Benefit-Cost Analysis, Pier 4 Wharf Improvements, Hilo, Hawaii:

for Hawaii State Department of Transportation Application for TIGER funding, 2014

Summary of Results

The Hawaii State Department of Transportation, Harbors Division, is applying for $15 million in TIGER grant funding for construction of the Hilo Harbor Pier 4 Wharf Improvements Project which will cost $47.0 million to complete. Additional improvements in preparation for the Pier 4 Wharf improvement have had to be made to the container yard and access point at a cost of $15.2 million. The benefits of the project must therefore be weighed against a total cost of $62.2 million. The design of the project has been completed. Construction of the Pier 4 Terminal area is scheduled to begin in February 2015 with a completion target date of August 2016.

Use of the new terminal will increase the port's capacity to serve the island's people and better support its economy. The increase in yard area will allow improvements in efficiency and safety within the harbor area, benefitting all cargo and passenger operations. The additional barge-traffic-only access by way of Kumau Street will reduce congestion at the main port entrance, where vehicles serving cargo barges, fuel barges, cruise ships and other functions in the harbor converge. It will also decrease congestion on Kalanianaole Avenue outside the port, saving travel time for both truckers and non-truckers on the roadways. Related reductions in fuel use are expected to decrease greenhouse gas production.

Development of two ports capable of handling both interisland and overseas cargo is important in emergency response and economic recovery after disasters. The Pier 4 interisland cargo terminal project greatly lowers the risk of both short-term harm and long-term economic problems for Hawaii. There are national implications since the lowered risk raises the state's ability to encourage international tourist spending.

This report describes the approach taken to calculate costs and benefits and provides information on information sources, assumptions, factors applied, and estimates. Actual calculations and detailed references may be found in the accompanying spreadsheet, HawaiiDOT-TIGER2014.xls.

Table 1 is a matrix of benefits associated with the Pier 4 project. Table 2 summarizes the results of the life cycle cost analysis and covers the period from 2013 through 2067, i.e., construction through at least 50 full years of operations of the new pier and yard. It shows that benefits outweigh costs of the entire terminal whether these are discounted at 3 percent or at 7 percent.

