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Recycling and Reusing Hardscapes and Landscape Waste Cost Calculator

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Environmentally Beneficial Landscaping

This Cost Calculator is designed to help landscaping companies and landscape managers estimate the cost savings associated with recycling and reusing hardscapes and green waste Green waste includes yard trimmings, leaves, plants, grass and other organic waste. The specific hardscape materials addressed in this tool include: lumber, brick, and concrete and aspalt. The Cost Calculator demonstrates that recycling and reusing hardscapes and landscape waste can offer significant savings compared to disposal, depending on a facility's material needs and proximity to recycling facilities.

Based on the values that you enter in the Inputs tab, the Cost Calculator tab estimates the cost of four scenarios for handling hardscape and landscape waste: (1) reusing all waste possible on-site, then recycling all waste possible, and then disposing of the rest; (2) reusing all waste possible and disposing of the rest; (3) recycling as much of the remaining waste as possible and disposing of the rest; and (4) disposing of all materials. If you are not generating a particular waste during a given time frame, enter "0" in the corresponding cell. Increasing the use of compost over time may offer additional cost savings in terms of reduced fertilizer and/or pesticide use, but the calculator does not consider these potential savings.

In the Cost Data tab, EPA provides national averages of costs associated with recycling and disposing landscape waste. Cost data collected from sources dated before 2006 are adjusted for inflation. If you prefer, you can substitute your own cost data into the green cells. EPA encourages users to change the fuel cost data in cell B26 of the Cost Data tab.

The EHS Benefits tab provides a summary of the environmental, health and safety benefits of recycling and reusing landscape waste.

The Quantified Benefits tab provides estimates of environmental impacts avoided by reusing and recycling waste instead of landfilling waste. Although many benefits are quantified, including lifecycle benefits of avoided virgin material production, and avoided impacts from transportation, data are not available to develop a general estimate of some key benefits associated with recycling and reusing landscape waste, including reducing runoff and nonpoint source pollution and improving soil health. To calculate your GHG emissions from alternative green waste management methods, see EPA's WARM model at: http://epa.gov/climatechange/wycd/waste/calculators/Warm_home.html

The Environmental Data tab presents data utilized on the environmental impacts associated with the production, use, disposal, and transportation of asphalt, concrete, bricks, and lumber.

Macros need to be enabled for the calculator to work properly. Each time you run the calculator, you should save the file under a different file name to maintain a complete record. The file name will appear at the top of each printed page.

Please direct any questions or comments on this cost calculator to: Jean Schwab, U.S. EPA GreenScapes Program Manager, schwab.jean@epa.gov or 703-308-8669.

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Recycling and Reusing Hardscape and Landscape Waste

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In which region are you located?	West

Green Waste			
How many cubic yards of green waste are generated annually?	60		
What percentage of the volume of green waste is wood > 1" diameter?	25%		
How many cubic yards of compost will you use per year, on average over the next 10 years?	10		
How many cubic yards of mulch will you use per year, on average over the next 10 years?	10		
Do you own a large chipper (6"+) to chip lumber and large branches?	Yes		
Do you have access to a local green waste recycling facility?	Yes		
How much does green waste recycling cost per ton (including transportation)?	$15.00		
How many miles is it to the nearest recycling facility for green waste?	25		
How many miles is it to the nearest landfill?	25		
How many miles does new compost and mulch travel to reach your site?	50		
Lumber		**Loss Rate**	**Feet Usable for Reuse**
How many linear feet of lumber will be removed over the course of the next year?	1000		800
Over the next three years?	3000		2400
Over the next six years?	6000		4800
Over the next ten years?	10000	20%	8000
What percentage of the volume of removed lumber is pressure treated?	0%		
How many linear feet of lumber will you need over the next year?	500		
Over the next three years?	1500		
Over the next six years?	3000		
Over the next ten years?	5000		
Do you have access to a local lumber recycling facility?	Yes		
How much does lumber recycling cost per ton (including transportation)?	$15.00		
How many miles is it to the nearest lumber recycling facility?	25		
Roughly how many times will you remove lumber in the next year?	1		
In the next three years?	3		
In the next six years?	6		
In the next ten years?	10		
How many miles does new lumber travel to reach your site?	50		
Roughly how many times will you need to order lumber in the next year?	1		
In the next three years?	3		
In the next six years?	6		
In the next ten years?	10		
Brick		**Loss Rate**	**Bricks Usable for Reuse**
How many bricks will be removed over the next year?	1000		900
Over the next three years?	3000		2700
Over the next six years?	6000		5400
Over the next ten years?	10000	10%	9000
How many bricks will you need over the next year?	500		
Over the next three years?	1500		
Over the next six years?	3000		
Over the next ten years?	5000		
Do you have access to a local brick recycling facility?	Yes		
How much does brick recycling cost per ton (including transportation)?	$15.00		
How many miles is it to the nearest brick recycling facility?	25		
Do you plan on purchasing recycled bricks instead of new bricks for construction projects?	Yes		
How much do recycled bricks cost (per used brick)?	$0.20		
Roughly how many times will you remove brick in the next year?	1		
In the next three years?	3		
In the next six years?	6		
In the next ten years?	10		
How many miles does new brick travel to reach your site?	50		
Roughly how many times will you need to order brick in the next year?	1		
In the next three years?	3		
In the next six years?	6		
In the next ten years?	10		
Concrete & Asphalt			
How many tons of concrete waste will be generated at your site over the next year?	1		
Over the next three years?	3		
Over the next six years?	6		
Over the next ten years?	10		

Do you own a crusher to crush and reuse concrete and asphalt?	No
How many tons of asphalt waste will be generated at your site over the next year?	1
Over the next three years?	3
Over the next six years?	6
Over the next ten years?	10
How many tons of crushed surfacing will you need over the next year?	2
Over the next three years?	6
Over the next six years?	12
Over the next ten years?	20
Do you have access to a local concrete recycling facility?	Yes
How much does recycling concrete cost per ton (including transportation)?	$15.00
How many miles is it to the nearest concrete recycling facility?	25
Roughly how many times will you remove concrete in the next year?	1
In the next three years?	3
In the next six years?	6
In the next ten years?	10
How many miles does new concrete travel to reach your site?	50
Roughly how many times will you need to order concrete in the next year?	1
In the next three years?	3
In the next six years?	6
In the next ten years?	10
Do you have access to a local asphalt recycling facility?	Yes
How much does recycling asphalt cost per ton (including transportation)?	$15.00
How many miles is it to the nearest asphalt recycling facility?	25
Roughly how many times will you remove asphalt in the next year?	1
In the next three years?	3
In the next six years?	6
In the next ten years?	10
How many miles does new asphalt travel to reach your site?	50
Roughly how many times will you need to order asphalt in the next year?	1
In the next three years?	3
In the next six years?	6
In the next ten years?	10

