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R-009-204.40

DRAFT EVALUATION OF ALTERNATIVES DOCUMENT FOR THE REHABILITATION OF THE MAIN OUTFALL LINE AND REMOVAL SITE EVALUATION FOR THE REGION BETWEEN MANHOLES 179 AND 180

01/15/91

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DOE-FN USEPA
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REPORT

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JAN 1 5 1991

DOE-593-91

Ms. Catherine A. McCord, Remedial Project Director
U. S. Environmental Protection Agency
Region V - 5HR-12
230 South Dearborn Street
Chicago, IL 60604

Dear Ms. McCord:

DRAFT EVALUATION OF ALTERNATIVES DOCUMENT FOR THE REHABILITATION OF THE MAIN OUTFALL LINE AND REMOVAL SITE EVALUATION FOR THE REGION BETWEEN MANHOLES 179 AND 180

Enclosed for your information are the Draft Evaluation of Alternatives Document for the rehabilitation of the FMPC Outfall Line from Manhole 177 to the Great Miami River and a Removal Site Evaluation for the Potentially Leaking Effluent Line Section between Manholes 179 and 180.

The Evaluation of Alternatives Document contains the evaluation of repair alternatives, including a cost analysis of hydrostatic testing and Insituform relining. Also, enclosed are comments, dated December 13, 1990, and DOE responses.

If you have any questions, please contact Carlos J. Fermaintt at FTS 774-6157.

Sincerely,

Andrew P. Avel

Andrew P. Avel
FMPC Remedial Action
Project Director

DP-84:Fermaintt

Enclosure: As stated

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USEPA COMMENTS AND DOE RESPONSES FOR EVALUATING AND REHABILITATING THE MAIN OUTFALL LINE

COMMENT:

1. **U.S. DOE should state the purpose of the field work in the Work Plan Addendum.**

RESPONSE:

This is not a Work Plan Addendum. The testing and rehabilitation activities described in the Evaluation of Alternatives document will be conducted as a Removal Action as stated in the Removal Action Memorandum.

COMMENT:

2. **The procedures used to test the integrity of the pipeline are capable only of detecting leaks under low-pressure conditions, such as gravity flow in sewer pipe constructed of vitrified clay or concrete. The outfall pipeline is constructed of cast-iron and sections have operated under pressure flow conditions. Therefore, testing procedures may not have been sufficient to determine the structural weaknesses under past operating conditions. Also, the integrity testing is not adequate to determine the outfall pipeline's potential to leak under proposed operating conditions.**

RESPONSE:

Since the pneumatic testing was performed, additional flow requirements have been proposed under the South Plume Removal Action. Under the proposed South Plume Removal Action, the effluent line could be surcharged, under high river level conditions, from Manhole 177 to the Great Miami River. The maximum pressure expected in the line has been calculated at 20 psi. Therefore, based on the information contained in the Evaluation of Alternatives document, the following approach is viewed as a more cost effective solution for rehabilitating the outfall pipeline: 1) installation of a new manhole near the Great Miami River, 2) Insituform relining of the effluent line from Manhole 177 to the Great Miami River with the ANSI/AWWA C600-87 ductile-iron hydrostatic testing performed as part of this installation, and 3) hydrostatically testing the pressurized manholes also according to the ANSI/AWWA C600-87 Standard.

COMMENT:

3. **A more appropriate test method, such as pressure testing of the ductile iron, must be proposed.**

RESPONSE:

As stated in the response to Comment 2, a component of the Insituform relining process the ANSI/AWWA C600-87 Standard will be utilized on the pipeline and pressurized manholes.

COMMENT:

4. **None of the manholes were pressure tested.**

RESPONSE:

As stated in the response to Comment 2, the pressurized manholes will be hydrostatically tested. In addition, a new manhole will be installed at the Great Miami River for future maintenance and testing purposes.

COMMENT:

5. **The results of the integrity testing cannot be used to determine the potential for leaks under proposed operating conditions. Additional testing should be proposed (as state above) to include pressure testing to 150 percent of the maximum expected flow (pressure). This is necessary to demonstrate that the effluent line is suitable to handle the proposed added flows.**

RESPONSE:

As stated above, the ANSI/AWWA ductile-iron standard will be utilized to test the rehabilitated pipeline as a component of the Insituform process. Similarly, the pressurized manholes will be hydrostatically tested after the relining process is completed. The Removal Site Evaluation evaluates the potential health effects associated with the potential leaking effluent line under past operating conditions; along with the soil and groundwater sampling and analysis activities, which are planned as a component of the RI/FS activities, the relative magnitude of threat can be determined. The specific RI/FS soil and groundwater sampling and analysis activities which are planned are outlined below.

The planned sampling and analysis will consist of the installation of a 2,000 series monitoring well near Manhole 180, which will function to assess the impact of any contamination that may have been channeled along the pipeline backfill material. This well will be sampled for full HSL, full radiological, and general groundwater parameters. Additionally, three borings between Manhole 179 and 180 will be installed to assess any pipeline leakage in the soil surrounding the pipeline. A magnetometer will be used to pinpoint the line and the borings will be located as close as possible to the pipeline. The borings will be sampled for full radiological and full HSL analysis as defined in the proposed addendum of the RI/FS Work Plan beginning at a depth of two feet above the crown of the pipeline. Each boring will consist of four split-spoon samples.

COMMENT:

6. **Two methods of testing the last section of the effluent line (from Manhole 180 to the Great Miami River) would provide additional information. First, it may be possible to position a plug at the end of the last section of the pipeline from an upstream location (i.e., Manhole 179). Second, the river may provide enough pressure at high water stages to conduct the low-pressure integrity test.**

RESPONSE:

The installation of a new manhole near the Great Miami River is being proposed. This new Manhole will greatly aid in the installation of the Insituform liner as well as facilitate future maintenance and testing activities on the effluent line.

COMMENT:

7. **The section of pipeline between Manholes 179 and 180 failed the integrity testing; however, no soil samples were collected from this last section. Soil sampling and possibly groundwater monitoring is required.**

RESPONSE:

As discussed in the response to Comment # 5, soil and groundwater sampling and analysis activities for the region between Manholes 179 and 180 have been planned under the RI/FS Work Plan Addendum

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EVALUATION OF ALTERNATIVES FOR THE REHABILITATION OF THE FMPC OUTFALL PIPELINE

JANUARY 1991

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ATTACHMENT A: PRELIMINARY COST ESTIMATE OF HYDROSTATIC TESTING AND OUTFALL LINE RECONSTRUCTION

ATTACHMENT B: CALCULATIONS OF OUTFALL LINE AND MANHOLE LID PRESSURES

EXECUTIVE SUMMARY

The U.S. Department of Energy (DOE) has completed a Removal Site Evaluation (RSE) under authorities delegated to the agency under Section 104 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), through Executive Order 12580. The RSE addressed potential leakage from the FMPC effluent pipeline between Manholes 179 and 180 and was completed to support the decision as to whether the present conditions warrant a removal action. The Evaluation of Alternatives document investigated the repair alternatives for relining the main outfall line from Manhole 177 to the Great Miami River (GMR). Based upon the information in the RSE, DOE has determined that a Removal Action is appropriate and has issued an Action Memorandum. The Action Memorandum requested that a Work Plan be submitted which details the implementation of the selected alternatives.

Comments received from the USEPA on the Outfall Pipeline Investigation Study would require retesting of the outfall line using standards for new ductile-iron pipe. The FMPC recommends the rehabilitation of the outfall line from Manhole 177 to the GMR with testing performed after restoration. This approach is viewed as a more cost effective approach in the overall outfall line rehabilitation. Based on the technical Evaluation of Alternatives, the preferred rehabilitation alternatives include: 1) installation of a new manhole near the Great Miami River, 2) Insituform relining of the effluent line from Manhole 177 to the Great Miami River with a hydrostatic test performed as part of this installation, and 3) hydrostatically testing the pressurized manholes, Manholes 178, 179, 180, 181, and the newly installed manhole at 150% of their maximum anticipated pressures (which were determined to be 20 psi as shown in Attachment B).

Wastewater effluent is discharged from the Feed Materials Production Center (FMPC) to the Great Miami River through the main outfall pipeline which extends through the southeast quadrant of the production area. This discharge is monitored and permitted under the National Pollutant Discharge Elimination System (NPDES). The wastewater originates from primarily three sources: 1) treated effluent from the process wastewater treatment plants, 2) treated effluent from the sanitary wastewater treatment plant, and 3) storm water runoff from the Storm Water Retention Basin. The effluent line, which is a total of 4,650 feet long with a diameter of sixteen inches, was constructed in 1952. Seven concrete manholes, four of which are pressurized manholes (Manholes 178, 179, 180, and 181), are currently located along the line for access and maintenance purposes, and are numbered as 175 through 181. The pipeline is located at a depth of between four to sixteen feet below grade, with a minimum and maximum slope of 0.1 and 12.9 percent, respectively.

Initially, the outfall pipeline's integrity was investigated by two methods: soil testing of the gravel pack surrounding the pipeline to determine whether excessive amounts of contaminants were present; and pneumatic testing of the pipeline itself exclusive of the manholes. The results of the pneumatic tests indicated that all sections of the pipeline passed except the section between Manholes 179 and 180; it was therefore determined that the region between Manhole 179 and 180 had the potential for leaking. As required by the Consent Decree with the State of Ohio, the damaged pipeline section between Manholes 179 and 180 must be repaired as soon as possible. This lack of integrity in the pipeline also constitutes a potential release of contaminants into the environment under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Section IX, Subpart B, of the 1990 CERCLA Consent Agreement requires a Work Plan be submitted for implementation of the Removal Actions at the FMPC. The Work Plan will address the implementation of the actions to repair the potentially leaking pipeline between Manholes 179 and 180 as well as rehabilitate and hydrostatically test the remaining sections and pressurized manholes of the outfall line from Manhole 177 to the Great Miami River.

