

**ABANDONED MOBILE HOMES TOOLKIT
BEST MANAGEMENT PRACTICES RESOURCE GUIDE**

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EXECUTIVE SUMMARY

Mobile Homes (or Manufactured Homes as they are commonly referred to today)¹ have been a consistent feature of many American communities since the 1940s when they were first widely used to provide affordable housing for migrating workers and returning World War II veterans. These types of homes have historically been viewed as an attractive option to traditional site-built housing due to their affordability and mobility. Historically, these homes have lacked the durability of site-built housing and as a result, they tended to have a shorter life span. At the end of their useful life they are often abandoned rather than properly disposed because of the high costs of transport and disposal. When abandoned they fall into disrepair and can have negative impacts on the local community. These can include:

- devaluing surrounding property values;
- becoming an attractive location for illegal dumping;
- attracting illegal scavenging of component items (including copper wiring as well as other recyclable metals and materials);
- becoming attractive locations for individuals who might use the structures for illegal purposes such as methamphetamine laboratories or other criminal activities; and
- attracting children to an unsafe play area.

These activities can present health concerns for individuals who visit them because the abandoned structures are often in a state of disrepair, with hidden dangers including structural flaws, water and mold damage, disease carrying rodents, as well as hazardous materials including, but not limited to, lead, asbestos, and mercury.

Three Indian Nations with territory in New York state (the Tuscarora Nation, Tonawanda Seneca Nation, and the Seneca Nation of Indians) have reported these concerns to the United States Environmental Protection Agency Region 2 (EPA Region 2). In response, EPA Region 2 embarked on a demonstration project to address some of these concerns. The EPA Region 2 Tribal Solid Waste Management Program encourages municipal solid waste management practices in Indian Country that are protective of human health and the environment. The program supports EPA's Office of Solid Waste Strategic Architecture Goal 3 - Land Preservation and Restoration. Under this program, EPA Region 2 designed an Abandoned Mobile Homes Best Management Toolkit project with the stated purpose of providing resources, knowledge transfer, and tools to local communities to aid them in determining the best methods for dealing with abandoned mobile homes.

¹ Note, the term "manufactured home" is the common term used in the industry to describe homes built after June 15, 1976 (the date national building standards were implemented by the Department of Housing and Urban Development (HUD)). The industry currently uses the term "mobile home" to describe homes built prior to implementation of the HUD standards. This report will use the term "mobile home" throughout the report except when specifically discussing homes built after June 15, 1976.

In the past, a variety of support programs designed to deal with this issue had focused solely on removal and disposal of the units as the solution. However, EPA Region 2 sought to develop a more environmentally sustainable and responsible solution to the problem. This project deconstructed two abandoned homes for the purpose of reclaiming as many materials as possible, and reducing the waste that would be disposed in landfills. In addition, some reclaimed materials were reused in the construction of a new structure.

The objectives of this demonstration project included:

- Assisting communities in their decisions regarding the benefits and feasibility of deconstructing abandoned mobile homes and reclaiming the salvaged materials;
- Training federal, state, local, and tribal representatives in safe deconstruction techniques that maximize the amount of material that can be reused or recycled; and
- Developing a best management practices toolkit on this subject for communities to consider.

Widespread deconstruction and salvaging of reclaimable materials from abandoned mobile homes may yield a variety of economic and environmental benefits including the conservation of natural resources, a reduction of the amount of materials disposed of in local landfills, promoting the creation of local jobs, and improvement in real estate values.

The results of this demonstration project are contained in the Abandoned Mobile Homes Best Management Practices Toolkit (Toolkit). The Toolkit consists of the following components.

- A video of the deconstruction of two abandoned mobile homes located on the Cattaraugus Reservation of the Seneca Nation of Indians (SNI). This video shows best management techniques for deconstructing the homes as well as re-construction techniques for re-using the reclaimed materials to build a new structure.
- A Resource Guide which includes the history of mobile home manufacturing, typical materials used in construction, information regarding hazardous materials that may have been used in the construction of the mobile homes, a review of previous studies conducted regarding the feasibility of deconstructing and recycling abandoned mobile homes, and a discussion regarding best management practices for the assessment, inventory and planning of the deconstruction of an abandoned mobile home.
- A Bibliography which includes list of guidance documents and other available resources associated with deconstruction-related topics.
- A Recycling Facilities Database providing contact information for recycling facilities located in New York and New Jersey, as well as nationally recognized organizations.

Note that at the time of release of the Toolkit, all online resources and links were active and accurate; however, over time online resources and links may be subject to change.

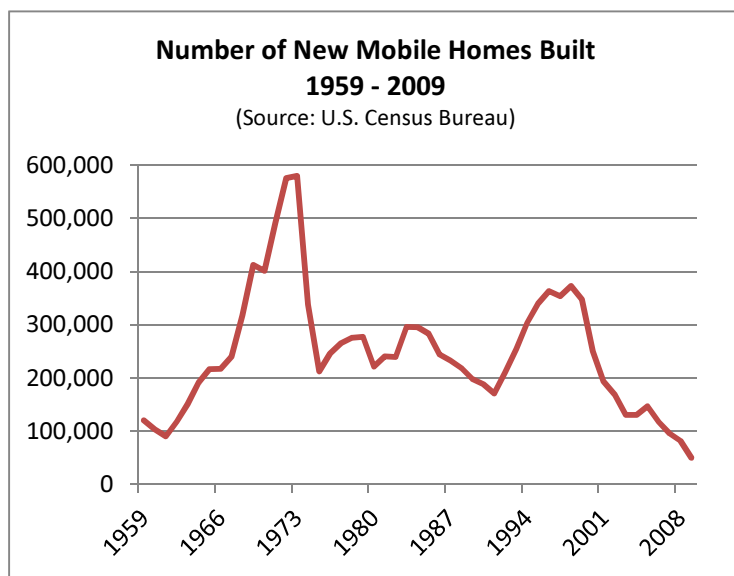
RESOURCE GUIDE

INTRODUCTION

Approximately 8.7 million mobile homes were scattered throughout the United States as of 2007.² These units represent 6.8 percent of the total housing stock of the nation. The prevalence of these structures historically has been due to their relative affordability, quick construction, and use as temporary housing. However, the life expectancy of these structures can be significantly shorter than a traditional site-built home. Prior to adoption of nationwide construction regulations in 1974, the quality of these structures varied widely. Older mobile homes (those built in the 1950s to early 1970s) could have life expectancies as short as ten years.³ In contrast, modern manufactured homes have life expectancies of over fifty years.⁴

Of these 8.7 million mobile homes, 332,000 were classified as vacant in 2007.⁵ U.S. Census data shows that mobile home construction peaked in the early 1970s (just prior to enactment of nationwide regulations designed to combat past manufacturing quality concerns). As a result, many of these 332,000 vacant mobile homes were likely built before enactment of the nationwide construction standards. They are reaching the end of their useful lifespans. Figure 1 graphically depicts the number of new mobile homes built between 1959 and 2009.⁶

Figure 1 - Number of New Mobile Homes Built 1959 - 2009



Three Indian Nations located in New York, the Tuscarora Nation, Tonawanda Seneca Nation, and the Seneca Nation of Indians (SNI), have reported concerns related to abandoned mobile homes to EPA Region 2. In response, EPA, in cooperation with the SNI selected two abandoned mobile homes located within the SNI Cattaraugus Reservation for this demonstration project.

The SNI Cattaraugus Reservation is located near Gowanda and Irving,

² *American Housing Survey for the United States: 2007*, U.S. Department of Housing and Urban Development; available at: <http://www.huduser.org/portal/datasets/ahs/ahsdata07.html>.

³ *The Future of Manufactured Housing*, Joint Center for Housing Studies, Harvard University, January 1997; available at: http://www.jchs.harvard.edu/publications/markets/R97-1_vermeer_louie_Futmanhousing.pdf.

⁴ *An Examination of Manufactured Housing as a Community-and Asset-Building Strategy*, Report to the Ford Foundation by Neighborhood Reinvestment Corporation in collaboration with the Joint Center for Housing Studies of Harvard University, September 2002; available at:

http://www.jchs.harvard.edu/publications/communitydevelopment/W02-11_apgar_et_al.pdf.

⁵ *American Housing Survey for the United States: 2007*, U.S. Department of Housing and Urban Development.

⁶ *Manufactured Homes Survey*, U.S. Census Bureau; available at: www.census.gov/const/www/mhsindex.html.

New York, and covers approximately 21,618 acres. Over 7,200 members are enrolled in the SNI and approximately 60 percent live in mobile homes.⁷ The median age of the mobile homes found on the SNI Cattaraugus Reservation is between 30 and 40 years. The SNI initiated the Programs United for Seneca Homes (PUSH) program which provides funding for the construction of site-built homes as well as support for mortgage payments for SNI members. Through this initiative, many SNI members have transitioned from aging mobile homes into traditional site-built homes. As SNI residents complete this transition, the mobile homes they formerly occupied often remain vacant on the property since costs associated with transportation and disposal of the units are often high (as much as \$3,000 to \$5,000 per unit). In 2008, SNI and EPA Region 2 staff identified over 130 abandoned mobile homes located in the SNI Cattaraugus Reservation.⁸

Over the past ten years, several case studies have been conducted on deconstructing or recycling mobile homes; however, few of these studies have demonstrated alternative methods for the reuse and recycling of the salvaged material. This current project provides a unique perspective since the highlighted activities were filmed and a re-construction project was included as part of the demonstration.

⁷ Seneca Nation of Indians, <http://www.sni.org>, 2008.

⁸ Mr. Adrian Stevens, Director, Department of Environmental Protection, SNI, August 2009.

HISTORY OF MOBILE AND MANUFACTURED HOMES

Mobile homes first came in to common usage in the United States in the 1920s when they were primarily known as “trailer coaches.” These structures became popular because they could be pulled behind a vehicle. They were easily moved as transient workers traveled throughout the country seeking employment. In the 1940s the use of these structures for longer term housing exploded as a result of workers migrating to war effort jobs where they needed immediate housing. After the war, these structures served for returning service veterans as inexpensive housing.⁹

Beginning in the 1960s, mobile homes evolved into larger structures and many took on more permanent attributes including ground skirting, decks, and peaked roofs. By 1970, this simple, light-weight housing option transitioned into more durable, wider, and longer structures.

