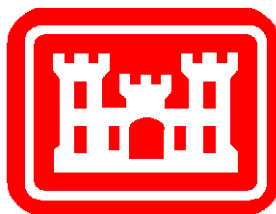


PUBLIC WORKS TECHNICAL BULLETIN PWTB 200-1-26  
30 APRIL 2005

**MARKET VALUATION OF DEMOLITION  
SALVAGE MATERIALS**



Public Works Technical Bulletins are published by the U.S. Army Corps of Engineers, Washington, DC. They are intended to provide information on specific topics in areas of Facilities Engineering and Public Works. They are not intended to establish new DA policy.

DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
441 G Street, NW  
Washington, DC 20314-1000

CEMP-CE

Public Works Technical Bulletin  
No. PWTB 200-1-26

30 April 2005

FACILITIES ENGINEERING  
ENVIRONMENTAL  
MARKET VALUATION OF DEMOLITION  
SALVAGE MATERIALS

1. Purpose. The purpose of this Public Works Technical Bulletin (PWTB) is to transmit information on the evaluation of salvage materials from construction and demolition (C&D) activities for recycle or reuse.
2. Applicability. This PWTB applies to all U.S. Army facilities engineering activities.
3. References.
  - a. Army Regulation (AR) 200-1, Environmental Protection and Enhancement, 21 February 1997.
  - b. Army Regulation (AR) 420-49, Utility Services, 28 April 1997.
  - c. Unified Facilities Guide Specifications (UFGS) 01572, Construction and Demolition Waste Management, 03 February 2003.
4. Discussion.
  - a. Army Regulation (AR) 200-1, para. 5-10 contains policy for solid waste management, including participation in recycling programs and the sale of recyclables.

30 April 2005

b. AR 420-49 contains policy and criteria for the operation, maintenance, repair, and construction of facilities and systems, for efficient and economical solid (nonhazardous) waste management including source reduction, re-use, recycling, collection, transport, storage, and treatment of solid waste.

c. Disposing of demolition debris in landfills is expensive. It wastes natural resources and valuable landfill space. The U.S. Army engages in a great number of C&D projects on installations across the nation that generate a significant amount of waste. The DoD Pollution Prevention Measure of Merit is to divert 40% of non-hazardous solid waste (such as the demolition debris from C&D projects) from landfills by 2005, while providing an economic benefit.

d. This PWTB can help installations achieve this goal by identifying market sources for reusable and recyclable materials generated from construction and/or demolition (C&D) projects. Appendix A contains procedures, information, and resources that will enable Army installations to implement alternative strategies to conventional demolition and landfilling.

e. A number of outlets, services, material exchanges, and other resources for salvaged building materials offer viable alternative to landfilling in many commercial markets. Appendix B lists associations, publications, website URLs, and other available resources to help installations locate recycling opportunities.

f. Appendix C contains a bibliography of source material on the topics of recycling, reuse, and marketing of recyclable materials.

5. Points of Contact. HQUSACE is the proponent for this document. The POC at HQUSACE is Mr. Malcolm E. McLeod, CEMP-II, 202-761-0632, or e-mail: [malcolm.e.mcleod@usace.army.mil](mailto:malcolm.e.mcleod@usace.army.mil)

PWTB 200-1-26  
30 April 2005

6. Questions and/or comments regarding this subject should be directed to the technical POC:

U.S. Army Engineer Research and Development Center  
Construction Engineering Research Laboratory  
ATTN: CEERD-CN-E (Stephen D. Cospers)  
2902 Newmark Drive  
Champaign, IL 61822-1072  
Tel. (217) 373-5569  
FAX: (217) 373-3430  
e-mail: [Stephen.D.Cospers@erdc.usace.army.mil](mailto:Stephen.D.Cospers@erdc.usace.army.mil)

FOR THE COMMANDER:



DONALD L. BASHAM, P.E  
Chief, Engineering and Construction  
Directorate of Civil Works



Appendix A  
MARKET VALUATION OF DEMOLITION SALVAGE MATERIALS

**INTRODUCTION**

Disposing of demolition debris in landfills is both economically and environmentally costly - wasting both natural resources and valuable landfill space. The U.S. Army engages in a great number of C&D projects on installations across the nation that generate a significant amount of waste (Figure A-1). The DoD Pollution Prevention Measure of Merit is to divert 40% of non-hazardous solid waste from landfills<sup>1</sup>, while providing an economic benefit. One way to do this is to identify market sources for reusable and recyclable materials generated from construction and/or demolition (C&D) projects. There are several outlets, services, material exchanges, and other resources for salvaged building materials as a viable alternative to landfilling in many commercial markets.

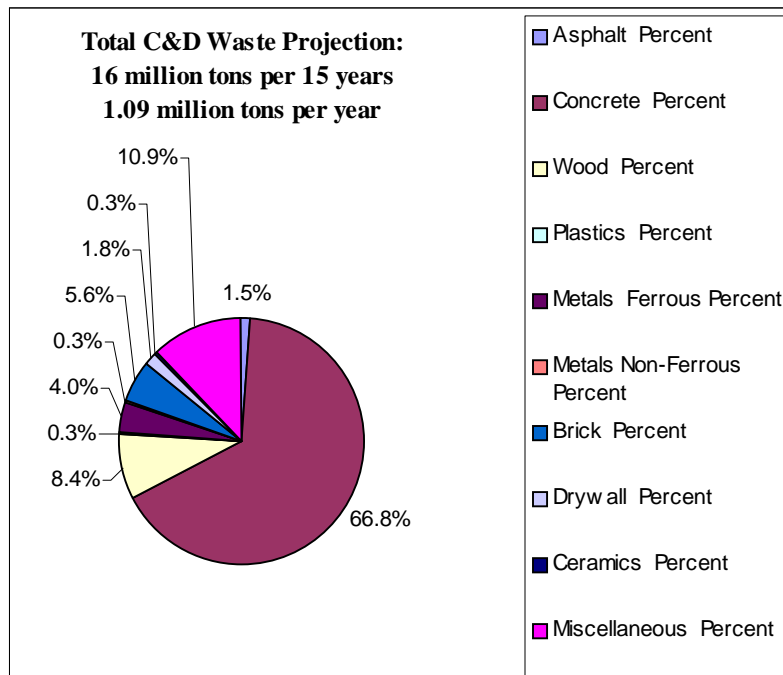


Figure A-1. Projection of C&D Waste in the Army over the Next 15 Years.