Currently, planned activities under the proposed FMPC RI/FS Work Plan Addendum are being initiated to perform sampling between Manholes 179 and 180 in order to characterize any contamination in this region. Upon the completion of sampling and analysis, an evaluation will be made as to the need for any additional removal action(s).

Since the pneumatic testing was completed, additional removal actions at the Feed Materials Production Center have been proposed which would utilize the main outfall line as an integral component for the discharge of wastewater effluents. For instance, the South Plume Removal Action which is tentatively scheduled to begin pumping activities in December of 1991 would join the reconstructed outfall line at Manhole 177. The South Plume proposed action would surcharge the effluent line under high river level conditions from the first pressurized manhole, located at Manhole 178, to the Great Miami River. The resulting maximum pressure in the line, considering the South Plume Removal Action, has been estimated at 20 psi which corresponds to a flow rate of 3600 gallons per minute (gpm). These calculations, as well as the calculations for other flood cases and situations are illustrated in Attachment B of the Evaluation of Alternatives document.

The preferred alternative, as recommended in the Alternative Evaluation Report, is the type of "cast-in-place" or "in-situ" method of relining the pipeline from Manhole 177 to the Great Miami River. The "in situ" process is a state-of-the-art pipeline repair technique which basically creates a new pipe within a pipe. The process involves no excavation, thereby eliminating the disconfiguration of surface features or disturbance of adjacent crop areas and as a result, minimizes waste. In addition, the capacity of the line will not be reduced since the roughness of the pipes interior will be minimized as well as more than compensate for the slight decrease in pipe diameter. The "in-situ" process uses a polyester fiber mesh tube which is coated on one side with an impermeable material and impregnated with a liquid thermosetting resin. The tube is tailored to the exact diameter and length of pipeline section. The proposal is to initially insert the polyester tube through Manhole 177 and reline the pipeline, section-by-section, to the Great Miami River.

1.0 INTRODUCTION

Section 4.12 of the Consent Decree between the U.S. Department of Energy and the State of Ohio (Ohio Civil Action No. C-1-86-0217), signed in December of 1988, called for a study of the discharge to the Great Miami River. The study included locating any leaks or holes in the outfall pipeline. As a result of the requirement, any leakage from the pipe must be stopped as soon as possible.

To comply with the Consent Decree requirement, pneumatic testing of the pipeline was conducted on April 28, 1990. Pneumatic testing of the pipeline was initially compared with hydrostatic testing and the former method was chosen for several reasons: 1) pneumatic testing provided a more time efficient method than the hydrostatic method, 2) pneumatic testing required less equipment and preparation which resulted in a more cost-effective technique, 3) on a qualitative basis pneumatic testing provided as accurate a test as the hydrostatic method, and 4) the test method and specification used was based on the best available information at the time of the investigation. Additionally, the proposed pneumatic test method was presented at a Technical Information Exchange Meeting (TIE) for comment by those present and the proposed pneumatic testing received no significant comments. The results of the testing indicated that the pipeline would not maintain the pressure to the required four pounds per square inch (psi: lbs/in^2) for 10 min. for the section between Manholes 179 and 180. The remaining outfall sections passed the pneumatic pressure testing (FMPC, 1990).

Since the pneumatic testing was completed, additional removal actions at the Feed Materials Production Center have been proposed which would utilize the outfall line. Specifically, the outfall line is an integral component of the South Plume Removal Action. This Removal Action would contribute additional flows to the outfall line. It is anticipated that these additional flows would be tied into the existing outfall line within Manhole 177 and Manhole 178, and would bring the total flow in the line, down stream of Manhole 177, to approximately 3600 gallons per minute. The maximum expected pressure in the outfall pipeline is approximately 20 psi and is based on the calculations presented in attachment B.

As required by the Consent Decree with the State of Ohio, the pipeline section between Manholes 179 and 180 must be repaired as well as additional testing and/or up-grading of the effluent line to facilitate the additional proposed actions. The purpose of this report is to evaluate the alternatives of repairing or up-grading the pipeline as well as analyze the costs associated with hydrostatically testing the effluent line and repairing selective sections. This report includes a description of the pipeline section which failed the pneumatic test, a technical evaluation and cost comparison of alternatives, and a recommendation of the preferred alternative for rehabilitation by the FMPC.

2.0 DESCRIPTION OF THE PIPELINE AND THE MANHOLE 179/180 REGION WHICH FAILED THE PNEUMATIC TESTING

The pipeline section which failed the pneumatic test is located between Manholes 179 and 180. The pipeline itself is constructed of cast-iron, with an inside diameter of 16 inches. The length of the section between Manholes 179 and 180 is approximately 280 feet and has a slope of approximately 13 percent. The pipeline is located at a depth of between three to eight feet below grade. The pipeline is approximately 35 years old and stretches a total of 4400 feet from Manhole 175 to the Great Miami River. The wastewater effluent originates from primarily three sources: 1) treated effluent from the process wastewater treatment plants, 2) treated effluent from the sanitary wastewater treatment plant, and 3) storm water runoff from the Storm Water Retention Basin. The discharge to the Great Miami River is subject to NPDES permit effluent limitations and is monitored for compliance at Manhole 175 prior to the effluent leaving the site. As previously stated, it is anticipated that future flows will include the water from the South Plume Removal Action.

Based on a visual examination of the Manhole 179/180 section using a video camera, the overall integrity of the pipeline appears to be good. However, several "dislocated joints" were observed. The dislocations were estimated to be 1/4 to 3/8 of an inch in separation. These dislocated joints are assumed to be the reason for the failed pneumatic pressure testing (WMCO, 1990).

3.0 EVALUATION OF ALTERNATIVES FOR PIPELINE REPAIR

3.1 Description of Alternatives for Pipeline Repair

There are three viable alternatives which were considered for repairing the outfall pipeline section between Manholes 179 and 180, as well as for up-grading the entire section of line, from Manhole 177 to the Great Miami River, which are the sections which may operate in a surcharged state. Each of these alternatives will require the installation of a new manhole near the Great Miami River to allow access from the end of the last section. This new manhole would replace Manhole 182 which was previously washed-out by the river.

When the effluent line was originally installed, Manhole 182 functioned as the access junction point between the effluent line and the Great Miami River. In 1965 high waters and a slowly westwardly migrating river swept Manhole 182 away. Subsequently, sheet metal pilings were installed around the pipeline to support and protect it from similar damage. Manhole 182 provided an access point to the effluent line for maintenance and testing purposes. In order to effectively test and/or reline this last section of effluent line, a new manhole must be installed. This manhole would allow routine hydrostatic testing of the effluent line as well as provide a means for evacuating the last section of the pipeline to facilitate the installation of the insituform liner.

The alternatives are:

A. *In-Situ Method* - Under an *in-situ* process a polyester fiber mesh tube is coated on one side with an impermeable material and impregnated with a liquid thermosetting resin. This tube, tailored to the exact diameter and length of pipeline section, is inverted into the line through an existing manhole or other access point. Cold water in a vertical standpipe located at a manhole or access point forces the tube through the pipe, inverting and pressing it firmly against the existing pipe wall. The water is then heated, curing the resin. The curing water is finally cooled down, released, and the ends of the new pipe are cut off. This type of in situ or "cast in place" process must be performed by a licensed contractor of Insituform of North America (INA).

B. *Slip-Lining Method* - This method involves the pulling or pushing of a semi-rigid polyethylene pipe through a straight section of pipeline to function as a replacement sleeve. The equipment required for the installation of the polyethylene liner includes heat fusion ring (joining equipment), pulling head (nose cone), rollers, proofing tool, grout tank, and pump. The heat fusion ring is used to join the standard polyethylene pipe sections above ground into a continuous pipe of the desired length. The other pieces of equipment are used to facilitate the insertion of the polyethylene liner into the existing pipe, and to grout the annular space between the pipe and manhole connections to prevent groundwater infiltration. When greater structural strength is desired, the annular space in the entire manhole-to manhole distance can also be grouted. The installation normally requires excavation to expose the pipe and removal of the crown of the pipe to allow pipe insertion. Access is normally required near each break in grade or at changes in direction. The access ditch at each excavation (or insertion) point should be long enough to avoid imposing a bending radius less than 35 to 40 times the outside diameter of the pipeliner during insertion. The ditch is sloped gradually from the ground surface to the top of the pipe. The width of the ditch should be sufficient to allow the entry of the workman. Shoring and bracing may be required depending on the depth and ground conditions. The insertion of a pipeliner through manholes is normally not feasible due to the bending restrictions.

