



# Determination of the Costs and Benefits of Implementing NIOSH Recommendations Relating To Child Labor Hazardous Orders

*Prepared for:*

United States Department of Labor  
Employment Standards Administration  
Wage and Hour Division

VOLUME I – FINAL REPORT

November 1, 2004

**Prepared by:**

**SiloSmashers™**

2677 Prosperity Avenue, Suite 100

Fairfax, VA 22031

P | 703 | 797 | 5600

F | 703 | 797 | 5601

[www.silosmashers.com](http://www.silosmashers.com)

## TABLE OF CONTENTS

### VOLUME I - FINAL REPORT

EXECUTIVE SUMMARY.....	iv
1. Background .....	1
2. Suggestions For Using This Report.....	2
3. Findings 2	
3.1 Primary Findings .....	2
3.2 Additional Considerations.....	3
3.2.1 Trends in Youth Workforce .....	3
3.2.2 Trends in Emerging Industries .....	3
3.2.3 Agricultural Industry .....	4
3.2.4 Non-Agricultural Industries.....	5
4. Quantitative Summary .....	5
4.1 General Methodological Approach .....	6
4.2 Assumptions and Limitations.....	10
4.3 Sensitivity Analysis .....	11
5. Qualitative Summary .....	15
6. HO Summaries.....	16
6.1 Agricultural Hazardous Orders.....	16
6.2 Non-Agricultural Hazardous Orders .....	18
6.3 New Hazardous Orders.....	22
7. CONCLUSION .....	26

### TABLES

HO Comprehensive Summary.....	v
TABLE 1: COST MODELS .....	9
TABLE 2 – SENSITIVITY ANALYSIS - AGRICULTURAL HOs .....	13
TABLE 3 – SENSITIVITY ANALYSIS SUMMARY - NONAGRICULTURAL HOs .....	14
TABLE 3a – SENSITIVITY ANALYSIS SUMMARY - NONAGRICULTURAL HOs (EXCLUDING HO 6 AND HO 9) .....	14
TABLE 4 – SENSITIVITY ANALYSIS SUMMARY - NEW HOs .....	15
TABLE 5 – HO COMPREHENSIVE SUMMARY.....	28
TABLE 5a – AGRICULTURAL HO SUMMARY.....	29
TABLE 5b – NON-AGRICULTURAL HO SUMMARY .....	30
TABLE 5c – NEW HO SUMMARY .....	31

## APPENDICES

Appendix A – SiloSmashers Study Team

Appendix B – List of Hazardous Orders Not Studied

Appendix C – List of Contacts and References

Appendix D – CBA Cost Models

Appendix E – References

Appendix F – Master Data, Sources, and References

F1 Agriculture HOs

F2 Non-Agriculture HOs

F3 New HOs

## VOLUME II – AGRICULTURE HOS

AG-HO 1 — Operating a Tractor Over 20 PTO Horsepower

AG-HOs 2 and 3 — Operating or Assisting to Operate Machinery

AG-HO 5 — Felling, Bucking, Skidding, Loading or Unloading Timber with Butt  
Diameter of More Than 6 Inches

AG-HO 6 — Working from a Ladder or Scaffold at a Height of Over 20 Feet

AG-HO 7 — Driving a Bus, Truck, or Automobile When Transporting Passengers,  
or Riding on a Tractor as a Passenger or Helper

AG-HO 8 — Working Inside a Fruit, Forage, or Grain Storage; a Silo; or a Manure  
Pit

AG-HO 9 — Handling or Applying Agricultural Chemicals Classified Under the  
Federal Insecticide, Fungicide, and Rodenticide Act

## VOLUME III – NON-AGRICULTURE HOS

NA-HO 4 — Logging and Sawmilling Occupations

NA-HO 5 — Power-Driven Woodworking Machine Operations

NA-HO 6 — Occupations Involving Exposure to Radioactive Substances and to  
Ionizing Radiation

NA-HO 7 — Power-Driven Hoisting Apparatus Operations

NA-HO 8 — Power-Driven Metal Forming, Punching, and Shearing Machine  
Operations

NA-HO 9 — Occupations in Connection with Mining, Other Than Coal

**NA-HO 10 — Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering**

**NA-HO 11 — Power-Drive Bakery Machine Occupations**

**NA-HO 12 — Power-Driven Paper-Products Machine Occupations**

**NA-HO 14 — Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears**

## **VOLUME IV – NEW HOS**

**New HO 1 — Commercial Fishing Occupations**

**New HO 2 — Construction Occupations**

**New HO 3 — Work in Refuse Occupations**

**New HO 4 — Water Transportation Industries**

**New HO 5 — Work in Scrap and Waste Materials Industry**

**New HO 6 — Farm Product Raw Materials Wholesale Trade Industry**

**New HO 7 — Railroad Industry**

**New HO 8 — Work at Heights**

**New HO 9 — Tractors**

**New HO 10 — Heavy Machinery**

**New HO 11 — Welding**

**New HO 12 — Confined Spaces**

**New HO 13 — Work Involving Powered Conveyors**

**New HO 14 — Pesticide Handling**

**New HO 15 — Exposure to Lead**

**New HO 16 — Exposure to Silica**

**New HO 17 — Work Requiring the Use of Respiratory Protection**

## EXECUTIVE SUMMARY

The purpose of this study was to determine the costs and benefits of implementing recommendations made in the National Institute for Occupational Safety and Health (NIOSH) report, entitled *National Institutes for Occupational Safety and Health (NIOSH) Recommendations to the U. S. Department of Labor for Changes to Hazardous Orders*, relating to Hazardous Orders (HOs) which prohibit or limit youth working in certain occupations or engaging in certain activities in the workplace. A total of 34 HO studies were completed. There are two types of existing HOs — Agriculture and Non-Agriculture — and NIOSH recommended changes to many of them. Additionally, it recommended a number of new HOs that cover occupations or activities not presently addressed in any existing HO.

The analysis of the NIOSH recommendation report compared directly the costs and benefits of implementing or revising HOs, as recommended by NIOSH, with the costs and benefits of not implementing HOs, with each recommendation analyzed on a mutually-exclusive basis. The study team, which primarily consisted of five individuals with extensive backgrounds in both government as well as public- and private-sector industry recognized that prior to any regulatory activity, a complete study would include not only a quantitative analysis, but a qualitative analysis as well. This report summarizes some of these qualitative or contributing factors that may be considered, and the analysis of each HO found in other volumes explains in more detail the factors considered respectively.

Ultimately, we recommend that decision-makers consider both quantitative and qualitative factors as well as other internal and external factors (e.g., budget constraints, priorities established by the Department or Administration, additional stakeholder input) when deciding which existing HOs should be amended or new HOs promulgated through the formal rule-making process. In addition, certain universal constraints of the project, such as the availability of reliable data, further necessitate the need for a comprehensive review of all relevant factors as part of the decision-making process.

As a final review of the overall analyses and after considering other relevant factors, including qualitative issues, sensitivity analysis, and other financial ratios, the comprehensive summary table presented below provides a snapshot of all 34 HOs analyzed.

## HO Comprehensive Summary

COMPREHENSIVE SUMMARY (QUANTITATIVE AND QUALITATIVE FACTORS)

HO #	HO Title	NPV <sup>1</sup> (000's)	BCR <sup>2</sup>	Sensitivity Analysis (000's)		CER <sup>3</sup>	OTHER CONTRIBUTING FACTORS (QUALITATIVE FACTORS) <sup>4</sup>					
				Low	High		Apprenticeship Programs	Economic Feasibility/ Impact	Technological Trends	Days Away From Work/School	Work Opportunities for Youth	Illegal Working
<b>AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 1	Operating a tractor > 20 PTO horsepower or connecting or disconnecting an implement or any of its parts to or from such a tractor	\$227,540	3.62	\$0	\$0	\$83,931	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 2 and HO 3	Operating or assisting to operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the felling, bucking, skidding, loading, or unloading timber with butt diameter of > 6 inches	\$372,296	3.82	\$128,256	\$221,563	\$55,019	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 5	Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of > 20 feet	(\$7,150)	(0.35)	\$210,171	\$366,318	\$684,222	No Impact	Low	Low	Low to Moderate	Moderate	Moderate
HO 6	Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper	\$838,877	4.06	(\$4,161)	\$7,511	\$41,308	No Impact	High	Low	High	Moderate	Moderate
HO 7	Working inside a fruit, forage, or grain storage...; an upright silo; a manure pit; a horizontal silo...	\$866,573	4.13	\$413,069	\$832,900	\$41,286	No Impact	High	Low	High	Moderate	Moderate
HO 8	Handling or applying agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act as Toxicity Category I	\$292,369	3.47	(\$490,768)	\$860,596	\$57,185	No Impact	Low	No Impact	High	Moderate	Moderate
HO 9	Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering	(\$11,129)	(0.91)	(\$163,809)	\$286,391	\$4,409,646	No Impact	Low	No Impact	Low to Moderate	Moderate	Moderate
<b>NON-AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 4	Logging and Sawmilling Occupations	(\$6,265)	(1.00)	(\$10,830)	\$33,752	N/A	Moderate	Low	No Impact	No Impact	Moderate	Moderate
HO 5	Power-Driven Woodworking Machine Operations	\$ 113,566	3.75	\$50,530	\$112,425	\$69,765	No Impact	High	No Impact	No to Low Impact	High	Moderate
HO 6	Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation	(\$7,735)	(0.64)	(\$6,264)	\$169,155	\$213,087	Low to Moderate	Low	No Impact	Low to Moderate	Low to Moderate	Low
HO 7	Power-Driven Hoisting apparatus Operations	\$74,338	4.19	\$39,040	\$73,197	\$61,954	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 8	Power-Driven Metal Forming, Punching, and Sharing Machine Operations	\$113,566	3.75	\$50,530	\$112,425	\$62,547	No Impact	High	No Impact	Moderate	High	Moderate
HO 9	Occupations in Connection with Mining, Other Than Coal	(\$1,210)	(0.51)	(\$1,374)	\$34,087	\$1,038,716	No Impact	Low	Moderate to High	Low	Low	Low
HO 10	Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears	\$8,902	0.07	(\$45,843)	\$2,611	\$1,159,706	Low	Moderate	Low to Moderate	Moderate to High	Low to Moderate	Low
HO 11	Power-Driven Bakery Machine Operations	(\$7,844)	(1.00)	\$18,593	\$49,363	N/A	No Impact	Low	No Impact	No Impact	Moderate	Low
HO 12	Power-Driven Paper Products Machine Operations	(\$3,490)	(0.51)	(\$4,463)	(\$0,637)	N/A	No Impact	Low	No Impact	No Impact	Low	Moderate
HO 14	Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears	(\$9,537)	(1.00)	(\$12,937)	(\$6,684)	N/A	Moderate	Moderate	No Impact	No Impact	Moderate	Moderate
<b>NEW HAZARDOUS ORDERS</b>												
HO 1	Commercial Fishing Occupations	\$13,410	0.47	(\$4,863)	\$13,274	\$113,810	Low	Low	Low	Low	Low	Low
HO 2	Construction Occupations	\$453,990	4.88	\$292,479	\$553,038	\$53,445	Moderate to High	Moderate	Moderate	Low to Moderate	Moderate	Moderate
HO 3	Work in Refuse Occupations	(\$1,738)	(1.00)	(\$1,655)	\$17,856	N/A	No Impact to Low	Low	High	No Impact to Low	No Impact to Low	Low
HO 4	Water Transportation Industries	\$2,728	0.36	\$1,282	\$5,581	\$319,051	Low	Low	No Impact	Low	Low	Moderate
HO 5	Work in Scrap and Waste Materials Industry	\$41,295	4.66	\$25,902	\$41,263	\$38,510	Low	Low	Moderate	Low to Moderate	Low	Low
HO 6	Farm Product Raw Materials Wholesale Trade Industry	\$3,930	1.47	\$1,097	\$3,765	\$158,685	Low	Low	Low	Moderate	Low	Low
HO 7	Railroad Industry	(\$5,240)	(0.83)	(\$5,671)	(\$2,387)	\$564,549	Low	Low	Moderate to High	Low	Low	Low
HO 8	Work at Heights	\$445,765	6.37	\$258,491	\$443,773	\$99,013	High	Moderate	No Impact	Moderate to High	High	Moderate
HO 9	Tractors	\$66,062	3.97	\$38,289	\$68,916	\$454,014	No Impact	Low	No Impact	Low	Low	Moderate
HO 10	Heavy Machinery	\$36,307	2.28	\$19,596	\$39,160	\$338,092	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate
HO 11	Welding	\$46,510	2.69	\$18,593	\$49,363	\$76,149	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 12	Confined Spaces	\$38,026	3.01	\$2,728	\$36,885	\$497,405	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate
HO 13	Work Involving Powered Conveyors	\$20,034	1.82	\$6,634	\$22,887	\$121,550	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 14	Pesticide Handling	\$2,187	0.11	(\$4,221)	\$4,728	\$347,013	Low to Moderate	Low to Moderate	Low	Low	Low	Low to Moderate
HO 15	Exposure to Lead	(\$29,450)	(1.00)	(\$26,572)	\$53,635	N/A	Low to Moderate	Moderate	No Impact to Low	Moderate	Low to Moderate	Moderate
HO 16	Exposure to Silica	(\$8,368)	(0.67)	(\$6,937)	\$63,061	N/A	Moderate to High	Moderate	Low to Moderate	Moderate to High	Moderate	Moderate
HO 17	Work Requiring the Use of Respiratory Protection	\$38,354	1.49	(\$417,408)	\$37,213	\$276,248	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate

<sup>1</sup> NPV is the discounted stream of cash flows over the entire planning horizon (10 years was used for these analyses) and is shown using a 7% discount rate. The NPV formula is:  $\sum_{t=0}^T \frac{CF_t}{(1+r)^t}$  where "T" is the total planning horizon of 10 years, "CF" is cash flow, and "r" is the discount rate of 7%.

<sup>2</sup> BCR (Benefit to Cost Ratio) is the NPV of total benefits of implementation of the HO divided by the total costs of implementation. A positive BCR indicates that there is merit in implementing the HO, and the higher the BCR, the greater the estimated benefit.

<sup>3</sup> CER (Cost Effectiveness Ratio), for this study, is the cost of implementing the HO as recommended divided by the number of lives saved/injuries and illnesses averted. Because of the wide disparity between the figures used for a life (\$5 million) and an injury/illness (\$50,000), the injury rate was multiplied by a factor of 5 to compensate.

<sup>4</sup> Definitions of the subjective ratings for the qualitative factors are: "No Impact" = factor has no effect, either positively or negatively, on individuals, industry, and/or government; "Low Impact" = factor may have some effect, either positively or negatively, on individuals, industry, and/or government; "Moderate Impact" = factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government; and "High Impact" = Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.

## OVERVIEW

### 1. BACKGROUND

The Fair Labor Standards Act (FLSA) directs the Secretary of Labor to designate work activities prohibited for youth workers. Twenty-eight HOs, for both agricultural and nonagricultural activities and issued by the Department of Labor (DOL), prohibit or limit youth employment in occupations determined to be particularly hazardous to youth. These HOs were issued several decades ago, and some have not been altered for a number of years.

