BENDWAY WEIR DESIGN MANUAL

US Army Corps
of Engineers

BENDWAY WEIR DESIGN MANUAL

U.S. Army Corps of Engineers
St. Louis District
Engineering Division
Potamology Section

CONTENTS

FOREWORD

This information package was put together in a conscience effort to help others interested in the Bendway Weir concept. Although there are still some lessons to learn, the St. Louis District feels confident that the current design approach can be applied in a quick, efficient, and cost effective manner.

The goal of this package is to examine all of the variables that have been discovered to date, including optimum design, construction techniques, prototype evaluation, international research, and future considerations as they relate to the Mississippi River.

Hopefully, one can take the information contained within this package and design and construct a series of Bendway Weirs. The concept may be applied under any scale conditions, whether it be a small creek channel to a very large Lower Mississippi River channel.

Finally, any additional information or detail may be obtained upon request from this office by calling or writing to:

U.S. Army Corps of Engineers
St. Louis District
Potamology Section
1222 Spruce Street
St. Louis , Missouri 63103-2833
Phone 314-331-8348
Fax 314-331-8346

I. Recent Summary for Corps of Engineers Design Award Submitted December 1990.

NARRATIVE

1. **Name and Project.** The Bendway Weir. Construction General Funding.

2. **Location.** Middle Mississippi River, Dogtooth Bend Reach, Mile 24.0 to Mile 22.0.

3. **Program and Solution.** A problem of great magnitude exists on many of the bendways in the Mississippi River. Many of the point bars encroach into the navigation channel. This creates a very deep, narrow, and fast navigation channel through the bend. The barge tows have to slowly flank through the bend to avoid groundings. This sets up the potential for a bottleneck at any given bend. Long delay times, some up to 12 hours, have occurred in these bends. Also, accidents have resulted from tows grounding on these point bars. When one considers the number of narrow bends and the volume of traffic that exists over the entire waterway, it becomes obvious that these delay times incur massive costs (estimated at close to 60 million dollars in 1988 alone) to the towing industry, the federal government, and ultimately to the consumer. The Corps annually dredges millions of cubic yards of material at these point bars to try to compensate for the width inadequacies. Unfortunately, the point bars periodically reform. This leads to continual repetitive maintenance dredging costs which additionally burden the taxpayer.

In addition, overbank scour holes are formed on the outside of many of these bends during high flows. These holes are formed as a result of deflection flow patterns developed from poorly defined alignments with multiple radii. The scour holes destroy farmland and encourage river cut-off formation.

In the past, three-dimensional flow, or the secondary current through these curved reaches of river, introduced hydraulic dynamics that could not be addressed by traditional channel improvement structures. The Bendway Weir is a new non-traditional structural solution to bendway problems. This solution has been researched, model tested, and constructed in a prototype reach of the Middle Mississippi River.

The Bendway Weir is a level crested, submerged rock weir that is actually directed upstream toward the main flow. This is contrary to traditional structures such as dikes that are normally built at much higher elevations and placed perpendicular or angled downstream to the main flow. Built in series, the Bendway Weir widens the navigation channel throughout the bend, stabilizes the toe of the outside bank, and improves the downstream crossing channel. The structure also redirects detrimental deflection flow patterns that form the overbank scour holes.

A total of 13 weirs have been constructed in Dogtooth Bend, mile 24.0 to mile 22.0. This work was completed in November of 1990.

The construction of the Bendway Weirs was a difficulty overcome by innovative construction methods. The main consideration was placing the rock underwater in the fast, deep bendway channel. Both the final alignment and height of the structures were critical. This problem was overcome by using velocity meters and sounding equipment to determine the offset distance upstream that the rock actually needed to be dropped in the river. By constantly monitoring velocity and depth, the Bendway Weirs were built rapidly and efficiently in the correct alignment and height. The number of days it took to place the 13 weirs in Dogtooth Bend was only 76 days, or about 6 days per structure.

4. **Cost Information.** Total cost of the 13 weirs placed in Dogtooth Bend is $2,000,000, or $154,000 per structure. Costs associated with delay times in bends are estimated at approximately $60,000,000 per year. The cost of dredging in these bends to maintain a less than stable channel average approximately $1,000,000 per year within the St. Louis District alone.

5. **Innovation.** The Bendway Weir creates a man-made torque force to counteract the natural torque force developed by the water flowing through a curved reach of river. The result is the redistribution of sediment throughout the bendway. Under natural conditions, sediment deposition occurs on the inside of a bend thereby forming a point bar. The Bendway Weir forces deposition to occur on the outside of the bend. This not only widens the navigation channel, but stabilizes the toe of the outer bendway bankline.

User satisfaction. The St. Louis District has been surprised at the rate of success the 13 Bendway Weirs
ıdy shown in the prototype. Just 2 months after construction, the point bar has been significantly
.o the advantage of navigation. Also, the velocities have slowed considerably through the bend, and
industry personnel have commented on the relative ease of steering through the navigation channel
e of the reduced velocity conditions.

7. **Compatibility.** The direct positive impacts of the Bendway Weir are extensive. Because the navigation channel is widened, the towing industry is now able to steer quickly through the bend instead of having to flank, thereby avoiding delays and groundings. The Bendway Weirs are submerged deep in the channel, allowing the passage of traffic over the tops of the structures at all flow conditions. They also improve the downstream crossing channel, saving additional dredging costs. Detrimental deflection flow patterns that form the overbank scour holes are directed away from the outside of the bend toward the middle of the channel. This protects against overbank cutoff formation and farmland destruction.

The overall velocities in the bend are reduced after weir placement. This saves fuel costs and increases the control of the tows through the bend.

8. **Siting.** The project was sighted at Dogtooth Bend because this particular bendway has one of the worst navigation alignments on the Middle Mississippi River.

9. **Technology and Energy Conservation.** There are unique features associated with these structures. The first feature is that the structures are very deep in the bend and designed to have at least 15 feet of water above them during low flow. This enables the structures to be placed directly in the navigation channel without inhibiting traffic.

Secondly, the structures are pointed upstream and attached to the outside of the bendway bank at an angle of 30 degrees to a line drawn perpendicular to flow. This angle minimizes any structural damage because the Bendway Weir actually cuts upstream into the direct flow attack. Traditional structures such as dikes are normally angled perpendicular or downstream to the flow. They are subject to periodic maintenance costs because they take more of a direct impact from the flow attack.

10. **Environmental Impact.** The environmental aspects of the Bendway Weirs are:

- The widening effect in the bend creates a greater amount of water surface area. This decreases the hydraulic radius of the channel cross section, leading to a drastic improvement in the riverine habitat and total ecosystem throughout the bend.

- The placement of the Bendway Weirs in the deep channel side of the bend means that no traditional channel improvement structures will have to be built across the sand bar. This preserves habitat for an endangered species of bird, the least tern. This bird nests and lays its eggs on the open sand bar. They are very vulnerable to nest killing from predators and All Terrain Recreational Vehicles. These sources of habitat destruction gain access to the sand bar from the inside bank of the bendway by route of high, attached bar dikes and side channel closure structures. By building Bendway Weirs in the opposite deep channel, sand bar access and the resulting disturbance is eliminated.

- Deflection of overbank flow patterns from the Bendway Weir preserves wetland habitat in the floodplain that would otherwise be subjected to overbank scour.

- Elimination of most of the dredging through these bends means a direct positive environmental impact. The sediments through the bend can now be managed naturally instead of artificially by dredge.

- Because the Bendway Weirs are always submerged, the structures aesthetically preserve the natural beauty of the scenic waterway.

11. **Accessibility for Handicapped.** Not applicable.

12. **Summary.** The Bendway Weir offers a low cost structural technique to eliminate bendway problems and enhance the environment, and has been recognized internationally by the Permanent International Navigation Congress as having applications to both developed and developing nations throughout the world.

II. Article Presented in Osaka, Japan at the 27th Congress of PIANC and Recently Published in PIANC Bulletin 69.

BENDWAY WEIRS, A NEW STRUCTURAL SOLUTION TO NAVIGATION PROBLEMS EXPERIENCED ON THE MISSISSIPPI RIVER *

by

Robert D. DAVINROY, River Engineer
U.S. Army Corps of Engineers, St. Louis District, 210 Tucker Boulevard North, St. Louis Mo. 63101 (U.S.A.)

ABSTRACT

A problem of great magnitude exists in many of the bendways on the Mississippi River. A large number of point bars are encroaching into the navigation channel, causing tremendous delay times to the towing industry. Millions of cubic yards of material are being dredged each year at these point bars. Overbank scour holes on the outside of these bends are forming during high flows, destroying farmland. These sensitive problems have not been effectively addressed in the past. Examining the problem sources in the bendways can help to achieve a final structural design solution. The problem sources are a combination of morphology, hydraulics, and man-induced constraints.

The complexities of river mechanics in bendways have always perplexed river engineers. Three-dimensional flow through curved reaches introduces problems that cannot always be addressed by «traditional» training structures. A new «non-traditional» structural solution to bendway problems has been discovered which has been model tested and constructed in a prototype reach of the Mississippi River.

The structures are bendway weirs. They are level crested, totally submerged rock weirs that are directed upstream at an angle of 30 degrees to the perpendicular midbank flowline. Built in series, they widen the navigation channel through the bend and improve the downstream crossing. They also redirect detrimental high flow velocity patterns.

Bendway weirs will be used extensively in the future on the Mississippi River. The design principle may be used in straight reaches as well. The structures may also be scaled down and applied in many types of tributary and/or small stream bendways.

SOMMAIRE

Un problème de grande ampleur se rencontre fréquemment dans les courbes du système de navigation du Mississippi. Un grand nombre de seuils empiètent sur le chenal de navigation, causant des retards énormes dans l'industrie du transport par eau. Des millions de mètres cubes de matériau sont dragués chaque année sur ces seuils. Lors des crues, des fosses d'affouillement se forment derrière les rives et détruisent les terrains arables. Il n'a pas été remédié de façon efficace à ces problèmes délicats dans le passé. L'examen de l'origine du problème dans les courbes peut aider à apporter une solution de conception structurelle définitive. Le problème découle d'une combinaison de contraintes morphologiques, hydrauliques et induites par l'activité des hommes.

La complexité de la mécanique des fleuves dans les courbes a toujours rendu les ingénieurs perplexes. L'écoulement tridimensionnel dans les courbes comporte des aspects qui ne peuvent pas toujours être compensés par des aménagements «traditionnels». Une nouvelle solution structurelle «non-traditionnelle» a été trouvée, testée sur modèle et construite dans une section-prototype du Mississippi.

Il s'agit de barrages de courbe, consistant en digues en enrochements à crête plane totalement immergées, orientées vers l'amont à un angle de 30 dégrés à la perpendiculaire du plan d'eau moyen. Construits en série, ces barrages conduisent à l'élargissement du chenal de navigation dans la courbe, ainsi qu'à l'amélioration de la section aval. Ils réorientent aussi la direction des courants de crue défavorables.

Dans l'avenir, les barrages de courbe seront utilisés abondamment sur le Mississippi. Leur principe de conception peut être appliqué aussi dans les sections droites du fleuve. A échelle réduite, ces structures peuvent être utilisées dans les courbes de divers types d'affluents et/ou de petits cours d'eau.

KEYWORDS

Navigation, point bars, delay times, overbank scour holes, river mechanics, three-dimensional flow, bendway weirs.

MOTS-CLEFS

Navigation, seuils de courbes, retards, fosses d'affouillement derrière les rives, mécanique des fleuves, écoulement tridimensionnel, barrages de courbe.

* This article has been awarded the Gustave Willems Prize for 1990.

INTRODUCTION

The United States, in its quest for the development of a permanent inland waterway navigation system on the Mississippi River, has overcome great obstacles in its efforts to ensure the safe and efficient transportation of waterborne commerce.

The main consideration in the development of a navigation system on a river as dynamic as the Mississippi is man's ability to transform the tremendous energy forces that are available into an accepted economical, environmental and social coexistence. With the vast amount of regulatory works installed throughout history, including the construction of locks and dams, dikes, revetments, etc., and the employment of dredging works, the Mississippi River has been, for the most part, successfully managed to ensure efficient channel depths from the Gulf of Mexico to Minneapolis, Minnesota, a total distance of 2,972 kilometers.

Yet, there are still energy forces in the river that are having massive economical, social and environmental consequences. These energy forces are located at bendways, the important geomorphic channel configurations of a river that are a result of Mother Nature's natural, sinusoidal response to water and sediment management in an alluvial floodplain.

Bendways are one of the last remaining sources of energy on the Mississippi River that have not been fully managed by man. They serve as necessary and natural flow management devices of the river, but they also lead to many negative impacts, including erosion of banklines, inadequate channel widths, excessive downstream channel crossing deposition, cutoff development, detrimental high flow velocity patterns, destruction of farmland and levees, and the loss of wildlife habitat. All of these problems directly impact the economy and the environment.

The bendway weir is a new structural design solution developed to minimize or alleviate the problems generated in bendways on the Mississippi River. They are cost-effective submerged rock structures. When properly designed and constructed, they can effectively manage the water and sediments through a bendway while still maintaining the integrity of the natural sinusoidal channel pattern. The direct physical attributes of bendway weir design include: a widening of the existing narrow navigational channel, a deepening and corresponding improvement of the downstream crossing channel, stabilization of the existing bankline, and redirection of otherwise detrimental high flow velocity patterns. Also, bendway weirs are low-elevation structures. They are totally submerged underwater, thereby maintaining the natural beauty of the scenic waterway.

Physical model tests to develop and evaluate the design of these new structures have been extensively conducted on a movable bed model of a selected prototype reach.

Construction of the first bendway weir has been completed on the Mississippi River, and post construction field monitoring has indicated favorable velocity and bed sediment trends have been established in the river channel.

It is the goal of this article to first discuss the problems that exist in bendways on the Mississippi River; secondly, to outline the sources of these problems; thirdly, to discuss the research and development of a structural solution gained by model testing; and finally, to describe the actual construction and field monitoring that has been completed in the river.

BENDWAY PROBLEMS

The negative impacts of bendways are discussed to make one aware of the magnitude and extent of the problems currently being experienced on the Mississippi River.

1. NARROW BENDWAY WIDTHS

Many of the bendways in the open river system below St. Louis, Mo., create a major problem to the navigation industry. The problem is inadequate navigation channel widths. The navigation channel becomes so narrow through a bend that a downbound barge tow has to expend a tremendous amount of time and energy using skilled flanking techniques to safely navigate through the bend. It is not uncommon for a tow to take up to three hours to transit through a troublesome bend. This undesirable channel condition usually takes place after a high water event on the river followed by a corresponding fast recession of the hydrograph. The end result is a narrowing of the navigation channel. Fig. 1 illustrates excessive narrowing of the navigation channel at Dogtooth Bend (located 256 kilometers below St. Louis). While a downbound tow is flanking through the bend, any upbound tow has to wait until the downbound tow is safely through the bendway. Depending on how much downbound traffic exists on a particular day, the wait could be as long as 12 hours. When one considers the number of bends and the volume of traffic that exist over the entire length of the waterway, it becomes obvious that these traffic delay times create massive costs to the towing industry and ultimately to the consumer. In 1988, an investigation was made to assess the cost of delay times impacted to the navigation industry. Examination of daily navigation logs of a particular towing company led to a determination of the average delay time per trip due to narrow bends. Also, the hourly towing cost and average daily traffic volumes were calculated. Based on this information, the impact cost of delay time due to bends in 1988 was estimated to be approximately $ 24 million. In 1988 there were no high flow events on the Mississippi, so there was no excessive narrowing of the navigation channel. A year with a fast falling, high flow hydrograph would add considerably to the above estimated cost.

Another impact cost to the navigation industry is the number of accidents that occur at these bends due to groundings. From 1985 to 1988, in the reach of the river from St. Louis to Cairo, Ill., there were an average of 20 groundings per year that occurred in bends. A large majority

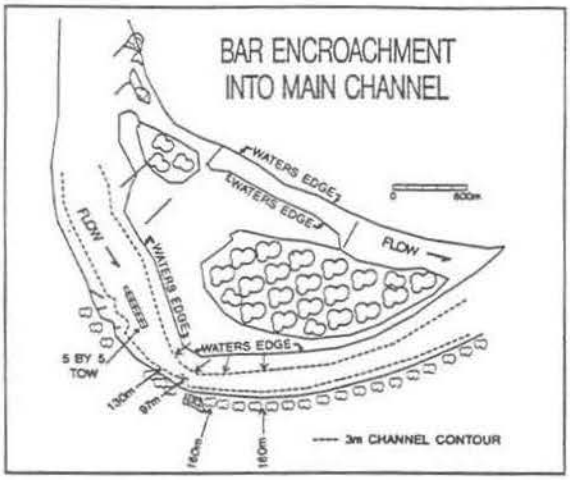

Fig. 1 - Excessive narrowing of navigation channel at Dogtooth Bend

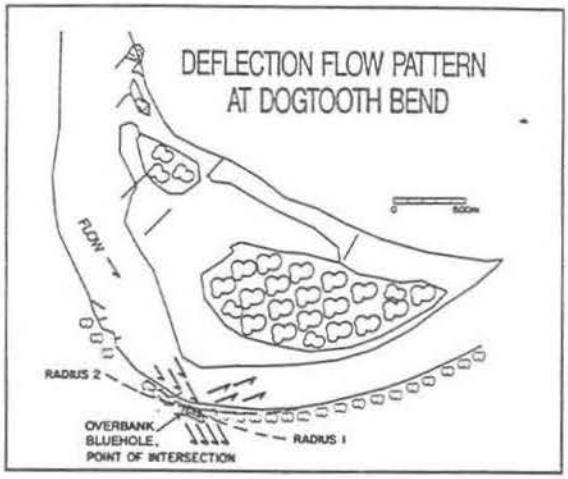

Fig. 3 - Illustration of deflection flow patterns at Dogtooth Bend

of these events were the result of barges running aground on the point bars. Each time a barge grounding occurred in a bend, the following circumstances usually took place :

a. The integrity of the navigation channel was threatened because the actions necessary to remove the tow were often injurious to the channel.
b. The bendway became a bottleneck until the grounded vessel was removed, adding further to delay times.
c. The safety of the crews on-board both the grounded vessel and the vessels passing the accident was threatened.

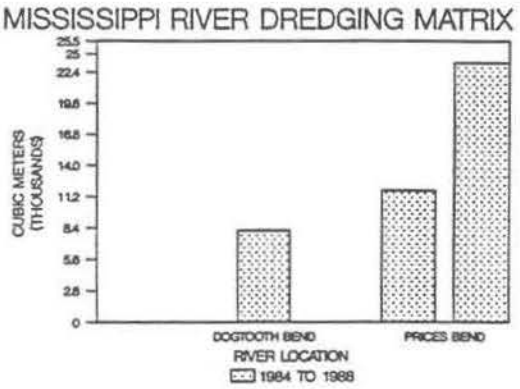

Fig. 2 - Dredging matrix showing amount of material removed at two bends on the Mississippi River

Additionally, the United States spends millions of dollars each year dredging the point bars at these troublesome bends. Fig. 2 is an example of the quantity of dredged material removed at two bends in the Mississippi. The frequency of this dredging occurs on an interval dependent upon the behavior of the hydrograph and the availability of dredges. Dredging of point bars serves as a short, temporary cure to the sympton, but it is not a permanent cure to the problem.

2. OVERBANK DEFLECTION FLOW

At bankfull conditions in some bends, a phenomenon occurs which leads to excessive overbank scour. The phenomenon is deflection flow, the detrimental velocity pattern developed as a result of a stabilized, multiple radii bankline alignment. The deflection occurs at the intersection point of two different outside bank radii. Instead of the velocities flowing in a curved, uniform pattern around the bend, they actually deflect off the high bank at the point of intersection. The problem is exaggerated when treeline protection on the riverbank is removed or nonexistent, as is the case at Dogtooth Bend on the Mississippi River. Figure 3 illustrates the deflection flow patterns at Dogtooth Bend. An overbank scour hole (commonly referred to as a bluehole) has formed behind the bank, and with time, a crossover channel could develop over the floodplain at this point.

BENDWAY PROBLEM SOURCES

A straightforward discussion into the problem sources of bendways can lead to a better understanding of what is required for a systematic design approach. The sources listed here are in order of importance.

1. MEANDERING PROCESS AND CAPTURED ALIGNMENT

Fig. 4 is a morphological depiction of the meander belts of the Mississippi River between Thebes Gap and its confluence with the Ohio River. Before the intervention of man, the floodplain consisted of alluvial deposits which contained primarily marshlands, swamps and prairies. Except for various geologic controls like Thebes Gap (shown in the upper left of the photo in Fig. 4), the river . meandered across the floodplain unrestrained. Then, as man took advantage of the fertile soil and began cultivation, the need for protection against erosion dictated the installation of bank stabilization. In the 1920's, the early revetment works in the bendways were initiated. These works were built with hand-placed cobblestone, and eventually evolved into the

present day revetment practices. Gradually, the once continually meandering river was becoming harnessed. The early economic demands for stabilization influenced the engineers to stabilize the natural existing alignments of the bends. Unfortunately, many of the bends were in transition, containing multiple radii, and the resulting captured alignment of the bend was not conducive to a favorable navigation channel.

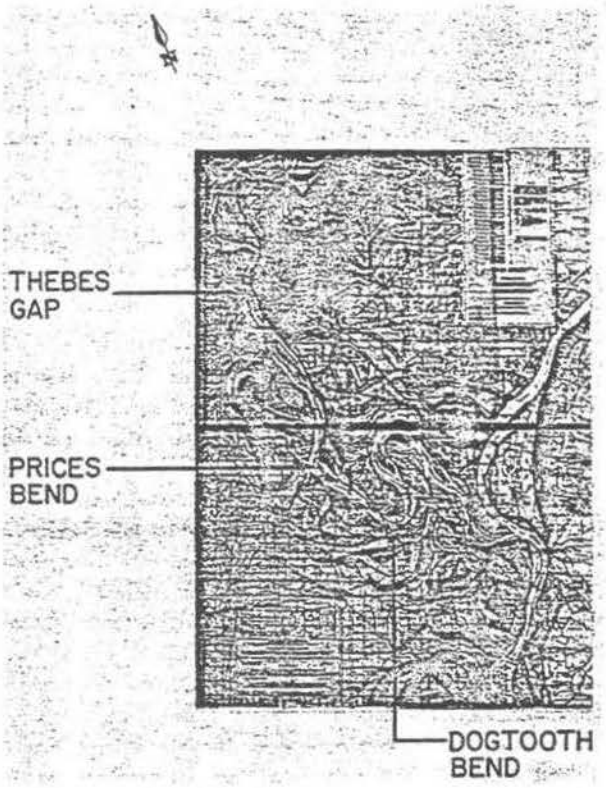

Fig. 4 - Historic Mississippi River meander belts, Thebes Gap to the confluence with the Ohio River

2. CHANNEL AND POINT BAR MIGRATION

The stationary revetted bankline and resulting captured alignment of a bendway causes problems that were not totally understood by the early engineers. Channel and point bar migration conditions have been totally changed. Fig. 5 illustrates channel and point bar migration for a theoretical unstabilized bend vs. an actual stabilized bend on the Mississippi River. Boxes 1A and 1B typify original bendway conditions. At Dogtooth Bend, revetment has been placed on the right descending bank. 2A shows the theoretical outward migration of the channel and point bar in an alluvial floodplain. The left and right descending banks migrate outward from the base of the point. The right bank migrates by erosion and bank caving, while the left bank migrates by deposition. In 2B, the right bank does not migrate outward from the point base because of the revetment. Instead, by conservation of energy and the centrifugal bend force, the river diverts its restricted horizontal energy into vertical energy, resulting in a deepening of the channel. The left bank continues to migrate by deposition, thus, the point bar actually encroaches into the channel, conversely narrowing the navigation channel. 3A shows that, during highbank flows, a cutoff occurs at the narrow neck formed a comparatively short distance from the base of the point. This cutoff is a result of headcutting and scour. The cutoff, or chute, is not well aligned with the channel upstream and downstream. This poor alignment and the extreme slope through the chute forces the principal currents to adhere toward the side of the chute against the base of the point, in the case of 3A, the left bank of the chute. As a result, the chute scours to correct the poor alignment, and with time, eventually evolves into the main channel, while the old bendway evolves into an oxbow lake (4A). In 3B, the chute has formed and the point bar continues to encroach into the main navigation channel by deposition. Eventually, the bendway becomes the chute, while the cutoff chute becomes the main channel (4B).

Field monitoring conducted on the Mississippi River, including surveys, discharge measurements, and visual observations have verified that many of the side chutes are enlarging and many of the main channels are decreasing in size.

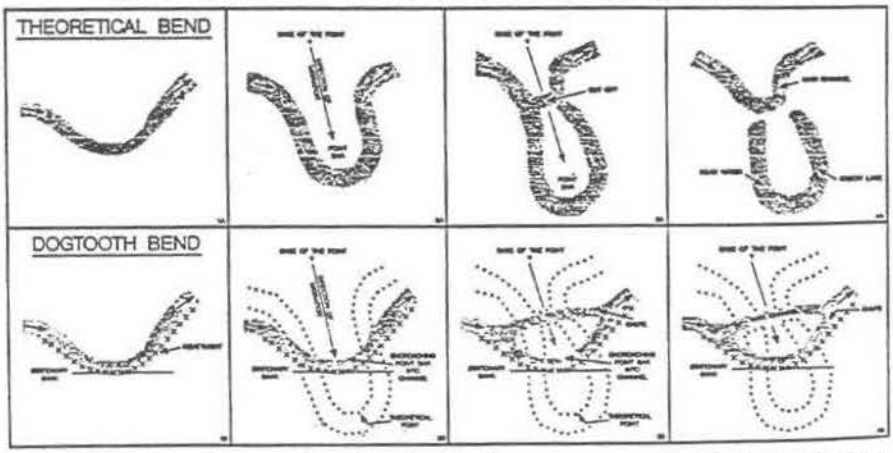

Fig. 5 - Channel and point bar formation, evolutionary steps, theoretical vs. prototype conditions

3. BENDWAY MECHANICS

The study of bendway mechanics involves complex, three-dimensional flow analyses. Fig. 6 depicts a three-dimensional bend flow element. Besides the normal and lateral velocity components which occur at a bend, transverse velocity components occur as well. This transverse velocity, or secondary flow, spirals about the channel cross-sectional axis. This spiraling effect is a direct result of the torque established from the centrifugal force action of the water flowing around the curve of the bend. Straight reach mechanics are much easier to manage than curved reach mechanics because the centrifugal force action is minimal. A channel cross section in a straight reach is made up of a series of manageable secondary cells. The simple conveyance equation applies, and the overall navigation depths and widths can usually be managed by « traditional » dike structures. However, in a bendway, the centrifugal force is so great that the conveyance equation does not apply, and « traditional » structures do not always work.

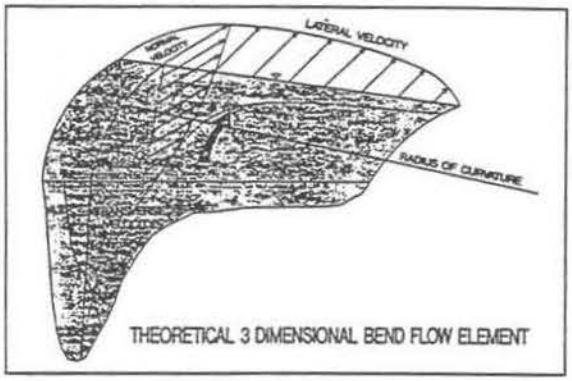

Fig. 6 - Three-dimensional bend flow

In a bend, two predominant secondary cells normally exist: the centrifugal force cell and the bankline friction cell. The cells spiral in opposite directions to each other. The bankline friction cell is of a very small magnitude in comparison to the centrifugal cell. The interface of the two cells forms the threadline of the flow in the channel (channel thalweg). If a structure could be placed in the bend that would increase the friction cell and decrease the centrifugal cell, then the threadline would be moved away from the outer bank and shifted toward the inner bar. This shift in the threadline would, in time, widen the navigation channel.

HYDRAULIC MODEL TESTS

1. STUDY REACH AND MODEL DESIGN CONSIDERATIONS

Fig. 7 shows an aerial view of a 31-kilometer study reach of the Mississippi River containing two problem bends, Prices and Dogtooth Bends. A model of the movable bed type was constructed of this reach. Granulated coal with a specific gravity of 1.3 and a median diameter of .635 cm was used as a bed medium. The horizontal scale was 1 : 400; the vertical, 1 : 100, for a 4 to 1 distortion ratio. Fig. 8 is a view of the model, looking downstream. The design hydrograph was determined by the author using historical records and mathematical model computations.

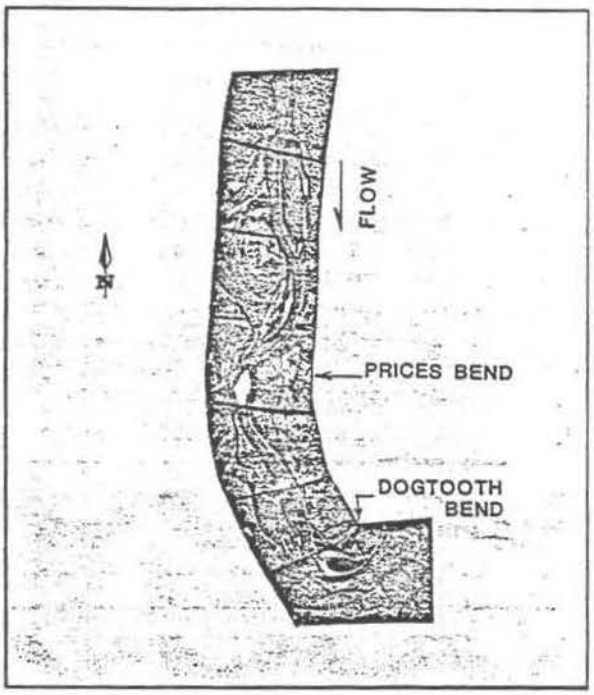

Fig. 7 - Aerial view of model study reach

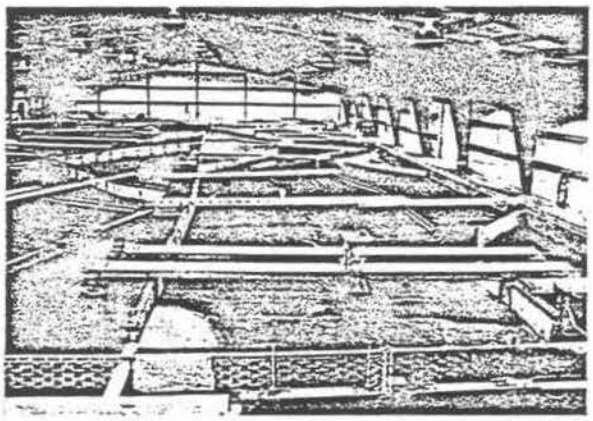

Fig. 8 - View of movable bed model

Successful verification of the model was achieved. Five consecutive design hydrographs were run to develop base test conditions. The base test is the comparative test which shows the tendencies of the river with existing conditions. Results of this test indicated that both of the bends had a tendency to narrow and deepen, and the depths of the crossing channel between the bends had a tendency to shoal.

On the Mississippi River, navigation channel design elevations are established in relation to the Low Water Reference Plane (LWRP). LWRP is a theoretical reference profile of the river based upon historical hydrologic data. A depth of 3 meters below the LWRP is the standard minimum design depth for the navigation channel. Survey contours developed on the model are thus referred to this LWRP datum, and the -3 m contour represents the design channel.

2. ATTEMPTED STRUCTURAL SOLUTIONS

The goal of the model tests was to arrive at a practical and cost-effective solution to the problem sources, hence many different structural alternatives were studied. A picture of the attempted structural solutions is shown in Fig. 9. Structures that did not benefit served as a lesson and helped in the formulation of new alternatives. The attempted structural solutions were :

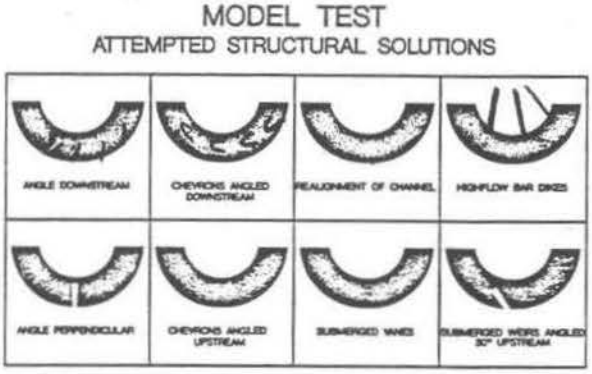

Fig. 9 - Attempted structural solutions in model study

a) DIKES LOCATED ON THE OUTSIDE OF THE BEND, ANGLED DOWNSTREAM

This plan had no effect on deflecting velocity toward the point bar; instead, velocities were actually deflected in toward the revetted bank, threatening the integrity and stability of the bank.

b) DIKES LOCATED ON THE OUTSIDE OF THE BEND, ANGLED PERPENDICULAR

This configuration had no effect on the existing channel, however, deflection flow patterns were minimized.

c) CHEVRONS ANGLED UPSTREAM AND DOWNSTREAM

The chevron (a flow dividing structure) had no effect on the point bar. They moved velocities in toward the outside bank, thereby threatening stability.

d) REALIGNMENT OF THE CHANNEL

Several different realignments of the channel were tested. Redevelopment of the upstream entrance channel had little effect on creating desired conditions in the bend. A constant radius alignment was also constructed through the bend and achieved some desirable results. However, major channel realignment is deemed cost-prohibitive.

e) SUBMERGED VANES

Submerged vanes developed by the University of Iowa were tested. Although they caused a small quantity of deposition to occur on the outside of the bend, they had little effect on attacking the point bar. More research and development on submerged vanes in navigation channels should be conducted in the future.

f) HIGHFLOW BAR DIKES

Dikes located on the point bar itself were tested. They had no effect on widening the channel, but they did seem to inhibit the tendency for cutoff development in the side chute.

g) SUBMERGED WEIRS ANGLED 30 DEGREES UPSTREAM

This plan showed very desirable results, as discussed further in this article. Evolution of this concept plan was as follows :

3. EVOLUTION OF BENDWAY WEIR DESIGN CONCEPT

The design concept for bendway weirs evolved from a previous model study on dike configurations in near straight reaches of the Mississippi River. In the study « Hydraulic Design of River Training Structures in Crossings » (WES 1989), various angles, both upstream and downstream were evaluated. There appeared to be some promise to upstream-angled dikes in straight reaches. The only skepticism that remained was if the concept could work in a bend, since the structures would have to be submerged in order for traffic to be able to pass through the bend. Results of this model study indicated that a dike angled upstream 45 degrees to the perpendicular flowline proved to be undesirable because the scour generated on the upstream face of the structure was so great that the stability of the entire structure was jeopardized. Dikes angled 20 degrees upstream to the perpendicular flowline generated so little scour action that the benefits were minimal. With this information, the bendway weir was developed with a compromised, upstream angle of 30 degrees to the perpendicular flowline. This angle proved to be extremely efficient.

4. BENDWAY WEIR MODEL TEST RESULTS

A total of 20 bendway weirs were placed in the two bends of the model study reach. Each weir was attached to the existing outside bankline and angled upstream 30

degrees to a line drawn perpendicular to the midbank flowline. The structures were constructed level crested with a top elevation of 5.49 meters below the LWRP.

Fig. 10 shows the survey comparisons for the model test results of the most upstream bend in the model study reach, Prices Bend. The base test represents the « before » conditions of the channel. The calculated radius of curvature for this bend is 2.4 kilometers. Notice should be given to the existing perpendicular short weirs that exist in the prototype. These weirs have little or no effect on the channel. They were constructed in the 1960s to stabilize the toe of the bendway bankline. After the installation of 9 bendway weirs, the channel through the bend widened an average of 130 meters. Figs. 11 and 12 show the « before » and « after » cross-sectional plots at range X-X on the plan view. Fig. 13 shows the comparison overlay of the two plots. Approximately 12 meters of deposition occurred on the outside of the bend at this section.

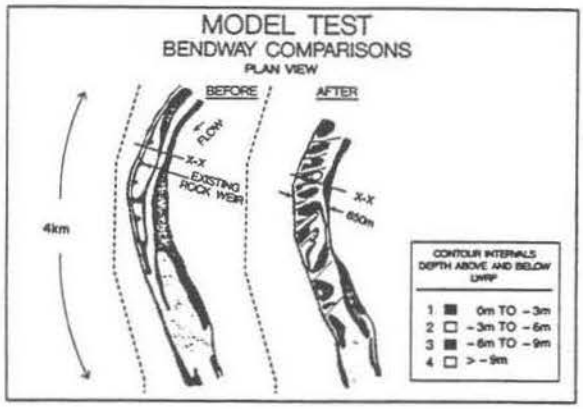

Fig. 10 - Model survey comparisons of Prices Bend

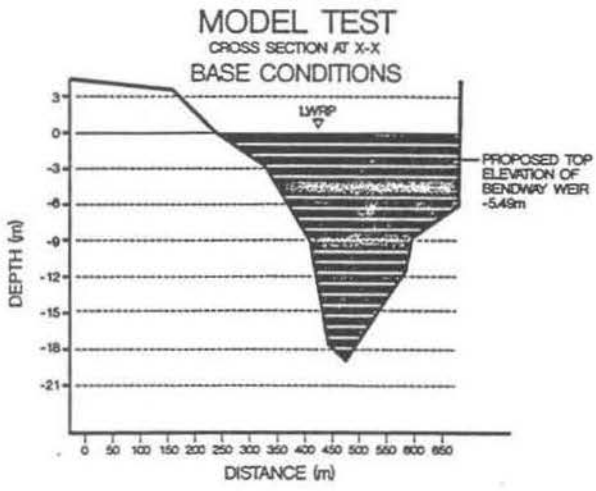

Fig. 11 - Cross-sectional plot of base test at X-X

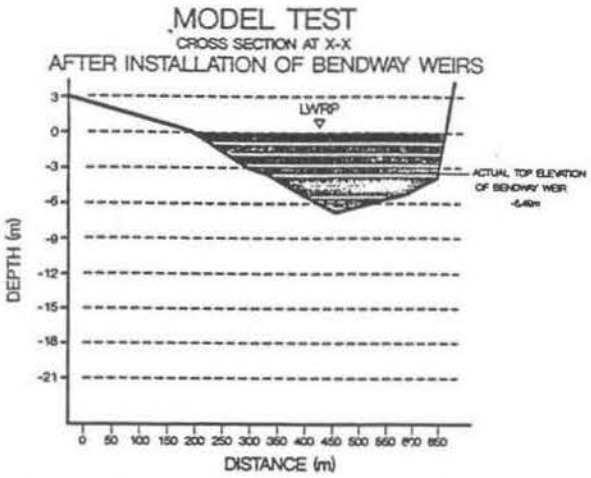

Fig. 12 - Cross-sectional plot of bendway weir plan at X-X

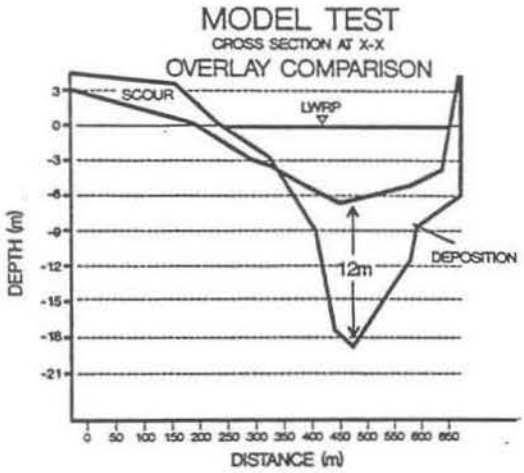

Fig. 13 - Overlay plot comparison at X-X

Fig. 14 shows the comparison survey of the next downstream bend, Dogtooth Bend, with an average radius of 1.8 kilometers. After the installation of 11 bendway weirs, the channel widened out an average of 85 meters. Figs. 15, 16 and 17 show the before, after, and the overlay cross-sectional plots at range H-H of the model. Approximately 15 meters of deposition occurred at the outside of the bend at this section.

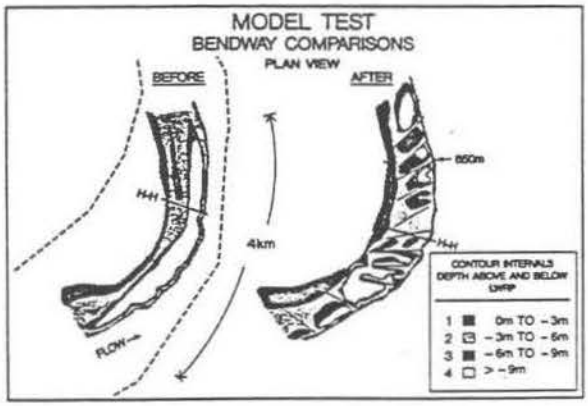

Fig. 14 - Model survey comparisons of Dogtooth Bend

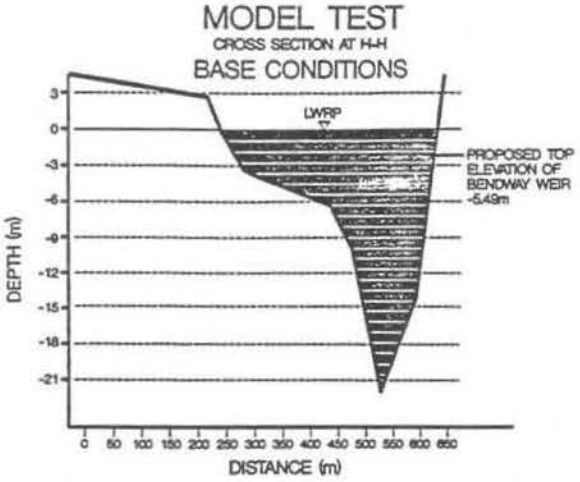

Fig. 15 - Cross-sectional plot of base test at H-H

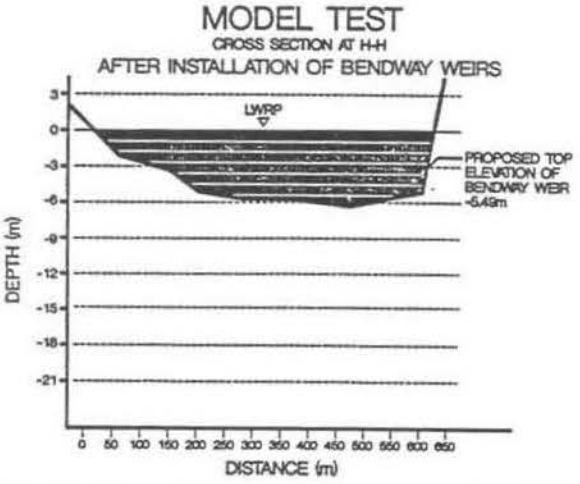

Fig. 16 - Cross-sectional plot of bendway weir plan at H-H

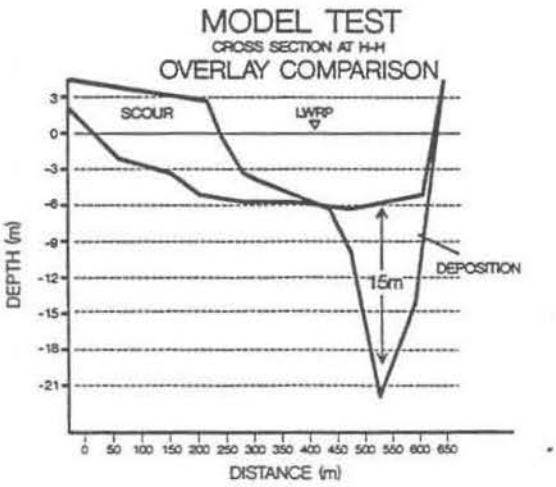

Fig. 17 - Overlay plot comparison at H-H

Fig. 18 shows the comparison survey of the channel crossing reach between the two bends. The comparison shows that after the installation of the weirs in the upstream bend (Prices), the channel widened and deepened considerably.

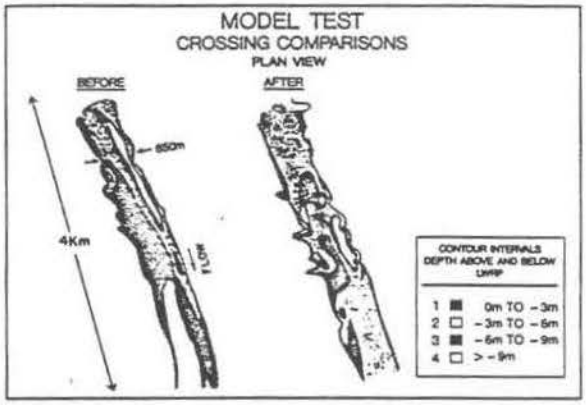

Fig. 18 - Model survey comparisons of crossing channel between Prices and Dogtooth Bends

Fig. 19 is a view of the bendway weirs in the model. These photos show the degree of deposition within each structure and the amount of scour located at the point bar. Evaluation of the functioning attributes of these structures were conducted during the course of the hydrograph. The following results were observed:

a) The 30-degree design angle proved optimum, as no unacceptable scour on the upstream face of the structures was experienced. The structural stability thus remained intact.
b) Detrimental deflection flow patterns were beneficially redirected, as verified by model confetti tests.

Numerous tests were conducted on various crest elevations for cost-efficiency. None of these alternatives were as efficient as the level crested weirs with a design elevation of -5.49 m LWRP.

5. CONCLUSIONS OF MODEL TEST RESULTS

After satisfactory results from the bendway weir plan, simulation of a flood hydrograph was run through the model as a final test to determine the overall response of the channel to both normal and high flow conditions. From surveys, confetti tests, and video tape review, the following conclusions were derived by the author:

The sinuosity and sediment management scheme is still maintained after installation of the weirs. Now, instead of the point bar location serving as sediment storage during low flows, some storage is diverted to the opposite outside bendway bank at a depth determined by the height of the weirs. Thus, at the low to midbank flows, the sediment storage becomes redistributed in the bend to the advantage of navigation, i.e., the bendway becomes wider and more

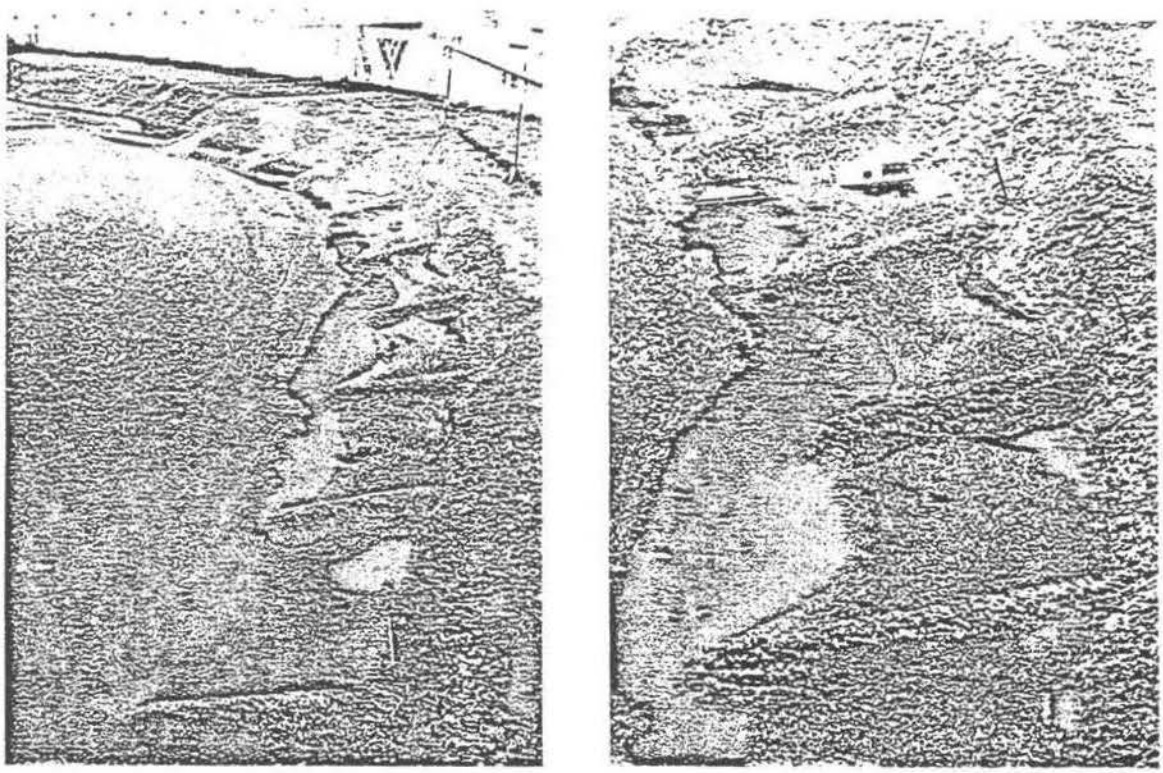

Fig. 19 - View of bendway weirs in model, looking downstream

shallow while still maintaining a navigable depth. The downstream crossing becomes drastically improved due to the temporary change in sediment transport geometry. At midbank to high flows, normal flow conveyance occurs and the storage sediments are transported downstream. As the hydrograph falls, the weir influence takes over again and the sediments fall out in storage to a manageable, desired configuration that is beneficial to navigation. Optimum sediment management is thus achieved in the bendway at all flow conditions.

Hydraulically, this new sediment management in the bend has been developed by the creation of a dominating friction cell counteracting against the natural centrifugal cell. The end result is a shift in the channel threadline at the low to medium flows.

CONSTRUCTION

Placement of the first bendway weir on the Mississippi River occurred in June 1989. The total time that was required for the construction of the weir consisted of only 4 days. The sequence of construction is summarized as follows:

1. Survey target points on both sides of the river were established. A 30-degree alignment centerline was established (the same angle as in the model tests), starting at the outside of the revetted bank and extending upstream across the channel toward the point bar. Also, an offset line 10 meters upstream and parallel to the centerline was established. This compensated for the drift forces against the sinking rock. This line was adjusted according to the particular changing velocities experienced over the length of construction. Drift velocities during construction never exceeded 1.5 m/sec due to backwater effects from the Ohio River.

GRADED STONE A

STONE WEIGHT POUNDS	CUMULATIVE PERCENT FINER BY WEIGHT
5,000	100
2,500	70 - 100
500	40 - 65
100	20 - 45
5	0 - 15
1	0 - 5

Not more than 5 percent by weight finer than 1/2-inch screen

Table 1 - Gradation requirements for Graded Stone A

containing proper gradation. Because of the offset line, the stone drifted on the desired centerline alignment.

5. Intensive, computerized soundings were performed during the construction to check the alignment and elevation of the structure.
6. The entire mobilization process had to be repeated frequently in order to allow navigation traffic to pass through the bend.

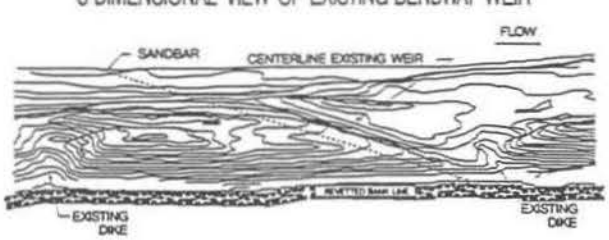

Fig. 26 - Three-dimensional contour generated from hydrographic survey, after construction

PROTOTYPE MONITORING

Intensive prototype monitoring was conducted before, during, and after construction of the bendway weir. The monitoring included :

1. DETAILED BED SOUNDINGS

Figs. 23, 24 and 25 show detailed hydrographic surveys established from sounding data. As seen in Fig. 25, a scour hole approximately 3 m in depth developed 120 meters out into the channel, downstream of the center of the weir. This is very encouraging and desirable, as it verifies a tendency for thalweg shift as replicated in the model. Fig. 26 is a three-dimensional contour plot generated from the after construction hydrographic surveys.

2. SONAR PICTURE

Fig. 27 is a bottom image of the weir and channel bed. This was generated using an Image Side Scan Sonar. The image defines the bed scour tendencies experienced downstream of the weir, as well as deposition tendencies on the outside of the bank.

3. VELOCITY CROSS SECTIONS

Fig. 28 shows the established data collection range, A-A, that was used to collect velocity data both before and after placement of the weir. A velocity isovel plot was generated from a velocity grid. Fig. 29 is the plot before weir placement, and Fig. 30 is the plot of data collected one month after construction. A definite trend of an overall flow shift toward the middle of the channel can be seen.

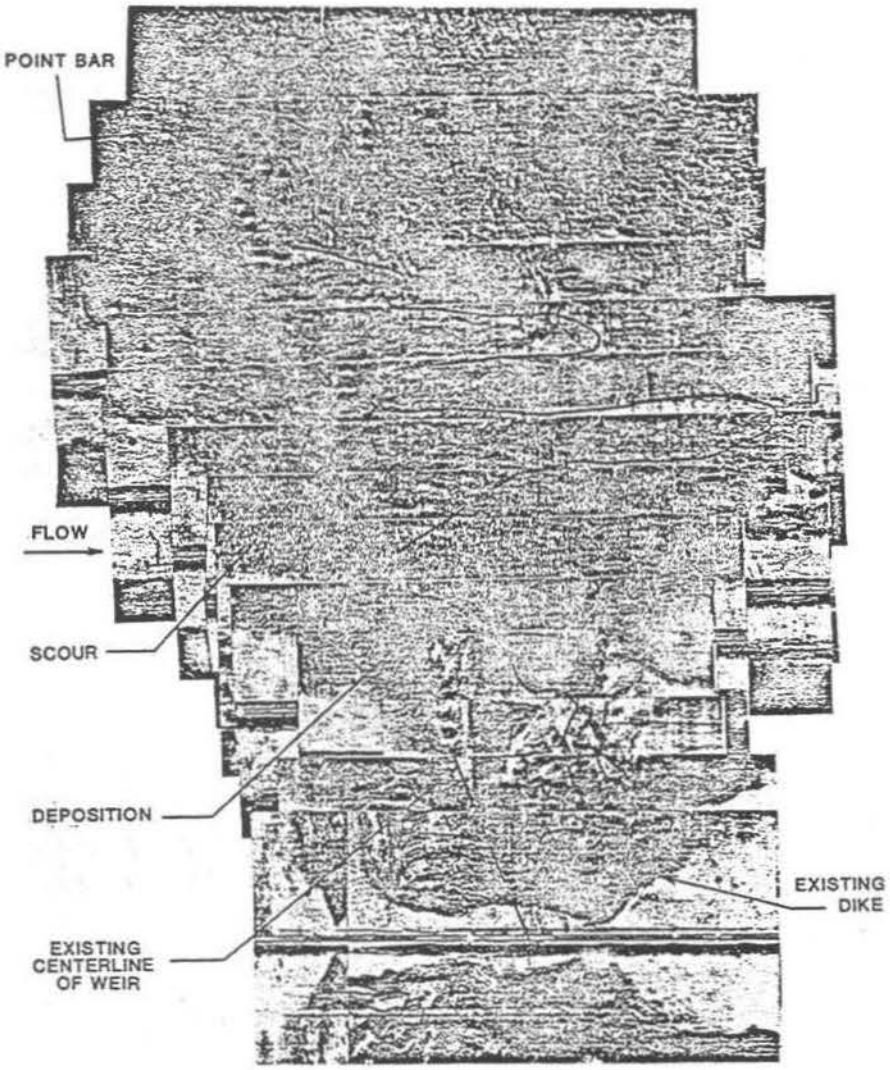

Fig. 27 - Image side scan sonar picture of weir and channel bottom

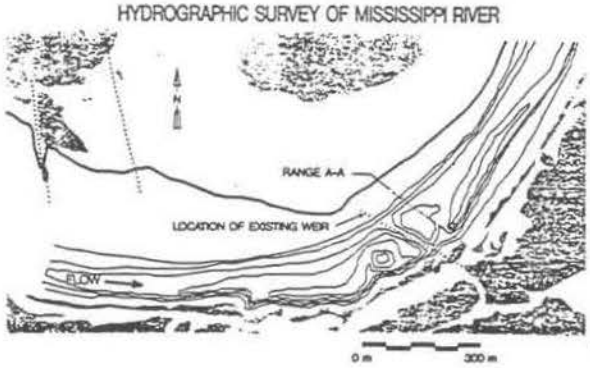

Fig. 28 - Location of data collection range A-A

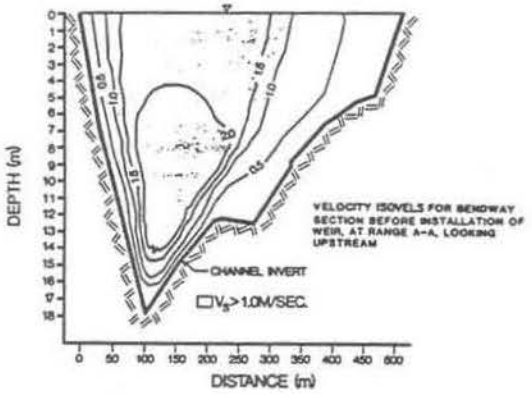

Fig. 29 - Velocity isovels at range A-A, pre-construction

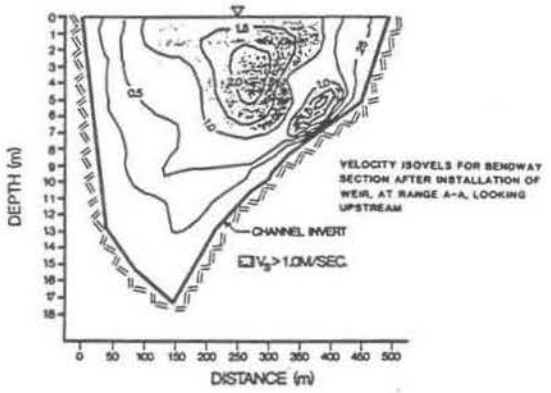

Fig. 30 - Velocity isovels at range A-A, after construction

4. DEPTH INTEGRATED SUSPENDED SEDIMENT SAMPLES

Suspended sediment samples were taken at a bend control section to investigate the sediment characteristics of a typical, unmodified bend (a bend that contained no structures). Fig. 31 is a plot of the sediment concentrations for this unmodified bend section. Fig. 32 is a concentration plot developed from samplings taken at range A-A, downstream of the bendway weir. By comparing these two plots, a definite shift can be seen in the passage of suspended sediments in the bendway weir section. The concentrations extend farther across the section toward the point bar, verifying a shift in flow characteristics toward the middle of the channel.

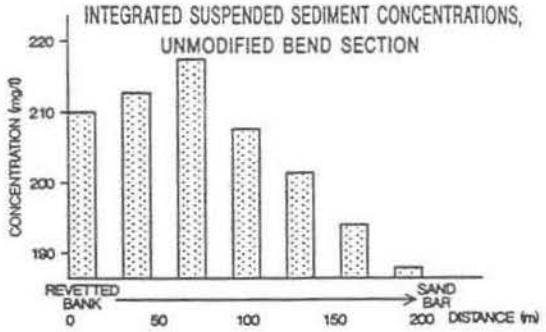

Fig. 31 - Integrated suspended sediment concentrations across unmodified bend section

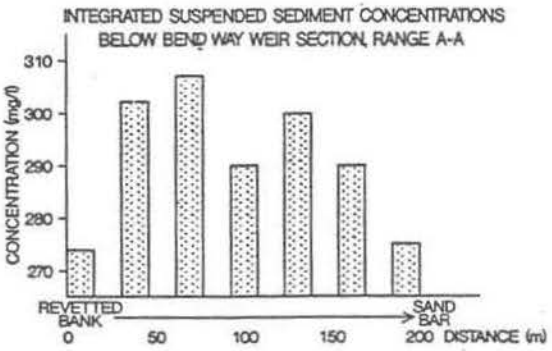

Fig. 32 - Integrated suspended sediment concentrations across bend section just downstream of weir, range A-A

FUTURE CONSTRUCTION AND MODEL TESTS

A contract will be awarded in 1990 to construct an additional 10 bendway weirs throughout Dogtooth Bend. The spacing and construction sequencing will duplicate what was found conclusive in the model. In general, the optimum spacing is approximately 175 meters between each structure. Tests are being conducted to develop a spacing criterion dependent on the radius of curvature of the bend.

CONCLUSIONS

The design and installation of bendway weirs in the Mississippi River is revolutionary. The centrifugal bend forces can now be managed to effectively influence the water and sediments of a bendway, including the downstream crossing. Sediment storage is redistributed in a favorable arrangement for the navigation channel while the natural sinuosity of the river is still maintained.

Construction of the first bendway weir proves that the model test design can be quickly and economically installed in the Mississippi River. If the drift velocities are taken into account, then successful placement of materials can be conducted with acceptable accuracy.

Field verification of model tests has occurred. The first prototype bendway weir has shown desirable velocity and sediment trends.

The long-term benefits from bendway weir design are on a magnitude that can only be evaluated over the course of time. Fuel consumption will be saved by the towing industry, and typical delay times on the open river system will be greatly reduced. Accidents as a result of groundings on point bars will become minimal. Banklines will become further stabilized, and detrimental deflection flow patterns will be minimized. Finally, the goal of maintaining a safe and dependable navigation channel can be advanced on the Mississippi River by the bendway weir concept.

The application of bendway weirs is not limited to bendways. The design may also be used in near straight reaches to realign the thalweg. Scaled-down versions of the structures can be utilized on some of the tributaries and smaller streams throughout the United States and the world abroad.

The aforementioned discussion represents the views of the author and are not necessarily the views of the Corps of Engineers.

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Without the progressive attitudes and positive enthusiasm of the St. Louis District Corps of Engineers, the concept and construction of the bendway weir would not have been possible, and this article could not have been written. Acknowledgement goes to the management staff, including Colonel James E. Corbin, District Engineer, Mr. Jack R. Niemi, Deputy District Engineer for Project Management, Mr. Art Johnson, Chief, Engineering Division, Mr. James T. Lovelace, Chief, Hydrologic and Hydraulics Branch, and Mr. Claude N. Strauser, Chief, Potamology Section.

Recognition is also given to Mr. Tom Pokrefke, Mr. Dave Derrick, Mr. James Crutchfield, and Mr. Rusty Henderson, all of the Waterways Experiment Station, Hydraulics Laboratory, Vicksburg, Mississippi, for their superior work and insights given during the conduction of the movable bed model tests. Their research abilities are unsurpassed.

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III. Discussion of the Placement Procedures for Construction of Bendway Weirs in the Deep Channel, with an Insight to Gradation of Stone Requirements for Bendway Weir Construction.

Introduction. Experience and insight was recently gained on the placement of rock in a deep channel during the Dogtooth Bend Construction Contract conducted during 1990. The following is a discussion on the procedures used before, during, and after the construction of the Bendway Weirs:

1. Initial Alignment Setup. For accurate structural alignment of the Bendway Weir, adequate survey points were placed in the field to serve as control for all construction procedures.

Target points were set up on both the sand bar and outside bank along the desired alignment line called for in the Plans and Specifications of the construction contract. One point was placed at midbank, another placed at highbank, both to ensure construction points at all working river stages. Two points were placed on the sand bar as well. Each point was set at a different elevation to also ensure at least one available reference point at all working river stages. For each alignment line then, there were a total of 4 points available for reference. All points were established by the coordinate system from latitude and longitude.

2. Stone Drift Compensation Test. At the start of each day of construction, the contractor determined an upstream offset alignment line. This line is the actual line from which the stone was dropped into the river. To determine this line, stone dumps were performed upstream of the desired final alignment line. Soundings were then taken over the final alignment line to examine where the stone actually landed on the river bottom. By dumping and then sounding over the alignment line, the contractor could determine just how far upstream of the desired alignment line the stone placement equipment had to be set. This offset line ranged from as little as 10 ft. to as much as 50 feet upstream. This of course depended on influences such as velocity, depth, water surface slope, size of drag bucket, etc.

2. Mobilization of Construction Equipment. Once the offset alignment line was established, a 600 hp tender boat set two, three ton anchors upstream of the established alignment line. These anchors were attached to a 175 ft. by 35 ft. by 10 ft. spudbarge. The spudbarge had 80 ft. spuds at each its' two ends. The spudbarge had 1.5 inch wire rope run through a snatch block then attached to a multi-drum wench with a 651 Cat Power Plant. Attached to the downstream side of the spudbarge were two 17 ft. spreader blocks. These blocks served as templates or voids for the stone dumping.

After the anchors were set, the spudbarge was lowered downstream on wires until proper offset distance and alignment were established. The alignment and distance were fine tuned by raising one spud at a time and letting out or bringing in the wire rope.

Once the spud barge was finally in a correct upstream position with both spuds firmly set into the riverbed, the tender boat would then bring in a 175 ft. by 35 ft. by 10 ft. flat deck rock barge with loaded Grade A Stone. A typical loaded barge grossed approximately 950 tons of stone. This barge was brought up against the spreader block template attached to the spudbarge. The stone barge was also set up with a series of wires and anchors similar to the spudbarge.

An 88B, 365 hp dragline with a 3 cubic yard bucket was positioned on the spudbarge. The stone was then dragged from the rock barge into the void created by the template and skillfully dumped as massive units.

Downstream on the desired alignment line, the dumps were constantly monitored with soundings to ensure proper height and width of structure, repeating sequence until the completion of work.

Gradation of Stone Requirements. Initially, there was some concern to the Corps on whether the present stone gradation would be adequate for proper placement and construction of the Bendway Weirs in the deep channel of the Mississippi River

This Office conducted several meetings with various experts within the District office. After much discussion, it was decided that most of the answers could be gained by site visits to the various rock quarries on the river. Those quarries that were visited were: Grays Point Quarry, Tower Rock Quarry, Dravo Materials Quarry, and Reed Quarry. Each of the quarries demonstrated current production procedures on the formation of Grade A stone, Grade B stone, Grade C stone, crushed rock, and Derrick stone.

Grade A stone is actually termed "quarry run" stone or "shot rock" simply because it is the start of all other gradations. This is why it is so cheap. The gradation is controlled by the blasting grid system drilled into the rock face of the quarry. Once blasted, the rock is picked up and loaded on a dump truck. It is then hauled directly to the loading dock, where it is carefully placed on the barge.

To protect the deck of the barge, the stone is placed on the barge in overlapping piles. The result is that the larger stone will end up on one side and the finer will end up on the other. The existing loaded stone, then, is probably not representative of the true gradation curve. However, this is compensated for by the way the stone is eventually dumped into the river. By carefully dragging the bucket over the stone, a massive, well graded dump can be achieved. Of course, some of the finer stone will be lost in the river, but probably not more than 25 percent.

Several ideas have been proposed on the types of equipment to be used for Grade A stone placement for Bendway Weirs in the river. These ideas were discussed with area contractors. A bottom dump barge may be of some value, although the scarcity of these barges would seem to make this idea non-feasible. Contractors have stated that grade A stone would probably tear up barges of this type. The idea of using the modern giant backhoes was also discussed with contractors. Although these backhoes can have buckets as large as 9 cubic feet and can extend down into the water column 30 to 40 feet, the inefficiency of having to continually raise and lower the bucket down into the water column would offset any benefit gained from the larger bucket capacity.

ED

REGULATING WORKS

MISSISSIPPI RIVER

MILES 40.0 TO 20.0

DOGTOOTH BEND REACH - PHASE III

CONSTRUCTION OF STONE FILL WEIRS

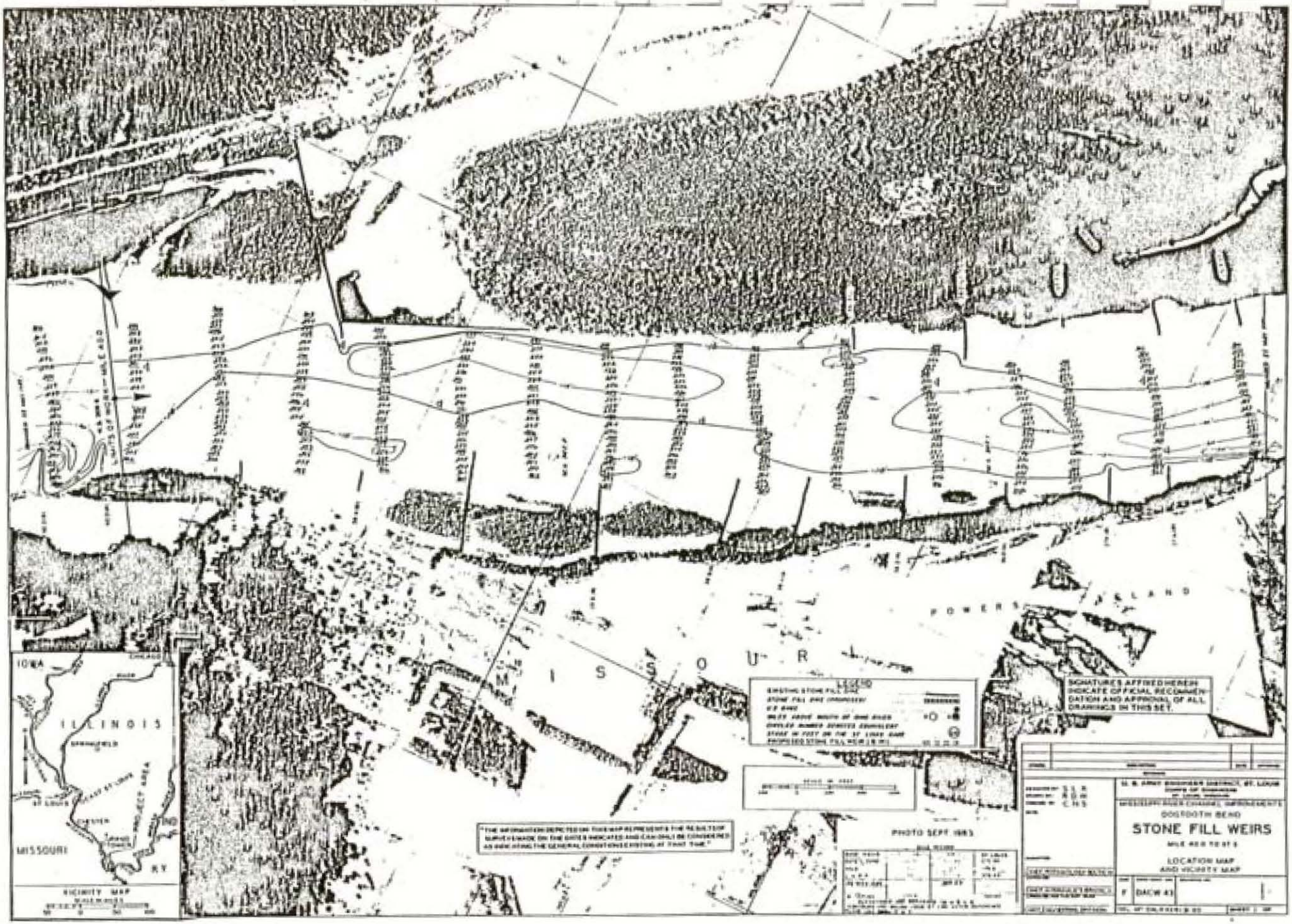
SOLICITATION NO. DACW43-91-B-00

US Army Corps
of Engineers
St. Louis District

Leaders in Customer Care

APRIL 1991

IV. Copy of Plans and Specs for Bendway Weirs.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POWERS ISLAND
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MISSOURI
KY
ST LOUIS
VICINITY MAP
LEGEND
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"THE INFORMATION DEPICTED ON THIS MAP REPRESENTS THE RESULTS OF SURVEYS MADE ON THE DATES INDICATED AND CAN ONLY BE CONSIDERED AS INDICATING THE GENERAL CONDITIONS EXISTING AT THAT TIME."
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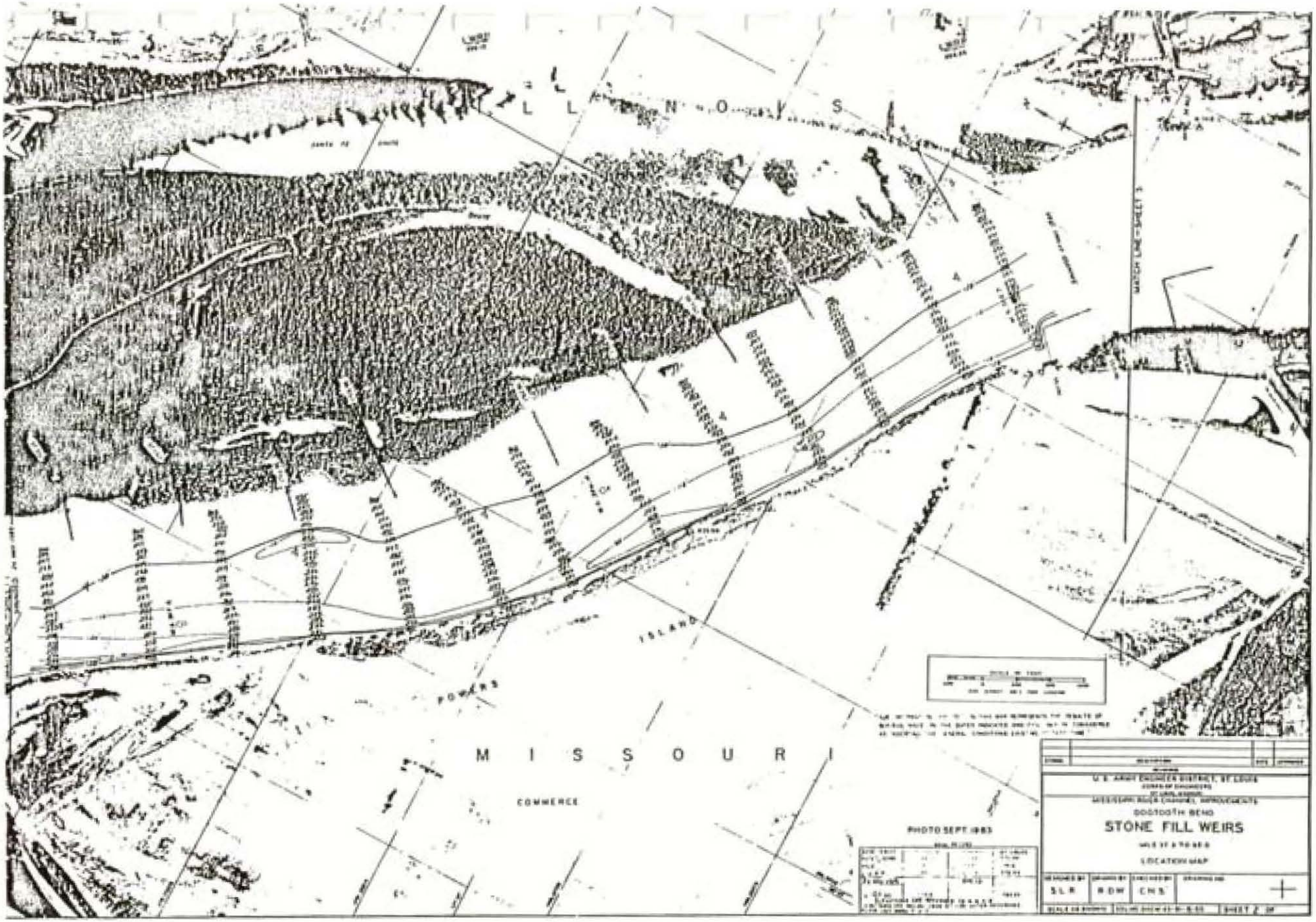
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND
STONE FILL WEIRS
MILE 40.0 TO 41.5
LOCATION MAP
AND VICINITY MAP
DACW 43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STONE FILL WEIRS
LOCATION MAP
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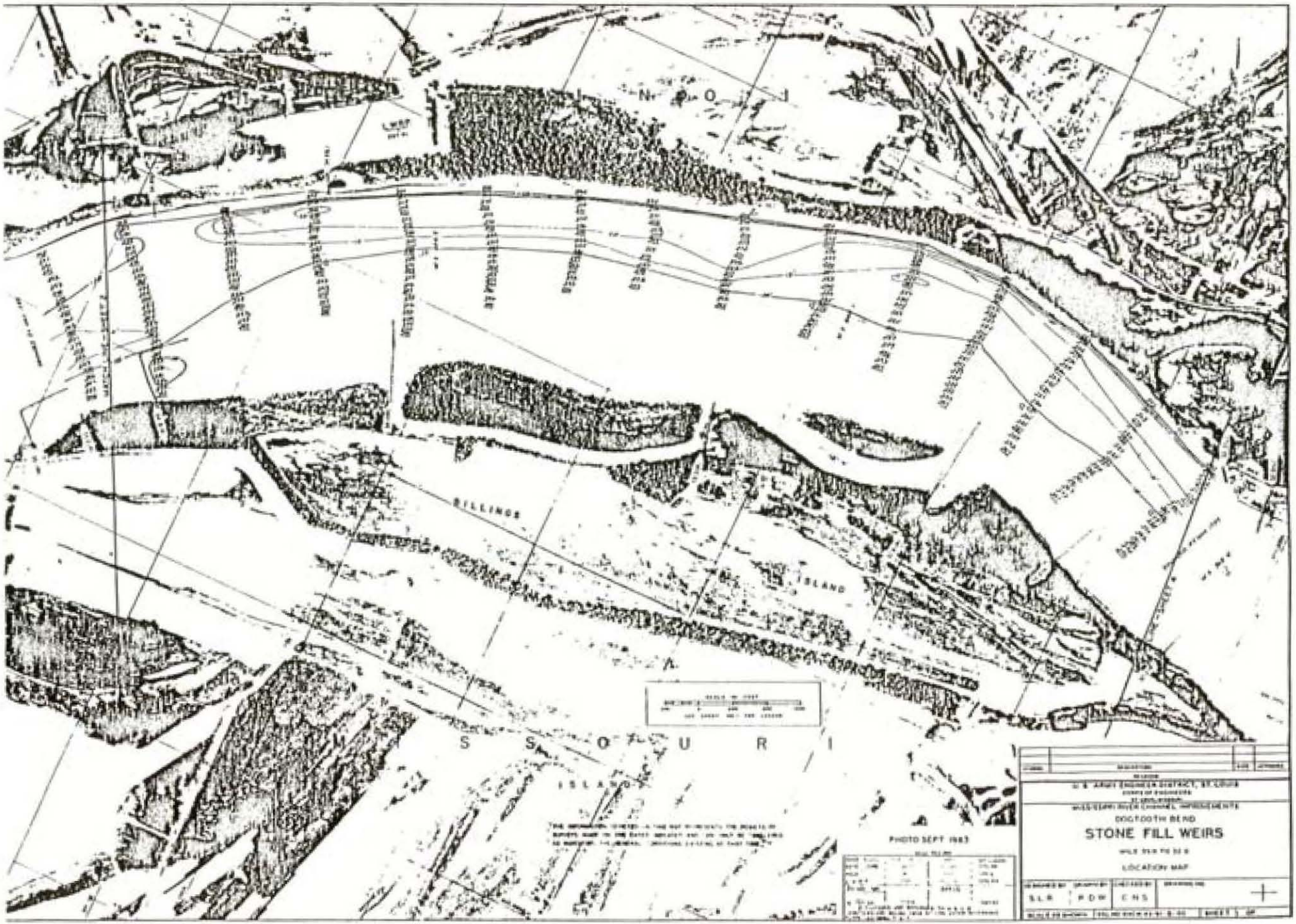
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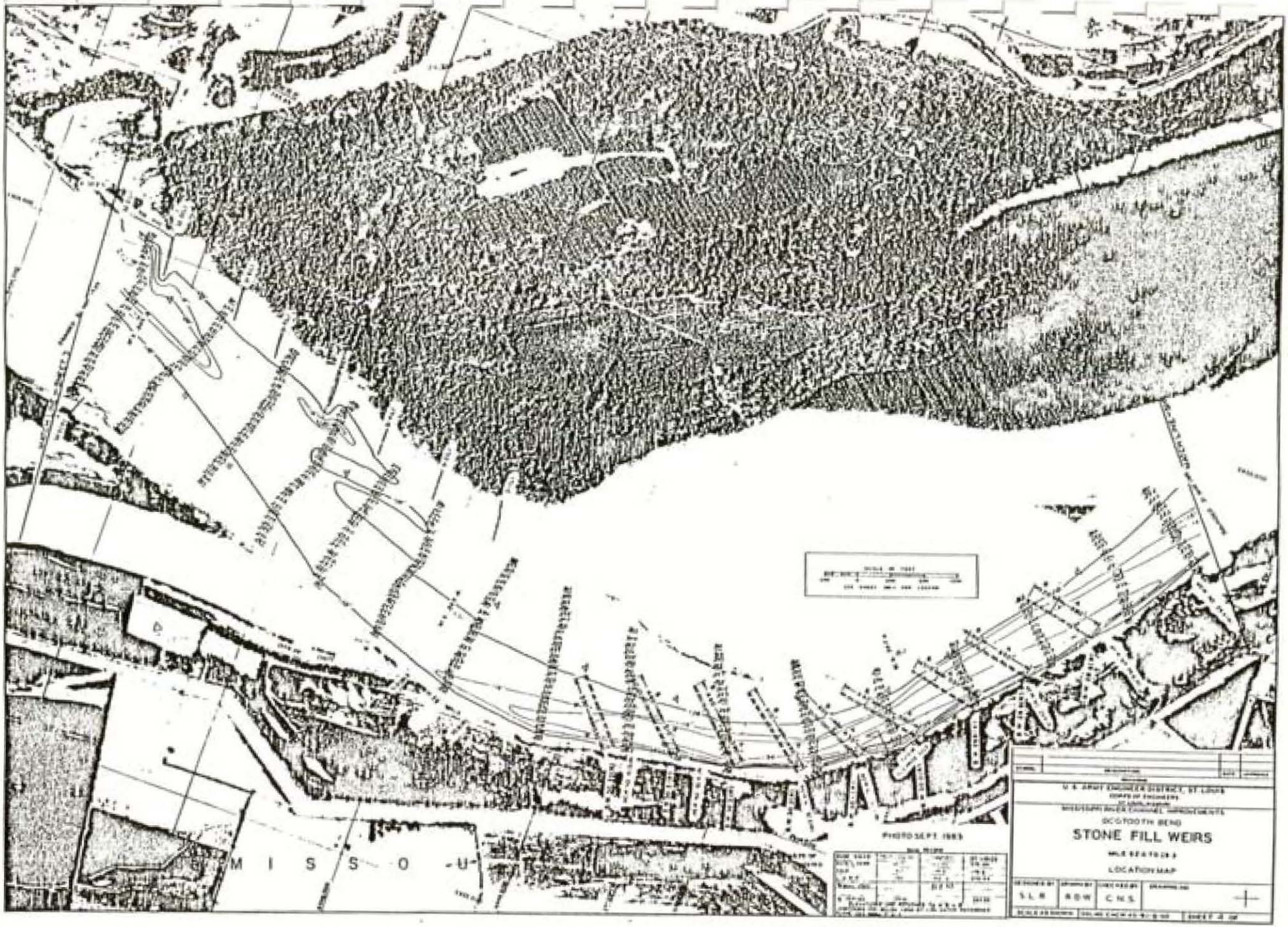
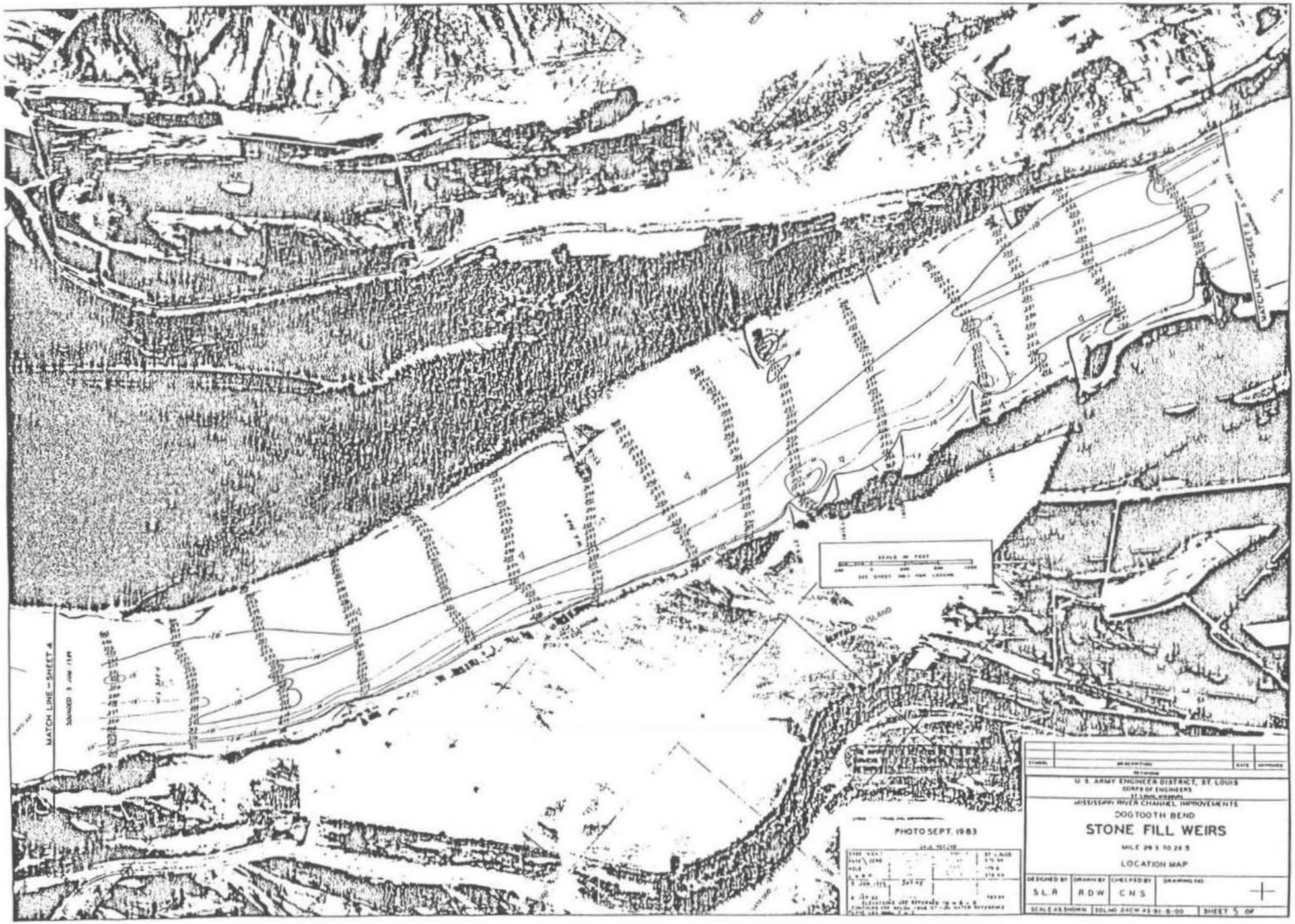
DOGTOOTH BEND
STONE FILL WEIRS
LOCATION MAP
SLR
PDW
CNS


