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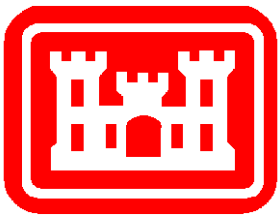
OPPORTUNITIES TO INCREASE CONSTRUCTION AND DEMOLITION WASTE DIVERSION



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FACILITIES ENGINEERING ENVIRONMENTAL

OPPORTUNITIES TO INCREASE CONSTRUCTION AND DEMOLITION WASTE DIVERSION

1. Purpose

a. This Public Works Technical Bulletin (PWTB) provides guidance for increasing construction and demolition (C&D) waste diversion rates and reducing the amount of C&D waste generated in Army demolition, construction, and renovation projects as targeted in Goal 5 of Executive Order (EO) 13514.

b. All PWTBs are available electronically at the National Institute of Building Sciences' Whole Building Design Guide (WBDG) webpage, which is accessible through this link:

http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215

2. Applicability

a. This PWTB applies to installation Directorates of Public Works (DPWs), Public Works Business Centers, Directorates of Engineering, supporting USACE Districts, and other US Army facilities' engineering activities.

b. This PWTB does not apply directly to Residential Communities Initiative (RCI) programs. However, the information included in this PWTB should be offered to RCI partners in support of their C&D waste reduction activities.

3. References

a. Army Regulation (AR) 200-1, “Environmental Protection and Enhancement,” 13 December 2007.

b. AR 420-1, “Army Facilities Management,” 12 February 2008.

c. Memorandum, Office of the Assistant Chief of Staff for Installation Management (OACSIM), “Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities – Supplemental Guidance,” February 2006, revised 11 July 2006.

d. Enclosure to Memorandum from OACSIM of 11 Jul 2006, “Requirements for Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities,” 5 July 2006.

e. Memorandum, OACSIM, “Army Integrated (Non-Hazardous) Solid Waste Management Policy,” 28 Nov 2008.

f. Memorandum, Deputy Assistant Secretary of the Army, Installations and Housing (DASA [I&H]), “Sustainable Design and Development Policy Update (Environmental and Energy Performance),” 27 Oct 2010.

g. Memorandum of Understanding (MOU), “Federal Leadership in High Performance and Sustainable Buildings” (including Guiding Principles), 06 March 2006.

h. EO 13423, “Strengthening Federal Environmental, Energy, and Transportation Management,” 24 January 2007.

i. EO 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” 5 October 2009.

j. Engineering and Construction Bulletin (ECB) 2008-14, “Construction and Demolition (C&D) Waste Diversion – Applicability Information,” Headquarters USACE, 22 April 2008.

k. American National Standards Institute / American Society of Heating, Refrigeration and Air Conditioning Engineers / US Green Building Council / Illuminating Engineers Society (ANSI/ASHRAE/ USGBC/IES) Standard 189.1-2009, implemented by the DASA(I&H) Memorandum of 27 October 10.

l. “Army Vision for Net Zero,” White Paper by Ms. Katherine Hammack, the Assistant Secretary of the Army (IE&E), 10 October 2010.

m. “Department of Defense Strategic Sustainability Performance Plan, FY 2011.” Washington, DC: DoD Senior Sustainability Officer Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L), 2011.

4. Discussion.

a. AR-200-1 contains policy for environmental protection and enhancement, implementation of pollution prevention, conservation of natural resources, sustainable practices, compliance with environmental laws, and restoration of previously damaged or contaminated sites. Chapter 10 includes requirements to integrate the management of waste into construction and demolition (C&D) activities to reuse materials in their original form through disassembly or deconstruction, more careful handling, segregating, and making them available to specialized markets.

b. AR 420-1 provides policies and responsibilities for conduct and management of facilities engineering and environmental support on Army installations. Chapter 16, “Disposal of Real Estate” is relevant with regard to building demolition.

c. The 2006 OACSIM policy memorandum and accompanying enclosure implemented an Army requirement to divert a minimum of 50% of C&D materials from construction, renovation, and demolition projects.

d. The 2008 OACSIM memorandum requires Army installations to take a comprehensive approach to managing all nonhazardous solid waste and incorporate the minimum 50% C&D waste diversion requirement into their Integrated Solid Waste Management Plans.

e. The 2010 DASA memorandum implements Standard 189.1-2009 of the American National Standards Institute / American Society of Heating, Refrigeration and Air Conditioning Engineers / US Green Building Council / Illuminating Engineers Society (ANSI/ASHRAE/USGBC/IES).

f. The Federal Leadership MOU of 2006 and its accompanying Guiding Principles call for federal agencies to implement common strategies for planning, acquiring, siting, designing, building, operating, and maintaining high-performance and sustainable buildings.

g. EO 13423 implements the Guiding Principles of the Federal Leadership MOU, and EO 13514 establishes a federal integrated strategy toward sustainability including efforts to “eliminate waste, recycle, and prevent pollution.”

h. Goal 5 of EO 13514 established targets to divert non-hazardous solid waste, including construction and demolition debris, from the waste stream.

i. ECB 2008-14 provides guidance, clarification, and additional information to meet the ACSIM policy mandating that Army military construction, renovation, and demolition projects achieve a minimum of 50 percent diversion of C&D waste.

j. Ms. Hammack's white paper directs the Army to reduce, reuse, and recover waste streams to convert them to resource values with zero landfill — a true cradle-to-cradle strategy.

k. The Department of Defense Strategic Sustainability Management Plan (SSPP), Sub-Goal 5.3, sets C&D diversion goals of 56% for FY 2013, 58% for FY 2014, and 60% for FY 2015–FY 2020.

l. Appendix A outlines lessons learned from recent Army practices for diverting C&D waste materials from the waste stream during construction, demolition, and renovation projects. Recommendations and supporting resources are also provided for improving C&D materials diversion performance. These recommendations are based on experiences recorded from 11 Army installations subsequent to the issuance of the OACSIM Policy Memorandum of July 2006, as well as input from personnel at Headquarters USACE (HQUSACE), USACE Districts, Installation Management Command (IMCOM), and OACSIM who are involved with construction, demolition, and solid waste management activities.

m. Appendix B provides recent SWAR summary data for C&D waste diversion.

n. Appendix C provides supporting information, such as example contract language and references to other relevant resources.

o. Appendix D is a list of references cited in the Appendix A-D.

p. Appendix E lists previous PWTBs that provide guidance for reducing C&D waste and finding beneficial uses for C&D materials.

q. Appendix F lists abbreviations used in this PWTB. A table of conversions from the inch-pound system of measure to the international system (SI) is also provided.

5. Points of Contact.

a. HQUSACE is the proponent for this document. The point of contact (POC) at HQUSACE is Mr. Malcolm E. McLeod, CEMP-CEP, 202-761-5696, or e-mail: Malcolm.E.Mcleod@usace.army.mil.

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

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FOR THE COMMANDER:

For JAMES C. DALTON, P.E., SES
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APPENDIX A

LESSONS LEARNED AND RECOMMENDATIONS FOR INCREASING C&D WASTE DIVERSION

Background

Economic and environmental burdens associated with landfill disposal of C&D materials are well documented, as are various agency directives aimed at the reduction of C&D waste. In addition, the Army's plan to achieve 25 net-zero Army installations by 2030 should leave no doubt as to the mandate for C&D waste reduction.

Since implementing C&D waste diversion policies, the Army's green building practices, along with the construction industry's practices in general, have progressed significantly. According to Solid Waste Annual Reporting (SWAR) data, Army-wide C&D diversion rates have exceeded the original 50% minimum mandate, and, given current diversion rates, will exceed the 60% SSPP goal for FY 2015-2020. However, this level of performance is not consistent throughout all installations or Army facility programs. Opportunities to improve diversion rates exist because the most successful practices to divert C&D materials are not being applied as broadly as they could be.

The following discussion represents experiences gathered from USACE and installation DPW projects that involve demolition and new construction. The discussion also includes input from DPW personnel at 11 Army installations that represent the largest amount of Military Construction (MILCON), and feedback received from HQUSACE, USACE District, IMCOM, and OACSIM personnel involved with construction, demolition, and waste management activities.

The resulting lessons learned are described and accompanied by recommended practices to improve C&D waste diversion performance. Lessons learned and project experiences are generalized where they are common to multiple installations; thus, specific events or practices are not attributed to individual installations or USACE offices.

Project Type, Location, and Scope

Construction, demolition, and renovation projects of different types and magnitude that are located in different regions within

the United States will entail different opportunities and limitations for waste reduction.

Lessons Learned

- The same C&D waste diversion practices and rates cannot be universally expected among all types of Army construction, demolition, and renovation projects.

- C&D waste reduction efforts have been successful at installations with a substantial MILCON program; the volume of construction attracts the necessary services.

- C&D waste reduction efforts also have been successful at installations near urban areas. In these areas, the salvage, reuse, and recycling services are usually available to participate in MILCON or Sustainment, Restoration, and Modernization (SRM) projects.

- C&D waste reduction efforts have generally been less successful for small construction or remodeling projects that do not generate a significant amount of recyclable or reusable materials. In addition, these smaller projects usually are located in remote areas of the United States that do not have a recycling infrastructure.

Recommendations

Installation and USACE personnel involved with small projects or projects at rural locations should exploit on-post opportunities for materials recycling and reuse to the greatest extent possible. Personnel in those situations should consider taking the following actions.

- Survey organizations on-post for potential use of furnishings, fixtures, equipment, built-in casework and cabinetry, and other removable items that are not already taken by the Defense Logistics Agency (DLA) Disposition Services. Serviceable doors, windows, hardware, electrical and plumbing equipment and fixtures, and other removable and reusable items may also be of use to DPW shops for repair and replacement.

- Consult the state’s solid waste management agency and utilize available resources and information to the extent possible.

- Consult the installation's Qualified Recycling Program (QRP) and DLA Disposition Services for recycling and reuse opportunities.

- Allow contractors to stock recyclable materials on the jobsite until a full load can be generated and hauled. This will save the expense of hauling multiple partial loads. Consult with the state solid waste management agency to avoid violating speculative accumulation regulations.

- Encourage contractors for projects that generate small quantities of reusable or recyclable materials to develop an arrangement to combine waste streams with contractors for larger MILCON-scale projects. While the government cannot require this arrangement, it can be suggested as a means for increasing waste diversion.

Further discussions for regional knowledge opportunities and limitations, along with supporting contractors with information and outreach activities, are given throughout the remainder of this appendix.

Resistance to C&D Waste Diversion Requirements

Resistance to the Army's C&D waste diversion requirements is still encountered in some places. Some Army personnel, construction contractors, and demolition contractors have the perception that recovering or recycling building materials adds to a project's cost.

Lessons Learned

- Acceptance of C&D waste diversion is increasing because both building owners and contractors are adapting to this requirement. Installations and USACE District personnel report that the Army requirement for new construction projects to obtain a Leadership in Energy and Environmental Design (LEED) Silver rating has helped the government, designers, engineers, and contractors to be more conscious of diverting construction materials.

- According to the USGBC, more than 80% of projects submitted for LEED Silver certification achieved at least 50% C&D waste reduction. A vast majority of these same projects achieved more than a 75% reduction in C&D waste.

- Governmental entities are promoting measures to reduce C&D waste. Notable examples include (1) the State of California's law and the City of Chicago's ordinances to divert C&D waste by a minimum of 50%, (2) the Commonwealth of Massachusetts' landfill regulations prohibiting most C&D materials from landfill disposal, and (3) various state, county, and municipal jurisdictions requiring LEED certification on public building projects.

