Repurposing Landfills for Solar Energy:

A site suitability + prioritization analysis in Massachusetts

Cartography by Betsy McDonald on 12/16/13
UEP 232: Intro to GIS
Data Sources: MassGIS, Mass DEP,
NREL, NLCD, USGS National Map
Projected Coordinate System: NAD 1983 State Plane MA Mainland FIPS 2001
Geographic Coordinate System: GCS North American 1983

Tufts

OVERVIEW

Properly sited solar photovoltaic (PV) development in Massachusetts is becoming more and more financially feasible. With this in mind, communities may look for opportunities to develop large scale municipal projects to support the electric load of municipal buildings or assist with the development of community owned solar projects for residents and other electric customers who may not be able to site a system on their own property for technical, monetary or other reasons. The Environmental Protection Agency (EPA) and Department of Energy Resources (DOER) have separately issued guidance on the potential for utilizing landfills for solar development. Siting solar PV on landfills can be advantageous—landfills typically have open space and minimal shading, and solar offers a new use for otherwise unusable or undesirable land. However, there are several geographic criteria that help make some sites more suitable than others. In the larger context of comprehensive energy planning, this analysis aims to model a process for streamlining site identification through spatial analysis by identifying and prioritizing sites with the highest potential for solar PV development, keeping in mind that the analysis is not able to address certain structural and electrical design issues. This analysis assesses the suitability of both capped (closed) and uncapped (active or inactive) existing municipal solid waste (MSW) landfills that do not have other identified post-closure uses. It also looks at how existing landfill PV sites match the set of suitability criteria.

METHODS

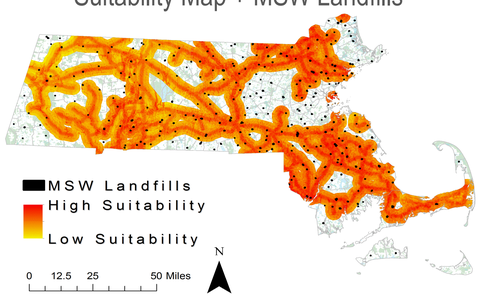
As this analysis targets MSW facilities, landfill sites were first screened to remove landfills that did not meet basic minimum criteria for large scale PV development on MSW landfills. First, landfills that were not classified as MSW were removed. Remaining landfills were removed if they had less than two acres of space and/or if they were far from transmission lines. Landfills were also eliminated if they already had (or had permits for) other non-PV post-closure uses. Landfills that already had (or had permits for) PV onsite were identified and separated. This left two lists: (1) capped and uncapped landfills which met threshold eligibility requirements for future PV development, and (2) sites with existing or pipeline solar PV.

With a refined list of eligible landfills, other significant factors were identified as suitability criteria: specific distance to electric transmission lines (closer is better, with 3 miles as an upper maximum), total solar resource/insolation (higher is better), percent canopy cover (less is better), slope (smaller is better), and proximity to wetlands (further is better). All data layers were converted to raster grids and reclassified on a scale of 1-5 (5 being the best). Each criteria was also assigned an overall weighting to establish the importance of each factor. As an example, the values for distance to transmission are provided below:

Criteria for Suitability	Value (miles)	Score	Overall Weight
Proximity to Transmission Lines	0-.50	5	0.3
	.50-.75	4	
	.75-1.00	3	
	1.00-2.00	2	
	2.00-3.00	1	

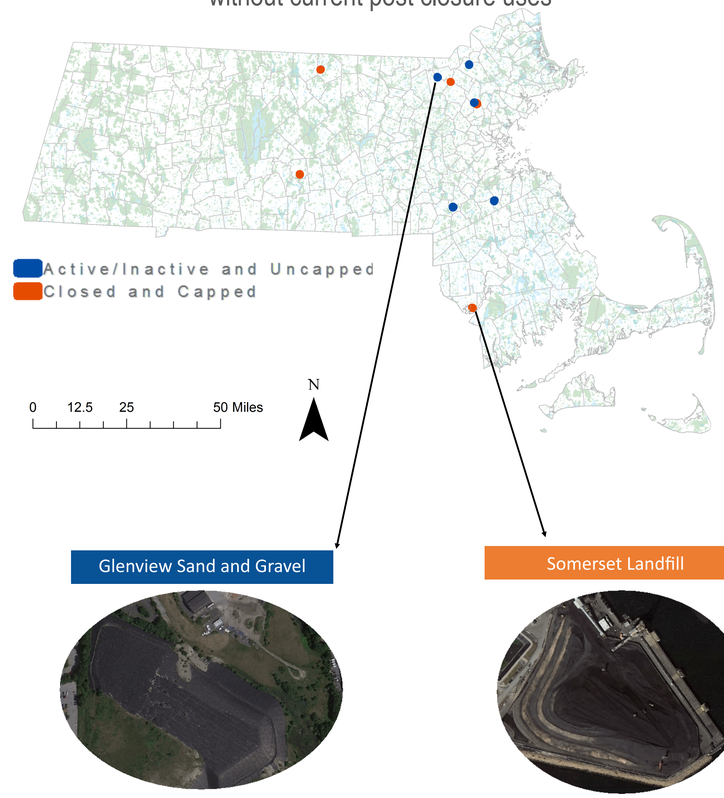
Once all factors were reclassified and individual factor maps were created, a suitability map (extending a 3 mile radius from transmission lines) was created by overlaying and combining scores from each map. For each landfill within the suitability area, an average (mean) score was generated using the zonal statistics as a table tool, and the top 5 capped and top 5 uncapped landfills were identified as priority sites. Scores were also generated for those landfills which already have PV (onsite or in the pipeline). For additional detail on each step and the specific rank and weight structure, please see the accompanying paper.

