Appendix F: Economic Calculators

The Open Space, Parks and Recreation (OSPR) system in the City of Pittsburgh provides significant economic benefits to local residents and businesses and also contributes to the overall economic vitality of the city and the broader region. The role of the OSPR system in contributing to quality of life in the city is broadly understood, but has never been defined in strictly quantitative terms. In order to bridge this gap in applied research related to the economic benefits of the Pittsburgh OSPR system, an economic model has been created to quantify current economic benefits based on available data and research, as well as to provide an economic decision-making tool for considering future investments in the OSPR system.

The types of economic factors that have been quantified for the OpenSpacePGH Plan include: clean air, property values, property tax revenues, stormwater maintenance, and vacant property reuse. Additional factors that could be considered in the future based on additional primary research include direct use value, community cohesion, and general public health[1].

This document serves as an instructional manual for using the *Valuation_Calculators.xls* file supplied to the City in a digital format.

Model Design

The model is structured as series of linked Excel spreadsheets consisting of specific economic calculators designed to receive inputs (acres, square feet, percentage of pervious land, etc.) and generate outputs (economic value, tax revenues, hedonic price factors, etc.). The model serves as a predicative tool but also provides a baseline 2011 assessment of economic impacts at the citywide level. The model is designed to be consistent with PGHSNAP to facilitate the thematic mapping of certain economic outputs at later stages of the OpenSpacePGH process or for future planning purposes.

Summary of Existing Benefits

The existing economic benefits calculated for this process include:

1) Increased property values based on proximity to large (30+ acre) parks
2) Property tax receipts associated with increased property values from park proximity
3) Cost savings to the City government from stormwater mitigation
4) Cost savings to the City government from air pollution removal

[1] These types of economic impacts have been calculated by the Trust for Public Land (TPL) and others in a variety of jurisdictions across the United States. The economic impacts summarized here are based on economic research and analysis conducted by BAE Urban Economics using available secondary data and research for the City of Pittsburgh.

In addition, the summary of existing economic impacts includes a cost to the City of Pittsburgh of city services needed for the maintenance of its large inventory of vacant and abandoned properties.

Taking into account these various economic factors, the total economic value of the OSPR system is approximately $2 billion, with the majority of the economic benefits accruing to individual homeowners in the form of increased property values associated with park amenities[2]. Specific details and the methodology for determining each of the factors displayed in the following table are provided below.

Estimated Value of the Pittsburgh Open Space, Parks and Recreation System - Summary	
Tax Receipts from Increased Property Value	**$48,789,773**
Cost Savings Factors for City Government	
Stormwater Management Value	*$3,010,148*
Air Pollution Mitigation Value	*$397,008*
Estimated Total, Municipal Cost Savings	**$3,407,157**
Property Value from Park Proximity	**$1,951,590,900**
Total Estimated Value	**$2,003,787,829**
Cost of Maintaining Vacant/Abandoned Properties	**-$20,457,155**
Total Economic Impacts of All Open Space	**$1,983,330,674**

Calculator Methodology

Like the summary of existing benefits, the predicative calculator focuses on property values, property tax receipts, stormwater management value, air pollution mitigation value, and the disposal of vacant and abandoned properties. For each type of economic factor, the predicative calculator requires an input such as acres of new park land, number of single family homes within 500 feet of the new or renovated park, and number of vacant and abandoned sites to be transferred to private or nonprofit ownership. Depending on the project being designed, the predicative calculator will provide a series of outputs with dollar values associated with each factor and also the total economic impact of the proposed OpenSpacePGH project. Values, unless otherwise noted, are provided in 2010 dollars, but can be inflated using the consumer price index or a similar index in the future, as needed.

[2] Figures are represented in uninflated 2010 dollars unless otherwise noted.

Specific detailed descriptions of each calculator follow below, including a description of the existing base data and how it might be updated in the future.

Hedonic Property Values and Property Taxes

The hedonic property value calculator quantifies the increase in the value of single-family residences (SFRs) that would result from the development of new park land in Pittsburgh and calculates the increase in municipal tax revenue to follow.

The hedonic value calculator takes the number of non-vacant SFRs that fall within each buffer zone by sector and applies the "green premium" determined by Carnegie Mellon Heinz College researchers through their regression analysis of residential property values. The green premium is the segment of a property's value that can be attributed to its proximity to a public park. By applying the green premium, which is in 2000 dollars, the calculator estimates the gross value of residential property that can be attributed to Pittsburgh parks by sector. Finally, by applying the average residential property tax rate, the calculator yields the estimated annual boost in SFR property tax revenue that is created by the park system.

Note that this calculator differs from the others in that it only applies to park land, and not other types of open space covered in the OSPR system. This is because research on the relationship between open space and property values in Pittsburgh has only been conducted regarding parks. In addition, the results are further constrained by the fact that the calculator only pertains to SFRs, and therefore does not capture the effect that park land may have on the value of other housing types and/or commercial properties.

Data source. The hedonic value calculator utilizes the parcel database provided by the City of Pittsburgh. Each parcel is coded with a use description ("USEDESC"). For the purposes of this calculator, the database was pared down to SFRs only.

