United States General Accounting Office

GAO

Report to the Honorable
Robert C. Byrd, U.S. Senate

August 1990

WATER RESOURCES

Corps of Engineers' Inspections of West Williamson Flood Wall Project

GAO

United States
General Accounting Office

Cincinnati Regional Office

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August 7, 1989

The Honorable Robert C. Byrd
United States Senate

Dear Senator Byrd:

This report responds to your request that we review the U.S. Army Corps of Engineers' inspections of the work by Metric Constructors, Inc., a contractor for a flood protection project in West Williamson, West Virginia. In your March 23, 1988, letter, you asked us to identify the types of inspection activities required by the Corps and to determine whether those activities were carried out in accordance with Corps procedures.

During the course of our work, we briefed your office on our preliminary results. Because we had not found anything at that time which would indicate that the Corps was lax in its inspection activities, your office agreed that additional work on this project was not necessary. Your office, however, requested that we prepare a written report describing the information we presented at the briefing. The results of our review are summarized below and discussed in more detail in the appendixes.

Background

The Corps of Engineers' contract with Metric Constructors, Inc., provides for Metric to build a levee with a flood wall on the Tug Fork of the Big Sandy River in West Williamson, West Virginia. This construction work, which will cost about $25 million, is part of a long-term flood protection project that covers a large area in western West Virginia, southwestern Virginia, and eastern Kentucky. The overall project involves flood control activities in the Big Sandy and Upper Cumberland River basins which will probably cost about $740 million. (See app. II.)

The basic policies for administering government construction contracts are contained in the Federal Acquisition Regulation. These policies require contractors and federal agencies to share responsibility for continually inspecting construction work to ensure that it is of high quality and fully conforms to contract requirements. The Corps has included the federal inspection policies in its regulations.

Results in Brief

Corps regulations require it to (1) ensure that contractors develop plans, establish organizations, and commit resources to independently inspect construction activities and (2) systematically oversee contractors' tests and inspections and perform independent inspections to confirm that the materials and workmanship meet all contract and project requirements. These inspection requirements, which are further explained in appendix III, were included in the Corps' contract with Metric, and in Corps procedures for overseeing Metric's work, respectively.

On the basis of our interviews of Corps and contractor officials and our limited review of selected inspection records and other documentation, we believe that the Corps took reasonable actions to ensure that the inspection activities for the construction work under the Metric contract were carried out in accordance with Corps requirements. For example:

- The contractor developed a quality control plan, approved by the Corps, which established an independent construction inspection activity at the work site. The chief inspector and his staff inspectors reported their inspection activities to the Corps on daily quality control reports as provided for in the plan.
- The Corps assigned inspectors to the work site who observed contract work on a daily basis, conducted tests and inspections, and prepared daily quality assurance reports. In addition, Corps management officials made periodic site visits to review construction progress and to oversee the work of Corps inspectors. (See app. IV.)

We conducted our review from April to December 1988, in accordance with generally accepted government auditing standards. Details of our objectives, scope, and methodology are presented in appendix I. The Assistant Secretary of the Army (Civil Works), on behalf of the Department of Defense, concurred with our report and offered no further comments. (See app. V.)

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to the Secretary of Defense, the Secretary of the Army, and other interested parties.

Major contributors to this report are listed in appendix VI.

Sincerely yours,

C. William Moore

C. William Moore
Regional Manager

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FAR Federal Acquisition Regulation

Objectives, Scope, and Methodology

Senator Robert C. Byrd's March 23, 1988, letter discussed information about construction activities at a Corps of Engineers flood protection project in West Williamson, West Virginia. Senator Byrd was particularly concerned because a former employee of Metric Constructors, Inc., had alleged that Metric encouraged him to overlook discrepancies in survey records and to disregard the improper installation of a drainage system.

We agreed with Senator Byrd's office to review the Corps of Engineers' oversight of Metric's construction activities rather than the specific allegations of the former Metric employee. More specifically, we agreed to (1) identify the inspection procedures the Corps has in place to ensure quality construction at the West Williamson flood protection project and (2) determine whether the inspection activities were carried out in accordance with these procedures.