TABLE 1: MATRIX OF BENEFITS

Long-Term Outcome	Types of Societal Benefits	Current Status/ Baseline & Problem to be Addressed	Change to Baseline	Types of Impacts	Population Affected	Economic Benefit	Summary of results (Undiscounted)	Page Reference in BCA Report
Livability (Quality of Life)	**Increased Accessibility**	Co-mingling of pedestrians and cargo	Separation of routes taken by cargo vehicles and cruise ship passengers	Pedestrian and cargo handling routes	Cruise ship passengers and resident population	Easier, safer access to County Walking Trails Program (by residents and visitors)	Not calculated	Pages 3,7, and 9
Economic Competitiveness	**Travel Time Savings**	Limited wharf and surrounding space	Additional access to yards; faster through movement, separation of barge, ship cargo, and transport trucks; reduced wait on roads near harbor	Overlap of interisland and out-of-state cargo handling activities	Maritime workers; truckers, all drivers in Hilo area	Truckers' time	Not calculated	Pages 7-9
	Operating Cost Savings	Limited harbor capacity in Hilo	New pier (602 linear ft) = **21.9% increase** over total existing pier length of 2,749 linear ft at Hilo Harbor	Efficiency of cargo movement	Hawaii County (190,821 residents, 2013)	Increased efficiency of operations, capacity for greater throughput	Efficiency in harbor : Benefit 1: **$95.1 Million**	Pages 3, 7, and 8
				Space for additional barge at Pier 2	Hawaii County (190,821 residents, 2013)	Ability to support large projects	Not calculated	Page 14
		Limited wharf and surrounding space	Additional access to yards; faster through movement, separation of barge, ship cargo, and transport trucks; reduced wait on roads near harbor	Overlap of interisland and out-of-state cargo handling activities	Maritime workers; truckers, all drivers in Hilo area	Efficiency of operations	Not calculated	Pages 8 and 9
						Use of equipment	Not calculated	Pages 7 and 8
						Transport costs (land)	Benefit 3: **$60.1 Million**	Pages 7-9
		Dependence of Hawaii Island on limited port facilities; vulnerability to disaster impacts	Additional pier built to current standards to allow use of modern container equipment, in order to meet needs of island community	Capacity to support reconstruction after a disaster affecting one of the ports	Hawaii County (190,821 residents, 2013)	Rebuild after disaster	Benefit from US visitors not calculated	Pages 12 and 13
				Capacity to support revival of economy after a disaster affecting one of the ports	Tourists, especially international visitors to State of Hawaii (2 million in 2011)	Attract int'l visitors to revive tourism industry post-disaster	Benefit from US visitors not calculated	Page 13
Safety	**Prevented Accidents (Property Damage), Injuries, and Fatalities**	Limited wharf and surrounding space	Additional container yard (10 acres) = **48.1% increase** over total existing yard acreage of 20.8 at Hilo Harbor	Overlap of interisland and out-of-state cargo handling activities	Cruise passengers: 273,171 in 2013)	Safety by eliminating co-mingling of pedestrians and cargo vehicles	Not calculated	Pages 8 and 9
			Additional access to yards; faster through movement, separation of barge, ship cargo, and transport trucks; reduced wait on roads near harbor	Overlap of interisland and out-of-state cargo handling activities	Maritime workers; truckers, all drivers in Hilo area	Safety by decrease in traffic congestion	Benefit 1; Benefit 2: **$9.00 Million**	Pages 8 and 9
		Dependence of Hawaii Island on limited port facilities; vulnerability to disaster impacts	Additional pier built to current standards to allow use of modern container equipment, in order to meet needs of island community	Capacity to support emergency response and reconstruction after a disaster affecting one of the ports	Hawaii County residents	Provide emergency supples, equipment quickly	Benefit 4: **$ 195.2 Million**	Pages 12
State of Good Repair	**Maintenance and Repair Savings**	Limited wharf and surrounding space	Additional pier built as part of a three-part harbor improvement plan; (1) expanded container yard area and (2) additional access point will be completed in advance of the new pier		Hawaii County residents (including businesses) and cruise ship passengers	Complete improvement to the harbor system for multiple users: shippers, container yard staff, cruise ship passengers, and business clients	Not calculated	Pages 3 and 6
Environmental Sustainability	**Environmental Benefits from Reduced Emissions**	Limited wharf and surrounding space	Additional access to yards; faster through movement, separation of barge, ship cargo, and transport trucks; reduced wait on roads near harbor	Overlap of interisland and out-of-state cargo handling activities	Maritime workers; truckers, all drivers in Hilo area	Greenhouse Gas emissions	Benefit 5: **$2.4 Million**	Page 10

TABLE 2: RESULTS OF THE LIFE CYCLE COST ANALYSIS

Undiscounted benefit totals			
	Efficiency in harbor area	$95.1	million
	Safety in harbor area	$9.0	million
	Lower travel costs, roadways	$60.1	million
	Emergency response and recovery	$195.2	million
	Social cost of carbon	$2.4	million
Undiscounted costs			
	Construction	$47.0	million
	Sustainment	$8.4	million
Benefit-Cost Ratio & Net Present Value		**NPV**	**Ratio**
	At 3% discount rate	$100,629,763	3.00
	At 7% (except carbon at 3%)	$17,371,962	1.37
Notes:	Efficiency in harbor area is measured through yard man-hours, customer time, fuel use, equipment replacement, and lowered risk of injury.		
	Safety pertains to the lower risk of injuries due to a larger yard area.		
	Lower travel costs, roadways are benefits of less congestion.		
	Emergency response and recovery includes, specifically, post-disaster economic recovery.		
	Social cost of carbon is the benefit of reduced fuel use.		

Project

The Hawaii State Department of Transportation is submitting an application for funding through the National Infrastructure Investments (TIGER) grant program. The application is for $15 million to complete work on the new Pier 4 in Hilo Harbor, County of Hawaii. Pier 4 is being built as part of a three-part harbor improvement plan; (1) an expanded container yard area and (2) an additional access point will be completed in advance of the new pier. Pier 4 will expand the Hilo harbor berth space by 602 feet, an increase of 21.9 percent. The additional yard space serving Pier 4 covers ten acres. It expands the harbor's working yard space by 48.1 percent. With the additional yard, different cargo loading and unloading operations can be separated, and handling of barge cargo can be moved away from the route used by cruise passengers to cross between Pier 1 and Hilo town.

