Building Dismantling and Resource Recovery

Steve Salzman, P.E.
Waste Management Engineer
Winzler & Kelly, Consulting Engineers

This paper presents an overview of the building dismantling and resource recovery process, reasons to maximize recovery of resources from obsolete structures, and a description of a project the author completed for the Port of Portland. Let us begin by defining a few terms common to this field of practice.

Definitions

Reuse: Building materials recovered from a structure are reused for the same purpose as they were in the original structure. Timbers, framing lumber, doors, windows, and other hardware and equipment are prime candidates for reuse.

Recycle: The building materials are crushed or shredded, sorted, and then utilized as a raw material in some other manufacturing process. Examples of this include recycling of scrap metals by foundries, recycling of concrete into aggregate, recycling of wood for use as fuel or mulch.

Disposal: Some materials that cannot be economically segregated into individual components will have to be landfilled. The real creativity in this resource recovery process is in finding economical ways to dismantle the building or process the debris that eliminates the need for disposal.

Dismantling: Taking the building apart in sections or piece by piece, typically in the reverse order in which it was constructed (sometimes referred to as deconstruction.) For wooden structures the process usually starts with the siding or roof and ends with the foundation. Good quality timbers, framing lumber, siding, doors, windows, and other fixtures or equipment are carefully removed in a manner that maintains their reuse value. Dismantling large structures is typically done using excavators or cranes to lift the structural components free of the building. Hand crews are then used to recover individual items and remove fasteners (denailing.)

Demolition: The entire structure is reduced to rubble with a wrecking ball or other heavy equipment, implosions, or torch cutting and the raw material components are recovered through various sizing and sorting operations. Most contractors recover as much of the reusable materials as possible before demolishing the structure.

Reasons to Maximize Recovery

Dismantling a building and maximizing the recovery of reusable materials and recyclable resources requires more planning, more lay-down space, and more time than a conventional demolition procedure. Even so, this approach to decommissioning obsolete structures is becoming more common. The two main reasons for this are the increasing demand for the materials that can be recovered and rising disposal costs.

Increasing Demand

The demand for used building materials is growing as the cost of new materials increases. Many buildings contain functional components such as doors, windows, and plumbing fixtures that can be reconditioned and reused in repair work in other existing structures. Often the styles or quality of the older materials cannot be matched with new materials. Structural components such as timbers and other dimensional lumber are often very high quality as they were milled from old growth trees and have had many years to cure and stabilize. This type of wood is sought after by architects, timber framers, furniture and cabinet makers, and finish carpenters. While the domestic markets for high quality timber is strong, overseas markets are even stronger.

Increased Disposal Costs

Over the last ten years, the field of waste management has shifted its focus from disposal of solid waste to recovery of resources. The new rules and regulations that have been responsible for this change have also increased the cost to design, construct, operate, and close landfills while at the same time have instituted mandatory waste reduction requirements. This has provided the economic and regulatory incentive for public and private entities to reduce the amount of waste they generate. A great deal of public effort and money has been expended in the development of consumer recycling programs. While programs that target cans, bottles, and newspaper help to raise the consciousness of consumers and are responsible for diversion of significant amounts of waste; they often require subsidies in the form of high tipping fees to make them economically viable. This is due to high collection and processing costs and the long distances the recovered materials have to be transported for remanufacturing. Construction and demolition debris, on the other hand, represent a highly concentrated waste stream for which markets are typically found in the geographic region from which they are recovered. The cost of dismantling and recovering materials from a structure is similar to that of demolition and so does not represent a significant added expense. Construction and demolition debris diversion programs are proving to be cost-effective ways to meet waste reduction goals.

Other Reasons

Two other reasons that are harder to quantify but play a significant role in the decision making process are job creation and resource stewardship. Dismantling, processing, reconditioning, and reusing or recycling building materials creates jobs that can be performed by semi-skilled and un-skilled labor. These types of jobs can provide entry points into a number of career fields including carpentry, mechanics, and waste management. Dismantling projects have also been successfully combined with construction of affordable housing. Proper stewardship of our natural resources has also become a lightening rod issue for many public agencies and private companies. The reuse of timbers and dimensional lumber reduces the pressures on private and national forestlands and the recycling of steel and aggregates reduces the demand for mining. Reuse and recycling of obsolete structures provides a tangible, high-profile project that provides very positive public relations.