- The Army's experience in C&D waste reduction has been positive. Demolition projects employing deconstruction have achieved more than 90% waste reduction by reusing and recycling materials from obsolete buildings. New MILCON projects have achieved waste reduction rates of more than 90% by recycling construction scrap. Appendix B summarizes recent SWAR C&D waste diversion data.

Recommendation

In the absence of extenuating circumstances, Army and USACE offices responsible for administering construction, renovation, or demolition projects should feel no reluctance to apply the Army's C&D diversion requirement to Operation and Maintenance Army (OMA), Facility Reduction Program (FRP), and MILCON projects. In fact, they should expect that requirement to be met or exceeded.

Cost and Schedule Impacts

There is a lingering perception among some government and contractor personnel that recovering or recycling materials from both demolition and new construction sites incurs a cost with little or no payback. Data from Army private market projects suggest otherwise.

Lessons Learned

- C&D waste diversion activities are difficult to accommodate when introduced to the project after the project's budget and schedule have been established. Any additional perceived cost would have to be compensated by a reduction of project scope, which is highly undesirable. Any perceived schedule slippage is not tolerable, especially when removing existing buildings is involved, as this time will have to be recovered throughout the schedule.

- Once a contract or task order is enacted, the contractor is obligated to perform the task within the agreed-upon cost and completion times. Modifying the contract is possible, but this will typically result in a significantly higher cost. Without a modification, the government would have to appeal to the contractor's goodwill and willingness to try something different to achieve diversion requirements within the established contract scope and compensation.

- The perception of additional cost associated with C&D material diversion is frequently overestimated. The total cost of conventional waste management is typically tenths of a percent of the overall construction cost; even if this amount was increased by some modest proportion, there should not be a major impact on the project's budget. Both private construction and Army experience suggests that C&D waste diversion incurs no appreciable project cost increase, if any. Reduced tipping fees and receipts from recycling should generally reduce any waste management costs.

- The perception of schedule growth associated with C&D material diversion also is frequently overstated. Both private construction and Army experience suggest recycling construction materials incurs virtually no project schedule increase. While deconstruction can take significantly longer than mechanical wrecking, this need not be the case. Deconstruction methods have been developed (e.g., panelizing buildings, tipping buildings) whereby building sites can be cleared in roughly the same time as conventional demolition.

- Demolition schedules, however, are frequently established by the government based on conventional wrecking practices. This duration may be driven by the time it usually takes to remove facilities, rather than future construction requirements or other pressure on the site. Such artificially short completion deadlines may inhibit opportunities for deconstruction or extensive salvage.

- The preferred reuse or recycling scenario occurs where a demolition or construction contractor can use materials recycled from the existing facilities in the new construction, such as recycling concrete into recycled concrete aggregate (RCA) or recycling landscape waste into mulch. A complication is encountered when responsibilities (and cost) for recycling materials is separated from the benefi-

cial use of the materials, (e.g., when the construction contractor is required to recycle concrete into aggregate, but the RCA is used by the installation, not in the project). In that case, the expense is borne by the construction contract, but the benefit is gained by the installation. Therefore, the program that is funding construction is often reluctant to support the recycling cost.

Recommendations

- C&D waste diversion must be addressed at the beginning of a construction or demolition project's planning process. The potential to meet or exceed the minimum 50% C&D waste diversion requirement must be addressed and goals established. Consideration must be given to how the goals will be accomplished (such as through contract and specification provisions, waste management quality control/assurance (QC/QA) practices, disposition of materials, and other issues). The goals should be reviewed as the planning, design, and/or acquisition progress. If cost and schedule impacts are anticipated and identified early in the process, they can be accommodated into budget and schedule development. Project planning processes differ among the Army's various construction and facility removal programs.

- C&D waste reduction opportunities and goals also must be addressed during charrettes for MILCON projects and refined as the project's design progresses. Virtually all Military Transformation (MT) Requests for Proposal (RFPs) have included the option to divert the minimum 50% of C&D materials. Exceeding this rate should be considered wherever feasible. Diverting more than 70% C&D waste is common in MT new construction projects. MT projects have achieved additional LEED Innovation in Design credits for achieving more than 90% C&D waste diversion.

- C&D waste reduction opportunities and goals must be established by the installation's DPW as Minor Construction or SRM projects are being defined, especially when they include removing infrastructure (e.g., buildings, paving, other structures). Task orders or solicitation documents must include a criterion for minimum diversion, and may include a higher diversion rate where feasible.

- Diversion goals should also be established for FRP projects and included in contract requirements administered both at

the installation level and through USACE regional contracts. Consider the structures, materials involved, local opportunities and limitations, and recent project experience. Diversion rates exceeding 50% should be feasible in many cases.

Tipping Fees

Tipping of C&D debris at on-post landfills is free to the contractors but has associated costs to the Army.

Lessons Learned

- Where installations operate C&D landfills, demolition and construction contractors have been allowed free tipping in almost all cases. The full cost of waste management is not included in demolition or new-construction cost analyses. While this exclusion is a perceived economy from a construction perspective, it provides a disincentive for contractors to divert C&D materials.

- Meanwhile, installations must bear the cost of operating, maintaining, and eventually monitoring landfills long-term, even after they are closed. Some installations estimate this cost to be $35–$50 per ton of debris; other estimates are quoted at $1,000,000/acre throughout the landfill's life cycle.

- Furthermore, an installation's landfill capacity is finite and there is a monetary value associated with every cubic yard consumed by debris. Further expansion or construction of new landfills on-post is unlikely. With a few exceptions, closed landfills are lost for any other mission-oriented purposes. Figure A-1 illustrates the adverse impact that landfills have on land use at Army installations.

Figure A-1. Active construction and demolition landfill cell at Fort Hood (left) and closed landfill cells at Fort Lewis (right).

Recommendation

- Installations' DPW personnel involved with Minor Construction or SRM projects must be made aware of the value of existing landfill capacity, costs involved in managing landfills, and the importance of conserving this resource.

- The installation must also impress upon USACE project personnel supporting the installation or administering MILCON projects that their requirements are to reduce the landfill disposal of C&D materials to the greatest extent practical, which may exceed the 50% minimum requirement.

- Per OACSIM Memorandum "Requirements for Sustainable Management of Waste in Military Construction, Renovation, and Demolition Activities" (paragraph 6.h), DPWs may charge the prevailing local landfill rates for tipping at on-post landfills as an incentive for contractors to divert C&D materials.

Knowledge of Local Resources

Businesses and services exist within installations' regions that can be instrumental in reducing C&D waste. However, these businesses and services frequently do not engage in government contracts and thus are not well informed about participating in Army projects.

Lessons Learned

- While installation DPW and USACE personnel are knowledgeable about conventional construction, demolition, and envi-

ronmental services, government and contractor personnel are frequently unfamiliar with available regional resources that can support the Army's C&D waste diversion requirements. This occurs because deconstruction contractors, used building material outlets, timber and lumber brokers, and other nontraditional resources typically do not engage in public projects, especially federal or military solicitations. Furthermore, such services do not always perform general contracting work; rather they work as subcontractors to others. As subcontractors, they would be unlikely to respond directly to USACE or Army solicitations.

- Installation DPW and USACE personnel are sometimes reluctant to seek support from state-level departments of environmental protection or quality. The traditional relationship between state environmental agencies and installations has been that of regulator vs. regulated. By not engaging state agencies, however, installations cannot take advantage of the agencies' constructive contribution to the installation's C&D diversion requirements.

- Installation DPW and USACE personnel are sometimes reluctant to initiate conversations with contractors or nontraditional resources (such as Habitat for Humanity) as they fear an impression of selective communications or preferential treatment may be given, which may compromise the integrity of a procurement action. While preferential treatment is not appropriate, an unnecessarily cautious posture can prevent the government from obtaining necessary information about industry capabilities.

- Without a working knowledge of deconstruction, salvage, recycling, and used building materials infrastructure, government personnel may underestimate the potential for C&D materials diversion and therefore the potential value or costs involved. This under-recognition of values can lead the government to accept unnecessarily high bids or price proposals. It can also lead to allowing the contractor to underachieve their diversion performance; diverting only the minimum, most easily recyclable materials; and not making an effort to extract all the value available.

- Insufficient knowledge of local industry can also result in the government specifying and expecting unrealistically high diversion rates for specific project conditions. This expectation can lead to inflated bids or price proposals,

lack of participation in the procurement, or conflict in the field as the work commences.

- Although the QRP and DLA Disposition Services missions are to recover and recycle equipment and materials, they are rarely used as outlets for C&D materials.

Recommendations

DPW Environmental Division solid waste management personnel are normally familiar with conventional municipal solid waste (MSW) recycling resources available in the region, as are installation QRP personnel.

- Personnel can seek further information about building and construction materials reuse and recycling services from the following resources.
    - State, county, and local solid waste management agencies. Many states also maintain web-based recycled materials exchange and brokering services.
    - The WBDG Construction Waste Management Resource Page (http://www.wbdg.org/resources/cwmgmt.php) and Construction Waste Management Database (http://www.wbdg.org/tools/cwm.php)
    - Construction Industry Compliance Assistance Center, C&D Debris State Resources, State Resource Locator (http://www.cicacenter.org/solidregs.html) and C&D Recycling (http://www.cicacenter.org/cdrecycling.html)
    - Building Materials Reuse Association's directory of deconstruction, material reuse, and used building materials businesses (http://www.bmra.org/listings/directory-map)
    - Construction Material Recycling Association directory of C&D recycling businesses (http://www.cdrecycling.org/find.html)
    - Habitat for Humanity ReStore Directory: (http://www.habitat.org/cd/env/restore.aspx)
    - Associated General Contractors of America Recycling Toolkit (http://www.agc.org/cs/recycling_toolkit)

  - IRN The Recycling Network (formerly the Institutional Recycling Network) one-stop recycling (http://www.ir-network.com/)

  - On-line building materials exchanges include, among others: Planet Reuse (http://www.planetreuse.com), Construction Materials Depot (http://www.cmdepot.com), American Builders Surplus (http://www.americanbuildersurplus.com), and Reuse Alliance (http://www.reusealliance.org)

  - Several other state, county, and local directories or guides that are cited in the WBDG Resource Page (http://www.wbdg.org/resources/cwmgmt.php)

- Both DPW and USACE engineering and construction personnel involved with new construction, demolition, and remodeling projects should consult with the installation's solid waste management offices and the relevant C&D materials reuse and recycling resources to ensure they are knowledgeable about the availability of services, capabilities, and limitations of the C&D diversion infrastructure in their region. This information, and consensus among the stakeholders, will be necessary to establish reasonable C&D diversion goals and apply (i.e., enforce) reasonable C&D diversion criteria to project requirements.

- DPW and USACE project personnel should consult with installations' QRP to identify opportunities for recycling construction scrap and demolition materials. Once the QRP identifies materials acceptable to them, disposition of these materials with the QRP can be included in the project's contract provisions or specifications as an option for the contractor. While contractors will not be paid for depositing materials with the QRP, doing so may be more convenient than hauling these materials off-post. All materials deposited with the QRP must be documented for LEED and/or SWAR recording purposes. Metal buildings shown in Figure A-2 were sold through Fort Hood's QRP.