Mobile homes became subject to national building standards beginning in 1976 with the passage of the *Mobile Home Construction Safety and Standards Act* in 1974. This act empowered the U.S. Department of Housing and Urban Development (HUD) to develop a set of national standard construction requirements for all mobile homes. These regulations went into effect on June 15, 1976. Prior to enactment of these regulations, mobile homes were regulated on a state-by-state basis. As a result, there was a wide range in the quality of the homes built before HUD enacted these regulations.

The national standards came into effect as an effort to try to reduce the risk of fire and substandard construction that had plagued the mobile home industry. As a result, homes built after June 15, 1976, are required to meet certain construction and safety requirements. The HUD regulations are performance-based regulations. This means that the regulations do not mandate specific structural designs or specific construction materials, but instead, the regulations require that the mobile homes meet specific performance criteria such as being able to withstand certain wind velocity or specific load bearing capacities.¹⁰ Manufacturers are free to design and construct the homes as they wish, provided that they meet the performance criteria specified by the Act. The regulations have resulted in raising the overall quality of mobile homes, thereby increasing fire safety, energy efficiency, and safe transportation of the units to their sites.¹¹

In 1980 the act was renamed the *National Manufactured Housing Construction & Safety Standards Act*. Part of the initiative for renaming this Act from a “Mobile Home” Act to a “Manufactured Housing” Act was due to the industries’ attempt to rebrand mobile homes as more permanent structures. By the 1980s, mobile homes, due to the lack of regulation and past quality concerns, had acquired a negative reputation. The industry chose to rename these structures as “Manufactured Homes” in an attempt to reflect the increased quality achieved by the industry since passage of the national regulations as well as to differentiate these structures

⁹ *A Feasibility Study of Mobile Home Recycling*, Vermont Agency of Natural Resources-Waste Management Division and Town of Bristol, Vermont, October 2001; available at: www.anr.state.vt.us/dec/wastediv/recycling/pubs/TRAILER.pdf.

¹⁰ See Manufactured Homes article written by David L. Gibbs, April 27, 2009; available at: <http://real-estate.lawyers.com/blogs/archives/882-Manufactured-Homes.html>.

¹¹ See <http://www.hud.gov/offices/hsg/ramh/mhs/mhsmfgst.cfm>. A copy of the HUD regulations can be found at http://www.access.gpo.gov/nara/cfr/waisidx_01/24cfr3280_01.html.

from the older homes that predated the Act. Today, manufactured home is the recognized name to describe all factory constructed homes built to the standards of the HUD requirements.¹²

In 2000, the American Homeownership and Economic Opportunity Act of 2000 included legislation designed to reform the HUD-Code. This Act was also designed to develop a Model Installation Standards Act. These two changes went into effect in October 2008.¹³

As a result of these HUD regulations, manufactured homes have become more uniform in their design and overall quality. Because of the earlier absence of regulation, greater variety of materials and designs will be encountered in homes predating the June 15, 1976 date.

In recent years, manufactured homes have gained notoriety as a result of their use for emergency shelter for thousands of citizens displaced by Hurricane Katrina and Rita. The Federal Emergency Management Agency (FEMA) purchased approximately 145,000¹⁴ travel trailers and manufactured homes to serve as temporary to long-term shelter for disaster-affected residents.¹⁵ Unfortunately, many of these units had high concentrations levels of formaldehyde which were alleged to threaten residents' health.

A. Manufactured Home Construction

Perhaps its greatest attraction is the short time required to construct a manufactured home. Depending upon the work force, a large manufacturing plant can produce a manufactured home in a matter of days. Once it is delivered to the user's site, it can also be installed quickly as only utility connections and cosmetic finishes need to be completed (i.e., removal of the axles and wheels, installation of ground skirting, etc.). Construction of the home begins in a factory. The manufactured home moves through the factory, much like an automobile does on a production line. Construction generally consists of following stages:¹⁶

- (1) The frame is built of steel and placed on the axles and wheels that will serve to transport the home through the factory, and ultimately to the site where the home will be installed.
- (2) Plumbing (water and sewer), electrical connections, heating and cooling ducting are installed.
- (3) Floors are attached to the frame.
- (4) The water heater and furnace are installed.
- (5) Floor covering such as vinyl is installed and plumbing fixtures such as the toilets are installed.
- (6) An exterior side wall is first attached to the frame, followed by the end walls. Exterior walls have been pre-made and consist of 2 x 4-inch construction with 16-inch spacing between the studs. Fiberglass insulation has been previously installed in the wall and fills the voids between the studs; precut panels cover the walls.

¹² See Manufactured Homes article written by David L. Gibbs, April 27, 2009.

¹³ *Id.*

¹⁴ Management Advisory Report: FEMA's Housing Strategy for Future Disasters, Department of Homeland Security Office of Inspector General; available at: http://www.dhs.gov/xoig/assets/mgmtrpts/OIG_09-111_Sep09.pdf.

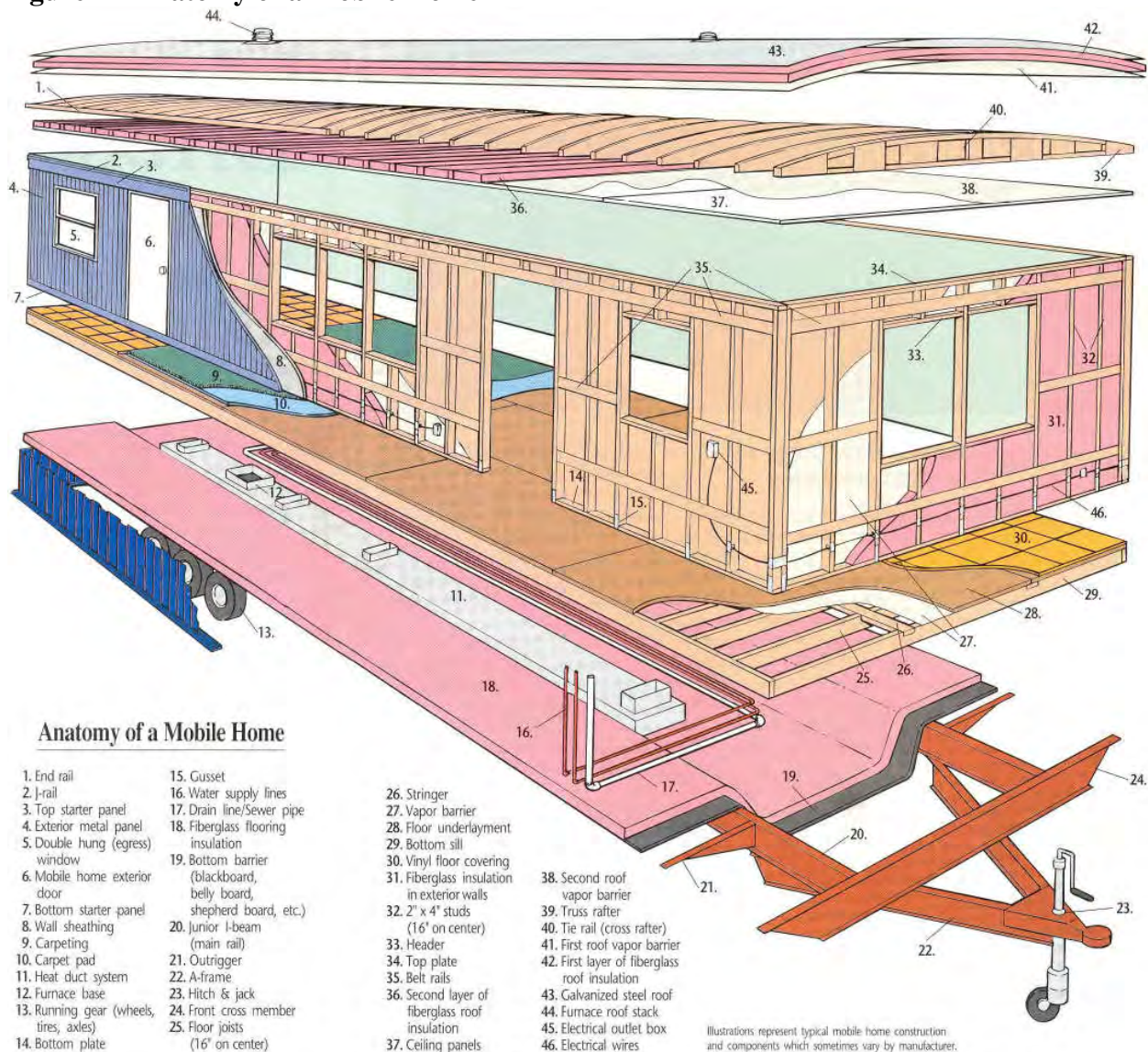
¹⁵ *Frequently Requested National Statistics Hurricane Katrina – One Year Later*, Federal Emergency Management Agency; available at: http://www.fema.gov/hazard/hurricane/2005katrina/anniversary_factsheet.shtm

¹⁶ See <http://mobilehomedoctor.com/mobile-home-construction-at-the-factory/>.

- (7) Interior walls are installed. Interior walls have been pre-framed and are covered on only one side to allow for installation of electrical wiring and electrical junction boxes.
- (8) After these walls are installed, pre-made cabinets and counters are mounted. Electrical lines and plumbing are connected.
- (9) The final exterior wall is attached.
- (10) Separately, a pre-built roof truss system with an installed ceiling underneath has been built. This is then lowered into place and attached to the exterior walls using metal strapping, around the perimeter.
- (11) Electrical wires from the ceiling fixtures are attached to the main electrical breaker box, which is installed at this time. Interior wall wiring is also connected to fixtures.
- (12) Showers, tubs, and sinks are installed.
- (13) Ceiling insulation is installed and exterior plywood is nailed to the roof trusses. The exterior paneling is covered with tar paper and roofing shingles are installed (or, if a metal roof is to be provided, then a large roll of galvanized sheet steel, or sheet aluminum is unrolled over the house, fastened down at one end of the house and stretched over to the opposite end wall; it is then secured on the three remaining sides of the structure with fasteners and caulking).
- (14) Exterior siding (hardboard, metal, or vinyl) is attached.
- (15) Finished surfaces are installed on interior walls.
- (16) Any interior trim work is completed and carpeting is installed.
- (17) Windows are installed and interior and exterior doors are hung.

