

## Improving Oregon Recycling Systems Infrastructure Research

# Collection Alternatives Research (Phase 2 Task 1)

April 10, 2020

### Single-Family, Dual-Stream Collection Research Summary

#### Research Overview

Cascadia Consulting Group and subcontractor Bell & Associates researched two types of systems to understand the operations, costs, impacts, and changes necessary if Oregon were to migrate from the current state standard of a commingled mix with glass collected separately to a dual-stream of paper/fiber and mixed containers/other materials, with glass continuing to be collected separately. In other words, from Oregon's standard dual-stream system to a triple-stream system. The goal of this task was to provide DEQ and Partners with information on alternative collection methods that will help them decide which collection methods to include in scenario analysis.

The two collection systems reviewed were cart-based single-family residential dual-stream (fibers collected separately from containers) using:

- Two carts (one per stream) collected on alternating weeks:
  - Mill Valley, California
  - Wentzville, Missouri
- One split cart that holds both streams:
  - Milpitas, California
  - Mountain View and Sunnyvale, California
  - Sault Ste. Marie, Ontario

Systems that collect glass in a third stream, separately from fibers and other containers, were not found; however Wentzville, Missouri does not accept glass in the container cart.

## Systems Researched

### Two Carts

**Mill Valley** Refuse in California changed its collection system on August 2019 to be able to send material to a lower cost sorting facility that accepted only dual-stream materials: the Marin Resource Recovery Center (<https://marinsanitaryservice.com/marin-resource-recovery-center/>).

**Wentzville**, Missouri converted from single-stream to dual-stream in November 2018, also to match the material stream requirements of its new sorting facility: the Recycle City material recovery facility (MRF) in St. Peters. The change occurred because the single-stream MRF that had been taking the City's recycling ceased operations. In order to maintain the residential recycling program, Wentzville converted to a dual-stream system so the materials could be processed by the MRF owned and operated by the City of St. Peters.

### Split Carts

**Milpitas**, California, switched from single-stream to dual-stream in December 2016 to reduce contamination. Milpitas is the only jurisdiction researched that sends dual-stream collected recyclable materials to a single-stream material recovery facility (MRF) for processing. Milpitas Sanitation is the contracted hauler for the city. Louie Pellegrini, the owner of Milpitas Sanitation, said it took approximately 90 days for customers to become acclimated to the split-cart system.

The split-cart system used in **Sunnyvale** and **Mountain View**, California, was implemented over 15 years ago when both municipalities converted from a three-bin system. Both cities use the Sunnyvale SMaRT facility, which was designed to process a separate paper/fiber material stream and a separate container stream of glass, plastic, and metal.

**Sault Ste. Marie**, Ontario, also migrated from a three-bin system to the split cart to accommodate its material processor. Their contamination levels are 3% to 5%.

All of these collection systems were changed to accommodate the specific dual-stream material mix that their processor would accept.



## Overall Dual-Stream Methods

### Benefits

#### Reduced Contamination

According to most collectors interviewed and other research reports reviewed, dual-stream reduces contamination. However, some of the contamination data from the researched systems are anecdotal and in some cases the effect of dual-stream cannot be separated from the effects of increased customer engagement the haulers or jurisdictions conducted during the transition or visual cart audits by drivers during semi-automated collection. As a result, it is not possible to make a definitive statement regarding the effect dual-stream on contamination.

#### Case Study: Mill Valley

Mill Valley reported reduced contamination during the dual-stream pilot, but an anticontamination campaign was conducted at the same time as the pilot.

The Mill Valley pilot study report quoted the Marin Sanitary facility manager, Nicholas Minton, as saying, "I would say your residual rate is 6% to 7% or under based on the loads that I saw. I would say about 2-2.5% was nonrecyclable #1-7 plastics, 2-2.5% mixed paper contamination, and the rest of the total is true residual such as waxed cardboard and glass residual in the fiber. There was very little or no plastic bags and absurd contamination like diapers and food, which was great." Contamination by the receiving MRF has not been measured specifically for Mill Valley, but the MRF's overall contamination rate for dual-stream is 15% compared to 30% for single-stream.

#### Case Study: Wentzville and St. Peters

According to the St. Peters MRF, contamination from St. Peters residents is below 5% due to the City's extensive education efforts while contamination from Wentzville remains high at an estimated 10% to 20% due to lack of customer education.

#### Case Study: Milpitas

According to Louie Pellegrini, contamination in Milpitas decreased from 25% to 10% after switching from single-stream to dual-stream.<sup>1</sup> However, the collected recyclables from Milpitas are processed at a single-stream facility, which diminishes the efforts of the dual-stream system.

#### Case Study: Mountain View

Mountain View provided contamination information for single-family dwellings, based on a 2019 waste characterization study:

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<sup>1</sup> Jared Paben, "Experts Duel Over Dual-Stream's Merits," Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

- Paper residue: 4.7% (mostly tin cans, which are recycled and not counted as residue)
- Container residue: 24% residue (primarily non-program plastics, especially thermoforms)

#### Independent Studies Reviewed

Four independent studies on the topic of single-stream compared to dual-stream systems were also reviewed, generally finding that dual-stream collection is associated with lower contamination rates.

*An Assessment of Single and Dual Stream Recycling* prepared for the Waste Diversion Ontario, HDR 2013

- The report concluded that **single-stream collection generates higher volumes and participation with increased contamination**. However, the dual-stream jurisdictions in this assessment mainly used tubs (“blue box collection”) while the single-stream jurisdictions used carts.<sup>2</sup>

*A Comparison of Single and Multi-Stream Recycling Systems in Ontario, Canada* by Calvin Lakhan, Department of Geography, Wilfrid Laurier University, June 2015

- The study examined the differences in cost and recycling performance between single and multi-stream recycling systems in Ontario, Canada. One of the primary conclusions of the research from page 4 was:
  - “Reports evaluating the effectiveness of single stream recycling systems have also found that the **commodities recovered from single-stream programs are of lower quality than those recovered from multi-stream systems**. This results in decreased value and/or difficulties in finding end-markets. [Dan Lantz in “Metro Waste Paper Recovery Study” published in *Resource Recycling* in 2008] found that single-stream systems had eight times the yield loss compared to multi-stream systems for paper fibers collected curbside. Plastics processors reported that material from single stream MRFs had a yield rate 10% lower than multi-stream MRFs.”<sup>3</sup>

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<sup>2</sup> HDR, Inc, “An Assessment of Single and Dual Stream Recycling Including Current Program Performance in Large Ontario Municipalities” Prepared for Waste Diversion Ontario, 2013  
([https://thecif.ca/projects/documents/716-Final\\_Report-REV.pdf](https://thecif.ca/projects/documents/716-Final_Report-REV.pdf))

<sup>3</sup> Calvin Lakhan, “A Comparison of Single and Multi-Stream Recycling Systems in Ontario, Canada” *Resources*, 4, pp 384-397, 2015, doi:10.3390/resources4020384  
([https://www.researchgate.net/publication/278627301\\_A\\_Comparison\\_of\\_Single\\_and\\_Multi-Stream\\_Recycling\\_Systems\\_in\\_Ontario\\_Canada](https://www.researchgate.net/publication/278627301_A_Comparison_of_Single_and_Multi-Stream_Recycling_Systems_in_Ontario_Canada))

*Assessment of the Impact of Single Stream Recycling on Paper Contamination in Recovery Facilities and Paper Mills* by Duygu Yasar, et al, University of Miami Department of Industrial Engineering, 2017

- This study researched both inbound and outbound contamination from single-stream recycling (SSR) and dual-stream recycling (DSR). Regarding contamination, the study concluded, “the standard deviation (8.97) and mean (18.54) contamination rates of the samples from SSR were higher than the samples from DSR. (3.08 and 3.89, respectively). [An] Analysis of variance was conducted to determine the difference in contamination rates. **The difference between SSR and DSR inbound contamination rates was found to be statistically significant.**”<sup>4</sup>

*Conversion from Dual Stream to Single Stream Recycling Results in Nuanced Effects on Revenues and Waste Stream Amounts and Composition* by Tonjes, David J. et al., Department of Technology and Society, Stony Brook University, 2018.