- Note that EO 13514 and the DoD SSPP provide different metrics for the division of Non-Hazardous Solid Waste (NHSW) and C&D waste. Therefore, each type of waste must be recorded and reported separately. Any C&D materials that may be delivered to and sold through the QRP must be reported as either NHSW or C&D waste diversion; they cannot be reported as both. Care must be taken that the QRP maintains

separate weights for these waste categories and also reports revenues separately for each type of waste.

Figure A-2. Metal buildings were sold for deconstruction through the Fort Hood Qualified Recycling Program.

- For demolition projects, DPW and USACE project personnel should also consult with the DLA Disposition Services as a potential outlet for real property (e.g., building) components and products that are removable and in serviceable condition. These items may include equipment, architectural specialties, institutional casework and finishes (such as carpet tiles or integrated lighting and ceiling systems), and other marketable products. Project personnel should develop an inventory of items that may be available and, with Disposition Services, determine what documentation is appropriate to enable transfer from the contractor to Disposition Services. If agreeable to DLA personnel, disposition of these items with the DLA can be included in the project's contract provisions or specifications as an option for the contractor. These provisions must include any DLA Disposition Services requirements (e.g., documentation, condition, packing or handling, drop-off).

C&D Diversion Minimum

Achieving the minimum C&D waste diversion criterion is sometimes perceived as a *pro forma* exercise. With that perception, once minimums are achieved, then no further efforts are devoted to more significant waste reduction.

Lessons Learned

- Government personnel administering construction, demolition, or renovation projects frequently treat the 50% minimum criterion as a fixed criterion. They establish that value in contract language or specifications and are satisfied once that criterion is met.

- Contractors tend to select materials that are the easiest to recycle and achieve the minimum requirements by weight (typically with concrete and metals). They frequently ignore the potential of other salvageable items (e.g., equipment, fixtures, and architectural components, lumber and timber framing), even though these items are still serviceable, marketable, and contribute significantly to debris volume when landfilled. Figure A-3–Figure A-6, respectively, illustrate some recoverable architectural, plumbing, mechanical, and electrical items that are typically wasted through a conventional demolition (or “wrecking”) process.






Figure A-3. Left to right, top to bottom: windows, doors, vinyl siding, custom-grade Douglas Fir siding, ceiling tiles, and antique tongue-in-groove flooring that were recovered for reuse from buildings at Fort Campbell, Fort Carson, and Fort Lewis.

Figure A-4.Plumbing fixtures recovered for reuse from builidngs at Fort Lewis.

Figure A-5. Mechanical equipment recovered for reuse from buildings at Fort Campbell and Fort Carson.

Figure A-6. Electrical components recovered for reuse from buildings at Fort Carson.

- The USACE FRP Base Performance Work Statement (PWS) addresses the OACSIM Policy Memorandum for 50% reduction of C&D waste materials. In that Base PWS, a superior perfor-

mance metric for Quality is defined as exceeding milestones and deliverables but does not address C&D waste reduction. The superior performance metric for Compliance and Conformance is meeting standards, which would include the OACSIM diversion requirement by inference but does not address exceeding that performance.

- Hauling comingled debris to a C&D recycling facility does not (in and of itself) constitute recycling or satisfy a specified minimum waste reduction criterion; thus, it is not an accurate representation of waste reduction. Some C&D recycling facilities may actually separate and send as little as 15% of the materials they receive to recycling outlets.[1] The actual diversion rate for demolition debris or construction scrap is a function of the quantity of materials actually sent to recycling outlets, not simply the quantity of materials hauled to the C&D recycling facility. Figure A-7 shows mixed C&D deposited at a C&D recycling facility, not all of which will actually be recycled.

Figure A-7. Mixed C&D debris deposited at a C&D recycling facility.

1 Conversation between Mr. Tom Napier, ERDC/CERL Research Architect and Mr. William Turley, Executive Director Construction Materials Recycling Association (CMRA), 9 January 2012. Note that CMRA has developed draft versions of a Certification of Recycling Rates (CORR) program that aims to verify recycling rates for authorities that are requiring diversion.

- The primary outlet for C&D wood materials is hog fuel boilers (boilers that can burn combination wood). Note that Army policy does not count incineration as diversion. Other materials that are not sent to recycling outlets are commonly used as alternate daily cover at landfills. Figure A-8 shows C&D wood shredded for boiler fuel.

Figure A-8. Lumber debris shredded for boiler fuel.

Recommendations

- The OACSIM Memorandum establishes a minimum of 50% nonhazardous C&D waste materials to be diverted from landfill disposal; however, there is nothing to prevent requiring a higher diversion rate where practical. Where an installation DPW has a record of routinely achieving higher C&D waste diversion rates, a minimum rate higher than 50% should be specified.

- Where new construction or building removal is performed under a PWS, superior performance metrics should include exceeding the minimum 50% C&D debris diversion.

- Diligent development of a C&D waste management plan by the contractor, and critical review by the government prior to issuing a Notice to Proceed should ensure services and resources in the region are being applied to the project and the maximum diversion rate practical will be achieved. Diligent observation and documentation by both parties

throughout the project should ensure that actual diversion matches the approved C&D waste management plan.

- When C&D materials are taken to a C&D recycling facility, the government's contract provisions and specifications for C&D diversion data should require documentation of the actual amount of materials sent from the C&D recycling facility to material recycling outlets, not simply the quantity of materials hauled to the C&D recycling facility. C&D recycling facilities commonly provide these data upon request.

Hazardous Materials

The presence of hazardous materials commonly found in buildings is frequently perceived to be an obstacle to materials recovery, reuse, or recycling, although not necessarily an obstacle to wrecking and landfill disposal.

Lessons Learned

- In most cases, asbestos-containing materials (ACMs) and other hazardous materials should have no impact on building removal methods. ACM and other hazardous materials such as mercury in fluorescent lamps, thermostat ampoules, motor switches, other equipment, and polychlorinated biphenyls (PCBs) will be removed prior to demolition (or deconstruction or salvage), and the building will be cleared for occupancy. Thus, ACM and hazardous materials should ordinarily have no impact on building removal methods.

- The installation DPW frequently contracts for abatement independently of and prior to demolition or deconstruction. Inaccurate and incomplete hazardous materials surveys result in incomplete removal of ACM and project delays when the ACM is discovered during demolition or deconstruction activities. Demolition or deconstruction must stop until the undiscovered ACM is abated. Figure A-9 illustrates cement asbestos siding removal prior to deconstruction.

Figure A-9. Hazardous material removal (cement-asbestos siding), prior to deconstruction at Fort Lewis.

- Where states allow non-friable ACM such as floor tiles or mastics to remain in a building during demolition, the presence of these materials can affect the potential to recover materials for reuse or recycling. In a wood-frame building, for example, vinyl asbestos floor tiles would have to be removed in order to remove the subfloor and floor joists. Otherwise, they could not be removed without disturbing the floor tiles, which would violate occupational safety and air quality regulations.

- Where ACM remains in a concrete building during demolition, or ACMs are missed on the hazardous material survey and not abated, the ACM will contaminate the concrete debris and render the rubble unsuitable for recycling into aggregate.

- The presence of lead-based paint (LBP) is frequently perceived to be an obstacle to salvaging materials for reuse or recycling. Siding materials on wood-framed buildings frequently have high concentrations of lead, and this is perceived to be the case throughout the building, as illustrated in Figure A-10. In most cases, however, floor, roof, and often wall framing have never been painted and are therefore not LBP-contaminated. Figure A-11 illustrates the quantities of unpainted framing materials available in many WWII-era buildings. Interior paints typically have much lower concentrations of lead and often do not suffer the flaking and detachment of exterior materials. If the exte-

rior material's lead concentration is high enough, the mechanical wrecking and co-mingling of the building's debris may render the whole content as hazardous waste.

Figure A-10. Exterior siding painted with lead based paint at Fort Carson.

Figure A-11. Unpainted framing lumber at Fort Campbell (above) and Fort Gordon (below).

- No federal-level regulation prohibits the removal, resale, and reuse of building materials coated with LBP. The US Environmental Protection Agency (USEPA) and Department of Housing and Urban Development (HUD) define LBP in target housing and child-occupied facilities as a hazard where

paint dust is generated by friction or impact (e.g., windows and doors) and as deteriorated paint that is detached from the surface and available for ingestion by children (EPA 2001). Thus the paint is not defined as a hazard if it is in good condition and is not subject to friction or impact. The definition of paint applies to facilities in which young children will be present. Further information is available on regulatory and policy issues related to reuse of LBP (Napier et al. 2005).

- Manual removal of LBP-coated items (as in a deconstruction and salvage scenario) is often perceived as increasing the occupational hazard to personnel. According to the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard and Lead in Construction Standard (29 CFR 1910.1200 and 29 CFR 1926.62), workers must be notified of the presence of lead. Workers must be protected under an assumption that a maximum hazard is present until a lower level of hazard is proven. The Army experience (which is shared by the deconstruction industry) is that both ambient and personal air monitoring during the Part 62 Negative Assessment analyses shows that most frequently, airborne lead is at non-detectable levels. Figure A-12 shows deconstruction workers with respiratory protection during negative assessment analysis, then post-negative assessment analysis.

Figure A-12. Deconstruction workers during negative assessment (left, note personal air-monitor pump worn on belt) and following the negative assessment (right).

- Air monitoring, negative exposure analysis, and personal protective equipment are rarely seen during mechanical demolition of LBP-coated World War II-era (WWII) buildings. However, valuable, high-quality wood from these buildings is often destroyed and landfilled because of LBP concerns. By contrast, both research and practice have shown that the LBP can be safely removed, and the materials can be reused or remanufactured into higher-value materials. Residual lead remaining in the wood materials is very low; in fact, much lower than the 600 parts per million (ppm) allowed in contemporary “lead-free” paint. For further information on removal of LBP from wood siding, see ERDC/CERL TR-06-30 (Falk et al. 2006).

- The presence of LBP on reinforced concrete buildings is often perceived to render the concrete unsuitable for recycling and use as aggregate. Research shows that very low concentrations of lead are found in RCA materials, lead in dust can be effectively controlled during the recycling operations, and the tendency of lead to migrate in water and soil is extremely low (Cosper 2010). Figure A-13 shows a concrete building with lead-based paint. Figure A-14 shows that same building recycled into pavement base.

Figure A-13. Reinforced concrete building painted with lead-based paint at Fort Jackson.

Figure A-14. Concrete from lead-based painted building was recycled as pavement base at Fort Jackson.

- Currently, much confusion surrounds the USEPA's Renovation, Repair and Painting (RRP) Rule (EPA 2008) and how it applies to demolition, deconstruction, and salvage for reuse or recycling. The rule's intent is to prevent airborne lead contamination of target housing and child-occupied facilities; thus, the RRP Rule does not apply to removing buildings (regardless of the removal method) because they will no longer be occupied structures.

- The RRP Rule does apply to remodeling in target housing or child-occupied facilities, whether items are removed or not, and if removed, whether they are salvaged, reused, or landfilled. The subsequent transfer, resale, or reuse of salvaged materials is outside the scope of the RRP Rule. Again, the RRP Rule does not apply to facilities that are not target housing or child-occupied; therefore, it does not inhibit salvage and reuse or recycling of building materials in a building-removal scenario.

Recommendations

- Occupational safety plus health and public safety must remain high priorities when applying C&D waste diversion requirements. Conformance to the prevailing safety regulations must be required regardless of the building

construction, demolition, or remodeling activities and regardless of the Army programs under which these activities are funded and administered.

