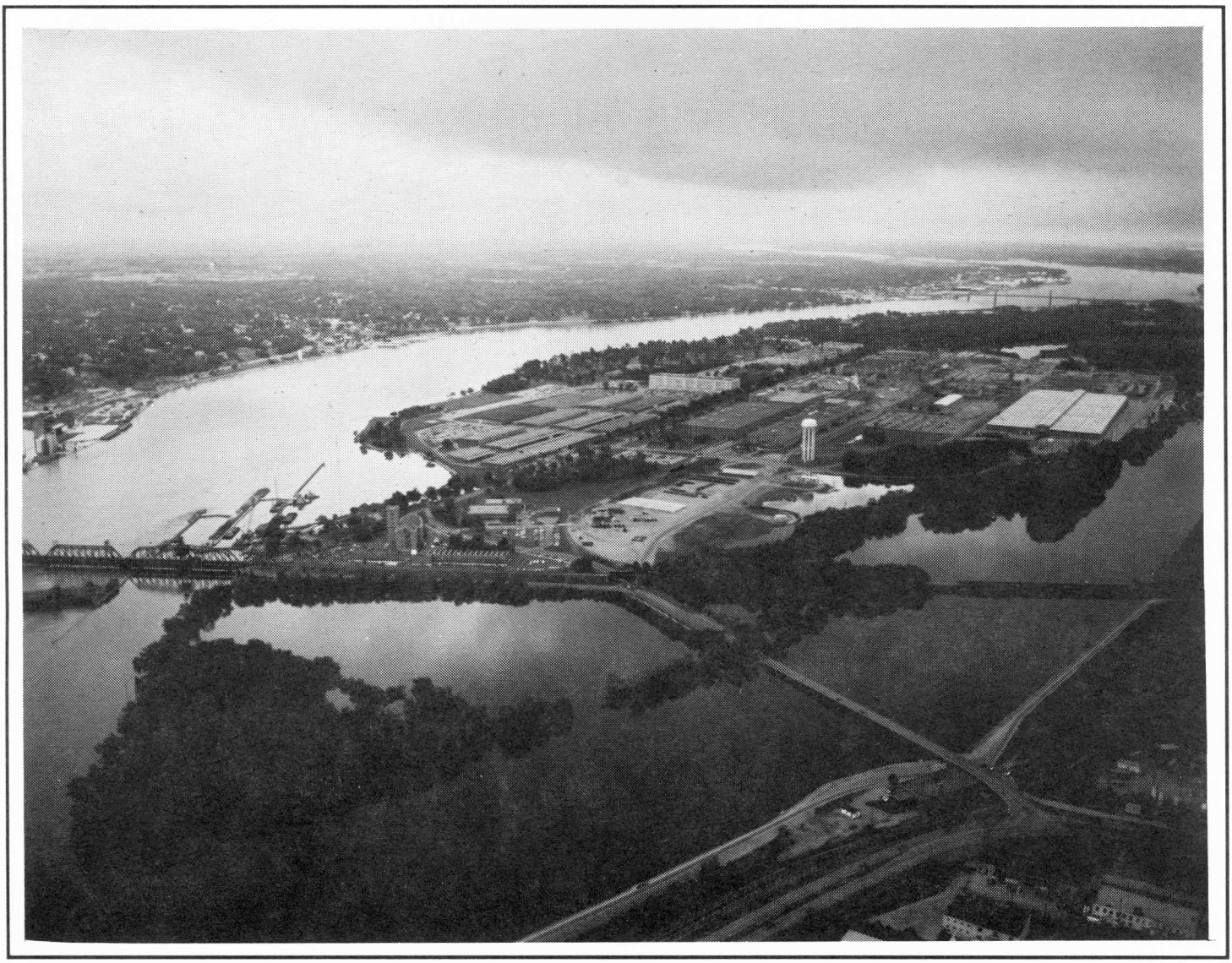
A Brief History Of The
ROCK ISLAND ARSENAL FLOOD CONTROL EFFORT
DURING THE GREAT FLOOD OF 1993



A BRIEF HISTORY OF THE ROCK ISLAND ARSENAL FLOOD CONTROL EFFORT DURING THE GREAT FLOOD OF 1993

BY
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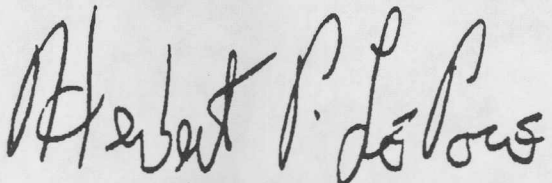
Rock Island, IL 61299-6000

FOREWORD

This concise history of Rock Island Arsenal's (RIA) flood control efforts during the great flood of 1993 was researched and written by Historian Thomas J. Slattery. Flood control management provided by the Directorate of Engineering and Housing; flood control measures completed by crews of military personnel, civilian employees, and volunteers; and a summary of lessons learned were documented in this history. Mr. Slattery also included a comparison of the 1965 and 1993 floods so that the event could be placed in historical perspective. He attended flood control update meetings, examined electronic mail messages,daily situation reports, developed an historic photographic collection, and conducted numerous oral history interviews with key participants.

Appreciation is extended to all those who provided their observations and insight through the interview process, and to those who provided documents, data, and video tapes on the flood. A special thank you is extended to Colonel Terry L. Nienhouse, RIA Commander, who requested this event be documented and provided his personal file on the flood to the Historical Office. The writer would also like to thank Dr. Herbert LePore, Chief, AMCCOM Historical Office, Mr. Ronald L. Verstraete, who was the Acting Director of the Directorate of Engineering and Housing (SMCRI-EH) during the flood emergency, and Mr. James A. Thompson, Chief, Engineering and Services Division for their comments which proved very helpful in the completion of this history. Finally, the writer would like to thank photographers Ted Cavanaugh and Tony Lopez of E.L. Hamm, and Associates, Incorporated, and the entire visual information contractor's staff for their quality work. This history documents the fine professional and volunteer effort exerted by not only the Rock Island Arsenal but that of the entire Arsenal Island community during the flood of 1993.



HERBERT P. LEPORE
Chief, Historical Office

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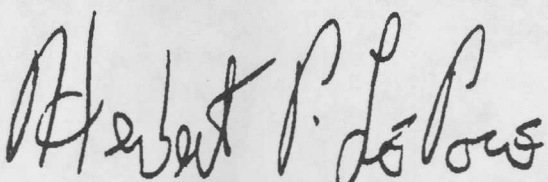

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Below: Colonel Terry L. Nienhouse, Commanding Officer of the Rock Island Arsenal thanked the many people who gave their time to help prevent the flooding of Arsenal Island. Civilian and military volunteers, who without fanfare, filled sandbags and built temporary dikes during their off-duty hours, received "Flood of 1993" Certificates of Commendation signed by the Arsenal Commander. Lieutenant Colonel Nathan E. Acree, Jr., AMCCOM Inspector General, quietly joined sandbagging operations during the evening and weekend shifts, received his certificate from COL Nienhouse. According to COL Nienhouse, "the cooperation and teamwork from the entire Arsenal community was just great."

Below: Aerial view of Rodman Avenue, the Island's main east/west thoroughfare photographed on 7 July 1993, 48 hours before flood crest.

A BRIEF HISTORY OF THE ROCK ISLAND ARSENAL FLOOD CONTROL EFFORT DURING THE GREAT FLOOD OF 1993

Introduction

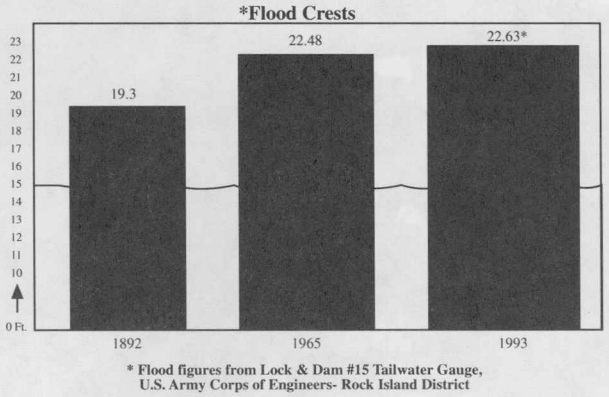
"Island escapes record flood with minor damages". This August headline of the Rock Island Arsenal (RIA) newspaper accurately capsulated the results of the Mississippi River's1993 flooding at Arsenal Island.[1] Although high water threatened Arsenal Island for approximately 5 weeks during the summer of 1993, the island remained open, business continued, and due to a safety conscious work force there were no flood-related accidents or injuries. This good news happened because of the planning, preparation, and collective effort exerted by many Arsenal Island organizations and their civilian and military employees. Their story continues an installation tradition of preventing flood waters from interfering with the island's operations or quality of life of its employees and its military families who reside on Arsenal Island.

The RIA Directorate of Engineering and Housing (EH) successfully planned and supervised the flood control preparations for the 1993 flood. Its engineers used the flood of 1965 as a benchmark, while focusing much of their energy on the reinforcement of the island's levee system, a system which last received serious attention during the ensuing years of the 1965 flood. During the last couple decades, floods have not seriously threatened Arsenal Island. Flood control priority, however, faded during that time frame because of budgetary constraints and below normal precipitation. Now that the upper Mississippi River Valley is experiencing heavier than normal precipitation, flood control is again an important issue. A brief survey of past Arsenal Island flood experiences should provide an historical perspective to the flood of 1993.

An aerial view of the water in take pumping station, Building 9, during the flood of 1965. Note the building was surrounded by high water.

An aerial view of turbulent water flowing through old Moline Lock during the 1965 flood. In 1993 only 25 acres of noncritical land on the fringe of Arsenal Island were inundated with flood waters compared to approximately 308 acres in 1965.

Historical Perspective



* Flood figures from Lock & Dam #15 Tailwater Gauge, U.S. Army Corps of Engineers- Rock Island District

During the last 101 years, the Arsenal experienced record-breaking flood crests in 1892, 1965, and 1993. Yet Arsenal Island civilian and military employees have successfully held back the mighty Mississippi on each of those occasions.

Prior to the 22.63 foot crest of the 1993 flood, the Mississippi River's previous high water mark at Arsenal Island was 22.48 feet, reached during the flood of 1965. The 1965 flood crest shattered the earlier record crest of 19.3 feet, held for nearly three-quarters-of-a-century by the flood of 1892.[2]

The local press touted the flood of 1965 as the greatest single event of that year. The story of the 1965 flood-fighting effort of Arsenal Island and the surrounding Quad Cities became legendary and part of the local Mississippi River folklore. Now, nearly 30 years later, 1993 has replaced 1965 as the year of the river's all-time record flood at Arsenal Island.

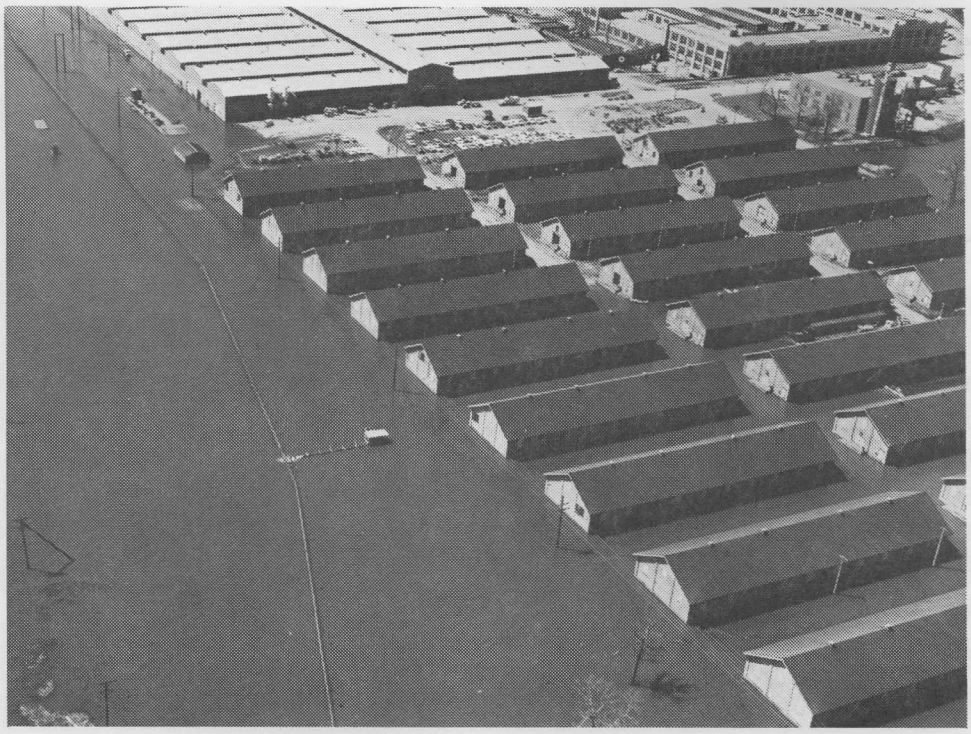
Comparison of the 1965 and 1993 Floods

Major floods such as those of 1965 and 1993 are unusual, so unusual that they are referred to as 100 year floods. A flood of that magnitude has a 1 to 100 chance of occurring in any given year. In 1993, it required a summer of record-breaking rains throughout the upper Midwest to create the flood conditions. For instance, Iowa's 26.79 inches of summer rain in 1993 shattered the state's summer rain mark of 21.18 inches set a century ago in 1892.[3]

Heavier than normal snowfall or rainfall throughout the states of the upper Midwest has historically swelled the tributaries which drain into the Mississippi River. Both the 1965 and 1993 floods were the result of much heavier than normal precipitation, locally and farther north. A Minneapolis hydrologist predicted the current heavy precipitation for the upper midwest to continue through winter which could mean further flooding next spring. After experiencing years of below normal precipitation nature is balancing the average with some heavy precipitation.