C. *Chemical Grouting Method* - Chemical grouting is most commonly used to seal leaking joints in otherwise structurally sound pipes. There are two chemical grouts which have been used extensively: acrylamide gel and polyurethane foam. Basically, grouting with the acrylamide gel stops the leaks by internally injecting the grout to the soils surrounding the leaks to decrease their permeability. Grouting with the polyurethane foam, on the other hand, seals the leaks by injecting the grout into the cracks and letting it solidify to form a barrier. Grouting of pipe joints is generally accomplished with a sealing packer and closed-circuit television camera. The sealing packer is used to apply the chemical grout to the pipe joint. It is usually made of a hollow metal cylinder with three inflatable rubber sleeves covered by a continuous outer sleeve. The television camera is used to remotely position the packer on the pipe joint and to inspect the joint before and after the sealing operation. The sealing packer and television camera are pulled by cables through the pipe section from manhole-to-manhole. In operation, the packer is positioned on the joint to be grouted with the aid of the television camera and its end sleeves are inflated. The chemical grout is then introduced into the space created between the two inflated sleeves, and finally forced into the pipe joint (when the polyurethane foam is used) or surrounding soils (when the acrylamide gel is used) by inflation of the center sleeve of the packer. After the cure or gelation time ends, the sleeves of the packer are deflated and the packer is moved to the next joint.

3.2 Technical Evaluation of Alternatives

A. *In-situ* type Method -- Although a state-of-the-art technology, in principle the process is rather simple. The process offers a number of advantages over the other repair methods, including:

1. The system can be installed without excavation by using existing manholes for inversion of the tube into the pipeline, thereby eliminating destruction of surface features.

2. It gives a continuous "no-joint" inner pipe and causes only a marginal reduction in the diameter of the pipe. The smooth liner surface and absence of joints between openings usually combine to increase flow capacity by improving the friction characteristics and save future maintenance since deposits will be less apt to collect on the smooth surface.

3. The resin used in an *in-situ* type system provides a primary corrosion barrier when cured.

4. The installation takes a fraction of the time of the other methods.

5. The pipe thickness can be adjusted to fit pressure pipe applications.

6. It provides a permanent and thorough repair estimated to last as long as forty to fifty years.

The major drawback of an *in-situ* type process, as compared with the other alternatives, is its higher cost per linear foot. However, much of this cost may be off-set since little or no excavation and resulting waste disposal costs will be incurred.

B. Slip-Lining Method -- As mentioned earlier, the slip-lining method involves the insertion of a polyurethane liner into an existing pipe. This method, therefore, offers some advantages over the "in situ" or "cast in place" method which basically creates a pipe within a pipe. The advantages of the slip-lining method are outlined below:

1. It gives a complete new inner pipe. The smooth inner surface of the polyethylene pipe offers very low resistance to flow.

2. The installed pipe will have low joint leakage since all joints are butt-fusion welded.

3. The polyethylene liner is corrosion and abrasion resistant.

4. The liner thickness can be designed to fit pressure pipe applications.

5. The pipe is capable of deflection and movement without breaking.

6. It provides a thorough repair and usually a longer life expectancy.

The slip-lining method, however, requires excavation of access trenches and cutting holes in the pipeline for insertion of a liner. The excavated access trenches may require shoring and dewatering. In addition, this would require the accession of construction right-of-way. After the installation is complete, the excavated trenches must be backfilled and restored with cut holes being repaired. All these activities could cause several problems and costs associated with potentially contaminated soil and water, destruction of some surface features, and disturbance of adjacent crop areas. Furthermore, the insertion of the polyethylene pipe will cause loss of flow capacity due to a reduction in the pipe size.

C. Chemical Grouting Method -- The chemical grouting method is a relatively simple repair method. The installation will consist of television monitoring while a grout mixture is injected into the dislocated joint surfaces. The grout injection is performed by a sealing packer remotely controlled from the ground at a manhole. The method requires a minimal staging area and no excavation. Therefore, the destruction to surface features and disruption to the environment are small.

The chemical grouting method is best suited for leaking problems at joints. The cost of this repair is normally relatively inexpensive. However, it is considered a less permanent and less thorough repair method. As a result, it provides a relatively short life expectancy, typically less than five years.

3.3 Evaluation of Alternatives

In addition to technical and cost considerations in the selection of a repair method, there are a number of restricting guidelines that must be adhered to regardless of the remedy selected. These guidelines were established to comply with FMPC operational requirements, weather conditions, and general public opinion. These restricting guidelines are:

1. All installation work must be performed under dry weather conditions when the amount of by-pass pumping around the repairing pipeline section is minimal.

2. All installation work must be performed during off-work hours when the pipeline flow is minimal. Setup and staging activities can be done at any time.

3. The approximate time limit for outfall line shutdown is 12 hours. After the twelve hour limit, bypassing the pipeline flow may be required.

4. The method selected should be expected to result in the piping's ability to pass the 150% maximum anticipated hydrostatic pressure test in accordance with the Recommended Specifications of the ANSI Standard AWWA C-600-87, Installation of Ductile-Iron Water Mains and their Appurtenances.

5. The method selected should be installed without excavation and with minimal disruption to the environment.

6. A long term repair (> 5 years) is the most desired alternative.

7. An improvement in the flow characteristics of the pipeline as a result of the repair, if possible, is desirable to accommodate future flows.

8. All installers must complete the required training as specified by the FMPC.

The three alternatives, as described above, are evaluated against the above restricting guidelines as follows:

A. An *in-situ* type Method -- Based on product research and contact with representatives of Insituform of Ohio, Incorporated, with the assistance of procurements, has shown that this type of "cast in place" technology would be effective in complying with Guideline Numbers 1, 2, and 3 above. A representative from Insituform stated that an eight hour day for staging each section would be required, no shut down of effluent would be needed for staging, and approximately twelve hours for the actual installation. If Insituform is the selected vendor and their installation process exceeds the twelve hour limitation, the flow may need to be bypassed by pumping around the applicable pipeline section. As a result, all bypass pumping equipment, including pumps and pipes, would be provided by Insituform of Ohio, Incorporated. All Insituform installers will comply with the FMPC requirements with respect to the hazardous waste and radiation training.

   FMPC Guideline #4, above, is fully expected to be met by this process. After installation, a hydrostatic test and a video tape review of the installation will be completed by Insituform.

The "cast in place" method also has the advantage, based on the technical evaluation of alternatives, of meeting Guideline Nos. 5, 6, and 7. In summary, the "cast in place" method, as represented by Insituform of Ohio, Incorporated, meets all restricting guidelines.

B. Slip-Lining Method -- As described in the technical evaluation of alternatives, this method will involve activities which could cause some problems, including soil excavation, destruction of some surface features, and disturbance of adjacent crop areas. These problems conflict with Guideline No. 5. For this reason, this alternative is eliminated from further consideration.

C. Chemical Grouting Method -- As described in the technical evaluation of alternatives, chemical grouting is not considered a "long term" repair method. It usually provides a short life expectancy. This is not a desirable method as prescribed by Guideline No. 6. For this reason, this alternative is eliminated from further consideration.

3.4 Cost Considerations

Based on information provided by Insituform of Ohio, patented supplier of the *in situ* type process for this region, the total cost for completing the relining of the effluent line between Manholes 179 and 180 is approximately $80,000.00. The entire pipeline, from Manhole 175 to the Great Miami River, would cost approximately $800,000.00. While relining the pipeline from Manhole 177 to the Great Miami River would cost approximately $675,000.00. Cost information was not obtained for the other two methods of repair since they were eliminated due to their failure to comply with all of the guidelines. Attachment A contains a preliminary cost estimate of hydrostatically testing and Insituform relining the effluent line.

5.0 RECOMMENDATION

Comments received from the USEPA, on the review of the Outfall Pipeline Investigation Report, would require retesting of the outfall line using standards for ductile-iron pipe. FMPC recommends the restoration of the outfall line with testing performed after rehabilitation. This approach is viewed as a more cost effective approach in the overall outfall line rehabilitation. Based on the technical evaluation of alternatives and the FMPC guidelines, the preferred repair alternative is the *in-situ* type process, patented by Insituform of Ohio, Incorporated. The Insituform method is therefore recommended for implementation.

Based on the previously discussed evaluation of alternatives and the cost considerations contained in Attachment A, the recommendation for up-grading, testing, and repairing the main outfall line should consist of: 1) installation of a new manhole near the Great Miami River, 2) Insituform relining of the effluent line from Manhole 177 to the Great Miami River with a hydrostatic test performed as part of this installation, and 3) hydrostatically testing the pressurized manholes, Manholes 178, 179, 180, 181, and the newly installed manhole and the Insituform liners at 150% of their maximum anticipated pressures (20 psi as shown in Attachment B).

ATTACHMENT A

PRELIMINARY COST ESTIMATE OF HYDROSTATIC TESTING AND REHABILITATION

Cost Analysis

Preliminary cost data have been obtained from Insituform of Ohio, Incorporated to estimate the cost of insituform relining of the pipeline and Advanced Companies to estimate the cost of hydrostatic testing of the pipeline and/or hydrostatic testing of the manholes. In order to properly evaluate the cost data, specific technical information concerning the pipeline was provided to each company which consisted of the following information:

1) Outfall pipeline total length, from Manhole 175 to Great Miami River, consists of 4400 ft.

2) Pipeline constructed of cast-iron with a diameter of 16 inches.

3) A total 7 manholes (MH 175 to 181) currently exist, four of which are pressurized.

4) An effluent line which could be surcharged to the elevation of the outgoing pipe at Manhole 177 causing a maximum pressure on the pipeline of 20 psi.

Relining the Effluent Line with the Insituform Liner

Insituform of Ohio Incorporated provided a rough order of magnitude cost estimate of $180 to $190 (dollars) per linear foot. This would correspond to a total cost of between:

$792,000 to $836,000 to Reline the pipeline from MH 175 to the GMR.

The Insituform process would effectively repair any damaged or potentially leaking sections of the pipeline and at the same time increase the "C" factor of the line which translates to an increased flow rate.