The anatomy of a typical mobile home is depicted in Figure 2.

Figure 2 - Anatomy of a Mobile Home¹⁷



B. Hazardous Materials Historically Found in Mobile Homes

Older mobile homes can contain hazardous materials that, if mishandled, can expose the deconstruction team, and the general public, to health hazards. As a result, it is recommended that a hazardous material screening be performed on any unit prior to deconstruction activities. Following below is a summary of some of the hazardous materials that may be found in older homes.

Lead Paint

Lead was a common additive to interior and exterior paints used prior to 1978 (when it was banned by the federal government). Individuals are primarily exposed to lead paint through lead

¹⁷ Used with the permission of, and copywrited by, Foremost Insurance Group. The diagram is available on their website at: www.mygreathome.com/fix-it_guide/diagram.htm.

dust, paint chips, or soil contaminated with lead. Lead dust is often invisible. Demolition activities in lead paint contaminated homes can result in further lead exposure, if the demolition is not performed properly. The EPA promulgated a rule requiring the use of lead-safe practices designed to prevent lead poisoning. Beginning on April 22, 2010, all contractors must be certified as an EPA approved lead-paint contractor. The contractors are required to follow specific work practices to prevent lead contamination. This rule applies to demolition of housing units.¹⁸

In addition to lead-based paint, lead pipe or solder can also be a concern.¹⁹ According to the Washington State Department of Ecology, lead pipe and solder can be found in almost all housing except for housing that has been manufactured in the recent past. The state of Washington recommends that lead pipe would probably be designated as a dangerous waste and recommends that it should be removed prior to demolition projects, separated from the waste pile, and recycled as scrap metal.

Asbestos

Asbestos-containing material is another common hazardous material potentially found in homes constructed prior to the 1970s.²⁰ Asbestos was primarily used for heat insulation as well as reinforcement in roofing, siding, and vinyl flooring. Exposure to asbestos fibers is known to cause increased risks of several types of respiratory cancers. Some sources of asbestos in older mobile homes can include (but are not limited to):

- Roofing and siding shingles (made with asbestos cement);
- Attic and wall insulation (for homes built between 1930 and 1950);
- Textured paint and patching compounds used on wall and ceiling joints (predating 1977);
- Some vinyl floor tiles as well as the backing on vinyl sheet flooring and adhesives;
- Insulation for hot water and steam pipes; and
- Oil and coal furnaces and door gaskets.

There are two types of asbestos-containing materials: *friable* materials which easily release fibers when disturbed and *non-friable* materials where asbestos fibers are not easily released unless the materials are mishandled, damaged, or in poor condition. It is impossible to know whether a material contains asbestos (unless it is labeled as such) simply by looking at it. Only a qualified asbestos professional can qualify it by taking samples of the material and analyzing them under a microscope.

EPA recommends that a home inspection be conducted if demolition activities are likely to disturb asbestos containing materials. Asbestos remediation must be conducted by licensed professionals. Some areas will have specific state or local requirements. For example, the state of Oregon requires that an asbestos survey be conducted by an accredited inspector to determine if asbestos is present in any materials that are to be renovated or demolished. The state has

¹⁸ See EPA's *Renovation, Repair and Painting* website for additional information regarding lead paint: <http://www.epa.gov/lead/pubs/renovation.htm#content>.

¹⁹ See State of Washington, Department of Ecology's *Lead in Demolition Debris* website; available at: <http://www.ecy.wa.gov/programs/hwtr/demodebris/pages2/leadsummary.html>.

²⁰ See EPA's *Asbestos in Your Home* website for more information regarding asbestos and asbestos removal: <http://www.epa.gov/asbestos/pubs/ashome.html>.

prepared a fact sheet entitled *Asbestos Advisory & Informational Outreach for Manufactured Home Dealers and Contractors*.²¹

Formaldehyde

Formaldehyde is a chemical used widely by industry to manufacture building materials and household products.²² The most significant source of formaldehyde found in homes is pressed wood products that contain urea-formaldehyde (UF) resins. These materials include particleboard (used as sub-flooring and shelving and in cabinetry and furniture), hardwood plywood paneling (used for decorative wall covering and used in cabinets and furniture), and medium density fiberboard (used for drawer fronts, cabinets, and furniture tops). Due to its manufacturing process, medium density fiberboard is generally recognized as being the highest formaldehyde-emitting pressed wood product.

Studies have found that manufactured homes often have higher levels of formaldehyde as compared to traditional site-built homes.²³ This is attributed to the fact that manufactured homes generally have lower ventilation rates, due to their construction.

Presently, there is no generally agreed upon safe emission level for formaldehyde in residential environments. HUD has designated a specific formaldehyde emission limit for plywood and particleboard used in the construction of manufactured homes.²⁴ This level is 300 parts per billion (ppb) for particleboard and 200 ppb for plywood. However, if the manufactured home was constructed prior to 1985, it may have contained a higher level of high-emitting pressed wood product.

The most publicized case of formaldehyde contamination found in manufactured homes is associated with the FEMA purchased trailers in response to Hurricanes Katrina and Rita in August 2005. FEMA purchased approximately 145,000²⁵ travel trailers, park model trailers, manufactured homes, and non-mobile prefabricated housing units.²⁶ These housing units were to act as temporary housing for families displaced by the hurricanes.

Symptoms from acute exposure to formaldehyde can include irritation of the throat, nose, eyes, and skin.²⁷ These symptoms can potentially exacerbate respiratory conditions such as asthma and

²¹ *Asbestos Advisory for Homeowners*, State of Oregon Department of Environmental Quality; available at: <http://www.deq.state.or.us/aq/factsheets/06-NWR-011-ASBHomeowners.pdf>.

²² See EPA's *An Introduction to Indoor Air Quality* website: <http://www.epa.gov/iaq/formalde.html>.

²³ *Formaldehyde Exposure in Homes: A Reference for State Officials to Use in Decision-making*, Centers for Disease Control, March 2008; available at: <http://www.cdc.gov/nceh/ehhe/trailerstudy/compendium.htm>.

²⁴ *Final Report on Formaldehyde Levels in FEMA-Supplied Travel Trailers, Park Models, and Mobile Homes*, Centers for Disease Control and Prevention, July 2, 2008; available at: www.cdc.gov/nceh/ehhe/trailerstudy/pdfs/FEMAFinalReport.pdf.

²⁵ Management Advisory Report: FEMA's Housing Strategy for Future Disasters, Department of Homeland Security Office of Inspector General; available at: http://www.dhs.gov/xoig/assets/mgmtrpts/OIG_09-111_Sep09.pdf.

²⁶ *Evaluation of Mitigation Strategies for Reducing Formaldehyde Concentrations in Unoccupied Federal Emergency Management Agency-Owned Travel Trailers*, Centers for Disease Control and Prevention, December 10, 2009; available at: <http://www.cdc.gov/nceh/ehhe/trailerstudy/assessment.htm>.

²⁷ *Formaldehyde Exposure in Homes: A Reference for State Officials to Use in Decision-making*, Centers for Disease Control, March 2008.

other respiratory illnesses. Chronic exposure can lead to the following symptoms: chronic runny nose, chronic bronchitis, and obstructive lung disease.

Tests conducted by the Center for Disease Control and Prevention and FEMA determined many of the trailers tested had higher levels of formaldehyde (77 ppb) as compared to typical U.S. indoor levels.²⁸ However, the study also noted that temperature, relative humidity, ventilation, and the age of the housing can contribute to the differences in formaldehyde levels. Reportedly, formaldehyde off-gassing from formaldehyde containing materials continues for extended periods, but decreases over time. Older homes tend to have lower levels of formaldehyde as compared to newly constructed homes.²⁹

As far as deconstructing older mobile homes goes, formaldehyde most likely is not a major concern.

²⁸ *Final Report on Formaldehyde Levels in FEMA-Supplied Travel Trailers, Park Models, and Mobile Homes*, Centers for Disease Control and Prevention, July 2, 2008.

²⁹ *Id.*

PREVIOUS MOBILE HOME DECONSTRUCTION AND RECYCLING STUDIES

Several studies have been undertaken in response to the need for removing unwanted abandoned mobile homes. Generally, the economic benefits derived from deconstructing and recycling these units is not, on its own, incentive enough to justify the amount of effort that goes into the project. However, when all environmental and economic benefits are considered, then results can be quite significant. The benefits derived from deconstruction of these units have been evaluated in a number of studies. Following below is a summary of some of the results from these past studies.

A. Bristol, Vermont, 1998

A June 1998 flood of the New Haven River destroyed a trailer court in the town of Bristol, Vermont.³⁰ As part of the cleanup, a study was commissioned to investigate the techniques and feasibility of dismantling and recycling as many of the constituent elements from the mobile homes as possible.

Five of the mobile homes from the trailer court were selected and transported to the Town of Bristol's municipal landfill for deconstruction. Each of the five units was a pre-HUD code mobile home. The components of each mobile home were segregated into various categories, and materials from each category were documented and weighed. Categories of materials consisted of reusable, recyclable, or disposable components.

Deconstruction was accomplished primarily using hand tools in an effort to maximize the amount of reclaimable materials. Power tools consisted mainly of a chain saw and rechargeable battery operated power drills and drivers. An acetylene torch was also used to cut up the trailer frames. A bucket loader was used to move the units around the deconstruction area and to collapse a trailer after it had been gutted. Two to three employees conducted the deconstruction and overall labor hours ranged from 79 to 97 hours for each unit; with an average of 88.7 hours per unit.