There are a number of good reasons to maximize the recovery of resources contained in obsolete structures and it is becoming more common for public entities to include this requirement in their demolition contracts. In order for this requirement to be meaningful the owner must be able to quantify the amount of materials that are recoverable. While most demolition contractors have experience with salvage and have a well developed network of outlets for recovered materials, some of the resources that are available may not be recovered for their highest and best use due to time constraints or market conditions. A contractor might decide to chip serviceable timbers to take advantage of a strong hog fuel market or because of the extra time required to salvage, process, and market them. There is an emerging need to develop a standard process through which owners can make informed decisions regarding the amount of materials they expect to be recovered from their structures. The process must take into account the age and condition of the materials, accessibility of markets, extra time and space requirements, and other site specific factors. The process described in the following section was successfully used by the Port of Portland in their Terminal 4 demolition project.

The Port of Portland Project

The Port of Portland's Terminal 4 complex included approximately 9 acres of 1920's vintage warehouses and piers. The terminal's configuration was outmoded and the structures had fallen into disrepair and were no longer being fully utilized. Due of the estimated remodeling and repair costs, the Port decided to demolish Terminal 4. Because of factors sited earlier and progressive thinking by Port staff a decision was made to minimize waste generation and to maximize the recovery of resources. The Port retained qualified engineering consultants to assist them in their planning process. The first step in the process was to develop an inventory of building materials and hazardous and nonhazardous wastes that were present. The inventory was then evaluated to determine the percentages that were reusable or recyclable and the volumes and types of waste that would require disposal. A market survey was completed to determine the value of the resources and the costs to dispose of waste. Various demolition contractors provided rough cost estimates for the dismantling and recovery processes. Because of the presence of asbestos in the roof membrane a pilot project was implemented to determine if the debris would be considered friable and what the handling and disposal costs would be. A Request for Proposals was then developed that provided all prospective bidders with the inventory. The selection process included points for documented past performance and for high projected recovery rate. The contract required that the contractor accurately track the amount of materials that were recovered for reuse and recycle and those that would be disposed. Additional details are provided below.

Inventory and Evaluation

As a first step in the materials evaluation process an environmental assessment was completed to determine the nature and extent of potentially hazardous and regulated materials that were present. The results of that investigation are contained in a report titled "Terminal 4, Building Materials Survey" (PBS, October 1994). Asbestos-containing materials, creosote treated lumber, mercury vapor lighting, lead-based paint, and pigeon excrement were identified and quantified.

The Winzler & Kelly project team reviewed the as-built plans for the original structure and the various remodels that had occurred as well as the environmental assessment. Survey sheets were prepared to for use in the field inventory. A three person crew spent 5 days visually inspecting the various structural and non-structural elements of the warehouses and piers. The survey sheets, photographs, and a video camera were utilized during the materials survey. The focus of this phase of the work was to collect enough information to develop an accurate inventory of the standing timber and the other materials in the structures, and to establish the physical condition of this inventory.

The inventory included timbers, pilings, dimensional lumber, concrete, asphalt, roofing, metal siding, fire sprinkler system, electrical system, roll-up doors, and windows. Surveying and organizing the inventory of the wood resources was very time consuming. There was over 8,900,000 board feet of lumber, timbers, and pilings in the structures. The wood inventory was entered into a spreadsheet to facilitate it evaluation. The resulting tables are presented at the end of the text. It was estimated that between 4,500,000 to 6,230,000 board feet of wood could be recovered for reuse, that between 3,700 and 5,500 bone dry tons of untreated wood waste residual would be recycled, and that between 193,000 and 388,000 board feet (320 to 650 tons) of treated wood waste would require disposal.

There was approximately 401,000 square feet of built-up roofing membrane on the warehouses that contain asbestos fibers. It was not clear that this material could be considered simple construction and demolition debris and may have had to be handled and disposed as hazardous waste. A pilot removal project was recommended (and later completed) to establish this classification.

The volumes and weights of the concrete, asphalt, and scrap metals were also determined. After the inventory and evaluation was complete research was begun to identify the markets for all of the materials.

Market survey

Research was completed to determine the approximate net value of the inventory. Various demolition contractors were contacted and the dismantling and salvage costs were estimated to fall between $2,100,000 and $5,500,000. The large range was due to the undefined condition of the asbestos roofing and the uncertainty associated with the piling extraction. This range was narrowed down to $2,000,000 to $3,500,000 after the asbestos pilot project was completed.