During the flood of 1965 civilian employees filled sandbags at night outside Building 133. Employees such as these filled approximately 375,000 sandbags in 1965. In 1993, only 60,000 sandbags were filled since a large portion of the sand was applied in bulk to reinforce the levees.

The storage buildings in the old XYZ area (right foreground), experienced high water during the 1965 flood. This area, now a parking/storage lot, was dry during the 1993 flood.



Following the 1965 flood, communities up and down the Mississippi River completed extensive flood protection projects. At Arsenal Island, an earthen levee along the island's north shore was markedly raised and storm sewers installed at key locations throughout the island. During the flood of 1993, the Directorate of Engineering and Housing directed a great deal of its resources toward reinforcing that levee. Flood levees and walls are remedial measures not flood prevention devices. They hold back floods but do not prevent them from happening. Flood control engineers from the U.S. Army Corps of Engineers are currently studying the Mississippi River's flood plain to identify areas where high water could be released to reduce flood pressure downstream.

A statistical comparison of tonnage of sand and number of sandbags used during each of these two major floods revealed a significant shift in Arsenal Island's flood control policy since 1965. During the 1965 flood work crews used 8,000 tons of sand to fill 375,000 sandbags. In the flood of 1993, 6,844 tons of sand were used, but only 60,000 sandbags were filled since a large portion of the sand was applied in bulk to reinforce the levees. Reinforcement of the levee with bulk sand rather than sandbags was a change from past flood control practices.[4]

Another significant difference in the 1965 and 1993 flood at Arsenal Island was the amount of acres covered by high water. In 1965, 308 acres flooded compared to only 25 acres in non-critical areas of the island in 1993. The flood control measures taken after the 1965 flood, the use of bulk sand to reinforce the levees during the 1993 flood, and the determination of flood control management not to allow unnecessary water on the island accounted for the difference.[5]

Following the summer flood of 1993 the organization title of the Directorate of Engineering and Housing was changed to the Directorate of Public Works on 1 October 1993. Mr. John A. Ruble's position as Director of Engineering and Housing was also changed to the Arsenal's Director of Public Works.

During the 1965 flood RIA reactivated several old WWII relics, M76 amphious cargo carriers, to haul sandbags to swampy areas. This vehicle, called an "otter", was used to build this temporary sandbag dike along the eastern edge of Arsenal Island.


BRAINERD
ST. PAUL DISTRICT
ST. CROIX RIVER
MINNEAPOLIS
ST. PAUL
MINNESOTA RIVER
CHIPPEWA RIVER
BLACK RIVER
WISCONSIN RIVER
MINNESOTA
MISSISSIPPI RIVER
LA CROSSE
WISCONSIN
IOWA
WAPSIPINICON
CEDAR RIVER
IOWA RIVER
DUBUQUE
ROCK ISLAND DISTRICT
SAYLORVILLE LAKE
ROCK RIVER
CHICAGO
CORALVILLE LAKE
RED ROCK
ARSENAL ISLAND
DES MOINES
QUAD CITIES
DES MOINES RIVER
PEORIA
ILLINOIS RIVER
ILLINOIS
QUINCY
MISSOURI
ST. LOUIS DISTRICT
MISSOURI RIVER
ST. LOUIS
OHIO RIVER
UPPER MISSISSIPPI RIVER SYSTEM
CAIRO

The Flood of 1993

The flood began quietly in June 1993 with the river rising toward a crest then predicted at a little over 19 feet. Initially, it directly involved only those employees of the facilities contractor, Serv-Air, Inc., who performed Arsenal Island's flood control maintenance and the RIA Contract Administration Office for Base Operations which oversaw and coordinated their work. The Base Operations Contract contained the flood control steps to be taken at various flood stages as measured at the lower pool of Lock and Dam #15. These measures included checking manholes for water seepage; closing gates on storm sewers; testing pump stations to ensure their readiness; and protecting equipment and facilities at the Government Bridge with plywood and sandbags. The flood at that time consisted of some high water around the fringe of Arsenal Island.[6]

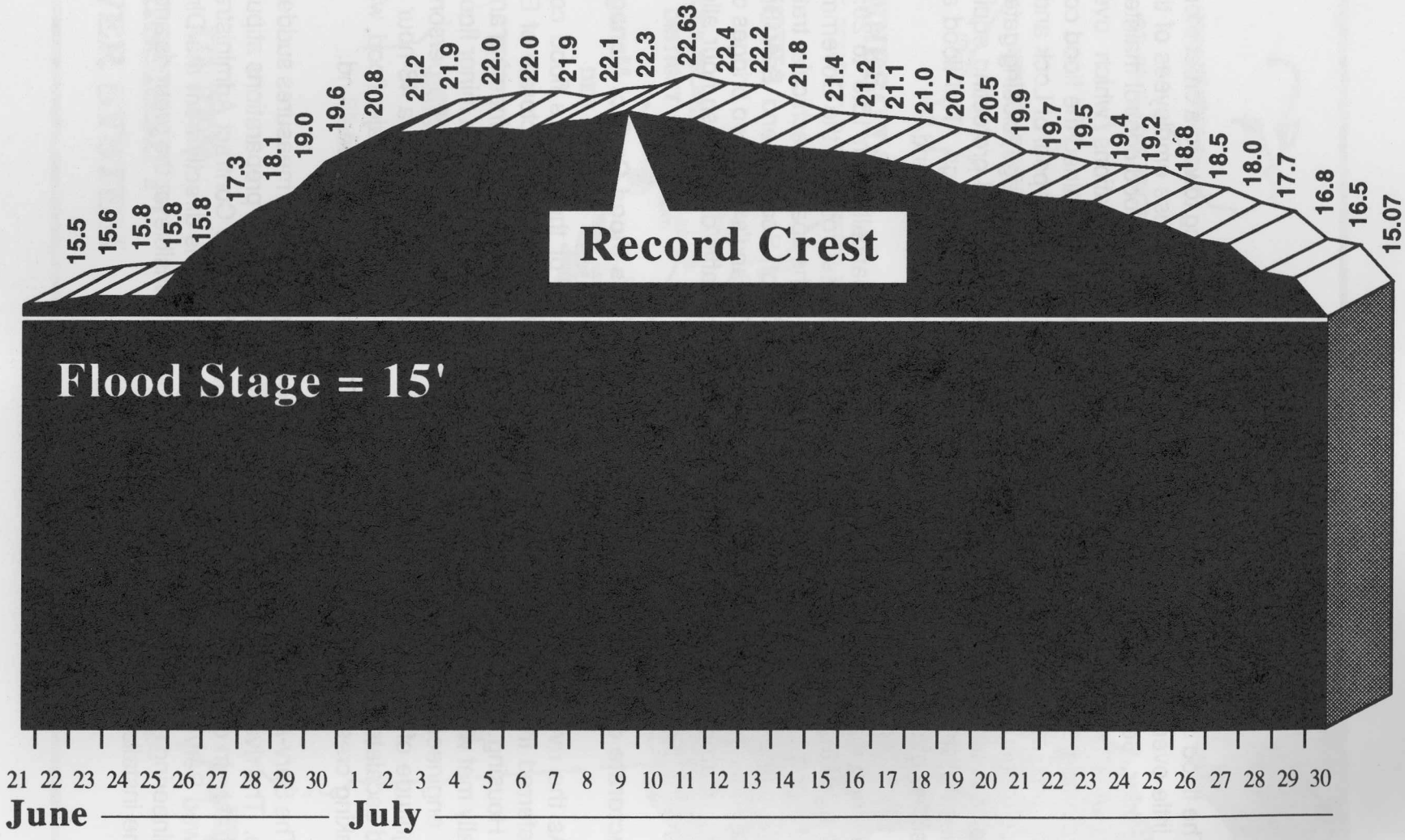
During the last week of June the river rose dramatically from 15.8' to 20.8'. On the evening of 30 June 1993, high water covered the access roads to the Government Bridge in Davenport, Iowa, forcing the temporary closure of the span to vechicular traffic until the river's stage dropped to below 20'. Directorate of Security and Law Enforcement personnel altered vehicle traffic patterns on and off island's other two bridges during peak hours. Carpooling and the utilizing of double/lane traffic during rush hour alleviated the congestion caused by the bridge's closing.

Directorate of Engineering and Housing Assumes Flood Control Management

As the river continued to rise, the management of the island's flood control effort transferred from the Contract Administration Office to RIA's Directorate of Engineering and Housing. Mr. Ronald L. Verstraete, the Acting Director of Engineering and Housing, initially met with EH engineers to discuss the routine monitoring of a minor flood situation. The engineers began holding regular meetings with Serv-Air, Inc., personnel as the magnitude of the flood changed during the last week of June. In a 48-hour period, the flood escalated from being an ordinary high water condition to a major flood, with a record breaking crest predicted for the upcoming Independence Day weekend.

The Serv-Air, Inc., employees performing the flood control measures suddenly needed help. The river stage went beyond the level of flood control preparations stipulated in the contract. In order to expedite the flood control effort, the Contract Administration Office allowed Serv-Air, Inc., employees to receive instructions directly from the Directorate of Engineering and Housing, which was ultimately responsible for the grounds and structures of the installation.[7]

SUMMER FLOOD of 1993
Mississippi: River Daily Stage



As measured in the Quad-Cities at Lock and Dam 15

Mr. Verstraete sought and received expert advice from flood control experts of the Rock Island District, U.S. Army Corps of Engineers, headquartered at Arsenal Island. Virtually all arsenal engineers with flood control experience had retired, taking advantage of recent retirement incentives. Therefore, guidance EH received from the U.S. Army Corps of Engineers concerning flood control strategy and procedures was key to the success of flood control efforts.

Experts from the U.S. Army Corps of Engineers provided a variety of guidance to the Directorate of Engineering and Housing. The Corps' experienced flood control engineers accompanied EH personnel on an inspection of the island's levee system. They surveyed the levee and determined that it would hold if reinforced.

In preparation for the assumption of flood control management, the EH engineering staff reviewed documents and photographs of earlier floods from historical files, studied topographical maps; questioned retirees about past flood control measures; and reviewed the directorate's flood control plan for a course of action. Many EH engineers worked double shifts, and at times, around-the-clock, preparing for the record-breaking crest predicted to arrive on 4 July 1993.

The EH engineering staff monitored the island's levees and other critical areas around-the-clock. The island was divided into three areas, and two EH personnel per shift were assigned to patrol the levee in each area. Providing six levee watchers for three shifts, for a total of 18 per day, exhausted the EH engineering staff. Eventually, employees of the Arsenal Operation Directorate assumed first and second shift levee patrols, and RIA Fire Department and military personnel, organized by Headquarters Support Troops, took over third shift patrol.[8]

The island's levees and other critical areas were monitored around-the-clock during the flood. Norm Hatcher, SMCRI-EH (with cap) and Reggie Williams, SMCRI-AO, patrolled the north shore levee near the old Moline Lock at the north east end of the island. (Photo courtesy of SMCRI-EH).

Acting Engineering and Housing Director Ronald L. Verstraete, in the midst of briefing top RIA officials and other interested parties during the directorate's daily 1:30 pm Flood Control Update meeting, held in the EH Conference Room, Building 102.

