

EROSION & SEDIMENTATION CONTROL (E&S) NARRATIVE

FOR

KEYSTONE TRADE CENTER – PHASE 2 DEVELOPMENT

Falls Township
Bucks County, PA
File No. 2020-07083-15

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The Erosion and Sediment Control (E&S) Plans and Calculations and the Post Construction Stormwater Management (PCSM) Plans and Calculations have been provided, planned, designed, and implemented to be consistent with one another. Please refer to the Post Construction Stormwater Management Plans and Calculations for the project, dated October 7, 2021, revised October 1, 2024.



GILMORE & ASSOCIATES, INC.
ENGINEERING & CONSULTING SERVICES

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EXECUTIVE SUMMARY

Keystone Trade Center - Phase 2 Development is a redevelopment project in Falls Township, Bucks County, Pennsylvania located in the MPM – Materials Processing and Manufacturing Zoning District within the Keystone Industrial Port Complex (KIPC). The project is located on tax map parcel TMP 13-051-001 (Lot 1a) which has a gross project area of 1,366.21 acres. The overall limit of disturbance and project site boundary for *Phase 2 Development* of the project shall be 310.19 acres. The proposed project for *Phase 2 Development* involves the construction of one (1) water tank, one (1) 1,318 S.F. pump house, one (1) 1,225 S.F. guard house, one (1) 8,000 S.F. refrigeration building, one (1) 10,020 S.F. administration building, one (1) 3,135 S.F. goods in building, one (1) 1,177,656 S.F. warehouse building and two (2) 1,035,696 S.F. warehouse buildings for product distribution and warehousing, a permitted use by-right.

The Keystone Industrial Port Complex is located on the west bank of the Delaware River and encompasses about 2,800 acres. Industrial operations began in 1952 involving integrated steel making and finishing. Prior to 1952, the area was used for agricultural purposes. Industrial activities expanded through the early 1970's. Most steel making activities were shut down by 1991. Today the complex supports several independent industrial operations.

A soil management Plan entitled “Material Management Plan for Keystone Trade Center”, prepared by *Langan Engineering & Environmental Services, Inc.*, for *NP Falls Township Industrial, LLC*, dated 2/24/21, revised 11/22/22, was developed as a facility-wide approach for identifying, assessing, handling, properly staging and managing materials toward compliance with relevant and applicable federal, state and local requirements and recommended best practices for materials that are likely to be encountered during planned demolition and construction. This material management plan is incorporated into the Erosion & Sediment Control Plan, Post-Construction Stormwater Management Plan, and the Construction Documents for this project.

The management plan also contains the results of the environmental due diligence performed on the site including locations of testing, regulated substances encountered and their corresponding concentrations. Within the designated project boundary, soil exceedances of direct contact MSCs were discovered for four substances: benzo(a)pyrene, iron, thallium and vanadium. No soil-to-groundwater MSCs were exceeded for a non-residential, non-use aquifer. The management plan includes a Site-specific Human Health Risk Assessment which concludes that there are no unacceptable cancer risks present. Mitigation of non-cancer risks from exposure to concentrations of constituents of potential concern during construction activities include the requirement of OSHA Level D personal protective equipment, dust control measures, implementing good hygiene practices, and the preparation of Site-specific Health and Safety Plans that comply with OSHA and other relevant and applicable rules, regulations and requirements for construction worker protection and safe work practices, for any contractor involved with material handling at the project site. In addition, and in accordance with the management plan, an environmental professional shall be required on-site during any earthwork activities within 100' of sample locations which demonstrated a risk assessment exceedance for thallium (as shown on the Plan), to ensure implementation of the soil handling procedures described in the management plan. These measures have been included in the PCSM Plan.

I. PROJECT DESCRIPTION

Introduction

Keystone Trade Center - Phase 2 Development is a redevelopment project in Falls Township, Bucks County, Pennsylvania located in the MPM – Materials Processing and Manufacturing Zoning District within the Keystone Industrial Port Complex (KIPC). The project is located on tax map parcel TMP 13-051-001 (Lot 1a) which has a gross project area of 1,366.21 acres. The overall limit of disturbance and project site boundary for *Phase 2 Development* of the project shall be 310.19 acres. The proposed project for *Phase 2 Development* involves the construction of one (1) water tank, one (1) 1,318 S.F. pump house, one (1) 1,225 S.F. guard house, one (1) 8,000 S.F. refrigeration building, one (1) 10,020 S.F. administration building, one (1) 3,135 S.F. goods in building, one (1) 1,177,656 S.F. warehouse building and two (2) 1,035,696 S.F. warehouse buildings for product distribution and warehousing, a permitted use by-right.

S. Port Road and Ben Fairless Drive, both industrial collectors with a 60'-wide ultimate right-of-way, shall be re-aligned and extended, respectively, as part of *Phase 2* development and construction. The project area will be bound by Old Bordentown Road to the north, Ben Fairless Drive and its proposed extension to the east and south, and re-aligned S. Port Road to the west. See *Figure 1 - Location Map* and *Figure 2 – U.S.G.S. Quad Map (Trenton East, NJ/PA)*.

Existing land use for the subject parcel over the past 50 years is industrial. Present land use for the last 5 years is industrial. The proposed land use of this redevelopment project will be industrial.

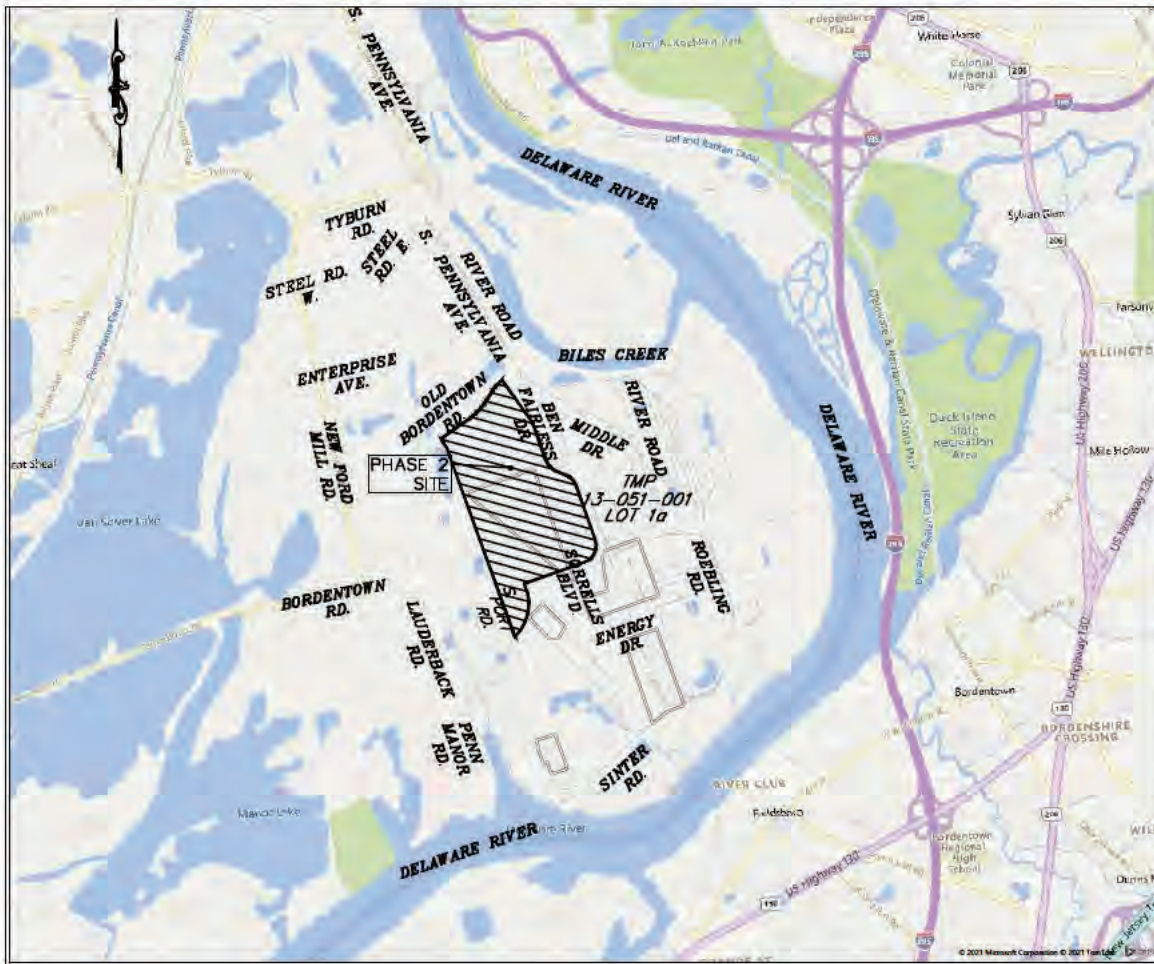
The Keystone Industrial Port Complex is located on the west bank of the Delaware River and encompasses approximately 2,800 acres. Industrial operations began in 1952 involving integrated steel making and finishing. Prior to 1952, the area was used for agricultural purposes. Industrial activities expanded through the early 1970's. Today the complex supports several independent industrial operations.

Existing Topographical Features and Land Cover

The boundary and existing features depicted on the plans have been prepared based on: (1) plan entitled "Galvanized Minor Subdivision Plan" by *R.L. Showalter & Associates, Inc.* dated 08/17/2020, last revised 09/18/2020, and (2) plan entitled "ALTA/NSPS Land Title Survey Parcel Plan – Keystone Industrial Port Complex," prepared for *NorthPoint Development, LLC*, dated 10/09/2020. The development area is flat for most of the site, with slopes ranging from nearly flat (0.0%) to 2.0%. There are areas of steep slopes within associated with the existing canal on-site.

The existing site contains one (2) point of interest. Drainage Point #1 (DP 001) consists of area on-site that generally drains from north-to-south toward an existing conveyance system (Canal No. 2). Canal No. 2 directly discharges into the Delaware River at the far southern portion of the KIPC site. The overall studied drainage area for *Phase 2 Development* contains approximately 137.42 acres of existing impervious cover, consisting of buildings, asphalt access driveways and parking lots, concrete walkways, railway lines, and staging/operating areas for the current businesses located on the site. Large pervious meadow areas are located throughout the site, with a sizeable portion of woodland area contained to the northern edge of the development.

FIGURE NO. 1



LOCATION MAP

NORTHPOINT PHASE 2

FALLS TOWNSHIP, BUCKS COUNTY, PENNSYLVANIA

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www.gilmore-assoc.com

JOB NO.:

2020-0708315

DATE:

09-09-2021

SCALE:

1"=5,000'

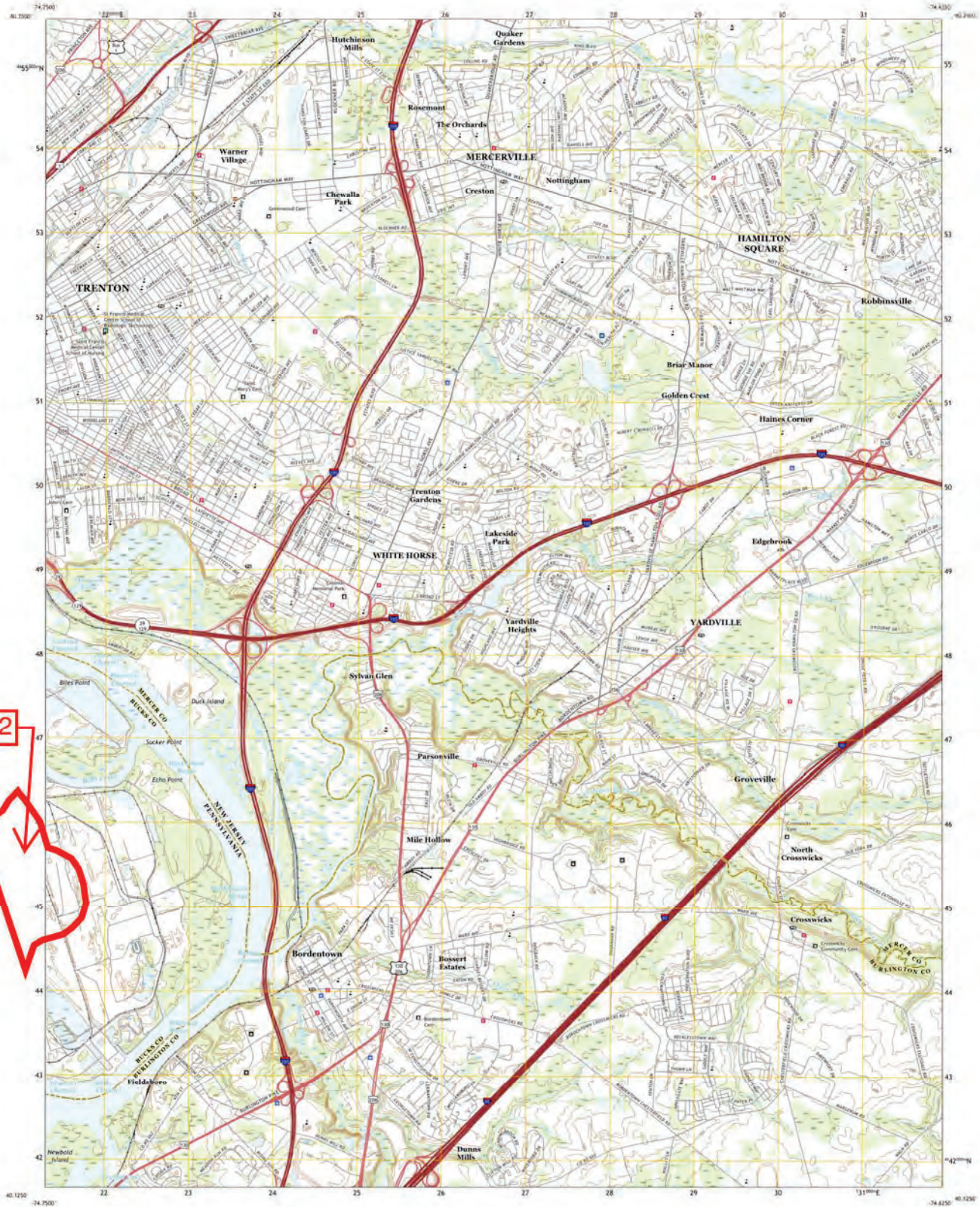
FIGURE NO. 2a



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRENTON EAST QUADRANGLE
NEW JERSEY - PENNSYLVANIA
7.5-MINUTE SERIES



PHASE 2

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
This map is a derivative of the 1:250,000-scale, 7.5-minute series topographic map of the Trenton East Quadrangle, New Jersey - Pennsylvania, 7.5-minute series, published in 1983. This map is a derivative of the 1:250,000-scale, 7.5-minute series topographic map of the Trenton East Quadrangle, New Jersey - Pennsylvania, 7.5-minute series, published in 1983. This map is a derivative of the 1:250,000-scale, 7.5-minute series topographic map of the Trenton East Quadrangle, New Jersey - Pennsylvania, 7.5-minute series, published in 1983.



ROAD CLASSIFICATION

Interstate	State Road
County Road	Local Road
Trail	Other

TRENTON EAST, NJ, PA
2019

74301688473
U.S. GEOLOGICAL SURVEY

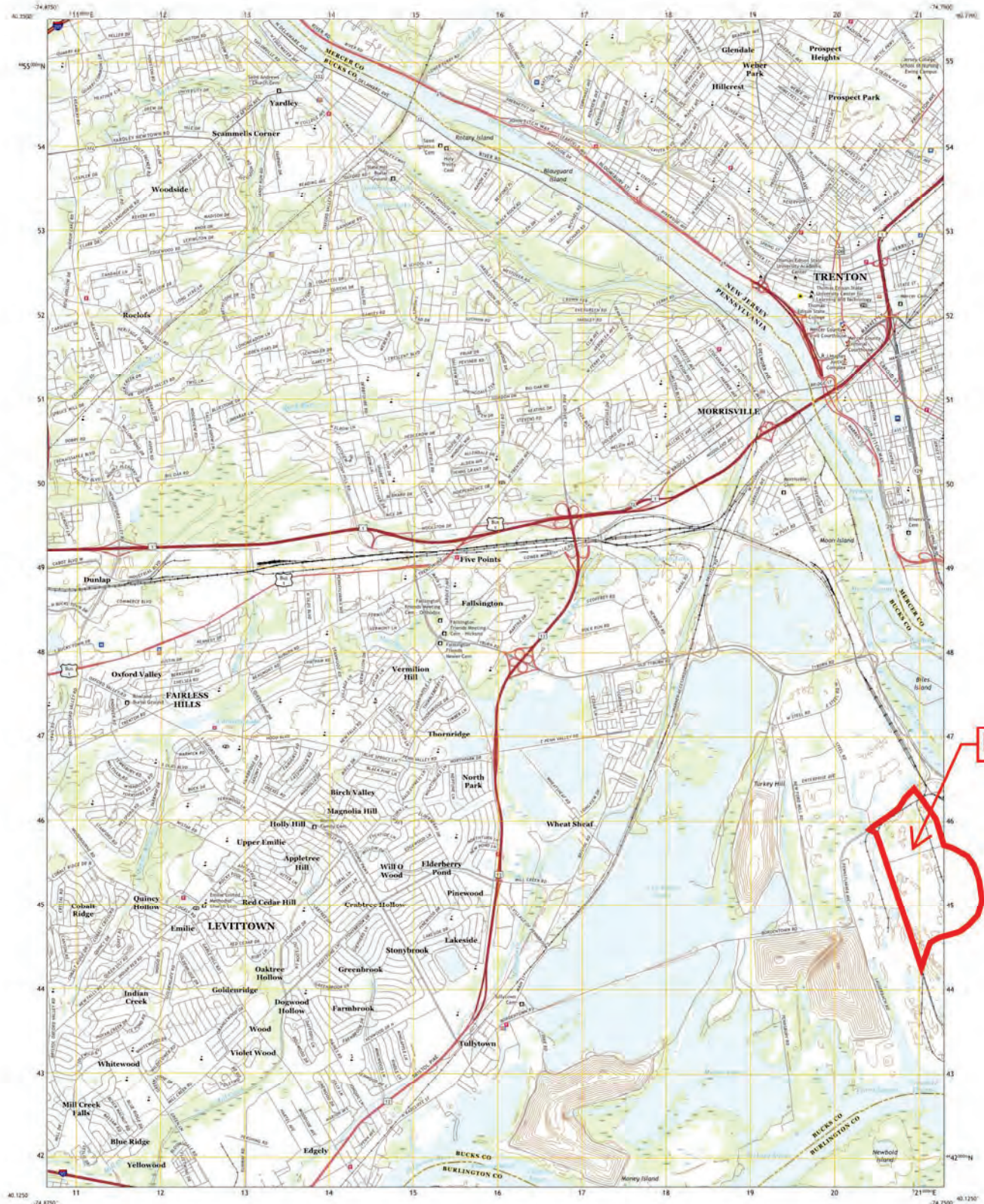
FIGURE NO. 2b



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRENTON WEST QUADRANGLE
NEW JERSEY - PENNSYLVANIA
7.5-MINUTE SERIES



PHASE 2

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
Digital Elevation Model (DEM) derived from 1:50,000-scale topographic maps, 1987
This map is not a legal document. Boundaries may be
generated for this map. Private lands within government
boundaries may not be shown. Other government features
may not be shown.



ROAD CLASSIFICATION

Interstate	State Road
Major Road	Local Road
Minor Road	Unimproved Road
Interstate	State Road

LEGEND

1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10

TRENTON WEST, NJ, PA
2019

74301688476
U.S. GEOLOGICAL SURVEY
NEW JERSEY - PENNSYLVANIA
7.5-MINUTE SERIES

Custom Soil Resource Report Soil Map



Soils

Soils information for the project area was obtained from the USDA NRCS Soil Survey of Bucks County, Pennsylvania, and is presented in *Figure 3*. The majority of the soil area within the development area is classified as Urban Land (UfuB), with the remaining areas consisting of Udorthents, Gravelly (Ua), Delaware Loam (DaA), and Water (W). No soil limitations are listed for these soil types. The geologic formation for the project area is Qt – Trenton Gravel (Gravelly Sand).

Improvements

The *Phase 2 Development* proposed site improvements include: one (1) water tank, one (1) 1,318 S.F. pump house, one (1) 1,225 S.F. guard house, one (1) 8,000 S.F. refrigeration building, one (1) 10,020 S.F. administration building, one (1) 3,135 S.F. goods in building, one (1) 1,177,656 S.F. warehouse building and two (2) 1,035,696 S.F. warehouse buildings serviced by approximately 1,360 employees and managers. S. Port Road shall be re-aligned, Ben Fairless Drive shall be extended, and Drive A shall be constructed to connect these two roads as part of development and construction. Eight (8) proposed driveways will be installed for access to the site along Ben Fairless Drive and its extension, while three (3) proposed driveways will be installed for access to the site along re-aligned S. Port Road. Other improvements include: proposed asphalt parking areas, warehouse loading docks areas, concrete walkways, underground utilities, landscaping, lighting, and stormwater management facilities.

E&S Planning and Design

The following measures are taken to minimize the extent and duration of earth disturbance:

- Access the site thru designated construction entrance(s).
- Sequence construction activities by limiting disturbances to a specific task such that each task is completed before the next task is initiated.

The following measures are taken to maximize protection of existing drainage features and vegetation:

- Access the site thru designated construction entrance(s) and earthwork only allowed within the limits of disturbances.

The following measures are taken to minimize soil compaction:

- Access the site thru designated construction entrance(s).
- Earthwork only allowed within the limits of disturbance.
- Use of treaded machinery where practical during earthmoving operations

The following measures are taken to prevent or minimize generation of increased storm water runoff:

- Provide planted bio-retention basins
- Provide landscape restoration BMP (tree plantings)

Erosion & Sediment Control BMP Measures

There are several temporary and permanent measures that will be taken to prevent accelerated erosion and sedimentation due to construction activities. These measures have been designed in accordance with PADEP, Chapter 102: *Erosion and Sediment Pollution Control Program Manual* and include:

Waste Management - procedures and facilities to ensure that building materials and other construction site wastes are properly managed and disposed of to reduce potential for pollution to surface and groundwaters as per 25 PA Code §102.4(b)(5)(vi)

Dewatering Work Areas - controlled methods for the removal of sediment from water removed from the work area prior to its release to receiving waters.

Pumped Water Filter Bag - a geotextile fabric device used to filter water pumped during dewatering operations from disturbed area to well-vegetated (grassy), stable, erosion-resistant areas.

Concrete Washout - facility designed to store wash water from concrete delivery vehicles to allow removal without permitting wash water to be released to receiving waters.

Dust Control (Irrigation) - practices that help reduce surface air movement of dust from disturbed soil surfaces.

Rock Construction Entrance - a stone pad that shall be placed at the entrances of the proposed site where large vehicles enter or exit for construction activities. RCE must be at least 50 feet in length and the width of the proposed entrance.

Compost Filter Sock - a filter fabric fence used to control runoff from small disturbed areas when it is in the form of sheet flow.

Rock Filter Outlet - a stone sediment barrier used to address problems due unanticipated concentrated runoff to other types of sediment barriers.

Inlet Protection - silt sack device inserted into type 'm' and type 'c' inlets during construction activities to prevent sediment runoff downstream.

Erosion Control Blankets - erosion prevention fabric or approved equal that protects drainage swales, berms, and basin embankments from accelerated erosion during construction activities.

Rip-Rap Apron Outlet Protection - permanent erosion prevention feature containing energy-dissipating rock sized according to the proposed stormwater flow rate.

Maintenance

Erosion control measures in this plan shall be maintained in accordance with the Maintenance Program for E&S Control Facilities. Inspections shall occur weekly, or more frequently if stated in the Maintenance Program, and after each measurable runoff event of 0.25 inches over 24 hours. Inspections, repairs and bookkeeping shall be in accordance with the Monitoring, Inspection and Reporting Requirements.

Maintenance Program for E&S Control Facilities

1. Waste Management:

- Building materials and other construction site wastes must be properly managed and disposed of in accordance with the recycling or disposal of materials guidelines. under no circumstances shall erosion and sediment control BMPs be used for temporary storage of demolition materials or construction wastes.
- Wherever heavy equipment will be used during construction of the cuts and fills or proposed buildings, a Pollution Prevention Contingency (PPC) plan shall be available on site. the permittee shall be responsible for preparing and implementing a PPC plan when storing, using or transporting materials including: fuels, chemicals, solvents, pesticides, fertilizers, lime, petrochemicals, waste water, wash water, core drilling waste water, cement, sanitary wastes, solid wastes, or hazardous materials onto, on, or from the project site during earth disturbance activities. the PPC shall be available upon request by the department or conservation district.
- All applicable federal, state and local laws and regulations shall be followed in the use, handling and disposal of potentially hazardous materials.

2. Dewatering Work Areas:

- Whenever site conditions require dewatering, pumped water shall be treated for sediment removal prior to discharging to a surface water. water pumped from disturbed areas shall not be directed to the basin or any erosion and sediment control bmp not specifically designed for this purpose.

3. Pumped Water Filter Bag:

- Filter bags may be used to filter sediment from dewatering operations as needed.
- The maximum pumping rate for any bag in use or proposed for use shall be available at the site at all times during pumping operations.
- Pumping rate shall be no greater than 750 gpm or 1/2 the maximum specified by the manufacturer, whichever is less.
- Pump discharge hose shall be inserted in the manner specified by the manufacturer and securely clamped.
- A suitable means of accessing the bag with machinery required for disposal purposes shall be provided.
- Bags shall be placed on straps to facilitate removal unless bags come with lifting straps already attached.
- Pump intakes shall be floating and screened.
- Spare bags shall be kept available for replacement of those that have failed or are filled.
- Bags shall be located in well-vegetated (grassy) areas, and discharge onto stable, erosion resistant areas. where this is not possible, a geotextile underlayment and flow path shall be provided.
- Bags shall not be placed on slopes greater than 5%. for slopes exceeding 5%, clean rock or other non-erodible, non-polluting material shall be placed under the bag to reduce the slope steepness.
- Bags may be placed on filter stone to increase discharge capacity.
- Compost filter sock shall be installed downstream of bags if located within 50 feet of receiving surface water or where grassy area is not available.
- Filter bags shall be inspected daily. if any problem is detected, pumping shall cease immediately and not resume until the problem is corrected.

4. Concrete Washout:

- A suitable washout facility shall be provided for the cleaning of chutes, mixers and hoppers of concrete delivery vehicles. under no circumstances shall wash water from these vehicles be allowed to enter any surface waters
- Temporary signage shall be provided to direct drivers to the locations of these facilities.
- Concrete washout facilities shall not be placed within 50 feet of storm drains, open ditches or surface waters. wherever possible, they shall be located on slopes not exceeding a 2% grade.
- Concrete washout facilities shall be inspected daily. Damaged or leaking washouts shall be deactivated and repaired replaced immediately.
- accumulated materials shall be removed when they reach 75% capacity or sooner if recommended by the manufacturer.
- plastic liners shall be replaced with each cleaning of the facility.

5. Dust Control (Irrigation):

- The contractor shall have available water trucks to control excessive dust and airborne debris.
- Water shall normally be applied a minimum 3 times per day unless weather conditions warrant more or less applications.

6. Rock Construction Entrance:
 - Inspect weekly and after each runoff event
 - Maintain thickness to the specified dimensions by adding rock as needed. A stockpile of rock shall be maintained on site for this purpose.
 - All sediment deposited on paved roadways shall be removed and returned to the construction site immediately.
 - If extensive amounts of sediment are being deposited on roadway, extend length of rock construction entrance by 50 feet increments until condition is alleviated or install wash rack. Sediment deposits shall not be washed or swept into roadway ditches, sewers, culverts or other drainage courses.
7. Compost Filter Sock:
 - Compost filter socks shall be inspected and maintained on a weekly basis and after each runoff event.
 - Accumulated sediment shall be removed when it reaches half the above ground height of the sock.
 - Damaged socks shall be repaired according to manufacturer's specifications or replaced within 24 hours of inspection.
 - Compost filter socks shall be replaced after 1 year of operation.
8. Rock Filter Outlet:
 - Rock filter outlets shall only be utilized if a perimeter control fails due to unexpected concentrated flow.
 - A stockpile of stone shall be maintained on site for installing or repairing rock filter outlets as needed.
 - Inspect weekly and after each runoff event.
 - Accumulated sediment shall be removed when it reaches 1/3 height of outlet.
9. Inlet Protection:
 - Inlet filter bags shall be inspected on a weekly basis and after each runoff event.
 - Needed repairs shall be initiated immediately after inspection.
 - Filter bags shall be cleaned and/or replaced when the bag is half full or when flow capacity has been reduced so as to cause flooding or bypassing of the inlet.
 - A supply of filter bags shall be maintained on site for replacements.
10. Erosion Control Blankets:
 - Blanketed areas shall be inspected weekly and after each runoff event until perennial vegetation is established to a minimum uniform 70% coverage throughout the blanketed area.
 - Damaged or displaced blankets shall be restored or replaced within 4 calendar days.
11. Rip Rap Aprons:
 - Aprons shall be inspected weekly and after each runoff event.
 - Displaced rip rap within the apron shall be replaced immediately.

12. Until the site is stabilized, all erosion and sediment control devices must be maintained properly. Maintenance must include inspections of all erosion and sediment controls after each runoff event and on a weekly basis. All preventative and remedial maintenance work, including clean out, repair, replacement, regrading, reseeding, remulching, and renetting must be performed immediately. If E&S control BMPs fail to perform as expected, replacement BMPs or modifications of installed measures will be required.
13. All areas of concentrated surface drainage shall be seeded and mulched, and protected with temporary turf reinforcement mat: North American Green C350 (or equal). If areas are to be sodded, turf reinforcement is not required.
14. After the storm conveyance system is constructed, monthly inspections for each device shall be made. An inspection of all facilities will be made after every storm to determine their resistance to driving rains and accumulated runoff.
15. Seeded areas that have washed away shall be filled and graded as necessary and then reseeded. A burlap or straw cover will be applied to retain the seed until it has a chance to root properly.
16. The above procedure shall be repeated after each sizable storm until no more signs of erosion are evident. At monthly intervals thereafter, inspections and necessary cleaning shall be completed. Trash that is removed from any of the control devices shall be disposed of at an approved disposal area. Silt that has accumulated shall be removed and allowed to dry and used as fill wherever required on the site.
17. Immediately upon discovering unforeseen circumstances posing the potential for accelerated erosion and/or sediment pollution, the contractor shall implement appropriate measures to address said circumstances and to prevent damage to adjacent properties. Appropriate materials shall be kept on hand to address such emergency conditions. Contractor shall notify local conservation district and/or the regional office of DEP regarding said condition and measures used to address same.
18. Immediately after earth disturbance activity has ceased for a period of 4 days or more, all areas shall be stabilized. During non-germinating periods, mulch shall be applied at specified rates. Disturbed areas that are not at finished grade and which will be redisturbed within one year shall be stabilized with temporary vegetation. Areas which are at finished grade or which will not be redisturbed within one year shall receive permanent stabilization. (see seeding and mulching schedule for details)
19. Sediment removed from E&S BMPs shall be disposed of in landscape areas outside of steep slopes, wetlands, floodplains, or drainage swales, and immediately stabilized, or placed in topsoil stockpiles.
20. Contractor shall maintain and make available to the Bucks County Conservation District complete, written inspection logs of the above noted inspection and maintenance.

Monitoring, Inspection and Reporting Requirements:

Visual Inspections

The Permittee / Co-Permittee(s) must ensure that visual site inspections are conducted weekly, and within 24 hours after each measurable runoff event throughout the duration of construction and until the receipt and acknowledgement of the Notice of Termination by the Department or authorized conservation district. The visual site inspections and reports shall be completed in a format provided by the Department, and conducted by qualified personnel, trained and experienced in erosion and sediment control, to ascertain that E&S BMPs and PCSM BMPs are properly constructed and maintained to effectively minimize pollution to the waters of the Commonwealth. A written report of each inspection shall be kept and include at a minimum:

1. A summary of site conditions, E&S BMP and PCSM BMP implementation and maintenance, and compliance actions; and
2. The date, time, name, and signature of the person conducting the inspection.

Noncompliance Reporting

Where E&S, PCSM or PPC BMPs are found to be inoperative or ineffective during an inspection, or any other time, the Permittee / Co-Permittee(s) shall, within 24 hours, contact the Department or authorized conservation district, by phone or personal contact, followed by the submission of a written report within 5 days of the initial contact. Noncompliance reports shall include the following information:

1. Any condition on the project site which may endanger public health, safety, or the environment, or involve incidents which cause or threaten pollution;
2. The period of noncompliance, including exact dates and times and/or anticipated time when the activity will return to compliance;
3. Steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance; and
4. The date or schedule of dates, and identifying remedies for correcting noncompliance conditions.

Reduction, Loss, or Failure of the BMPs

Upon reduction, loss, or failure of the BMPs, the Permittee / Co-Permittee shall take immediate action to restore the BMPs or provide an alternative method of treatment. Such restored BMPs or alternative treatment shall be at least as effective as the original BMPs.

Termination of Coverage

Note: upon permanent stabilization of earth disturbance activities associated with construction activities that are authorized by this permit and when BMPs identified in the PCSM plan have been properly installed, the Permittee and/or Co-Permittee of the facility must submit a Notice of Termination (N.O.T.) Form that is signed in accordance with Part B, section 1.C, signatory requirements, of the permit. All letters certifying discharge termination are to be sent to the Department or authorized conservation district. The N.O.T. Must contain the following information: facility name, address, and location, operator name and address, permit number, identification and proof of acknowledgment from the person(s) who will be responsible for operation and maintenance of the PCSM BMPs in accordance with the approved PCSM Plan, and the reason for permit termination. Until the Permittee has received written acknowledgement of the N.O.T., the Permittee will remain responsible for operating and maintaining all E&S BMPs and PCSM BMPs on the project site and will be responsible for violations occurring on the project site.

Completion Certificate and Final Plans

Within 30 days after the completion of earth disturbance activities authorized by this permit, including the permanent stabilization of the site and proper installation of PCSM BMPs in accordance with the approved PCSM Plan, or upon submission of the N.O.T. If sooner, the Permittee shall file with the Department or authorized conservation district a statement signed by a licensed professional and by the Permittee certifying that work has been performed in accordance with the terms and conditions of the permit and the approved E&S and PCSM plans.

Erosion and Sediment Control Notes

General Erosion and Sediment Control Notes:

1. General site clearing, grubbing, and topsoil stripping shall not commence in any stage or phase of the project until the E&S measures specified in the sequence for that stage/phase have been installed and are functioning as intended.
2. Local roads are to remain free of sediment and construction vehicles and equipment.
3. Upon completion of an earth disturbance activity or any stage or phase of an activity, the site shall be immediately seeded, mulched, or otherwise protected from accelerated erosion and sedimentation as per seeding and mulching schedule.
4. Compost filter sock may be removed when the site is permanently stabilized. accumulated sediment may be spread at the site in areas not subject to erosion.
5. Before initiating any revisions to the approved erosion and sediment control plan, or revisions to other plans which may affect the effectiveness of the approved E&S control plan, the contractor shall receive approval of the revisions from the Bucks County Conservation District.
6. The contractor is advised to become familiar with the provisions of Appendix 64, 'Erosion Control Rules and Regulations,' Title 25, Part 1, Dept. of Environmental Protection, Subpart C-Protection of Natural Resources, Article III-Water Resources, Chapter 102-Erosion Control and with the "Erosion and Sediment Pollution Control Program Manual" by the Commonwealth of PA., Department of Environmental Protection, March 2012 or latest edition.
7. Technical advice for the implementation of this program may be obtained by contacting the Bucks County Conservation District at (215) 345-7577.
8. The following are additional E&S notes:
 - a. Existing trees and other existing vegetation will be disrupted as little as possible.
 - b. Grade all cut and fill slopes to 3 foot horizontal for every 1 foot vertical or flatter, and apply seeding and mulch. Areas with grades greater than 3:1 shall receive steep slope seed mix and permanent turf reinforcement mat: North American Green #C350 or equal.
 - c. Rip-rap will be applied to all areas where heavy concentrations of drainage are prevalent (greater than 3.5 cfs). This would be at culvert outlets, where water is in transition from an open channel into a culvert, or as specified.
 - d. Significant stands of trees, designated to remain, will be protected with fencing, see detail. install along the drip line of the tree branches.
 - e. Erosion control facilities must discharge into adequate storm sewers, natural waterways, or stable erosion-resistant areas.

- f. Concrete washout area shall be provided for cleaning of chutes, mixers, and hoppers of delivery vehicles. No wash water from these vehicles shall be allowed to enter any surface waters. Washout facilities shall not be located within 50 feet of storm drains, open ditches, infiltration facilities or surface waters.
- g. Any sediment or mud that is tracked onto the public roadway must be cleaned off immediately by brooming and/or shoveling to the satisfaction of the Township at the expense of the developer and/or responsible contractor. Use of a backhoe bucket to scrape roadway surface is prohibited. Where sand and/or sediment is causing slick or hazardous conditions, roadway surface shall be pressure washed to remove the condition. All sediment-laden water must be filtered in a manner satisfactory to the Bucks County Conservation District before entering storm sewers and/or drainage channels.
- h. No sediment or sediment-laden water must be allowed to leave the site/property without first being filtered to the satisfaction of Bucks County Conservation District. Any inlets which do not direct flow to a sediment basin must be protected with stone filter inlet protection.
- i. Absolutely no earthmoving, placement of fill material, or the entry of sediment-laden water must take place in wetlands. all wetlands shall be protected from encroachment with fencing.
- j. Rock filter outlets must be provided immediately where silt/super silt fencing has been undermined or overtopped.
- k. The sediment and erosion control measures shown on this plan have been prepared in accordance with requirements of the Bucks County Conservation District. Gilmore and Associates does not take any responsibility in observing and certifying the construction of these facilities unless requested specifically by the owner and/or contractor. Therefore, Gilmore and Associates does not accept any responsibility for damages as a result of improper construction and/or maintenance of facilities during construction.
- l. Accumulated sediments removed from any and all erosion and sediment control measures shall be disposed of in landscaped areas outside of steep slopes, wetlands, floodplains or drainage swales. Immediately stabilize replaced soils with seed & mulch or deposit in soil stockpiles and stabilize.
- m. The contractor shall remove from the site, recycle or dispose of all building material and wastes in accordance with DEP's solid waste management regulations, and/or any additional local, state or federal regulations. No building materials (used or unused) or waste materials shall be burned, buried, dumped or discharged at the site.

Bucks County Conservation District E&S Standard Notes

1. Stockpile heights must not exceed 35 feet; stockpile slopes must not exceed 2:1.
2. The Operator/Responsible Person (O/RP) on site shall assure that the approved Erosion and Sediment Control Plan is properly and completely implemented.
3. Immediately upon discovering unforeseen circumstances posing the potential for accelerated erosion and/or sediment pollution, the O/RP shall implement appropriate best management practices (BMPs) to eliminate the potential for accelerated erosion and/or sediment pollution.
4. The O/RP shall assure that an Erosion and Sediment Control Plan has been prepared and approved by the Bucks County Conservation District and is being implemented and maintained for all soils and/or rock spoil and borrow areas regardless of their locations.

5. All pumping of sediment-laden water shall be through a sediment control BMP such as a pumped water filter bag discharging over an undisturbed area.
6. A copy of the approved Erosion and Sediment Control Plan must be available on the project site at all times.
7. Erosion and sediment BMPs must be constructed, stabilized and functional before site disturbance begins within the tributary areas of those BMPs.
8. After final site stabilization has been achieved, temporary erosion and sediment BMP controls must be removed. Areas disturbed during the removal of the BMPs must be stabilized immediately.
9. At least seven (7) days before starting any earth disturbance activity, the O/RP shall invite all contractors involved in that activity, the landowner, all appropriate municipal officials, the Erosion and Sediment Control Plan designer and the Bucks County Conservation District to a pre-construction meeting. Also, at least three days before starting any earth disturbance activity, all contractors involved in that activity shall notify the Pennsylvania One-Call System Inc. At 1-800-242- 1776 to determine any underground utilities locations.
10. Immediately after earth disturbance activity ceases, the O/RP shall stabilize any areas disturbed by the activity. During non-germinating periods, mulch must be applied at specified rates. Disturbed areas that are not finished grade and which will be re-disturbed within one year must be stabilized in accordance with temporary vegetative stabilization specifications.
11. Disturbed areas that are at a finished grade or which will not be re-disturbed within one year must be stabilized in accordance with permanent vegetative stabilization specifications.
12. An area shall be considered to have achieved final stabilization when it has a minimum uniform 70% vegetative or other permanent non-vegetative cover with a density sufficient to resist accelerated surface erosion and subsurface characteristics sufficient to resist sliding and other movements.
13. Upon the installation of temporary sediment basin riser(s), a qualified site representative shall conduct an immediate inspection of the riser(s), whereupon the Bucks County Conservation District shall be notified in writing that the riser is sealed (watertight).
14. At stream crossings, a 50-foot buffer shall be maintained. On buffers, clearings, sod disturbances and excavations, equipment traffic should be minimized. Activity such as stacking logs, burning cleared brush, discharged rainwater from trenches, welding pipe sections, refueling and maintaining equipment should be avoided within buffer zones.
15. Until a site is stabilized, all erosion and sediment BMPs must be maintained properly. Maintenance must include inspections of all erosion control BMPs after each runoff event and on a weekly basis. All preventative and remedial maintenance work, including cleanout, repair, replacement, re-grading, re-seeding, re-mulching and re-netting must be performed immediately. If erosion and sediment control BMPs fail to perform as expected, replacement BMPs, or modifications of those installed, will be required.
16. Sediment removed from BMPs shall be disposed of on-site in landscaped areas outside of steep slopes, wetlands, floodplains or drainage swales and immediately stabilized or placed in soil stockpiles and stabilized.
17. All building material and wastes must be removed from the site and recycled in accordance with DEP's Solid Waste Regulations (25 PA Code 260.1 et seq., 271.1 et seq., and 287.1 et seq.) and/or any additional local, state or federal regulations. No building materials (used or unused) or waste materials shall be burned, buried, dumped, or discharged at the site.

Geologic Formations or Soil Conditions

The known geologic formation Qt – Trenton Gravel Formation, has no known potential to cause pollution during earth disturbance activities. If any potential for pollution is identified, immediately connect the Falls Township Engineer and the Bucks County Conservation District to avoid, minimize, or mitigate any pollution.

Clean Fill Requirements

A site-specific soil reuse plan has been developed for the Keystone Industrial Port Complex which includes the subject parcel. Refer to the report entitled "Onsite Soil Reuse Plan - Former U. S. Steel Fairless Works - Keystone Industrial Port Complex - Fairless Hills, Pennsylvania", prepared by Langan Engineering & Environmental Services, for U. S. Steel Real Estate Group, dated July 15, 2008. All fill originating from the Keystone Industrial Port Complex shall meet the criteria of this soil reuse plan. Should fill material need to be imported from outside the Keystone Industrial Port Complex, it shall meet the criteria of clean fill as defined by the PADEP. The responsibility for performing environmental due diligence and determination of clean fill will rest with the contractor.

Clean fill is defined as: uncontaminated, non-water soluble, non-decomposable, inert, solid material. The term includes soil, rock, stone, dredged material, used asphalt, and brick, block or concrete from construction and demolition activities that is separate from other waste and is recognizable as such. The term does not include materials placed in or on the waters of the commonwealth unless otherwise authorized. (the term "used asphalt" does not include milled asphalt or asphalt that has been processed for re-use).

Clean fill affected by a spill or release of a regulated substance: fill materials affected by a spill or release of a regulated substance still qualifies as clean fill provided the testing reveals that the fill material contains concentrations of regulated substances that are below the residential limits as noted in tables FP-1A and FP-1B found in the Pennsylvania Department of Environmental Protection's policy "Management of Fill."

Any person placing clean fill that has been affected by a spill or release of a regulated substance must use form FP-001 to certify the origin of the fill material and the results of the analytical testing to qualify the material as clean fill. Form FP-001 must be retained by the owner of the property receiving the fill.

Environmental due diligence: The landowner/applicant must perform environmental due diligence to determine if the fill materials associated with the project qualify as clean fill. Environmental due diligence is defined as investigative techniques, including, but not limited to, visual property inspections, electronic data base searches, review of property ownership, review of property use history, Sanborn maps, environmental questionnaires, transaction screens, analytical testing, environmental assessments or audits. Analytical testing is not a required part of due diligence unless visual inspection and/or review of the past land use of the property indicates that the fill may have been subjected to a spill or release of regulated substance. If the fill may have been affected by a spill or release of a regulated substance, it must be tested to determine if it qualifies as clean fill. Testing should be performed in accordance with Appendix A of the Pennsylvania Department of Environmental Protection's policy "Management of Fill."

Fill material that does not qualify as clean fill is regulated fill. Regulated fill is waste and must be managed in accordance with the Pennsylvania Department of Environmental Protection's municipal or residual waste regulations based on 25 Pa. Code Chapter 287 Residual Waste Management or Chapter 271 Municipal Waste Management, whichever is applicable. These regulations are available on-line at www.pacode.com.

Recycling or Disposal of Materials

1. The operator shall remove from the site, recycle, or dispose of all building materials and waste in accordance with the Department's Solid Waste Management regulations at 25 Pa. Code 260.1 et seq., 271.1 et seq., and 287.1 et seq. The contractor shall not illegally bury, dump, or discharge any building material or wastes at the site.
2. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain on the property, demolished or excavated materials shall be removed from the site. Materials slated for removal from the site shall be disposed of in accordance with any and all applicable municipal or other governmental agency current regulations. Debris shall not be permitted to accumulate on the job-site. Dust and dirt shall be held to a minimum during demolition, by wetting down, as required. On site burning of materials will not be permitted. At the completion of work, the entire area involved will be clean and left in a neat condition, free of rubbish. Recycling or disposal of materials associated with or from this project site shall be undertaken in accordance with Pennsylvania Department of Environmental Protection rules and regulations.
3. Sediment removed from control facilities as a part of regular maintenance shall be disposed of upslope of the control facility.

Seeding & Mulching Schedule

1. Site preparation, stabilization and maintenance shall be performed in accordance with Penn State University's "The Agronomy Guide" and PennDOT Form 408 Specifications' most recent addition.

Temporary Seeding Specification Formula E - Annual Rye Grass

Permanent Seeding Specification Formula B -

50% Kentucky Bluegrass mixture

30% Pennlawn Red Fescue

20% Perennial Ryegrass mixture

Steep Slope Seeding Specification Formula W -

70% Tall Fescue

20% Birdsfoot Trefoil mixture

10% Redtop

Seeding rate for the above mixtures:

10 lbs/1,000 sy for Temporary Seeding

21 lbs/1,000 sy for Permanent Seeding

11 lbs/1,000 sy for Steep Slope Seeding (see note 5)

2. Hay or straw mulch shall be applied at the rates of at least 3.0 tons per acre. Straw mulch shall be applied in long strands, not chopped or finely broken. Slopes of 3:1 shall be anchored with mulch control netting.
3. Pulverized agricultural limestone and commercial fertilizer shall be applied to all disturbed areas which are to be seeded except for temporary seed areas are the following rates:
Pulverized agricultural limestone - 90 lbs/1,000 sf
10-20-20 analysis comm. fertilizer - 20 lbs/1,000 sf
Note: Application of lime and fertilizer for temporary seeding is unnecessary and only serves to contribute to an overabundance of nutrient pollution in the watershed.
4. Permanent seeding shall take place from march 15 to June 1 or from August 1 to October 15. If completed at in other seasons, areas shall receive temporary seeding and 3.0 tons per acre mulch.
5. Steep slope areas, considered slopes greater than 3:1, shall be protected from erosion by one of the following methods. Manufacturer's recommendations shall be followed for particular method and specific site conditions.

Flexible Growth Medium: Shall be hydraulically applied combination of seed, mulch, and erosion protection material similar to "Flexterra" by ACF or equal by other manufacturer.

Erosion Control Matting: Shall be temporary matting similar to C350 by North American Green or equal by other manufacturer.

Potential Thermal Impacts

All runoff from impervious areas is directed to the bio-retention basins designed to contain the volume generated by the 1.2-in/2-hr storm and release this volume slowly over several days in a manner that replicates native infiltration and promotes evapotranspiration. Thermal impacts from the impervious surfaces within this site will be mitigated through these processes.

Existing/Proposed Riparian Forest Buffers

There are no areas of High Quality (HQ) or Exceptional Value (EV) watersheds on the property site, nor does any area of the property flow to an HQ or EV watershed. Therefore, riparian buffer, riparian forest buffer, or equivalency demonstration are not required nor applicable as part of this project.

Antidegradation Analysis

There are no areas of High Quality (HQ) or Exceptional Value (EV) watersheds on the property site, nor does any area of the property flow to an HQ or EV watershed. Therefore, antidegradation analysis is not applicable to this project.

E&S and PCSM Plan Consistency

The Erosion and Sediment Control Plan and the Post Construction Stormwater Management Plan have been provided separately; however, they have been planned, designed, and implemented to be consistent with one another. The Post Construction Stormwater Management Plan is provided as part of the PCSM report and the Erosion and Sediment Control Plan has been provided as part of a separate E&S Control report.

Sequence of Construction

SEQUENCE OF CONSTRUCTION (SITE-WIDE):

ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING SEQUENCE. EACH STAGE SHALL BE COMPLETED BEFORE ANY FOLLOWING STAGE IS INITIATED, UNLESS NOTED OTHERWISE. CLEARING AND GRUBBING SHALL BE LIMITED ONLY TO THOSE AREAS DESCRIBED IN EACH STAGE. NOTE: CESSATION OF CONSTRUCTION ACTIVITIES FOR 4 DAYS OR LONGER REQUIRES TEMPORARY STABILIZATION.

AT LEAST 7 DAYS PRIOR TO START OF WORK OR EARTH DISTURBANCE ACTIVITIES, A PRE-CONSTRUCTION MEETING SHALL BE HELD INCLUDING THE OWNER, SITE CONTRACTOR, TOWNSHIP ENGINEER, BUCKS COUNTY CONSERVATION DISTRICT, AND A LICENSED PROFESSIONAL.

AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

SITE IS CONTAMINATED AND THE WORK PERFORMED ON CONTAMINATED AREAS WAS AUTHORIZED OR WILL BE AUTHORIZED UNDER THE PADEP ACT 2-LAND RECYCLING PROGRAM. THE SITE CONTAINS REGULATED SOILS. FINAL REPORTS FOR SOIL CLEANUP HAVE BEEN APPROVED FOR LOTS 5, 6, 7, 11, 17, 19, 26, G, AND H. FUTURE EARTH DISTURBANCES WILL BE GUIDED BY THE MATERIAL MANAGEMENT PLAN PREPARED BY LANGAN ENGINEERING, DATED FEBRUARY 24, 2021, REVISED NOVEMBER 22, 2022. SOILS WILL BE MANAGED CONSISTENT WITH THAT PLAN IN A MANNER TO ENSURE THAT DUE CARE IS TAKEN TO NOT INADVERTENTLY CHANGE OR ALTER EXPOSURE PATTERNS UPON WHICH ANY ACT 2 REMEDIATION WAS BASED.

WORK PERFORMED ON CONTAMINATED AREAS WAS AUTHORIZED OR WILL BE AUTHORIZED UNDER THE PADEP ACT 2-LAND RECYCLING PROGRAM WITH APPROVED FINAL REPORTS DEMONSTRATING ATTAINMENT OF ACT 2 STANDARDS. ANY FUTURE WORK OR DISTURBANCE TO THIS AREA SHOULD BE APPROVED BY THE SAME PROGRAM PRIOR TO COMMENCING.

CONTRACTOR TO REFERENCE THE E&S NOTES FOR REGULATED SOILS ON E&S SHEET 65.

A MINIMUM OF OSHA LEVEL D PERSONAL PROTECTIVE EQUIPMENT (PPE) SHALL BE REQUIRED FOR ALL WORKERS OR SITE PERSONNEL WITH THE POTENTIAL TO COME IN CONTACT WITH SITE SOILS AND/OR GROUNDWATER.

CONTRACTORS INVOLVED WITH MATERIAL HANDLING SHALL PREPARE A SITE-SPECIFIC HEALTH AND SAFETY PLAN, IN ACCORDANCE WITH THE MATERIAL MANAGEMENT PLAN, AND COMPLY WITH OSHA AND OTHER RELEVANT AND APPLICABLE RULES, REGULATIONS AND REQUIREMENTS FOR CONSTRUCTION WORKER PROTECTION AND SAFE WORK PRACTICES.

NOTE: CONTRACTOR(S) TO REFER TO 'SEQUENCE OF CONSTRUCTION (MAJOR AMENDMENT NO. 2)' ON THIS SHEET FOR RELEVANT SEQUENCE STEPS FOR INSTALLATION OF E&S AND PCSM ITEMS PERTAINING TO MAJOR AMENDMENT NO. 2.

