MAI-2006-22

UNITED STATES
DEPARTMENT OF LABOR
MINE SAFETY AND HEALTH ADMINISTRATION
Metal and Nonmetal Mine Safety and Health

# REPORT OF INVESTIGATION

Surface Nonmetal Mine
(Sand and Gravel)

Fatal Machinery Accident
October 10, 2006

American Aggregates of Michigan, Inc.
Oxford Plant
Oxford, Oakland County, Michigan
Mine I.D. No. 20-02688

Investigators

Stephen W. Field
Mine Safety and Health Specialist

Charles V. Hoffman
Mine Safety and Health Inspector

Michael L. Clift
Mine Safety and Health Inspector

Dale P. Ingold
General Engineer

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Thomas D. Barkand
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Originating Office
Mine Safety and Health Administration
North Central District
515 West First Street, Room 333
Duluth, MN 55802-1302
Steven M. Richetta, District Manager

## OVERVIEW

Mark J. Hickmott, dredge operator, age 45, drowned on October 10, 2006, when the floating clamshell dredge he was operating capsized.

Management policies, standards, and controls were inadequate and failed to ensure that the dredge was maintained in safe operating condition. The accident occurred because the dredge had been modified and used beyond the design capacity intended by the manufacturer. The high dredge alarm overload sensors were not set at the recommended settings; steel plating had been added to the front deck and crusher feed chute; one pontoon cell contained water and large rocks were stored on the dredge deck. These modifications impacted the stability of the dredge and contributed to the cause of the accident.

## GENERAL INFORMATION

Oxford Plant, a surface sand and gravel mining operation, owned and operated by American Aggregates of Michigan, Inc., was located at Oxford, Oakland County, Michigan. The principal operating official was R. Scott Carson, vice president/general manager. The dredge was normally operated three, 9-hour shifts per day, six days a week. Total employment was 22 persons.

Material was mined, crushed, and screened from the pit with a floating clamshell dredge. The material was then transported to the plant on a floating and overland conveyor system where it was further crushed, screened, and washed. The finished products were sold for use as construction aggregate.

The last regular inspection of this operation was completed on September 5, 2006.

## DESCRIPTION OF ACCIDENT

On the day of the accident, Mark J. Hickmott, dredge operator (victim), and Pedro H. Solis, conveyor attendant, reported to work at 12:00 a.m., their normal starting time. Hickmott relieved John R. Wolf, dredge operator, who stated the dredge was operating normally. Solis stated that material flowed as usual on the conveyor during the shift. At 4:30 a.m., Solis radioed Hickmott to report that he had trained the #5 conveyor belt and had finished cleaning around the tail pulley. Solis reported Hickmott responded that everything was okay.

Solis stated the conveyors stopped and all of the lights went out about 4:50 a.m. He attempted to contact Hickmott by radio and cell phone but could not reach him. Solis then traveled to the shoreline and discovered the dredge had capsized.

Greg Egan, manager of Norse Trucking, located adjacent to the mine, arrived for work and noticed the lights off. Upon entering the mine to investigate the reason, Egan learned of the accident and called for emergency assistance at 5:45 a.m. The Oakland County Sheriffs Office Dive Team, Oxford Fire Department Divers, and Charles Tulip, commercial technical diver, were dispatched to the scene. The victim was recovered at 5:30 p.m. and pronounced dead at the scene by an Oakland County medical examiner. The cause of death was attributed to drowning.

## INVESTIGATION OF THE ACCIDENT

MSHA was notified of the accident at 6:07 a.m. on October 10, 2006, by a telephone call from Terry O. Wagaman, safety manager, to Gerald Holeman, assistant district manager. An investigation began the same day. An order was issued pursuant to Section 103(k) of the Mine Act to ensure the safety of miners.

MSHA's accident investigation team conducted a physical inspection of the accident site, interviewed employees, and reviewed conditions and work procedures relevant to the accident. MSHA conducted the investigation with the assistance of mine management and employees.