Recognizing the need to address the adequacy and relevance of existing HOs to protect youth, the DOL, through the Wage and Hour Division (WHD), funded a study performed by NIOSH, an agency of the Centers for Disease Control of the Department of Health and Human Services. The purpose of NIOSH's study was to recommend changes to existing HOs and the possible promulgation of new HOs, based on the review of scientific literature and data related to deaths, injuries, and illnesses across certain occupations, industries, and activities.

The results of this study were contained in a report entitled "*National Institutes for Occupational Safety and Health (NIOSH) Recommendations to the U. S. Department of Labor for Changes to Hazardous Orders*" issued on May 2, 2002. The report is available on line at <http://www.youthrules.dol.gov/resources.htm>. In the report, NIOSH found justification to continue the existence of all existing HOs, but in many cases recommended revisions that would expand, and in two cases reduce, the scope of the HO. Additionally, they recommended the promulgation of 17 new HOs. In six cases, NIOSH recommended that the existing HO be retained in its current form with no change.

NIOSH was charged with examining specific activities addressed by existing individual HOs (or activities not currently addressed by an HO) to determine if the activity was inherently dangerous for youth under 18 and resulted in or could result in youth deaths, injuries, and/or illnesses. NIOSH in many cases provided anecdotal evidence which included specific cases where one or more youths were killed or injured while engaged in the subject activities.

It was not within the scope of their charge, however, to make any cost/benefit analysis for enacting a specific HO recommendation, only that the activity was inherently "hazardous" for the target youth. This limitation was confirmed in an interview with Dawn N. Castillo, Chief of the Surveillance and Field Investigations Branch of NIOSH's Division of Safety Research, who supervised execution and publication of the NIOSH study.

Subsequent to the issuance of the May 2002 NIOSH report, DOL/WHD determined it was desirable to conduct a detailed cost-benefit analysis of each HO recommendation (existing or new) to establish a priority order (based on a quantitative analysis) for implementation. To this end, DOL's Office of the Assistant Secretary for Administration and Management (OASAM), contracted with SiloSmashers (then operating as Denali Associates) to conduct a detailed study, the results of which are the subject of this report. A listing of the study team, including relevant experience and educational background, is included in Appendix A — *SiloSmashers Study Team*.

A total of 34 detailed HO analyses are included in Volume II (Existing Agricultural – seven HOs; two were combined for purposes of this study), Volume III (Existing Nonagricultural – 10 HOs), and Volume IV (New – 17 HOs) of this report. In addition to the six HOs which are to be retained as they currently stand, several others were already the subject of ongoing rulemaking by DOL/WHD and are therefore not

included in this report. A list of HOs included in the NIOSH report, but not studied, is found in Appendix B.

## 2. SUGGESTIONS FOR USING THIS REPORT

Cost-benefit analysis in a regulatory environment often results in several decision-making variables, none of which, as stand-alone factors, provide the decision maker with an absolute “answer.” Other factors, such as unquantifiable issues, quality of data, and other potentially feasible alternatives, often also become part of the decision equation. Moreover, because cost-benefit analysis relies on projections of estimated costs to the relevant stakeholders, it is not intended to be used as a budgetary tool. This report is organized by initially providing a summary of the findings of the 34 HO analyses based on the Net Present Value (NPV)<sup>1</sup> at a 7 percent discount rate for each. In subsequent sections, other factors are introduced and summarized, with a final comprehensive summary table presented as the conclusion of the report. An additional section (Section 6 — HO Summaries) presented prior to the conclusion of the report provides individual summaries of the most relevant findings for each of the 34 individual analyses. It should be noted, however, that while Section 6 is intended to highlight significant points from each of the analyses, these summaries provide only a general synopsis; a full understanding of the underlying nuances of individual studies requires an evaluation of the analysis in its entirety.

The analysis of the NIOSH recommendation report was conducted to compare directly the costs and benefits of implementing or revising HOs as recommended by NIOSH with the costs and benefits of not implementing HOs, with each recommendation analyzed on a mutually-exclusive basis. Although the Office of Management and Budget (OMB) suggests a minimum of three alternatives be examined in cost-benefit analysis, such an approach was both outside the context of the NIOSH report as well as time and resource intensive considering the breadth and depth of the recommendations and limited data availability. In a meeting held by the team with OMB to discuss this and other methodological issues, OMB generally concurred that an approach examining only two alternatives was reasonable. (Appendix C — *List of Contacts and References*, lists the OMB contact, as well as other sources contacted throughout the course of this study.) Other less-restrictive alternatives to approaching child labor regulations may achieve similar outcomes but at a lower “cost” to involved stakeholders. While not formulated specifically in this report, such alternatives should also be considered where relevant and practicable.

## 3. FINDINGS

### 3.1 Primary Findings

A comprehensive analysis of NIOSH findings was conducted. The recommendations were organized into logical groupings, and a cost-benefit analysis of each of 34 sets was conducted. Assumptions made for the cost-benefit analyses were sensitivity tested, and these results are found elsewhere in this report.

It should be noted that the results reflected in the cost-benefit analyses are predicated on the assumption that actions taken by DOL/WHI would result in attainment of complete reduction of fatalities and injuries for the occupational area. However, alternative actions might be taken to address unsafe conditions and may only partially incur estimated costs and partially achieve the estimated benefits. HO strategies for revisions might include:

- ? Requiring safety education and awareness
- ? Mandating use of safety equipment

---

<sup>1</sup> NPV is the discounted stream of cash flows over the entire horizon planning (10 years was used for these analyses). An additional discussion of NPV is presented under Section 4.1 — *General Methodological Approach* of this report.



- ? Requiring closer supervision
- ? Setting task limitations and restrictions

In making such choices, policy decisions that balance the desire to provide ample employment opportunities for youth, ensure a supply of skilled workers, and ensure youth safety are necessary.

### 3.2 Additional Considerations

The employment landscape has changed considerably since the child labor laws were first enacted over 70 years ago. More specifically, the use of technology across almost every industry has increased significantly, the demographic profile of workers has changed, attitudes concerning employment practices have evolved, and there has been an overall shift from a production-oriented workforce to a more service-oriented workforce. In terms of the employed youth population, these changes have significantly influenced the types of activities and occupations performed by youth workers today.

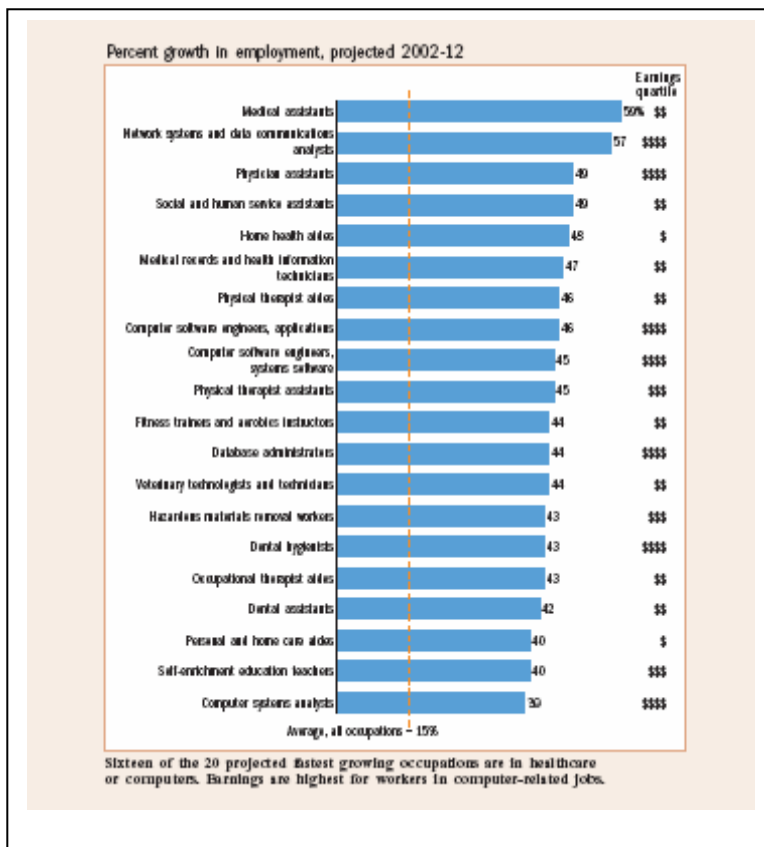
#### 3.2.1 Trends in Youth Workforce

The youth workforce is a distinctive segment of the overall U.S. labor market, specifically in terms of occupational classifications typically held by youths as well as overall work habits. These workers are typically employed part time, although many work on a full-time basis during the summer and other periods when school is not in session, and are in and out of the labor market more frequently than adult workers. Because as a group youth workers are typically underemployed, primary occupations are mostly low skilled and service oriented (retail and food serving establishments, for example), categorized by low wages, few benefits, and minimal job security. [Tannock S; 2001]

#### 3.2.2 Trends in Emerging Industries

Over the last several decades, the labor market has shifted dramatically from a production- and manufacturing-oriented workforce to one that is predominantly service-oriented today. From 1960 through 1990, general workforce declines were seen in several major industries, including agriculture, mining, and manufacturing (both durable and non-durable goods). Retail and wholesale trade, business and personal services, educational services, entertainment, and government services, on the other hand, are industries in which the general employment trend has been increasing. [Sobek M; 2001] The new “service” economy that emerged is largely attributed to the rate of technological growth over the past decades, which has increased the competitive nature across industries both domestically and globally.

In 2001, occupational categories with the highest gains were those in the managerial, technical, professional, and protective services groups; the highest number of job losses was concentrated in manufacturing (assembly, machine operating, production crafts) and transportation occupations. Overall, lower-skilled occupations accounted for almost half of all jobs lost. [Osterman P, et. al.; 2002] In the wake of September 11<sup>th</sup>, protective services occupations are also an area of high growth, with an increase of 3.9 percent in November 2001. [Osterman P, et. al.; 2002] Figure 1 depicts the occupations predicted to have the highest growth rate through 2012.



**Figure 1.** Projected Employment Growth – Top 20 Occupations  
Source: U.S. Department of Labor (DOL), Bureau of Labor Statistics (BLS); 2003-2004.

Found at: <http://www.bls.gov/opub/ooq/2003/winter/art02.htm>

In terms of the youth workforce, the retail trade and services industry accounted for over 85 percent of all youths who worked in 2001. [GAO; 2002] The shift of employment from the more production-oriented industries to the service sector has also contributed to a shift in the types and nature of occupational injuries and fatalities occurring in the youth population as well. Over the past few decades, there has been an increased rate of workplace violent acts (homicides, suicides), motor vehicle accidents, and repetitive stress injuries, while overall the rate of workplace accidents has decreased. In a study of the 1998 National Electronic Injury Surveillance System (NEISS) data, there was a notable decrease by almost 50 percent of young worker reportable incidents. [Jackson LL; 2001] However, although workers under the age of 20 represented less than eight percent of total occupational injuries treated in hospital emergency rooms in 1998, the ratio of injury to number of hours worked was higher than all other age groups. The most significant sources of injuries were falls from ladders and sometimes getting caught or compressed in equipment or objects. [Jackson LL; 2001]

### 3.2.3 Agricultural Industry

Several factors, including the growth of technology in the farming industry and overall market changes have led to a consolidation within the agricultural industry, as all but the largest commercial farms have faced economic adversity over the last several decades. [Gardner BL; 2000] Nonetheless, despite a shift in the number of large production-oriented farms, the number of working household youth remains the largest percentage of all youths working in the agricultural industry. This trend is particularly significant given the fact that household youth workers (those working on farms operated by their own parent or

family member) are exempt from federal youth employment laws. In 1998, there were an estimated 608,063 total youth employed on farms; over 166,000 of these youths were hired workers. [NIOSH/NASS CAIS, 2004] In 2001, total youth farm employment had decreased by 24 percent to 460,739; the largest decrease was in the number of hired youths, which had decreased by 49 percent to 84,570. The number of household working youth over this same period, which includes children of farmers exempt from federal regulation, decreased by only 14 percent from 442,000 in 1998 to 376,000 in 2001. [NIOSH/NASS CAIS; 2004] Estimating the number of youths employed within the agricultural industry is often difficult, however, given the seasonality of farm work as well as the available data collection sources. For example, the U.S. Census Bureau conducts occupational census counts in March, when less farm workers are typically employed, and uses general occupational codes that group together farming, forestry, and fishery workers aged 16 and older.

In terms of occupational safety, agricultural production remains a significant source of workplace injuries and illnesses, even when considering that the number of workers in the industry continues to decrease considerably each year. In 1999, there were over 42,000 recorded injuries and illnesses occurring in agricultural production workers with an incidence rate of 7.7 per 100 full-time workers. [BLS; 2001] In 2002, there were over 38,000 recorded injuries and illnesses with an incidence rate of 7.0 per 100 full-time workers. [BLS; 2003] Youth workers, especially those who are part of the farm household, are particularly susceptible to occupational injury and illness. In 2001, of a total of 22,648 agricultural-related injuries that occurred in youths under the age of 20, over 74 percent occurred to non-employed youths. The highest percentage, 46 percent, of all injuries occurred to youths between the ages of 10 and 15. [NASS; 2004]

### 3.2.4 Non-Agricultural Industries

While the output mix of goods produced within the U.S. has changed somewhat over the past half century, increasing from an economy where agriculture, mining, manufacturing, and construction comprised 41 percent of total output to an almost 50/50 mix today between goods and services, the employment mix has been dramatically more volatile. [Bernstein PL; 1994] Technological innovations over the past several decades have contributed significantly to increased productivity in both manufacturing and agriculture, which in turn has dramatically shifted employment opportunities across a wider variety of industries. Employment in goods-producing industries, which accounted for 80 percent of all employment at the end of the Civil War, decreased to 62 percent after World War I, 49 percent after World War II, and 20 percent by the early 1990s. [Bernstein PL; 1994] The increase in the number and types of service sector industries absorbed the decrease in excess production labor, although by the 1990s even the service industries were beginning to shed excess labor as well. [Bernstein PL; 1994]

From an occupational health perspective, while mining injuries and fatalities have declined considerably, the construction industry remains one of the most hazardous non-agricultural industries today in terms of the youth workforce. Increased focus on this industry, however, by safety agencies such as OSHA and NIOSH has reduced the rate of fall-related fatalities, yet the injury and fatality rate still remains high for other types of occupational accidents. Empirical studies suggest that while the focus on specific problems in specific industries is beneficial in increasing workplace safety for those particular industries, there are very few mechanisms in place to transfer such knowledge across other industries, which may explain why occupational fatalities and injuries/illnesses continue to occur and even increase in some sectors while decrease in others. [Stout NA, Linn HI; 2002]

## 4. QUANTITATIVE SUMMARY

The objective of the quantitative analysis was to distinguish between two alternatives — the “Without Implementation” approach (i.e., status quo) and the “With Implementation” approach (i.e., implementing the HO as recommended in the NIOSH report). For some HOs, the baseline NPV was negative, indicating

that the overall costs of implementation exceed the overall benefits; i.e., there is a net cost to society. In these instances, it is important to note that the baseline analyses were based on both the specific recommendation as proposed by NIOSH as well as certain key assumptions derived from historical data and other estimates. The use of sensitivity analysis, discussed in further detail below, resulted in a range of potential NPVs, and in some cases, changed net losses to net benefits.

