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PERCEPTION AND REALITY CONCERNING THE 1993 MISSISSIPPI RIVER FLOOD: AN ENGINEERS' PERSPECTIVE

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DESCRIPTION OF THE EVENT

The 1993 flood affected most of the Upper Mississippi River Basin The basin drains all of part of 13 states and several Canadian provinces and encompasses 723,700 square miles above the confluence of the Mississippi and Ohio Rivers at Cairo, Illinois. The upper basin includes the Mississippi River from its source in Minnesota and the principal tributary, the Missouri River, which drains 529,300 square miles above its mouth at St Louis, Missouri, including 9,700 square miles in Canada. Other major tributaries include the Minnesota, Wisconsin, Iowa, Des Moines, and Illinois Rivers. (See Figure 1.) It is the basin where the deluge of rain and consequent record flooding occurred during the spring, summer and fall of 1993

The conditions that produced the flood began in the summer of 1992 July, September and November, 1992 were much wetter than normal in the Upper Mississippi River Basin. Winter precipitation was near normal, but a wet spring followed The period from April to June 1993 was the wettest observed in the upper basin in the last 99 years. As a result, soils were saturated, and many streams were flowing well above normal levels when summer rains began

A persistent atmospheric pattern during the summer of 1993 caused excessive rainfall across much of the Upper Mississippi River Basin. Major flooding resulted primarily from a series of heavy rainfall events over the Upper Mississippi River Basin from May to August 1993 which were unmatched in the historical records of the Central United States During the June-August 1993 period, rainfall totals surpassed 12 inches across the eastern Dakotas, southern Minnesota, eastern Nebraska, and most of Wisconsin, Kansas, Iowa, Missouri, Illinois, and Indiana Over 24 inches of rain fell on central and northeastern Kansas, northern and central Missouri, most of Iowa, southern Minnesota and southeastern Nebraska. Up to 38 4 inches fell in east-central Iowa

Wet antecedent soil, swollen river conditions, and record rainfall resulted in 1993 flood levels that ranged from below the 100-year up to the 500-year recurrence interval magnitude at many locations For example, the 1993 flood stage at Louisiana, Missouri (about 100 miles above St. Louis, Missouri), is estimated to have had a recurrence interval of nearly 500 years At St Louis, Missouri, the recurrence interval was about 175 years and at Chester, Illinois (about 70 miles below St Louis, Missouri), the recurrence interval was about 100 years.

The Flood of 1993 in the Midwestern United States was a hydrometeorological event without precedent in modern times In terms of precipitation amounts, record river levels, flood duration, area of flooding, and economic losses, it surpassed all previous floods in the United States. Floods greater than the 1993 flood will happen in the future and it would be prudent to prepare for such future floods. *U S Army Corps of Engineers (1995); U.S Government Accounting Office (1995), Report of the Interagency Flood Plain Management Review Committee to the Administration Flood Plain Management Task Force (1994); U.S Army Corps of Engineers (April 1994); Gaffney, Richard M. (1996); St Louis District, Corps of Engineers (March 1994).*

THE UPPER MISSISSIPPI RIVER FLOOD PROTECTION SYSTEM

The flood control system for the Upper Mississippi is made up of three components: flood control reservoirs, urban levees/floodwalls, and agricultural levees. There are about 60 Federal flood control reservoirs above St. Louis and about 1,600 levees. About 95% of these levees are agricultural levees (most are privately owned) providing relatively low levels of flood protection to millions of acres of cropland against floods of 10 to 50 years frequency. The remaining 5% are urban levees/floodwalls (mostly Federal) built to a very high level to protect cities and towns against floods of great magnitude. When the performance of a flood control system like this is evaluated, all three components must be considered as a whole and not evaluated as separate features.

During the 1993 flood, the Federal flood control reservoir system stored over 17 million acre feet of flood water. None of this flood water reached St. Louis until after the crest in August 1993. These reservoirs are credited with reducing flood levels at St. Louis by about three feet.

