

CITY OF PHILADELPHIA

CASE STUDY:

**COST-SAVINGS FROM SOLAR-POWERED COMPACTORS FOR
TRASH AND RECYCLING**

**Impacts of Solar-Powered Trash Compactors, Companion Recycling Units and
Wireless Notification Technology on Operating Costs, Fuel Consumption and
Vehicle Emissions in Center City Philadelphia**



Inaugural Report

June 2009

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Executive Summary

On April 30, 2009, Mayor Michael Nutter unveiled the first of 500 solar-powered trash compactors and 210 companion single-stream recycling units to be installed throughout Center City Philadelphia. The City had been making 17 trips each week to empty 700 wire baskets throughout Center City, at an annual cost of about \$2.3 million. After replacing those 700 receptacles with 500 solar-powered compactors and 210 recycling units, the City collects only 5 times a week, at an annual operating cost of about \$720,000 – representing a 70% savings. Performing those 17 collections each week required 33 workers on 3 shifts, while performing the 5 collections per week under the new program requires only 9 workers on a single shift. The other workers have been re-assigned to other, more productive tasks. The deployment plan was a comprehensive package including a 3-year financing program, a 4-year extended warranty and service plan, and a wireless monitoring system on all 500 units.

Highlights of the program include:

- Immediate savings: By entering into a 3-year financing arrangement, the City has no up-front capital cost and will realize collection cost savings in the first year of approximately \$850,000.
- Ongoing savings: The City will save nearly \$13 million in cumulative collection cost savings over the next 10 years, net of the equipment cost.
- Annual operating cost reduction of 70 percent: compaction reduces collection demand, which directly reduces operating costs and associated vehicle fuel use and emissions.

	Before	After	Savings
Collection frequency	17/week	5/week	12/week (70%)
Annual operating cost	\$2,300,000	\$720,000	\$1,580,000 (70%)
Cumulative 10-year cost	\$23 million	\$10 million	\$13 million (70%)

In conjunction with the installation of the solar-powered trash compactors, the City introduced public space recycling for the very first time in Philadelphia. Mayor Nutter has launched a major public relations and neighborhood education campaign called "Philly Throws Green" with a (www.phillythrowsgreen.org). This program is part of the Mayor's broader initiative called "Greenworks Philadelphia" (www.greenworksphila.org), the new comprehensive sustainability framework designed to help the City meet its proclaimed goal of becoming "America's number one green city."

In the current economy, many cities and towns are actively seeking ways to reduce operating costs and balance their budgets. The City of Philadelphia is demonstrating that solar compactors can significantly reduce annual operating costs in the first year, and for years thereafter, by reducing collection frequency requirements. Providing the City's first public-space recycling program and having the ability to track operations are additional features of the program, which offers clear economic, environmental and educational benefits.



Case Study

With a population of about 1.5 million people, Philadelphia is the largest city in Pennsylvania and the sixth most populous city in the United States. Philadelphia contains many national historic sites that relate to the founding of the United States, and attracts millions of visitors each year for business and tourism. Philadelphia's economy is heavily based upon manufacturing, refining, food and financial services. The City is also a national center of law study.

The Center City district, located between the Schuylkill and Delaware Rivers and between Spring Garden and South Streets, represents the heart of downtown Philadelphia and is home to a majority of the shopping, nightlife, businesses, and historical attractions for which Philadelphia is famous.

Significant waste challenge

The volume of pedestrian traffic in the downtown area creates a significant challenge to the City's Department of Streets, the agency tasked with keeping the streets clean and staying current with a massive public waste challenge. The volume of trash in the district has traditionally required the use of 700 trash receptacles, each collected 17 times per week via four distinct collection routes. The headcount to staff these routes totaled 33, working three full time shifts at a cost to the City of \$2.3 million per year.

A Novel Solution

City officials and specialists from the Massachusetts-based company BigBelly Solar (the Company) jointly completed a comprehensive analysis of the number and placement of all trash receptacles, the timing of the collection routes, and the costs associated with the entire operation. Then, in an effort to maximize efficiencies for the City, the parties carefully completed capacity planning and determined the optimal deployment of the Company's solar compactors, companion recycling units, and related wireless notification technology. The resulting solution, consisting of 500 "BigBelly" solar compactors and 210 matching single-stream recycling containers, proved to be a cost-efficient alternative to current expensive and time-consuming collection efforts. The recycling containers represent the first public space recycling offering ever in the City of Philadelphia, which Mayor Michael Nutter introduced following the success of the City's single stream residential recycling program.

Substantial Savings

The solar compactors increase capacity by approximately 5 times compared to the City's wire mesh litter baskets, enabling Philadelphia to reduce its collection frequency from 17 times per week to 5 times per week, and to reduce budgeted staffing from 33 to 9, operating on a single shift rather than three. Reduced collection trips will also substantially cut related fuel use and greenhouse gas emissions. The annual cost of collection with the new system is estimated to be approximately \$720,000 – representing a 70 percent reduction from the old system.

The comparison of collection frequency and associated costs under the old system and under the new system are summarized in the chart below:

	Before	After	Savings
Collection frequency	17/week	5/week	12/week (71%)
Number of workers	33	9	24 (73%)
Number of shifts	3	1	2 (67%)
Annual operating cost	\$2,300,000	\$720,000	\$1,580,000 (67%)
Cumulative 10-year cost	\$23 million	\$10 million*	\$13 million (70%)

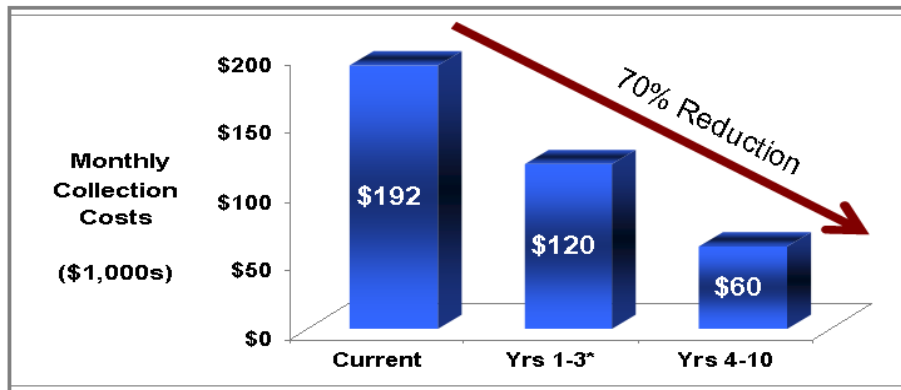
*Including the cost of the solar compactor and recycling equipment