- Removal of hazardous materials should proceed in a similar fashion to conventional demolition projects; this action should have no impact relative to the Army's C&D diversion requirements.

- Removal of all ACM prior to demolition or deconstruction is recommended, even if state regulations allow nonfriable ACM to remain. Removing all ACM will increase the potential yield of material for salvage, reuse, and recycling.

- Asbestos surveys must be conducted in a thorough manner to prevent undocumented ACM and materials from being landfilled that would otherwise be suitable for salvage, reuse, and recycling.

- Salvaging wood components from WWII-era wood buildings is permissible and provides an opportunity to increase C&D diversion performance. Lead-safe practices should be addressed in project contract requirements and specifications. Figure A-15 illustrates lead-based painted, tongue-in-groove siding salvaged for reuse.

Figure A-15. Painted siding materials salvaged for reuse at Fort Carson.

- The government should provide a statement disclosing the possible presence of LBP to any party removing painted materials from installation property, as well as appropriate handling, safety, and health provisions. Example language can be found in PWTB 200-1-23, which is available online (see Appendix E).

- The government should continue applying OSHA provisions for protection against lead hazard to workers and EPA RCRA regulations for hazardous levels of lead in demolition debris in construction, renovation, demolition and deconstruction projects.

Landscape Demolition

Landscape materials can be reused and recycled.

Lessons Learned

- Live bushes, shrubs, and ornamental materials have been salvaged and replanted elsewhere on-post, as illustrated by Figure A-16.

Figure A-16. Replanted landscape materials at Fort Lewis (USACE Seattle District).

- Contractors have recycled landscape demolition materials (green waste) into mulch and compost. If green waste is shredded for mulch and/or compost during the clearing and

grubbing phase on a new construction project, it can usually be applied during the landscaping phase.

- DPWs at some installations collect green waste for composting and routine landscape maintenance; in addition, these DPWs also accept new-construction green waste materials.

Recommendations

- Where the available amount of landscape material is sufficient at a new construction site, the contractor should be allowed and even encouraged to incorporate it into the work as a landscape material. If space on the jobsite is limited, the installation could offer the contractor space nearby, if available during the project. Contract provisions and specifications must address the conditions in which the contractor can use this space, including the requirement to clean and restore it to its prior condition. Even though USGBC does not offer credit for recycling green waste under MR 2.1 (Materials and Resources Credit 2.1, Construction Waste Management: Divert 50% from Disposal), this opportunity should not be ignored, if at all possible.

- If the amount of green waste coming from the jobsite is not worthwhile to reuse in a single project, the contractor should be required to deposit green waste at the installation’s wood recycling yard. This requirement must then be included in the contract provision or specification.

Recycling Asphalt/Brick/Concrete

Recycling asphalt/brick/concrete (ABC) rubble on-post for use on-post is an economical method of reducing waste as well obtaining materials for other DPW uses.

Lessons Learned

Installation DPWs indicate they can use all the aggregate products that can be produced from pavement, infrastructure, and building demolition. Two frequently cited uses of these materials on ranges for trails and erosion control. Similar in-house markets should exist on most installations.

- Concrete that is free from collateral debris is the highest quality, most useful source for higher grade recycled aggregate. Comingled concrete debris is more difficult to

process and results in lower grade recycled products (Figure A-17).

Figure A-17. Clean (left) and comingled (right) concrete rubble (Photo on the right by Wilmot Associates).

- Brick also can be salvaged for reuse. Solid brick or "Chicago-style" antique brick is valuable in specialty markets. Contemporary brick with cores is not especially valuable in the marketplace, although it may be useful for repair or replacement on-post. Otherwise, brick can be recycled as fill or incorporated into engineered fill as illustrated by Figure A-18. Brick can also be crushed as a landscape material or groundcover on-post.

Figure A-18. Mixed brick and concrete rubble (left) recycled into engineered fill (right) at Andrews AFB.

- Asphalt can be recycled into new hot-mix asphalt pavement, or used for cold patch, temporary surface cover, or erosion or dust protection, as illustrated by Figure A-19.

Figure A-19. Asphalt paving segregated for recycling at Andrews AFB.

- Some installations collect concrete rubble at their landfill sites and contract for periodic crushing services to produce aggregate as specified by installation DPW (see Figure A-20). This practice has proven to be an economically viable method for diverting concrete and recovering reinforcing steel to recycle as scrap. On one occasion, however, some metal scrap remained in the aggregate product. This problem was remedied with appropriate equipment selection in subsequent contracts.

Figure A-20. Fort Campbell's concrete recycling operation.

- Contractors frequently recycle concrete on their own initiative for economic purposes. On one occasion, a contractor leased property adjacent to the installation, set up a temporary recycling operation, and successfully reused demolition concrete in the same project, as shown in Figure A-21.

Figure A-21. Contractor's concrete recycling operation and recycled concrete aggregate product adjacent to Fort Campbell.

- On another occasion, the contractor attempted to recycle demolition concrete within the new building's footprint. The recycling equipment selected by the contractor was of insufficient capacity to perform the task, and the recycling operation delayed the project. The government waived the diversion specification to prevent further delays.

- Some problems have occurred with separating reinforcing steel from concrete rubble. Equipment of insufficient capacity or power has been applied to crushing operations. Difficulty in recycling typically results in the concrete and reinforcing steel materials being landfilled.

- If demolition and recycling are contracted independently, and demolition specifications did not include dimensional parameters for the rubble, it may prevent subsequent crushing and recycling by others. Specifically, long pieces of reinforcing bar can accumulate in hoppers and form large balls of rebar, as shown in Figure A-22.

Figure A-22. Tangled reinforcing bar that resulted from improper sizing of concrete debris prior to recycling and under-capacity equipment selected by the contractor (Photo by Wilmot Associates).

- USACE and installation DPW personnel are frequently at odds when the expense of recycling concrete rubble would be borne by one party, but the benefit of using the RCA is accrued by another party. This may happen when a MILCON project's requirements require recycling, the materials are not used in the project, and the installation receives "free" aggregate materials. Conversely, USACE personnel may consider offering the contractor government-furnished RCA, which was produced at DPW expense. Opportunities to recycle concrete may be lost if the parties cannot resolve the funding vs. benefit issue.

- The presence of LBP on reinforced concrete buildings is often perceived to render the concrete unsuitable for recycling and use as aggregate products. In fact, very low concentrations of lead are found in RCA materials (refer to "Hazardous Materials" subsection above). Concrete that has been painted with LBP should generally be appropriate for recycling into aggregate.

Recommendations

- The preferred scenario for recycling concrete from demolition is to recycle the concrete at or near the new construction site and reuse the RCA products in the new construction. When this can happen, the contractor selects

demolition and recycling methods and equipment. The government should not direct these methods. However, the government can and should review the contractor's proposed process prior to issuing a Notice to Proceed for demolition and ensure that the process, equipment, logistics, and reuse of the RCA materials are appropriate, will be consistent with the project schedule, and will satisfy the engineering requirements of the aggregate products. Both the expense of recycling concrete and the beneficial reuse in the project are the contractor's responsibility.

- On-post uses of RCA should ensure a high rate of concrete recycling in most cases. Installation DPW and USACE personnel involved with concrete pavement, building, and infrastructure demolition should survey all installation agencies for their aggregate, rip-rap, erosion control, and similar requirements. DPW personnel responsible for crushing concrete rubble on-post should include specifications for RCA products that are most useful to the installation's aggregate product requirements. Figure A-23 shows RCA end product and reinforcing steel recovered from crushing concrete.

Figure A-23. Recycled concrete aggregate ready for use (left) and recyclable steel reinforcing (right) at Fort Campbell.

- Concrete rubble generated through the various SRM activities should be taken to a designated location on-post for recycling. This location is typically at the installation's landfill site. The DPW (typically the Environmental Division) contracts for concrete recycling services on a peri-

odic basis (typically 90 days) or the period needed to remain in compliance with the state's regulations for speculative accumulation of debris materials. A sample contract is included in Appendix B of this PWTB.

- Where RCA from building demolition within a MILCON project cannot be used in the new construction, concrete rubble should be taken to the installation's concrete recycling location.

- Where concrete demolition and recycling will be accomplished under independent contracts, the demolition specification must include criteria for the concrete rubble. Concrete rubble must be free from other collateral building materials such as wood, fibrous materials, and plastics that will contaminate the RCA product. Other inert materials may or may not be tolerable in the RCA product, depending on its intended use. Separating out bricks and concrete masonry may also be necessary prior to recycling. Ferrous metals can be separated out by recycling equipment. Concrete rubble should, ideally, be broken into pieces no larger than 2 x 2 x 5 ft, with rebar protruding no more than 1 ft in any direction.

- The installation's DPW and USACE personnel should not be reluctant to use, or allow contractors to use, RCA from LBP-coated concrete buildings as base, fill, trails, parking, or other uses because of fears of lead migration.

In Appendix E (Resources), further information about RCA and LBP concerns can be found in ERDC-CERL TR-07-2 and TR-10-1; further guidance for recycling concrete from buildings is found in PWTB 200-1-27.

Recycling Metals

Recycling metals is standard practice within the demolition industry.

Lessons Learned

- Contractors typically separate metals from demolition projects to haul separately for recycling. Construction trades usually generate metal scrap in a homogeneous manner, segregating it as it is incorporated into the work. Keeping metals segregated may be a challenge, so the workforce must be trained to prevent comingling and contamination. Figure

A-24 illustrates metal segregated for recycling from new construction and demolition sites.

Figure A-24. Metal scrap segregated for recycling from new construction at Fort Campbell (left) and deconstruction at Fort Carson) (right). (Photo on the left by Wilmot Associates.)

- Alternately, contractors may subcontract waste hauling services that provide separate receptacles for metals and other recyclables (Figure A-25).

Figure A-25.”Metal Only” receptacle for recycling (Photo by ReNu Recycling Services).

- Segregating metals by type on-site (copper, brass, aluminum, ferrous, other miscellaneous metals) will accrue the highest scrap prices, and comingling metals will reduce the price recyclers are willing to pay. Contaminating metals with other debris will further reduce the value of metals

for recycling. While it is not the government's responsibility nor is it good practice to direct the contractor in their metal recycling methods, the government should maintain awareness of metal values and ensure bids or price proposals represent the highest recycling value practical for the project. The DPW solid waste manager and/or QRP manager are usually knowledgeable about the metals recycling market. USACE project personnel should consult with installation solid waste and QRP personnel.

- Contractors typically survey buildings for metals and incorporate the anticipated receipts from recycling into their cost estimating and bidding strategy. Thus, contract disputes have been encountered where metals have been removed from vacant buildings between the time when prospective contractors perform their site surveys and when they begin work. Such disputes can result in claims for lost value of the missing recyclable materials.

Recommendations

- There is no reason metals from either demolition or new construction projects should not be recycled.

- While the government should not direct the contractor's recycling practices, the government should be knowledgeable of the metals recycling market and should be vigilant that offerors or proposers are representing the greatest practical value in building removal bids.

- DPW personnel should secure vacant buildings to prevent theft of recyclable materials, preserve the value to the contractor, and avoid contract modifications and claims.

Recovering Wood Materials

The value of lumber and timber materials is frequently not well known to government or contractor personnel. Opportunities for significantly increased waste diversion with wood building demolition projects are frequently missed.

Lessons Learned

Lumber and timber from wood buildings (WWII-era wood buildings being of special interest to the Army) can be recovered for reuse or recycling. Wood-framed buildings lend themselves to disassembly. Lumber and timber members, if removed intact, lend themselves to reuse.

