## DEFINITIONS

1. THE CONTRACTOR IS DEFINED AS THE INSTALLATION CONTRACTOR FOR THE HILFIKER MSE RETAINING WALL SYSTEM.
2. KANE GEOTECH, INC. (KANE GEOTECH) IS HEREIN DEFINED AS THE DESIGN ENGINEER FOR THE HILFIKER MSE RETAINING WALL SYSTEM AND WHOSE STAMP IS ON THESE WORKING DRAWINGS.
3. THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION (FHWA) CENRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD) IS HEREIN DEFINED AS THE CONTRACTING OFFICER (CO) AND GOVERNING AGENCY.
4. M.S.E. WALL IS HEREIN DEFINED AS A MECHANICALLY STABILIZED EARTH WALL.

## GENERAL

1. DIMENSIONS SHOWN ON THESE WORKING DRAWINGS ARE BASED ON BEST AVAILABLE INFORMATION PROVIDED TO AND MAY NOT BE PRECISELY INDICATIVE OF FIELD CONDITIONS. ALL DIMENSIONS AND DETAILS SHOWN ON THESE WORKING DRAWINGS SHALL BE REVIEWED AND VERIFIED BY THE CONTRACTOR BEFORE THE START OF ANY CONSTRUCTION.
2. ANY DISCREPANCIES BETWEEN WORKING DRAWINGS AND ACTUAL FIELD CONDITIONS SHALL BE BROUGHT TO THE ATTENTION OF THE FHWA CONTRACTING OFFICER (CO) AND DESIGN ENGINEER IMMEDIATELY FOR CLARIFICATION.
3. FINAL WORKING DRAWINGS SHALL BE APPROVED BY THE FHWA CFLHD PRIOR TO THE START OF WORK.

## REQUESTS FOR INFORMATION (RFI)

1. REQUESTS FOR INFORMATION (RFI) OR DEVIATIONS FROM THESE WORKING DRAWINGS ENCOUNTERED IN THE FIELD SHALL BE SUBMITTED BY THE CONTRACTOR IN WRITING TO THE GOVERNING AGENCY. THE DESIGN ENGINEER SHALL HAVE A MINIMUM OF TWO WORKING DAYS FOR RESPONSE.

## REQUESTS FOR SUBSTITUTION

1. SUBSTITUTION REQUESTS IN REGARDS TO THESE WORKING DRAWINGS SHALL BE SUBMITTED BY THE CONTRACTOR IN WRITING AND REVIEWED BY FHWA PRIOR TO APPROVAL BY THE DESIGN ENGINEER. THE DESIGN ENGINEER SHALL HAVE A MINIMUM OF TWO WORKING DAYS FOR REVIEW AND RESPONSE. NO CHANGE IMPLEMENTATION SHALL BE ALLOWED UNTIL THE DESIGN ENGINEER APPROVAL.

## SITE LAYOUT

1. THE MSE RETAINING WALL SYSTEM LIMITS SHOWN ON THESE WORKING DRAWINGS ARE APPROXIMATE. ACTUAL FIELD LOCATION LIMITS SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR BEFORE CONSTRUCTION.
2. THE MSE RETAINING WALL DIMENSIONS AND LIMITS SHOWN ON THESE WORKING DRAWINGS ARE BASED ON THE FHWA WY TIG US212(9) CROSS-SECTIONS SHEETS X35 - X83, DATED FEBRUARY 16, 2019.

## ESTIMATED MATERIAL QUANTITIES

1. MSE WALL HEIGHTS, STATIONING LIMITS, WALL ELEVATIONS, AND MSE QUANTITIES ARE BASED ON THE INFORMATION PROVIDED ON THE FHWA BID PLANS WY TIG US212(9) SHEETS H1 - H17, DATED FEBRUARY 16, 2019 AND THE FHWA WY TIG US212(9) CROSS-SECTIONS SHEETS X35 - X83, DATED FEBRUARY 16, 2019.

## ON-SITE INSPECTIONS

1. ON-SITE INSPECTIONS SHALL BE DETERMINED BY THE CONTRACTING OFFICER (CO) AND GOVERNING AGENCY FOR THE FHWA WY TIG US212(9) MSE RETAINING WALL SYSTEM AND AS DEFINED IN THE FHWA STANDARD SPECIFICATIONS FP-03 AND THE SPECIAL PROVISIONS.

## QUALITY ASSURANCE (QA) INSPECTIONS

1. QUALITY ASSURANCE INSPECTIONS PRIOR AND DURING CONSTRUCTION SHALL BE DETERMINED BY THE CONTRACTING OFFICER (CO) AND GOVERNING AGENCY FOR THE WY TIG US212(9) MSE RETAINING WALL SYSTEM AND AS DEFINED IN THE FHWA STANDARD SPECIFICATIONS FP-03 AND THE SPECIAL PROVISIONS.

## MSE WALL INSTALLATION

1. THE MSE RETAINING WALL SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FP-03 AND THE SPECIAL PROVISIONS SECTION 255 "MECHANICALLY STABILIZED EARTH WALLS".

## BACKFILL TESTING - CRITERIA

1. BACKFILL MATERIAL TESTING SHALL BE PERFORMED FOR ALL TYPES OF BACKFILL IDENTIFIED AND NOTED ON THESE WORKING DRAWINGS. BACKFILL TESTING SHALL BE IN ACCORDANCE WITH THE FHWA STANDARD SPECIFICATIONS FP-03 SECTION 208, TABLE 208-1 "SAMPLING AND TESTING REQUIREMENTS".

## BACKFILL TESTING - QUANTITIES

1. BACKFILL MATERIAL TESTING SHALL BE PERFORMED FOR ALL TYPES OF BACKFILL IDENTIFIED AND NOTED ON THESE WORKING DRAWINGS. BACKFILL TESTING SHALL BE IN ACCORDANCE WITH THE FHWA STANDARD SPECIFICATIONS FP-03 SECTION 208, TABLE 208-1 "SAMPLING AND TESTING REQUIREMENTS".

## BACKFILL TESTING - ACCEPTANCE

1. TEST RESULTS AND REPORTING FOR THE BACKFILL MATERIALS SHALL BE IN ACCORDANCE WITH FP-03 SECTION 208 "TEST RESULTS AND REPORTING".

## FINAL INSPECTION

1. THE CONTRACTOR, DESIGN ENGINEER, AND GOVERNING AGENCY SHALL BE ON-SITE FOR THE FINAL INSPECTION.
2. IF ADDITIONAL FIELD CHANGES ARE REQUIRED TO PROVIDE APPROVAL,THE CONTRACTOR SHALL MAKE ALL NECESSARY CHANGES PRIOR TO THE GOVERNING AGENCY APPROVAL.
3. IS THE RESPONSIBILITY OF THE CONTRACTOR TO MEET ALL REQUIREMENTS PROVIDED IN THESE WORKING DRAWINGS AND ON THE FHWA BID PLANS WY TIG US212(9).

## DISCLAIMERS

1. TO ENSURE THAT THE PROJECT DURING CONSTRUCTION IS IN CONFORMANCE WITH THE APPROVED SUBMITTALS, IT IS RECOMMENDED THAT KANE GEOTECH, INC. BE RETAINED TO OBSERVE CONSTRUCTION DURING THE PROJECT. KANE GEOTECH, INC. IS NOT RESPONSIBLE FOR CONSTRUCTION PERFORMED WITHOUT ITS OVERSIGHT.
2. SLOPE FAILURES CAN BE SPORADIC AND UNPREDICTABLE. CAUSES RANGE FROM HUMAN CONSTRUCTION TO ENVIRONMENTAL EFFECTS (WEATHER, EARTHQUAKES, ETC.). BECAUSE OF THE MULTIPLICITY OF FACTORS AFFECTING SUCH EVENTS IT IS NOT, AND CANNOT BE, AN EXACT SCIENCE THAT GUARANTEES THE SAFETY OF INDIVIDUALS AND PROPERTY. HOWEVER, BY THE APPLICATION OF SOUND ENGINEERING PRINCIPLES TO A PREDICTABLE RANGE OF PARAMETERS, THE RISK OF INJURY AND PROPERTY LOSS CAN BE SUBSTANTIALLY REDUCED USING PROPERLY DESIGNED PROTECTION MEASURES IN IDENTIFIED RISK AREAS. INSPECTION AND MAINTENANCE OF SUCH SYSTEMS ARE NECESSARY TO ENSURE THE DESIRED PROTECTION LEVEL IS NOT DEGRADED BY IMPACT DAMAGE, CORROSION, OR OTHER FACTORS.

## REVIEWED AND OR REFERENCE DOCUMENTS

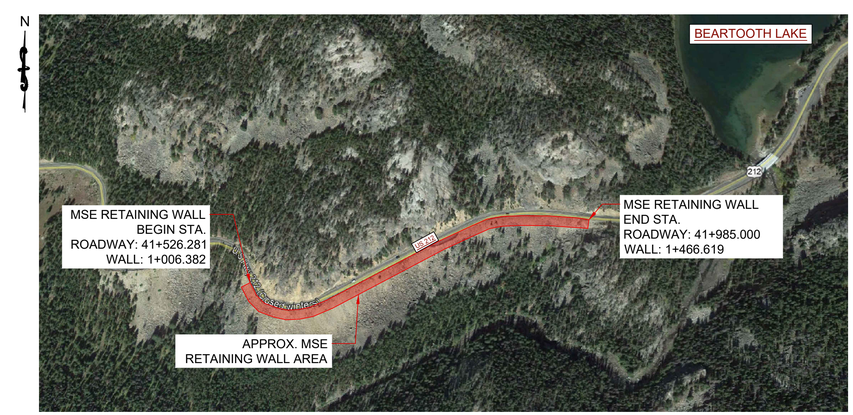

1. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO). AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS. 8TH EDITION. SEPTEMBER 2017.
2. HILFIKER RETAINING WALLS (2007). WELDED WIRE RETAINING WALL, STANDARD DRAWING DETAILS. SHEETS 1-3. DATE SEPTEMBER 17, 2007.
3. HILFIKER RETAINING WALLS (2009). WELDED WIRE RETAINING WALL, CONSTRUCTION GUIDE MANUAL. DATE APRIL, 2009.
4. HILFIKER RETAINING WALLS (2020). TECHNICAL SPECIFICATIONS, HILFIKER MSE WALL SYSTEM, WELDED WIRE WALL, HOT DIPPED GALVANIZED WIRE (HDG).
5. HILFIKER RETAINING WALLS (2019). MATERIAL WARRANTY FOR HILFIKER SYSTEMS. AUGUST 12, 2019.
6. HILFIKER RETAINING WALLS (2020). WELDED WIRE WALL - WIRE INVENTORY CHART. OCTOBER 14, 2020.
7. HILFIKER RETAINING WALLS (2020). WELDED WIRE SIZE TABLE.
8. KANE GEOTECH, INC. (2020). WY TIGER US219(9), TEMPORARY SURFICIAL SLOPE STABILIZATION, CALCULATION REPORT. WY TIGER US 212(9), PARK COUNTY, WYOMING. KGT20-22, DATE JUNE 1, 2020. REV. MAY 21, 2021.
9. KANE GEOTECH, INC. (2020). WY TIGER US219(9), TEMPORARY SURFICIAL SLOPE STABILIZATION, WORKING DRAWINGS. WY TIGER US 212(9), PARK COUNTY, WYOMING. KGT20-22, DATE JUNE 1, 2020. REV. MAY 21, 2021.
10. KANE GEOTECH, INC. (2020). WY TIGER US219(9), FHWA016 - RESPONSE TO MRC006 - STRUCTURE EXCAVATION AND SHORING PLAN. DATED 7/6/2020.
11. KANE GEOTECH, INC. (2021). WY TIGER US219(9), BEARTOOTH HIGHWAY, HILFIKER MSE RETAINING WALL, ENGINEERING DESIGN CALCULATION REPORT. WY TIGER US 212(9), SHOSHONE NATIONAL FOREST, WYOMING. KGT20-19, DATE MARCH 25, 2021. REVISED MAY 21, 2021.
12. URS CORP. (2002). FINAL REPORT - GEOTECHNICAL INVESTIGATION, BEARTOOTH RAVINE AND FEN MITIGATION AREA, BEARTOOTH HIGHWAY, U.S. 212, PARK COUNTY, WY, 15PP (PLUS APPENDICES), 2002 09-23.
13. URS CORP. (2002). FINAL REPORT - GEOTECHNICAL INVESTIGATION OF BEARTOOTH HIGHWAY, STATIONS: 49+100 - 49+300 AND 50+240 - 50+360, 2001 09-19
14. URS CORP. (2002). BEARTOOTH GEOTECHNICAL STATION BORELOGS. PROJECT NUMBERS 68FHAT0027.00 & 68-FHAT0039.00.
15. URS (2002). GEOTECHNICAL INVESTIGATION FOR THE BEARTOOTH RAVINE AND FEN MITIGATION AREA FINAL REPORT, BEARTOOTH HIGHWAY, US 212, PARK COUNTY, WYOMING. SEPTEMBER 23, 2002. PROJECT NO. 68-FHAT0039.00.
16. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). FHWA CENTRAL FEDERAL LANDS (CFL), BEARTOOTH HIGHWAY HPP 4-1(8), FEN MITIGATION ANALYSIS. BEARTOOTH HIGHWAY, PARK COUNTY, WYOMING. 9/24/2015.
17. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). FHWA CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD),TECHNICAL MEMORANDUM, SLOPE STABILITY ASSESSMENT FOR THE BEARTOOTH RAVINE RETAINING WALL, WY FS 4-1(4). APRIL 30, 2004.
18. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). FHWA CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD),TECHNICAL MEMORANDUM, UPDATES AND REVISIONS TO BEARTOOTH RAVINE BRIDGE FOUNDATION AND RETAINING WALL DESIGN, WY TIG US212(9) BEARTOOTH HIGHWAY. JANUARY 22, 2019.
19. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). FHWA CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD),QUESTIONS AND ANSWERS DURING ADVERTISEMENT FOR WY TIG US212(9) BEARTOOTH HIGHWAY. MAY 6, 2019.
20. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). FHWA CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD), INVITATION FOR BID, WY TIG US212(9) BEARTOOTH HIGHWAY PROJECT SPECIAL PROVISIONS. SN: 6982AF19B000008.
21. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). STANDARD SPECIFICATIONS FOR CONSTRUCTION OF ROADS AND BRIDGES ON FEDERAL HIGHWAY PROJECTS. FP-03, METRIC UNITS.
22. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD), WY TIG US212(9) BEARTOOTH HIGHWAY, PARK COUNTY, WYOMING, PROJECT PLANS. FEBRUARY 26, 2019. RETAINING WALL PLANS SHEETS H1 - H17.
23. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). CENTRAL FEDERAL LANDS HIGHWAY DIVISION (CFLHD), WY TIG US212(9) BEARTOOTH HIGHWAY, PARK COUNTY, WYOMING, ROADWAY CROSS-SECTIONS. FEBRUARY 16, 2019. PLANS SHEETS X35 - H83.
24. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). DESIGN AND CONSTRUCTION OF MECHANICALLY STABILIZED EARTH WALLS AND REINFORCED SOIL SLOPES - VOLUME I. FHWA GEC 011. PUBLICATION NO. FHWA-NHI-10-024. NOVEMBER 2009.
25. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). DESIGN AND CONSTRUCTION OF MECHANICALLY STABILIZED EARTH WALLS AND REINFORCED SOIL SLOPES - VOLUME II. FHWA GEC 011. PUBLICATION NO. FHWA-NHI-10-025. NOVEMBER 2009.
26. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). DESIGN AND CONSTRUCTION GUIDELINES FOR GEOSYNTHETIC REINFORCED SOIL ABUTMENTS AND INTEGRATED BRIDGE SYSTEMS. PUBLICATION NO. FHWA-HRT-17-080. JUNE 2018.
27. U.S. DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION (FHWA). CENTRAL FEDERAL LANDS HIGH DIVISION (CFLHD). LETTER OF TRANSMITTAL, WY TIG US212(9) BEARTOOTH RAVINE BRIDGE PROJECT, RFI034 MSE WALL MATERIAL TYPE, LETTER OF ACCEPTANCE. JANUARY 8, 2021.
28. WIRE REINFORCEMENT INSTITUTE (WRI) (2016). MANUAL OF STANDARD PRACTICE, STRUCTURAL WELDED WIRE REINFORCEMENT. WWR-500 9TH EDITION.


# BEARTOOTH HIGHWAY

FHWA WY TIG US212(9)
HILFIKER MSE RETAINING WALL
SHOSHONE NATIONAL FOREST, WYOMING

## INDEX OF SHEETS


| DESCRIPTION | NUMBER |
|---|---|
| MSE RETAINING WALL TITLE SHEET | 1 |
| MSE WALL ELEVATION VIEW LAYOUT SECTIONS 1-2 | 2 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 3 | 3 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 4 | 4 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 5 | 5 |
| MSE WALL ELEVATION VIEW LAYOUT SECTIONS 6-7 | 6 |
| MSE WALL ELEVATION VIEW LAYOUT SECTIONS 8-9 | 7 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 10 | 8 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 11 | 9 |
| MSE WALL ELEVATION VIEW LAYOUT SECTIONS 12-13 | 10 |
| MSE WALL ELEVATION VIEW LAYOUT SECTIONS 14-15 | 11 |
| MSE WALL ELEVATION VIEW LAYOUT SECTION 16 | 12 |
| MSE WALL PLAN VIEW LAYOUT | 13 |
| HILFIKER MSE W.W.M. MATERIAL SPECIFICATIONS | 14 |
| HILFIKER MSE W.W.M. CONSTRUCTION SPECIFICATIONS | 15 |
| HILFIKER MSE W.W.M. WALL ASSEMBLY DETAILS I | 16 |
| HILFIKER MSE W.W.M. WALL ASSEMBLY DETAILS II | 17 |
| HILFIKER MSE W.W.M. WALL ASSEMBLY DETAILS III | 18 |
| MSE RETAINING WALL PROFILES STA. 41+570 & STA. 41+900 | 19 |
| MSE RETAINING WALL PROFILE STA. 41+620 | 20 |
| MSE RETAINING WALL PROFILES STA. 41+810 & STA. 41+971 | 21 |
| MSE RETAINING WALL PROFILES STA. 41+860 & STA. 41+980 | 22 |
| MSE RETAINING WALL DRAINAGE DETAILS | 23 |
| MSE RETAINING WALL RETURN AND WING WALL TRANSITION DETAILS | 24 |
| MSE RETAINING END OF WALL TRANSITION DETAILS | 25 |
| MSE RETAINING WALL DESIGN SCHEDULES | 26 |


P-1 / 1 PROJECT LOCATION
SCALE: N.T.S.

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL RETAINING WALL TITLE SHEET

REVISIONS

2021 03-25: Added Sheets 13 and 25 to plan set and index of sheets.
2021 03-25: Revised Sheet Numbering.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants

Stockton Office
7400 Shoreline Drive, Suite 6
Stockton, CA 95219
(209) 472-1822

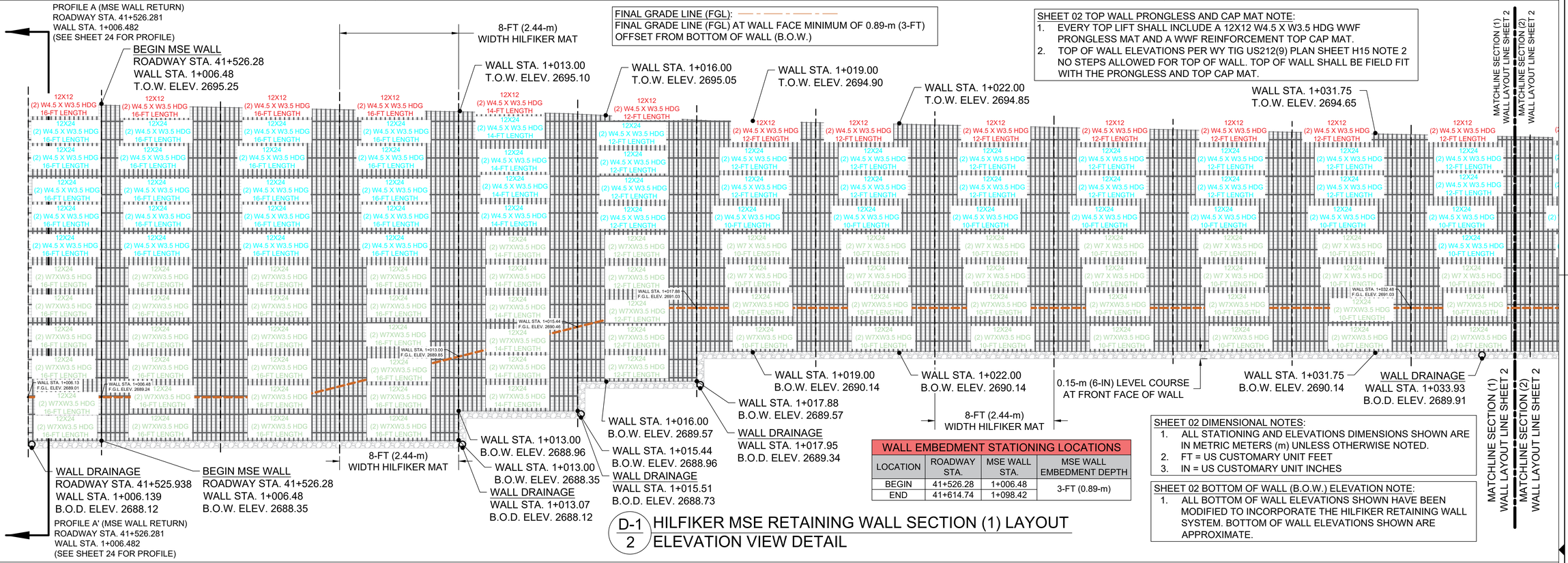
Los Angeles Office
6080 Center Drive, Suite 600
Los Angeles, CA 90045
(323) 331-9222

Honolulu Office
1441 Kapiolani Blvd, Suite 1115
Honolulu, HI 96814
(808) 468-9993


SHEET 1 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.




FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

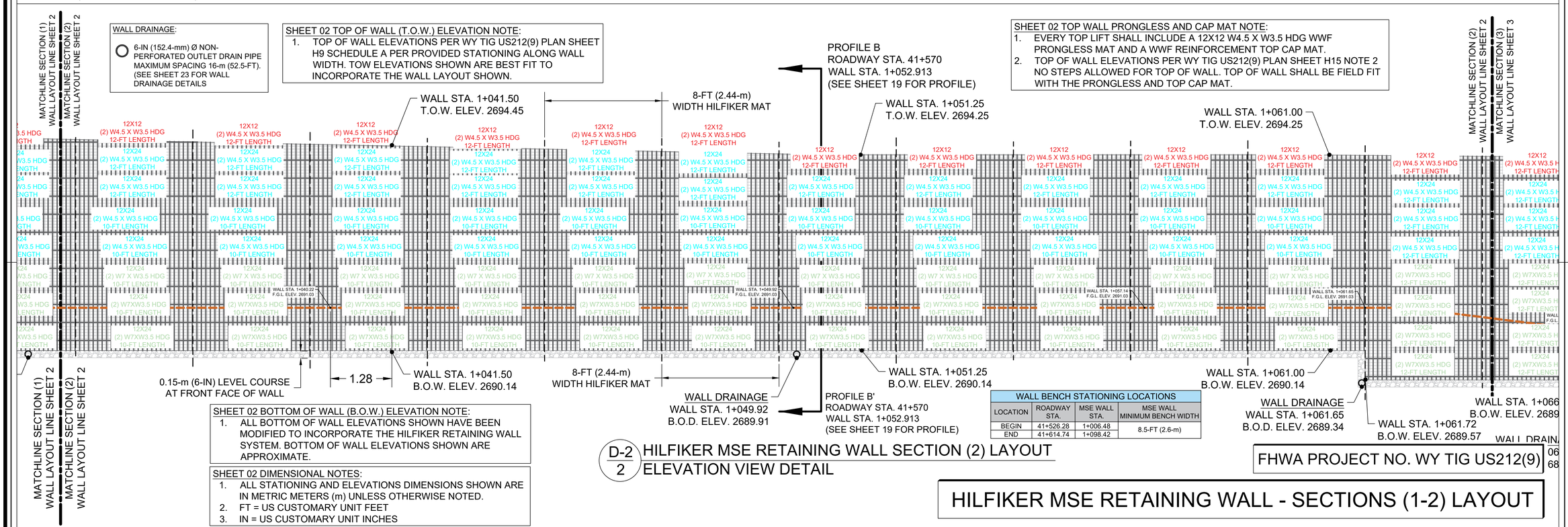
SHEET 02 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |

SHEET 02 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

SHEET 02 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

D-1 / 2 HILFIKER MSE RETAINING WALL SECTION (1) LAYOUT ELEVATION VIEW DETAIL




SHEET 02 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |

SHEET 02 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

SHEET 02 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

D-2 / 2 HILFIKER MSE RETAINING WALL SECTION (2) LAYOUT ELEVATION VIEW DETAIL

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTIONS (1-2) LAYOUT

REVISIONS
- 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
- 2021 05-07: Added drainage locations per FHWA Transmittal 155.
- 2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr., Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

SHEET 2 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

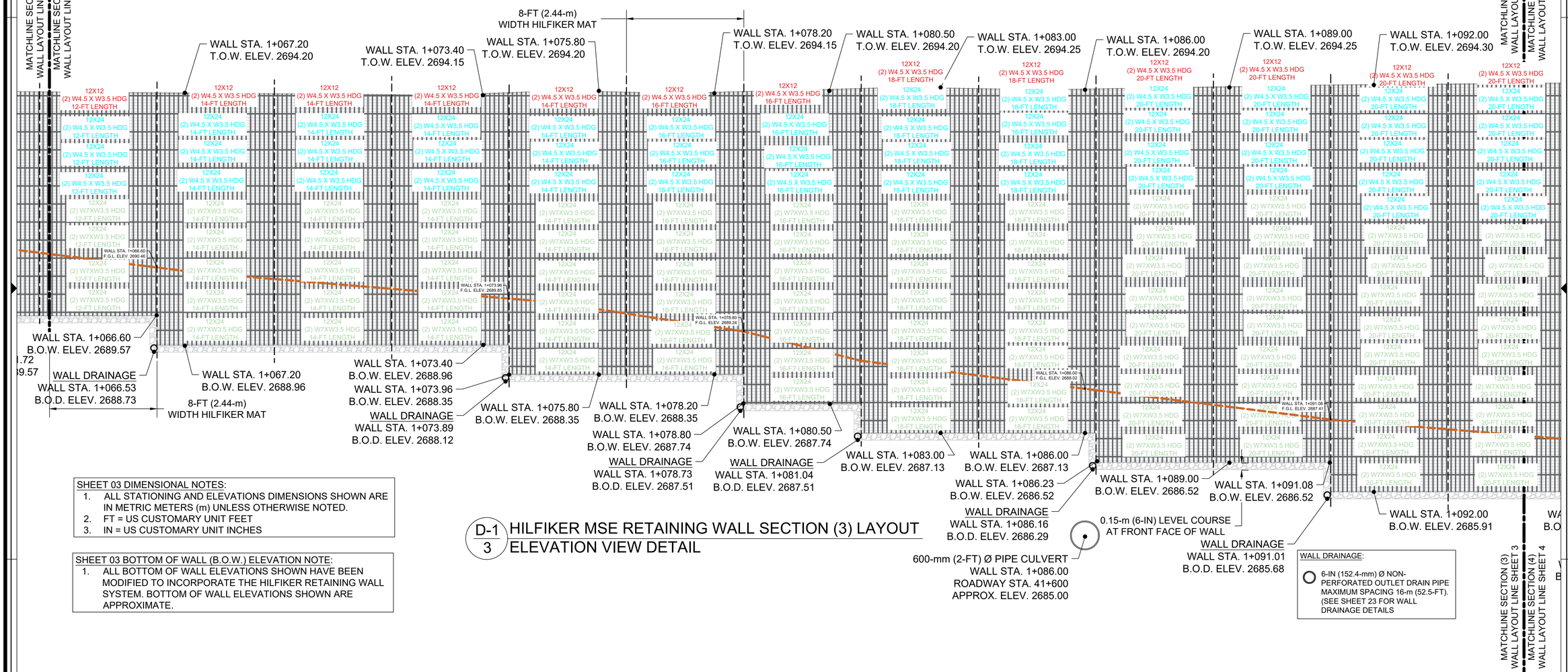
| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |

FINAL GRADE LINE (FGL): — - — - — - —
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

SHEET 03 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 03 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




SHEET 03 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

SHEET 03 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

D-1 / 3 HILFIKER MSE RETAINING WALL SECTION (3) LAYOUT ELEVATION VIEW DETAIL

WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (3) LAYOUT

2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
2021 05-07: Added drainage locations per FHWA Transmittal 155.
2021 05-21: Added FGL callouts per FHWA Transmittal 165.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office 1441 Kapiolani Blvd. Suite 1115 Honolulu, HI 96814 (808) 468-9993
Los Angeles Office 6080 Center Drive, Suite 600 Los Angeles, CA 90045 (323) 331-9222
Stockton Office 7400 Shoreline Drive, Suite 6 Stockton, CA 95219 (209) 472-1822