Financing the Equipment Costs

The City purchased the equipment through a lease-to-own finance program offered by the Company and therefore was not required to make an upfront capital expenditure to realize an immediate cash flow improvement. This allowed the City to use the deployment to help close a budget shortfall they faced for fiscal year 2010. The financing arrangement is for three years, during which the equipment lease costs will be less than half the amount of the operating cost savings, resulting in a net cash-flow savings for the City even during the lease period. Over the ten-year useful life of the compactors, the cumulative projected savings that the City expects to realize is about \$13 million.

The net operating cost reductions are illustrated in the following graph.

Driving Down Collection Costs



Replacing 700 standard trashcans on 4 routes in Center City Philadelphia with 500 BigBelly Solar Compactors and 210 Recycling Units.

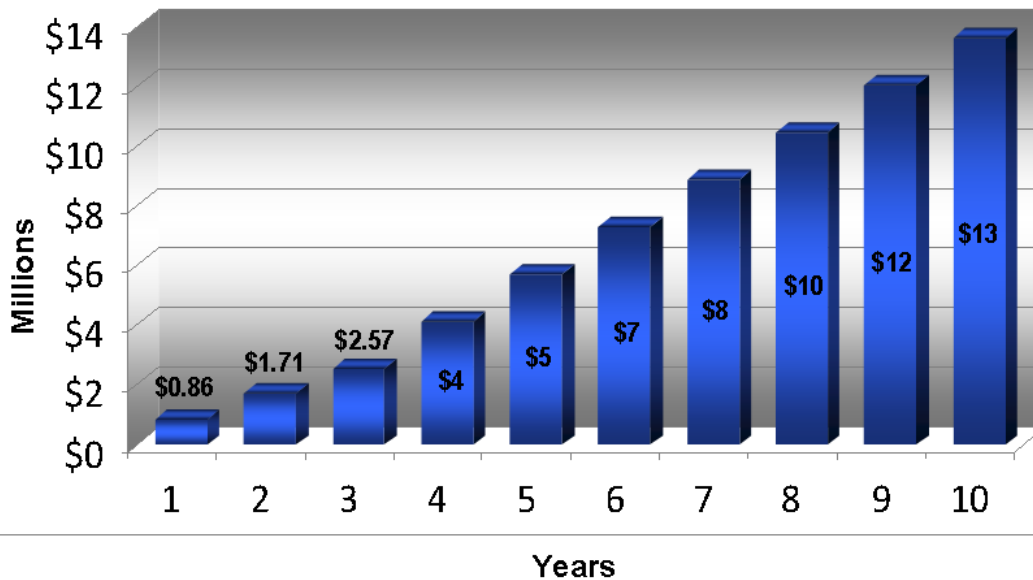
* Includes 36-month lease.

Highlights of the program include:

- **Immediate savings:** By entering into a 3-year financing arrangement, the City has no up-front capital cost and will realize cash flow savings in the first year of approximately \$850,000.
- **Ongoing savings:** The City will save nearly \$13 million in cumulative operating cost savings over the next 10 years, net of the equipment cost.
- **Annual operating cost reduction of 70 percent:** compaction reduces collection demand, which directly reduces operating costs and associated vehicle fuel use and emissions.

The net annual operating cost savings accrue starting in the first year of the program, and over time add up to a substantial savings for the City, as illustrated in the following graph.

Cumulative 10-Year Savings



Description of the Solar-Powered Compactors

The compactors are self-powered, requiring no wiring or external electrical connection, and automatically compact the waste when the trash inside reaches a certain level. The solar photovoltaic panel turns daylight into electricity, which is stored in a small battery inside the unit, allowing the machine to run at night and during prolonged periods of inclement weather on only battery reserve power. As users deposit trash, it falls into a 32-gallon bin inside the machine. When the level of trash eventually rises above the top of the inner bin, the trash interrupts an electric eye beam, triggering the motor to compact the trash down into the bin, making room for more trash. Users can safely continue to deposit additional trash during compaction cycles: the machines have an insertion hopper that prevents hands from reaching into the compaction area, and do not lock users out during compaction to prevent litter.

This process repeats automatically as needed until the machine is ready for collection, typically holding about 160 gallons of uncompacted trash. At that point, the LED light indicator on the front panel goes from green to yellow, and the machine sends a wireless message to a central computer server, notifying staff that the unit is ready for collection. (See next section for more information on the wireless monitoring and notification system.) The machines will continue to receive more trash and run automatic compaction cycles even after signaling they are ready for collection. The units can be adjusted to provide earlier or later notice that collection is required. Eventually the machines will be unable to compact any more trash in the inner bin, and the LED indicator will be red, notifying staff that immediate collection is required. The units will still continue to accept trash after they are full, since there is room inside the machine above the inner bins, preventing litter until crews come to empty the machines.

Collection crews empty the compactor units much like other ornamental street receptacles: they open the front door with a key, slide out the inner plastic bin and pull the liner bag full of trash. After replacing with a new liner bag, crews slide the bin inside the machine, close the self-locking door and the unit resets to “green” status.

The recycling units are attached to the solar-powered compactors to facilitate separation of trash from recycling. Both units have the same overall design and appearance for aesthetic purposes and to help guide members of the public as they look to dispose of trash and recycling in the appropriate receptacles. The recycling units are non-compacting, and have a 50-gallon inner bin. As with the trash compactors, crews unlock the front door to remove the inner bin.



For a more detailed description of the equipment see **Appendix C: Product Specifications**.