Inherent in the Insituform process is a hydrostatic test, since the liner is inverted in the line and maintained at constant hydrostatic pressure and temperature for approximately 4 to 10 hours. However, under the Insituform process the manholes would not be effectively evaluated for integrity or the potential for leaking; therefore, the manholes would have to be tested using a hydrostatic test at the applicable test pressure and conditions. More specifically, the pressurized manholes would need to be tested along with the small segment of line before and immediately after each manhole. This is because the line is applied in segments (between manholes) with the ends of each segment are cut-off after the polymer has cured. The cost for testing the manholes was estimated (rough order of magnitude cost +/- 20%) by Advanced Companies to be:

$20,000 to Hydrostatically Test the Four Pressurized Manholes (+/- 20%)

Therefore, the price for Insituform repairing and testing would be between:

$810,000 to $860,000 to Insituform Reline and Hydrostatically Test Manholes

Alternatively, to Insituform reline only the pressurized sections, from Manhole 177 to the Great Miami River, would cost approximately:

$675,000 to Insituform Reline from Manhole 177 to the Great Miami River

In addition to hydrostatically test the four pressurized manholes would cost approximately:

$695,000 to Insituform Reline from Manhole 177 to the Great Miami River and Hydrostatically Test the Four Pressurized Manholes

Hydrostatic Testing and Limited Insituform Relining

It was conservatively assumed that if hydrostatic testing was initially performed on the effluent line it would result in repairing or relining approximately 2,860 feet of the total 4,400 feet. This corresponds to relining those sections between Manholes 179 and the GMR. These manhole sections were assumed to be in need of repair since: 1) the section between Manhole 179 and 180 was previously found to have dislocated joints, 2) these sections represent those segments which could be in a surcharged state (pressurized), and 3) the section from Manhole 180 to the Great Miami River represents the segment with the smallest slope and therefore the potential for the largest percentage of lime and other deposits to be present in the effluent line. Furthermore, if one assumes then that the higher cost estimate is utilized, ie $190 per liner foot, the total cost for relining the 2,860 feet of the effluent line would be approximately:

$550,000 to Reline from Manhole 179 to the Great Miami River

Advanced Companies provided a rough order of magnitude estimate to hydrostatically test the effluent line and manholes from Manhole 175 to the Great Miami River. Their estimate is:

$100,000 (+/- 20%) to Hydrostatically Test the Effluent Line and Pressurized Manholes

Therefore, the total cost for testing the manholes and effluent line prior to the partial relining of the effluent line would be:

$650,000 to Test Manholes and Effluent Line and Partially Reline Effluent Line.

Cost Summary

The total cost for testing and partial repair (MH 179 to GMR) was estimated at $650,000. While the cost for relining the effluent line (MH 175 to GMR) and hydrostatically testing the pressurized manholes was estimated at between $810,000 to $860,000. Alternatively, Insituform relining from Manhole 177 to the Great Miami River would cost approximately $675,000 plus $20,000 to hydrostatically test the four pressurized manholes for a total cost estimated at $695,000.

ATTACHMENT B

EVALUATION OF OUTFALL LINE PRESSURES FOR VARIOUS SCENARIOS

INTRODUCTION

The following calculations were performed in order to determine the maximum potential pressures in the outfall line and its manholes. The calculations assume a worst case future flow condition that would surcharge the outfall line to the top of the pipe elevation at the outgoing pipe at Manhole 177. This scenario utilizes (surcharges) the entire section of the pipeline originally designed to operate in a surcharged (pressurized) state. This assumes that future flows contributed to the outfall line will be regulated so as not to surcharge the outfall line beyond Manhole 177.

These calculations determine the pressures at Manhole 180 only. This is due to the fact that Manhole 180, and the pipeline associated with it, will experience the greatest pressure differential when compared to the other manhole locations on the line.

It was necessary to evaluate the above conditions for two different flood elevations on the Great Miami River since each represents the maximum pressure condition to be exerted on either the pipeline itself or the manhole lid at Manhole 180.

The first case presented evaluates the 100 year flood elevation of the Great Miami River (548.5 feet). A flood to this elevation would exert the greatest pressure on the pipeline at Manhole 180. In this case, the flood waters would exert a confining pressure on the manhole lid, but since the ground surrounding the pipe may not be saturated no confining pressure on the pipeline is assumed, and therefore a maximum differential pressure on the pipe would be observed.

The second case presented evaluates a flood elevation of the Great Miami River to the level of State Route 128 (540.0 feet). A flood to this elevation would exert the greatest pressure on the Manhole 180 lid. In this case, State Route 128 would act as a levy and prevent flood waters from covering Manhole 180 and exerting any confining pressure.

CASE 1 - Outfall Pipeline Worst Case Pressure Scenario

This scenario is based on the 100 year flood elevation of 548.5 feet. The flow in the outfall line would surcharge the line to Manhole 177 with the top of the outgoing pipe at an elevation of 585.7 feet. The first step is to determine the slope of the hydraulic grade line (HGL). Equation B-1 below defines the calculation of the HGL. Figure B-1 shows a schematic diagram of Case 1.

$$\text{HGL} = \frac{\text{(Top of Outgoing Pipe @ MH 177 Elev. - 100 yr. Flood Elev.)}}{\text{(End of Outfall Line Station - MH 177)}} \qquad \text{(B-1)}$$

$$\text{HGL} = \frac{(585.7' - 548.5')}{(4400' - 750.3')} = 0.0102 \text{ ft/ft}$$

The next step is to determine the elevation of the HGL at Manhole 180. This calculation is determined by using Equation B-2 below. Physically, the elevation of the hydraulic grade line at Manhole 180 is described by multiplying the HGL slope by the distance from the end of the pipeline to Manhole 180 and adding to this value the 100 year flood elevation.

$$\text{Elev. of HGL @ MH 180} = \text{HGL Slope} \times (\text{Dist. from End of Pipe to MH 180}) + \text{100 year Flood Elev.} \qquad \text{(B-2)}$$

$$\text{Elev. of HGL @ MH 180} = 0.0102 \times (4400' - 1810.3') + 548.5' = 574.9'$$

The final step for Case 1 is to determine the pressure change at Manhole 180. The differential pressure is illustrated by Equation B-3.

$$\Delta P = (\text{HGL Elev. @ MH 180} - \text{Pipe Elev. @ MH 180}) \times \left(\frac{1 \text{ psi}}{2.31 \text{ ft. } H_2O}\right)$$

$$\Delta P = (574.9' - 529.9') \times \left(\frac{1 \text{ psi}}{2.31 \text{ ft. } H_2O}\right) \qquad \text{(B-3)}$$

$$\Delta P = 19.5 \text{ psi}$$

CASE 2 - Outfall Line Manhole 180 Lid Worst Case Pressure Scenario

The greatest pressure which will be exerted on the lid of Manhole 180 occurs when: 1) the flood elevation is at State Route 128 (540 feet) and 2) the flow in the outfall line surcharges the line to Manhole 177 (top of outgoing pipe would be at 585.7 feet). In a similar manner to Case 1, the first step is to determine the slope of the hydraulic grade line (HGL). Equation B-4 defines the calculation of the hydraulic grade line slope. Figure B-2 illustrates a schematic diagram of Case 2.

$$\text{HGL SLope} = \frac{(\text{Top Outgoing Pipe @ MH 177} - \text{Flood to SR 128 Elev.})}{(\text{End of Outfall Line Station} - \text{MH 177 Station})} \qquad \text{(B-4)}$$

$$\text{HGL Slope} = \frac{(585.7 - 540')}{(4400' - 750.3')} = 0.0125 \text{ ft/ft}$$

The next step is to determine the elevation of the hydraulic grade line at the lid of Manhole 180. Equation B-5 illustrates this calculation.

$$\text{Elev. of HGL @ MH 180} = \text{HGL Slope} \times (\text{Dist. End of Pipe to MH 180}) + \text{Elev. of Flood to SR 128} \qquad \text{(B-5)}$$

$$\text{Elev. of HGL @ MH 180} = 0.0125 \times (4400' - 1810.3') + 540'$$

$$\text{Elev. of HGL @ MH 180} = 572.5'$$

Similar to Case 1, the final step is to determine the change in pressure on the lid at Manhole 180. Equation B-6 illustrates this calculation.