For the life cycle cost analysis, dollar values are expressed as 2013 values. Escalation is calculated in proportion to the Honolulu Consumer Price Index, except where federal guidance specifies other forms of escalation (e.g., sustainment costs; medical costs of injuries on the waterfront).

Construction is scheduled to end in August 2016. Five months of operations are anticipated in 2016. The life cycle cost analysis runs for calendar years through 2067, i.e., at least 50 full years of operations, since all components of the terminal have a service life of 50 years or more.

Baseline

With or without the project, Hilo will see increasing cargo tonnages and passenger arrivals.

Projections of increasing demand for goods, observed in terms of cargo tonnage, were developed for the Hawaii Island Commercial Harbors 2035 Master Plan, where the compound annual growth rate [CAGR] was 2.5 percent.

The future of cruise ship traffic is much less certain. One line dedicated three ships to Hawaii during the last decade but found the initiative unprofitable. Passenger counts have declined only to increase again with the end of the recession and more frequent visits by ships from other lines. In the analysis, the Hilo cruise passenger count is projected to be 2.6 percent.

The State of Hawaii's long-term projections through 2040 call for growth in population (1.0% for Hawaii Island), visitor spending (3.4%, all visitors to Hawaii Island), and specifically cruise visitor spending statewide (3.4%).

In sum, continuing growth in demand for space in the harbors can be expected. Problems, risks and inefficiency due to congested harbor space and access to the harbors will increasingly add to the cost of doing business on Hawaii Island unless major repairs and improvements are made. Table 3 presents key trends in the local economy.

TABLE 3: GROWTH PROJECTIONS, HAWAII ISLAND

	BASELINE *2010*	**2020**	**PROJECTED 2030**	**2040**
Hawaii County				
Population	185,406	220,880	258,510	296,320
Employment (Civilian Jobs)	93,927	112,230	131,430	151,690
Personal Income (2010 $, Millions)	$5,040	$6,700	$8,450	$10,120
Average (Daily) Visitor Census	24,749	29,260	32,700	36,320
Visitor Spending (2010 $, Millions)				
Total Spending (Hawaii County)	$1,162	$1,512	$1,679	$1,865
Cruise Visitor Spending Statewide)	$19	$29	$32	$36
	BASELINE *2010*	**2020**	**PROJECTED 2030**	**2040**
Activity in Hilo Harbor				
Total Cargo (ST)	1,182,322	1,405,409	1,799,043	2,302,927
Passengers	369,427	442,140	571,523	738,767

SOURCES:
Hawaii State Department of Business, Economic Development and Tourism, *Population and Economic Projections for the State of Hawaii to 2040*. Posted at http://dbedt.hawaii.gov/economic/economic-forecast/2040-long-range-forecast/.

Hawaii State Department of Transportation, Harbors Division (EP); wharfage statistics.

Costs

Costs include construction costs for the pier, yard and access point[1] as well as long-term sustainment (including normal maintenance and repair). Construction costs and times have been calculated by Hawaii State DOT Harbors Division as totaling $62.2 million:

1. Pier 4: $47.0 million, from February 2015 to August 2016 (18 months);
2. Yard area: $11.6 million, from November 2013 to January 2015 (14 months)
3. Access route: $3.6 million, from February 2014 to February 2015 (12 months)

Sustainment provides for maintenance and repair activities necessary to keep a typical inventory of facilities in good working order over their expected service life. It includes:

1. regularly scheduled adjustments and inspections, including maintenance inspections (fire sprinkler heads, HVAC systems) and regulatory inspections (elevators, bridges)
2. preventive maintenance tasks
3. emergency response and service calls for minor repairs
4. major repair or replacement of facility components expected to occur periodically throughout facility service life

Sustainment costs can be estimated using standards developed from national data sets:

> Sustainment requirement = Facility Quantity x Sustainment Unit Cost x Area Cost Factor x Inflation Factor.

The Unified Facilities Criteria[2] database has annual sustainment unit cost rates as follow:

1. FAC code 1511: pier: $31.76/SY
2. FAC code: 1531: marine cargo yard: $1.31/SY

The Hawaii average cost factor for sustainment is 2.04. The escalation rate for sustainment to 2013 is 1.018. This calculation is used in the life cycle cost (LCC) analysis, allowing for a 20% reduction in annual cost in the first five full years of operation. Maintenance and repair are expected to be minimally needed during the first five years and to be required more in the years after.