- This study compared recycling system performance and costs in Brookhaven, New York, before and after a switch from dual-stream collection to single-stream collection. The study found that while recycling set-out quantities increased significantly, the change was largely due to non-recyclable materials. However, concurrent changes in the waste stream mean that results are not straightforward. After the change the same quantity of recyclables were placed in recycling containers, but separation rates increased and the residual garbage stream contained fewer recyclable materials.<sup>5</sup>

#### Reduced Processing Costs

Processors have been willing to charge less for material from the dual-stream collection: Mill Valley saves \$43 per ton in processing costs: single-stream costs \$83 per ton and dual-stream costs \$40 per ton. Cost comparison details were not available from other systems.

The agreement that St. Peters has with Wentzville is that there will be no processing fee as long as Wentzville delivers enough material that can be sorted and sold for no less than \$200,000 of material value. If the mix of materials is low quality with significant levels of contamination, then the City of Wentzville will pay the difference. This is a significant savings when compared to the current processing fee for single-stream recycling at the Republic Services MRF in St. Louis, which is \$125 per ton.

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<sup>4</sup> Duygu Yasar et al., “Assessment of the Impact of Single Stream Recycling on Paper Contamination in Recovery Facilities and Paper Mills,” Submitted to University of Florida (see page 28, section 6).  
<https://pdfs.semanticscholar.org/c34c/910adaade9294bae35f0a41f02427e19c1ee.pdf>

<sup>5</sup> David J Tonyes et al., “Conversion from Dual Stream to Single Stream Recycling Results in Nuanced Effects on Revenues and Waste Stream Amounts and Composition,” *Resources, Conservation & Recycling*, 138, pp 151-159, 2018.

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## Drawbacks

### Increased Collection Costs

In both systems, dual-stream collection increases collection costs compared to single-stream. Due to the need for more expensive trucks and carts, split-cart collection costs substantially more than two-cart collection. Details are described in the summary cost section for each system below.

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## Other Considerations

### Customer Acceptance and Participation

Dual-stream and split carts do not appear to reduce capture rates, relative to single-stream or three-bin systems, and customers appear to accept both systems well after implementation.

When Milpitas changed from dual- to single-stream, the collector said it took approximately 90 days for customers to become acclimated to the split-cart system.

In a survey of participants in the Mill Valley pilot, over half (54%) reported one or more problems with dual-stream collection, primarily storing recyclables for two weeks, following the every-other-week collection schedule, and separating materials into two streams. About half (52%) said they would be willing to pay up to \$5 more per month to keep single-stream recycling.

During the Mill Valley dual-stream pilot, customer participation and tonnages collected were similar for single-stream and dual-stream. Participation in recycling remained high during the dual-stream pilot: the average percentage of “No Carts Out” was 13% (for a set-out rate of 87%) with dual-stream compared to 19% (set-out rate of 81%) for single-stream. During the pilot, the percentage of set-outs that were prepared properly (i.e., the right materials on the right days) started low at 68% and increased to 92% by the third week and 99% in the fifteenth week.

Mountain View conducted a participation study in 2011, in which set-out rates for most single-family dwelling routes ranged from 83% to 93%, although one route had a 75% participation rate. Nearly all single-family dwelling garbage accounts have a split recycling cart.

In 2018, Mountain View’s overall capture rate for single-family dwellings was 75% for all recyclables. Capture rates by material were also high: 89% of cardboard, 75% of other paper, 73% of glass, and 71% of plastic.

## Two-Cart Dual-Stream

### Benefits

#### Reduced Cost Compared to Split Cart

If collection of residential recycling is a weekly service, then migrating to a two-cart system would maintain weekly collection frequency. Therefore, a two-cart dual-stream system requires only purchasing additional carts, a lower cost compared to split-cart systems.

For Mill Valley, the \$40 per ton savings in processing costs is approximately the same on a monthly per-household basis as the additional cost of the second roll cart, as detailed in the Table 1. Mill Valley explored the capital costs of using a split cart, which was estimated to be \$410,677 per split-body truck (eight trucks required) and \$600,000 for 14,000 new split-body carts.

**Table 1 – Processing Savings Compared to Cart Cost**

<b>Processing Savings</b>	
Savings on Processing per Ton (for Mill Valley)	\$40.00
Monthly Set-out Weight	35 pounds
Savings per Customer (35÷2000 lbs./ton) × \$40	\$0.70 per month
<b>New Cart Costs</b>	
64-gallon cart (cart + shipping + distribution)	\$55.00
Depreciation Life in Months	84 months
Cost per Month (\$55÷84 months)	\$0.65 per month

However, if the single-stream recycling collection frequency is every-other-week (EOW), the collection frequency would need to be effectively doubled in a dual-cart system either by collecting each cart every other week (resulting in effectively weekly collection) or collecting both carts on the same day every two weeks. Additional collection frequency increases both operational costs and requires investing in additional trucks. The total additional operational and truck capital collection cost for this change is estimated to range from \$4.00 to \$5.00 per customer per month. In 2019, the City of Hillsboro, Oregon studied the additional cost to increase yard debris collection from EOW to weekly, estimating the cost to be \$4.33<sup>6</sup> per customer per month. The following table details the calculation for increasing yard waste collection. It does not include estimates of changes in volume or in costs for landfill disposal versus organics processing.

<sup>6</sup> The cost did not include the 8% operating margin or the 3% franchise fee.

Description	Note	Amount
Cost per Collection Hour (Collection Cost / Truck Hours)	A	\$94.31
Additional Truck Hours for Weekly Collection	B	\$8,302
Additional Cost for Weekly Collection	$C = A \times B$	\$782,996
Cost per Truck	D	\$282,400
Required Trucks	D	5
Annual Depreciation (7 year life)	E	\$201,714
Additional Labor	F	\$90,818
Total Cost	$G = C + E + F$	\$1,075,528
Customers	H	20,699
Cost per Customer per Month	I	\$4.33

#### Table Notes

A: Hillsboro franchised composite cost per truck hour

B: Hours estimated by the Hillsboro haulers to provide weekly service

C: Cost per Hour multiplied by the increased collection hours ( $A \times B$ )

D: Hillsboro haulers estimated cost and number of additional collection trucks

E: Cost per Truck multiplied by 5 trucks and then divided over their 7 year life

F: Employee cost for non-route hours

G: Total additional collection costs, truck depreciation, and non-route labor ( $C + E + F$ )

H: Customer count

I: Total Cost divided by 12 months and then divided by customers ( $G / 12 \text{ months} / \text{Customers}$ )

Table 2 compares the difference in cost from weekly collection to EOW collection of a two-cart system.

**Table 2 – Collection Cost Impacts of a Dual-Cart System**

	Previously Weekly Collection	Previously Every-Other-Week
Additional operational cost	\$0	\$3.20 to \$4.20
Additional truck capital cost	\$0	\$0.80
Additional cart capital cost	\$0.65	\$0.65
Total additional cost	\$0.65	\$4.65 to \$5.65



#### More Flexibility Compared to Split Cart

Using two single-body carts allows the collector to use the same collection trucks for recycling as for other waste streams.

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### Drawbacks

#### Need for Space for Additional Cart

A two-cart system requires customers to store an additional cart. During the Mill Valley pilot, about 15% of participants surveyed reported they do not have space for another cart. For these customers, Mill Valley Refuse allows them to use one cart and alternately place the two streams in it, as long as they set-out the correct material each week.

### Split-Cart Dual-Stream

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### Benefits

#### Similar Customer Storage Requirements

Customers would not need additional space to store an extra cart.

#### Contamination Reduction Due to Reduced Recycling Capacity

In Milpitas, the collector felt that reduced recycling capacity led to reduced contamination, saying: “What I believe the dual-split cart brings is the size of the lid — it’s not easy for them to put the stuff in that shouldn’t be there.”<sup>7</sup> However, sufficient data were not available to compare contamination in split cart versus two-cart systems or to assess whether the size of the lid affected all materials or only large materials like cardboard and bagged garbage.

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<sup>7</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

## Drawbacks

### Increased Capital and Operating Costs

#### Increased Collection Truck Costs

Split-cart systems researched used either Labrie or Bridgeport split collection body side-loader trucks, with the body typically split 60% for fiber and 40% for containers. Split-body trucks cost \$16,000 to \$25,000 more than a single-body truck on the same chassis. All of the split-body trucks in California had separate compartments to collect oil. Assuming 550 customers are collected each day, five days per week, the financial impact is \$0.07 to \$0.11 per customer per month. If a subsequent truck is purchased for backup, then the cost per customer would increase depending on the front-line to spare ratio.