During the course of our work, we briefed Senator Byrd's office on our preliminary results, which were based primarily on numerous interviews with Corps and contractor officials plus a limited review of several construction inspection reports and other related documentation. Because we had not found anything at that time indicating that the contractor or the Corps was lax in its inspection activities, Senator Byrd's office agreed that additional work on this project was not necessary. Nevertheless, Senator Byrd's office requested that we prepare a report describing the information we presented at the briefing. This report responds to that request.

To obtain a general understanding of the flood control project in West Williamson and to specifically address the two review objectives, we reviewed various project plans, financial records, and contract documents associated with the West Williamson flood control project. These reviews gave us a good understanding of the background, characteristics, and historical justification, not only for the West Williamson project, but also for other flood protection projects in the Big Sandy and Upper Cumberland River basins.

To identify and understand Corps construction inspection procedures, we reviewed (1) the Federal Acquisition Regulation which identifies governmentwide construction inspection requirements and (2) specific Corps regulations and publications which provide further implementing guidance for overseeing and inspecting the quality of construction activities. We also obtained clarification on these requirements by discussing them with Corps management and inspection personnel. This provided

us with an additional perspective on the personnel's knowledge of inspection requirements.

To determine if construction inspection was being carried out in accordance with Corps procedures, we did a number of things. First, we identified specific inspection activities required by Corps procedures and interviewed contractor and Corps officials to determine if the inspection procedures had been carried out. We then obtained and reviewed selected documents to assess the information told to us during the interviews. Finally, we attempted to corroborate information by talking with more that one person knowledgeable about the inspection activities. For example, to determine if Corps inspectors maintained a daily presence at the construction site and performed periodic inspections and tests, we talked to the inspectors as well as to contractor personnel who dealt daily with these inspectors. We also reviewed selected test reports which had been documented on daily inspection reports.

To further assess Corps inspections, we:

- Interviewed Corps and contractor officials to determine if inspectors met Corps qualification, experience, and training requirements. Our interviews included (1) Huntington District Corps Officials, such as the Chief of the Supervision and Inspection/ Quality Assurance Branch and the resident engineer at the Williamson office, and (2) three Metric Constructors' officials at the site, including the Project Engineer.
- Examined contractor and Corps inspection reports for the period September 1986 (when construction began) to August 1988, to determine if the reports were being prepared. We did not, however, evaluate the content of these reports or verify that the reported inspections had actually taken place.
- Randomly selected 29 Corps inspection reports (with the contractor's inspection reports attached) to satisfy ourselves that the inspection reports were being completed and filed in accordance with Corps procedures and discussed this with the resident engineer. This step also gave us some limited understanding of how familiar the resident engineer was with the inspection activities at the West Williamson site. We did not, however, attempt to verify that the inspections and tests actually took place.
- Obtained copies of trip reports, memoranda, and other documents prepared by Corps management officials who visited Metric's construction site. This step was done to verify information provided to us by management officials during earlier interviews and to document the level of

senior management attention given to construction activities at the West Williamson site.

Our work was performed from April to December 1988, in accordance with generally accepted government auditing standards.

Background on the Corps of Engineers' West Williamson Flood Wall Project

The Corps of Engineers' flood wall project in West Williamson, West Virginia, is part of a major long-term flood protection project that covers a large area in western West Virginia, southwestern Virginia, and eastern Kentucky. This $25.1 million project is part of the larger $740.2 million project being undertaken in this area.

