Eco-industrial redevelopment of LA brownfields

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Abstract

This paper focuses on the use of Geographic Information Systems (GIS) within the City of Los Angles (LA) municipal government in the context of eco-industrial redevelopment of brownfield sites. LA, like many cities around the world, has implemented a Brownfields Program to address the problem of urban blight arising from environmental impairment. The program has now expanded to consider eco-industrial concepts. The increasing and dual interests of quality job generation through industrial development and community-focused environmental protection have initiated investigative efforts on eco-industrial redevelopment by the City’s Brownfields Team. Although the definition and understanding of eco-industrial development varies, the City’s efforts revolve around a broadly interpreted encouragement of networks among businesses to achieve maximum economic and environmental performance. This may include waste exchange, sustainable design, pollution prevention, service sharing, and life cycle analysis.

The “Industrial Symbiosis” park in Kalundborg, Denmark, while exemplary, does not provide a model directly relevant to LA, with its different mix of industries and scarcity of undeveloped large tracts of land. Instead, the Brownfields Program may adapt the traditional model to its dense urban fabric by facilitating waste and materials exchanges among existing businesses and using redeveloping brownfields to fill-in the gaps in potential eco-industrial relationships. This approach extends the eco-industrial concept to redevelopment by involving brownfields themselves as an integral component of the reclamation, recycling and reuse process—a scenario that is highly relevant to densifying urban settings with intermittent patterns of decline. The paper illustrates how demonstration GIS analyses on target areas will assess existing industrial conditions, facilitate optimal matching of businesses, and inform policy making for future sites.

Introduction

The use of GIS has become widespread within the LA municipal government and proves particularly helpful in facilitating early action on
contaminated properties or brownfield sites because it enables many environmental and socioeconomic factors to be considered simultaneously. Thus, the City's dual interests in encouraging quality job generation through industrial development and community-focused environmental improvement may be addressed in concert using GIS-based analysis of brownfield sites. This strategy takes the form of an eco-industrial approach to redevelopment, which is consistent with efforts to encourage the growth of recycling markets—as the City has been designated a Recycling Market Development Zone by the California Integrated Waste Management Board (RMDZ 2002). The City's Brownfields Team, comprised of experts from a variety of departments and agencies, has expressed enthusiasm for this approach: the Mayor's Office of Economic Development is evaluating candidate businesses for certain brownfields, the Community Redevelopment Agency (Rodino Associates 2002) has examined the potential for attracting environmental technology industries to LA, and the Environmental Affairs Department has encouraged sustainable infrastructure and amenities on brownfields developments.

LA, like many cities around the world, implemented its Brownfields Program in order to address the problem of urban blight arising from environmental impairment. Specifically, brownfields are "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination." (USEPA 2001) Brownfields often exist because landowners and potential developers lack sufficient information to quell their fears of stigma and liability associated with federal mandates pertaining to past examples of more severely contaminated sites.

This situation has resulted in governments taking action to return brownfields to productive use by providing early decision-making information on sites, incentives for cleanup, and liability protection. The eco-industrial approach transcends traditional redevelopment by allowing governments and industry to collaboratively dialogue about optimal strategies for promoting industrial growth that is compatible with more systematic environmental stewardship. Although the definition of eco-industrial development varies, the key principle behind it is: "an emphasis on fostering networks among businesses and communities to optimize resource use and reduce economic and environmental costs...including pollution prevention, byproduct exchange, green design, life cycle analysis, joint training programs, and public participation." (Schlarb 2001, iv) Eco-industrial development is derived from the field of industrial ecology (e.g., Ausubel 1997) which emphasizes a symbiotic understanding of industry and the natural environment; both of these are closely linked with the wider concept of sustainable development (Allenby 1992)—emphasizing a simultaneous focus on the environment, economy, and social equity in planning and policymaking.