Wireless Monitoring Technology

The solar-powered compactors are all equipped with the Company's wireless monitoring and notification system. The system uses text message technology to signal a web-based database that allows the viewing of machine status and fullness levels from any computer with internet access. This in turn allows managers to ensure that the trash is collected when needed but no more often than needed, to optimize collection efficiency. Having intelligence from each trash receptacle on a collection route enables route optimization on a real-time basis. The City plans to use the historical data collected by the system to further refine their collection routes over time and realize incremental efficiencies.

Extended Warranty and Service Plan

The solar compactor project includes a four-year on-site service and extended warranty program bundled in to the equipment lease, whereby the Company contracted with local minority-owned service provider Advanced Enviro Systems. This program gives the City a local service company to ensure the machines are operating properly through the financing period and for a full year afterward.

Other Benefits Associated with Compactor Deployment

The City identified a number of other tangible benefits of the solar-powered compactor deployment beyond the cost-savings described above:

- **Reduced truck traffic** – avoiding 12 collection trips per week, and avoiding the second or third collection trip each day, keeps collection vehicles off the streets and thereby reduces congestion, traffic and road wear
- **Reduced litter** – the compactors are enclosed, which decreases litter and improves the cleanliness and appearance of public spaces
- **Pest-resistant** – the compactors' enclosed design prevents rodents, birds and other pests from accessing the trash
- **Reduced CO₂ emissions** – reduced collection trips leads to reduced fuel consumption and associated greenhouse gas emissions
- **Discourage household dumping** – the limited size of the insertion hopper makes illegal dumping of household or commercial trash more difficult
- **Advertising revenue potential** – the City is considering potential revenue from selling advertising space on the compactors and recycling units

Conclusion

The solar-powered compactors and recycling units provide the City of Philadelphia with significant operating cost savings in the first year of the program, and substantial cumulative savings over time:

- Immediate savings: By entering into a 3-year financing arrangement, the City has no up-front capital cost and will realize collection cost savings in the first year of approximately \$850,000;
- Ongoing savings: The City will save nearly \$13 million in cumulative collection cost savings over the next 10 years, net of the equipment cost;
- Annual operating cost reduction of 70 percent: compaction reduces collection demand, which directly reduces operating costs and associated vehicle fuel use and emissions.

The program also supports the City's commitment to advancing recycling and sustainability by introducing public space recycling to the City for the very first time, and by reducing waste collection vehicle trips by 70 percent. With the solar compactors' wireless monitoring system, the City is demonstrating leadership by using cutting edge technology to streamline operations and maximize efficiency. As Mayor Nutter announced at the press conference on April 30, 2009 for the solar compactor program: "Today we are proud to announce the largest deployment of solar powered trash compactors anywhere in America. This technology will save taxpayers money, introduce sidewalk recycling and keep our streets clean. This is one more important step towards achieving our sustainability goals."



Appendix A: City of Philadelphia Public Relations and Education Programs

1. Philly Throws Green: The City of Philadelphia has incorporated the solar compactor and recycling program into a number of neighborhood education and public relations programs. One of these has a dedicated website with information about the solar compactors and public space recycling efforts, called Philly Throws Green. The website is:

<http://www.phillythrowsgreen.org/>

“One goal, many hands” is the tagline for the site, which includes descriptions of how the solar compactors work, a map of locations, and information on how the machines help:

Philadelphia will have more of these new bins than any other American city. Here's how that benefits all of us-economically and environmentally:



Solar-Powered Trash Compactors

- Five times more capacity than regular bins
- Saves the city money by:
 - requiring fewer trash collections
 - lowering truck fuel costs
 - conserving landfill space
- Reduces greenhouse gas emissions
- Sealed to keep trash and odor in, pests out
- Sturdy and practically maintenance free
- Inspires everyone to keep city streets free of litter

On-The-Go Recycling Stations

- Lets you recycle on the go
- Saves the city money
- Single Stream - clean paper, metal cans, plastic bottles, glass jars and all go in this one bin
- Conserves natural resources
- Sturdy and practically maintenance free
- Supports the city's commitment to increase recycling tonnage
- Helps create a greener, cleaner Philadelphia

2. Greenworks Philadelphia – another program the City has launched to promote sustainability that includes the solar compactor project is called “Greenworks Philadelphia”. This program has a comprehensive guide and plan to achieve Mayor Nutter’s ambitious goal of making Philadelphia “the Greenest City in America.” The website includes an overview video, a downloadable Plan and other information:

www.greenworksphila.org

3. City of Philadelphia press release – the press release from the April 30, 2009 event follows on the next page. The release generated print and web articles with combined circulation/audience of about 3.3 million people.



CITY OF PHILADELPHIA

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For Immediate Release: April 30, 2009

MAYOR NUTTER UNVEILS NEW BIGBELLY LITTER BASKETS *The Future of Pedestrian Waste Management!*

PHILADELPHIA, PA – On Thursday, April 30, at 12:00 pm the City of Philadelphia Streets Department will announce the installation of 500 BigBelly solar-powered litter baskets in Center City Philadelphia. The first litter basket installation is at the northwest corner of 15th Street and JFK Boulevard.

Streets Commissioner Clarena Tolson will be joined by Mayor Michael Nutter, Deputy Mayor Rina Cutler, and other City officials in unveiling the latest innovation.

“Yesterday we unveiled Greenworks Philadelphia, Philadelphia’s new comprehensive sustainability framework that sets us on the path to becoming America’s number one green city,” said Mayor Nutter. “Today we are proud to announce the largest deployment of solar powered litter baskets anywhere in America. This technology will save taxpayers money, introduce sidewalk recycling and keep our streets clean. This is one more important step towards achieving our sustainability goals.

“We are pleased to be using this advanced technology and embrace ideas like this that will save us money and natural resources,” according to Streets Commissioner Clarena Tolson.