WWII-era buildings, especially in the western part of the United States, were typically built with framing and siding of old-growth Douglas fir. In addition, redwood was sometimes used for siding. These are high-quality woods that are no longer available in the marketplace and can command high prices on the resale market (see Figure A-26). Their market includes their use as feed stock for architectural millwork or as framing materials for upscale timber-framed homes. Figure A-27–Figure A-29 illustrate some reuse applications.

Figure A-26. Redwood siding removed from buildings at Camp Roberts for reuse (left) and double 2-inch X 12-inch X 16-foot old growth Douglas Fir floor joists removed from buildings at Fort Carson for reuse.

Figure A-27. Custom-grade, Douglas Fir siding from buildings at Fort Ord remanufactured into antique flooring (upper) and furniture (lower).

Figure A-28. Custom-grade Douglas Fir siding from Fort Lewis (left), used for historic building restoration near Seattle.

Figure A-29. Timber-frame home built with salvaged lumber near Badger Army Ammunition Plant.

- The value of lumber is frequently ignored by both the contractor and government personnel. As a consequence, valuable lumber and timber are being destroyed during demolition and deposited in landfill or recycled for boiler fuel or mulch. Recovering lumber and timber for reuse is often perceived as an additional effort with little payback (see Figure A-30).

Figure A-30. Solid 12-in. x 18-in. x 24-ft Douglas Fir columns destroyed by wrecking at Fort Ord (left) and FRP demolition at Fort Polk (right)(Photo on the right is by USACE Huntsville Engineering Support Center).

- The market for salvaged lumber is often difficult to assess. Therefore, the effort to recover and store lumber for reuse is perceived as a risk by the contractor. Conventional demolition contractors typically have not developed a business model that includes handling and marketing materials subsequent to the demolition project itself.

- Deconstruction of WWII-era wood buildings has been performed successfully, economically, and efficiently on Army installations. Panelizing and disassembling larger components away from a building’s footprint, in contrast to a stick-by-stick disassembly, is one method of reducing the labor expense and project duration. Stripping the siding and shear walls and then tipping the building is another. This latter method has the advantage of enabling work at ground level, avoiding the hazard of working at elevation. Figure A-31–Figure A-33 illustrate deconstruction by panelizing and tipping.

Figure A-31. Panelized deconstruction at Fort Lewis.

Figure A-32. Inverting a barracks floor deck for "upside-down" disassembly at Fort Lewis.

Figure A-33. Tipping a physical fitness center at Fort Lewis and a barracks at Camp Roberts for on-the-ground disassembly.

Troop units can provide an outlet for wood material taken from WWII-era wood buildings. In past Army deconstruction projects, troops have requested materials for use in field exercises for constructing targets and range structures. Using scrap lumber avoids the necessity of purchasing new materials for these projects. DPW-maintained Self-Help projects are another popular outlet for scrap lumber. For example, landscape materials and lumber were donated from one deconstruction project for use in the installation's Warriors Transition Program. Figure A-34 illustrates on-post outlets for used building materials.

Figure A-34. Deconstruction lumber used for troop construction training at Fort Lewis (left) and deconstruction scrap wood offered to Fort Carson personnel.

- Lumber members that are damaged or unsuitable for reuse can be crushed for mulch or erosion control. Incorporating lumber scrap into compost may or may not be feasible depending on the proportion and moisture content of the scrap lumber. For example, demolition wood debris, pallets, and other older wood products are usually too dry and too hard to incorporate into compost.

- Agreement is not universal that recycling of composite wood products with resins (e.g., plywood, oriented strand board, engineered wood products) is appropriate for either mulch or hog fuel. C&D recycling facilities will typically discard these products as waste.

Recommendations

- Installation and USACE project personnel should canvass the local market for services and market outlets instrumental to the successful diversion of lumber and timber from the removal of wood-framed buildings. While the government cannot assign either subcontractors or services to a contractor, helping contractors to learn to achieve the Army's objectives is completely appropriate. These types of outreach activities are discussed in more detail in subsections of this report entitled "Knowledge of Local Resources," (A-8) and "Project Delivery and Contract Provisions," (A-46).

- Project personnel must become familiar with the regional recovered lumber and timber markets and the potential value of lumber and timber materials available from a building removal project. Project personnel must then ensure bids or price proposals are reasonable given the potential to recover lumber and its value. Knowledge of recovered lumber and timber markets will also help government personnel assess whether the proposers or contractors are putting forth a legitimate effort to divert as much material as reasonable for the project when reviewing and approving contractors' C&D Waste Management Plans.

- The installation should canvass troop units for potential uses of salvaged wood materials, such as Self-Help projects, target and range structures, or special purposes such as rehabilitation projects for Warrior Transition Program projects. Where these opportunities are present, they should be identified to building removal contractors as potential outlets.

- As part of the government's contractor QC requirements, the disposition of wood demolition materials and construction scrap must be included and documented. Likewise, the government's QA process must verify the appropriate reuse and recycling of wood materials. Wood that is recycled as hog fuel cannot be counted as waste diversion.

- Consideration should be given to selling WWII-era wood buildings to the public for deconstruction and salvage. This building removal method has been successfully applied by four major Army installations. PWTB 200-1-23 and PWTB 420-49-30 can provide further guidance (see Appendix E).

Other Materials

C&D waste reduction must also include MSW types of materials that are generated by construction personnel.

Lessons Learned

- Office paper, corrugated cardboard, packaging materials, beverage containers, plastics, and other materials generated by construction administration and the construction workforce are recyclable.

Recommendations

- MSW-type materials should be included in the contractor's C&D Waste Management Plan. Alternatively, the contractor should be required to deposit recyclable materials at the installation's recycling center, or collect and segregate recyclable materials and arrange with the DPW for pick-up at the jobsite.

- The contract provisions and specifications must include a description of acceptable materials and arrangements for drop-off or pick-up.

- The contractor's C&D Waste Management Plan and/or QC Plan must include provisions for policing recycling receptacles (both C&D and MSW) and preventing contamination from comingling recyclable materials and trash.

Diligence in Applying Army C&D Waste Diversion Requirements

Establishing C&D waste reduction criteria in building removal contract and specification requirements is a necessary step to achieve the Army's mandate to reduce solid waste on Army instal-

lations. However, the reduction criteria, in and of themselves, are not sufficient to ensure actual performance. Waste reduction must be planned, executed, and verified throughout the project.

Lessons Learned

- Including the 50% C&D waste reduction in project specifications or contract language does not guarantee that performance will be achieved. Reasons may include the following:
    - A C&D management plan is either not required in the contract requirements or is not diligently applied to the project.
    - To conform to a requirement for a C&D waste management plan, the contractor submits a standard template or plan but does not address the specific conditions of the project at hand.
    - C&D waste diversion activities were not addressed within the contractor's QC system and/or the government's QA systems. Methods of diversion performance verification are not articulated in the contract requirements. Jobsite monitoring and/or documentation was either absent or insufficient to verify the diversion performance claimed by the contractor.
    - The contractor encountered difficulties performing salvage or recycling activities during demolition and/or construction. Rather than delay the project, government personnel essentially "waived" the diversion requirements and allowed the project to proceed.
- While it is the exception rather than the rule, fraudulent recycling weight slips or landfill tickets have been given to installation and USACE project personnel, including:
    - Diversion has been claimed although the recycling or reuse business does not exist, or it simply disposes of the material in the landfill once delivered by the contractor.
    - Diversion has been claimed by depositing debris in an off-post landfill in lieu of the on-post landfill.
    - Contractors have used installation-issued landfill passes long after the projects have concluded and the passes have expired. While this is not directly relat-

ed to landfill disposal of recyclable or reusable materials, it provides a no-cost disposal to the contractor, which is a disincentive to reuse and recycling.

Recommendations

In addition to the 50% minimum C&D diversion requirement, contract requirements must include provisions for verifying that actual performance meets or exceeds the specified performance.

- Contract requirements should require the contractor to develop a C&D waste management plan and diligently apply it throughout the project. Figure A-35 provides an example C&D Waste Management Plan Worksheet.

EXAMPLE CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT WORKSHEET INSTALLATION MANAGEMENT INSTITUTE, January 2007

Material	Estimated Quantity	Actual Quantity	Destination	Means of Transport	Cost to Salvage / Recycle (+)	Cost if Landfilled	Cost Compared to landfilling
Salvage for Reuse							
Total Salvage							
Recycle							
Total Recycle							
Debris							
Total Debris							
TOTAL MATERIALS							

DIVERSION RATE *(Salvage Total + Recycled Total) / Total Materials*

Figure A-35. Example C&D Waste Management Plan Worksheet.

- Contractor QC plans should include the following tasks.
  - o Activities for which C&D materials will be generated

  - Processes for monitoring diversion activities, measuring diverted and disposal quantities
  - Documenting diversion and disposal activities and performance
  - Submitting documentation to the government
  - Submittal and inspection schedules
  - QC meetings
  - Verification that the specified diversion rate has been met. (Remember that tipping debris in an off-post landfill does not constitute diversion.)

- Salvage and recycling processes must be described in the C&D waste management plan. While the government should not direct the contractor to apply any specific equipment, means, or methods, the government can and should ensure the methods proposed by the contractor will perform as required.

- If there is any question whether the proposed process will accomplish the required results, the government can request further verification, especially if such activities are on the contractor's critical path. If the process is shown to be insufficient, the contractor must revise these plans. This step reduces the risk that diversion activities will delay the project's progress and reduce the temptation to compromise the diversion requirement. If conditions have been encountered that make diversion impractical under the circumstances, then the contract must be modified to revise the diversion requirement.

- USACE and installation DPW personnel must be diligent in confirming the recycling and reuse outlets that contractors propose and actually use are legitimate and do actually provide recycling and reuse services, not simply a pass-through service for the contractor.

Project Delivery and Contract Provisions

Exercising a range of acquisition and contracting tools will help achieve the Army's C&D waste reduction mandates.

Lessons Learned

- Conventional demolition contracts and specification language that does not require C&D waste diversion or a C&D Waste Management Plan will not be effective in achieving the Army's C&D waste reduction mandates.

- Conventional competitive bidding practices may not fully achieve the Army's objectives for C&D waste reduction as well as the other engineering requirements for building removal. Relying on the lowest bidder does not ensure the necessary qualifications or the most effective building removal and waste diversion methods will be applied to the project.

- Successful C&D waste diversion performance has been achieved when building removal has been contracted separately from the remainder of a large design-build or construction contract.

- Establishing a definitive C&D waste diversion criterion is an effective way to communicate and enforce C&D waste diversion. QA provisions must include verification of the specified performance.

- Successful C&D waste diversion performance has been achieved when the bid schedule includes contract line items for successively higher C&D waste diversion rates above the minimum 50%. Fixing each line item price at a modest amount provided incentive for significantly improved performance. Note that these are not incentive contracts; rather, firm fixed-price contracts with multiple bid schedule line items.

- Where the installation or USACE District has a pool of contractors on Indefinite Delivery/Indefinite Quantity (IDIQ) contracts, and these contractors are all well-versed in salvage and materials reuse, competitive bidding within the IDIQ contractors can provide economic and quality advantages over open competition. A Multiple Task Order Contract is one such IDIQ contract mechanism.

- Performance-based contracting has been successively used to ensure the minimum diversion criteria are met and exceeded. Performance awards for enhanced diversion, such as higher diversion rates or preference for reuse over recycling, can provide an effective incentive to improve performance.

