILDLIFE HABITAT

Field observations were conducted in October 2015, January 2016 and May 2016. As a result of this limited time period, direct observations primarily limited to non-migratory wildlife species. The site was closely inspected for wildlife sign, including tracks, scat, browse, scrapes, den sites, burrows, cavity trees, and other structural features that would indicate presence of wildlife. Locations of berry-producing shrubs, mast trees and other food sources were also noted.

The site and immediate surrounding land does not contain rare or endangered species habitat as determined by reference to data provided by the Mass. Division of Fisheries and Wildlife - Natural Heritage and Endangered Species Program. It is an entirely man-made landscape due to its history as a landfill and was capped with shallow and poor quality soils with limited organic matter. The lack of a natural soil profile in turn provides poor habitat for invertebrates that would normally support the base of the food chain. The shallow soil and gravel cap also makes it difficult for many species to establish dens and burrows. The annual mowing artificially maintains an herbaceous cover and inhibits natural succession. Overall habitat is relatively homogenous and contains little structural diversity that directly provides food, nesting or cover for wildlife species. Some landfill sites exhibit evidence of settling which creates small depressions in the landscape that can collect water and these areas create pockets that provide an additional habitat feature. There is no such settling that has been observed at this site.

The field is not large enough to support typical grassland nesting species such as bobolinks or eastern meadowlarks, which typically require at least 10 acres of uninterrupted grassland. There are some patches of milkweed that are important to migrating butterflies, especially monarchs. The ubiquitous queen anne's lace, though an introduced species, still provides a food source for black swallowtail caterpillars, lacewings and other insects and the goldenrods, asters and black-eyed susans also attract pollinators. Small mammals will forage on the grasses and seeds and the small patches of lowbush blueberry near the top of the mound and blackberry near the western forested area provide a food source for small and large mammals. Many of the mammal species may be attracted to the site due to the potential food sources due to human activity in and out of the transfer station.

The following is a summary of vertebrate species observed or likely to utilize the site:

Fish: The site does not support fish habitat and the nearest permanent waterbody, Folly Pond, is located more than 600 feet northwest of the project site.

Amphibians: Amphibians require wetter habitat than that which is provided by this site, and not surprisingly none were observed on site. There may be American toad and possibly Red-backed salamander on the margins near the forested areas and possible foraging habitat for Northern leopard frog and Pickerel frog on the lower portions of the field near wetlands, but otherwise the majority of the study is not suitable to amphibians. However, there is a confirmed vernal pool located immediately adjacent to the landfill's southern slope. This pool was found to contain at least eight (8) spotted salamander egg masses in addition to invertebrate vernal pool indicator species such as fairy shrimp (*Eubrancipus vernalis*) and caddisfly larvae.

Photo 6: Spotted salamander egg masses

Photo 7: Vernal pool as viewed from southern slope of landfill

Reptiles: Many reptile species that would occur in the project area also require either forested or aquatic habitats, including most turtle species. Several snake species are likely to use the open field to hunt for invertebrates and small mammals, including common garter snake and Eastern milk snake but none are likely to nest in the open field area. A painted turtle was observed moving from a likely nest site on the southern landfill slope toward the vernal pool during the spring inspection.

Birds: A detailed list of bird species was provided by Vin Durso based upon observations from May 14-September 14, 2015. This list was amended to include additional species observed by REC and is included as Appendix 3. The site is too small and the quality of the grassland probably too low to support grassland nesting bird habitat and none have been observed on the site during the surveys by Mr. Durso. The adjacent fields at the Ricci Conservation Area are more likely to support these species. Nest boxes to attract bluebirds, tree swallows or other species were placed on the upper portions of the landfill but are in need of repair and are presently occupied by wasp nests. Presence of small mammals likely attracts a number of prey species. Red-tailed hawk were observed circling over the field at the time of inspection. The only breeding species observed by Mr. Durso were wild turkey.