1. INSTALL ROCK CONSTRUCTION ENTRANCES AND TREE PROTECTION FENCING WHERE INDICATED ON THE PLANS.
2. STAKE OUT LIMIT OF DISTURBANCE AS SHOWN ON THE PLANS. INSTALL COMPOST FILTER SOCK AS SHOWN ON THE PLANS.
 - A. EXISTING VEGETATION SHALL BE CUT TO GROUND AS NECESSARY PRIOR TO INSTALLATION OF COMPOST FILTER SOCK TO ENSURE CONTACT WITH EARTH. LOOSE COMPOST OR EARTHEN MATERIAL SHALL BE BLOWN OR PLACED INTO UPSTREAM SIDE TO MINIMIZE UNDERMINING.
3. REMOVE EXISTING UTILITIES AND OTHER IMPROVEMENTS AND CLEAR AND GRUB REMAINDER OF THE CONSTRUCTION AREA AS DELINEATED ON THE PLAN. CONTRACTOR(S) TO NOTIFY UTILITY COMPANIES AND NORTHPOINT THREE (3) DAYS PRIOR TO ANY UTILITY OR EXCAVATION WORK. ALL UTILITY REMOVAL OR ALTERATION SHALL BE REVIEWED AND APPROVED BY NORTHPOINT OR THEIR REPRESENTATIVE. THE SUBGRADE SHALL BE RESTORED TO A STABLE CONDITION AS STATED IN THE GEOTECHNICAL REPORT REGARDING UTILITY REMOVALS.
4. STRIP AND STOCKPILE TOPSOIL WHERE INDICATED ON THE PLANS.
5. ROUGH GRADE SITE. EXCAVATE ALL DRY EXTENDED DETENTION BASINS, BIO-RETENTION BASINS, AND WET POND/RETENTION BASINS, AND INSTALL TEMPORARY SEDIMENT BASINS. INSTALL OUTLET STRUCTURES, OUTLET PIPES, EMBANKMENTS, SPILLWAYS, AND ALL TEMPORARY SEDIMENT BASIN STRUCTURES. INSTALL ORANGE CONSTRUCTION FENCE AROUND SEDIMENT BASINS WHERE SHOWN ON THE PLANS TO PREVENT COMPACTION DURING CONSTRUCTION ACTIVITIES. IMMEDIATELY STABILIZE SEDIMENT BASINS WITH SEED AND MULCH.
6. BEGIN INSTALLATION OF PROPOSED WAREHOUSE BUILDINGS FOUNDATIONS.
7. BEGIN INSTALLATION AS PROPOSED FOR BEN FAIRLESS DRIVE AND RELOCATED SOUTH PORT ROAD.
8. INSTALL STORM SEWER AND STRUCTURES IN A DOWNSTREAM-TO-UPSTREAM MANNER FOR ALL BUILDINGS. INSTALL INLET PROTECTION ON INLETS AS THEY ARE INSTALLED IN THIS STAGE. INSTALL REMAINDER OF UTILITIES UP TO THE CONNECTION POINT WITH THE PROPOSED WAREHOUSE BUILDINGS.
9. INSTALL 6" CRUSHED CONCRETE (OR EQUIVALENT) TO SUBGRADE ELEVATION ACROSS THE BUILDING PADS AND 12" CRUSHED CONCRETE (OR EQUIVALENT) TO SUBGRADE ELEVATION FOR BUILDING PADS ACCESS AND STAGING AS SHOWN ON THE PLANS TO PREVENT ACCELERATED EROSION ON-SITE.
10. BEGIN INSTALLATION OF PROPOSED BUILDINGS ABOVE FOUNDATION.
11. CONNECT WATER, SANITARY, AND ALL OTHER PROPOSED UTILITIES TO BUILDINGS, AND CONNECT TO EXISTING INFRASTRUCTURE. INSTALL ROOF LEADERS AND CONNECT TO PROPOSED CANAL ON-SITE.
12. FINAL GRADE THE PAVEMENT AREAS INCLUDING BEN FAIRLESS DRIVE AND SOUTH PORT ROAD, LOADING DOCK, INSTALL CURBS AND SIDEWALKS WHERE SHOWN, AND STONE AND BINDER COURSES.
13. CRITICAL STAGE: CONVERT SEDIMENT BASINS TO FINAL GRADE DRY EXTENDED DETENTION BASINS, BIO-RETENTION BASINS, AND WET POND/RETENTION BASINS. REMOVE SEDIMENT AND EXCAVATE TO FINISHED BOTTOM OF BASIN ELEVATIONS. INSTALL UNDERDRAINS AND AMENDED SOILS AS DESIGNED IN THE BMP BASINS. ADD SOIL MIXTURE PER DETAIL AND SPECIFICATIONS. INSTALL ORANGE CONSTRUCTION FENCE AROUND THE BASINS WHERE SHOWN ON THE PLANS TO PREVENT COMPACTION DURING CONSTRUCTION ACTIVITIES. A LICENSED PROFESSIONAL OR DESIGNER SHALL BE PRESENT ON THE PROJECT SITE DURING INSTALLATION OF THESE BMPs.
14. CONTRACTOR SHALL CONTACT THE BUCKS COUNTY CONSERVATION DISTRICT (BCCD) THREE (3) DAYS PRIOR TO FINAL STORMWATER BASIN STABILIZATION FOR THE PURPOSES OF INSPECTION OF SAID STABILIZATION.
15. CRITICAL STAGE: INSTALL PROPOSED SOIL AMENDMENTS AND LANDSCAPE RESTORATION (TREES) AS SHOWN ON THE PLANS. CARE SHALL BE TAKEN NOT TO COMPACT THE AREAS WHERE SOIL AMENDMENTS ARE INSTALLED. A LICENSED PROFESSIONAL OR DESIGNER SHALL BE PRESENT ON THE PROJECT SITE DURING INSTALLATION OF THESE BMPs.
16. AS LAWN AREAS ARE BROUGHT TO GRADE, THEY SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 5-12" THEN PROVIDED WITH A MINIMUM 8" OF TOPSOIL AND SEEDS IMMEDIATELY. ALL VEGETATED AREAS SHALL BE STABILIZED WITH VEGETATION AND MULCH AS SOON AS POSSIBLE.
 - A. ALL 3:1 SLOPES OF MORE THAN 6' VERTICAL HEIGHT SHALL BE PROVIDED WITH EROSION CONTROL MATTING IN ACCORDANCE WITH PLANS AND DETAIL 'N.A.G. SLOPE INSTALLATION'.
 - B. ALL SWALES AND AREAS OF CONCENTRATED DISCHARGE SHALL BE PROVIDED WITH EROSION CONTROL MATTING IN ACCORDANCE WITH PLANS AND DETAIL 'N.A.G. SWALE INSTALLATION'.
17. FINE GRADE SITE, SPREAD TOPSOIL WHERE APPROPRIATE, AND STABILIZE IMMEDIATELY.
18. CRITICAL STAGE: INSTALL WATER QUALITY FILTER INSERTS ON PROPOSED INLETS AS SHOWN ON THE PLANS. A LICENSED PROFESSIONAL OR DESIGNER SHALL BE PRESENT ON THE PROJECT SITE DURING INSTALLATION OF THESE BMPs.
19. AFTER THE SITE HAS BEEN STABILIZED WITH THE APPROVAL OF THE CONSERVATION DISTRICT, ALL TEMPORARY E&S CONTROLS SHALL BE REMOVED.
20. ALL ACCUMULATED SEDIMENTS SHALL BE DISPOSED OF IN APPROVED UPLAND AREAS.
21. STABILIZATION SHALL BE CONSIDERED THE PLACEMENT OF BASE COURSE IN PAVED AREAS OR BY 75% OR MORE VEGETATION, UNIFORM COVERAGE, IN LAWN AREAS OR BY OTHER PERMANENT MEANS WITH A DENSITY SUFFICIENT TO RESIST ACCELERATED SURFACE EROSION AND SUBSURFACE CHARACTERISTICS SUFFICIENT TO RESIST SLIDING AND OTHER MOVEMENTS.
22. AFTER COMPLETING ALL PUNCHLIST ITEMS TO THE SATISFACTION OF THE TOWNSHIP ENGINEER, INSTALL WEARING COURSE, STRIPING, ADA CURB RAMPS, AND SIGNAGE.
23. SUBMIT THE NOTICE OF TERMINATION (N.O.T.) ALONG WITH SIGNED RECORD DOCUMENT AS REQUIRED TO CLOSE OUT THE NPDES PERMIT.

SEQUENCE OF CONSTRUCTION (MAJOR AMENDMENT NO. 3):

ALL EARTH DISTURBANCE ACTIVITIES SHALL PROCEED IN ACCORDANCE WITH THE FOLLOWING SEQUENCE. EACH STAGE SHALL BE COMPLETED BEFORE ANY FOLLOWING STAGE IS INITIATED, UNLESS NOTED OTHERWISE. CLEARING AND GRUBBING SHALL BE LIMITED ONLY TO THOSE AREAS DESCRIBED IN EACH STAGE. NOTE: CESSATION OF CONSTRUCTION ACTIVITIES FOR 4 DAYS OR LONGER REQUIRES TEMPORARY STABILIZATION.

AT LEAST 7 DAYS PRIOR TO START OF WORK OR EARTH DISTURBANCE ACTIVITIES, A PRE-CONSTRUCTION MEETING SHALL BE HELD INCLUDING THE OWNER, SITE CONTRACTOR, TOWNSHIP ENGINEER, BUCKS COUNTY CONSERVATION DISTRICT, AND A LICENSED PROFESSIONAL.

AT LEAST 3 DAYS PRIOR TO STARTING ANY EARTH DISTURBANCE ACTIVITIES, OR EXPANDING INTO AN AREA PREVIOUSLY UNMARKED, THE PENNSYLVANIA ONE CALL SYSTEM INC. SHALL BE NOTIFIED AT 1-800-242-1776 FOR THE LOCATION OF EXISTING UNDERGROUND UTILITIES.

SITE IS CONTAMINATED AND THE WORK PERFORMED ON CONTAMINATED AREAS WAS AUTHORIZED OR WILL BE AUTHORIZED UNDER THE PADEP ACT 2-LAND RECYCLING PROGRAM. THE SITE CONTAINS REGULATED SOILS. FINAL REPORTS FOR SOIL CLEANUP HAVE BEEN APPROVED FOR LOTS 5, 6, 7, 11, 17, 19, 26, G, AND H. FUTURE EARTH DISTURBANCES WILL BE GUIDED BY THE MATERIAL MANAGEMENT PLAN PREPARED BY LANGAN ENGINEERING, DATED FEBRUARY 24, 2021, REVISED NOVEMBER 22, 2022. SOILS WILL BE MANAGED CONSISTENT WITH THAT PLAN IN A MANNER TO ENSURE THAT DUE CARE IS TAKEN TO NOT INADVERTENTLY CHANGE OR ALTER EXPOSURE PATTERNS UPON WHICH ANY ACT 2 REMEDIATION WAS BASED.

WORK PERFORMED ON CONTAMINATED AREAS WAS AUTHORIZED OR WILL BE AUTHORIZED UNDER THE PADEP ACT 2 LAND RECYCLING PROGRAM WITH APPROVED FINAL REPORTS DEMONSTRATING ATTAINMENT OF ACT 2 STANDARDS. ANY FUTURE WORK OR DISTURBANCE TO THIS AREA SHOULD BE APPROVED BY THE SAME PROGRAM PRIOR TO COMMENCING.

CONTRACTOR TO REFERENCE THE E&S NOTES FOR REGULATED SOILS ON E&S SHEET 65.

A MINIMUM OF OSHA LEVEL D PERSONAL PROTECTIVE EQUIPMENT (PPE) SHALL BE REQUIRED FOR ALL WORKERS OR SITE PERSONNEL WITH THE POTENTIAL TO COME IN CONTACT WITH SITE SOILS AND/OR GROUNDWATER.

CONTRACTORS INVOLVED WITH MATERIAL HANDLING SHALL PREPARE A SITE-SPECIFIC HEALTH AND SAFETY PLAN, IN ACCORDANCE WITH THE MATERIAL MANAGEMENT PLAN, AND COMPLIES WITH OSHA AND OTHER RELEVANT AND APPLICABLE RULES, REGULATIONS AND REQUIREMENTS FOR CONSTRUCTION WORKER PROTECTION AND SAFE WORK PRACTICES.

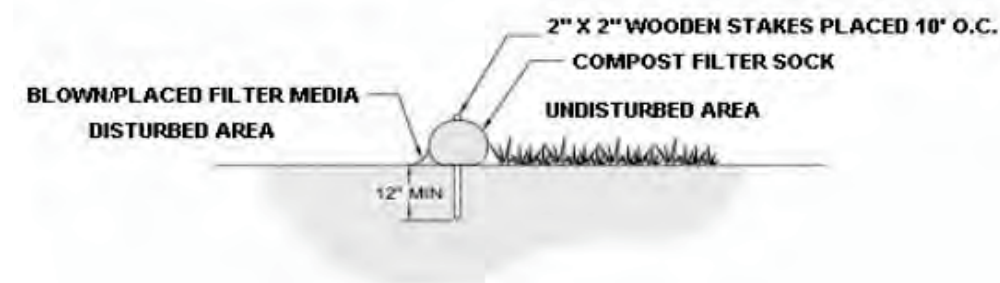
1. ALL E&S BMPs NOT ASSOCIATED WITH THE WORK IN THIS SEQUENCE SHALL REMAIN IN PLACE AND PROPER FUNCTIONALITY.
2. INSTALL ROCK CONSTRUCTION ENTRANCE AND TREE PROTECTION FENCE IN THIS NEW AREA AS SHOWN ON THE PLANS.
3. STAKE OUT UPDATED LIMIT OF DISTURBANCE AS SHOWN ON THE PLANS. INSTALL COMPOST FILTER SOCK AS SHOWN ON THE PLANS.
 - A. EXISTING VEGETATION SHALL BE CUT TO GROUND AS NECESSARY PRIOR TO INSTALLATION OF COMPOST FILTER SOCK TO ENSURE CONTACT WITH EARTH. LOOSE COMPOST OR EARTHEN MATERIAL SHALL BE BLOWN OR PLACED INTO UPSTREAM SIDE TO MINIMIZE UNDERMINING.
4. REMOVE EXISTING UTILITIES AND OTHER IMPROVEMENTS AND CLEAR AND GRUB REMAINDER OF THE THIS AREA AS DELINEATED ON THE PLAN. **CONTRACTOR(S) TO NOTIFY UTILITY COMPANIES AND NORTHPOINT THREE (3) DAYS PRIOR TO ANY UTILITY OR EXCAVATION WORK. ALL UTILITY REMOVAL OR ALTERATION SHALL BE REVIEWED AND APPROVED BY NORTHPOINT OR THEIR REPRESENTATIVE. THE SUBGRADE SHALL BE RESTORED TO A STABLE CONDITION AS STATED IN THE GEOTECHNICAL REPORT REGARDING UTILITY REMOVALS.**
 - A. INSTALL PROPOSED FIRE LOOP AS INDICATED ON PLANS. EXISTING FIRE LOOP TO REMAIN ACTIVE.
 - B. RELOCATE EXISTING FIRE HYDRANTS FROM EXISTING FIRE LOOP TO PROPOSED FIRE LOOP.
 - C. REMOVE EXISTING STORM, EXISTING ROOF LEADER STORM SYSTEMS, AND SANITARY STRUCTURES AS INDICATED ON THE PLANS. EXISTING FIRE LOOP TO BE ABANDONED IN PLACE.
5. BEGIN BUILDING 6 RENOVATIONS.
6. REMOVE EXISTING CONCRETE, ASPHALT, SIDEWALKS, AND UTILITIES AS INDICATED ON PLANS.
7. STRIP AND STOCKPILE TOPSOIL WHERE INDICATED ON THE PLANS.
8. ROUGH GRADE DRIVE AISLES AND PARKING AREAS. EXCAVATE BASINS AS NEEDED. INSTALL TEMPORARY SEDIMENT BASINS INSTALL OUTLET STRUCTURES, OUTLET PIPES, EMBANKMENTS, SPILLWAYS, AND ALL TEMPORARY SEDIMENT BASIN STRUCTURES. INSTALL ORANGE CONSTRUCTION FENCE AROUND SEDIMENT BASIN A WHERE SHOWN ON THE PLANS TO PREVENT COMPACTION DURING CONSTRUCTION ACTIVITIES. IMMEDIATELY STABILIZE SEDIMENT BASIN WITH SEED AND MULCH.
9. INSTALL STORM SEWER, ROOF LEADER STORM SEWER, AND STRUCTURES IN A DOWNSTREAM-TO-UPSTREAM MANNER IN THIS AREA. INSTALL INLET PROTECTION ON INLETS AS THEY ARE INSTALLED IN THIS STAGE.
10. FINAL GRADE THESE AREAS AS SHOWN ON THE PLANS.
11. **CRITICAL STAGE:** CONVERT SEDIMENT BASINS TO FINAL GRADE MRC BASINS AND DRY EXTENDED DETENTION BASINS. REMOVE SEDIMENT AND EXCAVATE TO FINISHED BOTTOM OF BASIN ELEVATION. INSTALL UNDERDRAINS AND AMENDED SOILS AS DESIGNED IN MRC BASIN. ADD SOIL MIXTURE PER DETAIL AND SPECIFICATIONS. INSTALL ORANGE CONSTRUCTION FENCE AROUND THE BASINS WHERE SHOWN ON THE PLANS TO PREVENT COMPACTION DURING CONSTRUCTION ACTIVITIES. **A LICENSED PROFESSIONAL OR DESIGNER SHALL BE PRESENT ON THE PROJECT SITE DURING INSTALLATION OF THESE BMPs.**
12. CONTRACTOR SHALL CONTACT THE BUCKS COUNTY CONSERVATION DISTRICT (BCCD) THREE (3) DAYS PRIOR TO FINAL STORMWATER BASIN STABILIZATION FOR THE PURPOSES OF INSPECTION OF SAID STABILIZATION.
13. **CRITICAL STAGE:** INSTALL PROPOSED SOIL AMENDMENTS FOR MRC BASINS AS SHOWN ON THE PLANS. CARE SHALL BE TAKEN NOT TO COMPACT THE AREAS WHERE SOIL AMENDMENTS ARE INSTALLED. **A LICENSED PROFESSIONAL OR DESIGNER SHALL BE PRESENT ON THE PROJECT SITE DURING INSTALLATION OF THESE BMPs.**
14. REFER TO 'SEQUENCE OF CONSTRUCTION (SITE-WIDE)' STAGE 16 ON THIS SHEET FOR CONTINUATION OF WORK TO BE PERFORMED.

Conclusion

Through efficient dust control, maintenance of erosion control BMPs, and adherence to the sequence of construction, it is not anticipated that special erosion control measures will be warranted at this project site. Following all erosion control and prevention procedures, there are no anticipated issues that will occur during the construction phase, transition from construction to permanent stabilization, or during post-construction.

II. EROSION & SEDIMENT CONTROL CALCULATIONS

PROJECT NAME:	NorthPoint Phase 2		
LOCATION:	Falls Township, Bucks County, Pennsylvania		
PREPARED BY:	WJD	DATE:	9/23/2024
CHECKED BY:		DATE:	



Sock #	Dia. (in)	Location (See E&S Plan)	Slope Percent %	Slope Length Above Barrier (ft)
CFS#1	18	Eastern Building 4 Entrance at Property Boundary	2.0%	50
CFS#2	18	North of Sediment Basin #8D	33.3%	50
CFS#3	18	Staging Area for Impacted Materials (Building 4)	33.3%	50
CFS#4	18	East Topsoil Stockpile (Building 4)	33.3%	40
CFS#5	18	North Topsoil Stockpile (Building 4)	33.3%	50
CFS#6	18	Northern Railroad Tracks (Building 4)	33.3%	50
CFS#7	18	West Topsoil Stockpile (Building 4)	33.3%	40
CFS#8	18	West of Proposed Railroad (Building 4)	2.0%	100
CFS#9	18	South of Old Bordentown Road	33.3%	50
CFS#10	18	East of Ben Fairless Drive	33.3%	20
CFS#11	18	East Topsoil Stockpile (Building 5)	33.3%	50
CFS#12	18	North Topsoil Stockpile (Building 5)	33.3%	40
CFS#13	18	Staging Area for Impacted Materials (Building 5)	33.3%	50
CFS#14	18	West Topsoil Stockpile (Building 5)	33.3%	50
CFS#15	18	South Topsoil Stockpile (Building 5)	33.3%	40
CFS#16	18	West of Proposed Railroad	2.0%	100
CFS#17	18	North Topsoil Stockpiles (Building 6)	33.3%	50
CFS#18	18	Southeast Topsoil Stockpile (Building 6)	33.3%	15
CFS#19	18	Southwest Topsoil Stockpile (Building 6)	33.3%	15

STANDARD WORKSHEET

Rip-Rap Apron Outlet Protection

PROJECT NAME:	NorthPoint Phase 2 - Building 4 Construction			
LOCATION:	Falls Township		Bucks County	
PREPARED BY:	LS		DATE:	3/31/2022
CHECKED BY:	DPB		DATE:	1/31/2024

METHODOLOGY:

Utilize PA D.E.P. *Erosion and Sediment Control Manual* to construct a Rock Apron at culvert, endwall, headwall or channel outfalls. First, tailwater condition must be determined (minimum or maximum). Second, with a known discharge, determine D50 rock size and length of apron "La". Third, determine the width and thickness of the apron. Lastly, ensure the permissible velocity of the rock size chosen is not exceeded by the velocity of the discharge entering the apron.

Equations Utilized:

Minimum Tailwater Condition: $W2 = 3do + La$

Maximum Tailwater Condition: $W2 = 3do + 0.4La$

Blanket Thickness: $T = 1.5 \cdot D_{max}$

Discharge (Q) and Velocity (V) - obtained from the 100 Year Storm

do = pipe diameter

Width 1 = initial width of apron at end of structure

Width 2 = terminal width of apron, W2

STRUCTURE DATA							RIP-RAP DATA			APRON DATA		
EW #	PIPE DIA. (in)	Tailwtr Cond. MIN/MAX	Mngs "n"	Pipe Slope (ft/ft)	Q (cfs)	V (fps)	D50 (in.)	ROCK SIZE	Rock T (in.)	La (ft)	W at pipe (ft)	W at tailwtr (ft)
1000	24	MIN	0.011	1.28	12.71	4.05	6	R-4	18	12	6	18
1010	24	MIN	0.011	3.84	11.77	3.75	6	R-4	18	12	6	18
1020	24	MIN	0.011	1.49	7.82	2.49	6	R-4	18	12	6	18
1030	24	MIN	0.011	3.85	11.13	3.54	6	R-4	18	12	6	18
1040	24	MIN	0.011	3.82	11.64	3.70	6	R-4	18	12	6	18
1050	24	MIN	0.011	2.60	11.95	3.80	6	R-4	18	12	6	18
1060	36	MIN	0.011	0.50	32.18	5.93	9	R-5	27	20	9	29
1070	30	MIN	0.011	0.50	19.36	4.13	6	R-4	18	16	7.5	23.5
1080	30	MIN	0.011	0.50	21.35	4.48	6	R-4	18	16	7.5	23.5
1100	18	MIN	0.011	0.74	7.95	4.50	6	R-4	18	8	4.5	12.5
1110	24	MIN	0.011	2.65	9.19	2.93	6	R-4	18	12	6	18
1120	30	MIN	0.011	0.40	19.13	3.90	6	R-4	18	16	7.5	23.5
1130	24	MIN	0.011	0.50	1.69	0.54	6	R-4	18	12	6	18
1140	36	MIN	0.011	0.40	36.87	5.59	9	R-5	27	20	9	29
1200	24	MIN	0.011	0.44	7.68	2.45	6	R-4	18	12	6	18
1210	36	MIN	0.011	0.53	28.71	4.06	9	R-5	27	20	9	29
1220	18	MIN	0.011	1.50	3.48	2.06	6	R-4	18	8	4.5	12.5
1230	18	MIN	0.011	2.04	3.74	2.11	6	R-4	18	8	4.5	12.5
1240	36	MIN	0.011	0.51	33.98	4.81	9	R-5	27	20	9	29
1250	36	MIN	0.011	0.50	31.68	5.87	9	R-5	27	20	9	29
1260	18	MIN	0.011	0.50	6.85	3.88	6	R-4	18	8	4.5	12.5
1270	24	MIN	0.011	0.50	2.14	0.68	6	R-4	18	12	6	18
1280	36	MIN	0.011	0.50	30.52	5.73	9	R-5	27	20	9	29
9	(2) 48	MIN	0.011	0.54	16.56	2.04	12	R-6	36	26	12	38
12	(2) 66	MIN	0.011	0.50	266.99	5.62	18	R-7	54	32	12	44
1295	24	MIN	0.011	0.55	1.06	0.34	6	R-4	18	12	6	18
1297	24	MIN	0.011	0.51	5.10	1.63	6	R-4	18	12	6	18
1900	36	MIN	0.011	0.43	23.46	4.83	9	R-5	27	20	9	29

Note: Rock size selected has been increased from the suggested d50 values based upon flow (Q) and/or velocity parameters. Energy Dissipator shall be hand placed and dimensions adjusted to conform to the existing roadside conveyance.

Stone larger than R-4 shall have stone filter blanket installed prior to the rip-rap in lieu of non-woven geotextile. Filter stone shall meet the following requirements:

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1000

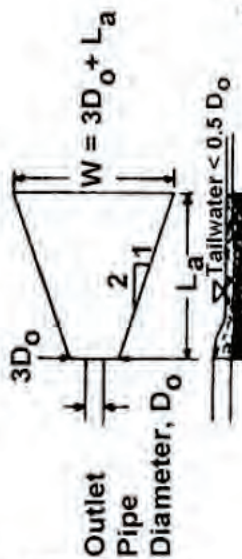
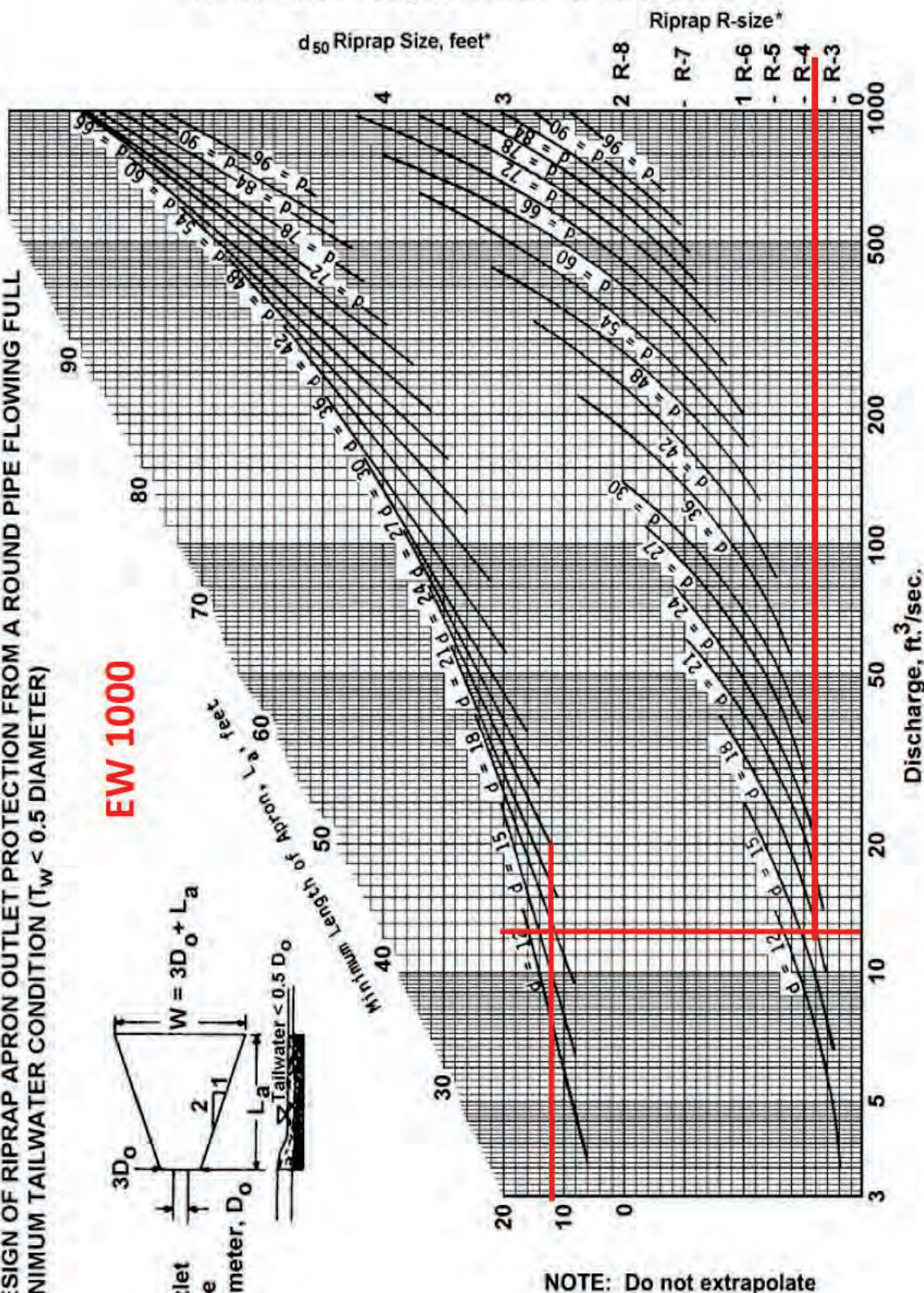


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1000

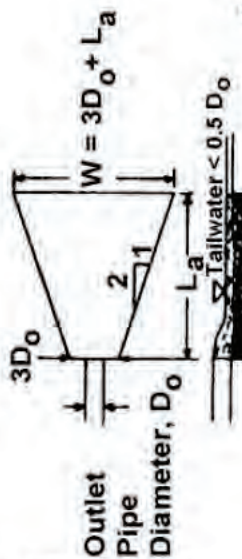
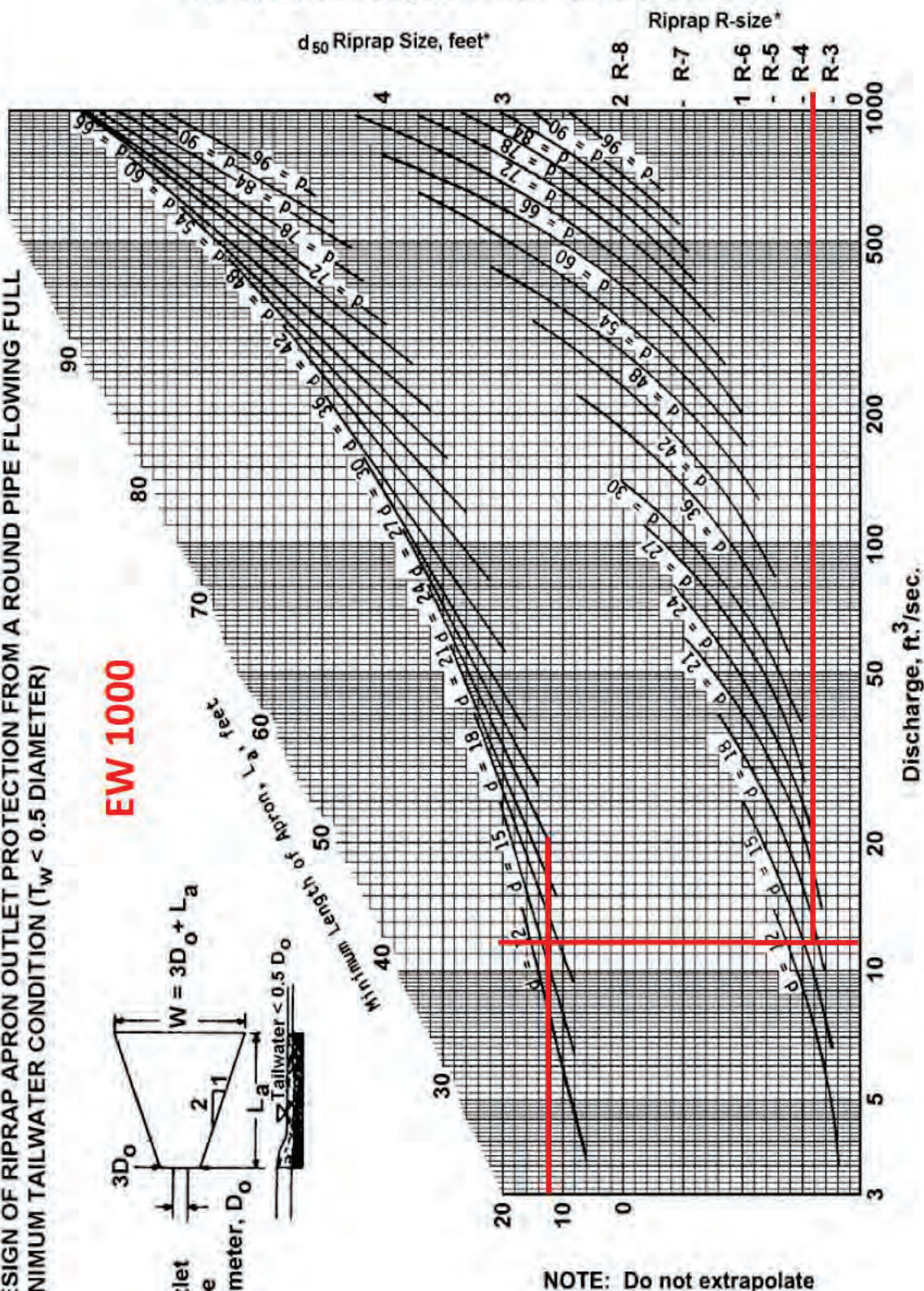


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1020

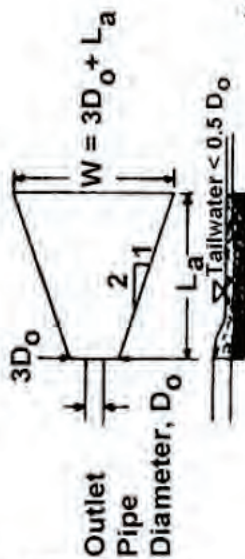
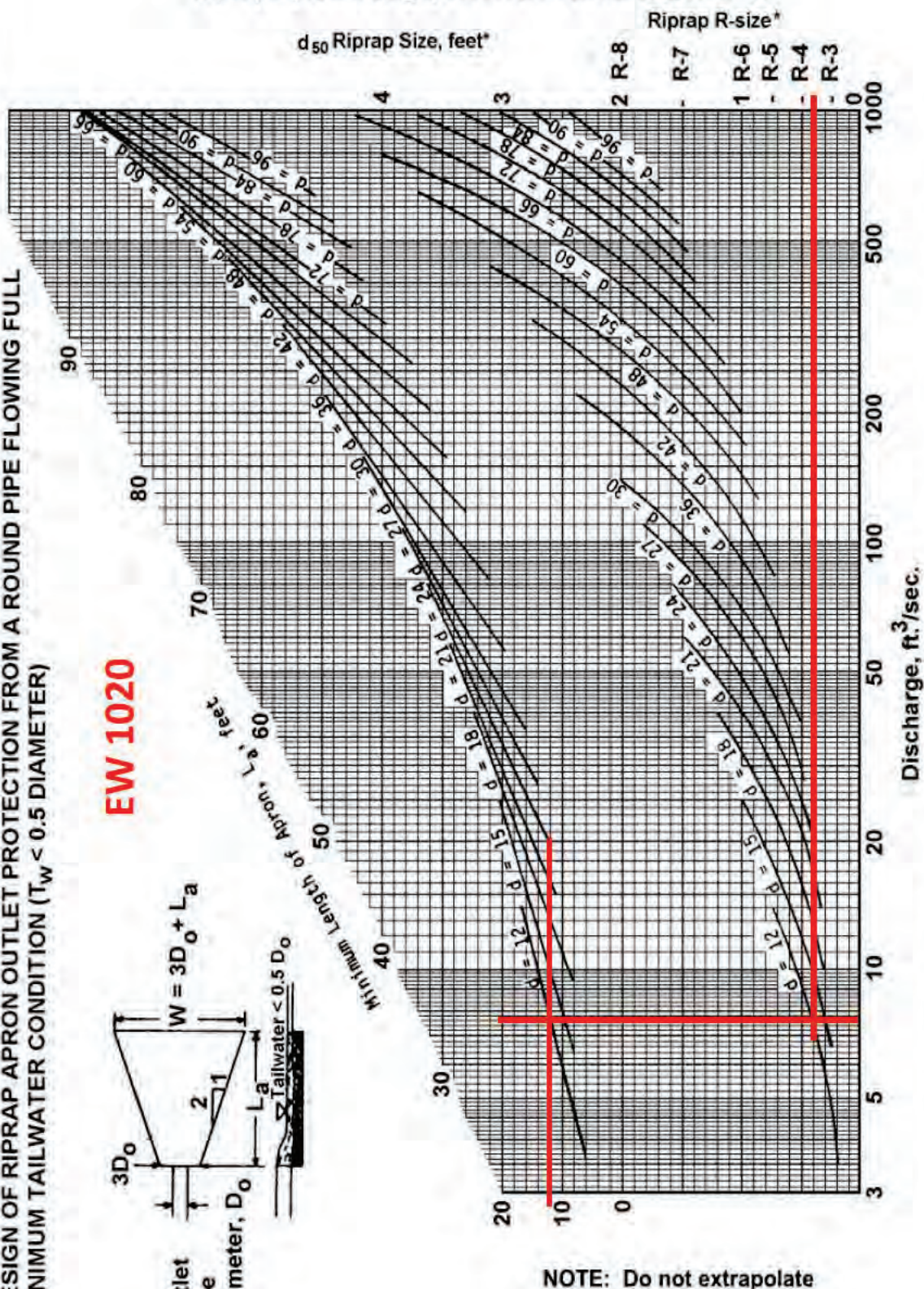


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



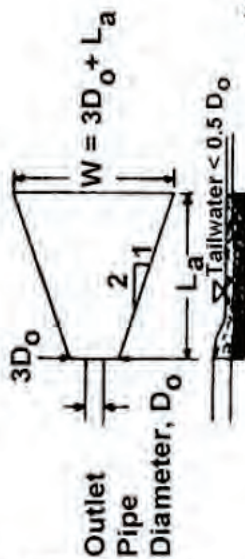
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

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 LOCATION: Falls Township, Bucks County, Pennsylvania
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 CHECKED BY: DATE: 10/7/2021
 DATE:

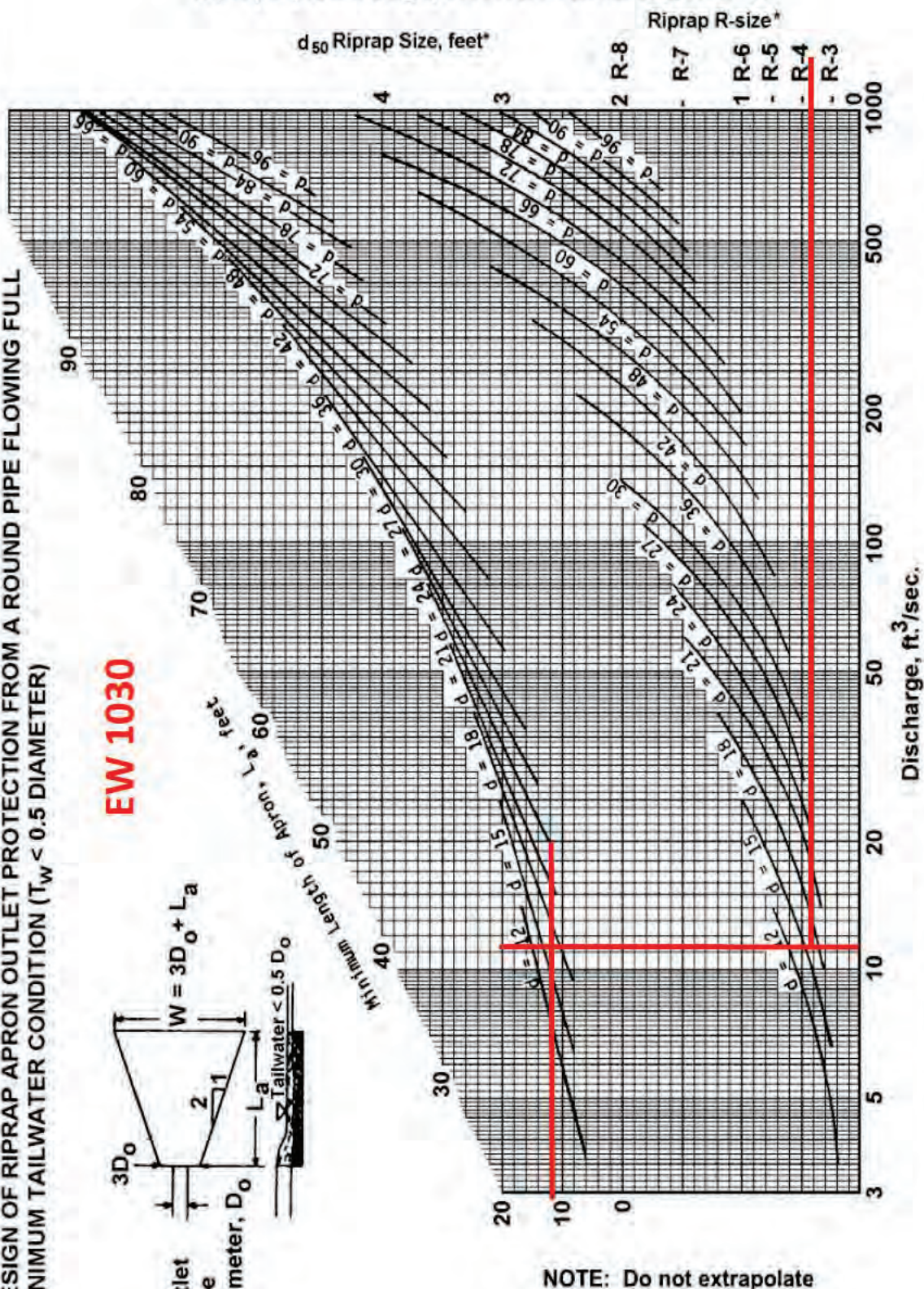
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1030



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

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 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1040

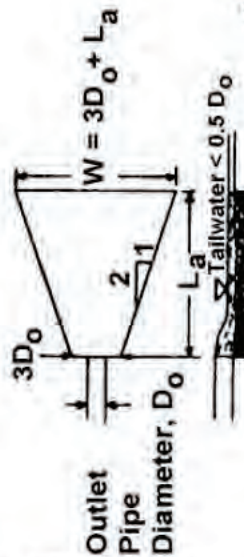
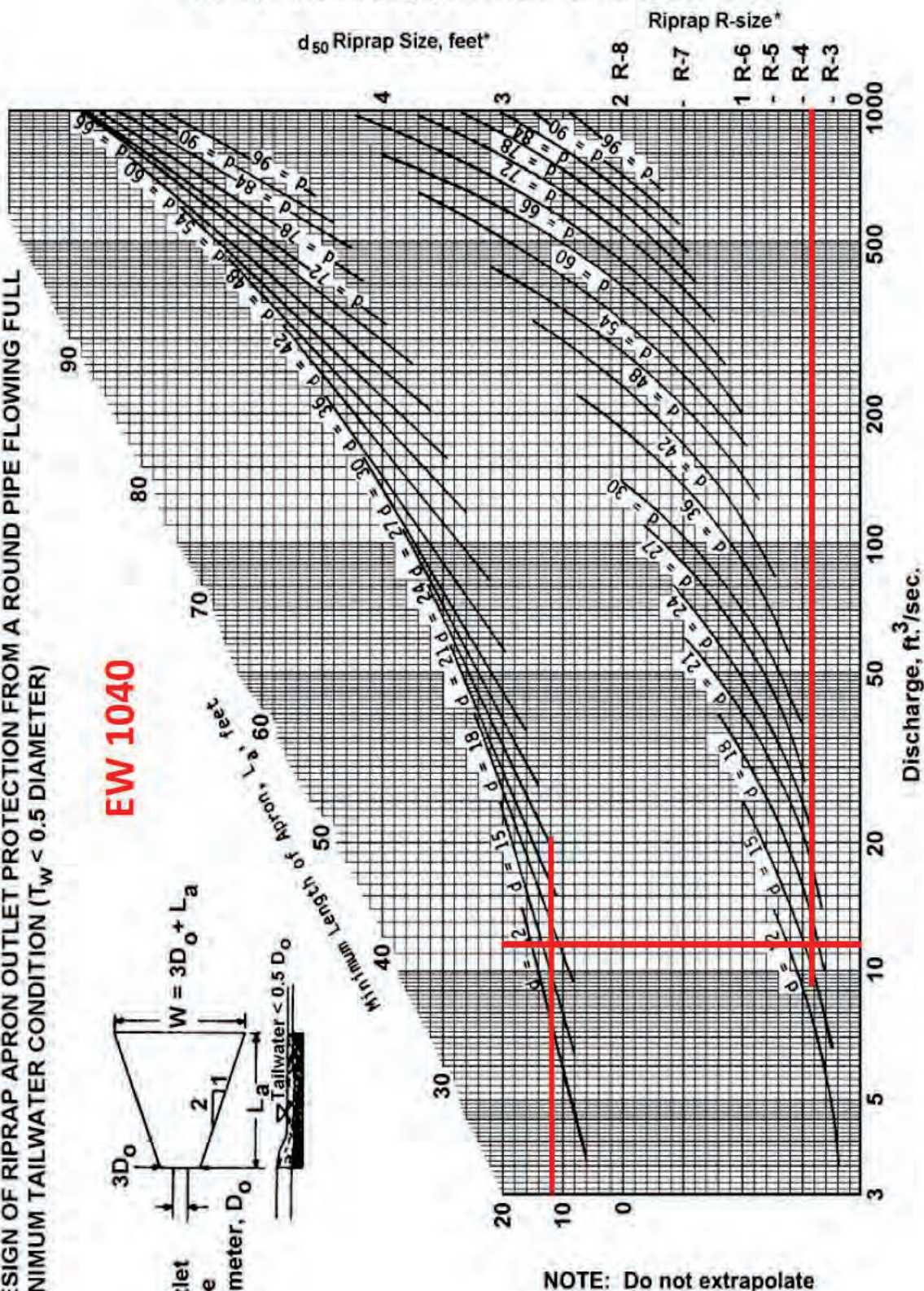


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

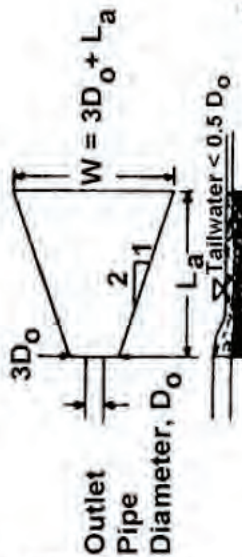


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

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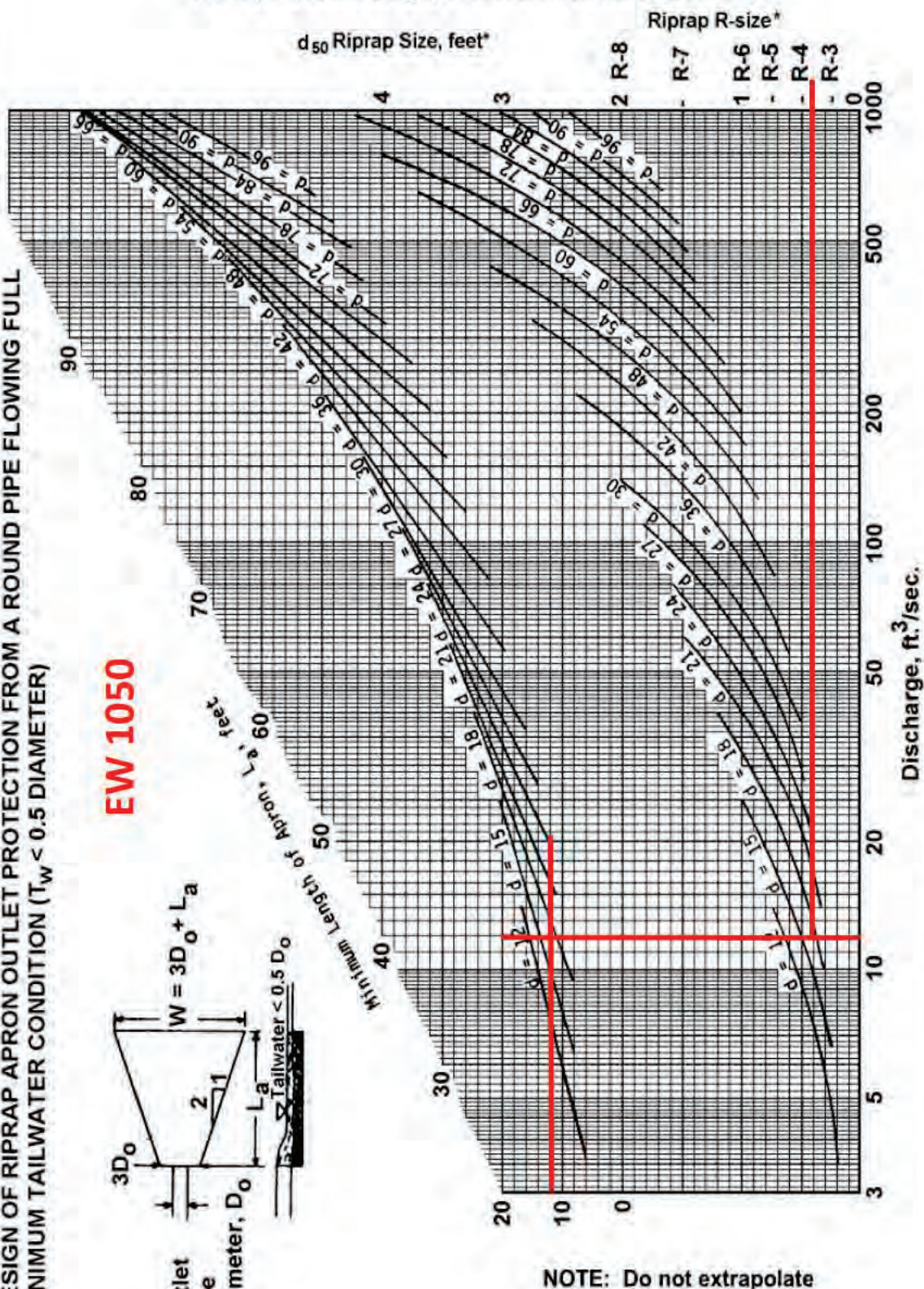
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1050



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1060

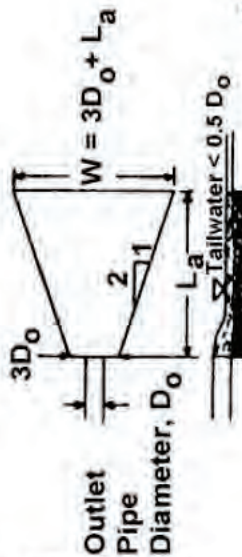
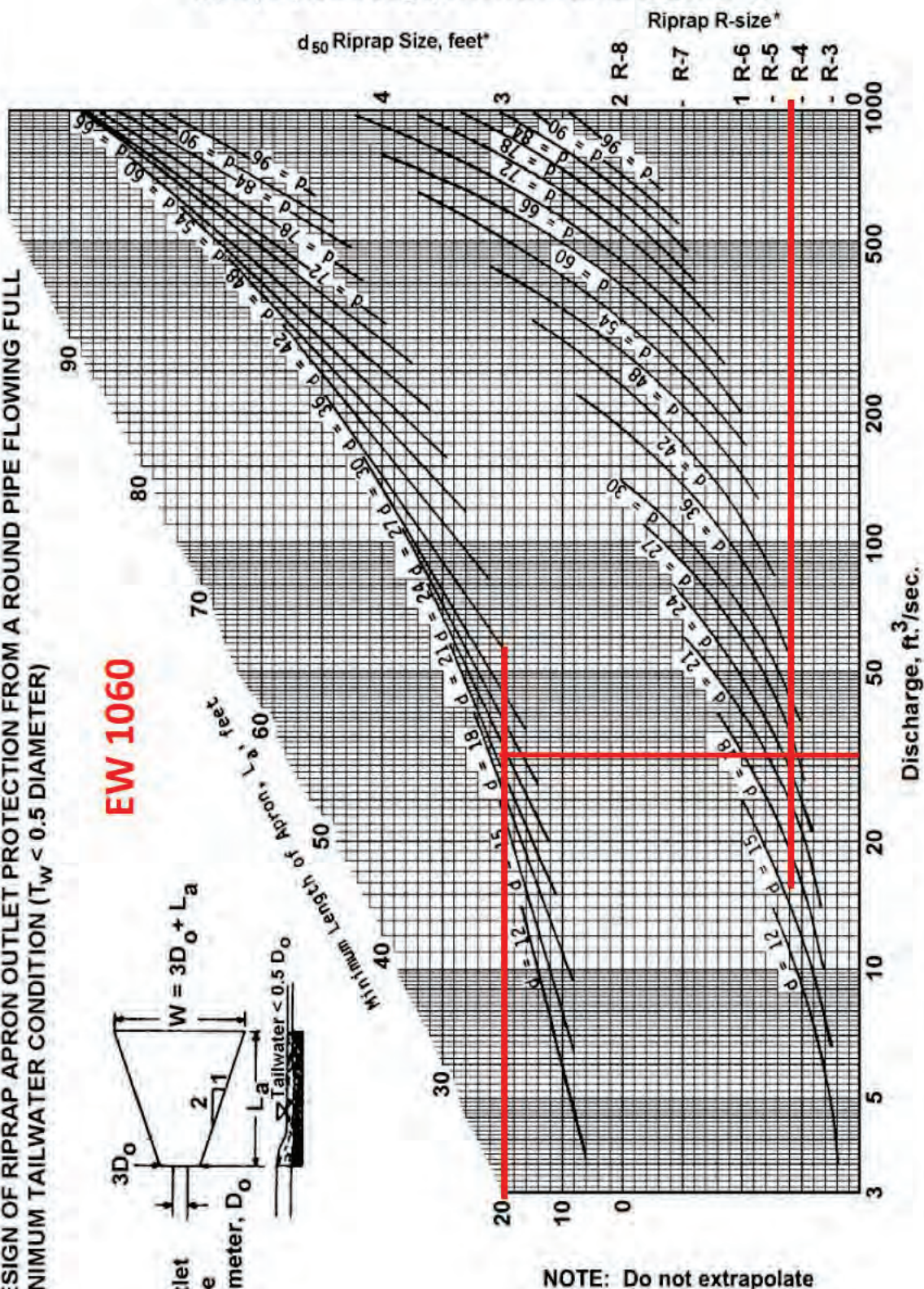