SHEET 3 OF 26

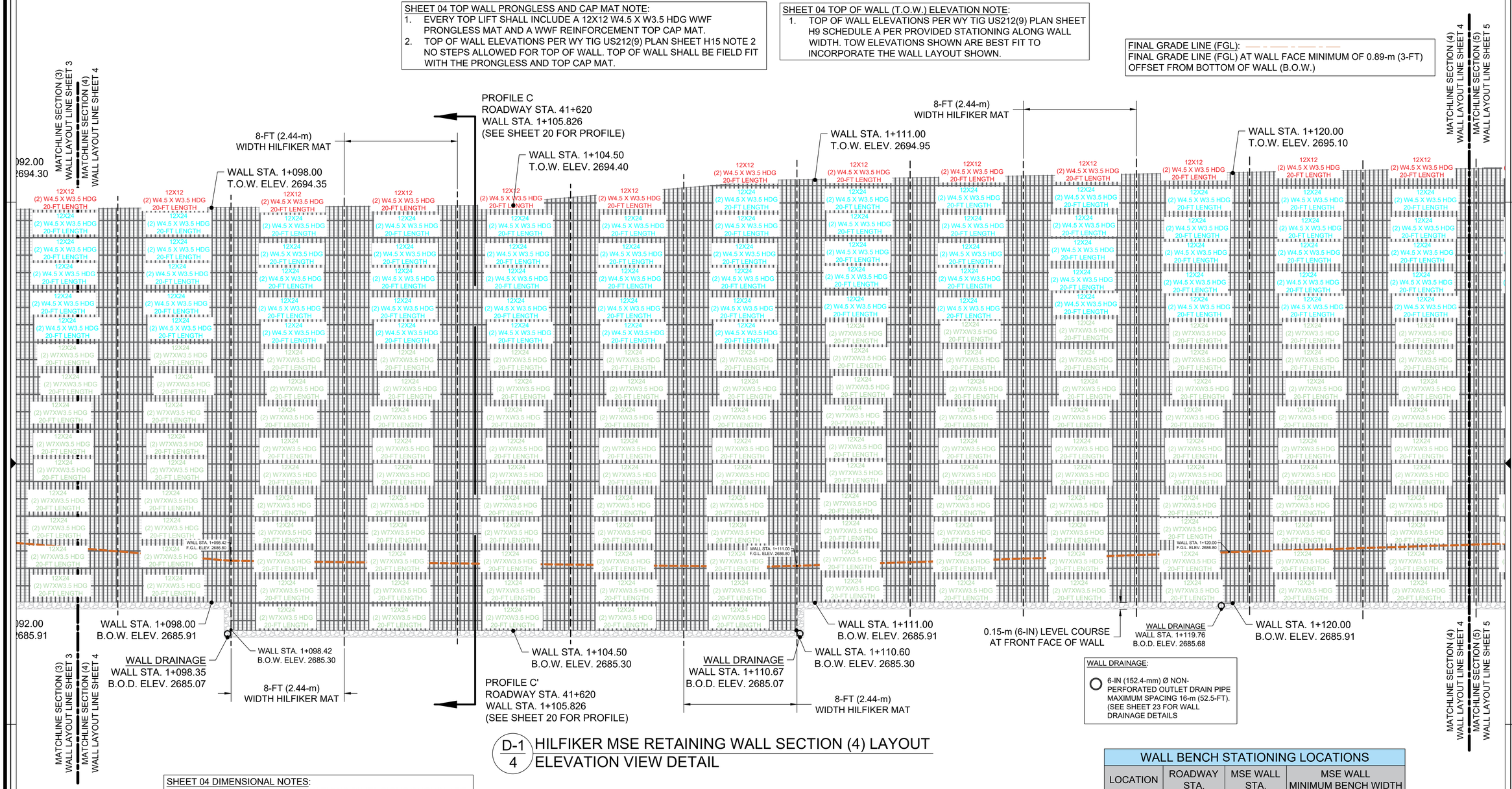
DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 04 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 04 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)




WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

D-1 / 4 HILFIKER MSE RETAINING WALL SECTION (4) LAYOUT
ELEVATION VIEW DETAIL

SHEET 04 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

SHEET 04 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

WALL EMBEDMENT STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |

WALL BENCH STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (4) LAYOUT

REVISIONS
- 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
- 2021 05-07: Added drainage locations per FHWA Transmittal 155.
- 2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Drive, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993

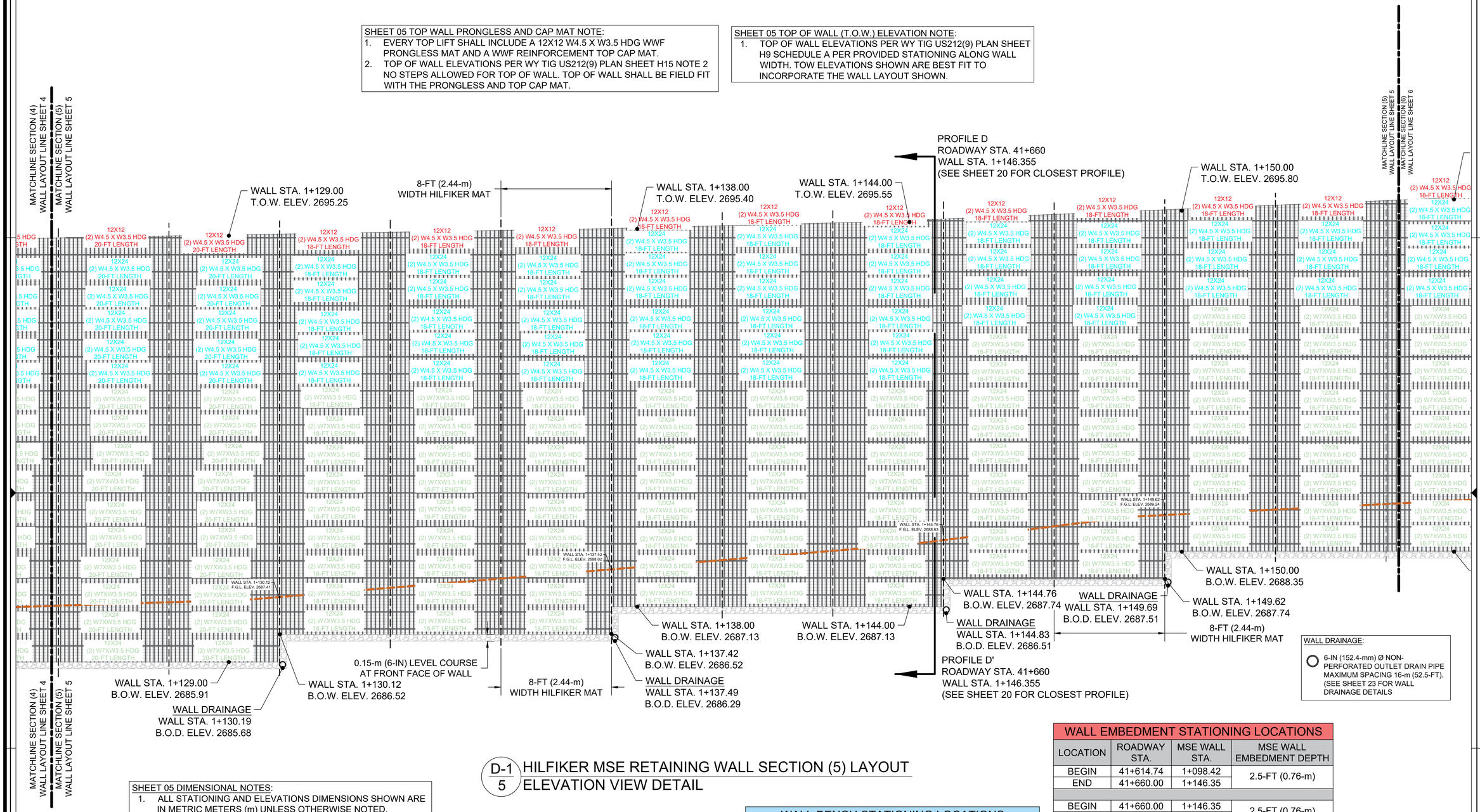

SHEET 4 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 05 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 05 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

D-1 / 5 HILFIKER MSE RETAINING WALL SECTION (5) LAYOUT
ELEVATION VIEW DETAIL

SHEET 05 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

SHEET 05 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

WALL BENCH STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |
| | | | |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |

WALL EMBEDMENT STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |
| | | | |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (5) LAYOUT

REVISIONS
- 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
- 2021 05-07: Added drainage locations per FHWA Transmittal 155.
- 2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Spanos Park Drive, Suite 6, Stockton, CA 95219, (209) 472-1822

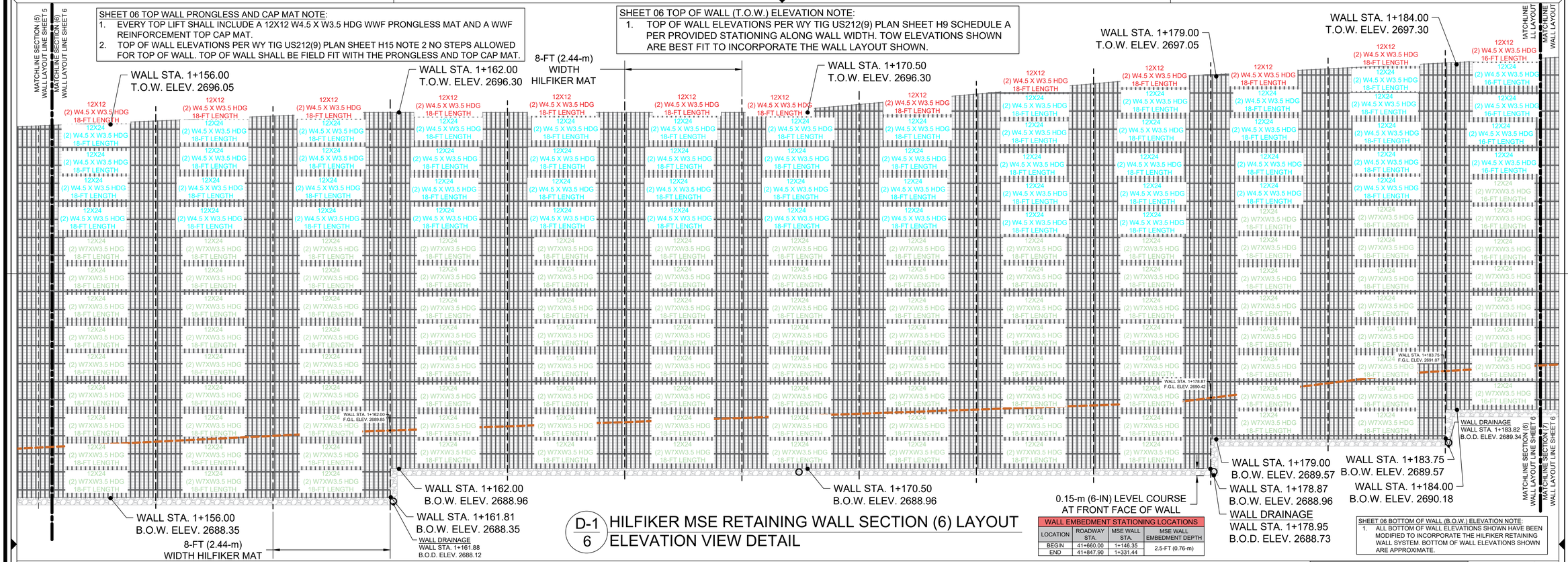

SHEET 5 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 06 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 06 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




D-1 / 6 HILFIKER MSE RETAINING WALL SECTION (6) LAYOUT ELEVATION VIEW DETAIL

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |

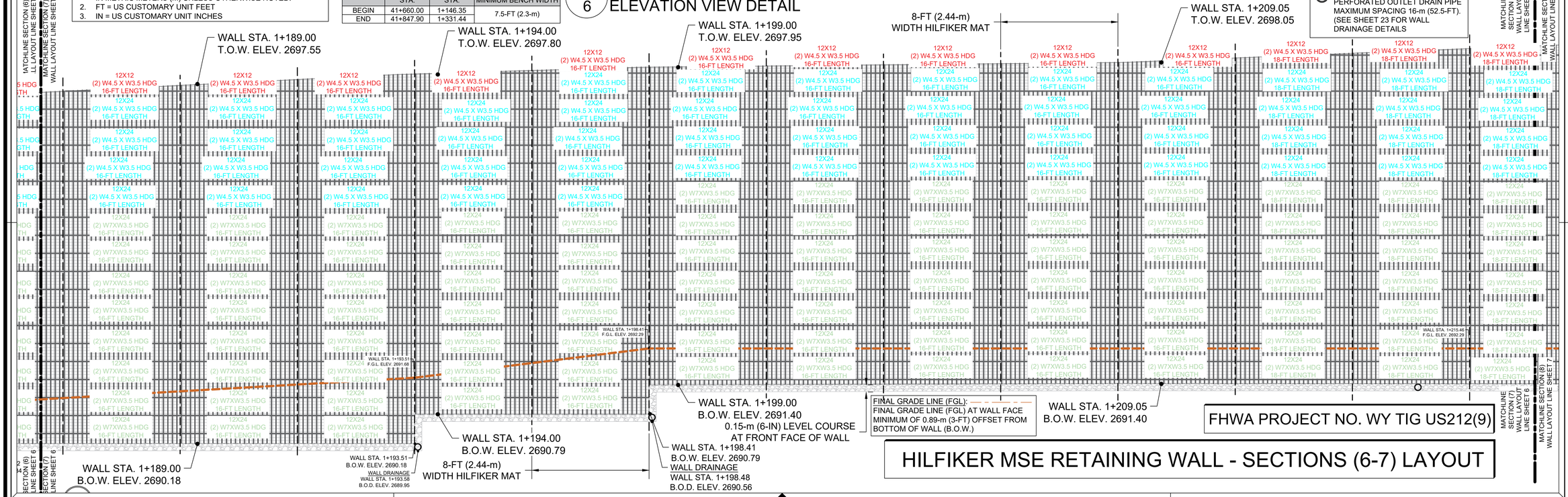
SHEET 06 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

SHEET 06 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |

D-2 / 6 HILFIKER MSE RETAINING WALL SECTION (7) LAYOUT ELEVATION VIEW DETAIL

WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS




FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTIONS (6-7) LAYOUT

| REVISIONS |
|---|
| 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144. |
| 2021 03-25: Revised Sheet Numbering. |
| 2021 05-07: Added final grade at wall face per FHWA Transmittal 155. |
| 2021 05-07: Added drainage locations per FHWA Transmittal 155. |
| 2021 05-21: Added FGL callouts per FHWA Transmittal 165. |

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd. Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Drive Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Drive, Suite 6, Stockton, CA 95219, (209) 472-1822


SCALE: N.T.S.
DRAWN BY: JAM
SHEET 6 OF 26
DATE: 2021 02-19
DESIGNED BY: WFK
KANE PROJECT NO: KGT20-19
CHECKED BY: WFK

© 2021 KANE GeoTech, Inc.

SHEET 07 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

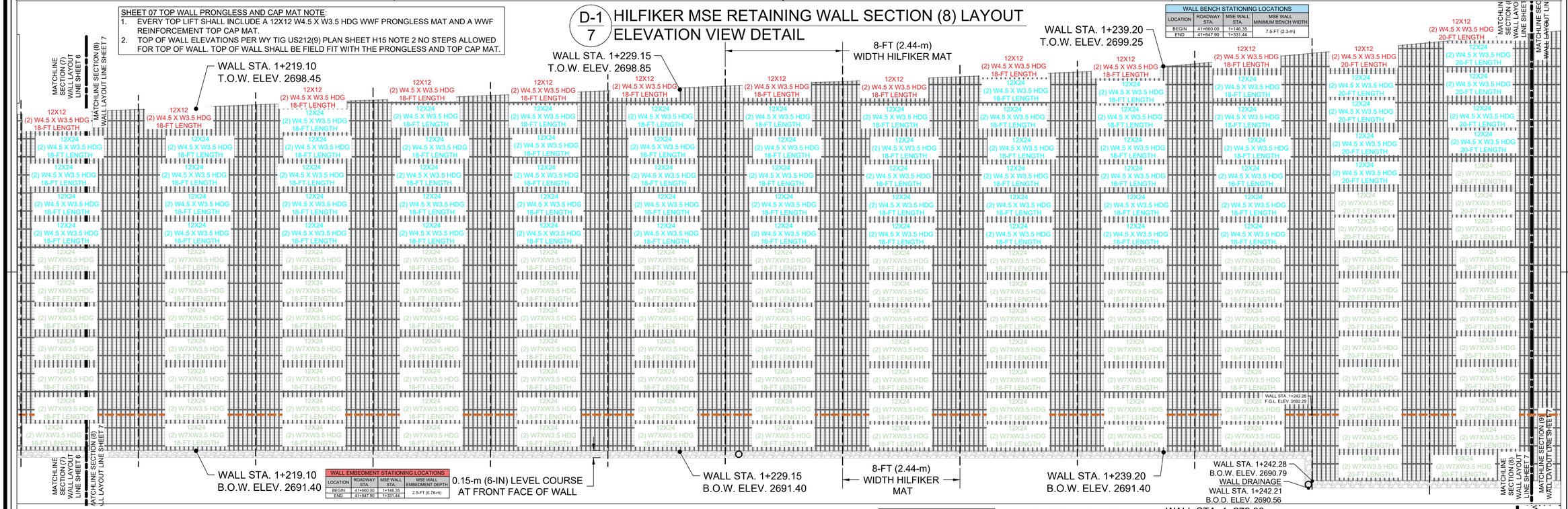
# D-1 / 7 HILFIKER MSE RETAINING WALL SECTION (8) LAYOUT ELEVATION VIEW DETAIL

WALL BENCH STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |

WALL EMBEDMENT STATIONING LOCATIONS

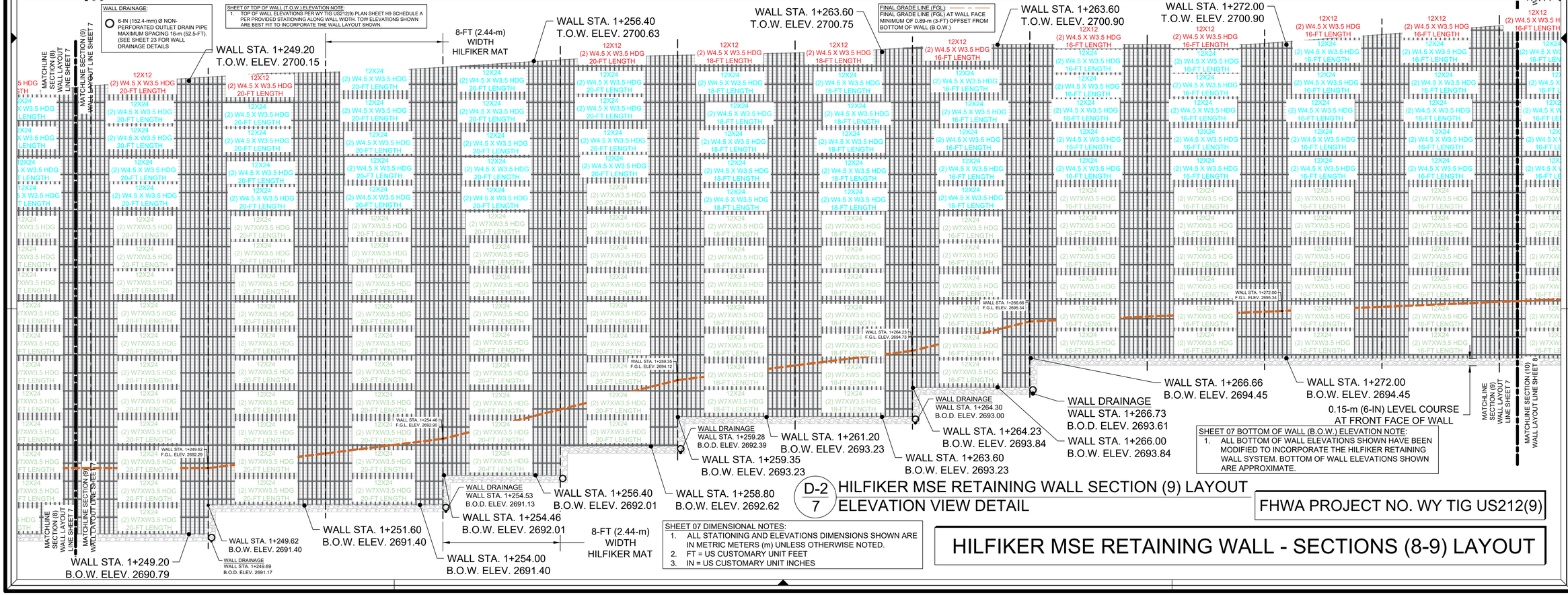
| LOCATION | ROADWAY STA. | MSE WALL STA | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |




WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

SHEET 07 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)




SHEET 07 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

# D-2 / 7 HILFIKER MSE RETAINING WALL SECTION (9) LAYOUT ELEVATION VIEW DETAIL

SHEET 07 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTIONS (8-9) LAYOUT

REVISIONS

2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
2021 05-07: Added drainage locations per FHWA Transmittal 155.
2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants

Honolulu Office
1441 Kapiolani Blvd, Suite 1115
Honolulu, HI 96814
(808) 468-9993

Los Angeles Office
6080 Center Drive, Suite 600
Los Angeles, CA 90045
(323) 331-9222

Stockton Office
7400 Shoreline Dr, Suite 6
Stockton, CA 95219
(209) 472-1822


SHEET 7 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

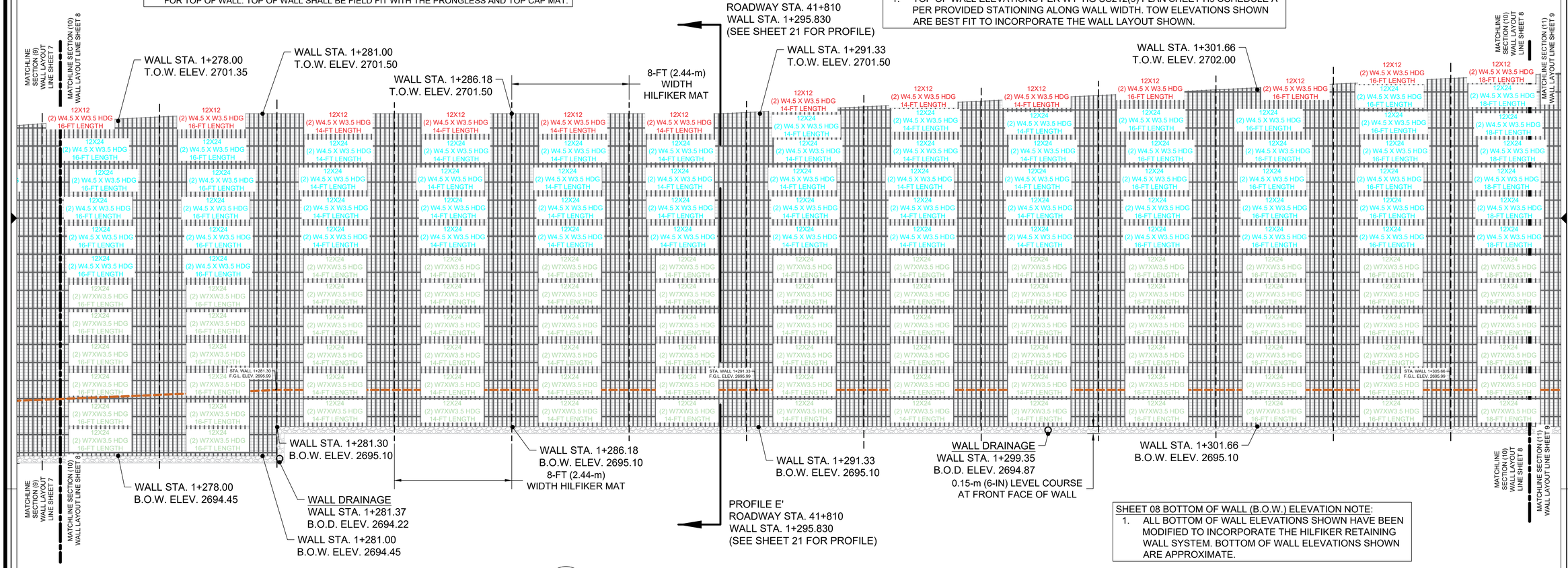
| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |

FINAL GRADE LINE (FGL): — — — — — — — —
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

SHEET 08 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 08 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




D-1 / 8 HILFIKER MSE RETAINING WALL SECTION (10) LAYOUT ELEVATION VIEW DETAIL

SHEET 08 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

WALL DRAINAGE:
O 6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

SHEET 08 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (10) LAYOUT

REVISIONS
2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
2021 05-07: Added drainage locations per FHWA Transmittal 155.
2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Spanos Drive, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

Professional Engineer Wilfred F. Kane 14595 Date 3-25-21 Wyoming

SHEET 8 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

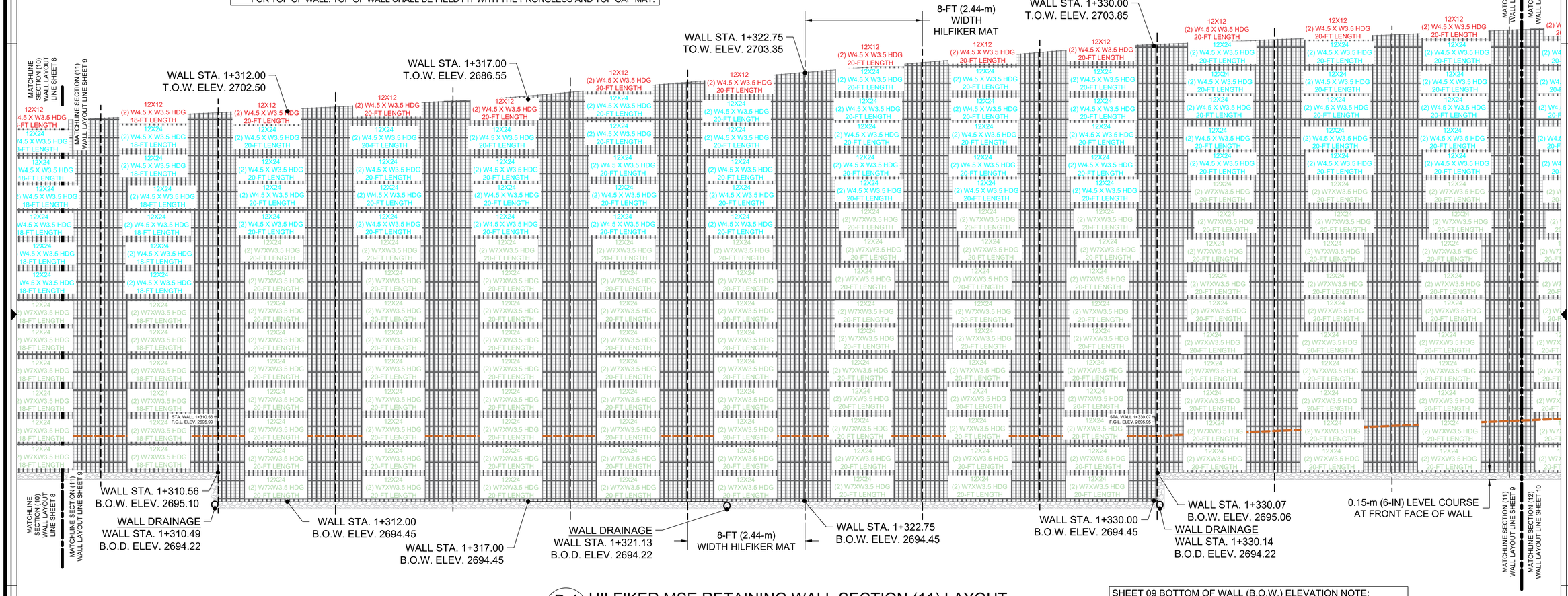
| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |
| | | | |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |
| | | | |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

SHEET 09 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.

SHEET 09 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.




SHEET 09 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

D-1 / 9 HILFIKER MSE RETAINING WALL SECTION (11) LAYOUT
ELEVATION VIEW DETAIL

WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

SHEET 09 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (11) LAYOUT

REVISIONS
- 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
- 2021 05-07: Added drainage locations per FHWA Transmittal 155.
- 2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Dr, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993


Professional Engineer, Wyoming, Wesley F. Kane, 16695, Date 2-19-21

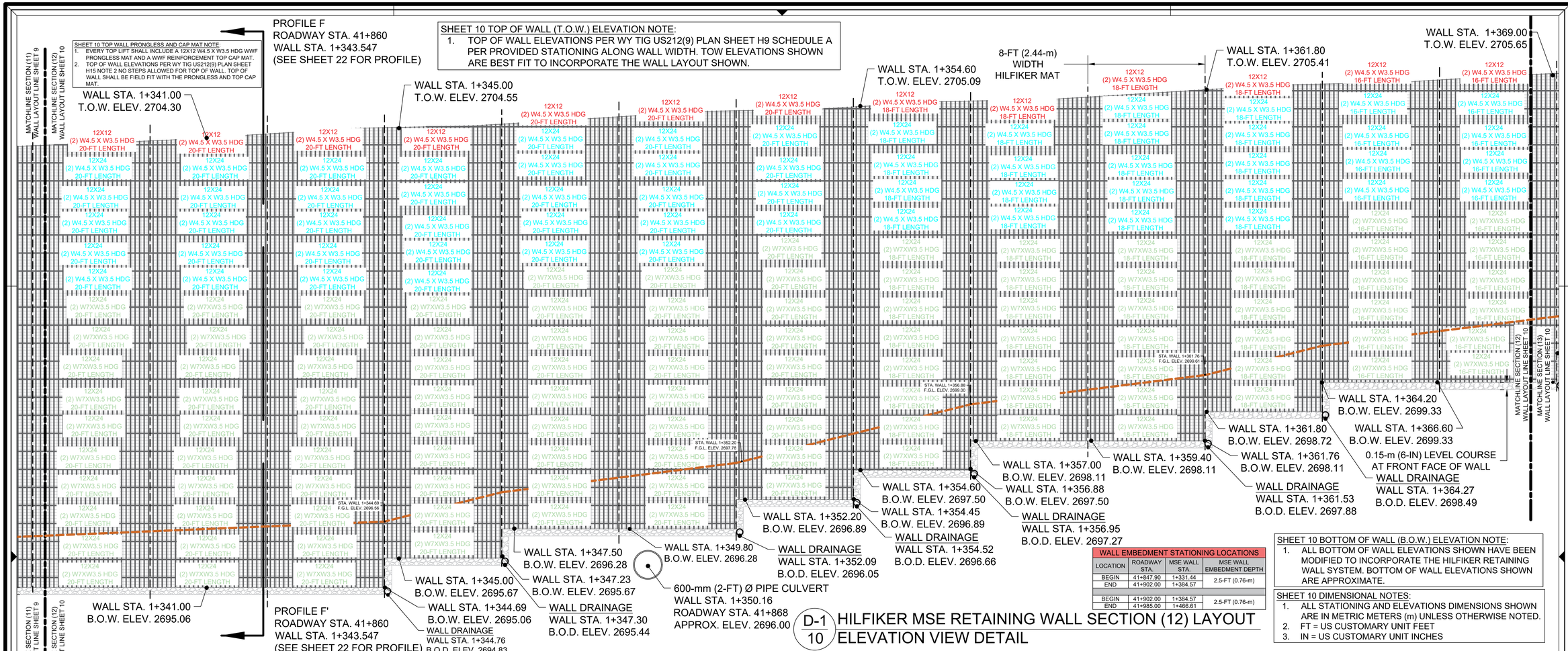
SHEET 9 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 10 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

SHEET 10 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.



