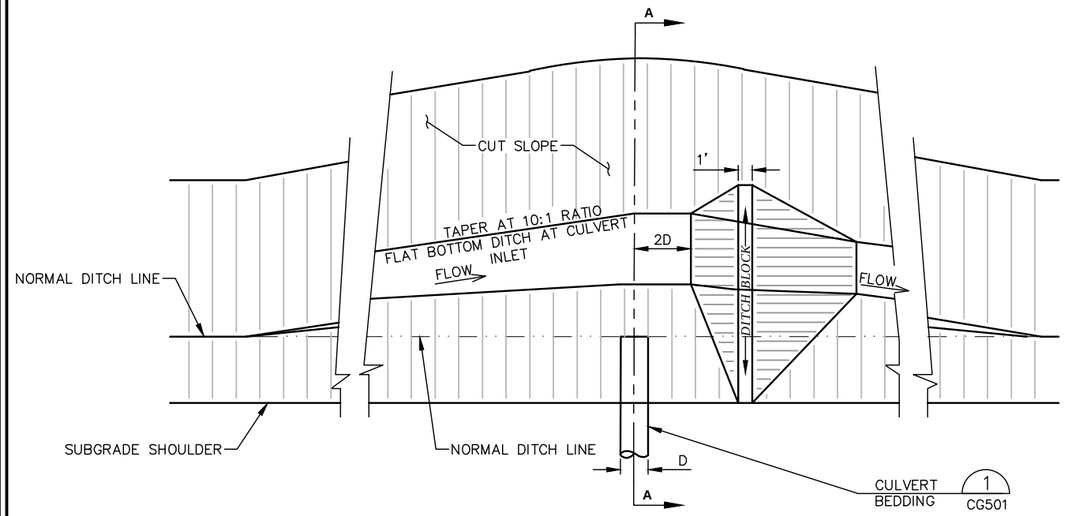
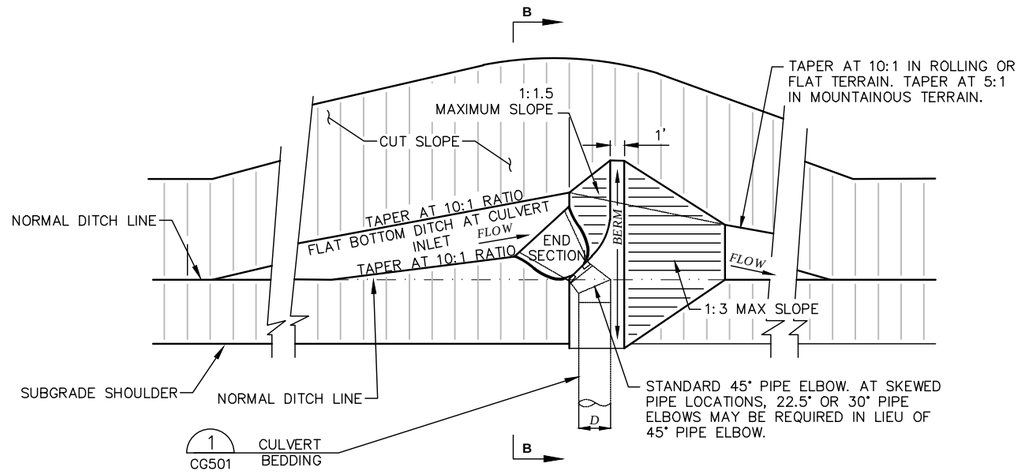


PLAN



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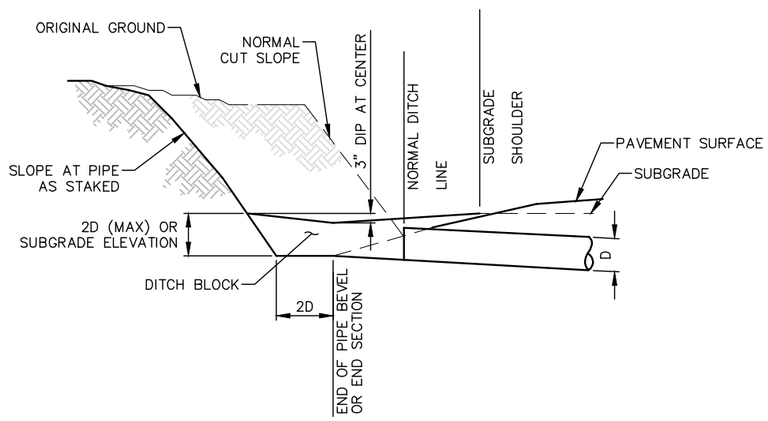
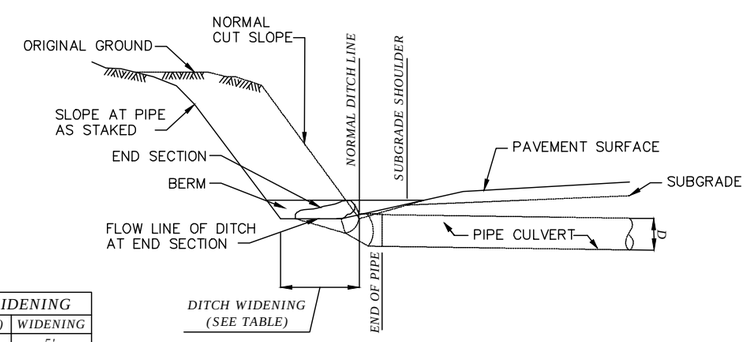