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1070

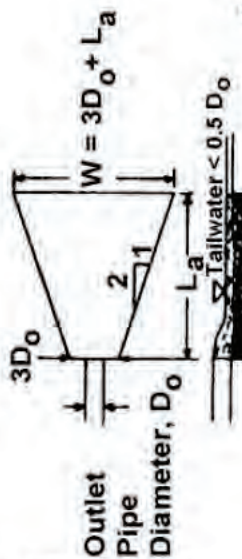
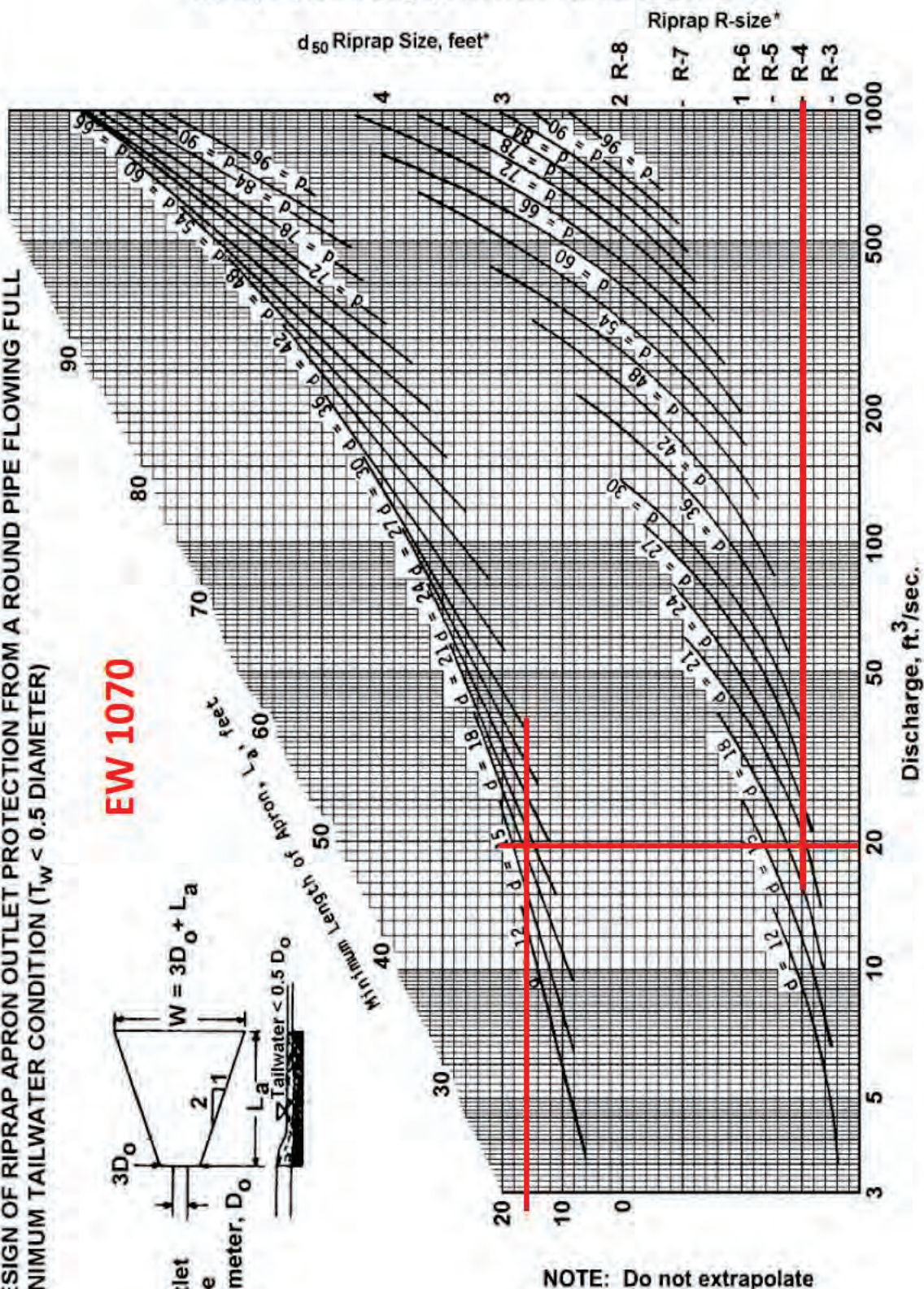


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
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 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1080

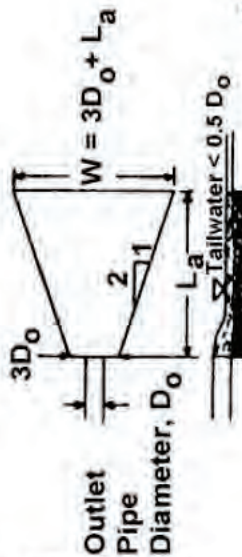
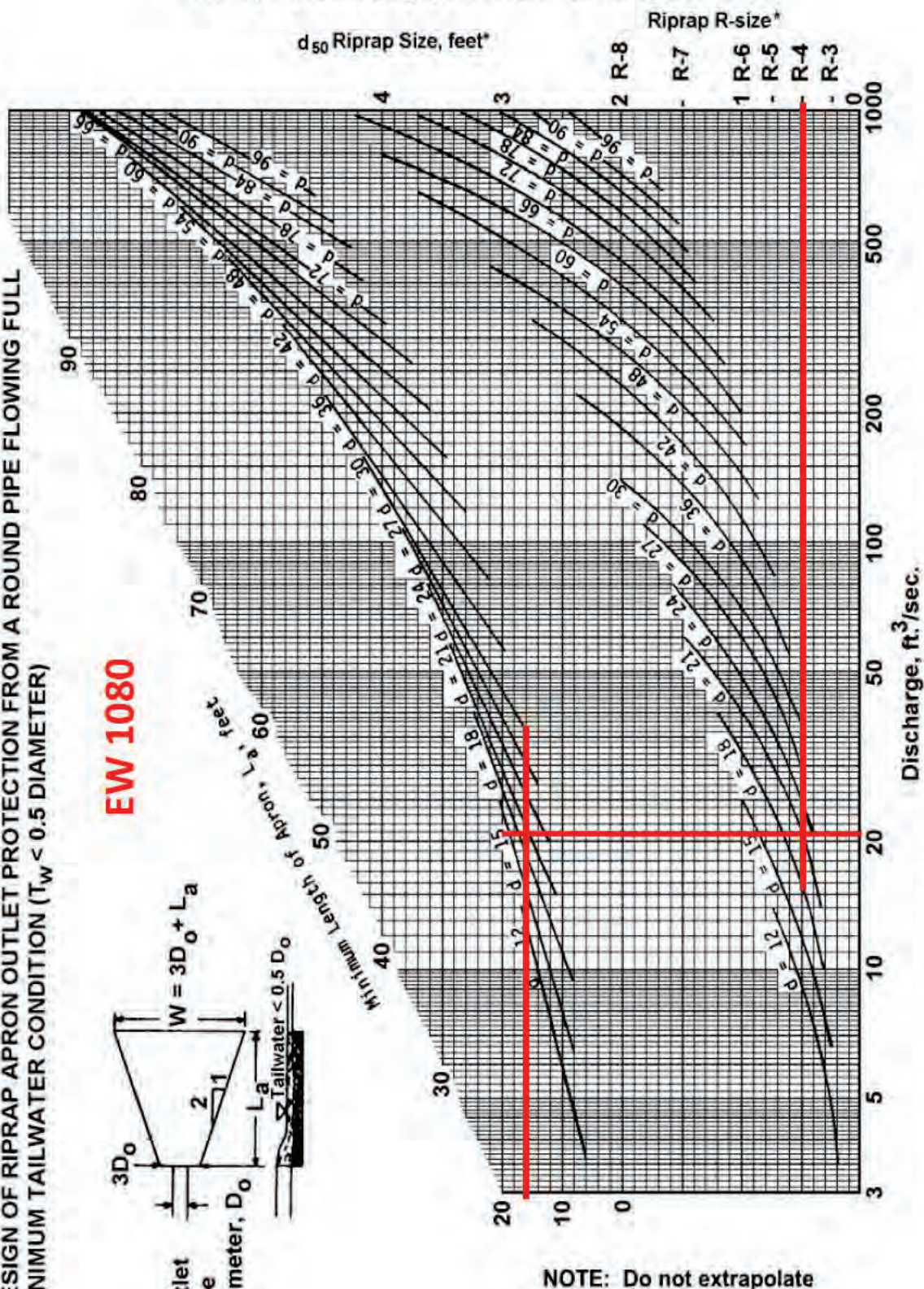


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

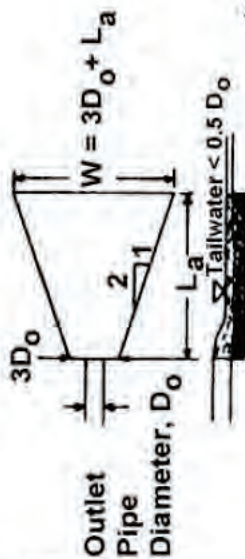


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PROJECT NAME: North Point Phase 2
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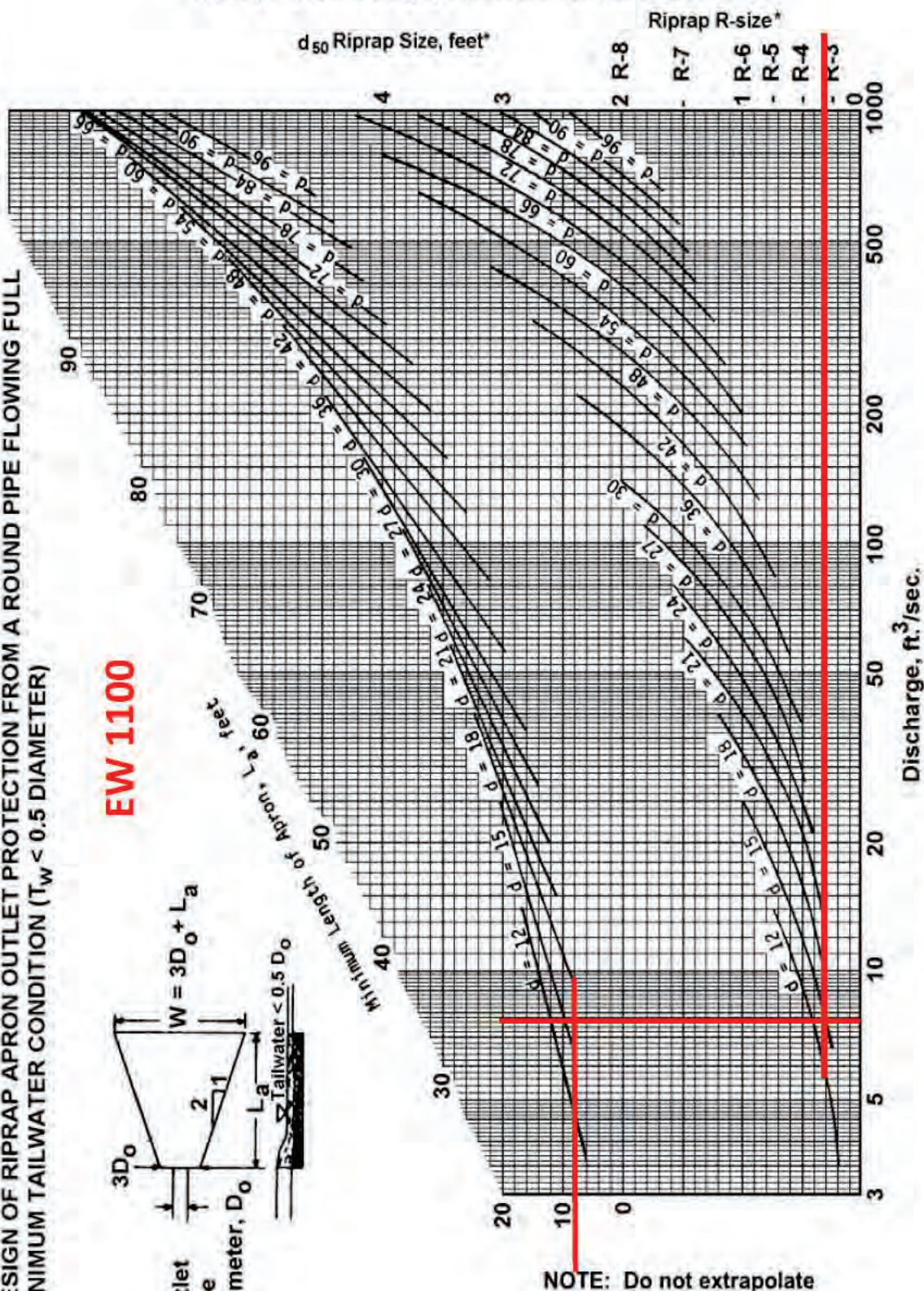
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1100



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1110

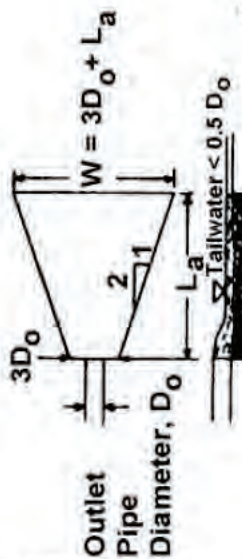
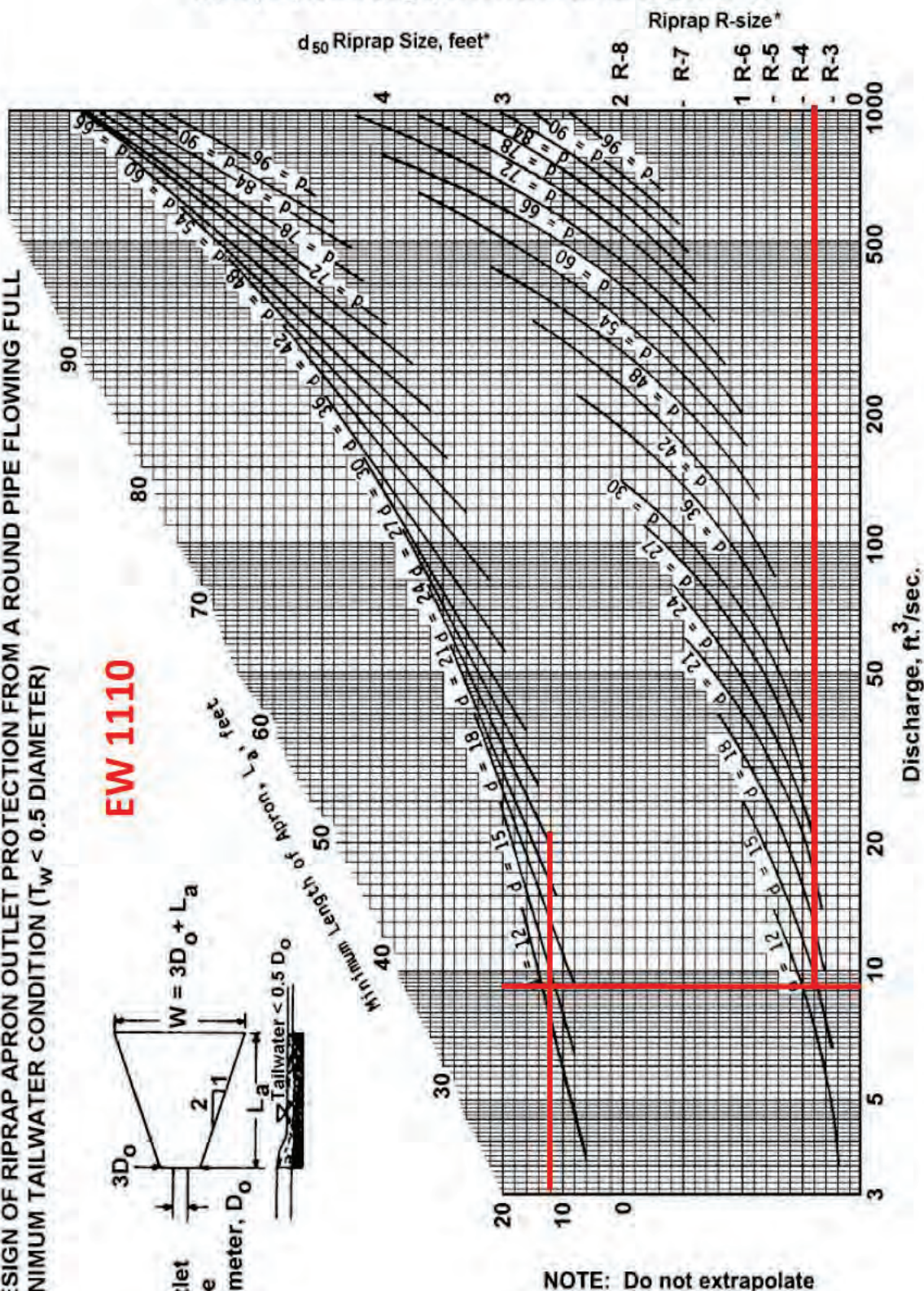


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1120

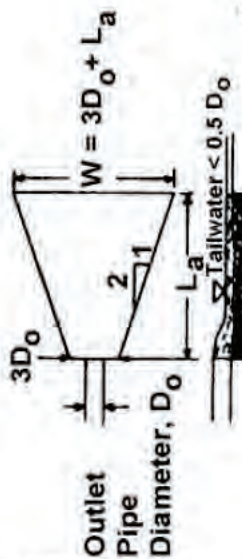
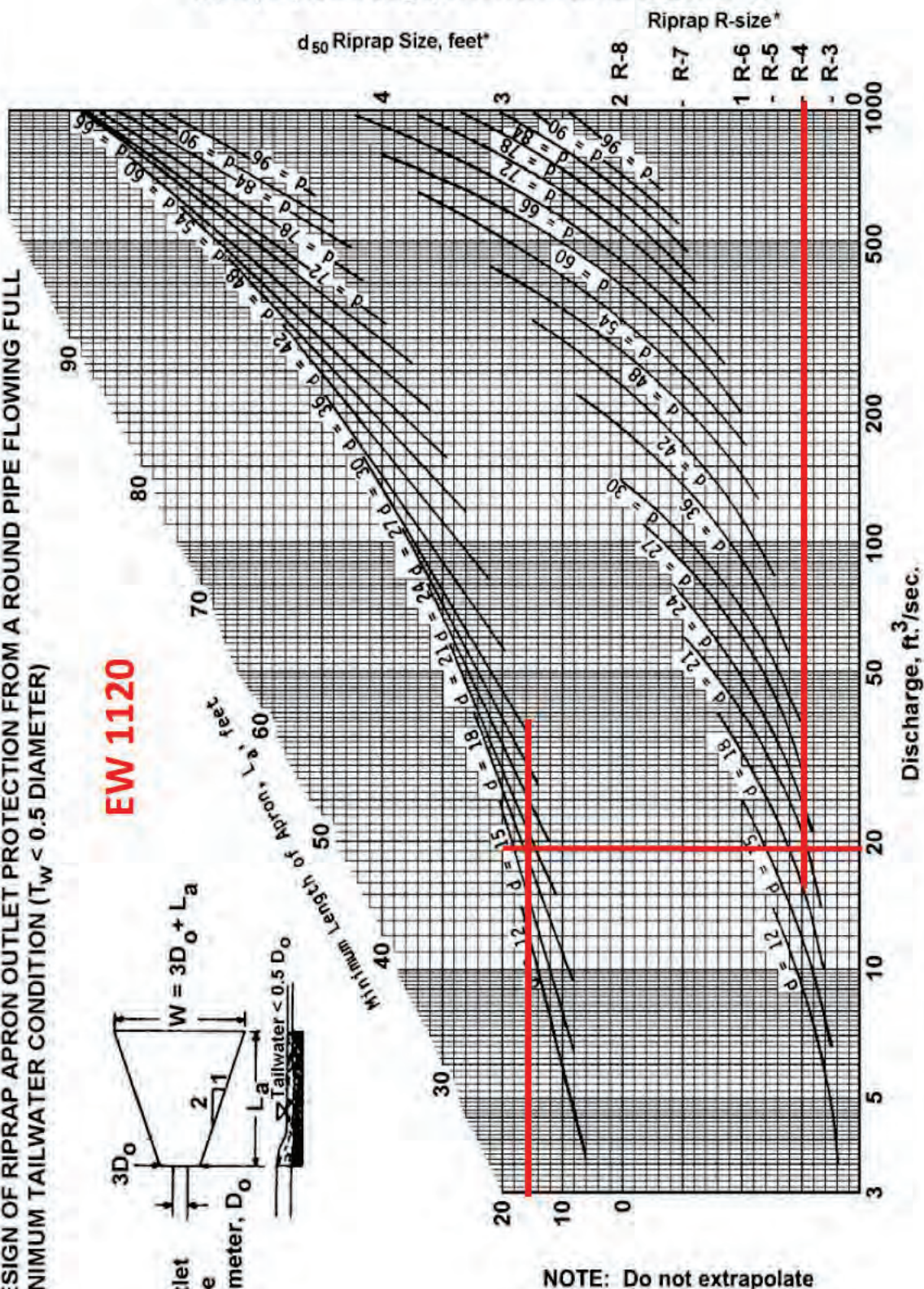


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

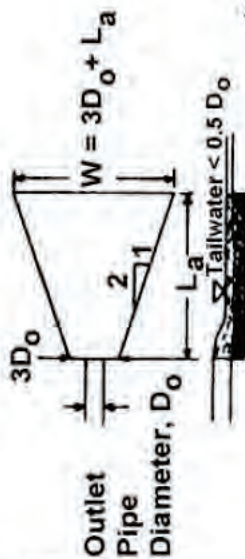


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

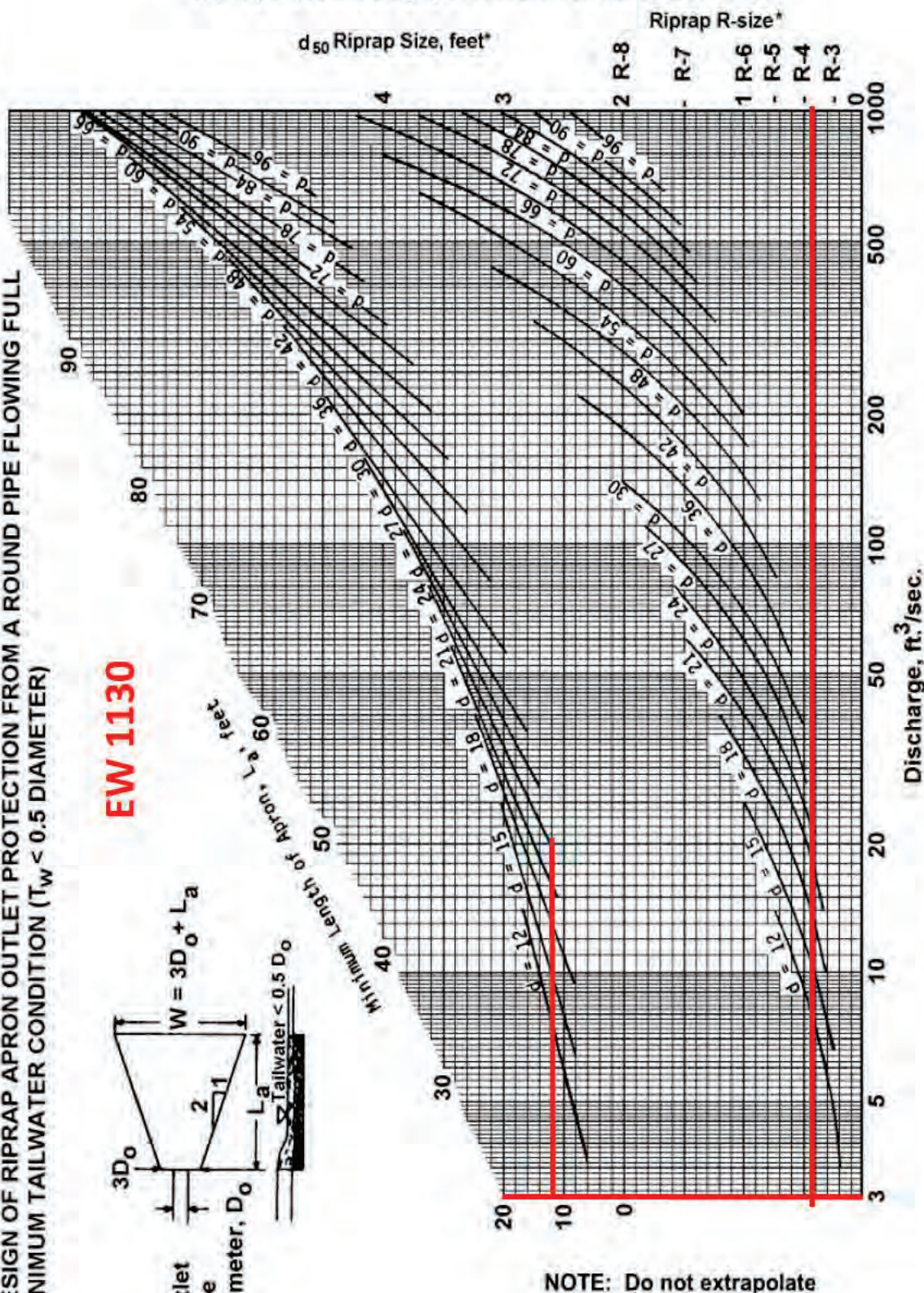
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1130



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1140

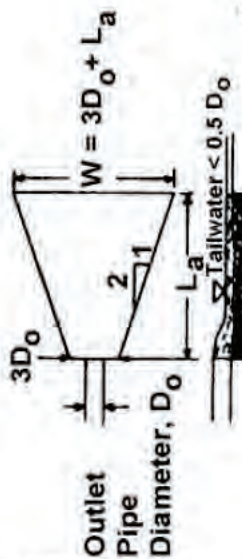
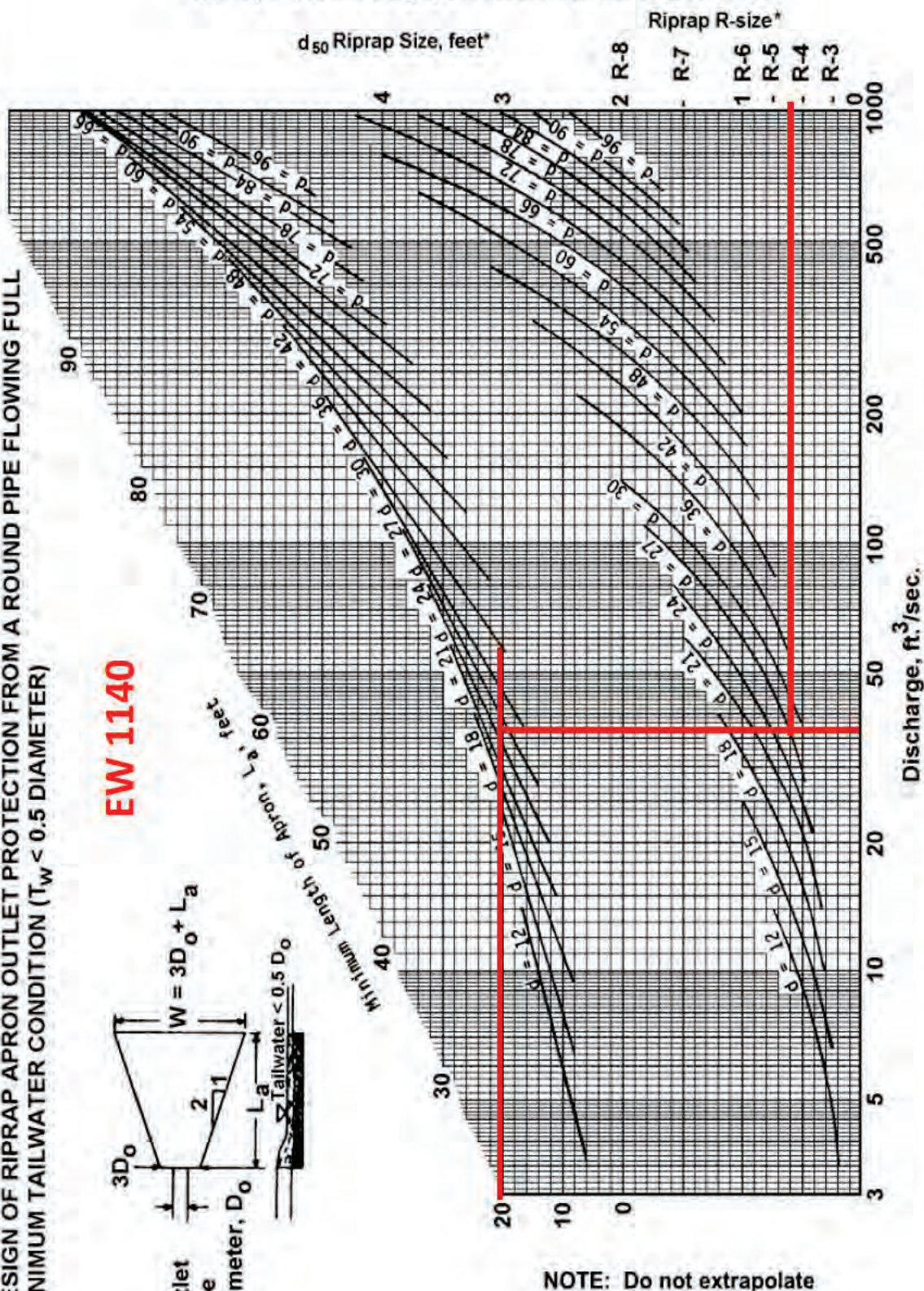


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1200

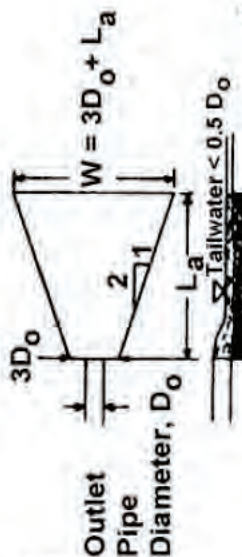
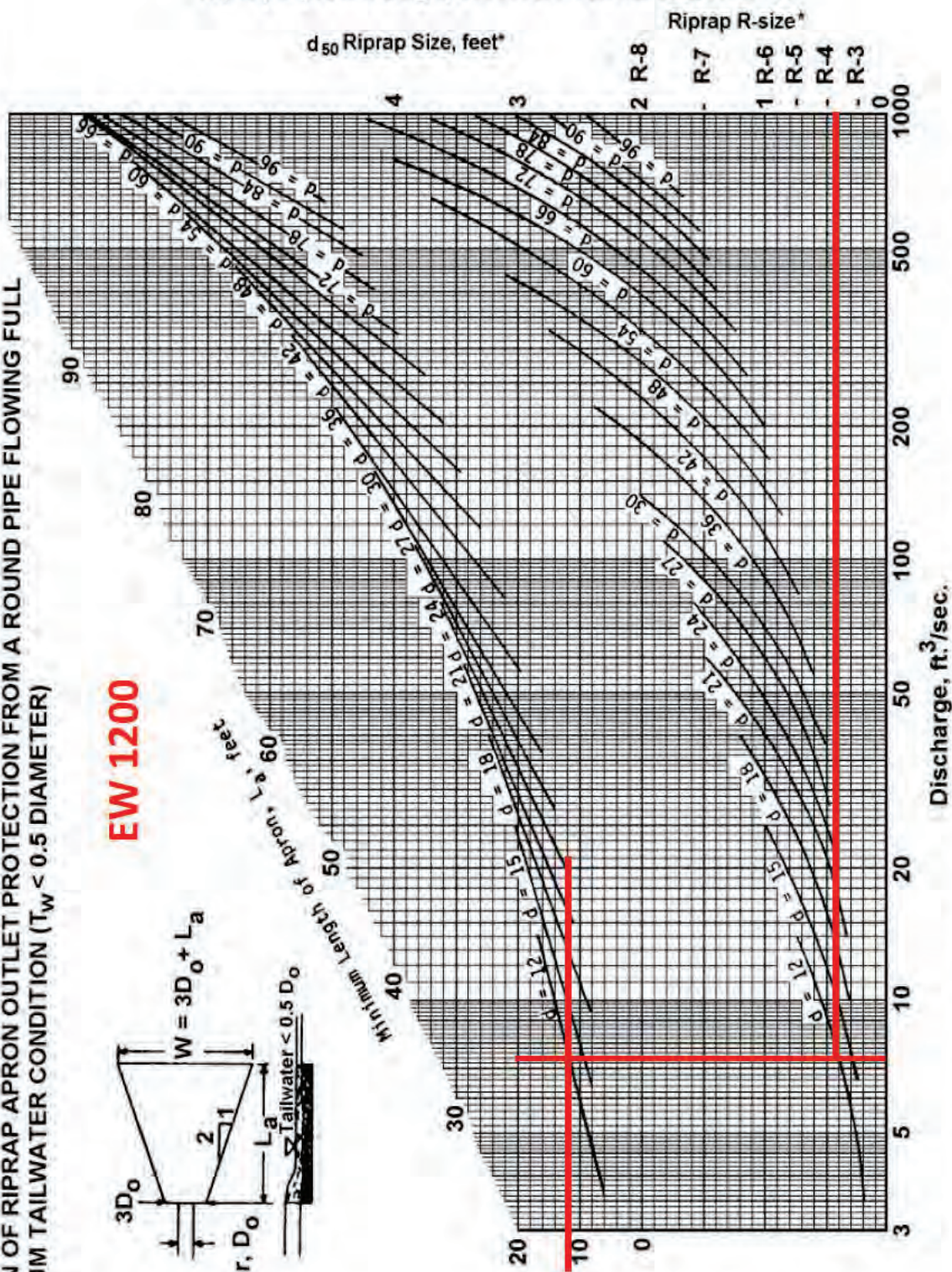


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



NOTE: Do not extrapolate

* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
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DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1210

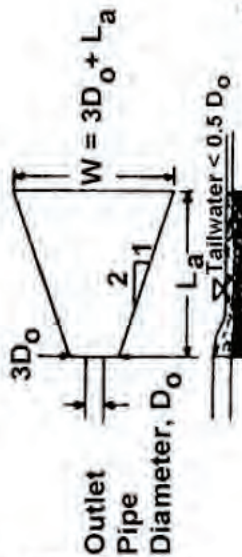
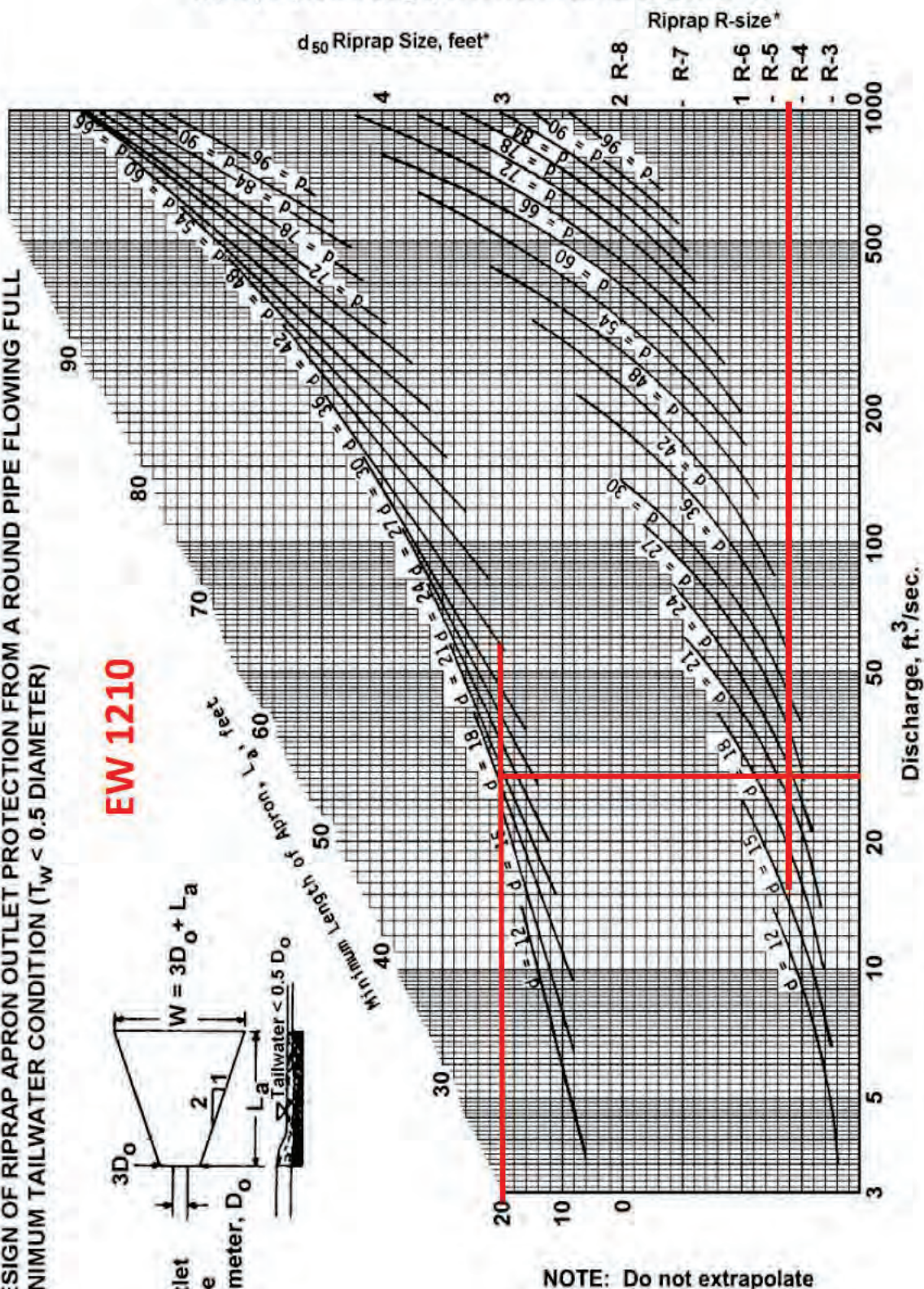


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



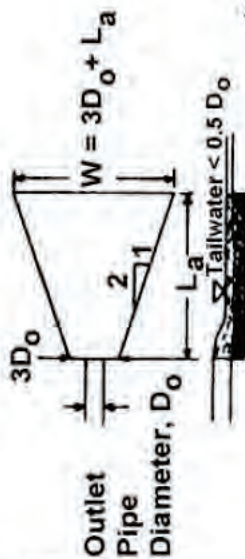
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

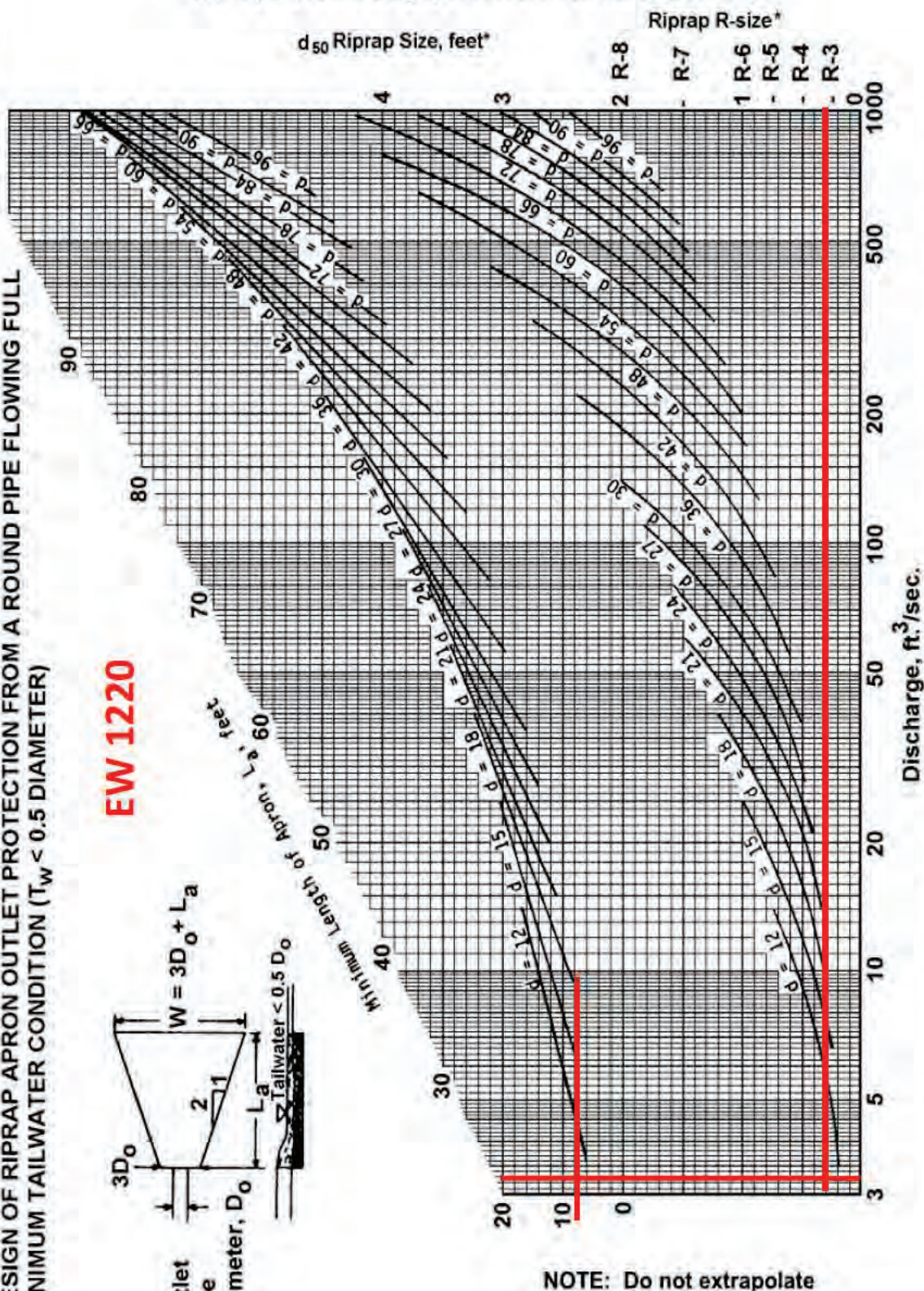
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1220



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



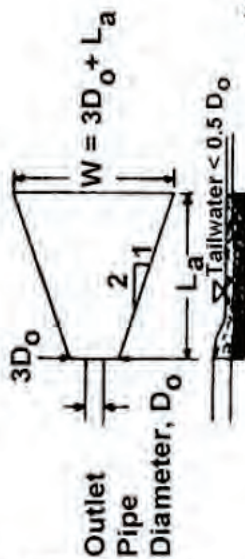
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

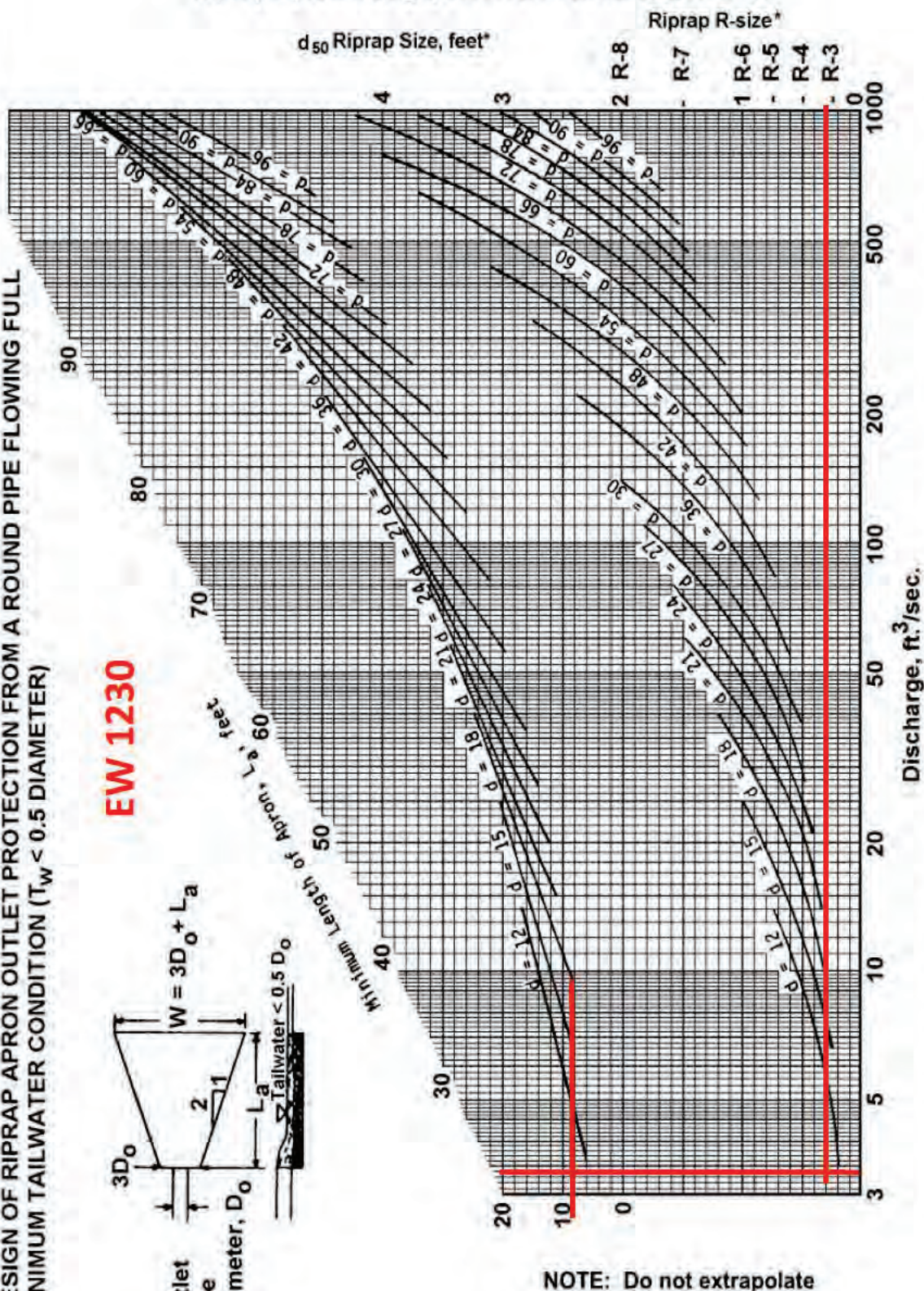
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1230



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



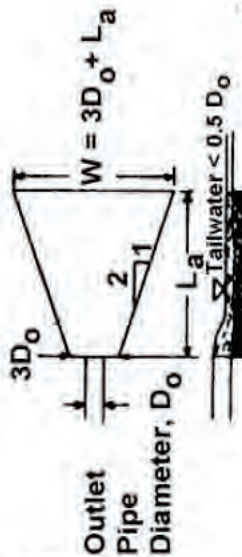
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

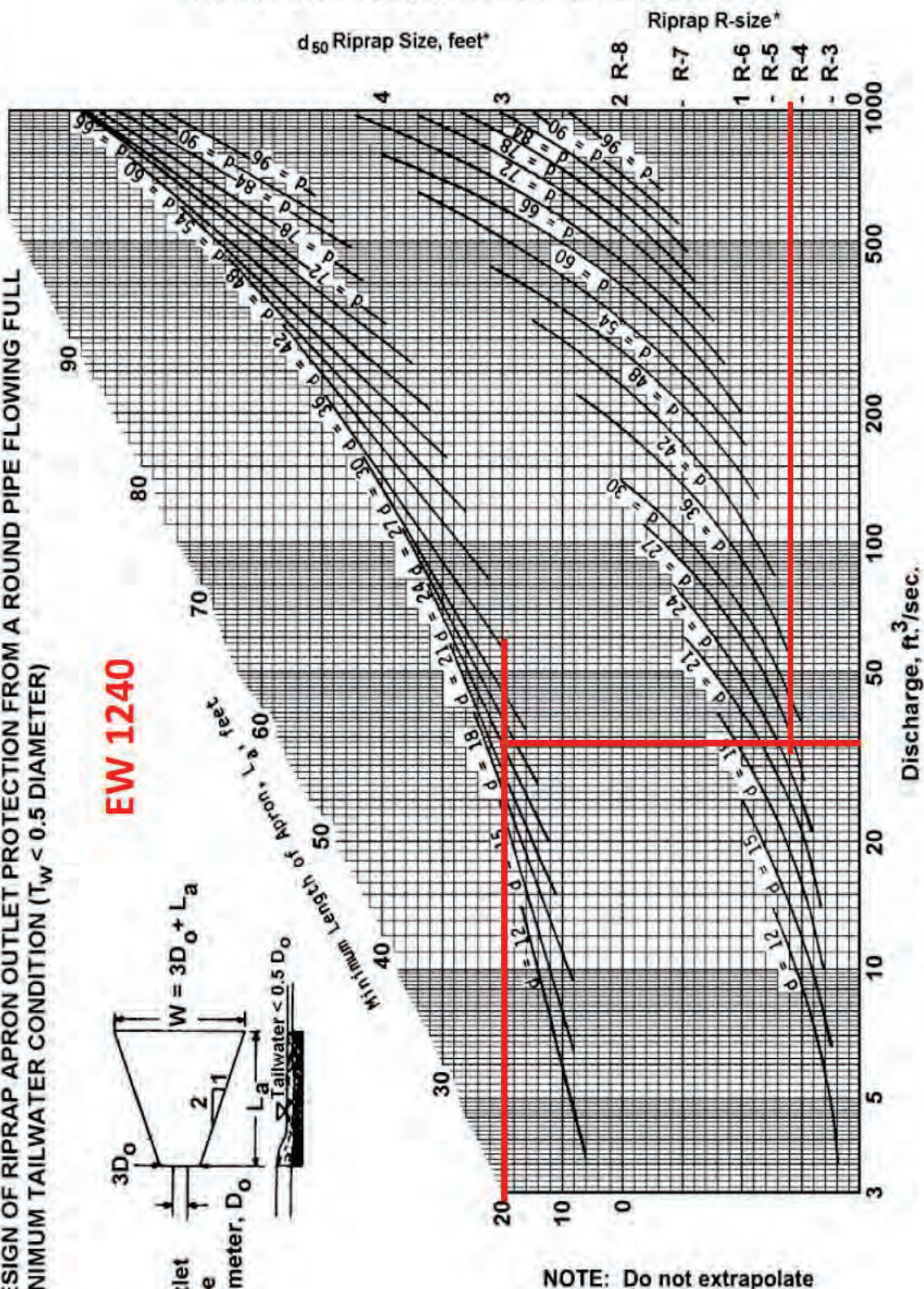
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1240