Data extraction. Using ArcMap, MIG exported all parcels coded as SFRs and then coded those that were designated as vacant by the City, as well as those that were designated vacant by the Community Technical Assistance Center (CTAC). Then, BAE removed all parcel records designated vacant by either the City, CTAC, or both. Next, BAE created a shapefile with buffers drawn around each large park at five distance ranges tailored to match the Heinz research. (Note that BAE has used the following protocols dictated by the Heinz report: the hedonic value analysis is limited to SFRs located within certain distances of parks that are 30 acres or larger.) Finally, each eligible parcel that fell within one of the buffer distances was coded with its distance from a city park.

Predicative calculator methodology. The hedonic value predictive calculator takes the number of non-vacant SFRs that fall within 500 feet of any new or renovated park and applies a "green premium" of five percent. Unlike the summary of existing economic benefits, this calculator assumes that economic benefits will accrue from any new park regardless of size. By applying a relatively conservative[3] green

[3] Standard green premiums in other major US cities range from 5 to 15 percent. The premium is calculated as five percent of the total number of SFRs within 500 feet of a park amenity based on a median home value of approximately $83,100 as provided by the US Census American Community Survey. Future research into home

premium of five percent to SFRs within a 500 foot buffer range of any new park project, the calculator estimates the gross value of residential property that can be attributed to Pittsburgh parks by sector. Finally, by applying the average residential property tax rate, the calculator yields the estimated annual boost in SFR property tax revenue that is created by the park system.

Removal of Air Pollution

The air pollution calculator quantifies the amount of airborne pollutants sequestered by the creation of new, vegetated open space in Pittsburgh and calculates what it would otherwise cost the City to remove those pollutants by other means.

Data source. The pollution removal calculator utilizes a comprehensive tree canopy dataset produced as part of the National Land Cover Database (NLCD) by the Multi-Resolution Land Characteristics (MRLC) Consortium—a partnership of federal agencies, including the EPA, USGS, USFS, NOAA, and NPS. The dataset, which dates from 2001, was produced by analyzing satellite imagery at a one meter squared resolution and coding each pixel either "canopied" or "not canopied." Then, those pixels were summed within 30 meter squared zones to determine the percent canopied. The dataset, therefore, consists of 30 meter squared pixels that are coded with a percent canopy ranging from zero to 100. By "cross-validating" the dataset with samples of on-the-ground tree surveys, the MRLC determined that its canopy data was 90 percent accurate.

Data extraction. In order to utilize the NLCD data, BAE matched the canopy data to the boundaries of Pittsburgh's OSPR system. This was performed in ArcMap by "clipping" the canopy shapefile so that it matched perfectly the spaces in question. As many of the 30 meter squared pixels were altered in the process, BAE used ArcMap to calculate the area of the remaining shapes. By exporting the clipped data, BAE produced a dataset that broke the City's OSPR into small zones that were coded with both their area (in square meters) and their percent canopy.

Data analysis. BAE separated the OSPR canopy dataset by sector. Then, the area of each shape was converted to square feet and multiplied by its percent canopy to create a "weighted area," or the square feet of canopy within each shape. By summing the weighted areas and converting that figure to acres, BAE obtained the estimated acreage of tree canopy that exists within the OSPR in each sector of the city.

Predicative calculator methodology. The pollution removal calculator follows the method provided by the Trust for Public Land (TPL). First, the calculator tabulates and sums the acres of canopy within the OSPR by sector to find the total acres of tree canopy that can be attributed to Pittsburgh's public open space. Next, the calculator applies "pollutant flux values" for five airborne pollutants identified in the TPL report as having adverse environmental impacts. The flux values estimate the amount of each pollutant removed from the atmosphere annually on a per canopy area basis. David Nowak at the U.S. Forest Service produced the flux values by researching the pollutant concentration and their "rate of deposition" in many American cities, including Pittsburgh, making these flux values location-specific. BAE

values by sector of the City could result in more refined estimates of hedonic value associated with new park amenities.

translated Nowak's figures into pounds sequestered per acre of canopy. Multiplying the acres of canopy throughout the OSPR by the flux values yields the pounds of each pollutant removed annually by the open space system.

Finally, the calculator applies the "median U.S. externality value" for the removal of each airborne pollutant—or the median cost of preventing a pound of that pollutant from entering the atmosphere by other means—to the pounds removed in order to determine the market value of pollution removal provided by the OSPR each year. The user operates the model by inputting proposed acreage of new public open space into the green highlighted cells. Then, the model applies the average percent canopy to this figure to predict how many acres of new canopy would result. Finally, by applying the pollutant flux and externality values (described above), the model outputs the estimated annual value of pollution removal that would be created by adding to the OSPR.

Stormwater Management

The stormwater management calculator quantifies the reduction in runoff that would result from the development of new open space in Pittsburgh over a baseline scenario and calculates what the City would save in municipal expenditures on stormwater maintenance.