The study separated the metals into three subcategories, non-ferrous, light ferrous, and heavy ferrous. Non-ferrous metals salvaged from the five homes included exterior aluminum sheathing and aluminum window frames, copper plumbing, brass fixtures, and copper electrical wiring. Light ferrous materials collected included sheet metal or tin collected from the homes' roofing, ductwork, fixtures, and other miscellaneous items. Finally, the steel frame represented the heavy ferrous category.

The aluminum salvaged from the homes accounted for the largest quantity of the non-ferrous metal by weight, and, given aluminum's market value (at the time the study was undertaken), also ranked as the most valuable recyclable material salvaged. The light ferrous materials had little economic worth. The steel frame (the heavy ferrous) reportedly had economic value, as the

³⁰ *A Feasibility Study of Mobile Home Recycling*, Vermont Agency of Natural Resources; available at: <http://www.anr.state.vt.us/dec/wastediv/recycling/pubs/TRAILER.pdf>

study reported it would be more economical to reuse or recycle the frame than it would be to dispose of it (again, these findings are based on the market prices of scrap metals in 2000).

Wood reclaimed from the units included some dimensional lumber. However, the study noted that the wall studs in several of the units typically include 2" x 2" or 2" x 3" lumber which was determined to not be reusable due to their limited value in reconstruction projects. Some 2" x 4" wall studs were salvaged, however the study also noted that some of this lumber was either water damaged, or determined to require too much effort (de-nailing) to justify salvaging it. Most of the lumber that was salvaged came from the floor joists. However, the study noted that because the trailers were collapsed during deconstruction, many ceiling joists were broken in the process. In all, an estimated 261 pounds to 770 pounds of dimensional lumber was salvaged for each of the units.

The study noted that miscellaneous salvageable items from these units typically includes fiberglass insulation, furnaces, electrical breaker boxes, metal exterior doors, kitchen sinks, cabinets, countertops, electrical fixtures, bathroom sinks, toilets, bathtubs, lighting fixtures, interior doors, paneling, and carpeting. Many of these materials, due to their exposure to the flood, or due to the fact that the items had already been removed, were not salvageable from the five mobile homes deconstructed for this project. As a result, these items did not contribute to the final cost analysis of the study.

The study found that the portion of each individual home that was either recyclable or reusable ranged from 20 percent to 37 percent of the total materials. According to the study, the aggregated weight of the recyclable and reusable materials amounted to 17,353 pounds (8.67 tons), or 29 percent of the total. As a result, the deconstruction of these five mobile homes diverted over 17,000 pounds of materials from the local landfill.

Economically, the study found that each unit cost approximately \$775 to deconstruct. This cost was measured by totaling the gross expenditures for a subcontractor to deconstruct the five homes, associated tipping fees, related Town of Bristol administrative costs, as well as revenues received from salvaged metals (and one piece of furniture). It is worth noting however, that some valuable salvageable items were either previously removed or damaged by flooding. As a result, they did not contribute to the overall revenues derived from the effort.

B. Alburg, Vermont, 2006

The Alburg Mobile Home Deconstruction Project was undertaken, in part, to find a cost efficient means of removing abandoned mobile homes from the community.³¹ In all, 22 abandoned homes were identified as being located in the community. The study was undertaken to remove ten of the 22 structures. The study was conducted in two phases. Each phase focused on the deconstruction of five abandoned mobile homes. The mobile homes were deconstructed primarily mechanically using excavators with hydraulic thumbs or grapples. Materials were loaded into dump trucks and disposed of either at the local landfill, or transported to recycling facilities.

³¹*Alburg Mobile Home Deconstruction Project*, submitted to the Vermont Department of Environmental Conservation, April 2006; available at: <http://www.anr.state.vt.us/dec/wastediv/recycling/pubs/AlburgTrailerRPT.pdf>.

Two different mechanical methods were employed to deconstruct the ten homes. One method used two excavators (one equipped with a hydraulic thumb, and one equipped with a grapple). The machines were used to crush the mobile home and separate the tin roof and siding from the rest of the debris. The excavators were also used to remove some of the appliances. Once the mobile home was reduced to the steel frame, the frame was cut into manageable pieces with a gas powered chop saw and then loaded into a dump truck for removal.

The second method of deconstruction also employed an excavator with a hydraulic thumb to complete most of the deconstruction. However, instead of crushing the home (and then separating the metal from the debris), the tin siding was first peeled off using the hydraulic thumb of the excavator. Next, the remaining wall structure was removed using the excavator and placed into the dump trucks for disposal. Once the base structure was stripped down to the steel frame, a chop saw was used to cut the mobile home into five or six sizable pieces in order to fit in the dump trucks.

The total weight of the mobile homes deconstructed ranged from 4.74 to 5.29 tons. The amount of metal salvaged from the structures ranged from 1.06 to 2.13 tons. The total amount of salvageable metal per mobile home ranged from 14 to 39 percent.

Using these mechanical deconstruction techniques resulted in speedy deconstruction projects. The average total time required to deconstruct these units was approximately 12 hours of labor time. Salvaging metals from the units reduced landfill costs both by reducing tipping costs and by realizing income from the salvaged materials. This resulted in an average savings of approximately \$223 per unit. Average landfill costs for each of the ten deconstructed and salvaged mobile homes were \$353 per unit.

In addition, the study estimated that the contractor costs would have averaged approximately \$887 per unit, if the contractors had not volunteered their time and services. Combining the average landfill costs for each unit (\$353) with the average associated contractor costs for each unit (\$887) resulted in an average cost of deconstruction and disposal of the remaining reclaimed material of \$1,240 per unit.

C. Roseburg, Oregon, 2006: Mobile Homes, Manufactured Homes and Trailers

A feasibility study on deconstruction techniques was conducted by the Umpqua Community Development Corporation (CDC) and Heartwood ReSources.³² This study focused in part, on investigating the feasibility of deconstructing outdated mobile homes, manufactured homes, and trailers with a focus on diverting as much material from area landfills as possible.

The pilot project involved disassembling six manufactured (or mobile) homes. Four of these units were single wide units (built between 1971 and 1980), and two double wide units (built in 1975 and 1984). The work was conducted using manual tools by an experienced deconstruction

³² *Feasibility Study for a Deconstruction Program for MMHUITs*, with Contributions from Douglas County Public Works Solid Waste Management Division, the University of Oregon, and Heartwood ReSources, December 2006; available at: http://www.heartwoodresources.org/Final_MMHUIT_Report_wExecSummary.pdf

crew. Five of the structures were transported to a staging site for disassembly; one structure was deconstructed on-site.

The pilot project found that the average weight of each of materials diverted from landfills (reclaimed) was 4.0 tons or 71 percent of the total weight of the units (5.7 tons). An average of 106.5 labor hours was expended per structure to complete the deconstruction.

Average total costs associated with deconstructing the units were estimated at \$5,015. These costs included transportation related costs, asbestos assessment and abatement costs,³³ decommissioning labor costs, and tipping fees.

The value of the reclaimed and recycled materials was estimated at \$520 per structure.

D. Brunswick County, North Carolina, 2000 - 2003

In February 2000, Brunswick County, North Carolina, began a mobile home recycling program for its residents.³⁴ The intent of the program was to remove and demolish unwanted, outdated, mobile homes. An emphasis was also placed on removing recyclable materials in an effort to reduce the amount of material entering the waste stream.

First, selected homes were transported to the county landfill site. Deconstruction and recycling sorting was primarily conducted by mechanical means. An excavator was used to rotate the mobile home onto its side. This typically caused the axle and frame to pull away from the rest of the mobile home. The axle and frame are then separated and moved to another section for recycling. The operator then used an excavator equipped with a bucket to demolish the topside of the mobile home in order to get access to the bulky fixtures (sinks, bathtubs, and water heaters) and white goods (appliances) located within the home. These items were then placed in a dump truck and transported to another section for sorting. The operator then finished demolishing the mobile home.

Mobile homes delivered to the landfill site took approximately 30 minutes to recycle, with an in-house cost of about \$65 for the demolition and recycling of one mobile home. This cost included the costs for two operators, one excavator and one dump truck.

Under the Brunswick County Recycling Program a total of 507 mobile homes were recycled in this manner between 2000 and 2003.

The county found that an average single-wide mobile home weighed between three to five tons, and that the axle and frame weighed approximately one ton. The county estimated that on average, one ton of material per mobile home was salvaged and diverted from the landfill; four tons of debris was ultimately disposed of in the landfill. As a result, approximately 25 percent of materials from mobile homes were diverted from the landfill.

³³ Note, five of the six units deconstructed were found to contain asbestos.

³⁴ *Local Government Case Study: Brunswick County Mobile Home Recycling Program*, North Carolina Department of Environment and Natural Resources Division of Pollution Prevention and Environmental Assistance, August 2003; available at: <http://www.p2pays.org/ref/26/25971.pdf>.

E. Previous Mobile Home Deconstruction and Recycling Studies: Conclusions

Results from each of the above-referenced deconstruction studies indicated that the percentage of material salvaged and diverted from landfills can vary greatly depending upon the level of effort and the method (mechanical or by hand) used to conduct the work.

Careful deconstructions performed by hand can produce salvage rates as high as 70 percent of the total weight of the unit. However, this high percentage rate comes at a high cost in terms of labor hours and cost. In contrast, quick mechanical deconstructions can be accomplished in a fraction of the time. However, the salvageable material percentage can be as low as 14 percent of the deconstructed unit.

These studies also demonstrate that a wide range of materials can be salvaged from abandoned mobile homes. These include: metal, wood, gypsum, fiberglass insulation, household appliances, and fixtures (furnaces, electrical breaker boxes, metal exterior doors, kitchen sinks, cabinets, countertops, electrical fixtures, bathroom sinks, toilets, bathtubs, lighting fixtures, interior doors, paneling, and carpeting).