Suitability Map + MSW Landfills



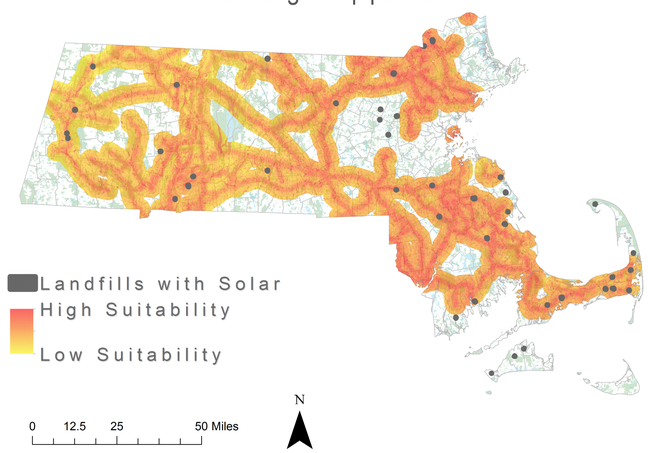
RESULTS + RANKING

Most Suitable Capped and Uncapped Landfills
without current post closure uses



DO EXISTING LANDFILL PV SITES MEET CRITERIA?

Landfills with PV
existing + in pipeline



COMPARISON RANKING OF TOP 5 SITES
for capped, uncapped, and capped with existing PV landfills

Score	Site Name	Location	Cap Status	Post-Closure Use
4.392	Maple Meadow Landfill	Wilmington	Uncapped	None Yet
4.160	Walpole Dump	Walpole	Uncapped	None Yet
4.147	Woburn Landfill	Woburn	Capped	None Yet
4.127	North Brookfield Landfill	North Brookfield	Capped	None Yet
4.127	Easton Landfill	Easton	Capped	PV onsite
4.123	Mashpee Landfill	Mashpee	Capped	PV onsite
4.105	Andover Landfill	Andover	Uncapped	None Yet
4.047	Glenview Sand & Gravel	Chelmsford	Uncapped	None Yet
4.046	Ashburnham Landfill	Ashburnham	Capped	None Yet
4.033	Somerset Landfill	Somerset	Capped	None Yet
4.017	Baker Commodities Landfill	Billerica	Capped	None Yet
4.015	Stoughton Landfill	Stoughton	Uncapped	None Yet
3.866	Greenfield Landfill	Greenfield	Capped	PV onsite
3.858	Barnstable Landfill	Barnstable	Capped	PV onsite
3.740	Canton Landfill	Candton	Capped	PV onsite

DISCUSSION + CONCLUSIONS

While the analysis demonstrates the basic process of site suitability assessment and the prioritization of geographically ideal sites, it should be noted that numerous additional technical and social factors may influence site determination. The criteria considered in this analysis provide a basic, approximate understanding of suitability. Further, there are several limiting factors that influence the ultimate validity of the findings. In particular, the time period in which some of the data sets were last updated may limit the accuracy of the suitability map and the overall rankings. For example, the canopy cover data set was last updated in 2001. While landfill sites may generally be assumed to consist of open and unshaded land, the lack of up-to-date canopy information may have influenced the canopy score for certain landfills. For this reason, canopy cover was weighted slightly less than it might have been had more recent data been available. Additionally, while the specific criteria were all identified through a literature review, the specific value categories and weights were assigned based on more general understandings that certain criteria (proximity to transmission lines, insolation data, canopy) were more significant than others. The final rankings and scores should be interpreted loosely.

With these limitations in mind, this analysis presents an approximate prioritization of 5 capped and 5 uncapped MSW landfills that are particularly geographically suited for solar PV development, based on the selected criteria and available data sets. Capped and uncapped landfills were identified separately due to the unique challenges and opportunities each category faces for solar PV development. While no sites achieved the highest score feasible (a mean score of 5, which would have required a perfect score for each individual criteria factor), several of them ranked with total scores over 4. Only 2 (out of 42) sites that currently have solar or are in the process of installing solar achieved a score over 4. Further, several of these landfill locations were not even within the suitability zone identified by this analysis. A comparison of geographically ideal sites for future development with sites that already have or are currently installing solar reinforces the understanding that additional factors influence site selection. Future iterations of this type of analysis may attempt to visualize some of these additional factors. Going forward, it may be helpful to more explicitly break out municipal goals in installing solar PV (to cover municipal load vs. to help develop participatory community solar projects). More specific delineation of goals may help with considerations of political will or viability and the importance of proximity to urban centers, as examples.

ADDITIONAL REFERENCES

Guide to Developing Solar Photovoltaics at Massachusetts Landfills (Rep.). (2011). Retrieved November 5, 2013, from Massachusetts Department of Energy Resources website: http://www.mass.gov/eea/docs/doer/green-communities/pubs-reports/pvlandfillguide.pdf

Kiatreungwattana, K., Mosey, G., Jones-Johnson, S., Dufficy, C., Bourg, J., Conroy, A., ... Brown, K. (2013, February). *Best practices for siting solar photovoltaics on municipal solid waste landfills* (Rep.). Retrieved November 20, 2013, from Environmental Protection Agency website.