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Maximum Reuse, then Recycle, Landfill Remaining Waste	1 year	3 years	6 years	10 years	
New Material Cost					
Compost	$0	$0	$0	$0	
Mulch	$0	$0	$0	$0	
Lumber	$0	$0	$0	$0	
Brick	$0	$0	$0	$0	
Crushed Surfacing	$24	$72	$143	$238	
Reuse Costs					
Initial Cost of Crusher	N/A	N/A	N/A	N/A	
Crushing Labor	N/A	N/A	N/A	N/A	
Crusher Maintenance	N/A	N/A	N/A	N/A	
Initial Cost of Chipper	$0	$0	$0	$0	
Wood Chipper Maintenance	$30	$89	$177	$295	
Wood Chipping Labor	$14	$42	$84	$140	
Recycling Cost/Disposal Cost					
Green Waste	$70	$210	$420	$700	
Lumber	$11	$34	$68	$113	
Brick	$17	$51	$101	$169	
Asphalt	$15	$45	$90	$150	
Concrete	$15	$45	$90	$150	
Total Cost	**$195**	**$586**	**$1,173**	**$1,955**	**$195.49**
Average Annual Cost to Date	**$195**	**$195**	**$195**	**$195**	

Maximum Reuse, Landfill Remaining Waste	1 year	3 years	6 years	10 years	
New Material Cost					
Compost	$0	$0	$0	$0	
Mulch	$0	$0	$0	$0	
Lumber	$0	$0	$0	$0	
Brick	$0	$0	$0	$0	
Crushed Surfacing	$24	$72	$143	$238	
Reuse Costs					
Initial Cost of Crusher	N/A	N/A	N/A	N/A	
Crushing Labor	N/A	N/A	N/A	N/A	
Crusher Maintenance	N/A	N/A	N/A	N/A	
Initial Cost of Chipper	$0	$0	$0	$0	
Wood Chipper Maintenance	$30	$89	$177	$295	
Wood Chipping Labor	$14	$42	$84	$140	
Disposal Cost					
Green Waste	$124	$371	$741	$1,235	
Lumber	$20	$60	$119	$199	
Brick	$30	$89	$179	$298	
Asphalt	$26	$79	$159	$265	
Concrete	$26	$79	$159	$265	
Total Cost	**$293**	**$880**	**$1,761**	**$2,935**	$293.46
Average Annual Cost to Date	**$293**	**$293**	**$293**	**$293**	

Recycle All Waste Where Facilities Exist	1 year	3 years	6 years	10 years	
New Material Cost					
Compost	$171	$513	$1,026	$1,710	
Mulch	$71	$214	$428	$713	
Lumber	$195	$585	$1,170	$1,950	
Brick	$100	$300	$600	$1,000	
Crushed Surfacing	$24	$72	$143	$238	
Recycling Cost/Disposal Cost					
Green Waste	$180	$540	$1,080	$1,800	
Lumber	$23	$68	$135	$225	
Brick	$34	$101	$203	$338	
Asphalt	$15	$45	$90	$150	
Concrete	$15	$45	$90	$150	
Total Cost	**$827**	**$2,482**	**$4,964**	**$8,274**	$827.39
Average Annual Cost to Date	**$827**	**$827**	**$827**	**$827**	

Landfill All Waste	1 year	3 years	6 years	10 years	
New Material Cost					
Compost	$171	$513	$1,026	$1,710	
Mulch	$71	$214	$428	$713	
Lumber	$195	$585	$1,170	$1,950	
Brick	$100	$300	$600	$1,000	
Crushed Surfacing	$24	$72	$143	$238	
Disposal Cost					
Green Waste	$318	$953	$1,906	$3,176	
Lumber	$40	$119	$238	$397	
Brick	$60	$179	$357	$596	
Asphalt	$26	$79	$159	$265	
Concrete	$26	$79	$159	$265	
Total Cost	**$1,031**	**$3,093**	**$6,186**	**$10,310**	$1,030.98
Average Annual Cost to Date	**$1,031**	**$1,031**	**$1,031**	**$1,031**	

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Recycling and Reusing Hardscape and Landscape Waste Cost Data

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Disposal Fees	Unit	Cost Estimate	Source and Comment	States
Northeast		$77.58	Repa, Edward, Ph.D (2005) *NSWMA 2005 Tip Fee Survey*.	CT, ME, MA, NH, NY, RI, VT
Mid-Atlantic		$50.92	<http://wastec.isproductions.net/webmodules/webarticles/articlefiles/478-	DE, MD, NJ, PA, VA, WV
South		$34.07	Tipping%20Fee%20Bulletin%202005.pdf>	AL, FL, GA, KY, MS, NC, SC, TN
Midwest		$38.46	If you know your own disposal cost per ton, change the green cell to the left for your	IN, IA, MI, MN, MO, OH, WI
South-Central		$26.47	region.	AZ, AR, LA, NM, OK, TX
West-Central		$41.51		CO, KS, MT, NE, ND, SD, UT, WY
West	$/Ton	$37.72		CA, HI, ID, NV, OR, WA

On-site Asphalt and Concrete Crushing Costs	Units	Cost Estimate	Sources	Comments
Capital Cost	N/A	$64,350	Concrete/Asphalt Crushers. September, 2003. <http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/7_III_6.html>	
Labor Cost	$/Ton	$7.02	Concrete/Asphalt Crushers. September, 2003. <http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/7_III_6.html>	
Equipment Maintenance Cost	$/Ton	$0.59	Concrete/Asphalt Crushers. September, 2003.	

Green Waste Grinding Costs	Units	Cost Estimate	Sources	Comments
Labor cost of green waste chipping/shredding	$/Hour	$26.00	Mulch Mule Brochure. Accessed August 28, 2007. <http://www.mulchmule.com/files/10730Literature.pdf >	This brochure says that the industry average for mulching-related labor is $25/hour.
Time to shred/chip	Hours/CY	0.05	Personal Communication with Customer Service, BearCat. August 29, 2007	Bear Cat estimated that a 6" chipper can chip 100 feet per minute. 100 feet was multiplied by
Maintenance of Commercial Chipper	$/Hour Used	$54.96		See Total Below
Initial Cost of 6" Commercial	N/A	$8,318.96	Norwalk Power Equipment Company. Bear Cat Commercial Chippers (Gravity Feed) 6"	The Bear Cat 71620 sells for $7,999.
Amount Saved by Mulching	$/CY	$2.78	This value is calculated by subtracting the total cost of producing a CY of mulch from the	This is the amount saved by mulching on-site