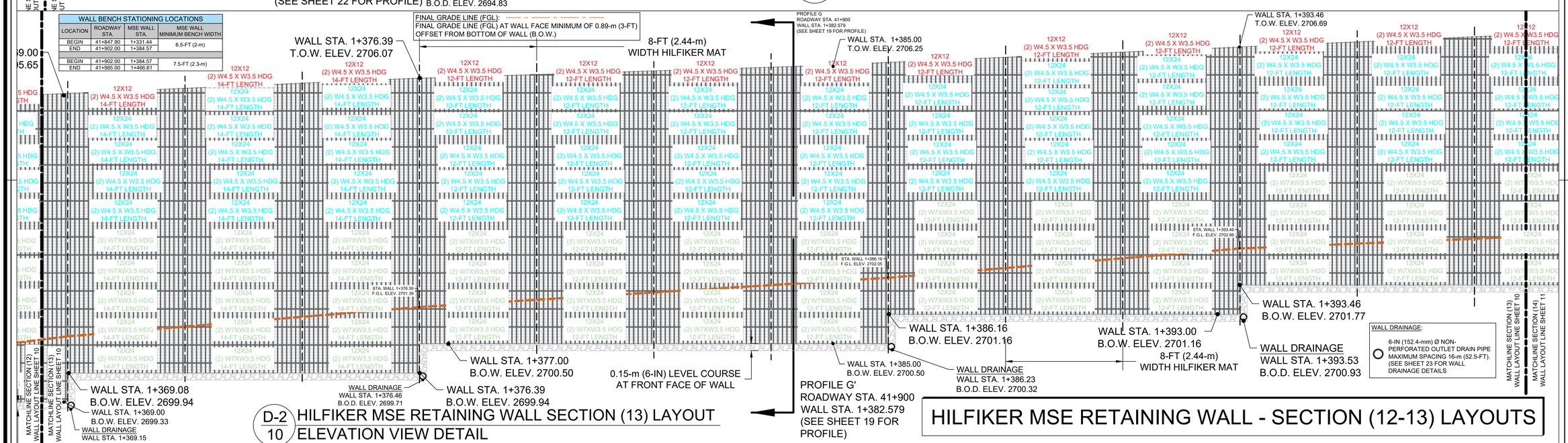

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

SHEET 10 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

SHEET 10 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

D-1 / 10 HILFIKER MSE RETAINING WALL SECTION (12) LAYOUT ELEVATION VIEW DETAIL

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |




WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

D-2 / 10 HILFIKER MSE RETAINING WALL SECTION (13) LAYOUT ELEVATION VIEW DETAIL

# HILFIKER MSE RETAINING WALL - SECTION (12-13) LAYOUTS

REVISIONS

2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
2021 05-07: Added drainage locations per FHWA Transmittal 155.
2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd. Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Dr. Suite 6, Stockton, CA 95219, (209) 472-1822

SHEET 10 OF 26

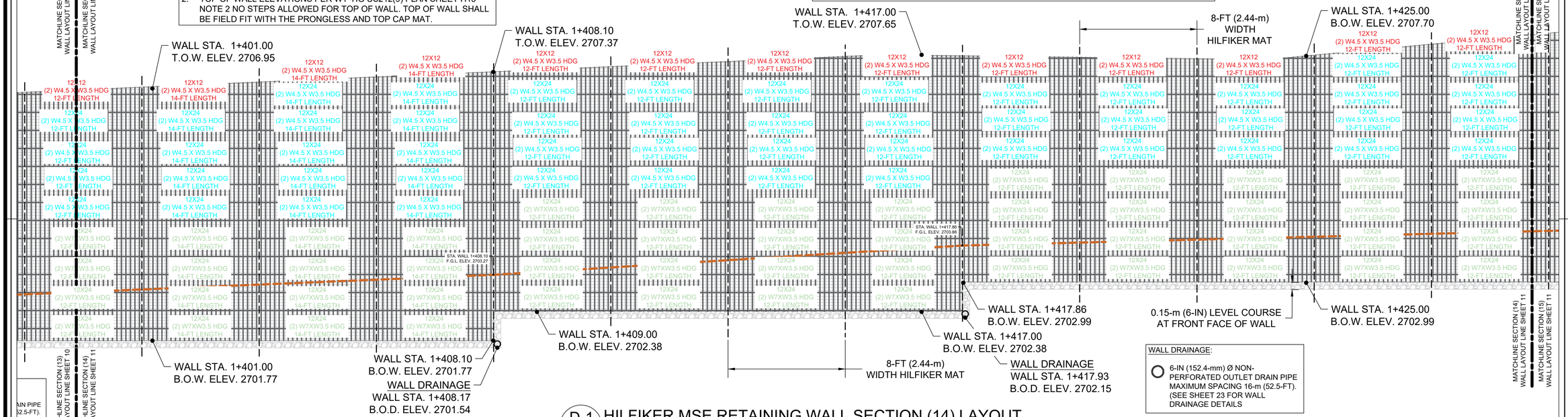
DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 11 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

SHEET 11 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




SHEET 11 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

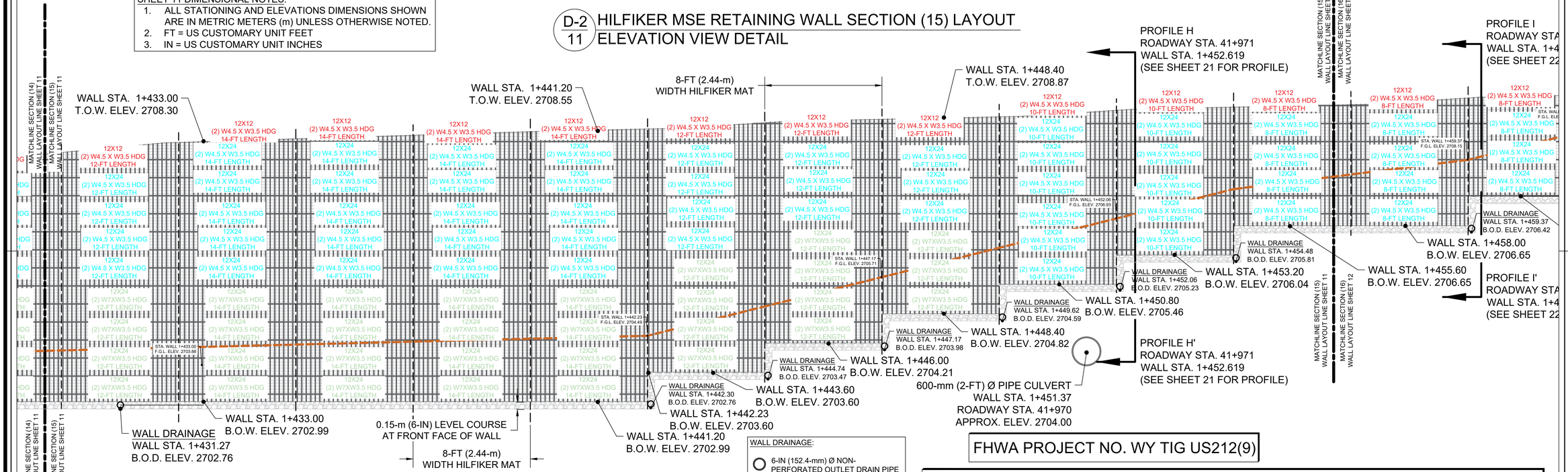
## D-1 / 11 HILFIKER MSE RETAINING WALL SECTION (14) LAYOUT ELEVATION VIEW DETAIL

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

SHEET 11 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

## D-2 / 11 HILFIKER MSE RETAINING WALL SECTION (15) LAYOUT ELEVATION VIEW DETAIL




WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (14-15) LAYOUTS

| REVISIONS |
|---|
| 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144. |
| 2021 03-25: Revised Sheet Numbering. |
| 2021 05-07: Added final grade at wall face per FHWA Transmittal 155. |
| 2021 05-07: Added drainage locations per FHWA Transmittal 155. |
| 2021 05-21: Added FGL callouts per FHWA Transmittal 165. |

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd. Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Dr., Suite 6, Stockton, CA 95219, (209) 472-1822


SHEET 11 OF 26

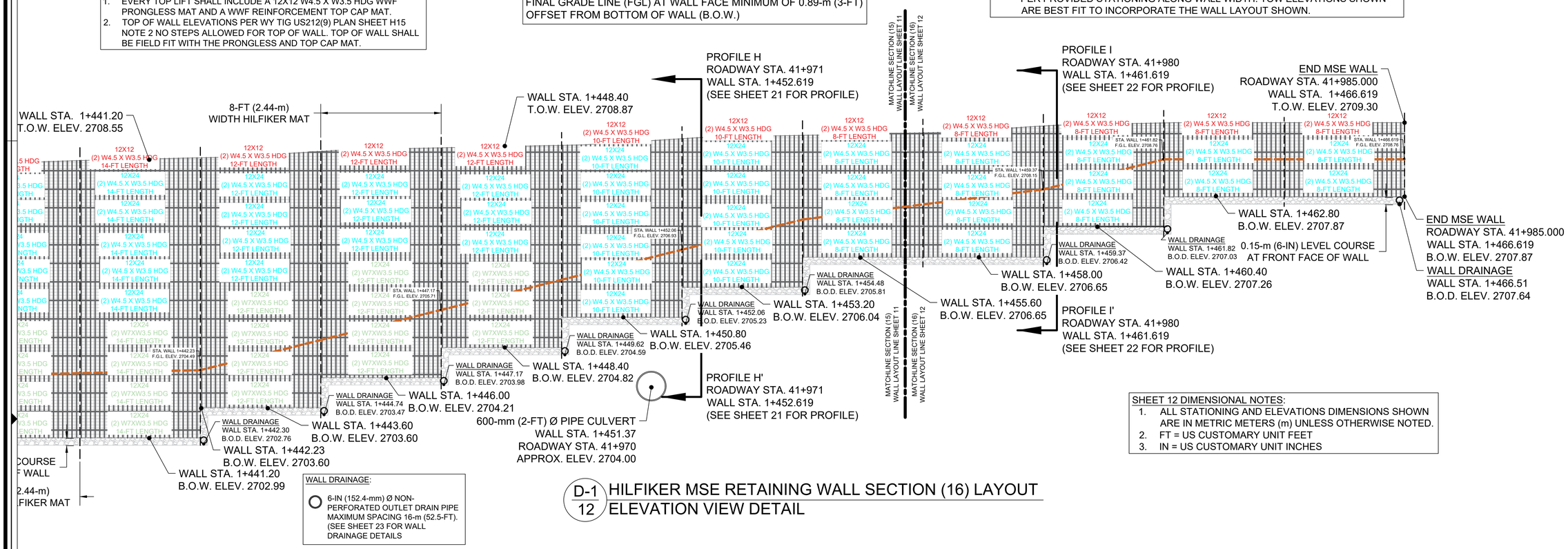
DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

SHEET 12 TOP WALL PRONGLESS AND CAP MAT NOTE:
1. EVERY TOP LIFT SHALL INCLUDE A 12X12 W4.5 X W3.5 HDG WWF PRONGLESS MAT AND A WWF REINFORCEMENT TOP CAP MAT.
2. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H15 NOTE 2 NO STEPS ALLOWED FOR TOP OF WALL. TOP OF WALL SHALL BE FIELD FIT WITH THE PRONGLESS AND TOP CAP MAT.

FINAL GRADE LINE (FGL):
FINAL GRADE LINE (FGL) AT WALL FACE MINIMUM OF 0.89-m (3-FT) OFFSET FROM BOTTOM OF WALL (B.O.W.)

SHEET 12 TOP OF WALL (T.O.W.) ELEVATION NOTE:
1. TOP OF WALL ELEVATIONS PER WY TIG US212(9) PLAN SHEET H9 SCHEDULE A PER PROVIDED STATIONING ALONG WALL WIDTH. TOW ELEVATIONS SHOWN ARE BEST FIT TO INCORPORATE THE WALL LAYOUT SHOWN.




SHEET 12 DIMENSIONAL NOTES:
1. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (m) UNLESS OTHERWISE NOTED.
2. FT = US CUSTOMARY UNIT FEET
3. IN = US CUSTOMARY UNIT INCHES

WALL DRAINAGE:
6-IN (152.4-mm) Ø NON-PERFORATED OUTLET DRAIN PIPE MAXIMUM SPACING 16-m (52.5-FT). (SEE SHEET 23 FOR WALL DRAINAGE DETAILS

D-1 / 12 HILFIKER MSE RETAINING WALL SECTION (16) LAYOUT
ELEVATION VIEW DETAIL

SHEET 12 BOTTOM OF WALL (B.O.W.) ELEVATION NOTE:
1. ALL BOTTOM OF WALL ELEVATIONS SHOWN HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.

**WALL EMBEDMENT STATIONING LOCATIONS**

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

**WALL BENCH STATIONING LOCATIONS**

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - SECTION (16) LAYOUT

REVISIONS
- 2021 03-25: Added Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Added final grade at wall face per FHWA Transmittal 155.
- 2021 05-07: Added drainage locations per FHWA Transmittal 155.
- 2021 05-21: Added FGL callouts per FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

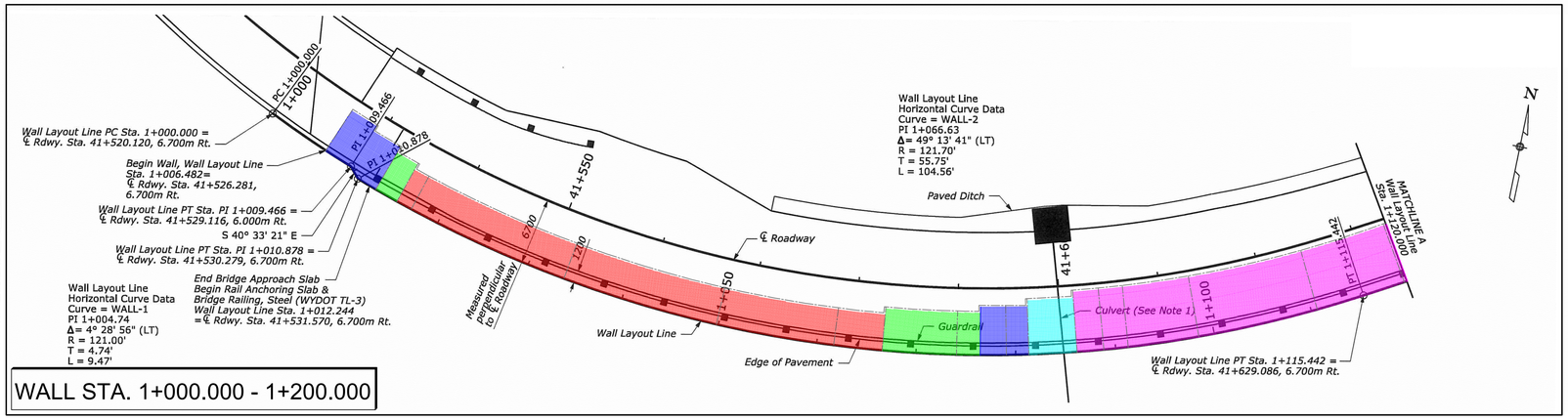
PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Dr, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Dr, Suite 6, Stockton, CA 95219, (209) 472-1822

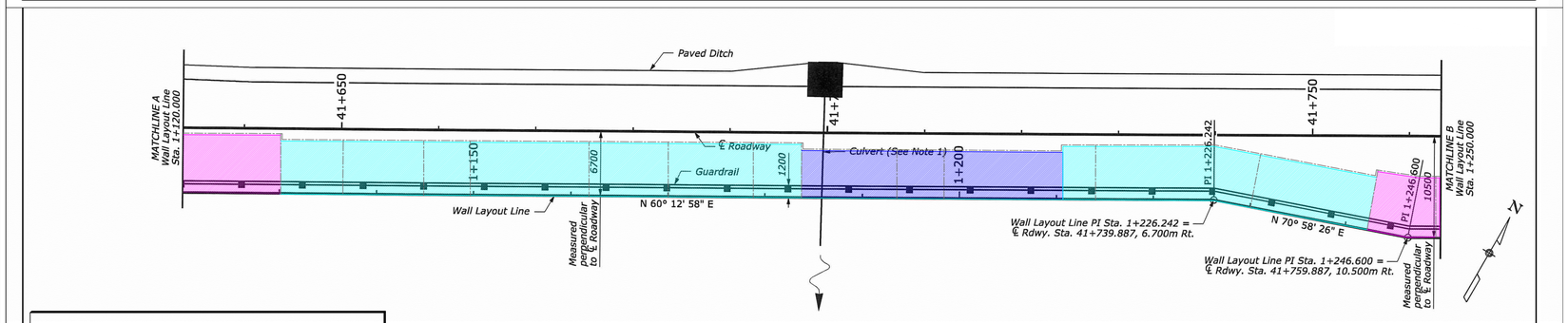
SHEET 12 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

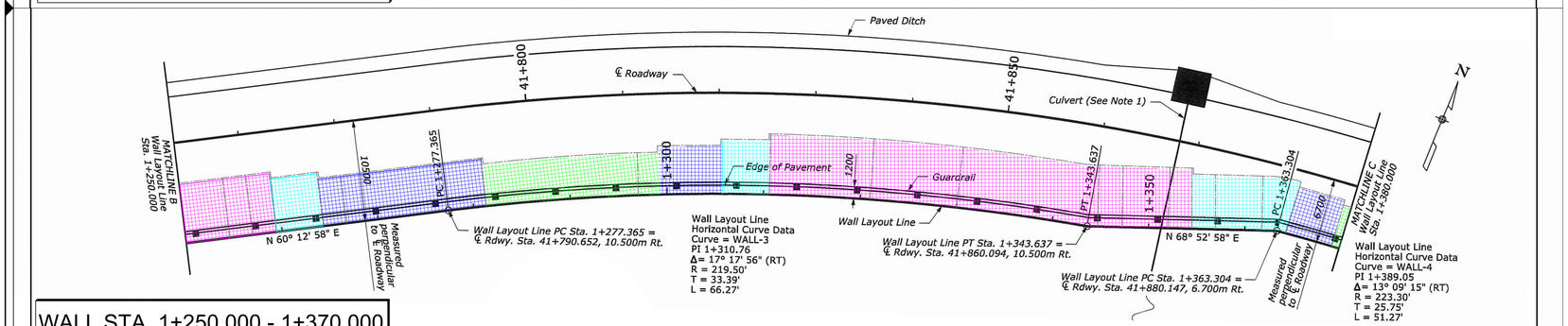
© 2021 KANE GeoTech, Inc.



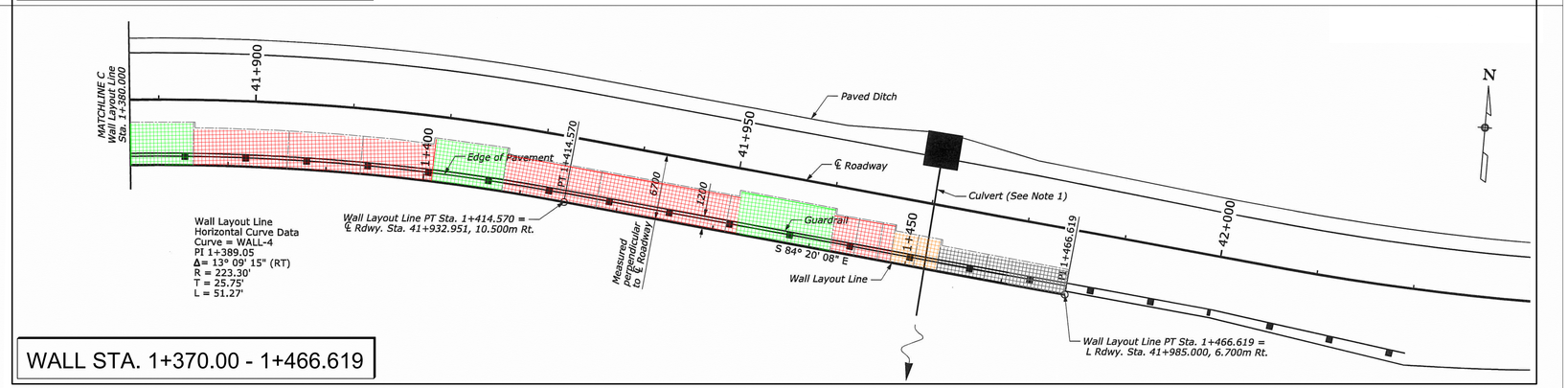

WALL STA. 1+000.000 - 1+200.000




WALL STA. 1+120.000 - 1+250.000




WALL STA. 1+250.000 - 1+370.000




WALL STA. 1+370.00 - 1+466.619

## HILFIKER MSE RETAINING WALL MATERIAL LEGEND

- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 8-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 10-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 12-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 14-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 16-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 18-FT
- HILFIKER METALLIC STEEL REINFORCEMENT MAT REINFORCED MAT LENGTH: 20-FT
- PERFORATED AND NON-PERFORATED DRAIN PIPE PIPE LENGTHS: SEE SHEET 26

NOTES:

1. MATERIAL QUANTITIES SHOWN IN SCHEDULES ON SHEET 26.
2. UNDERLYING HORIZONTAL CURVATURE DATA AND WALL LAYOUT LINES SHOWN PER WYTIGUS212(9) BID PLANS SHEETS H5 - H8.
3. ALL STATIONING AND ELEVATIONS DIMENSIONS SHOWN ARE IN METRIC METERS (M) UNLESS OTHERWISE NOTED.
4. FT = US CUSTOMARY UNIT FEET

### FRONT (DOWNSLOPE) WALL DRAINAGE OUTLET LOCATIONS

| DRAIN NO. | MSE WALL STA. | ELEV. | DRAIN NO. | MSE WALL STA. | ELEV. |
|---|---|---|---|---|---|
| 1 | 1+006.139 | 2688.1 | 33 | 1+256.97 | 2691.8 |
| 2 | 1+013.07 | 2688.1 | 34 | 1+259.28 | 2692.4 |
| 3 | 1+015.51 | 2688.7 | 35 | 1+264.30 | 2693.0 |
| 4 | 1+017.95 | 2689.3 | 36 | 1+266.73 | 2693.6 |
| 5 | 1+033.93 | 2689.9 | 37 | 1+281.37 | 2694.2 |
| 6 | 1+049.92 | 2689.9 | 38 | 1+299.35 | 2694.9 |
| 7 | 1+061.65 | 2689.3 | 39 | 1+310.49 | 2694.2 |
| 8 | 1+066.53 | 2688.7 | 40 | 1+321.13 | 2694.2 |
| 9 | 1+073.89 | 2688.1 | 41 | 1+330.14 | 2694.2 |
| 10 | 1+078.73 | 2687.5 | 42 | 1+344.76 | 2694.8 |
| 11 | 1+081.04 | 2687.5 | 43 | 1+347.30 | 2695.4 |
| 12 | 1+086.16 | 2686.3 | 44 | 1+352.09 | 2696.1 |
| 13 | 1+091.01 | 2685.7 | 45 | 1+354.52 | 2696.7 |
| 14 | 1+098.35 | 2685.1 | 46 | 1+356.95 | 2697.3 |
| 15 | 1+110.67 | 2685.1 | 47 | 1+361.53 | 2697.9 |
| 16 | 1+119.76 | 2685.7 | 48 | 1+364.27 | 2698.5 |
| 17 | 1+130.19 | 2685.7 | 49 | 1+369.15 | 2699.1 |
| 18 | 1+137.49 | 2686.3 | 50 | 1+376.46 | 2699.7 |
| 19 | 1+144.83 | 2686.5 | 51 | 1+386.23 | 2700.3 |
| 20 | 1+149.69 | 2687.5 | 52 | 1+393.53 | 2700.9 |
| 21 | 1+156.00 | 2688.4 | 53 | 1+408.17 | 2701.5 |
| 22 | 1+161.88 | 2688.1 | 54 | 1+417.93 | 2702.2 |
| 23 | 1+170.32 | 2688.7 | 55 | 1+431.27 | 2702.8 |
| 24 | 1+178.95 | 2688.7 | 56 | 1+442.30 | 2702.8 |
| 25 | 1+183.82 | 2689.3 | 57 | 1+444.74 | 2703.5 |
| 26 | 1+193.58 | 2690.0 | 58 | 1+447.17 | 2704.0 |
| 27 | 1+198.48 | 2690.6 | 59 | 1+449.62 | 2704.6 |
| 28 | 1+214.39 | 2691.2 | 60 | 1+452.06 | 2705.2 |
| 29 | 1+230.38 | 2691.2 | 61 | 1+454.48 | 2705.8 |
| 30 | 1+242.21 | 2690.6 | 62 | 1+459.37 | 2706.4 |
| 31 | 1+249.69 | 2691.2 | 63 | 1+461.82 | 2707.0 |
| 32 | 1+254.53 | 2691.1 | 64 | 1+466.51 | 2707.6 |

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL PLAN VIEW LAYOUT

2021 05-07: Added Front Wall Drainage Outlet Location Table.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Dr, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993

SCALE: 1" = 7 Meters
DATE: 2021 03-25
KANE PROJECT NO: KGT20-19
DRAWN BY: BJF
DESIGNED BY: WFK
CHECKED BY: WFK
SHEET 13 OF 26

© 2021 KANE GeoTech, Inc.

## HILFIKER MSE RETAINING WALL SYSTEM - MATERIAL SPECIFICATIONS

### 1. MSE WALL SYSTEM DESCRIPTION

1.1. THIS WORK SHALL CONSIST OF A WELDED WIRE RETAINING WALL (WWW), MECHANICALLY STABILIZED EARTH RETAINING WALL [MSE] CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS, FHWA STANDARD SPECIFICATIONS FP-03, AND THE FHWA FHWA BID SPECIAL PROVISIONS.

### 2. MATERIAL ORDERING

2.1. THE CONTRACTOR SHALL MAKE HIS OWN ARRANGEMENTS TO PURCHASE ALL WWW M.S.E. MATERIALS, INCLUDING WIRE MESH REINFORCEMENT MATS, BACKING MATERIALS, AND ALL NECESSARY INCIDENTALS FROM HILFIKER RETAINING WALLS, 1902 HILFIKER LANE, EUREKA, CA 95503- 5711, PH. 707/443-5093; WWW.HILFIKER.COM; INFO@HILFIKER.COM.

### 3. WELDED WIRE MESH REINFORCEMENT

3.1. WELDED WIRE MESH (WWM) REINFORCEMENT SHALL MEET THE REQUIREMENTS PER FHWA FP-03 SECTION 720.01(H).

3.2. FABRICATE FROM COLD-DRAWN STEEL WIRE CONFORMING TO AASHTO M 32. WELD THE WIRE INTO THE FINISHED MESH FABRIC ACCORDING TO AASHTO M 55. AFTER FABRICATION, GALVANIZE ACCORDING TO AASHTO M 111, COATING GRADE 85 AFTER FABRICATION. REPAIR ALL DAMAGE TO THE GALVANIZED COATING BEFORE INSTALLATION.

3.3. THE WELDED WIRE MESH REINFORCEMENT SHALL BE SHOP FABRICATED OF COLD DRAWN STEEL WIRE AND SHALL BE WELDED INTO THE FINISHED MESH FABRIC CONFORMING TO THE MINIMUM REQUIREMENTS OF ASTM A-1064, WITH A YIELD STRENGTH MINIMUM OF 450-mPa (65-KSI).

3.4. WELDED WIRE REINFORCEMENT WIRE GRID TYPES ARE SHOWN ON THE PLANS AND PROVIDED:
- 3.4.1. 12-IN x 24-IN W4.5 x W3.5
  - 3.4.1.1. NOMINAL WIRE DIAMETER (0.239-IN X 0.211-IN)
  - 3.4.1.2. MINIMUM L.T.D.S:
    - 3.4.1.2.1. STATIC: 972-LB/FT (14.2-kN/m)
    - 3.4.1.2.2. SEISMIC: 1,270-LB/FT (18.5-kN/m)
- 3.4.2. 12-IN X 24-IN W7.0 X W3.5
  - 3.4.2.1. NOMINAL WIRE DIAMETER (0.299-IN X 0.211-IN)
  - 3.4.2.2. MINIMUM L.T.D.S:
    - 3.4.2.2.1. STATIC: 1,713-LB/FT (25-kN/m)
    - 3.4.2.2.2. SEISMIC: 2,240-LB/FT (32.7-kN/m)

3.5. WELDED WIRE CAP REINFORCEMENT WIRE GRID TYPE IS SHOWN ON THE PLANS AND PROVIDED:
- 3.5.1. 12-IN X 12-IN W4.5 X W3.5
  - 3.5.1.1. NOMINAL WIRE DIAMETER (0.239-IN X 0.211-IN)
  - 3.5.1.2. MINIMUM L.T.D.S:
    - 3.5.1.2.1. STATIC: 833-LB/FT (12.2-kN/m)
    - 3.5.1.2.2. SEISMIC: 1,089-LB/FT (15.9-kN/m)

3.6. WELDED WIRE MESH SHALL BE HOT DIP GALVANIZED (2.0 OZ./SF, ASTM A-123; 605-G/M2).

### 4. WELDED WIRE MESH FACING / CAP

4.1. WELDED WIRE MESH (WWM) FACING SHALL MEET THE REQUIREMENTS PER FHWA FP-03 SECTION 720.01(B).

4.2. FABRICATE FROM WELDED WIRE FABRIC CONFORMING TO AASHTO M 55, EXCEPT THAT SUBSECTION 7.4. APPLIES FOR LONGITUDINAL AND TRANSVERSE WIRE SIZES. GALVANIZE ACCORDING TO AASHTO M 111, COATING GRADE 85 AFTER FABRICATION.

4.3. WELDED WIRE MESH FOR FACING SHALL BE FORMED BY A 90-DEGREE BEND OF THE WELDED WIRE REINFORCEMENT MESH AND A PRONG TO INTERLOCK WITH THE WELDED WIRE REINFORCING MESH ABOVE.

4.4. THE WELDED WIRE MESH FACING SHALL BE SHOP FABRICATED OF COLD DRAWN STEEL WIRE AND SHALL BE WELDED INTO THE FINISHED MESH FABRIC CONFORMING TO THE MINIMUM REQUIREMENTS OF ASTM A-1064, WITH A YIELD STRENGTH MINIMUM OF 450-mPa (65-KSI).

4.5. WELDED WIRE FACING WIRE GRID TYPES ARE SHOWN ON THE PLANS AND PROVIDED:
- 4.5.1. 12-IN X 24-IN W4.5 X W3.5
  - 4.5.1.1. NOMINAL WIRE DIAMETER (0.239-IN X 0.211-IN)
  - 4.5.1.2. MINIMUM L.T.D.S:
    - 4.5.1.2.1. STATIC: 972-LB/FT (14.2-kN/m)
    - 4.5.1.2.2. SEISMIC: 1,270-LB/FT (18.5-kN/m)
- 4.5.2. 12-IN X 24-IN W7.0 X W3.5
  - 4.5.2.1. NOMINAL WIRE DIAMETER (0.299-IN X 0.211-IN)
  - 4.5.2.2. MINIMUM L.T.D.S:
    - 4.5.2.2.1. STATIC: 1,713-LB/FT (25-kN/m)
  - 4.5.2.3. SEISMIC: 2,240-LB/FT (32.7-kN/m)

4.6. WELDED WIRE CAPS WIRE GRID TYPE IS SHOWN ON THE PLANS AND PROVIDED:
- 3.5.1. 12-IN X 12-IN W4.5 X W3.5
  - 3.5.1.1. NOMINAL WIRE DIAMETER (0.239-IN X 0.211-IN)
  - 3.5.1.2. MINIMUM L.T.D.S:
    - 3.5.1.2.1. STATIC: 833-LB/FT (12.2-kN/m)
  - 3.5.1.3. SEISMIC: 1,089-LB/FT (15.9-kN/m)

3.6. WELDED WIRE MESH SHALL BE HOT DIP GALVANIZED (2.0 OZ./SF, ASTM A-123; 605-G/M2).

3.7. ANY DAMAGE DONE TO THE MESH GALVANIZATION PRIOR TO INSTALLATION SHALL BE REPAIRED IN AN ACCEPTABLE MANNER AND IN A GALVANIZED COATING COMPARABLE TO THAT PROVIDED.