Flood Control Center

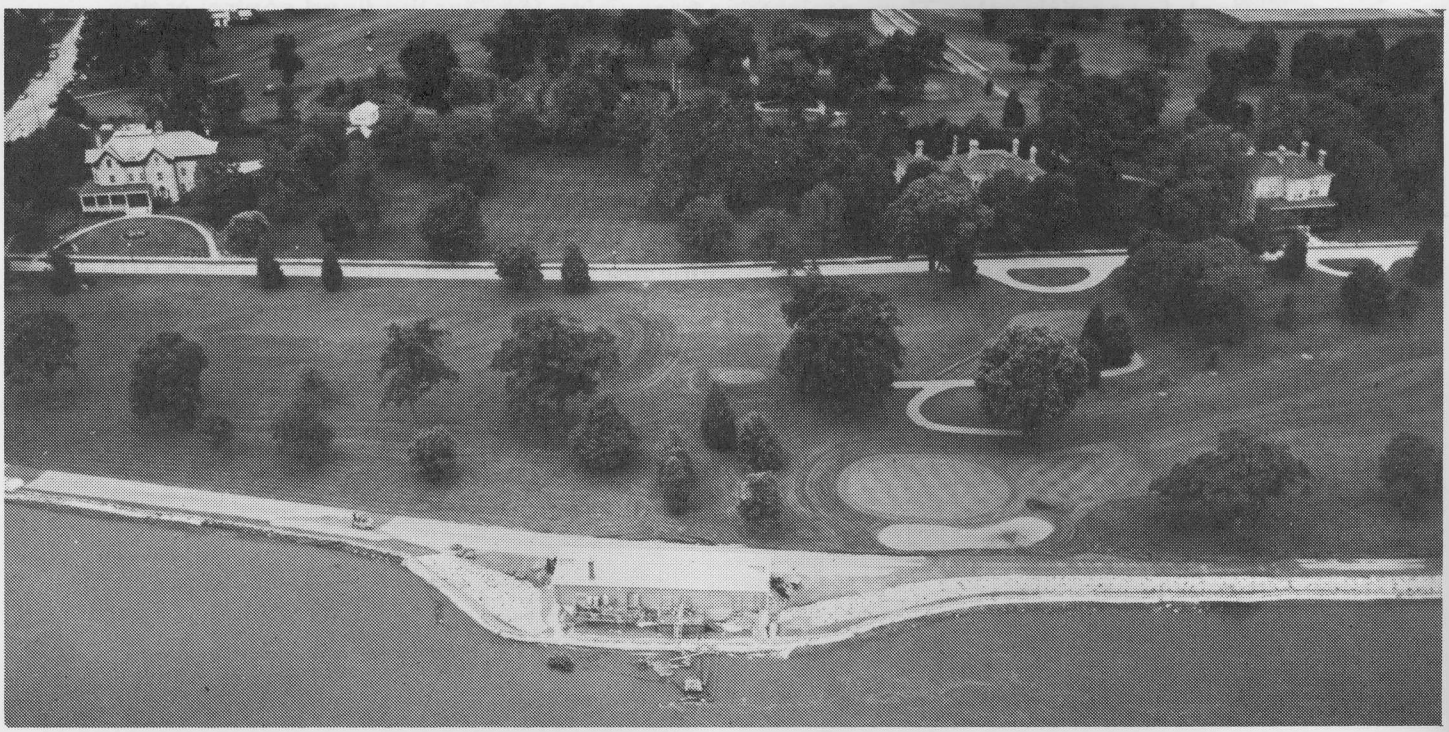
On 30 June 1993, Mr. Verstraete established an emergency 24-hour Flood Control Center in Building 102 to communicate with flood control crews and coordinate their activities. Its staff consisted of primarily EH supervisory engineers and three plans analysts from the Arsenal Program and Control Office. Mr. Lanny Biehler, Chief of EH's Planning and Inspection Division (SMCR-EHP), Mr. James A. Thompson, Chief of Engineering Services Division (SMCRI-EHS), and Mr. Jerry Sechser, Chief of Engineering Resource Management Division (SMCRI-EHC) organized the Flood Control Center into three, 9-hour shifts. The shifts overlapped an hour so those coming on duty could be briefed on events before assuming their duties. Mr. Verstraete briefed RIA Commander Colonel Terry L. Nienhouse, and Deputy Commander Major Timothy R. Bilderback during regularly scheduled daily flood control update meetings.[9]

Personnel from the Arsenal Programs and Control Office manned the center's communications and assisted with logistics. Mr. David P. Block served as radio dispatcher during first shift, Mr. Robert W. Emmert, second shift, and Mr. William S, Ingeneri, third shift. They dispatched work crews, equipment, and material to various flood threatened points on Arsenal Island. Mr. Block's and Mr. Emmert's disaster control experience proved extremely valuable to the flood control effort in that they knew all aspects of Arsenal Island so well and, in particular, who to contact in other organizations for critically needed material, equipment, and personnel. Mr. Ingeneri also delivered food to those working third shift at the various flood control sites. The Flood Control Center was also staffed with EH clerical help, see the 24-hour flood control duty rosters towards end of book for participants. They assisted in organizing food for the flood control crews, preparing electronic mail messages, answering telephones, and dealing with volunteers.

The Flood Control Center experienced start up problems with communications. At first, everyone was on different frequencies, using four different radios. The Contract Administration Office, Serv-Air, Inc., and Directorates of Engineering and Housing and Security were on separate frequencies on different networks. The Flood Control Center initially needed four different radios to communicate with these organizations. The RIA disaster control officer simplified the matter by borrowing ten radios from the Arsenal Operations Directorate which were multi-frequency. The multi-frequency radios also could be used as telephones by field personnel. Communications were further simplified by moving Serv-Air's Inc.'s dispatcher into the Flood Control Center. The center's staff also monitored cable CNN television and weather channels throughout the flood for the

A panoramic view of Arsenal Island's north shore levee between Gillespie Avenue on the right to East Avenue just to the left of the water pump house, Building 9. This was a critical area during both floods of 1965 and 1993.

An aerial view of 1993 flood control preparations at the water intake pump station, Building 9. Note the family residence of Colonel Terry L. Nienhouse, RIA Commander, was situated along Terrace Drive, left corner of photograph.



latest updates on local and regional weather conditions. Cable television provided the Flood Control Center with fast information on approaching weather and high water, which in turn, provided flood crews with a greater window of time to complete their flood preparations.[10]

Flood control management quickly established twice-a-day electronic mail Flood Control Update messages, to keep employees and island tenants informed, and to prevent the spread of flood related rumors. Mr. Verstraete, issued directives to gain firm control of the island's critical flood threatened areas. The arsenal security staff closed Blunt Road, the north shore levee road which parallels the river's main channel, to unauthorized traffic, and joggers and walkers were diverted to alternative routes inland. Fishing was prohibited until further notice. Other precautionary measures included the transfer of activities at the day camp and sports complexes to higher ground at Memorial Field. The 48 hours of preparation prior to the arrival of the predicated crest of 22.6 feet for Sunday, 4 July, proved critical to the success of the flood control plan.[11]

Organization of Flood Control Effort

Acting on advice from the U.S. Army Corps of Engineers, the island was divided into three flood control areas with an engineer in charge of each area. Mr. Charles L. Swyenberg, SMCRI-EHS engineer, provided front line supervision for the north shore levee along Blunt Road, between Gillespie and East Avenue, which included Building 9. Mr. Norman P. Hatcher, SMCRI-EHP engineer, served as first line supervisor for flood control preparations at Quarters 30/31, near the old Moline lock, and the levee east of the quarters. Mr. Richard E. Todd, SMCRI-EHS engineer directed flood control efforts on the island's south side, which included the hydroelectric plant, Building 160; warehouse, Building 299; and the sewage lift station, Building 204.[12]

Building 9, an 85-year old, brick structure, situated at a low point along the north shore levee between Gillespie Avenue and East Avenue, was a critical site for flood protection. Maintaining integrity of the island's raw water intake station, Building 9 on the north shore and its sewage pumping station, Building 204, on the south side of Arsenal Island, were critical priorities of EH's flood control plan. If drinking water was not available or the water became contaminated, most operations on Arsenal Island would have probably shutdown. As a health precaution the Arsenal's Environmental Management Office directed the drinking water be tested and monitored throughout the flood.[13]

Facilities engineers directed flood protection preparations for Building 9. Mr. Charles L. Swyenberg supervised the overall levee flood control preparations along Blunt Road, which included Building 9. He was ably assisted by Mr. David L. Osborn, SMCRI-EHS engineer, who concentrated on flood control preparations for Building 9, and Mr. Timothy Friemel, SMCRI-EHS engineer.

Sandbags in place ready for the worst. Major Timothy R. Bilderback, Deputy RIA Commander, inspecting flood control preparations during the 1993 flood, along the north shore levee at Building 9.

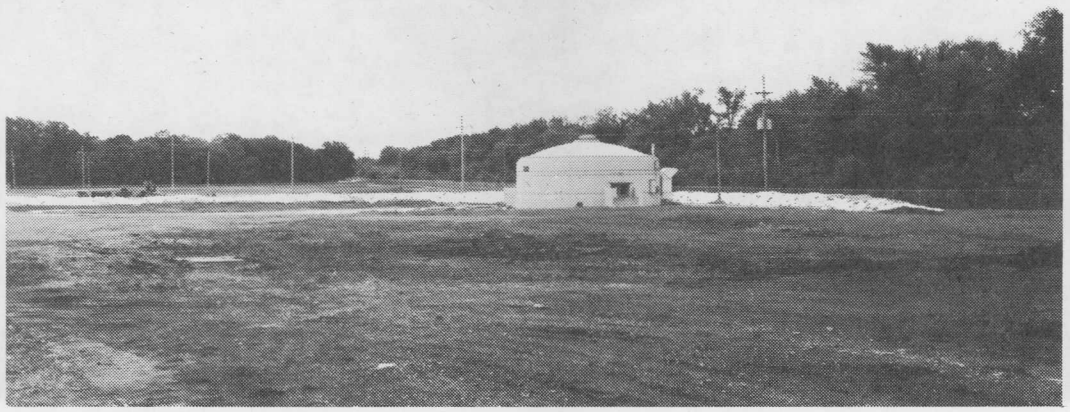
This photograph depicts civilian, military, and Serv-Air, Inc., employees working together to complete flood control preparations for Building 9. Facilities contractor employees are in blue shirts.

As instructed, flood control crews placed layers of plastic and sandbags around openings up to 6' high; secured doors and windows with plywood; covered drains with plastic, weighted down with sandbags; and covered the top of the water inlet screens with plastic and sandbags to keep out debris. The pressure of sandbags and sand packed against its exterior may have weakened the north central and northeast sections of the structure. Although threatened by high water, the pump station remained dry and operational. Across the island, a temporary earthen dike constructed by Serv-Air employees, using an endloader with a scoop shovel, and sandbags, protected the sewage building, Building 204, throughout the flood. On a couple of occasions the Arsenal received permission from the Illinois Environmental Protection Agency (EPA) to pump sewage directly to the Mississippi River. Other Quad City communities received the same ok from the EPA. [14]

Of the more than 200 military personnel and their families who live on Arsenal Island, only one family was moved from its quarters because of the flood. According to Mr. Norman P.Hatcher, SMCRI-EH engineer, the family of RIA Sergeant Major Amos L. Richardson was temporarily moved from Quarters 31 as a precautionary measure, due to the nearby turbulent water rushing through the old Moline lock. Although Quarters 30/31 were threatened by high water, little damage actually occurred to the buildings.[15]

The levee east of the hydroelectric plant, however, became so saturated and soft that people literally sank up to their knees in places. These soft spots were reinforced with dump truck loads of sand, poured in bulk on the levee. Arsenal security marked the area with restrictive yellow tape to keep unauthorized personnel out of the area. As a health safety measure, Serv-Air, Inc. employees regularly trapped mosquitos so that samples could be examined by RIA Health Clinic preventive medicine specialist for dangerous species, such as the Asian Tiger mosquito, which can carry encephalities. None were discovered and the mosquitos were kept in check by application of larvacide and fog spraying.

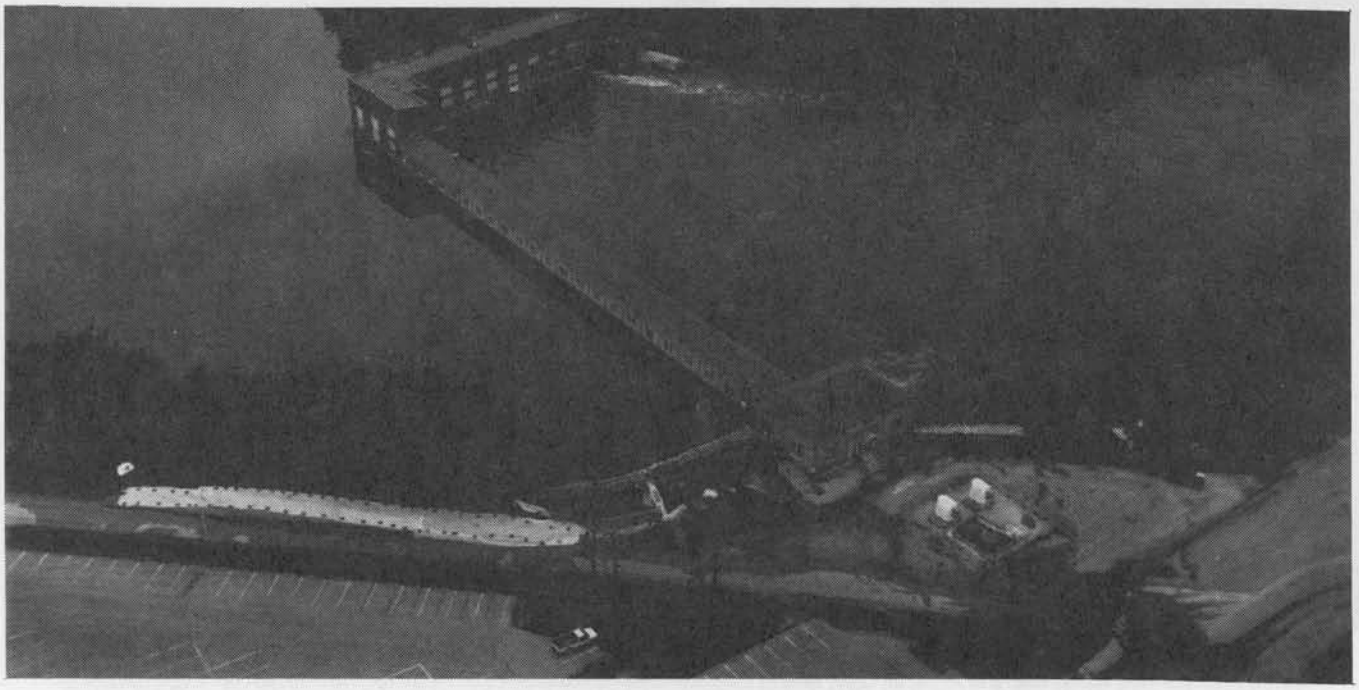
View of sewage building, Building 204. Note temporary earthen dike built to protect structure.