SECTION A–A

TYPE I



DITCH WIDENING	
PIPE SIZE (D)	WIDENING
18"	5'
24"	6'
30"	7'
36"	8'

SECTION B–B

TYPE II

NOTES:

1. D = DIAMETER OF ALL ROUND PIPE OR THE RISE DIMENSION OF ALL PIPE ARCH CULVERTS.
2. CONSTRUCT CULVERT INLET TREATMENT AT NEW OR EXTENDED CULVERTS WITH CUT SLOPES AT THE INLET.
3. REVIEW WITH ENGINEER PRIOR TO CONSTRUCTION.

CULVERT INLET TREATMENT IN CUT SLOPES (1)

SCALE: NONE

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RPA

SYM	REVISION	BY	APPR.	DATE

R. MORTON, PE — DESIGNED BY
G. LESOFSKI — DRAWN BY
J. KEY, PE — CHECKED BY
JUNE 2018 — DATE
17353 — PROJECT NO.
CG502 — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
CULVERT INLET DETAILS

SHEET
CG502

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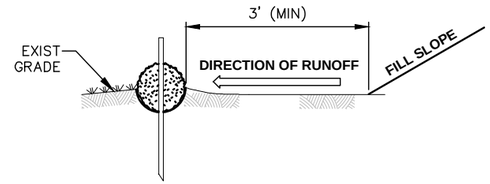
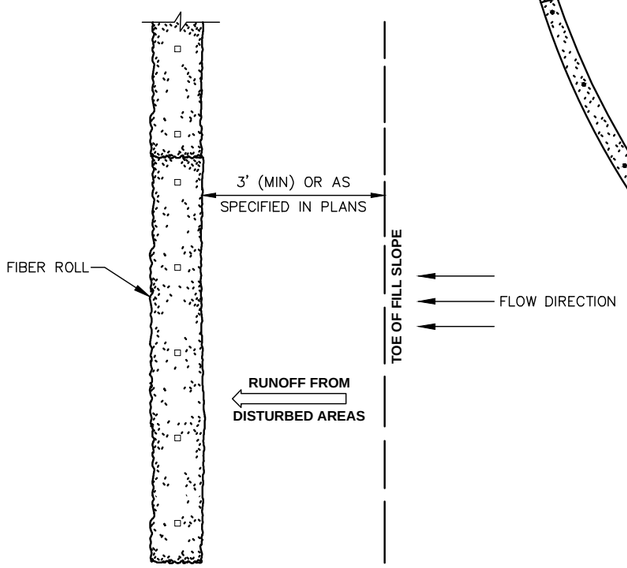
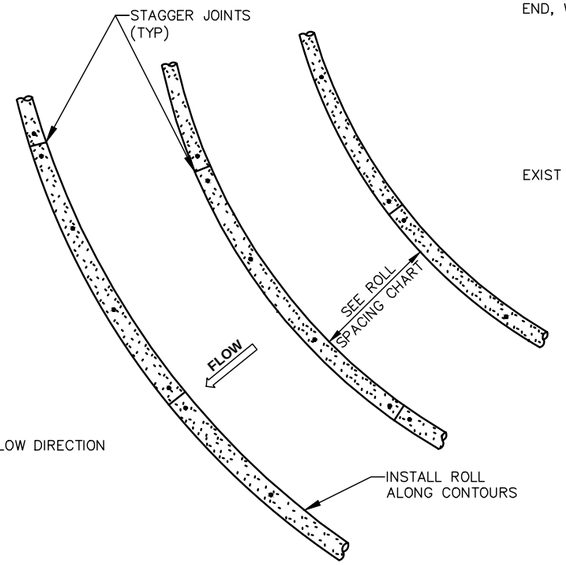


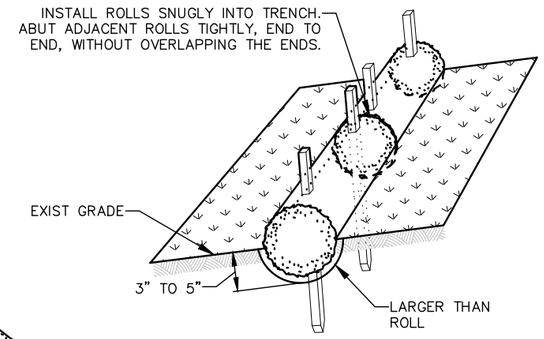
ELEVATION



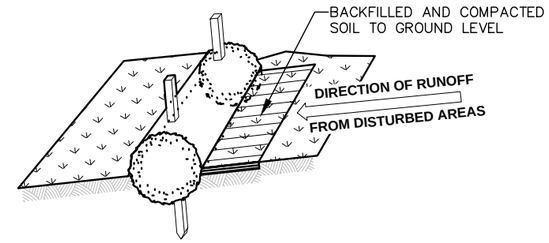
PLAN

INSTALLATION BEYOND TOE OF SLOPE





STEP 1: EXCAVATE TRENCH AND INSTALL ROLLS



STEP 2: BACKFILL SOIL AGAINST ROLLS

INSTALLATION ALONG SLOPES

PROPERLY STAKED AND ENTRENCHED ROLL

NOTES:

