Mead & Hunt

Kirkpatrick Dam Inspection Summary Notes

Project Name:	Kirkpatrick Dam	**Owner:**	Department of Environmental Protection
Mead & Hunt Representatives:	Marty Kemps, PE (FL) Jim Botz, PE	**Date:**	August 2 and 3, 2021

The following findings are a summary of Mead & Hunt's inspection. Detailed information regarding the inspection will be provided in the inspection report which will also contain the requested Condition Assessment, recommendations, additional photos, final dive report, and repair / maintenance information.

Dive Inspection

Volkert, Inc. performed a dive inspection of the project on August 2 and 3, 2021. The following is a summary of their findings.

A. No significant areas of deterioration were noted by the divers that require immediate repairs.

B. Wood debris was present along the upstream side of the spillway. As a result, the divers were unable to inspect the upstream face of the ogee and upstream apron.

C. The downstream apron was undermined with approximately 18-inches of the downstream sheet piling cut-off wall exposed. Material has also eroded beneath the apron, through the pick-holes located throughout the sheet pile cut-off wall.

D. The debris barrier cables and connecting hardware below the waterline are no longer supported by the timber pile clusters.

E. Hardware securing the gate seals are corroded.

Inspection

The following is a summary of the observations made by Mead & Hunt during our inspection.

Spillway

A. No immediate dam safety concerns with regards to the spillway were observed during the inspection.

B. With the debris barrier system in dis-repair, heavy woody debris exists immediately upstream of the spillway. This debris significantly reduces the discharge capacity of the spillway.

C. The walking path over the culverts that collect seepage from the left[1] along the left side, downstream side of the spillway is undermined. Although not a dam safety concern, if this undermined section settles, it would be a tripping hazard.

D. Gate seals leak.

E. The support frame of the hydraulic cylinders, gates, and connecting hardware for the gates contained areas of rust with slight to moderate corroding.

Embankments

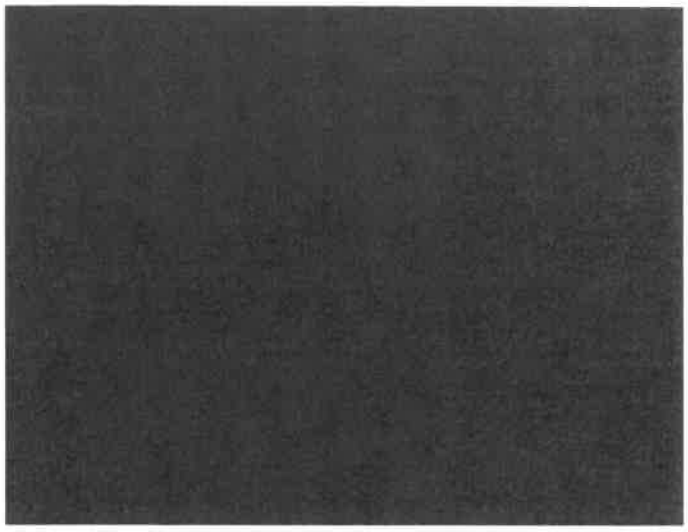
A. No sinkholes, low spots, or signs of slope instability were observed at both the left and right embankments. The embankments were well vegetated and maintained.

B. Minor rutting and bare spots were observed at select, small areas along the embankments.

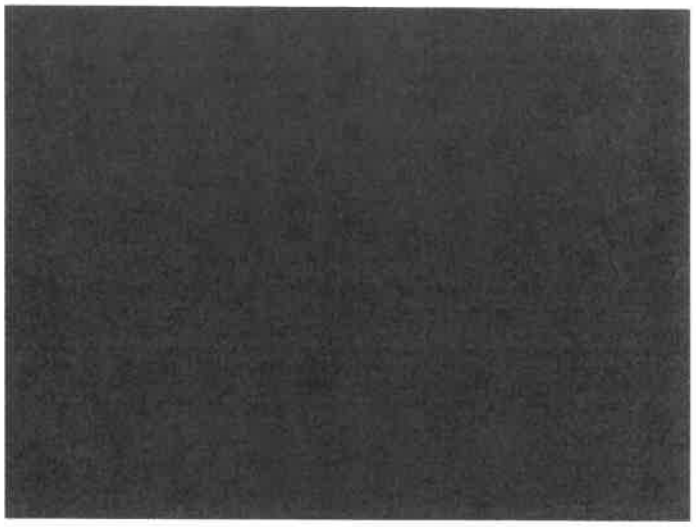
C. Some palm trees were noted at the toe of the embankment which will require removal.

D. Each embankment contained seepage along the downstream toe. This seepage is collected in a trench and discharged to the river.

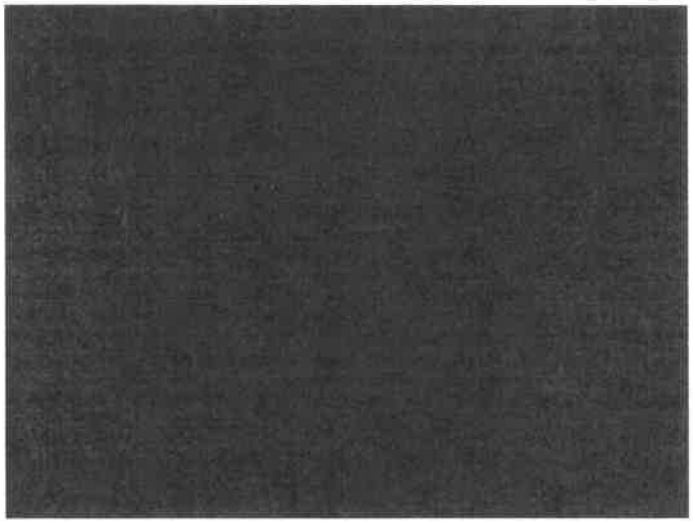
[1] The project structures are referred to in this memo as left and right looking downstream.



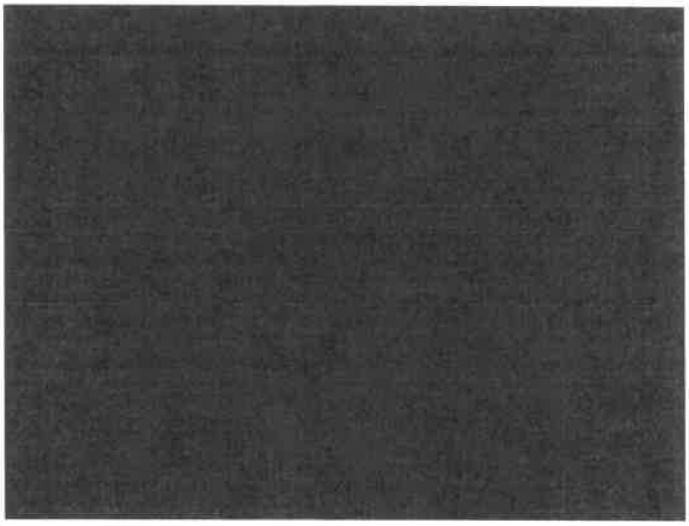
Photograph No. 1: View of downstream end of spillway



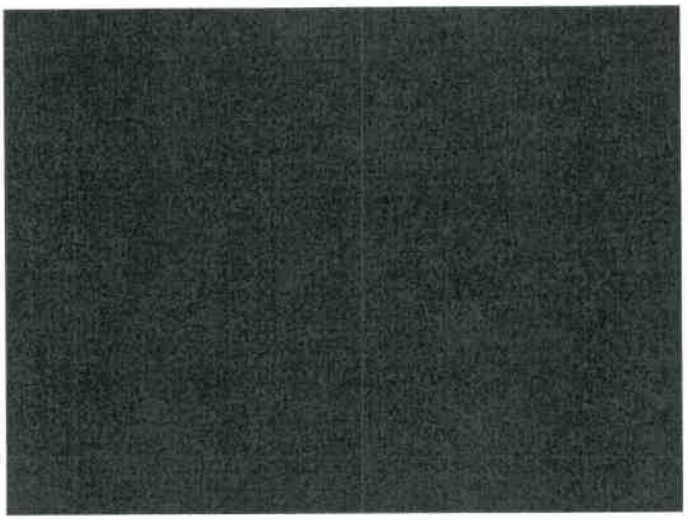
Photograph No.2: Spillway piers



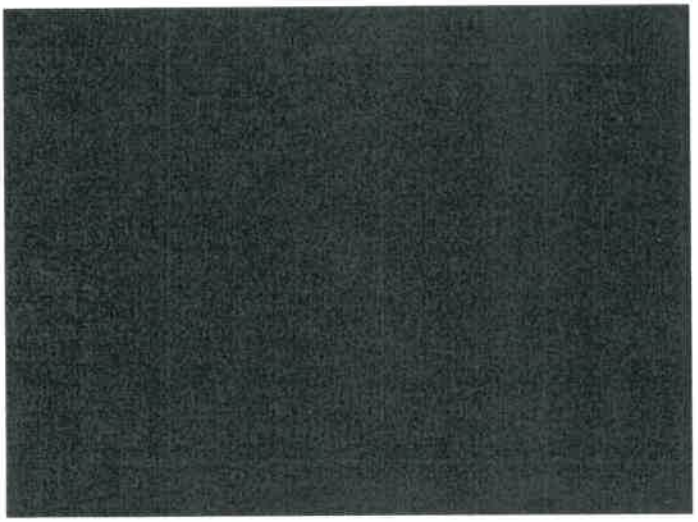
Photograph No. 3: Diver inspecting Gate 1



Photograph No. 4: Debris upstream of gates



Photograph No. 5: Corrosion of gate hoist supports



Photograph No. 6: Downstream view of gate

Photograph No. 7: Upstream slope of left embankment

Photograph No.8: Downstream slope of left embankment

Photograph No. 9: Upstream slope of right embankment

Photograph No. 10: Downstream slope of right embankment

2021 Inspection Report

Kirkpatrick Dam

Ocklawaha River
Putman County, Florida

Report prepared for

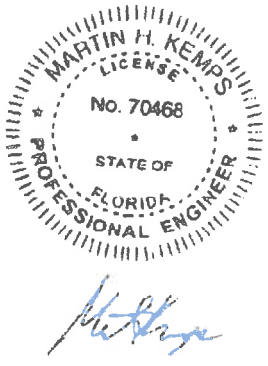
Florida Department of Environmental Protection #

Report prepared by

Mead Hunt

www.meadhunt.com

November 2021



This item has been digitally signed and sealed by Martin Kemps, PE on 11/10/2021.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Table of Contents

Page

1. **General** 1
2. **Project Description** 1
3. **Field Inspection** 2
   - 3.1 Field Inspection Observations 3
     - 3.1.1 Spillway 3
     - 3.1.2 Left Embankment 5
     - 3.1.3 Right Embankment 6
4. **Surveillance and Monitoring** 6
5. **Opinion of Probable Cost and Timeline** 7
6. **Drawdown Impacts** 9
7. **References** 10

Appendices

A Project Drawings

B Photographs

C Dive Inspection Report

D Condition Assessment Report For Florida Dams and Impoundments

1. General

The Kirkpatrick Dam (Project) is owned, operated, and maintained by the Florida Department of Environmental Protection (FDEP). Mead & Hunt, Inc. (Mead & Hunt) performed the inspection of the Kirkpatrick Dam on August 2 and 3, 2021. A dive inspection was also performed as part of the inspection on August 2 and 3, 2021. This report provides a summary of the inspection and recommendations for long-term monitoring along with a cost estimate for repairs.

The conclusions and recommendations herein are based on the engineer's opinion and are made independently of the FDEP, its employees, and its representatives. The conclusions regarding the condition and safety of the dam and related facilities are not guaranteed but do represent our best judgment.

This report was prepared by Martin Kemps, PE and reviewed by Jim Botz, PE.

2. Project Description

The Kirkpatrick Dam was designed by the U.S. Army Corps of Engineers (USACE) as part of the Cross Florida Barge Canal system. The dam is currently listed as "Low Hazard Potential" in the National Inventory of Dams (FL00156), meaning failure of mis-operation results in no probable loss of human life and low economic and/or environmental losses.

The Kirkpatrick Dam consists of three primary water-retaining structures – a left embankment[1], a vertical lift gate spillway, and a right embankment. The embankments are homogenous and consist of clean sand, silty sand, and clayey sand. The crest is 30 feet wide with a top elevation of 28.0. The downstream section consists of 4(H):1(V) downstream slopes. The downstream slopes contain a rip rap revetment to elevation[2] 19.3 which is underlain by a two-stage filter system. The upstream slopes consist of 4(H):1(V) slopes to elevation 25.0, 10(H):1(V) slopes to elevation 13.0, and a 3(H):1(V) slope that ties back into the existing ground surface.

The spillway consists of a reinforced ogee weir with a top elevation of 6.0 and four vertical lift gates (numbered from 1 – 4, from left to right). The upstream cut-off consists of reinforced concrete to elevation -21.0 with a steel sheetpile extending down to elevation -35.0. Four 15-foot-high by 40-foot-wide vertical lift gates which are operated with hydraulic rams that are situated on an overhead operating platform. The forebay and tailrace walls consist of sheetpile with a whaler. The forebay walls extend down to elevation -15.5 to -33.5, with a top elevation ranging from elevation 28.0 to 8.9. The tailrace walls extend to a bottom elevation -20.5 to -31.0 with a top elevation 16.0 to 0.5. The downstream apron consists of a 30-inch-thick reinforced concrete slab supported by timber pile, with a sheet pile cut-off wall at the downstream end.

Upstream of the spillway there is a debris barrier system which consists of cables supported by 17 timber dolphins. A concrete walking path which crosses the culverts that collect seepage from the left embankment is located along the left side of the spillway. Rodman Road crosses over the concrete weir, downstream of the spillway gates. Select project drawings of the Project for reference are included in Appendix A.

---

[1] Left and right are referred to in this report relative to an observer facing downstream.

[2] Elevations in this report are referenced to NGVD 29.

3. Field Inspection

The field inspection of the Project was performed on August 2 and 3, 2021. The following individuals participated in the visual inspection:

John DeHoff – FDEP
Jim Botz, PE – Mead & Hunt, Inc.
Marty Kemps, PE – Mead & Hunt, Inc.

At the time of the inspection, the weather was overcast to heavy rains with temperature of 75°F to 86°F. The reservoir was at approximate elevation 19.6. The conditions allowed for a visual assessment of all the Project's water-retaining structures. No condition that requires immediate action were noted during the field inspection.

Visual observations of the Project's water-retaining structures were made during the field inspection to note the following conditions:

- Cracking of concrete
- Deterioration of concrete
- Joint movement or offsets
- Misalignment
- Movement
- Settlement
- Excessive debris
- Deformation of gate members
- Leakage
- Seepage
- Erosion
- Debris
- Instrumentation
- Offsets

The field inspection started along the spillway, then along the crest and upstream slope of the left embankment and back across the downstream slope. The spillway was inspected from the roadway downstream, followed by the crest and downstream slope of the right embankment and back across the upstream slope of the right embankment. Photographs taken during the inspection and referenced below can be found in Appendix B.

An underwater dive inspection was performed by Volkert, Inc. (Volkert) on August 2 and 3, 2021. A copy of the underwater inspection report can be found in Appendix C.

The condition of Project components was evaluated relative to the following definitions.

Excellent	Appearance is essentially equivalent to post-construction condition. Feature or system functions as intended and without problems. Maintenance needs are less than or equivalent to design intent.
Good	Appearance has minor deterioration such as concrete shrinkage cracks or damage to coatings over less than 5 percent of area, which would be expected for a structure or system of similar age and exposure. Feature or system reliably functions as intended. Maintenance needs are essentially equivalent to design intent.

Fair — Appearance has deterioration such as concrete cracking, spalling, joint offsets, or metal corrosion over more than 25 percent of area, which is indicative of age, weathering, or wear. Feature or system accommodates design loadings and functions as intended; however, operation may periodically require minor manipulation. Maintenance needs are evident and likely greater than design intent.

Poor — Appearance has significant deterioration that could be indicative of reduced structural integrity and ability to accommodate design loadings. Feature or system often does not function as intended and requires repair or replacement. Maintenance needs are frequent and far exceed the design intent.

Unsatisfactory — The feature or system is no longer able to perform its function as intended and poses a threat to the safe operation of the facility. Immediate attention is required to remedy the condition.

A *Condition Assessment Report For Florida Dams and Impoundments* form was also completed and is included in Appendix D.

3.1 Field Inspection Observations

3.1.1 Spillway

The spillway appeared in good condition overall. Debris consisting of logs and vegetation were located upstream of the spillway (see Photograph Nos. 1, 2, and 3). These logs extended to the bottom of the reservoir and prevented the divers from inspecting the upstream portion of the ogee below elevation 4.0, manatee barrier at Gate Nos. 1-3, and the entire left forebay wall. The divers noted minor spalling (1/2-inch deep) with no exposed rebar along the upstream side of the concrete weir where visible.

The upstream debris (boat) barrier is in disrepair with failed cables and connecting hardware. The anchor piles themselves appeared to be in relatively good condition. This debris could clog the spillway bays reducing the discharge capacity of the Project. If discharge capacity is restricted, the reservoir could surcharge and overtop the embankments during a heavy rain event. In addition the logs may prevent the vertical lift gates from opening or closing as intended. It is recommended that the debris in front of the spillway be removed to maintain discharge capacity and ensure proper gate operation.

2021-REC-1 — Remove the logs, vegetation, and other debris from in front of the spillway by July 2022.

2021-REC-2 — Revise the upstream debris barrier design and repair barrier so that logs do not accumulate in front of the gates by December 2023.

Some light spalling (see Photograph No. 4) was noted on the right side of the left pier at Gate No. 1. A vertical crack with spalling (see Photograph No. 5) was also noted along the right side of the left pier at Gate No. 1. These spalls appear to be the same size when compared to the 2015 and 2019 inspection reports. The divers noted some light spalling along the upstream side of the concrete weir where visible.

The upstream sheetpile forebay walls had light surface rust on the pile caps but appeared to be straight, with no signs of buckling and in good condition (see Photograph Nos. 6 and 7). Where the divers could access the upstream forebay walls, only light corrosion was noted.

The concrete operating platform where the hoists for the gates are located, the concrete was in good condition (see Photograph Nos. 8 and 9) with hairline cracks. Rust and corrosion were noted on the frames that support the hydraulic cylinders Nos. 2 through 4 (see Photograph Nos. 10 and 11). The housing for the hydraulic cylinders also contained rust (see Photograph No. 12), with the exception of the hydraulic operating system for Gate No. 1, which was replaced in 2019.

2021-REC-3 The hydraulic cylinders and support framing for Gate Nos. 2-4 should be cleaned (sandblasted) and re-coated by end of December 2023 to extend service life.

The vertical lift gates appeared to be in fair condition. The horizontal structural members collect debris and water which increases the rate of corrosion (see Photograph No. 13). Vegetation was also observed to be growing from within the horizontal members (see Photograph No. 14). To document the amount of corrosion and overall condition of the gates, a detailed, hands-on inspection which includes climbing the gates along with taking thickness measurements should be performed and the results reviewed by a qualified hydraulic steel structural engineer.

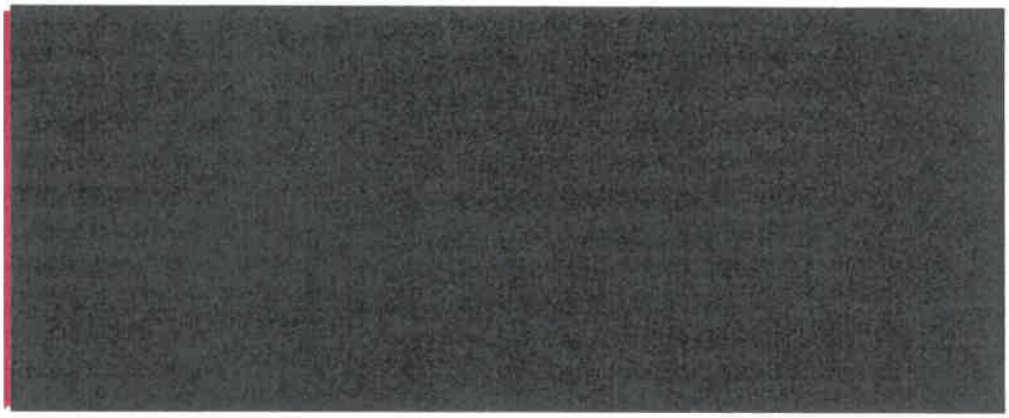
2021-REC-4 Debris and vegetation should be removed from the horizontal members of the gates along with cleaning of the gate members so a detailed, hands-on inspection of the gates can be performed, including taking thickness measurements of gate members. The findings should be reviewed by a qualified hydraulic steel structural engineer by December 2023.

Each of the gates are operated by its own electrically driven hydraulic ram operating system. A standby generator is available to operate the gates and is tested at least yearly by a vendor.

The downstream sheetpile tailrace walls had light surface rust on the pile caps but appeared to be straight, no signs of buckling and in good condition (see Photograph Nos. 15 and 16). The divers also only noted light corrosion below the waterline. The sealant was missing along the vertical construction joint at the concrete abutment walls. The divers could see a PVC waterstop located between the joints, which the plans also show. Since the joint isn't subject to freeze-thaw conditions and there is a waterstop present, no action is required other than continue routine inspections for deteriorating joint conditions.

The downstream portion of the concrete ogee weir was in good condition, with minor scaling of the concrete. The downstream apron continued to show some undermining (**Figure 1**) beneath the downstream edge but has not changed significantly when compared to the 2015 readings. The undermining extended a distance of 3'-8" upstream beyond the sheet piling and a maximum of 27-inches beneath the concrete, downstream of the sheet piling.

Figure 1. Location of undermining



2021-REC-5 The void beneath the downstream edge of the apron should be grouted and rip rap placed to prevent future undermining by the end of 2024.

3.1.2 Left Embankment

Overall the left embankment was in good condition. No signs of settlement, slope instability, cracking or wet areas were observed. No cracks or depressions were observed along the crest which consists of asphaltic concrete. The upstream and downstream slopes had adequate cover of grass (see Photograph Nos. 17 and 18) with the exception of a relatively small section located just above the rip rap (see Photograph No. 19) which had only sparse vegetation. Overall the grass was well-maintained. The rip rap along the upstream slope along the edge of the reservoir had adequate cover and was in excellent condition. A small palm tree was growing near the rip rap along the upstream slope which should be removed (see Photograph No. 20).

2021-REC-6 The palm tree located along the rip rap of the upstream slope of the left embankment should be removed by July 2022.

Seepage was observed within the rip rap revetment along the downstream toe. Heavy vegetation (see Photograph No. 21) was noted along the upstream slope of revetment. The downstream slope of the revetment did not contain heavy vegetation. This heavy vegetation should be killed or removed to allow seepage water to flow more freely and to improve visibility of the ditch for inspections.

2021-REC-7 The heavy vegetation along the downstream revetment of the left embankment that collects seepage should be killed or removed by July 2022.

Although not a dam safety concern, the concrete walking path over the culverts that collect seepage from the left embankment is undermined, which if settles, could be a tripping hazard. The grouted rip rap slopes adjacent to the spillway tailrace walls appeared in good condition (see Photograph No. 22). We understand that the hollow areas beneath the rip rap that were identified in the 2019 GPI Inspection Report have not been repaired. The grout cover is still intact and has not cracked or settled into the underlying voids.

3.1.3 Right Embankment

Overall the right embankment was in good condition. No signs of settlement, slope instability, cracking or wet areas were observed. No cracks or depressions were observed along the crest which consists of asphaltic concrete. The rip rap along the upstream slope along the edge of the reservoir had adequate cover and was in good condition. The upstream and downstream slopes had adequate cover of grass (see Photograph Nos. 23 and 24). Heavier vegetation was located on the downstream slope by the spillway (Photograph No. 25). We understand that this vegetation has grown this year and will be cut during the FDEP's annual maintenance activities. Heavy vegetation and a small palm tree were growing in the rip rap along the downstream of the rip rap revetment which should be removed (see Photograph No. 26).

2021-REC-8 The palm tree along with the heavy vegetation located along the upstream side of the rip rap revetment on the right embankment should be removed by July 2022.

The rip rap along both the upstream slope and downstream revetment had adequate cover and was in excellent condition. Seepage was observed within the rip rap revetment along the downstream toe which flows into the Ocklawaha River.

4. Surveillance and Monitoring

The only monitoring currently performed is from operator observations during weekly site visits and viewing staff gages to monitor headwater and tailwater elevations. The Project currently does not have any active instrumentation such as monitoring wells, piezometers, survey control points, or seepage monitoring systems.

Since the Project is low-hazard and is in fairly good condition, the only recommendation we have regarding instrumentation is to monitor survey control points on the spillway piers. Permanent benchmarks not located on the spillway would need to be installed along with control points on each of the four piers. Readings should be taken annually for the first three years to establish a baseline, then every five years. The data should be plotted and reviewed after each survey to determine if any movement or adverse trends are developing that would compromise the safety of the dam.

2021-REC-9 Establish an elevation and alignment survey program for the spillway piers. Take readings yearly for three years, then every five years. The data should be plotted and reviewed after each survey for excessive movement or any spurious trends that may be developing. The first baseline survey should be completed by December 2022.

5. Opinion of Probable Cost and Timeline

The cost estimate is considered a Class 4 estimate based upon the Association for the Advancement of Cost Engineering (AACE) International *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry*. A summary of the Class 5 estimate is shown in Table 5-1 for reference:

Table 5-1. AACE Cost Estimate Matrix

COST ESTIMATE CLASSIFICATION MATRIX FOR THE HYDROPOWER INDUSTRY

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES Expressed as % of complete definition	END USAGE Typical purpose of estimate	METHODOLOGY Typical estimating method	EXPECTED ACCURACY RANGE Typical variation in low and high ranges [a]
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

The following table is a summary of costs with regards to Mead & Hunt's 2021 recommendations with a 20-30% contingency included.

Table 5-2. Maintenance, Cost, and Timeline Estimation

KIRKPATRICK MAINTENANCE AND REPAIR ITEMS			
Mead & Hunt's 2021 Inspection Report			
Recommendation	**Estimated Cost***	**Recommended Completion Date**	**Remarks**
Remove the logs, vegetation, and other debris from in front of the spillway. (2021-REC-1)	$280,000	July 2023	• Includes 20% contingency • Assumes reservoir drawndown to elevation 6.0 • Assumes disposal at nearby original borrow pit for dam
Revise the upstream debris barrier design and repair barrier so that logs do not accumulate in front of the gates. (2021-REC-2)	$635,000	December 2022	• Includes 20% contingency • Assumes reservoir drawndown to elevation 6.0 • Repair will utilize existing pile clusters • Includes engineering

The hydraulic cylinders and support framing for Gate Nos. 2-4 should be cleaned (sandblasted) and re-coated. (2021-REC-3)	$160,000	July 2023	• Assumes re-coating in-place with on-site containment • Zinc primer, epoxy intermediate, and polyurethane topcoat
Debris and vegetation should be removed from the horizontal members of the gates along with cleaning of the gate members so a detailed, hands-on inspection of the gates can be performed, including taking thickness measurements of gate members. The findings should be reviewed by a qualified hydraulic steel structural engineer by December 2023. (2021-REC-4)	$38,000	December 2023	• Inspection includes physically climbing the gates • Includes engineering review
The void beneath the downstream edge of the apron should be grouted and rip rap placed to prevent future undermining. (2021-REC-5)	$220,000	December 2024	• Assumes grout pumped from land • Barge to place rip rap • Includes engineering
The palm tree located along the rip rap of the upstream slope of the left embankment should be removed. (2021-REC-6 and 2021-REC-8)	N/A	July 2022	• Assumes trees will be removed by operating personnel
The heavy vegetation along the downstream revetment of the left embankment that collects seepage should be killed or removed by July 2022. (2021-REC-7)	$5,000	July 2022	• Assumes about a half-acre of clearing
Establish an elevation and alignment survey for the spillway piers. Take readings yearly for three years, then every five years. The data should be plotted and reviewed after each survey for excessive movement or any spurious trends that may be developing. (2021-REC-7)	$4,000 initial survey / $1,400 per year afterwards	Begin December 2022	• Assumes operators review yearly data

* Information presented on this sheet represents our opinion of probable project costs in 2021 dollars and is based upon limited engineering. Unit and lump sum prices are based on costs for similar projects, discussions with contractors, vendor quotes, FDOT, engineering judgement, and/or published data. Actual bids and total project cost will vary based on contractor's perceived risk, site access, market conditions, availability of materials, etc. No warranties concerning the accuracy of costs presented herein are expressed or implied.

Besides the maintained and repaired items mentioned above in Table 4-2, GPI also recommended in their 2019 inspection report that the gate seals and the rip rap slopes adjacent to the spillway be grouted to fill voids. The prices (in 2019 dollars) appear reasonable but need to account for inflation of about 2-3% per year. We recommend that these additional items be completed by December 2023.

The estimated schedules to perform repairs assumes the conditions described do not become significantly worse. If operators observe these areas becoming significantly more deteriorated, a qualified consultant should be notified to discuss a revised timeline of repair / maintenance items.

6. Drawdown Impacts

We understand the FDEP is considering lowering the reservoir pool from the normal elevation of 20.0 feet. The reservoir elevations which are being considered are elevation 18.0, 16.0, and 14.0 feet NGVD 29. The following is a summary of the recommendations provided in Section 4.0 with commentary if the reservoir levels are permanently lowered.

Table 5-1. Drawdown vs Impact on Repairs

KIRKPATRICK MAINTENANCE AND REPAIR ITEMS VS LOWERED HEADWATER ELEVATION	
RECOMMENDATION	**IMPACT OF LOWERED RESERVOIR POOL**
Remove the logs, vegetation, and other debris from in front of the spillway. (2021-REC-1)	Upstream debris would be able to clog the spillway bays reducing the discharge capacity of the Project, regardless of pool level. If discharge capacity is restricted, the reservoir could surcharge and overtop the embankments during a heavy rain event. The large logs may also prevent the vertical lift gates from opening or closing as intended. The debris should be removed in front of the spillway as discussed in Section 4 regardless of the reservoir elevation.
Revise the upstream debris barrier design and repair barrier so that logs do not accumulate in front of the gates. (2021-REC-2)	To prevent debris from accumulating and reducing spillway capacity along with interfering with gate operations, the upstream debris barrier should be repaired with the schedule discussed in Section 4 regardless of reservation elevation.
The hydraulic cylinders and support framing for Gate Nos. 2-4 should be cleaned (sandblasted) and re-coated. (2021-REC-3)	The gates would need to continue to operate regardless of pool level. To prolong the useful life of the gate operating system, the framing and cylinders should be re-coated as recommended in Section 4.
Debris and vegetation should be removed from the horizontal members of the gates along with cleaning of the gate members so a detailed, hands-on inspection of the gates can be performed, including taking thickness measurements of gate members. The findings should be reviewed by a qualified hydraulic steel structural engineer by December 2023. (2021-REC-4)	The gates would need to continue to operate regardless of pool level. To help provide long-term reliability the gate should be cleaned and inspected per the schedule discussed in Section 4.
The void beneath the downstream edge of the apron should be grouted and rip rap placed to prevent future undermining. (2021-REC-5)	If the pool is lowered, discharge through the gates would still be required, at any pool level. To prevent the downstream apron from undermining, the schedule to repair the apron discussed in Section 4 would need to be maintained.

KIRKPATRICK MAINTENANCE AND REPAIR ITEMS VS LOWERED HEADWATER ELEVATION	
RECOMMENDATION	**IMPACT OF LOWERED RESERVOIR POOL**
The palm tree located along the rip rap of the upstream slope of the left embankment should be removed. (2021-REC-6 and 2021-REC-8)	The palm trees should be removed per the schedule discussed in Section 4 to reduce seepage paths that may be created by the root system, regardless of pool level elevation.
The heavy vegetation along the downstream revetment of the left embankment that collects seepage should be killed or removed by July 2022. (2021-REC-7)	To maintain flow and to allow for visual inspections regardless of pool level, the vegetation along the left downstream revetment should be removed per the schedule discussed in Section 4.
Establish an elevation and alignment survey for the spillway piers. Take readings yearly for three years, then every five years. The data should be plotted and reviewed after each survey for excessive movement or any spurious trends that may be developing. (2021-REC-7)	The recommendation to survey the spillway piers could be removed if the pool was lowered to elevation 18 or lower. The likelihood of the structure moving with a reduced hydrostatic loading condition is low.

7. References

AACE International Recommended Practice No. 69R-12, *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry,* January 25, 2013.

Amec Foster Wheeler Environmental & Infrastructure, Inc., *Kirkpatrick Dam & Buckman Lock Geotechnical Inspection Report*, July 2017.

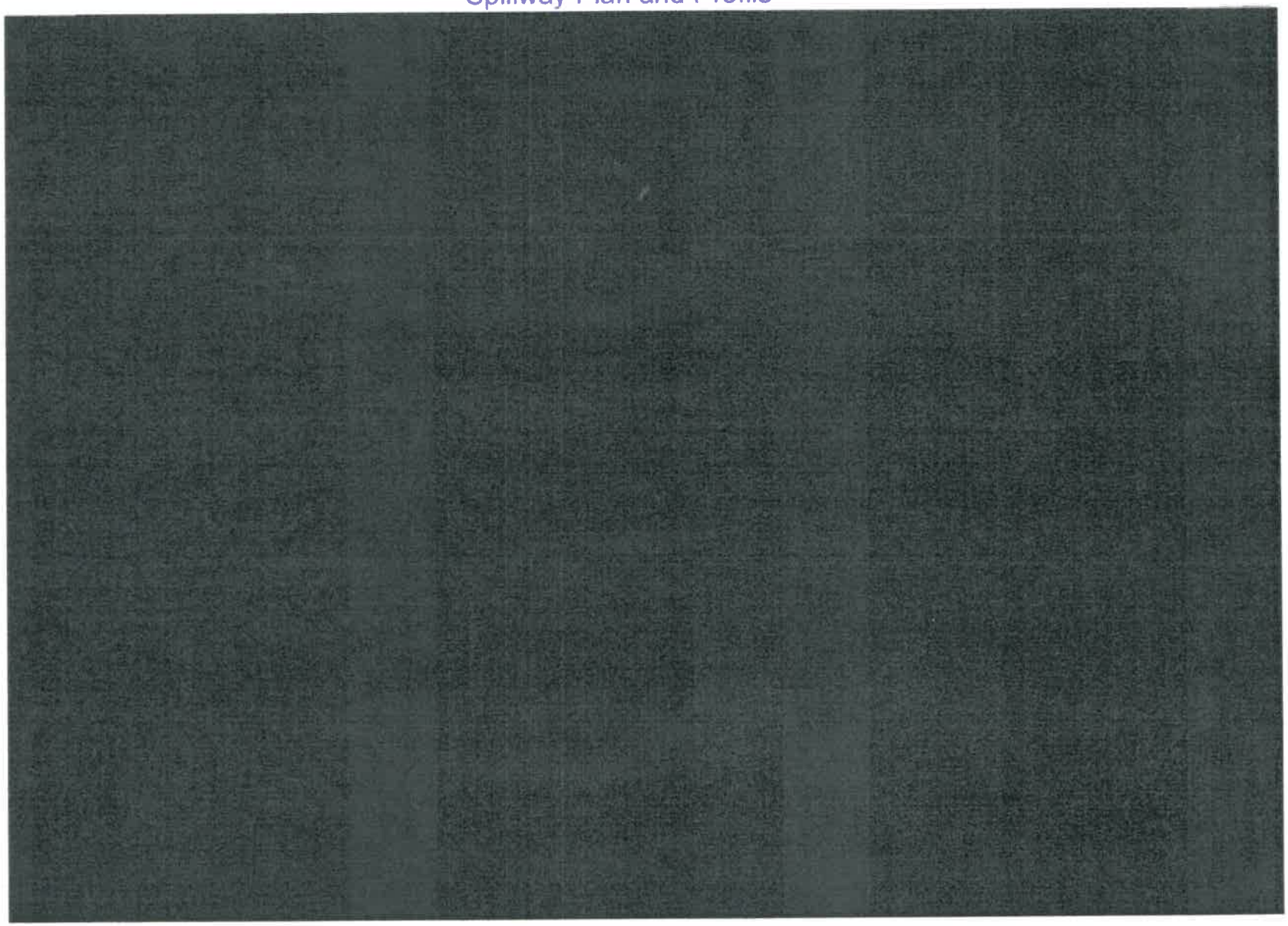
Greenman-Pedersen, Inc., *Report of Findings – Inspection of Kirkpatrick Dam*, October 2019.

U.S. Army Engineer District, Jacksonville Corps of Engineers, *Cross Florida Barge Canal Plans Rodman Dam and Spillway*, January 1966.

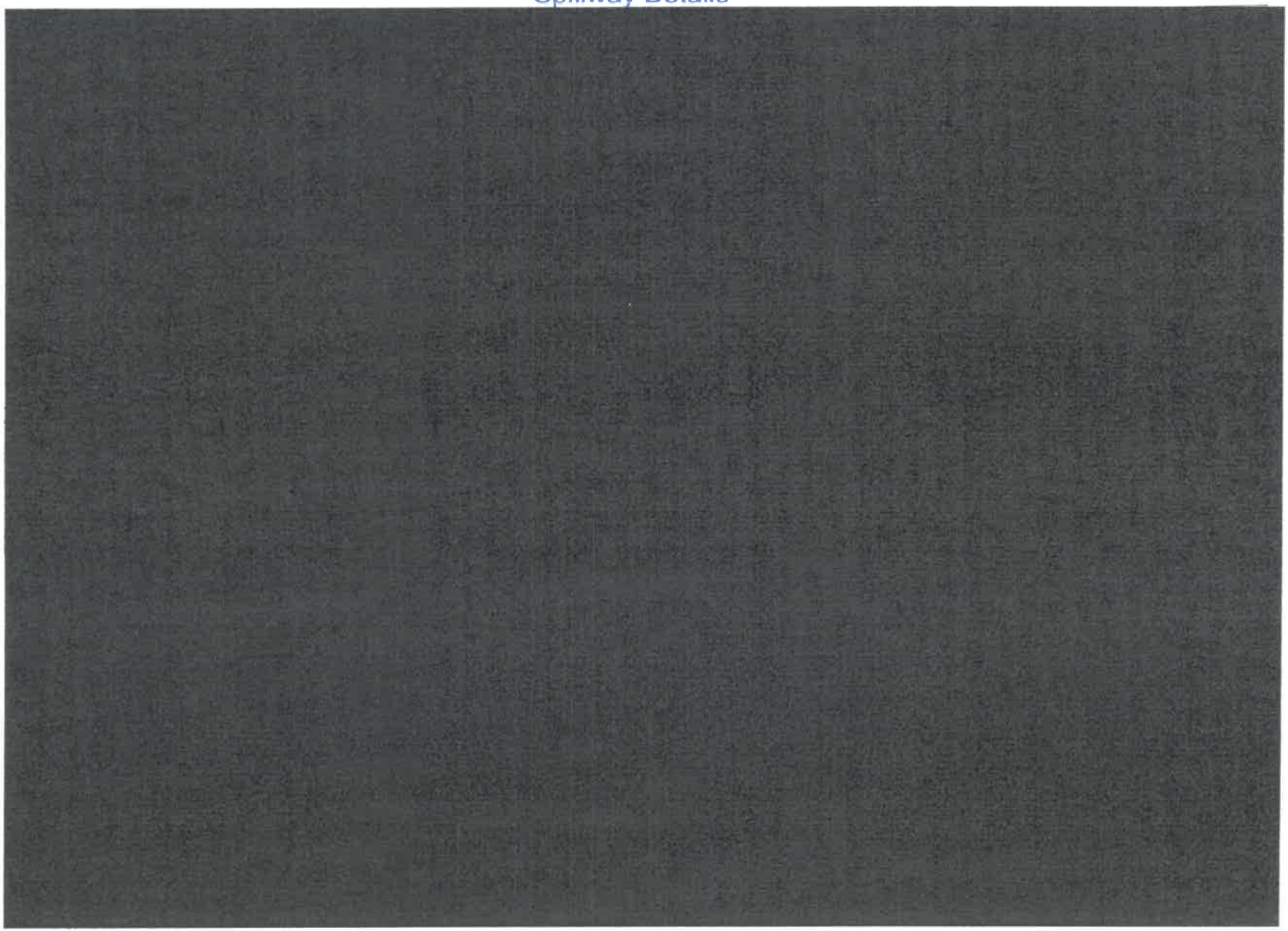
URS Corporation Southern, *Kirkpatrick Dam and Spillway Condition Assessment*, September 2015.

Appendix A. Project Drawings

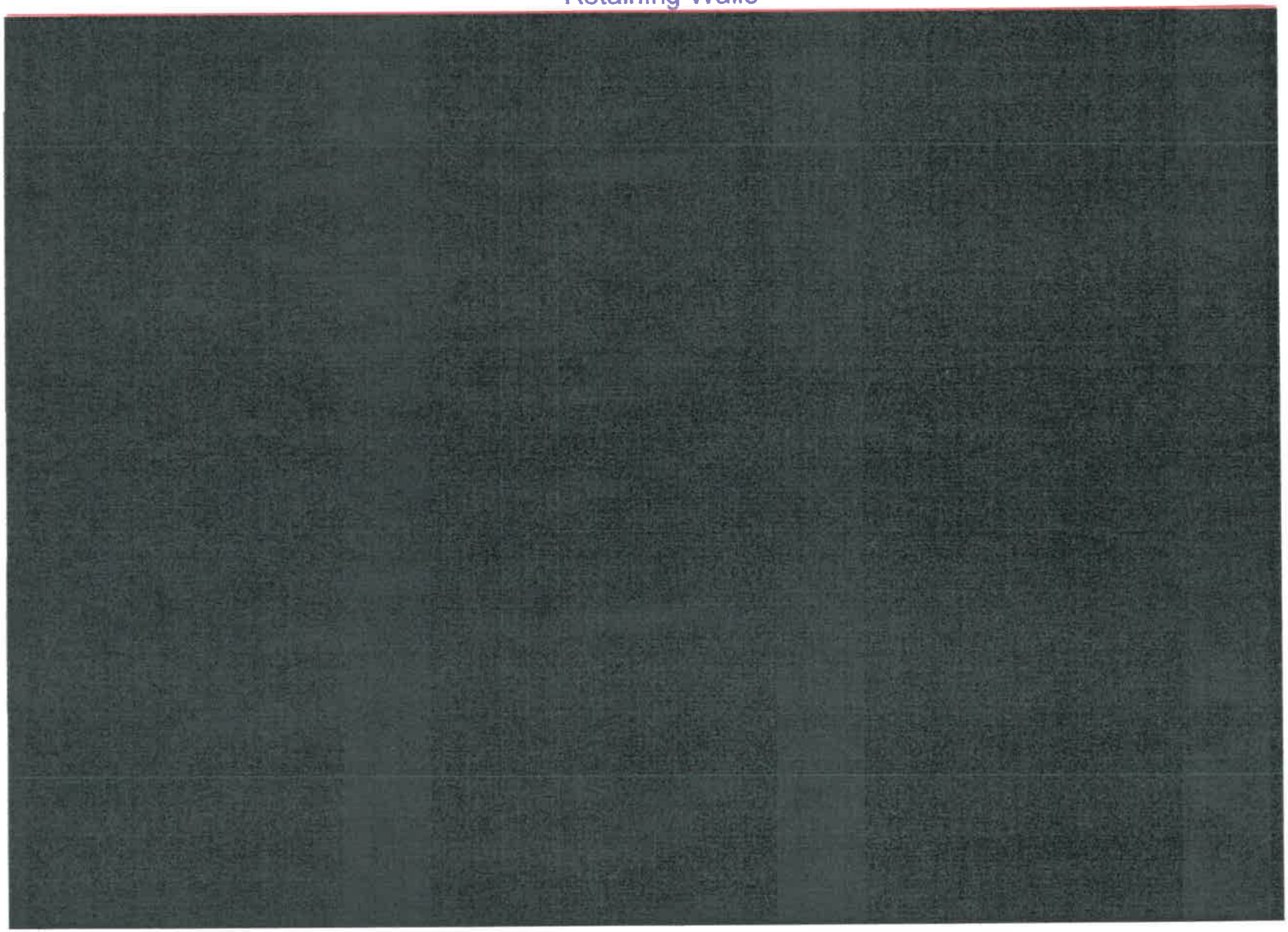
Spillway Plan and Profile



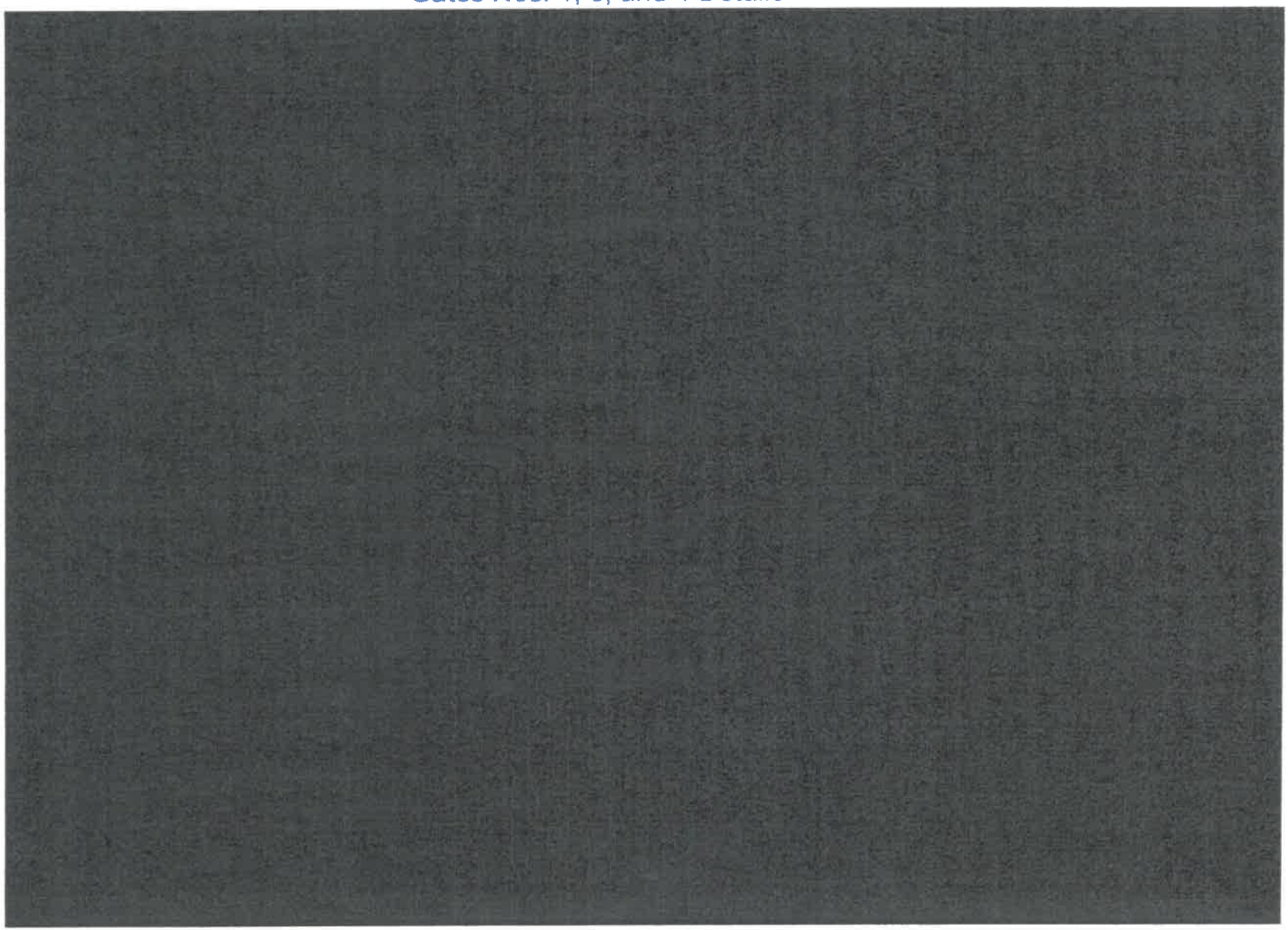
Spillway Details



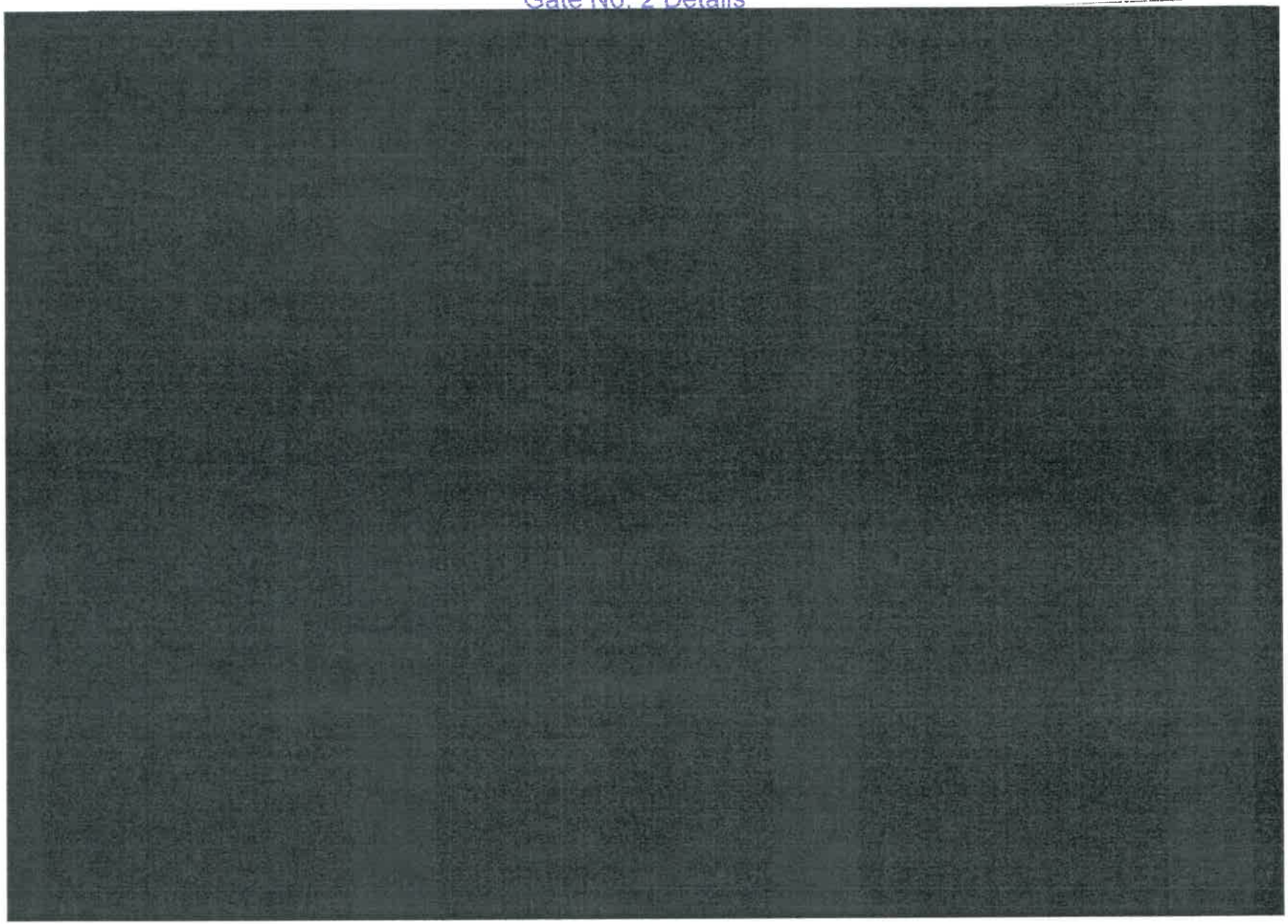
Retaining Walls



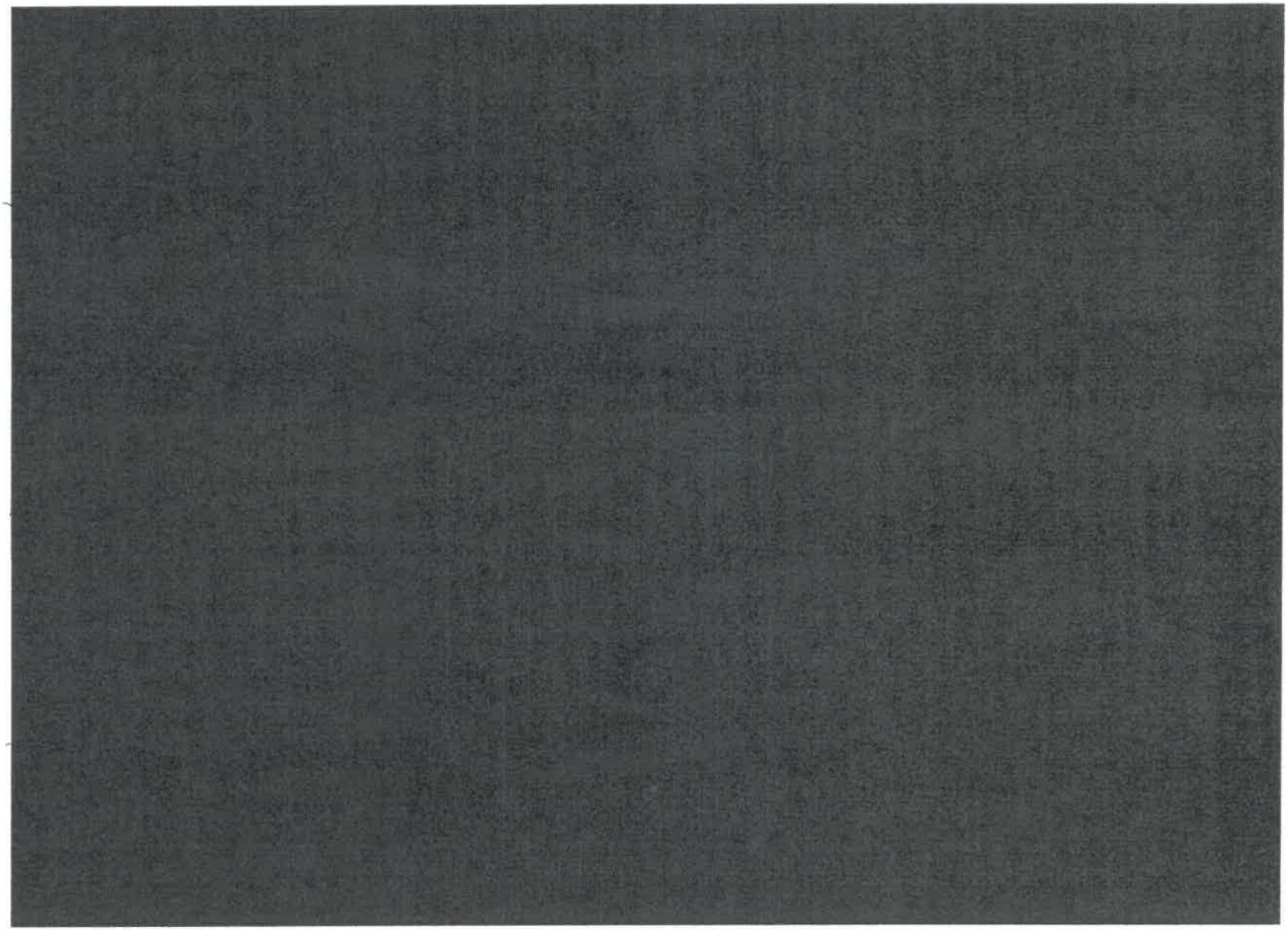
Gates Nos. 1, 3, and 4 Details



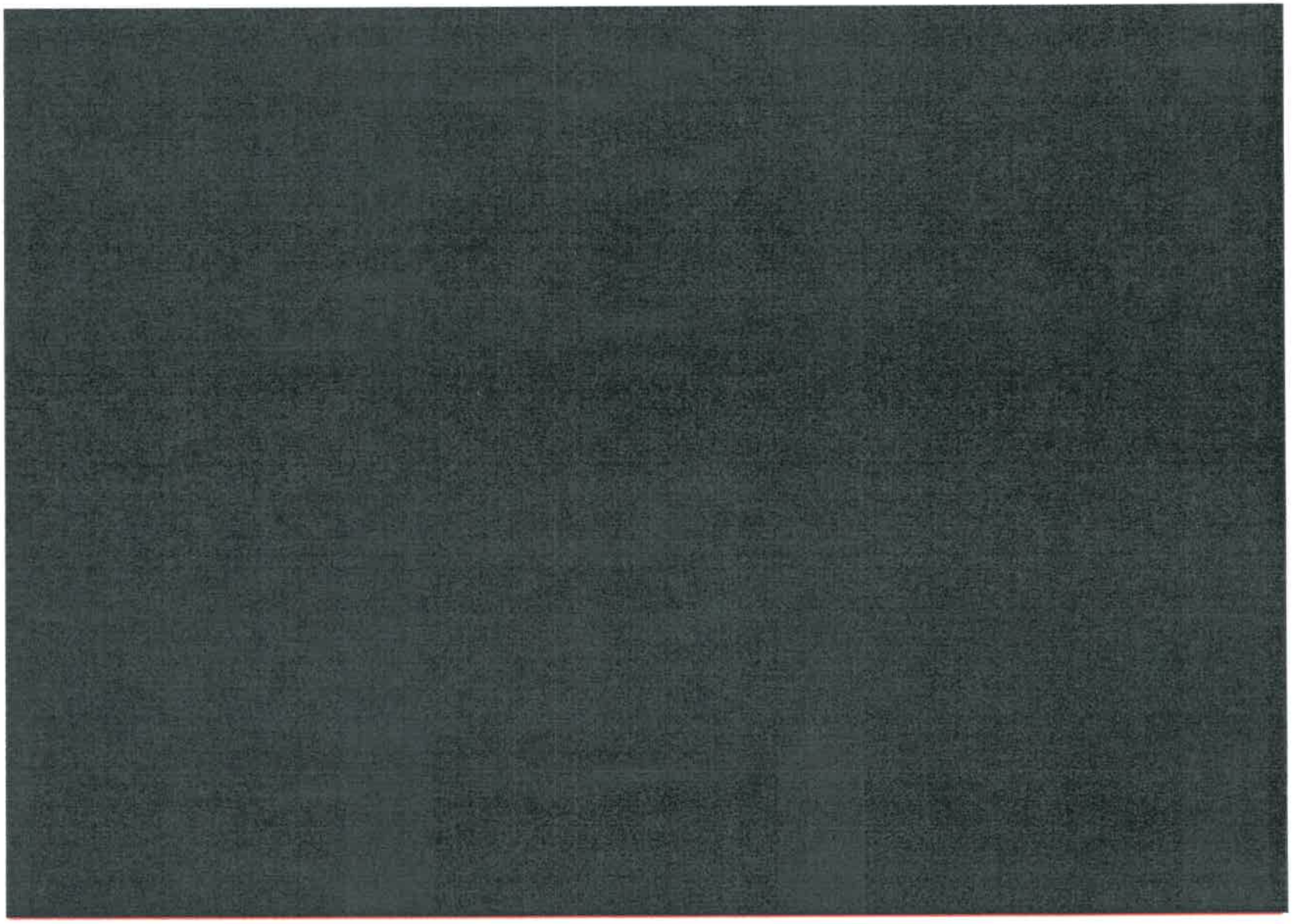
Gate No. 2 Details



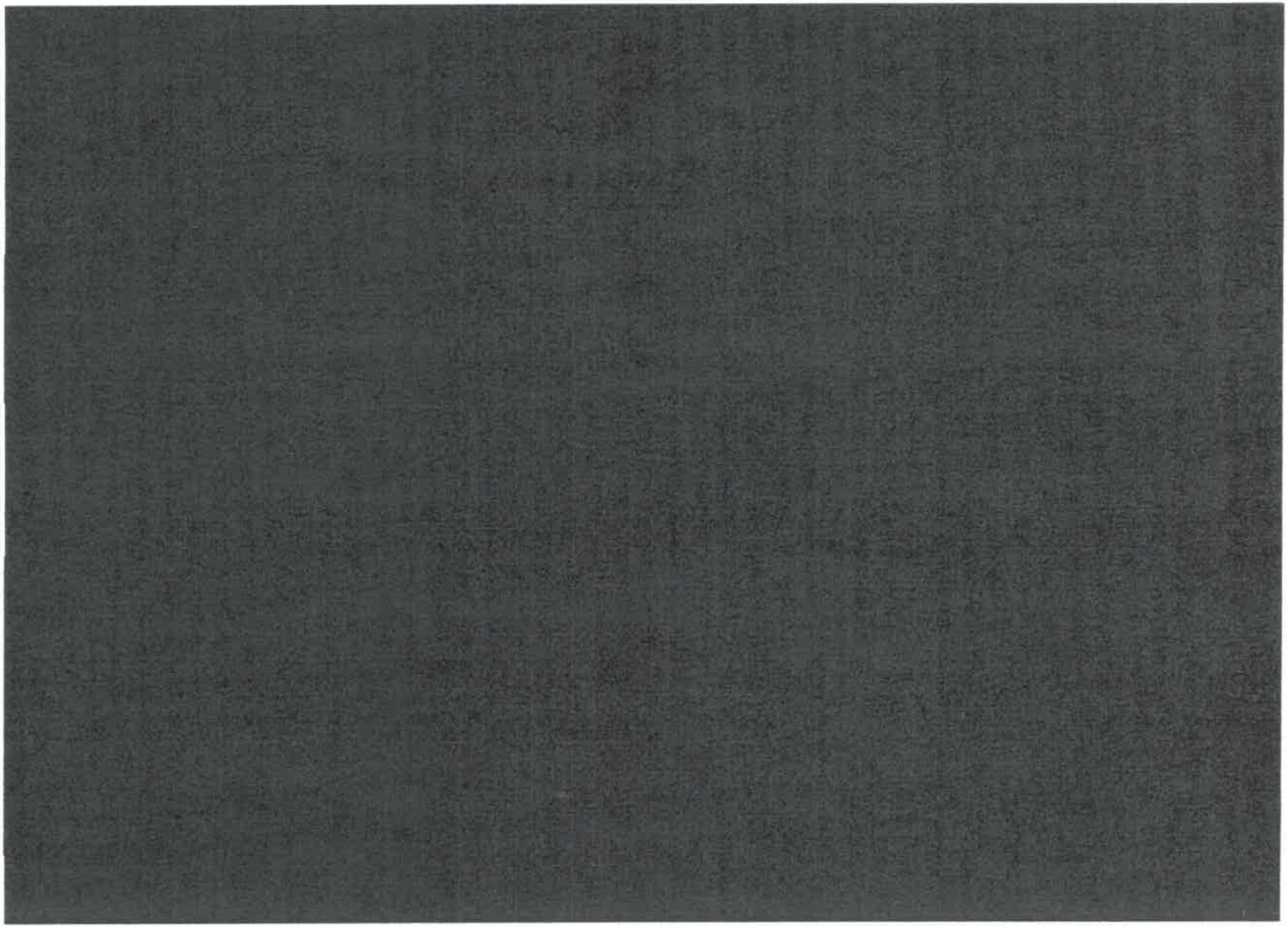
Gate Hoist Details



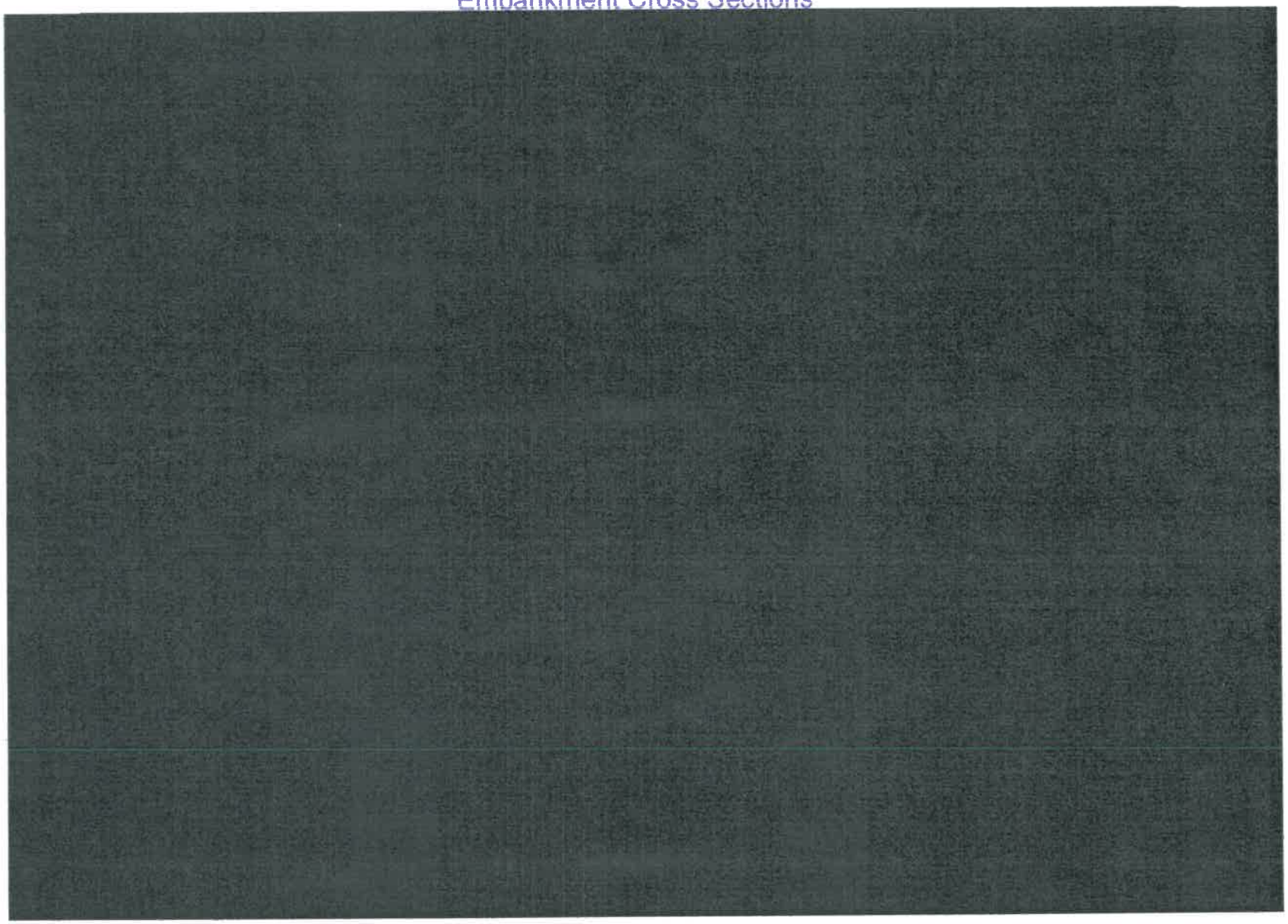
Gate Hoist Details



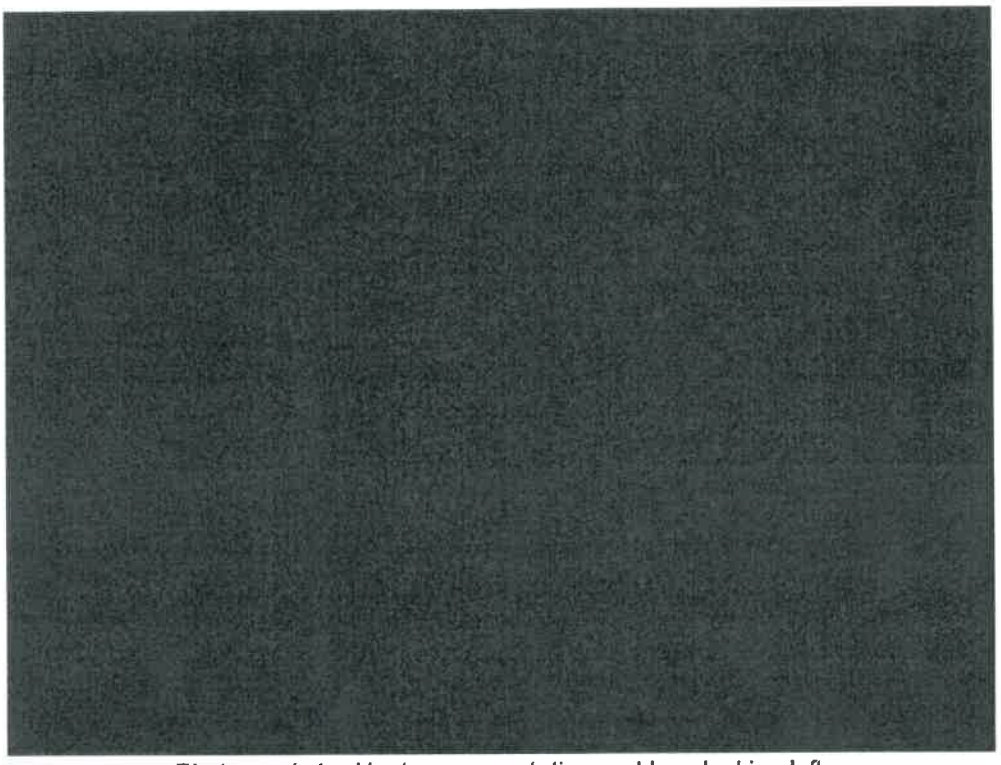
Embankment Profile



Embankment Cross Sections

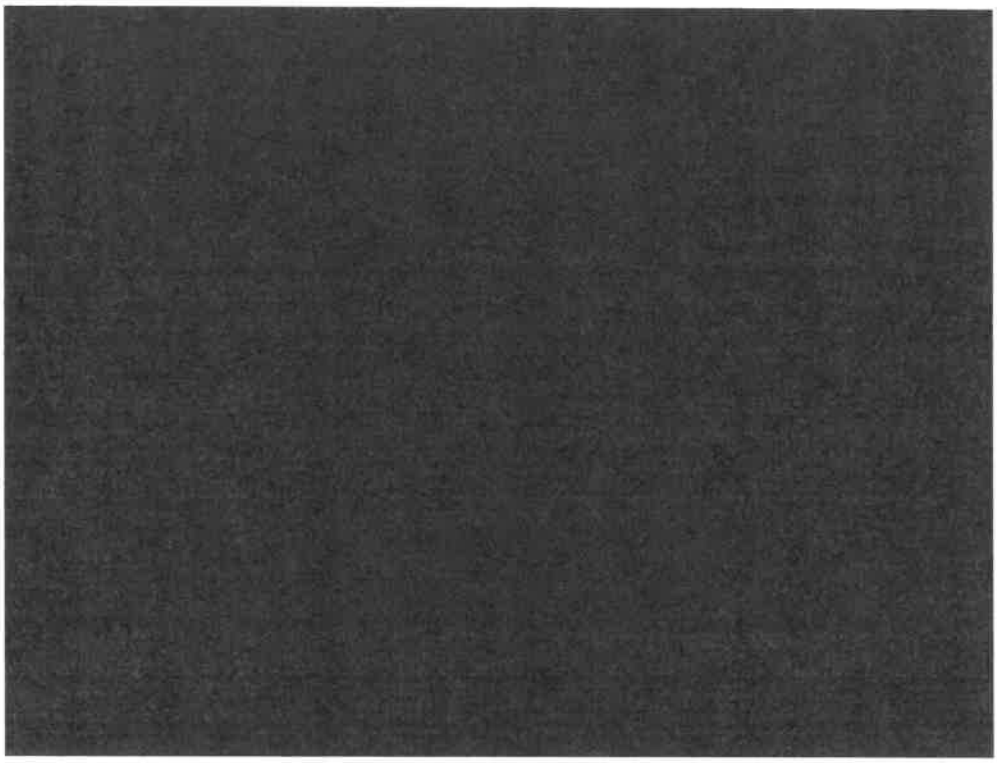


Appendix B. Photographs

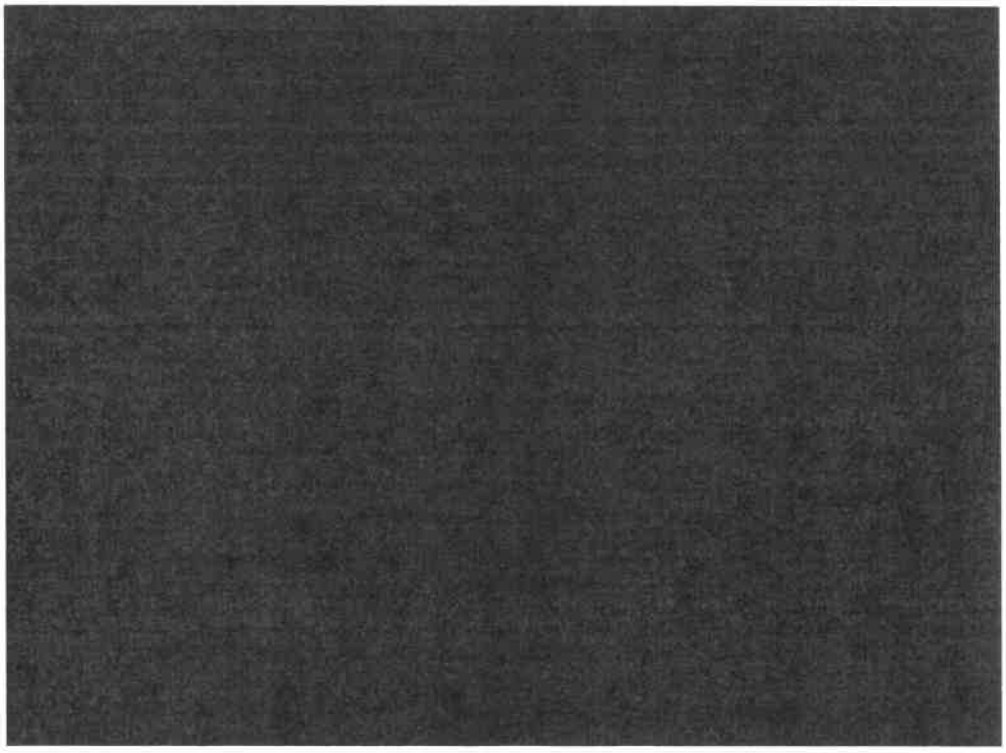


Photograph 1 – Upstream vegetation and logs looking left

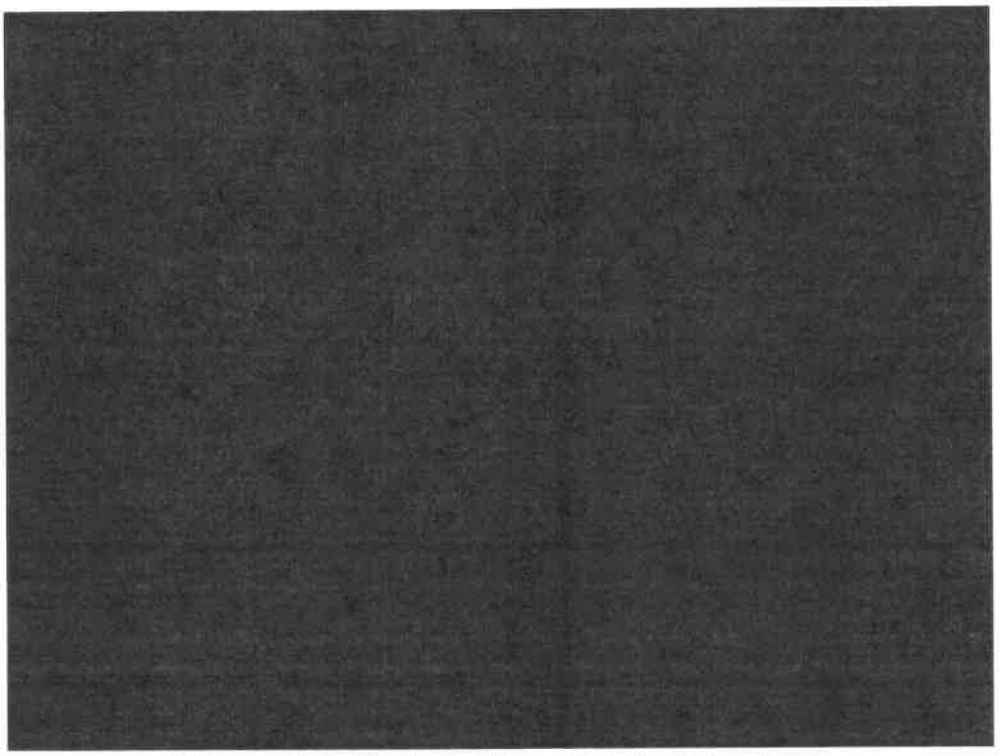
Photograph 2 – Up-close view of log debris



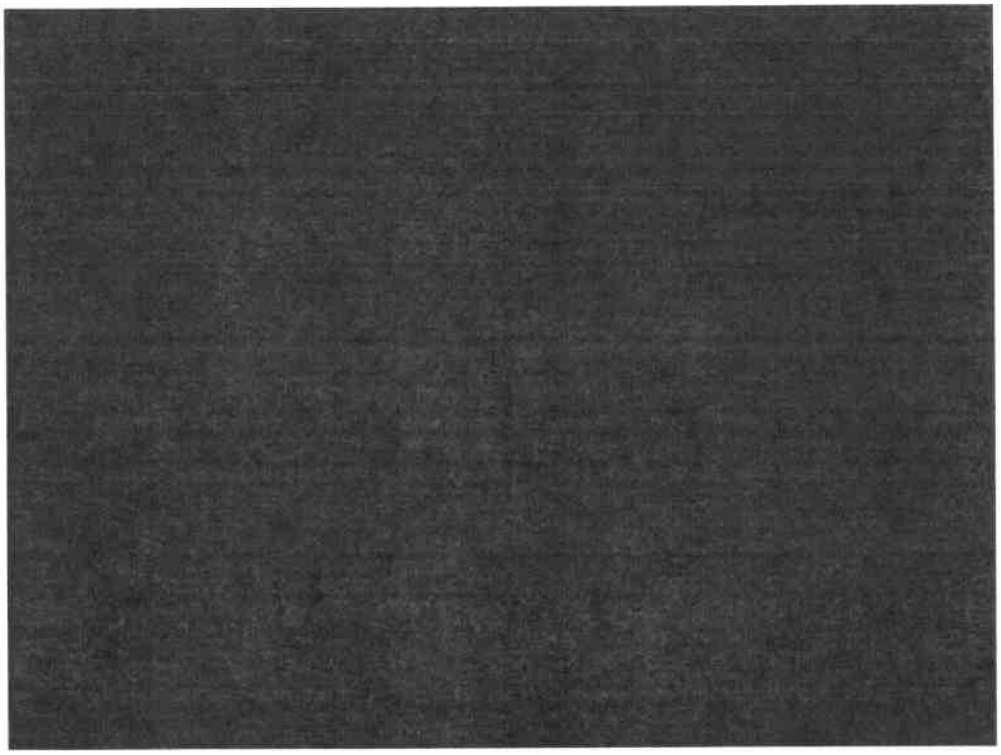
Photograph 3 – Debris immediately upstream of gate



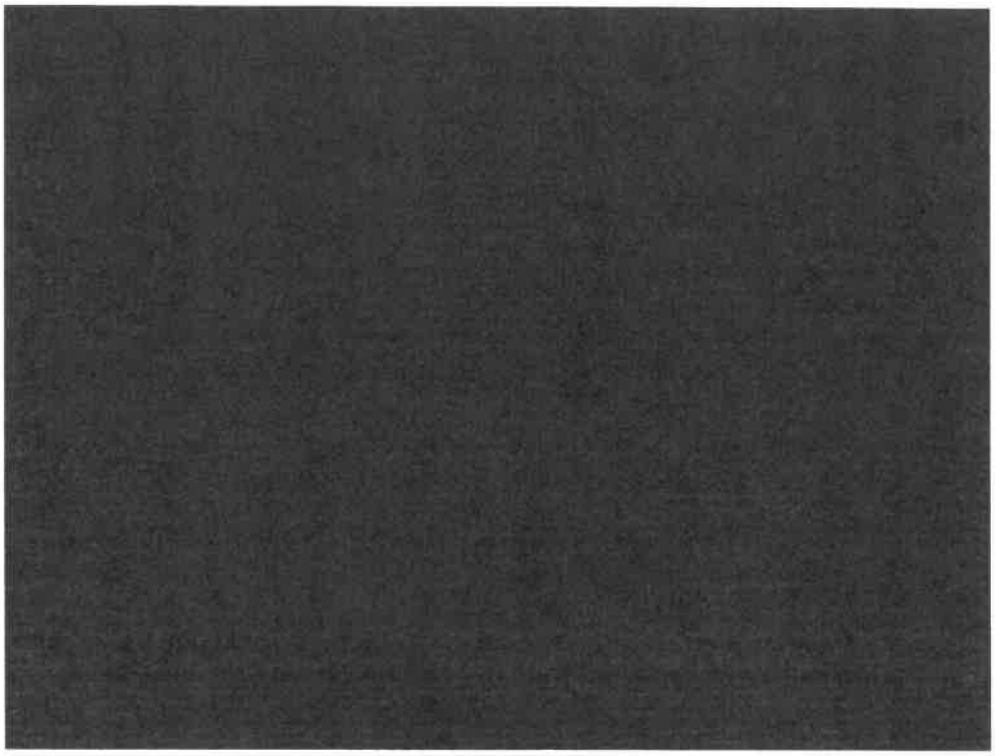
Photograph 4 – Light spalling at left pier of Gate No. 1



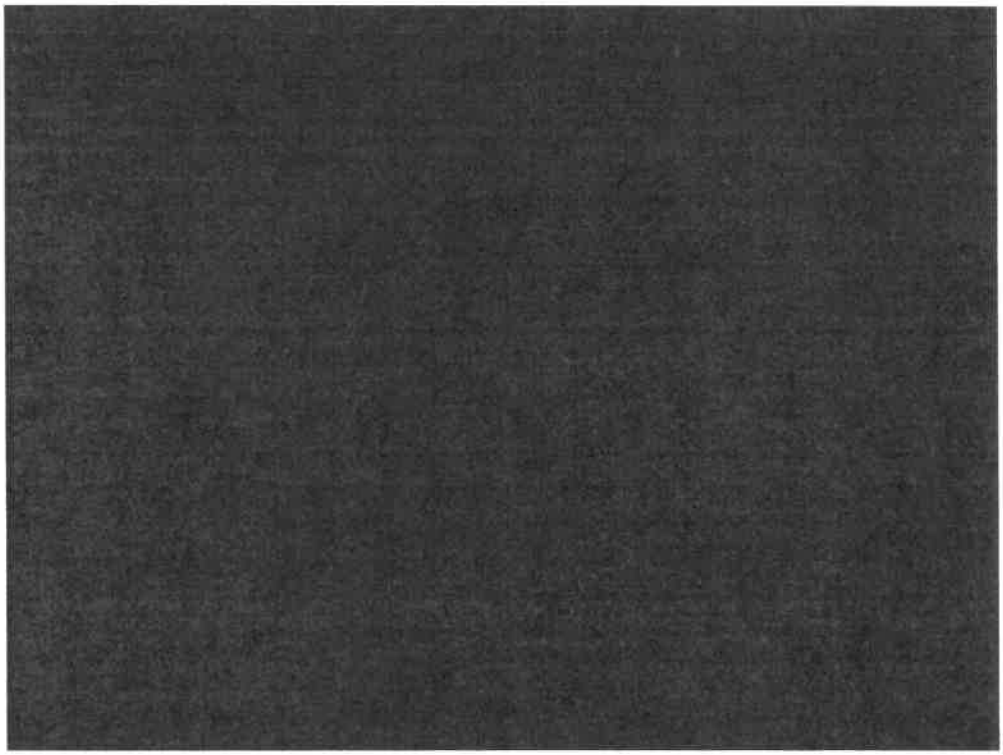
Photograph 5 – Vertical spalling at left pier of Gate No. 1



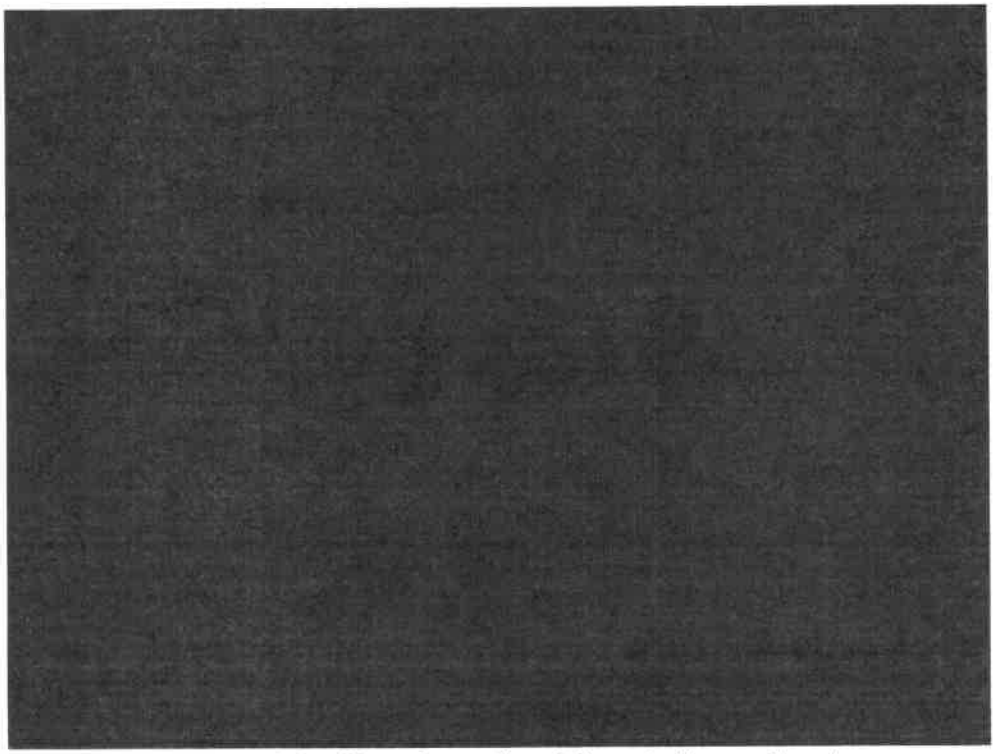
Photograph 6 – Left forebay wall



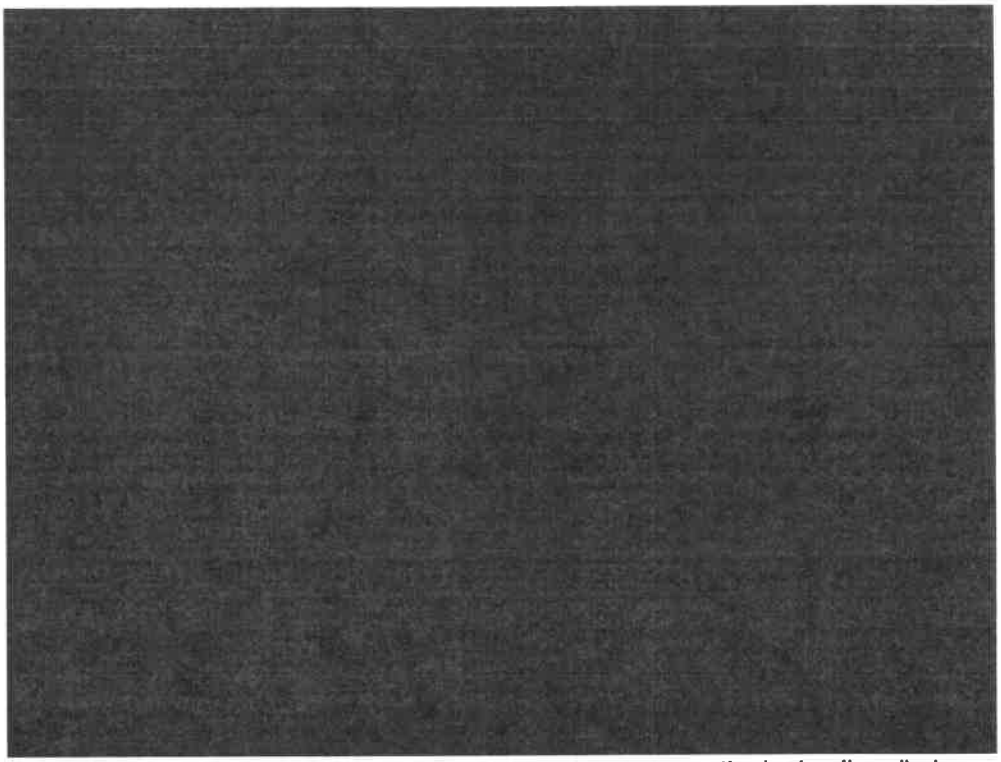
Photograph 7 – Right forebay wall



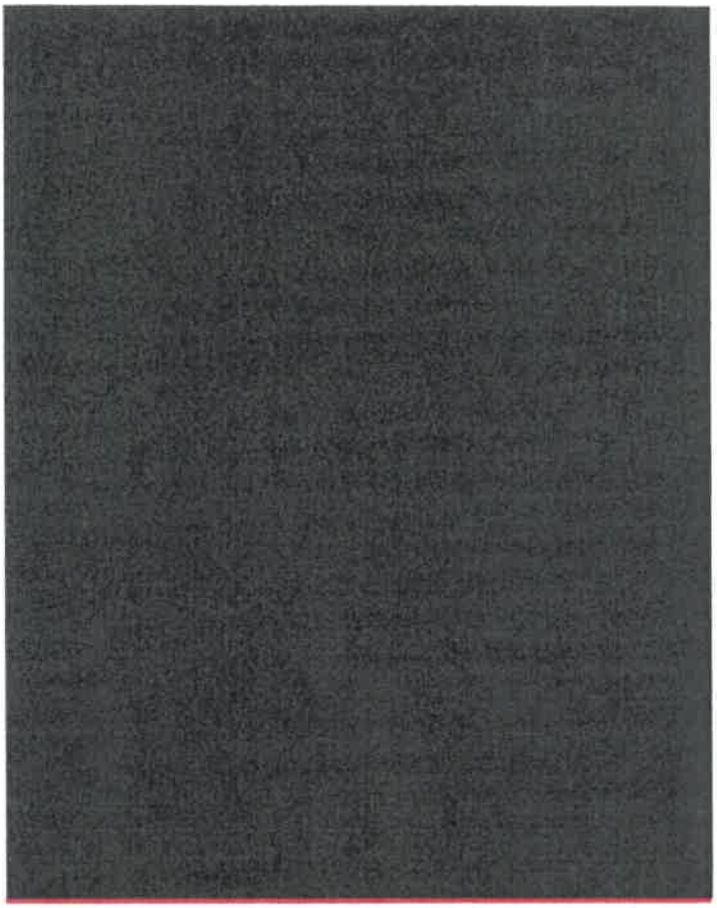
Photograph 8 – View of operating platform looking northwest