Sandbag dike built on levee east of hydrolectric plant. Note large boil ringed with sandbags in foreground, and sandbags stacked on pallets as reserves.

Below: Hydroelectric plant building 160, downstream side of plant. Note pump operating in foreground.

An aerial view taken on 7 July 1993 of the RIA hydroelectric plant, Building 160, river stage at 22.26". Note flood control measures in place along levee, east of plant.



Although flood waters seeped into the hydroelectric plant, Building 160, during the flood, the water was relatively easily pumped back into the slough. Electrical substations A and B, however, were more critical to the island than the hydroelectric plant. The plant only supplies approximately 20 percent of the island's power at normal capacity, but the substations transfer the remaining 80 percent from a local community power plant. Substation A near Building 299 and substation B, situated directly south of the hydroelectric plant, were protected by sandbags. Except for one brief power outage for the repair of a 2400 volt E-7 cable, probably caused by water seeping into its manhole, all utilities were maintained and normal operations continued on Arsenal Island during the flood.[16]

The only down time attributed to the flood occurred at the simulation and testing facility at the far eastern edge of Arsenal Island. A flood control crew reinforced the levee near the testing facility. As a precautionary measure, the Director of Science and Engineering decided to remove expensive hydraulic simulators from the building. A 25-man crew from the Arsenal Operations Directorate disassembled and removed the equipment. This temporary removal of equipment halted testing of recoil mechanisms which, in turn, delayed outgoing shipments.[17]

Military personnel, along with the Arsenal Operations Directorate employees, provided the "muscle" to reinforce the north shore levee. This is a view of the early reinforcement effort along the north shore levee.

This later view depicts soldiers completing flood control preparations along the north shore levee. Soldiers finished the sandbag dike at the top of the levee and were in the process of placing sandbags at the base of the levee to prevent sloughing.

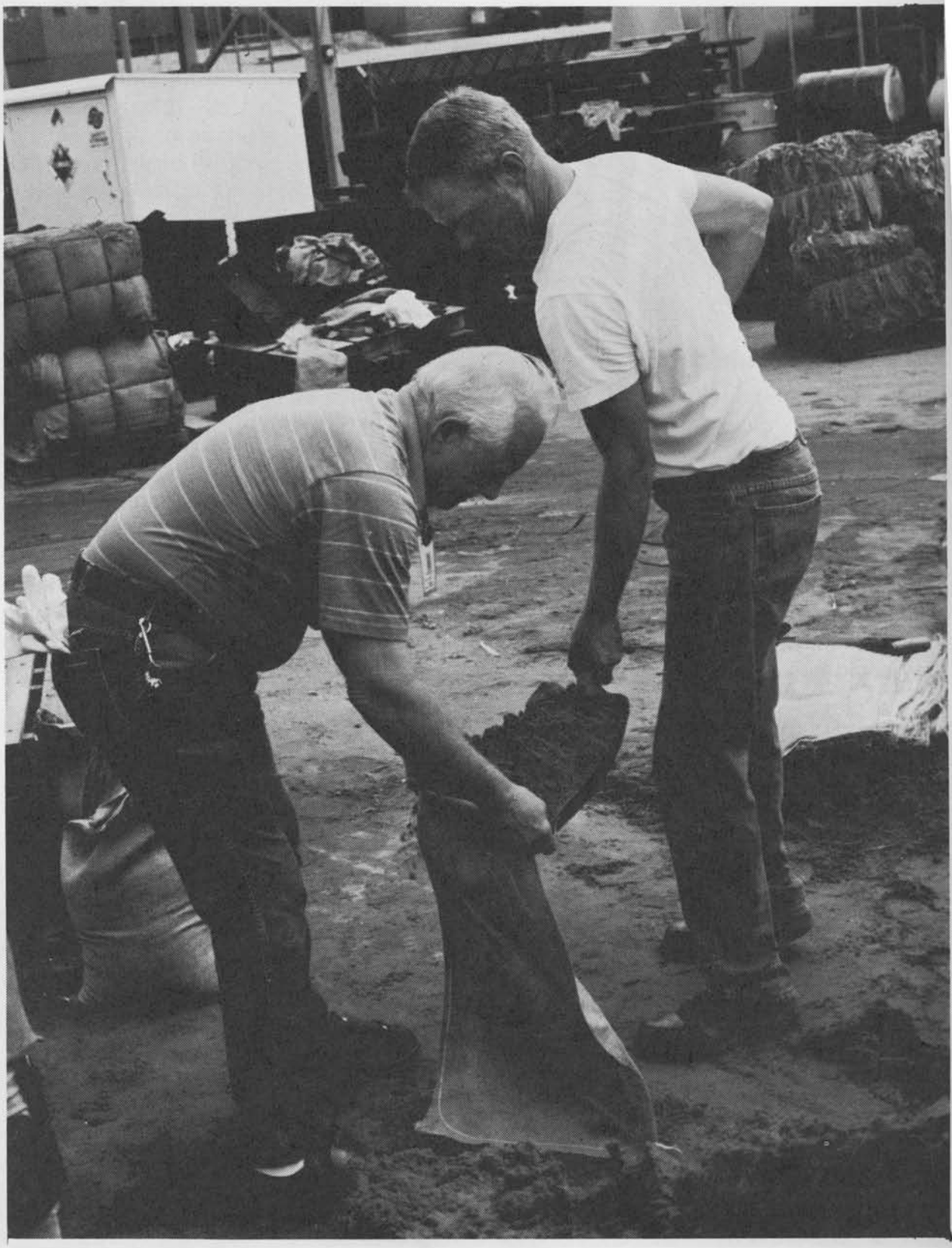
Mobilization

The fact that the high water mark was predicted to arrive on the Sunday of an extended holiday weekend created some serious problems for flood control management. The crest was predicted for a time when government offices and shops would be closed. The island's normal pool of reserve labor to draw from would not be available on that weekend. Flood control crews consisting primarily of civilian and military volunteers worked the holiday period. Because of this, EH engineers strove to have the island's flood control effort on a maintenance footing before the weekend. They had prepared from the beginning for the worst case scenario, a record-breaking flood. This was the best way to ensure the safety of the installation and, in the end, this decision proved to be a major key to the success of their flood control plan. A retired Facilities Engineer wisely reminded the acting director of EH that, "floods don't wait for meetings, you better get moving or it [flood] will pass you by".[18]

Mr. Verstraete, described the initial start up period as frantic, with people working at a furious pace. There was such a desire to get things accomplished, that at times the work got ahead of the planning. Briefly, zealous volunteers filled sandbags too full for effective stacking, and placed them improperly along the levee. Distribution of a Corps of Engineers instruction sheet on how to construct a sandbag emergency levee and how to properly fill a sandbag quickly rectified the situation. Arsenal facilities engineers participated in the early construction of sandbag dikes. In addition to supervising construction, engineers often positioned themselves last in a sandbag-tossing line, so they could ensure the proper stacking of the bags.

The response to electronic mail messages calling for volunteers for weekend flood control work was mildly disappointing. Some organizations filtered the messages down to their work force, others did not. Thus the workers did not respond in large numbers to the E-mail messages. However a sufficient number of military and civilians volunteered to work the extended weekend. First shift flood control work force usually varied between 40-80 workers, second shift 30-40 workers, and third shift 20-30 during the flood. Peak participation occurred during preparations for the two crests which occurred on 4 and 9 July.[19]

The RIA Fire Department provided workers during the weekend and evening shifts, as did the military. They traded family reunions, picnics, and fireworks for shoveling sand and tossing sandbags. The Fire Department's entire force stayed on the island throughout the first week of critical preparation. While one team manned the fire station and performed its normal duties, the other team placed sandbags on the levee. The Fire Department also provided portable lighting so that sandbagging and levee reinforcement could continue during second and third shifts.[20]



As the flood became more severe, the number of people engaged in flood control preparation increased. Military and civilian employees joined in cooperative sandbagging operations on the levee. Disagreements over who was in charge gave way to the importance of the work. Everyone recognized that teamwork was the crucial to their success.

Soldiers and civilian employees worked hand-in-glove with Serv-Air, Inc., personnel. When the Flood Control Center radio dispatcher put out a general call for additional workers to help with preparations at a particular site, Arsenal Operations Directorate foremen, monitoring the radio message, immediately dispatched personnel to that site. Arsenal Operations Directorate (AOD) employees and the military provided the bulk of the manpower and muscle needed for the flood control preparations.

Military assigned to RIA and the U.S. Army Armament, Munitions, and Chemical Command (AMCCOM) were joined at various times by members of other smaller military tenant or associate organizations during preparations for the crest. Soldiers. with their ability to work as a unit, proved invaluable in support of the reinforcement effort at the levee. Marines, Navy and Air Force personnel were sprinkled among the uniformed crews that filled sandbags and formed "bucket brigade" type lines to move sandbags from trucks or pallets to the top of the levee. Soldiers toiled late into the night on 1 July in a "beat-the-clock" effort to prepare for the record crest predicted for Sunday, 4 July. During the peak effort approximately 100 military personnel were actively supporting the island's flood effort. Additional support came at various times from other Arsenal Island organizations. Even the Golf Club provided personnel to support the levee when additional workers were needed during the holiday weekend.[21]

Captain Steven Conyne and First Sergeant Reginald Madden of Headquarters Support Troop, both commented that it was satisfying to carry out a tangible mission against a visible treat. They also praised the Post Restaurant and Fire Department personnel for delivering food and water to the work crews filling sand bags and those working at the three critical areas during all three shifts.[22]

Facilities contractor, Serv-Air, Inc., employees bolstered by soldiers maintained a sandbagging operation in Building 168 during the flood of 1993.

Day shift, sandbagging crew pose for group photograph on 7 July 1993, in courtyard of Arsenal foundry, Building 212. Note they are filling bags with limestone crushings rather than sand. This substitute proved not as effective as sand in holding back water.

Sandbagging Operations

Flood control management temporarily expanded the sandbag filling operations to three sites so that a stockpile of sandbags would be ready for volunteers to use during the upcoming long Independence Day weekend. An exhausted Serv-Air, Inc. crew received needed assistance from soldiers who bolstered its sandbagging operation at Building 168. Also, Arsenal Operations Directorate employees, diverted from their normal duties, established a second sandbag filling operation at the foundry,building 212. A third sandbagging site was briefly established near the sun dial at the intersection of Gillespie Avenue and Blunt Road.

Mr. Jay Richter, SMCRI-EHS engineer, explored using a faster, automated system of bagging sand at the foundry. The foundry poured 200 tons of sand in 10 hours and produced about 10,000 sandbags using the sand shaker machines to automate the bagging operation. The machines produced approximately 18 bags per minute, and provided a "kick start" to the stockpile of sandbags being filled in preparation of the crest's arrival. Flood control management maintained a central reserve of sandbags while also pre-positioning pallets of sandbags near critical sites as ready reserves for potential emergencies.[23]

Approximately more than two dozen workers were busy filling bags around-the-clock in preparation for the flood crest arrival on 4 July. However the final number of participants who filled sandbags in support of reinforcement efforts at the levee totaled several hundred. Because of the physically demanding labor, the Flood Control Center made a conscientious effort to rotate personnel whenever possible.