$$\Delta P = (\text{HGL Elev. @ MH 180} - \text{Elev. MH 180 Lid}) \times \left(\frac{1 \text{ psi}}{2.31 \text{ ft. } H_2O}\right)$$

$$\Delta P = (572.5' - 537.0') \times \frac{1}{2.31'} \qquad \text{(B-6)}$$

$$\Delta P = 15.3 \text{ psi}$$

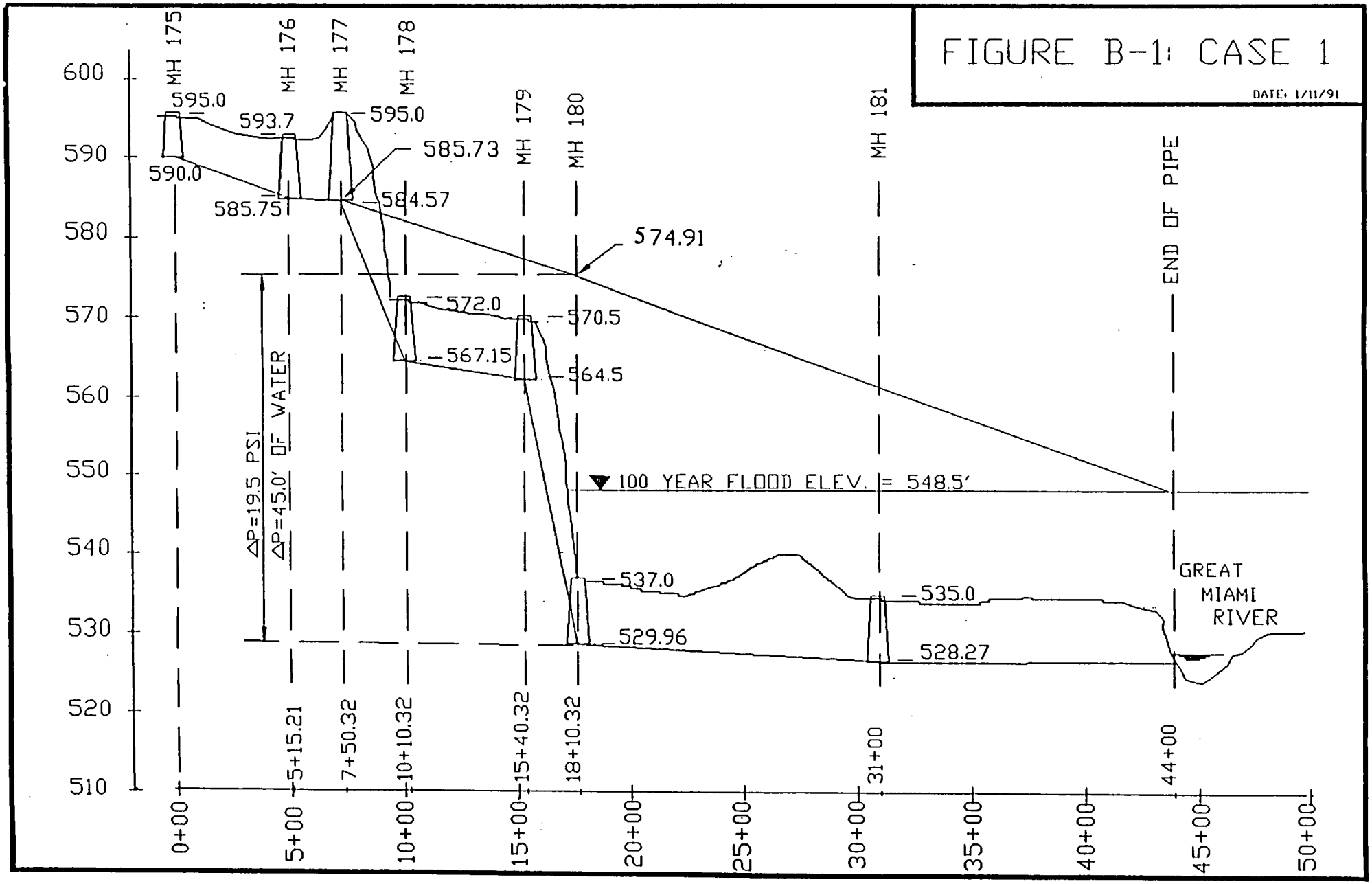
FIGURE B-1: CASE 1
DATE: 1/11/91
MH 175
MH 176
MH 177
MH 178
MH 179
MH 180
MH 181
END OF PIPE
595.0
593.7
595.0
585.73
590.0
585.75
584.57
574.91
572.0
570.5
567.15
564.5
100 YEAR FLOOD ELEV. = 548.5'
537.0
535.0
529.96
528.27
GREAT MIAMI RIVER
ΔP=19.5 PSI
ΔP=45.0' OF WATER
600
590
580
570
560
550
540
530
520
510
0+00
5+00
5+15.21
7+50.32
10+00
10+10.32
15+00
15+40.32
18+10.32
20+00
25+00
30+00
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35+00
40+00
44+00
45+00
50+00

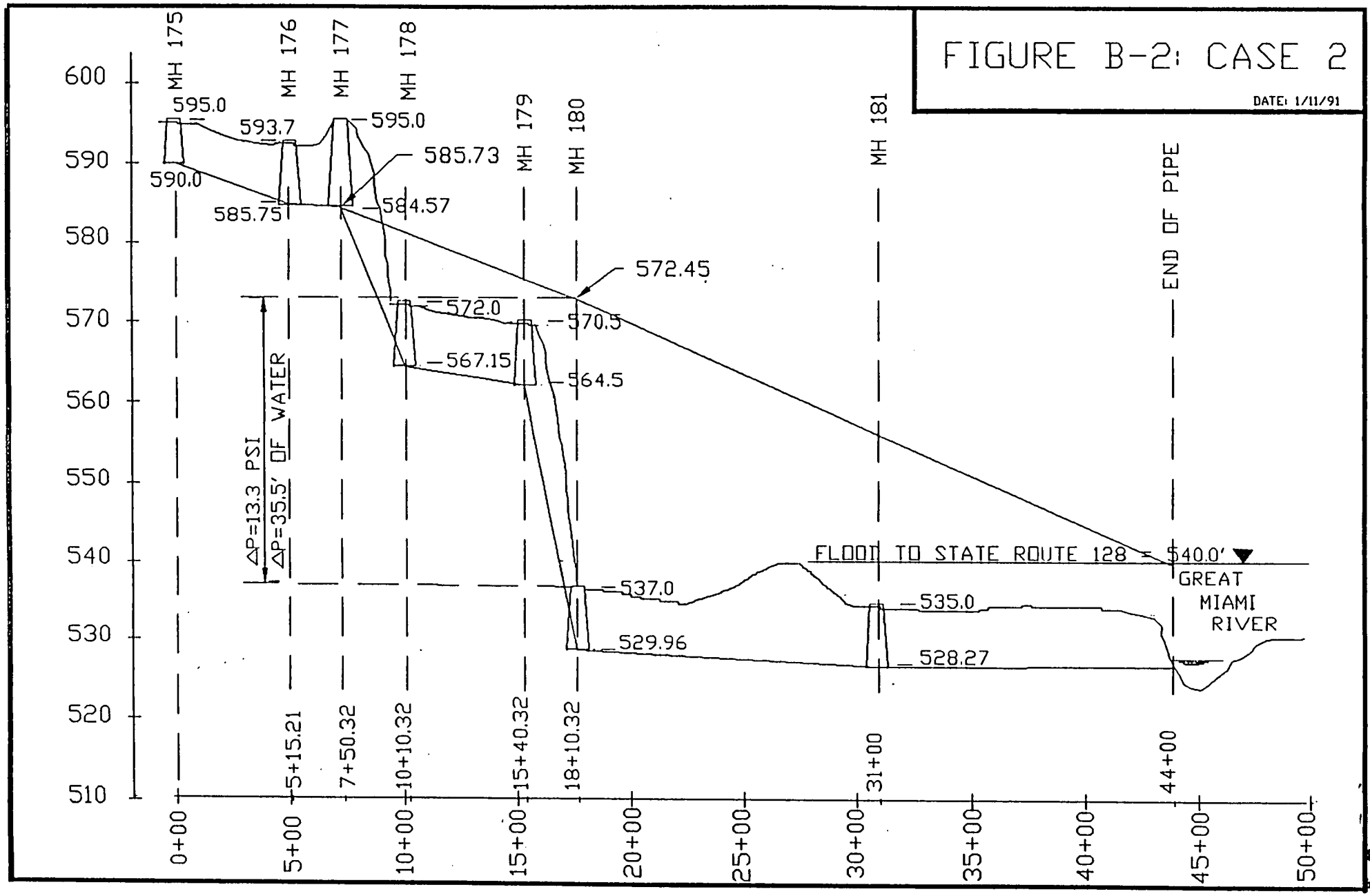
FIGURE B-2: CASE 2
DATE: 1/11/91
MH 175
MH 176
MH 177
MH 178
MH 179
MH 180
MH 181
END OF PIPE
595.0
593.7
595.0
590.0
585.75
585.73
584.57
572.45
572.0
570.5
567.15
564.5
537.0
535.0
529.96
528.27
FLOOD TO STATE ROUTE 128 = 540.0'
GREAT MIAMI RIVER
ΔP=13.3 PSI
ΔP=35.5' OF WATER
600
590
580
570
560
550
540
530
520
510
5+15.21
7+50.32
10+10.32
15+40.32
18+10.32
31+00
44+00
0+00
5+00
10+00
15+00
20+00
25+00
30+00
35+00
40+00
45+00
50+00

Department of Energy
FMPC Site Office
P.O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 738-6319

JAN 14 1991
DOE-415-91

Mr. W. H. Britton, President
Westinghouse Materials Company
of Ohio
P. O. Box 398704
Cincinnati, OH 45239-8704

Dear Mr. Britton:

REMOVAL ACTION MEMORANDUM: REHABILITATION OF THE MAIN OUTFALL LINE

The enclosed Removal Site Evaluation addressing the rehabilitation of the FMPC Outfall Pipeline to the Great Miami River has been reviewed by my office. Based on this review, DOE has determined that the up-grading of the Outfall Pipeline constitutes a time-critical Removal Action. The Administrative Record for the RI/FS should include this document.

WMCO should complete a Work Plan detailing the implementation of the Insituform relining alternative. This Work Plan should be submitted to my office by February 12, 1991.

In addition to this removal action, WMCO should proceed to complete the following actions to determine if additional removal actions will be required concerning the Main Outfall Pipeline:

1) Evaluate the soil characterization results currently being planned by ASI under the RI/FS.