*Cost-Effectiveness Analysis.* Cost effectiveness analysis, as measured by the cost-effectiveness ratio (CER), compares the incremental cost of implementing the regulation in relation to the number of lives saved and injuries/illnesses averted. In contrast to the cost-benefit analysis, a cost effectiveness analysis directly compares the number of fatalities, illnesses, and injuries saved or prevented with the overall cost of implementing a particular policy or HO. Using a real number rather than an arbitrary monetary value as the denominator of the formula eliminates the doubt surrounding the “true” benefit to individuals and provides a more tangible measure of the effectiveness that the policy will have on the stakeholders. In comparing multiple policy decisions using the cost-effectiveness ratio, the alternatives with the lowest cost per life saved and injury/illness averted may be considered the most cost effective. Cost effectiveness can be measured in a variety of ways and depends primarily on the relevance to the decision-maker. For this analysis, the effectiveness of policy implementation relative to the individual stakeholder is measured; however, the effectiveness to industry (i.e., the difference between implementation costs versus current cost of fatalities and injuries/illnesses), as well as the effectiveness to government, are also measurable objectives that can be examined.

One potential drawback of using CER for this analysis was the inclusion of fatalities with injuries and illnesses, especially given that a fatality is incomparable to a minor injury, such as a laceration. Given the importance of avoiding fatalities (of which there are relatively few in comparison to youth injuries in many occupations and industries), as well as injuries and illnesses, an adjustment to the denominator is made whereby the annual number of fatalities is inflated by a factor of five while keeping the injury and illness count at their actual levels. In similar cost effectiveness studies, injury to fatality ratios ranged from 1:3 to 1:22, depending on injury severity.<sup>2</sup> In this study, the ratio of the estimated individual cost of an injury/illness to individual cost of a fatality was 1:100. In view of these various ratios, and given the lack of significant data concerning injury and illness types, as well as the likelihood that occupational fatalities in the youth population may be underestimated (see Section 4 — Assumptions and Constraints), the factor of five provides for a conservative adjustment to the denominator of the CER formula to more accurately determine the efficiency of HO implementation. This approach, discussed with WHD, is an attempt to provide a more equal comparison of the effectiveness of the policy given the diversity in significance of the potential outcomes.

#### 4.1 General Methodological Approach

Conducting cost/benefit analyses to measure the effects of government policy change is complex, particularly given the potential for broad implications across diverse populations and the costs and benefits such change may bring. As a result, such analyses are often viewed with skepticism by both relevant stakeholders and non-stakeholders alike. To objectively approach this study in light of these complexities, an analytical process and general methodological framework were developed and followed for each of the HOs analyzed. Specifically, the analytical process involved the following steps:

---

<sup>2</sup> The National Highway Transportation Safety Administration (NHTSA), U.S. Department of Transportation (DOT), has performed several economic analyses comparable to this study that attempt to estimate the efficiencies of highway safety programs. The ranges of the injury to fatality ratios vary and are dependent on the nature of the injuries studies. These analyses can be found at the NHTSA website at : <http://www.nhtsa.dot.gov>.

- ? *Literature Review.* The literature was reviewed, and facts and information was collected to study the overall industry and/or occupational class, employment trends, safety and health issues, and economic factors. Literature consisted of peer-reviewed journals and other publications, sources referenced in the NIOSH report (where available), and government and industry sources.
- ? *Data Collection.* Statistics and associated information were collected and analyzed with regard to fatalities, injuries, and illnesses in the industry or occupation. The study relied on the use of federally-available sources for fatality, injury, and illness data, including NIOSH, the Bureau of Labor Statistics (BLS), Occupational and Safety Health Administration (OSHA), and the U.S. Department of Agriculture (USDA).

The main sources of data utilized by NIOSH were the Census of Fatal Occupational Injuries (CFOI) (for fatalities) and the Survey of Occupational Injuries and Illnesses (SOII) (for injuries and illnesses). NIOSH used data from the period 1992 to 1997 (six years) for fatalities and for 1996 and 1997 for injuries and illnesses. OSHA and WHD provided the study team with the CFOI data for fatalities covering the period 1992 to 2002 (11 years) and the SOII data for injuries and illnesses covering the period 1992 to 2001 (2002 data were not available). In general, NIOSH report data could be replicated in the data used by the study team. However, the study team did have the advantage of having access to more data and the most recent trends.

Data pertaining to industry statistics, including the size of industries, number of employees, and average annual sales, were taken from the Department of Commerce (DOC) Bureau of the Census, USDA, and commercially-available sources, such as Dun & Bradstreet reports.

The study team also sought additional or supplemental data to that cited in the NIOSH report. The purpose of this effort was to provide additional validation to the NIOSH conclusions and to seek, where possible, more up-to-date or relevant data. The team developed “Master Data Elements” charts where data relevant to each HO would be researched and listed in a central document and subsequently used to develop the individual HO analysis. (See Appendix F.)

In addition to these sources, the team also consulted with and interviewed various other key government resources to better determine the scope of the project, to assure the validity of the selected methodology was consistent with OMB guidelines, and to identify additional reference sources for data collection. Specifically, the study team interviewed Dawn Castillo of NIOSH to better understand the scope of the original project and to discuss in general terms the proposed direction of the cost-benefit analysis. The team also met with representatives of OMB to assure the project direction was consistent with published guidelines. Both NIOSH and OMB generally endorsed the proposed methodology and project direction. The team also met or consulted with representatives of the USDA, DOC, OSHA, and the BLS, among others. A complete list of organizations and persons consulted for this project is found in Appendix C.

- ? It should be noted that in a number of cases, inconsistent data was found between the NIOSH report (or sources cited therein) and other reference sources. Although frequently these inconsistencies were a result of differences in methods of evaluating data, they were cited in the individual HO analyses where appropriate. The study team carefully evaluated all data assembled and, for purposes of an individual analysis, used the data it determined to be the most accurate, recent, or relevant to the study, and this was noted in the respective individual HO analysis.
- ? Other factors regarding implementation of the HO were examined, including those associated with the feasibility of implementing the HO and possible cause-and-effect relationships. Additionally, the impact on small and family-owned business, although not necessarily affecting the quantitative analysis, was considered to be important to address as small and family-owned businesses, more so than large corporate employers, which tend to rely more heavily on the youth labor market.

- ? Current state labor laws (if any) related to an individual HO were reviewed to compare current levels of stringency with the proposed NIOSH recommendations.
- ? Qualitative costs and benefits (those costs that are non-quantifiable and/or immeasurable within the scope of the analysis) were determined based on the literature review and information gathering process.
- ? Sensitivity analyses were conducted on those assumptions and variables considered to be the most uncertain to determine the impacts of the changes on the overall quantitative results.

A specific methodological framework was also developed to serve as the means to ensure that the overall end result yielded an accurate and equal comparison of the likely costs and benefits of each of the HOs analyzed. Following the applicable guidelines of the OMB Circular A-4 guidance, this framework also helps to address likely uncertainties concerning the quantification of expected costs and benefits. Specific framework components include the following:

- ? *Relevant Stakeholders.* In view of the nature of child labor laws and the primary impact of such regulation, each of the analyses measured the likely costs and benefits to three primary stakeholders: the affected individuals (i.e. youth workforce), industry, and government (federal and state). Each analysis focused on costs and benefits relevant to each of these stakeholder groups independently. Limiting the number of relevant stakeholders better defines the parameters for each analysis, eliminating outlier effects that are more difficult to assess and measure.
- ? *Ten-Year Planning Horizon.* It is conceivable that the injury and fatality rate among employed youths will continue at current levels indefinitely; however, it is unreasonable to conduct a cost/benefit analysis over an indeterminate period. Given changes in the demographics of working youths, as well as within industry in general, a 10-year planning horizon was used as a baseline for comparison. This planning horizon is believed to most fairly capture the potential benefits of policy implementation while taking into account the evolution of industry.
- ? *Discount Rates.* The practice of discounting streams of expected cash flows in cost/benefit analysis is meant to account for lost opportunity cost — a dollar today is more beneficial than a dollar received at some point in the future. In regulatory analysis, however, this practice is often scrutinized because it discounts the value of human life across the planning horizon; a life saved today is no more valuable than a life saved one year, five years, or ten years from now. In an attempt to compensate for this justifiable argument, and as mandated by OMB guidance, two separate discount rates were used. The first discount rate (3 percent) represents a “social rate of discount,” which attempts to compensate for the human factor, or the social implication of the analysis (the diminishing benefit effect of discounting the monetized benefit of a life saved or an injury/illness averted). The second discount rate (7 percent) represents a rate more in line with a capital planning approach.
- ? *Financial Ratios.* From a summary perspective, comparing outcomes of individual analyses in terms of general ratios simplifies the comparison process. These ratios are purely quantitative in nature; costs and benefits that were impractical or infeasible to measure in dollar units were treated as qualitative costs and benefits. The financial ratios used included the benefit-cost ratio (BCR) as well as Net Present Value (NPV).

The **benefit cost ratio (BCR)** is a numerical ratio which indicates the economic performance of the investment. Similar to Return on Investment (ROI) used in capital planning investment decisions, the BCR is simply the ratio of net benefits to costs — a positive BCR in these analyses indicates that implementation of a particular new or amended HO produces an overall benefit to the stakeholders collectively while a negative BCR indicates that the costs outweigh any likely benefit. As a comparison tool, the higher the BCR, the higher the likely benefit.

**Net Present Value (NPV)** is the discounted dollar value of an investment across the expected planning horizon. As a dollar figure, NPV is presented at the full value level for each implementation approach (implementing versus not implementing) as well as at the incremental approach (the difference between implementing versus not implementing). As a comparison tool and under the incremental approach, the higher the NPV, the higher the expected value of implementation.

- ? *Cost Models.* To ensure an overall consistent measurement of all proposed HO amendments or additions, several models were developed to estimate costs and benefits attributed to each stakeholder. The calculations for these models are as follows; more detailed calculations of the underlying factors are provided in Appendix D.

**TABLE 1: COST MODELS**

Stakeholder	Cost Model Calculation
Individual	<i>Cost of a Fatality.</i> The average number of fatalities occurring annually in the subject population times a Value of a Statistical Life (VSL) figure of \$5 million.
	<i>Cost of an Injury.</i> The average number of injuries/illnesses occurring annually in the subject population times a Willingness to Pay (WTP) figure of \$50,000.
Industry	<i>Cost of a Fatality.</i> The average number of fatalities occurring annually in the subject population times a factor of \$25,687. <sup>3</sup>
	<i>Cost of an Injury/Illness.</i> The average number of injuries/illnesses occurring annually in the subject population times an estimate of the total direct and indirect costs of the specific type(s) of injuries and illnesses as provided by the Occupational Safety and Health Administration (OSHA) “Safety Pays” database.
	<i>Implementation Costs.</i> The estimated number of youths impacted by the regulation times a cost per employee based on an SBA study, “The Impact of Regulatory Costs on Small Firms.”
Government	<i>Medicaid/Disability Costs.</i> The annual number of injuries/illnesses occurring in the subject population times a proportion estimate to result in long-term illness or disability times a factor of \$10,344. (See Appendix D for a detailed breakdown of this calculation).
	<i>Promulgation/Implementation Costs.</i> Federal government costs are based on 3 GS-13s (estimated \$120,000 annual burdened salary) times one year plus an additional \$50,000 for publication costs. State government costs are assuming an abbreviated adoption process of two legal workers per 51 states times 16 hours times an average hourly pay rate of \$43.41.
	<i>Enforcement Costs.</i> Approximate number of investigations estimated annually times a per-case rate of \$1,625.

- ? *Value of a Statistical Life (VSL), Willingness-To-Pay (WTP), and the Human Capital Approach.* The primary “benefit” and cost driver of the cost-benefit analyses is that of the monetized value of a life; however, deriving a figure that accurately places a dollar value on such an abstract factor

<sup>3</sup> Leigh, JP, McCurdy, SA, Schenker, MB. Costs of Occupational Injuries in Agriculture. Public Health Reports. May 2001, Vol. 116, Issue 3, pp235-248.

was complex. The subject continues to be one of immense controversy and debate; as a result, there currently is no singular figure that exists that is generally accepted and used consistently across government. Within the federal government, the range of VSL used across various agencies differed dramatically, from around \$1 million to well over \$6 million depending on the circumstances of the particular study. In reviewing both the literature as well as other federal agency approaches to determine the best method to monetize these values, the two methods of WTP and the human capital approach were evaluated within the context of the project. Input from both the WHD and OMB, however, endorsed the use of the WTP approach, and a VSL figure of \$5 million for each fatality and \$50,000 for each injury or illness was used throughout the analyses.

The VSL is calculated using a WTP approach, a statistical method whereby the additional dollars that society is willing to pay for an increased risk are divided by the increased probability that a fatality will occur as a result of the increased risk. The resulting figure includes “intangibles,” such as foregone opportunities and quality of life aspects. The human capital approach, on the other hand, is a calculation based solely on lost earnings an individual foregoes as a result of death or injury. Quality of life issues, pain and suffering, and other intangible factors are not included in the calculation, resulting in a lower estimate than the WTP approach. Appendix D provides a sample estimate of the value of a fatality using the human capital approach.

The human capital and WTP approaches differ with regard to the method used to estimate the value of future costs of occupational-related mortality in a given year. Whereas the human capital approach relies on foregone income to estimate lost productivity, the willingness-to-pay method considers what people are willing to pay to avoid death or disability. The primary criticisms of the WTP approach are that it values lives based on income distributions (the wealthier are more able to pay than the poor) and that it is difficult to monetize small changes in the probability of a fatality. Criticisms of the human capital approach include the lack of recognition of pain and suffering, as well as an over-emphasis on predicted earnings to determine an individual’s value to society.

## 4.2 Assumptions and Limitations

For each HO analysis, certain assumptions and study constraints were delineated that were unique to the industry or youth activity covered by the respective HO. However, certain global assumptions were made and study limitations noted which applied to all or most of the HOs. The general assumptions and limitations of the study were:

- ? In some cases, data regarding the number of youth employed by occupational category, as well as within a given industry, were not normally collected by various government agencies (for example, the BLS collects data in age groups of 16 to 17, 18 to 19, and sometimes 16 to 19). Therefore, it was necessary to extrapolate this figure based on other data, including the number of youths employed in general and current ratios of occupations within industries. While approximating youth employment in this way is inherently risky, it was necessitated by a lack of available data and therefore often became an assumption tested further in a sensitivity analysis.
- ? Industry will fully implement and comply with the HO, if adopted.
- ? The counts for injuries and illnesses were assumed to be separate and mutually exclusive, with each based on a separate incident.
- ? Adoption of the HO will have a direct positive impact on the number of deaths, injuries and illnesses, and will reduce the rate to zero for the age group under consideration. Although in reality, fatality, injury, and illness rates are attributable to a number of factors and may *not* be reduced to zero as a result of HO implementation, this assumption applied universally led to an



equal baseline estimate across all of the analyses, which subsequently could be challenged via a sensitivity analysis.