A market survey was then completed to ascertain the demand for the inventory and to establish a range of values for the various elements of the inventory. Numerous brokers, wholesalers, retailers, and contractors were contacted and queried. An extensive listing of re-users and recyclers in the Portland area was provided by Metro. The demand for the wood resources was very strong. Its estimated value alone was between $1,300,000 and $2,600,000. The asphalt and concrete had a net zero value but could be completely recycled into new products. The metals had enough value as scrap to justify their removal and salvage. Many of the brokers and retailers could not commit to prices on materials until they could were available for inspection and sale. This is because of volatile markets for these materials, the unconfirmed quality and the

amount of reconditioning or processing that would be required to bring them to market.

The miscellaneous materials such as metal siding, fire sprinkler system, and doors do not have as large an economic impact on the project as the wood, but removal of these materials from the buildings prior to beginning the dismantling procedure was estimated to decrease the cost to the contractor (and so to the project) by 10%.

Alternate uses and disposal options for the materials that had no market value, were contaminated, or unsalvageable were also researched. A number of disposal sites, recyclers, and regulatory agencies were contacted for information on specific materials. These materials included broken timbers that had been treated with creosote or coated with lead-based paint and the pigeon excrement/lead-based paint dust that was present throughout the buildings. A processor that extracts creosote from treated wood was found and various options for removing lead-based paint from timbers and concrete were explored. The issue of determining when a reusable building material constitutes a hazardous waste and at what point in the process samples should be taken was discussed with Oregon's Department of Environmental Quality (DEQ) and the US Environmental Protection Agency. These issues can dramatically increase the cost of the dismantling, processing and shipping operations. The regulations are not hard and fast for this field of waste management and there is a lot of room for interpretation.

Report of Findings

The information gathered and developed was presented in a Report of Findings titled, "Terminal 4 Pier and Warehouse Removal Materials Survey, Inventory and Evaluation" (Winzler & Kelly, February, 1995.) The report included a complete inventory and evaluation of the materials present, a proposed dismantling procedure, a discussion regarding the effect the hazardous waste components would have on the dismantling procedures, and recommendations regarding pilot projects and the Port's approach to contracting for the work.

Pilot Projects

In order to more accurately define the costs of removing and disposing the asbestos-containing roofing materials a pilot project was planned and implemented. It was a cooperative effort between the DEQ, the Port, an asbestos abatement contractor, and a landfill. The pilot project included removal of a section of the roofing membrane and the roof decking. The intent of the project was to determine 1) if the roofing materials would be considered friable (hazardous), 2) if the roof decking could be economically rendered asbestos free, and 3) the associated handling and disposal costs. The asbestos pilot project resulted in significant reductions in the estimated costs for this element of the project. Similar pilot projects could have been implemented for creosote treated timbers and lead-base painted materials but this work was left as the responsibility of the demolition contractor.

Request for Proposals

The Port decided to select a contractor through a Request for Proposals (RFP) process. The contractor would be responsible for all phases of the work and would receive all salvage rights. An alternate approach considered by the Port was retaining ownership of the salvaged materials, marketing them, and depositing the revenues into an enterprise fund for future evaluations and dismantling projects.

An RFP was developed only for Pier 2 (approximately one quarter of the Terminal 4 complex.) By completing the project in phases, the Port will be able to gain experience with the process and modify their requirements or approach before committing to the larger Pier 1. The RFP included a clearly defined scope of work and statement of the Port's goal of maximizing reuse. Although the Port was processing some of the required permits for the project, the contractor was also responsible for most of the permitting processes. Local state and federal permits were required. The selection criteria included prior experience with dismantling and salvaging large wooden structures, experience with development and implementation of hazardous and nonhazardous waste plans, projected recovery rates and cost. A $1,000,000 performance bond was also required. It was a very comprehensive RFP that required a lot of research and planning in response.

Due to the complexity of the project and the many disciplines involved, most contractors teamed with various other specialists including marine contractors, hazardous waste experts, and materials processors. Approximately twenty-five companies were represented at the pre-bid meeting and nine submitted formal bids. The bids ranged from $587,000 to $1,677,000.

Tracking and Documentation

The contractor was required to track and document, on a monthly basis, the amount of materials that were salvaged for reuse and recycle and the amount that was destined for disposal. This information will be utilized by the Port in their planning for the second phase of the Terminal 4 Project.

For additional questions contact Mr. Steve Salzman at Winzler & Kelly, Consulting Engineers, in Eureka, California (707) 443-8326, or Mr. Walt Haynes at the Port of Portland, in Portland, Oregon (503) 731-7343.