#### Increased Cart Costs

The cost for a 96-gallon split collection cart is \$68.70 each. Shipping quantities are limited to 336 carts, and the cost to transport from the factory to Portland is \$3,121 or \$9.29 per cart. Carts require assembly and distribution, which can vary from \$5 to \$10 per cart depending on the location and quantity distributed. Total cost per cart ranges from \$82.99 to \$87.99. Depreciated over a seven-year life, the customer cost for a 96-gallon split cart is \$0.99 per month. In comparison, a 96-gallon single-body cart costs approximately \$55.00 with distribution, or \$0.65 per customer per month over seven years — \$0.34 cents per month less.



In Milpitas, the cumulative capital cost (for new trucks and carts) was \$0.21 per household, which is offset by a monthly savings of \$0.68 from decreased disposal and increased recycling.<sup>8</sup>

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<sup>8</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

## Reduced Productivity



The cost-per-hour to operate an automated split-body truck is similar to an automated single-body truck; however, productivity is slower because large pieces of cardboard that can't fit into the cart require the driver to manually load the items. The Bridgeport Ranger used in Mountain View requires the driver to open a door to the hopper to load cardboard that didn't fit into the cart. The average time to manually load large items was 60 seconds compared to 20 seconds to pick up the cart with the automated arm. John Zirelli, the general manager for Recology of Mountain View estimates that 10% to 20% of the residential stops require

the driver to exit the cab to pick up cardboard, oil, and batteries that are set out next to the cart. The average route size for Milpitas Sanitation is 550 houses per day for an eight-hour shift. Collection productivity in the Portland area ranges from 450 to 700 houses per day and primarily depends on route density and traffic.

Table 3 compares the monthly customer cost from changes in collection productivity, assuming an average collection cost of \$115 per hour over an eight-hour day ( $\$115 \times 8 = \$920$ ). As an example, Oregon's City of Beaverton composite collection productivity in 2018 was 700 homes per day. A decrease from 700 to 550 daily pick-ups would increase collection cost in Beaverton by \$1.55 per customer per month.

**Table 3 – Productivity Impacts on Collection Costs**

<b>Cart Pick-ups per Truck per Day (Productivity)</b>	<b>450</b>	<b>550</b>	<b>650</b>	<b>700</b>
Change in Collection Productivity	(18%)	NA	15%	21%
Collection Cost per 8-hour Day ( $\$115 \times 8$ )	\$920	\$920	\$920	\$920
Cost per Pick-Up per Day (Cost $\div$ Pick-ups per Day)	\$2.04	\$1.67	\$1.42	\$1.31
Monthly Cost for Weekly Collection (Pick-up Cost x 4.33 Weeks per Month)	\$8.85	\$7.24	\$6.13	\$5.69
<b>Monthly Cost Change Compared to 550 Pick-ups</b>	<b>+\$1.61</b>	<b>NA</b>	<b>-\$1.11</b>	<b>-\$1.55</b>

## Oregon-Specific: Need for Separate Glass Collection Truck

Currently in Oregon, glass "on the side" is often collected in a separate compartment of the single-body recycling trucks. If glass continues to be collected in the 14-gallon curbside tub in a split cart and split-body truck system, then a second truck would likely be required to collect the glass separately. The cost of separate glass collection could range from \$1.50 for every-other-week collection to \$2.50 for weekly collection. These costs would have less of an impact in the Portland Metro area, where some haulers more commonly collect glass in a second truck.

### Summary of Customer Cost Impacts

Based on the calculations above, which assumes no changes in collection frequency and collection productivity at 550 daily pick-ups, the additional monthly cost of weekly split-cart instead of weekly single-stream or two-cart dual-stream is summarized in Table 4. For collection systems collecting single-stream recycling every other week, there would be an additional operational cost of \$4 to \$5 per month per customer.

**Table 4 – Additional Monthly Cost per Customer of Split-Cart Dual-stream**

	<b>Weekly Split-Cart Compared to Weekly Single-Stream Collection</b>	<b>Weekly Split-Cart Compared to Two-Cart Dual-stream Collected on Alternating Weeks</b>	<b>Weekly Split-Cart Compared to Every- Other-Week Single Stream Collection</b>
<b>Additional truck capital cost</b>	\$0.07 to \$0.11	\$0.07 to \$0.11	\$0.07 to \$0.11
<b>Additional cart capital cost</b>	\$0.99	\$0.34	\$0.99
<b>Additional Collection Cost</b>	n/a	n/a	\$4.00 to \$5.00
<b>Total additional cost</b>	\$1.06 to \$1.10	\$0.41 to \$0.45	\$5.06 to \$6.10

Assuming a \$25,000 cost difference per truck, a \$30 difference per cart, and 550 customers per truck per day over a standard five-day work week, the initial capital outlay to service each 2,750-customer block would require a minimum of \$550,000 up to \$650,000 for the split truck and split carts, not including the need for separate glass collection.

#### Reduced Fleet Flexibility

Split-body trucks cannot be used to augment garbage or organics collection routes unless these waste streams are collected in a split cart too, reducing fleet flexibility especially for smaller haulers. Therefore, a second split-body truck is required to sit in reserve if the other waste streams use a dedicated cart. This limitation is not a problem in Milpitas or Sunnyvale, because they also use a split cart for garbage and food scraps.

#### Reduced Container Capacity

Split carts reduce the container capacity, creating two key problems. First, they are more difficult to empty. Visalia, California, (not profiled in case studies), switched from dual-stream to single-stream in part because of this challenge. In addition, split carts reduce the space available for cardboard, requiring more customers to set cardboard out in bundles that drivers must pick up by hand.

## Recommendations

Dual-stream collection has the potential to reduce contamination collected at the curb but at a likely substantial cost (at least \$0.65 per month per customer). Additional education and advanced processing systems, researched in other tasks, also have the potential to reduce or remove contamination to create clean commodities. Because education, collection and processing work together as an integrated system, recommendations here should be considered provisional pending the results of other research tasks.

Cascadia Consulting Group provisionally recommends continuing to consider including two-cart dual-stream collection in one scenario as a single-family residential collection option. However, separate collection of glass in Oregon is still problematic for most collection systems where a single truck is used for multiple waste streams. As previously noted, a separate route/truck for glass collection, if necessary, increases collection system operations and costs to the customers. In addition, there may be implications for the multifamily and non-residential collection systems if they would need to send materials to the same dual-stream MRFs.

Compared to the split-cart system, Mill Valley and Wentzville's approach of using two carts instead of a new split roll cart and collection truck is preferable for the following reasons:

- **Low Capital Cost** — A 96-gallon split cart costs approximately \$30 more than a second 64-gallon non-split cart. The cost for a split-body collection truck ranges from \$16,000 to \$25,000 more than a single compartment truck; however, the splitting of the truck limits overall use for collecting other material streams, a common practice by many smaller haulers in Oregon. The split-body truck can only be used to collect either a split roll cart or to collect garbage and yard debris or recycling at the same time on the same route (requiring washing between collecting putrescible wastes and recyclables).
- **Simpler to Implement** — Split carts pose other challenges that are more difficult to overcome than adding a second cart: their smaller compartment sizes diminish the overall storage capacity for recyclables and can create problems associated with emptying carts. While adding a second cart for recycling presents a problem for customers with limited space to store carts, Mill Valley overcame it by allowing them to use the same cart on alternating weeks. The alternating week schedule requires all customers to keep track of which day to set out various carts, but jurisdictions in Oregon with alternating collection have already addressed the tracking issue using customized calendars or mobile phone apps to help customers remember which container to set out on collection day.
- **Wet Climate** — Bundled cardboard left out of the cart during the wet season significantly increases the amount of water absorbed in the material stream. Wet cardboard is difficult to sort and causes other fiber to stick together, which increases the likelihood that it will be disposed.

Other collection methods that may be included in scenarios, but are more well-known and are not studied here, are:

- Single-stream collection, such as that conducted in Oregon, with commingled containers and fibers in one containers and glass on the side (for residential and commercial).
- Collection of both commingled and separated materials from nonresidential waste generators in both dumpsters and/or carts.