M I S S O U
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
STONE FILL WEIRS
LOCATION MAP
SLR
RDW
CNS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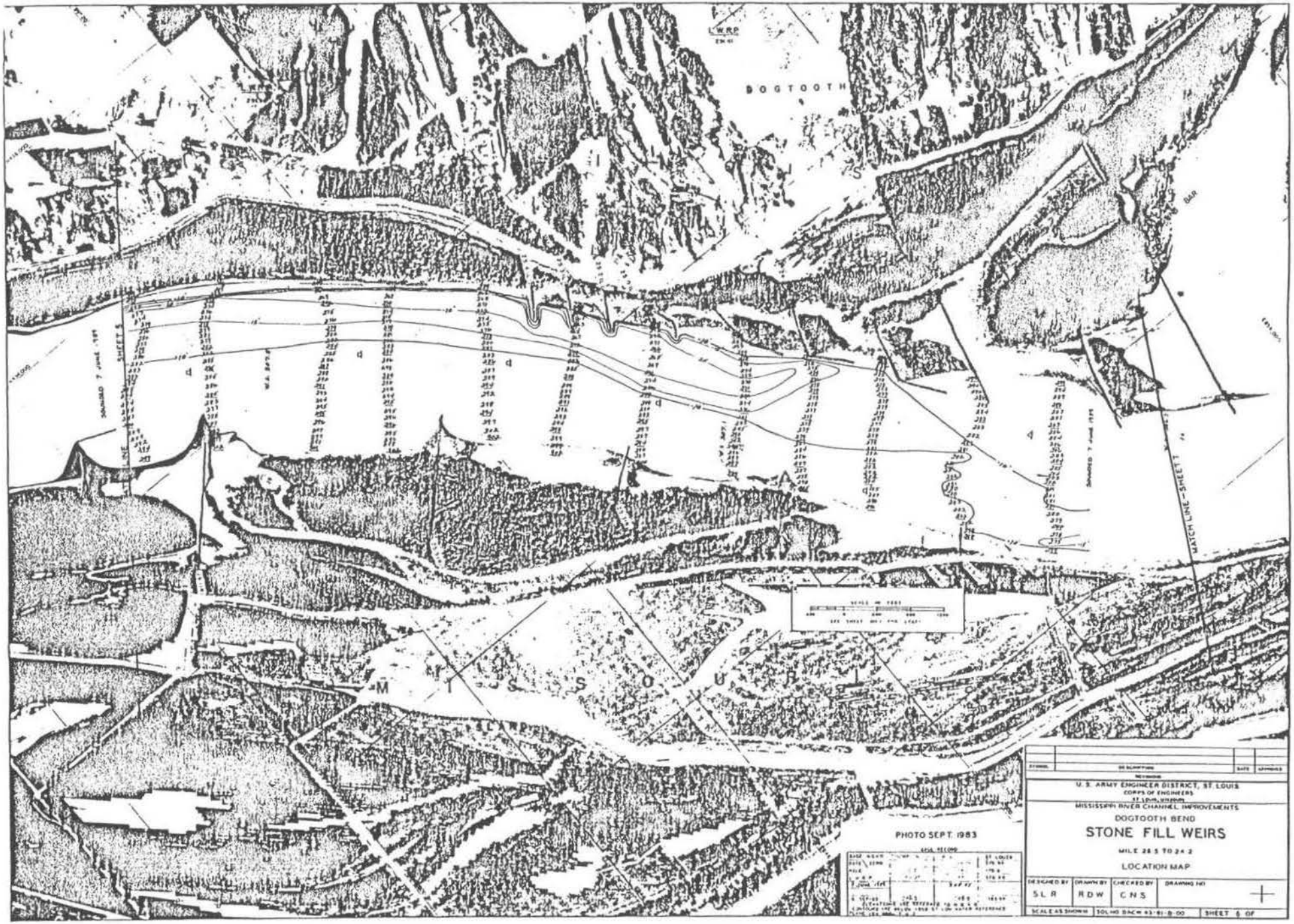
U. S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOG TOOTH BEND
STONE FILL WEIRS
MILE 29.5 TO 24.5
LOCATION MAP
DESIGNED BY SLA
DRAWN BY RDW
CHECKED BY CNS
SCALE AS SHOWN
SHEET 5 OF


DOGTOOTH
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CORPS OF ENGINEERS
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND
STONE FILL WEIRS
MILE 28.5 TO 24.2
LOCATION MAP
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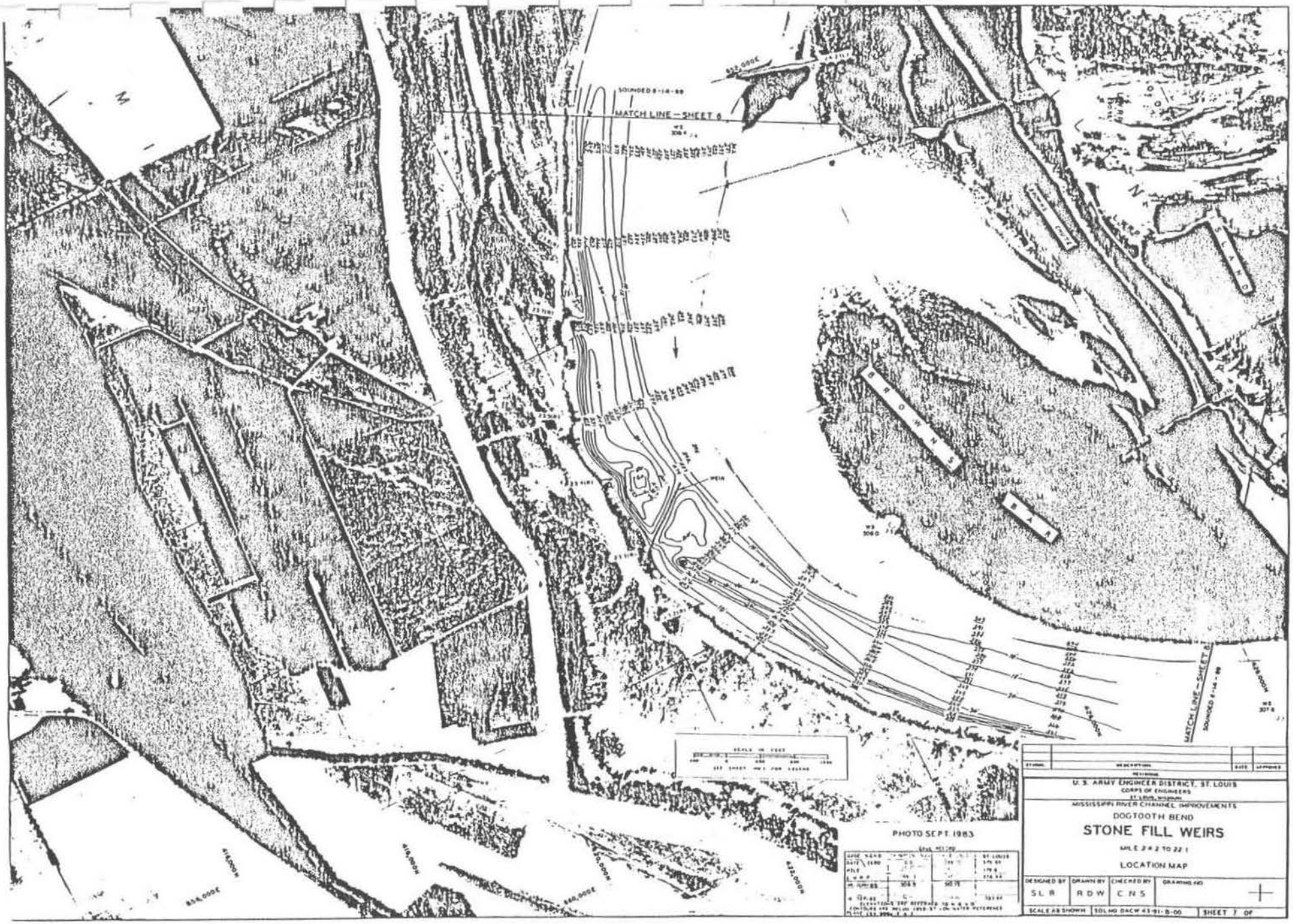
SHEET 6 OF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ISLAND
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MATCH LINE — SHEET 8
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U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND
STONE FILL WEIRS
MILE 24.2 TO 22.1
LOCATION MAP
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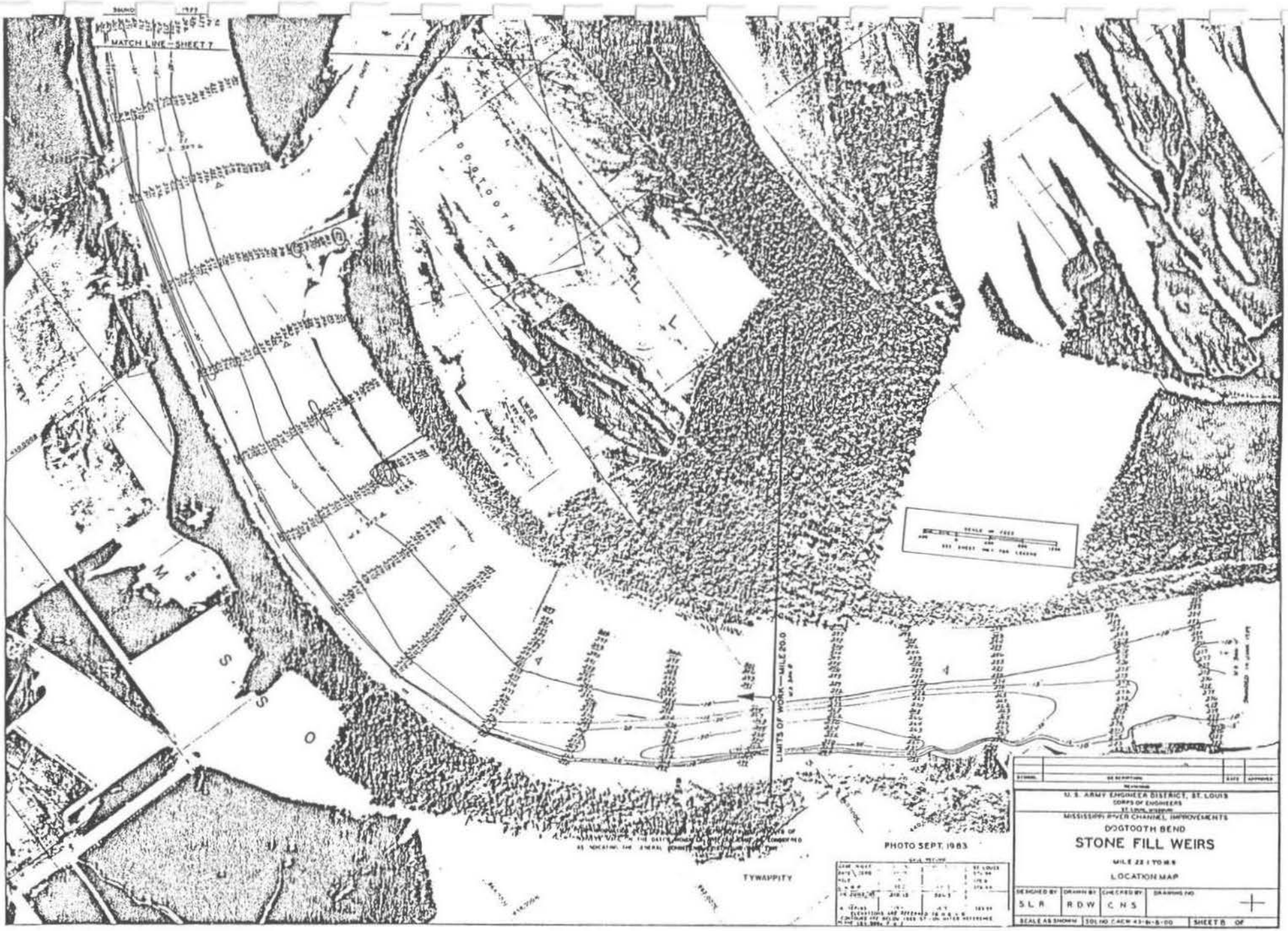
SCALE AS SHOWN
SHEET 7 OF


MATCH LINE – SHEET 7
DOGTOOTH
LIMITS OF WORK – MILE 20.0
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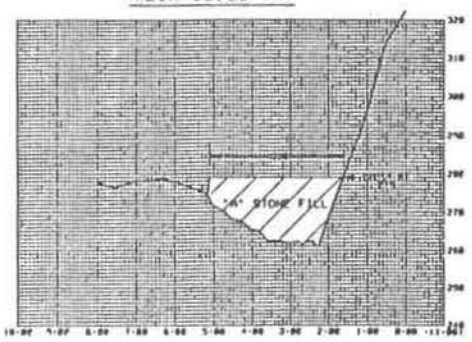
U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND
STONE FILL WEIRS
MILE 22 ± TO 18 ±
LOCATION MAP
DESIGNED BY S L R
DRAWN BY R D W
CHECKED BY C N S
SCALE AS SHOWN
SHEET 8 OF

WEIR 30.55 (R)



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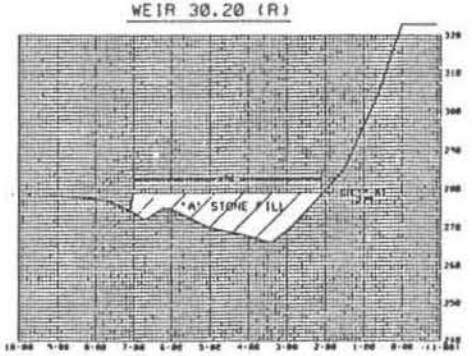

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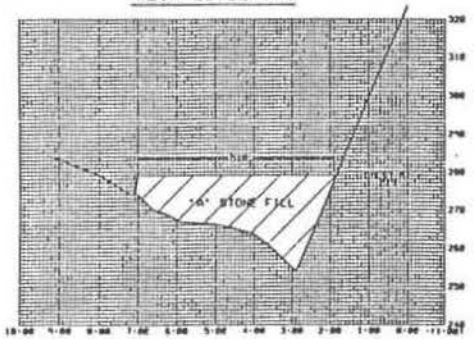

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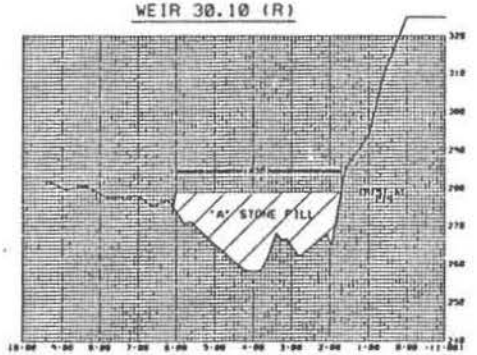

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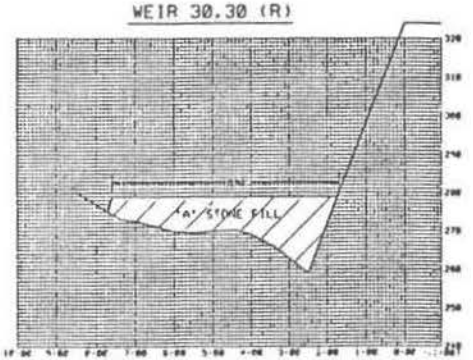

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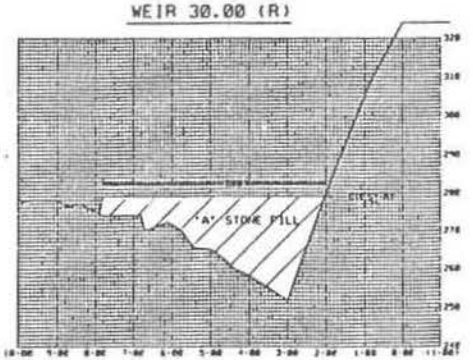


ELEVATION,FEET,N.G.V.D.

ELEVATION,FEET,N.G.V.D.

LOOKING DOWNSTREAM

U.S.ARMY ENGINEER DISTRICT,ST.LOUIS
CORPS OF ENGINEERS

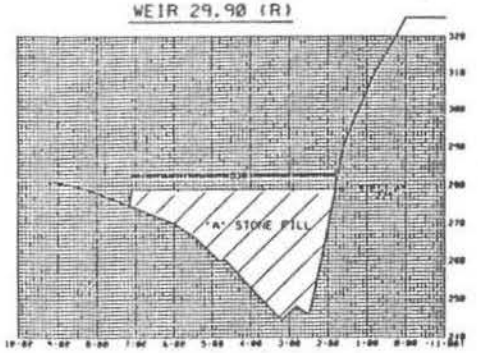
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND REACH
PHASE III

STONE FILL WEIRS
MILES 40.0 TO 20.0
PROFILES

DESIGNED BY	DRAWN BY	CHECKED BY	DRAWING NO.
S.L.R.	G.R.S.	C.N.S.	

SCALE AS SHOWN | SHEET OF

WEIR 29.90 (R)



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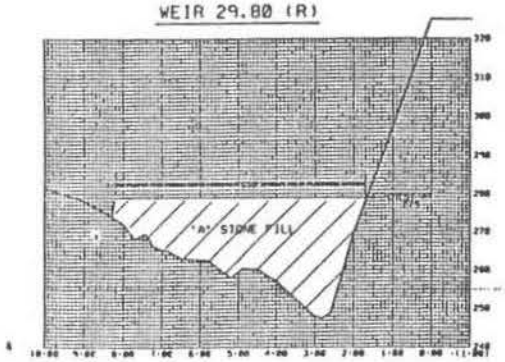

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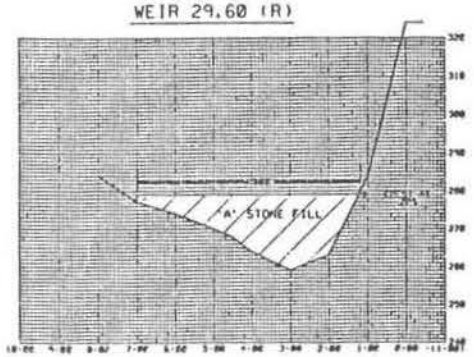


ELEVATION, FEET, N.G.V.D.

ELEVATION, FEET, N.G.V.D.

LOOKING DOWNSTREAM

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

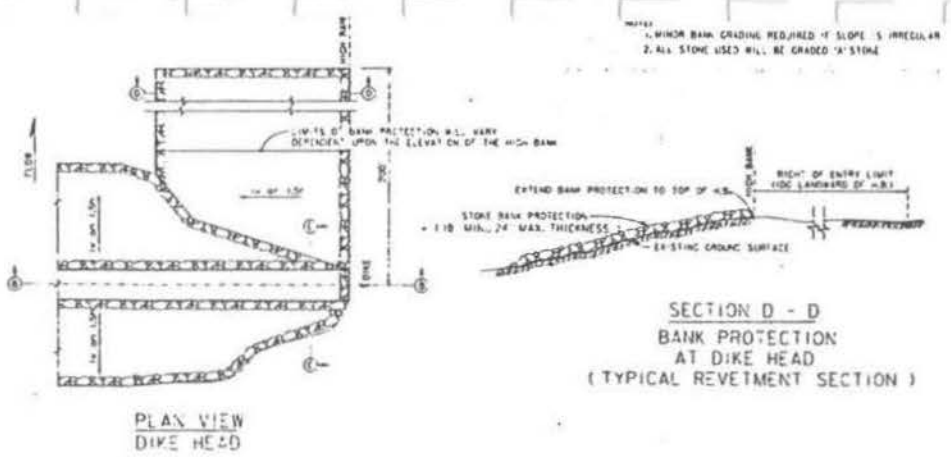
MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOG TOOTH BEND REACH
PHASE III

STONE FILL WEIRS
MILES 40.0 TO 20.0
PROFILES

DESIGNED BY:	DRAWN BY:	CHECKED BY:	DRAWING NO.
S.L.R.	G.R.S.	C.N.S.	

SCALE AS SHOWN | SO. NO. DECKS: | SHEET 1 OF 1

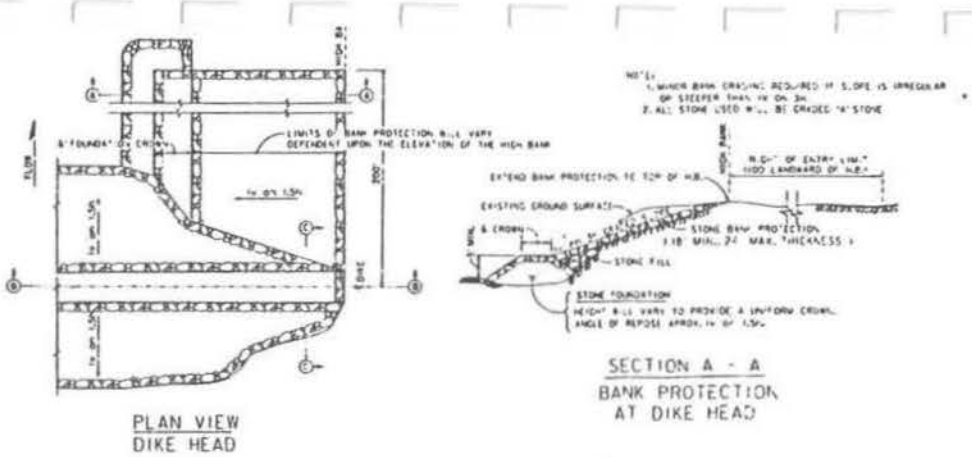
FILE: REDWEIR2.DGN



PLAN VIEW
DIKE HEAD

SECTION D - D
BANK PROTECTION
AT DIKE HEAD
(TYPICAL REVETMENT SECTION)

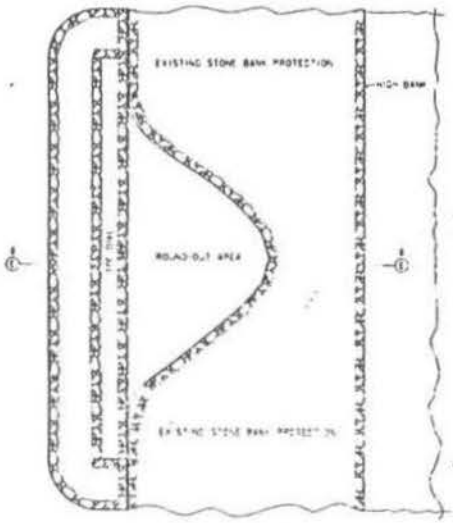
TYPICAL DIKE AT FLAT BANKS



PLAN VIEW
DIKE HEAD

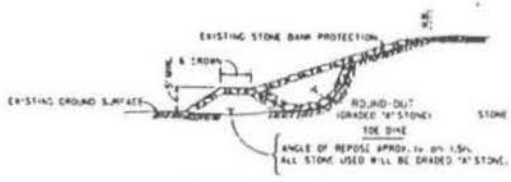
SECTION A - A
BANK PROTECTION
AT DIKE HEAD

TYPICAL STONE ROOT FOR NORMAL BANKS

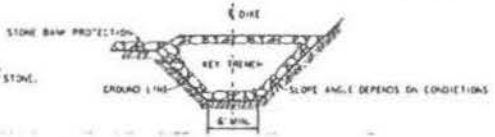


PLAN VIEW

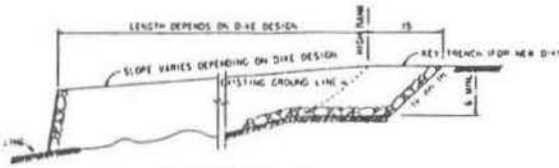
ROUND-OUT AND STONE BANK PROTECTION



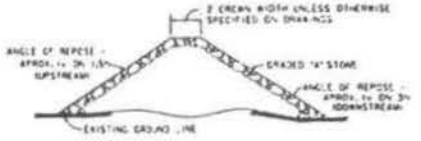
SECTION E - E



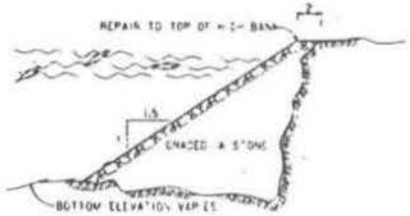
SECTION C - C
ROOT DIKE



SECTION B - B
STONE DIKE PROFILE
(TYPICAL)



TYPICAL STONE DIKE SECTION



TYPICAL SECTION FOR STABILIZATION
OF VERTICAL CAVING BANK LINE

GENERAL NOTE:
CONSTRUCTION AND REPAIR OF STONE FOUNDATION, TOE DIKES AND DIKE HEADS WILL BE MADE WITH GRADED "A" STONE. STONE LARGER THAN 500 lb WILL BE UTILIZED IN THE STONE FOUNDATION. STONE SMALLER THAN 500 lb WILL BE UTILIZED IN THE BANK PROTECTION REVETMENTS.

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

MISSISSIPPI RIVER CHANNEL IMPROVEMENTS
DOGTOOTH BEND

STONE FILL WEIRS
AND
STONE BANK REVETMENTS
MILES 40.0 TO 20.0

CONSTRUCTION DETAILS

ED+P

REGULATING WORKS

MISSISSIPPI RIVER

MILES 40.0 TO 20.0

DOGTOOTH BEND REACH - PHASE II

SPECIFICATIONS FOR

CONSTRUCTION OF STONE FILL WEIRS

SOLICITATION NO. DACW43-90-B-0008

THIS SOLICITATION IS UNRESTRICTED

GOOD ENGINEERING ENHANCES THE ENVIRONMENT

US Army Corps
of Engineers
St. Louis District

Leaders in Customer Care

JANUARY 1990

SOLICITATION, OFFER, AND AWARD *(Construction, Alteration, or Repair)*	1. SOLICITATION NO.	2. TYPE OF SOLICITATION	3. DATE ISSUED	PAGE OF PAGES
	DACW43-90-B-0008	[X] SEALED BID (IFB) [ ] NEGOTIATED (RFP)	90 JAN 16	1 of 21

IMPORTANT – The "offer" section on the reverse must be fully completed by offeror.

4. CONTRACT NO.	5. REQUISITION/PURCHASE REQUEST NO.	6. PROJECT NO.
	CD 0000 9331-0001	

7. ISSUED BY CODE	8. ADDRESS OFFER TO
Department of the Army St. Louis District, Corps of Engineers Attention: CELMS-CT-C 210 Tucker Boulevard, North St. Louis, Missouri 63101-1986	Same as Block 7 Bid Opening Room: 629 Hand carried bids will be received in Room 964 until 1:45 P.M. and in Room 629 after 1:45 P.M. until 2:00 P.M.

9. FOR INFORMATION CALL:	A. NAME	B. TELEPHONE NO. (Include area code) (NO COLLECT CALLS)
	Mrs. Joan F. Schick	314/263-5845

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS (Title, identifying no., date):

CONSTRUCTION OF STONE FILL WEIRS, REGULATING WORKS, MISSISSIPPI RIVER MILES 40.0 TO 20.0 DOGTOOTH BEND REACH - PHASE II

Description of Work. The work is located in Mississippi and Scott Counties, Missouri and Alexander County, Illinois and consists of furnishing all plant, labor material and equipment for the construction of approximately 8,080 linear feet of submerged stone fill weirs.

The estimate cost range of the project is between $500,000 and $1,000,000

11. The Contractor shall begin performance within 15 calendar days and complete it within 360 calendar days after receiving [ ] award, [X] notice to proceed. This performance period is [X] mandatory, [ ] negotiable. (See _____)

12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE AND PAYMENT BONDS? (If "YES," indicate within how many calendar days after award in Item 12B.)	12B. CALENDAR DAYS
[X] YES [ ] NO	10

13. ADDITIONAL SOLICITATION REQUIREMENTS:

A. Sealed offers in original and 1 copies to perform the work required are due at the place specified in Item 8 by 2:00 P.M. (hour) local time February 21, 1990 (date). If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.

B. An offer guarantee [X] is, [ ] is not required.

C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.

D. Offers providing less than 60 calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.

OFFER *(Must be fully completed by offeror)*

14. NAME AND ADDRESS OF OFFEROR *(Include ZIP Code)*	15. TELEPHONE NO. *(Include area code)*
CEC: _____ CAGE: _____ CODE FACILITY CODE	16. REMITTANCE ADDRESS *(Include only if different than Item 14)*

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within ___ calendar days after the date offers are due. *(Insert any number equal to or greater than the minimum requirement stated in Item 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)*

AMOUNTS ▶

18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGMENT OF AMENDMENTS
(The offeror acknowledges receipt of amendments to the solicitation — give number and date of each)

AMENDMENT NO.										
DATE										

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER *(Type or print)*	20B. SIGNATURE	20C. OFFER DATE

AWARD *(To be completed by Government)*

21. ITEMS ACCEPTED:

22. AMOUNT	23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN ▶ *(4 copies unless otherwise specified)*	ITEM 26 ATTN: F&A	25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO ☐ 10 U.S.C. 2304(c) ( ) ☐ 41 U.S.C. 253(c) ( )

26. ADMINISTERED BY CODE	27. PAYMENT WILL BE MADE BY
Department of the Army St. Louis District, Corps of Engineers 210 Tucker Boulevard, North St. Louis, Missouri 63101-1986	Disbursing Officer U.S. Army Engr. District, Memphis, CE B-314 Clifford Davis Federal Bldg. Memphis, TN 38103-1816

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

☐ 28. NEGOTIATED AGREEMENT *(Contractor is required to sign this document and return ___ copies to issuing office.)* Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.

☐ 29. AWARD *(Contractor is not required to sign this document.)* Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN *(Type or print)*	31A. NAME OF CONTRACTING OFFICER *(Type or print)*

30B. SIGNATURE	30C. DATE	31B. UNITED STATES OF AMERICA BY	31C. AWARD DATE

FP26-89

NOTICES

1. SOLICITATION DEFINITIONS - SEALED BIDDING (JUL 1987) FAR 52.214-1.

   "OFFER" MEANS "BID" IN SEALED BIDDING.

   "SOLICITATION" MEANS AN INVITATION FOR BIDS IN SEALED BIDDING.

   "GOVERNMENT" MEANS UNITED STATES GOVERNMENT.

2. BIDDERS MUST PROVIDE FULL, ACCURATE, AND COMPLETE INFORMATION AS REQUIRED BY THIS SOLICITATION AND ITS ATTACHMENTS. THE PENALTY FOR MAKING FALSE STATEMENTS IN BIDS IS PRESCRIBED IN 18 USC 1001. (FAR 52.214-4)

3. NOTE THE AFFIRMATIVE ACTION REQUIREMENT OF THE EQUAL OPPORTUNITY CLAUSE WHICH MAY APPLY TO THE CONTRACT RESULTING FROM THIS SOLICITATION.

4. NOTE THE CERTIFICATION OF NONSEGREGATED FACILITIES IN THIS SOLICITATION. FAILURE OF A BIDDER OR OFFEROR TO AGREE TO THE CERTIFICATION WILL RENDER HIS BID OR OFFER NONRESPONSIVE TO THE TERMS OF SOLICITATIONS INVOLVING AWARDS OF CONTRACTS EXCEEDING $10,000 WHICH ARE NOT EXEMPT FROM THE PROVISIONS OF THE EQUAL OPPORTUNITY CLAUSE.

BIDDING SCHEDULE

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Amount
1.	Stone:				
	a. Mobilization and Demobilization	sum	job		$_____
	b. Stone Weir: Graded Stone A	170,000	tons	$_____	_____
				TOTAL	$_____

(See NOTES on Page 5)

BIDDING SCHEDULE NOTES

NOTES: (a) All quantities shown on the BIDDING SCHEDULE are estimated quantities except when the unit is shown as "job".

(b) When bids are solicited on a unit price basis, bidders shall insert in the spaces provided therefor in the SCHEDULE both the "unit price" and the "estimated amount" resulting from applying the said unit price to the estimated quantity shown. In event the bidder quotes only a total price ("estimated amount") in his bid and fails to quote the unit price, the Government will determine such unit price by dividing the total price quoted by the quantity of the item set out in the SCHEDULE. The bidder agrees that the unit price so determined shall be used for the purpose of bid evaluation, award and all payments to the Contractor including final payment.

(c) All extensions of the unit prices shown will be subject to verification by the Government. In case of variation between the unit price and the extension, the unit price will be considered to be the bid and the extension will be corrected accordingly.

(d) If a modification to a bid based on unit prices is submitted, which provides for a lump sum adjustment to the total estimated cost, the application of the lump sum adjustment to each unit price in the bid schedule must be stated. If it is not stated, the bidder agrees that the lump sum adjustment shall be applied on a pro rata basis to every unit price in the bid schedule.

(e) Bidders are required to bid on all items listed on the Bidding Schedule in addition to inserting a total quoted bid in the appropriate space provided. Failure to do so will be considered good cause to disqualify the bid.

(f) Item No. 1 has been subdivided into subitems. A bid for the work shall include a bid for each of these subitems. Bidders should refer to Special Clause SC-50 before preparing their bids for these items.

Arithmetic Discrepancies. EFARS 14.406-2 (JUL 89)

a. For the purpose of initial evaluation of bids, the following will be utilized in resolving arithmetic discrepancies found on the face of the bidding schedule as submitted by bidders:

(1) Obviously misplaced decimal points will be corrected;

(2) In case of discrepancy between unit price and extended price, the unit price will govern;

(3) Apparent errors in extension of unit prices will be corrected; and

(4) Apparent errors in addition of lump-sum and extended prices will be corrected.

b. For the purposes of bid evaluation, the Government will proceed on the assumption that the bidder intends his bid to be evaluated on the basis of the unit prices, extensions, and totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (APR 1984) FAR 52.222-23.

a. The Offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clauses of this solicitation.

b. The goals for minority and female participation, expressed in percentage terms for the contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

SMSA/EA Economic Area	Goals for Minority Participation For Each Trade	Goals for Female Participation for Each Trade
St. Louis, MO(EA)	11.4	6.9

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in the geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs Office.

c. The Contractor's compliance with the Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on its (1) implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet prescribed goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

d. The Contractor shall provide written notification to the Director, Office of Federal Contract Compliance Programs, within 10 working days following award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list:

(1) Name, address and telephone number of the subcontractor;
    (i) Employer identification number of the subcontractor;
(2) Estimated dollar amount of the subcontract;
(3) Estimated starting and completion dates of the subcontract; and
(4) Geographical area in which the subcontract is to be performed.

e. As used in this Notice, and in the contract resulting from this Solicitation, the "covered area" is: (a) Mississippi and Scott Counties, Missouri and Alexander County, Illinois.

The bidder makes the following representations and certifications as a part of the bid identified above. (Check appropriate boxes.)

1A. SMALL BUSINESS CONCERN REPRESENTATION (MAY 1986) FAR 52.219-1.

The offeror represents and certifies as part of its offer that it /___/ is, /___/ is not a small business concern and that /___/ all, /___/ not all end items to be furnished will be manufactured or produced by a small business concern in the United States, its territories or possessions, Puerto Rico or the Trust Territory of the Pacific Islands. "Small business concern", as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the size standards in this solicitation.

1B. SMALL BUSINESS SIZE STANDARD.

The work to be procured under this solicitation is classified in Standard Industrial Classification Code 1629 and, for the purpose of this procurement to qualify as a small business concern, in addition to being independently owned and operated and not dominant in the field of operation in which it is bidding on Government contracts, the average annual receipts of the concern and its affiliates for the preceding three fiscal years do not exceed $17.0 million.

2. SMALL DISADVANTAGED BUSINESS CONCERN REPRESENTATION (DOD FAR SUPPLEMENT DEVIATION) (JUN 1988) DFARS 252.219-7005.

(a) Definition. "Small disadvantaged business concern", as used in this provision, means a small business concern, including mass media, owned and controlled by individuals who are both socially and economically disadvantaged, as defined in regulations prescribed by the U.S. Small Business Administration at 13 CFR Part 124, the majority of earnings of which directly accrue to such individuals. (13 CFR Part 124 generally provides that a small disadvantaged business concern is a small business concern (1) which is at least 51 percent (51%) owned by one or more socially and economically disadvantaged individuals; or in the case of any publicly owned business, at least 51 percent (51%) of the voting stock of which is owned by one or more socially or economically disadvantaged individuals, and (2) whose management and daily business operations are controlled by one or more such individuals.) (See 13 CFR 124.101 through 124.110.)

(b) Representation. The Offeror represents that its qualifying ownership falls within at least one of the following categories, (check the applicable categories):

_____ Subcontinent Asian (Asian-Indian) American (US Citizen with origins from India, Pakistan, Bangladesh, or Sri Lanka)

_____ Asian-Pacific American (US Citizen with origins from Japan, China, The Philippines, Vietnam, Korea, Samoa, Guam, U.S. Trust Territory of the Pacific Islands, Northern Mariana Islands, Laos, Cambodia, or Taiwan)

Black American (US Citizen)

_____ Hispanic American (US Citizen with origins from South America, Central America, Mexico, Cuba, the Dominican Republic, Puerto Rico, Spain or Portugal)

_____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians)

_____ Individual/concern certified for participation in the Minority Small Business and Capital Ownership Development Program under section 8(a) of the Small Business Act (15 U.S.C. 637(a))

_____ Other minority found to be socially disadvantaged by the Small Business Administration (U.S. Citizen)

(c) Certification.

(1) The Offeror represents and certifies, as part of its offer, that it is _____, is not _____ a small disadvantaged business concern.

(2) (Complete only if item (b) above is checked "Other")
The Offeror represents and certifies, as part of its offer, that the Small Business Administration (SBA) has _____, has not _____ made a determination concerning the Offeror's status as a small disadvantaged business concern. If the SBA has made such a determination, the date of the determination was _____ _____ and the Offeror certifies that it was _____, was not _____ found by the SBA to be socially and economically disadvantaged as a result of that determination and that no circumstances have changed to vary that determination.

(d) Notification. The Offeror agrees to notify the Contracting Officer before award of any change in its status as a small disadvantaged business concern occurring between the submission of its offer and contract award.

(e) Penalty. The Offeror represents and certifies that the above information is true and understands that whoever for the purpose of securing a contract or subcontract under subsection (a) of Section 1207 of Public Law 99-661 misrepresents the status of any concern or person as a small business concern owned and controlled by a minority (as described in subsection (a)) shall be punished by a fine of not less than $10,000 or by imprisonment for not more than a year, or both.

3. WOMEN-OWNED SMALL BUSINESS REPRESENTATION (APR 1984) FAR 52.219-3.

a. REPRESENTATION: The offeror represents that it /___/ is, /___/ is not a women-owned small business concern.

b. DEFINITIONS:

(1) "Small business concern," as used in this provision, means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

(2) "Women-owned," as used in this provision, means a small business that is at least 51 percent owned by a woman or women who are U.S. citizens and who also control and operate the business.

4. CONTINGENT FEE REPRESENTATION AND AGREEMENT (APR 1984) FAR 52.203-4.

a. REPRESENTATION: The offeror represents that, except for full-time bona fide employees working solely for the offeror, the offeror -

(NOTE: The offeror must check the appropriate boxes. For interpretation of the representation, including the term "bona fide employee," see Subpart 3.4 or the Federal Acquisition Regulation.)

(1) /___/ has /___/has not employed or retained any person or company to solicit or obtain this contract; and

(2) /___/ has /___/ has not paid or agreed to pay to any person or company employed or retained to solicit or obtain this contract any commission, percentage, brokerage, or other fee contingent upon or resulting from the award of this contract.

b. AGREEMENT: The offeror agrees to provide information relating to the above Representation as requested by the Contracting Officer and, when

subparagraph a.(1) or a.(2) is answered affirmatively, to promptly submit to the Contracting Officer -

(1) A completed Standard Form 119, Statement of Contingent or Other Fees, (SF 119); or

(2) A signed statement indicating that the SF 119 was previously submitted to the same contracting office, including the date and applicable solicitation or contract number, and representing that the prior SF 119 applies to this offer or quotation.

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

15. NOTICE OF RESTRICTIONS ON CONTRACTING WITH SANCTIONED PERSONS. FAR 52.225-12 (MAY 1989)

(a) Statutory prohibitions have been imposed on contracting with sanctioned persons, as specified in Federal Acquisition Regulation (FAR) 52.225-13, Restrictions on Contracting with Sanctioned Persons.

(b) By submission of this offer, the Offeror represents that no products or services, except those listed in this paragraph (b), delivered to the Government under any contract resulting from this solicitation will be products or services of a sanctioned person, as defined in the clause referenced in paragraph (a) of this provision, unless one of the exceptions in paragraph (d) of the clause at FAR 52.225-13 applies.

Product or Service	Sanctioned Person

(List as necessary)

16. INFORMATION REGARDING THE EXECUTION OF A COMPETITIVE INFORMATION CERTIFICATE (AUG 1989) AL 89-21

Prospective bidders/offerors are hereby notified that, prior to award, the apparent low bidder or apparently successful offeror will be required to execute a "Competitive Information Certificate" if such prospective awardee is listed as a Contractor from whom a "Competitive Information Certificate" is required. This certification is required for all competitive procurements expected to exceed $100,000 and is in addition to the Contractor certification requirements set forth in FAR 3.104-9.

17. SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (JAN 1989). DFARS 252.219-7012.

(a) Definition.

"Emerging Small Business", as used in this Solicitation, means a Small Business Concern whose size is no greater than 50 percent of the numerical size standard applicable to the standard industrial classification code assigned to a contracting opportunity.

(b) (Complete only if offeror has certified itself under the clause at FAR 52.219-1 as a small business concern under the size standards of this solicitation.) The offeror represents and certifies as part of its offer that it is, is not an emerging small business.

(c) (Complete only if the Offeror is a Small Business or an Emerging Small Business, indicating its size range.) Offeror's number of employees for the past twelve months or Offeror's average annual gross revenue for the last three fiscal years. (Check one of the following.)

No. of Employees	Average Annual Gross Revenues
50 or fewer	$1 million or less
51 - 100	$1,000,001 - $2 million

101 - 250	$2,000,001 - $3.5 million
251 - 500	$3,500,001 - $5 million
501 - 750	$5,000,001 - $10 million
751 - 1,000	$10,000,001 - $17 million
Over 1,000	Over $17 million

18. CERTIFICATION REGARDING A DRUG-FREE WORKPLACE (MAR 1989) FAR 52.223-5.

(a) Definitions. As used in this provision,

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substance Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

"Drug-free workplace" means a site for the performance of work done in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) By submission of its offer, the offeror, if other than an individual, who is making an offer that equals or exceeds certifies and agrees, that with respect to all employees of the offeror to be employed under a contract resulting from this solicitation, it will--

(1) Publish a statement notifying such employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish a drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this provision;

(4) Notify such employees in the statement required by subparagraph (b)(1) of this provision, that as a condition of continued employment on the contract resulting from this solicitation, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;

(5) Notify the contracting officer within ten (10) days after receiving notice under subdivision (b)(4)(ii) of this provision, from an employee or otherwise receiving actual notice of such conviction; and

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this provision of a conviction, impose the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace:

(i) Take appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this provision.

(c) By subcommission of its offer, the offeror, if an individual who is making an offer of any dollar value, certifies and agrees that the offeror will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in the performance of the contract resulting from this solicitation.

(d) Failure of the offeror to provide the certification required by paragraphs (b) or (c) of this provision, renders the offeror unqualified and ineligible for award. (See FAR 9.104-1(g) and 19.602-1(a)(2)(i).)

(e) In addition to other remedies available to the Government, the certification in paragraphs (b) and (c) of this provision concerns a matter within the jurisdiction of an agency of the United States and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States Code, Section 1001.

19. TAXPAYER IDENTIFICATION. FAR 52.204-3 (SEP 89).

(a) Definitions.

"Common parent," as used in this solicitation provision, means that corporate entity that owns or controls and affiliated group of corporations that files its Federal income tax returns on a consolidated bases, and of which the offeror is a member.

"Corporate status," as used in this solicitation provision, means a designation as to whether the offeror is a corporate entity, and unincorporated entity (e.g., sole proprietorship of partnership), or a corporation providing medical and health care services.

"Taxpayer Identification Number (TIN)," as used in this solicitation provision, means the number required by the IRS to be used by the offeror in reporting income tax and other returns.

(b) The offeror is required to submit the information required in paragraphs (c) through (e) of this solicitation provision in order to comply with reporting requirements of 26 U>S>C> 6041, 6041A, and 6050M and implementing regulations issued by the Internal Revenue Service (IRS). If the resulting contract is subject to the reporting requirements described in 4.902(a), the failure or refusal by the offeror to furnish the information may result in a 20 percent reduction of payments otherwise due under the contract.

(c) Taxpayer Identification Number (TIN).

☐ TIN:_____.

☐ TIN has been applied for.

[ ] TIN is not required because:

[ ] Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the U>S> and does not have an office or place of business or a fiscal paying agent in the U.S.;

[ ] Offeror is an agency or instrumentality of a foreign government;

[ ] Offeror is an agency or instrumentality of a Federal, state, or local government;

[ ] Other. State basis_____.

(d) Corporate Status.

[ ] Corporation providing medical and health care services, or engaged in the billing and collecting of payments for such services;

[ ] Other corporate entity;

[ ] Not a corporate entity;

[ ] Sole proprietorship

[ ] Partnership

[ ] Hospital or extended care facility described in 26 CFR 501(c)(3) that is exempt from taxation under 26 CFR 501(a).

(e) Common Parent.

[ ] Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this clause.

[ ] Name and TIN of common parent:

Name _____

TIN _____

INSTRUCTIONS TO BIDDERS

1. EXPLANATION TO PROSPECTIVE BIDDERS (APR 1984) FAR 52.214-6.

Any prospective bidder desiring an explanation or interpretation of the solicitation, drawings, specifications, etc., must request it in writing soon enough to allow a reply to reach all prospective bidders before the submission of their bids. Oral explanations or instructions given before the award of a contract will not be binding. Any information given a prospective bidder concerning a solicitation will be furnished promptly to all other prospective bidders as an amendment to the solicitation, if that information is necessary in submitting bids or if the lack of it would be prejudicial to other prospective bidders.

2. PREPARATION OF BIDS - CONSTRUCTION (APR 1984) FAR 52.214-18.

a. Bids must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing the bid must initial each erasure or change appearing on any bid form.

b. The bid form may require bidders to submit bid prices for one or more item on various bases, including -

(1) Lump sum bidding;

(2) Alternate prices;

(3) Units of construction; or

(4) Any combination of subparagraph (1) through (3) above.

c. If the solicitation requires bidding on all items, failure to do so will disqualify the bid. If bidding on all items is not required, bidders should insert the words "no bid" in the space provided for any item on which no price is submitted.

d. Alternate bids will not be considered unless this solicitation authorizes their submission.

3. BIDDER'S QUALIFICATIONS.

Before a bid is considered for award, the bidder may be requested by the Government to submit a statement regarding his previous experience in performing comparable work, his business and technical organization, financial resources, and plant available to be used in performing the work.

4. SUBMISSION OF BIDS (APR 1984) FAR 52.214-5.

a. Bids and bid modifications shall be submitted in sealed envelopes or packages (1) addressed to the office specified in the solicitation and (2) showing the time specified for receipt, the solicitation number, and the name and address of the bidder.

b. Telegraphic bids will not be considered unless authorized by the solicitation; however, bids may be modified or withdrawn by written or telegraphic notice, if such notice is received by the time specified for receipt of bids.

5. LATE SUBMISSIONS, MODIFICATIONS, AND WITHDRAWALS OF BIDS (APR 1984) FAR 52.214-7.

a. Any bid received at the office designated in the solicitation after the exact time specified for receipt will not be considered unless it is received before the award is made and it -

(1) Was sent by registered or certified mail not later than the fifth calendar day before the date specified for receipt of bids (e.g., a bid submitted in response to a solicitation requiring receipt of bids by the 20th of the month must have been mailed by the 15th); or

(2) Was sent by mail (or was telegraphic bid if authorized), and it is determined by the Government that the late receipt was due solely to mishandling by the Government after receipt at the Government installation.

b. Any modification or withdrawal of a bid is subject to the same conditions as in paragraph a. above.

c. The only acceptable evidence to establish the date of mailing of a late bid, modification, or withdrawal sent either by registered or certified mail is the U.S. or Canadian Postal Service postmark on the wrapper or on the original receipt from the U.S. or Canadian Postal Service. If neither postmark shows a legible date, the bid, modification, or withdrawal shall be processed as if mailed late. "Postmark" means a printed, stamped, or otherwise placed impression (exclusive of a postage meter machine impression) that is readily identifiable without further action as having been supplied and affixed by employees of the U.S. or Canadian Postal Service on the date of mailing. Therefore, bidders should request the postal clerks to place a hand cancellation bull's-eye postmark on both the receipt and the envelope or wrapper.

d. The only acceptable evidence to establish the time of receipt at the Government installation is the time/date stamp of that installation on the bid wrapper or other documentary evidence of receipt maintained by the installation.

e. Notwithstanding paragraph (a) above, a late modification of an otherwise successful bid that makes its terms more favorable to the Government will be considered at any time it is received and may be accepted.

f. A bid may be withdrawn in person by a bidder or its authorized representative if, before the exact time set for receipt of bids, the identity of the person requesting withdrawal is established and that person signs a receipt for the bid.

6. BID BOND (MAR 1989) DFARS 252.228-7007.

(a) The Offeror (Bidder) shall furnish a separate bid bond, or United States bonds, Treasury notes or other public debt obligations of the United States, in the proper form and amount, by the time set for opening of bids. Failure to do so may be cause for rejection of the bid. The Contracting Officer will return bond or notes of the United States (1) to unsuccessful bidders as soon as practicable after the opening of bids; and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.

(b) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or give a bond(s) as required by the solicitation within the time specified, the Contracting Officer may terminate the contract for default.

(c) Unless otherwise specified in the bid, the Bidder will (1) allow sixty (60) days for acceptance of its bid; and (2) give bond within ten (10) days after receipt of the forms by the Bidder.

(d) In the event the contract is terminated for default, the Bidder is liable for any cost of acquiring the work that exceeds the amount of its bid. The bid bond, or bonds or notes of the United States, is available to offset the difference.

7. BONDS.

Bonds listed below are required when the bid amount exceeds $25,000.

a. Bid Bonds. - Each bidder shall submit with his bid a Bid Bond (Standard Form 24) with good and sufficient surety or sureties acceptable to the Government, or other security as provided in paragraph 6 above in the form of twenty percent (20%) of the bid price or $3,000,000 whichever is lesser. The bid bond penalty may be expressed in terms of a percentage of the bid price or may be expressed in dollars and cents.

b. Performance and Payment Bonds. - Within 10 days after the prescribed forms are presented to the bidder to whom award is made for signature, a written contract on the form prescribed by the specifications shall be executed and two bonds, each with good and sufficient surety or sureties acceptable to

the Government, furnished; namely a performance bond (Standard Form 25) and a payment bond (Standard Form 25-A). The penal sums of such bonds will be as follows:

(1) Performance Bond. - The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.

(2) Payment Bond -

(a) When the contract price is $1,000,000 or less, the penal sum will be fifty percent (50%) of the contract price.

(b) When the contract price is in excess of $1,000,000 but not more than $5,000,000, the penal sum shall be forty percent (40%) of the contract price.

(c) When the contract price is more than $5,000,000, the penal sum shall be $2,500,000.

Any bonds furnished will be furnished by the Contractor to the Government prior to commencement of contract performance.

8. AMENDMENTS PRIOR TO DATE SET FOR OPENING BIDS.

The right is reserved, as the interest of the Government may require, to revise or amend the specifications or drawings or both prior to the date set for opening bids. Such revisions and amendments, if any, will be announced by an amendment or amendments to this Solicitation. If the revisions and amendments are of a nature which requires material changes in quantities or prices bid or both, the date set for opening bids may be postponed by such number of days as in the opinion of the issuing officer will enable bidders to revise their bids. In such cases, the amendment will include an announcement of the new date for the opening bids.

9. AMENDMENTS TO INVITATIONS FOR BIDS (NOV 1988) FAR 52.214-3.

(a) If this solicitation is amended, then all terms and conditions which are not modified remain unchanged.

(b) Bidders shall acknowledge receipt of any amendments to this Solicitation (1) by signing and returning the amendment; (2) by identifying the amendment number and date in the space provided for this purpose on the form for submitting a bid; or (3) by letter or telegram. The Government must receive the acknowledgement by the time and at the place specified for receipt of bids.

10. TELEGRAPHIC BID MODIFICATIONS.

Telegraphic bids are not authorized, however, modification or withdrawal of bids by telegram is authorized, provided telegraphic notice is submitted so as to be received in the office designated in this Solicitation not later than the exact time set for opening of bids. The telegraphic modification or

withdrawal received in such office by telephone from the receiving telegraph office not later than the time set for opening of bids shall be considered if such message is confirmed by the telegraph company by sending a copy of the telegram which formed the basis for the telephone call.

11. PRE-AWARD INFORMATION.

The low bidder shall, upon request of the Contracting Officer, furnish a statement of whether he is now or ever has been engaged in any work similar to that covered by the specifications herein, the dollar value thereof, the year in which such work was performed, a brief description of the work, and the manner of its execution, and giving such other information as will tend to show the bidder's ability to prosecute the required work. The bidder shall furnish the above information for at least 4 commercial firms and/or Government agencies for whom he has performed work. The "such other information" referred to above shall include but is not limited to the following:

(1) The name and address of the office or firm under which such work was performed.

(2) A brief history of business experience, including length of time in present business.

(3) A list of key personnel available for instant project and their qualifications.

(4) A copy of bidder's latest financial statement, including the names of banks or other financial institutions with which the bidder conducts business. If the financial statement is more than 60 days old, a certificate should be attached stating that the financial condition is substantially the same, or if not the same, the changes that have taken place. Such statement will be treated as confidential.

(5) A list of present commitments, including the dollar value thereof, and name of office under which the work is being performed.

(6) A list of the plant available to the bidder and proposed for use on the work.

12. CONTRACTOR ESTABLISHMENT CODE. FAR 52.204-4 (AUG 1989).

In the block with its name and address, the offeror should supply the Contractor Establishment Code applicable to that name and address, if known to the offeror. The number should be preceded by "CEC: Offerors should take care to report the correct CEC and not a similar number assigned to the Offeror in a different system."

The CEC is a 9-digit code assigned to a contractor establishment that contracts with a Federal executive agency. The CEC system is a contractor identification coding system which is currently the Dun and Bradstreet Data Universal Numbering System (DUNS). The CEC system is distinct from the Federal Taxpayer Identification Number (TIN) system.

The Government will obtain a Contractor Establishment Code for any awardee that does not have or does not know its CEC.

13. DRAWINGS AND SPECIFICATIONS.

Prior to the opening of bids, drawings and specifications will be furnished to order upon receipt of payment therefor in the amount(s) indicated in the following schedule, which includes $2.50 mailing costs. No refund of the payment will be made and the drawings and specifications need not be returned. Payment shall be in the form of certified check, money order, or cashiers check made payable to "FAO, USACE, Memphis District" and delivered to the Dept. of the Army, St. Louis District, Corps of Engineers, 210 Tucker Boulevard, North, St. Louis, Missouri 63101-1986. After the opening of bids, the provisions of Special Clause SC-3 will apply.

Schedule of Payments

Complete set specifications and half-size drawings $13.50 per set

Complete set specifications and full-size drawings $20.00 per set

One set specifications only No Charge

Additional copies of specifications without drawings $7.00 each

Individual sheets of half-size drawings: $0.50 per sheet (Maximum charge $6.50 per set)

Individual sheets of full-size drawings: $1.00 per sheet (Maximum charge $13.00 per set)

If the project is cancelled or no award is made under the Solicitation, upon request, refund of the payment for the plans and specifications, not including the $2.50 mailing costs, will be made upon return thereof to the issuing office.

14. INSPECTION TRIP.

An inspection trip with Government transportation to enable prospective bidders to visit the site of the work will be scheduled only at the request of a prospective bidder. Bidders desiring transportation with a Government representative accompanying them to the site should notify Mr. William E. Busch, Project Manager, Lower Mississippi River Project Office, Room 102 Federal Building, 339 Broadway, Cape Girardeau, Missouri 63701-7344 at Area Code 314/335-3386. If an inspection trip is requested, it will take place at 10:00 A.M. local time, on 7 February 1990, and all prospective bidders desiring to make the trip must notify the Project Manager at least 7 days prior to the above date. Bidders will board and disembark the motor vessel at Buffalo Island Grain Elevator, Mississippi River Mile 28.0(R). Bidders shall provide their own return transportation. Unaccompanied site visits may be made anytime prior to bid opening provided bidders notify Mr. Busch before such visits.

15. QUESTIONS.

Prospective bidders are encouraged to submit written questions on any aspect of the Solicitation. In this connection, see Paragraph 1 of "INSTRUCTIONS TO BIDDERS." Responses to written or verbal questions that result in a change to the plans and specifications will be answered by amendment only in order to provide all prospective bidders the changes at the same time. All technical questions, written or verbal, regarding this Solicitation, before bids have been opened, should be referred to Ms. Janet C. Ulivi, P.E., Environmental/Specifications Section (314/263-5861), Room 631, U.S. Army Corps of Engineers, 210 Tucker Blvd., N., St. Louis, Missouri 63101-1986. Questions concerning contractual matters or information on obtaining plans, specifications, and bidding documents should be referred to Mrs. Joan F. Schick, Chief, Contracts Branch, Room 964, address as above, (Area Code 314/263-5845). COLLECT TELEPHONE CALLS WILL NOT BE ACCEPTED.

16. INSPECTION OF INFORMATION.

All requests to review items listed in Special Clause SC-7a should be referred to Ms. Janet Ulivi, Room 631, U.S. Army Corps of Engineers, 210 Tucker Blvd. N., St. Louis, Missouri, 63101-1986.

17. QUANTITIES IN LUMP SUM ITEMS.

Estimates of quantities involved in certain items of work for which bids are being solicited on a lump sum or job basis have been made for the use of the Government. Copies of these quantity estimates may be obtained by contacting the Contracts Branch, Telephone No. (314) 263-5845 Dept. of the Army, St. Louis District, Corps of Engineers, 210 Tucker Boulevard, North, St. Louis, Missouri 63101-1986. It is to be expressly understood that the accuracy of these estimates is in no wise warranted and that the furnishing of this information to a bidder will not relieve him of his responsibility to estimate the quantities involved. It is further to be expressly understood that in no case will such estimates be used as a basis of a claim against the Government.

18. SITE OF THE WORK.

Bidders are advised that for purpose of applicability of the Davis-Bacon Act and other contract labor standards provisions, "the site of the work" under the contract to be awarded pursuant to this Solicitation may not be limited to the physical place(s) where the construction called for in the contract will remain when work on it has been completed. The "site of the work" may include other adjacent or nearby property used by the contractor or subcontractors during such construction. For example, fabrication plants, mobile factories, batch plants, borrow pits, job headquarters, tool yards, etc., will be considered part of the site of the work, provided they are dedicated exclusively or nearly so to performance on the contract and are so located in proximity to the actual construction location that it would be reasonable to include them.

19. CONTRACT AWARD--SEALED BIDDING--CONSTRUCTION (FEB 1986) FAR 52.214-19.

a. The Government will evaluate bids in response to this solicitation without discussion and will award a contract to the responsible bidder whose bid, conforming to the solicitation, will be most advantageous to the Government, considering only price and the price-related factors specified elsewhere in the solicitation.

b. The Government may reject any or all bids, and waive informalities or minor irregularities in bids received.

c. The Government may accept any item or combination of items, unless doing so is precluded by a restrictive limitation in the solicitation or the bid.

20. SERVICE OF PROTEST (NOV 1988) FAR 52.233-2.

(a) Protests as defined in Section 33.101 of the Federal Acquisition Regulation that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO) or the General Services Administration Board of Contract Appeals (GSBCA), shall be served on the Contracting Officer by obtaining written and dated acknowledgement of receipt from District Counsel, Dept. of the Army, St. Louis District, Corps of Engineers, 210 Tucker Blvd, N., St. Louis, MO 63101-1986.

(b) The copy of any protest shall be received in the office designated above on the same day a protest is filed with the GSBCA or within one day of filing a protest with the GAO.

21. AUTHORITY, APPROPRIATION AND ACCOUNTING DATA.

The work provided for herein is authorized under:

Appropriation: 96X3122 Construction, General

22. AUTHORITY.

This contract is effected pursuant to 10 U.S.C. 2304.

23. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE.

Whenever a modification or equitable adjustment of contract price is required, the Contractor's cost proposals for equipment ownership and operating expenses shall be determined in accordance with the requirements of Clause SC-34 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE, contained in the Special Clauses of the specifications. A copy of EP 1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" is available for review by bonafide bidders in the District Library, Room 926, 210 Tucker Boulevard, North, St. Louis, Missouri 63101-1986, or may be obtained, at a cost of $11.00 per copy, from:

Superintendent of Documents
U.S. Government Printing Office
Document Warehouse
8160 Cherry Lane
Laurel, MD 20707
Telephone (301) 953-7974

24. AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) (APR 1984) FAR 52.210-2.

Single copies of specifications cited in this solicitation may be obtained by submitting a written request to the supply point listed below. The request must contain the title of the specification, its number, date, applicable amendment(s), and the solicitation or contract number. In case of urgency, telephone or telegraphic requests are acceptable. Voluntary standards, which are not available to offerors and contractors from Government sources, may be obtained from the organization responsible for their preparation, maintenance, or publication.

Commanding Officer
U.S. Naval Publication and Forms Center
5801 Tabor Avenue
Philadelphia, PA 19120
Telex Number.....834295
Western Union Number.....710-670-1685
Telephone Number.....215-697-3321

25. AVAILABILITY OF DESCRIPTIONS LISTED IN DOD 5010.12-L, (SEP 1987) DFARS 252.210-7001.

Copies of the Acquisition Management Systems and Data Requirements Control List, DOD 5010.12-L may also be ordered from the supply point listed herein. When requesting a data item description, the request shall cite applicable data item number set forth in the solicitation.

26. VALUE ENGINEERING (VE) PAYMENT TO CONTRACTORS.

Value Engineering. Special attention is invited to the Contract Clause entitled, Value Engineering--Construction. The St. Louis District policy to authorize immediate payment to contractors for their portion of VECP savings is an important step in providing adequate incentives to contractors for their support of this program. Carefully review the contract documents for potential savings and submit ideas promptly upon award to maximize savings.

27. WORK TO BE PERFORMED BY CONTRACTOR'S OWN ORGANIZATION.

Within five days after award the successful bidder/contractor must furnish the Contracting Officer a description of the items of work which will be performed with its own forces and the estimated cost of those items. (See Special Clause SC-14 of these specifications.)

28. TEMPORARY PROJECT FENCING.

Bidders are advised that Paragraph 06.A.06 of Safety and Health Requirements Manual EM 385-1-1 dated April 1981, Revised Oct 1987, requires temporary project fencing on projects located in areas actively utilized by the general public. Temporary fencing is not required for this project.

29. HARBOR MAINTENANCE FEE (EAL 88-1).

Offerors or bidders contemplating use of U.S. ports in the performance of contract work are subject to paying a harbor maintenance fee as authorized under Section 1402 of the Water Resource Development Act of 1986 (Public Law 99-662). The fee imposed by the act is equal to a percentage (as set forth by the Act and amendments thereto) of the value of the commercial cargo involved. Firms performing work under U.S. Government contracts are not exempt from the act. Offerors and bidders are responsible for ensuring that the applicable fee and associated cost are taken into consideration in the preparation of their offer or bid.

Information pertaining to the act and a list of U.S. ports which subjects the cargo to the harbor maintenance fee may be obtained from local U.S. Customs, Service Offices or by writing to the Director, User Fee Task Force, Division of Inspection and Control, Room 4132, U.S. Customs Service, 1301 Constitution Avenue, N.W., Washington, D.C. 20229.

30. COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (OCT 1987) DFARS 252.204-7007.

In the block with its name and address, the Offeror should supply the CAGE code applicable to that name and address. The CAGE code should be preceded by "CAGE:". If the Offeror does not have a CAGE code, the Offeror may request the Contracting Officer to initiate a DD Form 2051. The Contracting Activity will complete Section A and the Offeror must complete Section B of the DD Form 2051. A CAGE code will be assigned when a completed DD Form 2051 is received by the Defense Logistics Services Center, Attn: DLSC-FBA, Federal Center, 74 N. Washington, Battle Creek, MI 49017-3084. No Offeror should delay the submission of its offer pending receipt of its CAGE code.

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1. EFARS 52.202-10001 DEFINITIONS (JUL 1989) (DEVIATION)

(a) The term "head of the agency" or "Secretary" as used herein means the Secretary of the Army; and the term "his duly authorized representative" means the Chief of Engineers, Department of the Army, or an individual or board designated by him.

(b) The agency board of contract appeals having jurisdiction over all appeals from final decisions of the Contracting Officer under the Contract Disputes Act of 1978 is the Corps of Engineers Board of Contract Appeals, Office of the Chief of Engineers, Pulaski Building, 20 Massachusetts Avenue, N.W., Washington, D.C. 20314-1000.#

2. FAR 52.203-1 OFFICIALS NOT TO BENEFIT (APR 1984)

No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this contract, or to any benefit arising from it. However, this clause does not apply to this contract to the extent that this contract is made with a corporation for the corporation's general benefit.#

3. FAR 52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to and officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) above, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c) (2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.#

4. FAR 52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this

contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.#

5. FAR 52.203-7 ANTI-KICKBACK PROCEDURES (OCT 1988)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits

any person from --

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c) (1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal Agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the prime Contractor withhold from sums owed a subcontractor under the prime contract, monies withheld, the amount of the kickback. The Contracting Officer may order that monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract.#

6. DFARS 252.203-7001 SPECIAL PROHIBITION ON EMPLOYMENT (MAR 1989)

(a) Definitions. "Arising out of a contract with the Department of Defense," as used in this clause, means any act in connection with (1) attempting to obtain, (2) obtaining, or (3) performing a contract or subcontract of any agency, department, or component of the Department of Defense.

"Conviction of fraud or any other felony", as used in this clause, means any conviction for fraud or a felony in violation of state or Federal criminal statutes, whether entered on a verdict or plea, including a plea of nolo contendere, for which sentence has been imposed.

"Date of conviction", as used in this clause, means the date judgment was entered against the individual.

(b) 10 U.S.C. 2408 prohibits a person who is convicted of fraud or any other felony arising out of a contract with the Department of Defense from working in a management or supervisory capacity on any defense contract, or serving in various other capacities for a defense contractor, for up to five (5) years from the date of conviction, as set forth in paragraph (c) below. Defense

contractors are subject to a criminal penalty of not more than $500,000 if they are convicted of knowingly employing a person under a prohibition or allowing that person to serve in violation of 10 U.S.C. 2408.

(c)(1) The Contractor agrees not to knowingly employ any person, convicted after September 29, 1988, of fraud or any other felony arising out of a contract with the Department of Defense, in a management or supervisory capacity on any Department of Defense contract or subcontract or allow that person to serve either on its board of directors, as a consultant, or as an agent or representative for a period of five (5) years from the date of conviction or for the period of any resultant debarment of the convicted person, whichever is longer, unless waived.

(2) The Contractor agrees not to knowingly employ any person, convicted on or before September 29, 1988, of fraud or any other felony arising out of a contract with the Department of Defense, in a management or supervisory capacity on any Department of Defense contract or subcontract or allow that person to serve on its board of directors for a period of one (1) year from the date of conviction or for the period of any resultant debarment, whichever is longer.

(d) In addition to the criminal penalties contained in 10 U.S.C. 2408, the Government may consider other available remedies, such as suspension or debarment, may direct the cancellation of the contract at no cost to the Government, or terminate this contract for default.

(e) The Contractor may submit written requests for waiver of the prohibitions in paragraph (c)(1) above to the Contracting Officer who will process such requests in accordance with DFARS 203.571-4. Requests shall clearly identify the person involved, the nature of the conviction and resultant sentence or punishment imposed, the reasons for the requested waiver, and an explanation of why waiver of the prohibitions of paragraph (c)(1) above is in the interests of national security.

(f) The Contractor agrees to include the substance of this clause, including this paragraph (f), appropriately modified to reflect the identity and relationship of the parties, in all subcontracts exceeding $25,000.#

7. DFARS 252.203-7002 STATUTORY COMPENSATION PROHIBITIONS AND REPORTING REQUIREMENTS RELATING TO CERTAIN FORMER DEPARTMENT OF DEFENSE (DOD) EMPLOYEES (APR 1988)

(The following clause is applicable if the amount of this contract is expected to exceed $100,000.)

(a) **Definitions.** Terms used in this clause are defined at section 3.170-1 of the Defense Federal Acquisition Regulation Supplement (48 CFR Chapter 2).

(b) **Prohibition on Compensation.**

(1) 10 U.S.C. 2397b and 2397c prohibit a major defense contractor from offering or providing any compensation valued in excess of two hundred fifty dollars ($250) to a former Department of Defense (DoD) official who left DoD service on or after 16 April 1987 and who, while employed by DoD, performed procurement-related functions in connection with that same defense contractor. This prohibition runs for the two-year period beginning on the date of such person's separation from service in DoD.

(2) The Contractor, if a major defense contractor, agrees not to provide, for such two-year period, any compensation to such a former DoD official.

(3) DoD employees may request from their Designated Agency Ethics

Official (DAEO) a written opinion on the applicability of 10 U.S.C. 2397b prior to the acceptance of compensation. If the opinion rendered by the DAEO states that the law is inapplicable, and that the individual may accept compensation from the Contractor, there shall be a conclusive presumption that the offering and the acceptance of such compensation is not a violation of the statute.

(c) **Report Concerning Former DoD Employees.**

(1) The Contractor shall submit a separate written report, as described in (c)(2) below, for each calendar year covered by this contract (commencing with the calendar year of award and extending through the end of the calendar year in which final payment is made) if the calendar year commenced after the end of a Government fiscal year in which the Contractor was awarded one or more DoD contracts aggregating ten million dollars ($10,000,000) or more. In multidivisional corporations, in addition to corporate headquarters, each segment which contracts directly with the Government shall separately submit such reports. Each report shall be submitted to the Office of the Assistant General Counsel (Legal Counsel), Standards of Conduct Office, Attn: OAGC/LC, Pentagon, Washington, DC 20301-1600 listing those persons in its employ or whom it has otherwise compensated, who are former DoD employees who left service on or after 16 April 1987, if--

(i) They served in a civilian position for which the rate of pay was equal to or greater than the minimum rate of pay for Grade GS-13 of the General Schedule or served in the Armed Forces in a pay grade of 04 or higher;

(ii) They were compensated by the Contractor during the reporting period; and

(iii) Such compensation was provided within two (2) years after the former DoD employee left service in the Department of Defense.

(2) The report shall contain the following elements:

(i) Each individual's name and an identification of the agency in which each individual was employed or served on active duty during the last two (2) years of the individual's service with DoD;

(ii) Each individual's job title(s) during the person's last two (2) years of service with DoD and a list of major defense systems on which each individual performed any work;

(iii) A complete description (exclusive of proprietary information) of any work that each individual is performing, or did perform, on behalf of the Contractor during the calendar year covered by the report. (If the procurement is classified, the Contractor may use a generalized description which will not compromise the classified nature of the work.);

(iv) An identification of each major defense system on which each individual has performed any work on behalf of the Contractor.

(3) Each report required under (c)(1) above shall be submitted not later than April 1 of the year following the end of the calendar year for which the report is being made.

(4) A DD Form 1787 properly certified by the individual to whom it

relates may be submitted to satisfy the reporting requirement as to any single individual.

(5) The Contractor need not submit duplicate reports to the Government. Submission of a report meeting the requirements of this clause, under another, concurrent contract with DoD will satisfy the reporting requirement of this contract as to any single calendar year.

(d) **Penalties for Failure to Comply.**

(1) **Civil Fines for Failure to Comply with 10 U.S.C. 2397b.** A Contractor who knowingly offers or provides any compensation to a former DoD official in violation of the statute, and who knew or should have known that the acceptance of such compensation would be in violation of such statute, shall be subject to a civil fine, not to exceed five hundred thousands dollars ($500,000).

(2) **Liquidated Damages for Failure to Comply with 10 U.S.C. 2397c.**

(i) For each knowing violation of the statutory prohibition on providing compensation, the Contractor agrees to pay to the United States Government as liquidated damages the greater of either one hundred thousand dollars ($100,000) or three (3) times the total amount of compensation paid by the Contractor to the former DoD official during the period in which such compensation was in violation of the statutory prohibition.

(ii) Liability for liquidated damages under this clause survives final payment under this contract and may be recouped against payments due under other contracts with the Contractor. The rights and remedies under this clause are in addition to and do not limit any rights afforded to the Government under this contract or as otherwise provided by law.

(iii) Liquidated damages will be computed based upon the number of actual violations by the Contractor, and not on the number of contracts in which this clause appears.

(3) **Penalties for Failure to Report.** If the Contractor knowingly fails to file a report in accordance with (c) above, the Contractor shall be subject to an administrative penalty not to exceed ten thousand dollars ($10,000). The final determination of the penalty to be charged to the Contractor shall be made by the Secretary of Defense or designee after the Contractor is afforded an opportunity for an agency hearing on the record in accordance with agency hearing procedures. The Secretary's determination shall form a part of the record and shall be subject to judicial review under Chapter 7 of Title 5, United States Code.#

8. **FAR 52.203-9 REQUIREMENT FOR CERTIFICATE OF PROCUREMENT INTEGRITY--MODIFICATION (MAY 1989)** (The following clause is applicable if the amount of this contract is expected to exceed $100,000.)

(a) Definitions. The definitions det forth in FAR 3.104-4 are hereby incorporated in this clause.

(b) The Contractor agrees that it will execute the certification set forth in paragraph (c) of this clause, when requested by the contracting officer in connection with the execution of any modification of this contract. A contract modification may not be executed without the certification.

(c) Certification. As required in paragraph (b) of this clause, the

officer or employee responsible for the modification proposal shall execute the following certification:

CERTIFICATE OF PROCUREMENT
INTEGRITY--MODIFICATION (MAY 1989)

(1) I, [Name of certifier] am the officer or employee responsible for the preparation of this modification proposal and hereby certify that, to the best of my knowledge and belief, with the exception of any information described in this certification, I have no information concerning a violation or possible violation of subsection 27(a), (b), (c), or (e) of the Office of Federal Procurement Policy Act* (41 U.S.C. 423), (hereinafter referred to as the Act), as implemented in the FAR, occurring during the conduct of this procurement (contract and modification number).

(2) As required by subsection 27(d)(1)(B) of the Act, I further certify that each officer, employee, agent, representative, and consultant of [Name of offeror] who has participated personally and substantially in the preparation or submission of this proposal has certified that he or she is familiar with, and will comply with, the requirements of subsection 27(a) of the Act, as implemented in the FAR, and will report immediately to me any information concerning a violation or possible violation of subsections 27(a), (b), (c), or (e) of the Act, as implemented in the FAR, pertaining to this procurement.

(3) Violations or possible violations: (Continue on plain bond paper if necessary and label Certificate of Procurement Integrity--Modification (Continuation Sheet), ENTER "NONE" IF NONE EXISTS)

[Signature of the Officer or Employee Responsible for the Modification Proposal and date]

[Typed Name of the Officer or Employee Responsible for the Modification Proposal]

*Section 27 became effective on July 16, 1989.

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITES STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER TITLE 18, UNITED STATES CODE, SECTION 1001.

(End of Certification)

(d) In making the certification in paragraph (2) of the certificate, the Contractor may rely upon the certification by an officer, employee, agent, representative, or consultant that such person is in compliance with the requirements of subsections 27(a), (b), (c), or (e) of the Office of Federal Procurement Policy Act (41 U.S.C. 423), as implemented in the FAR, unless the Contractor knows, or should have known, of reasons to the contrary. The Contractor may rely upon periodic certifications that must be obtained at least annually, supplemented with periodic training programs. These certifications shall be maintained by the Contractor for a period of 6 years from the date of execution.