Photo 8: Bird nesting box

Photo 9: wild turkey feather

Mammals: Several species of mammals were observed either through direct observation or sign, including white tailed deer, red fox, eastern coyote, eastern cottontail, grey squirrel, and Norway Rat. Mr. Vin Durso reports a family of coyote utilizing the site. Four to six-inch burrows were observed near several of the standpipes at the top of the landfill that are likely created and used by Norway rat based on the burrow size. Winter tracking with snow cover indicated that the perimeter fencing around the transfer station was a barrier to movement, with eastern cottontail tracks concentrating in this area.

Photo 10: White tailed deer leg bone

Photo 11: Burrow – likely Norway Rat

Photo 12: Coyote Scat

The greatest limitation for small mammals is the inability to create burrows within the capped portion of the site, with the exception of those created at the standpipes which have already penetrated the cap. Burrows and dens would have to be located along the side slopes near the margins in areas that may be uncapped or where topsoil depths are greater. There is ample food for small mammals and good cover in most places so they are still expected to be there, just in fewer numbers than a typical grassland habitat. Fewer opportunities for nest sites for small mammals also translates to less prey available for large mammals, hawks and owls.

In summary, while all undeveloped land provides some wildlife habitat, the quality of the habitat at this site is greatly affected by its past use as a landfill. It is an entirely man-made environment and its value for wildlife habitat is limited by its lack of a natural soil profile, a generally non-native plant cover and the requirements of maintaining and protecting the integrity of the cap itself. While it does not appear to be an important site for nesting or breeding species, its proximity to adjacent woodland on three sides creates an edge effect

which allows species that occupy the undisturbed forested habitat to benefit from the additional ecological niche provided by the open field. Therefore, typical woodland species utilize the perimeter of the field where it may be easier to hunt for small mammals, for example, without having to stray far from cover. This surrounding forested land provides perch sites for birds and shades the edges of the field allowing a greater diversity of plants in that portion of the field. The interior portion of the field has been observed to be utilized by numerous species as forage but does not provide good cover or nest sites.

3.0 PROPOSED CONDITIONS

While little is known of the specifics of any proposed solar array for this site, all arrays have the potential for short term disruption of habitat during construction and long-term impacts should important habitat functions not be restored following completion of work. The nature of these impacts varies depending on site specific conditions including the type and quality of the existing habitat. An article in Renewable and Sustainable Energy Reviews on the environmental impacts of utility-scale solar energy (Hernandez et al. 2013) finds that studies quantifying the direct impact of large-scale solar on biodiversity in otherwise undisturbed habitats are few. However, reference to other wildlife disturbance-related studies can provide insight into how these facilities may impact biodiversity locally within the facility footprint. Generally, the better the existing habitat, the more there is potential for adverse impacts to wildlife, especially if the habitat is locally uncommon. The position of the site with respect to other quality habitat is also important as there is significant interaction between habitat types. The security requirements (i.e., fencing) for solar sites have the potential to disrupt wildlife movement for less mobile species through the site and between other habitats. The location of the project close to other sensitive habitats such as vernal pools may exacerbate construction related impacts to wildlife and can result in long-term impacts to those habitats as well.

The type of solar array planned will also have a bearing on the extent of habitat loss expected. The anchoring system proposed will result in direct displacement of vegetation. Surface anchored systems may result in more total long-term surface area covered than pile mounted systems but may result in less soil disturbance to install. On landfill sites, the necessity of preserving the integrity of the cap means that most solar installations will be surface anchored. The design of the racking system, especially the density and height of the panels, directly affects the amount of light available to surface vegetation and the type of long-term cover that can be expected to be maintained. The type of perimeter fencing used can have significant impacts on access to the site and passage through the site by large mammals such as deer and coyote.

The following are typical short and long-term impacts, both positive and negative, from solar construction that might be expected from installation of a solar array within the Town of Lincoln project site.