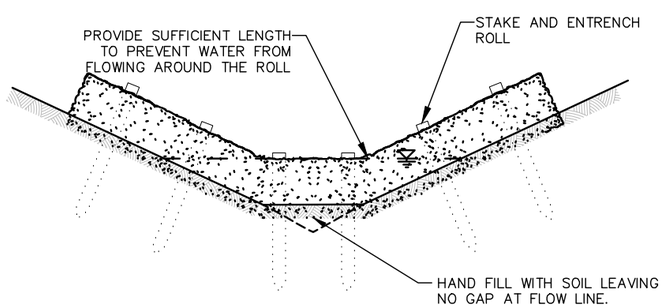
1. UNTIL ROLL IS SECURE TO SLOPE, DO NOT CRUSH ROLL WHILE STAKING. LIVE STAKES MAY BE USED FOR PERMANENT INSTALLATIONS.
2. USE DRAINAGE DITCH INSTALLATION ONLY IN LOW FLOW CONDITIONS.
3. PLACE STAKES AT 6 INCHES FROM FIBER ROLL ENDS AND SPACE STAKES AT 4–FOOT MAX.
4. 50–FT SPACING IN DRAINAGE DITCH. MIN 1 ROLL PER CULVERT DITCH.
5. ROLL INSTALLATION APPLIES TO ALL PROJECT DRAINAGE WORK.

STAKES REQUIRED

Roll length (ft)	Stakes required for each roll
25	8
20	6
12	4

ROLL SPACING

Slope	Spacing (ft)
4:1 or flatter	40
3:1	30
2:1	20
1:1	10



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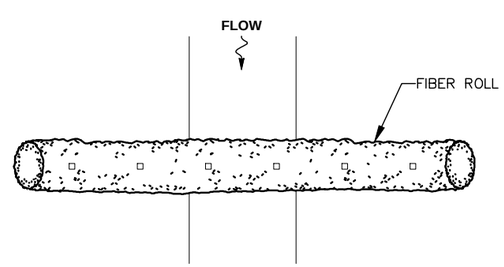
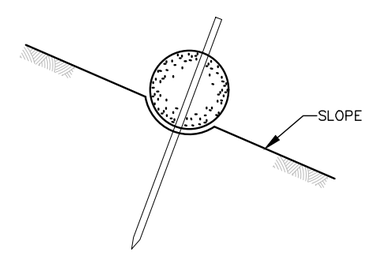


PLAN

DRAINAGE DITCH INSTALLATION



ROLL STAKING DETAIL

FIBER ROLL (1)
SCALE: NONE

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R. MORTON, PE — DESIGNED BY
G. LESOFSKI — DRAWN BY
J. KEY, PE — CHECKED BY
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17353 — PROJECT NO.
CG503 — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
EROSION AND SEDIMENT CONTROL DETAILS

SHEET
CG503

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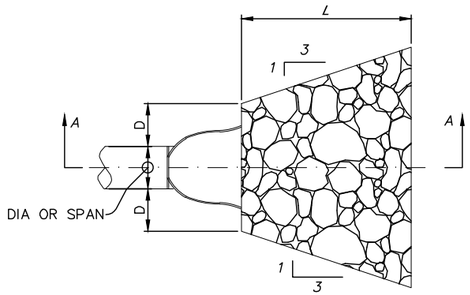
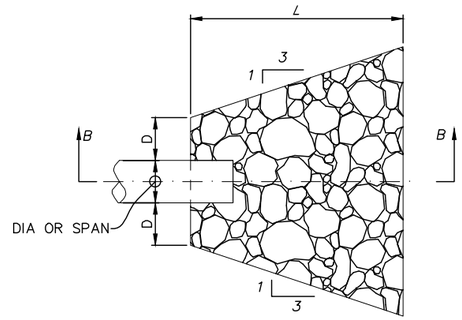
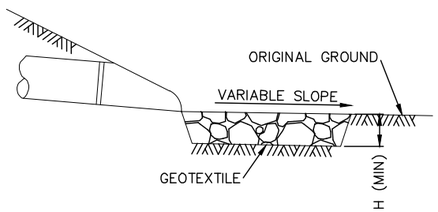