The metals recycled primarily consist of aluminum siding and the steel frame and axles. Although a simple cost benefit analysis of the resale of the salvaged materials and the reduced tipping fees compared to the deconstruction costs show that deconstruction is not an economical undertaking, one must also consider the other benefits associated with these efforts. These include:

- increased landfill capacity;
- conservation of natural resources; and
- local job creation.

Also, as the price of construction lumber increases, used dimension wood (2 x 4s and the like) has some substitution value, especially in small projects. This value is difficult to estimate accurately but might be expressed as some fraction of the cost of the new lumber of significant dimensions. Currently in the US Northeast, the retail price of a new 10 foot long 2 x 4 – the size commonly used for wall studs – is about \$4.00.

These additional benefits are often hard to value; however, considering the many thousands of vacant abandoned mobile homes currently blighting the country, taken together, these benefits can be quite significant.

SENECA NATION OF INDIANS DECONSTRUCTION AND RECONSTRUCTION PROJECT OVERVIEW

The Seneca Nation of Indians (SNI) and EPA Region 2 initiated a project to train interested parties on how to deconstruct mobile homes and identify innovative ideas in reusing the salvaged material collected from the deconstruction. The lessons learned from projects previously discussed provided useful guidelines to the deconstruction project. EPA Region 2 contracted with the Umpqua CDC and its affiliated business, Heartwood ReSources of Roseburg, Oregon and with Mr. Graydon Brown, an independent consultant, to conduct deconstruction and reconstruction training at the SNI Cattaraugus Territory. The following sections summarize the activities conducted during the SNI Deconstruction and Reconstruction Project. Appendix A, Photographs of the Deconstruction Training, illustrates the deconstruction and reconstruction process and techniques. Please refer to it as you read the following sections.

A. SNI Deconstruction and Reconstruction Project

The objectives were:

- Confirm the feasibility of deconstructing abandoned mobile homes;
- Identify innovative uses for materials salvaged from deconstructed mobile homes;
- Train SNI representatives on proper deconstruction techniques; and
- Film the project to serve as a standing teaching tool.

During the first phase of the project, EPA and SNI conducted a count and rough survey of the abandoned mobile homes on the SNI Cattaraugus reservation to identify potential candidates for the deconstruction training. SNI arranged for a tour of their community so that EPA representatives could observe and evaluate the abandoned structures. EPA and the SNI Environmental Department Staff interviewed known owners of the abandoned mobile homes to determine the state of the structures and to ensure that the owners granted consent for the deconstruction project. Owners also shared their recollections of maintenance issues related to the units as well as details such as how long the units had been vacant and the reason for their abandonment. As far as possible, project personnel determined each unit's age, duration of abandonment, and feasibility of transporting the unit to the designated staging area.

Final selection of the abandoned mobile homes was based on the feasibility of transporting the structures to the designated staging area. As a result, two structures (Mobile Home Unit 1 and 2 (MHU1 and MHU2)), aged 30 to 40 years, were selected for the deconstruction training project. They both demonstrated different levels of physical damage and would likely provide different types of salvageable material.

Once the two homes to be used for the training were selected, SNI chose an appropriate staging area. The staging area was picked for its access to major roads, its clean and flat work space, and accessibility to electricity. The location of the staging area required transporting the two mobile homes from their original location prior to deconstruction.

B. Inventory and Assessment of the Abandoned Mobile Homes

The next step in the project was to conduct a detailed inventory of the two selected abandoned structures. The purpose was first, to estimate the likely amount of salvageable material each structure might render after deconstruction; and second, to determine the safest and most time efficient approach to the deconstruction based on the condition of each structure. Each mobile home had identical dimensions but required different deconstruction strategies. Both structures measured 60 feet long by 10 feet wide. Each contained two bedrooms, a hallway, bathroom, living room, and kitchen. The description of the mobile home layouts are presented below in Table 1.

Table 1 - Dimensions of Mobile Home Units 1 and 2

Specific Area of the Mobile Homes	Length (feet)	Width (feet)	Area (square feet)
Bedroom 1	11	10	110
Bathroom	10	7	70
Bedroom 2	14	10	140
Hallway	10	3	30
Living Room	16	10	160
Kitchen	9	10	90
Total for Each Mobile Home	60	10	600

Mobile Home Unit 1

MHU1 was presumed to be manufactured after 1976 (approximately 30 years old) as there was evidence of a HUD emblem on one of the exterior walls. Several families inhabited MHU1 until June 2009. Initially, the inventory phase of MHU1 suggested that the structure was stable and that the unit was in relatively good condition. However, further inspection revealed that the roof and ceiling of the structure had significant water damage. The following observations were made during the inventory phase:

- The interior was in relatively good condition;
- Floor and wall structures were stable as there was minimal water and/or mold damage;
- The structure contained a number of appliances and fixtures (i.e. water heater, toilet, furnace, etc.) which were in good condition and therefore, were salvageable;
- Mold was discovered in the exposed insulation;
- Rodent feces were found in the insulation and in the wall and floor cavities; and
- The majority of the roof trusses were observed to be collapsed into an inverted position.

Based on these observations, specifically, the stability of the walls and floors, it was determined that the most efficient approach to deconstructing MHU1 was to begin from the interior and work to the exterior. The extensive water damage observed on the ceiling of the structure

affected the insulation and plywood which, as a result, provided an environment for mold, mildew, and rodents.

Mobile Home Unit 2

MHU2 appeared to have been manufactured before 1976 as there was no HUD emblem observed on the structure. Based on interviews with the owners, the structure was estimated to be approximately 40 years old. According to interviews with SNI members, the structure was abandoned when a family was instructed to move due to safety concerns. The structure had been abandoned for at least a year.



Photograph depicting the rotted floors of MHU2. The floor cavities were exposed raising a safety concern

During the inventory phase, the interior of MHU2 was determined to be unstable. The lower portions of the walls were rotted out and posed a significant safety hazard to the deconstruction team. The deconstruction experts determined that it would be safest to conduct this deconstruction by first removing the roof of the structure; next, deconstruction of the bottom portions of the exterior walls (including removal of the aluminum siding) would take place; finally, deconstruction of the interior would commence. The following observations were made during the inventory phase for this unit:

- The structure's roof appeared to be stable;
- The most salvageable portion of the structure was determined to be the roof and ceiling materials (i.e. trusses and roof paneling).
- Lower portions of the walls and some of the floor were rotted;
- Mold was discovered in the exposed insulation; and
- Rodent feces were found in the insulation and in the wall and floor cavities.

C. Deconstruction Activities

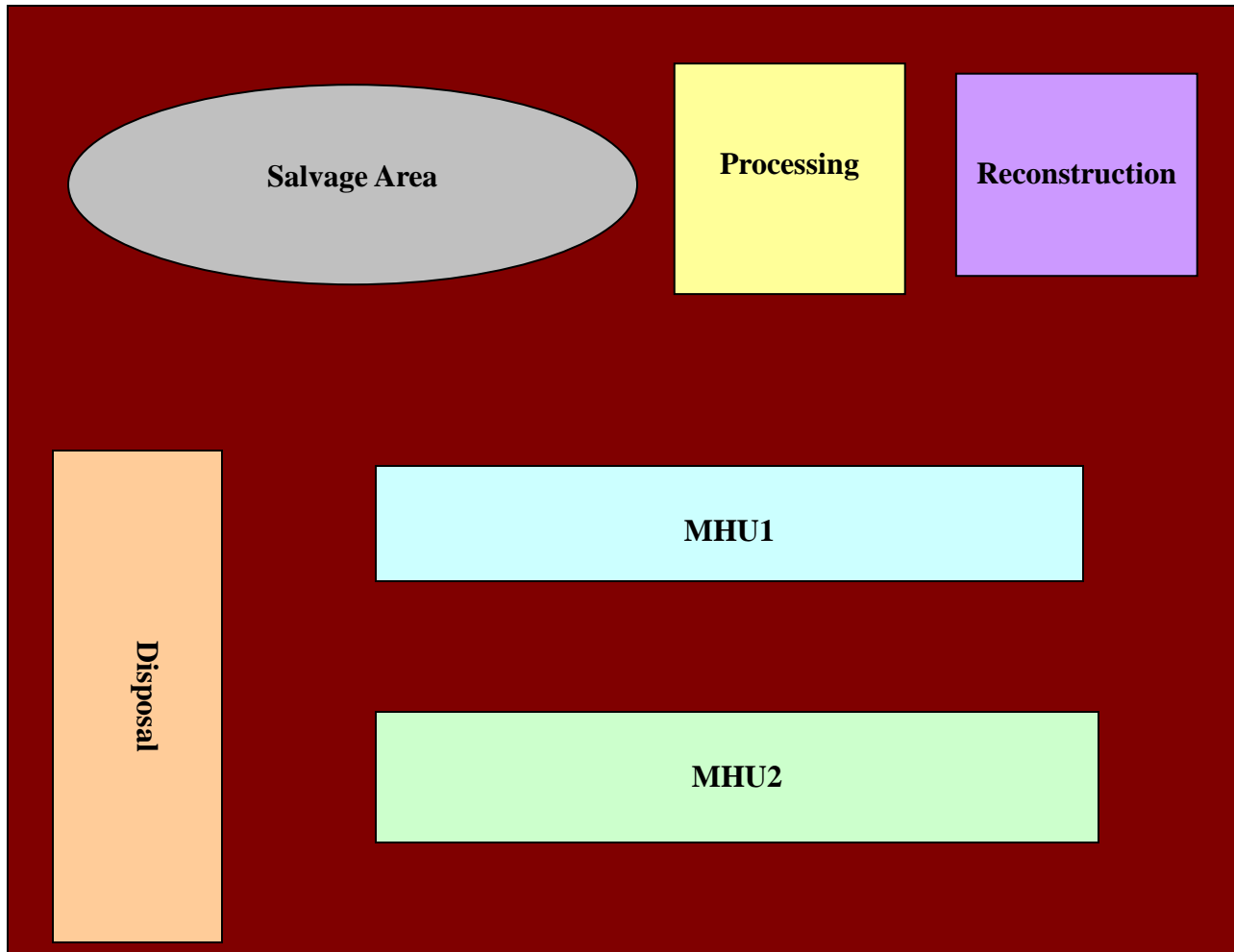
The deconstruction activities conducted for the two mobile homes were carefully planned based on the condition of the construction materials and the overall stability of the mobile homes. The deconstruction training project was conducted between August 3 and August 9, 2009. Nine volunteers participated in the deconstruction training, though not all nine participated throughout the entire week long project. Each mobile home presented significant challenges that affected the amount of time needed to deconstruct, the types of tools used, and the amount of material salvaged.