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1250

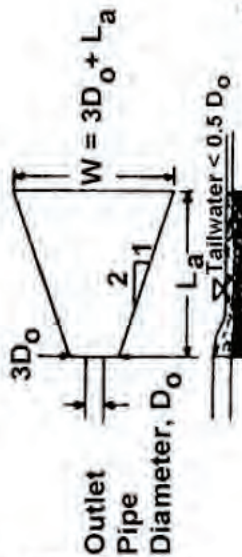
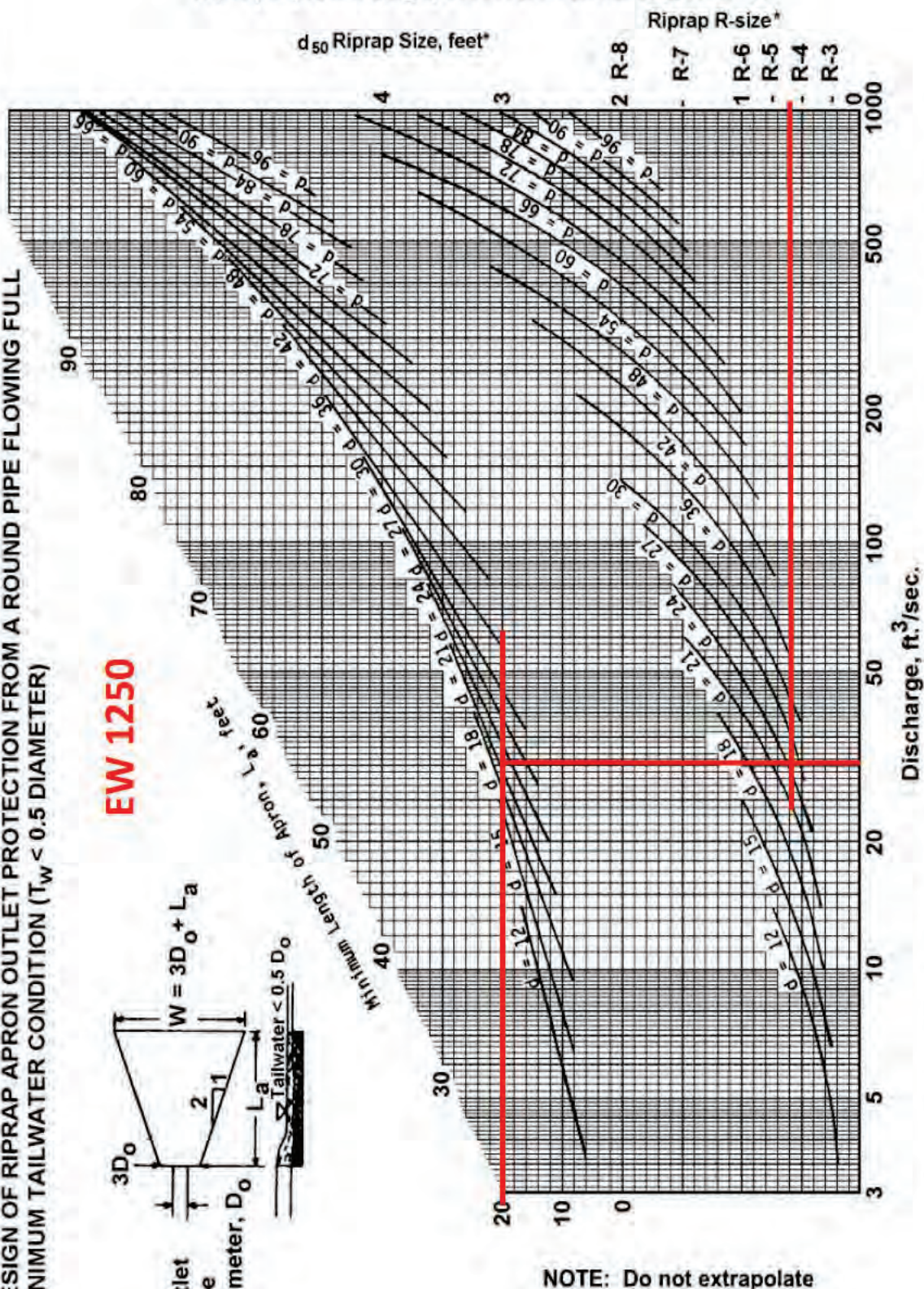


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

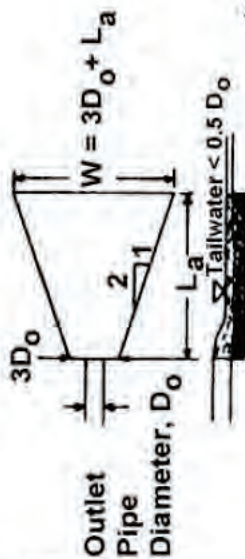


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

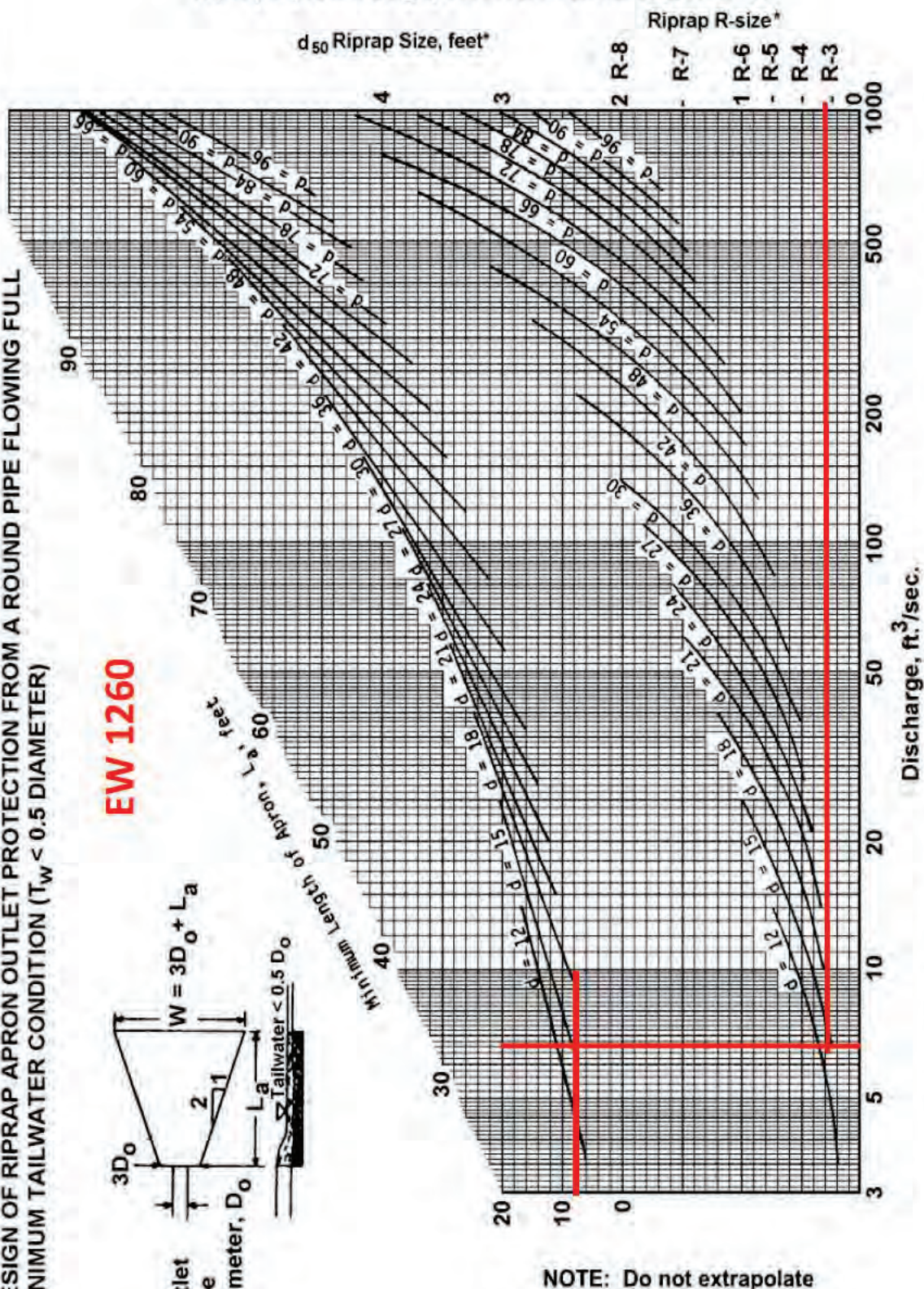
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1260



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

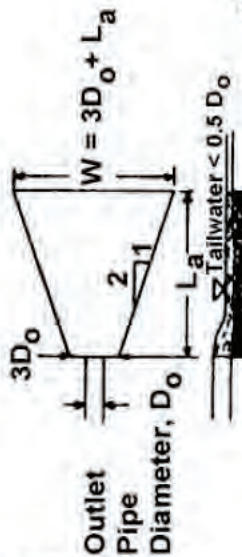


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

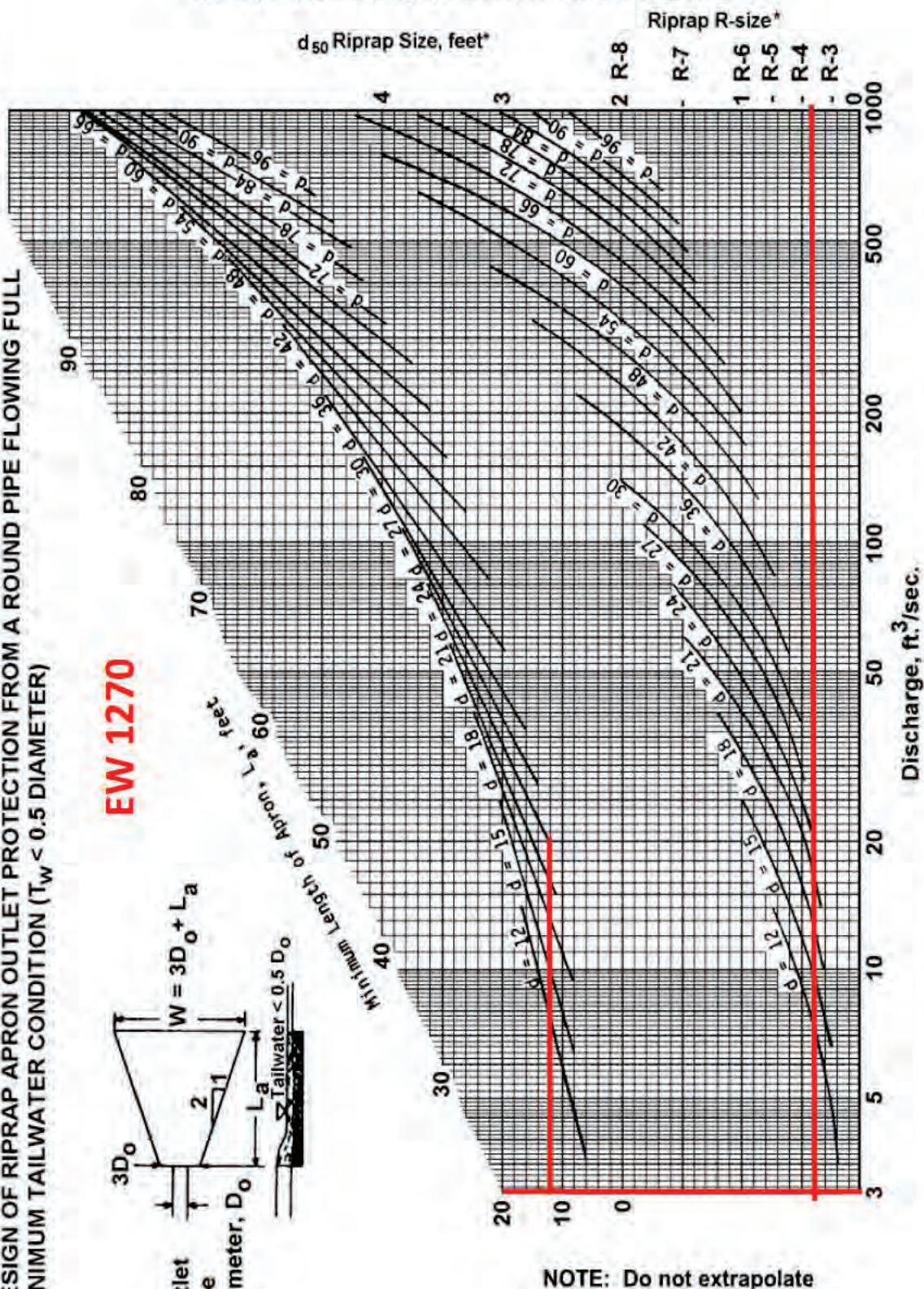
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1270



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1280

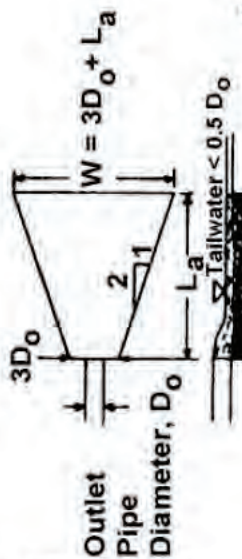
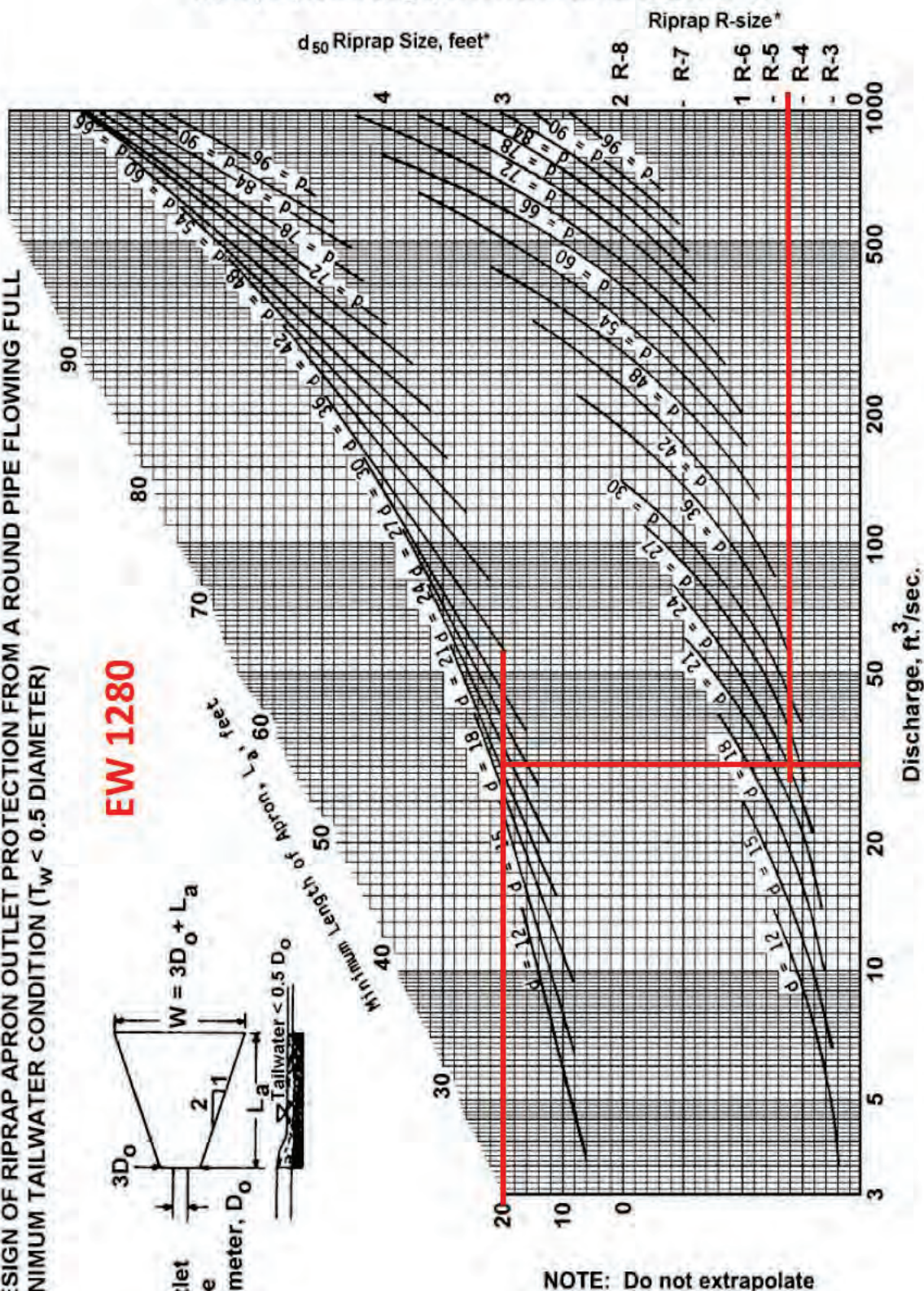


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 9

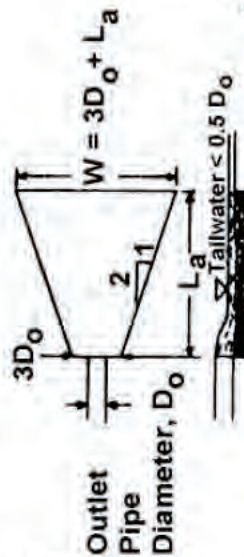
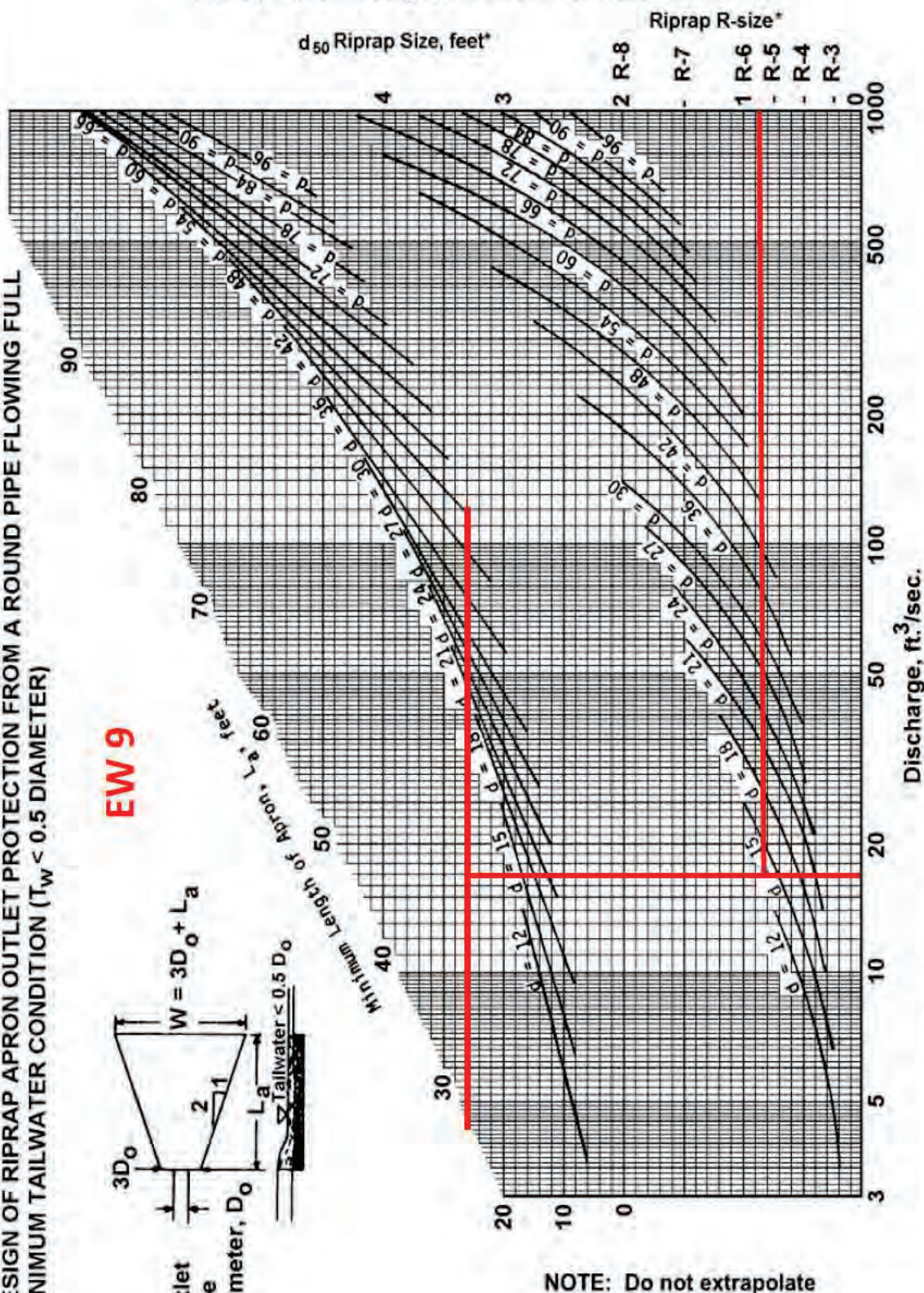


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



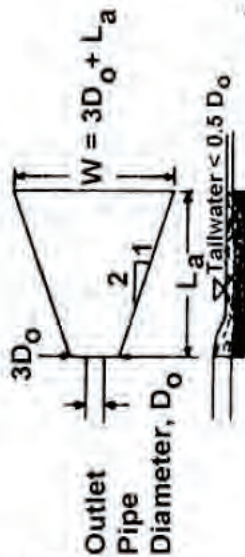
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: MLK
 CHECKED BY: DATE: 10/7/2021
 DATE:

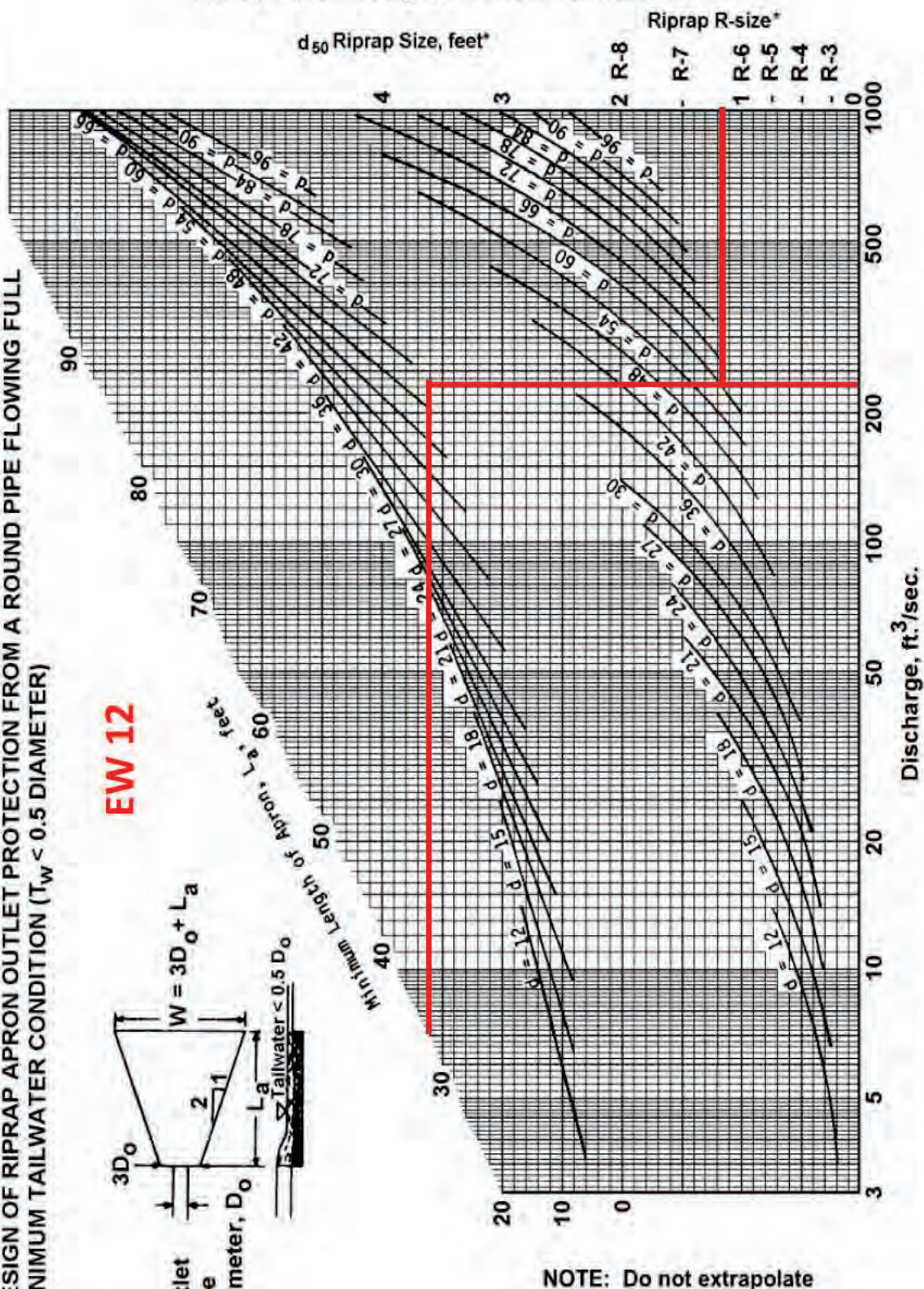
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 12



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



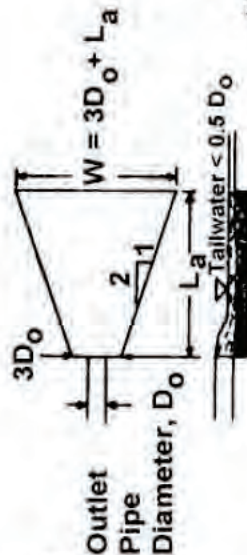
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME:	North Point Phase 2
LOCATION:	Falls Township, Bucks County, Pennsylvania
PREPARED BY:	VT
CHECKED BY:	
DATE:	5/7/2023
DATE:	

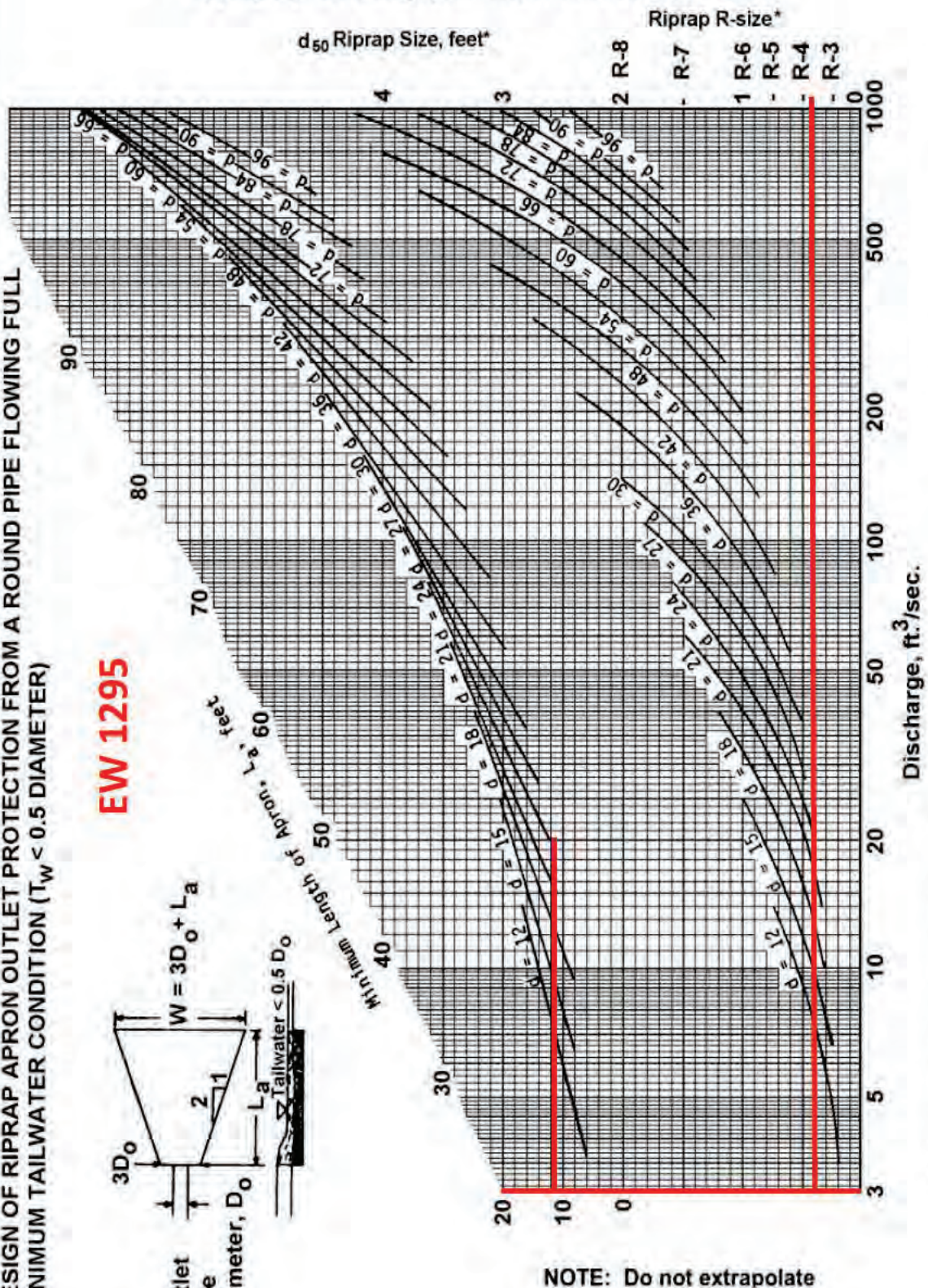
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1295



Adapted from USDA - NRCS

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



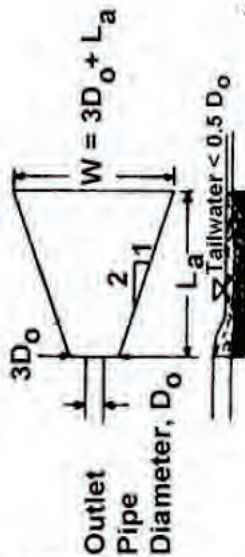
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: VT
 CHECKED BY: DATE: 7/5/2023
 DATE:

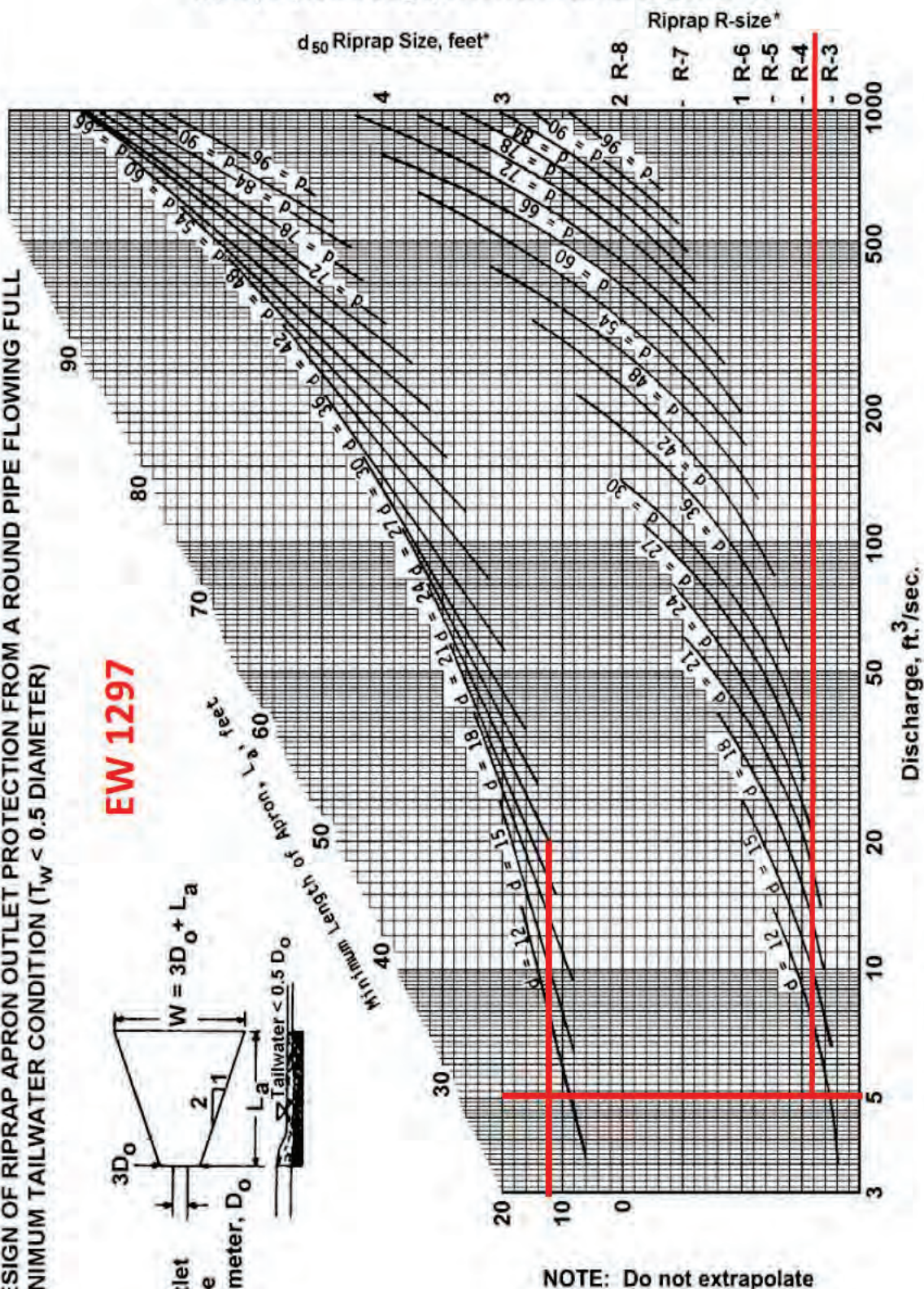
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1297



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: VT
 CHECKED BY: DATE: 7/5/2023
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1900

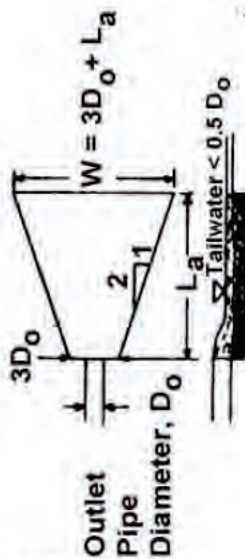
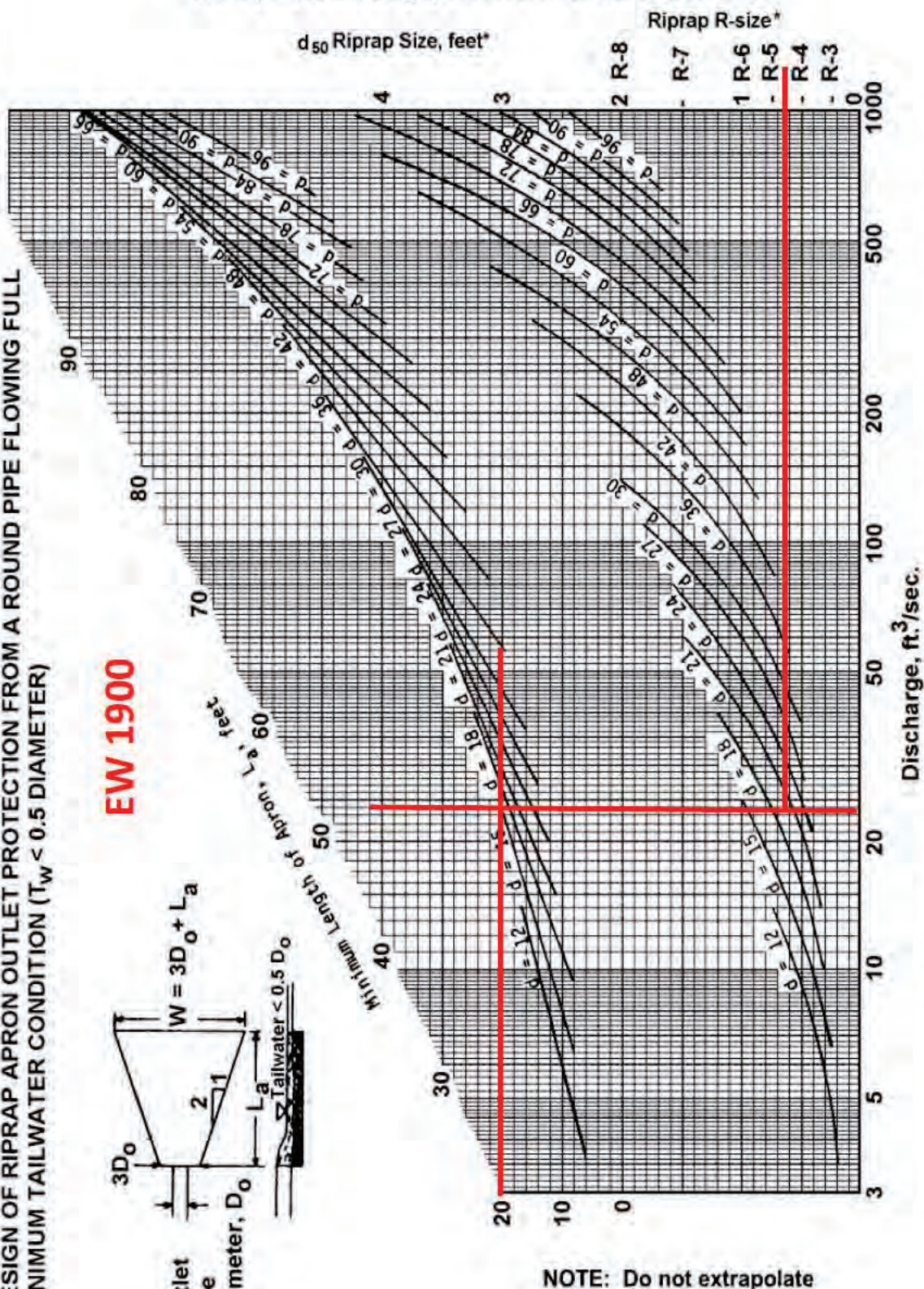


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

STANDARD WORKSHEET
Rip-Rap Apron Outlet Protection

PROJECT NAME:	NorthPoint Phase 2 - Building 5 Construction		
LOCATION:	Falls Township		Bucks County
PREPARED BY:	RCG	DATE:	10/7/2021
CHECKED BY:	DPB	DATE:	7/7/2022

METHODOLOGY:

Utilize *PA D.E.P. Erosion and Sediment Control Manual* to construct a Rock Apron at culvert, endwall, headwall or channel outfalls. First, tailwater condition must be determined (minimum or maximum). Second, with a known discharge, determine D50 rock size and length of apron "La". Third, determine the width and thickness of the apron. Lastly, ensure the permissible velocity of the rock size chosen is not exceeded by the velocity of the discharge entering the apron.

Equations Utilized:

Minimum Tailwater Condition: $W2 = 3do + La$

Maximum Tailwater Condition: $W2 = 3do + 0.4La$

Blanket Thickness: $T = 1.5 \cdot D_{max}$

Discharge (Q) and Velocity (V) - obtained from the 100 Year Storm

do = pipe diameter

Width 1 = initial width of apron at end of structure

Width 2 = terminal width of apron, W2

STRUCTURE DATA							RIP-RAP DATA			APRON DATA		
EW #	PIPE DIA. (in)	Tailwtr Cond. MIN/MAX	Mngs "n"	Pipe Slope (ft/ft)	Q (cfs)	V (fps)	D50 (in.)	ROCK SIZE	Rock T (in.)	La (ft)	W at pipe (ft)	W at tailwtr (ft)
1300	24	min	0.011	3.15%	9.65	3.07	6	R-4	18	12	6	18
1310	24	min	0.011	1.22%	14.14	4.50	6	R-4	18	12	6	18
1320	24	min	0.011	1.22%	14.12	4.50	6	R-4	18	12	6	18
1330	24	min	0.011	1.22%	15.07	4.80	6	R-4	18	12	6	18
1340	24	min	0.011	1.35%	10.91	3.47	6	R-4	18	12	6	18
1350	24	min	0.011	1.22%	14.14	4.50	6	R-4	18	12	6	18
1360	24	min	0.011	1.22%	14.12	4.50	6	R-4	18	12	6	18
1370	24	min	0.011	1.22%	15.68	4.99	6	R-4	18	12	6	18
1380	30	min	0.011	0.53%	25.64	5.45	6	R-4	18	16	7.5	23.5
1390	30	min	0.011	0.85%	23.15	5.76	6	R-4	18	12	7.5	19.5
1400	30	min	0.011	0.92%	23.35	5.79	6	R-4	18	12	7.5	19.5
1410	30	min	0.011	1.08%	17.18	4.79	6	R-4	18	12	7.5	19.5
1420	30	min	0.011	0.85%	19.93	4.79	6	R-4	18	12	7.5	19.5
1430	30	min	0.011	0.56%	25.68	5.56	6	R-4	18	12	7.5	19.5
1440	30	min	0.011	0.78%	26.05	6.23	6	R-4	18	12	7.5	19.5
1450	30	min	0.011	1.08%	17.18	4.79	6	R-4	18	12	7.5	19.5
1460	24	min	0.011	7.64%	6.64	3.44	6	R-4	18	12	6	18
1470	24	min	0.011	5.56%	13.64	5.25	6	R-4	18	12	6	18
1480	18	min	0.011	2.54%	2.92	3.03	6	R-4	18	12	4.5	16.5
1490	18	min	0.011	5.59%	1.63	2.14	6	R-4	18	12	4.5	16.5
1500	18	min	0.011	2.10%	2.02	4.76	6	R-4	18	12	4.5	16.5
1510	18	min	0.011	3.74%	3.83	2.17	6	R-4	18	12	4.5	16.5
1520	24	min	0.011	2.44%	15.90	5.06	6	R-4	18	12	6	18
1530	24	min	0.011	3.54%	10.85	3.46	6	R-4	18	12	6	18
1950	18	min	0.011	2.34%	6.13	5.14	6	R-4	18	12	4.5	16.5
1960	18	min	0.011	2.35%	6.13	5.14	6	R-4	18	12	4.5	16.5

Note: Rock size selected has been increased from the suggested d50 values based upon flow (Q) and/or velocity parameters. Energy Dissipator shall be hand placed and dimensions adjusted to conform to the existing roadside conveyance.

Stone larger than R-4 shall have stone filter blanket installed prior to the rip-rap in lieu of non-woven geotextile. Filter stone shall meet the following requirements:

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1300

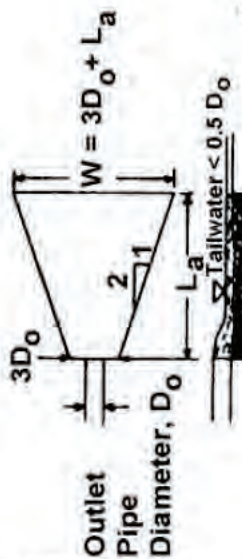
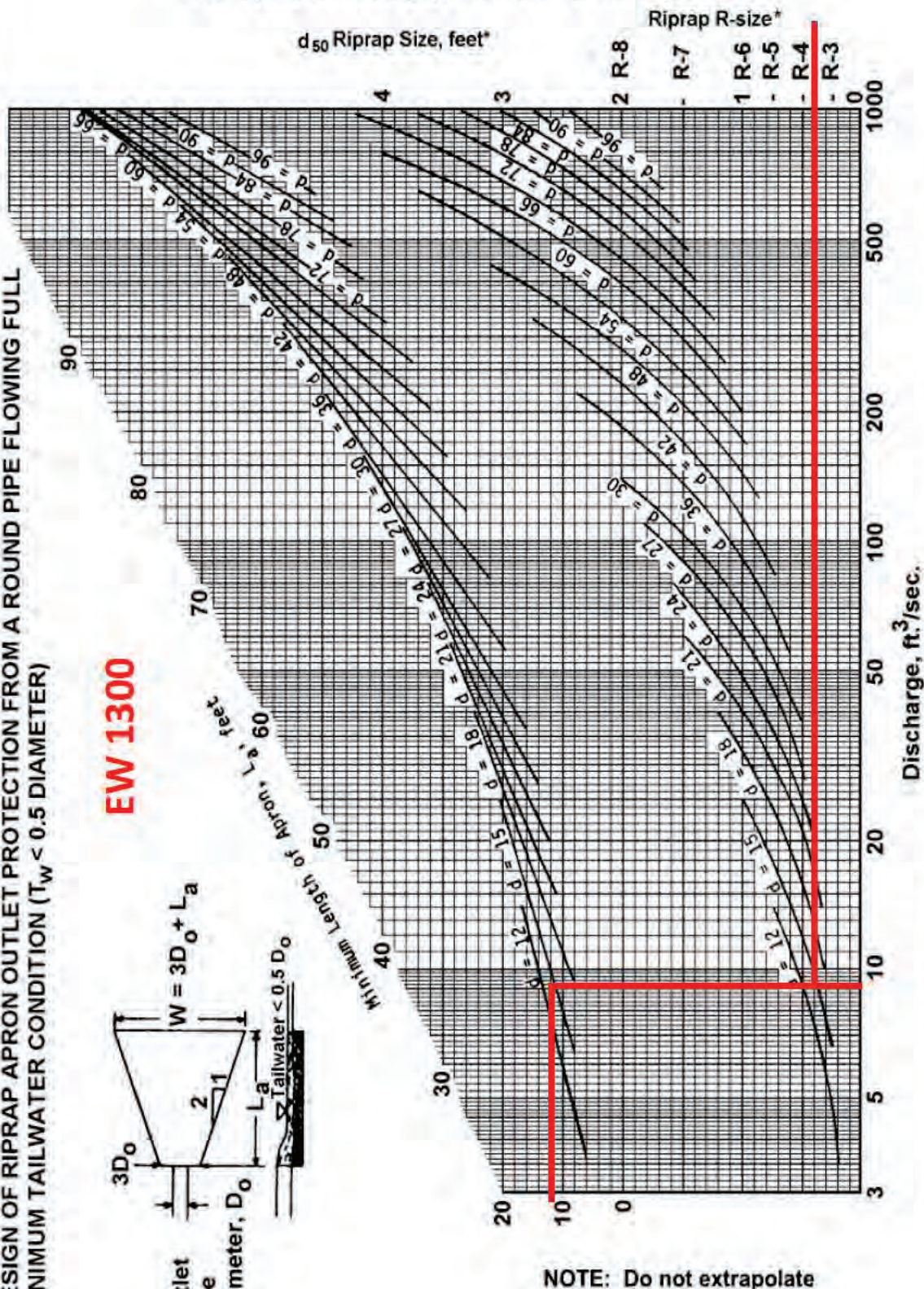


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY:

DATE: 10/7/2021

DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1310

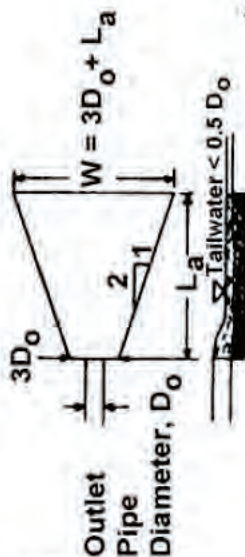
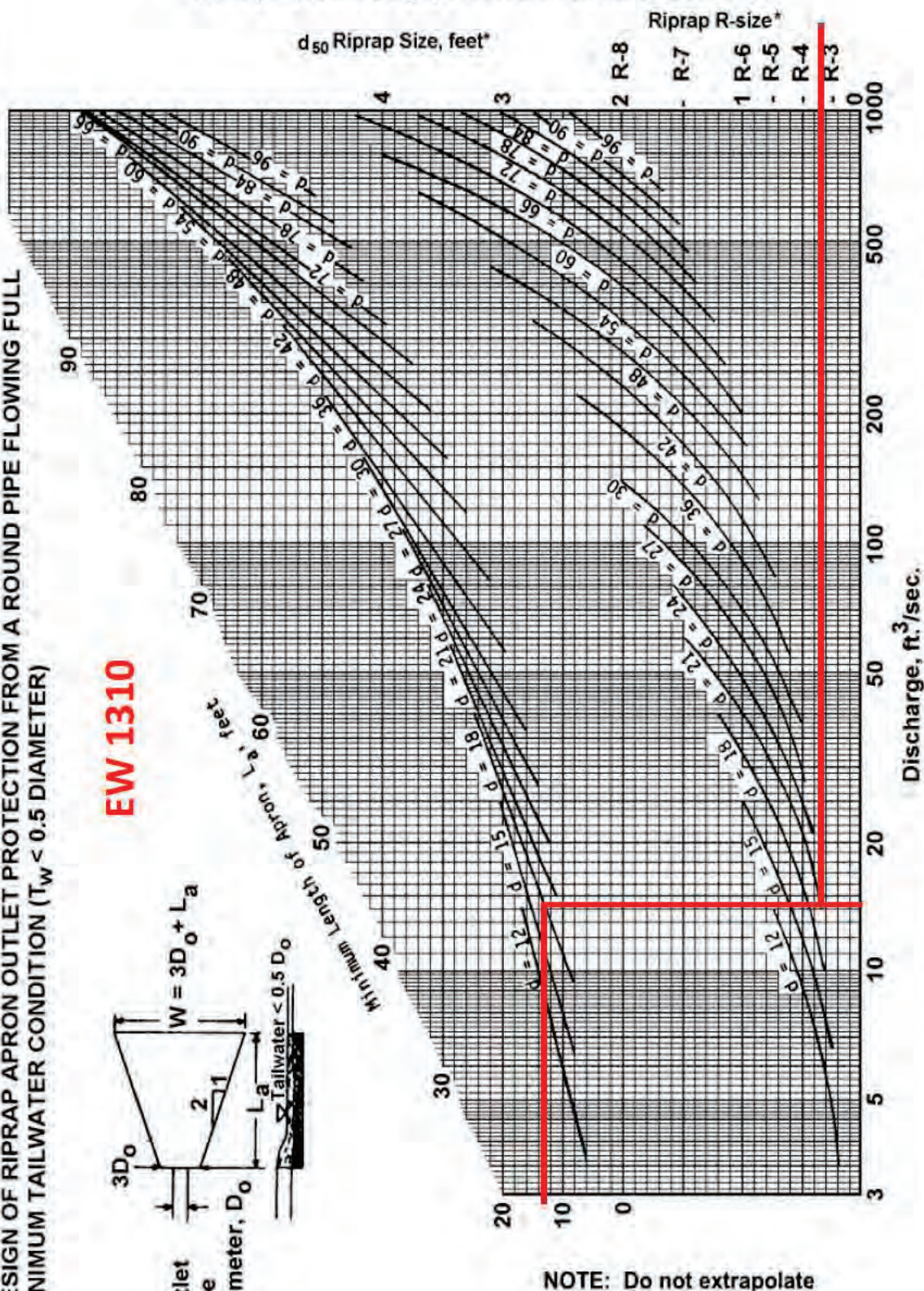


FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



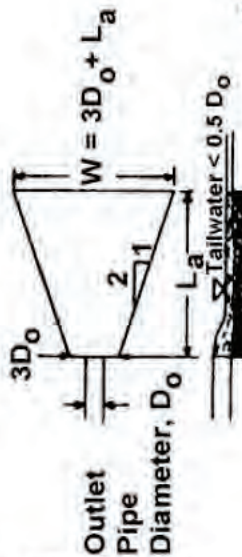
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021

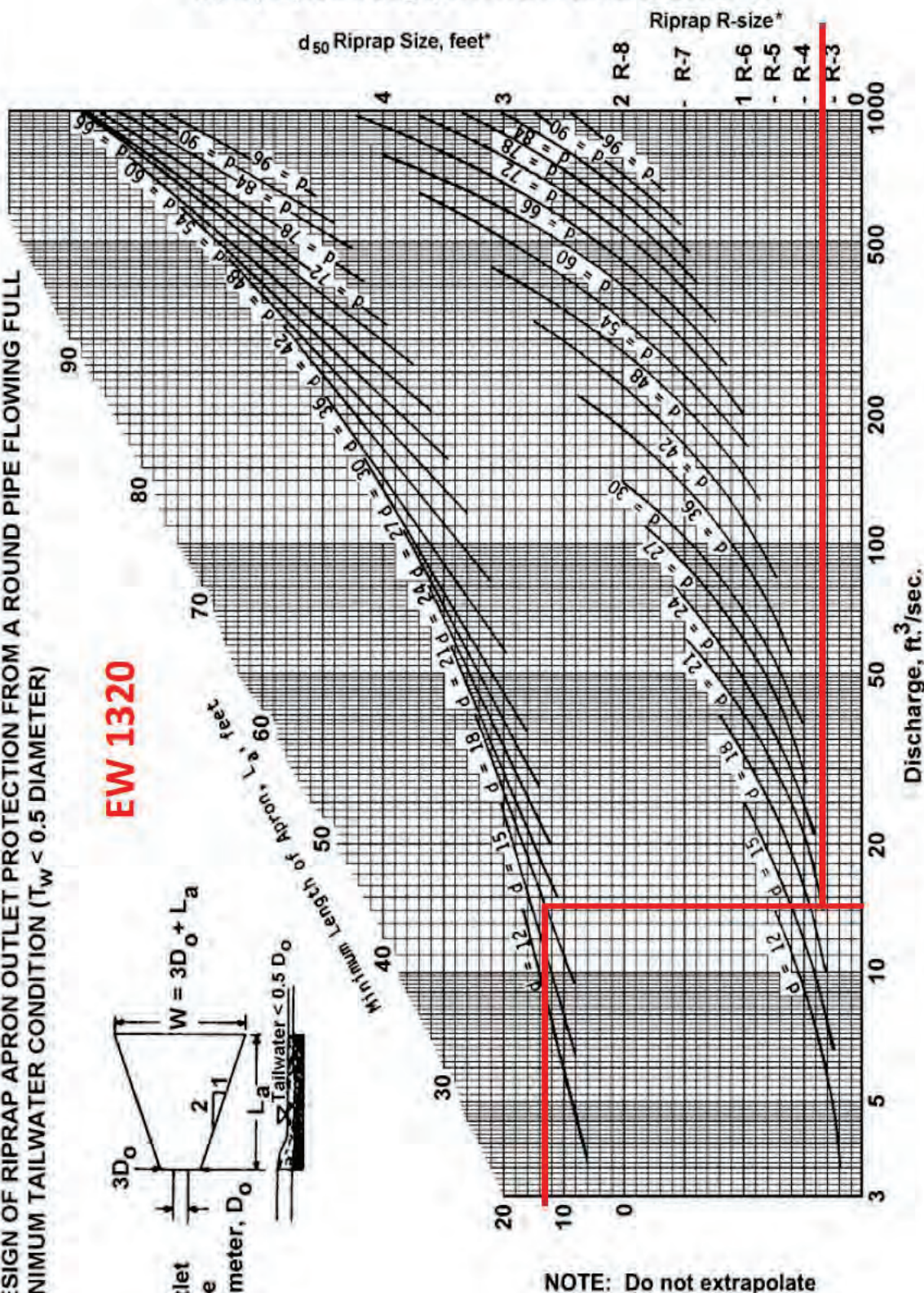
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1320