Eco-industrial approaches benefit the redevelopment of brownfield sites because they not only encourage site cleanup, but a more sustainable stewardship of problem properties into the future—whereby tenants engage in more environmentally-sensitive business practices that minimize their impacts on the local environment. This can be done through waste reduction via reuse or recycling among businesses (e.g., one business’ wastewater output is another business’ input) or by pledging to use renewable energy or less-toxic production inputs, packaging, etc. Ultimately, eco-industrial development not only benefits the local environment, but it saves money in the long-run, while also providing jobs, training, and tax-base revenue—the typical benefits of traditional economic development. (Schlarb 2001) Necessarily, eco-industrial development includes a partnering of businesses and
heightened social vigilance on the part of each participant business—since they are investing in the success of each other. The National Center for Eco-Industrial Development lists a variety of implemented eco-industrial park cases on its website.

The “Industrial Symbiosis” park in Kalundborg, Denmark, provides the classic example of a successful eco-industrial development. The park uses bilateral agreements among businesses that include a power plant that produces steam and heated water, which is used by a fish farm and pharmaceutical company within a web of similar exchanges. (Ibid., 19) In LA, the scenario is different because eco-industrial relationships must be forged among already-operating firms. Assessing existing industrial conditions surrounding brownfield sites is thus the first step in determining the feasibility of eco-industrial redevelopment. GIS facilitates the streamlining of necessary data and helps make it palatable to a wide variety of decision makers. Although the City has potentially thousands of brownfield properties, the Brownfields Program focuses on a limited number of these, largely due to a combination of community priorities, non-systematic reporting practices, and limited fiscal resources. Each of these factors directly influences the creation of an adequate GIS model to assess eco-industrial redevelopment potential.

Overview of GIS

As mentioned previously, the Brownfields Program is not a stand-alone agency within the City government; it is implemented by a Resource Team of staff from various agencies, including the Community Redevelopment Agency, the Mayor’s Office of Economic Development, the Community Development Department, and the Environmental Affairs Department. While no single department has jurisdiction over the Brownfields Program, the Environmental Affairs Department (EAD) provides most of the Program’s GIS capability. Brownfield sites are reported to the EAD primarily from City Council offices, the Mayor’s office and various City departments that deal with problem properties. EAD staff records newly reported sites in a spreadsheet database linked to a GIS maintained in ArcView 3.2 software. Approximately fifty sites now receive some level of assistance in the City of LA Program, which has been in existence for about five years. (EAD 2001)

The City offers five categories of assistance to the selected properties, which range from the least intensive “on-call technical assistance” to “major demonstration” status involving the use of funds for issues such as cleanup and site purchase. Program funds come primarily from federal sources—including the U.S. Department of Housing and Urban Development and the U.S. Environmental Protection Agency (USEPA) Showcase Community designation. A portion of these funds has been allocated to information technology strategies including the development of a more efficient GIS to identify and monitor brownfield properties. The City’s Bureau of Engineering (BOE) and Information Technology Agency (ITA) combine to provide parcel polygon shape-files (BOE) and other useful layers served through internal City networks. Though the contamination itself may deviate from parcel boundaries, the City relies on such boundaries to spatially define its brownfield sites due to the underpinning philosophy that brownfields solutions often take the form of complex real estate transactions.
Model Creation Process

Brownfield sites with the best eco-industrial potential consist of either a larger mostly vacant tract of land or an area with a number of blighted parcels that may be assembled into a coherent exchange network. The challenge in LA usually stems from the latter because of the City’s dense and well-entrenched development patterns. Exceptions include the large vacant sites of the Cornfields and Mission Road River District, which currently are not available for eco-industrial development. Most brownfields, however, are small stand-alone parcels, such as abandoned gas stations, or vacant/abandoned sites interspersed among operating enterprises. Examples of the latter are Beverley-Virgil Gully near Hollywood, and the Wilmington Industrial Complex near the Port of LA, each with many parcels and zoning for manufacturing usage. The GIS model will focus upon these two sites.