[1] Sustainment is not calculated for Kumau Street. This is a County of Hawaii roadway that will be strengthened and widened by the State and returned to County management. Sustainment costs will be minimal.

[2] Unified Facilities Criteria (UFC): *DoD Facilities Pricing Guide\2\/2/*, No. 3-701-01; Most recent update: August 2013 (Change 5).

Benefits

A. Quantifiable Benefits

Quantifiable benefits to the Hilo Harbor area include:

1. Increased efficiency in cargo handling at the pier and yard, measured through yard man-hours, customer time, fuel use, and equipment replacement;
2. Increased safety through the lowering of injury risk;
3. Lower travel costs and improved roadways as outcomes of reduction in traffic congestion;
4. Improved capability to facilitate emergency response and recovery efforts both immediately after a crisis and for longer-term recovery; and
5. Reducing the social cost of carbon by reducing fuel use.

Improved Efficiency at Hilo Harbor and in the Yard for Interisland Barge Cargo

Inter-island cargo loading and unloading at the well-used and weakened Pier 2 will be moved to the new Pier 4 at Hilo Harbor. Movement of these operations to Pier 4 will reduce co-mingling of passengers arriving at Pier 1 with cargo movements as well as restore productivity to shipper operations.

With the new pier built to code with larger, convenient yard space, the barge cargo operator will be able to operate much more efficiently. Improvements are anticipated in:

1. Cargo Handler Operations: Load and unload operations using two ramps per barge would shorten the operation time. Handlers would also experience lower wait times as well as fewer incidents of having to move loads to clear paths for others. Based on estimates by private sector and Harbors professionals, the impact would be a savings of 15 percent of operators' time.

2. Container Yard Customer Service: With a larger yard, customer service systems can be reorganized to speed cargo handling. The larger area would also allow staff to strategically place cargo for better access by customers. The estimated impact is ten percent of customer service staff time.

3. Fuel Usage: With fewer and shorter cargo movements, fuel usage would decline as well by 15 percent.

4. Equipment Life: Shorter movements by large equipment would reduce wear and tear, allowing the equipment to be maintained well and used over a longer period. The increase in service life is estimated at 10 percent.[3]

[3] The value of heavy equipment is treated statically here, based on input from the cargo operator. The increase in service life was estimated by operator management after consultation with Hilo staff.

The benefits of the new pier and yard are expected to increase over time as cargo volumes grow. In 2011 dollar values, savings in man-hours ($116,042), customer service man-hours ($42,978), fuel usage ($9,352), and extended equipment service life ($16,000) total to $184,372.[4]

Efficiency of Work in Hilo Harbor yards, other than Interisland Cargo Barges

Once interisland cargo barge traffic and yard activities are moved to Pier 4, movement of all equipment and other vehicles in the yards will be more efficient, with reduced wait times and storage or staging of materials and vehicles at convenient sites, not just wherever there is space. The benefit is estimated to be a 10 percent reduction in man-hours for workers in the harbor yards. With more efficient movement and less time spent waiting for others to clear the way between the piers and yard areas, fuel usage would similarly decline.

Customers' Time in the Hilo Harbor Yards

Hilo Harbor serves cargo barges, cargo ships (including RoRo and RoRo/container mixed operations), fuel barges, and cruise ships. The mix of customers passing through the main entrance[5] varies depending on the vessel types present in the harbor. Interisland cargo barges visit Hilo Harbor an average of 121 days annually[6]. Cruise ships visit seasonally over a period of about nine months (i.e., 100 days). Ordinarily, truckers visiting the interisland yard must pass through two security stops. When cruise ships are present, however, they must pass through three security checks. In either case, there are delays depending on the number of others ahead waiting to pass through.

Although many interisland barge yard customers come on barge days, they also come on other days to drop off or pick up loads. The analysis is based on the number of vehicles to sites in the harbor (interisland cargo yard, cruise ship, office, fuel pier and other) at four levels of traffic (no vessel; barge only; cruise ship only; both barge and cruise ship present). Reductions in travel time within the harbor are due to fewer security checks, shorter lines to pass through those checks, and increased capacity to move, park and load within the yards.