(e) The certification required by paragraph (c) of this clause is a material representation of fact upon which reliance will be placed in executing this modification.#

9. FAR 52.203-10 REMEDIES FOR ILLEGAL OR IMPROPER ACTIVITY (MAY 1989)

(a) The Government, at its election, may reduce the price of a fixed-price-type contract or contract modification and the total cost and fee under a cost-type contract or contract modification by the amount of profit or fee determined as set forth in paragraph (c) of this clause if the head of the agency or his or her designee, determines that there was a violation of subsection 27(a) of the Office of Federal Procurement Policy Act (41 U.S.C. 423) as implemented in the FAR. In the case of a contract modification the fee subject to the reduction is the fee associated with the particular contract modification.

(b) Prior to making such a fee or profit reduction, the agency head or his or her designee shall provide to the Contractor a written notice of the action being considered and the basis therefor. The Contractor shall have a period determined by the agency head or his or her designee, but in no event less than 30 calendar days after receipt of such notice to submit in person, in writing, or through a representative, information and argument in opposition to the proposed reduction. The agency head or his or her designee may, upon good cause shown, determine to reduce the contract or contract modification price or fee by an amount which is less than the amount determined under paragraph (c) of this clause.

(c) The price or fee reduction referred to in paragraph (a) of this clause shall be--

(1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;

(2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award notwithstanding any minimum fee or "fee floor" specified in the contract.

(3) For cost-plus-award-fee contracts--

(i) The base fee established in the contract at the time of contract award;

(ii) If no base fee is specified in the contract, 10 percent of the amount of each award fee otherwise payable to the Contractor for each incentive period or at each award fee determination point;

(4) For fixed-price-incentive contracts, the Government may-

(i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award;

(ii) When the contract provides for multiple deliverables, reduce the amount otherwise payable to the Contractor upon each delivery and acceptance by an amount determined by the Contracting Officer to be the profit portion of each payable amount until the cumulative total of such reductions is equal the initial target profit amount specified in the contract at the time of contract award;

(iii) In addition to any other withholdings, retentions or reserves, reduce the amount of progress payments otherwise payable in connection with each invoice or voucher properly submitted by the Contractor for payment until the aggregate progress payments amounts so withheld equal the initial target profit established at the time of contract award; or

(iv) If the Government elects either (c)(4)(ii) or (iii) of this clause, at the time of total final price establishment, the price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the amount of initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price. Any progress payments amounts

retained by the Government in (c)(4)(iii) of this clause shall be returned to the Contractor, if appropriate.

(5) For firm-fixed-price contract or contract modifications, by 10 percent of the initial contract price; 10 percent of the contract modification price; or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award or modification.

(d) The Government may, at its election, reduce a prime Contractor's price or fee in accordance with the procedures of paragraphs (b) and (c) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(e) In addition to the remedy in paragraph (a) of this clause, the Government may terminate this contract or modification for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

10. FAR 52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (MAY 1989)

(a) The Government suspends or debars Contractors to protect the Government's interests. Contractors shall not enter into any subcontract equal to or in excess of $25,000 with a Contractor that has been debarred, suspended, or proposed for debarment unless there is a compelling reason to do so. If a Contractor intends to subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the list of Parties Excluded from Procurement Programs), a corporate officer or designee of the Contractor shall notify the Contracting Officer, in writing, before entering into such subcontract. The notice must include the following:

(1) The name of the subcontractor;

(2) The Contractor's knowledge of the reasons for the subcontractor being on the list of Parties Excluded from Procurement Programs;

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the list of Parties Excluded from Procurement Programs; and

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(b) The Contractor's compliance with the requirements of 52.209-6 will be reviewed during Contractor Purchasing System Reviews (see FAR Subpart 44.3).#

11. FAR 52.212-8 DEFENSE PRIORITY AND ALLOCATION REQUIREMENTS (MAY 1986)

(The following clause is applicable if this is a rated order.)

This is a rated order certified for national defense use and the Contractor shall follow all the requirements of the Defense and Allocations System regulation (15 CFR 350).#

12. FAR 52.212-11 VARIATION IN ESTIMATED QUANTITY (APR 1984)

(The following clause is not applicable to bid items listed in the "Variations in Estimated Quantities--Subdivided Items" clause and also is not applicable to contracts for dredging work which contain the "Variations in Estimated Quantities--Dredging" clause).

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, and equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the dated of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgement of the Contracting Officer, is justified.#

13. FAR 52.212-12 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract.

(c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.#

14. FAR 52.214-26 AUDIT-SEALED BIDDING (APR 1985)

(The following clause is applicable if this contract is in excess of $100,000.)

(a) Cost or Pricing Data. If the Contractor has submitted cost or pricing data in connection with the pricing of any modification to this contract, unless the pricing was based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation, the Contracting Officer or a representative who is an employee of the Government shall have the right to examine and audit all books, records, documents, and other data of the Contractor (including computations and projections) related to negotiating, pricing or

performing the modification, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data. In the case of pricing any modification, the Comptroller General of the United States or a representative who is an employee of the Government shall have the same rights.

(b) **Availability.** The Contractor shall make available at its office at all reasonable times the materials described in paragraph (a) above, for examination, audit, or reproduction, until 3 years after final payment under this contract, or for any other period specified in Subpart 4.7 of the Federal Acquisition Regulation (FAR). FAR Subpart 4.7, Contractor Records Retention, in effect on the date of this contract, is incorporated by reference in its entirety and made a part of this contract.

(1) If this contract is completely or partially terminated, the records relating to the work terminated shall be made available for 3 years after any resulting final termination settlement.

(2) Records pertaining to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to the performance of this contract shall be made available until disposition of such appeals, litigation, or claims.

(c) The Contractor shall insert a clause containing all the provisions of this clause, including this paragraph (c), in all subcontracts over $10,000 under this contract, altering the clause only as necessary to identify properly the contracting parties and the contracting office under the Government prime contract.#

15. FAR 52.214-27 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS--SEALED BIDDING (APR 1988)

(a) This clause shall become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, of more than $100,000 except that this clause does not apply to any modification for which the price is--

(1) Based on adequate price competition;

(2) Based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or

(3) Set by law or regulation.

(b) If any price, including profit, negotiated in connection with any modification under this clause, was increased by any significant amount because (1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data, (2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) any of these parties furnished data of any description that were not accurate, the price shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) above.

(c) Any reduction in the contract price under paragraph (b) above due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which (1) the actual subcontract or (2) the actual cost to the Contractor, if there was no subcontract, was less than the prospective

subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.

(d) (1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2) (i) Except as prohibited by subdivision (d)(2)(ii) of this clause, and offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the date of agreement on the price of the contract (or price of the modification) and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

(A) The understated data was known by the Contractor to be understated when the Certificate of Current Cost or Pricing Data was signed; or

(B) The Government proves that the facts demonstrated that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the date of agreement on price.#

16. FAR 52.214-28 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATION --SEALED BIDDING (APR 1985)

(a) The requirements of paragraphs (b) and (c) of this clause shall (1) become operative only for any modification to this contract involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed $100,000 and (2) be limited to such modifications.

(b) Before awarding any subcontract expected to exceed $100,000 when

entered into, or pricing any subcontract modification involving aggregate increases and/or decreases in costs, plus applicable profits, expected to exceed $100,000, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless the price is--

(1) Based on adequate price competition;

(2) Based on established catalog or market prices of commercial items sold in substantial quantities to the general public; or

(3) Set by law or regulation.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in subsection 15.804-4 of the Federal Acquisition Regulation that, to the best of its knowledge and belief, the data submitted under paragraph (b) above were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(d) The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that exceeds $100,000 when entered into.#

17. FAR 52.214-29 ORDER OF PRECEDENCE--SEALED BIDDING (JAN 1986)

Any inconsistency in this solicitation or contract shall be resolved by giving precedence in the following order: (a) the Schedule (excluding the specifications); (b) representations and other instructions; (c) contract clauses; (d) other documents, exhibits, and attachments; and (e) the specifications.#

18. FAR 52.215-1 EXAMINATION OF RECORDS BY COMPTROLLER GENERAL (APR 1984)

(a) This clause applies if this contract exceeds $10,000 and was entered into by negotiation.

(b) The Comptroller General of the United States or a duly authorized representative from the General Accounting Office shall, until 3 years after final payment under this contract or for any shorter period specified in Federal Acquisition Regulation (FAR) Subpart 4.7, Contractor Records Retention, have access to and the right to examine any of the Contractor's directly pertinent books, documents, papers, or other records involving transactions related to this contract.

(c) The Contractor agrees to include in first-tier subcontracts under this contract a clause to the effect that the Comptroller General or a duly authorized representative from the General Accounting Office shall, until 3 years after final payment under the subcontract or for any shorter period specified in FAR Subpart 4.7, have access to and the right to examine any of the subcontractor's directly pertinent books, documents, paners, or other records involving transactions related to the subcontract. "Subcontract," as used in this clause, excludes (1) purchase orders not exceeding $10,000 and (2) subcontracts or purchase orders for public utility services at rates established to apply uniformly to the public, plus any applicable reasonable connection charge.

(d) The periods of access and examination in paragraphs (b) and (c) above for records relating to (1) appeals under the Disputes clause, (2) litigation or settlement of claims arising from the performance of this contract, or (3) costs and expenses of this contract to which the Comptroller General or a duly authorized representative from the General Accounting Office has taken exception shall continue until such appeals, litigation, claims, or exceptions are disposed of.#

19. FAR 52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS AND SMALL DISADVANTAGED BUSINESS CONCERNS (JUN 1985)

(a) It is the policy of the United States that small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns and small business concerns owned and controlled by socially and economically disadvantaged individuals.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

(c) As used in this contract, the term "small business concern" shall mean a small business as defined pursuant to section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto. The term "small business concern owned and controlled by socially and economically disadvantaged individuals" shall mean a small business concern--

(1) Which is at least 51 percent owned by one or more socially and economically disadvantaged individuals; or, in the case of any publicly owned business, at least 51 per centum of the stock of which is owned by one or more socially and economically disadvantaged individuals; and

(2) Whose management and daily business operations controlled by one or more of such individuals.

The Contractor shall presume that socially and economically disadvantaged individuals include Black Americans, Hispanic Americans, Native Americans, Asian-Pacific Americans, Asian-Indian Americans and other minorities, or any other individual found to be disadvantaged by the Administration pursuant to section 8(a) of the Small Business Act.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as either a small business concern or a small business concern owned and controlled by socially and economically disadvantaged individuals.#

20. FAR 52.219-9 SMALL BUSINESS AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING PLAN ALTERNATE I--(AUG 1989)

(The following clause is applicable if this contract (1) offers subcontracting possibilities, (2) is in excess $500,000, (3) includes the clause at FAR 52.219-8, and (4) is a sealed bid contract.)

(a) This clause does not apply to small business concerns.

(b) "Commercial product," as used in this clause, means a product in regular production that is sold in substantial quantities to the general public and/or industry at established catalog or market prices. It also means a product which, in the opinion of the Contracting Officer, differs only insignificantly from the Contractor's commercial product.

"Subcontract," as used in this clause, means any agreement (other than on involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) The apparent low bidder, upon request by the Contracting Officer, shall submit a subcontracting plan, where applicable, which separately addresses subcontracting with small business concerns and small disadvantaged business concerns. If the bidder is submitting an individual contract plan, the plan must separately address subcontracting with small business concerns and with small disadvantaged business concerns with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant contract. The subcontracting plan shall be submitted within the time specified by the Contracting Officer. Failure to submit the subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business concerns and small disadvantaged business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted;

(ii) Total dollars planned to be subcontracted to small business concerns; and

(iii) Total dollars planned to be subcontracted to small disadvantaged business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to (i) small business concerns and (ii) small disadvantaged business concerns.

(4) A description of the method used to develop the subcontracting goals in (1) above.

(5) A description of the method used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Automated Source System (PASS) of the Small Business Administration, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small and small disadvantaged business concerns trade associations).

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns and (ii) small disadvantaged business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small business concerns and small disadvantaged business concerns have and equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause in this

contract entitled "Utilization of Small Business Concerns and Small Disadvantaged Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) who receive subcontracts in excess of $500,000 ($1,000,000 for construction of any public facility), to adopt a plan similar to the plan agreed to by the offeror.

(10) Assurances that the offeror will (i) cooperate in any studies or surveys as may be required, (ii) submit periodic reports in order to allow the Government to determine the extent of compliance by the offeror with the subcontracting plan, (iii) submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with the instructions on the forms, and (iv) ensure that its subcontractors agree to submit Standard Forms 294 and 295.

(11) A recitation of the types of records the offeror will maintain to demonstrate procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of its efforts to locate small and small disadvantaged business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated):

(i) Source lists, guides, and other data that identify small and small disadvantaged business concerns.

(ii) Organizations contacted in an attempt to locate sources that are small or small disadvantaged business concerns.

(iii) Records on each subcontract solicitation resulting in an award of more than $100,000, indicating (A) whether small business concerns were solicited and if not, why not, (B) whether small disadvantaged business concerns were solicited and if not, why not, and (C) if applicable, the reason award was not made to a small business concern.

(iv) Records of any outreach efforts to contact (A) trade associations, (B) business development organizations, and (C) conferences and trade fairs to locate small and small disadvantaged business sources.

(v) Records of internal guidance and encouragement provided to buyers through (A) workshops, seminars, training, etc., and (B) monitoring performance to evaluate compliance with the program's requirements.

(vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having company or division wide annual plans need not comply with this requirement.

(e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:

(1) Assist small business and small disadvantaged business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small business and small disadvantaged subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over

a period of time.

(2) Provide adequate and timely consideration of the potentialities of small business and small disadvantaged business concerns in all "make-or-buy" decisions.

(3) Counsel and discuss subcontracting opportunities with representatives of small and small disadvantaged business firms.

(f) A master subcontracting plan on a plant or division-wide basis which contains all the elements required by (d) above, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided, (1) the master plan has been approved, (2) the offeror provides copies of the approved master plan and evidence of its approval to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) (1) If a commercial product is offered, the subcontracting plan required by this clause may relate to the offeror's production generally, for both commercial and noncommercial products, rather than solely to the Government contract. In these cases, the offeror shall, with the concurrence of the Contracting Officer, submit one company-wide or division-wide annual plan.

(2) The annual plan shall be reviewed for approval by the agency awarding the offeror its first prime contract requiring a subcontracting plan during the fiscal year, or by an agency satisfactory to the Contracting Officer.

(3) The approved plan shall remain in effect during the offeror's fiscal year for all of the offeror's commercial products.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization of Small Business Concerns and Small Disadvantaged Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.#

21. FAR 52.219-13 UTILIZATION OF WOMEN-OWNED SMALL BUSINESS (AUG 1986)

(a) "Women-owned small businesses," as used in this clause, means shall business concerns that are at least 51 percent owned by women who are United States citizens and who also control and operate the business.

"Control," as used in this clause, means exercising the power to make policy decisions.

"Operate," as used in this clause, means being actively involved in the day-to-day management of the business.

"Small business concern," as used in this clause, means a concern including its affiliates, that is independently owned and operated, not dominate in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria and size standards in 13 CFR 121.

(b) It is the policy of the United States that women-owned small businesses shall have the maximum practicable opportunity to participate in performing contracts awarded by any Federal agency.

(c) The Contractor agrees to use its best efforts to give women-owned small businesses the maximum practicable opportunity to participate in the subcontracts it awards to the fullest extent consistent with the efficient performance of its contract.

(d) The Contractor may rely on written representations by its subcontractors regarding their status as woman-owned small businesses.#

22. FAR 52.219-16 LIQUIDATED DAMAGES--SMALL BUSINESS SUBCONTRACTING PLAN (AUG 1989) (This clause is applicable to all contracts containing the clause at FAR 25.219-9 or its Alternate I)

(a) "Failure to make a good faith effort to comply with the subcontracting plan," as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small Business and Small Disadvantaged Business Subcontracting Plan," or willful or intentional action to frustrate the plan.

(b) If, at contract completion, or in the case of a commercial products plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled Small and Small Disadvantaged Business Subcontracting Plans, the Contractor shall pay the Government liquidated damages in an amount stated. The amount of damages attributable to the Contractor's failure to comply shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal or, in the case of a commercial products plan, that portion of the dollar amount allocable to Government contracts by which the Contractor failed to achieve each subcontract goal.

(c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all the pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

(d) With respect to commercial products plans, i.e., company-wide or division-wide subcontracting plans approved under paragraph (g) of the clause in this contract entitled, Small Business and Small Disadvantaged Business Subcontracting Plan, the Contracting Officer of the agency that originally approved the plan will exercise the functions of the Contracting Officer under this clause on behalf of all agencies that awarded contracts covered by that commercial products plan.

(e) The Contractor shall have the right of appeal, under the clause in this contract entitled, Disputes, from any final decision of the Contracting Officer.

(f) Liquidated damages shall be in addition to any other remedies that Government may have.#

23. DFARS 252.219-7000 SMALL BUSINESS AND SMALL DISADVANTAGED BUSINESS SUBCONTRACTING PLAN (DoD CONTRACTS) (JUN 1988)

(a) Except for plans submitted under paragraph (g) of the clause of this contract entitled "Small Business and Small Disadvantaged Business Subcontracting

Plan," FAR 52.219-9, whenever the term "small disadvantaged business" is used in the FAR clause, such term shall be deemed to include (in addition to small disadvantaged business concerns), Historically Black Colleges and Universities (HBCUs) and Minority Institutions (MIs) as those terms are defined at DoD FAR Supplement 26.7002. A list of qualifying HBCUs is published periodically by the U.S. Department of Education, and is available from the Contracting Officer.

(b) In addition, master plans referred to in FAR 52.219-9 must be approved by the Government's cognizant Contract Administration Office.#

24. FAR 52.220-3 UTILIZATION OF LABOR SURPLUS AREA CONCERNS (APR 1984)

(a) **Applicability.** This clause is applicable if this contract exceeds the appropriate small purchase limitation in Part 13 of the Federal Acquisition Regulation.

(b) **Policy.** It is the policy of the Government to award contracts to concerns that agree to perform substantially in labor suplus areas (LSA's) when this can be done consistent with the efficient performance of the contract and at prices no higher than are obtainable elsewhere. The Contractor agrees to use its best efforts to place subcontracts in accordance with this policy.

(c) **Order of preference.** In complying with paragraph (b) above and with paragraph (c) of the clause of this contract entitled Utilization of Small Business Concerns and Small Disadvantaged Business Concerns, the Contractor shall observe the following order of preference in awarding subcontracts: (1) small business concerns that are LSA concerns, (2) other small busienss concerns, and (3) other LSA concerns.

(d) **Definitions.** "Labor surplus area," as used in this clause, means a geographical area identified by the Department of Labor in accordance with 20 CFR 654, Subpart A, as an area of concentrated unemployment or underemployment or an area of labor surplus.

"Labor surplus area concern," as used in this clause, means a concern that together with its first-tier subcontractors will perform substantially in labor surplus areas. Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production, or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.#

25. FAR 52.220-4 LABOR SURPLUS AREA SUBCONTRACTING PROGRAM (APR 1984)

(The following clause is applicable if this contract is in excess of $500,000.)

(a) See the Utilization of Labor Surplus Area Concerns clause of this contract for applicable definitions.

(b) The Contractor agrees to establish and conduct a program to encourage labor surplus area (LSA) concerns to compete for subcontracts within their capabilities when the subcontracts are consistent with the efficient performance of the contract at prices no higher than obtainable elsewhere. The Contractor shall--

(1) Designate a liaison officer who will (i) maintain liaison with authorized representatives of the Government on LSA matters, (ii) supervise compliance with the Utilization of Labor Surplus Area Concerns clause, and (iii) administer the Contractor's labor surplus area subcontracting program;

(2) Provide adequate and timely consideration of the potentialities of LSA concerns in all make-or-buy decisions;

(3) Ensure that LSA concerns have an equitable opportunity to

compete for subcontracts, particularly by arranging solicitaitons, time for the preparation of offers, quantities, specifications, and delivery schedules so as to facilitate the participation of LSA concerns;

(4) Include the Utilization of Labor Surplus Area Concerns clause in subcontracts that offer substantial LSA subcontracting opportunities; and

(5) Maintain records showing (i) the procedures adopted and (ii) the Contractor's performance, to comply with this clause. The records will be kept available for review by the Government until the expiration of 1 year after the awrad of this contract, or for such longer period as may be required by any other clause of this contract or by applicable law or regulations.

(c) The Contractor further agrees to insert in any related subcontract that may exceed $500,000 and that contains the Utilization of Labor Surplus Area Concerns clause, including this paragraph (c), and to notify the Contracting Officer of the names of subcontractors.#

26. FAR 52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (APR 1984)

(a) If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice, including all relevant information, to the Contracting Officer.

(b) The Contractor agrees to insert the substance of this clause, including this paragraph (b), in any subcontract to which a labor dispute may delay the timely performance of this contract; except that each subcontract shall provide that in the event its timely performance is delayed or threatened by delay by any actual or potential labor dispute, the subcontractor shall immediately notify the next higher tier subcontractor or the prime Contractor, as the case may be, of all relevant information concerning the dispute.#

27. FAR 52.222-3 CONVICT LABOR (APR 1984)

The Contractor agrees not to employ any person undergoing sentence of imprisonment in performing this contract except as provided by 18 U.S.C. 4082(c)(2) and Executive Order 11755, December 29, 1973.#

28. FAR 52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT--OVERTIME COMPENSATION (MAR 1986)

(a) **Overtime requirements.** Any Contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics (see Federal Acquisition Regulation (FAR) 22.300) shall require or permit any such laborers or mechanics in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours worked in excess of 40 hours in such workweek,

(b) **Violation; liability for unpaid wages; liquidated damages.** In the event of any violation of the provisions set forth in paragraph (a) of this clause, the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violation of the provisions set forth in paragraph (a) of this clause in the sum of $10 for each calendar

day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the provisions set forth in paragraph (a) of this clause.

(c) **Withholding for unpaid wages and liquidated damages.** The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same Prime Contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act which is held by the same Prime Contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Contractor or subcontractor for unpaid wages and liquidated damages as provided in the provisions set forth in paragraph (b) of this clause.

(d) **Payrolls and basic records.** (1) The Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of contract work and shall preserve them for a period of 3 years from the completion of the contract for all laborers and mechanics working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Nothing in this paragraph shall require the duplication of records required to be maintained for construction work by Department of Labor regulations at 29 CFR 5.5 (a)(3) implementing the Davis-Bacon Act.

(2) The records to be maintained under paragraph (d)(1) of this clause shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit such representatives to interview employees during working hours on the job.

(e) **Subcontracts.** The Contractor or subcontractor shall insert in any subcontracts the provisions set forth in paragraphs (a) through (e) of this clause and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts. The prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the provisions set forth in paragraphs (a) through (e) of this clause.#

29. FAR 52.222-6 DAVIS-BACON ACT (FEB 1988)

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such

period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; **provided**, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b) (1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits therefor only when all the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination.

(ii) The classification is utilized in the area by the construction industry.

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, D.C. 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract

from the first day on which work is performed in the classification.

(c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(d) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; **provided**, that the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.#

30. FAR 52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.#

31. FAR 52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence
of the registration of apprenticeship programs and certification of trainee

programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b) (1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification as set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in the clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause, the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.#

32. FAR 52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(a) **Apprentices.** Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) **Trainees.** Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage And Hour Division determines that there is an

apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) **Equal employment opportunity.** The utilization of apprentices, trainees and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.#

33. **FAR 52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)**

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.#

34. **FAR 52.222-11 SUBCONTRACTS (LABOR STANDARDS) (FEB 1988)**

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled **Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination-Debarment, Disputes Concerning Labor Standards, Compliance with Davis-Bacon and Related Act Regulations,** and **Certification of Eligibility,** and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b) (1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(2) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.#

35. **FAR 52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)**

A breach of the contract clauses entitled **Davis-Bacon Act, Contract Work Hours and Safety Standards Act--Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis-Bacon and Related Act Regulations,** or **Certification of Eligibility** may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.#

36. FAR 52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.#

37. FAR 52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.#

38. FAR 52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(c) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.#

39. FAR 52.222-26 EQUAL OPPORTUNITY (APR 1984)

(a) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of $10,000, the Contractor shall comply with subparagraphs (b)(1) through (11) below. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.

(b) During performing this contract, the Contractor agrees as follows:

(1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.

(2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.

(3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.

(4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(5) The Contractor shall send, to each labor union or representative

of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or worker's representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.

(6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.

(7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor, Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within 30 days following the award, unless filed within 12 months preceding the date of award.

(8) The Contractor shall permit access to its books, records, and accounts by the contracting agency or the office of Federal Contract Compliance Programs (OFCCP) for the purposes of investigation to ascertain the Contractor's compliance with the applicable rules, regulations, and orders.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended, In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraph (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.#

40. FAR 52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (APR 1984)

(a) Definitions. "Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Director," as used in this clause, means Director, Office of Federal Contract Compliance Programs (OFCCP), United States Department of Labor, or any person to whom the Director delegates authority.

"Employer identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable

tribal affiliations through membership and participation or community identification);

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of $10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the Solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the Solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its

actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) above.

(6) Disseminate the Contractor's equal employee policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment

decisions. Conduct review of this policy with all onsite supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16). The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16), provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill and obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246. as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) above, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Director shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

(o) Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).#

41. FAR 52.222-35 AFFIRMATIVE ACTION FOR SPECIAL DISABLED AND VIETNAM ERA

VETERANS (APR 1984)

(This clause is applicable pursuant to 41 C.F.R. 60-250, if this contract is for $10,000 or more.)

(a) **Definitions.** "Appropriate office of the State employment service system," as used in this clause, means the local office of the Federal-State national system of public employment offices assigned to serve the area where the employment opening is to be filled, including the District of Columbia, Guam, Puerto Rico, Virgin Islands, American Samoa, and the Trust Territory of the Pacific Islands.

"Openings that the Contractor proposes to fill from within its own organization," as used in this clause, means employment openings for which no one outside the Contractor's organization (including any affiliates, subsidiaries, and the parent companies) will be considered and includes any openings that the Contractor proposes to fill from regularly established "recall" lists.

"Openings that the Contractor proposes to fill under a customary and traditional employer-union hiring arrangement," as used in this clause, means employment openings that the Contractor proposes to fill from union halls, under their customary and traditional employer-union hiring relationship.

"Suitable employment openings," as used in this clause--

(1) Includes, but is not limited to, openings that occur in jobs categorized as--

(i) Production and nonproduction;
(ii) Plant and office;
(iii) Laborers and mechanics;
(iv) Supervisory and nonsupervisory;
(v) Technical; and
(vi) Executive, administrative, and professional positions compensated on a salary basis of less than $25,000 a year; and

(2) Includes full-time employment, temporary employment of over 3 days, and part-time employment, but not openings that the Contractor proposes to fill from within its own organization or under a customary and traditional employer-union hiring arrangement, nor openings in an educational institution that are restricted to students of that institution.

(b) **General.**

(1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against the individual because the individual is a special disabled or Vietnam Era veteran. The Contractor agrees to take affirmative action to employ, advance in

employment, and otherwise treat qualified special disabled and Vietnam Era veterans without discrimination based upon their disability or veterans' status in all employment practices such as--

(i) Employment;
(ii) Upgrading;
(iii) Demotion or transfer;
(iv) Recruitment;
(v) Advertising;
(vi) Layoff or termination;
(vii) Rates of pay or other forms of compensation; and
(viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended.

(c) Listing openings.

(1) The Contractor agrees to list all suitable employment openings existing at contract award or occurring during contract performance, at an appropriate office of the State employment service system in the locality where the opening occurs. These openings include those occurring at any Contracting facility, including one not connected with performing this contract. An independent corporate affiliate is exempt from this requirement.

(2) State and local government agencies holding Federal contracts of $10,000 or more shall also list all their suitable openings with the appropriate office of the State employment service.

(3) The listing of suitable employment openings with the State employment service system is required at least concurrently with using any other recruitment source or effort and involves the obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(4) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State employment service system, in each State where it has establishments, of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State system, it need not advise the State system of subsequent contracts. The Contractor may advise the State system when it is no longer bound by this contract clause.

(5) Under the most compelling circumstances, an employment opening may not be suitable for listing, including situations when (i) the Government's needs cannot reasonably be supplied, (ii) listing would be contrary to national security, or (iii) the requirement of listing would not be in the Government's interest.

(d) Applicability.

(1) This clause does not apply to the listing of employment openings which occur and are filled outside the 50 states, the District of Columbia, Puerto Rico, Guam, Virgin Islands, American Samoa, and the Trust Territory of the Pacific Islands.

(2) The terms of paragraph (c) above of this clause do not apply to openings that the Contractor proposes to fill from within its own organization or under a customary and traditional employer-union hiring arrangement. This exclusion does not apply to a particular opening once an employer decides to consider applicants outside of its own organization or employer-union arrangement for that opening.

(e) Postings.

(1) The Contractor agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified special disabled veterans and veterans of the Vietnam Era, and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form

prescribed by the Director, Office of Federal Contract Compliance Programs, Department of Labor (Director), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of the Act, and is committed to take affirmative action to employ, and advance in employment, qualified special disabled and Vietnam Era Veterans.

(f) **Noncompliance.** If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(g) **Subcontracts.** The Contractor shall include the terms of this clause in every subcontract or purchase order or $10,000 or more unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Director to enforce the terms, including action for noncompliance.#

42. FAR 52.222-36 AFFIRMATIVE ACTION FOR HANDICAPPED WORKERS (APR 1984)

(Contracts and subcontracts are exempt from the requirements of the following clause with regard to work performed outside the United States by employees who were not recruited within the United States).

(a) General.

(1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental handicap. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified handicapped individuals without discrimination based upon their physical or mental handicap in all employment practices such as--

(i) Employment;
(ii) Upgrading;
(iii) Demotion or transfer;
(iv) Recruitment;
(v) Advertising;
(vi) Layoff or termination;
(vii) Rates of pay or other forms of compensation; and
(viii) Selection for training, including apprenticeship.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Posting.

(1) The Contractor Agrees to post employment notices stating (i) the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified handicapped individuals and (ii) the rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. They shall be in a form prescribed by the Director, Office of Federal Contract Compliance Programs, Department of Labor (Director), and provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified physically and mentally handicapped individuals.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of $2,500 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Director to enforce the terms, including action for noncompliance.#

43. FAR 52.222-37 EMPLOYMENT REPORTS ON SPECIAL DISABLED VETERANS AND VETERAN OF THE VIETNAM ERA (JAN 1988)

(The following clause is applicable if the amount of this contract is in excess of $10,000.)

(a) The Contractor shall report at least annually, as required by the Secretary of Labor, on:

(1) The number of special disabled veterans and the number of veterans of the Vietnam era in the workforce of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of special disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than March 31 of each year beginning March 31, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending date selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay report is due, or (2) as of December 31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each contractor subject to the reporting requirements at 38 U.S.C. 2012(d) shall invite all special disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 2012 to identify themselves to the Contractor. The invitation shall state that the information is voluntarily provided, that the information will be kept confidential, that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 2012.

(f) Subcontracts. The contractor shall include the terms of this clause in every subcontract or purchase order of $10,000 or more unless exempted by rules, regulations, or orders of the Secretary.#

44. FAR 52.223-2 CLEAN AIR AND WATER (APR 1984)

(a) "Air Act," as used in this clause, means the Clean Air Act (42 U.S.C. 7401 et seq.).

"Clean air standards," as used in this clause, means--

(1) Any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, work practices, or other requirements contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738;

(2) An applicable implementation plan as described in section 110(d) of the Air Act (42 U.S.C. 7410(d));

(3) An approved implementation plan as described in section 111(c) or section 111(d) of the Air Act (42 U.S.C. 7411(c) or (d)); or

(4) An approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 7412(d)).

"Clean water standards," as used in this clause, means any enforceable limitation, control, condition, prohibition, standard, or other requirement promulgated under the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by local government to ensure compliance with pretreatment regulations as required by

section 307 of the Water Act (33 U.S.C. 1317).

"Compliance," as used in this clause, means compliance with--

(1) Clean air or water standards; or

(2) A schedule or plan ordered or approved by a court of competent jurisdiction, the Environmental Protection Agency, or an air or water pollution control agency under the requirements of the Air Act or Water Act and related regulations.

"Facility," as used in this clause, means any building, plant, installation, structure, mine, vessel or other floating craft, location, or site of operations, owned, leased, or supervised by a Contractor or subcontractor, used in the performance of a contract or subcontract. When a location or site of operations includes more than one building, plant, installation, or structure, the entire location or site shall be deemed a facility except when the Administrator, or a designee, of the Environmental Protection Agency determines that independent facilities are collocated in one geographical area.

"Water Act," as used in this clause, means Clean Water Act (33 U.S.C. 1251 et seq.).

(b) The Contractor agrees--

(1) To comply with all the requirements of Section 114 of the Clean Air Act (42 U.S.C. 7414) and section 308 of the Clean Water Act (33 U.S.C. 1318) relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and Water Act, and all regulations and guidelines issued to implement those acts before the award of this contract;

(2) That no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency List of Violating Facilities on the date when this contract was awarded unless and until the EPA eliminates the name of the facility from the listing;

(3) To use best efforts to comply with clean air standards and clean water standards at the facility in which the contract is being performed; and

(4) To insert the substance of this clause into any nonexempt subcontract, including this paragraph (b)(4).#

45. FAR 52.223-6 DRUG-FREE WORKPLACE (MAR 1989).

(a) Definitions. As used in this clause,

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession or use of any controlled substance.

"Drug-free workplace" means a site for the performance of work done in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract.

"Individual" means an Offeror/Contractor that has no more than one employee

including the Offeror/Contractor.

(b) The Contractor, if other than an individual, shall--

(1) Publish a statement notifying such employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish a drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in the statement required by subparagraph (b)(1) of this clause, that as a condition of continued employment on the contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five (5) days after such conviction;

(5) Notify the Contracting Officer within ten (10) days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, impose the following sanctions or remedial measures on any employee who is convicted of drug abuse violations occurring in the workplace:

(i) Take appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purpose by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in the performance of this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraphs (b) and (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of this contract for default, and suspension or debarment.#

46. DFARS 252.223-7500 DRUG-FREE WORK FORCE (SEP 1988)

This clause does not apply to that part of a contract that is to be

performed outside of the United States, its territories, and positions.

(a) **Definitions.**

"Illegal Drugs," as used in this clause, means controlled substances included in Schedule I and II, as defined by Section 802(b) of Title 21 of the United States Code, the possession of which is unlawful under Chapter 13 of that title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

"Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security, health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, Contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) below that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance program emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees.

(3) Provision for self-referrals as will as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on considerations that include the nature of the work being performed under the contract, the employee's duties, the efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employee has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants

for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by Section 2.1 of Subpart B of the "Mandatory Guidelines for Federal Work Place Drug Testing Program," (53 FR 11980 (April 11, 1988)), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such time as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing programs shall not apply to the extent they are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the Contractor agrees that those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.#

47. FAR 52.225-5 BUY AMERICAN ACT--CONSTRUCTION MATERIALS (APR 1984)

(a) The Buy American Act (41 U.S.C. 10) provides that the Government give preference to domestic construction material.

"Components," as used in this clause, means those articles, materials, and supplies incorporated directly into construction materials.

"Construction materials," as used in this clause, means articles, materials, and supplies brought to the construction site for incorporation into the building or work.

"Domestic construction material," as used in this clause, means (1) an unmanufactured construction material mined or produced in the United States, or (2) a construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind as the construction materials determined to be unavailable pursuant to subparagraph 25.202 (a)(3) of the Federal Acquisition Regulation (FAR) shall be treated as domestic.

(b) The Contractor agrees that only domestic construction material will be used by the Contractor, subcontractors, materialmen, and suppliers in the performance of this contract, except for foreign construction materials, if any, listed in this contract.

(The foregoing requirements are administered in accordance with Executive Order No. 10582, dated December 17, 1954, as amended, and Subpart 25.2 of the FAR).#

48. FAR 52.225-13 RESTRICTIONS ON CONTRACTING WITH SANCTIONED PERSONS (MAY 1989)

(a) Definitions.

(1) "Component part" means any article which is not usable for its intended functions without being imbedded or integrated into any other product and which, if used in production of a finished product, would be substantially transformed in that process.

(2) "Finished product" means any article which is usable for its intended function without being imbedded in, or integrated, into, any other product. It does not include an article produced by a person, other than a

sanctioned person, that contains parts or components of the sanctioned person if the parts or components have been substantially transformed during production of the finished product.

(3) "Sanctioned person" means a company or other foreign person upon whom prohibitions have been imposed.

(4) "Substantially transformed," when referring to a component part of finished product, means that the part or product has been subjected to a substantial manufacturing or processing operation by which the part or product is converted or combined into a new and different article of commerce having a new name, character, and use.

(b) General. Section 2443 of the Multilateral Export Control Enhancement Amendments Act (Pub. L. 100-418) and Executive Order 12661, effective December 28, 1988, impose, for a period of 3 years, with certain exceptions, a prohibition on contracting with, or procuring (including rental and lease/purchase) directly or indirectly the products or service of (1) Toshiba Machine Company, (2) Kongsberg Trading Company, (3) Toshiba Corporation, or (4) Kongsberg Vaapenfabrikk. The Act and Executive Order also prohibit, for the same 3-year period, the importation into the United States of all products produced by Toshiba Machine Company and Kongsberg Trading Company. These prohibitions also apply to subsidiaries, successor entities or joint ventures of Toshiba Machine Company or Kongsberg Trading Company.

(c) Restriction. Unless listed by the Contractor in its offer, in the solicitation provision at FAR 52.225-12, Notice of Restrictions on Contracting with Sanctioned Persons, or unless one of the exceptions in paragraph (d) of this clause applies, the Contractor agrees that no products or services delivered to the Government under this contract will be products or services of a sanctioned person.

(d) Exceptions. The restrictions do not apply--

(1) To finished products of nonsanctioned persons containing components of a sanctioned person if these components have been substantially transformed during the manufacture of the finished product.

(2) To products or services of a sanctioned person provided--

(i) The products are designed to the specifications of a nonsanctioned person marketed under the trademark, brand, or name of the nonsanctioned person;

(ii) The business relationship between the nonsanctioned person and the sanctioned person clearly existed prior to June 30, 1987; and

(iii) The nonsanctioned person is not directly or indirectly owned by a sanctioned person.

(3) If a determination has been made in accordance with FAR 25.1003(a) or (b).

(e) Award. Award of any contract resulting from this solicitation will not affect the Contractor's obligation to comply with importation regulations of the Secretary of the Treasury.#

49. FAR 52.227-1 AUTHORIZATION AND CONSENT (APR 1984)

(a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with

(i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

(b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed $25,000; however, omission of this clause from any subcontract, under or over $25,000, does not affect this authorization and consent.#

50. FAR 52.227-2 NOTICE AND ASSISTANCE REGARDING PATENT AND COPYRIGHT INFRINGEMENT (APR 1984)

(a) The Contractor shall report to the Contracting Officer, promptly and in reasonable written detail, each notice or claim of patent or copyright infringement based on the performance or this contract of which the Contractor has knowledge.

(b) In the event of any claim or suit against the Government on account of any alleged patent or copyright infringement arising out of the performance of this contract or out of the use of any supplies furnished or work or services performed under this contract, the Contractor shall furnish to the Government, when requested by the Contracting Officer, all evidence and information in possession of the Contractor pertaining to such suit or claim. Such evidence and information shall be furnished at the expense of the Government except where the Contractor has agreed to indemnify the Government.

(c) The Contractor agrees to include, and require inclusion of, this clause in all subcontracts at any tier for supplies or services (including construction and architect-engineer subcontracts and those for material, supplies, models, samples, or design or testing services) expected to exceed the dollar amount set forth in 13.000 of the Federal Acquisition Regulation (FAR).#

51. FAR 52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.#

52. DFARS 252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

(a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment.

The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.#

53. FAR 52.228-2 ADDITIONAL BOND SECURITY (APR 1984)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

(a) Any surety upon any bond furnished with this contract becomes unacceptable to the Government;

(b) Any surety fails to furnish reports on its financial condition as required by the Government; or

(c) The Contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer.#

54. FAR 52.228-5 INSURANCE--WORK ON A GOVERNMENT INSTALLATION (SEP 1989)

(The following clause is applicable if the services involved are performed on a Government Installation.)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance period of this contract at least the kinds and minimum amounts of insurance required in the Schedule or elsewhere in the contract.

(b) Before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the schedule or elsewhere in the contract. The Contractor shall maintain a copy of all subcontractor's proofs of required insurance, and shall make copies available to the Contracting Officer upon request.#

55. FAR 52.229-3 FEDERAL, STATE, AND LOCAL TAXES (APR 1984)

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative,

judicial, or administrative action taking effect after the contract date. It does not include social security tax or other employment taxes.

"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds $100.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.#

56. FAR 52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (APR 1989)

(a) The Government shall pay the Contractor the contract price as provided in this contract.

(b) The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer. The Contractor shall furnish a breakdown of the total contract price showing the amount included therein for each principal category of the work, which shall substantiate the payment amount requested in order to provide a basis for determining progress payments, in such detail as requested by the Contracting Officer. In the preparation of estimates the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site may also be taken into consideration if--

(1) Consideration is specifically authorized by this contract; and

(2) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.

(c) Along with each request for progress payments, the Contractor shall

furnish the following certification, or payment shall not be made:

I hereby certify, to the best of my knowledge and belief, that--

(1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;

(2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code; and

(3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

_____
(Name)

_____
(Title)

_____
(Date)

(d) If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

(1) Notify the Contracting Officer of such performance deficiency; and

(2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in 31 U.S.C. 3903 (c)(1)) equal to interest on the unearned amount from the date of receipt of the unearned amount until--

(i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or

(ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount of the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.#

57. FAR 52.232-17 INTEREST (APR 1984)

(a) Notwithstanding any other clause of this contract, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the internal Revenue Code (26 U.S.C. 1481) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this Clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid.

(b) Amount shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.#

58. FAR 52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)

(a) The Contractor under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence.

(b) Any assignment or reassignment authorized under the ACT and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.#

59. FAR 52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (APR 1989)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments and contract financing payments under the terms and conditions specified in this clause. Payment shall be considered as being made on the day a check is dated or an electronic funds transfer is made. Definitions of pertinent terms are set forth in 32.902. All days referred to in this clause are calendar days, unless otherwise specified. The term "foreign vendor" means

an incorporated concern not incorporated in the United States or an unincorporated concern having its principal place of business outside the United States.

(a) Invoice Payments.

(1) For purposes of this clause, there are several types of invoice payments which may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project:

(A) The due date for making such payments shall be 14 days after receipt of the payment request by the designated billing office. However, if the designated billing office fails to annotate the payment request with the actual date of receipt, the payment due date shall be deemed to be the 14th day after the date the Contractor's payment request is dated, provided a proper payment request is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, shall be as specified in the contract or, if not specified, 30 days after approval for release to the Contractor by the Contracting Officer.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract):

(A) The due date for making such payments shall be either the 30th day after receipt by the designated billing office of a proper invoice from the Contractor, or the 30th day after Government acceptance of the work or services completed by the Contractor, whichever is later. However, if the designated billing office fails to annotate the invoice with the date of actual receipt, the invoice payment due date shall be deemed to be the 30th day after the Contractor's invoice is dated, provided a proper invoice is received and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) On a final invoice where the payment amount is subject to contract settlements actions (e.g., release of claims), acceptance shall be deemed to have occurred on the effective date of the contract settlement.

(2) An invoice is the Contractor's bill or written request for payment under the contract for work or services performed under the contract. An invoice shall be prepared and submitted to the designated billing office. A proper invoice must include the items listed in subdivisions (a)(2)(i) through (a)(2)(ix) of this clause. If the invoice does not comply with these requirements, the Contractor will be notified of the defect within 7 days after receipt of the invoice at the designated billing office. Untimely notification will be taken into account in the computation of any interest penalty owed the Contractor in the manner described in subparagraph (a)(4) of this clause:

(i) Name and address of the Contractor.

(ii) Invoice date.

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., prompt payment discount terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to be notified in event of a defective invoice.

(viii) For payments described in subdivision (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Any other information or documentation required by the contract.

(3) An interest penalty shall be paid automatically by the designated payment office, without request from the Contractor, if payment is not made by the due date and the conditions listed in subdivisions (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. An interest penalty shall not be paid on contracts awarded to foreign vendors outside the United States for work performed outside the United States.

(i) A proper invoice was received by the designated billing office.

(ii) A receiving report or other Government documentation authorizing payment was processed and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) The interest penalty shall be at the rate established by the Secretary of the Treasury under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) that is in effect on the day after the due date, except where the interest penalty is prescribed by other governmental authority. This rate is referred to as the "Renegotiation Board Interest Rate," and it is published in the Federal Register semiannually on or about January 1 and July 1. The interest penalty shall accrue daily on the invoice payment amount approved by the Government and be compounded in 30-day increments inclusive from the first day after the due date through the payment date. That is, interest accrued at the end of and 30-day period will be added to the approved invoice payment amount and be subject to interest penalties if not paid in the succeeding 30-day period. If the designated billing office failed to notify the Contractor of a defective invoice within the periods prescribed in subparagraph (a)(2) of this clause, then the due date on the corrected invoice will be adjusted by subtracting the number of days taken beyond the prescribed notification of defects period. Any interest penalty owed the Contractor will be based on this adjusted due date. Adjustments will be made by the designated payment office for errors in calculating interest penalties, if requested by the Contractor.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in subdivision (a)(1)(ii) of this clause, Government acceptance or approval shall be deemed to have occurred

constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. In the event that actual acceptance or approval occurs within the constructive acceptance or approval period, the determination of an interest penalty shall be based on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities

(ii) The following periods of time will not be included in the determination of an interest penalty:

(A) The period taken to notify the Contractor of defects in invoices submitted to the Government, but this may not exceed 7 days.

(B) The period between the defects notice and resubmission of the corrected invoice by the Contractor.

(iii) Interest penalties will not continue to accrue after the filing of a claim for such penalties under the clause at 52.233-1, Disputes, or for more than 1 year. Interest penalties of less than $1.00 need not be paid.

(iv) Interest penalties are not required on payment delays due to disagreement between the Government and Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. Claims involving disputes, and any interest that may be payable, will be resolved in accordance with the clause at 52.233-1, Disputes.

(5) An interest penalty shall also be paid automatically by the designated payment office, without request from the Contractor, if a discount for prompt payment is taken improperly. The interest penalty will be calculated on the amount of discount taken for the period beginning with the first day after the end of the discount period through the date when the Contractor is paid.

(6) If this contract was awarded on or after October 1, 1989, a penalty amount, calculated in accordance with regulations issued by the Office of Management and Budget, shall be paid in addition to the interest penalty amount if the Contractor---

(i) Is owed an interest penalty;

(ii) Is not paid the interest penalty within 10 days after the date the invoice amount is paid; and

(iii) Makes a written demand, not later than 40 days after the date the invoice amount is paid, that the agency pay such a penalty.

(b) Contract Financing Payments.

(1) For purposes of the clause, if applicable, "contract financing payment" means a Government disbursement of monies to a Contractor under a contract clause or other authorization prior to acceptance of supplies or services by the Government, other than progress payments based on estimates of amount and value of work performed, Contract financing payments include advance payments and interim payments under cost-type contracts.

(2) If this contract provides for contract financing, requests for payments shall be submitted to the designated billing office as specified in this contract or as directed by the Contracting Officer. Contract financing payments shall be made on the 30th day after receipt of a proper contract financing request by the designated billing office. In the event that an audit or other review of a specific financing request is required to ensure compliance with the

terms and conditions of the contract, the designated payment office is not compelled to make payment by the due date specified. For advance payments, loans, or other arrangements that do not involve recurrent submissions of contract financing requests, payment shall be made in accordance with the corresponding contract terms or as directed by the Contracting Officer. Contract financing payments shall not be assessed an interest penalty for payment delays.

(c) The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) A payment clause which obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) An interest penalty clause which obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) A clause requiring each subcontractor to include a payment clause and an interest penalty clause conforming to the standards set forth in subparagraphs (c)(1) and (c)(2) of this clause in each of its subcontracts, and to require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) The clauses required by paragraph (c) of this clause shall not be construed to impair the right of Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions which--

(1) Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without incurring any obligation to pay a late payment interest penalty, in accordance with the terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause has been previously furnished to the subcontractor; and

(ii) A copy of any notice issued by a Contractor pursuant to subdivision (d)(3)(i) of this clause has been furnished to the Contractor Officer.

(e) If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of

the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to subparagraph (e)(1) of this clause;

(3) Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under subparagraph (e)(1) of this clause;

(4) Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under subdivision (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under subparagraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under subdivision (e)(5)(i) of this clause.

(f)(1) If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with

the subcontract agreement, then the Contractor may, without incurring an obligation to pay an interest penalty under subparagraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under subdivision (f)(1)(i) of this clause.

(2) As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall pay the amount withheld under subdivision (f)(1)(ii) of this clause to such first-tier subcontractor, or shall incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) A written notice of any withholding shall be issued to a subcontractor (with a copy to the Contracting Officer of any such notice issued by the Contractor), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the United States is a party. The United States may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative,or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the United States for such interest penalty. A cost reimbursement claim may not include any amount for reimbursement of such interest penalty.#

60. FAR 52.233-1 DISPUTES (APR 1984)

(a) This contract is subject to the Contract Disputes Act of 1978 (41 U.S.C. 601-613) (the ACT).

(b) Except as provided in the Act, all disputes arising under or relating

to this contract shall be resolved under this clause.

(c) "Claim," as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. A claim arising under a contract, unlike a claim relating to that contract, is a claim that can be resolved under a contract clause that provides for the relief sought by the claimant. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding $50,000 is not a claim under the Act until certified as required by subparagraph (d) (2) below. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirement of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.

(d) (1) A claim by the Contractor shall be made in writing and submitted to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.

(2) For Contractor claims exceeding $50,000, the Contractor shall submit with the claim a certification that--

(i) The claim is made in good faith;

(ii) Supporting data are accurate and complete to the best of the Contractor's knowledge and belief; and

(iii) The amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable.

(3) (i) If the Contractor is an individual, the certification shall be executed by that individual.

(ii) If the Contractor is not an individual, the certification shall be executed by--

(A) A senior company official in charge at the Contractor's plant or location involved; or

(B) An officer or general partner of the Contractor having overall responsibility for the conduct of the Contractor's affairs.

(e) For Contractor claims of $50,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claim over $50,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.

(f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.

(g) The Government shall pay interest on the amount found due and unpaid from (1) the date the Contracting Officer receives the claim (properly certified if required), or (2) the date payment otherwise would be due, if that date is later, until the date of payment. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(h) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the

Contracting Officer.#

61. FAR 52.233-3 PROTEST AFTER AWARD (AUG 1989)

(a) Upon receipt of a notice of protest (as defined in 33.101 of the FAR) the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of cost allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either-

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both and the contract shall be modified, in writing, accordingly, if-

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.#

62. DFARS 252.233-7000 CERTIFICATION OF REQUESTS FOR ADJUSTMENT OR RELIEF EXCEEDING $100,000 (FEB 1980)

(The following clause is applicable if this contract is expected to exceed $100,000 and the procurement instrument identification number is prefixed by the letters "DACA".)

(a) Any contract claim, request for equitable adjustment to contract terms, request for relief under Public Law 85-804, or other similar request exceeding $100,000 shall bear, at the time of submission, the following certification given by a senior company official in charge at the plant or location involved:

I certify that the claim is made in good faith, that the supporting data

are accurate and complete to the best of my knowledge and belief; and that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable.

_____
(Official's Name)

_____
(Title)

(b) The certification in paragraph (a) requires full disclosure of all relevant facts, including cost and pricing data.

(c) The certification requirement in paragraph (a) does not apply to:

(1) request for routine contract payments; for example those for payment for accepted supplies and services, routine vouchers under cost-reimbursement type contracts, and progress payment invoices; and

(2) final adjustments under incentive provisions of contracts.

(d) In those situations where no claim certification for the purposes of Section 813 has been submitted prior to the inception of a contract dispute, a single certification, using the language prescribed by the Contract Disputes Act but signed by a senior company official in charge at the plant or location involved, will be deemed to comply with both statutes.#

63. FAR 52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of (1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or (2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, weather or not changed as a result of the conditions, an equitable adjustment shall be under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for and equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.#

64. FAR 52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has

investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to (1) conditions bearing upon transportation disposal, handling, and storage of materials; (2) the availability of labor, water, electric power, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.#

, > All equipment

65. FAR 52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgement of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the

Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.#

66. FAR 52.236-6 SUPERINTENDENCE BY THE CONTRACTOR (APR 1984)

At all times during performance of this contract and until the work is completed and accepted, the Contractor shall directly superintend the work or assign and have on the work a competent superintendent who is satisfactory to the Contracting Officer and has a competent authority to act for the Contractor.#

67. FAR 52.236-7 PERMITS AND RESPONSIBILITIES (APR 1984)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence, and shall take proper safety and health precautions to protect the work, the workers, the public, and the property of others. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.#

68. FAR 52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any action that will interfere with the performance of work by any other contractor or by Government employees.#

69. FAR 52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation or equipment, or by workmen, the Contractor shall trim those limbs or branches with clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities (1) at or near the work site and (2) on adjacent property of a third party, the locations of which are made know to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.#

70. FAR 52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.#

71. FAR 52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.#

72. FAR 52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.#

73. FAR 52.236-13 ACCIDENT PREVENTION (APR 1984)--ALTERNATE I-- (APR 1984)

(a) In performing this contract, the Contractor shall provide for protecting the lives and health of employees and other persons; preventing damage to property, materials, supplies, and equipment; and avoiding work interruptions. For these purposes, the Contractor shall--

(1) Provide appropriate safety barricades, signs and signal lights;

(2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and

(3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for this purpose are taken.

(b) if this contract is with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, dated April 1984.

(c) The Contractor shall maintain an accurate record of exposure data on all accidents incident to work performed under this contract resulting in death, traumatic injury, occupational disease, or damage to property, materials, supplies, or equipment. The Contractor shall report this data in the manner prescribed by the Contracting Officer.

(d) The Contracting Officer shall notify the Contractor of any noncompliance with these requirements and of the corrective action required. This notice, when delivered to the Contractor or the Contractor's representative at the site of the work, shall be deemed sufficient notice of the noncompliance and corrective action required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to take corrective action promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not base any claim or request for equitable adjustment for additional time or money on any stop order issued under these circumstances.

(e) The Contractor shall be responsible for its subcontractors' compliance with this clause.

(f) Before commencing the work, the Contractor shall--

(1) Submit a written proposal for implementing this clause; and

(2) Meet with representatives of the Contracting Officer to discuss and develop a mutual understanding relative to administration of the overall safety program.#

74. FAR 52.236-15 SCHEDULE FOR CONSTRUCTION CONTRACTS (APR 1984)

(a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as

directed by the Contracting Officer, and upon doing so shall immediately delivery three copies of the annotated schedule to the Contracting Officer. If in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.#

75. FAR 52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (APR 1984)

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by", or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown", "as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place", that is "furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements and (2) the installation (i.e., form, fit, and attachment details) of materials of equipment. It includes drawings, diagrams, layout, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in

detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

(h) This clause shall be included in all subcontracts at any tier.#

76. DFARS 252.236-7000 COMPOSITION OF CONTRACTOR (JAN 1965)

If the Contractor hereunder is comprised of more than one legal entity, each such entity shall be jointly and severally liable hereunder.#

77. DFARS 252.236-7001 MODIFICATION OF PROPOSALS - PRICE BREAKDOWN (APR 1968)

The Contractor, in connection with any proposal he makes for a contract modification, shall furnish a price breakdown, itemized as required by the Contracting Officer. Unless otherwise directed, the breakdown shall in sufficient detail to permit an analysis of all material, labor, equipment, subcontract, and overhead costs, as well as profit, and shall cover all work involved in the modification, whether such work was deleted, added or changed. Any amount claimed for subcontracts shall be supported by a similar price breakdown. In addition, if the proposal includes a time extension, a justification therefor shall also be furnished. The proposal, together with the price breakdown and time extension justification, shall be furnished by the date specified by the Contracting Officer.#

78. DFARS 252.236-7004 CONTRACT PRICES - BIDDING SCHEDULES (APR 1968)

Payment for the various items listed in the Bidding Schedule shall constitute full compensation for furnishing all plant, labor, equipment, appliances, and materials, and for performing all operations required to complete

the work in conformity with the drawings and specifications. All costs for work not specifically mentioned in the Bidding Schedule shall be included in the contract prices for the items listed.#

79. FAR 52.237-9 PROCUREMENT INTEGRITY (MAY 1989)

(a) Definitions. The definitions in FAR 3.104-4 are hereby incorporated in this clause.

(b) The Contractor shall establish a procurement ethics training program for its employees serving as procurement officials. The program shall, at a minimum-

(1) Provide for the distribution of written explanations of the provisions of section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) as implemented in the FAR to such employees; and

(2) Require each such employee, as a condition of serving as a procurement official, to certify to the Contracting Officer that he or she is familiar with the provisions of the Act, as implemented in the FAR, and will not engage in any conduct prohibited by subsections 27(a), (b), (c), or (e) of the Act, as implemented in the FAR, and will report immediately to the Contracting Officer any information concerning a violation or possible violation of the prohibitions.

(c) Pursuant to FAR 3.104-9(d), a Contractor employee who is serving as a procurement official may be requested to execute additional certifications.

(d) If a Contractor employee serving as a procurement official ceases performance of these duties during the conduct of such procurement expected to result in a contract or contract modification in excess of $100,000, such employee shall certify to the Contracting Officer that he or she understands the continuing obligation, during the conduct of the agency procurement, not to disclose proprietary or source selection information related to such agency procurement.#

80. FAR 52.243-4 CHANGES (AUG 1987)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designed or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

(1) In the specifications (including drawings and design);

(2) In the method or manner of performance of the work;

(3) In the Government-furnished facilities, equipment, materials, services, or site; or

(4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided that the Contractor gives the Contracting Officer written notice stating (1) the date, circumstances, and source of the order and (2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the

Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required, In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after (1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.#

81. DFARS 252.243-7001 PRICING OF ADJUSTMENTS (APR 1984)

When costs are a factor in any determination of a contract price adjustment pursuant to the Changes clause or any other clause of this contract, such costs shall be in accordance with Part 31 of the Federal Acquisition Regulation and the DoD FAR Supplement in effect on the date of this contract.#

82. FAR 52.244-1 SUBCONTRACTS (FIXED-PRICE CONTRACTS) (JAN 1986)

(The following clause is applicable if this contract is in excess of $500,000.)

(a) This clause does not apply to firm-fixed-price contracts and fixed-price contracts with economic price adjustment. However, it does apply to subcontracts resulting from unpriced modifications to such contracts.

(b) "Subcontract," as used in this clause includes but is not limited to purchase orders, and changes and modifications to purchase orders. The Contractor shall notify the Contracting Officer reasonably in advance of entering into any subcontract if the Contractor does not have an approved purchasing system and if the subcontract--

(1) Is to be a cost-reimbursement, time-and-materials, or labor-hour contract estimated to exceed $25,000 including any fee;

(2) Is proposed to exceed $100,000; or

(3) Is one of a number of subcontracts with a single subcontractor, under this contract, for the same or related supplies or services, that in the aggregate are expected to exceed $100,000.

(c) The advance notification required by paragraph (b) above shall include -

(1) A description of the supplies or services to be subcontracted;

(2) Identification of the type of subcontract to be used;

(3) Identification of the proposed subcontractor and an explanation of why and how the proposed subcontractor was selected, including the competition obtained;

(4) The proposed subcontract price and the Contractor's cost or price analysis;

(5) The subcontractor's current, complete, and accurate cost or pricing data and Certificate of Current Cost or Pricing Data, if required by

other contract provisions;

(6) The subcontractor's Disclosure Statement or Certificate relating to Cost Accounting Standards when such data are required by other provisions of this contract; and

(7) A negotiation memorandum reflecting--

(i) The principal elements of the subcontract price negotiations;

(ii) The most significant considerations controlling establishment of initial or revised prices;

(iii) The reason cost or pricing data were or were not required;

(iv) The extent, if any, to which the Contractor did not rely on the subcontractor's cost or pricing data in determining the price objective and in negotiating the final price;

(v) The extent, if any, to which it was recognized in the negotiation that the subcontractor's cost or pricing data were not accurate, complete or current; the action taken by the Contractor and subcontractor; and the effect of any such defective data on the total price negotiated;

(vi) The reasons for any significant difference between the Contractor's price objective and the price negotiated; and

(vii) A complete explanation of the incentive fee or profit plan when incentives are used. The explanation shall identify each critical performance element, management decisions used to quantify each incentive element, reason for the incentives, and a summary of all trade-off possibilities considered.

(d) The Contractor shall obtain the Contracting Officer's written consent before placing any subcontract for which advance notification is required under paragraph (b) above. However, the Contracting Officer may ratify in writing any such subcontract. Ratification shall constitute the consent of the Contracting Officer.

(e) Even if the Contractor's purchasing system has been approved, the Contractor shall obtain the Contracting Officer's written consent before placing subcontracts that have been selected for special surveillance and so identified in the Schedule of this contract.

(f) Unless the consent or approval specifically provides otherwise, neither consent by the Contracting Officer to any subcontract nor approval of the Contractor's purchasing system shall constitute a determination (1) of the acceptability of any subcontract terms or conditions, (2) of the acceptability of any subcontract price or of any amount paid under any subcontract, or (3) to relieve the Contractor of any responsibility for performing this contract.

(g) No subcontract placed under this contract shall provide for payment on a cost-plus-a-percentage-of-cost basis, and any fee payable under cost-reimbursement subcontracts shall not exceed the fee limitations in subsection 15.903(d) of the Federal Acquisition Regulation (FAR)

(h) The Government reserves the right to review the Contractor's purchasing system as set forth in FAR Subpart 44.3.#

83.1 FAR 52.245-2 GOVERNMENT PROPERTY (FIXED-PRICE CONTRACTS) (APR 1984)

(The following clause is applicable when Government Property having an acquisition cost in excess of $50,000 is furnished to or acquired by the Contractor.)

(a) Government-furnished property.

(1) The Government shall deliver to the Contractor, for use in connection with and under the terms of this contract, the Government-furnished property described in the Schedule or specifications together with any related data and information that the Contractor may request and is reasonably required for the intended use of the property (hereinafter referred to as "Government-furnished property").

(2) The delivery or performance dates for this contract are based upon the expectation that Government-furnished property suitable for use (except for property furnished "as-is") will be delivered to the Contractor at the times stated in the Schedule or, if not so stated, in sufficient time to enable the Contractor to meet the contract's delivery or performance dates.

(3) If Government-furnished property is received by the Contractor in a condition not suitable for the intended use, the Contractor shall, upon receipt of it, notify the Contracting Officer, detailing the facts, and, as directed by the Contracting Officer and at Government expense, either repair, modify, return, or otherwise dispose of the property. After completing the directed action and upon written request of the Contractor, the Contracting Officer shall make and equitable adjustment as provided in paragraph (h) of this clause.

(4) If Government-furnished property is not delivered to the Contractor by the required time, the Contracting Officer shall, upon the Contractor's timely written request, make a determination of the delay, if any, caused the Contractor and shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(b) Changes in Government-furnished property.

(1) The Contracting Officer may, by written notice, (i) decrease the Government-furnished property provided or to be provided under this contract, or (ii) substitute other Government furnished property for the property to be provided by the Government, or to be acquired by the Contractor for the Government, under this contract. The Contractor shall promptly take such action as the Contracting Officer may direct regarding the removal, shipment, or disposal of the property covered by such notice.

(2) Upon the Contractor's written request, the Contracting Officer shall make an equitable adjustment to the contract in accordance with paragraph (h) of this clause, if the Government has agreed in the Schedule to make the property available for performing this contract and there is any--

(i) Decrease or substitution in this property pursuant to subparagraph (b)(1) above; or

(ii) Withdrawal of authority to use this property, if provided under any other contract or lease.

(c) Title in Government property.

(1) The Government shall retain title to all Government-furnished property.

(2) All Government-furnished property and all property acquired by the Contractor, title to which vests in the Government under this paragraph

(collectively referred to as "Government property"), are subject to the provisions of this clause. Title to Government property shall not be affected by its incorporation into or attachment to any property not owned by the Government, nor shall Government property become a fixture or lose its identity as personal property by being attached to any real property.

(3) Title to each item of facilities, special test equipment, and special tooling (other than that subject to a special tooling clause) acquired by the Contractor for the Government under this contract shall pass to and vest in the Government when its use in performing this contract commences or when the Government has paid for it, whichever is earlier, whether or not title previously vested in the Government.

(4) If this contract contains a provision directing the Contractor to purchase material for which the Government will reimburse the Contractor as a direct item of cost under this contract--

(i) Title to material purchased from a vendor shall pass to and vest in the Government upon the vendor's delivery of such material; and

(ii) Title to all other material shall pass to and vest in the Government upon--

(A) Issuance of the material for use in contract performance;

(B) Commencement of processing of the material or its use in contract performance; or

(C) Reimbursement of the cost of the material by the Government, whichever occurs first.

(d) Use of Government property. The Government property shall be used only for performing this contract, unless otherwise provided in this contract or approved by the Contracting Officer.

(e) Property administration.

(1) The Contractor shall be responsible and accountable for all Government property provided under this contract and shall comply with Federal Acquisition Regulation (FAR) Subpart 45.5, as in effect on the date of this contract.

(2) The Contractor shall establish and maintain a program for the use, maintenance, repair, protection, and preservation of Government property in accordance with sound industrial practice and the applicable provisions of Subpart 45.5 of the FAR.

(3) If damage occurs to Government property, the risk of which has been assumed by the Government under this contract, the Government shall replace the items or the Contractor shall make such repairs as the Government directs. However, if the Contractor cannot effect such repairs within the time required, the Contractor shall dispose of the property as directed by the Contracting Officer. When any property for which the Government is responsible is replaced or repaired, the Contracting Officer shall make an equitable adjustment in accordance with paragraph (h) of this clause.

(4) The Contractor represents that the contract price does not include any amount for repairs or replacement for which the Government is responsible. Repair or replacement of property for which the Contractor is responsible shall be accomplished by the Contractor at its own expense.

(f) Access. The Government and all its designees shall have access at all reasonable times to the premises in which any Government property is located

for the purpose of inspecting the Government property

(g) **Risk of loss.** Unless otherwise provided in this contract the Contractor assumes the risk of, and shall be responsible for, any loss or destruction of, or damage to, Government property upon its delivery to the Contractor or upon passage of title to the Government under paragraph (c) of this clause. However, the Contractor is not responsible for reasonable wear and tear to Government property or for Government property properly consumed in performing this contract.

(h) **Equitable adjustment.** When this clause specifies an equitable adjustment, it shall be made to any affected contract provision in accordance with the procedures of the Changes clause. When appropriate, the Contracting Officer may initiate an equitable adjustment in favor of the Government. The right to an equitable adjustment shall be the Contractor's exclusive remedy. The government shall not be liable to suit for breach of contract for-

(1) Any delay in delivery of Government-furnished property;

(2) Delivery of Government-furnished property in a condition not suitable for its intended use;

(3) A decrease in or substitution of Government-furnished property; or

(4) Failure to repair or replace Government property for which the Government is responsible.

(i) **Final accounting and disposition of Government property.** Upon completing this contract, or at such earlier dates as may be fixed by the Contracting Officer, the Contractor shall submit, in a form acceptable to the Contracting Officer, inventory schedules covering all items of Government property (including any resulting scrap) not consumed in performing this contract or delivered to the Government. The Contractor shall prepare for shipment, deliver f.o.b. origin, or dispose of the Government property as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as the Contracting Officer directs.

(j) **Abandonment and restoration of Contractor's premises.** Unless otherwise provided herein, the Government--

(1) May abandon any Government property in place, at which time all obligations of the Government regarding such abandoned property shall cease; and

(2) Has no obligation to restore or rehabilitate the Contractor's premises under any circumstances (e.g., abandonment, disposition upon completion of need, or upon contract completion). However, if the Government-furnished property (listed in the Schedule or specifications) is withdrawn or is unsuitable for the intended use, or if other Government property is substituted, then the equitable adjustment under paragraph (h) of this clause may properly include restoration or rehabilitation costs.

(k) **Communications.** All communications under this clause shall be in writing.

(l) **Overseas contracts.** If this contract is to be performed outside the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.#

83.2 FAR 52.245-4 GOVERNMENT-FURNISHED PROPERTY (SHORT FORM) (APR

1984)

(The following clause is applicable when Government Property having an acquisition cost of $50,000 or less is furnished to or acquired by the Contractor.)

(a) The Government shall deliver to the Contractor, at the time and locations stated in this contract, the Government-furnished property described in the Schedule or specifications. If that property, suitable for its intended use, is not delivered to the Contractor, the Contracting Officer shall equitably adjust affected provisions of this contract in accordance with the Changes clause when--

(1) The Contractor submits a timely written request for an equitable adjustment; and

(2) The facts warrant an equitable adjustment.

(b) Title to Government-furnished property shall remain in the Government. The Contractor shall maintain adequate property control records in accordance with sound industrial practice and will make such records available for Government inspection at all reasonable times, unless the clause at Federal Acquisition Regulation 52.245-1, Property Records, is included in this contract.

(c) Upon delivery of Government-furnished property to the Contractor, the Contractor assumes the risk and responsibility for its loss or damage, except--

(1) For reasonable wear and tear;

(2) To the extent property is consumed in performing this contract; or

(3) As otherwise provided for by the provisions of this contract.

(d) Upon completing this contract, the Contractor shall follow the instructions of the Contracting Officer regarding the disposition of all Government-furnished property not consumed in performing this contract or previously delivered to the Government. The Contractor shall prepare for shipment, deliver f.o.b. origin, or dispose of the Government property, as may be directed or authorized by the Contracting Officer. The net proceeds of any such disposal shall be credited to the contract price or shall be paid to the Government as directed by the Contracting Officer.

(e) If this contract is to be performed outside the United States of America, its territories, or possessions, the words "Government" and "Government-furnished" (Wherever they appear in this clause) shall be construed as "United States Government" and "United States Government-furnished," respectively.#

84. FAR 52.246-12 INSPECTION OF CONSTRUCTION (JUL 1986)

(a) **Definition.** "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate

quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the completed work under paragraph (i) below.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, without additional charge, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor of its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make and equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.#

85. FAR 52.247-64 PREFERENCE FOR PRIVATELY OWNED U.S.-FLAG COMMERCIAL VESSELS (APR 1984)--ALTERNATE II--(APR 1984)

(a) When ocean transportation is required to bring supplies, materials, or equipment to the construction site from the United States either for use in performance of, or for incorporation in, the work called for by this contract, the Contractor shall use privately owned U.S.-flag commercial vessels to the

extent that such vessels are available at rates that are fair and reasonable for privately owned U.S.-flag commercial vessels.

(b) The Contractor shall not make any shipment exceeding 10 measurement tons (400 cubic feet) by vessels other than privately owned U.S.-flag commercial vessels without (1) notifying the Contracting Officer that U.S.-flag commercial vessels are not available at rates that are fair and reasonable for such vessels and (2) obtaining permission to ship in other vessels. If permission is granted, the contract price shall be equitably adjusted to reflect the difference in cost.

(c) (1) The Contractor shall submit one legible copy of a rated on-board ocean bill of lading for each shipment to both (i) the Contracting Officer and (ii) the Division of National Cargo, Office of Market Development, Maritime Administration, U.S. Department of Transportation, Washington, DC 20590. Subcontractor bills of lading shall be submitted through the Prime Contractor.

(2) The Contractor shall furnish these bill of lading copies (i) within 20 working days of the date of loading for shipments originating in the United States, or (ii) within 30 working days for shipments originating outside the United States. Each bill of lading copy shall contain the following information:

(A) Sponsoring U.S. Government agency.
(B) Name of vessel.
(C) Vessel flag of registry.
(D) Date of loading.
(E) Port of loading.
(F) Port of final discharge.
(G) Description of commodity.
(H) Gross weight in pounds and cubic feet if available.
(I) Total ocean freight revenue in U.S. dollars.

(d) Except for small purchases as described in 48 CFR 13, the Contractor shall insert the substance of this clause, including this paragraph (d), in all subcontracts or purchase orders under this contract.

(e) The requirement in paragraph (a) does not apply to--

(1) Small purchases as defined in 48 CFR 13;

(2) Cargoes carried in vessels of the Panama Canal Commission or as required or authorized by law or treaty;

(3) Ocean transportation between foreign countries of supplies purchased with foreign currencies made available, or derived from funds that are made available, under the Foreign Assistance Act of 1961 (22 U.S.C. 2353); and

(4) Shipments of classified supplies when the classification prohibits the use of non-Government vessels.

(f) Guidance regarding fair and reasonable rates for privately owned U.S.-flag commercial vessels may be obtained from the Division of National Cargo, Office of Market Development, Maritime Administration, U.S. Department of Transportation, Washington, DC 20590, Phone: 202-426-4610.#

86. FAR 52.248-3 VALUE ENGINEERING--CONSTRUCTION (MAR 1989)
ALTERNATE I (APR 1984)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) Definitions.

"Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP)" means a proposal that --

(1) Requires a change to this, the instant contract, to implement; and

(2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--

(i) In deliverable end item quantities only; or

(ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for (i) the affected portions of the existing contract requirement and (ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action.

(1) The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer shall notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer shall notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(3) Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Contracting Officer's decision to accept or reject all or part of any VECP shall be final and not subject to the Disputes clause or otherwise subject to litigation under the Contract Disputes Act of 1978 (41 U.S.C. 601-613).

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by (i) 45 percent for fixed-price contracts or (ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

(i) Accept the VECP;

(ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of $50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor

value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(h) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

> "These data furnished under the Value Engineering--Construction clause of contract, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

87.1 FAR 52.249-1 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SHORT FORM) (APR 1984)

(The following clause is applicable if this contract is not in excess of $100,000.)

The Contracting Officer, by written notice, may terminate this contract, in whole or in part, when it is in the Government's interest. If this contract is terminated, the rights, duties, and obligations of the parties, including compensation to the Contractor, shall be in accordance with Part 49 of the Federal Acquisition Regulation in effect on the date of this contract.#

87.2 FAR 52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (APR 1984)--ALTERNATE I--(APR 1984)

(The following clause is applicable if this contract is in excess of $100,000.)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

(1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting

officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (6) above; provided, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(d) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(e) Subject to paragraph (d) above, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (e) or paragraph (f) below, exclusive of costs shown in subparagraph (f)(2) below, may

not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be amended, and the Contractor paid the agreed amount. Paragraph (f) below shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(f) If the Contractor and the Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (e) above:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (i) above; and

(iii) A sum, as profit on (i) above, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The Termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(g) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (f) above, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(h) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all

costs claimed, agreed to, or determined under this clause.

(i) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (d), (f), or (k), except that if the Contractor failed to submit the termination settlement proposal within the time provided in paragraph (d) or (k), and failed to request a time extension, there is no right of appeal. If the Contracting Officer has made a determination of the amount due under paragraph (d), (f), or (k), the Government shall pay the Contractor (1) the amount determined by the Contracting Officer if there is no right of appeal or if no timely appeal has been taken, or (2) the amount finally determined on an appeal.

(j) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(k) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(l) (1) The Government may, under the terms and condition it prescribes, make partial payments and payment against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess in repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(m) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under the contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.#

88. FAR 52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include (i) acts of God or of the public enemy, (ii) acts of the Government in either its sovereign or contractual capacity, (iii) acts of another Contractor in the performance of a contract with the Government, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

(d) The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.#

89. FAR 52.252-6 AUTHORIZED DEVIATIONS IN CLAUSES (APR 1984)

(a) The use in this solicitation or contract of any Federal Acquisition Regulation (48 CFR Chapter 1) clause with an authorized deviation is indicated by the addition of "(DEVIATION)" after the date of the clause.#

GENERAL WAGE DECISION NO. IL89-16

Supersedes General Wage Decision No. IL88-16

State: ILLINOIS

County(ies): Alexander, Clay, Crawford, Edwards, Effingham, Fayette, Franklin, Gallatin, Hamilton, Hardin, Jackson, Jasper, Jefferson, Johnson, Lawrence, Marion, Massac, Perry, Pope, Pulaski, Randolph, Richland, Saline, Union, Wabash, Wayne, White, & Williamson

Construction Type: Heavy & Highway

Construction Description: Heavy & Highway Construction Projects

Modification Record:

No.	Publication Date	Page No.(s)
1	Mar. 3, 1989	212-214
2	Mar. 24, 1989	212
3	Oct. 27, 1989	212-214,220

	Basic Hourly Rates	Fringe Benefits
*CARPENTERS:		
Area 1:		
Carpenters	15.77	2.55
Piledrivermen	16.27	2.55
Area 2:		
Carpenters	15.41	2.91
Piledrivermen	15.91	2.91
Area 3:		
Carpenters	15.77	2.55
Piledrivermen	16.27	2.55
*Area 4	16.48	2.82
*Area 5:		
Carpenters	16.48	2.82
*Area 6	18.41	3.32
CEMENT MASONS:		
Area 1	17.95	
Area 2	15.35	
Area 3	17.515	.825
Area 4	13.75	1.60
Area 5	16.35	.80
*ELECTRICIANS:		
Area 1	18.77	2.26+ 3%
*Area 2	19.45	2.65+ 3.35%
*Area 3	21.30	19.25%
Area 4	20.63	1.25+ 9.5%
Area 5	19.82	1.25+ 14%
*IRONWORKERS:		
*Area 1	16.40	2.70
Area 2	16.70	4.65
*Area 3	16.85	4.73
*Area 4	19.25	4.00
*LABORERS:		
Area 1	14.50	2.535
*Area 2:		
*Heavy Construction:		
Group 1	17.25	2.35
Group 2	17.50	2.35
Group 3	17.75	2.35
Group 4	18.775	2.35
*Highway Construction:		
Group 1	17.15	2.45
Group 2	17.40	2.45
Group 3	17.65	2.45
Group 4	18.675	2.45
*Area 3:		
*Heavy Construction:		
Group 1	15.10	4.50
Group 2	15.35	4.50
Group 3	15.60	4.50
Group 4	16.625	4.50
Highway Construction:		
Group 1	15.10	4.25

Group 2	15.35	4.25
Group 3	15.60	4.25
Group 4	16.625	4.25
*Area 4	14.15	2.985
*LINE CONSTRUCTION:		
*Area 1:		
Lineman	20.61	1.25+ 13.5%
Equipment Operator Class 1	19.21	1.25+ 13.5%
Truck Driver with winch	14.63	1.25+ 13.5%
Truck Driver w/o winch	13.79	1.25+ 13.5%
Groundman	13.14	1.25+ 13.5%
Area 2:		
Lineman	18.85	1.25+ 13.5%
Groundman Equipment Operator Class 1	16.07	1.25+ 13.5%
Groundman Equipment Operator Class 2	14.39	1.25+ 13.5%
Groundman	11.96	1.25+ 13.5%
*PAINTERS:		
Area 1:		
Commercial Brush (old)	13.11	
Commercial Brush (new)	15.00	
Commercial Spray & Sandblast	13.61	
Industrial Brush	16.30	
Industrial Spray & Sandblast	16.80	
Dams, Tanks, Towers	17.33	
Bridges	19.67	
*Area 2:		
Industrial Brush	14.20	1.35
Bridges,	17.20	1.35
Sandblasting & Spray	17.20	1.35
Area 3:		
Brush & Roller:		
0-30 ft.	16.10	1.00
Over 30 ft.	16.90	1.00
Over 300 ft.	17.90	1.00
Blasting & Spraying		
0-30 ft.	16.80	1.00
Over 30 ft.	17.60	1.00
Over 300 ft.	18.60	1.00
*Area 4:		
Commercial Brush	17.65	2.52
Commercial Spray & Blast	19.65	2.52
Industrial Brush	18.85	2.52
Industrial Spray & Blast	20.85	2.52
Bridges - Brush	19.10	2.52
Bridges - Spray & Blast	21.10	2.52
Area 5:		
Commercial Brush	9.50	
Commercial Sandblast & Spray	10.50	
Industrial Brush	11.50	
Industrial Sandblast & Spray	12.50	
*Area 6:		
Commercial:		
Brush	13.00	.33
Structural Steel	13.50	.33
Sandblast, Spray	14.00	.33
Industrial:		
*Brush, Structural Steel, Sandblast,		

Spray	17.10	.34
Area 7	12.00	
Area 8:		
Commercial:		
Brush; Roller	11.60	.80
Sandblast; Power Tools	12.50	.80
Industrial:		
Brush; Roller	13.65	.80
Sandblast; Power Tools	14.20	.80
Bridges	14.65	.80
Steeplejacks	14.80	.80
*Area 9:		
Commercial:		
Brush	17.35	
Spray and Blast	18.85	
Industrial:		
Brush	17.85	
Spray and Blast	19.35	
Area 10:		
Commercial:		
Brush	14.80	
Sandblast, Spray	15.80	
Industrial:		
Brush	15.65	
Sandblast, Spray	16.65	
*POWER EQUIPMENT OPERATORS:		
Area 1:		
Group 1	18.50	2.985
Group 2	16.60	2.985
Group 3	15.85	2.985
Group 4	15.20	2.985
Group 5	14.60	2.985
Group 6	18.60	2.985
Group 7	15.15	2.985
Area 2:		
Group 1	17.30	4.70
Group 2	10.15	4.70
*Area 3:		
Group 1	20.97	3.42
Group 2	16.79	3.42
Group 3	16.04	3.42
Group 4	15.74	3.42
Group 5	21.47	3.42
Group 6	21.72	3.42
Group 7	21.97	3.42
*TRUCK DRIVERS:		
Group 1	16.175	2.10+ a
Group 2	16.575	2.10+ a
Group 3	16.775	2.10+ a
Group 4	17.025	2.10+ a

WELDERS - Receive rate for craft to which welding is incidental.