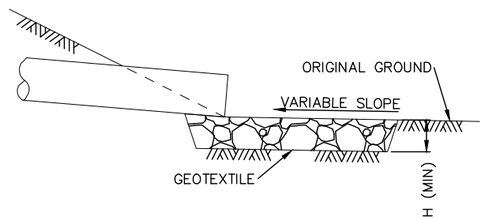
PLAN
CULVERT WITH STANDARD
END SECTION



PLAN
CULVERT WITHOUT STANDARD
END SECTION



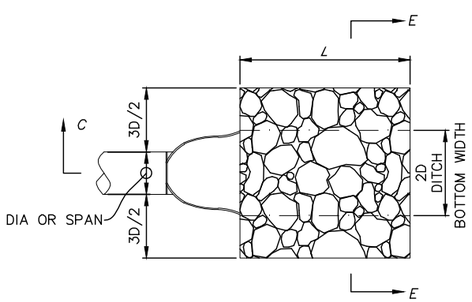
SECTION A–A



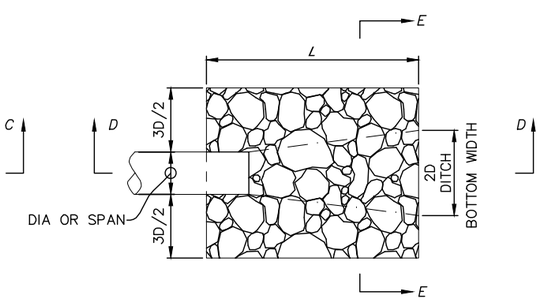
SECTION B–B

PROTECTIVE APRON AT CULVERT OUTLET WITHOUT DITCH

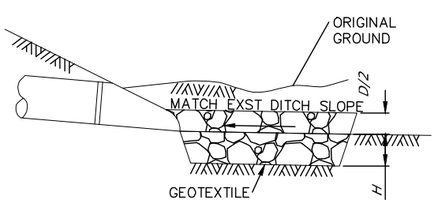
OUTLET WITHOUT DITCH PROTECTIVE APRON DIMENSIONS AND QUANTITIES FOR INFORMATION ONLY						
	CULVERT SIZE D (IN)	RIPAP CLASS	APRON LENGTH L (FT)	APRON DEPTH H (IN)	ESTIMATED RIPRAP QUANTITY (CY)	ESTIMATED GEOTEXTILE QUANTITY (SY)
WITH END SECTION	12	2	4	18	1.0	5
	18	2	6	18	2.2	9
	24	2	8	18	3.9	13
	30	3	12.5	24	10.8	27
	36	3	15	24	15.6	37
	42	4	21	30	34.0	63
	48	4	24	30	44.4	78
WITHOUT END SECTION	12	2	6	18	1.7	7
	18	2	8	18	3.2	12
	24	2	10	18	5.2	17
	30	3	14.5	24	13.2	32
	36	3	17	24	18.5	42
	42	4	23	30	38.7	70
	48	4	26	30	49.8	86



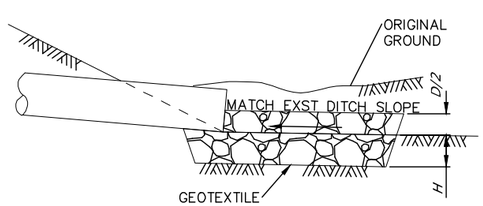
PLAN
CULVERT WITH STANDARD
END SECTION



PLAN
CULVERT WITHOUT STANDARD
END SECTION



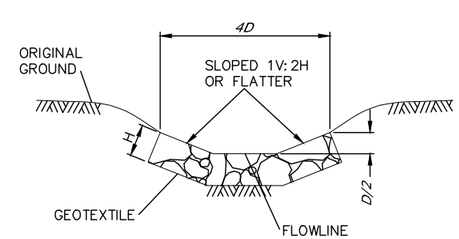
SECTION C–C



SECTION D–D

PROTECTIVE APRON AT CULVERT OUTLET WITH DITCH

OUTLET WITH DITCH PROTECTIVE APRON DIMENSIONS AND QUANTITIES FOR INFORMATION ONLY						
	CULVERT SIZE D (IN)	RIPAP CLASS	APRON LENGTH L (FT)	APRON DEPTH H (IN)	ESTIMATED RIPRAP QUANTITY (CY)	ESTIMATED GEOTEXTILE QUANTITY (SY)
WITH END SECTION	12	2	4	18	0.9	4
	18	2	6	18	2.0	8
	24	2	8	18	3.6	12
	30	3	12.5	24	9.3	24
	36	3	15	24	13.3	32
	42	4	21	30	27.2	52
	48	4	24	30	35.6	65
WITHOUT END SECTION	12	2	6	18	1.3	6
	18	2	8	18	2.7	10
	24	2	10	18	4.4	15
	30	3	14.5	24	10.7	27
	36	3	17	24	15.1	36
	42	4	23	30	29.8	56
	48	4	26	30	38.5	70



SECTION E–E

NOTES:

1. USE FOR APRONS SERVING CULVERTS WITH SLOPES LESS THAN 10%.
2. FURNISH SEPARATION AND STABILIZATION GEOTEXTILE.
3. DO NOT MEASURE RIPRAP PLACEMENT EXCAVATION FOR PAYMENT.

