DRAFT

Growth Impacts in Pitkin County – Materials Management

I. Introduction

Construction & demolition (C&D) debris is the largest component of Pitkin County's and the upper Roaring Fork Valley waste stream, making up approximately 40% of the total incoming material received at the Pitkin County Solid Waste Center (SWC) and over 50% of landfilled waste. It is estimated that the SWC receives the majority of C&D debris generated between Aspen and Carbondale.

To reduce the volume of materials that must be disposed of in the landfill, the SWC runs various waste diversion processes including commercial composting, aggregate (e.g. concrete, asphalt, rock) and soils recycling, household hazardous waste and other unique diversion programs. The landfill currently has only eight remaining years of permitted space, so these diversion programs are important to conserve this shared resource. Closure of the landfill will create additional future costs for the community as the SWC converts to a transfer facility, requiring that trash be trucked down valley to another landfill and necessitating increased landfill prices.

While the SWC's primary focus is diverting material from the landfill to conserve airspace, waste reduction and diversion are also linked to greenhouse gas (GHG) emissions. GHG reductions are realized indirectly by diverting more material from landfill, as a result of the difference in energy required to produce goods with raw materials vs reused and recycled content.

This white paper outlines the SWC's efforts to improve C&D waste diversion, presents an analysis of GHG impacts resulting from materials management activities as well as provides examples of policies that have been proposed or enacted in the United States that Pitkin County could consider to approach the C&D waste problem from a sustainable materials management perspective.

> "Sustainable materials management (SMM) is a systematic approach to using and reusing materials more productively over their entire life cycles. It represents a change in how our society thinks about the use of natural resources and environmental protection. By examining how materials are used throughout their life cycle, an SMM approach seeks to:
>
> - Use materials in the most productive way with an emphasis on using less.
> - Reduce toxic chemicals and environmental impacts throughout the material life cycle.
> - Assure we have sufficient resources to meet today's needs and those of the future.
>
> (EPA)

II. C&D Debris Landfill Impacts

C&D debris is comprised of the materials used to construct and maintain buildings, infrastructure and landscaping, including recyclable or reusable and non-recyclable materials. C&D debris received at the SWC is primarily associated with residential and commercial construction activities, with residential projects being the main source for unincorporated Pitkin County. Much of the material generated by infrastructure and landscaping projects can be recovered for composting, recycling or reuse, while many types of residential and commercial building products such as drywall, engineered lumber products, plumbing and insulation either are not recyclable or lack local recycling markets so must be landfilled.

a) C&D Trash

Since 2019, the SWC has received about 30,000 tons of construction-related trash per year, which is 40% of total incoming material. This equals about 50,000 cubic yards of airspace in the landfill, which is 6.25% of remaining permitted space per year. According to current projections, the landfill is expected to run out of space in less than eight years.[1]

It is estimated that only 20% of incoming materials are generated in unincorporated Pitkin County, while the remaining 80% are generated in the City of Aspen, Town of Snowmass Village and other regional communities based on past studies.

b) Recoverable Materials

When materials are source-separated at a job site and hauled in individual loads to the SWC, many of the largest constituents of the C&D waste stream by weight and volume like dirt, concrete, and metal can be diverted from the landfill through recycling and reuse processes. Source-separation is required as the SWC currently lacks the costly equipment that would allow for sorting of mixed loads.

The following example materials can either be processed onsite to produce recycled landscaping and building products or are collected and sent to third party recycling facilities.

Type	**Tons**
Asphalt	626.36
Concrete	11,730.52
Lumber	292.52
Scrap metal	443.72
Cardboard	9.4

Table 1: Total Recoverable Materials Received in 2022

c) Construction & Demolition Debris Diversion Ordinance (2020)

In 2015, the SWC completed an analysis of incoming trash and found that 1/3 of C&D materials ending up in the landfill could have been recycled through existing waste diversion programs. In response, the SWC began researching strategies to divert more of this material away from landfill disposal to secondary uses to extend the life of the landfill.

The Construction & Demolition Debris Diversion Ordinance was adopted in 2020 (SEE APPENDIX X FOR ORDINANCE LANGUAGE) which created a deposit-refund system tied to the building permit process for building, remodel and demolition projects in unincorporated Pitkin County. Projects must track their waste data in the Green Halo reporting system and can receive a full refund of the deposit if minimum waste diversion requirements are met. The deposit-refund system is implemented through a partnership between the SWC and Community Development.

