



**Progress Report 1: October 1, 2008 – September 30, 2009**  
**Assessing Brownfield Sustainability: Lifecycle Assessment and Carbon Footprinting**  
**The Western Pennsylvania Brownfields Center at Carnegie Mellon, in collaboration with**  
**the Pennsylvania Downtown Center**  
**US Environmental Protection Agency Brownfield Training Research and Technical**  
**Assistance Grant**  
**Award: TR – 83417301 – 0**  
**October 1, 2009**

**A. Overall Progress**

The primary purpose of this project is to develop the methodology and subsequent tools that stakeholders can use to assess the sustainability of Brownfield development as measured through carbon footprinting, pollutant emissions and energy impacts. The research is intended to apply innovative analytical techniques (such as economic input-output life cycle analysis) to estimate the carbon emissions, pollutant emissions and energy impacts associated with Brownfield development; while documenting the drivers of these impacts given alternative Brownfield development scenarios.

Training and technical assistance efforts complement the primary research purpose. Through training, we intend to educate and disseminate information that will allow the members of the community to better understand the public health risks of unattended Brownfields and the benefits of alternative remediation strategies. Through technical assistance, we intend to provide targeted communities with a prioritization tool that will allow for fair, transparent and equitable Brownfield development decisions.

Our work has been divided into 3 primary Activities:

- *Activity 1: Training – Empowerment Through Knowledge.* Enhance Pennsylvania Downtown Center's (PDC) webpage for Brownfield relevant information, participate in annual PDC events to provide Brownfield related content, and conduct topic specific seminars. As the

project proceeds, the target group for training will be expanded beyond PDC's current membership.

- *Activity 2: Research – Quantifying the Sustainable Brownfield.* Develop a life cycle assessment model, including footprinting, for comparison of Brownfield development relative to greenfield development, beta test the tool on test sites selected in cooperation with PDC members, finalize and validate the model, develop a computer based tool, train PDC members to use the tool, and coordinate with US Environmental Protection Agency to develop strategy for transferring tool to other Brownfield stakeholders
- *Activity 3: Technical Assistance – Site Selection Through Prioritization.* Assist PDC members in developing inventories of sites, beta test the Site Prioritization tool with select PDC members, finalize Site Prioritization tool, distribute Tool to remainder of PDC members, and coordinate with the Pennsylvania Department of Environmental Protections and the USEPA to develop strategy for transferring both tools to other Brownfield stakeholders

The official date of the award was March 12, 2009. Pre-award approval from the USEPA Project Officer allowed our work to commence in October 2008 and progress, therefore, has been generally on track with the commitments made in our application package.

Carnegie Mellon personnel working on technical aspects of the project include Professor Chris Hendrickson, Dr. Deborah Lange, Amy Nagengast and Michael Blackhurst (graduate students), and Daisy Wang and Ronell Auld (undergraduate students). PDC personnel working on the project include Bill Fontana and Eddy Kaplaniak.

Please note that this work has also leveraged other efforts. First, with Professor Cliff Davidson and Civil Engineering Senior Jeff Miller, we have prepared two draft technical papers based on data compiled in the USEPA 'ACRES' database. One focuses on the demographics of census tracts that contain brownfield projects that have been funded by the USEPA and the other focuses on contamination located on those same brownfields. Second, with the support of the Pennsylvania Department of Environmental Protection, we are working with Michael Baker Corporation to develop an internet accessible version of the multi-attribute decision making tool that we are preparing as part of Activity 3.

## **B. Efforts and Accomplishments by Activity**

### *Activity 1: Training – Empowerment Through Knowledge*

The following training activities have been performed during the time period from October 1, 2008 – September 30, 2009:

#### General Education of PDC Membership

- October 08 – Managers Meeting – State College, PA  
Deborah Lange – Presented brownfield information. A survey was passed out to 126 Elm Street and Main Street revitalization specialists. Thirty-five (35) communities turned in the surveys
- February 09 – Community Revitalization Academy – Harrisburg, PA  
Deborah Lange - Presented ‘Brownfield’s 101’ to twenty-seven (27) first-year Main Street and Elm Street managers.
- March 09 – Western PA Managers Meeting – Pittsburgh, PA  
Deborah Lange - Presented brownfield information and PDC/CMU’s project partnership to forty-one (41) Main Street and Elm Street managers.
- June 09 – PDC’s Annual Conference – Johnstown, PA  
Deborah Lange – Held two “Ask The Expert” sessions. The first session had five (5) community stakeholders and the second session had four (4) community stakeholders.

Although the actual attendance at the session were low, approximately three hundred people were at the conference and numerous casual conversations developed around brownfield redevelopment.