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RPA

SYM	REVISION	BY	APPR.	DATE

R. MORTON, PE — DESIGNED BY
G. LESOFSKI — DRAWN BY
J. KEY, PE — CHECKED BY
JUNE 2018 — DATE
17353 — PROJECT NO.
CG504 — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
PLACED RIPRAP AT CULVERT OUTLETS

SHEET
CG504

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CONCRETE ROUND PIPE CULVERT									
PIPE SIZE	FILL HEIGHT AND PIPE CLASS TABLE								
		EMBANKMENT				TRENCH			
DIAMETER INCHES	MINIMUM COVER INCHES	CLASS II	CLASS III	CLASS IV	CLASS V	CLASS II	CLASS III	CLASS IV	CLASS V
		MAXIMUM FILL HEIGHT ABOVE TOP OF PIPE IN FEET							
12	12	10	10	15	23	18	18	26	13
18	12	10	10	25	39	13	13	31	45
24	12	10	10	15	30	15	15	22	40
30	12	9	13	15	35	13	16	20	46
36	12	9	9	20	41	10	13	26	56

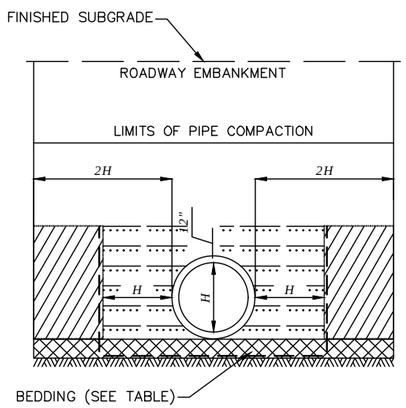
BEDDING DEPTH	
PIPE SIZE (H)	DEPTH
12" TO 54"	4"

LEGEND:

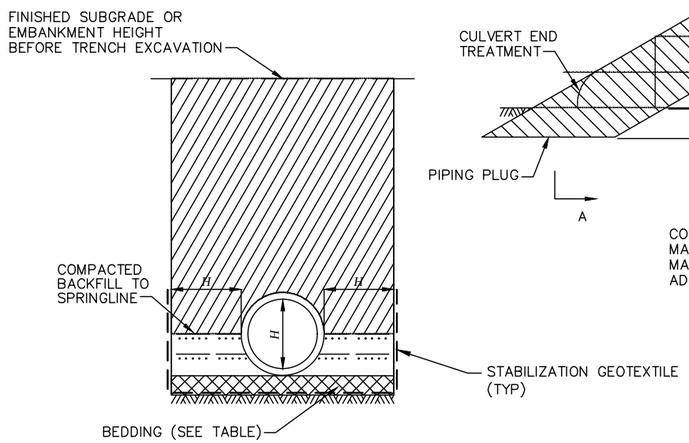
- BEDDING MATERIAL (UNCOMPACTED)
- COMPACTED EMBANKMENT MATERIAL PLACED IN LAYERS NOT EXCEEDING 6" COMPACTED DEPTH
- COMPACTED BACKFILL MATERIAL PLACED IN LAYERS NOT EXCEEDING 6" COMPACTED DEPTH, OR LEAN CONCRETE BACKFILL IN ACCORDANCE WITH SECTION 614 (FHWA FP–14)
- IMPERMEABLE BACKFILL MATERIAL

NOTES:

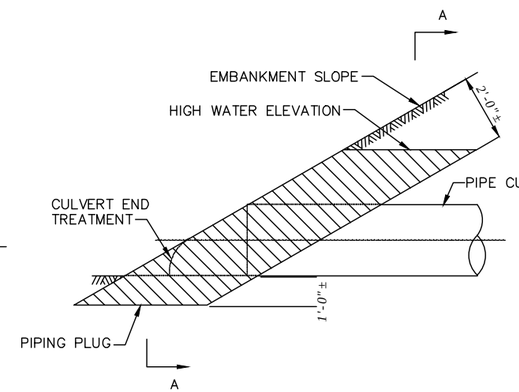
1. WHEN DIRECTED, CAMBER PIPE CULVERTS UPWARDS FROM A CHORD THROUGH THE INLET AND OUTLET INVERTS AN ORDINATE AMOUNT EQUAL TO 1% OF THE PIPE LENGTH. DEVELOP CAMBER ON A PARABOLIC CURVE. IF THE MIDPOINT ELEVATION ON THE PARABOLIC CURVE AS DESIGNED EXCEEDS THE ELEVATION OF THE INLET INVERT, REDUCE THE AMOUNT OF CAMBER OR INCREASE THE PIPE CULVERT GRADIENT.
2. MEASURE MINIMUM COVER FROM THE TOP OF THE PIPE CULVERT TO THE SUBGRADE FOR FLEXIBLE PAVEMENTS, AND TO THE TOP OF THE PAVEMENT FOR RIGID PAVEMENTS. MEASURE MAXIMUM FILL HEIGHT FROM THE TOP OF THE PIPE TO THE TOP OF THE PAVEMENT FOR BOTH FLEXIBLE AND RIGID PAVEMENTS.
3. PIPE COMPACTION LIMITS SHOWN ARE FOR PIPE INSTALLATION IN AN EMBANKMENT. FOR PIPE INSTALLATION IN A TRENCH, THE COMPACTION LIMITS SHALL BE THE WALLS OF THE TRENCH.
4. WHERE UNYIELDING OR UNSTABLE MATERIAL IS ENCOUNTERED, INSTALL THE PIPE CULVERT ACCORDING TO THE LIMITS OF PIPE COMPACTION SHOWN ON STANDARD 602–3. (FHWA FP–14).
5. MAXIMUM FILL HEIGHTS FOR PIPE CULVERT INSTALLATIONS MAY BE INCREASED ON APPROVAL OF SITE–SPECIFIC STRUCTURAL PIPE DESIGNS MEETING THE CRITERIA OF AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES.
6. USE SUPPLEMENTAL CONCRETE PIPE TIE WHEN SPECIFIED IN THE CONTRACT DOCUMENTS.
7. THIS SHEET REFERENCES FEDERAL HIGHWAYS ADMINISTRATION (FHWA) STANDARDS IN PUBLICATION FP–14.