History of Flooding in the Three-State Area

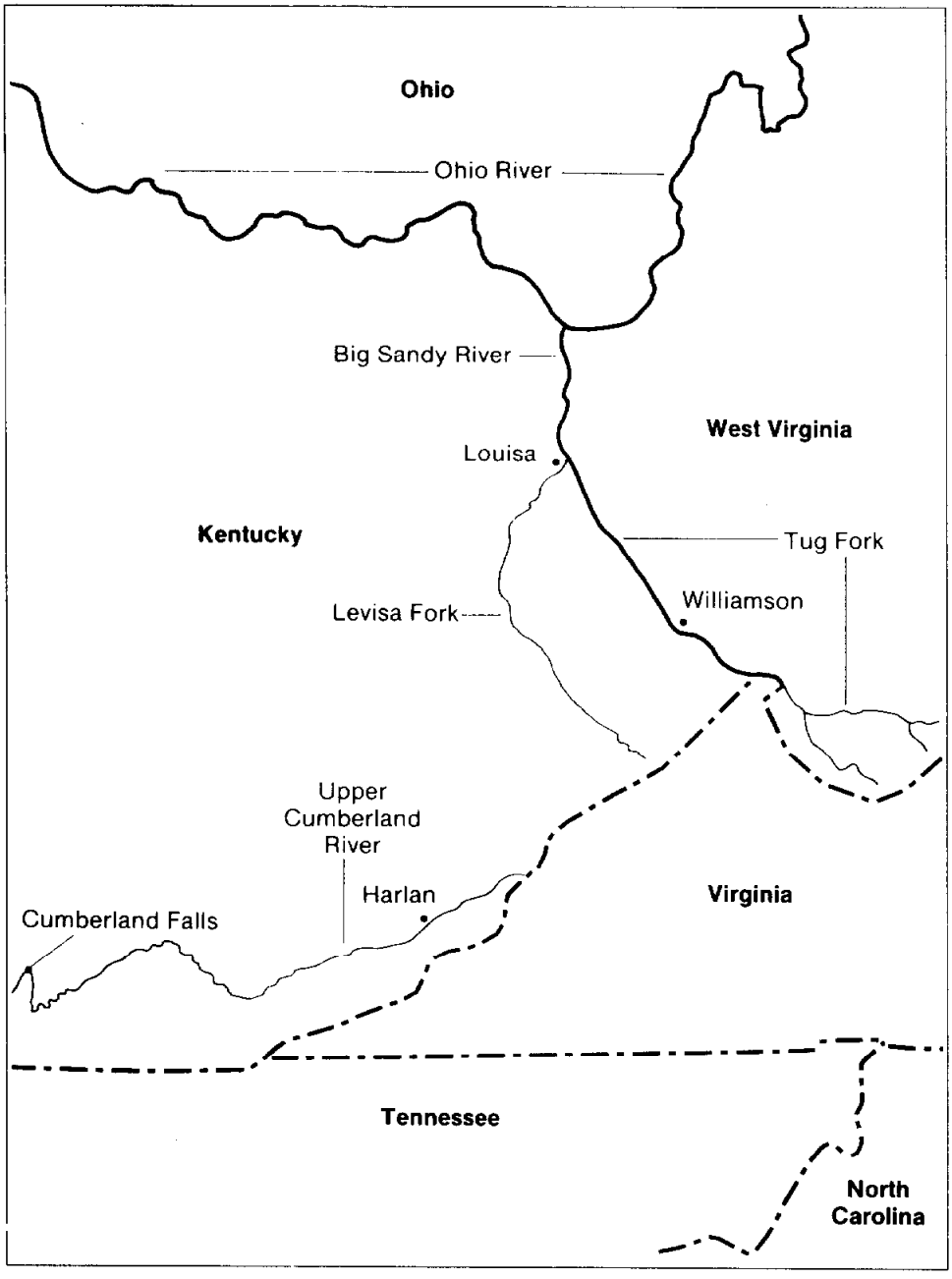
Since 1875, ten major floods have affected the Big Sandy and Upper Cumberland River basins, which cover an area of about 3,500 square miles in southwestern West Virginia, southwestern Virginia, and southeastern Kentucky. The area's record flood occurred in 1977, causing damage totaling $243.7 million. Over 6,000 structures were damaged in the Big Sandy basin alone.

The Big Sandy basin includes the Levisa Fork and Tug Fork, which flow northward and join at Louisa, Kentucky, to become the Big Sandy River, a tributary of the Ohio River. The Upper Cumberland River basin covers the area which stretches 132 miles in Kentucky southwestward from Harlan to Cumberland Falls. Figure II.1 depicts the area covered by the two basins.