- ? Costs associated with implementation by the industry will be passed along in the form of higher prices to consumers.
- ? State adoption of an HO (when necessary) will occur via an expedited rule-making process and will not include a lengthy analysis and comment period.
- ? Multiplier effects to the economy are not included in the analysis (e.g., any increase in prices as a result of industry implementation of the HO will be offset by a decrease in workers' compensation premiums via taxes collected by a state to fund the workers' compensation program).
- ? Any implementation costs associated with translation of the HO into multilingual formats are considered to be sunk costs and have not been considered in the HO analysis (based on Executive Order 13166, which establishes mandatory accessibility to government services for individuals with limited English proficiency).

In addition to these general assumptions and constraints, however, the issue of the data availability and reliability was the most complex constraint with the broadest consequences. Because of the diversity of these data sources, including the manner in which data is routinely collected, analyzed, and published, variations in the resulting data were often encountered, complicating data analysis efforts.

It is routinely highlighted in the literature that government data does not adequately capture the true volume of injuries, illnesses, and fatalities that occur annually, especially given jurisdictional and other issues. In certain industries, such as agriculture, there is a strong disincentive to underreport or not report injuries and fatalities to government data collection entities. [Leigh JP, McCurdy SA, Schenker MB; 2001] Moreover, while NIOSH and OSHA reports contain narrative, descriptive data (which in many cases provided an extra level of analysis in that the applicability of certain fatalities or injuries to a particular industry could be more readily determined), these databases do not capture all of the accident data necessary to make an accurate prediction of prevalence. Data sources based on hospital emergency department records provided more anecdotal evidence, but such data is dependent on the knowledge of the hospital staff that the injury or fatality was occupationally-related. In general, while the study attempted to measure the actual number of fatalities, injuries, and illnesses occurring each year in the youth population, it is highly probable that based on the utilized data sources, the resulting estimates represent an underestimation of the prevalence of these data.

### 4.3 Sensitivity Analysis

Sensitivity analysis is a highly useful tool when conducting cost/benefit analyses in which there is some degree of uncertainty concerning the underlying assumptions made. For each of the cost-benefit analyses, a sensitivity analysis was performed to determine the sensitivity of the baseline results to changes in the underlying assumptions. Because the fatality, injury, and illness estimates were valued using a VSL method (see Section 3 for further discussion on valuation methods), the estimated number of lives saved and injuries/illnesses averted was obviously a strong cost driver for each analysis. However, given limitations on the available data with regard to this count, as well as in some cases the specificity of the NIOSH recommendation in relation to historical data, it was appropriate to use sensitivity analysis to compensate for these constraints.

Besides fatality, injury, and illness counts, other major recurring assumptions made for the majority of the analyses included the estimated number of youths employed within certain industries and occupations, the estimated cost to industry of implementation, the proportion of injuries and illnesses resulting in long-term disability, and the planning horizon necessary to fully implement the HOs. Because these issues

were common across all HOs, and in support of a “fortiori approach”<sup>4</sup> to the sensitivity analyses, these assumptions were challenged in order to determine the sensitivity of the baseline results. Specific examples of how the fortiori approach was used are summarized below:

- ? In some cases, and in view of the fact that updates to some existing HOs have not kept pace with changes across industry and the youth working population, data appeared to support a natural decrease in the number of fatalities and/or injuries and illnesses. Because the baseline analyses assumed a continuance of fatalities and injuries/illnesses based on a rate averaged across recent years, changes in certain factors, such as a decrease in the number of youths employed in the industry and technological innovations resulting in improved occupational safety, in some instances supported a revised assumption based on a natural decrease in the fatality, injury, and illness occurrence rate.
- ? The underlying data was collected from a variety of sources, and each source obviously employed its own methodology for collection. As a result, reconciling data often produced dissimilar results on which to perform the baseline analysis. The use of sensitivity analysis, therefore, attempted to compensate for conflicting data.
- ? Because of cessation lags and difficulties in determining cause-and-effect relationships for certain occupational illnesses, sensitivity analysis provided a necessary means to measure long-term impact when historical data did not provide evidentiary support. In these instances, estimating a single fatality in perpetuity (occurring indefinitely) provided a strong argument for implementation of an HO that did not exist otherwise.

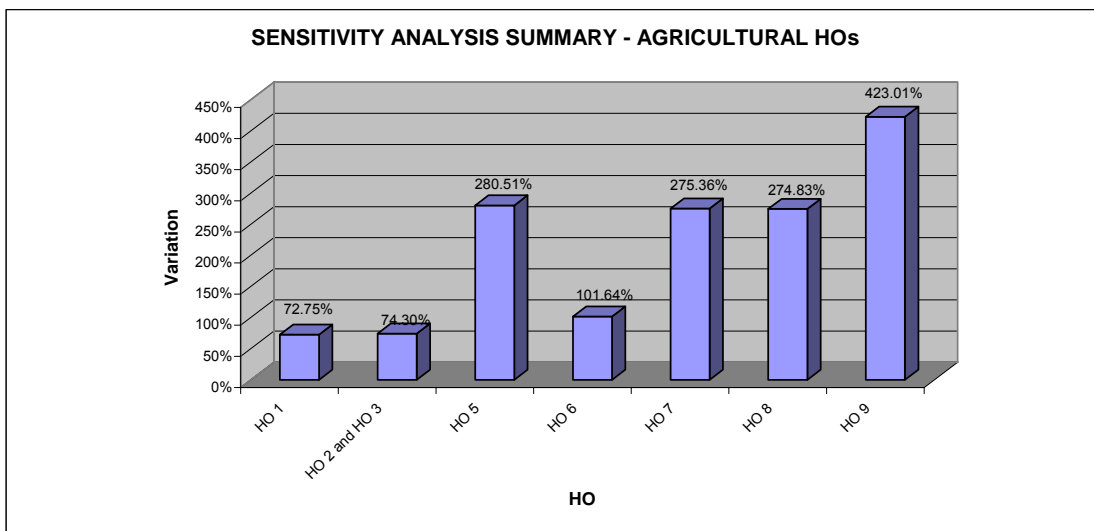
The charts beginning on page 13 summarize the sensitivity analysis for each category of HOs studies and graphically depict the percent of variation. To maintain some consistency across all HOs, assumptions were varied by specific percentages (i.e., 20 percent, 50 percent, 100 percent), depending on how realistic such variations in assumptions were believed likely to occur. In the case of HOs addressing illnesses with cessation lags, the assumption of continuous fatalities was added to determine the net effect. As a general rule, higher degrees of variability in sensitivity analysis outcomes represent higher levels of sensitivity to plausible changes in the underlying assumptions. From a decision-maker standpoint, high degrees of variability more often translate into higher degrees of risk in terms of estimating the likely benefits and costs of a decision.

---

<sup>4</sup> A “fortiori approach” to sensitivity analysis requires changing the underlying assumptions *against* the baseline results. For instance, if the baseline analysis favored implementing the HO, the underlying assumptions were changed, where plausible, in the sensitivity analysis in a deliberate attempt to skew the results towards the “Without Implementation” alternative.

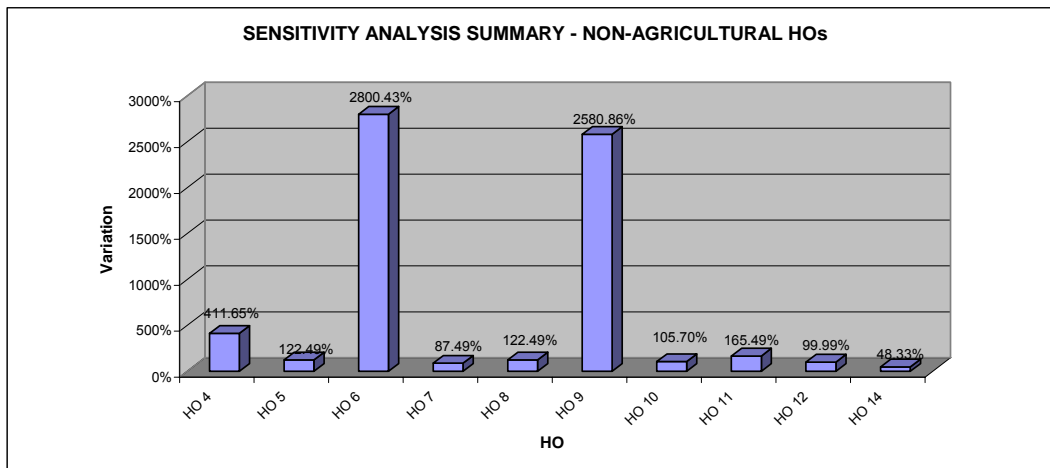
**TABLE 2 – SENSITIVITY ANALYSIS - AGRICULTURAL HOs**

HO #	HO Title	Baseline NPV (000's)	Sensitivity Analysis		% Variation
			Low	High	
<b>AGRICULTURAL HAZARDOUS ORDERS</b>					
HO 1	Operating a tractor > 20 PTO horsepower or connecting or disconnecting an implement or any of its parts to or from such a tractor	\$227,540	\$128,256	\$221,563	72.75%
HO 2 and HO 3	Operating or assisting to operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the operation) any of the following machines...	\$372,296	\$210,171	\$366,318	74.30%
HO 5	Felling, bucking, skidding, loading, or unloading timber with butt diameter of > 6 inches	(\$7,150)	(\$4,161)	\$7,511	280.51%
HO 6	Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of > 20 feet	\$838,877	\$413,069	\$832,900	101.64%
HO 7	Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper	\$866,573	(\$490,768)	\$860,596	275.36%
HO 8	Working inside a fruit, forage, or grain storage...; an upright silo; a manure pit; a horizontal silo...	\$292,369	(\$163,809)	\$286,391	274.83%
HO 9	Handling or applying agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act as Toxicity Category I	(\$11,129)	(\$8,140)	\$26,293	423.01%

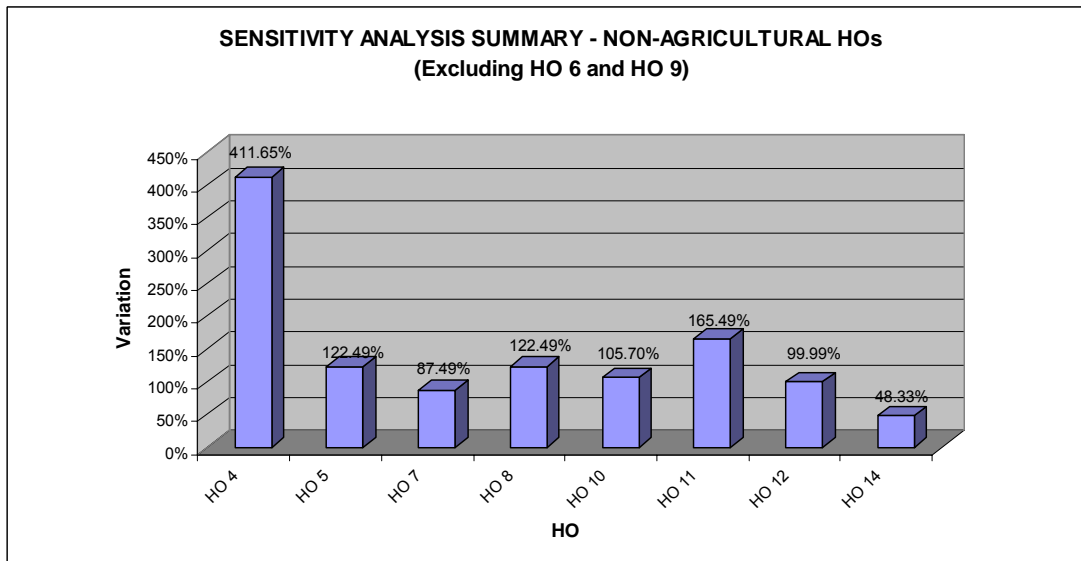


**TABLE 3 – SENSITIVITY ANALYSIS SUMMARY - NONAGRICULTURAL HOs**

HO #	HO Title	Baseline NPV (000's)	Sensitivity Analysis		% Variation
			Low	High	
<b>NON-AGRICULTURAL HAZARDOUS ORDERS</b>					
HO 4	Logging and Sawmilling Occupations	(\$6,265)	(\$10,830)	\$33,752	411.65%
HO 5	Power-Driven Woodworking Machine Operations	\$113,566	\$50,530	\$112,425	122.49%
HO 6	Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation	(\$7,735)	(\$6,264)	\$169,155	2800.43%
HO 7	Power-Driven Hoisting Apparatus Operations	\$74,338	\$39,040	\$73,197	87.49%
HO 8	Power-Driven Metal Forming, Punching, and Sharing Machine Operations	\$113,566	\$50,530	\$112,425	122.49%
HO 9	Occupations in Connection with Mining, Other Than Coal	(\$1,210)	(\$1,374)	\$34,087	2580.86%
HO 10	Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering	\$8,902	(\$45,843)	\$2,611	105.70%
HO 11	Power-Driven Bakery Machine Occupations	(\$7,844)	\$18,593	\$49,363	165.49%
HO 12	Power-Driven Paper Products Machine Occupations	(\$3,490)	(\$4,463)	(\$0,637)	99.99%
HO 14	Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears	(\$9,537)	(\$12,937)	(\$6,684)	48.33%