EMBANKMENT INSTALLATION

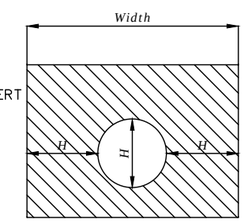


TRENCH INSTALLATION

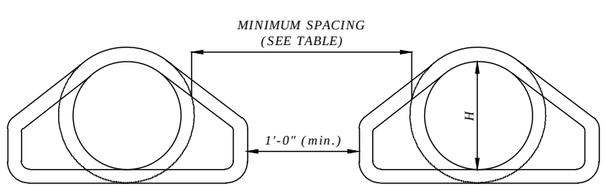


CONSTRUCT A PIPING PLUG OF IMPERMEABLE BACKFILL MATERIAL AT THE PIPE INLET WHERE GRANULAR MATERIAL IS USED FOR BACKFILL. WIDTH MAY BE ADJUSTED TO TIE INTO IMPERVIOUS MATERIAL.

PIPING PLUG

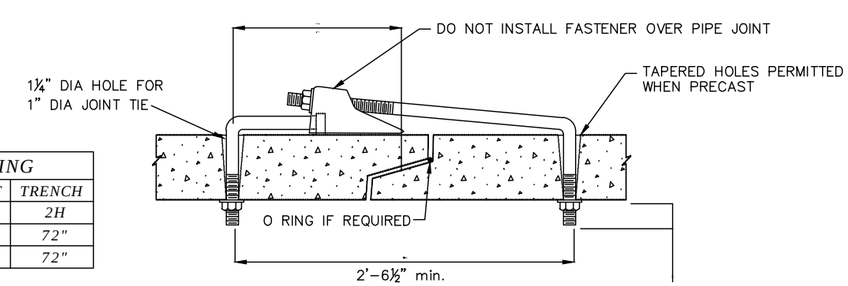


SECTION A-A

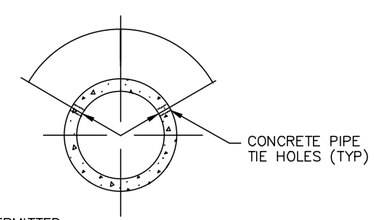


MULTIPLE ROUND PIPE INSTALLATION

MINIMUM SPACING		
DIAMETER	EMBANKMENT	TRENCH
12"-36"	15"	2H
36"-96"	0.5H	72"
OVER 96"	48"	72"



SUPPLEMENTAL CONCRETE PIPE TIE



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SYM	REVISION	BY	APPR.	DATE

R. MORTON, PE — DESIGNED BY
G. LESOFSKI — DRAWN BY
J. KEY, PE — CHECKED BY
JUNE 2018 — DATE
17353 — PROJECT NO.
CG505 — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
CONCRETE PIPE CULVERT INSTALLATION

SHEET
CG505

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POLYETHYLENE (PE) PLASTIC ROUND PIPE CULVERT

FILL HEIGHT TABLE AND MINIMUM CELL CLASSIFICATION NUMBER PER ASTM D 3350

SMOOTH WALL (SOLID WALL)

PIPE SIZE DIAMETER INCHES	MINIMUM COVER INCHES	CELL CLASSIFICATION NUMBER 335434C — MINIMUM WALL THICKNESS (INCHES) 0.607	0.857	0.923	1.154	1.385	1.292	1.477
		MAXIMUM FILL HEIGHT (FEET)						
12	12	57						
18	12		52					
24	12			38				
30	12				38			
36	12					38		
42	12						27	
48	12							27

CORRUGATED

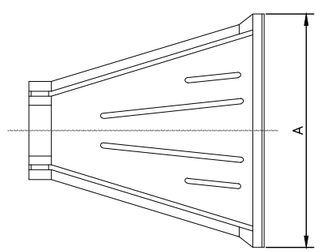
PIPE SIZE DIAMETER INCHES	MINIMUM COVER INCHES	CELL CLASS. NO. 435400C MAXIMUM FILL HEIGHT (FEET)
12	12	10
15	12	10
18	12	10
24	12	10
30	12	10
36	12	10