Table 1. Standing Inventory of Wood Above Floors

Pier 1 - House 1

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			9,450	3,780	1,260	1,260	6,300
Studs	3" x 6"	10	175	1,750	2,100	525		2,625
Posts	12" x 14"	18	52	936		13,104		13,104
	6" x 6"	12	26	312	749	187		936
Braces	6" x 10"	10	390	3,900	15,600	3,900		19,500
	6" x 10"	20	42	840	3,360	840		4,200
Roof Purlins	8" x 14"			4,788	35,750	8,938		44,688
	6" x 8"			1,260	4,032	1,008		5,040
	6" x 12"			1,260	6,048	1,512		7,560
Rafters	4" x 6"			12,960	20,736	5,184		25,920
Top Chord	8" x 10"			2,340	11,700	4,680		16,380
Bottom Chord (Laminated)	8" x 10"			2,340	12,480	3,744		16,224
Roof Deck	1-1/4" x 6"			90,720	28,350	22,680	5,670	56,700
TOTAL BOARD FEET					144,685	67,562	6,930	219,177

Pier 1 - House 2

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			10,800	2,880	960	960	4,800
Studs	3" x 6"	10	200	2,000	2,400	600		3,000
Posts	12" x 14"	18	60	1,080		15,120		15,120
	6" x 6"	12	30	360	864	216		1,080
Braces	6" x 10"	10	450	4,500	18,000	4,500		22,500
	6" x 10"	20	48	960	3,840	960		4,800
Roof Purlins	8" x 14"			5,472	40,858	10,214		51,072
	6" x 8"			1,440	4,608	1,152		5,760
	6" x 12"			1,440	6,912	1,728		8,640
Rafters	4" x 6"			14,760	23,616	5,904		29,520
Top Chord	8" x 10"			2,700	13,500	4,500		18,000
Bottom Chord (Laminated)	8" x 10"			2,700	14,400	3,600		18,000
Roof Deck	1-1/4" x 6"			103,680	32,400	25,920	6,480	64,800
TOTAL BOARD FEET					164,278	75,374	7,440	247,092

Table 1. Continued

Pier 1 - House 3

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			12,150	3,240	1,080	1,080	5,400
Studs	3" x 6"	10	225	2,250	2,700	675		3,375
Posts	12" x 14"	18	68	1,224		17,136		17,136
	6" x 6"	12	34	408	979	245		1,224
Braces	6" x 10"	10	510	5,100	20,400	5,100		25,500
	6" x 10"	20	54	1,080	4,320	1,080		5,400
Roof Purlins	8" x 14"			6,156	45,965	11,491		57,456
	6" x 8"			1,620	5,184	1,296		6,480
	6" x 12"			1,620	7,776	1,944		9,720
Rafters	4" x 6"			16,560	26,496	6,624		33,120
Top Chord	8" x 10"			3,060	15,300	5,100		20,400
Bottom Chord								
(Laminated)	8" x 10"			3,060	16,320	4,080		20,400
Roof Deck	1-1/4" x 6"			116,640	36,450	29,160	7,290	72,900
TOTAL BOARD FEET					185,130	85,011	8,370	278,511

Pier 1 - House 4

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			24,300	6,480	2,160	2,160	10,800
Studs	3" x 6"	10	450	4,500	5,400	1,350		6,750
Posts	12" x 14"	18	140	2,520		35,280		35,280
	6" x 6"	12	70	840	2,016	504		2,520
Braces	6" x 10"	10	1,050	10,500	47,250	5,250		52,500
	6" x 10"	20	108	2,160	9,720	1,080		10,800
Roof Purlins	8" x 14"			12,312	91,930	22,982		114,912
	6" x 8"			3,240	10,368	2,592		12,960
	6" x 12"			3,240	15,552	3,888		19,440
Rafters	4" x 6"			33,300	53,280	13,320		66,600
Top Chord	8" x 10"			6,300	31,500	10,500		42,000
Bottom Chord								
(Laminated)	8" x 10"			6,300	33,600	8,400		42,000
Roof Deck	1-1/4" x 6"			233,280	72,900	58,320	14,580	145,800
TOTAL BOARD FEET					379,996	165,626	16,740	562,362