During the 1993 flood, all the levees/floodwalls built to urban design standards withstood the onslaught. No urban levee or floodwall was overtopped and the densely populated areas they protected were not flooded by the river.

As might be expected, most of the agricultural levees were overtopped in 1993 due to their relatively low level of protection. When very large floods occur, the agricultural levees overtop and this serves to reduce pressure on urban levees/floodwalls.

The flood control system on the Upper Mississippi River is a "patchwork" compared to the comprehensive system on the Lower Mississippi River, but it is still a substantial system. The Upper Mississippi River Flood Control System could not prevent all damages caused by a flood like the one in 1993, because it was not designed to do so. About 15 billion dollars of flood damage actually occurred in 1993, as much as a third of which occurred in upland areas out of the flood plain. The flood control system, however, did an excellent job and prevented 19 billion dollars of additional flood damage and averted an even worse disaster. *Report of the Interagency Flood Plain Management Review Committee to the Administration Flood Plain Management Task Force (1994); U.S. Army Corps of Engineers (April 1994).*

MEDIA COVERAGE

Media coverage of the 1993 Mississippi River flood can be characterized as being a combination of "War" and "You can't fight Mother Nature" type reporting. The July 11, 1993, edition of the New York Times noted that, "there is nothing anyone can do—people sandbagged like crazy and still lost the war". As the flood progressed, environmental and "back to nature" special interest groups persistently and efficiently presented their views to the media. Their basic view was that flood control structures were at best ineffective and at worst might be "causing the flood". Much of their view was based on little, if any, scientific evidence and when they did present evidence, it was generally of the "junk science" variety. Ironically, some of these groups also made suggestions for ways to improve flood management which were positive and promising. Their efforts, however, often seemed aimed as much at advancing their favorite long-term goals (wetlands restoration, for example) as improving flood management.

During the flood, the media seldom analyzed what was working or not working, at least in any manner understandable by the public. As a result, portrayal of the 1993 flood in the Upper Mississippi River Basin left most people with the opinion that engineered flood control systems did not work. Day after day the electronic and print media highlighted agricultural levees overtopping or farm houses being washed away by rushing floodwaters. The basic theme of media coverage after they got past the obvious human suffering and property damage, was that the flood control system wasn't working. As previously discussed, the flood control system worked very well and performed the way it was designed.

Another criticism of the coverage of the Great Flood of 1993 is that so much misinformation was generated about the flood. Most of this came about by the dissemination of "Factoids" put out by special interest groups. "Factoids" have been defined, perhaps humorously, but none-the-less appropriately, as "misleading information, presented as factual, and because of constant repetition, accepted as fact". The media often seemed most interested in

generating controversy and creating a contentious climate, apparently hoping to generate increased public interest in their reporting.

An example of this can be illustrated by how the media repeatedly used a "partial" quotation from Mark Twain. They took a famous Mark Twain quotation, out of context, in an attempt to make a point. The quotation was from his book entitled, Life on the Mississippi. The media repeatedly used the first part of that quote:

> "One who knows the Mississippi will promptly aver - not aloud, but to himself that ten thousand River Commissions, with the minds of the world at their back, cannot tame that lawless stream, cannot curb it or confine it, cannot say to it, go here, or go there, and make it obey; cannot save a shore which it has sentenced; cannot bar its path with an obstruction which it will not tear down, dance over, and laugh at."

This part of the quotation was generally used to convey the message that works of man on the rivers have been futile and unsuccessful and that further attempts are without merit. When you read the second half of Mark Twain's quote, a more positive point of view can also be supported:

> "But a discreet man will not put these things into spoken words, for the West Point engineers have not their superiors anywhere; they know all that can be known of their abstruse science; and so, since they conceive that they can fetter and handcuff that river and boss him, it is but wisdom for the unscientific man to keep still, lie low, and wait til they do it."

When you read Mark Twain's whole quotation, it appears that he was not so certain that works of man on the river were hopeless or that man's attempt to work with the river were necessarily without merit.