2) If the data collected per Item 1 above warrants additional removal action (s), prepare an evaluation of possible removal action control measures and identify the recommended alternative for the additional removal action(s).

If your staff has any questions, please ask them to contact Carlos J. Fermaintt at extension 6157.

Sincerely,

Ray Hansen for
Gerald W. Westerbeck
FMPC Site Manager

DP-84:Fermaintt

7157

Enclosure: As stated

cc w/encl.:

S. W. Coyle, WMCO
D. J. Carr, WMCO
R. S. Shirley, WMCO
O. B. Adams, Parsons
R. D. Warner, LWA
D. Mayfield, ASI/IT
S. H. Wolinsky, ASI/IT
AR File

7157

REMOVAL SITE EVALUATION

REHABILITATION OF THE MAIN OUTFALL LINE

Feed Materials Production Center

U.S. Department of Energy

January 1991

000030

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Appendix A: Estimating Doses and Risks

Appendix B: Evaluating the Health Impact from Non-Radiological Contaminants

1.0 Introduction

The FMPC discharge pipeline to the Great Miami River represents a National Pollutant Discharge Elimination System (NPDES) permitted outfall for the discharge of wastewater from the FMPC to the surface waters of the State. The NPDES regulated discharge system is monitored for compliance at Manhole 175 prior to the effluent leaving the site boundary. The wastewater effluent originates from primarily three sources: 1) treated effluent from the process wastewater treatment plants, 2) treated effluent from the sanitary wastewater treatment plant, and 3) storm water runoff from the storm water retention basins. The cast-iron effluent line, which is a total of 4,650 feet long with a diameter of 16 inches, was constructed in 1952. Seven concrete manholes are located along the line for access and maintenance purposes, and are numbered as 175 through 181. The pipeline is located at a depth of between 4 to 16 feet below grade, with a minimum and maximum slope of 0.1 and 12.9 percent, respectively.

The main effluent line extends through the southeast quadrant of the production area. The region of the outfall line between Manholes 179 and 180 resides off-site, see Figure 1, east of the site property boundary and west of State Route 128 and the Great Miami River. Pursuant to the State of Ohio Director's Findings and Orders (DFO), issued and effective on June 26, 1987, and the Consent Decree, signed in December 1988, the FMPC was required to ascertain the integrity of the outfall pipeline.

The outfall pipeline's integrity was investigated by two methods: soil testing of the gravel pack surrounding the pipeline to determine whether excessive amounts of contaminants were present; and pneumatic testing of the pipeline itself. The final report of the FMPC pipeline investigation was released on September 18, 1990 (FMPC, 1990). The pneumatic method was chosen because it was found to be the most adaptable to testing the pipeline's integrity on a section by section basis and at the same time was considered to be at least as accurate, in a qualitative manner, as the other methods evaluated. Based on a visual examination of the pipeline section using a video camera, several "dislocated" joints were noted. The dislocations were estimated to be 1/4" to 3/8". These dislocated joints are considered for the purposes of this investigation to be a potential source of leakage to the environment (FMPC, 1990).

The results of the pneumatic tests indicated that all sections of the pipeline passed except the section between Manholes 179 and 180; it therefore has the potential for leaking. Currently, activities under the FMPC RI/FS Work Plan are being initiated to perform sampling between Manholes 179 and 180 in order to characterize any contamination in this region. Upon the completion of sampling and analysis, an evaluation will be made as to the need for any additional removal action(s).

Access to the ground surface above Manholes 179 and 180 region is uncontrolled. The soils associated with the outfall pipeline have been identified as "suspect areas" to be addressed under the Operable Unit 3 RI/FS. The Operable Unit 3 RI/FS, which consists of the production area and other suspect areas outside the production area, is presently underway.

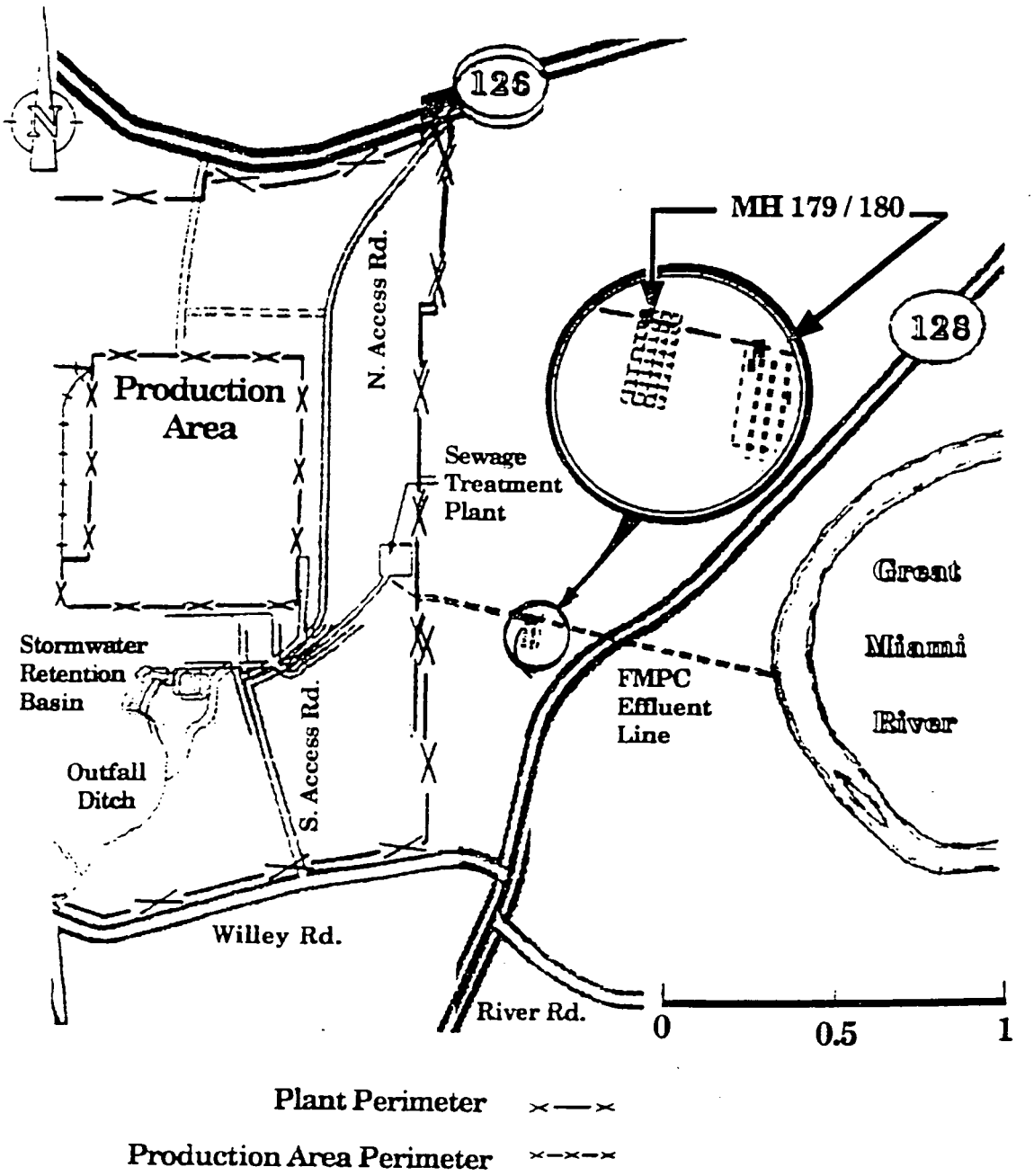

FIGURE I
LOCATION OF MANHOLE 179/180 REGION

This Removal Site Evaluation (RSE) has been completed by the DOE under authorities delegated by Executive Order 12580 under Section 104 of CERCLA and is consistent with Section 300 of the National Oil and Hazardous Substance Contingency Plan (NCP). This RSE addresses the potential leak identified in the effluent pipeline between Manholes 179 and 180 and has been completed to support the decision as to whether the present conditions warrant a removal action.

2.0 Source Term

The source term consists of those radionuclides present in the FMPC daily effluent. The source term describing the soil concentrations in the vicinity of Manhole 179 and 180 is currently being characterized. Based on weekly composites from 1986, the average concentration of total uranium in the FMPC effluent discharge was found to be 450 picocuries per liter (IT Inc., 1988). Soil samples taken down gradient from Manhole 179 and 180 show total uranium and total thorium concentrations below commonly accepted concentration based action levels, established as 35 picocuries per gram for depleted uranium and 10 picocuries per gram for total thorium, based on the NRC Branch Technical Position Guideline (USNRC, 1981). Nonradiological contaminants were also investigated, such as lead, chromium, and silver. Monitoring data from the NPDES discharge permit reports indicated that the concentrations for these contaminants are below the Toxicity Characteristic Leaching Procedure (TCLP) extract concentrations.

2.1 Soil Sampling Data

Table 1, taken from the Final Report for the FMPC Outfall Pipeline Investigation, lists the concentrations of total uranium for each sampling point for the region between Manhole 180 and the discharge at the Great Miami River. The location of these sampling points are illustrated in Figure 1. Note that the highest concentration of total uranium was observed to be approximately 21 picocuries per gram of soil by sample number 00536 which represented boring number 1532. This maximum observed concentration is below the NRC Branch Technical Position Guideline of 35 picocuries per gram of soil for depleted uranium (USNRC, 1981). Considering the steep gradient and the gravel packing surrounding the pipeline, these concentrations probably represent the maximum concentrations which would be observed in the region between Manholes 179 and 180.