Chipper Maintenance	Cost	Replacement Time	Cost Per Hour	Source	Comments
Blades	$266	10	$26.62	Customer service at Bear Cat provided estimates regarding how often each of these maintenance elements would be needed, as well as how much it would cost to replace all the blades and bearings. This information was given on August 30, 2007.	$248 is the retail price for the blade replacement kit
Fuel	$27.13	1	$27.13		The average price of gasoline in the United States was multiplied by the volume of the chipper's gas tank.
Bearings	$60	50	$1.21	The average price of fuel, $4.11 per gallon, was taken from the Energy Information Administration's U.S. Retail Gas Prices. Accessed July 18, 2008. <http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_home_page.html>. To update the calculator for changing fuel prices, go to the that website, find the current price of fuel, multiply that value by 6.6, and enter the result into cell B26.	Each bearing costs $29 and the chipper contains two bearings.
Total	N/A	N/A	$54.96		

New Material Costs	Units	Cost Estimate	Sources	Comments
Compost	$/Cu. Yard	$17.10	Alexander, Ron, Tyler, Rod, and Goldstein, Nora. "Increasing Dollar Value for Compost Products." Biocycle. Oct. 2004 <http://www.environmental-	
Mulch	$/Cu. Yard	$7.13	Earth Products. Orange County Landfill -- Orange County, NC. Accessed December 29, 2006. <http://www.co.orange.nc.us/recycling/earthproducts.asp>	Orange County landfill sells yard waste mulch for $20 per 3 cubic yards. This price was divided by three to find the price per cubic yard.
Lumber (2"x 6" Decking Boards)	$/LF	$0.39	Lumber and Plywood Estimating Price Guide. Ace Hardware. January 30, 2006. <http://www.acehardware.net/estimate/>.	The seven price estimates divided by their corresponding linear feet are all at or very close to $0.36 per LF.

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Brick	$/Brick	$0.39	Liu, Henry; Williams, Burkett and Haynes, Kirk. *Improving Freezing and Thawing Properties of Fly Ash Bricks. March, 2005.* <http://www.flyash.info/2005/20liu.pdf>.	This website states that ordinary bricks cost between $300-$400 per thousand. This range was averaged to $350 per thousand or $0.35 per brick.
Crushed Surfacing	$/Ton	$11.92	Dayton, Kevin J., State Construction Engineer, WSDOT Headquarters Construction Office. *Construction Update.* August 8, 2006. p. 1. <http://www.wsdot.wa.gov/biz/Construction/CostIndex/CostIndexPdf/constructionupdatereport.pdf>	

Conversion Factors	From	To	Factor	Source	Comments
Brick	Bricks	Tons	0.00225	Table 4. Accessed on November 4, 2006. <http://ntl.bts.gov/DOCS/tables2.html>.	This value was given in pounds and converted to tons by dividing by 2000.
Concrete, Asphalt & Brick	Tons	Cu. Yards	0.83	http://www.buckscontainerservices.com/conversions.htm	
Green House Gas	Carbon	CO_2	3.6667	US EPA - Non-CO2 Gases and Carbon Sequestration - Conversion Units. http://www.epa.gov/nonco2/units.html. Accessed October 30, 2007.	
2"x 6" Wood Decking Boards	Cubic Meters	mbf (1000 Board Feet)	1.6240	Milota, M.; West, C.; and Hartley, I. Gate-to-Gate Life-Cycle Inventory of Softwood Lumber Production. Wood and Fiber Science, December 2005, v. 37.	
2"x 6" Wood Decking Boards	Linear Feet	Tons	0.0015	Lumber Weight Calculator. Accessed November 4, 2006. <http://www.csgnetwork.com/lumberweight.html>.	This value was derived by using a lumber weight calculator. Pine was chosen to convert linear feet to tons because it is commonly used in decking. If you are using heavier wood(s), you may want to replace this conversion factor.
2"x 6" Wood Decking Boards	Linear Feet	Cubic Yards	0.0031		One linear foot of 2"x6" contains .0031 cubic
General	KWh	MJ	3.6		
General	MJ	BTU	947.8		
General	Kilograms	Pounds	2.2046		
General	Metric Tons	Tons	1.1023		
General	Ounces	Grams	28.3495		
GHG	$MTCO_2E$	MTCE	0.2727		
Water	Gallons	Kilograms	3.79		
Yard Waste	Cu. Yards	Tons	0.2	General Permit for Yard Waste Composting Facilities Under the South Dakota Waste Management Program. Board of Minerals and Environment. Department of Environment and Natural Resources. October 13, 1998. p. 6. <http://www.state.sd.us/DENR/DES/WasteMgn/SWaste/COMPGEN.pdf>.	This value was given in pounds and converted to tons by dividing by 2000.
Yard Waste to Compost	Cu. Yards	Cu. Yards	0.375	Wilson, C.R. and Feucht, J.R. *Composting of Yard Waste.* Colorado State University Coopertive Extension. October, 1997. <http://www.ext.colostate.edu/PUBS/GARDEN/07212.pdf>.	The article states that 50-75% of plant volume is reduced by composting. This range was averaged to derive a conversion factor.

Inflation Adjustment Table

One Dollar in…	Equals this many 2008 Dollars
2003	$1.17
2004	$1.14
2005	$1.10
2006	$1.07
2007	$1.04

Source: *CPI Inflation Calculator.* <http://data.bls.gov/cgi-bin/cpicalc.pl>

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Recycling and Reusing Hardscape and Landscape Waste Cost Graph

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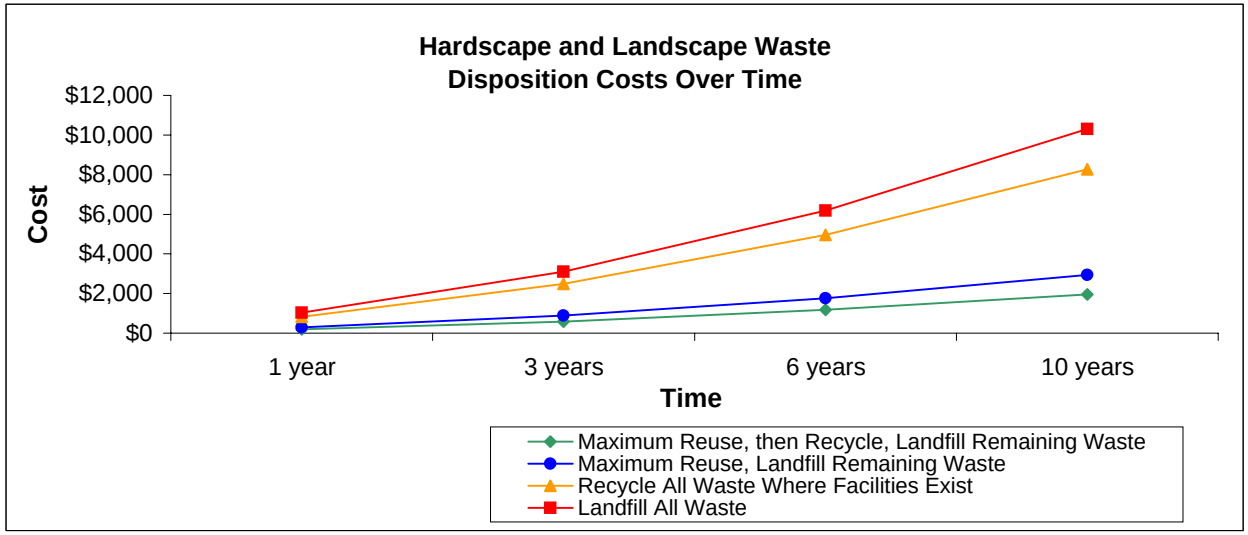