[1] This is dependent on if incoming trash volumes continue to increase, the density achieved when compacting trash in the landfill (assumed 1200lbs/yd^3), and if the Solid Waste Center is not permitted to further expand the landfill operation by State of Colorado regulators.

To influence projects outside of the county permitting process, the ordinance also established a differentiated pricing structure at the SWC that charges lower weight-based disposal fees for recyclable materials than for trash. In addition, a premium mixed load rate is assessed for loads containing a mixture of trash and recoverable materials to encourage source-separation at the job site.

d) Outcomes

Actions taken under the C&D Debris Diversion Ordinance have so far produced the desired effect of improving waste diversion. The waste diversion rate of materials for the overall C&D Debris Recovery Program is over 80%, while the average project-level waste diversion rate is almost 50%.[2] The SWC previously did not have access to this type of data, and as such we can only report back to 2020.

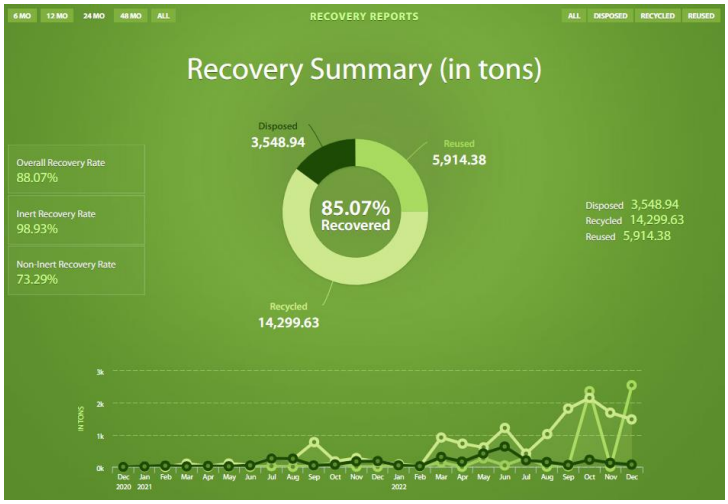

Figure 1: C&D program recovery summary (Green Halo)

We have also seen an improvement in the overall C&D recycling rate at the SWC which includes C&D loads generated in unincorporated Pitkin County, the incorporated cities and towns and from out of the County.

Year	Waste Diversion Rate
2019	15.92%
2020	19.89%
2021	22.95%
Jan-Oct. 2022	37.85%

Table 2: SWC overall waste div. rate

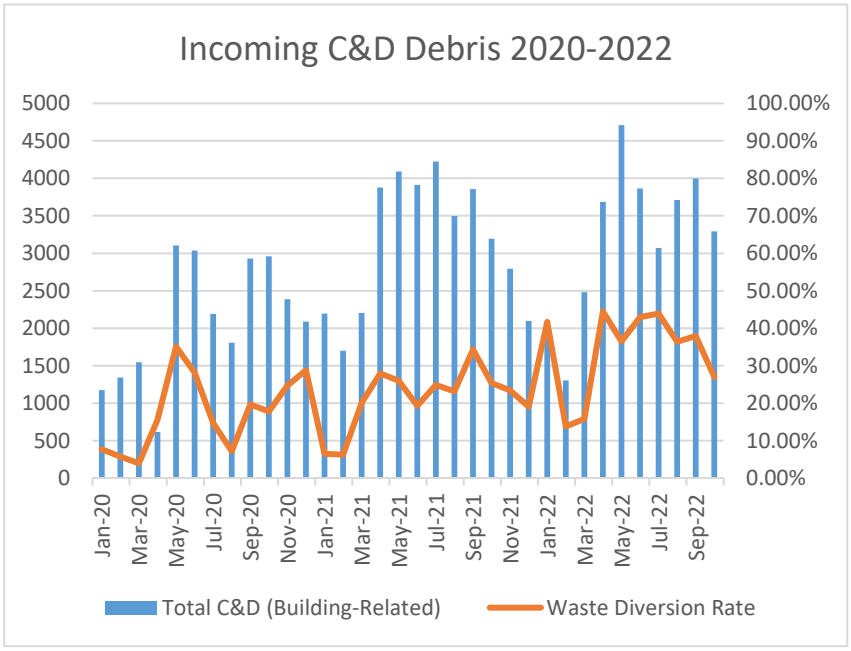

Figure 2: Total C&D debris and waste diversion rate

[2] The overall waste diversion rate accounts for all materials disposed of under the program. Some large demolition projects generate hundreds of tons of concrete and dirt and achieve >80% diversion, while other projects generate far smaller amounts of material and have less impact on the average. The project-level diversion rate is the average of the individual waste diversion rates achieved by completed projects.

