APPENDIX D: ECONOMIC IMAPACT ANALYSIS

PURPOSE

Buffalo Sewer Authority (BSA) wishes to estimate the quantifiable economic benefits of its green infrastructure (GI) initiative, Rain Check 2.0, as part of a broader effort to incorporate social equity into BSA's decision-support process. Based on the Buffalo Metropolitan Statistical Area (MSA), more precisely Buffalo-Cheektowaga-Niagara Falls, NY, which covers all of Erie and Niagara Counties, this memorandum:

- Explores the economic impact of a hypothetical GI project using IMPLAN
- Provides an overview of the size, composition, and income of Buffalo's "Green Infrastructure Workforce," as defined by Jobs for the Future, a nonprofit organization, using standard occupation classifications used by the US Government to gather economic statistics

The results should be interpreted as the approximate expected impacts to the Buffalo economy based on a single change in spending in several sectors related to GI (i.e., the construction of a green infrastructure project) in a single year. The reader should also bear in mind that this analysis is of a non-specific, hypothetical project, and the impacts of actual projects or larger programs may vary significantly depending on scale and composition.

METHODOLOGY AND DATA SOURCES

IMPLAN Economic Impact

The economic impact of green infrastructure (GI) projects was modeled using IMPLAN, a software program with proprietary data sets commonly used by planners to model economic impacts of projects and policy changes. The data is for 2016, the most recent year available. The analysis study area is the Buffalo Metropolitan Area (MSA), which is defined as Erie and Niagara Counties, as shown in Figure 1.

For the analysis, a hypothetical $1 million green infrastructure project was modeled as an Industry Change. The $1 million project was separated into industry sectors to accurately model the impacts. Using project experience with BSA input, Arcadis divided the $1 million into six sectors, as shown in Table 1. The table also includes Local Purchase Percentage (LPP), which is the amount (on a scale of 0-1) of the value of impact event (in this case "industry sales") that will be applied to the regional multipliers. It implies that 1-LPP will be the proportion of the impact event activity that will be imported from outside the economy and have no impact on the local economy. These values are provided by IMPLAN.

Multipliers are key to modeling the economic impact of the industry change. Multipliers represent the total production requirements within the Study Area for every unit of production sold to Final Demand. For example, purchasing a restaurant meal in the study area requires the restaurant to make purchases of ingredients, utilities, labor, and rent, for example, and these purchases will in turn induce additional spending in the region.

A Type I Multiplier is calculated by dividing the sum of the Direct Effects (the change in Final Demand that the analyst inputs into IMPLAN) plus the Indirect Effects (the additional economic activity from Industries buying from other local Industries) by the Direct Effects.

A Type SAM Multiplier (where SAM stands for Social Accounting Matrix) is calculated by dividing the sum of the Direct Effects, Indirect Effects, and Induced Effects by the Direct Effects. The Induced Effects represent the spending of Labor Income by the employees working in the Indirectly-impacted Industries, under the assumption that the more income households earn, the more money those households spend. Note that IMPLAN does not assume that 100% of this Labor Income is spent, nor that it is spent locally. IMPLAN removes payroll taxes, personal