3.1 POTENTIAL SHORT-TERM CONSTRUCTION RELATED IMPACTS:

1. Soil disturbance from any modifications to the landfill cap to make the site suitable to support the project can result in erosion of soil and potential migration of sediment toward wetlands and waterbodies. Appropriate erosion controls are necessary during installation to mitigate these potential impacts. Any modifications to the cap should also be designed so as to minimize further changes to drainage patterns that could affect adjacent wetlands.

2. Any necessary improvements to the cap to support the proposed construction may present an opportunity to install higher quality topsoil and vegetative cover if such modifications to the surface treatment are allowed by state solid waste regulators. This in turn would provide additional food, nesting and cover for a variety of wildlife species. New seeding should favor native vegetation with shade tolerances appropriate to the proposed design.

3. Installation of utility lines, inverters, transformers, construction access roads and other structures similarly cause soil disturbance and temporary disruption of habitat. Timing of construction is important to minimize the disturbance during sensitive breeding or nesting periods both within the site and immediately surrounding undisturbed areas.

4. Tree clearing to reduce shading impacts in the surrounding area can adversely impact adjacent habitat. Care should be taken to avoid removal of high quality mast trees, or dead standing trees that provide important roosting sites or cavities for nesting birds and small mammals and clearing of trees near sensitive habitats such as vernal pools, waterbodies and waterways.

3.2 POTENTIAL LONG-TERM RELATED IMPACTS:

1. The design of the racking system and the density and height of panels all have a direct bearing on the extent and nature of vegetation that will be retained underneath the panels. Large areas occupied by concrete ballast to support ground mounted arrays, areas of bare soil, or areas covered in gravel do not support the same quality habitat as dense vegetative cover. Smaller, low-impact anchoring systems and taller panels are generally preferable as they affect less vegetation. Dense spacing between panels or rows may not allow vegetation to thrive. Many of the solar sites reviewed under Section 4 below do provide vegetative cover beneath the panels, though there are often shading impacts that favor vegetation adapted to lower light conditions.

2. Construction of access roads to maintain equipment will result in long-term soil and vegetation disturbance and their location and extent should be restricted as much as possible. Import of gravel or other foreign material to construct roads always carries with it the opportunity to introduce non-native and invasive plant species.

3. The design of the perimeter fencing is important since it can create an obstacle to wildlife accessing the site. A fence that is 2.4m high will exclude a typical non-stressed adult deer (Falk, et al. 1978). Studies indicate that even a 25 cm gap will allow an adult deer to pass under a fence (Falk, et al. 1978) and (Feldhamer, et al. 1986) and that a particularly motivated deer could manage with 19 cm (Feldhamer, et al. 1986). Such a design should be considered to minimize impacts to wildlife where the site adjoins other undisturbed habitat. Fencing can also present an obstacle to more general migratory pathways and wildlife corridors. However, because of the orientation of this site and its position in the landscape, even with perimeter fencing in place there is not expected to be a major disruption of wildlife movement between important adjoining conservation parcels, including the Minuteman Park and the Ricci Conservation Area, provided the margins of the open field remain unfenced.

4. There is a vernal pool within the wetland located immediately to the south of the landfill. Cutting of trees in the vicinity of a vernal pool can affect potential migratory routes and overwintering sites for vernal pool species. The landfill site itself does not provide important contributing habitat to the vernal pool.

5. The type of vegetation management practices, including the type of equipment, the frequency and timing of mowing and whether herbicides are permitted to be used can greatly affect wildlife habitat quality. To optimize habitat quality, mowing would be limited to once per year and delayed until at least August 1. Taller panels might require even less frequent management of vegetation. Use of herbicides is not recommended as it is difficult to avoid contact with non-target species, which can affect overall cover, species diversity and potentially adversely impact invertebrate populations. The extent of long-term tree clearing that is required to support the installation can also have a significant impact as loss of food source, nesting, roosting and perch sites. Improper vegetation management can increase the dominance of non-native and invasive plant species so a vegetation management plan should be an integral part of any proposed solar installation.