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY:

DATE: 10/7/2021

DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1330

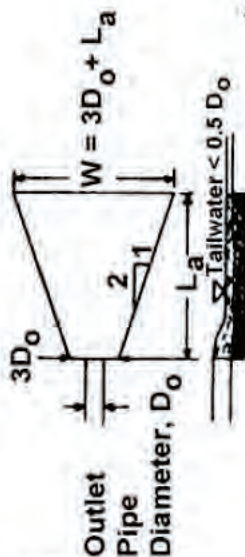
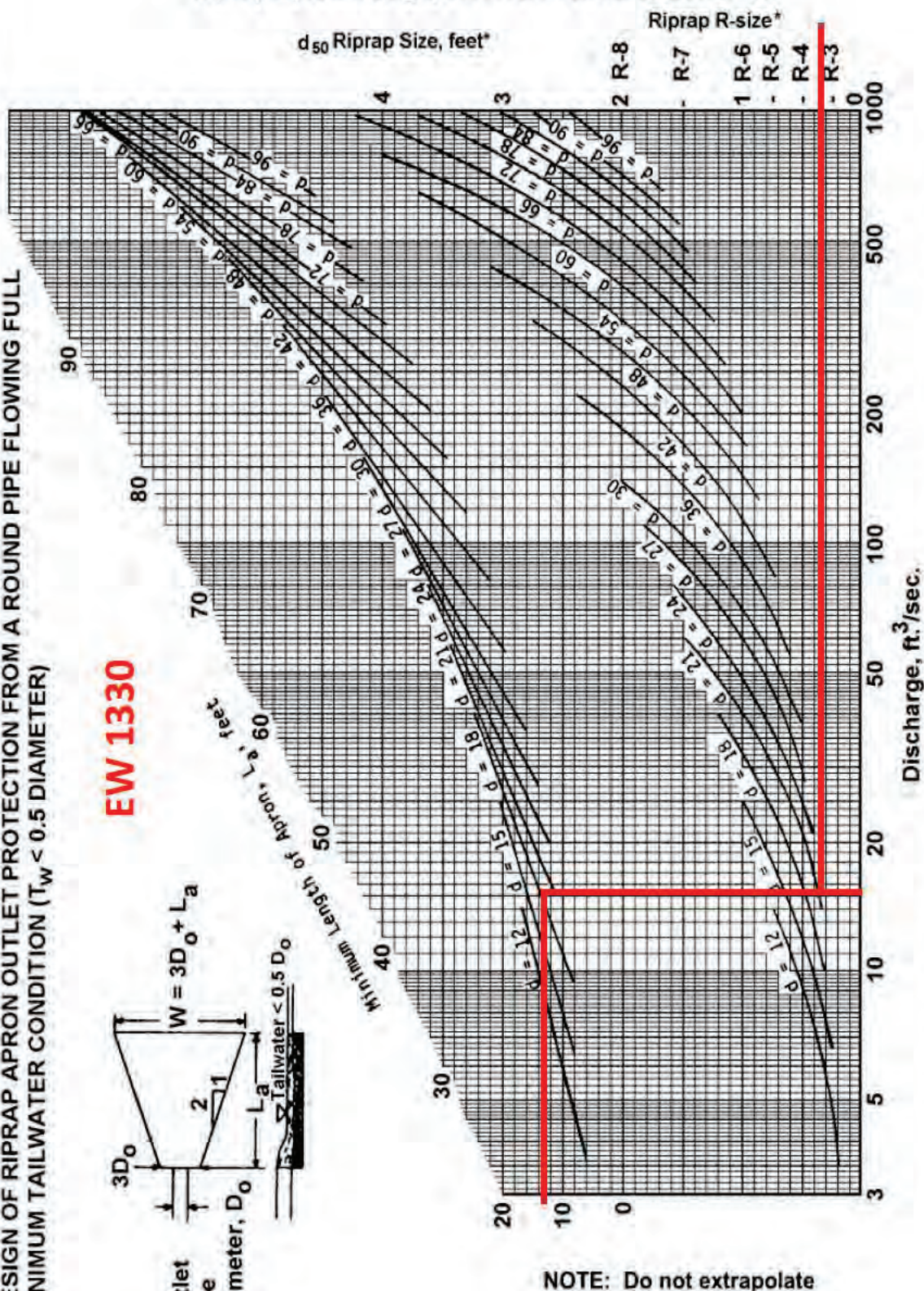


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

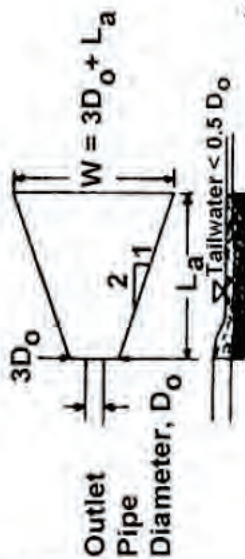


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

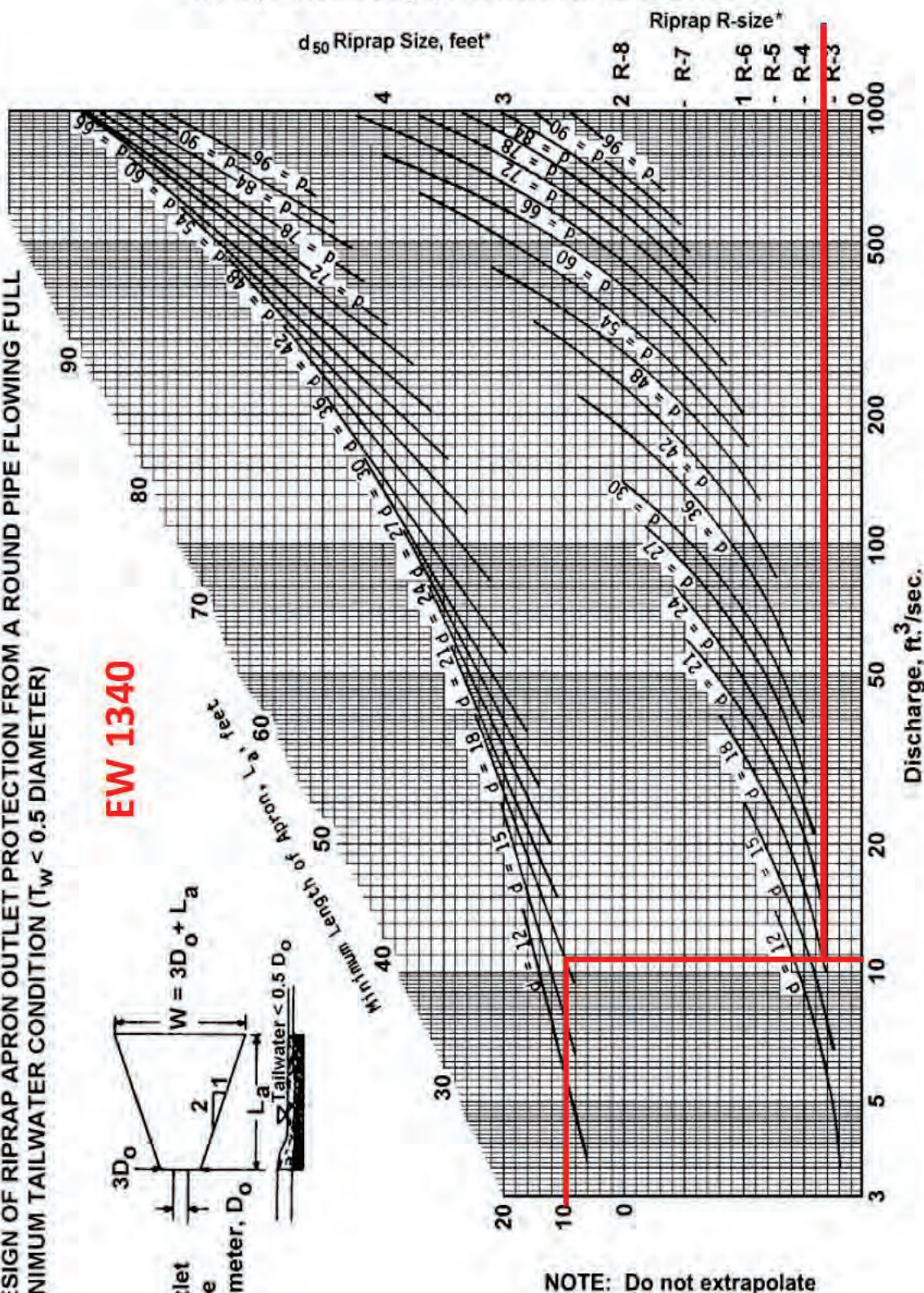
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1340



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



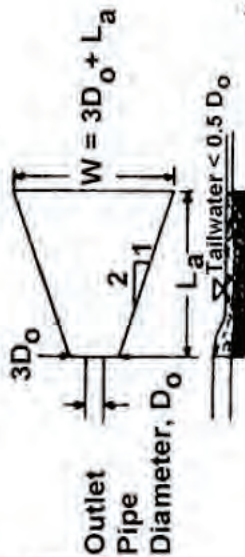
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

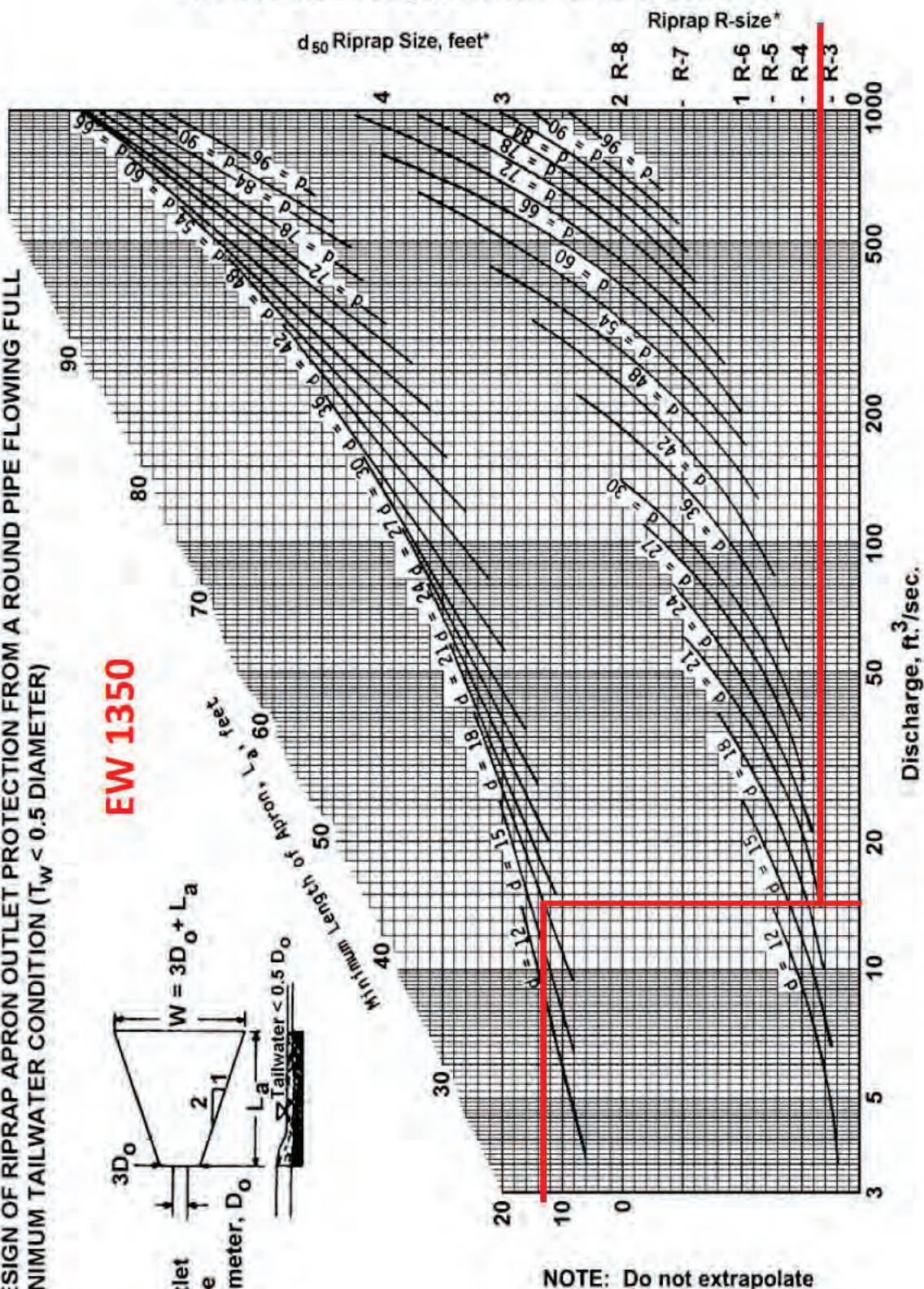
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1350



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

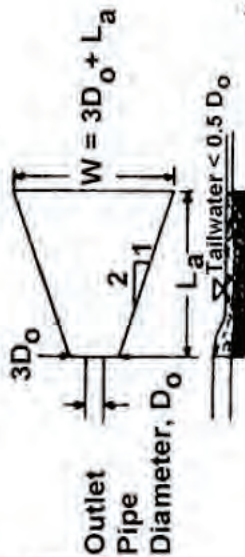


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

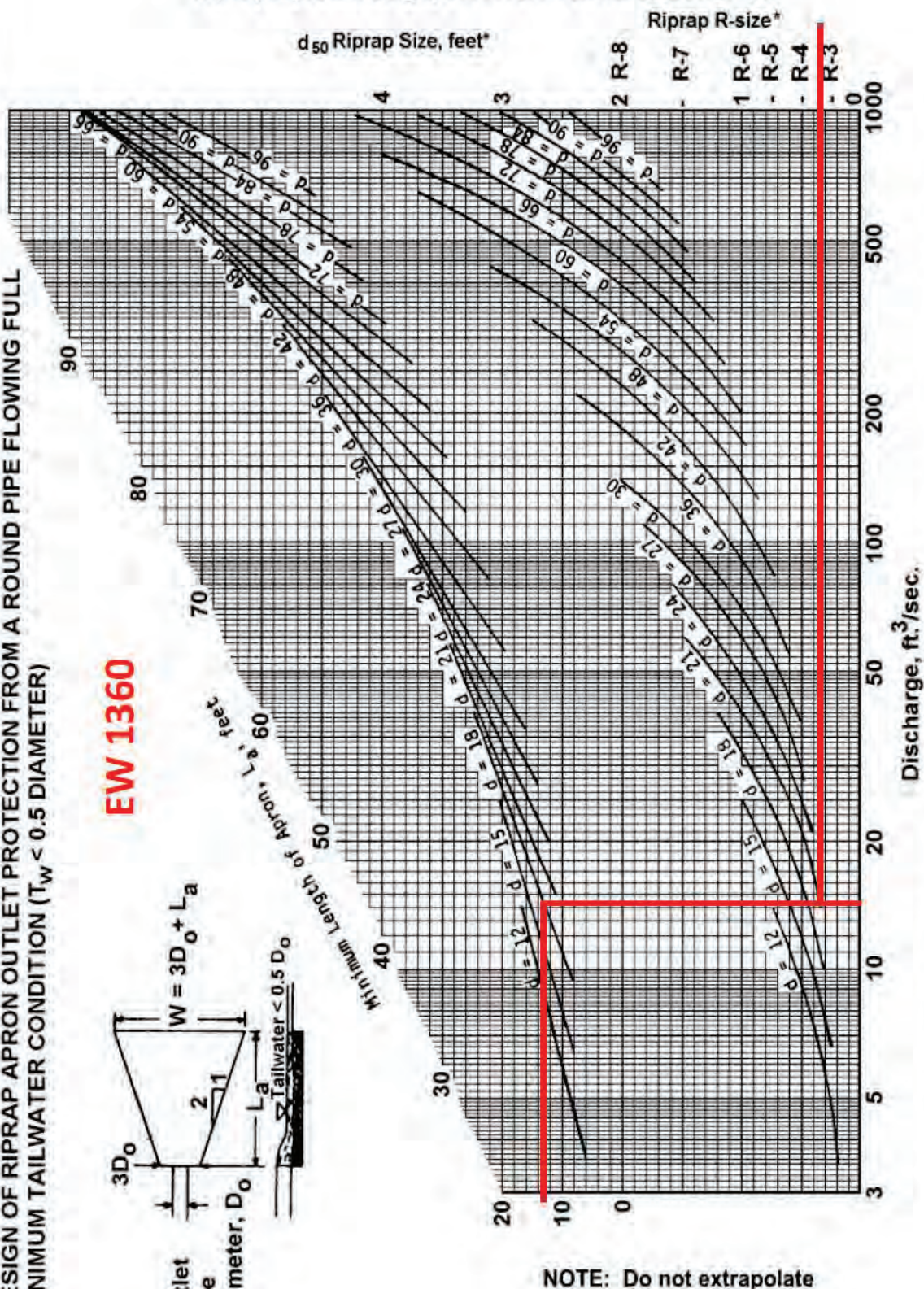
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1360



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

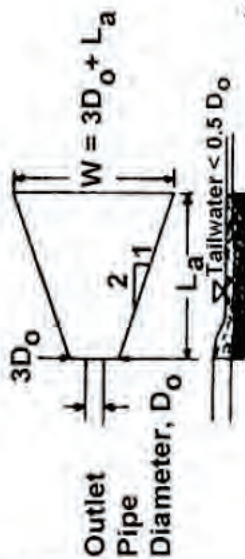


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

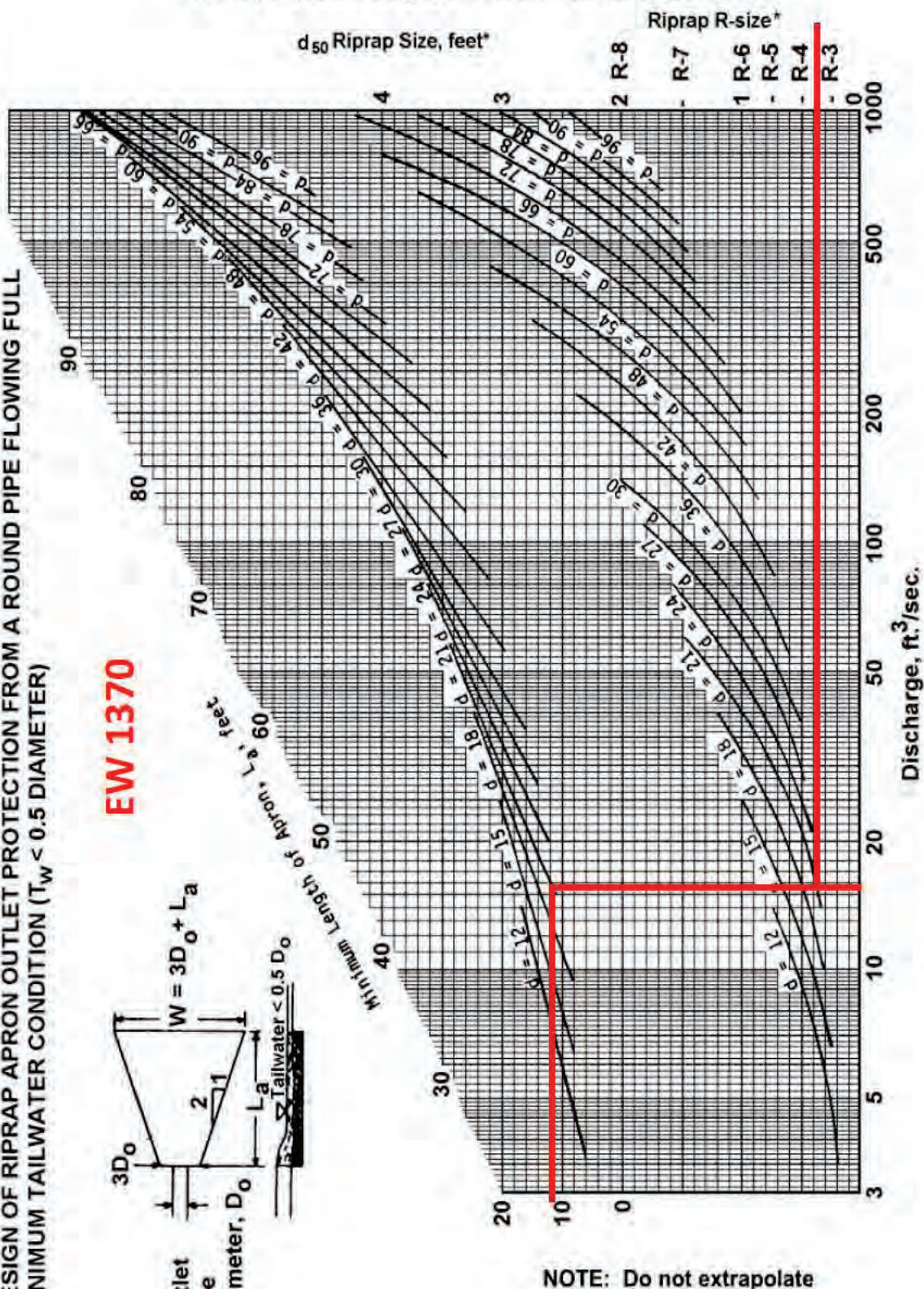
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1370



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

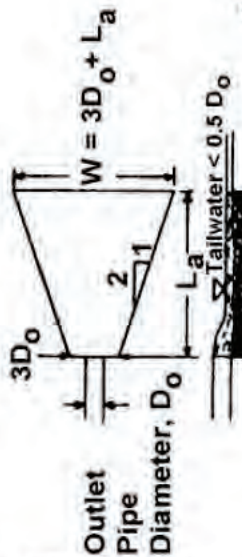


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

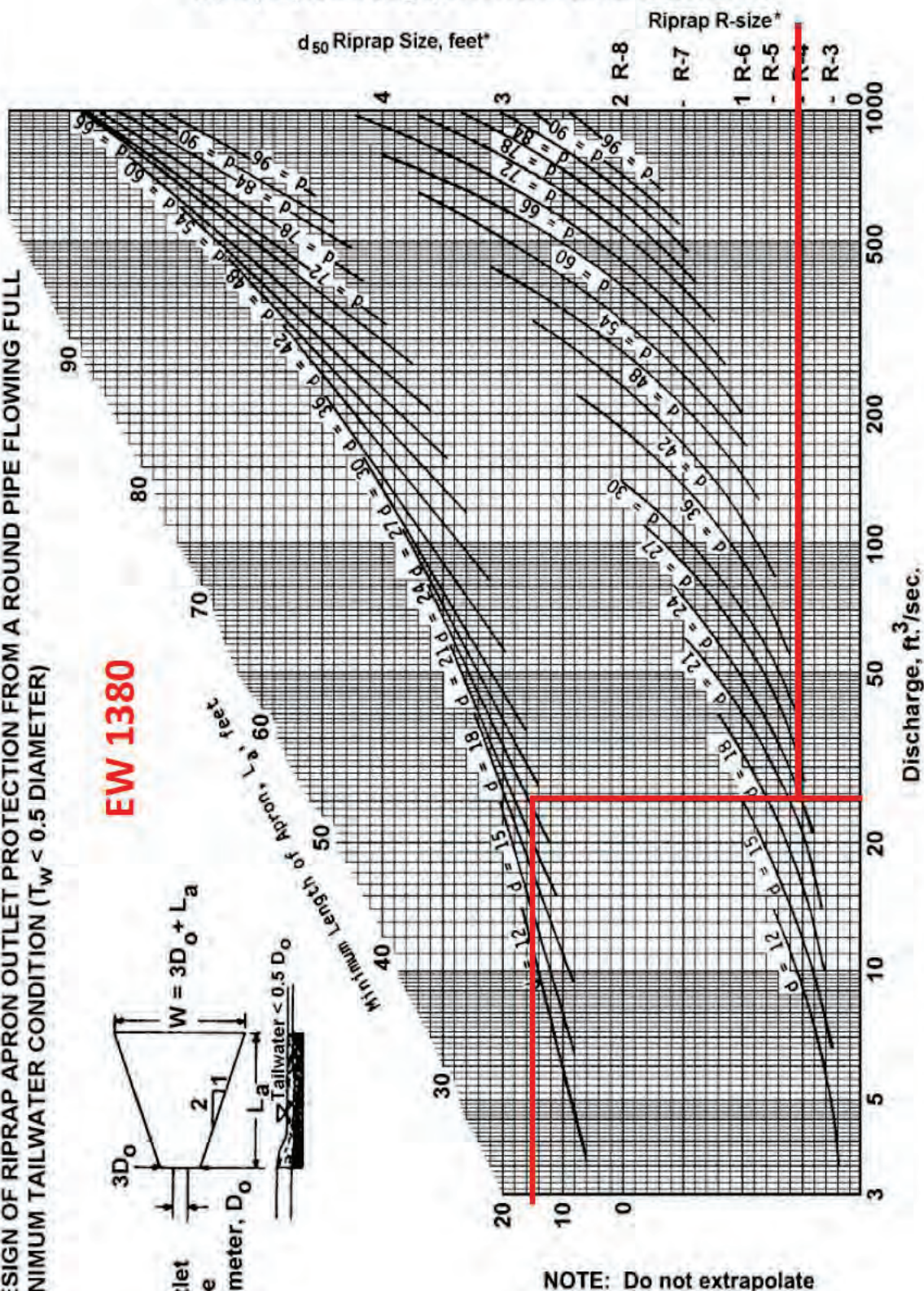
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1380



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

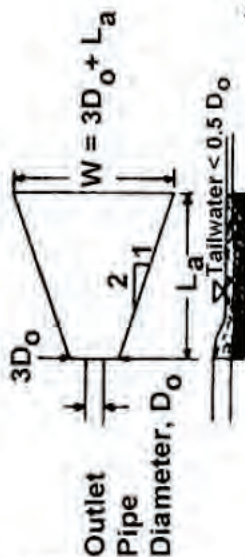


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

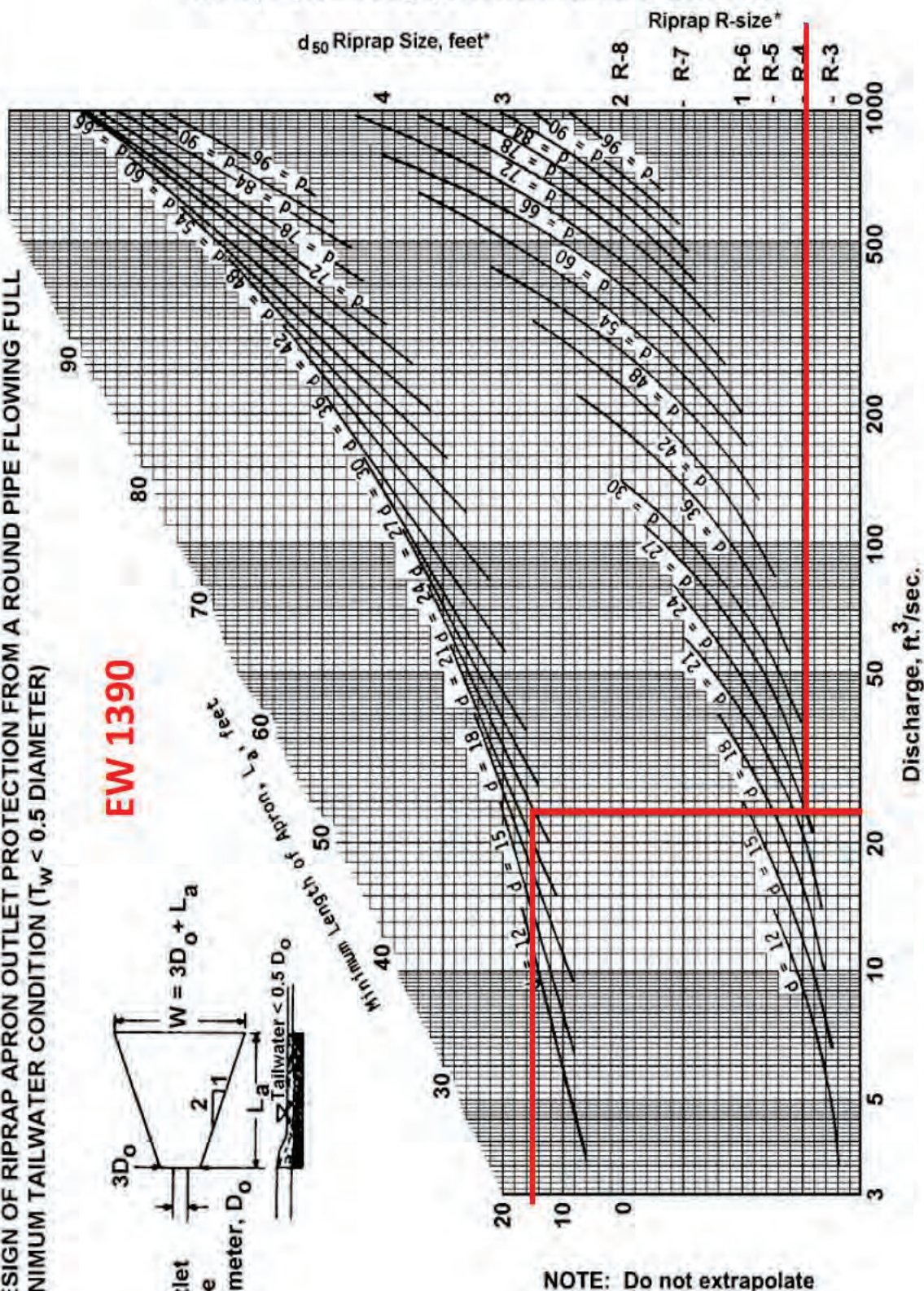
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1390



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

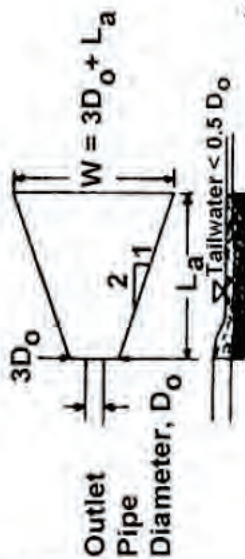


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

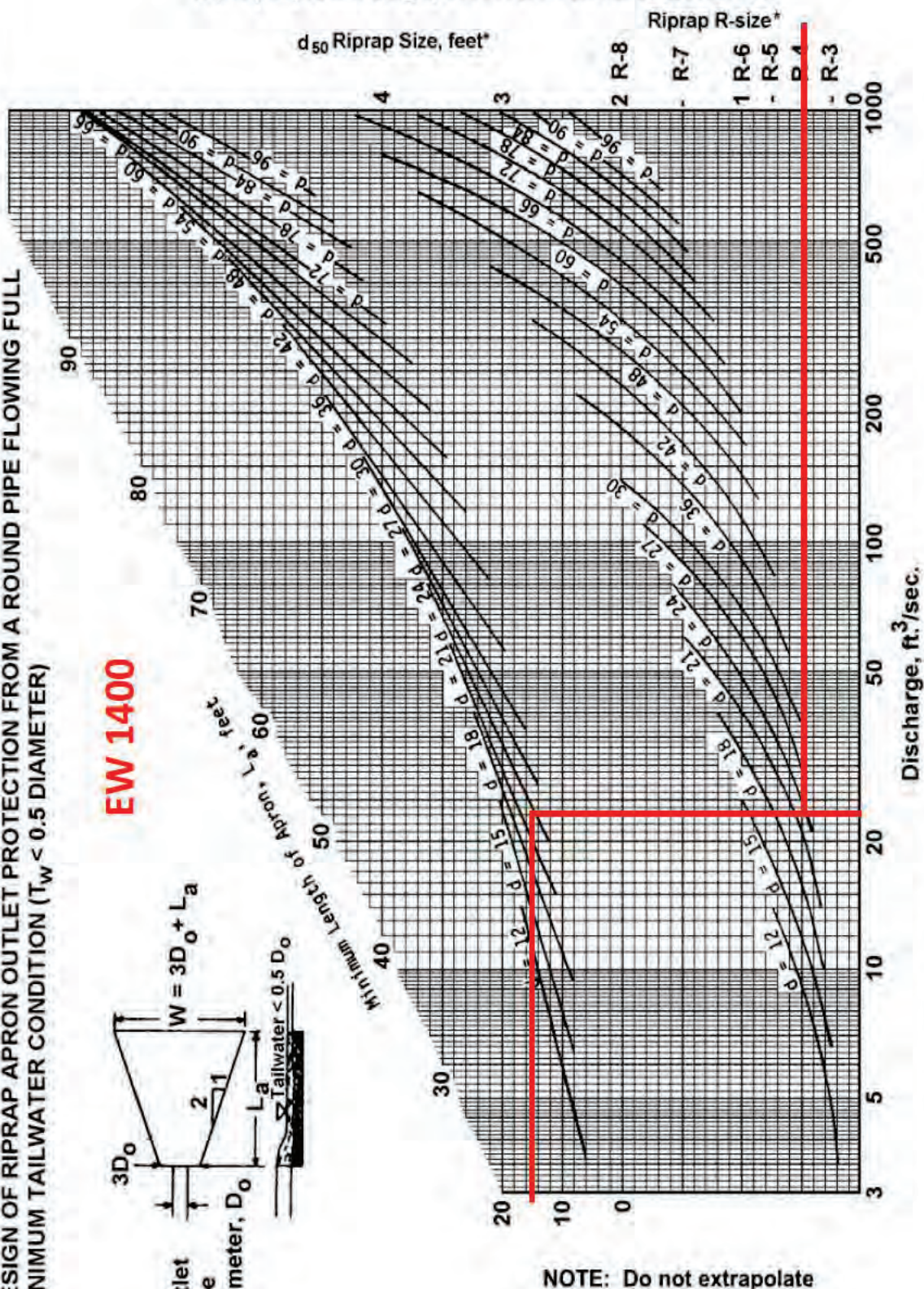
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1400



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

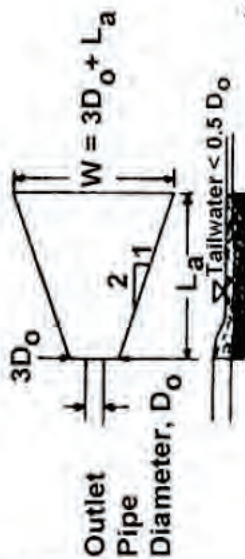


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

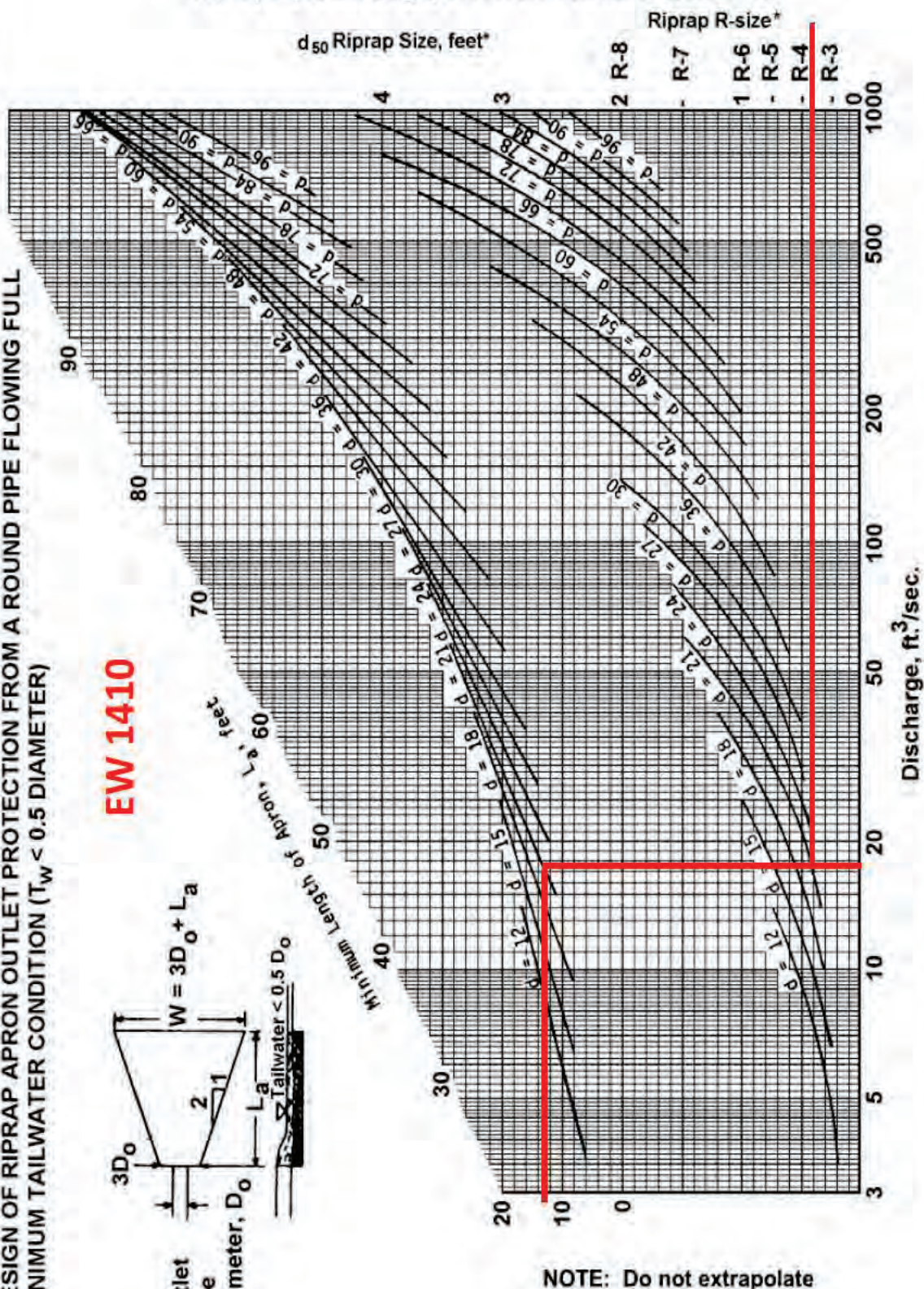
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1410



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

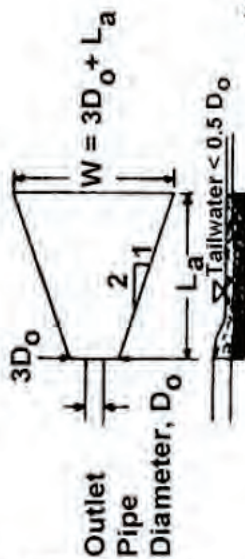


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

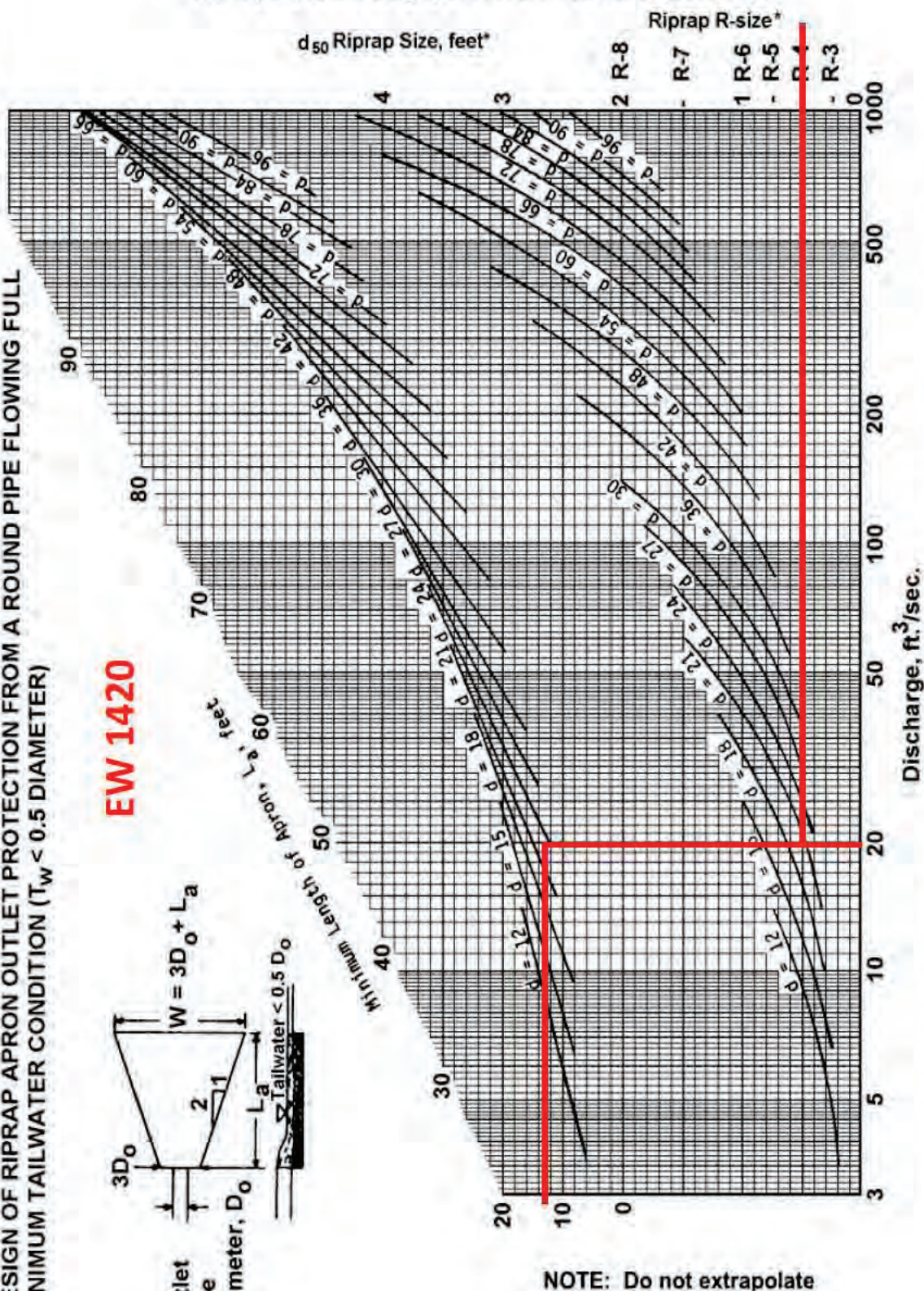
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1420



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



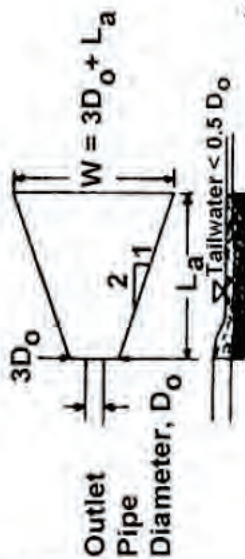
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021

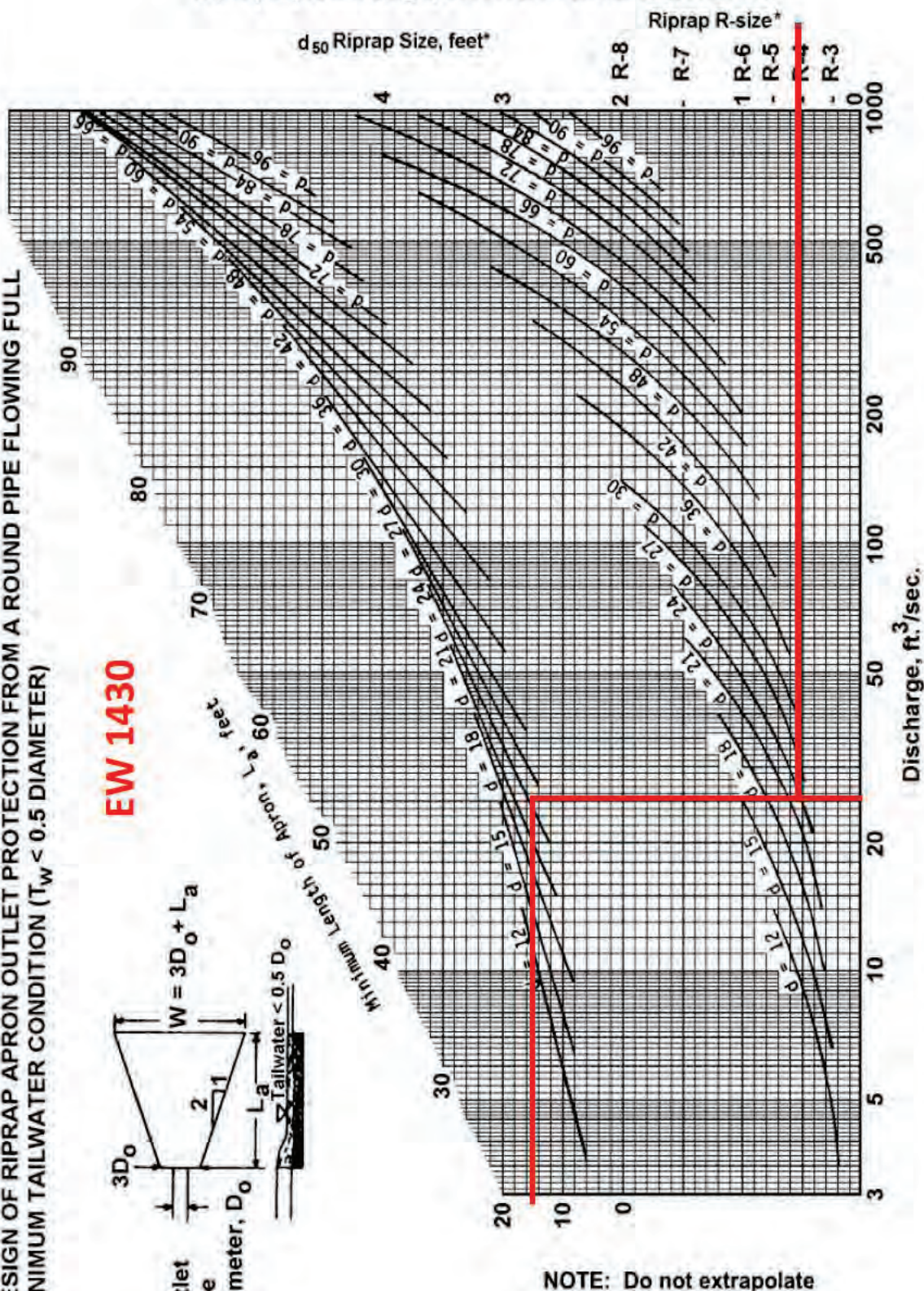
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1430



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1440

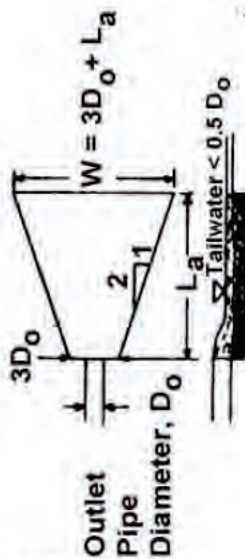
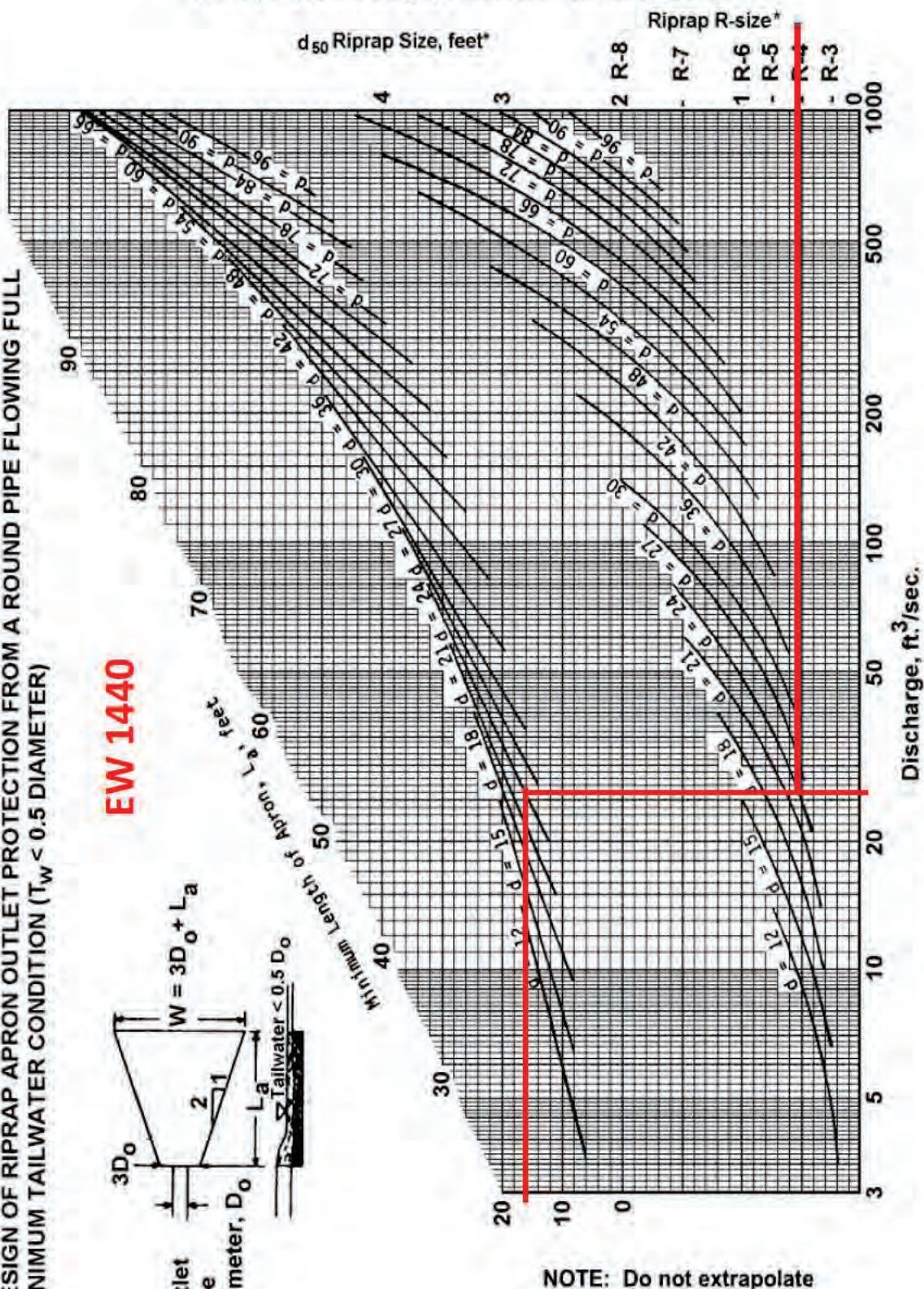


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



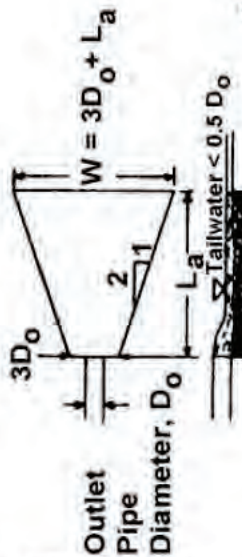
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