Table 1. Continued

Pier 1 - House 5

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			9,720	2,592	864	864	4,320
Studs	3" x 6"	10	180	1,800	2,160	540		2,700
Posts	12" x 12"	18	64	1,152		13,824		13,824
	6" x 6"	12	32	384	922	230		1,152
Braces	6" x 10"	10	480	4,800	19,200	4,800		24,000
	6" x 10"	20	48	960	3,840	960		4,800
Roof Purlins	8" x 14"			6,080	45,397	11,349		56,747
	6" x 8"			1,600	5,120	1,280		6,400
	6" x 12"			1,600	7,680	1,920		9,600
Rafters	4" x 6"			13,650	21,840	5,460		27,300
Top Chord	8" x 10"			2,400	12,000	1,200		13,200
Bottom Chord (Laminated)	8" x 10"			2,400	12,800	960		13,760
Roof Deck	1-1/4" x 6"			52,000	16,250	13,000	3,250	32,500
TOTAL BOARD FEET					149,801	56,388	4,114	210,303

Pier 2 - House 1

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			7,776	2,592	864	864	4,320
Studs	3" x 6"	10	180	1,800	2,160	540		2,700
Posts	12" x 12"	18	64	1,152		13,824		13,824
	6" x 6"	12	32	384	922	230		1,152
Braces	6" x 10"	10	480	4,800	19,200	4,800		24,000
	6" x 10"	20	51	1,020	4,080	1,020		5,100
Roof Purlins	8" x 14"			6,460	48,235	12,059		60,293
	6" x 8"			1,700	5,440	1,360		6,800
	6" x 12"			1,700	8,160	2,040		10,200
Rafters	4" x 6"			16,102	25,763	6,441		32,204
Top Chord	8" x 10"			2,656	13,280	4,427		17,707
Bottom Chord (Laminated)	8" x 10"			2,656	14,165	3,541		17,707
Roof Deck	1-1/4" x 6"			112,880	35,275	28,220	7,055	70,550
Flooring	1-1/4" x 4"			84,660	52,913			52,913
TOTAL BOARD FEET					232,184	79,366	7,919	319,469

Table 1. Continued

Pier 2 - House 2

Description	Dimensions	Length	Number of Pieces	Total Lineal Feet	Total Board Feet			
					#1	#2	#3	Combined
Sheathing	1" x 8"			3,024	1,008	336	336	1,680
Studs	3" x 6"	10	70	700	840	210		1,050
Posts	12" x 12"	18	52	936		11,232		11,232
	6" x 6"	12	26	312	749	187		936
Braces	6" x 10"	10	390	3,900	15,600	3,900		19,500
	6" x 10"	20	42	840	3,360	840		4,200
Roof Purlins	8" x 14"			5,320	39,723	9,931		49,653
	6" x 8"			1,400	4,480	1,120		5,600
	6" x 12"			1,400	6,720	1,680		8,400
Rafters	4" x 6"			15,106	24,170	6,042		30,212
Top Chord	8" x 10"			2,158	10,790	3,597		14,387
Bottom Chord (Laminated)	8" x 10"			2,158	11,509	2,877		14,387
Roof Deck	1-1/4" x 6"			92,960	29,050	23,240	5,810	58,100
Flooring	1-1/4" x 4"			79,680	49,800			49,800
TOTAL BOARD FEET					197,798	65,192	6,146	269,137

Notes:
#1 Quality wood is clear or has small knots and is free of Heart Center
#2 Quality wood has pronounced check cracks
#3 Quality wood is defective and non-reusable

Table 2. Summary and Evaluation of Standing Inventory of Wood Above Floor

Untreated Lumber

Description	Dimensions	Total Board Feet				Marketable BF Of # 1 and # 2		Dollar Value Marketable Wood		Nonmarketable Residue - BF		Bone Dry Tons Residue	
		#1	#2	#3	Combined	Low	High	Low	High	Low	High	Low	High
Sheathing	1" x 8"	22,572	7,524	7,524	37620	0	18,810	$0	$9,405	18,810	37,620	21.9	43.9
Studs	3" x 6"	17,760	4,440	0	22,200	13,320	17,760	$3,996	$7,104	4,440	8,880	5.2	10.4
Posts	12" x 12"	0	38880	0	38,880	23,328	31,104	$4,666	$9,331	7,776	15,552	9.1	18.1
	12" x 14"	0	80640	0	80640	48,384	64,512	$9,677	$19,354	16,128	32,256	18.8	37.6
	6" x 6"	7,200	1,800	0	9,000	5,400	7,200	$1,080	$2,880	1,800	3,600	2.1	4.2
Braces	6" x 10"	187,770	39,030	0	226,800	136,080	181,440	$61,236	$90,720	45,360	90,720	52.9	105.8
Roof Purlins	8" x 14"	347,857	86,964	0	434,821	304,375	347,857	$121,750	$173,929	86,964	130,446	101.5	152.2
	6" x 8"	39,232	9,808	0	49,040	34,328	39,232	$13,731	$19,616	9,808	14,712	11.4	17.2
	6" x 12"	58,848	14,712	0	73,560	51,492	58,848	$20,597	$29,424	14,712	22,068	17.2	25.7
Rafters	4" x 6"	195,901	48,975	0	244,876	146,926	171,413	$44,078	$68,565	73,463	97,950	85.7	114.3
Top Chord	8" x 10"	108,070	34,003	0	142,073	85,244	99,451	$25,573	$49,726	42,622	56,829	49.7	66.3
Bottom Chord	8" x 10"	115,275	27,203	0	142,477	71,239	85,486	$3,562	$8,549	56,991	71,239	66.5	83.1
Roof Deck	1-1/4" x 6"	250,675	200,540	50,135	501,350	0	300,810	$0	$90,243	200,540	501,350	234.0	584.9
Flooring	1-1/4" x 4"	102,713	0	0	102,713	0	41,085	$0	$20,543	61,628	102,713	71.9	119.8
TOTAL		1,453,872	594,519	57,659	2,106,051	920,115	1,465,009	$309,945	$599,387	641,042	1,185,935	747.9	1,383.6