6. Some have suggested that the panels themselves increase collision risks for birds, though there is presently little scientific evidence to support this assertion and additional studies may be needed on this topic. The consensus seems to be that the panels are likely to present the same hazard to birds as any other type of man-made structure. There have been reports in Europe of dragonflies attempting to lay eggs on the panels, mistaking them for water. While not a significant concern at this site due to the low odonate populations, measures to address this concern in Europe have included installation of

white tape around the perimeter of the panels to reduce their overall reflectivity.

7. Any other incidental activity or product application such as dust suppressors, rust inhibitors, antifreeze agents, etc. should be carefully regulated and monitored to prevent releases that could harm vegetation or wildlife.

8. The life span of landfill solar projects is estimated to be between 20-30 years. Plans for de-activation of the site should include restoration of any degraded habitat.

4.0 SUMMARY

In summary, the ecological value of the project site lies primarily along the lower slopes that adjoin undisturbed woodland areas. Most of the wildlife observed rely on the adjacent woodland area for their primary habitat requirements but benefit from the edge ecotone along the field. Upon completion of construction activities, assuming full restoration of vegetative cover and the installation of wildlife-friendly perimeter fencing along the portions of the site abutting other undisturbed habitat, it is expected that much of the wildlife habitat value the site now provides would continue to be available. Permanent loss of vegetative cover from structures, utilities, ballast, etc. might be off-set by improvements to the quality of cover to allow for more native vegetation. Small mammals would likely return to the site following construction activities and most birds of prey would continue to be able to hunt within and through the panels, with the exception of large hawks such as the Red-tailed hawk. More agile birds like the Cooper's hawk are capable of navigating around the panels. Occasionally, birds have been observed to nest within the racking systems themselves. If small mammals are available, coyote and fox will continue to seek them if they have access to the site. One of the benefits of solar farms is that once constructed, there is very little human activity which significantly reduces the daily disruption to wildlife.

Below are examples of solar sites depicting the various structural components and extent of vegetation to be impacted and maintained within the facilities.

Photo 13: Ballast Installation, Parklands Landfill, NJ
Approx. 40 acres, 10 mW facility (Photo courtesy of Waste Mangement)

Photo 14: Racking System installation, Parklands Landfill, NJ. Note concrete ballast
(Photo courtesy of Waste Management)

Photo 15: True North Energy, Salisbury, MA largest solar park in New England at time of construction in 2012. Installation is 5.7 mW and includes 50 acres

5.0 REPRESENTATIVE SOLAR SITES ON LANDFILLS IN MASSACHUSETTS

There are at least 30 solar installations on closed landfill in Massachusetts and the number is growing. The following is a representative list of sites.

Town of Ludlow – 2.7mW, Borrego Solar, 17 acres

Town of Sudbury – 1.5 MW Ameresco, 5.3 acres

East Hampton, - 2.3 mW Borrego Solar, 16 acres

West Tisbury - 1.2 mW, Cape and Vineyard Electric Cooperative, 6 acres

Maynard Landfill, 1.2 mW Patriot Solar Group, 14 acres

Concord – Keersarge Energy 1.7 MW DC Installation, 35 acres

APPENDIX 1: VEGETATIVE COMMUNITIES

1. Upland Grassland:

*Sheep fescue/Festuca ovina
*Queen anne's lace/Daucus carota
*Red clover/Trifolium pretense
*English plaintain/Plantago lanceolate
*Smooth Brome/Bromus inermis
Slender goldenrod/Solidago erecta
Rough-stem goldenrod/Solidago rugosa
Purple vetch/Vicia americana
Timothy/Phleum pratense
Multiflora rose/Rosa multiflora
Dock/Rumex sp.
Blackberry/Rubus allegheniensis
Deertongue grass/Dicanthelium clandestium
Orchard grass/Dactylis glomerata
Black-eyed susan/Rudbeckia hirta
Wild strawberry/Fragaria virginiana
Cinquefoil/Potentilla recta
St. Johnswort/Hypericum sp.
Quack grass/Elymus repens
Cypress spurge/Auphorbia cyparissius
Aster/Aster sp.
Purple lovegrass/Eragrostis spectabilis
Rough bentgrass/Agrostis scabra
Beach wormwood/Artemisia stelleriana