As part of Commissioner Tolson’s ongoing measures to support the City of Philadelphia’s vision for high efficiency and innovative services, the Streets Department is adding solar-powered litter baskets which are cost effective and more efficient than our traditional litter baskets. They will reduce overflowing, decrease the number of

- more -

STREETS DEPARTMENT'S INSTALLATION OF BIG BELLY SOLAR-POWERED LITTER BASKETS

April 30, 2009

Page 2

collection trips and cut related fuel use and greenhouse gas emissions by 80%. It has the capacity to hold 200 gallons of trash (normal city trash cans hold 55 gallons) and can operate for a week on the energy it takes to make a pot of coffee.

For the first time in Philadelphia, there will be pedestrian recycling baskets. These recycling baskets will be set next to 210 of these solar-powered litter baskets to allow pedestrians to place their recyclables in as they walk by.

The solar-powered litter baskets are replacing 700 wire baskets located in high traffic areas, from the Delaware River to the Schuylkill River and from South Street to Spring Garden Street. Installation of the solar-powered litter baskets will start in May and will be completed by July 2009.

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Appendix B: Savings Analysis from Four Collection Routes

The City of Philadelphia collected trash from 700 litter baskets installed along four collection routes in Center City, from Spring Garden Street in the north down to South Street, and from Front Street to the east over to 24th Street near the Schuylkill River (see **Appendix D** for detailed maps). The City replaced all 700 litter baskets with 500 “BigBelly” solar compactors and 210 companion recycling units to achieve significant time and cost savings from reduced collection demand, as shown below.

Collection Route Details:

Route Number:	Number of Receptacles:	Location:
Route 1 – East	275	Front Street to 8 th Street
Route 2 – Central	185	8 th Street to 15 th Street
Route 3 – West	167	16 th Street to 24 th Street
Route 4 – Broad Street (partial)	73	Between Girard and Washington Avenues

Cost Savings Comparison:

BEFORE:		AFTER:	
Annual Cost of Old Collection System		Annual Cost of BigBelly Collection System	
No. of receptacles	700	No. of receptacles	500 compactors 210 recycling units
No. of collections per week	17	No. of collections per week	5
Total hours/year on routes	18,564	Total hours/year on routes	5,807
x Total cost/hour	\$124	x Total cost/hour	\$124
Total annual cost	\$2,301,936	Total annual cost	\$720,068

Annual Cost Savings: \$1,581,868

Notes:

1. Total time per collection on all four routes combined is approximately 21 hours.
2. Total cost/hour includes labor, fuel and all other vehicle costs combined.

Appendix C: Product Specifications

Overall Machine Dimensions (Solar-powered compactor)

Height: 50.4" (128 cm)

Width: 26.1 (664 cm)

Depth: 25.9" (65.7 cm)

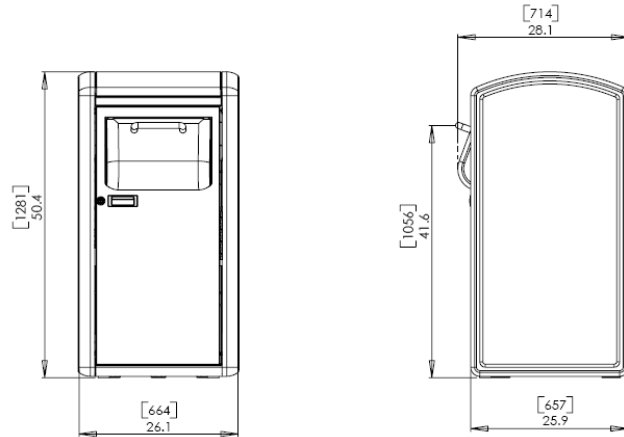
Handle Height (ADA Compliant): 41.6"
(105.6 cm)

Weight: 300 lbs (136 kg)

Trash Hopper Insertion Opening: 6" x 17"
(152mm x 432mm)

Bin Volume: 32 gallons

Liner Bag: 32" H, 92" circumference
(recommended thickness at least 2 mil)



Materials

Galvanized sheet metal steel interior and exterior construction (recycled content)

Heavy duty plastic side panels (recycled content)

Exterior Finish: polyester TGIC powder-coat finish

Trash Bin: low-density polyethylene plastic leak proof bin (recycled content)

CE approved, RoHS compliant

Compaction Features

Compaction Force: 1250 lbs. max.(570 kg)

Cycle Time: 41 seconds

Motor Size: 1/6-HP DC gear-motor

System Voltage: 12 Volts DC

Drive System: Gear-motor with chain drive

Fully automated, IC processor controlled system

3-color LED status lamps indicate compacted trash level, machine status and error codes

Photovoltaic System

Polycrystalline silicon cell module

Nominal Output: 30 Watts

Shock-dampening mount system

PV panel protected by polycarbonate bubble
Spill-proof, sealed maintenance-free 12V battery
Charge maintained by Pulse Width Modulator

Recycling Units (attached to compactor units)

Height: 50.5" (128 cm)

Width: 50.1" (127 cm) (combined)

Depth: 25.9" (65.7 cm)

Weight: 470 lbs. (combined)

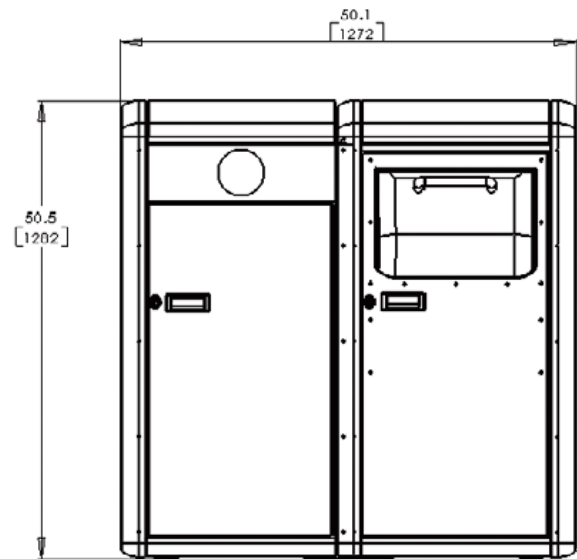
Insertion height: 42.5" (108 cm)

Galvanized sheet metal steel interior and exterior construction (recycled content)