## DISCUSSION

### Location of the Accident

The accident occurred at the pit area of this sand and gravel mining operation. The pit area was approximately 15 acres in size. The dredge was actively mining in approximately 115 feet of water at the time of the accident.

### Dredge

The Rohr, Model RS 12,0/400Bf floating clamshell dredge was erected in 1998 at the mine. A clamshell bucket was used to extract sand and gravel from the bottom of the lake. The bucket was hoisted and transported by a trolley rail system to an onboard hopper where the material was deposited. Material was then crushed, screened, and discharged onto a floating product conveyor belt that connected to a land-based conveyor belt system

Attempts to right the dredge have been unsuccessful and the mine operator has considered scrapping it. The following factors were based on witness statements, manuals, and components examined or viewed as the dredge was repositioned during recovery attempts.

Management had made structural modifications to the dredge. A plywood and metal cover was built over the walkway to the operator's station access stairs. Approximately 200 square feet of ¾-inch steel plate, weighing about 6,125 pounds, had been placed on the dig end deck to reinforce the area where boulders rested. The chute from the grizzly to the crusher, an approximate 106 square foot area, was lined with a ½-inch thick steel plate weighing approximately 2,165 pounds. The total added weight in steel deck reinforcement and chute lining was approximately 8,290 pounds or 4.14 tons.

The dredge was powered by electricity that was supplied by a 13,600 volt insulated feeder cable which was strung along the floating product conveyor. The floating conveyor system connected the dredge to the shore.

The dredge was manufactured with rectangular shaped pontoons that were divided into 27 separate compartments or cells (Appendix B, Picture #1). During inspection of the capsized dredge, cracks were observed in the pontoon which supported the crusher on the conveyor side of the dredge (see Appendix B, Picture #2 and Overhead View of Dredge). Prior to the accident, unsuccessful

attempts had been made to repair cracks from the inside of the pontoon cells. Five cells were determined to be leaking.

**Damaged Pontoon Cells**

1) One cell on the operator's side had a sump pump permanently installed in it. A 6-inch hole was cut in the deck to access the cell. A stand pipe, which stood 24 inches off the deck, was placed in the hole to route the sump pump discharge pipe and electrical cord. The cell hatch cover was secured in place. The 120 volt pump was plugged into a receptacle with ground fault circuit interruption (gfci) protection and controlled by a water level switch. The pump reportedly ran a few times a day.
2) Two cells were on the discharge end, towards the conveyor side and were pumped periodically when water was observed during inspections.
3) Two cells were on the conveyor side towards the discharge end. One cell was allowed to stay full of water to maintain a level dredge. The other cell had to be pumped approximately every half hour with a permanently installed sump pump.

During dredge operation, equipment operators had to periodically inspect the operation of pontoon pumps because the gfci devices would trip and the pumps would stop.

The dredge was equipped with four draft gauges (overloads) that acted as dredge level alarm sensors. When water levels reached a gauge, the clamshell operation would shut down. The manufacturer recommended the draft gauges be set to activate when the dredge deck came within 12 inches of the water surface. Two of the four draft gauges were recovered and examined(Appendix B, picture #4). Calculations showed that the draft gauges would not activate until the deck was approximately I.5 inches from the water surface.

The dredge was equipped with a hopper full level alarm to guard against overloading due to a plugged hopper. The sensor, when activated, would not permit the clamshell to be positioned over the hopper and dump. The manufacturer recommended the minimum hopper full alarm sensor to activate when the discharge end of the dredge came within 14 -15 inches of the water surface. Investigators determined that this sensor was not functional at the time of the accident.

Based on the twist in the floating conveyor and dredge coupling point, the location of the only unbroken dredge anchoring cable, and the evaluation by the manufacturer's representative and mine personnel, investigators determined that the dredge capsized by rotating around the operator's side. A rotation in this direction caused the heaviest side of the dredge to rise in the air. A roll around

the operator's side of the dredge would have been caused by a sudden shift in weight to the lighter side.