<sup>1</sup>This MoM is currently (August 2004) under revision.

30 April 2005

Recent private sector experience has successfully demonstrated that deconstruction and salvage of building materials is a viable alternative to demolition and landfill in many commercial markets. Under the appropriate conditions, it is realistic to expect over three quarters of a building's content can be salvaged for reuse or recycling. The salvage of demolition materials can be a significant means to reduce solid waste volume, avoid tipping fees, and provide a revenue source from materials sale or reuse.

#### **SCOPE OF WORK**

The purpose of this guidance is to provide Army installations with procedures, information, and resources that will enable them to plan and manage building removal projects that employ alternative strategies to conventional demolition and landfilling. The materials that result from demolition or deconstruction have many potential applications. Depending on the condition and types of materials, many of these materials can be donated or sold for reuse. Other materials may be recycled into new products. These materials also may be used as feedstock for new materials instead of using virgin sources.

This document is intended to serve as a reference for those responsible for construction, demolition, and remodeling projects within the Army who are interested in preserving natural resources with the opportunity to reduce waste volume, demolition costs, and generate revenue.

#### **BENEFITS**

Salvaging benefits the Army by providing materials and components that can be used instead of virgin materials, or recycled into materials useable on-post. Salvaged building materials offer many opportunities to owners, consultants, and contractors, including:

- Lower material costs than virgin (e.g., crushed concrete in place of virgin aggregate)
- High quality building materials
- Historical context
- Reduced waste disposal costs
- Avoided environmental impacts from manufacturing of new materials
- Increased material choices.



30 April 2005

Reuse includes the removal and recovery of materials or components from the solid waste stream in a manner that retains its original form and identity for the purpose of using the material again in the same or similar form as it was produced. Many items removed during a demolition project have not exhausted their useful life and can be reused either on site or through transfer to others.

Recycling transforms discarded materials into useful products. It involves the collection of recyclable materials from the demolition, construction, or recycling of a building. After collection, these materials must be processed or prepared to specifications to meet market requirements. This stage of processing and brokering is referred to as the secondary markets stage. Following the secondary markets stage, the materials move on to the manufacturer or end user where they are used as raw materials to produce new products (Ohio DNR). Note that the use of recycled materials on the installation will yield a greater return by eliminating transportation costs.

#### **DEVELOPING A SALVAGE PLAN**

It is very important for the demolition practitioner to establish a marketing plan for all salvaged materials before starting a project. Of course, they should have some knowledge before bidding on the work. The contractor's project manager should consult a demolition and salvage contractor experienced in salvaging structural and non-structural building materials. UFGS 01572 requires contractors to develop and submit a demolition waste management plan. See:

<http://www.wbdg.org/ccb>

The contractor would establish their own diversion criteria, based on their knowledge of the services and markets available in the region. This plan should require the following:

- Description of the method and approach taken to demolish buildings and to salvage or recycle materials
- Participation by any non-traditional service such as non-profit organizations or vocational training programs
- Characterization of materials to be recycled by type and quantity
- Assessment and abatement of hazardous and banned materials
- Destination where recycled or salvaged materials will be taken and description of materials' end uses

30 April 2005

- Market demand and value for materials that are removed from buildings and salvaged for reuse
- Market resources (including names and addresses of used building materials yards, and licensed recycling and disposal facilities accepting materials generated by the project.)

Requiring recycling without these considerations can be counterproductive to both the installation and the contractor. Public Works personnel, or the project manager, must become familiar enough with the marketplace to specify salvage or recycling requirements that can be accomplished within the cost and time constraints of the project.

### **BUILDING REMOVAL**

Just as many types of materials can be recycled, many methods can be employed to recycle these materials. Many alternatives are practiced in the commercial market and have proven to be successful at reducing the amount of demolition debris that ends up in the landfill. The most effective method depends on the size and conditions of the job-site, and the building construction type. It is important to note that no single strategy for waste diversion is applicable to all buildings, construction types, and locations. PWTB 420-49-32, Selection of Methods for the Reduction, Reuse, and Recycling of Demolition Waste, provides guidelines on evaluating specific project conditions and assessing the feasibility of deconstruction, reuse, and recycling methods.

Deconstruction is a cost-competitive and environmentally responsible alternative to conventional building demolition. PWTB 200-1-23, Guidance of the Reduction of Demolition Waste Through Reuse and Recycling, describes procedures for incorporating deconstruction, salvage, and recycling practices into building removal projects with the objectives of reducing landfill burdens and making better use of the resources available in surplus Army buildings. By choosing deconstruction over conventional demolition, you can improve your bottom line through avoided waste disposal costs, and also by generating revenue from salvaged building materials to offset the demolition costs. In turn, high-quality used building materials are produced for use in new construction or renovation projects.

### **PARTICIPATION BY ANY NON-TRADITIONAL SERVICE**

In addition to traditional processors, a number of businesses recover and resell used building materials that have a potential

30 April 2005

for reuse in renovation and construction, including lumber, doors, windows, fixtures, whole bricks, and other materials.

Installations should evaluate the potential for using non-profit organizations or vocational training programs to provide services to assist in recovering, processing, and reselling or reusing building materials. Be creative. Do not overlook any opportunity to educate or publicize, and take advantage of unusual ways to solicit support from local recycling, environmental, or other organizations. These may include housing providers (such as Habitat for Humanity), national service organizations (such as National Civilian Conservation Corps / AmeriCorps), academic institutions, community vocational and training programs, and similar potential sources of services.

More than 50 Habitat for Humanity affiliates across the United States and Canada have established ReStores, which sell quality used and surplus building materials at a fraction of retail prices. Proceeds from ReStores fund the construction of Habitat houses in the community. All materials sold by Habitat ReStores were donated for that purpose - often from demolition crews salvaging reusable materials. The donor receives a tax deduction in place of an invoice from a disposal company. The nonprofit organization gets stock for its warehouse, which in turn, supplies the community groups with quality, affordable building materials. For more information visit their website at [www.habitat.org](http://www.habitat.org).