Mobile Home Unit 1

Due to the fact that MHU1 seemed to have a more stable floor, the strategy for deconstruction involved the removal of material from the interior to exterior and from the top to bottom. The disposal area for the deconstruction activities was located in the southwestern corner of the deconstruction site (Figure 3). A disposal path was provided by removing the wall of MHU1.

This path made disposal more efficient, provided more ventilation, and encouraged a clean work site.

Figure 3 - Deconstruction Site Layout



Upon removal of the end wall, the following steps were taken:

- (1) Interior walls, cabinets, and white goods were removed to provide an open work space;
- (2) The ceiling of MHU1 was removed layer-by-layer until the trusses were exposed;
- (3) The exterior asphalt/metal roof was removed;
- (4) Ceiling trusses were removed (note, the majority of the trusses were unsalvageable due to water damage);
- (5) A tension strap was installed as temporary support for the exterior long walls;
- (6) The exterior aluminum siding was removed; followed by the exterior walls;
- (7) The flooring was removed and salvaged as minimal damage was on the floor deck of MHU1; and
- (8) The metal bottom cover, surrounding insulation, and metal frame were then removed and disposed.

A photographic log depicting the step-by-step deconstruction of MHU1 is included in Appendix A.

Mobile Home Unit 2

During the pre-deconstruction assessment, large holes were observed where moisture had rotted the floor and lower walls of MHU2. This was a safety hazard for the deconstruction team. As a result, the strategy for MHU2 involved deconstructing the unit from the exterior portions to the interior, and from the top of the unit to the bottom.

MHU2 was deconstructed in the following manner:

- The exterior roof cap panel was removed to assess the overall condition of the roof;
- The metal exterior roofing was removed, exposing the trusses;
- The trusses were removed and salvaged;
- Exterior walls were removed, followed by the interior walls.

A photographic log depicting the step-by-step deconstruction of MHU2 can be found in Appendix A.

D. Reconstruction Activities

Reconstruction activities consisted of building four saw horses and a tool shed. The reconstruction project was completed in approximately 18 hours. This included approximately eight hours using manual tools and labor and ten hours using power tools. The reconstruction project used approximately 26 percent of the materials salvaged from MHU1 and MHU2. Five volunteers supported the construction of four saw horses as well as a tool storage shed. The tool shed was constructed using lumber from the floor and wall frames from MHU1, some salvaged roof trusses, and the aluminum siding salvaged from both structures.



The main reconstruction project, the tool shed; 12 feet high by 6 feet wide.



The first reconstruction project; saw horses.

E. Results of the SNI Deconstruction Project

MHU1 was completely deconstructed within three days. This was largely because the unit was in relatively good condition and did not require as much planning to deconstruct as MHU2 required. In contrast, MHU2 was deconstructed in four days due to the unit's rotting interior floor and the unstable condition of the unit's structural integrity.

Approximately 1.75 tons of salvaged material was gathered from MHU1. Of the 1.75 tons, 0.53 tons of salvaged materials were immediately reused on construction of the four saw horses and the tool shed. The majority of this material was comprised of the 2 x 4 lumber that was salvaged and used in constructing the floor and walls of the tool shed.



Salvaged material from the deconstruction of the two abandoned manufactured homes.

In comparison, approximately 1.01 tons of materials were salvaged from the deconstruction of MHU2; 0.63 tons of this material was reused as ceiling trusses for constructing the tool shed's roof.

Overall, approximately 22 percent of the material gathered from deconstructing both MHU1 and MHU2 was salvaged. Of that 22 percent, approximately 52 percent was used for the reconstruction projects. Tables 2 and 3, Results from MHU1 and MHU2 respectively, provide a summary of the percentage of material salvaged from the deconstruction training.

Table 2 - Results from MHU1

	Total Amount (Tons)	Total Percentage (%)
Estimated Total Weight	4.96	
Estimated Total Disposed	3.14	63 %
Estimated Total Material Stockpiled for Reuse	1.82	37 %
Estimated Total Material Used for the Reconstruction Project	0.53	11 %

Table 3 - Results from MHU2

	Total Amount (Tons)	Total Percentage (%)
Estimated Total Weight	4.50	
Estimated Total Disposed	2.89	64 %
Estimated Total Material Stockpiled for Reuse	1.61	36 %
Estimated Total Material Used for the Reconstruction Project	0.63	14 %

In all, a total of 7.23 tons of material was disposed at the local landfill. Tipping fees were \$96 per ton. Therefore, the total cost to dispose of the material at the local landfill cost approximately \$700.

In comparison, transportation fees for transporting each home to the local landfill would have been approximately \$500 per home. The combined weight of MHU1 and MHU2 prior to deconstruction was 10 tons. Tipping fees for MHU1 and MHU2 would have been approximately \$960. The estimated combined transportation costs and combined tipping fees to dispose of both units are estimated at \$1,960.

As a result, deconstructing the two abandoned mobile homes saved approximately \$1,260 in tipping fees and transportation costs.

The second measure of the success of deconstruction involves labor and time efficiency. Time and labor efficiency directly affect costs. Labor efficiency is directly affected by the types of tools used during the deconstruction project. Manual labor involves using man-power to remove material as well as those tools that require manual force (i.e. sweeping, using a crow bar, wheel barrowing, etc.). Power tools are those items that require electrical input (i.e. power saws, power drills/drivers, etc.).

Of the 88 hours expended on deconstruction activities, approximately 63 percent of the recorded time involved the use of manual labor. A summary, dividing the work stations and the respective percentage of time documented for the use of manual or powered labor, is provided in Table 4, Work Station Summary.

Table 4 - Work Station Summary

Activity	Total Time for Activities (Hours)	Number of Volunteers	Use of Hand/Manual Labor (Hours)	Use of Power Tools (Hours)
MHU1				
Deconstruction	16	3	8	8
Processing	12	6	10	2
Reconstruction	1	5	1	0
Cleaning	2	9	2	0
Total	31	9	21	10
MHU2				
Deconstruction	28	3	17	11
Processing	9	10	7	2
Reconstruction	19	5	8	10
Cleaning	2	3	2	0
Total	57	9	34	23
	88	18	55	33

The salvaged material that was not used for the reconstruction activities was stockpiled and will be used during other SNI reconstruction projects.

The results of the SNI Deconstruction and Reconstruction project were in line with those from previous deconstruction projects and demonstrated the feasibility of deconstructing these structures as opposed to sending them to disposal. Cost savings may play a significant part in the benefits in deconstructing mobile homes, but other factors such as conserving local landfill space, resource conservation, job training, and supporting local recycling and reuse markets are also tangible benefits of deconstruction. Table 5, Comparison Table, provides a summary of the previous deconstruction projects.

Table 5 - Comparison Table

Project	Percentage of Salvaged Material	Number of Mobile Homes Deconstructed	Time for Deconstruction	Means of Deconstruction
Vermont	20-30%	5	Estimated 18 hours per home	Manual
Alburg	14-39%	10	4 hours per home	Both
Umpqua	71%	6	106 per home	Manual
SNI	22%	2	20 hours per home	Majority Manual

DECONSTRUCTION OF ABANDONED MOBILE HOMES BEST MANAGEMENT PRACTICES

Deconstruction is the process of taking apart portions of a structure and removing some or all of the contents for recovery. Component elements of the structure, such as appliances, metals, electrical fixtures, wood timbers and flooring, doors and knobs, windows, and more may be salvaged from a mobile home.

This guide is intended to provide tools to aid in developing a cost efficient deconstruction process, one that maximizes the amount of materials recovered, reused, or recycled. The following sections provide recommended best management practices. They were compiled by reviewing the deconstruction literature currently available, as well as from lessons learned from the SNI Deconstruction Training conducted in August 2009.

Appendix B, Deconstruction Checklists, contains a number of useful checklists to be used when planning for and conducting deconstruction projects. In addition, other relevant deconstruction guidance documents and resources are cited on the companion DVD under Resources.

In addition, the Umpqua CDC and Heartwood ReSources produced a feasibility study on deconstruction techniques which can serve as a tool to assist communities in determining the benefits associated with reusing and recycling mobile home constituent materials.³⁵

A. Planning for Deconstruction

A successful deconstruction project requires planning prior to the actual deconstruction activities. Proper planning includes:

- Assessing abandoned mobile home candidates;
- Conducting an inventory of the mobile home(s);
- Conducting environmental health surveys (including an asbestos assessment, if applicable);
- Obtaining any required permits and authorizations;
- Conducting a Pre-Deconstruction Assessment of selected mobile homes;
- Preparing a Deconstruction Project Plan which includes addressing site characteristics, project organization, health and safety, and materials management;
- Arranging for site security;
- Procuring all required equipment and supplies; and
- Training workers on specifics of the deconstruction project.

A discussion of each of the planning steps is presented in the following paragraphs.

³⁵ *Feasibility Study for a Deconstruction Program for MMHUITs*, with Contributions from Douglas County Public Works Solid Waste Management Division, the University of Oregon, and Heartwood ReSources, December 2006; available at: http://www.heartwoodresources.org/Final_MMHUIT_Report_wExecSummary.pdf

Assessing Abandoned Mobile Home Candidates

The first step for any deconstruction project is to conduct a visual inspection of potential structures to determine if it is a suitable candidate for deconstruction. This generally consists of having an experienced deconstruction expert inspect the structure to evaluate the basic material types and the overall condition of the structure. The condition of the structure should be documented and photographed to ensure that all relevant details are recorded. The individual assessing the structure should attempt to determine the age of the unit and look for any evidence of fire damage, water damage, rot, mold, obvious leaks, and other possible hazards such as evidence of asbestos or lead paint concerns.