### 4. BACKING MAT

4.1. STEEL BACKING MAT SHALL MEET THE REQUIREMENTS PER FHWA FP-03 SECTION 720.01(C).

4.2. FABRICATE FROM WELDED WIRE FABRIC CONFORMING TO AASHTO M 55, EXCEPT THAT SUBSECTION 7.4 APPLIES FOR LONGITUDINAL AND TRANSVERSE WIRE SIZES. GALVANIZE ACCORDING TO AASHTO M 111, COATING GRADE 85 AFTER FABRICATION.

4.3. BACKING MAT WIRE GRID TYPE IS SHOWN ON THE PLANS AND PROVIDED:
- 4.3.1. 4-IN X 3-IN W5.0 X W2.5
- 4.3.2. NOMINAL WIRE DIAMETER (0.252-IN X 0.178-IN)

4.4. STEEL BACKING MAT SHALL MEET THE REQUIREMENTS OF ASTM A-1064 AND BE HOT DIP GALVANIZED (2.0 OZ./SF, ASTM A-123; 605 G/M2).

### 5. HARDWARE CLOTH

5.1. HARDWARE CLOTH SHALL BE WELDED GALVANIZED STEEL WIRE FABRIC WITH A MAXIMUM 1/4-IN X 1/4-IN SQUARE OPENING CONFORMING TO ASTM A740.

### 6. FASTENERS

6.1. FASTENERS (HOG RINGS) SHALL MEET THE REQUIREMENTS PER FHWA FP-03 SECTION 720.01(F). HOG RING FASTENER CONNECTIONS ARE AS SHOWN ON THE PLANS.

6.2. HOG RING FASTENERS SHALL BE SUPPLIED BY THE MSE WALL SUPPLIER. HOG RINGS SHALL BE GALVANIZED IN ACCORDANCE TO AASHTO M232.

### 7. GEOTEXTILE - STABILIZATION OF LEVELING COURSE

7.1. WOVEN GEOTEXTILE FABRIC SHALL BE USED FOR STABILIZATION BETWEEN THE LEVELING BACKFILL COURSE AND THE REINFORCED MSE SELECTED GRANULAR BACKFILL.

7.2. GEOTEXTILE SHALL BE WOVEN TYPE III (A-B) STABILIZATION GEOTEXTILE AND MEET THE REQUIREMENTS PER FHWA FP-03 TABLE 714-3.

7.3. STABILIZATION GEOTEXTILE SHALL MEET THE SAME STRENGTH REQUIREMENT AS THE LOWEST METALLIC REINFORCEMENT GRID LAYER.

7.4. ELEVATE AND PROTECT ROLLS WITH A WATERPROOF COVER IF STORED OUTDOORS. WHEN USING A GEOTEXTILE FOR A PERMANENT INSTALLATION, LIMIT THE GEOTEXTILE EXPOSURE TO ULTRAVIOLET RADIATION TO LESS THAN 10 DAYS.

### 8. GEOTEXTILE FILTER FABRIC - DRAINAGE PIPE / FACING FILL

8.1. GEOTEXTILE FILTER FABRIC SHALL BE USED AROUND THE DRAINAGE COLLECTOR INLET PIPE AND THE GRANULAR BACKFILL.

8.2. GEOTEXTILE FILTER FABRIC SHALL BE PLACED TO SEPERATE THE REINFORCED MSE WALL MATERIAL AND THE WALL FACING FILL.

8.3. ALL GEOTEXTILE SHALL BE NON-WOVEN TYPE I (A) AND MEET THE REQUIREMENTS PER FHWA FP-03 TABLE 714-1.

8.4. ELEVATE AND PROTECT ROLLS WITH A WATERPROOF COVER IF STORED OUTDOORS. WHEN USING A GEOTEXTILE FOR A PERMANENT INSTALLATION, LIMIT THE GEOTEXTILE EXPOSURE TO ULTRAVIOLET RADIATION TO LESS THAN 10 DAYS.

### 9. GEOCOMPOSITE SHEET DRAIN - DRAINAGE PIPE

9.1. GEOCOMPOSITE SHEET DRAINS SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 SECTION 714.02 "GEOCOMPOSITE DRAINS".

9.2. GEOCOMPOSITE SHEET DRAIN SHALL BE USED ON THE CUT SLOPE SURFACE A MINIMUM OF 2/3 OF THE HEIGHT OR AS DIRECTED BY THE FHWA CFLHD.

9.3. GEOCOMPOSITE SHEET DRAINS SHALL BE MINIMUM 1-m (3-FT) WIDE WITH A SPACING BETWEEN DRAINS TO ACHIEVE 30% ± 5% COVERAGE AREA OF THE 2/3 HEIGHT.

9.4. WHEN USING A GEOCOMPOSITE DRAIN FOR A PERMANENT INSTALLATION, LIMIT THE GEOCOMPOSITE EXPOSURE TO ULTRAVIOLET RADIATION TO LESS THAN 10 DAYS.

9.5. MINIMUM REQUIRED FLOW RATE SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 SECTION 714.02(B).

### 10. WALL FACING FILL MATERIAL

10.1. MSE WALL FACING BACKFILL MATERIAL SHALL BE PLACED WITHIN THE MSE WALL FACING ZONE.

10.2. MSE WALL FACING FILL SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 AND THE FHWA WY TIG US212(9) SPECIAL PROVISIONS SECTION 705.08 "WALL FACING FILL".

10.3. FURNISH HARD, DURABLE, ANGULAR ROCK THAT IS FREE OF ORGANIC OR OTHER UNSUITABLE MATERIAL. ANGULAR ROCK IS CHARACTERIZED BY SHARP, CLEAN EDGES AT THE INTERSECTIONS OF RELATIVELY FLAT SURFACES. DO NOT USE SHALE, ROCK WITH SHALE SEAMS, OR OTHER FISSILE OR FISSURED ROCK THAT MAY BREAK INTO SMALLER PIECES IN THE PROCESS OF HANDLING AND PLACING. CONFORM TO THE FOLLOWING:
- 10.3.1. GRADATION. FURNISH ROCK WITH BREADTH AND THICKNESS AT LEAST ONE-THIRD ITS LENGTH WITH A 6-IN (150-MM) MAXIMUM DIMENSION. ENSURE THAT 95 PERCENT OF WALL FACING FILL PARTICLES MINIMUM DIMENSION EXCEEDS WELDED WIRE FACING OPENING WITH REMAINING 5 PERCENT EXCEEDING ONE-HALF WELDED WIRE FACING OPENING.
- 10.3.2. SOUNDNESS OF AGGREGATE USING SODIUM SULFATE, 15% LOSS MAX. AASHTO T 104 (5 CYCLES).
- 10.3.3. LOS ANGELES ABRASION, AASHTO T 96 50% MAX.

### 11. BACKFILL MATERIAL

11.1. BACKFILL MATERIAL SHALL BE PLACED BETWEEN THE MSE WALL REINFORCED ZONE AND THE CUT SLOPE SHORING. BACKFILL MATERIAL SHALL ALSO BE PLACED IN FRONT OF THE MSE WALL TOE.

11.2. BACKFILL MATERIAL SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 AND THE FHWA WY TIG US212(9) SPECIAL PROVISIONS SECTION 704.03(a) "BACKFILL MATERIAL".

11.3. BACKFILL MATERIAL SHALL BE WELL-GRADED COMPACTABLE MATERIAL FREE OF EXCESS MOISTURE, MUCK, FROZEN LUMP, ROOTS, SOD, ORGANICS, OR OTHER DELETERIOUS MATERIAL.

11.4. BACKFILL MATERIAL SHALL BE A MAXIMUM PARTICLE SIZE OF 75-mm (3-IN) AND SOIL CLASSIFICATION PER AASHTO M 145 OF A-1, A-2, OR A-3.

11.5. BACKFILL MATERIAL SHALL CONFORM TO THE FOLLOWING GRADATION LIMITS PER FHWA FP-03 TABLE 704-2 AND AS DETERMINED BY AASHTO T 27 AND AASHTO T 11:

11.6. SIEVE SIZE / PERCENT BY MASS PASSING DESIGNATE SIEVE
- 11.6.1. 75-mm (3-IN) / 100%

11.7. THE BACKFILL SHALL CONFORM TO ALL OF THE FOLLOWING ADDITIONAL REQUIREMENTS:

11.7.1. THE PLASTICITY INDEX (P.I.), AS DETERMINED BY AASHTO R 58 AND T 90, SHALL NOT EXCEED 6.

11.7.2. THE FRACTION FINER THAN 15 MICRONS (0.015-mm), AS DETERMINED BY AASHTO T 88 SHALL NOT EXCEED 15 PERCENT.

11.7.3. THE MATERIAL SHALL EXHIBIT AN ANGLE OF INTERNAL FRICTION OF NOT LESS THAN 40 DEGREES, AS DETERMINED BY THE STANDARD DIRECT SHEAR TEST AASHTO T 236, UTILIZING A SAMPLE OF THE MATERIAL COMPACTED TO 90% PERCENT OF ASTM D-1557-92.

11.7.4. NO TESTING IS REQUIRED FOR BACKFILL WHERE 80 PERCENT OF THE MATERIAL IS GREATER THAN 3/4-IN (19-mm). BEFORE CONSTRUCTION BEGINS, THE SELECTED BACKFILL MATERIAL SHALL BE SUBJECT TO SHOW CONFORMANCE WITH THIS FRICTIONAL REQUIREMENT.

11.8. IN ADDITION, BACKFILL MATERIALS SHALL ALSO MEET THE FOLLOWING CORROSION REQUIREMENTS:
- 11.8.1. RESISTIVITY: > 3,000-OHM-cm (MIN.), AASHTO T 288
- 11.8.2. PH: 5.0 TO 10.0, INCLUSIVE, AASHTO T 289
- 11.8.3. CHLORIDES: < 100-ppm, AASHTO T 291
- 11.8.4. SULFATES: < 200-ppm, AASHTO T 290
- 11.8.5. ORGANIC CONTENT: <1%, AASHTO T267-86
- 11.8.6. IF THE RESISTIVITY IS GREATER THAN OR EQUAL TO 5,000-OHM-CM, AND THE PH IS BETWEEN 6.0 - 8.0, THE CHLORIDES AND SULFATES TESTING REQUIREMENTS ARE NOT REQUIRED.

### 12. SELECT GRANULAR BACKFILL MATERIAL

12.1. SELECT GRANULAR BACKFILL MATERIAL SHALL BE PLACED WITHIN THE MSE WALL REINFORCED ZONE. SELECT GRANULAR BACKFILL SHALL BE PLACED FOR THE LEVELING COURSE.

12.2. BACKFILL MATERIAL SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 AND THE FHWA WY TIG US212(9) SPECIAL PROVISIONS SECTION 704.10 "SELECT GRANULAR BACKFILL MATERIAL".

12.3. SELECT GRANULAR BACKFILL MATERIAL SHALL BE WELL-GRADED COMPACTABLE MATERIAL FREE OF EXCESS MOISTURE, MUCK, FROZEN LUMP, ROOTS, SOD, ORGANICS, OR OTHER DELETERIOUS MATERIAL

12.4. SELECT GRANULAR BACKFILL SHALL MEET THE GRADATION QUALITY REQUIREMENTS PROVIDED BELOW AND FROM THE SPECIAL PROVISIONS TABLE 704-2 AND IN ACCORDANCE WITH AASHTO T27 AND T 11:

12.5. SIEVE SIZE / PERCENT BY MASS PASSING DESIGNATED SIEVE
- 12.5.1. 3-IN (76.2-mm) / 100%
- 12.5.1. 1/2-IN (12.5-mm) / 60% - 85%
- 12.5.2. NO. 4 SIEVE (4.75-mm) / 35% - 55%
- 12.5.3. NO. 8 SIEVE (2.36-mm) / 25% - 50%

12.6. THE REINFORCED MSE WALL FILL ANGLE OF INTERNAL FRICTION ON THE PORTION PASSING THE NO. 10 (2-mm) SIEVE PER AASHTO T 236: 45-DEG MINIMUM.

12.7. DIRECT SHEAR TESTS FOR ANGLE OF INTERNAL FRICTION ARE NOT REQUIRED FOR MATERIAL MEETING THE REQUIREMENTS OF THE SPECIAL PROVISIONS SECTION 704.10 AND WITH MORE THAN 40% RETAINED ON THE NO. 4 (4.75-mm) SIEVE. WHEN THE TEST IS REQUIRED, COMPACT SAMPLES FOR AASHTO T 236 TO 95 PERCENT OF THE MAXIMUM DENSITY AT +/-2 PERCENT OF THE OPTIMUM MOISTURE CONTENT DETERMINED ACCORDING TO AASHTO T 99, METHOD A OR B WITHOUT CORRECTIONS FOR OVERSIZED MATERIAL. SATURATE THE SPECIMENS AND PERFORM THE TEST FOR CONFINING STRESSES OF 1, 2, 4, AND 8-KSF (48, 96, 192, AND 384-kPa).

12.8. SOUNDNESS OF AGGREGATE USING SODIUM SULFATE PER AASHTO T 104 (5 CYCLES): 15 PERCENT LOSS MAX.

12.9. PLASTICITY INDEX (P.I.) PER AASHTO R 58 AND T 90: 6 MAX.

12.10. LOS ANGELES ABRASION PER AASHTO T 96: 50% MAX.

12.11. LIQUID LIMIT (L.L.) PER AASHTO R 58 AND T 89: 30 MAX.

12.12. IN ADDITION, THE SELECTED GRANULAR BACKFILL MATERIALS SHALL ALSO MEET THE FOLLOWING CORROSION (ELECTROCHEMICAL) REQUIREMENTS FOR THE MSE WALL WITH METALLIC REINFORCEMENT:
- 12.12.1. RESISTIVITY: > 3,000-OHM-cm (MIN.), AASHTO T 288
- 12.12.2. PH: 5.0 TO 10.0, AASHTO T 289
- 12.12.3. CHLORIDES: < 100-ppm, AASHTO T 291
- 12.12.4. SULFATES: < 200-ppm, AASHTO T 290
- 12.12.5. ORGANIC CONTENT: <1%, AASHTO T267-86
- 12.12.6. IF THE RESISTIVITY IS GREATER THAN OR EQUAL TO 5,000-OHM-cm, AND THE pH IS BETWEEN 6.0 - 8.0, THE CHLORIDES AND SULFATES TESTING REQUIREMENTS ARE NOT REQUIRED.

### 13. GRANULAR BACKFILL - DRAIN COLLECTOR PIPE

13.1. GRANULAR BACKFILL SHALL BE PLACED AROUND THE PERFORATED DRAIN COLLECTOR PIPE AS SHOWN ON THE PLANS. GRANULAR BACKFILL SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 SECTION 703.03(A) "GRANULAR BACKFILL".

13.2. FURNISH GRANULAR BACKFILL CONFORMING TO AASHTO M 80, CLASS E AND AASHTO M 43, SIZE NUMBER 3, 4, 5, 7, 57, OR 67.

### 14. DRAIN COLLECTOR INLET PIPE - PERFORATED

14.1. THE PERFORATED DRAIN COLLECTOR PIPE SHALL BE USED AS SHOWN ON THE PLANS. THE PERFORATED DRAIN COLLECTOR PIPE SHALL MEET THE REQUIREMENTS OF THE FHWA FP-03 SECTION 706.08 AND THE SPECIAL PROVISIONS.

14.2. THE PERFORATED DRAIN PIPE SHALL BE 6-IN (152.4-MM) DIAMETER.

14.3. FURNISH PERFORATED PLASTIC PIPE CONFORMING TO THE FOLLOWING FOR TYPES:
- 14.3.1. POLYETHYLENE PERFORATED CONFORMING TO AASHTO M 252.
- 14.3.2. PERFORATED POLYVINYL CHLORIDE PIPE WITH SMOOTH INTERIOR, SMOOTH OR RIBBED EXTERIOR CONFORMING TO AASHTO M 278, ASTM F 758, OR ASTM F 949.

14.4. FOR WATERTIGHT JOINTS, CONFORM TO ASTM D 3212. FOR PIPE CULVERT, FURNISH PIPE CONFORMING TO TYPES (A), (B), OR (C) FOR THE SIZE SPECIFIED.

### 15. DRAIN OUTLET PIPE - NON-PERFORATED

15.1. THE NON-PERFORATED DRAIN OUTLET PIPE SHALL BE USED AS SHOWN ON THE PLANS. THE NON-PERFORATED DRAIN PIPE SHALL MEET THE REQUIREMENTS OF THE FHWA FP-03 SECTION 706.08 AND THE SPECIAL PROVISIONS.

15.2. THE NON-PERFORATED DRAIN PIPE SHALL BE 6-IN (152.4-MM) DIAMETER.

15.3. FURNISH NON-PERFORATED PIPE CONFORMING TO THE FOLLOWING FOR TYPES:
- 15.3.1. NON-PERFORATED CORRUGATED PLASTIC PIPE CONFORMING TO AASHTO M 252.
- 15.3.2. NON-PERFORATED POLYVINYL CHLORIDE PIPE WITH SMOOTH INTERIOR, SMOOTH OR RIBBED EXTERIOR CONFORMING TO AASHTO M 278, ASTM F 758, OR ASTM F 949.

15.4. FOR WATERTIGHT JOINTS, CONFORM TO ASTM D 3212. FOR PIPE CULVERT, FURNISH PIPE CONFORMING TO TYPES (A), (B), OR (C) FOR THE SIZE SPECIFIED.

15.5. OUTLET PIPE END AS SHOWN ON THE PLANS WITH A SCREEN IN ACCORDANCE WITH FHWA FP-03 SECTION 605.03. SCREEN SHALL BE SECURELY PLACES WITH STANDARD COUPLE BANDS OR SECURING SCREWS.

15.6. OUTLET PIPE OUTLET LOCATIONS SHALL BE STAKED WITH A 4-FT (1.2-m) POST. STAKE MARKER SHALL BE WITHIN 1-FT (300-mm) OF THE END OF THE PIPE.

### 16. ACCEPTANCE OF MATERIALS

16.1. THE CONTRACTOR SHALL FURNISH TO THE DESIGN ENGINEER AND THE FHWA CFLHD A CERTIFICATE OF COMPLIANCE FOR EACH MATERIAL CERTIFYING THAT THE MATERIAL COMPLIES WITH THE SPECIFICATIONS.

16.2. A COPY OF ALL TEST RESULTS PERFORMED BY THE CONTRACTOR, WHICH ARE NECESSARY TO ASSURE COMPLIANCE WITH THE SPECIFICATIONS, SHALL ALSO BE FURNISHED TO THE DESIGN ENGINEER, MSE SUPPLIER, AND THE FHWA CFLHD.

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - MATERIAL SPECIFICATIONS

2021 03-25: Revised Sheet Numbering.
2021 05-07: Revised Note 10.7.3 for the backfill material friction angle.
2021 05-07: Revised Note 7 for addition of wall facing fill geotextile.
2021 05-21: Added Section 5 Hardware Cloth Specifications.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Dr, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993

SHEET 14 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

## HILFIKER MSE RETAINING WALL - CONSTRUCTION SPECIFICATIONS

### 1. MSE WALL SYSTEM DESCRIPTION

1.1. THIS WORK SHALL CONSIST OF A WELDED WIRE RETAINING WALL (WWW), MECHANICALLY STABILIZED EARTH RETAINING WALL [MSE] CONSTRUCTED IN ACCORDANCE WITH THESE SPECIFICATIONS, FHWA STANDARD SPECIFICATIONS FP-03, AND THE FHWA FHWA BID SPECIAL PROVISIONS.

1.2. THE MSE WALL CONSTRUCTION SHALL BE ACCORDANCE WITH THE ELEVATIONS, LINES, GRADES, DESIGN, AND DIMENSIONS SHOWN ON THESE PLANS OR ESTABLISHED BY THE FHWA CFLHD.

### 2. MSE WALL SUPERELEVATION

2.1. MSE WALL SUPERELEVATIONS AND TRANSITION RATES SHALL BE IN ACCORDANCE WITH THE DESIGN VALUES PROVIDED IN THE WY TIG US212(9) BID PLANS DRAWING NO. RG2779-B DATED JANUARY 2019.

2.2. ANY DEVIATIONS OR DISCREPANCIES FROM THE SUPER ELEVATIONS AND TRANSITION RATES SHOWN ON THE WY TIG US212(9) PLANS SHALL BE BROUGHT TO THE ATTENTION OF THE FHWA CFLHD.

### 3. MSE WALL TO PROPOSED ROADWAY CONSTRUCTION SEQUENCE

3.1. PROPOSED ROADWAY CONSTRUCTION INCLUDING BUT NOT LIMITED TO THE PAVEMENT, SUBGRADE, AND GUARD RAILING IS NOT PART OF THIS WORK. THIS WORK ONLY INCLUDES THE MSE WALL CONSTRUCTION. SEE THE WY TIG US212(9) BID PLANS DRAWING NO. RG2779-C DATED JANUARY 2019 FOR ADDITIONAL INFORMATION.

### 4. MSE WALL LIMITS

4.1. THE MSE WALL BEGINNING AND END STATIONING LIMITS ARE IN ACCORDANCE WITH THE FHWA WY TIG US212(9) BID PLANS DRAWING NO. RG2779-E TO RG2779-H DATED JANUARY 2019.

4.1.1. BEGIN MSE WALL STATIONS:

4.1.1.1. WALL STA. 1+006.482m

4.1.1.2. ROADWAY STA. 41+526.281m

4.1.2. END MSE WALL STATIONS:

4.1.2.1. WALL STA. 1+466.619m

4.1.2.2. ROADWAY STA. 41+985m

4.2. THE MSE WALL CURVATURE SHALL BE IN ACCORDANCE WITH THE FHWA WY TIG US212(9) BID PLANS DRAWING NO. RG2779-E TO RG2779-H DATED JANUARY 2019.

### 5. MSE WALL EXCAVATION

5.1. WALL EXCAVATION SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THESE PLANS, SPECIFICATIONS, AND IN REASONABLY CLOSE CONFORMITY WITH THE LIMITS AND CONSTRUCTION STAGES SHOWN ON THE PLANS.

5.2. ADDITIONAL CUT SLOPE EXCAVATION(S) MAY BE REQUIRED DURING ON-SITE CONSTRUCTION FOR THE MSE WALL. MSE METALLIC REINFORCEMENT LENGTHS SHOWN SHALL BE CONSTRUCTED.

5.3. THE DESIGN OR GEOTECHNICAL ENGINEER SHALL INSPECT THE EXISTING SLOPE CONDITIONS PRIOR TO ANY EXCAVATION. DESIGN OR GEOTECHNICAL SHALL PROVIDE APPROVAL OR SHORING RECOMMENDATIONS PRIOR TO EXCAVATION COMMENCEMENT.

5.4. CONTRACTOR SHALL INSPECT THE SLOPE EXCAVATIONS PER THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY REGULATIONS (29 CFR. PART 1926, SUBPART P, EXCAVATION).

5.5. THE CONTRACTOR SHALL INSPECT THE SLOPE EXCAVATIONS PER THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY REGULATIONS (29 CFR. PART 1926.651, SPECIFIC EXCAVATION REQUIREMENTS).

5.6. THE CONTRACTOR SHALL INSPECT THE SLOPE EXCAVATIONS PER THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY REGULATIONS (29 CFR. PART 1926.651, SUBSECTION J, PROTECTION OF EMPLOYEES FROM LOOSE ROCK OR SOIL).

5.7. THE CONTRACTOR SHALL INSPECT THE SLOPE EXCAVATIONS PER THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) SAFETY REGULATIONS (29 CFR. PART 1926.651, SUBSECTION K, INSPECTIONS).

### 6. WALL FOUNDATION PREPARATION

6.1. THE FOUNDATION FOR THE STRUCTURE SHALL BE GRADE THE FOUNDATION FOR A WIDTH EQUAL TO THE LENGTH OF REINFORCING ELEMENTS PLUS 0.5-m (1.5-FT). LENGTH OF THE REINFORCEMENT MAT OR AS SHOWN ON THE PLANS. (SEE SECTION 2 "WALL EXCAVATION" FOR INFORMATION).

6.2. PRIOR TO WALL CONSTRUCTION, THE FOUNDATION, IF NOT IN ROCK, SHALL BE COMPACTED, AS DIRECTED BY THE DESIGN ENGINEER AND OR FHWA CFLHD.

6.3. ANY UNSUITABLE FOUNDATION MATERIAL BELOW THE REINFORCED MSE WALL AT FOUNDATION GRADE SHALL BE REMOVED AND REPLACED AS DIRECTED BY THE DESIGN ENGINEER AND OR THE FHWA CFLHD. REPLACED MATERIAL SHALL BE FOUNDATION FILL. PLACE AND COMPACT THE FOUNDATION FILL MATERIAL ACCORDING TO FHWA FP-03 SUBSECTION 208.09(D) "FOUNDATION PREPARATION".

6.4. PLACE FOUNDATION FILL MATERIAL IN HORIZONTAL LAYERS THAT, WHEN COMPACTED, DO NOT EXCEED 150-mm (6-IN) DEPTH.

6.5. FOUNDATION SURFACE SHALL BE SLIGHTLY SLOPED AS SHOWN ON THE PLANS A MINIMUM 2% SLOPE TO THE DRAINAGE COLLECTOR.

6.6. COMPACT EACH LAYER ACCORDING TO SUBSECTION 208.11.

6.7. DETERMINE OPTIMUM MOISTURE CONTENT AND MAXIMUM DENSITY ACCORDING, TO AASHTO T 99, METHOD C. ADJUST THE MOISTURE CONTENT OF THE BACKFILL MATERIAL TO A MOISTURE CONTENT SUITABLE FOR COMPACTION.

6.8. COMPACT MATERIAL PLACED IN ALL LAYERS TO AT LEAST 95 PERCENT OF THE MAXIMUM DENSITY. DETERMINE THE INPLACE DENSITY AND MOISTURE CONTENT ACCORDING TO AASHTO T 310 OR OTHER APPROVED TEST PROCEDURES.

6.9. FOR FOUNDATION ACCEPTANCE, SEE FHWA FP-03 TABLE 208-1 FOR "SAMPLING AND TESTING REQUIREMENTS".

6.9.1. FOUNDATION FILL:

6.9.1.1. CLASSIFICATION: AASHTO M145

6.9.1.1.1. 1 PER MATERIAL TYPE

6.9.1.2. GRADATION: AASHTO T 27 & T 11

6.9.1.2.1. 1 PER MATERIAL TYPE

6.9.1.3. MOISTURE DENSITY: AASHTO T99 & METHOD C

6.9.1.3.1. 1 PER MATERIAL TYPE

6.9.1.4. COMPACTION: AASHTO T310

6.9.1.4.1. 1 PER 250-M3 (327-CY)

6.10. THE MAXIMUM ALLOWED BEARING PRESSURE AT THE FOUNDATION LEVELS AT VARIOUS SECTIONS ALONG THE WALL ARE PROVIDED ON THE DETAIL SHEETS.

### 7. MSE WALL - DRAIN PIPE

7.1. PERFORATED DRAINAGE COLLECTOR PIPE SHALL BE INSTALLED ABOVE THE FOUNDATION SURFACE. PERFORATED PIPE, BACKFILL ROCK, NON-WOVEN GEOTEXTILE, AND DIMENSIONS ARE SHOWN ON THE PLANS.

7.2. NON-PERFORATED OUTLET PIPE SHALL DRAIN TO THE "FILL" SIDE OF THE ROADWAY AS SHOWN ON THE PLANS. NON-PERFORATED OUTLET PIPE SHALL BE INCLINED AT A MINIMUM 2% SLOPE.

7.3. CONNECT COLLECTOR PIPS TO OUTLET PIPS USING A T-CONNECTOR AND OUTLET AT LOW POINTS OF WALL. OUTLET PIPES SHALL BE SPACED AT A MAXIMUM OF 16-m (53-FT).

7.4. ASSEMBLY FITTINGS FOR THE DRAINAGE SEE MATERIAL SPECIFICATIONS AND FHWA FP-03 SECTION 706.08.

7.5. END OF OUTLET PIPS SHALL BE COVERED WITH A SCREEN IN ACCORDANCE WITH FHWA FP-03 SECTION 605.03. SCREEN SHALL BE SECURELY HELD IN PLACE WITH COUPLING BANDS OR FASTENERS.

7.6. OUTLET OF THE OUTLET DRAINAGE PIPE LOCATIONS SHALL BE MARKED AND IDENTIFIED USING A 4-FT (1.5-m) POST OR STAKE. MARKER SHALL BE PLACED WITHIN 300-mm (1-FT) OF THE END OF PIPE.

### 8. MSE WALL - SHEET DRAIN

8.1. PLACE GEOCOMPOSITE SHEET DRAINS ON THE CUT SLOPE SURFACE. GEOCOMPOSITE SHEET DRAINS SHALL BE A MINIMUM 1-m (3-FT) WIDTH STRIPS WITH A SPACING TO ACHIEVE 30% ±5% COVERAGE AREA ON THE CUT SLOPE TO 2/3 HEIGHT.

### 9. WALL LEVEL COURSE

9.1. PLACE LEVEL COURSE FILL MATERIAL IN HORIZONTAL LAYERS THAT, WHEN COMPACTED, DO NOT EXCEED 150-mm (6-IN) DEPTH.

9.2. LEVEL COURSE TO COVER NON-PERFORATED AND PERFORATED DRAINAGE PIPES. LEVEL COURSE SHALL PROVIDE A LEVEL SURFACE FOR THE MSE WALL ERECTION.

9.3. COMPACT EACH LAYER ACCORDING TO SUBSECTION 208.11.

9.4. DETERMINE OPTIMUM MOISTURE CONTENT AND MAXIMUM DENSITY ACCORDING, TO AASHTO T 99, METHOD C. ADJUST THE MOISTURE CONTENT OF THE BACKFILL MATERIAL TO A MOISTURE CONTENT SUITABLE FOR COMPACTION.

9.5. COMPACT MATERIAL PLACED IN ALL LAYERS TO AT LEAST 95 PERCENT OF THE MAXIMUM DENSITY. DETERMINE THE INPLACE DENSITY AND MOISTURE CONTENT ACCORDING TO AASHTO T 310 OR OTHER APPROVED TEST PROCEDURES.