After the new Pier 4 opens, parts of Pier 2 can be used to stage buses and other cruise-related traffic, reducing delays.

Risk of Unintentional Injuries or Fatalities in the Harbor Area

In a crowded harbor area, events causing unintentional injuries or fatalities can occur, affecting maritime workers and others in the harbor. At Hilo, the risk of these kinds of events is, in the baseline case, raised by

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[4] See BCA file for Hawai'i, worksheet "1-individual calculations."

[5] In recent years, a second entrance serving the cargo yard used by Matson south of Pier 1 was opened. This has lessened traffic through the main gate and quickened the flow. This improved efficiency has been, in part, reported anecdotally.

[6] Hawai'i Dept of Transportation - Harbors (EP), wharfage statistics.

the use of a single entry for access to barges, ships, and the Harbor office; by limited yard space where equipment operators must wait for traffic or negotiate with each other to move cargo; and by the mix of workers, customers coming to pick up cargo, cruise passengers, buses and other vehicles.

The risk of injury to harbor workers can be estimated from government data; there is insufficient data, however, to calculate the risks to others (e.g., passengers, visitors, truckers).

The U.S. Department of Labor tracks the cost of injuries and fatalities to maritime workers. Data on that cost for the Hawaii harbor system is available for 2006-2008.[7] At that time, the total average annual cost for the Hawaii system as a whole was $6.6 million. The share of the average cost attributable to activities at Hilo can be estimated as a share of the system cost. That share is calculated here in terms of the share of cargo, other than petroleum, handled in each port.[8] Hilo's share in 2011 was 7.2 percent.

The 2006-2008 risk of injuries or fatalities at Hilo were assigned an estimated cost of $473,958. This can be updated to 2013 values, given the high rate of increase in medical costs, as $735,258, based on increases in the statistical value of a life.

The terminal lowers the risk of accidents by separating barge traffic from cruise and other traffic and by increasing yard space. With yard space increasing by 45 percent, it is reasonable to expect that the likelihood of events leading to injuries or fatalities would decline at half that rate (23 percent). The averted risk can be valued at $167,104 annually.

Traffic Congestion on Kalanianaole Avenue and Nearby Roadways

Reduced congestion, and hence wait time for truckers and others traveling to and from Hilo harbor (truckers' and drivers' time, fuel usage).

Kalanianaole Avenue stretches from the Hilo urban center approximately five miles to the south, past the harbor and the community of Keaukaha to popular beach parks. The road is often congested by traffic to and from the harbor, especially when cruise ships are in port with a variety of buses, taxis, trucks and cars converging on the harbor. As with the benefit from reducing the risk of unintentional injury, the analysis of traffic congestion considers congestion on different days.

The added point of access[9] will reduce queuing of vehicles on the roadway north of the harbor and eliminate long waits for traffic turning onto or from the main roadway. The expected impact would average a wait time of a minute for vehicles on most days and a little more on days when a cruise ship is in port. Given all the traffic on the roadway, the improved traffic flow would reduce travelers' time by more than 40,000 hours per year, at a time savings (for truckers and others) of an estimated $638,798 as of 2013. With savings

[7] U.S. Department of Labor, Division of Longshore and Harbor Workers' Compensation, San Francisco Office, 2011.

[8] Nearly all petroleum products used in Hawaii enter the state via an offshore mooring near Barbers Point Kalaeloa Harbor, O'ahu. These are excluded in order to focus on human activities in the ports. (without a barge or ship, with a barge, with a cruise ship, with both), but considers both harbor traffic and other traffic nearby.

[9] Results of a traffic study are presented in the Environmental Assessment for the Kumau Street access: R.M. Towill Corporation, *Draft Environmental Assessment, Kumau Street Entrance Improvements at Pier 4, Interisland Cargo Terminal Project.* Prepared for the Hawaii State Department of Transportation, Harbors Division. Honolulu, HI, 2012. The study provides information on peak traffic hours and volumes.

in drivers' time also comes fuel savings. As of 2013, fuel savings are estimated at $138,152 annually, increasing over time.

Greenhouse Gases – Measure of the Social Cost of Carbon

Both within and outside of Hilo harbor, lower fuel usage would reduce Greenhouse Gas (GHG) production, a measure of the social cost of carbon.