Exterior Finish: polyester TGIC powder-coat finish

Recycling Bin: low-density polyethylene plastic leak proof bin (recycled content)

CE approved, RoHS compliant

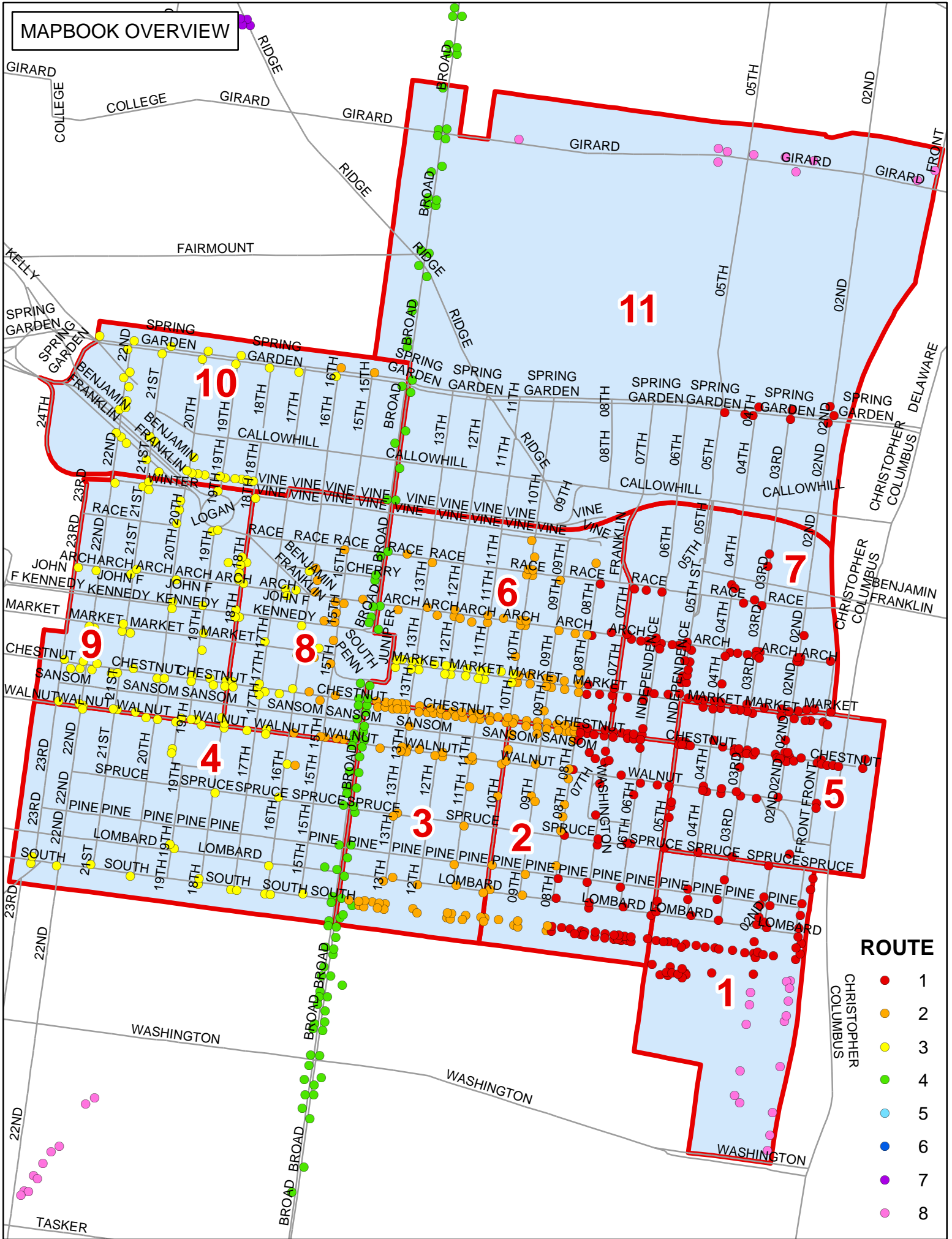


Appendix D: Completed Maps of Existing Collection Routes

The following pages include an overview map of the four collection routes in Center City and 11 detailed “basket area” maps showing specific locations of all 700 of the old litter baskets that were in the area.

The 500 solar compactors and 210 companion recycling units have replaced these 700 litter baskets. The City plans to create a revised set of collection maps showing all the new units.