Notes:
#1 Quality wood is clear or has small knots and is free of Heart Center
#2 Quality wood has pronounced check cracks
#3 Quality wood is defective and non-reusable
Dollar Value is determined as stacked lumber ready for shipping to markets

Table 3. Standing Inventory of Wood Below Floors (Treated and Untreated)

Pier 1 - House 1

		Treated					Untreated				
		Total	Total Board Feet				Total	Total Board Feet			
Description	Dimensions	Lineal Feet	#1	#2	#3	Combined	Lineal Feet	#1	#2	#3	Combined
Caps	14" x 14"	840	13,720			13,720					0
Posts	14" x 14"	5,670	92,610			92,610	320		3,659	1,568	5,227
	14" Round					0	2,240		6,160	6,160	12,320
Joists	6" x 12"					0	10,530	50,544	12,636		63,180
Girders	14" x 14"					0	2,700		35,280	8,820	44,100
Bracing	4" x 10"	8,400	22,400	5,600		28,000					0
Flooring	4" x 12"		0	0	0	0	40,370	96,888	48,444	16,148	161,480
Total Board Feet			128,730	5,600	0	134,330		147,432	106,179	32,696	286,307

Pier 1 - House 2

		Treated					Untreated				
		Total	Total Board Feet				Total	Total Board Feet			
Description	Dimensions	Lineal Feet	#1	#2	#3	Combined	Lineal Feet	#1	#2	#3	Combined
Caps	14" x 14"	868	14,177			14,177					0
Posts	14" x 14"	6,355	103,798			103,798					0
	14" Round					0	2,480		6,820	6,820	13,640
Joists	6" x 12"					0	7,223	30,337	13,001		43,338
	14" x 14"					0	2,097		34,251		34,251
Girders	14" x 14"					0	2,790		36,456	9,114	45,570
Bracing	4" x 10"	8,680	23,147	5,787		28,933					0
Flooring	4" x 12"		0	0		0	46,138		18,455	166,097	184,552
Total Board Feet			141,122	5,787	0	146,909		30,337	108,984	182,031	321,351

Pier 1 - House 3

		Treated					Untreated				
		Total	Total Board Feet				Total	Total Board Feet			
Description	Dimensions	Lineal Feet	#1	#2	#3	Combined	Lineal Feet	#1	#2	#3	Combined
Caps	14" x 14"	868	14,177			14,177					0
Posts	14" x 14"	5,934	96,922			96,922	400		3,267	3,267	6,533
	14" Round					0	2,400		6,600	6,600	13,200
Joists	6" x 12"					0	9,072	43,546	10,886		54,432
Girders	14" x 14"					0	2,790		31,899	13,671	45,570
Bracing	4" x 8"					0	3,150	4,200		4,200	8,400
	4" x 10"	4,480	14,933			14,933					0
Flooring	4" x 12"		0	0	0	0	51,905	124,572	62,286	20,762	207,620
Total Board Feet			126,033	0	0	126,033		172,318	114,938	48,500	335,755