9.6. FOR FOUNDATION ACCEPTANCE, SEE FHWA FP-03 TABLE 208-1 FOR "SAMPLING AND TESTING REQUIREMENTS".

9.6.1. FOUNDATION FILL:

9.6.1.1. CLASSIFICATION: AASHTO M145

9.6.1.1.1. 1 PER MATERIAL TYPE

9.6.1.2. GRADATION: AASHTO T 27 & T 11

9.6.1.2.1. 1 PER MATERIAL TYPE

9.6.1.3. MOISTURE DENSITY: AASHTO T99 & METHOD C

9.6.1.3.1. 1 PER MATERIAL TYPE

9.6.1.4. COMPACTION: AASHTO T310

9.6.1.4.1. 1 PER 250-M3 (327-CY)

### 10. WOVEN GEOTEXTILE PLACEMENT

10.1. WOVEN STABILIZATION GEOTEXTILE SHALL BE PLACE AT THE BOTTOM OF WALL ABOVE LEVEL COURSE PRIOR TO THE MSE REINFORCEMENT PLACEMENT.

### 11. BENCH WIDTH

11.1. REQUIRED BENCH WIDTHS AT STATIONING LOCATIONS ALONG THE WALL WIDTH ARE SHOWN ON THE PLAN SHEETS 19-22.

### 12. MSE WALL ERECTION

12.1. A FIELD REPRESENTATIVE FROM THE WALL SYSTEM MANUFACTURER SHALL BE ON-SITE DURING THE STARTUP OF THE WALL ERECTION. WALL ERECTION SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 AND WY TIG US212(9) SECTION 255.

12.2. INTERMEDIATE WIRE MESH REINFORCEMENT MATS, AND FACING MATERIALS, SHALL BE PLACED IN 12-IN (304.8-mm) SUCCESSIVE HORIZONTAL LIFTS IN THE SEQUENCE SHOWN ON THE PLANS AS BACKFILL PLACEMENT PROCEEDS.

12.3. STANDARD WIRE MESH REINFORCEMENT MATS SHALL BE PLACED IN 24-IN (609.6-mm) SUCCESSIVE HORIZONTAL LIFTS IN THE SEQUENCE SHOWN ON THE PLANS AS BACKFILL PLACEMENT PROCEEDS.

12.4. EACH STANDARD LIFT SHALL HAVE THE ABILITY TO COMPRESS A MINIMUM OF 2-IN (51-mm) WITHOUT CREATING ANY OUTWARD BULGE OF THE FACING ELEMENTS. VERTICAL TOLERANCE (PLUMBNESS) AND HORIZONTAL ALIGNMENT TOLERANCE SHALL NOT EXCEED 2-IN (51-mm) WHEN MEASURED AT THE JUNCTION OF THE WIRE FACING AND REINFORCEMENT ALONG A 10-FT (3-m) STRAIGHT EDGE.

12.5. THE MSE WALL CONSTRUCTION TOLERANCE FOR THE WWM SHALL BE IN ACCORDANCE WITH THE FHWA WY TIG US212(9) SPECIAL PROVISIONS SECTION 255.04 TABLE 255-1.

12.6. FOR THE BATTERED WWM FACING, THE OVERALL TOLERANCE FROM THE THEORETICAL BATTERED LOCATIONS SHALL NOT EXCEED 1/2-IN (13-mm) PER 10-FT (3-m) OF BATTERED WALL HEIGHT. WALL BATTER IS 1H:18V AS SHOWN ON THE PLANS.

### 13. BACKFILL PLACEMENT

13.1. PLACEMENT OF THE SELECT GRANULAR BACKFILL FOR THE MSE REINFORCED ZONE AND THE SPACING BETWEEN THE CUT SLOPE AND MSE SHALL BE IN ACCORDANCE WITH THE FHWA FP-03 AND SPECIAL PROVISIONS SECTION 209.10(E). BACKFILLING SHALL BE IN ACCORDANCE WITH SECTION 255.

13.2. BACKFILL PLACEMENT SHALL CLOSELY FOLLOW ERECTION OF EACH COURSE OF REINFORCEMENT MATS. BACKFILL SHALL BE PLACED IN SUCH A MANNER AS TO AVOID ANY DAMAGE OR DISTURBANCE TO THE WALL MATERIALS OR MISALIGNMENT OF THE FACING. ANY WALL MATERIALS, WHICH BECOME DAMAGED OR DISTURBED DURING BACKFILL PLACEMENT, SHALL BE EITHER REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE OR CORRECTED, AS DIRECTED BY THE ENGINEER.

13.3. THE CONTRACTOR, AT THEIR EXPENSE, SHALL CORRECT ANY MISALIGNMENT OR DISTORTION OF THE WALL FACING DUE TO PLACEMENT OF BACKFILL OUTSIDE THE LIMITS OF THIS SPECIFICATION.

13.4. BACKFILL SHALL BE PLACED IN EVEN LAYERS. PLACE BACKFILL MATERIAL IN COMPACTED LAYERS NOT EXCEEDING 1-FT (305-mm) IN DEPTH. COMPACT EACH LAYER IN ACCORDANCE WITH FHWA FP-03 SECTION 209.11.

13.5. COMPACTION WITHIN THREE (3) FEET (1 M) OF THE BACKFACE OF THE WALL FACING SHALL BE ACHIEVED BY AT LEAST THREE (3) PASSES OF A LIGHTWEIGHT MECHANICAL TAMPER, ROLLER, OR VIBRATORY SYSTEM. SOIL DENSITY TESTS ARE NOT REQUIRED WITHIN THIS AREA.

13.6. BACKFILL SHALL BE COMPACTED TO 95 PERCENT OF AASHTO T 99 METHOD C OR D, WITH OVERSIZE CORRECTION, AT OPTIMUM MOISTURE CONTENT (±2%).

13.7. THE MOISTURE CONTENT OF THE BACKFILL MATERIAL PRIOR TO AND DURING COMPACTION SHALL BE UNIFORMLY DISTRIBUTED THROUGHOUT EACH LAYER. BACKFILL MATERIAL SHALL HAVE A PLACEMENT MOISTURE CONTENT EQUAL TO OR WITHIN TWO PERCENTAGE POINTS OF OPTIMUM MOISTURE CONTENT ($W_{OPT}$ ±2%). BACKFILL MATERIAL WITH PLACEMENT MOISTURE CONTENT IN EXCESS OR LESS THAN $W_{OPT}$ ±2% SHALL BE REMOVED AND REWORKED UNTIL THE MOISTURE CONTENT IS UNIFORMLY ACCEPTABLE THROUGHOUT THE ENTIRE LIFT. THE CONTRACTOR SHALL DECREASE THE PERCENTAGE OF DEVIATION FROM OPTIMUM MOISTURE, IF NECESSARY, TO OBTAIN THE SPECIFIED DENSITY. THE OPTIMUM MOISTURE CONTENT SHALL BE DETERMINED IN ACCORDANCE WITH AASHTO T 99 STANDARD PROCTOR METHOD A, WITH COARSE PARTICLE CORRECTION ACCORDING TO AASHTO T 224.

13.8. BACKFILL SHALL BE PLACED IN COMPLETE HORIZONTAL LIFTS. THE MAXIMUM LIFT THICKNESS AFTER COMPACTION SHALL NOT EXCEED TWELVE (12) INCHES (305 MM). THE CONTRACTOR SHALL DECREASE THIS LIFT THICKNESS, IF NECESSARY, TO OBTAIN THE DESIRED DENSITY.

13.9. COMPACTION WITHIN THREE (3) FEET (1 M) OF THE BACKFACE OF THE WALL FACING SHALL BE ACHIEVED BY AT LEAST THREE (3) PASSES OF A LIGHTWEIGHT MECHANICAL TAMPER, ROLLER, OR VIBRATORY SYSTEM. SOIL DENSITY TESTS ARE NOT REQUIRED WITHIN THIS AREA.

13.10. COMPACT MATERIAL PLACED IN ALL LAYERS TO AT LEAST 95 PERCENT OF THE MAXIMUM DENSITY. DETERMINE THE INPLACE DENSITY AND MOISTURE CONTENT ACCORDING TO AASHTO T 310 OR OTHER APPROVED TEST PROCEDURES.

13.11. FOR STRUCTURAL FILL ACCEPTANCE, SEE FHWA FP-03 TABLE 208-1 FOR "SAMPLING AND TESTING REQUIREMENTS".

13.11.1. CLASSIFICATION: AASHTO M145

13.11.1.1. 1 PER MATERIAL TYPE

13.11.2. GRADATION: AASHTO T 27 & T 11

13.11.2.1. 1 PER MATERIAL TYPE

13.11.3. MOISTURE DENSITY: AASHTO T99 & METHOD C

13.11.3.1. 1 PER MATERIAL TYPE

13.11.4. COMPACTION: AASHTO T310

13.11.5. 1 PER 250-M3 (327-CY)

13.12. AT THE END OF EACH DAY'S OPERATION, THE CONTRACTOR SHALL SLOPE THE LAST LEVEL OF BACKFILL AWAY FROM THE WALL FACING TO RAPIDLY DIRECT RUN-OFF OF RAINWATER AWAY FROM THE WALL FACE. IN ADDITION, THE CONTRACTOR SHALL NOT ALLOW SURFACE RUN-OFF FROM ADJACENT AREAS TO ENTER THE WALL CONSTRUCTION.

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - CONSTRUCTION SPECIFICATIONS

2021 03-25: Revised Sheet Numbering.
2021 05-21: Revised Note Section 11.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants

Stockton Office
7400 Shopping Ctr. Dr., Suite 6
Stockton, CA 95219
(209) 472-1822

Los Angeles Office
6080 Center Drive, Suite 600
Los Angeles, CA 90045
(323) 331-9222

Honolulu Office
1441 Kapiolani Blvd., Suite 1115
Honolulu, HI 96814
(808) 468-9993

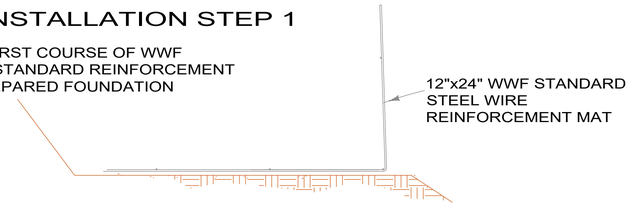
SHEET 15 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

## WALL INSTALLATION STEP 1

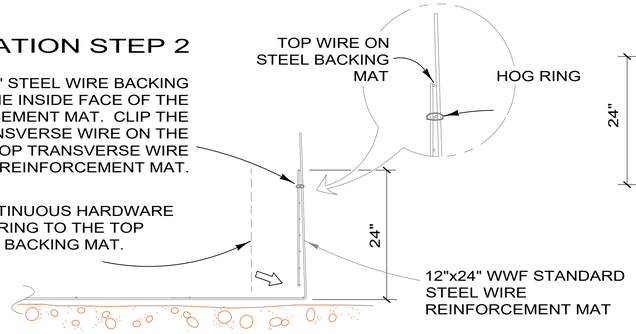
PLACE THE FIRST COURSE OF WWF STEEL WIRE STANDARD REINFORCEMENT MATS ON PREPARED FOUNDATION




## WALL INSTALLATION STEP 2

PLACE THE STEEL 4" X 3" STEEL WIRE BACKING MAT AGAINST THE INSIDE FACE OF THE STANDARD REINFORCEMENT MAT. CLIP THE SECOND-TO-TOP TRANSVERSE WIRE ON THE BACKING MAT TO THE TOP TRANSVERSE WIRE ON THE STANDARD REINFORCEMENT MAT.

INSTALL CONTINUOUS HARDWARE CLOTH, HOG-RING TO THE TOP WIRE ON THE BACKING MAT.

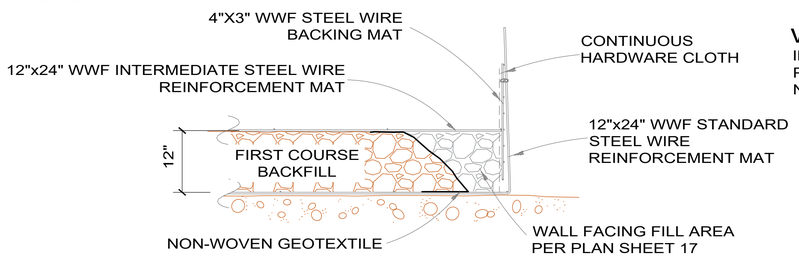



## WALL INSTALLATION STEP 3

PLACE AND COMPACT THE BACKFILL IN LAYERS AND DENSITIES AS SPECIFIED IN THE PROJECT PLANS.

PLACE THE WALL FACING FILL AND THE NON-WOVEN GEOTEXTILE AS SHOWN AND PER SHEET 17 DETAILS.

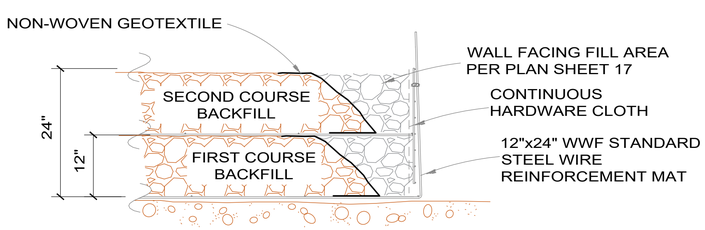
PLACE THE INTERMEDIATE WWF REINFORCEMENT MATS ONTO THE COMPACTED FIRST COURSE FILL LAYER.




## WALL INSTALLATION STEP 4

PLACE AND COMPACT THE BACKFILL IN LAYERS AND DENSITIES AS SPECIFIED IN THE PROJECT PLANS.

PLACE THE SECOND COURSE OF STRUCTURAL BACKFILL ONTO INTERMEDIATE WWF REINFORCEMENT MAT.

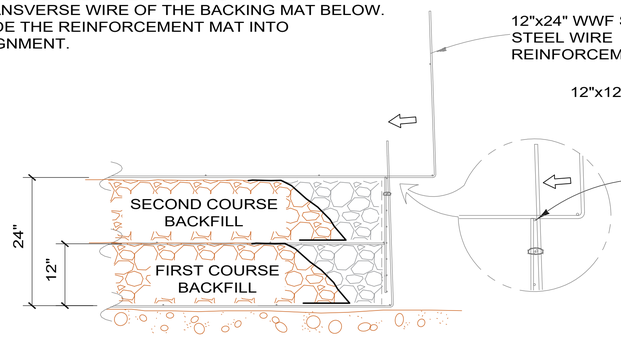



## CONSTRUCTION SEQUENCE

NOT TO SCALE

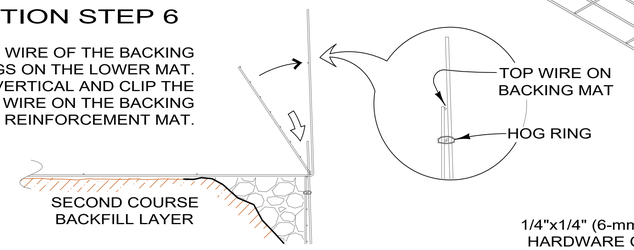
## WALL INSTALLATION STEP 5

PLACE THE SUBSEQUENT STANDARD WWF REINFORCEMENT MATS WITH THE BASE LONGITUDINAL WIRES RESTING ON THE TOP TRANSVERSE WIRE OF THE BACKING MAT BELOW. SLIDE THE REINFORCEMENT MAT INTO ALIGNMENT.



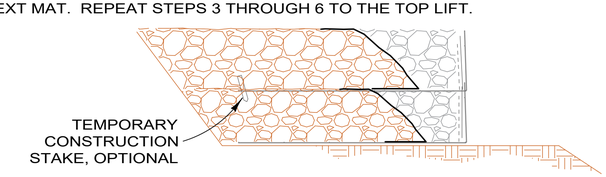

## WALL INSTALLATION STEP 6

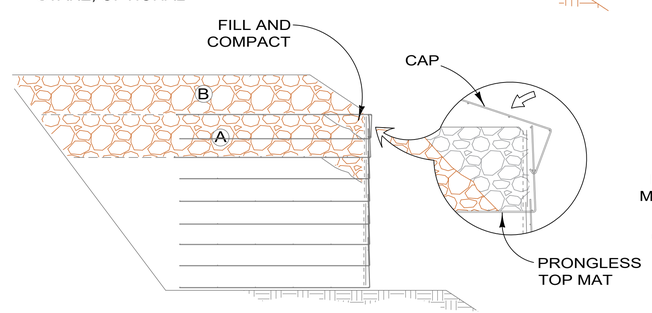
HOOK THE BOTTOM TRANSVERSE WIRE OF THE BACKING MAT OVER THE VERTICAL PRONGS ON THE LOWER MAT. ROTATE THE BACKING MAT TO VERTICAL AND CLIP THE SECOND-TO-TOP TRANSVERSE WIRE ON THE BACKING MAT TO THE TOP WIRE ON THE REINFORCEMENT MAT.




## WALL INSTALLATION STEP 7

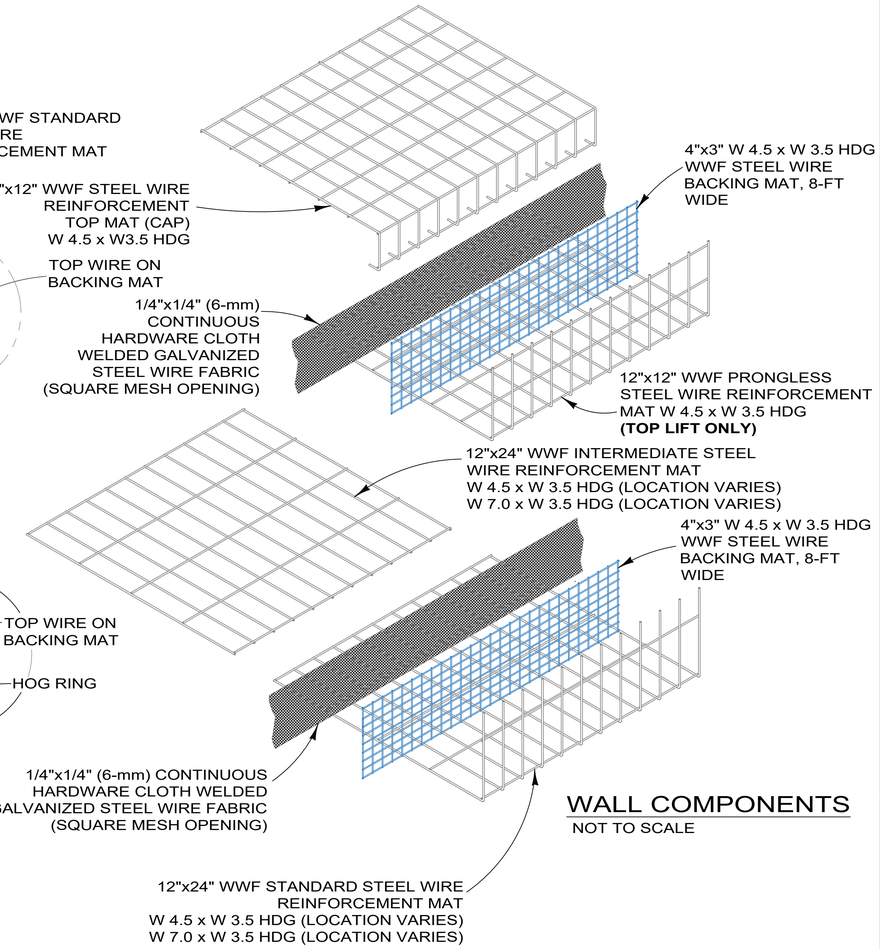
INSTALL THE CONTINUOUS HARDWARE CLOTH.
PLACE AND COMPACT THE BACKFILL TO THE BASE ELEVATION OF THE NEXT MAT. REPEAT STEPS 3 THROUGH 6 TO THE TOP LIFT.



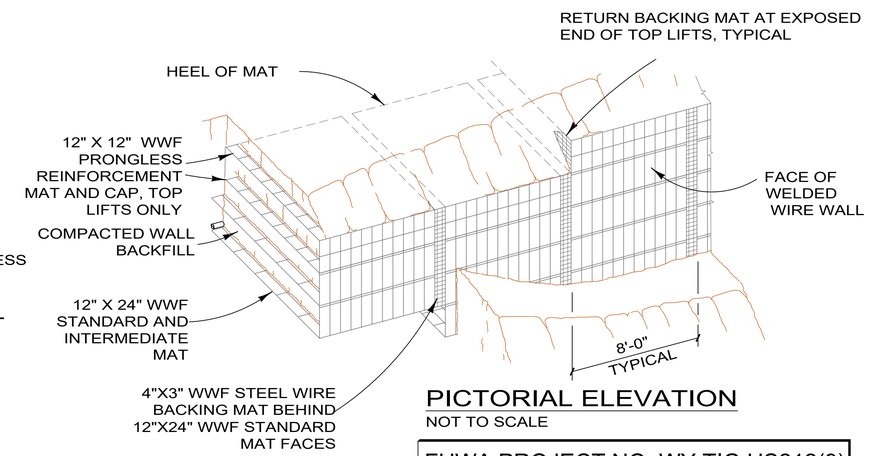

## WALL INSTALLATION STEP 8: TOP LIFT

PLACE THE TOP LIFT (PRONGLESS MAT) AND BACKING MAT. PLACE AND COMPACT BACKFILL IN AREA "A". HOOK THE CAP OVER THE MIDDLE TRANSVERSE WIRE ON THE PRONGLESS MAT, AND ROTATE INTO PLACE. BACKFILL "B" TO 1'-6" MIN. COVER OVER THE CAP.




## WALL COMPONENTS

NOT TO SCALE




## PICTORIAL ELEVATION

NOT TO SCALE

FHWA PROJECT NO. WY TIG US212(9)

## NOTES:

1. THESE DETAILS ARE TYPICAL FOR THE HILFIKER MSE WALL SHOWN. INTENDED FOR INFORMATION ONLY.
2. WWF = WELDED WIRE FABRIC

# HILFIKER WWM MSE WALL - STANDARD ASSEMBLY DETAILS 1

REVISIONS

2021 03-25: Revised Sheet Numbering.
2021 05-21: Added hardware cloth per the FHWA Transmittal 165.
2021 05-21: Revised wall installation steps to include wall facing fill.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

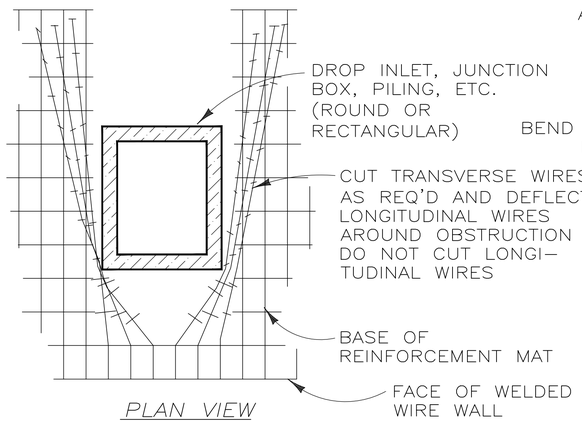
PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7409 Spanoso Rd., Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Dr., Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

SHEET 16 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

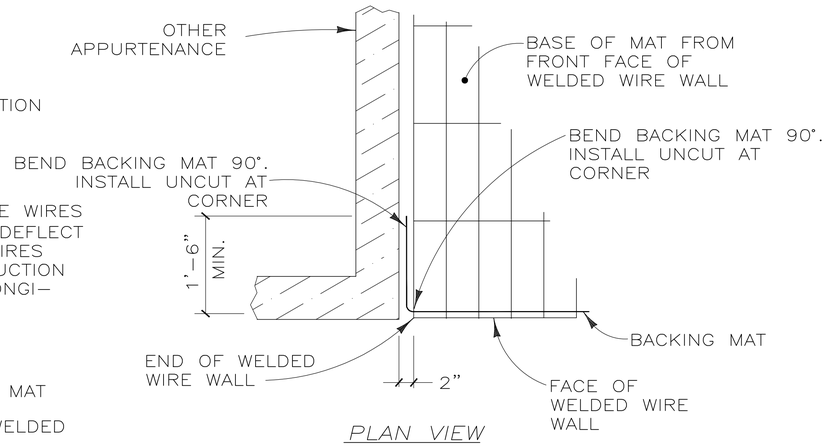
© 2021 KANE GeoTech, Inc.




PLAN VIEW

## MAT PENETRATION DETAIL

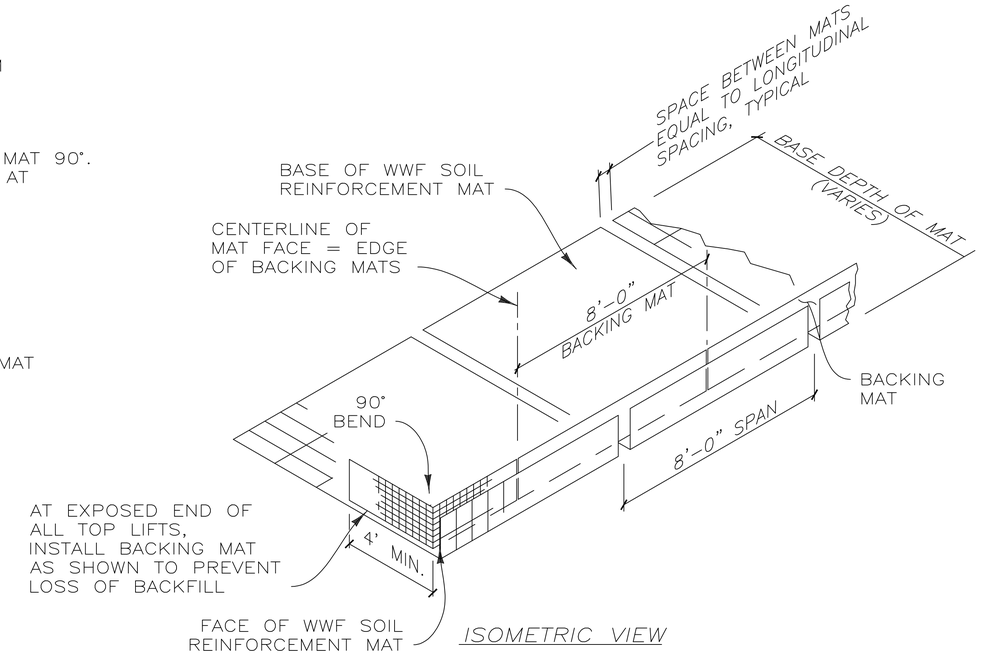
NOT TO SCALE




PLAN VIEW

## WELDED WIRE WALL END AT OTHER APPURTENANCE

NOT TO SCALE




ISOMETRIC VIEW

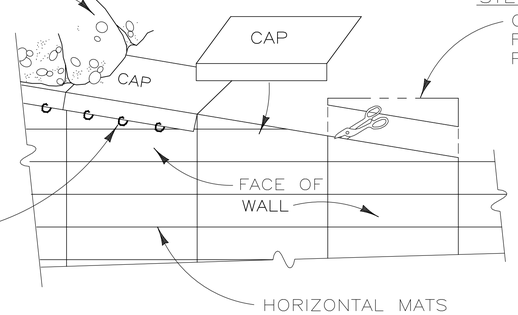
## WELDED WIRE WALL COMPONENTS WITH RETURN MAT

NOT TO SCALE

STEP 4
PLACE AND COMPACT BACKFILL OVER THE SLOPED CAPS TO FINAL GRADE

STEP 2
PLACE CAPS ON SLOPE

STEP 1
CUT OFF TOP OF THE MAT FACES AND BACKING MATS PARALLEL TO FINAL GRADE




STEP 3
CLIP CAPS TO MAT FACES WITH HOG RINGS

PICTORIAL ELEVATION

## SLOPED CAP MAT DETAIL

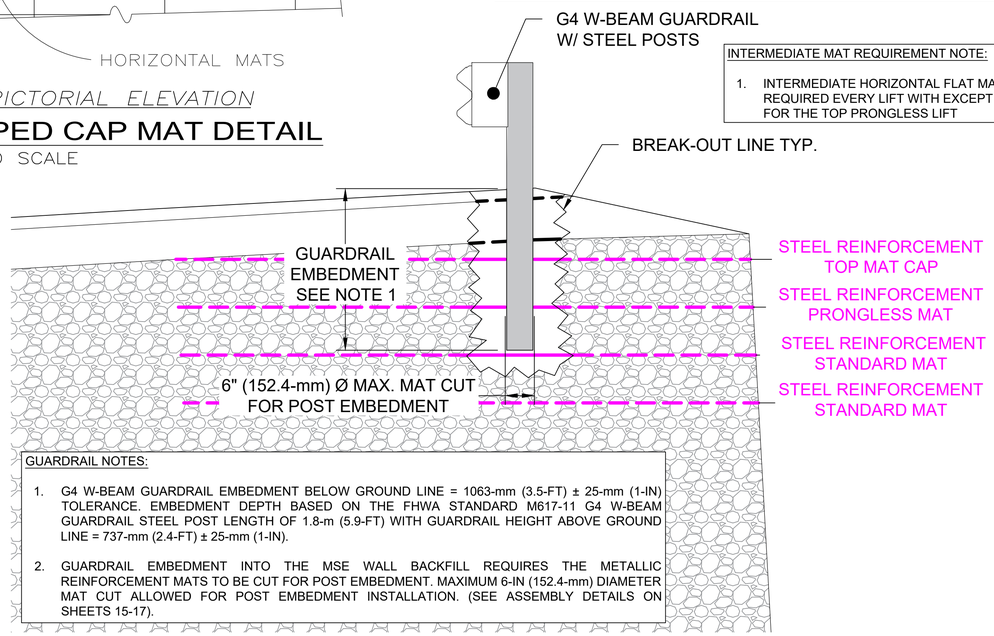
NOT TO SCALE

GUARDRAIL INSTALLATION NOTE:

1. G4 W-BEAM GUARDRAIL INSTALLATION SHALL BE IN ACCORDANCE WITH THE FHWA STANDARD SPECIFICATIONS FP-03 AND THE WY TIG US212(9) SPECIAL PROVISIONS SECTION 617.03.