MAPBOOK OVERVIEW



ROUTE

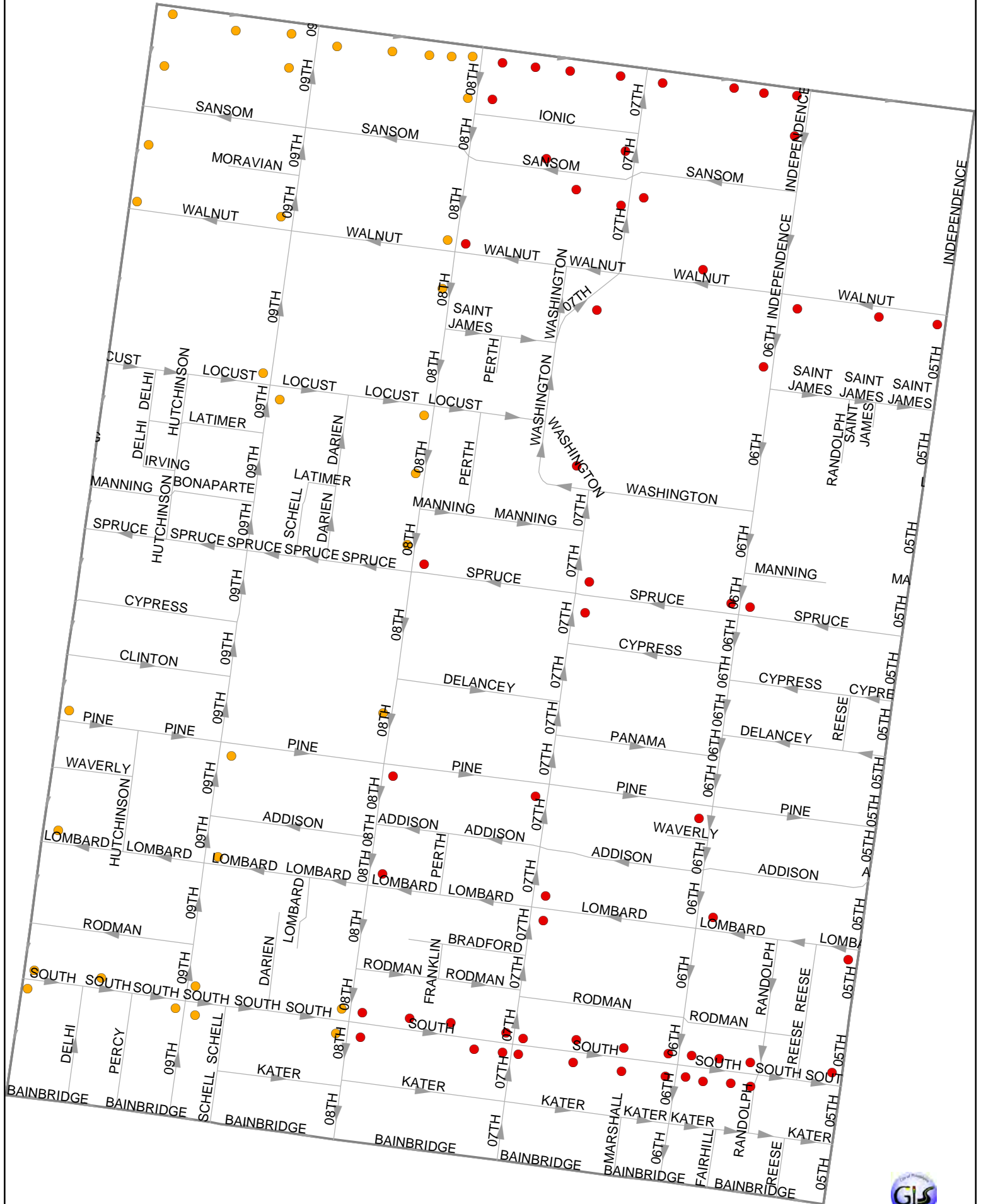
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CHRISTOPHER
COLUMBUS