Table 3. Continued

Pier 1 - House 4

Description	Dimensions	Treated					Untreated				
		Total Lineal Feet	Total Board Feet				Total Lineal Feet	Total Board Feet			
			#1	#2	#3	Combined		#1	#2	#3	Combined
Caps	14" x 14"	1,800	29,400			29,400					0
Posts	14" x 14"	11,414	186,429			186,429	1,776		14,504	14,504	29,008
Joists	10" x 16"	1,230	16,400			16,400					0
	8" x 18"	4,920	59,040			59,040					0
	10" x 18"	615	9,225			9,225	21,475	257,700	64,425		322,125
	6" x 12"	3,690	22,140			22,140					0
Girders	14" x 30"					0	3,598	100,744	25,186		125,930
	14" x 14"	884	14,439			14,439					0
	12" x 14"	408	5,712			5,712					0
Bracing	4" x 10"	16,000	53,333			53,333					0
Flooring	4" x 12"		0	0	0	0	103,810		290,668	124,572	415,240
Total Board Feet			396,118	0	0	396,118		358,444	394,783	139,076	892,303

Pier 1 - House 5

Description	Dimensions	Treated					Untreated				
		Total Lineal Feet	Total Board Feet				Total Lineal Feet	Total Board Feet			
			#1	#2	#3	Combined		#1	#2	#3	Combined
Caps	14" x 14"	2,320	37,893			37,893					0
Posts	14" x 14"	7,635	99,764	24,941		124,705	1,100		13,475	4,492	17,967
	14" Round					0	200		825	275	1,100
Joists	6" x 12"	132	792			792	18,000	86,400	21,600		108,000
	8" x 16"					0	2,450	26,133			26,133
Girders	14" x 14"					0	3,790	61,903			61,903
Bracing	4" x 10"	6,000	20,000			20,000					0
Flooring	4" x 12"		0	0	0	0	23,140	37,024	37,024	20,800	94,848
Total Board Feet			158,449	24,941	0	183,390		211,461	72,924	25,567	309,951

Pier 1 - Pilings

Description	Untreated Length	Pieces	Linear Ft.	Board Ft.
14" Round	70	730	51,100	281,050
Untreated	65	231	15,015	82,583
	60	784	47,040	258,720
	55	492	27,060	148,830
	50	463	23,150	127,325
	45	602	27,090	148,995
	40	1,251	50,040	275,220
	35	764	26,740	147,070
	30	590	17,700	97,350
Total	-	5,907	284,935	1,567,143

Table 3. Continued

Pier 2 - House 1

		Treated					Untreated				
		Total	Total Board Feet				Total	Total Board Feet			
Description	Dimensions	Lineal Feet	#1	#2	#3	Combined	Lineal Feet	#1	#2	#3	Combined
Caps	14" x 14"	800	13,067			13,067					0
Posts	14" x 14"	2,400	39,200			39,200	9,024		88,435	58,957	147,392
Joists	6" x 12"					0	11,560	41,616	27,744		69,360
Girders	14" x 14"					0	3,432		56,056		56,056
Bracing	4" x 10"	6,600	22,000			22,000					0
Apron	8" x 20"	3,740	49,867			49,867					0
	6" x 16"	680	5,440			5,440					0
	6" x 12"	1,020	6,120			6,120					0
RR Track						0					0
Support	9" x 16"					0	2,040	24,480			24,480
	8" x 10"					0	2,720	18,133			18,133
Flooring	4" x 12"		0	0	0	0	56,440	90,304	67,728	67,728	225,760
Total Board Feet			135,693	0	0	135,693		174,533	239,963	126,685	541,181

Pier 2 - House 2

		Treated					Untreated				
		Total	Total Board Feet				Total	Total Board Feet			
Description	Dimensions	Lineal Feet	#1	#2	#3	Combined	Lineal Feet	#1	#2	#3	Combined
Caps	14" x 14"	1,748	28,551			28,551					0
Posts	14" x 14"	5,616	91,728			91,728	7,758		76,028	50,686	126,714
Joists	6" x 12"					0	15,450	55,620	37,080		92,700
Apron	6" x 12"	505	3,030			3,030					0
	14" x 14"	195	3,185			3,185					0
Girders	14" x 14"					0	6,400		104,533		104,533
Bracing	4" x 10"	10,800	36,000			36,000					0
RR Track						0					0
Support	10" x 20"					0	5,120	85,333			85,333
	8" x 10"					0	2,560		10,240	6,827	17,067
Flooring	4" x 12"		0	0	0	0	46,480	74,368	55,776	55,776	185,920
Total Board Feet			162,494	0	0	162,494		215,321	283,658	113,288	612,267