INTERMEDIATE MAT REQUIREMENT NOTE:

1. INTERMEDIATE HORIZONTAL FLAT MATS REQUIRED EVERY LIFT WITH EXCEPTION FOR THE TOP PRONGLESS LIFT

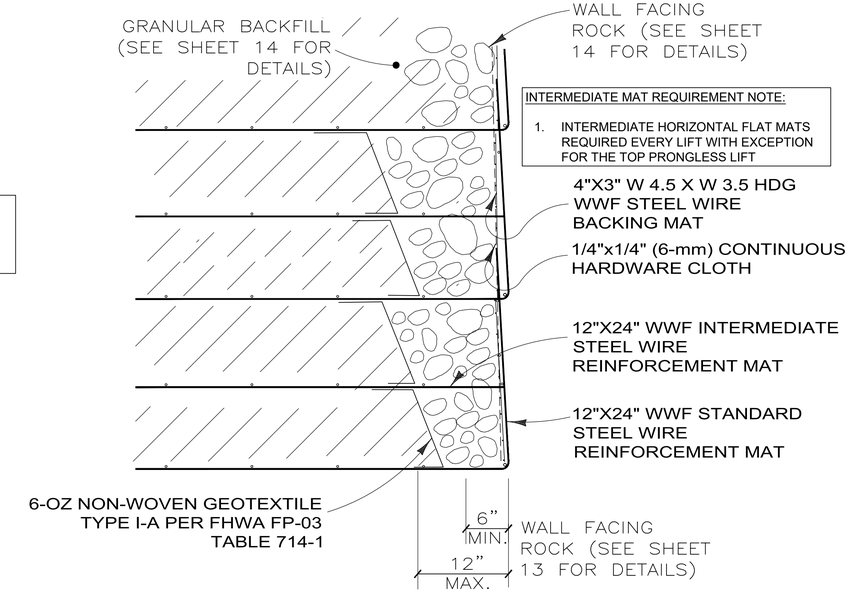



GUARDRAIL NOTES:

1. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
2. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

## GUARDRAIL EMBEDMENT CROSS-SECTIONAL VIEW DETAIL

NOT TO SCALE




INTERMEDIATE MAT REQUIREMENT NOTE:

1. INTERMEDIATE HORIZONTAL FLAT MATS REQUIRED EVERY LIFT WITH EXCEPTION FOR THE TOP PRONGLESS LIFT

SECTION

## ROCK FACING DETAIL

NOT TO SCALE

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER WWM MSE WALL - STANDARD ASSEMBLY DETAILS 2

REVISIONS

2021 03-25: Guardrail Detail per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Revised details to include non-woven geotextile.
2021 05-21: Added hardware cloth per the FHWA Transmittal 165.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

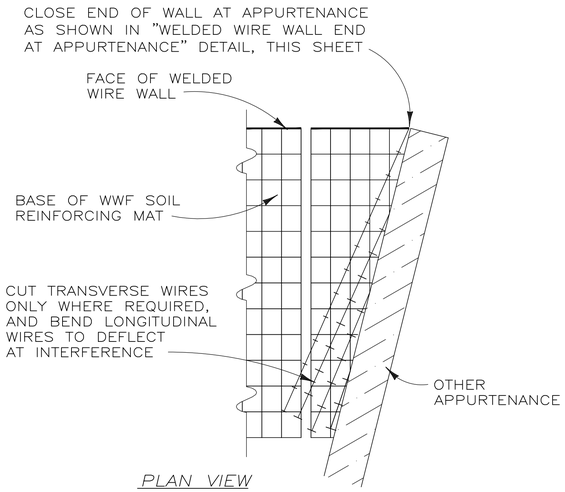
PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office 1441 Kapiolani Blvd, Suite 1115 Honolulu, HI 96814 (808) 468-9993
Los Angeles Office 6080 Center Dr., Suite 600 Los Angeles, CA 90045 (323) 331-9222
Stockton Office 7400 Sierra Ct., Suite 6 Stockton, CA 95219 (209) 472-1822

SHEET 17 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

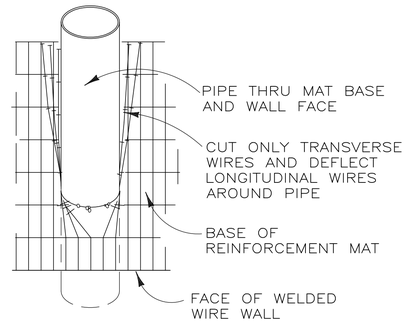
© 2021 KANE GeoTech, Inc.




*PLAN VIEW*

## DEFLECTED LONGITUDINAL WIRES

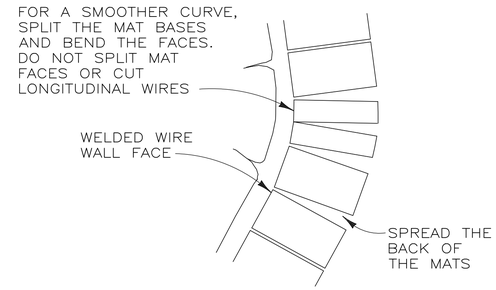
NOT TO SCALE




*PLAN VIEW*

## ANGLED PIPE PENETRATION

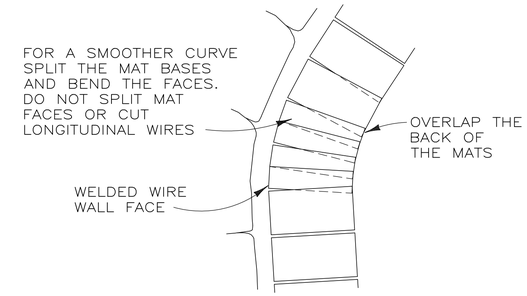
NOT TO SCALE




*PLAN VIEW*

## CONCAVE CURVE

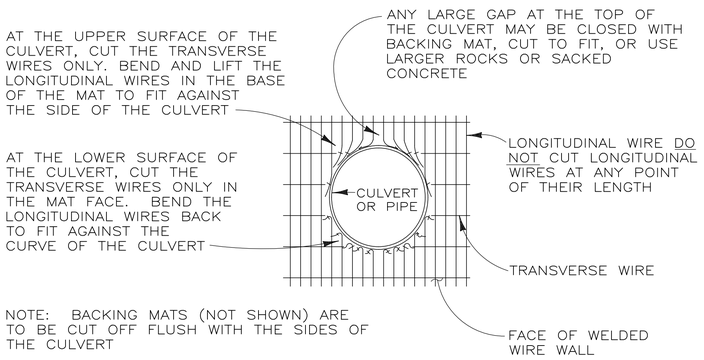
NOT TO SCALE




*PLAN VIEW*

## CONVEX CURVE

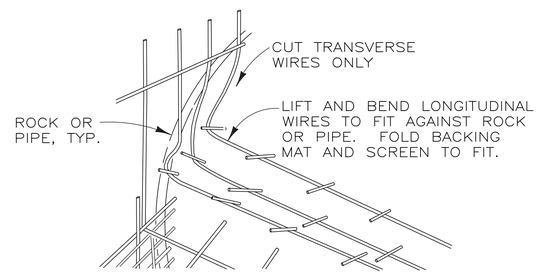
NOT TO SCALE




*ELEVATION*

## CULVERT THRU WALL FACE

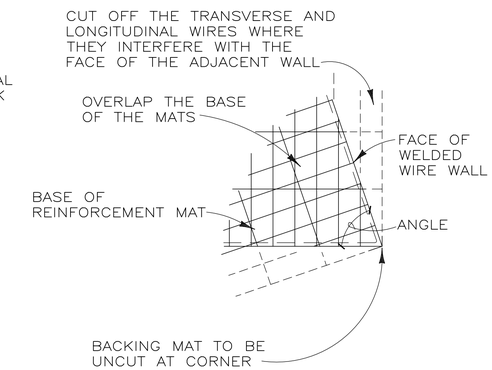
NOT TO SCALE




*PICTORIAL*

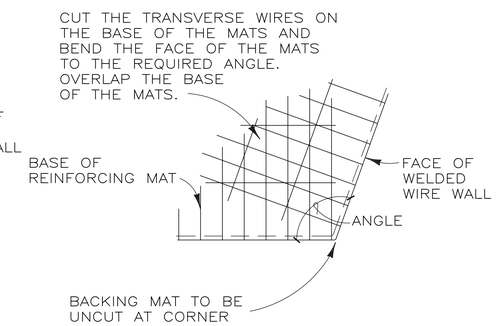
## FITTING MATS TO OBSTRUCTION

NOT TO SCALE




## ACUTE CONVEX ANGLE

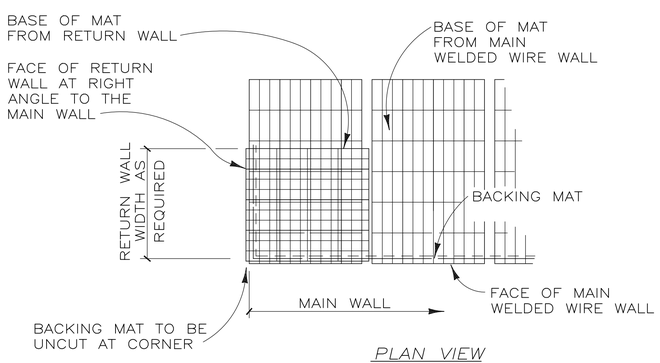
NOT TO SCALE




*PLAN VIEW*

## OBTUSE CONVEX ANGLE

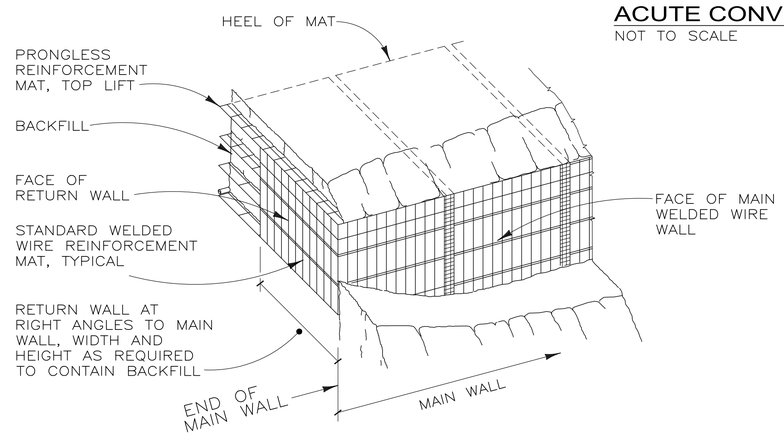
NOT TO SCALE




*PLAN VIEW*

## RETURN WALL DETAIL

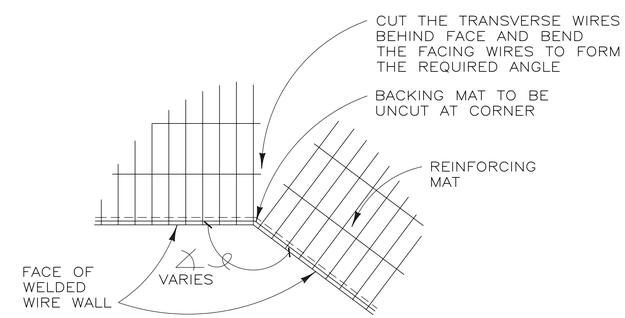
NOT TO SCALE




*PICTORIAL*

## RETURN WALL DETAIL

NOT TO SCALE




*PLAN VIEW*

## CONCAVE ANGLE DETAIL

NOT TO SCALE

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER WWM MSE WALL - STANDARD ASSEMBLY DETAILS 3

2021 03-25: Revised Sheet Numbering.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants

Honolulu Office
1441 Kapiolani Blvd, Suite 1115
Honolulu, HI 96814
(808) 468-9993

Los Angeles Office
6080 Center Dr, Suite 600
Los Angeles, CA 90045
(323) 331-9222

Stockton Office
7400 Spanos Dr, Suite 6
Stockton, CA 95219
(209) 472-1822

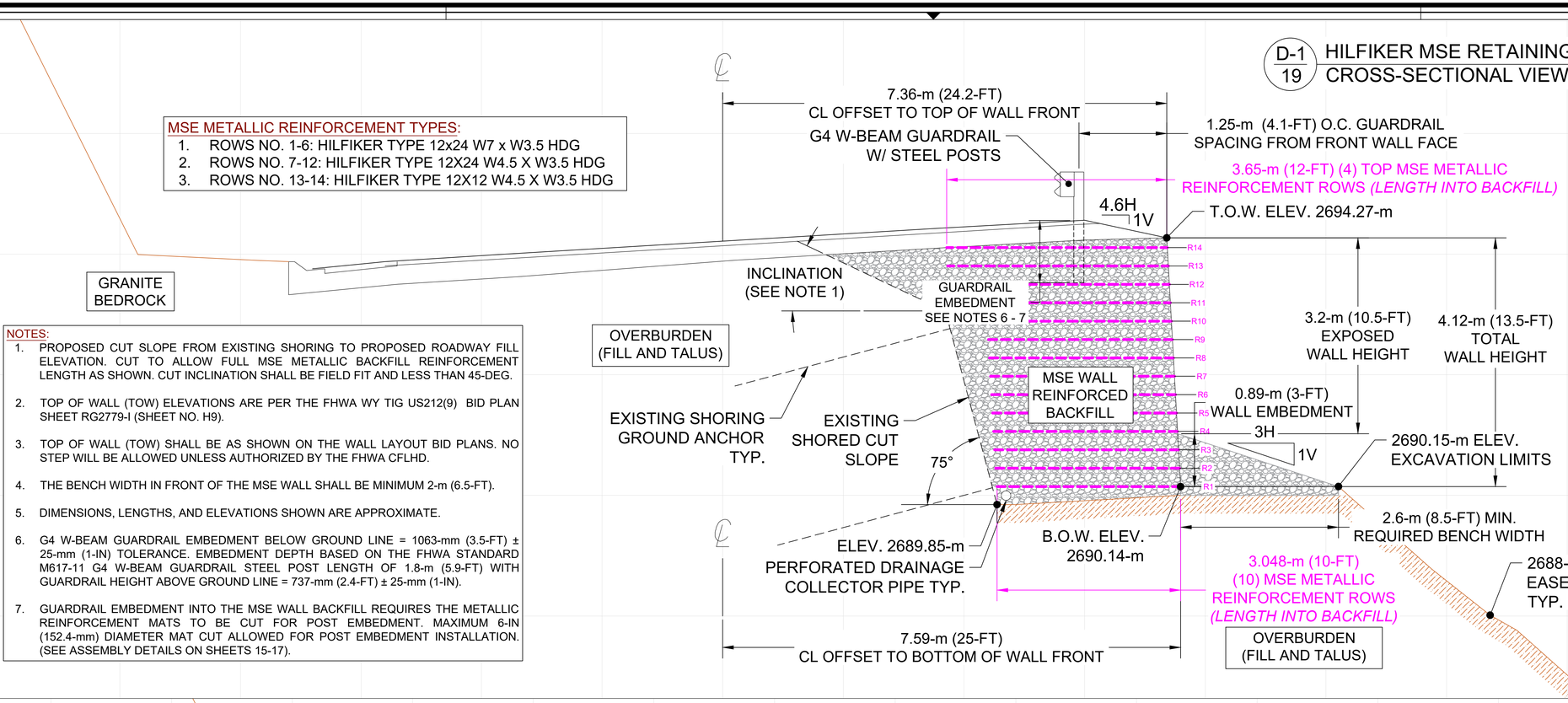
SHEET 18 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK

SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

## D-1 / 19 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+570 CROSS-SECTIONAL VIEW DETAIL




MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-6: HILFIKER TYPE 12x24 W7 x W3.5 HDG
2. ROWS NO. 7-12: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
3. ROWS NO. 13-14: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

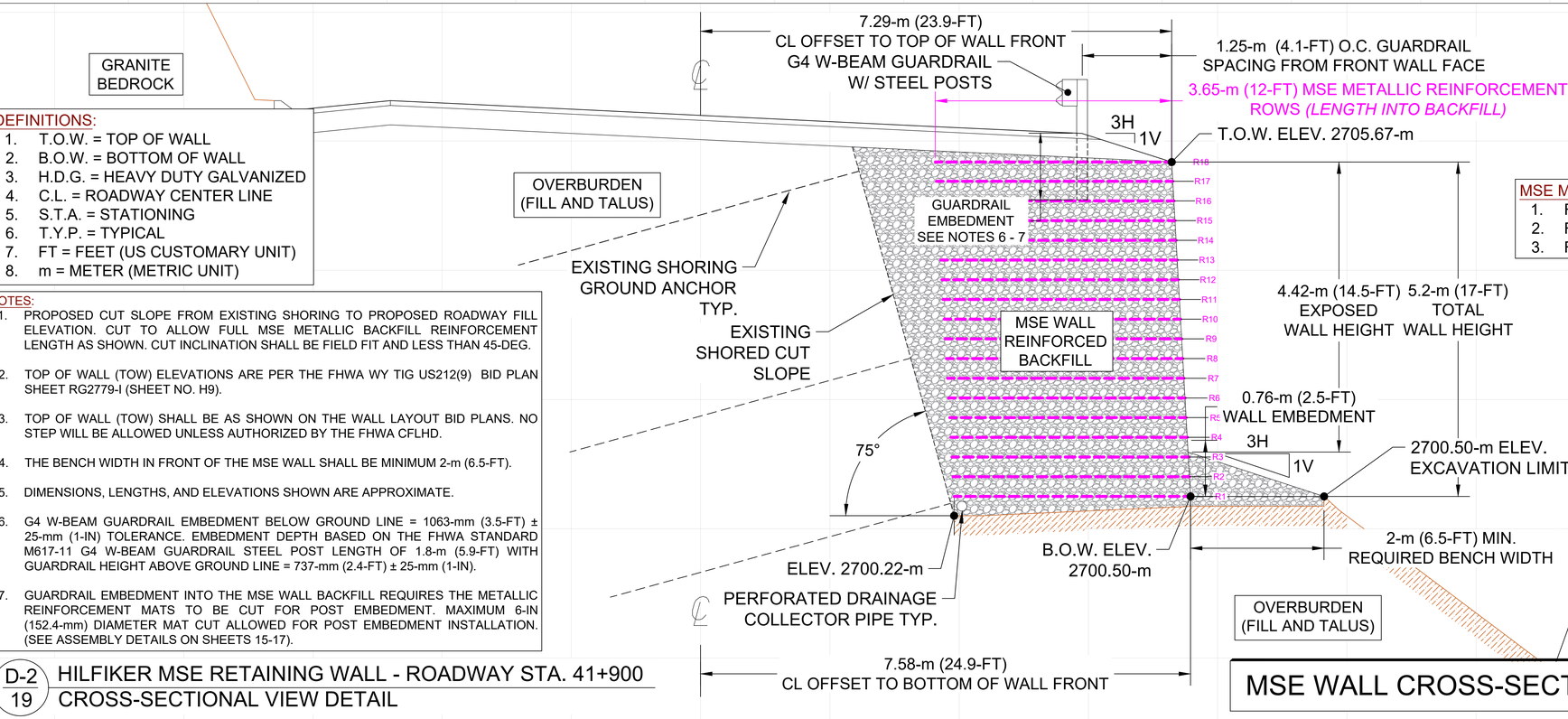
DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. THE BENCH WIDTH IN FRONT OF THE MSE WALL SHALL BE MINIMUM 2-m (6.5-FT).
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

WALL EMBEDMENT STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

## D-2 / 19 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+900 CROSS-SECTIONAL VIEW DETAIL




DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-8: HILFIKER TYPE 12x24 W7 x W3.5 HDG
2. ROWS NO. 9-16: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
3. ROWS NO. 17-18: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. THE BENCH WIDTH IN FRONT OF THE MSE WALL SHALL BE MINIMUM 2-m (6.5-FT).
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

WALL BENCH STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL CROSS-SECTIONS: STA. 41+570 , STA. 41+900

REVISIONS
- 2021 03-25: Guardrail Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Revised Elevations for Details D-1 and D-2.
- 2021 05-07: Added Schedules for Wall Embedment and Bench Widths.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Dr., Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Dr., Suite 6, Stockton, CA 95219, (209) 472-1822


Professional Engineer, WILLIAM F. KANE, 14886, Date 2-02-21, WYOMING

SHEET 19 OF 26

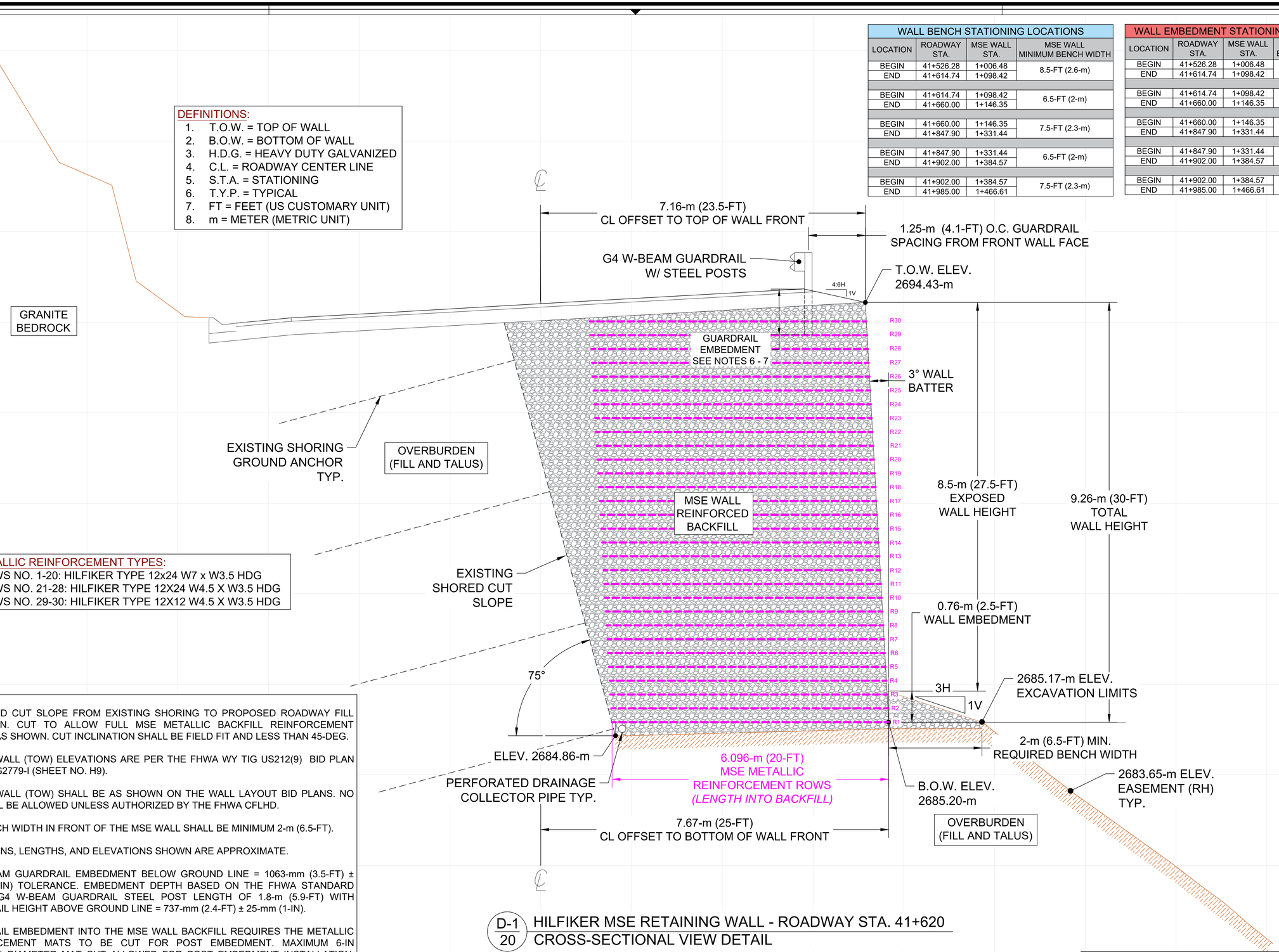
DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)




MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-20: HILFIKER TYPE 12x24 W7 x W3.5 HDG
2. ROWS NO. 21-28: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
3. ROWS NO. 29-30: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. THE BENCH WIDTH IN FRONT OF THE MSE WALL SHALL BE MINIMUM 2-m (6.5-FT).
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

D-1 / 20 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+620
CROSS-SECTIONAL VIEW DETAIL

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL CROSS-SECTION: STA. 41+620

2021 03-25: Guardrail Details per FHWA RFI 37 and Transmittal 144.
2021 03-25: Revised Sheet Numbering.
2021 05-07: Revised Elevations for Details D-1 and D-2.
2021 05-07: Added Schedules for Wall Embedment and Bench Widths.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7409 Spanos Dr., Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

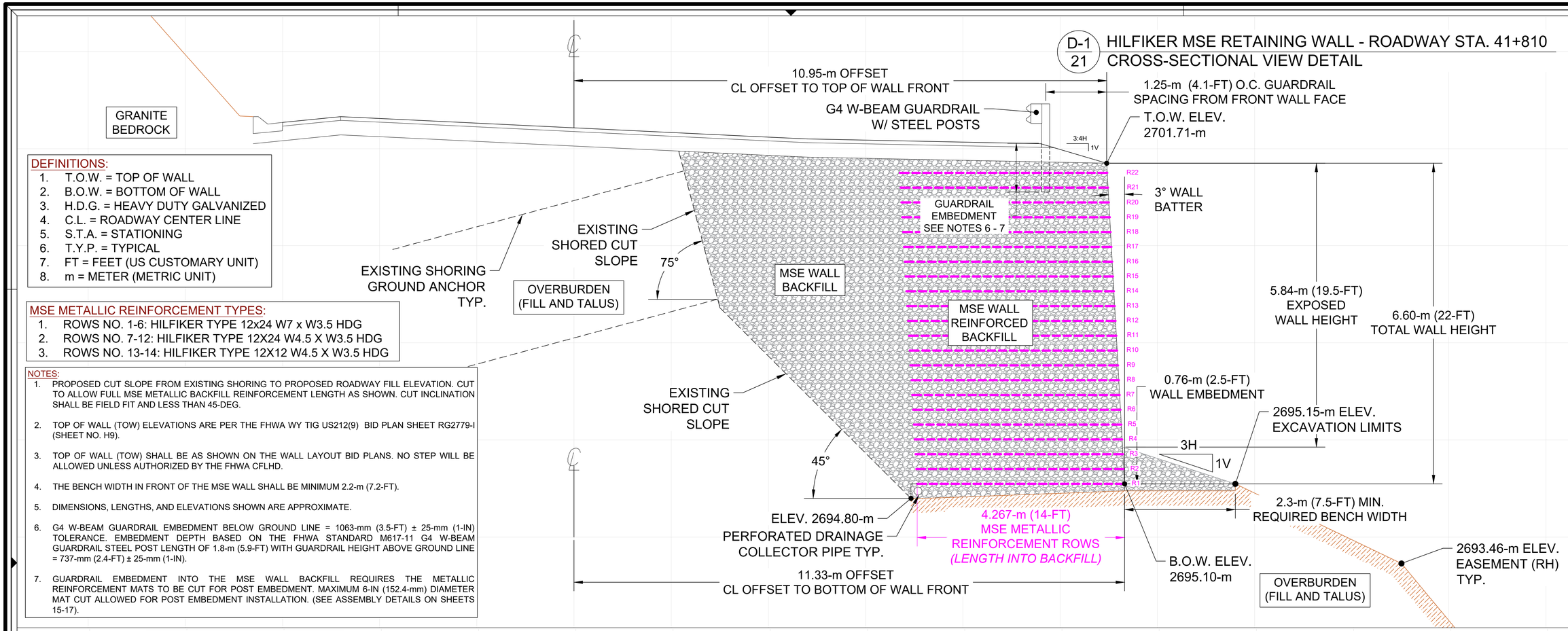

Professional Engineer WILLIAM F. KANE 14886 Date 2021 WYOMING

SHEET 20 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

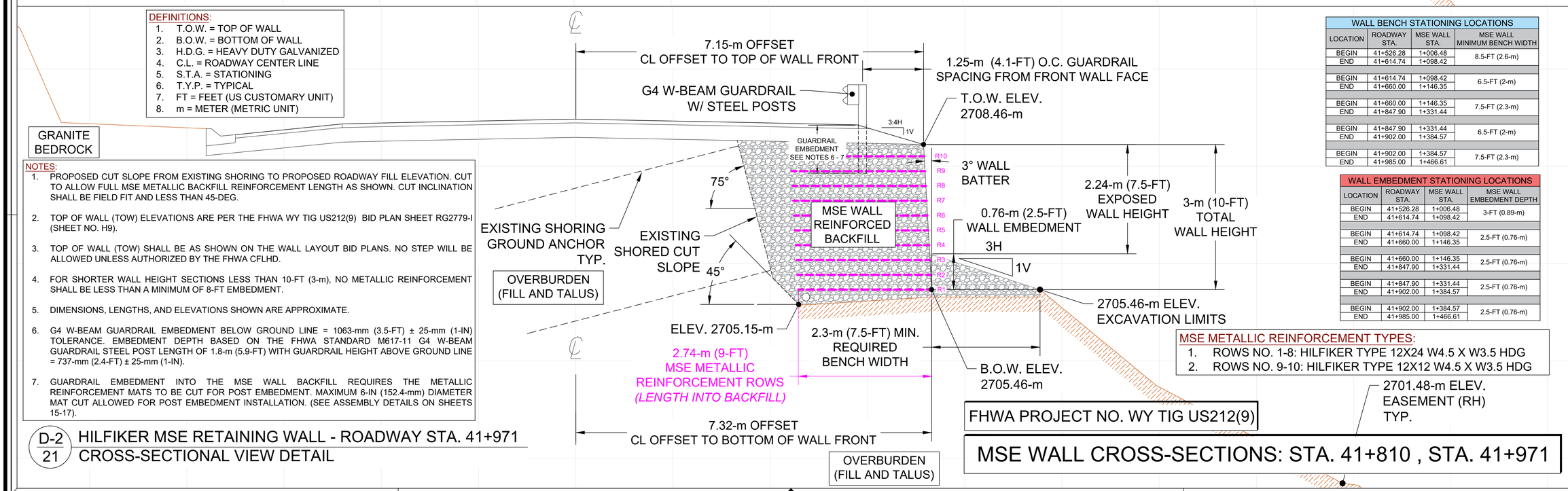
## D-1 / 21 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+810
## CROSS-SECTIONAL VIEW DETAIL




DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-6: HILFIKER TYPE 12x24 W7 x W3.5 HDG
2. ROWS NO. 7-12: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
3. ROWS NO. 13-14: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. THE BENCH WIDTH IN FRONT OF THE MSE WALL SHALL BE MINIMUM 2.2-m (7.2-FT).
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).




DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. FOR SHORTER WALL HEIGHT SECTIONS LESS THAN 10-FT (3-m), NO METALLIC REINFORCEMENT SHALL BE LESS THAN A MINIMUM OF 8-FT EMBEDMENT.
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

## D-2 / 21 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+971
## CROSS-SECTIONAL VIEW DETAIL

WALL BENCH STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
|---|---|---|---|
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

WALL EMBEDMENT STATIONING LOCATIONS

| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
|---|---|---|---|
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-8: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
2. ROWS NO. 9-10: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL CROSS-SECTIONS: STA. 41+810 , STA. 41+971

REVISIONS
- 2021 03-25: Guardrail Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Revised Elevations for Details D-1 and D-2.
- 2021 05-07: Added Schedules for Wall Embedment and Bench Widths.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601


KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Dr, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Shoreline Dr, Suite 6, Stockton, CA 95219, (209) 472-1822

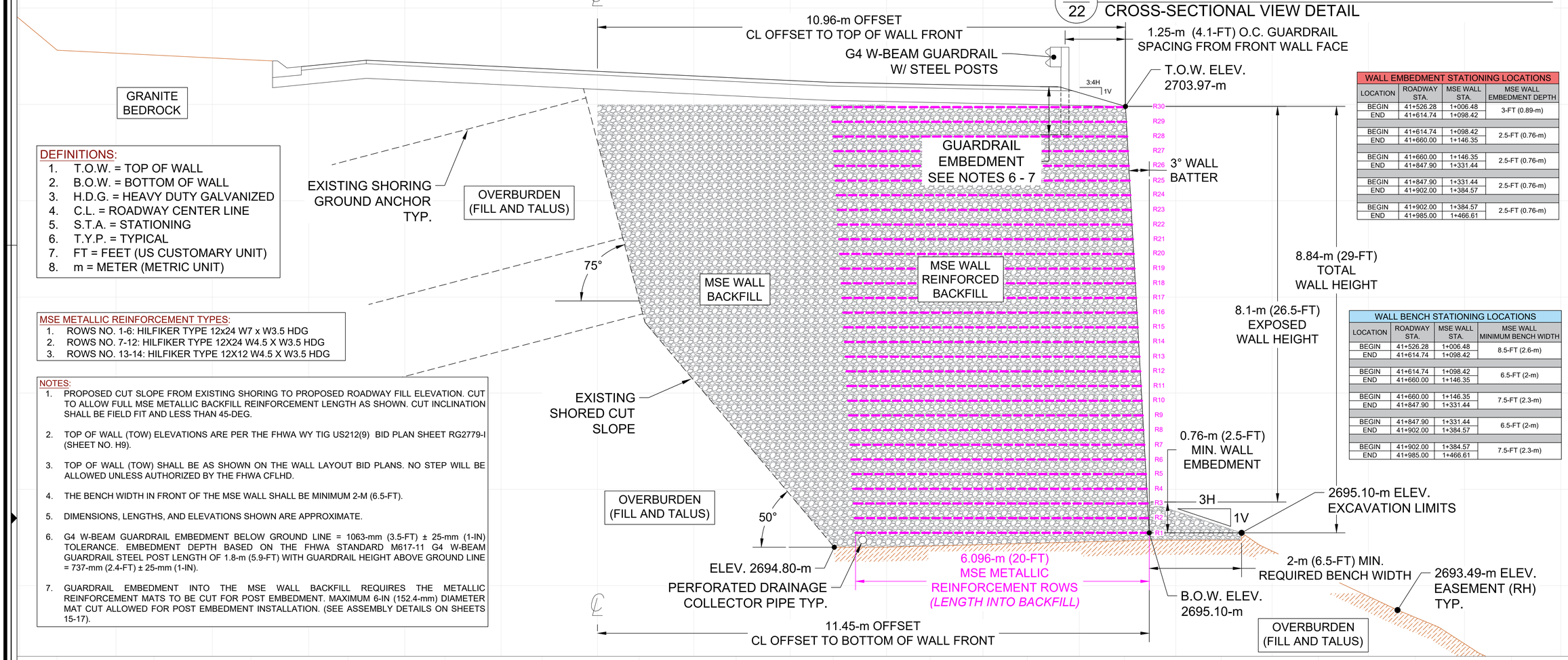

PROFESSIONAL ENGINEER WILLIAM F. KANE 14685 WYOMING

SHEET 21 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

## D-1 / 22 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+860 CROSS-SECTIONAL VIEW DETAIL




| WALL EMBEDMENT STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL EMBEDMENT DEPTH |
| BEGIN | 41+526.28 | 1+006.48 | 3-FT (0.89-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 2.5-FT (0.76-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 2.5-FT (0.76-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 2.5-FT (0.76-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 2.5-FT (0.76-m) |
| END | 41+985.00 | 1+466.61 | |

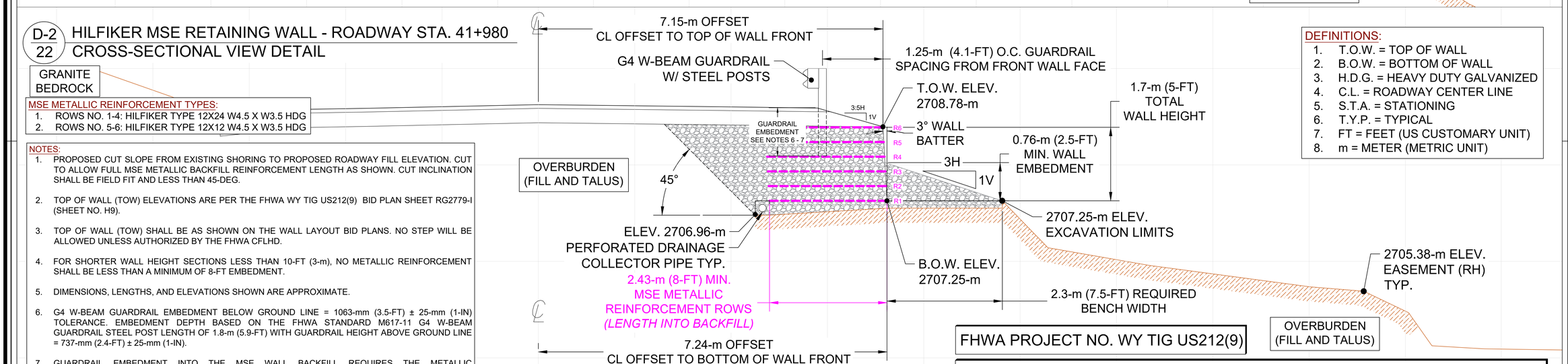
| WALL BENCH STATIONING LOCATIONS | | | |
|---|---|---|---|
| LOCATION | ROADWAY STA. | MSE WALL STA. | MSE WALL MINIMUM BENCH WIDTH |
| BEGIN | 41+526.28 | 1+006.48 | 8.5-FT (2.6-m) |
| END | 41+614.74 | 1+098.42 | |
| BEGIN | 41+614.74 | 1+098.42 | 6.5-FT (2-m) |
| END | 41+660.00 | 1+146.35 | |
| BEGIN | 41+660.00 | 1+146.35 | 7.5-FT (2.3-m) |
| END | 41+847.90 | 1+331.44 | |
| BEGIN | 41+847.90 | 1+331.44 | 6.5-FT (2-m) |
| END | 41+902.00 | 1+384.57 | |
| BEGIN | 41+902.00 | 1+384.57 | 7.5-FT (2.3-m) |
| END | 41+985.00 | 1+466.61 | |

DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-6: HILFIKER TYPE 12x24 W7 x W3.5 HDG
2. ROWS NO. 7-12: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
3. ROWS NO. 13-14: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. THE BENCH WIDTH IN FRONT OF THE MSE WALL SHALL BE MINIMUM 2-M (6.5-FT).
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

## D-2 / 22 HILFIKER MSE RETAINING WALL - ROADWAY STA. 41+980 CROSS-SECTIONAL VIEW DETAIL




MSE METALLIC REINFORCEMENT TYPES:
1. ROWS NO. 1-4: HILFIKER TYPE 12X24 W4.5 X W3.5 HDG
2. ROWS NO. 5-6: HILFIKER TYPE 12X12 W4.5 X W3.5 HDG

NOTES:
1. PROPOSED CUT SLOPE FROM EXISTING SHORING TO PROPOSED ROADWAY FILL ELEVATION. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN. CUT INCLINATION SHALL BE FIELD FIT AND LESS THAN 45-DEG.
2. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
3. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
4. FOR SHORTER WALL HEIGHT SECTIONS LESS THAN 10-FT (3-m), NO METALLIC REINFORCEMENT SHALL BE LESS THAN A MINIMUM OF 8-FT EMBEDMENT.
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.
6. G4 W-BEAM GUARDRAIL EMBEDMENT BELOW GROUND LINE = 1063-mm (3.5-FT) ± 25-mm (1-IN) TOLERANCE. EMBEDMENT DEPTH BASED ON THE FHWA STANDARD M617-11 G4 W-BEAM GUARDRAIL STEEL POST LENGTH OF 1.8-m (5.9-FT) WITH GUARDRAIL HEIGHT ABOVE GROUND LINE = 737-mm (2.4-FT) ± 25-mm (1-IN).
7. GUARDRAIL EMBEDMENT INTO THE MSE WALL BACKFILL REQUIRES THE METALLIC REINFORCEMENT MATS TO BE CUT FOR POST EMBEDMENT. MAXIMUM 6-IN (152.4-mm) DIAMETER MAT CUT ALLOWED FOR POST EMBEDMENT INSTALLATION. (SEE ASSEMBLY DETAILS ON SHEETS 15-17).

DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL CROSS-SECTIONS: STA. 41+860 , STA. 41+980

REVISIONS
- 2021 03-25: Guardrail Details per FHWA RFI 37 and Transmittal 144.
- 2021 03-25: Revised Sheet Numbering.
- 2021 05-07: Revised Elevations for Details D-1 and D-2.
- 2021 05-07: Added Schedules for Wall Embedment and Bench Widths.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

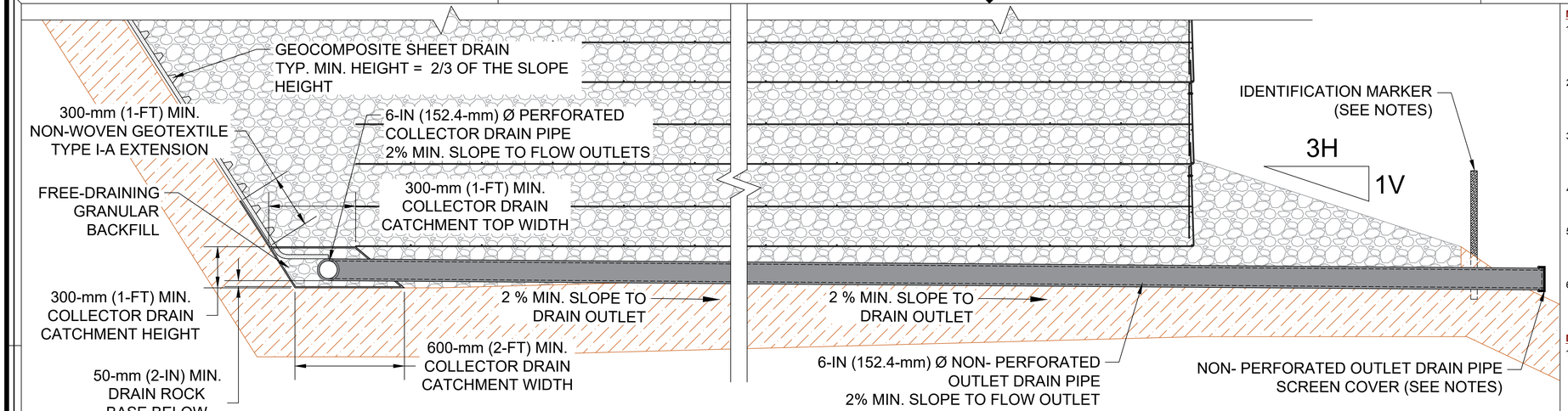

KANE GeoTech, Inc.
Geoengineering Consultants
Honolulu Office: 1441 Kapiolani Blvd, Suite 1115, Honolulu, HI 96814, (808) 468-9993
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Stockton Office: 7400 Spanish Oak Dr, Suite 6, Stockton, CA 95219, (209) 472-1822


Professional Engineer, William F. Kane, 14886, Date 2-19-21, Wyoming

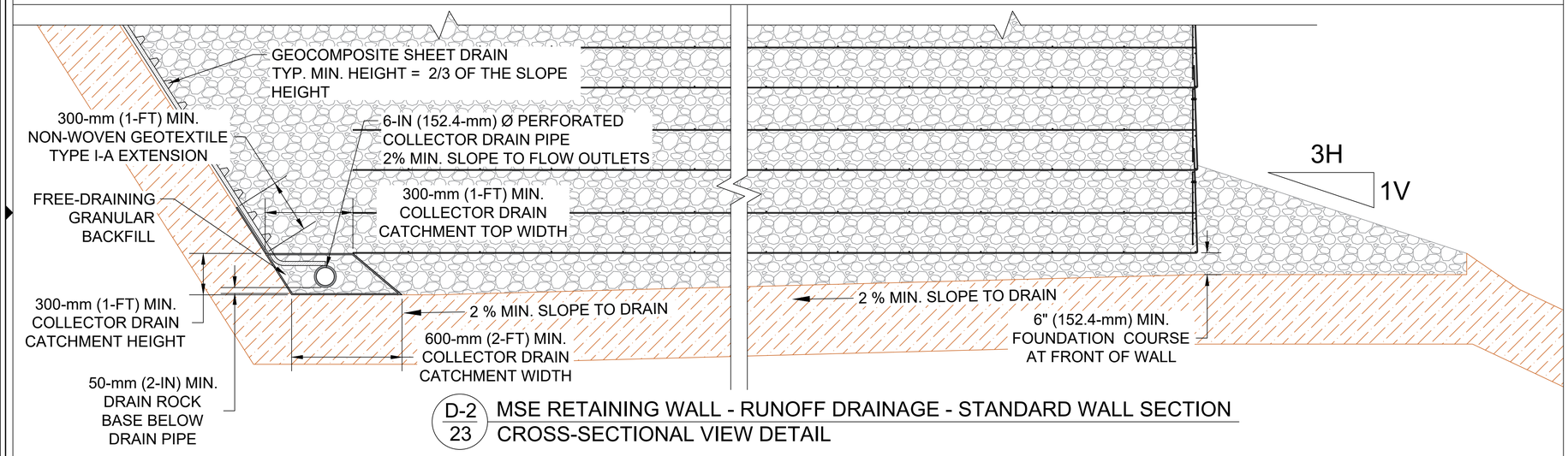
SHEET 22 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.




D-1 / 23 MSE RETAINING WALL - RUNOFF DRAINAGE - WALL OUTLET SECTION
CROSS-SECTIONAL VIEW DETAIL




D-2 / 23 MSE RETAINING WALL - RUNOFF DRAINAGE - STANDARD WALL SECTION
CROSS-SECTIONAL VIEW DETAIL

**MSE WALL - DRAIN PIPE**

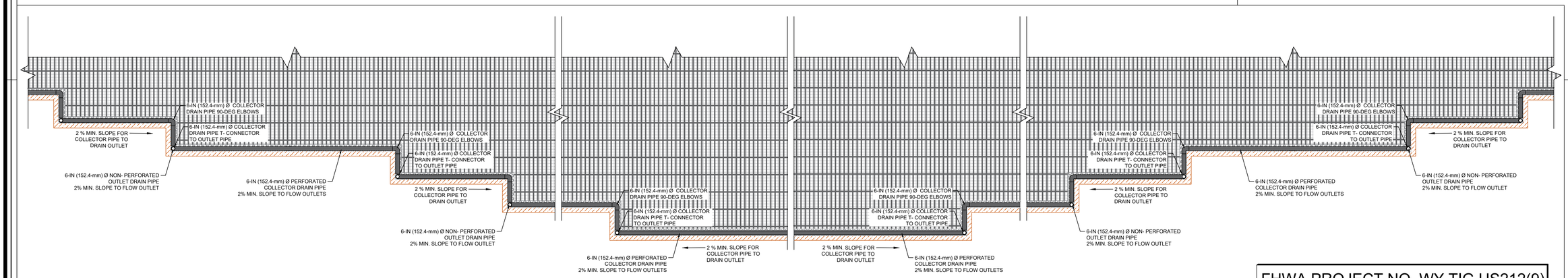
1. PERFORATED DRAINAGE COLLECTOR PIPE SHALL BE INSTALLED ABOVE THE FOUNDATION SURFACE. PERFORATED PIPE, BACKFILL ROCK, NON-WOVEN GEOTEXTILE, AND DIMENSIONS ARE SHOWN ON THE PLANS.
2. NON-PERFORATED OUTLET PIPE SHALL DRAIN TO THE "FILL" SIDE OF THE ROADWAY AS SHOWN ON THE PLANS. NON-PERFORATED OUTLET PIPE SHALL BE INCLINED AT A MINIMUM 2% SLOPE.
3. CONNECT COLLECTOR PIPS TO OUTLET PIPS USING A T-CONNECTOR AND OUTLET AT LOW POINTS PF WALL. OUTLET PIPES SHALL BE SPACED AT A MAXIMUM OF 16-M (53-FT).
4. ASSEMBLY FITTINGS FOR THE DRAINAGE SEE MATERIAL SPECIFICATIONS AND FHWA FP-03 SECTION 706.08.
5. END OF OUTLET PIPES SHALL BE COVERED WITH A SCREEN IN ACCORDANCE WITH FHWA FP-03 SECTION 605.03. SCREEN SHALL BE SECURELY HELD IN PLACE WITH COUPLING BANDS OR FASTENERS.
6. OUTLET OF THE OUTLET DRAINAGE PIPE LOCATIONS SHALL BE MARKED AND IDENTIFIED USING A 4-FT (1.5-M) POST OR STAKE. MARKER SHALL BE PLACED WITHIN 300-MM (1-FT) OF THE END OF PIPE.

**DRAIN COLLECTOR INLET PIPE - PERFORATED**

1. THE PERFORATED DRAIN COLLECTOR PIPE SHALL BE USED AS SHOWN ON THE PLANS. THE PERFORATED DRAIN COLLECTOR PIPE SHALL MEET THE REQUIREMENTS OF THE FHWA FP-03 SECTION 706.08 AND THE SPECIAL PROVISIONS.
2. THE PERFORATED DRAIN PIPE SHALL BE 6-IN (152.4-MM) DIAMETER.
3. FURNISH PERFORATED PLASTIC PIPE CONFORMING TO THE FOLLOWING FOR TYPES:
   - 3.1. POLYETHYLENE PERFORATED CONFORMING TO AASHTO M 252.
   - 3.2. PERFORATED POLYVINYL CHLORIDE PIPE WITH SMOOTH INTERIOR, SMOOTH OR RIBBED EXTERIOR CONFORMING TO AASHTO M 278, ASTM F 758, OR ASTM F 949.
4. FOR WATERTIGHT JOINTS, CONFORM TO ASTM D 3212. FOR PIPE CULVERT, FURNISH PIPE CONFORMING TO TYPES (A), (B), OR (C) FOR THE SIZE SPECIFIED.
5. ESTIMATED OVERALL PIPE LENGTH BETWEEN BEGIN AND ENDING WALL STATIONING: 500-m (1,640-FT.)

**DRAIN OUTLET PIPE - NON-PERFORATED**

1. THE NON-PERFORATED DRAIN OUTLET PIPE SHALL BE USED AS SHOWN ON THE PLANS. THE NON-PERFORATED DRAIN PIPE SHALL MEET THE REQUIREMENTS OF THE FHWA FP-03 SECTION 706.08 AND THE SPECIAL PROVISIONS.
2. THE NON-PERFORATED DRAIN PIPE SHALL BE 6-IN (152.4-MM) DIAMETER.
3. FURNISH NON-PERFORATED PIPE CONFORMING TO THE FOLLOWING FOR TYPES:
   - 3.1. NON-PERFORATED CORRUGATED PLASTIC PIPE CONFORMING TO AASHTO M 252.
   - 3.2. NON-PERFORATED POLYVINYL CHLORIDE PIPE WITH SMOOTH INTERIOR, SMOOTH OR RIBBED EXTERIOR CONFORMING TO AASHTO M 278, ASTM F 758, OR ASTM F 949.
4. FOR WATERTIGHT JOINTS, CONFORM TO ASTM D 3212. FOR PIPE CULVERT, FURNISH PIPE CONFORMING TO TYPES (A), (B), OR (C) FOR THE SIZE SPECIFIED.
5. PIPE SECTION ESTIMATED LENGTHS:
   - 5.1. 30-FT (9-m) MAXIMUM, 20-FT (6-m) MINIMUM
   - 5.2. NUMBER OF PIPE SECTIONS SHOWN ON SHEETS 2-12 AND LISTED IN SHEET 26 TABLES.




D-3 / 23 MSE RETAINING WALL - RUNOFF DRAINAGE - SPACING AND LOCATIONS
ELEVATION VIEW DETAIL

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL DRAINAGE DETAILS

2021 03-25: Revised Sheet Numbering.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

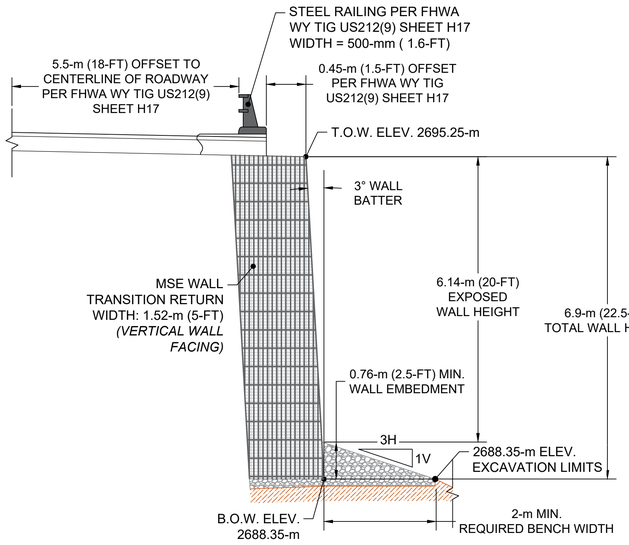
PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr., Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

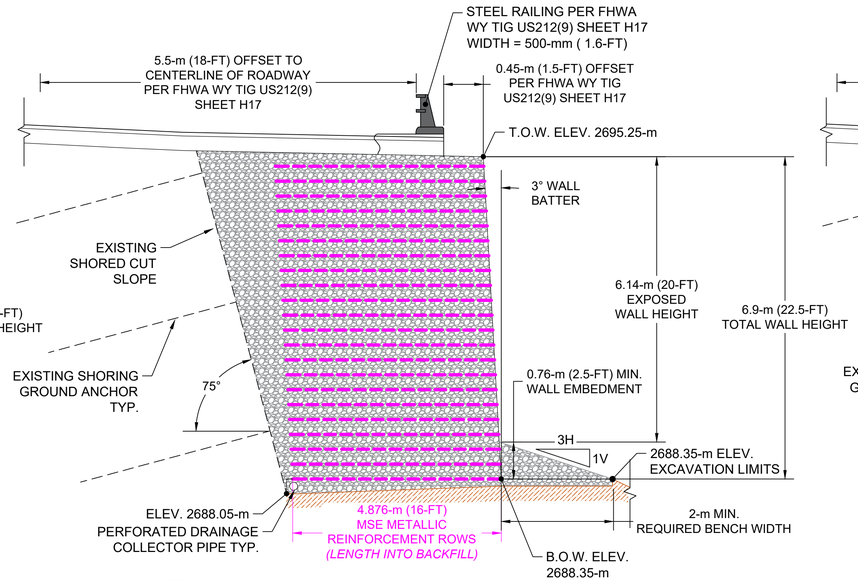
SHEET 23 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

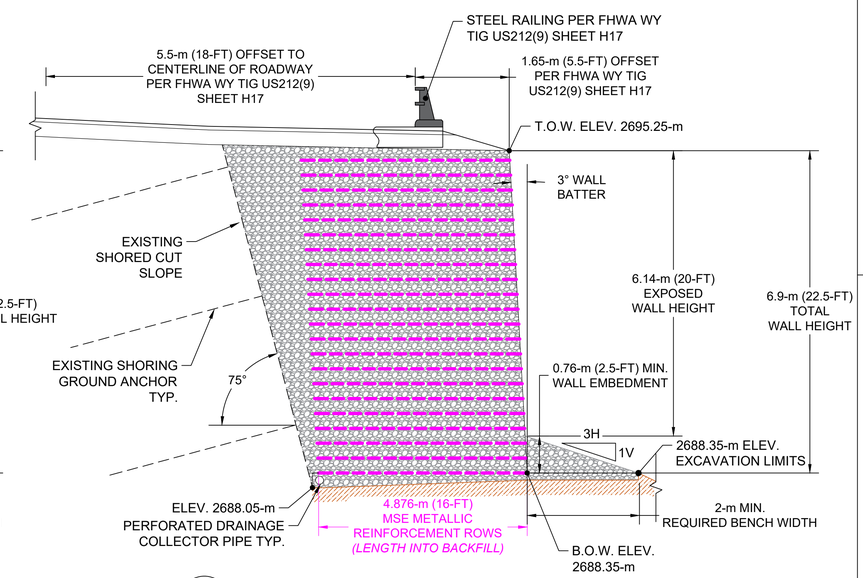
© 2021 KANE GeoTech, Inc.



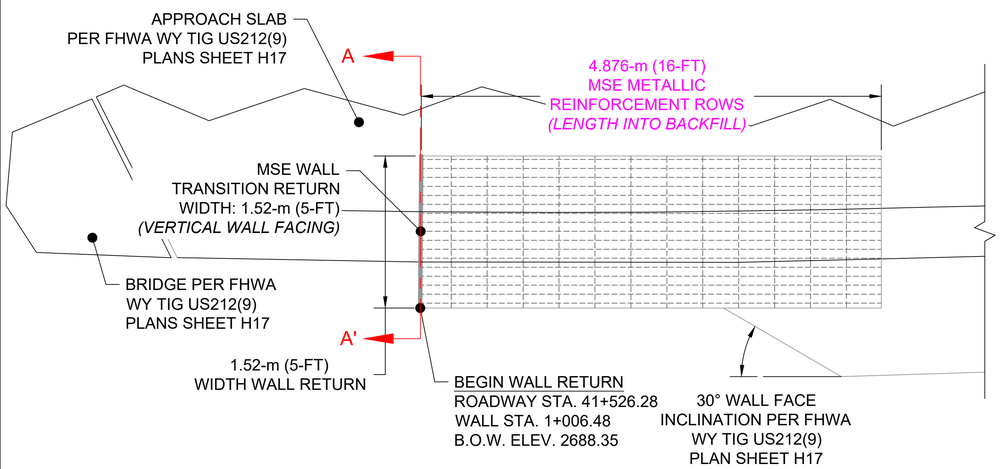

D-1 / 24 HILFIKER MSE RETAINING WALL - MSE WALL RETURN
CROSS-SECTIONAL VIEW A-A' DETAIL



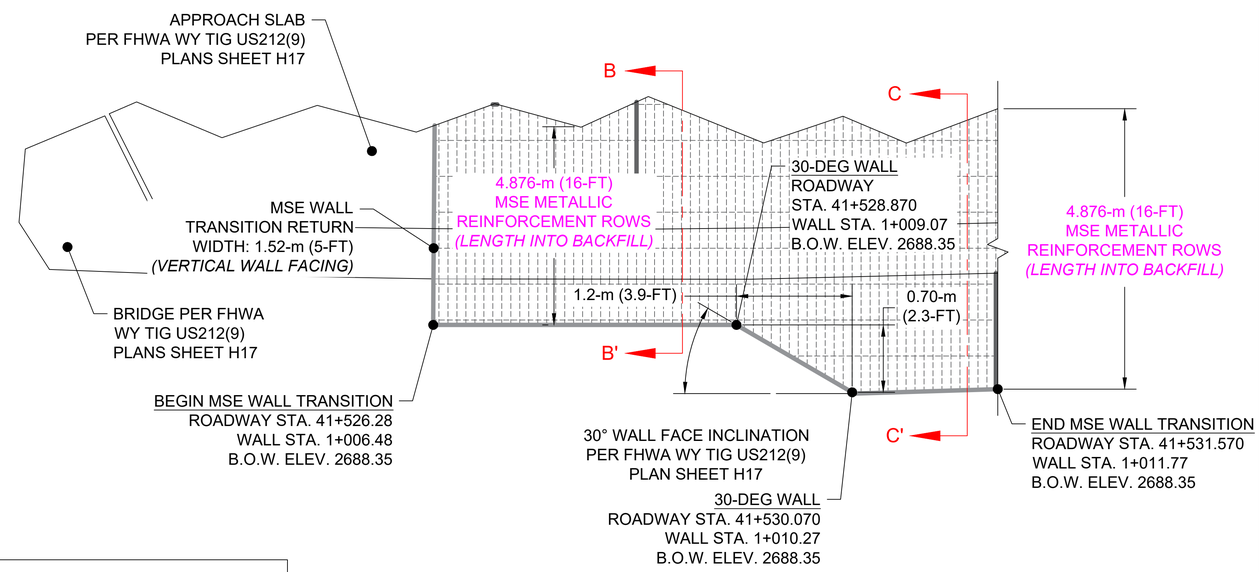

D-2 / 24 HILFIKER MSE RETAINING WALL - MSE WALL RETURN
CROSS-SECTIONAL VIEW B-B' DETAIL




D-3 / 24 HILFIKER MSE RETAINING WALL - MSE WALL RETURN
CROSS-SECTIONAL VIEW C-C' DETAIL




D-4 / 24 HILFIKER MSE RETAINING WALL - MSE WALL RETURN
PLAN VIEW DETAIL




D-5 / 24 HILFIKER MSE RETAINING WALL - MSE WALL TRANSITION
PLAN VIEW DETAIL

DEFINITIONS:
1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

NOTES:
1. BEGIN OF MSE WALL AND TRANSITION DETAILS LIMITED BASED ON THE PROVIDED CROSS-SECTIONS AND DETAILS FROM THE FHWA BID PLANS WY TIG US212(9). DIMENSIONS AND LIMITS SHOWN ARE APPROXIMATE.
2. CUT TO ALLOW FULL MSE METALLIC BACKFILL REINFORCEMENT LENGTH AS SHOWN.
3. TOP OF WALL (TOW) ELEVATIONS ARE PER THE FHWA WY TIG US212(9) BID PLAN SHEET RG2779-I (SHEET NO. H9).
4. TOP OF WALL (TOW) SHALL BE AS SHOWN ON THE WALL LAYOUT BID PLANS. NO STEP WILL BE ALLOWED UNLESS AUTHORIZED BY THE FHWA CFLHD.
5. DIMENSIONS, LENGTHS, AND ELEVATIONS SHOWN ARE APPROXIMATE.

FHWA PROJECT NO. WY TIG US212(9)

# MSE WALL RETURN AND WINGWALL TRANSITION DETAILS

2021 03-25: Revised Sheet Numbering.