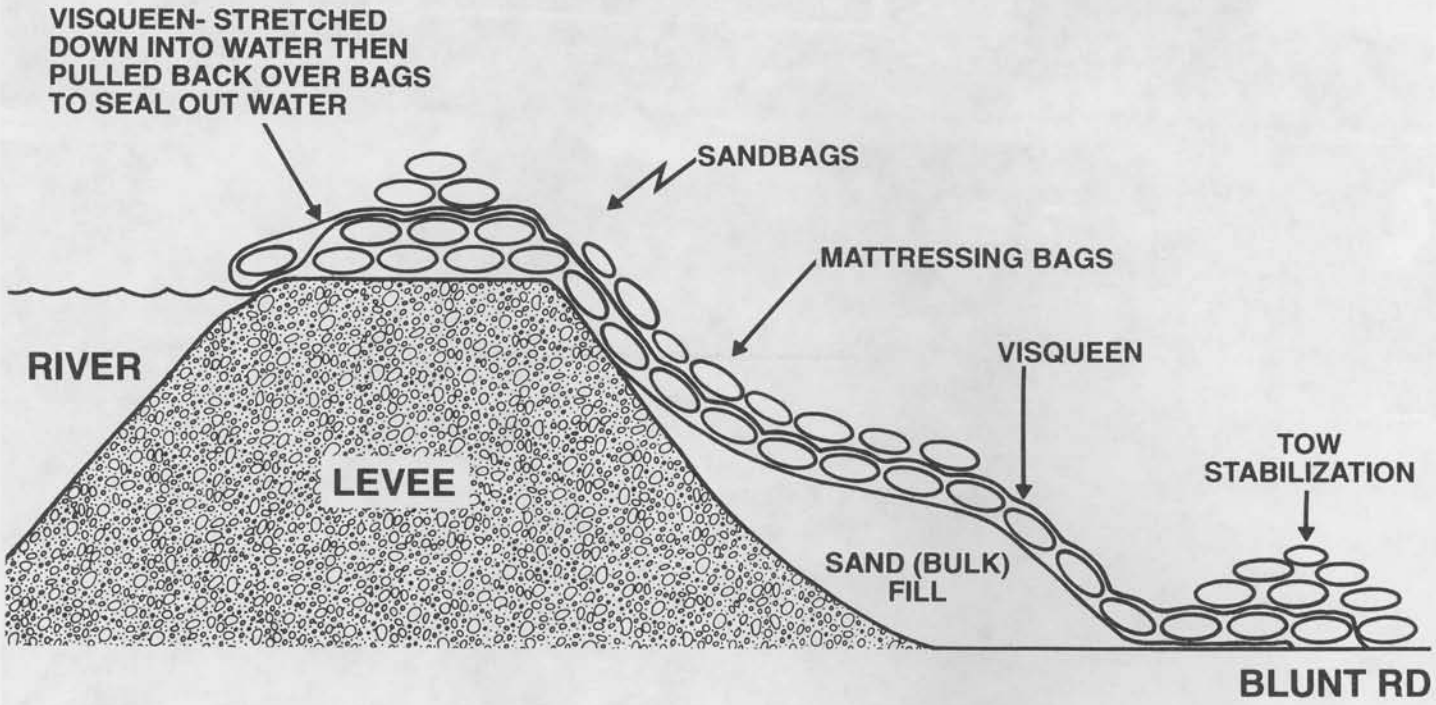
Early on, flood control management discovered that volunteers preferred filling sandbags outdoors, rather than in a hot, confined building. The open courtyard of Building 212 provided more space and a cool breeze for those shoveling sand into bags. Other lessons learned from sandbagging operations included reminding volunteers that it is best to fill sandbags only three-quarters full and tie them at the top to allow the bags to settle when they are stacked on their sides. Also limestone shavings or crushed limestone turned out to be a poor substitute for sand. Its consistency did not respond well to water therefore it could not be used in bulk to hold back the high water. Also the limestone shavings became very heavy when wet, much heavier than sand.[24]

A crew of Arsenal Operations Directorate employees filling sandbags at an outside site, in courtyard of Building 212, the Arsenal foundry.

For a brief period sandbagging operations were conducted at the north shore levee, near the sun dial. Note the crew pictured here consisted of civilian employees, family members, and military.

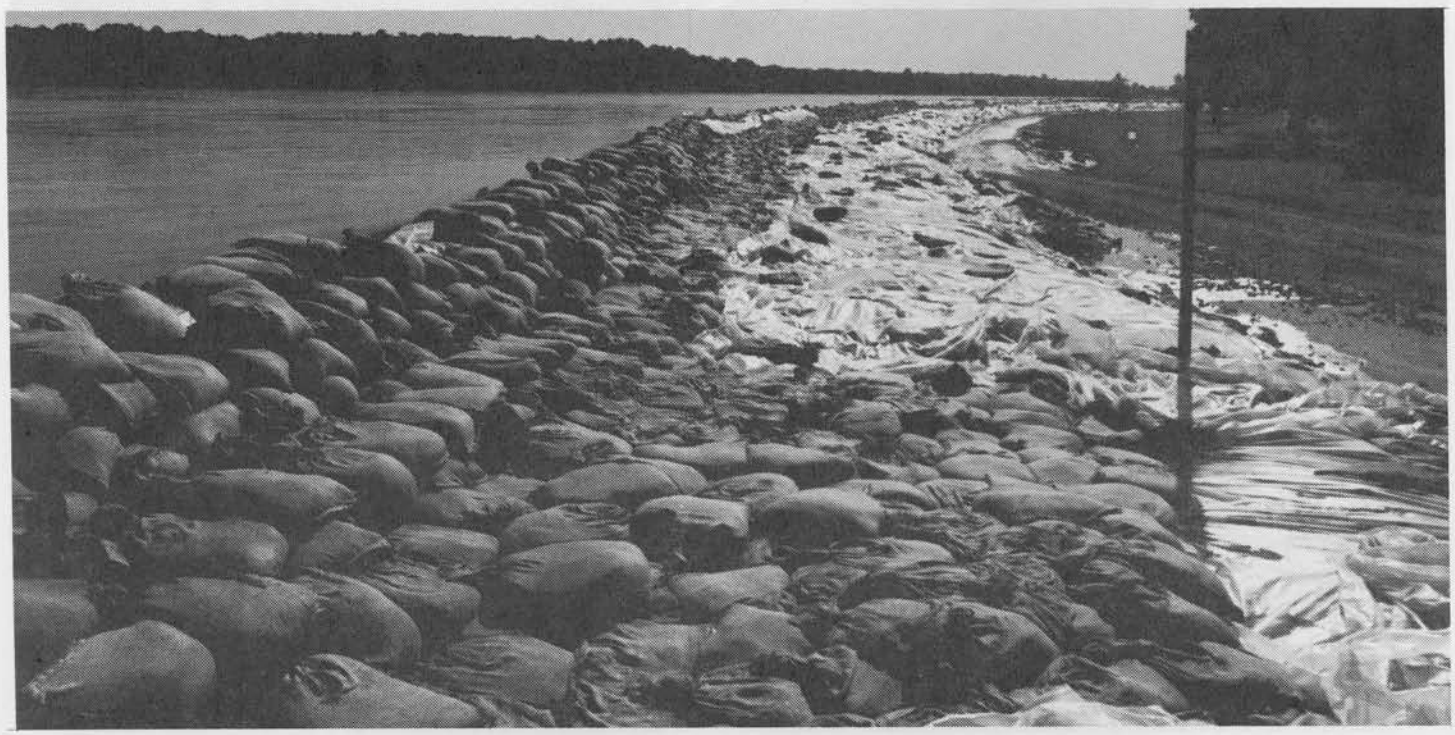
Above: Teamwork. The Arsenal Community pulled together to work as a unit.

REINFORCEMENT OF LEVEE ALONG BLUNT ROAD



This diagram illustrates how crews reinforced the levee along Blunt Road. Note the use of bulk sand covered with plastic and anchored with sandbags proved effective means of strengthening the levee. C. L. Sywenberg, EH engineer, drew the original sketch.

Layers of sandbags mattressed against the levee and bulk sand placed its base, covered with plastic, reinforced the levee during the 1993 flood.



Bulk Sand Used To Reinforce Levee

The U.S. Army Corps of Engineers suggested what became a pivotal change in tactics used to reinforce levee. On 1 July 1993, their experts advised pouring sand in bulk along the base of the Blunt Road levee as an effective and quick means of smothering and reinforcing the levee. Over the years the levee had become honeycombed with holes formed by tunneling ground hogs and decaying roots of trees. Flood waters pushed through these weak spots in the levee, seeping, bubbling or boiling through the levee. There were too many boils and too few hours to control them individually. A more blanket approach was required. Sand placed at the base or toe of the levee reinforced areas which were becoming soft. The weight of the sand prevented the base from sloughing, giving way or sliding as the levee became more saturated. Mr. Jay Richter, SMCRI-EHS engineer, served as EH's point-of-contact (POC) for ordering sand. He used a cellular phone to contact Ms. Alberta Simmons of the Contracting Directorate, who was authorized to purchase sand around-the-clock from her home phone.

Truckloads of sand were poured in bulk along the slope of the north shore levee; smoothed out, covered with plastic; and weighted down with sandbags. This shift in flood control tactics enabled crews to have Arsenal Island on a flood control maintenance footing prior to the arrival the record-breaking crest on 4 July.[25]

Equipment

The heavy-duty large-wheeled forklifts, used to move pallets of sandbags provided better traction on the muddy terrain around the levee than the smaller wheeled forklifts. The small ones were of little use under those conditions.

Finding enough licensed forklift drivers and truck drivers was a reoccurring problem throughout the flood. However many organizations filled in with drivers to ease the situation. Serv-Air, Inc., employees drove the heavy equipment, such as end loaders, scoop shovels and semi-trucks. Serv-Air truck drivers, heavy equipment operators, and pipefitters worked in around-the-clock shifts. But additional drivers were needed, especially during the night. The Directorate of Logistics (DL) provided additional drivers for each shift, plus vehicles and fuel. Military and EH personnel filled in during critical times as forklift drivers. The Rock Island District, U.S. Army Corps of Engineers brought in a bulldozer and a heavy duty endloader to move sand at Quarters 30/31. The Directorate of Logistics also provided supplies of raincoats, insect repellent, shovels, and plastic sheeting to flood control crews.[26]

An aerial view of Building 299 and lot, the former XYZ area to the right. Though high water approached the warehouse, which contains 778,000 square feet of floor space, it and the lot remained dry and operational during the flood.

The Arsenal's manufacturing, storage, and office buildings continued operations during the flood. Note in this 2 July 1993 aerial view, with the river crest at 21.86', these structures were dry and unencumbered by the high water.

Pumps were another item in demand during the flood. The Directorate of Logistics located two available pumps at an Army Ammunition Plant (AAP), and had them delivered by air freight. Also the community of Milan, IL, provided two pumps which Serv-Air repaired before using. The facilities contractor employees were responsible for the pump maintenance and keeping them supplied with fuel. By the end of the flood, Serv-Air, Inc., staff had 20 pumps strategically placed throughout the island.

Flood Related Statistics

The Mississippi River crested for a second time at a record breaking 22.63 feet at Arsenal Island on 8-9 July 1993. Approximately 17,000 manhours, including military and volunteer time were expended during the flood. The Directorate of Engineering and Housing purchased a total of 6,844 tons of sand, and 13 ton of crushed rock from three contractors - Builders Sand and Cement Company, Davenport, IA.; Moline Consumers Company, Moline, IL.; and Wendling Quarries, Inc., DeWitt, IA. The base operations contractor, Serv-Air, Inc., used an additional 900 tons of sand and 3,600 tons of crushed rock for flood control measures performed during 1993. Crews filled approximately 60,000 sandbags for flood control use. The flood damaged 1.5 miles of roads and levee. Only 25 of the island's 946 acres were inundated with flood water. All 25 acres were in fringe non-critical locations, such as the skeet/trap range area at the far eastern edge of the island. Approximately 100 volunteers worked Independence Day and the following weekend on flood control preparations and maintenance. Other than scrapes and bruises, the flood control crews received zero accidents and injuries related to flood control work.[27]

Truckloads of sand were used in bulk to reinforce the levee near Quarters 30/31 at the Old Moline Lock.

Truck convoys, such as this one, delivered sand in bulk directly to the north shore levee during the flood of 1993.

The tow of the levee east of Quarters 30/31 was also reinforced with sand poured in bulk and covered with plastic. This was done to smother boils which seeped through the base of the dike.

Clean-up Operations

After cresting at 22.63' on 9 July 1993, the river began a slow falling trend. As the high water receded clean-up work began. The Flood Emergency Operation Center remained in effect until 17 July, when flood control coordination for second and third shift was transferred to the Fire Department. Gradually those employees diverted to flood control work were returned to their normal duties.

The Directorate of Engineering and Housing planned and oversaw the clean-up operations which Serv-Air, Inc. primarily carried out. Under the EH plan clean-up operations were divided into three classifications - short term, mid term, and long term. The short term clean-up projects included basic road repairs, safety and health issues, and general clean-up. Mid term clean-up projects focused on sand and sandbag clean-up and continued road restoration. However major sand and sandbag reinforcement of key areas was left in place until any danger of reocurring high water passed. Long term clean-up centered on reviewing of the island's flood protection system and identifying ways to improve that system.[28]

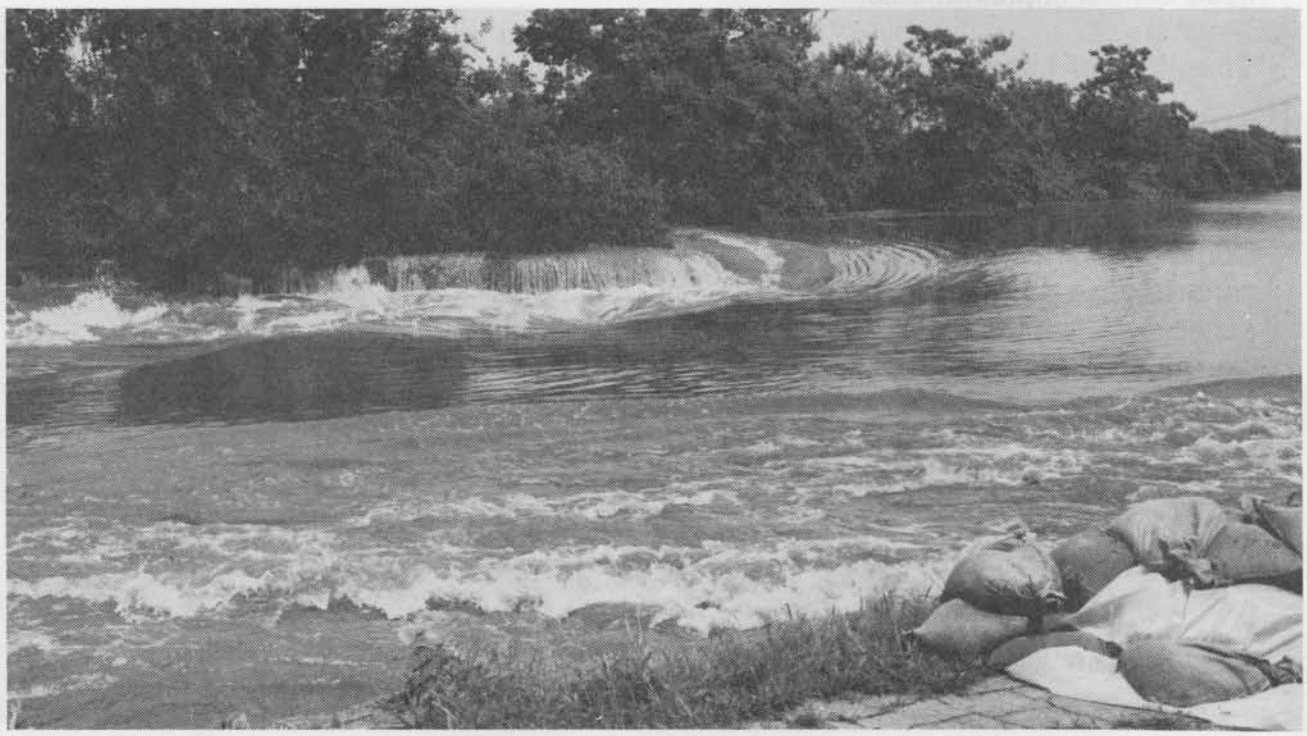
Flood control and clean-up cost estimates for labor, materials, additional purchased electricity, additional sewage treatment, contract contingency, and clean-up totaled $3,188,440. The estimated cost for repair of damages will depend upon the extent that the levee system is upgraded. Plans included reusing sand and sandbags in future repairs of roads or levees. The Directorate of Engineering and Housing also planned to consult with U.S. Army Corps of Engineers experts on their recommendations for future flood control improvements.[29]