RIBBED

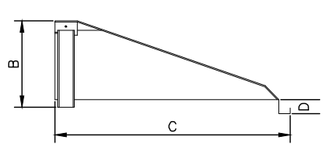
PIPE SIZE DIAMETER INCHES	MINIMUM COVER INCHES	CELL CLASS. NO. 334433C	CELL CLASS. NO. 335434C
		MAXIMUM FILL HEIGHT (FEET)	
18	12	18	24
24	12	22	28
30	12	22	28
36	12	25	31
42	12	21	27
48	12	21	26

NOTES:

1. WHEN DIRECTED, CAMBER PIPE CULVERTS UPWARD FROM A CHORD THROUGH THE INLET AND OUTLET INVERTS AN ORDINATE AMOUNT EQUAL TO 1% OF THE PIPE LENGTH. DEVELOP CAMBER ON A PARABOLIC CURVE. IF THE MIDPOINT ELEVATION ON THE PARABOLIC CURVE AS DESIGNED EXCEEDS THE ELEVATION OF THE INLET INVERT, REDUCE THE AMOUNT OF CAMBER OR INCREASE THE PIPE CULVERT GRADIENT.
2. MEASURE MINIMUM COVER FROM THE TOP OF THE PIPE CULVERT TO THE SUBGRADE FOR FLEXIBLE PAVEMENTS, AND TO THE TOP OF THE PAVEMENT FOR RIGID PAVEMENTS. MEASURE MAXIMUM FILL HEIGHT FROM THE TOP OF THE PIPE TO THE TOP OF THE PAVEMENT FOR BOTH FLEXIBLE AND RIGID PAVEMENT.



TOP



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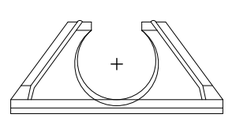

FRONT

PLASTIC PIPE END SECTION

END SECTION DIMENSIONS				
PIPE SIZE DIAMETER INCHES	DIMENSIONS INCHES A	B	C	D
12	42	14.5	33	6
15	46	24.5	45.5	6
18	54	29	55	6
24	64	37	65	6
30	88	36	63.5	6
36	88	43	66.5	6

HDPE PIPE (1)
SCALE=NONE CG102, CG103

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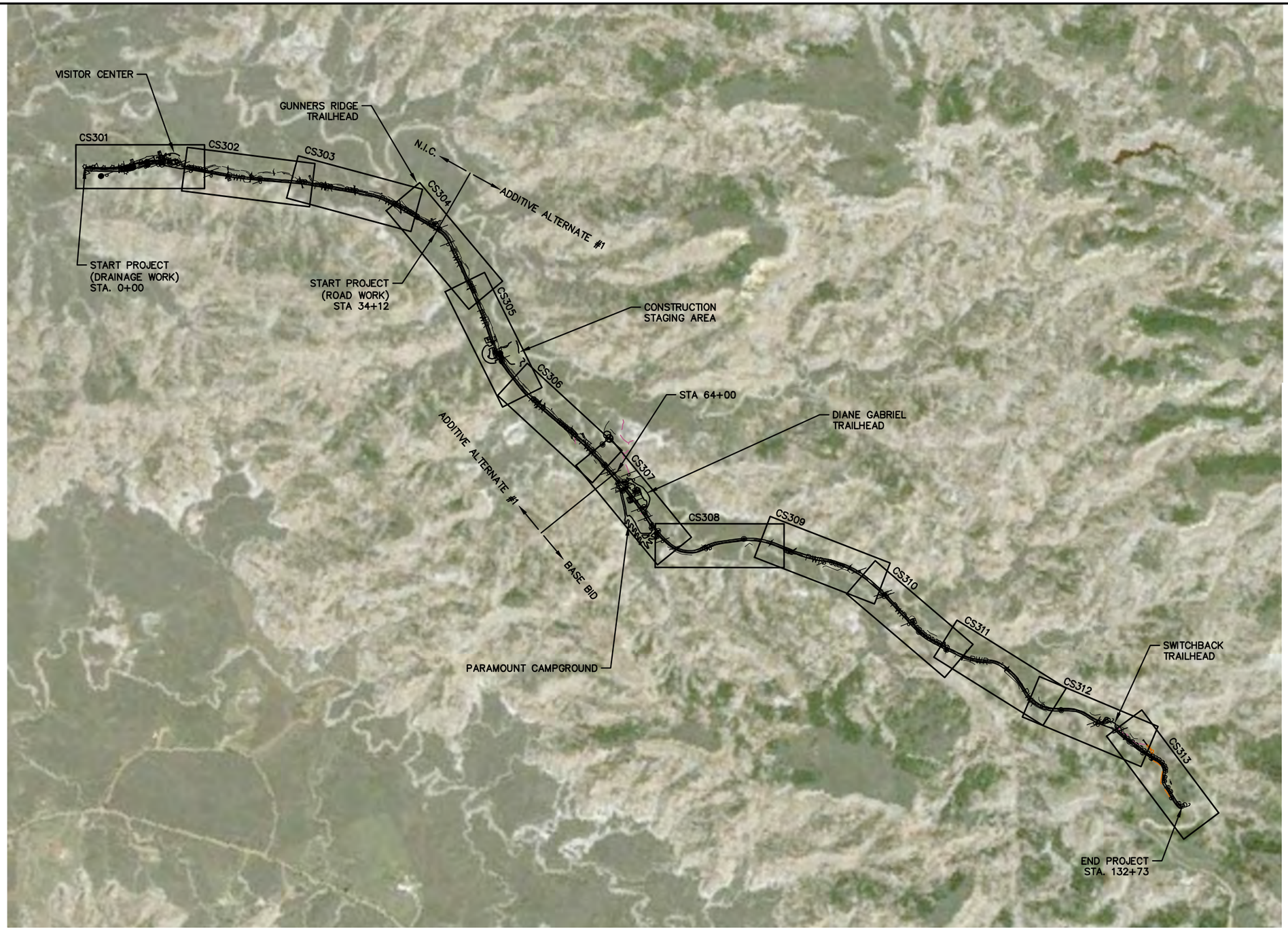
17353 — PROJECT NO.
CG506 — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
PLASTIC PIPE CULVERT