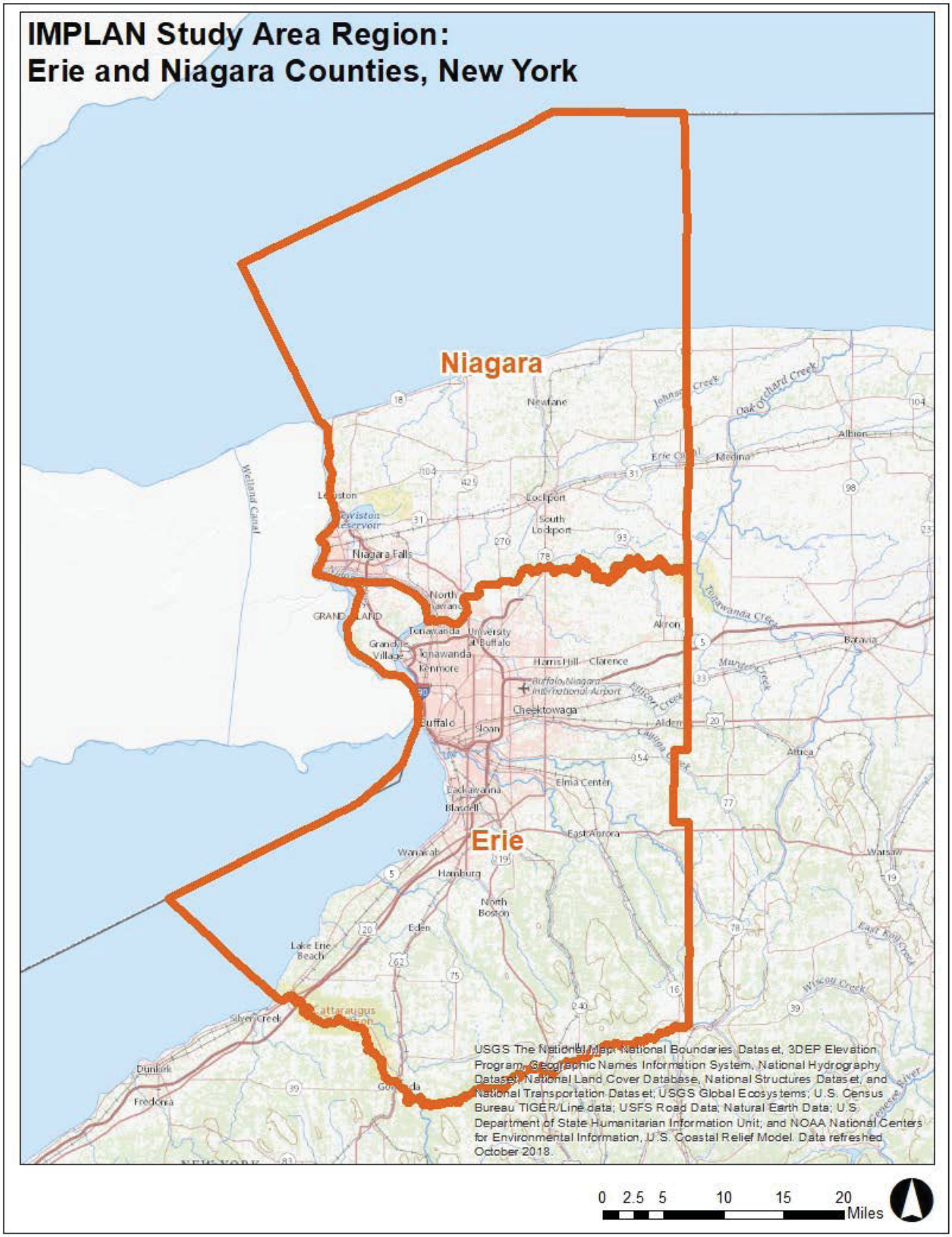
IMPLAN Study Area Region:
Erie and Niagara Counties, New York
Niagara
Erie
Newfane
Lockport
South Lockport
Niagara Falls
North Tonawanda
Tonawanda
University at Buffalo
Grand Island
Grand Island Village
Kenmore
Harris Hill
Clarence
Buffalo Niagara International Airport
Cheektowaga
Buffalo
Sloan
Akron
Batavia
Attica
Elma Center
Lackawanna
Blasdell
East Aurora
Warsaw
Wanakah
Hamburg
North Boston
Eden
Lake Erie Beach
Silver Creek
Dunkirk
Fredonia
Albion
Medina
Oak Orchard Creek
Johnson Creek
Tonawanda Creek
Murder Creek
Eighteen Mile Creek
Cayuga Creek
Wiscoy Creek
Welland Canal
USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global Ecosystems; U.S. Census Bureau TIGER/Line data; USFS Road Data; Natural Earth Data; U.S. Department of State Humanitarian Information Unit; and NOAA National Centers for Environmental Information, U.S. Coastal Relief Model. Data refreshed October 2018.
0 2.5 5 10 15 20
Miles

Figure 1

Table 1: Breakdown of Green Infrastructure Project by Sector

IMPLAN Code	Description	Green Infrastructure Investment	Local Purchase (%)
6	Greenhouse, nursery, and floriculture production	$50,000	5.35
51	Water, sewage and other systems	$300,000	99.89
58	Construction of other new non-residential structures	$300,000	98.80
449	Architectural, engineering, and related services	$105,000	73.55
455	Environmental and other technical consulting services	$70,000	66.22
469	Landscape and horticultural services	$175,000	60.70
TOTAL		$1,000,000	

Table 2: Green Infrastructure Sector Multipliers for Buffalo MSA, from IMPLAN

IMPLAN Code	Description	Type I Multiplier	Type SAM Multiplier
6	Greenhouse, nursery, and floriculture production	1.214831259	1.474679763
51	Water, sewage and other systems	1.361177175	1.838196391
58	Construction of other new nonresidential structures	1.202653738	1.601569156
449	Architectural, engineering, and related services	1.491248268	2.088430739
455	Environmental and other technical consulting services	1.212623187	1.707998386
469	Landscape and horticultural services	1.073732759	1.298422266

income taxes, savings, in-commuter income, and non-local purchases before spending the rest locally. These leakages and expenditures are based on information in the SAM. IMPLAN's SAM is localized at the county level.