Sand and gravel found on the floating conveyor indicated the dredge was producing at a low rate before capsizing. Dredge operators indicated this type of production happened when pockets of gravel, with little sand, were encountered. Since the first 50 feet of the floating conveyor was empty, investigators determined that the conveyor belt continued to run about 8 seconds after the dredge stopped discharging product.

On the shift prior to the accident, five or six boulders were positioned on the digging end pontoon. Standard practice was to store boulders on the dredge because they wouldn't pass through the crusher at this location. The boulders ranged in size from about 4 feet by 5 feet by 1.5 feet to 2 feet by 2 feet by 1.5 feet. Based on a standard 457 pounds per cubic foot sandstone rock, these boulders would have placed an additional 12.3 to 13.7 estimated tons of weight on the digging end pontoon.

## Weather Conditions

Weather conditions were clear and calm, with a temperature of approximately 50 degrees Fahrenheit. Weather conditions were not considered a factor in the accident.

## Training and Experience

Mark J. Hickmott had 9 years mining experience, all at this operation, and had received training in accordance with 30 CFR, Part 46. He had 8 years experience operating the dredge.

# ROOT CAUSE ANALYSIS

A root cause analysis was conducted and the following root causes were identified:

**Root Cause:** Management policies and controls were inadequate. Procedures had not been established to ensure that leaks in the dredge pontoons were repaired. Sump pumps were installed in four leaking pontoon cells. The pumps were plugged into electrical ground fault circuit interrupters (gfci) which had to be regularly monitored to ensure they were operating.

**Corrective Action:** Management should establish procedures for repairing the dredge pontoon cells when leaks develop.

**Root Cause:** Management policies and controls were inadequate. Procedures had not been established for modifying the original design of the dredge.

Additional steel plating had been added on the front end of the dredge to support the storage of large boulders encountered while mining. Additional steel plating had also been added to the crusher feed chute.

**Corrective Action:** Management should establish procedures to ensure that modifications to the original design of the dredge were within the design capacity of the manufacturer.

**Root Cause:** Management policies and controls were inadequate. Procedures had not been established to ensure the high dredge overload and full hopper alarm switches were properly positioned and functioning within the specifications set by the manufacturer. The switches were set to permit approximately 1-1/2 inches of freeboard. The dredge was designed for a minimum 12 inches of freeboard to prevent overloading the dredge.

**Corrective Action:** Management should establish procedures for proper examination and maintenance of safety controls provided by the dredge manufacturer to ensure that modifications to the original design of the dredge do not reduce the in process weight safety margin. Miners should be thoroughly trained in the established procedures.

## CONCLUSION

The dredge capsized because it had been modified and used beyond the design capacity intended by the manufacturer. The high dredge alarm overload sensors were not maintained at the setting specified by the manufacturer. Steel plating had been added to the front end of the dredge and to the crusher feed chute. Large boulders were stored on the deck of the dredge. One pontoon cell was allowed to stay filled with water. These modifications impacted the stability of the dredge and created a hazard to miners.

## ENFORCEMENT ACTIONS

Order No. 6195462 was issued on October 10, 2006, under Section 103(k) of the Mine Act:

> A fatal accident occurred at this mining operation on October 10, 2006, when one miner was operating a dredge and it rolled completely upside down at the lake area north of North Hummer Lake Road. This order is issued to assure the safety of all persons at this operation. It prohibits all activity at the area the dredge is located on the north side of Hummer Lake Road until MSHA has determined it is safe to resume mining operations in the area. The mine operator shall obtain prior approval from an authorized representative for all actions to recover/restore operations to the affected area.

This order was terminated on January 23, 2007, after conditions that contributed to the accident no longer exist. The mine operator intends to scrap the dredge because attempts to recover it have been unsuccessful.