#### **CHARACTERIZATION OF MATERIALS**

Any type of building can be disassembled, although deconstruction is most commonly associated with wood-framed buildings. The condition of a building and its components are important factors for salvage opportunities. Many of the Army barracks buildings were built during the decades of old-growth harvest and contain material largely unavailable from any other resource making them good candidates for deconstruction (Falk). In general, buildings exhibiting one or more of the following characteristics are likely to be good deconstruction candidates:

- wood-framed with heavy-timbers and beams, or with high quality woods such as Douglas fir, American chestnut, and old growth southern yellow pine
- constructed with high-value specialty materials such as hardwood flooring, multi-paned windows, architectural molding, and unique doors or plumbing/electrical fixtures

30 April 2005

- constructed with high-quality brick laid with low-quality mortar (to allow relatively easy break-up and cleaning)
- constructed mainly of concrete and/or steel may be good candidates for partial deconstruction, or the "stripping" of salvageable material
- structurally sound, i.e., generally weather tight to minimize rotted and decayed materials.

PWTB 200-1-23, Guidance of the Reduction of Demolition Waste Through Reuse and Recycling, contains a list of resources available in buildings. The types and the condition of the building materials vary greatly from one job to the next. Note that there is no single list of materials applicable to all demolition situations. All materials may not be present in any one building or group of buildings. The deconstruction contractor will have to perform a detailed inspection of the building, to understand the structural design and to estimate the quality and quantity of materials that can be salvaged..

Some materials are almost always recovered, while others are recovered when circumstances allow, or not at all. Table A-1 provides a general categorization of materials that can be marketed successfully in a demolition project.

#### **HAZARDOUS MATERIALS**

In general, C&D waste is considered non-hazardous. Under state and Federal statutes the components of the C&D waste stream that are considered hazardous include waste solvents, paints and coatings, and adhesives. Other examples of potentially hazardous materials include (but are not limited to): asbestos, lead-based paint, PCBs, Freon, and mercury.

Any hazardous materials must be identified before any salvage or demolition work.

Under the Resource Conservation Recovery Act (RCRA), waste generators are responsible for determining if their wastes are hazardous. All wastes or by-product materials that are being considered for use, regardless of whether or not the material is exempt from regulation under the RCRA, should be evaluated before use to fully assess the inherent hazard potential of the material. Hazardous materials, such as friable asbestos insulation and siding, must be properly removed and disposed of by a qualified professional before deconstruction and before any reuse and recycling can take place.

**Table A-1**  
**Salvage and Recovery Patterns in Demolition Projects (Gildea)**

<p>Typically recovered for Reuse:</p>	<ul style="list-style-type: none"> <li>• Large, heavy timbers</li> <li>• dimensional lumber (e.g. 2x10, 2x8, 2x6)</li> <li>• metals, structural steel</li> <li>• concrete</li> <li>• brick /masonry</li> <li>• wood paneling, molding, and trim</li> <li>• hardwood flooring</li> <li>• siding</li> <li>• cabinets and casework</li> <li>• electric equipment and light fixtures</li> <li>• plumbing fixtures and brass</li> <li>• windows, doors, and frames</li> <li>• heating ducts</li> </ul> <p>architectural antiques</p>
<p>Typically recovered for Recycling:</p>	<ul style="list-style-type: none"> <li>• dimensional lumber (2x4 or smaller)</li> <li>• gypsum drywall</li> <li>• carpet /carpet pad</li> <li>• structural concrete</li> <li>• rebar</li> <li>• brick /masonry</li> <li>• roofing material</li> <li>• insulation</li> <li>• ceiling tiles</li> <li>• glass</li> <li>• fluorescent tubes</li> <li>• scrap metal</li> <li>• electrical cable</li> <li>• copper and metal pipe</li> </ul>

**END USES**

Consideration should be given to the way the recovered materials will be used once they are extracted from buildings. Reusing building materials and components in their existing condition, reconditioning materials to increase their resale value, or reprocessing materials into higher value products are preferred over recycling.

Table A-2 lists end markets for some of the commonly recovered building materials.

**Table A-2  
 End Markets: Where Does It All Go?**

Wood	<ul style="list-style-type: none"> <li>• Wood fuel</li> <li>• Mulch</li> <li>• Bulking agents for composting</li> <li>• Manufactured wood products</li> <li>• Alternative wood fiber-based materials (e.g., particle board, MDF)</li> </ul>	Glass	<ul style="list-style-type: none"> <li>• Reuse of windows and mirrors</li> <li>• Inert granular material additive</li> <li>• fiberglass</li> <li>• Reflective beads</li> <li>• glasphalt</li> </ul>
Concrete	<ul style="list-style-type: none"> <li>• Roadbase</li> <li>• Fill material</li> <li>• Aggregate for new ready-mix</li> <li>• Lime for neutralizing agent</li> <li>• Rip-rap</li> </ul>	Drywall	<ul style="list-style-type: none"> <li>• Soil amendment (gypsum)</li> <li>• Cement additive (gypsum)</li> <li>• new drywall (gypsum)</li> <li>• Animal bedding (paper)</li> </ul>
		Asphalt Roofing	<ul style="list-style-type: none"> <li>• Asphalt patch for roads</li> </ul>
Metals	<ul style="list-style-type: none"> <li>• Reuse by salvagers</li> </ul>	Ruble	<ul style="list-style-type: none"> <li>• Aggregate for fill or roadbase</li> <li>• Construction entrance roads</li> <li>• drainage bed material</li> <li>• landfill cover material</li> </ul>
	<ul style="list-style-type: none"> <li>• Metal feedstocks</li> <li>• Scrap dealers</li> </ul>		
OCC	<ul style="list-style-type: none"> <li>• Paper fiber feedstock</li> </ul>		

30 April 2005

Deconstruction requires either a ready market for the salvaged materials or the ability to warehouse the materials (on-site or off-site) until they are sold. In the context of building removal, some materials are better suited to recycling and some to reuse. When specifying salvage or recycle requirements, care must be taken to ensure that the materials are worthwhile. Certain materials need market development assistance such as gypsum wallboard. Other large volume materials, such as metals, are well suited to recycling and can be marketed to scrap metal dealers. Prices for end markets can fluctuate, sometimes be quite low. It is important to ensure that the end markets exist to avoid stockpiling problems.