#### PDC’s Brownfield Website Hub

- August 09 - A Brownfield’s website section “Hub” outline was developed by PDC and approved by Carnegie Mellon

- September 09 – A brownfield’s section on PDC’s website is scheduled to lunch at the end of September. Content updates will be added on the ongoing basis.

### *Activity 2: Research – Quantifying the Sustainable Brownfield*

We are pursuing two sub-activities within Activity 2. In Activity 2A, we are making site specific comparisons between a local brownfield and greenfield development. In Activity 2B, we are looking at 2000 census data to evaluate the commuting behavior of people living in census tracts that contain brownfield development as compared to census tracts that contain greenfield developments. Both activities are in a pilot stage and will be expanded to include more communities as our work proceeds.

#### Activity 2A: Site Specific Comparisons

The site analysis is broken into two segments, construction and operation. The construction portion estimates the carbon dioxide contributed by the services and the production of materials, used to erect each development site. The operation segment approximates the annual carbon dioxide emitted from residential utility and vehicle use each year.

It is important to mention the use of the Economic Input Output Life Cycle Assessment (EIO-LCA) tool, developed at Carnegie Mellon, in this carbon footprint analysis. The EIO-LCA tool is able to estimate the amount of carbon dioxide attributed to a certain activity (material production or service), given both the economic sector and the monetary amount pertaining to the activity.

Data for the construction section was provided by the sites’ developer and engineers, in an array of line items specifying the materials and services that underwent the construction phase. The line items were bulked together under their appropriate economic sectors, where their combined sector costs were used alongside the EIO-LCA tool to estimate the construction related emissions. We are in the process of verifying the input data and evaluating the results.

Data for the operation phase was acquired using a residential survey. The survey had four components: Household data, Travel Behavior, Total Mileage and Household Utilities.

Household Data collected the address, the move in date, the number of residents and the months of occupancy for each residential home. Travel Behavior requested the job zip code for each working member of the house, along with the school zip code for each student. In addition to the zip codes, the Travel Behavior also asked for the number of days the workers and students took either a private vehicle, public transit, or walk/bike to their respective zip code. Total Mileage required each household to report the total private vehicle miles traveled per year; as well as the total public transportation miles per week, and total non-leisurely walking/biking miles per week. Household Utilities requested the typical low and high monthly bill for utility gas, electricity and water.

The EIO-LCA tool was used in the operation segment to estimate the carbon dioxide emissions pertaining to utility consumption (in a similar fashion to that of the construction phase). The travel data was transformed using conversion rates for vehicle miles traveled to carbon dioxide emitted.

In addition to cataloging the annual travel distances and the associated carbon dioxide emissions, the operation section also diagrams the commuting behavior by way of the zip code data from the survey. We are in the process of verifying the input data and evaluating the results and the specific conclusions for Activity 2A will be provided in a technical paper currently in development.

#### Activity 2B – Commuting Behavior of Residents

For this activity, we sought a sample of representative US brownfield and greenfield residential developments. We restricted our sample to metropolitan areas for which knowledgeable local residents could identify two relatively large brownfield developments and two comparable greenfield development areas. The developments were chosen to have occurred in the past twenty years and include one hundred or more households. Our final sample is based on suggestions from local urban planners and community economic and development organizations that were contacted via email and telephone. The final sample includes developments in Baltimore, Chicago, Milwaukee, Minneapolis, Pittsburgh, and St. Louis.

We compare the impacts of commuting from a sample of brownfield and greenfield development neighborhoods. Our intent is to investigate the various long-term effects of brownfield developments relative to conventional greenfield developments. Commuting is an important component of such long-term effects. Data on commuting and household incomes are taken from the 2000 Census (Census 09), so our results are for census tracts that include the brownfield and greenfield residential developments as well as surrounding housing.

Using the US Census data for 2000, we were able to identify and compare 12 brownfield and 12 greenfield neighborhoods based on the following parameters:

- Differences in commuting modal splits,
- Travel time for each mode, and;
- Average Travel time to work.

Using these parameters, we were able to draw conclusions on the differences between census tracts that contain brownfield and greenfield developments. The specific conclusions will be provided in a technical paper currently in development. In addition, we are working on completing the carbon emissions resulting from commuting patterns for both types of neighborhoods.

### *Activity 3: Technical Assistance – Site Selection Through Prioritization*

Prior to this award, the Western Pennsylvania Brownfields Center was developing a multi-attribute decision making tool to support communities in making objective and rational decisions relative to the distribution of limited resources. The USEPA award has allowed us to further develop that tool. Progress during the subject reporting period is summarized as follows.