- Several Army installations have developed successful programs for selling obsolete buildings to the public. Wood and pre-engineered metal buildings have been deconstructed, and small wood buildings have been removed from the installations intact. While executing building sales is not without expense, the cost has typically been less than half the cost of demolition. Furthermore, installations accrue some monetary amount for selling the buildings. Once the regional community became accustomed to the building sale process, prices for buildings increased significantly. USACE Districts have either conducted the real property transactions or have delegated this authority to the installation.

- Requiring LEED Silver for new construction projects — especially those including building removal tasks — does not, by itself, ensure the minimum C&D diversion rate of 50% will be achieved. The contractor can achieve LEED Silver without achieving credit MR 2.1, “Materials and Resources Credit 2.1, Construction Waste Management: Divert 50% from Disposal.”

- Some locally developed demolition contract specifications required all materials be deposited in on-post landfills, with no opportunity for diversion. While the intent of these provisions was likely to prevent fugitive dumping, they are preventing the beneficial reuse of any demolition materials. In effect, these provisions make salvage, reuse, and recycling illegal.

Recommendations

Project personnel should collaborate with their contracting offices to identify contract and project delivery alternatives that can better accomplish both construction and C&D material diversion goals of the project.

- A source-selection (or best-value) contractor selection process can incorporate C&D waste reduction. An example RFP is included in PWTB 200-1-23 (see Appendix E). Note that a minimum 50% C&D waste reduction is included in the USACE MT RFP.

- A performance-based contract (PBC) can designate C&D waste reduction as a factor. An example PBC task description, provided by the USACE Seattle District, is available from ERDC-CERL (see contact information on page 2 of this document).

- If the installation or USACE District has IDIQ contractors that are well-versed in C&D materials recycling and reuse, competition within this pool may be preferable to conventional competition. An example IDIQ task description, provided by the USACE Seattle District, is provided in Appendix B.

- Where a construction project includes a significant demolition requirement, a separate demolition contract can be awarded. In this way, the demolition task is not simply a small component of a larger contract, but a contract in and of itself with full attention paid to C&D waste reduction. An example IDIQ bid schedule and payment provisions, provided by the USACE Seattle District, is provided in Appendix B.

- While not an Incentive Contract per se, bid line items can be developed to encourage contractors to increase C&D waste reduction by more than the 50% minimum. Seattle District did this with an IDIQ task and achieved a 90% diversion rate. Note, however, that Seattle District has discontinued this practice, as building removal contracts now require a minimum 75% waste reduction, and contractors have adjusted to this requirement, meaning that no further dollar incentive is necessary.

- Wherever buildings (e.g., most WWII-era wood buildings or pre-engineered metal buildings) can be disassembled or removed whole from an installation, the installation can sell the buildings to the public through their USACE District. This has been successfully accomplished for many years at Fort Knox and Fort Campbell, Kentucky. Aggressive publicity enhances the success of this approach. Example sale-to-the-public contracts are provided in PWTB 200-1-23 (see Appendix E).

- The Service Contract Act (SCA) of 1965 (41 US Code 351) should be applied wherever it can or wherever the Davis-Bacon Act of 1931 (Public Law 71-798) does not apply. The SCA generally includes lower wage rates.

- The acquisition process should include outreach to stimulate participation in the project. The purpose of this outreach is to introduce the deconstruction, salvage, recycling, and building materials reuse businesses to demolition and environmental contractors more familiar with government contracting processes and conditions typically

encountered with demolition projects. Outreach may include direct mailings or notices to services and businesses, notices in local trade and public media, workshops conducted in conjunction with job walks, and other methods to inform potential participants of projects and processes. Figure A-36 illustrates outreach by conducting contractor workshops prior to deconstruction projects. Figure A-37 illustrates publicizing deconstruction and recycling efforts to inform installation personnel and contractors about the Army's waste reduction goals.

Figure A-36. Contractor deconstruction workshops at Fort Lewis and Fort Jackson.

Figure A-37. Getting the word out about deconstruction at Fort Lewis and Fort Campbell.

- Knowledge of the building materials salvage, reuse, and recycling markets should be applied to bid or proposal evaluation to ensure the government is receiving fair pricing that also reflects the contractors' benefits from diversion. This knowledge should also be applied to reviewing and approving contractors' C&D Waste Management Plans to

ensure the maximum waste reduction practical for the project is being achieved.

- Definitive C&D waste reduction criteria can be incorporated into an otherwise conventional demolition specification. An example specification is included in PWTB 200-1-23 (see Appendix E).

- In order for a contractor to have any incentive for diverting C&D materials, the contractor must be given title to these materials, be allowed to sell them, and be allowed to accrue cost savings from recycling revenue and other means.

SWAR Data Capture and Entry

C&D waste and diversion data must be entered into the Army's SWAR system.

Lessons Learned

C&D waste and diversion data are frequently not available to the installation DPW's Environmental Division personnel for entry into SWAR. USACE Resident Offices record waste and diversion data but do not always provide it to the Environmental Division, or Environmental Division personnel do not always seek it through USACE offices.

Recommendations

DPW and USACE project personnel must collaborate to ensure the required data are provided to Environmental Division personnel for entry into SWAR.

Addressing this during the project's planning stages, even during planning charrettes, is not too early to establish this requirement.

Collaboration as requirements, contract provisions, and specifications are developed should be maintained to ensure USACE compiling data that are compatible with the SWAR format.

Environmental Division personnel should also maintain a relationship with the USACE Resident Office throughout projects' durations to ensure the necessary C&D waste and diversion is being collected and validated throughout the project.

Additional Success Stories

The following are additional examples of successful projects and programs for installations' diversion of C&D materials.

Fort Sill Composting

The Fort Sill compost program is an ambitious, large-scale, long-term project. The Directorate of Environmental Quality planned and constructed the facility in the mid-1990s. Directorate personnel prepared a Compost Facility Business Plan that went into much detail on regulatory requirements, solid waste assessment, composting operations, cooperation with their host community, and, especially, an economic analysis of the program. The original plans called for eventual composting of many different types of materials collected in biodegradable bags: land-clearing debris, leaves, food wastes, sewage sludge, and nonrecyclable paper. The installation started collecting an average of 500 tons a month. However, the volume and mix of materials also included many items that were not compostable. Eventually, the composting windrows contained too much contamination (especially plastics) to be useful. Personnel then had to revise the material types and be more selective on what went into the composting windrows. The program has now grown to be a very successful venture that composts a high volume of organics. The DPW uses 15% of the finished compost for landscaping and the rest is used for land conservation in training areas, thereby avoiding the cost of buying the material.

Fort Lewis Composting

Fort Lewis manufactures compost at the Earthworks facility in their EcoPark, which formerly was an approximately 240-acre landfill that opened in the 1960s but ceased operation in 2005. The site is a former EPA National Priority List site that was successfully delisted in 1992. It is now operated in compliance with state and local regulations under an approved Post Closure Plan/Permit, which includes monitoring, compliance, and associated requirements such as maintenance of cover, leachate, and methane control systems. The Earthworks facility also has a recycling/reuse center which provides materials the Fort Lewis DPW would have to otherwise purchase, reduces the cost to maintain the landfill cap, and decreases maintenance cost of training lands by converting waste to resources (Figure A-38 and Figure A-39). The Earthworks facility provides such benefits as:

- providing aggregate replacement product (saves roughly $340K annually)

- providing compost-amended soil product (saves roughly $455K annually)
- avoiding offsite treatment and disposal costs associated with petroleum-contaminated soil through onsite treatment and soil reuse
- manufacturing topsoil from waste products
- recycling wood to be used in soil manufacturing processes or for wood chips
- developing aggregate products from used concrete and asphalt
- demonstrating use of such materials in onsite maintenance and garden demonstration projects.

Figure A-38. Compost production at Fort Lewis Earthworks recycling center.

Figure A-39. Wood, concrete, and asphalt at Fort Lewis Earthworks awaiting recycling.

Partnering with Local Communities

There are many examples where installations have partnered with local communities to divert materials from the landfill. Here are some examples.

Redstone Arsenal Partnering for Waste-to-Energy (WTE)

The Arsenal went in with the local community and built a WTE plant. The Huntsville WTE Facility (also known as The Steam Plant) is the only WTE Facility in the State of Alabama. It is located at 5251 Triana Boulevard, Huntsville, on 20.5 acres adjacent to Redstone Arsenal. The facility began commercial operation in July 1990. The Solid Waste Disposal Authority owns the facility, but it is operated by Covanta Huntsville, Inc. The facility processes 690 tons per day of solid waste and sewage sludge from the Huntsville wastewater treatment plant. This facility has no electric generating capabilities, but it does produce nearly 180,000 pounds of steam per hour that travels through a 6-mile long export line for the Arsenal's heating and air conditioning needs. Because the facility is equipped with four fossil-fuel package boilers, it provides complete redundancy and, as such, steam is available 100% of the time. The facility is also equipped to burn landfill gas from a nearby landfill.

Waste arriving at the facility is fed into chutes and then on to the grates of two mass-burn furnaces where temperatures exceed 2000°F. This incineration process reduces waste volumes by 90%, enabling the landfill to have a longer life. As an example, incinerating the waste in a fully loaded residential garbage truck would produce only enough ash to fit into a wheel barrow.

Steam produced at the facility is shipped via 6 miles of pipeline to Redstone Arsenal, which uses the steam for heating as well as running other equipment. The plant can burn 690 tons per day of municipal solid waste, significantly reducing the volume of garbage going to the landfill.

Fort Bliss/El Paso, Texas Cooperative Recyclable Collection

The Fort Bliss recycling center did not have the manpower or the equipment to manage the anticipated increase in recyclables generated by single-stream collection. Many entities and partners had to come together to make it work.

The first step toward making single stream a reality at Fort Bliss was the City of El Paso's transition to residential recy-

cling in 2007. This was facilitated by the city's partnership with Friedman Recycling. This Arizona company built a materials recovery facility capable of handling large amounts of mixed recyclables. Once that was in place, Fort Bliss was positioned to build on the city's success, but the Fort Bliss program would have to target administration, retail outlets, partner organizations, and motor pools. Once launched, the Fort Bliss single-stream recycling program would make Fort Bliss the first US Army installation to go single stream for all entities.

The Fort Bliss DPW became an integral partner by providing the necessary financial support and altering current custodial contracts to include the collection of recyclables, as well as garbage. The custodial contractor would collect the recyclables and deposit them into the more than 600 blue dumpsters now dotting the entire installation, eliminating the need for personnel to carry recyclables to a recycling point in their area, making recycling much more convenient.

While increasing recycling by 62% is impressive, the cost benefit has yet to be determined. It will take some time to weigh cost benefit versus cost incurred for single-stream recycling. However, one of the main premises behind recycling is that the costs incurred for recycling are offset by avoiding waste disposal and landfill costs. Cost benefit versus actual costs has been widely debated and should be based on the needs of the individual community.

Ultimately for Fort Bliss, it is future cost avoidance that is paramount. If the installation does not extend the life of its landfill, it will eventually incur additional costs (e.g., fuel and tipping fees) to landfill its waste elsewhere. Therefore, the increased numbers of recyclables collected in just three short months support the argument that recycling is a cost benefit and ultimately a cost avoidance.