In order to understand the eco-industrial potential of Beverley-Virgil and Wilmington, it is necessary to acquire data on the businesses within each area. A promising strategy for assessing eco-industrial potential is to develop a proxy on (1) the kinds of wastes generated by each business and (2) the kinds of wastes that may be a potential production input for each business. These data may be used to estimate potential waste exchange among businesses or to recruit new businesses that may be in the market for use of the aggregate waste generated by the businesses within the target area. The California Integrated Waste Management Board recently initiated waste exchange modeling which relies upon the input of locally-relevant data. (CIWMB 2002) The CIWMB presents a waste characterization model that allows localities to assess local wasteshed parameters by using proxy disposal rate codes correlated with business type and size (by number of employees). This proxy assumes the form of a waste-disposal-per-business-per-year statistic that is widely understood in waste management policy circles. (Tseng 2001) The waste disposal per business may be aggregated for wider areas and, subsequently, the data may be used to either (1) recruit new businesses that may use the waste in their production processes as “feedstock” or (2) develop new waste exchange relationships among existing businesses.

The CIWMB system is based upon survey work done to assess the waste inputs and outputs of a sample of California businesses. (Ibid.) This has enabled the development of a model that may be linked to business type as per the U.S. Department of Commerce’s Standard Industrial Classification (SIC) code system. Local business data containing this SIC coding system are available from the American Business Institute (ABI) as well as the U.S. Small Business Administration. The proposed GIS model incorporates ABI data (as it is readily available to the City through contract) for all of LA, with the ultimate goal of implementing a waste characterization analysis for each of the Brownfield Program sites. Here, the Beverley-Virgil and Wilmington Industrial Park sites comprise the initial attempt at adapting the CIWMB model to a community scale within LA.

The ABI data were transmitted from the vendor in electronic spreadsheet format and then converted to spatial data in the form of a point-based shape-file compatible with the EAD’s ArcView 3.2 software. The network of points enables consideration of key factors regarding potential eco-industrial relations among businesses: proximity (because of transport relations among inputs and outputs); adjacency (possibly more conducive for service-sharing); containment (whether any
processes may be completed within the eco-park area in closed-loop use fashion); and direction (to determine compatibility with the wider ecosystem and transportation infrastructure).

Echoing Pequet's (1990) discussion of the stages in data abstraction, the target entity in this case is the piece of land, but it is abstracted through several levels—from the parcel—to the business contained on the parcel—to the SIC code business definition—to the waste behavior classification of that business based upon the SIC code. Depending upon the variation among the types and sizes of businesses and their waste characterization profiles within each of the two target areas, different themes and layers will need to be created to represent them most realistically.

Research Issue and Question: The targeted research question that model will address is: What feedstock exists in urban waste streams within and around the two selected brownfields? The motivation for this question stems from the City's desire to redevelop large brownfield sites where abandoned or underutilized parcels are interspersed with operational businesses; the intention is to redevelop certain parcels in an environmentally-sensitive manner—via reuse and recycling of local waste in their production processes—without disrupting the surrounding businesses. Characterizing waste types and amounts in a certain area provides policymakers with data-ammunition to target the appropriate industries for recruitment.

GIS—Limitations and Future Needs: Drawing a boundary around any area is problematic because functioning relationships could exist across those boundaries that are not captured. Recognizing this limitation, a number of obstacles exist in implementing the kind of GIS model proposed here. First, it is obviously a rough approximation of actual business production and consumption exchanges. Second, this kind of approach is relatively new and lacks a precedent of widespread success; it is therefore extremely exploratory in nature. Third, even given that the waste exchange could be approximated and target types of businesses could be identified, there is another element of complication regarding owners' willingness to either sell their properties, relocate to a remediated brownfield, change their practices, and/or engage in dependency relationships with other businesses.

Anticipating this, however, invites a further challenge to somehow incorporate the feedback of such stakeholders into a GIS model that might more closely approximate real-world conditions, such as which neighborhoods and types of industries might be more amenable to implementing eco-industrial redevelopment strategies. While such a public outreach endeavor is beyond the scope of the subject addressed here, it exists as an important opportunity for future research. However, even if the model lacks in technical prescription, it does provide value in advancing inquiry in these new directions—in a manner described by Haggett and Chorley (1967): “Successful application of models in geography ensures no teleological progress toward full understanding, for scientific effort does not reduce the sum total of problems to be solved—it rather increases them.” Thus, the truest value of the model discussed here is likely found in its function as a link in a chain—moving toward a better understanding of how cities develop and change. The next sections will address key implementation issues.
Business Data: The ABI data are presented in tabular spreadsheet format, containing fields on business name, address (with street number), city, state, zip code (zone), employee class, and industry code. SIC codes were used to classify waste by industry type—using an approximation that has been calculated by the CIWMB that divides these into 39 industry groups. The industry codes were matched with employee class (size) codes to determine waste-generated per employee—a measure for approximating waste volume. These rates have been predetermined by the CIWMB also, yielding a measure of “tons of waste disposed per employee per year”. The table below indicates the number of businesses in all of LA by industry group type.