Data source. The stormwater management calculator utilizes another NLCD dataset that provides information on impervious surfaces. The impervious surface data was produced using the same methodology as the tree canopy data: the MRLC coded one meter squared pixels of satellite imagery either "pervious" or "impervious" and aggregated that data to produce 30 meter squared pixels that are coded with a percent *impervious* ranging from zero to 100. The MRLC has determined that its impervious surface data is 87 percent accurate.

Data extraction. BAE created two "clipped" datasets to use for analysis in the calculator. The first was produced by clipping the impervious surface dataset to the boundaries of the OSPR. The other was created by *removing* all impervious surface data that fell within the boundaries of the OSPR and clipping the remaining data to the boundaries of the city in order to obtain information on the impervious surfaces that fall *outside* of the OSPR.

Data analysis. BAE separated the clipped OSPR data by sector and according to category and calculated the weighted area in order to obtain the acres of impervious surface within each OSPR category that exist in each sector of the city. In addition, BAE took the dataset clipped to all remaining land and calculated the weighted area in order to obtain the acres of impervious surface that exist outside of the OSPR within each sector.

Predictive calculator methodology. In order to predict fluctuations in the volume of runoff that would result from changes to the OSPR, the predictive model calculates the average percent impervious surface of each park category by dividing the acres of impervious land by the total acres of land within that category (from the citywide inventory). The user operates the model by inputting the acres of proposed new open space according to category and sector in the green highlighted cells. Then, the model applies the annual rainfall and the average percent impervious surface to the proposed new acres to calculate the amount of runoff that would result from those facilities.

Next, the model applies the acres of proposed new open space and annual rainfall to the average percent impervious of *all remaining land* by sector in order to estimate how much runoff is currently produced by the land in question. By subtracting the estimated runoff from any and all additions to the OSPR from the amount of runoff currently produced by that land, the model calculates the runoff reduction that would result from the proposed changes. Finally, by applying the per cubic foot cost of stormwater treatment described above, the model estimates the annual cost savings that would result from the proposed changes by sector.

Disposition of Vacant and Abandoned Residential Properties

The property disposition calculator estimates the cost savings that would result from the sale of vacant and abandoned residential properties for use as open space in Pittsburgh.

The calculator operates by taking (1) the number of vacant and abandoned residential properties proposed for sale and applying (2) a municipal costs multiplier. This multiplier provides an approximate estimate of the costs borne by the City to maintain and protect each property, as well as the loss of tax revenue resulting from delinquency. The model thus predicts the positive fiscal impact on the City of Pittsburgh as a factor of decreased costs and increased revenues.

As the per property multiplier is based on residential scaled lots in Ohio, its application to larger properties likely underestimates the true fiscal impact. Further research and analysis would be needed to provide more refined estimates of costs associated with larger, commercial lots in Pittsburgh.

Data source. The vacant and abandoned properties calculator utilizes the vacant parcel database provided by the City, which includes all those records from the City's comprehensive database that were coded as vacant during the last citywide survey.

Data extraction. Using ArcMap, BAE selected and exported those vacant parcel records that fell within each sector in order to regroup the database by sector.

Data analysis. Each parcel in the database is coded with what appears to be—and, for the purposes of this analysis, is treated as—a land use designation ("STATEDESC"). BAE tabulated the number of parcels that are listed as vacant within each sector according to their designation.

Predictive calculator methodology. The vacant and abandoned properties calculator takes the number of vacant properties that are coded as residential and applies a per property municipal cost multiplier in order to model the amount of money that the City of Pittsburgh spends annually providing services to those properties (fencing, trash removal, police and fire runs, etc.). These expenditures are calculated by sector.

BAE derived the cost multiplier from the 2008 report conducted by Community Research Partners (CRP) detailing the amount of money spent by eight Ohio cities to service and maintain vacant and abandoned residential properties. While the CRP report does not provide an analysis of direct municipal costs on a per acre basis, BAE used CRP's data on gross annual expenditures and the number of vacant and abandoned residential properties surveyed to derive a rough per property cost estimate. BAE inflated that cost estimate to 2010 dollars.

(Though the CRP report also detailed the fiscal impact of tax delinquency resulting from vacancy and abandonment, BAE chose not to utilize that data for two reasons. First, it is likely that the tax structure in Pittsburgh differs substantially from the Ohio study cities. Second, the City of Pittsburgh cannot regain tax value on these properties through the OSPR planning process, because if a vacant residential parcel were to be converted to public open space it would become permanently tax exempt. Also, note that while the calculator tabulates the number of vacant properties in Pittsburgh that are non-residential, those properties are not included in the estimate of municipal costs because the cost multiplier applies to residential properties only. The count of non-residential properties is merely provided as a point of interest.)

The calculator is also designed to predict the municipal cost savings that would result from the disposition of vacant and abandoned residential properties. Assuming that, upon disposal, those properties will no longer be a public burden, the user inputs the number of proposed properties to be sold in the green highlighted cell. Then, the calculator applies the same municipal cost multiplier described above to predict the amount of money that the City of Pittsburgh will save annually in maintenance costs by pushing those properties back into private use.

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