Summary of Lessons Learned/Recommendations

The Directorate of Engineering and Housing formed numerous lessons learned/recommendations from its flood control experience. The EH engineering staff commented that they received valuable advice from the Rock Island District, U.S. Army Corps of Engineers' flood control experts. In particular, the Corps' suggestion to use bulk sand as an effective means of quickly preventing boils and reinforcing the levee was especially useful. Also its tips on how to best organize the island's flood control effort were timely. Because of their contribution, Mr. Verstraete recommended that Corps experts be consulted about future Arsenal Island flood control improvements. [30]

An aerial view of the old Moline Lock and Quarters 30/31. Compare this 1993 view with that of 1965 shown earlier. Note the small amount of water standing across the road from the quarters.

A close-up view of the turbulent flood waters passing through the old Moline Lock at the northeast end of Arsenal Island. As a precautionary measure, the family of RIA SGM A. L. Richardson was temporarily moved from Quarters 31.



Facilities engineers expressed concern that the electronic mail messages used to solicit volunteers for flood control work did not reach all of the island's general work force. These messages proved to be too easily overlooked. In the future, a more direct appeal for volunteers should supplement the electronic mail message to insure greater response from the work force. It must be pointed out that the acting director of the Directorate of Engineering and Housing felt he had sufficient manpower numbers to complete flood control preparations, but additional volunteers in ready reserve would have increased everyone's comfort zone. The general feeling was that more workers would have volunteered had they received notification and permission for their supervisors.[31]

In regard to Flood Control Center's communications, future field units should be equipped with multi-frequency radios, and have access to cellular phones. The multi-frequency radios borrowed from the Arsenal Operations Directorate allowed all the different elements involved with the flood to communicate with one radio. The use of RIA disaster control officers as radio dispatchers worked well and should be continued in future flood control center operations. An updated inventory record of flood control equipment, its place of storage, and point of contact for their release should be maintained either by the disaster control officer or EH personnel.[32]

The EH engineers urged that an aggressive animal control policy be established to reduce the island's ground hog population and eliminate their settlements near the levees. Their extensive tunneling has weakened the levee. Serv-Air, Inc., employees and security police trapped and/or exterminated approximately 170 ground hogs during the flood. Several engineers also recommended the removal of small trees which have sprouted along the levee. Decaying tree roots also contributed to the number of holes in the levee. The Arsenal structural engineers recommended that future levee maintenance should include monitoring and keeping the levee clear of trees.[33]

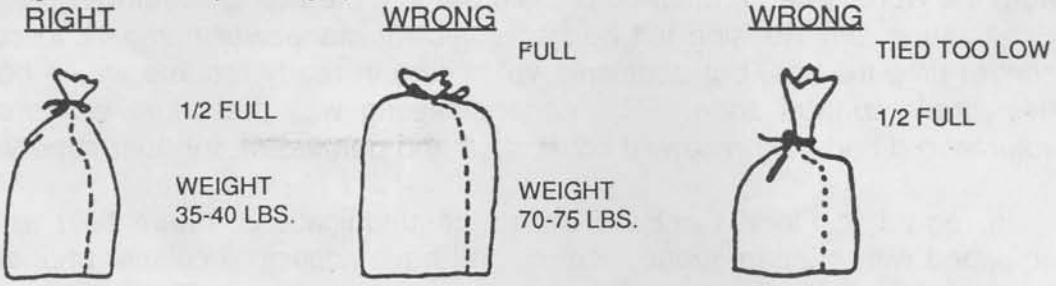
Engineers discovered during the flood that sections of the north shore levee, especially along Blunt Road between the sundial and Building 9, primarily consisted of compressed sand. Structural engineers are investigating the feasibility of reinforcing and possibly upgrading the north shore levee to current U.S. Army Corps of Engineers specifications. Also, facilities engineering supervisors recommended raising the pump in Building 9 to a higher level and strengthening the brick walls of the 85-year old structure. The Rock Island Arsenal submitted a Military Construction Project for new flood protection,

U.S. Army Corps of Engineers flood control personnel provided this timely handout sheet with instructions on how to construct a sandbag levee and how to properly fill sandbags.

HOW TO CONSTRUCT A SANDBAG EMERGENCY LEVEE

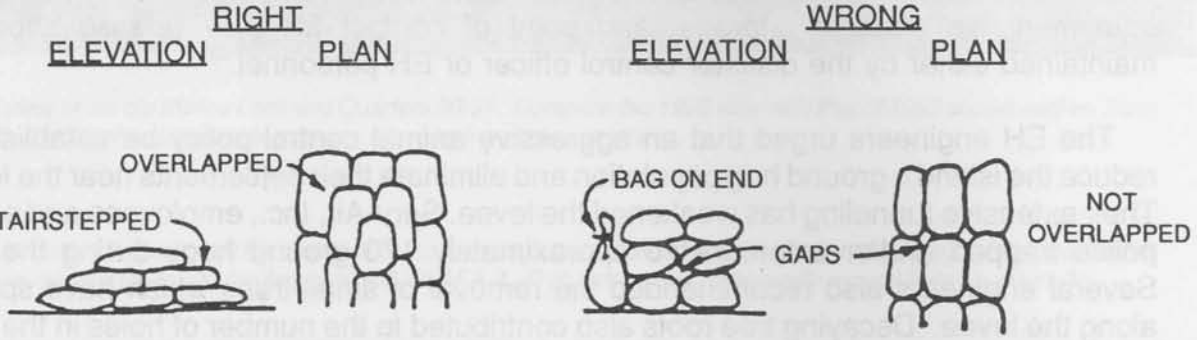
HOW TO FILL SANDBAGS

Fill sandbags 1/2 to 2/3 full, tie at top so bag will lay flat when put in place. (Overfilled bags leave gaps in levee allowing water to seep through.)



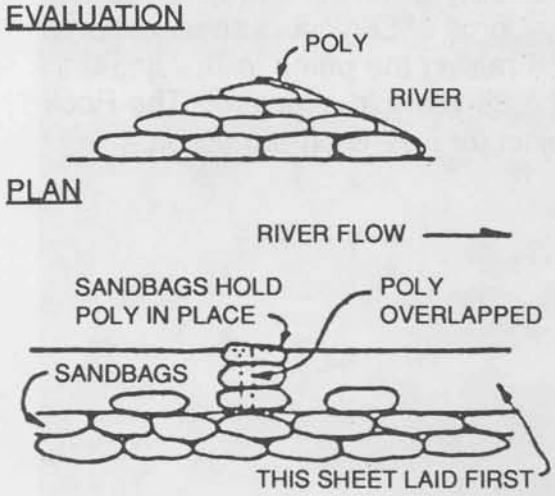
PLACING SANDBAGS

Sandbags should be placed flat on ground, overlapped, tamped into place, and stairstepped.



POLYETHYLENE

Polyethylene (poly) comes in rolls 20 ft. wide and 100 ft. long. It's used to wrap sandbag levees to prevent seepage. Poly should be placed on downstream portion of levee first, then worked upstream with a two- to three-foot overlap. Poly is held in place with sandbags.



Estimated number of sandbags per linear foot of wall.

Height in Feet	Bags Required
1	5
2	10
3	21
4	36
5	55

Five feet is the practical limit of a sandbag levee. If a higher levee is needed, alternate means of construction should be considered. Note: Preferred levee limit is 3 feet high.

including earthen levee and flood wall twice in the last ten years, but budgetary constraints and years of below normal precipitation stalled the project. If the upper Mississippi River basin area above Arsenal Island is entering into a cycle of heavier than normal precipitation then such an investment in permanent flood control devices may be more economical than continuing to build temporary levees of sandbags for each new flood warning. [34]

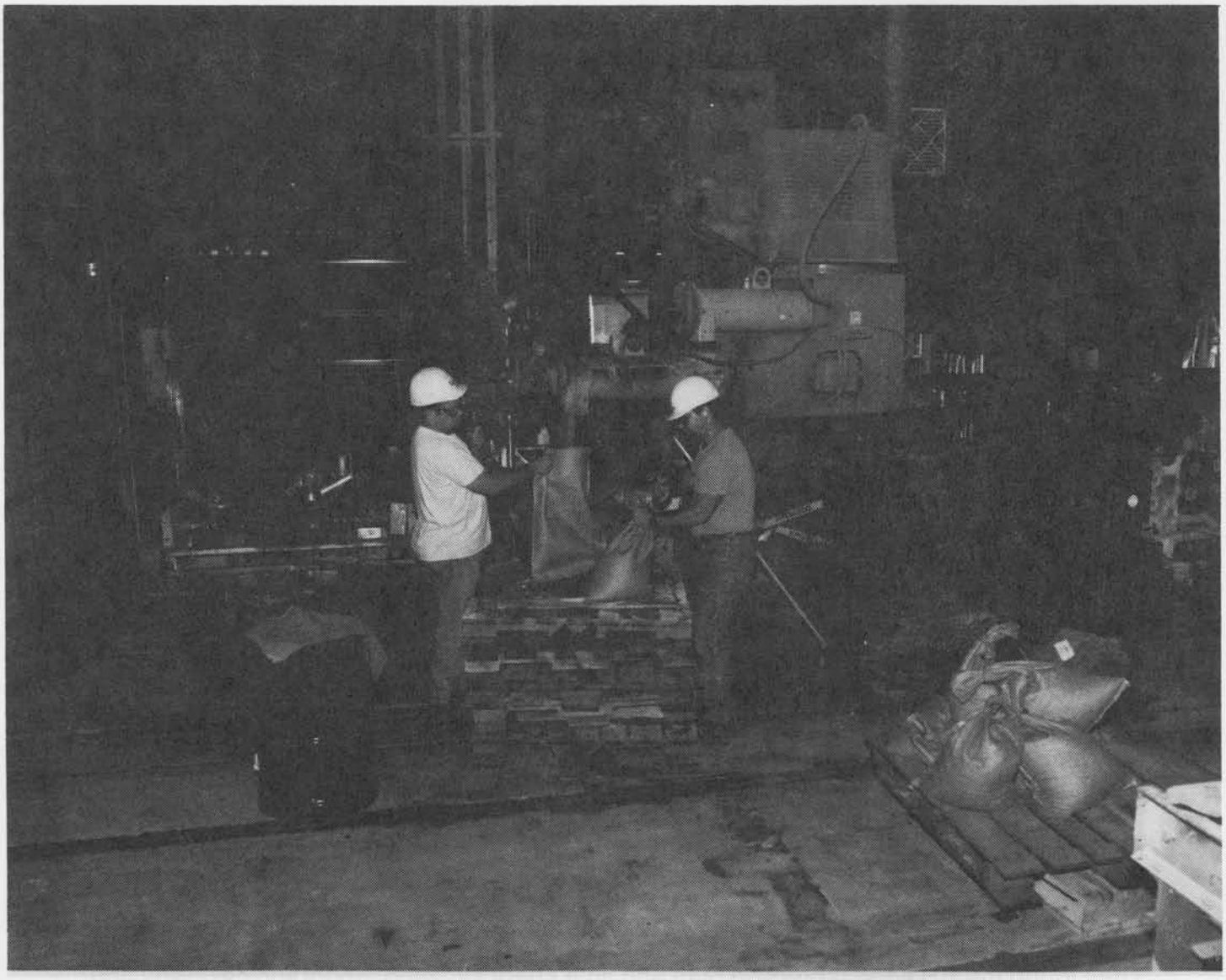
Many of the problems and pitfalls encountered during the initial start-up period could be attributed to inexperience. Some simple things were overlooked at first but were quickly corrected. Establishing sandbagging operations inside building 168 and the foundry seemed like a good idea, but it soon became obvious an outdoor operation would be better. The open space, fresh air and cool breeze in the courtyard of Building 212 provided a better environment for the physically demanding work of shoveling sand into bags. Also, volunteers initially filled bags too full and stacked them improperly on the levees. This was easily corrected by distributing handout sheets with sandbag filling and stacking instructions. The foundry's sand pouring machines filled thousands of bags with fine silica sand but clogged when damp river sand was substituted. Another experiment using crushed limestone as a substituted for sand failed. It was ineffective when used in bulk to smother boils in the levee and became too heavy when wet to use in sandbags. Also large wheeled, heavy-duty forklifts operated better on the muddy terrain around the levee than the lighter, small-wheeled ones.[35]

Ways should be explored to more easily protect the expensive hydraulic simulators in the testing facility at the far east edge of Arsenal Island. The temporary removal of equipment, as a precautionary measure, not only halted the testing of recoil mechanisms but also delayed outgoing shipments.