III. C&D Debris GHG Impacts

While the SWC's primary focus is diverting material from the landfill to conserve airspace, waste reduction and diversion are also linked to greenhouse gas (GHG) emissions. Indirect GHG reductions can be achieved by diverting more material from landfill, since goods produced with recycled or reused content typically require less energy than those with all virgin raw materials. The waste tracking platform Green Halo provides aggregated GHG benefits for projects regulated by the C&D Debris Diversion Ordinance.

Figure 3: Green Halo carbon footprint estimates from C&D diversion

Green Halo's estimates are based on the EPA's Waste Reduction Model (WARM). The tables below provide an estimation of the GHG benefits of the SWC's recycling efforts in 2022 and also compares against if the materials were not disposed of at all (source reduction).

Type	Tons Recycled in 2022	$MTCO_2E$* Savings per Ton Recycled	$MTCO_2E$ Savings from Recycling	$MTCO_2E$ Savings per Ton Source Reduced	$MTCO_2E$ Savings from Source Reduction
Asphalt	626.36	0.08	50.11	0.11	68.9
Concrete	11,730.52	0.01	117.31	--	--
Lumber	292.52	2.66	778.1	2.13	623.07
Metal	443.72	4.39	1947.93	3.65	1619.58
Cardboard	9.4	3.14	29.52	5.58	52.45

Table 3: GHG impacts from C&D waste diversion (using EPA WARM recycling and source reduction estimates)

*$MTCO_2E$ = metric tons of carbon dioxide equivalent

When accounting for the energy embedded in products from their total life cycle (e.g. raw material extraction, manufacturing, and transport), it is estimated that more than half of all GHG emissions attributed to buildings are related to materials management. Current building codes address operating energy, but do not typically address the impacts 'embodied' in building materials and products (Carbon Leadership Forum, 2019).

The design phase of a construction project is the critical moment that determines a building's lifecycle footprint. Certain materials are preferable over others when accounting for embodied carbon, and choosing materials that are difficult or not possible to recycle locks them in as future trash when those

elements are demolished. As the County takes on current and future ambitious goals related to GHG reductions, this is an area that will become increasingly important.

IV. Estimating Waste from Future Growth in Pitkin County

Sections II and III demonstrate that C&D materials generated by our growing community have a significant impact on landfill space and the GHG emissions associated with our building sector. Source reduction is preferred (preventing waste from being produced), while improvements in reuse and recycling volumes also reduce the amount of material entering the landfill.

Using data collected from two years of implementation of the C&D Debris Diversion Ordinance, we can estimate the materials footprint of different project types in Pitkin County. As shown below, new construction projects have the smallest debris generated per square foot (waste intensity) when compared to remodels and demolitions.

Residential Projects	**Debris lbs/ft2 (Program Data)**	**Average Square Feet (Program Data)**	**Average Debris Generated (tons)**
New construction*	8.37	4433.79*	18.56
Addition/remodel to existing	33.12	2576.68	42.67
Full structure demolition	122.01	5960.69	363.63

Table 4: Average debris generated by project type in Pitkin County

*The majority of "New Construction" projects represented are garages due to the long duration of a full single family residence construction. The average square feet provided is the average of new construction projects currently in permitting or with construction underway.

Using the average debris generated for each project type in the table above, the total waste generated by Pitkin County projects can be estimated when combined with building permit data from 2022 (taken from Existing Conditions, Trends and Impacts of House Size in Unincorporated Pitkin County, 2022).