The Corps' Ohio River Division and two of its districts—Huntington (W.Va.) and Nashville (Tenn.)—have continually made studies of the flooding problems in the project area. The Huntington District, which is responsible for the Big Sandy basin, has led most of the studies. Other studies have been conducted by the state of West Virginia, the Commonwealth of Kentucky, the Appalachian Regional Commission, and the Battelle Memorial Institute.

In response to the flooding problems in this part of the country, the Congress enacted legislation (Sec. 202 of the Energy and Water Development Appropriation Act of 1981—P.L. 96-367) which authorized funds for a large flood control project for both basins. The total estimated federal cost of the project, according to the fiscal year 1990 Corps estimate, is $721.7 million. Another $18.5 million is expected from nonfederal sources (such as state and local governments) through cost-sharing arrangements. Initial funds were allocated in fiscal year 1981. As of February 1988, about $160 million of federal funds had been allocated to the project. The construction of the West Williamson flood wall is the first major project undertaken as part of the congressionally approved program. West Williamson is located in the Tug Fork Valley.

Figure II.1: Levisa Fork and Tug Fork of the Big Sandy River



Source: U.S. Army Corps of Engineers

Impact of Floods in the Tug Fork Valley

The Tug Fork Valley, which crosses seven counties between Louisa, Kentucky, and Welch, West Virginia, is about 140 miles long and receives runoff water from about a 1,555-square-mile area. While the Big Sandy basin's width averages about 25 miles, the Tug Fork Valley and most of its tributary valleys are extremely narrow. Heights range from 500 to 1,500 feet above the river valley, and surface slopes of 45 degrees or more are common. Level land, therefore, is very limited and most of it is located along the Tug Fork, where the tributary streams join the fork.

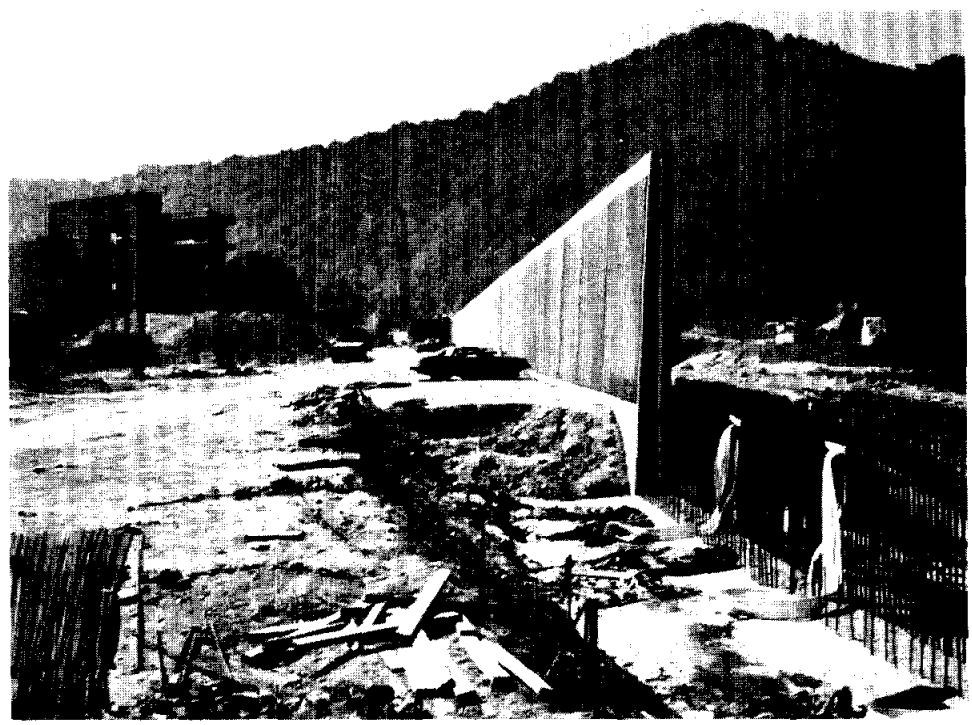
Coal has been the primary economic base of the area's economy since the turn of the century, and mining has brought pressures for land development in the valley. The area has about 166 billion tons of unmined low-sulfur coal, and currently produces 8 to 10 percent of the nation's total coal output. Repeated flood disasters and losses have weakened the area's economic capability to support national coal needs.