Currently steps are being initiated as specified in the planned RI/FS Work Plan Addendum to perform a full radiological and hazardous substance list (HSL) sampling and analysis for the region between Manholes 179 and 180. The planned sampling plan outlines the completion of three soil borings and the installation of one (2000) series well. The Work Plan Addendum will be submitted to the USEPA for review and approval.

TABLE 1

BORING NUMBER	SAMPLE NUMBER	TOTAL THORIUM (1)	TOTAL URANIUM (1)	HNu READING (2)
1524	00452	5.0	11.6	0.0
	00455	11.0	10.1	0.0
	00459	3.0	9.3	0.0
	00462	3.0	6.3	0.0
	00465	7.0	9.6	0.0
	00468	5.0	7.2	0.0
	00472	<4.0	8.8	0.0
	00474	<5.0	9.5	0.0
1525	00400	6.0	13.9	0.0
	00403	<3.0	9.5	0.0
	00407	4.0	12.3	0.0
	00410	8.0	6.9	0.0
1526	00414	4.0	27.1	0.0
	00415	7.0	9.7	0.0
	00420	<4.0	18.1	0.0
	00421	2.0	8.4	0.0
1527	00426	6.0	6.9	0.0
	00428	7.0	11.1	0.0
	00432	6.0	9.2	0.0
	00435	<3.0	5.9	0.0
1528	00439	6.0	10.0	0.0
	00444	<4.0	7.8	0.0
	00445	<4.0	8.7	0.0
	00448	<4.0	7.0	0.0
1529	00478	7.0	9.9	0.0
	00481	4.0	9.4	0.0
	00484	5.0	8.9	0.0
	00488	3.0	10.8	0.0
1530	00491	7.0	11.8	0.0
	00494	6.0	15.6	0.0
	00494	8.0	6.3	0.0
	00501	3.0	8.4	0.0
1531	00505	<4.0	9.2	0.0
	00507	4.0	9.7	0.0
	00510	3.0	8.2	0.0
	00513	4.0	7.5	0.0
1532	00531	6.0	9.5	0.0
	00533	3.0	15.3	0.0
	00536	12.0	31.2	0.0
	00539	6.0	11.5	0.0
1533	00546	6.0	8.6	0.0
	00547	5.0	15.2	0.0
	00550	<4.0	7.7	0.0
	00552	<4.0	4.5	0.0
	00559	5.0	8.7	0.0
	00560	6.0	10.3	0.0
	00562	4.0	13.6	0.0
	00564	<4.0	6.5	0.0

(1) Units are in microgram per gram (ug/g).
(2) Units are in parts per million (ppm).

2.2 Radiological Pathway Assessment

Since radiological soil analysis has not been completed for the area between Manholes 179 and 180, the purpose of the following radiological pathway assessment is to estimate the upper limit on the health effects (maximum) for this region based on average total uranium concentration levels present in the wastewater in the effluent line. On the basis of the failure of the pneumatic tests, it is assumed for purposes of this assessment that the pipeline section is indeed leaking. Since the radionuclides would be released through a leak in the outfall line, the source characterization can be described as subsurface radionuclide contamination with potential future exposures occurring through the ingestion of contaminated groundwater. Because the radionuclides are potentially being released beneath the surface soil, the pathways of external radiation and inhalation of resuspended contaminated soil would represent negligible dose contributions since the soil cover would provide shielding as well as significantly reduce the availability for the atmospheric resuspension of contaminated soil particles. Calculations indicate that dose estimates resulting from the ingestion of crops or plants contribute insignificantly to the potential future exposure assessment of an individual residing in this region. Specifically, these food ingestion pathways are negligible for several reasons:

1) Low concentrations of the radionuclides exist in the root zone, since the pipeline is at a depth of between 4 and 16 feet.

2) Since the radionuclides were potentially released at a greater than 4 foot depth in the subsurface soil, atmospheric redistribution and subsequent foliar deposition and uptake, as a mechanism for plant uptake and accumulation, is eliminated.

3) Due to the steep gradient (approximately 13%) which occurs between Manholes 179 and 180, erosion, runoff, and subsurface transport of contaminants within the gravel packing of the effluent line would be enhanced which results in a lower concentration of radionuclides being available for uptake and accumulation.

The pathway assessment, summarized in Section 3.0, investigates a maximum dose and risk based on the potential future drinking water exposure route to an individual who is assumed to represent the reasonable maximum exposure (RME) for the Manhole 179/180 region. This RME individual's dose and risk assessments are based on exposure factors from the Environmental Protection Agency and the Nuclear Regulatory Commission's Regulatory Guide 1.109. Dose conversion factors were obtained from the Department of Energy (DOE, 1988); while effective dose equivalent risk coefficients were obtained from BEIR V (NAS, 1989). Appendix A contains the specific pathway equation as well as intermediate calculations.

The potential health effects from nonradiological contaminants were investigated using data from NPDES discharge permit reports (NPDES, 1990). Appendix B contains representative NPDES discharge permit data which details maximum observed concentrations of heavy metals for January through September of 1990. Since the concentrations for lead, chromium, and silver are below the quoted Toxicity Characteristic Leaching Procedure (TCLP) values, also shown in Appendix B, a nonradiological pathway assessment was not performed.

3.0 Evaluation of the Magnitude of the Potential Threat

The available data permits only a conservative pathway assessment, which is sufficient to justify consideration for removal action(s). Currently, additional soil sampling and analysis are planned to investigate residual contamination within the subsurface soils and groundwater in the area of the failed section. This conservative pathway assessment estimated an annual dose to an RME individual to be 9 millirem (mrem). Furthermore, this dose, using the risk coefficient of 5×10^{-7} risk per mrem (NAS, 1989), resulted in an annual risk of 5×10^{-6}. The lifetime risk to the RME individual was estimated to be approximately 3×10^{-4}, which equals approximately 3 chances in 10,000 of the RME individual developing a fatal cancer in his lifetime. The Environmental Protection Agency generally considers an acceptable lifetime risk of between 1×10^{-4} to 1×10^{-6} (NCP, 1989). It should be recognized that the RME individual does not represent a current exposure scenario, but a hypothetical maximum exposure scenario.

The nonradiological health impact from a potentially leaking effluent line are minimal considering the levels of toxic and carcinogenic chemicals observed in the effluent line under the NPDES permit. A comparison of observed NPDES discharge concentration levels with TCLP extract concentration levels is shown in Table B-1 of Appendix B.

4.0 Assessment of the Need for a Removal Action

Consistent with Section 40 CFR Part 300.410 of the National Contingency Plan, the Department of Energy (DOE) shall determine the appropriateness of a removal action. Eight factors to be considered in this determination are listed in 40 CFR 300.415 (b)(2). The following sections apply specifically to the Manhole 179 and 180 region.

- *Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants.*
- *Actual or potential contamination of drinking water supplies or sensitive ecosystems.*
- *Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.*

These three factors are considered an appropriate result of the investigation which revealed the pipeline to be damaged and in need of repair. The drinking water pathway analyzed represents a hypothetical maximum human exposure route.

5.0 Appropriateness of a Response

If it is determined that a response action is appropriate due to both the level of contamination found in the soils and groundwater, after sampling has been completed and the potential for contamination migration exists, removal action(s) beyond the repair of the pipeline may be required to address the situation.

The analysis contained in this Removal Site Evaluation is based on current operating flow conditions. Currently, a proposal is underway to utilize the main outfall pipeline, starting from Manhole 177, to pump effluent from the South Plume Removal Action to the Great Miami River. A future total flow rate of approximately 3600 gallons per minute (gpm) is expected with the additional effluent generated by the South Plume Removal Project.

If a planning period of less than six months exists prior to the initiation of a response action, DOE will issue an Action Memorandum. The Action Memorandum will describe the selected response and provide supporting documentation for the decision.

If it is determined that there is a planning period greater than six months before a response is initiated, DOE will issue an Engineering Evaluation / Cost Analysis (EE/CA) Approval Memorandum. This memorandum is to be used to document the threat of public health and the environment and to evaluate viable alternative response actions. It will also serve as a decision document to be included in the Administrative Record.

Appendix A

Estimating Doses and Risks for Potential Contamination at Manhole 179/180 Region Determined using a Pathway Assessment Methodology

Introduction

The purpose of this pathway assessment is to estimate the maximum potential health effects resulting from possible radionuclide contamination of the ground water in the region between Manholes 179 and 180. The methodology consists of using the average total uranium concentrations reported in the effluent of the main outfall pipeline for 1986 to predict a resulting drinking water intake and dose. Several assumptions were made in order to conservatively quantify a steady state leak rate for the pipeline. Using a mixture model, total uranium levels in the pipeline were used to estimate the resulting groundwater concentration levels which would be available for ingestion. This assessment is considered to be conservative for several reasons:

1) Due to the relatively short transport times for the radionuclides within the gravel pack region surrounding the effluent line, suspect radionuclides would most likely migrate out of the assessment region.

2) Only a fraction of the uranium present in the effluent line has been or is being released to the soil and water media surrounding the outfall pipeline based upon the flow capacity and the slope of the effluent line. Furthermore, a portion of the uranium released will be absorbed onto the soil particles lying between the pipeline and the aquifer.

3) The pathway analysis methodology used conservatively assumes that an individual will ingest 2 liters or 0.53 gallons of the assessment region water each day (USEPA, 1989).

This pathway assessment attempts to identify the reasonable maximum exposure route through the ingestion of contaminated groundwater from the Manhole 179/180 region. Health effects are based on committed effective dose equivalents and lifetime risk of contracting a fatal cancer.