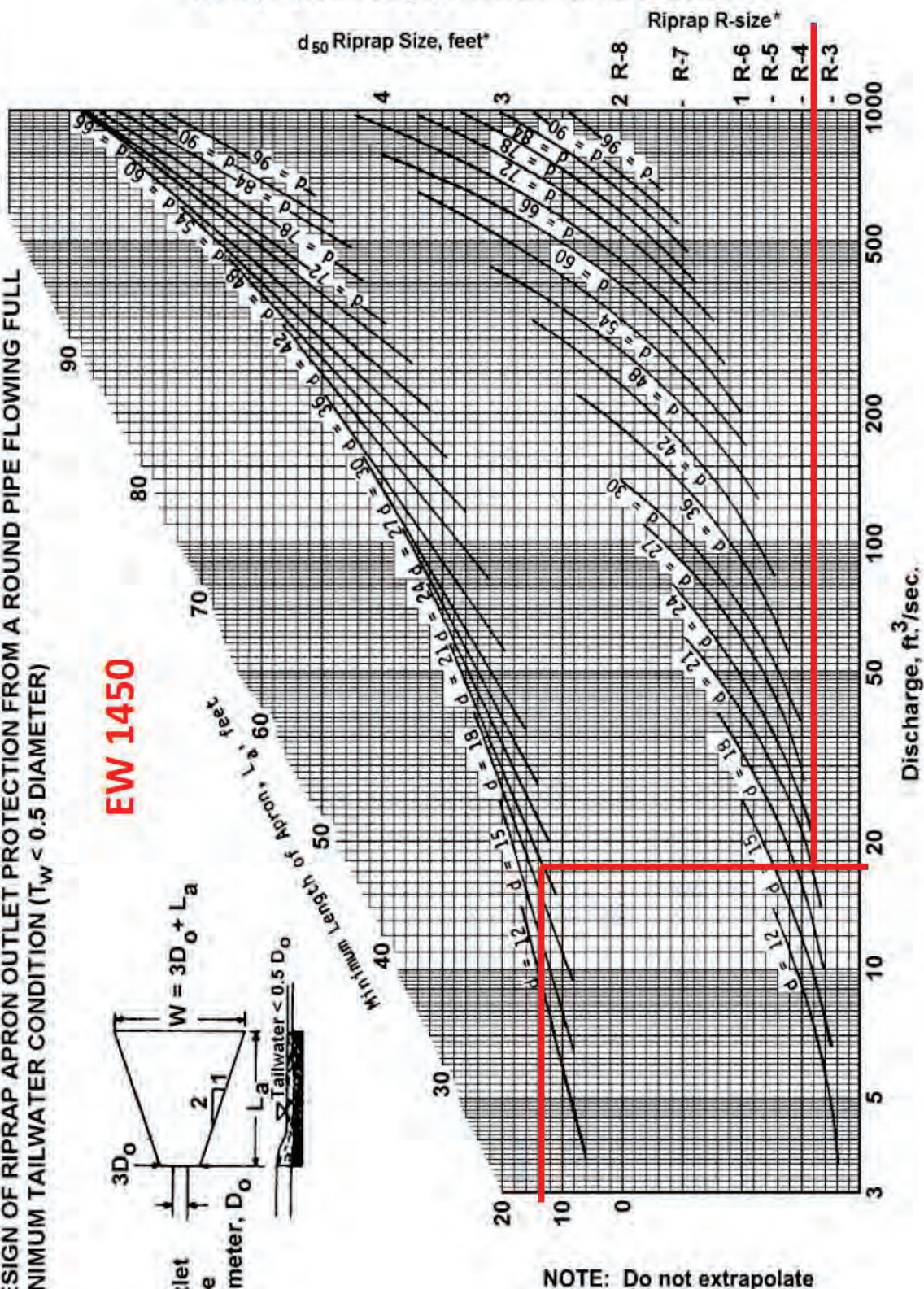
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1450



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

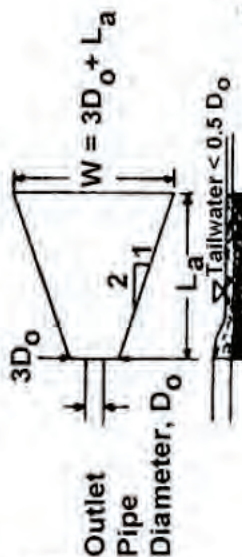
PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY:

DATE: 10/7/2021

DATE:

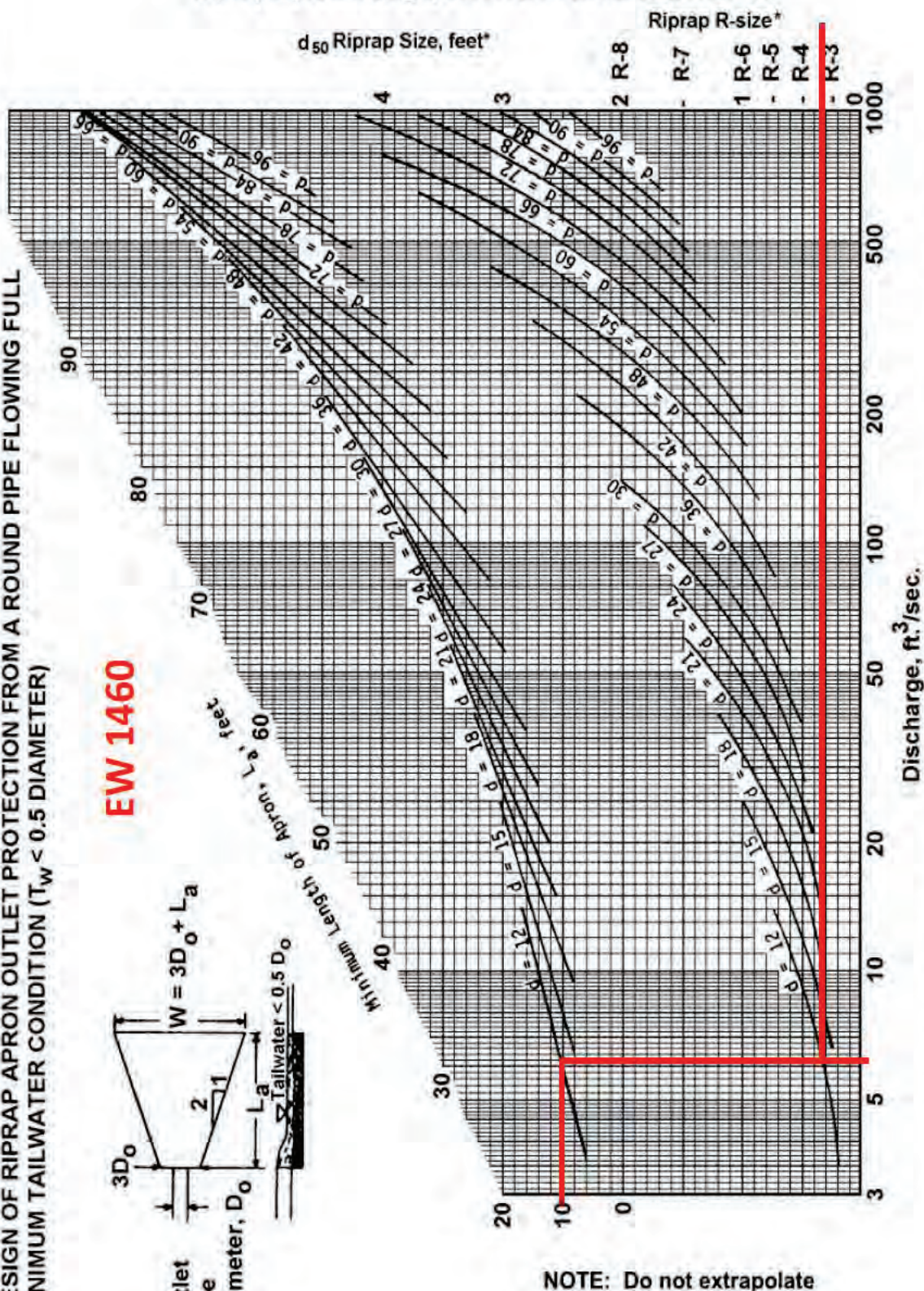
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1460



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

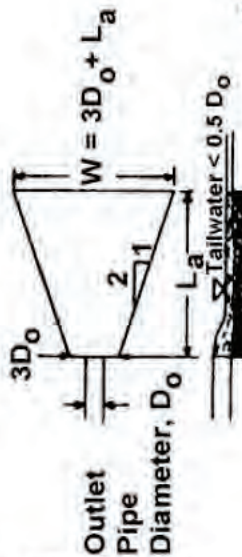


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

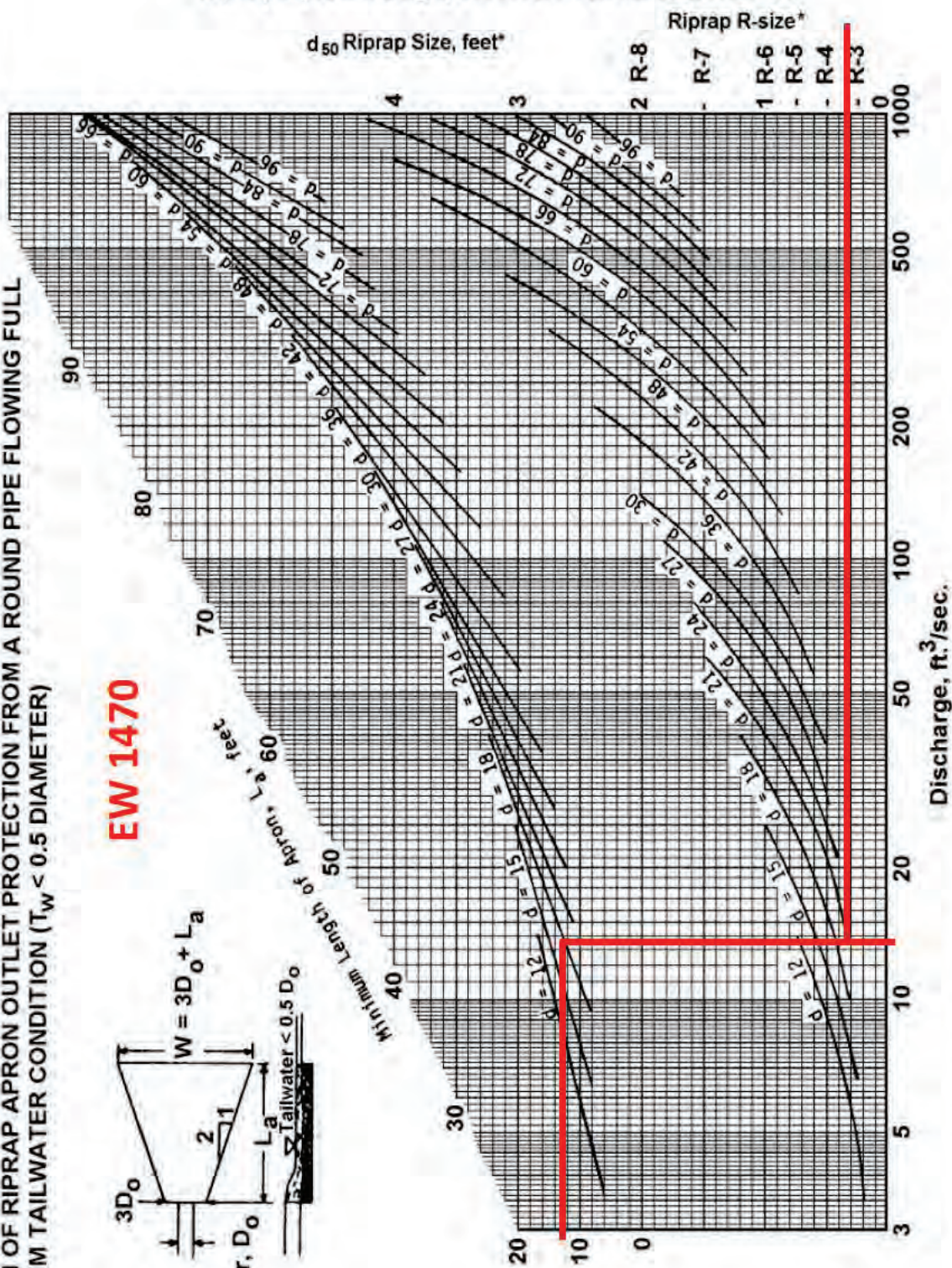
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1470



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

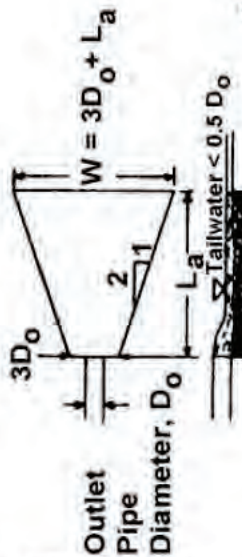


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

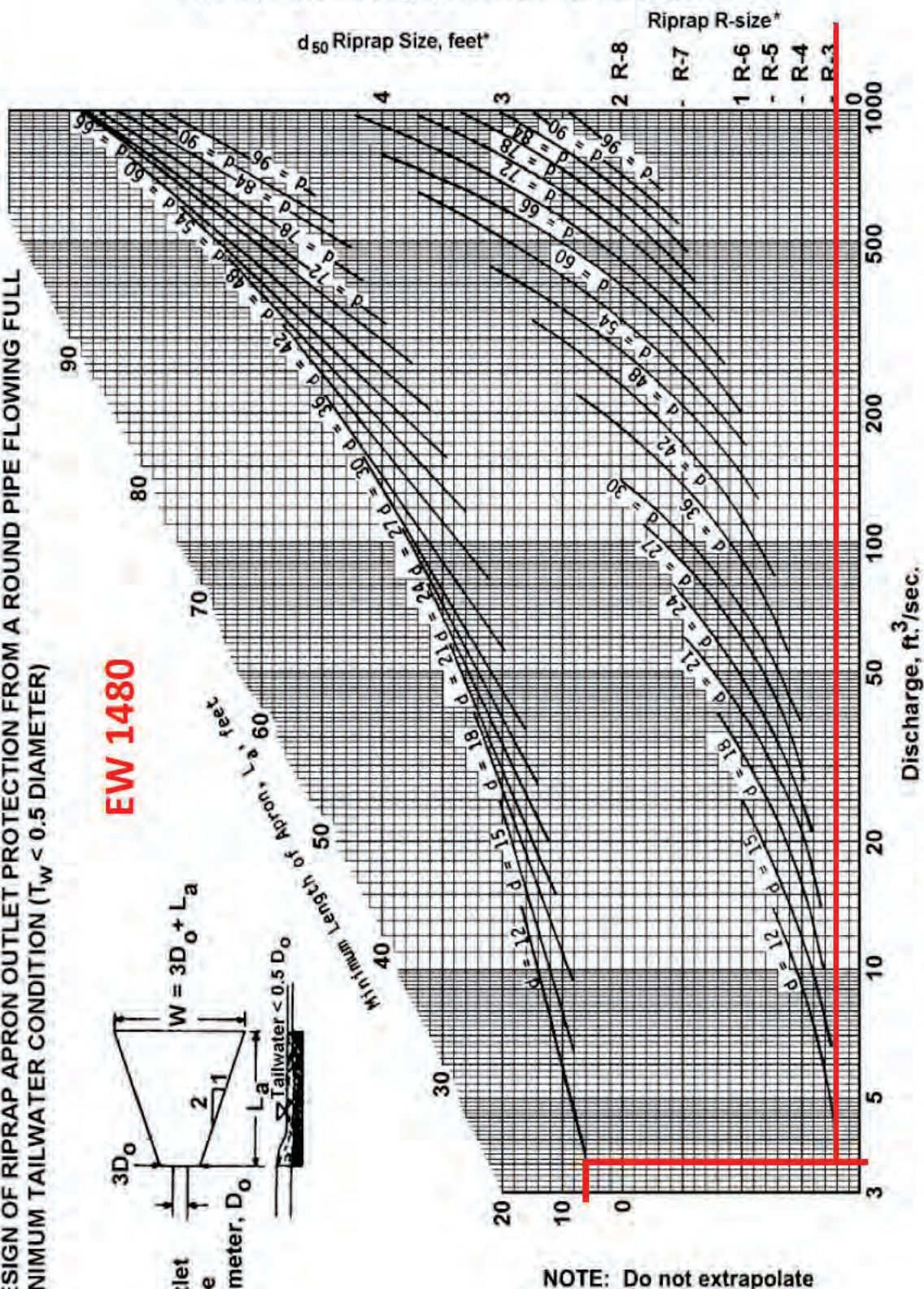
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1480



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

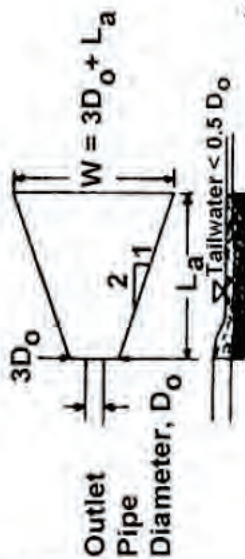


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

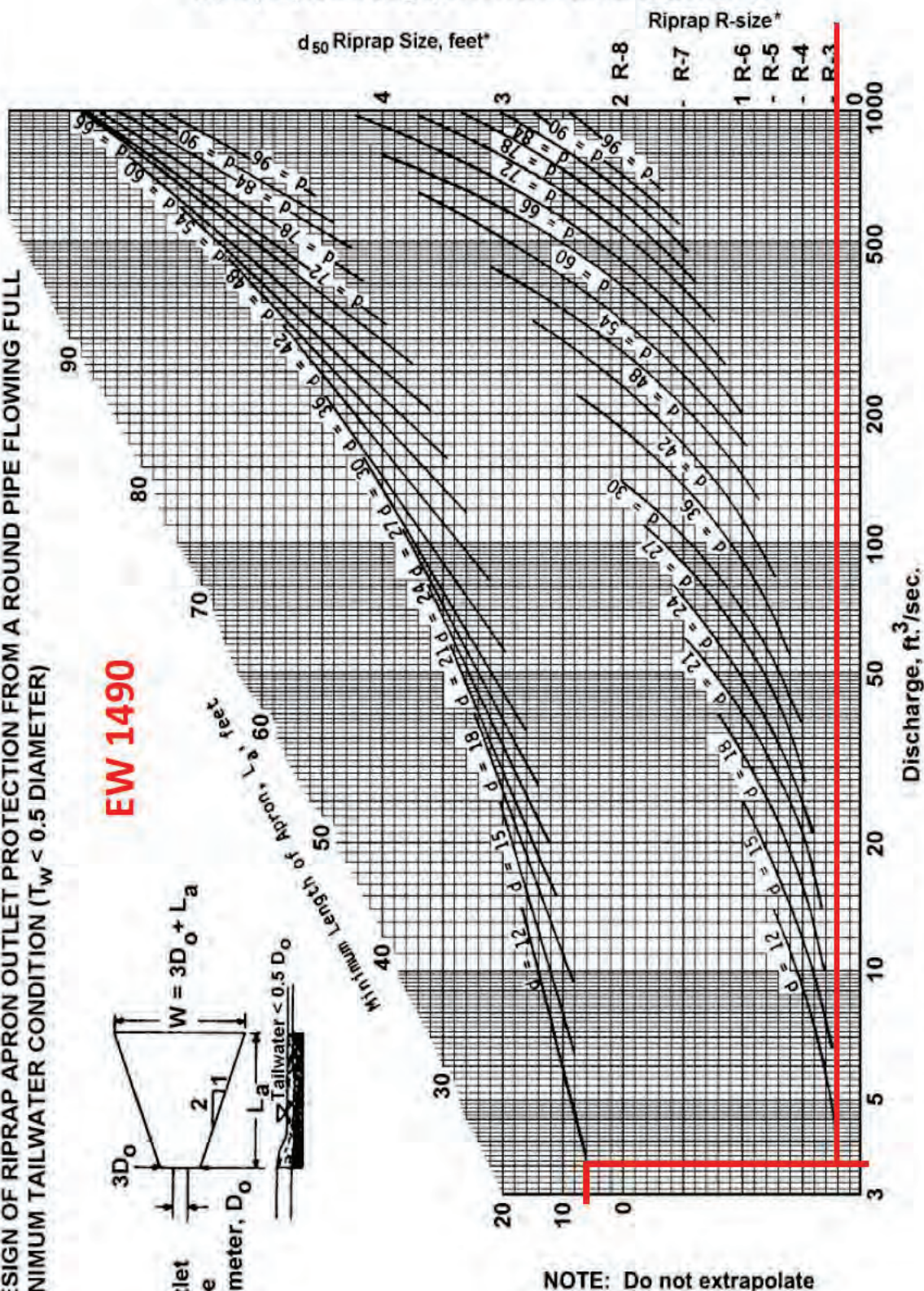
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1490



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

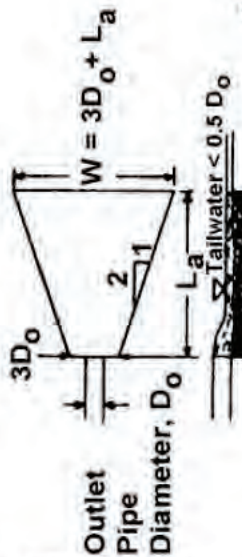


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

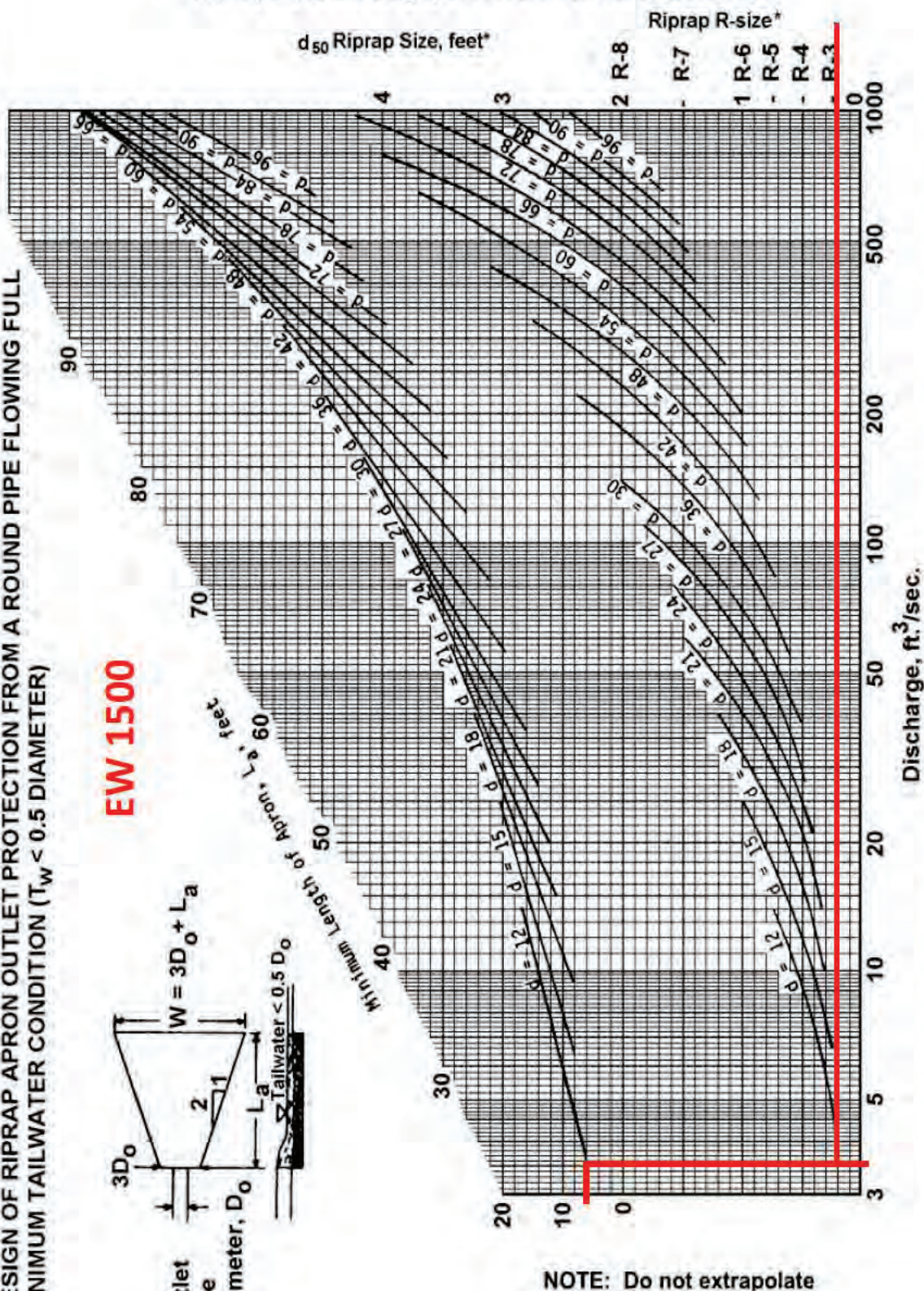
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1500



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



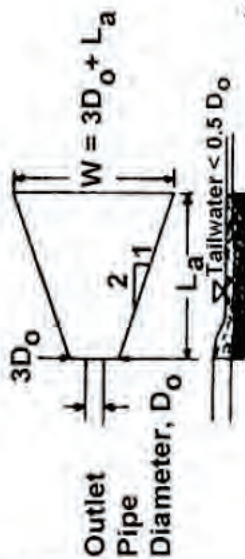
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

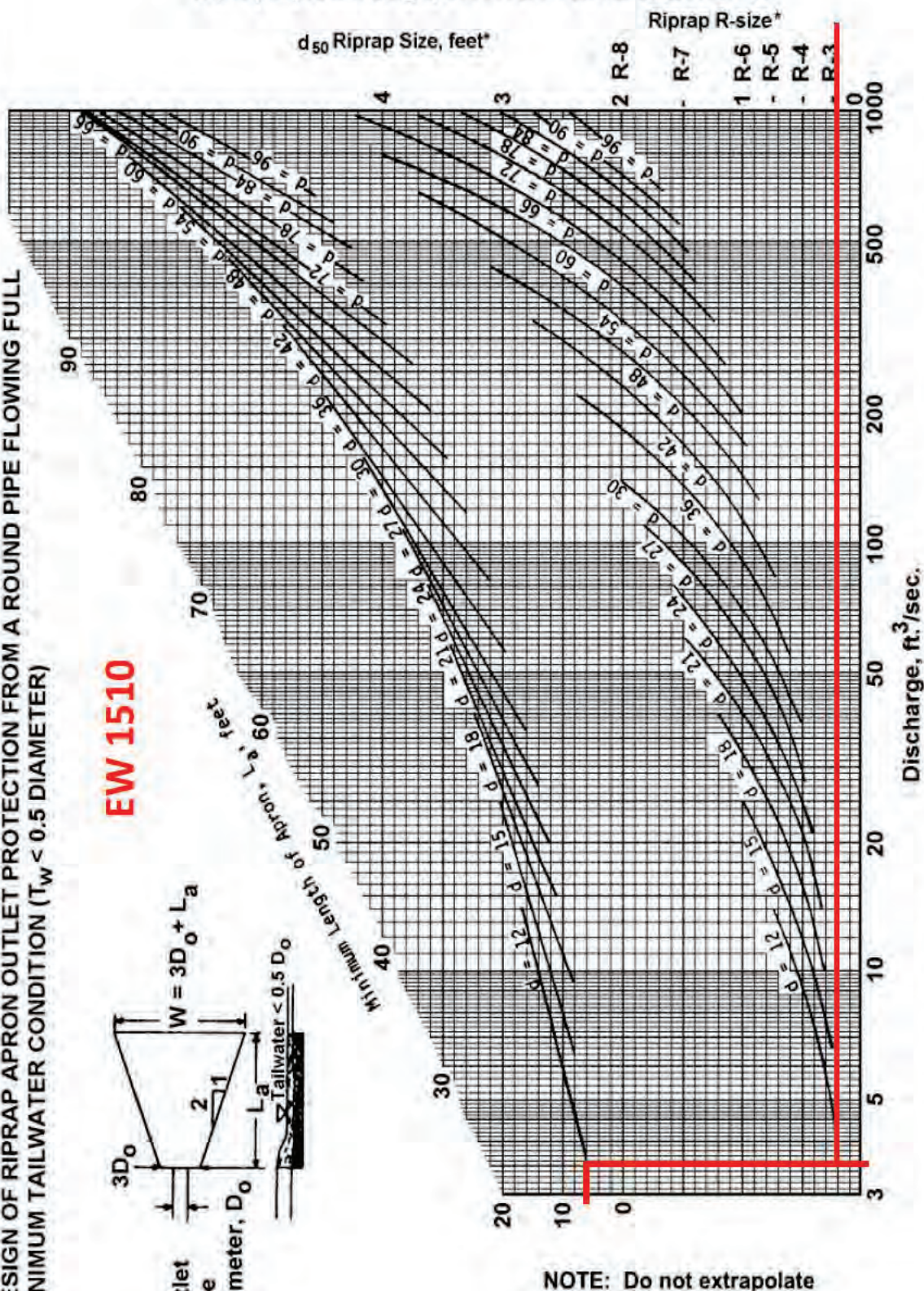
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1510



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

Adapted from USDA - NRCS

EW 1520

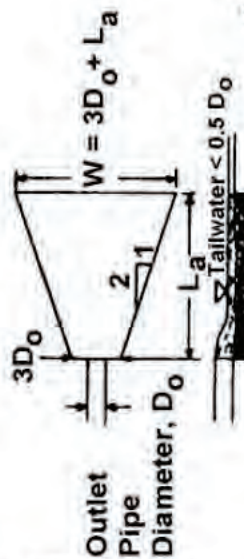
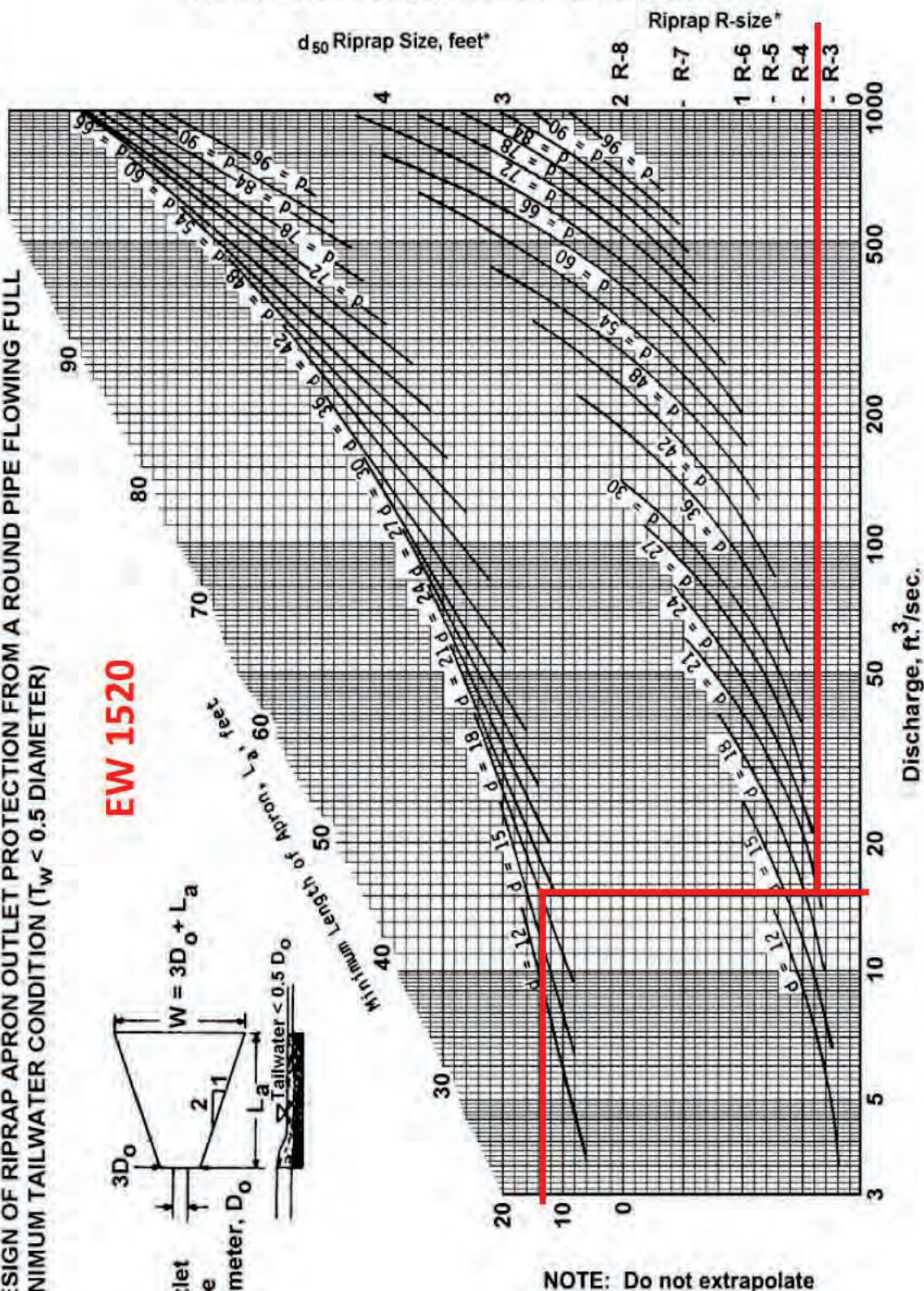


FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



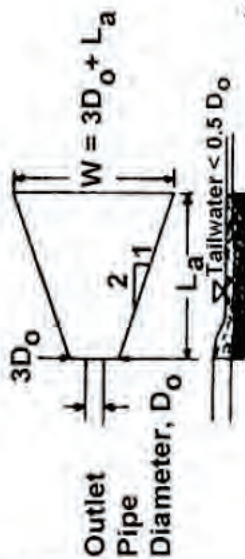
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

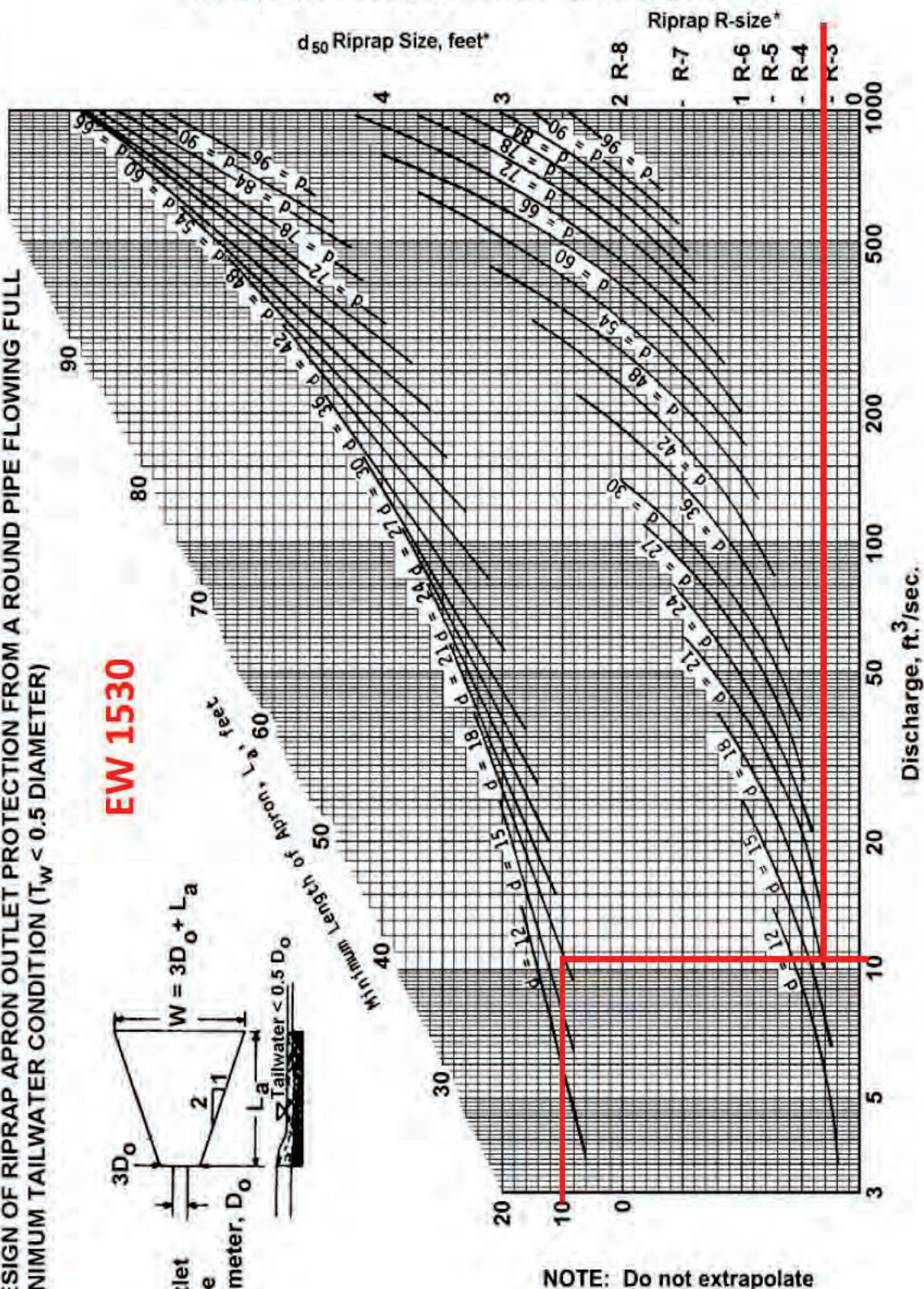
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1530



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



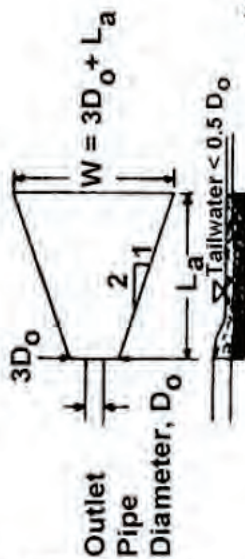
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY: DATE: 10/7/2021
 DATE:

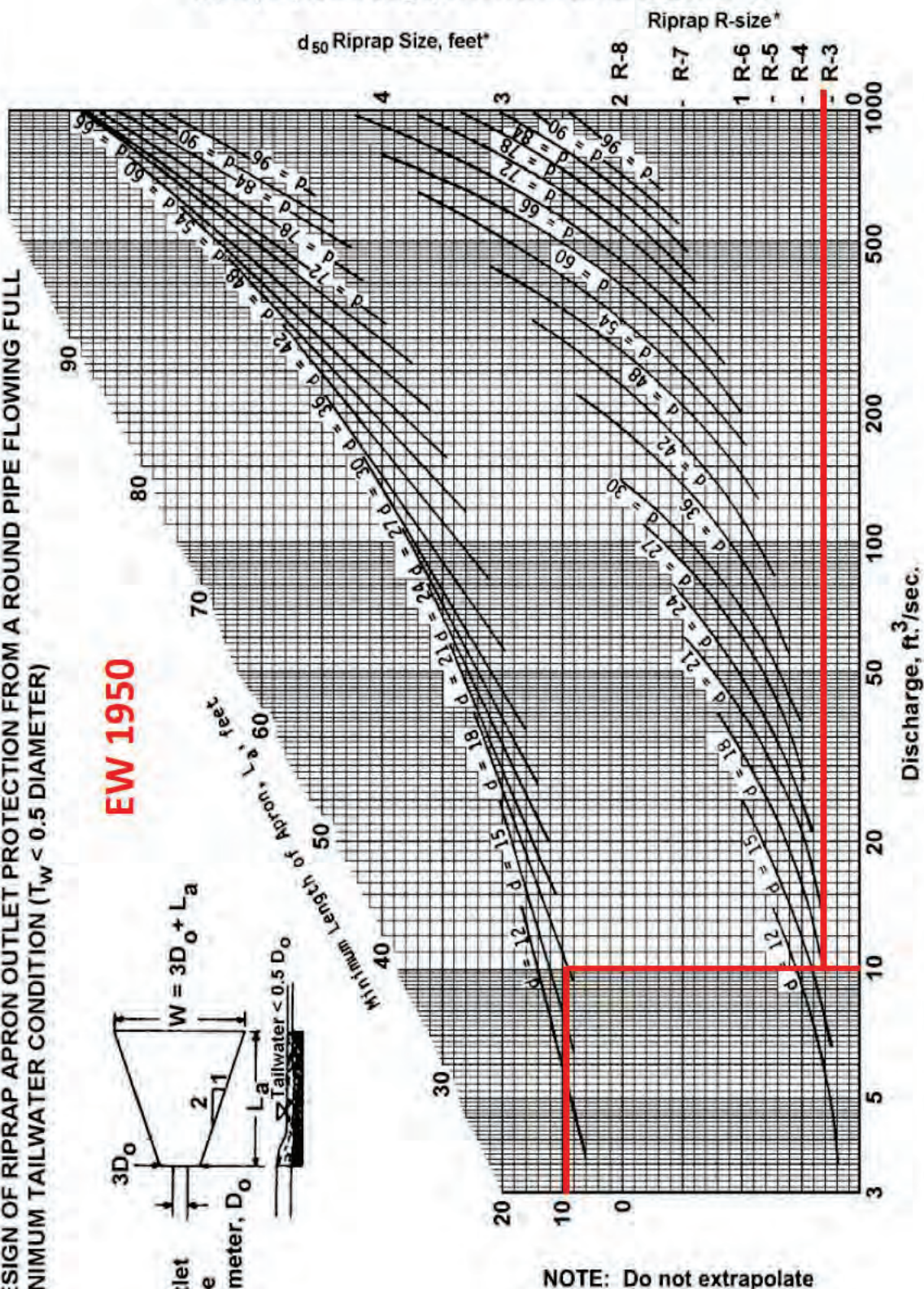
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1950



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

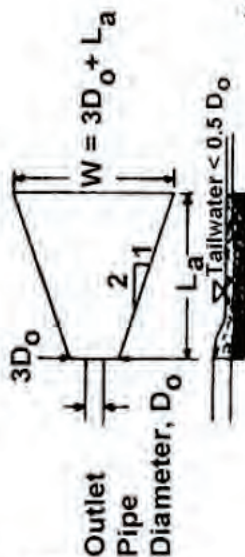
PROJECT NAME: North Point Phase 2
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: RCG
 CHECKED BY:

DATE: 10/7/2021

DATE:

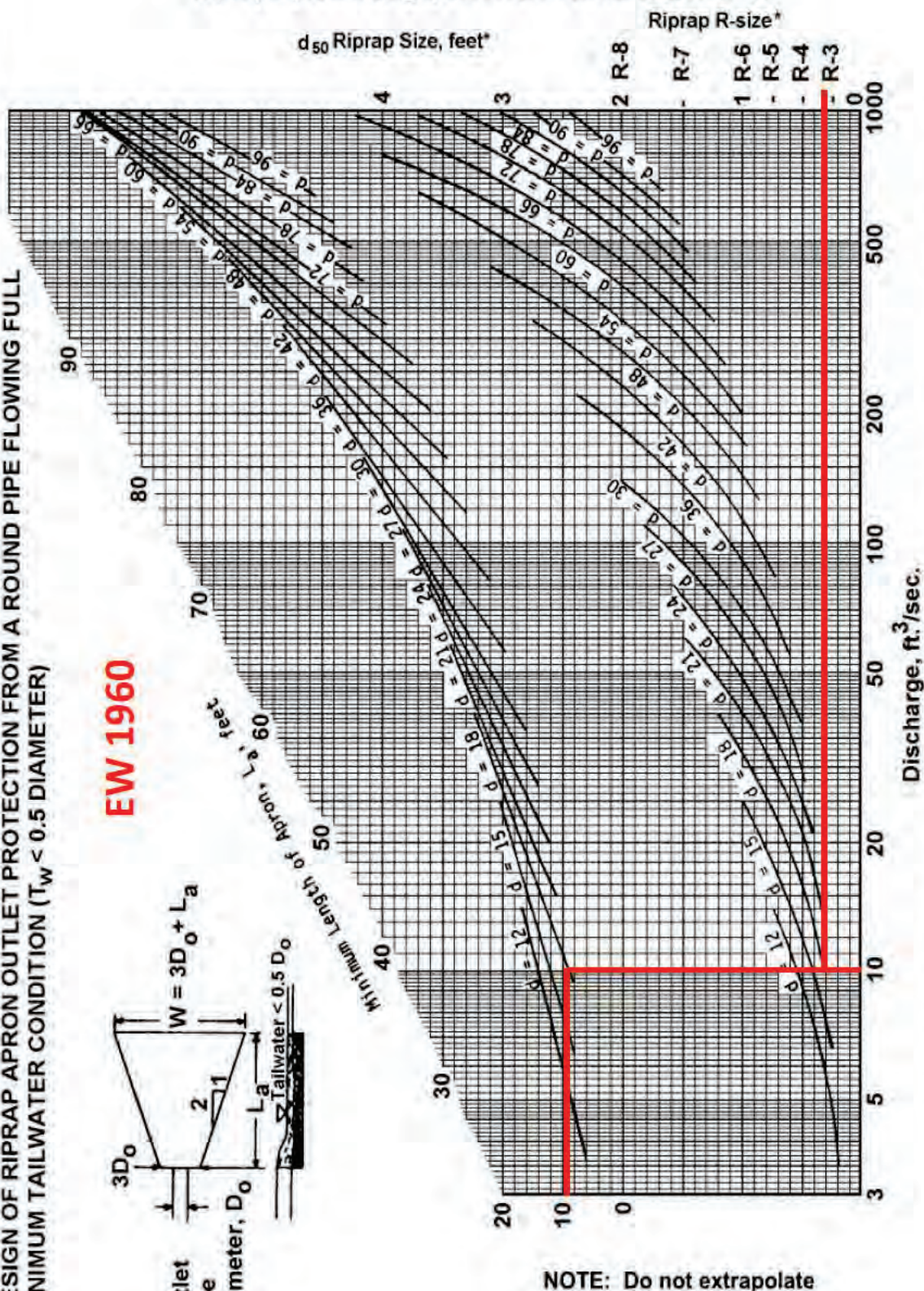
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1960



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

STANDARD WORKSHEET

Rip-Rap Apron Outlet Protection

PROJECT NAME:	NorthPoint Phase 2 - Building 6 Construction		
LOCATION:	Falls Township	Bucks County	
PREPARED BY:	WJD	DATE:	9/23/2024
CHECKED BY:		DATE:	

METHODOLOGY:

Utilize *PA D.E.P. Erosion and Sediment Control Manual* to construct a Rock Apron at culvert, endwall, headwall or channel outfalls. First, tailwater condition must be determined (minimum or maximum). Second, with a known discharge, determine D50 rock size and length of apron "La". Third, determine the width and thickness of the apron. Lastly, ensure the permissible velocity of the rock size chosen is not exceeded by the velocity of the discharge entering the apron.

Equations Utilized:

Minimum Tailwater Condition: $W2 = 3do + La$

Maximum Tailwater Condition: $W2 = 3do + 0.4La$

Blanket Thickness: $T = 1.5 \cdot D_{max}$

Discharge (Q) and Velocity (V) - obtained from the 100 Year Storm

do = pipe diameter

Width 1 = initial width of apron at end of structure

Width 2 = terminal width of apron, W2

STRUCTURE DATA							RIP-RAP DATA			APRON DATA		
EW #	PIPE DIA. (in)	Tailwtr Cond. MIN/MAX	Mngs "n"	Pipe Slope (ft/ft)	Q (cfs)	V (fps)	D50 (in.)	ROCK SIZE	Rock T (in.)	La (ft)	W at pipe (ft)	W at tailwtr (ft)
1600	24	min	0.013	1.47%	13.98	4.45	6	R-4	18	12	6	18
1605	24	min	0.013	1.20%	16.58	5.28	6	R-4	18	12	6	18
1610	24	min	0.013	1.20%	16.67	5.31	6	R-4	18	12	6	18
1615	24	min	0.013	1.20%	16.67	5.31	6	R-4	18	12	6	18
1660	18	min	0.013	5.83%	4.52	3.16	6	R-4	18	8	4.5	12.5
1680	36	min	0.013	10.00%	33.49	5.97	6	R-5	18	20	9	29
1685	36	min	0.013	4.17%	27.72	5.31	6	R-5	18	8	9	17
1690	36	min	0.013	0.50%	24.20	6.39	6	R-5	18	16	9	25
1695	36	min	0.013	0.85%	23.47	4.82	6	R-5	18	16	9	25
1740	24	min	0.013	0.92%	8.41	2.80	6	R-4	18	12	6	18
1765	24	min	0.013	1.08%	10.36	3.30	6	R-4	18	12	6	18
1770	24	min	0.013	6.50%	4.89	1.56	6	R-4	18	12	6	18
1800	36	min	0.013	6.50%	33.49	5.97	6	R-5	18	12	9	21
1805	36	min	0.013	0.50%	23.92	4.87	6	R-5	18	12	9	21
1810	36	min	0.013	6.40%	28.99	5.46	6	R-5	18	12	9	21
1815	36	min	0.013	1.58%	23.13	4.78	6	R-5	18	12	9	21
1820	24	min	0.013	0.62%	11.42	3.63	6	R-4	18	12	6	18
1825	24	min	0.013	0.85%	16.20	5.16	6	R-4	18	12	6	18
1830	24	min	0.013	0.78%	16.09	5.12	6	R-4	18	12	6	18
1835	24	min	0.013	1.05%	12.29	3.91	6	R-4	18	12	6	18
1875	24	min	0.013	1.25%	4.57	1.46	6	R-4	18	12	6	18
1820A	18	min	0.013	1.26%	3.65	2.07	6	R-4	18	8	4.5	12.5

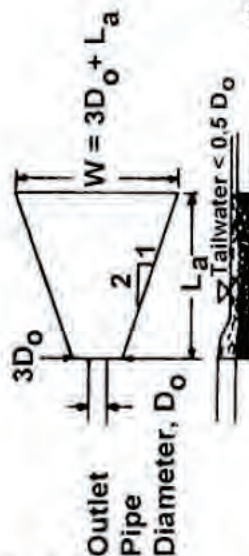
Note: Rock size selected has been increased from the suggested d50 values based upon flow (Q) and/or velocity parameters. Energy Dissipator shall be hand placed and dimensions adjusted to conform to the existing roadside conveyance.