<table>
<thead>
<tr>
<th>Ind Grp</th>
<th>Group Name</th>
<th># Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Agriculture and Fisheries</td>
<td>1,123</td>
</tr>
<tr>
<td>2</td>
<td>Forestry</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>Trucking and Warehousing</td>
<td>1,395</td>
</tr>
<tr>
<td>19</td>
<td>Transportation (Air)</td>
<td>366</td>
</tr>
</tbody>
</table>

Source: CIWMB 2002

One data limitation of the employee class sizes is that the employee class is represented with a letter corresponding to a range, e.g., “A” equals businesses with 1-4 employees. In order to convert the letters to usable numbers, the midpoint range is determined (Tseng 2002), e.g., in this case, 2.5; however, this becomes problematic with larger businesses when the class size range is much larger, e.g., 1000-4,999. Other limitations concern those businesses that were not assigned an employee class code, which made them unusable for the model, as well as those labeled with a 9999 SIC code, which were not classified under the CIWMB system. A breakdown of the dataset includes 180,422 businesses in the full usable set, with the unusable portion of businesses at approximately 5 percent (These include businesses with no employee codes assigned or “other” classifications not incorporated in the CIWMB’s 39 groups.).

Site Selection: The brownfield sites selected for this study are located in the City of LA—Beverly-Virgil in the north and Wilmington to the south. The Beverly-Virgil site is in the Wilshire Center/Korea Town redevelopment area, covering approximately 57-acres and 209 separate parcels. The Wilmington site is in the LA Harbor/Wilmington redevelopment area and covers hundreds of parcels within approximately 232-acres.

Beverly-Virgil was selected for this analysis because of its socioeconomic conditions, strategic location, and local political activism. It is one of the few areas near Hollywood that is zoned manufacturing, has nearby freeway and subway access, and offers an opportunity to better match jobs to local skills—via the vacant or underutilized parcels within the manufacturing zone. Also, there has been considerable attention paid to the sustainable development potential of the region—instigated locally by the Eco-Village project and spearheaded within the Council Office and City Planning Department in the Station Neighborhood Area Plan (SNAP). The SNAP was adopted by the City Council and is a first-of-its-kind policy proposal to take a systematic approach to environmental improvement in an
LA neighborhood via integrated open space creation, reduced auto-dependency, industrial ecology, and worker training and education (among other prescriptions). The somewhat larger Wilmington Industrial Park area was selected for many of the same reasons. It has been a targeted redevelopment area for over twenty years, but remains an underutilized manufacturing area with significant access to transportation and material flows. The Mayor’s Office of Economic Development has collaborated with the NCEID at the University of Southern California to investigate eco-industrial redevelopment options at this site. Also, a recent Economic Development Administration-funded development/market study will evaluate eco-industrial potential.

**GIS Format:** The GIS fundamentals for the model should be vector-based given that topology is important for the analysis—e.g., containment, adjacency and connectivity will be central to the area-wide waste characterization. For instance, once businesses are geocoded by their physical location and a point file is created, the nodes (and their data attributes, including industry type and employee class size) will then need to be aggregated using buffers around the site areas. Also, the nodes representing businesses' waste disposal behaviors will form the basis of network analysis—to include calculations of shortest transportation routes for the waste exchange relationships and/or determining which parcels are most eligible for construction of new facilities to increase the area-wide capacity for absorbing the extant waste. In this way, pooling waste collection, transport services, and/or treatment becomes a manageable strategy.