Why did the media end up disseminating misinformation? Why did they quote so many "factoids"? Marvin Kalb, a former NBC reporter now at Harvard University's John F. Kennedy School of Government, says, "there is a mean-spiritedness to American journalism, a desire to tear down rather than build up. You cannot even give a public official the benefit of the doubt."

Hal Bruno of ABC says, "although younger reporters today are "much smarter and much better educated, there is a lack of discipline, a laziness. Why do Americans hate the press? asks Marvin Kalb—Because they (the press) deserve it".

One of the unfortunate results of how the media covered the 1993 Upper Mississippi River Flood is that a "gap in understanding and trust" has developed between engineers and the people they serve in the Upper Mississippi River Basin. This gap may eventually result in short-sighted flood management decisions that could ultimately hurt those who can be helped the most by a well engineered flood protection system—the people who live in the Upper Mississippi River Valley. *Changnon S. (1996); Mark Twain (1961), U.S. News and World Report, (January 9, 1995 References 7, 8 and 9).*

CLIMATE AND FUTURE FLOOD PLAIN MANAGEMENT

Severe Midwest flooding in 1993 and more recently in 1995 generated hot debate about what "caused" the floods and what actions could be taken to reduce future flood problems. Some propose building many new and higher levees and more flood control reservoirs. On the other end of the spectrum are those that blame flooding on flood control structures like levees and advocate abandoning the flood plains and returning them to nature.

Some have expressed the opinion that floods seem to be more severe and more frequent than in the past. A study of flood stages at St. Louis would seem to support this view. As can be seen on Figure 2, almost 60% of all daily record high stages at St. Louis have occurred since about 1980.

Are levees, floodwalls, flood control reservoirs and other river structures built by mankind to blame for this increased flooding? Figure 3 shows over 80% of these structures were built before 1980 and construction of these

structures peaked in the 1950's and 1960's. *U.S. Army Corps of Engineers (1995); U.S. Army Corps of Engineers (April 1987); U.S. Geological Survey (1993).* It would seem likely that if these structures were primarily to blame for flood, the increase in the aforementioned record flood stages would have shown up well before 1980.

Has the loss of wetlands been the primary cause of recent higher flood stages? According to a Government Accounting Office (GAO) report, 53% of all wetlands existing in this country in 1780, have been drained. In the Upper Mississippi River Basin over 50% of these wetlands disappeared well before 1980. According to a GAO report, the rate of wetland loss has been reduced by half since wetlands protection laws went into effect about 1980. *Reuss, Martin, P.H.D., U.S. Government Accounting Office (1991); Donald L. Hey and Nancy Phillipi (March, 1995).* If loss of wetlands is the primary reason for the increase in record flood stages recently, why did this trend not start before 1980?

Other factors both natural and those caused by humans can affect flood levels: agricultural land management, urban development, flood duration, seasonal variation in vegetation, the nature of sediment carried by the river, and water temperature can all affect the peak flood levels of any particular flood. *U.S. Government Accounting Office (1995).*

None of the previous discussion is meant to diminish the relative importance of any of these issues in regard to increased flood levels. At this point, it does seem reasonable, however, to open the discussion to another possible cause of increased flood levels—one of a broader nature.

For purposes of discussion, let us consider the possibility that the upsurge in flood levels in the last 15 years might be tied to a wetter weather cycle and not primarily due to the presence of levees, wetland losses, or any of the other parameters previously mentioned. The Midwestern United States is at the end of a "Global Weather Pipeline". Weather systems travel around the globe in a very complicated and variable pattern before they arrive over us and produce benign or adverse conditions. Weather cycles are a natural phenomenon and while there may be differences of opinion as to how much mankind may be affecting these cycles, now and in the future, there is no doubt the weather cycles exist.

Variation in our weather has been attributed to many things:

- Changes in the position of the jet stream
- Air pollution
- Volcanic eruptions
- Sun spots
- Solar retrograde motion
- Solar flares
- Global warming
- El Nino
- Natural long-term weather cycles
- Hole in ozone layer

We should be careful about making decisions on future flood plain use, based only on two recent, large and widely reported floods.