Aluminum: All aluminum is recyclable and can be separated easily at the source, including siding, gutters, downspouts, storm door and window frames, and hundreds of other common consumer items. Most scrap metal processors are eager to handle this material.

Iron and Steel: Iron and steel are among the most efficient and beneficial materials to recycle, regardless of their form or condition - whether they are bent, torn apart, and otherwise roughly treated. Steel should not be perceived as a waste but as a commodity of intrinsic value. There is no reason to dispose of an item made of steel since it is 100 percent recyclable. Even if it is intermixed with other materials, it can be separated out magnetically for recycling.

Glass: Although the United States has an abundant supply of the primary components of glass - sand, soda ash, and limestone - the use of crushed glass, or cullet, in manufacturing offers economic advantages over virgin materials. Most significant is that cullet melts at a lower temperature than the raw materials, so energy usage is reduced. Recycled glass is used as a direct substitute for raw materials in the production of new glass, as well as fiberglass and a new road-paving product known as "glasphalt."

Wood: There are numerous possible uses for old wood. Old-growth timber, especially, is of higher aesthetic quality (higher density, slower grown, fewer defects, etc.) than the lumber produced today, making it very valuable in the marketplace. Typically, prices for salvaged dimensional lumber are set at 50 percent of retail lumber prices. Salvaged timber, because of their large size, can command higher prices depending on the quality, quantity, and species. Remanufacturing can greatly increase the value of salvaged lumber. Pine flooring

30 April 2005

from salvaged timbers commands a high price in the specialty building products market.

Mulch, fuel, particleboard, or fiberboard are other possible end uses for lumber, but these are low-value end uses and should not be considered if high quality lumber is present. Wood fuel markets can also be volatile, with recyclers dependent on the fortunes of one major regional consumer.

Concrete: Waste concrete is the single largest category of demolition waste. Recycled concrete markets remain stable in most regions, although these markets could be spurred on if more states begin to develop specifications for using recycled aggregates in highway applications. Crushed concrete can be used as an aggregate or a base material for fill in the construction of roads, parking lots as well as other applications. More information on concrete recycling is available in the Draft PWTB "Reuse of Concrete Materials from Building Demolition" (30 September 2003).

Brick: Brick can be recovered from old buildings for reuse in exterior construction if it meets current specifications and code requirements. More often, brick is crushed to form aggregate for roadbeds and construction.

Gypsum Wallboard: Scrap drywall can be used by drywall manufacturers, by Portland cement makers (who can accept up to 5 percent gypsum content), and by farmers seeking to enrich the calcium content of their soil. At some facilities, the scrap paper portion of the drywall is added to compost piles. Landfill operators who do not want the unpleasant odors arising from scrap drywall may help spur the gypsum recycling market. So may a movement among state regulators to consider banning the disposal of waste gypsum from landfills.

### **SALVAGE VALUE**

Salvage value is defined as the estimated value that an asset will realize on its sale at the end of its useful life. The salvage value depends on the material's quantity, quality, or condition, and on the type of salvageable building materials removed.

Salvage values fluctuate frequently and may vary significantly based on various economic factors. Whether a waste may or may not be cost-effectively recycled depends on local market conditions. Some areas may not have a market for certain materials, or an installation may not generate enough of a



30 April 2005

particular material to make recycling cost-effective. If no market exists for the material, then Installations may have to pay for removal of some recyclable materials. This could still save money through avoided costs for landfill disposal.

To calculate if salvage is economically worthwhile, estimate the costs associated with demolition and salvage for target materials. Salvage of a material is economically feasible if:

$$\text{Added Costs} < \text{Avoided Costs} + \text{Revenue}$$

Added costs would include the expense of increased time, effort, and possibly equipment associated with removing salvageable material from the waste stream and subsequently preparing it for sale. Estimate avoided costs by determining the quantity (by weight or volume) of each salvageable material diverted from the waste disposal stream. Calculate tipping fees, surcharges, labor, prorated maintenance, hauling fees, permit fees, and generator "taxes" saved by reusing or recycling that quantity of material instead of disposing it. This may or may not be a significant factor, depending on the material.

For example, avoided costs can include reductions in tipping fees. Savings can be realized by less frequent pickups such as once instead of twice per week. The total avoided cost savings can be calculated on a monthly or annual basis.

For each recyclable material, estimate sales revenue. As a rule of thumb, Habitat for Humanity (HfH) estimates the value of salvaged materials to be 50 percent of the new material's retail price. Some items in high demand may sell for more. Used building materials sales outlets may provide price schedules, or may provide receipts itemizing the materials and allow donors to establish their own value. Table A-3 lists representative samples of the value of salvaged materials. These values are for illustration purposes only, and to show the relationship between salvaged and new items. Project cost estimating should be based on actual, current, local values. Note that prices increase for items with special historic or architectural value.

Selling recoverable materials can raise money but may not always be cost-effective because the income from sales will be offset by labor costs and the costs of operating the program. Therefore, before any recycling of a specific material can be officially approved, an economic analysis must be performed for each material considered for recycling.

**Table A-3**  
**Approximate Values of Selected Recovered Materials<sup>2</sup>**

Item	Description	Unit	Estimated Salvage Value
Metals (spot market prices, truckload minimum)	Aluminum Scrap	Ton	\$580
	Brass Scrap	Ton	\$1,500
	Copper Scrap	Ton	\$2,100
	Lead Scrap	Ton	\$640
	Mixed Scrap Iron and Steel	Ton	\$180
Oak Flooring	2-1/4" wide	SF	\$2.00
Framing Lumber	2 x 4 (8'-10')	EA	\$1.50
	2 x 8 (12')	EA	\$4.50
Brick	Flush	EA	25¢
Windows	double glazed replacement	EA	\$50
Doors	36" ext. wood	EA	\$30
Tub/toilet/sink <sup>3</sup>	Cast iron tub/ stainless steel	EA	\$5-\$30
Stair units, treads	Oak treads/ units include stringers	EA	\$25-\$50
HVAC	Ductwork	Ton	\$45

Figure A-2 shows a sample worksheet for performing a recycling economic analysis. A project's performance can be evaluated to determine its success in diverting waste materials from disposal by keeping track of the added and avoided cost plus the revenue generated.