**Identification of Themes:** A number of different themes are useful to development of the GIS model; however, they may be subsumed within three groups: parcels, firms, and waste. Parcel data are necessary because they include information about site size, ownership, tax status, shape, and, of course, location. Given these different attributes, sites can be converted to other shape-file groups—such as by parcels with the same owner and/or those that are vacant. Tax status may be used to locate parcels that are tax delinquent and therefore (potentially) more easily acquired by the relevant government. Parcel shape is also useful in making decisions, such as where to site recycling facilities, e.g., in the case of siting materials recycling activities in back-lot areas not in full view of a street. Firm-level data are derived from the ABI spreadsheet as a point file geocoded to a street network file. The street network file is necessary in order to geocode the business addresses, but also to evaluate waste transport scenarios. New fields can be added to the business point file in order to calculate waste-by-employment size category (referenced earlier). Also, other themes can be created based upon dominant industry- or waste-type categories in each area.

The waste category involves the use of themes to demonstrate both waste type and amount. These are designed to adhere to the CIWMB categories that calculates the percentage of waste stream for each of the 39 business groups according to the following waste categories: PAPER (uncoated corrugated cardboard, paper bags, newspaper, white ledger, color ledger, computer paper, and other office paper, magazines and catalogs, phone books and directory, other miscellaneous paper, remainder/composite paper); GLASS (clear glass bottles and containers, green glass bottles and containers, brown glass bottles and containers, other colored glass bottles and containers, flat glass, remainder/composite glass); METAL (tin/steel cans, major appliances, other ferrous, aluminum cans, other non-
ferrous, remainder/composite metal); PLASTIC (HDPE containers, PETE containers, miscellaneous plastic containers, film plastic, durable plastic items, remainder/composite plastic); OTHER ORGANIC (food, leaves and grass, prunings and trimmings, branches and stumps, agricultural crop residues, manures, textiles, remainder/composite organic); CONSTRUCTION AND DEMOLITION (concrete, asphalt paving, asphalt roofing, lumber, gypsum board, rock, soil and fines, remainder/composite construction and demolition); HOUSEHOLD HAZARDOUS WASTE (paint, vehicle and equipment fluids, used oil, batteries, remainder/composite household hazardous); SPECIAL WASTE (ash, sewage solids, industrial sludge, treated medical waste, bulky items, tires, remainder/composite special waste); and MIXED RESIDUE.

The CIWMB model, like the one proposed here, is based upon the premise that "Knowing what materials different types of businesses typically dispose can help them reduce waste, recycle more, and save money...[and]...This information is usually collected by examining waste discarded by individual businesses (a.k.a. "dumpster sorting")." (CIWMB 2002) To calculate the end statistic of tons of waste disposed of per business per year, the following calculations are used:

**Example of ABI data with CIWMB codes:**

```
BUS_NAME     SIC_CODE  INDGRP  DISPRATE  DISPEMP  EMPGRP  EMSIZENUM
Business X   019101    1        0.9       2.25     A        2.5
```

**Example of CIWMB waste type codes:**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Business Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>PAPER</td>
<td>0.134</td>
</tr>
<tr>
<td>1A1</td>
<td>Uncured Corrugated Cardboard</td>
<td>0.044</td>
</tr>
<tr>
<td>1A2</td>
<td>Paper Bags</td>
<td>0.003</td>
</tr>
<tr>
<td>1B1</td>
<td>Newspaper</td>
<td>0.030</td>
</tr>
</tbody>
</table>

Source: California Integrated Waste Management Board 2002

1. Business X, which is classified with a SIC code of 019101 is assigned to CIWMB Industry Group 1 based upon the SIC code groupings assigned in the CIWMB model (each is assigned to one of 39 total groups).
2. Business X, which is classified in Employee Group A (1-4 employees) is assigned an employee number (which is the midpoint value of this employee range in all cases except where the lowest value is used for the category of 10,000 employees or more); in this case, 2.5.
3. The employee number of Business X is then multiplied by the Disposal Rate 0.9 corresponding to Business X’s Industry Group (determined in Step 1 above), which yields the total disposal for Business X in tons per year; in this case, 2.25.
4. To determine the composition of the waste amount derived in Step 4, the waste type factor (e.g., for PAPER), which is unique to each of the 39 Industry Groups, is then multiplied by the total disposal amount from Step 4 to yield the percentage of the total waste that is comprised of each type; in this case 0.134. The resulting amount of paper disposed of per year at Business X is then: 2.25 * 0.134 = .3015 tons.