Assessment Region

The assessment region is defined as the groundwater bearing region lying between Manholes 179 and 180 of the main outfall line. Furthermore, it is assumed that a drinking water well will be installed within 1.4 meters (4.5 feet) on each side of the pipeline. The pipeline section between Manholes 179 and 180 is approximately 85.3 meters (280 feet) long. Using 2.74 meters (9 feet) as the width and 85.3 meters as the length of the pipeline region, the area of the rectangular aquifer region under investigation was determined to be approximately 234 square meters (2,520 square feet).

Methodology

The procedure for performing this assessment consists of four components: 1) estimate the quantity of water released through the leaking pipeline, 2) use the average total uranium concentration for 1986 (IT Inc., 1988) to determine the quantity of uranium released from the pipeline, 3) use a total mix model to predict the effect of dilution between the leaking effluent line and the assessment region of the buried valley aquifer, and 4) characterize the doses and risks based on the assumptions of the Reasonable Maximum Exposure (RME) scenario.

Estimate the Effluent Leak Release Rate

In 1986 the average rate of discharge through the outfall line was 0.78 cubic feet per second (0.78 ft^3/s) as reported in the Environmental Monitoring Report (WMCO, 1987). Conversely, the minimum flow rate during 1986 was 0.31 ft^3/s. Based on a visual examination of the pipeline section using a video camera, the overall integrity of the line appears to be good, no cracks, breaks, or crushed areas; however, several "dislocated" joints were noted. The dislocations were estimated to be 1/4" to 3/8". The leaking release rate for the pipeline was conservatively estimated to be approximately 1 %. The following assumptions were used to substantiate the 1 % since the pneumatic tests did not reveal an actual leak rate. The discharge data from 1986 was utilized since it corresponded to the document, "Hydrogeological Study of FMPC Discharge to the Great Miami River, Final Report," which was used to model the mixture equation and the data also represented a more realistic historical picture of the FMPC total uranium discharge concentrations than more recent environmental monitoring data indicates. These values also represent a more conservative pathway assessment.

1) This segment of the pipeline is a gravity drain. The effluent is not normally under pressure in this segment.

2) The pipeline was designed to transport more capacity than the current flow.

3) Pressure difference between the pipeline and the surrounding soil is relatively small, therefore the path of least resistance would still be the pipeline itself and not the surrounding soil matrix, especially considering the steep slope of this segment.

Equation (A-1) illustrates the calculation for determining the effluent leak release rate based on the leak representing 1 percent of the outfall pipeline's discharge rate. This corresponds to a release rate of 0.22 liters per second or 0.058 gallons per second.

$$Leak\ Release\ Rate = 0.78\ (\frac{ft^3}{s})\ x\ .01 = 0.0078\ (\frac{ft^3}{s}) \qquad (A\text{-}1)$$

Calculate Aquifer Flow Rate

Equation (A-2) describes a general formula for determining the flow rate in a groundwater medium. This simplified equation assumes a homogeneous isotopic medium in which the gradient is constant over the horizontal increment, delta x.

$$V = -k \times \frac{\Delta H}{\Delta X} \qquad (A\text{-}2)$$

V = Groundwater flow rate with units of meters per day, (0.675 m/day) (Equation from: Till, 1983).

-k = Hydraulic Conductivity with units of meters per day, (250 m/day) (GeoTrans Inc., 1985).

$\Delta H / \Delta X$ = Hydraulic Gradient in the direction of flow. The hydraulic gradient was determined from twelve groundwater isopleths for the months of September 1986 to August 1987 (IT Inc., 1988). The average hydraulic gradient was determined to be 0.0027.

Equation (A-3) was used to determine the total groundwater flow rate, with units of cubic meters per day. Recall the assessment region beneath Manhole 179/180 was defined as a rectangle 85.3 meters long by 2.7 meters wide or a total area of 234 square meters.

$$Volumetric\ Flow\ Rate,\ Q = 0.675\ m/day \times 234\ m^2 \qquad (A\text{-}3)$$

$$Q = 158\ \frac{m^3}{day}$$

The total flow rate in the groundwater region beneath Manholes 179 and 180 equals approximately 158 m^3/day or approximately 1.8 liters per second.

Characterize the Extent of Dilution between the Aquifer and the Effluent Line

A complete mix model was utilized to determine the resulting groundwater concentration (pCi/L) of the assessment region after mixing with the effluent release. The basic assumption of the model is that the total mass flux of uranium mixes completely and instantaneously with the background mass flux of uranium in the groundwater. Since the mass flux can be described by the product of the flow rate and uranium concentration, the concentration in the groundwater after mixing is defined by Equation (A-4) (IT Inc., 1988). The extent of soil absorption is not included in the analysis.

$$C_{GRND} = \frac{(Q_p \times C_{effluent} + Q_{GRND} \times C_{Bkg})}{Q_p + Q_{GRND}} \qquad (A\text{-}4)$$

$$49\ pCi/L = \frac{(0.22\ L/sec \times 450\ pCi/L + 1.8\ L/sec \times 1.2\ pCi/L)}{0.22\ L/s + 1.8\ L/s}$$

C_{GRND} = Resulting concentration of uranium in groundwater after mixing (49 pCi/L).

Q_p = Leak rate of the effluent from the pipeline (0.22 L/sec).

Q_{GRND} = Flow rate in groundwater of the assessment region (1.8 L/sec).

$C_{effluent}$ = Concentration of total uranium in effluent (450 pCi/L) (IT Inc., 1988).

C_{Bkg} = Background concentration of uranium in the groundwater (1.2 pCi/L).

Estimate Doses and Risks

An exposure scenario was outlined for a reasonable maximum exposure individual who ingests two liters of water each day for 365 days each year for the rest of his life. The assumptions for this pathway are as follows:

Drinking Water Pathway Assumptions

1) No dilution or filtering of groundwater assumed.

2) Exposure is 2 liters (0.53 gallons) per day and 365 days per year.

3) Committed effective dose equivalent conversion factors were used in the analysis (USDOE, 1988.)

4) Uranium concentrations exist in the effluent line which provide for the assumption of a continuous and uniform source within the groundwater beneath the assessment region.

Equation (A-5) describes the calculation of dose equivalents for the drinking water pathway using the average source term concentration for the ith radionuclide.

$$Dose\left(\frac{mrem}{year}\right) = S\left(\frac{pCi}{L}\right) \times DF\left(\frac{L}{day}\right) \times EF\left(365\frac{day}{year}\right) \times DCF\left(\frac{mrem}{pCi}\right) \quad (A\text{-}5)$$

The terms of Equation (A-5) are defined as follows:

Dose = Annual contribution to the committed effective dose equivalent with units of millirem of dose per year.

S_i = Source concentration for the ith radionuclide with units of picocuries per liter of water (found to be 49 pCi/L from Equation A-4).

DF = Dietary factor for the ingestion of drinking water on an average daily basis (2 liters per day).

DCF_i = Dose conversion factor for i^{th} radionuclide with units of dose equivalent (millirem) per picocurie of radionuclide ingested. A total uranium DCF, based on a natural isotopic activity distribution, is 2.53×10^{-4} mrem per year.

EF = Exposure Frequency with units of days of exposures per year (365 days per year).

The annual dose commitment using the previous equations and assumptions was found to be:

Annual Dose Equivalent = 9 mrem

Equation (A-6) illustrates the calculation of annual risk from the drinking water pathway based on a dose equivalent. The risk coefficient employed is from BEIR V (NAS, 1989) and represents the most recent findings of the Scientific Community.

$$Risk(Annual) = Dose\ Equivalent\left(\frac{millirem}{year}\right) \times Risk\ Coefficient\left(\frac{risk}{millirem}\right) \quad (A\text{-}6)$$

The terms of Equation (A-6) are defined as follows:

Risk = Annual risk to RME individual for the drinking water pathway.

Dose Equivalent = Annual dose equivalent to RME individual with units of millirem per year.

Risk Coefficient = Annual Risk of developing a fatal cancer based on the BEIR V risk estimate with units of risk per mrem (5×10^{-7} risk per mrem).

The annual risk using Equation (A-6) was found to be: 5×10^{-6} Risk / Year

Equation (A-7) illustrates the calculation of lifetime risk based on the annual risk multiplied by the standard lifetime defined by the Environmental Protection Agency of 70 years.

$$Lifetime\ Risk\ \left(\frac{risk}{70}years\right) = Annual\ Risk \times 70\ years \quad (A\text{-}7)$$

The lifetime risk was found to be: 3×10^{-4} Risk

Appendix B

Evaluating the Health Impact from Non-Radiological Contaminants for the Manhole 179 and 180 Region

Introduction

The purpose of this appendix is to investigate the possible nonradiological health effects associated with the potentially leaking effluent line between Manholes 179 and 180. The evaluation of nonradiological contaminants in the effluent line consisted of comparing the observed concentration levels, obtained from the NPDES permit discharge reports, with the TCLP extract concentration levels. Table B-1 below illustrates this comparison. The NPDES data were taken from discharge reports for 1990. The TCLP concentration levels are usually reported in terms of milligrams per liter, for comparison purposes these values were converted to micrograms per liter.

Table B-1

Comparison of Maximum Observed Concentrations from the NPDES Permit Discharge Reports with the TCLP Extract Concentration Levels

Contaminant	NPDES Level (micrograms/Liter)	TCLP Level (micrograms/Liter)
Chromium, Total	70	1,000
Lead	30	5,000
Silver	2.9	5,000