---

<sup>2</sup> Sources: PWTB 420-49-32; Global Recycling Network <http://www.grn.com>; Lowe's <<http://www.lowes.com>>

<sup>3</sup> Note that older toilets may not be reused in some jurisdictions due to low flow requirements.

Installation: _____	Date: _____
Preparer: _____	_____
Location: _____	Tons - Lbs Gal / Yr _____
<b>ESTIMATED ADDED COST</b>	
1. Source separation and material preparation	\$ _____/Yr
a. Equipment (amortize over life of equipment)	\$ _____/Yr
b. Labor	\$ _____/Yr
(1) Procurement (amortize over life of equipment)	\$ _____/Yr
(2) Operations	\$ _____/Yr
(3) Maintenance	\$ _____/Yr
c. Other (materials, supplies)	\$ _____/Yr
Subtotal	\$ _____/Yr
2. Collection and storage	\$ _____/Yr
a. Equipment (amortize over life of equipment)	\$ _____/Yr
b. Labor	\$ _____/Yr
(1) Procurement (amortize over life of equipment)	\$ _____/Yr
(2) Operations	\$ _____/Yr
(3) Maintenance	\$ _____/Yr
c. Other (materials, supplies)	\$ _____/Yr
Subtotal	\$ _____/Yr
3. Program administration	\$ _____/Yr
a. Equipment (amortize over life of equipment)	\$ _____/Yr
b. Labor	\$ _____/Yr
(1) Procurement (amortize over life of equipment)	\$ _____/Yr
(2) Operations	\$ _____/Yr
(3) Maintenance	\$ _____/Yr
c. Other (materials, supplies)	\$ _____/Yr
Subtotal	\$ _____/Yr
<b>TOTAL ADDED COST</b>	\$ _____/Yr

Figure A-2. Recycling Economic Analysis Worksheet

ESTIMATED AVOIDED COSTS AND REVENUE	
1. Savings resulting from reduced volume going to a disposal facility	\$_____/Yr
2. Sales revenue (tons-lb-gal / yr) x (\$ / ton-lb-gal)	\$_____/Yr
TOTAL AVOIDED COSTS + REVENUE	\$_____/Yr
TOTAL ADDED COST	\$_____/Yr
ESTIMATED RETURN (TOTAL AVOIDED COSTS + REVENUE) - (TOTAL ADDED COST)=	\$_____/Yr

Figure A-2. (Cont'd).

If the economic analysis shows promise and the item is qualified, recycling personnel should begin collecting and segregating the material. If the economic analysis is not positive, state solid waste regulations may still require you to recycle. There are other benefits besides the cost savings. A salvage program also benefits the local community. Community members have used recycled lumber to build houses, hunting cabins, garages, sheds, and churches (Weiner). Used building material customers are primarily homeowners, commonly "do it yourselfers." Landlords, arts and crafts artisans, and small business owner/operators are also regular consumers of recycled materials.

#### **MARKETING THE SALVAGED MATERIALS**

Before you begin recycling, familiarize yourself with the local markets. It cannot be overemphasized; researching local markets can make the difference between a demolition with a successful salvage operation that offsets project costs, and a

30 April 2005

unprofitable, costly demolition that stockpiles unwanted materials that cannot be sold for a profit.

Market research is the systematic analysis of sales methods, market area, price trends, merchandising techniques, alternate usage data, and buyer interests for the purpose of improving proceeds (DoD 4160.21-H). Market research involves knowledge of the product, an understanding of the customer, and knowledge of the market. There are different approaches to marketing recovered materials, including:

- Direct marketing to retailers/end users
- Marketing through a materials broker
- Selling at regional or on-line used materials auctions
- Conducting a site sale
- Specifying in new construction or rehabilitation projects.

Commercial salvage and deconstruction contractors recover building materials for resale and reuse, either in their own businesses, or through used building materials outlets. Becoming familiar with potential buyers and learning their supply needs, quality requirements and material handling capability, will help fine tune recycling and salvage to buyer requirements.

Habitat for Humanity (HfH) resells salvaged materials through their "ReStore" network.

Some ReStores reach their customers by advertising in the classifieds in the daily paper and a weekly "advertiser" type paper. Classified advertising is essential to a small-sized store, not only to keep the business name in the public eye, but also to help manage limited space. When the store is tight for space, increasing "short lead time" advertising, such as classifieds or radio ads, can help make more space in the store.

Dealers and brokers act as "middlemen" between the recycling program and the end use. Brokers consolidate then sell the debris to end markets or processors who prepare the debris for end markets by sorting, crushing, grinding, chipping, etc. Brokers have accumulated information about end users and markets for used building materials. Brokers' services will be most useful to contractors working on installations that are small, are geographically remote from end users, have a wide variety of materials, or have fluctuating generation rates (PWTB 420-49-18). Scrap dealers will inspect the materials offered for sale

30 April 2005

and will determine their price based on what they can sell it for, and what they believe their competitors will bid.

High quality salvaged building materials may be used on site for a subsequent construction project by the contractor or government. Under certain circumstances, salvaged materials might be stored on site in preparation for sale elsewhere. The materials can be advertised and made available through materials exchanges or through newspaper advertisements. PWTB 420-49-18, *Direct Sales of Recyclables*, includes information that helps in sales contracting and marketing of recyclables. This PWTB explains the policies and procedures of marketing recyclable materials directly to the private sector.

Understanding the types of markets available is important because it will influence which ones you choose to work with. For example, if the materials generated will not be processed, then you will most likely want to work with a hauler, broker, scrap dealer or processor. If however, the capability exists to sort and/or grind scrap, such as concrete rubble, then you may prefer to work with a processor or end user.