Only two local flood protection projects have been previously completed in the valley. One is a flood wall in Williamson's central business district built in the 1950s. The second project, built by the Corps in the early 1970s, is a flood wall protecting the Appalachian Regional Hospital in South Williamson. This wall was just high enough to protect the hospital during the 1977 flood.

The West Williamson Flood Control Project

The major construction project in the Tug Fork Valley is a levee, with a concrete flood wall on top, in West Williamson. The flood wall is about 6,000 feet long and 27 feet high. Work was started in September 1986 by Metric Constructors, Inc., and is estimated to cost $25.1 million. Metric's contract work includes constructing 4 flood wall gates, rerouting 1,300 feet of river channel, relocating portions of a nearby road, and building a retaining wall. Another contractor built a pump station, which is needed to drain storm sewer and flood waters that get behind the flood wall. Construction of the flood wall, which sits atop the levee, was completed in December 1988, about a year ahead of schedule. Finishing work, such as paving, landscaping, and cleanup was all that remained to be completed. Figure II.2 shows the concrete wall being constructed on top of the levee. Figure II.3 shows the project as of December 1988.

Figure II.2: West Williamson Concrete Wall Under Construction



Source: U.S. Army Corps of Engineers.

Figure II.3: Nearly Completed Floodwall Atop the Levee

Source: U.S. Army Corps of Engineers.

Corps Regulations Require Both Contractor and Corps Inspections

The Federal Acquisition Regulation (FAR) (48 CFR) includes the basic policies for administering government construction contracts. These policies (Part 46) require contractors and federal agencies to share inspection responsibilities to ensure that construction work is of high quality and conforms to contract requirements. These policies have been implemented by Corps of Engineers Regulation Number 1180-1-6.

The FAR requires government agencies to charge contractors with the responsibility for accomplishing the inspections and tests needed to ensure that services and supplies conform to federal contract quality requirements. Accordingly, the nature and quality of the products and services required by the government and agreed to by contractors are established in contract specifications. The FAR also directs federal agencies to oversee contractor inspection and testing activities. For example, agencies are required to ensure that contractors maintain acceptable inspection systems and furnish records of their inspections. Agencies are also required to make selected tests of the contractor's work while work is in progress.

The Corps' implementing regulation describes the contractor responsibilities, and how agency officials should oversee contractor's work. Further inspection guidance is also provided in other Corps regulations and publications. These requirements, which are further explained below, were included in the Corps' contract with Metric, and in Corps operating procedures for overseeing Metric's work, respectively.

Contractor Responsibilities

Contractors have primary responsibility for the quality of their construction work and for meeting contract specifications. The FAR and the Corps' implementing regulation, cited above, require contractors to establish a Contractor Quality Control system to manage, control, and document contract activities to meet all contract requirements. Corps regulations require the contractor quality control system manager to report to a project manager, or someone higher in the contractor's organization, to ensure that key contractor officials are directly aware of inspection activities and results.

The regulations also require the contractor quality control system manager to prepare a quality control plan and for the government contracting officer (or his representative) to approve the plan before work begins. The plan must outline the system's organizational structure; list the type and qualifications of the staff assigned; describe the duties and reporting methods to be used; and provide oversight over all subcontractors, suppliers, and testing laboratories.

The contractor's quality control staff is required by the regulations to make on-site inspections to ensure that construction work conforms to contract plans and specifications. Besides inspections, the staff is primarily responsible for seeing that equipment and construction materials are tested, either by contractor personnel or by qualified testing laboratories.