APPENDIX B

SUMMARY OF SOLID WASTE ANNUAL REPORTING DATA

The following are observations from the SWAR data:

1. The total amount of C&D materials diverted Army-wide between 2006 and 2008 was 1,916,375 tons.
2. The largest item diverted was “asphalt/concrete/brick” (ABC), consisting of 745,087 tons or 38% of the total amount diverted.
3. The next largest category was “other” at 645,387 tons or 34% of the total amount diverted.
4. The next largest category was “land clearing” at 454,487 tons or 24% of the total amount diverted.
5. These three categories totaled 1,844,961 tons or 96% of the total amount diverted.
6. The categories of “wood” and “metal” added only 4%.
7. Eleven installations diverted 1,682,378 tons or 88% of the Army’s total C&D materials.
8. These same 11 installations diverted 1,328,620 tons of ABC or 89% of the total amount diverted for ABC.

APPENDIX C

SUPPORTING DOCUMENTS AND EXAMPLES

Fort Lewis/Seattle District IDIQ Building Removal Statement of Work, Bid Schedule, and Measurement Payment Provisions

The following are actual excerpts from an IDIQ contract providing bid options for successively higher C&D waste diversion levels above the 50% minimum. Included is a Summary of Work, optional bid line items from the Bid Schedule, and Measure and Payment provisions for the optional line items.

SECTION 01010

SUMMARY OF WORK

05/05

PART 1 GENERAL

3.01.. PROJECT BACKGROUND

Sixteen (16) WWII wooden buildings have been identified for required demolition as part of the FY03 Battle Simulation Center Project. The buildings are located within Alpha Block of North Fort Lewis, Washington (See Figure 1). Descriptions of the buildings are found in Table 1.

1.2 PROJECT OBJECTIVE

The Contractor shall provide all labor, tools, equipment, and materials necessary to remove the entire structure at each site according to the construction specifications provided. The Contractor shall perform Hazardous Material Surveys at each structure prior to hazardous material abatement and subsequent demolition. The structures are known to have asbestos-containing material, lead-containing material, PCB ballasts, fluorescent lamps, mercury switches, ozone-depleting substances, underground and above-ground storage tanks, petroleum-contaminated soil, and lead-contaminated soil. The Contractor is required to obtain all permits required for all elements of this project.

The Contractor shall ensure that all construction and project activities are developed, implemented, and maintained using the most current environmental operating procedures (EOPs) including waste prevention, waste diversion (salvage, reuse, recycle), and waste minimization. 50%, by weight, waste diversion is required for contract compliance; 75%, by weight, waste diversion is the project target goal.

This project will require significant documentation. All waste material (regulated, diverted, landfilled) leaving the site must be weighed and documented. Complete and full documentation is required prior to final payment.

The work shall be planned and accomplished so that there will be a minimum of interference and inconvenience to tenants and military activities. Blockage of building exits or driveways must be coordinated in advance. The Contractor is reminded that this project is to be conducted on an active military base and security shall be a primary focus. A site visit is recommended to clarify project objectives.

SECTION 00101

BID SCHEDULE

05/05

PART 1 GENERAL

3.01.. PRICE SCHEDULE

This contract will be awarded with base items awarded as one lump sum with unit prices required for specifically selected work and option items awarded with unit prices required for specifically selected work as needed. A description of the base items, option items and schedule of the unit price work is contained in Standard Form 1442, "Solicitation, Offer and Award." See Contract Clauses, "FAR 52.211-18, Variation in Estimated Quantity" and "FAR 52.236-16, Quantity Surveys."

Contractor shall submit with this Bid Schedule, assumptions and back-up documentation for determination of unit prices.

[NOTE: ONLY OPTIONAL LINE ITEMS ARE SHOWN IN THIS PWTB APPENDIX]

OPTION ITEMS						
ITEM	**DESCRIPTION**	**ESTIMATE QUANTITY**	**UNIT**	**UNIT PRICE**	**CONTRACT UNIT**	**ITEM TOTAL**
0010	Removal, Transport, and Disposal of Pumpable Fuel from the USTs and ASTs Associated with 16 WWII Buildings.	8,500	GAL	$	GAL	$
0011	If Contractor achieves 51% to 60%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0012, 0013, and 0014.	1	NA	NA	LS	$11,000
0012	If Contractor achieves 61% to 74%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011, 0013, and 0014.	1	NA	NA	LS	$22,000
0013	If Contractor achieves 75%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011, 0012, and 0014.	1	NA	NA	LS	$45,000

OPTION ITEMS						
ITEM	DESCRIPTION	ESTIMATE QUANTITY	UNIT	UNIT PRICE	CONTRACT UNIT	ITEM TOTAL
0014	If Contractor achieves 95%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011, 0012, and 0013.	1	NA	NA	LS	$56,000

SECTION 01025

MEASUREMENT AND PAYMENT

05/05

PART 1 GENERAL

3.01.. GENERAL

The contract price for each item shall constitute full compensation for furnishing all plant, labor, materials, appurtenances, and incidentals and performing all operations necessary to construct and complete the items in accordance with these specifications and the applicable drawings, including surveying performed by the Contractor. Payment for each item shall be considered as full compensation, notwithstanding that minor features may not be mentioned herein. Work paid for under one item will not be paid for under any other item. No separate payment will be made for the work, services, or operations required by the Contractor, as specified in DIVISION 1, GENERAL REQUIREMENTS, to complete the project in accordance with these specifications; all costs thereof shall be considered as incidental to the work. Documentation shall be provided for all line items to be paid on a unit cost basis prior to final payment for the respective line item.

1.2 MEASUREMENT

Lump Sum (LS): Measurement shall be for the job identified complete. Estimated quantities are for bidding purposes only. Actual quantities are expected to vary. Significant variation (+ 20%) from the estimated quantities, the line item shall be paid for by the unit price.

Tons (TON): Measurement of tons of materials shall be to the tenth of a ton.

1.3 PAYMENT

[NOTE: ONLY OPTIONAL LINE ITEMS ARE SHOWN IN THIS PWTB APPENDIX]

1.3.11 ITEM 0011 (OPTIONAL ITEM)

Payment will be made at the contract lump sum price for Item No. 0011, “If Contractor achieves 51% to 60%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0012 thru 0014,” payment of which shall constitute full compensation for Item No. 0011, complete. **ALL** construction waste (landfilled or diverted) shall be weighed. Documentation of **ALL** construction waste weight and calcu-

lations demonstrating 100% of construction waste accounted for and quantity of waste diverted is required for payment of Item No. 0011.

1.3.12 ITEM 0012 (OPTIONAL ITEM)

Payment will be made at the contract lump sum price for Item No. 0012, "If Contractor achieves 61% to 74%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011, 0013, and 0014", payment of which shall constitute full compensation for Item No. 0012, complete. **ALL** construction waste (landfilled or diverted) shall be weighed. Documentation of **ALL** construction waste weight and calculations demonstrating 100% of construction waste accounted for and quantity of waste diverted is required for payment of Item No. 0012.

1.3.13 ITEM 0013 (OPTIONAL ITEM)

Payment will be made at the contract lump sum price for Item No. 0013, "If Contractor achieves 75%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011, 0012, and 0014", payment of which shall constitute full compensation for Item No. 0013, complete. **ALL** construction waste (landfilled or diverted) shall be weighed. Documentation of **ALL** construction waste weight and calculations demonstrating 100% of construction waste accounted for and quantity of waste diverted is required for payment of Item No. 0013.

1.3.14 ITEM 0014 (OPTIONAL ITEM)

Payment will be made at the contract lump sum price for Item No. 0014, "If Contractor achieves 95%, by weight, waste diversion – to offset costs associated with extra effort required to maximize sustainability goals, but not including the Work Specified under Item Nos. 0011 thru 0013", payment of which shall constitute full compensation for Item No. 0014, complete. **ALL** construction waste (landfilled or diverted) shall be weighed. Documentation of **ALL** construction waste weight and calculations demonstrating 100% of construction waste accounted for and quantity of waste diverted is required for payment of Item No. 0014.

End of Section 01025

Fort Lewis/Seattle District Building Removal Performance Work Statement

The following are excerpts from a Performance Work Statement developed by USACE Seattle District and used for building removal. It includes the performance standards and excerpts from the Quality Surveillance Plan.

2. Performance Objectives and Standards

The Contractor shall furnish all plant, labor, materials and equipment necessary to meet the performance objectives and standards identified in Table 1 below. The current status of the buildings to be demolished is described in Attachment A.

Table 1: Performance Requirements Summary.

Performance Objective	*Performance Standards*	*Incentives/Disincentives**
Achieve certificate of cleared and clean demolished property (deemed suitable for new construction) of the following building(s) by 30 June 2007: • 3448 Oil Storage • 3449 Oil Storage • 3450 Oil Storage • 3451 Oil Storage • 3452 Vehicle Maintenance Shop • 3453 Vehicle Maintenance Shop • 3454 Vehicle Maintenance Shop • 3455 Vehicle Maintenance Shop • 3456 Oil Storage • 3457 Oil Storage • 3458 Dispatch Building	Ft. Lewis acceptance of the DD 1354s for all buildings.	Penalty will be assessed for schedule delays that negatively impact start of new construction. Penalty equals amount of delay of new construction claim.
Achieve certificate of cleared and clean demolished property (deemed suitable for new construction) of the following building(s) by 19 January 2007 (cont.): • 3459 Fuel Station • 3461 Org Storage • GP34E Grease Rack • GP34F Grease Rack • Asphalt Parking Area	Ft. Lewis acceptance of the DD 1354s for all buildings.	Penalty will be assessed for schedule delays that negatively impact start of new construction. Penalty equals amount of delay of new construction claim.
Achieve 75% (by weight) diversion of C&D debris	USACE approval of the Waste Management Report	Disincentive assessed if achieve <75% diversion of C&D debris (contract non-compliance). Disincentive equals nonpayment of this item.

Excerpt from **Quality Assurance and Surveillance Plan**

Performance Standards for Key Milestones/Deliverables

Since cost is fixed in the PBCs utilized by USACE, the Contractor's performance will be evaluated by assessing the key milestones/deliverables described above according to three standards: quality, C-6imelyness, and safety. For each of these performance standards, the COR will assign one of four ratings of the Contractor's performance: superior, acceptable, marginal, or unacceptable (as shown in Table 1).

Table 1. Performance Standards.

Performance Standard	***Superior Performance***	***Acceptable Quality Level***	***Marginal Performance***	***Unacceptable Performance***
Quality	Contractor exceeds the requirements in the PWS for the milestone/deliver-able. Deliverables/ milestones are approved after one round of comments from USACE and Regulators and no revisions are required.	Contractor meets the requirements in the PWS for the milestone/deliver-able. Deliverables/ milestones are approved with two rounds of comments received from USACE and Regulators and no further revisions are required.	Contractor does not meet the requirements in the PWS for the milestone/ deliverable. Deliverables/milest ones require more than two rounds of USACE and Regulators comments before being approved.	Document is never accepted.
Timeliness	Contractor provides acceptable milestones/ deliverables resulting in overall project completion 10% ahead of schedule.	Contractor provides milestone / deliverable according to the schedule.	Contractor provides milestone/deliverab le behind the project schedule.	Contractor pro-vides milestone/ deliverable behind the project schedule resulting in new construction delay. Performance delays >10% deviation from project schedule.
Safety	No reportable or lost time accidents.	No reportable or lost time accidents above industry standard.	Reportable lost time accidents above industry standard; no regulatory citations.	Contractor has lost time acci-dents above industry standard and received regulatory citation for noncompliance.