AREA DESCRIPTIONS

CARPENTERS & PILEDRIVERMEN

Area 1: Clay, Edwards, Fayette, Lawrence, Marion, Richland and Wabash Cos.
Area 2: Crawford, Effington and Jasper Cos.
Area 3: Hamilton, Jefferson, Wayne and White Cos.
Area 4: Franklin, Perry, Jackson, Union, Williamson, Johnson, Saline and Gallatin Cos.
Area 5: Alexander, Hardin, Massac, Pope and Pulaski Cos.
Area 6: Randolph Co.

CEMENT MASONS

Area 1: Alexander, Fayette (except N. part), Franklin, Hamilton, Jackson, Jefferson, Marion, Massac, Perry, Pulaski, Randolph, Union, Wayne & Williamson
Area 2: Clay, Edwards, Effingham, Gallatin, Hardin, Jasper, Johnson, Pope, Richland, Saline, and White
Area 3: Crawford (N 1/2 of Co.) Co.
Area 4: Crawford S 1/2 of Co.), Lawrence, & Wabash Cos.
Area 5: Fayette (N. part) Co.

ELECTRICIANS

Area 1: Crawford, Jasper, Lawrence, & Richland Cos.
Area 2: Effingham (Banner, Bishop, Douglas, Liberty, Lucas, Moccasin, St. Francis, Summit, & Teulopolis Twps.), Fayette (Hurricane, S. Hurricane, Ramsey, Bowling Green, Carson & Loudon Twps.) Cos.
Area 3: Randolph (RedBud Twp.) Co.
Area 4: Wabash Co.
Area 5: Remaining Cos.

IRONWORKERS

Area 1: Alexander, Franklin, Gallatin, Hardin, Jackson (exclu. Ava. & Elkville), Johnson, Massac, Pope, Pulaski, Saline (exclu. Vic. of El Dorado & Area NE), Union & Williamson Cos.
Area 2: Clay (exclu. Louisville & S.), Crawford, Effingham (Dexter & E. thereof), Jasper, Lawrence (N 1/2 of Co., exclu. Lawrenceville,),
Area 3: Effingham (exclu. Dexter & E. thereof), & Fayette (Avena & N. thereof) Cos.
Area 4: Fayette (S 1/2 below Brownstown), Jackson (Rem. of Co.), Jefferson (Mt. Vernon & Area W. thereof), Marion, Perry & Randolph Cos.

LABORERS

Area 1: Alexander, Franklin, Gallatin, Hardin, Jackson, Johnson, Massac, Perry, Pope, Pulaski, Saline, Union & Williamson Cos.
Area 2: Randolph (Chester & Vic.) Co.
Area 3: Randolph (Sparta & Vic.) Co.
Area 4: Remaining Cos.

LINE CONSTRUCTION

Area 1: Fayette (Portion N. of Avena) Co.
Area 2: Remaining Counties

PAINTERS

Area 1: Alexander & Pulaski
Area 2: Clay, Edwards, Hamilton, Jefferson, Marion (exclu. Salem city limits), & Wayne Cos.
Area 3: Crawford, Effingham, Jasper, Lawrence, Richland, & Wabash Cos.
Area 4: Fayette
Area 5: Franklin (City of Benton)
Area 6: Jackson, Perry, & Randolph Cos.
Area 7: Marion (Salem City limits) Co.
Area 8: Massac Co.
Area 9: Union Co.
Area 10: Franklin (Remainder of County), Johnson, Williamson

POWER EQUIPMENT OPERATORS

Area 1: Alexander, Franklin, Gallatin, Hamilton, Hardin, Jackson, Johnson, Massac, Pope, Pulaski, Saline, Union, White & Williamson Cos.
Area 2: Clay, Crawford, Edwards, Effingham, Jasper, Lawrence, Richland, Wabash, & Wayne Cos.
Area 3: Fayette, Jefferson, Marion, Perry & Randolph Cos.

CLASSIFICATIONS DEFINITIONS
LABORERS - RANDOLPH COUNTY - AREAS 2 & 3

HEAVY CONSTRUCTION

Group 1 - Unskilled
Group 2 - Workmen while cutting & burning with a Torch; Men working on the bottom of Sewer Trenches on the final Grading, laying or caulking of preformed sectional Sanitary or Storm Sewer Pipe, including Reinforced Concrete Tile, but not including Box Culverts, Tin Whistles or Multiplate Culverts
Group 3 - Tender to all Brick & Plaster Masons
Group 4 - Dynamite Men

HIGHWAY CONSTRUCTION

Group 1 - Laborers
Group 2 - Asphalt Raker; Weighman on Asphalt Platform
Group 3 - Men working on the Bottom of Sewer Trenches on the final grading, laying or caulking of preformed sectional Sanitary or Storm Sewer Pipe (including Reinforced Concrete Tile but not including Box Culverts)
Group 4 - Brickmasons Tenders
Group 5 - Dynamite Men

POWER EQUIPMENT OPERATORS

AREA 1

Group 1: APSCO or equal Spreading Machine, Backhoe, Boom or Winch

Cat, Bituminous Mixplane Machine, Blacksmith, Bituminous Surfacing Machine, Bulldozer, Crane, Shovel, Dragline, Truck Crane, Pile Driver, Concrete Finishing Machine or Spreader Machine, Concrete Breaker, Concrete or Pumpcrete Pumps, Dinky or standard Locomotives, Well or Caisson Drills, Elevating Grader, Fork Lifts, Flexplane, Gradall, Hi-Lift, Hoists, Guy-Derricks, Hyster, Mechanic, Motor Patrol, Mixers - 21 cu. ft. or over, Push cats, Pulls, & Scrapers, Two Well Point Pumps, Pulverizer or Tiller, Pugmill, Rubber-Tired Farm Type Tractor with Bulldozer/Blade/Auger or Hi-Lift over 1/2 yd., Jersey Spreader, Tract Air used with Drill or Hi-Lift, Trenching or Ditching Machines, Wood Chipper w/Tractor, Self-Propelled Roller w/Blade, Equipment Greaser, Self-propelled Bump Grinder on Concrete Highway pavement

Group 2: Air Compressor W/Valve driving piling, Two Air Compressors (220 cu. ft. capacity or over), Two Airtract Drills, Airtrack Drill w/Compressor, Automatic Bins or Scales W/Compressor or Generator, Pipeline Boring Machine, Bulk Cement Plant W/Separate Compressor, Power Operated BullFloat, Hydra-Lift W/Single Motor, Straw Mulcher Blower W/Spout, Self-Propelled Roller/Compactor, Back-End Man on Bituminous Surfacing Machine

Group 3: Boom or Winch Truck, Two Conveyors, Self-Propelled Concrete Saw, Self-Propelled Vibrator, any Type Tractor pulling any type Roller or Disc, Rubber Tired Farm Type Tractor W/Blade/ Bulldozer/Auger/Hi-Lift 1/2 yd. or less, Elevator Operator, Self-Propelled Chip Spreader, Form Grader, Truck Crane Oiler

Group 4: Air-Track Drill (one), Belt Drag Machine, Power Broom, Mechanical Plasterer Applicator, Trac-Air, Air Compressor (220 cu. ft. or over) One, Air Compressor (under 220 cu. ft.) four, Automatic Bin, Bulk Cement Plant Self-Propelled Form Tamper, Light Plants (4), Welding Machine (4), Pumps (4), or Combination of four Pumps, Light Plants, Welding Machines, Air-Compressors (under 200 cu. ft.), Mudjacks or Wood Chipper, Mixer- less than 21 cu. ft., Mortar Mixer w/skip or Pump, Pipeline Tract Jack

Group 5: One Air Compressor (under 220 cu. ft.), One Conveyor, One Motor Driven Heater, One Light Plant, One Pump, One Welding Machine, One Ulmac or Equal Spreader, Conveyor Operator on Self-Propelled Chip Spreader, Oiler.

RIVER WORK AND LEVEE WORK ON MISSISSIPPI AND OHIO RIVERS

Group 6: Crane, Shovel, Dragline, Scrapers, Dredge, Derrick, Pile-Driver, Push Boat, Mechanic, Engine-Man on Dredge, Lever-Man on Dredge, APSCO or equal Spreading machine, Backhoe, Backfiller, Boom or Winch Cat, Bituminuous Mixplane Machine, Blacksmith, Bituminous Surfacing machine, Bulldozer, Truckcrane, Concrete Finishing machine or Spreader machine Concrete Breaker, Concrete or Pumpcrete machines, Dinky or Standard Locomotives, Well Drill, Elevating Grader, ForkLifts, Flexplane, Gradeall, Hi-Lift, Power Handblade, Tugger type Hoist, Hoist Lift Two Drum (or over one), Guyderrick, Hyster, Motor Patrol, Mixers - 21 cu. ft. or over, Push Cat, Pulls @ Scrapers, Pumps- Two Well Points, Equipment Greaser, P@H Pulverizer or Pulverizer equal to Pugmill, Pugmill, Rubber-Tired Farm type tractor w/Bulldozer/Blade/Auger or Hi-Lift-over Byd, Skimmer Scoops, Seaman

Tiller, Jersey Spreader, Tract-Air used with Drill or Hi-Lift, Trenching or Ditching Machine, Wood Chipper w/Tractor, Self-Propelled Roller w/Blade, Concrete Pumps, Small Equipment Operators.

Group 7: Oiler or Fireman on Crane, Dragline, Shovel, Dredge, Truck Crane, Pile Driver, Gradeall, Dinky or Standard Locomotive, Guy Derrick, Trenching Machine or Ditching Machine 80 H. P. and over, All Terrain (cherry-picker) Cranes with 20 ton Lifting Capacity or over, Deck Oiler on Ohio River

AREA 2

Group 1: Power Cranes, Draglines, Derricks, Shovels, Gradalls, Mechanics, Concrete Mixers with Skip, Tournamixers, Two Drum Machine, One Drum Hoists with Tower or Boom, Cableways, Tower Machines, Motor Patrol, Boom Tractor, Boom or Winch Truck, Winch or Hydraulic Boom Truck, Truck Crane, Tournapull, Tractor Operating Scoops, Bulldozer, Push Tractor, Asphalt Planer, Finishing Machine on Asphalt, Large Rollers on Earth, Rollers on Asphalt Mix, Ross Carriers or similar Machine,Gravel Processing Machine, Asphalt Plant Engineer, Paver Operator, Farm Tractor w/half yard Bucket and/or Backhoe Attachment, Dredging Equipment or Dredge Engineer or Dredge Operator, Central Mix Plant Engineer, CMI or similar type machine, Concrete Pump, Truck or Skid Mounted, Tower Crane, Engine or Rock Crusher Plant, Concrete Plant Engineer, Ditching Machine with dual attachment, Tractor Mounted Loaders, Cherry Picker, Hydro Crane, Standard or Dinkey Locomotives, Scoopmobiles, Euclid Loader, Soil Cement Machine, Back Filler, Elevating Machine, Power Blade , Drilling Machines, incl. Well Testing, Caisson, Shaft or any similar type Drilling Machines, Motor Driven Paint Machine, Pipe Cleaning Machine, Pipe Wrapping Machine, Pipe Bending Machine, Apsco Paver, Boring Machine, Equipment Greaser, Barber-Greene Loaders, Formless Paver, Well Point System, Concrete Spreader, Hydra Ax, Resco Concrete Saw, Marine Scoops, Brush Mulcher, Brush Burner, Mesh Placer, Tree Mover, Helicopter Crew (3), Piledriver - Skid or Crawler, Stump Remover, Root Rake, Tug Boat Operator, Refrigerating Machine, Freezing Operator, Chair Cart - Self-Propelled, Hydra Seeder, Straw Blower, Power Sub Grader, Bull Float, Finishing Machine, Self-Propelled Pavement Breaker (Backhoe Attached), Lull (or similar type machine), Two Air Compressors, Compressors hooked in Manifold, Overhead Crane, Chip Spreader, Mud Cat, Sull-Air Tractor highlift, tournadozer

Group 2: Concrete Mixers without Skips, Rock Crusher, Ditching Machine under 6', Curbing Machine, One Drum Machines without Tower or Boom, Air Tugger, Self Propelled Concrete Saw, Machine Mounted Post Hole Digger, Two to Four Generators, Water Pumps, or Welding Machines, within 400 feet, Air Compressor 600 cu. ft. and under, Rollers on Aggregate and Seal Coat Surfaces, Fork Lift, Concrete and Blacktop Curb Machines, Farm Tractor with less than half yard Bucket, One Water Pump, Oilers, Air Valves or Steam Valves, One Welding Machine, Truck Jack, Mud Jack, Gunite Machines, House Elevators when used for Hoisting Material, Engine Tenders, Fireman, Wagon Drill, Flex Plane, Conveyor, Siphons and Pulsometer, Switchman,Fireman on Paint Pots, Fireman on Asphalt Plants, Distributor Operator on Truck, Tampers, Self-Propelled Power Broom, Striping Machine (motor driven), Form Tamper, Seaman Tiller, Bulk Cement Plant Equipment Greaser, Deck

Hands, Truck Crane, Oiler Driver, Cement Blimps, Form Grader, Temporary Heat, Throttle Valve, Farm Tractor

AREA 3

Group 1 - Cranes, Draglines, Shovels, Skimmer Scoops, Clamshells or Derrick Boats,- Pile Drivers, Crane-Type Backhoes, Asphalt Plant Oprs., Plant Opers., Ditching Machines or Backfillers, Dredges, Asphalt Spreading Machines, Heavy Duty Mechanic, Ass't Master Mechanic, All Locomotives, Cableways or Tower Machines, Hoists - 2 Drum or more, Hydraulic Backhoes, Ditching Machines or Backfiller, Cherry Pickers, Overhead Cranes, Roller (Steam or Gas) Concrete Pavers, Excavators, Concrete Breakers, Concrete Pump, Bulk Cement Plants, Cement Pumps, Derricks-Type Drills, Mixers (over 3 bags) and Boat Oprs., (25' & over), Motor graders or Pushcats, Scoops or Tournapulls, Bulldozers, End Loaders or Fork-Lift, Power Blade or Elevating Graders, Winch Cats, Boom Tractors, and Pipe Wrapping or Painting Machines, Drill (other than derrick type), 1 Drum-Hoists, Mud Jacks, Mixers (2 or 3 bags), Conveyors (2), Air Compressors (2), Water Pumps regardless of size (2), Welding Machines (2) Siphons or Jets (2), Winch Heads or Apparatus (2) and Light Plants (2), Mixers (under 2 bags), all Tractors regardless of size (Stral.ght Tractor Only), Fireman on Stationary Boilers, Automatic Elevators, Form Grading Machines, Finishing Machine, Power-Sub-Grader or Ribbon Machine, Longitudinal Floats, Boat Oprs., (under 25 ft. conveyors (1) Distribution Opers., On Trucks,Siphons or Jets (1) Winch Heads or Apparatuses (1), Light Plant (1) Mixers (under 2 bags)

Group 2 - Air Compressor (1), Water Pumps regardless of size (1) Welding Machine (1)

Group 3 - Fireman and Asphalt Spreader Oilers

Group 4 - Heavy Equipment Oilers (truck cranes, dredges, monigans, large cranes, etc.)

Group 5 Oilers

Group 6
a. Engineers Operating under air pressure
b. Engineers Operating in air over 10 lbs. pressure
c. Oilers Operating under air pressure
d. Oilers Operating in air over 10 lbs. prssure

TRUCK DRIVERS

Group 1 - Drivers on 2 Axles hauling less than 9 tons; Air Compressor & Welding Machine incl. those pulled by separate units; Fork Lifts up to 6,000 lbs. cap.; Mechanic Tenders; Pick-ups when hauling materials tools, or men to and from and on the job site; & Truck Driver Tenders

Group 2 - 2 or 3 Axles hauling more than 9 tons, but hauling less than 16 tons; A-Frame Winches; Fork Lifts over 6,000 lbs. cap; 4-axle Combination units; Hydrolifts or similar equipment when used for transportation purposes; & Winches

Group 3 - 2, 3, or 4 Axles hauling 16 tons or more; Dispatcher; 5-Axles or more combination units; Mechanics & Working Foreman; & Water Pulls

Group 4 - Drivers on Oil Distributors; & Drivers on Semi-Lowboys when moving equipment

*FOOTNOTE:
*a. $69.00 Per Week

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR, 5.5 (a)(1)(ii))

GENERAL WAGE DECISION NO. MO89-1

Supersedes General Wage Decision No. MO88-1

State: MISSOURI

County(ies): STATEWIDE

Construction Type: HEAVY AND HIGHWAY

Construction Description: Heavy and Highway Construction Projects

Modification Record:

No.	Publication Date	Page No.(s)
1	Apr. 21, 1989	629
2	June 2, 1989	628-634
3	Sept. 29, 1989	628-629,631 634,640,646
4	Oct. 27, 1989	629

	BASIC HOURLY RATES	FRINGE BENEFITS
*CARPENTERS & PILEDRIVERMEN:		
Zone 1	19.81	3.18
Zone 1A	19.00	3.18
Zone 2	19.00	3.18
Zone 2A	18.61	3.18
Zone 2B	17.66	3.18
Zone 3	16.85	3.03
Zone 4	16.25	3.03
Zone 5	16.95	3.18
Zone 6	18.10	2.03
Zone 6A	17.25	2.03
Zone 7	18.90	1.23
Zone 7A	18.10	2.03
Zone 7B	18.90	1.23
Zone 7C	18.10	2.03
Zone 7D	18.10	2.03
Zone 8	18.00	1.98
Zone 9	17.35	3.53
Zone 10	19.81	3.33
*CEMENT MASONS:		
Zone 1	16.85	2.53
Zone 2	15.30	2.68
Zone 3	17.07	3.03
Zone 4	14.35	
Zone 5	16.45	
Zone 6	16.40	
Zone 7	16.45	
Zone 8	16.95	2.93
Zone 9	17.86	4.74
Zone 10:		
Projects less than $1,000,000.00	16.60	4.35
Projects over $1,000,000.00	17.30	4.35
Zone 11	12.95	2.95
*ELECTRICIANS:		
Zone 1		
Electrical contracts exceeding $155,000.00	17.10	1.40 + 14.25%
Electrical contracts not to exceed $155,000.00	13.62	1.40 + 14.25%
*Zone 2	18.74	4.05 + 10%
*Zone 3		
Electrical contracts not to exceed 2000 man hours	17.74	4.05 + 10%
Electrical contracts 2000 man hours and over	18.74	4.05 + 10%
*Zone 4		
Electrical contracts not to exceed 2000 man hours	17.74	4.05 + 10%
Electrical contracts 2000 man hours and over	18.74	4.05 + 10%
*Zone 5		
Electrical contracts not to exceeed 2000 man hours	17.14	4.05 + 10%

Electrical contracts 2000 man hours and over	18.74	4.05 + 10%
Zone 6	19.40	2.20 + 33-1/2%
Zone 7		
Electrical contracts over $100,000.00	19.40	2.20 + 33-1/2%
Electrical contracts $100.000.00 and under	14.78	2.20 + 33-1/2%
Zone 8		
Electrical contracts over $200,000.00	19.40	2.20 + 33-1/2%
Electrical contracts $200.000.00 and under	11.43	2.20 + 33-1/2%
Zone 9	15.00	2.36 + 9%
Zone 10	16.04	2.36 + 9%
Zone 11	16.22	2.52 + 10%
Zone 12:		
Electricians	13.19	1.85 + 3%
Cable Splicers	13.54	1.85 + 3%
Zone 13:		
Electricians	17.04	3.87 + 10%
Cable Splicers	17.29	3.87 + 10%
IRONWORKERS:		
Zone 1	17.14	4.30
Zone 2	18.41	4.22
Zone 3	15.41	4.22
Zone 4	13.30	3.27
Zone 5	15.00	3.46
Zone 6	16.40	2.70
Projects $500,000.00 or more		
Projects less than $500,000.00	14.00	2.70
Zone 7	19.58	4.34
*LABORERS:		
Group 1:		
Zone 1	13.23	4.10
Zone 2	12.08	3.85
Zone 3:		
(a)	15.60	2.55
(b)	15.35	2.80
Zone 4:		
(a)	14.65	2.55
(b)	14.40	2.80
Group 2:		
Zone 1	13.58	4.10
Zone 2	12.63	3.85
Zone 3:		
(a)	16.20	2.55
(b)	15.95	2.80
Zone 4:		
(a)	15.25	2.55
(b)	15.00	2.80
*Zone 5: (Clay, Jackson, Platte, and Ray Counties):		
Group 1	14.37	4.10
Group 2	15.17	4.10
Group 3	12.37	4.10
Zone 6: (St. Louis City and County):		
General Laborer & Flagperson	17.11	4.25
Dynamiter or Powderman	16.86	3.00

LINE CONSTRUCTION:		
Zone 1:		
Lineman	19.93	1.25 + 15%
Lineman Operator	18.60	1.25 + 15%
Groundman Powderman	13.95	1.25 + 15%
Groundman	13.29	1.25 + 15%
Zone 2:		
Lineman	19.10	1.25 + 15%
Lineman Operator	18.20	1.25 + 15%
Groundman Powderman	13.36	1.25 + 15%
Groundman	12.37	1.25 + 15%
Zone 3:		
Lineman & Cable Splicer	18.55	1.25 + 30%
Groundman-Winch Driver	13.65	1.25 + 30%
Groundmen-Driver	13.15	1.25 + 30%
Equipment Operator	16.60	1.25 + 30%
Groundman	13.15	1.25 + 30%
Zone 4:		
Lineman	18.19	1.25 + 13-1/2%
Groundman Equipment Operator	16.07	1.25 + 13-1/2%
Groundman - Class A	11.36	1.25 + 13-1/2%
Zone 5: Railroad & Cross Country		
Transmission Lines (Underground):		
Lineman	17.78	1.25 + 15 1/4%
Lineman Operator	16.44	1.25 + 15 1/4%
Groundman Powderman	12.28	1.25 + 15 1/4%
Groundman	11.46	1.25 + 15 1/4%
Pole Treating Specialist	18.94	1.25 + 15 1/4%
Pole Treating Truck Driver	12.28	1.25 + 15 1/4%
Pole Treating Groundman	11.46	1.25 + 15 1/4%
Zone 6: Telephone and Telegraph Railroad Communications and C.A.T.V. Work:		
Cable Splicer, Air Pressure Technician, Central Office Equipment Man and Key System Installer	13.09	1.25 +18%
Telephone Lineman, Installer, CATV Terminator and Equipment Operator (D-4 or larger Crawler, Wheel Trencher Quarter Yard Backhoe or larger)	12.55	1.25 +18%
Equipment Operator (all other small equipment)	10.96	1.25 +18%
Groundman - Winch Driver	9.83	1.25 +18%
Groundman	8.62	1.25 +18%
Zone 7: Telephone & Telegraph Railroad Communications & CATV Work:		
Cable Splicers, Air Pressure Technician, Central Office Equipment Man	13.08	1.25 +3-3/4%
Telephone Lineman & Installer, Repairman, CATV Terminator, Equipment Operator (1/4 yd. Backhoe & larger & D-4 Crawler & larger)	12.41	1.25 +3-3/4%
PAINTERS:		
Zone 1:		
Brush & Roller	16.99	2.00
Spray	17.99	2.00

Bridge: steel	17.74	2.00
Stageman, spray; steelman spray; spray storage bin and tanks; bridge spray	18.74	2.00
Sadblast bridge; stage; erected steel; and sandblast storage bin and tanks	18.49	2.80
Steeplejack	21.68	2.80
Steeplejack, spray or sandblast	22.68	2.80
Zone 2:		
Brush	12.05	2.13
Spray	13.05	2.13
Sandblasting & Waterblasting	15.00	2.13
Tower, Stacks, Walkway, Cables, Tanks, and Bridges	13.85	2.13
Bridges over 500 ft. in legnth	17.27	2.13
Zone 3:		
Brush	13.50	2.90
Spray, Structural Steel, and Sandblasting	14.75	2.90
*Zone 4:		
Brush	16.00	
Bridge	16.75	
Spray, Sandblasting Operator; Work performed on bridges 75 ft. in height	17.00	
All Structural Steel over 50 ft. in height	16.75	
Zone 5:		
Brush	16.30	3.05
Spray	15.60	1.45
Steel, Storage bin & tank	15.00	1.45
Bridges, stage, belt,Bazooka	15.10	1.45
Zone 6:		
Brush, Roller	13.37	.60
Spray	13.87	.60
Zone 7:		
Brush	13.95	.45
Spray	14.45	.45
Zone 8:		
Brush	16.95	4.00
Spray	18.95	4.00
Zone 9:		
Brush	13.73	1.28
Spray, Bridgeman, Steelmen	14.23	1.28
Zone 10:		
Brush	14.00	
Spray	16.00	
Zone 11:		
Sign painters	14.85	2.40+d
Serviceman (repair of signs)	14.18	1.90+c
*POWER EQUIPMENT OPERATORS:		
*Zone 1:		
Group I	16.50	4.52
Group II	16.25	4.52
Group III	15.55	4.52
Group IV:		
(a)	11.53	4.52

(b)	14.55	4.52
Zone 2:		
Group I	17.42	4.82
Group II	17.42	4.82
Group III	16.12	4.82
Group IV	15.67	4.82
Group V:		
(a)	18.12	4.82
(b)	18.97	4.82
(c)	19.42	4.82
(d)	20.17	4.82
Zone 3:		
Group I	17.10	4.52
Group II	16.90	4.52
Group III	16.70	4.52
Group IV	16.10	4.52
Zone 4:		
Group I	15.05	4.52
Group II	14.70	4.52
Group III	14.50	4.52
Group IV	13.65	4.52
one 5:		
Group I	15.75	4.15
Group II	15.50	4.15
Group III	14.80	4.15
Group IV	13.30	4.15
Zone 6:		
Group I	15.70	4.15
Group II	15.35	4.15
Group III	15.15	4.15
Group IV	13.35	4.15
Zone 7:		
Group I	15.47	2.90
Group II	15.12	2.90
Group III	14.82	2.90
Group IV	12.87	2.90
Zone 8:		
Group I	16.55	4.52
Group II	16.35	4.52
Group III	16.15	4.52
Group IV	15.55	4.52
*TRUCK DRIVERS:		
Zone 1:		
Group 1	15.07	5.00
Group 2	14.82	5.00
Group 3	14.61	5.00
Group 4	14.41	5.00
Group 5	14.19	5.00
Zone 2		
Contact value less than $750,000 for work on farm ponds, water lines, curbs, streets, gutter & pipeline work:		
Group 1	17.65	
Group 2	17.80	
Group 3	17.87	
Group 4	17.76	
Group 5	17.55	

All other work:		
Group 1	21.15	
Group 2	21.30	
Group 3	21.87	
Group 4	21.26	
Group 5	21.05	
Zone 3:		
Contact value less than $750,000 for work on farm ponds, water lines, curbs, streets, gutter & pipeline work:		
Group 1	16.30	
Group 2	16.45	
Group 3	16.52	
Group 4	16.41	
Group 5	16.20	
All other work:		
Group 1	19.80	
Group 2	19.95	
Group 3	20.02	
Group 4	19.91	
Group 5	19.70	
Zone 4:		
Contact value less than $750,000 for work on farm ponds, water lines, curbs, streets, gutter & pipeline work:		
Group 1	12.54	3.75
Group 2	12.69	3.75
Group 3	12.76	3.75
Group 4	12.65	3.75
Group 5	12.44	3.75
All other work:		
Group 1	16.04	3.75
Group 2	16.19	3.75
Group 3	16.26	3.75
Group 4	16.15	3.75
Group 5	15.94	3.75
Zone 5:		
Contact value less than $750,000 for work on farm ponds, water lines, curbs, streets, gutter & pipeline work:		
Group 1	11.33	3.75
Group 2	11.48	3.75
Group 3	11.60	3.75
Group 4	11.49	3.75
Group 5	11.23	3.75
All other work:		
Group 1	14.83	3.75
Group 2	14.98	3.75
Group 3	15.10	3.75
Group 4	14.99	3.75
Group 5	14.73	3.75
Zone 6:		
Contact value less than $750,000 for work on farm ponds, water lines, curbs, streets, gutter & pipeline work:		
Group 1	10.60	3.75
Group 2	10.75	3.75

Group 3	10.87	3.75
Group 4	10.76	3.75
Group 5	10.50	3.75
All other work:		
Group 1	14.10	3.75
Group 2	14.25	3.75
Group 3	14.37	3.75
Group 4	14.26	3.75
Group 5	14.00	3.75
Zone 7:		
Group 1: Trucks or Trailers of a water level capacity of 11.99 cu. yds. or less. Forklift Trucks; Job Site Ambulance & Pickup Trucks & Flat Bed Trucks	16.67	4.31 + a
Group 2: Truck or Trailers of a water level capacity of 12.0 cu. yds. up to 22.0 cu. yds. including Euclids, Speedace and similar equipment of same capacity and Compressors	16.87	4.31 + a
Group 3: Trucks or Trailers of a water level capacity of 22.0 cu. yds. and over including Euclids, speedace and all Floats, Flat Bed Trailers, Boom Trucks, Winch Trucks including small trailers, Farm Wagons, Tilt-top Trailers, Field Offices Tool Trailers, Concrete Pumps, Concrete Conveyors and Gasoline Tank Trailers	16.97	4.31 + a
Zone 8:		
Traffic control service driver	10.40	3.00

FOOTNOTE:
a - 7 Paid Holidays A thru G also, paid vacation of 3 days 600 hours of service in any one contract year; 4 days paid vacation for 800 hours of service in any contract year; 5 days paid vacation for 1,000 hours of service in any one contract year; also .80 per hour health and welfare.
b - Employed for 1 year but less thab 2 years shall receive 1 week vacation with pay; 2 years or more shall receive 2 weeks vacation with pay.
c - Employed for (1) year but less than (3) years shall receive 1 week vacation with pay; 3 to 9 years shall receive 2 weeks with pay; 10 years or more shall receive 3 weeks vacation with pay. Also 8 Paid Holidays. A thru H.

Paid Holidays: A-Christmas Day, B-New Year's Day, C-Labor Day, D-Memorial Day, E-Independence Day, F-TYhanksgiving Day, G-Day after Thanksgiving Day, H-Washington's Birthday.
WELDERS: Receive rate prescribed for craft performing operation to which welding is incidental.

AREAS COVERED BY CARPENTERS AND PILEDRIVERMEN ZONES

Zone 1 - Jefferson, St. Charles Counties

Zone 1A - Franklin County
Zone 2 - Warren Counties
Zone 2A - Lincoln County
Zone 2B - Pike, St. Francois, Washington Counties
Zone 3 - Cass, Lafayette, Buchanan, Clinton and Johnson Counties
Zone 4 - Atchison, Andrew, Barry, Barton, Bates, Caldwell, Camden, Carroll, Cedar, Christian, Dade, Dallas,Daviess, DeKalb, Douglas, Gentry, Greene, Grundy, Harrison, Henry, Hickory, Holt, Jasper, Laclede, Lawrence, Livingston, McDonald, Mercer, Newton, Nodaway, Ozark, Polk, St. Clair, Saline, Stone, Taney, Vernon, Webster, Worth & Wright Counties
Zone 5 - Crawford, Dent, Gasconade, Iron, Madison, Maries, Montgomery, Phelps, Pulaski, Reynolds, Shannon & Texas Counties
Zone 6 - Boone, Cooper and Howard Counties
Zone 6A - Pettis, Benton and Morgan Counties
Zone 7 - Lewis, Marion and Ralls Counties
Zone 7A - Callaway, Cole, Miller, Moniteau and Osage Counties
Zone 7B - Adair, Putnam, Schuyler, Knox, Clark, Scotland and Sullivan Counties
Zone 7C - Audrain and Monroe Counties
Zone 7D - Randolph, Chariton, Linn, Macon and Shelby Counties
Zone 8 - Bollinger, Butler, Cape Girardeau, Carter, Dunklin, Howell, Mississippi, New Madrid, Oregon, Pemiscot, Perry, Ripley, Ste. Genevieve, Scott, Stoddard and Wayne Counties
Zone 9 - Clay, Jackson, Platte and Ray Counties
Zone 10 - St. Louis County and City

AREAS COVERED BY CEMENT MASONS ZONES

Zone 1 - Bates, Carroll, Cass & Lafayette Counties
Zone 2 - Dent, Phelps, Pike, Pulaski, Texas, Marion, Ralls, Crawford, and Shannon Counties
Zone 3 - Clay, Jackson, Platte & Ray Counties
Zone 4 - Cedar, Christian,Dade, Dallas, Douglas, Greene, Howell, Laclede, Ozark, Polk, Stone, Taney, Webster & Wright Counties
Zone 5 - Benton, Henry, Hickory, Johnson, Morgan, Pettis, Saline & St. Clair Counties
Zone 6 - Adair, Audrain, Boone, Chariton, Cooper, Howard, Linn, Macon, Moniteau, Monroe, Randolph, Shelby, Schuyler, Sullivan & Putnam Counties
Zone 7 - Callaway, Camden, Cole, Gasconade, Maries, Miller, Montgomery, & Osage Counties
Zone 8 - Andrew, Atchison, Buchanan, Caldwell, Clinton, Daviess, DeKalb, Gentry, Grundy, Harrison, Holt, Livingston, Mercer, Nodaway & Worth Counties
Zone 9 - St. Louis City & County, Jefferson & St. Charles Counties
Zone 10 - Franklin, Lincoln, Warren, Iron, St. Francois, Ste. Genevieve, Washington, Reynolds & Madison Counties
Zone 11 - Bollinger, Butler, Cape Girardeau, Carter, Dunklin, Mississippi, New Madrid, Oregon, Pemiscot, Perry, Ripley, Scott, Stoddard and Wayne Counties

AREAS COVERED BY ELECTRICIAN ZONES

Zone 1 - Adair, Audrain (that part east of Highway 19), Clark, Knox, Lewis, Linn, Macon, Marion, Monroe, Montgomery, Pike, Putnam, Ralls, Schuyler, Scotland, Shelby and Sullivan Counties

Zone 2 - Area bounded on the North by State Highway 92 in Platte & Clay Counties; east by a straight line from Intersection of State Highway 92 & 33 in Clay County Intersection of U.S. Highway 24 & State Highway 7 in Jackson County, south on Highway 7 to Pleasant Hill; South from Pleasant Hill due West to the Missouri - Kansas State Line; West by the Missouri - Kansas State Line. Towns of Pleasant Hill & Blue Springs are excluded

Zone 3 - Portion of Cass, Clay, Jackson and Platte Counties not included in Zone 2

Zone 4 - Bates, Benton, Henry, Johnson, Lafayette & Pettis Counties

Zone 5 - Carroll, Cooper, Morgan, Ray and Saline Counties

Zone 6 - St. Charles County, St. Louis County and City

Zone 7 - Franklin, Jefferson, Lincoln & Warren Counties

Zone 8 - Bollinger, Cape Girardeau, Perry, Scott, St. Francois, Ste. Genevieve, Butler, Carter, Dunklin, Iron, Madison, Mississippi, New Madrid, Pemiscot, Ripley, Reynolds, Stoddard, Washington and Wayne Counties

Zone 9 - Christian, Dallas, Douglas, Greene, Hickory, Howell, Laclede, Oregon, Ozark, Polk, Shannon, Stone, Taney, Texas, Webster and Wright Counties

Zone 10 - Pulaski County

Zone 11 - Andrew, Buchanan, Clinton, DeKalb, Atchison, Holt, Mercer, Gentry, Harrison, Daviess, Grundy, Worth, Livingston, Nodaway, Caldwell Counties

Zone 12 - Barry, Barton, Cedar, Dade, Jasper, McDonald, Newton, St. Clair, Vernon and Lawrence Counties

Zone 13 - Audrain (except Cuivre Township), Boone, Callaway, Camden, Chariton, Cole, Crawford, Dent, Gasconade, Howard, Maries, Miller, Moniteau, Osage, Phelps and Randolph Counties

AREAS COVERED BY IRONWORKERS ZONES

Zone 1 - Audrain, Callaway, Cole, Crawford, Dent, Gasconade, Maries, Montgomery, Osage, Phelps, Pike, Pulaski, Texas and Wright Counties; and portions of Camden, Douglas, Howell, Miller, Oregon, Boone, Shannon, Leclede, Monroe, and Ralls Counties

Zone 2 - Buchanan, Cass, Clay, Jackson, Lafayette, Platte and Ray Counties

Zone 3 - Andrew, Atchison, Barton, Bates, Benton, Caldwell, Carroll, Cedar, Chariton, Christian, Clinton, Cooper, Dade, Dallas, Daviess, DeKalb, Gentry, Greene, Grundy, Harrison, Henry, Hickory, Holt, Howard, Johnson, Laclede, Linn, Livingston, Mercer, Moniteau, Morgan, Nodaway, Pettis, Ozark, Polk, Randolph, St. Clair, Saline, Sullivan, Vernon, Webster, Taney, Wright and Worth Counties; and portions of Boone, Camden, Douglas, Laclede, and Miller Counties

Zone 4 - Barry, Jasper, Lawrence, McDonald, Newton and Stone Counties

Zone 5 - Adair, Clark, Knox, Lewis, Macon, Marion, Schuyler, Scotland, Ralls, Monroe and Shelby Counties

Zone 6 - Butler, Cape, Girardeau, Mississippi, New Madrid, Scott, and Stoddard Counties; and portions of Wayne, Carter, Ripley, Madison, Bollinger, Pemiscot and Dunklin Counties.

Zone 7 - City & County of St. Louis, St. Charles, Jefferson, Perry, Franklin, Lincoln, Warren, Washington, St. Francois, Ste. Genevieve, and Reynolds Counties; and portions of Madison, Bollinger, Wayne, Iron, and Carter Counties

LABORERS CLASSIFICATIONS DEFINITIONS ZONES 1 AND 2

GROUP 1 - General Laborers - Carpenter tenders; salamander tenders; loading trucks under bins; hopper & conveyors; track men & all other general laborers; air tool operator;cement handler, bulk or sack; dump man on earth fill; georgie buggie man; material batch hopper man; material mixer man (except on manholes); coffer dams; riprap pavers - rock, block or brick; scaffolds over ten feet notself-supported from ground up; skipman on concrete paving; wire mesh setters on concrete paving; all work in connection with sewer, water, gas, gasoline, oil, drainage pipe, conduit pipe, tile and duct lines and all other pipe lines; power tool operator, all work in connection with hydraulic or general dredging operations; puddlers (paving only); straw blower nozzleman; asphalt plant platform man; chuck tender; crusher feeder; men handling creosote ties or creosote materials; men working with and handling epoxy material or materials (where special protection is required); topper of standing trees; batter board man on pipe and ditch work; feeder man on wood pulverizers; board and willow mat weavers and cable tiers on river work; deck hands; pile dike and revetment work; all laborers working on underground tunnels less than 25 feet where compressed air is not used; abutment and pier hole men working six (6) feet or more below ground; men working in coffer dams for bridge piers and footings in the river; ditchliners; pressure groutmen; caulker and chain or concrete saw; cliffscalers working from scaffolds, bosuns' chairs or platforms on dams or power plants over (10) feet above ground; mortarmen on brick or block manholes; flagperson

GROUP 2 - Skilled Laborers - Head pipe layer on sewer work; laser beam man; Jackson on any other similar tamp; cutting torch man; form setters; liners and stringline men on concrete paving, curb, gutters; hot mastic kettleman; hot tar applicator; sandblasting and gunite nozzlemen; air tool operator in tunnels; screed man on asphalt machine; asphalt raker; barco tamper; churn drills; air track drills and all similar drills; vibrator man; stringline man for electronic grade control; manhole builders--brick or block; dynamite and powder men; welder; grade checker on cuts and fills

LABORERS CLASSIFICATIONS DEFINITIONS ZONES 3 AND 4

GROUP 1 - General Labor-Carpenter tenders; salamander tenders; dump man; ticket takers; loading trucks under bins, hoppers, and conveyors; track man; cement handler; dump man on earth fill; georgie buggie man; material batch hopper man; spreader on asphalt machine; material mixer man (except on manholes); coffer dams; riprap pavers-rock, block or brick; scaffolds over ten feet not self-supported from ground up; skipman on concrete paving; wire mesh setters on concrete paving; all work in connection with sewer, water, gas, gasoline, oil,drainage pipe, conduit pipe, tile and duct lines and all other pipe lines; power tool operator; all work in connection with hydraulic or general dredging operations; form setters, puddlers (paving only); straw blower nozzleman; asphalt plant platform man; chuck tender; crusher feeder; men handling creosote ties or creosote materials; men working with and handling epoxy material; topper of standing trees; feeder man on wood pulverizers, board and willow mat

weavers and cable tiers on river work; deck hands; pile dike and revetment work; all laborers working on underground tunnels less than 25 ft. where compressed air is not used; abutment and pier hole men working six (6) ft. or more below ground; men working in coffer dams for bridge piers and footings in the river; barco tamper; jackson or any other similar tamp; cutting torch man; liners, curb, gutters, ditch liners; hot mastic kettleman; hot tar applicator; hand blade operator; mortar men on brick or block manholes; rubbing concrete, air tool operator under 65 lbs.; caulker and lead man; chain or concrete saw under 15 h.p.; Flaggers

GROUP 2 - Skilled Laborers - Vibrator man; asphalt raker; head pipe layer on sewer work; batterboard man on pipe and ditch work; cliff scalers working from bosun's chairs; scaffolds or platforms on dams or power plants over 10 ft. high; air tool operator over 65 lbs.; stringline man on concrete paving; sandblast man; laser beam man; wagon drill; churn drill; air track drill and all other similar type drills,gunite nozzle man; pressure grout man; screed man on asphalt; concrete saw 15 h.p. and over; grade checker; stringline man on electronic grade control; manhole builder; dynamite man; powder man; welder; tunnel man; waterblaster - 1000 psi or over; asbestos and/or hazardous waste removal and/or disposal

AREAS COVERED BY LABORERS

Zone 1 - Buchanan, Cass and Lafayette Counties

Zone 2 - Andrew, Atchison, Barry, Barton, Bates, Benton, Caldwell, Camden, Carroll, Cedar, Christian, Clinton, Dade, Dallas, Daviess, DeKalb, Douglas, Greene,Gentry, Grundy, Harrison, Henry, Hickory, Holt, Jasper, Johnson, Laclede, Lawrence, Livingston, McDonald, Mercer, Morgan, Newton, Nodaway, Ozark, Pettis, Polk, St. Clair, Saline, Stone, Taney, Vernon, Webster, Wright and Worth Counties.

Zone 3:
a - Franklin and Jefferson Counties
b - St. Charles County

Zone 4:
a - Adair, Audrain, Bollinger, Boone, Butler, Callaway, Cape Girardeau, Carter, Chariton, Clark, Cole, Cooper, Crawford, Dent, Dunklin, Gasconade, Howard, Howell, Iron, Knox, Lewis, Linn, Macon, Madison, Maries, Marion, Miller, Mississippi, Moniteau, Monroe, New Madrid, Oregon, Osage, Pemiscot, Perry, Phelps, Pike, Pulaski, Putnam,Ralls, Randolph, Reynolds, Ripley, St.Francois, Ste. Genevieve, Schuyler, Scotland, Scott, Shannon, Shelby, Stoddard, Sullivan, Texas, Washington and Wayne Counties

b - Lincoln, Montgomery and Warren Counties

LABORER CLASSIFICATION DEFINITIONS - ZONE 5 - CLAY, JACKSON PLATTE AND RAY COUNTIES

Group 1 - General laborer - Carpenter tenders, salamander tenders; loading trucks under bins, hoppers and conveyors; track men and all other general laborers; air tool operator; cement handler (bulk or sack); chain or concrete saw; deck hands; dump man on earth fill;

guage; mechanics and welders, field; maintenance operator; mucking machine; pile driver operator; pitman crane operator; pump-2; pusncat operators; quad-trac; scoop operator- all types; scoops in tandem; self-propelled rotary drill (leroy or equal-not air trac); shovel operator; side discharge spreader; sideboom cats; skimmer scoop operator; slipform paver (CMI, REX or Equal); throttle man; truck crane; welding machine maintenance operator-2

Group II - "A" frame truck; asphalt hot mix silo; asphalt plant fireman, drum or boiler; asphalt plant mixer operator; asphalt plant man; asphalt roller operator; backfiller operator; chip spreader; concrete batch plant, dry-power operated; concrete mixer operator, skip loader; concrete pump operator; crusher operator; elevating grader operator; greaser; hoisting engine-1 drum; LaTourneau rooter; multiple compactor; pavement breaker, self-propelled, of the hydra-hammer or similar type; power shield; pub mill operator; stump cutting machine; towboat operator; tractor operator-over 50 HP

Group III - Boilers-1; chip spreader (front man); churn drill operator; compressor maintenance operator-1; concrete saws, self-propelled; conveyor operator; distributor operator; finishing machine operator; fireman, rig; float operator; form grader operator; pump; pump maintenance operator, other than dredge; roller operator, other than high type asphalt; screening and washing plant operator; self-propelled street broom or sweeper; siphons and jets; subgrading machine operator; tank car heater operator - combination boiler and booster; tractor, 50 HP or less, without attachments; vibrating machine operator, not hand; welding machine maintenance operator-1

Group IV:
(a) Oilers
(b) Oiler driver, (all types)

FOOTNOTE :
HOURLY PREMIUMS
FOLLOWING CLASSIFICATIONS SHALL RECEIVE $.25) ABOVE GROUP I RATE
Clamshells - 3 yd. capacity or over - crane or rigs, 80 ft. boom or over (including jib) - draglines, 3 yd. capacity or over - piledrivers, 80 ft. of boom or over (including jib) - shovels & backhoes, 3 yd. capacity or over

Power Equipment Operators Zone 2

Group I - Backhoe/ cable or hydraullic; cableway; crane, crawler or truck; crane, hydraulic-truck or cruiser mounted - 16 tons & over; crane locomotive; derrick, steam; derrick car & derrick boat; dragline; dredge; gradall, crawler or tire mounted; locomotive, gas, steam & other powers; pile driver, land or floating; scoop, skimmer; shovel, power (steam, gas, electric, or other powers); switch boat; whirley

Group II - Air tugger w/air compressor; anchor-placing barge; asphalt spreader; athey force feeder loader (self-propelled); backfilling machine; boat operator-push boat or tow boat (jobsite); boiler, high pressure breaking in period; boom truck, placing or erecting; boring machine, footing foundation; bullfloat; cherry picker; combination concrete hoist & mixer (such as mixermobile); compressors, two, not

more than 50 ft. apart; compressor (when operator runs throttle): compressor-generator combination, compressor-pump combination; generators, two 30 KW or over, or any number developing over 30 KW; generator-pump combination; compressor-welder combination; concrete breaker (truck or tractor mounted); concrete pump, such as pump-crete machine; concrete spreader; conveyor, large (not self-propelled), hoisting or moving brick and concrete into, or into and on floor level, one or both; crane, hydraulic-rough terrain, self-propelled; crane hydraulic-truck or cruiser mounted-under 16 tons; drilling machines,self-powered, used for earth or rock drilling or boring (wagon drills and any hand drills obtaining power from other sources including concrete breakers, jackhammers and barco equipment - no engineer required); elevating grader; engineman, dredge; excavator or powerbelt machine; finishing machine, self-propelled oscillating screed; forklift; grader, road with power blade; highlift; hoist; concrete and brick (brick cages or concrete skips operating in or on tower, towermobile, or similar equipment); hoist; stack; hydro-hammer; lad-a-vator, hoisting brick or concrete; loading machine (such as barber-greene); mechanic, on job site; mixer, paving; mixer-mobile; mucking machine; pipe cleantng machine; pipe wrapping machines; plant asphalt; plant, concrete producing or ready-mix job site; plant heating- job site; plant mixing-job site; plant power, generating-job site; pumps, two self-powered over 2" through 6"; pumps, electric submersible, one through three, over 4"; quad-track; roller, asphalt, top or sub-grade; scoop, tractor drawn; spreader box; sub-grader; tie tamper; tractor-crawler, or wheel type with or without power unit, power take-offs, and attachments regardless of size; trenching machine; tunnel boring machine; vibrating machine automatic, automatic propelled; welding machines (gasoline or diesel) more than one but not over four (regardless of size); well drilling machine

Group III - Conveyor, large (not self-propelled); conveyor, large (not self-propelled) moving brick and concrete (distributing) on floor level; mixer two or more mixers of one bag capacityor less, air tugger w/plant air; boiler, for power or heating on construction projects; boiler, temporary; compressor, air-one; compressor air (mounted on truck; concrete saw, self-propelled;curb finishing machine; ditch paving machine; elevator (building construction or alteration); endless chain hoist; form grader; generator, one over 30 KW or any number developing over 30 KW; greaser; hoist; one drum regardless of size (except brick or concrete); lad-a-vator, other hoisting; manlift; mixer, asphalt, over 8 cu. ft. capacity, mixer, if two or more mixers of one bag capacity or less are used by one employer on job an operator is required; mixer, with outside loader, 2 bag capacity or more; mixer, with side loader,regardless of size, not paver; oiler on dredge; oiler on truck crane pug mill operator; Pump, sump-self-powered, automatic controlled over 2" during use in connection with construction work; sweeper, street; welding machine, one over 400 amp.; winch operating from truck; scissor lift (used for hoisting); tractor, small wheel type 50 h.p. & under with grader blade & similar equipment

Group IV - Boat operator-outboard motor (job site); conveyor (such as con-vay-it) regardless of how used; sweeper, floor

Group V - (a) Air pressure, oiler engineer, operating under ten

pounds (b) air pressure, oiler engineer operating over ten pounds (c) air pressure engineer operating under ten pounds (d) air pressure engineer operating over ten pounds (e) crane-piledriving and extracting; crane using rock socket tool; dragline - 7 cu. yds. & over; shovel, power - 7 cu. yds. and over; crane, climbing such as Linden); derrick, diesel, gas or electric hoisting material and erecting steel - 150' or more above ground; hoists, three or more drums; scoop,tandem; tractor, tandem crawler

Crane with boom (including jib), over 100' from pin to pin (add 1: per foot to maximum of $2.00) above basic rate for crane

Work in tunnel or tunnel shaft, .50 above base rate

Power Equipment Operators Zones 3, 4 and 8

Group I - Asphalt finishing machine & trench widening spreader, asphalt plant console operator; autograder; automatic slipform paver; back hoe; blade operator - all types; boat operator - tow; boiler - 2; central mix concrete plant operator; clam shell operator; concrete mixer paver; crane operator; derrick or derrick trucks; ditching machine; dozer operator; dragline opr.; dredge booster pump; dredge engineman; dredge operator; drill cat with compressor mounted on cat; drilling or boring machine rotary self-propelled; highloader; hoisting engine - 2 active drums; launch-hammer wheel; locomotive operator- standard guage; mechanics and welders; mucking machine; piledriver operator; pitman crane operator; push cat operator; quad-trac; scoop operator; sideboom cats; skimmer scoop operator; trenching machine operator; truck crane, shovel operator

Group II - A-Frame; asphalt hot-mix silo; asphalt roller operator; asphalt plant fireman (drum or boiler); asphalt plant man; asphalt plant mixer operator; backfiller operator; barber-greene loader; boat operator (bridge & dams); chip spreader; concrete mixer operator - skip loader; concrete plant operator; concrete pump operator; dredge oiler; elevating grader operator; fork lift; grease fleet; hoisting engine - 1; locomotive operator - narrow guage; multiple compactor; pavement breaker; powerbroom self-propelled; power shield; rooter; slip-form finishing machine; stumpcutter machine; side discharge concrete spreader; throttleman; tractor operator (over 50 hp); winch truck; asphalt roller operator; crusher operator

Group III - Spreader box operator, self-propelled (not asphalt; tractor operator (50 h.p. or less); boilers - 1; chip spreader (front man); churn drill operator; compressor over 105 CFM 2 - 3 pumps 4" & over; 2-3 light plant 7.5 KWA or any combination thereof; clef plane opr.; compressor maintenance operator 2 or 3; concrete saw operator (self-propelled); curb finishing machine; distributor operator; finishing machine operator; flex plane operator; float operator; form grader operator; pugmill operator; roller operator, other than high type asphalt; screening & washing plant operator; siphons & jets; subgrading machine operator; tank car heater (combination boiler & booster); ulmac, ulric or similar spreader; vibrating machine operator; hydrobroom

Clark, Cole, Cooper, Crawford, Dent, Franklin, Gasconade, Howard, Howell, Iron, Jefferson, Knox, Lewis, Lincoln, Linn, Macon, Maries, Marion, Miller, Moniteau, Monroe, Montgomery, Morgan, Oregon, Osage, Perry, Phelps, Pike, Pulaski, Putnam, Ralls, Randolph, Reynolds, Ripley, St. Charles, St. Francois, St. Louis and City, Ste. Genevieve, Schuyler, Scotland, Shannon, Shelby, Sullivan, Texas, Warren and Washington Counties

Zone 7 - Atchison, Nodaway, Worth, Harrison, Mercer, Holt, Andrew, DeKalb, Daviess, Grundy, Buchanan, Clinton, Caldwell, Livingston, Platte, Clay, Ray Carroll, Jackson, Lafayette, Saline, Cass, Johnson, Pettis, Bates, Henry, Benton, Vernon, St. Clair, Hickory, Barton, Cedar, Polk, Dallas, Laclede, Jasper, Dade, Lawrence, Greene, Webster, Wright, Newton, McDonald, Barry, Stone, Christian, Douglas, Taney, Ozark, and Gentry Counties

AREA COVERED BY PAINTERS

Zone 1 - Bates, Caldwell, Carroll, Clinton, Cass, Clay, Daviess, Grundy, Linn, Henry, Harrison, Jackson, Johnson (excluding Whiteman Air Force Base, Lafayette, Livingston, Mercer, Platte and Ray Counties

Zone 2 - Bollinger, Cape Girardeau, Dunklin, Mississippi, New Madrid, Pemiscot, Scott, Stoddard, Reynolds, Iron,Butler, Carter, Shannon, Wayne, Oregon, Ripley, Ste. Genevieve, St.Francois, Perry, Washington, & Madison Counties

Zone 3 - Camden, Crawford, Dent, Laclede, Maries, Miller, Phelps, Pulaski and Texas Counties

Zone 4 - Benton, Cooper, Moniteau, Morgan, Pettis and Saline Counties and Whiteman AFB in Johnson County

Zone 5 - Andrew, Atchinson, Buchanan, DeKalb, Gentry, Holt, Nodaway,& Worth Counties

Zone 6 - Barry, Barton, Cedar, Dade, Jasper, Lawrence, McDonald, Newton, St. Clair and Vernon Counties

Zone 7 - Adair, Audrain, Boone, Callaway, Chariton, Cole, Gasconade, Howard, Monroe, Montgomery, Linn, Osage, Scotland and Randolph Counties

Zone 8 - Jefferson, St. Charles, St. Louis & City, Warren, Lincoln, Pike and Franklin Counties

Zone 9 - Christian, Dallas, Douglas, Greene, Hickory, Howell, Ozark, Polk, Stone, Taney, Webster and Wright Counties

Zone 10 - Clark, Lewis, Marion, and Ralls Counties

Zone 11 - Buchanan, Platte, Clinton, Clay, Ray, Jackson, Cass, Bates, Lafayette, and Johnson Counties

CLASSIFICATION DEFINITIONS

Power Equipment Operators Zone 1

Group I - Asphalt paver and spreader; asphalt plant console operator; auto grader; backhoe; blade operator, all types; boilers-2; boring machine (truck or crane mounted); bulldozer operator; clamshell operator; compressor maintenance operator-2; concrete plant operator, central mix; concrete mixer paver; crane operator, derrick or derrick-trucks; ditching machine; dragline operator; dredge engineman; dredge operator; drill-cat with compressor mounted on cat; drilling or boring machine, rotary, self-propelled; high loader-fork lift; hoisting engineer-2 active drums; locomotive operator, standard

FOOTNOTE:
HOURLY PREMIUMS
FOLLOWING CLASSIFICATIONS SHALL RECEIVE ($.25) ABOVE GROUP I RATE
DRAGLINE operator - 3 yds. & over; shovel - 3 yds. & over; clam-shell - 3 yds. & over; crane, rigs or piledrivers, 100' of boom or over (incl. jib.), hoists - each additional active drum over 2 drums

FOLLOWING CLASSIFICATIONS SHALL RECEIVE ($.50) ABOVE GROUP I RATE
Tandem scoop operator; crane, rigs or piledrivers 150' to 200' of boom (incl. jib.)

FOLLOWING CLASSIFICATIONS SHALL RECEIVE ($.75) ABOVE GROUP I RATE
Crane rigs, or piledrivers 200 ft. of boom or over (incl. jib.)

AREAS COVERED BY POWER EQUIPMENT OPERATORS ZONES

ZONE 1 - Clay, Jackson, Platte and Ray Counties,
ZONE 2 - St. Louis City and County
ZONE 3 - Franklin, Jefferson, St. Charles Counties
ZONE 4 - Adair, Audrain, Boillinger, Boone, Butler, Callaway, Cape Girardeau, Carter, Clark, Cole, Crawford, Dent, Dunklin, Gasconade, Howell, Iron, Knox, Lewis, Macon, Madison, Maries, Marion, Miller, Mississippi, Moniteau, Monroe, Montgomery, Morgan, New Madrid, Oregon, Osage, Pemiscot, Perry, Phelps, Pike, Pulaski, Putnam, Ralls, Randolph, Reynolds, Ripley, St. Francois, Ste. Genevieve, Schuyler, Scotland, Scott, Shannon, Shelby, Stoddard, Texas, Washington, and Wayne Counties
ZONE 5 - Buchanan, Cass, Clinton and Lafayette Counties
ZONE 6 - Andrew, Atchinson, Bates, Benton, Caldwell, Carroll, Chariton, Cooper, Daviess, DeKalb, Gentry, Grundy, Harrison, Henry, Holt, Howard, Johnson, Linn, Livingston, Mercer, Nodaway, Pettis, Saline, Sullivan and Worth Counties
ZONE 7 - Christian, Greene, Jasper, Lawrence, Taney, Barry, Barton, Camden, Cedar, Dade, Dallas, Douglas, Hickory, Laclede, McDonald, Newton, Ozark, Polk, St. Clair, Stone, Vernon, Webster and Wright Counties
ZONE 8 - Lincoln and Warren Counties

TRUCK DRIVER CLASSIFICATION DEFINITIONS

ZONE 1

Group 1 - Mechanics & Welders-field
Group 2 - A-frame low boy-boom truck driver
Group 3 - Insley wagons; dump trucks, excavating, 5 cu. yds. and over; dumpsters; half-tracks: speedace: euclids and similar excavating equipment material trucks, tandem two teams; semi-trailers; winch-truck-fork trucks; distributor drivers and operators; agitator and transit mix; tank wagon drivers, tandem or semi
Group 4 - One team; station wagons; pickup truck; material trucks, single axle, tank wagon drivers, single axle
Group 5 - Oilers and greasers-field

ZONES 2, 3, 4, 5 & 6

Group IV - Oiler; grout machine; oiler-driver; compressor over 105 CFM-1; conveyor operator - 1; maintenance operator; pump - 4" & over - 1

FOOTNOTE:
HOURLY PREMIUMS
FOLLOWING CLASSIFICATIONS SHALL RECEIVE ($.25) ABOVE GROUP I RATE
Crane with 3 yds. & over buckets; dragline operator - 3 yds. & over; shovel - 3 yds. & over; piledrivers - all types; clamshell - 3 yds. & over; hoists - each additional active drum over 2 drums

FOLLOWING CLASSIFICATION SHALL RECEIVE ($.50) ABOVE GROUP I RATE
Tandem scoop operator

Crane, rigs over 100 feet (incl. jib) - .01 Per foot

Power Equipment Operators Zones 5, 6 & 7

Group I - Asphalt finishing machine & trench widening spreader; asphalt plant console operator; automatic slipform paver; autograder; backhoe; blade operator, - all types; boat operator - tow; boilers - 2; central mix concrete plant operator; clamshell operator; concrete mixer paver; crane operator; derrick or derrick trucks; ditching machine; dozer operator; dragline operator; dredge booster pump; dredge engineman; dredge operator; drill cat with compressor mounted on cat; drilling or boring machine rotary self-propelled; highloader; hoisting engine - 2 active drums; launch hammer wheel; locomotive operator; - standard guage; mechanics and welder; mucking machine; piledriver operator; sideboom cats; skimmer scoop operators; trenching machine operator; truck crane; scoop operators - all types; pitman crane operator; push cat operator; quad trac; shovel operator

Group II - A-frame; asphalt hot mix silo; asphalt plant fireman (drum or boiler); asphalt roller operator; asphalt plant man; asphalt plant mixer operator; backfiller operator; barber-greene loader; boat operator (bridges and dams); chip spreader; concrete mixer operator - skip loader; concrete plant operator; concrete pump operator; crusher operator; dredge oiler; elevating grader operator; fork lift; greaser-fleet; hoisting engine - 1; locomotive operator - narrow guage; multiple compactor, pavement breaker; power - broom - self-propelled; power shield; rooter; slip form finishing machine; stumpcutter machine; side discharge concrete spreader; throttle man; tractor operator (over 50 hp); winch truck

Group III - Boilers - 1; chip spreader (front man); churn drill operator; clef plane operator; concrete saw operator (self-propelled); curb finishing machine; distributor operator; finishing machine operator; flex plane operator; float operator; form grader operator; pugmill operator; roller operator, other than high type asphalt; screening & washing plant operator; siphons & jets; subgrading machine operator; spreader box operator, self-propelled (not asphalt); tank car heater operator; (combination boiler & booster); ulmac, ulric, or similar spreader; vibrating machine operator, not hands; tractor operator (50 hp or less)

Group IV - Oiler; oiler driver

Group 1 - Flat bed trucks - single axle; station wagon; pickup trucks; material trucks - single axle; tank wagon - single axle
Group 2 - Flat bed trucks - tandem axle; material trucks, tandem axle; tank wagon - tandem axle
Group 3 - Semi and/or pole trailers; winch fork and steel trucks; Insley wagons, dumpsters, half tracks, speedace, euclids, and other similar equipment, a-frame and derrick trucks, float or low boy distributor drivers and operators, tank wagon, semi-trailer
Group 4 - Agitator and transit mix truck
Group 5 - Warehousemen

AREA COVERED BY TRUCK DRIVER ZONES

ZONE 1 - Clay, Jackson, Platte & Ray Counties
ZONE 2 - Franklin, Jefferson, and St. Charles Counties
ZONE 3 - Lincoln and Warren Counties
ZONE 4 - Buchanan, Cass, Johnson and Lafayette Counties
ZONE 5 - Andrew, Audrain, Barton, Bates, Benton, Bollinger, Boone, Caldwell, Callaway, Camden, Cape Girardeau, Carroll, Carter, Cedar, Chariton, Christian, Clinton, Cole, Cooper, Crawford, Dade, Dallas, Daviess, DeKalb, Dent, Douglas, Gasconade, Greene, Henry, Hickory, Howard, Iron, Jasper, Laclede, Lawrence, Linn, Livingston, Macon, Maidson, Maries, Marion, Miller, Mississippi, Moniteau, Monroe, Montgomery, Morgran, New Madrid, Newton, Osage, Pemiscot, Perry, Pettis, Phelps, Pike, Polk, Pulaski, Ralls, Randolpn, Reynolds, St. Clair, St. Francois, Ste. Genevieve, Saline, Scott, Shannon, Shelby, Stoddard, Texas, Vernon, Washington, Wayne, Webster and Wright Counties
ZONE 6 - Adair, Atchinson, Butler, Clark, Dunklin, Gentry, Grundy, Harrison, Holt, Howell, Knox, Lewis, McDonald, Mercer, Nodaway, Oregon, Ozark, Putnam, Ripley, Schuyler, Scotland, Stone, Sullivan, Taney and Worth Counties
ZONE 7 - St. Louis City and County
ZONE 8 - Hickory, Camde, Polk, Dallas, Laclede, Greene, Webster, Wright, Christian, Douglas, Ozark, Taney, Stone, Jackson, Clay, Platte, Ray, Lafayette, Johnson, Bates, Henry, and Cass Counties

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR, 5.5 (a) (1) (ii)).

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SPECIFICATIONS

PART I - SPECIAL CLAUSES

SC-1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984). FAR 52.212-3. The Contractor shall be required to:

a. commence work under this contract within 15 calendar days after the date the Contractor receives the Notice to Proceed,

b. prosecute said work diligently, and

c. complete the entire work ready for use not later than 360 calendar days after the date the Contractor receives the Notice to Proceed. The time stated for completion shall include final cleanup of the premises.

SC-2. LIQUIDATED DAMAGES (APR 1984).

a. If the Contractor fails to complete the work within the time specified in the contract, or any extensions, the Contractor shall pay the Government as liquidated damages, the sum of $520.00 for each day of delay.

b. If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased cost occasioned the Government in completing the work.

c. If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

SC-3. CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (SEP 1987). DFARS 252.236-7002

a. Five sets of large scale contract drawings, and specifications will be furnished the Contractor without charge, except applicable publications incorporated into the technical provisions by reference. Additional sets will be furnished on request at the cost of reproduction. One set of reproducibles will be furnished the Contractor on a one-time basis in lieu of the above contract drawings at the option of the Contracting Officer. The work shall conform to the specifications and the following contract drawings:

DRAWING NO.	TITLE	SHEET NO.
	Cover	
1/12 - 7/89	Stone Fill Weirs Mile 40.0 to 37.3 Location Map and Vicinity Map	1 of 12

DRAWING NO.	TITLE	SHEET NO.
1/12 - 8/89	Stone Fill Weirs Mile 37.3 to 35.0 Location Map	2 of 12
1/12 - 9/89	Stone Fill Weirs Miles 35.0 to 32.0 Location Map	3 of 12
1/12 - 10/89	Stone Fill Weirs Mile 32.0 to 29.3 Location Map	4 of 12
1/12 - 11/89	Stone Fill Weirs Mile 29.3 to 26.5 Location Map	5 of 12
1/12 - 12/89	Stone Fill Weirs Mile 26.5 to 24.2 Location Map	6 of 12
1/12 - 13/89	Stone Fill Weirs Mile 24.2 to 22.1 Location Map	7 of 12
1/12 - 14/89	Stone Fill Weirs Mile 22.1 to 18.9 Location Map	8 of 12
4/12 - 4/89	Stone Fill Weirs Mile 24.2 to 23.4 Profiles	9 of 12
4/12 - 5/89	Stone Fill Weirs Mile 23.2 to 22.9 Profiles	10 of 12
4/12 - 6/89	Stone Fill Weirs Mile 22.8 to 22.45 Profiles	11 of 12
2/22 - 2/89	Stone Fill Weirs And Stone Bank Revetment Mile 40.0 to 20.0 Construction Details	12 of 12

b. Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omitted or misdescribed details of the work, but they shall be performed as if fully and correctly set forth and described in the drawings and specifications.

c. The Contractor shall check all drawings furnished him immediately upon their receipt and shall promptly notify the Contracting Officer of any discrepancies. Figures marked on drawings shall in general be followed in preference to scale measurements. Large scale drawings shall in general govern small scale drawings. The Contractor shall compare all drawings and verify the figures before laying out the work and will be responsible for any errors which might have been avoided thereby.

SC-4. SURVEYS. The work indicated on the drawings listed in SC-3, is as determined from the latest available survey data. Surveys will be made before and/or during construction. If these surveys indicate any substantial changes which, in the opinion of the Contracting officer, require a revision in any design feature, drawings and supplementary specifications will be issued. They will include the location, azimuth, length, and top elevation of the dike, the grading and paving requirements, ground profiles, revised estimated quantities, and other pertinent detailed requirements and information.

SC-5 AND SC-6. NOT USED.

SC-7. PHYSICAL DATA (APR 1984). FAR 52.236-4. Data and information furnished or referred to below is furnished for the Contractor's information. The Government shall not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

a. Physical Conditions. The indications of physical conditions on the drawings and in the specifications are the result of site investigations by surveys. Hydrographic surveys are available for examination by contacting the Surveys Branch, Dept. of the Army, St. Louis District, Corps of Engineers, 210 Tucker Boulevard, North, St. Louis, Missouri 63101-1986. The copies of the hydrograph survey sheets will be furnished to the successful bidder at award of the contract.

b. Weather Conditions. Information with respect to temperatures and precipitation may be obtained from the National Weather Service.

c. Transportation Facilities. Railroads and highways serve the general area of the work. Water transportation is available to the site of the work.

d. Condition of River Channel. Data relating to river stages, soundings, and flow may be examined at the office of the Dept. of the Army, St. Louis District, Corps of Engineers St. Louis, Missouri. The mean river stages on gages in the vicinity of the work are shown on the chart at the end of the Special Clauses.

e. Channel Traffic. There is moderate commercial and pleasure traffic operating in the Mississippi River adjacent to the site. The passage of large craft may delay operations in the channel.

f. Obstruction of Channel. The Government will not undertake to keep the channel free from vessels or other obstructions, except to the extent of such regulations, if any, as may be prescribed by the Secretary of the Army, in accordance with the provisions of Section 7 of the River and Harbor Act approved 8 August 1917. The Contractor will be required to conduct the work in such manner as to obstruct navigation as little as possible, and in case the Contractor's plant so obstructs the channel as to make difficult or endanger the passage of vessels, said plant shall be promptly moved on the approach of any vessel to such an extent as may be necessary to afford a practicable passage. Upon completion of the work the Contractor shall promptly remove his plant, including ranges, buoys, piles, and other marks placed by him under the contract in navigable waters or on shore.

g. Datum and Gages. The plane of reference as used in these specifications is the zero stage of the St. Louis, Missouri, gage, Elevation 379.94 feet NGVD (National Geodetic Vertical Datum). Equivalent stages, based on steady river flow, for various stages on the St. Louis, Missouri, gage, as determined by the Contracting Officer for gages in the localities where the work is to be done, are as shown on the chart at the end of the Special Clauses.

SC-8. RIGHTS-OF-WAY.

a. Rights-of-way and/or construction easements for construction purposes will be furnished by the Government without cost to the Contractor as indicated in subparagraph b. below.

b. Construction permits have been obtained by the Government covering the area where the work will be performed. The work area extends 350 feet downstream from dike centerline at a point on the ordinary high water line on the Mississippi River; thence 100 feet landward, at right anglesto the ordinary high water line; thence 500 feet upstream and parallel to the ordinary high water line; thence riverward at right angles to the last described course to a point on the ordinary high water line; thence 150 feet downstream along the ordinary high water line, to the point of the beginning. The right of entry permit will generally encompass a somewhat larger area that extends 150 feet downstream from the downstream end of the work location, as determined from aerial photos, at a point on the ordinary high water line on the Mississippi River; thence 100 feet landward at right angles to the ordinary high water line; thence upstream parallel to the ordinary high water line, to a point 150 feet upstream of the dike centerline; thence riverward at right angles to a point on the ordinary high water line 150 feet upstream of the dike centerline. Right of entry permits for the revetment repair locations will be broad enough to encompass an area beginning on the ordinary high water line at least 150 feet downstream of the downstream end of the work area; thence 100 feet landward; thence upstream parallel to the ordinary high

water line, to a point at least 150 feet upstream of the upper end of the repair area; thence at right angles to a point on the ordinary high water line.

c. The Contractor shall procure without expense to the Government all additional lands, access roads, and/or right-of-way that he may desire for his use in the performance of the work. Any delays to the Contractor resulting from delays in procuring such additional lands, access roads, right-of-way, or permits for moving material and equipment for his own use will not be made a basis of any claim for increases in the cost of performance of the work. The Contractor shall make his own investigations to determine the conditions, restrictions, and difficulties which may be encountered in the transportation of material and equipment to the work sites shown on the drawings.

SC-9. NOT USED.

SC-10. DAMAGE TO WORK. The responsibility for damage to any part of the permanent work shall be as set forth in the clause of the contract entitled "Permits and Responsibilities." However, if in the judgment of the Contracting Officer any part of the permanent work performed by the Contractor is damaged by flood or earthquake, which damage is not due to the failure of the Contractor to take reasonable precautions or to exercise sound engineering and construction practices in the conduct of the work, the Contractor will make the repairs as ordered by the Contracting Officer and full compensation for such repairs will be made at the applicable contract unit or lump sum prices as fixed and established in the contract. If in the opinion of the Contracting Officer there are no contract unit or lump sum prices applicable to any part of such work, an equitable adjustment pursuant to the Contract Clause entitled, "Changes," of the contract will be made as full compensation for the repairs of that part of the permanent work for which there are no applicable contract unit or lump sum prices. Except as herein provided, damage to all work (including temporary construction), utilities, materials, equipment, and plant shall be repaired to the satisfaction of the Contracting Officer at the Contractor's expense, regardless of the cause of such damage.

SC-11. LAYOUT OF WORK.

a. The Government will establish the following base lines and bench marks at the site of the work:

(1) Alignment and/or Cutoff targets for each dike. Alignment targets will be added when work commences.

(2) Temporary bench marks- Set two iron pins with elevations for vertical as well as horizontal control at each weir dike location. (Horizontal and vertical control will be furnished to the low bidder).

b. From the base lines and bench marks established by the Government, the Contractor shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on

the contract drawings, subject to such modifications as the Contracting Officer may require to meet changed conditions or as a result of necessary modifications to the contract work.

c. The Contractor shall furnish at his own expense such stakes, templates, platforms, equipment, tools and material, and all labor as may be required in laying out any part of the work from the base lines and bench marks established by the Government. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks established by the Contracting Officer until authorized to remove them, and if such marks are destroyed by the Contractor or through his negligence prior to their authorized removal, they may be replaced by the Contracting Officer, at his discretion, and the expense of replacement will be deducted from any amounts due or to become due the Contractor. The Contracting Officer may require that work be suspended at any time when location and limit marks established by the Contractor are not reasonably adequate to permit checking of the work.

SC-12 AND SC-13. NOT USED.

SC-14. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984). FAR 52.236-1. The Contractor shall perform on the site, and with his own organization, work equivalent to at least forty percent (40%) of the total amount of work to be performed under the contract. This percentage may be reduced by a supplemental agreement to this contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

SC-15 AND SC-16. NOT USED.

SC-17. REVISIONS TO EM 385-1-1, SAFETY AND HEALTH REQUIREMENTS MANUAL. EM 385-1-1, April 1981, Revised October 1987, subject: Safety and Health Requirements Manual, forms a part of these specifications including the following changes:

1. Page 21, Section 07.A.03, replace with the following:

"07.A.03 - Protective footwear, such as rubber boots, protective covers, ice clamp-ons, or steel-toed safety boots, shall be worn by all persons exposed to hazards to the feet (including, but not limited to, impact, puncture, slipping, electrical, or chemical hazards).

a. For all activities in which Corps or contractor personnel or official visitors are potentially exposed to foot hazards, the applicable job/activity hazard analysis, accident prevention plan, or project safety plan shall include an analysis of, and prescribe specific protective measures to be enforced for, foot hazards.

b. Footwear providing protection against impact and compressive forces, conduction hazards, electrical hazards, and sole puncture shall meet the applicable requirements of ANSI Z41."

2. Page 143, Section 18.C.05, replace the following:

"18.C.05 - All load drums on loading-hoisting equipment shall be equipped with at least one positive holding device. This device should be applied directly to the motor shaft or some part of the gear train. It is not necessary that the positive holding device utilize shearing of metal to meet this requirement. Friction surfaces are acceptable."

3. Page 145, add Sections 18.C.24 and 18.C.25 which will read:

"18.C.24 - During personnel handling operations load and boom hoist drum brakes, swing brakes, and locking devices such as pawls or dogs shall be engaged when the occupied platform is in a stationary working position.

"18.C.25 - During personnel handling operations the load hoist drum shall have a system or device on the power train other than the load hoist brake, which regulates the lowering rate of speed of the hoist mechanism (controlled load lowering). Free fall is prohibited."

4. Page 146, Section 18.D.09, replace the following:

"18.D.09 - All telescopic boom cranes engaged in standard lift operations (including concrete bucket) should be equipped with a two-block warning feature(s), a two-block damage prevention feature, or an anti-two block device for all points of two-blocking (i.e., jibs, extension, etc.). In addition, all new telescopic boom cranes shall be equipped with a anti-two block device or a two-block damage prevention feature for all points of two-blocking. Cranes that are used exclusively as duty cycle machines (clamshell, dragline, grapple, pile driving operations) are exempt from this requirement but will meet the requirements of ANSI/ASME-B30.5-1982 (as revised). To alleviate difficulties associated with attaining compliance, an implementation time period until 1 January 1991 is granted. In all cases where cranes are utilized without these safeguards equivalent protection shall be established, documented and approved by the designated authority."

5. Page 146, add Sections 18.D.10 and 18.D.11, which will read:

"18.D.10 - All lattice boom cranes engaged in standard lift crane operations (including concrete bucket) should be equipped with a two-block warning feature which functions for all points of two-blocking. Cranes that are used exclusively as duty cycle machines (clamshell, dragline, grapple, pile driving operations) are exempt from this requirement but will meet the requirements of ANSI/ASME-B30.5-1982 (as revised). To alleviate difficulties associated with attaining compliance, an implementation time period until 1 January 1991 is granted. In all cases where cranes are utilized without these safeguards equivalent protection shall be established and documented and then approved by the designated authority."

"18.D.11 - During personnel handling operations all telescopic and lattice boom cranes shall be equipped with a device which when activated disengages all functions whose movement can cause contact between the load block or overhaul ball and the boom tip (anti-two block device), or a system shall be used which deactivates the hoisting action before damage occurs in

the event of a two-blocking situation (two-block damage prevention feature). The device or system must be installed for all points of two-blocking (i.e. jib or boom points) and in the case of the anti-two block device the crane must be equipped with automatic brakes on each hoist line; hoist lines not so equipped must be taken out of service while personnel lifts are being made."

SC-18. ACCIDENT INVESTIGATIONS AND REPORTING. Refer to EM 385-1-1, Paragraph 02.A.01. Accidents shall be investigated by the immediate supervisor of the employee(s) involved and reported to the Contracting Officer or his representative within one working day after the accident occurs. The accident Investigation report shall be made on ENG Form 3394.

SC-19. ACCIDENT PREVENTION PROGRAM. Refer to the Contract Clause entitled, "Accident Prevention". Within 15 days after receipt of Notice of Award of the contract, and at least 7 days prior to the prework conference, the original and one copy of the Accident Prevention Program shall be submitted to the Contracting Officer for review and approval. The program shall be prepared in the following format:

a. An executed LMV Form 358R, Administrative Plan.

b. An executed LMV Form 359R, Job Hazard Analysis.

c. A copy of company policy statement of accident prevention and any other guidance statements normally provided new employees. Each company employee shall be required to sign the company policy statement of accident prevention to verify that all employees have been informed of the safety program, and such signed statements shall be maintained at the project site.

d. When marine plant and equipment are in use under a contract, the method of fuel oil transfer shall be included on LMV Form 414R, Fuel Oil Transfer (refer to 33 CFR 156).

The Contractor shall not commence physical work at the site until the program has been approved by the Contracting Officer, or his authorized representative. At the Contracting Officer's discretion, the Contractor may submit his Job Hazard Analysis only for the first phase of construction provided that it is accompanied by an outline of the remaining phases of construction. All remaining phases shall be submitted and accepted prior to the beginning of work in each phase. Also refer to Section 1 of EM 385-1-1.

SC-20. DAILY INSPECTIONS. The Contractor shall institute a daily inspection program to assure all safety requirements are being fulfilled. Reports of daily inspections shall be maintained at the job site. The reports shall be records of the daily inspections and resulting actions. Each report will include, as a minimum, the following:

a. Phase(s) of construction underway during the inspection.

b. Locations of areas inspections were made.

c. Results of inspection, including nature of deficiencies observed and corrective actions taken, or to be taken, date, and signature of the person responsible for its contents.

SC-21. NOT USED.

SC-22. BASIS FOR SETTLEMENT OF PROPOSALS. Actual costs will be used to determine equipment cost for a settlement proposal submitted on the total cost basis under FAR 49.206-2(b). In evaluating a termination settlement proposal using the total cost basis, the following principles will be applied to determine allowable equipment costs:

(1) Actual costs for each piece of equipment, or groups of similar serial or series equipment, need not be available in the Contractor's accounting records to determine total actual equipment costs.

(2) If equipment costs have been allocated to a contract using predetermined rates, those charges will be adjusted to actual costs.

(3) Recorded job costs adjusted for unallowable and unallocable expenses will be used to determine equipment operating expenses.

(4) Ownership costs (depreciation) will be determined using the Contractor's depreciation schedule (subject to the provisions of FAR 31.205-11).

(5) License, taxes, storage and insurance costs are normally recovered as an indirect expense and unless the Contractor charges these costs directly to contracts, they will be recovered through the indirect expense rate.

SC-23. ENVIRONMENTAL LITIGATION.

(a) If the performance of all or any part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a Subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a Subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the "Suspension of Work" clause of this contract. The period of such suspension, delay or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof.

(b) The term "environmental litigation", as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantively or procedurally, the effect of the work on the environment.

SC-24. MACHINERY AND MECHANIZED EQUIPMENT. Machinery and mechanized equipment used under this contract shall comply with the following:

a. When a rubber-tired front-end loader, bulldozer, etc., is operated on floating plant, either a bumper or curb with a minimum height of one-third of the outside diameter of the largest tire on the equipment, a barge tied alongside, or other means approved in writing by the Contracting Officer shall be used to prevent equipment from moving or falling into the water.

b. The stability of crawler, truck, and wheel-mounted cranes shall be assured.