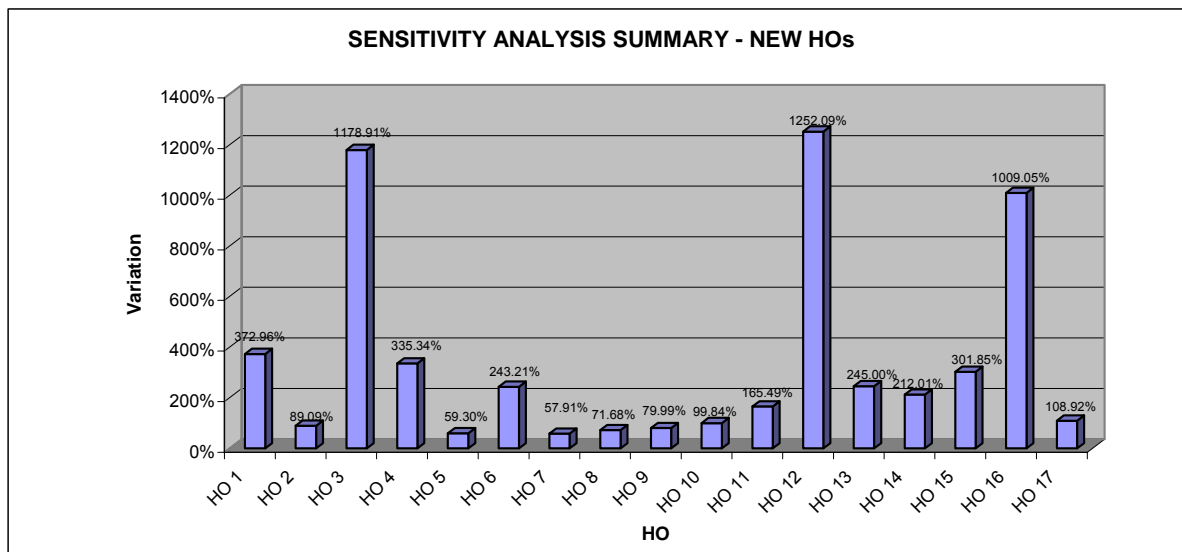


**TABLE 3a – SENSITIVITY ANALYSIS SUMMARY - NONAGRICULTURAL HOs (EXCLUDING HO 6 AND HO 9)**



**TABLE 4 – SENSITIVITY ANALYSIS SUMMARY - NEW HOs**

HO #	HO Title	Baseline NPV (000's)	Sensitivity Analysis (000's)		% Variation
			Low	High	
<b>AGRICULTURAL HAZARDOUS ORDERS</b>					
HO 1	Commercial Fishing Occupations	\$13,410	(\$4,863)	\$13,274	372.96%
HO 2	Construction Occupations	\$453,990	\$292,479	\$553,038	89.09%
HO 3	Work in Refuse Occupations	(\$1,738)	(\$1,655)	\$17,856	1178.91%
HO 4	Water Transportation Industries	\$2,728	\$1,282	\$5,581	335.34%
HO 5	Work in Scrap and Waste Materials Industry	\$41,295	\$25,902	\$41,263	59.30%
HO 6	Farm Product Raw Materials Wholesale Trade Industry	\$3,930	\$1,097	\$3,765	243.21%
HO 7	Railroad Industry	(\$5,240)	(\$5,671)	(\$2,387)	57.91%
HO 8	Work at Heights	\$445,765	\$258,491	\$443,773	71.68%
HO 9	Tractors	\$66,062	\$38,289	\$68,916	79.99%
HO 10	Heavy Machinery	\$36,307	\$19,596	\$39,160	99.84%
HO 11	Welding	\$46,510	\$18,593	\$49,363	165.49%
HO 12	Confined Spaces	\$38,026	\$2,728	\$36,885	1252.09%
HO 13	Work Involving Powered Conveyors	\$20,034	\$6,634	\$22,887	245.00%
HO 14	Pesticide Handling	\$2,187	(\$4,221)	\$4,728	212.01%
HO 15	Exposure to Lead	(\$29,450)	(\$26,572)	\$53,635	301.85%
HO 16	Exposure to Silica	(\$8,368)	(\$6,937)	\$63,061	1009.05%
HO 17	Work Requiring the Use of Respiratory Protection	\$38,354	(\$417,408)	\$37,213	108.92%



## 5. QUALITATIVE SUMMARY

It is normally not feasible to capture all of the relevant decision-making factors when conducting the cost/benefit analyses solely via quantitative methods. Certain factors outside the scope of quantifiable costs, as well as those that are limited by data collection constraints, are included in cost/benefit analysis as qualitative factors and measured using more subjective terms. These factors are important to the overall analysis and may be relevant in evaluating whether or not an HO should be revised or implemented or in determining the priority order for implementation. For each HO, some qualitative information is presented for consideration and evaluation by DOL/WHI as it deems appropriate. Each of these qualitative criteria was evaluated based on the results of literature reviews and data analysis, and represent subjective best estimates of the likely effects of implementation. Finally, it is important to note that

although the criteria below are presented for each of the HOs, certain factors are more relevant than others and depend on the nature of the specific HO. For example, there was little quantifiable evidence of fatalities for HO recommendations related to long-term, exposure-related (silica, radiation, and lead) illnesses; however, cessation lags and the determination of cause-and-effect relationships are qualitative factors in these instances that merit additional consideration.

The primary qualitative factors reviewed in this study included such considerations as:

- ? Impact prohibiting apprenticeships for some occupations or activities will have on the respective industry. For certain occupations, apprenticeship and school-to-work programs represent an important means of long-term employment opportunity for both youth workers as well as industry.
- ? Increase in number of youth working illegally after ban is imposed and related enforcement issues. In industries comprised largely of small businesses where barriers to entry are low, it is more likely that youths will continue to work regardless of changes or additions to existing child labor laws.
- ? Loss of youth labor pool. Certain industries rely more heavily on the youth labor market and may be impacted more significantly should child labor laws change.
- ? Issues of opportunity, fairness, and equity. Some occupations, such as those requiring minimum skills, but having a wage rate higher than minimum wage, are more attractive to youth workers; however, the tradeoff to employment in these occupations may be a higher risk of occupational injury.
- ? Economic feasibility of implementing an HO. The tradeoff between cost to industry of implementation versus the impact in terms of fatalities, injuries, and illnesses averted may represent more of an economic hardship to industry rather than an economic benefit to society.
- ? Lost employment opportunities for youth.
- ? Impact on small and family operated businesses.
- ? Time necessary for industry, businesses, and states to analyze, implement, and adjust to new standards.

While these factors did not change the overall quantitative analysis when considered in concert with the quantitative results, they provide DOL/WHM additional background information to better evaluate the decision to revise or create an HO or to establishing the priority order for implementation.

## 6. HO SUMMARIES

Each of the individual cost-benefit analyses are provided in their entirety in Volumes II through IV of this report. The following sections summarize the most relevant points of each of the 34 individual analyses conducted in each of the three areas (agricultural, non-agricultural, and new).

### 6.1 Agricultural Hazardous Orders

In general, the agricultural HOs differ from the non-agricultural HOs in that they are applicable to the age group “under 16” and contain exemptions only to those youths who obtain specialized certification via 4-H-type federal safety programs. From a state legislation perspective, while certain states have specific HOs relating to youth workers within the agricultural industry, other states adopt the federal non-agricultural HOs as applicable across all industries. Youths who work on family-owned farms, estimated to be a significant portion of the youth population in the study, are exempt from agricultural HOs. Finally, several of the revisions suggested by NIOSH would require more specific, narrative language in order to estimate the likely effects of such amendments. Development of estimates was obviously more difficult in

these cases since historical data did not normally include the detail necessary to derive more definitive estimates.

### *HO 1 — Operating a Tractor Over 20 PTO Horsepower*

Accidents involving tractors and other machinery represent the greatest source of fatalities and injuries in the agricultural industry, accounting for over half of all injuries and fatalities annually. The NIOSH report recommends 1) eliminating the 20 PTO horsepower threshold (tractor horsepower is not always known or reported in accident reports), and 2) require the use of Rollover Protective Structures (ROPS) combined with seatbelts on tractors operated by 14- and 15-year olds with certification. ROPS have been routinely installed on agricultural tractors beginning in 1985; however, many tractors manufactured prior to 1985 remain in use across farms today. Because of general design features of tractors (i.e., higher center of gravity), tractors are prone to roll over more easily, especially given the types of work performed in agricultural operations using tractors. Based on the analysis, implementation of the NIOSH recommendation will provide a substantive overall benefit assuming the avoidance of 2.09 fatalities and 334 injuries within the subject population.

### *HOs 2 and 3 — Operating or Assisting to Operate Machinery*

The NIOSH recommendation for revisions to the agricultural machinery HOs combines HOs 2 and 3, both of which are applicable to agricultural-specific and general types of machinery, and further expands coverage to cover machinery by function (e.g., harvesting machinery) rather than by specific type (e.g., corn picker). Technological advancements in the area of agricultural machinery continue to increase at a rapid rate. The recommendation addresses the implications of technology by imposing a blanket prohibition on agricultural machinery with the intent to lessen the need to re-address the HO as new technologies are introduced. In terms of fatalities and injuries, a baseline estimate of 2.36 fatalities annually and 787 injuries yielded an overall net benefit of implementing the HO as suggested.

### *HO 5 — Felling, Bucking, Skidding, Loading or Unloading Timber with Butt Diameter of More Than 6 Inches*

The current agricultural HO relating to timber prohibits youths from performing specific activities involving timber with butt diameters greater than six inches; the NIOSH recommendation is to remove the diameter threshold so that all timber regardless of size is covered. Of note with this recommendation is the nature of the activities included, which are more closely associated with the timber industry versus the agricultural industry in general. Activities more often associated within the agricultural industry include tree delimiting (i.e., in orchard production sectors), tree stump removal, and transplanting/replanting activities. Because of the nature of the suggested revision, however, it was necessary to rely on more narrative data to determine the butt diameter of the timber in question. As a result, no evidence of any fatalities was found; a conservative estimate of the number of injuries derived was 27.375 annually. The baseline result yielded an overall net loss.

### *HO 6 — Working from a Ladder or Scaffold at a Height of Over 20 Feet*

Similar to HO 5 regarding timber, the NIOSH recommendation suggests expanding coverage of the existing HO related to working from heights to cover a broader array of structures as well as reducing the allowable height youths should be permitted to work from 20 feet to 6 feet. While a substantial number of injuries were estimated to occur each year (a baseline estimate of 2,197.5 was used), no fatalities were found that occurred at heights above 6 feet and below 20 feet. In addition, the recommendation sought to prevent injuries and fatalities occurring to youths as a result of falls from animals (horses) and ATVs. While these sources are inherently hazardous, it is unlikely that the heights involved are above 6 feet, thus the resulting impact is estimated to be minimal. Based on the high number of injuries occurring annually, however, the overall analysis yielded a net benefit.

### *HO 7 — Driving a Bus, Truck, or Automobile When Transporting Passengers, or Riding on a Tractor as a Passenger or Helper*

In an effort to expand the coverage of this existing HO, NIOSH recommended that the scope be broadened to include all vehicles, both on-highway and off-highway, prohibit youths from working as outside helpers on motor vehicles, and move the current portion regarding tractor passengers under HO 1 (which is assumed to have no economic impact as it does not change the current scope). Other findings relevant to this HO included the current use of graduated driver's licenses across states (currently, only six states permit full licensing of youths under the age of 16; the majority of states permit intermediate and learner's permits, both of which require a licensed driver to accompany the youth), as well as past legislation concerning youths operating ATVs. Because of the complexity of the recommendation and resulting assumptions, the baseline analysis assumed a reduction of one fatality and 2,178 injuries annually and yielded an overall net benefit.

### *HO 8 — Working Inside a Fruit, Forage, or Grain Storage; a Silo; or a Manure Pit*

The NIOSH recommendation addresses components of the current HO that do not adequately provide youths protection against confined space accidents. Specifically, the recommendation suggests removing the two-week waiting period in addition to expanding the scope to include any silo or storage bin, whether designed to be oxygen deficient or not. There currently exists studies and literature supporting the hazards of silos and other agricultural storage spaces at all intervals and not only during the first few weeks after silage has been added. Illnesses as a result of exposure (both acute and long-term) to silage dust also have been positively identified and linked. However, fatality and injury/illness data did not indicate a significant number of avoidable fatalities. The analysis was conducted using a baseline estimate of 0.67 fatalities and 735 injuries/illnesses annually, yielding a net overall benefit.

### *HO 9 — Handling or Applying Agricultural Chemicals Classified Under the Federal Insecticide, Fungicide, and Rodenticide Act*

NIOSH's recommendation is based on the current EPA Worker Protection Standard for pesticide handling in an effort to expand the current youth protection standard to cover both acute as well as chronic pesticide exposure. In reviewing the literature and fatality, injury, and illness data, however, and in comparing the data with the suggested recommendation, it was determined that very few illnesses and no fatalities would be averted as a result of implementation. Moreover, the EPA standard does not specifically prohibit youths from entering a field shortly after pesticides are applied, an activity most frequently associated with pesticide illness in agricultural workers. Based on these data, the baseline analysis resulted in an overall net loss if implementing the NIOSH recommendation as suggested.

## **6.2 Non-Agricultural Hazardous Orders**

The non-agricultural HO recommendations encompass certain proposals DOL has already placed into rulemaking. While the majority of the NIOSH recommendations attempt to make existing laws more stringent, two of the recommendations (bakery machines and meat processing occupations) suggest loosening the current restrictions based on a historical reduction in the injury rates overall. Many of the occupations and industries are currently included in apprenticeship programs and are currently exempt from the HO regulations; in most instances, however, NIOSH recommends eliminating such an exemption. For almost every recommendation, an estimate concerning the number of affected youths was derived using federal occupational census data, and although an approximation, such data was necessary to determine overall impact. All of these HOs are applicable to FLSA-covered youths under the age of 18 and span a variety of occupations, industries, and activities.

### *HO 4 — Logging and Sawmilling Occupations*

NIOSH report recommendations have little to do with actual logging and sawmilling, but rather cover Forestry Services, Operation of Timber Tracts, and Construction of Administrative and Living Quarters



for Logging and Sawmilling — occupations found within the logging and sawmill industries and included within the current HO 4. There are relatively few workers employed in Forestry and Timber Tracts. Extrapolation of the data leads to the conclusion that as few as 500 youth are employed in Forestry and 100 in Timber Tracts. The NIOSH Fatality Assessment and Control Evaluation (FACE) Program reports contain no accidents in these areas. It was concluded, therefore, that the Cost & Benefit Analysis (CBA) could show no deaths or injuries. Data for Construction does not identify work in Logging and Sawmilling. Hence, there is no data for numbers employed or for fatalities and injuries, so the CBA shows no fatalities or injuries. The financial analysis is neutral for the individual, but a cost to industry and government: net cost overall. No State has an HO stricter than the existing. Only two states, Michigan and Oregon, mention forestry or trees. Many states already have a ban on construction work for living quarters in place via a general prohibition on all construction work for youth.

### *HO 5 — Power-Driven Woodworking Machine Operations*

The recommendation expands the HO to include similar power-driven machines used to operate on materials other than wood; e.g., metals; metallic alloys; non-metallic materials such as plastics, glass and stone, and composite materials combining two or more materials; e.g., carbon or glass fiber reinforced plastics or polyesters. Note that some of the functions for metals and metal alloys may already be covered by HO 8, but the latter does not cover turning, drilling, boring, reaming, planing, or grinding processes for metals and metallic alloys. These functions are widespread in industry. U.S. Census data shows up to one million workers could be using the machines. The Cost-Benefit Analysis (CBA) assumed that 30,000 youth could be affected by the ban. The data led to the assumption of one life of a youth per year would be saved and 200 injuries and illnesses avoided. The CBA showed financial benefits to the individual and industry, but a cost to government: net benefit overall. Arizona and Connecticut already include power-driven metal working machines in their laws. Delaware, District of Columbia, North Dakota, Oregon, and Washington broaden the definition to any machinery. Minnesota and Wisconsin mention a variety of metal shaping machines. New Jersey, New York, Pennsylvania, and Virginia mention grinding/abrasive wheels; e.g., emery.