An evaluation of the deconstruction work site should also be conducted at this time. Consideration should be given to setting up the work site so as to maximize efficiency for removal and disassembling component items. Materials recovery occurs most efficiently if the deconstruction site is large enough to allow on-site sorting of materials. Adequate space should be made available around the units to allow for disassembling the structure, storing materials removed from the structure, and processing of removed items. Having a separate storage or disposal area for each type of salvaged or non-salvaged materials can reduce contamination.

A suggested deconstruction assessment checklist is provided as part of Appendix B.

In addition, the work site should be adjacent to accessible roads for disposal pick-ups and drop-offs; should offer access to nearby facilities that are air conditioned or heated (if the deconstruction is to take place in extreme heat or cold conditions); and should provide adequate space for the placement of each work station. If multiple mobile homes are to be deconstructed at the same time, then it may be most efficient to select a central location for the deconstruction and to have the mobile homes transported there.

Inventory of the Abandoned Mobile Homes

After the initial assessment, the next step is to conduct an inventory of the mobile home and estimate the amount of materials contained in the structure. First, the estimator should conduct a thorough inventory of all materials, identifying those for salvage, recycling, or disposal.

Using a checklist, the estimator will evaluate:

- The material remaining in the structure (such as furniture, cabinetry, interior and exterior doors, white goods, and light fixtures) and their current conditions;
- Potential reuse options for the identified potentially salvaged material; and
- An estimate of the volume of the salvageable and non-salvageable materials.

The checklist will include information on the structure's overall dimensions and include the number of windows and doors. This information will assist the estimator in calculating the volume of salvageable and non-salvageable materials and will also aid in developing a schedule for the deconstruction, the number and type of tools required, and the number of workers required.

At the same time that the initial assessment is being conducted, consideration should be given to selecting and identifying local recycling or salvage markets. Often these structures contain furnishings that are in usable condition. Rather than disposing of these items at the local landfill, consideration should be given to donating these materials to a local charity or posting them on a local recycling website.

Environmental Health Survey

Many of the abandoned mobile homes that will be candidates for deconstruction will be more than 30 years old, as is the case with those on the SNI Cattaraugus Reservation. Environmental surveys for lead-based paint and asbestos must be completed for any structure built before 1978. EPA, OSHA and HUD all have regulations for dealing with lead-based paint and asbestos containing materials. **Note that deconstruction is considered a demolition and is subject to OSHA Code of Federal Regulations (CFR) 29 Part 1926 for Labor.**

Asbestos

If a mobile home is suspected of containing asbestos, consult with a licensed asbestos professional who can determine its true nature before coming in contact with it. Until the material has been classified as either hazardous or non-hazardous, it is critical to continue treating the material as if it were hazardous.

If the mobile home is determined to contain asbestos, an asbestos abatement will need to be performed **prior** to implementing any demolition activities. The federal government considers handling asbestos as a serious activity and if not properly handled, fines can be issued. This occurred at a Bend, Oregon Mobile Home Park where \$15,000 in fines were issued because asbestos abatement professionals were not contacted to handle asbestos where mobile homes were being demolished.³⁶

Asbestos abatement should be conducted by a licensed, certified technician. When asbestos containing materials are damaged or disturbed by repair, remodeling, or demolition activities, the fibers become airborne. Inhaling asbestos fibers can cause significant health problems such as lung cancer, mesothelioma (a cancer of the lining of the chest and the abdominal cavity), and asbestosis.

Lead-based Paint

As of April 22, 2010, federal law requires that any person performing renovation, repair, and painting projects that disturb more than six square feet of paint in homes, child care facilities, and schools built before 1978 must be certified and trained to follow specific work practices to prevent lead contamination. The EPA recommends using a professional to conduct an investigation of a home to confirm the presence of lead.³⁷

³⁶ Mesothelioma News. Asbestos Violations Cited at Bend, Oregon Mobile Home Park. December 8, 2008. <http://www.mesotheliomanews.com/2008/12/12/asbestos-violations-cited-at-bend-oregon/>

³⁷ U.S. EPA Renovation, Repair and Painting Rule, <http://www.epa.gov/lead/pubs/renovation.htm#opt>.

There are two types of professional inspections that can be performed on a home depending on the level of information that is known: a paint inspection or a risk assessment. A paint inspection provides information of the lead content of each type of painted surface. A risk assessment identifies any source of serious lead exposure (such as peeling paint and lead dust) as well as what actions to take to address these hazards.

The deconstruction costs and processes will be heavily influenced by the presence of asbestos and lead-based paint materials. Please note that the disposal of these hazardous materials will be different from the disposal practices adopted for non-hazardous material. Please refer to www.epa.gov/lead or www.osha.gov for detailed information on regulations, or contact your local agency representative.

IMPORTANT! Remember to hire a professional to conduct a lead-based paint and asbestos inspection if a manufactured home was built before 1978!

Obtaining Permits and Required Authorizations

Most tribal and local governments have an agency that is responsible for permitting demolition, renovation, and deconstruction projects. Project managers should check with all applicable authorities to determine their permit requirements.

When deconstructing an abandoned mobile home, permission should be obtained from the owner, if possible. If the owner is unknown, the appropriate authority, such as tribal management or, on non tribal land, the local tax assessor's office, should be contacted to identify the current owner. Upon identifying the current owner, additional information regarding the history of the structure should be collected. Interviews with the owner may reveal important elements to the deconstruction project. For example, the owner may be able to provide information on the condition of the home or the age of the home. Both pieces of information are useful as the age of the home will assist the team in ascertaining whether it is likely to contain lead-based paint or asbestos. The last known condition of the unit will aid the team in preparing for certain conditions (e.g. a history of rodent infestation, water damage, or structural concerns).

Should the mobile home require re-location for purposes of providing adequate work space for the deconstruction, the appropriate authority should be contacted as a permit or other required documentation may be needed prior to re-location.

Pre-Deconstruction Assessment of the Abandoned Mobile Homes

The pre-deconstruction assessment phase consists of inspecting the structure to determine potential threats to the overall health and safety of the deconstruction team. The assessment also aids the team in further planning for the deconstruction activities. Assessment is critical as it will determine the most efficient approach to the deconstruction. It is suggested that a deconstruction expert perform the assessment to ensure that all major issues are identified and properly forecasted. The information gathered during the pre-deconstruction assessment will be used to develop the Deconstruction Project Plan.

Assessment should include a review of the known history of the structure. The entire structure from the exterior to the interior should be carefully inspected. The inspection of the ceiling and roof, as well as overall structural integrity of the unit should be assessed. This information will assist the team in planning the best strategies for deconstructing the mobile home. The strategies should consider the safest and most effective manner of deconstruction in terms of time, labor, and cost.

Preparing a Deconstruction Project Plan

A Deconstruction Project Plan should be developed based upon the information gathered up to this point. This project plan should consist of the following subsections (note each section will be discussed individually below):

- Site Plan;
- Project Organization;
- Health and Safety; and
- Materials Management.

Site Plan

A Site Plan should be developed prior to beginning the deconstruction activities. See Figure 3, for a sample site plan.

The plan should be designed to maximize safety, and also to facilitate movement around the site. The Site Plan should include deconstruction, re-construction, processing, disposal, and stockpile work stations. The plan should be communicated to all members of the deconstruction team to ensure that members understand how the deconstruction activities are to proceed.

Rational location of the work stations will promote proper health and safety practices and, in addition, will increase the labor and time efficiency of deconstruction activities.

Specifics of the plan should be customized based on site conditions. The following general guidelines should be employed, if possible:

- The deconstruction work station should be located near the disposal area to promote a clean work site;
- The disposal work station should be located near an access road to allow pickup of disposed or salvaged items; and
- The processing and re-construction work stations should be located near the stockpiling as the conduct of these activities rely on the salvaged material.

The Deconstruction Institute's *A Guide to Deconstruction* recommends that the following items be considered when designing a site plan:³⁸

³⁸ *A Guide to Deconstruction*, Deconstruction Institute, 2003; available at: http://www.deconstructioninstitute.com/learning_center.php.

- Entrance and exit to site for people and equipment, including loading materials.
- Worker and visitor parking that does not conflict with other vehicles such as roll-off hauler.
- Secure central facility for overnight storage of tools.
- Hauling material from the site should be convenient to the generation of materials and flexible as the materials will be coming from different locations in the building.
- Deconstruction activity must be safely demarcated and workers should not be in conflict with machinery.
- Processing location will be flexible depending upon where and what activities are taking place. Identify areas to capture nails and off-cuts that are convenient to both waste disposal and the removal of processed materials from the site.
- For the comfort of workers, provide shade, if possible.
- Temporary storage location for materials left on the site should be secure from pilferage, protected from weather and the ground.
- Metal recycling location should remain in one location throughout the project and should be easily accessible for removal when enough metals have been accumulated to make a sufficient load.
- Hazardous material locations should be in approved containers, safe from damage from other activities and away from workers' rest areas, etc. Hazardous materials should be removed for disposal as quickly as possible.
- Site security may or not include fencing but will include signage, warning tape and barricades as necessary. Signage and security must be maintained on a daily basis with a walk-through and check at the end of every workday.
- Tree protection should be considered for significant or heritage trees on the site. Roll-offs and heavy equipment can damage tree roots. Trees may need to be removed if they present a safety hazard to workers (e.g. tree branches overhanging a roof where workers are present).
- Temporary toilet should be close enough to be readily accessible.

Project Organization

Project organization addresses the internal and external resources that will be required to conduct deconstruction. These resources will include the personnel required as well as the tools and equipment required. In addition, the project organization section of the Deconstruction Project Plan will include:³⁹

- A listing of the training needs based on the experience and knowledge of the available workers or volunteers.
- A list of any heavy equipment, disposal roll-offs, generator, forklift, rentals, etc. that needs to be ordered and schedule for ordering.
- Landfill access information, including the proper disposal of hazardous materials.
- A complete tool inventory and schedule for purchase of any known additional tools needed.
- Assignment of personnel roles and responsibilities.
- Schedule and time-line for project.