Pier 2 Pilings

	Untreated			
Description	Length	Pieces	Linear Ft.	Board Ft.
14" Round	70	134	9,380	51,590
Untreated	65	443	28,795	158,373
	60	385	23,100	127,050
	55	178	9,790	53,845
	50	256	12,800	70,400
	45	138	6,210	34,155
	40	335	13,400	73,700
	35	288	10,080	55,440
	30	143	4,290	23,595
Total	-	2,300	117,845	648,148

Notes:
#1 Quality wood is clear or has small knots and is free of Heart Center
#2 Quality wood has pronounced check cracks
#3 Quality wood is defective and non-reusable

Table 4. Summary and Evaluation of Standing Inventory of Wood Below Floors

Untreated Lumber

Description	Dimension	Total Board Feet				Marketable BF of # 1 and # 2		Dollar Value Marketable Wood		Nonmarketable Residue - BF		Bone Dry Tons Residue	
		#1	#2	#3	Combined	Low	High	Low	High	Low	High	Low	High
Posts	14" X 14'	0	199,368	133,473	332,841	99683.97	159494.3	$9,968	$39,874	173,346	233,157	202.2	272.0
	14" Round	0	20,405	19,855	40,260	8162	12243	$816	$3,061	28,017	32,098	32.7	37.4
Joists	6" X 12"	308,062	122,948	0	431,010	258606	344808	$64,652	$155,164	86,202	172,404	100.6	201.1
	10" X 18"	257,700	64,425	0	322,125	193275	257700	$48,319	$115,965	64,425	128,850	75.2	150.3
	8" X 16"	26,133	0	0	26,133	15680	20906.67	$3,920	$9,408	5,227	10,453	6.1	12.2
	14" X 14"	0	34,251	0	34,251	20550.6	27400.8	$5,138	$9,590	6,850	13,700	8.0	16.0
Girders	14" X 14"	61,903	264,224	31,605	357,733	195676.6	260902.1	$48,919	$78,271	96,831	162,056	113.0	189.1
	14" X 30"	100,744	25,186	0	125,930	75558	100744	$30,223	$50,372	25,186	50,372	29.4	58.8
Bracing	4" X 8"	4,200	0	4,200	8,400	840	2520	$126	$756	5,880	7,560	6.9	8.8
Flooring	4" X 12"	423,156	580,381	471,883	1,475,420	401414.9	602122.3	$100,354	$210,743	873,298	1,074,005	1,018.8	1,253.0
RR Track	10" X 20"	85,333	0	0	85,333	51200	68266.67	$15,360	$34,133	17,067	34,133	19.9	39.8
Support	8" X 10"	18,133	10,240	6,827	35,200	17024	22698.67	$5,107	$11,349	12,501	18,176	14.6	21.2
	9" X 16"	24,480	0	0	24,480	14688	19584	$4,406	$9,792	4,896	9,792	5.7	11.4
TOTAL		1,309,846	1,321,428	667,842	3,299,116	1,352,359	1,899,391	$337,308	$728,477	1,399,725	1,946,757	1,633	2,271

Untreated Pilings

Description	Length Ft	Number of Pieces	Total Lineal Ft.	Total Board Ft.	Marketable Board Feet		Dollar Value of Marketable Wood		Nonmarketable Residue - BF		Bone Dry Tons Residue	
					Low	High	Low	High	Low	High	Low	High
14" Round	70	864	60,480	332,640	199,584	266,112	59,875	109,078	66,528	133,056	77.6	155.2
	65	674	43,810	240,955	144,573	192,764	43,372	100,794	48,191	96,382	56.2	112.4
	60	1,169	70,140	385,770	231,462	308,616	69,439	138,600	77,154	154,308	90.0	180.0
	55	670	36,850	202,675	121,605	162,140	36,482	70,495	40,535	81,070	47.3	94.6
	50	719	35,950	197,725	118,635	158,180	35,591	71,990	39,545	79,090	46.1	92.3
	45	740	33,300	183,150	109,890	146,520	32,967	61,093	36,630	73,260	42.7	85.5
	40	1,586	63,440	348,920	209,352	279,136	62,806	117,942	69,784	139,568	81.4	162.8
	35	1,052	36,820	202,510	121,506	162,008	36,452	70,732	40,502	81,004	47.3	94.5
	30	733	21,990	120,945	72,567	96,756	21,770	40,531	24,189	48,378	28.2	56.4
TOTAL	-	8,207	402,780	2,215,290	1,329,174	1,772,232	$398,752	$781,254	443,058	886,116	516.9	1,033.8