#### **MARKET AREA**

Businesses in the region to be served should be studied to determine the process structures for services that will influence the cost and viability of the recycling program. For example, the relative fees at landfills in close proximity are important factors. It is also important to survey and to understand the region's needs for recycled products. For example, if wood is a plentiful C&D material, the market for virgin and recycled wood chips should be explored. If recycled wood chips are more cost-effective or plentiful than virgin chips, then that indicates a potential market. If virgin wood chips are scarce and high-priced, and it is cost-effective for you to recycle wood chips, then that would also indicate a good potential market.

Along the same lines, if there is going to be new construction taking place after the demolition, plan to use some of the salvaged building materials for that construction project. Concrete, for example, can be crushed and recycled for use as fill or stockpiled for future use on other projects on the installations. Draft PWTB 200-1-XX, *Reuse of Concrete Materials from Building Demolition* elaborates on the uses of recycled concrete from building demolition.

30 April 2005

## **PRICE TRENDS**

Several factors drive the supply, demand and pricing for recovered materials. Six key factors (Fickes) are:

1. **Export Markets**. The Far East, where fiber is in short supply, represents a particularly strong export market for recycled materials.
2. **Virgin Capacities and Recycled Capacities**. When price and availability of virgin commodities change, the price and availability of recycled commodities follows.
3. **Geography**. A West coast generator with access to markets in the Pacific Rim has different opportunities than a generator in the Midwest.
4. **Transportation Costs**. The distance to market plays a role in the pricing of all commodities, whether recycled or virgin.
5. **End Product Demand**. Recycled materials serve three key sectors of the economy: automobiles, housing and retail. When the auto industry booms, so does the steel and plastic industries. When housing booms, business increases for suppliers of steel, paper, plastic and other virgin and recycled materials. Likewise, when retail sales climb, so do paper and plastic packaging material sales.
6. **Natural Disasters Around the World**. When a community begins to rebuild after a natural disaster, demand for recycled materials in all areas spikes up. Hurricane Andrew, which hit Florida's Dade County in August 1992, gives some idea of the enormous waste challenges that natural disasters can create by producing more than six million tons of debris. To manage all this material, county officials tapped into existing recycling and composting programs. From the World Trade Center wreckage in September 2001, 1.2 million tons of debris was produced including about 285,000 tons of steel. Salvage and recycling of the steel and metals would net tens of millions of dollars.

## **MERCHANDISING TECHNIQUES**

### Stimulate Development of Markets for Key Materials

While there are substantial markets for salvaged concrete, metal, and high quality wood, other markets are weak for materials such as drywall, carpet and mixed/composite materials. This presents a significant barrier to the expansion of materials recovery (Gildea). Developing new markets for materials such as small pieces of unpainted wood, roofing materials, drywall, carpet, brick, and other materials common to

30 April 2005

the demolition stream is key to improving recovery rates of these materials. Many of the demolition contractors and developers emphasized the need for technology and market development for C&D materials that are difficult to recover. These materials comprise a relatively large portion of the unrecovered demolition waste stream. Although some do have markets in certain parts of the state, they are generally not recovered for lack of demand.

#### Support and Expand Use of Building Material Resale Yards

One factor that limits the ability of demolition contractors to increase recovery is lack of salvage yards for storing, processing, and marketing reusable building materials. These yards were common until the 1980s when land costs, market competition and other factors made it infeasible for most contractors to maintain their own sites. Competition for high-end materials, labor intensiveness, liability, and availability of cheap new building supplies continue to make resale yards an unattractive business. The companies that survive in this business typically concentrate on the highest quality materials that are already being recovered. State and local government should focus efforts on supporting existing building resale yards through grants, material sourcing and marketing efforts.

Support innovative lead-based paint handling pilot projects: Support technology research and development efforts to develop markets for problem demolition material such as lead-based paint covered wood. Wood with lead-base paint is often considered too expensive to remove and landfill. Enforcement of rules governing removal/disposal of lead-based paint waste is inconsistent from jurisdiction to jurisdiction. Where such rules are strictly enforced, there is less incentive to remove lead-based paint because special testing and landfilling is too expensive. The high-end market for large timbers of specialty woods may be good enough to make lead-base paint removal cost effective. The U.S. Army Corps of Engineers ERDC/CERL along with the FPL have taken a look at some innovative ways to remove the lead-based paint from the wood, and to re-mill the lumber. This technology is considered very effective, despite being very time consuming and too costly to be used on a regular basis. Significant cost savings in landfill fees can be obtained from this process because less waste is generated. However, in some regions, it is usually not cost effective to try to get higher value out of wood with lead-base paint because the market will not absorb the added costs of paint removal, and will not generally accept painted wood.



Provide Information to Planning Departments

The distribution of information on recycling markets and building resale outlets throughout the region will assist demolition contractors to plan jobs, bid contracts, and market materials. As part of this effort, the state should work with the demolition industry to increase awareness. Federal, state and local agency contracting authorities should identify and remove barriers to material reuse and recycling in the language, process and procedures of government contracting.

Provide Demolition Contractors with Information on Reuse and Recycling Outlets

Distribute information to demolition contractors on recycling markets and building resale outlets throughout the state to assist them in planning jobs and bidding contracts. PWTB 420-49-32 provides sources of information for recycling businesses, used materials outlets, materials exchanges, public agencies that promote recycling, and other recycling-related sources. This information is presented state-by-state, to easily identify regional availability of resources and services.

Information about material exchanges can be obtained from local solid waste managers, regional offices of state solid waste management agencies, and waste haulers. Many U.S. Environmental Protection Agency (USEPA) regional websites contain information and website links to materials exchanges within their respective regions as well as website links to national material exchanges. The USEPA website, [www.epa.gov](http://www.epa.gov) is a good source for information on material exchanges.

Other websites contain additional links to regional material exchanges and specific information related to the reuse and recycling of C&D material. Table A-4 lists websites with direct links to material exchanges. Although the list is not exhaustive, it may serve as a good starting point to locate a material exchange near the location of the deconstruction.