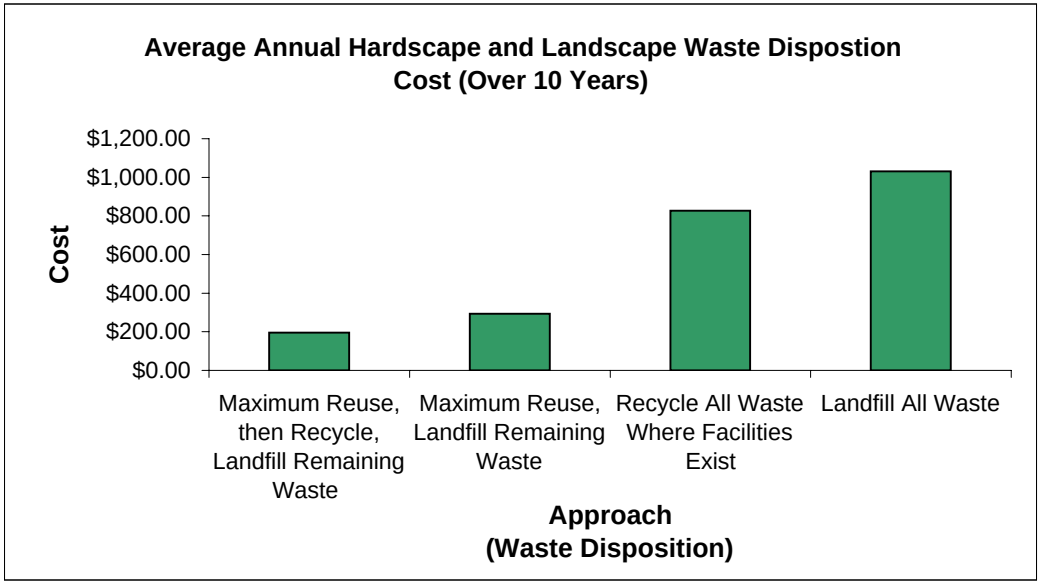

Recycling and Reusing Hardscape and Landscape Waste Environmental, Health and Safety Benefits

Reduces waste/demand for landfill space because materials that would otherwise be disposed of are reused or recycled.

Reuses waste materials because hardscape and landscape waste is being reused directly on-site.

Reduces air pollution or improves air quality because reusing materials on-site results in fewer pollutants emitted from transporting waste materials, and methane emissions from landfills are reduced from both reuse and recycling.

Conserves fossil fuels because energy needed to transport both hardscape and landscape wastes, as well as new materials, will be reduced. Also, compost can reduce the need for chemical fertilizers, the production of which is fossil fuel intensive.

Conserves timber because reused and recycled lumber reduces demand for virgin lumber.

In addition to the above benefits, the following benefits are associated with maximizing compost use and minimizing use of fertilizers and pesticides:

Conserves water because compost can improve the water retention of the soil, reducing the need for irrigation.

Reduces human exposure to hazardous materials or substances because compost can reduce the need for pesticides and herbicides and the associated human exposures.

Reduces runoff and nonpoint source pollution because compost can substitute for pesticides and fertilizers, which can produce polluted runoff.

Improves groundwater recharge because compost increases the soil's ability to retain water.

Improves soil quality and retards erosion because using compost improves soil quality.

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Recycling and Reusing Hardscape and Landscape Waste Environmental Benefits

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Maximum Reuse, then Recycle, Landfill Remaining Waste

Green Waste	1 year	3 years	6 years	10 years
Quantity Reused (lbs.)	14,667	44,000	88,000	146,667
Quantity Recycled (lbs.)	9,333	28,000	56,000	93,333
Quantity Landfilled (lbs.)	0	0	0	0
Lumber	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	1,500	4,500	9,000	15,000
Quantity Recycled (lbs.)	1,500	4,500	9,000	15,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Energy Conserved (MJ)	3,586	10,757	21,514	35,856
GHG Avoided (lbs. Of CO2 Equivalent)	8,414	25,243	50,486	84,143
CO Avoided (grams)	1,758	5,274	10,549	17,582
VOC Avoided (grams)	308	923	1,846	3,077
NO_x Avoided (grams)	2,389	7,167	14,334	23,890
SO_2 Avoided (grams)	621	1,862	3,724	6,207
PM Avoided (grams)	97	292	584	973
Brick	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	2,250	6,750	13,500	22,500
Quantity Recycled (lbs.)	2,250	6,750	13,500	22,500
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	95	284	567	945
Energy Conserved (MJ)	4,739	14,216	28,431	47,385
GHG Avoided (lbs. Of CO2 Equivalent)	1,280	3,839	7,678	12,797
CO Avoided (grams)	535	1,605	3,210	5,351
VOC Avoided (grams)	127	382	765	1,274
NO_x Avoided (grams)	2,598	7,795	15,590	25,984
SO_2 Avoided (grams)	4,523	13,569	27,138	45,230
PM Avoided (grams)	3,222	9,667	19,333	32,222
Concrete	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	2,000	6,000	12,000	20,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	113	340	679	1,132
Energy Conserved (MJ)	65	196	392	653
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	22	66	132	220
CO Avoided (grams)	11	32	63	105
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	25	75	150	250
SO_2 Avoided (grams)	22	66	133	221
PM Avoided (grams)	2	5	11	18
Asphalt	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	2,000	6,000	12,000	20,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	113	340	679	1,132
Energy Conserved (MJ)	65	196	392	653
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	22	66	132	220
CO Avoided (grams)	11	32	63	105
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	25	75	150	250
SO_2 Avoided (grams)	22	66	133	221
PM Avoided (grams)	2	5	11	18

Total Env Benefit	1 year	3 years	6 years	10 years
Waste Reused (lbs.)	18,417	55,250	110,500	184,167
Waste Recycled (lbs.)	17,083	51,250	102,500	170,833
Waste Landfilled (lbs.)	0	0	0	0
Total Recycled or Reusec	35,500	106,500	213,000	355,000
Energy Use (MJ)	8,455	25,364	50,729	84,548
Avoided Air Emissions				
GHG Avoided (lbs. Of CO2 Equivalent)	9,738	29,214	58,429	97,381
CO Avoided (grams)	2,314	6,943	13,886	23,143
VOC Avoided (grams)	435	1,305	2,611	4,352
NO_x Avoided (grams)	5,037	15,112	30,225	50,374
SO_2 Avoided (grams)	5,188	15,564	31,128	51,879
PM Avoided (grams)	3,323	9,969	19,938	33,230
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
Water Conserved (ga.)	321	963	1,926	3,209