We must keep in mind what the basic cause of flooding is–RAIN!! We must develop flood plain strategies that allow us to cope with cycles in future weather patterns with perhaps wider extremes of "wet" and "dry". *Daniel Glick and Adam Rogers (January 22, 1996); Jessica Matthews (1995).* This will require using all the "tools" at our disposal to minimize flood damage; but at the same time, we must resist quick fixes and one-dimensional solutions. A reasonable approach might include:

- Removing non-essential uses from the flood plain and preventing future unnecessary uses. This will reduce future flood damages.

•Where appropriate, flood control dams, floodwalls and levees, especially in urban areas, can provide effective engineering solutions to flooding problems and so will continue to be necessary. They must, however, be designed to safely handle possible wider fluctuations in weather over the long period of their life.

•Restoration of flood plain wetlands, where appropriate, can reduce flood damages at that specific location where the restoration occurs, provide biotic habitat, and help filter polluted water. Upland wetlands restoration can provide some flood control for small floods.

Making common sense, long-term decisions on flood plain usage can allow us to live with whatever flooding conditions "Mother Nature" throws at us in the future. We may have little control over flooding, but we can learn to wisely live with it and minimize damages from it. *Report of the Interagency Flood Plain Management Review Committee to the Administration Flood Plain Management Task Force (1994).*

CONCLUSION

The flood control system in the Upper Mississippi River Basin worked well during 1993; and, in fact, the overall flood control system of the United States has paid for itself seven times since 1983. As in any natural disaster, lessons have been learned from the 1993 flood that can be used to improve the existing structural flood control system. On the other hand, certain so called nontraditional flood management techniques appear to need more emphasis. Techniques such as improving flood forecast methods, flood proofing, and/or controlling what is built in flood-prone areas should be included as tools used to reduce future flood damages.

After the 1993 flood, as in the aftermath of other recent worldwide disasters, such as earthquakes, hurricanes and even terrorist attacks, the engineering profession received little credit for past design efforts which reduced loss of life and property damage. In some instances, the engineering profession was criticized for the adequacy of these efforts. Eugene Fasullo, Chief Engineer for the New York and New Jersey Port Authority and technical spokesman after The World Trade Center explosion, believes that engineers "have to project the true value engineering adds to society".

It is unrealistic to expect the media, elected officials and the general public to make the effort required to understand the concepts and benefits of well-engineered structures and infrastructure. The engineering profession itself must learn to communicate better with the general public and explain to the decision makers in government what we do and why we do it. Engineers must get more directly involved in local and national government either as elected officials or advisors to insure that the engineering viewpoint is properly considered during public debate and decision making on issues that affect public health and safety. If we don't do it, others will speak for us and we increasingly run the risk of becoming an "irrelevant" profession. If that happens, the general public will suffer in the long run.

It is the responsibility of the engineering profession, not the media or other non-technical groups, to ensure that public policy and decision making is based on sound engineering principles and good engineering judgment. *Engineering News Record (June 5, 1995).*

NOTE: The views expressed in this paper are the authors' views and are not necessarily those of the U.S. Army Corps of Engineers.