- Staffed and unstaffed drop-off depots for a range of materials.

## Single-Family Residential Dual-Stream Collection Case Studies

### Mill Valley, California (Two Carts)

To reduce processing costs by sending material to a lower-cost sorting facility, Mill Valley switched from single-stream to dual-stream in August 2019 after a pilot program. In the pilot, households on four collection routes were given a 22-gallon bin for containers and told to use the 64-gallon cart they already had for paper. The bin and the cart were picked up on alternating weeks. During the pilot, the collector recorded set-out rates, visual observations of contamination, and the total weight of materials collected. The pilot program evaluation report includes contamination rates; however, those rates may be anecdotal rather than measured.

Mill Valley chose a two-container system instead of a split-cart system to avoid the capital cost of a split-body collection truck dedicated to residential recycling. By using two containers for dual-stream collection, Mill Valley could continue to use any of its truck fleet to collect materials. Purchasing a split-body truck may be too expensive for most Oregon waste collectors, so this program is a great alternative.

### Data Sources

- Interview with Jim Lavarone, general manager, at Mill Valley Refuse
- Case study by Mill Valley Refuse, "Dual-Stream Pilot Recycling Program: Program Summary and Evaluation," 2019. [https://legistarweb-production.s3.amazonaws.com/uploads/attachment/pdf/363150/MVRS\\_Dual-Stream\\_Pilot\\_Report\\_032119.pdf](https://legistarweb-production.s3.amazonaws.com/uploads/attachment/pdf/363150/MVRS_Dual-Stream_Pilot_Report_032119.pdf)
- Mill Valley Refuse website: [www.millvalleyrefuse.com](http://www.millvalleyrefuse.com)
- News articles:
  - <https://www.marinij.com/2019/03/31/mill-valley-refuse-seeks-vote-on-double-bin-recycling/>
  - <https://www.marinij.com/2019/05/25/mill-valley-refuse-pitches-two-bin-recycling-program>

### Costs and Equipment

#### Capital and Operating Costs

The only capital cost was the second recycling cart (see table below). Mill Valley was able to use existing trucks for collection.

Rollcart Volume	Cart \$	Trans \$	Assm/Dist	Total Cost	7 yr. dep
48 gallon	\$ 40.50	\$ 3.42	\$ 5.95	\$ 49.87	\$ 0.59
64 gallon	\$ 44.03	\$ 4.18	\$ 5.95	\$ 54.15	\$ 0.64
96 gallon	\$ 47.55	\$ 4.18	\$ 5.95	\$ 57.68	\$ 0.69

Operating costs are comparable to weekly single-stream, with some costs for outreach, education, and the rerouting. With the change to the dual-cart system, Mill Valley set up routes to collect from approximately 500 houses per day. The papers take up a greater amount of volume and are higher in weight than the containers, but neither route requires a second dump.

Processing costs paid by the collector are lower for dual-stream than for single-stream: single-stream costs \$83 per ton and dual-stream is \$40 per ton, for a cost savings of \$43 per ton. For the 9,370 tons of single-stream recycling material Mill Valley Refuse collected in 2018, the cost savings would have been \$402,910.

Mill Valley explored costs of using a split cart, which were estimated to be \$410,677 per split-body truck (8 trucks required) and \$600,000 for 14,000 new split-body carts.

### Collection Equipment

Second 64-gallon cart with a blue lid and instructions for fiber recycling, supplementing the existing recycling cart that was repurposed for containers.

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### Accepted Materials

#### Container Cart

- Glass bottles & jars (clean)
- Aluminum cans & foil (clean)
- Plastic bottles, tubs & jugs (clean; okay to leave caps on)
- Tin & bi-metal cans and food trays (clean)
- Pressurized aerosol cans (empty)

#### Paper Cart

- Office paper (any color)
- Newspaper & magazines

- Paperboard (like cereal & shoe boxes)
- Junk mail and catalogs
- Paper tubes / Paper egg cartons
- Paperback books
- Shredded paper in a paper bag
- Cardboard – Cardboard must be packed in 2' x2' x2' bundles or smaller and tied with twine or string (no plastic tape) if it does not fit into the cart. If it easily fits in the Paper Cart, cardboard does not need to be bundled.





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## Contamination

### Contamination Issues

The pilot study report quoted the Marin Sanitary MRF facility manager, Nicholas Minton, as saying, “I would say your residual rate is 6% to 7% or under based on the loads that I saw. I would say about 2-2.5% was nonrecyclable #1-7 plastics, 2-2.5% mixed paper contamination, and the rest of the total is true residual such as waxed cardboard and glass residual in the fiber. There was very little or no plastic bags and absurd contamination like diapers and food, which was great.”

Since rolling out the program Citywide, Mill Valley Refuse reports the following:

- Contamination is low because the collection system is semi-automatic; therefore, the driver flips the lid prior to dumping, providing an opportunity to observe contamination.
- Most of the contamination that is discovered on-route is found in the container cart, where it is easily seen because there isn’t any paper to cover up the contamination.
- Contamination has not been measured specifically for Mill Valley by the MRF, but the MRF’s overall contamination rate for dual-stream is 15% compared to 30% for single-stream.
- The MRF has requested that the container loads not be compacted during collection to reduce the amount of broken glass.

### Ability to Spot Contamination

Contamination in the container cart is easy to spot; whereas paper allows items to be more easily hidden. Mill Valley Refuse uses semi-automated trucks that require the driver to check each cart prior to dumping in the truck. This provides the driver the opportunity to spot contamination before dumping and has resulted in lower levels of garbage being collected with the recycling.

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## Customer Participation and Acceptance

### Customer Participation

Participation in recycling remained high during the pilot: the average percentage of “No Carts Out” was 13% (for a set-out rate of 87%) with dual-stream compared to 19% (set-out rate of 81%) for single-stream.

During the pilot, the percentage of set-out that were prepared properly (i.e., the right materials on the right days) started low at 68% and increased to 92% by the third week and 99% in the fifteenth week.

Tons of recycling collected were similar during the dual-stream pilot compared before and after (after adjusting for temporary changes to the routes).

Anecdotally, residual levels were substantially lower during the pilot: according to the facility manager Nicholas Minton. “I would say your residual rate is 6% to 7% or under based on the loads that I saw.”

### Consumer Acceptance

In a survey of pilot participants, over half (54%) reported one or more problems, primarily storing recyclables for two weeks, following the every-other-week collection schedule, and separating materials into two streams. About half (52%) said they would be willing to pay up to \$5 more per month to keep single-stream recycling.

Based on survey feedback and to increase customer satisfaction with the change, all customers were supplied with a second 64-gallon cart with a blue lid for paper. Customers already had a 64-gallon cart for commingled, which is now used for the containers. In pilot testing, customers did not like using a tub for their second container.

About 15% of participants surveyed reported they do not have space for another cart. For these customers, Mill Valley Refuse allows them to use one cart and alternately place the two streams in it, as long as they set-out the correct material each week.

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## Type of MRF Receiving Collected Materials

The receiving MRF, operated by Marin Sanitary Service, is set up for dual-stream.

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## Customer Education and Compliance

Mill Valley used extensive mailers and cart tags to provide education. At the same time, they were conducting the pilot, Mill Valley also conducted an anticontamination campaign. The campaign consisted of a brochure mailed to all single-stream customers to inform them of what is allowed in the recycling carts and what should be thrown into the waste cart (shown on page 58 of the pilot study report).

## Collection Fee and Service Structure

Mill Valley uses a variable-rate fee structure based on size of garbage container or pay-as-you-throw (PAYT) with weekly garbage and organics collection and alternating recycling collection (one container per week). Rates for the “flat area” are shown below. Garbage customers receive two carts for recyclables and one container for yard waste.

Garbage Container Size	Curbside Monthly Rate
20-gallon (1)	\$44.40
32-gallon (1)	\$44.96
32-gallon (2)	\$81.75
32-gallon (3)	\$114.48
32-gallon (4)	\$147.26
32-gallon (5)	\$179.98
45-gallon (1)	\$71.28

## Relevant Recycling Regulations

**Mandatory recycling service:** in California, new organics-focused regulations will soon make recycling and organics collection practically mandatory for all residents; however they are not currently in place.