(1) The manufacturers' load-rating chart may be used to determine the maximum allowable working load for each particular crane's boom angle provided: (a) a test load, with a boom angle of 20 degrees, confirms the manufacturer's load-rating table; (b) there has been no change in the boom or other structural members; and (c) there has been no change in the machine's original counterweight.

(2) Stability tests are required, however, if: (a) there is no manufacturer's load-rating chart securely fixed to the operator's cab; (b) there has been a change in the boom or other structural members; (c) there has been a change in the counterweight. The test shall consist of lifting a load with the boom in the least stable undercarriage position and at an angle of 20 degrees above the horizontal. The test shall be conducted under close supervision on a firm, level surface. The load that tilts the machine shall be identified as the test load. The test load moment (in foot pounds) shall then be calculated by multiplying the horizontal distance (in feet) from the center of rotation of the machine to the test load, times the test load (in pounds). Three-fourths of this test-load moment shall then be used to compute the maximum allowable operating loads for the boom at 20, 40, 60, and 80 degrees above horizontal. From these maximum allowable operating loads, a curve shall be plotted and posted in the cab of the machine in sight of the operator. These values shall not be exceeded except in the performance test described below. The test load shall never exceed 110 percent of the manufacturer's maximum rated capacity.

(3) In lieu of the test and computations above, the crane may be load tested for stability at each of the four boom positions listed above.

c. Performance tests shall demonstrate the strength, capability, an adequacy of power, brakes, clutches, and controls to safely maneuver 125 percent of the maximum allowable load as determined above for the 80-degree position or the manufacturers rated load for the 80 degree position whichever is applicable. A performance test shall be conducted after each stability test, when the crane is placed in service on a project, and at least every 12 months.

d. Inspections shall be made which will ensure a safe economical operation of both cranes and draglines. Specific inspections and their frequencies are listed on the appropriate checklists noted below. Results of inspections and tests for cranes shall be recorded on the Safety Inspection Check List, LMV Form 326R and inspection results for draglines shall be recorded on LMV Form 373R. Copies of the inspections and tests shall be available at the jobsite for review. All stability and performance tests on cranes and all complete dragline inspections shall be witnessed by the Contracting Officer or his authorized representative.

e. A complete dragline inspection shall be made: (1) at least annually; (2) prior to the dragline being placed in operation; and (3) after the dragline has been out of service for more than 6 months.

SC-25 AND SC-26. NOT USED.

SC-27. SAFETY SIGN. The Contractor shall furnish, erect, and maintain a safety sign at the site, as located by the Contracting Officer. The sign shall conform to the requirements of this paragraph and the drawing included at the end of these Special Clauses. The lettering shall be black, the castle red, and the background white. When placed on a floating plant, the sign may be half size. Upon request, the Government will furnish two decals of the engineer castle. The sign shall be erected as soon as practicable, but not later than 15 calendar days after the date established for commencement of work. The data required shall be current.

SC-28. SUBCONTRACTS. In accordance with the Contract Clause entitled "Subcontracts", the Contractor shall, within seven days after the award of any subcontract by the Contractor or a Subcontractor, deliver to the Contracting Officer two copies of a completed Standard Form 1413. Both copies must contain the original signatures of both parties.

SC-29. REQUIRED INSURANCE - WORK ON A NON-GOVERNMENT INSTALLATION.

a. The Contractor shall, at its own expense, provide and maintain during the entire performance period of this contact at least the kinds and minimum amounts of insurance required in the following schedule:

(1) Workmen's Compensation. Amounts required by applicable jurisdictional statutes.

(2) Employer's Liability Insurance. $100,000

(3) Comprehensive General Liability Insurance.

Bodily Injury	-	$500,000 per occurrence
Property Damage	-	$ 20,000 per occurrence

(4) Comprehensive Automobile Insurance.

Bodily Injury	-	$200,000 each person $500,000 each accident
Property Damage	-	$ 20,000 each accident

b. Within 15 days after receipt of Notice of Award and before commencing work under this contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective (1) for such period as the laws of the State in which this contract is to be performed prescribe, or (2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

c. The Contractor shall insert the substance of this clause, including this paragraph c, in subcontracts under this contract and shall require subcontractors to provide and maintain the insurance required in paragraph a above. The Contractor shall maintain a copy of all subcontractor's proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

d. Certificates of insurance should be submitted to the following address:

Department of the Army
St. Louis District, Corps of Engineers
ATTN: CELMS-CD-CP
210 Tucker Blvd., North
St. Louis, Missouri 63101-1986

SC-30. NOT USED.

SC-31. CONTRACTOR QUALITY CONTROL.

a. General. The Contractor shall establish and maintain an effective quality control system in compliance with the Contract Clause entitled "Inspection of Construction". The quality control system shall consist of plans, procedures, and organization necessary to provide materials, equipment, workmanship, fabrication, construction and operations which comply with contract requirements. The system shall cover construction operations both onsite and offsite, and shall be keyed to the proposed construction sequence.

b. Coordination Meeting.

After acceptance of the Contractors Quality Control System and before commencing work, the Contractor shall meet with the Contracting Officer and discuss the Contractor's quality control system. During the meeting, a mutual understanding of the system details shall be developed, including the

forms for recording the Contractor Quality Control operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's inspection and control with the Government's inspection. Minutes of the meeting shall be prepared and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may also be occasions when subsequent conferences will be called to reconfirm mutual understandings.

c. Quality Control Plan.

(1) General. The Government will consider an interim plan for the first 60 days of operation to be submitted no later than 15 days after receipt of Notice of Award. Subsequent to submittal of an interim plan, the Contractor shall furnish for acceptance by the Government, not later than 35 days after receipt of Notice of Award, the original and one copy of the total Contractor Quality Control Plan with which he proposes to implement the requirements of Contract Clause entitled "Inspection of Construction". If the Contractor elects not to submit an interim plan, he shall furnish for approval within 15 days after receipt of Notice of Award, the Quality Control Plan specified above. The plan shall identify personnel, procedures, instructions, records, and forms to be used. If the Contractor fails to submit an acceptable quality control plan within the time herein prescribed, the Contracting Officer may refuse to allow construction to start, or he may withhold funds from progress payments in accordance with the Contract Clause entitled "Payments Under Fixed-Price Construction Contracts" until such time as the Contractor submits an acceptable final plan.

(2) The Quality Control Plan. This plan shall include as a minimum, the following:

(a) A description of the quality control organization, including chart showing lines of authority and acknowledgement that the Contractor Quality Control staff shall conduct the phase inspections for all aspects of the work specified and shall report to the project manager or someone higher in the Contractor's organization.

(b) The name, qualifications, duties, responsibilities and authorities of each person assigned a quality control function.

(c) A copy of the letter to the quality control manager signed by an authorized official of the firm, which describes the responsibilities and delegates the authorities of the quality control manager shall be furnished.

(d) Procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.

(e) Control testing procedures for each specific test. (Laboratory facilities will be approved by the Contracting Officer)

(f) Reporting procedures including proposed reporting formats.

(3) Acceptance of Plan. Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his quality control plan and operations as necessary to obtain the quality specified.

(4) Notification of Changes. After acceptance of the quality control plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

d. Quality Control Organization.

(1) Contractor Quality Control System Manager. The Contractor shall identify an individual, within his organization at the site of the work, who shall be responsible for overall management of Contractor quality control and have the authority to act in all Contractor quality control matters for the Contractor. This Contractor Quality Control System Manager shall be approved by the Contracting Officer.

(2) Personnel. A staff shall be maintained under the direction of the system manager to perform all quality control activities. The actual strength of the staff during any specific work period may vary to cover work phase needs, shifts, and rates of placement. The personnel of this staff shall be fully qualified by experience and technical training to perform their assigned responsibilities and shall be directly hired by and work for the prime Contractor.

e. Submittals. Submittals shall be as specified in the Contract Clause entitled "Specifications and Drawings for Construction" and in the Special Clause entitled "Contractor Submittal Procedures". The Contractor quality control organization shall be responsible for certifying that all submittals are in compliance with the contract requirements.

f. Control. Contractor Quality Control is the means by which the Contractor assures himself that his construction complies with the requirements of the contract plans and specifications. The controls shall be adequate to cover all construction operations, including both onsite and offsite fabrication, and will be keyed to the proposed construction sequence. The controls shall include at least three phases of inspection for all definitive features of work as follows:

(1) Preparatory Phase. This phase shall occur prior to beginning any work on any definable feature of work. It shall include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted and approved; a check to assure that provisions have been made to provide required control testing; examination of

the work area to ascertain that all preliminary work has been completed; and a physical examination of materials, equipment and sample work to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Contracting Officer's Representative shall be notified at least 24 hours in advance of beginning any of the required action of the preparatory phase. The results of the preparatory phase actions shall be made a matter of record in the Contractor's quality control documentation as required below. Subsequent to the preparatory phase and prior to commencement of work, the Contractor shall instruct each applicable worker as to the acceptable level of workmanship required in his Contractor quality control plan in order to meet contract specifications.

(2) Initial Phase. This phase starts as soon as a representative portion of the particular feature of work has been accomplished and shall include examination of the quality of workmanship and a review of control testing for compliance with contract requirements. The work shall be inspected for use of defective or damaged materials, omissions, and dimensional requirements. The Contracting Officer's Representative shall be notified at least 24 hours in advance of the initial phase. The inspection results shall be made a matter of record in the Contractor quality control documentation as required below. The initial phase shall be repeated for each new crew to work on site, or if acceptable standards of workmanship are not being met.

(3) Follow-up Phase. Daily inspections shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. Such inspections shall be made a matter of record in the Contractor quality control documentation as required below. Final follow-up inspections shall be conducted and all deficiencies corrected prior to the start of additional features of work.

g. Tests.

(1) Testing Procedure. The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to contract requirements. The Contractor shall procure the services of an industry recognized testing laboratory or he may establish an approved testing laboratory at the project site. A list of tests which the Contractor understands he is to perform shall be furnished as a part of the Contractor quality control plan to the Contracting Officer. The list shall give the test name, specification paragraph containing the test requirements, and the personnel and laboratory responsible for each type of test. The Contractor shall perform the following activities and record and provide the following data:

(a) Verify that testing procedures comply with contract requirements.

(b) Verify that facilities and testing equipment are available and comply with testing standards.

(c) Check test instrument calibration data against certified standards.

(d) Verify that recording forms, including all of the test documentation requirements, have been prepared.

(2) Testing.

(a) Capability Check: The Contracting Officer's Representative will have the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques.

(b) Capability Re-Check: If the selected laboratory fails the capability check, the Contractor will be assessed a charge of $250 to reimburse the Government for each succeeding re-check of the laboratory or the checking of a subsequently-selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

(c) Project laboratory: The Contracting Officer's Representative will have the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

(d) Transportation of Samples for Testing: Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineer Division Laboratory, f.o.b., at the following address:

For delivery by mail:

Waterways Experiment Station
P.O. Box 631
Vicksburg, MS 39180-0631

For other deliveries:

Halls Ferry Road
Vicksburg, MS

h. Completion Inspection. At the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work" or stated elsewhere in the specifications, the Contractor Quality Control System Manager shall conduct a completion inspection of the work and develop a 'punch list' of items which do not conform to the approved plans and specifications. Such a list of deficiencies shall be included in the Contractor quality control documentation, as required by Paragraph i below, and shall include the estimated date by which the deficiencies will be corrected. The Contractor

Quality Control System Manager or his staff shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify the Contracting Officer's Representative. The completion inspection and any deficiency corrections required by this paragraph shall be accomplished within the time stated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

i. Documentation.

(1) The Contractor shall maintain current records of quality control operations, activities, and test performed including the work of suppliers and subcontractors. These records shall be on an acceptable form and indicate a description of trades working on the project, the numbers of personnel working, the weather conditions encountered, any delays encountered, and acknowledgement of deficiencies noted along with the corrective actions taken on current and previous deficiencies. In addition, these records shall include factual evidence that required activities or tests have been performed, including but not limited to the following:

(a) Type and number of control activities and tests involved.

(b) Results of control activities or tests.

(c) Nature of defects, causes for rejection, etc.

(d) Proposed remedial action.

(e) Corrective actions taken.

(2) These records shall cover both conforming and defective or deficient features and shall include a statement that supplies and materials incorporated in the work comply with the contract. The Contractor shall furnish 3 legible copies of these records on a daily basis within 24 hours after date of report.

j. Notification of Noncompliance. The Contracting Officer will notify the Contractor of any noncompliance with the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his representative at the site of the work, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

SC-32. PERFORMANCE EVALUATION OF CONTRACTOR.

a. (The following clause is applicable to construction contracts as follows:

1. Contracts greater than $500,000.
2. Contracts over $10,000 if any element of performance is either unsatisfactory or outstanding.
3. Contracts of $10,000 or more that are terminated for default.
4. Contracts of $100,000 or more that are terminated for convenience.

b. The Contractor's performance will be evaluated upon final acceptance of the work. However, interim evaluation may be prepared at any time during contract performance when determined to be in the best interest of the Government.

c. The format for the evaluation will be Standard Form 1420, and the Contractor will be rated either outstanding, satisfactory, or unsatisfactory in the areas of Contractor Quality Control, Timely Performance, Effectiveness of Management, Compliance with Labor Standards, and Compliance with Safety Standards. The Contractor will be advised of any unsatisfactory rating either in an individual element or in the overall rating, prior to completing the evaluation, and all Contractor comments will be made a part of the official record. Performance Evaluation Reports will be available to all DOD Contracting Offices for their future use in determining Contractor responsibility, in compliance with DFARS 36.201 (c)(1).

SC-33. CONTAMINATION OF WATER. In addition to the requirements set forth in 2A-8, Protection of Water Resources, the Contractor shall take positive protective measures to prevent spillage of potential pollutant materials such as fuel, emulsion materials, chemicals etc., from storage containers or equipment, into lakes or tributary waters. Such positive protective measures may include, but not limited to, the following:

(1) A berm enclosure of sufficient capacity to contain such materials.

(2) Security measures to prevent acts of vandalism which could result in spillage of such materials (fences, guards, etc.).

(3) Storage of such materials in an area where the terrain would preclude leakage into lake or tributary waters.

(4) Utilization of secure Government storage areas if the Contracting Officer indicates such space is available. No storage past immediate needs (2 days) without the consent of the Contracting Officer.

The Contractor shall submit his proposals for implementing the above provisions in accordance with 2A-6, Implementation.

SC-34. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE.

(a) Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a Contractor or Subcontractor at any tier shall be based on actual cost data for each piece of equipment or equipment groups of similar serial and series for which the Government can determine both ownership and operating costs from the Contractor's accounting records. When both ownership and operating costs cannot be determined for any peice of equipment or groups of similar serial or series equipment from the Contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, "Construction Equipment Ownership and Operating Expense Schedule Region V". Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the Contracting Officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retrospective pricing, the schedule in effect at the time the work was performed shall apply.

(b) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36 substantiated by certified copies of paid invoices. Rates for equipment rented from an organization under common control, lease-purchase or sale-leaseback arrangements will be determined using the schedule except that rental costs leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees are allowable. Costs for major repairs and overhaul are unallowable.

(c) When actual equipment costs are proposed and the total amount of the pricing action is over $25,000, cost or pricing data shall be submitted on Standard Form 1411, "Contract Pricing Proposal Cover Sheet." By submitting cost or pricing data, the Contractor grants to the Contracting Officer or an authorized representative the right to examine those books, records, documents and other supporting data that will permit evaluation of the proposed equipment costs. After price agreement the Contractor shall certify that the equipment costs or pricing data submitted are accurate, complete and current.

(d) This does not apply to terminations. See 49.113(100) and FAR Part 4.9.

SC-35. NOT USED.

SC-36. ORDER AND COORDINATION OF WORK. The Contractor may start and complete the work in such order and sequence as he may desire subject to compliance with the following paragraph:

(1) River closure must be coordinated with United States Coast Guard two weeks prior to beginning of work so proper notices can be prepared.

SC-37. CONTINUING CONTRACTS (1985 JAN HQ USACE). EFARS 52.232-10001.

a. This is a continuing contract, as authorized by Section 10 of the River and Harbor Act of September 22, 1922 (33 U.S. Code 621). The payment of some portion of the contract price is dependent upon reservations of funds from future appropriations. The responsibilities of the Government are limited by this clause, notwithstanding any contrary provision of the "Payments Under Fixed-Price Construction Contracts" clause or any other clause of this contract, by issuing an administrative change order to the contract.

b. (1) The sum of $600,000 has been reserved for this contract and is available for payments to the Contractor during the current fiscal year. It is expected that Congress will make appropriations for future fiscal years from which additional funds will be reserved for this contract.

(2) Failure to make payments in excess of the amount currently reserved, or that may be reserved from time to time, shall not entitle the Contractor to a price adjustment under the terms of this contract, except as specifically provided in paragraphs d and e below. No such failure shall constitute a breach of this contract, except that this provision shall not bar a breach-of-contract action if an amount finally determined to be due as a termination allowance remains unpaid for one year due solely to a failure to reserve sufficient additional funds therefor.

c. (1) The Government may at any time reserve additional funds for payments under the contract if there are funds available for such purpose. The Contracting Officer will promptly notify the Contractor of any additional funds reserved for the contract by issuing an administrative change order to the contract.

(2) If earnings will be such that funds reserved for the contract will be exhausted before the end of any fiscal year, the Contractor shall give written notice to the Contracting Officer of the estimated date of exhaustion and the amount of additional funds which will be needed to meet payments due or to become due under the contract during that fiscal year. This notice shall be given not less than 45 nor more than 60 days prior to the estimated date of exhaustion.

d. (1) No payments will be made after exhaustion of funds except to the extent that additional funds are reserved for the contract. The Contractor shall be entitled to simple interest on any payment that the Contracting Officer determines was actually earned under the terms of the contract and would have been made except for exhaustion of funds. Interest shall be computed from the time such payment would otherwise have been made until actually or constructively made, and shall be at the rate established by the Secretary of the Treasury pursuant to Public Law 92-41, 85 STAT 97, for the Renegotiation Board, as in effect on the first day of the delay in such payment.

(2) Any suspension, delay, or interruption of work arising from exhaustion or anticipated exhaustion of funds shall not constitute a breach of this contract and shall not entitle the Contractor to any price adjustment under the "Suspension of Work" clause or in any other manner under this contract.

(3) An equitable adjustment in performance time shall be made for any increase in the time required for performance of any part of the work arising from exhaustion of funds or the reasonable anticipation of exhaustion of funds.

e. If, upon the expiration of sixty (60) days after the beginning of the fiscal year following an exhaustion of funds, the Government has failed to reserve sufficient additional funds to cover payments otherwise due, the Contractor, by written notice delivered to the Contracting Officer at any time before such additional funds are reserved, may elect to treat his right to proceed with the work as having been terminated. Such a termination shall be considered a termination for the convenience of the Government.

f. If at any time it becomes apparent that the funds reserved for any fiscal year are in excess of the funds required to meet all payments due or to become due the Contractor because of work performed and to be performed under the contract during the fiscal year, the Government reserves the right, after notice to the Contractor, to reduce said reservation by the amount of such excess.

SC-38. AS-BUILT DRAWINGS.

a. "As-Built" Contract Drawings. The Contractor shall maintain a separate set of full-size contract drawings, marked up in red, to indicate as-built conditions. Each as-built contract drawing shall include the Contract Number (DACW43-XX-C-XXXX) associated with the contract. These drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by Government personnel at all times. All variations from the contract drawings, for whatever reason, including those occasioned by modifications, optional materials, and the required coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the contract drawings. Upon completion of the work, the marked-up drawings shall be furnished to the Contracting Officer prior to acceptance of the work. The Government will withhold two percent of the total bid price of the items for which as-built contract drawings have not been submitted.

SC-39 THRU SC-41. NOT USED.

SC-42. MEANS OF ESCAPE FOR PERSONNEL QUARTERED OR WORKING ON FLOATING PLANT. Two means of escape shall be provided for assembly, sleeping, and messing areas on floating plants. For areas involving 10 or more persons, both means of egress shall be through standard size doors opening to different exit routes. Where 9 or fewer persons are involved, one of the means of escape may be a window (minimum dimensions 24-inch by 36-inch) which leads to a different exit route. Refer to Section 26 of EM 385-1-1.

SC-43. EMERGENCY ALARMS AND SIGNALS.

a. Alarms. Emergency alarms shall be installed and maintained on all floating plant requiring a crew where it is possible for either a passenger or crewman to be out of sight or hearing from any other person. The alarm system shall be operated from the primary electrical system with standby batteries on trickle charge that will automatically furnish the required energy during an electrical-system failure. A sufficient number of signaling devices shall be placed on each deck so that the sound can be heard distinctly at any point above the usual background noise. All signaling devices shall be so interconnected that actuation can occur from at least one strategic point on each deck.

b. Signals.

(1) Fire Alarm Signals. The general fire alarm signal shall be in accordance with paragraph 97.13-15b of the Coast Guard Rules and Regulations for Cargo and Miscellaneous Vessels, Subchapter I, 1 Sep 77 (CG 257).

(2) Abandon Ship Signals. The signal for abandon ship shall be in accordance with paragraph 97.13-15c of reference cited in (1) above.

(3) Man-Overboard Signal. Hail and pass the word to the bridge. All personnel and vessels capable of rendering assistance shall respond.

SC-44. MOORING LINES. Eye loops on mooring lines will be equipped with beckets or handling ropes to protect the hands of deckhands.

SC-45. MISPLACED MATERIAL (1965 JAN). DFARS 252.236-7006. Should the Contractor, during the progress of the work, lose, dump, throw overboard, sink, or misplace any material, plant, machinery, or appliance, which in the opinion of the Contracting Officer may be dangerous to or obstruct navigation, the Contractor shall recover and remove the same with the utmost dispatch. The Contractor shall give immediate notice, with description and location of such obstructions, to the Contracting Officer or inspector, and when required shall mark or buoy such obstructions until the same are removed. Should he refuse, neglect, or delay compliance with the above requirements, such obstructions may be removed by the Contracting Officer, and the cost of such removal may be deducted from any money due or to become due the Contractor, or may be recovered under his bond. The liability of the Contractor for the removal of a vessel wrecked or sunk without fault or negligence shall be limited to that provided in Sections 15, 19, and 20 of the River and Harbor Act of 3 March 1899 (33 U.S.C. 410 et seq.).

SC-46. SIGNAL LIGHTS. The Contractor shall display signal lights and conduct his operations in accordance with the General Regulations of the Department of the Army and of the Coast Guard governing lights and day signals to be displayed by towing vessels with tows on which no signals can be displayed, vessels working on wrecks, dredges, and vessels engaged in laying cables or pipe in submarine or bank protection operations, lights to be displayed on dredge pipe lines, and day signals to be displayed by vessels of more than 65 feet in length moored or anchored in a fairway or channel, and

the passing by other vessels of floating plant working in navigable channels, as set forth in Commandant U.S. Coast Guard Instruction M16672.2, Navigation Rules: International-Inland (Comdtinst M16672.2) or 33 CFR81 Appendix A (International) and 33 CFR 84 through 33 CFR 89 (Inland) as applicable.

SC-47. INSPECTION FACILITIES.

a. In order to facilitate inspection, the Contractor will be required, without additional cost to the Government:

(1) To furnish, on the request of the Contracting Officer or any inspector, the use of such boats, boatmen, laborers, and material forming a part of the ordinary and usual equipment and crew of the plant as may be reasonably necessary in inspecting and supervising the work.

(2) To furnish, on the request of the Contracting Officer or any inspector, suitable transportation from all points on shore designated by the Contracting Officer to and from the various pieces of plant.

b. Should the Contractor refuse, neglect, or delay compliance with these requirements, the specific facilities may be furnished and maintained by the Contracting Officer, and the cost thereof will be deducted from any amounts due or to become due the Contractor.

SC-48. STONE SOURCES.

a. On the basis of information and data available to the Contracting Officer, stone meeting the quality requirements of these specifications has been produced from the sources listed at the end of these Special Clauses.

b. Stone may be furnished from any of the currently listed sources or, at the option of the Contractor, may be furnished from any other source designated by the Contractor and accepted by the Contracting Officer, subject to the conditions hereinafter stated.

c. It is the Contractor's responsibility to determine that the stone source or combination of sources selected are capable of supplying the quantities and gradation needed and at the rate needed to maintain the scheduled progress of the work.

d. After the award of the contract, the Contractor shall designate in writing only one source or one combination of sources from which he proposes to furnish stone. If the Contractor proposes to furnish stone from a source not currently listed, he may designate only a single additional source for stone. Samples for acceptance testing shall be provided as required by 2D-3.2. If a source for stone so designated by the Contractor is not accepted for use by the Contracting Officer, the Contractor may not propose other sources but shall furnish the stone from a source listed at no additional cost to the Government.

e. Acceptance of a source of stone is not to be construed as acceptance of all material from that source. The right is reserved to reject materials from certain localized areas, zones, strata, or channels when such materials are unsuitable for stone as determined by the Contracting Officer. Materials produced from a listed or unlisted source shall meet all the requirements of SECTION 2D, of the Technical Provisions of these specifications.

SC-49. NOT USED.

SC-50. VARIATIONS IN ESTIMATED QUANTITIES - SUBDIVIDED ITEMS. ERARS 12.402(100)(JUL 89). The Variation in Estimated Quantities clause is applicable only to Items No. 1b.

a. Variation from the estimated quantity in the actual work performed under any second or subsequent subitem or elimination of all work under such a second or subsequent subitem will not be the basis for an adjustment in contract unit price.

b. If the quantity of work performed under the second subitem or any subsequent subitem under Item No. 1b exceeds 115 percent or is less than 85 percent of the estimated quantity of any such subitem, and if such variation causes an increase or a decrease in the time required for performance of this contract, the contract completion time will be adjusted in accordance with the Contract Clause FAR 52.212-11, entitled, "Variation in Estimated Quantities".

SC-51 AND SC-52. NOT USED.

SC-53. MOBILIZATION AND DEMOBILIZATION PAYMENT ITEM NO. 1a. (DEC 1985). DFARS 252.236-7009(b)

a. All costs connected with the mobilization and demobilization of all of the Contractor's plant and equipment will be paid for at the contract lump sum price for this item. Sixty percent (60%) of the lump sum price will be paid to the Contractor upon completion of his mobilization at the work site. The remaining forty percent (40%) will be paid to the Contractor upon completion of demobilization.

b. In the event the Contracting Officer considers that the amount in this item (60%) which represents mobilization and (40%) which represents demobilization does not bear a reasonable relation to the cost of the work in this contract, the Contracting Officer may require the Contractor to produce cost data to justify this portion of the bid. Failure to justify such price to the satisfaction of the Contracting Officer will result in payment of actual mobilization costs, as determined by the Contracting Officer at the completion of mobilization, and actual demobilization costs, as determined by the Contracting Officer at the completion of demobilization, and payment of the remainder of this item in the final payment under this contract. The determination of the Contracting Officer is not subject to appeal.

SC-54 THRU SC-61. NOT USED.

SC-62. AVAILABILITY OF COMMERCIAL SPECIFICATIONS, STANDARDS, AND DESCRIPTIONS. These specifications, standards, and descriptions are not available from Government sources. They may be obtained from the publishers listed below. See Paragraphs 24 and 25 of the Instructions to Bidders for the availability of non-commercial specifications.

May Be Obtained From

Corps of Engineers, U.S. Army (CRD-C)
(To be obtained from U.S. Army Engineers
Waterways Experiment Station
ATTN: Publications Distribution
P. O. Box 631, Vicksburg, MS 39180)

Corps of Engineers, U.S. Army (EM)
(To be obtained from Superintendent of Documents,
U. S. Government Printing Office
Washington, DC 20402)

xxx

SUBMITTALS REQUIRED WITHIN 15 DAYS
AFTER RECEIPT OF NOTICE OF AWARD

Specification Paragraph Number	Description of Submittal
SC-19	ACCIDENT PREVENTION PROGRAM
a.	An executed LMV Form 358R, Administrative Plan
b.	An executed LMV Form 359R, Job Hazard Analysis
c.	A copy of Company Policy statement of Accident Prevention
d.	An executed LMV Form 414R, Fuel Oil Transfer
SC-29	REQUIRED INSURANCE CERTIFICATION
SC-31	QUALITY CONTROL PLAN
2A-6	ENVIRONMENTAL PROTECTION PLAN

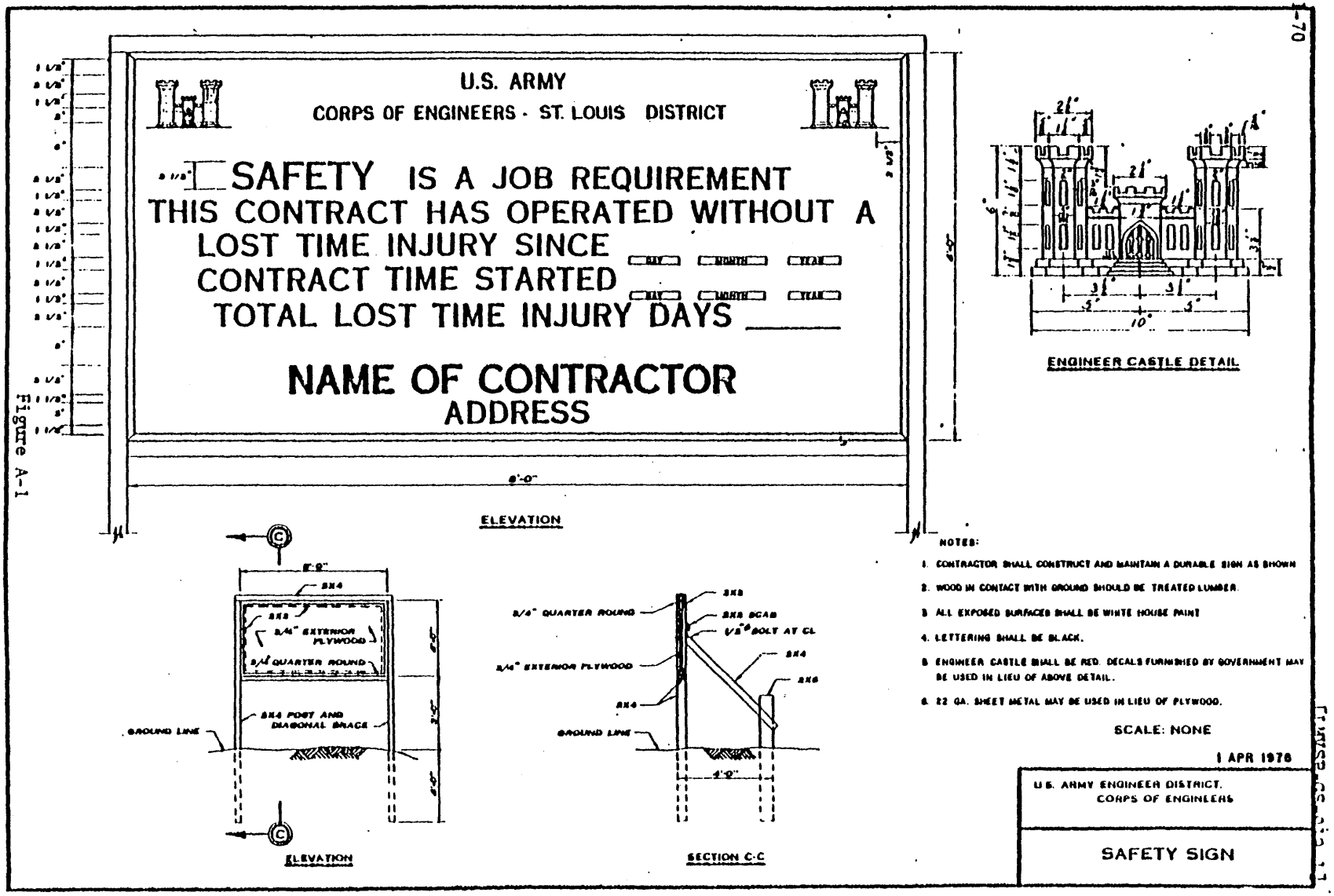
U.S. ARMY
CORPS OF ENGINEERS - ST. LOUIS DISTRICT
SAFETY IS A JOB REQUIREMENT
THIS CONTRACT HAS OPERATED WITHOUT A
LOST TIME INJURY SINCE
CONTRACT TIME STARTED
TOTAL LOST TIME INJURY DAYS
NAME OF CONTRACTOR
ADDRESS
8'-0"
ELEVATION
ENGINEER CASTLE DETAIL
NOTES:
1. CONTRACTOR SHALL CONSTRUCT AND MAINTAIN A DURABLE SIGN AS SHOWN
2. WOOD IN CONTACT WITH GROUND SHOULD BE TREATED LUMBER.
3. ALL EXPOSED SURFACES SHALL BE WHITE HOUSE PAINT
4. LETTERING SHALL BE BLACK.
5. ENGINEER CASTLE SHALL BE RED. DECALS FURNISHED BY GOVERNMENT MAY BE USED IN LIEU OF ABOVE DETAIL.
6. 22 GA. SHEET METAL MAY BE USED IN LIEU OF PLYWOOD.
SCALE: NONE
1 APR 1978
U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS
SAFETY SIGN
8'-0"
2X4
2X8
3/4" EXTERIOR PLYWOOD
3/4" QUARTER ROUND
2X4 POST AND DIAGONAL BRACE
GROUND LINE
ELEVATION
2X8
2X8 SCAB
1/2" BOLT AT CL
2X4
2X6
4'-0"
SECTION C-C

Figure A-1

MEDICAL EXAMINATION FOR EQUIPMENT OPERATOR

1. EMPLOYER:

2. NAME OF INDIVIDUAL: | 3. DATE OF BIRTH:

4. EQUIPMENT OPERATED:

5. EYES:

DISTANT VISION (SNELLEN):	Without glasses	With glasses
Right	20	20
Left	20	20

Visual Acquity _____ Depth Perception _____ Peripheral Vision _____

6. EARS: Is there evidence of disease, or injury: Right ear _____ Left ear _____

Audiogram: Attach copy, signed by a qualified physician, showing the results of the threshold of hearing for a minimum of six frequencies between 200 and 8,000 hertz.

7. NOSE:

8. MOUTH AND THROAT:

9. BLOOD PRESSURE: Systolic _____ Is organic heart disease present?
MM. HG. Diastolic _____ Yes ☐ No ☐

Pulse rate; Sitting _____. Immediately after exercise (unless contra-indicated) _____.
Two minutes after exercise _____.
Cardiac reserve (Good, Fair, or Poor).

10. LUNGS: Right _____ Left _____ History of tuberculoses: Yes ☐ No ☐
If yes, how long has disease been arrested? _____
If there is history of tuberculoses, is any type of collapse therapy being received at present? Yes ☐ No ☐
If yes, give full details under remarks.
Is medical supervision necessary? Yes ☐ No ☐
If X-ray is made, give report under remarks.
Spriogram: FVC _____ FEVT _____ FEF _____

11. HERNIA: Yes ☐ No ☐
If yes, name variety (inguinal, ventral, femoral, post-operative, etc) _____
If present, is it supported by a well-fitting truss? Yes ☐ No ☐

12. Any history of epilespy, diabetic, hypertension, venereal, or other disease that would affect safe operation of equipment?
Yes ☐ No ☐

13. Any deformities, atrophies or other abnormalities that would affect safe operation of equipment?
Yes ☐ No ☐

14. The individual (is) (is not) subject to fainting spells.

15. REMARKS:

In my opinion, the incumbent (is) (is not) physically qualified to operate safely the equipment indicated.

_____ (Examining Physician)

_____ (Date)

LMV1 FORM Oct 79284-R Previous editions may be used.

ACCIDENT PREVENTION PROGRAM
ADMINISTRATIVE PLAN

Willingness to correct safety hazards detected by the Corps is commendable, but a poor substitute for a positive program that prevents or detects and corrects hazards.

Contractor	Contract Name & No.	Date
1	2	3

Project Superintendent	Shifts/day	Hours/shift	Maximum employees/shift
4	5	5a	5b

Superintendent's training in Corps' safety requirements

6

Major Units of Equipment

7

Who will inspect equipment?	Inspector's qualifications	Inspection frequency?
8	8a	8b

Who is responsible for operators' physicals?	Location of all records	Day and hour weekly safety meeting
9	10	11

Who is responsible for employee training?	Who will orient new employees?
12	13

Who is responsible for clean-up?	Where will drinking water be obtained?
14	15

Who will investigate accidents?	Who is responsible for providing personal protective equipment?
16	17

Name Doctors, Hospitals & Ambulance services with whom arrangements have been made for this contract.

Doctor	Hospital	Ambulance
18	18a	18b

What form of communication will be used to summon ambulance?

18c

ACCIDENT PREVENTION PROGRAM
JOB HAZARD ANALYSIS

1. Contract No.	2. Project	3. Facility
4. Date	5. Location	6. Estimated Start Date

7. Item	8. Phase of Work	9. Safety Hazard	10. Precautionary Action Taken

11. Contractor (Signature & date)

12. Report discussed with contractor/superintendant on _____.

_____
Area/Resident Engineer (Signature)

13. Contracting Officer (Signature & date)
or
Contracting Officer Representative

LMV FORM MAR 83 359-R PREVIOUS EDITIONS ARE OBSOLETE.

Names of first aid attendants having certificates	Type of certificate and expiration date	Names of U.S.C.G. licensed boat operators, type license & expiration date
19	19a	20

21 Fire Fighting Equipment				22 First Aid Kits		23 Wash Facilities	
No.	Rating	Type	Location	No.	Type	No.	Type

24 Toilets	
No.	Type

What flammable or combustible liquids or gases will be on job site?

25

Where and how will flammables and combustibles be stored?

26

Who will be responsible for inspection and maintenance of fire fighting equipment?

27

If the Company has a published statement of safety policy, please transmit a copy with the return of your Accident Prevention Program.

On a separate sheet submit your proposed layout of temporary buildings and facilities (including subcontractors) and traffic patterns including access roads, haul roads, R.R.s, utilities, etc.

The _____ will pursue a positive program of training,
(Company)
inspections and hazard control throughout the term of this contract. Mr./Ms. _____
has the responsibility and authority for enforcing them.

_____ _____ _____ _____

Contractor's signature date C.O. or C.O.R. signature date

28

ACCIDENT PREVENTION PROGRAM
FUEL OIL TRANSFER - FLOATING PLANT
U.S. Army Engineer Division, Lower Mississippi Valley

Contractor	Contract Name & Number	Date
1	2	3

Officer in Charge of Fuel Transfer	Name of Vessel	Fuel to be Transferred
4	4a	4b

Name of Vessel	Names of Qualified Tankermen	Type of Certification and expiration date
5	5a	5b

Name of Vessel	Type of fill nozzle or connection on Vessel	Location of fill pipes openings	Location of vents openings
6	6a	6b	6c

Type, number, and size of fire fighting equipment to be available during fuel transfer operations.

7

Sequential steps to be followed when taking on fuel.

8

Contractor's Signature	Date	C.O. or C.O.R. Signature	Date

LMV FORM 1 JUL 61 414-R

DIKE STONE AND REVETMENT STONE SOURCES 1 Nov. 1989

ST. LOUIS DISTRICT

Source No.	Producer	MRM*	Lat	Long
1.	West Lake Quarry, Grays Point, Mo.	47.0	37N	89W
2.	West Lake Quarry, Neely's Landing Mo	71.5	37N	89W
3.	Tower Rock Stone Co. Ste Genevieve Mo	127.6	38N	90W
4.	Plattin Quarry, Ste. Genevieve, Mo.	139.0	38N	90W
5.	Bussen Quarry, Glenn Park, Mo.	155.5	38N	90W
6.	Mississippi Lime Quarry, Ste. Genevieve, Mo.	155.0	38N	90W
7.	West Lake Quarry, Sulphur Springs, Mo.	156.0	38N	90W
8.	Bussen Quarry, St. Louis County, Mo.	168.0	38N	90W
9.	West Lake Quarry, Plant No. 2 Fort Bellefontaine, Mo.	8.0**	38N	90W
10.	Central Stone Co. Ft. Bellefontaine, Mo.	7.0**	38N	90W
11.	West Lake Quarry, Golden Eagle, Ill.	228.5	38N	90W
12.	Meyer Quarry, Batchtown, Ill.	241.0	38N	90W
13.	Wayne Smith Quarry, Louisiana, Mo.	281.0	39N	91W
14.	Riverview Quarry, St. Louis County, Mo.	17.0**	38N	90W
15.	Anna, Quarry, Anna, Ill.		37N	89W
16.	Bussen Quarry, Eureka, Mo.		38N	90W
17.	Calender Quarry, Pittsfield, Ill.		39N	90W
18.	Central Stone Quarry, #1, Huntington, Mo.		39N	91W
19.	Central Stone Quarry, #9, Perry, Mo.		39N	91W
20.	Central Stone Quarry, Florence, Ill.		39N	91W
21.	Charles Stone co., Cypress,Ill.		37N	89E
22.	Charleston Stone Co., Charleston, Ill.		39N	88W
23.	Columbia Quarry, #1 Columbia, Ill.		38N	90W
24.	Columbia Quarry, #8 Ullin, Ill.		37N	89W

RIVER GAGE INFORMATION - MISSISSIPPI RIVER, ALTON, ILLINOIS, TO MOUTH OF OHIO RIVER

GAGE NAME	RIVER MILE	GAGE ZERO 1929 ADJ.	FLOOD STAGE	LOW OF RECORD DATE	LOW OF RECORD STAGE	HIGH OF RECORD DATE	HIGH OF RECORD STAGE	ACCUMULATIVE MEAN THRU 1980 YEARS OF RECORD	ACCUMULATIVE MEAN THRU 1980 VALUE
Alton (Tailwater)	202.7 L	0.00	417	2/29/64	*395.95	4/28/73	432.15	17	405.30
Hartford	196.8 L	0.00	417	2/29/64	*395.85	4/28/73	431.20	17	404.34
Chain of Rocks (Water Pl)	190.4 R	313.91	101	2/4-6/77	* 80.4	4/28/73	115.4	17	86.43
Chain of Rocks (Tailwater)	190.3 L	0.00	N/A	9/25/76	389.1	Spring 1979	**	7	391.51
Locks 27 (Tailwater)	185.1 L[a]	0.00	N/A	1/1/64	376.18	4/28/73	426.30	29	391.06
St. Louis (Market St.)	179.6 R	379.94	30	1/16/40	- 6.2	4/28&29/73	43.3	119	10.93
Engineer Depot	176.8 R	379.58	29	1/16/40	- 6.5	4/28/73	41.1	86	9.86
Jefferson Barracks	168.7 R	377.69	26	(1)	- 7.8	4/29/73	38.7	70	8.57
Waters Point	158.5 R	370.39	27	1/19/77	- 6.5	4/29/73	40.45	88	10.17
Selma	145.8 R	0.00	390	1/20/77	356.9	4/29/73	404.12	15	374.78
Brickeys	136.0 R	357.78	26	1/1/64	- 5.4	4/29/73	E 40.45	66	10.08
Little Rock Landing	125.5 R	213.79	163	1/21/77	133.0	4/29/73	177.50	85	147.92
Chester	109.9 L	341.05	27	1/2/64	- 4.3	4/30/73	43.32	89	10.85
Bishop Landing	100.8 R	334.11	29	1/1/64	- 0.9	4/30/73	45.35	46	12.93
Red Rock Landing	94.1 R	328.92	31	1/2/64	- 0.5	4/30/73	47.8	64	14.46
Grand Tower	81.9 L	321.93	28	1/21/40	- 0.5	4/30/73	47.4	94	14.09
Moccasin Springs	66.3 R	313.89	28	1/22/40	0.62	5/1/73	E 44.6	65	15.14
Cape Girardeau (6)	52 1R	304.65	32	1/15/09	0.6	5/1/73	45.6	83	16.25
Grays Point	46.3 R	301.18	25	1/15/09	0.2	5/1&2/73	44.5	101	15.72
Thebes	43.7 L	300.00	33	1/15/09	0.88	4/30/73	43.43	39	16.87
Counterfeit Rock	42.3 R	304.35	24	1/2/64	- 3.2	4/17/79	38.3	41	11.62
Commerce	39.5 R	301.83	24	1/21/40	- 3.1	4/17/79	38.7	79.5 (4)	11.65
Price Landing	28.2 R	299.75	24	1/4/64	- 8.8	5/2/73	E 34.2	44	8.29
Thompson Landing	20.2 R	0.00	319	1/22&23/40	285.78	4/16/79	331.5	47	303.72
Beechridge (2)	13.2 L	282.88	34	12/14/37	- 2.1	5/2/73	46.1 (3)	57	17.12
Birds Point	2.0 R	274.53	38	1/6/40	- 0.1	2/4/37	54.6	47	20.93
Cairo	2.0 (5)	270.47	44 (Bankfull)	12/24/1871	- 1.0	2/3&4/37	59.51	N/A	N/A

(1) Jan 27 and 31, 1963; Jan 1, 1964.
(2) Gage temporarily discontinued.
(3) Gage temporarily discontinued prior to 1973 flood. Value and data given have been interpolated.
(4) Broken period of record.
(5) Miles upstream on Ohio River from the confluence of Mississippi and Ohio Rivers.
(6) Record High and Low Stages recorded at previous location and datum of 304.77 feet (N.G.V.D.).
* Lowest stage recorded since 1963, upon completion of the Chain of Rocks low-water dam.
** Gage established in 1974; upper limit of gage is 410.0 feet N.G.V.D. (higher stages may have been reached).
E Estimated value
L Left Bank looking downstream R Right bank looking downstream
a Mileage equivalent to 183.6L due to trail dike 184.2L.

Revised 10 Aug 8
LMSED-H(P)

25.	Columbia Quarry, #9 Dupo, Ill.	38N	90W
26.	Stolle Quarry, Falling Springs, Ill.	38N	90W
27.	Magruder Quarry, Troy, Mo.	38N	90W
28.	Perry C. Stone Co., Perry Co., Mo.	37N	89W
29.	Meyer Quarry, Old Monroe, Mo.	38N	90W
30.	Mississippi Lime Quarry,E Alton, Ill.	38N	90W
31.	Quality Stone Co. Waterloo, Ill.	38N	90W
32.	Seminole Ag. Lime Co. Dexter, Mo.	37N	90W
33.	Smith Quarry, New London, Mo.	39N	91W
34.	South East Mo. Stone Co. Cape Girardeau, Mo.	37N	89W
35.	Kaskaskia Stone Co. Prairie DuRocher, Ill.	38N	90W
36.	Valley Dolomite, Bonne Terre, Mo.	37N	90W
37.	Williamsville Stone Co., Poplar Bluff, Mo.	36N	90W

* Mississippi River Mile

** Missouri River Mile

INDEX

DIVISION 1 - GENERAL REQUIREMENTS

ST. LOUIS STAGE RELATIONSHIPS TO OTHER GAGES (TAKEN FROM 1956-57 PROFILES)

EXAMPLE OF USE: "UNDER STABLE CONDITIONS, A READING OF 10 FEET ON THE ST. LOUIS GAGE SHOULD RESULT IN A READING OF 11.1 FEET ON THE CHESTER GAGE."

GAGE NAME	RIVER MILE		GAGE ZERO 1929 ADJ	Low-Water Ref. Plane -3.5	0.0	5.0	10.0	15.0	20.0	26.0	30.0	40.0
Alton (Tailwater)	202.7	L	0.00									
Hartford	196.8	L	0.00									
Chain of Rocks (Pool)	190.4	R	313.91								101.0	111.2
Chain of Rocks (Tailwater)	190.3	L	0.00		388.8	393.5	396.5	400.6	404.9	411.4	414.8	425.1
Locks 27 (Tailwater)	185.1	L	0.00		382.0	386.6	391.4	396.5	401.7	408.0	411.8	422.7
St. Louis (Market St.)	179.6	R	379.94	-3.5	0.0	5.0	10.0	15.0	20.0	26.0	30.0	40.0
Engineer Depot	176.8	R	379.58	- 3.8	- 0.4	4.7	9.6	14.6	19.5	25.1	29.1	38.4
Jefferson Barracks	168.7	R	377.69	- 4.6	- 1.1	3.8	8.4	13.1	18.5	23.4	27.4	35.3
Waters Point	158.5	R	370.39	- 3.0	0.5	5.1	10.1	14.6	19.3	24.7	28.5	36.3
Selma	145.8	R	0.00	361.0	364.6	368.6	373.2	378.0	382.5	388.0	392.2	400.0
Brickeys	136.0	R	357.78	- 1.6	1.9	5.7	10.3	14.9	19.4	24.6	29.2	37.3
Little Rock Landing	125.5	R	213.79	135.4	138.7	143.5	147.9	152.5	157.5	162.4	166.4	174.4
Chester	109.9	L	341.05	- 0.6	2.6	6.9	11.1	15.5	20.1	26.5	30.3	39.3
Bishop Landing	100.8	R	334.11	1.3	4.5	8.6	12.9	17.5	22.2	28.7	32.6	41.5
Red Rock Landing	94.1	R	328.92	1.8	5.5	9.4	14.3	19.2	24.2	30.8	34.9	43.7
Grand Tower	81.9	L	321.93	3.0	6.3	10.2	14.4	19.0	23.5	29.3	32.6	40.8
Moccasin Springs	66.3	R	313.89	3.9	7.1	11.2	15.3	19.6	24.5	29.7	33.4	40.7
Cape Girardeau	51.9	R	304.77	5.1	8.4	13.0	16.5	20.5	26.0	31.3	34.6	41.5
Grays Point	46.3	R	301.18	5.1	8.1	12.7	16.0	20.1	25.6	31.3	34.5	40.7
Thebes	43.7		300.00	4.8	7.7	12.2	15.7	19.6	25.3	31.0	34.4	39.9
Counterfeit Rock	42.3	R	304.35	- 0.3	2.5	6.9	10.4	14.4	20.1	25.8	29.2	34.4
Commerce	39.5	R	301.83	0.3	3.0	7.2	11.3	15.4	21.2	26.8	29.8	34.8
Price Landing	28.2	R	299.75	- 5.8	- 2.4	2.0	7.2	11.5	17.3	24.7	27.6	32.3
Thompson Landing	20.2	R	0.00	289.0	292.2	295.8	301.2	305.6	311.1	321.7	324.6	329.5
Beechridge	13.2		282.88	1.5	5.6	9.1	13.9	18.2	23.9	37.0	41.3	46.2
Birds Point	2.0	R	274.53	3.4	7.1	10.5	15.5	19.8	24.9	40.6	43.5	48.5
Cairo	2.0		270.6									

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PART II - TECHNICAL PROVISIONS

SECTION 1A - TEMPORARY FIELD OFFICE

1. SCOPE. The work covered by this section consists of providing a temporary field office for use by the Government, complete.

2. TEMPORARY FIELD OFFICE.

2.1 General. As soon as practicable, but not later than 15 days after the date established for commencement of work, the Contractor shall provide a temporary field office, located near the site of the work, for use by the Government. The Contractor shall have the option of either constructing a new building for use as the temporary field office, or providing such facilities in an existing building, vessel, or trailer.

2.2 New Building. In the event a new building is constructed for the temporary field office, it shall contain approximately 200 square feet of clear floor space, and a minimum of 7 feet in headroom. It shall be equipped with approved electrical wiring, at least one double convenience outlet and the required switches and fuses to provide 110-120 volt power. It shall be provided with a work table, desk and chairs. The building shall be weatherproof and be supplied with heat and air conditioning in season, a minimum of one door, electric lights, a telephone, a sufficient number of adjustable windows for adequate light and ventilation, and a supply of approved drinking water. Sanitary facilities shall be furnished in accordance with Section 03.B of EM 385-1-1. The doors shall be screened and provided with dead bolt type locking devices, or be equipped with a padlock and heavy duty hasp bolted to the door. The windows shall be arranged to open and to be securely fastened from the inside. Glass panels in windows shall be screened and shall be equipped with bars or heavy mesh screen to prevent easy access. Any trailer or vessel furnished, or new building erected by the Contractor for a temporary field office shall be maintained by him during the life of the contract, shall remain his property, and shall be removed by him from the site of the work upon completion and acceptance of work under this contract.

2.3 Existing Building, Vessel, or Trailer. In the event the temporary field office is provided in an existing building, vessel, or trailer, the Contractor shall furnish space, facilities and services equivalent to those specified in 1A-2-2. and 1A-2.4.

2.4 Security Provisions. Adequate outside security lighting shall be provided. The Contractor shall be responsible for security of his equipment. In addition, the Contractor shall notify the appropriate law enforcement agency and request them to make periodic security checks of the field office.

3. PAYMENT. No separate payment will be made for furnishing, erecting, maintaining or removing the temporary field office and all costs in connection therewith during the life of this contract shall be included in the contract prices for other work for which payment is provided.

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SECTION 2A - ENVIRONMENTAL PROTECTION

1. SCOPE. The work covered by this section consists of furnishing all labor, materials and equipment and performing all work required for the prevention of environmental pollution during and as the result of construction operations under this contract. For the purpose of this specification, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and recreational purposes. The control of environmental pollution requires consideration of air, water, and land, and involves noise, solid waste management and management of radiant energy and radioactive materials, as well as other pollutants.

2. QUALITY CONTROL.

2.1 General. The Contractor shall inspect all environmental protection operations for compliance with contract requirements and maintain records of his quality control for all operations, including but not limited to the following:

(1) Disposal of cleared material and other debris.

(2) Collection of trash, waste, garbage, oil, grease, chemicals, etc.

(3) Level of smoke, dust, and noise pollution resulting from each type of construction activity, and comparison with any permissible levels established by laws or regulations.

(4) Action taken to protect trees, vegetation, and wildlife habitat adjacent to construction areas.

(5) Obliteration of temporary construction facilities.

2.2 Reporting. A copy of these records and tests, as well as corrective action taken, shall be furnished to the Government daily.

3. APPLICABLE REGULATIONS. In order to prevent, and to provide for abatement and control of, any environmental pollution arising from construction activities in the performance of this contract, the Contractor and his subcontractors shall comply with all applicable Federal, State, and local laws, and regulations concerning environmental pollution control and abatement.

4. NOTIFICATION. The Contracting Officer will notify the Contractor in writing of any non-compliance with the foregoing provisions and the action to be taken. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient

for the purpose. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor.

5. SUBCONTRACTORS. Compliance with the provisions of this section by subcontractors will be the responsibility of the Contractor.

6. IMPLEMENTATION. Within 10 days after receipt of notice to proceed, the Contractor shall:

(1) submit in writing his proposals for implementing this section for environmental pollution control and disposal of debris;

(2) meet with representatives of the Contracting Officer to develop mutual understandings relative to compliance with this provision and administration of the environmental pollution control program.

7. PROTECTION OF LAND RESOURCES.

7.1 General. The land resources within the project boundaries and outside the limits of permanent work performed under this contract shall be preserved in their present condition or be restored to a condition after completion of construction that will appear to be natural and not detract from the appearance of the project. The Contractor shall confine his construction activities to areas defined by the plans or specifications. The following additional requirements are intended to supplement and clarify the requirements of Contract Clauses entitled "Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements, "Operations and Storage Areas", and "Cleaning Up.".

7.2 Prevention of Landscape Defacement. Except in areas specified to be cleared, and as provided in 2A-7.3, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without the approval of the Contracting Officer. Felling of trees shall be performed in such a manner as to avoid damage to trees to be left standing. Where trees may possibly be defaced, bruised, injured, or otherwise damaged by the Contractor's operations or equipment, he shall protect adequately such trees. Stone or earth that is displaced into uncleared areas shall be removed. Monuments and markers shall be protected before beginning operations near them. Any trees or other landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original conditions at the Contractor's expense. Any trees which are damaged beyond restoration shall be removed and disposed of as directed in 2A-10.

7.3 Temporary Excavation and Embankments. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall obtain approval of the Contracting Officer prior to start of such temporary work. No unauthorized road construction, excavation, or embankment construction (including disposal areas) will be permitted.

7.4 Post-Construction Cleanup or Obliteration. The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials upon completion of construction. The Contractor will be required to restore the construction area to near natural conditions which will permit the growth of vegetation.

7.5 Recording and Preserving Historical and Archeological Finds. All items having any apparent historical or archeological interest which are discovered in the course of any construction activities shall be carefully preserved. The Contractor shall leave the archeological find undisturbed and shall immediately report the find to the Contracting Officer so that the proper authorities may be notified.

8. PROTECTION OF WATER RESOURCES.

8.1 Contamination of Water. The Contractor shall not pollute lakes, ditches, rivers, bayous, canals, waterways, or reservoirs with fuels, oils, bitumens, calcium chloride, insecticides, herbicides, or other similar materials harmful to fish, shellfish, or wildlife, or materials which may be a detriment to outdoor recreation.

8.2 Disposal of Materials. The methods and locations of disposal of materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., within the right-of-way limits shall be such that harmful debris will not enter lakes, ditches, rivers, bayous, canals, waterways, or reservoirs by erosion, and thus prevent the use of the area for recreation or present a hazard to wildlife.

9. JANITOR SERVICE. The Contractor shall furnish daily janitorial services for the office on floating plant on the project site and perform any required maintenance of facilities and grounds during the entire life of the contract. Toilet facilities shall be kept clean and sanitary at all times. Services shall be performed at such a time and in such a manner to least interfere with the operations but will be accomplished only when the floating plant is in daily use.

10. DISPOSAL OF CLEARED MATERIAL AND OTHER DEBRIS.

10.1 General. All debris resulting from construction operations on this contract may, at the Contractor's option, be disposed of by burying or removal from the site. The Contractor shall make a reasonable effort to utilize the latter method to channel materials of value resulting from clearing operations into beneficial use.

10.2 Burying. If the Contractor elects to bury the debris, the area available for burial will be between the landward edge of the paving and the landward clearing limit. No material shall be buried within 20 feet of any standing timber or within 10 feet of the top of bank. All material disposed of in such manner shall be covered with a minimum of 18 inches of earth.

SECTION 2B - GENERAL

1. SCOPE. The work provided for herein consists of furnishing all plant, labor, material, and equipment and performing all work in strict accordance with the specifications, drawings, and schedules, for the construction of approximately 8,080 linear feet of stone fill weir in the Mississippi River. The work includes clearing, grading and excavating; constructing stone weirs; and performing environment protection in connection with the above work. The work shall be completed as expeditiously as possible even though river conditions may become increasingly severe as the construction progresses. The work requires steady and uninterrupted progress to minimize loss of stone during construction. The Contractor shall diligently prosecute the work and provide the necessary equipment, a skilled and experienced crew, and a regular and well-balanced supply of stone to ensure uniform and continuous progress once construction of the weir has started. Unless otherwise authorized, the Contractor shall start and complete the weirs as specified in 2B-3.

2. RIVER STAGE AND WEATHER LIMITATIONS.

2.1 No work will be permitted under this contract at times when the river stage on gages in the vicinity of the worksite exceeds 24.0 Price Landing gage, as determined by the Contracting Officer in accordance with SC-7g and the National Geodetic Vertical Datum elevation established for suspension of work for each weir to be constructed under this contract as shown in 2B-3.3, unless specifically authorized by the Contracting Officer. When construction work is prevented during such times and because of such conditions, the Contracting Officer will determine the extent of the delay to the work as a whole, and the time fixed for completion of the contract will be extended for the period of such delay.

2.2 In the event high river stages require the Contractor to suspend operations entirely, the Contracting Officer will determine the extent of the delay to work as a whole, and the time fixed for completion of the contract will be extended for the period of such delay.

2.3 In the event adverse weather conditions, such as fog, heavy ice, thunderstorms, and heavy snowfall, delay the timely prosecution of the work, the Contracting Officer will determine the extent of the delay to the work as a whole, and the time fixed for completion of the contract will be extended for the period of such delay.

3. ORDER OF WORK.

3.1 The Contractor shall construct the weirs in an upstream to downstream order, subject to the requirements of 2B-3.2, 2B-3.3, and the construction procedure specified in 2B-4.

3.2 After the work has been commenced at any weir location, the Contractor will not be permitted to suspend work at that location in order to move to another weir location until the following has been accomplished:

3.3.1 The weirs shall be constructed in an upstream to downstream order unless high river stages require a temporary suspension of work at specific worksites.

4. CONSTRUCTION PROCEDURE. Unless otherwise authorized, the work at each weir location shall be performed in accordance with the procedure outlined below. Where any of the listed operations are not required at a specified location, the operations that do apply shall be performed in the same sequence, omitting the inapplicable operations.

(1) The weir shall then be constructed to full grade and section, as shown on the contract drawings for a distance of 100 feet, measured from the intersection of the weir with the bank or from the end of the existing dike, as the case may be, and the downstream portion of the weir base blanketed with Graded Stone A to a depth of 4 feet and a minimum width of 10 feet for a distance of at least an additional 200 feet.

(2) The weir shall then be completed to full grade and section, keeping the 4-foot-thick stone blanket base constructed either at least 200 feet in advance of the completed portion or to the end of the weir, whichever is shorter.

5. ACCEPTANCE. Each completed weir will be accepted as a whole. If river and current conditions are such that, in the opinion of the Contracting Officer, completion of any weir to the prescribed grade and/or section becomes impracticable, and it is determined to be in the best interest of the Government, that weir may be accepted even though it has not been completed to the prescribed grade and/or section.

10.3 Removal. The Contractor may elect to remove all debris resulting from contract operations from the site of the work. Such disposal shall comply with all applicable Federal, State, and local laws. The Contractor may, at his option, retain for his own use or disposal by sale or otherwise any such materials of value. The Government assumes no responsibility for the protection or safekeeping of any materials retained by the Contractor. Such materials shall be removed from the site of the work before the date of completion of the work under these specifications.

11. MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION. During the life of this contract the Contractor shall maintain all facilities constructed for pollution control under this contract as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created. Early in the construction period the Contractor shall conduct a training course that will emphasize all phases of environmental protection.

12. PAYMENT. No payment will be made for the cost of the work covered under this section, and all such work will be considered as a subsidiary obligation of the Contractor.

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SECTION 2C - STONE FILL WEIRS

1. SCOPE. The work provided for herein consists of furnishing all plant, labor, material, and equipment and performing all work in strict accordance with the specifications, drawings, and schedules for construction of the stone fill weirs.

2. QUALITY CONTROL.

2.1 General. The Contractor shall establish and maintain quality control for all stone fill weir operations to assure compliance with contract requirements, and shall maintain records of his quality control for all construction operations, including but not limited to the following:

(1) Stone gradation and cleanliness.

(2) Placement and alignment of stone in the weir.

(3) Periodic fathometer surveys.

(4) Record of the tonnage of stone placed.

(5) Periodic check for compliance with specified weir grade and section.

2.2 Reporting. A copy of the inspection and tests, as well as the records of corrective action taken, shall be furnished the Government daily.

3. STONE.

3.1 General. All stone shall be of a hard, durable quality that will not disintegrate under the elements nor be easily broken in handling. It shall be clean and free from earth, dust, and other refuse. The faces of individual pieces of stone shall be roughly angular, not rounded, in shape. Field stone will not be accepted.

3.2 Sources and Evaluation Testing. All stone shall be obtained in accordance with the provisions of SC-48, STONE SOURCES. If the Contractor proposes to furnish stone from a source not listed in SC-48, the Government will make such investigations as necessary to determine whether acceptable stone can be produced from the proposed source. Satisfactory service records on work outside the Corps of Engineers will be acceptable. If no such records are available, the Government will make tests to ensure the acceptability of the stone. The tests to which the stone may be subjected will include petrographic analysis, specific gravity, abrasion, absorption, wetting and drying, freezing and thawing, and such other tests as may be considered necessary by the Contracting Officer. The following guidance is provided for

(1) The weir has been completed for a minimum distance of 100 feet.

(2) The downstream portion of the weir base has been blanketed with stone to a depth of not less than 4 feet and a minimum width of 10 feet for a distance of at least 200 feet beyond the end of the completed portion of the weir.

3.3 Except as specified above, the work shall be constructed in the sequence shown below.

NOTE: Statements made under comments are intended to convey a brief description and summary of proposed work. All of the required construction details are provided on the plan sheets and the profile/cross section sheets.

WORK LOCATION	COMMENTS
Weir 24.2(R)	Construct 640 ft. to Crown Elevation 273 NGVD
Weir 23.9(R)	Construct 410 ft. to Crown Elevation 273 NGVD
Weir 23.7(R)	Construct 470 ft. to Crown Elevation 273 NGVD
Weir 23.5(R)	Construct 860 ft. to Crown Elevation 273 NGVD
Weir 23.4(R)	Construct 750 ft. to Crown Elevation 273 NGVD
Weir 23.2(R)	Construct 880 ft. to Crown Elevation 273 NGVD
Weir 23.1(R)	Construct 680 ft. to Crown Elevation 272 NGVD
Weir 23.0(R)	Construct 580 ft. to Crown Elevation 272 NGVD
Weir 22.9(R)	Construct 680 ft. to Crown Elevation 272 NGVD
Weir 22.8(R)	Construct 730 ft. to Crown Elevation 272 NGVD
Weir 22.7(R)	Construct 780 ft. to Crown Elevation 272 NGVD
Weir 22.45	Construct 620 ft. to Crown Elevation 272 NGVD

4.2 Gradation of Stone. Gradation tests of stone shall be accomplished at the quarry. Tests by weight shall be made by the Contractor in the presence of the Contracting Officer's representative. The Contractor shall notify the Contracting Officer not less than 3 days in advance of each test. In the event of nonavailability of the Government representative, the Contractor shall perform the tests and certify to the Contracting Officer that the stone shipped complies with the specifications. A minimum of one test shall be performed for each 50,000 tons of Graded Stone A supplied to the Government from each source. Each test sample shall be representative of the stone being shipped and shall consist of not less than 50 tons for Graded Stone A. Percentage determinations shall be made for each stone weight specified in 2C-3.3. Gradation test data shall be recorded on LMV Form 602-R "Gradation Test Data Sheet," a copy of which is shown at the end of this section. Failure of the test on the initial sample and on an additional sample will be considered cause for rejection of the quarry and/or quarry process, and all stone represented by the failed tests shall be set aside and not incorporated into the work. Any additional tests required because of the failure of an initial test sample will not be considered as one of the other required tests. Certification and test results represent stone shipped from the quarry and must be received by the Government representative before the stone is used in the work. The Contractor shall designate on the test form that portion (in tons) of the lot tested which is applicable to this contract. Any deviation from reported tonnage shall be corrected on a revised gradation test form. The Contracting Officer may direct, under Contract Clause entitled "Inspection of Construction", additional testing of stone furnished to the worksite if the stone appears, by visual inspection, to be of questionable gradation or quality.

5. WEIR STONE PLACEMENT. The weir shall be constructed to the elevations, cross sections, and minimum thicknesses, and within the limits, shown on the contract drawings. Side slopes on the upstream side of each weir shall be determined by the angle of repose of the stone, approximately 1V on 1.5H. The weir shall be constructed of Graded Stone A, as specified in 2C-3. Stone shall be placed in the weir in such manner as to produce a reasonably well-graded mass of stone with the minimum practicable percentage of voids. The stone may be placed by crane or dragline equipped with skip, grapple, clamshell, or rock bucket; by front-end loader or bulldozer, except when placing the base blanket subaqueously; and by trucks and other methods, if approved by the Contracting Officer. Additional stone shall be added if either soundings or sections indicate such to be necessary. The large stones shall be well distributed throughout the mass and the finished weir shall be free from pockets of small stones and clusters of large stones. Bulldozing stone into excavated trenches will not be permitted. All stone placement in weirs is subaqueous placement.

6. PLACEMENT CONTROL. The Contractor shall be responsible for control of the placement of stone in the weir, and he shall furnish, operate, and maintain the necessary equipment and furnish all necessary material and supplies. At all times when stone placement from floating plant is underway, the means by which the Contractor positions his plant, equipment, and stone supply barges must function accurately and consistently. Whatever the method

to the edge of the barge and be no less than 4 inches wide and 1 foot long, on both the deck and side of the barge. Barges with rakes shall have displacement gaging lines placed at each corner of the box section between the rakes. If a barge has a box end or ends, the gaging lines shall be placed approximately four feet from the box end. The freeboard will be measured at the four gaging locations and the displacement determined by the use of the "CELMV standard Barge tables" from the average of these measurements. The displacement shall be determined before and after the barge in unloaded and the difference between these values shall be the quantity delivered.

7.2 Payment. Payment for stone satisfactorily placed in the work will be made at the applicable contract unit prices for "Stone: 'b. Stone; Weir, Graded Stone A' which price and payment shall constitute full compensation for furnishing all labor, plant, material, and equipment and accomplishing all work required to construct the stone fill weirs in accordance with these specifications and as shown on the drawings.

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ST. LOUIS DISTRICT

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use by the Contractor in analyzing a source of stone not listed in SC-48. Stone that either weighs less than 155 pounds per cubic foot or has more than 2 percent absorption will not be accepted unless other tests and service records show that the stone is satisfactory. The method of tests for unit weight and absorption will be CRD-C-107-87, entitled "Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate." Samples of stone from a source not listed in SC-48 shall be submitted to the Contracting Officer for testing and acceptance prior to delivery of any stone to the worksite. Samples shall consist of at least seven pieces of stone, roughly cubical in shape and weighing not less than 100 pounds each. All such samples shall be taken by the Contractor under the supervision of the Contracting Officer. The samples shall be shipped at the Contractor's expense to the Waterways Experiment Station, Vicksburg, Mississippi, at least 60 days in advance of the time the placing of the stone is expected to begin. The tests will be conducted in accordance with applicable Corps of Engineers methods of test given in the Handbook of Concrete and Cement, and will be performed at the Waterways Experiment Station, Vicksburg, Mississippi. The cost of testing will be borne by the Government.

3.3 Graded Stone A. Graded Stone A shall conform to the following table:

GRADED STONE A

STONE WEIGHT POUNDS	CUMULATIVE PERCENT FINER BY WEIGHT
5,000	100
2,500	70-100
500	40-65
100	20-45
5	0-15
1	0-5

Not more than 5 percent by weight finer than 1/2-inch screen. A plot of the gradation curve is attached at the end of this section.

4. INSPECTION OF STONE.

4.1 General. Stone will normally be inspected at the site of the work as it is incorporated into the work. In the event the Contractor desires preliminary inspection service at either the quarry or the point of unloading from railroad cars or upon delivery to barges, a charge of $75.00 per inspector per working day will be made against the Contractor and these amounts will be deducted from any payments due the Contractor. All stone will receive final inspection as it is incorporated into the work, and any stone found to be defective will be rejected, whether or not previously inspected as provided for above.

GRADATION TEST DATA SHEET

Sample No.: _____

Quarry _____ Type of Stone Tested _____

Date of Test _____ Testing Rate _____ Tons

Contractor _____ Location _____

TEST REPRESENTS

Contract No.	District	Tons
	TOTAL	

GRADATION

Stone Size (lbs)	Weight Retained	Individual % Retained	Cumulative % Ret.	Cumulative % Pass	Specification % Finer by wt
Total Weight					

Remarks: _____

I certify that the above stone sample is representative of the total tonnage covered by this test report:

Contractor Representative _____

Government Representative _____

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employed, it must permit the Contractor and the Government inspector readily to determine the exact position of the stone-placing operation.

6.1 Alignment Control. The method of alignment control may be by a manned transit or a laser, or colored or polorized light beams, or any other method demonstrable to be practicable and sufficiently precise and reliable.

6.2 Distance Control. The method of distance control for floating plant engaged in the subaqueous placement of stone shall be by the use of electronic distance-surveying instruments or any other method demonstrable to be practicable and sufficiently precise and reliable.

6.3 Depth Finder. An electronic recording depth finder, approved by the Contracting Officer shall be provided during the construction of each weir. The depth finder shall have a recording scroll not less than 6 inches wide with a scale of not more than 10 feet of depth to the inch. The depth finder shall be capable of obtaining accurate profiles and cross sections during construction of the weir, and shall be used as an aid in the control of stone placement. The Contractor shall furnish and maintain an adequate stock of recording paper for the depth finder.

6.4 Nonpermitted Devices. The use of buoys as placement control devices will not be permitted. The use of bank targets for alignment control will not be permitted for working distances of more than 400 feet without prior approval by the Contracting Officer.

7. MEASUREMENT AND PAYMENT.

7.1 Measurement. The unit of measurement for stone satisfactorily placed in the work will be the ton (2,000 pounds). Quantities will be computed to the nearest whole ton. If delivered by barge, the Contracting Officer's Representative will measure stone for payment by weight determined by barge displacement. The Contractor shall furnish the Contracting Officer a barge displacement table not less than 10 days prior to unloading stone from any barge for which a displacement table has not previously been furnished and approved. The Contractor shall furnish with the barge displacement tables a drawing or sketch of each barge, dimensioned in sufficient detail to permit checking of the tables. The drawings shall show, as a minimum, the length, width, and depth of the barge and dimensions of the rake or rakes. Each such table shall have its accuracy certified by a person or firm, other than the Contractor, customarily performing this service and who has been approved by the Contracting Officer. Each table submitted shall show the name and/or number of the barge, the barge dimensions, the barge owner, the name of the fabricator, certification, and date of certification of the person or firm preparing the table. All new or modified barges shall be field checked for current dimensions by the Contractor, in the presence of the Contracting Officer's Representative. Each table submitted shall contain in parallel columns, the freeboard of the barge in feet and tenths from zero to the full depth of the barge, and the corresponding gross displacement to the nearest ton. Each barge shall be suitably marked with two displacement gaging lines along each side of the barge. Each gaging line shall be painted perpendicular

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STANDARD TEST METHOD FOR GRADATION OF RIPRAP

A. Select a representative sample (Note No. 1), weigh and dump on hard stand.

B. Select specific sizes (see example) on which to run "individual weight larger than" test. (See Note No. 2). Procedure is similar to the standard aggregate gradation test for "individual weight retained."

C. Determine the largest size stone in the sample. (100 percent size)

D. Separate by "size larger than" the selected weights, starting with the larger sizes. Use reference stones, with identified weights, for visual comparison in separating the obviously "larger than' stones. Stones that appear close to the specific weight must be individually weighed to determine size grouping. Weigh each size group, either individually or cumulatively.

E. Paragraph d above will result in "individual weight retained" figures. Calculate individual percent retained (heavier than), cumulative percent retained, and cumulative percent passing (lighter than). Plot percent passing, along with the specification curve on Eng Form 4055.

Notes

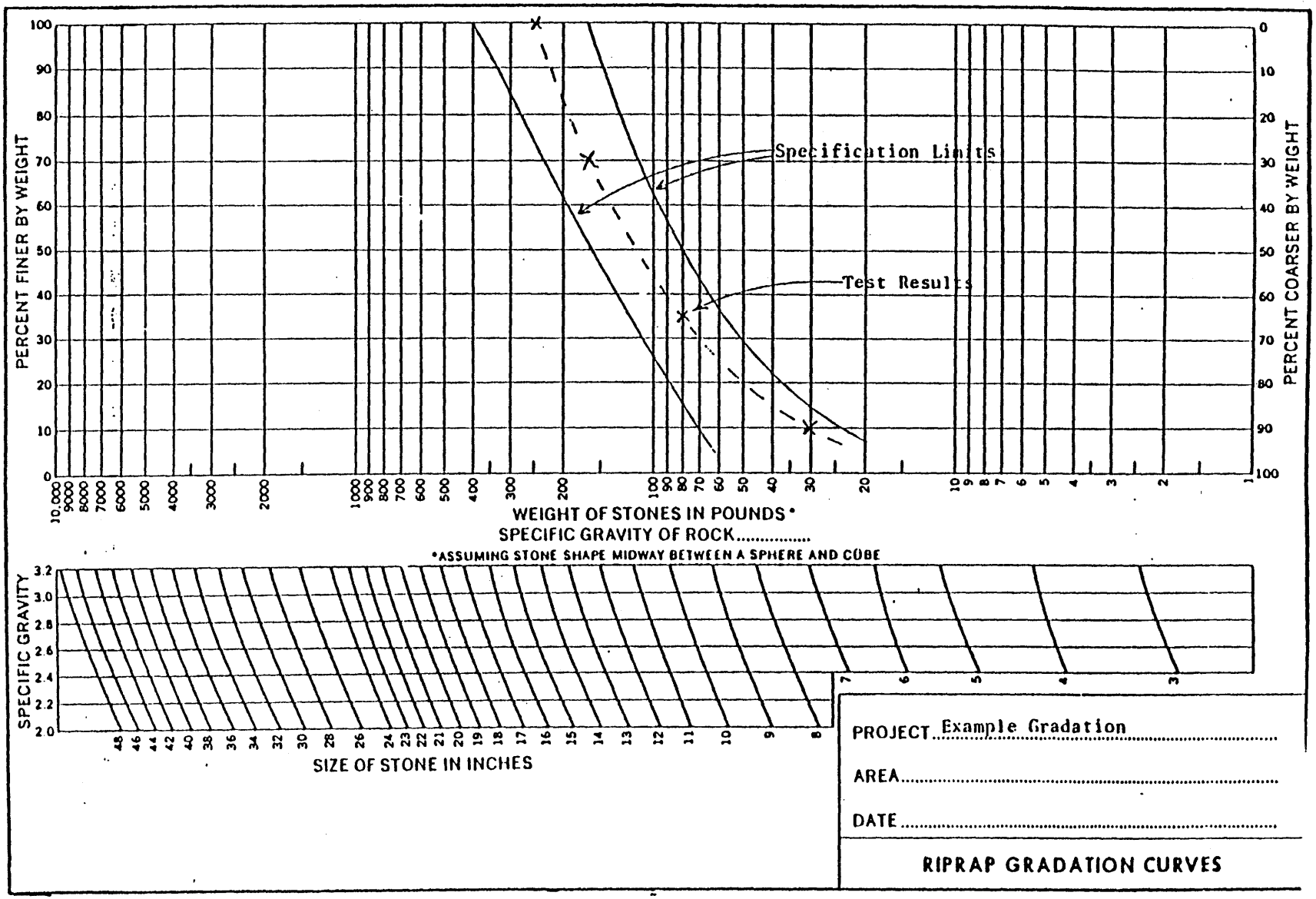
1. Sample Selection. The most important part of the test and least precise is the selection of a representative sample. No "standard' can be devised; larger quarry run stone is best sampled at the shot or muck pile by given direction to the loader; small graded riprap is best sampled by random selection from the transporting vehicles. If possible, all parties should take part in the sample selection, and agree before the sample is run, that the sample is representative.

2. Selection of Size for Separation. It is quite possible and accurate to run a gradation using any convenient sizes for the separation, without reference to the specifications. After the test is plotted on a curve, the gradation limits may be plotted. Overlapping gradation with this method are no problem. It is usually more convenient, however, to select points from the gradation limits, such as the minimum 50 percent size, the minimum 15 percent size, and one or two others, as separation points.

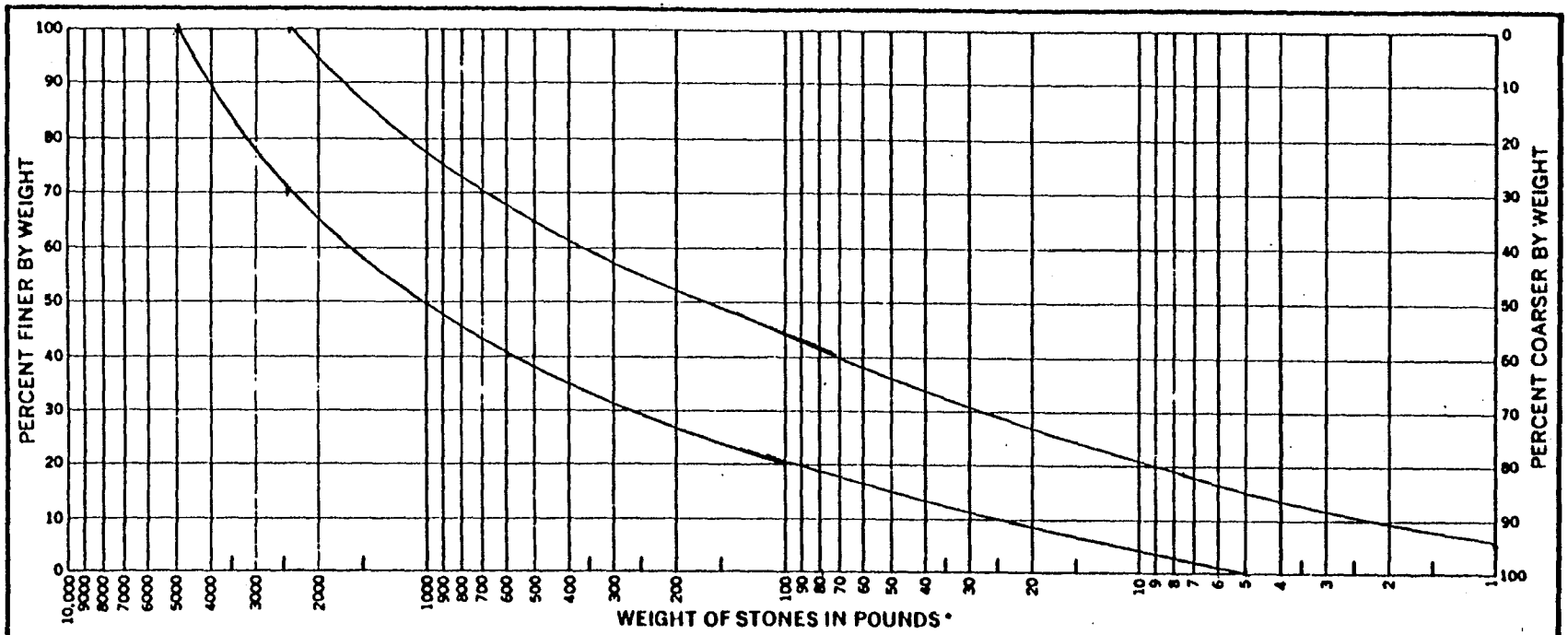
Example Gradation

Specifications

Stone Weight in Lbs	Percent Finer by Weight
400-160	100
160-80	50
80-30	15



ENG FORM 4055
APR 87



Stone Weight (lbs.)	Cumulative % Finer by Weight
5000	100
2500	70 - 100
500	40 - 65
100	20 - 45
5	0 - 15
1	0 - 5

Not more than 5 percent by weight finer than ½-inch screen.