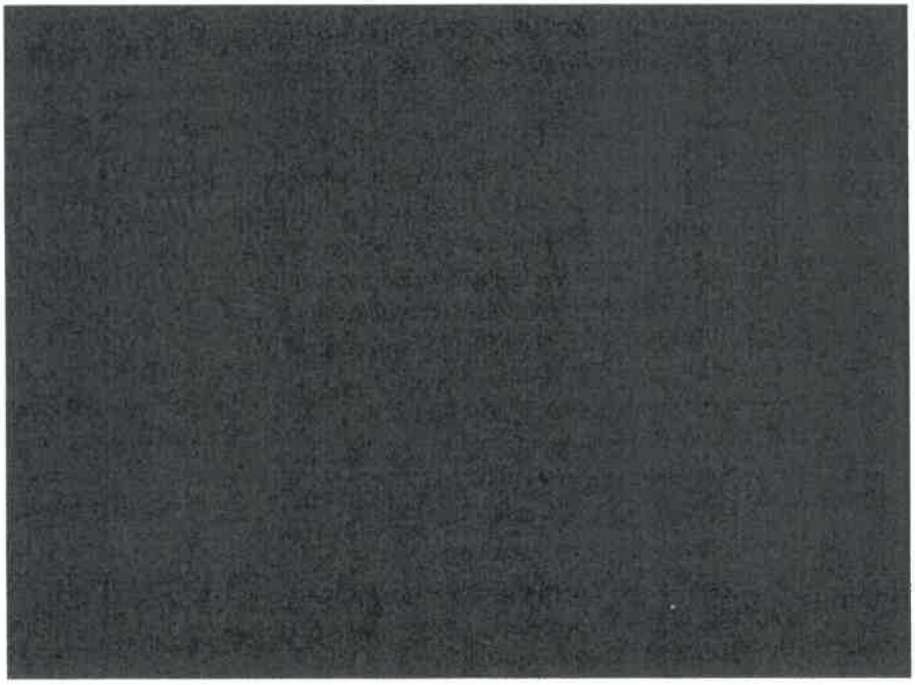
Photograph 9 – View of operating platform looking southeast



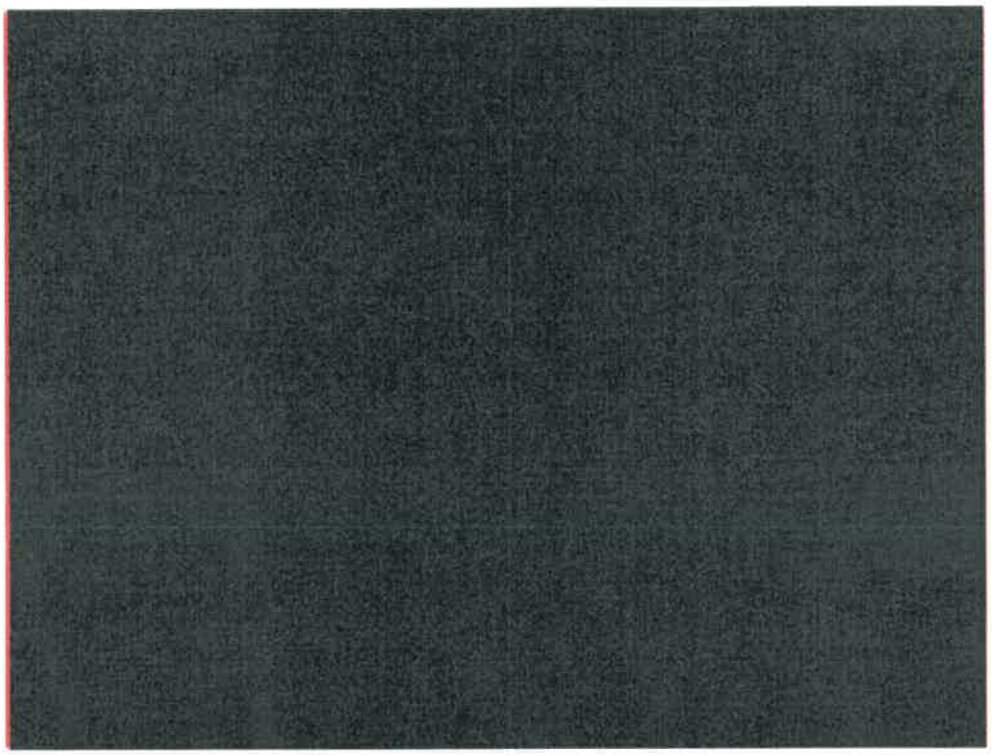
Photograph 10 – Rust and corrosion on framing that supports the hydraulic cylinders



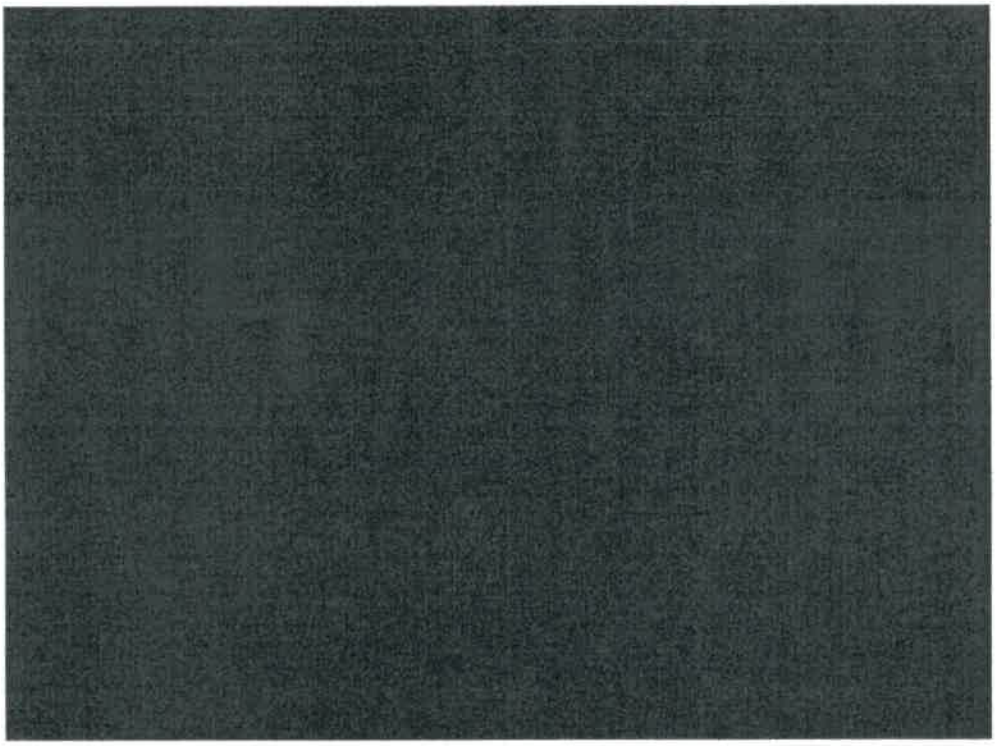
Photograph 11 – Rust and corrosion on top of framing that supports the hydraulic cylinders



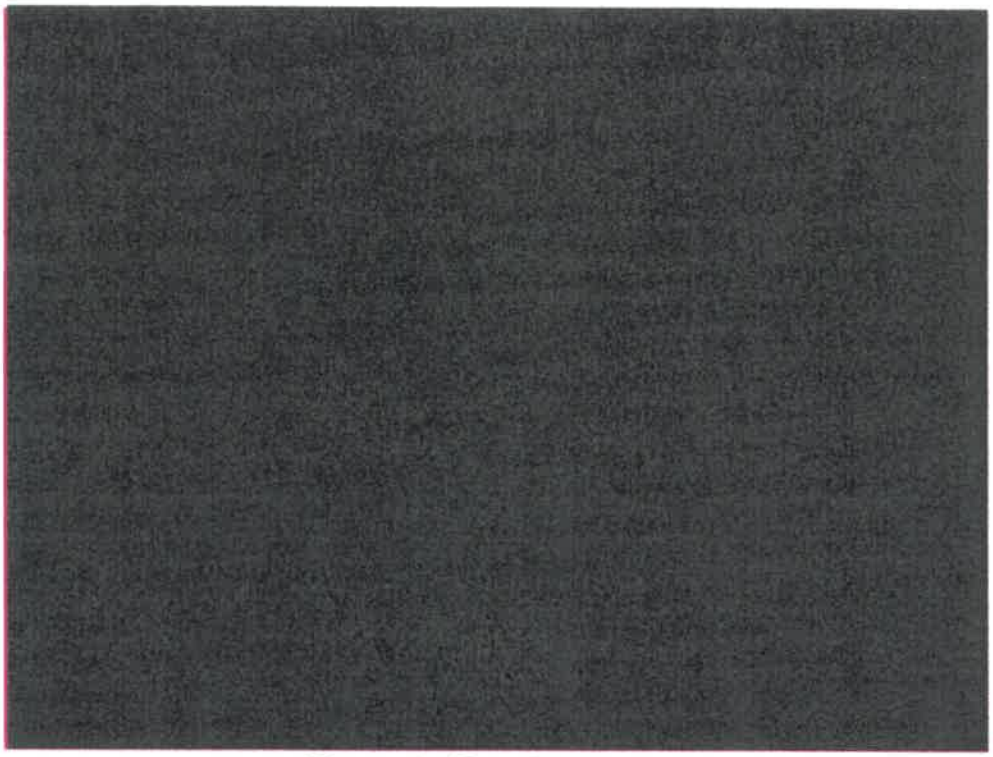
Photograph 12 – Rust on hydraulic cylinder housing



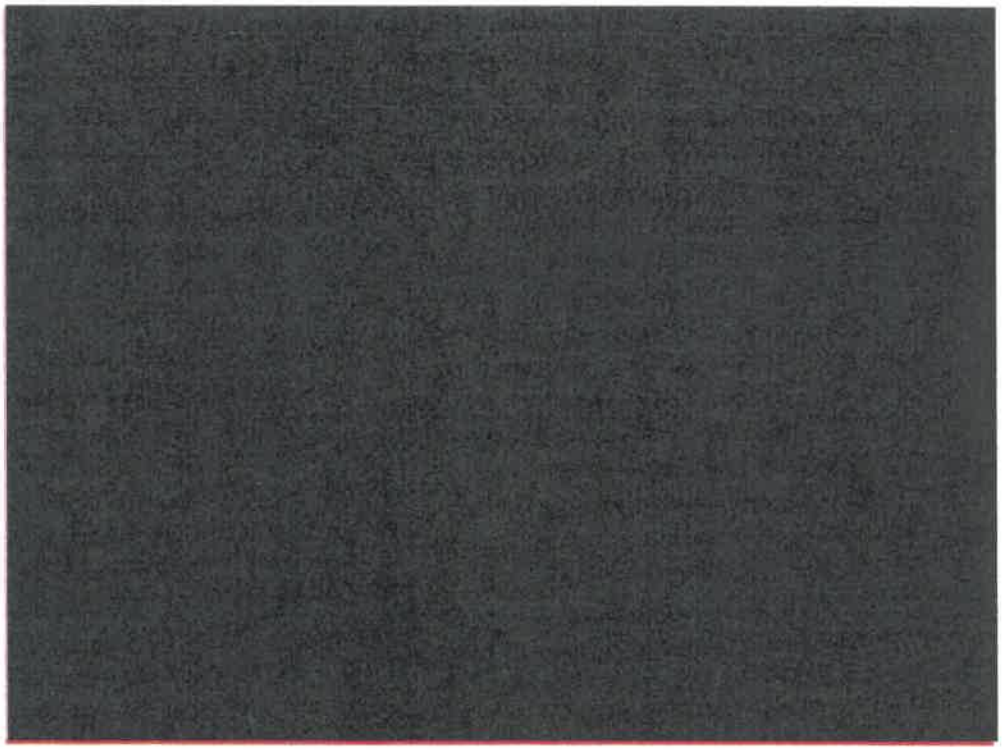
Photograph 13 – Typical vertical lift gate with corrosion along horizontal members



Photograph 14 – Vegetation growing in vertical structural members



Photograph 15 – Left tailrace wall



Photograph 16 – Hairline cracks and efflorescence on tainter gate piers

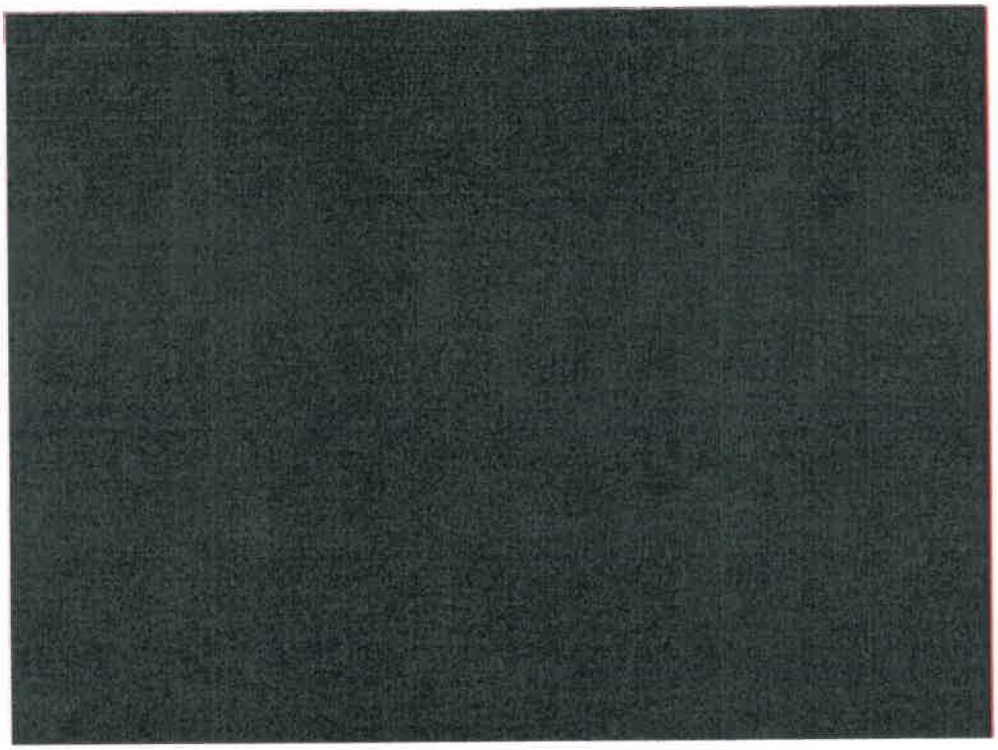
Photograph 17 – Upstream face of left embankment

Photograph 18 – Downstream face of left embankment

Photograph 19 – Sparse vegetation along upstream slope of left embankment

Photograph 20 – Palm tree on upstream slope that should be removed

Photograph 21 – Heavy vegetation along the rip rap revetment of the left embankment



Photograph 22 – Grouted rip rap along the downstream side of the left embankment, adjacent to spillway

Photograph 23 – Upstream slope of right embankment

Photograph 24 – Downstream slope of right embankment

Photograph 25 – Vegetation along the downstream side of the right embankment

Photograph 26 – Palm tree located on the downstream slope of the right embankment

Appendix C. Dive Inspection Report

Underwater Inspection Report

for

TAYLOR ENGINEERING, INC.

NBI Structure ID. (8): **Kirkpatrick Dam** Underwater Date (93): 08/02/21 and 08/03/21

Structure/Roadway Identification:

District (2): 02
County (3): Putnam
Feature Intersected (6): N/A
Facility Carried (7): Kirkpatrick Dam

Underwater Inspection Details:

Special Crew Hours:
Max. Depth:
Type of Dive Insp.: Level II (SCUBA)
Type of Boat Used: N/A
Water Type/Marine Growth: Fresh – Algae

Inspection Personnel:

Field Personnel:	Title	P.E./C.B.I. No.:	Duty:	Signature:
Hoogland, Keith S.	SUCBI	00341/Lead	Dive	KLH
Mauer, Jarred M.	AUBI		Dive	
Marston, Douglas W.	AUBIT		Tend	

SCOPE:
Divers inspected the spillway upstream and downstream, retaining walls, abutments, piers and gates upstream, stilling basin and wingwalls downstream including connections and joints in the walls and floor.

CONTROL STRUCTURE:

Weir

Upstream
The concrete surfaces have typical scale (loss of aggregate) up to 1/2in. deep, with no exposed rebar.

Downstream
The concrete surfaces have typical scale (loss of matrix) up to 1-1/2in. deep, with no exposed rebar.

East Abutment (including joints)

Upstream
There is typical scale (loss of aggregate) up to 1/4in. deep, with no exposed rebar.

Downstream
There is typical scale (loss of matrix) up to 1/2in. deep, with no exposed rebar.

Piers 1 through 3

Upstream
There is typical scale (loss of aggregate) up to 1/2in. deep, with no exposed rebar.

Downstream
There is typical scale (loss of matrix) up to 1/2in. deep, with no exposed rebar.

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

CONTROL STRUCTURE (CONTINUED):

West Abutment (including joints)

Upstream
There is typical scale (loss of aggregate) up to 1/4in. deep, with no exposed rebar.

Downstream
There is typical scale (loss of matrix) up to 1/4in. deep, with no exposed rebar.

STILLING BASIN:

West Stilling Abutment

Both joints (walls) are missing joint sealant and can be probed 8in. to water stop, with no leakage.

East Stilling Abutment

Both joints (walls) are missing joint sealant and can be probed 8in. to water stop, with no leakage.

Downstream Apron

Along the end sill, starting 15ft. from the east end, the downstream apron floor is undercut, 100ft. L x 27in. H, extending back 12in. to 18in. to a steel sheet pile wall. There are fifteen lifting holes in the steel sheet pile located just below the concrete floor. The holes are up to 2in. diameter and can be probed 3ft. 8in., no water flow was observed through the lifting holes.

Top of End sill to groundline (south side), End sill is 5ft. high:

Location	2015	2021
West end	14in.	18in.
Floor Seam 3	6ft.	4ft. 5in.
Floor Seam 2	6ft. 6in.	6ft. 6in.
Floor Seam 1	5ft. 6in.	6ft.
East end	18in.	18in.

There is rock rubble lining the wingwall and along the end seal and light rock rubble toward the center.

WINGWALLS:

Upstream
The steel sheet piles have random areas of light corrosion.

Downstream
The steel sheet piles have random areas of light corrosion.

Divers could not access the NE wingwall due to numerous logs accumulated in the area.

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

GATES 1 THROUGH 4

There are four lift gates, each lift gate has four manatee barriers in front of them.
Divers could only access the west manatee barrier at Gate 4 from the north side, all others were blocked by numerous logs.

Upstream
The bolts holding the side seal and brackets on all four gates have severe corrosion with up to 100% section loss.

All gates, the single seal bracket holding the seals have moderate corrosion/light pitting.

All gates, the side seal bolts have severe deterioration from the fifth bolt, several bolts are deteriorated to flush with the bracket surface.

On the side seal brackets where they are attached to the gate on Gate 1 on the east side has one loose and one missing bolt. Gate 3 on the east side has one missing bolt.

The bolts holding the bottom seal bracket on all four gates are in good condition.

The gates have minor leakage along the seal.

The manatee barriers (frames and grating) have several areas of minor corrosion/pitting.

CHANNEL

There are logs and heavy vegetation throughout the upstream channel.

Boat/Debris Barriers

Upstream
Boat/Debris barrier is comprised of seventeen timber pile clusters each with two to five timber piles, vertical supports and horizontal cables (10ft. high in some areas).

Clusters 1 through 4 and 14 through 18 have six vertical supports. Clusters 5 through 13 have five vertical supports.

Clusters 1, 2 and 18 are inaccessible due to logs.

Below the waterline, most of the vertical cable supports (pipe) at the boat barrier are broken or corroded through.

The bottom eye bolts are approximately 9ft. below the waterline at each cluster.

Several of the eye bolts at the timber piles are loose or are corroded through.

There are four visible cables (above the waterline).

There are minor checks and weathering in the timber piles.

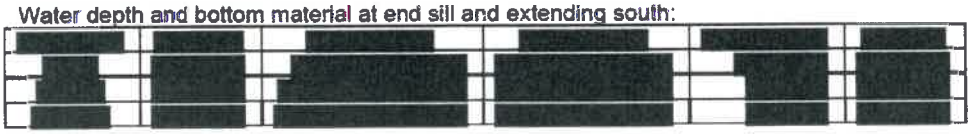
Cluster 14 south pile, below fifth eye bolt from top has a void. 12in. H x 1-1/2in. W x 3in. D.

There are numerous logs on the channel bottom in front of all four gates/manatee barriers and along the boat/debris barriers.

Downstream
Floats are metal can type floats and have moderate corrosion and light pitting below the waterline.

Bottom Conditions/Water Depths South of Downstream Apron

Water depth and bottom material at end sill and extending south:



This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG:

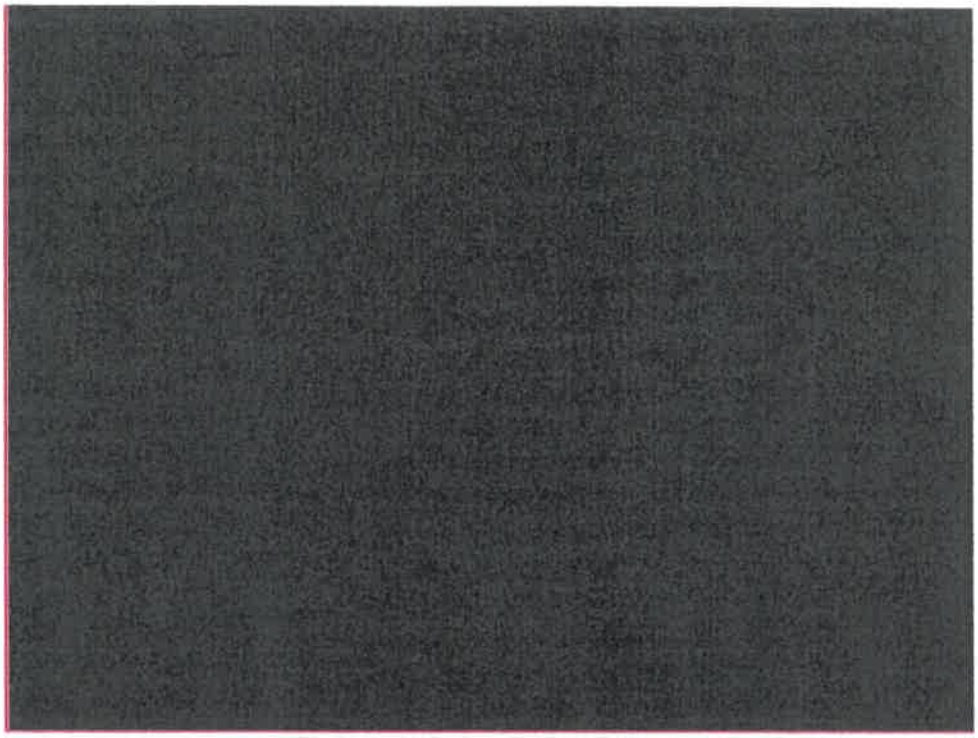


Photo 1: North elevation/Log Build-up

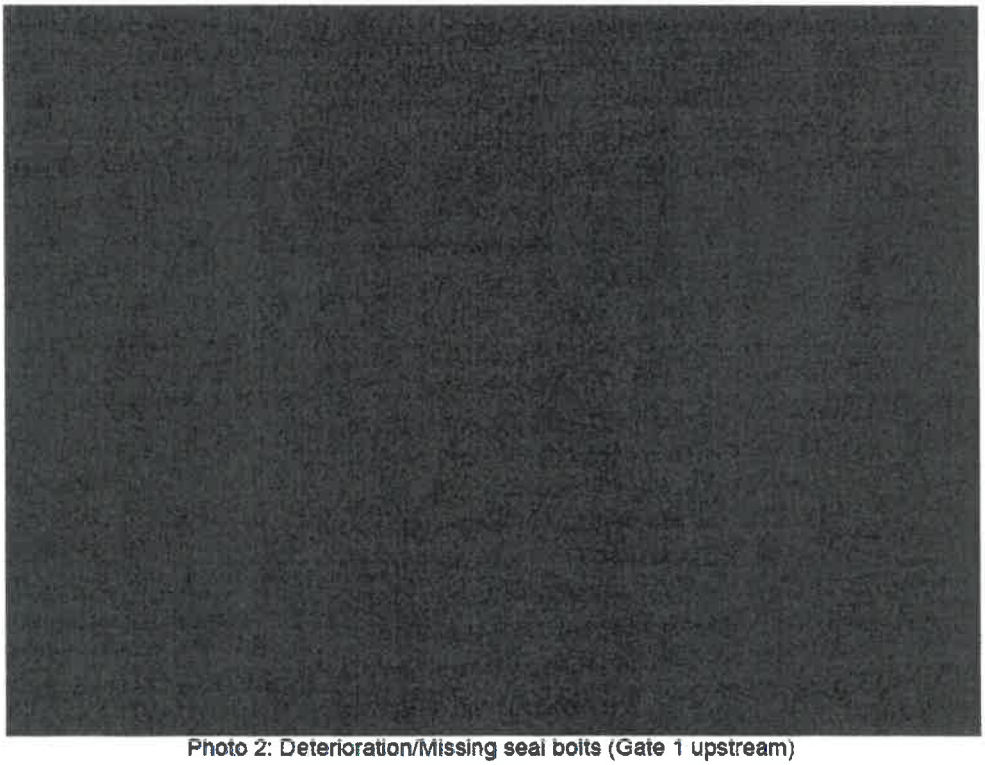


Photo 2: Deterioration/Missing seal bolts (Gate 1 upstream)

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

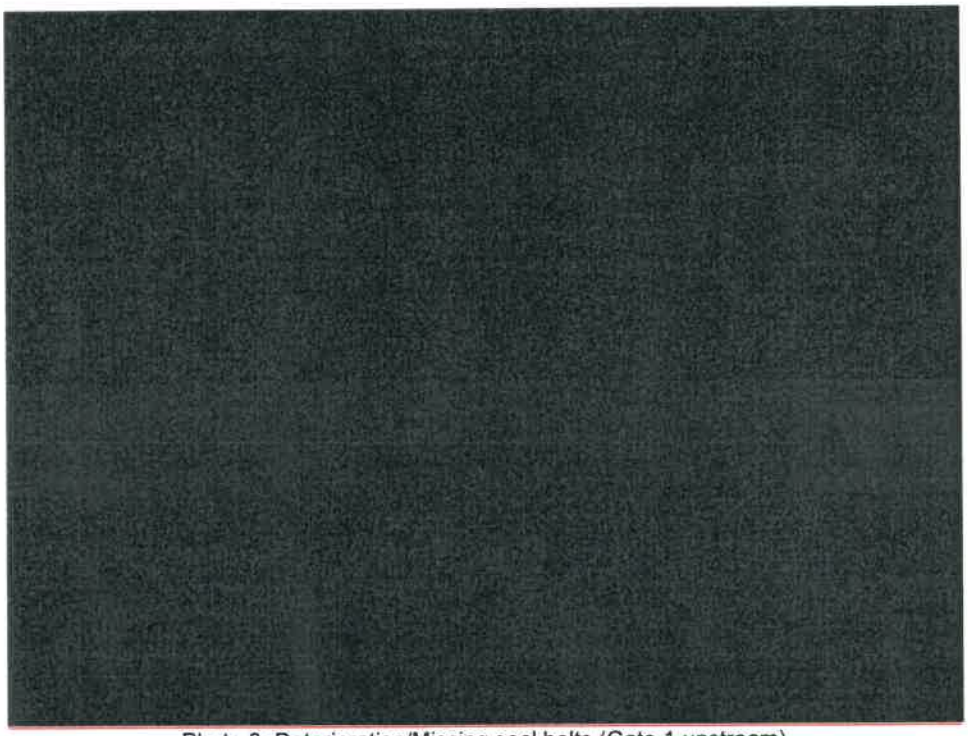


Photo 3: Deterioration/Missing seal bolts (Gate 1 upstream)

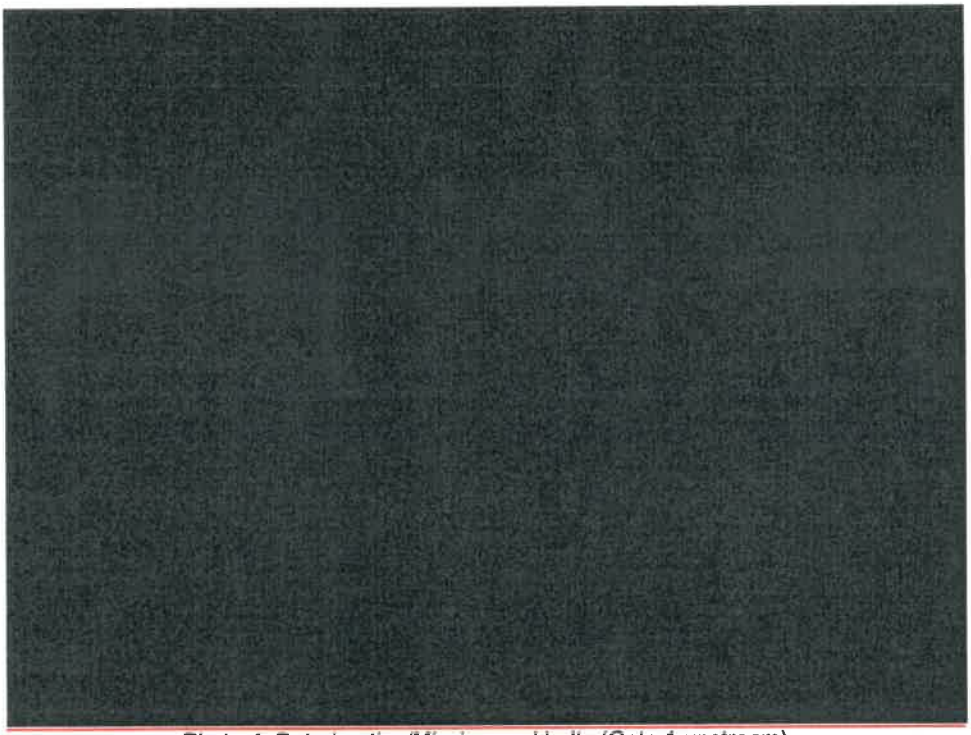


Photo 4: Deterioration/Missing seal bolts (Gate 1 upstream)

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

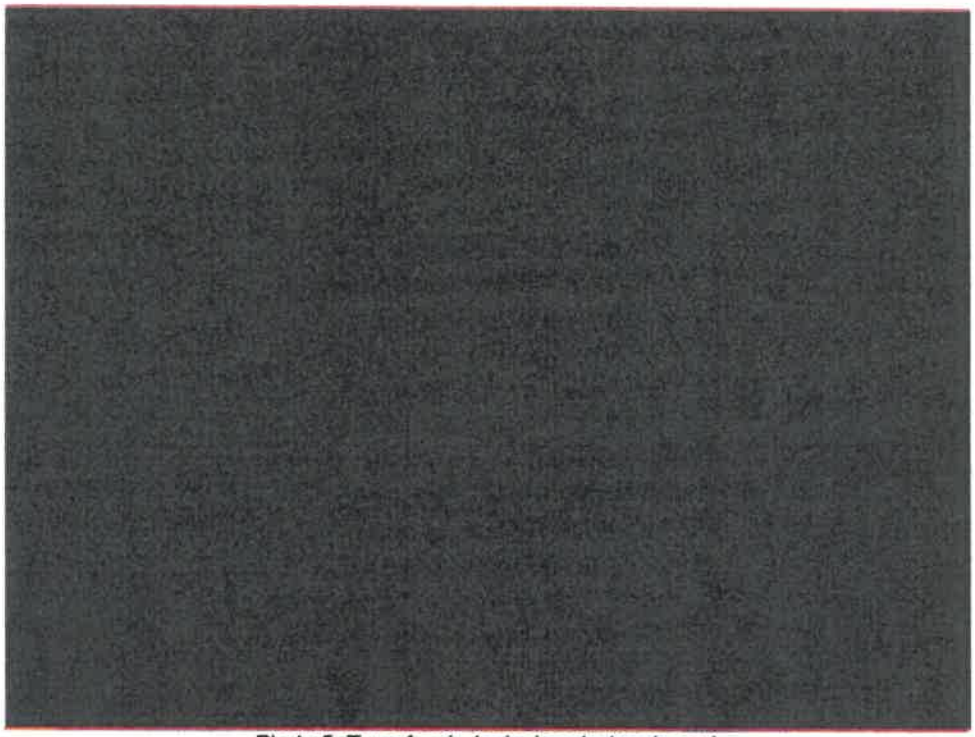


Photo 5: Top of weir, typical scale (upstream)

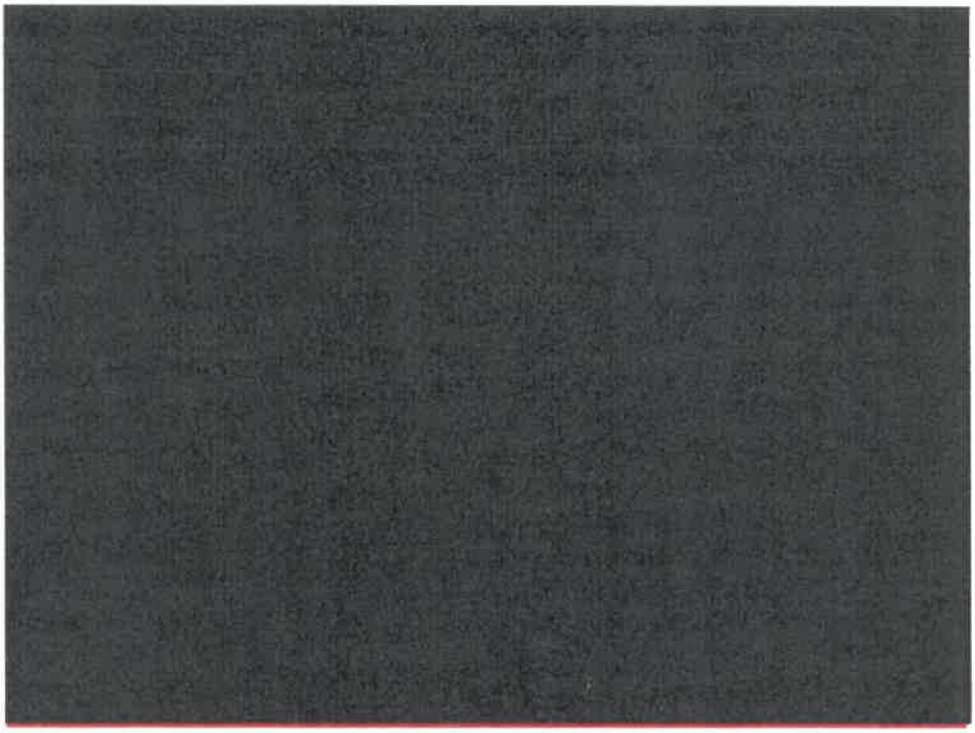


Photo 6: East abutment, typical scale (upstream)

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

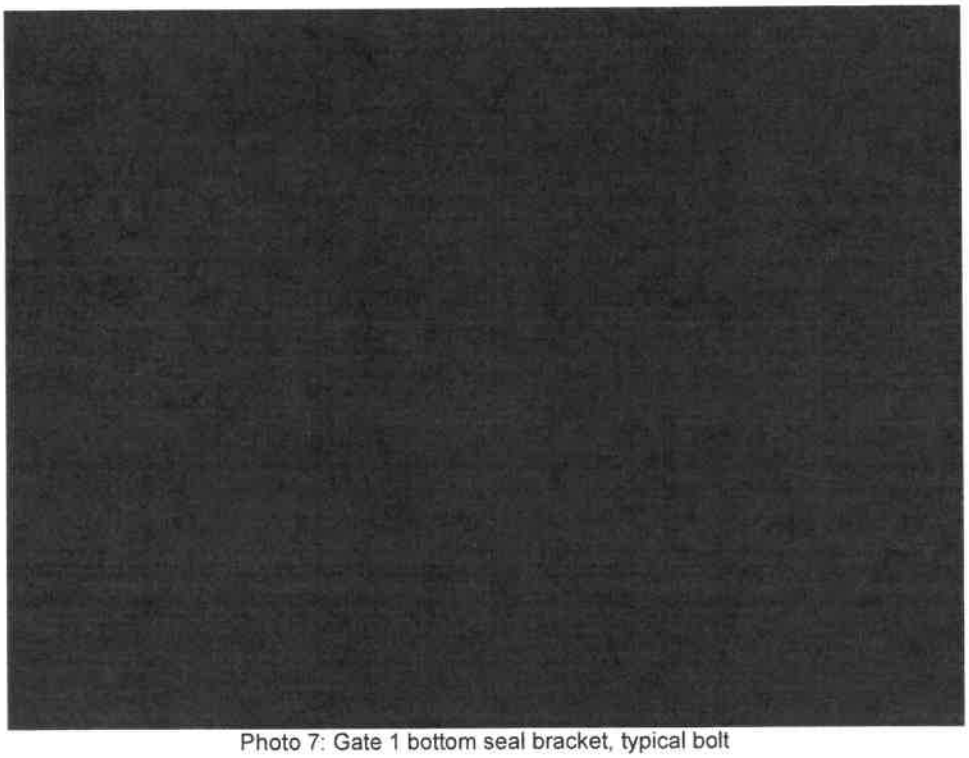


Photo 7: Gate 1 bottom seal bracket, typical bolt

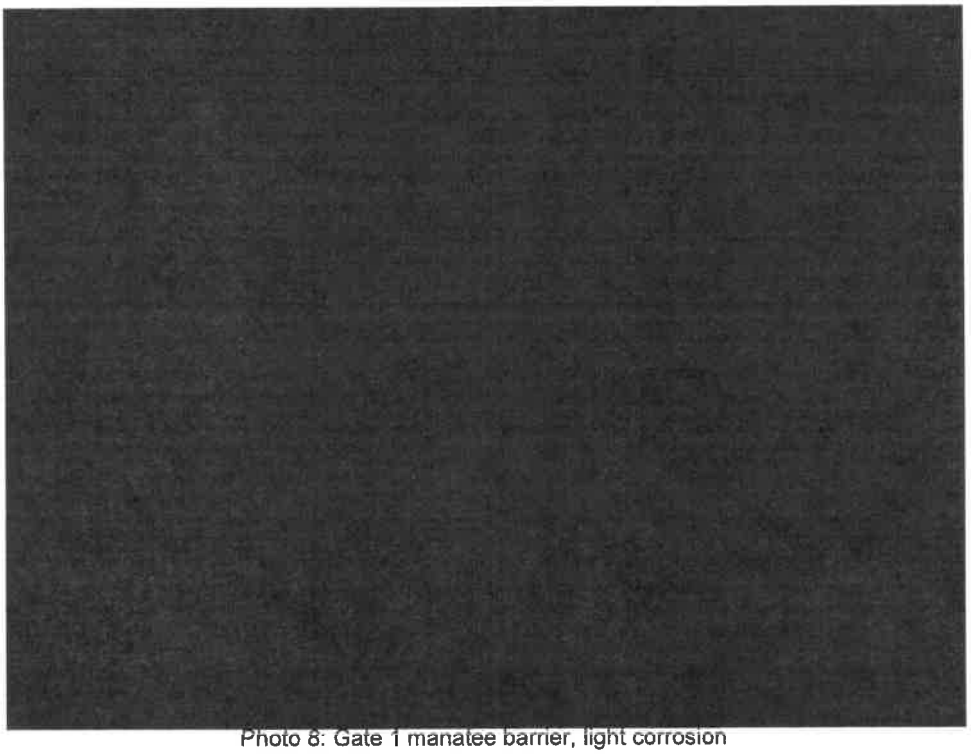


Photo 8: Gate 1 manatee barrier, light corrosion

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

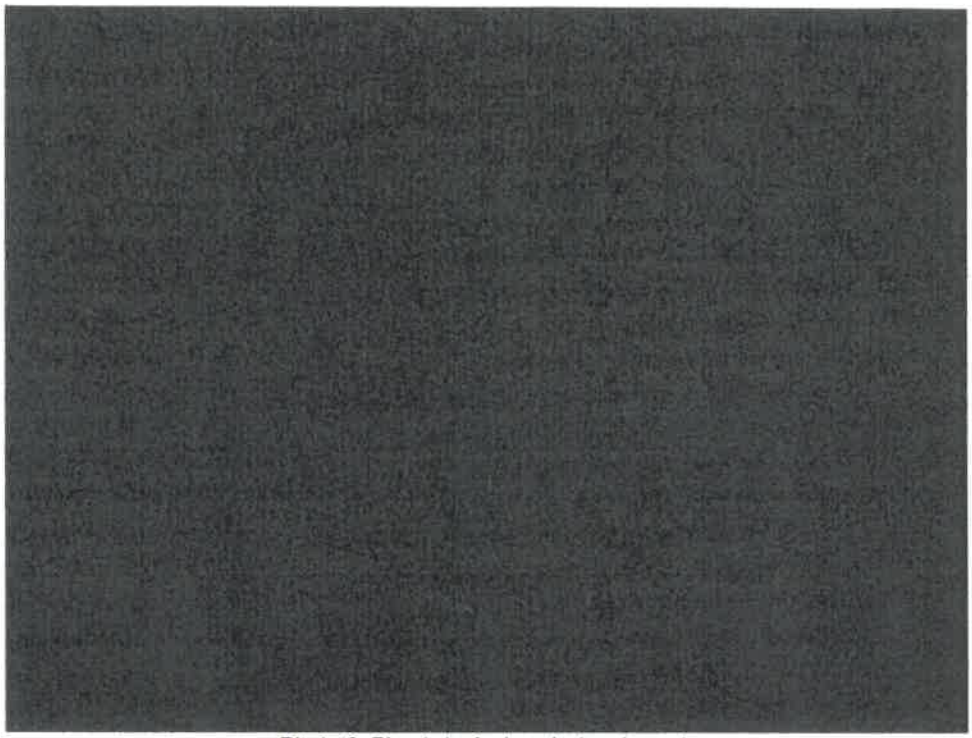


Photo 9: Pier 1, typical scale (upstream)

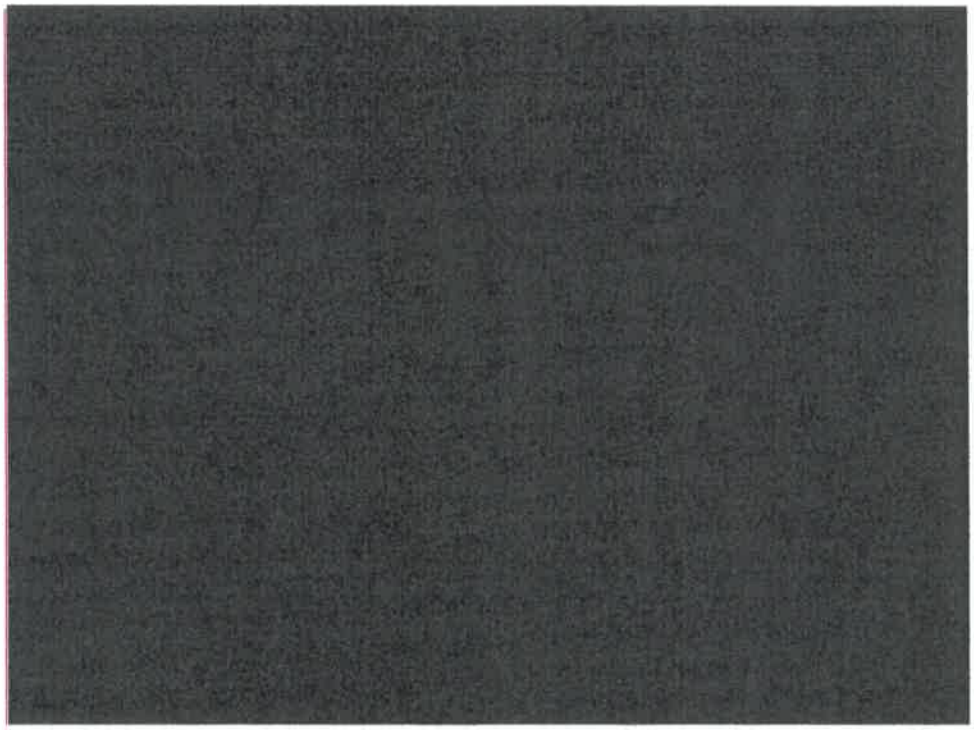


Photo 10: Deterioration/Missing seal bolts (Gate 2 upstream)

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

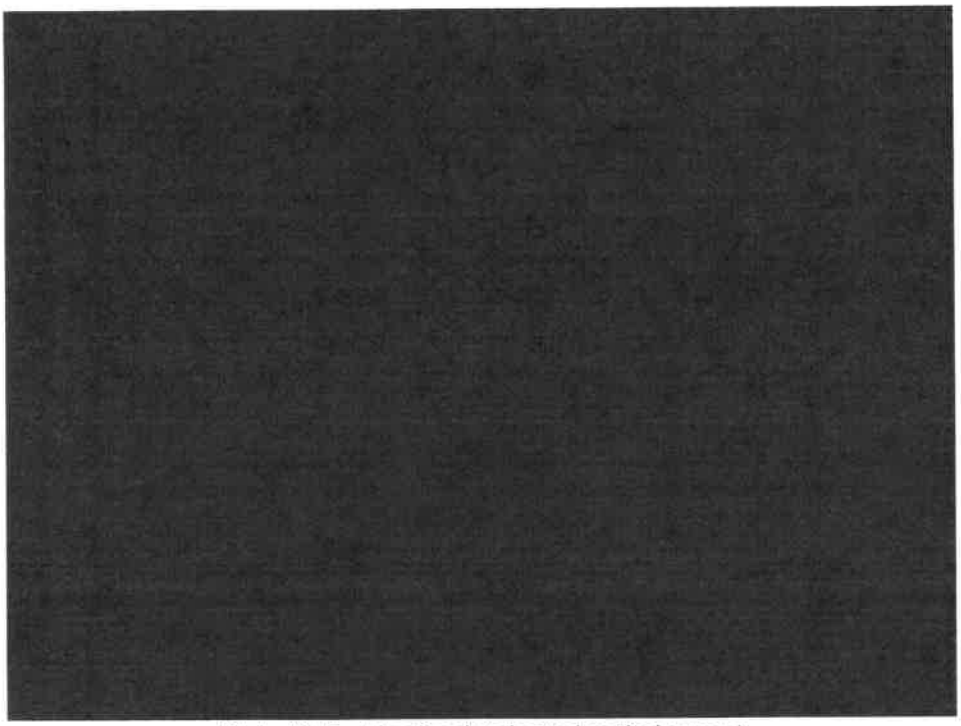


Photo 11: Boat barrier, deteriorated vertical support

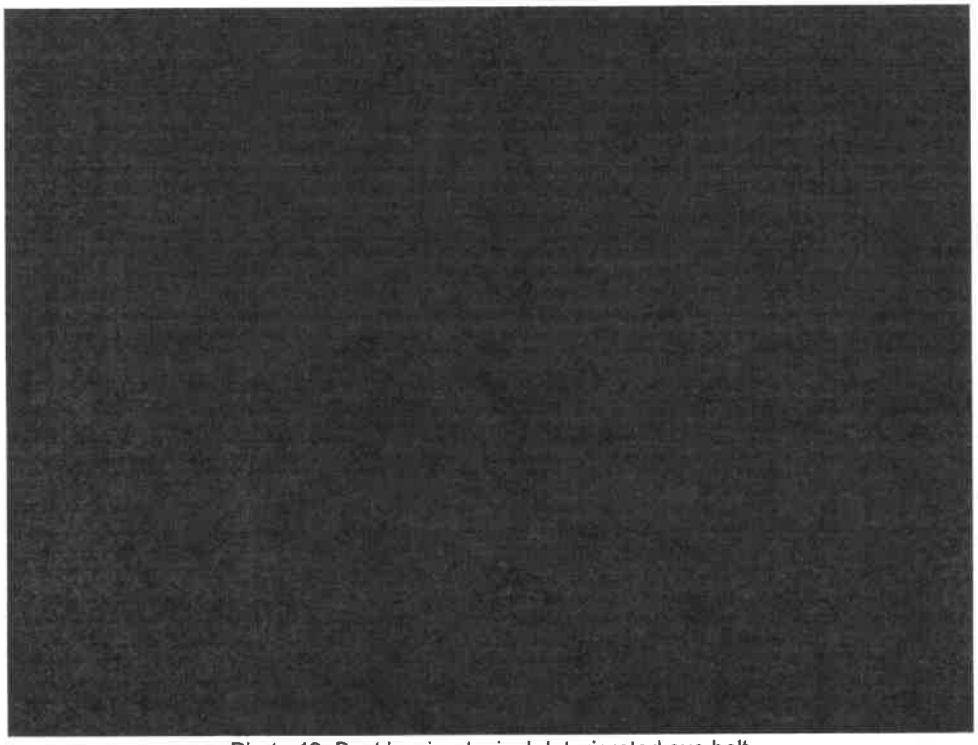


Photo 12: Boat barrier, typical deteriorated eye bolt

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

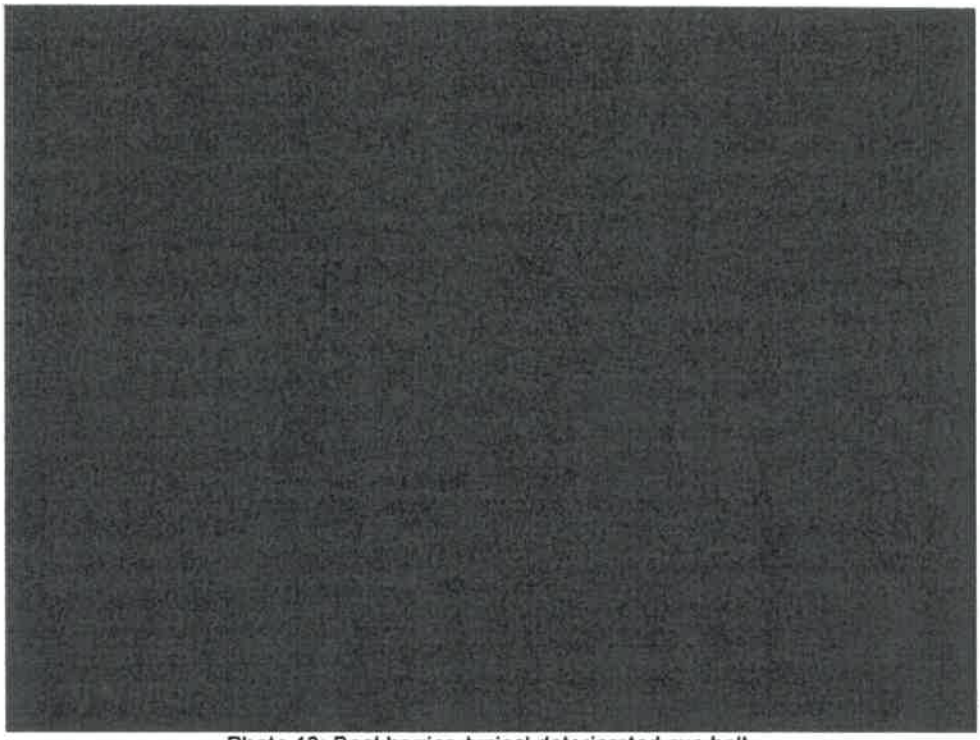


Photo 13: Boat barrier, typical deteriorated eye bolt

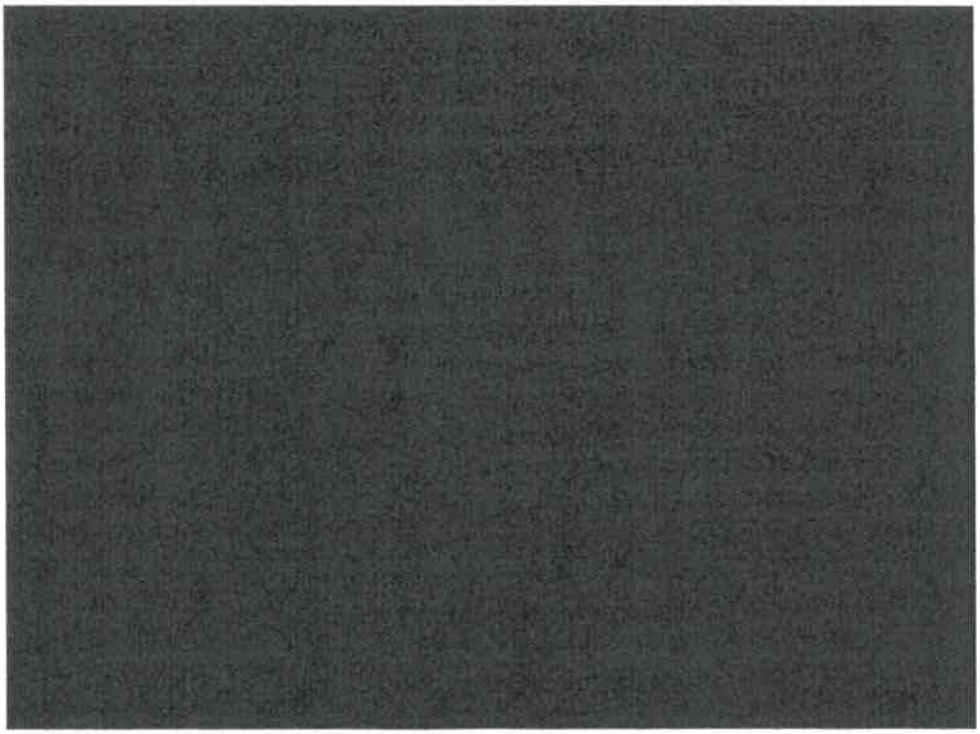


Photo 14: Boat barrier, loose cables

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

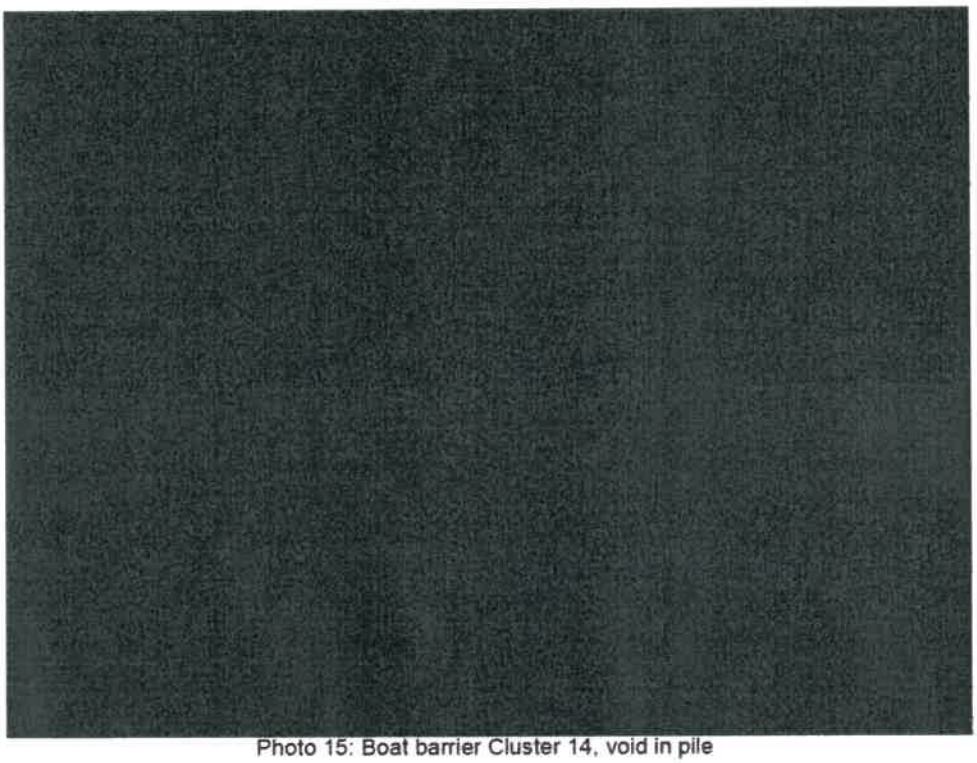


Photo 15: Boat barrier Cluster 14, void in pile

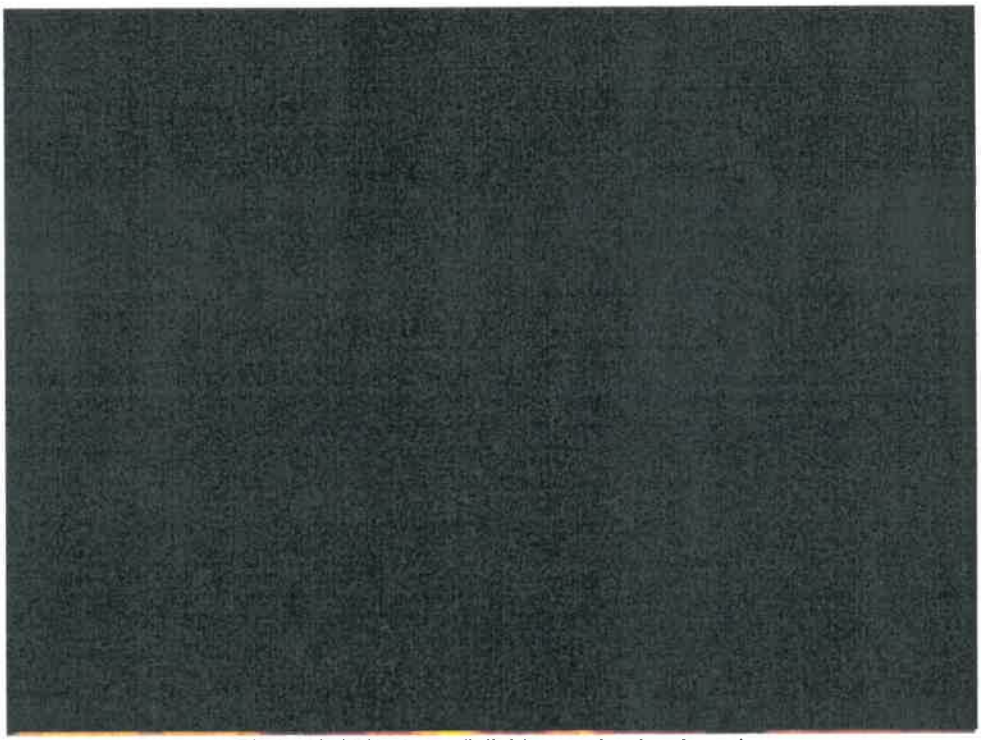


Photo 16: NW wingwall, light corrosion (upstream)

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

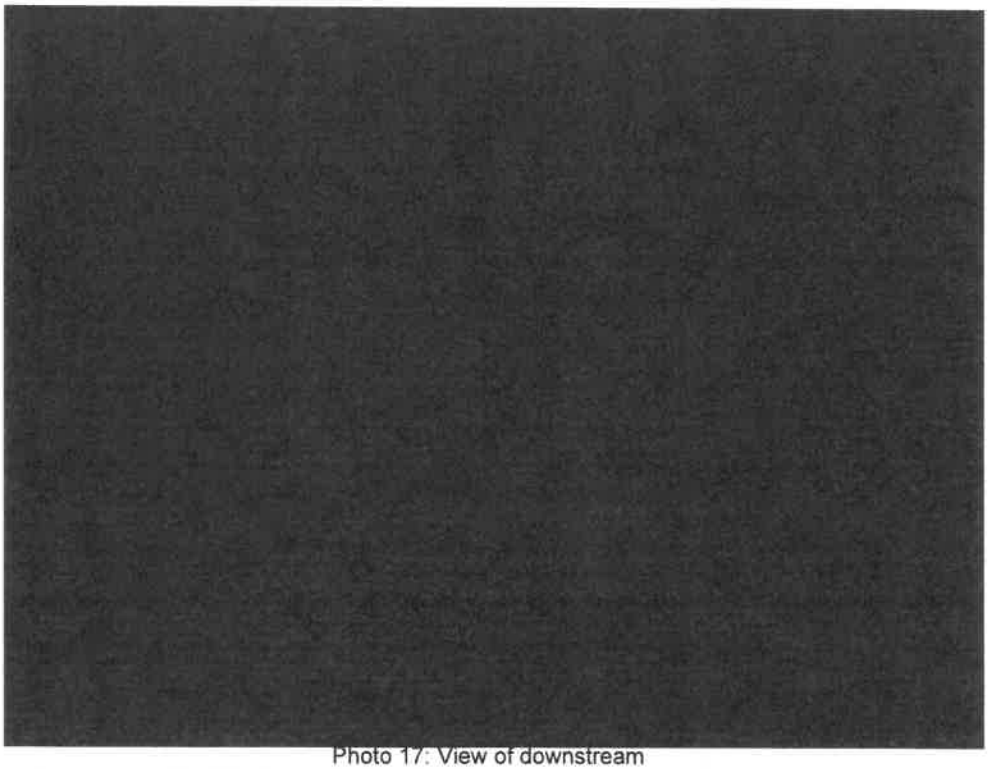


Photo 17: View of downstream

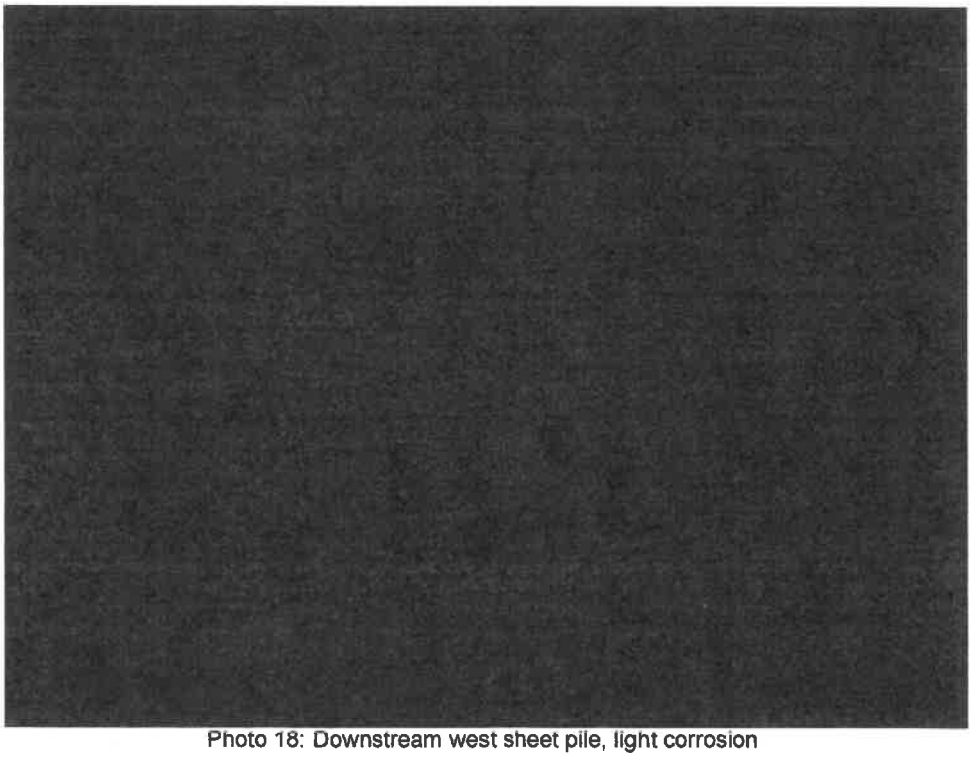


Photo 18: Downstream west sheet pile, light corrosion

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

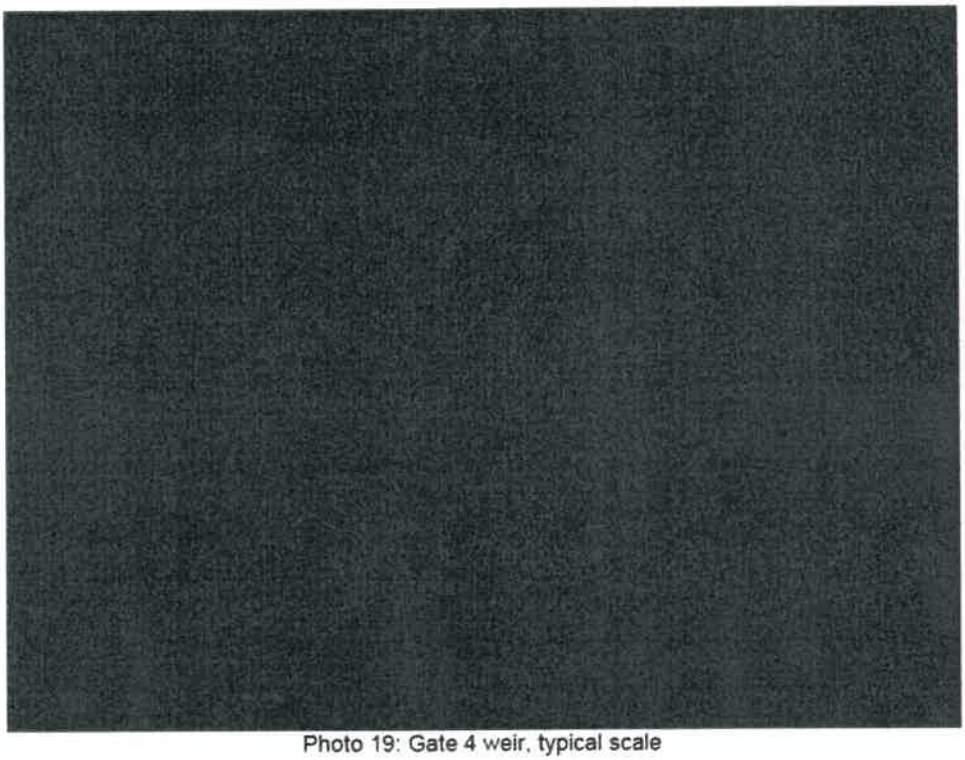


Photo 19: Gate 4 weir, typical scale

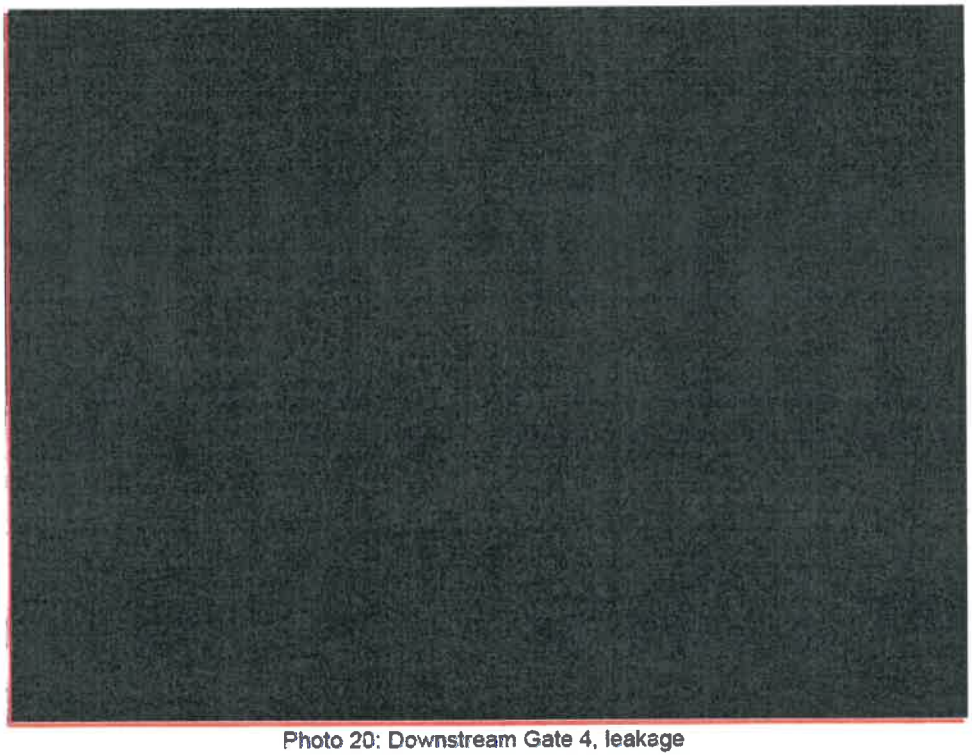


Photo 20: Downstream Gate 4, leakage

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

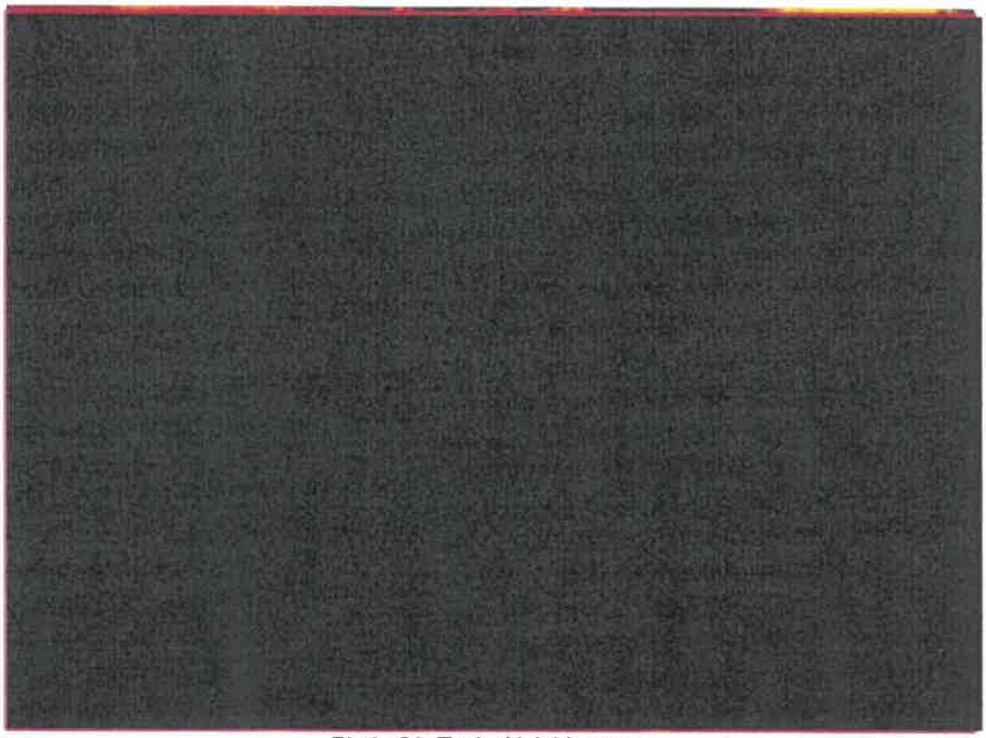


Photo 21: Typical joint in apron

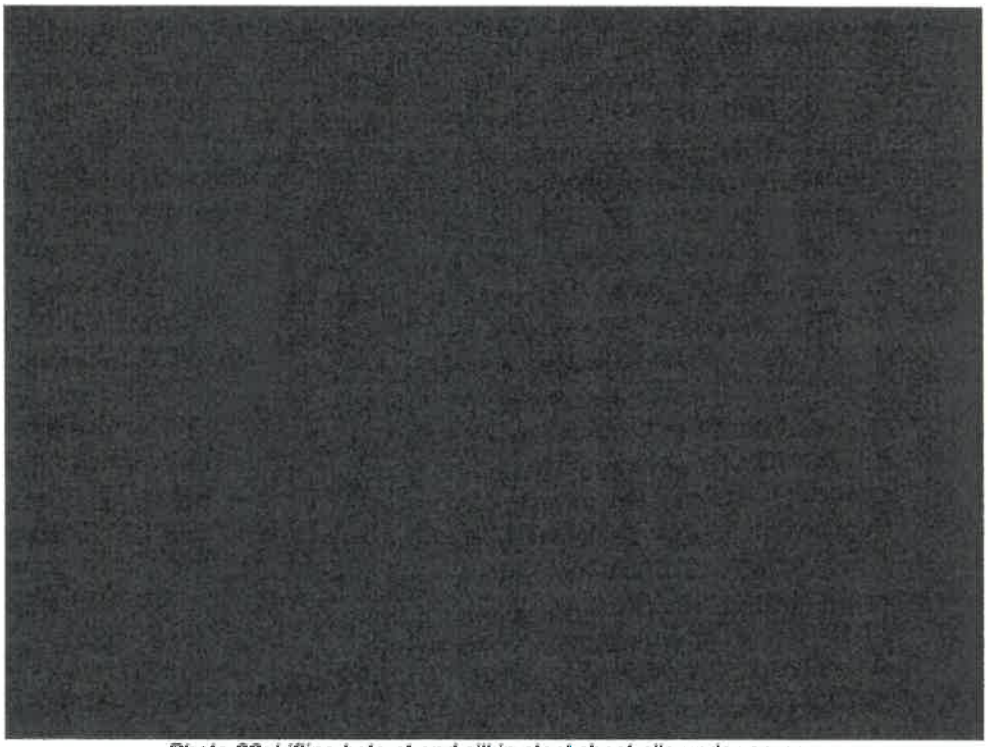


Photo 22: Lifting hole at end sill in steel sheet pile under apron

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

PHOTO LOG (CONTINUED):

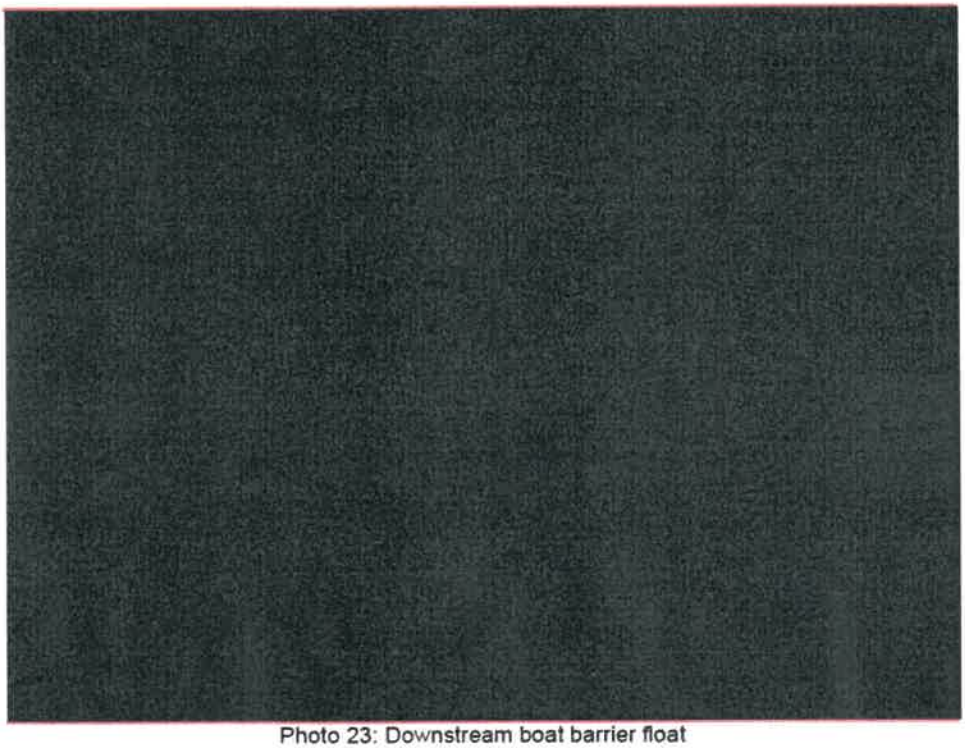


Photo 23: Downstream boat barrier float

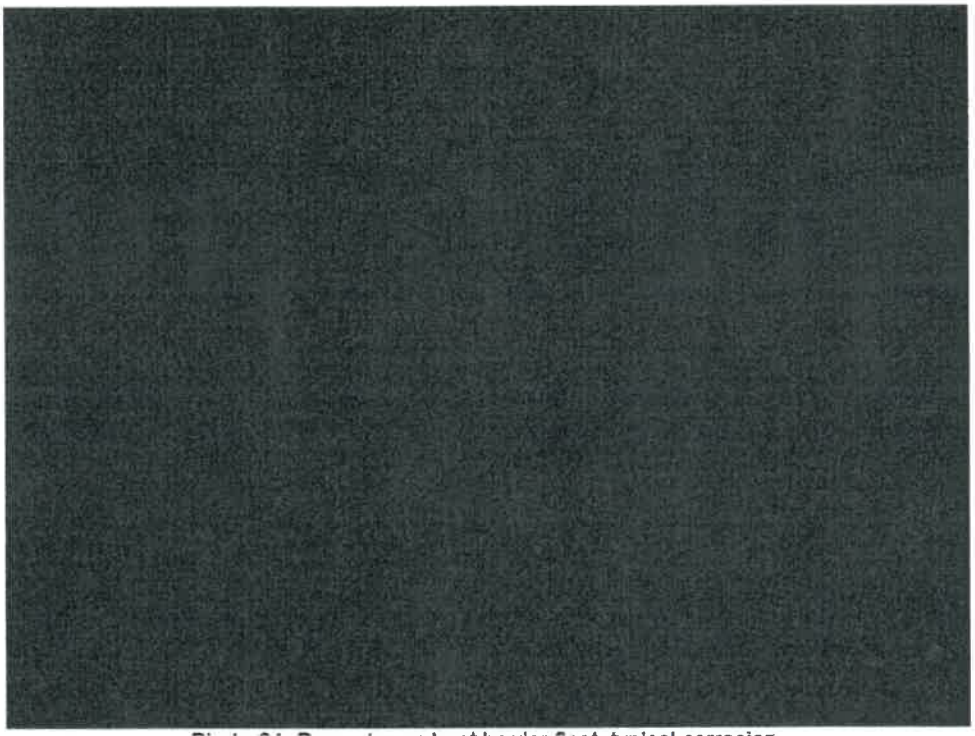


Photo 24: Downstream boat barrier float. typical corrosion

This report contains information relating to the physical security of a structure and depictions of the structure. This information is confidential and exempt from public inspection pursuant to sections 119.071(3)(a) and 119.071(3)(b), Florida Statutes.

Appendix D. Condition Assessment Report For Florida Dams and Impoundments

Date Prepared: September 28, 2021

Prepared By: Martin Kemps, PE

CONDITION ASSESSMENT REPORT FOR FLORIDA DAMS AND IMPOUNDMENTS

Dam Information

Name of Dam: Kirkpatrick Dam (Rodman Dam and Spillway)

National Inventory of Dams Identification Number: FL00156

Location-City/County: Palatka / Putnam County / Florida

Hazard Classification: Low Name of Waterbody: Rodman Reservoir

Purpose of Dam/Waterbody: Recreation / flood control Total Surface Area: 20.3 square miles

Crest Elevation: 28.0 (NGVD) Crest Width: 30 feet Crest Length: 7,200 feet

U/S Water Depth: 6' to 19' D/S Ground Elev.: 5.0 (NGVD) U/S Water Elev. 18.0 - 20.0 (NGVD)

Crest Material: Sand U/S Slope: 3(H):1(V) to 10(H):1(V) to 4(H):1(V) D/Slope: 4(H):1(V)

Owner's Information

Owner's Name(s): Florida Department of Environmental Protection

Owner's Address: 8282 S.E. Highway 314, Ocala Florida

Contact Person (if different from above): Mr. Mickey Thomason

Telephone No.: 352-236-7143

Email Address (or other means of communication): www.floridadep.gov

Owner's Engineer

Name of Engineering Firm or Engineer: Mead & Hunt, Inc.

Florida Professional Engineer License Number: 70468

Mailing Address: 2440 Deming Way, Middleton, WI 53562

Telephone Number: (Business): 608-273-6380

Date of Inspection: August 2nd and 3rd, 2021

1. **Crest**

a. How would you describe the vegetation on the crest? (Check all that apply)

Recently Mowed X Overgrown_____ Good Cover X Sparse_____

Other (describe): Rodman Dam Road which consists of asphaltic concrete is located on the crest.

b. Are there any trees or other inappropriate vegetation on the crest? Yes____ No X

If yes, describe (type of vegetation, size, location, etc.):_____

_____

_____

c. Is there a paved road or driveway on the crest? Yes X No____

If yes, describe the condition (for example, good condition, numerous cracks, newly paved, etc.):
The asphaltic concrete is in relatively good condition considering it appears to be relatively old. Only minor cracking noted.

d. Are there any depressions, ruts or holes on the crest? Yes____ No X

If yes, describe (length and width, location, direction of cracking, etc.):_____

_____

_____

e. Are there any cracks on the crest? Yes X No____

If yes, describe (length and width, location, direction of cracking, etc.): Numerous minor cracks in asphaltic concrete. The cracks are due to age of the asphaltic concrete and not related to slope instability.

f. Other observations on the crest: Crest is very wide, but no cut-off wall exists.

2. **Upstream Slope** (refer to Glossary for description)

a. What is the reservoir level today?

At Normal Pool X (19.6 NGVD) Above Normal Pool_____ Feet Below Normal Pool_____ Feet

b. How would you describe the vegetation on the upstream slope? (Check all that apply)

Recently Mowed X Overgrown_____ Good Cover X Sparse_____

Other (describe):_____

_____

c. Are there any trees or other inappropriate vegetation on the slope?
Yes X No ___

If yes, describe (type of vegetation, size, location, etc.): The left embankment had a small Palm tree along the upstream slope that should be removed.

d. Are there any depressions, bulges, ruts, or holes (such as animal burrows) on the slope?
Yes ___ No X

If yes, describe (size, location, etc.)_____

_____

e. Are there any eroded areas on the slope (such as wave erosion along the shoreline)? No

If yes, describe (size of area, location, severity, etc.):_____

_____

_____

f. Are there any cracks, sloughs or slides (vertical cliffs) on the slope?
Yes___ No X

If yes, describe (length, width, height, location, etc.)_____

_____

g. Is there any type of slope protection along the shoreline (such as riprap)?
Yes X No___

If yes, describe what type and its condition (for example, riprap - adequate, inadequate, sparse, etc.):
Other observations on the upstream slope Rip rap exists along the upstream slope to approximate El. 22 (NGVD). Rip rap had adequate cover and consisted of high-quality granite material.

3. **Downstream Slope** (refer to Glossary for description)

a. How would you describe the vegetation on the downstream slope? (Check all that apply)

Recently Mowed X Overgrown_____ Good Cover X Sparse_____

Other (describe):_____

b. Are there any trees or other inappropriate vegetation on the slope? Yes X No___

If yes, describe (type of vegetation, size, location, etc.): The right embankment had a small Palm tree along the downstream slope that should be removed.

c. Are there any depressions, bulges, ruts, or holes (such as animal burrows) on the slope?
Yes X No___

If yes, describe (size, location, etc.): The right embankment contained some rutting due to vehicles driving off the main roadway.

d. Are there any eroded areas on the slope (such as along abutment contacts)?
Yes___ No X

If yes, describe (size of area, location, severity, etc.):_____

_____

e. Are there any cracks, sloughs or slides (vertical cliffs) on the slope? Yes___ No X

If yes, describe (length, width, height, location, etc.):_____

_____

f. Are there any wet areas or areas of hydrophilic (lush, water-loving) vegetation?
Yes X No___

If yes, describe (length, width, height, location, etc.): Along the toe of each embankment seepage water collects in a trench that discharges into the river. Lush vegetation including cattails are present within these drainage trenches. The drainage trench is protected by a rip rap revetment.

g. Do any wet areas indicate seepage through the dam (such as rust-colored, stained water)?
Yes X No___ N/A___

If yes, describe (for example, new area of seepage, no change from past observations, size of area, location, etc.): The seepage in the drainage ditches appears to be similar when compared to the 2015 inspection of the project performed by Amec Foster Wheeler Environment & Infrastructure, Inc.

h. Are there any leaks (flowing water) from the slope or beyond the toe of the dam?
Yes X No___

If yes, describe (location, rate of flow, turbidity of flow, etc.): Along the toe of each embankment seepage water collects in a trench that discharges into the river. The flow was free flowing and did not appear to be turbid or carrying soil but was very difficult to tell since the natural color of the reservoir is very dark brown. Seepage along the left embankment that discharges through the culverts was estimated to be 45 to 70 gallons per minute. Seepage from the right embankment could not be estimated since there isn't any culverts or weirs installed to collect and monitor the seepage.

i. Other observations on the downstream slope: None

4. Plunge Pool

a. Is there any type of erosion protection around the plunge pool (such as riprap)?
Yes X No___

If yes, describe what type and its condition (for example, riprap - adequate, inadequate, obstructed by vegetation): A timber pile supported, 2'-6" thick reinforced concrete apron exists below the spillway. A sheetpile cut-off wall extends along the downstream end. The apron has a 2' high end sill to help dissipate flows. The downstream apron and end sill concrete appear to be in satisfactory condition based upon the dive inspection performed by Volkert, Inc. in August 2021.

b. Is there any erosion around the plunge pool? Yes X No

c. If yes, describe (size of area, location, severity, etc.): The divers reported that the downstream end of the downstream apron was undermined approximately 27-inches, exposing the sheet pile cut-off wall. Material has also eroded beneath the apron which extended 3'-8" upstream of the sheet piling.

d. Other observations around the plunge pool: None

5. Principal and Emergency Spillways

a. What types of spillways are on the dam and what is there composition (such as corrugated metal, concrete, or siphon pipe; concrete or earth channel)?

Principal Spillway X Emergency Spillway_____ Other_____

Describe: The spillway consists of a four-bay reinforced concrete ogee weir with four hydraulically operated, vertical lift gates. The steel gates are approximately 15' high by 40' wide. A sheetpile cut-off wall extends along upstream face of the ogee weir. An upstream apron consisting of rip rap underlain by bedding layers extends 50' upstream of the weir. An operating platform contains the hydraulic operating system.

b. Has the emergency spillway activated (had flow) since the last inspection?
Yes___ No X (there is no emergency (auxiliary) spillway at the project)

If yes describe (date(s) of flow, reason for activation, depth of flow, erosion damage, etc.): _____

c. For pipe spillways, is the intake obstructed in any way (such as with excessive debris)?
Yes___ No X (there is no pipe spillway at the project)

d. If yes, describe (type of debris, reason for obstruction, etc.):_____

e. For pipe spillways, what is the condition of any trash racks (for example, adequate, inadequate, damaged)? NA

f. For pipe spillways, are there any visible cracks, separations or holes in the pipe(s) (intake or outlet)? NA
If yes, describe (location, width of crack or separation, etc.): _____

g. For pipe spillways, are there any apparent leaks in the pipe(s)? NA
If yes, describe (location, rate of flow from leak, etc.):_____

h. For pipe spillways, how would you describe the overall condition of the pipe(s)? (Check all that apply) NA

Functioning Normally___ Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

i. For concrete or earth channel spillways, is the entrance or channel obstructed in any way?
Yes X No___

If yes, describe (type of obstruction, location, etc.): Heavy wood debris and vegetation extends along the upstream side of the concrete weir. The upstream debris barrier is not operational, which allows debris to collect in front of the spillway. The debris limits the discharge capacity of the gates.

j. For earth channel spillways, how would you describe the vegetation in the spillway? (Check all that apply) NA

For earth channel spillways, are there any trees or other inappropriate vegetation in the spillway? NA

If yes, describe (type of vegetation, size, location, etc.):_____

k. For earth channel spillways, are there any eroded areas in the spillway? NA

If yes, describe (size of area, location, severity, etc.):_____

_____

_____

l. For concrete channel spillways, are there any cracks or holes in the spillway? Yes___ No X

If yes, describe (width of crack or hole, location, etc.):_____

m. For concrete channel spillways, are there any leaks or evidence of undermining (flow under the concrete)? Yes___ No X

If yes, describe (location, rate of flow from leak, indicators of undermining, etc.):

n. For earth or concrete channel spillways, how would you describe the overall condition of the spillway? (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

o. Other observations on the spillways: The spillway itself functions normally, however the debris present upstream of the spillway can lodge in front of the spillway gates and decrease spillway capacity during large rain events and overtop other areas of the project. The woody debris may also prohibit the gates from operating properly(lodging).