**Table A-4  
Materials Exchanges**

Website	Description
California Materials Exchange (CalMAX) <a href="http://www.ciwmb.ca.gov/CalMAX/">http://www.ciwmb.ca.gov/CalMAX/</a>	CalMAX is a free service designed to help businesses find markets for non-hazardous materials they have traditionally discarded.
Environmental Yellow Pages <a href="http://www.enviroyellowpages.com/swix/">http://www.enviroyellowpages.com/swix/</a>	This resource has a list of material exchanges nationwide and worldwide.
USEPA Office of Solid Waste <a href="http://www.epa.gov/epaoswer/osw/">http://www.epa.gov/epaoswer/osw/</a>	Regional EPA websites may have additional information on material exchanges for reusable and recyclable materials locally or in neighboring states.
2 Good 2 Toss <a href="http://www.2good2toss.com/">http://www.2good2toss.com/</a> <a href="http://www.metrokc.gov/hazwaste/imex/">http://www.metrokc.gov/hazwaste/imex/</a>	Washington State Dept of Ecology Reusable Building Materials Exchange
Inter Continental Wood Exchange (IWE) Index <a href="http://www.woodfibre.com/exchange/">http://www.woodfibre.com/exchange/</a> <a href="http://www.woodfibre.com/a/view/wf0380.html">http://www.woodfibre.com/a/view/wf0380.html</a>	The IWE is an electronic information service designed to promote trade in Wood Products & Services by bringing buyers and sellers together using the Internet.
Recycler's World <a href="http://www.recycle.net/">http://www.recycle.net/</a>	Recycler's World is a world wide trading site for information related to secondary or recyclable commodities, by-products, used & surplus items or materials.
Southern Waste Information Exchange (SWIX) <a href="http://wastexchange.org/">http://wastexchange.org/</a>	SWIX has its own national online materials exchange and a list of additional domestic and foreign material exchanges.
Source: <i>Draft Final Summary Technical Report - Material Recovery and Reuse Opportunities During Building Removal Activities</i> , CDRL A010(16 May 2003).	

## **MARKET SURVEY**

Once a number of potential markets have been identified, conduct a market survey to determine which market is right for each of the salvaged materials. Some questions to ask during a market survey are:

- Where is the market located? (Remember, transportation costs can significantly affect the economics of salvage; therefore, the closer the market, the lower the transportation cost.)
- How long has the market been in business?
- Has the market worked with Government agencies like yours before?
- How willing is the market to work with you to achieve quality material? (It may take some time to develop a system to recover clean material in sufficient quantities and of sufficient quality to meet the market's specifications.)
- What additional services, if any, will the market provide? (Will it provide technical assistance, training programs, collection containers, or other assistance?)

Once the market research is complete, narrowed down the list of markets. Some questions that will help you evaluate the practicality of a salvage or recycling program are:

- What are the market's specifications, if any, for the material?
- What happens if the material does not meet the market's specifications? (Is the price reduced? If so, by how much and how are determinations made? Will the material need to be landfilled? If so, who is responsible for transporting the material and who pays the transportation costs?)
- How should the materials be delivered to market? (Who is responsible for transporting the material? Who pays the transportation costs?)
- What quantities are required? (What is the minimum amount of material acceptable? Are there any maximum amount restrictions?)
- In what form should the material be?
- Are there any other requirements related to storing, shipping, and/or handling the material before marketing it?

30 April 2005

- What is the current price for the recovered material? (How often is the price subject to change?)
- What has the price history been for the market? (Is data available showing the prices paid for the last year, 2 years, and/or 5 years?)
- What are the market's price projections in the short and long terms?
- What is the length of the contract offered by the market? (Is it willing to make a long-term agreement to help even out price fluctuations?)

### **SUMMARY AND CONCLUSIONS**

Salvage is a long-established form of recycling and material reuse. The byproducts of demolition are products of society - what becomes obsolete for one person is useful for another, and may therefore be saved or salvaged. While the idea of salvage is not new, building C&D projects pose unique challenges in the area of waste management; each project is different, each generates its own unique combination of wastes. To deconstruct and salvage usable building materials demands flexibility, resourcefulness, and coordination by building professionals and the Army Installation.

This document is designed to:

- Provide a roadmap for the user to identify markets for salvageable materials generated from C&D projects on Army installations.
- Describe the parameters involved in creating a successful marketing plan for salvaged materials
- Provides enough information to start researching and developing a marketing plan.
- To show how to assess current markets and values for a particular building material. (Appendix B includes organizations to contact for additional information regarding the deconstruction of buildings for reuse and recycling.)
- To enable installation managers to make better, more informed decisions about deconstruction to reduce waste volume, lower demolition costs, generate revenue, and to achieve economic and environmental savings through avoiding the cost of disposal by marketing salvageable demolition materials.

APPENDIX B  
ASSOCIATIONS, PUBLICATIONS AND RESOURCES

**American Forest & Paper  
Association**

1111 Nineteenth Street, NW,  
Suite 800  
Washington, DC 20036  
800-878-8878  
[www.afandpa.org](http://www.afandpa.org)

**Asphalt Recycling &  
Reclaiming Association**

#3 Church Circle, Suite 250  
Annapolis, MD 21401  
410-267-0023  
[www.arra.org](http://www.arra.org)

**C&D Recycler**

Subscription Department  
4012 Bridge Avenue  
Cleveland, OH 44113-3399  
[www.cdrecycler.com](http://www.cdrecycler.com)

**The Carpet and Rug Institute**

310 Holiday Avenue  
Dalton, GA 30720  
800-882-8846  
706-278-3176  
[www.carpet-rug.com](http://www.carpet-rug.com)

**Carpet Cushion Council**

P.O. Box 546  
Riverside, CT 06878  
203-637-1312  
[www.carpetcushion.org](http://www.carpetcushion.org)

**Clean Washington Center**

2200 Alaskan Way Suite 460  
Seattle, WA 98121  
206 443-7746  
[www.cwc.org](http://www.cwc.org)

**Construction Materials  
Recycling Association**

P.O. Box 644  
Lisle, IL 60532  
630-548-7530  
630-585-7593 fax  
[www.cdrecycling.org](http://www.cdrecycling.org)