### *HO 6 — Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation*

The NIOSH recommendation seeks to expand coverage of the existing HO regarding exposure to ionizing radiation by eliminating the current threshold of 0.5 rems in an attempt to protect youth workers in medical and veterinarian settings. The recommendation is based on certain scientific literature sources as well as an overall scientific belief that radiation, at any dose, is inherently risky and therefore should be avoided, particularly in occupational settings. Other literature sources, however, are in direct opposition to this viewpoint, suggesting that low levels of radiation may actually be beneficial. Determining a fatality rate was difficult given 1) health outcomes as a result of exposure to low levels of radiation are long-term in nature, occurring after many years, and 2) determining a cause-and-effect relationship given the diversity of sources of radiation (i.e., sources occurring naturally in the environment, medical and dental x-rays, etc.) is speculative. Given these complexities, a baseline estimate of zero fatalities and 55 injuries/illnesses annually based on historical data yielded an overall net loss. However, sensitivity analysis performed on the assumption of fatalities beginning in year 10 based on the current estimated number of youth employed in medical and veterinarian offices yielded an overall net benefit.

### *HO 7 — Power-Driven Hoisting Apparatus Operations*

There are five NIOSH recommendations extending coverage of the HO:

1. Expand the HO to cover repairing, servicing, disassembling, and assisting in tasks being performed by the machine. This recommendation applies to all machinery covered under this HO.

2. Expand the HO to prohibit youth from riding on any part of a forklift as a passenger (including the forks), and from working from forks, platforms, buckets, or cages attached to a moving or stationary forklift.
3. Expand the HO to prohibit work from truck-mounted bucket or basket hoists commonly termed “bucket trucks” or “cherry pickers.”
4. Expand the HO to cover commonly used man-lifts that do not meet the current definition, specifically aerial platforms.
5. Remove the exception that currently permits youth to operate an electric or air-operated hoist of less than one ton capacity.

Power-driven hoisting apparatus is used universally in industry and in the wholesale and retail trades — forklift trucks, cranes, hoists, elevators, derricks, chairlifts, bucket lifts, cherry pickers, reach trucks, etc. Although difficult to estimate the number of workers operating, assisting, and working in the vicinity of such equipment, for the purposes of the CBA, an arbitrary figure of 1,000 was used for the number of youth affected. The number was tested in sensitivity analysis. Analyzing data for deaths and injuries was difficult as they do not always distinguish between, for example, operation and working with or in the vicinity of forklift trucks. However, forklift trucks had the most information and data available. After careful evaluation, the CBA assumed that one life per year could be saved and 100 injuries and illnesses avoided. Financial analysis shows benefits to the individual and industry, but a cost to government: net overall benefit. Many states already have regulations covering the first NIOSH report recommendation — repairing, servicing, disassembling, etc.

#### *HO 8 — Power-Driven Metal Forming, Punching, and Shearing Machine Operations*

NIOSH recommends expanding the HO to include several types of metalworking machinery specifically excluded; namely, milling function machines, turning function machines, grinding function machines, and boring function machines. The extension overlaps with the recommendation to expand coverage of HO 5. The same figures for youth employees affected (30,000) potential savings of lives (1 per year) and injuries and illnesses avoided (200 per year) apply as already estimated for HO 5. The CBA showed financial benefits to the individual and industry, but a cost to government: net overall benefit. Arizona and Connecticut already include power-driven metal working machines in their laws. Delaware, District of Columbia, North Dakota, Oregon, and Washington broaden the definition to any machinery. Minnesota and Wisconsin mention a variety of metal shaping machines. Massachusetts, New Jersey, New York, Pennsylvania and Virginia mention grinding/abrasive wheels; e.g., emery.

#### *HO 9 — Occupations in Connection with Mining, Other Than Coal*

The NIOSH recommendation concerning mining operations other than coal was two-part: 1) expanding the HO to include all types of work performed in petroleum and natural gas extraction; and 2) eliminating the current exemption permitting youths to work on road and track crews. The industry in general is categorized by an older, more stable workforce engaged in full-time, technical work, and often working in off-shore locations. In reviewing employment and fatality/injury/illness data while performing the analysis, it was estimated that very few youths are employed in this industry, particularly given the overall nature of the industry, and that relatively few injuries (baseline estimate of 2.14 injuries) and no fatalities would be avoided as a result of implementation. Further, data to support the second part of the NIOSH recommendation may exist, but may be included in data collected within the construction industry in general. The resulting analysis yielded an overall net loss, although not substantial because of the low estimate of the number of youths employed within the industry.

### *HO 10 — Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering*

The NIOSH recommendation includes both an expansion to include retail, wholesale, and manufacturing industries and general occupations as well as a relaxation of the current HO concerning the use of meat slicing machines. The recommendation was based on the continued number of accidents occurring involving youth across various industries, including repetitive and cumulative trauma injuries, in addition to an apparent decrease in the number and severity of injuries as a result of meat slicing machines. In reviewing the data, however, there still exist a substantial number of injuries, particularly lacerations and amputations, which occur as a result of meat slicing machines. Further, because of the relaxation recommendation, an analysis of state laws revealed that several states will have laws more stringent than federal regulations should the recommendation be implemented. The baseline estimate used accounted for an increase in injuries as a result of meat slicing machinery, with an injury rate of 229.5 annually without implementation and 137.34 with implementation. The fatality rate used was 0. Although the overall result yielded a net benefit, it was marginal; sensitivity analysis showed that assuming a 10-percent increase in the injury rate as a result of relaxation yielded an overall net loss to implement over the planning horizon.

### *HO 11 — Power-Drive Bakery Machine Occupations*

Recommendation is a relaxation of the rule prohibiting youth operating counter-top bakery machines. The CBA analyzed the impact in the same way as for prohibitions. The number of youth who might be affected is very difficult to estimate, but a figure of 7,500 was assumed using Bread and Bakery Product Manufacturing as the source. No fatalities, injuries, or illnesses could be found in the data attributable to counter-top machines. End result of the financial analysis is a cost to industry and government to implement the new regulation: net overall cost. Although many States follow Federal Law in this area, there are 23 States with a stricter law in place and, hence, the relaxation will have no effect unless they relax their laws in line with the proposed recommendation.

### *HO 12 — Power-Driven Paper-Products Machine Occupations*

WHD already had rulemaking in progress covering all of the NIOSH report recommendations except part of one; i.e., balers and compactors processing materials other than paper-products were not included. This CBA focused on the impact of the excluded recommendation; i.e., machines processing; e.g., steel drums, aluminum cans, plastic containers, aerosol cans, paint cans, expanded polystyrene, etc. It was difficult to estimate the number of youth employees, but a figure of 3,300 was eventually assumed. Only one fatality of youth was found which occurred in a fiber mill in Georgia in 1995. The CBA assumed that this isolated fatality would occur again and incorporated the event into the analysis. No injuries or illnesses could be found so none was assumed. End result is a benefit to the individual and a cost to industry and government: net overall cost. No State has a law matching the NIOSH recommendation.

### *HO 14 — Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears*

Recommendation is to revise the definition of machinery covered by this HO to include other machines, such as chainsaws, which perform cutting and sawing functions through direct contact between the cutting surfaces and the material (the current definition is based on the presence of a continuous series of notches or jagged teeth). HO 14 was intended as a “catch all” to fill in the gaps left after implementation of HOs 4, 5, 8, 10, 11, and 12. Although only chainsaws are specifically mentioned, it is assumed that saws such as jigsaws, wire saws, and friction saws are also to be included in the extension. Power-driven saws and cutting and shearing machines are used throughout industry making an estimation of the number of workers difficult. However, using data from U.S. Census and BLS, extrapolation indicates that 16,000 youth could be affected. CFOI data showed no fatalities, so none has been assumed. Likewise, no reduction in injuries and illnesses was found. Financial analysis is neutral to the individual, but a cost to industry and government: net overall cost. Note that the CBA for HO 5 showed an overall benefit. The

reason is that the revisions to HO 5 will cover a much wider range of machines than the revised HO 14, and the CFOI data did indicate that there may be some fatalities of youth. Only one State includes some or all of the NIOSH report recommendations. South Carolina prohibits Alligator Shears, Rotary Shears, and Squaring Shears.

### 6.3 New Hazardous Orders

The NIOSH recommendations for new HOs cover those industries and occupations not specifically covered in the existing agricultural and non-agricultural HOs. Although certain activities within existing HOs are covered to various degrees in the new HO recommendations, the formulation of these new HOs is intended to capture the specific occupations and industries in which current data suggests are particularly hazardous. For almost all of these recommendations, the estimated number of affected youths is derived based on current occupational and industry ratios.

#### *New HO 1 — Commercial Fishing Occupations*

The NIOSH report implies that the HO is aimed at commercial fishing from boats and trawlers, both inshore and deep sea. Mention is also made of scuba divers gathering sea urchins and sea cucumbers. The definition of commercial fishing implied by the NIOSH report resulted in an assumption that recreational fishing occupations were not included. The CBA has assumed that the new HO will apply to Fin Fishing, Shell Fishing, and Miscellaneous Marine Products as defined by North American Industry Classification System (NAICS). The number of youth employed in these areas of fishing has been estimated at 600 using U.S. Census and BLS data. CFOI data infer that there is a potential saving of one life of youth per year while SOII data infer that three injuries and illnesses per year could be avoided. Analysis shows financial benefits to the individual and industry, but a cost to government; net result being an overall benefit. There is no state that has a Child Labor Law covering specifically Commercial Fishing.

#### *New HO 2 — Construction Occupations*

The construction industry represents a significant source of employment opportunities for youth workers, including several of the most commonly found occupations in apprenticeship programs. The NIOSH recommendation suggests implementing a new HO prohibiting youths from working in specific construction-related occupations; however, given the occupational classifications provided in the recommendation, the resulting HO would encompass the entire construction industry, including apprenticeships. The industry is one of the most hazardous industries in general; however, it is also categorized by a large number of small, family-owned businesses, which may be exempt from the scope of an HO. The federal rules, along with many state labor laws, currently prohibit youths under the age of 16 from working within the construction industry, and other laws are applicable to the most hazardous occupations in general (e.g., roofing). While the baseline estimate of 7.83 fatalities and 447 injuries/illnesses annually yielded a substantial net benefit, it is also notable that such a broad prohibition on youth apprenticeships within this industry would likely have a significant impact on both youth workers and industry alike.

#### *New HO 3 — Work in Refuse Occupations*

The objective of the NIOSH recommendation to implement a new HO prohibiting youths from working in refuse occupations is related to the current non-agricultural HO concerning youths who work on vehicles as outside helpers. Creation of an additional HO to cover youths in the refuse industry was recommended by NIOSH to expand on the existing coverage. In reviewing the literature in addition to current state labor laws, it was not clear that such an HO would have a measurable impact on the youth population. It is estimated that because of the full-time nature of the work, very few youths are employed within the industry, and further, no evidence of any fatalities or injuries was found. Technological advances in the types of vehicles used within the industry have also helped to make the industry safer by reducing the number of workers required as well as by eliminating much of the heavy lifting traditionally

required for the occupation. The baseline estimate of zero fatalities and zero injuries resulted in an overall net loss; however, in assuming a youth injury rate comparable to the all-worker injury rate, the revised estimate resulted in an overall net benefit.

#### *New HO 4 — Water Transportation Industries*

The recommendation is to prohibit youth working on boats, barges, ships, and any other water craft used to transport people or materials on the open seas, Great Lakes, and inland waterways (rivers and canals). Although around 80,000 people are employed in water transportation, only 30,000 (approximately) of these jobs would be open to youth because of the levels of education and certification required. With 30,000 jobs open to youth, it was estimated that around 1,000 youth were employed in the industry. There is no record of a fatality in the industry since 1992 so the CBA assumed no lives would be saved. There have been injuries and illnesses and the CBA assumed that 20 per year could be avoided. The CBA showed financial benefits to the individual, but a cost to industry and government: net overall benefit. The federal youth employment rules currently prohibit youth under 16 years of age from employment in this industry, at least for the deep sea and the Great Lakes. There are six States with laws in line with the recommendation, 13 prohibit youths under age 16 from employment within the industry, four partially meet the recommendation and 28 make no mention of water transportation.

#### *New HO 5 — Work in Scrap and Waste Materials Industry*

The scrap and waste materials industry is a wholesale industry engaged in recycling activities of metals, plastics, glass, paper, and other waste. The NIOSH recommendation, in keeping with other similar recommendations, would prohibit youths from working within the industry based on the inherent hazards associated with recycling materials. In reviewing the data, it was estimated that very few youths are employed within the industry based on the nature of the occupations involved. Further, many of the activities involved across the industry involved working with powered conveyors, balers, shredders, compactors, shears, and other similar machinery currently prohibited under existing non-agricultural HOs. The industry is somewhat fragmented, with the majority of sales attributed to scrap metal recycling. Based on a baseline assumption of 0.2 fatalities and 72.84 avoidable injuries annually, the resulting estimate was an overall net benefit.

#### *New HO 6 — Farm Product Raw Materials Wholesale Trade Industry*

The recommendation for a new HO concerning youths working in the agricultural-related wholesale trade industry is based on the hazardous nature of the agricultural industry in general; i.e., working with large animals, in confined spaces such as silos as well as vehicle and machinery hazards. In reviewing the literature regarding the industry in general and in attempting to determine the number of youths employed, it was determined that the livestock wholesale sector is becoming more vertically integrated with the production (agriculture) and manufacturing (meat processing) sectors in general, although the overall industry is still heavily fragmented. With relatively few numbers of youths employed in the wholesale industry, the estimated impact for this HO is minimal. The baseline analysis estimated a reduction of zero fatalities and 11.875 injuries, which resulted in an overall net benefit because of the small number of impacted youths involved.

#### *New HO 7 — Railroad Industry*

The proposed NIOSH recommendation to establish a new HO prohibiting young workers from working in railroad occupations was based on the inherent dangers of the railroad industry in general. Research showed that youth employees represented less than one percent of the total employees for all ages employed by the railroad industry (approximately 336 employees out of a total 177,060). Further, there were no youth fatalities reported during the 10-year period between 1994 and 2003. As a result, the cost benefit analysis showed that although implementing the NIOSH recommendation was feasible, the new HO would not result in any tangible benefits. The NPV of implementing the new HO was calculated to be

an overall net loss. Results of the sensitivity analyses conducted yielded similar conclusions with no tangible benefit identified.

### *New HO 8 — Work at Heights*

The scope in the NIOSH report is precise and means that youth will be prohibited from any work location where they could fall from a height of six feet or more. Vehicle cabs could be included in the scope and this would be contentious as already noted in the remarks of some stakeholders. Falls from heights has been the subject of nine publications by NIOSH over the period 1989 to 2001. There have been many deaths of all age groups and, for youth, 45 over the 11 years from 1992 to 2002. CBA assumed 4 lives of youth per year could be saved. There have also been many injuries and, for the CBA, the data indicates 685 injuries per year of youth could be avoided. There are financial benefits to the individual, industry, and government because of the large reduction in deaths and injuries: net overall benefit. Twenty-nine States prohibit some aspects of working at height, but only North Carolina and North Dakota come close to the NIOSH recommendation. An apprentice exemption is not recommended so there will be a considerable, adverse impact on that group.