**Bottle bill:** in California, most beverage containers (aluminum, glass, plastic and bi-metal containers) are covered by the California Redemption Value recycling program. Milk, wine, and distilled spirits are excluded from the bottle bill. Processing facilities receive redemption values for containers sorted from curbside recycling.

## Cities of Wentzville, Missouri and Meridian Waste (Dual Carts) City of St. Peters Recycle City MRF (Dual Carts)

The City of Wentzville, Missouri, provides waste and recycling collection services to its residents through a collection contract with Meridian Waste. The City invoices for collection and disposal services to residents of Wentzville on a combined water-sewer-waste invoice generated by the City’s utility section. Previously, residential recycling from Wentzville was collected single-stream and sent to the Earth City MRF near the City of St. Charles.



Resource Management closed its Earth City MRF in October 2018 due to the downturn in the markets. Prior to the closure, the facility processed single-stream recycling for many of the jurisdictions and the collection companies on the North County area of the St. Louis metropolitan region including Wentzville

and O’Fallon. The impacted cities and haulers were given 13 days’ notice before they needed to find alternative processors. Many jurisdictions stopped collecting recycling while others found alternative processors. Wentzville began sending material to the Recycle City MRF in the City of St. Peters.

The City of St. Peters owns the Recycle City MRF, which can accept only a dual-stream collection of fiber and containers. The St. Peters recycling program uses a market-driven approach to recycling by emphasizing quality instead of quantity. While the commodity value of the processed materials has decreased over the last 18 months, the MRF has not had a problem with selling the baled product, which generated adequate revenue to maintain operations. As long as Wentzville sends recyclables with at least \$200,000 worth of material value annually to the MRF, it does not incur processing fees. If Wentzville had chosen to maintain single-stream collection, the City’s processing costs could be much higher: the nearby Republic Services MRF in St. Louis is currently charging \$125 per ton to process recycling. However, at least part of the additional cost is because Republic Services is shipping material from the area to MRFs elsewhere due to limited capacity at its St. Louis facility.

To be able to send material to St. Peters, Wentzville replaced its single-stream cart program with a dual-stream system using two carts. Using two carts instead of split carts allowed Wentzville to quickly adapt their recycling collection operation to meet the dual-stream material requirements of the St. Peters MRF without large capital outlays. One cart, included in base collection services, now accepts rigid metal and plastic containers and is collected every other week. Residents who want to continue recycling cardboard and mixed paper collection every other week must subscribe to this additional service for \$2.50 and are given a second cart. Customers who choose not to subscribe to fiber collection can drop off the cardboard and paper at several local recycling depots along with their glass.

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## Data Sources

### City of Wentzville and Meridian Waste

- Interview with Natalie Denando, government & community affairs manager with Meridian Waste (the contracted collector for the City of Wentzville)
- City website at: <https://wentzvillemo.org/>
- Meridian Waste website: <https://www.meridianwaste.com/>
- KMOV.com / Future of recycling in St. Charles County cities uncertain, September 17, 2018
- 70 West Sentinel / City of Wentzville announces changes to recycling program: No glass or paper pickup, November 5, 2018 <https://www.70westsentinel.com/city-of-wentzville-announces-changes-to-recycling-program-no-glass-or-paper-pickup/>
- St. Charles County Suburban Journals / Changes announced to recycling service in Wentzville, December 5, 2018 [https://www.stltoday.com/suburban-journals/stcharles/changes-announced-to-recycling-service-in-wentzville/article\\_3499bcef-5c11-5032-a261-db4dc7313661.html](https://www.stltoday.com/suburban-journals/stcharles/changes-announced-to-recycling-service-in-wentzville/article_3499bcef-5c11-5032-a261-db4dc7313661.html)
- St. Louis Post-Dispatch / New Recycling Landscape, March 8, 2019 [https://www.stltoday.com/business/local/in-new-recycling-landscape-wildwood-is-the-latest-area-city/article\\_fa14b958-693b-53a8-bea3-5077bd1ad476.html](https://www.stltoday.com/business/local/in-new-recycling-landscape-wildwood-is-the-latest-area-city/article_fa14b958-693b-53a8-bea3-5077bd1ad476.html)

- St. Charles County Suburban Journals / Curbside fiber recycling begins this week in Wentzville, July 17, 2019 Source: [https://www.stltoday.com/suburban-journals/stcharles/curbside-fiber-recycling-begins-this-week-in-wentzville/article\\_19635897-3382-5cdd-8fea-a207ed54b8a3.html](https://www.stltoday.com/suburban-journals/stcharles/curbside-fiber-recycling-begins-this-week-in-wentzville/article_19635897-3382-5cdd-8fea-a207ed54b8a3.html)

#### City of St. Peters Recycle City MRF

- Interview with Cheryl Sinecki, director of environmental services for the City of St. Peters
- City website at: <https://www.stpetersmo.net/>
- KSDK, “St. Peters’ Recycling Center is One of the Most Efficient in the County” July 23, 2019, <https://www.ksdk.com/article/news/st-peters-recycling-center-is-one-of-the-most-efficient-in-the-county/63-a8bbee85-577f-4afc-b6b5-4f08b68100c0>
- City of St. Peters Board of Aldermen Meeting Minutes June 7, 2019. <https://www.stpetersmo.net/FY-19%20Budget%20Work%20Session%20Minutes%206-7-18.pdf>

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## Costs and Equipment

### Capital and Operating Costs

#### Wentzville

No data were provided on collection beyond customer rates.

To maintain the previous rate structure, Wentzville reduced collection in the base level of services to metal and plastic containers. Customers who want to retain fiber collection must subscribe for an additional \$2.50 per month to receive the additional cart. Glass is no longer collected at curbside. Fiber and glass are accepted at drop-off sites located within Wentzville.

#### St. Peters

No data were provided on collection beyond customer rates.

### Collection Equipment

#### Wentzville

The hauler uses an automated side loader truck with 35-, 65-, and 95-gallon roll carts. Customers who do not subscribe to the optional fiber collection service use 65-gallon carts for rigid containers; these carts were previously used for single-stream recycling. Customers who subscribe to the optional fiber collection service receive a 35-gallon cart for rigid containers, and the solid waste collector converts the existing 65-gallon cart to fiber with a new lid sticker.

### St. Peters

The City uses an Heil automated side loader truck with 96-gallon carts. The City provides blue bags for recycling.

In St. Peters, recycling is collected twice a week, alongside garbage in the garbage cart. Participating residents place accepted recyclables in City-provided blue bags (separating containers from fibers), which are separated at the transfer station. The City also provides “backer boards” listing what belongs in each bag that residents can use inside their home (see photo at right).



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## Accepted Recyclable Materials

### Wentzville

#### Rigid container cart

- Metal cans: aluminum, tin, and steel cans
- Plastic containers: clear or colored (excluding black) plastic containers labeled #1, #2, #3, #5, and #7

#### Fiber cart

- Cardboard
- Mixed paper: newspapers, magazines, junk mail, computer paper, and telephone books

## St. Peters

### Containers bag

- Aluminum cans
- Glass bottles and jars
- Plastic containers: clear or colored (excluding black) plastic containers labeled #1, #2, #3, #5, and #7
- Tin or steel cans

### Paper-based products bag

- Newspapers (with inserts) and telephone books
- Magazines and junk mail
- Computer paper
- Brown grocery bags
- Small pieces of cardboard and pressed fiber (such as cereal boxes, shoe boxes, clean pizza boxes, tissue boxes)

### Loose (no bag)

- Large pieces of cardboard can be placed directly in the trash cart and will be separated at the transfer station

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## Contamination

### Contamination Issues

#### Wentzville

According to the interviewee at St. Peters, the contamination rate for material from Wentzville at the MRF appears to be 15% to 20%. The St. Peters' MRF has not yet rejected any loads; however it invoices Wentzville and other cities sending contaminated material to the MRF for the cost of transfer, transport, and disposal of contamination sorted from their recycling streams. The City charges \$49 per ton for waste disposal.

Prior to closing, the Earth City MRF, which received material from Wentzville, would accept high levels of contamination. Continued contamination in Wentzville's recycling after switching to dual-stream collection seems attributable to poor outreach efforts. Wentzville and Meridian Waste have not determined who should bear the responsibility of outreach and the methods to reduce contamination at the curb.