- Began work on a manual for the prioritization tool – with background information appropriate to the previous knowledge of the user
  - What are brownfields and what are the issues?
  - An explanation of the questionnaire – used to collect site specific data to be entered into the tool
    - How its scored
    - Qualitative vs. quantitative

- Explanation of property attributes, indicators and sub-indicators
  - Explaining the Multi-attribute decision making model
    - How the hierarchy was established
    - How to design a unique set of weight
- Revised the Questionnaire
  - Removed questions deemed too difficult to answer/ non-essential information
  - Simplified wording
  - Included brief instructions for answering the questionnaire
  - Streamlined the layout
- Sent the revised questionnaire and instructional documents to a select subset of PDC Main Street managers.

**C. Progress vs Proposed Milestones**

The proposed milestones for Year 1 as presented in our application package are summarized as follows:

<b>Completion YEAR</b>	<b>Activity 1: Training – Empowerment through Knowledge</b>	<b>Activity 2: Research – Quantifying a Sustainable Brownfield</b>	<b>Activity 3: Technical Assistance – Site Selection through Prioritization</b>
1	.Participate in PDC regional events .Update PDC webpage with Brownfield related content .Nat'l Brownfields Conference (Fall 2009)	Develop framework and scope for life cycle assessment and carbon footprinting tool	Complete inventories in all select Main Street/ Elm Street Communities

Our progress to date can be summarized as follows:

Activity 1: We are on track and will attend the National Brownfields Conference (as a presenter) in New Orleans on November 15-18.

Activity 2: We are on track.

Activity 3: We have been challenged in finding the best way to engage PDC’s Main Street managers so we are delayed in the completion of inventories. PDC and Carnegie Mellon are developing a new strategy, one that includes more education and outreach, to engage the Main Street Managers.

## **D. Actual vs, Proposed Expenditures**

Actual expenditures lag proposed expenditures due to delays in getting the award finalized.

## **E. Lessons Learned and Goals by Activity**

### *Activity 1: Training – Empowerment Through Knowledge*

We have found that participation in regularly schedule PDC events is efficient, but conflicting sessions my limit the brownfield discussion. The PDC and Carnegie Mellon are working to find more opportunities for brownfield specific discussions. In the near term, we will also upload the new brownfield webpage. We will encourage feedback from PDC members with the intent to not only improve the content of the webpage but to promote the dialogue and the associated educational process.

### *Activity 2: Research – Quantifying the Sustainable Brownfield*

Activity 2A - Looking forward, the major comparisons between the two sites will be the emissions produced during their operation phase; in particular, those tied to vehicle travel and household operations (utilities). We must take care to differentiate between those conclusions that are clearly dependent on the type of development and those that are independent of the fact that the residents live in a greenfield or a brownfield development.

Activity 2B - A few cities have well documented brownfield redevelopment success stories and have city departments that support such efforts. However, many brownfield restoration projects are small and were not redeveloped for residential uses. Therefore, finding brownfields that met our criteria were challenging. Even more difficult than finding brownfield sites were identifying the large greenfield housing projects that were built in the 1990s near the specific metropolitan areas. Often the collaboration with planning and housing authorities required substantial persistence and time both by email and phone.

### *Activity 3: Technical Assistance – Site Selection Through Prioritization*

We have miscalculated the Main Street Managers' level of understanding with respect to brownfield development. As per Activity 1, we need to find more ways to educate and engage, then focus on the collection of the inventory data before advancing to the prioritization tool.



Regarding the prioritization tool, the manual and questionnaire must be designed and packaged in a way that does not discourage users from reading/completing due to length or tediousness.

The manual to explain the methodology to potential users needs to have the following qualities:

- 1) Short– municipal leaders do not have the time nor expertise to understand all technical aspects of the method. It is not necessary for them to completely understand every aspect. They need to understand only what applies to their task (answering the questionnaire, designing weights, etc.)
- 2) Succinct – the manual needs to help the prioritization process become “transparent” to the user. This means that the user should be comfortable with the prioritization process and satisfied with their knowledge.
- 3) Modular – When being written, it is ideal to write different sections in such a way that they can stand alone. This is because the sections will eventually be moved around and arranged in different ways to suit the needs of different users. A municipal leader who is completing the questionnaire will have questions that are different than the stakeholders who are devising the weights.

*We note that Progress Report 2 will include efforts performed between October 1, 2009 and March 31, 2010.*

Respectfully submitted,



Deborah Lange

Executive Director

Steinbrenner Institute and the Western Pennsylvania Brownfields Center

[dlange@cmu.edu](mailto:dlange@cmu.edu)

(412) 268-7121