GRADATION

GRADED STONE A

Example Worksheet

Stone Size Lbs	Individual Wt. Retained	Individual Percent Retained	Cumulative Percent Retained	Cumulative Percent Passing
400	0	0	-	100
160	9,600	30	30	70
80	11,200	35	65	35
30	8,000	25	90	10
30	3,200	10	100	-
	32,000 lbs			

NOTE:
Largest stone 251 lbs

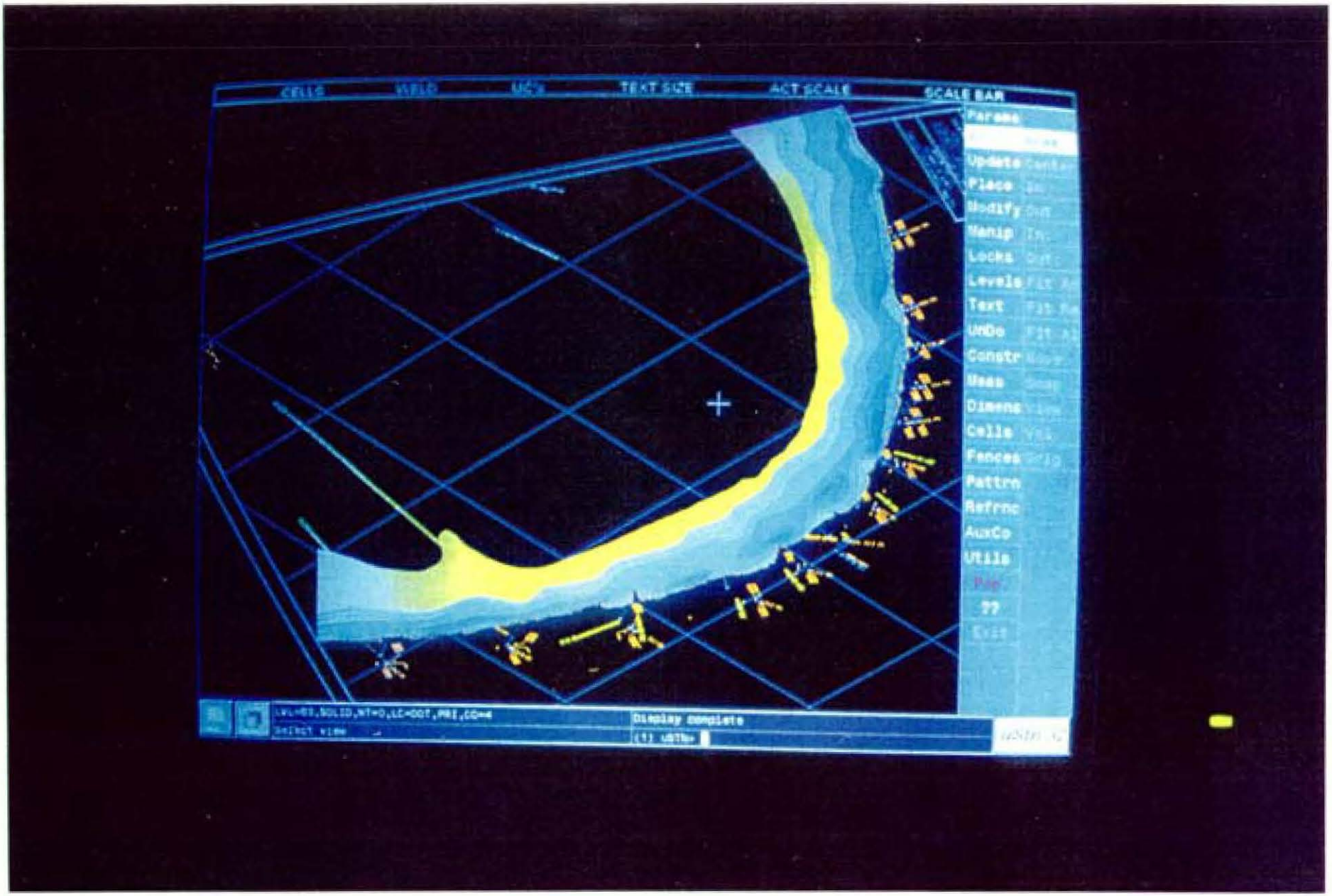
INDEX

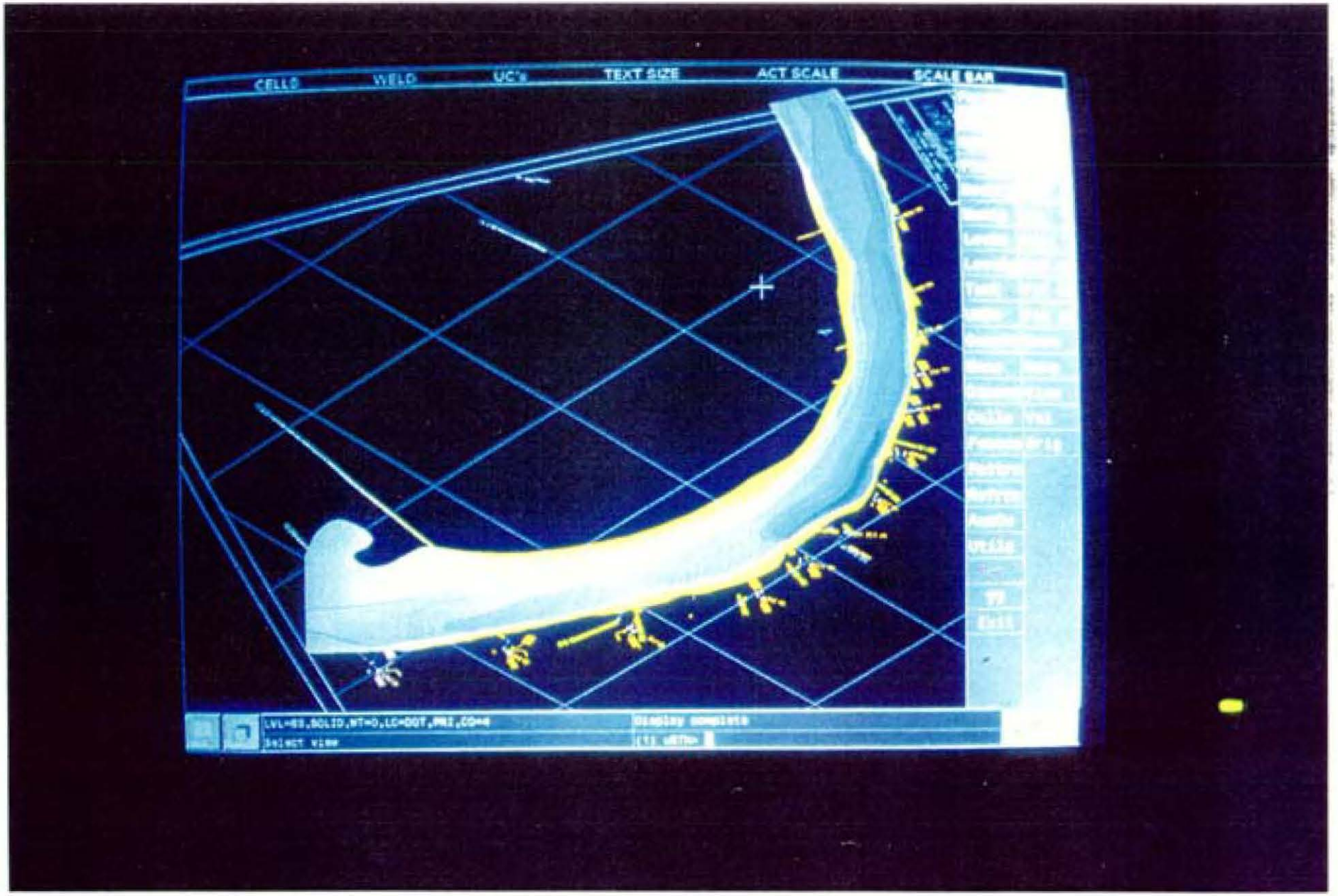
DIVISIONS 3 THRU 16

(NOT USED)

(26-89)

*U.S. Government Printing Office:1990-754-057/49


CELLS
WELD
UCS
TEXT SIZE
ACT SCALE
SCALE BAR
Update
Place
Modify
Manip
Locks
Levels
Text
UnDo
Constr
Meas
Dimens
Cells
Fences
Pattrn
Refrnc
AuxCo
Utils
Help
??
Exit
Display complete


CELLS
WELD
UC's
TEXT SIZE
ACT SCALE
SCALE BAR

VI. Comments to Side Scan Sonar Report.

The proceeding document is a side scan sonar report completed for the St. Louis District by EG and G Oceanographic Services. The survey covers two The first is the location of a sunken vessel in the Grand Tower area of the Mississippi River just below Tower Rock. The second survey was taken through the Dogtooth Bend Reach after construction of the Bendway Weirs. Although the reduced scale of the bend may be at first hard to decipher, careful study will illustrate the bottom of the river with all 13 Bendway Weirs in place. Scour can be seen on the inside of the bend running perpendicular and downstream of the structures. A special note worth mentioning is that the structures below mile 23.3 produced more scour than did those structures upstream. It is not quite sure why the downstream weirs were initially more efficient. It may have been a combination of the relatively flat slope of the river (0.4 ft. per mile) and the effects of the drought. A close watch will be given to the bend, especially after a high water event, to examine the overall efficiency of the structures.

The side scan sonar is a qualitative tool for examining the bottom of the river. Combined with a detailed sounding survey, one can define the effects of structures in deep channels. The District went one step further in this analysis by combining the side scan sonar output with the channel sweep survey output. These comparisons are available upon request from this office. They show combined qualitative and quantitative effects of the Bendway Weirs as well as the effects of existing outside "stub" dikes.

VII. Side Scan Sonar Report.

SIDE SCAN SURVEY

MISSISSIPPI RIVER

GRAND TOWER

FOR

BLANKINSHIP ENGINEERING

MURPHYSBORO, ILLINOIS

1ST PHASE

GRAND TOWER HOLE

TARGET ANALYSIS

BENDWAY WEIR LOCATIONS

MILES 22.3 - 24.3

EG&G

WASHINGTON ANALYTICAL SERVICES CENTER, INC.

OCEANOGRAPHIC SERVICES

SIDE SCAN SONAR

GRAND TOWER HOLE SURVEY

After reviewing the seven target records included with this report, it would appear that there is an 80% probability of wreckage/debris in the area referred to as the Grand Tower Hole. Because of the different speed and approaches to the target and the difficulty in surveying into this hole, the target size varies due to the angle of reflection and height of the tow fish. Because of the bottom condition, it was impossible to run these lines at a constant speed. As we approached the hole heading up river, we had to stop when we approached the ledge, which has a vertical rise of approximately 60 feet, with the hole bottom at 110 feet. As all the records indicate, the object sits at the downriver end of the hole in about 70 feet of water.

Line "A," which was run without navigation, shows the object 5 meters off the starboard side. The outline appears to have a shape consistent with what you would expect a vessel lying on the bottom to look like. The total object reflection is approximately 25 meters in length, with an acoustic shadow of 22.5 meters. This would indicate that the object is approximately 6 meters high. This record also defines the forward structure extending 15 meters before the highest point is reached.

Line "7," also run upriver, is a look at the object on the 50 meter range. The object lies at event 3 (with layback, that should be at about event 2.5). This target gives additional detail as to the type of structure. There is a raised area in the center of the object, rectangular in shape extending back approximately 8 meters.

Line "6," which was run up river, shows the object as the boat passed directly over the top. This record shows the height in the bathymetric channel as well as the acoustic shadow on the seafloor.

The two cross river lines show the target, but due to the ship movement, it is difficult to determine size and height. Line "8" shows a strong target with some structure and shadowing. As evidenced by all the records, the object lies on the downriver side of the hole on a sand bottom in approximately 70 feet of water.

If the target is of interest, it is recommended that further investigation be attempted using a diver for object identification. Included are object height determination sheets for this target on all the lines in which it was detected. As the reflection and shadowing are different each run, I have tried to calculate for each target. The average height is 5 meters and the average length is 15 meters.

Lines "1" through "4" were run to create a mosaic of the hole area. However, due to varying boat speed and water flow, the lines will not align and a mosaic is not possible. Each of the lines are labeled with some annotation. The target on line "3" event 17 is similar to the target found on line "A" except that it was run on the 50 meter range.

Included in this report are the individual height determination sheets, annotated data records, and excerpts from the EG&G Model 260 manual for determining slant range corrections and object height.

* For additional detail, see Exhibits accompanying this report or the individual side scan charts.

J.T. BLANKINSHIP & ASSOCIATES
Consulting Engineers and Land Surveyors
401 SOUTH 17TH STREET - P.O. BOX 40 - MURPHYSBORO, ILLINOIS 62966

WATER AND SEWERAGE IMPROVEMENTS
STREET AND HIGHWAY IMPROVEMENTS
AIRPORTS - EVALUATION SURVEYS - SUBDIVISIONS
AREA 618 TELEPHONE 687-1771

SIDE SCAN SONAR

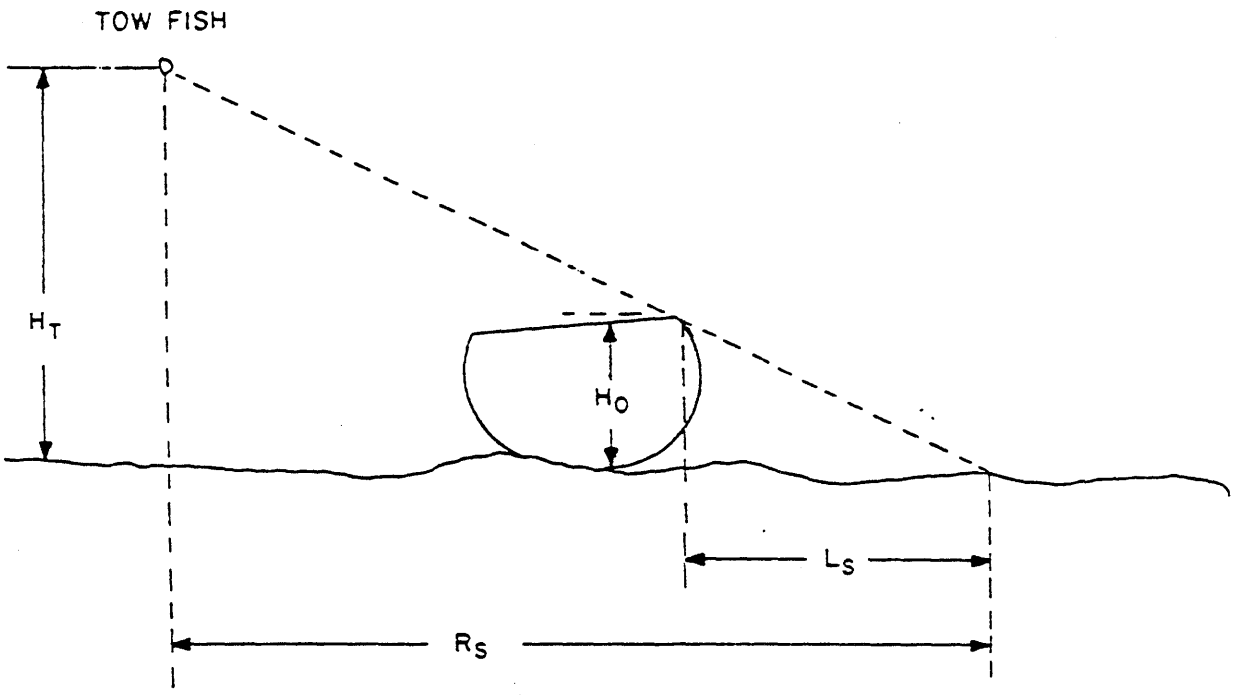
BENDWAY WEIR SURVEY

On November 15, 1990 a side scan survey was made of the Bendway Weirs located at the Dogtooth Bend segment of the Lower Mississippi River. The section of river covered in this survey includes the area between miles 22.3 to 24.3. The 13 Bendway Weirs are all located on the right bank of the river and vary in length across the channel.

The survey lines were all run upstream of the river to help control the boat speed. Three survey lines were run using a side scan width of 100 m. Line 1 was run upstream along the left bank. Line 2 was run upstream along the center of the river. Line 3 was run upstream along the right bank of the river.

The side scan charts show the varying geology of the river bottom including the dikes and weir construction. The acoustic shadow show the relative height of the weirs and reveals the scouring and deposition going on around the weir locations.

* For additional detail, see Exhibits accompanying this report or the individual side scan charts.

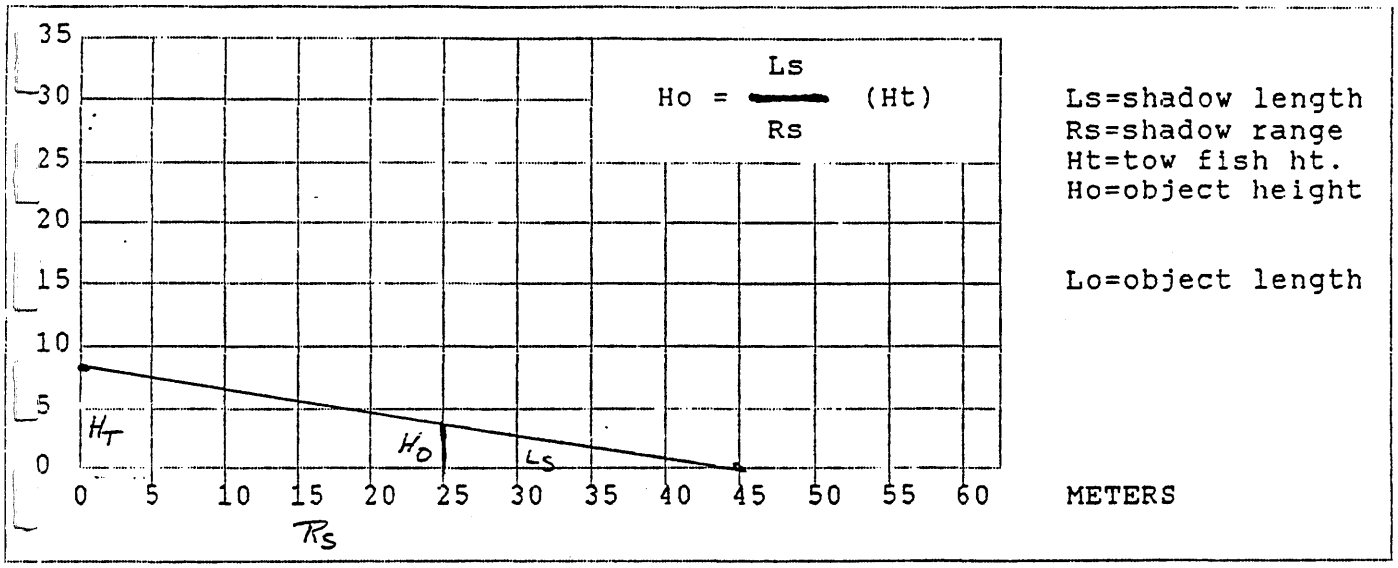


$$H_O = \frac{L_S}{R_S} H_T$$

For example:

If, Shadow length (L_S)	=	15 Meters
Shadow range (R_S)	=	50 Meters
Tow fish height (H_T)	=	20 Meters
Then, Object height (H_O)	=	6 Meters

Figure 3-6. Object height determination.



LINE # 8

EVENT# 7

SCALE 50 (M)

OFFSET 9.8 (M) TO P

TOW FISH LAYBACK 20 (M)

Ls = 20m

Rs = 45m

Ht = 8m

OBJECT HEIGHT= 3.6m

OBJECT LENGTH= 12m

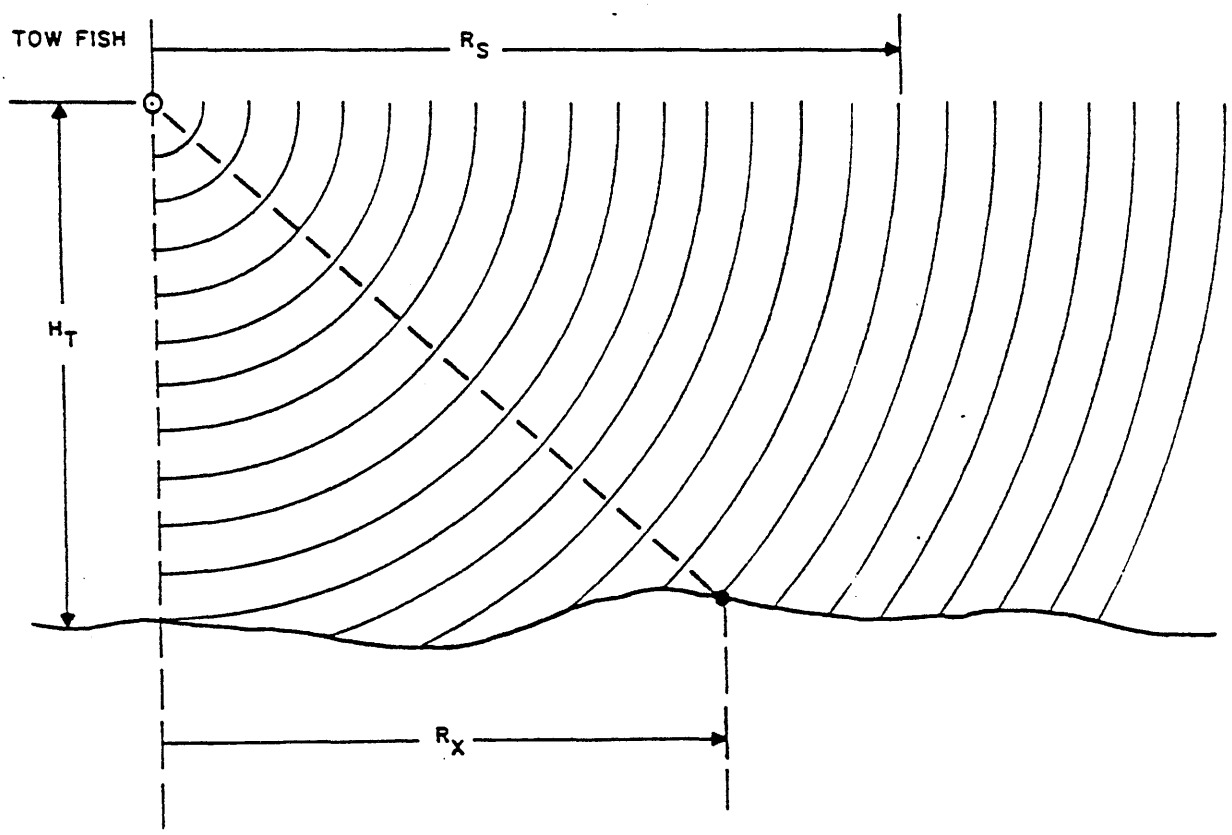
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

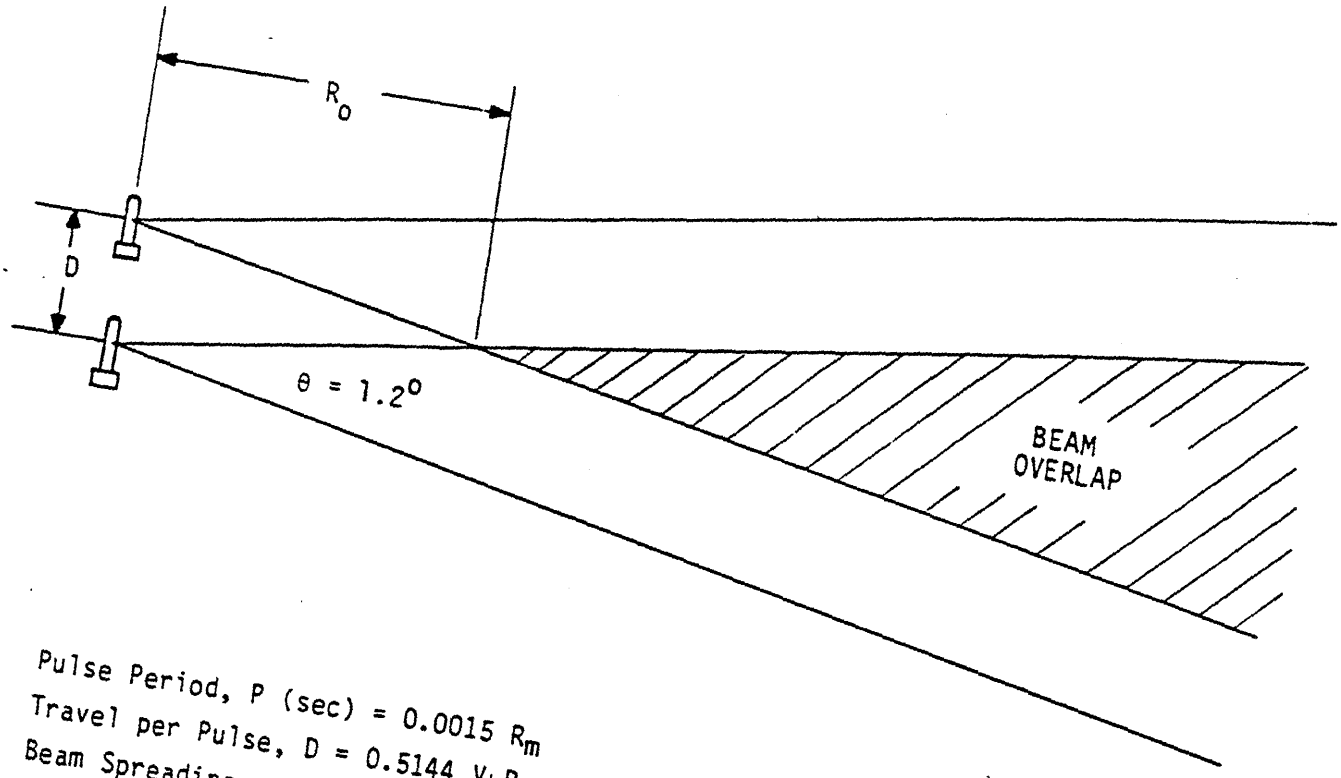
where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



$$R_X = \sqrt{R_S^2 - H_T^2}$$

Figure 4-2. Slant range correction.



Pulse Period, P (sec) = $0.0015\ R_m$

Travel per Pulse, D = $0.5144\ V_k P = 0.00077\ V_k R_m$

Beam Spreading = $R\theta = 0.021\ R$

Range for No Overlap, $R_o = \frac{D}{0.021} = 0.037\ V_k R_M$

where

R_m = Selected system range in meters

V_k = Tow fish speed in knots

NOTE

Since beam spreading occurs both vertically and horizontally, there will be no loss of coverage when R_o equals the tow fish height. For example, when the tow fish height is 20% of the range, there will be no loss of coverage for speeds less than 5.4 knots.

Figure 4-3. Speed correction.

Daily Field Log

Blankenship
Grand Tower

TIME	Description of Activities
11/12/90	Grand Tower
1130	Arrived St. Louis.
1430	Arrived Murphysboro, Blankenship Engineering.
1530	Arrived at work site, set up Side-scan - problem with tow cable - found short in EO connector - system O.K.
1800	Repaired tow cable.
11/13/90	Grand Tower
0800	Arrived on survey vessel - setting up SSS
0900	Problem with primary cable - using secondary - looks O.K. Waiting for C of E personnel
1230	Left for work site.
1320	SOL 1
1348	SOL 2
1359	SOL 3
1412	SOL 4
1428	Side-scan on bottom - retrieved.
1500	System checked out O.K.
1630	Back at dock. (Ordered new cable).
11/14/90	Grand Tower
0800	Arrived at boat ramp, Grand Tower.
0900	Boat arrived - onboard.
0935	SOL 1
1006	SOL 2
1019	SOL 3
1129	SOL 4
1140	SOL 5
1310	SOL 6
1320	SOL 7
1330	SOL 8
1343	SOL 9
1352	SOL 10
1400	Head to shore.
11/15/90	Cape Gerdeaux
0730	Left Murphysboro for Cape Geradeaux.
0930	Arrived Cape G. - checked into motel.
1030	Arrived at barge dock - meet boat "BLANKENSHIP" - left for work area.
1133	SOL 1
1305	SOL 2
1400	SOL 4
1440	End of survey day - heading to dock.

11/16/90 Thebes
0800 Arrived at Thebes - C of E dock.
0825 Left for work area.
0913 SOL 1
1050 SOL 2
1140 SOL 3
1325 SOL 4
End of survey - heading to dock.

GEOPHYSICAL SURVEY LOG

Line Information

Blankenship
Grand Tower

11/13/90 Grand Tower

	TIME		EVENT				CABLE OUT	
Line	SOL	EOL	SOL	EOL	Course	SPD	SSS	
1	1320	1330	1	29	Up	2.5	20′	Grand Tower Hole
2	1348	1355	1	12	Down	3.5	30′	
3	1359	1406	13	30	Up	2.5	30′	
4	1412	1428	1	13	Down	3.5	20′	

11/14/90 Grand Tower

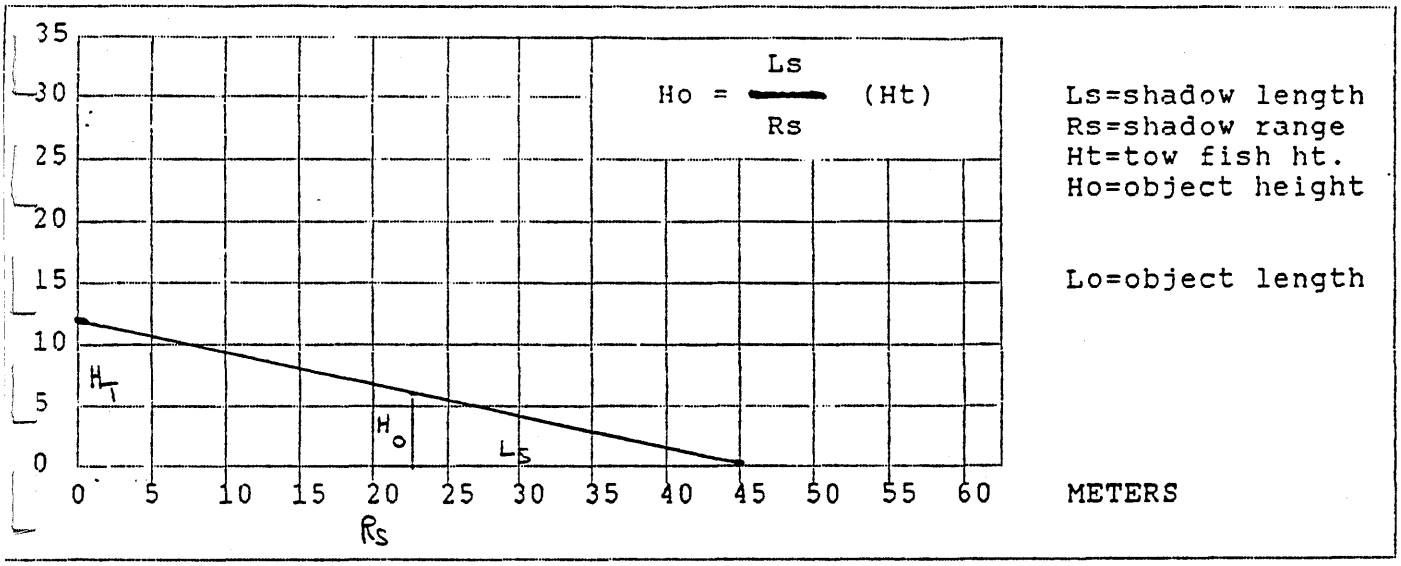
1	0935	0950	1	23	Up	1.0	20′	Grand Tower Shute
2	1006	1013	1	11	Down	3.5	20′	500 kHz
3	1019	1035	1	23	Up	1.0	20′	100 kHz
4	1129	1135	1	13	Down	3.0	20′	
5	1140	1151	1	21	Up	1.0	20′	
Hole								
6	1310	1315	1	10	Up	1.0	Var.	
7	1320	1322	1	6	Up	1.0	Var.	
8	1330	1338	1	8	Up	1.0	Var.	
9	1343	1345	1	6	Cross	1.0	Var.	
10	1352	1359	1	11	Cross	1.0	Var.	
11	No navigation							

11/15/90 Cape Gerdeaux

1	1133		1	Abort	Up	3	10′- 20′	Boat
1	1217	1250	1	38	Up	2.5	10′- 20′	Traffic
2	1305	1342	1	42	Up	2.5	10′- 20′	
3	1400	1435	1	42	Up	2.5	10′- 20′	

11/16/90 Thebes

1	0913	1038	1	107	Up	3.5	20′	Right Bank
2	1050	1118	1(2)	38	Down	4.0	10′	Center River
3	1140	1312	1	115	Up	3.5	20′	Left Bank
4	1325	1338	1	24	Down	5.0	10′	Left Bank



LINE # A

EVENT# None

SCALE 100m (M)

OFFSET ? (M) TO _____

TOW FISH LAYBACK ? (M)

Ls = 22.5m

Rs = 45m

Ht = 12m

OBJECT HEIGHT= 6m

OBJECT LENGTH= 25m

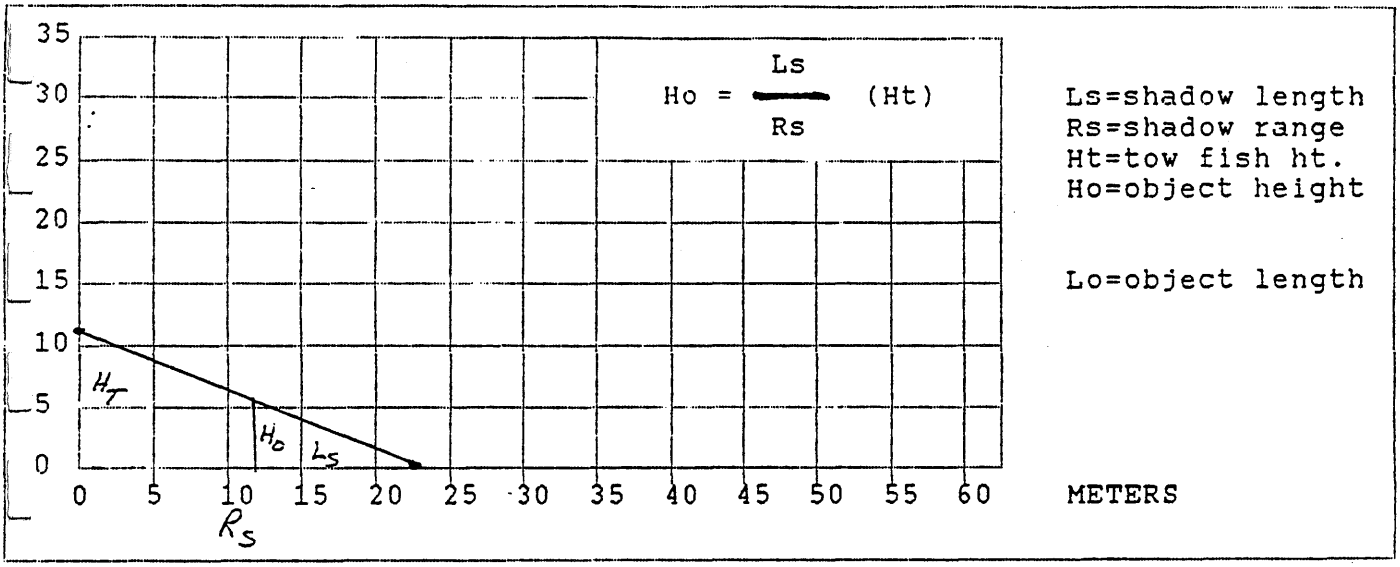
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



LINE # 6

EVENT# 6.75

SCALE 50 (M)

OFFSET 0 (M) TO _____

TOW FISH LAYBACK 25 (M)

Ls = 12m

Rs = 22.5m

Ht = 11m

OBJECT HEIGHT= 5.9m

OBJECT LENGTH= 8.5m

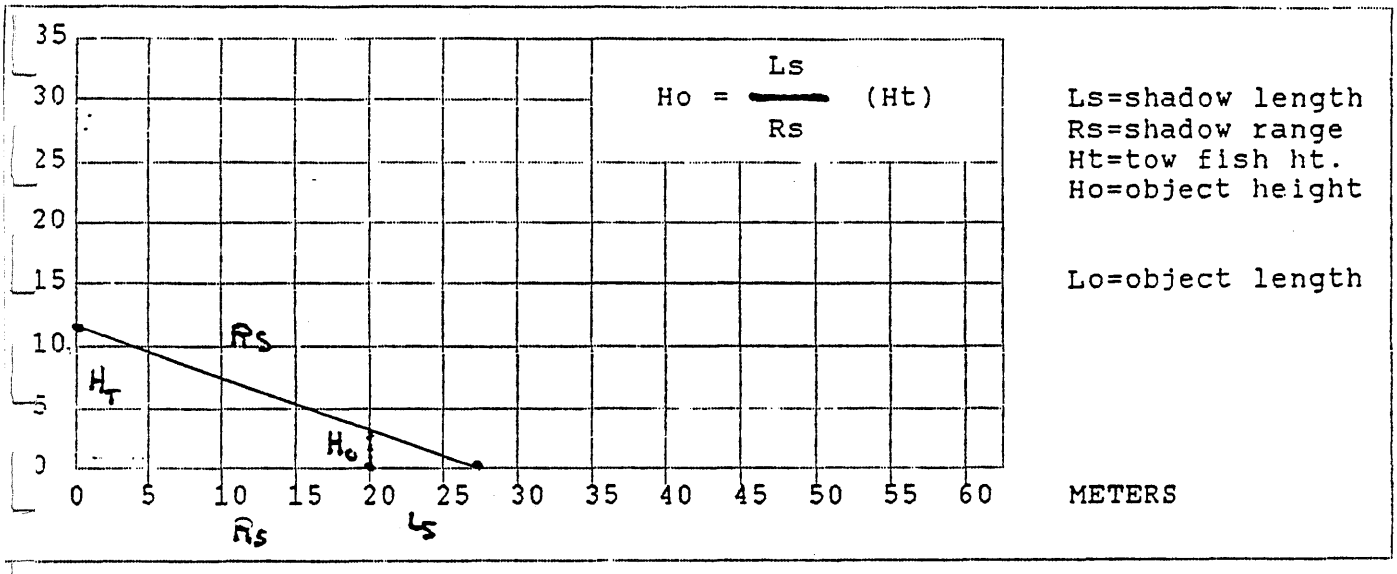
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



LINE # 7

EVENT# 2.8

SCALE 50 (M)

OFFSET 1 (M) TO S

TOW FISH LAYBACK 20 (M)

Ls = 7.5m

Rs = 27.5m

Ht = 11m

OBJECT HEIGHT= 3m

OBJECT LENGTH= 10m

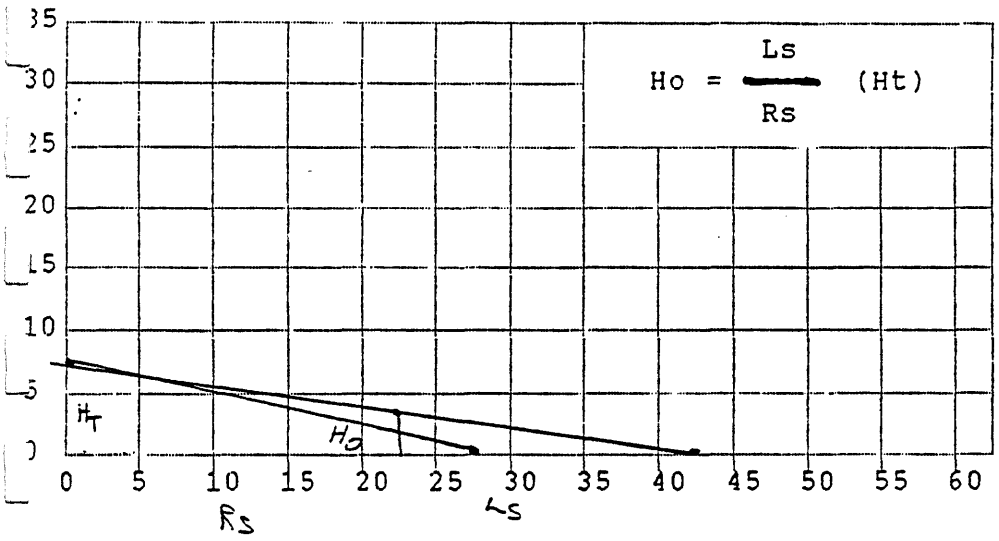
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



LINE # 9

EVENT# 5.5

SCALE 50 (M)

OFFSET 3 (M) TO S

TOW FISH LAYBACK 20 (M)

Ls = 27.5m

Rs = 45m

Ht = 7.5m

OBJECT HEIGHT= 4.6m

OBJECT LENGTH= 20m

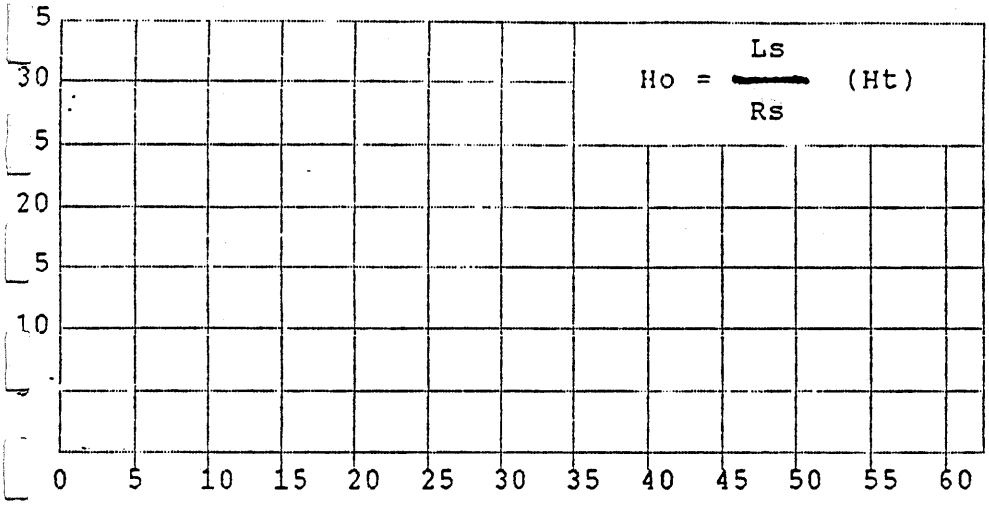
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



LINE # 10

EVENT# 9 - 10.5

SCALE 50 (M)

OFFSET 8 (M) TO P

TOW FISH LAYBACK 25 (M)

Ls = ?

Rs = ?

Ht =

unable to determine size or height due to ship movement.

OBJECT HEIGHT= ?

OBJECT LENGTH= ?

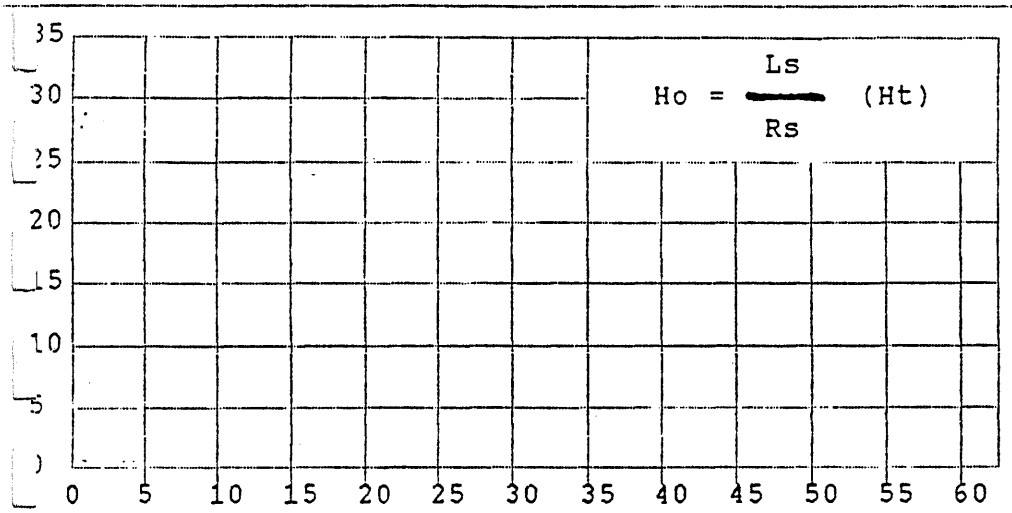
NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom



LINE # 3

EVENT# 17

SCALE 50 (M)

OFFSET 12.5 (M) TO S

TOW FISH LAYBACK 20 (M)

Ls = 23

Rs = 48

Ht = 16

OBJECT HEIGHT= 7.6m

OBJECT LENGTH= 24m

NOTE* If image correcting is in use you may measure the distance from the tow fish to the object directly from the record. Also the size of the object may be measured directly.

If image correcting is off then you will have to solve for the slant range of the distance from the tow fish. The following formula should be used.

$$Rx = \sqrt{Rs^2 - Ht^2}$$

where,

Rx = corrected range
Rs = apparent range from record
Ht = tow fish height off bottom

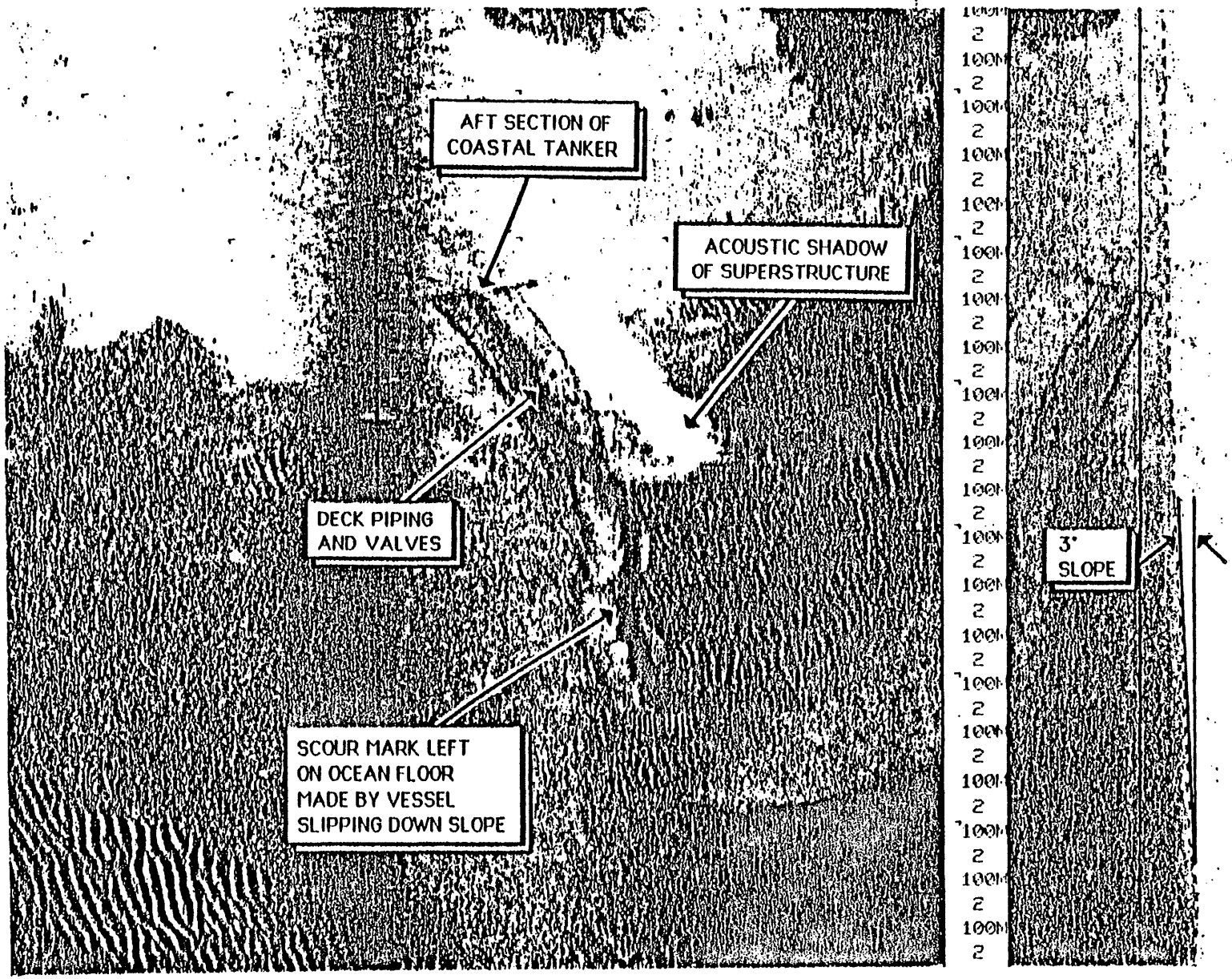


Figure 3-5. Coastal tanker shipwreck.

EXHIBITS

SECTION I

1. PLAN VIEW GRAND TOWER/TARGET
2. OVERVIEW MOSAIC (PHOTO)
3. TARGET CLOSEUP (PHOTO)
4. TARGET PROFILE (PHOTO)
5. TARGET ENLARGEMENT

SECTION II

6. PLAN VIEW DOGTOOTH BEND BENDWAY WEIRS
7. OVERVIEW MOSAIC (PHOTO)
8. UPPER REACH BENDWAY WEIR
9. MIDDLE REACH BENDWAY WEIR
10. LOWER REACH BENDWAY WEIR
11. BATHYMETRIC CHANNEL BENDWAY WEIR

SECTION I

N 654000

N 658000

E 786000

E 788000

ST.L.-S.F. RAILROAD

TOWER ROCK

TARGET LOCATION

HOLE

LINE 1

LINE 2

LINE 3

LINE 4

LINE 6

LINE 7

LINE 8

LINE 10

SANDBAR

SANDBAR

BACKBONE

DEVIL'S

BOAT RAMP

N

GAGE RECORD			
GAGE N.G.V.D. / DATE ZERO	GRAYS POINT	CAPE GIRARDEAU	ST. LOUIS
MILE	301.18	304.77	379.94
L.W.R.P.	46.3	51.9	179.6
	306.30	309.88	376.44

ELEVATIONS ARE REFERED TO N.G.V.D.
CONTOURS ARE BELOW 1956-57 LOW WATER REFERENCE PLANE (54,000 c.f.s.)

SURVEYED BY

COMPUTER AIDED DESIGN & DRAFTING

J.T. BLANKINSHIP AND ASSOC.

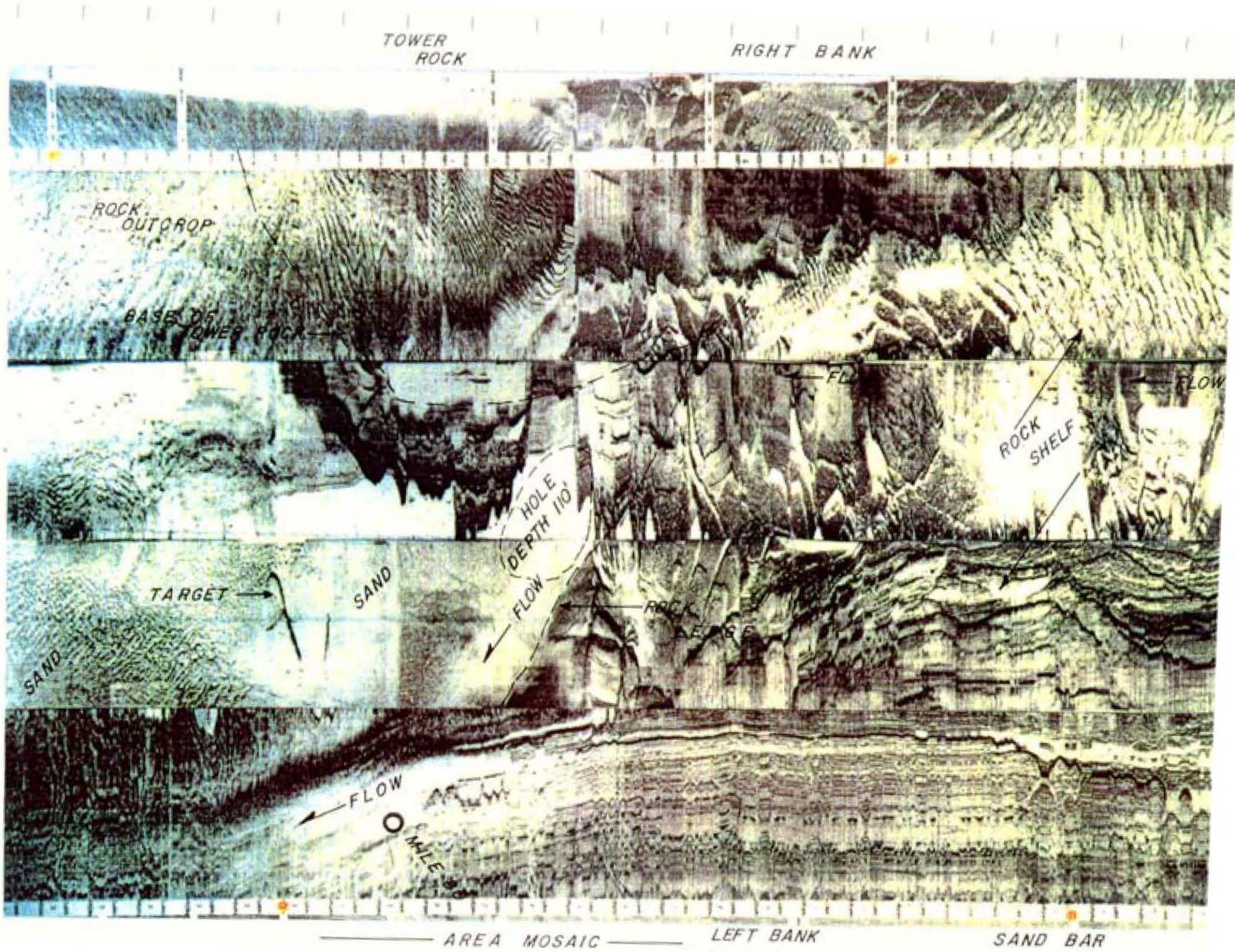
U.S. ARMY ENGINEER DISTRICT ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

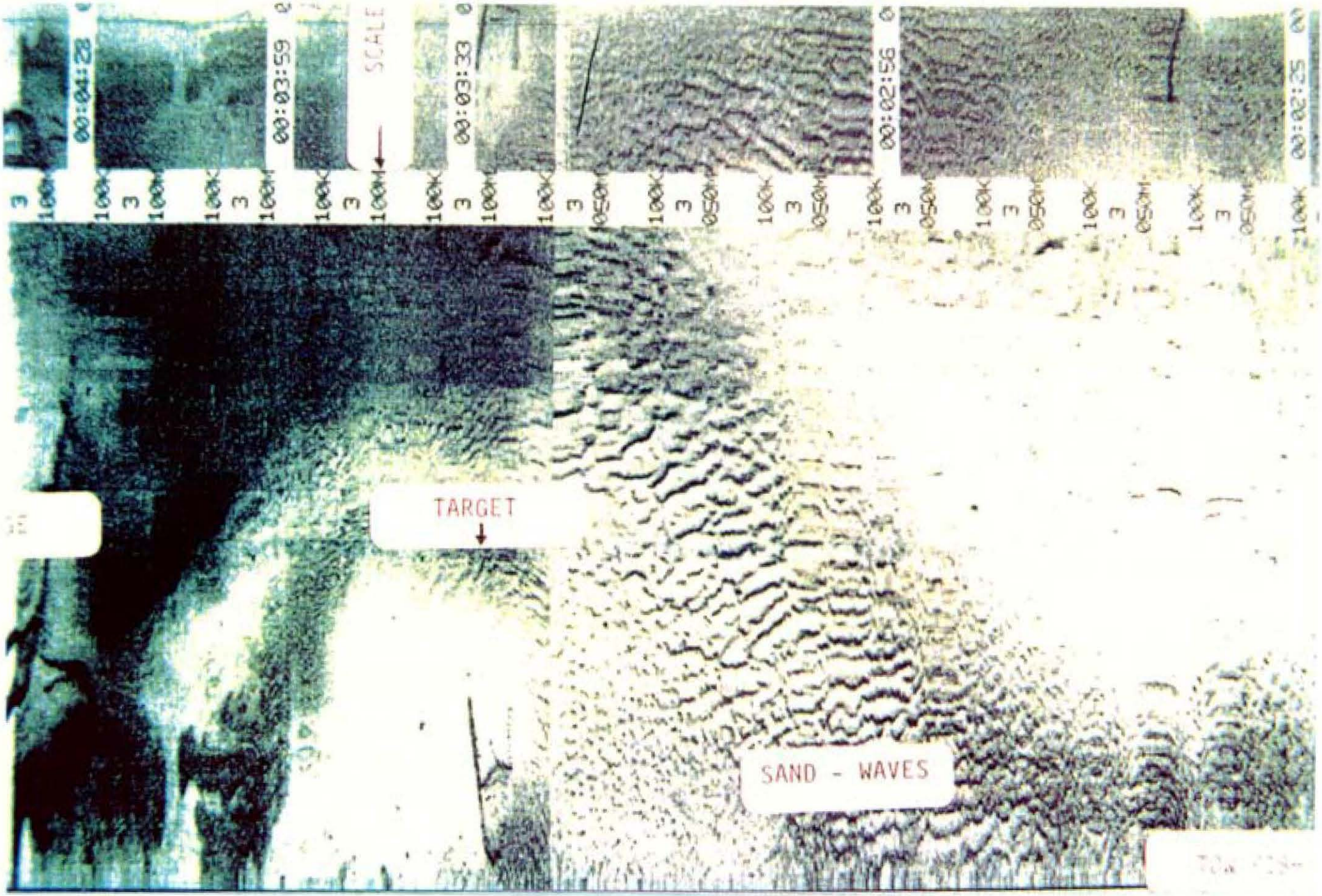
MISSISSIPPI RIVER
HYDROGRAPHIC SURVEY
MILE 78.1 TO MILE 80.3

120 0 120 240 METERS
400 0 400 800 FEET

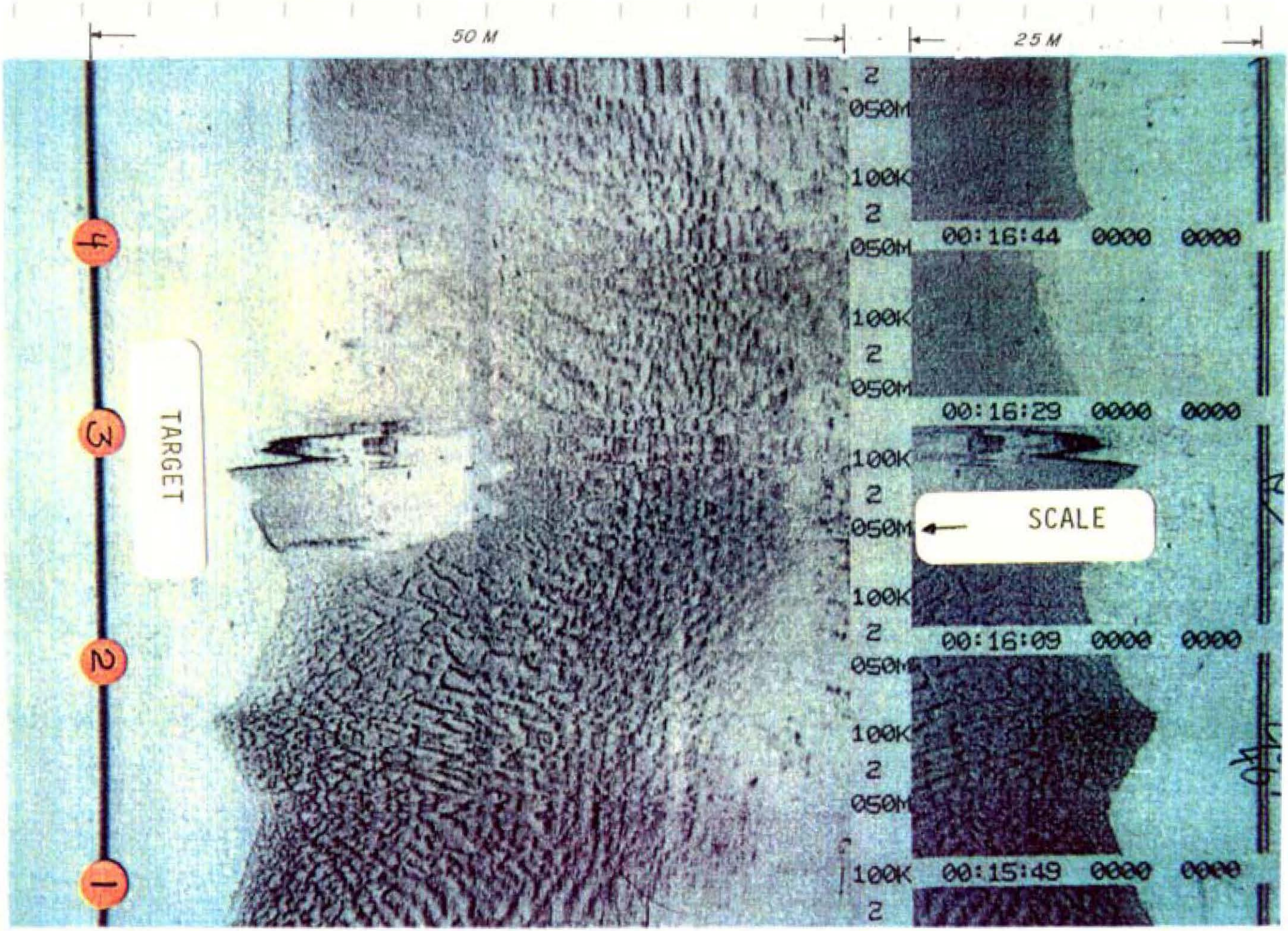
DATE SOUNDED 13-14 NOVEMBER 1990
CHECKED BY
DATE OF PHOTO 31 JAN 1989

PLATE NO. 33

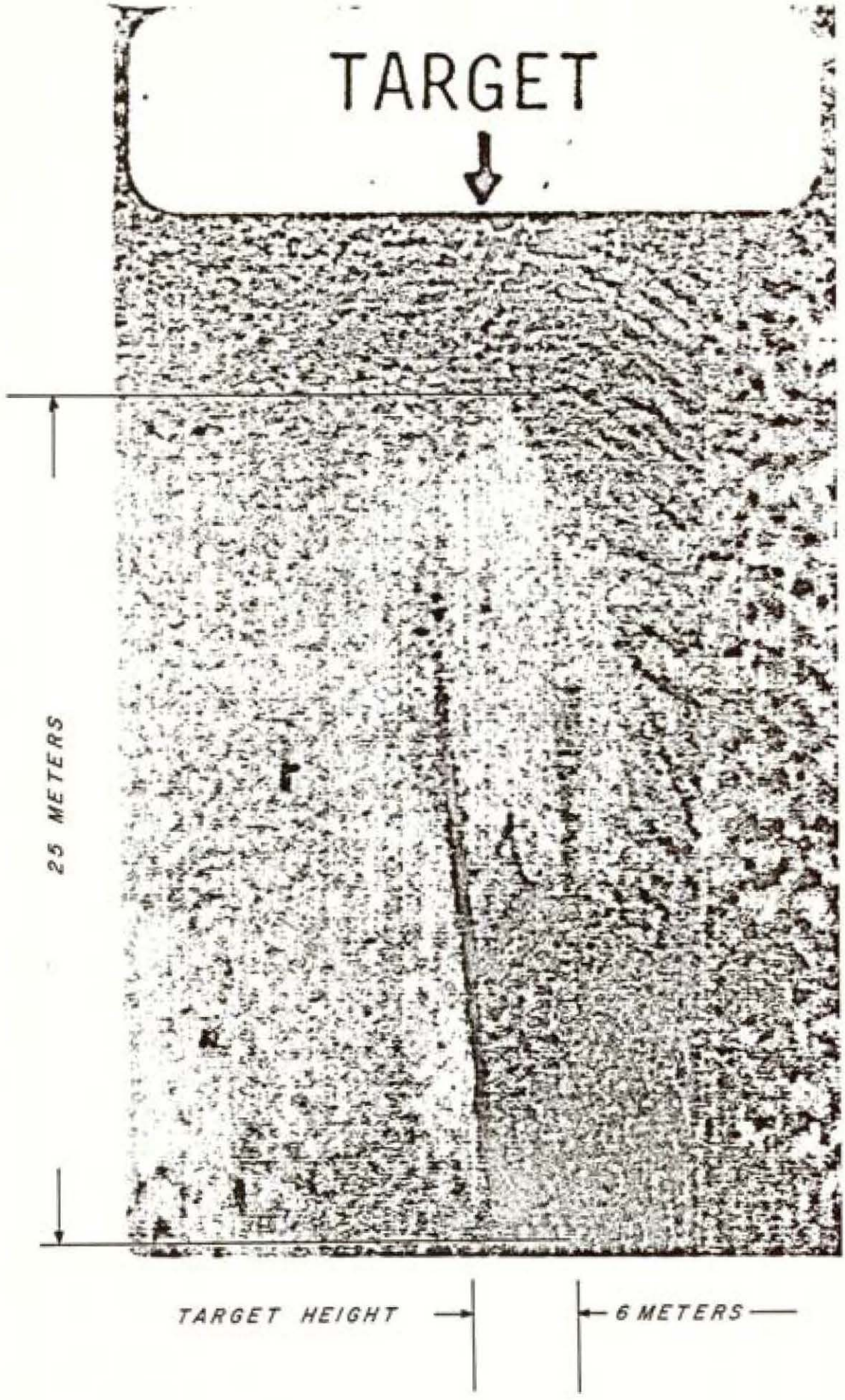

TOWER ROCK
RIGHT BANK
ROCK OUTCROP
BASE OF TOWER ROCK
FLOW
ROCK SHELF
HOLE DEPTH 110'
TARGET
SAND
FLOW
ROCK
SAND
FLOW
MILE
AREA MOSAIC
LEFT BANK
SAND BAR



TARGET - CLOSE UP



TARGET PROFILE


TARGET
25 METERS
TARGET HEIGHT
6 METERS
TARGET ENLARGEMENT

SECTION II

ILLINOIS

MISSOURI

SLIDING TOWHEAD

DOGTOOTH BEND

BROWN'S BAR

SOUNDED 15 NOVEMBER 1990

LINE 1

LINE 2

LINE 3

CENTERLINE PROPOSED WEB

E 650000

N 420000

E 659000

N 428000

1½" ALUM. PIN

GAGE RECORD			
GAGE N.G.V.D. DATE ZERO	GRAYS POINT	CAPE GIRARDEAU	ST. LOUIS
MILE	301.18	304.77	379.94
L.W.R.P.	46.3	51.9	179.6
	306.30	309.88	376.44

ELEVATIONS ARE REFERED TO N.G.V.D.
CONTOURS ARE BELOW 1956-57 LOW WATER REFERENCE PLANE (54,000 c.f.s.)

SURVEYED BY

COMPUTER AIDED DESIGN & DRAFTING

J.T. BLANKINSHIP AND ASSOC.

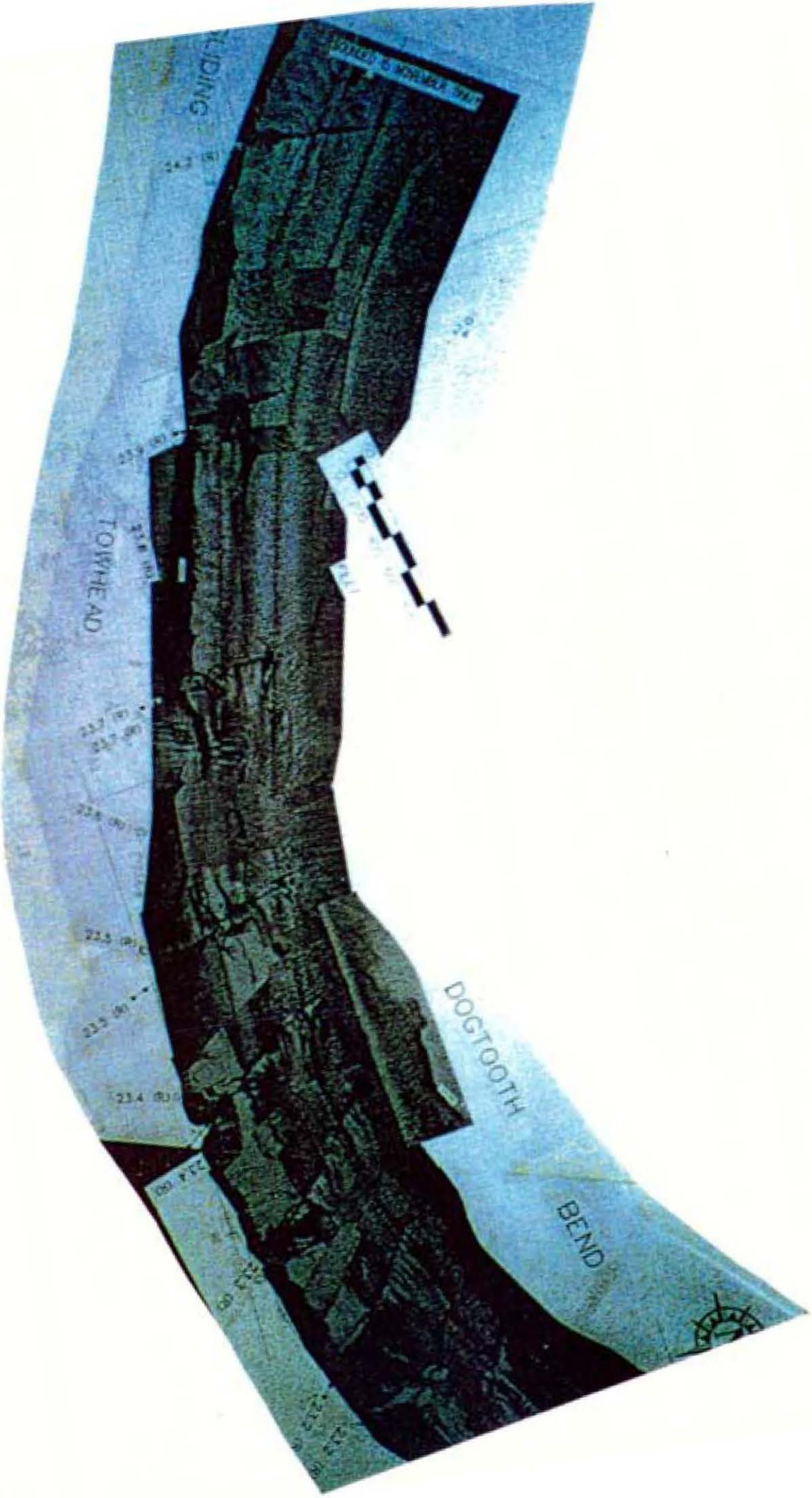
U.S. ARMY ENGINEER DISTRICT ST. LOUIS
CORPS OF ENGINEERS
ST. LOUIS, MISSOURI

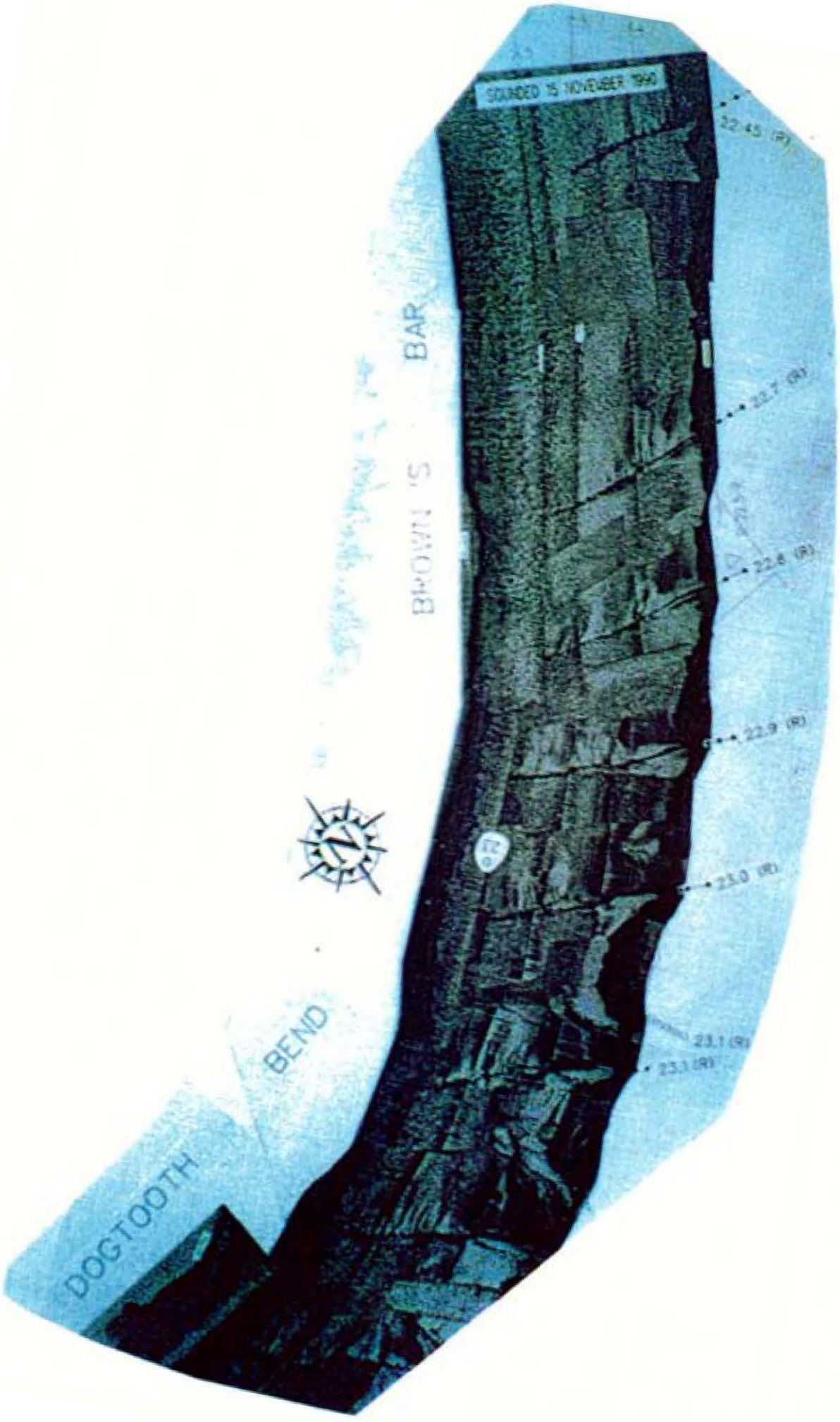
MISSISSIPPI RIVER
HYDROGRAPHIC SURVEY
MILE 24.2 TO MILE 26.5

120 0 120 240 METERS
400 0 400 800 FEET

DATE SOUNDED 11 NOVEMBER 1990
CHECKED BY
DATE OF PHOTO 31 JAN 1989

PLATE NO. 10


TOWHEAD
DOGTOOTH
BEND

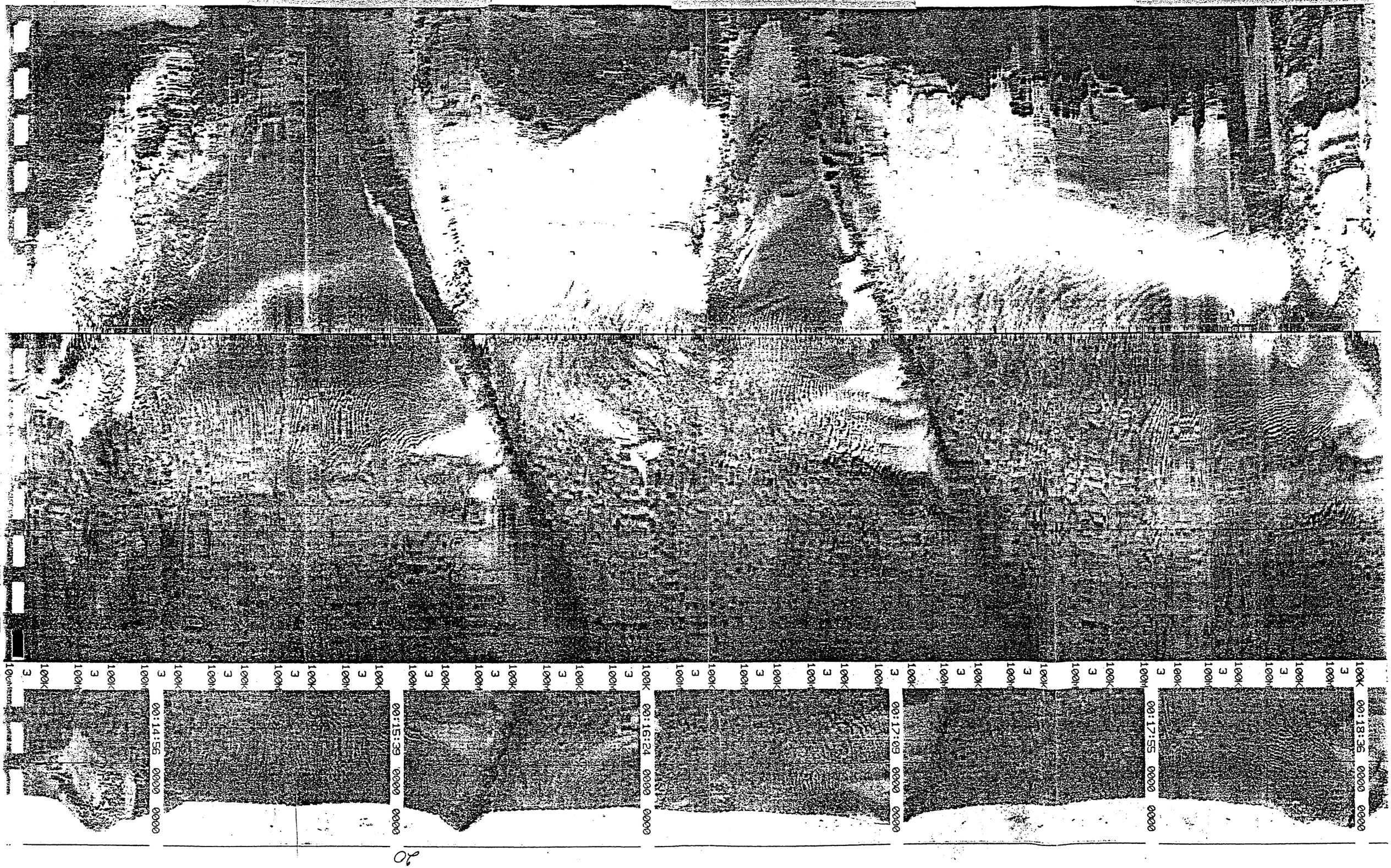

SOUNDED IN NOVEMBER 1990
22.45 (R)
22.7 (R)
22.6 (R)
22.9 (R)
23.0 (R)
23.1 (R)
23.1 (R)
BROWN'S BAR
DOGTOOTH BEND

Dike

WEIR 23.2R

WEIR 23.3R

WEIR 23.4R



VIII. Underwater Weir Investigation Report from The Netherlands, with Introductory Comments.

This report was obtained from a Dutch engineer after discussing the Bendway Weir Concept with him during the PIANC trip to Japan. The report was translated by the Federal Bureau of Investigation. The Dutch are going to start building their structures sometime in 1991. Note that the design angle called for in this report is exactly the same design angle that was arrived upon at WES.

The Dutch goals are very similar to the Corps goals of establishing a wider and more stable bendway.

The Dutch bring up an alternate solution of armoring the entire bed of the bend, which would probably work as well as the Bendway Weirs but would become obviously quite expensive.

The second half of this report discusses the possibility of constructing the "groins" out of sand bags made of geo-textiles. Interesting concept, although with the cheap cost of A stone, this may not be practical on the Mississippi River. However, the idea may be worth investigating for smaller rivers.

The District will stay in contact with the Dutch and continue to share as much information as possible on the Bendway Weir concept. New ideas and insights will no doubt be gained from both countries.

Onderzoekresultaten en belangen-inventarisatie

Eindelijk zicht op Waalbochtverbeteringen

Reeds jarenlang bestaat de wens om de nautische situatie in de bochten van de rivier de Waal tussen Nijmegen en de Pannerdense Kop te verbeteren (zie figuur 1). Deze wens is recentelijk weer met nadruk onder de aandacht gekomen door het aanwijzen van de Waal als zogenaamde hoofdtransportas in het (Tweede) Structuurschema Verkeer en Vervoer (2e SVV), een gezamenlijk produkt van de Ministeries Verkeer en Waterstaat en VROM. In deze nota wordt ook vergroting van de mogelijkheden voor de zesbaksduwvaart bepleit. Het 2e SVV is een uitwerking van de vierde Nota Ruimtelijke Ordening, waarin onder meer wordt uitgesproken dat het om economische redenen gewenst is om de vaarwegverbinding tussen Rotterdam en het Duitse achterland optimaal te benutten. De argumenten voor het beter benutten van de Waal zijn echter niet van louter economische aard. Verbetering van de nautische situatie op het bochtige traject tussen Nijmegen en de Duitse grens is vooral ook gewenst om veiligheidsredenen en (op de lange termijn) voor het milieu: vervoer over water is ook gunstiger voor het milieu en veiliger dan vervoer over de weg.