Future fuel costs may be estimated based on the average costs of diesel ($4.75 per gallon) and regular gasoline ($4.08 per gallon) in Hilo, as of March 2014.

Various reductions in fuel use contribute to reductions in the production of carbon. Based on emissions rates for idling vehicles, there would be a savings of 18,829 gallons of diesel and 42,633 gallons of gasoline due to improved traffic in or near the harbor. The amount of carbon averted through this reduction would exceed 600 short tons by 2016, providing an annual benefit in dollars of $17,055 in 2016 and rising to $98,647 by 2065[10].

Emergency Response and Recovery after Major Emergencies

Hawaii Island has had continuous volcanic eruptions since 1983 and is always, like the other islands, at risk of natural disasters (i.e., tsunami, hurricanes, earthquakes). Kawaihae was severely damaged in 2006 during the Kiholo Bay/Mahukona earthquake. No port activity occurred at the harbor there for three days afterward; two of the three piers were unusable for more than a year. The Mauna Kea Beach Hotel nearby closed for repairs for over a year. In 2011, a tsunami inundated much of the Kona Village Resort.
Hilo has not been exempt from disaster. The 1946 Hilo tsunami swept over the port and parts of the town near the ocean, killing 159 people. (The piers currently in use at Hilo Harbor were re-built in 1946 after the wave destruction.) Lava flows from Kilauea have reached the outskirts of Hilo; the community of Kalapana was completely encased and destroyed by lava in 1990. The geological record further indicates that extensive landslides can be triggered by eruptions, leading to massive tsunami. There is the risk of such a slide off lower Puna, affecting coastal areas around the island.

Hawaii Island is served by two commercial ports, Kawaihae Harbor and Hilo Harbor. Kawaihae, located in West Hawai'i, receives cargo vessels but none of the cruise ships. Hilo Harbor receives cargo, all the cruise ships visiting the island, and much of the fuel cargo for distribution island-wide. Each harbor serves a slightly different shipping purpose. However, in the event of an emergency, having both ports in states of good repair will better facilitate emergency response for the island and decrease the risks to health and safety.

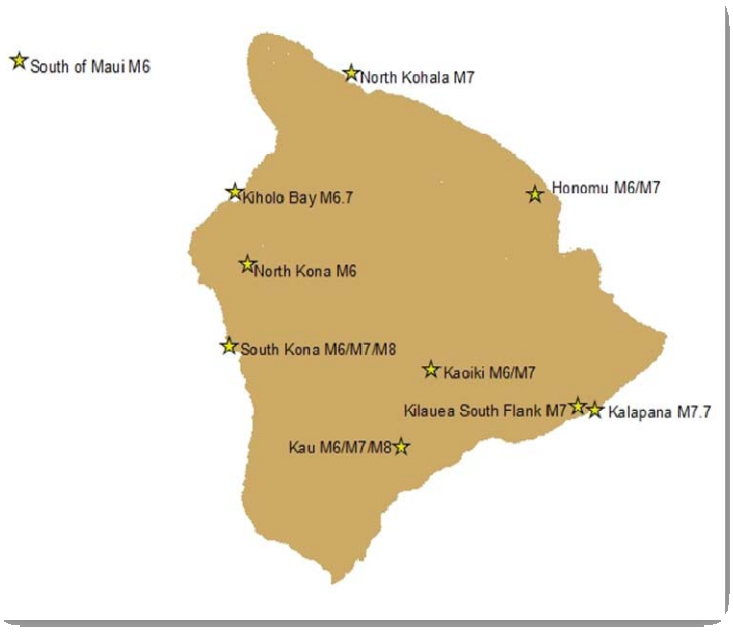
The benefits of quick and reliable access to emergency supplies and equipment as well as the capacity to import materials needed for repair and recovery after a disaster are estimated herein. Potential earthquake scenarios, based on Hawaii Island geography and history, are listed in Table 4. The estimates and modeled scenarios are based on both actual and hypothetical events and are made available as reference points to disaster managers, in case of an actual earthquake, until new HAZUS model results come in.[11]

[10] Calculations apply cost factors provided in the *TIGER Benefit-Cost Analysis (BCA) Resource Guide.*
[11] Pacific Disaster Center, Hawaii HAZUS Atlas, "Earthquake Planning Scenarios for Hawaii Disaster Managers."