The EH supervisory engineers cited the value of planning, preparation, and teamwork. They found the EH flood protection plan and time spent studying topographical maps and photographs of past floods to be valuable to their planning. Nine hour work shifts also proved useful, as the extra hour was used to brief personnel coming on board for change of shift.

The supervisors pointed out that flood control maintenance must continue in non-flood years to ensure proper flood control protection. They learned that teamwork was essential, no person or organization placed themselves or their organization above the flood control mission. No one said no when asked for help. The military, civilian employees, Serv-Air, Inc., employees, and volunteers all pulled together as a unit.

The sand pouring machines at the Arsenal foundry provided a faster, more automatic way of filling sandbags than the physically demanding manual method.

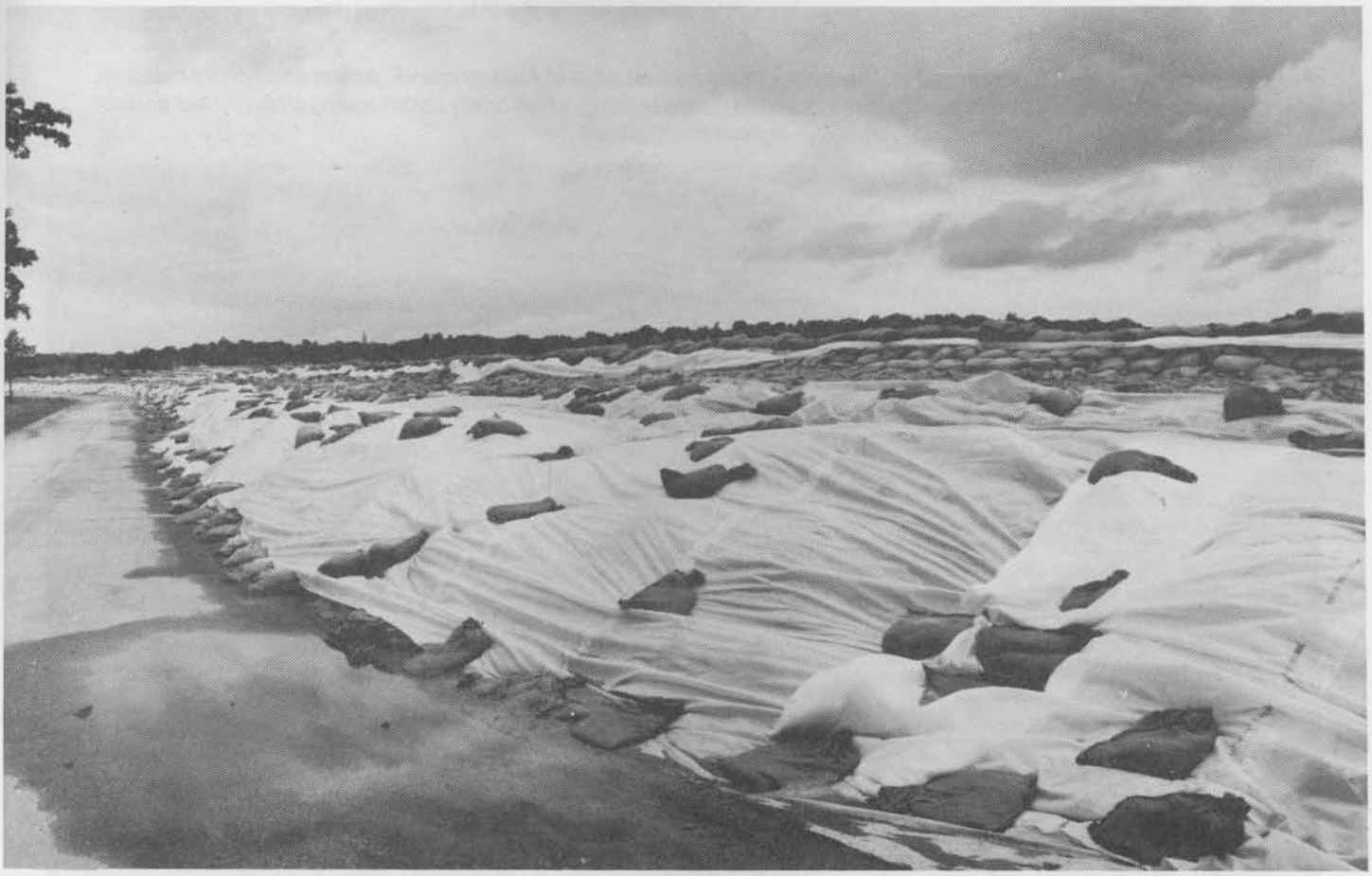


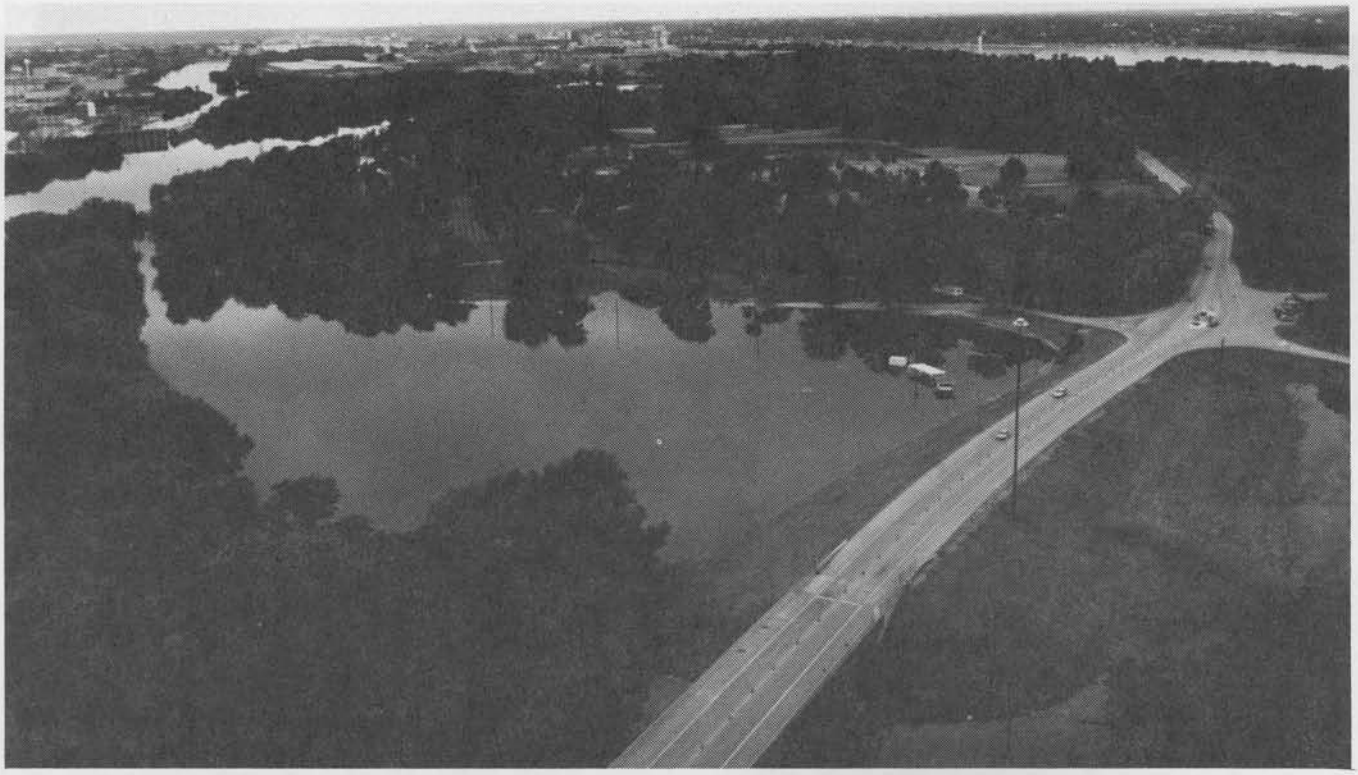
The different chains of command were softened to allow a freer exchange of ideas and greater flexibility, which proved valuable in solving numerous problems. Until the 1993 flood Arsenal Island had few employees with flood control experience. Now the island has a core of confident professionals with flood control experience capable of managing flood preparations on a major scale. This added experience undoubtedly has enhanced their leadership skills.[36]

During the flood emergency, Rock Island Arsenal continued to be a good neighbor to local communities. On Sunday, 4 July, the Quad Cities Chapter of the American Red Cross, requested space on Arsenal Island to establish a regional depot for flood relief supplies. Rock Island Arsenal provided approximately 10,000 square feet in "V" area storehouse, building 333. Also RIA foundry aided Keokuk Steel Castings, Inc., of Keokuk, IA, whose facility for finishing castings was inundated by flood waters. RIA agreed to finsh work on the castings made by the company for military customers.

Arsenal Island escaped the great flood of 1993 with minor damages thanks to the efforts of those who formed the island's flood control team. The Arsenal, the Command, and tenant organizations continued operations throughout the flood. The island work force continued to be productive and the Quad Cities' "heart" continued to beat.

Reinforcements in place, the levee held thanks to a stellar effort by the entire Arsenal Island community.





Moline bridge access road to Arsenal Island on 7 July 1993. Note the bridge and road remained open throughout the flood despite the high water covering skeet/trap range.

An aerial view of the simulation and testing facility, at the far east edge of Arsenal Island. As a precautionary measure, expensive hydraulic simulators were removed from the testing building, which briefly halted testing of recoil mechanisms.

Saturday Flood Control

Work Area	First Shift	Second Shift	Third Shift
Time	7AM-4PM	3PM-Midnite	11PM-8AM
Flood Center	Ron Verstraete		
Coordinator	Steve Biehler	Jim Thompson	Jerry Sechser
Admin Support	Kay McIntyre	Kay/Nancy	Nancy Williams
	Sue Miller	Val Swynenberg	
AP Support	Dave Block	Bob Emmert	Bill Ingenieri
Staff Support	Gary Cook	Jay Richter	
Building 9/Dike			
Dike Coordinator	Swynenberg	Swynenberg	Swynenberg
Inspector	Rodney Delp	Paul Schnell	Kim Johnson
Inspector	Alison David	Dave Osborn	Brenda Vivier
10 Volunteer Group			
5 Military Group			
Building 30/31/Dike			
Dike Coordinator	Hatcher	Hatcher	Hatcher
Inspector	Don Duff	Marc Dewey	Ray Tatro
Inspector	Cindee Thornbrugh	Ron Faletti	Terry Harris
10 Volunteer Group			
5 Military Group			
Island South Control Points			
Dike Coordinator	Todd	Todd	Todd
Inspector	Terry Renihan	Jeff Dupont	Joe Jones
Inspector		Dan Nuti	Jim Klarkowski
5 Volunteer Group			
2 Military Group			

Reserve Group		Leave
		Betty Dickson
Dane Hansen	Holly Luebrecht	Bob Kalantari
	Jim Galusha	Mary Bautista (not Monday)

The Directorate of Engineering and Housing's 24-hour flood control duty roster for Independence Day weekend. Note men and women from EH participated in virtually all aspects of flood control.