6. Instrumentation

a. Are there any toe drains at the downstream toe or any other seepage drains on the dam? Yes X No___

If yes, describe the condition (for example, clogged, free flowing, deteriorated, good condition, etc.): Along the toe of each embankment seepage water collects in a trench that discharges into the river. The flow was free flowing and did not appear to be turbid or carrying soil but was very difficult to tell since the natural color of the reservoir is very dark brown. Seepage along the left embankment that discharges through the culverts was estimated to be 45 to 70 gallons per minute. Seepage from the right embankment could not be estimated since there aren't any culverts or weirs installed to collect and monitor the seepage.

b. For drains, is an animal guard installed at the outlet of each drain? NA

If no, which drains lack animal guards? _____

c. For drains, measure the rate of flow from each drain and record below (use additional pages if necessary):

Designation/Location of Drain	Flow Rate	Flow Rate in GPM*	Turbidity Flow (Describe clear, muddy, etc.)
Culverts left of spillway	45 to 70 gpm	45 to 70 gpm	Appeared clear, but natural color of water is dark brown

d. Are there any piezometers on the dam? Yes___ No X

If yes, describe the condition (for example, good condition, damaged, etc.):_____

_____

e. For piezometers, does each piezometer have a cap with a lock? Yes___ No___

If no, which piezometers need caps (to prevent rainwater intrusion) and/or locks (to prevent tampering)?

_____

f. For piezometers, are you able to take a measurement (depth to water) in each piezometer? Yes___ No___

If yes, record depth to water (in feet) in each piezometer, record on a separate page and attach to this form.

g. Are there any other monitoring devices on the dam? Yes___ No X

If yes, describe what type and the condition (for example, monitoring wells - good condition, damaged, etc.):_____

h. Other observations on instrumentation: Survey monuments located on operating platform and concrete tailrace walls. These monuments are not surveyed.

7. Outlet Pipe

a. Any water flowing outside of discharge pipe through the impounding structure. (Check all that apply) NA

Functioning Normally___ Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

b. Describe any deficiencies:_____

8. Stilling Basin

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

b. Exposure of rebar? Yes___ No X

c. Deterioration of basin sloes and repairs done:_____

d. Any obstruction to flow:_____

9. Waterbody Structures

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

Describe: Overall the spillway was in good condition

b. Exposure of rebar? Yes___ No X

c. Deterioration of basin slopes and any repairs done:_____

d. Any obstruction to flow: Woody debris and vegetation is present upstream of the spillway which can lodge in front of the spillway gates, decreasing spillway capacity during large rain events.

10. Downstream Hazard Issues

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

b. Exposure of rebar? Yes___ No X

c. Deterioration of basin sloes and any repairs done: Some minor voids were noted beneath the grouted rip rap in the 2019 inspection by Greenman-Pedersen, Inc. These voids have not been filled. These areas appeared to be in the same condition in 2021 as compared to the 2019 photographs.

d. Any obstruction to flow: No

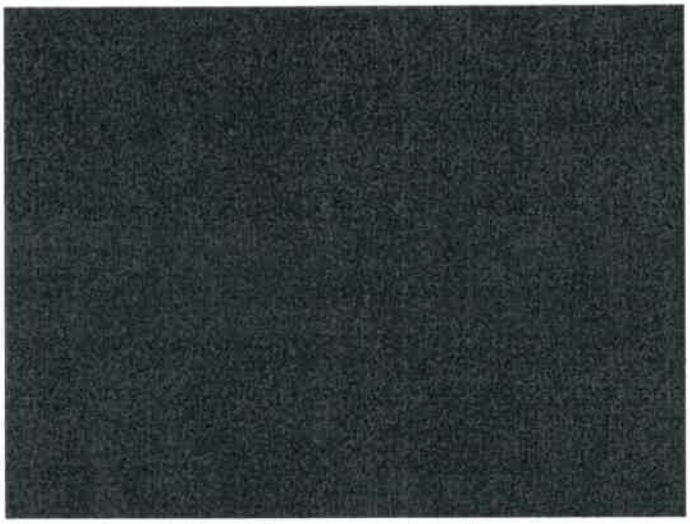
e. Are there homes downstream from the dam? Yes X No___

Approximate distance: Closest dwelling estimated to be 1.3 Miles

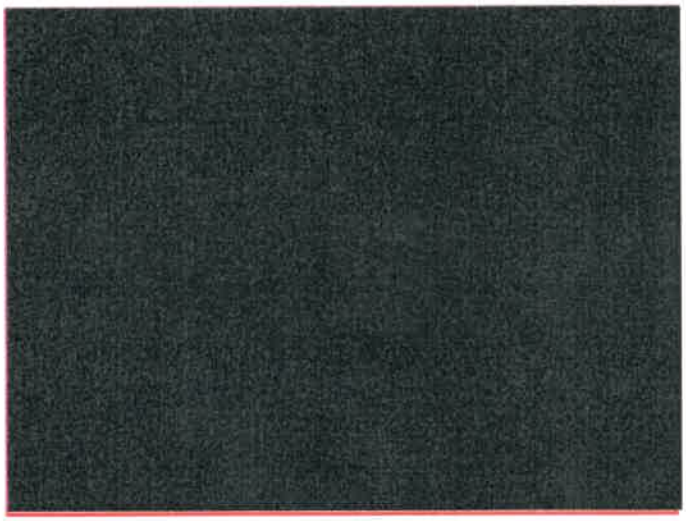
11. Photographs

At a minimum, photographs should be taken of the crest, upstream slope, downstream slope, principle and emergency spillways, and any other notable features. (Example: structures, seepages, ruts, slope failure, etc.)

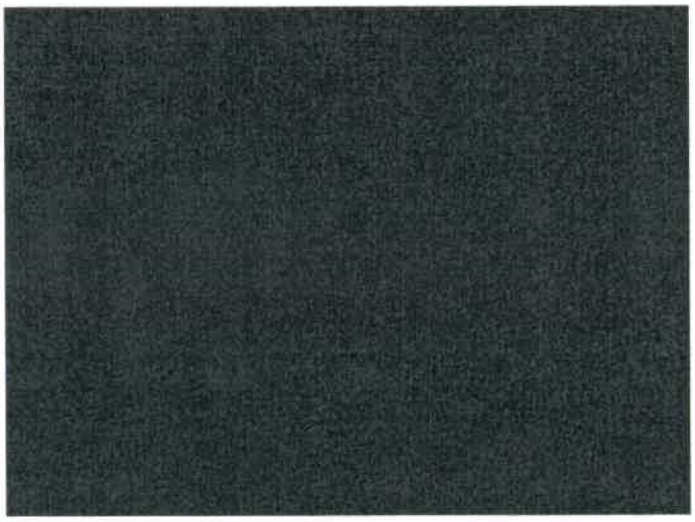
Photographs:



Photograph No. 1: View of downstream end of spillway

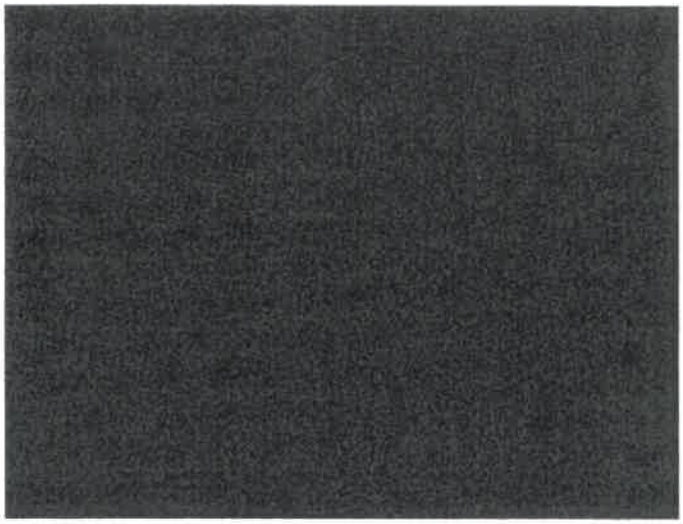


Photograph No.2: Spillway piers

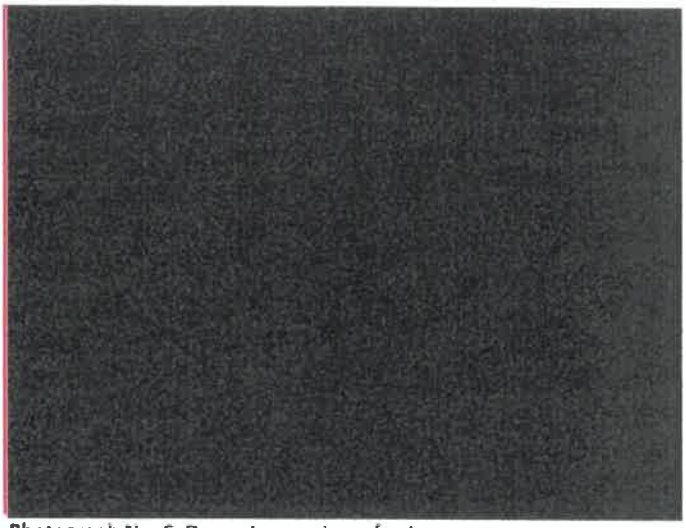


Photograph No. 3: Diver inspecting Gate 1

.Photograph No. 4: Debris upstream of gates



Photograph No. 5: Corrosion of gate hoist supports



Photograph No. 6: Downstream view of gates

Photograph No. 7: Upstream slope of left embankment

Photograph No.8: Downstream slope of left embankment

Photograph No. 9: Upstream slope of right embankment

Photograph No. 10: Downstream slope of right embankment

OVERALL CONDITION ASSESSMENT OF IMPOUNDING STRUCTURE AND APPURTENANCES

(Check one)

SATISFACTORY X FAIR ☐ POOR ☐ UNSATISFACTORY ☐ NOT RATED ☐

1. SATISFACTORY
   No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

2. FAIR
   No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

3. POOR
   A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.

4. UNSATISFACTORY
   A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

5. NOT RATED
   The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

Supplemental Comments (Add narrative on your overall assessment category):_____

_____

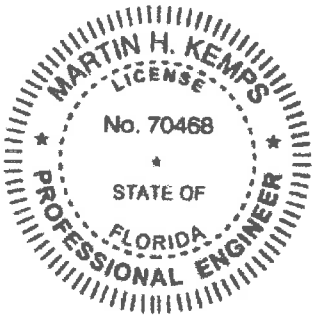
_____

_____

_____

CERTIFICATION BY PROFESSIONAL ENGINEER

I hereby certify, by signing, dating, and sealing, that the information provided in this report has been examined by me and found to be true and correct in my professional judgment.



This item has been digitally signed and sealed by Martin Kemps, PE on 9/28/2021.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

E-Mail Tracy Woods, P.G., State Dam Safety Officer, at Tracy.Woods@FloridaDEP.gov, when the executed form is ready for download from a secure account.

Buckman Lock Inspection
Summary Notes

Project Name:	Buckman Lock	**Owner:**	Department of Environmental Protection
Mead & Hunt Representatives:	Marty Kemps, PE (FL) Jim Botz, PE	**Date:**	August 3 and 4, 2021

The following findings are a summary of Mead & Hunt's inspection. Detailed information regarding the inspection will be provided in the inspection report which will also contain the requested Condition Assessment, recommendations, additional photos, and repair / maintenance information.

Visual Inspection

The following is a summary of the observations made by Mead & Hunt during our inspection.

A. No immediate safety concerns with regards to the lock structure were observed during our inspection.

B. We observed both miter gates opening and closing. No binding or vibration was noted while operating.

C. The canal water was flushed twice during our inspection. The emptying and filling valves appeared to function properly.

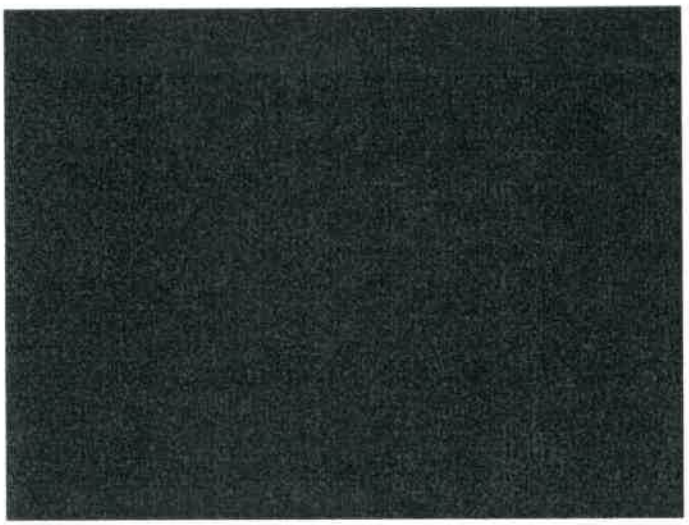
D. No significant concrete deterioration of the lock chamber was observed. Some hairline cracking and minor efflorescence was noted throughout the lock chamber.

E. Operator mentioned that approximately 75% of the lubrication lines used to grease the operating system no longer accept grease.

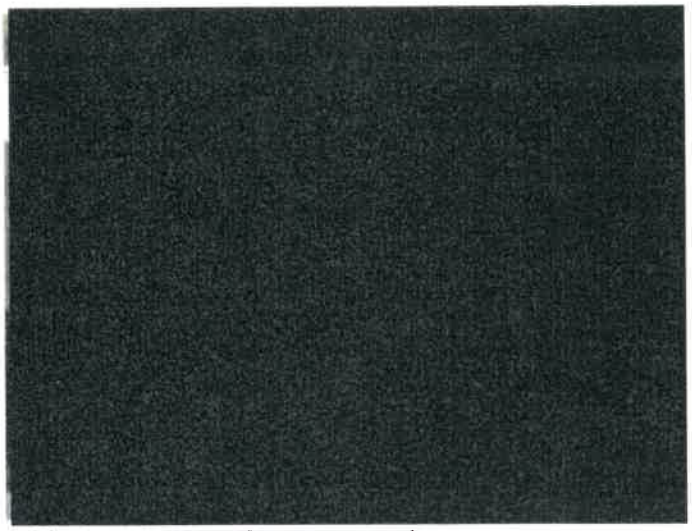
F. No seepage around the structure was noted.

G. Flap valves at the outlets of the drainage system, used to reduce hydrostatic pressures on the lock walls, appeared to function as intended.

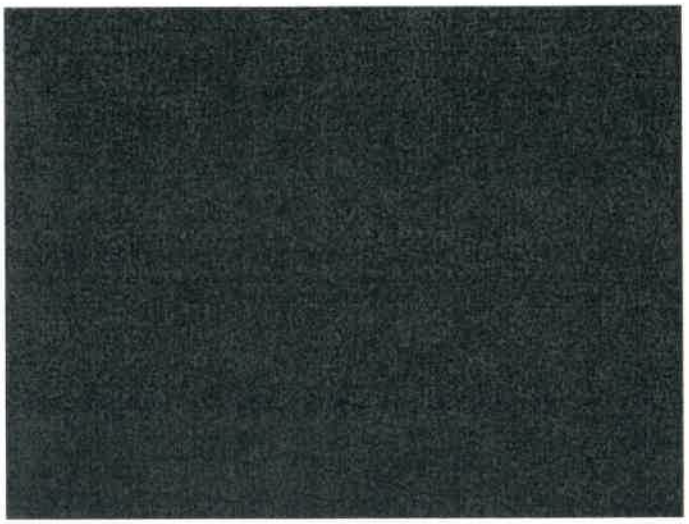
H. The concrete guide walls were in good condition with very minimal hairline cracking and efflorescence.



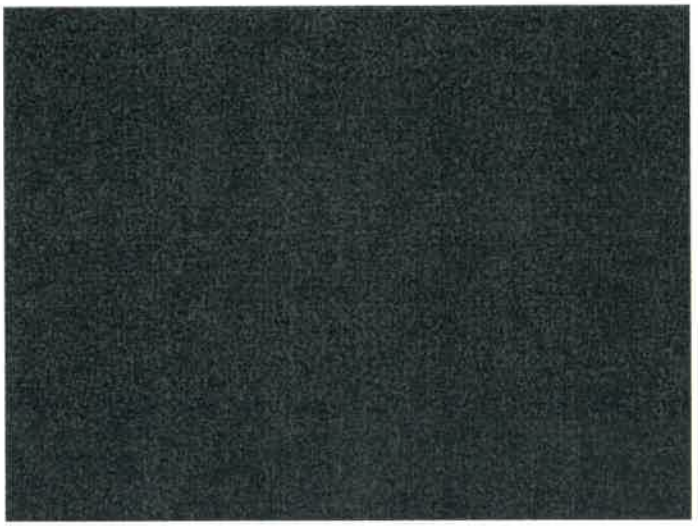
Photograph No. 1: View of lock looking upstream



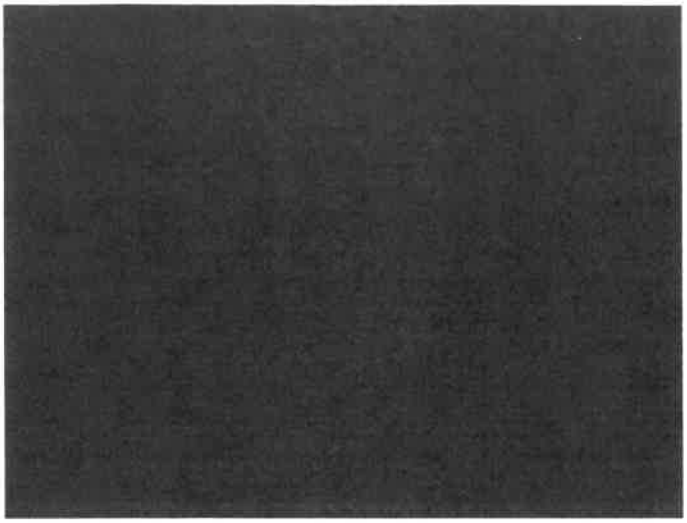
Photograph No.2: Downstream miter gates



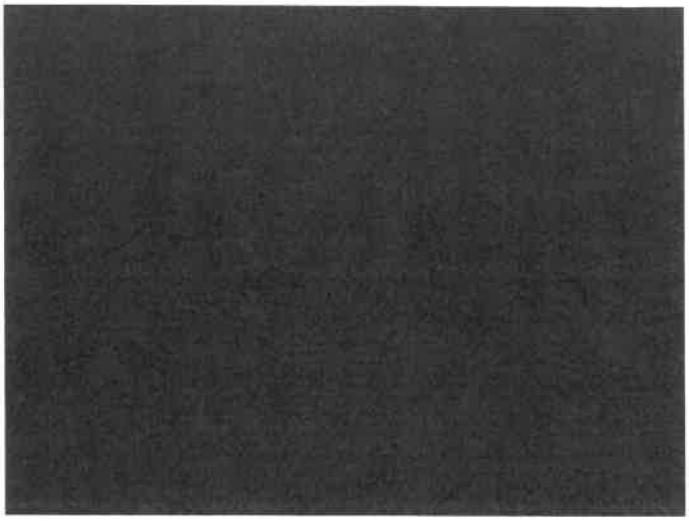
Photograph No. 3: Typical hydraulic ram for miter gates



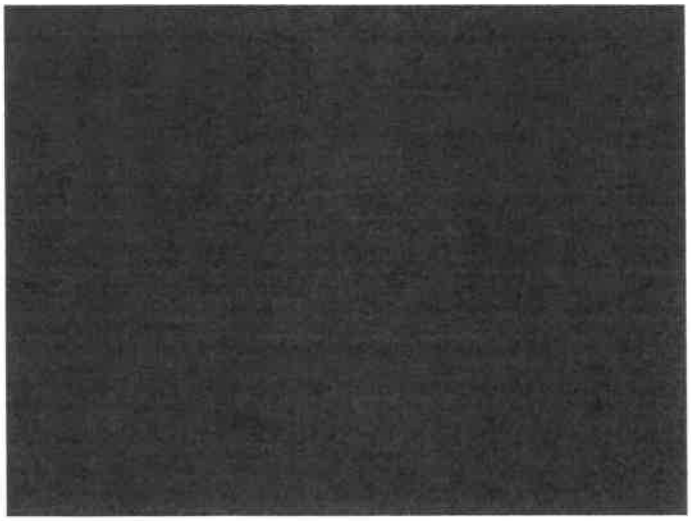
Photograph No. 4: Lock chamber being lowered looking upstream



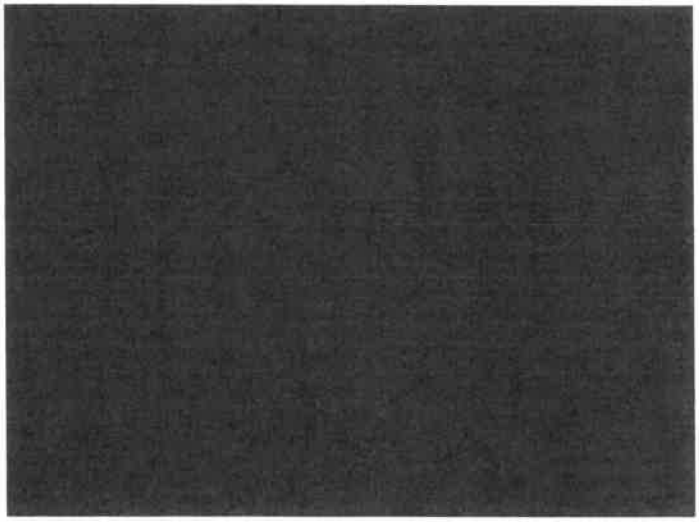
Photograph No. 5: Lock lowered looking downstream



Photograph No. 6: Upstream mitre gate seal leakage



Photograph No. 7: Downstream rip rap protection



Photograph No. 8: Downstream concrete guide wall

2021 Inspection Report

Buckman Lock

Ocklawaha River
Putman County, Florida

Report prepared for

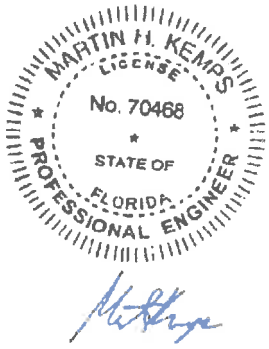
Florida Department of Environmental Protection #

Report prepared by

Mead & Hunt

www.meadhunt.com

November 2021



This item has been digitally signed and sealed by Martin Kemps, PE on 11/10/2021.

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Table of Contents

Page

1. **General** 1
2. **Project Description** 1
3. **Field Inspection** 2
   - 3.1 Field Inspection Observations 3
     - 3.1.1 Lock 3
     - 3.1.2 Miter Gates 3
     - 3.1.3 Concrete guide wall 4
     - 3.1.4 Control Room 4
   - 4. Surveillance and Monitoring 4
   - 5. Opinion of Probable Cost and Timeline 5
6. **References** 7

Appendices

A Project Drawings

B Photographs

C Condition Assessment Report For Florida Dams and Impoundments

1. General

The Buckman Lock (Project) is owned, operated, and maintained by the Florida Department of Environmental Protection (FDEP). Mead & Hunt, Inc. (Mead & Hunt) performed the inspection of the Buckman Lock on August 2 and 4, 2021. This report provides a summary of the inspection and recommendations for long-term monitoring along with a cost estimate for repairs.

The conclusions and recommendations herein are based on the engineer's opinion and are made independently of the FDEP, its employees, and its representatives. The conclusions regarding the condition and safety of the lock and related facilities are not guaranteed but do represent our best judgment.

This report was prepared by Martin Kemps, PE and reviewed by Jim Botz, PE.

2. Project Description

The Buckman Lock was designed by the U.S. Army Corps of Engineers (USACE) as part of the Cross Florida Barge Canal system. The Project connects the Rodman Reservoir to the St. Johns River.

The Buckman Lock consists of reinforced concrete with vertical walls and a horizontal floor. The walls range between seven to twenty-five feet wide at top elevation of 25.5[1]. The bottom of the walls range between thirty-one to thirty-seven feet wide with a bottom elevation between -11.0 and -28.0. The concrete lock floor is two feet thick and has a top elevation of -16.5, with 5-foot-thick concrete struts. A pressure relief system beneath the floor consists of coarse filter material with 18-inch perforated, corrugated metal pipes.

The lock has four miter gates, each 47'-9" wide. The upstream gates are 19.5 feet high, while the downstream gates are 42 feet high. Each gate is controlled by a hydraulic power unit (HPU) with a horizontally mounted hydraulic cylinder. A manatee protection system is in-place at each set of the miter gates that prevents injury to passing by manatees due to operating the gates. There is an upstream concrete guide wall on the right[2] side of the lock and a downstream concrete guide wall along the left side of the lock.

The lock is open to the public Thursday through Sunday. During days when the lock is not open to the public, the lock chamber is flushed daily for environmental reasons.

Representative drawings of the lock structure can be found in Appendix A.

---

[1] Elevations in this report are referenced to NGVD 29.

[2] Left and right are referred to in this report relative to an observer facing downstream.

3. Field Inspection

The field inspection of the Project was performed on August 2 and 4, 2021. The following individuals participated in the visual inspection:

Arthur Annis – FDEP
Jim Botz, PE – Mead & Hunt, Inc.
Marty Kemps, PE – Mead & Hunt, Inc.

At the time of the inspection, the weather was overcast to heavy rains with temperature between 75°F to 82°F. The conditions allowed for a visual assessment of the lock. During the inspection, both the upstream and downstream miter gates were operated.

Visual observations of the Project's water-retaining structures were made during the field inspection to note the following conditions:

- Cracking of concrete
- Deterioration of concrete
- Joint movement or offsets
- Misalignment
- Movement
- Settlement
- Excessive debris
- Deformation of gate members
- Leakage
- Seepage
- Erosion
- Debris
- Instrumentation
- Offsets

The field inspection started along the left side of the lock, down to the end of the downstream guide wall, up the right side of the lock, across the upstream gates and up and down the upstream guide wall then inside the upstream control building. No condition that requires immediate action was noted during the field inspection. Photographs taken during the inspection and referenced below can be found in Appendix B.

The condition of Project components was evaluated relative to the following definitions.

Excellent	Appearance is essentially equivalent to post-construction condition. Feature or system functions as intended and without problems. Maintenance needs are less than or equivalent to design intent.
Good	Appearance has minor deterioration such as concrete shrinkage cracks or damage to coatings over less than 5 percent of area, which would be expected for a structure or system of similar age and exposure. Feature or system reliably functions as intended. Maintenance needs are essentially equivalent to design intent.
Fair	Appearance has deterioration such as concrete cracking, spalling, joint offsets, or metal corrosion over more than 25 percent of area, which is indicative of age, weathering, or wear. Feature or system accommodates design loadings and functions as intended;

however, operation may periodically require minor manipulation. Maintenance needs are evident and likely greater than design intent.

Poor — Appearance has significant deterioration that could be indicative of reduced structural integrity and ability to accommodate design loadings. Feature or system often does not function as intended and requires repair or replacement. Maintenance needs are frequent and far exceed the design intent.

Unsatisfactory — The feature or system is no longer able to perform its function as intended and poses a threat to the safe operation of the facility. Immediate attention is required to remedy the condition.

As requested by the FDEP, A *Condition Assessment Report For Florida Dams and Impoundments* form was also completed and is included in Appendix C.

3.1 Field Inspection Observations

3.1.1 Lock

The lock appeared in good condition overall. Some minor hairline cracks along the concrete parapet walls (see Photograph Nos. 1 and 2) were observed. Efflorescence (Photograph Nos. 3 and 4) and light cracking (Photograph No. 5) was noted along the lock walls.

The lock was operated through a couple of cycles during our inspection (Photographs 6 through 10). Both the upstream and downstream gates appeared to operate smoothly without signs of binding or other problems. The uplift pressure relief system also appeared to be functioning as designed. Water could be seen flowing from the flap valve (Photograph No. 11) during dewatering. While the lock chamber was lowered, the top of the upstream gate sill was visible and appeared to be in good condition (Photograph No. 12). Although the gates operated smoothly, the operator mentioned that most of the grease lines are not operable. To help prevent more expensive future repairs, the grease lines should be repaired to allow for proper lubrication.

2021-REC-1 — The grease lines for the lock should be repaired to allow for proper lubrication and to prevent more expensive future repairs by December 2022.

3.1.2 Miter Gates

The miter gates are from original construction (1968). Although gates appeared to be in good condition during the site visit, some minor corrosion was noted on the gates (Photograph Nos. 13 and 14). We understand that a detailed gate inspection has not been performed within the last ten plus years. To document the amount of corrosion and overall condition of the gates, the gates should be cleaned and a detailed, hands-on inspection which includes climbing the gates, along with taking thickness measurements be performed and the results reviewed by a qualified hydraulic steel structural engineer.

2021-REC-2 A detailed, hands-on inspection of the gates should be performed, including taking thickness measurements of gate members. The findings should be reviewed by a qualified hydraulic steel structural engineer by December 2023.

3.1.3 Concrete guide wall

The upstream and downstream concrete guide walls are also in good condition (Photograph Nos. 15 and 16). The rip rap shoreline protection (Photograph Nos. 17 to 19) was in good condition and had sufficient coverage. Some vegetation was noted on the left, downstream side that should be removed or killed before it becomes well-established.

2021-REC-3 The heavy vegetation along the left, downstream side of the lock within the rip rap should be killed or removed by July 2022.

3.1.4 Control Room

The upstream control room was observed. The operator reported that all controls were in working condition. The facility was clean and well maintained (Photograph No. 20). Air conditioning is kept on to maintain an anti-corrosion environment for the hydraulic power units (Photograph No. 21) and other operating equipment. The display monitor (Photograph No. 22) includes percentage of gate opening, lock chamber water level, and information regarding the manatee protection system.

4. Surveillance and Monitoring

The only monitoring currently performed is from operator observations during site visits and viewing staff gages to monitor lock chamber water level elevations. The Project does have twenty-seven piezometers, but they are currently, and historically not measured. Water was observed within the boxes that housed the piezometers and the system likely needs refurbishing repairs. Since the lock is constantly de-watered to the upstream sill elevation, with no signs of stress or movement, we recommend that the operators pay special attention to the uplift pressure release system to ensure it is still functioning as intended, instead of refurbishing the piezometer system and taking routine measurements. If water cannot be observed exiting or drastically reduced from the pressure relief valves in the future, then the pressure relief system should be inspected and cleaned.

2021-REC-4 Operators should pay special attention to the pressure relief system when de-watering the lock to ensure the pressure relief system is functioning as intended. If flow through the relief valves is not visible, or drastically reduced, the pressure relief system should be inspected and cleaned within one month of reduced / no flow.

5. Opinion of Probable Cost and Timeline

The cost estimate is considered a Class 4 estimate based upon the Association for the Advancement of Cost Engineering (AACE) International *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry*. A summary of the Class 5 estimate is shown in Table 5-1 for reference:

Table 5-1. AACE Cost Estimate Matrix

COST ESTIMATE CLASSIFICATION MATRIX FOR THE HYDROPOWER INDUSTRY

	Primary Characteristic	*Secondary Characteristic*		
ESTIMATE CLASS	**MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgment, or analogy	L: -20% to -50% H: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	L: -15% to -30% H: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	L: -10% to -20% H: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	L: -5% to -15% H: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-off	L: -3% to -10% H: +3% to +15%

Notes: [a] The state of technology, availability of applicable reference cost data, and many other risks affect the range markedly. The +/ value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.

The following table is a summary of costs with regards to Mead & Hunt's 2021 recommendations with a 20-30% contingency added included.

Table 5-2. Maintenance, Cost, and Timeline Estimation

BUCKMAN LOCK MAINTENANCE AND REPAIR ITEMS			
Mead & Hunt's 2021 Inspection Report			
Recommendation	**Estimated Cost***	**Recommended Completion Date**	**Remarks**
The grease lines for the lock should be repaired to allow for proper lubrication and to prevent more expensive future repairs. (2021-REC-1)	$215,000 (see remarks)	December 2022	• Based upon previous contractor bids with inflation accounted for and contingency. • Contractors would need to visit the Project to review existing conditions to develop a better understanding of costs.
A detailed, hands-on inspection of the gates should be performed, including taking thickness measurements of gate members. The findings should be reviewed by a qualified hydraulic steel structural engineer. (2021-REC-2)	$38,000	December 2023	• Inspection includes physically climbing the gates • Includes engineering review
The heavy vegetation along the left, downstream side of the lock within the rip rap shoreline protection should be killed or removed. (2021-REC-3)	N/A	July 2022	• Assumes vegetation will be removed by operating personnel
Operators should pay special attention to the pressure relief system when de-watering the lock to ensure the pressure relief system is functioning as intended. If flow through the relief valves is not visible, or drastically reduced, the pressure relief system should be inspected and cleaned within one month of reduced/no flow. (2021-REC-4)	N/A	Within 1 month after observing no flow from pressure release valves	• None

* Information presented on this sheet represents our opinion of probably project costs in 2021 dollars and is based upon limited engineering. Actual bids and total project cost will vary based on contractor's perceived risk, site access, market conditions, availability of materials, etc. No warranties concerning the accuracy of costs presented herein are expressed or implied.

6. References

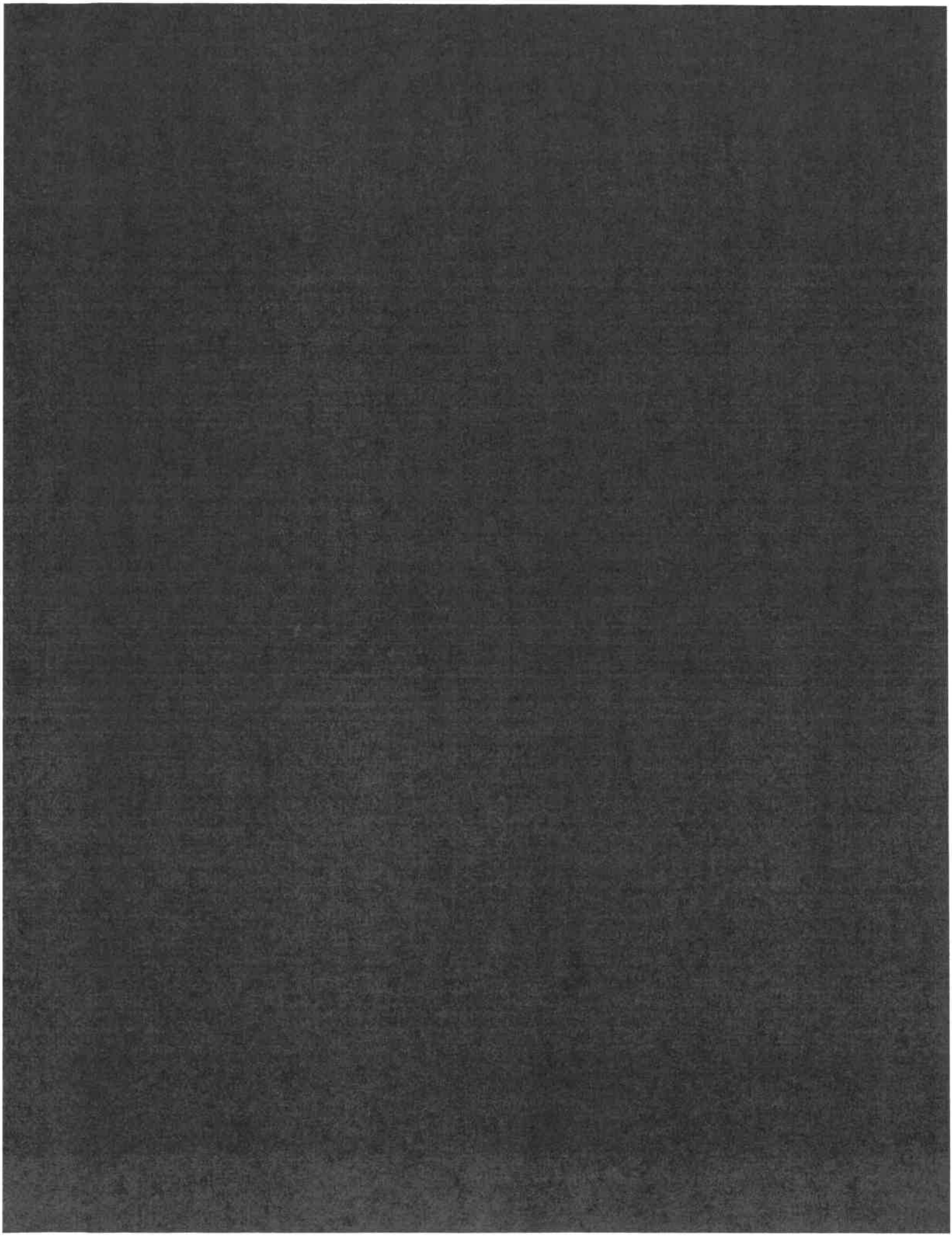
AACE International Recommended Practice No. 69R-12, *Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Hydropower Industry,* January 25, 2013.

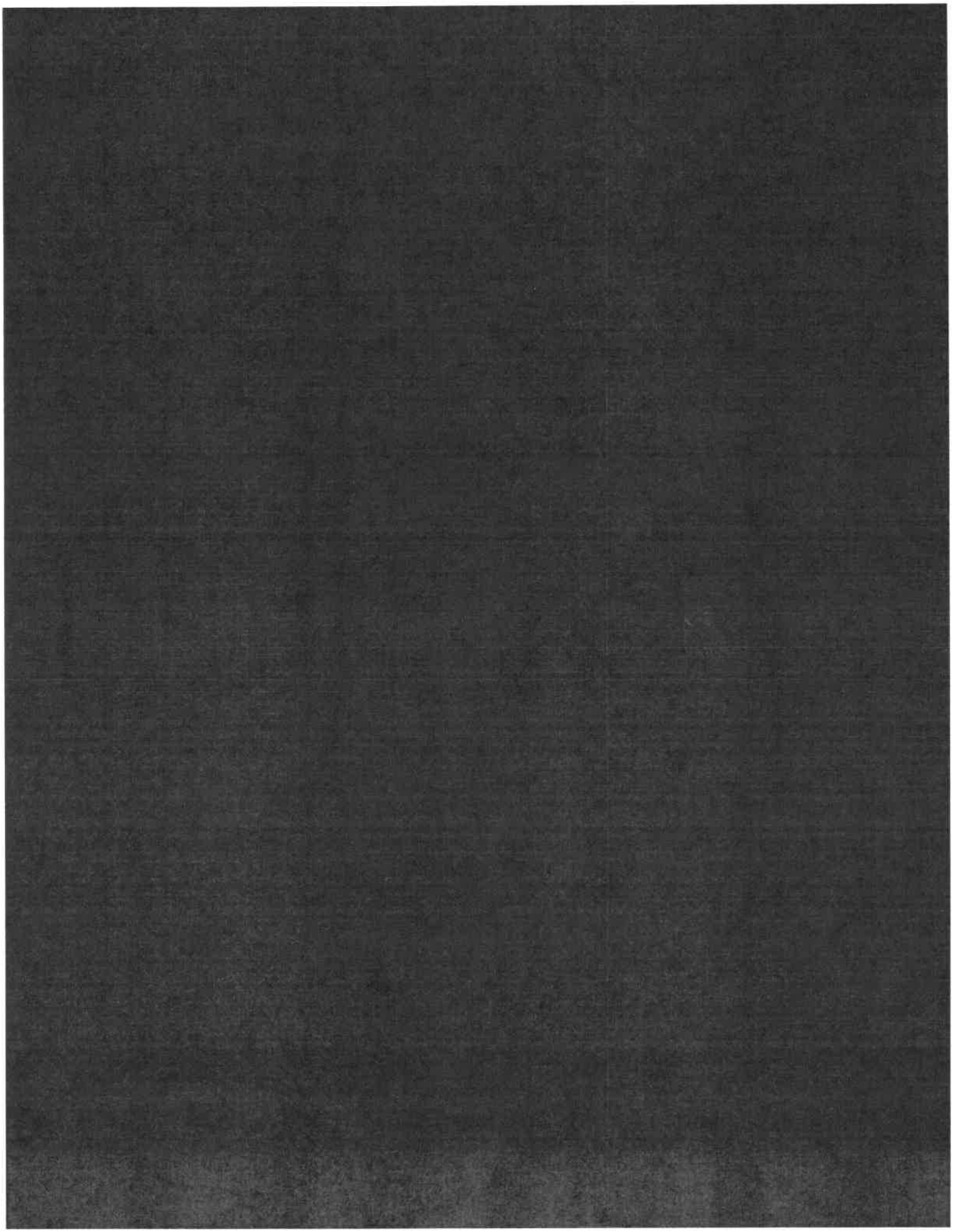
Amec Foster Wheeler Environmental & Infrastructure, Inc., *Kirkpatrick Dam & Buckman Lock Geotechnical Inspection Report*, July 2017.

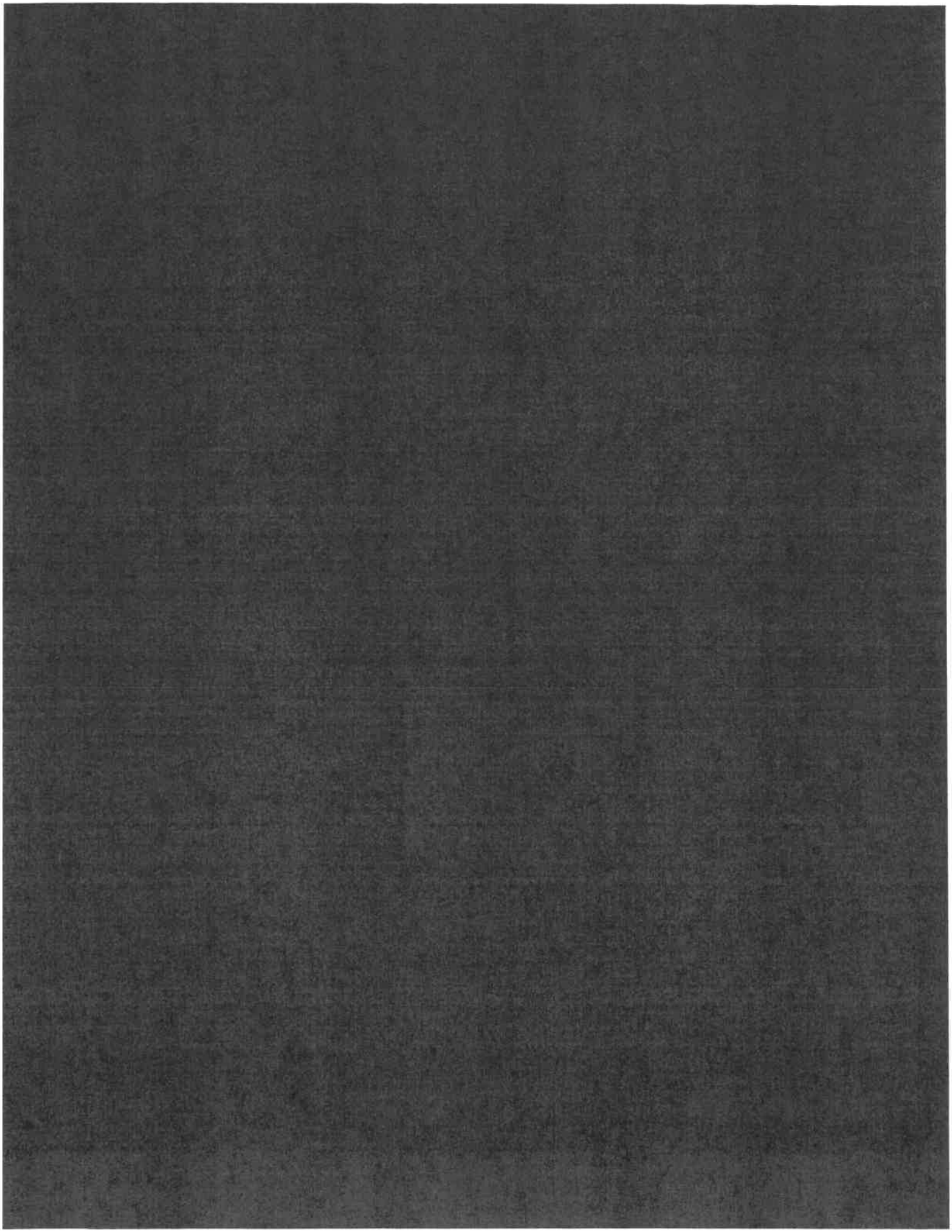
U.S. Army Engineer District, Jacksonville Corps of Engineers, *Cross Florida Barge Canal Plans St. Johns Lock,* February 1976.

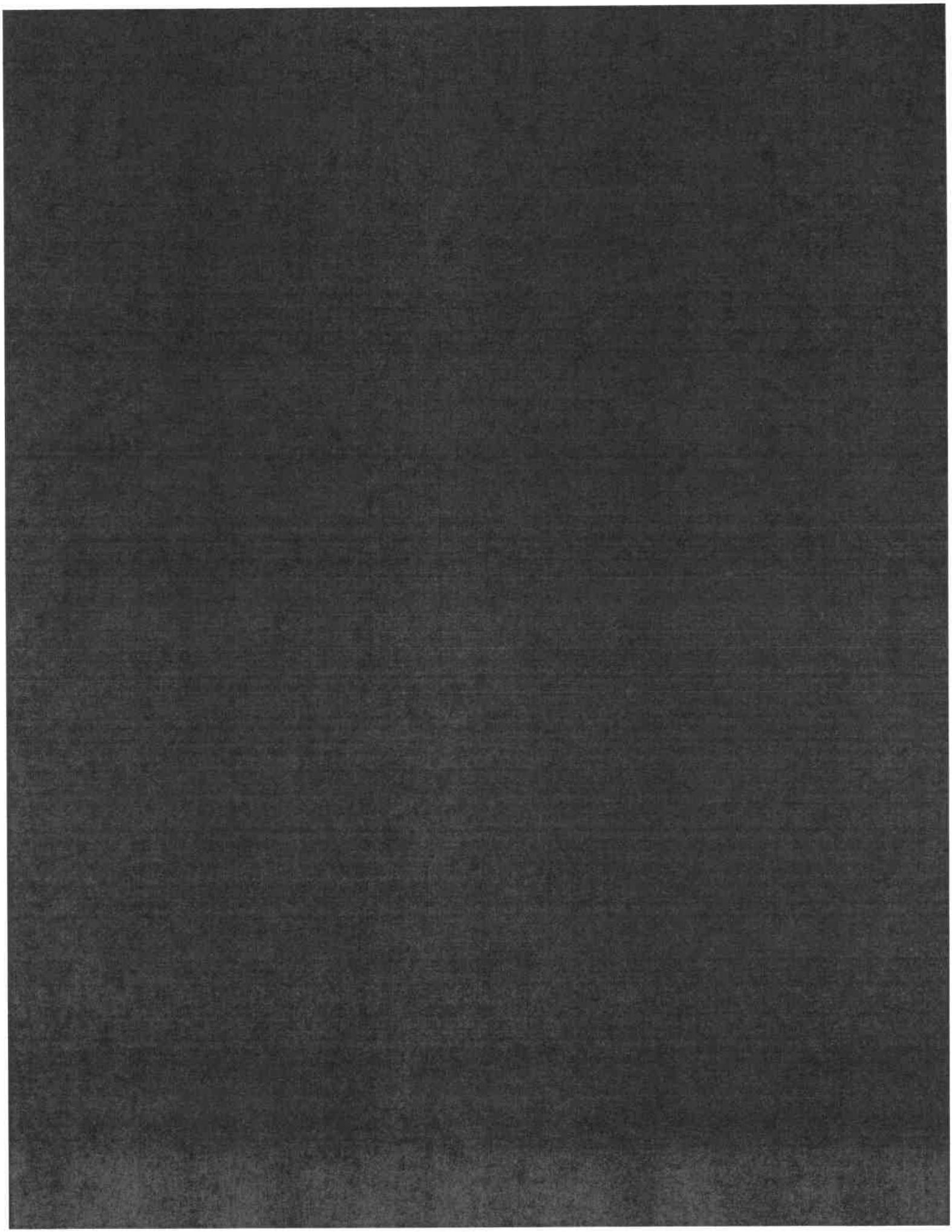
URS Corporation Southern, *Kirkpatrick Dam and Spillway Condition Assessment*, September 2015.

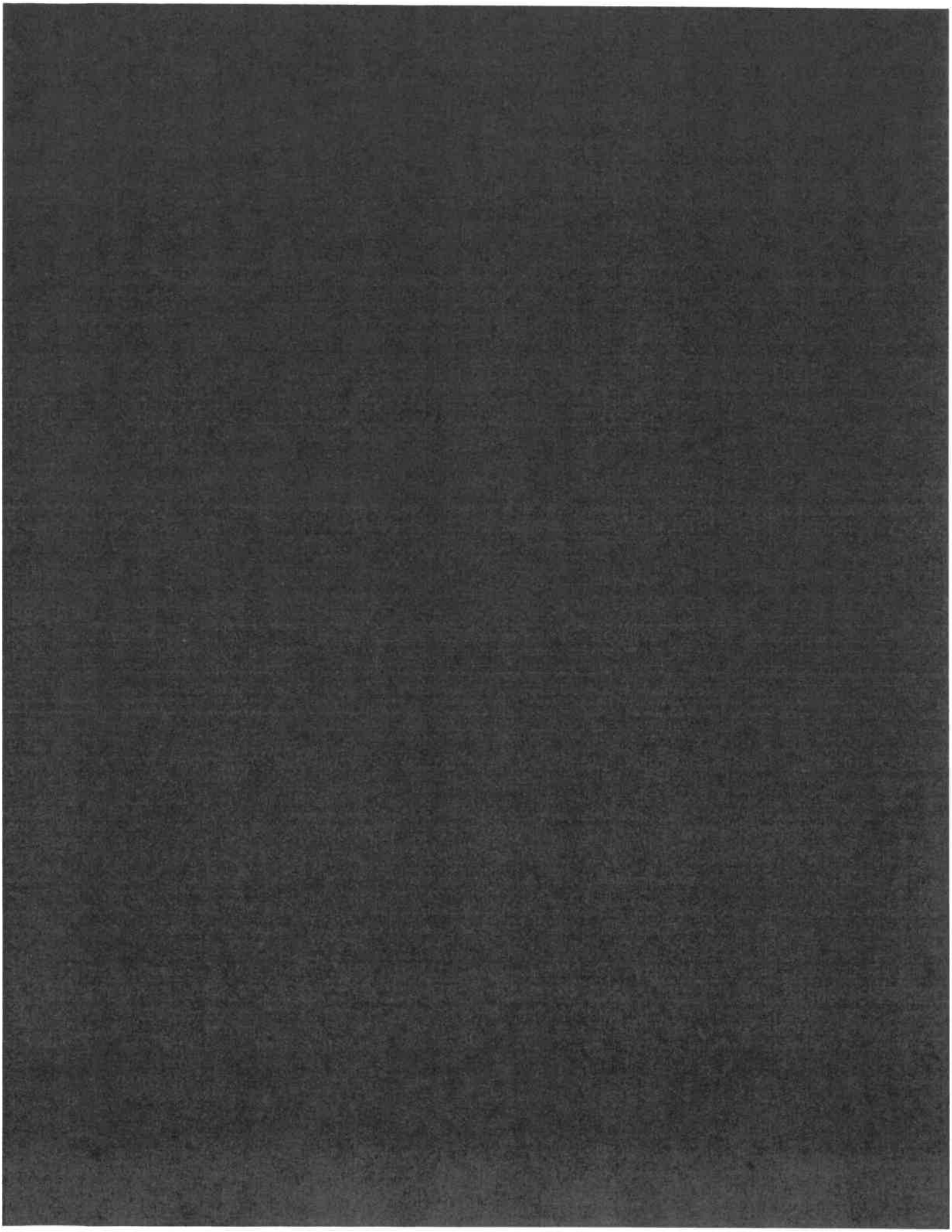
Appendix A. Project Drawings

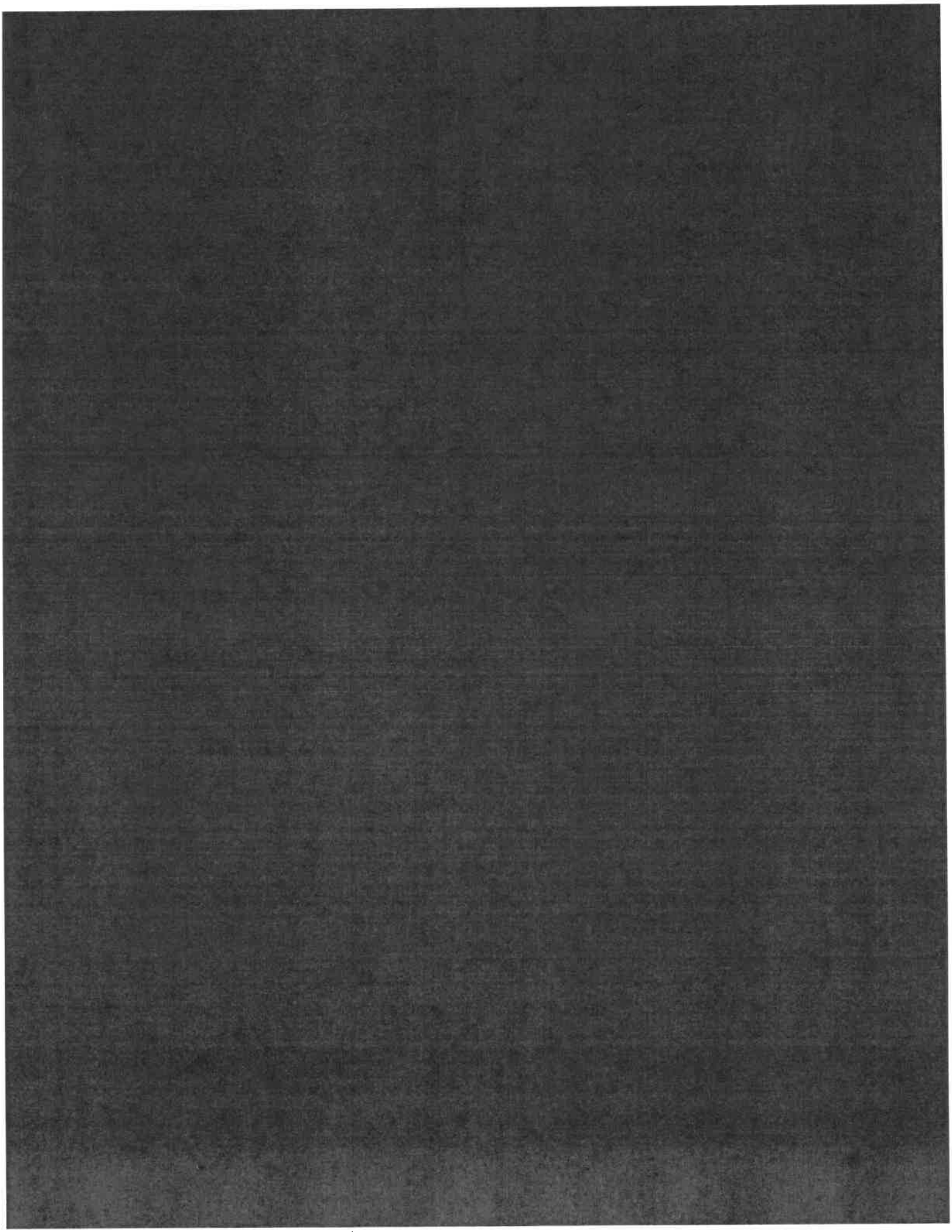


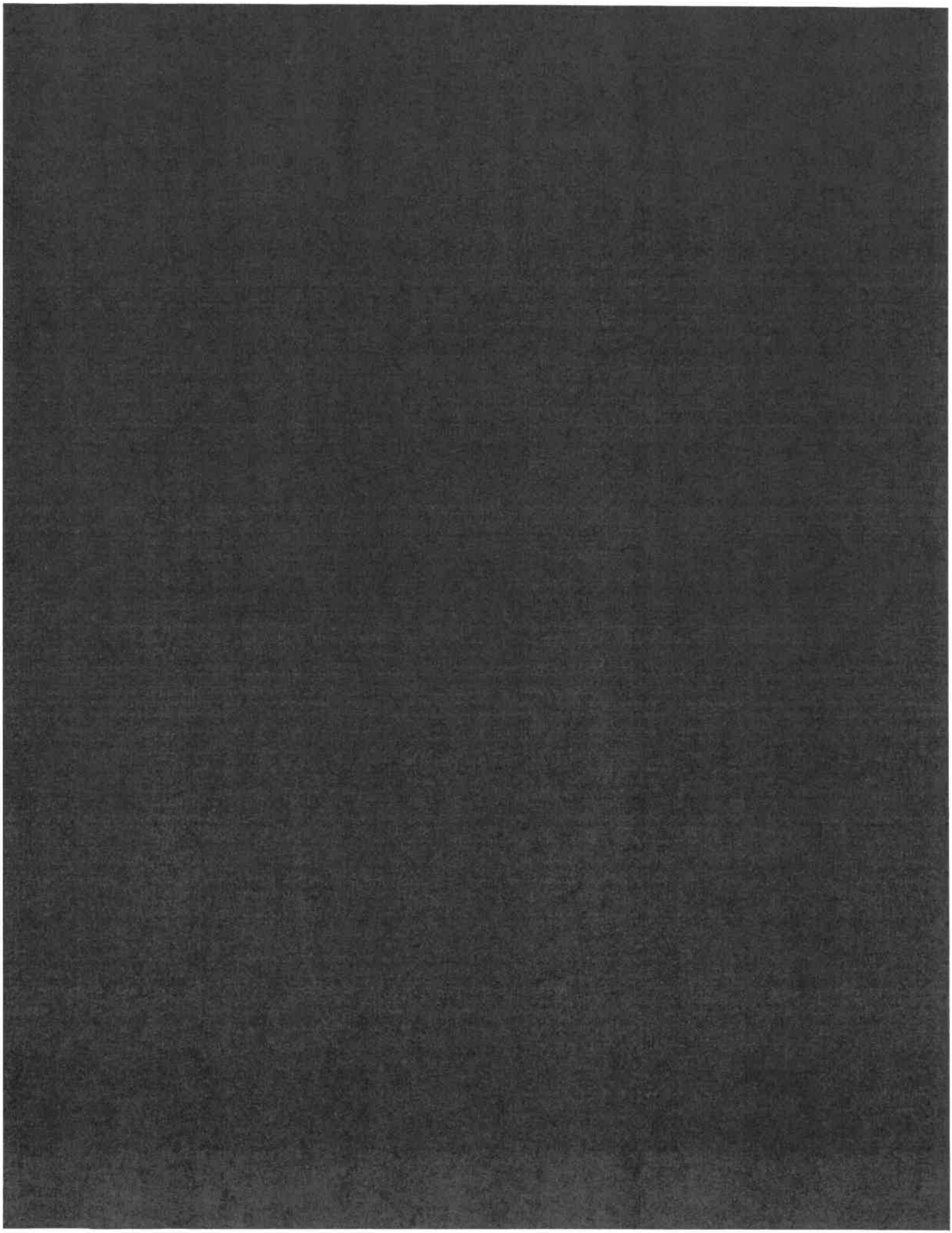


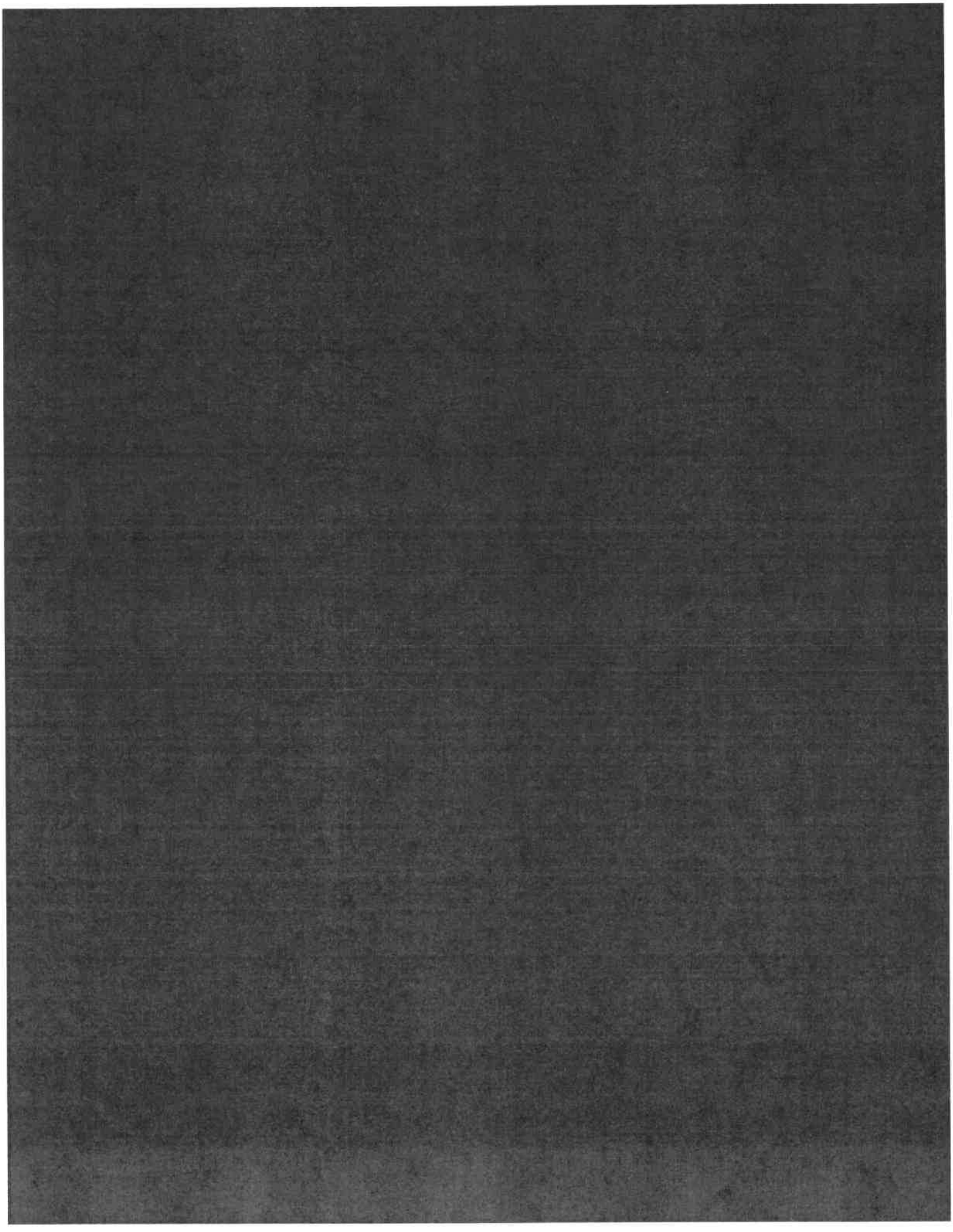


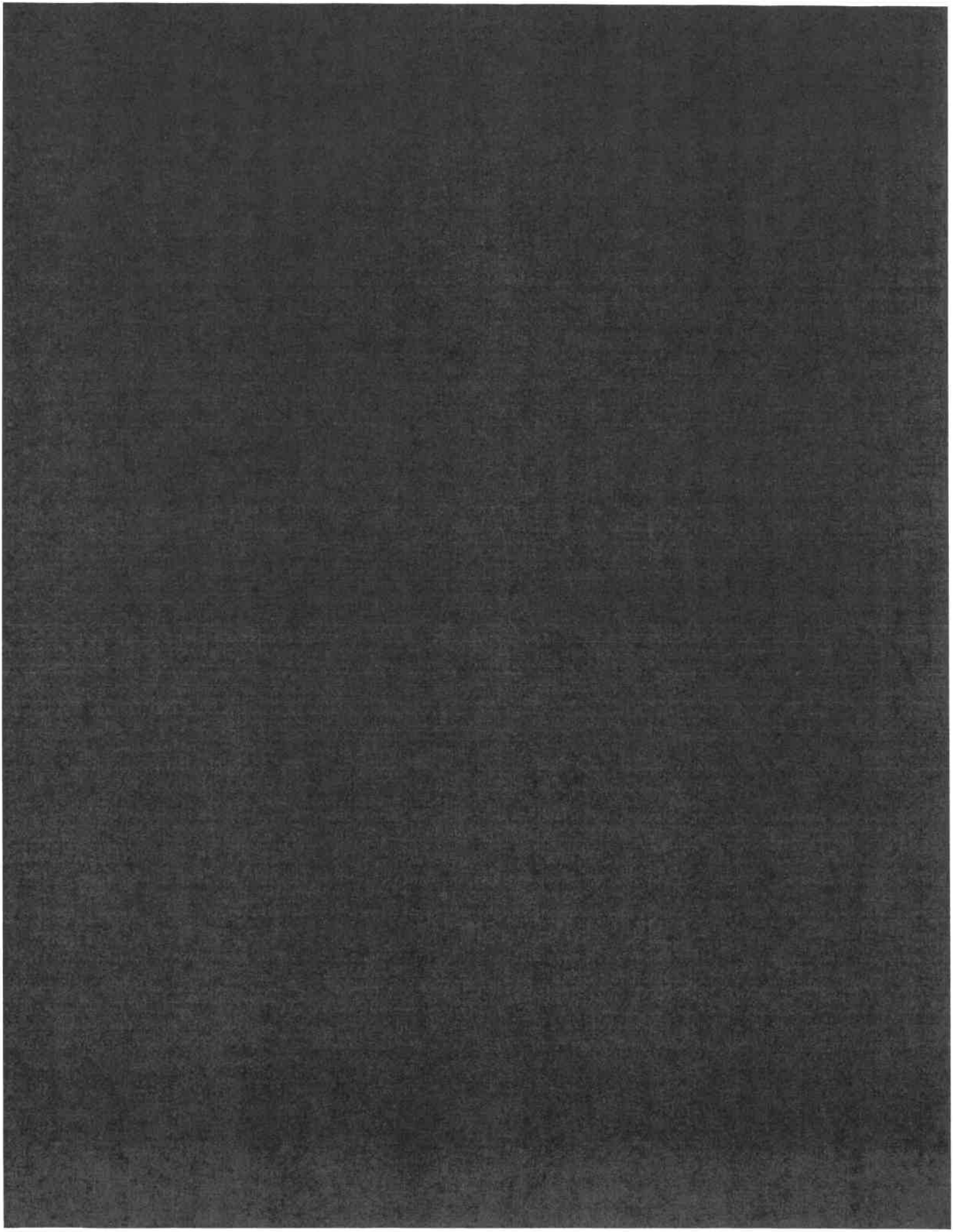




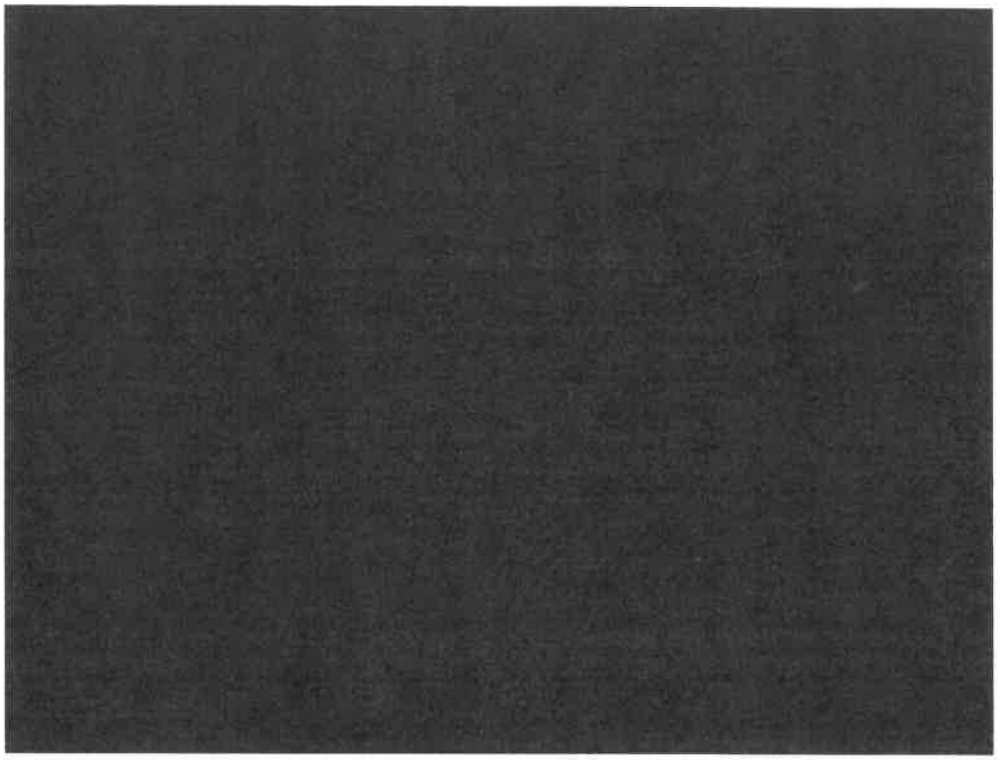




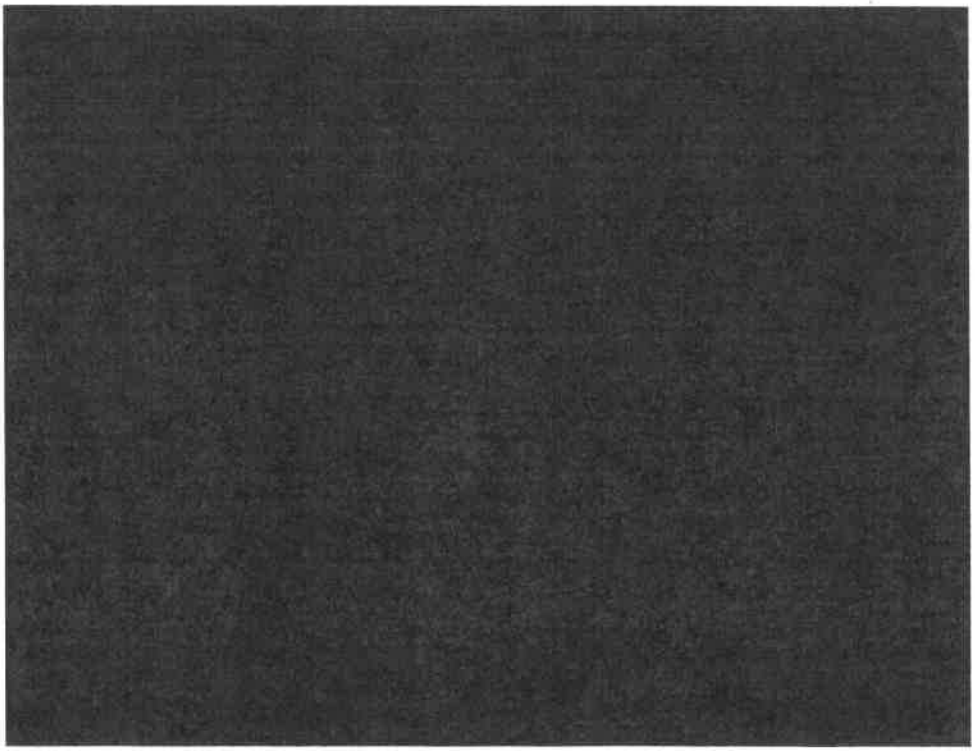




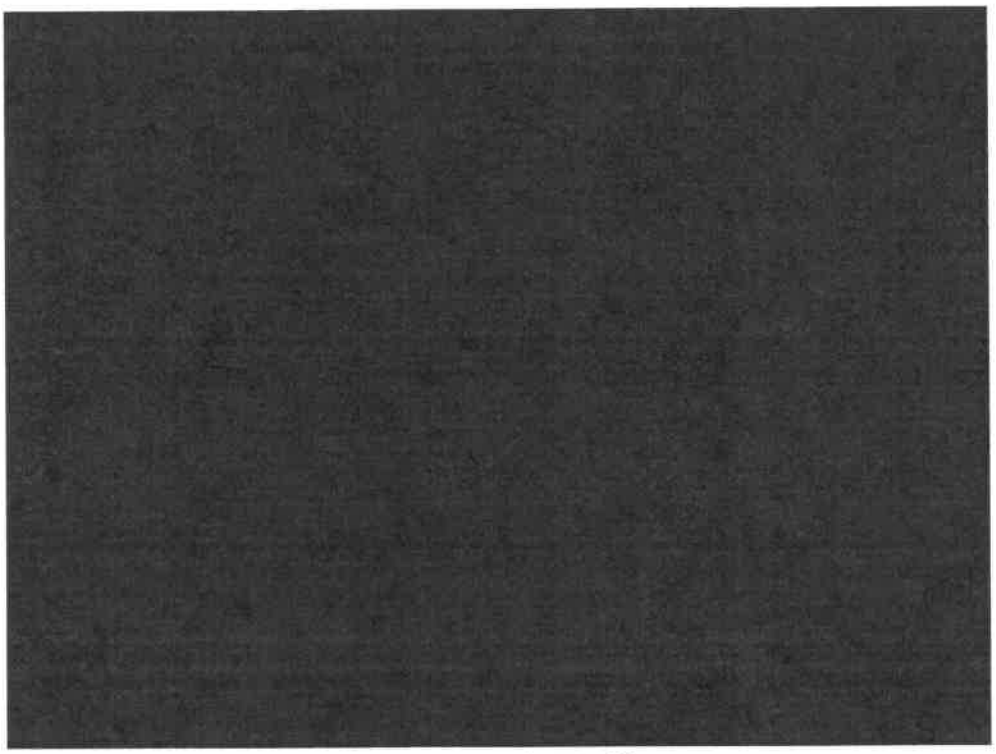
Appendix B. Photographs



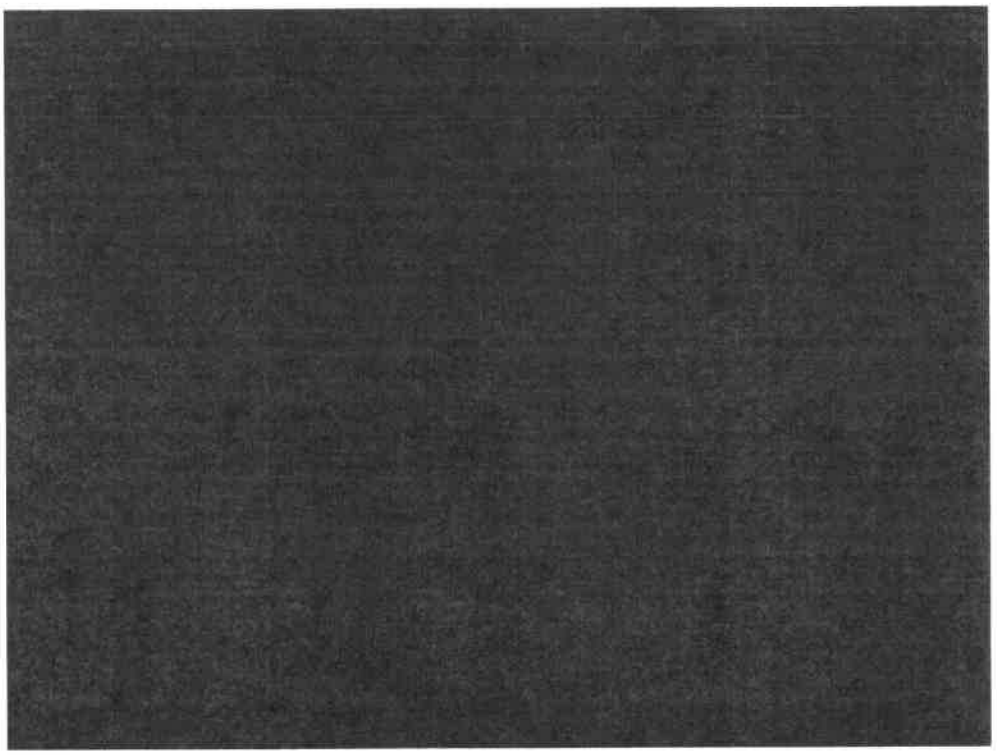
Photograph 1 – Typical light cracking of parapet wall



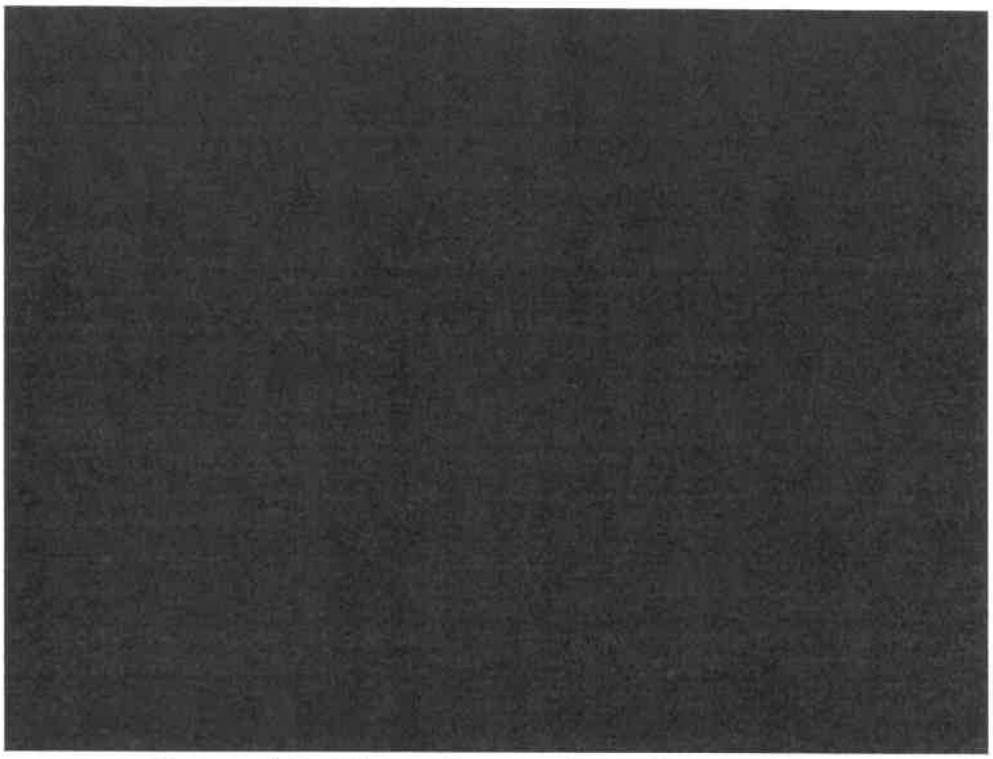
Photograph 2 – Typical light cracking of parapet wall



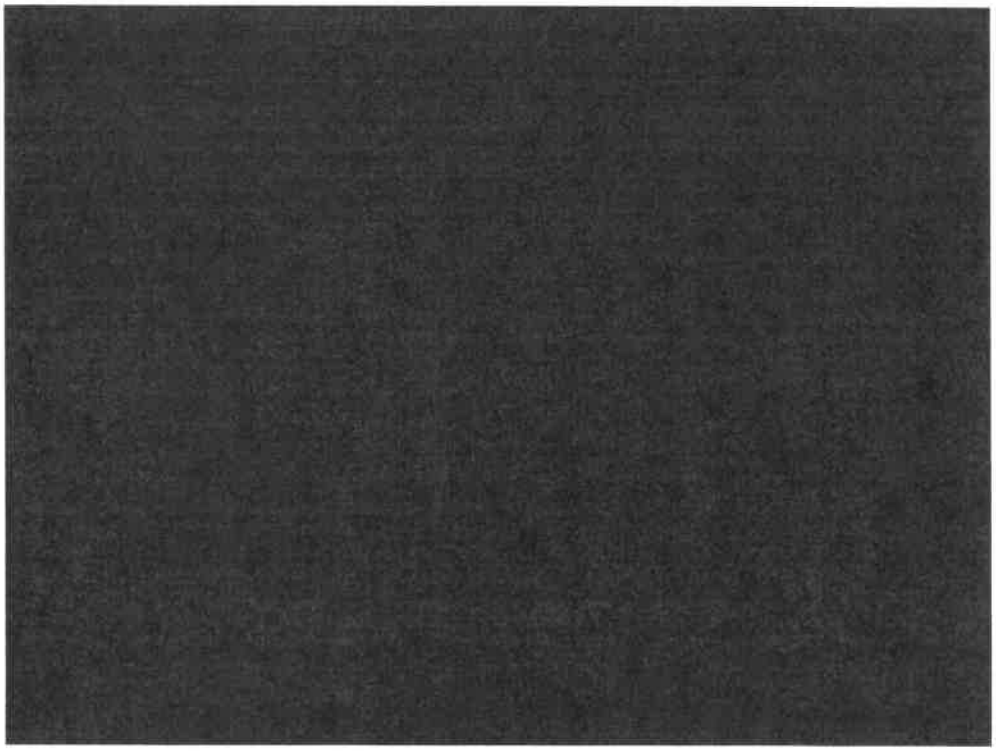
Photograph 3 – Lock wall with efflorescence



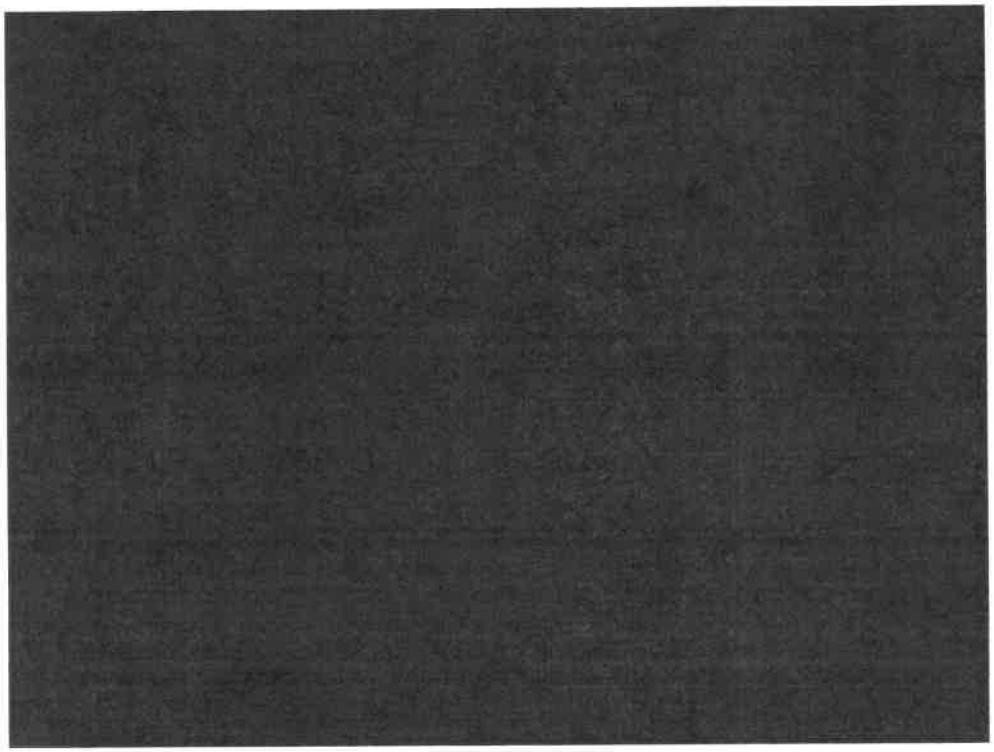
Photograph 4 – Lock wall with efflorescence



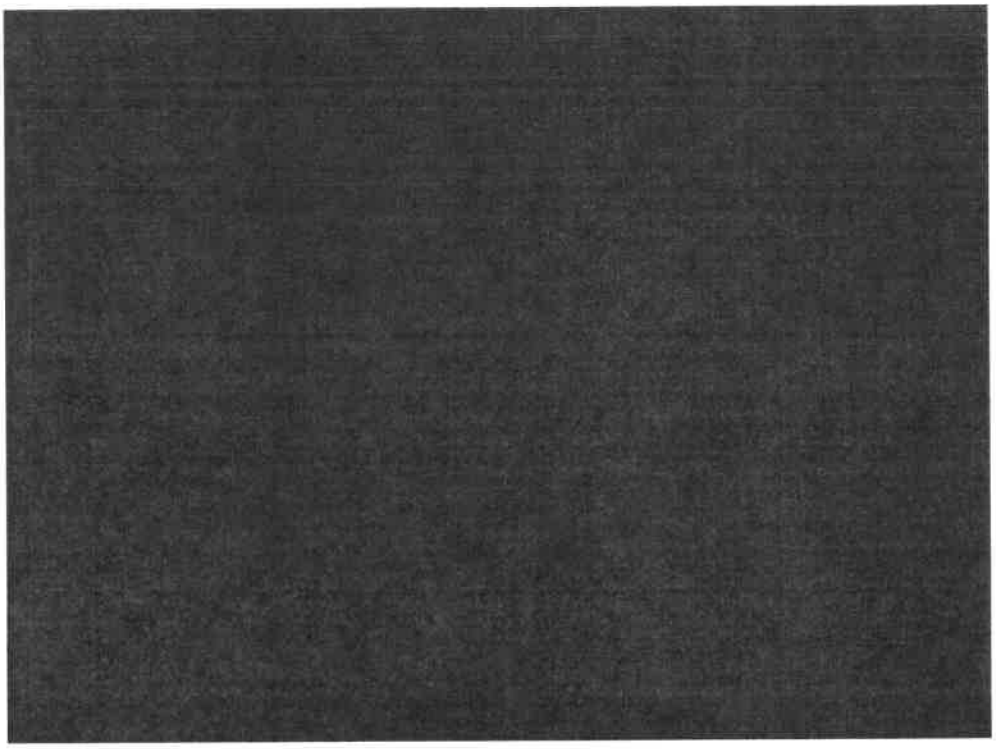
Photograph 5 – Light cracking along lock wall (looking down)



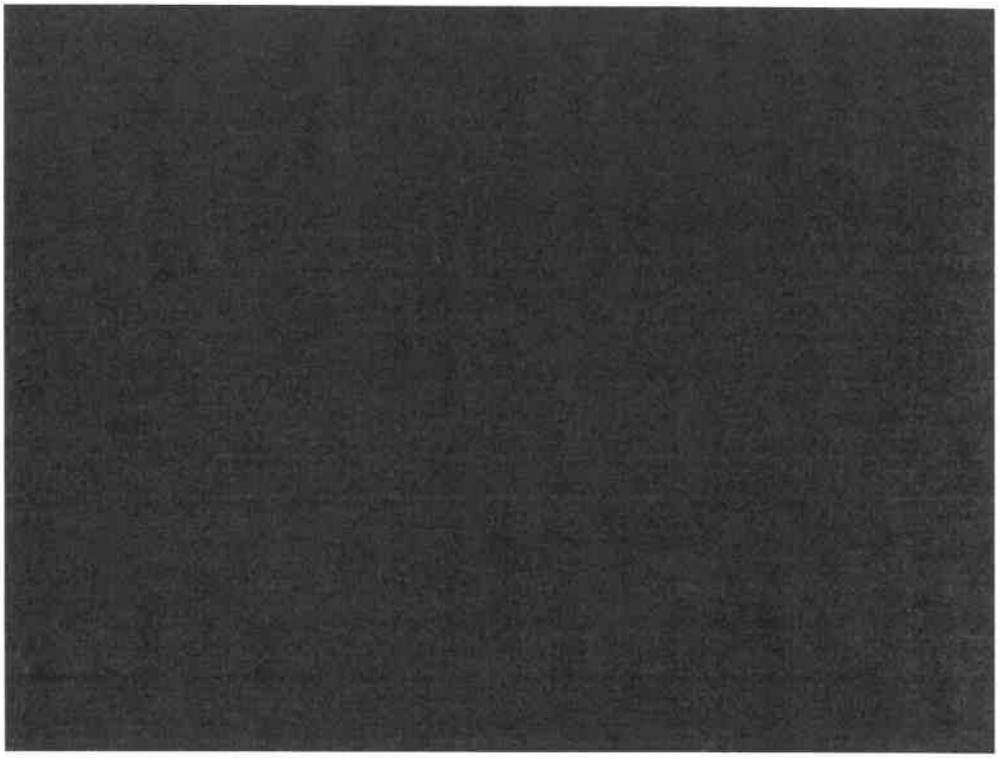
Photograph 6 – Lock chamber dewatered looking downstream



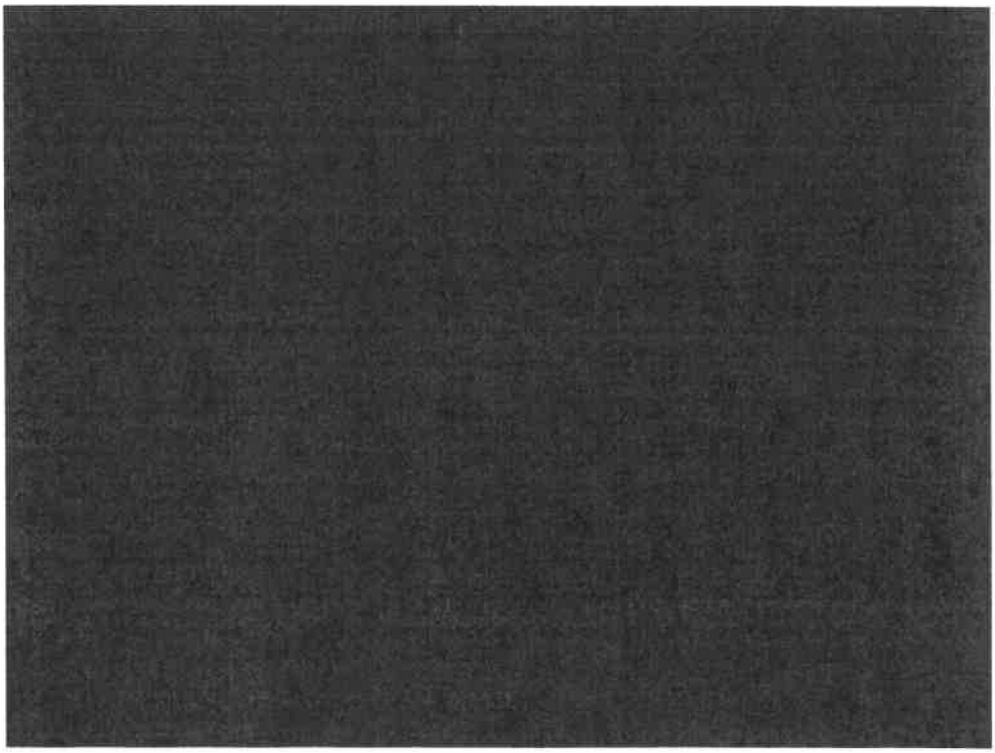
Photograph 7 – Lock chamber dewatered looking upstream from guide wall



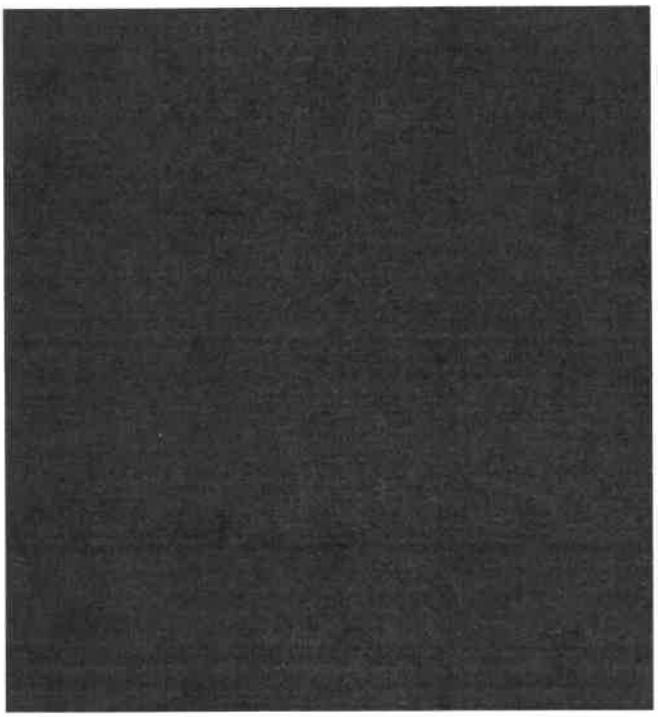
Photograph 8 – Lock chamber being dewatered looking upstream.