Stone larger than R-4 shall have stone filter blanket installed prior to the rip-rap in lieu of non-woven geotextile. Filter stone shall meet the following requirements:

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

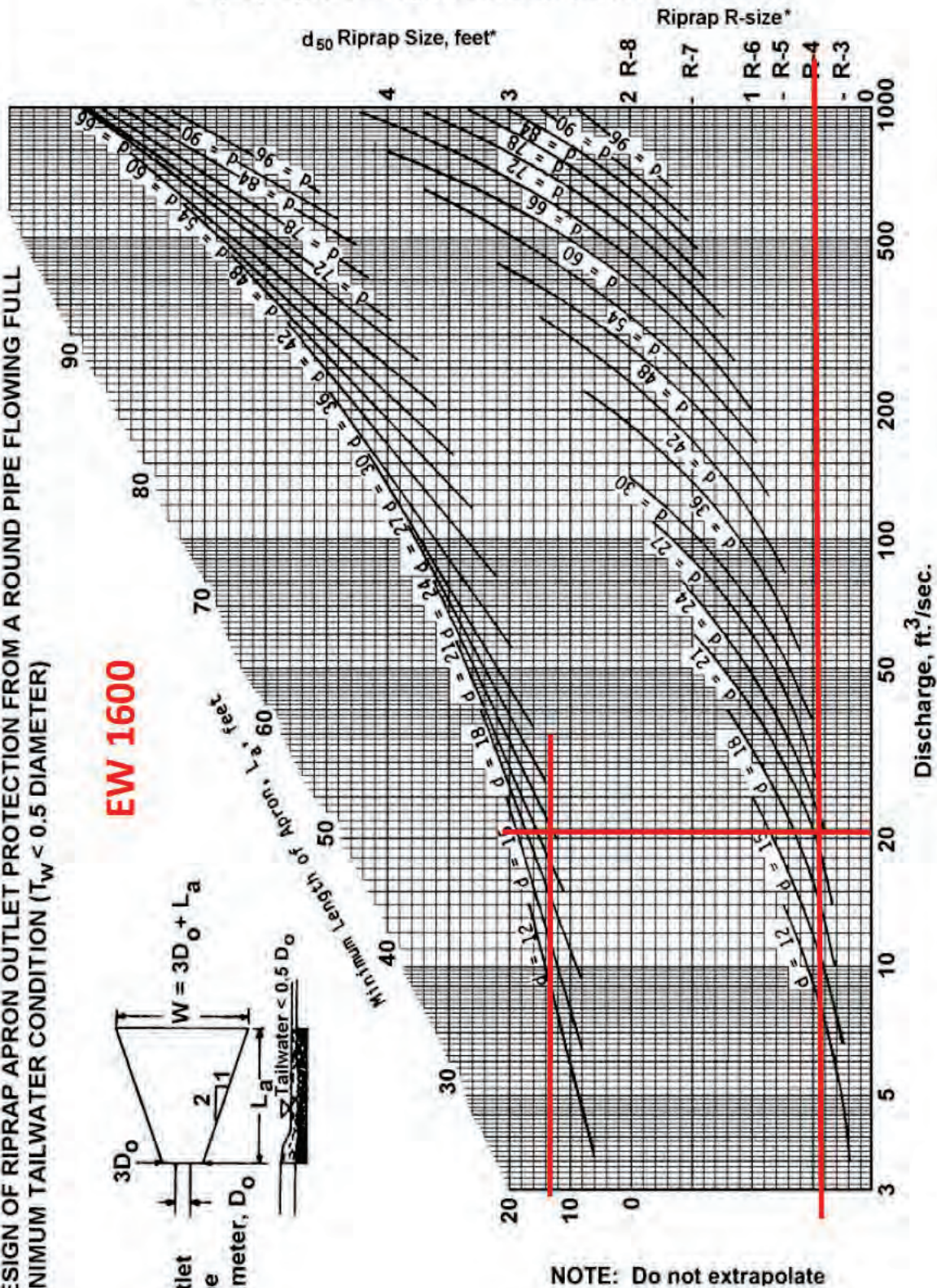
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1600



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

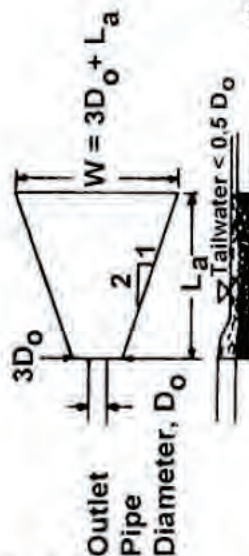


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

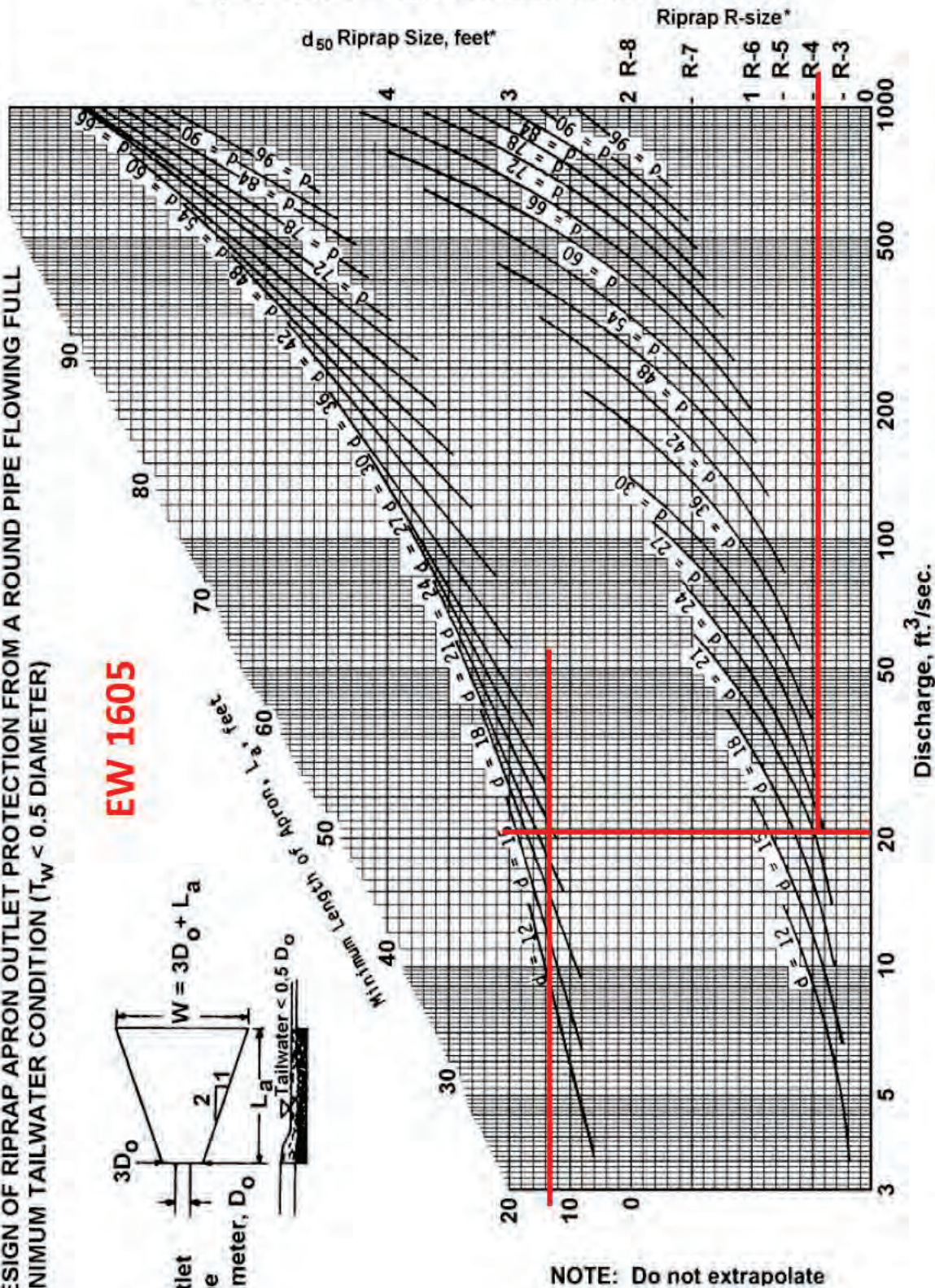
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1605



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



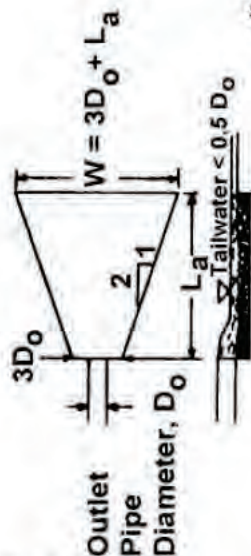
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

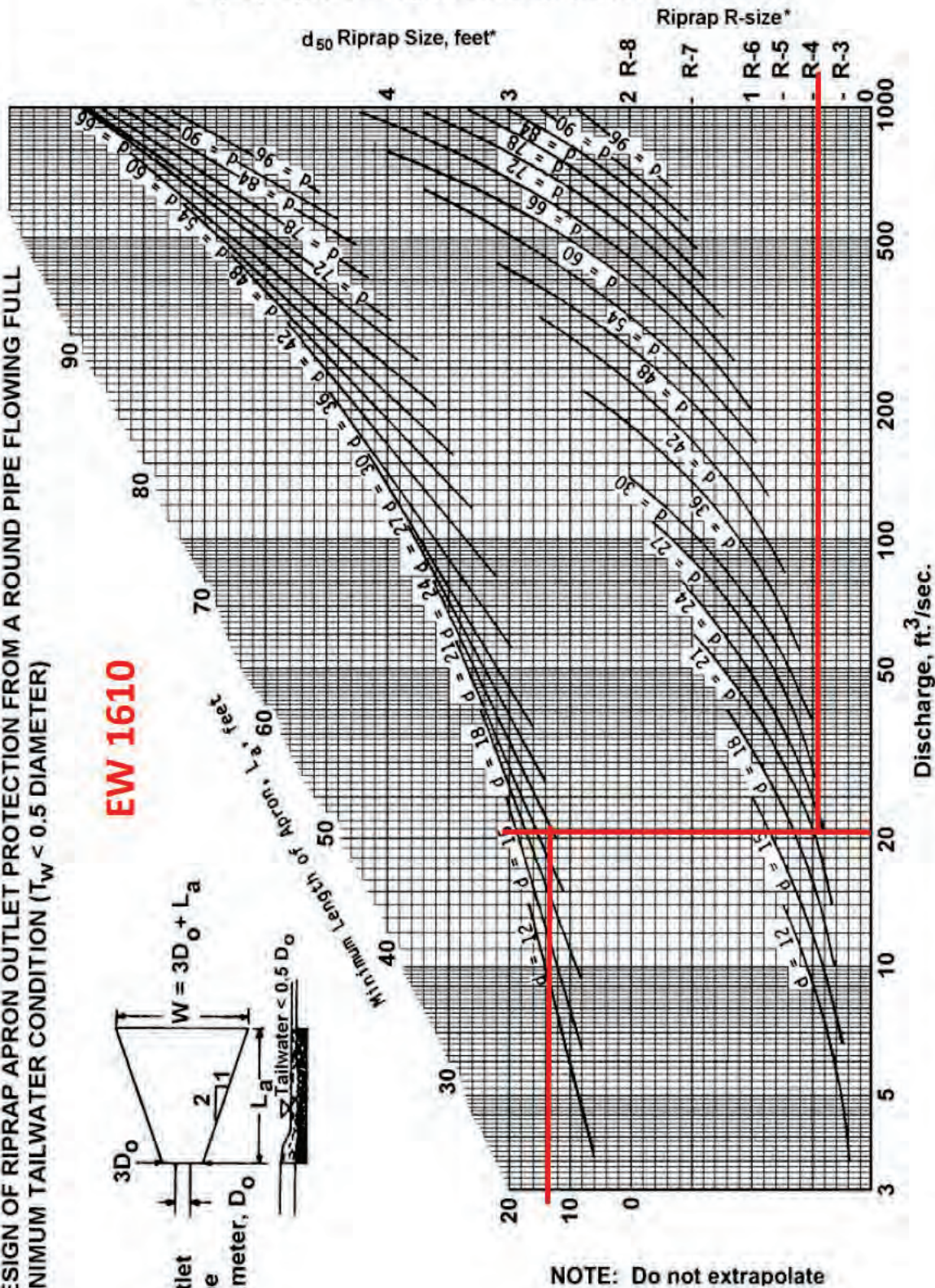
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1610



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



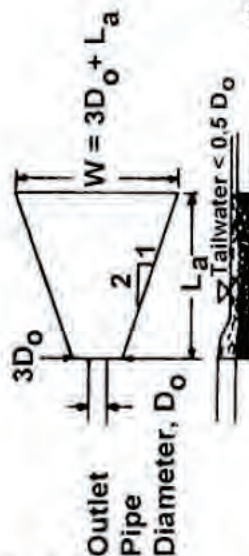
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

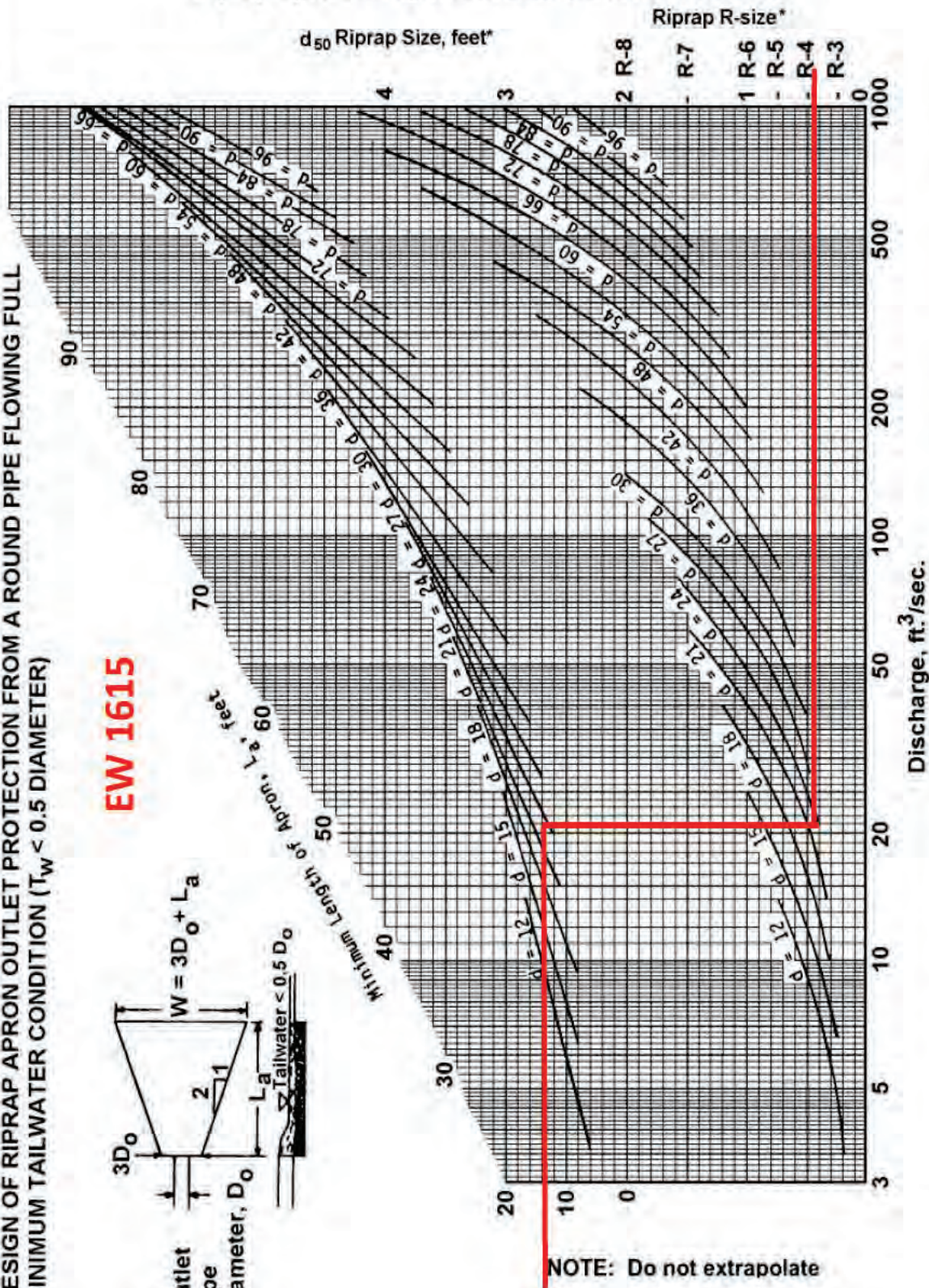
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1615



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



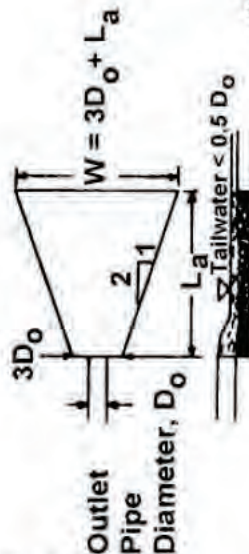
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

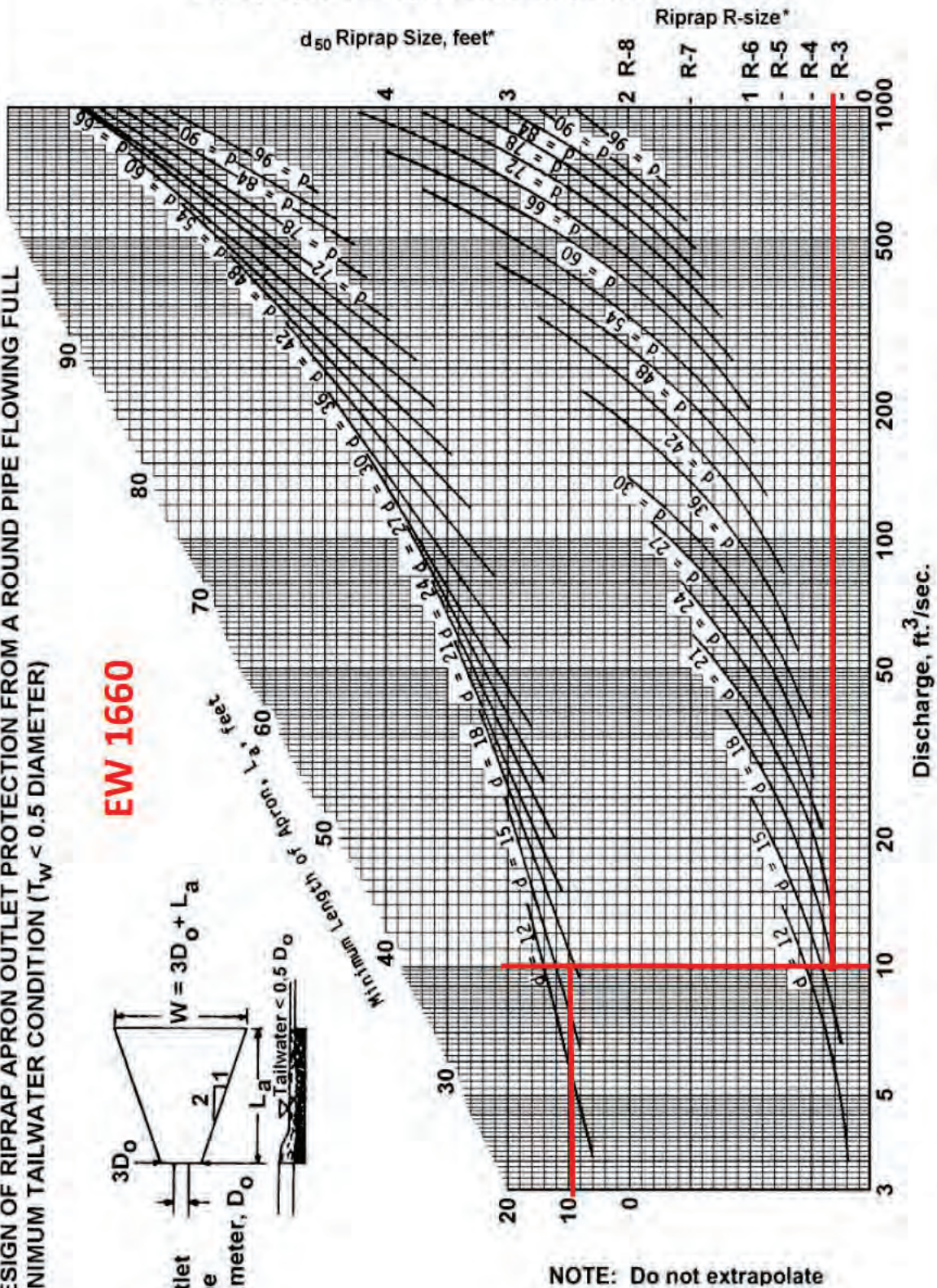
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1660



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

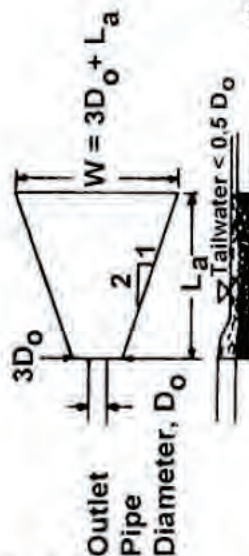


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

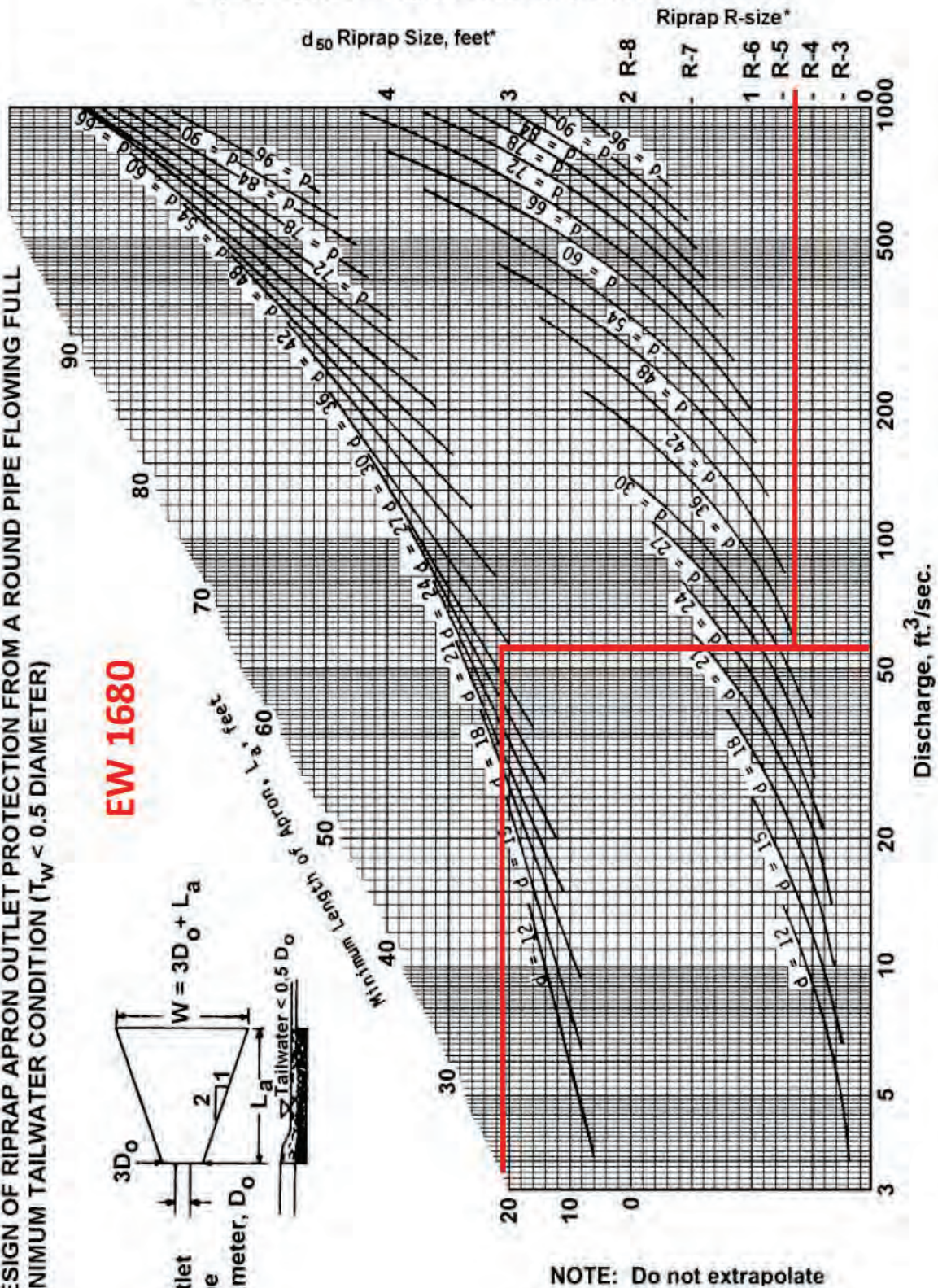
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1680



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



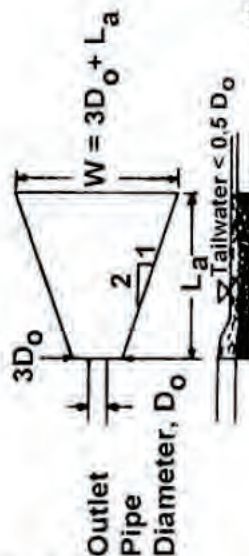
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

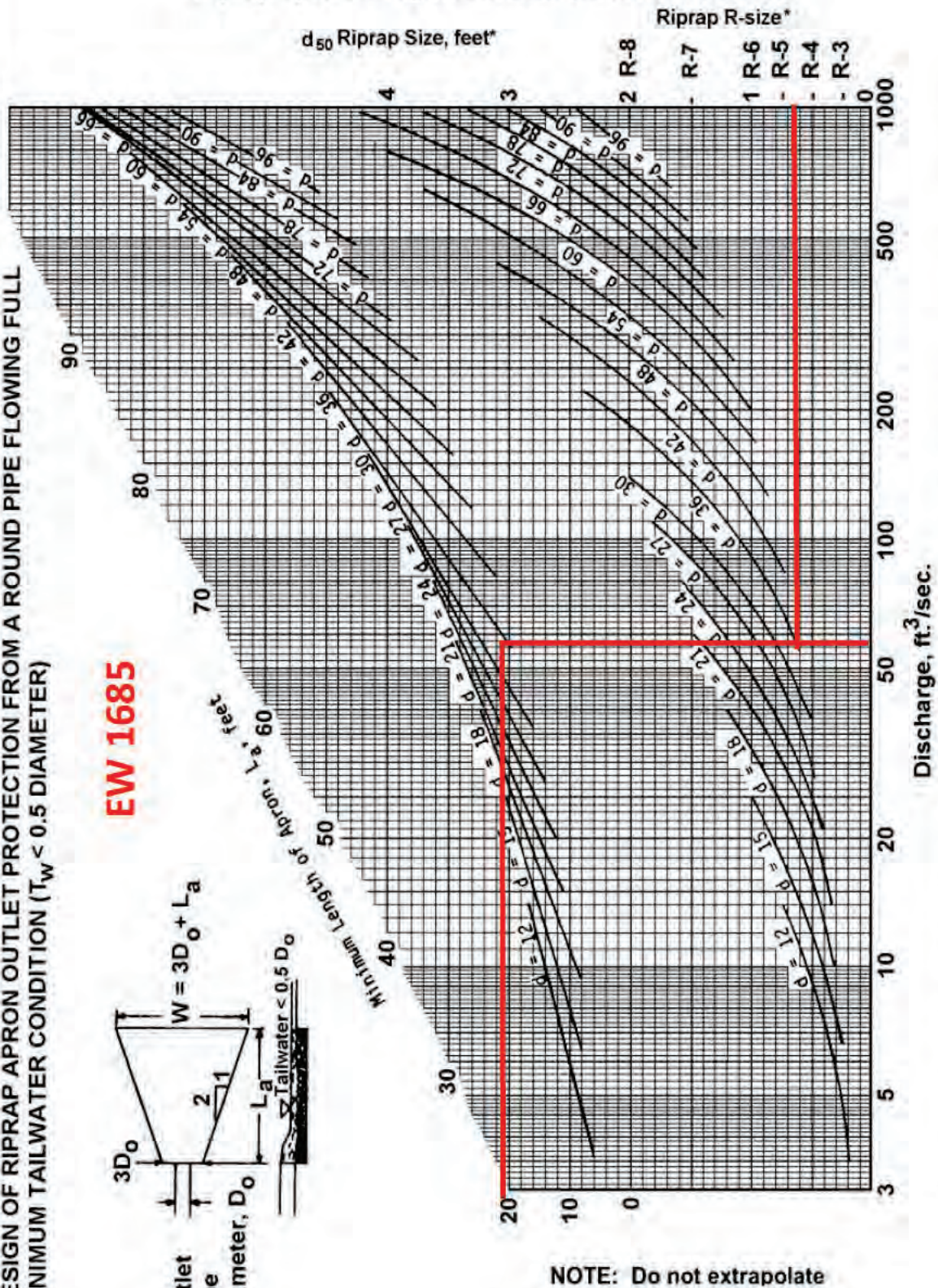
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1685



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

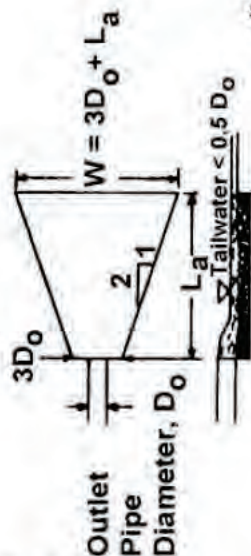


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

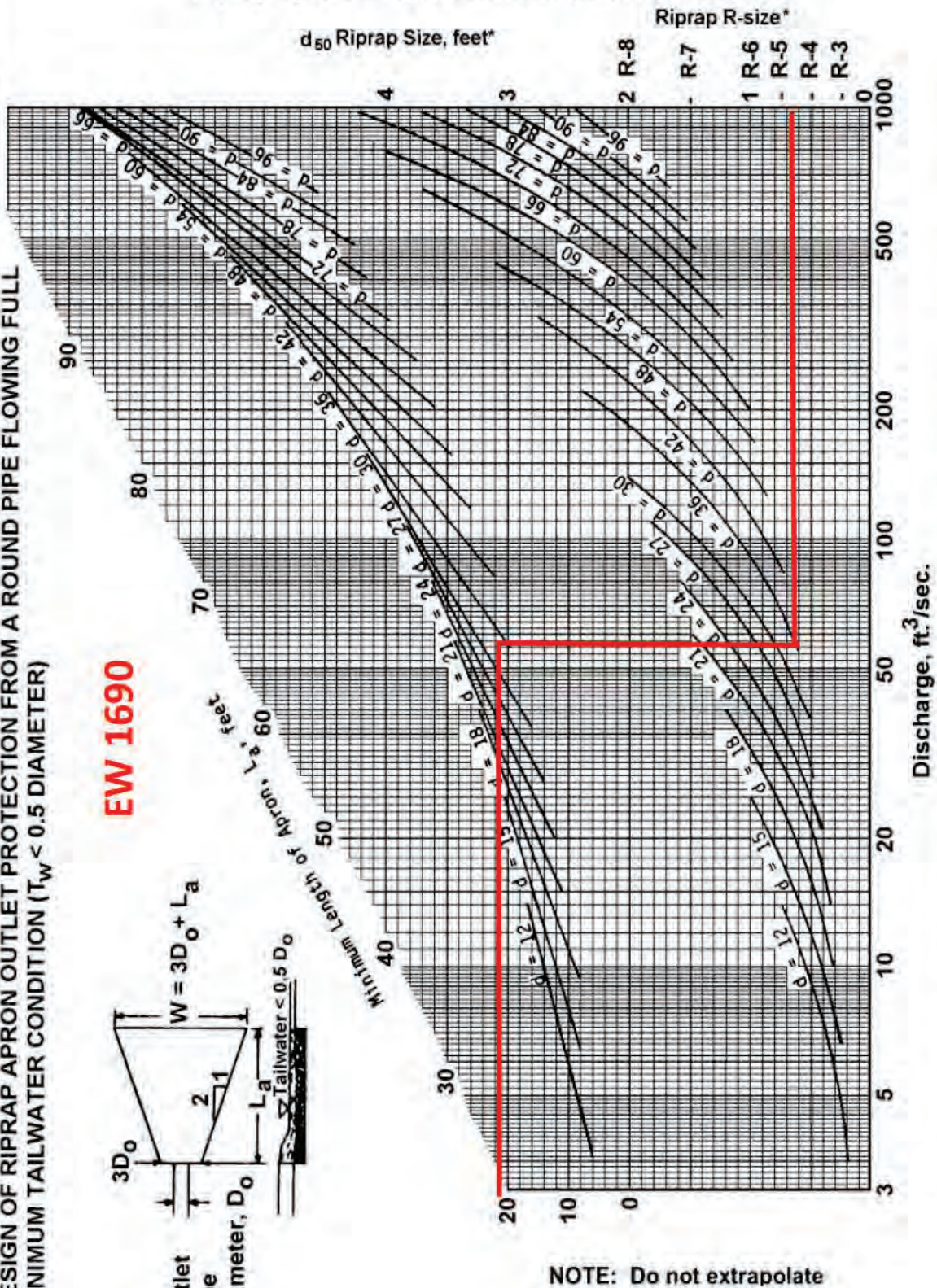
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1690



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



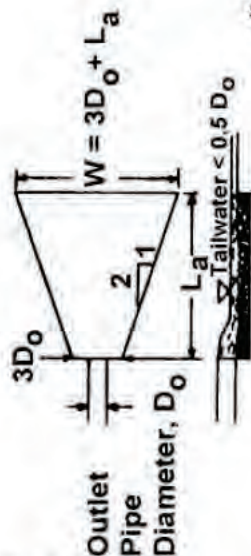
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

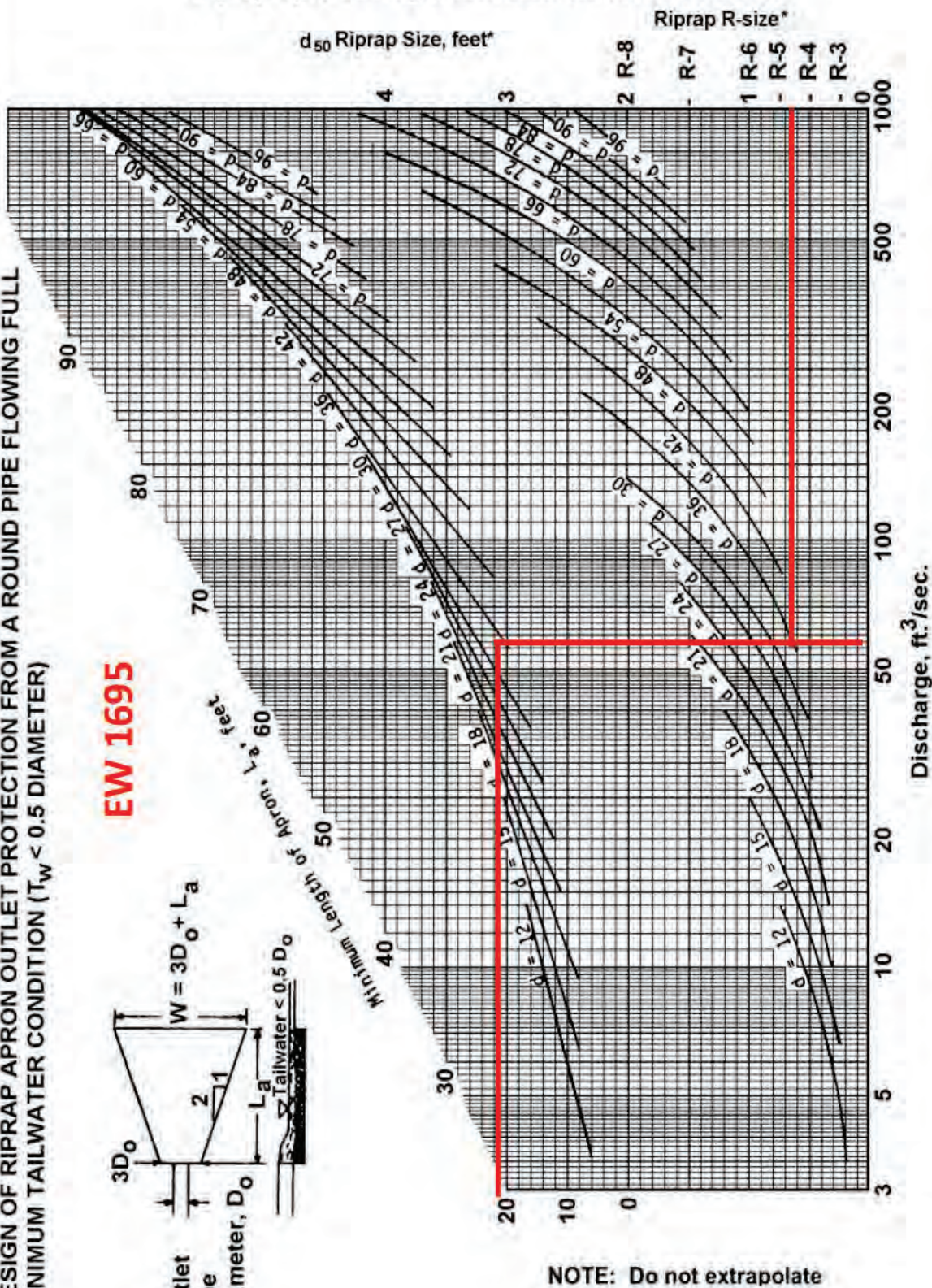
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1695



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



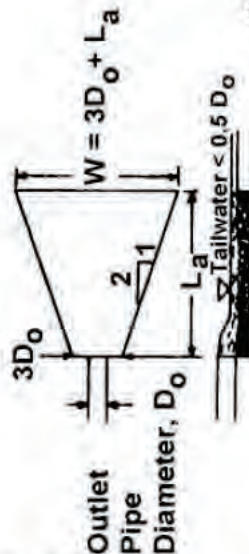
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

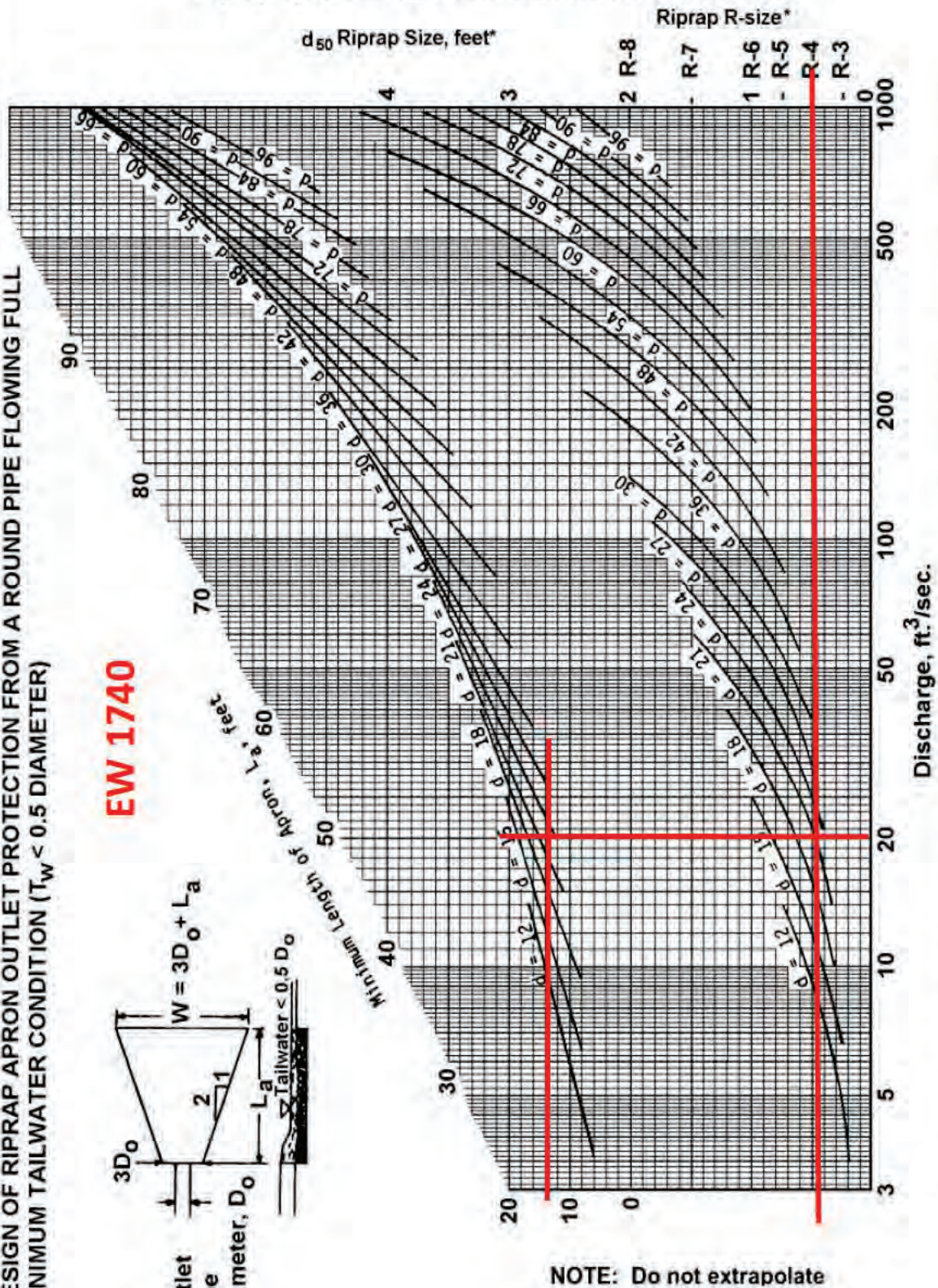
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1740



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

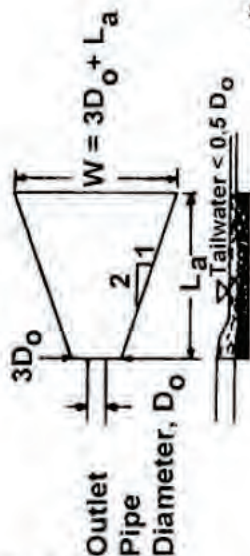
Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY:

DATE: 9/23/2024
 DATE:

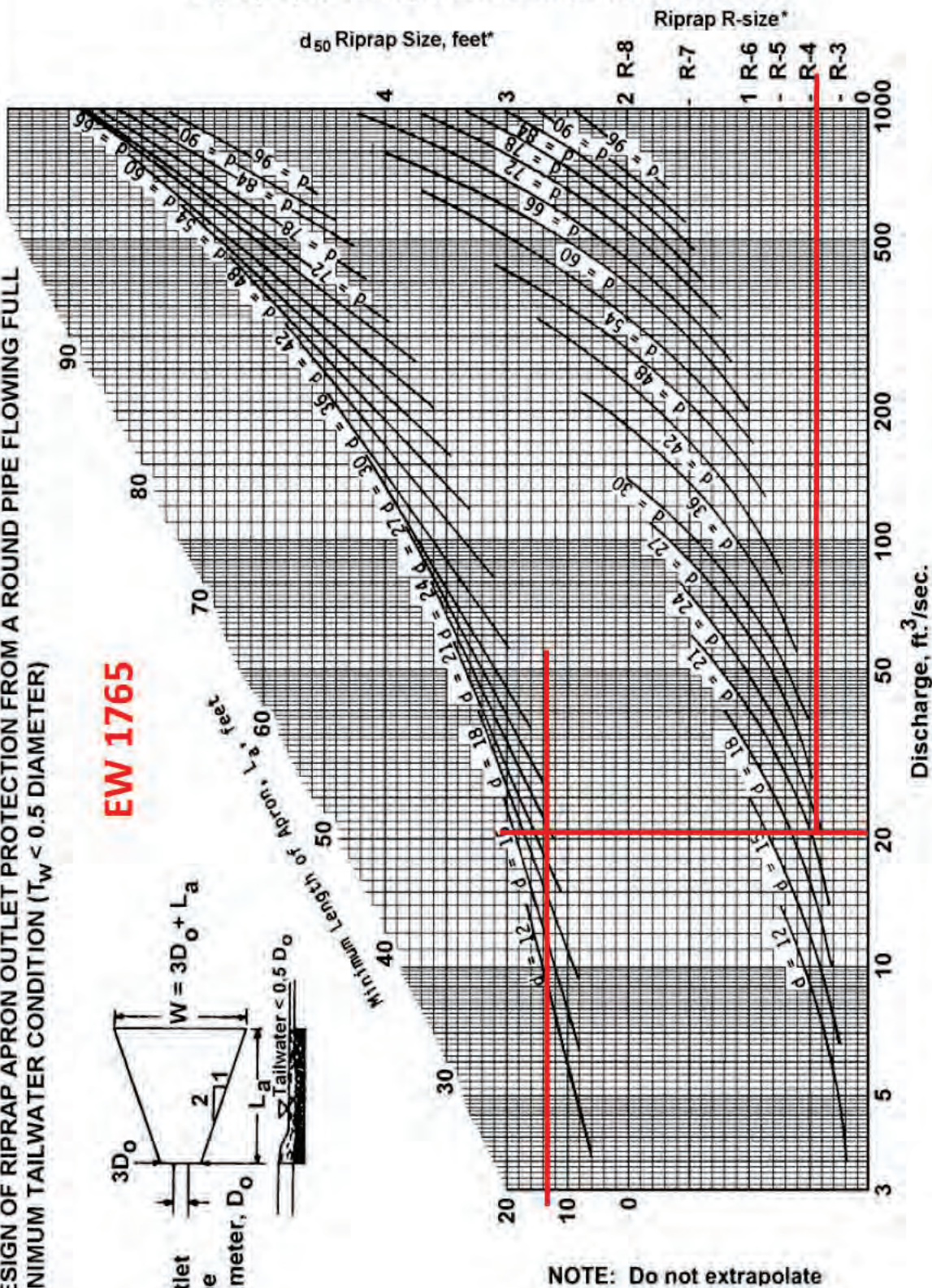
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1765



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



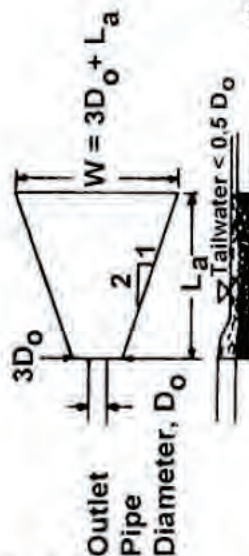
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

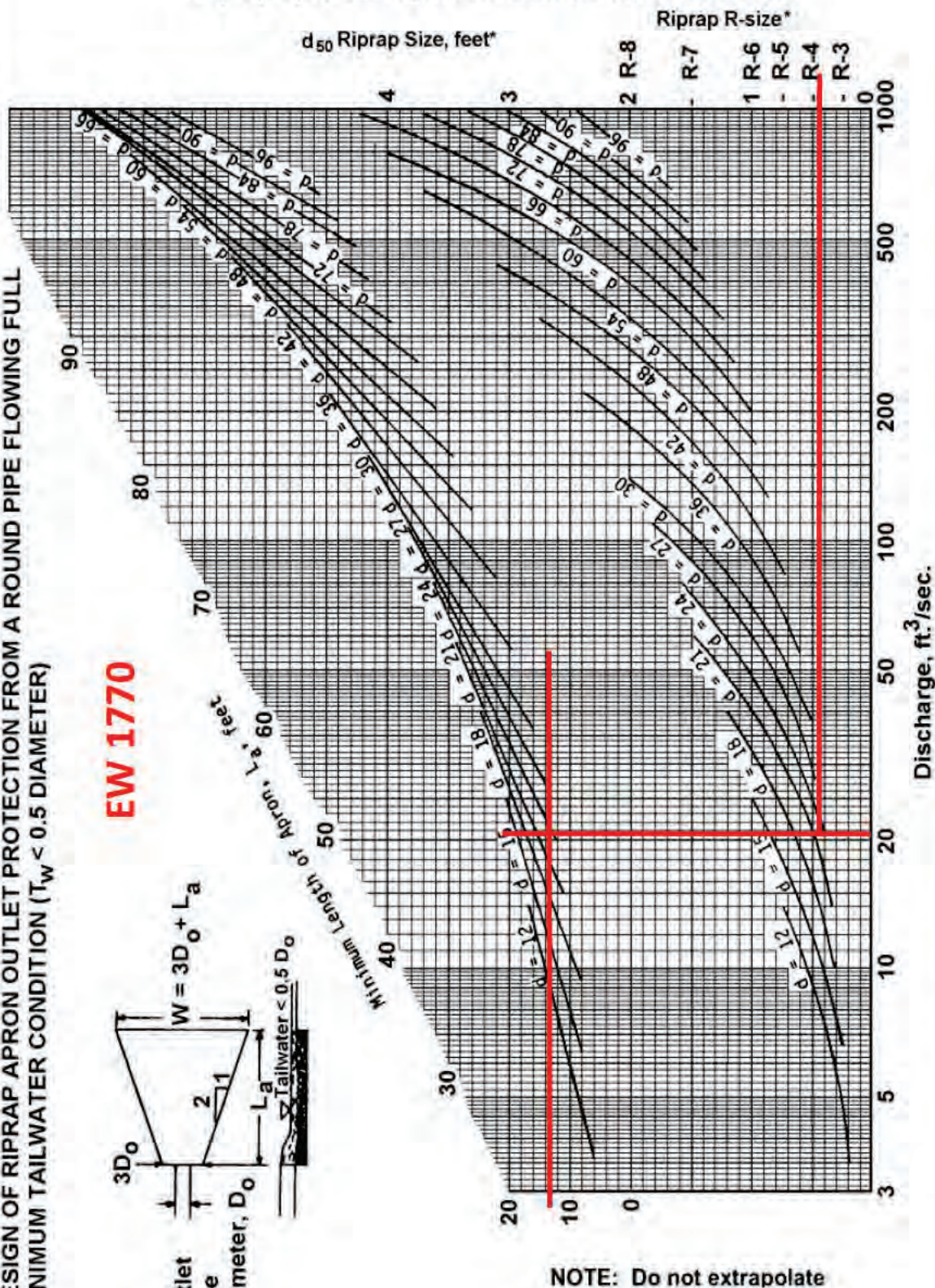
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1770



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

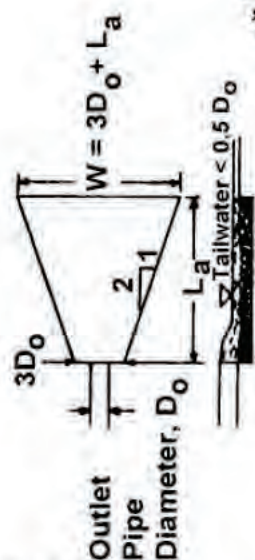


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME:	Northpoint Phase 2 - Building 6
LOCATION:	Falls Township, Bucks County, Pennsylvania
PREPARED BY:	WJD
CHECKED BY:	
DATE:	9/23/2024
DATE:	

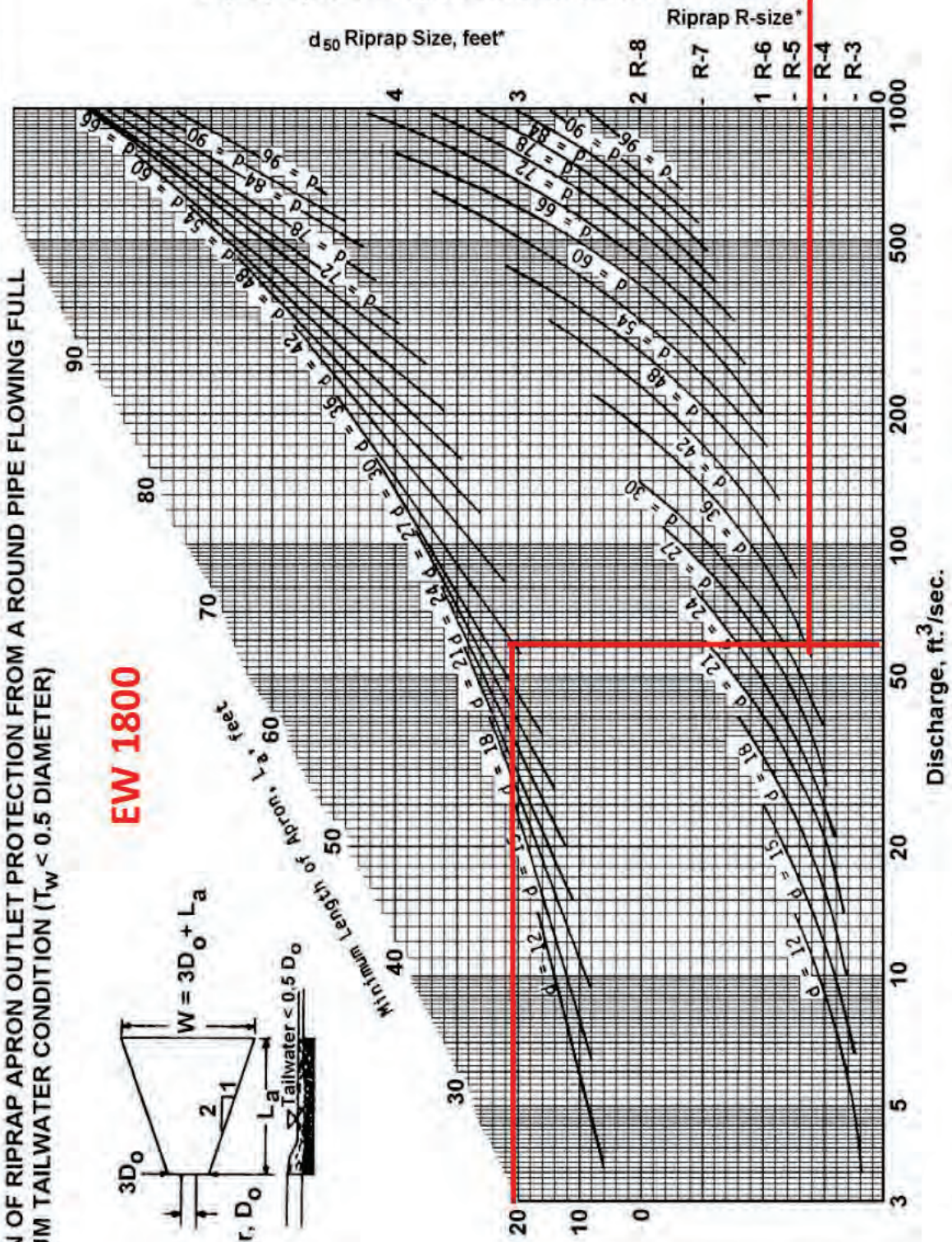
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1800



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



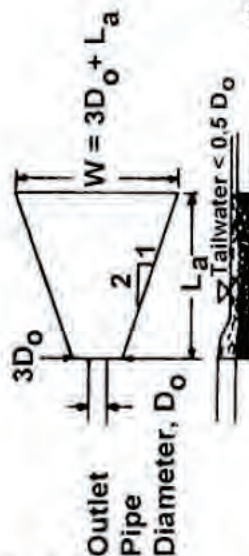
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