#### St. Peters

Currently, material collected in St. Peters has a very low level of contamination – estimated to be below 5% – due to recent program changes that included requiring residents to opt-in to recycling, conducting robust education and outreach effort, strictly enforcing contamination standards.

To reduce previous contamination from residents using City-provided blue bags for garbage as well as the cost of blue bags, the City has stopped automatically providing blue bags to all residents. Previously, only between 20% and 30% of blue bags supplied by the City were used for recycling. As of April 1, 2019, residents who want to recycle must enroll in the free "Blue Cart Crew" program, which involves pledging



to use blue bags only for recycling and agreeing to periodic compliance checks. To identify participating residents, the City has either replaced their green garbage cart with a blue cart or place a blue sticker on their current green cart. Blue recycling bags continue to be collected in the same container as garbage bags.

#### Ability to Spot Contamination

##### **Wentzville**

Meridian Waste uses hopper cameras to observe material as it is being collected. The interviewee at Meridian Waste reported the company will be upgrading their system to include tablets that will allow the drivers to take photos of contamination and send to the customers when a problem is observed. Despite these technologies, Wentzville has not significantly decreased its levels of contamination since beginning dual-stream collection, according to the St. Peters MRF.

##### **St. Peters**

Contamination is difficult to spot with the bagged system. Although bags are translucent, workers at the transfer facility and MRF were opening many bags of garbage prior to the change in the recycling program.

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## Customer Participation and Acceptance

#### Customer Participation

Meridian Waste does not track recycling participation because Wentzville does not request this information. Anecdotally, the hauler estimated that participation rates range from 50% to 60%.

Data were not available for St. Peters.

#### Customer Acceptance

Data regarding customer acceptance was not available.



## Type of MRF Receiving Collected Materials

Recycle City takes collected residential recycling from the cities of St. Peters, Wentzville, and O’Fallon. St. Charles County also delivers source-separated OCC to Recycle City. The facility, which shares a building with a transfer station, is owned and operated by the City of St. Peters Environmental Services Department. The joint facility has 24 full-time FTEs (full-time equivalent employees) and 11 part-time FTEs for processing recyclables and transferring solid waste. Approximately 20 FTEs are assigned to recycling services, and the remainder are assigned to transfer operations.

Generating clean material bales for sale is the primary objective of the St. Peters MRF, which is why the City of St. Peters uses dual-stream collection and requires residents to opt in to recycling, albeit at no additional cost over garbage collection.



## Capital and Operating Costs

Because this is a shared facility (transfer station and MRF) that has two separate sort lines, the City has not estimated a per-ton processing cost. The facility estimates that the cost to generate a bale of material is approximately \$15.61, although it did not specify how large bales are. In 2018, the facility generated 6,358 bales of material for sale.

## Facility Design

The facility was designed in 1997 as a dual-stream and modeled after a facility in North Augusta, South Carolina. Except for the magnets and the eddy current on the sorting line, the rest of the sorting system is manual. Because the material is separated by residents, the amount of labor required to sort is less than a single-stream facility.

## Material Marketing

St. Peters has not had any problems selling the sorted materials. The City has a three-year contract that pays \$20 per ton for OCC over the current RISI market index price (Yellow Sheet). Other sorted materials are placed out to bid on three-year contracts.

## Processing Fees

St. Peters has a payment agreement with Wentzville and O’Fallon that each city must deliver no less than \$200,000 of materials value annually. The value is determined by the revenue generated from the sale of material delivered, and the value fluctuates with the market. If the value is less than \$200,000, the cities pay the difference. If the value is more than \$200,000, then St. Peters evenly splits the additional revenue with the respective city in proportion to the amount they deliver. When Wentzville and O’Fallon send contaminated material to the MRF, the facility invoices them for the cost of transfer, transport, and disposal of contamination sorted from their recycling streams.

For comparison, the Republic Services MRF in St. Louis, which is single-stream, is currently charging \$125 per ton to process recycling. However, the processing fee is higher in part because Republic Services is transporting material to MRFs elsewhere due to limited capacity at its St. Louis facility.

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## Customer Education and Compliance

### Wentzville

Education for Wentzville residents is minimal, primarily provided through the City's website. Educational efforts are limited by lack of agreement between the City and the contracted collector regarding who should bear the cost of providing education. Wentzville and Meridian Waste are working together to develop invoice flyers and an email campaign to reduce contamination.

### St. Peters

St. Peters reported conducting extensive education and compliance activities to combat contamination. The City has a robust website and social media presence. It also uses the ReCollect app to inform residents about solid waste and recycling. Residents must opt in to receive blue bags for recycling, and the City periodically conducts contamination compliance checks of recycling bags.

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## Collection Fee and Service Structure

### Wentzville

Under the dual-cart system in Wentzville, garbage is collected weekly, and the container and fiber carts are collected on alternating weeks. The current tipping fee is \$26 per ton.	Service	Monthly Rate
	96-gallon hauler-provided garbage cart and rigid recycling cart	\$15.00
	Private garbage cart and rigid recycling cart	\$13.50
	Yard waste with cart (March- December)	\$11.00
	Fiber recycling pick-up with a cart	\$2.50

### St. Peters

In St. Peters, recyclables in blue bags are collected with garbage in non-blue bags, all inside the garbage cart twice a week. Participating residents place accepted recyclables in City-provided blue bags (separating containers from fibers), which are separated at the transfer station. The current monthly cost for collection is \$24.61 per month plus a \$0.50 landfill fee.

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## Relevant Recycling Regulations

Unlike Oregon and California, Missouri does not have container deposit legislation. All recycling regulation is at the local level (city or county) within the State of Missouri. Wentzville and St. Peters do not have regulations requiring recycling.

### Milpitas, California (Split Carts)

Milpitas, California switched from single-stream to dual-stream in December 2016 to reduce contamination. Milpitas is the only jurisdiction researched that sends dual-stream collected recyclable materials to a single-stream MRF for processing. Milpitas Sanitation is the contracted hauler for the city. Louie Pellegrini, owner of Milpitas Sanitation, said it took approximately 90 days for customers to become acclimated with the split-cart system.

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## Data Sources

- Interview with Louie Pellegrini, owner of Milpitas Sanitation
- Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

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## Costs and Equipment

### Capital and Operating Costs

In capital costs, the cost for the split-body collection truck was \$16,000 higher than a similar single-material-collection body (Labrie). Milpitas Sanitation reported that operating costs are comparable to a single-body truck. Collection frequency is weekly. All routes average 550 houses per day on an 8-hour shift, and routes were designed not to exceed 8 hours.

Louie Pellegrini reported the following costs and saving (as of May 2019):<sup>9</sup>

- “His company is currently receiving an average of about \$94 per ton for recyclables, and landfill transportation and tip fees costs are around \$80 per ton. So diverting what was previously a MRF residual brings a potential financial benefit of \$174 a ton if diverted from landfill and sold for recycling, Pellegrini said.”
- “On a per-household calculation, the switch nets a clear benefit, he said. In the expense column, the implementation costs (purchase of trucks and split carts) come out to about 21 cents per household per month (he noted split carts are roughly one-third more expensive than single-compartment ones). The potential benefit from converting MRF residue into saleable commodities is 68 cents per

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<sup>9</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

household per month. That means the switch to dual-stream service is potentially saving 47 cents per household per month, Pellegrini said.”

### Collection Equipment

The hauler uses Labrie trucks with a truck body split 60% for fiber and 40% for containers (plastic, metal, and glass). Customers are given 96-gallon split carts and may request a 64-gallon split recycling cart instead.