Upper Mississippi River Basin

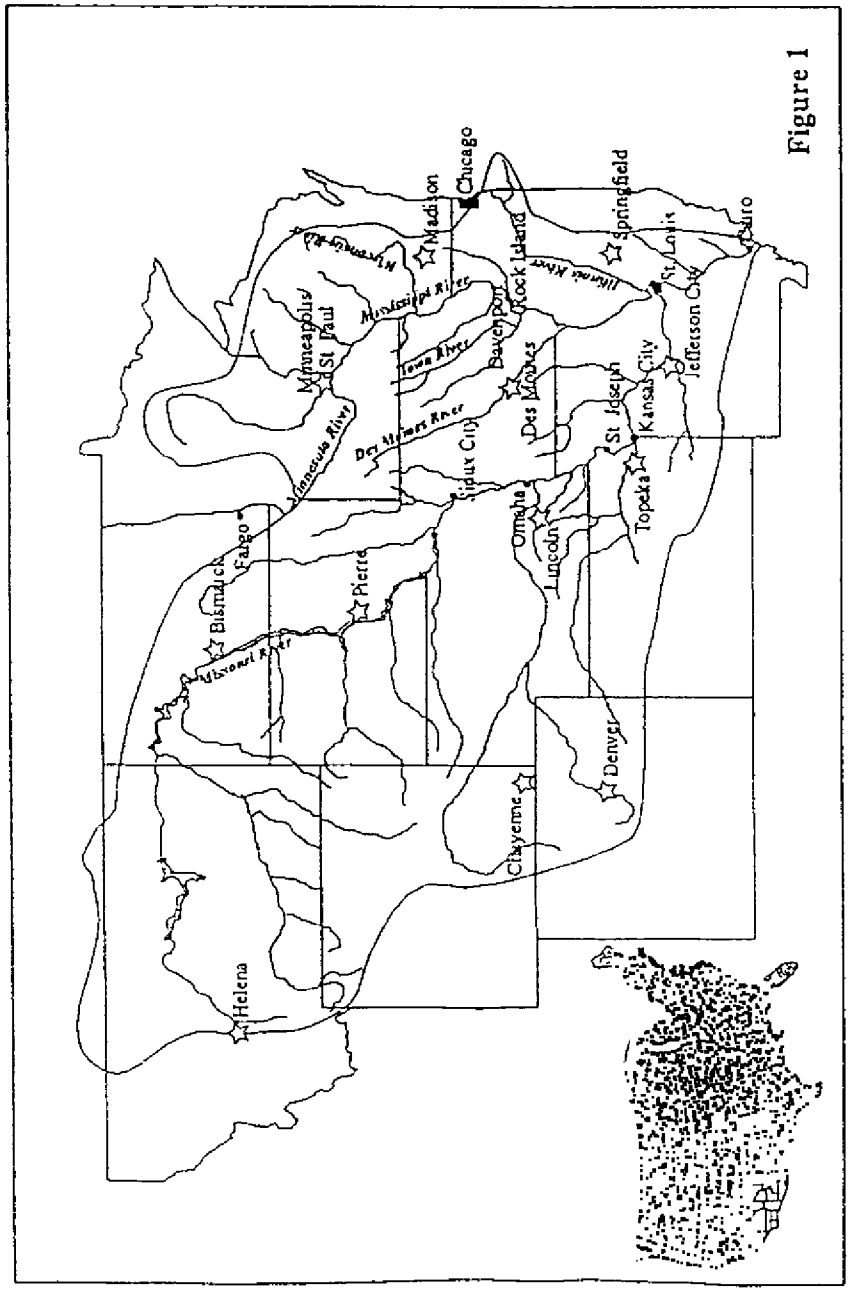
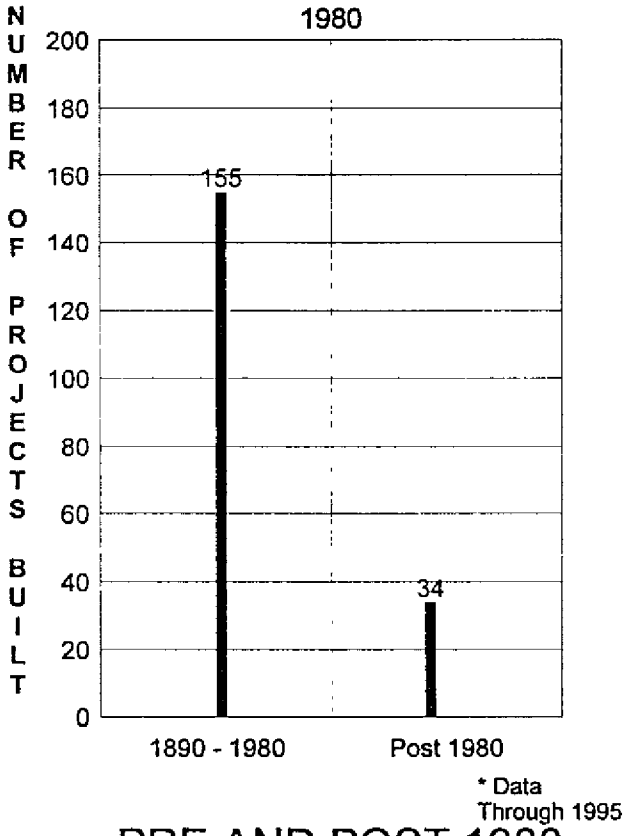