Sunday Flood Control

Work Area	First Shift	Second Shift	Third Shift
Time	7AM-4PM	3PM-Midnite	11PM-8AM
Flood Center	Ron Verstraete		
Coordinator	Steve Biehler	Jim Thompson	Jerry Sechser
Admin Support	Kay McIntyre	Val Swynenberg	Nancy Williams
	Michelle Trask	Kelly Just	Cory Border
AP Support	Dave Block	Bob Emmert	Bill Ingenieri
Staff Support	Gary Cook	Jay Richter	
Building 9/Dike			
Dike Coordinator	Swynenberg	Swynenberg	Swynenberg
Inspector	Rodney Delp	Paul Schnell	Kim Johnson
Inspector	Alison David	Dave Osborn	Brenda Vivier
10 Volunteer Group			
5 Military Group			
Building 30/31/Dike			
Dike Coordinator	Hatcher	Hatcher	Hatcher
Inspector	Don Duff	Cindee Thornbrugh	Ray Tatro
Inspector	Marc Dewey	Ron Faletti	Terry Harris
10 Volunteer Group			
5 Military Group			
Island South Control Points			
Dike Coordinator	Todd	Todd	Todd
Inspector	Terry Renihan	Jeff Dupont	Joe Jones
Inspector		Dan Nuti	Jim Klarkowski
5 Volunteer Group			
2 Military Group			

Reserve Group		Leave
		Betty Dickson
Dane Hansen	Holly Luebrecht	Bob Kalantari
	Jim Galusha	Mary Bautista (not Monday)

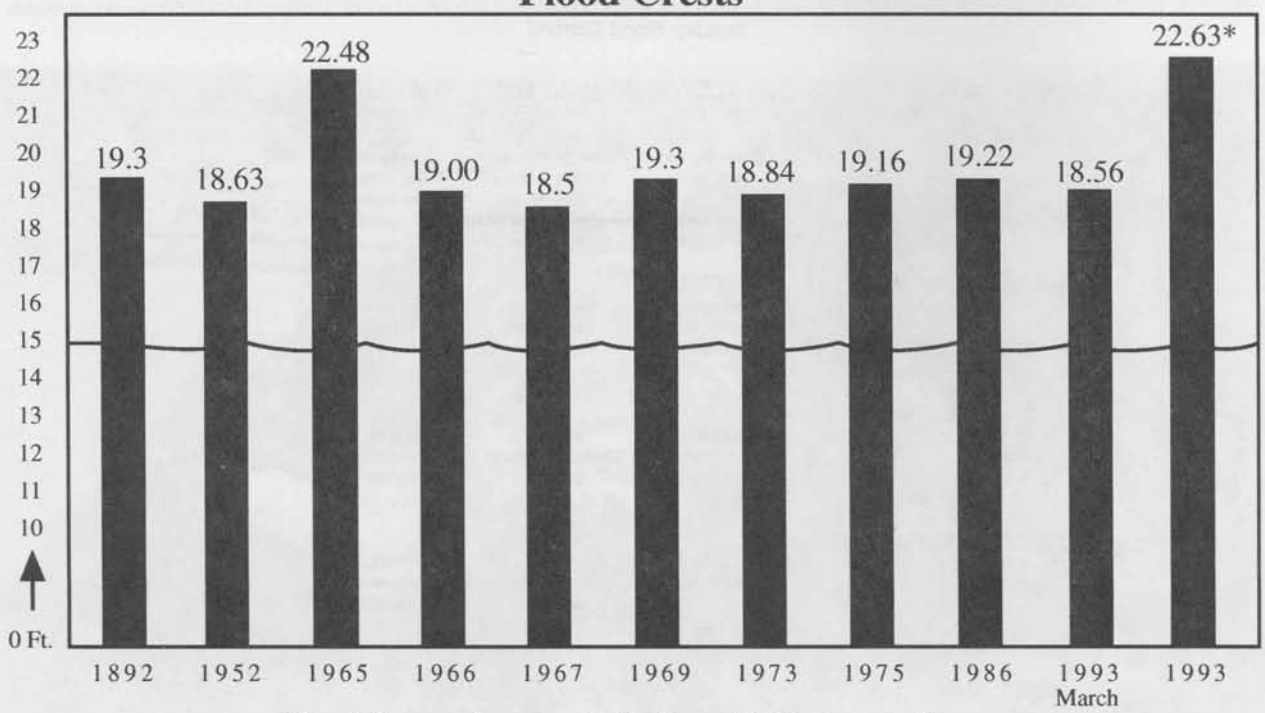
Monday Flood Control

Work Area	Time	First Shift 7AM-4PM	Second Shift 3PM-Midnite	Third Shift 11PM-8AM
Flood Center		Ron Verstraete		
Coordinator		Steve Biehler	Jim Thompson	Jerry Sechser
Admin Support		Kay McIntyre	Mary Bautista	Nancy Williams
		Val Swynenberg	Michelle Trask	Sue Miller
AP Support		Dave Block	Bob Emmert	Bill Ingenieri
Staff Support		Gary Cook	Jay Richter	
Building 9/Dike				
Dike Coordinator		Swynenberg	Swynenberg	Swynenberg
Inspector		Rodney Delp	Paul Schnell	Kim Johnson
Inspector		Alison David	Dave Osborn	Brenda Vivier
10 Volunteer Group				
5 Military Group				
Building 30/31/Dike				
Dike Coordinator		Hatcher	Hatcher	Hatcher
Inspector		Don Duff	Marc Dewey	Ray Tatro
Inspector		Cindee Thornbrugh	Ron Faletti	Terry Harris
10 Volunteer Group				
5 Military Group				
Island South Control Points				
Dike Coordinator		Todd	Todd	Todd
Inspector		Terry Renihan	Jeff Dupont	Joe Jones
Inspector			Dan Nuti	Jim Klarkowski
5 Volunteer Group				
2 Military Group				
Reserve Group				
Dane Hansen		Holly Luebrecht		
		Jim Galusha		

Leave
Betty Dickson
Bob Kalantari
Mary Bautista (not Monday)

MAJOR Floods of Mississippi River during the last 100 years

*Flood Crests



*** Flood figures from Lock & Dam #15 Tailwater Gauge, U.S. Army Corps of Engineers- Rock Island District**

NOTES

1. Paul Levesque, "Island escapes flood with minor damage", **TARGET**, (16 August 1993), p. 1.

2. No Author, "Chart Shows River Levels", **Davenport Times-Democrat,** (12 April 1967); Clifford W. Stephens, "The Great Flood of 1965", **U.S. Army Rock Island Arsenal Annual Historical Report, Fiscal-Year 1965,** (Rock Island, Illinois: Rock Island Arsenal), p. 95.

3. Scott Reeder, "Minneapolis hydrologist predicts river's water levels", **QUAD CITIES TIMES,** (3 July 1993), p. 6A; No Author,"Set Summer Rain Record", **QUAD CITIES TIMES**, (1 September 1993), p. 1A.

4. Memorandum For AMSMC-HO (Mr. Slattery) from John A. Ruble, Director, SMCRI-EH; Subject: Amount of Sand and Rock used for Flood Fighting Purposes, (13 October 1993), p. 1; Paul Levesque, "By the Numbers", **TARGET**, (16 August 1993), p. 7.

5. Paul Levesque, "By the Number", **TARGET,** (16 August 1993), p. 7.

6 Notes, Ronald L. Verstraete, Acting Director, Directorate of Engineering and Housing, (SMCRI-EH) Subject: **TV Flood Control Effort at Arsenal Island**, 13 July 1993; Interview, T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993); Interview T. J. Slattery, AMSMC-HO, with Stephen A. Clark, SMCRI-CR, (26 August 1993); "High Water Control", **Technical Exhibit,** 7-1, p. 1.

7. Memorandum For Serv-Air, Inc.,(SAI), S. A. Clark, Chief, Contract Administration Office, Subject: **Emergency Flood Situation**, (30 June 1993); Interview, T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993); Interview, T. J. Slattery, AMSMC-HO, with S. A. Clark, (26 August 1993).

8. Information Paper, R. L. Verstraete, SMCRI-EH, to COL T.L. Nienhouse, SMCRI-CO, Subject: **Flood Control**, (30 June 1993); Interview, T. J. Slattery, AMSMC-HO, with J. A. Thompson, SMCRI-EHA, (10 August 1993).

9. The Directorate of Engineering and Housing's Flood Control Roster, 3-5 July 1993.

10. Interview, T. J. Slattery, AMSMC-HO, with D. P. Block, RIA Disaster Control Officer, SMCRI-APP, (28 July 1993); Interview, T. J. Slattery, AMSMC-HO with R. W. Emmert, Alternate RIA Disaster Control Officer, SMCRI-APP, (10 August 1993).

11. Message, R. L. Verstraete, Acting Director, SMCRI-EH, to All Arsenal Island Personnel, Subject: **Flood Damage Avoidance Program,** (12:21:16 CDT, 30 June 1993).

12. Directorate of Engineering and Housing Flood Control Roster for 3-5 July 1993.

13. Information Paper, R. L. Verstraete, SMCRI-EH, to COL. T.L. Nienhouse, SMCRI-CO, Subject: **Flood Control**, (30 June 1993).

14. Memorandum For SMCRI-DC (MAJ Bilderback) from R. L. Verstraete, Acting Director, SMCRI-EH, Subject: **Mississippi River High Water,** (29 June 1993); Interview, T. J. Slattery, AMSMC-HO, with C. L. Swyenberg and T. Friemel, SMCRI-EHS, (10 August 1993); Interview, T. J.Slattery, with D. L. Osborn, SMCRI-EHS, (11 August 1993).

15. Interview, T. J. Slattery, AMSMC-HO, with N. P. Hatcher, SMCRI-EHP, (10 August 1993); Paul Levesque, "Island escapes record flood with minor damage", **TARGET**, (16 August 1993).

16. Interview T. J. Slattery, AMSMC-HO, with R. E. Todd, SMCRI-EHP, (9 August 1993); Message, S. A. Clark, Chief, Contract Administration Office (SMCRI-CR), to all personnel, and military living in quarters, Subject: **Power Outage**, 12:56:51 CDT, 9 July 1993.

17. FONECON, Achiel M. Dupont, Director, Directorate of Science and Engineering (SMCRI-SE) 17 August 1993; Interview T. J. Slattery, AMSMC-HO, with R.E. Todd, SMCRI-EHP, (9 August 1993); Paul Levesque, "Who helped and how", **TARGET**, (16 August 1993), p. 7.

18. Interview T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (10 August 1993).

19. Ibid.; Interview T. J. Slattery, AMSMC-HO, with J. A. Thompson, SMCRI-EHS, (10 August 1993).

20. Interview, T. J. Slattery, AMSMC-HO, with CPT R. Dominicus, and Assistant Chief J. E. Bickett, RIA Fire Department (SMCRI-EHF), (10 August 1993).

21. Interview, T. J. Slattery, AMSMC-HO, with First Sergeant R. M. Madden, Headquarters Support Troop (SMCRI-HD),(10 August 1993); Interview, T. J. Slattery, with D. P. Block, RIA Disaster Control Officer, SMCRI-APP, (28 July 1993).

22. Interview, T. J. Slattery, AMSMC-HO, with CPT S. Conyne, SMCRI-HD, (28 July 1993), and Interview, First Sergeant R. Madden, SMCRI-HD, (10 August 1993).

23. Message, S. P. Bostwick, Chief, SMCRI-APP, to COL T. L. Nienhouse, SMCRI-CO, Subject: **Commander's Emergency Situation Report,** (9 July 1993); Interview, T. J. Slattery, AMSMC-HO, with J. A. Thompson, SMCRI-EHS, and J. D. Richter, SMCRI-EHS, (10 August 1993).

24. Interview, T. J. Slattery, AMSMC-HO, with J. D. Richter, SMCRI-EHS, (10 August 1993).

25. Interview, T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993).

26. Interview, T. J. Slattery, AMSMC-HO, with J.A. Thompson, SMCRI-EHS, (10 August 1993).

27. Memorandum For AMSMC-HO, (Mr. Slattery) from John A. Ruble, Director, SMCRI-EH, Subject: Amount of Sand and Rock used for Flood Fighting Purposes, (13 October

1993), p. 1; Memorandum For SMCRI-EH from Alberta A. Simmons, Contracting Officer, SMCRI-CTI, Subject: Material Procured for Flood Control, (29 August 1993).

28. Message, David P. Block, RIA Disaster Control Officer, to COL T.L. Nienhouse, SMCRI-CO, Subject: **Commander's Emergency Situation Report, Potential Flooding of RIA,** (16 July 1993); Directorate of Engineering and Housing (SMCRI-EH), Mississippi River Flood Protection/Clean-up Plan, (20 July 1993).

29. Message, D. P. Block, RIA Disaster Control Officer, to COL T. L. Nienhouse,SMCRI-CO, Subject: **Commander's Emergency Situation Report, Potential Flooding on Rock Island Arsenal**, (19 July 1993) pp.1-2.

30. Information Paper, R. L. Verstraete, Acting Director, SMCRI-EH, Subject: **Flood of 1993, Media Visit**, (12 July 1993; Interview, T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993).

31. Memorandum For Record, SMCRI-CO, Subject: **Mississippi River Flood Control As of 1400 hrs, 3 July,** (3 July 1993); Interview T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993).

32. Interview, T. J. Slattery, AMSMC-HO, with D. P. Block, SMCRI-APP, (28 July 1993), Interview, T. J. Slattery, AMSMC-HO, with R. W. Emmert, SMCRI-APP, (10 August 1993).

33. Interview T. J. Slattery, AMSMC-HO, with R. E. Todd, SMCRI-EHS, (9 August 1993).

34. Interview. T. J. Slattery, AMSMC-HO with R. L. Verstraete, SMCRI-EH, (9 August 1993); Interview, T. J. Slattery, AMSMC-HO, with J.A. Thompson, SMCRI-EHS, (10 August 1993).

35. Interview, T. J. Slattery, AMSMC-HO, with J. D. Richter, SMCRI-EHS, (10 August 1993); Interview, T. J. Slattery, AMSMC-HO, with C. S. Lipovic, General Foreman, (SMCRI-AOF-FF), (12 August 1993).

36. Interview, T. J. Slattery, AMSMC-HO, with R. L. Verstraete, SMCRI-EH, (9 August 1993); Message, COL Terry L. Nienhouse, SMCRI-CO, to RIA Directors, AMCCOM Directors, and Tenants, Subject: **Flood Control Efforts,** (17:16:21 CDT, 6 July 1993).

Aerial view of RIA, looking upstream during FY 1993 flood. Note that the Arsenal's major manufacturing and storage buildings are situated on high ground.