Maximum Reuse, Landfill Remaining Waste

Green Waste	1 year	3 years	6 years	10 years
Quantity Reused (lbs.)	14,667	44,000	88,000	146,667
Quantity Recycled (lbs.)	0	0	0	0
Quantity Landfilled (lbs.)	9,333	28,000	56,000	93,333
Lumber	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	1,500	4,500	9,000	15,000
Quantity Recycled (lbs.)	0	0	0	0
Quantity Landfilled (lbs.)	1,500	4,500	9,000	15,000
Environmental Benefit				
Energy Conserved (MJ)	1,799	5,398	10,796	17,993
GHG Avoided (lbs. Of CO2 Equivalent)	4,363	13,090	26,180	43,634
CO Avoided (grams)	1,757	5,272	10,544	17,574
VOC Avoided (grams)	307	921	1,843	3,071
NO_x Avoided (grams)	2,386	7,157	14,313	23,855
SO_2 Avoided (grams)	620	1,861	3,721	6,202
PM Avoided (grams)	90	271	542	903
Brick	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	2,250	6,750	13,500	22,500
Quantity Recycled (lbs.)	0	0	0	0
Quantity Landfilled (lbs.)	2,250	6,750	13,500	22,500
Environmental Benefit				
Water Conserved (ga.)	47	142	284	473
Energy Conserved (MJ)	2,369	7,108	14,216	23,693
GHG Avoided (lbs. Of CO2 Equivalent)	779	2,338	4,675	7,792
CO Avoided (grams)	484	1,453	2,907	4,844
VOC Avoided (grams)	102	305	609	1,016
NO_x Avoided (grams)	2,226	6,678	13,356	22,260
SO_2 Avoided (grams)	2,275	6,826	13,651	22,752
PM Avoided (grams)	1,636	4,908	9,816	16,360
Concrete	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	0	0	0	0
Quantity Landfilled (lbs.)	2,000	6,000	12,000	20,000
Environmental Benefit				
Water Conserved (ga.)	0	0	0	0
Energy Conserved (MJ)	0	0	0	0
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	0	0	0	0
CO Avoided (grams)	0	0	0	0
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	0	0	0	0
SO_2 Avoided (grams)	0	0	0	0
PM Avoided (grams)	0	0	0	0
Asphalt	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	0	0	0	0
Quantity Landfilled (lbs.)	2,000	6,000	12,000	20,000
Environmental Benefit				
Water Conserved (ga.)	0	0	0	0
Energy Conserved (MJ)	0	0	0	0
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	0	0	0	0
CO Avoided (grams)	0	0	0	0
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	0	0	0	0
SO_2 Avoided (grams)	0	0	0	0
PM Avoided (grams)	0	0	0	0

Total Env Benefit	1 year	3 years	6 years	10 years
Waste Reused (lbs.)	18,417	55,250	110,500	184,167
Waste Recycled (lbs.)	0	0	0	0
Waste Landfilled (lbs.)	17,083	51,250	102,500	170,833
Total Recycled or Reusec	18,417	55,250	110,500	184,167
Energy Use (MJ)	4,169	12,506	25,011	41,685
Avoided Air Emissions				
GHG Avoided (lbs. Of CO2 Equivalent)	5,143	15,428	30,855	51,426
CO Avoided (grams)	2,242	6,725	13,451	22,418
VOC Avoided (grams)	409	1,226	2,452	4,087
NO_x Avoided (grams)	4,612	13,835	27,669	46,115
SO_2 Avoided (grams)	2,895	8,686	17,373	28,955
PM Avoided (grams)	1,726	5,179	10,358	17,263
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
Water Conserved (ga.)	47	142	284	473

Recycle All Waste Where Facilities Exis

Green Waste	1 year	3 years	6 years	10 years
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	24,000	72,000	144,000	240,000
Quantity Landfilled (lbs.)	0	0	0	0
Lumber	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	3,000	9,000	18,000	30,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Energy Conserved (MJ)	3,573	10,718	21,436	35,727
GHG Avoided (lbs. Of CO2 Equivalent)	8,102	24,306	48,612	81,020
CO Avoided (grams)	2	5	9	16
VOC Avoided (grams)	1	4	8	13
NO_x Avoided (grams)	7	21	42	69
SO_2 Avoided (grams)	1	3	5	8
PM Avoided (grams)	14	42	83	139
Brick	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	4,500	13,500	27,000	45,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	95	284	567	945
Energy Conserved (MJ)	4,739	14,216	28,431	47,385
GHG Avoided (lbs. Of CO2 Equivalent)	1,001	3,003	6,006	10,010
CO Avoided (grams)	101	304	608	1,013
VOC Avoided (grams)	52	155	311	518
NO_x Avoided (grams)	745	2,234	4,469	7,448
SO_2 Avoided (grams)	4,496	13,487	26,973	44,955
PM Avoided (grams)	3,173	9,518	19,035	31,725
Concrete	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	2,000	6,000	12,000	20,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	113	340	679	1,132
Energy Conserved (MJ)	65	196	392	653
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	22	66	132	220
CO Avoided (grams)	11	32	63	105
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	25	75	150	250
SO_2 Avoided (grams)	22	66	133	221
PM Avoided (grams)	2	5	11	18
Asphalt	**1 year**	**3 years**	**6 years**	**10 years**
Quantity Reused (lbs.)	0	0	0	0
Quantity Recycled (lbs.)	2,000	6,000	12,000	20,000
Quantity Landfilled (lbs.)	0	0	0	0
Environmental Benefit				
Water Conserved (ga.)	113	340	679	1,132
Energy Conserved (MJ)	65	196	392	653
RCRA Hazardous Waste Avoided (grams)	0	0	0	0
GHG Avoided (lbs. Of CO2 Equivalent)	22	66	132	220
CO Avoided (grams)	11	32	63	105
VOC Avoided (grams)	0	0	0	0
NO_x Avoided (grams)	25	75	150	250
SO_2 Avoided (grams)	22	66	133	221
PM Avoided (grams)	2	5	11	18

Total Env Benefit	1 year	3 years	6 years	10 years	
Waste Reused (lbs.)	0	0	0	0	0
Waste Recycled (lbs.)	35,500	106,500	213,000	355,000	35,500
Waste Landfilled (lbs.)	0	0	0	0	0
Total Recycled or Reusec	35,500	106,500	213,000	355,000	35,500
Energy Use (MJ)	8,442	25,326	50,651	84,419	8,442
Avoided Air Emissions					0
GHG Avoided (lbs. Of CO2 Equivalent)	9,147	27,441	54,882	91,471	9,147
CO Avoided (grams)	124	372	743	1,239	124
VOC Avoided (grams)	53	159	318	530	53
NO_x Avoided (grams)	802	2,405	4,811	8,018	802
SO_2 Avoided (grams)	4,541	13,622	27,244	45,406	4,541
PM Avoided (grams)	3,190	9,570	19,139	31,899	3,190
RCRA Hazardous Waste Avoided (grams)	0	0	0	0	0
Water Conserved (ga.)	321	963	1,926	3,209	321