BASKET AREA 1



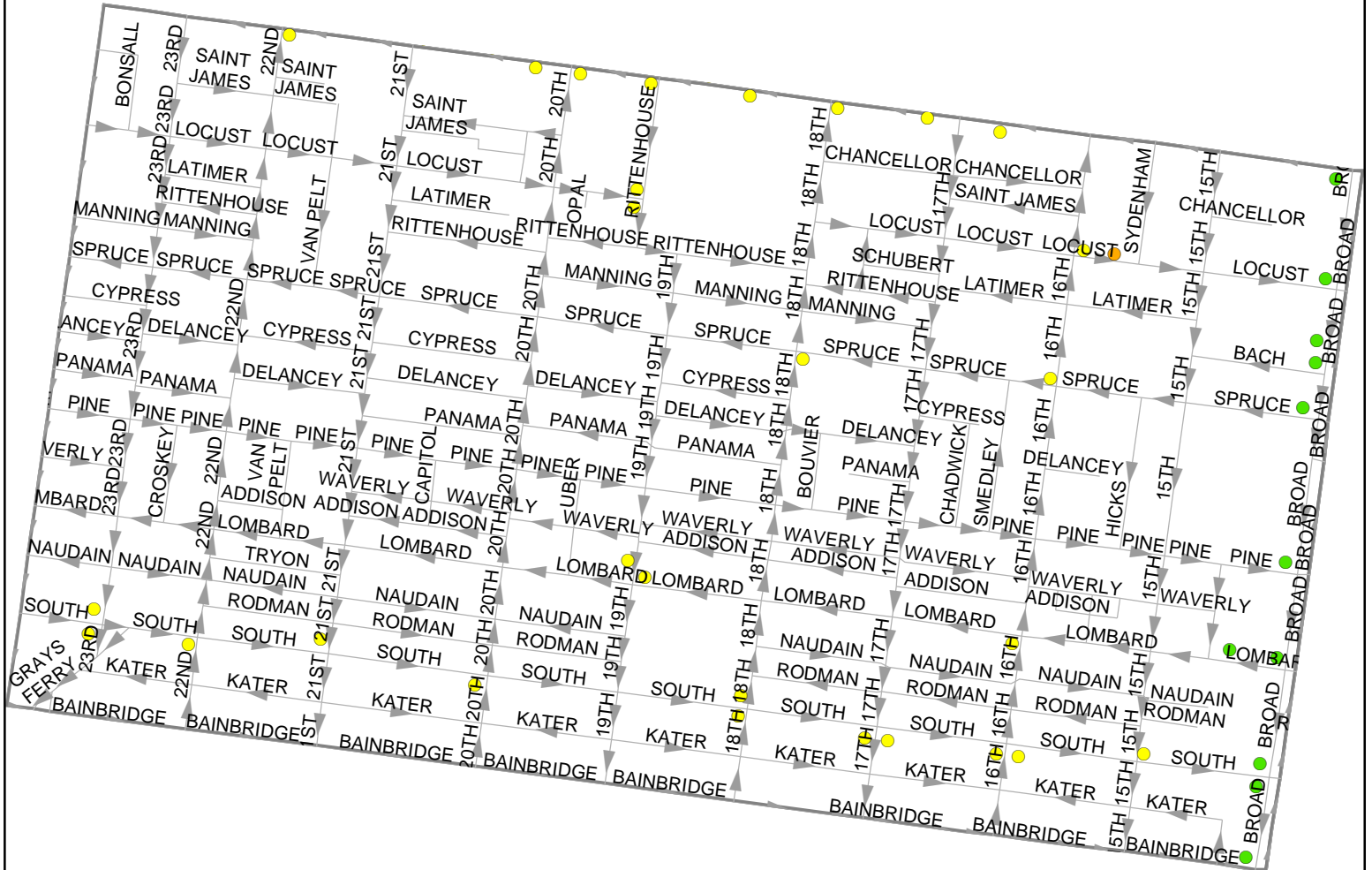
BASKET AREA 2



BASKET AREA 3



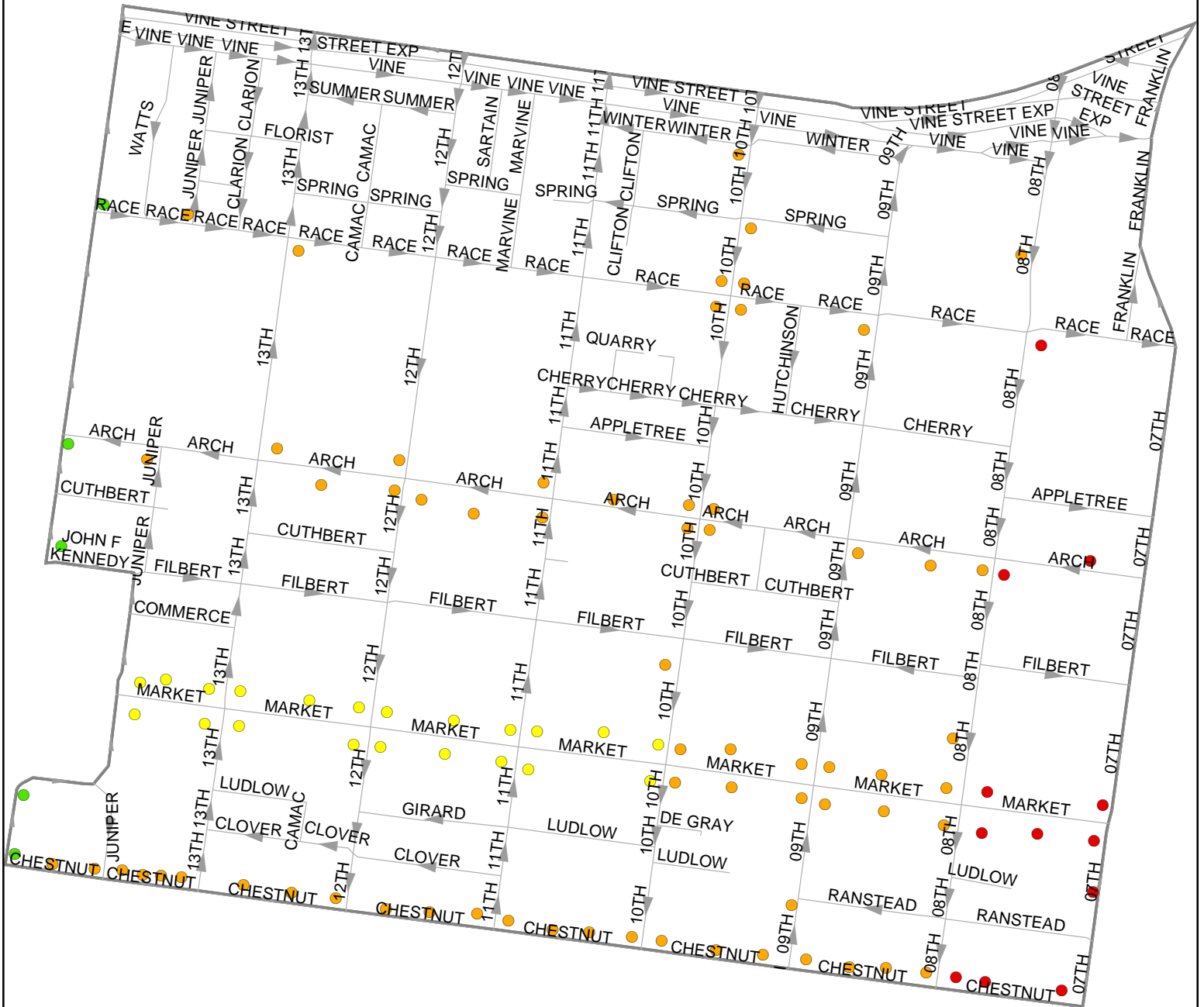
BASKET AREA 4



BASKET AREA 5