### *New HO 9 — Tractors*

The NIOSH report did not specify what was meant by tractors. The CBA took a broad definition as described in the web sites of the manufacturers. Tractor mowers were included by NIOSH. An apprentice exemption was recommended provided that a Roll-Over Protection System (ROPS) is fitted. Although there are many deaths caused by tractors, 73 percent occur on farms and are subject to the separate agricultural HO. However, the CBA still found an average of two deaths of youth per year would be saved in prohibiting their use of tractors in non-agriculture. Savings in injuries was calculated to be four per year. There are financial benefits to the individual and industry, but a cost to government: net overall benefit. There are 44 States that make no mention of youth being prohibited from using tractors in a non-agricultural setting. The other seven States prohibit the use of tractors, but in some cases only for youth under 16 years old.

### *New HO 10 — Heavy Machinery*

The scope of the HO is “prohibiting operating, repairing, assisting in the operation of excavating machinery, loaders, and road grading and surfacing machinery, or assisting with tasks performed by these machines.” The HO overlaps with a number of others: excavating machinery is already covered by the existing HO 17; loaders are already covered by existing HO 4 and existing HO 7; road grading and surfacing machinery would be covered by the proposed new HO for Construction. The overlaps were ignored for the purpose of the CBA. Analysis showed that one to two lives of youth per year could be saved. The CBA assumed one life because in many cases an adult would have been as likely to die as a youth. It was estimated that 23 injuries to youth per year could be avoided by implementing this HO. There is a financial benefit to the individual, but only costs to industry and government: net overall benefit. There are 45 States including Washington, DC that make no mention of heavy machinery in the summaries of their HOs. Of the remaining six States, only New Jersey has anything that is near to what is proposed by NIOSH.

### *New HO 11 — Welding*

The NIOSH recommendation simply specified work in welding. The CBA assumed that all materials would be covered as well as any hot cutting process. The scope is in line with the definitions of the American Welding Society. Hence, soldering and brazing are also included as are manual and automatic welding and hot cutting processes. The number of youth affected was estimated to be a highly speculative 15,000. Only one fatality of youth in 1987 could be found in the data. There was enough evidence to assume 125 injuries and illnesses of youth per year would be avoided. The end result is an overall benefit to individuals and industry, but a cost to government: net overall benefit. The NIOSH report makes no

mention of apprentices. The HO without an apprentice exemption would create difficulty for many apprentices, particularly welders. Only one state, Connecticut, prohibits welding, brazing, soldering and hot cutting. Nine States prohibit one, two, or three, but not all four. However, 41 States make no mention of welding or cutting.

### *New HO 12 — Confined Spaces*

NIOSH defined a confined space as a space which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. (There is already an agricultural HO prohibiting youth from working in certain confined spaces.) It is extremely difficult to estimate the number of working youth who might be affected. An arbitrary number, 1,000, was assumed and later tested in sensitivity analysis. The initial estimate for number of lives of youth saved per year was 2. However, in many accidents, an adult would be just as likely to lose his life as a youth. Therefore, the assumption is that one youth life per year will be saved. The number of injuries and illnesses avoided per year was estimated to be 20. The end result is a benefit to individuals and industry, but a cost to government: net overall benefit. Note that only three states, Michigan, North Carolina, and Wisconsin, already have regulations prohibiting youth under 18 years of age from working in confined spaces.

### *New HO 13 — Work Involving Powered Conveyors*

The scope of the HO could be very wide — conveyors can be horizontal, vertical, inclined, or curved; they can be rubber belt, steel belt, steel mesh, screw, chain (redler), bucket, and many more types; they can convey solids in many different forms and not just powders or granular forms; they can convey liquids or slurries. Note that the recommendation states only manufacturing conveyors which means that conveyors elsewhere will not be covered. It is very difficult to estimate the number of youth affected; however, for purposes of this study 5,000 has been assumed and then tested in sensitivity analysis. There were no fatalities recorded since 1988 so zero saving is assumed in the CBA. Injuries and illnesses estimated at 30 per year from the most recent data so this figure was used in the CBA. There is an overall financial benefit to individuals and industry, but a cost to government: net overall benefit. No apprentice exemption is recommended so, there will be an effect on apprentices who install, maintain, and repair conveyors. There are seven States prohibiting work on powered conveyors for youth under 16 years of age, but none for the 16 to 17 year olds. Forty-four states make no mention of powered conveyors.

### *New HO 14 — Pesticide Handling*

Although youth workers are prohibited from working as “pesticide handlers” within the agricultural industry, there is no comparable HO across non-agricultural industries, including landscaping and horticultural services, and retail nurseries and garden stores. The term “pesticide” is diverse, including both chemically- and biologically-based substances, and applicable to many products, including fungicides, herbicides, insect repellants, household disinfectants and sanitizers, pet products, and swimming pool chemicals. Based on the definition, the analysis assumed that all workers within the industries as delineated in the recommendation are included, with the baseline estimate based on zero fatalities and 48.27 injuries/illnesses avoidable annually. The net result was a net benefit, although sensitive to changes in the assumption concerning implementation costs.

### *New HO 15 — Exposure to Lead*

The NIOSH recommendation suggests implementation of a new HO prohibiting youths from working in any industry and/or occupation involving the potential for lead exposure. Because lead is commonly found in many industries and occupations, it is estimated that implementation of a lead HO would impact nearly 100,000 youth workers. Currently, many federal agencies, including the Food and Drug Administration (FDA), Department of Housing and Urban Development (HUD), Health Care Financing Administration (HCFA), Centers for Disease Control (CDC), and others, have implemented surveillance-

type programs to monitor and prevent lead exposure. Additionally, several states have instituted blood lead level registries, although occupational lead exposure is often un-reported or under-reported and continues to be an occupational health hazard. More specifically, it is often the case that when an occupationally-exposed worker presents to a physician, the lead levels are reported to the appropriate registry, but notification is never presented to the worker's employer to be acted on. Detrimental effects of lead exposure are sometimes acute, but most often are long-term in nature, ranging from anemia, peripheral neuropathy, hypertension, central nervous system dysfunction, renal impairment, and impaired reproductive functions in chronically, occupationally-exposed individuals. While the medical repercussions of lead exposure are well documented, an adequate reporting system continues to be evasive, and data regarding the number of fatalities and illnesses/injuries yields minimal data. Assuming a baseline estimate of zero fatalities and zero injuries/illnesses obviously results in an overall net loss. However, in revisiting the estimate via a sensitivity analysis and assuming a single fatality occurring in perpetuity (indefinitely) as a result of lead exposure, the overall result is a net benefit.

### *New HO 16 — Exposure to Silica*

Similar to the recommendation discussed above for lead, the NIOSH recommendation for a new HO relating to youth workers exposed to silica involves a similarly diverse set of industries and occupations found to be at particular risk for the long-term implications of silica exposure. Exposure to any of the various forms of silica results in a variety of long-term illnesses, including pneumoconiosis, occupational asthma, renal disease, tuberculosis, chronic obstructive pulmonary disease, some types of cancers, and autoimmune diseases (Sjogren's syndrome, systemic sclerosis, systemic lupus erythematosus, "overlap syndrome"). OSHA, the Environmental Protection Agency (EPA), and the National Institute of Health (NIH) all have programs in place to monitor and prevent silicosis; however, silica exposure continues to remain a hazardous issue in certain workplaces. As a baseline estimate, 0.10 fatalities and zero illnesses was assumed, yielding an overall net loss. Through a sensitivity analysis, however, and assuming one fatality in perpetuity, the revised estimate yielded an overall net benefit.

### *New HO 17 — Work Requiring the Use of Respiratory Protection*

The recommendation is to prohibit youth from working at any activity which requires the use of respiratory protection. The CBA assumed that the OSHA Regulation would define the scope; i.e., if level of air contaminant in the air exceeds stipulated level in the regulation, then respiratory protection must be worn. Respiratory protection may be anything from the simple dust mask to fully self-contained breathing apparatus. A BLS survey showed that around 3.3 million workers need to use respiratory protection full-time, part-time, or occasionally. It is estimated that there may be 55,000 youth in the 3.3 million workers who will be affected by the ban. Apprentices will be affected by the ban. CFOI data from 1992 to 2002 showed that one life of youth per year might be saved by a ban. SOII data indicated that 46 injuries and illnesses per year could be avoided. The CBA shows a financial benefit to the individual, but a cost to industry and government: net overall benefit. One state, North Carolina, already has the recommendation in place and even links it to OSHA Regulations. However, 38 States make no mention and 12 States prohibit for specific hazards.

## **7. CONCLUSION**

The NIOSH recommendations for changes to and creation of child labor laws encompass a diverse range of industries, activities, and occupations in which youths historically have been employed to some degree. While some occupations and industries remain inherently hazardous, much has changed across the youth labor landscape since the inception of child labor HOs over 30 years ago. Some industries, such as the coal mining industry, have seen dramatic downswings in employment while others, such as the construction industry, continue to expand. Technological advances have not only led to improved safety practices, particularly in hazardous industries and occupations, but have also significantly shifted



employment opportunities across the labor force. To adequately analyze the impact of implementing the NIOSH recommendations, therefore, a comprehensive analysis of all relevant factors is necessary, including both quantitative as well as qualitative variables. To begin the process, this report presents several decision-making variables, including NPV, BCR, sensitivity analysis results, and qualitative factors. A comprehensive summary chart listing the results of the individual analyses is found in Tables 5, 5A, 5B, and 5C beginning on page 34.

Finally, when used in conjunction with other decision-making inputs, including both internal and external considerations, this report is intended to assist in the decision-making process. Given the assumptions and limitations of the analysis, other less stringent alternatives may also represent feasible options for consideration, in lieu of the proposed NIOSH recommendation.

**TABLE 5 – HO COMPREHENSIVE SUMMARY**

COMPREHENSIVE SUMMARY (QUANTITATIVE AND QUALITATIVE FACTORS)

HO #	HO Title	NPV <sup>1</sup> (000's)	BCR <sup>2</sup>	Sensitivity Analysis (000's)		CER <sup>3</sup>	OTHER CONTRIBUTING FACTORS (QUALITATIVE FACTORS) <sup>4</sup>					
				Low	High		Apprenticeship Programs	Economic Feasibility/ Impact	Technological Trends	Days Away From Work/School	Work Opportunities for Youth	Illegal Working
<b>AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 1	Operating a tractor > 20 PTO horsepower or connecting or disconnecting an implement or any of its parts to or from such a tractor	\$227,540	3.62	\$0	\$0	\$83,931	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 2 and HO 3	Operating or assisting to operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the felling, bucking, skidding, loading, or unloading timber with butt diameter of > 6 inches	\$372,296	3.82	\$128,256	\$221,563	\$55,019	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 5	Felling, bucking, skidding, loading, or unloading timber with butt diameter of > 6 inches	(\$7,150)	(0.35)	\$210,171	\$366,318	\$684,222	No Impact	Low	Low	Low to Moderate	Moderate	Moderate
HO 6	Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of > 20 feet	\$838,877	4.06	(\$4,161)	\$7,511	\$41,308	No Impact	High	Low	High	Moderate	Moderate
HO 7	Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper	\$866,573	4.13	\$413,069	\$832,900	\$41,286	No Impact	High	Low	High	Moderate	Moderate
HO 8	Working inside a fruit, forage, or grain storage...; an upright silo; a manure pit; a horizontal silo...	\$292,369	3.47	(\$490,768)	\$860,596	\$57,185	No Impact	Low	No Impact	High	Moderate	Moderate
HO 9	Handling or applying agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act as Toxicity Category I	(\$11,129)	(0.91)	(\$163,809)	\$286,391	\$4,409,646	No Impact	Low	No Impact	Low to Moderate	Moderate	Moderate
<b>NON-AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 4	Logging and Sawmilling Occupations	(\$6,265)	(1.00)	(\$10,830)	\$33,752	N/A	Moderate	Low	No Impact	No Impact	Moderate	Moderate
HO 5	Power-Driven Woodworking Machine Operations	\$ 113,566	3.75	\$50,530	\$112,425	\$69,765	No Impact	High	No Impact	No to Low Impact	High	Moderate
HO 6	Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation	(\$7,735)	(0.64)	(\$6,264)	\$169,155	\$213,087	Low to Moderate	Low	No Impact	Low to Moderate	Low to Moderate	Low
HO 7	Power-Driven Hoisting apparatus Operations	\$74,338	4.19	\$39,040	\$73,197	\$61,954	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 8	Power-Driven Metal Forming, Punching, and Sharing Machine Operations	\$113,566	3.75	\$50,530	\$112,425	\$62,547	No Impact	High	No Impact	Moderate	High	Moderate
HO 9	Occupations in Connection with Mining, Other Than Coal	(\$1,210)	(0.51)	(\$1,374)	\$34,087	\$1,038,716	No Impact	Low	Moderate to High	Low	Low	Low
HO 10	Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering	\$8,902	0.07	(\$45,843)	\$2,611	\$1,159,706	Low	Moderate	Low to Moderate	Moderate to High	Low to Moderate	Low
HO 11	Power-Driven Bakery Machine Occupations	(\$7,844)	(1.00)	\$18,593	\$49,363	N/A	No Impact	Low	No Impact	No Impact	Moderate	Low
HO 12	Power-Driven Paper Products Machine Occupations	(\$3,490)	(0.51)	(\$4,463)	(\$0,637)	N/A	No Impact	Low	No Impact	No Impact	Low	Moderate
HO 14	Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears	(\$9,537)	(1.00)	(\$12,937)	(\$6,684)	N/A	Moderate	Moderate	No Impact	No Impact	Moderate	Moderate
<b>NEW HAZARDOUS ORDERS</b>												
HO 1	Commercial Fishing Occupations	\$13,410	0.47	(\$4,863)	\$13,274	\$113,810	Low	Low	Low	Low	Low	Low
HO 2	Construction Occupations	\$453,990	4.88	\$292,479	\$553,038	\$53,445	Moderate to High	Moderate	Moderate	Low to Moderate	Moderate	Moderate
HO 3	Work in Refuse Occupations	(\$1,738)	(1.00)	(\$1,655)	\$17,856	N/A	No Impact to Low	Low	High	No Impact to Low	No Impact to Low	Low
HO 4	Water Transportation Industries	\$2,728	0.36	\$1,282	\$5,581	\$319,051	Low	Low	No Impact	Low	Low	Moderate
HO 5	Work in Scrap and Waste Materials Industry	\$41,295	4.66	\$25,902	\$41,263	\$38,510	Low	Low	Moderate	Low to Moderate	Low	Low
HO 6	Farm Product Raw Materials Wholesale Trade Industry	\$3,930	1.47	\$1,097	\$3,765	\$158,685	Low	Low	Low	Moderate	Low	Low
HO 7	Railroad Industry	(\$5,240)	(0.83)	(\$5,671)	(\$2,387)	\$564,549	Low	Low	Moderate to High	Low	Low	Low
HO 8	Work at Heights	\$445,765	6.37	\$258,491	\$443,773	\$99,013	High	Moderate	No Impact	Moderate to High	High	Moderate
HO 9	Tractors	\$66,062	3.97	\$38,289	\$68,916	\$454,014	No Impact	Low	No Impact	Low	Low	Moderate
HO 10	Heavy Machinery	\$36,307	2.28	\$19,596	\$39,160	\$338,092	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate
HO 11	Welding	\$46,510	2.69	\$18,593	\$49,363	\$76,149	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 12	Confined Spaces	\$38,026	3.01	\$2,728	\$36,885	\$497,405	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 13	Work Involving Powered Conveyors	\$20,034	1.82	\$6,634	\$22,887	\$121,550	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 14	Pesticide Handling	\$2,187	0.11	(\$4,221)	\$4,728	\$347,013	Low to Moderate	Low to Moderate	Low	Low	Low	Low to Moderate
HO 15	Exposure to Lead	(\$29,450)	(1.00)	(\$26,572)	\$53,635	N/A	Low to Moderate	Moderate	No Impact to Low	Moderate	Low to Moderate	Moderate
HO 16	Exposure to Silica	(\$8,368)	(0.67)	(\$6,937)	\$63,061	N/A	Moderate to High	Moderate	Low to Moderate	Moderate to High	Moderate	Moderate
HO 17	Work Requiring the Use of Respiratory Protection	\$38,354	1.49	(\$417,408)	\$37,213	\$276,248	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate

<sup>1</sup> NPV is the discounted stream of cash flows over the entire planning horizon (10 years was used for these analyses) and is shown using a 7% discount rate. The NPV formula is:  $\sum_{t=0}^{10} \frac{CF_t}{(1+r)^t}$  where "T" is the total planning horizon of 10 years, "CF" is cash flow, and "r" is the discount rate of 7%.