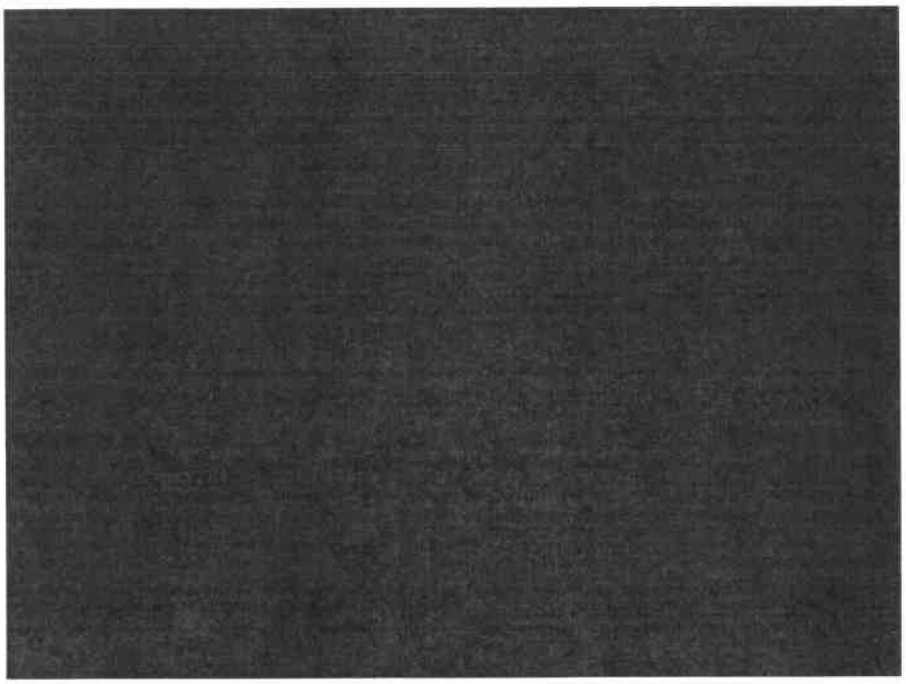
Photograph 9 – Lock chamber full looking downstream



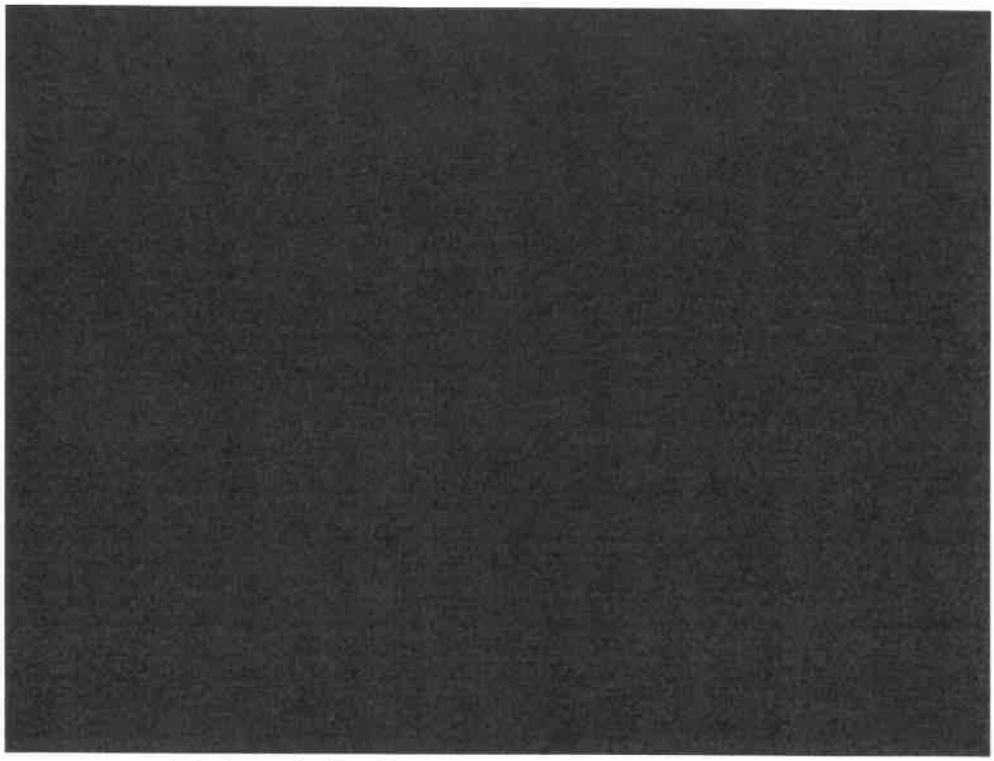
Photograph 10 – Lock chamber full looking upstream with gates partially open



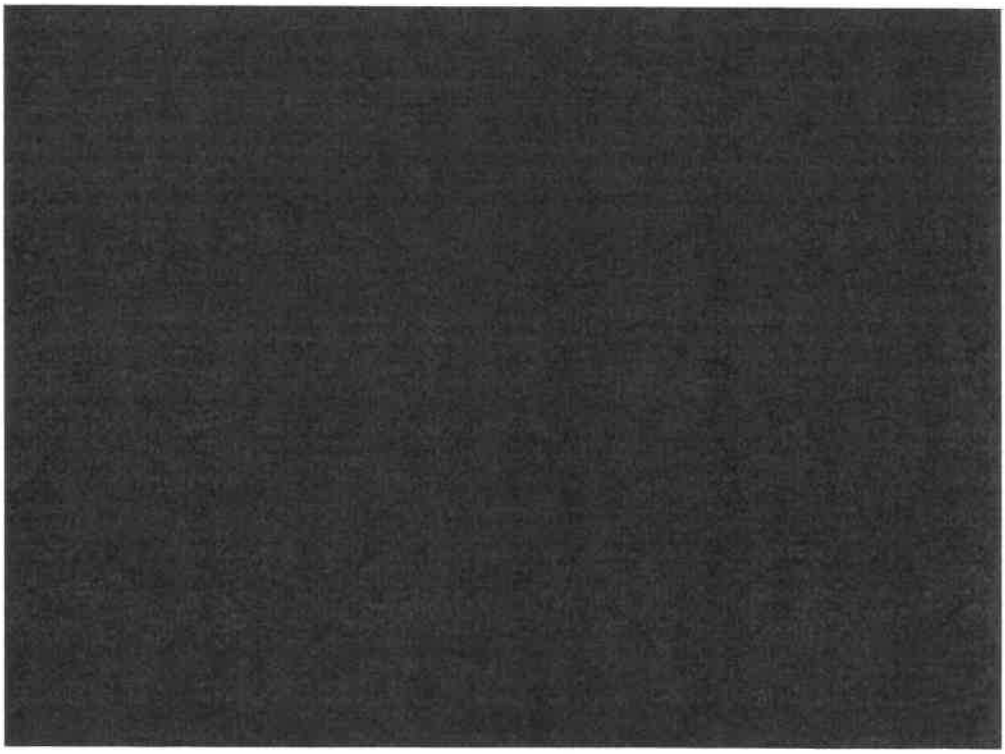
Photograph 11 – Flap valve for uplift pressure release system



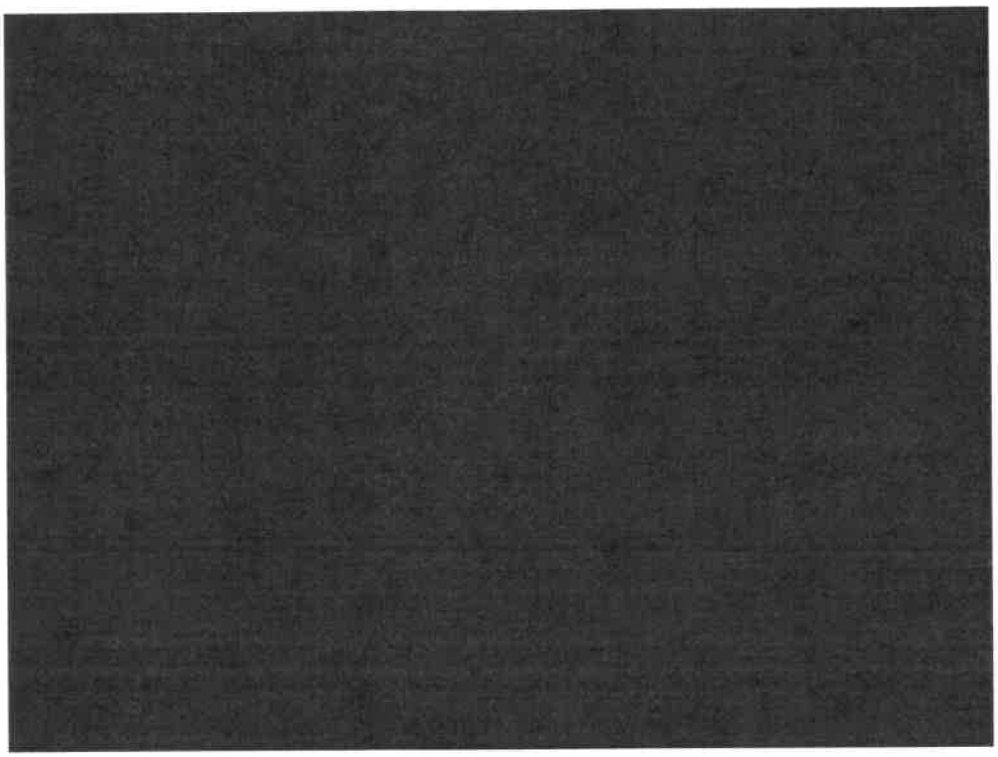
Photograph 12 – Upstream miter gate sill (gates not completely closed in picture)



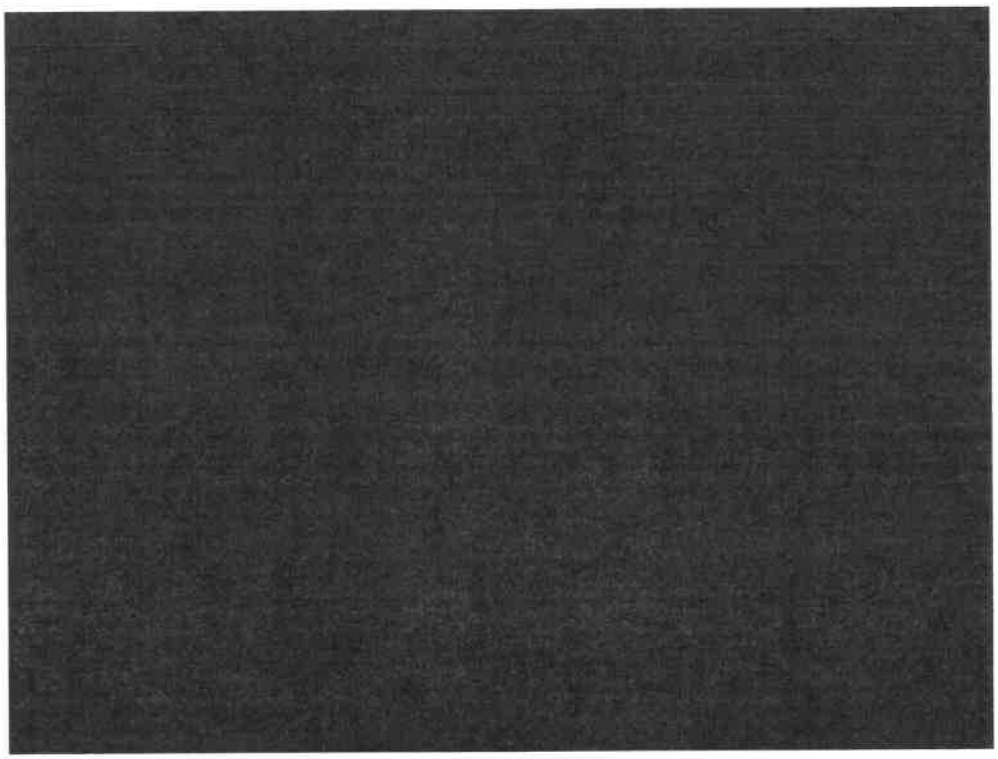
Photograph 13 – Downstream gates with light corrosion



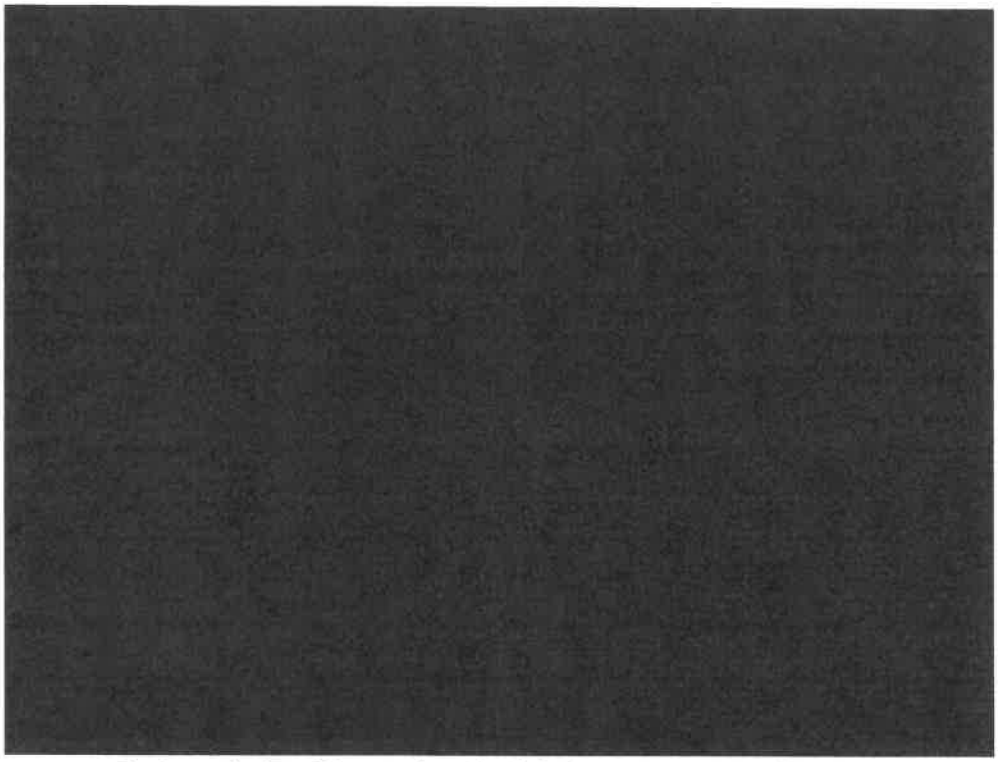
Photograph 14 – Upstream gates with light corrosion



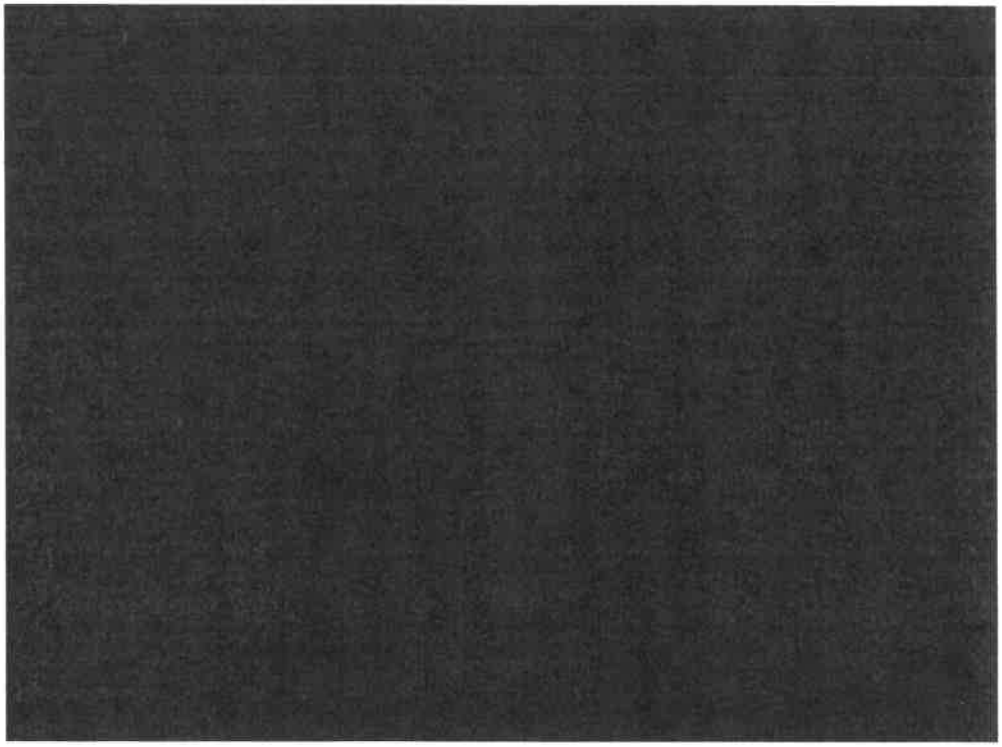
Photograph 15 – Downstream concrete guide wall



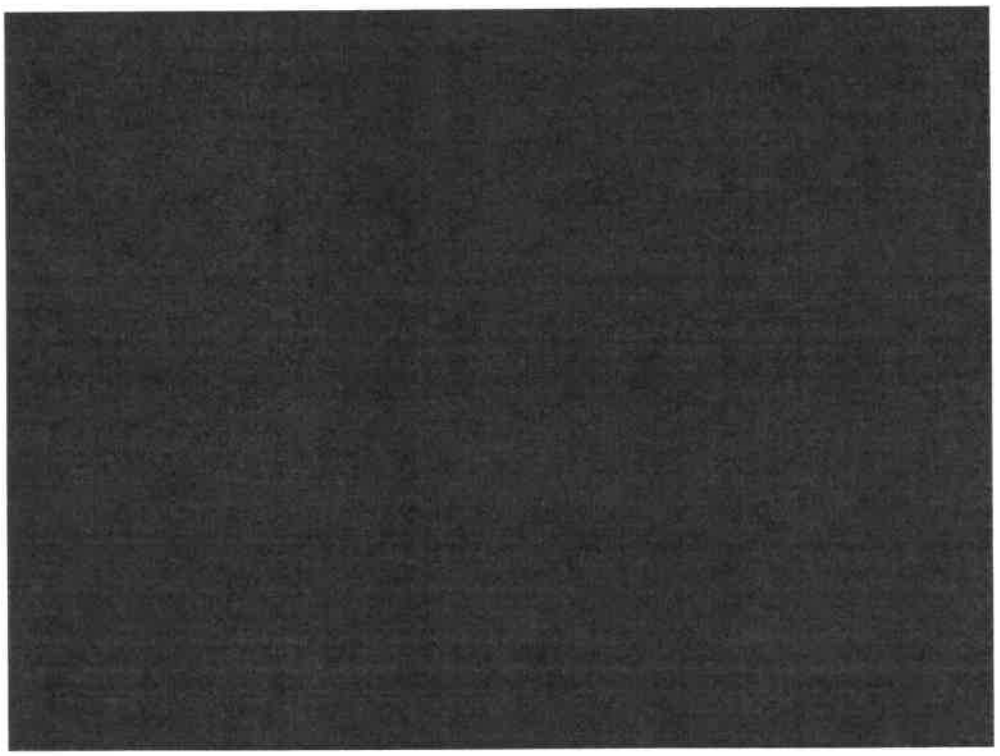
Photograph 16 – Upstream guide wall



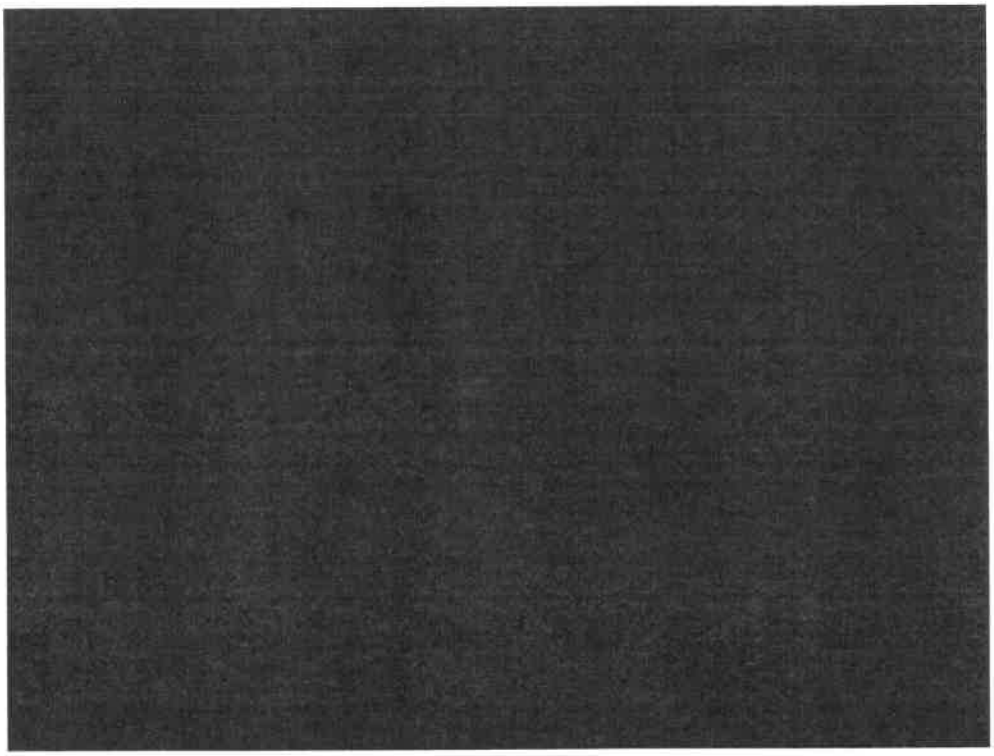
Photograph 17 – Rip rap along the left, downstream side of the lock



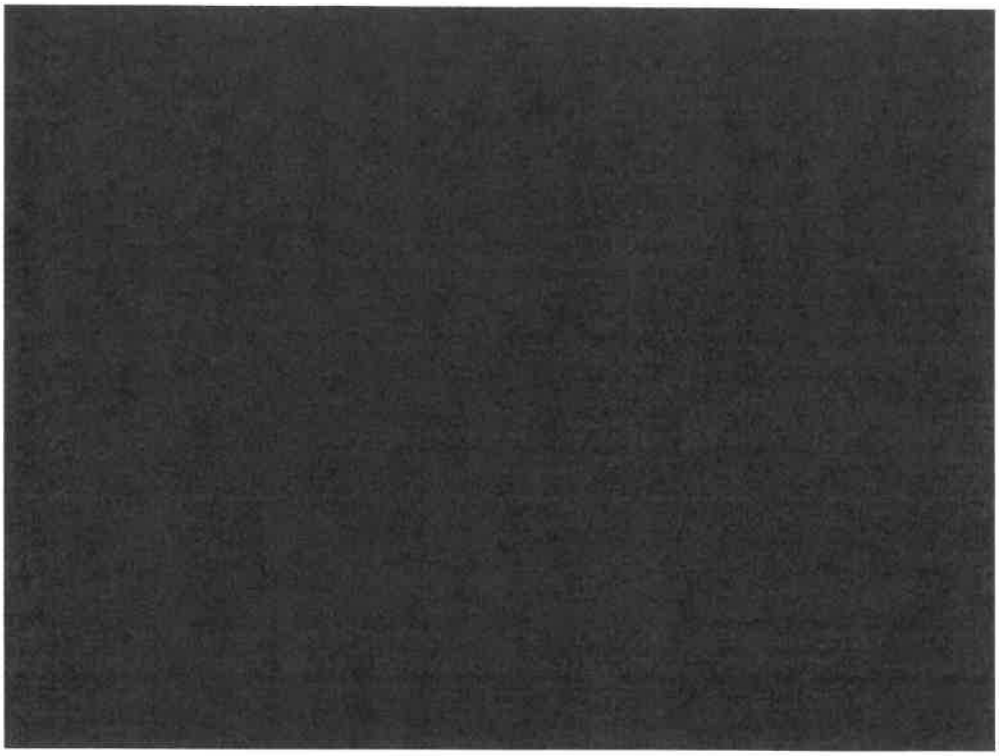
Photograph 18 – Upstream rip rap, left side of lock



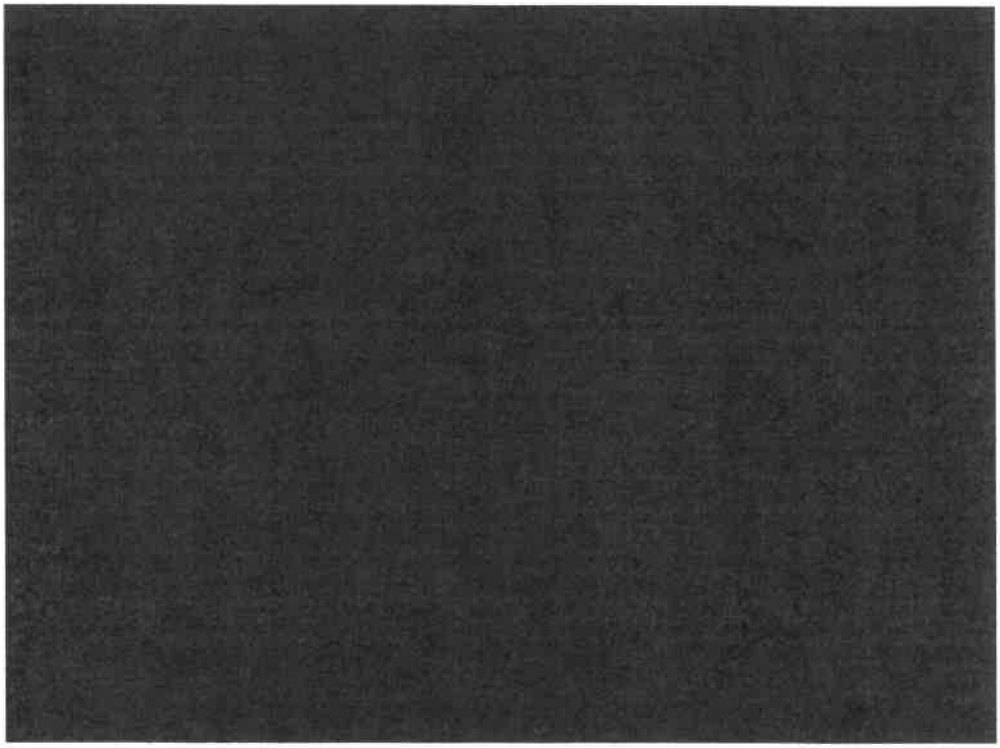
Photograph 19 – Upstream rip rap, right side of lock



Photograph 20 – View inside of control room



Photograph 21 – Hydraulic power unit in upstream control building



Photograph 22 – View of control screen

Appendix C. Condition Assessment Report For Florida Dams and Impoundments

Date Prepared: October 1, 2021
Prepared By: Martin Kemps, PE

CONDITION ASSESSMENT REPORT FOR FLORIDA DAMS AND IMPOUNDMENTS

Dam Information

Name of Dam: Buckman Lock

National Inventory of Dams Identification Number: NA

Location-City/County: Palatka / Putnam County / Florida

Hazard Classification: Unknown Name of Waterbody: Cross Florida Barge Canal

Purpose of Dam/Waterbody: Boat/fish/Manatee passage Total Surface Area: 50,400 square feet (Lock)

Crest Elevation: Lock Walls 25.5 (NGVD) Width: Lock Chamber 84` Lock: Chamber Length 600`

U/S Water Depth: 18.0 – 20.0 (NGVD) D/S Ground Elev.: NA U/S Water Elev. 4.0 (NGVD)

Crest Material: NA U/S Slope: NA D/Slope: NA

Owner's Information

Owner's Name(s): Florida Department of Environmental Protection

Owner's Address: 8282 S.E. Highway 314, Ocala Florida

Contact Person (if different from above): Mr. Mickey Thomason

Telephone No.: 352-236-7143

Email Address (or other means of communication): www.floridadep.gov

Owner's Engineer

Name of Engineering Firm or Engineer: Mead & Hunt, Inc.

Florida Professional Engineer License Number: 70468

Mailing Address: 2440 Deming Way, Middleton, WI 53562

Telephone Number: (Business): 608-273-6380

Date of Inspection: August 2nd and 4th, 2021

1. **Crest** (refer to the Bureau of Reclamation's Glossary (Glossary) for description)

a. How would you describe the vegetation on the crest? (Check all that apply)

Recently Mowed X Overgrown_____ Good Cover_____ Sparse_____

Other (describe): Although there isn't a crest associated with the lock, the grass adjacent to lock structure is well maintained.

b. Are there any trees or other inappropriate vegetation on the crest? Yes____ No X

If yes, describe (type of vegetation, size, location, etc.):_____

c. Is there a paved road or driveway on the crest? Yes____ No X

If yes, describe the condition (for example, good condition, numerous cracks, newly paved, etc.):

_____

d. Are there any depressions, ruts, or holes on the crest? Yes____ No X

e. If yes, describe (length and width, location, direction of cracking, etc.):_____

f. Are there any cracks on the crest? Yes____ No X

If yes, describe (length and width, location, direction of cracking, etc.):_____

_____

_____

g. Other observations on the crest: There is no crest associated with the lock structure

2. **Upstream Slope** (refer to Glossary for description)

a. What is the reservoir level today?

At Normal Pool X Above Normal Pool_____ Feet Below Normal Pool_____ Feet

b. How would you describe the vegetation on the upstream slope? (Check all that apply)

NA X Recently Mowed_____ Overgrown_____ Good Cover_____ Sparse_____

Other (describe):_____

c. Are there any trees or other inappropriate vegetation on the slope?
Yes___ No X

If yes, describe (type of vegetation, size, location, etc.):_____

_____

d. Are there any depressions, bulges, ruts, or holes (such as animal burrows) on the slope?
NA X Yes___ No___

If yes, describe (size, location, etc.)_____

e. Are there any eroded areas on the slope (such as wave erosion along the shoreline)? No

If yes, describe (size of area, location, severity, etc.):_____

f. Are there any cracks, sloughs, or slides (vertical cliffs) on the slope?
Yes___ No X

If yes, describe (length, width, height, location, etc.)_____

_____

g. Is there any type of slope protection along the shoreline (such as riprap)?
Yes X No___

If yes, describe what type and its condition (for example, riprap - adequate, inadequate, sparse, etc.): Rip rap is present along the river slopes. Rip rap has adequate cover and consists of high-quality granite material.

Other observations on the upstream slope:_____

3. **Downstream Slope** (refer to Glossary for description)

a. How would you describe the vegetation on the downstream slope? (Check all that apply)

NA X Recently Mowed_____ Overgrown_____ Good Cover_____ Sparse_____

Other (describe):_____

b. Are there any trees or other inappropriate vegetation on the slope? NA X

If yes, describe (type of vegetation, size, location, etc.):_____

_____

c. Are there any depressions, bulges, ruts, or holes (such as animal burrows) on the slope?
NA X Yes___ No___

If yes, describe (size, location, etc.):_____

_____

d. Are there any eroded areas on the slope (such as along abutment contacts)?
NA X Yes___ No___

If yes, describe (size of area, location, severity, etc.):_____

_____

e. Are there any cracks, sloughs, or slides (vertical cliffs) on the slope? NA X

If yes, describe (length, width, height, location, etc.):_____

f. Are there any wet areas or areas of hydrophilic (lush, water-loving) vegetation?
Yes___ No X

If yes, describe (length, width, height, location, etc.):_____

g. Do any wet areas indicate seepage through the dam (such as rust-colored, stained water)?
Yes___ No X N/A___

If yes, describe (for example, new area of seepage, no change from past observations, size of area, location,
etc.):_____

h. Are there any leaks (flowing water) from the slope or beyond the toe of the dam?
Yes___ No X

If yes, describe (location, rate of flow, turbidity of flow, etc.):_____

i. Other observations on the downstream slope:_____

4. **Plunge Pool** (refer to Glossary for description)

a. Is there any type of erosion protection around the plunge pool (such as riprap)?
Yes X No___

If yes, describe what type and its condition (for example, riprap - adequate, inadequate, obstructed by vegetation): Rip rap is present along the canal edges by the miter gates. Rip rap has adequate cover and consists of high-quality granite material.

b. Is there any erosion around the plunge pool? Yes___ No X (nothing visible above waterline)

If yes, describe (size of area, location, severity, etc.):_____

c. Other observations around the plunge pool:_____

5. **Principal and Emergency Spillways** (refer to Glossary for description)

a. What types of spillways are on the dam and what is their composition (such as corrugated metal, concrete, or siphon pipe; concrete or earth channel)?

Principal Spillway_____ Emergency Spillway_____ Other Miter gates associated with the lock

Describe: Miter gates do not act as a spillway but would provide some discharge capacity.

b. Has the emergency spillway activated (had flow) since the last inspection?
Yes___ No___ NA X

If yes describe (date(s) of flow, reason for activation, depth of flow, erosion damage, etc.): _____

_____

c. For pipe spillways, is the intake obstructed in any way (such as with excessive debris)?
Yes___ No___ NA X

If yes, describe (type of debris, reason for obstruction, etc.):_____

_____

d. For pipe spillways, what is the condition of any trash racks (for example, adequate, inadequate, damaged)? _____

e. For pipe spillways, are there any visible cracks, separations, or holes in the pipe(s) (intake or outlet)? Yes___ No___ NA X

If yes, describe (location, width of crack or separation, etc.): _____

_____

f. For pipe spillways, are there any apparent leaks in the pipe(s)? Yes___ No___ NA X

If yes, describe (location, rate of flow from leak, etc.):_____

_____

g. For pipe spillways, how would you describe the overall condition of the pipe(s)? (Check all that apply)

Functioning Normally___ Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

h. For concrete or earth channel spillways, is the entrance or channel obstructed in any way?
Yes___ No___ NA X

If yes, describe (type of obstruction, location, etc.):_____

i. For earth channel spillways, how would you describe the vegetation in the spillway? (Check all that apply)

Recently Mowed_____ Overgrown_____ Good Cover_____ Sparse_____

Other (describe): NA

j. For earth channel spillways, are there any trees or other inappropriate vegetation in the spillway? Yes___ No___ NA X

If yes, describe (type of vegetation, size, location, etc.):_____

k. For earth channel spillways, are there any eroded areas in the spillway?
Yes___ No___ NA X

If yes, describe (size of area, location, severity, etc.):_____

l. For concrete channel spillways, are there any cracks or holes in the spillway? Yes X No___

If yes, describe (width of crack or hole, location, etc.): Minor hairline cracks were noted along the chamber walls.

m. For concrete channel spillways, are there any leaks or evidence of undermining (flow under the concrete)? Yes___ No X

If yes, describe (location, rate of flow from leak, indicators of undermining, etc.):_____

_____

n. For earth or concrete channel spillways, how would you describe the overall condition of the spillway? (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

o. Other observations on the spillways: Although the lock is not a spillway, the gates operated smoothly and without binding.

6. **Instrumentation** (refer to Glossary for description)

a. Are there any toe drains at the downstream toe or any other seepage drains on the dam? Yes X No___

If yes, describe the condition (for example, clogged, free flowing, deteriorated, good condition, etc.): There is an uplift pressure relief system consisting of 18-inch diameter corrugated metal pipes that discharge through the flap gates on the downstream side of the canal. During our inspection, the drainage system appeared to operate as intended. Discharge water could be seen exiting the flap valves when the lock chamber water was being lowered.

b. For drains, is an animal guard installed at the outlet of each drain? Yes X No___

If no, which drains lack animal guards? _____

_____

c. For drains, measure the rate of flow from each drain and record below (use additional pages if necessary):

Designation/Location of Drain	Flow Rate	Flow Rate in GPM*	Turbidity Flow (Describe clear, muddy, etc.)
Five lateral drains to relief uplift pressures	**10-20 GPM**	**10-20 GPM**	**Clear**

d. Are there any piezometers on the dam? Yes X No___

If yes, describe the condition (for example, good condition, damaged, etc.): Twenty-seven piezometers exist at the project. The piezometers are not currently monitored by ad.

e. For piezometers, does each piezometer have a cap with a lock? Yes X No___

If no, which piezometers need caps (to prevent rainwater intrusion) and/or locks (to prevent tampering)? . Standing water was observed within the housing boxes.

f. For piezometers, are you able to take a measurement (depth to water) in each piezometer? Not attempted, standing water in housing boxes.

If yes, record depth to water (in feet) in each piezometer, record on a separate page and attach to this form.

g. Are there any other monitoring devices on the dam? Yes X No___

If yes, describe what type and the condition (for example, monitoring wells - good condition, damaged, etc.): Staff gauge for water levels within the lock.

h. Other observations on instrumentation: Survey monuments were noted along the top of the lock chamber walls. These monuments are not surveyed.

7. Outlet Pipe (refer to Glossary for description)

a. Any water flowing outside of discharge pipe through the impounding structure. (Check all that apply) There is an uplift pressure relief system consisting of 18-inch diameter corrugated metal pipes that discharge through the flap gates on the downstream side of the canal. During our inspection, the drainage system appeared to operate as intended. Discharge water could be seen exiting the flap valves when the lock chamber water was being lowered

b. Describe any deficiencies:_____

8. Stilling Basin (refer to Glossary for description) NA

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally___ Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

b. Exposure of rebar? Yes___ No___

c. Deterioration of basin sloes and repairs done:_____

_____

d. Any obstruction to flow:_____

_____

_____

9. Waterbody Structures

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

Describe: _____

b. Exposure of rebar? Yes___ No X

c. Deterioration of basin slopes and any repairs done: NA

d. Any obstruction to flow: *No*

10. Downstream Hazard Issues

a. Deterioration of concrete structures (Check all that apply)

Functioning Normally X Not Functional___ Deteriorated___ Damaged___ Adequate___ Inadequate___

b. Exposure of rebar? Yes___ No X

c. Deterioration of basin sloes and any repairs done: None

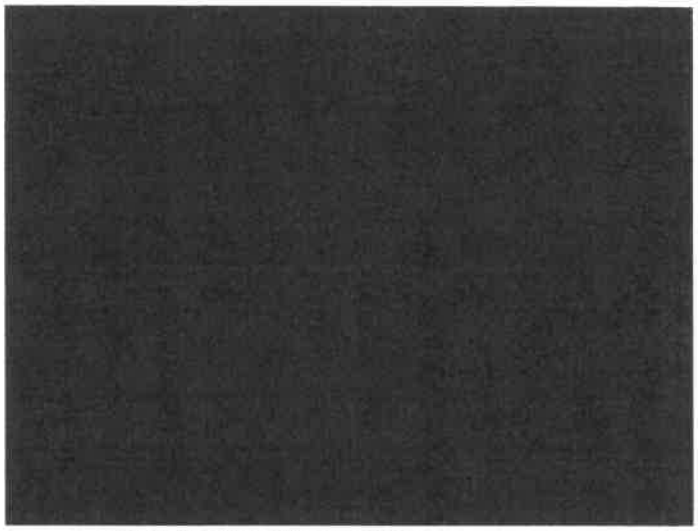
d. Any obstruction to flow: No

e. Are there homes downstream from the dam? Yes X No___

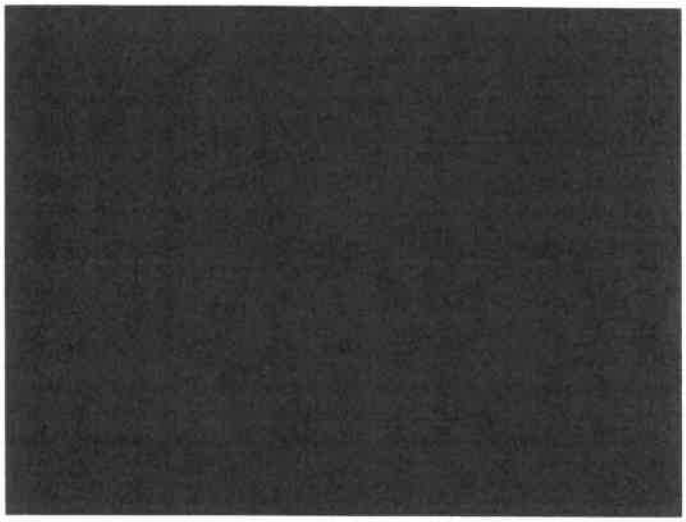
Approximate distance: Operator houses are located immediately downstream of lock.

11. Photographs

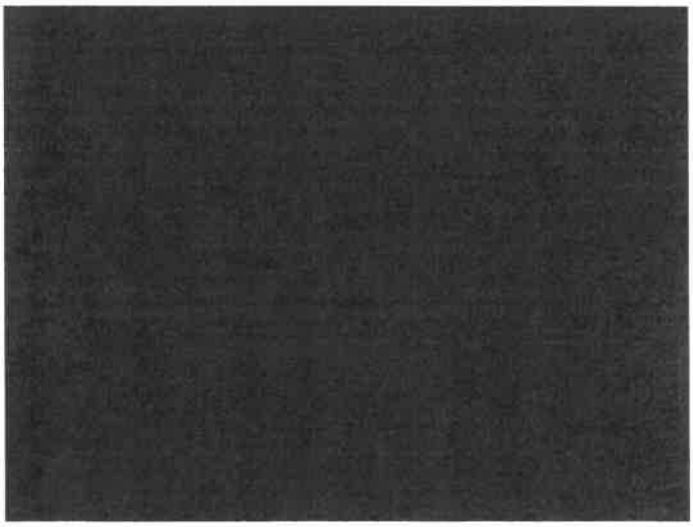
At a minimum, photographs should be taken of the crest, upstream slope, downstream slope, principle and emergency spillways, and any other notable features. (Example: structures, seepages, ruts, slope failure, etc.)



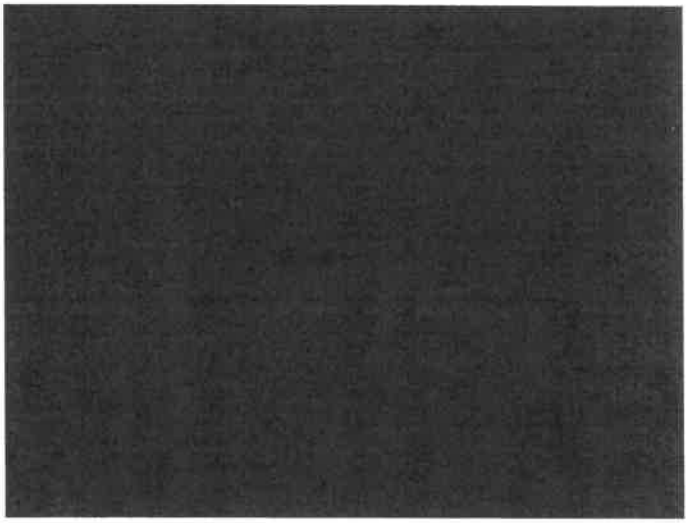
View of lock looking upstream



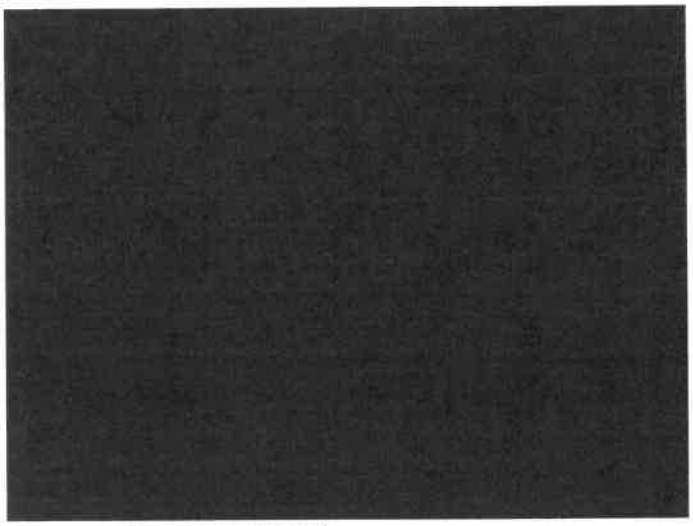
Downstream miter gates



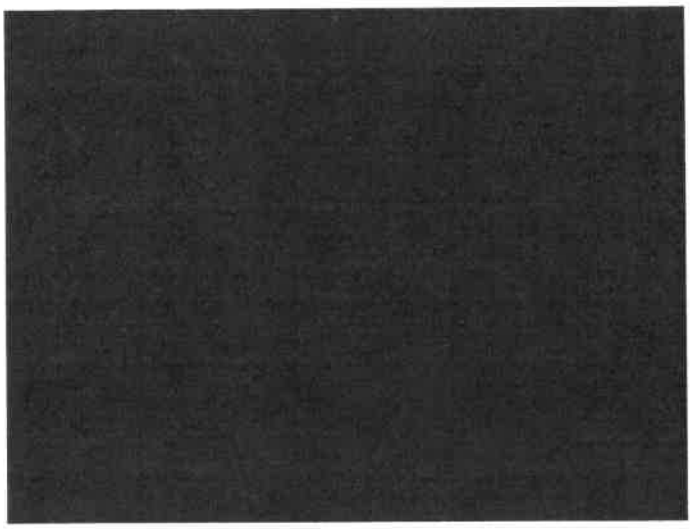
Upstream miter gates



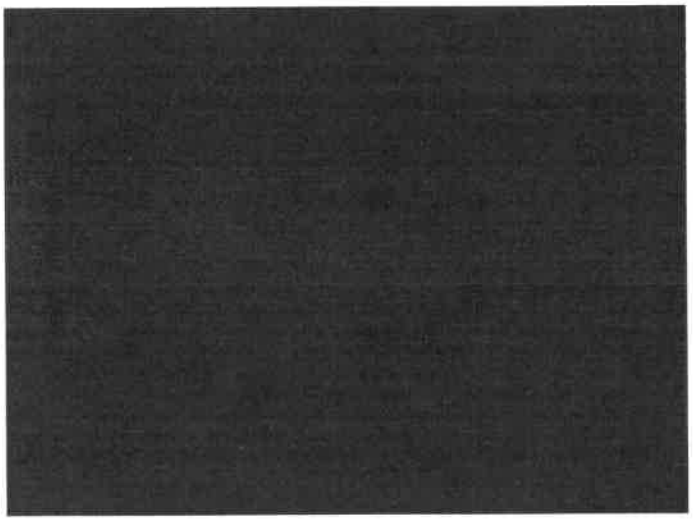
Tailrace channel



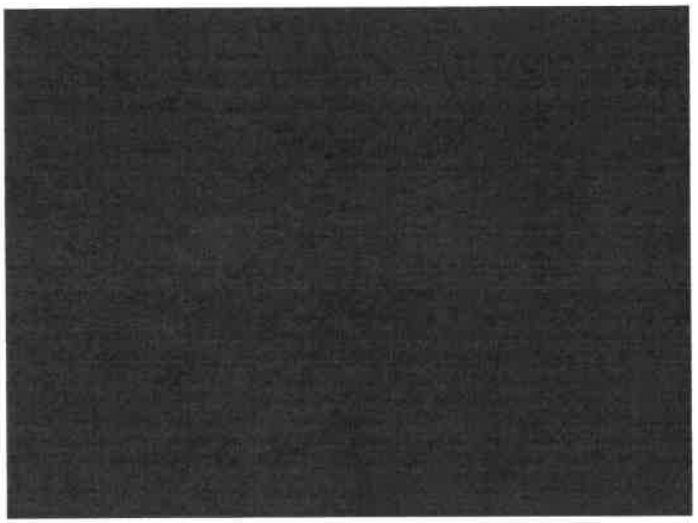
Upstream channel



Typical cracking along canal wall



Staff gauge on lock wall



Display panel in operating house

OVERALL CONDITION ASSESSMENT OF IMPOUNDING STRUCTURE AND APPURTENANCES

(Check one)

SATISFACTORY X FAIR ☐ POOR ☐ UNSATISFACTORY ☐ NOT RATED ☐

1. SATISFACTORY
   No existing or potential dam safety deficiencies are recognized. Acceptable performance is expected under all loading conditions (static, hydrologic, seismic) in accordance with the applicable regulatory criteria or tolerable risk guidelines.

2. FAIR
   No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

3. POOR
   A dam safety deficiency is recognized for loading conditions which may realistically occur. Remedial action is necessary. POOR may also be used when uncertainties exist as to critical analysis parameters which identify a potential dam safety deficiency. Further investigations and studies are necessary.

4. UNSATISFACTORY
   A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution.

5. NOT RATED
   The dam has not been inspected, is not under state jurisdiction, or has been inspected but, for whatever reason, has not been rated.

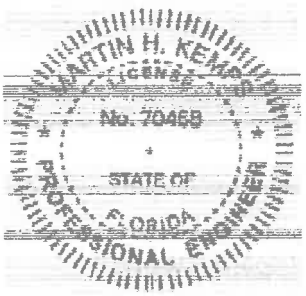
Supplemental Comments (Add narrative on your overall assessment category): No stability analyses of the project were available for review.

CERTIFICATION BY PROFESSIONAL ENGINEER

I hereby certify, by signing, dating, and sealing, that the information provided in this report has been examined by me and found to be true and correct in my professional judgment.

Martin Kemps, PE

October 1, 2021



This item has been digitally signed and sealed by Martin Kemps, PE on 10/1/2021

Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Technical Memorandum

To:	Richard J. Rowe, Florida Department of Environmental Protection
From:	Martin Kemps, P.E., Project Manager
Date:	8/20/2021
Subject:	Kirkpatrick Dam Breach Modelling Approach

1. Introduction and Background

The Kirkpatrick Dam consists of three water retaining structures: a southwest embankment, a concrete spillway with four lift gates, and a northeast embankment. The reservoir, known as the Rodman Reservoir, is created by the Kirkpatrick Dam and Buckman Lock, which span across the Ocklawaha River and the Cross Florida Barge Canal, respectively. At normal pool, the reservoir has a surface area of approximately 20.3 square miles, a gross volume of approximately 82,000 acre-feet, and a length of approximately 16.4 miles. The dam is currently listed as "Low Hazard Potential" in the National Inventory of Dams (FL00156), meaning failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses.

To better understand downstream consequences and to assess the hazard potential of the dam, Mead & Hunt will perform a dam failure analysis (DFA). It is our understanding that there is not an existing dam breach hydraulic analysis that can be referenced. In advance of developing a hydraulic model and performing the DFA, this document summarizes available information, assumptions, and model parameters/methodology that will be used.

2. Computer Model

The computer program HEC-RAS (Version 6.0), developed by the U.S. Army Corps of Engineers (USACE), Hydrologic Engineering Center (HEC), will be used for the dam failure analysis. A coupled one-dimensional (1D) and two-dimensional (2D) unsteady-state model will be developed within HEC-RAS to analyze the flood wave resulting from a breach of the Kirkpatrick dam that travels down the Ocklawaha River and into the St. Johns River. Where needed, the RAS Mapper application included within HEC-RAS will be used in conjunction with ESRI's ArcGIS Pro to develop model geometric data using collected geospatial data.

3. Development of Geometric Data

The upstream extent of the coupled 1D/2D HEC-RAS model will be located at the approximate start of the Rodman Reservoir pool. The downstream extent of the model and inundation mapping will be the same as the downstream extent used in the June 2018 Emergency Action Plan, which is just upstream of the Seaboard Coastline Railroad bridge. The 1D portion of the model will cover the reservoir itself, whereas the 2D portion will include the length of the Ocklawaha River downstream of Kirkpatrick Dam and the St. John's River from south of the confluence with the Ocklawaha River north to the railroad bridge.

3.1 Topographic Data

The topographic data needed for the model were obtained from two LiDAR survey digital elevation models (DEM) that are publicly available. The first DEM was generated from a LiDAR survey performed in 2007 by the Florida Division of Emergency Management along the St. Johns River through Clay and Putnam Counties. The resulting DEM has a 5-foot grid resolution. The second DEM was produced from a LiDAR survey performed in 2012 by the St. Johns River Water Management District. This DEM has a 5-foot grid resolution and covers the project area outside of the 2007 survey extents. The two DEMs will be merged into a single 5-foot grid DEM and trimmed to the project area using tools in ArcGIS to create the model terrain.

Efforts are being made to obtain bathymetry data of the Ocklawaha River and St. Johns River from publicly available sources of depth contours as well as nautical/chart plotter companies. If contour data from these sources is obtained, the contours will be converted into a DEM with a 5-foot grid resolution using tools in ArcGIS. The bathymetry DEM will be merged with the terrain DEM to create a single DEM that will be used in the hydraulic model development. If this information cannot be obtained, a proxy bathymetry will be created using 1D channel geometry within the RAS Mapper application. This 1D generated bathymetry will be designed with a capacity that meets known conveyance capacity of the downstream Ocklawaha River.

3.2 Bridge Structure Data

Two bridges span the Ocklawaha River downstream of the Kirkpatrick Dam. Bridge piers in or near the river will be included in the model terrain to accurately reflect the impact of the bridge on water surface elevation and flow disruption. Bridge deck elevations will be considered when evaluating the model results to determine if overtopping occurs.

The two bridges are located on Florida State Road 19 and are managed by the Florida Department of Transportation (FDOT) and Florida State Highway Patrol. Bridge 760035 spans the main channel of the Ocklawaha River and has two large piers within the river channel as well as multiple piers on each overbank of the river. The distance between abutments is approximately 1,400 feet. Bridge 760036 spans the north channel of the Ocklawaha River and has six piers within the river channel. The abutments are located near the channel banks with a separation of approximately 300 feet.

Construction drawings of the bridges were obtained from the FDOT through an exempt document request. Information from these drawings will be used to add bridge piers to the model DEM.

3.3 Rodman Reservoir

The 1D portion of the model will represent the reservoir itself using a storage area with a level-pool routing scheme. The storage volume will be defined by a stage-storage relationship that was provided by the Kirkpatrick Dam principal operator. This stage-storage relationship was originally established by the USACE in 1977 and is shown in Table 1.

Table 1: Rodman Reservoir Stage-Storage Relationship

Elevation NGVD	Reservoir Volume (Acre – ft)
[redacted]	[redacted]

*Calculated using flood pool surface area determined in ArcGIS

3.4 2D Flow Area

The 2D flow area will be used within the HEC-RAS model to represent hydraulics downstream of the Kirkpatrick Dam. The 2D area will account for the flood wave resulting from a breach of the gated spillway propagating downstream through the Ocklawaha main channel, network of side channels, and overbank areas. These flow patterns cannot be accurately represented with a 1D model. A 2D mesh will be generated over the terrain DEM with varying cell sizes. A smaller cell size and break lines will be used to define high ground features, steep terrain, and areas near the river to improve model accuracy and performance.

The Manning's n roughness values for the 2D area will be defined based on polygons digitized in ArcGIS using aerial imagery. Roughness values for various surface types will be set based on common practice and engineering judgement.

3.5 Kirkpatrick Dam

The Kirkpatrick earthen dam and gated spillway will be represented in the model using a storage area connection which will connect the upstream storage area to the downstream 2D flow area. Geometry of the dam structure, the four gate bays, and the four lift gates were obtained from as-built construction drawings. The gates will be included in the connection as sluice gates with ogee sill weirs, and appropriate discharge coefficients will be selected for weir, orifice, and sluice discharge.

Gate openings will be based on reservoir inflows and assumed operations for each of the scenarios described below. From discussions with the principal operator, we understand that typical operating

procedure involves having the outer two gates opened less than the inner two gates for fishing benefits. This gate operation protocol will be applied to the model.

4. Model Scenarios

As outlined in our contract, we will model five dam breach scenarios involving different reservoir pool elevations: maximum design elevation, normal pool elevation, and three pool elevations below normal pool as shown in Table 2.

For the maximum pool scenario, we will assume that operations personnel will have all four gates fully open to prevent further pool rise. Based on dam and spillway data included in a 2015 Condition Assessment Report by URS, the peak spillway discharge at a headwater elevation of 23.2 feet with all four gates open is 36,300 cfs. To allow the reservoir to stabilize at the defined pool elevation for the maximum pool scenario, a reservoir inflow of 36,300 cfs will be used.

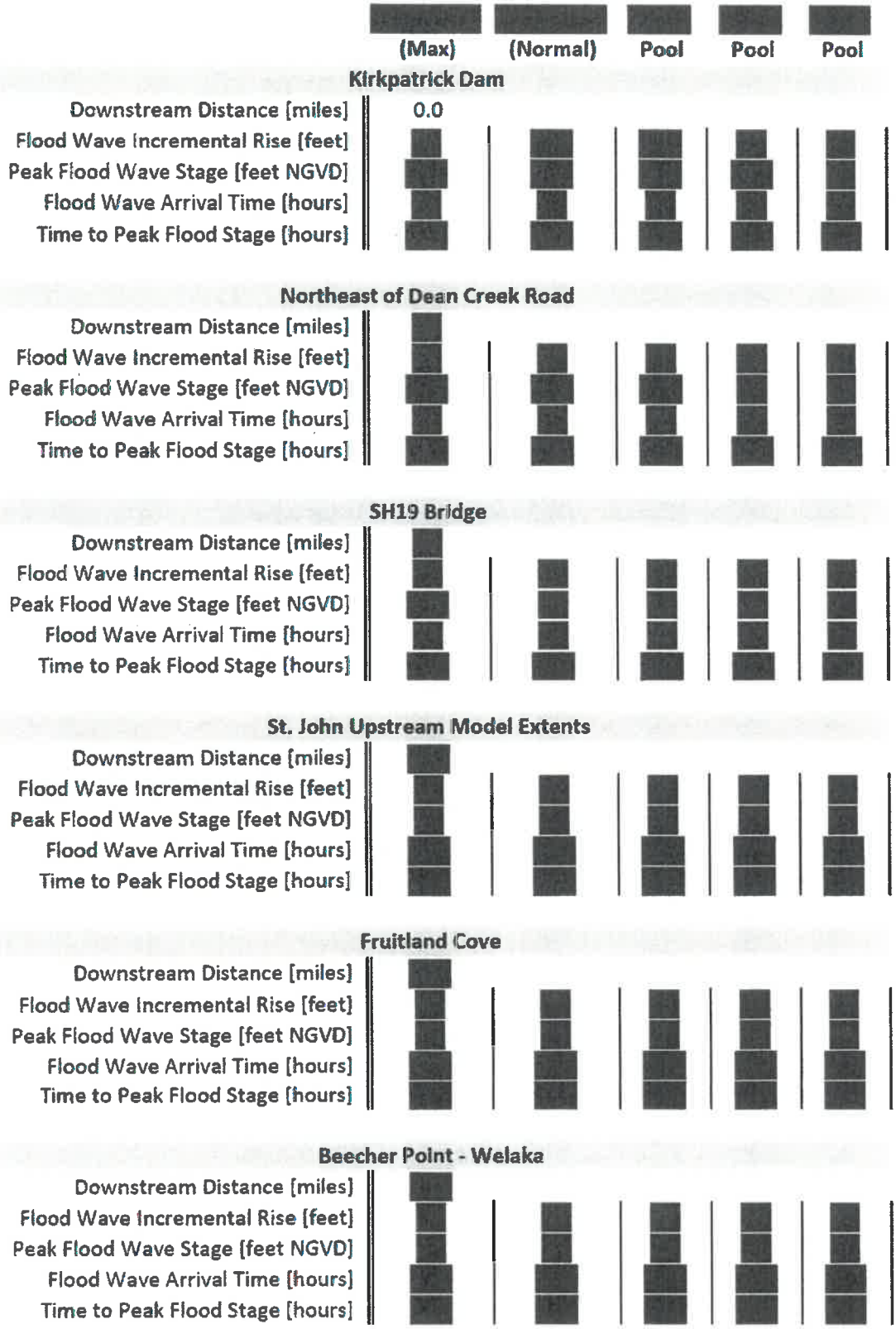
For the remaining four scenarios, we will assume that operations personnel have the gates open to maintain a minimum flow in the downstream river. From discussions with the principal operator, we understand that the minimum flow maintained through the spillway is 400 cfs. To allow the reservoir to stabilize at the defined pool elevation for each scenario, a reservoir inflow of 400 cfs will be used.

Table 2: Summary of Model Scenarios

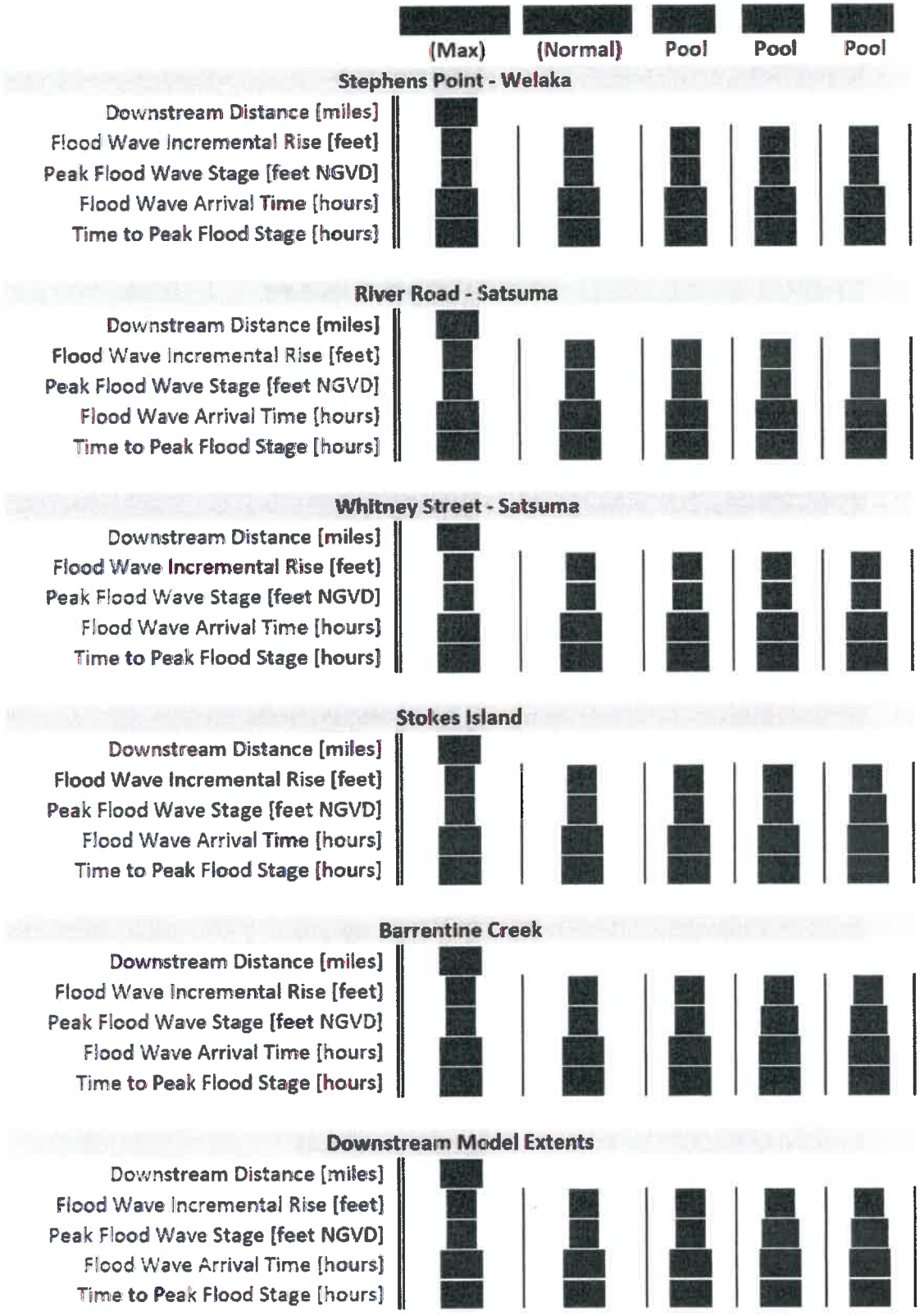
Scenario	Reservoir pool Elevation NGVD	Reservoir Inflow [CFS]	Gate Opening(s)
Maximum Pool	[redacted]	[redacted]	[redacted]
Normal Pool	[redacted]	[redacted]	[redacted]
Draw Down 1	[redacted]	[redacted]	[redacted]
Draw Down 2	[redacted]	[redacted]	[redacted]
Draw Down 3	[redacted]	[redacted]	[redacted]

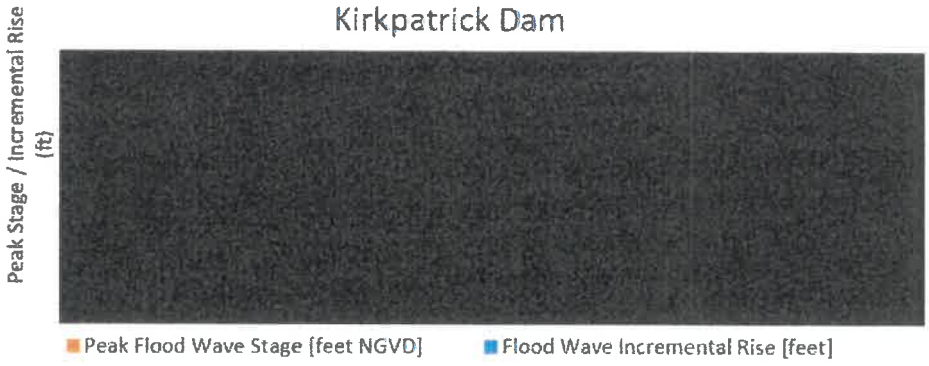
For all five scenarios, the 178-foot-wide concrete spillway structure will be breached down to an elevation of -4 feet NGVD. The breach will initiate after the model has stabilized and will form in 0.1 hours.

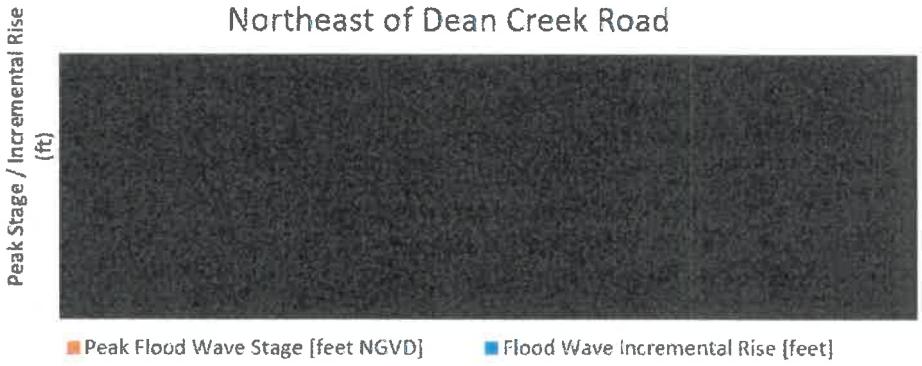
Kirkpatrick Dam Failure Analysis
Breach Wave Results Table

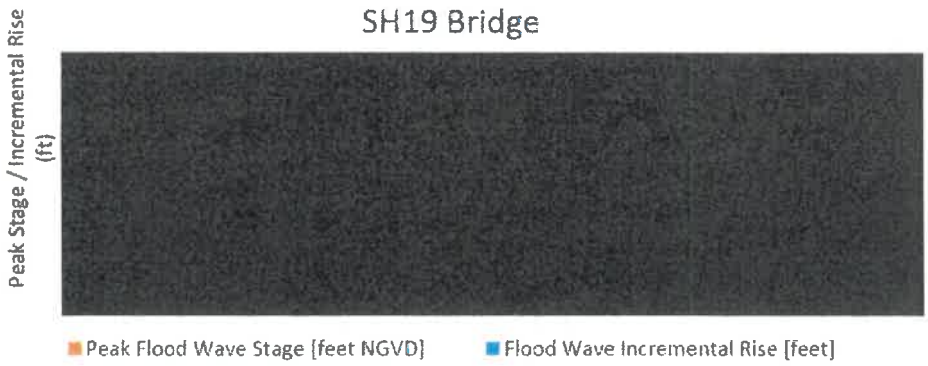


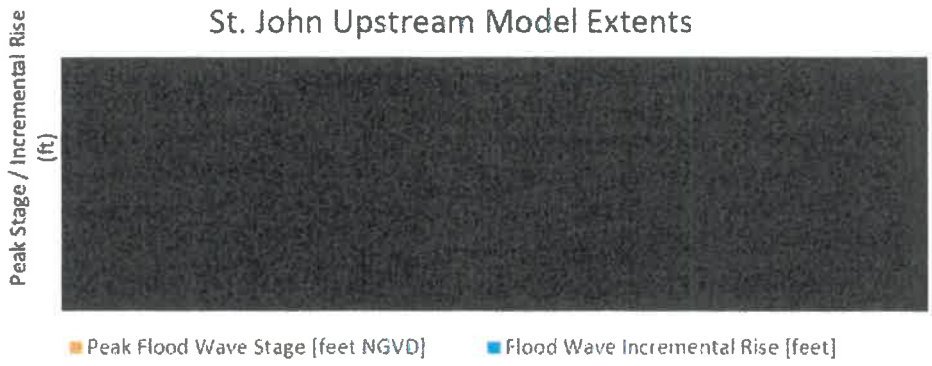
Kirkpatrick Dam Failure Analysis
Breach Wave Results Table



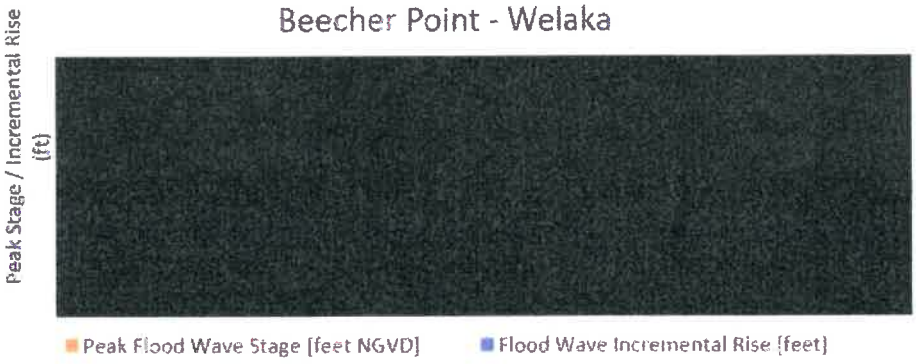

Kirkpatrick Dam
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


Northeast of Dean Creek Road
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


SH19 Bridge
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


St. John Upstream Model Extents
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

Fruitland Cove
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


Beecher Point - Welaka
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

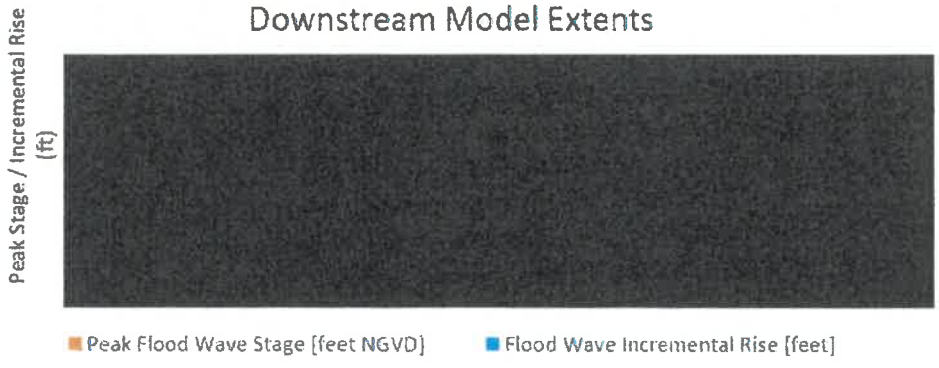
Stephens Point - Welaka
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

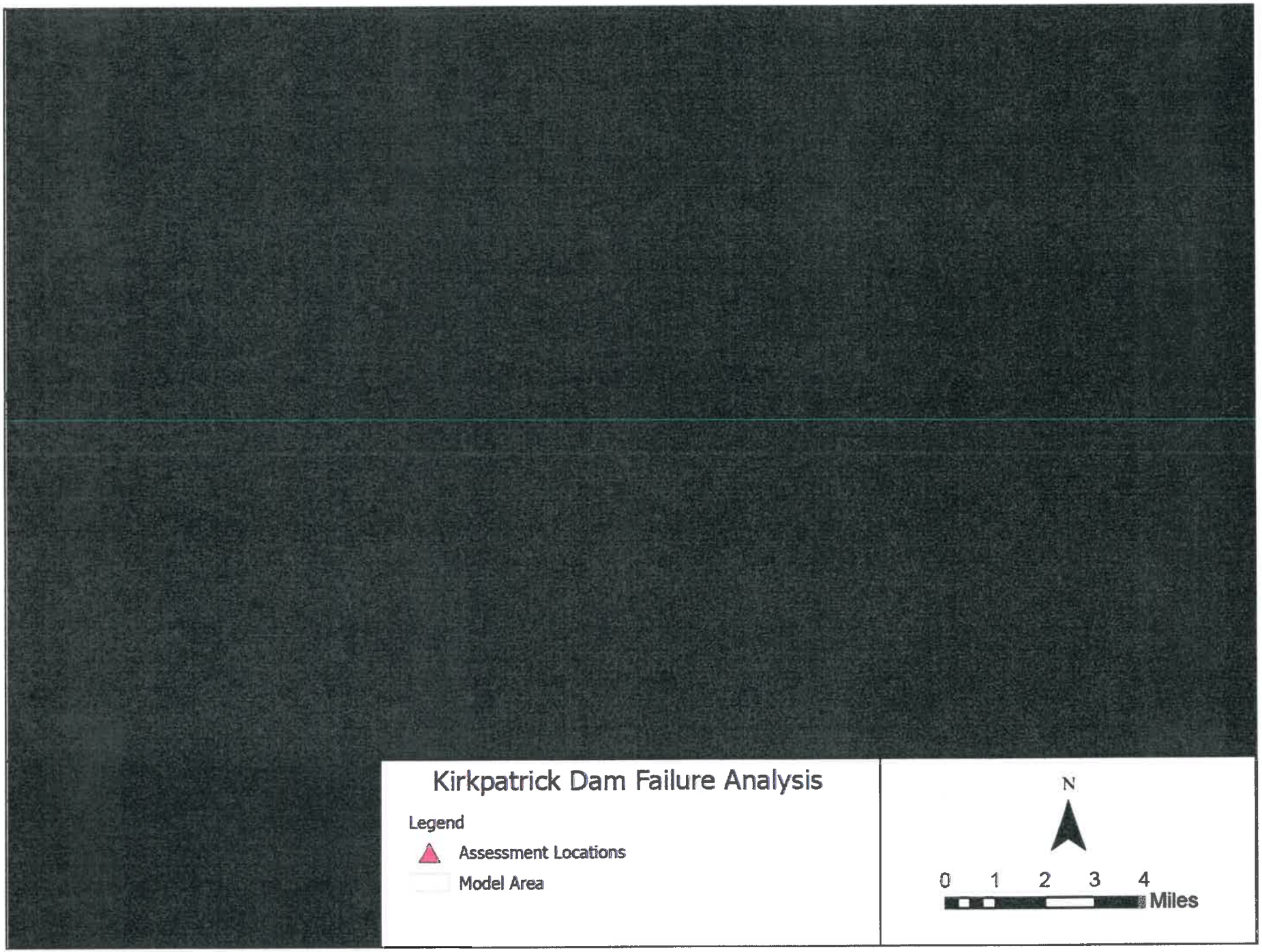
River Road - Satsuma
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

Whitney Street - Satsuma
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

Stokes Island
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]

Barrentine Creek
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


Downstream Model Extents
Peak Stage / Incremental Rise (ft)
Peak Flood Wave Stage [feet NGVD]
Flood Wave Incremental Rise [feet]


Kirkpatrick Dam Failure Analysis
Legend
Assessment Locations
Model Area
N
0 1 2 3 4
Miles

Dam Failure Analysis and Hazard Rating Assessment

Kirkpatrick Dam

Putnam County, Florida

Report prepared for

Florida Department of Environmental Protection

Report prepared by

Mead & Hunt

www.meadhunt.com

January 2022

MARTIN H. KEMPS LICENSE No. 70468 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Martin Kemps, PE on 01/26/2022.

Printed copies of this document are not considered signed and sealed, and the signature must be verified on any electronic copies.

Table of Contents

Page

Executive Summary 1

1. Introduction 2

2. Project Description 3

3. Model Development 4

3.1 Terrain Data 4
3.2 Bathymetry Data 5
3.3 Reservoir Stage – Storage Relationship 6
3.4 Dam and Spillway Geometric Data 7
3.5 State Highway 19 Bridge Geometric Data 7
3.6 Manning's Roughness Values 8
3.7 2D Flow Area 8

4. Unsteady Flow Data 9

4.1 Ocklawaha River Inflows 9
4.2 Kirkpatrick Dam Gate Openings 10
4.3 St. John's River Inflows 10

5. Model Initialization 13

6. Breach Parameters 14

6.1 Regression Equations 14
6.2 Selected Breach Parameters 16

7. Breach Results 18

7.1 Breach Results 18
7.2 Affected Structure Assessment 18

8. Assessment of Dam Hazard Potential 20

References 21

Figures

Page

Figure 1: USGS Gage No. 02243960 2017 Discharge 10
Figure 2: USGS Gage No. 02244040 September 2021 Discharge 11
Figure 3: USGS Gage No. 02244040 Historical Stage-Duration Analysis 11

Tables

Page

Table 1: Summary of Model Scenarios 2
Table 2: Ocklawaha River Bathymetry Generation 6
Table 3: Discharge Channel Bathymetry Generation 6
Table 4: Rodman Reservoir Stage Storage Relationship 7
Table 5: Model Gate Opening Height 10
Table 6: Summary of Initialization Model Parameters 13
Table 7: Kirkpatrick Dam Tailwater Elevations 13
Table 8: Sensitivity Analysis of Possible Breach Parameters 16
Table 9: Breach Parameters for Model Scenarios 17
Table 10: Summary of Affected Parcels 19

Appendices

A Location Map

B Dam Drawings

C Maps and Exhibits

D Affected Structures Table

E Miscellaneous Information

List of Contributors

This report was prepared by or under the direct supervision of the individuals listed below:

Connor Collies, EIT
Jesse Piotrowski, PE, CFM
Marty Kemps, PE
Warren Hayden, PE
Jen Schuetz
Samantha Gulick

Executive Summary

This report presents the findings of a Dam Failure Analysis for the Kirkpatrick Dam in Putnam County, Florida.

Combined 1D/2D HEC-RAS models were developed to simulate a failure of the Kirkpatrick Dam under multiple reservoir pool elevation scenarios including reservoir at maximum pool elevation of 23.2 feet NGVD 29, reservoir at normal pool elevation of 20.0 feet, and the reservoir drawn down to elevations of 18.0, 16.0, and 14.0 feet. Results from these models were used to determine flood wave heights and arrival times at important locations downstream of the dam. An assessment of parcels with habitable structures that are impacted by dam failure under each scenario was also performed.

Results of the failure models and affected structure assessment were compared to FEMA standards for dam hazard potential classification. Based on FEMA guidelines and definitions of the hazard levels, Kirkpatrick Dam should be classified as a HIGH hazard dam. It is important to note that the hazard potential classification does not reflect in any way the current condition of the dam (e.g., safety, structural integrity, flood routing capacity).

The results and discussions presented in this report may assist the Florida Department of Environmental Protection in understanding the downstream hazard potential of the dam and how changes to reservoir elevation affect the hazard potential.

1. Introduction

The Kirkpatrick Dam (Project) is owned, operated, and maintained by the Florida Department of Environmental Protection (FDEP). The dam is currently listed as "Low Hazard Potential" in the National Inventory of Dams (FL00156), meaning failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Recent consideration has been given to reducing the normal pool elevation of the reservoir to reduce operation costs and potentially reduce the downstream hazards.

The FDEP retained Mead & Hunt, Inc. (Mead & Hunt) to perform a dam failure analysis (DFA) of the Project under various reservoir pool elevations to better understand downstream consequences and to assess the hazard potential of the dam. The modeled scenarios include the reservoir at maximum design elevation, the reservoir at normal pool elevation, and three reservoir draw-down conditions as summarized in the table below.

Table 1: Summary of Model Scenarios

Scenario	Reservoir pool Elevation NGVD 29[1]

Two known DFA studies have previously been completed for the Project in conjunction with Emergency Action Plan (EAP) efforts. The first was developed by URS in April 2006 (URS Corporation, 2006) and considered a sunny-day breach at normal pool elevation. The second was developed by the FDEP in June 2018 (FDEP, 2018) and considered a sunny-day breach at both a normal pool and PMF event conditions. Reports for both studies were made available by FDEP and used as references during the development of this analysis. However, the associated models were not available, and a new model was needed.

[1] All elevations in this report are given in feet and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

2. Project Description

The Kirkpatrick Dam is located on the Ocklawaha River and impounds the Rodman Reservoir. The dam and nearby Buckman Lock are a part of the Marjorie Harris Carr Cross Florida Greenway. A location map is included in Appendix A. Downstream of the dam the Ocklawaha River flows through a swamp and bifurcates into multiple distributaries before a confluence with the St. John's River downstream of Lake George.

At normal pool, the reservoir has a surface area of approximately 20.3 square miles, a gross volume of approximately 82,000 acre-feet, and a length of approximately 16.4 miles (URS, September 2015). The earthen dam embankments measure approximately 7,200 feet long and consist of homogenous sand material. The crest is 30 feet wide with a top elevation of 28.3 feet. The crest is topped with an asphalt access road. The concrete spillway section measures 178 feet wide and contains four slide gates, each measuring 40-feet wide by 15-feet tall (U.S. Army Corps of Engineers Jacksonville District, January 1966).

Drawings for the dam are included in Appendix B.

3. Model Development

The U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 6.0.0 was used for the dam failure analysis. Due to the complexity of the downstream river, a coupled one-dimensional (1D) and two-dimensional (2D) unsteady-state model was developed within HEC-RAS to analyze the flood wave resulting from a breach of the Kirkpatrick Dam that travels down the Ocklawaha River and into the St. John's River.

The upstream extent of the coupled 1D/2D HEC-RAS model is the Rodman Reservoir pool. The downstream extent of the model and inundation mapping is the same as the downstream extent used in the 2018 FDEP report, which is just upstream of the Seaboard Coastline Railroad bridge. The 1D portion of the model covers the reservoir itself, whereas the 2D portion includes the length of the Ocklawaha River downstream of Kirkpatrick Dam and the St. John's River reach from 4.5 miles upstream of the confluence with the Ocklawaha River to the Seaboard Coastline Railroad bridge.

3.1 Terrain Data

Model terrain data was obtained from publicly available Light Detection and Ranging (LiDAR) Digital Elevation Model (DEM) files. The terrain data was processed, analyzed, and modified using tools in ArcMap version 10.7.

A DEM was obtained from the USGS National Elevation Dataset (NED) (USGS, 2021) with a 1/3 arc second cell size. This DEM covers the entire model domain but at a resolution of 1/3 arc second (approximately 10 meters), the Ocklawaha River channel is not clearly defined in some areas. The NED data was used to assess the accuracy of local DEM data sources.

A DEM raster was obtained from the National Oceanic and Atmospheric Administration (NOAA) Continuously Updated Digital Elevation Model (CUDEM) (NOAA, 2021). This DEM has a resolution of 9.84 feet (3 meters) and includes St. John's River bathymetry. The CUDEM covers the eastern portion of the model domain, extending approximately 3,000 feet west (upstream) of the State Highway 19 bridge. It was found that the CUDEM matches poorly with the NED data along the right[2] descending bluff line of the Ocklawaha River floodplain. During data processing, this region of disagreement with the NED data was clipped from the CUDEM data. The CUDEM also includes bathymetry for the Ocklawaha River; however, it only extends upstream from the St. John's River to approximately 5,000 feet east (downstream) of the State Highway 19 Bridge.

Two DEMs with resolutions of 5 feet were provided by the Saint John's River Water Management District (SJRWMD) (SJRWMD, 2012) which has jurisdiction over the model area. The first DEM raster covers the eastern portion of the model area, with a similar extent as the CUDEM data, but there is a 5-foot vertical discontinuity with the NED data in the floodplain. Due to this discontinuity and the availability of other data, this DEM raster was not used. The second DEM raster covers the western portion of the model domain and matches well with the NED data.

[2] Left and right are referred to in this report relative to an observer facing downstream.

The NED and CUDEM DEMs were projected to the North American Datum (NAD) 1983 Florida State Plane East (feet), converted from meters to feet, and snapped to the SJRWMD DEM grid. The three DEMs were then mosaiced together, with the lowest resolution NED data on bottom and the highest resolution SJRWMD data on top. The mosaiced raster was converted from a vertical datum of NAVD88 to the NGVD29 datum using the NOAA National Geodetic Survey (NGS) coordinate conversion tool. As shown in Appendix E, the conversion for the Project location is:

$$NGVD29 = NAVD88 + 0.9186 \text{ feet}$$

These horizontal and vertical datums were used for the HEC-RAS model.

3.2 Bathymetry Data

As discussed above, bathymetric data of the St. John's River and portions of the Ocklawaha River were obtained from the CUDEM DEM data. High quality Ocklawaha River bathymetry ends approximately 5,000 feet east (downstream) of the State Highway 19 bridge. Additional bathymetry was required for the remaining Ocklawaha River reach between the outlet of the dam and the high quality CUDEM bathymetry.

Bathymetry was created using a combination of the RAS Mapper application and ArcMap tools. Within RAS Mapper, the Ocklawaha River centerline was digitized, and cross sections were drawn with sufficient spacing to approximate the channel path. Three locations with known channel invert elevations were used to determine channel slopes. As-built drawings of Kirkpatrick Dam and State Highway 19 bridge crossing show channel inverts of -4 feet and -6 feet, respectively. The CUDEM DEM shows that the channel invert at the confluence with the St. John's River is -9.4 feet.

Constant channel slopes between (1) the dam and bridge and (2) the bridge and confluence were used to interpolate channel inverts for the other cross sections. A schematic of Ocklawaha channel slopes is included in Appendix E. A constant elevation, representing the interpolated invert of the channel, was defined for the full width of each cross-section. Channel inverts are shown in Table 2. An interpolated surface was created between the cross sections and exported.

Table 2: Ocklawaha River Bathymetry Generation

Downstream Reach Distance (miles)	Channel Invert (ft NGVD 29)	Notes

Table 3: Discharge Channel Bathymetry Generation

Downstream Reach Distance (miles)	Channel Invert (ft NGVD 29)	Notes

This process was repeated to create an interpolated surface representing the deepened discharge channel downstream of the dam spillway, see Table 3. Geometric data of the discharge channel was obtained from as-built construction drawings included in Appendix B.

The interpolated surfaces were imported into ArcMap. Each surface was clipped to the channel boundary using polygon features. The resulting surface represents a flat channel bottom at the interpolated invert elevation within the channel banks. The generated bathymetry data transitions to the CUDEM bathymetry data where the interpolated channel invert intersects the CUDEM data. The clipped surfaces were burned into the mosaiced DEM terrain to create the final model terrain.

3.3 Reservoir Stage – Storage Relationship

The 1D portion of the model represents the reservoir using a storage area with a level-pool routing

scheme. The storage volume was defined by a stage-storage relationship that was provided by the Kirkpatrick Dam principal operator. This stage-storage relationship was originally established by the USACE in 1977 and is shown in Table 4. The maximum elevation in the USACE table is 20 feet. Mead & Hunt extended the table to an elevation of 23.2 feet using ArcGIS.

Table 4: Rodman Reservoir Stage Storage Relationship

Elevation NGVD 29	Reservoir Volume (Acre – ft)

*Calculated using flood pool surface area determined in ArcGIS.

3.4 Dam and Spillway Geometric Data

The Kirkpatrick Dam and gated spillway were represented in the model using a storage area connection which connects the upstream storage area to the downstream 2D flow area. Geometry of the dam structure, the four gate bays, and the four lift gates were obtained from as-built construction drawings. These drawings are included in Appendix B. The spillway gates were included in the connection as sluice gates with ogee sill weirs. To improve model stability, the gates were modeled in two gate groups, each group containing two gates. The outer two gates were modeled as one gate group, and the inner two gates were modeled as a second gate group. Typical discharge coefficients of 0.6, 0.8, and 3.47 were used for sluice, orifice, and weir discharge, respectively.

3.5 State Highway 19 Bridge Geometric Data

Two bridges span the Ocklawaha River downstream of the Kirkpatrick Dam. The two bridges are located on Florida State Road 19 and are managed by the Florida Department of Transportation (FDOT) and Florida State Highway Patrol. Bridge 760035 spans the main channel of the Ocklawaha River and has two large piers within the river channel as well as 14 piers in the left overbank and 14 piers in the right overbank. The distance between abutments is approximately 1,400 feet. Bridge 760036 spans the north channel of the Ocklawaha River and has six piers within the river channel. The abutments are located

near the channel banks with a separation of approximately 300 feet. Construction drawings of the bridges were obtained from the FDOT through an exempt document request (Florida Department of Transportation, 1966).

The bridges were modeled as internal connections within the 2D flow area of the model. Bridge piers were included to accurately reflect the impact of the bridge on water surface elevation and flow disruption. Bridge deck elevations were also included to evaluate whether overtopping occurs following a dam breach. Battered piers were modeled with twice the thickness of vertical piers.

3.6 Manning's Roughness Values

A land use polygon dataset was obtained from the SJRWMD geospatial open data portal (SJRWMD, 2012). The dataset was imported into RAS Mapper as a land cover layer and associated with the model. Each land use designation was given a manning's roughness value. Values were determined based on aerial and street view imagery and engineering judgement.

3.7 2D Flow Area

The 2D flow area was used within the model to represent the hydraulics downstream of the dam. The flow area perimeter was extended outward from the floodplain until a terrain elevation exceeding any probable flood wave elevation was reached. A 2D mesh with 100-foot cell size was generated within the flow area perimeter.

The 2D mesh was revised to improve model stability. The mesh was refined to a 25-foot cell spacing along the discharge channel and a break line was included to orient the cells in the direction of flow. Break lines were also added along the crest of State Highway 19 and the two bridge crossings. Near the State Highway 19 bridges, the mesh cell size was reduced to 50 feet and cells were oriented parallel to the highway centerline.

4. Unsteady Flow Data

Between the five modeled scenarios (see Table 1), there are two different unsteady flow conditions. For the normal pool and draw down scenarios, it is assumed that the river system will be experiencing average conditions that are independent of headwater management at the dam. For the max stage scenario, it is assumed that the elevated reservoir level is resulting from a significant flooding event within the river system. As such, this scenario must be treated differently for inflow and dam operations.

The 1D/2D model requires boundary conditions and defined gate openings at Kirkpatrick Dam. The upstream boundary conditions are inflow hydrographs for the Rodman Reservoir and St. John's River. A normal depth boundary condition matching the slope of the St. John's River water surface elevation was set at the downstream extent of the model domain.

4.1 Ocklawaha River Inflows

The USGS operates stream gages both upstream (No. 02243959) and downstream (No. 02243960) of the Kirkpatrick Dam (USGS, 2021). Review of readily available historical data and discussions with Project personnel has shown that the Ocklawaha River experiences varying trends in flow, occasionally experiencing long periods of drought and flood events following hurricanes.

During historical droughts, inflow into the Rodman Reservoir has been reduced to zero and discharge through the dam has been significantly reduced. During periods of low discharge, the downstream reach of the Ocklawaha River has been observed to flow upstream due to tidal effects in the St. John's River. When flows through the system allow, the principal gate operator maintains a minimum discharge of 400 cfs. In HEC-RAS, for the normal pool and draw down scenarios, the minimum flow of 400 cfs was set as a constant inflow to the reservoir. These conditions would be consistent with a typical sunny-day event at the Project.

The flood of record for the Project occurred on September 13, 2017, during landfall of Hurricane Irma. Flow in the river downstream of the dam was recorded at the USGS stream gage. As shown in Figure 1, discharge during this event reached a maximum of 13,100 cfs. This flow is significantly larger than any other historical values recorded since the gage was installed in 2002, with the next largest flow being 7,690 cfs which occurred on August 26, 2008. For the maximum pool scenario, the maximum historical discharge of 13,100 cfs was set as constant inflow to the reservoir.

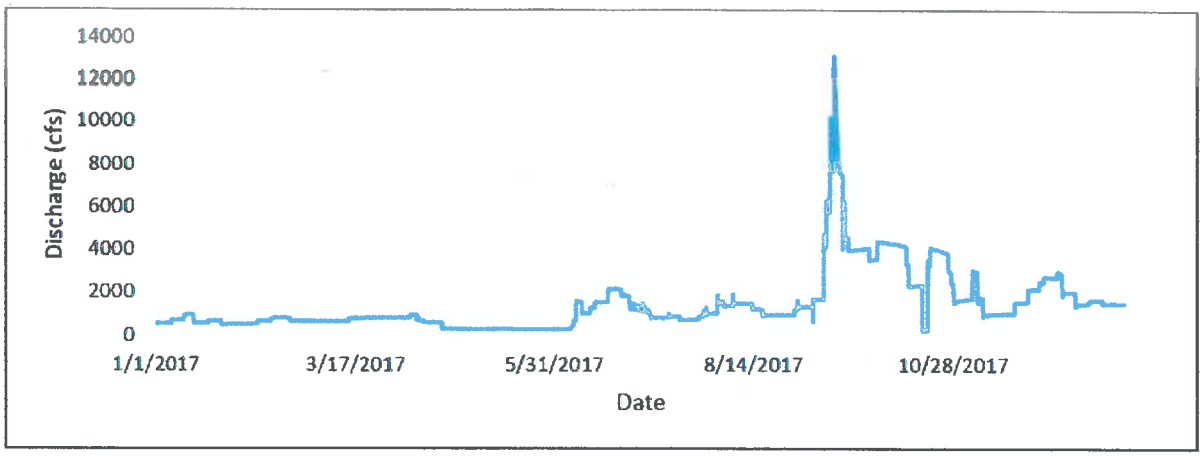


Figure 1: USGS Gage No. 02243960 Discharge During the September 2017 Flood of Record

4.2 Kirkpatrick Dam Gate Openings

For all five model scenarios, gate opening heights were iteratively adjusted until the gates passed the reservoir inflow, allowing the reservoir elevation to stabilize prior to breaching the dam structure. The principal gate operator stated that it is common practice to have the inner two gates open slightly more than the outer two gates to promote favorable conditions for aquatic life downstream. This operating practice was included in the model gate openings. In the draw down model scenarios, larger gate opening heights were needed to pass the minimum discharge due to a decrease of head in the reservoir. A summary of the gate opening heights for each model scenario is shown in Table 5 below.

Table 5: Model Gate Opening Height

Model Scenario	Outer Gates Opening Height (ft)	Inner Gates Opening Height (ft)

4.3 St. John's River Inflows

The USGS operates a stream gage (No. 02244040) (USGS, 2021) on the St. John's River at the downstream extent of the model domain, adjacent to the Buffalo Bluff railroad crossing. There are no St. John's River stream gages located upstream of the Ocklawaha River confluence. The St. John's River is tidally influenced from the river delta upstream to Lake George. The stream gage records daily fluctuations of flows moving both downstream and upstream following the rise and fall of the tide. The graph below shows an example of this oscillation for the month of September 2021. Due to these varying flow rates, the St. John's River can be considered a level pool.

A level pool is typically modeled with a constant stage downstream boundary condition which maintains the water surface elevation during simulation. During a dam failure model, a large volume of water must be passed through the downstream model boundary. Using a constant stage at the downstream

boundary for a dam failure model would constrain outflow and artificially increase water surface elevations within the model domain. Instead, a normal depth slope matching the St. John's River slope was chosen as the downstream boundary condition. This boundary condition will allow the St. John's River to have a riverine profile during dam break.

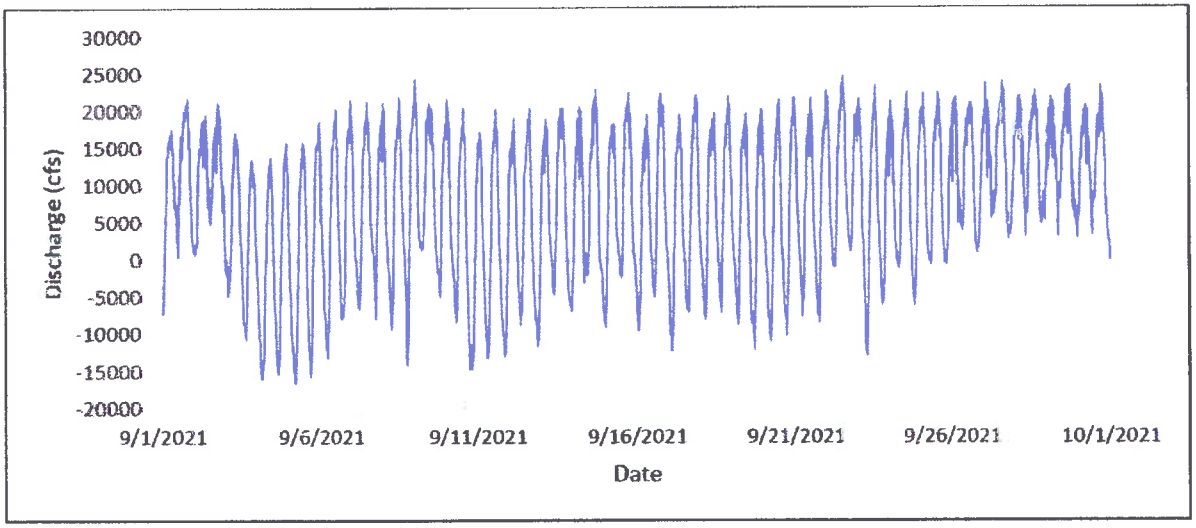


Figure 2: USGS Gage No. 02244040 September 2021 Discharge

The St. John's River inflow determines the water surface elevation at the Ocklawaha confluence. To determine an appropriate water surface elevation of the St. John's River, the full range of historical stage data from the downstream gage was plotted as a duration curve. The historical data shows that the 50 percent exceedance (median) stage value is 1.0-foot NGVD 29. This value was chosen as the water surface elevation at the Ocklawaha River confluence.

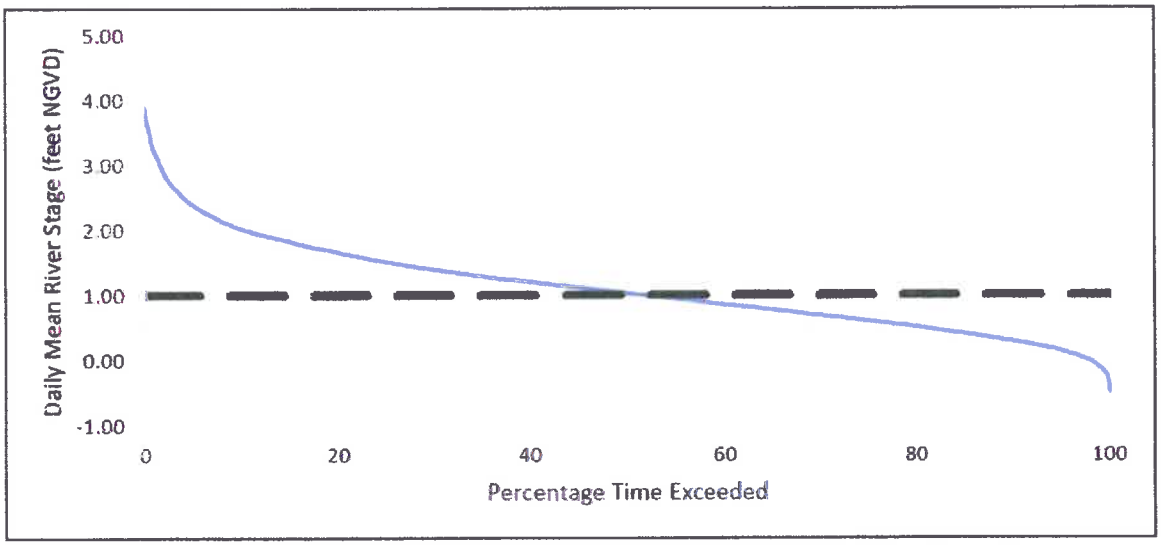


Figure 3: USGS Gage No. 02244040 Historical Stage-Duration Analysis

An upstream inflow for the St. John's River which results in a water surface elevation of 1.0-foot at the

confluence was determined through multiple iterations of the model. All other values in the model, including Ocklawaha inflow, gate openings, and downstream boundary condition were left constant between iterations. It was determined that a St. John's River flow of 16,620 cfs would result in the desired water surface elevation. This flow was set as a constant inflow for the St. John's River for all five scenarios.

5. Model Initialization

A separate model for each of the five scenarios was created within HEC-RAS. Each model was based on the same geometry data as discussed in Section 3 of this report and individual unsteady flow data as discussed in Section 4 of this report. Model parameters for each scenario are summarized in the table below. The Kirkpatrick Dam was not breached during this modeling phase.

Table 6: Summary of Initialization Model Parameters

Model Scenario	Simulation Time	Initial Reservoir Elevation	Reservoir Inflow	St. John River Inflow	Outer Gate Opening Height	Inner Gate Opening Height
	Days	feet	cfs	cfs	feet	feet
[redacted]						

The 2D flow area for each model was started dry, and models were run for a period of 5.5 days. This simulation time allowed water to flow through the system until flows stabilized and the downstream extent of the model reached a constant water surface elevation. Results from the end of these simulations were used as the initial condition for the dam breach models.

The initialization models were also used to provide dam tailwater elevations for each of the scenarios. These tailwater elevations have been incorporated into structural and stability analyses for the Project. The tailwater elevations determined from the initialization models are shown in Table 7 below.

Table 7: Kirkpatrick Dam Tailwater Elevations

Reservoir Elevation	Tailwater Elevation
feet	feet
[redacted]	

6. Breach Parameters

This section of the report documents the procedure that was used to identify applicable regression equations, the sensitivity analysis performed using values developed from each equation, and the selection of breach parameters for each model scenario.

Multiple dam failure mechanisms were considered for this DFA. A common mechanism for dam failure is overtopping of the embankment and erosion of the downstream face until a breach occurs. As indicated in Section 4 of this report, for this analysis it was assumed that the gate(s) would be opened to pass reservoir inflows and maintain the reservoir elevation for each scenario. However, if the gates were closed for an extended period due to mis-operation or mechanical failure, water could flow over the top of the gates when reservoir stage exceeds 21 feet. This is well below the top of the dam elevation (28.3 feet) and thus overtopping is not likely to occur.

Excessive seepage or piping through the dam embankment is a major cause of failure for earthen embankment type dams. Piping failure occurs when seepage through the dam causes erosion, which in turn causes more flow to go through the dam, creating a positive feedback loop and an accelerating rate of material loss until failure occurs. A significant body of data is available regarding this type of failure. Piping failure was considered in this analysis.

A structural or mechanical failure could cause partial or complete failure of the concrete spillway structure. For this analysis, a sudden failure of the entire spillway structure was considered as a failure mechanism. For this mechanism it was assumed that the entire 173-foot-wide spillway width would be breached with vertical side slopes. It is also expected that a failure of the concrete spillway structure would form quickly, so a formation time of 0.2 hours was used.

6.1 Regression Equations

Several researchers have developed empirical regression equations by assembling data from historical dam failures. These equations are commonly used to estimate the breach parameters for dam failure analyses and have been proven to have strong correlation with historical data. The parameters that are determined from these equations are breach bottom width, breach side slopes, and breach development time.

HEC-RAS version 6.0 includes a "Parameter Calculator" within the breach data window of the structure. This calculator takes user inputs and applies them using five different regression equations to create possible breach parameters. The HEC-RAS manual references a dam safety research report written by Tony L. Wahl which discusses the data collection and analysis that occurred to create these equations (Wahl, 1998). These five regression equations are discussed below.

MacDonald et. al. (1984)

MacDonald and Langridge-Monopolis proposed a breach formation factor which is defined as the product of breach outflow volume and depth of water above the breach invert at time of failure. They used this factor and 42 case studies to estimate volume of embankment material removed during the breach. A breach time equation was also created as a function of eroded volume.

$$V_{eroded} = 0.00348(V_{out}h_w)^{0.852}$$
$$t_f = 0.0179{V_{eroded}}^{0.364}$$

Where V_{out} is volume of breach outflow in cubic meters, V_{eroded} is the volume of embankment material removed in cubic meters, h_w is the depth of water above the breach invert in meters, and t_f is the breach formation time in hours.

Breach side slopes were assumed to be 1H:2V and the breach width was determined based on the width needed to provide the eroded material volume. For this analysis the V_{out} term was assumed to be the reservoir volume above the bottom of the breach. An upstream dam face slope of 10:1 and downstream dam face of 4:1 were used (see Appendix B).

Froehlich (1995)

Froehlich revised his previous 1987 analysis in 1995 by adding data for an additional eighteen dam failures, bringing the total to 63 historical failure cases. From this collection of data, he developed new prediction equations for average breach width and time of failure:

$$B_{AVE} = 0.1803K_0{V_W}^{0.32}{h_b}^{0.19}$$
$$t_f = 0.00254{V_W}^{0.53}{h_b}^{-0.90}$$

Where V_w is reservoir volume above breach bottom in cubic meters, h_b is the height of breach in meters, B_{AVE} is the average width of the breach in meters, and t_f is the breach formation time in hours.

Froehlich did not provide an equation for determination of breach side slopes in his 1995 report. Instead, he suggested that side slope ratios of 1.4 and 0.9 be used for overtopping and all other failure modes, respectively. K_0 is a constant set as 1.4 for overtopping and 1.0 for all other mechanisms.

Froehlich (2008)

Froehlich further revised his equations with an additional 11 dam failure cases in 2008.

$$B_{AVE} = 0.27K_0{V_W}^{0.32}{h_b}^{0.04}$$
$$t_f = 63.2\sqrt{\frac{V_W}{g{h_b}^2}}$$

The K_0 constant was changed to 1.3 for overtopping and 1.0 for all other mechanisms. Also, side slopes were adjusted to be ratios of 1.0 for overtopping and 0.7 for other failure modes.

Von Thun & Gillette (1990)

Von Thun & Gillette used data collected by Froehlich and MacDonald to develop guidance for estimating breach parameters. They proposed that breach side slopes be 1:1 for dams with cohesionless soil. They developed the following relationships:

$$B_{AVE} = 2.5h_w + C_b$$
$$t_f = 0.020h_w + 0.25$$

Where h_w is the depth of water at the time of failure in meters, and C_b is a function of reservoir storage volume. For the Rodman Reservoir, C_b should be 54.9 meters.

Xu & Zhang (2009)

The breach development time from the Xu & Zhang equations include periods of initial erosion and periods of erosion after breach formation. These periods are beyond what is used in the HEC-RAS program and thus result in unrealistically large development times. This method is not recommended and was not used.

6.2 Selected Breach Parameters

A sensitivity analysis of the breach parameters determined by the four regression equations and spillway failure was performed to determine which set of parameters resulted in the largest discharge during the breach. The sensitivity analysis was performed for the normal pool scenario with reservoir at elevation 20.0 NGVD 29 and total reservoir breach volume at failure of 80,500 acre-feet (U.S. Army Corps of Engineers Jacksonville District, January 1966). A summary of considered parameters and the resulting discharge is shown in Table 8 below.

Table 8: Sensitivity Analysis of Possible Breach Parameters

Method	Bottom Width feet	Side Slope	Breach Formation Time hours	Breach Peak Discharge cfs

The largest discharge resulting from the sensitivity analysis was using the MacDonald et. al. equation. The breach width determined from this regression equation was significantly larger than the other methods and was considered unlikely to occur. For this reason, the MacDonald values were not selected for this analysis and the highest peak flow from the remaining methods was selected.

The breach parameters determined from the Froehlich 2008 equations were used for this DFA. The breach parameters for each model scenario are shown in Table 9 below. The breach centerline was

placed where the embankment crosses the original Ocklawaha River channel because this is a common vulnerable area, with respect to potential failure, for earthen embankments.

Table 9: Breach Parameters for Model Scenarios

Model Scenario	Failure Mode	Initial Piping Elevation feet	Final Bottom Elevation feet	Final Bottom Width feet	Side Slope	Breach Weir Coeff.	Piping Coeff.	Breach Formation Time hours

7. Breach Results

7.1 Breach Results

HEC-RAS shows water surface elevation, water depth, and velocity results as rasters within RAS Mapper. These rasters were post-processed in RAS Mapper and ArcGIS Pro to produce inundation boundaries which graphically illustrate the areas that would experience flooding during a particular dam failure. Assessment locations were placed in critical areas within the model domain. Detailed results were extracted from these locations using hydrographs generated in RAS Mapper. From these results critical information including peak flood wave stage, incremental rise from antecedent conditions, time to peak flood stage, and flood wave arrival time were determined. Flood wave arrival time was defined by the time when the water stage at the location rose 1-foot from antecedent conditions. Time to peak and arrival time are measured from the initiation of breach.

Inundation boundaries were combined with other cartographic data in ArcGIS Pro to create map exhibits. These maps also present the assessment location information generated from the HEC-RAS results. Parcel data was included in the exhibits for use in the affected structure assessment.

HEC-RAS water surface elevation rasters were exported from RAS Mapper and processed in ArcGIS Pro to create incremental rise rasters. These rasters represent the difference in peak water surface elevation of the max pool scenario and draw down scenarios compared to the normal pool scenario. The exhibits can be used by FDEP to assess how a decision to lower the normal pool of the reservoir would affect downstream hazard potential.

Digital copies of the HEC-RAS models are provided with this report.

7.2 Affected Structure Assessment

As part of this DFA, affected structures were assessed to quantify the downstream hazard for each model scenario and to serve as a tool when comparing hazard potential between scenarios. Affected structures were assessed based on parcel data within the model domain and inundation boundaries developed during this DFA. Tabular results of the affected structure assessment, including parcel identification number and owner name, are included in Appendix D. Affected parcels are graphically shown on the inundation maps in Appendix C.

The methodology used to develop the information described above utilized the results of the 1D/2D modeling. This method was repeated for each model scenario. The method is summarized below:

Step 1: Current parcel data in GIS format was obtained from the Florida Department of Revenue (Florida Department of Revenue, 2021) and Putnam County's (Putnam County, 2021) GIS open data portal. This parcel data was imported into ArcGIS Pro along with inundation boundaries developed from the model results.

Step 2: Using tools in ArcGIS Pro, the inundation boundary was used to select all parcels that are partially or fully within the inundation boundary. All other parcels from the county wide data set were removed, leaving only the parcels inundated by the flood wave.

Step 3: The County parcel GIS data includes a "CLASSCD" attribute which is a three number and one letter code designating the property type of the parcel. Parcels with a CLASSCD code ending in V are designated as vacant, meaning no habitable structure is present. Tools in ArcGIS Pro were used to filter the remaining parcels and remove all parcels designated as being vacant, leaving only parcels that have a habitable structure and are inundated by the flood wave.

Step 4: The parcel attributes contain no information regarding structure location within the parcel, and no land survey was conducted to locate structures as part of this assessment. Therefore, in cases where the entire parcel is not located within the inundation boundary, the presence of a structure on the parcel does not necessarily signify that the structure is within the inundation boundary and affected by the dam breach. For each partially inundated parcel, a visual assessment was performed using aerial imagery to verify that the parcel contained a structure within the inundation boundary. Parcels found to have no habitable structures within the inundation boundary were removed from the data set.

Step 5: The parcels remaining after step 4 contain habitable structures within the inundation boundary. These parcels were shaded on the inundation maps and added to the affected structures results table.

The affected structures assessment was repeated for each model scenario. The results, expressed as number of affected parcels, is summarized in Table 10 below. It should be noted that the number of affected parcels is not synonymous with the number of affected buildings. Each parcel may contain multiple structures within the inundation boundary.

Table 10: Summary of Affected Parcels

Model Scenario	Number of Affected Parcels With Habitable Structures
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

8. Assessment of Dam Hazard Potential

The Kirkpatrick Dam is currently listed as a low hazard facility on the web-enabled version of the National Inventory of Dams (USACE, 2021).

The Federal Emergency Management Agency (FEMA) has developed a dam hazard classification system (Interagency Committee on Dam Safety, 2004) which is applied uniformly by all federal and state dam safety agencies. It is important to note that this hazard potential classification does not reflect in any way the current condition of the dam (e.g., safety, structural integrity, flood routing capacity) but instead categorizes dams based on the probable loss of life and impacts on economic and environmental interests. Loss of life is considered probable at locations within the inundation zone that are occupied for long durations, such as homes and businesses. Areas of temporary occupation or recreational areas are not considered with this classification system. Further, no allowances for evacuation or other emergency actions that could remove people from inundated areas are considered.

The FEMA guidelines define three hazard classification levels:

Low Hazard Potential

"Dams assigned the low hazard potential classification are those where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property."

Significant Hazard Potential

"Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure."

High Hazard Potential

"Dams assigned the high hazard potential classification are those where failure or mis-operation will probably cause loss of human life."

As part of this assessment, comprehensive models for five different water elevation scenarios were developed. Following the results of the affected structure assessment presented in the previous section, there is evidence of probable loss of life resulting from a dam failure under all five model scenarios. The affected parcels listed in Appendix D contain structures which are expected to be occupied for extended periods or overnight. Neighborhoods located in Stephens Point and Beecher Point experience inundation depths exceeding 4-feet during the maximum pool failure scenario.

Economic losses are expected to occur on affected parcels and may affect private property owners as well as local infrastructure. A significant flood wave moving through the Caravelle Ranch Wildlife Management Area, downstream of Kirkpatrick Dam, has the potential to cause significant environmental damage to the ecosystem.

According to FEMA standards, the Kirkpatrick Dam should be classified as a **HIGH** hazard dam. It is important to note that this hazard potential classification does not reflect in any way the current condition of the dam (e.g., safety, structural integrity, flood routing capacity).

References

FDEP. (2018). *Emergency Action Plan for Kirkpatrick Dam and Rodman Reservoir.* Tallahassee, Florida.

Florida Department of Revenue. (2021). *GIS and Cadastral Mapping.* Retrieved from Florida Department of Revenue: https://floridarevenue.com/property/Pages/Official_GIS.aspx

Florida Department of Transportation. (1966, January). Plans of Proposed State Highway - State road No. 19. Tallahassee, Florida.

Interagency Committee on Dam Safety. (2004). *Federal Guidelines for Dam Safety - Hazard Potential Classification System for Dams.* U.S. Department of Homeland Security - FEMA.

NOAA. (2021, September 1). *Digital Coast: Data Access Viewer.* Retrieved from National Oceanic and Atmospheric Administration: https://coast.noaa.gov/dataviewer/#/lidar/search/where:ID=8483

Putnam County. (2021, November 4). *Putnam County Open Data.* Retrieved from ArcGIS.com: https://pc-open-data-site-pcgis.hub.arcgis.com/search?tags=property

SJRWMD. (2012, April). *Geographic Information System (GIS) Development Program.* Retrieved from St. Johns. River Water Management District: https://www.sjrwmd.com/data/gis/#basemap

U.S. Army Corps of Engineers Jacksonville District. (January 1966). *Cross Florida Barge Canal Plans Rodman Dam and Spillway.*

URS Corporation. (2006). *Rodman Reservoir Dam Failure Flood Boundary Mapping Assessment.* Tampa, Florida.

URS. (September 2015). *Kirkpatrick Dam and Spillway Condition Assessment.*

USACE. (2021, April 1). *Kirkpatrick Dam and Rodman Reservoir.* Retrieved from National Inventory of Dams: https://nid.sec.usace.army.mil/#/dams/system/471799/summary

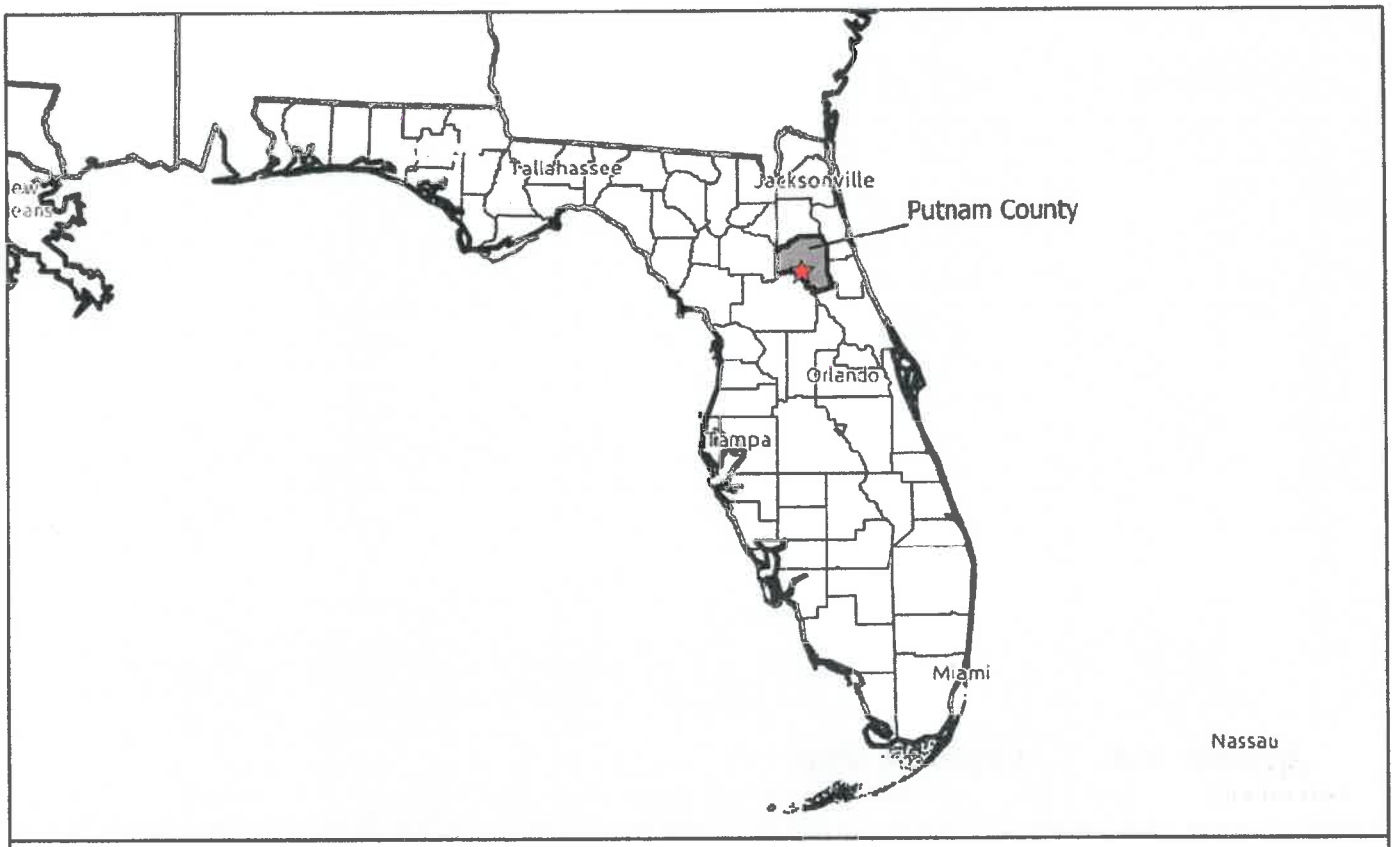
USGS. (2021, May 3). *National Geospatial Program.* Retrieved from USGS.gov: https://www.usgs.gov/core-science-systems/national-geospatial-program/national-map

USGS. (2021, November 15). *National Water Information System.* Retrieved from USGS.gov: https://nwis.waterdata.usgs.gov/nwis/uv?cb_00060=on&cb_00065=on&cb_63160=on&format=gif_stats&site_no=02244040&period=&begin_date=2010-09-20&end_date=2021-09-27

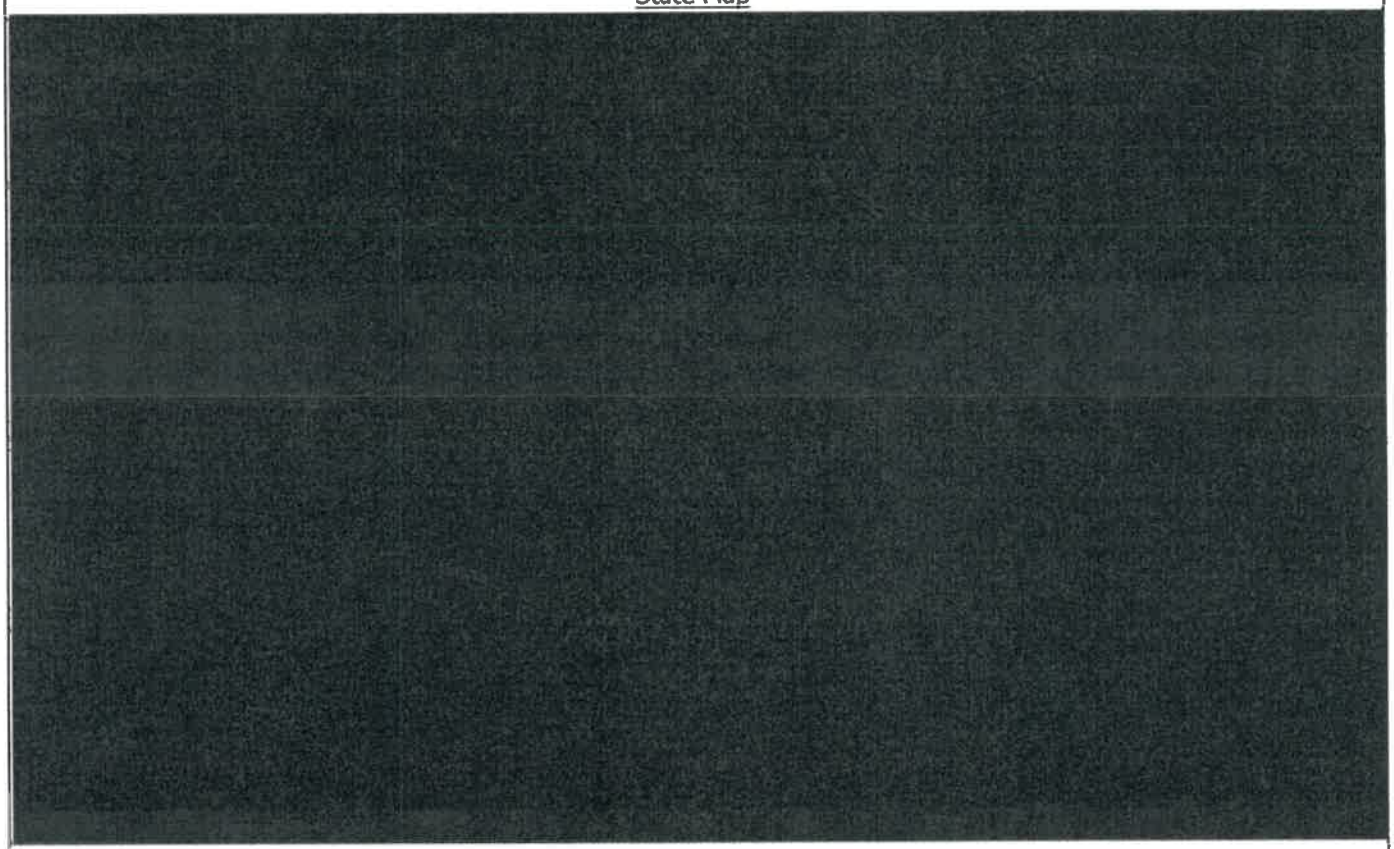
USGS. (2021, November 15). *National Water Information System.* Retrieved from USGS.gov: https://nwis.waterdata.usgs.gov/nwis/uv?cb_00060=on&cb_00065=on&cb_45592=on&cb_45592=on&cb_45592=on&cb_45592=on&cb_63160=on&format=gif_stats&site_no=02243960&period=&begin_date=2017-04-01&end_date=2021-09-27

Wahl, T. L. (1998). *Prediction of Embankment Dam Breach Parameters: A Literature Review and Needs Assessment.* U.S. Departmnet of the Interior Bureau of Reclamation: Dam Safety Office.

Appendix A. Location Map



State Map



Vicinity Map

LOCATION MAP

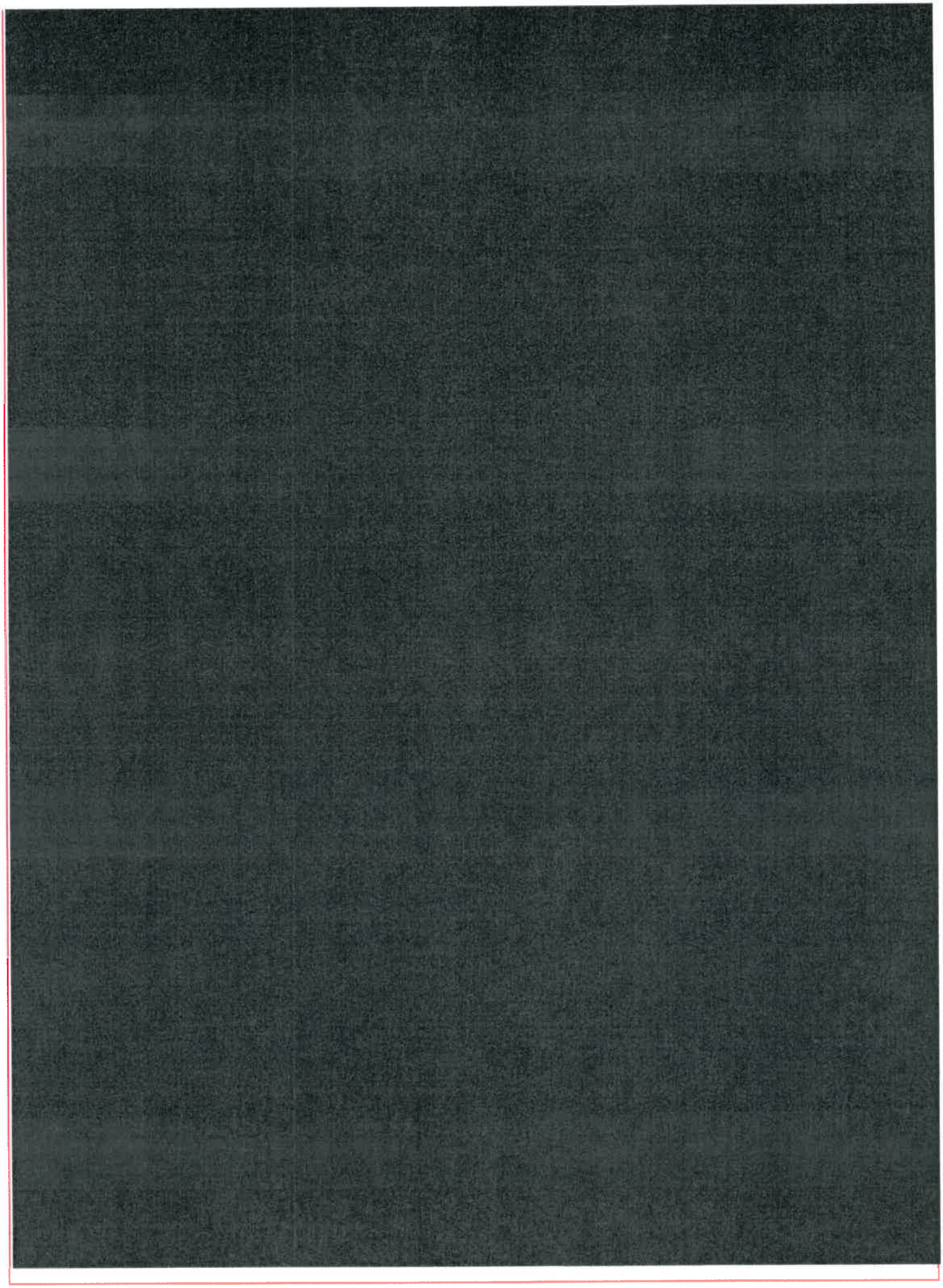
Kirkpatrick Dam Failure Analysis

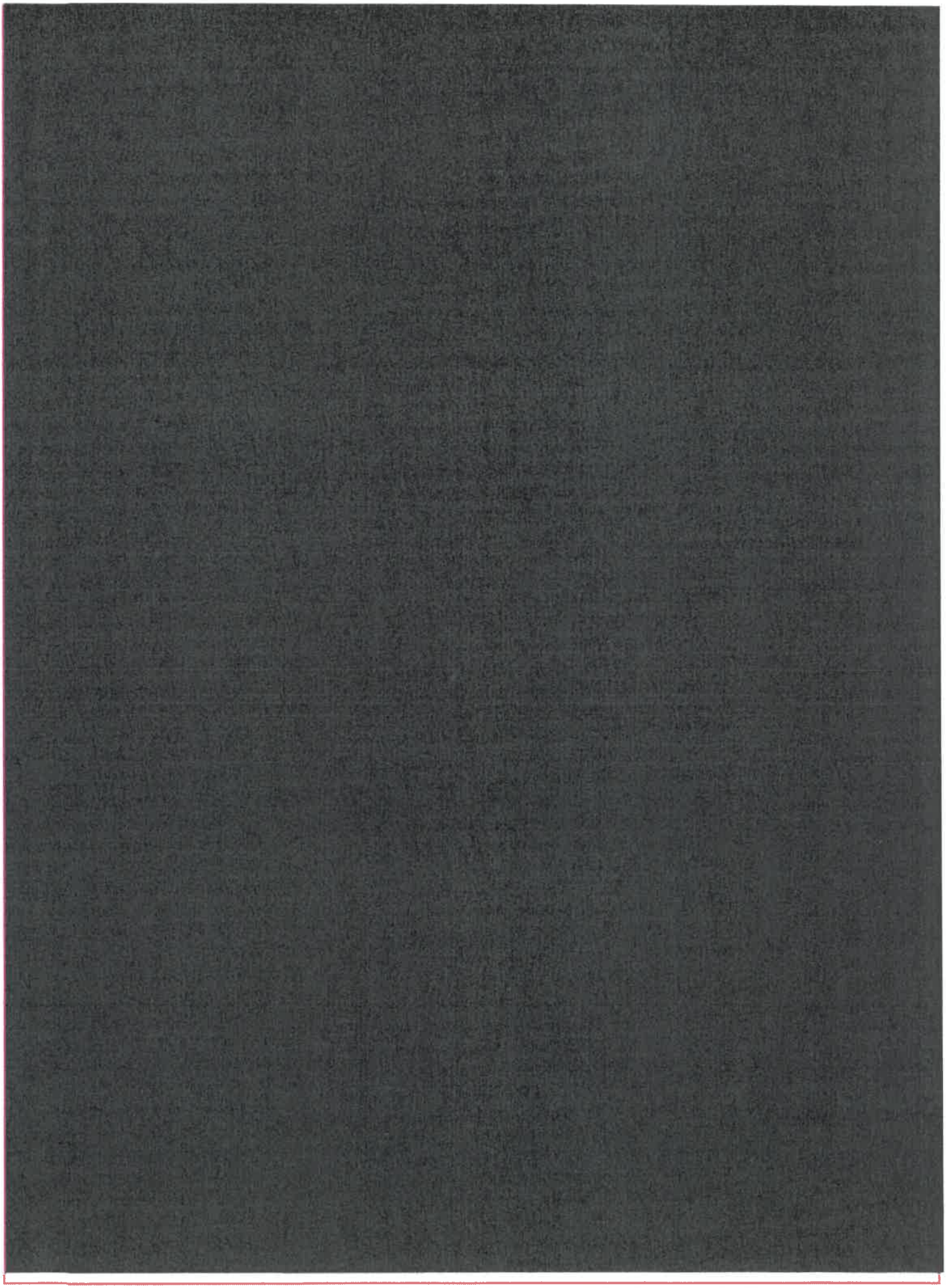
Florida Department of Environmental Protection

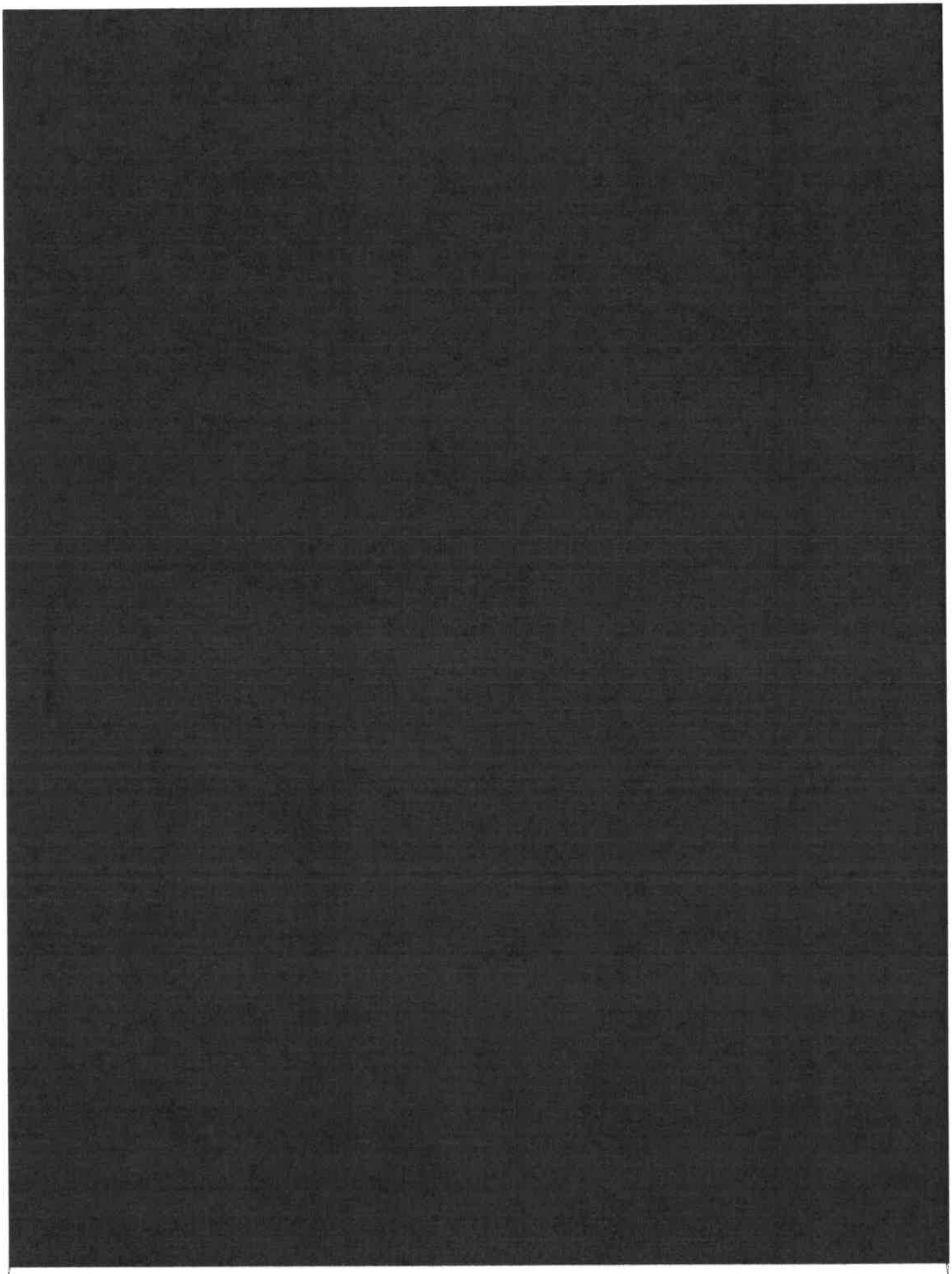
Mead & Hunt

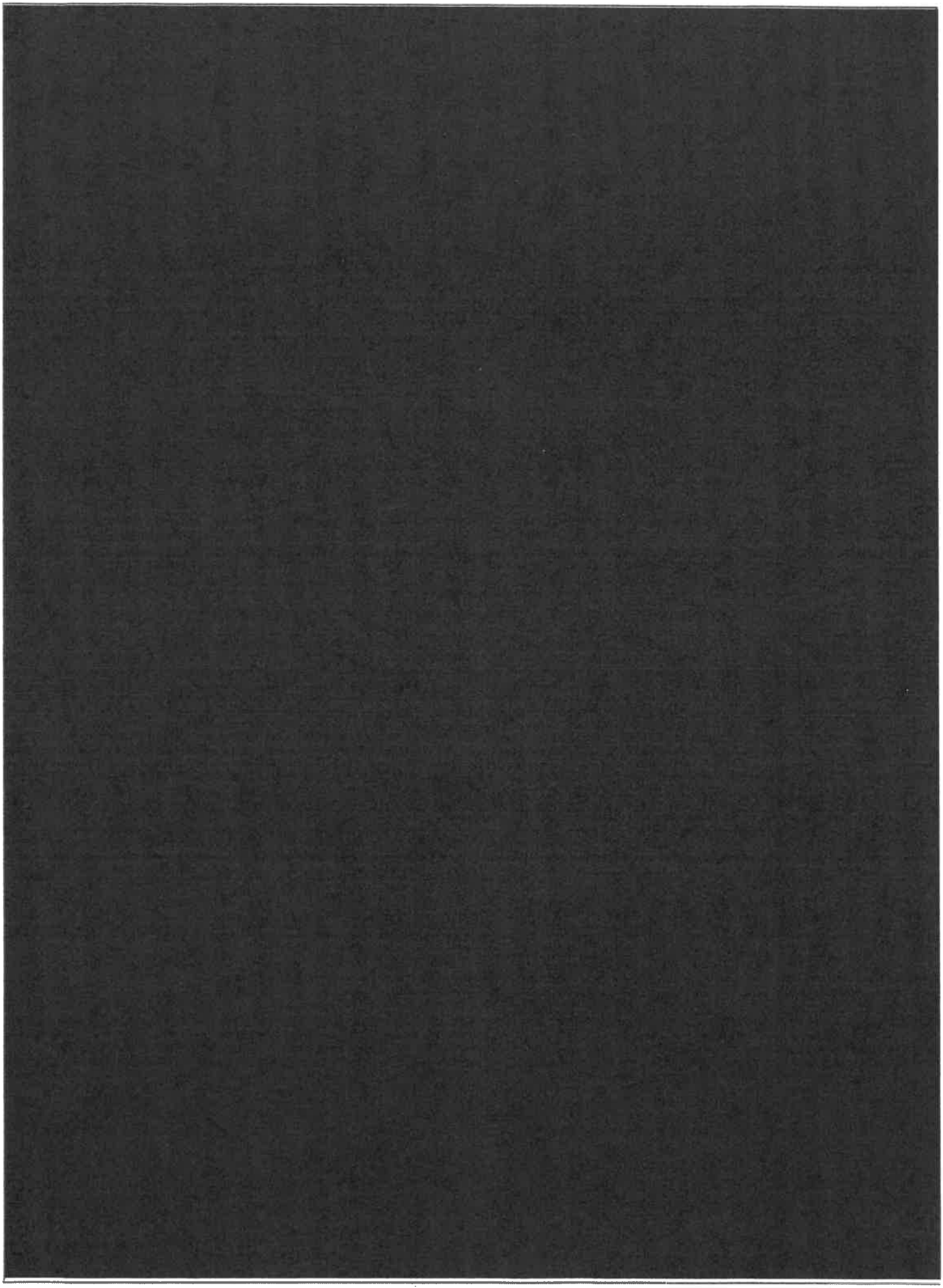
FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri, CGIAR, USGS, Marion County IT GIS, FDEP, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS

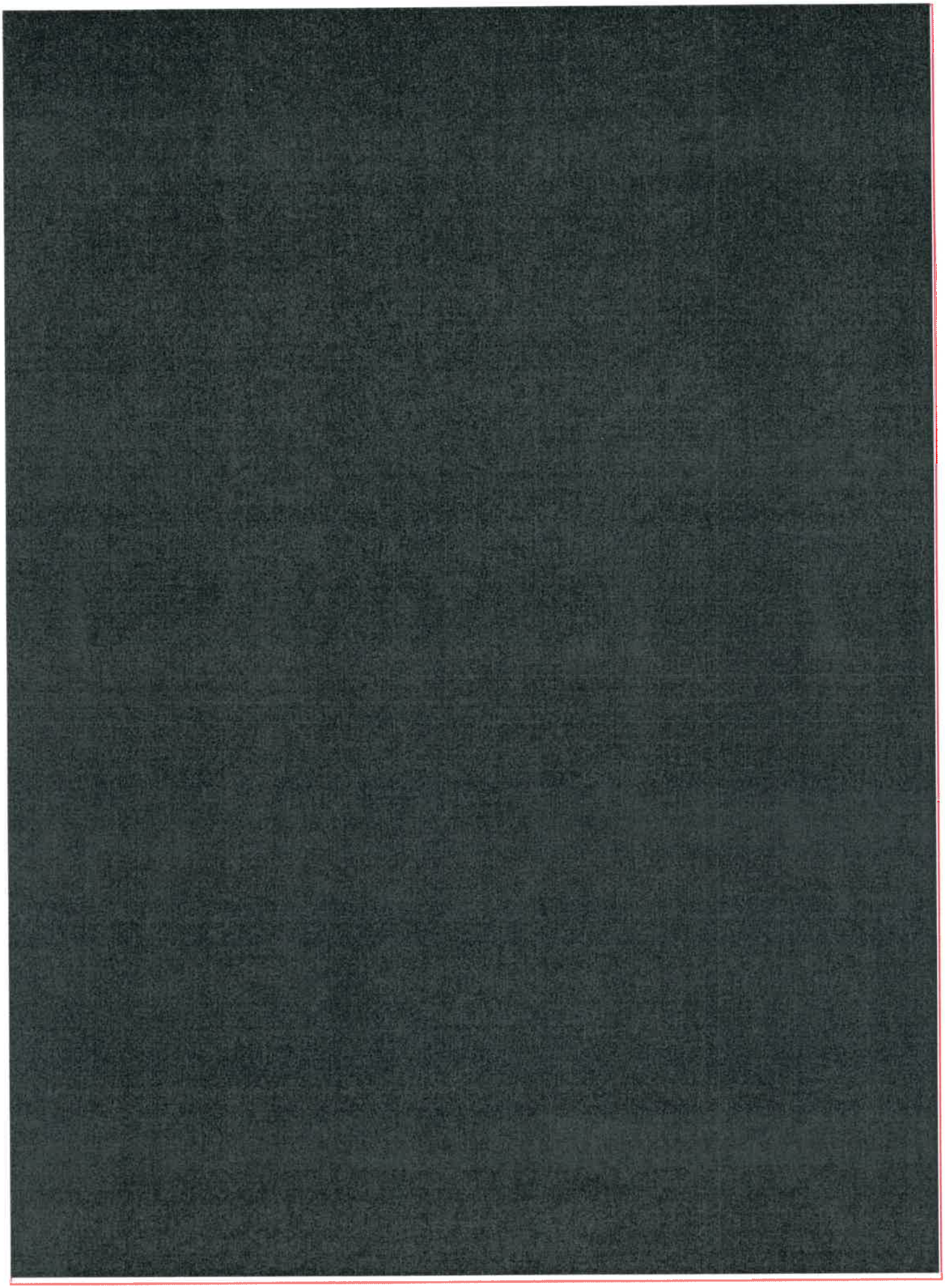
Appendix B. Dam Drawings

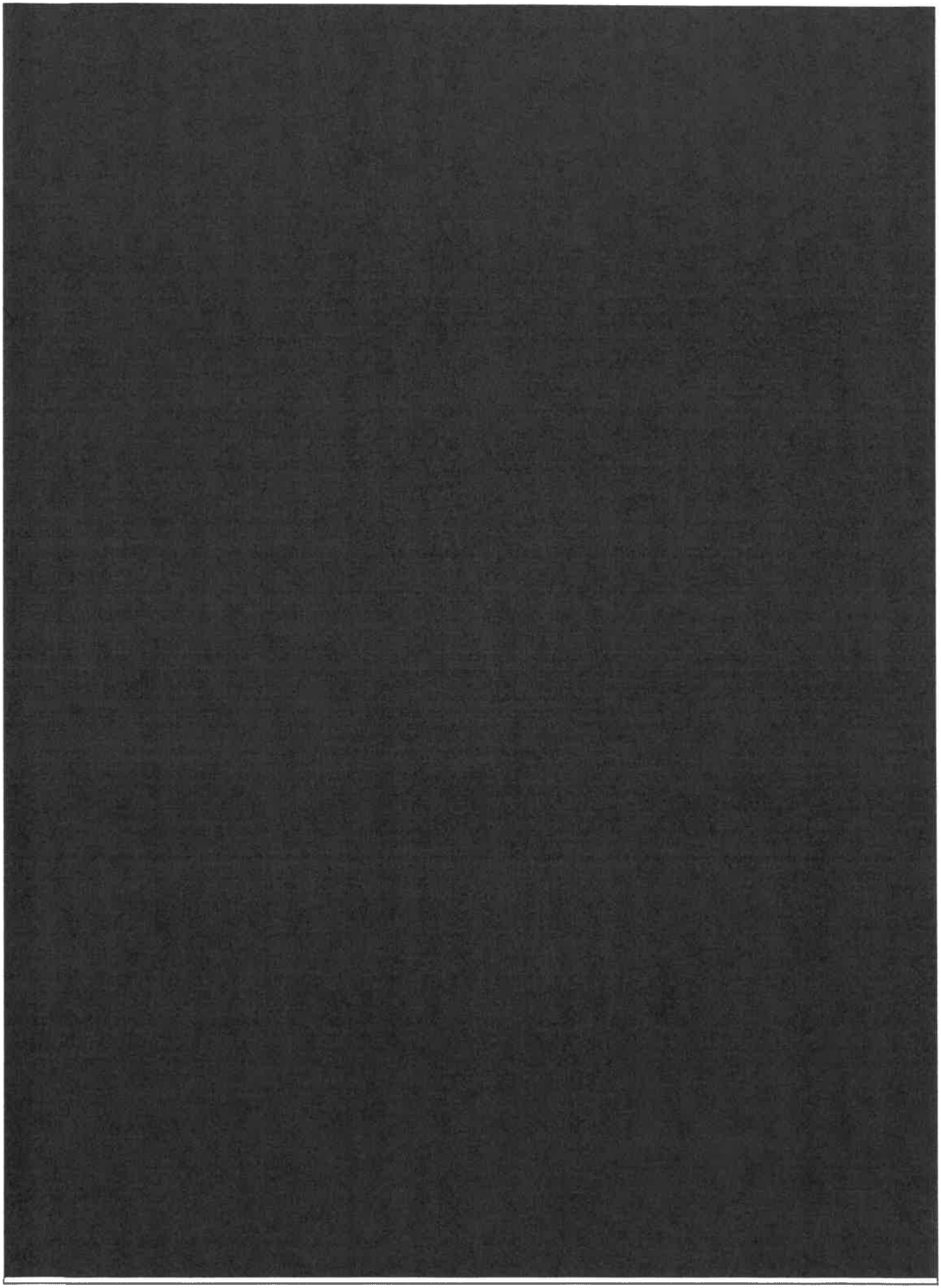


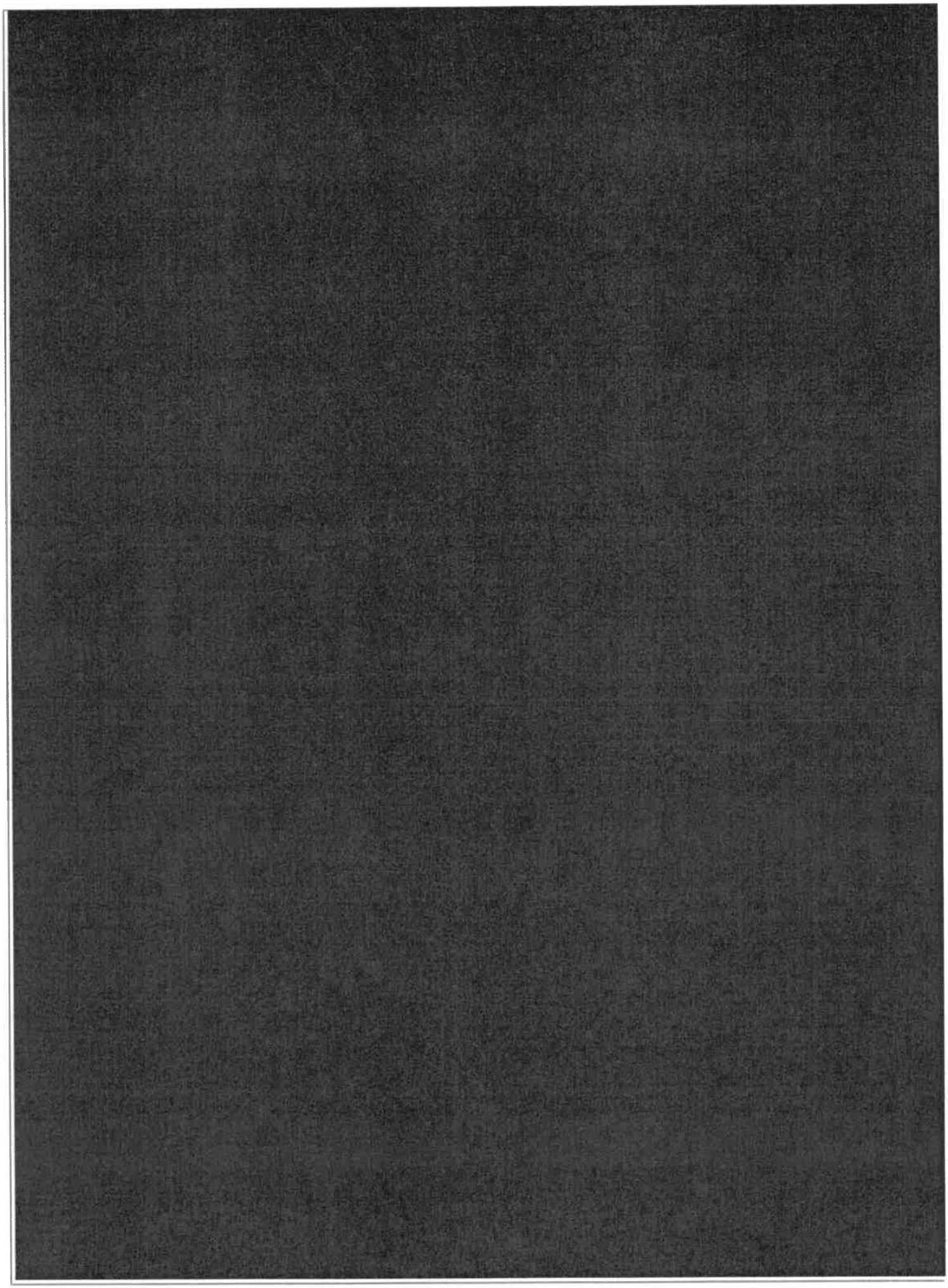


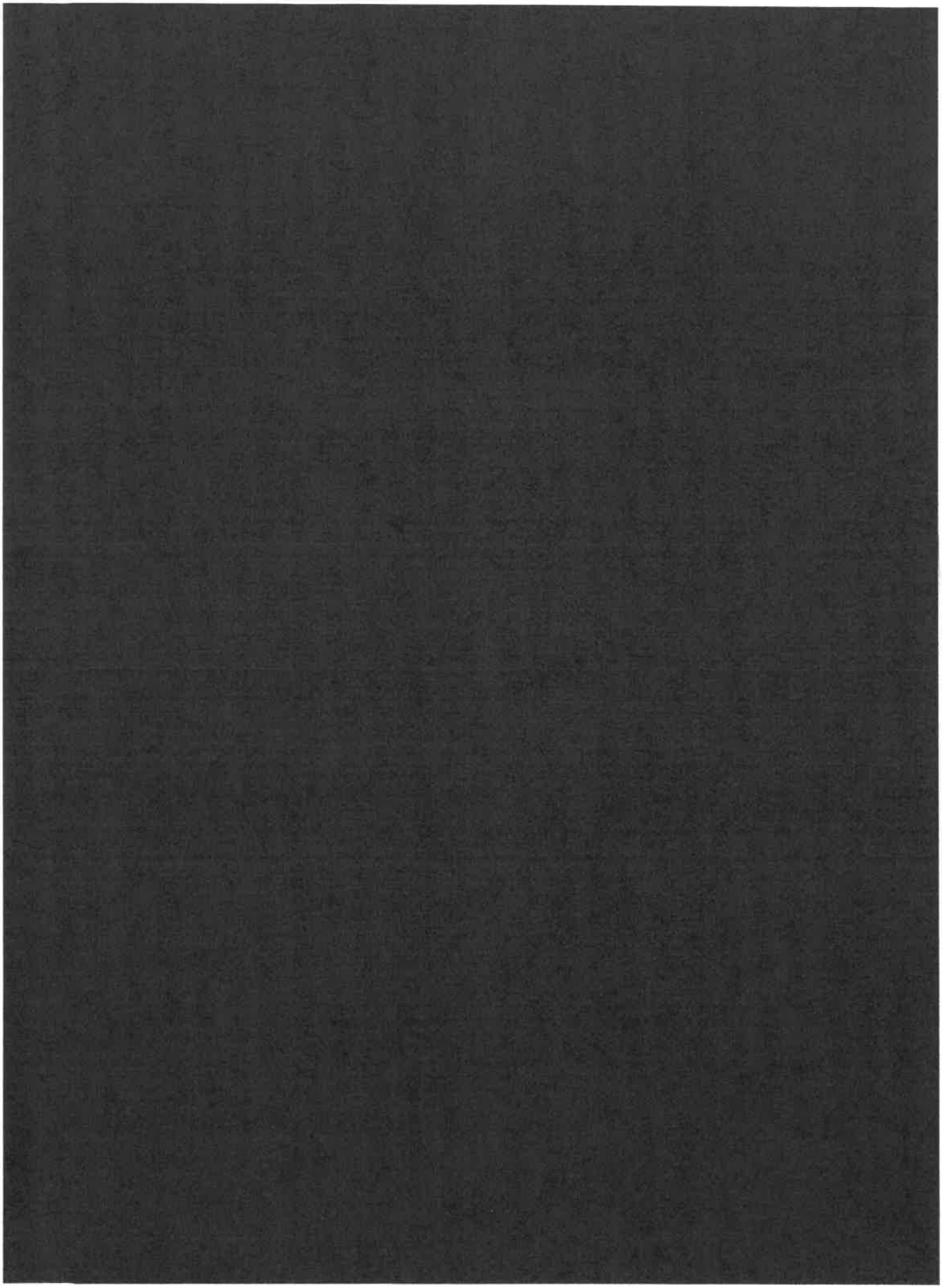


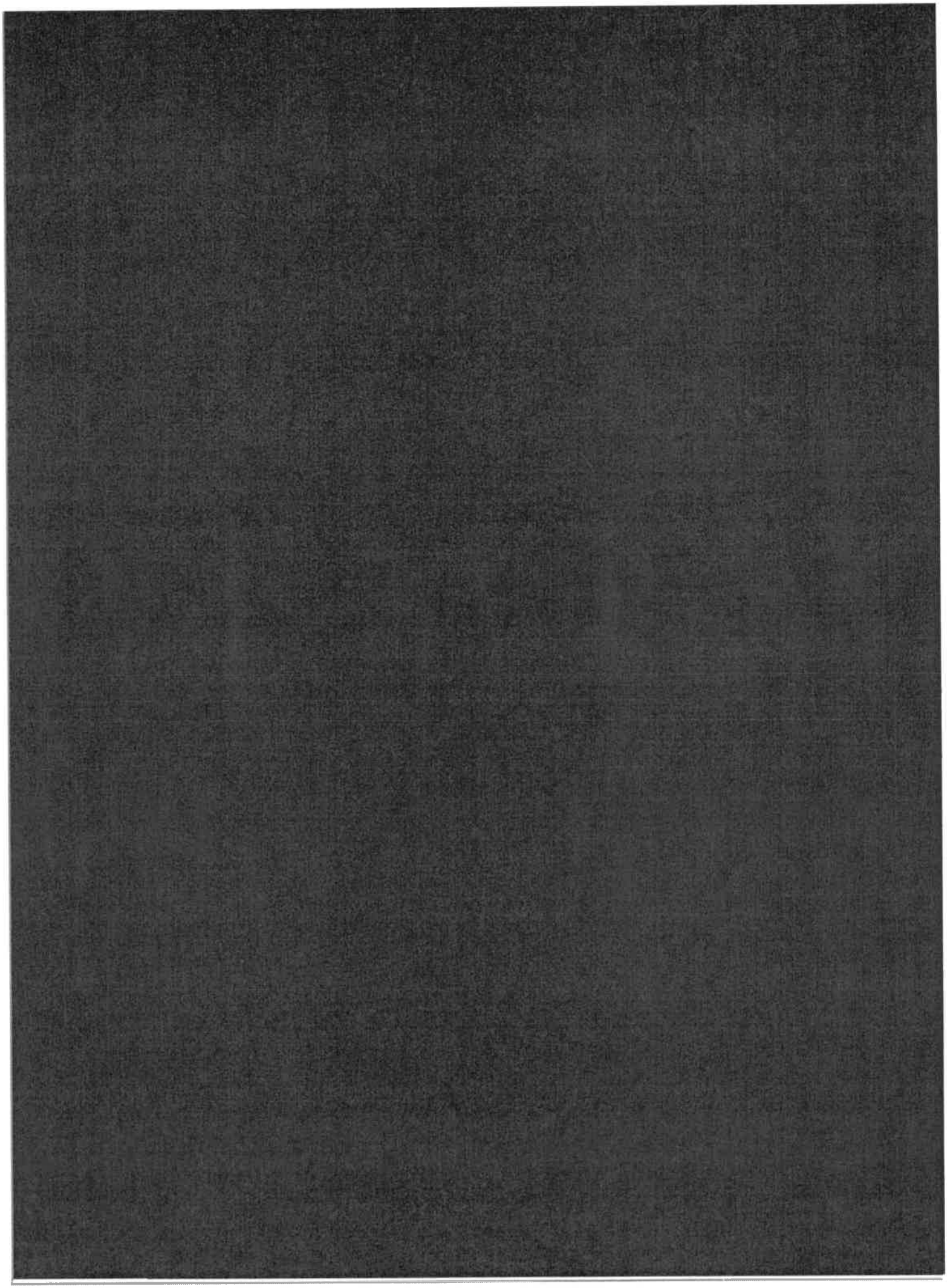


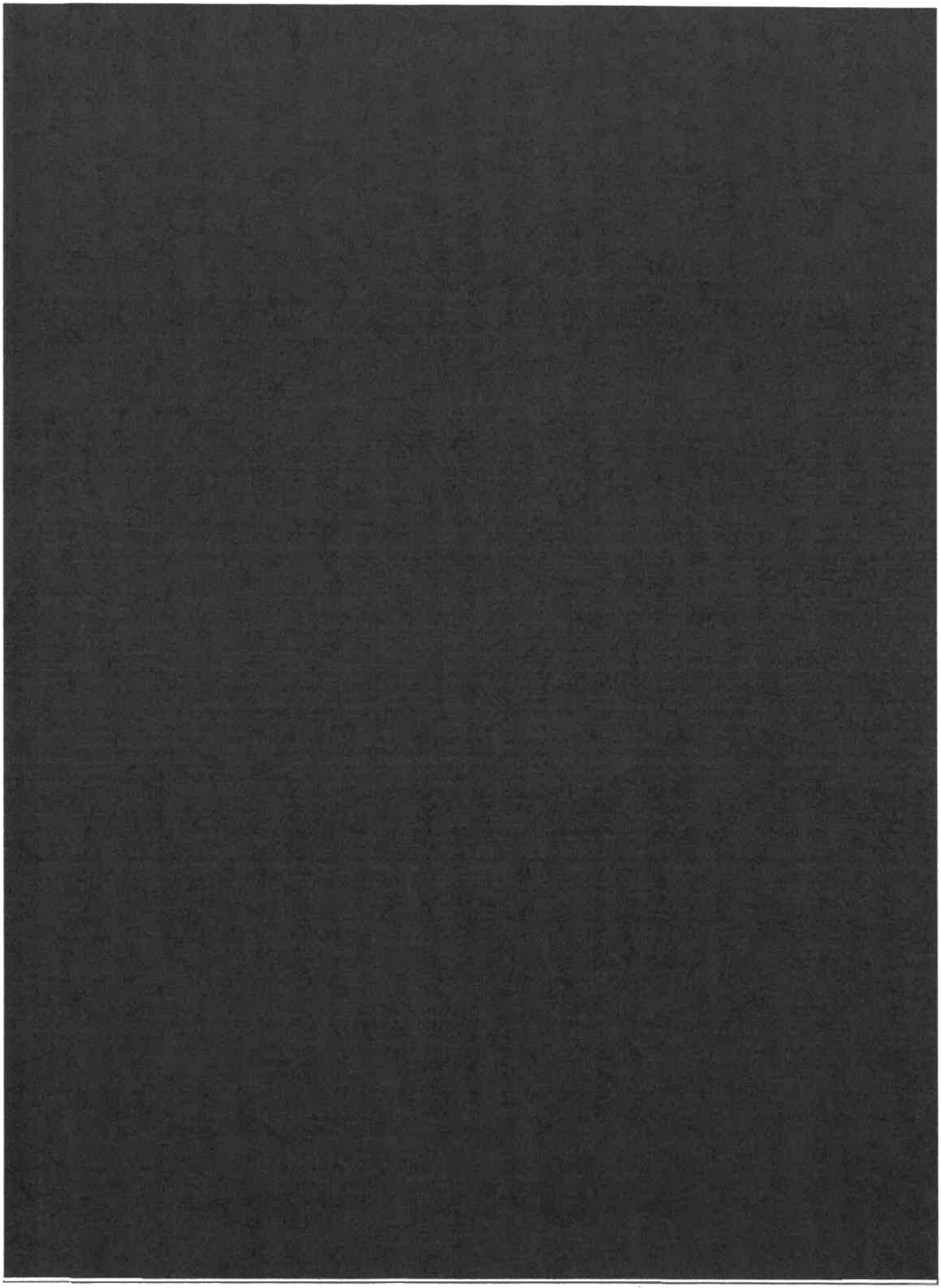


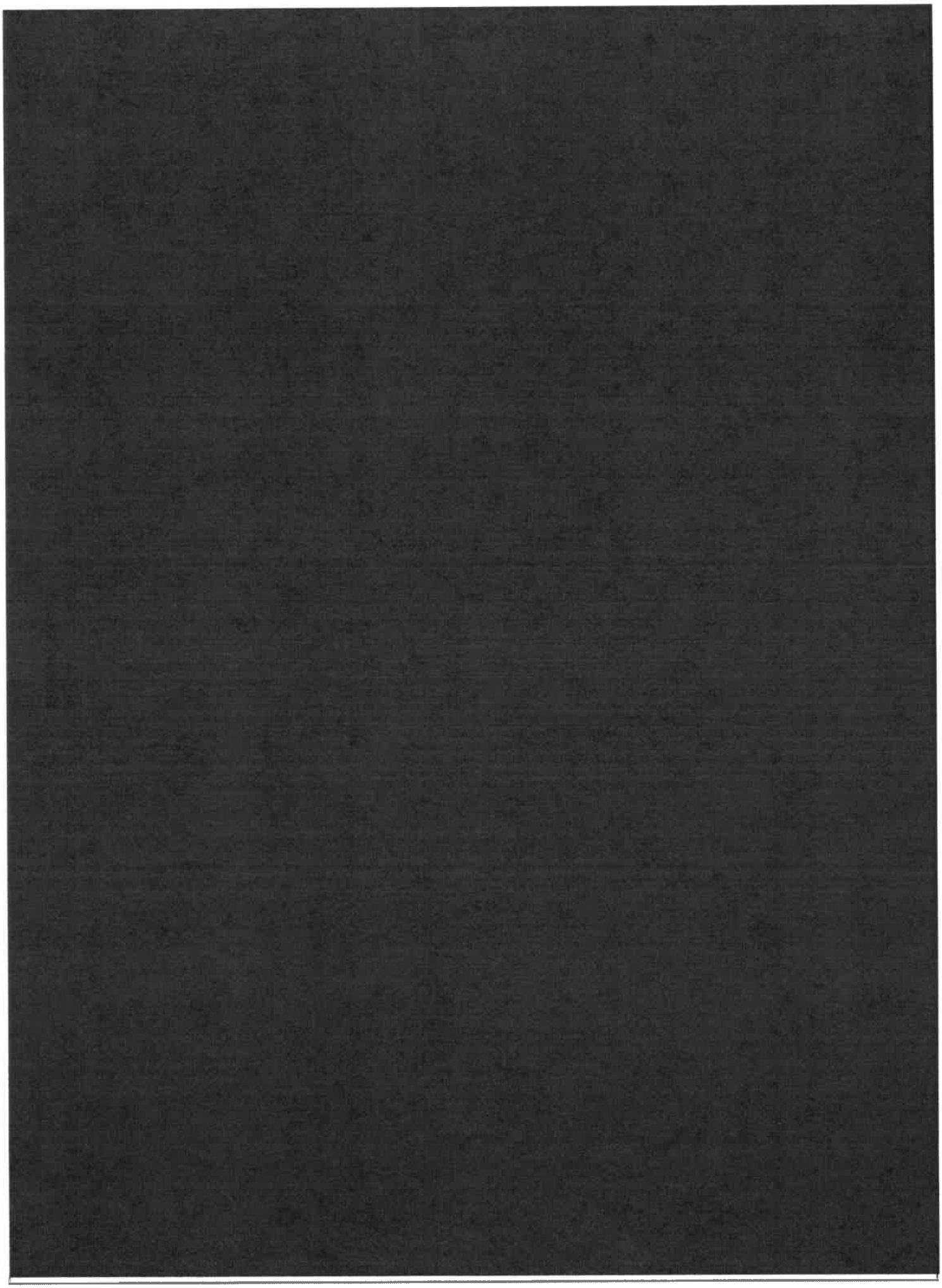


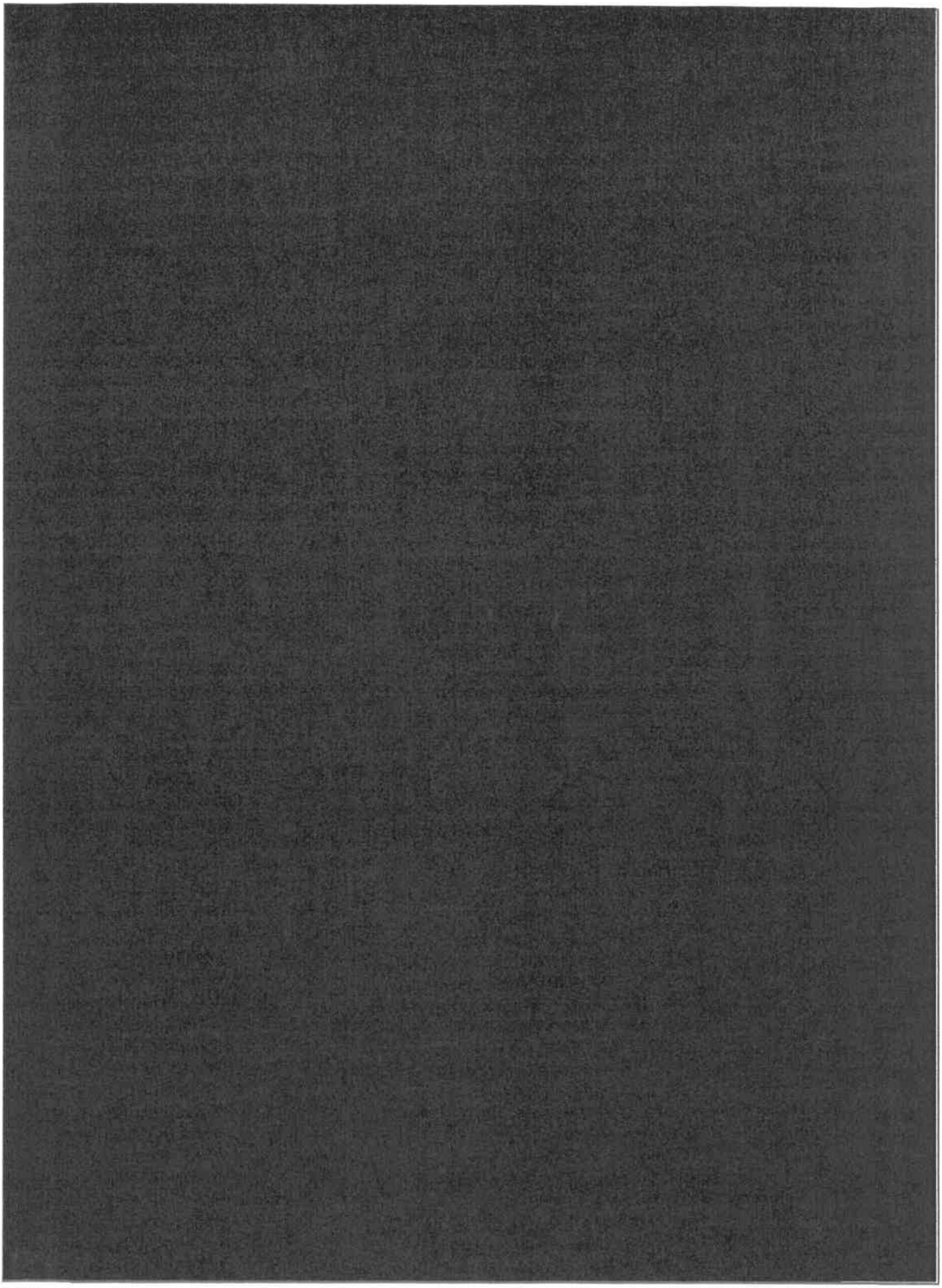


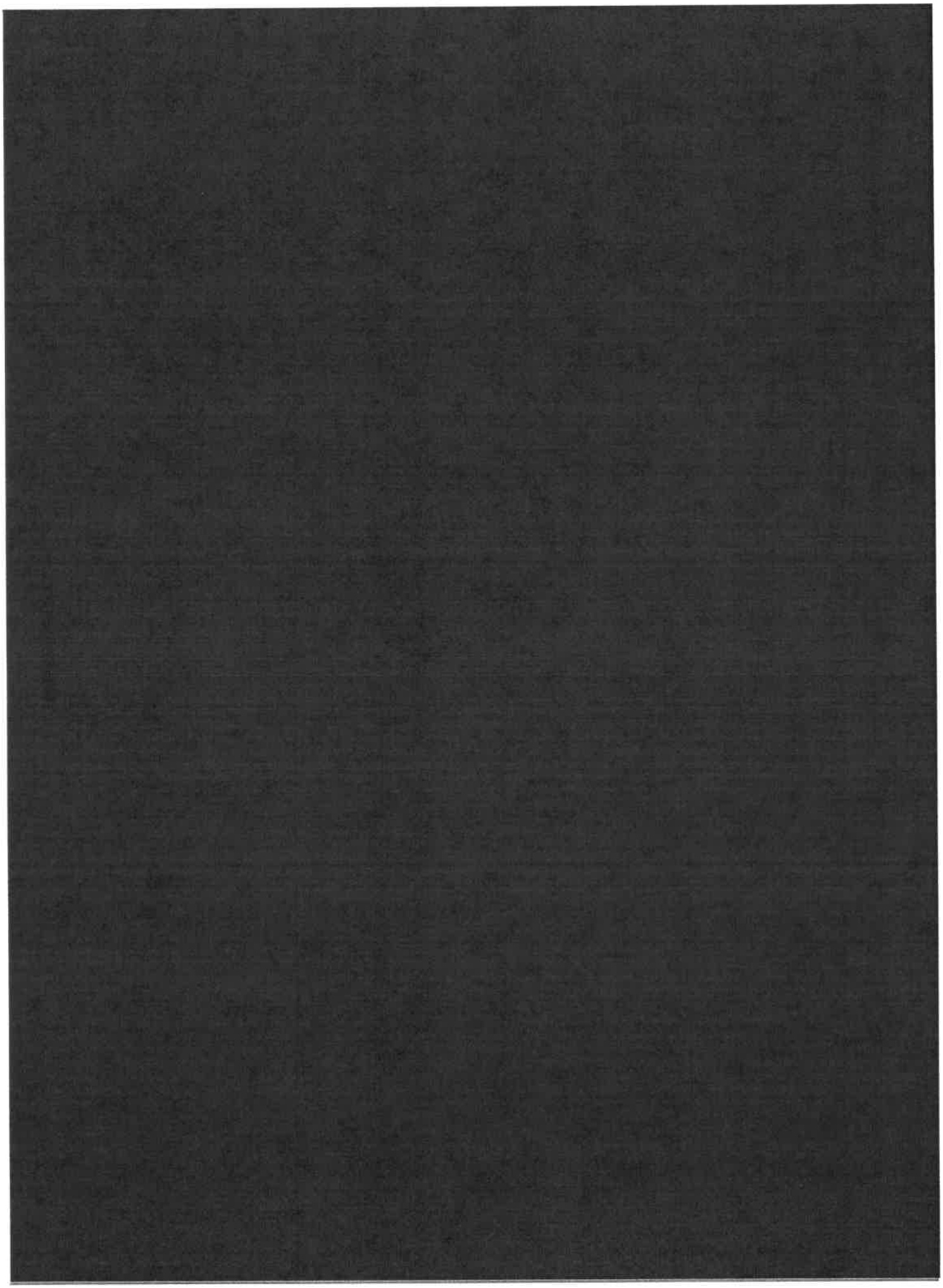


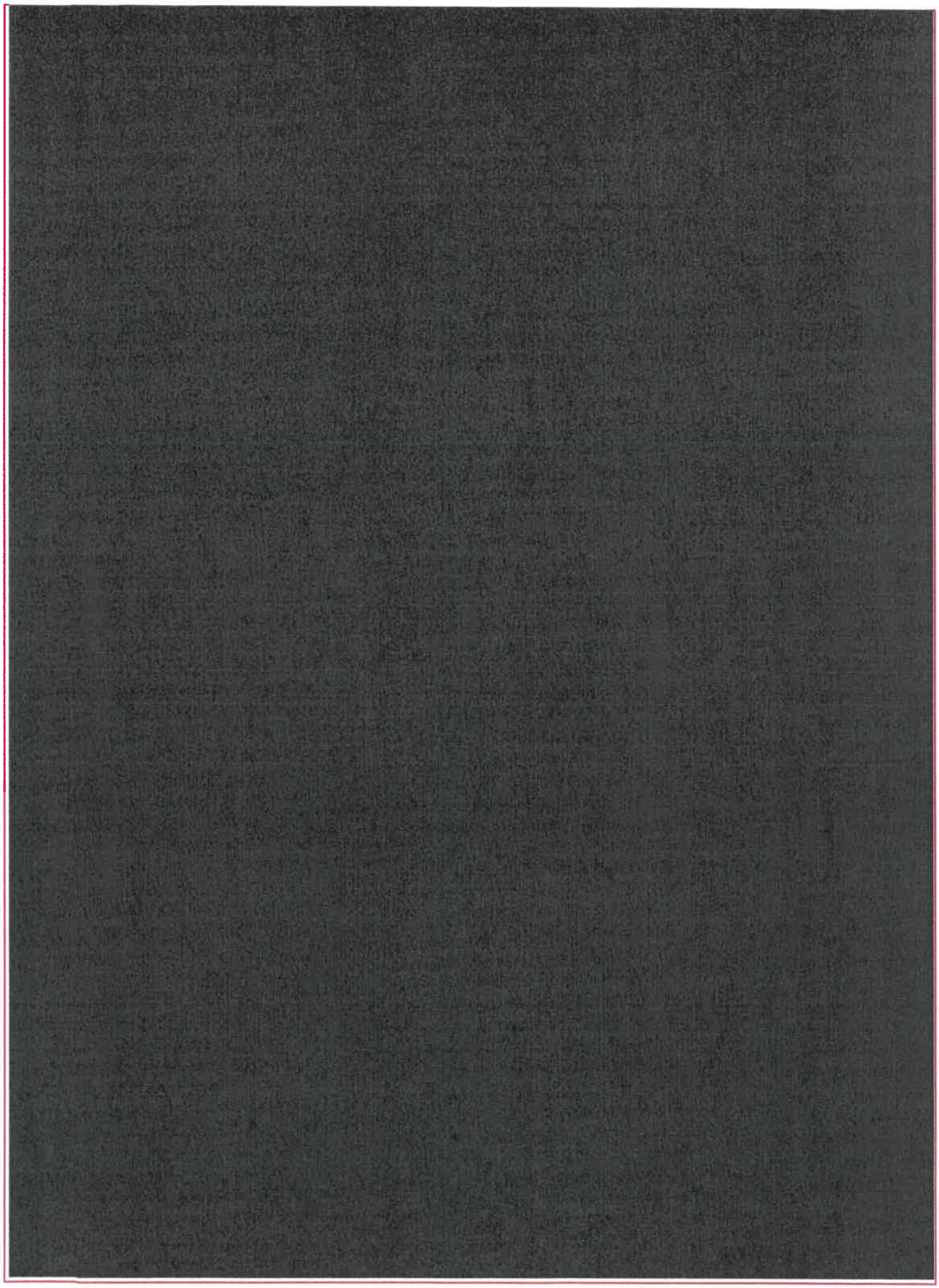


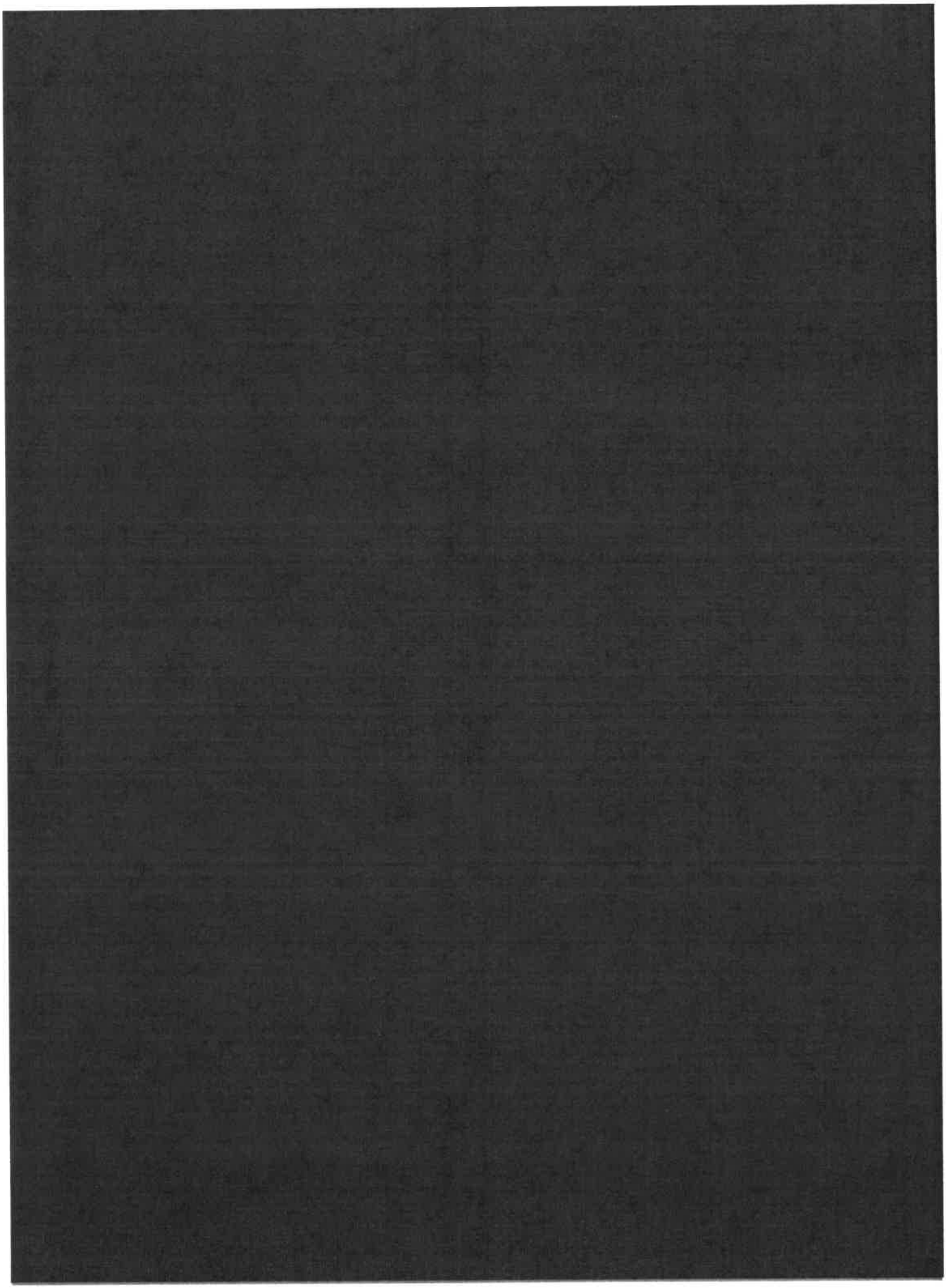


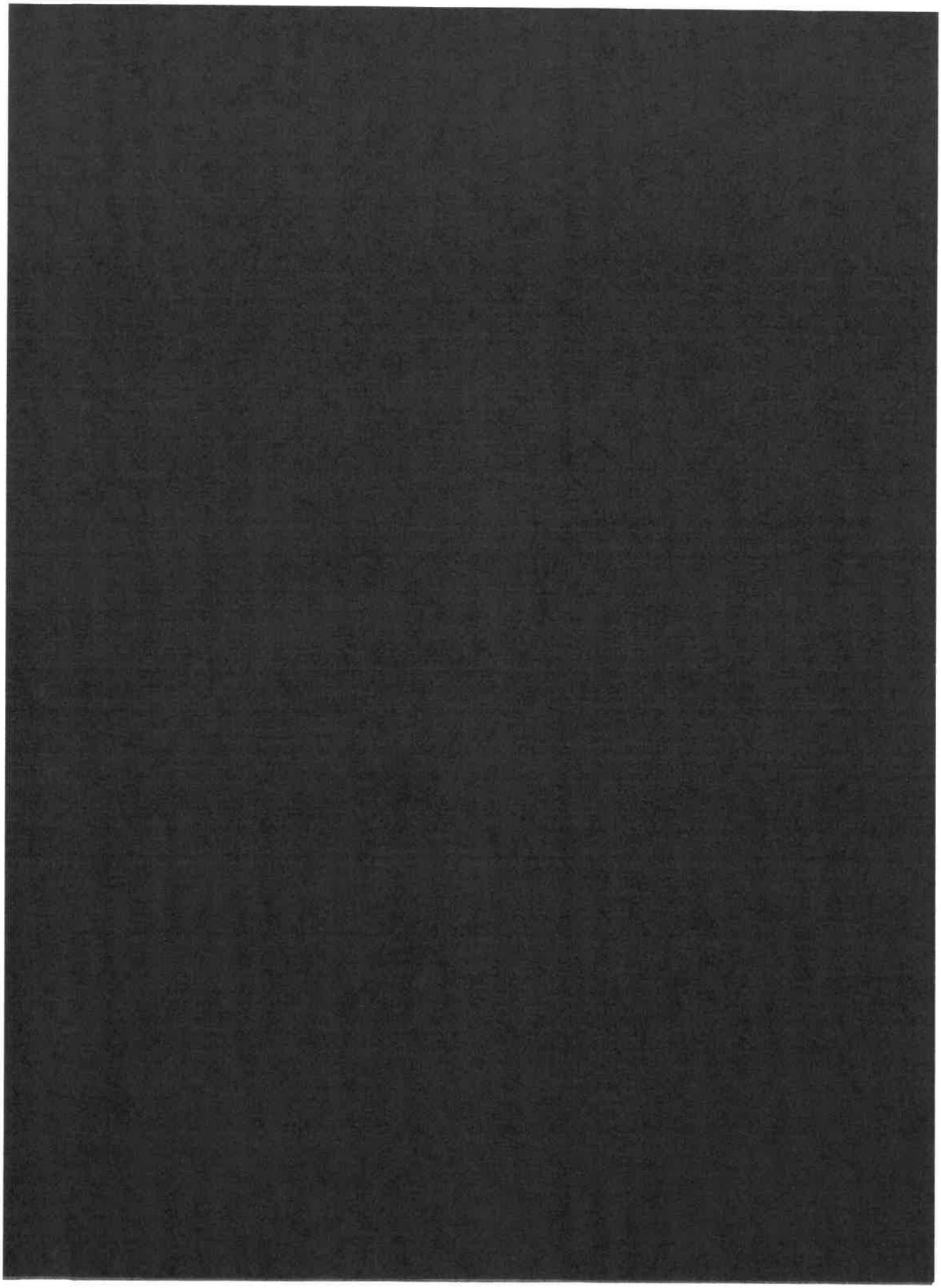


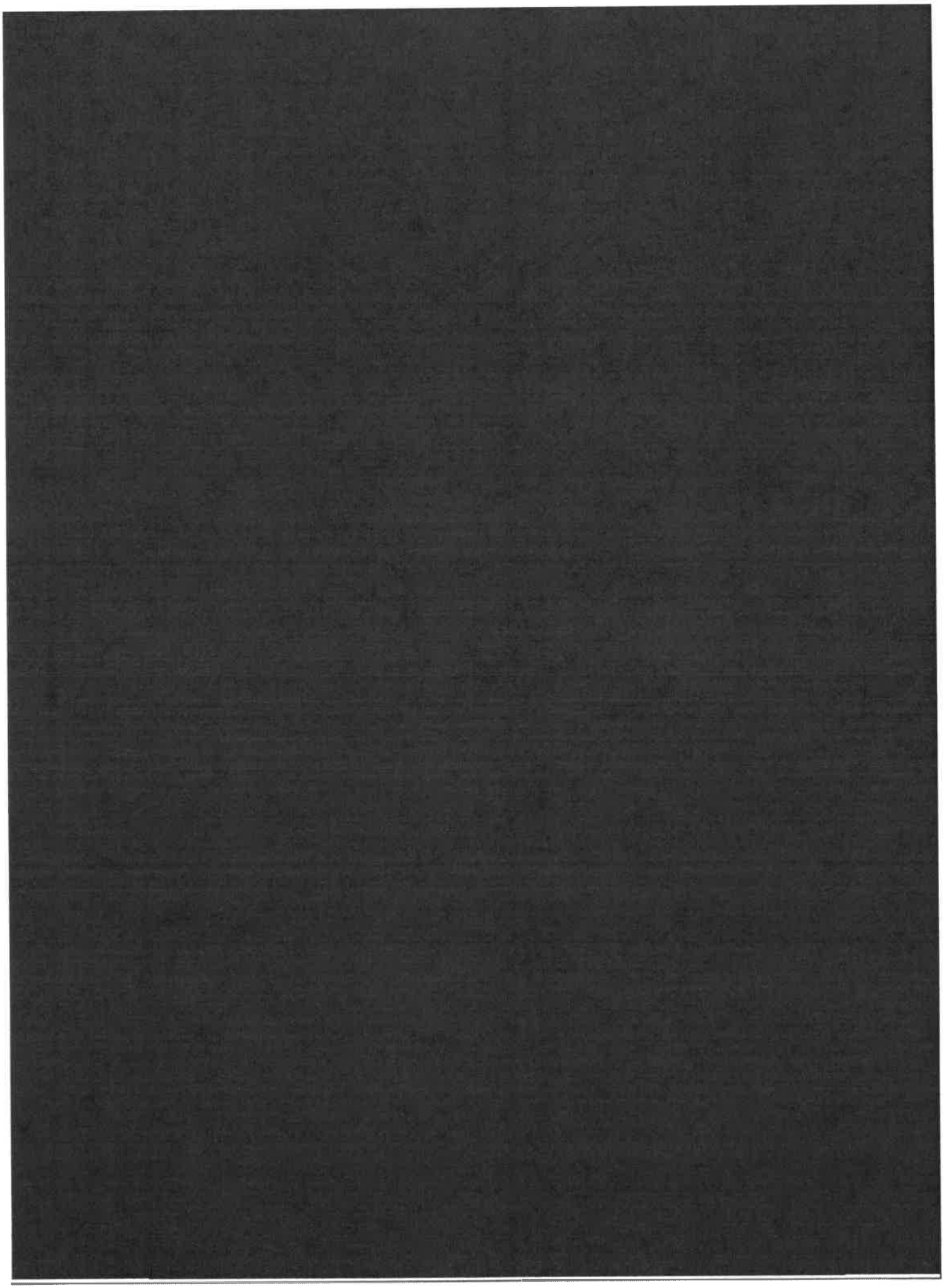


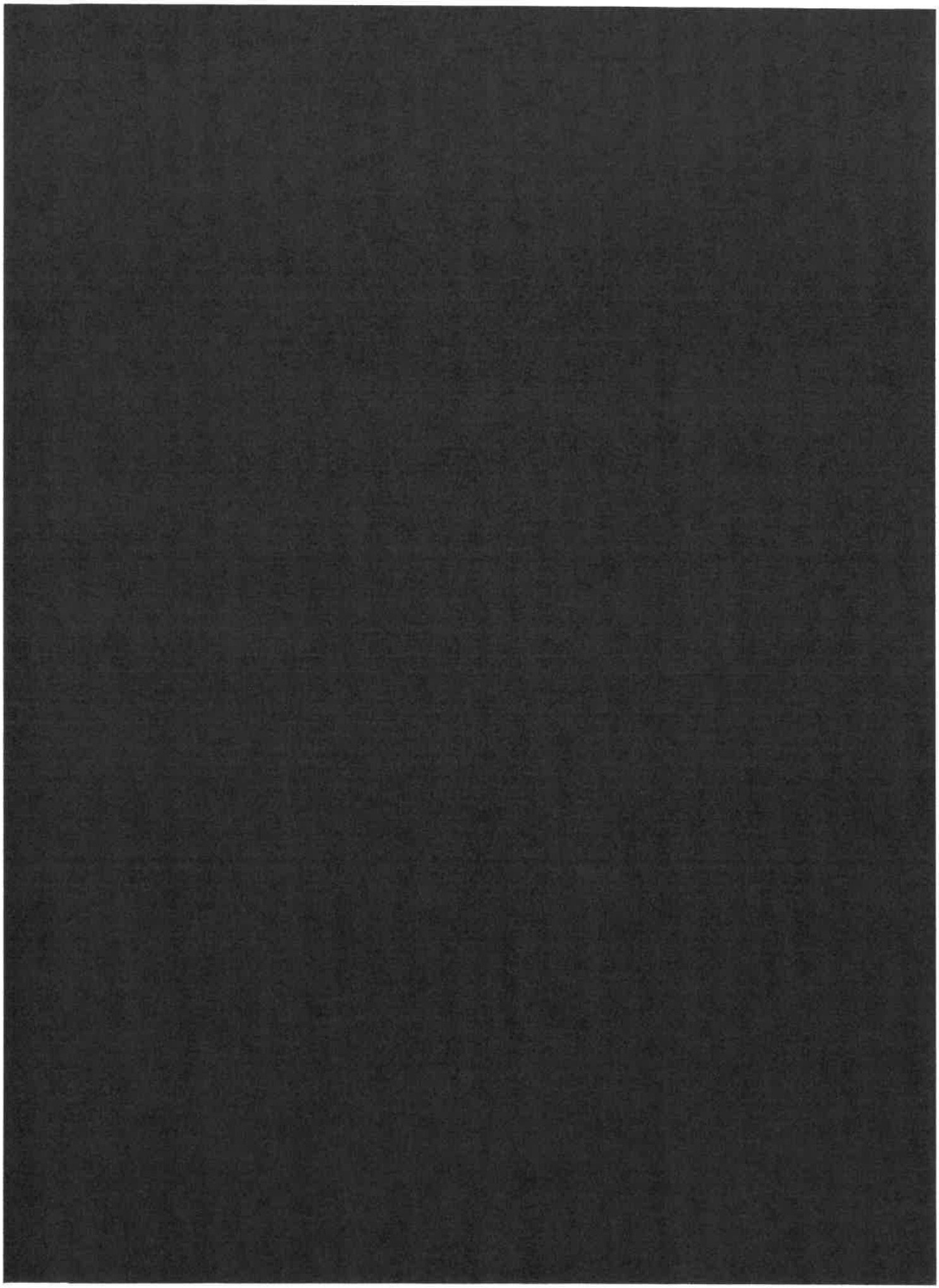


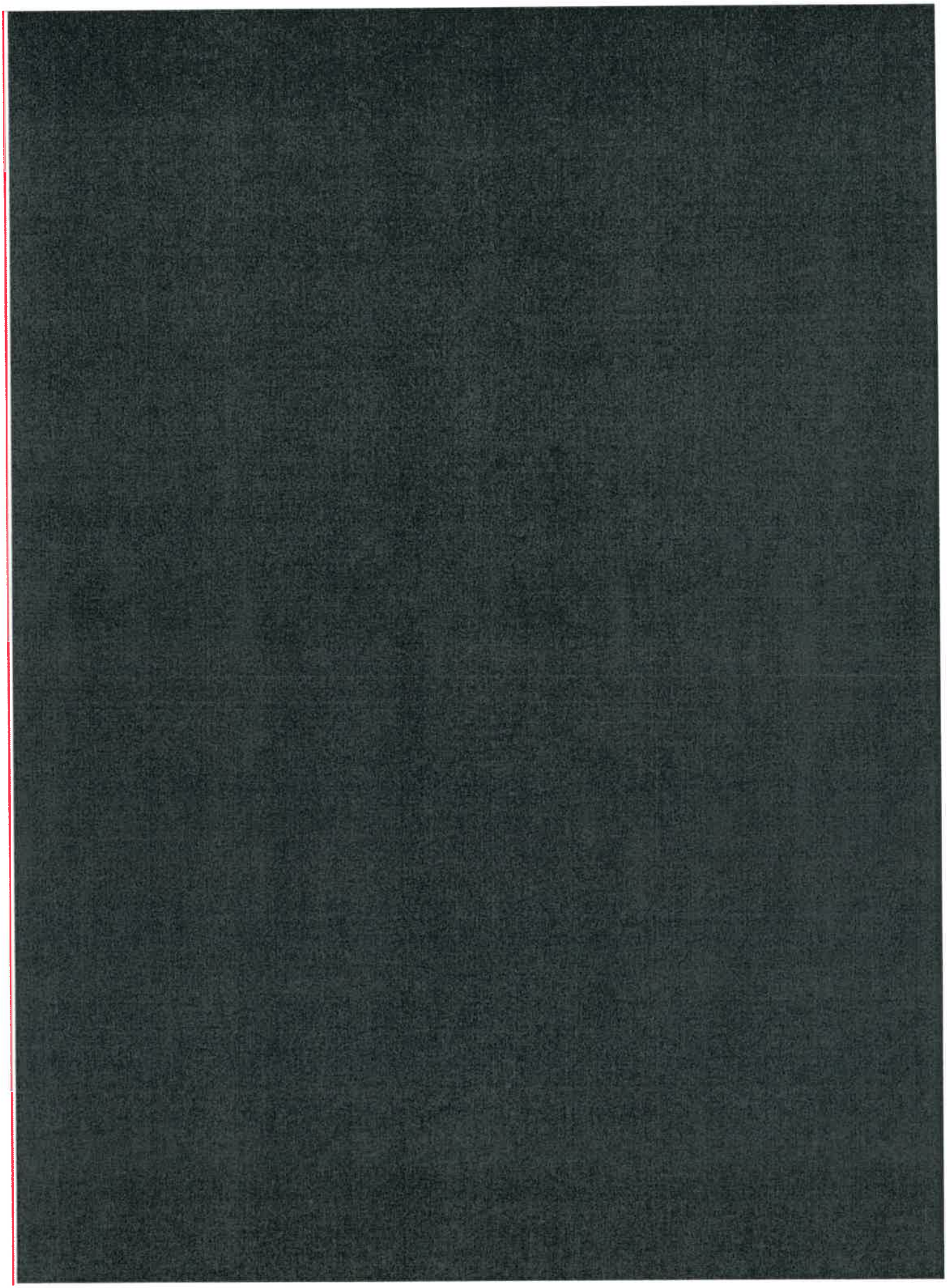




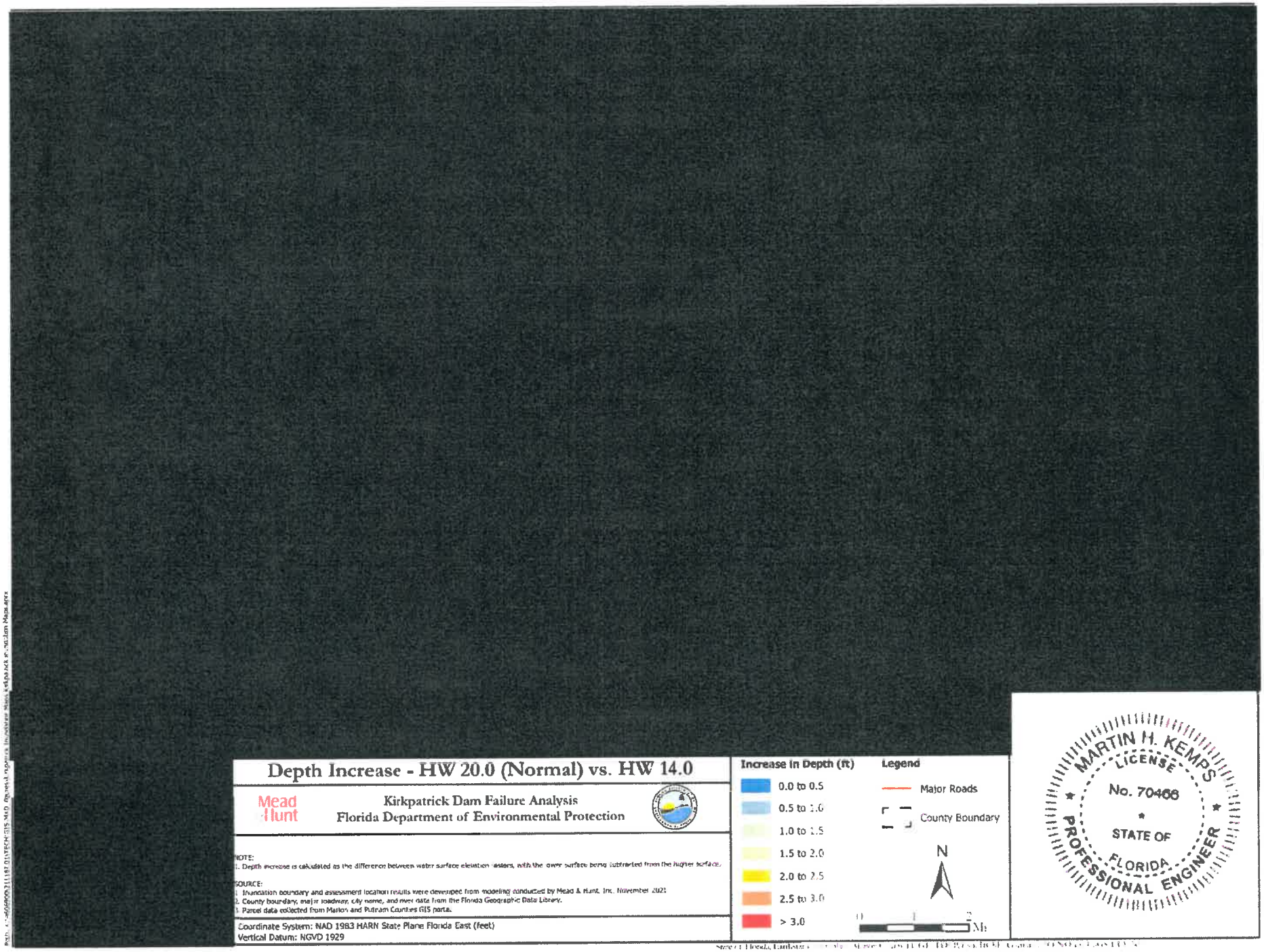








Appendix C. Maps and Exhibits



Depth Increase - HW 20.0 (Normal) vs. HW 14.0

Mead Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. Depth increase is calculated as the difference between water surface elevation rasters, with the lower surface being subtracted from the higher surface.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS parts.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Increase in Depth (ft)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- > 3.0

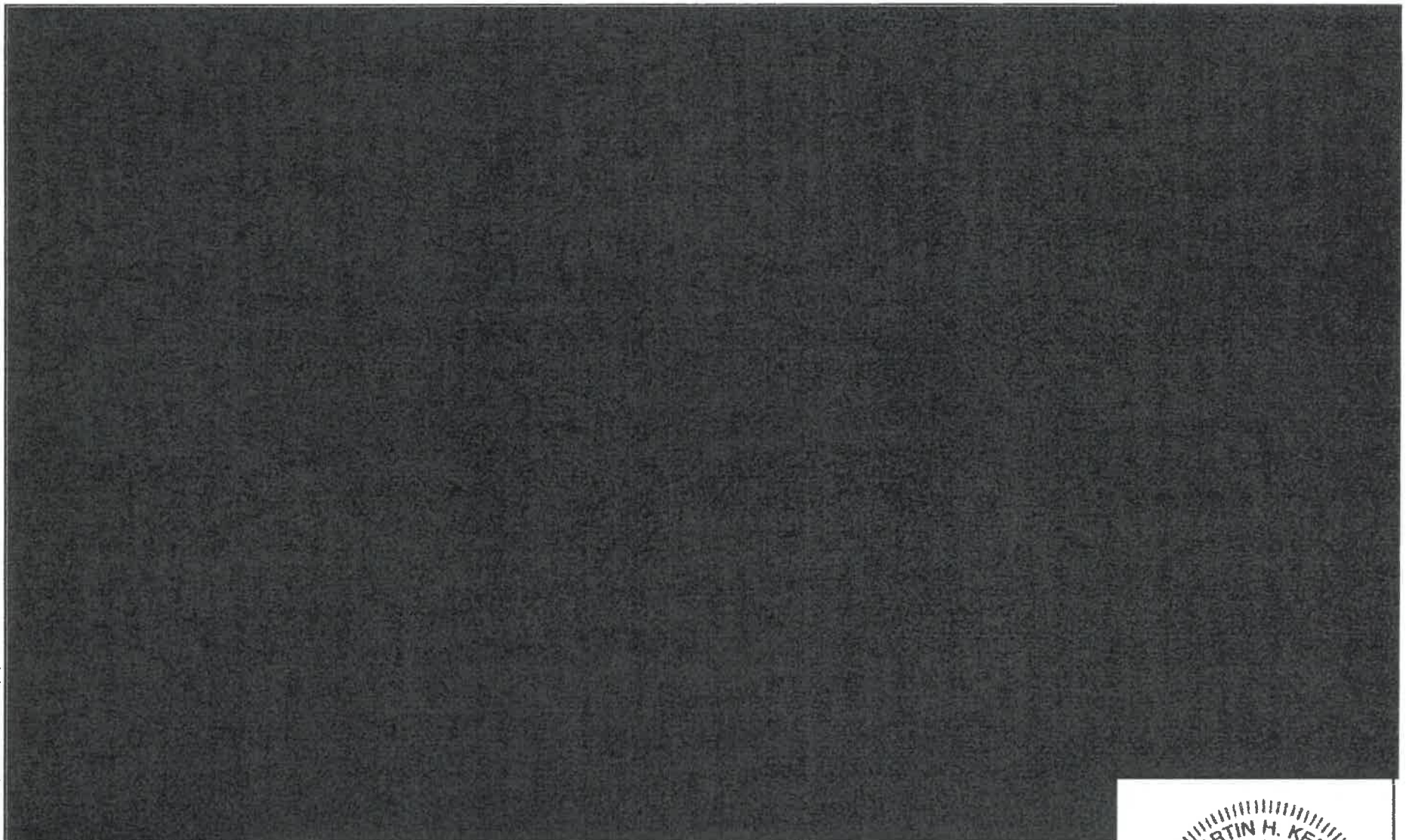
Legend

- Major Roads
- County Boundary

N

0 1 2 Miles

MARTIN H. KEMPS
LICENSE
No. 70466
STATE OF
FLORIDA
PROFESSIONAL ENGINEER



Depth Increase - HW 20.0 (Normal) vs. HW 16.0

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. Depth increase is calculated as the difference between water surface elevation rasters, with the lower surface being subtracted from the higher surface.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Increase in Depth (ft)
- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- > 3.0

Legend
- Major Roads
- County Boundary

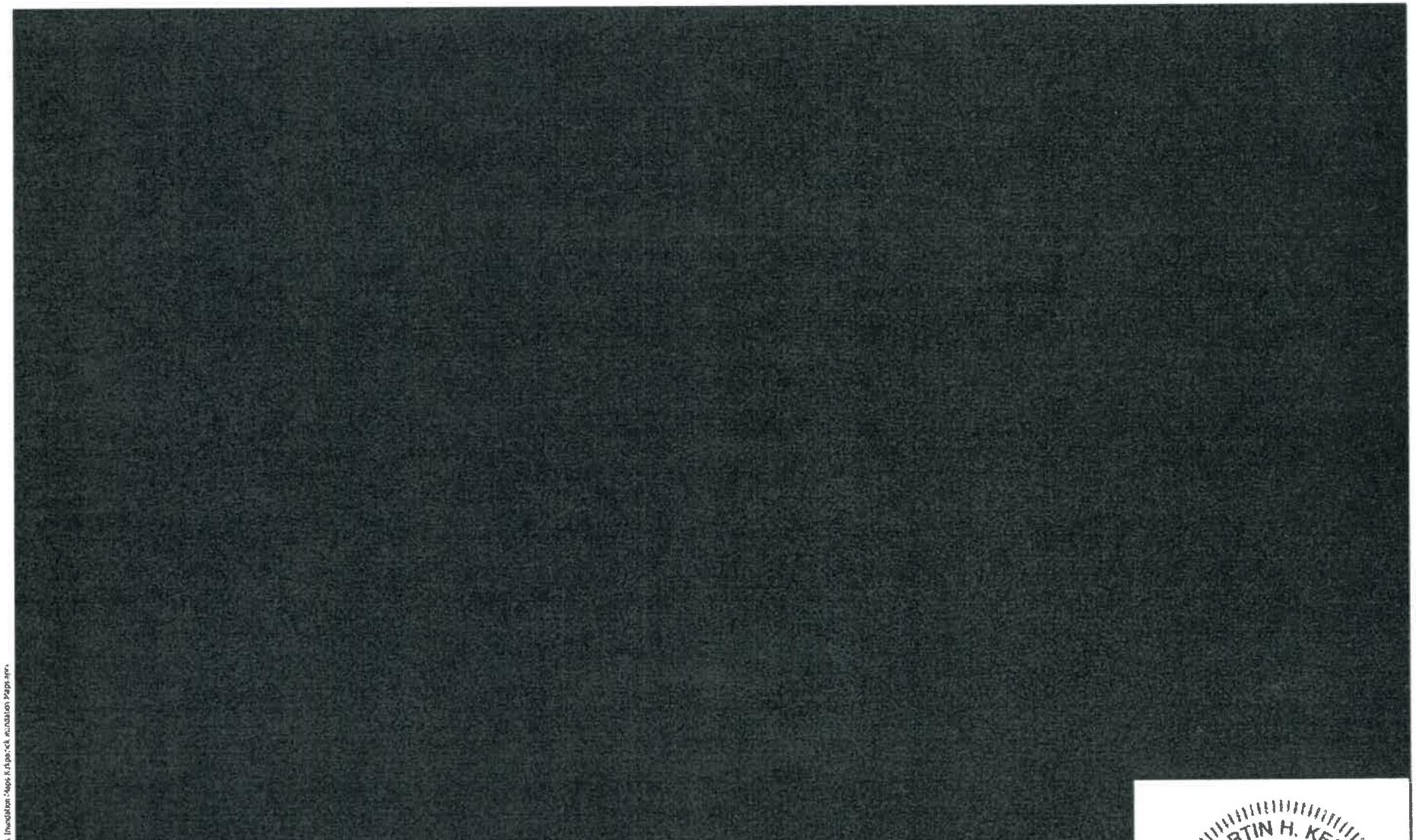
N

0 1 2 Mi

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Path: X:\46069002111187.01\TECH\GIS\MXD\Figures\Kirkpatrick Inundation Maps Kirkpatrick Inundation Maps.aprx

State of Florida, Earthstar Geographics, FL GIS, FDOT, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS



Depth Increase - HW 20.0 (Normal) vs. HW 18.0

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. Depth increase is calculated as the difference between water surface elevation rasters, with the lower surface being subtracted from the higher surface.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

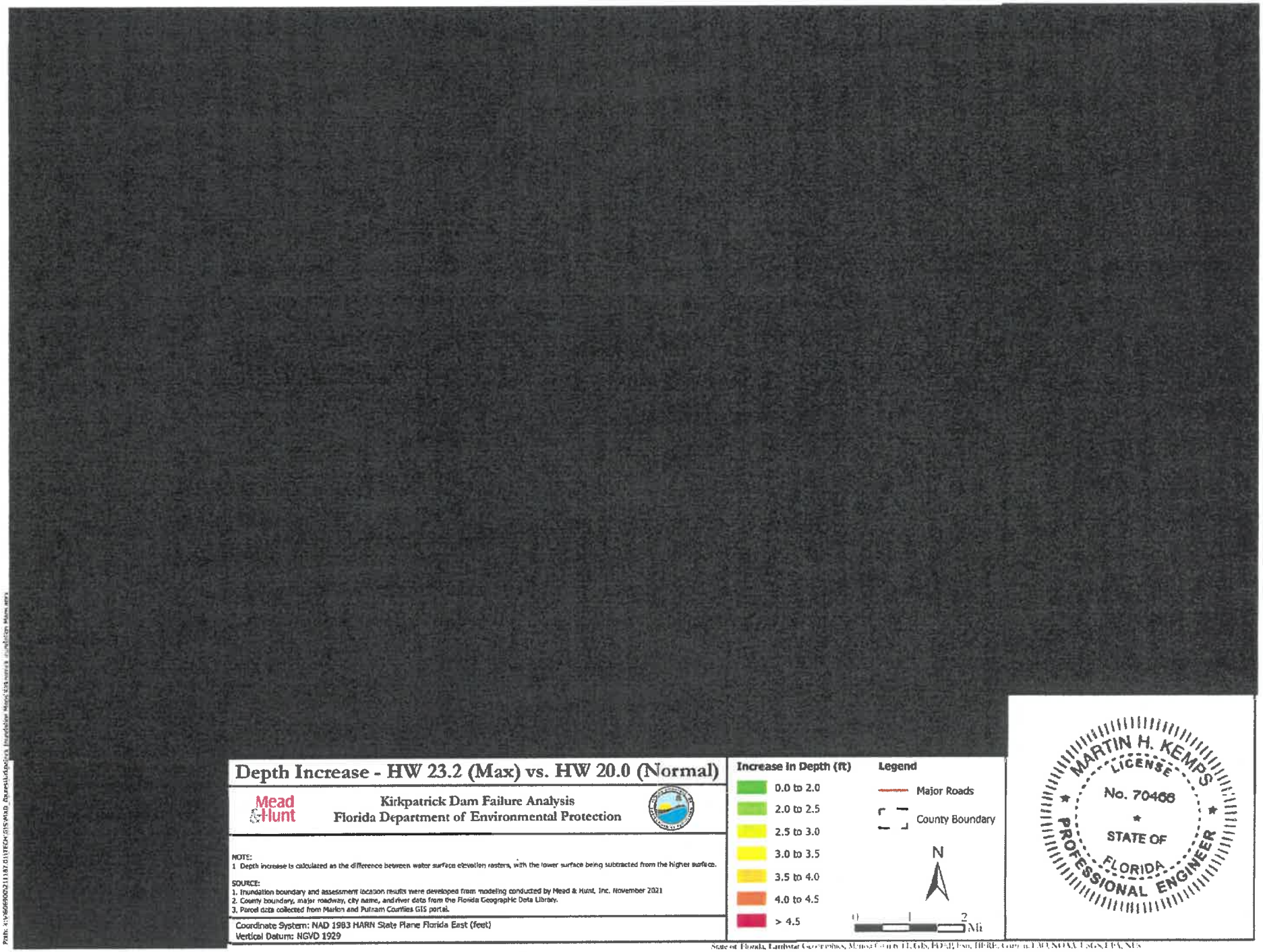
Increase in Depth (ft)
- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- > 3.0

Legend
- Major Roads
- County Boundary

N

0 1 2 Mi

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER



Depth Increase - HW 23.2 (Max) vs. HW 20.0 (Normal)

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1 Depth increase is calculated as the difference between water surface elevation rasters, with the lower surface being subtracted from the higher surface.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Increase in Depth (ft)

- 0.0 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5
- 3.5 to 4.0
- 4.0 to 4.5
- > 4.5

Legend

- Major Roads
- County Boundary

N

0 1 2 Mi

MARTIN H. KEMPS
LICENSE
No. 70466
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

State of Florida, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS

Dam Failure Inundation Map - Pool 14.0

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. The limits of flooding and the travel times shown on this map are approximate and should be used solely as a guideline for establishing evacuation zones. The actual evacuation zones may be greater or smaller than the flooded area shown on the map.
2. A parcel is designated as "affected" if it contains a habitable structure within the inundation extents.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc, November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portals.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

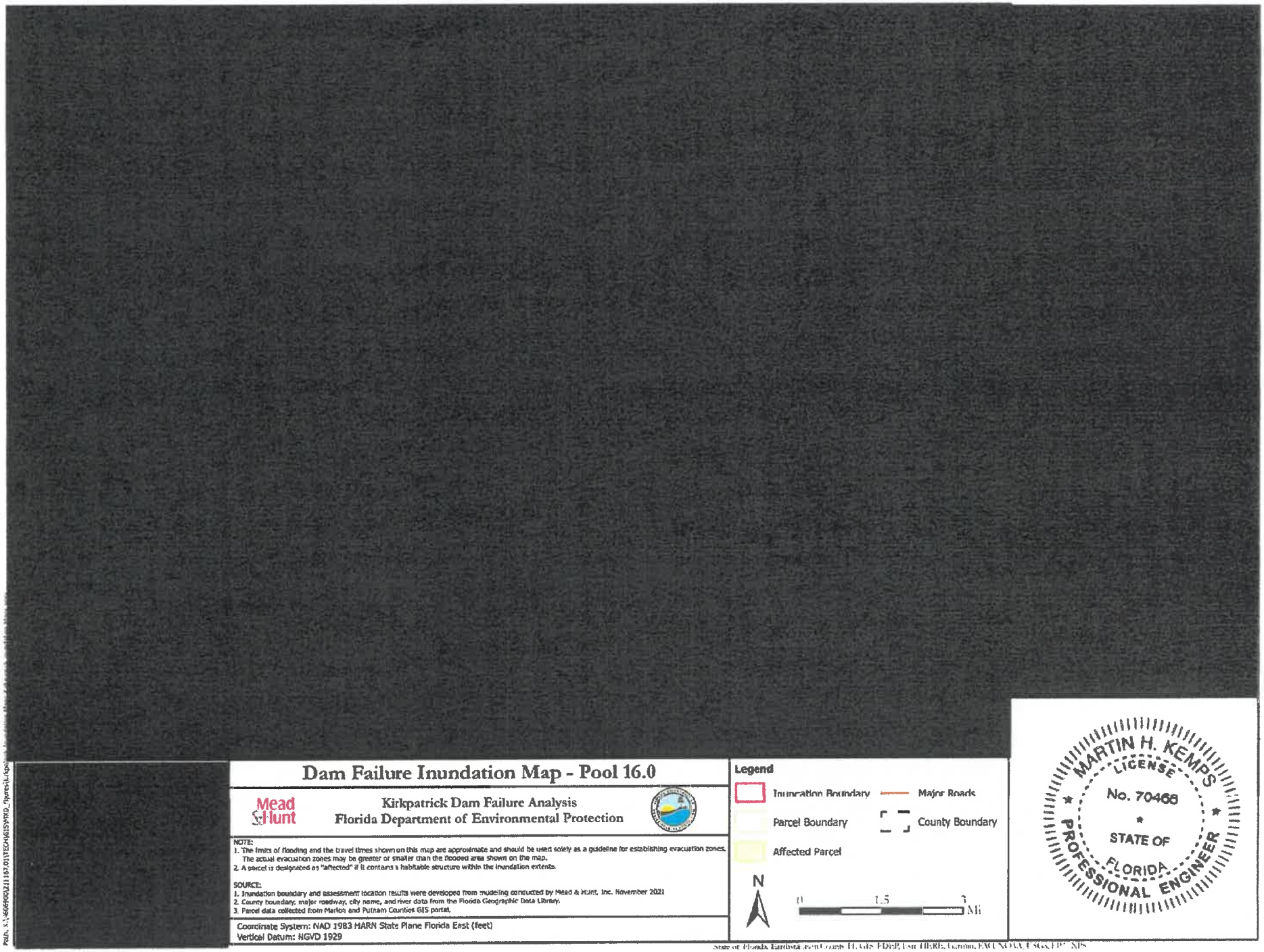
Legend

- Inundation Boundary
- Parcel Boundary
- Affected Parcel
- Major Roads
- County Boundary

N

0 1.5 3 Mi

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER



Dam Failure Inundation Map - Pool 16.0

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. The limits of flooding and the travel times shown on this map are approximate and should be used solely as a guideline for establishing evacuation zones. The actual evacuation zones may be greater or smaller than the flooded area shown on the map.
2. A parcel is designated as "affected" if it contains a habitable structure within the inundation extents.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

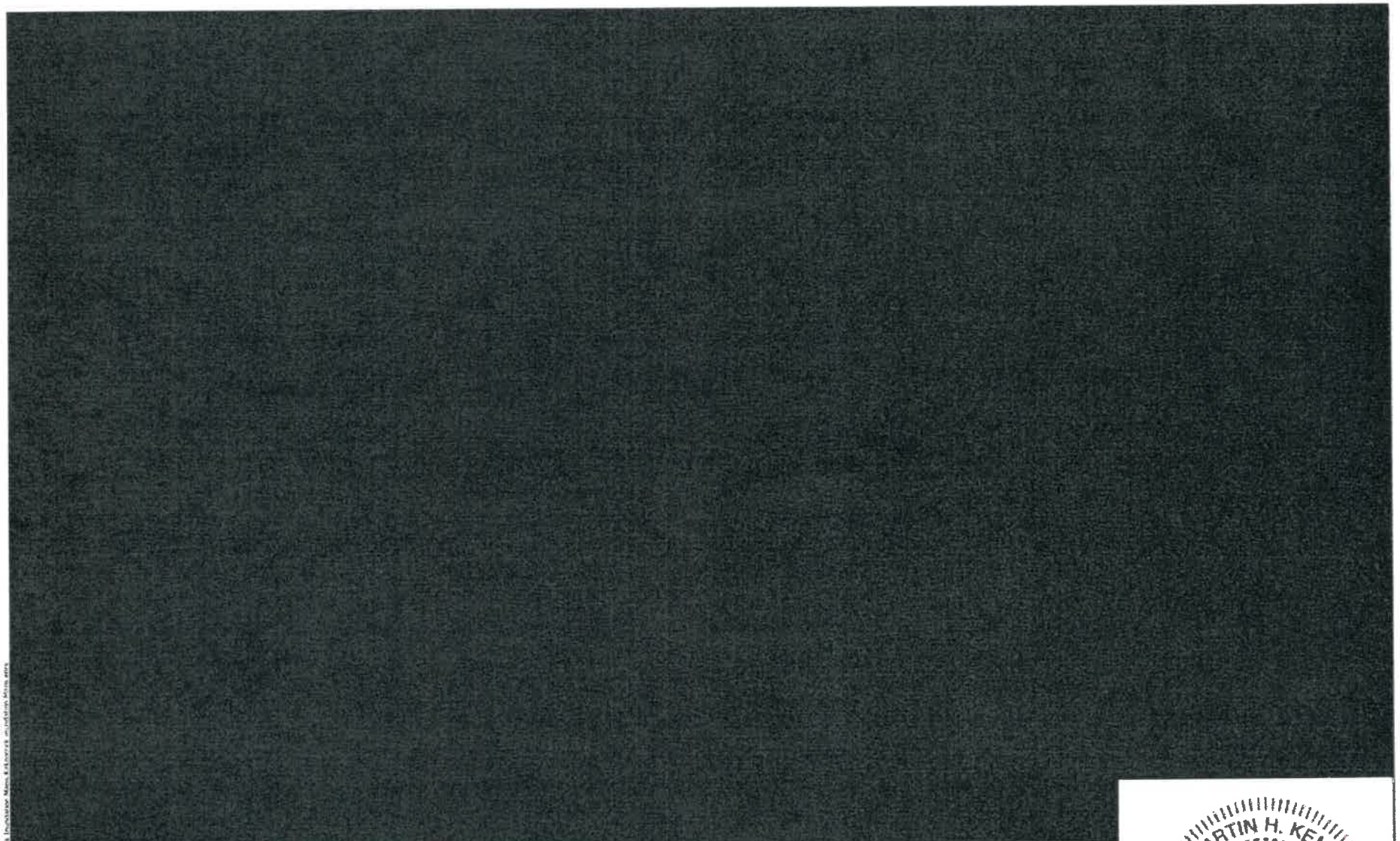
Legend
- Inundation Boundary
- Major Roads
- Parcel Boundary
- County Boundary
- Affected Parcel

N

0 1.5 3 MI

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

State of Florida, Earthstar Geographics, FL GIS, FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS



Dam Failure Inundation Map - Pool 18.0

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. The limits of flooding and the travel times shown on this map are approximate and should be used solely as a guideline for establishing evacuation zones. The actual evacuation zones may be greater or smaller than the flooded area shown on the map.
2. A parcel is designated as "affected" if it contains a habitable structure within the inundation extents.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc, November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Legend

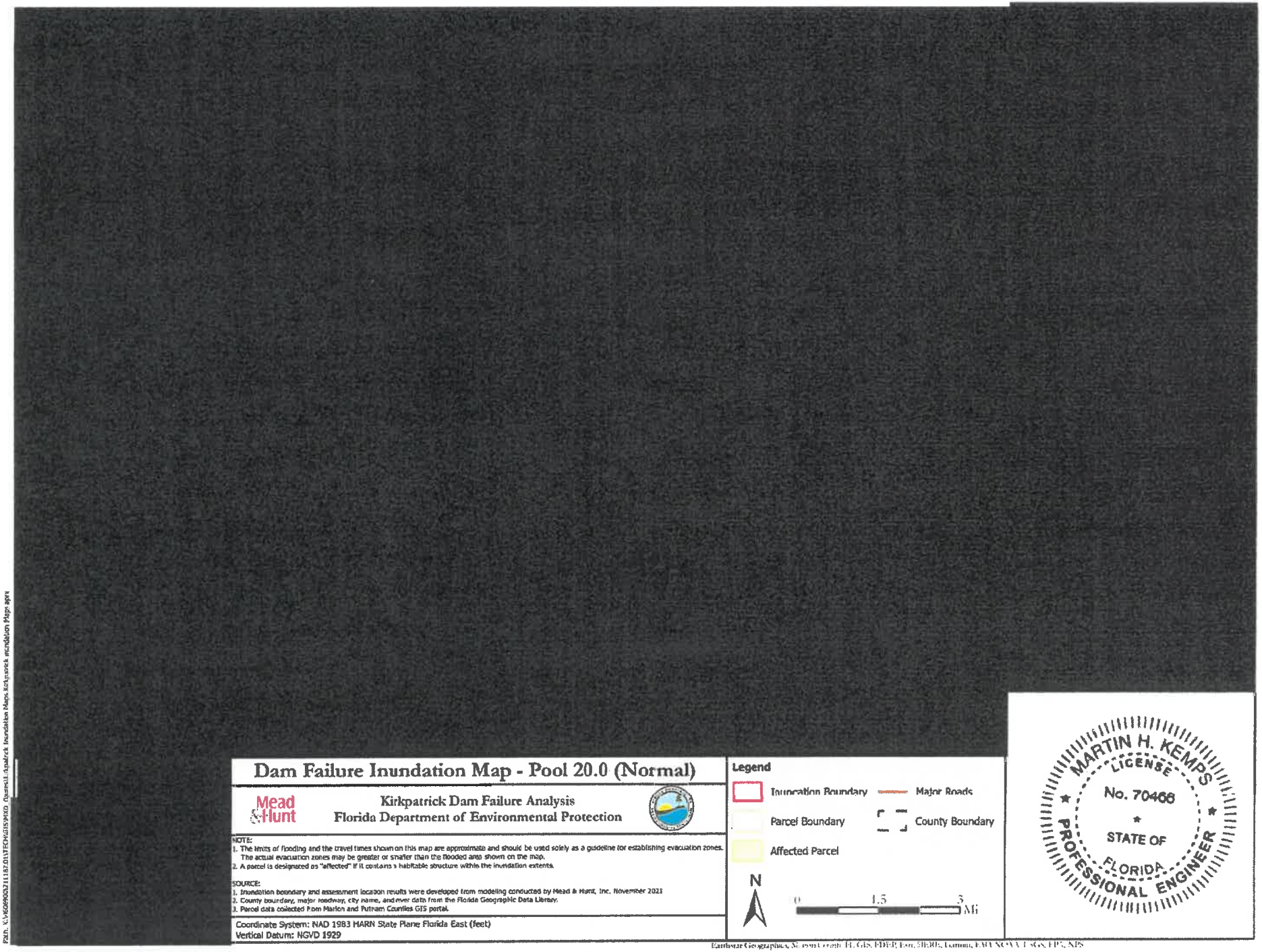
- Inundation Boundary
- Major Roads
- Parcel Boundary
- County Boundary
- Affected Parcel

N

0 1.5 3 Mi

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Earthstar Geographics, Maxar, Cnes/Airbus DS, USDA, USGS, EPA, NPS



Dam Failure Inundation Map - Pool 20.0 (Normal)

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. The limits of flooding and the travel times shown on this map are approximate and should be used solely as a guideline for establishing evacuation zones. The actual evacuation zones may be greater or smaller than the flooded area shown on the map.
2. A parcel is designated as "affected" if it contains a habitable structure within the inundation extents.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Legend

- Inundation Boundary
- Major Roads
- Parcel Boundary
- County Boundary
- Affected Parcel

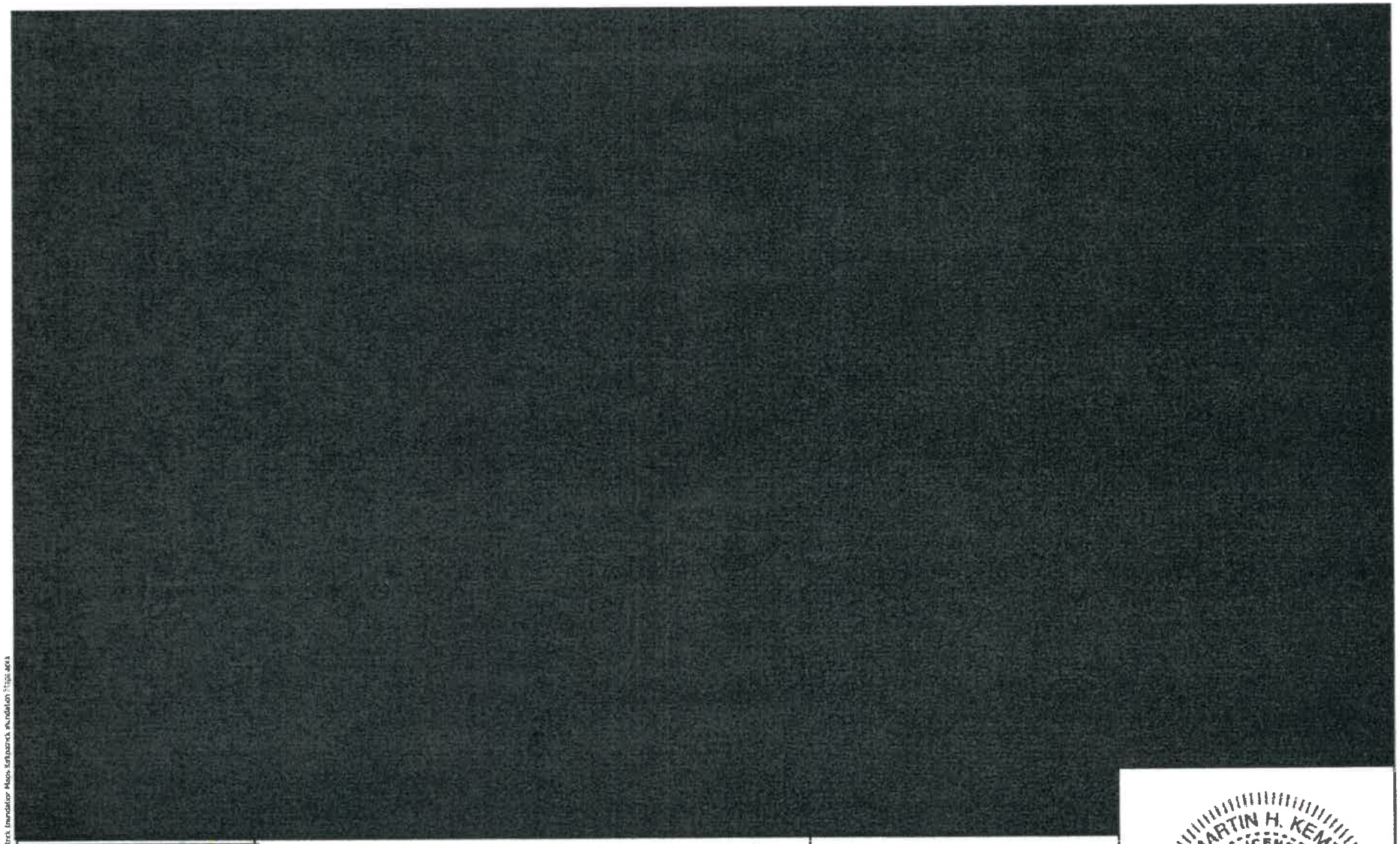
N

0 1.5 3 Mi

MARTIN H. KEMPS
LICENSE
No. 70466
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Path: K:\M60690021118\7.01\TECH\GIS\MXD_Queries\Kirkpatrick Inundation Maps\Kirkpatrick Inundation Maps.aprx

Earthstar Geographics, Maxar Group, FL GIS, FDEP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS



Dam Failure Inundation Map - Pool 23.2 (Max)

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

NOTE:
1. The limits of flooding and the travel times shown on this map are approximate and should be used solely as a guideline for establishing evacuation zones. The actual evacuation zones may be greater or smaller than the flooded area shown on the map.
2. A parcel is designated as "affected" if it contains a habitable structure within the inundation extents.

SOURCE:
1. Inundation boundary and assessment location results were developed from modeling conducted by Mead & Hunt, Inc. NOVEMBER 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Parcel data collected from Marion and Putnam Counties GIS portal.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

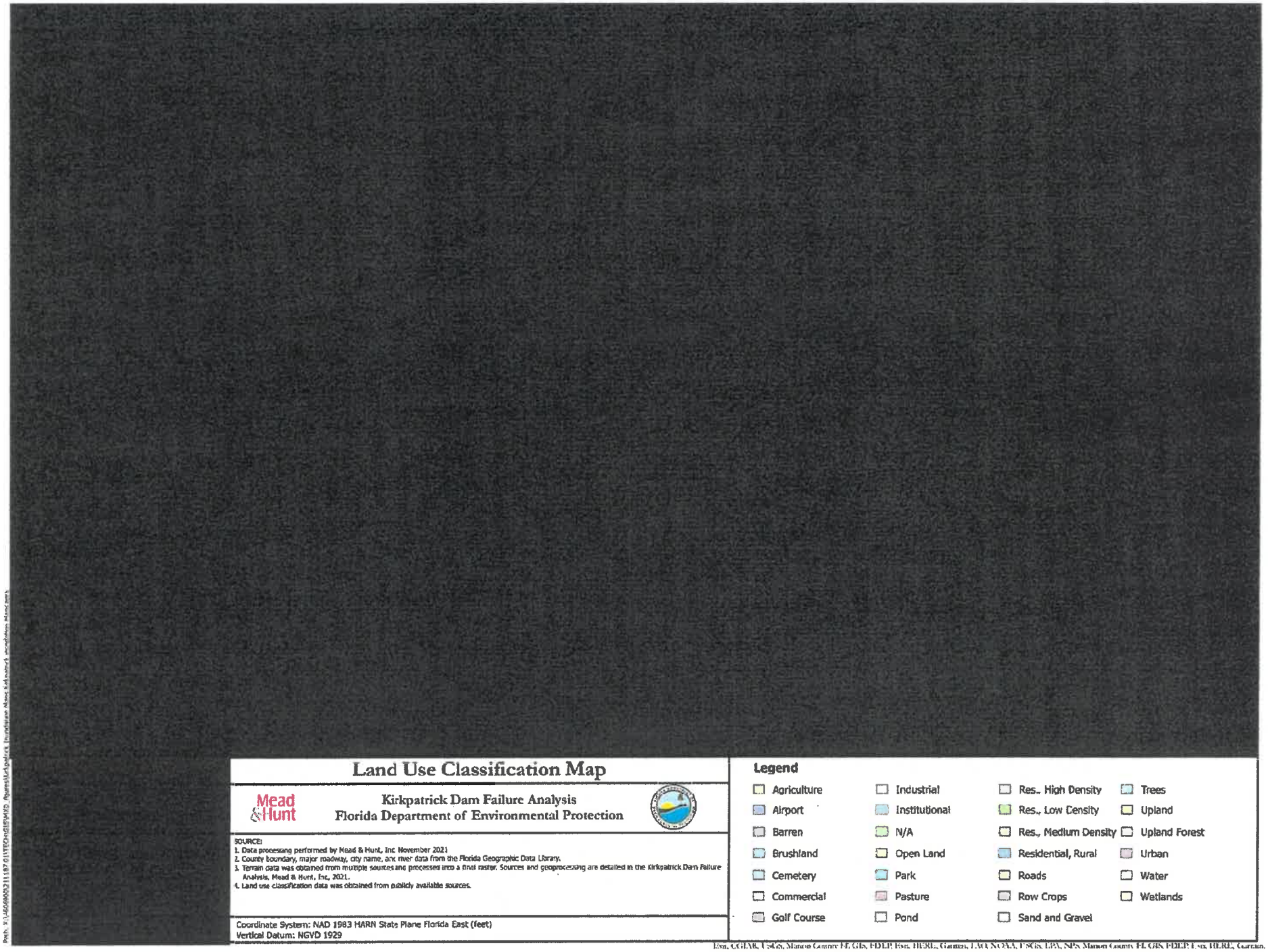
Legend

- Inundation Boundary
- Major Roads
- Parcel Boundary
- County Boundary
- Affected Parcel

N

0 1.5 3 Mi

MARTIN H. KEMPS
LICENSE
No. 70468
STATE OF
FLORIDA
PROFESSIONAL ENGINEER



Land Use Classification Map

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

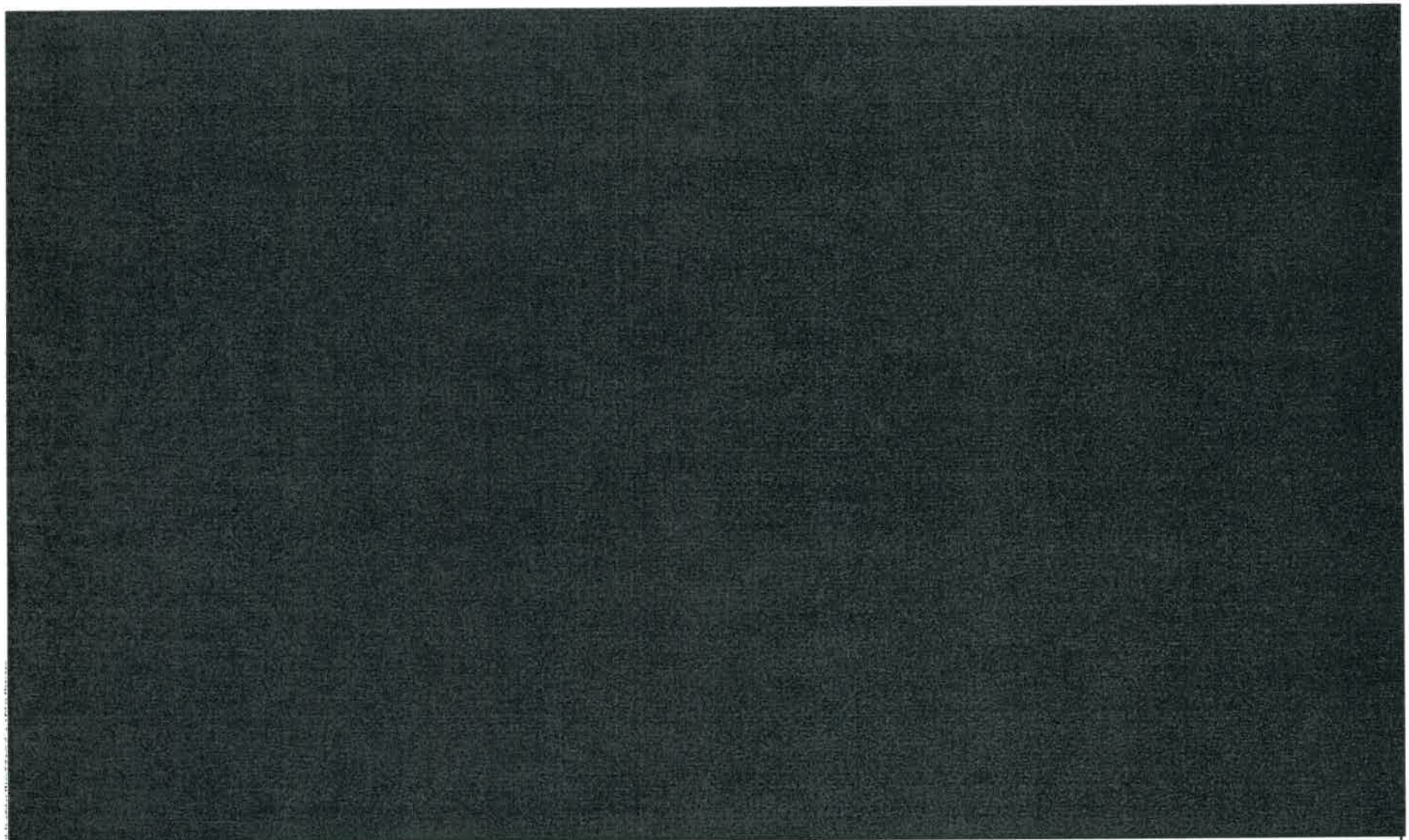
SOURCE:
1. Data processing performed by Mead & Hunt, Inc November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Terrain data was obtained from multiple sources and processed into a final raster. Sources and geoprocessing are detailed in the Kirkpatrick Dam Failure Analysis, Mead & Hunt, Inc, 2021.
4. Land use classification data was obtained from publicly available sources.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Legend

- Agriculture
- Airport
- Barren
- Brushland
- Cemetery
- Commercial
- Golf Course
- Industrial
- Institutional
- N/A
- Open Land
- Park
- Pasture
- Pond
- Res., High Density
- Res., Low Density
- Res., Medium Density
- Residential, Rural
- Roads
- Row Crops
- Sand and Gravel
- Trees
- Upland
- Upland Forest
- Urban
- Water
- Wetlands

Esri, CGIAR, USGS, Marion County FL GIS, FDLP, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Marion County FL GIS, FDEP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA



Model Geometry

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

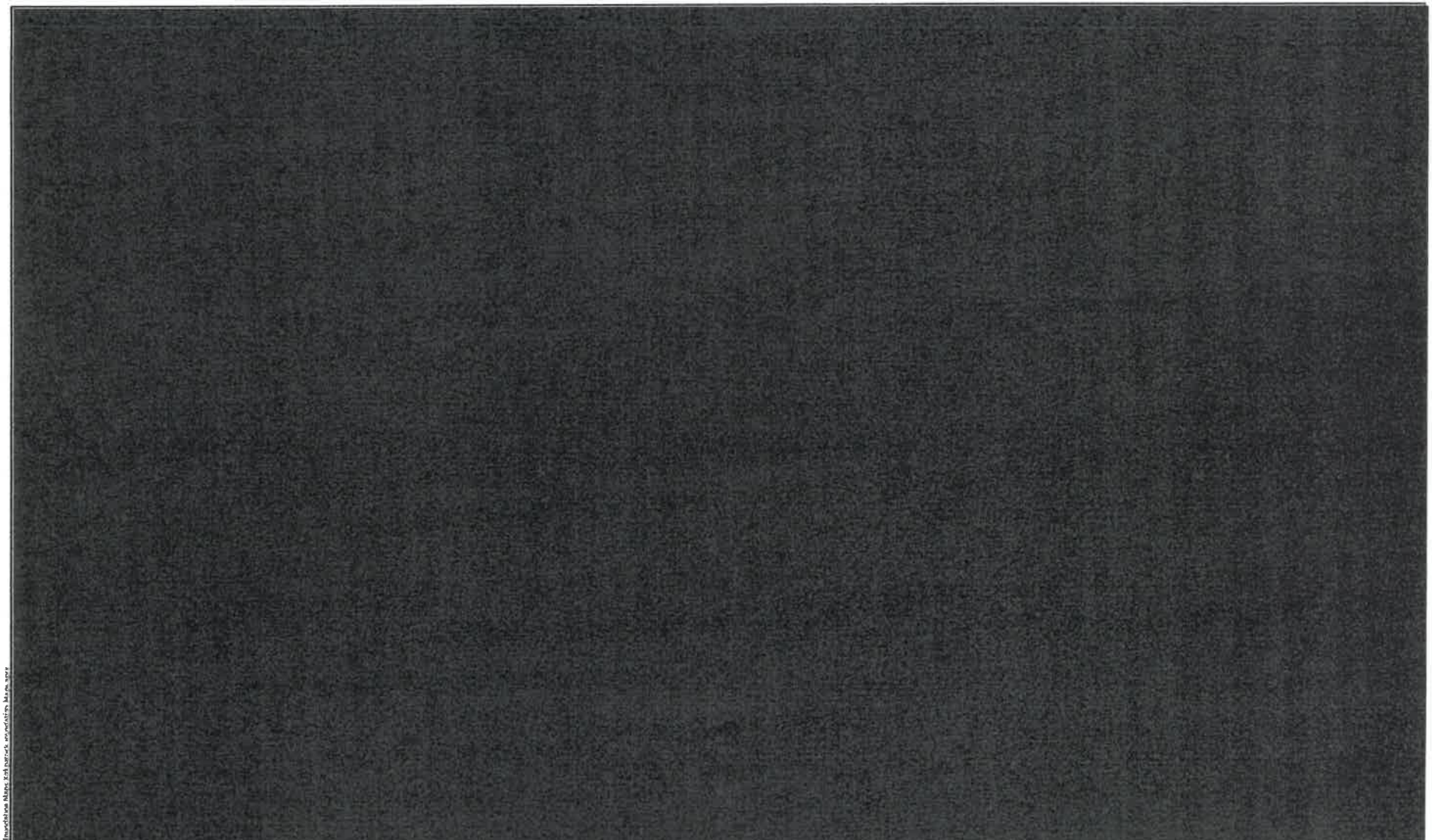
SOURCE:
1. Model geometry was developed from during modeling conducted by Mead & Hunt, Inc. November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library
3. Terrain data was obtained from multiple sources and processed into a final raster. Sources and geoprocessing are detailed in the Kirkpatrick Dam Failure Analysis, Mead & Hunt, Inc, 2021.
4. Land use classification data was obtained from publicly available sources.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Legend

- Boundary Condition Line
- SH-19 Breakline
- Kirkpatrick Dam Centerline
- Bridge Centerline
- Storage Area
- Modeling Extents

Esri, CGIAR, USGS, Maxar, Microsoft, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NPS, Maxar, Microsoft, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA



Model Terrain DEM

Mead & Hunt

Kirkpatrick Dam Failure Analysis
Florida Department of Environmental Protection

SOURCE:
1. Data processing performed by Mead & Hunt, Inc November 2021
2. County boundary, major roadway, city name, and river data from the Florida Geographic Data Library.
3. Terrain data was obtained from multiple sources and processed into a final raster. Sources and geoprocessing are detailed in the Kirkpatrick Dam Failure Analysis, Mead & Hunt, Inc, 2021.
4. Land use classification data was obtained from publicly available sources.

Coordinate System: NAD 1983 HARN State Plane Florida East (feet)
Vertical Datum: NGVD 1929

Elevation (ft, NGVD29)

176

-24

Esri, CGIAR, USGS, Maxar, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community, FAO, NOAA, USGS, EPA, NPS, USDA

Appendix D. Affected Structures Table

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identificaiton Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:									
04-11-26-0000-0021-000(	STOKES LANDING LLC	560 STOKES LANDING RD PALATKA	Stokes Island										
04-11-26-0000-0020-000(	JACKMAC PROPERTIES LLC	606 STOKES LANDING RD PALATKA	Stokes Island										
04-11-26-0000-0020-034(	MERCER JOHNNY R + SHERRI L	604 STOKES LANDING RD PALATKA	Stokes Island										
04-12-26-9200-0030-402(	MATHEN DAVID K + THEA M H/W	901 FRONT ST WELAKA	Beecher Point										
26-12-26-0000-0370-003(	SANDS JOSEPH E + REBECCA H/W	122 N HUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove										
21-11-26-0000-0050-001?	SHELL HARBOUR LLC	148 SHELL HARBOUR RD SATSUMA	River Road										
26-12-26-0000-0540-002(	GUINTHER L A + TAMMY H/W	117 ST JOHNS FISHING LODGE RD CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0470-000(	HARTZOG STACY R REVOCABLE TRUST	215 WALKER RD CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0340-000(	HUBER CHARLES JOSEPH	129 S HUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0340-004(	SANDS JOSEPH E IV	125 N HUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0711-000(	OD KING REAL PROPERTY HOLDINGS LLC	118 CAMP GEORGE RD CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0470-000(	HARTZOG STACY R REVOCABLE TRUST	217 WALKER RD CRESCENT CITY	Fruitland Cove										
26-12-26-2770-0000-001(	WISEMAN GARY R + LYNN A H/W	723 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
26-12-26-7800-0060-004(	SENGSTAKEN DAVID + KERRI H/W	206 S HAYES AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0060-001(	THOMAS DORSEY A + CAROL E H/W	200 S HAYES AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0070-009(	WICKHAM ANGELA R	111 LUDWIG AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0470-001(	RAHRLE RICK A + CYNTHIA D H/W	207 WALKER RD CRESCENT CITY	Fruitland Cove										
26-12-26-7800-0080-001(	ROBERSON LEONARD R + HEIDI C H/W	107 LUDWIG AV CRESCENT CITY	St. John Upstream Extent										
27-12-26-0000-0030-004(	ASHLEY MILES H + LISA A H/W	111 RAMONA RD CRESCENT CITY	Fruitland Cove										
26-12-26-2770-0000-0051	DAY TALLIFER REES + RITA CORNETT H/W	750 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
26-12-26-7800-0060-010(	ANCHETA GEORGE TRUST	606 BASS DR CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0040-010(	SEPTIEN CARLOS M + MARIANA H/W	219 PARK AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0340-001(	WILLMAN DANIEL B + MEREDITH J H/W	134 S HUBERS FISH CAMP RD RD CRESCENT CITY	Fruitland Cove										
23-12-26-0000-0110-000(	UNITED STATES OF AMERICA	1028 COUNTY RD 309 CRESCENT CITY	Fruitland Cove										
26-12-26-7800-0060-012(	NIXON SHIRLEY N LIFE ESTATE REM: SHIRLEY N NIXON TRUST	604 BASS DR CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0040-014(	HAZELGROVE STANLEY BYRON + SUSAN LEIGH H/W	118 LUDWIG AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0780-000(	WHITEHEAD CARL J + VIRGINIA D H/W	1189 COUNTY RD 309 CRESCENT CITY	St. John Upstream Extent										
28-11-26-9220-0300-001(	COOLIDGE BRYAN M+AMYD FAMILY TRUST	134 NORTONS FISH CAMP RD SATSUMA	River Road										
25-12-26-2770-0000-009(	SCHNEIDER RICHARD G + LINDA S H/W	772 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
26-12-26-7800-0060-006(	LUTGENS DAVID + AMANDA DICKINSON (JTRS)	210 S HAYES AV CRESCENT CITY	St. John Upstream Extent										
27-12-26-0000-0030-009(	WELAKA DEVELOPMENT LLC	131 RAMONA RD CRESCENT CITY	Fruitland Cove										
26-12-26-7800-0060-014(	BONE DAVID P	600 BASS DR CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0030-011(	HAWTHORNE RENE D	300 BASS DR CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0010-030(	BEASLEY TIMOTHY	134 HAYES AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0520-000(	ANGLERS PARADISE LLC	1171 COUNTY RD 309 CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0280-004(	JONES MICHAEL R	120 NATIONAL FOREST RD 29 PALATKA	St. John Upstream Extent										
27-12-26-0000-0030-005(	BROUWER REGINALD A	115 RAMONA RD CRESCENT CITY	Fruitland Cove										
27-10-26-0000-0060-001(	JOHNSON CARY V	181 BUFFALO BLUFF RD PALATKA	Downstream Model Extents										
21-11-26-0000-0050-006(	MCGUIRE RANDALL J + ADRIANA BALLESTERO H/W	141 SHELL HARBOUR RD SATSUMA	River Road										
26-12-26-7800-0030-014(	UCHA JOSEPH PAUL	218 PARK AV CRESCENT CITY	St. John Upstream Extent										
28-11-26-0000-0010-003(	WALTERS RANDY DEAN	134 EASY DR SATSUMA	River Road										
26-12-26-2770-0000-008(	GALFAS MILTON+FREDERICK GALFAS ET AL	739 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
26-12-26-7800-0060-016(	WOOLEY HALLEY B JR+MARIDELL C TRUST	129 W PALM AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0020-014(	BENTLEY CAMILLA ELAINE	200 BASS DR CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0030-009(	ADAMS ROBERT J	117 SHAFFER AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-7800-0040-012(	ECKHOFF MARK + CANDICE H/W	120 LUDWIG AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0360-003(	HAIR ROBERT + CYNTHIA SIMMONS HAIR H/W	130 S HUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove										
26-12-26-7800-0040-006(	PAINTER ELSA J LIFE ESTATE REM: JOANNA GRILLIOT	211 PARK AV CRESCENT CITY	St. John Upstream Extent										
27-12-26-0000-0030-011(	SHELBY DAVID R + MARNA J H/W	139 RAMONA RD CRESCENT CITY	Fruitland Cove										
26-12-26-0000-0770-001(	D & S HOUCHIN LLC	1187 COUNTY RD 309 CRESCENT CITY	St. John Upstream Extent										
27-12-26-0000-0030-008(	CRAWFORD MICHAEL B + LINDA D H/W	127 RAMONA RD CRESCENT CITY	Fruitland Cove										
26-12-26-2770-0000-003)	MULLINS MARLIN LEE REV TRUST	746 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
33-11-25-0000-0050-000(	JOHNSON KAREN W	120 DEANS CREEK TRL PALATKA	Dean Creek Road										
26-12-26-2770-0000-007)	COPELY ANDREW R JR + BRENDA J H/W	756 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent										
26-12-26-7800-0010-026(	JLW RESIDENTIAL LLC	126 HAYES AV CRESCENT CITY	St. John Upstream Extent										
26-12-26-0000-0400-000(	ELLIOTT FREDERICK T + BETHANY A H/W	1965 COUNTY RD 308 CRESCENT CITY	Fruitland Cove										
27-12-26-0000-0030-007(	CRAWFORD MICHAEL B + LINDA D H/W	123 RAMONA RD CRESCENT CITY	Fruitland Cove										
33-11-25-0000-0020-000(	LOWENSTEIN PETER E + JAN DENISE H/W	7986 NATIONAL FOREST RD 74 PALATKA	Kirkpatrick Dam										
27-12-26-0000-0030-003(	BELCHER BOBBY J + LISA M H/W	107 RAMONA RD CRESCENT CITY	Fruitland Cove										
23-11-26-0000-0050-030)	SHELL HARBOUR LLC	151 SHELL HARBOUR RD SATSUMA	River Road										
33-11-26-0000-0050-000(	FLORIDIAN HOLDINGS LLC	110 FLORIDIAN CLUB LN WELAKA	Stephens Point										

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
33-10-26-3610-0000-089(	JOHNSTON ROBERT E JR	116 POINSETTIA DR SATSUMA	Barrentine Creek	
26-12-26-7800-0020-008(	VARN LILLIAN A	115 HAYES AV CRESCENT CITY	St. John Upstream Extent	
28-10-26-0000-0180-011(	PONS AGNES LORI	106 KRANTZ RD PALATKA	Downstream Model Extents	
26-12-26-7800-0060-005(	FREELAND JAMIE E	208 S HAYES AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-0000-0200-000(	FLORIDIAN HOLDINGS LLC	146 FLORIDIAN CLUB RD WELAKA	Stephens Point	
27-12-26-0000-0030-012(	TUCKER DOUGLAS ALAN + MICHELLE BOMBA H/W	143 RAMONA RD CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-071(	SANDEFORD RALPH H	71 CAREFREE DR WELAKA	Stephens Point	
33-11-26-0000-0100-002(	HASIS THEODORE J + MAUREEN G H/W	112 FLORIDIAN CLUB LN WELAKA	Stephens Point	
25-12-26-2770-0000-009(	MELLEN ROBERT L + REBECCA T H/W	776 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent	
33-10-26-3610-0000-214(	FLOYD GENEVIEVE P+LISA J FLOYD (JTRS)	103 ST JOHNS CT SATSUMA	Barrentine Creek	
26-12-26-7800-0020-019(	KINGS FAMILY LLC	114 SHAFFER AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-0000-0350-000(	FLORIDIAN HOLDINGS LLC	113 FLORIDIAN CLUB LN WELAKA	Stephens Point	
27-12-26-0000-0030-013(	ROMIG JAMES C + JULIE ELIZABETH H/W	147 RAMONA RD CRESCENT CITY	Fruitland Cove	
26-12-26-0000-0540-002(	PENDULUM PROPERTIES LLC	119 CAMP GEORGE RD CRESCENT CITY	Fruitland Cove	
33-11-26-0000-0240-000(	FLORIDIAN HOLDINGS LLC	103 FLORIDIAN CLUB LN WELAKA	Stephens Point	
33-11-26-0000-0380-000(	CAIN FAMILY REVOCABLE TRUST	141 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-0000-0210-000(	SMITH KEVIN W + ELIZABETH I H/W	133 FLORIDIAN CLUB RD WELAKA	Stephens Point	
26-12-26-7800-0060-008(	SILVEY MICHAEL L + DIANA L H/W	207 S HAYES AV CRESCENT CITY	St. John Upstream Extent	
26-12-26-7800-0030-016(	SPITZ FRANK + SHELLEY H/W	214 PARK AV CRESCENT CITY	St. John Upstream Extent	
26-12-26-7800-0040-017(	ROSAS GODOFREDO R + PEGGY B	110 LUDWIG AV CRESCENT CITY	St. John Upstream Extent	
28-11-26-9220-0000-004(	CARTER MELVIN O + SHERAN L H/W	140 NORTONS FISH CAMP RD SATSUMA	River Road	
33-11-26-0000-0106-000(	PREVATT SEAN G + REBECCA D H/W	144 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-10-26-3610-0000-086(	WARD JAMES B JR + TERESA M H/W	110 POINSETTIA DR SATSUMA	Barrentine Creek	
26-12-26-7800-0060-002(	HOFFPAUIR JOHN WADE REVOCABLE TRUST	202 S HAYES AV CRESCENT CITY	St. John Upstream Extent	
26-12-26-7800-0030-008(	ADAMS ROBERT J	115 SHAFFER AV CRESCENT CITY	St. John Upstream Extent	
25-12-26-2770-0000-009)	CONSTABLE MICHAEL + LAURIE	774 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent	
33-11-26-8791-0000-076(	ZIMMER ARTHUR F II + JANET H/W	76 CAREFREE DR WELAKA	Stephens Point	
33-11-26-0000-0250-000(	DOWN BY THE RIVER LLC	101 FLORIDIAN CLUB LN WELAKA	Stephens Point	
27-12-26-0000-0030-014(	DENAZARIE JULES W + JUDITH ANN	151 RAMONA RD CRESCENT CITY	Fruitland Cove	
33-11-26-8790-0000-025(	LAVEN KENYON S	25 SCOTT ST WELAKA	Stephens Point	
26-12-26-7800-0030-015(	GRAIN VALERIE ANN + GARY JAMES W/H	216 PARK AV CRESCENT CITY	St. John Upstream Extent	
33-10-26-3610-0000-210(	SHASTEEN CHARLES E + LINDA M H/W	111 ST JOHNS CT SATSUMA	Barrentine Creek	
28-11-26-0000-0020-001(	KNOTT MARK CALVIN	107 SHELL TRL SATSUMA	River Road	
26-12-26-0000-0370-006(	TALIAFERRO FAMILY TRUST	114 N MUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-082(	WARD FRANCES M	82 CAREFREE DR WELAKA	Stephens Point	
33-11-26-0000-0070-000(	FLORIDIAN HOLDINGS LLC	108 FLORIDIAN CLUB LN WELAKA	Stephens Point	
33-11-26-8791-0000-092(	FAIX JACQUELINE Y	92 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-112(	RALEY SCOTT A	112 HAPPINESS DR WELAKA	Stephens Point	
28-11-26-9220-0000-0011	REDDING WAYNE B + VICKY L H/W	132 NORTONS FISH CAMP RD SATSUMA	River Road	
33-11-26-8790-0000-032(	HADLEY RICHARD B + JOY A MCGUIRL- HADLEY H/W	32 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-041(	HONOUR KIRK C + TINA M H/W	41 SCOTT ST WELAKA	Stephens Point	
33-10-26-3610-0000-090(	LAGASSE WAYNE A + ELMA S H/W	118 POINSETTIA DR SATSUMA	Barrentine Creek	
33-11-26-8790-0000-006(	SCHILLO KENNETH G	6 HOCKEY DR WELAKA	Stephens Point	
33-11-26-8791-0000-089(	JOHNSON CONRAD A JR+KATHLEEN H/W LIFE ESTATE	89 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-073(	ROGERS EDGAR C + LAWANNA D H/W	73 CAREFREE DR WELAKA	Stephens Point	
33-10-26-3610-0000-215(	BOYLE VICKIE G	101 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-25-0000-0050-0001	BROOKS EDWARD EUGENE + JAMES E AND BRADLEY A JTRS	100 DEANS CREEK TRL PALATKA	Dean Creek Road	
33-11-26-8791-0000-069(	69 CAREFREE DRIVE RE HOLDINGS LLC	69 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8791-0000-113(	DUKE ANNETTE + PHILIP DUKE (JTRS)	113 HAPPINESS DR WELAKA	Stephens Point	
28-11-26-0000-0012-000(	GOODSON KATHY M	103 SHELL TRL SATSUMA	River Road	
33-11-26-0000-0280-000(	SANFORD STEVEN + ROBIN POE H/W	139 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-8791-0000-067(	RUSSELL KERRY P + LEAH M H/W	67 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8791-0000-111(	SMITH RONALD W + JANICE L H/W	111 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-0000-0270-000(	HIPPENSTEEL RANDY C+LISA R H/W+AMANDA R (JTRS)	149 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-8791-0000-129(	SCHWAB RANDALL E + JANINE W H/W	130 PARADISE DR WELAKA	Stephens Point	
33-11-26-0000-0290-000(	SKAGGS FRANKIE	105 TALL PALMS LN WELAKA	Stephens Point	
33-11-26-8791-0000-107(	GENTRY DONALD R + TAMMIE L H/W	108 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-161(	ALTMAN DELORES JEAN + ANTHONY W/H	161 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-1660	STAHLIN/SORENSEN LAND TRUST WP+EM STAHLIN+DD+CL SORENSEN TRSTS	166 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-136(	KOCH FAMILY TRUST	136 PARADISE DR WELAKA	Stephens Point	
26-12-26-0000-0491-000(	DD KING REAL PROPERTY HOLDINGS LLC	1163 COUNTY RD 309 CRESCENT CITY	Fruitland Cove	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
28-10-26-0000-0013-001(	VICKERS ROY LIFE ESTATE	107 LUCYRILLA LN PALATKA	Downstream Model Extents	
33-11-26-8791-0000-079(	MCCULLOUGH TREK + JEANEVA H/W	79 CAREFREE DR WELAKA	Stephens Point	
33-10-26-0000-0012-005(	CRUDEN DONALD G + CHERYLEE G H/W	211 WOODBURY TRL SATSUMA	Downstream Model Extents	
33-11-26-8791-0000-034(	LARSON RONALD A + DEBRA J H/W	35 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-150(	PETER LARRY D + S LOU H/W	150 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-200(	PETERSON REA CHARLENE	200 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-119(	HALL DENNIS P	119 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-205(	DEKLE DOROTHY M + JOHN R W/H	205 SPORTSMAN DR WELAKA	Stephens Point	
35-11-25-0000-0020-000(	UNITED STATES OF AMERICA	2300 S STATE RD 19 PALATKA	SH19 Bridge	
33-11-26-8791-0000-190(	BROWN FRANCIS J + LYNETTE H/W	190 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-199(	BOBER THOMAS P + PATSY A H/W LIFE ESTATE	199 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-114(	BARKER TAMMIE W + VICKIE C WALTERS	114 HAPPINESS DR WELAKA	Stephens Point	
33-10-26-0000-0012-003(	HARRIS PATRICK J + LYNN R H/W	215 WOODBURY TRL SATSUMA	Downstream Model Extents	
33-11-26-8791-0000-191(	LATHBURY SEAN L	191 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-0740	HAGGARD WILLIAM ANDREW LIVING TRUST WILLIAM ANDREW HAGGARD TRUSTEE	74 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8791-0000-154(	CZEPIEL RICHARD J LIFE ESTATE	154 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-137(	RENFROE MICHAEL B + PENNY K H/W	137 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-155(	TEXEIRA ESPERANZA M + NELSON L H/W	155 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-042(	SKAGGS FRANKIE W + DEBRA C H/W	42 SCOTT ST WELAKA	Stephens Point	
33-10-26-0000-0011-004(	PICKENS JOE H	125 WOODBURY TRL SATSUMA	Downstream Model Extents	
26-12-26-0000-0270-000(	SAPP WILLARD J JR	108 NATIONAL FOREST RD 29 PALATKA	St. John Upstream Extent	
33-11-26-8791-0000-212(	CHIODO RUSSEL L	212 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-0000-0011-001(	HARRISON MICHAEL CHARLES + KIMBERLY SUZAN H/W	128 WOODBURY TRL SATSUMA	Downstream Model Extents	
33-11-26-8791-0000-088(	JOHNSON CONRAD A JR+KATHLEEN D H/W LIFE ESTATE	88 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-201(	CASTRILLO VICTOR + AMY L H/W JT/RS	201 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-0000-0012-002(	HUDSON PATRICIA P + RONALD D W/H	219 WOODBURY TRL # UNIT 1 SATSUMA	Downstream Model Extents	
33-11-26-8791-0000-146(	VERSTRAETE ALBERTINE LIFE ESTATE	146 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-1010	RICHARDSON WILLIAM + LORI REV TRUST WILLIAM + LORI RICHARDSON TRUSTEES	101 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-170(	MASON RICKIE + KAREN H/W	170 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-070(	FAULKNER GENA H + HARRY P JR W/H	70 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8791-0000-216(	PORATH MICHAEL L + LAURIE J H/W	216 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-171(	GREGROW DENNIS R + DIANA H/W	171 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-168(	BURKHART WAYNE	168 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-147(	OSTEEN JAMIE E + CAREY A H/W	147 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-219(	CROOMS GENEVA+ALMA A DIXON TRUSTEES	219 SPORTSMAN DR WELAKA	Stephens Point	
26-12-26-7800-0010-027(	GILMORE J M TRUST B (THE) WILDA M GILMORE TRUSTEE	128 HAYES AV CRESCENT CITY	St. John Upstream Extent	
33-10-26-0000-0030-006J	MALPHRUS HERMAN E + GENEVA B H/W LIFE ESTATE	323 E BUFFALO BLUFF RD SATSUMA	Barrentine Creek	
33-11-26-0000-0190-0000	SANFORD STEVE + ROBIN POE H/W + DEVIN W + ELIZABETH I SMITH H/W	137 FLORIDIAN CLUB RD WELAKA	Stephens Point	
28-10-26-0000-0180-008(	OWENS RANDY H	124 KRANTZ RD PALATKA	Downstream Model Extents	
33-11-26-8791-0000-078(	FAULKNER RICHARD R + KAY H H/W	78 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8790-0000-026(	ROVER DEBRA S LIVING TRUST	26 SCOTT ST WELAKA	Stephens Point	
38-12-26-7800-0090-010(	HOXWORTH STEPHEN ANDREW JR ET AL (JTRS)	130 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-039(	NOBLES RONALD J + CYNTHIA D BROWN H/W	39 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-100(	MEHAFFEY MARY KAY	100 HAPPINESS DR WELAKA	Stephens Point	
28-10-26-0000-0180-007(	WILLIAMS JUDITH M	126 KRANTZ RD PALATKA	Downstream Model Extents	
28-10-26-0000-0180-014(	FARMER PAUL E	116 KRANTZ RD PALATKA	Downstream Model Extents	
33-10-26-0000-0010-050(	VEREKER ERNEST J LIFE ESTATE	114 ROGERS LN PALATKA	Stokes Island	
33-11-25-0000-0052-000(	OWENS EILEEN M+WALTER W GUNTER+ROBERT COUCH HEIRS	221 DEANS CREEK RD PALATKA	Dean Creek Road	
33-10-26-3610-0000-211(	BONNER RALPH	107 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-25-0000-0050-021(	WARD TROY + STEPHEN P (TIC)	224 DEANS CREEK RD PALATKA	Dean Creek Road	
33-10-26-3610-0000-213(	FLOYD GENEVIEVE P + LISA J FLOYD (JTRS)	105 ST JOHNS CT SATSUMA	Barrentine Creek	
38-12-26-7800-0090-021(	HASIERA LLC	152 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-10-26-0000-0040-002(	WEICHERT BRADLEY A + RITA J H/W	319 E BUFFALO BLUFF RD SATSUMA	Barrentine Creek	
33-11-26-8791-0000-182(	HOWARD EDGAR PAUL + JANET N H/W	182 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-192(	STALNAKER WALTER	192 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-152(	0	0	Stephens Point	
33-11-26-0000-0105-000(	BARR FREDERICK + RHONDA K H/W	140 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-8791-0000-066(	SUBBERT JAMES A + SHARON L H/W	66 CAREFREE DR WELAKA	Stephens Point	
26-12-26-7800-0080-002(	MORROW JAMES R ET AL (JTRS)	108 CHERYL LN CRESCENT CITY	St. John Upstream Extent	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
28-11-26-9220-0000-0110	WILLIAMS CLAUDE + SHIRLEY H/W L EST REM: DENNIS CLAUDE WILLIAMS	150 NORTONS FISH CAMP RD SATSUMA	River Road	
26-12-26-7800-0070-003(	BURRELL SHARON C	119 LUDWIG AV CRESCENT CITY	St. John Upstream Extent	
38-12-26-7800-0090-008(	ALEXANDER VIVIAN J	126 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-077(	ODWYER WILLIAM J	77 CAREFREE DR WELAKA	Stephens Point	
33-11-26-0000-0180-000(	DOWN BY THE RIVER LLC	106 FLORIDIAN CLUB LN WELAKA	Stephens Point	
33-11-26-8791-0000-156(	ACKLAND KAY L REVOCABLE LIVING TRUST	156 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-128(	DEAN SOUGLAS A + DANA H/W	128 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-091(	MAHAN JAMES J LIFE ESTATE	91 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-0000-0340-009(	MCCULLERS SEAN DANIEL + MELISSA M BIBLE (JTRS)	145 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-0000-0330-000(	WIGAND HARRY J + JEANNE E H/W	147 FLORIDIAN CLUB RD WELAKA	Stephens Point	
28-11-26-9220-0000-005(	KIMBROUGH MARVIN WINSTON LIFE ESTATE	142 NORTONS FISH CAMP RD SATSUMA	River Road	
28-10-26-0000-0010-000(	BROTHERS WILLIAM E + KATHLEEN L H/W	318 PENIEL CHURCH RD PALATKA	Downstream Model Extents	
33-11-26-8791-0000-141(	PATRICK DEBRA G	141 PARADISE DR WELAKA	Stephens Point	
38-12-26-7800-0090-019(	BARRUS BRIAN	148 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-202(	DAUGHERTY MARTHA R	202 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-162(	PAGANO KENNETH J + DIANE H/W	162 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-164(	PITTMAN M DIANNE + LANDER WILSON W/H	164 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-040(	JOHNS RICHARD A SR + TERESA L H/W	40 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-207(	BRIM WILLIAM F + KATHLEEN H H/W LIFE ESTATE	207 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-142(	MCDANIEL ROY BRUCE + SUSAN P H/W	142 PARADISE DR WELAKA	Stephens Point	
33-11-26-0000-0104-000(	COTTON ANTHONY S + SUSAN H H/W	103 TALL PALMS LN WELAKA	Stephens Point	
33-11-26-0000-0108-000(	LOGAN JOHN BRUCE LIFE ESTATE	142 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-11-26-8791-0000-033(	OBRIEN CHRISTOPHER L + CYNTHIA L H/W	33 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-176(	WINDSOR KIM D	176 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-138(	ROUNTREE LISA + HARRY W/H	138 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-109(	LECREUX THEODORE J + LEIGH M H/W	109 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-197(	KILCHRISS DORIS HEIRS OF	197 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8790-0000-027(	CHRISTOPHERSON CHAD + LOLA H/W	27 SCOTT ST WELAKA	Stephens Point	
33-11-26-0000-0370-000(	MCCULLERS DANIEL B + CAROLYN L H/W	143 FLORIDIAN CLUB RD WELAKA	Stephens Point	
38-12-26-7800-0090-014(	ROBINSON MAGNOLIA	138 HICKS AV CRESCENT CITY	St. John Upstream Extent	
38-12-26-0000-0040-001(	PETERSON RAND G + DEBORAH A H/W LIFE ESTATE	123 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-193(	TREECE FAMILY REVOCABLE LIVING TRUST	193 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-096(	EISMAN JOINT REVOCABLE TRUST	96 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-203(	RUNNERSTROM THERESA M	203 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-122(	HANLON KATHLEEN ANN	122 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-062(	LANE NORMA	62 CAREFREE DR WELAKA	Stephens Point	
39-10-26-3610-0000-207(	JOHNSON SCOTT A	117 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-26-8791-0000-125(	BUSH PAMELA K	125 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-215(	BERRY RICHARD E + DEBORAH A WEYER H/W	215 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-217(	KELLY TIMOTHY P + SALLY J H/W	217 SPORTSMAN DR WELAKA	Stephens Point	
27-12-26-0000-0030-006(	IMAGE PROPERTIES LLC	119 RAMONA RD CRESCENT CITY	Fruitland Cove	
26-12-26-0000-0260-000(	LYNN BELINDA SEPARATE PROPERTY TRST	101 NATIONAL FOREST RD 29 PALATKA	St. John Upstream Extent	
38-12-26-7800-0090-003(	LARKIN WILLIAM M + CANDACE C H/W	118 HICKS AV CRESCENT CITY	St. John Upstream Extent	
39-10-26-3610-0000-202(	THE PONDER TRUST	127 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-26-8791-0000-139(	CRABTREE NICOLE + MICHAEL F W/H	139 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-160(	LEWIS DWIGHT + LISA H/W	160 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-133(	BEHRENDT ROBERT H + BARBARA H H/W	133 PARADISE DR WELAKA	Stephens Point	
39-10-26-3610-0000-209(	PLISKA FRANK III + HOLLY S PLISKA (JTRS)	113 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-26-8791-0000-175(	YOHO CAROLYN M	175 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-098(	WRIGHT MARLEEN H	98 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-184(	WONORSKI JANET K + WALTER CHABOUDE (JTRS)	184 SPORTSMAN DR WELAKA	Stephens Point	
28-10-26-0000-0080-000(	BENNETT BRETT M + CHELSEY M H/W	350 PENIEL CHURCH RD PALATKA	Downstream Model Extents	
28-10-26-0000-0180-006(	WILSON RAE LAUREN + NE ASHA NEOMI HUNTER	142 SESAME ST PALATKA	Downstream Model Extents	
33-11-26-8791-0000-060(	SMITH BRUCE A + JANET Y H/W	60 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8791-0000-063(	LEWIS FRANCIS T + PEGGY A H/W	63 CAREFREE DR WELAKA	Stephens Point	
33-11-26-8790-0000-0300	TUCKER TINA+CHARLES REVOCABLE TRSTS TINA TICKER+CHARLES TUCKER TRUSTEES	30 SCOTT ST WELAKA	Stephens Point	
39-10-26-3610-0000-015(	GREEN NELLIE J	205 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0000-012(	ANDERSON ROBERT A SR + SONYA P H/W	156 BEECHERS POINT DR WELAKA	Beecher Point	
33-10-26-0000-0011-0013	TORBECK CYNTHIA L	357 E BUFFALO BLUFF RD SATSUMA	Downstream Model Extents	
33-11-26-8791-0000-036(	TAYLOR LILA JEAN	37 SCOTT ST WELAKA	Stephens Point	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
33-10-26-3610-0000-041(	MCLENDON BRANDON	259 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0000-015(	OKLEVITCH CHRISTOPHER + JOAN H/W	162 BEECHERS POINT DR WELAKA	Beecher Point	
33-10-26-3610-0000-017(	SCHULTZ CHARLES + MARLA VEIT (JTRS)	209 HERMITS DR SATSUMA	Barrentine Creek	
33-10-26-3610-0000-018(	BREEDEN MAYNARD J SR LIFE ESTATE	211 HERMITS DR SATSUMA	Barrentine Creek	
39-10-26-3610-0000-197(	ACKERSON DAN J (A/K/A DANIEL J)	137 ST JOHNS CT SATSUMA	Barrentine Creek	
35-12-26-7800-0070-014(	BOYDA PATRICIA ANN	110 W PALM AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-140(	PADGETT JAMES RAY LIFE ESTATE	140 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-213(	SPEELER W RENEE REVOCABLE TRUST	213 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0000-006(	PENDLETON RONALD DAVID + CAROLE F H/W	142 BEECHERS POINT DR WELAKA	Beecher Point	
25-12-26-2770-0000-009:	HOLZDERBER DONALD J + PHYLLIS C H/W	778 NATIONAL FOREST RD 75G PALATKA	St. John Upstream Extent	
26-12-26-7800-0020-016(	SHORE DAVID W	122 SHAFFER AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-173(	SPRINKLE TODD LEE + JERRIE DANA H/W	173 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8791-0000-103(	TORREY DEREK RICHARD + DONNA KAYE H/W	103 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-126(	BOLLES MONTA M	126 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-158(	SMITH LESLIE ANN	158 MOONLITE DR WELAKA	Stephens Point	
33-11-26-8790-0000-008(	CONRAD RICHARD E + JANIS C H/W	9 HOCKEY DR WELAKA	Stephens Point	
38-12-26-7800-0090-017(	STARLING DONNIE M + JOHN MARCUS + MAX J (JTRS)	144 HICKS AV CRESCENT CITY	St. John Upstream Extent	
40-12-26-0530-0000-003(	BRADBERRY VICTOR A + DEANNE H/W	136 BEECHERS POINT DR WELAKA	Beecher Point	
33-11-26-8791-0000-172(	HALL SHARON B + THOMAS D W/H	172 MOONLITE DR WELAKA	Stephens Point	
40-12-26-0000-0270-000(	BROWNING JOHN P	121 TERONDA RD WELAKA	Beecher Point	
33-11-26-8790-0000-005(	MCGEE ROBERT L + DONNA H JIMMERSON	5 HOCKEY DR WELAKA	Stephens Point	
33-11-26-0000-0260-000(	MORTON PATRICIA A + PAUL L W/H	148 FLORIDIAN CLUB RD WELAKA	Stephens Point	
37-12-26-6085-0020-011(	HUNGERFORD KENNETH W + SALLY J H/W	108 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-124(	NEWMAN HERSCHEL J	124 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-087(	RICHMAN GREGORY PAUL + CATHY LYNN H/W	87 HAPPINESS DR WELAKA	Stephens Point	
40-12-26-0530-0000-028(	GANNON WILLIAM J + TAMMIE H/W	163 BEECHERS POINT DR WELAKA	Beecher Point	
41-12-26-9200-0010-001(	LAU CARL N + BETTY A H/W LIFE ESTATE	1 PALMETTO ST WELAKA	Beecher Point	
37-12-26-6085-0020-012(	SEASHORE GREGORY F+MARJORIE A TRUST	106 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
40-12-26-0530-0000-011(	SCOTT ROBERT ALAN + MARY ANN EDWARDS H/W	154 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-0000-0230-001(	HARNER MICHAEL + PATRICIA H/W	124 BEECHERS POINT DR WELAKA	Beecher Point	
39-11-26-8234-0040-017(	WOODMAN WILLIAM S II	133 BUCHANAN CIR SATSUMA	Barrentine Creek	
41-12-26-9200-0030-104(	LICKEY ADRIENNE ATKINS	809 FRONT ST WELAKA	Beecher Point	
40-12-26-0530-0010-100(	BEECHERS POINT CONDOMINIUM OWNERS	00 Unassigned Location RE	Beecher Point	
33-10-26-0000-0011-001(	GILES BARBARA LLOYD REVOC TRUST	203 WOODBURY TRL SATSUMA	Downstream Model Extents	
38-12-26-0000-0040-006(	HEMMY ARTHUR + MARSHA H/W	1235 COUNTY RD 309 CRESCENT CITY	St. John Upstream Extent	
38-12-26-7800-0090-018(	SENGSTAKEN DAVID + KERRI H/W	146 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8790-0000-029(	STALDER RICKY L + FELICIA JO H/W	29 SCOTT ST WELAKA	Stephens Point	
33-10-26-3610-0000-026(	PSHONICK DAVID + JOAN B H/W	227 HERMITS DR SATSUMA	Barrentine Creek	
37-12-26-6085-0020-008(	SEITA PATRICIA I REVOCABLE TRUST PATRICIA I SEITA TRUSTEE	116 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-186(	SPEAS CARON LIFE ESTATE	186 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-135(	FELEGI JOSEPH + THOMAS SLAVIN + SHAWN PATCH	135 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-209(	COLIAN JEFFREY M + MICHELE H/W	209 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-210(	TOLLE DAVID RUSS + CYNTHIA S H/W	210 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-208(	SHARP GARY L+KARIN E H/W+GARRETT T SHARP (JTRS)	208 SPORTSMAN DR WELAKA	Stephens Point	
39-11-26-8234-0040-025(	MCCARTY ROBERT A + PAULA H/W	149 BUCHANAN CIR SATSUMA	Barrentine Creek	
45-11-26-8791-0000-229(	PRINE THOMAS CHARLES + CHARLOTTE LYNN H/W	229 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0000-0210-000(	PHILLIPS JOSEPH TRAVIS	1075 FRONT ST WELAKA	Beecher Point	
40-12-26-0530-0010-104(	EMERSON WILLIAM MICHAEL JR	104 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
37-12-26-6085-0020-013(	MADDEN JOSEPHINE	104 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
33-11-26-8790-0000-028(	GARMON DONALD JOHN JR	28 SCOTT ST WELAKA	Stephens Point	
26-12-26-0000-026D-002(	LYNN BELINDA SEPARATE PROPERTY TRST	104 NATIONAL FOREST RD 29 PALATKA	St. John Upstream Extent	
33-10-26-0000-0030-006(	KUDLO KATHLEEN	325 E BUFFALO BLUFF RD SATSUMA	Barrentine Creek	
33-10-26-3610-0000-038(	MARONEY MICHAEL T + LYNN A MARONEY	251 HERMITS DR SATSUMA	Barrentine Creek	
37-12-26-6085-0020-006(	CARTER MELVIN O + SHERAN L H/W	122 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-117(	SCHNOOR BARRY D + VICKI L H/W L EST	118 PARADISE DR WELAKA	Stephens Point	
33-10-26-0000-0010-051(	WILKINSON BARNEY A HEIRS OF	120 ROGERS LN PALATKA	Stokes Island	
37-12-26-6085-0010-007(	DOYLE THOMAS S + PAMELA ANN MONROE (JTRS)	108 DEXTER CT CRESCENT CITY	Fruitland Cove	
29-11-26-0000-0010-000(	TIITF/FWCC CARAVELLE RANCH WILDLIFE MGMT AREA	575 CARAVELLE FARMS RD PALATKA	River Road	
40-12-26-0530-0010-223(	DOMAGALSKI ROBERT GERARD	223 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
33-10-26-3610-0000-067(	COURCHESNE SCOTT E + SUSAN C BARNES (JTRS)	104 CAMELLIA DR SATSUMA	Barrentine Creek	
40-12-26-0530-0020-133(	HARR JOHN + ELLA H/W	133 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
33-10-26-3610-0000-024(	SNYDER TINA J + JAMES H WILLIAMS (JTRS)	223 HERMITS DR SATSUMA	Barrentine Creek	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
40-12-26-0000-0180-001(	CARTER PATRICIA A TRUST	112 POINT SOUTH DR WELAKA	Beecher Point	
33-11-26-8791-0000-151(	MODLIN TERRY W	151 MOONLITE DR WELAKA	Stephens Point	
40-12-26-0000-0190-003(	SCHERWINSKI HARRY S + CYNTHIA S H/W	1013 FRONT ST WELAKA	Beecher Point	
40-12-26-0530-0010-117(	HOLLAND CHARLES RONALD SR	117 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
35-12-26-7800-0070-017(	HAYES MARK S	104 W PALM AV CRESCENT CITY	St. John Upstream Extent	
40-12-26-0530-0010-116(	HULL JOEL M + NANCY S H/W	116 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
39-11-26-0000-0200-000(	CSX TRANSPORTATION	248 WHITNEY ST SATSUMA	Whitney Street	
39-11-26-0000-0063-001(	NELSEN KENNETH R + ASHLEY M H/W	309 SARATOGA DR SATSUMA	River Road	
39-10-26-3610-0000-204(	TREASURE JACK R + SHIRLEY J H/W LIFE ESTATE	123 ST JOHNS CT SATSUMA	Barrentine Creek	
40-12-26-0530-0020-113(	HUDSON RONALD D + PATRICIA P H/W	113 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0010-129(	BRINSON LONNIE M + GUINDAL ELAINE	129 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0000-016(	LAWRENCE CHARLES + RETA H/W	164 BEECHERS POINT DR WELAKA	Beecher Point	
33-11-26-8791-0000-094(	BOYD-BERRY TRUST	94 HAPPINESS DR WELAKA	Stephens Point	
33-11-26-8791-0000-143(	PARADISE INVESTORS LLC	143 PARADISE DR WELAKA	Stephens Point	
33-11-26-8791-0000-180(	FIELDS SHERRI Y + WILLIAM P ALLMAN (JTRS)	180 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-206(	COLEMAN KNOX F + SHIRLEY D H/W	206 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-204(	HOLTON ROBERT	204 SPORTSMAN DR WELAKA	Stephens Point	
37-12-26-6085-0020-020(	MCCOLLUM JAMES M + LINDA B H/W	162 MOUNT ROYAL AV CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-188(	SPORTSMANS HARBOR COMMUNITY CLUB	188 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-232(	CLEMENTS JACK + CAROLYN H JOINT TRUST	232 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-080(	FALESKIE FAMILY TRUST	80 CAREFREE DR WELAKA	Stephens Point	
40-12-26-0530-0000-017(	STEVENS ROBERT GARY + LINDY CLEMONS H/W	166 BEECHERS POINT DR WELAKA	Beecher Point	
39-11-26-0000-0063-000(	JACKSON GEORGE F + PATRICIA D H/W	311 SARATOGA DR SATSUMA	River Road	
40-12-26-0000-0400-000(	MARTY NATHANIEL + CHELSY L H/W	105 TERONDA RD WELAKA	Beecher Point	
33-10-26-0000-0030-004:	PARRISH RICHARD M + YVONNE C H/W	121 CODY DR SATSUMA	Barrentine Creek	
41-12-26-9200-0010-002(	KIELAS MICHAEL ANTHONY + ESTELLA J FRANSBERGEN	603 FRONT ST WELAKA	Beecher Point	
37-12-26-6085-0010-015(	CHANDLEE SUSAN M	113 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
45-11-26-8791-0000-241(	GEISEL PROPERTIES LLC	241 SPORTSMAN DR WELAKA	Stephens Point	
37-11-26-0000-0100-000(	RODEHEAVER BOYS RANCH INC	380 BOYS RANCH RD PALATKA	Whitney Street	
33-10-26-3610-0000-062(	BOYETT RITA COLLINS	112 CAMELLIA DR SATSUMA	Barrentine Creek	
39-10-26-3610-0000-188(	WHEELES RONALD WINSTON + DEBRA D	468 COVE DR SATSUMA	Barrentine Creek	
33-10-26-3610-0000-031(	WEEDMAN RANDOLPH P	237 HERMITS DR SATSUMA	Barrentine Creek	
45-11-26-8791-0000-244(	KOESTERING JAMES H	244 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0010-216(	COLES JULIE A + MARIE H COMBS JT/RS	216 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
33-10-26-3610-0000-076(	JENNINGS JEFF A + SANDRA M HEADLEY (TIC)	119 CAMELLIA DR SATSUMA	Barrentine Creek	
40-12-26-0530-0030-206(	WILLIAMSON CURTIS JR + TERRI L H/W	206 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
33-11-26-8791-0000-165(	KILCOMMONS PATRICK MICHAEL	165 MOONLITE DR WELAKA	Stephens Point	
37-12-26-6085-0020-010(	BUTENSKY JAN D + BARBARA P H/W	112 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
35-12-26-7900-0060-018(	FARNHAM HEATHER LEA + STEPHEN FRANK JR H/W	125 W PALM AV CRESCENT CITY	St. John Upstream Extent	
45-11-26-8791-0000-053(	RANEY DARWIN S + ELIZABETH A H/W	53 SPORTSMAN DR WELAKA	Stephens Point	
39-10-26-3610-0000-198(	CATTERTON CHESTER J	133 ST JOHNS CT SATSUMA	Barrentine Creek	
40-12-26-0530-0020-107(	CURTIS BRANDI RAE	107 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
26-12-26-0000-0370-005(	ADVANTA IRA ADMINISTRATION LLC FBO JOSEPH SANDS IV IRA	118 N HUBERS FISH CAMP RD CRESCENT CITY	Fruitland Cove	
40-12-26-0000-0180-001:	ACKERMAN JAMES J + SALLY M H/W	110 POINT SOUTH DR WELAKA	Beecher Point	
33-11-26-8791-0000-211(	BENNETT ROLAND + S CAROL H/W	211 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-198(	BARNETT DONALD J	198 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0000-0230-001(	MARCHIONE MARK A + MICHELLE N LESTER H/W	117 TERONDA RD WELAKA	Beecher Point	
40-12-26-0530-0030-227(	VETTEN CORNELIUS N + KATHLENE H/W	227 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
33-11-26-8791-0000-102(	BASS ROY + WILLA DEAN H/W	102 HAPPINESS DR WELAKA	Stephens Point	
39-11-26-8234-0040-026(	FAZEKAS NICHOLAS J JR + LINDA M FAMILY LIVING TRUST	151 BUCHANAN CIR SATSUMA	Barrentine Creek	
39-10-26-3610-0000-187(	LEVY WILLIAM R + SHARON M H/W	464 COVE DR SATSUMA	Barrentine Creek	
45-11-26-8791-0000-245(	STURM ROBIN SR + BRADLEY (JTRS)	245 SPORTSMAN DR WELAKA	Stephens Point	
38-12-26-7800-0090-001(	HARDIE FAMILY TRUST JOSEPH A III + PAMELA H HARDIE TRS	112 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-10-26-3610-0000-048(	MEADORS STEVE L + RYOKO K H/W	270 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-5117-0320-001:	LAZY DAYS CAMP RESORT LOT OWNERS ASSOCIATION INC	1074 FRONT ST WELAKA	Beecher Point	
45-11-26-8791-0000-225(	WATERS DONALD RAY + RENETTE M H/W	225 SPORTSMAN DR WELAKA	Stephens Point	
33-11-26-8791-0000-189(	LAWRENCE BILLY DON + PHYLLIS ANN H/W	189 SPORTSMAN DR WELAKA	Stephens Point	
37-11-26-0000-0030-001(	KITTLES STEPHEN D	599 STOKES LANDING RD PALATKA	Stokes Island	
45-11-26-8790-0000-019(	KOESTERING JAMES	19 SCOTT ST WELAKA	Stephens Point	
33-11-26-8791-0000-081(	PAPPAS JACQUELINE A + MICHAEL S W/H	81 CAREFREE DR WELAKA	Stephens Point	
40-12-26-0530-0010-131(	BRAZIL DONALD K	131 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
33-11-26-8791-0000-132(	TRUST B	132 PARADISE DR WELAKA	Stephens Point	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
40-12-26-0530-0010-224(	ENFINGER GERALD E + JANETTE M DIMOND H/W	224 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
40-12-26-0530-0010-102(	DULANEY PAUL + TERESA H/W	102 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
39-11-26-8234-0040-019(	BUMP NANCY H HEIRS OF	137 BUCHANAN CIR SATSUMA	Barrentine Creek	
33-11-26-0000-0310-001(	WELLS CAROL A LIFE ESTATE	136 FLORIDIAN CLUB RD WELAKA	Stephens Point	
33-10-26-0000-0012-000(	HOLLAND KEITH V + GEORGA ISRAEL III	221 WOODBURY TRL SATSUMA	Downstream Model Extents	
33-10-26-3610-0000-065(	JANKOWSKI KENNETH A	106 CAMELLIA DR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-230(	HUGHES KEVIN C + SANDRA E H/W	230 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
33-10-26-3610-0303-077(	HAVILLE RONALD W	121 CAMELLIA DR SATSUMA	Barrentine Creek	
33-10-26-3610-0006-023(	TOUART JOHN T	221 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0030-213(	BROWNING FAMILY TRUST	213 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
45-11-26-8791-0000-233(	LANE MICHAEL R + MYRNA P H/W	233 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-085(	FISH BRANTLEY MICHAEL + LORINDA G H/W + BRANTLEY J	85 SPORTSMAN DR WELAKA	Stephens Point	
26-12-26-0000-0271-000(	SAPP WILLARD J JR	110 NATIONAL FOREST RD 29 PALATKA	St. John Upstream Extent	
40-12-26-0530-0020-105(	BURBRIDGE H CLINTON + AMO H/W	105 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
45-11-26-8790-0000-013(	MAXWELL JOHN + WILMA	14 HOCKEY DR WELAKA	Stephens Point	
37-12-26-6085-0010-011(	SHORT WILLIAM	163 MOUNT ROYAL AV CRESCENT CITY	Fruitland Cove	
40-12-26-0530-0000-010(	LEONARD LINDA LIVING TRUST	150 BEECHERS POINT DR WELAKA	Beecher Point	
39-11-26-8234-0040-022(	BOWER LIVING TRUST	143 BUCHANAN CIR SATSUMA	Barrentine Creek	
35-12-26-7800-0060-024(	KOWALSKI KEITH JOHN + NANCY LEE H/W	111 W PALM AV CRESCENT CITY	St. John Upstream Extent	
40-12-26-0530-0020-135(	MORRISSEY BRIAN + AGNES H/W	135 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0010-218(	WUEST CARL + SHARON H/W LIFE ESTATE	218 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
45-11-26-8791-0000-223(	HAMMOND GLENN M + LYNN M H/W	223 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0030-222(	MADDOX SIBLEY B REV LIVING TRUST	222 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
38-12-26-7800-0090-006(	PETERSON RAND G + DEBORAH A H/W LIFE ESTATE	124 HICKS AV CRESCENT CITY	St. John Upstream Extent	
33-11-26-8791-0000-194(	MINIX WALTER L JR	194 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0030-236(	PRUITT WILLIAM A+EVELYN D REVOCABLE TRUST	236 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
33-10-26-3610-0000-035(	FERRELL GEORGE	245 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-130(	BRINSON LONNIE M + GUINDAL ELAINE	130 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0000-0220-000(	PHILLIPS TERESA A POWERS	103 TERONDA RD WELAKA	Beecher Point	
39-11-26-8234-0040-020(	BROOME MARY H + ROBERT W BROOME	139 BUCHANAN CIR SATSUMA	Barrentine Creek	
40-12-26-5117-0320-031(	POLAND CYNTHIA A LUEDERS+LADONNA L LUEDERS WILSON	1074 FRONT ST # LOT 31 WELAKA	Beecher Point	
40-12-26-0000-0180-003(	SEYMOUR WILLIAM G+MARY M JOINT LIVING TRUST	128 BEECHERS POINT DR WELAKA	Beecher Point	
45-11-26-8790-0000-024(	ROBERTSON LAURA ET AL (JTRS)	24 SCOTT ST WELAKA	Stephens Point	
37-12-26-6085-0020-018(	ANDERSON ROBERT L + MARYANN W H/W	166 MOUNT ROYAL AV CRESCENT CITY	Fruitland Cove	
39-10-26-3610-0000-183(	CARTER LINDA JO	456 COVE DR SATSUMA	Barrentine Creek	
33-10-26-3610-0000-0430	GINTERT CHARLES WALTER LIFE ESTATE RMDR:BRIAN LYNN GINTERT	263 HERMITS DR SATSUMA	Barrentine Creek	
33-10-26-3610-0000-069(	MOYER RICHARD L	100 CAMELLIA DR SATSUMA	Barrentine Creek	
33-10-26-3610-0000-037(	HATANPA DAVID	249 HERMITS DR SATSUMA	Barrentine Creek	
45-11-26-8791-0000-226(	WEBB CYNTHIA	226 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-3610-0000-021(	BREEDLOVE JEWELL M+ELIZABETH A BELL	219 HERMITS DR SATSUMA	Barrentine Creek	
37-12-26-6085-0020-023(	FURYK MICHAEL J LIV TRUST+LINDA J FURYK LIV TRUST	156 MOUNT ROYAL AV CRESCENT CITY	Fruitland Cove	
37-12-26-6085-0020-016(	VINSON DONALD M + DONNA L H/W	107 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
33-11-26-8791-0000-181(	KOMATINENI ANNMARIE	181 SPORTSMAN DR WELAKA	Stephens Point	
39-10-26-3610-0000-205(	CREAGLE JIMMIE H SR LIFE ESTATE	119 ST JOHNS CT SATSUMA	Barrentine Creek	
40-12-26-0530-0010-132(	NEWTON WARREN RAY REVOCABLE TRUST	132 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0030-225(	SMITH THOMAS A + LOUISE B H/W	225 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
40-12-26-0530-0010-203(	NICE LARRY C + ALIXANDRIA H/W	203 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-5117-0320-019(	MINNICK LARRY D + CHARLA S H/W	1074 FRONT ST # LOT 19 WELAKA	Beecher Point	
40-12-26-0530-0010-126(	PETERS MALCOLM W + BONNIE L H/W	124 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
41-12-26-8791-0000-248(	WARMUTH MARC A + AINSLEY C H/W	248 SPORTSMAN DR WELAKA	Stephens Point	
39-10-26-3610-0000-208(	MOES DONNA M LIFE ESTATE	115 ST JOHNS CT SATSUMA	Barrentine Creek	
40-12-26-0530-0030-208(	DAILEY SAM H + KRYSTEL T H/W	208 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
41-12-26-8790-0000-018(	ALVAREZ ROBERT + RONA COWART (JTRS)	18 SCOTT ST WELAKA	Stephens Point	
40-12-26-0530-0020-177(	SWEETING JAMES D + GAIL A H/W	127 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
33-11-26-8790-0000-007(	PLEVIK FREDERICK W + LINDA H/W	7 HOCKEY DR WELAKA	Stephens Point	
45-11-26-8790-0000-011(	SPRINKLE LAWRENCE EUGENE + ROSEMARIE H/W	11 HOCKEY DR WELAKA	Stephens Point	
45-11-26-8791-0000-116(	BLAIR JEANNIE R + JERRY L HOLLINGSWORTH W/H	116 PARADISE DR WELAKA	Stephens Point	
40-12-26-0530-0000-030(	ROGOZINSKI ANTHONY MICHAEL + LINA MARCELA H/W	159 BEECHERS POINT DR WELAKA	Beecher Point	
33-10-26-0000-0011-001(	BEHRENDT ALFRED F JR + BRENDA B FLETCHER	130 WOODBURY TRL SATSUMA	Downstream Model Extents	
40-12-26-0530-0010-209(	AUSTIN WILLIAM E JR ET AL (TIC)	208 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0000-0180-001(	CUTHILL JAMES L + LAWRENCE CUTHILL	104 POINT SOUTH DR WELAKA	Beecher Point	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identification Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario
40-12-26-0530-0020-205(	BATEMAN JOSEPH B + ANN P H/W	205 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-0530-0010-115(	MADARA PAUL A LIFE ESTATE	115 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
45-11-26-8791-0000-064(	KING ANGELA M	84 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-3610-0000-030(	GORMAN TERRY L	235 HERMITS DR SATSUMA	Barrentine Creek	
39-11-26-8461-0060-016(	LARRY FRANKLIN PROPERTIES INC	129 RIVER RD SATSUMA	River Road	
37-11-26-0000-0110-001(	TIITF/DEP-GREENWAYS GREENWAYS STATE REC PARK	202 BUCKMAN LOCK RD PALATKA	Whitney Street	
40-12-26-0530-0020-120(	SMITH THOMAS A + LOUISE B H/W	120 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
45-11-26-8791-0000-234(	HARRELL THOMAS CARL	234 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-2390	MILES HENRY GAINES HEIRS OF JOHN A + WILLIAM E MILES PERS REPS	239 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-3610-0000-078(	DUNCAN STEVEN + SHERRY H/W	123 CAMELLIA DR SATSUMA	Barrentine Creek	
39-11-26-8234-0040-021(	MYERS STEVEN R + MARISOL H/W	141 BUCHANAN CIR SATSUMA	Barrentine Creek	
40-12-26-0530-0000-032(	OPFERMAN JAMES M	155 BEECHERS POINT DR WELAKA	Beecher Point	
34-10-26-0000-0010-015(	PARKER AMANDA DAWN + MATTHEW ALAN KNIGHTON (TIC)	157 PINE TREE RD PALATKA	Downstream Model Extents	
38-12-26-7800-0050-019(	SYKES PHILLIP + DOROTHEA A H/W	108 HICKS AV CRESCENT CITY	St. John Upstream Extent	
34-11-25-0000-0020-000(	MAY STEVEN E + BRENDA W H/W	100 GUMPS PL PALATKA	Dean Creek Road	
40-12-26-0530-0030-233(	BURNETT RICHARD J JR+JOAN P H/W LIFE ESTATE	233 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
39-11-26-0000-0023-000(	NUCKOLLS WILLIAM S + SHARON H H/W	237 WHITNEY ST SATSUMA	Whitney Street	
39-11-26-0000-0020-000(	DINWIDDIE KAREN S	245 WHITNEY ST SATSUMA	Whitney Street	
41-12-26-5070-0090-000(	DIXON LOUISE W LIFE ESTATE	1 BOSTON ST WELAKA	Stephens Point	
39-10-26-3610-0000-200(	SOUCIA GERALD + ABBIE H/W	131 ST JOHNS CT SATSUMA	Barrentine Creek	
33-11-26-8791-0000-174(	RUSSELL RAYMOND W + BENETTA D FAMILY TRUST	174 MOONLITE DR WELAKA	Stephens Point	
40-12-26-0000-0300-000(	SHEPARD ROBERT D + PATRICIA A H/W	118 BEECHERS POINT DR WELAKA	Beecher Point	
45-11-26-8791-0000-230(	HADAWAY RAYMOND TERRY	230 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0010-123(	PERKINS CARLTON DAVID JR	123 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
40-12-26-0530-0010-204(	PUTNAM RENTALS LLC	204 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-0530-0010-109(	SK WATSON LLC	109 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
41-12-26-9200-0020-003(	STEELE ALLEN J	703 FRONT ST WELAKA	Beecher Point	
39-11-26-8234-0040-027(	RIGGS CHRISTOPHER ASHER	153 BUCHANAN CIR SATSUMA	Barrentine Creek	
45-11-26-8790-0000-022(	WATERS HAROLD H + JANICE T H/W	22 SCOTT ST WELAKA	Stephens Point	
33-10-26-3610-0000-047(	MARRO PASQUALE J + DEBORAH M H/W	269 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0000-018(	PALUSZYNSKI MICHAEL A + KAY C H/W	168 BEECHERS POINT DR WELAKA	Beecher Point	
35-12-26-7800-0060-019(	ROWLEY ALBERT	123 W PALM AV CRESCENT CITY	St. John Upstream Extent	
41-11-26-0000-0020-001(	HARVEY RONALD S + MICHELLE R H/W	104 SONATA CT SATSUMA	Stephens Point	
33-10-26-3610-0000-068(	MOYER RICHARD L	102 CAMELLIA DR SATSUMA	Barrentine Creek	
40-12-26-5117-0320-033(	WENDEL TAMMY L + GEORGANNA W PILCHER (JTRS)	1074 FRONT ST # LOT 33 WELAKA	Beecher Point	
40-12-26-0000-0240-000(	MEGILL RALPH R + NADINE H/W	113 TERONDA RD WELAKA	Beecher Point	
40-12-26-0530-0010-201(	PICKENS ROBERT W III	201 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
45-11-26-8791-0000-222(	HATCHER FAMILY TRUST	222 SPORTSMAN DR WELAKA	Stephens Point	
33-10-26-3610-0000-045(	BRODE ALFRED	265 HERMITS DR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-232(	BELL ROLAND R + KATHY L H/W	232 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
37-12-26-6085-0020-015(	DAUGHTERY JOEY + LISA D H/W	103 WILLIAM BARTRAM DR CRESCENT CITY	Fruitland Cove	
39-10-26-3610-0000-195(	SMALL PAMELA JEAN	480 COVE DR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-101(	GREGG JOHN L + JENNIFER L H/W	101 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-0000-0231-000(	SHEPARD ROBERT + PATRICIA H/W	122 BEECHERS POINT DR WELAKA	Beecher Point	
34-10-26-0000-0010-014(	CONE JESSICA LYNN + DANIEL EDWARD W/H	147 PINE TREE RD PALATKA	Downstream Model Extents	
40-12-26-0530-0020-111(	HOLLAND CHARLES R	111 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0030-212(	SPALDING MARC + LINDA FAMILY TRUST	212 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0000-020(	HROSIK PATRICIA E LIFE ESTATE	172 BEECHERS POINT DR WELAKA	Beecher Point	
45-11-26-8791-0000-228(	WEATHERWAX BRIAN + HEATHER DAVIS (JTRS)	228 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0030-235(	MANN JOHN CHARLES + LYNDA R H/W	235 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0000-042(	MAXWELL DENNIS L LIFE ESTATE	135 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-0530-0010-103(	BEERBOWER PEGGY MCMICHAEL LIVING TRUST	103 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
39-10-26-3610-0000-185(	JAMES SAMUEL	460 COVE DR SATSUMA	Barrentine Creek	
40-12-26-0530-0030-207(	R B CONDOMINIUM ASSOC INC	207 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-0530-0000-001(	HOFFMAN HENRY B	132 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-5117-0320-020(	DELOACH EDITH	1074 FRONT ST # LOT 20 WELAKA	Beecher Point	
40-12-26-0530-0030-219(	HEUSINGER THOMAS + ANN H/W LIFE ESTATE	219 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
39-11-26-8461-0060-015(	BAILEY TIMOTHY L + MARIE A H/W	131 RIVER RD SATSUMA	River Road	
40-12-26-0000-0380-000(	CARTER S RUSSELL JR + COURTNEY L	109 TERONDA RD WELAKA	Beecher Point	
40-12-26-5117-0320-030(	WALDRON JASON + KIMBERLY H/W	1074 FRONT ST # LOT 30 WELAKA	Beecher Point	
40-12-26-0531-0000-004(	GANNON WILLIAM J + TAMMY L H/W	101 BEECHERS POINT DR WELAKA	Beecher Point	

LIST OF PARCELS WITH AFFECTED STRUCTURES

KIRKPATRICK DAM FAILURE ANALYSIS

Parcel Identificaiton Number	Owner Name	Site Address	Nearest Assessment Location	Affected in Model Scenario:
45-11-26-8791-0000-056(	DALEY THOMAS EUGENE + JONE LISA H/W	57 CAREFREE DR WELAKA	Stephens Point	
45-11-26-8791-0000-2210	HAGGARD WILLIAM ANDREW LIVING TRUST WILLIAM ANDREW HAGGARD TRUSTEE	221 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-240(	GEISEL RAYMOND J JR TRUST	240 SPORTSMAN DR WELAKA	Stephens Point	
39-11-26-8234-0040-024(	HUTCHINSON ROSE MARY	147 BUCHANAN CIR SATSUMA	Barrentine Creek	
39-11-26-8234-0040-018(	MALO GREGORY GEORGE	135 BUCHANAN CIR SATSUMA	Barrentine Creek	
45-11-26-8791-0000-231(	CLEMENTS JACK + CAROLYN H JOINT TRUST	231 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0010-210(	EHLERS DENNIS H + CAROLYN F H/W	210 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
33-10-26-3610-0000-013(	KESSLER ANA L + WILLIAM J W/H	204 COVE DR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-118(	NELSON BEN W	118 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
45-11-26-8791-0000-054(	THIELMAN DAVID PAUL HEIRS OF	54 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-237(	GEISEL CHERYL ANN	238 SPORTSMAN DR WELAKA	Stephens Point	
39-11-26-0000-0022-000(	VOLKOVA NADEZDA	241 WHITNEY ST SATSUMA	Whitney Street	
40-12-26-0530-0010-229(	RITTER ROBERT	229 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0010-110(	TILLMAN DONALD WAYNE	110 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0010-202(	GROOMS RUSSELL E JR + CATHERINE M	202 RIVER BEND CT # BLDG A WELAKA	Beecher Point	
40-12-26-0530-0030-220(	LEE THOMAS R JR	220 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
40-12-26-5117-0320-034(	ANDERSON JAMES M + DARLENE T H/W	1074 FRONT ST # LOT 34 WELAKA	Beecher Point	
45-11-26-8791-0000-058(	CLARKE KIMBERLY DANESE + ROBERT JOHN JR W/H	58 CAREFREE DR WELAKA	Stephens Point	
45-11-26-8791-0000-083(	WOLF DONALD J + PATRICIA H/W	83 CAREFREE DR WELAKA	Stephens Point	
45-11-26-8791-0000-045(	SKAGGS FRANKIE W + DEBRA C H/W	45 SCOTT ST WELAKA	Stephens Point	
45-11-26-8791-0000-235(	DICKS RONALD D + AIMEE R H/W	235 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-242(	FERRY RICHARD P	242 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0020-125(	FERBER GEORGE A LIVING TRUST ET AL	125 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
45-11-26-8790-0000-015(	CHRISTOPHERSON MARY DAWN	15 HOCKEY DR WELAKA	Stephens Point	
45-11-26-8791-0000-246(	VOHO CAROLYN REVOCABLE TRUST	246 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-043(	MATHEWS RANDALL S + TRENTON HANK JOHNS (JTRS)	44 SCOTT ST WELAKA	Stephens Point	
40-12-26-0530-0030-211(	COX JAMES S + TAMMY S H/W	211 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0000-009(	STANTON PAMELA Z + PAUL G W/H	146 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-0530-0010-215(	PARETTE KEITH T + VICTORIA H/W	215 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
40-12-26-0530-0030-226(	BUENTE DALE L + PHYLLIS	226 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
33-10-26-0000-0060-004(	BIRKETT BARRY + SUSAN ZABAWA	439 COVE DR SATSUMA	Barrentine Creek	
40-12-26-0530-0030-221(	LEVIN ROY STUART + CYNTHIE LYNN H/W	221 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
40-12-26-0000-0360-000(	EVANS JEFFREY S + MARY A H/W (JTRS)	123 TERONDA RD WELAKA	Beecher Point	
45-11-26-8790-0000-021(	MCGAULEY GILBERT E + JEANNETTE B	21 SCOTT ST WELAKA	Stephens Point	
45-11-26-8791-0000-224(	LIGHTKEP BAXTER	224 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8790-0000-012(	LAMB CHRISTINA MARIE + DANIEL W/H	12 HOCKEY DR WELAKA	Stephens Point	
45-11-26-8791-0000-220(	GREEN ALBERT E JR + LYNETTE M H/W	220 SPORTSMAN DR WELAKA	Stephens Point	
40-12-26-0530-0020-122(	PUTNAM RENTALS LLC + NELSON JACKSON PADGETT (TIC)	122 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
40-12-26-0530-0030-234(	BUSH JAMES F + ALICIA M H/W + KIMBERLY A STONER	234 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
40-12-26-0530-0030-214(	HOLLAND CHARLES R	214 RIVER BEND PL # BLDG B WELAKA	Beecher Point	
40-12-26-0530-0000-004(	BEASLEY HARRY B + PATSY R H/W	140 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-0000-0340-000(	SCHOLL ROBERT A + BARBARA M H/W LIFE ESTATE	104 BEECHERS POINT DR WELAKA	Beecher Point	
40-12-26-0530-0030-228(	TOWNSEND MELANIE Y + WILLIAM W W/H	228 RIVER BEND PL # BLDG D WELAKA	Beecher Point	
35-12-26-7800-0060-021(	NELSON BRANDON JOSEPH + TARRIN H/W	119 W PALM AV CRESCENT CITY	St. John Upstream Extent	
39-11-26-8234-0040-023(	HUTCHINSON ROBERT WILLIAM + DARLENE LIFE ESTATE	145 BUCHANAN CIR SATSUMA	Barrentine Creek	
40-12-26-0530-0010-231(	ABBATINOZZI PAUL + DOROTHY W M H/W	231 RIVER BEND PL # BLDG E WELAKA	Beecher Point	
45-11-26-8791-0000-236(	GANN EMILY + CLIFFORD W/H	236 SPORTSMAN DR WELAKA	Stephens Point	
45-11-26-8791-0000-115(	MOODY FRANK M + SUSAN M H/W	115 HAPPINESS DR WELAKA	Stephens Point	
40-12-26-0000-0280-000(	COWAN CAROL L + HENRY S W/H	110 BEECHERS POINT DR WELAKA	Beecher Point	
38-12-26-0000-0042-0020	FENDER FRANKLIN D+MARION B TRUST FRANKLIN D+MARION B FENDER TRUSTEES	147 HICKS AV CRESCENT CITY	St. John Upstream Extent	
40-12-26-0530-0010-217(	SCOTT ROBERT A	217 RIVER BEND PL # BLDG C WELAKA	Beecher Point	
05648-001-00	BROWN DOROTHY M TRUST		Dean Creek Road	
05640-000-00	BALDWIN JOHN A ET AL		Dean Creek Road	

Appendix E. Miscellaneous Information

NGS Coordinate Conversion and Transformation Tool (NCAT)

Convert/Transform from:

Horizontal

Horizontal+height

XYZ

Select the type of horizontal coordinate:

Geodetic lat-long

SPC

UTM

USNG

Select a height

Ellipsoidal

Orthometric

Enter lat-lon in decimal degrees

Lat

29.5113300273

Lon

-81.8151855469

or degrees-minutes-seconds

Lat

N

29-30-40.78810

Lon

W

081-48-54.66797

or drag map marker to a location of interest

Input reference frame
(historically called 'horizontal datum')

NAD83(HARN)

Output reference frame
(historically called 'horizontal datum')

NAD83(HARN)

Don't see a reference frame in the list?Click here to learn more.

Orthometric Height (m)

0.000

Input geopotential datum
(historically called 'vertical datum')

NAVD88

Output geopotential datum
(historically called 'vertical datum')

NGVD29

SPC zone

Auto Pick (default zone)

Submit

Export Results to

Click blue bar(s) to expand/collapse

Input Coordinate

Latitude

N29° 30' 40.78810"
N293040.78810
29.5113300273

Longitude

E278° 11' 5.33203"
W0814854.66797
-81.8151855469

Ellipsoid Height (m)

Not given

Orthometric Height (m)

0.000

Reference Frame

NAD83(HARN)

Geopotential Datum

NAVD88

Output Coordinate

Latitude

N29° 30' 40.78810"
N293040.78810
29.5113300273

Longitude

E278° 11' 5.33203"
W0814854.66797
-81.8151855469

Ellipsoid Height (m)

Not given

Orthometric Height (m)

0.279

Reference Frame

NAD83(HARN)

Geopotential Datum

NGVD29

Total Change + Uncertainty

Latitude

0.00000″ ±0.000000″
(0.000 m ±0.0000 m)*

Longitude

0.00000″ ±0.000000″
(0.000 m ±0.0000 m)*

Ellipsoid Height

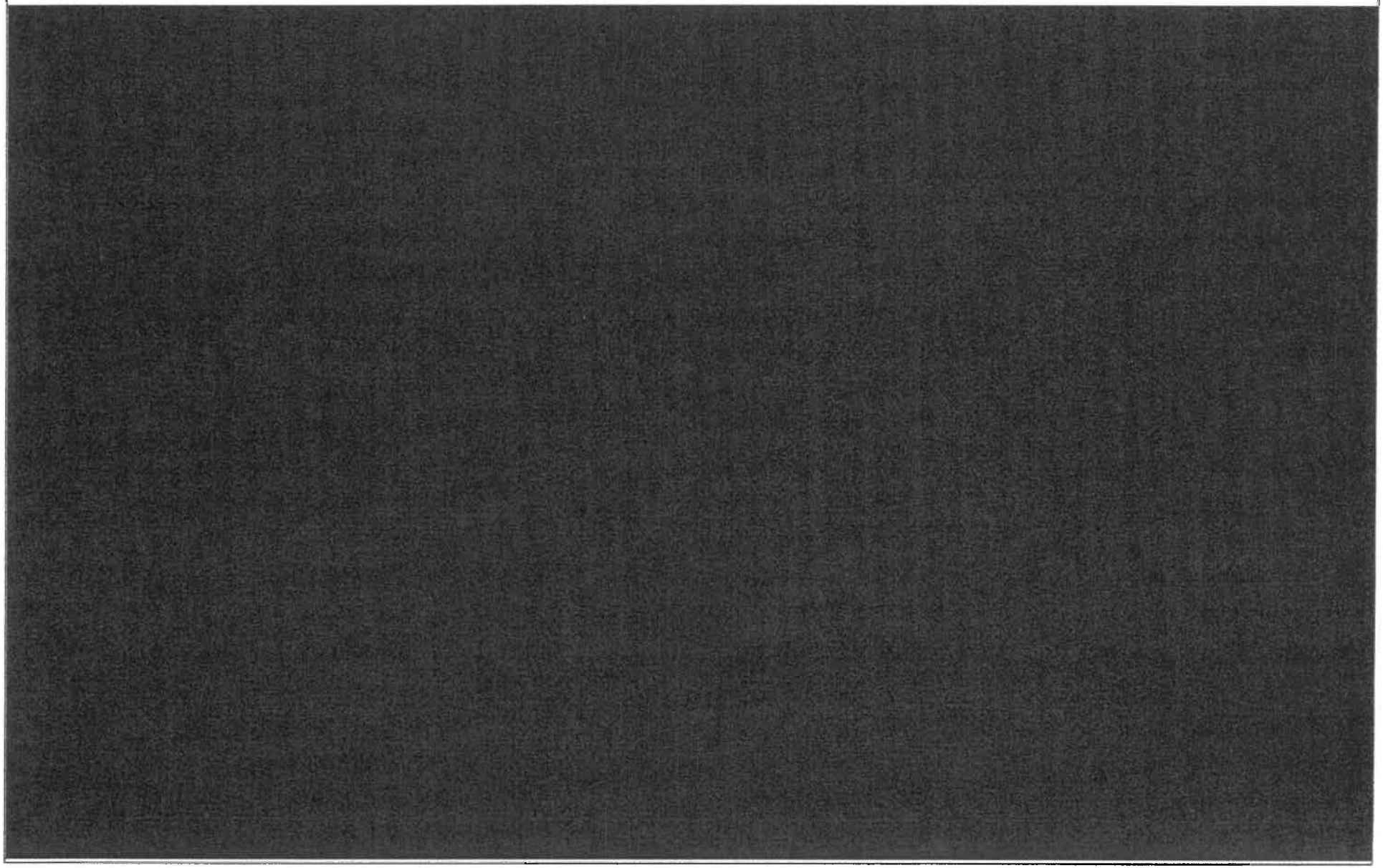
Not given

Orthometric Height

0.279 m ±0.008 m

*Approximate value to aid interpretation and not an actual distance. See TM NOS NGS 82 for more details.

Ocklawaha Channel Invert Profile



Slope Stability Analyses

Kirkpatrick Dam

Report prepared for

Florida Department of Environmental Protection

Report prepared by

Mead & Hunt

www.meadhunt.com

February 2022

MARTIN H. KEMPS LICENSE No. 70468 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Martin Kemps, PE on 02/10/2022.

Printed copies of this document are not considered signed and sealed, and the signature must be verified on any electronic copies.

Table of Contents

Page

1. **Introduction** 1
   - A. Project description 1
   - B. Background 1
   - C. Limitations 1
2. **Slope Stability Analysis** 2
   - A. Description 2
   - B. Analysis criteria 2
   - C. Load Cases 2
   - D. Phreatic Surface Development 2
   - E. Material Properties 2
   - F. Results 3
   - G. Conclusions 3

Appendices

A Left Embankment Graphical Output

B Right Embankment Graphical Output

List of Contributors

This report was prepared by or under the direct supervision of the individual listed below:

Martin Kemps, P.E.
Project Engineer

This report was reviewed by:

Jim Botz, P.E.
Senior Engineer

1. Introduction

A. Project description

The reservoir, known as Rodman Reservoir, is created by the Kirkpatrick Dam and Buckman Lock, which expands across the Ocklawaha River and the Cross Florida Barge Canal, respectively. The normal reservoir pool elevation of Rodman Reservoir is 20.0 feet, NGVD 29[1] at which the reservoir has a surface area of approximately 20.3 square miles, a gross volume of approximately 82,000 acre-feet, and a length of approximately 16.4 miles. The Kirkpatrick Dam (dam) consists of three water retaining structures: a left[2] (southwest) embankment, a concrete spillway with four lift gates, and a right northeast embankment.

B. Background

To better understand how factors of safety of the embankment change with various headwater levels, the Florida Department of Environmental Protection (FDEP) requested Mead & Hunt, Inc. (Mead & Hunt) to perform slope stability sensitivity analyses of the earthen embankments with the headwater elevations ranging from elevation 14.0 (six feet below normal) to elevation 23.2.

C. Limitations

All calculations and modeling were based upon as-built drawings and soil borings from the original construction. No surveys, soil borings, or laboratory tests were performed for this evaluation.

[1] All elevations in this report are given in feet and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929).

[2] Left and right are referred to in this report relative to an observer facing downstream.

2. Slope Stability Analysis

A. Description

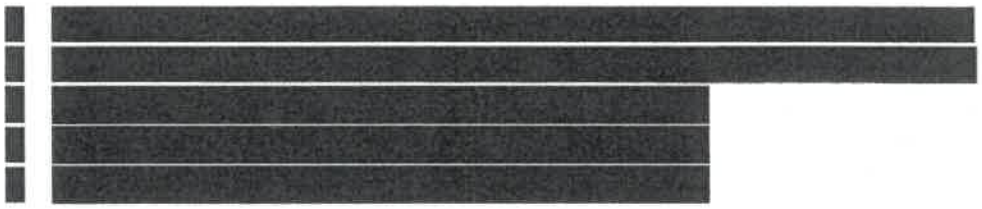
The embankments at Kirkpatrick Dam are homogenous and consist of sand. The crest is 30 feet wide with a top elevation of 28.3. The downstream section consists of 4(H):1(V) downstream slopes. The downstream slopes contain a rip rap revetment to elevation 19.3 which is underlain by a two-stage filter system. The upstream slopes consist of 4(H):1(V) slopes to elevation 25.0, 10(H):1(V) slopes to elevation 13.0, and a 3(H):1(V) slope that ties back into the existing ground surface. The drawings do not indicate that an impermeable core or cut-off wall was included in the design.

B. Analysis criteria

Since the state of Florida does not have slope stability criteria for embankment dams, factors of safety were compared to the recommended values in the Federal Energy Regulatory Commissions (FERC), *Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter IV, Embankment Dams*, September 2006.

C. Load Cases

The following headwater and tailwater elevations were used in the models:



Seismic conditions were not analyzed since the current USGS data estimates a peak ground acceleration (PGA) between 0.02g and 0.04g at the Kirkpatrick Dam for a 2% chance of exceedance in 50 years (i.e. a return period of 2,500 years).

D. Phreatic Surface Development

Mead & Hunt performed seepage analyses of both the left and right embankments using the 2D finite element analyses (FEA) module within the Slide2 software by Rocscience (Version 9.005, 2020) to estimate the phreatic surface. Soil type was obtained from the subsurface exploration program performed in 1964. As requested, headwater elevations used ranged from a maximum pool elevation of 23.2 to a drawn-down pool elevation of 14.0. A horizontal to vertical permeability ratio of 3.0 was used for the granular embankment and foundation soils. Normal tailwater was used for all cases except for the maximum pool. Tailwater at the maximum pool was estimated to be at elevation 9.55 based upon the dam failure analysis performed by Mead & Hunt in 2022. The seepage model results appear reasonable, but they could not be calibrated because there are no monitoring wells in the embankment to measure the phreatic surface.

E. Material Properties

Material strength parameters used in the analyses were estimated from the N-values obtained during sampling during the subsurface exploration program performed during original construction. Unit

weight assumptions were based on values provided in Table 6 of *Naval Facilities Design Manual 7.01, Soil Mechanics*.

Hydraulic soil properties from Figure 8.3.2.3.3-1 of the *U.S. Bureau of Reclamation Design, Standard No. 13* were used in the model to estimate permeability rates.

F. Results

Mead & Hunt conducted slope stability analyses for the right embankment using the Slide2 (Version 9.005) slope stability program (Rocscience, 2020). The procedure used was the simplified Bishop's Method of Slices which satisfies all conditions of force and moment equilibrium. Both circular and non-circular searches were performed to find the lowest global FOS. The models were checked to see if tension cracks could develop. No tension within the soils was determined to exist. Global failure of the cross-sections was considered to be those failure surfaces having a FOS, which could realistically lead to a breach of the dam and an uncontrolled release of water. As a result, shallow surface failures were eliminated from consideration. Results of the slope stability analyses are presented in Table 2.

Table 2. Slope Stability Analyses Results

Headwater Elevation	Left Embankment		Right Embankment	
	Calculated Factor of Safety	Recommended Factor of Safety	Calculated Factor of Safety	Recommended Factor of Safety
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

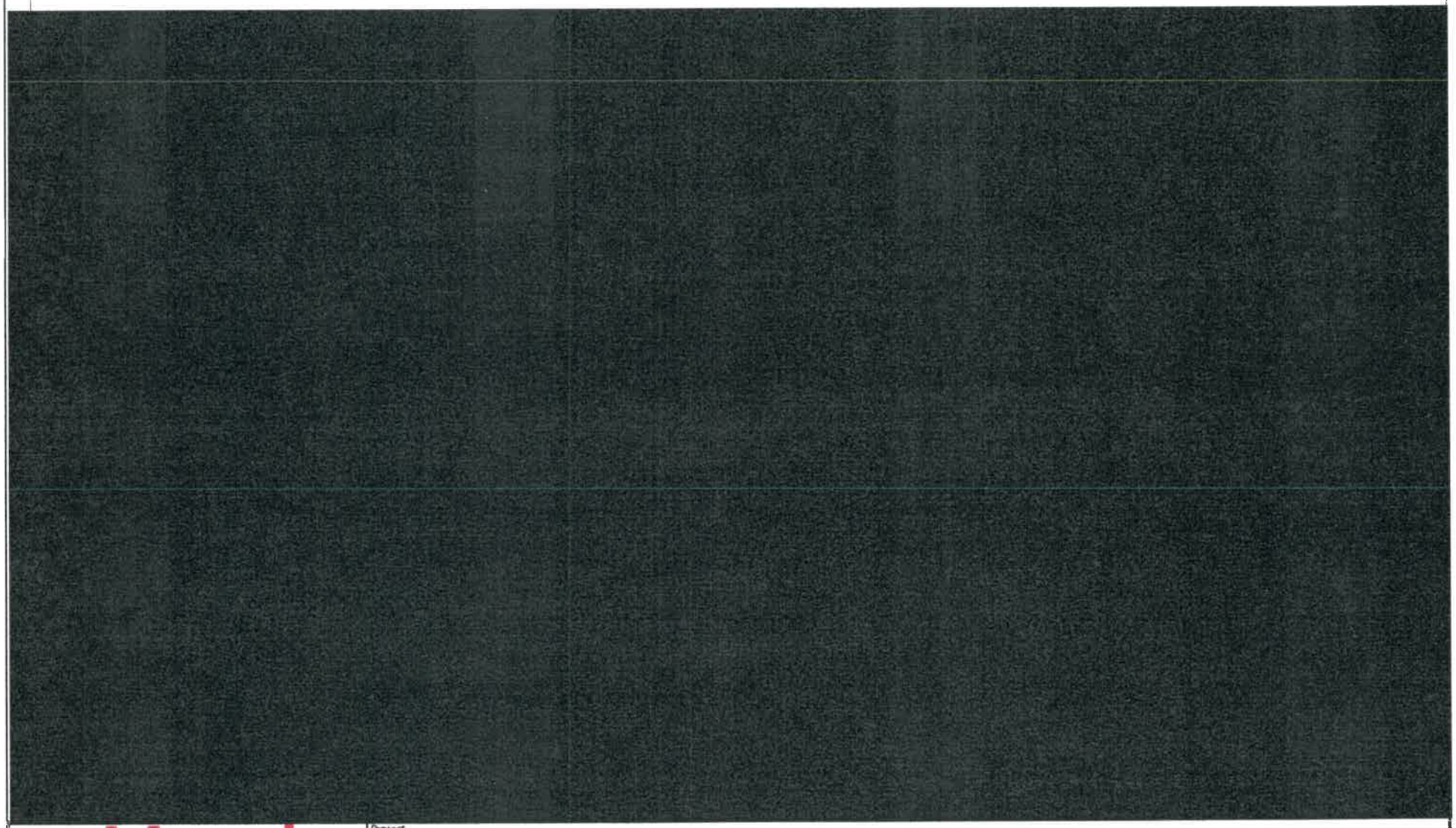
Graphical cross-sections of the slope stability analysis results and controlling failure surfaces are presented in Appendix A and B for the left and right embankments, respectively.

G. Conclusions

The existing embankment slopes exceed the factor of safety as recommended by the FERC for all load cases analyzed. The factor of safety does increase with lower pool elevations which would be expected. The relatively high factors of safety can be attributed to the wide crest and gradual slopes.

Appendix A. Left Embankment Graphical Output

Left Embankment

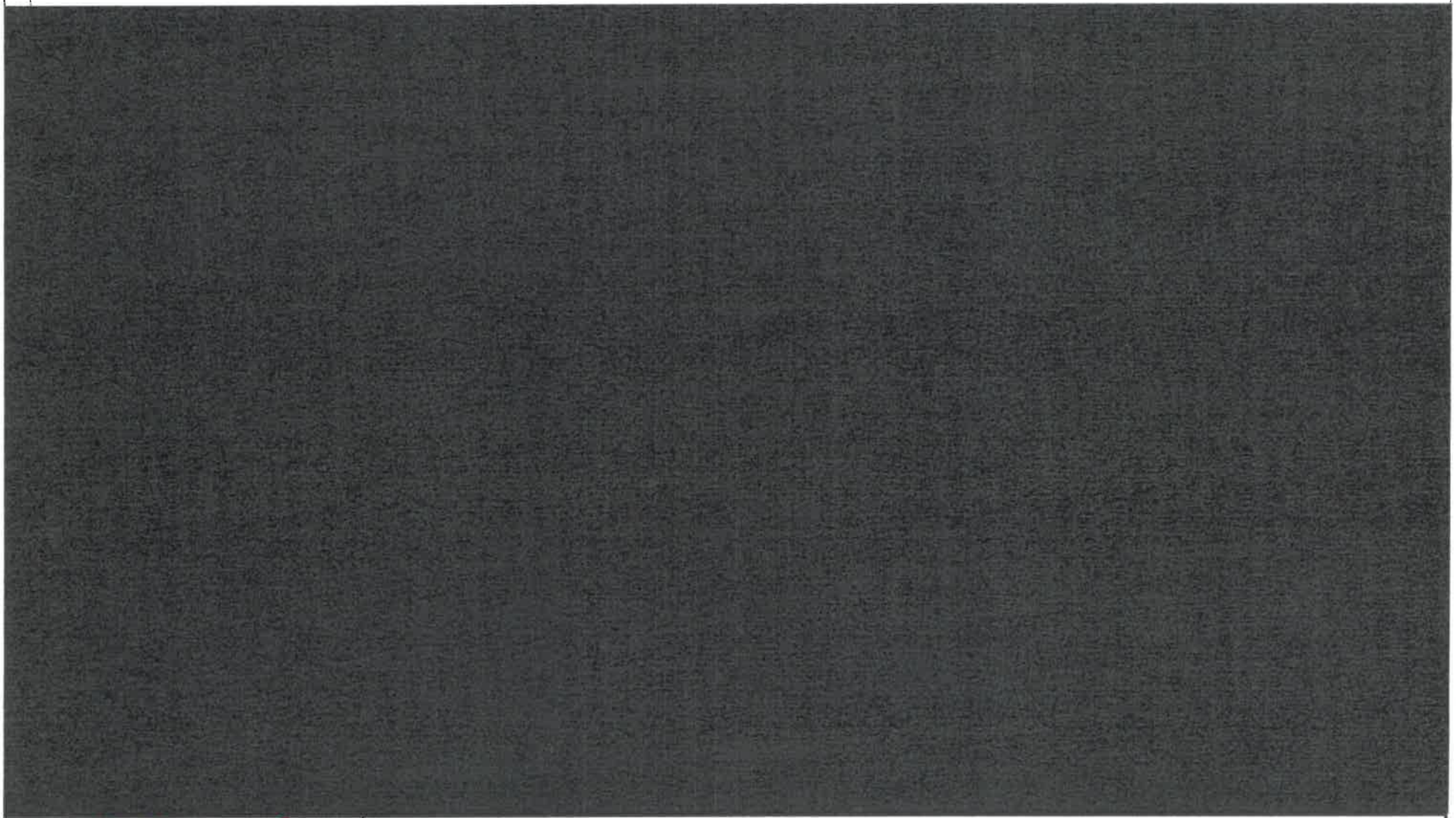


Mead Hunt

SLIDEINTERPRET 9.015

Project:	Kirkpatrick Dam		
Group:	Left Embankment	Scenario	HW = 23.2
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	Kirkpatrick Dam Left Embankment.slmd

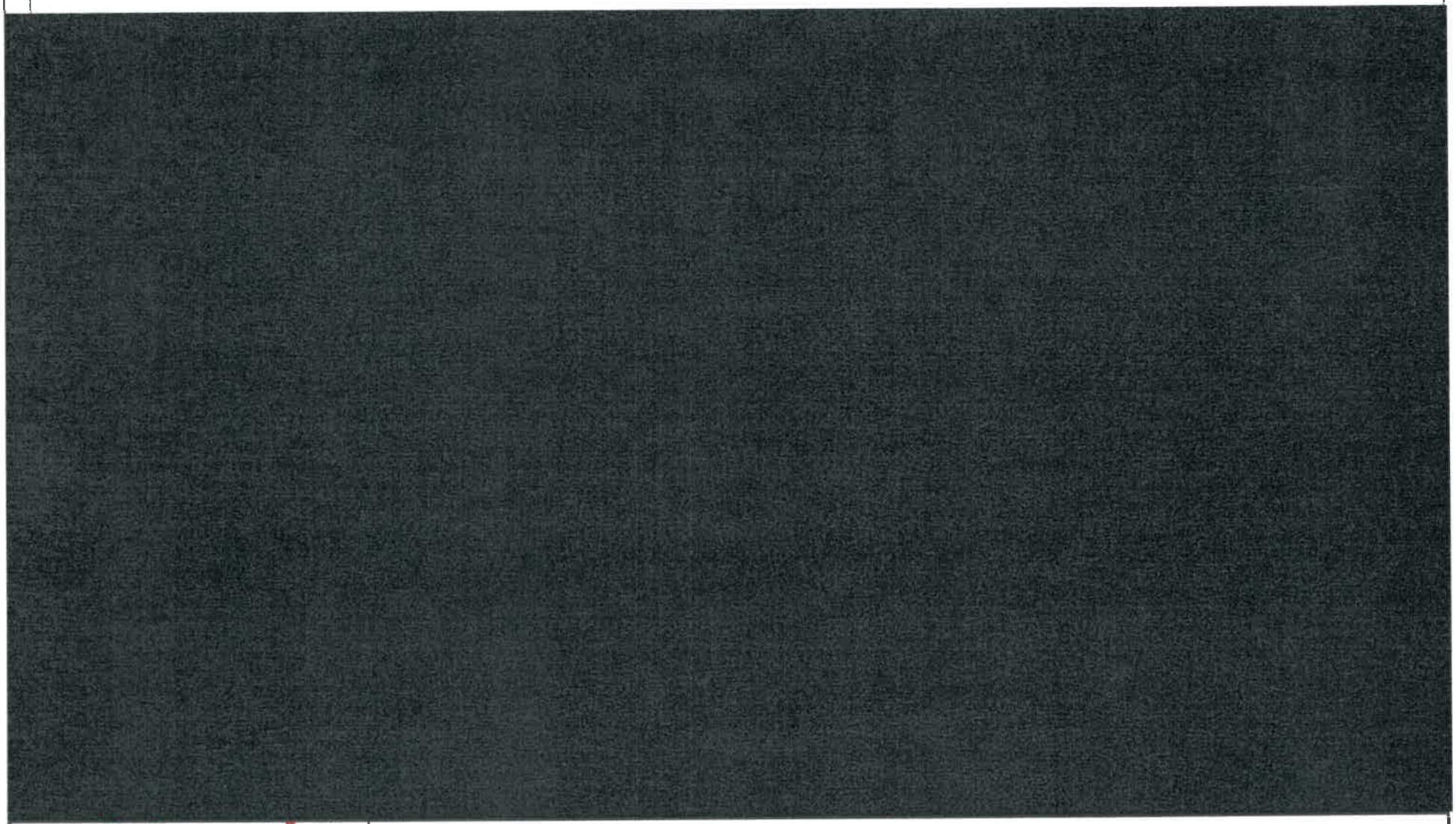
Left Embankment



Mead & Hunt	Project	Kirkpatrick Dam	
	Group	Left Embankment	Scenario: HW = 20
	Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company: Mead & Hunt, Inc.
	Date	October 2021	File Name: Kirkpatrick Dam Left Embankment.slmd

SLIDEINTERPRET 9.019

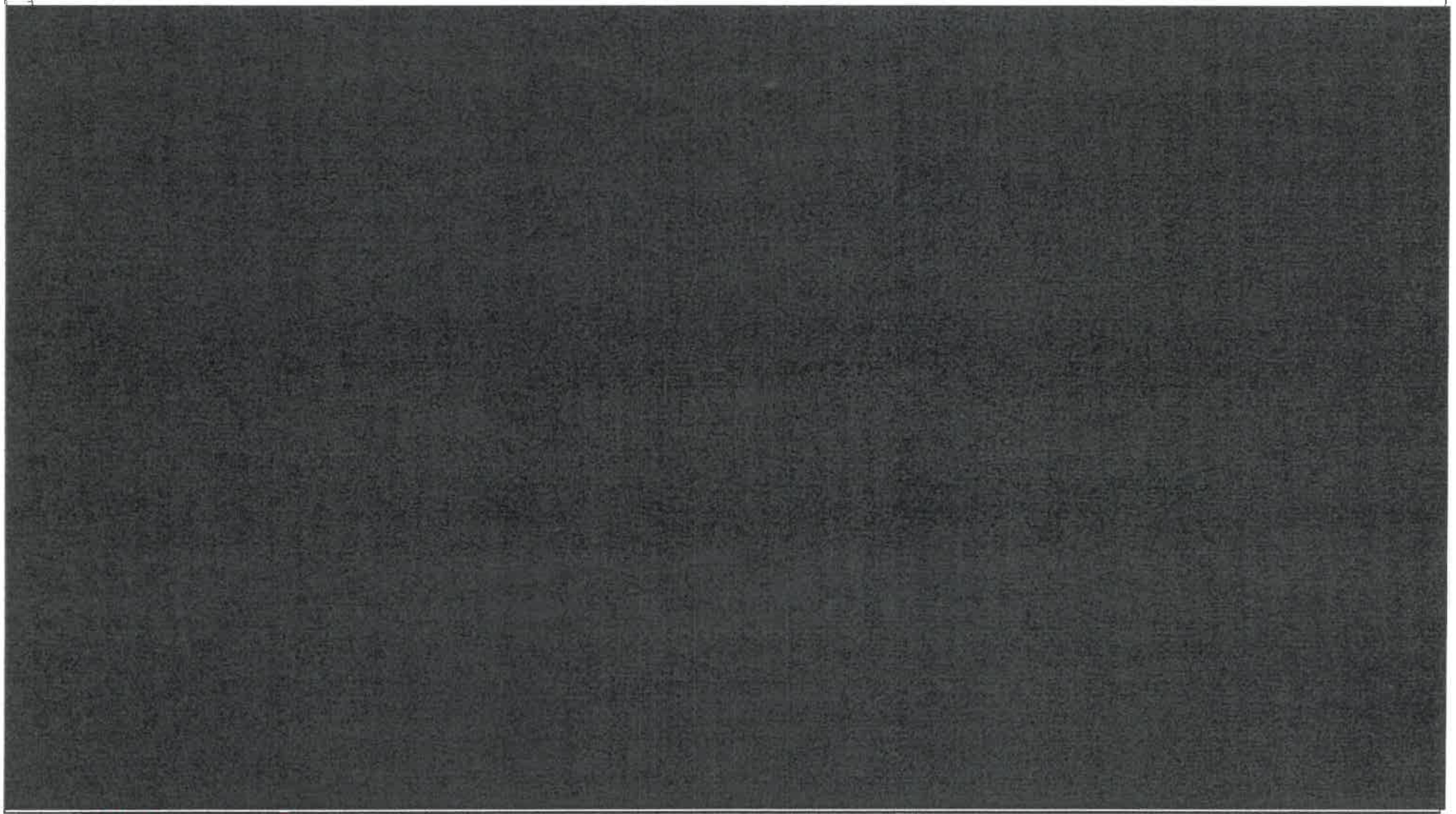
Left Embankment



Project	Kirkpatrick Dam		
Group	Left Embankment	Scenario	HW = 18
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	Kirkpatrick Dam Left Embankment.slmd

SLIDEINTERPRET 9.015

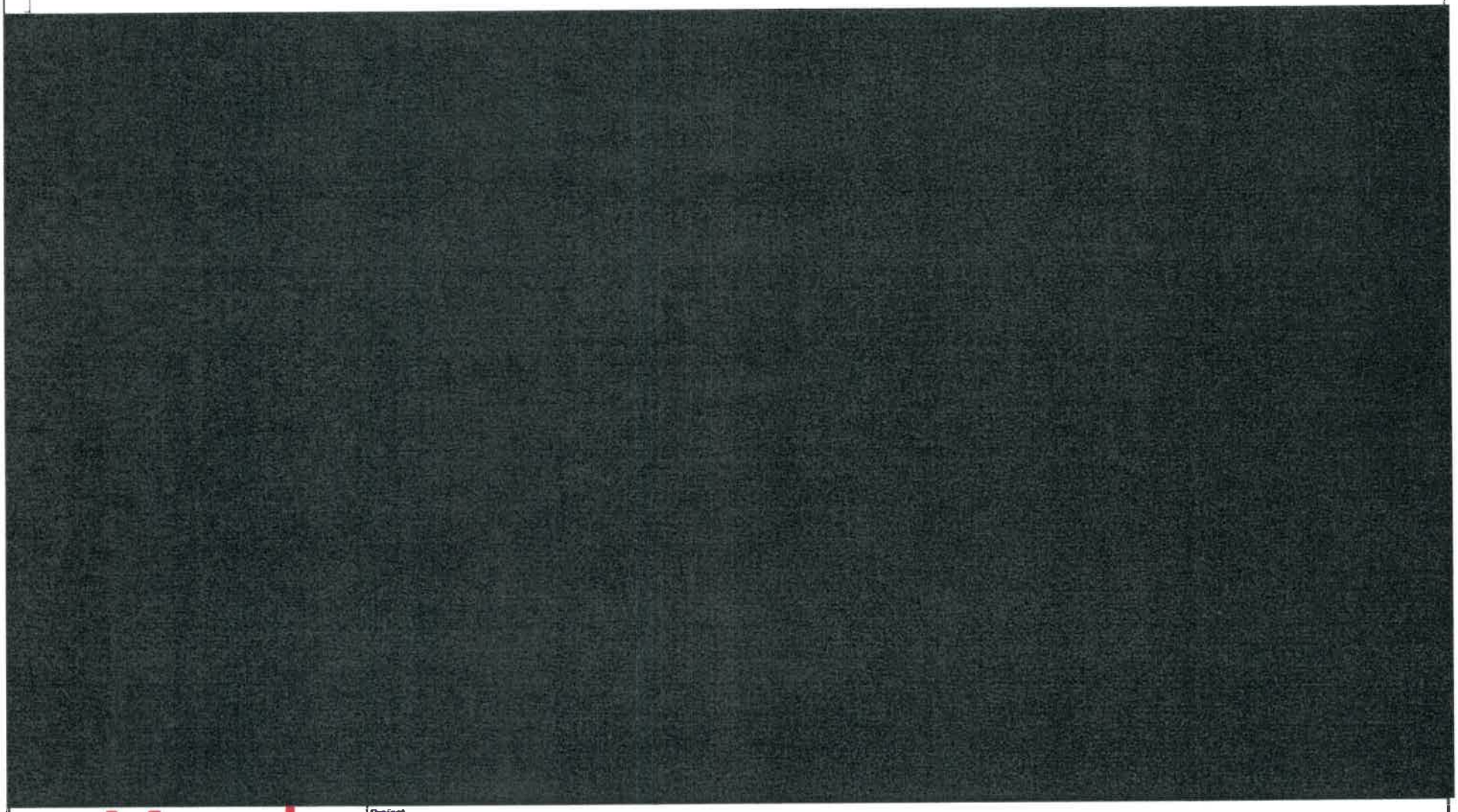
Left Embankment



Mead & Hunt	Project	Kirkpatrick Dam	
	Group: Left Embankment		Scenario: HW = 16
	Drawn By: M. Kemps, PE Reviewed J. Botz, PE		Company: Mead & Hunt, Inc.
	Date: October 2021		File Name: Kirkpatrick Dam Left Embankment.slmd

SLIDEINTERPRET 9.019

Left Embankment

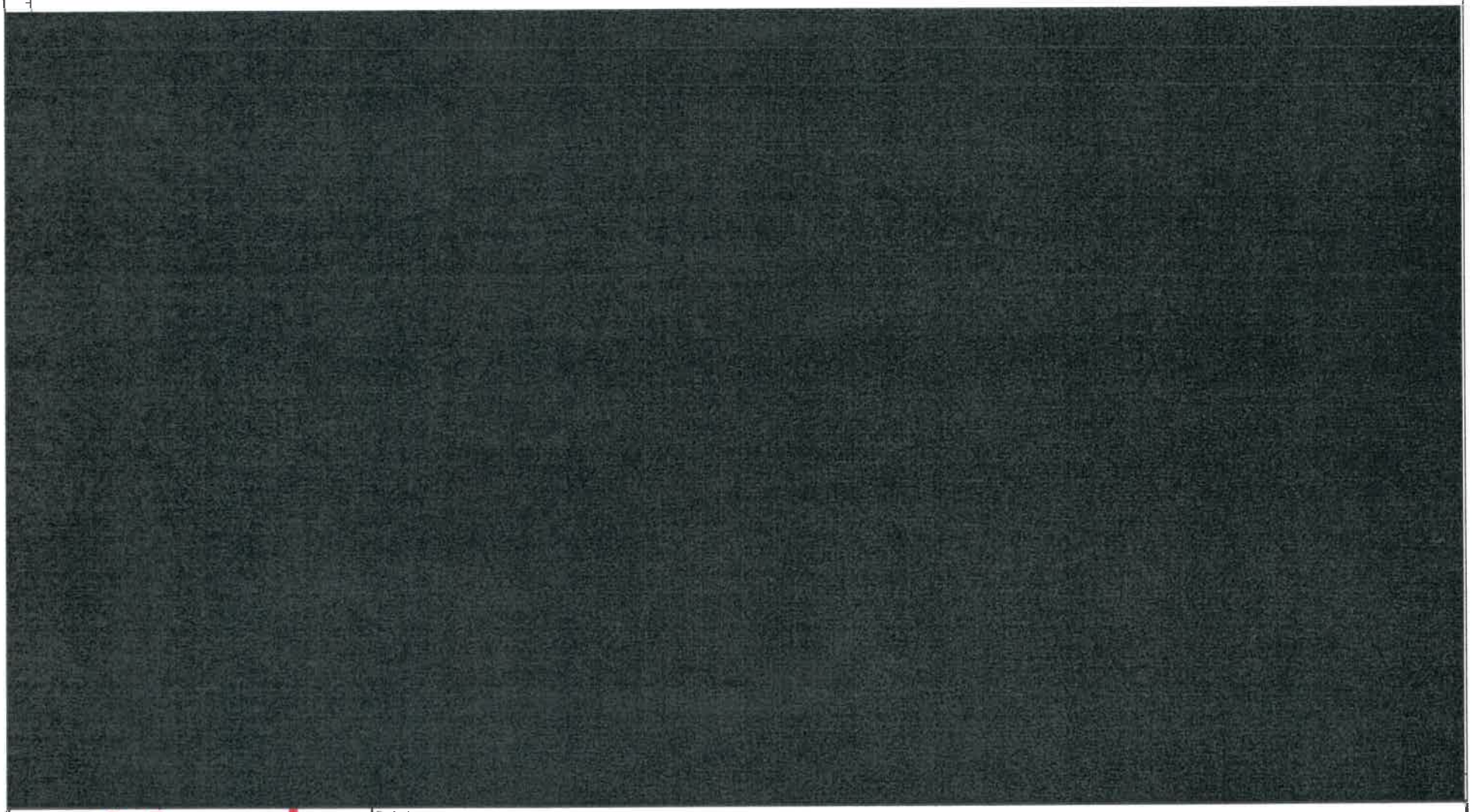


Project	Kirkpatrick Dam		
Group	Left Embankment	Scenario	HW = 14
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	Kirkpatrick Dam Left Embankment.slmd

SLIDEINTERPRET 9.019

Appendix B. Right Embankment Graphical Output

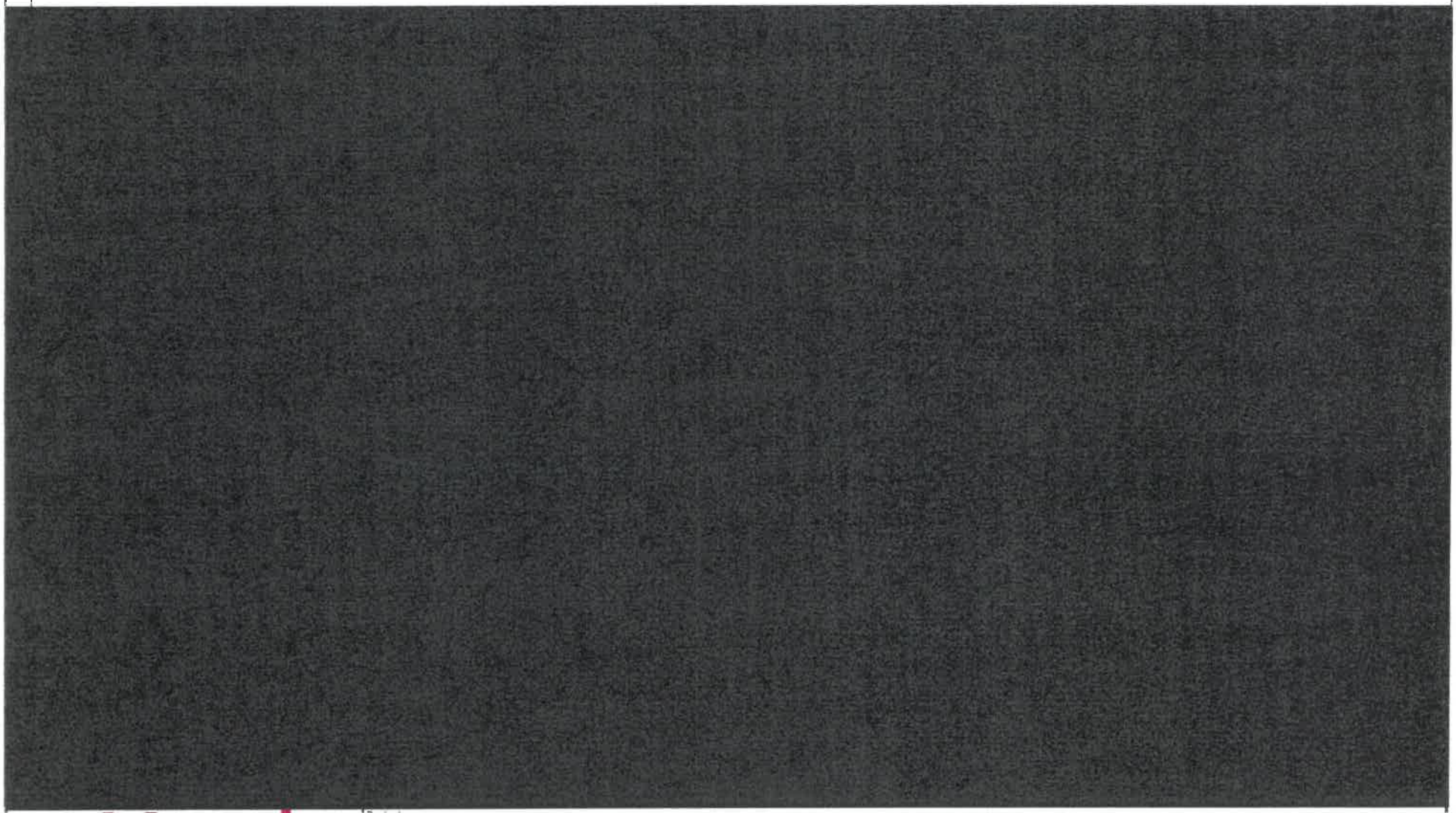
Right Embankment



Mead Hunt	Project	Kirkpatrick Dam	
	Group: Right Embankment	Scenario	HW = 23.2
	Drawn By: M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
	Date: October 2021	File Name	kirkpatrick dam right embankment.slmd

SLIDEINTERPRET 9.019

Right Embankment

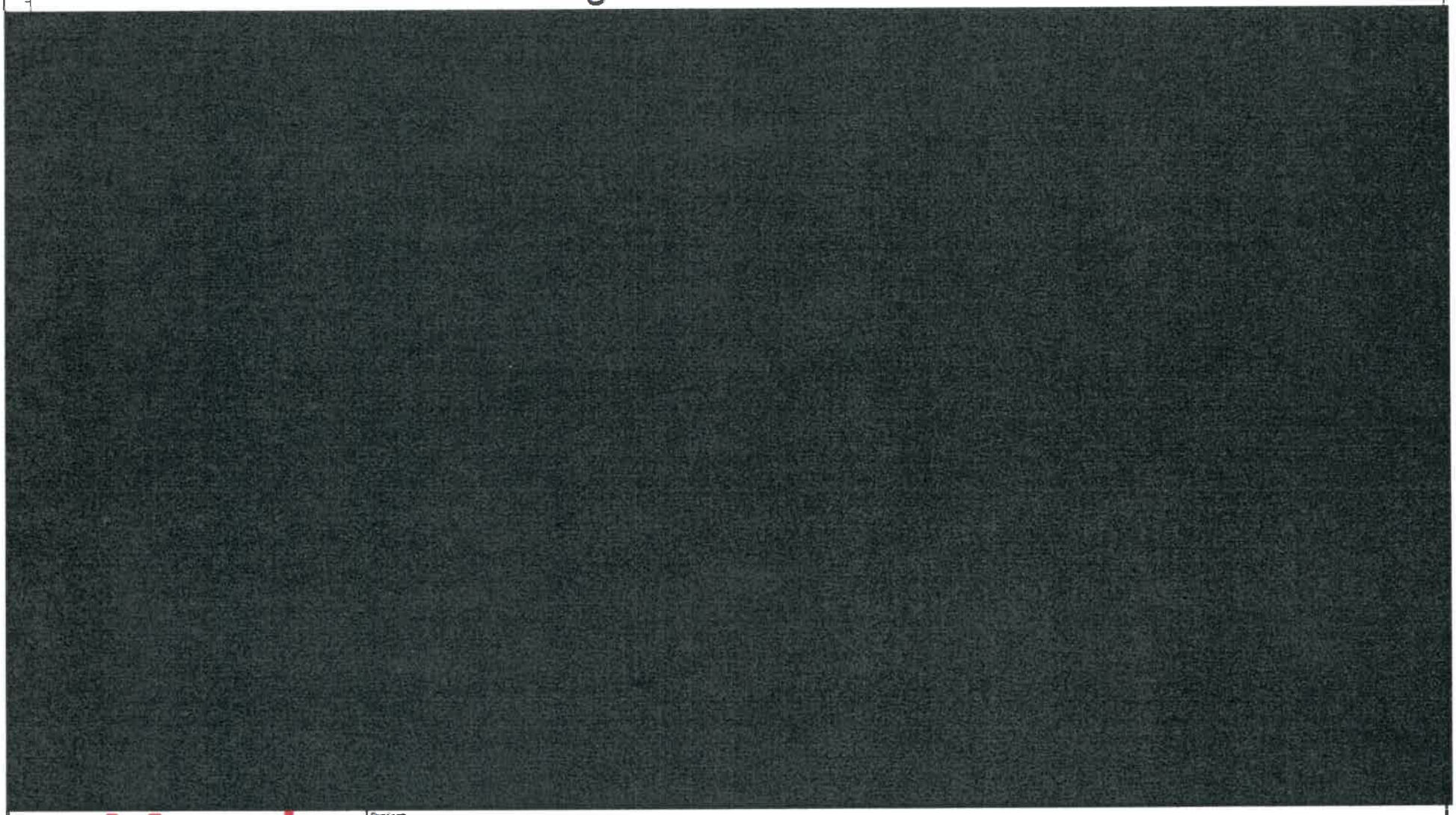


Mead & Hunt

SLIDEINTERPRET 9.019

Project	Kirkpatrick Dam		
Group	Right Embankment	Scenario	HW = 20
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	kirkpatrick dam right embankment.slmd

Right Embankment

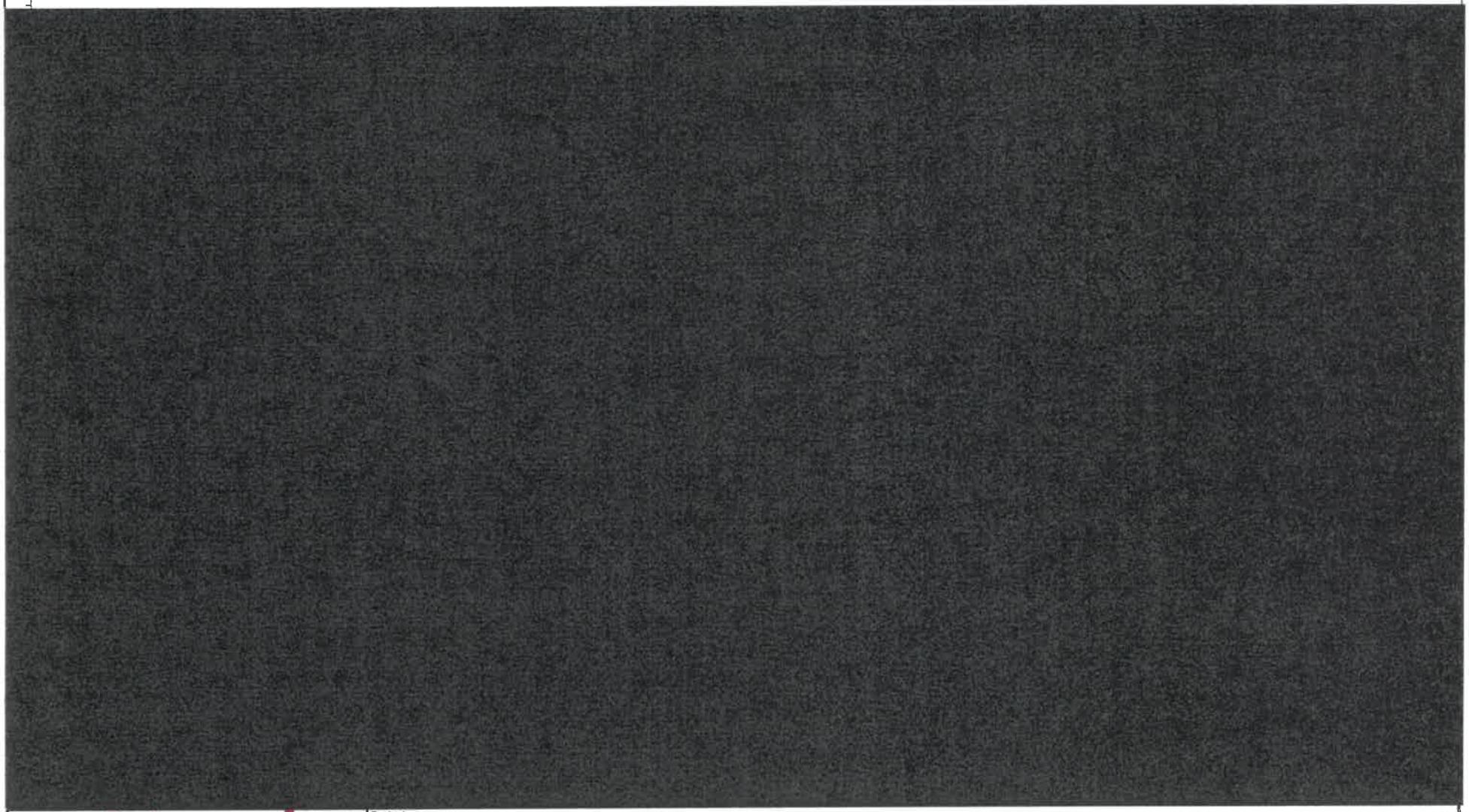


Mead & Hunt

SLIDEINTERPRET 9.019

Project	Kirkpatrick Dam		
Group	Right Embankment	Scenario	HW = 18
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	kirkpatrick dam right embankment.slmd

Right Embankment

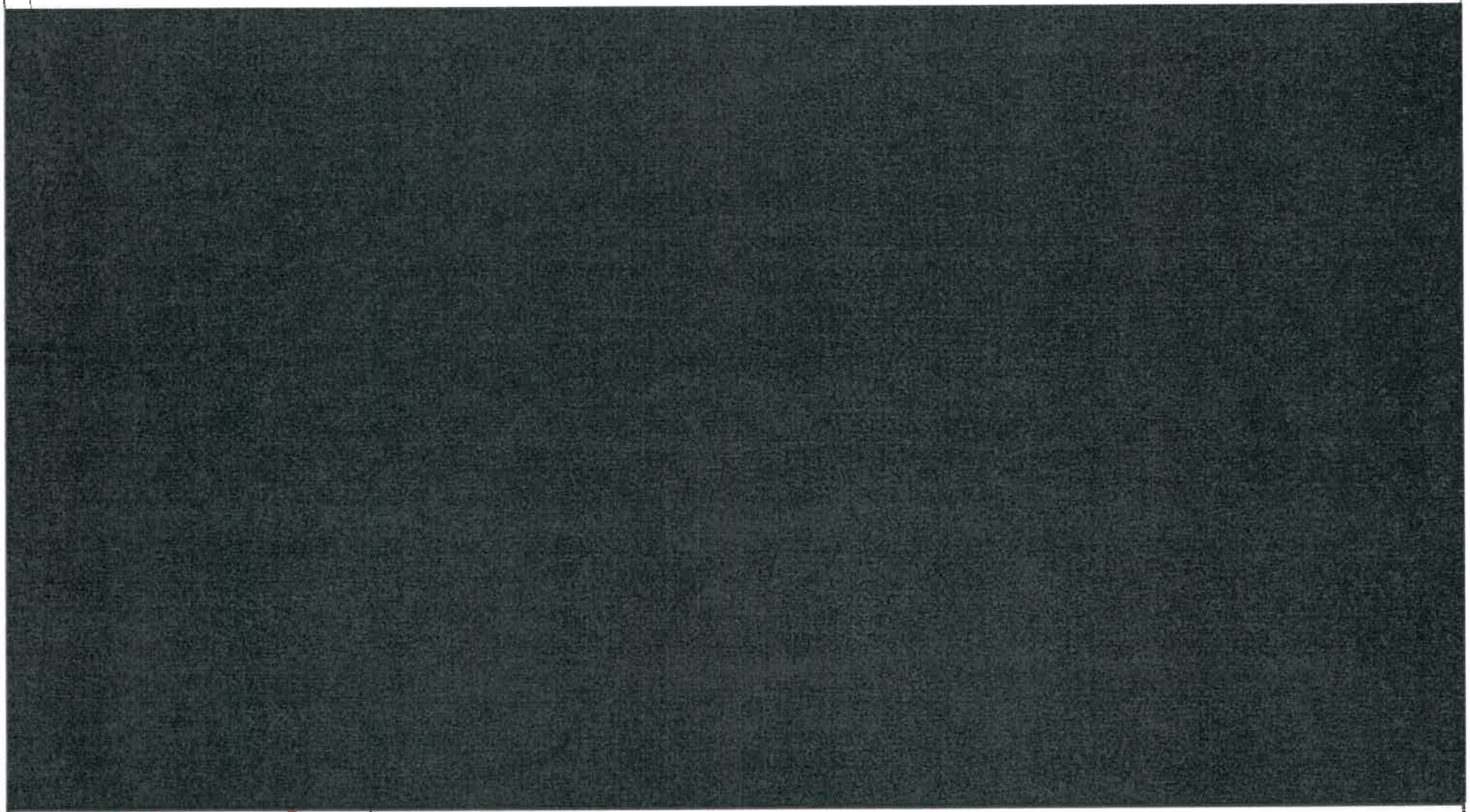


Mead & Hunt

SLIDEINTERPRET 9.019

Project	Kirkpatrick Dam		
Group	Right Embankment	Scenario	HW = 16
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	kirkpatrick dam right embankment.slmd

Right Embankment



Project	Kirkpatrick Dam		
Group	Right Embankment	Scenario	HW = 14
Drawn By	M. Kemps, PE Reviewed J. Botz, PE	Company	Mead & Hunt, Inc.
Date	October 2021	File Name	kirkpatrick dam right embankment.slmd

SLIDEINTERPRET 9.019

Stability Analysis

Gated Spillway

Kirkpatrick Dam

Report prepared for

Florida Department of Environmental Protection

Report prepared by

Mead & Hunt

www.meadhunt.com

February 2022

MARTIN H. KEMPS LICENSE No. 70468 STATE OF FLORIDA PROFESSIONAL ENGINEER

This item has been digitally signed and sealed by Martin Kemps, PE on 02/10/2022.