The Corps' regulation requires the contractor's quality control staff to make four different types of inspections during the construction, depending on how far along work has progressed:

- A preparatory inspection is to be made before construction begins on any definable project segment. The quality control staff reviews contract requirements, checks equipment and materials to be used, makes sure that a workable system for control testing has been set up, and checks the site to see that preparation work has been done.
- Once work is underway, an initial inspection is to be made by the quality control staff to determine if the tests required by the quality control plan are being made and if the work being accomplished meets contract specifications.
- Follow-up inspections are to be performed by the quality control staff every day until a particular feature of work is finished to ensure that contract requirements are being met on a continual basis.
- A completion inspection is to be made when work is finished. The staff is to inspect the finished product and make a list of items not conforming to plans and specifications. Steps are to be taken to correct any problems found, and additional completion inspections are to be made until all problems on the list are resolved.

The Corps' contracting officer, or his representative, and the contractor decide how the inspections and tests are to be documented soon after a contract is awarded. The decisions are to be included in the contractor's quality control plan.

Corps Responsibility

The job of the Corps is to make sure that the contractor's quality control system meets requirements. To do this, Corps contracting officers (who are primarily responsible for monitoring contractor performance) appoint a Corps resident engineer as their representative to administer construction contracts.

The Corps' resident engineer has an inspection staff, known as the Quality Assurance staff, to assist in administering the contract. The Corps' resident engineer and staff are responsible for

- carrying out on-site supervision and oversight of contracts, including interpreting contract plans and specifications;
- monitoring the contractor's quality control activities and daily reports to ensure that sufficient qualified inspectors are on-site and performing the required inspections and tests;
- conducting quality assurance inspections, documenting inspection results, performing independent tests of the materials used during construction, and preparing daily activity reports; and
- enforcing compliance with contract specifications, and reporting progress and problems to the contracting officer.

General guidelines and procedures for Corps on-site inspections and tests are outlined in the Federal Acquisition Regulation and Corps regulations, manuals, and pamphlets. Specific inspection and testing requirements depend on the specifications in each contract. The government's quality assurance plan, which is prepared by the Corps' resident engineer and approved by the Corps' contracting officer, includes the inspections and the type and number of tests needed to verify the contractor's test procedures and results.

The Corps requires that the quality assurance staff should observe about 10 percent of the contractor's tests. The extent of the inspection activities and the number of quality assurance tests to be performed, however, depend substantially on the confidence of the Corps in the contractor's quality control system and the consistency of the contractor's and the Corps' inspection and test results.

Inspection Activities Were Undertaken in Accordance With Corps Requirements

The contractor and the Corps had assigned inspectors to the construction work site at the start of construction work. Each developed inspection plans as required by federal policies and Corps procedures and inspected the construction work performed under Metric's contract. On the basis of our interviews of contractor and Corps officials, our reviews of the contractor's and Corps inspection plans, and our limited reviews of selected inspection records and other documents, we believe that the Corps took reasonable actions to ensure that construction inspection activities were carried out in accordance with Corps requirements.

By the time the Metric contract was awarded, the Corps had appointed a resident engineer to oversee all contractor work in the Williamson area and provided him with staff. The resident engineer assigned to the Williamson area is a graduate engineer who, according to a key Corps official, has extensive and varied experience and training with the Corps. According to this engineer, he and two or more experienced and trained inspectors have inspected Metric's work since construction began. Although his office was initially located about an hour from Williamson, the resident engineer told us that he regularly visited the construction site twice a week to ensure that Corps on-site quality assurance staff were properly performing their daily inspections. His statement was confirmed by other Corps inspectors as well as contractor personnel. As contract work increased, the Corps opened new office and testing facilities in Williamson in December 1987, and the resident engineer was reassigned to work full-time in the Williamson area.

As required by the Corps' regulation, Metric submitted a quality control plan which was reviewed and approved by the resident engineer. According to the engineer, he required Metric to make several changes prior to approving the plan. In addition, he said he required changes as construction activity and conditions changed. While we neither assessed the adequacy of the plan nor the changes referred to by the resident engineer, we did read segments of the plan to get a general understanding as to whether it complied with contract requirements and other Corps requirements. The plan, for example, showed that Metric was to establish a quality control organization to meet the contract requirements for an independent contractor inspection activity. The plan called for Metric's chief inspector to report directly to a Metric vice-president who was not involved in day-to-day construction activities. (The chief inspector, however, was to report daily inspection results to Metric's on-site project director to facilitate prompt corrective actions.) Officials from both Metric and the Corps confirmed that Metric's quality control

organization was established—and functioned—in accordance with the approved plan.