A video of the carts in use can be seen at: [https://www.youtube.com/watch?v=ITmSY\\_2ZFzI](https://www.youtube.com/watch?v=ITmSY_2ZFzI)



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### Accepted Materials



#### Containers

- Glass Bottles & Jars
- Aluminum & Metal
  - Food & beverage cans
  - Aerosol cans (empty)
- Foil and scrap pieces (up to 30 pounds per item)
- Plastics Labeled 1-7
  - Bottles, jars, tubs & trays

### Paper/Fibers

- Any recyclable paper that tears, including:
  - Aseptic boxes (juice, soup & soy milk)
  - Dairy cartons
  - Catalog, magazines, junk mail & phone books
- Corrugated cardboard & paper boxes (large/multi pieces should be flattened and/or cut)
- Newspaper (including inserts)
- Shredded paper (contained in a paper bag or box)

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## Contamination

### Contamination Issues

“As a result of the change, Louie Pellegrini, owner of Milpitas Sanitation, estimates residual at the MRF has dropped from 25% to 10%.”<sup>10</sup>

“‘What I believe the dual-split cart brings is the size of the lid — it’s not easy for them to put the stuff in that shouldn’t be there.’ He pointed to pay-as-you-throw (PAYT) service as worsening contamination. A great concept, PAYT is often employed as a way to motivate people to reduce their garbage generation, but if they can’t fit garbage in the smaller waste container, they put it in the recyclables container instead, Pellegrini said. Exacerbating the issue in the San Francisco Bay Area is a housing shortage.”<sup>11</sup>

### Ability to Spot Contamination

Large pieces of cardboard need to be set next to the recycling cart where the driver must manually pick up the items and throw them into the truck, increasing labor costs but providing an opportunity to look for contamination. Milpitas Sanitation didn’t have the data available to know how many times a day the driver needs to get out of the truck to pick up cardboard.

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## Customer Participation and Acceptance

### Customer Participation

Participation and set-out rate data were not provided, but according to Louie Pellegrini, “during the first quarter of this year [2019], Milpitas households are diverting 56% of material, including food scraps, recyclables and yard debris, from landfill.”<sup>12</sup>

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<sup>10</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

<sup>11</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

<sup>12</sup> Jared Paben, “Experts Duel Over Dual-Stream’s Merits,” Resource Recycling, May 14, 2019 (<https://resource-recycling.com/recycling/2019/05/14/experts-duel-over-dual-streams-merits/>)

### Customer Acceptance

Louie Pellegrini said it took approximately 90 days for customers to become acclimated to the split-cart system instead of single-stream.

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### Type of MRF Receiving Materials

Dual-stream collected recyclable materials are sent to Alameda County Industries' single-stream (MRF) in San Leandro.

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### Customer Education and Compliance

Milpitas Sanitation uses newsletters, postcards, online instructional videos, and newspaper advertising to educate customers. They also offer classroom presentations.

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### Collection Fee and Service Structure

Milpitas uses a PAYT fee structure with weekly collection for all streams. Quarterly rates based on container size for a split garbage and food scraps container, are shown in the table below. Garbage customers also receive a 96-gallon split cart for recyclables and a 96-gallon yard waste cart. A 64-gallon split cart for recyclables is available upon request. Customers may also set-out used motor oil and cooking oil, when properly prepared.

Split Cart Service Container Size	Curbside Quarterly Rate
19-gallon garbage/19-gallon food scraps	\$100.78
26-gallon garbage/19-gallon food scraps	\$109.54
45-gallon garbage/19-gallon food scraps	\$128.83
67-gallon garbage/29-gallon food scraps	\$148.01

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### Relevant Recycling Regulations

**Mandatory recycling service:** in California, new organics-focused regulations will soon make recycling and organics collection practically mandatory for all residents; however they are not currently in place.

**Bottle bill:** in California, most beverage containers (aluminum, glass, plastic and bi-metal containers) are covered by the California Redemption Value recycling program. Milk, wine, and distilled spirits are excluded from the bottle bill. Processing facilities receive redemption values for containers sorted from curbside recycling.



## Cities of Mountain View and Sunnyvale, California SMaRT MRF (Split Carts)

The cities of Mountain View and Sunnyvale migrated from a three-bin system to the split-cart system. Collection services are provided to both cities by contracted haulers: Recology in Mountain View and Specialty Solid Waste and Recycling in Sunnyvale. Materials collected from both cities are processed at the SMaRT station operated by the City of Sunnyvale. SMaRT was designed for the dual-material stream: paper on one line and containers (glass, plastic, and metal) on the other.



### Data Sources:

- Interview with Lori Topley at City of Mountain View
- Interview with Debbi Sargent at Sunnyvale SMaRT
- Questionnaire completed by John Zirelli, General Manager for Recology Mountain View
- Web-based research for program information on City websites:
  - [https://www.mountainview.gov/depts/pw/recycling\\_and\\_zero\\_waste/default.asp](https://www.mountainview.gov/depts/pw/recycling_and_zero_waste/default.asp)
  - <https://sunnyvale.ca.gov/property/recycling/default.htm>

### Costs and Equipment

#### Capital and Operating Costs

No data were provided on collection.

#### Collection Equipment

In Mountain View, single-family dwellings use a split cart made by Toter, offering 64-gallon carts as the standard size with an option to request a 96-gallon cart. Large pieces or bundles of cardboard may be placed for collection outside of carts. Carts are collected using a fully-automated, split, side loader.



In Mountain View, multifamily dwellings are given two 96-gallon carts made by Toter, one for paper and one for containers. They are collected using a semi-automated side loader.

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## Accepted Recyclable Materials

### Mountain View

The full list can be found at

<http://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=25383>

#### Paper

- Cardboard (flatten) put small pieces in cart; and large pieces tie or bundled into 3'x3' sizes outside cart
- Catalogs, phone books and magazines (no plastic wrap)
- Cereal and cake boxes (no plastic liners)
- Colored and white paper
- Donut boxes (clean, no food stain/residue, no plastic)
- Gift wrap (no metallic), greeting cards (no musical)
- Junk mail (plastic windows ok) but no laminated postcards that cannot be torn by hand
- Manila file folders and envelopes (no padded; clasps ok)
- Newspaper and colored inserts
- Paperback books (no hardbacks)
- Pizza boxes (clean, no food stain/residue or plastic)

#### Containers

- Cartons: milk, juice, soy milk, soup, broth (put on container side, lids okay)
- Plastic bottles, tubs, and jars
  - Only plastic bottles, tubs and jars are accepted.
  - Plastic bottles and jars (food, peanut butter, syrup, catsup, drink or detergent, shampoo, prescription)
  - Plastic jugs (milk jugs, orange juice)
  - Plastic tubs (cottage cheese, yogurt, baby wipes)
  - Lids and caps are okay but prefer metal
- Metal cans
  - Aluminum cans, trays, or clean aluminum foil
  - Bimetal cans (cat food cans)
  - Metal food cans, tin and steel cans
  - Metal lids and caps (but no wire or scrap metal)
- Glass Bottles and Jars
  - Beverage bottles (any color)
  - Canning jars Jam or peanut butter jars
  - Olive oil and vinegar bottles
  - Soup or spaghetti jars
  - Wine bottles (no corks/metal or plastic wrapper)

### Sunnyvale



### **Paper**

- Catalogs, magazines, paperback books
- Newspapers and inserts
- Junk mail
- Paper boxes (cereal, tissue, etc.; remove inserts)
- Office paper
- Non-metallic gift wrap and greeting cards
- Cardboard (small pieces)

### **Containers**

- Glass bottles and jars

- Metal cans
- Plastic bottles and tubs (i.e., shampoo, detergent, yogurt)
- Milk, soup and juice cartons
- Clean foil ok

### **Outside the Cart**

- Cardboard (large, bundled)
- Paper in a labeled paper bag
- Motor oil and oil filters (properly contained)
- Batteries (properly prepared)

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## **Contamination**

### **Contamination Issues**

Mountain View provided contamination information based on a 2019 waste characterization study:

- 7.43% of the material in the paper side of the single-family cart is containers, mostly tin cans (which are recycled and not counted as residue)
- 2.17% of material in the multifamily dwelling paper cart is containers.

The waste characterization tables say no paper was found with the containers, but it was unclear whether it wasn't recorded separately in the residue or if there really was not any paper in containers. The only reason material would mix during collection is if a resident put the cart at the curb backward. Mountain View had never once heard Recology say there is any issue with this.

Residue for materials processed from single-family dwellings:

- Paper residue: 4.7%
- Container residue: 24% residue (they get a lot of plastics that they don't accept, especially thermoforms)

Residue for materials processed from multifamily dwellings:

- Paper residue: 7.6%
- Container residue 28.9%

According to SMaRT, the facility does not have contamination issues with sorted materials, but it has experienced issues with marketing materials because of China's National Sword and the use of

alternative markets for fiber. The facility noted feedstock contamination issues when residents put non-recyclable materials in their cart (plastic film, plastic bags — such as potato chip bags).