Table 2 lists the Type I and SAM multipliers for the selected industry sectors relevant to Green infrastructure, as previously described.

Green Infrastructure Jobs and Employment

Jobs for the Future (JFF), a national non-profit foundation, in a Natureworks Issue Brief titled, Exploring the Green Infrastructure Workforce identified 30 occupations in the interconnected sectors of construction, landscaping, groundskeeping, urban forestry, tree care, ecological restoration, and water/

wastewater. These occupations, including their Standard Occupational Classification (SOC) numerical codes, are listed in Table 3.

The US Bureau of Labor Statistics (BLS) published employment data at the MSA level by SOC code, including wages. Table 4 lists the occupations that comprise the green infrastructure workforce, and the estimated number of these occupations in the Buffalo MSA, as well as the hourly median wage for each.

Note that not all the green infrastructure workforce occupations identified by JFF were present in the Buffalo MSA according to the BLS data. This may be due to a statistically insignificant number of workers in these fields in Buffalo. Several occupations were omitted from the analysis because they were considered inapplicable, such as Roofers, since green roofs are not part of the initiative, or because they are too general, such as Maintenance and Repair Workers, General. Table 5 lists the occupations missing or omitted from the Buffalo MSA data.

Location quotient is a measure of how significant or "concentrated" that occupation is in Buffalo's economy relative to the United States as a whole; a value of 1.0 means the same concentration of workers as the US as a whole; a value less than 1.0 means that occupation is less concentrated in Buffalo, a value greater than 1.0 means it is more concentrated. High location quotient often indicates an export-oriented occupation, with export meaning good or services sold outside the Buffalo MSA.

SUMMARY OF FINDINGS

IMPLAN Economic Impact

A green infrastructure project costing $1 million (a cost estimate is provided in Table 1) should have a $1.5 million impact on Buffalo's economy in the year the project is built, or $1.52 for each $1 invested.

Table 6 summarizes the economic impacts observed using the IMPLAN model for the $1 Million GI project. The definitions are as follows:

Direct Effect—The set of production changes or expenditures made by producers/consumers because of the project. Applying these initial changes to the multipliers in an IMPLAN model will then display how the region will respond, economically to these initial changes.

Indirect Effect—The impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to value added. The impacts are calculated by applying Direct Effects to the Type I Multipliers.

Induced Effect—The response by an economy to the project (direct effect) that occurs through re-spending of income received by a component of value added. IMPLAN's default multiplier recognizes that labor income (employee compensation and proprietor income components of value added) is recirculated through the household spending patterns causing further local economic activity.

Employment—A job in IMPLAN = the annual average of monthly jobs in that industry. Thus, 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each. A job can be either full-time or part-time.

Labor Income—All forms of employment income, including Employee Compensation (wages and benefits) and Proprietor Income resulting from the project.

Value Added—The difference between an industry's or an establishment's total output and the cost of its intermediate inputs. It equals gross output (sales or receipts and other operating income, plus inventory change) minus intermediate inputs (consumption of goods and services purchased from

Table 3: Installation, Maintenance, and Inspection Occupations from Exploring the Green Infrastructure Workforce

SOC Code	Occupation Title
Architecture and Engineering Occupations	
17-3025	Environmental Engineering Technicians
Life, Physical, and Social Science Occupations	
19-4093	Forest and Conservation Technicians
Building and Grounds Cleaning and Maintenance Occupations	
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers
37-3011	Landscaping and Groundskeeping Workers
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation
37-3013	Tree Trimmers and Pruners
Fishing, Farming, and Forestry Occupations	
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse
45-4011	Forest and Conservation Workers
Construction and Extraction Occupations	
47-1011	First-Line Supervisors, Construction Trades and Extraction Workers
47-2051	Cement Masons and Concrete Finishers
47-2061	Construction Laborers
47-2071	Paving, Surfacing, and Tamping Equipment Operators
47-2073	Operating Engineers and other Construction Equipment Operators
47-2151	Pipelayers
47-2181	Roofers
47-3015	Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters
47-3016	Helpers—Roofers
47-4011	Construction and Building Inspectors
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners
47-4091	Segmental Pavers
47-5021	Earth Drillers, Except Oil and Gas
Installation, Maintenance, and Repair Occupations	
49-9012	Control and Valve Installers and Repairers, Minus Mechanical Door
49-9098	Helpers—Installation, Maintenance, and Repair Workers
Production Occupations	
51-8031	Water and Wastewater Treatment Plant and System Operators
Transportation and Materials Moving Occupations	
53-7032	Excavating and Loading Machine and Dragline Operators
53-7051	Industrial Truck and Tractor Operators
53-7072	Pump Operators, Except Wellhead Pumpers