Citation No. 6188396 was issued on February 28, 2007, under the provisions of Section 104(a) of the Mine Act for violation of 30 CFR 56.14205:

> A fatal accident occurred at this mining operation on October 10, 2006, when a dredge operator drowned after the floating grab "clamshell" dredge he was operating capsized. The dredge was being operated beyond the manufacturer's design capacity in that the high dredge alarm overload switches were set above the manufacturer's recommended settings. Also, unsecured boulders had been placed on the dredge's front end deck and several of the pontoon cells, which had developed leaks, were being dewatered by sump pumps which frequently failed to operate. The manufacturer does not recommend storing boulders on the front end deck of the dredge or using sump pumps in lieu of repairing the leaking pontoon cells.

This citation was terminated on March 29, 2007. The accident has rendered the dredge inoperable and the citation is terminated. The mine operator is required to comply with the provisions of the standard before placing the dredge back in operation. Failure to correct the cited conditions prior to resuming these activities will be considered by MSHA to be aggravated conduct constituting more than ordinary negligence.

Citation No. 6188397 was issued on February 28, 2007, under the provisions of Section 104 (a) of the Mine Act for violation of 30 CFR 56.14100(b):

> A fatal accident occurred at this mining operation on October 10, 2006, when a dredge operator drowned after the floating grab "clamshell" dredge he was operating capsized. The dredge pontoons were not being maintained because several of the 27 pontoon cells had developed leaks. Sump pumps, which frequently failed to operate, were installed to dewater the leaking cells at least six months prior to the accident. The dredge manufacturer does not recommend using sump pumps in lieu of repairing the leaking pontoon cells.

This citation was terminated on March 29, 2007. The accident has rendered the dredge inoperable and the citation is terminated. The mine operator is required to comply with the provisions of the standard before placing the dredge back in operation. Failure to correct the cited conditions prior to resuming these activities

will be considered by MSHA to be aggravated conduct constituting more than ordinary negligence.

Approved By: Date:

Steven M. Richetta
District Manager
North Central District

## APPENDIX A

### Persons Participating in the Investigation

**American Aggregates of Michigan, Inc.**

| | |
|---|---|
| Marc K. Taylor | plant maintenance manager |
| Michael J. Taylor | area operations manager |
| Daniel M. Mergens | corporate vice president |
| R. Scott Carson | vice president/general manager |
| Edward B. Ward | plant manager |
| Terry O. Wagaman | safety manager |
| Eric J. Rossman | assistant plant manager |
| John R. Wolf | dredge operator |
| Pedro H. Solis | conveyor attendant |
| Scott A. Hill | dredge operator |

**Mine Safety and Health Administration**

| | |
|---|---|
| Stephen W. Field | mine safety and health specialist |
| Charles V. Hoffman | mine safety and health inspector |
| Michael L. Clift | mine safety and health inspector |
| Dale P. Ingold | general engineer |
| Duane L. Wease | mine safety and health specialist |
| Thomas D. Barkand | electrical engineer |