Figure 1

UPPER AND MIDDLE MISSISSIPPI AND MISSOURI RIVERS

FLOOD CONTROL PROJECTS (1)

(A Cumulative Analysis)



PRE AND POST 1980

(1) Includes flood control reservoirs and urban and agricultural flood protection works.

FIGURE 2

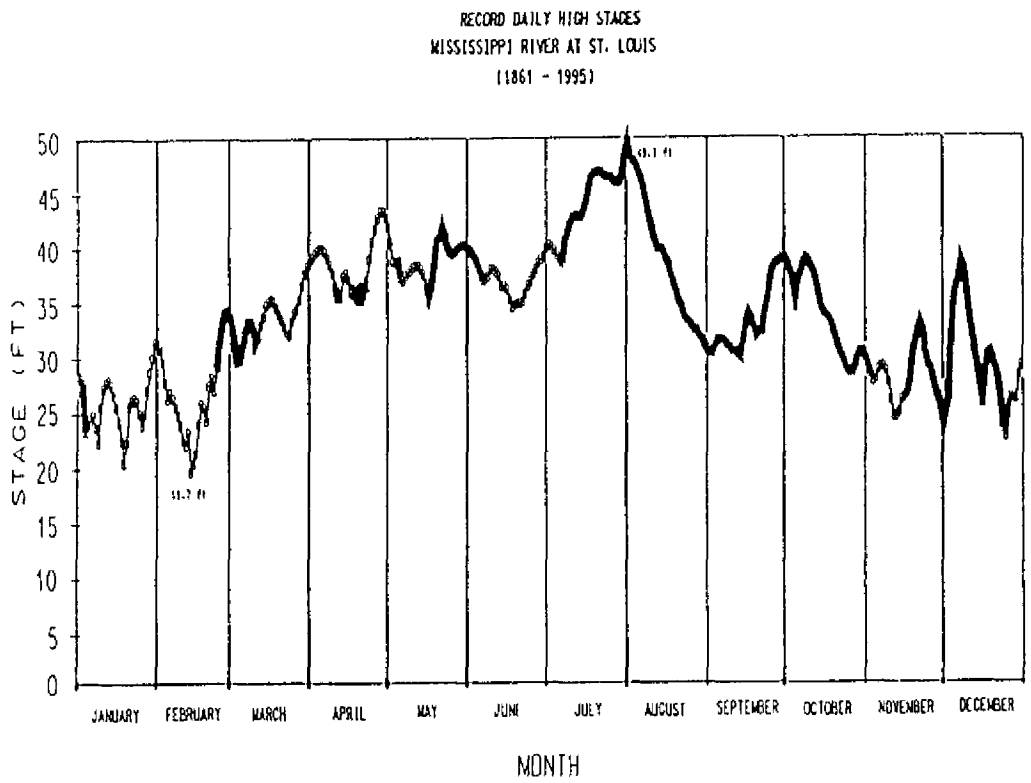

RECORD DAILY HIGH STAGES
MISSISSIPPI RIVER AT ST. LOUIS
(1861 - 1995)
STAGE (FT)
50
45
40
35
30
25
20
15
10
5
0
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MONTH
O - RE · HIGH STAGES BEFORE 1980
X - RE. HIGH STAGES AFTER 1980
57% of Records Set After 1980

FIGURE 3

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