Since the data collection method of CIWMB is sample-based on “dumpster sorting”, it is important to note that all calculations derived from it are rough approximations. Therefore, certain reservations should be considered in at least three points within the analysis: (1) in using the midpoint range for employee class size; (2) in extrapolating from business type to waste stream type and size; and (3) in inferring that the random sample collected statewide applies to the two LA sites.

Once the basic themes were included in the GIS model, then new buffer themes were created to demonstrate how much waste of each kind is generated...
within a certain distance of each site. Determining the buffer distance settings is a relatively exploratory procedure given that it is unclear how far potential waste exchange participants might be willing to travel/operate to engage in the transaction. For each of the two sites, buffers were created at three radii: 1 mile, 2.5 miles and 5 miles (See example map of the Beverly-Virgil site.) The buffers were used to create new shape-files containing only the businesses within the specific radius. Each subsequently larger radius incorporates the businesses within the smaller radii.

Below is a table detailing the results of the buffer analysis for the two sites (Note that only the major categories are presented here; however, the analysis also provides results for the subcategories listed in the Identification of Themes section):

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Beverly-Virgil Gully</th>
<th>Wilmington Industrial Park</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 Mile</td>
<td>2.5 Miles</td>
</tr>
<tr>
<td>1</td>
<td>PAPER</td>
<td>18,398</td>
<td>139,291</td>
</tr>
<tr>
<td>2</td>
<td>GLASS</td>
<td>1,442</td>
<td>10,950</td>
</tr>
<tr>
<td>3</td>
<td>METAL</td>
<td>3,295</td>
<td>18,748</td>
</tr>
<tr>
<td>4</td>
<td>PLASTIC</td>
<td>4,975</td>
<td>32,026</td>
</tr>
<tr>
<td>5</td>
<td>OTHER ORGANIC</td>
<td>18,668</td>
<td>118,751</td>
</tr>
<tr>
<td>6</td>
<td>CONSTRUCTION AND DEMOLITION</td>
<td>4,285</td>
<td>23,094</td>
</tr>
<tr>
<td>7</td>
<td>HOUSEHOLD HAZARDOUS WASTE</td>
<td>145</td>
<td>966</td>
</tr>
<tr>
<td>8</td>
<td>SPECIAL WASTE</td>
<td>1,261</td>
<td>10,602</td>
</tr>
<tr>
<td>9</td>
<td>MIXED RESIDUE</td>
<td>251</td>
<td>1,720</td>
</tr>
<tr>
<td>Total No. Businesses</td>
<td>4,251</td>
<td>22,404</td>
<td>58,070</td>
</tr>
<tr>
<td>Total Useable for Analysis</td>
<td>3,991</td>
<td>20,714</td>
<td>54,202</td>
</tr>
<tr>
<td>Total Percent Useable</td>
<td>94%</td>
<td>92%</td>
<td>93%</td>
</tr>
</tbody>
</table>

Next Steps

The GIS model uncovers important information about waste types and amounts by location, but to provide value in an eco-industrial exchange context a corresponding reuse scenario must also be designed. The City has embarked on this effort by creating a database of environmentally preferable manufacturers and prioritizing it by the ability to match conditions in market and infrastructure. Since the intention of the model is to look at innovative ways to use waste and divert it from the landfill-bound stream, this kind of analysis will be critical to the model’s success.
Therefore, once waste compositions are profiled for each of the two brownfield sites, then assessments need to be made regarding (1) characterization of parcels available for development within each site and (2) types of businesses that would be able to make use of the identified waste stream as feedstock in their operations. The latter involves identifying operational businesses in other locations that make use of similar feedstock inputs and determining what might influence establishing a similar operation within the two target locations, i.e., interviews might uncover that certain government incentives would be necessary or that crime is a major deterrent, etc. Seen this way, the GIS model is important as a lens in looking at old, used places in a new way. Notably, it serves as a catalyst for reaching a better understanding of the nexus between small-scale entrepreneurship and civic environmentalism.

References