18,417	18,417
17,083	0
0	17,083
35,500	18,417
8,455	4,169
0	0
9,738	5,143
2,314	2,242
435	409
5,037	4,612
5,188	2,895
3,323	1,726
0	0
321	47

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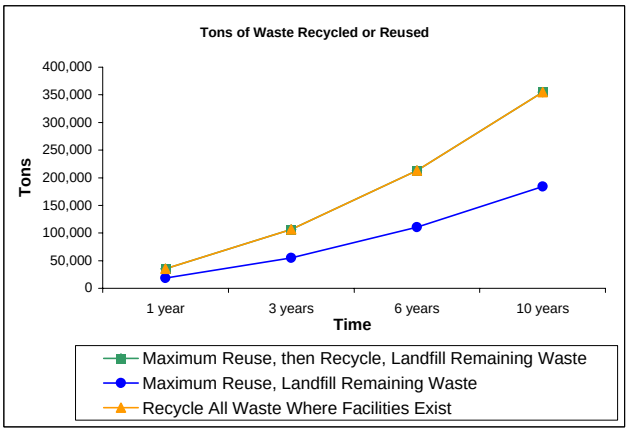
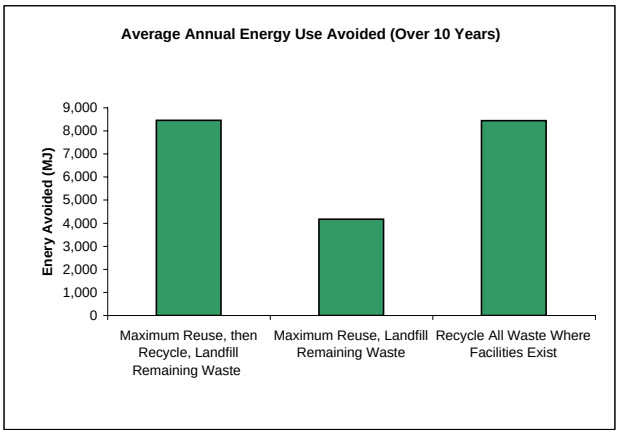
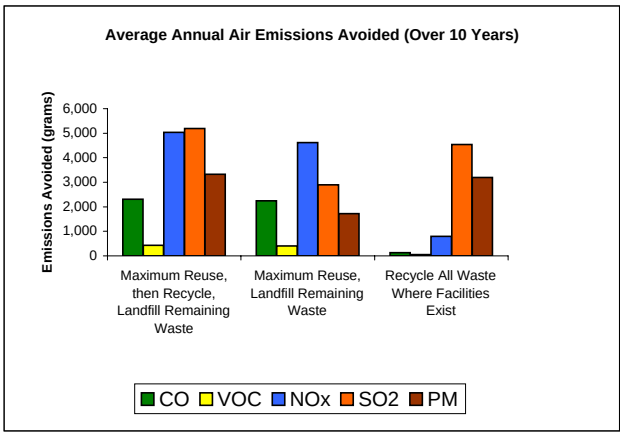
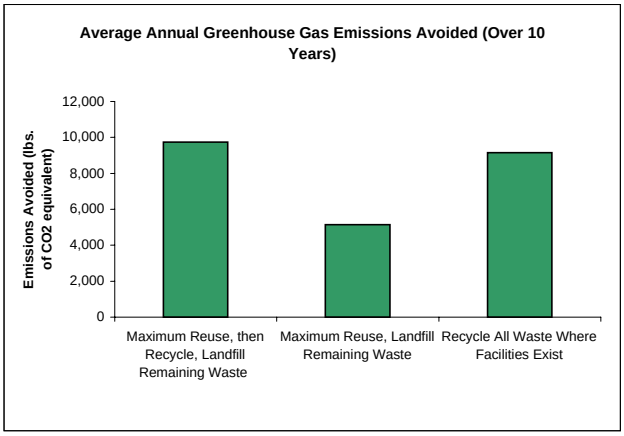
Recycling and Reusing Hardscape and Landscape Waste Environmental Benefits Graphs

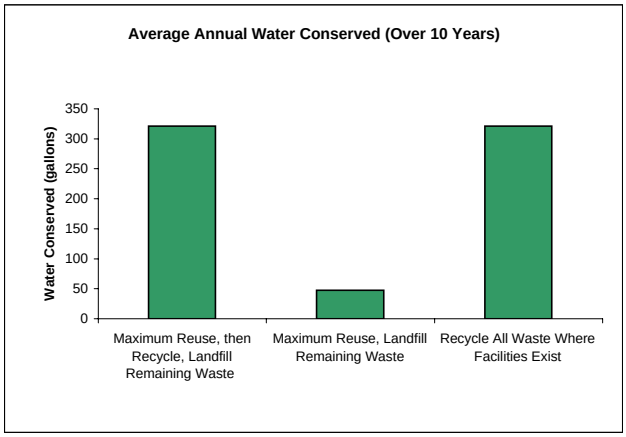
GreenScapes
Environmentally Beneficial Landscaping

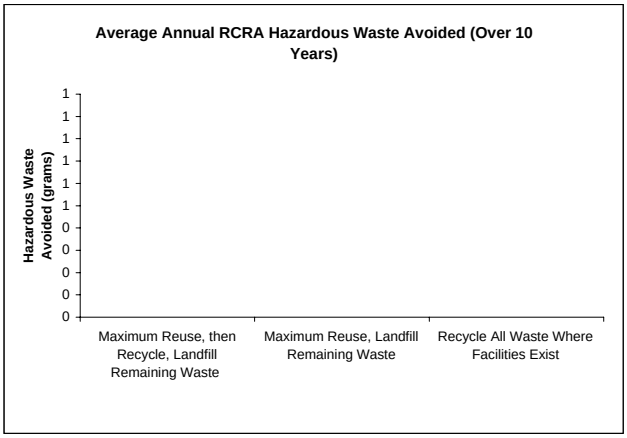












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Recycling and Reusing Hardscape and Landscape Waste Environmental Equivalents

GreenScapes

The charts below present the quantity of pollutants avoided on average, for each of the three alternative scenarios and contexual measures.