Table 4: Green Infrastructure Workforce statistics for Buffalo MSA, Courtesy US Bureau of Labor Statistics

Standard Occupational Classification (SOC) Code	Occupation	Total Employment in Buffalo MSA (rounded to nearest 10)	Employment per 1,000 of total jobs in Buffalo MSA	Location Quotient	Hourly median wage
17-3025	Environmental Engineering Technicians	40	0.068	0.55	$21.28
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	220	0.406	0.58	$23.05
37-3011	Landscaping and Groundskeeping Workers	3,360	6.14	0.96	$14.16
37-3013	Tree Trimmers and Pruners	60	0.105	0.37	$23.70
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	1,550	2.834	0.73	$33.80
47-2051	Cement Masons and Concrete Finishers	470	0.854	0.68	$18.60
47-2061	Construction Laborers	3,860	7.039	1.04	$17.16
47-2071	Paving, Surfacing, and Tamping Equipment Operators	160	0.286	0.82	$30.18
47-2073	Operating Engineers and Other Construction Equipment Operators	890	1.633	0.64	$28.85
47-2151	Pipelayers	30	0.06	0.22	$27.08
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	90	0.166	0.43	$13.32
47-3016	Helpers--Roofers	**	**	**	$14.36
47-4011	Construction and Building Inspectors	540	0.985	1.42	$27.96
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	70	0.119	0.64	$20.82
49-9012	Control and Valve Installers and Repairers, Except Mechanical Door	360	0.661	1.98	$34.31
51-8031	Water and Wastewater Treatment Plant and System Operators	430	0.778	0.94	$24.70
53-7051	Industrial Truck and Tractor Operators	1,710	3.122	0.78	$18.29
TOTAL		13,840	25	**	(Average) $23.04

Table 5: Green Infrastructure Occupations not present in Buffalo MSA data, or omitted

SOC Code	Occupation Title	Not Present/ Omitted
Life, Physical, and Social Science Occupations		
19-4093	Forest and Conservation Technicians	NP
Building and Grounds Cleaning and Maintenance Occupations		
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	NP
37-3013	Tree Trimmers and Pruners	NP
Fishing, Farming, and Forestry Occupations		
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	NP
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	NP
45-4011	Forest and Conservation Workers	NP
Construction and Extraction Occupations		
47-4091	Segmental Pavers	NP
47-5021	Earth Drillers, Except Oil and Gas	NP
47-2181	Roofers	O
Installation, Maintenance, and Repair Occupations		
49-9071	Maintenance and Repair Workers, General	O
49-9098	Helpers—Installation, Maintenance, and Repair Workers	O
Transportation and Materials Moving Occupations		
53-7032	Excavating and Loading Machine and Dragline Operators	NP
53-7072	Pump Operators, Except Wellhead Pumpers	NP
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	O

Table 6: Summary of Economic Impacts

Impact Type	Employment	Labor Income ($)	Value Added ($)	Output ($)
Direct Effect	8.7	476,980	613,516	828,588
Indirect Effect	1.5	86,317	132,728	235,590
Induced Effect	3.3	148,173	274,474	456,769
Total Effect	13.5	711,470	1,020,719	1,520,947

other industries or imported). Value added consists of compensation of employees, taxes on production and imports less subsidies (formerly indirect business taxes and nontax payments), and gross operating surplus

Output—Output represents the value of industry production. In IMPLAN these are annual production estimates for the year of the data set and are in producer prices. For manufacturers this would be sales plus/minus change in inventory.

The Green Infrastructure Workforce in Buffalo

The $1 million project would be expected to generate approximately 13 jobs during its design and construction, primarily in the construction, water/sewer systems, and landscaping industries.

As of May 2017, the Buffalo Metropolitan Area had approximately 13,840 jobs in industry sectors related to green infrastructure design, construction, and maintenance (the total number of jobs in all occupations in the Buffalo MSA in 2017 was 547,750, according to BLS). These jobs had an average median hourly wage of $23.04, which is 30 percent higher than the median hourly wage for the Metropolitan Area as a whole, $17.77.

1) Bureau of Labor Statistics Occupational Employment Statistics Survey, May 2017 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates; Buffalo-Cheektowaga-Niagara Falls, NY. Retrieved 10/16/2018. https://www.bls.gov/oes/current/oes_15380.htm