2. Moss/Bluestem Area

*Little bluestem/Schizachyrium scoparium
*Juniper haircap moss/Polytrichnum juniperinum
English plaintain/Plantago lanceolate
Red clover/Trifolium pretense
Queen Anne's lace/Daucus carota
Mouse-eared chickweed/Cerastium vulgatum
Rough-stem goldenrod/Solidago rugosa
Slender goldenrod/Solidago erecta
Canadien goldenrod/Solidago canadensis
Glossy buckthorn/Frangula alnus
Lowbush blueberry/Vaccinium angustifolia
Sheep fescue/Festuca ovina
White pine seedling/Pinus strobus

*= dominant

3. Goldenrod Pasture

*Queen Anne's lace/Daucus carota
*Sheep fescue/Festuca ovina
Rough stem goldenrod/Solidago rugosa
Canadien goldenrod/Solidago canadensis
Red clover/Trifolium pretense
Aster/Aster sp.
English plaintain/Plantago lanceolate
Lowbush blueberry/Vaccinium angustifolia

Crabgrass/Digitaria sanguinalis
Crabapple/Malus floribunda
Common milkweed/Asclepias syriaca
Common tansy/Tanacetum vulgare

4. Wet Meadow

*rough-stem goldenrod/Solidago rugosa
*Canadien goldenrod/Solidago canadensis
*reed canary grass/Phalaris arundinacea
Woolgrass/Scirpus cyperinus
Purple loosestrife/Lythrum salicaria
Soft rush/Juncus effusus
Aster/Aster sp.
Foxtail/Setaria italic
Timothy/Phleum pretense
Willow/Salix sp.
Potentilla/Potentilla norvegica

APPENDIX 2: VERTEBRATES

Reptiles

	Direct Observation	Potential Habitat
Common Garter snake/Thamnophis sitralis	N	food
DeKay's Brownsnake/Storeria dekayi	N	possibly on margin
Red-bellied snake/Storeria occipitomaculata	N	possibly on margin
North American racer/Coluber constrictor	N	food
Northern watersnake/Nerodia spiedon	N	possibly on margin
Eastern milksnake/Lampropeltis triangulum	N	food
Smooth Greensnake/Opheodrys vernalis	N	food
Painted turtle/Chrysemys picta	Y	in VP. Nesting on slope

Amphibians

American toad/Bufo americanus	N	den, forage on margin
Redback salamander/Plethodon cinereus	N	forage on margin
Northern leopard frog/Lithobates pipiens	N	forage on margin
Pickerel frog/Lithobates palustris	N	forage on margin
Spotted salamander/Ambystoma maculatum	N	vernal pool

Mammals

White-tailed deer	tracks, scat, carcass	bedding area
Raccoon/Procyon lotor	tracks	foraging
Opossum/Didelphis virginiana	N	forage on margins
Red fox/Vulpes vulpes	tracks	forage/hunting
Grey fox/Urocyon cinereoargenteus	N	forage/hunting
Coyote/Canis latrans	tracks and scat	forage
Woodchuck/Marmota monax	N	forage/nesting margins
Grey squirrel/Sciurus carolinensis forage	Y	forage on margins
Red squirrel/Tamiasciurus hudsonicus	N	forage on margins
Southern flying squirrel/ Glaucomys Volans	N	possibly on margin
Northern flying squirrel/Glaucomys sabrinus	N	possibly on margin

Eastern chipmunk/Tanuas striatus	N	forage on margin
White-footed mouse/Peromyscus leucopus tracks	tracks	nesting/forage
House mouse/Mus musculus	N	nesting/forage margins
Southern red-backed vole/Clethrionomys gapperi	N	forage on margins
Meadow vole/Microtus pennsylvanicus	N	forage/nesting margins
Eastern mole/Scalopus aquaticus	N	burrows on margins