Maximum Reuse, then Recycle, Landfill Remaining Waste

Total Environmental Benefit	# Waste Avoided	Statistic		Statistic		
Quantity Reused (lbs.) =	18,417	the muncipal solid waste generated by	11.96	1,539.9	U.S. households per day[1, 2, 3]	#VALUE!
Quantity Recycled (lbs.) =	17,083	the muncipal solid waste generated by	11.96	1,428.4	U.S. households per day[1, 2, 3]	
Quantity Landfilled (lbs.) =	0	the muncipal solid waste generated by	11.96	0.0	U.S. households per day[1, 2, 3]	
Energy Use (MJ) =	8,455	the electricity used to power	118	71.6	U.S. households per day[2]	
GHG Avoided (lbs. Of CO2 Equivalent) =	9,738	the daily GHG emissions of	33	295.3	passenger vehicles[2]	#VALUE!
CO Avoided (grams) =	2,314	the CO emissions of driving	14.2	163.0	miles in the average car[4]	#VALUE!
VOC Avoided (grams) =	435	the VOC emissions of driving	1.40	310.8	miles in the average car[4]	#VALUE!
NO_x Avoided (grams) =	5,037	the daily NOx emissions of	47	106.1	passenger vehicles[5]	#VALUE!
SO_2 Avoided (grams) =	5,188	running an old coal plant fo	277,324	0.02	minutes[5]	#VALUE!
PM Avoided (grams) =	3,323	the PM emissions of driving	0.75	4,430.7	miles in the average U.S. truck[7]	#VALUE!
RCRA Hazardous Waste Avoided (grams) =	0	the amount of mercury contained in	0.7	0.0	fever thermometers[8]	#VALUE!
Water Conserved (ga.) =	321	the water used by	40	8.0	loads of laundry[9]	#VALUE!

Maximum Reuse, Landfill Remaining Waste

Total Environmental Benefit	# Waste Avoided	Statistic		Statistic		
Quantity Reused (lbs.) =	18,417	the muncipal solid waste generated by	11.96	1,539.9	U.S. households per day[1, 2, 3]	0
Quantity Recycled (lbs.) =	0	the muncipal solid waste generated by	11.96	0.0	U.S. households per day[1, 2, 3]	
Quantity Landfilled (lbs.) =	17,083	the muncipal solid waste generated by	11.96	1,428.4	U.S. households per day[1, 2, 3]	
Energy Use (MJ) =	4,169	the electricity used to power	118	35.3	U.S. households per day[2]	
GHG Avoided (lbs. Of CO2 Equivalent) =	5,143	the daily GHG emissions of	33	155.9	passenger vehicles[2]	
CO Avoided (grams) =	2,242	the CO emissions of driving	14.2	157.9	miles in the average car[4]	
VOC Avoided (grams) =	409	the VOC emissions of driving	1.40	291.9	miles in the average car[4]	
NO_x Avoided (grams) =	4,612	the daily NOx emissions of	47	97.1	passenger vehicles[5]	
SO_2 Avoided (grams) =	2,895	running an old coal plant fo	277,324	0.01	minutes[5]	
PM Avoided (grams) =	1,726	the PM emissions of driving	0.75	2,301.8	miles in the average U.S. truck[7]	
RCRA Hazardous Waste Avoided (grams) =	0	the amount of mercury contained in	0.7	0.0	fever thermometers[8]	
Water Conserved (ga.) =	47	the water used by	40	1.2	loads of laundry[9]	

Recycle All Waste Where Facilities Exist

Total Environmental Benefit	# Waste Avoided	Statistic		Statistic		
Quantity Reused (lbs.) =	0	the muncipal solid waste generated by	11.96	0.0	U.S. households per day[1, 2, 3]	0
Quantity Recycled (lbs.) =	35,500	the muncipal solid waste generated by	11.96	2,968.2	U.S. households per day[1, 2, 3]	
Quantity Landfilled (lbs.) =	0	the muncipal solid waste generated by	11.96	0.0	U.S. households per day[1, 2, 3]	
Energy Use (MJ) =	8,442	the electricity used to power	118	71.5	U.S. households per day[2]	
GHG Avoided (lbs. Of CO2 Equivalent) =	9,147	the daily GHG emissions of	33	277.4	passenger vehicles[2]	
CO Avoided (grams) =	124	the CO emissions of driving	14.2	8.7	miles in the average car[4]	
VOC Avoided (grams) =	53	the VOC emissions of driving	1.40	37.9	miles in the average car[4]	
NO_x Avoided (grams) =	802	the daily NOx emissions of	47	16.9	passenger vehicles[5]	
SO_2 Avoided (grams) =	4,541	running an old coal plant fo	277,324	0.02	minutes[5]	
PM Avoided (grams) =	3,190	the PM emissions of driving	0.75	4,253.2	miles in the average U.S. truck[7]	
RCRA Hazardous Waste Avoided (grams) =	0	the amount of mercury contained in	0.7	0.0	fever thermometers[8]	
Water Conserved (ga.) =	321	the water used by	40	8.0	loads of laundry[9]	

Sources

1. Wastes: What You Can Do - Basic Facts About Waste. Environmental Protection Agency. http://www.epa.gov/epaoswer/osw/facts.htm

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3. USA Quickfacts. U.S. Census Bureau State and County Quickfacts. http://quickfacts.census.gov/qfd/states/00000.html

4. Vehicle Emissions - Transportation Air Quality Selected Facts and Figures. EPA. January 2006. http://www.fhwa.dot.gov/environment/aqfactbk/page15.htm

5. EPA, Emissions Facts, http://www.epa.gov/otaq/consumer/f00013.htm

6. Lethal Legacy, U.S. PIRG Education Fund, 2003. http://uspirg.org/uspirg.asp?id2=11087

7. ICF Consulting, North American Trade and Transportation Corridors: Environmental Impacts and Mitigation Strategies, Prepared for the North American Commission for Environmental Cooperation, February 2001.

8. Clothes Washers, Energy Guide, http://www.energyguide.com/library//EnergyLibraryTopic.asp?bid=austin&prd=10&TID=17246&SubjectID=8374

9. Mercury Thermometer Fact Sheet. http://www.hendersoncountync.org/health/Documents/Mercury%20Thermometer%20fact%20sheet.pdf

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Recycling and Reusing Hardscape and Landscape Waste Default Cost Data

Reference this sheet if you want to re-enter default values into the Cost Data Page

Disposal Fees	Unit	Cost Estimate	Source and Comment	States
Northeast		$77.58	Repa, Edward, Ph.D (2005) *NSWMA 2005 Tip Fee Survey*.	CT, ME, MA, NH, NY, RI, VT
Mid-Atlantic		$50.92	<http://wastec.isproductions.net/webmodules/webarticles/articlefiles/478-	DE, MD, NJ, PA, VA, WV
South		$34.07	Tipping%20Fee%20Bulletin%202005.pdf>	AL, FL, GA, KY, MS, NC, SC, TN
Midwest		$38.46	If you know your own disposal cost per ton, change the green cell to the left for your	IN, IA, MI, MN, MO, OH, WI
South-Central		$26.47	region.	AZ, AR, LA, NM, OK, TX
West-Central		$41.51		CO, KS, MT, NE, ND, SD, UT, WY
West	$/Ton	$37.72		CA, HI, ID, NV, OR, WA

On-site Asphalt and Concrete Crushing Costs	Units	Cost Estimate	Sources	Comments
Capital Cost	N/A	$64,350	Concrete/Asphalt Crushers. September, 2003. <http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/7_III_6.html>	
Labor Cost	$/Ton	$7.02	Concrete/Asphalt Crushers. September, 2003. <http://p2library.nfesc.navy.mil/P2_Opportunity_Handbook/7_III_6.html>	
Equipment Maintenance Cost	$/Ton	$0.59	Concrete/Asphalt Crushers. September, 2003.	