H. Havinga

De heer Havinga is werkzaam bij de directie Gelderland van de Rijkswaterstaat.

Verbetering betekent in dit verband dat er voldoende vaarbaanbreedte en vaardiepte aanwezig moet zijn voor een veilige en vlotte afwikkeling van de scheepvaart op de Waal. De bochten tussen Nijmegen en de Pannerdense Kop, bekend als 'Haalderen, Erlecom (of de Zandberg) en Hulhuizen', vormen in dit opzicht een knelpunt.

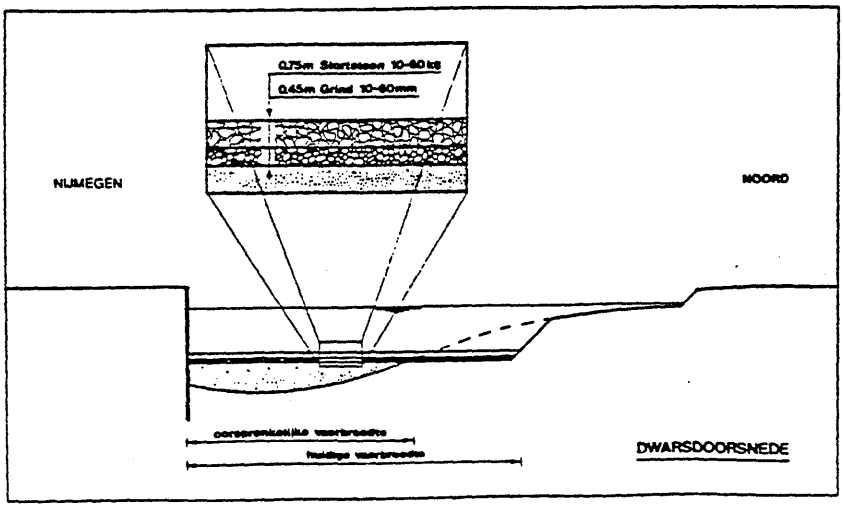
1. Waal bij Nijmegen.

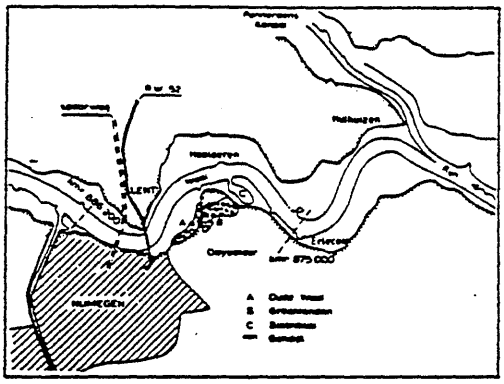
Vroegere plannen en recente verbeteringen

Ter voorbereiding van verbeteringswerken in bovengenoemde bochten is in de jaren zeventig al veel onderzoek uitgevoerd naar zogenaamde tracé-oplossingen (bochtafsnijdingen) en naar de effecten van deze werken op de afvoerverdeling bij het splitsingspunt de Pannerdens Kop, waar de Boven-Rijn zich splitst in de Waal en het Pannerdens Kanaal.

Vanwege de aantasting van natuur- en landschapswaarden door de destijds geplande doorsnijding van de Ooypolder en de tegen het eind van de jaren zeventig toenemende budgettaire proble-

2. Verbetering vaarbreedte.





men van de overheid werd er vóór 1983 echter geen plan gerealiseerd. In dat jaar werd de middenpijler van de spoorbrug over de Waal in de bocht bij Nijmegen verwijderd en werd aldus de (vaar)weg vrij gemaakt voor een grootscheepse bochtverbetering die het op dat moment grootste knelpunt (de 'bocht Nijmegen') op het traject Rotterdam-Ruhrgebied zou elimineren. In juni van het vorige jaar is dit verbeteringswerk gereedgekomen en werd daarmee het tot dan toe grootste nautische knelpunt op de Waal opgeheven. Rijkswaterstaat koos bij Nijmegen een 'zomerbed'-oplossing: er werd geen bocht afgesneden. Het werk bestond kort gezegd uit het ophogen van de diepe buitenbocht met zand en grind dat met stortsteen werd afgedekt (figuur 2). Door de opgehoogde en (vooral) verruwde bodem in de buitenbocht wordt het water meer naar de ondiepe binnenbocht gedwongen, waar door uitschuring blijvend meer vaardiepte wordt gecreëerd. Op deze wijze is bereikt dat de vaarbaanbreedte vooral tijdens de lage waterstanden fors is vergroot (zie ook tabel 1). De vergroting bedraagt 30 tot 60 meter (afhankelijk van de waterstand). De maat van de beoogde vergroting in de nog te verbeteren bochten Haalderen, Erlecom en Hulhuizen is ongeveer dezelfde.

Uitgangspunten

Bij het in 1988 aangevangen hernieuwde onderzoek naar verbetering van de Waalbochten, gelden de volgende nautische uitgangspunten:
de vaarweg moet geschikt worden gemaakt voor driestrooksverkeer met vierbaksduwstellen bij een vaardiepte van 2,5 m onder OLR (Overeengekomen Lage Rivierstand, overeenkomend met circa 8 meter + NAP bij Lobith) met een minimale breedte van de vaargeul van 150 m. De vaarwegverbeteringen moeten dusdanig effectief zijn dat ook bij (in overeenstemming met de vaarbaanverbreding) verruimde toelatingsgrenzen voor de zesbaksduwvaart het huidige veiligheidsniveau bij 9,50 m minstens blijft gehandhaafd. Hiervoor is

Study Results and Stock-Taking of Interests

Waal Bend Improvements Finally in Sight

Amsterdam CIVIELE TECHNIEK in Dutch Feb 90 pp 14-19

[Article by H. Havinga of the Gelderland Division of the Department of Public Works]

For years now, there has been a desire to improve the navigational situation in the bends of the Waal River between Nijmegen and the Pannerdense Kop (see Figure 1). Recently, this desire has gained new impetus through the designation of the Waal as a so-called primary transportation axis in the (Second) Structural Plan for Traffic and Transportation (2nd SVV), a joint product of the Ministries of Transport & Public Works and of Housing, Physical Planning & Environment. In this report, an expansion of the options for push navigation with six-barge units is also advocated. The 2nd SVV is an elaboration of the fourth Physical Planning Report, which states, inter alia, that for economic reasons it is desirable to make optimal use of the waterway link between Rotterdam and the German hinterland. However, the arguments for better utilization of the Waal are not merely economic in nature. An improvement of the navigational situation in the tortuous route between Nijmegen and the German border is also desirable first and foremost for safety reasons and (in the long run) for the environment: Transportation by water is better for the environment and safer than road transportation.

Improvement in this sense means that there should be an adequate channel width and navigation depth for safe and expedient pursuit of shipping on the Waal. The bends between Nijmegen and the Pannerdense Kop, known as "Haalderen, Erlecom (or the Zandberg), and Hulhuizen," constitute a bottleneck in this regard.

Previous Plans and Recent Improvements

In preparation for improvement projects in the aforementioned bends, a great deal of research was conducted during the 1970s into so-called line solutions (bend truncations) and into the effect of these projects on the discharge distribution at the Pannerdense Kop branching point, where the Upper Rhine splits into the Waal and the Pannerdense Canal.

Because of the effects on natural and landscape interests by the then-planned bisection of the Ooy Polder and the increasing governmental budgetary problems around the end of the 1970s, however, no plan was implemented prior to 1983. During that year, the middle pillar of the railroad bridge over the Waal in the bend at Nijmegen was removed, thus clearing the way for a large-scale bend improvement, intended to eliminate the biggest bottleneck at that point (the "Nijmegen bend") on the route between Rotterdam and the Ruhr area. In June of last year, this improvement project was completed, meaning that the biggest navigational bottleneck on the Waal up to that time was eliminated. The Department of Public Works opted for a "summer bed" solution at Nijmegen: The bend was not truncated. Basically, the project consisted of aggrading the deep concave side of the bend with sand and gravel topped with rubble (Figure 2). Because of the aggraded and (especially) roughened bed in the concave side of the bend, the water is forced more towards the shallow convex side,

where greater navigation depth is continually created through erosion. In this way, it was possible to significantly increase the channel width, especially during low water levels (see also Table 1). The increase amounts to between 30 and 60 meters (depending on the water level). The amount of the projected increase in the Haalderen, Erlecom, and Hulhuizen bends, which have yet to be improved, is approximately the same.

Basic Premises

The following basic navigational premises apply to the renewed research begun in 1988 into improvements in the Waal bends:

The channel must be made suitable for three-lane traffic with four-barge push points at a navigation depth of 2.5 m under OLR (agreed low river level, corresponding to approximately 8 meters + Amsterdam mean sea level at Lobith), with a minimum channel width of 150 m. The channel improvements must be so effective that the current safety level at 9.50 m is at least maintained, even with the expanded (in keeping with the channel widening) tolerance limits for push navigation with six-barge units. To this end, it is necessary that three-lane traffic be guaranteed for push navigation with six-barge units as well over as long a route length as possible. For channel improvements in bends, the noted 150 m is not critical. Here, the available channel width must be based on the required channel width for a given arc radius (for push points), whereby one may not yet assume the presence of enlarged head rudders on the front push barges.

In preparing for these bend improvements, the only measures to be considered are those that leave the natural and landscape interests as intact as possible, as was the case in preparing for the "Nijmegen." This means that only solutions in the summer bed are considered. At the time when the decision on implementing the Nijmegen bend improvement was made, however, most "summer bed" measures had not yet been researched enough to responsibly include them in considerations.

Possible Measures

Realizing a widening of the navigation channel exclusively in the summer bed requires drastic intervention in the transverse profile. In so doing, it must be remembered that the Waal is a so-called alluvial river, meaning a river that flows in its own transported sediment. One property of alluvial rivers is that by way of erosion and sand buildup they create a transverse and longitudinal profile that is ideal for the discharge of water and sediment, but that can be anything but ideal for shipping, for example. Using erosion-resistant structures (groins, bank revetments, and so on), however, the spatial development of the summer bed can be "guided" within certain limits.

In principle, the following measures are conceivable for navigation channel widening in a bend: aggrading the concave side of the bend ("Nijmegen" method), positioning bed groins on the concave side, positioning bed screens on the concave side, regularly dredging the sand bank on the convex side (Figure 3).

Of these methods, "aggrading" is currently the best-known; the initial results from "Nijmegen" inspire confidence in the practical use of this method. Bed

groins are also expected to yield good results, but due to the lack of practical experience there is still some uncertainty about the effectiveness of this method in practice. Only a test in a Waal bend and the application of two-dimensional morphological models can eliminate this uncertainty. According to tests with models, the solution with bed screens in the concave bend also works well. However, the only practical experience available with this method is in an (American) stream. Consequently, larger-scale application requires first a test in a Waal bend and in a morphological model. For practical reasons, this solution can probably be rejected: screens are like "knives" to shipping concerns. The screens must be very slender (sheet piling) in order to produce the desired "wing effect" and moreover must be positioned with great precision. In principle, widening the navigation channel by dredging the convex bank is also a reasonable solution, but over the course of time the work in turn will be negated by the river itself. Thus, the dredging must be continually repeated.

Study Results

During and after the implementation of the project in the "Nijmegen" bend, a number of the "summer bed" measures were further researched in the laboratory. This (symptomatic) study was prompted first and foremost by the idea that applying bed groins to the concave side of the bend could represent a good and relatively cheap solution, as an alternative to aggrading the concave bank. Over the course of the study, further attention was given to bed screens.

Four beneficial effects were credited to bed groins in the concave side of river bends:

- Discouragement of spiral flow (spiral flow is understood to be the helical propulsion of water in river bends, whereby the water particles near the bottom are propelled towards the convex bank and the water particles near the surface are propelled towards the concave bank), which is an important factor in the formation of shoals along the convex bank;

- The transport of bed sediment towards the concave bank, whereby the local sediment load of the convex side of the bend is reduced;

- Reduction in the size of the hydraulic transverse profile in the concave side of the bend, whereby the flow rates along the convex bank will increase, comparable to the phenomena when the concave bank is aggraded;

- An increase in roughness in the concave side of the bend, whereby more water is sent through the relatively less rough (smoother) convex side, where it provides for greater erosion (also comparable to aggrading).

An optimal balance between the effects of bed groins and practical realization was found to be present if the bed groins are spaced at intervals of approximately 70 meters, center to center (Waal situation). In addition, they must have a bearing of approximately 70 degrees with respect to the river axis in an upstream direction, together with a particularly steep incline downstream (approx. 1:1.5). The length of the bed groins is approximately 200 meters. Conversely, the bed screens are oriented towards the convex bank at an angle of only 15 degrees to the main stream. They are grouped in the concave portion parallel to each other in small groups of four to five and are

approximately 25 meters in length (Figure 4).

The laboratory research yielded the following results with respect to aggrading, bed groins, and bed screens:

• The model tests showed (again) that aggrading the concave bank provides a major widening of the navigation channel. This is also confirmed by the first evaluation of the test with aggrading in the Nijmegen bend. However, longer-term tests of the results of the improvement of the Nijmegen bend are needed in order to be absolutely certain of the ongoing effectiveness of a fixed layer positioned on an aggraded concave bed. The time-dependent development of the roughness of the fixed layer (will sand be deposited between the stones?) plays an important role here.

• According to the model tests, bed groins provide less of a widening effect than aggrading the concave bank. During these model tests, however, roughness resulting from substantial dunes unexpectedly played an important role. This made interpretation more difficult and did not do full justice to the effect of bed groins. Still, a minimum effectiveness of bed groins can be derived from the tests. Only a test in a Waal bend and the application of two-dimensional morphological models can eliminate this uncertainty.

• According to the model tests, the solution of positioning bed screens in the concave side of the bend works nearly as good as aggrading the concave bank by applying a fixed layer. However, full justice was not done to the effect of bed screens in the scale model either, for the above reasons. Practical experience with this method is available only in an (American) stream. Consequently, larger-scale application requires first a test in a Waal bend and in a morphological model.

• During the model study conducted, it turned out that the physical model could not reflect all relevant aspects that play a role in a thorough consideration of alternative measures. Thus, it is necessary that tests be conducted with bed groins and/or bed screens in practice, in order to gain greater certainty concerning this measures. The greatest uncertainty relates to the applicability of bed screens in conjunction with the precision requirements established for orientation and navigational aspects. This is why a prototype test with bed groins was first chosen. This solution is attractive if these groins can be cheaply executed, in the form of what could be called "sand elements": sand packed into sacks or bags made of geo-textiles (synthetics).

In the aforementioned study, the knowledge gained in the past within the framework of the so-called Public Works Applied Research (TOW)-Rivers was very helpful. In TOW-Rivers, employees of the Department of Public Works, the Technical University of Delft, and the Hydrodynamics Laboratory worked together in the area of bedding forms (on the sandy river bed), spiral flow in bends, and sediment transport.

Stock-Taking of Interests

As indicated above, preparations for this type of project involve not only the navigational effects of the projects, but must also take into account the effects on other interests. This is necessary so that all interests can be

The bed groins are positioned horizontally. First, the bottom or river bed is dredged even across the entire length of the bend improvement. Part of the dredged sand, amounting to 400,000 cubic meters, is transported to a dike reinforcement project in Herwen/Aerdt. This accounts for 210,000 cubic meters. The remainder is redeposited between the positioned groins.

A groin element consists of a bag made of synthetic fabric measuring 25 m in length and 1.2 m in diameter, filled with sand. The synthetic fabric is manufactured from threads of polypropene with a weight of 430 grams/square meter. The warp and weft are both 215 grams/square meter. The average tensile strength is 80 kN/m, and for sand density a value O 90 of 170 microns is required. The bags have two fill openings and are ready-manufactured at the factory.

The empty bags are laid in a sort of mold, the dredge shuttle, and then filled with sand. The sand-water pump is a Toyo pump that hangs on the river bottom. There, the pump sucks in the sand-water mixture and fills the bags. The mixture enters the element through the fill opening and inflates it. The sand remains in the element, and excess water is discharged via the other fill opening.

Positioning

Once the element is 90 percent full, it can be positioned. The bags have an effective height of 0.8 m and a width of 1.5 m. An electronic distance-measuring unit, the Nikon DTM 5, is used for positioning. With this instrument, the distances are measured in terms of length and width with respect to fixed points. First, the guide pontoon, the Moby Dick, is maneuvered into a good position in keeping with a predetermined placement plan. Then, the shuttle is moved in, and once its position is good, the shuttle is lowered to the bottom. With davits and winches, the shuttle can be lowered to above the spot where the element is to be positioned. The combined weight of the shuttle and element is 80 metric tons.

The tilt cords that are attached eccentrically to the shuttle, are drawn taut, and the hoisting cord is lowered. Through this action, the shuttle tips a meter and the element falls into place. The elements are positioned in a stretching bond on top of one another, so that seams in the axis direction of the river are avoided.

A number of navigation floats are positioned for the safety of the guide pontoon, which is moored diagonally in midstream. In the bend at Erlecom, there is a ban on anchoring, and ships must sail along the good bank. While laying the elements in the middle of the channel, the activities are accompanied by the navigation service. This means that ships sailing upstream and downstream are able to pass the guide pontoon safely.

considered carefully during the decision-making stage (1991). In the area of bend improvements, this means primarily river-science, landscape-related, navigational, and economic interests.

As far as river science is concerned, the points of interest are the resistance of the bed (to the discharging water) and the morphological effects. Installing a (rough) fixed layer or bed groin causes an increase in the resistance to discharge, through which the water level directly upstream will rise (order of magnitude: decimeters). Because of the dam-bowing effect, there will also be a discernible rise in the water level at the Pannerdense Kop branching point, which means that the discharge distribution will change: the Waal will get less water and the Pannerdense Canal will get more. Thus, without additional measures the adverse tendency of the last decade will be reinforced. This is unacceptable, given the current problems with higher water levels along the IJssel during the summer high waters. Consequently, a great deal of attention in the study will be devoted to compensating measures.

Bed screens do not provide in any extra resistance for the water in the longitudinal direction of the river, and thus do not cause any change in the water level.

The periodic dredging of a large quantity of sediment causes a local increase in the transverse profile and thus a lowering of the water level, because of which the water levels upstream will fall to a slight degree. This does significantly interfere with sand transport: Drops in the bed directly downstream from the bend will result. In principle, the drop in the bed can be counteracted by reintroducing the dredged sand to the river downstream (sand suppletion). However, there is not enough known about the factors that play a role here: Sand beds could multiply downstream, sandbars, etc. Thus, these factors must be studied as well.

The methods discussed have no inherently detrimental effects on the landscape and on nature. Only complementary activities, such as enlarging the arc radius, could interfere with the environment on the shore. The "environmental impact" of this must be taken into consideration.

Structures on the river bed could have effects on navigation. The current pattern changes, which could make it harder to steer the ships. Structures in the summer bed imply a ban on dropping anchor. From a nautical standpoint it is certainly undesirable, but in practice such problems are not that serious.

The channel improvements are motivated by safety and economic considerations. The benefits of the channel improvement lie primarily in the raising of the level of safety for shipping and in not exacerbating safety with increased opportunities for push navigation with six-barge units (even with lower water levels).

The economic benefits are defined by: an increase in the opportunities for overall shipping, a shortening of the travel time between Nijmegen and Lobith, and an increase in the opportunities for push navigation with six-barge units. In addition, the port of Rotterdam becomes more attractive due to the presence of a wet transport axis without major bottlenecks. It is precisely in this light that the economic benefits of channel improvements must be regarded, as

explained in the 2nd SVV: "The Waal primary transportation axis must be freed of bottlenecks." An indication of the economic advantages is evident when one considers that:

• By widening the bends in question, these bends are no longer the decision factor in determining the loading depth of ships. Thus, this means that ships can be loaded deeper on the average. An increase in the loading depth of ten centimeters means an annual cost advantage for the overall shipping industry of 5 to 10 million guilders;

• The travel time between Rotterdam and the hinterland is expected to be shortened by several minutes, which means an advantage for shipping amounting to several million guilders per year;

• A great deal of research has been done recently into the specific benefits for push navigation with six-barge units; in the evaluation report for the 1986 test year, the benefits of push navigation with six-barge units were estimated at between 1.5 and 11 million guilders on an annual basis, depending on factors such as fuel prices, acceptance limits, and the application of the push navigation fleet. On the basis of experience gained thus far, it can be stated that the benefits of improved Waal bends for push navigation with six-barge units alone will amount to between five and ten million guilders a year.

The costs of the various solutions are estimated at between 30 and 80 million guilders. Without further research into the feasibility of the noted measures, it is not possible to give a more precise figure. The alternative of bend truncation is not regarded as a serious alternative, in part due to the high costs (approximately 110 million, not including reequipping the truncated arms.

Plan of Approach

During the first six months of this year, a plan was drawn up in conjunction with the Hydrodynamics Laboratory for the overall study into the effects (on channel width and discharge distribution) and consequences (for nature and shipping) of conceivable solutions for increasing the channel width in the Haalderen, Erlecom, and Hulhuizen bends. In any event, a bed groin test in the Erlecom bend is an element of this study. In this bend, another ten bed groins are being installed this year in various configurations, the findings of which will be "put through the mill" (Figure 5).

It is estimated that the execution and interpretation of the bed groin test will take approximately 1.5 to 2 years. This is also approximately the amount of time required for a thorough analysis of the effects and consequences of all bend improvements between Nijmegen and Pannerdense Kop. All things considered, it is thus assumed that a decision can be made in the summer of 1991 on the method with which the Waal bends in this section can be improved.

Because of the desire to quickly free the Waal, as a primary transportation axis, from bottlenecks, an effort has been made in the formulation of the study to permit the beginning of work in 1991/1992.

In view of the above, the following broad elements are discernible:

• Conduct of test with bed groins in the Erlecom bend in order to gain missing information (1989). Consideration of the desirability of a dredging test and a test with bed screens.

• Conduct of mathematical model study in order to take stock of effects of various solutions on channel width and discharge distribution. In addition, a model study is used to look into the effectiveness of potentially necessary compensation measures. Research institutions (including the Hydrodynamics Laboratory) will be involved in this part of the study. In the course of the study, the missing information on the effectiveness and the roughness of the "aggrading" and "bed groins" methods will be made available.

• The necessary preparations will be made in the plan-study domain, so that the specifications can be written quickly in the end phase.

• In 1991, the decision can then be made between the various solutions.

Because of the innovative aspects of the research, definitive scheduling cannot yet be carried out. For the time being, a plan similar to that in Table 2 is being applied.

Literature

1. "Effect of Bed Groins in Channel Widening in River Bends," report of detailed study (fixed bed), study Q98, Hydrodynamics Laboratory, July 1987.

2. "Effect of Bed Groins in Channel Widening in River Bends," report of symptomatic study (effect of bed groins, screens, and a fixed layer in a curved groove with movable bottom), study Q98, Hydrodynamics Laboratory, September 1987.

3. "Waal Bends Project Plan," Department of Public Works, Gelderland Division, April 1989, H. Havinga.

4. "Final Report on the Push Navigation with Six-barge Units Test Period," Ministry of Transport & Public Works, The Hague, 22 April 1987.

5. "Nijmegen Waal Bend," reports pertaining to study M 1278, Hydrodynamics Laboratory, period 1981-1986.

6. "Second Structural Plan for Traffic and Transportation," Ministry of Transport & Public Works, 1988.

(1) Weir--(2) Lower Rhine--(3) Amsterdam-Rhine Canal--(4) Pannerdense Canal--(5) North Brabant

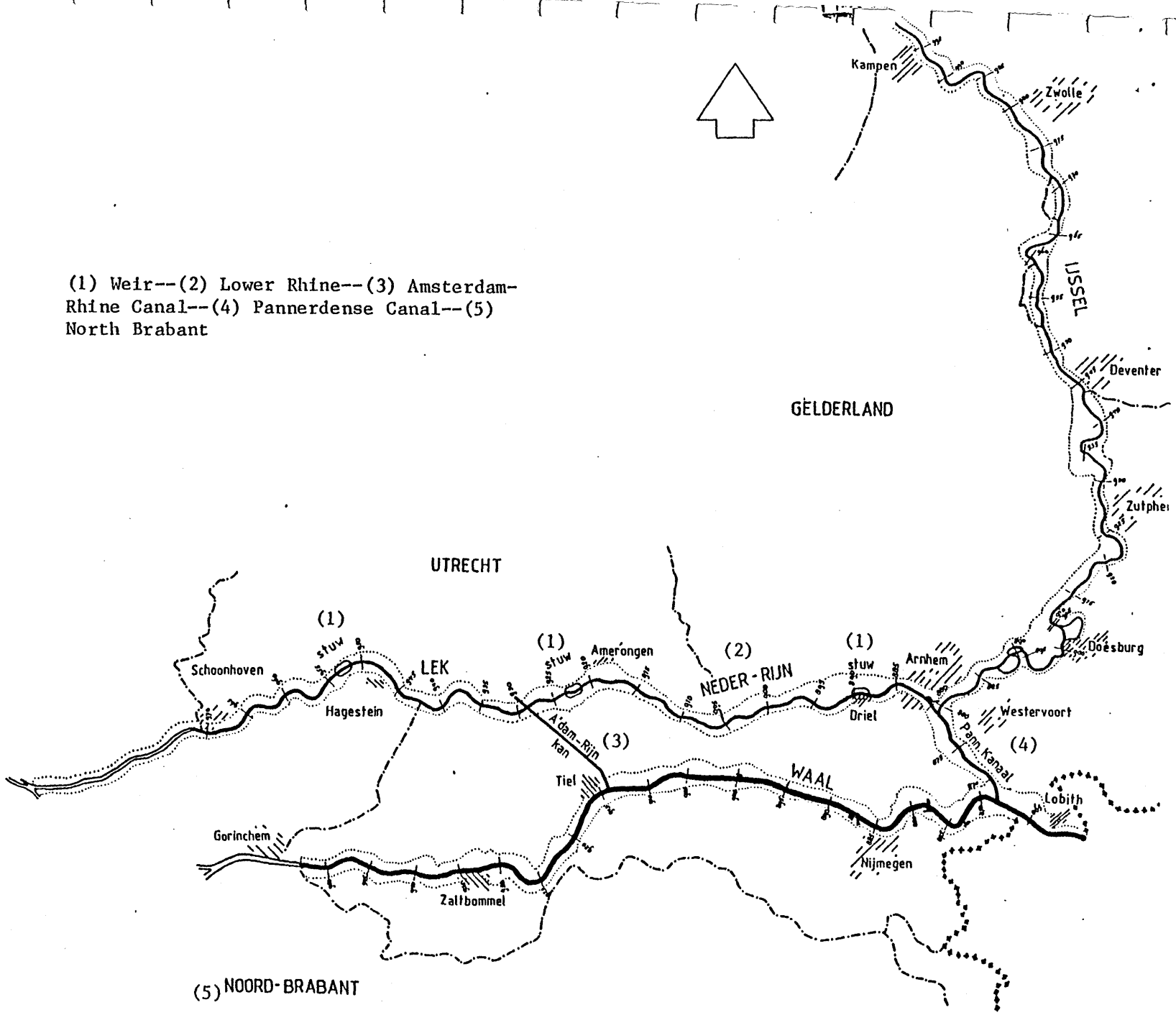
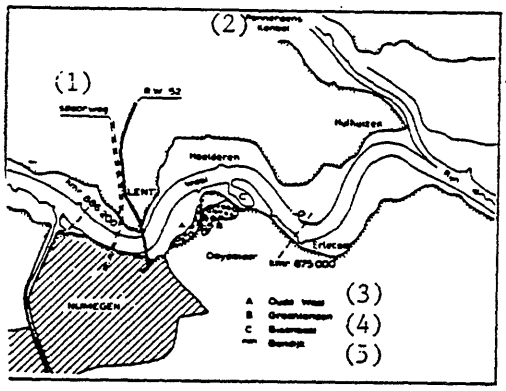
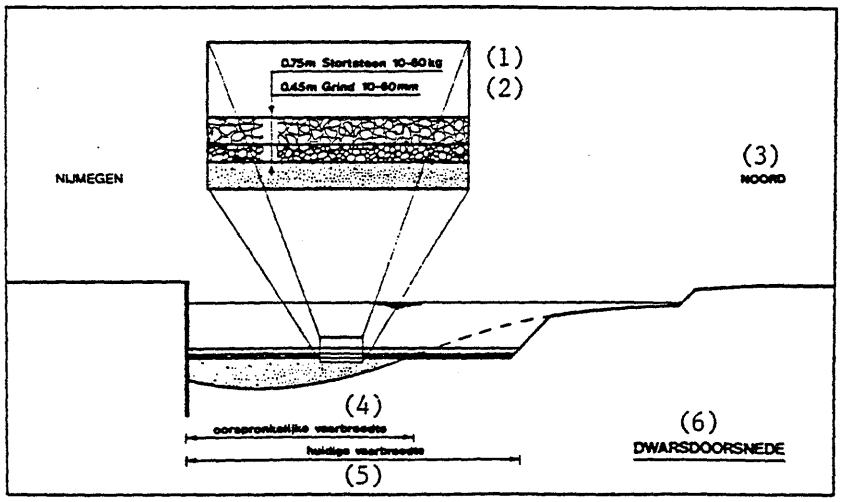


Figure 1. The Waal at Nijmegen



(1) Railroad--(2) Pannerdense Canal--(3) Old Waal--(4) Green lands--(5) Bison Cove

Figure 2. Improvement of Channel Width



(1) Rubble--(2) Gravel--(3) North--(4) Original channel width--(5) Current channel width--(6) Transverse section

Table 1. Present and Required Channel Width

Aanwezige breedte vóór verruiming waterstand bij Lobith t.o.v. NAP (1)				vereiste breedte (2)			bereikbare breedte bij w.s. Lobith t.o.v. NAP (3)		
				(4) 2str	(5) 3str	(6) 3str			
	8 m	8,75 m	10 m	6-b	4-b	6-b	8 m	8,75 m	10 m
St. Andries	150	170	200	155	160	185	180	190	210
Nijmegen	110	130	170	155	160	185	160	170	200
Haalderen	140	150	180	150	170	195	180	195	200
Erlecom	140	145	180	155	160	190	180	195	200
Hulhuizen	140	150	180	155	175	195	180	195	200

(1) Present width before widening, water level at Lobith relative to Amsterdam mean sea level--(2) Required width--(3) Achievable width at Lobith water level relative to Amsterdam mean sea level--(4) 2-lane 6-barge--(5) 3-lane 4-barge--(6) 3-lane 6-barge

Table 2. Provisional Planning Schedule

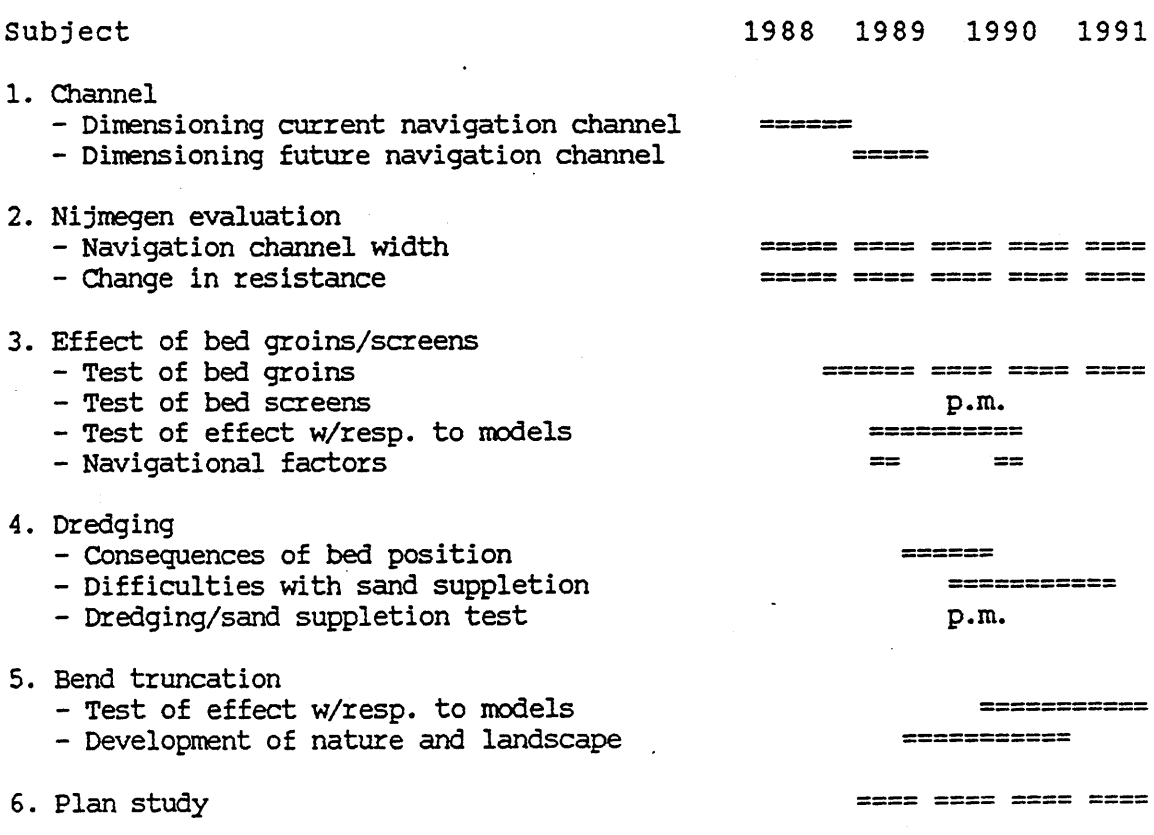
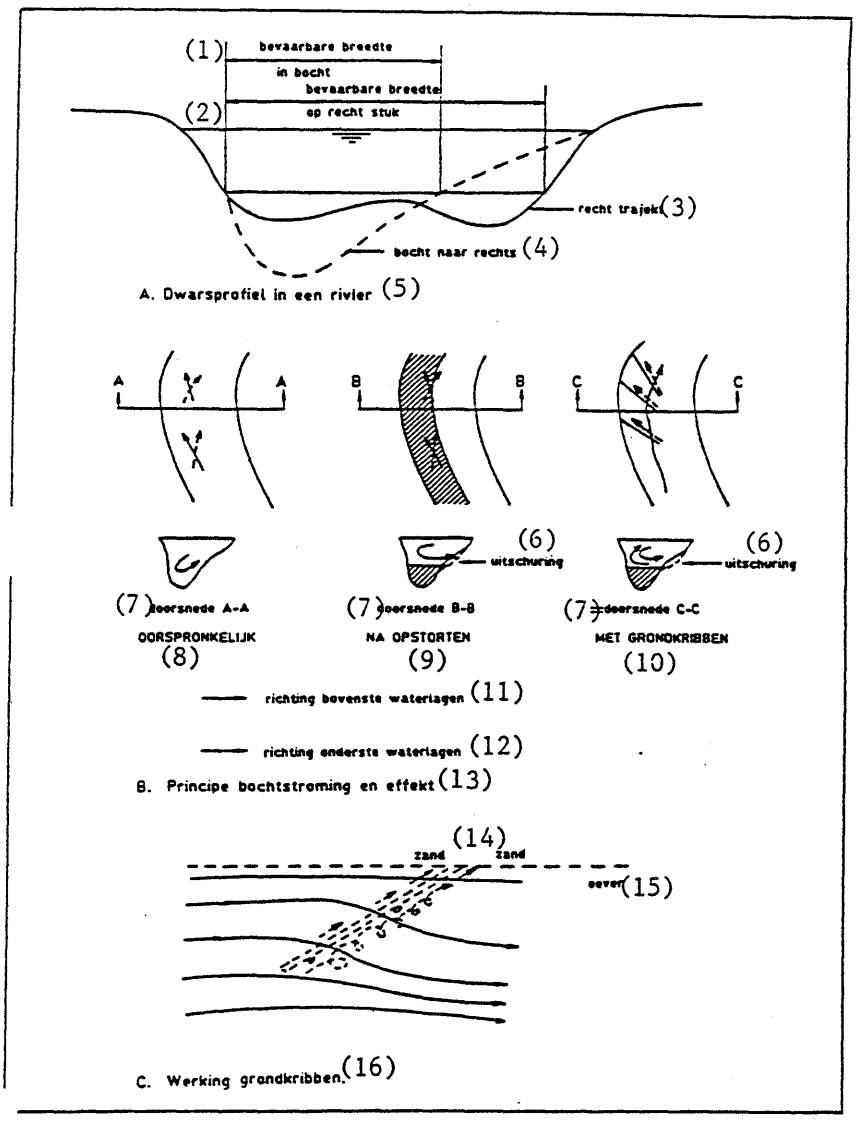
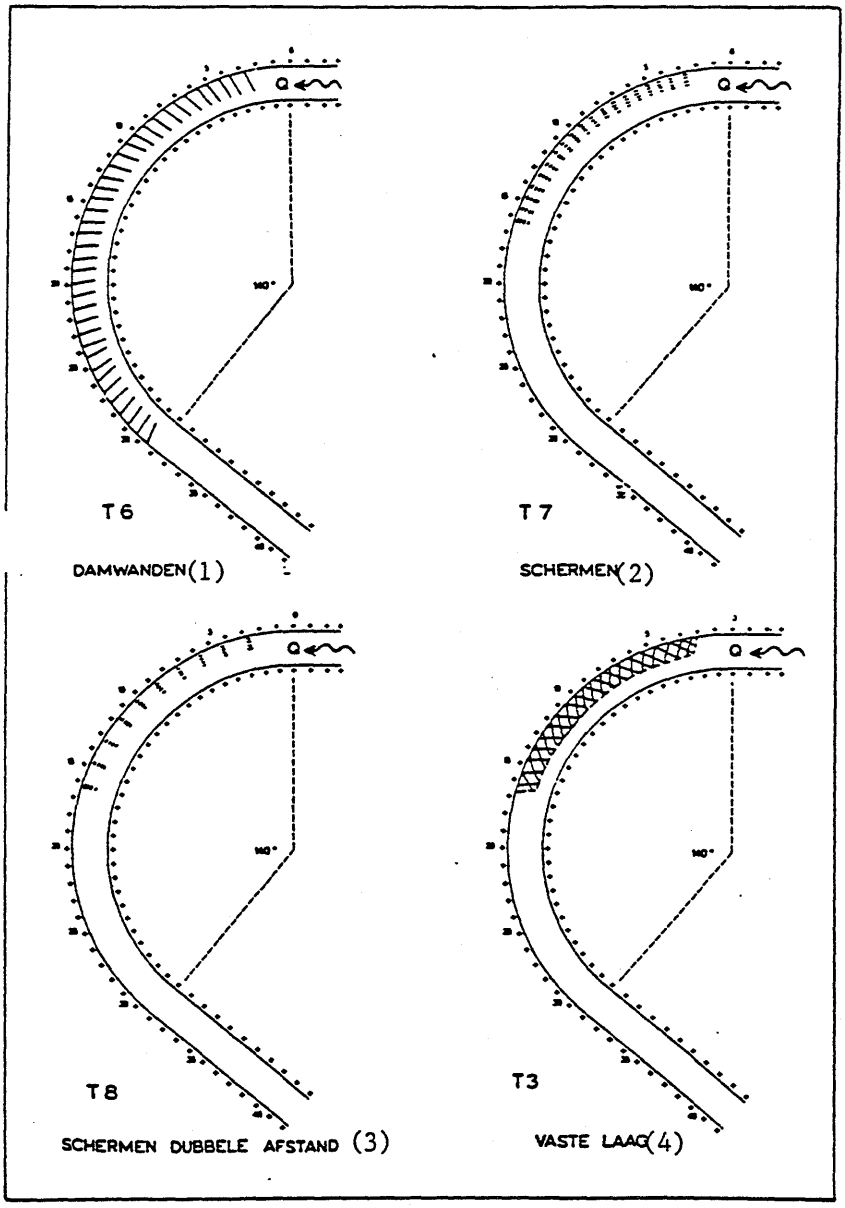


Figure 3. Various Possibilities for Channel Improvement



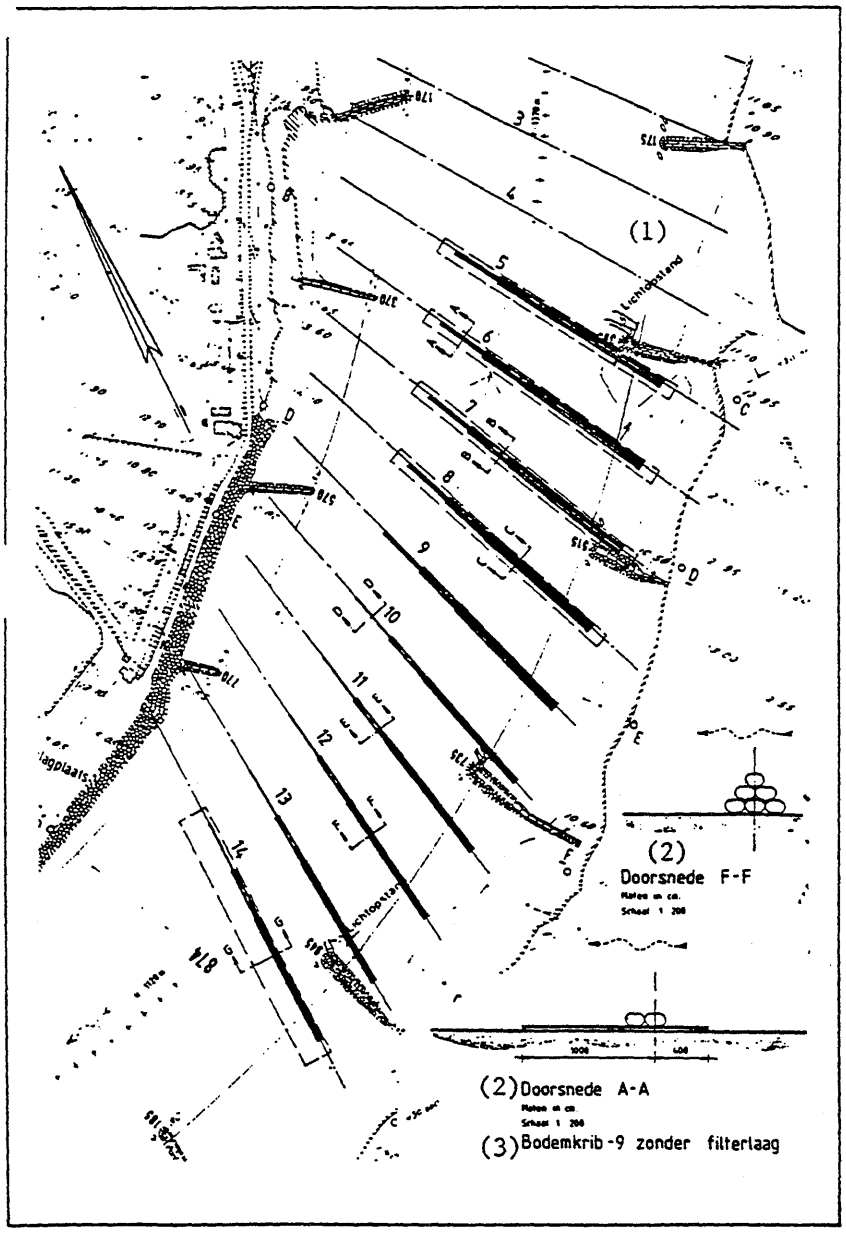
(1) Navigable width in bend--(2) Navigable width on right side--(3) Right section--(4) Bend to the right--(5) Transverse profile in a river--(6) Erosion--(7) Cross-section--(8) Original--(9) After aggrading--(10) With bed groins--(11) Direction of top water layers--(12) Direction of bottom water layers--(13) Principle of bend flow in effect--(14) Sand--(15) Bank--(16) Effect of bed groins

Figure 4. Positions of Bed Groins



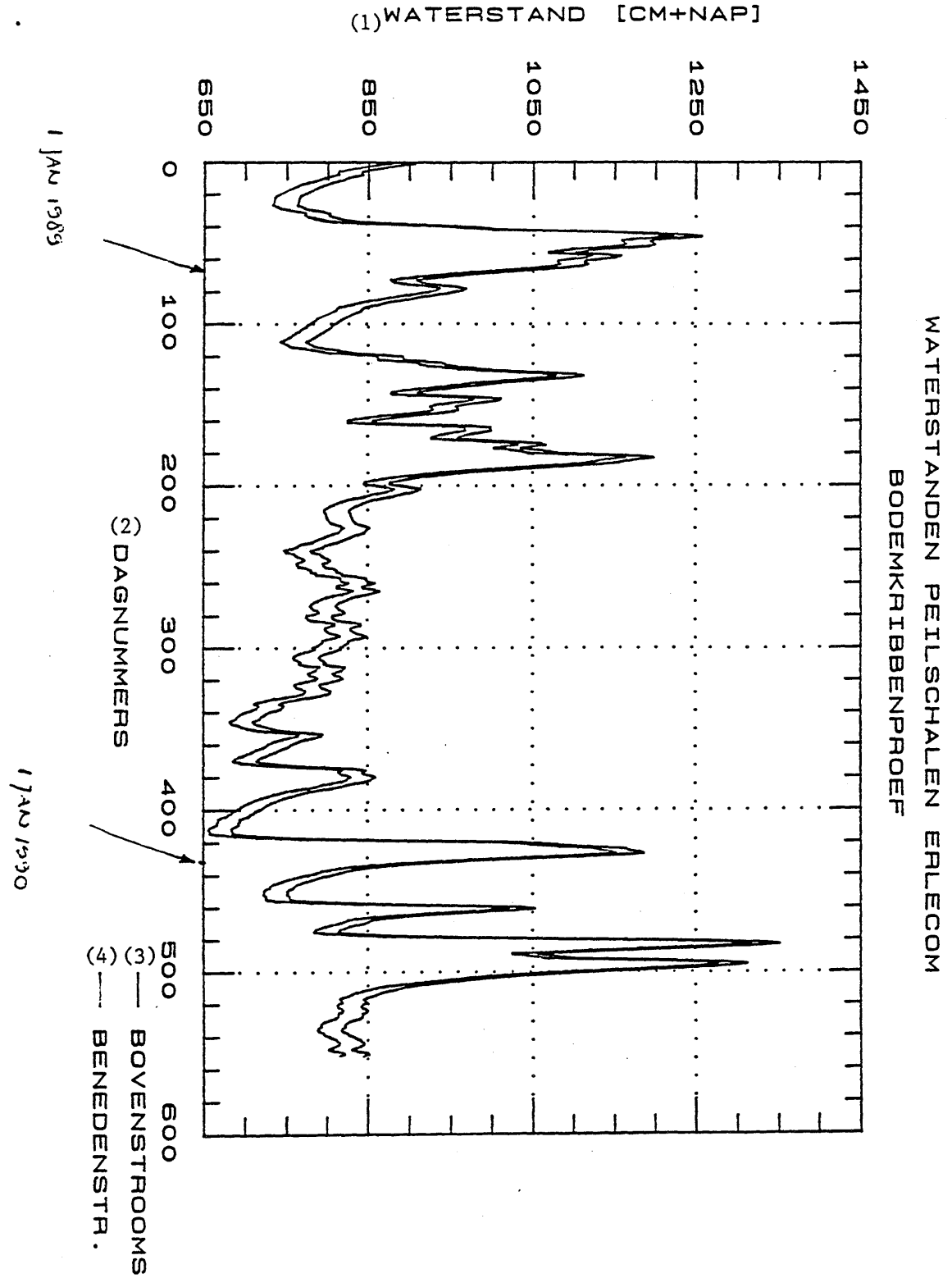
(1) Sheet piling--(2) Screens--(3) Screens double-spaced--(4) Fixed layer

Figure 5. Plan of Approach



(1) Light elevation--(2) Cross-section; dimensions in cm; scale 1:200--(3) Bed groin 9 without filter layer

Erlecom Water-Level Gauges, Bed Groin Test



(1) Water level (cm + Amsterdam mean sea level)--(2) Daily numbers--(3) Upstream--(4) Downstream

RWS voert proefproject uit met zandelementen op Waalbodem

Zandworsten als bodemkribben zijn alternatief voor steen

Rijkswaterstaat is bezig met het verbeteren van de nautische situatie op de Waal. In het algemeen zijn dat dure projecten door het gebruik van vele tonnen stortsteen. Een proef met zandelementen in de bocht bij Erlecom moet uitwijzen of deze een alternatief vormen voor het gebruik van breuksteen.

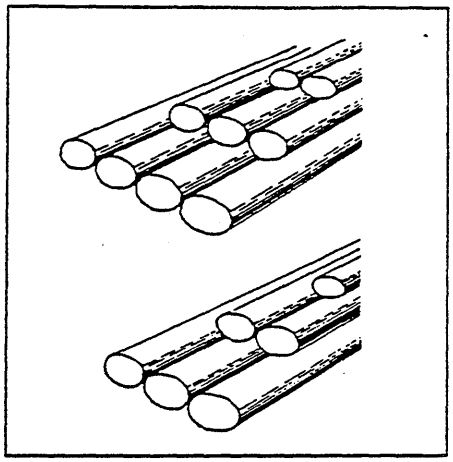
J.H. Derks, RWS directie Gelderland
Ir. H. Havinga, RWS directie Gelderland

Al jarenlang wil Rijkswaterstaat de nautische situatie verbeteren in de Waalbochten tussen Nijmegen en de Pannerdense Kop. De bochten bij Laalderen, Erlecom en Hulhuizen vormen een knelpunt. In de smalste gedeelten is er niet voldoende vaarbaanbreedte aanwezig voor een veilige en vlotte afwikkeling van de scheepvaart op de Waal. Bij de voorbereiding voor verbetering van die bochten worden alleen oplossingen beschouwd, die de natuur- en landschapswaarden zo goed mogelijk intact laten. Dat was ook het geval voor de bochtverbetering bij Nijmegen. Dit betekent dat uitsluitend oplossingen in het zomerbed overblijven. Toen de beslissing werd genomen over de uitvoering van de bochtverbetering bij Nijmegen, waren de meeste zomerbed alternatieven nog niet ver genoeg onderzocht. Tijdens en na uitvoering van *Nijmegen* zijn in het laboratorium die alternatieven wel verder onderzocht. Daarbij kwam de oplossing met bodemkribben in de diepe buitenbocht op onderlinge afstanden van 70 m als veelbelovend naar voren.

Deze oplossing wordt aantrekkelijk als die kribben goedkoop kunnen worden uitgevoerd in de vorm van *zandelementen*. Die elementen bestaan uit met zand gevulde zakken of worsten gemaakt van geo-textiel. Tijdens het uitgevoerde modelonderzoek bleek dat in het model niet alle relevante aspecten konden worden bestudeerd. Daarom is een prototype proef in uitvoering in de bocht bij Erlecom. Daar worden elf bodemkribben, opgebouwd uit zandelementen, in verschillende uitvoeringen aangelegd en *aan de tand gevoeld*. Geschat wordt dat de uitvoering en interpretatie van de bodemmaart waren er 300 van de 500 elementen gelegd en de verwachting is dat de uitvoering van het werk begin mei voltooid zal zijn.

Constructie

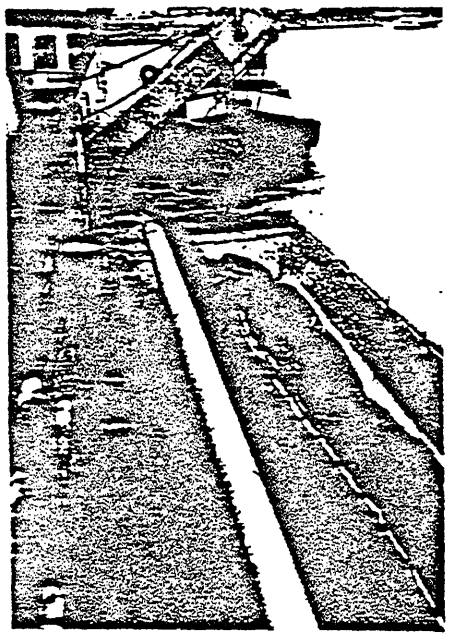
De elf bodemkribben liggen onder een hoek van 22° ten opzichte van de as van de rivier en bestaan uit elementen van kunststofweefsel die zijn gevuld met zand. Een vijftal kribben zijn voorzien van een filterlaag onder de elementen. Er is een verschil in opbouw van de kribben. De eerste vijf kribben hebben een onderlaag van vier elementen, met daarop een tweede laag van drie elementen en een bovenste laag van twee elementen naast elkaar. De andere zes kribben kennen een onderlaag van drie elementen met daarop een laag van twee stuks. De top daarvan bestaat uit één element.



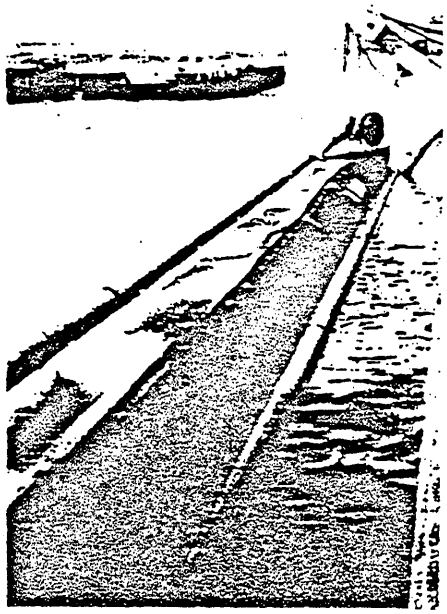
De bodemkribben worden piramidevormig aangelegd.

De bodemkribben worden horizontaal aangelegd. Vooraf wordt de bodem of rivierbedding vlak gebaggerd over de hele lengte van de bochtverbetering. Het opgebaggerde zand, 400.000 m³, wordt ten

De worst van geotextiel wordt leeg in de specie-shuttle gelegd en dan gevuld met zand.



Het zand blijft in het element achter en blaast dat op. Als het element vol is wordt het dichtgemaakt.



Department of Public Works Conducts Test Project With Sand Elements on Waal Bed

Sandbags Are Alternative to Stone as Bed Groins

Amsterdam CIVIELE TECHNIEK in Dutch Feb 90 pp 84-85

[Article by G.H. Derks and H. Havinga of Gelderland Division of the Department of Public Works]

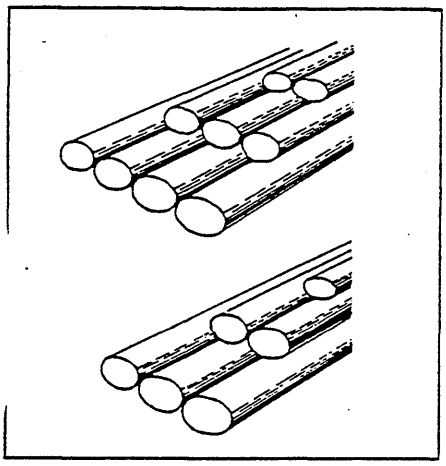
The Department of Public Works is working on improving the navigational situation on the Waal. In general, this involves costly projects, due to the use of many tons of rubble. A test with sand elements in the bend at Erlecom is intended to show whether they might be an alternative to using broken stone.

For years now, the Department of Public Works has wanted to improve the navigational situation in the bends in the Waal between Nijmegen and the Pannerdense Kop. The bends at Haalderen, Erlecom, and Hulhuizen constitute a bottleneck. At the narrowest sections, there is not an adequate channel width for safe and expedient shipping on the Waal. In preparing for improvements in the bends, the only solutions considered are those that leave the natural and landscape interests as intact as possible. This was also the case in the bend improvement at Nijmegen. This means that solutions in the summer bed are the only alternative. When the decision was made on implementing the bed improvement at Nijmegen, most summer bed alternatives had not yet been studied adequately. During and after execution of the Nijmegen project, however, these alternatives were further studied. In the process, the solution with bed groins in the deep concave side of the bend spaced at intervals of 70 m emerged as a promising possibility.

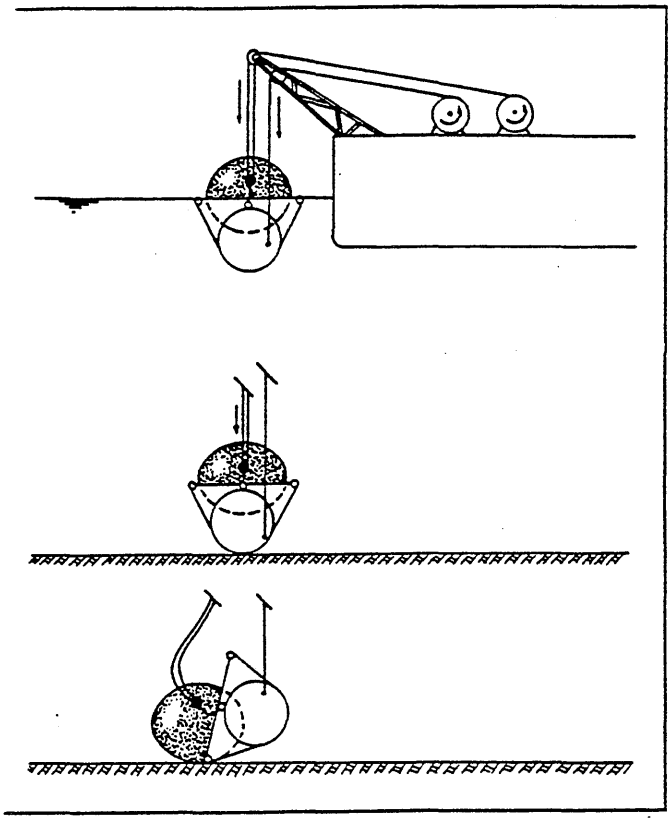
This solution becomes attractive if the groins can be executed cheaply in the form of sand elements. These elements consist of sacks filled with sand or bags made of geo-textiles. During the model study that was conducted, it was found that not all the relevant factors could be studied in the model. For this reason, a prototype test is under way in the bend at Erlecom. There, eleven bed groins, constructed from sand elements, are being positioned in various configurations and "put through the mill." It is estimated that the execution and interpretation of the bed groin test will take approximately one and a half to two years. In early March, 300 of the 500 elements were positioned, and it is expected that execution of the project will be completed by early May.

Design

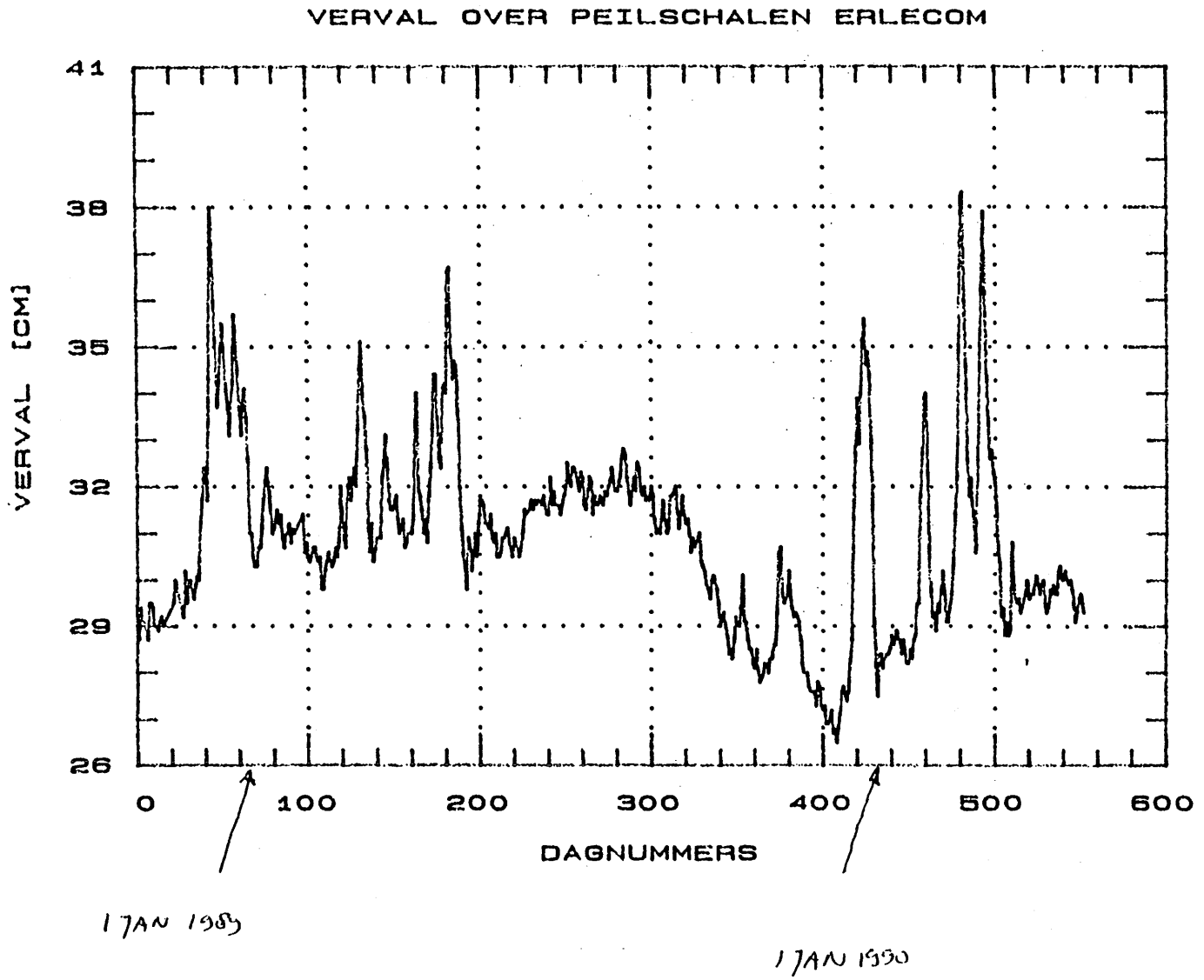
The eleven bed groins are positioned at an angle of 22° to the axis of the river, and consist of elements made of synthetic fabric filled with sand. Five of the groins have a filter layer under the elements. There is a difference in the construction of the groins. The first five groins have a bottom layer of four elements, covered by a second layer of three elements, and an upper layer of two elements side by side. The other six groins have a bottom layer of three elements covered by a layer of two elements. The top layer consists of one element.



The bed groins are positioned in pyramid formation.



The shuttle is lowered to the bottom. The tilt cords are drawn tight and the hoist cord lowered, so that the shuttle tilts and the element falls in place.


VERVAL OVER PEILSCHALEN ERLECOM
VERVAL [CM]
41
38
35
32
29
26
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100
200
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IX. Influence of the Point Bar on Flow through Curved Channels, with Introductory Comments.

WATER RESOURCES RESEARCH, VOL. 19, NO. 5, PAGES 1173–1192, OCTOBER 1983

Influence of the Point Bar on Flow Through Curved Channels

WILLIAM E. DIETRICH[1] AND J. DUNGAN SMITH

Department of Geological Sciences and Quaternary Research Center, Department of Geophysics, University of Washington

In a channel with bed topography that does not vary in the downstream direction, a secondary circulation composed of outward flow at the surface and inward flow near the bottom extends across the entire width. If the curvature is constant, the cross-stream velocity component near the bed and the pattern of boundary shear stress can be estimated by assuming fluid accelerations to be small. Unfortunately, this procedure cannot be used in analyzing the flow through natural river meanders, or through channels with downstream constant bottom topography but with rapidly changing curvature. In these latter cases, effects arising from bed- and bank-induced momentum changes must be accounted for. Evidence for a substantial topographically induced alteration in the cross-stream flow pattern relative to that for the analogous constant bottom topography case is provided through new analyses of several sets of laboratory and field data. Shoaling over the point bar in the upstream part of the bend is shown to force the high-velocity core of the flow toward the pool. This is accomplished by a convective acceleration–caused decrease in the cross-stream water surface slope and a resulting dominance of the vertically averaged centrifugal force. The primary effect is a velocity component toward the outside or concave bank throughout the flow depth over the upstream, shallow part of the point bar and an outward component of boundary shear stress in this region. The channel curvature–induced inward component of boundary shear stress consequently is confined to 20 or 30% of the channel width at the pool. Outward transfer of momentum over the point bar, as manifested by a rapid crossing of the high-velocity core from the inside bank to the outside one, contributes to an enhanced decrease in boundary shear stress along the convex side of the stream as the top of the bar is approached. Forces arising from topographically induced spatial accelerations are of the same order of magnitude as the downstream boundary shear stress and water surface slope force components, so they must be modeled as zero-order, not first- or second-order, effects.

INTRODUCTION

Natural river meanders generally have radii of curvature that vary continuously from infinity at upstream crossings to small values at the bend apices and then to infinity again in the downstream crossings. In association with this changing curvature the bed topography varies systematically. Crossings are of nearly uniform depth. In contrast, as the radius of curvature diminishes toward the bend apex, the depth decreases rapidly over a wide area from the convex bank toward the center of the channel, and it increases near the concave bank. At the bend apex the cross section is typically asymmetric, with a broad, shallow, nearly flat region extending well in from the inside bank toward the center of the channel. The zone of maximum depth is near the outside bank in this minimum radius of curvature region, and the maximum depth itself appears to vary inversely with radius of curvature to width ratio for different bends [*Leliavsky*, 1955; *Konditerova and Popov*, 1966]. Downstream of the radius of curvature minimum, the cross section remains asymmetric, but the pool tends to shoal, and the point bar top to deepen. The downstream end of the point bar top is often marked by a steep bed slope toward the channel thalweg. River meander bed morphology is documented in several laboratory and field studies [e.g., *Fredkin*, 1945; *Leopold and Wolman*, 1960; *Kondrat'yev*, 1968; *Bluck*, 1971; *Martvall and Nilsson*, 1972; *Hooke*, 1975], and asymmetry of channel cross sections in meanders is discussed by *Richards* [1982, pp. 178–179]. Downstream varying bed topography is an essential feature of natural river meanders, and it is the thesis of this paper that the spatial accelerations induced by these topographic changes are large in magnitude and strongly influence flow processes and, ultimately, the form of the bed topography itself.

It has long been recognized that channel curvature will induce a secondary circulation. Assumptions constraining how this secondary circulation varies in intensity with channel curvature and depth constitute an essential element of most models that seek to predict flow and bed topography in bends [*C. Yen*, 1970; *El-Khudairy*, 1970; *Allen*, 1970*a,b*; *Engelund*, 1974; *Gottlieb*, 1976; *Kikkawa et al.*, 1976; *Bridge*, 1977; *Zimmerman and Kennedy*, 1978; *Odgaard*, 1981]. In the past, such models typically have used a force balance argument that assumes equilibrium bed topography in bends is established when the outward forces acting on the particle, due mostly to the downslope component of its weight on the point bar face, are exactly balanced by the inward forces largely associated with the secondary circulation. We show here that shoaling over the point bar forces fluid outward, even near the streambed; therefore a more general closure scheme, such as provided by the equation for conservation of sediment mass, is required.

At present, the most commonly used model for flow and bed topography development in river meanders is that of *Engelund* [1974]. This author based his analysis on the force balance argument presented in the previous paragraph but attempted to account for the influences of spatial acceleration on the flow and of cross-stream sediment transport as secondary effects. The model was found to predict *Hooke*'s [1975] laboratory results quite well. It has also been used by *Bridge* [1977] and *Bridge and Jarvis* [1982] with general success in predicting major patterns of flow and bed topography in the South Esk river. Recently, *Ikeda et al.* [1981] and

[1] Now at Department of Geology and Geophysics, University of California, Berkeley.

Paper number 3W1080.
0397/83/003W-1080$05.00

Parker et al. [1982] have used the Engelund approach as part of their model to predict evolution of meander bends. In Engelund's formulation the forces arising from spatial accelerations in the flow are treated as if they were much smaller than the downstream boundary shear stress or pressure gradient forces (in other words, as if they were second order). We show here that both the laboratory data of C. Yen and B. C. Yen and data from our own field study yield downstream spatial acceleration terms that are of zero order. Also, we point out that Engelund has included only one of two equally important convective acceleration terms. To our knowledge these are the only experimental data sets that allow a quantitative investigation of the influence of channel curvature and bar-pool topography on flow processes in a river meander.

THEORETICAL FRAMEWORK

The equation of motion for a general fluid flow can be written as

$$\rho \frac{d\mathbf{u}}{dt} = -\nabla p + \nabla \cdot \bar{\tau} - \rho \mathbf{g} \tag{1}$$

Here $\mathbf{u}$ is the velocity vector; t and ρ represent time and density, respectively; p is pressure; $\bar{\tau}$ is the deviatoric (nonisotropic) stress; and g is the gravitational acceleration. In order to account for the effects of curvature, changes of curvature, and channel topography on the flow in river meanders, it is desirable to express (1) in a coordinate system that follows the channel path. *Smith and McLean* [1983] have used a right-handed, orthogonal, curvilinear coordinate system that follows the channel centerline for the purpose, and we shall do likewise. Their coordinate system consists of an s axis that points downstream parallel to the centerline, a nearly vertical z axis, and a cross-stream n axis that is positive toward the left bank. The scale factors for derivatives with respect to the cross-stream and vertical curvilinear coordinates are unity, but the one associated with the downstream coordinate is $1 - n/R = 1 - N$, where R is the local radius of curvature of the centerline. This scale factor compares an arc length measured along the channel centerline to that measured along any other line of constant n.

In order to examine the effects of channel geometry in river flow, Smith and McLean wrote (1) in this curvilinear coordinate system and then vertically averaged the resulting terms. Their downstream and cross-stream force balance equations are

$$(\tau_{zs})_b = -\frac{\rho g h}{(1-N)}\frac{\partial E}{\partial s} - \rho \frac{1}{1-N}\frac{\partial}{\partial s}\langle u_s^2\rangle h - \rho \frac{\partial}{\partial n}\langle u_s u_n\rangle h + 2\rho \frac{\langle u_s u_n\rangle h}{(1-N)R} \tag{2}$$

$$(\tau_{zn})_b = -\rho g h \frac{\partial E}{\partial n} - \rho \frac{\langle u_s^2\rangle h}{(1-N)R} - \rho \frac{1}{1-N}\frac{\partial}{\partial s}\langle u_s u_n\rangle h - \rho \frac{\partial}{\partial n}\langle u_n^2\rangle h + \rho \frac{\langle u_n^2\rangle h}{(1-N)R} \tag{3}$$

where $(\tau_{zs})_b$ and $(\tau_{zn})_b$ are the downstream and cross-stream components of boundary shear stress, h and E are the depth of flow and elevation of the water surface with respect to an arbitrary datum, and u_s and u_n are the downstream and cross-stream components of the velocity. The angle brackets indicate that the enclosed quantity has been vertically averaged. The first term on the right-hand side of (2) represents the downstream pressure gradient force; the next two express the change in momentum of the downstream flow in the downstream and cross-stream directions, respectively, and the last term represents the force associated with channel curvature. The cross-stream force balance, expressed by (3), indicates that the cross-stream boundary shear stress is equal to the sum of forces caused by the cross-stream pressure gradient, by the centrifugal acceleration of the flow (second and fifth terms on the right-hand side), and by the change in momentum in the cross-stream direction (third and fourth terms).

Smith and McLean showed that the vertically averaged continuity equation for steady flow is

$$\frac{1}{1-N}\frac{\partial \langle u_s\rangle h}{\partial s} - \frac{\langle u_n\rangle h}{(1-N)R} + \frac{\partial \langle u_n\rangle h}{\partial n} = 0 \tag{4}$$

and they solved it for $\langle u_n\rangle h$ to get

$$\langle u_n\rangle h = -\frac{1}{1-N}\int_{-w/2}^{n} \frac{\partial \langle u_s\rangle h}{\partial s}\, dn \tag{5}$$

where $-w/2$ is the right-bank position of a channel with a width w.

Analysis of field data collected at Muddy Creek (the study site described herein) indictes that $\langle u_s u_n\rangle h \approx \langle u_s\rangle \langle u_n\rangle h$, and $\langle u_s^2\rangle \approx \langle u_s\rangle^2$. Using these approximations with (4) and (5), Smith and McLean showed that (2) can be written as

$$\frac{-1}{1-N}\rho g h \frac{\partial E}{\partial s} = (\tau_{zs})_b + \frac{\rho \langle u_s\rangle h}{1-N}\frac{\partial \langle u_s\rangle}{\partial s} + \rho\left(\frac{\langle u_s\rangle}{(1-N)R} - \frac{\partial \langle u_s\rangle}{\partial n}\right)\frac{1}{1-N}\int_{w/2}^{n}\frac{\partial \langle u_s\rangle h}{\partial s}\, dn \tag{6}$$

It is well established that in meandering river channels in the upstream part of the bend, $\langle u_s\rangle$ decreases from the inside to the outside bank, i.e., as n increases [see *Leopold and Wolman*, 1960; *Rozovskii*, 1957; *Dietrich et al.*, 1979; *Bridge and Jarvis*, 1982]. Also, because of the bar-pool topography, $\partial h/\partial s$ is negative from the inside bank to roughly the channel centerline, at which point $\partial h/\partial s$ becomes positive. If $\partial \langle u_s\rangle/\partial s$ is small, then the term

$$-\rho \frac{\partial \langle u_s\rangle}{\partial n}\frac{1}{1-N}\int_{-w/2}^{n}\frac{\partial \langle u_s\rangle h}{\partial s}\, dn$$

in (6) will be negative near the inside bank and will decrease in absolute value toward the outer bank once $\partial h/\partial s$ becomes positive. We can expect that in the upstream part of the bend, protrusion of the point bar into a strongly skewed downstream velocity field will lead to reduced downstream pressure gradient along the inside bank and, possibly, to a steepened pressure gradient along the outside bank. These predicted changes are relative to that which would occur if the last term in (6) were not included in the calculations, not to that expected to occur in a flat bed. A similar modification of the pressure gradient will occur if $\partial \langle u_s\rangle/\partial s$ is negative over

the point bar and positive over the pool, as is often the case. These changes in the downstream pressure gradient field will reduce the cross-stream pressure gradient, causing a cross-stream imbalance with the centrifugal force and resulting in a net cross-stream flow. This important result will be confirmed subsequently using experimental data.

The equations of Smith and McLean differ in two important ways from those in the second approximation reported by *Engelund* [1974]. Equation (49) of the paper by Engelund is his second-order downstream component of the flow equation and can be written in the following manner using the symbols and coordinate system of this paper:

$$-\frac{1}{1-N}\rho g h\frac{\partial E}{\partial s}=(\tau_{zs})_b+\frac{\rho\langle u_s\rangle h}{1-N}\frac{\partial\langle u_s\rangle}{\partial s}$$

This expression is equivalent to the first three terms in (6). The last term of (6) is the force per unit volume due to spatial acceleration arising from downstream varying topography and, as the preceding paragraph suggests, is of primary importance in flow over natural bed topography. It is important to note also that (6) is a zero-order equation, whereas the analogous expression of Engelund's is second order.

Flow in a Channel With Smoothly Varying Curvature and Constant Bed Topography in the Downstream Direction

To our knowledge there have been no flume experiments in channels with spatially constant bed topography and smoothly varying curvatures. Most experiments have been carried out in rectangular or trapezoidal channels composed of straight sections connected to sections of constant curvature. Laboratory investigations in channels with the latter configuration are of limited value because the effects of a sudden reduction in channel radius of curvature can be substantial and complicated.

Fortunately, the following qualitative description of flow through a channel with smoothly varying curvature and downstream constant bed topography can be made on the basis of (2) and (3). As the flow enters a channel segment that has a decreasing radius of curvature, it experiences a progressively greater centrifugal force. This is counterbalanced by an increasing cross-stream tilt to the free surface. In the downstream direction this tilt causes the water surface slope to steepen near the inside bank and flatten near the outer one. Once the radius of curvature minimum is reached in a bend, the curvature decreases progressively in the downstream direction, and the corresponding gradual reduction in centrifugal force causes the downstream water surface slope to flatten near the inside bank and steepen near the outside bank. In addition, the intensity of the cross-stream circulation declines.

If the relatively small, flow-induced convective accelerations were zero, the downstream boundary shear force would equal the downstream pressure gradient force. Thus steepening of the downstream surface slope along the inside bank and flattening of it along the outside one (due to differences in path length in combination with a downstream increasing centrifugal force) would cause the boundary shear stress to be greatest near the inside bank at the center of the bend. Once the curvature minimum was crossed, the boundary shear stress would decrease along the inside bank and increase along the outside bank. Terms arising from the weak convective accelerations will counter and to some degree reduce, but cannot eliminate this trend.

Despite their limitations the results of available experiments in channels with constant curvature bends connected to straight sections support the predictions made above. For example, experiments in a variety of channel bends with constant curvature by *Ippen and Drinker* [1962], *Varshey and Garde* [1975], and *Choudhary and Narasimhan* [1977] demonstrate the development of a zone of high boundary shear stress along the inner bank that shifts toward the outer bank at the downstream end of the bend where the radius of curvature changes abruptly from a small constant value to infinite. Although it is not shown in his data. *B. C. Yen* [1965, p. 59] states: "In the following first quarter of the straight reach, the trace of maximum boundary shear shifts abruptly to the other side of the channel. . . ."

In a channel with constant curvature and bed topography the direction of boundary shear stress also can be estimated by assuming that convective accelerations are small. Under the latter assumption, (2) and (3) can be rewritten as follows in cylindrical coordinates:

$$(\tau_b)_\theta=\rho g h S_\theta \tag{7}$$

$$(\tau_b)_r=\rho g h S_r-\rho\langle u_\theta^2\rangle h/r \tag{8}$$

Here $(\tau_b)_\theta$ and $(\tau_b)_r$ are the downstream and cross-stream components of the boundary shear stress; S_θ and S_r are the downstream and cross-stream components of the water surface slope; ρ, g, and h are defined above; and u_θ is the downstream velocity component. As is noted above, the angle brackets indicate that a vertical average has been taken. The cross-stream boundary shear stress results from the cross-stream pressure gradient force, so if $(\tau_b)_r=\gamma_1\rho g h S_r$, where γ_1 is a proportionality factor, and $\langle u_\theta\rangle^2\simeq\langle u_\theta^2\rangle$, then (8) becomes

$$\gamma_1 g h S_r=\rho g h S_r-\rho\langle u_\theta\rangle^2 h/r \tag{9}$$

or

$$\rho g h S_r=\frac{1}{1-\gamma_1}\rho\langle u_\theta\rangle^2 h/r \tag{10}$$

The tangent of the angular deviation (ψ) of the boundary shear stress vector from the downstream direction is $(\tau_b)_r/(\tau_b)_\theta$. Combining (8) and (9) and employing $(\tau_b)_\theta=\gamma_2\rho\langle u_\theta\rangle^2$ yields

$$\tan\psi=\frac{[1/(1-\gamma_1)]\rho\langle u_\theta\rangle^2 h/r-\rho\langle u_\theta\rangle^2 h/r}{\gamma_2\rho\langle u_\theta\rangle^2}=\frac{\gamma_1}{1-\gamma_1}\frac{1}{\gamma_2}\frac{h}{r} \tag{11}$$

Now writing $\gamma_1/(1-\gamma_1)\equiv\gamma_3$, we get $\tan\psi=(\gamma_3/\gamma_2)(h/r)$. The constant γ_3 can be calculated once the eddy viscosity that relates the vertical velocity gradient near the bed to τ_b is specified. Alternatively, it can be estimated from results of the study of flow in a circular annulus carried out by *Zimmerman* [1977]. Specifically, he found that when $(\tan\psi)/(h/r)=5.0$, $\gamma_2=0.0063$. This sets $\gamma_3=0.03$, and (11) becomes $\tan\psi=(0.03/\gamma_2)(h/r)$. Because $\gamma_2=f/8$, where f is the Darcy-Weisbach friction factor,

$$\tan\psi=\frac{0.24}{f}\frac{h}{r} \tag{12}$$

As Zimmerman showed using a different approach, the smoother the bed (thus the smaller the value of f), the larger the angular deviation from the downstream direction. Equation (12) closely fits the experimental results obtained by *Zimmerman* [1977, p. 84, Figure 6] in his circular channel.

Using the same general assumptions, *Rozovskii* [1957] and *Engelund* [1974] had previously derived the expression

$$\tan \psi = Ch/r \tag{13}$$

where C is a constant for a given channel. This equation has since been widely used in modeling of flow in bends [e.g., *Engelund*, 1974; *Gottlieb*, 1976; *DeVriend*, 1977; *Bridge*, 1977; *Falcon*, 1978], and a general review of the application of (13) to river meander problems has been provided by *Allen* [1978]. Equations (12) and (13) as written and the force balance from which they were derived (equation (8)), however, apply only to flow in circular annuli with bed topography that does not vary in the downstream direction. If the channel has a rapidly changing radius of curvature, even in the absence of bar and pool topography, significant forces due to convective accelerations may be generated, and these cause a net cross-stream flow; hence an additional cross-stream boundary shear stress component must be added to (8).