# APPENDIX B

**Overhead View of Dredge**

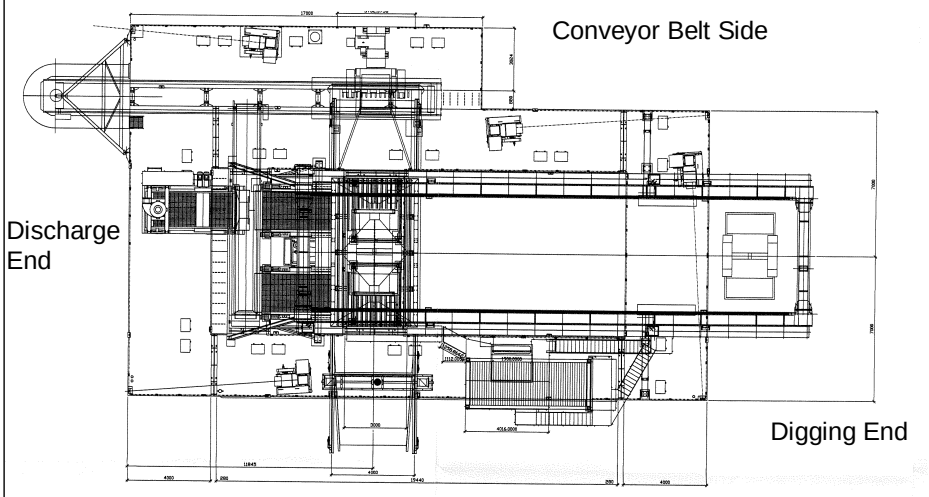


Figure 1

Picture # 1

**APPENDIX B (cont'd)**

Picture # 2

Picture # 3

## APPENDIX B (cont'd)


Picture # 4

Accident Investigation Data - Victim Information
Event Number: 0 9 9 6 3 0 4

**APPENDIX C**

**U.S. Department of Labor**
Mine Safety and Health Administration

**Victim Information: 1**

| 1. Name of Injured/Ill Employee: | 2. Sex | 3. Victim's Age | 4. Last Four Digits of SSN: | 5. Degree of Injury: |
|---|---|---|---|---|
| *Mark J. Hickmott* | *M* | *45* | | *01 Fatal* |

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death:
*a. Date: 10/10/2006 b.Time: 4:45*

7. Date and Time Started:
*a. Date: 10/09/2006 b.Time: 23:00*

8. Regular Job Title:
*160 Clamshell Operator*

9. Work Activity when Injured:
*046 Operating Dredge*

10. Was this work activity part of regular job? Yes | X | No

| 11. Experience | Years | Weeks | Days | | Years | Weeks | Days | | Years | Weeks | Days | | Years | Weeks | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a. This Work Activity: | 9 | 21 | 3 | b. Regular Job Title: | 8 | 0 | 0 | c: This Mine: | 9 | 21 | 3 | d. Total Mining: | 9 | 21 | 3 |

12. What Directly Inflicted Injury or Illness?
*126 Water*

13. Nature of Injury or Illness:
*110 Drowning*

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15. Company of Employment:(If different from production operator)
*Operator*

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: X | First-Aid: | CPR: | EMT: | Medical Professional: | None:

17. Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim: *9999 None (No Union Affiliation)*

**Victim Information:**

| 1. Name of Injured/Ill Employee: | 2. Sex | 3. Victim's Age | 4. Last Four Digits of SSN: | 5. Degree of Injury: |
|---|---|---|---|---|
| | | | | |

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death:

7. Date and Time Started

8. Regular Job Title:

9. Work Activity when Injured:

10. Was this work activity part of regular job? Yes | No

| 11. Experience: | Years | Weeks | Days | | Years | Weeks | Days | | Years | Week | Days | | Years | Weeks | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a. This Work Activity: | | | | b. Regular Job Title: | | | | c: This Mine: | | | | d. Total Mining: | | | |

12. What Directly Inflicted Injury or Illness?

13.Nature of Injury or Illness:

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15. Company of Employment: (If different from production operator)

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: | CPR: | EMT: | Medical Professional: | None:

17.Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim:

**Victim Information:**

| 1. Name of Injured/Ill Employee: | 2. Sex | 3. Victim's Age | 4. Last Four Digits of SSN: | 5. Degree of Injury: |
|---|---|---|---|---|
| | | | | |

6. Date(MM/DD/YY) and Time(24 Hr.) Of Death:

7. Date and Time Started:

8. Regular Job Title:

9. Work Activity when Injured:

10. Was this work activity part of regular job? Yes | No

| 11. Experience: | Years | Weeks | Days | | Years | Weeks | Days | | Years | Week | Days | | Years | Weeks | Days |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| a. This Work Activity: | | | | b. Regular Job Title: | | | | c: This Mine: | | | | d. Total Mining: | | | |

12. What Directly Inflicted Injury or Illness?

13. Nature of Injury or Illness:

14. Training Deficiencies:
Hazard: | New/Newly-Employed Experienced Miner: | Annual: | Task:

15.Company of Employment:(If different from production operator)

Independent Contractor ID: (if applicable)

16. On-site Emergency Medical Treatment:
Not Applicable: | First-Aid: | CPR: | EMT: | Medical Professional: | None:

17. Part 50 Document Control Number: (form 7000-1)

18. Union Affiliation of Victim: