

NPPEN

DEPARTMENT OF THE ARMY
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

PDR 1130-2-5

Regulation
No. 1130-2-5

17 March 1980

Project Operation
LEVEE ENCROACHMENT STANDARDS AND PROCEDURES

1. Purpose. This regulation provides technical guidelines related to levee encroachments and the fulfillment of local agency maintenance obligations specified in Part 208.10, Title 33, CFR. It will help to insure that the integrity of a levee system is maintained in situations where a proposed levee encroachment is considered to be in the public interest, and also provides design guidelines for such encroachments.
2. Applicability. This regulation is applicable to all Divisions within the Portland District having civil works responsibilities.
3. References.
 - a. ER 1130-2-335, Levee Maintenance Standards and Procedures.
 - b. Title 33, Code of Federal Regulations, Chapter 2, Part 208, Flood Control Regulations.
 - c. EM 1110-2-1903, Design and Construction of Levees, dated 31 March 1978.
 - d. EM 1110-2-1410, Interior Drainage and Urban Leveed Areas: Hydrology, dated 3 May 1965.
4. General. Adequate levee maintenance and control of levee encroachments are essential in maintaining levee stability and assuring maximum safety for protected areas. Urbanization, increased river recreation use, and environmental construction restrictions on navigable waterways have created public pressure to construct utility lines, buildings, and boating facilities on, across, adjacent to and through existing levee embankments and rights-of-ways. Uncontrolled levee encroachments weaken a levee system. Defined standards and technical requirements for construction of encroachments are considered a necessity to establishing a well maintained, high performance levee system.
5. Policy. The standards and procedures presented in ER 1130-2-335 and the provisions included in this regulation will be followed in performing permit reviews and inspection evaluations for levee systems within the Portland District. Special attention will be given to construction of encroachments, such as utility lines, buildings and appurtenant levee structures, and the guidelines in this District regulation followed in providing technical assistance to Drainage Districts and local agencies in design of new projects and for levee permit or inspection recommendations.

New regulation.

6. Levee Encroachments. The policy regarding levee encroachments will be to permit in the levee section only those appurtenant installations that provide a flood control function during high river stages and heavy storm conditions. Exceptions to this policy will be allowed in cases where the function of the encroachment is considered to be in the public interest and where adequate provisions can be made to maintain the integrity of the levee system. In order to establish guidelines for levee encroachments, several conditions for agricultural and urban levee systems are presented in Appendix A. Figures 1 through 8 of the appendix show minimum section and zone restriction requirements for encroachments. For the purpose of establishing, presenting and illustrating these guidelines, the levee embankment section and adjacent area have been divided into four zones, A through D as shown on figure 1. More detailed standards for common levee encroachments are as follows:

a. Levee Landscaping. A good growth of sod will be encouraged on unretted levee slopes. Vegetation producing heavy foliage or root systems capable of penetrating into Zones A, B, and C will not be permitted. On landfill or levee overbuild sections, sparsely spaced trees and other deep root landscaping will be permitted provided a root-free zone having a minimum depth of 3 feet is maintained over the underlying zones.

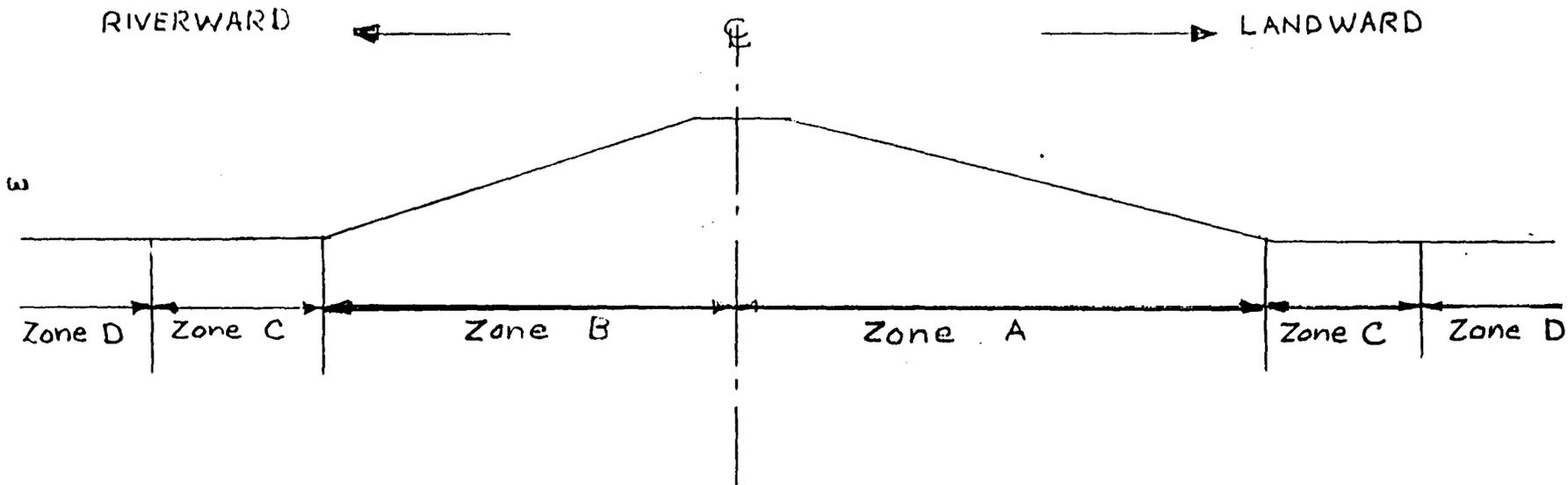
b. Fences. Fences required to prevent animal grazing on the levee section will be restricted to Zone D. A 10-foot minimum width access way will be maintained between the toe of levee slope and the fence row.

c. Utility Poles. Utility poles will be restricted to Zones B and C except for the Zone A utility poles required at pumping stations. Pumping station poles, located in Zone A, will be located within the limits specified in figures 1 and 5 of Appendix A.

d. Buried Cables. Buried power and telephone cables will be allowed in Zones A, B, and C. Cables located in Zone A will be restricted to the freeboard portion of the levee embankment.

e. Gravity Conduits and Pipes. In general, tide box structures and sewer lines are the only gravity flow installation allowed to pass through the minimum levee section below maximum flood stage. Where possible, small gravity flow pipes will cross through the freeboard or overbuild portion of the levee embankment. Lines parallel to the levee centerline will not be allowed in the minimum levee section.

(1) Tidebox Structures. Minimum levee section requirements and guidelines for selection of the river closure system (Appendix B) will be given special attention for all tidebox installations and only those encroachments necessary for proper operation of the tidebox will be allowed. The above restrictions on encroachments will be maintained along the adjoining levee sections a sufficient distance to permit excavation and emergency repair of the tidebox. An example of a tidebox installation with gatewell structure is shown in Appendix B.



MINIMUM LEVEE SECTION
 Note; See Appendix A for details.

Figure 1

(2) Sewer Lines. Where possible, sewer lines will cross through the levee embankment freeboard. Sewer lines crossing through the levee section below maximum flood stage will be provided with positive closure gates located on the riverside in Zone B or C. The type of river closure system will be selected using guidelines in Appendix B. On large sewer installations and sewer lines paralleling but not in the levee, a special foundation analysis will be required to determine need for gatewell river closure systems, inspection manholes and special seepage control measures.

f. Pressure Conduits and Pipes. In general, safeguards will be provided on all pressure conduits and pipes to insure maintenance of the minimum levee section. Guidelines on emergency closures, located on riverside of levee, are included in Appendix B.

(1) Pumping Stations. Minimum levee section requirements and location of the pumphouse and discharge lines will be given special attention and only those encroachments necessary for proper operation of the pumping facility will be allowed. Pile supports for the pumphouse will be located in Zone D at least 5 feet from the toe of the embankment or foundation slope. Discharge lines will cross through the levee embankment freeboard and on or above the minimum section across Zones A and B. The discharge lines will be encased in reinforced concrete at all roadway crossings. Adequate bank protection will be provided around the periphery of the pump sump and discharge outlet. Small footings and piles for support of discharge lines will be permitted. Encroachment restrictions for a pumping station will be applied to the levee a sufficient distance on either side of the discharge lines to allow for repair to levee embankment or discharge lines. Discharge encasement details and an example of a pumping station installation are shown in Appendix B.

(2) Water Lines. Small water service lines, properly encased, will be permitted to cross the levee section. Similar lines paralleling the levee will be located landward of Zone C. On larger fire and service mains, a special review of levee conditions will be required to determine if additional safeguards are needed. Guidelines on emergency closures, located on riverside of levee, are included in Appendix B.

(a) Levee Crossings. Water service lines will be permitted to cross through the embankment freeboard and overbuild zones and penetrate into Zones A, B and C to the depth required for frost protection. Lines will be encased in reinforced concrete or placed inside a metal encasement pipe. Encasements shall extend the full levee width plus a distance of 5 feet for concrete or 3 diameters of the encasement pipe beyond each toe. The ends of metal encasement pipes will be plugged with concrete and telltale risers for detection of leakage provided at the concrete plugs. A minimum 1.5-foot backfill cover will be provided over encasements. Encasement details are shown in Appendix B. Lines crossing a landfill section will be encased to the outer limits required for adjoining levee section.

(b) Paralleling Levees. In general, paralleling lines will be located in Zone D and no encasement of these lines will be required. Proposals to

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place lines in landfill and levee overbuild sections will require a special review of conditions to determine necessary safeguards or restrictions.

(3) Gas Lines. In general, gas lines will conform to the same restrictions specified for water lines.

g. Access Stairs and Bridges. Small footings in Zone A and pile supports in Zone B for access stairs and bridges will be permitted. Footings will be allowed to penetrate 1.5-feet into Zone A. On levee overbuild sections, pile supports in Zone A will be permitted if the embankment slope is flatter than 1 vertical on 10 horizontal.

h. Buildings and Structures. The general policy will be to restrict all buildings and structures to Zone D. No basements, tanks or permanent excavations will be allowed in Zones A, B, or C and adequate bank protection will be provided for structures built on the riverside of the levee. Structures supported by piles will not be permitted in Zone A. Any building or structure encroaching on Zone A will also be required to have toe drain or zoned filter systems with drainage outfalls provided for visual inspection or measurement of collected seepage. A special review of conditions will be required for all structures built into or on the minimum levee section, including backfill and overbuild sections, to determine if additional safeguards or restrictions are needed. Subsurface explorations will be required at all building and structure sites.

7. Inspections and Technical Assistance to Others. The standards and procedures presented in this regulation form the basis for providing technical assistance to local agencies, performing required or requested field inspections, and the designing of proposed new projects.

FOR THE DISTRICT ENGINEER:



DAN A. CONNER
Lieutenant Colonel, CE
Deputy District Engineer

DISTRIBUTION:
B-PDR

LEVEE ENCROACHMENT RESTRICTION ZONES

1. General. This appendix establishes minimum levee section requirements and specifies restriction zones within, overlying or adjoining the minimum section. The restriction zones are intended to clarify the general provisions necessary to maintain levee stability for common types of encroachments. In general, encroachments are installations where undesirable weaknesses in the levee system can develop. Where possible, encroachments should be limited to those providing a needed function for flood protection.

2. Definition of Terms. Terms pertinent to technical guidelines descriptions presented in paragraph 6 of the text and figures 1 through 8 of this appendix are as follows:

a. Minimum Levee Section. This term indicates the minimum section considered necessary to provide good embankment performance during flood stages on Lower Columbia and Willamette River levees. The bases for setting the limits of the minimum section are general knowledge of embankment, foundation and river conditions, performance of levee systems during past flood stages, and emergency needs for access.

b. Minimum Section with Overbuild. This term indicates a condition where the geometric description of an existing levee section is larger and contains more embankment materials than the minimum section. The materials in excess of the minimum section are termed as "overbuild".

c. Landfill Section. This term indicates a condition where the existing levee section consists of placed fill with riverward and/or landward slopes flatter than 1 vertical or 10 horizontal. The materials in excess of the minimum section projected from the levee adjoining the landfill are termed as "overbuild". In cases where the existing grade of the landfill is higher than the grade of the adjoining levee, materials above levee grade are termed as "excess overbuild".

d. Overbuild and Excess Overbuild. These terms are used in condition cases to show foundation and embankment locations above the projected lines defining the minimum section.

e. Restriction Zones. Descriptions of zones related to minimum and overbuild sections are as follows:

(1) Zone A. This zone includes the landward portion of the levee section extending from centerline to the intersection of the specified slope line with the existing interior ground elevation.

(2) Zone B. This zone includes the riverward portion of the levee section extending from centerline to the intersection of the specified slope line with the existing interior ground elevation. In cases where the existing river channel grade bordering the levee is lower than the interior elevation, the river channel grade will control the zone limit on the riverside.

(3) Zone C (Minimum Section). This zone extends landward or riverward of the outer limits of Zone A or B and includes a specified extended width beyond the intersection of the existing ground elevation by the projection of the specified slope line.

(4) Zone C (Landfill or Overbuild Section). This zone includes projected limits extending landward and riverward from levee centerline to specified riverward and landward widths below placed fill or the existing ground line. The materials above the projected slope lines forming the zone limits are classified as "overbuild" or "excess overbuild" depending on the grade at levee centerline.

(5) Zone D. This zone lies landward or riverward of Zone C.

(6) Embankment Freeboard. This zone, in general, is the zone 3 feet below the levee crest grade.

(7) Maximum Flood Stage. This term is defined as a horizontal line projected across the levee embankment 3 feet below crest grade.

3. Levee Case Conditions. Figures 1 through 8 present case conditions for urban and agricultural levees. Each case includes reconstruction zone remarks related to common levee encroachments.

PROJECT LEVEE MAINTENANCE STANDARDS
 SUBJECT MINIMUM SECTION RESTRICTION ZONES
 DATE: JAN 80

APPENDIX A
 LEVEE ENCROACHMENTS
 PDR- 1130-2-5

NOTE: SEE SECTIONS ON FIGURE A- 2

URBAN LEVEES

CASE U 1 - PUMPING STATION AND TIDEBOX SECTION

CASE U 2 - LEVEE EMBANKMENT OVER 15 FEET IN HEIGHT

ZONE	RESTRICTIONS/REMARKS	ZONE	RESTRICTIONS/REMARKS
A	No installations except discharge line foundation support and utility poles for pump. Pump sump E1 to be located landward of 1V on 6H slope. Tidebox inlet E1 and utility poles to be located landward of 1V on 5H slope. Pump discharge lines to cross through embankment freeboard with lines encased in reinforced concrete at levee crest and at any traffic crossing. Adequate bank protection to be provided at pump sump intake and tidebox inlet. No trees or deep root landscaping permitted.	A	No installations except pipe crossings or buried cables in or through embankment freeboard or section overbuild. Minimum landward zone limit to 1V on 6H projected slope. Small footings for access stairs or foot bridges permitted to 1.5-foot depth penetration into minimum section. Pressure pipes and conduits to be encased and sealed in concrete or equal substitute with risers provided for detection of leakage. Special review required on all building encroachments. Buildings and structures considered only when site explorations completed and toe drain, filter protection and positive drainage systems properly designed. No trees or deep root penetrating landscaping permitted. 1/
B	No installations except pump discharge lines, utility poles, buried cables, and foundation supports for pump discharge outlet. Piles and footings for access bridges to tidebox river closure systems permitted. Adequate bank protection to be provided at pump discharge and tidebox outlet. No trees or deep root landscaping permitted.	B	No installations except utility poles, buried cables, pipe crossings through embankment freeboard, gate installations for gravity sewer crossings, and footings and piles for foot bridges. Minimum riverward zone limits to 1V on 3H projected slope. Pressure pipe and conduits to be encased and sealed in concrete or equal substitute with risers for detection of leakage. Sewer installations to be provided with positive closure gates. No basements, tanks or open excavations permitted. Pressure conduits paralleling levee centerline not allowed. No trees or deep root penetrating landscaping permitted. 1/
C	Piles and footings permitted for pumping station or access structures. No tanks or permanent excavations permitted below slope projection line. Permanent excavations for intake or outlet channels permitted in the overbuild portion of the zone. Minimum zone width limit 50 feet riverward and landward to limit required for pump sump or tidebox inlet. No trees or deep root landscaping permitted.	C	Piles, footings and utility lines permitted. No basements, tanks, pressure conduits or permanent open excavations permitted below projected slope limits. Pressure conduits and pipes paralleling the levee centerline to be in overbuild portion of zone. Sparsely spaced trees and deep root landscaping and drainage ditches allowed in overbuild portion of zone. Minimum riverward zone width limit is 50 feet. Fifty feet also preferred for landward limit with the minimum width being 10 feet.
D	No restrictions except intake and outlet channels to be maintained free of flow obstructions.	D	No restrictions.

1/ Zones A and B are more restrictive than Zone C. Any Zone C restriction also applies to Zones A and B.

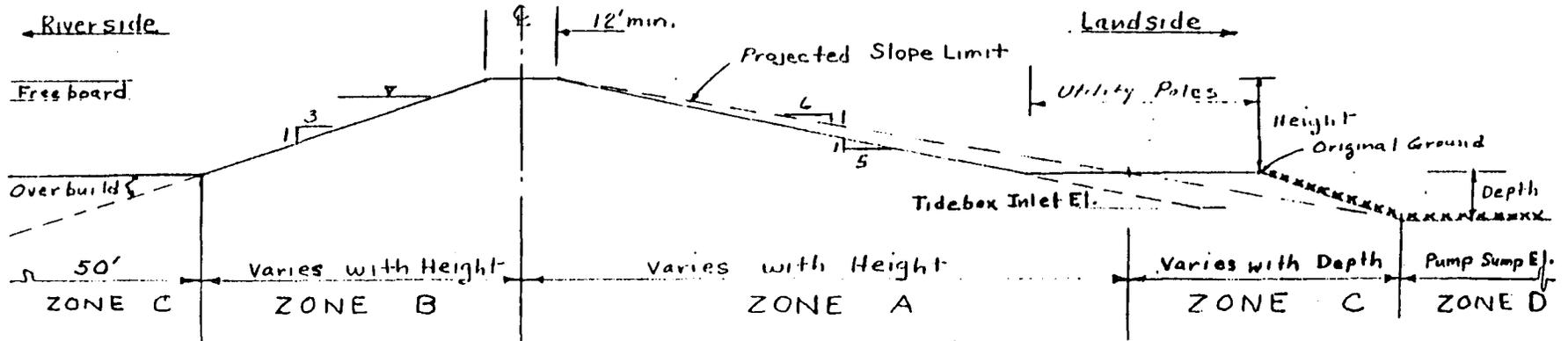
FIGURE A-1

DIV. _____ BRANCH _____ SECTION _____

PROJECT Levee Maintenance Standards

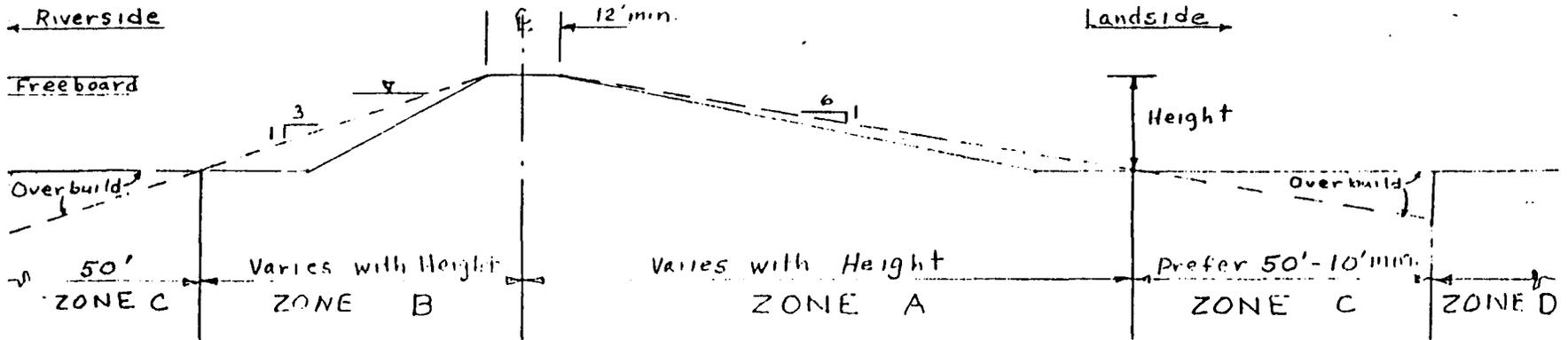
SUBJECT Minimum Section Restriction Zones

BY _____ DATE Jan 80 CHECKED _____ PART _____ PAGE _____ OF _____



CASE U1 - Pumping Station and Tide box Section

No Scale



CASE U2 - Levee Embankment Section Over 15 Feet in Height

No Scale

PROJECT MAINTENANCE STANDARDS
 SUBJECT MINIMUM SECTION RESTRICTION ZONES
 DATE JAN '80

APPENDIX A
 LEVEE ENCROACHMENTS
 PDR- 1130 -2-5

URBAN LEVEES

NOTE: SEE SECTIONS ON FIGURE A- 4

CASE U3 - LEVEE EMBANKMENT LESS THAN 15 FEET IN HEIGHT

CASE U4 - LANDFILL OR LEVEE EMBANKMENT OVERBUILD SECTION

ZONE	RESTRICTIONS/REMARKS	ZONE	RESTRICTIONS/REMARKS
A	No installations except pipe crossings or buried cables in or through embankment freeboard or section overbuild. Minimum landward zone limit to 1V on 5H project slope. Small footings for access stairs or foot bridges permitted to 1.5-foot depth penetration into minimum section. Pressure pipes and conduits to be encased and sealed in concrete or equal substitute with risers provided for detections of leakage. Building encroachment of minimum section allowed only when section modified with toe drain and positive piping system to landward outfall. Building encroachment to be considered only when adequate filter protection (piping) provided. No trees or deep root penetrating landscaping permitted.	A	Same as CASE U2 or U3 if the measured landfill slope is steeper than 1V on 10H. Fill placed above the minimum section slope line classified as overbuild. Where the purpose of the overbuild is for landscaping, the root-free zone will be maintained.
B	Same as CASE U2.	B	Same as CASE U2 or U3 if the measured landfill slope is steeper than 1V on 10H. Fill placed above the minimum section slope line classified as overbuild. Where the purpose of the overbuild is for landscaping, the root-free zone will be maintained.
C	Same as CASE U2.	C	Piles, footings, and utility lines permitted. No basements, tanks, pressure conduits or permanent excavations below projected slope limits. Project slope limits, measured from projected centerline grade, are 1V on 6H landward and 1V on 3H riverward. Pressure conduits paralleling centerline are to be in overbuild or excess over build zones. Root-free zone to be maintained for all landscaping above zone. Building encroachment will be allowed in or on the overbuild zones if positive drainage and filter protection against piping of materials from minimum section are provided.
D	No Restrictions.	D	No Restrictions.

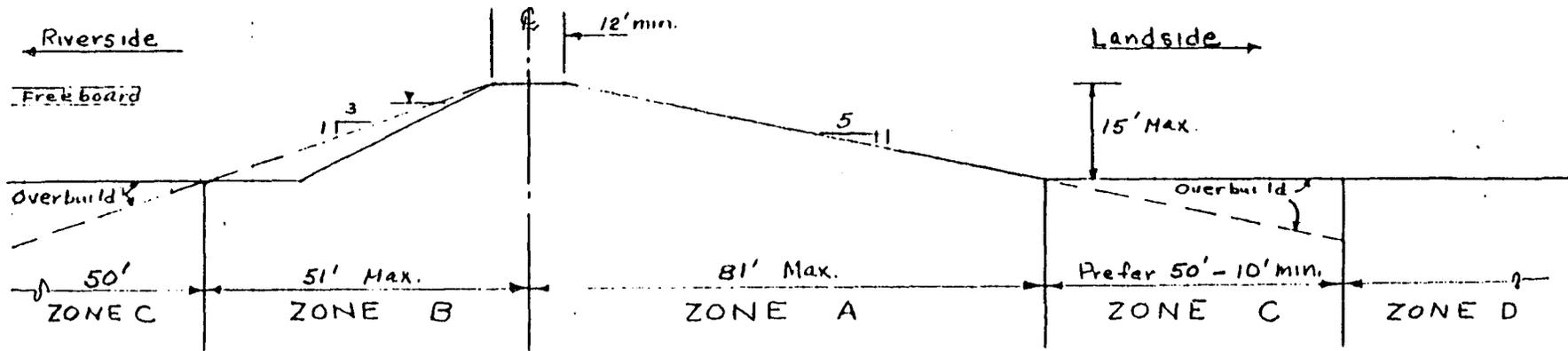
FIGURE A-3

DIV. _____ BRANCH _____ SECTION _____

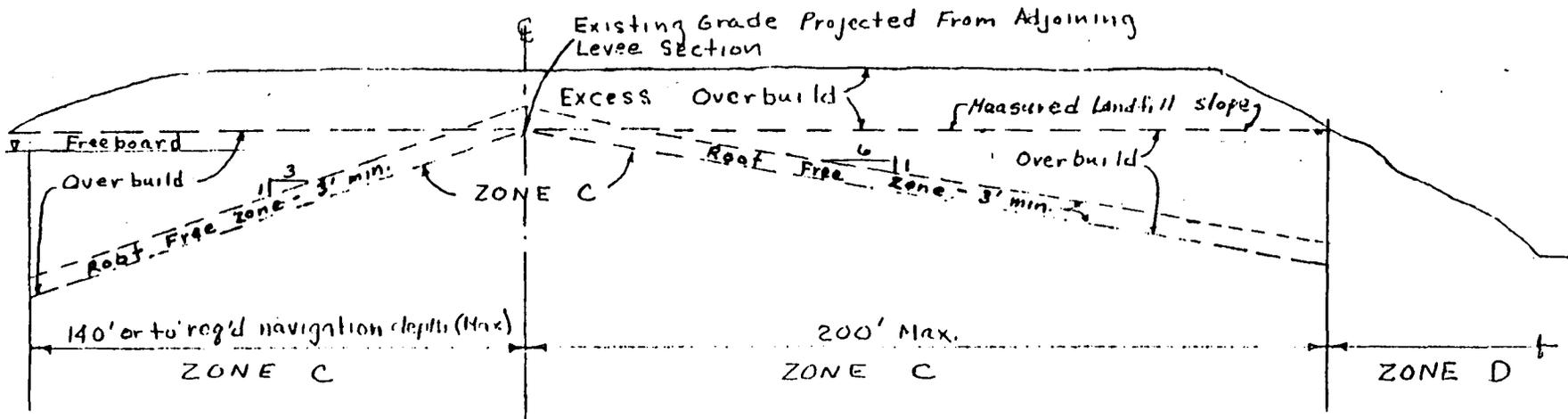
PROJECT Levee Maintenance Standards

SUBJECT Minimum Section Restriction Zones

BY _____ DATE Jan 80 CHECKED _____ PART _____ PAGE _____ OF _____



CASE U3 - Levee Embankment Section LESS THAN 15 FEET in Height
No Scale



CASE U4 - Landfill or Levee Embankment Overbuild Section
No Scale

PROJECT LEVEE MAINTENANCE STANDARDS
 SUBJECT MINIMUM SECTION RESTRICTION ZONES
 DATE: JAN 80

APPENDIX A
 LEVEE ENCROACHMENTS
 PDR- 1130-2-5

NOTE: SEE SECTIONS ON FIGURE A- 6

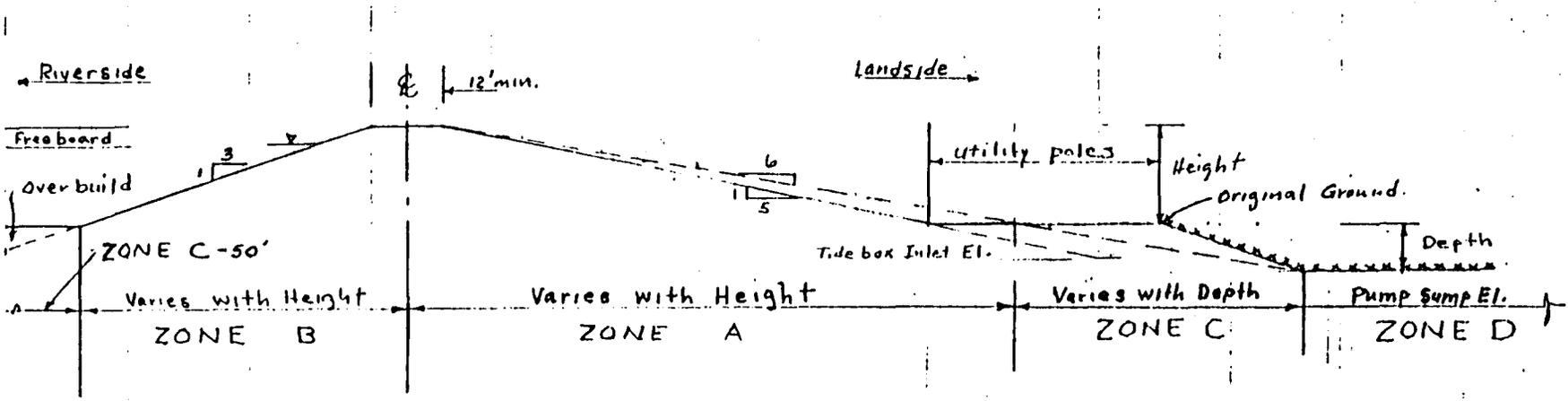
AGRICULTURAL LEVEES

CASE A 1 - PUMPING STATION OR TIDEBOX SECTION

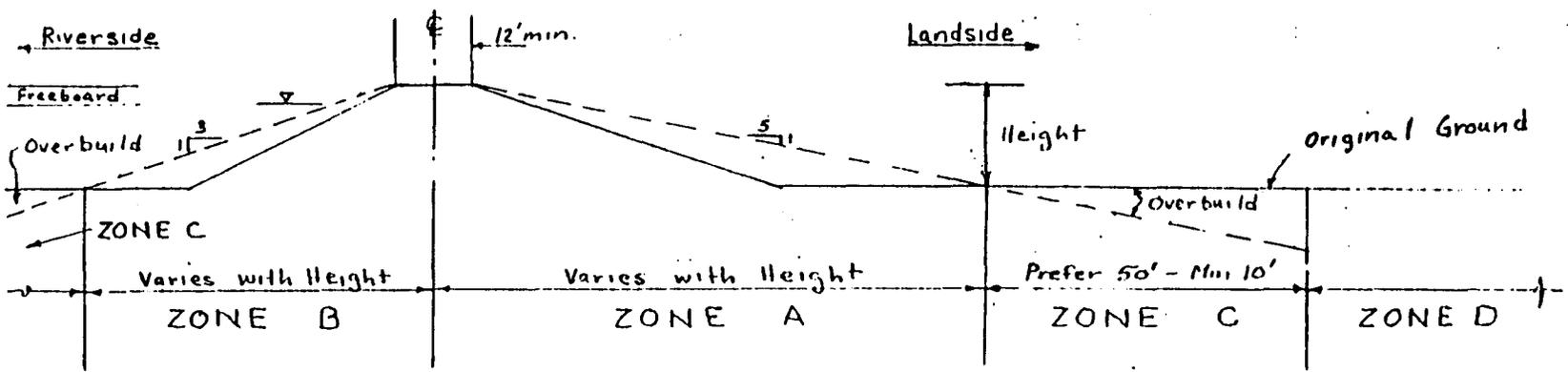
CASE A2 - LEVEE EMBANKMENT OVER 15 FEET IN HEIGHT

ZONE	RESTRICTIONS/REMARKS	ZONE	RESTRICTIONS/REMARKS
A	No installations except discharge line foundation support and utility poles for pump. Pump sump E1 to be located landward of 1V on 6H slope. Tidebox inlet E1 and utility poles to be located land of 1V on 5H slope. Pump discharge lines to cross through embankment freeboard with lines encased in reinforced concrete at levee crest and at any traffic crossing. Adequate bank protection to be provided at pump sump intake and tidebox inlet. No trees or deep root landscaping permitted.	A	No installations except pipe crossings or buried cables in or through embankment freeboard or section overbuild. Minimum landward zone limit to 1V on 5H projected slope. Small footings for access stairs or foot bridges permitted to 1.5-ft. depth penetration into minimum section. Pressure pipes and conduits to be encased and sealed in concrete or equal substitute with risers provided for detection of leakage. Special review required on all building encroachments. Buildings and structures considered only when site explorations completed and toe drain, filter protection and positive drainage systems properly designed. No trees or deep root penetrating landscaping permitted. 1/
B	No installations except pump discharge lines, utility poles, buried cables, and foundation supports for pump discharge outlet. Piles and footings for access bridges to tidebox river closure systems permitted. Adequate bank protection to be provided at pump discharge and tidebox outlet. No trees or deep root landscaping permitted.	B	No installations except utility poles, buried cables, pipe crossings through embankment freeboard, gate installations for gravity sewer crossings, and footings and piles for foot bridges. Minimum riverward zone limit to 1V on 3H projected slope. Pressure pipe and conduits to be encased and sealed in concrete or equal substitute with risers for detection of leakage. Sewer installations to be provided with positive closure gates. No basements, tanks, or open excavation permitted. Pressure conduits paralleling levee centerline not allowed unless overbuild section provided with riverward slope no steeper than 1V on 10H (pressure pipe in overbuild). No trees or deep root penetrating landscaping permitted. 1/
C	Piles and footings permitted for pumping station or access structures. No tanks or permanent excavations permitted below slope projection line. Permanent excavations for intake or outlet channels permitted in the overbuild portion of the zone. Minimum zone width limit 50 feet riverward and landward to limit required for pump sump or tidebox inlet. No trees or deep root landscaping permitted.	C	Piles, footings and utility lines permitted. No basements, tanks, pressure conduits or permanent open excavations permitted below projected slope limits. Pressure conduits and pipes paralleling the levee centerline to be in overbuild portion of zone. Sparsely spaced trees and deep root landscaping and drainage ditches allowed in overbuild portion of zone. Minimum riverward zone width limit is 50 feet. Fifty feet also preferred for landward limit with the minimum width being 10 feet.
D	No restrictions except intake and outlet channels to be maintained free of flow obstructions.	D	No restrictions.

1/ Zones A and B are more restrictive than Zone C. Any Zone C restriction also applies to Zones A and B.



CASE A1 - Pumping Station and Tidebox Section
No Scale



CASE A2 - Levee Embankment Section OVER 15 FEET in Height

PROJECT LEEVE MAINTENANCE STANDARDS
 SUBJECT MINIMUM SECTION RESTRICTION ZONES
 DATE: JAN 80

APPENDIX A
 LEVEE ENCROACHMENTS
 PDR- 1130-2-5

NOTE: SEE SECTIONS ON FIGURE A-8

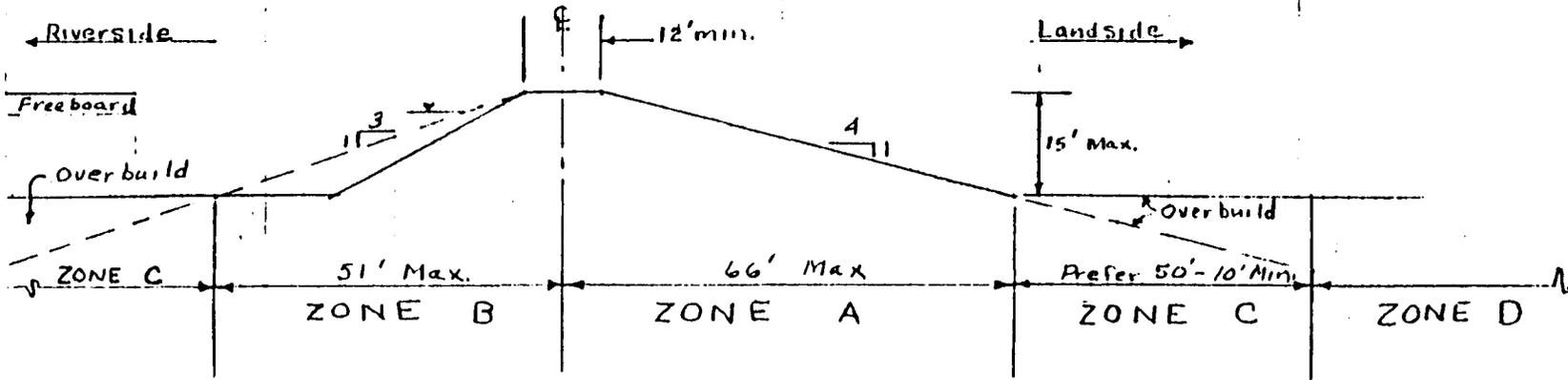
AGRICULTURAL LEEVES

CASE A 3 - LEVEE EMBANKMENT LESS THAN 15 FEET
 IN HEIGHT

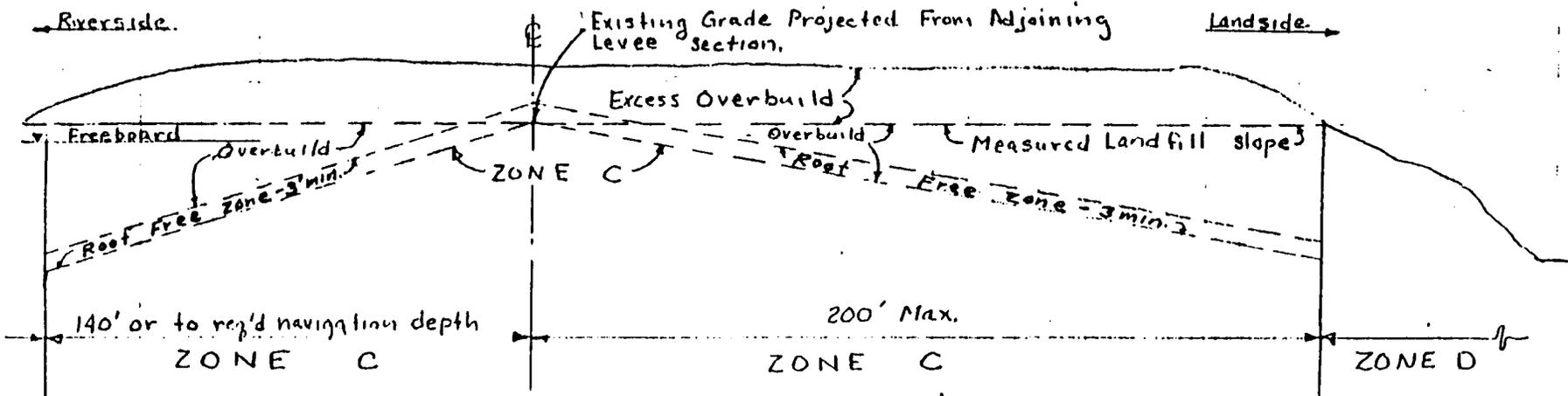
CASE A 4 - LANDFILL OR LEVEE EMBANKMENT OVERBUILD
 SECTION

ZONE	RESTRICTIONS/REMARKS	ZONE	RESTRICTIONS/REMARKS
A	<p>No installations except pipe crossings or buried cables in or through embankment freeboard of section overbuild. Minimum landward zone limit to 1V on 4H projected slope. Small footings for access stairs or foot bridges permitted to 1.5-foot depth penetration into minimum section. Pressure pipes and conduits to be encased and sealed with risers for detection of leakage. Building encroachment of minimum section allowed only when section modified with toe drain and positive piping system to landward outfall. Building encroachment to be considered only when adequate filter protection (piping) provided. No trees or deep root penetrating landscaping permitted.</p>	A	<p>Same as CASE A2 or A3, if the measured landfill slope is steeper than 1V on 10H. Fill placed above the minimum section slope line classified as overbuild. Where the purpose of the overbuild is for landscaping, the root-free zone will be maintained.</p>
B	<p>Same as CASE A2.</p>	B	<p>Same as CASE A2 or A3, if landfill slope is steeper than 1V on 10H. Fill placed above the minimum section slope line classified as overbuild. Where purpose of the overbuild is for landscaping, the root-free zone will be maintained.</p>
C	<p>Same as CASE A2.</p>	C	<p>Piles, footings and utility lines permitted. No basements, tanks, pressure conduits or permanent open excavations permitted below projected slope limits. Pressure conduits and pipes paralleling the levee centerline to be in overbuild portion of zone. Sparsely spaced trees and deep root landscaping and drainage ditches allowed in overbuilt portion of zone. Minimum riverward zone width limit is 50 feet. Fifty feet also preferred for landward limit with the minimum width being 10 feet.</p>
D	<p>No restrictions.</p>	D	<p>No restrictions.</p>

FIGURE A-7



CASE A3 - Levee Embankment Section LESS THAN 15 FEET in Height
No Scale



CASE A4 - Landfill or Levee Embankment Overbuild Section
No Scale

17 March 1980

Appendix B
PDR 1130-2-5

GRAVITY FLOW AND PRESSURE CONDUITS

1. General. This appendix presents examples of pumping station and tidebox installations and includes guidelines and pertinent details for emergency closure gates and pipe encasements for gravity flow and pressure conduits.
2. Pumping Station and Tidebox Plans and Sections. Plan and sections showing pumphouse and discharge lines crossing over the levee section are on figure B-1. A section showing a tidebox installation with gatewell structure constructed through the levee section is on figure B-2.
3. Emergency Closure Gates. Figure B-3 is a chart taken from Appendix D of Engineering Manual EM 1110-2-1410 (referenced in paragraph 3 of this regulation). This chart gives guidelines on gating requirements for pressure conduits and gravity flow conduits similar to a tidebox installation. Definitions of terms on the chart and descriptions of gate types are included in the engineering manual.
4. Encasement Details. In general, encasement of all pressure conduits crossing the levee will be required and paralleling lines in the levee section will not be allowed. Small conduits like water lines servicing one or two users are usually placed in a pipe encasement. Larger pipes like pump discharge or high multiple use lines are usually encased in reinforced concrete. Figure B-4 shows details for a metal pipe encasement. P.V.C. pipe may be used if adequate pipe strength and depth of backfill cover are provided. Figure B-5 shows general details for a reinforced concrete encasement. A special analysis of loading conditions is usually necessary to size concrete reinforcing steel.

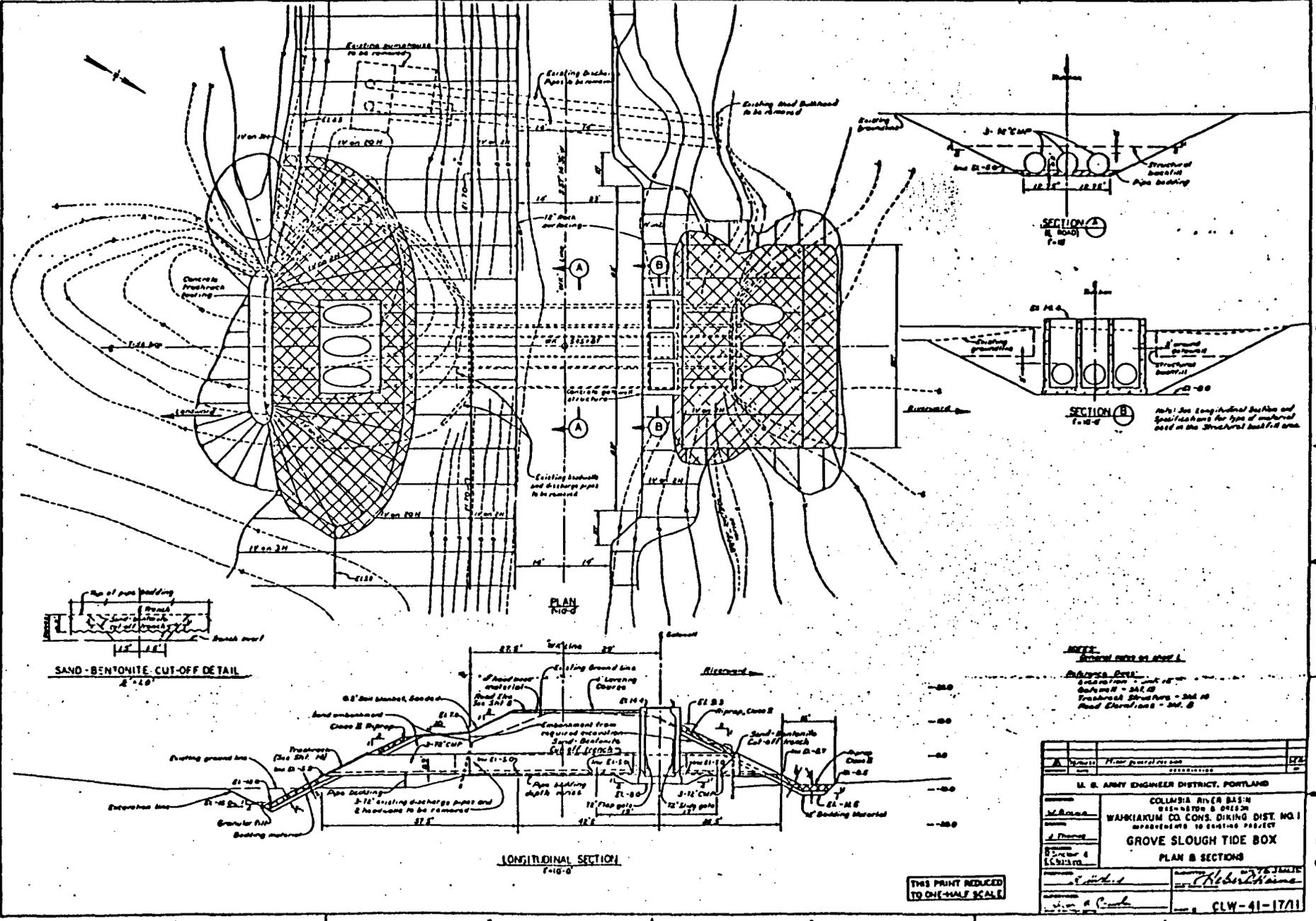


FIGURE B-2

THIS PRINT REDUCED TO ONE-HALF SCALE

U. S. ARMY ENGINEER DISTRICT, PORTLAND	
COLUMBIA RIVER BASIN WASHKIAMUM CO. CONS. DRAINING DIST. NO. 1 APPROVED TO EXISTING PROJECT	
GROVE SLOUGH TIDE BOX PLAN & SECTIONS	
Approved: <i>[Signature]</i> Checked: <i>[Signature]</i> Drawn: <i>[Signature]</i> Plotted: <i>[Signature]</i>	Approved: <i>[Signature]</i> Checked: <i>[Signature]</i> Drawn: <i>[Signature]</i> Plotted: <i>[Signature]</i>
CLW-41-17/1	

APPENDIX B
PDR 1130-2-5

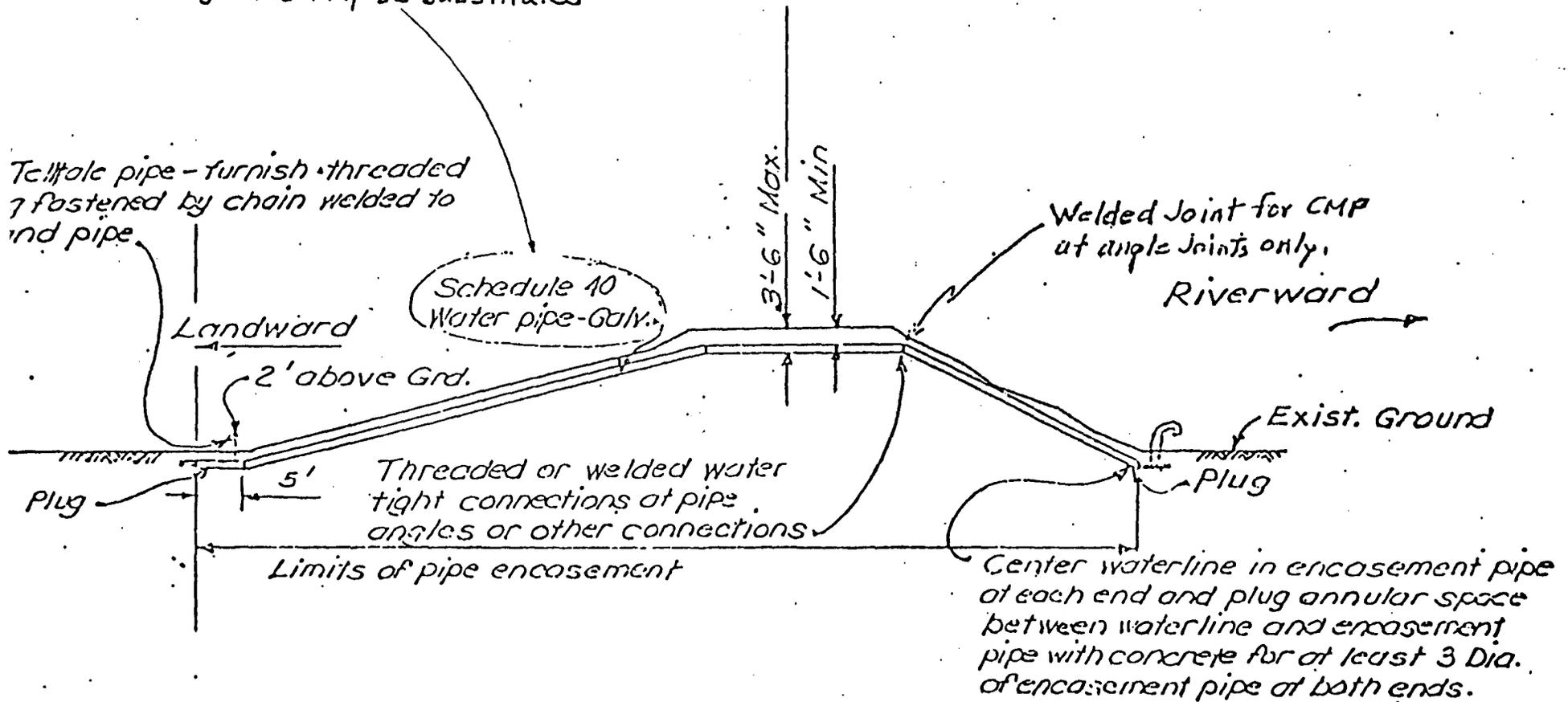
CIRCUMSTANCES UNDER WHICH EMERGENCY CLOSURE PROVISIONS ARE REQUIRED TO AUGMENT SERVICE GATES OR PRESSURE CONDUITS