Green Waste Grinding Costs	Units	Cost Estimate	Sources	Comments
Labor cost of green waste chipping/shredding	$/Hour	$26.00	Mulch Mule Brochure. Accessed August 28, 2007. <www.mulchmule.com/info/mulchmule2006.pdf >	This brochure says that the industry average for mulching-related labor is $25/hour.
Time to shred/chip	Hours/CY	0.05	Personal Communication with Customer Service, BearCat. August 29, 2007	Bear Cat estimated that a 6" chipper can chip 100 feet per minute. 100 feet was multiplied by
Maintenance of Commercial Chipper	$/Hour Used	$52.91		See Total Below
Initial Cost of 6" Commercial	N/A	$8,318.96	Norwalk Power Equipment Company. Bear Cat Commercial Chippers (Gravity	The Bear Cat 71620 sells for $7,999.
Amount Saved by Mulching	$/CY	$2.89	This value is calculated by subtracting the total cost of producing a CY of mulch	This is the amount saved by mulching on-site

Chipper Maintenance	Cost	Replacement Time	Cost Per	Source	Comments
Blades	$266	10	$26.62		$248 is the retail price for the blade replacement kit
Gasoline	$25.08	1	$25.08	Customer service at Bear Cat provided estimates regarding how often each of these maintenance elements would be needed, as well as how much it would cost to replace all the blades and bearings. This information was given on August 30, 2007.	The average price of gasoline in the United States was multiplied by the volume of the chipper's gas tank.
Bearings	$60	50	$1.21	The average price of gasoline, $2.75 per gallon, was taken from the Energy Information Administration's U.S. Retail Gas Prices. Accessed May 23, 2008. <http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_home_page.html>	Each bearing costs $29 and the chipper contains two bearings.
Total	N/A	N/A	$52.91		

New Material Costs	Units	Cost Estimate	Sources	Comments
Compost	$/Cu. Yard	$17.10	Alexander, Ron, Tyler, Rod, and Goldstein, Nora. "Increasing Dollar Value for Compost Products." Biocycle, Oct. 2004 <http://www.environmental-	
Mulch	$/Cu. Yard	$7.13	Earth Products. Orange County Landfill -- Orange County, NC. Accessed December 29, 2006. <http://www.co.orange.nc.us/recycling/earthproducts.asp>	Orange County landfill sells yard waste mulch for $20 per 3 cubic yards. This price was divided by three to find the price per cubic yard.
Lumber (2"x 6" Decking Boards)	$/LF	$0.39	Lumber and Plywood Estimating Price Guide. Ace Hardware. January 30, 2006. <http://www.acehardware.net/estimate/>.	The seven price estimates divided by their corresponding linear feet are all at or very close to $0.36 per LF.

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Brick	$/Brick	$0.39	Liu, Henry; Williams, Burkett and Haynes, Kirk. *Improving Freezing and Thawing Properties of Fly Ash Bricks. March, 2005.* <http://www.flyash.info/2005/20liu.pdf>.	This website states that ordinary bricks cost between $300-$400 per thousand. This range was averaged to $350 per thousand or $0.35 per brick.
Crushed Surfacing	$/Ton	$11.92	Dayton, Kevin J., State Construction Engineer, WSDOT Headquarters Construction Office. *Construction Update.* August 8, 2006. p. 1. <http://www.wsdot.wa.gov/biz/Construction/CostIndex/CostIndexPdf/constructionupdatereport.pdf>	

Conversion Factors	From	To	Factor	Source	Comments
Brick	Bricks	Tons	0.00225	Table 4. Accessed on November 4, 2006. <http://ntl.bts.gov/DOCS/tables2.html>.	This value was given in pounds and converted to tons by dividing by 2000.
Concrete, Asphalt & Brick	Tons	Cu. Yards	0.83	http://www.buckscontainerservices.com/conversions.htm	
Green House Gas	Carbon	CO_2	3.6667	US EPA - Non-CO2 Gases and Carbon Sequestration - Conversion Units. http://www.epa.gov/nonco2/units.html. Accessed October 30, 2007.	
2"x 6" Wood Decking Boards	Cubic Meters	mbf (1000 Board Feet)	1.6240	Milota, M.; West, C.; and Hartley, I. Gate-to-Gate Life-Cycle Inventory of Softwood Lumber Production. Wood and Fiber Science, December 2005, v. 37.	
2"x 6" Wood Decking Boards	Linear Feet	Tons	0.0015	Lumber Weight Calculator. Accessed November 4, 2006.	This value was derived by using a lumber
2"x 6" Wood Decking Boards	Linear Feet	Cubic Yards	0.0031		One linear foot of 2"x6" contains .0031 cubic
General	KWh	MJ	3.6		
General	MJ	BTU	947.8		
General	Kilograms	Pounds	2.2046		
General	Metric Tons	Tons	1.1023		
General	Ounces	Grams	28.3495		
GHG	$MTCO_2E$	MTCE	0.2727		
Water	Gallons	Kilograms	3.79		
Yard Waste	Cu. Yards	Tons	0.2	General Permit for Yard Waste Composting Facilities Under the South Dakota Waste Management Program. Board of Minerals and Environment. Department of Environment and Natural Resources. October 13, 1998. p. 6. <http://www.state.sd.us/DENR/DES/WasteMgn/SWaste/COMPGEN.pdf>.	This value was given in pounds and converted to tons by dividing by 2000.
Yard Waste to Compost	Cu. Yards	Cu. Yards	0.375	Wilson, C.R. and Feucht, J.R. *Composting of Yard Waste.* Colorado State University Coopertive Extension. October, 1997. <http://www.ext.colostate.edu/PUBS/GARDEN/07212.pdf>.	The article states that 50-75% of plant volume is reduced by composting. This range was averaged to derive a conversion factor.

Inflation Adjustment Table

One Dollar in…	Equals this many 2008 Dollars
2003	$1.17
2004	$1.14
2005	$1.10
2006	$1.07
2007	$1.04

Source: *CPI Inflation Calculator.* <http://data.bls.gov/cgi-bin/cpicalc.pl>