	Direct Observation	Potential Habitat
Least shrew/Cryptotis parva	N	burrows in loose soil
Norway rat/Rattus norvegicus	burrows	forage/nesting
Long-tailed weasel/Mustela frenata	N	forage on margins
Fisher/Martes pennanti	N	possible food
Eastern cottontail/Sylvilagus floridanus	tracks	forage
Striped skunk/Mephitis mephitis	N	forage
Little brown bat/Myotis lucifugus	N	possible forage
Big brown bat/Eptesicus fuscus	N	forage

BIRDS

DUCKS, GEESE, AND WATERFOWL
Wood Duck
PHEASANTS, GROUSE, AND ALLIES
Wild Turkey
HERONS, EGRETS, AND BITTERNS
Great Blue Heron
HAWKS, EAGLES, AND KITES
Cooper's Hawk
Red-tailed Hawk
PIGEONS AND DOVES
Mourning Dove
CUCKOOS
Black-billed Cuckoo
SWIFTS
Chimney Swift
WOODPECKERS
Red-bellied Woodpecker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
TYRANT FLYCATCHERS
Eastern Wood-Pewee
Eastern Phoebe
Great Crested Flycatcher
Eastern Kingbird
VIREOS
Warbling Vireo
Red-eyed Vireo
CROWS, JAYS, AND MAGPIES
Blue Jay
American Crow
Common Raven
SWALLOWS
Tree Swallow
Bam Swallow
CHICKADEES AND TITS
Black-capped Chickadee
Tufted Titmouse
NUTHATCHES
White-breasted Nuthatch
WRENS
House Wren
THRUSHES AND ALLIES
Wood Thrush
Eastern Bluebird
American Robin
MOCKINGBIRDS AND THRASHERS
Gray Catbird
STARLINGS
European Starling
WAXWINGS
Cedar Waxwing
NEW WORLD WARBLERS
Ovenbird
Northern Waterthrush
Black-and-white Warbler
Common Yellowthroat
American Redstart
Northern Parula
Magnolia Warbler
Yellow Warbler
Pine Warbler
BUNTINGS AND NEW WORLD SPARROWS
Chipping Sparrow
Song Sparrow
White-throated Sparrow
CARDINALS AND ALLIES
Scarlet Tanager
Northern Cardinal
Rose-breasted Grosbeak
TROUPIALS AND ALLIES
Red-winged Blackbird
Common Grackle
Brown-headed Cowbird
Orchard Oriole
Baltimore Oriole
SISKINS, CROSSBILLS, AND ALLIES
American Goldfinch
OLD WORLD SPARROWS
House Sparrow

Bird inventories were performed by Vin Durso beginning May 14, 2015, on a weekly basis throughout the breeding season and less often thereafter. Surveys are expected to continue through mid-May of 2016, but for the purpose of this report, the data was cut off after the September 14, 2015 survey. It is possible that additional migrants or wintering birds could be found after that date, but probably no additional breeding species. The species recorded were all birds seen or heard from his route around the edge of the landfill, including flyovers and birds in the woods or the wetlands sometimes fairly far beyond the edges of the field itself. A species was considered a possible breeder if it was, at a minimum, observed within a time period determined for that species by Mass Audubon for its Breeding Bird Atlas II in 2007, or if obvious breeding behavior was actually observed (examples: copulation, carrying nest materials, feeding young). 83% of the species encountered were possible breeders, some less likely than others. For example, a flyover Great Blue Heron occurred during the “safe date” period for that species so it is listed as a breeder in the area, but there is no known rookery in the immediate vicinity of the landfill. Other species have ample documentation of breeding and nesting.

Further detail on individual species or records is available. Data from the landfill and from surveys by other surveyors of other fields in Lincoln is maintained in a database designed for that purpose by Nancy Soulette.

While other wildlife was not typically recorded there were observations of a coyote family which spent several weeks in the area often in the field itself. The only species of bird which used the field itself for actual nesting was a family of Wild Turkeys, but other species used the field for foraging and many species used the field edges for a variety of purposes.

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