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

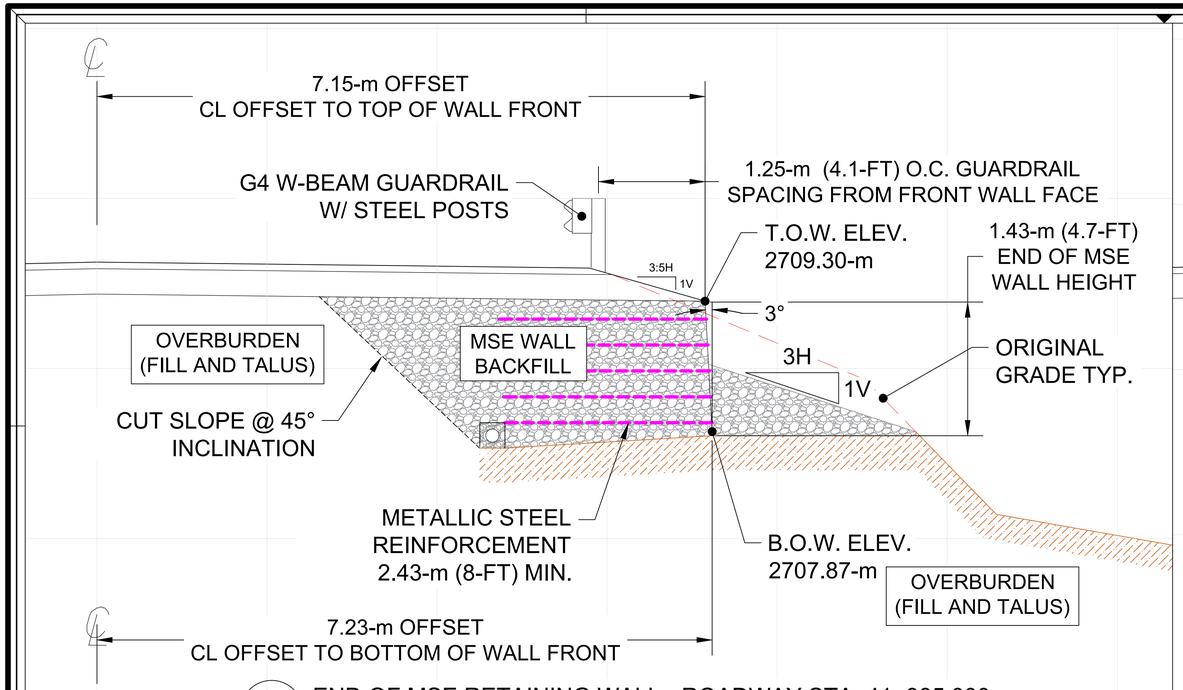
PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Shoreline Dr., Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Dr., Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

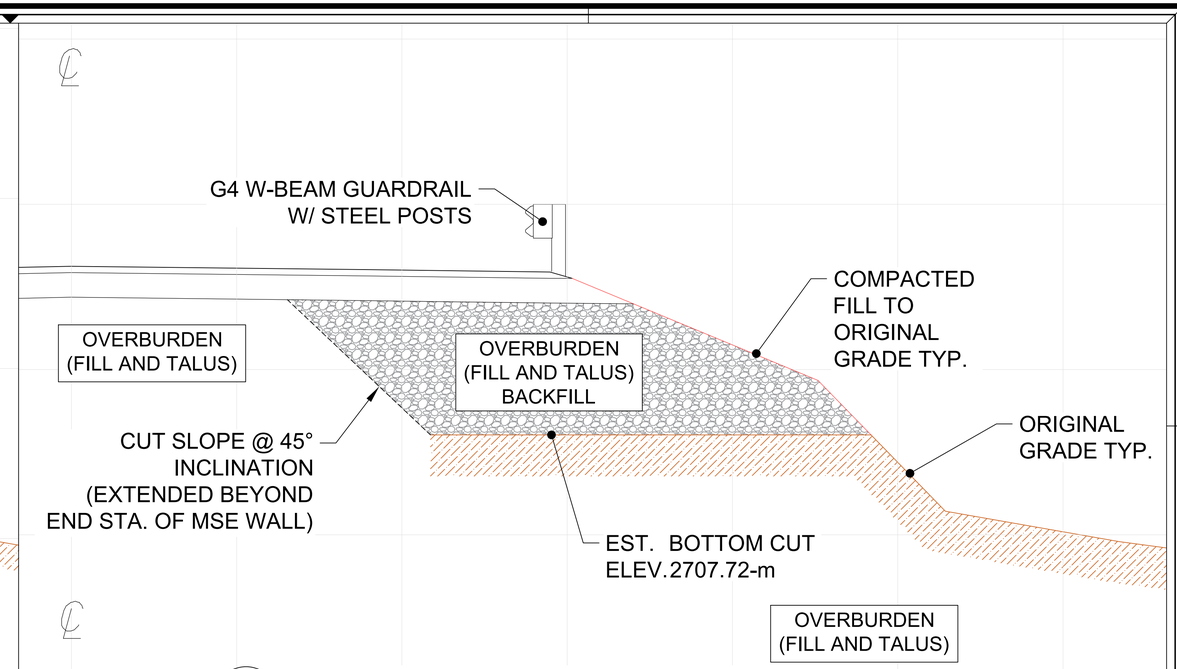
SHEET 24 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

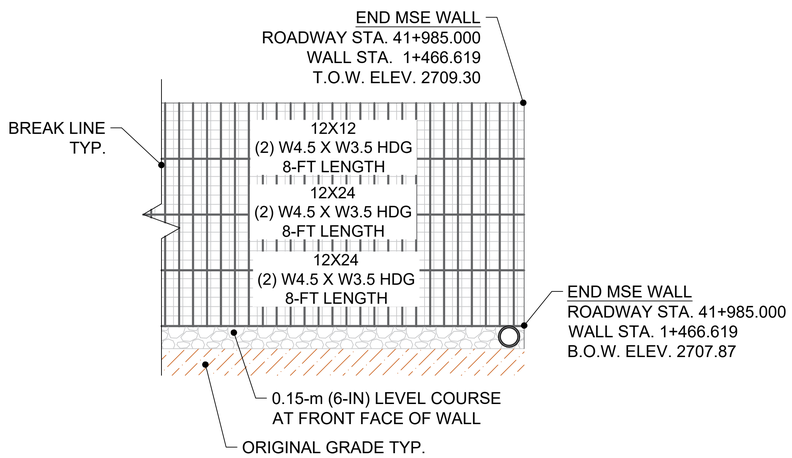
© 2021 KANE GeoTech, Inc.



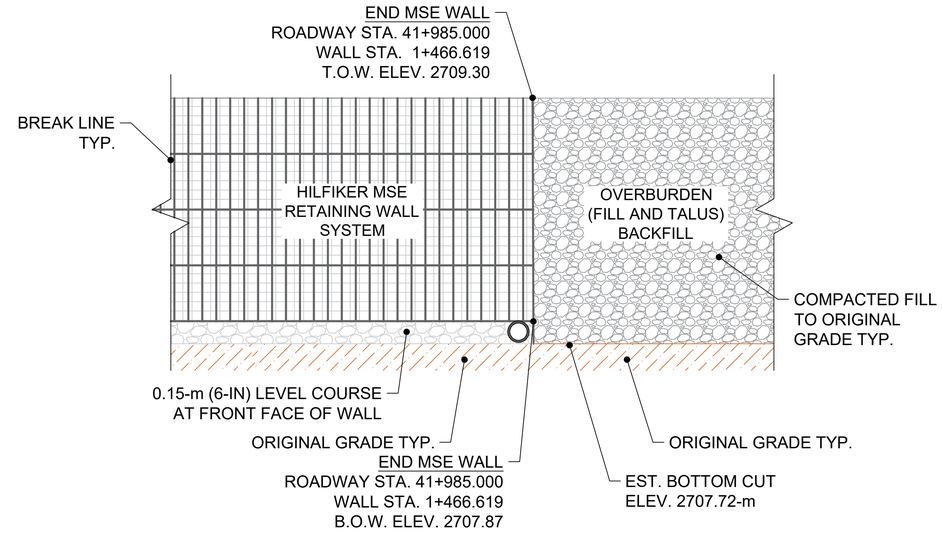

D-1 / 25 END OF MSE RETAINING WALL - ROADWAY STA. 41+985.000
CROSS-SECTIONAL VIEW DETAIL




D-2 / 25 ROADWAY STA. 41+985.100
CONCEPTUAL CROSS-SECTIONAL VIEW DETAIL




D-3 / 25 END OF MSE RETAINING WALL - ROADWAY STA. 41+985.000
ELEVATION VIEW DETAIL




D-4 / 25 END OF MSE RETAINING WALL - ROADWAY STA. 41+985.000
ELEVATION VIEW DETAIL

DEFINITIONS:

1. T.O.W. = TOP OF WALL
2. B.O.W. = BOTTOM OF WALL
3. H.D.G. = HEAVY DUTY GALVANIZED
4. C.L. = ROADWAY CENTER LINE
5. S.T.A. = STATIONING
6. T.Y.P. = TYPICAL
7. FT = FEET (US CUSTOMARY UNIT)
8. m = METER (METRIC UNIT)

NOTES:

1. CUT SLOPE LENGTH AND INCLINATION BEYOND THE END OF MSE RETAINING WALL LIMITS OF ROADWAY STA. 41+985.000 ARE NOT PART OF THIS MSE WALL DESIGN SCOPE OF WORK.
2. CUT SLOPE BEYOND THE END OF THE MSE RETAINING WALL LIMITS SHALL BE BACKFILLED AND COMPACTED TO THE ORIGINAL GRADE OF THE SLOPE PRIOR TO EXCAVATION.
3. COMPACTION INFORMATION IS PROVIDED ON SHEET 15 CONSTRUCTION SPECIFICATIONS AND IN THE FHWA FP-03 AND FHWA WY TIG US212(9) SPECIAL PROVISIONS.

FHWA PROJECT NO. WY TIG US212(9)

# END OF MSE RETAINING WALL TRANSITION DETAILS

REVISIONS

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants

Stockton Office
7400 Shoreline Dr., Suite 6
Stockton, CA 95219
(209) 472-1822

Los Angeles Office
6080 Center Dr., Suite 600
Los Angeles, CA 90045
(323) 331-9222

Honolulu Office
1441 Kapiolani Blvd, Suite 1115
Honolulu, HI 96814
(808) 468-9993

PROFESSIONAL ENGINEER
WILLIAM F. KANE
14885
WYOMING

SHEET 25 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 03-25
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.

## WY TIG US212(9)
## SCHEDULE 1 - MSE WALL DIMENSIONS

| Wall Stationing (m) | Roadway Stationing (m) | Top of Wall (TOW) Elevation (m) | Bottom of Wall (BOW) Elevation (m) | Wall Height (H) (m) |
|---|---|---|---|---|
| 1+006.482 | 41+526.281 | 2695.25 | 2688.35 | 6.90 |
| 1+012.244 | 41+530 | 2695.25 | 2688.35 | 6.90 |
| 1+021.165 | 41+540 | 2694.82 | 2690.18 | 4.64 |
| 1+031.748 | 41+550 | 2694.57 | 2690.18 | 4.39 |
| 1+042.330 | 41+560 | 2694.38 | 2690.18 | 4.20 |
| 1+052.913 | 41+570 | 2694.24 | 2690.18 | 4.06 |
| 1+063.496 | 41+580 | 2694.17 | 2689.57 | 4.60 |
| 1+074.078 | 41+590 | 2694.15 | 2688.35 | 5.80 |
| 1+083.603 | 41+599 | 2694.19 | 2687.13 | 7.06 |
| 1+085.719 | 41+601 | 2694.20 | 2687.13 | 7.07 |
| 1+095.243 | 41+610 | 2694.30 | 2685.91 | 8.39 |
| 1+105.826 | 41+620 | 2694.43 | 2685.30 | 9.13 |
| 1+116.355 | 41+630 | 2694.53 | 2685.91 | 8.62 |
| 1+126.355 | 41+640 | 2694.68 | 2685.91 | 8.77 |
| 1+136.355 | 41+650 | 2694.90 | 2686.52 | 8.38 |
| 1+146.355 | 41+660 | 2695.17 | 2687.74 | 7.43 |
| 1+156.355 | 41+670 | 2695.59 | 2688.35 | 7.24 |
| 1+166.355 | 41+680 | 2695.04 | 2688.96 | 6.08 |
| 1+176.355 | 41+690 | 2696.49 | 2688.96 | 7.53 |
| 1+186.355 | 41+700 | 2696.94 | 2690.18 | 6.76 |
| 1+196.355 | 41+710 | 2697.40 | 2690.79 | 6.61 |
| 1+206.355 | 41+720 | 2697.85 | 2691.40 | 6.45 |
| 1+216.355 | 41+730 | 2698.30 | 2691.40 | 6.90 |
| 1+226.353 | 41+740 | 2698.75 | 2691.40 | 7.35 |
| 1+236.536 | 41+750 | 2699.17 | 2691.40 | 7.77 |
| 1+246.713 | 41+760 | 2699.58 | 2690.79 | 8.79 |
| 1+256.713 | 41+770 | 2700.03 | 2692.01 | 8.02 |
| 1+266.713 | 41+780 | 2700.49 | 2693.84 | 6.64 |
| 1+277.365 | 41+790.652 | 2700.91 | 2694.45 | 6.46 |
| 1+286.286 | 41+800 | 2701.26 | 2695.06 | 6.20 |
| 1+295.830 | 41+810 | 2701.71 | 2695.06 | 6.65 |
| 1+305.373 | 41+820 | 2702.16 | 2695.06 | 7.10 |
| 1+314.917 | 41+830 | 2702.61 | 2694.45 | 8.16 |
| 1+324.460 | 41+840 | 2703.06 | 2694.45 | 8.61 |
| 1+334.004 | 41+850 | 2703.52 | 2695.06 | 8.45 |
| 1+343.547 | 41+860 | 2703.97 | 2695.06 | 8.91 |
| 1+353.268 | 41+870 | 2704.45 | 2696.89 | 7.56 |
| 1+363.165 | 41+880 | 2704.87 | 2698.72 | 6.15 |
| 1+372.870 | 41+890 | 2705.29 | 2699.94 | 5.35 |
| 1+382.579 | 41+900 | 2705.70 | 2700.55 | 5.15 |
| 1+392.287 | 41+910 | 2706.10 | 2701.16 | 4.94 |
| 1+401.996 | 41+920 | 2706.49 | 2701.77 | 4.72 |
| 1+411.705 | 41+930 | 2706.93 | 2702.38 | 4.55 |
| 1+414.570 | 41+932.951 | 2707.07 | 2702.38 | 4.69 |
| 1+421.619 | 41+940 | 2707.41 | 2702.99 | 4.42 |
| 1+431.619 | 41+950 | 2707.76 | 2702.99 | 4.77 |
| 1+441.619 | 41+960 | 2708.10 | 2702.99 | 5.11 |
| 1+450.619 | 41+969 | 2708.39 | 2705.43 | 2.96 |
| 1+452.619 | 41+971 | 2708.45 | 2706.04 | 2.41 |
| 1+461.619 | 41+980 | 2708.79 | 2707.26 | 1.53 |
| 1+466.619 | 41+985 | 2709.30 | 2707.87 | 1.43 |

SCHEDULE 1 NOTES:

1. WALL AND ROADWAY STATIONING IN SCHEDULE 1 PROVIDED BY THE FHWA WY TIG US212(9) BID PLANS SHEET H9.
2. TOP OF WALL (T.O.W.) ELEVATIONS IN SCHEDULE 1 PROVIDED BY THE FHWA WY TIG US212(9) BID PLANS SHEET H9.
3. BOTTOM OF WALL (B.O.W.) ELEVATIONS IN SCHEDULE 1 HAVE BEEN MODIFIED TO INCORPORATE THE HILFIKER RETAINING WALL SYSTEM. BOTTOM OF WALL ELEVATIONS SHOWN ARE APPROXIMATE.
4. DIMENSIONS SHOWN SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO WALL CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY FHWA CFLHD AND DESIGN ENGINEER IF ANY DISCREPANCIES ARISE.

## WY TIG US212(9)
## SCHEDULE 2 - MSE WALL OFFSET

| Wall Stationing (m) | Roadway Stationing (m) | Roadway Offset (m) |
|---|---|---|
| 1+006.482 | 41+526.281 | 6.7 |
| 1+012.244 | 41+530 | 6.7 |
| 1+021.165 | 41+540 | 6.7 |
| 1+031.748 | 41+550 | 6.7 |
| 1+042.330 | 41+560 | 6.7 |
| 1+052.913 | 41+570 | 6.7 |
| 1+063.496 | 41+580 | 6.7 |
| 1+074.078 | 41+590 | 6.7 |
| 1+083.603 | 41+599 | 6.7 |
| 1+085.719 | 41+601 | 6.7 |
| 1+095.243 | 41+610 | 6.7 |
| 1+105.826 | 41+620 | 6.7 |
| 1+116.355 | 41+630 | 6.7 |
| 1+126.355 | 41+640 | 6.7 |
| 1+136.355 | 41+650 | 6.7 |
| 1+146.355 | 41+660 | 6.7 |
| 1+156.355 | 41+670 | 6.7 |
| 1+166.355 | 41+680 | 6.7 |
| 1+176.355 | 41+690 | 6.7 |
| 1+186.355 | 41+700 | 6.7 |
| 1+196.355 | 41+710 | 6.7 |
| 1+206.355 | 41+720 | 6.7 |
| 1+216.355 | 41+730 | 6.7 |
| 1+226.353 | 41+740 | 6.7 |
| 1+236.536 | 41+750 | 8.621 |
| 1+246.713 | 41+760 | 10.5 |
| 1+256.713 | 41+770 | 10.5 |
| 1+266.713 | 41+780 | 10.5 |
| 1+277.365 | 41+790.652 | 10.5 |
| 1+286.286 | 41+800 | 10.5 |
| 1+295.830 | 41+810 | 10.5 |
| 1+305.373 | 41+820 | 10.5 |
| 1+314.917 | 41+830 | 10.5 |
| 1+324.460 | 41+840 | 10.5 |
| 1+334.004 | 41+850 | 10.5 |
| 1+343.547 | 41+860 | 10.5 |
| 1+353.268 | 41+870 | 8.849 |
| 1+363.165 | 41+880 | 6.7 |
| 1+372.870 | 41+890 | 6.7 |
| 1+382.579 | 41+900 | 6.7 |
| 1+392.287 | 41+910 | 6.7 |
| 1+401.996 | 41+920 | 6.7 |
| 1+411.705 | 41+930 | 6.7 |
| 1+414.570 | 41+932.951 | 6.7 |
| 1+421.619 | 41+940 | 6.7 |
| 1+431.619 | 41+950 | 6.7 |
| 1+441.619 | 41+960 | 6.7 |
| 1+450.619 | 41+969 | 6.7 |
| 1+452.619 | 41+971 | 6.7 |
| 1+461.619 | 41+980 | 6.7 |
| 1+466.619 | 41+985 | 6.7 |

SCHEDULE 2 NOTES:

1. WALL AND ROADWAY STATIONING IN SCHEDULE 2 PROVIDED BY THE FHWA WY TIG US212(9) BID PLANS SHEET H9.
2. ROADWAY OFFSET DISTANCES IN SCHEDULE 2 PROVIDED BY THE FHWA WY TIG US212(9) BID PLANS SHEET H9.
3. ROADWAY OFFSETS SHOWN SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO WALL CONSTRUCTION.

### SCHEDULE 4 - 12X24 W 7 X W 3.5 ESTIMATED STEEL REINFORCEMENT QUANTITIES

| METALLIC REINFORCEMENT DEPTH INTO STRUCTURAL BACKFILL | MAT TYPE | 8-FT WIDE STEEL REINFORCEMENT SECTIONS |
|---|---|---|
| 20-FT | STANDARD | 416 |
| | INTERMEDIATE | 416 |
| 18-FT | STANDARD | 347 |
| | INTERMEDIATE | 347 |
| 16-FT | STANDARD | 184 |
| | INTERMEDIATE | 184 |
| 14-FT | STANDARD | 112 |
| | INTERMEDIATE | 112 |
| 12-FT | STANDARD | 104 |
| | INTERMEDIATE | 104 |
| 10-FT | STANDARD | 60 |
| | INTERMEDIATE | 60 |

SCHEDULE 4 NOTES:

1. STANDARD 8-FT WIDE MAT
2. INTERMEDIATE 8-FT WIDE MAT

### SCHEDULE 5 - 12X24 W 4.5 X W 3.5 ESTIMATED STEEL REINFORCEMENT QUANTITIES

| METALLIC REINFORCEMENT DEPTH INTO STRUCTURAL BACKFILL | MAT TYPE | 8-FT WIDE STEEL REINFORCEMENT SECTIONS |
|---|---|---|
| 20-FT | STANDARD | 205 |
| | INTERMEDIATE | 205 |
| 18-FT | STANDARD | 210 |
| | INTERMEDIATE | 210 |
| 16-FT | STANDARD | 125 |
| | INTERMEDIATE | 125 |
| 14-FT | STANDARD | 95 |
| | INTERMEDIATE | 95 |
| 12-FT | STANDARD | 134 |
| | INTERMEDIATE | 134 |
| 10-FT | STANDARD | 39 |
| | INTERMEDIATE | 39 |
| 8-FT | STANDARD | 15 |
| | INTERMEDIATE | 15 |

SCHEDULE 5 NOTES:

1. STANDARD 8-FT WIDE MAT
2. INTERMEDIATE 8-FT WIDE MAT

### SCHEDULE 6 - 12X12 W 4.5 X W 3.5 ESTIMATED STEEL REINFORCEMENT QUANTITIES

| METALLIC REINFORCEMENT DEPTH INTO STRUCTURAL BACKFILL | MAT TYPE | 8-FT WIDE STEEL REINFORCEMENT SECTIONS |
|---|---|---|
| 20-FT | PRONGLESS | 20 |
| | TOP CAP | 43 |
| 18-FT | PRONGLESS | 19 |
| | TOP CAP | 45 |
| 16-FT | PRONGLESS | 13 |
| | TOP CAP | 28 |
| 14-FT | PRONGLESS | 11 |
| | TOP CAP | 22 |
| 12-FT | PRONGLESS | 31 |
| | TOP CAP | 44 |
| 10-FT | PRONGLESS | 0 |
| | TOP CAP | 2 |
| 8-FT | PRONGLESS | 4 |
| | TOP CAP | 5 |

SCHEDULE 6 NOTES:

1. PRONGLESS 8-FT WIDE MAT
2. TOP CAP 8-FT WIDE MAT

### SCHEDULE 7 - MSE WALL RETURN ESTIMATED STEEL REINFORCEMENT QUANTITIES

| METALLIC REINFORCEMENT MAT | | METALLIC REINFORCEMENT DEPTH INTO STRUCTURAL BACKFILL | MAT TYPE | 8-FT WIDE STEEL REINFORCEMENT SECTIONS (FIELD TRIM IF REQUIRED) |
|---|---|---|---|---|
| SIZE | TYPE | | | |
| 12X24 | W 7 X W 3.5 HDG | 16-FT | STANDARD | 5 |
| | | | INTERMEDIATE | 5 |
| 12X24 | W 4.5 X W 3.5 HDG | 16-FT | STANDARD | 6 |
| | | | INTERMEDIATE | 6 |
| 12X12 | W 4.5 X W 3.5 HDG | 16-FT | PRONGLESS | 1 |
| | | | TOP CAP | 1 |

SCHEDULE 7 NOTES:

1. MSE WALL TRANSITION RETURN AT BEGINNING OF MSE WALL STA. 1+006.48 (ROADWAY STA. 41+526.28) LENGTH OF 1.52-m (5-FT) NEAR THE FHWA WY TIG US212(9) PLAN SHEET H17 BRIDGE APPROACH ABUTMENT.
2. MSE WALL TRANSITION RETURN INCLINATION VERTICAL FACING.
3. STANDARD 5-FT WIDE MAT (MODIFIED WIDTH FOR REQUIRED RETURN WIDTH)
3. INTERMEDIATE 5-FT WIDE MAT (MODIFIED WIDTH FOR REQUIRED RETURN WIDTH)
4. PRONGLESS 5-FT WIDE MAT (MODIFIED WIDTH FOR REQUIRED RETURN WIDTH)
5. TOP CAP 5-FT WIDE MAT (MODIFIED WIDTH FOR REQUIRED RETURN WIDTH)

### SCHEDULE 3 - REQUIRED MINIMUM METALLIC REINFORCEMENT STRENGTH

| METALLIC REINFORCEMENT MAT TYPE | REINFORCEMENT MAT SIZE | LONG TERM DESIGN STRENGTH (LTDS) | | | |
|---|---|---|---|---|---|
| | | STATIC CONDITION | | SEISMIC CONDITION | |
| | | LB/FT | kN/m | LB/FT | kN/m |
| HILFIKER STANDARD / INTERMEDIATE STEEL WIRE MAT 12X24 | W 7 X W 3.5 HDG | 1,713 | 25 | 2,240 | 32.7 |
| HILFIKER STANDARD / INTERMEDIATE STEEL WIRE MAT 12X24 | W 4.5 X W 3.5 HDG | 971 | 14.2 | 1,270 | 18.5 |
| HILFIKER PRONGLESS / CAP STEEL WIRE MAT 12X12 | W 4.5 X W 3.5 HDG | 833 | 12.1 | 1,089 | 15.9 |

### SCHEDULE 10 - ESTIMATED WALL BACKFILL VOLUMES

| HILFIKER RETAINING WALL FILL / BACKFILL TYPES | EST. BACKFILL VOLUMES |
|---|---|
| WALL FACING FILL | **952.5-m$^3$ (33,637-C.F.) (1,246-C.Y.)** |
| GRANULAR REINFORCED BACKFILL | **14,288-m$^3$ (504,555-C.F.) (18,687-C.Y.)** |
| GRANULAR RETAINED BACKFILL | **1,600-m$^3$ (56,504-C.F.) (2,093-C.Y.)** |
| GRANULAR DRAINAGE FILL | **104-m$^3$ (3,650-C.F.) (136-C.Y.)** |

SCHEDULE 10 NOTES:

1. BACKFILL / FILL VOLUMES ARE ESTIMATED.
2. GRANULAR RETAINED BACKFILL VARIES ON FINAL TEMPORARY CUT SLOPE CONDITIONS.
3. GRANULAR DRAINAGE FILL BASED ON A 6-IN (152.4-mm) THICK BASE.

### SCHEDULE 8 - ESTIMATED WALL AREAS

| HILFIKER RETAINING WALL STEEL WIRE MAT 12X24 WITH 12X12 CAP | MSE WALL FACING AREA |
|---|---|
| MSE WALL RETURN AREA (AT ROADWAY STA. 41+526.28) | 11-SQ.M (118-S.F.) |
| MSE WALL FACING AREA (BEGIN ROADWAY STA. 41+526.28 END ROADWAY STA. 41+985.00) | 3,114-SQ.M (33,519-S.F.) |
| **EST. TOTAL MSE WALL AREA:** | **3,125-SQ.M (33,637-S.F.)** |
| **ESTIMATED SUPPLIER QUANTITY** | **34,480-S.F.** |

### SCHEDULE 9 - ESTIMATED BACKING MAT / HARDWARE CLOTH AREA

| HILFIKER RETAINING WALL (STEEL WIRE BACKING MAT 4X3 W 5.0 X W 2.5) (1/2X1/2 HARDWARE CLOTH) | MSE WALL BACKING MAT / HARDWARE CLOTH AREA |
|---|---|
| RETURN AREA (AT ROADWAY STA. 41+526.28) | 11-SQ.M (118-S.F.) |
| MSE WALL FACING AREA (BEGIN ROADWAY STA. 41+526.28 END ROADWAY STA. 41+985.00) | 3,114-SQ.M (33,519-S.F.) |
| **EST. BACKING MAT AREA:** | **3,125-SQ.M (33,637-S.F.)** |
| **EST. HARDWARE CLOTH AREA:** | **3,125-SQ.M (33,637-S.F.)** |
| **EST. BACKING MAT SUPPLIER QUANTITY** | **34,480-S.F.** |
| **EST. HARDWARE CLOTH SUPPLIER QUANTITY** | **34,480-S.F.** |

### SCHEDULE 11 - EST. DRAIN PIPE / SHEET DRAIN QUANTITIES

| DRAIN PIPE TYPE | PIPE LOCATION | EST. QUANTITY |
|---|---|---|
| 6-IN (152.3-mm) Ø NON-PERFORATED | UNDERNEATH BOTTOM OF WALL (BOW) ELEVATION TO FLOW OUTLET | 450-m (1,476-L.F.) |
| 6-IN (152.3-mm) Ø PERFORATED | BACK END OF CUT SLOPE NEAR BOTTOM OF WALL (BOW) ELEVATION | 500-m (1,640-L.F.) |
| GEOCOMPOSITE SHEET DRAIN | PLACED ON THE CUT SLOPE SURFACE (2/3 OF THE CUT SLOPE HEIGHT) | 2,076-SQ.M (22,346-S.F.) |

SCHEDULE 11 NOTES:

1. ESTIMATED QUANTITIES FOR DRAINAGE PIPE AND SHEET DRAIN.
2. NON-PERFORATED PIPE ESTIMATION BASED ON THE AVERAGE PIPE LENGTHS BETWEEN THE LIMITS OF 30-FT (9-m) MAXIMUM, 20-FT (6-m) MINIMUM.

**SCHEDULES 1-11 GENERAL NOTE:**
**DIMENSIONS, ELEVATIONS, LIMITS, AREAS, AND VOLUMES PROVIDED ON THIS SHEET ARE BASED ON THE BEST AVAILABLE INFORMATION PROVIDED TO KANE GEOTECH FOR THE PROJECT. ALL QUANTITIES PROVIDED ARE ESTIMATED.**

FHWA PROJECT NO. WY TIG US212(9)

# HILFIKER MSE RETAINING WALL - DESIGN SCHEDULES

REVISIONS

2021 03-25: Revised Sheet Numbering.
2021 05-07: Revised Schedules for updated material estimates.
2021 05-21: Revised Schedule 9 to include Hardware Cloth.

Beartooth Highway WY TIG US212(9)
Hilfiker MSE Retaining Wall
Shoshone National Forest, Wyoming

PREPARED AT THE REQUEST OF
Missouri River Contractors
3384 US-12
Helena, Montana 59601

KANE GeoTech, Inc.
Geoengineering Consultants
Stockton Office: 7400 Spanos Park Drive, Suite 6, Stockton, CA 95219, (209) 472-1822
Los Angeles Office: 6080 Center Drive, Suite 600, Los Angeles, CA 90045, (323) 331-9222
Honolulu Office: 1441 Kapiolani Blvd., Suite 1115, Honolulu, HI 96814, (808) 468-9993

PROFESSIONAL ENGINEER WILLIAM F. KANE 14656 WYOMING

SHEET 26 OF 26

DRAWN BY: JAM
DESIGNED BY: WFK
CHECKED BY: WFK
SCALE: N.T.S.
DATE: 2021 02-19
KANE PROJECT NO: KGT20-19

© 2021 KANE GeoTech, Inc.