³⁹ *A Guide to Deconstruction*, Deconstruction Institute, 2003; available at: http://www.deconstructioninstitute.com/files/learn_center/45762865_guidebook.pdf .

Volunteers are often used on deconstruction projects of this nature. The project manager should have each participant complete a self-evaluation of their strengths, weaknesses, desires for participating in the deconstruction activities, and familiarity with deconstruction-related activities. Based on these discussions, the planning of the deconstruction activities and the assignment of duties for individual participants can be done appropriately. It is also recommended that the project manager assign clear roles and responsibilities to each worker so that they know their respective duties.

Health and Safety

The health and safety plan should include:

- Overall objectives of the deconstruction project;
- A list of physical, chemical and biological hazards posed by the site and the steps to be taken to minimize risk;
- Contact information for each of the deconstruction team members;
- Directions to the nearest hospital, police station, fire station; and a designated facility with air conditioning or heat, if heat or cold stress is a concern;
- A list of allergies and prescriptions that each of the deconstruction team members may be taking; and
- A listing of the required personal protective equipment for all staff members.

All crew members should be educated on the contents of the health and safety plan and they should sign a statement that they have received this training.

Materials Management

The critical factor to consider in salvaged material handling is the efficient collection and disposition of the materials into the appropriate storage containers or areas prior to their removal from the work site. Consideration should be given to minimizing or avoiding contamination of the salvaged material, and spoilage due to weather, during handling or storage. Waste materials should be collected and handled in a safe and healthy manner. A person should be designated to segregate salvaged material into piles as it is removed from the mobile home. This will aid in time efficiency and will also promote a safe work environment.

Arranging for Site Security

Site security includes preventing the theft of salvaged materials, equipment, and tools. Site security also reduces the risk to the public. An assessment should be made as to whether the area needs to be protected using fencing or whether warning signs and marking the site off with tape would be adequate. In any event, site tools, salvageable materials of significant value (recyclable metals such as copper) should be stored securely overnight.

Procuring Required Equipment and Supplies

Although inspection of the mobile home or deconstruction site may not have required specific personal protection equipment (PPE), basic PPE should be used by all members of the project

team. Basic PPE includes:

- Hard hat,
- Safety glasses,
- Ear protection,
- Leather gloves, and
- Steel-toed and steel-shank boots.

The tools to be used should be adequate to the tasks, in proper working condition and used properly. Power tools must have proper insulation and grounding. The proper tools also include safety systems such as grounding for electrical generators, harnesses for fall protection, lock-out tags, warning tape, medical first aid kit, and fire extinguishers. Table 6, Suggested Tools and Equipment, provides examples of equipment and tools used during deconstruction training that may also be required for a typical reconstruction project.

Training Workers on the Deconstruction Project Plan

Deconstruction and demolition work are dangerous activities for untrained personnel. As a result, trained professionals should lead and accompany any volunteers involved in the project. It is essential that each deconstruction group include at least one trained deconstruction professional as well as an adequate number of volunteers to support the activity efficiently. A general rule-of-thumb is to have at least two persons per work station and for every work station, there should be one trained professional to provide guidance and ensure a safe environment.

Educating crews on materials recovery techniques and procedures such as sorting and storage methods, recoverable materials, and removal techniques can eliminate contamination problems and increase recovery rates.⁴⁰

Training should always be given and acknowledged for any new worker and then again for each new task and piece of equipment.

⁴⁰ *Building Savings Strategies for Waste Reduction of Construction and Demolition Debris from Buildings*, U.S. EPA (EPA-530-F-00-001), June 2000.

Table 6 - Suggested Tools and Equipment







Item and Description		Item and Description	
<p>Claw Hammer (Manual) Used for general demolition activities including nail removal.</p>		<p>Rechargeable Drill/Driver (Powered) Used for screw removal and general reconstruction activities.</p>	
<p>Vice Grips (Manual) Used for general demolition activities including holding objects firmly for cutting and bending materials.</p>		<p>Pry Bar (Manual) Used for the majority of the deconstruction activities to pry apart materials.</p>	
<p>Wheel Barrow (Manual) Used to transport material and equipment from one work station to another.</p>		<p>Measuring Tape and Pliers (Manual) Used for measuring reclaimable materials and for re-construction activities.</p>	

Table 6 - Suggested Tools and Equipment (Continued)















Item and Description		Item and Description	
<p>Bear Claw (Manual) Used during processing for prying nails from salvaged material.</p>		<p>Push Broom (Manual) Used to clean the work station which permitted hazardous materials to be removed as they posed potential safety issues.</p>	
<p>Variety of Tools (Manual) Used for both deconstruction and reconstruction.</p>		<p>Rubber Mallet, Adjustable Wrench, and Socket Wrench (Manual) Used during the reconstruction phase. The hammer was used to beat the salvaged aluminum siding around the corners of the storage shed.</p>	
<p>Dust Masks and Work Gloves (Personal Protective Equipment) These items are essential to the health and safety of the deconstruction team as dust and mold infested items will be encountered during the majority of deconstruction projects.</p>		<p>Tension Straps (Manual) Used to stabilize exterior walls whose support has been removed. The strap prevented the wall from collapsing on workers.</p>	

Table 6 - Suggested Tools and Equipment (Continued)

Item and Description		Item and Description	
<p>Heavy Duty Stapler (Manual) Used during the processing and reconstruction phases. Used to reinforce salvaged trusses prior to reuse.</p>		<p>Scaffolding Used during the deconstruction and reconstruction to prevent need for high ladders.</p>	
<p>Reciprocating Saw (Powered) Used during deconstruction to cut wood and sheet metals (Referred to by the trade name Sawzall™).</p>		<p>Tin Snips (Manual) Used during reconstruction to cut metal.</p>	
<p>Heavy Duty Trash Bags</p>		<p>Miter Saw (Powered) Used for the construction of the storage shed.</p>	
<p>Roll Off Container</p>		<p>Acetylene Torch</p>	

B. Deconstructing Mobile Homes - Summary

While each deconstruction project is unique, there are a number of elements that should be considered during any deconstruction process. These elements include:

- Health and safety considerations;
- Weather;
- Communication; and
- Maintaining a Clean Work Site.

Health and Safety Considerations

Health and safety is a primary factor in the success of any deconstruction project. Time and labor efficiency can be negatively affected if health and safety are not considered at the beginning of a project. Health effects such as traumatic injury, biological, and environmental hazards may be encountered. As a result, provision of PPE, encouragement of open communication with the deconstruction participants, and awareness of weather conditions are elements that encourage a safe work site.

At the beginning of the deconstruction process, the entire site should be checked for miscellaneous hazards such as holes, roots and uneven ground, biting animals and insect nests, tree limbs that might be in the way, overhead wires, fences, etc. that might cause accidents and inhibit equipment movement. Locating and killing all bee hives and hornet's nests prior to deconstruction activities are also important health and safety considerations.

As mentioned in the Assessment phase of the deconstruction training, a home that is constructed prior to HUD code enforcement should be fully assessed by a professional engineer or certified technician. Many hazardous materials are or have been used in the construction of mobile and site-built homes (i.e., asbestos, lead, mercury and formaldehyde). Therefore, it is important to stress that only specially trained individuals should come in contact with anything that may contain hazardous materials.

One aspect of deconstruction that differentiates it from more traditional and mechanized demolition is the use of hand labor. When hand labor and mechanized processes are integrated, the greatest care must be taken to insure that people and mechanical equipment are safely separated.

Weather Considerations

Deconstruction in northern climates is generally a seasonal activity, starting in late spring and ending by early fall (April-September). Depending on the region, outdoor temperatures could cause dehydration, heat stroke, or cold stress. Encouraging deconstruction participants to stop work frequently to take a break and to rehydrate, is the best means for preventing heat-induced illnesses. In addition, workers should be provided with 30 to 45 minute morning and afternoon breaks as well as an hour lunch for the entire deconstruction group. As a part of deconstruction supplies, adequate water should be provided.

As with any outdoor field activity, observing the weather and scheduling the deconstruction activities based upon the forecast is strongly encouraged. Weather conditions can affect the progress of the activities and safety of the deconstruction area. If heavy winds, rains, and thunderstorms are observed, all activities should be terminated. It is also suggested that a portable weather radio is useful for timely warning of severe weather conditions.

Communication

Open communication regarding the safety of the deconstruction activities is a beneficial practice that should be adopted for any deconstruction project. Open communication allows for deconstruction participants to be informed of the possible hazards that may be encountered, planned events for each day, and suggested approaches for the completion of the planned events. Open communication does not rely on one individual, but rather on **all** the deconstruction participants. Prior to initiating the deconstruction project, PPE should be distributed and any participant's allergies, reactions, and/or medical concerns should be discussed. Should additional hazards be identified during the deconstruction activities, all deconstruction participants should be informed immediately. For example, if a participant tells the group that she/he is allergic to fiberglass, which is a major component of insulation material, then the group would be cognizant of the need to keep that person away from contact with the insulation.

As a part of open communication, discussion of completed activities and suggested approaches for subsequent activities should be conducted daily. Establishing routine points during the day for discussion can enhance and improve overall communication and reduce errors or accidents. Many deconstruction projects include these debriefing sessions so that all participants are made aware of the current and forecasted activities.

As the deconstruction activities progress, lessons learned that may require the re-consideration of PPE, communication protocols, and other health and safety practices should be implemented. Discovery of any hazard should be communicated immediately to all participants so that the issue is addressed.

Maintaining a Clean Work Area

Finally, it is critical to the health and safety of each participant that a clean work area be maintained throughout the entire process. By maintaining a clean work area, safety hazards such as slips, trips, and falls, can be reduced. In addition, maintaining a clean area can reduce the amount of time projected for the entire deconstruction. Potential hazards can be reduced by regularly removing and disposing of any loose debris (insulation, small pieces of lumber, and any exposed nails and sharp edges).