TABLE 4: HAZUS EARTHQUAKE SCENARIOS, HAWAII ISLAND

Epicenter Location (See Map)	Depth (Km)	Magnitude (Moment)	Event Date	Damage ($ Million)
HHA Kau M6 Scenario	10	6	Sunday, June 30, 2013	12
HHA Kaoiki M6 Scenario	10	6	Sunday, June 30, 2013	10
HHA Kaoiki M7 Scenario	10	7	Sunday, June 30, 2013	229
HHA Kilauea South Flank M7 Scenario	10	7	Sunday, June 30, 2013	361
HHA South Kona M6 Scenario	10	6	Sunday, June 30, 2013	88
HHA Kau M7 Scenario	10	7	Sunday, June 30, 2013	146
HHA South Kona M7 Scenario	10	7	Sunday, June 30, 2013	556
HHA South Kona M8 Scenario	10	8	Sunday, June 30, 2013	558
HHA North Kona M6 Scenario	30	6	Sunday, June 30, 2013	66
HHA North Kohala M7 Scenario	30	7	Sunday, June 30, 2013	208
HHA Honomu M6 Scenario	42	6	Sunday, June 30, 2013	91
HHA Kau M8 Scenario	10	8	Sunday, June 30, 2013	569
HHA Kiholo Bay M6.7 Event	39	6	Sunday, Oct 15, 2006	498
HHA Kalapana M7.7 Scenario	10	7	Sunday, June 30, 2013	347
HHA Honomu M7 Scenario	42	7	Sunday, June 30, 2013	560

Figure 1 - Scenario Epicenters on Hawai'i Island



SOURCE: Hawaii HAZUS Atlas, HAZUS Scenario Summaries.

Based on the historical record and the HAZUS analyses, the likelihood of an event capable of crippling one or the other of the two ports on Hawaii Island is once in 50 years. The likelihood of a disaster capable of extensively damaging Kawaihae, leaving the island dependent on Hilo, would be once in 100 years.

Materials and equipment needed for emergency response are found on each island, but not in quantities sufficient to address either immediate or long-term needs. After a disaster, airplanes and barges would bring to the island emergency responders and their equipment, relief supplies, and heavy equipment to clear damaged areas and limit further deterioration. Early deployment of post-disaster response could limit damage and speed recovery. If an earthquake similar to the 2006 event were to take place today with the condition of Pier 2 as deteriorated as it is, the pace of recovery would be much slower than in 2006. Table 5 provides an estimate of the value of supplies needed for emergency response and recovery where their delivery would depend on the survival of a fully functioning harbor on the island. That value is expected to have a 1 in 50 likelihood of occurrence. The likelihood that Hilo would serve as the sole functioning harbor, with Kawaihae damaged, is then a 1 in 100 chance. Benefits from effective preparation for and emergency response to such an event are treated as accruing with construction of the Pier 4 terminal.

TABLE 5: BENEFITS ASSOCIATED WITH A FUNCTIONING HARBOR IN THE EVENT OF MAJOR DISASTER, HAWAII ISLAND

Damage, 2006 earthquake				
Value of immediate response	**Share of total damages**	**$366 million**	**Second Harbor Share (%)**	**Second Harbor Share in $ (Millions)**
1. medical supplies, assistance	1%	$3.7	30%	$1.1
2. other relief supplies	1%	$3.7	50%	$1.8
3. food (recovery)	1%	$3.7	30%	$1.1
4. cement	10%	$36.6	95%	$34.8
5. other building materials	10%	$36.6	95%	$34.8
				$73.6
Likelihood of event				
Annual value of avoiding any loss of capacity, either harbor	1 in 50			$1.5 million
Annual value, full capacity at Hilo if Kawaihae damaged	1 in 100			**$0.7** million

SOURCES: Interviews with emergency managers, Harbors personnel, shippers; presentation by James Bell on recovery and planning for Hilo after the 1946 tsunami. Estimated shares developed by Belt Collins Hawaii LLC.