Flow in a Curved Channel With a Point Bar: Studies by Yen and Yen

Laboratory Experiments and Method of Analysis

The most complete set of measurements of flow processes in a curved channel is that procured by *B. C. Yen* [1965] and *C. Yen* [1967]. Their measurements were obtained in the same channel with and without a point bar, respectively. The channel consisted of two 90° bends with an 8.5-m radius of curvature connected by a 4.3-m-long straight section. The flat-bottomed channel had a uniform trapezoidal cross section with a smooth cement mortar surface. The surface width was 2.3 m, and the walls sloped at 1:1. Width to depth ratios for five experimental flows in the trapezoidal channel ranged from 8.0 to 17.0. The bed topography in the curved channel with vertical walls was formed by the flow over an initially flat but mobile bottom, which was later stabilized with cement. The width to depth ratio for the single run conducted was 18.

In a subsequent paper, *Yen and Yen* [1971] derived in cylindrical coordinates downstream and cross-stream force balance equations analogous to (2) and (3). They then computed the magnitude of each term for the channel centerline in the downstream direction and in the cross-stream direction at three cross sections.

The equations of Yen and Yen can be written as

$$-\rho g h \frac{\partial E}{r\,\partial\theta} = \tau_b \cos\psi + \int_{z_0}^{E} \rho u_r \left(\frac{\partial u_\theta}{\partial r} + \frac{u_\theta}{r}\right) dz + \int_{z_0}^{E} \rho u_{\theta r} \frac{\partial u_\theta}{r\,\partial\theta}\, dz + \int_{z_0}^{E} \rho u_z \frac{\partial u}{\partial z}\, dz \tag{14}$$

$$-\rho g h \frac{\partial E}{\partial r} = \tau_b \sin\psi - \int_{z_0}^{E} \rho \frac{u_\theta^2}{r}\, dz + \int_{z_0}^{E} \rho u_\theta \frac{\partial u_r}{r\,\partial\theta}\, dz \tag{15}$$

Here θ is the downstream direction, r is the local cross-stream coordinate, z is the vertical direction, and ψ is the angle the boundary shear stress τ_b makes with the downstream direction. The equations are integrated from a roughness elevation z_0 to the surface elevation E above the bed.

To include the data from all five runs in the trapezoidal channel and to compare these data with the measurements made in the curved channel with natural bed topography, Yen and Yen normalized (14) and (15) in the following manner. All terms in (14) were multiplied by $2r/(hu_m^2)$, where u_m is the average velocity at the midsection of the straight channel upstream of the study bend, and the downstream slope, $-1[\partial E/(r\partial\theta)]$, was defined equal to S_θ, giving

$$\frac{2grS_\theta}{u_m^2} = \frac{2r\tau_b \cos\psi}{\rho h u_m^2} + \frac{2r}{hu_m^2}\int_{z_0}^{E} u_r \left(\frac{\partial u_\theta}{\partial r} + \frac{u_\theta}{r}\right) dz + \frac{2r}{hu_m^2}\int_{z_0}^{E} u_\theta \frac{\partial u_\theta}{r\,\partial\theta}\, dz + \frac{2r}{hu_m^2}\int_{z_0}^{E} u_z \frac{\partial u_\theta}{\partial z}\, dz \tag{16}$$

Each term was then assigned a label, so (16) was reduced to

$$C_\theta = C_{\theta 1} + C_{\theta 2} + C_{\theta 3} + C_{\theta 4} \tag{17}$$

where each term retains its respective position. The same normalization procedure was used for (15), yielding

$$\frac{2grS_r}{u_m^2} = \frac{-2r\tau_b \sin\psi}{\rho h u_m^2} + \frac{2r}{hu_m^2}\int_{z_0}^{E} \frac{u_\theta^2}{r}\, dz - \frac{2r}{hu_m^2}\int_{z_0}^{E} u_\theta \frac{\partial u_r}{r\,\partial\theta}\, dz \tag{18}$$

or

$$C_r = C_{r1} + C_{r2} + C_{r3} \tag{19}$$

Results of Analysis

Components of the downstream force balance at the channel centerline represented by (17) for the trapezoidal channel and the channel with bed topography (referred to as the equilibrium bed model by Yen and Yen) are shown in Figure 1. The curves labeled C_θ in Figures 1*a* and 1*c* are the sums of the four computed values. To compare predicted and observed downstream water surface profiles, Yen and Yen subtracted from the observed slope S_θ a uniform slope S_c along the centerline that passed through the mean water levels at midsections of the straight sections,

$$H_\theta = \int_0^L (S_\theta - S_c)\, dL = \int_0^L \left(C_\theta \frac{u_m^2}{2gr_c} - S_c\right) dL \tag{20}$$

where L is the downstream distance along the centerline measured from the midsection of the upstream section. If H_θ is positive, the accumulated elevation drop from the straight section is greater than the constant slope along the centerline. The predicted and observed values of H_θ are plotted in Figures 1*b* and 1*d*.

In the trapezoidal channel the dominant terms counterbalancing the downstream pressure gradient along the centerline are the downstream boundary shear stress $C_{\theta 1}$ and the downstream convective acceleration term $C_{\theta 3}$. The large deviations in $C_{\theta 3}$ at the entrance to the bend ($r_c\theta/r_c = 0$ to $\pi/8$) are generated by the infinite rate of change in the radius of curvature, a problem not recognized by *Yen and Yen* [1971]. Downstream of section $\pi/8$ the magnitude of $C_{\theta 3}$

remains significant, but it tends to be counterbalanced by the sum of the smaller terms $C_{\theta 2}$ and $C_{\theta 4}$, so that the computed downstream pressure gradient and observed boundary shear stress are relatively close.

In the equilibrium bed channel, $C_{\theta 2}$ was found to be as large as the downstream convective acceleration term, $C_{\theta 3}$. These inertial terms were of sufficient magnitude everywhere along the centerline that the predicted downstream pressure gradient and the observed downstream boundary shear stress bore little relation to each other. As in the trapezoidal channel, the data up to section $\pi/8$ are dominated by the sudden change in channel curvature, and the results add little to understanding processes in natural river meanders. Because of this, further discussion will focus on the region downstream of this effect.

Between sections $\pi/8$ and $5\pi/16$, $C_{\theta 2}$ and $C_{\theta 3}$ tended to be of opposite sign and larger than the scaled boundary shear stress. At the downstream end of the bend, the terms decreased to smaller negative values. Along the centerline the water surface slope at first steepens slightly and then flattens until the center of the bend ($\pi/4$); downstream and through the end of the bend, the slope steepens again. Comparison of Figures 1*b* and 1*c* indicates that the flattening of the slope is associated with a large downstream decrease in $C_{\theta 3}$. Although Yen and Yen's data were not reported in a way which allows easy comparison, it appears that the vertically averaged downstream velocity component decreased more rapidly in the downstream direction over the point bar near the inside bank. This velocity component increased in the downstream direction over the deep area. These obsesrvations indicate that the convective acceleration term can be expected to be strongly negative over the point bar and positive over the pool.

The results of the analysis of the cross-stream force balance, using (19) at three sections through the bend are shown in Figures 2*a* and 2*b*. In the trapezoidal channel the cross-stream pressure gradient nearly equaled the centrifugal force C_{r2} at all measurement sites. In the equilibrium bed channel, however, the convective acceleration of cross-stream velocity contributed significantly to the force balance. At section $\pi/4$, for example, C_{r3} equaled 35% of the total C_r.

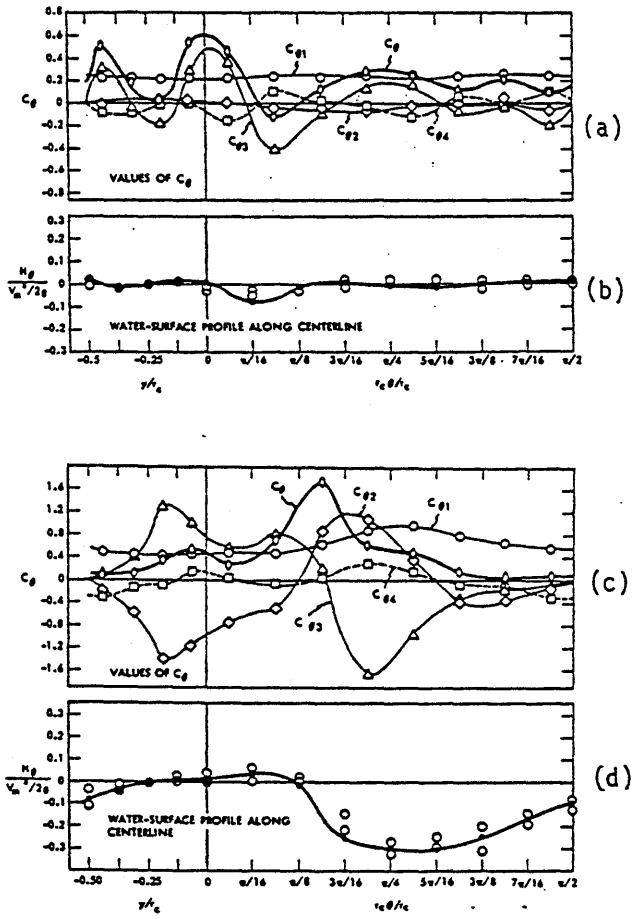


Fig. 1. Figures from *Yen and Yen* [1971] showing the downstream variation in components of the downstream force balance (equation (17)) at the centerline of (*a*) the trapezoidal channel and (*c*) the equilibrium bed channel, and the accumulative elevation change (equation (20)) of the downstream water surface along the centerline relative to the elevation for a constant slope through the bend in (*b*) in the trapezoidal channel and (*d*) the equilibrium bed channel. Reprinted with permission from the American Society of Civil Engineers.

Discussion

An important result of this analysis, about which Yen and Yen did not comment, is that at section $\pi/8$ the centrifugal force exceeds the cross-stream pressure gradient force over the point bar and is less than the pressure gradient force over the pool. This imbalance should and does cause the pattern of cross-stream velocity to differ significantly from that found in flat-bottomed channels. Where the vertically averaged centrifugal force exceeds the cross-stream pressure gradient force over the point bar, an outward velocity often extends through the entire water column to the bed. In contrast, a small vertically averaged centrifugal force relative to the cross-stream pressure gradient force can cause the velocity to be inward even in the region of highest flow at the surface. On the inside of the channel this imbalance arises from the pressure field associated with the cross-stream decrease in downstream velocity combined with a downstream decrease of the downstream velocity component and a reduction of depth of flow over the point bar; on the outside part it arises because of the downstream increase of the downstream velocity component and a deepening of flow over the pool. The downstream pressure gradient will decrease where the flow decelerates and shoals, and it will increase where it accelerates and deepens (equations (6) and (14)); thus it will cause the cross-stream pressure gradient to be reduced in the upstream part of the bend.

Figure 3 illustrates how topographically induced spatial accelerations in the downstream pressure gradient will influence the cross-stream pressure gradient. Flow in a curved channel without spatial accelerations would produce a water surface topography delineated by the solid lines. Downstream convective accelerations associated with shoaling of the flow over the point bar reduce the downstream water surface slope (dashed lines) near the inside bank. They also may increase the downstream water surface slope over the deep area (close to the concave bank). These changes reduce the cross-stream surface slope, causing, in particular, the cross-stream pressure gradient to be exceeded by the centrifugal force over the point bar, and leading to an outward component of the velocity near the bed in the shallow part of

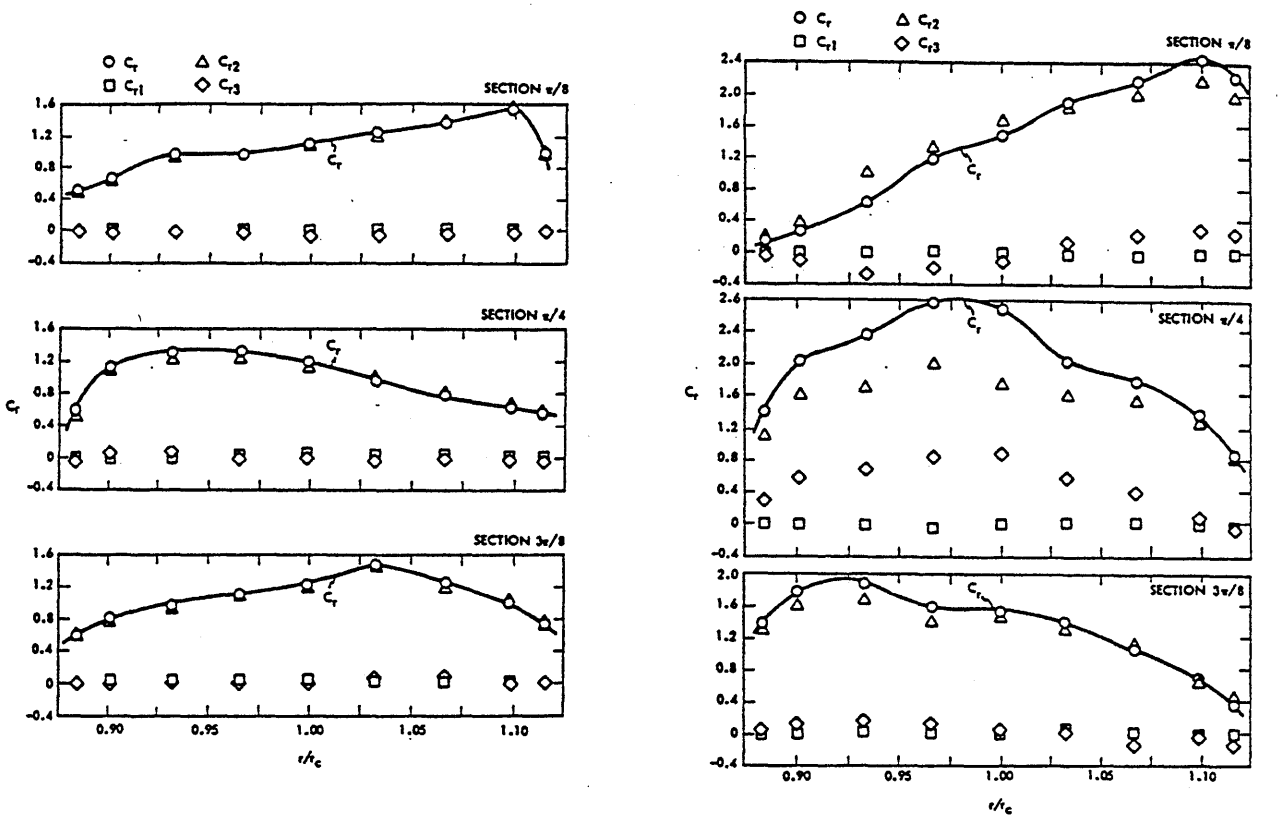


Fig. 2. Figures from *Yen and Yen* [1971] showing the cross-stream components of the force balance in the cross-stream direction at three sections through the bend; (*a*) trapezoidal channel and (*b*) equilibrium bed channel. Reprinted with permission from the American Society of Civil Engineers.

the flow. There is an analogous effect over the deep area, but it appears to be much smaller.

The prediction of outward velocity near the bed over the point bar is confirmed with data reported in graphs in the dissertations of *B. C. Yen* [1965], *C. Yen* [1967], and *Onishi* [1972]. In Figure 4*a* the direction of flow near the bed in the trapezoidal model studied by B. C. Yen is shown. The flow direction, toward the left bank, depicted between sections *S*0 and *C*π0 is due to the curvature effects of the upstream bend. Note that this effect does not extend into the bend of interest. Figure 4*b* shows the flow direction and the region of shoaling for the same flume with an equilibrium and stabilized bed topography that was studied by *C. Yen* [1967]. There is good correspondence between the shoaling regions on the point bar and the area of outward flow near the bed. Finally, Figure 4*c* shows the general pattern of flow direction and shoaling region for the mobile bed study reported by *Onishi* [1972] for the same flume as the other two studies. The correspondence between the shoaling region over the point bar and the outward near-bed flow is very strong. These data clearly confirm, at least for this general channel geometry, the outward flow prediction and show that it results from downstream changing bed topography rather than from flow patterns generated in the upstream bend.

The origin of the outward velocity over the point bar can only be explained quantitatively by solving (2) and (3). It was recognized by C. Yen that outward velocities near the bed occurred, but he attributed them to the effects of flow separation along the outside bank in the upstream crossing [*C. Yen*, 1967, p. 33]. There is, however, good coincidence of the outward velocities with the region in which the depth decreases downstream. It is also unlikely that flow separation affected such a large region of the bed. *Onishi* [1972], in fact, attributed the outward flow he observed to flow "being shifted . . . by the larger point bar . . ." [*Onishi*, 1972, p. 57].

The outward velocity over the top of the point bar significantly influences other processes. The net cross-stream discharge contributes to a rapid crossing of the maximum average velocity to the outer bank. In the equilibrium bed model the maximum velocity crossed to the outer bank by section 3π/8 (see Figure 5 for location) as compared to the trapezoidal channel in which the maximum average velocity crossed only to the channel centerline by the downstream end of the bend. Like the maximum average velocity, the zone of maximum boundary shear stress crossed to the outer bank much sooner (by section 3π/8) in the equilibrium bed model than in the trapezoidal channel. A rapid outward shifting at the zone of maximum boundary shear stress also was found in the laboratory meander with bar and pool topography studied by *Hooke* [1975].

As has been discussed previously, the large momentum flux terms caused by the point bar and pool degrade the usefulness of (13) for predicting the angular deviation of the boundary shear stress from the downstream direction. The outward velocity shown in Figure 4 confirms this conclu-

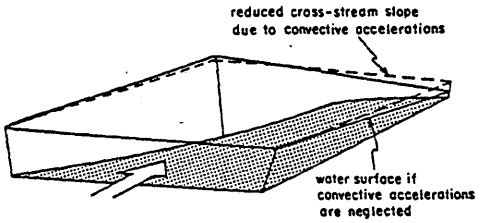


Fig. 3. Changes in water surface topography caused by shoaling of the flow over the point bar. Solid lines delineate channel outline and water surface in a curved channel with downstream varying bed topography but without the effects of spatial accelerations. The dashed lines indicate the water surface in the same channel with the effects of convective accelerations in the downstream direction included. Elevation changes are exaggerated.

sion. The data used to construct Figure 4 from the experiments by *C. Yen* [1967] were also used to compute the coefficient C. The average of 46 data points in which the velocity near the bed was inward is 7.7 with a standard deviation of 4.65. Although this agrees well with the expected values from empirical results of *Zimmerman* [1977], it is of limited value, because the coefficient C varied systematically through the bend and across the channel. In fact, it ranged over a factor of 5 across individual sections, particular at sections $5\pi/16$ through $\pi/2$. Equation (13) is sometimes useful in order to obtain a first guess of the magnitude of the inward velocity when the equation is modified to include the net outward boundary shear stress component described previously.

The Yen and Yen experiments clearly show that the bar-pool topography in a laboratory bend with constant curvature and immobile boundary causes significant cross-stream flow near the bed over the shallow part of the point bar. In natural river meanders we can expect the flow processes to be similar and considerably more difficult to document accurately. However, it is the natural river meander morphology we wish to explain. The following description of our field study demonstrates that the findings of these laboratory experiments have direct application to natural streams.

Flow in a River Meander: Measurements in Muddy Creek

Field Site

Muddy Creek is a sand-bedded, lowland tributary of the upper Green River in western Wyoming (Figure 5). *Andrews* [1981], in a study of rates of sediment transport, has described the general features of the river and has provided a location map. At the measurement site the stream has a drainage area of 235 km^2 and a gradient of 0.0014. Bank-full discharge, mean width, and mean depth are 1.6 m^3/s, 5.5 m, and 0.5 m, respectively, and the maximum pool depth at this stage is 1.1 m. The width to depth ratio of the stream is 11, a value typical of small streams. The slope, discharge, and depth are more accurate estimates than were reported in an earlier paper on our initial findings [*Dietrich et al.*, 1979]. Data presented here were collected in 1978 and 1979 as part of a study of flow, sediment transport, and boundary shear stress in a river meander [*Dietrich*, 1982*a*].

A topographic map of the channel made in June 1976 is shown in Figure 6. Muddy Creek has incised through outwash terraces to form a narrow floodplain. The outer banks of most bends on the creek are cut into these terraces and consist of steep sandy surfaces with a low concentration of gravel, often free of vegetation. At high stage the pools along the outer banks are excavated to a lag deposit of gravel accumulated from bank sloughing into the pool. Along the insides of the bends, and bordering the crossing between the bends, the banks are composed of sandy and silty deposits colonized by a dense network of grass roots. The channel narrows in the region where it is bounded on both sides by grassy banks, widens in the bends where the outer bank is easily eroded, and narrows downstream where it is again bounded by grassy banks (Figure 7).

Langbein and Leopold [1966] have shown that the path of many river meanders can be expressed by the sine-generated curve:

$$\Phi = \omega \sin \frac{2\pi s}{M} \tag{21}$$

where ϕ is the angular deviation of the centerline from the down-valley axis at a distance s downstream along the channel centerline, M is the meander wavelength, and ω is the angle between the centerline and the down-valley axis at the crossing between the bends. The crossing is defined as the segment of channel between the bends where the radius of curvature is infinite.

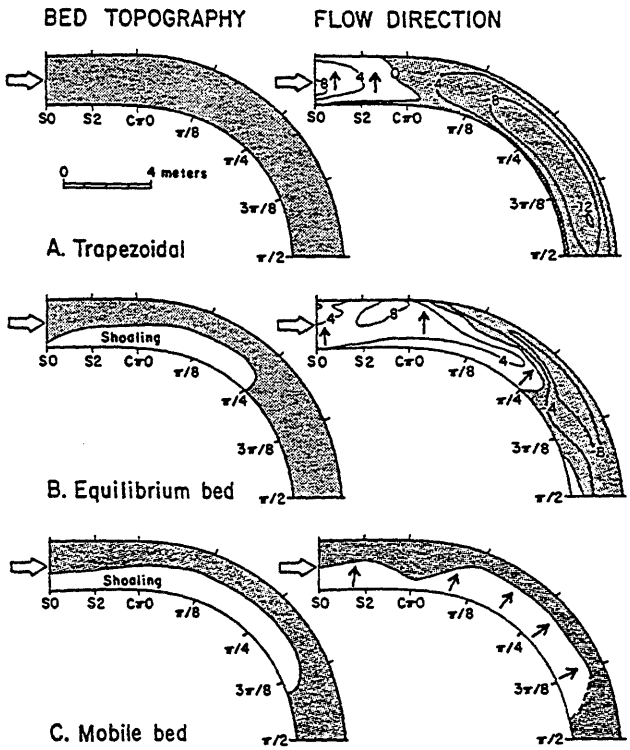


Fig. 4. Region of shoaling flow and direction of velocity near the bed relative to channel centerline for a flume meander with three different bed configurations: (*a*) trapezoidal channel [*B. C. Yen*, 1965]; (*b*) equilibrium bed channel [*C. Yen*, 1967]; and (*c*) mobile bed channel [*Onishi*, 1972]. Contour interval in Figures 4*a* and 4*b* is 4°. Data for mobile bed studies were not reported in a manner that permitted accurate contouring of flow directions. This sequence shows that although the bend shown is downstream of a bend opposite curvature, the outward near-bed flow over the point bar is due to shoaling and not to a carry-over of flow pattern from the upstream bend.

Fig. 5. Oblique aerial photograph of the study site taken in 1979. Flow is from lower right to upper left. Note the railing along the outside of the central bend and the regular pattern of bed forms.

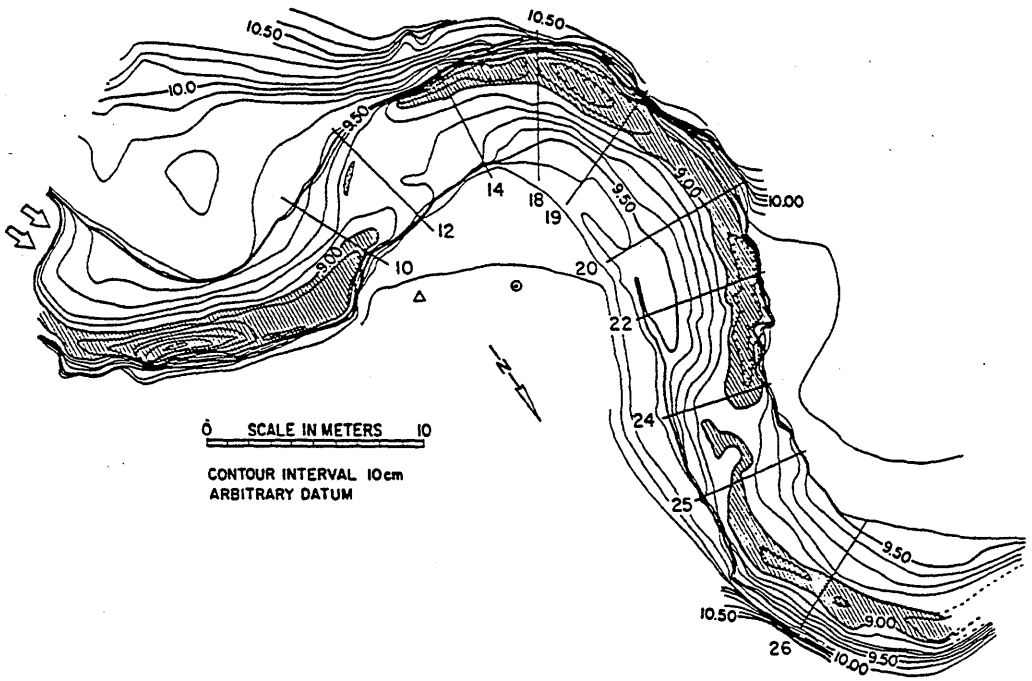


Fig. 6. Topography of the study site. The pools have been shaded for emphasis.

To define the channel path of the study site, we digitized the centerline of the channel at the discharge of interest in 1978, and we fit, using least squares, a sine-cosine function of three harmonics to the data. This function fitted the data well. As is shown in Figure 8, the sine-generated curve that describes the path of the Muddy Creek meander is

$$\Phi = 69.49° \sin \frac{360° s}{50.4 \text{ m}} \tag{22}$$

The change in Φ with s gives the predicted channel curvature, and this is plotted with the curvature computed from the least squares fit to the centerline in Figure 9. This indicates that the crossings between the bends occur between sections 10 and 12 and between sections 22 and 24. There is a very rapid decrease in curvature at the entrance to the bend and an equally rapid increase at the downstream end of the bend. A curvature minimum occurs between sections 14 and 18, but for most of the center of the bend, the curvature is relatively constant, at about 8 m. The minimum radius of curvature to width ratio is 1.5 for the central bend, 1.5 for the upstream bend, and 2.4 for the downstream bend. *Leopold and Wolman* [1960] have shown that the typical radius of curvature to width ratio of a meandering river is 2.4, so the study site is a relatively sharp bend in comparison to the average river meander. The sine-generated curve places the curvature minimum at the center of the bend, halfway between the crossings. It is interesting to note that it is in this region where the greatest bank erosion (about 40 cm/yr) is occurring [*Dietrich*, 1982*a*, *b*]. Were this process to continue, the present curvature minimum would shift downstream to this location.

Muddy Creek has long periods of nearly constant discharge when it receives irrigation outflow in the late spring and early summer. During these periods it transports a sand bed load with a median particle size of 0.7 mm in well-developed bed forms. At this time, suspended load is less than 10% of the total load, and the streambed is easily seen from above the water surface. Description of the bed forms and sediment transport processes is given elsewhere [*Dietrich et al.*, 1979; *Dietrich*, 1982*a*, *b*]. Most sediment is derived from channel migration into outwash terraces [*Andrews*, 1977]. During periods of continuous supply of sediment and constant discharge of water the channel develops a bed morphology that is close to steady state. Figure 10 shows the shape of cross sections at about 1.1 m^3/s for three field seasons (1976, 1978, and 1979) which are compared by matching centerlines to remove the effects of channel migration. Because of the passage of dunes along the stream channel, there is a 10- to 15-cm error associated with a single transect of depth measurement. This error was removed in the 1978 cross-section measurements by averaging repeated measurements across the channel for periods of up to 3 hours. In general, the difference between years is much less than that due to dune migration through a given section.

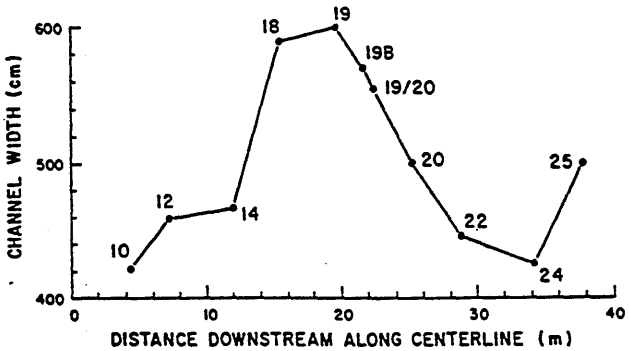


Fig. 7. Variation in stream width of a flow of 1.1 m^3/s as a function of distance downstream along the channel centerline. Numbers refer to cross sections.

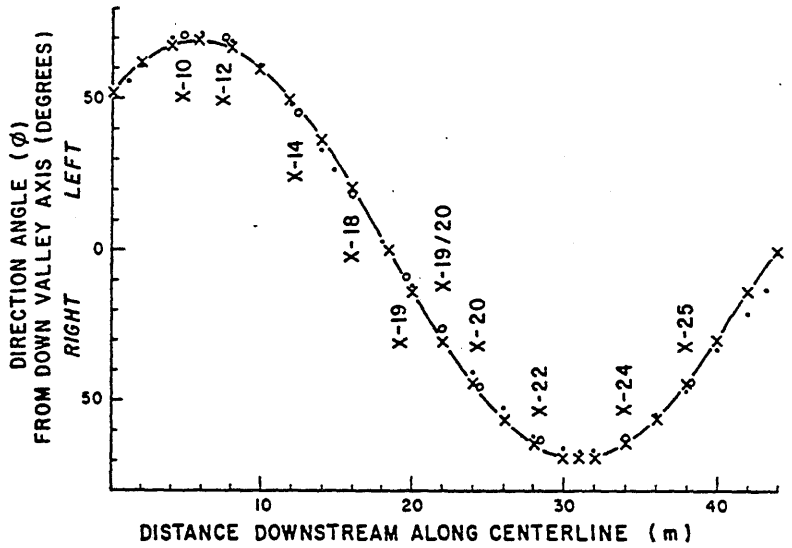


Fig. 8. Variation in the direction of the channel path relative to the down-valley axis (circles and dots) as compared to the sine-generated curve (solid curve with crosses).

Field Methods and Data Analysis

Flow measurements. The magnitude and direction of velocity were obtained at nine sections through the meander by means of 12 pairs of small rotor-type current meters positioned at regular intervals through the water column and across the channel. The current meters had 3.5-cm-diameter rotors that were held in a 1.6-cm-long, 4.2-cm-OD ring of 0.17-cm wall thickness. A support stem, 37 cm long and 1.3 cm in diameter, housed the circuitry for the meter. Magnets embedded in two of the four rotor blades are used to generate a pulse signal when the blades pass a Hall effect sensor in the support rod. Flow that encounters the current meter head-on can be monitored to an accuracy of ±0.3 cm/s or ±1.2% of the measured velocity, whichever is larger. Other characteristics of the current meter, including calibration as a function of angle of attack, have been published by *Smith* [1978].

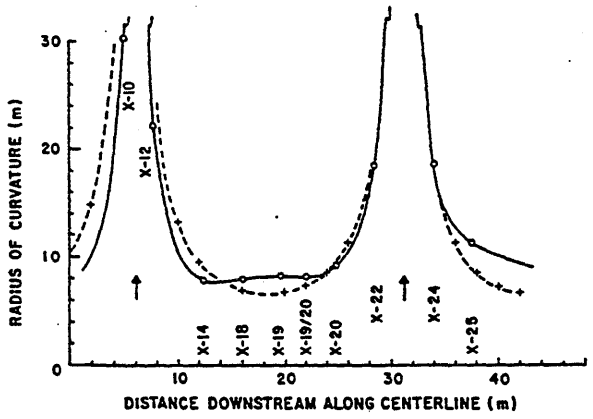


Fig. 9. Variation of radius of curvature as a function of distance downstream along channel centerline. Arrows point to where radius of curvature is infinite. These locations are defined as crossings between the bends. The dashed curve is the variation in radius of curvature that would result if the channel exactly followed the sine-generated curve path. The farthest downstream bend is less curved than the first two, so the sine-generated curve fitted to the central bend underpredicts the magnitude of the radius of curvature there.

Pairs of current meters were mounted such that the axes of the current meters were 10 cm apart and orthogonal. The current meters faced toward each other and upstream. The brackets were attached to an inverted T-shaped stainless steel rod bolted to an inverted L-shaped plywood platform. The rod could be moved vertically to change the height of the current meters, and four platforms were used to support the 24 current meters. A continuous railing along both banks was constructed upon which wooden bridges could be placed and freely moved to any position in the channel. This allowed the precise placement of the current meters in the flow.

The output from each meter was stored simultaneously by multichannel digital counters. Total number of pulses caused by rotor movement were accumulated for 10-min intervals and stored separately. As counting for the next 10-min interval proceeded, the stored values for each current meter were recorded manually in notebooks. The counts during successive intervals were watched closely to identify which if any of the current meters had been fouled or blocked by detritus.

The current meters could usually be left for 30 min before noticeable changes occurred in the quality of the output. At half-hour intervals each current meter was inspected and cleaned. Although inorganic suspended load was very low in Muddy Creek, the relatively large amounts of grass fibers and animal hair washed in with irrigation outflow made this cleaning of the current meters necessary.

The following procedure was used to determine the flow field through each of the nine sections. Before current metering was begun, the depth of flow at 10-cm intervals across the channel was measured repeatedly for a period of about 3 hours in order to define the mean bed elevation and temporal variation in depth due to the passage of dunes. The current meters were then installed, and their output was recorded for approximately 2 hours (about one dune period), after which time the positions of the platforms or the heights

of the current meters above the bed were changed. Owing to the magnitude of mobile dunes on the streambed the current meters could not be placed closer than about 5 cm above the bed. The highest current meter was generally 5 cm below the water surface. Velocity was monitored over the 2-hour periods at about 60 locations in the cross section. Twelve days and nights were required to complete the survey of all the sections.

The data were examined to remove those measurements that were anomalously low because of clogging of the current meters. The magnitude of each velocity vector at a position in the flow was plotted as a function of time. If the speed decreased systematically during the period after cleaning to a mangitude lower than that first recorded after the next cleaning, the low record was rejected. In a few cases, only the first 10-min average obtained after cleaning could be used. If the velocity decreased drastically in either one or both of the current meters in a pair, it was assumed that the low velocity was due to fouling of the current meter, and the record was rejected. A total of 6100 separate velocity values were plotted and subjected to this evaluation. Only 15% of the readings were deemed contaminated and not used.

During this period of measurement at sections 12 through 25, the average stage varied by 2.5 cm (6% of mean depth), and the computed discharge averaged 1060 l/s (0.66 bankfull) and ranged from 1016 to 1097 l/s. An incomplete survey was made at section 10 during a stage that was 5.3 cm below the average for all other sections.

The data presented were not corrected to the same discharge at each section because the difference measured in discharge between sections was smaller than the uncertainty in computing the discharge and the uncertainty in distributing the discharge correction to changes in width, depth, and velocity at specific heights above the bed. For sections 12 through 25 the error in the comparison of velocities due to discharge differences between sections is less than 4%. Differences between velocities due to discharge changes between section 10 and 12 are less than 5%.

Section orientation. The selection of the orientation of the cross-channel plane that defines the downstream and cross-stream components of flow is critical to examining the magnitude and direction of forces acting in the flow. In laboratory channels with constant width, cross sections perpendicular to both channel walls are easily determined. Natural rivers usually have irregular banks and vary in width through a meander. Selection in the field of the orientation of a section across a natural river channel is an arbitrary process. Given various kinds of assumptions, the range of possible orientations is probably over 10° for any position in a curved channel with natural banks. This error creates only a small uncertainty (less than about 5%) in the magnitude of the downstream velocity, but it can cause a change in direction and a substantial change in magnitude of the cross-stream velocity. The simplest approach is to choose a line that is apparently perpendicular to the banks and to the general path of the channel by visual estimation. In a rapidly curving channel with variable width this often is quite difficult. A less arbitrary procedure is to digitize the path of the centerline of the channel, fit a smoothly varying function to the data, and compute the perpendicular to the trend of the smooth curve. This yields a good estimate of the orientation most perpendicular to the local path of the channel. The selection of the smoothing function, however, arbitrarily defines the downstream length scale of the channel curvature that is used to compute the channel orientation. If the function follows the digitized data very closely, then it is the spacing of the data points that will have the greatest influence on the eventual computation of section orientation. In a rapidly curving channel with changing width, selection of the channel centerline is also imprecise.

A solution to this problem is to use the observed downstream velocity fields between successive sections to compute from the continuity equation (5) what the cross-stream

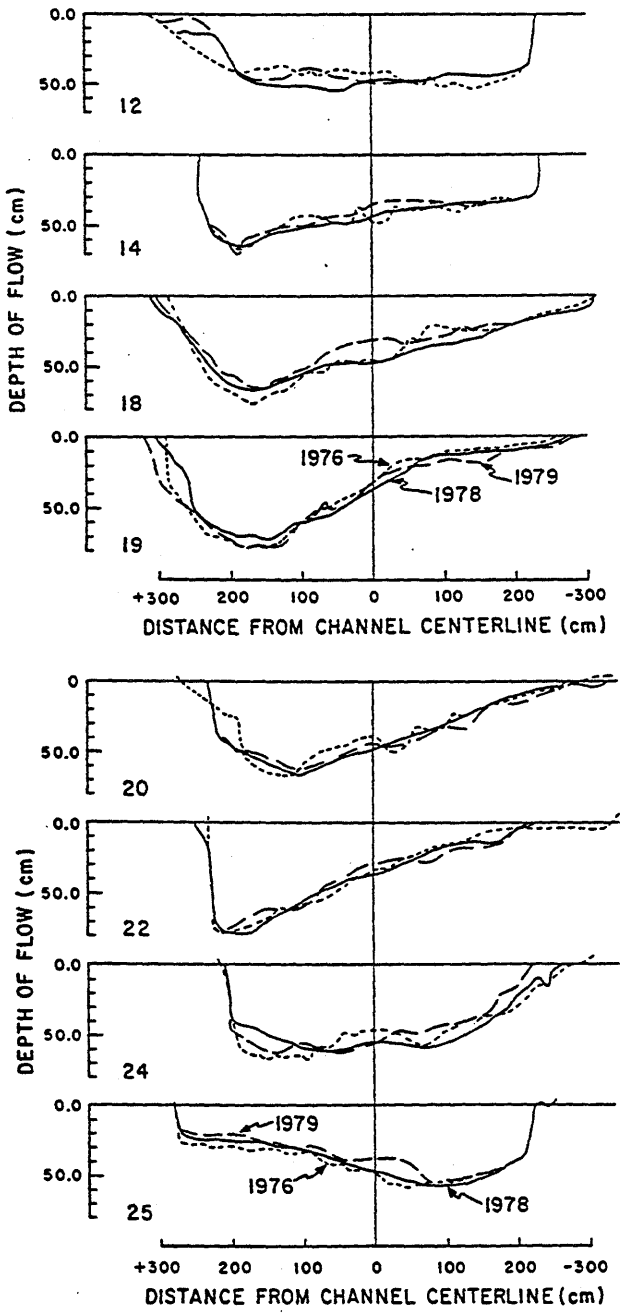


Fig. 10. Shape of cross sections at about 1.1 m^3/s for the three field seasons 1976, 1978, and 1979. Comparison was made by aligning centerline for each year. In 1977 a drought prevented high flow from occurring, and the bed topography was considerably different from previous or subsequent years.

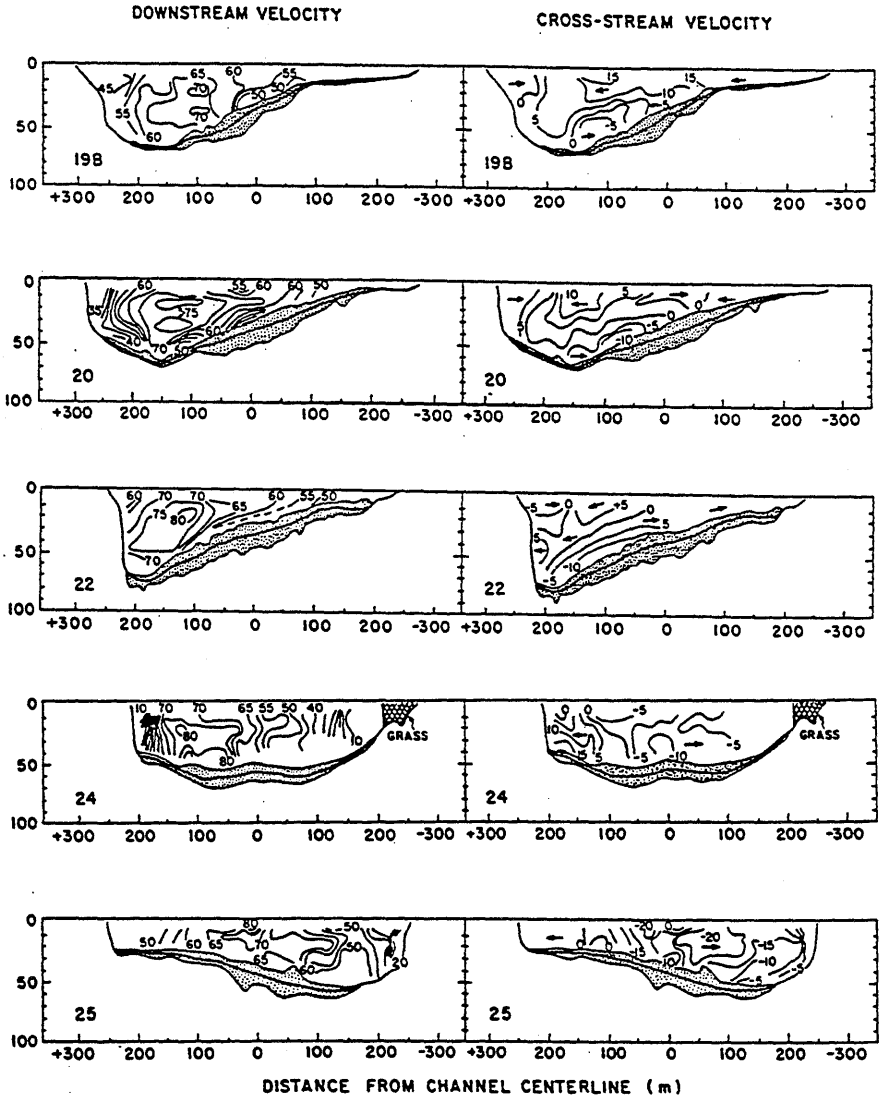


Fig. 11. (continued)

profile remained constant from the point of measurement to the respective boundary. Each vertically averaged velocity was then multiplied by the total depth of flow at the location of measurment, and these values were used to compute the total cross-stream and downstream discharge measured at each section.

The observed vertically averaged downstream velocities were located in the section with respect to the channel centerline. At 50-cm intervals starting at ±25 cm from the centerline, values for the vertically averaged velocity were computed by linearly interpolating between the two nearest points. These values were then used in (23) and (24) to compute the section orientation required by continuity. Table 1 lists the orientation change from that chosen in the field to that first made in order to conform to a line perpendicular to the path of the digitized centerline of the channel. It also gives the final correction required by continuity. The large correction required at section 19B resulted from the field alignment being chosen to make access to the current meters easier with the bridges available at that time, rather than being based on the apparent direction of the channel centerline. The average change in direction required, regardless of sign, was only 4.4°, even if section 19B is included in the averaging. None of the corrections changed significantly the pattern of the results.

Water surface topography. A topographic survey of the water surface was not made in the 1978 season because of lack of time. In the following year, during a stage that was only 1.3 cm lower than the 1978 mean for sections 12 through 25, the elevation of the water surface was surveyed at 10 sections across the meander. The survey was made by wading the stream. A survey rod with a sharply pointed base was held about 80 cm upstream of the wader's legs and slowly lowered to the water surface. As soon as the point touched the water, the person holding the rod would shout, and a reading would be taken to the nearest millimeter. At least three readings were made at each position in this manner, and the average sighting was recorded. Measurement error was about 2 mm for each reading. Error due to stagnation caused by the wader's legs was small. If the legs are approximated as a cylinder 30 cm in diameter, velocity reduces by the ratio $(15\text{ cm})^2/(95\text{ cm}^2)$, or only about 2%. For

TABLE 1. Orientation Corrections

Section	Centerline Fit	Continuity
10	+0.6	...
12	−4.7	−4.4
14	+1.6	−3.4
18	−3.6	−1.9
19B	−1.0	+10.3
20	+8.2	+4.0
22	+4.3	+2.4
24	+2.6	+5.1
25	+1.6	−3.3

Values are in degrees.

velocity should be and then rotate each section until the measured cross-stream discharge matches the computed one. In order to compute the total cross-stream discharge of water, Q_{nw}, (5) must be integrated from bank to bank:

$$Q_{nw} = \int_{-w/2}^{w/2} \langle u_n \rangle h \, dn = \int_{-w/2}^{w/2} \frac{-1}{1-N} \int_{-w/2}^{n} \frac{\partial \langle u_s \rangle h}{\partial s} \, dn \tag{23}$$

The average direction of flow, θ_w, between successive sections with an average downstream discharge Q_{sw} is

$$\theta_w = \tan^{-1} Q_{nw}/Q_{sw} \tag{24}$$

This angle can be compared with the angle computed from the observed cross-stream velocity, and the observed angle then corrected to give the computed value. Because this correction typically is small, there is no need to correct the downstream velocity, so iteration can be avoided.

This procedure for establishing the proper orientation of a section differs substantially from that used by *Rozovskii* [1957, p. 139] and more recently reintroduced by *Bathurst et al.* [1977]. The Rozovskii procedure requires that for either laboratory or natural meanders, the mean direction of flow be determined for individual vertical velocity profiles, not for the entire cross section. The cross-stream component of velocity is then computed in relation to the mean flow direction for each profile. The outward and inward discharges relative to this mean flow direction will be zero, and thus this analysis yields the secondary circulation but not the complete cross-stream velocity field. This is important because downstream and cross-stream forces caused by changes in momentum associated with the cross-stream velocity can only be computed in a frame of reference in which the cross-stream velocity field is correctly represented.

In order to apply (23) and (24) to Muddy Creek, the vertically averaged cross-stream and downstream velocities were computed for each vertical profile along the cross sections. To do this, we assumed that the velocity measured nearest the water surface and nearest the bed in an individual

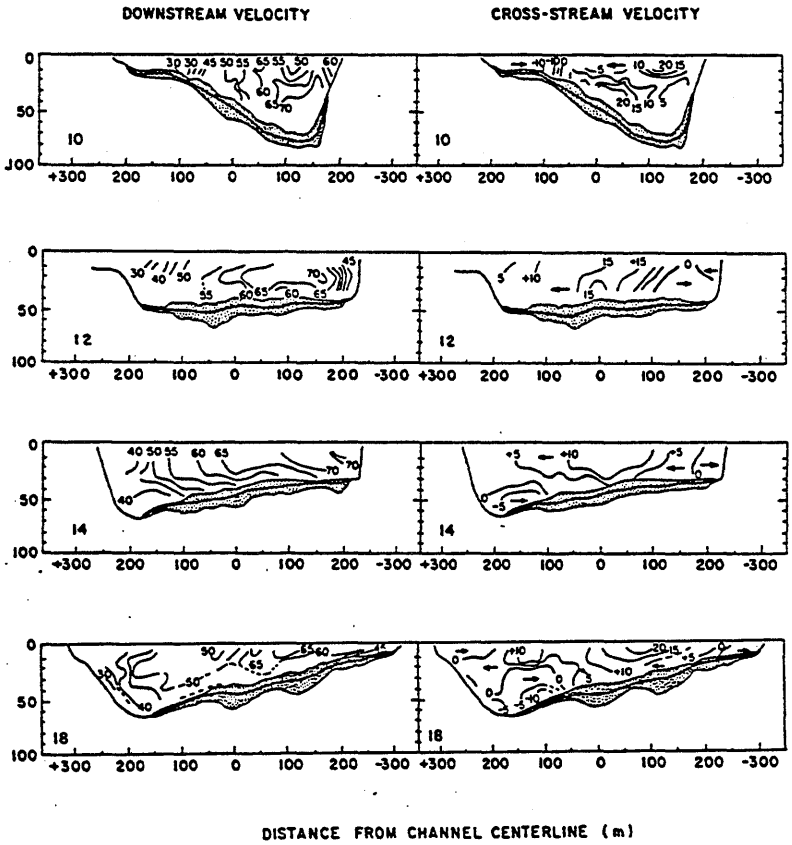


Fig. 11. Downstream view of cross sections of isovel (equal velocity) surfaces and downstream and cross-stream components of flow. The contour interval is 5 cm/s. Three lines at channel bed are the mean and range of depth determined from repeated measurement during a 2-hour period. Arrows indicate direction across the channel. Large numbers in the lower left-hand corners are the section numbers. The vertical axis is the depth in centimeters, and the horizontal axis is the distance from the channel centerline.

a mean velocity of 60 cm/s this would cause the water surface to rise by less than 1 mm, that is, less than reading error.

Results and Discussion

Downstream and cross-stream components of flow. The downstream and cross-stream components of the velocity field through the nine sections of the study site are given in Figure 11. The 1978 downstream velocity field is similar to the 1976 mean flow field published by *Dietrich et al.* [1979]. It consists of a high-velocity core that shifts from the inside to the outside channel with distance through the bend. This pattern is the same in both sets of data and agrees with the general flow pattern described by *Leopold and Wolman* [1960, pp. 780–781].

Figure 11 indicates that there are three typical patterns of cross-stream velocity at any section: flow near the bank that is opposite to the general pattern of cross-stream velocity flow, either all inward or all outward; outward flow near the surface and inward flow near the bed. The flow direction along the inner bank is opposite to the main flow direction from sections 12 to 18. This is due in part to the bank irregularity upstream of section 10 (Figure 4) that tended to deflect flow away from the inner bank. It is also due to channel widening downstream to section 18 (Figure 7). A region of secondary circulation opposite to the main flow pattern exists along the outer bank from sections 18 to 22. This arises where the maximum velocity in vertical profiles near the bank is some distance below the surface. Centrifugal acceleration is equal to the square of the downstream velocity divided by the local radius of curvature. The centrifugal acceleration forces the fluid toward the outer bank and causes significant vertical velocities at the bank. If the maximum velocity is at the surface, the vertical velocities at the outer bank will be directed toward the bed, whereas if the maximum velocity is suppressed below the surface, then the vertical velocity will be directed upward in the upper part of the flow and downward in the lower part. Further discussion of the process can be found in the paper by *Bathurst et al.* [1979]. An upward velocity near the bank is associated with a surface flow directed away from the bank, as found along the outer bank at sections 18 through 22. In contrast, the outward flow direction at sections 24 and 25 along the outer bank is due to a bank irregularity just upstream of section 24.

In the region away from the channel banks (toward the left bank) an outward cross-stream velocity extends throughout the entire water column across the width of section 12 and over the point bar from section 14 through section 19B. Beginning along the inner bank at section 22 and extending through section 25, the cross-stream velocity is directed toward the right bank, which at sections 24 and 25 is an outward direction. In contrast, the outward cross-stream flow at the surface and the inward cross-stream flow near the bed were confined to the 20 or 30% of the channel width (sections 14 through 22) where the depth of flow was greatest.

The pattern of cross-stream velocity in the region away from the channel banks agrees well with the observations by *C. Yen* [1967] and *Onishi* [1972] that were discussed previously. Figure 12 is a map of the direction of flow recorded in the current meters nearest the bed (5 to 10 cm above the bed). This map is very similar to the one presented in Figure 5. Figure 13 shows that the outward velocity over the point bar occurs where the depth decreases downstream, as found in the Yen data.

The ratio of the cross-section to downstream discharge and the direction of the discharge vector are listed in Table 2. Through the crossing and into the center of the bend, the discharge vector is oriented 4° to 7° toward the outer bank in relation to the centerline path. This is due almost entirely to forcing of the flow around the point bar. Downstream of the center of the bend, the cross-stream discharge drops rapidly to a small net inward discharge, and the discharge vector nearly follows the centerline path. This pattern of discharge through the bend is similar to that measured by *C. Yen* [1967, p. 102, Figure 20] in the equilibrium bed channel described previously. Yen found that the discharge vector increased from 7° in the crossing to 11° in the center of the bend, in relation to the channel centerline, and reduced to a slight inward discharge in the downstream end of the bend.

Analysis of several other field and laboratory studies indicates that where a zero-net cross-stream discharge has not been imposed on the data, outward flow over the upstream, shoaling part of the point bar is a general feature. *Leopold and Wolman* [1960] report the downstream and cross-stream velocity fields for four sections through a gravel-bedded river meander at bank-full conditions. The data are given in relation to section orientations selected in the field. We have already shown that if chosen carefully, this orientation should be close to the satisfying continuity. Their data demonstrate a strong outward flow over the upstream part of the point bar (Figure 14). The cross-stream velocity pattern of outward flow at the surface and inward flow near the bed is also confined to the deepest portions of the channel cross sections.

In Figure 15 we reproduce an illustration used by *Kondrat'yev* [1968] in his article on meandering processes. The data are from laboratory experiments by Z. M. Velikanova. Clearly depicted are outward oriented near-bed velocity vectors in the region of shoaling flow over the point bar.

Jackson [1975] studied general patterns of flow, particle size, and bed topography of the sand-bedded Wabash River. He showed stick diagrams of near-bed velocity vectors and also isobath maps of three bends of varying curvature. In all three bends, regions of outward flow are strongly correlated with shoaling areas or point bars. *Hickin* [1978] measured flow components at nine successive bends on the Beatton River, Canada. The channel became progressively less sinuous downstream and wider and shallower. Cross sections were quite far apart, and orientations were determined in relation to a measure of mean flow orientations. At five of the bends, relatively simple cross-stream velocity patterns could be deciphered. Of these five, three showed outward flow over the inside part of the point bar; one narrowed and deepened in the bend and showed no outward flow; and one showed an inward flow over the point bar, but this was associated with a 3-times downstream increase in velocity in the downstream direction. Hickin argued that there was little downstream carry-over of previous bend flow structures. He also used an approximate form of the continuity equation to reason correctly that there is net transport of water toward the concave bank.

Two data sets that have been used to test flow theories are those of *Bridge and Jarvis* [1982] and *Rozovskii* [1957]. At the entrance to the bend of the South Esk river studied by

Bridge and Jarvis, flow depth decreases rapidly by about one half over the inside part of the point bar (Figure 16*a*). In this region the area of highest velocity shifts outward, and the magnitude of the velocity increases by about 15%, but the average downstream velocity in the shoaling area changes little. In order to satisfy continuity there must be a large cross-stream discharge. Data shown in diagrams in the paper by *Bridge and Jarvis* [1982] were used with (5) and (23) to compute the vertically averaged cross-stream velocity at intervals across their section 6. Because of the large distance between sections a forward difference calculation was performed. The average cross-stream velocities required by continuity are shown in Figure 16*a*. Our calculations gave a slightly higher downstream discharge at section 7 than at section 6, so before (5) and (23) were employed, the discharge at section 7 was set equal to that of section 6 by reducing downstream mean velocities at section 7 by 10% (the computed difference in discharge).

Net cross-stream discharge was found to be 12.6% of the downstream discharge, and the discharge vector was 7° toward the outer bank relative to the centerline path. These values are quite similar to those for the Muddy Creek study site and for the equilibrium bed flume of *C. Yen* [1967]. The structure of the cross-stream velocity field is not easily corrected, so we simply indicate in Figure 16*a* a uniform outward flow that would satisfy continuity. Because the velocity field reported by *Bridge and Jarvis* [1982] shows little vertical variation over the shallow part of the point bar, the corrected uniform outward flow is probably close to the correct vertical structure. Outward flow near the bed probably also occurred over the inner one third of the channel at section 5.

Rozovskii [1957] explicitly oriented individual velocity profiles so that no net discharge occurred. This yields the correct circulation (as defined in fluid mechanics; see *Raudkivi and Callander* [1975, p. 98], for example), but not the correct cross-stream velocity field. Figure 16*b* indicates that as in the Bridge and Jarvis case, the reported data conflict with those required by continuity. Rozovskii's sections were too far apart to apply (5) and (23), so a quantitative correction cannot be made.

Water surface topography. Figures 17 and 18 give a contour map of the water surface topography and longitudinal profile of the water surface along the centerline. The general pattern of superelevation and resultant flattening of the downstream slope along the oustide bank and steepening along the inside bank is similar to that found in other natural river meanders [*Eakin*, 1935; *Leopold*, 1982; *Bridge and Jarvis*, 1982]. The maximum superelevation at section 18 occurs just downstream of the radius of curvature minimum. Average maximum difference in elevation across the channel at sections 14 through 22 was 2.0 cm, as compared to a total elevation lowering of only 3.5 cm from the upstream crossing (sections 10 to 12) to the downstream crossing (sections 22 to 24). The average cross-stream slope was 2.7 times greater than the centerline downstream slope between sections 12 to 18. From the centerline to the outer channel bank in this region, although the downstream velocity was 40 to 60 cm/s (Figure 11), the downstream slope was zero or negative. This implies that the downstream velocity through this region is controlled by the inertial forces (convective accelerations) acting on the flow.

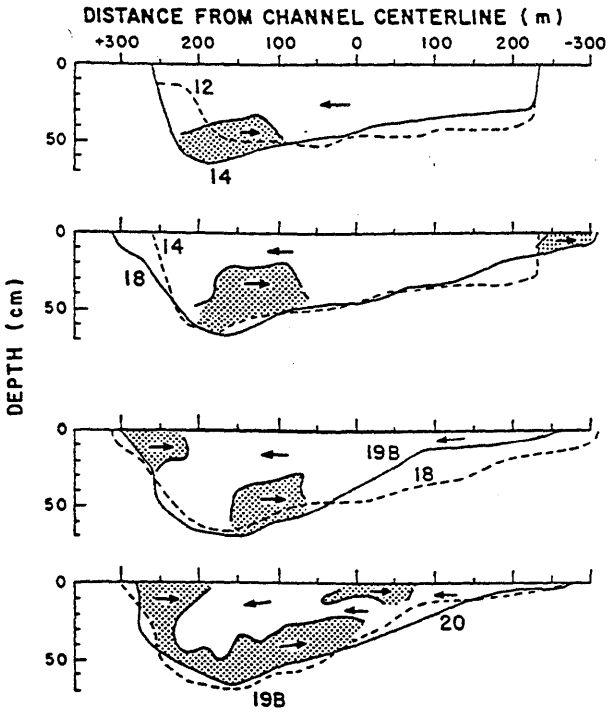


Fig. 13. Distribution of inward and outward velocity at successive cross sections through the bend. The arrow indicates direction of motion in this downstream view of the sections. The channel outline represented by the solid curve is the more downstream of the two sections portrayed, and the pattern of cross-stream velocity applies to that section.

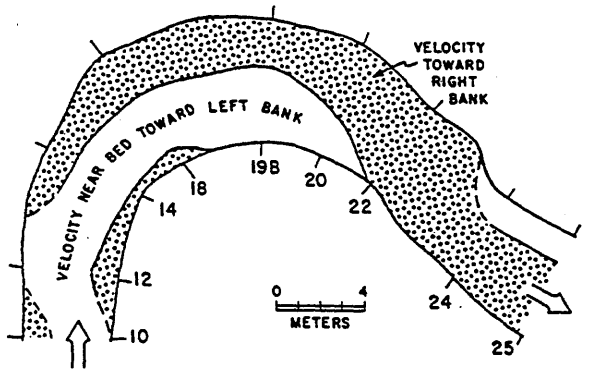


Fig. 12. Direction of flow near the bed, as determined with the current meter data shown in Figure 11. The left bank is the outside bank in the bend between sections 12 and 22 and the inside bank between sections 24 and 25.

TABLE 2. Cross-Stream Discharge

Section	Percentage of Downstream	Angular Deviation From Downstream, deg
12	7.0	+4.0
14	6.6	+3.8
18	10.7	+6.1
19B	11.8	+6.7
20	0.7	+0.4
22	3.1	−1.8
24	3.1	−1.8
25	19.8	−11.2

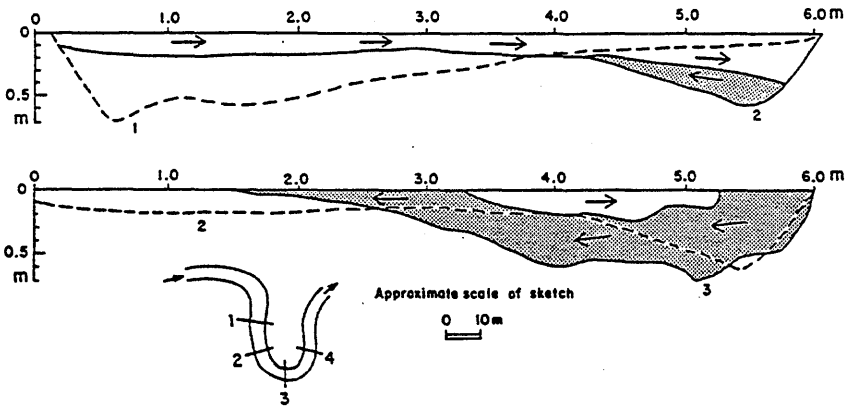


Fig. 14. Successive cross sections on Baldwin Creek reported by *Leopold and Wolman* [1960]. Shoaling region over point bar showed strong outward flow throughout the water column.

The longitudinal profile of the centerline (Figure 18) flattens between sections 14 and 19. This bulge in the profile is similar to that found in the equilibrium bed channel by *Yen and Yen* [1971] (Figure 1*d*). The reduced pressure gradient along the centerline occurs in large part because of drag caused by bar and pool topography, and the net outward velocity over the point bar (i.e., $\int_{-w/2}^{0}(\partial\langle u_s\rangle h/\partial s)\,dn$ is negative in (6)). This effect is discussed in some detail by *Smith and McLean* [1983].

Components of the force balance. An attempt was made to use (2) and (3) to compute the downstream and cross-stream boundary shear stress from the observed water surface topography and components of the velocity field. This was not successful for several reasons. The magnitudes of the convective acceleration terms were found to be very large, often 10 times greater than the downstream pressure gradient, and errors in their estimation dominated the solution. These errors dominated because the two downstream forces due to convective acceleration (second and third terms in (2)) tended to be of opposite sign and cancel: small errors would give a net difference between the two terms of the same magnitude as the downstream pressure gradient force. The errors occurred probably because there were an insufficient number of cross sections and too low a density of measurements at each cross section completed. It was also found that the water surface topography would have had to have been surveyed accurately to a fraction of a millimeter to allow sufficiently precise calculation of the downstream and cross-stream pressure gradients, and the available instrumentation did not permit this.

Qualitatively, the analysis supports and adds to the findings of *Yen and Yen* [1971] presented in Figure 1 for the equilibrium bed model. In the upstream end of the bend in Muddy Creek, as in the equilibrium bed model, the two terms arising from downstream convective acceleration (equation (2)) were large and tended to be of opposite sign. The data, however, indicate that these terms are smallest and tend to change sign at the channel centerline, where Yen and Yen performed their calculations. For example, data for section 14 in Muddy creek are plotted in Figure 19. Note the large magnitude and cross-stream variation of $-[\rho/(1-N)]\,\partial\langle u_s^2\rangle h/\partial s$ and $-\rho\,\partial\langle u_s u_n\rangle h/\partial n$. It could well be that

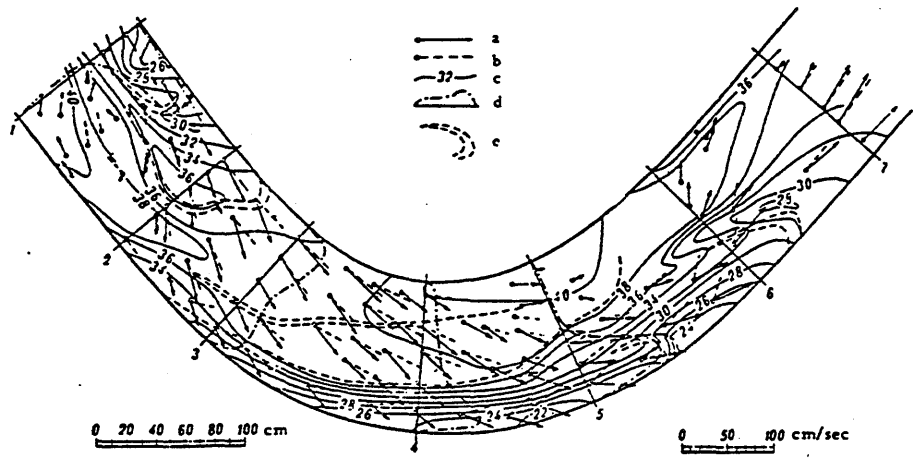


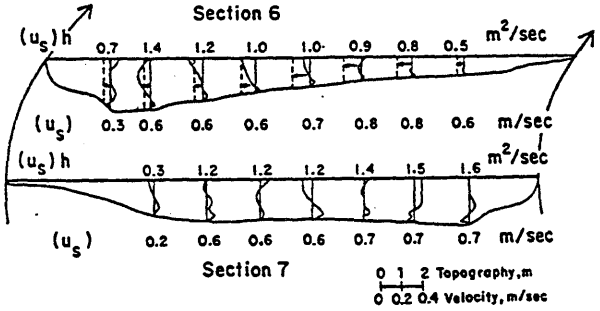
Fig. 15. Reproduction of illustration used by *Kondrat'yev* [1968], p. 323, Figure 16] showing the pattern of flow and bed topography in a laboratory channel at high Froude numbers: (curve *a*) surface velocities, (curve *b*) bottom velocities, (curve *c*) contour lines of the bottom (centimeters), (curve *d*) discharge distribution curves, and (curve *e*) bar contours. Kondrat'yev had reported curve *a* as bottom velocities, but this is clearly a misprint. Note strong outward bottom velocities in the shoaling region over the point bar.

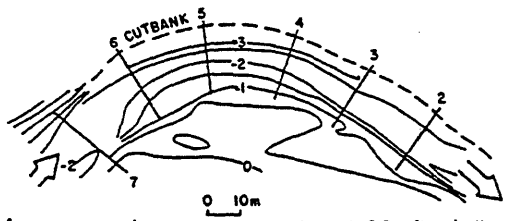
despite the precision and accuracy with which their laboratory data were collected, Yen and Yen may have also found that in the region away from the centerline the convective accelerations were too large to allow empirical computations.

In the region from halfway between sections 19 and 20 to just below section 22 (Figure 6) the bed topography varies little in the downstream direction, and correspondingly, the net cross-stream discharge is small (Table 2). Here the pattern of the forces due to convective acceleration is less well established, and, as Yen and Yen found in the downstream part of the equilibrium bed channel, the terms tended to be smaller and, in places, had the same sign.

In the Muddy Creek bend, the centrifugal force and cross-stream pressure gradient dominated the cross-stream force balance. The data were not of sufficient quality, however, to examine the imbalance found by Yen and Yen in the equilibrium bed model. Nevertheless, the data do suggest that both convective acceleration terms in (3) contribute to the total force balance.

Our analyses and those by *Yen and Yen* [1971] show that the downstream spatial acceleration term, $\rho\,\partial\langle u_s u_n\rangle h/\partial n$, in (2) is significant. Previous models for flow through river bends, such as the model by *Engelund* [1974], have omitted this term.





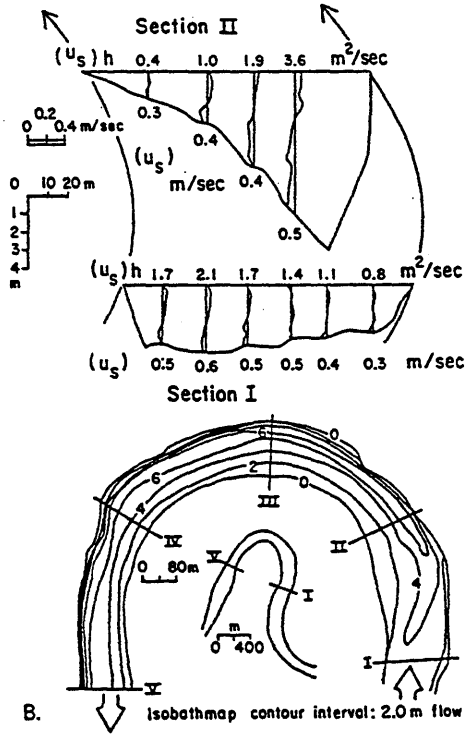


Fig. 16. Successive cross sections and flow fields at the entrance to river bends. (*a*) Data from *Bridge and Jarvis* [1982] for discharge of 19.6 m^3/s. Vertically averaged velocities and local discharge per unit width are shown and indicate that a strong outward flow must occur. The cross-stream velocity field reported by Bridge and Jarvis and that estimated from equations (5) and (23) are shown. (*b*) Data from *Rozovskii* [1957]. The need for a strong outward flow is indicated by the large reduction in the downstream discharge per unit width over the point bar.

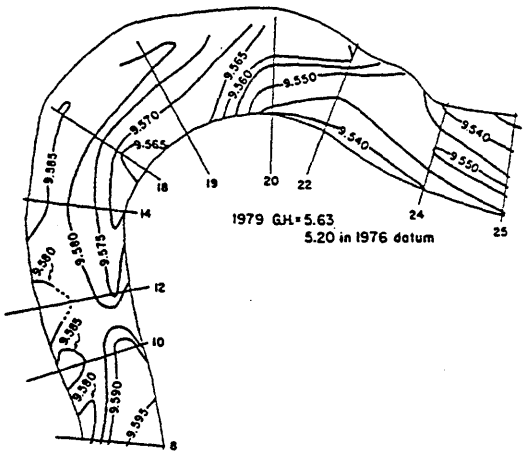


Fig. 17. Water surface topography during a constant discharge of 1.0 m^3/s. The contour interval is 5 mm. G.H. refers to the gage height on a staff plate near station 25.

CONCLUSION

The field data described here and the laboratory data presented by *Yen and Yen* [1971] demonstrate that the

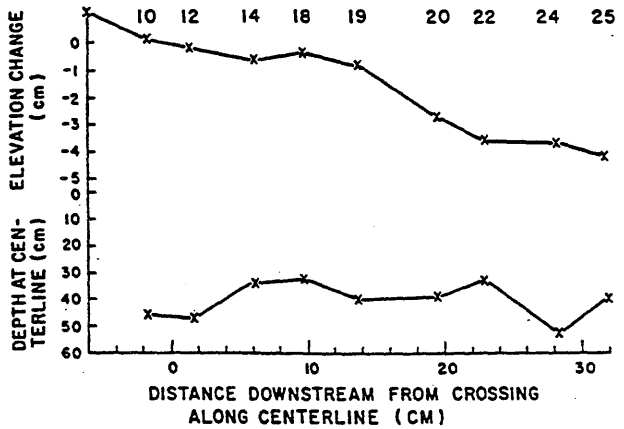


Fig. 18. Longitudinal profile of water surface and mean depth at centerline. The crossing between the successive bends occurs between sections 10 and 12 and sections 22 and 24. The zero elevation position was set at the upstream crossing.

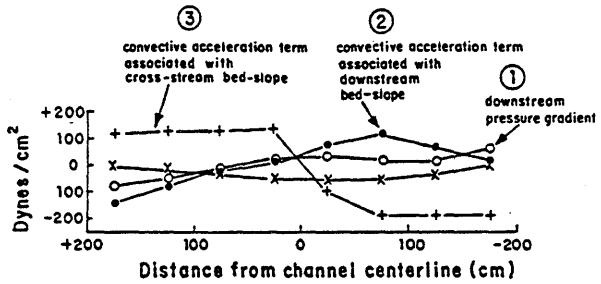


Fig. 19. Components of the downstream force balance, equation (2), for section 14 in Muddy Creek (see Figure 14 for location of the section). Numbered lines are as follows: (1) $[-\rho g h/(1 - N)]\ \partial E/\partial s$, (2) $-[1/(1 - N)]\rho\ \partial\langle u_s^2\rangle h/\partial s$, and (3) $-\rho\ \partial\langle u_s u_n\rangle h/\partial n$. The term $2\rho\langle u_s u_n\rangle h/(1 - N)R$ is represented by the crosses.

development of a point bar in a curved channel greatly modifies the pattern of flow and the downstream and cross-stream force balances. Channel curvature alone will cause the development of a high boundary shear stress zone near the inside bank, one that decreases in magnitude from the upstream part of the bend to the downstream end. Correspondingly, the boundary shear stress will increase near the outside bank in the downstream end of the bend. Downstream changing curvature will generate forces due to spatial accelerations that can be quite large if the curvature change is rapid. This was found to be the case at the abrupt transition from the straight section to the curved section in the flat-bottomed channel studied by Yen and Yen (Figure 1). A near balance in the centrifugal force and cross-stream pressure gradient results in a cross-stream velocity field through the bend consisting of outward velocity near the surface and inward velocity near the bed across the entire channel width (Figure 20*a*). If the downstream rate of change of curvature is also small, the high-momentum fluid near the inner bank crosses slowly toward the outer bank. G. Parker (personal communication, 1983) finds, however, that if the wavelength of the meander is about 10 times that of natural bends, a weak outward discharge may also develop at the bend apex in flat-bedded channels (Figure 20*b*). In a circular annulus or in a channel with a natural wavelength but with bed topography that does not vary in the downstream direction, net outward discharge also will not occur.

The development of downstream varying bar and pool topography alters this pattern of flow through a bend. Shoaling of flow over the point bar causes a large net outward discharge in the upstream part of the bend. An imbalance between the cross-stream pressure gradient and the centrifugal force results in outward velocity near the bed over the top of the point bar. Because of this the secondary circulation and the cross-stream velocity pattern are no longer equivalent. The cross-stream velocity pattern of outward velocity at the surface and inward velocity near the bed appears to be confined to 20 or 30% of the channel width, where depth of flow is greatest (Figure 20*d*). The net outward flow causes a substantial cross-stream outward transfer of momentum and thus contributes to a rapid outward shifting of the high-velocity core and of the zone of maximum boundary shear stress (see *Dietrich et al.* [1979] and *Dietrich* [1982*a*, *b*] for the pattern of boundary shear stress in the Muddy Creek bend).

In general, in a curved channel with bar and pool topography there is a tendency for the convective acceleration terms in the downstream force balance to be of opposite sign and to cancel in the upstream part of the bend. In the downstream end of the bend where the convective acceleration terms may be of the same sign, they are probably smaller in magnitude. Because of this there is a positive correlation between the downstream pressure gradient component and the downstream boundary shear stress. As a result, the general pattern of downstream boundary shear stress in a river meander can be roughly estimated from measurement of the water surface topography and calculation of the downstream pressure gradient. This pattern, however, cannot be sufficiently accurate to be used in quantitative modeling of sediment transport processes.

In a flat-bottomed curved channel the downstream decrease of the high boundary shear stress near the inside bank must cause the sediment transport rate to diminish, and net deposition of sediment must occur at the downstream end of the bend. Sediment deposition by this process contributes to emergence of the point bar. As the flow shoals, an outward component of boundary shear stress and thus sediment transport develops. This outward component of sediment transport across the point bar has been described by *Dietrich et al.* [1979] and is well documented elsewhere [*Dietrich*, 1982*a*]. An equilibrium point bar depth is established when the decreasing sediment transport along the inside bank is exactly balanced by topographically induced outward sediment transport.

Our analysis of the laboratory study by Yen and Yen and

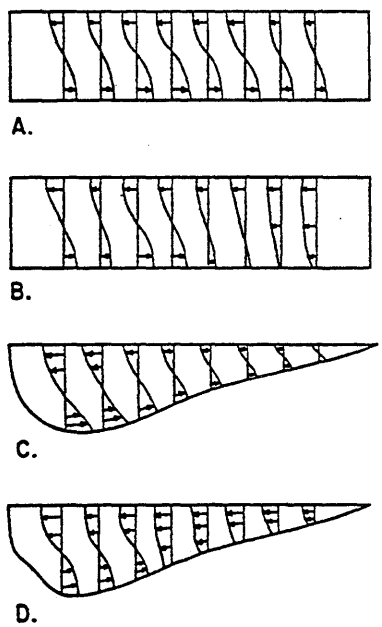


Fig. 20. Idealized pattern of cross-stream velocity in curved channels: (*a*) flat-bottomed channel, (*b*) flat-bottomed channel with wavelength about 10 times that of natural bends (G. Parker, personal communication, 1983), (*c*) channel with downstream varying bar and pool topography and assumed cross-stream velocity pattern and (*d*) channel with downstream varying bar and pool topography and observed cross-stream velocity pattern. Vertical lines indicate the positions of the measurements. The curves denote the magnitude of the cross-stream velocity in the direction indicated by the arrows. Note that the pattern of cross-stream velocity found in the flat-bottomed channel in Figure 20*a* is confined to the pool in Figure 20*d*.

of the field study that we performed on Muddy Creek indicates that the three major assumptions currently used in modeling flow and evolution of bar and pool topography in river meanders are, by themselves, insufficient. The pattern of cross-stream velocity assumed by previous authors of outward flow at the surface and inward flow near the bed (Figure 20*c*) is not as ubiquitous as has previously been thought. Instead, there is an outward flow over the top of the point bar. This means that the particle force balance used to determine bed morphology should include this effect such that net cross-stream sediment transported can be predicted. Forces arising from topographically induced convective accelerations are not small and cannot be ignored. Instead, we find the point bar at first emerging as a result of an inherent instability generated by channel curvature and then stabilizing as the flow and the sediment in transport are forced toward the pool.

NOTATION

- g gravitational acceleration.
- h local depth of flow.
- H_θ accumulated elevation change in downstream direction.
- L total distance downstream from midsection of straight channel.
- M meander wavelength.
- n cross-stream coordinate in curvilinear coordinate system.
- N the ratio, n/R, in curvilinear coordinates.
- Q_{sw} downstream component of water discharge.
- Q_{nw} cross-stream component of water discharge.
- r radius of curvature of channel centerline; cross-stream coordinate in cylindrical coordinate system.
- s distance downstream; downstream coordinate in curvilinear coordinate system.
- S_θ downstream water surface slope in cylindrical coordinate system.
- S_r cross-stream water surface slope in cylindrical coordinate system.
- S_c constant slope along channel centerline.
- t time.
- u_s downstream water velocity.
- u_n cross-stream water velocity.
- u_z vertical water velocity.
- u_m average water velocity at the midsection of straight channel.
- w width.
- z vertical coordinate in curvilinear coordinates.
- γ proportionality factor.
- θ downstream coordinate in cylindrical coordinate system.
- ν kinematic viscosity.
- ρ density of water.
- τ total deviation stress.
- τ_b boundary shear stress.
- $(\tau_{zs})_b$ downstream boundary shear stress in curvilinear coordinates.
- $(\tau_{zn})_b$ cross-stream boundary shear stress in curvilinear coordinates.
- Φ angular deviation of channel centerline from the down-valley axis.
- ψ angular deviation boundary shear stress vector from downstream direction.
- ω angle between the centerline and down-valley axis at the crossing between bends.
- E water surface elevation.
- E_c water surface elevation at channel centerline.

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William E. Dietrich, Department of Geology and Geophysics, University of California, Berkeley, CA 94720.
J. Dungan Smith, Department of Geophysics, University of Washington, Seattle, WA 98195.

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X. Current Design Parameter Considerations and Future Model Testing.

As with the design of dikes in the Mississippi River, there are no laws that are cut and dry. Because the conditions of the river are so variable, only qualitative values can be accessed to the impacts of dikes on the navigation channel. What may be extraordinary channel improvement over one particular year, may follow the next year with results not quite so impressive. The same applies to the Bendway Weir. Model tests show that for every successive hydrograph run, variable results were achieved, some better than others. Therefore, unless one were testing the Bendway weir concept with steady state conditions, including both flow and sediment, constant radius of curvature, perfect structure definition, etc. one could really not expect to come up with a golden set of design parameters.

However, some generalities can be used to help one intuitively design Bendway Weirs in bends and even straight reaches, knowing a few qualitative lessons learned from model testing. Also, as the actual prototype reacts with the present structures placed in the river, a better understanding of model to prototype correlation will be understood.

Height. The most efficient height of structures was 15 feet below the low water reference plane. This is the maximum height the structures could be built to in a navigation channel with a nine foot draft. If there were no navigation constraints, then the structures could be built higher and be even more efficient. But as a rule, to have any impact on the bend, the height of the structures should be at least 4\5 the height of top of bank, or 80% of the maximum bank height. This rule applies only to a navigable river where the main goal is to provide added width while still allowing the safe passage of tows over the tops of the structures.

If the main goal is stabilization of the toe of the bankline, then the Weirs could be built at much lower elevations. More research has to be done in this area on determining the minimum height of design required to form enough deposition on the outside of the bend to stabilize the bank. We do know that the height of deposition is approximately the same as the height of the structures.

Spacing. The spacing again is a variable that cannot be accurately tested unless steady state conditions are performed. As a rule, for obtaining maximum width in the bend, the spacing should be approximately the same distance as the width of the navigation channel at its narrowest point in the bend (usually at the point bar tip). In the case of Dogtooth Bend, this distance was measured as 700 feet.

Length. Of all the design parameters, this has seemed to be the most value for the dollar. The longer the structures can be built, the better the channel will become. There is a limit, though, on the amount of scour on the inside of the bend that will occur at a -15 LWRP height. The designers goal should be to build the structures as long as physically possible.

Of course, if one doesn't have a height constraint, then one would be able to build higher, shorter structures and achieve the same effects. More model research needs to be conducted in this area as well.