The quality control plan also provided for Metric to furnish the resident engineer with a list of its inspectors and their qualifications, and to identify testing arrangements to be used (e.g., consultants or testing facilities at other locations). The resident engineer and Metric's project manager said that Metric has used from one to six qualified inspectors since the contract began, depending on the extent and type of work underway at a particular time. They also said that at times, Metric had provided subcontractors to meet Corps inspection and test requirements.

Metric prepared daily inspection reports and submitted them to the resident engineer in accordance with their quality control plan. The Corps' quality assurance staff also prepared daily quality assurance reports for the resident engineer, which described Corps inspection activities and observations. Both of those reports were filed at the resident inspector's office in West Williamson. We examined those reports for the period between September 1986—when construction work began—and August 1988, to determine whether the required reports were being prepared. Signed reports were on file for the entire period.

We also reviewed 29 of the daily reports in more detail. We discussed their contents with the resident engineer and requested him to confirm that all inspection requirements had been met by contractor and Corps inspectors. The resident engineer told us that either he or his staff had been at the site on each of these days and that all required inspections and tests had been made and documented in accordance with Corps requirements.

The resident engineer's activities were periodically reviewed by Corps management site visits. Corps management has made various site visits to the project since 1986. For example:

- The Chief of the Construction Division from the Corps' Huntington District, who supervises the Corps' resident engineer in Williamson, made visits to the project area monthly to discuss and assess construction activities. Although he had prepared written records of only a few visits, the resident engineer stated that the chief and his staff had often provided supervisory guidance to administer the contract and to propose language for contract changes.
- The Huntington District's construction and engineering divisions sent teams of two or more professional staff members to the construction site

about once a month to view the work being accomplished. They recorded their observations and recommendations in trip reports. For example, during April and May 1987, engineers and geologists submitted trip reports with their observations on several activities, including the removal of material which was not suitable to support the floodwall, the excavating and setting of a sewer line, the selection and placement of stone slope protection, and the construction of a parking lot and a retaining wall adjacent to a major road. The trip reports stated that the work was satisfactory.

- Corps of Engineers headquarters personnel from Washington, D.C., visited the Williamson area in May 1988. They looked at design and construction execution, quality assurance management, contract administration, and adherence to Corps regulations. Their report stated that the contractor's quality control plan was sufficient to provide effective management. They also made minor recommendations to improve such matters as the use of plastic pipe, coating of underground conduits, and the design of inspection report forms.
- The Huntington District office commander conducted an inspection of the West Williamson resident engineer's office in August 1988. The Chief of the Construction Division and two of the division branch chiefs participated in the inspection. This inspection included reviews of various records in the office, such as quality control and quality assurance documentation, to see if contract administration procedures were being followed. The report concluded that contract administration had been satisfactory.

Conclusion

On the basis of our interviews of Corps and contractor officials, and our review of inspection plans, selected inspection records and other documents, we believe that the Corps took reasonable measures to ensure that construction inspection activities were carried out in accordance with its requirements.

Comments From the Department of the Army

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

17 MAY 1989

Mr. James Duffus III
Director
Natural Resources Management
  Issues, Resources, Community,
  and Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Duffus:

This is the Department of Defense (DOD) response to the General Accounting Office (GAO) draft report, "WATER RESOURCES: Corps of Engineers' Inspections of West Williamson Flood Wall Project," dated May 3, 1989 (GAO Code 140834/OSD Case 7976).

The DOD has reviewed the report, concurs with the findings and conclusions, and has no further comment. The Department appreciates the opportunity to review the draft.

Sincerely,

Robert W. Page
Assistant Secretary of the Army
(Civil Works)

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