Line Ref. No.	TYPE OF SERVICE GATE (See para 4-08 to 4-11 of EM)	Maximum Submergence Head Above Conduit Invert at Exit End	Duration of River Stage Above Flooding Stage A		EMERGENCY CLOSURE FACILITIES (See para 4-09 & 4-11 of EM)									NOTES
			General Type	Period, in Hours	Small-Size Conduit (36" Diam or Less)			Medium-Size Conduit (> 36" to 48")			Large-Size Conduit (> 48" Diam)			
					Moderate Damage Potential	Major Damage Potential	Critically Potentially	Moderate Damage Potential	Major Damage Potential	Critically Potentially	Moderate Damage Potential	Major Damage Potential	Critically Potentially	
1-12	I. PRESSURE CONDUIT, without service gate; intake and higher than design flood river stage.	High (> 10') Medium (12' to 18') Low (< 12')	Extended Long Medium Short	More than 72 30 to 72 12 to 30 Less than 12	SP/Access SP SP SP	SP/Access SP/Access SP SP	EG EG SP/Access SP	SP/Access SP/Access SP SP	SP/Access SP/Access SP SP	EG EG SP/Access SP	SP/Access SP/Access SP SP	EG EG SP/Access SP	EG EG SP SP	(1) Selection of service-type gate (column 2) in a specific case should be governed by operational requirements, overall economy, reliability, and other practical considerations, as indicated in paragraph 4-08 of EM; columns 5 to 14 of Chart 3 indicate additional facilities required for emergency purposes. Combinations shown are not equally suitable for all situations. (2) "EG" (Exit Gate) denotes any suitably designed gate installed at the river end of a pressure conduit that can be closed quickly in the event of emergency to prevent river flow from entering the protected area thru a crack or rupture of the pressure conduit; must be susceptible either to partial reopening to permit flow into the river from interior area in the event interior runoff raises ponding levels higher than river stage, or must have automatic relief feature (e.g., flap attachment). Normally design must provide for temporary emergency service only, pending repair of damaged conduit. Gate must be accessible from land by bridge or ramp, or by boat. Access by boat is usually limited to structures located in deep water on relatively straight streams.
13-24	II. FLAP GATE, installed at end of conduit without gatewell or access bridge.	High (> 10') Medium (12' to 18') Low (< 12')	Extended Long Medium Short	More than 72 30 to 72 12 to 30 Less than 12	GV - - -	GV GV - -	GV GV - GV	GV - - -	GV GV - -	GV GV - GV	GV GV - -	GV GV - -	GV GV - -	(3) "SP" (Structural Provisions) denotes any practical construction feature at the river end of a pressure conduit or gravity outlet that would facilitate emergency closure of the conduit to prevent river flow from entering the protected area thru a crack or ruptured section. These may include such features as indicated in para 4-09b(3) of the EM text, or others. SP features may be used during floods and/or after flood recession to prevent reflowing of protected area pending repair of damaged conduit. (4) "Access" denotes structural provisions for reaching an emergency facility or river end of conduit from land by a fixed bridge, ramp, or short portable footbridge. Access by boat to well marked structures located in deep water in reservoirs or slow moving streams may be acceptable if specially planned, and specifically justified.
25-31	III. SLIDE GATE WITH FLAP ATTACHMENT installed at river end of conduit without gatewell, but with access and working platform at gate location.	High or Medium Low (< 12')	Extended Long Medium Short	More than 72 30 to 72 12 to 30 Less than 12	- - - -	- - - -	- - - -	- - - -	- - - -	GV GV GV -	GV GV GV -	GV GV GV -	GV GV GV -	(5) "GV" denotes any suitably designed gate installed in a gatewell located on the river side of the levee with appropriate access for emergency use in the event a service-type gate (flap-type or combination slide- and flap-type) located on river end malfunctions. (See para 4-09k regarding design standards.) (6) "Damage Potential" (columns 5 to 14). See paragraph 4-09h of EM for explanation.
32-35	IV. FLAP GATE, installed in gatewell located on river side of levee with access	(All Heads)	Extended Long Medium Short	More than 72 30 to 72 12 to 30 Less than 12	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	SP SP SP -	(7) Maximum Hydraulic Head, measured from highest river stage during the design flood to Flooding Stage A, is usually about 7 to 10 feet less than the "Maximum Submergence Head Above Conduit Invert at Exit End" (column 3). (8) Alternatives. Where an Exit Gate (EG) is specified for a pressure conduit, an alternative arrangement of gate in a gatewell located on the river side of the levee with access may be adopted if more economical or otherwise satisfactory. An EG arrangement should be substituted for SP/Access where costs are approximately the same or less. With reference to Type II installations, "GV" facilities should be substituted for "Access" arrangements if costs are reasonably comparable.
36-40	V. SLIDE GATE, or SLIDE GATE WITH FLAP ATTACHMENT, installed in gatewell on river side of levee, with access.				(Supplemental gates are not required for emergency purposes. However, in some cases an "auxiliary" flap gate at exit end of a conduit may be advisable as an operational convenience to reduce frequent operation of a slide-type service gate. (See para 4-09k.)									

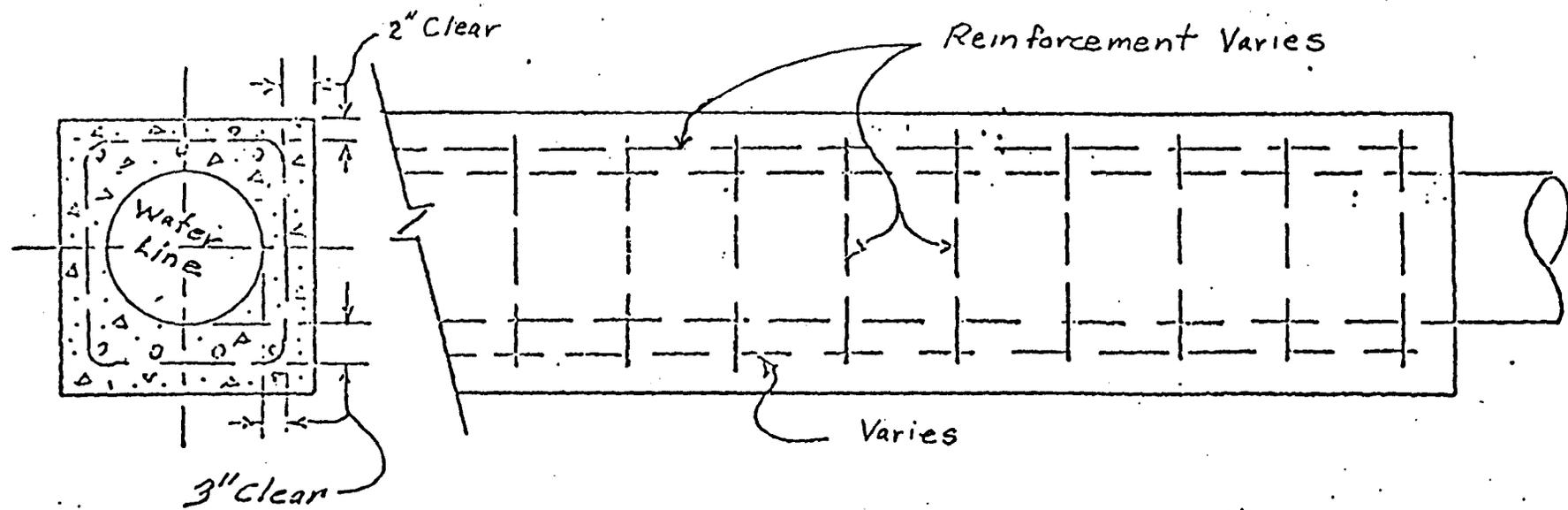
D4

CHART 0-3

NOTE: Corrugated Metal Pipe
or P.V.C Pipe with tight
joints may be substituted



WATERLINE ENCASUREMENT THROUGH LEVEE SECTION
METAL PIPE ENCASUREMENT



CONCRETE ENCASEMENT DETAILS

NOT TO SCALE

SAME LIMITS AS SHOWN FOR
METAL PIPE ENCASEMENT