

C&D Tonnage Generated by New Construction & Renovation in Rural King County

GBO Research Request

Research Focus

What is the typical amount of C&D materials (in tonnage) that is generally produced by a single family new construction or renovation project in the rural area?

Research Sources

- King County Department of Assessments – Residential Building zip file
<http://info.kingcounty.gov/assessor/DataDownload/default.aspx>
- King County Zip Code Boundaries
<http://your.kingcounty.gov/ftp/gis/web/vmc/boundaries/Zipcodes.pdf>
- EPA Waste Generation Model for Residential Construction, prepared by Herrera for EPA and Seattle Public Utilities (SPU)
- LEED for Homes
- Conversations with local contractors / builders working in rural King County:
 - Quadrant Homes (primarily rural jurisdictions)
 - Reached out to other small builder contacts – but were unable to talk with them in this timeframe.

Research Methodology

New Construction

1. Using the King County Department of Assessments Residential Building Data File, filter by zip codes to get single family building permit data for the following rural cities:

Auburn	98092
Black Diamond	98010
Carnation	98014
Covington	98042
Duvall	98019
Enumclaw	98022
Maple Valley	98025
North Bend	98045
Snoqualmie	98065

2. Filter the data by zip codes to get single family building permit data for unincorporated King County:

98077	98053
98019	98024
98092	98022

98045	98038
98051	

3. Filter data by year of construction to get information for new homes constructed ‘post recession’ – 2010 – 2012. These 2 filters produced information for 119 Building Permits for the zip codes above.
4. Generate average square footage (sft) home in rural areas.
5. Using the average square footage, run the EPA Waste Generation Model for Residential Construction to generate C&D Waste from Residential Construction.¹
6. Get feedback on this model-generated estimate from contractors building in rural King County.

Renovation

1. Refer to the EPA Waste Generation Model for Residential Construction for C&D waste generation rate estimates by type of renovation activity.
2. (Recommended) Conversations with local contractors / builders working in rural King County

Findings

C&D Estimates for New Construction

The average single family home square footage constructed between 2010 and 2012 in rural jurisdictions identified above was 2,366 sft. This is based off 118 homes in the Assessor’s database. The average single family home square footage for the same time period in unincorporated King County was 2,392 sft, based off 170 homes in the database. Both of these estimates are consistent with the distribution of average home size in Washington State constructed after 2000, which is 2,300 sft.²

The EPA Waste Generation Model uses an average waste generation of 4.38 lbs of C&D waste per square foot of residential construction. It is important to note that this includes weight from aggregates, rock, soil and metal – materials that are significantly heavier than other C&D materials generated (wood, cardboard, film plastics, roofing, carpet, etc.). Using this waste generation rate, the average C&D waste generated from new construction is **5 tons** per home.

To cross-check this estimate generated by a model, we spoke with the Director of Productions at Quadrant Homes, a production builder with significant single family developments in rural jurisdictions of King County. The average house models range between 2,200 – 2,400 sft, so within the range of new homes constructed in unincorporated King County and rural jurisdictions.

The initial response was that 5 tons per home seems very high, considering that an average lumber package for a new home is about 9 tons, and the heaviest components of C&D waste are typically lumber and Hardie Board (fiber cement) siding. Quadrant also indicated that the most materials (in volume, not

¹ EPA Waste Generation Spreadsheet was developed by Herrera for Seattle Public Utilities (SPU) and EPA information on waste generated per square foot (by type of structure) to estimate C&D debris generated from single family residential demolitions and residential remodel projects during 2012. This model uses a waste generation rate of 4.38 pounds of C&D waste for every square foot of new residential construction, based on numerous weight based composition studies performed on wood framed houses. Note that this waste generation rate is close to the NAHB national average of 4 lbs C&D waste per square foot.

² <http://neea.org/docs/reports/residential-building-stock-assessment-single-family-characteristics-and-energy-use.pdf?sfvrsn=8> and Mousumi Sarkar, *How American Homes Vary By the Year They Were Built*. Working Paper No. 2011-18; Demographic Directorate, Housing and Household Economic Statistics, U.S. Census Bureau. Washington, DC 20233. June 2011.

weight) are framing debris, sheathing and siding, cardboard, plastic film wrap, end cuts of carpet, empty caulk cans/paint cans.

However, since our modeled estimate does include aggregates and soil, the ‘gut response’ was that it seems fairly reasonable, though possibly a bit on the high side. Important to also note that Quadrant Homes as well as many other production scale builders, who build the largest number of single family homes in King County have transitioned to pre-cut framing packages, which cut down significantly on the amount of wood waste produced on site.

C&D Estimates for Renovation

C&D estimates for renovation in rural areas may be more challenging to quantify, since there is a vast range of kinds of renovation that occur.

The EPA Waste Generation Spreadsheet provides general C&D estimates for different kinds of renovation activities, outlined below, based on national waste composition studies:

Residential Renovation - Tons of waste produced from kitchen remodeling jobs	
Type of Remodel	C&D Waste Produced, in tons/job
Tons of waste produced from kitchen remodeling jobs	2.63
Tons of waste produced from bathroom remodeling jobs	0.63
Tons of waste produced from additions	0.75
Tons of waste produced from concrete driveway replacements	8.99
Tons of waste produced from asphalt roof replacements	1.68
Tons of waste produced from wood roof replacements	1.40
Tons of waste produced from heating and air conditioning replacements	0.22

These estimates were determined by weight based composition studies, taking the average tons/job based on a range of different sized renovations per type of remodel.

Limitations of Estimates

As noted in the EPA C&D Generation Methodology, there are limitations in the assumptions of this model. The estimate of 4.38 pounds per square foot is a national average, and is not reflective of targeted data on rural King County, and may not reflect specific trends in construction waste management in rural King County – specifically that aggregates are often not included in C&D weight because they are recycled or otherwise processed. The renovation estimates are not based on targeted data for rural King County, but are national averages. Additionally, many residential renovation projects are completed without permits.

Other Considerations

The following additional information was not accounted for in the estimates provided, but is worth taking into consideration:

- As a proxy for green building targets, LEED for Homes 2008 projects uses a target of 2.5 pounds per square foot of C&D waste going to the landfill, with many projects achieving less than 1 pound per square foot. The upcoming LEED for Homes v4 ‘reference home’ target is 4.2 lbs /sft, which includes landfill waste and diverted waste. The LEED for Homes reference home specifies

a maximum sqft for any bedroom count, equivalent to national averages (making large homes work harder, while not penalizing smaller than average homes – see bullet below).

- The pounds per square foot metric is useful, but actually favors bigger homes, which generally have more space and less wall, therefore generating less construction or renovation waste.

Recommended Next Steps

1. Confirm with King County if there are any Waste Diversion Forms that have been turned in from new construction projects or renovations in rural King County, and compare estimates against these / contact builder for more information.
2. Reach out to custom home builders and remodelers who service rural King County (specifically unincorporated King County) and ask if they have any documentation about tonnage C&D generated for new home construction or remodeling.
 - a. If possible, get statistics on size of home, and type of remodel job, and confirm if tonnage estimates include aggregates and soil.
 - b. Share tonnage estimates from new construction and remodeling research above, and get 'reality check' response from their on the ground experience.
 - c. Ask if there are any other considerations for homes in rural King County that factor into C&D waste produced.
 - d. Built Green King Snohomish County may be a good resource to help identify willing builders/remodelers who could provide information in a quick turnaround.

Attachments

- Assessor's data spreadsheet, including tabs for filtered data for unincorporated King County and rural jurisdictions.
- Zip Code map