BASKET AREA 6



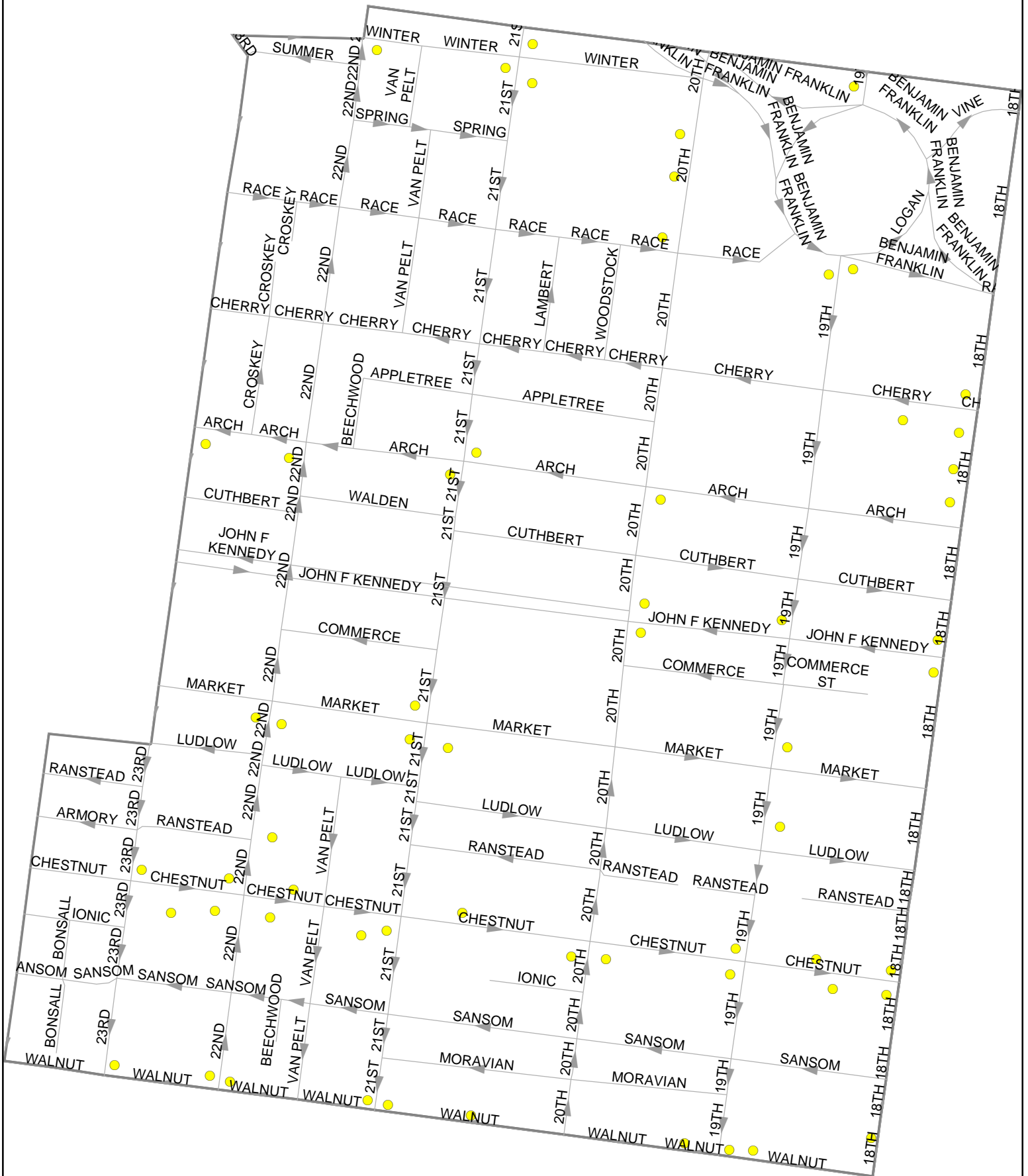
BASKET AREA 7



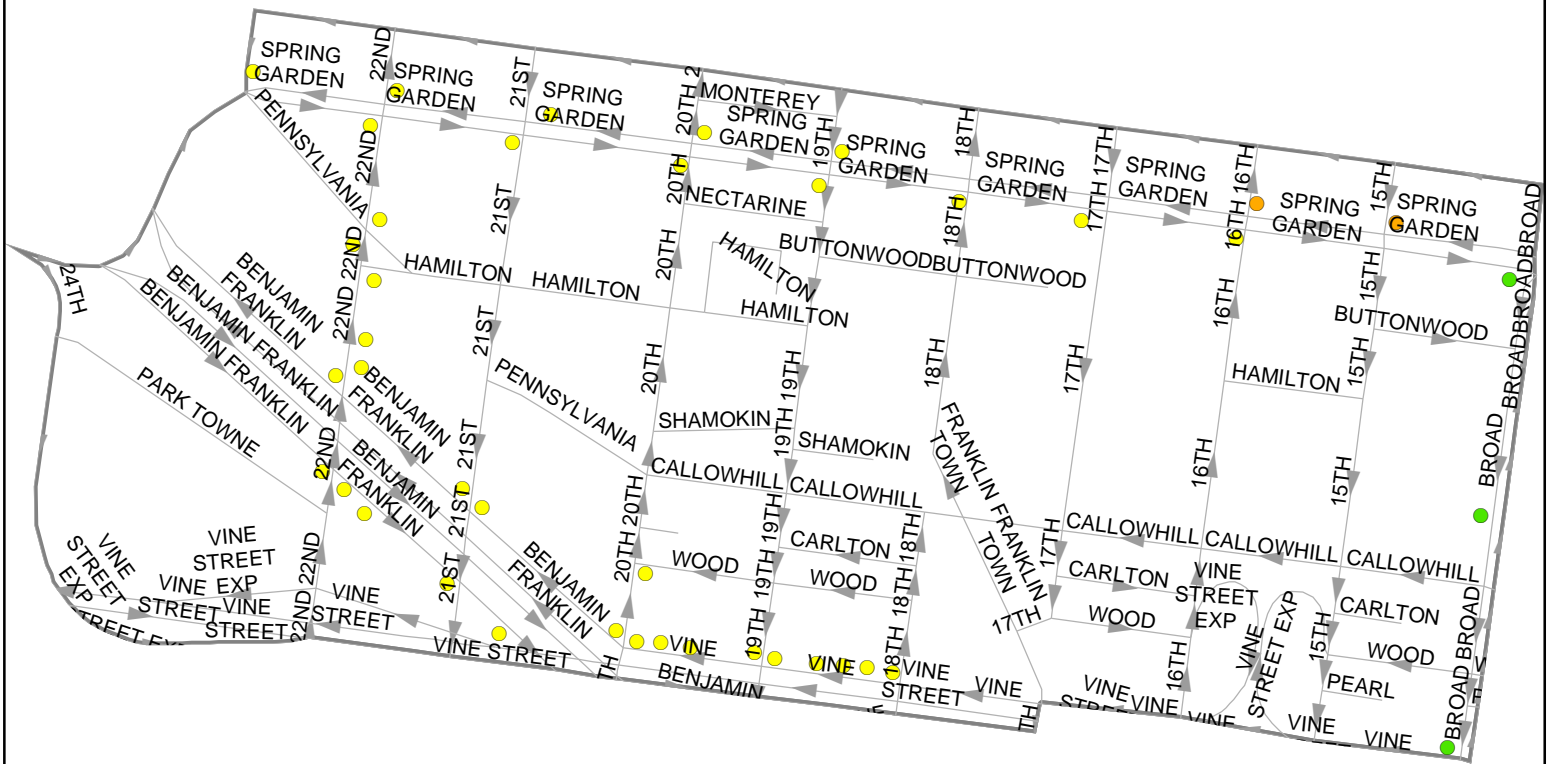
BASKET AREA 8



BASKET AREA 9



BASKET AREA 10



BASKET AREA 11