Printed copies of this document are not considered signed and sealed, and the signature must be verified on any electronic copies.

Table of Contents

Page

1. **Introduction** 1
   - A. Project description 1
   - B. Background 1
   - C. Analysis objectives 1
2. **Stability Analysis** 2
   - A. Description 2
   - B. Analysis criteria 2
   - C. Analysis methodology 2
   - D. Load cases 2
   - E. Assumptions 3
   - F. Material Properties 3
   - G. Results 4
   - H. Conclusions 4

Appendices

- A Loading Diagrams
- B Stability Calculations
- C Weighted Creep Uplift Calculations

List of Contributors

This report was prepared by or under the direct supervision of the individual listed below:

Gary Ruchti, P.E.
Project Engineer

The following individuals also contributed to the development of this document and/or the analyses presented herein:

Jeff Anderson, P.E.
Jonathan Salomon, E.I.T.
Samantha Gulick

1. Introduction

A. Project description

The reservoir, known as Rodman Reservoir, is created by the Kirkpatrick Dam and Buckman Lock, which expands across the Ocklawaha River and the Cross Florida Barge Canal, respectively. The normal reservoir pool elevation of Rodman Reservoir is 20.0 feet, NGVD 29[1] at which the reservoir has a surface area of approximately 20.3 square miles, a gross volume of approximately 82,000 acre-feet, and length of approximately 16.4 miles. The Kirkpatrick Dam (dam) consists of three water retaining structures: a southwest embankment, a concrete spillway with four lift gates, and a northeast embankment.

B. Background

The Florida Department of Environmental Protection (FDEP) retained Mead & Hunt, Inc. (Mead & Hunt) to provide a dam safety inspection and stability analyses of the embankments and gated spillway structure. To better understand how factors of safety are impacted with various headwater levels, the FDEP requested Mead & Hunt to perform a sensitivity stability analysis of the gated spillway structure.

C. Analysis objectives

The objective of this document is to summarize the sensitivity stability analyses performed for the gated spillway section and to provide supporting documentation of the analyses. This report summarizes the methodology, assumptions, results, and conclusions of our analyses.

[1] All elevations in this report are given in feet and referenced to the National Geodetic Vertical Datum of 1929 (NGVD 1929).

2. Stability Analysis

A. Description

The gated spillway consists of a mass concrete Ogee weir with four gates supported by three piers and two abutments. Additionally, the piers support a concrete service bridge, operating platform, and a walkway. The structure is founded on a sand foundation with steel sheet pile cut-off walls to reduce seepage, which are located along the upstream face of the spillway structure and along the edge of the downstream concrete apron.

B. Analysis criteria

The following is a summary of the references that served as a basis for this analysis:

Federal Energy Regulatory Commission, *Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter 3, Gravity Dams*, March 4, 2016.

Naval Facilities Engineering Command, *Design Manual 7.02, Foundations & Earth Structures*, September 1, 1986.

C. Analysis methodology

The stability of the gated spillway section was evaluated utilizing the mass gravity method in accordance with Chapter 3 (Gravity Dams) of the Federal Energy Regulatory Commission's (FERC's) *Engineering Guidelines for the Evaluation of Hydropower Projects*. Lane's weighted creep method was used to determine the uplift distribution and load on the gated spillway structure.

D. Load cases

The load cases that were evaluated as part of the sensitivity analyses are presented below. The loading diagram for each load case are presented in Appendix A.

Table 1 - Load Cases

Load Case	Gate Position	Headwater Level	Tailwater Level[2]

[2] The corresponding tailwater levels were calculated based on the results of the dam failure analyses performed by Mead & Hunt in 2022.

E. Assumptions

The following is a summary of the assumptions made as a part of this analysis:

- The uplift pressure distribution was determined using Lane's weight creep method.

- The following items were considered outside the scope of this study, and therefore, not included in the sensitivity analyses performed:
  - Ice expansion load
  - Seismic and debris loading
  - Sliding failure along one of the spillway structures construction joints

- The spillway structure gate was assumed to be fully opened during flood conditions (Load Case I), with a headwater level of 23.2 feet. The gate was assumed closed during lower headwater conditions (Load Cases II through V), with a headwater level of 20.0 feet or less.

- For Load Case I, where the gate is fully open and the water is moving over the weir, the tailwater elevation was reduced to 60% of expected height for the horizontal force on the dam to account for Nappe forces in accordance with the FERC Engineering Guidelines 3-2.3.2. The other load cases are assumed to have low/no flow and the Nappe forces were ignored in accordance with FERC Engineering Guidelines.

- The stability of the gated spillway structure was analyzed as a single bay (44 feet wide). The plane of analysis for overturning was taken at the base of the structure slab (elevation -13.0). The plane of analysis for sliding was taken at the bottom of the shear key (elevation -21.0)

F. Material Properties

- The unit weight and friction angle of the silt were assumed to be 110 pcf and 30 degrees, respectively. Horizontal silt loads were determined using at-rest earth pressure.

- The unit weight of concrete was assumed to be 150 pounds per cubic foot (pcf) and the unit weight of water was assumed to be 62.4 pcf.

- Historic soil boring provided in the project construction drawings were used to classify the underlying soil as medium to fine sand. The unit weight and friction angle of the underlying soil were assumed to be 125 pcf and 31 degrees, respectively. Passive and active lateral earth pressures were only considered for the sliding failure method.

- The allowable foundation bearing pressure was assumed to be 3.5 (ksf).

- Cohesion at the foundation interface was not anticipated due to the sand foundation and therefore not considered.

G. Results

The results of the sensitivity stability analyses performed for the structure are presented below. Supporting calculations for the stability analysis are provided in Appendix B and the uplift calculations are presented in Appendix C.

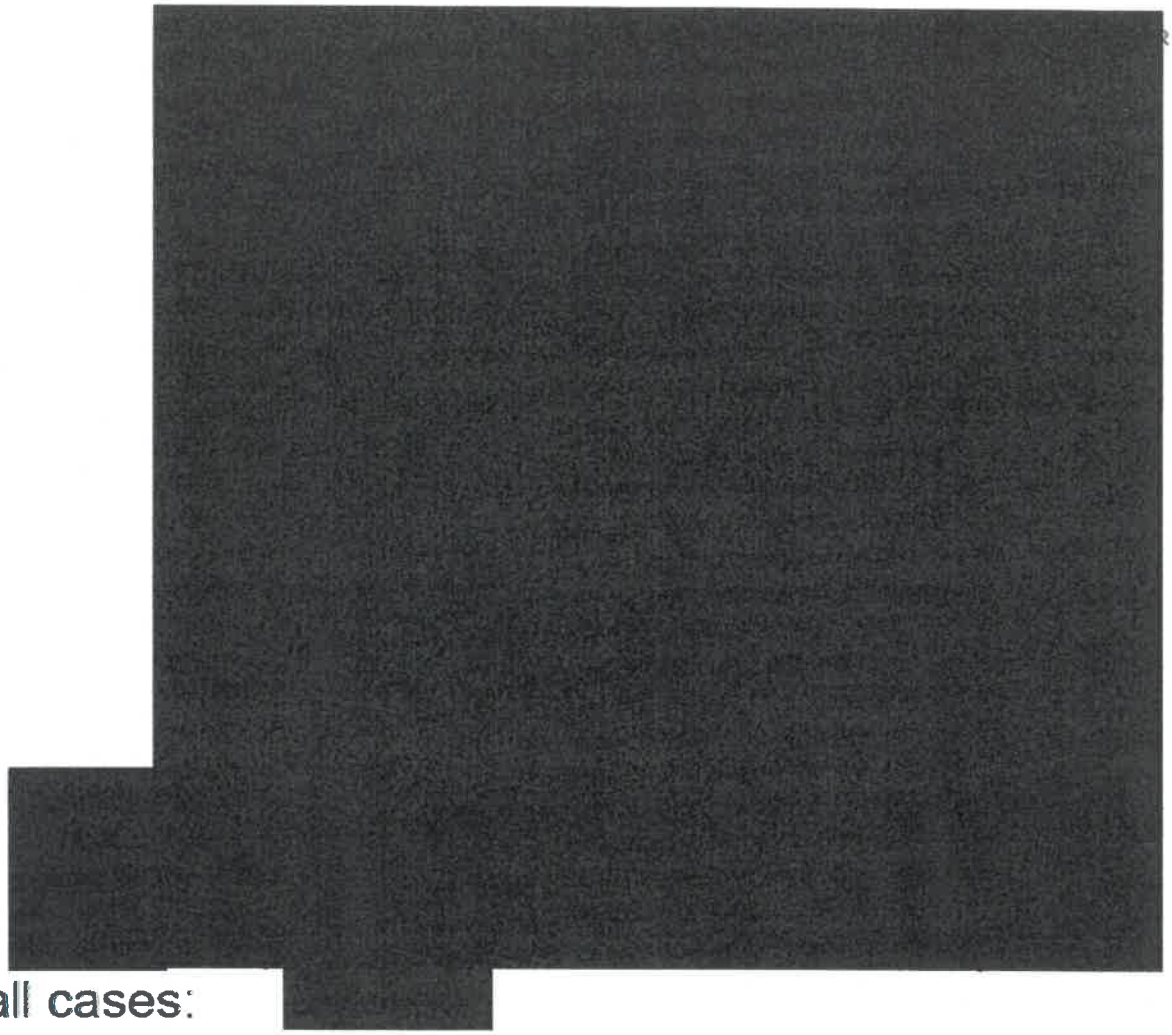
Table 2 - Stability Analysis Results

	Case I	Case II	Case III	Case IV	Case V
[redacted]					

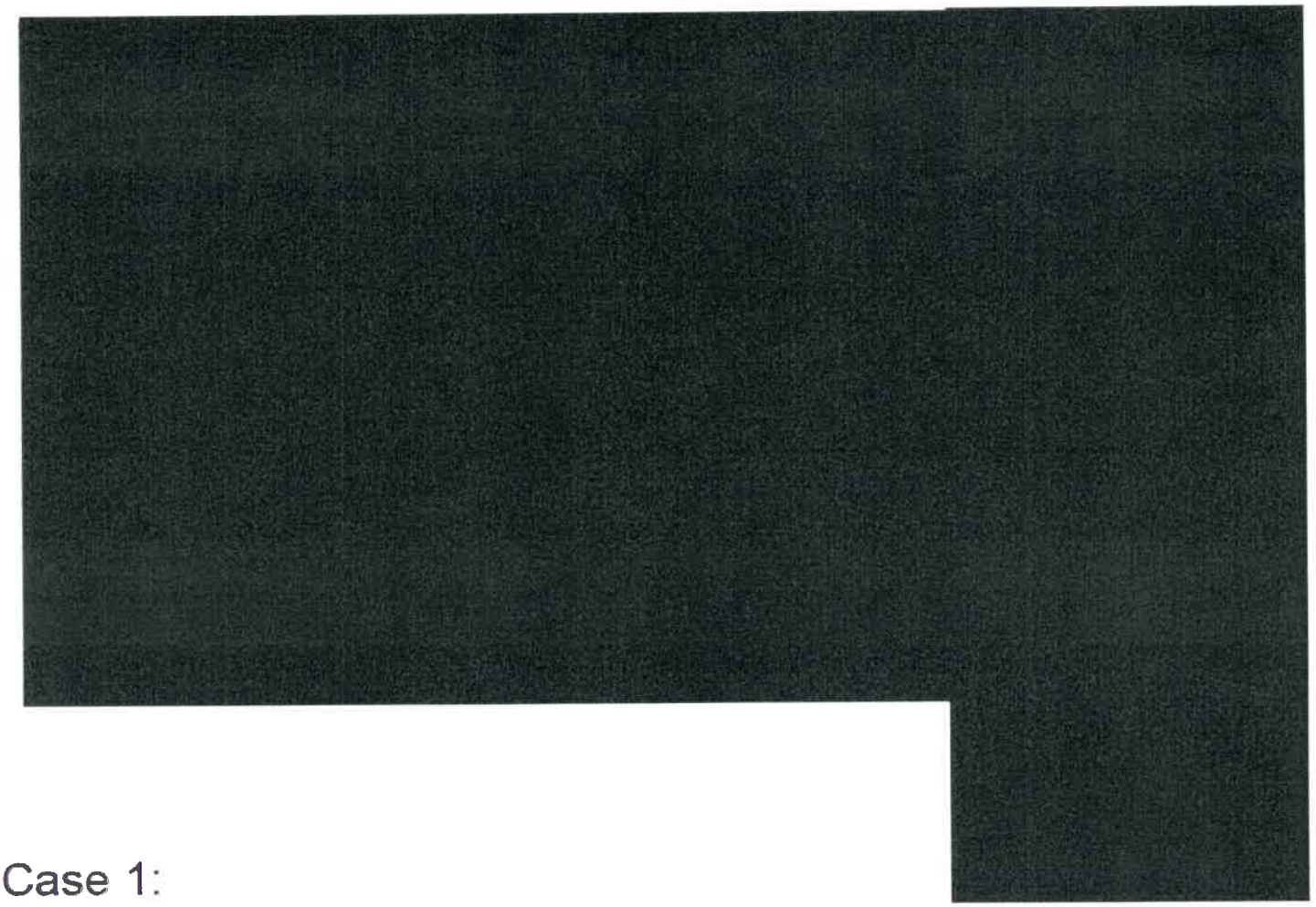
H. Conclusions

The stability analysis results presented in the previous section indicate that the dam has acceptable factors of safety with respect to overturning and sliding for the loading conditions evaluated.

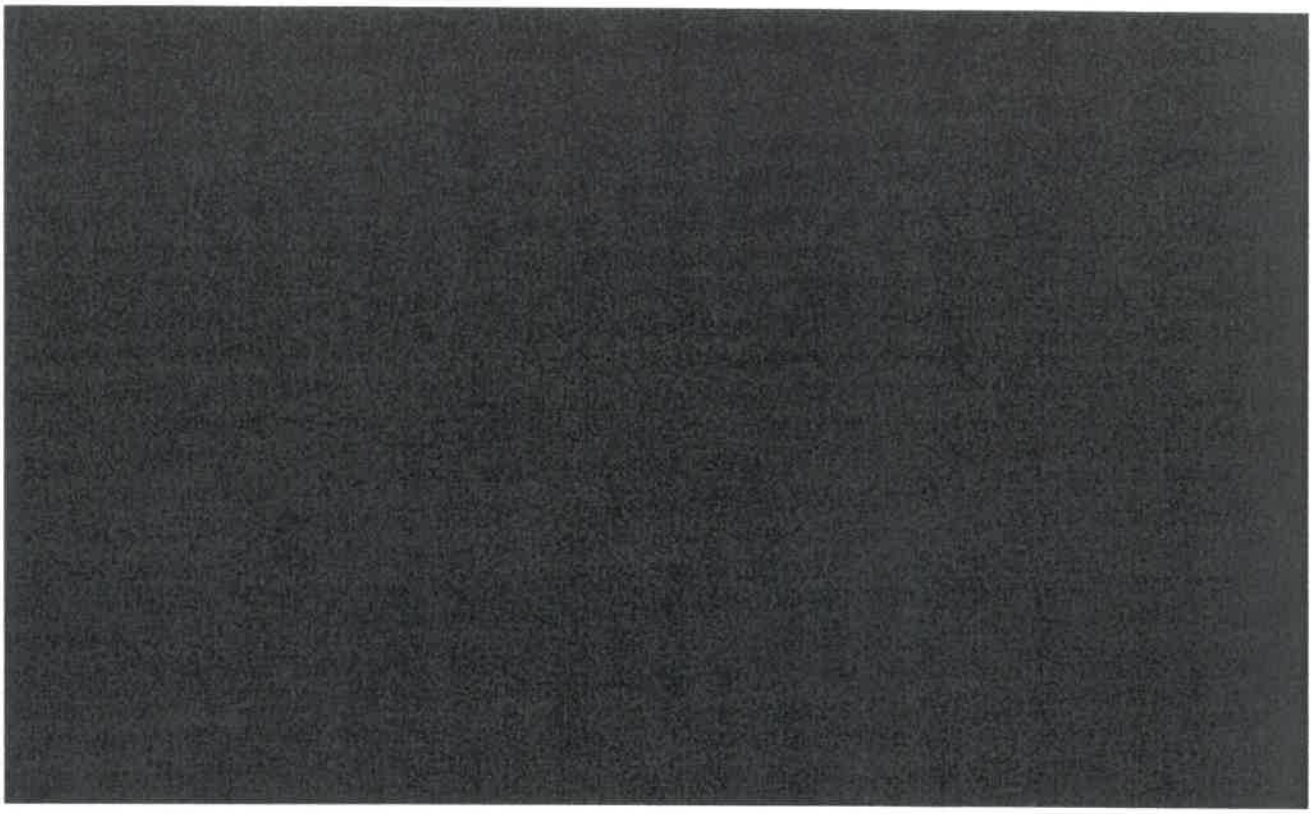
Appendix A. Loading Diagrams



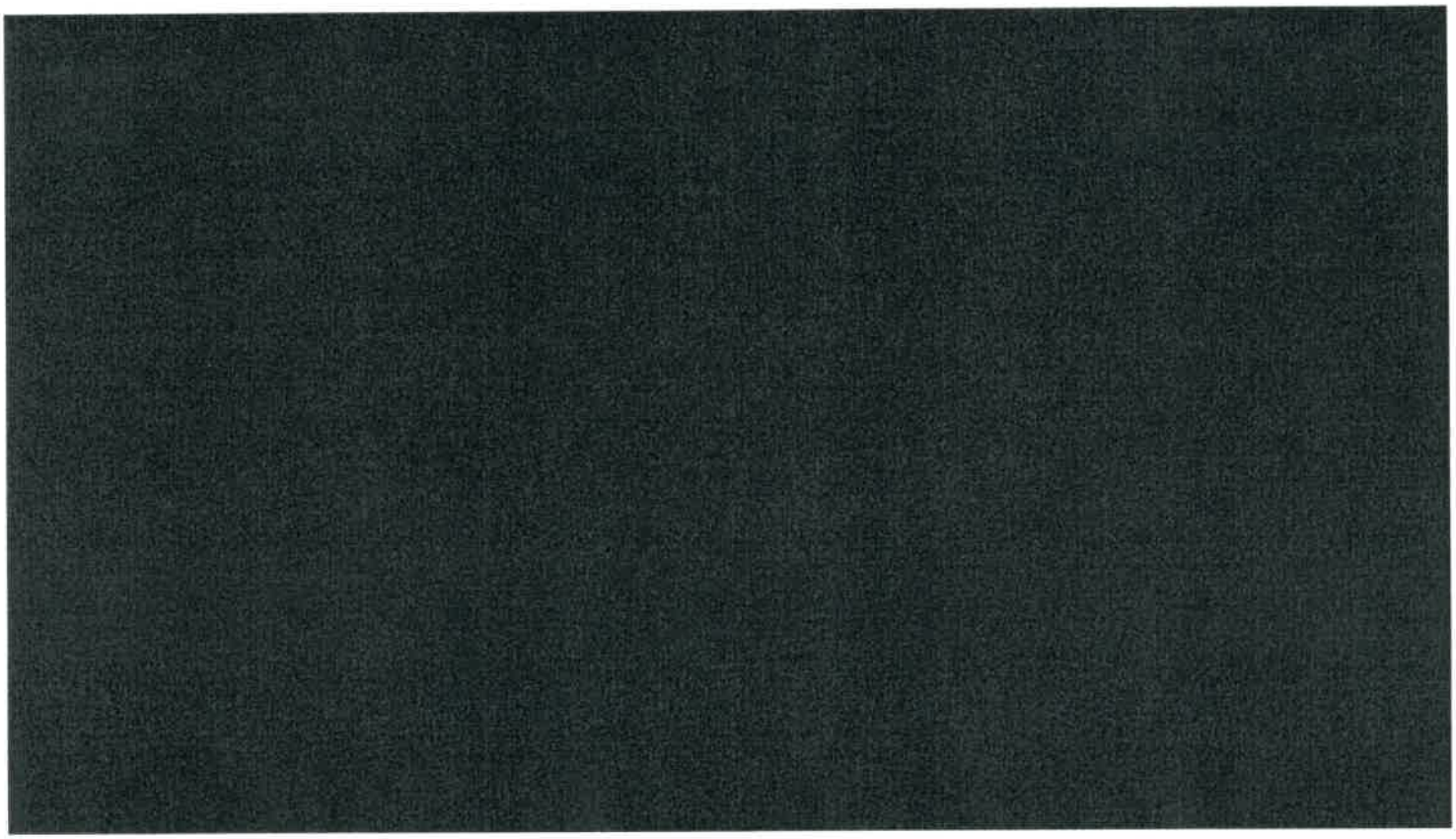
For all cases:
Earth pressures and sliding failure plane



Case 1:
Head and Tail-water Horizontal
Forces and Silt Forces on the Dam

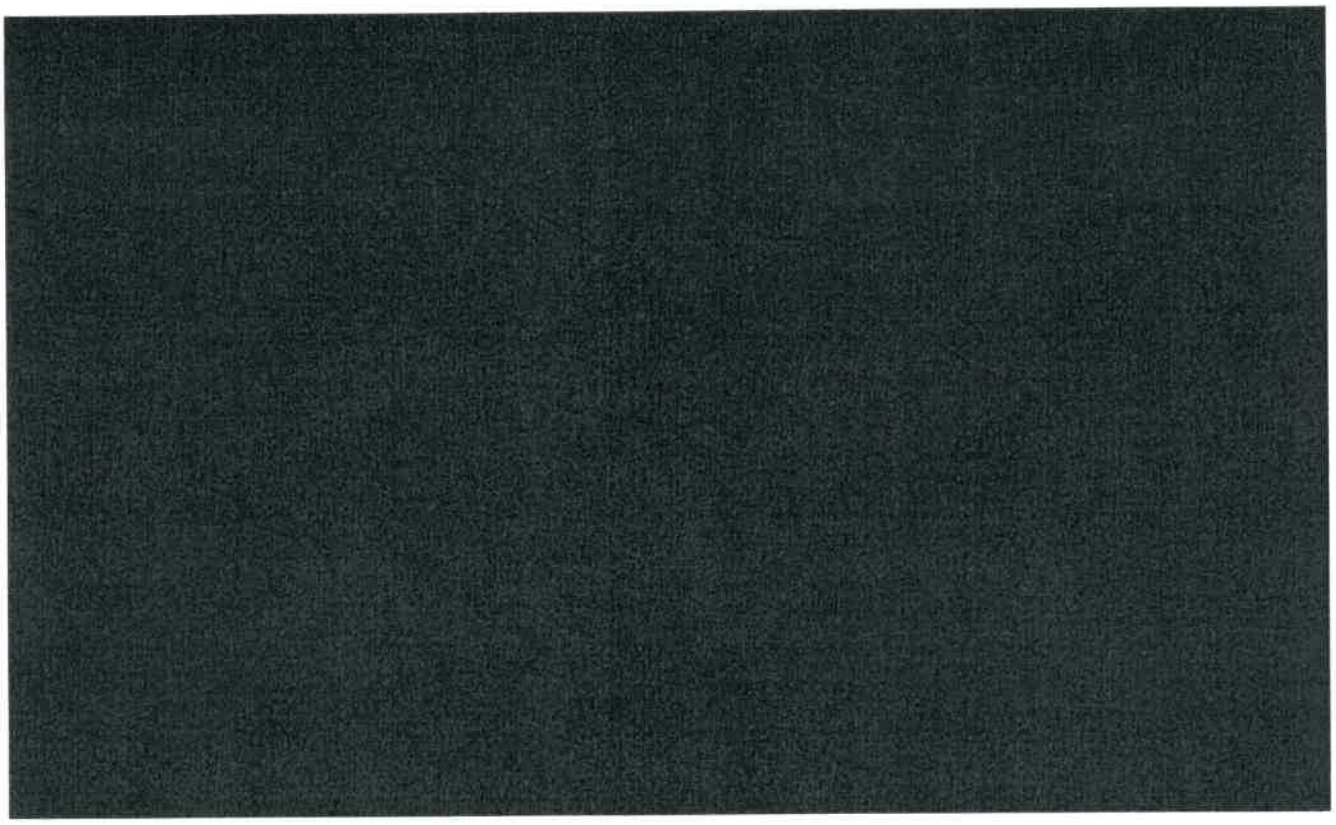


Case 1:
Head and Tail-water Vertical
Forces on the Dam

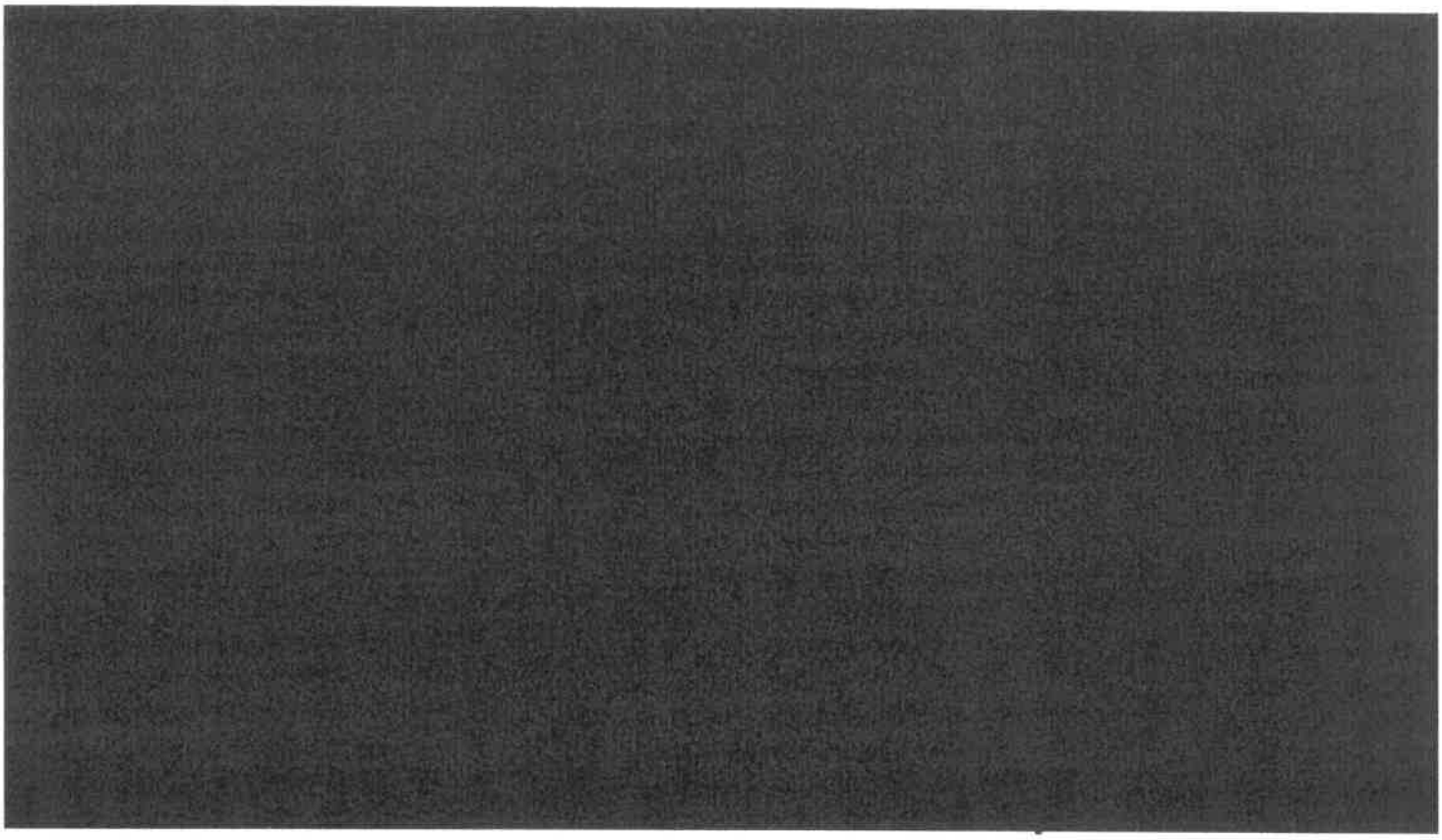


Case 1:
Uplift Forces on the Dam

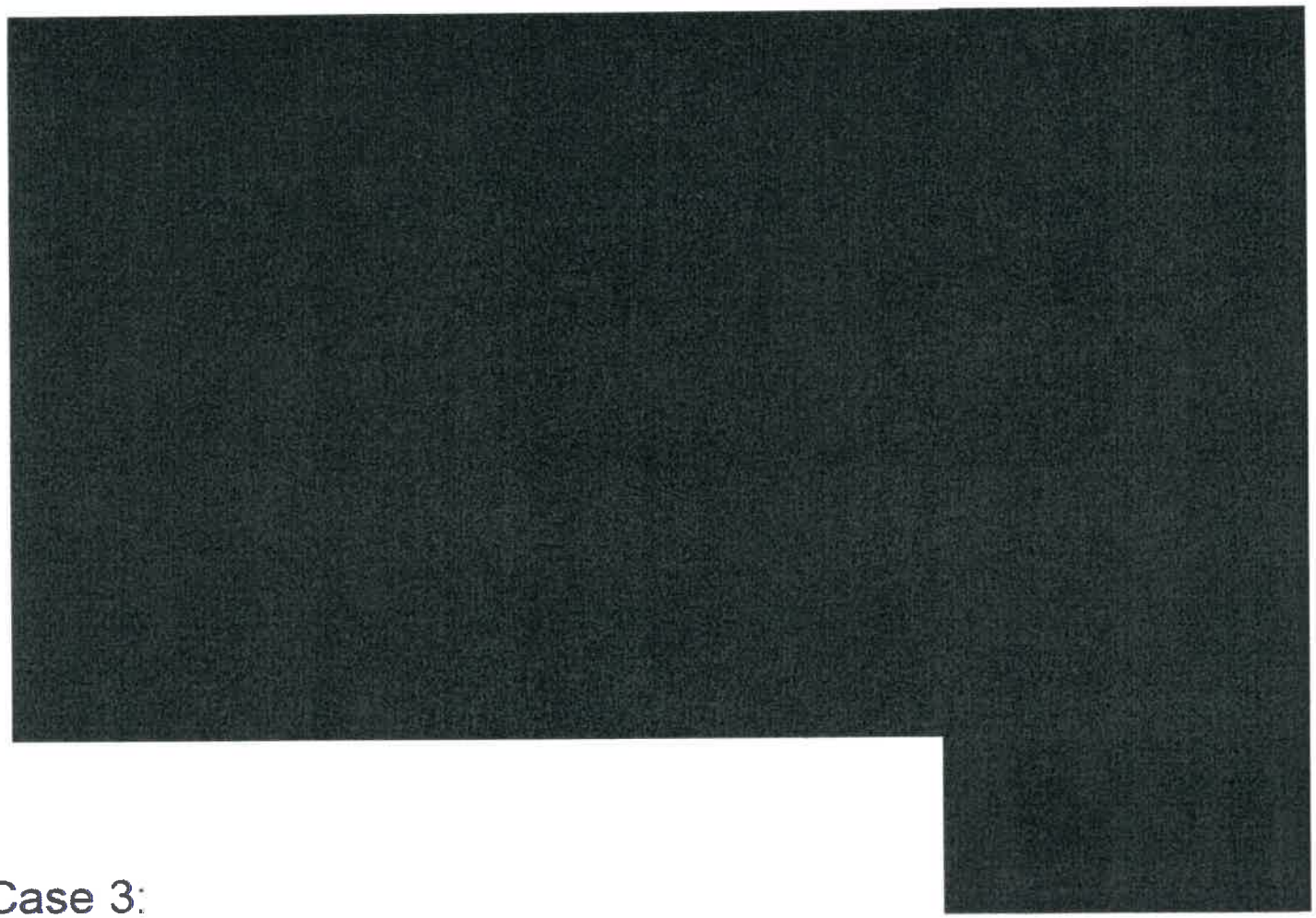
Case 2:
Head and Tail-water Horizontal
Forces and Silt Forces on the Dam



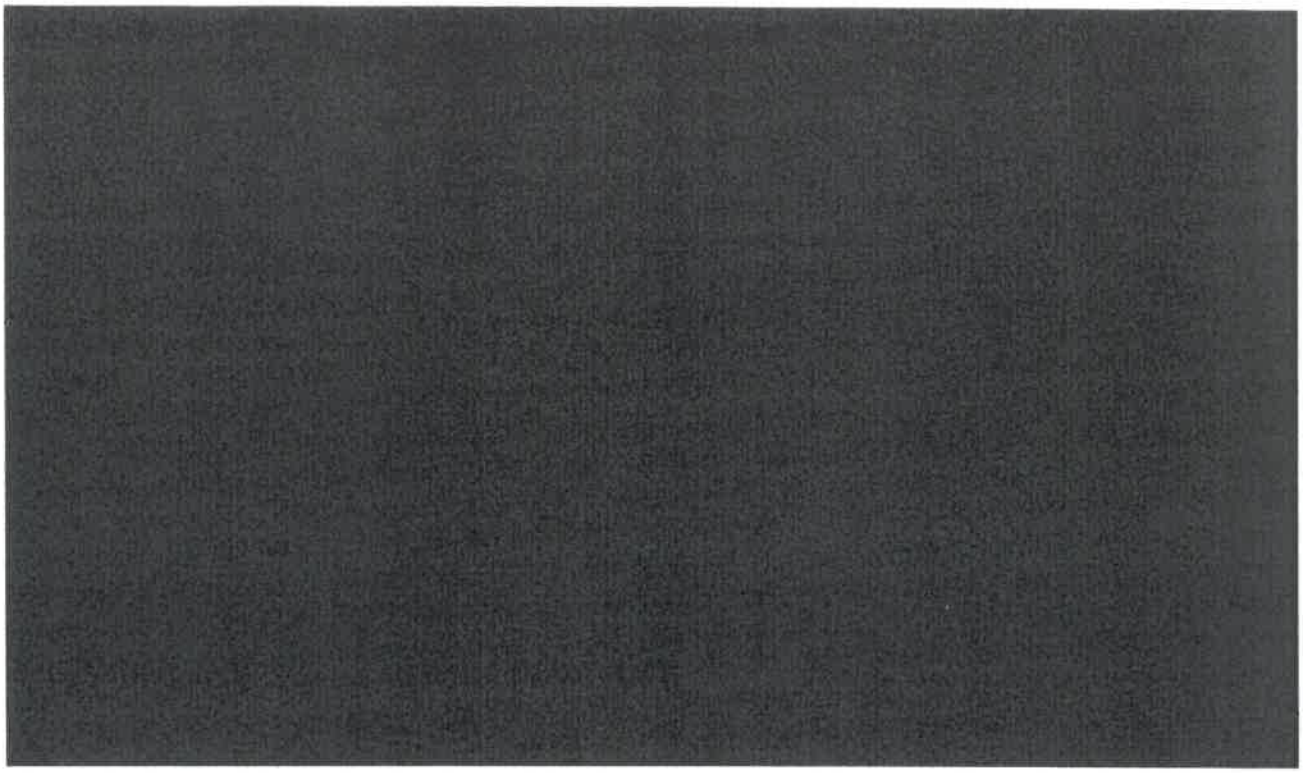
Case 2:
Head and Tail-water Vertical Forces on the Dam



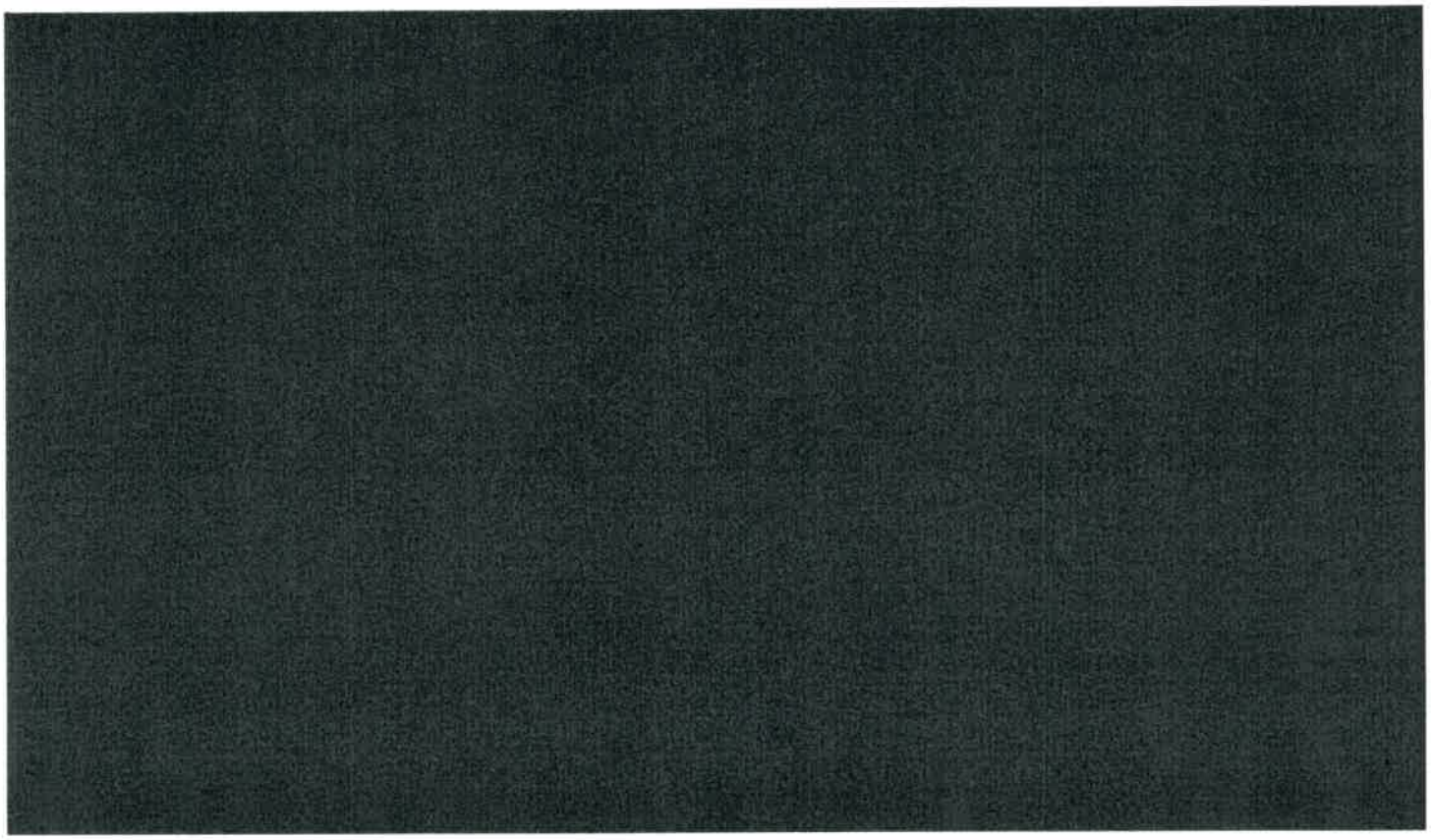
Case 2:
Uplift Forces on the Dam



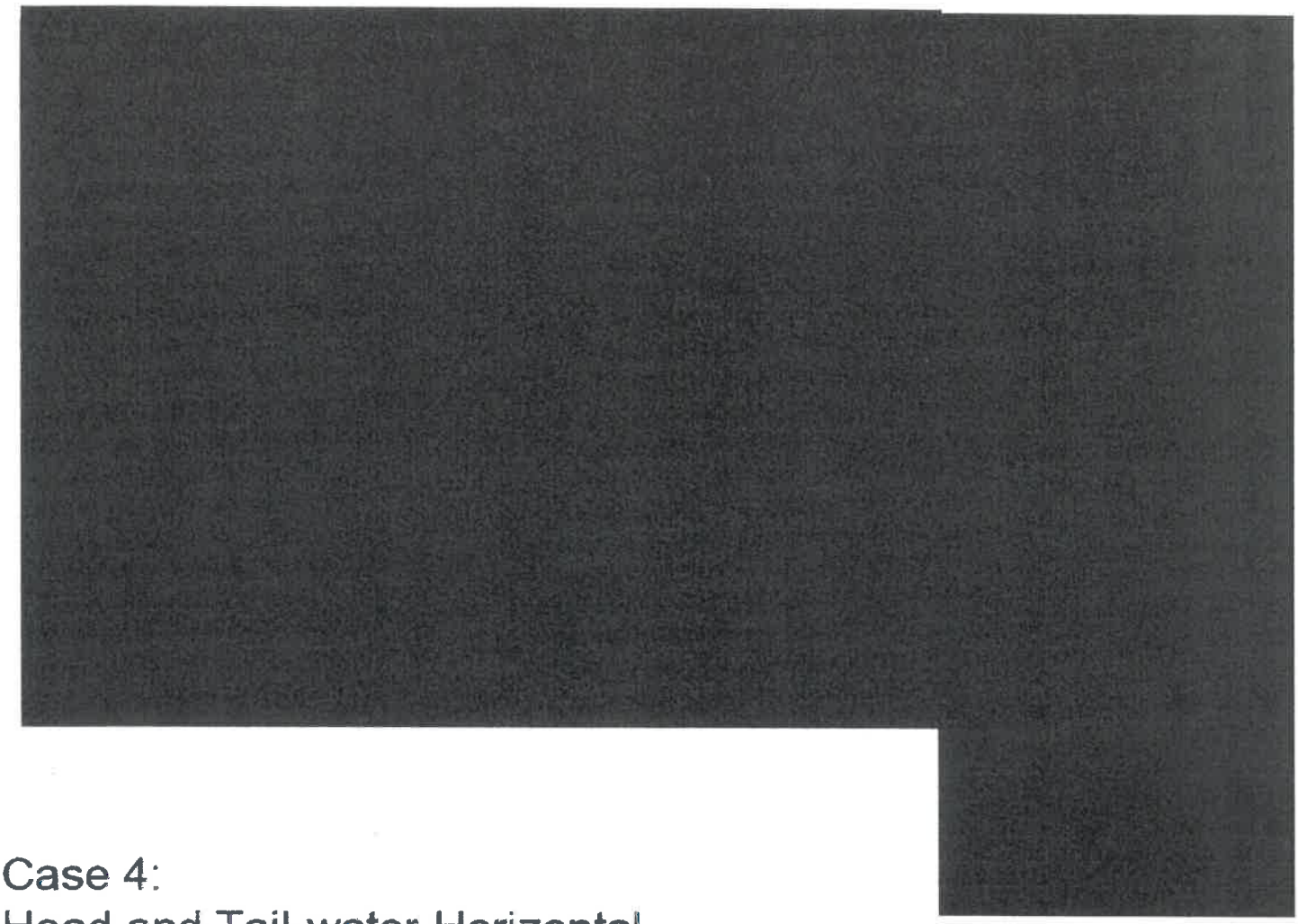
Case 3:
Head and Tail-water Horizontal
Forces and Silt Forces on the Dam



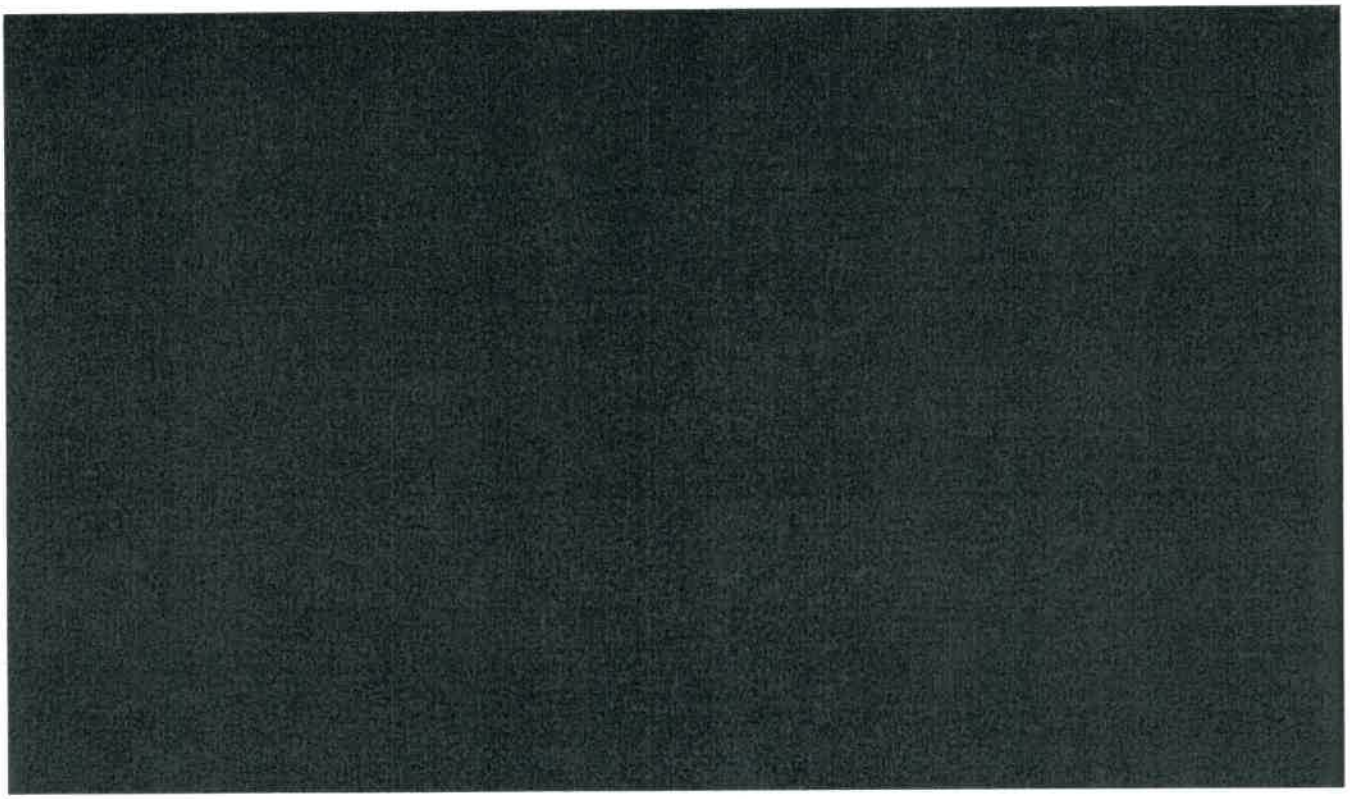
Case 3:
Head and Tail-water Vertical Forces on the Dam



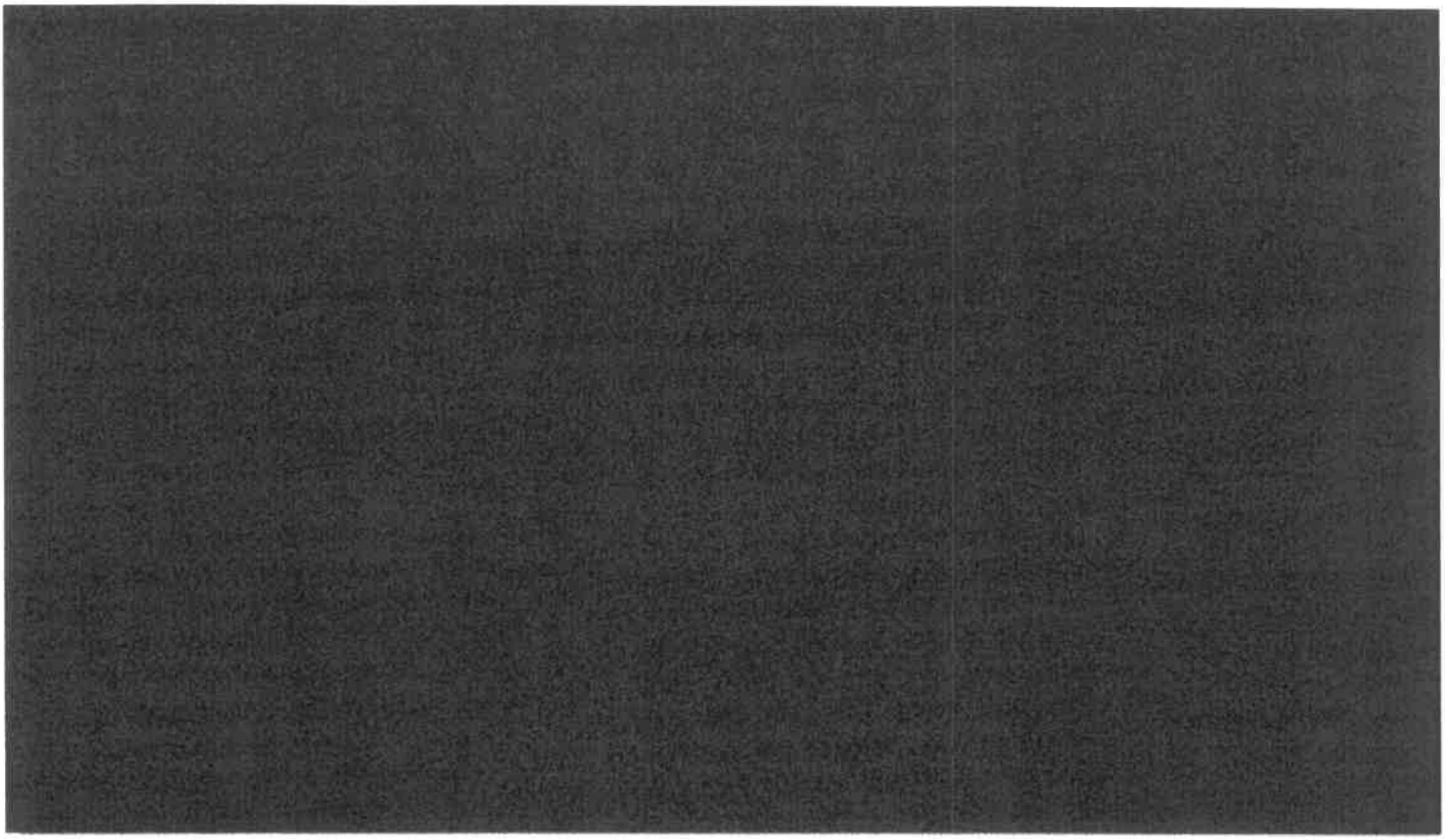
Case 3:
Uplift Forces on the Dam



Case 4:
Head and Tail-water Horizontal
Forces and Silt Forces on the Dam

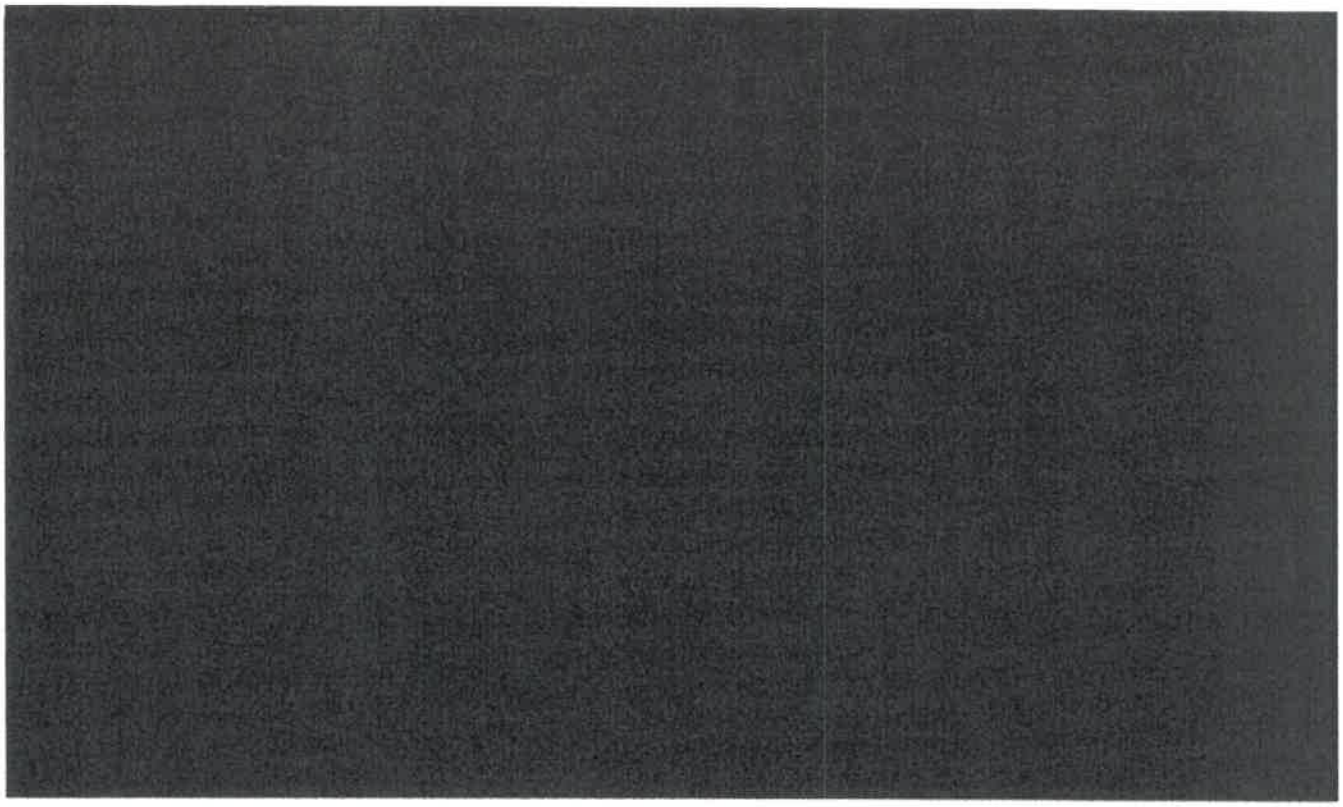


Case 4:
Head and Tail-water Vertical
Forces on the Dam

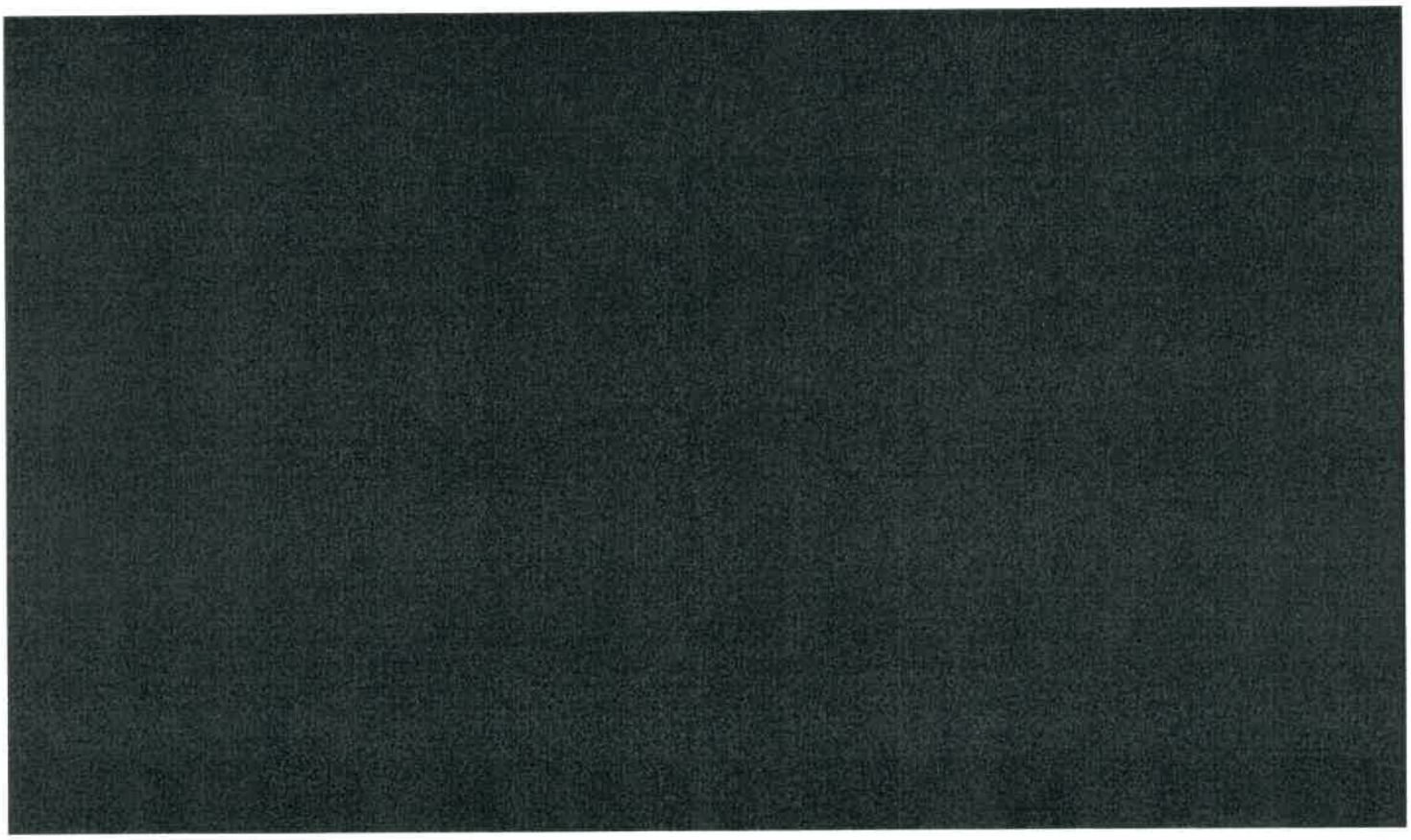


Case 4:
Uplift Forces on the Dam

Case 5:
Head and Tail-water Horizontal
Forces and Silt Forces on the Dam



Case 5:
Head and Tail-water Vertical
Forces on the Dam



Case 5:
Uplift Forces on the Dam

Appendix B. Stability Calculations

Mead & Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO	1	OF	7
CALC BY	JMS	DATE	10/6/21
CHECKED BY	GAR	DATE	10/7/21
SCALE	N/A	JOB NO.	4606900-211187.01

Stability Analysis Summary - Kirkpatrick Dam

Loading Combinations

Case I
Case II
Case III
Case IV
Case V

[redacted]

Analysis Results

	Case I	Case II	Case III	Case IV	Case V
Headwater Level (NGVD29)					
Tailwater Level (NGVD29)[1]					
Stability in Overturning					
Resultant as % Base (Without Uplift)					
Acceptable Range = 33% to 67%					
Resultant as % Base (With Uplift)					
Acceptable Range = 25% to 75%					
Bearing Pressure					
Maximum Net Base Pressure (ksf)					
Allowable Bearing Pressure (ksf) per the project's geotechnical Engineer					
Stability in Sliding					
Sheer Friction Factor (SFF)					
Minimum FERC-Recommended SFF					

1. The corresponding tailwater levels were calculated based on the results of the dam failure analyses performed under Subtask 3 of the project proposal by Mead and Hunt and will be presented in its forthcoming report

Analysis Assumptions

1) During the maximum flood elevation of 23.2', it is assumed the gates are fully opened and there is no resulting hydrostatic force on them.
2) The gates are assumed to be fully closed during cases II-V and the resulting hydrostatic forces are accounted for in the calculations.
3) During the site inspection, the silt level could not be determined due to debris. For this analysis, it was assumed the silt layer elevation was to the tangent point on the Ogee Weir, NGVD29 EL 3 5.
4) Per the scope for the project, seismic and debris loads on the structure were not considered.
5) To be conservative, a single bay was analyzed for stability utilizing its selfweight, the lateral earth pressures, and the sliding friction under its spillway.
6) The uplift pressure distribution was determined using Lane's weighted creep method accounting for both sheet pile walls and the downstream apron.
7) For loading case I where the gate fully open and the water is moving over the weir, the tailwater elevation was reduced to 60% of expected height for the horizontal force on the dam to account for Nappe forces per FERC Engineering Guidelines 3-2 3.2. The other load cases are assumed to have low/no flow and the Nappe forces can be ingored per FERC Engineering Guidelines.
8) The passive and active lateral earth pressures were only considered for the sliding analysis.

Section Geometry

Considering 1 Bay, see plan to the right

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Structure Height (H) = feet

[redacted]

Key Elevations

Plane of Analysis (overturning) = [redacted] feet
Plane of Analysis (sliding) = feet
Top of Structure = feet

Material Property Assumptions

Cohesion (c) = [redacted] ksf
Φ_{sand} = degrees
(Bouyant) γ_{sand} 125-62.4= lb/ft^3
Ka sand = $\tan^2\left(45-\frac{\phi}{2}\right)$ Active
Kp sand = $\tan^2\left(45+\frac{\phi}{2}\right)$ Passive
Φ_{silt} = degrees
(Bouyant) γ_{silt} 110-62.4= lb/ft^3
Ko silt = At-Rest
Ice Expansion Load = klf

Mead & Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO.	2	OF	7
CALC BY	JMS	DATE	10/6/21
CHECKED BY	GAR	DATE	10/7/21
SCALE	N/A	JOB NO.	4606900-211187.01

Loads	Forces (kips) V (+)	Forces (kips) H (+)	Arm (feet)	Moment (ft-kips) M_V (+)	Moment (ft-kips) M_H (+)

Load Summary - Dam

Selfweight Loads (All Load Cases)

	Description	Material	Unit Weight	Area sf	Height/Length ft
1)	Spillway	Concrete	0.15		
2)	Service Bridge Pier	Concrete	0.15		
3)	Operating Platform Pier	Concrete	0.15		
4)	Upstream Pier	Concrete	0.15		
5)	Service Bridge	Concrete	0.15		
6)	1/2 Operating Platform	Concrete	0.15		
7)	1/2 Operating Platform	Concrete	0.15		
8)	Walkway	Steel	2, assumed W2 tn40 beams, 4		ft long
9)	Gate	Steel	2.5, 21WF82 and 2; 24WF120, 40 feet long		

Water Loads at 23.2' Headwater

	Description	Material	Unit Weight	Shape	Height	Width	Length
HW 1)	HW on the Spillway	Water	0.0624	Trapezoid			
HW 2)	HW on the Pier with the gate open	Water	0.0624	Triangle			
TW)	TW (Height Reduced to 60% due to flow)	Water	0.0624	Triangle			
H1)	Weight of water above Spillway from HW	Water	0.0624	Rectangle			
H2)	Weight of water above Spillway from HW	Water	0.0624				
H3)	Weight of water above Spillway from TW	Water	0.0624				
Uplift 1)	Vertical Uplift calc. Weighted Creep						
Uplift 2)	Horizontal Uplift calc. Weighted Creep	Water	0.0624	Trapezoid			

Water Loads at 20.0' Headwater

	Description	Material	Unit Weight	Shape	Height	Width	Length
HW)	HW with the gate closed	Water	0.0624	Triangle			
TW)	TW	Water	0.0624	Triangle			
H1)	Weight of water above Spillway from HW	Water	0.0624	Rectangle			
H2)	Weight of water above Spillway from HW	Water	0.0624				
H3)	Weight of water above Spillway from TW	Water	0.0624				
Uplift 1)	Vertical Uplift calc. Weighted Creep						
Uplift 2)	Horizontal Uplift calc. Weighted Creep	Water	0.0624	Trapezoid			

Water Loads at 18.0' Headwater

	Description	Material	Unit Weight	Shape	Height	Width	Length
HW)	HW with the gate closed	Water	0.0624	Triangle			
TW)	TW	Water	0.0624	Triangle			
H1)	Weight of water above Spillway from HW	Water	0.0624	Rectangle			
H2)	Weight of water above Spillway from HW	Water	0.0624				
H3)	Weight of water above Spillway from TW	Water	0.0624				
Uplift 1)	Vertical Uplift calc. Weighted Creep						
Uplift 2)	Horizontal Uplift calc. Weighted Creep	Water	0.0624	Trapezoid			

Water Loads at 16.0' Headwater

	Description	Material	Unit Weight	Shape	Height	Width	Length
HW)	HW with the gate closed	Water	0.0624	Triangle			
TW)	TW	Water	0.0624	Triangle			
H1)	Weight of water above Spillway from HW	Water	0.0624	Rectangle			
H2)	Weight of water above Spillway from HW	Water	0.0624				
H3)	Weight of water above Spillway from TW	Water	0.0624				
Uplift 1)	Vertical Uplift calc. Weighted Creep						
Uplift 2)	Horizontal Uplift calc. Weighted Creep	Water	0.0624	Trapezoid			

Water Loads at 14.0' Headwater

	Description	Material	Unit Weight	Shape	Height	Width	Length
HW)	HW with the gate closed	Water	0.0624	Triangle			
TW)	TW	Water	0.0624	Triangle			
H1)	Weight of water above Spillway from HW	Water	0.0624	Rectangle			
H2)	Weight of water above Spillway from HW	Water	0.0624				
H3)	Weight of water above Spillway from TW	Water	0.0624				
Uplift 1)	Vertical Uplift calc. Weighted Creep						
Uplift 2)	Horizontal Uplift calc. Weighted Creep	Water	0.0624	Trapezoid			

Silt Loads (All Load Cases)

	Description	Material	Unit Weight	Shape	Height	Width	Length
Silt)	Silt build up - Lateral Earth Pressure	Silt	0.0476	Triangle			
Silt)	Silt build up - Soil Weight	Silt	0.0476	Rectangle			

Soil Loads (Sliding Only)

	Description	Material	Unit Weight	Shape
Soil)	Passive Lateral Earth Pressure	Sand	0.0626	Triangle
Soil)	Active Lateral Earth Pressure	Sand	0.0626	Triangle
Soil)	Weight of soil above Sliding plane	Sand	0.0626	Rectangle

Load Summary without Uplift(Overturning)

Load Case I -
Load Case II -
Load Case III
Load Case IV
Load Case V

Load Summary without Uplift (Sliding)

Load Case I -
Load Case II -
Load Case III
Load Case IV
Load Case V

Load Summary Uplift

Load Case I -
Load Case II -
Load Case III
Load Case IV
Load Case V

Load Case I

HWL = [redacted] feet
TWL = feet

Analysis Paramaters:

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Area = sf

Load Summary:

Forces	Moments
[redacted]	[redacted]

Calculate Base Pressures Without Uplift

Eccentricity:

$\mu = (M_V + M_H) / V$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle third of base, therefore O.K

Uplift Pressures:

$U_{u/s}$ = [redacted] ksf, see weighted creep uplift calculations
$U_{d/s}$ = ksf, see weighted creep uplift calculations

Base Pressures:

$P_{u/s} = V/A * [1 - (6e/B)]$ = [redacted] ksf > Uu/s, therefore O.K.
$P_{d/s} = V/A * [1 + (6e/B)]$ = ksf > Uu/s, therefore O.K.

Calculate Base Pressures With Uplift

Eccentricity:

$\mu = (M_V + M_H + M_U) / (V + U)$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle half of base, therefore O.K.

Base Pressures:

$P_{u/s} = (V + U) / A * [1 - (6e/B)]$ = [redacted] ksf Compression
$P_{d/s} = (V + U) / A * [1 + (6e/B)]$ = ksf Compression

Sliding Stability

Vertical Loads			Horizontal Loads		
V =	[redacted]	kips	H =	[redacted]	kips
U =		kips			

Shear Friction Factor = $[(V + U) \tan\Phi] / H$ = [redacted]

Where:

$\tan\Phi$ = 0.601 ($\Phi = 31°$)

Load Case II

HWL = [redacted] feet
TWL = feet

Analysis Paramaters:

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Area = [redacted] sf

Load Summary:

Forces			Moments		
V =	[redacted]	kips	M_V =	[redacted]	ft-kips
H =	[redacted]	kips	M_H =	[redacted]	ft-kips
U =	[redacted]	kips	M_U =	[redacted]	ft-kips

Calculate Base Pressures Without Uplift

Eccentricity:

$\mu = (M_V + M_H) / V$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle third of base, therefore O.K.

Uplift Pressures:

$U_{u/s}$ = [redacted] ksf, see weighted creep uplift calculations
$U_{d/s}$ = ksf, see weighted creep uplift calculations

Base Pressures:

$P_{u/s} = V/A * [1 - (6e/B)]$ = [redacted] ksf > Uu/s, therefore O.K.
$P_{d/s} = V/A * [1 + (6e/B)]$ = ksf > Uu/s, therefore O.K.

Calculate Base Pressures With Uplift

Eccentricity:

$\mu = (M_V + M_H + M_U) / (V + U)$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle half of base, therefore O.K.

Base Pressures:

$P_{u/s} = (V + U) / A * [1 - (6e/B)]$ = [redacted] ksf Compression
$P_{d/s} = (V + U) / A * [1 + (6e/B)]$ = ksf Compression

Sliding Stability

Vertical Loads			Horizontal Loads		
V =	[redacted]	kips	H =	[redacted]	kips
U =	[redacted]	kips			

Shear Friction Factor = $[(V + U) \tan\Phi] / H$ = [redacted]

Where:

$\tan\Phi$ = 0.601 ($\Phi = 31°$)

Load Case III

HWL = [redacted] feet
TWL = feet

Analysis Paramaters:

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Area = sf

Load Summary:

Forces			Moments		
V =	[redacted]	kips	M_V =	[redacted]	ft-kips
H =		kips	M_H =		ft-kips
U =		kips	M_U =		ft-kips

Calculate Base Pressures Without Uplift

Eccentricity:

$\mu = (M_V + M_H) / V$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle third of base, therefore O.K

Uplift Pressures:

$U_{u/s}$ = [redacted] ksf, see weighted creep uplift calculations
$U_{d/s}$ = ksf, see weighted creep uplift calculations

Base Pressures:

$P_{u/s} = V/A * [1 - (6e/B)]$ = [redacted] ksf > Uu/s, therefore O.K
$P_{d/s} = V/A * [1 + (6e/B)]$ = ksf > Ud/s, therefore O.K

Calculate Base Pressures With Uplift

Eccentricity:

$\mu = (M_V + M_H + M_U) / (V + U)$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle half of base, therefore O.K

Base Pressures:

$P_{u/s} = (V + U) / A * [1 - (6e/B)]$ = [redacted] ksf Compression
$P_{d/s} = (V + U) / A * [1 + (6e/B)]$ = ksf Compression

Sliding Stability

Vertical Loads			Horizontal Loads		
V =	[redacted]	kips	H =	[redacted]	kips
U =		kips			

Shear Friction Factor = $[(V + U) \tan\Phi] / H$ = [redacted]

Where:

$\tan\Phi$ = 0.601 ($\Phi = 31°$)

Load Case IV

HWL = [redacted] feet
TWL = feet

Analysis Paramaters:

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Area = sf

Load Summary:

Forces			Moments		
V =	[redacted]	kips	M_V =	[redacted]	ft-kips
H =		kips	M_H =		ft-kips
U =		kips	M_U =		ft-kips

Calculate Base Pressures Without Uplift

Eccentricity:

$\mu = (M_V + M_H) / V$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle third of base, therefore O.K.

Uplift Pressures:

$U_{u/s}$ = [redacted] ksf, see weighted creep uplift calculations
$U_{d/s}$ = ksf, see weighted creep uplift calculations

Base Pressures:

$P_{u/s} = V/A * [1 - (6e/B)]$ = [redacted] ksf > Uu/s, therefore O.K.
$P_{d/s} = V/A * [1 + (6e/B)]$ = ksf > Ud/s, therefore O.K.

Calculate Base Pressures With Uplift

Eccentricity:

$\mu = (M_V + M_H + M_U) / (V + U)$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle half of base, therefore O.K.

Base Pressures:

$P_{u/s} = (V + U) / A * [1 - (6e/B)]$ = [redacted] ksf Compression
$P_{d/s} = (V + U) / A * [1 + (6e/B)]$ = ksf Compression

Sliding Stability

Vertical Loads			Horizontal Loads		
V =	[redacted]	kips	H =	[redacted]	kips
U =		kips			

Shear Friction Factor = $[(V + U) \tan\Phi] / H$ = [redacted]

Where:

$\tan\Phi$ = 0.601 ($\Phi = 31°$)

Load Case V

HWL = [redacted] feet
TWL = feet

Analysis Paramaters:

Base Length (B) = [redacted] feet
Width of Analysis (W) = feet
Area = sf

Load Summary:

Forces			Moments		
V =	[redacted]	kips	M_V =	[redacted]	ft-kips
H =		kips	M_H =		ft-kips
U =		kips	M_U =		ft-kips

Calculate Base Pressures Without Uplift

Eccentricity:

$\mu = (M_V + M_H) / V$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle third of base, therefore O.K

Uplift Pressures:

$U_{u/s}$ = [redacted] ksf, see weighted creep uplift calculations
$U_{d/s}$ = ksf, see weighted creep uplift calculations

Base Pressures:

$P_{u/s} = V/A * [1 - (6e/B)]$ = [redacted] ksf > Uu/s, therefore O.K
$P_{d/s} = V/A * [1 + (6e/B)]$ = ksf > Ud/s, therefore O.K

Calculate Base Pressures With Uplift

Eccentricity:

$\mu = (M_V + M_H + M_U) / (V + U)$ = [redacted] feet
$e = B/2 - \mu$ = feet
% Base = μ / B =

Resultant falls within middle half of base, therefore O.K.

Base Pressures:

$P_{u/s} = (V + U) / A * [1 - (6e/B)]$ = [redacted] ksf Compression
$P_{d/s} = (V + U) / A * [1 + (6e/B)]$ = ksf Compression

Sliding Stability

Vertical Loads			Horizontal Loads		
V =	[redacted]	kips	H =	[redacted]	kips
U =		kips			

Shear Friction Factor = $[(V + U) \tan\Phi] / H$ = [redacted]

Where:

$\tan\Phi$ = 0.601 ($\Phi = 31°$)

Appendix C. Weighted Creep Uplift Calculations

Mead & Hunt, Inc.

Job No. 4606900-211187.01 Sheet 1 of 1
Job Name Kirkpatrick Dam Assessment
Task weighted Creep Uplift Layout
Calculated by JMS Date 7/25/21
Checked by _____ Date _____

Mead Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO.	1	OF	5
CALCULATED BY:	JMS	DATE	10/6/2021
CHECKED BY:	GAR	DATE	10/7/2021
SCALE	N/A	JOB NO.	4606900-211187.01

Weighted Creep Uplift Calculation

Structure: Kirkpatrick Dam
Load Case: Case I

Weighted Creep Ratio (C_w) = [redacted]
Weighted Creep Distance (D_{wc}) = [redacted] ft
Headwater Elevation = [redacted] ft
Tailwater Elevation = [redacted] ft
Net Head (H) = [redacted] ft

Hydraulic Gradient (G) = H / D_{wc} = [redacted] ft/ft
Unit Weight of Water = [redacted] kcf
Base Length = [redacted] ft
Analysis Width = [redacted] ft

Point	Elevation	Distance From Toe	Elevation Change D_v	Horizontal Distance D_h	Weighted Horiz. Dist. $D_h' = (1/3)*D_h$	Creep Distance $D = \lvert D_v \rvert + D_h'$	$H_{(n-1)}$	Total Head at Point $H_n = H_{(n-1)} - D_v - G*D$	Uplift Pressure ksf	Uplift Force (kips)	Moment Arm (feet)	Uplift Moment (kip-ft)
a	[redacted]											
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												
m												
n												

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = kip-ft (about toe)

tipping point @: [redacted]

Moment Arm (feet)	Uplift Moment (kip-ft)
[redacted]	

Total Uplift (U) = kips
Moment for Uplift (M_u) = kip-ft (about toe)

Mead & Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO.	2	OF	5
CALCULATED BY.	JMS	DATE	10/6/2021
CHECKED BY:	GAR	DATE	10/7/2021
SCALE	N/A	JOB NO.	4806900-211187.01

Weighted Creep Uplift Calculation

Structure: Kirkpatrick Dam
Load Case: Case II

Weighted Creep Ratio (C_w) = [redacted]
Weighted Creep Distance (D_{wc}) = [redacted] ft
Headwater Elevation = [redacted] ft
Tailwater Elevation = [redacted] ft
Net Head (H) = [redacted] ft

Hydraulic Gradient (G) = H / D_{wc} = [redacted] ft/ft
Unit Weight of Water = [redacted] kcf
Base Length = [redacted] ft
Analysis Width = [redacted] ft

Point	Elevation	Distance From Toe	Elevation Change D_v	Horizontal Distance D_h	Weighted Horiz. Dist. $D_h' = (1/3)*D_h$	Creep Distance $D = \|D_v\| + D_h'$	H_{n+1}	Total Head at Point $H_n = H_{n+1} - D_v - G*D$	Uplift Pressure ksf	Uplift Force (kips)	Moment Arm (feet)	Uplift Moment (kip-ft)
a	[redacted]											
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												
m												
n												

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = [redacted] kip-ft (about toe)

Upping point @: [redacted]

Moment Arm (feet)	Uplift Moment (kip-ft)
[redacted]	[redacted]

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = [redacted] kip-ft (about toe)

Mead & Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO.	3	OF	5
CALCULATED BY:	JMS	DATE	10/6/2021
CHECKED BY:	GAR	DATE	10/7/2021
SCALE	N/A	JOB NO.	4606900-211187.01

Weighted Creep Uplift Calculation

Structure: Kirkpatrick Dam
Load Case: Case III

Weighted Creep Ratio (C_w) = [redacted]
Weighted Creep Distance (D_{wc}) = [redacted] ft
Headwater Elevation = [redacted] ft
Tailwater Elevation = [redacted] ft
Net Head (H) = [redacted] ft

Hydraulic Gradient (G) = H / D_{wc} = [redacted] ft/ft
Unit Weight of Water = [redacted] kcf
Base Length = [redacted] ft
Analysis Width = [redacted] ft

Point	Elevation	Distance From Toe	Elevation Change D_v	Horizontal Distance D_h	Weighted Horiz. Dist. $D_h' = (1/3)*D_h$	Creep Distance $D = \lvert D_v \rvert + D_h'$	H_{net}	Total Head at Point $H_x = H_{x-1} - D_v * G * D$	Uplift Pressure ksf	Uplift Force (kips)	Moment Arm (feet)	Uplift Moment (kip-ft)
a	[redacted]											
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												
m												
n												

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = kip-ft (about toe)

tipping point @: [redacted]

Moment Arm (feet)	Uplift Moment (kip-ft)
[redacted]	

Total Uplift (U) = kips
Moment for Uplift (M_u) = kip-ft (about toe)

Mead & Hunt

JOB	Kirkpatrick Dam Assessment		
SHEET NO.	4	OF	5
CALCULATED BY:	JMS	DATE	10/6/2021
CHECKED BY:	GAR	DATE	10/7/2021
SCALE	N/A	JOB NO.	4606900-211187.01

Weighted Creep Uplift Calculation

Structure: Kirkpatrick Dam
Load Case: V

Weighted Creep Ratio (C_w) = [redacted]
Weighted Creep Distance (D_{wc}) = [redacted] ft
Headwater Elevation = [redacted] ft
Tailwater Elevation = [redacted] ft
Net Head (H) = [redacted] ft

Hydraulic Gradient (G) = H / D_{wc} = [redacted] ft/ft
Unit Weight of Water = [redacted] kcf
Base Length = [redacted] ft
Analysis Width = [redacted] ft

Point	Elevation	Distance From Toe	Elevation Change D_v	Horizontal Distance D_h	Weighted Horiz. Dist, $D_h' = (1/3)*D_h$	Creep Distance $D = \|D_v\| + D_h'$	$H_{(n-1)}$	Total Head at Point $H_n = H_{n-1} - D_v - G*D$	Uplift Pressure ksf	Uplift Force (kips)	Moment Arm (feet)	Uplift Moment (kip-ft)
a	[redacted]											
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												
m												
n												

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = [redacted] kip-ft (about toe)

tipping point @ [redacted]

Moment Arm (feet)	Uplift Moment (kip-ft)
[redacted]	[redacted]

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = [redacted] kip-ft (about toe)

Mead & Hunt

JOB	Kirkpatrick Dam Assessment			
SHEET NO.	5	OF	5	
CALCULATED BY:	JMS	DATE	10/6/2021	
CHECKED BY:	GAR	DATE	10/7/2021	
SCALE	N/A	JOB NO.	4606900-211187.01	

Weighted Creep Uplift Calculation

Structure: Kirkpatrick Dam
Load Case: Case V

Weighted Creep Ratio (C_w) = [redacted]
Weighted Creep Distance (D_{wc}) = [redacted] ft
Headwater Elevation = [redacted] ft
Tailwater Elevation = [redacted] ft
Net Head (H) = [redacted] ft

Hydraulic Gradient (G) = H / D_{wc} = [redacted] ft/ft
Unit Weight of Water = [redacted] kcf
Base Length = [redacted] ft
Analysis Width = [redacted] ft

Point	Elevation	Distance From Toe	Elevation Change D_e	Horizontal Distance D_h	Weighted Horiz. Dist. $D_h' = (1/3)*D_h$	Creep Distance $D = \|D_{i-1} - D_i\| + D_h'$	$H_{(tail)}$	Total Head at Point $H_i = H_{(i-1)} - D_e - G*D$	Uplift Pressure ksf	Uplift Force (kips)	Moment Arm (feet)	Uplift Moment (kip-ft)
a	[redacted]											
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												
m												
n												

Total Uplift (U) = [redacted] kips
Moment for Uplift (M_u) = kip-ft (about toe)

tipping point @: [redacted]

Moment Arm (feet)	Uplift Moment (kip-ft)
[redacted]	

Total Uplift (U) = kips
Moment for Uplift (M_u) = kip-ft (about toe)