The economic impact of repairs and recovery is significant. Hawaii Island and Kauai, located at opposite ends of the island chain, are at higher risk of being affected by natural disasters and report lower visitor occupancy rates than Oahu and Maui. After a disaster, the visitor industry works quickly to let the global public know that Hawaii is still "open for business." Recovery, however, is a slow process where repairs and renovations may take as long as a year or more. While recovery may mean an increase in construction employment locally, the infrastructure supporting the visitor industry must be restored before tourism levels and service industry employment return to normal. Port capacity is crucial to economic recovery at both state and island levels.

The benefit of earlier recovery for a tourism-based economy lies in an earlier return of visitors to minimize the share of visitors lost. A rapid recovery saves at least six months of visitor expenditures over a period of two or more years. Although some of the revenues lost due to a slower recovery could be regained later, dollars could be lost through tourist diversion to other locations. US visitor dollars could be diverted from Hawaii to Caribbean and Mexican resorts while international visitors could opt to visit Southeast Asia resorts or other Asian destinations instead. Since the share of domestic visitor spending that would be diverted from Hawaii to other United States destinations is unknown, this analysis deals only with international spending.

1. International visitor spending, Hawaii Island, 2011: $287.5 million (19% of total visitor spending)
2. Assumption (a) Rapid recovery would result in retaining six months of visitor expenditures
3. Assumption (b) Otherwise, 50 percent of those visitor expenditures would be lost to non-US destinations
4. Impact of rapid recovery is then estimated as $287.3 x .5 x .5 = $71.9 million (as of 2011)
5. The impact increases from year to year due to increases in visitor spending
6. The benefit is associated with (1) a 1 in 50 year likelihood (i.e., 2%) of a major disaster extensively damaging one of the ports, or (2) a 1 in 100 year likelihood (i.e., 1%) of a disaster leaving Hawaii Island dependent on shipments through Hilo alone. The annual benefit would amount to $0.7 million annually as of 2013, increasing over the study period.

B. Short-term Benefits

Short-term benefits can be calculated but are considered local impacts and are not included in the life cycle cost analysis. The immediate impact is an increase in emergency management and construction spending. Another possible impact is the positioning of the region for economic recovery through renovation of the infrastructure following a disaster. However, the likely overall impact is a reduction in economic activity.

The number of workers in direct construction would vary with construction cost. Heavy construction generates major expenditures for materials and equipment, where the share of the worker-related cost is lower. The number of person-years of work is calculated from the State of Hawaii average (for 2011):

- Construction job count / construction tax base *1,000,000 = 4.85 construction workers per million $ of construction spending;
- Adjusted to 75% of ratio (for heavy construction) = 3.64 worker/ million $.

The number of indirect and induced jobs can be calculated through either the Input-Output Model or the direct investment ratio included in the TIGER BCA Resource Guide. The Input-Output Model is based on

research by the federal Bureau of Economic Analysis and refined by the Hawaii State Department of Business, Economic Development and Tourism. It yields a Type II jobs multiplier of 2.68 (i.e., 1.68 indirect and induced jobs per direct job). At the national level, the *TIGER BCA Resource Guide* indicates that a job is created for every $76,900 of direct investment.

TABLE 6: SHORT-TERM BENEFITS – JOB CREATION

	2015	2016
Direct Construction Jobs, Hilo	446	284
Indirect and Induced Jobs, Hawaii	750	477
Additional Indirect and Induced Jobs, USA	(823)	(523)
Total Jobs	373	238

NOTE: Numbers in columns may not sum due to rounding.
SOURCES: DBEDT, *2007 Input-Output Benchmark Report;* US Department of Transportation, *TIGER BCA Resource Guide.*

C. Non-Monetized Benefits

Measures for some of the benefits recognized could not be quantified due to small sample size or lack of data, e.g., impact of traffic congestion at Hilo Harbor on cruise passengers. Another unquantifiable benefit is the increased capacity of Hawaii Island to manage major projects that require holding and staging areas near the ports. This capability will facilitate the construction of the Thirty Meter Telescope at the summit of Mauna Kea, planned to begin in the summer of 2014.

With respect to emergency response, it is not possible to estimate the number of lives saved due to early arrival of relief supplies. When hospitals on Hawaii Island were damaged in the 6.6 magnitude earthquake that occurred in 2006, many severely injured victims were airlifted to hospitals. The rapid arrival of emergency responders and supplies likely prevented deaths although it is not possible to provide a measurement of this.

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