<sup>2</sup> BCR (Benefit to Cost Ratio) is the NPV of total benefits of implementation of the HO divided by the total costs of implementation. A positive BCR indicates that there is merit in implementing the HO, and the higher the BCR, the greater the estimated benefit.

<sup>3</sup> CER (Cost Effectiveness Ratio), for this study, is the cost of implementing the HO as recommended divided by the number of lives saved/injuries and illnesses averted. Because of the wide disparity between the figures used for a life (\$5 million) and an injury/illness (\$50,000), the injury rate was multiplied by a factor of 5 to compensate.

<sup>4</sup> Definitions of the subjective ratings for the qualitative factors are: "No Impact" = factor has no effect, either positively or negatively, on individuals, industry, and/or government; "Low Impact" = factor may have some effect, either positively or negatively, on individuals, industry, and/or government; "Moderate Impact" = factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government; and "High Impact" = Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.

**TABLE 5a – AGRICULTURAL HO SUMMARY**

CDC-NIOSH/WHI CHILD LABOR HAZARDOUS ORDER COST-BENEFIT ANALYSIS  
COMPREHENSIVE SUMMARY (QUANTITATIVE AND QUALITATIVE FACTORS)

HO #	HO Title	NPV <sup>1</sup> (000's)					OTHER CONTRIBUTING FACTORS (QUALITATIVE FACTORS) <sup>4</sup>					
			BCR <sup>2</sup>	Sensitivity Analysis (000's)		CER <sup>3</sup>	Apprenticeship Programs	Economic Feasibility/Impact	Technological Trends	Days Away From Work/School	Work Opportunities for Youth	Illegal Working
				Low	High							
<b>AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 1	Operating a tractor > 20 PTO horsepower or connecting or disconnecting an implement or any of its parts to or from such a tractor	\$227,540	3.62	\$0	\$0	\$83,931	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 2 and HO 3	Operating or assisting to operate (including starting, stopping, adjusting, feeding or any other activity involving physical contact associated with the	\$372,296	3.82	\$128,256	\$221,563	\$55,019	No Impact	Moderate to High	Moderate	Moderate to High	Moderate	Moderate
HO 5	Felling, bucking, skidding, loading, or unloading timber with butt diameter of > 6 inches	(\$7,150)	(0.35)	\$210,171	\$366,318	\$684,222	No Impact	Low	Low	Low to Moderate	Moderate	Moderate
HO 6	Working from a ladder or scaffold (painting, repairing, or building structures, pruning trees, picking fruit, etc.) at a height of > 20 feet	\$838,877	4.06	(\$4,161)	\$7,511	\$41,308	No Impact	High	Low	High	Moderate	Moderate
HO 7	Driving a bus, truck, or automobile when transporting passengers, or riding on a tractor as a passenger or helper	\$866,573	4.13	\$413,069	\$832,900	\$41,286	No Impact	High	Low	High	Moderate	Moderate
HO 8	Working inside a fruit, forage, or grain storage...; an upright silo; a manure pit, a horizontal silo...	\$292,369	3.47	(\$490,768)	\$860,596	\$57,185	No Impact	Low	No Impact	High	Moderate	Moderate
HO 9	Handling or applying agricultural chemicals classified under the Federal Insecticide, Fungicide, and Rodenticide Act as Toxicity Category I	(\$11,129)	(0.91)	(\$163,809)	\$286,391	\$4,409,646	No Impact	Low	No Impact	Low to Moderate	Moderate	Moderate

<sup>1</sup> NPV is the discounted stream of cash flows over the entire planning horizon (10 years was used for these analyses) and is shown using a 7% discount rate. The NPV formula is:  $\sum_{t=0}^T \frac{CF_t}{(1+r)^t}$  where "T" is the total planning horizon of 10 years, "CF" is cash flow, and "r" is the discount rate of 7%.

<sup>2</sup> BCR (Benefit to Cost Ratio) is the NPV of total benefits of implementation of the HO divided by the total costs of implementation. A positive BCR indicates that there is merit in implementing the HO, and the higher the BCR, the greater the estimated benefit.

<sup>3</sup> CER (Cost Effectiveness Ratio), for this study, is the cost of implementing the HO as recommended divided by the number of lives saved/injuries and illnesses averted. Because of the wide disparity between the figures used for a life (\$5 million) and an injury/illness (\$50,000), the injury rate was multiplied by a factor of 5 to compensate.

<sup>4</sup> Definitions of the subjective ratings for the qualitative factors are: "No Impact" = factor has no effect, either positively or negatively, on individuals, industry, and/or government; "Low Impact" = factor may have some effect, either positively or negatively, on individuals, industry, and/or government; "Moderate Impact" = factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government; and "High Impact" = Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.

**TABLE 5b – NON-AGRICULTURAL HO SUMMARY**

**CDC-NIOSH/WHI CHILD LABOR HAZARDOUS ORDER COST-BENEFIT ANALYSIS  
COMPREHENSIVE SUMMARY (QUANTITATIVE AND QUALITATIVE FACTORS)**

HO #	HO Title	NPV <sup>1</sup> (000's)	Sensitivity Analysis (000's)				OTHER CONTRIBUTING FACTORS (QUALITATIVE FACTORS) <sup>4</sup>					
			BCR <sup>2</sup>	Low	High	CER <sup>3</sup>	Apprenticeship Programs	Economic Feasibility/Impact	Technological Trends	Days Away From Work/School	Work Opportunities for Youth	Illegal Working
<b>NON-AGRICULTURAL HAZARDOUS ORDERS</b>												
HO 4	Logging and Sawmilling Occupations	(\$6,265)	(1.00)	(\$10,830)	\$33,752	N/A	Moderate	Low	No Impact	No Impact	Moderate	Moderate
HO 5	Power-Driven Woodworking Machine Operations	\$ 113,566	3.75	\$50,530	\$112,425	\$69,765	No Impact	High	No Impact	No to Low Impact	High	Moderate
HO 6	Occupations Involving Exposure to Radioactive Substances and to Ionizing Radiation	(\$7,735)	(0.64)	(\$6,264)	\$169,155	\$213,087	Low to Moderate	Low	No Impact	Low to Moderate	Low to Moderate	Low
HO 7	Power-Driven Hoisting apparatus Operations	\$74,338	4.19	\$39,040	\$73,197	\$61,954	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 8	Power-Driven Metal Forming, Punching, and Shaping Machine Operations	\$113,566	3.75	\$50,530	\$112,425	\$62,547	No Impact	High	No Impact	Moderate	High	Moderate
HO 9	Occupations in Connection with Mining, Other Than Coal	(\$1,210)	(0.51)	(\$1,374)	\$34,087	\$1,038,716	No Impact	Low	Moderate to High	Low	Low	Low
HO 10	Occupations in the Operation of Power-Driven Meat-Processing Machines and Occupations Involving Slaughtering, Meat-Packing or Processing, or Rendering	\$8,902	0.07	(\$45,843)	\$2,611	\$1,159,706	Low	Moderate	Low to Moderate	Moderate to High	Low to Moderate	Low
HO 11	Power-Driven Bakery Machine Occupations	(\$7,844)	(1.00)	\$18,593	\$49,363	N/A	No Impact	Low	No Impact	No Impact	Moderate	Low
HO 12	Power-Driven Paper Products Machine Occupations	(\$3,490)	(0.51)	(\$4,463)	(\$0,637)	N/A	No Impact	Low	No Impact	No Impact	Low	Moderate
HO 14	Occupations in the Operation of Power-Driven Circular Saws, Band Saws, and Guillotine Shears	(\$9,537)	(1.00)	(\$12,937)	(\$6,684)	N/A	Moderate	Moderate	No Impact	No Impact	Moderate	Moderate

<sup>1</sup> NPV is the discounted stream of cash flows over the entire planning horizon (10 years was used for these analyses) and is shown using a 7% discount rate. The NPV formula is:  $\sum_{t=0}^T \frac{CF_t}{(1+r)^t}$  where "T" is the total planning horizon of 10 years, "CF" is cash flow, and "r" is the discount rate of 7%.

<sup>2</sup> BCR (Benefit to Cost Ratio) is the NPV of total benefits of implementation of the HO divided by the total costs of implementation. A positive BCR indicates that there is merit in implementing the HO, and the higher the BCR, the greater the estimated benefit.

<sup>3</sup> CER (Cost Effectiveness Ratio), for this study, is the cost of implementing the HO as recommended divided by the number of lives saved/injuries and illnesses averted. Because of the wide disparity between the figures used for a life (\$5 million) and an injury/illness (\$50,000), the injury rate was multiplied by a factor of 5 to compensate.

<sup>4</sup> Definitions of the subjective ratings for the qualitative factors are: "No Impact" = factor has no effect, either positively or negatively, on individuals, industry, and/or government; "Low Impact" = factor may have some effect, either positively or negatively, on individuals, industry, and/or government; "Moderate Impact" = factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government; and "High Impact" = Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.

**TABLE 5c – NEW HO SUMMARY**

**CDC-NIOSH/WHI CHILD LABOR HAZARDOUS ORDER COST-BENEFIT ANALYSIS  
COMPREHENSIVE SUMMARY (QUANTITATIVE AND QUALITATIVE FACTORS)**

HO #	HO Title	NPV <sup>1</sup> (000's)					OTHER CONTRIBUTING FACTORS (QUALITATIVE FACTORS) <sup>4</sup>					
			BCR <sup>2</sup>	Sensitivity Analysis (000's)		CER <sup>3</sup>	Apprenticeship Programs	Economic Feasibility/ Impact	Technological Trends	Days Away From Work/School	Work Opportunities for Youth	Illegal Working
				Low	High							
<b>NEW HAZARDOUS ORDERS</b>												
HO 1	Commercial Fishing Occupations	\$13,410	0.47	(\$4,863)	\$13,274	\$113,810	Low	Low	Low	Low	Low	Low
HO 2	Construction Occupations	\$453,990	4.88	\$292,479	\$553,038	\$53,445	Moderate to High	Moderate	Moderate	Low to Moderate	Moderate	Moderate
HO 3	Work in Refuse Occupations	(\$1,738)	(1.00)	(\$1,655)	\$17,856	N/A	No Impact to Low	Low	High	No Impact to Low	No Impact to Low	Low
HO 4	Water Transportation Industries	\$2,728	0.36	\$1,282	\$5,581	\$319,051	Low	Low	No Impact	Low	Low	Moderate
HO 5	Work in Scrap and Waste Materials Industry	\$41,295	4.66	\$25,902	\$41,263	\$38,510	Low	Low	Moderate	Low to Moderate	Low	Low
HO 6	Farm Product Raw Materials Wholesale Trade Industry	\$3,930	1.47	\$1,097	\$3,765	\$158,685	Low	Low	Low	Moderate	Low	Low
HO 7	Railroad Industry	(\$5,240)	(0.83)	(\$5,671)	(\$2,387)	\$564,549	Low	Low	Moderate to High	Low	Low	Low
HO 8	Work at Heights	\$445,765	6.37	\$258,491	\$443,773	\$99,013	High	Moderate	No Impact	Moderate to High	High	Moderate
HO 9	Tractors	\$66,062	3.97	\$38,289	\$68,916	\$454,014	No Impact	Low	No Impact	Low	Low	Moderate
HO 10	Heavy Machinery	\$36,307	2.28	\$19,596	\$39,160	\$338,092	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate
HO 11	Welding	\$46,510	2.69	\$18,593	\$49,363	\$76,149	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 12	Confined Spaces	\$38,026	3.01	\$2,728	\$36,885	\$497,405	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 13	Work Involving Powered Conveyors	\$20,034	1.82	\$6,634	\$22,887	\$121,550	High	Moderate	No Impact	Moderate	Moderate	Moderate
HO 14	Pesticide Handling	\$2,187	0.11	(\$4,221)	\$4,728	\$347,013	Low to Moderate	Low to Moderate	Low	Low	Low	Low to Moderate
HO 15	Exposure to Lead	(\$29,450)	(1.00)	(\$26,572)	\$53,635	N/A	Low to Moderate	Moderate	No Impact to Low	Moderate	Low to Moderate	Moderate
HO 16	Exposure to Silica	(\$8,368)	(0.67)	(\$6,937)	\$63,061	N/A	Moderate to High	Moderate	Low to Moderate	Moderate to High	Moderate	Moderate
HO 17	Work Requiring the Use of Respiratory Protection	\$38,354	1.49	(\$417,408)	\$37,213	\$276,248	Moderate	Moderate	No Impact	Moderate	Moderate	Moderate

<sup>1</sup> NPV is the discounted stream of cash flows over the entire planning horizon (10 years was used for these analyses) and is shown using a 7% discount rate. The NPV formula is:  $\sum_{t=0}^T \frac{CF_t}{(1+r)^t}$  where "T" is the total planning horizon of 10 years, "CF" is cash flow, and "r" is the discount rate of 7%.

<sup>2</sup> BCR (Benefit to Cost Ratio) is the NPV of total benefits of implementation of the HO divided by the total costs of implementation. A positive BCR indicates that there is merit in implementing the HO, and the higher the BCR, the greater the estimated benefit.

<sup>3</sup> CER (Cost Effectiveness Ratio), for this study, is the cost of implementing the HO as recommended divided by the number of lives saved/injuries and illnesses averted. Because of the wide disparity between the figures used for a life (\$5 million) and an injury/illness (\$50,000), the injury rate was multiplied by a factor of 5 to compensate.

<sup>4</sup> Definitions of the subjective ratings for the qualitative factors are: "No Impact" = factor has no effect, either positively or negatively, on individuals, industry, and/or government; "Low Impact" = factor may have some effect, either positively or negatively, on individuals, industry, and/or government; "Moderate Impact" = factor will most likely have an effect, either positively or negatively, on individuals, industry, and/or government; and "High Impact" = Factor will have an effect, either positively or negatively, on individuals, industry, and/or government.