**Habitat for Humanity  
International**

121 Habitat St.  
Americus, GA 31709-3498  
229-924-6935 ext. 2551 or  
2552  
[www.habitat.org](http://www.habitat.org)  
[www.habitat.org/env/restore.html](http://www.habitat.org/env/restore.html)

**Institute of Scrap Recycling  
Industries, Inc.**

1325 G Street, NW Suite 1000  
Washington, DC 20005-3104  
202-737-1770  
[www.isri.org](http://www.isri.org)

**Jobs Through Recycling  
Program**

USEPA  
Office of Solid Waste (5305W)  
1200 Pennsylvania Avenue, NW  
Washington, DC 20460  
[www.epa.gov/jtr](http://www.epa.gov/jtr)

**National Demolition  
Association**

16 N. Franklin Street, Suite  
203  
Doylestown, PA 18901-3536  
215-348-4949  
800-541-2412  
[www.demolitionassociation.com](http://www.demolitionassociation.com)

PWTB 200-1-26  
30 April 2005

**National Association of Home  
Builders Research Center**

4000 Prince George's  
Boulevard  
Upper Marlboro, MD 20772-  
8731  
301-249-4400  
800-638-8556  
[www.nahbrc.org](http://www.nahbrc.org)

**National Recycling Coalition**

1325 G Street NW  
Suite 1025  
Washington, DC 20005  
202-347-0450  
[www.nrc-recycle.org](http://www.nrc-recycle.org)

**Recycler's World**

Help Line: 519-767-2913  
[www.recycle.net](http://www.recycle.net)

**Reuse Development  
Organization (ReDO)**

P.O. Box 47454  
Indianapolis, IN 46227  
317-780-1503  
[www.redo.org](http://www.redo.org)

**Resource Recycling**

Subscription Department  
P.O. Box 42270  
Portland, OR 97242-0270  
[www.resource-recycling.com](http://www.resource-recycling.com)

**Steel Recycling Institute**

680 Andersen Drive  
Pittsburgh, PA 15220-2700  
412-922-2772  
800-876-7274  
[www.recycle-steel.org](http://www.recycle-steel.org)

**USDA Forest Service**

Forest Products Laboratory  
One Gifford Pinchot Drive  
Madison, WI 53705-2398  
(608) 231-9200  
[www.fpl.fs.fed.us](http://www.fpl.fs.fed.us)

**Used Building Materials  
Association**

1702 Walnut St.  
Boulder, CO 80302  
303-440-0703  
[www.ubma.org](http://www.ubma.org)

**Waste News**

Subscription Department  
965 E. Jefferson Avenue  
Detroit, MI 48207-3185  
800-678-9595  
313-446-0450  
[www.wastenews.com](http://www.wastenews.com)

PWTB 200-1-26  
30 April 2005

APPENDIX C  
REFERENCES

Allison, Peter, Jim McQuade, and Stephen Long, "Diverting C&D Debris The Interplay of Policies and Markets," Resource Recycling (December, 2002).

Colley, Sharon, "When Recycling C&D Makes Sense," World Wastes (May 1998), pp 60-62.

Construction and Demolition Site Recycling Guidebook, Illinois Department of Commerce and Community Affairs (1997).

Deconstruction: Building Disassembly and Material Salvage, National Association of Home Builders Research Center (pamphlet/brochure).

Defense Scrap Yard Handbook, DoD 4160.21-H Department of Defense, Defense Logistics Agency (June 1985)

"Diverting Commercial Building Materials," BioCycle (October 1992).

Draft: Closing the Solid Waste Circle: A Combined Services Guide For Qualified Recycling Programs (2 August 2000)

Draft Final Summary Technical Report - Material Recovery and Reuse Opportunities During Building Removal Activities, CDRL A010 (16 May 2003).

Public Works Technical Bulletin 200-1-23, Guidance for the Reduction of Demolition Waste Through Reuse and Recycling (10 March 2003).

Public Works Technical Bulletin 200-1-27, Reuse of Concrete Materials from Building Demolition (30 September 2003).

Falk, Bob, "Wood-Framed Building Deconstruction: A Source of Lumber for Construction?" Forest Products Journal, vol 52, No. 3 (March 2002).

Fickes, Michael, "What's Driving Post-Consumer Material Markets," World Wastes (December 1997).

PWTB 200-1-26

30 April 2005

Fox, Josh, Jill Zachary, and Karin Swarbrick, Constraints and Opportunities: Expanding Recovery in the Demolition Industry, Gildea Resource Center Community Environmental Council (February 1998).

Geller, Lisa, "High-Value Markets for Deconstruction Wood," Resource Recycling (August 1998).

Glanz, James, "Massive Effort Underway To Recycle Trade Center Wreckage," New York Times (9 October 2001), p B13.

Meyer, Kimberley, and Eric Lund, Waste Management and Recovery: A Field Guide for Residential Remodelers (National Association of Home Builders, undated).

Morden, Mark Robert, and Deborah Slaton, "Salvaging Brick," Masonry Construction (October 1990).

Ohio Department of Natural Resources (DNR), Ohio's Secondary Markets for Recycled Materials, available through URL: <http://www.dnr.state.oh.us/recycling/pages/secondary.htm>

"Processing C&D Debris for Markets," BioCycle, vol 39, No. 10 (October 1998) pp 35-6.

Public Works Technical Bulletin 420-49-18, Direct Sale of Recyclables (24 May 2001).

Recycling: The Economical and Environmentally Intelligent Alternative to Landfilling and Incineration (Institute of Scrap Recycling Industries), available through URL: [www.ISRI.org](http://www.ISRI.org)

Turley, William, "A Future for Gypsum Recycling," C&D Recycler (March 2003).

Turley, William, "Building the C&D Recycling Industry," Resource Recycling (February 1999).

Vinyl Siding Recycling: A How-To Guide (American Plastics Council, Inc. 2003), available through URL: <http://www.plasticsresource.com>

Witten, Matthew, "Reuse of Low-End Construction and Demolition Debris," Resource Recycling, vol 11, No. 4 (April 1992).



PWTB 200-1-26  
30 April 2005

This publication may be reproduced