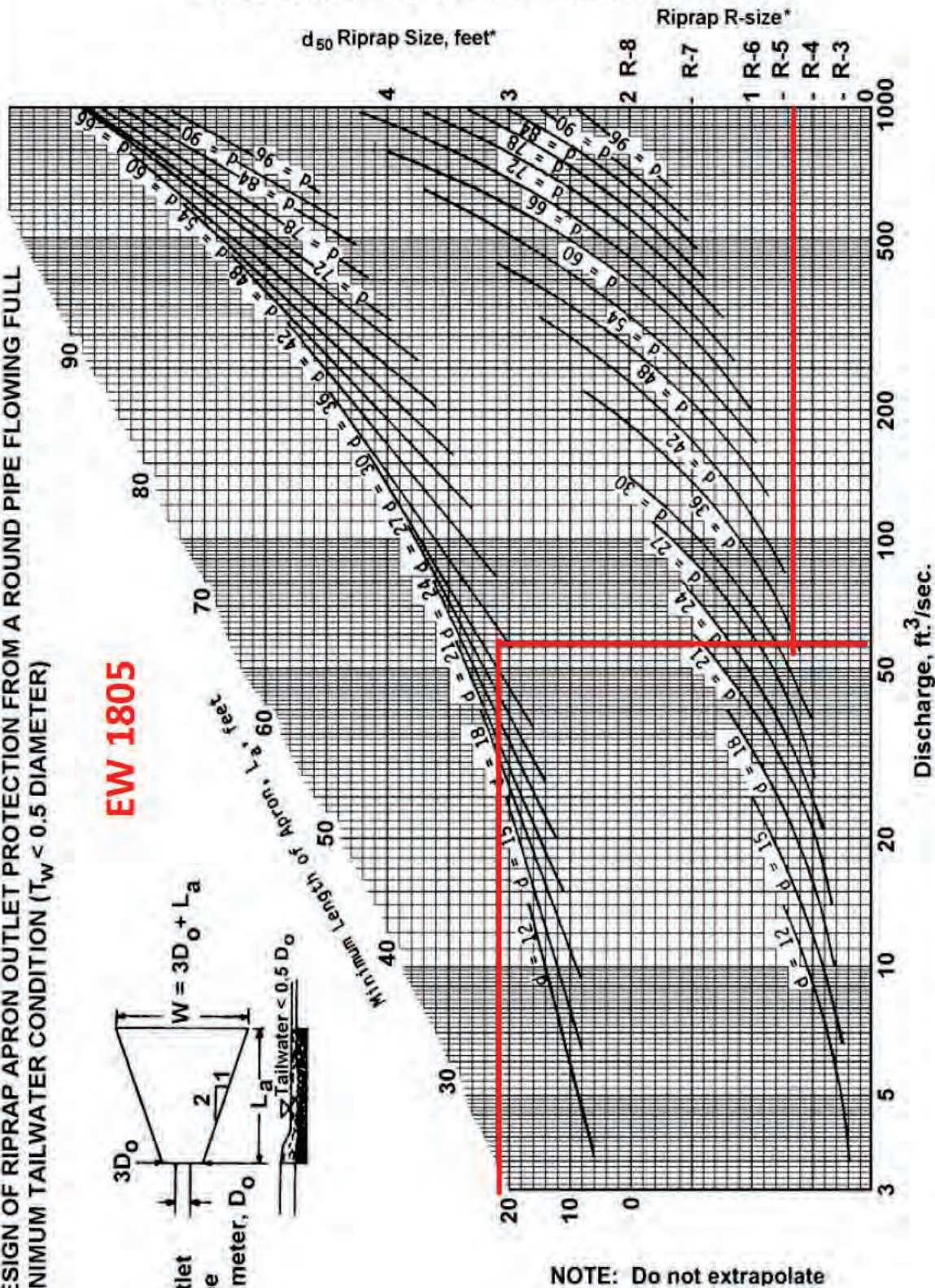
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1805



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition

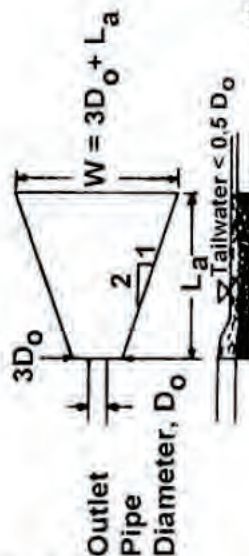


* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

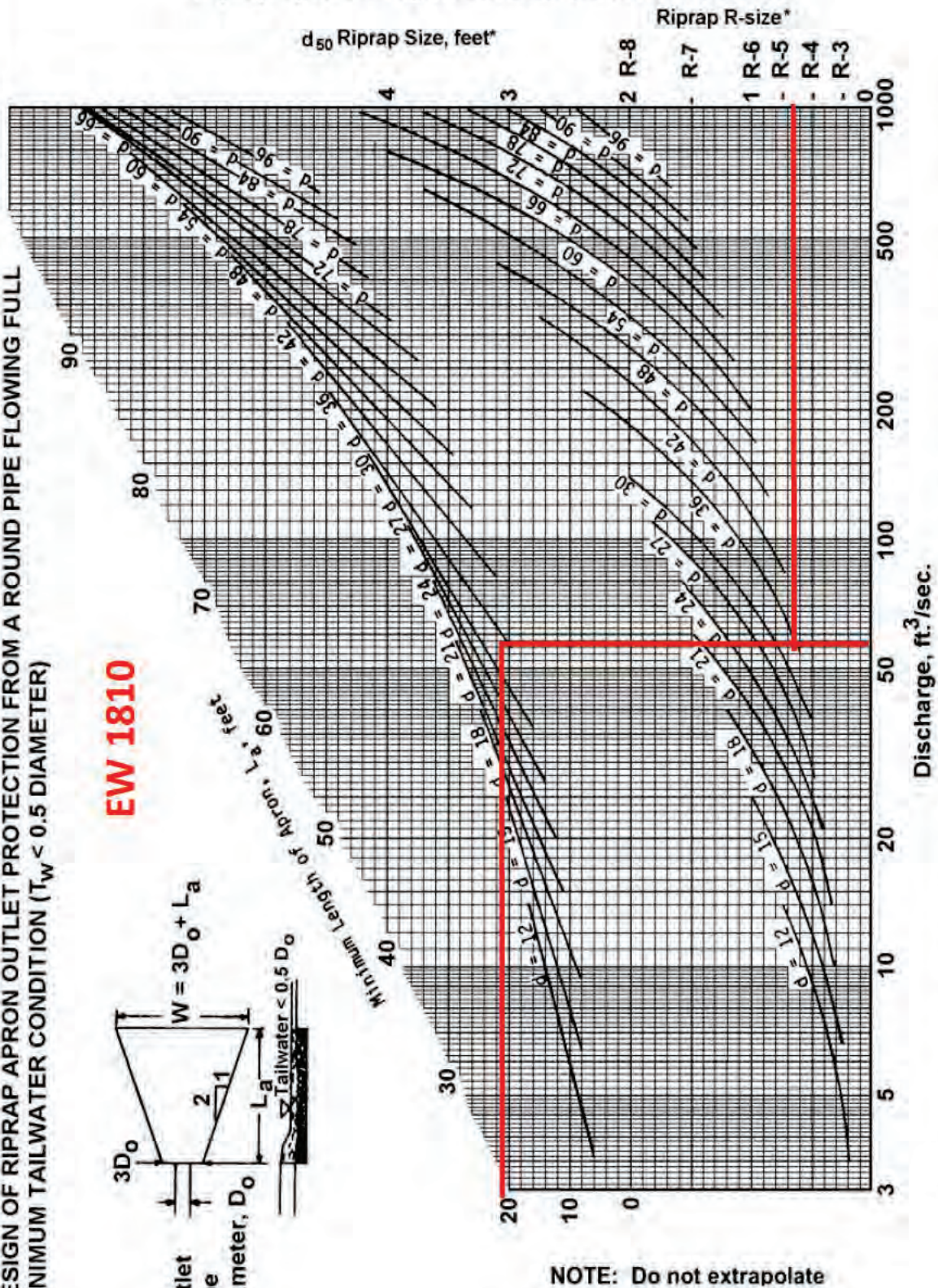
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1810



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



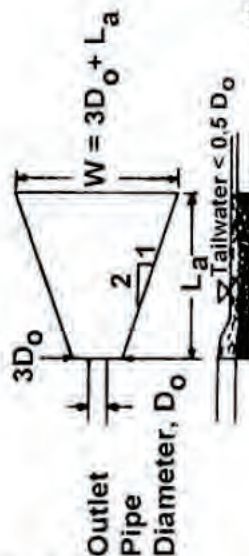
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

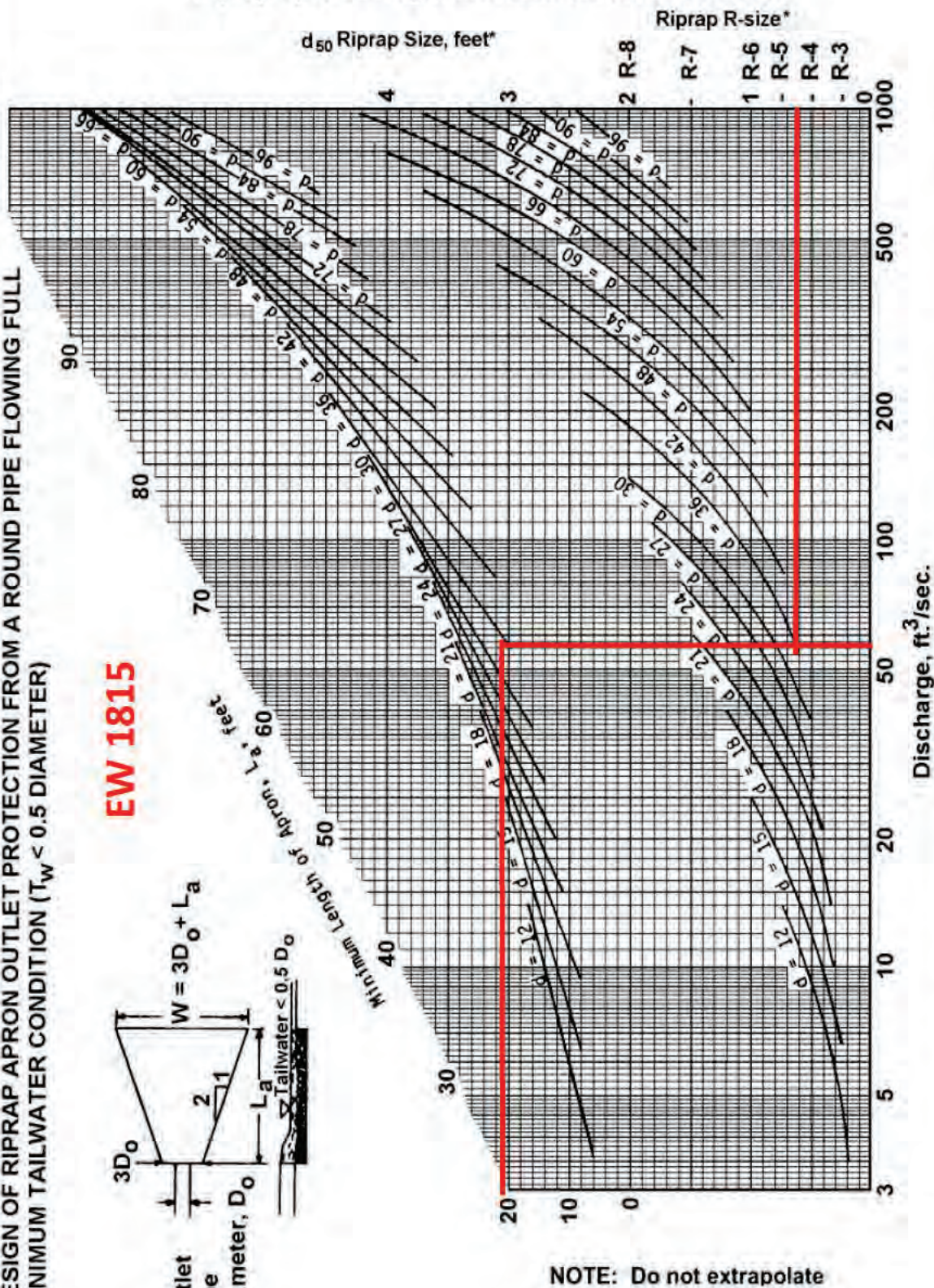
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1815



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



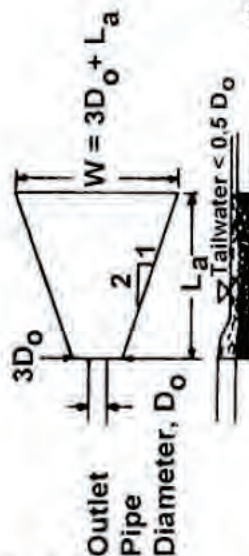
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

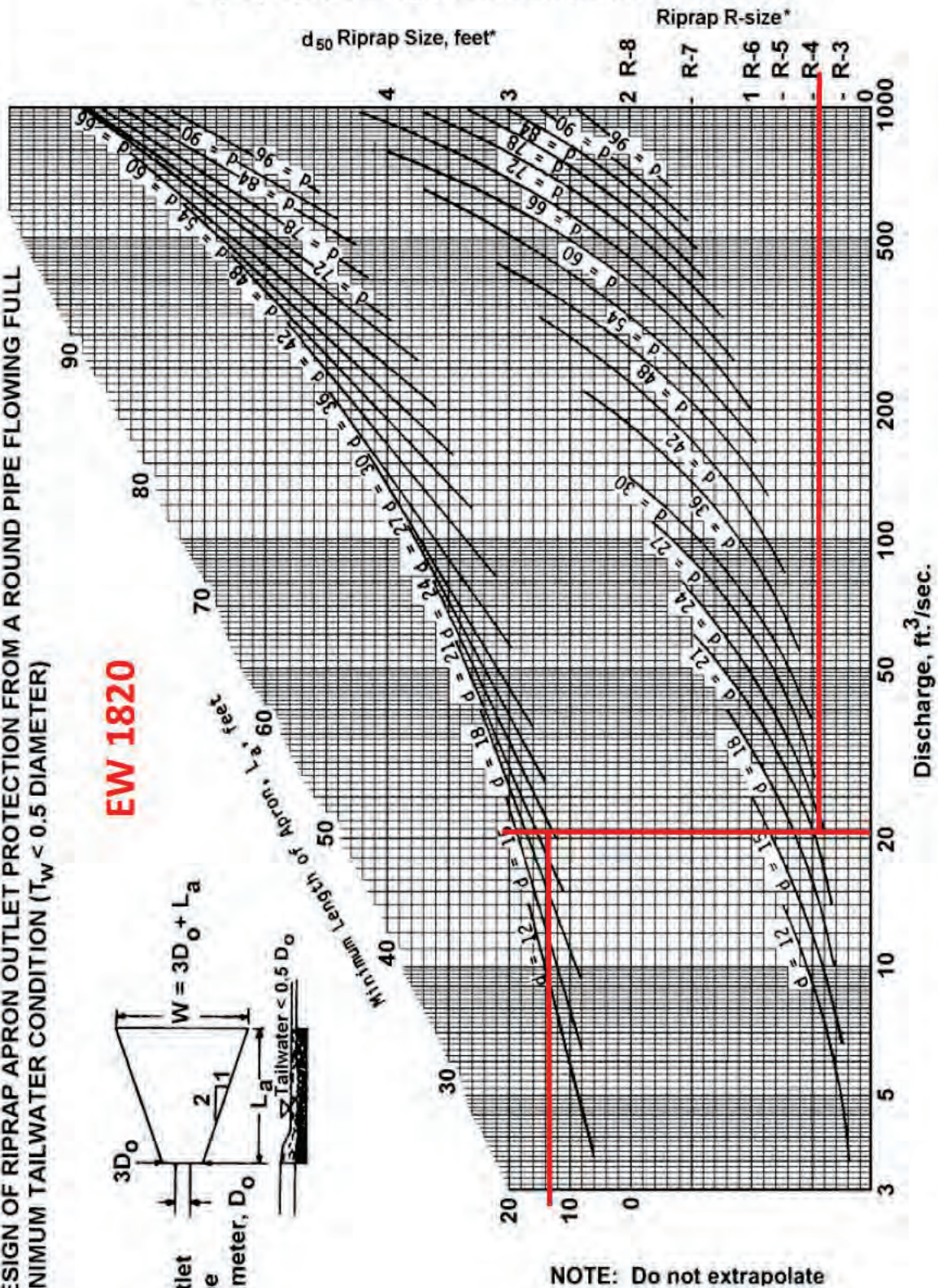
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1820



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



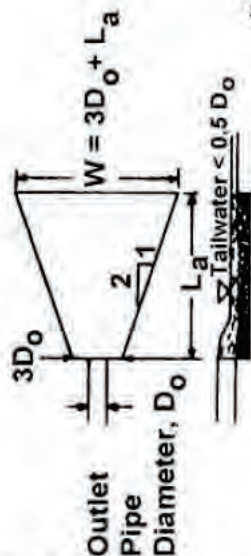
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

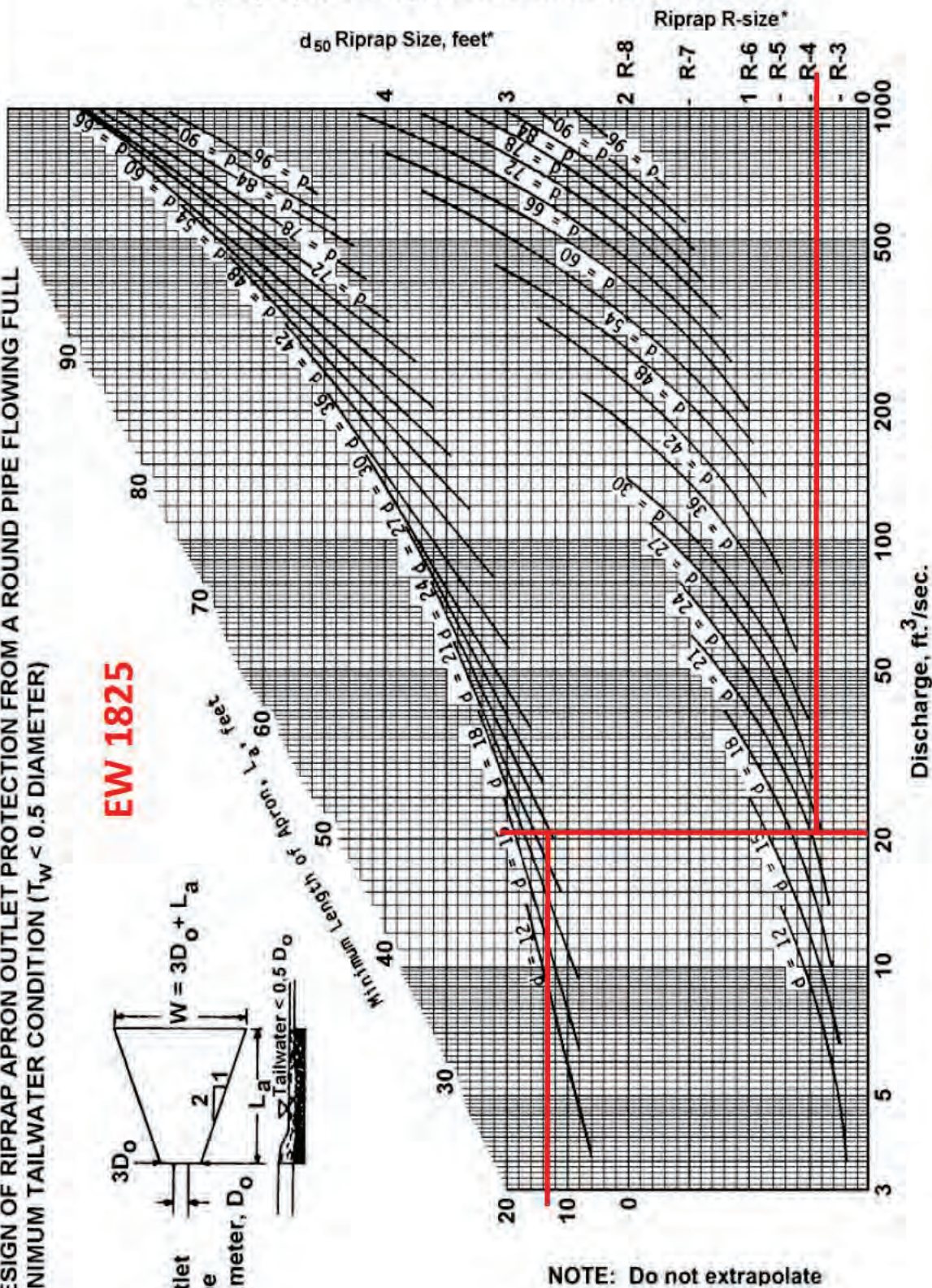
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1825



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



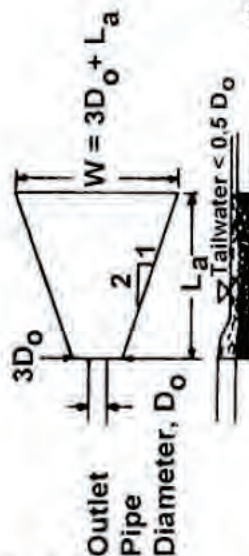
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY: DATE: 9/23/2024
 DATE:

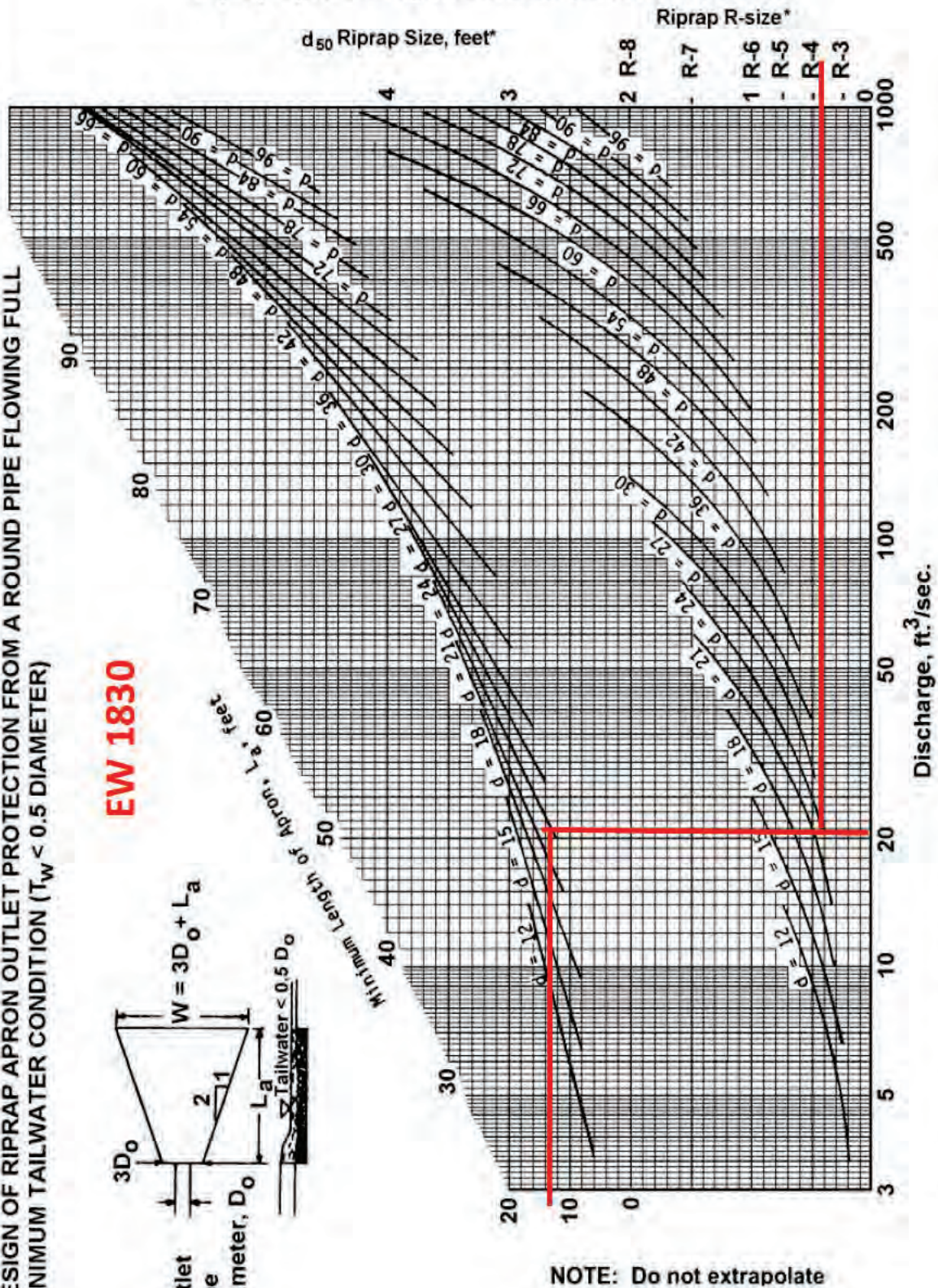
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1830



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



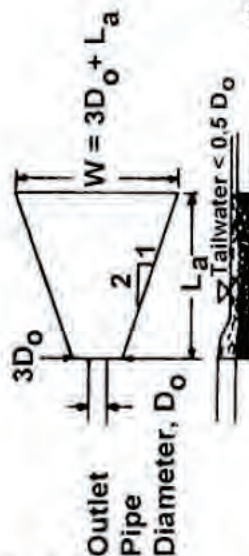
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD DATE: 9/23/2024
 CHECKED BY: DATE:

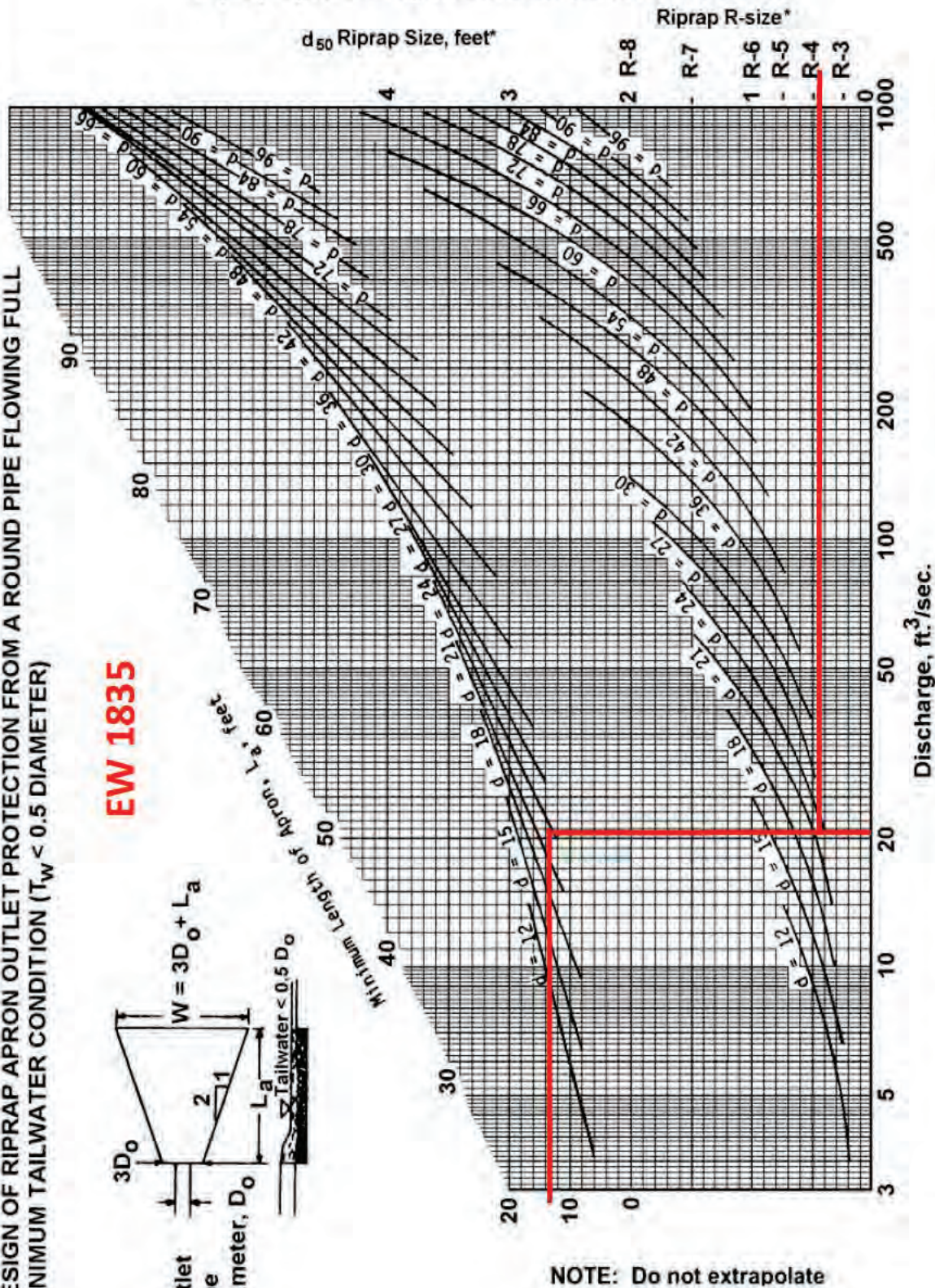
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1835



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



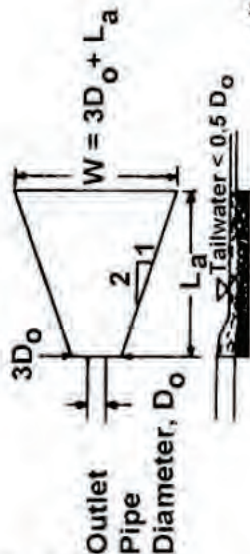
* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

PROJECT NAME: Northpoint Phase 2 - Building 6
 LOCATION: Falls Township, Bucks County, Pennsylvania
 PREPARED BY: WJD
 CHECKED BY:

DATE: 9/23/2024
 DATE:

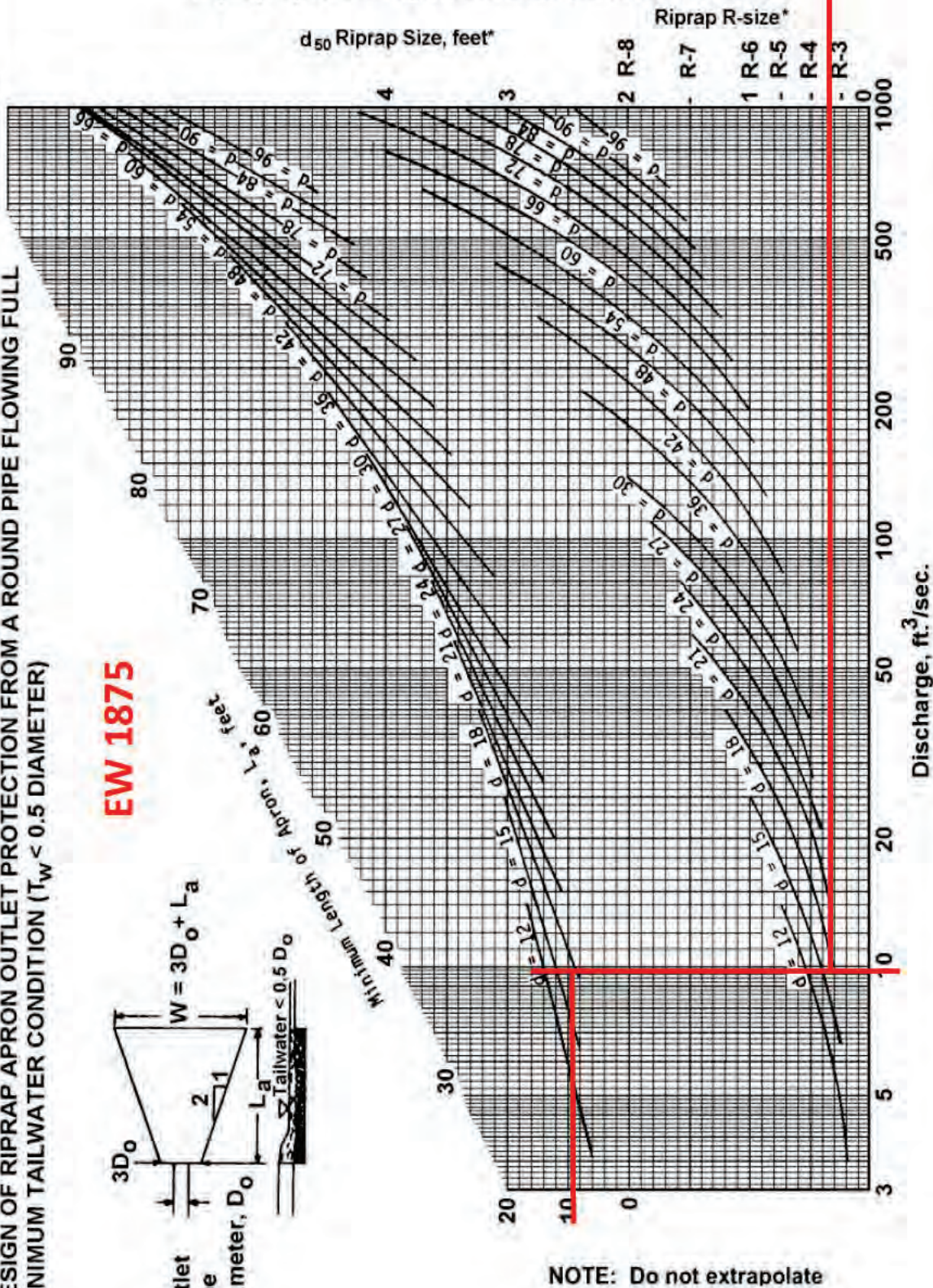
DESIGN OF RIPRAP APRON OUTLET PROTECTION FROM A ROUND PIPE FLOWING FULL
 MINIMUM TAILWATER CONDITION ($T_w < 0.5$ DIAMETER)

EW 1875



Adapted from USDA - NRCS

FIGURE 9.3
 Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Not to be used for Box Culverts

Sediment Basin Capacity Requirements

Basin Number		Pond 9	Combined Basins	Basin A
(A) Maximum Total Drainage Area	(ac)	75.50	186.59	5.99
(a) Maximum Disturbed Area	(ac)	16.87	186.59	5.99
(I) Initial Req'd Settling Volume (5000 x A)	(cu.ft)	377,500	932,950	29,950
(T) Reduction for Top Dewatering (-700 x A)	(cu.ft)	0	0	0
(P) Reduction for Permanent Pool (-700 x A)	(cu.ft)	0	0	0
(L) Red. for 4:1 Flow Length:Width (-350 x A)	(cu.ft)	0	0	0
(D) Red. for 4 to 7 day Dewatering (-350 x A)	(cu.ft)	0	0	0
(Sv) Req'd Settling Volume*** [I-(T+P+L+D)]	(cu.ft)	377,500	932,950	29,950
(Sd) Req'd Sediment Storage Volume (1000 x a)	(cu.ft)	16,870	186,590	5,990
(St) Total Req'd Storage Volume (Sv + Sd)	(cu.ft)	394,370	1,119,540	35,940
Total Storage Volume Provided****	(cu.ft)	518,685	1,543,136	35,993
Required Discharge Capacity (2 x A)	(cfs)	151.00	373.18	11.98
Principal Spillway Capacity @ Elev. 5	(cfs)	151.00	373.18	11.98
Emergency Spillway Capacity @ Elev. 5	(cfs)	246.55	189.36	31.56
Emergency Spillway Lining**		N/A		

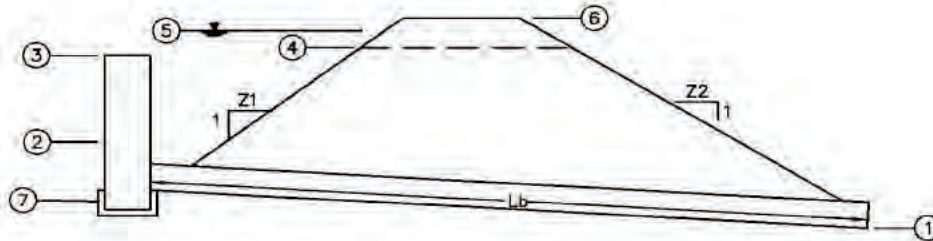
* A= Disturbed acres in Drainage Area

** If grass lining is proposed, spillway must be constructed in original ground, not fill.

*** 5000 cubic feet per acre settling volume is required for basins located in Special Protection (HQ & EV) watersheds. In other watersheds, the basin settling volume may be reduced per the Department's "Erosion and Sediment Pollution Control Program Manual," No. 363-2134-008 (January 1996), as amended and updated. The minimum settling volume for such basins is 3600 x A

**** Total Storage Volume provided at the riser crest.

Sediment Basin Dimensions / Elevations



Basin Number		Pond 9	Combined Basins	Basin A
1	Discharge pipe elevation	13.00	6.00	10.00
2	Top of Sediment Storage Zone (@ Sd)	9.00	14.00	14.00
3	Top of Dewatering Zone / Crest of Principal Spillway (@ St)	13.50	15.00	16.26
4	Emergency Spillway Crest elevation (minimum 0.5' above elevation 3)	14.75	17.00	17.00
5	2 cfs/acre elevation	15.50	17.95	16.89
6	Top of Embankment elevation (minimum 2.0' above elevation 5)	18.00	18.00	18.00
7	Bottom Elevation	8.00	13.00	13.00
Average bottom width (ft)*		180	110	57
Average bottom length (ft)*		460	6,900	330
Embankment top width (ft, 8' minimum)		10	10	10
Riser diameter / type (15" minimum)		48" CMP Stub	(2) 60" CMP	24" CMP
Barrel diameter / type (12" minimum)		(2) 48" RCP	(2) 48" RCP	18" RCP
Lb, Barrel length (ft)		78	122	540
Emergency Spillway width (ft)		16	72	12
Emergency Spillway side-slopes		N/A	N/A	N/A

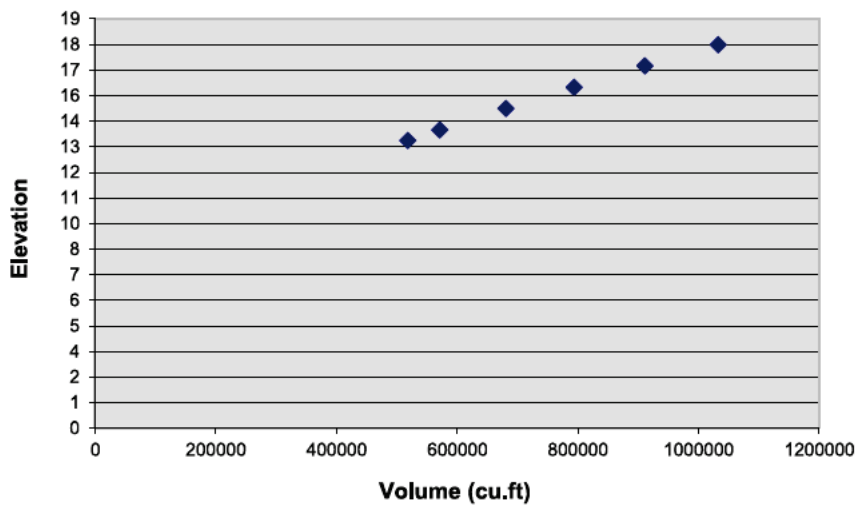
* See design plans for basin configuration.

** permanent outlet structure with skimmer device connected to 5" low-flow orifice.

WET POND 9: Stage-Storage Calculations

Elevation (ft)	Area (sq.ft.)	Avg Area (sq.ft.)	d Elevation (ft)	Storage Volume (cu.ft.)		
				Incremental	Total	(ac-ft)
8.00	83,798				0	0
		85,664	1.00	85,664		
9.00	87,544				85,664	1.967
		89,439	1.00	89,439		
10.00	91,347				175,103	4.020
		93,270	1.00	93,270		
11.00	95,207				268,373	6.161
		97,158	1.00	97,158		
12.00	99,123				365,532	8.391
		101,102	1.00	101,102		
13.00	103,095				466,634	10.712
		104,101	0.50	52,050		
13.50	105,110				518,685	11.907
		106,115	0.50	53,058		
14.00	107,124				571,742	13.125
		109,161	1.00	109,161		
15.00	111,210				680,903	15.631
		113,275	1.00	113,275		
16.00	115,352				794,178	18.232
		117,445	1.00	117,445		
17.00	119,551				911,623	20.928
		121,672	1.00	121,672		
18.00	123,806				1,033,295	23.721

Stage - Storage Curve



Emergency Spillway:

Invert Elevation:	14.75	Req'd Q100 (cfs):	151.00 =2*A - OS Discharge
Length (ft):	16.00	Provided Q (cfs):	246.55
Depth of Flow (ft):	3.250	Top of Berm Elevation:	18.00

$$Q = 2.63 * \text{Length} * (\text{depth})^{1.5}$$

WET POND 9: Principal Spillway Capacity

Barrel D: 48 (x2) Riser D: N/A Barrel L: 78
Discharge Elev: 13.00

Elevation	Principal Spillway Discharge						
	Weir Flow		Orifice Flow		Pipe Flow		Total Discharge
	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	
9.00	0.00	0.000					0.00
9.50	0.50	0.000					0.00
10.00	1.00	0.000					0.00
10.50	1.50	0.000					0.00
11.00	2.00	0.000					0.00
11.50	2.50	0.000					0.00
12.00	3.00	0.000					0.00
12.50	3.50	0.000					0.00
12.85	3.85	0.000					0.00
13.00	4.00	0.000					0.00
13.50	4.50	0.000			0.50	67.91	67.91
14.00	5.00	0.000			1.00	96.04	96.04
15.00	6.00	0.000			2.00	135.82	135.82
16.00	7.00	0.000			3.00	166.35	166.35
17.00	8.00	0.000			4.00	192.08	192.08
18.00	9.00	0.000			5.00	214.75	214.75

All holes are to be 1" diameter, uniformly spaced horizontally and vertically. holes

Row 1 0 holes Row 3 0 holes Row 5 0 holes
Row 2 0 holes Row 4 0 holes Row 6 0

Elevation	Riser Discharge: Orifice Row Elevation						Total Discharge (cfs)
	Row 1	Row 2	Row 3	Row 4	Row 5	Row 6	
9.00							0.000
9.50							0.000
10.00							0.000
10.50							0.000
11.00							0.000
11.50							0.000
12.00							0.000
12.50							0.000
12.98							0.000
13.00							0.000
13.50							0.000
14.00							0.000
15.00							0.000
16.00							0.000
17.00							0.000
18.00							0.000

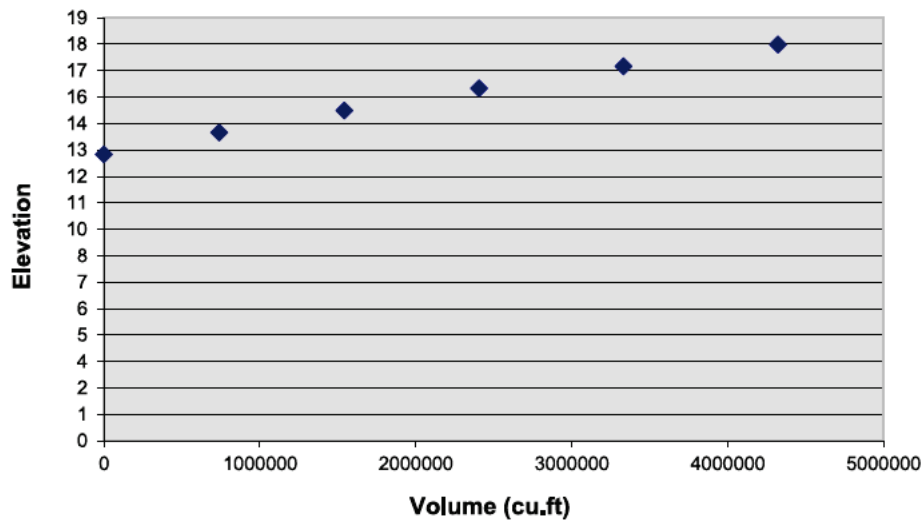
WET POND 9: Dewatering Time

Elevation (ft)	Storage Volume (cu.ft)	d Storage Volume (cu.ft)	Discharge (cfs)	Average Discharge (cfs)	Time (hrs)	Accum. Time (hrs)
15.50	737,227		151.000			0.00
		56,324		143.411	0.11	
15.00	680,903		135.822			0.11
		54,580		125.877	0.12	
14.50	626,323		115.931			0.23
		54,580		105.986	0.14	
14.00	571,742		96.041			0.37
		52,554		81.976	0.18	
13.50	519,188		67.911			0.55
		52,554		33.955	0.43	
13.00	466,634		0.000			0.98
					Days	0.04

COMBINED BASINS: Stage-Storage Calculations

Elevation (ft)	Area (sq.ft.)	Avg Area (sq.ft.)	d Elevation (ft)	Storage Volume (cu.ft.)		
				Incremental	Total	(ac-ft)
13.00	710,685				0	0.000
		741,012	1.00	741,012		
14.00	771,758				741,012	17.011
		802,124	1.00	802,124		
15.00	832,879				1,543,136	35.426
		863,793	1.00	863,793		
16.00	895,080				2,406,929	55.255
		926,400	1.00	926,400		
17.00	958,077				3,333,329	76.523
		990,005	1.00	990,005		
18.00	1,022,280				4,323,334	99.250

Stage - Storage Curve



Emergency Spillway:

Invert Elevation: 17.00
 Length (ft): 72.00
 Depth of Flow (ft): 1.000

$$Q = 2.63 * \text{Length} * (\text{depth})^{1.5}$$

Req'd Q100 (cfs): 94.70 = 2*A - OS Discharge
 Provided Q (cfs): 189.36
 Top of Berm Elevation: 18.00

COMBINED BASINS: Principal Spillway Capacity

Barrel D: 48 (x2) Riser D: 60 (x2) Barrel L: 122
 Discharge Elev: 6.00

Elevation	Principal Spillway Discharge						
	Weir Flow		Orifice Flow		Pipe Flow		Total Discharge
	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	
14.00	0.00	0.000					0.00
14.50	0.50	14.261					14.26
15.00	1.00	34.430					34.43
15.50	1.50	44.870	0.00	0.00			44.87
16.00	2.00	53.224	0.50	133.70			186.93
16.50	2.50	60.412	1.00	189.08			249.50
17.00	3.00	66.823	1.50	231.58	11.00	278.48	298.40
17.50	3.50	72.666	2.00	267.40	11.50	284.74	340.07
18.00	4.00	78.070	2.50	298.97	12.00	290.87	377.04

All holes are to be 8" diameter, uniformly spaced horizontally and vertically.

Row 1 12 holes Row 3 12 holes Row 5 0
 Row 2 12 holes Row 4 12 holes Row 6 0

Elevation	Riser Discharge: Orifice Row Elevation						Total Discharge (cfs)
	Row 1 14.00	Row 2 14.50	Row 3	Row 4	Row 5	Row 6	
14.00	0.000						0.000
14.50	14.261	0.000					14.261
15.00	20.169	14.261					34.430
15.50	24.702	20.169					44.870
16.00	28.523	24.702					53.224
16.50	31.890	28.523					60.412
17.00	34.933	31.890					66.823
17.50	37.732	34.933					72.666
18.00	40.337	37.732					78.070

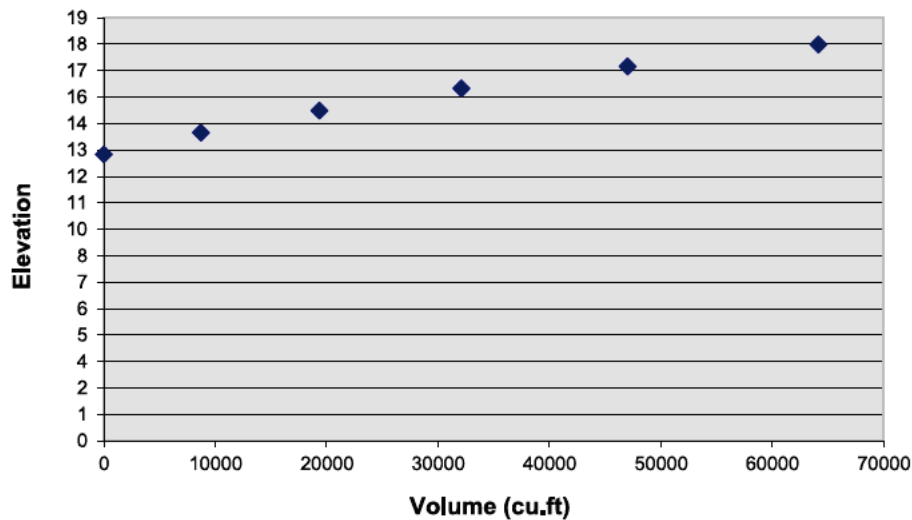
COMBINED BASINS: Dewatering Time

Elevation (ft)	Storage Volume (cu.ft)	d Storage Volume (cu.ft)	Discharge (cfs)	Average Discharge (cfs)	Time (hrs)	Accum. Time (hrs)
17.95	4,271,684		373.180			0.00
		938,355		335.791	0.78	
17.00	3,333,329		298.402			0.78
		447,725		273.949	0.45	
16.50	2,885,604		249.496			1.23
		478,675		218.211	0.61	
16.00	2,406,929		186.927			1.84
		431,896		115.899	1.04	
15.50	1,975,033		44.870			2.87
		431,896		39.650	3.03	
15.00	1,543,136		34.430			5.90
		385,689		24.346	4.40	
14.50	1,157,447		14.261			10.30
		385,689		7.131	15.02	
14.00	771,758		0.000			25.33
					Days	1.06

BASIN A: Stage-Storage Calculations

Elevation (ft)	Area (sq.ft.)	Avg Area (sq.ft.)	d Elevation (ft)	Storage Volume (cu.ft.)		
				Incremental	Total	(ac-ft)
13.00	7,813				0	0.000
		8,723	1.00	8,723		
14.00	9,665				8,723	0.200
		10,653	1.00	10,653		
15.00	11,673				19,376	0.445
		12,740	1.00	12,740		
16.00	13,837				32,115	0.737
		14,913	1.00	14,913		
17.00	16,016				47,029	1.080
		17,121	1.00	17,121		
18.00	18,250				64,150	1.473

Stage - Storage Curve



Emergency Spillway:

Invert Elevation: 17.00
 Length (ft): 12.00
 Depth of Flow (ft): 1.000

$$Q = 2.63 * \text{Length} * (\text{depth})^{1.5}$$

Req'd Q100 (cfs): 11.98 = 2*A - OS Discharge
 Provided Q (cfs): 31.56
 Top of Berm Elevation: 18.00

BASIN A: Principal Spillway Capacity

Barrel D: 18 (x1) Riser D: 24 (x1) Barrel L: 540
 Discharge Elev: 10.00

Elevation	Principal Spillway Discharge						
	Weir Flow		Orifice Flow		Pipe Flow		Total
	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	Head (ft)	Q (cfs)	Discharge
14.00	0.00	0.000			4.00	6.56	0.00
14.50	0.50	0.037			4.50	6.96	0.04
15.00	1.00	0.090			5.00	7.34	0.09
15.50	1.50	0.117			5.50	7.69	0.12
16.00	2.00	0.139			6.00	8.04	0.14
16.26	2.26	0.149	0.00	0.00	6.26	8.21	0.15
16.50	2.50	0.157	0.24	7.41	6.50	8.36	7.57
17.00	3.00	0.174	0.74	13.01	7.00	8.68	13.19
17.50	3.50	0.189	1.24	16.84	7.50	8.98	17.03
18.00	4.00	0.203	1.74	19.95	8.00	9.28	20.16

All holes are to be 1" diameter, uniformly spaced horizontally and vertically.

Row 1 2 holes Row 3 2 holes Row 5 0
 Row 2 2 holes Row 4 2 holes Row 6 0

Elevation	Riser Discharge: Orifice Row Elevation						Total Discharge (cfs)
	Row 1 14.00	Row 2 14.50	Row 3	Row 4	Row 5	Row 6	
14.00	0.000						0.000
14.50	0.037	0.000					0.037
15.00	0.052	0.037					0.090
15.50	0.064	0.052					0.117
16.00	0.074	0.064					0.139
16.26	0.079	0.070					0.149
16.50	0.083	0.074					0.157
17.00	0.091	0.083					0.174
17.50	0.098	0.091					0.189
18.00	0.105	0.098					0.203

BASIN A: Dewatering Time

Elevation (ft)	Storage Volume (cu.ft)	d Storage Volume (cu.ft)	Discharge (cfs)	Average Discharge (cfs)	Time (hrs)	Accum. Time (hrs)
16.89	45,428		11.980			0.00
		13,312		6.059	0.61	
16.00	32,115		0.139			0.61
		6,370		0.128	13.86	
15.50	25,746		0.117			14.47
		6,370		0.103	17.14	
15.00	19,376		0.090			31.61
		5,327		0.063	23.35	
14.50	14,049		0.037			54.96
		5,327		0.019	79.72	
14.00	8,723		0.000			134.68
					Days	5.61