#### Ability to Spot Contamination

Mountain View does not conduct contamination checks often, but they report it is easy to see contamination when they do spot checks.

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### Customer Participation and Acceptance

Customer participation and acceptance information was not available for Sunnyvale.

#### Mountain View Participation

Mountain View conducted a participation study in 2011, in which set-out rates for single-family dwellings ranged from 83% to 93% with only one route having 75%. Nearly all single-family dwelling garbage accounts have a split recycling cart.

Of the multifamily dwelling accounts with five or more housing units that are mandated to recycle by the State have recycling services, 99% of have subscribed to recycling.

In 2018, Mountain View collected 3,915 tons of recycling from single-family dwellings and 1,580 tons of recycling from multifamily dwellings. According to a 2018 study for single-family dwellings, capture rates were:

- All Recyclables 75%
- Cardboard 89%
- Paper 75%
- Glass 73%
- Plastic 71%

#### Mountain View Consumer Acceptance

Lori Topley, recycling manager for the City of Mountain View reported:

- “I only have anecdotal information, as we have not asked specifically about satisfaction with dual-stream since we had no ability to change it, as our agreement with the processor (SMaRT) does not expire until end of 2021 and they had no desire to change. When single-stream first became popular, we used to get a lot of inquiries about why we weren’t doing it. We have tried to do outreach explaining why we have dual-stream and that we believe it results in more marketable materials. People would say the trucks just mixed it together, so we started publishing a graphic and explanation of the split truck. The paper side fills up faster than the container side. Cardboard doesn’t fit in the paper side, and customers don’t like to bundle it, as we require, when they leave it next to cart. But we rarely get questions/complaints about dual-stream anymore. More complaints are about the fact we only collect recycling every other week.”

## Type of MRF Receiving Materials

Materials from Mountain View and Sunnyvale are sent to the Sunnyvale SMaRT facility. The facility was willing to provide some cost and equipment information.

### MRF Capital and Operating Costs

**Capital cost:** Most equipment was installed in 2001 at a cost of \$2.1 million and upgraded with optical sorter and eddy current in 2015 at a cost of \$1.6 million.

**Operating cost:** Not available. This cost was part of a larger bid in 2015 for the operation of the entire facility and cannot be segregated.

### Sorting Equipment Needs

Dual-stream processing uses two separate lines for processing. There is no need to separate fiber (2D) from containers (3D), so SMaRT does not have an initial screening device.

Containers are processed separately using the following equipment:

- Magnetic drum (sorts small chards of glass, bottle caps) removes ferrous cans
- Air gravity separator — Sorts “heavies” (glass) from “lights” plastic bottles, aluminum cans
- Optical sorter — Sorts plastic bottles by type (HDPE, PET), all other material sent first to eddy current separator (ECS) for aluminum cans, and finally to manual sort line to pull materials missed by optical and ECS.

Fiber is currently sorted manually on a conveyor. Material handlers pick out contaminants and old corrugated cardboard (OCC). The facility manager would suggest using an OCC screen and optical sorter to mechanically sort for these items in the future.

## Customer Education and Compliance

Mountain View sends an annual guide to all households once per year and sends a summer newsletter and monthly blurbs in the City's Sustainability e-zine. City staff do very little hands on compliance activity, but they have recently focused their outreach on cleaning up recycling (e.g., see screenshot below from last page of annual guide). The annual recycling guide can be found here:



<https://www.mountainview.gov/civicax/filebank/blobdload.aspx?BlobID=28825>

Recology tags recycling carts that have contamination.

## Collection Fee and Service Structure

### Mountain View

Mountain View uses PAYT with the rates set based on the 32-gallon garbage container (see schedule below). Recycling and composting are included in the garbage rate. Garbage and compost are collected weekly. Recycling is collected every other week. Services are not universal/automatic, but nearly all single-family and multifamily dwellings are subscribed.

Garbage Cart Size	Monthly Rate
20-Gallon	\$23.95
32-Gallon	\$34.95
64-Gallon	\$69.90
96-Gallon	\$104.85

### Sunnyvale

Sunnyvale also uses PAYT, offering prices for a split garbage cart (holding garbage and food scraps). All residents receive weekly recycling service.

Garbage plus Food Cart Size	Two-Month Rate
Small (27-gallon)	\$74.72
Medium (43-gallon)	\$82.94
Large (64-gallon)	\$93.34

## Relevant Recycling Regulations

**Mandatory recycling service:** in California, recycling service is mandatory for multifamily dwellings with five units or more in California. New organics-focused regulations are coming soon that will make recycling and organics collection practically mandatory for everyone.

**Bottle bill:** in California, most beverage containers (aluminum, glass, plastic and bi-metal containers) are covered by the California Redemption Value recycling program. Milk, wine, and distilled spirits are excluded from the bottle bill. Processing facilities receive redemption values for containers sorted from curbside recycling.

### Sault Ste. Marie Ontario Recycling System (Split Carts)

Sault Ste. Marie, Ontario also migrated from a bin system to the split-cart system. The reason to use the split cart was people were accustomed to segregating the materials in the bins, so the change was readily accepted. Collected materials are processed at a dual-stream facility. Contamination levels are 3% to 5%.

## Data Sources

- Interview with John Martella, general manager at Green For Life in Sault Ste. Marie, Ontario
- City website at: <https://saultstemarie.ca/City-Hall/City-Departments/Public-Works-Engineering-Services/Public-Works/Waste-Management.aspx>

## Costs and Equipment

### Capital and Operating Costs

Cost information was not provided for either collection operations (provided by municipal contract by Green For Life) or for the MRF receiving the materials.

### Collection Equipment

IPL split-body carts (see photo)

Labrie split-body trucks



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## Accepted Recyclable Materials

Recycling is collected weekly.

### Container side (blue):

- Steel (tin) food cans
- Aluminum cans
- No. 1 plastic bottles (i.e. pop bottles)
- No. 2 plastic bottles (i.e. shampoo bottles)
- Glass bottles and jars

### Bundled outside the cart:

Large cardboard

### Fiber side (gray):

- Newspapers and flyers
- Magazines
- Phone books
- Boxboard/small boxes (i.e. cereal boxes)
- Paper egg cartons
- Toilet/towel paper rolls
- Clean milk cartons
- Clean pizza boxes
- All other paper products (i.e. mail, computer paper)

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## Contamination

### Contamination Issues

Recycling is not collected if the material is contaminated, and the collector leaves a note stating the contamination.

According to the MRF, residual levels are 3% to 5%.

### Ability to Spot Contamination

Drivers do random spot checks on a daily basis. They refuse collection and leave a note if material is contaminated.

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## Customer Participation and Acceptance

### Participation

Data are not available, but City by-laws require customers to “actively recycle” in order to receive garbage collection. Recovery data were also not available.

### Consumer Acceptance

Because residents were accustomed to segregating the materials in the bins, the change was readily accepted. The main customer complaint was that the cart seemed too big, but customers soon became accustomed to it.

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### Type of MRF Receiving Collected Materials

The MRF is a two-stream facility using Bollegraaf sorting equipment. Further details were not provided.

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### Customer Education and Compliance

Sault Ste. Marie educates residents through a website with a recycling guide, answers to frequently asked questions, and videos:

- New recycling schedule, featuring split cart instructions: <https://www.youtube.com/watch?v=4b4cUXvrMGg>
- New automated garbage collection: <https://www.youtube.com/watch?v=prcuL5vh2z4>

Carts contain a legend on the top of the lid that describes what materials are accepted. The City leaves tags when carts are not collected due to contamination or improper set-outs.

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### Collection Fee and Service Structure

Waste collection is paid for through the City's tax base. Garbage is collected weekly in 65-gallon carts, and residents may purchase excess bag tags to set-out additional material. Prior to July 2019, residents used their own containers and were limited to two bags or container up to 20 kg (44 lbs.) and 76x98 cm (30"x39") each. Recycling is provided automatically to all residents.

The City paid for the additional recycling carts through the tax base. No cost information was provided.

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### Relevant Recycling Regulations

City by-laws require customers to "actively recycle" in order to receive garbage collection.

Ontario's "Blue Box" program is a partial EPR model in which producers and municipalities share responsibility for collecting materials. Ontario is in the process of transitioning to fully producer-paid EPR.