If a milestone/deliverable is rated as being of unacceptable quality at the time that the PMP deadline for the milestone/deliverable expires, the milestone/deliverable will automatically receive a marginal rating for timeliness. At no point will a milestone/deliverable receive an acceptable or superior rating for timeliness if

it is rated as being of marginal or unacceptable quality. Overall acceptable performance on a milestone/ deliverable requires ratings of acceptable or superior for both the quality and timeliness standards.

Example Concrete Crushing Statement of Work

Crush Concrete and Asphalt Debris

At the Public Works, Earthworks on Joint Base Lewis-McChord, WA

1.0 BASIC WORK. Provide all management, tools, supplies, equipment and labor necessary to mobilize, setup, and operate an industrial concrete and asphalt crusher at the Public Works Earthworks, located on Joint Base Lewis-McChord, WA to produce specification grade crushed aggregate products from stockpiled construction debris in accordance with commonly practiced commercial standards.

1.1 REFERENCES. The following list of commercial product guides, Federal, State, and local regulations pertain to the above described work, but are not all inclusive;

1. Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction, 2010, M 41-10
2. AR 200-1 Environmental Protection and Enhancement
3. AR 385-30 Safety Color Code Markings and Signs.
4. Clean Water Act 40 CFR Part 503, 40 CFR Part 257
5. Occupational Safety and Health Administration Act
6. Resource Conservation and Recovery Act
7. Washington Industrial Safety and Health Administration
8. Chapter 173-350 of the Washington Administrative Code – Solid Waste Handling Standards

1.2 DESCRIPTION OF WORK. The contractor will be responsible for all labor, material and equipment mobilization and set up of equipment including crusher(s), belt scale conveyors, loaders, screens and vehicles required to process stockpiled construction debris. The contractor shall generate two different specification grade products that are described in paragraph 1.2.5. The products generated shall be separately stockpiled at the work site.

1.2.1 The current particle size of the stockpiled debris varies from large boulder sized dimensions to less than three feet by three feet by three feet. Some of the concrete debris includes steel reinforcement (rebar and wire mesh) and some does not. The concrete and asphalt debris has been carefully segregated in separate stockpiles inside a fenced, gated, secure compound. The available work space is adjacent to the debris stockpiles. The debris stockpiles are available for previewing by appointment with the project manager, Mr. _____ by appointment through the contracting officer.

1.2.2 All concrete and asphalt debris is currently stockpiled at the Public Works Earthworks. A site diagram and driving directions are included in this document.

1.2.3 The contractor's equipment shall be capable of producing crushed aggregate products from steel reinforced concrete debris and asphalt debris generated from JBLM demolition projects. The operator and equipment must be capable of producing the products identified in paragraph 1.2.5.1; 1.2.5.2 and 1.2.5.3 of this document. The end product will be used for road maintenance, new road construction or other construction related projects.

1.2.4 The products generated shall contain less than 0.02% (by weight) contaminates such as rebar reinforcement, wire mesh, wood or otherwise objectionable non-aggregate material. The products generated from this effort shall meet specifications according to third party certified laboratory analysis. The various laboratory analysis required is listed in the reference sections 1.2.5.1; 1.2.5.2 and 1.2.5.3. At least one sample per 10,000 tons for each spec processed shall be taken and analyzed by third party certified construction materials laboratory. Laboratory reports shall be delivered to the COR, Mr. _____. End product acceptance is subject to approval by the government's Project Manager Mr. _____. The contractor may draw from and process debris from both stockpiles (concrete or asphalt) to generate aggregate products that meet the specifications identified in this scope of work.

1.2.5 <u>One third</u> (by weight) of the product generated from this effort shall consist of 2" to 4" Gravel Borrow consistent with reference 1 section 9-03.14 (1). <u>Two thirds</u> (by weight) of the product generated from this effort shall be either 1 ¼" minus Crushed Surfacing consistent with reference 1 section 9-03.9(3) or Gravel Backfill for Pipe Zone Bedding consistent with 9-03.12(3).

1.2.5.1 The <u>2" to 4" Gravel Borrow</u> – *Text provided from section 9-03.14 (1) of reference 1.* Aggregate for gravel base shall consist of granular material, either naturally occurring or processed, and shall meet the following requirements for grading and quality.

Sieve Size	**Percent Passing**
4" square	100
2" square	75 – 100
U.S. No. 4	50 – 80
U.S. No. 40	30 max.
U.S. No. 200	7.0 max.
Sand Equivalent	50 min.

All percentages are by weight

1.2.5.2 The <u>1 ¼" minus Crushed Surfacing</u> – *Text provided from section 9-03.9(3) of reference 1.*

Crushed surfacing shall be manufactured from ledge rock, talus, or gravel in accordance with the provisions of section 3-01. The materials shall be uniform in quality and substantially free from wood, roots, bark and other extraneous material and shall meet the following quality test requirements:

Los Angeles Wear, 500 Rev. 35% max.

Degradation Factor — Top Course 25 min.

Degradation Factor — Base Course 15 min.

	Base Course	**Top Course & Keystone**
Sieve Size	**Percent Passing**	
1 ¼" square	100	
1" square	80-100	
¾" square		100
5/8" square	50-80	
1/2" square		80-100
U.S. No. 4	25-45	46-66
U.S. No. 40	3-18	8-24
U.S. No. 200	7.5 max	10.0 max
% Fracture	75 min	75 min
Sand Equivalent	40 min	40 min

All percentages are by weight

1.2.5.3 Gravel Backfill for Pipe Zone Bedding – *Text provided from section 9-03.12(3) of reference 1.*

Gravel backfill for pipe zone bedding shall consist of crushed, processed or naturally occurring granular material. It shall be free from various types or wood waste or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact and shall meet the following specifications for grading and quality.

Sieve Size	Percent Passing
1 ½”	100
1”	75-100
5/8”	50-100
No. 4	20-80
No. 40	3-24
No. 200	10.0 max.
Sand Equivalent	35 min.

All percentages are by weight

1.2.6 METAL RECYCLING. The Contractor shall be responsible for collecting metal recovered from the operation and placing the material into a government furnished recycling dumpster. A government furnished regular garbage dumpster will be available for placement of non-metal items recovered from the operation.

1.3 EQUIPMENT. The contractor's equipment shall meet all Federal, State, and local government rules/regulations, and standards relating to ambient air quality and air pollution controls. The contractor shall provide the means for dust suppression at the site as necessary. The contractor shall provide accurate weights of aggregate materials produced each day.

1.4 SUPPORT REQUIREMENTS. The contractor shall provide support service for all of the contractor's equipment and operations**.** The contractor shall be responsible for feeding concrete debris into the crusher and screens. The contractor shall be responsible for placing the end product into predetermined stockpile location**.** Ensure that all equipment set up is properly completed, that the plant is fully operational and meets all applicable functional specifications. Provide the manpower necessary to operate and maintain the equipment, including the peripheral equipment. The contractor is responsible for taking samples and for procuring certified laboratory analysis for products generated.

The Government will furnish the following:

C.1 The general location (site) for the crushing operation.
C.2 Any site specific information deemed necessary to complete the plant operation.
C.3 A 30 cubic yard open-top drop box container for recyclable metal.
C.4 Access to on-site restroom facilities for contractor use during operating hours.
C.5 Access Keys.
C.6 Unrestricted access to truck scales.

C.7 Water and electric connections are available at the scale house but not adjacent to or near the specific work location for the crushing operation.

1.5 WORK HOURS. Normal work hours are from 0730 to 1600, Monday through Friday except Federal holidays.

1.6 SAFETY. All work and materials used will be in compliance with the provisions of the U.S. Department of Labor, Occupational Safety and Health Act.

1.7 CONTRACT PERIOD. The contractor will be required to commence work within ten calendar days of Notice to Proceed, diligently process the work, and complete the work not later than 30 days after commencement of work.

1.8 INSPECTION AND ACCEPTANCE. Final payment will be withheld pending inspection and acceptance of the end product including laboratory analysis, and work site by the Government's Project Manager Mr. _____.

1.8.1 At the end of each work day, the contractor shall provide the amount of total specification grade aggregate material produced for that work day to the project manager.

1.8.1.2 The contractor shall allow the project manager to verify the daily report.

Bid Schedule

CLIN	Description of line item	Quantity	Cost / ton	Cost
001	Crushing operations	XX,XXX tons min.	$X / ton	$X,XXX.00
002				
TOTAL				$XX,XXX.00

Notes

1. Performance of this contract must begin not later than ten days after notice to proceed is given by the contracting officer.
2. Performance of this contract shall be completed not later than thirty days after the start of operations.

3-01.3(4) Surplus Screenings

The surplus screenings accumulated during the production of the specified materials shall be stockpiled at a location within the site provided and become the property of the Contracting Agency. The stockpile site shall be prepared and constructed by the Contractor in accordance with the provisions of Section 3-02. All costs incurred in producing, hauling, and stockpiling the surplus screenings shall be incidental to the production of the specified materials and shall be included by the Contractor in the unit Bid prices in the Contract.

APPENDIX D

REFERENCES

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APPENDIX E

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APPENDIX F

ACRONYMS AND ABBREVIATIONS

Term	Spellout
ABC	asphalt, brick, concrete
ACM	asbestos-containing material
ACSIM	Assistant Chief of Staff for Installation Management
ANSI	American National Standards Institute
AR	Army Regulation
ASA(IE&E)	Assistant Secretary of the Army for Installations, Energy and Environment
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
C&D	construction and demolition
CECW	Directorate of Civil Works, United States Army Corps of Engineers
CEMP-CE	Directorate of Military Programs, United States Army Corps of Engineers
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
DASA(I&H)	Deputy Assistant Secretary of the Army (Installations and Housing)
DLA	Defense Logistics Agency
DPW	Directorate of Public Works
ECB	Engineering Construction Bulletin
EO	Executive Order
EPA	Environmental Protection Agency; also USEPA
ERDC	Engineer Research and Development Center
HUD	(Department of) Housing and Urban Development
IDIQ	indefinite delivery/indefinite quantity
IES	Illuminating Engineers Society
IMCOM	Installation Management Command
FRP	Facility Reduction Program
HQUSACE	Headquarters, United States Army Corps of Engineers
LBP	lead-based paint
LEED	Leadership in Energy and Environmental Design

Term	Spellout
MILCON	military construction
MOU	Memorandum of Understanding
MSW	municipal solid waste
MT	military transformation
OACSIM	Office of Assistant Chief of Staff for Installation Management
OSHA	Occupational Safety and Health Administration
PBC	performance-based contract
PCB	polychlorinated biphenyls
POC	point of contact
ppm	parts per million
PWS	Performance Work Statement
PWTB	Public Works Technical Bulletin
QC/QA	quality control/quality assurance
QRP	Qualified Recycling Program
RCA	recycled concrete aggregate
RCI	Residential Communities Initiative
RFP	Request for Proposal
RRP	renovation, repair and painting
SCA	Service Contract Act
SRM	sustainment, restoration, and modernization
SWAR	Solid Waste Annual Reporting
USGBC	United States Green Building Council
USACE	United States Army Corps of Engineers
USEPA	US Environmental Protection Agency
WBDG	Whole Building Design Guide
WTE	waste to energy
WWII	Word War II

Unit Conversion Factors

Multiply	**By**	**To Obtain**
acres	4,046.873	square meters
feet	0.3048	meters
degrees Fahrenheit	(F-32)/1.8	degrees Celsius
miles (US statute)	1,609.347	meters
tons	907.1847	kilograms