	Total in 2022	**Average Debris Generated (tons)**	**Total Debris Estimate (tons)**
New Builds	25	18.56	464
Remodels/Additions	69	42.67	2944.23
Single Family Demo	10	363.63	3636.3

Table 5: Total debris estimates for Pitkin County permits issued in 2022

Based on this analysis, debris from Pitkin County permitted jobs in 2022 would account for just over 20% of the total incoming C&D debris in 2022. The fastest way to curb the amount of C&D waste generated in the County would be to reduce the number of permits issued as the City of Aspen did with residential demolitions. Although outside of Pitkin County's jurisdiction, working with other local jurisdictions to

improve waste diversion practices valley wide will also be impactful in diverting materials from the landfill.

V. Policies to Promote Sustainable Materials Management

There are a variety of relatively new policy concepts intended to reduce the environmental impacts of construction activities through incentivizing or regulating practices that reduce waste, supporting the use of recycled content materials for new construction and increasing recyclability and reusability of building elements at their end of life. This section provides short summaries of policies Pitkin County could consider as part of its growth management efforts.

a) International Green Construction Code: Materials and Resources Standards

The International Green Construction Code (IgCC) is a model code developed by the ICC that governs the impact of buildings and structures on the environment. Chapter 9: Materials and Resources provides multiple regulations that could reduce the impact of construction activities on the landfill and support a local market for recycled materials.

Section 901.4.1.1 Recycled content and salvaged material content
The sum of the recycled content and the salvaged material content shall constitute a minimum of 10%, based on cost, of the total materials in the building project.

Section 901.4.1.2 Regional materials
A minimum of 15% of building materials or products used, based on cost, shall be regionally extracted/harvested/recovered or manufactured within a radius of 500 mi of the project site.

The County is in the process of adopting the 2021 International Building Codes, including the Energy Conservation Code, but is not using the IGCC.

b) Buy Clean Colorado Act – Embodied carbon for state projects

Colorado passed legislation that goes into effect in 2024 that directs public projects to procure lower carbon building materials when feasible.

“This law requires the Office of the State Architect to establish a maximum acceptable global warming potential (GWP) limit for each category of eligible materials. These materials are the focus for Buy Clean Colorado due to their high carbon emissions impact and volume use in public projects and since reducing the impact of these materials will provide the greatest reduction of greenhouse gas emissions during the construction of State public projects. Through design optimization and responsible selection of materials, reduction of embodied carbon emissions from building materials can be accomplished.”

The policy applies to “all construction projects for state agencies and institutions of higher education and CDOT's horizontal construction projects.”

c) Washington State Building Code – Reuse of Solid-Sawn Lumber

A significant obstacle in the reuse of salvaged lumber is the limited applications allowed by standard building codes. The State of Washington recently amended their state building code to create conditions for using salvaged lumber in structural applications. It is unclear whether it would be allowable for Pitkin County to adopt similar code language at the local level.

APPENDIX A

APPENDIX

DATA COLLECTION TERMS

The term "diversion rate" means different things both across Colorado and across the country, which makes it hard to compare between cities and states. This report distinguishes the recycling and composting rate based on the different parts of the community, including:

- Recycling rate—for the purpose of this report, refers to the amount of material recycled or composted.
- Citywide recycling rate—just households and businesses, also known as municipal solid waste (MSW)
- Residential recycling rate—single-family homes and apartment buildings of up to seven units (may not include homeowner associations, also known as HOAs)
- Industrial recycling rate—includes materials generated through agricultural activities, construction and demolition, energy production, and other industrial activities.

HOW TO CALCULATE THE RECYCLING RATE

The recycling rate, commonly called the diversion rate, is the amount of material collected for recycling and composting divided by the total amount of discards generated:

$$\frac{\text{recycling + composting}}{\text{recycling + composting + trash}} = \text{recycling rate}$$

Definitions:

- C&D debris – Umbrella term for all materials generated from construction and demolition activities. This includes those that are recoverable, and those that are not recoverable. (e.g. drywall)
- Waste diversion – All strategies utilized to keep waste out of the trash/landfill. For the local context this includes waste reduction, reuse, recycling.
- Recoverable Materials – All materials that can be recycled at the SWC. (See Section X below for the full list)
- C&D trash – Any material that is not otherwise recoverable at the SWC (e.g. drywall, insulation, PVC pipe, engineered lumber)
- Source separation – The process of sorting waste materials into different containers or piles prior to collection.

APPENDIX B – 2022 Waste Characterization Study