SHEET
CG506

F:\natres\17353 - FWP Makoshika\Makoshika-C3D\Cadd\Sheets\CG506.dwg Jun 04, 2018



NOTES:

1. REFER TO CG SHEETS FOR GRADING, DRAINAGE, AND CULVERT WORK.
2. FINISH EXISTING APPROACHES AND TURNOUTS TO MATCH EXISTING WIDTHS AND RADII AS APPROVED. TYPICAL ALL CS SHEETS.

HORIZONTAL

500 0 500 1000

(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD

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RPA

SYM	REVISION	BY	APPR.	DATE

R. MORTON, PE — DESIGNED BY
G. LESOFSKI — DRAWN BY
J. KEY, PE — CHECKED BY
JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

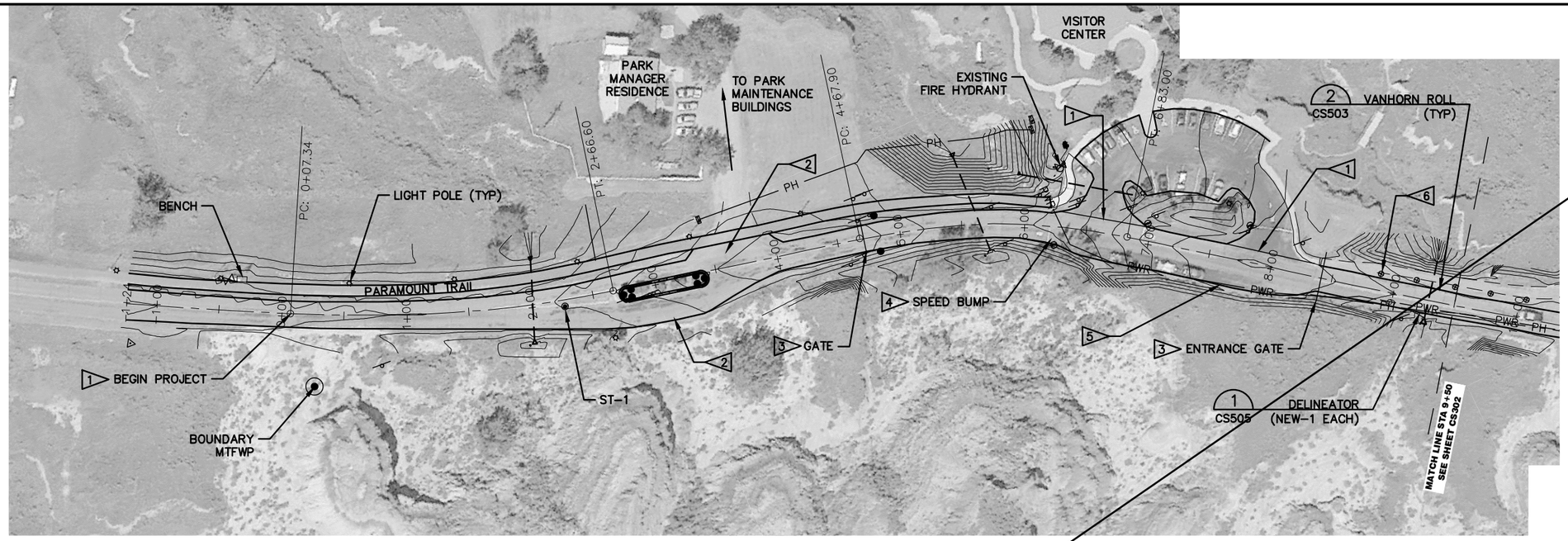
PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD OVERVIEW

SHEET
CS101

18 OF 37

F:\natfres\17353 - FWP Makoshika\Makoshika-C3D\Cadd\Sheets\P&Ps-MAKOSHIKA.dwg Jun 06, 2018



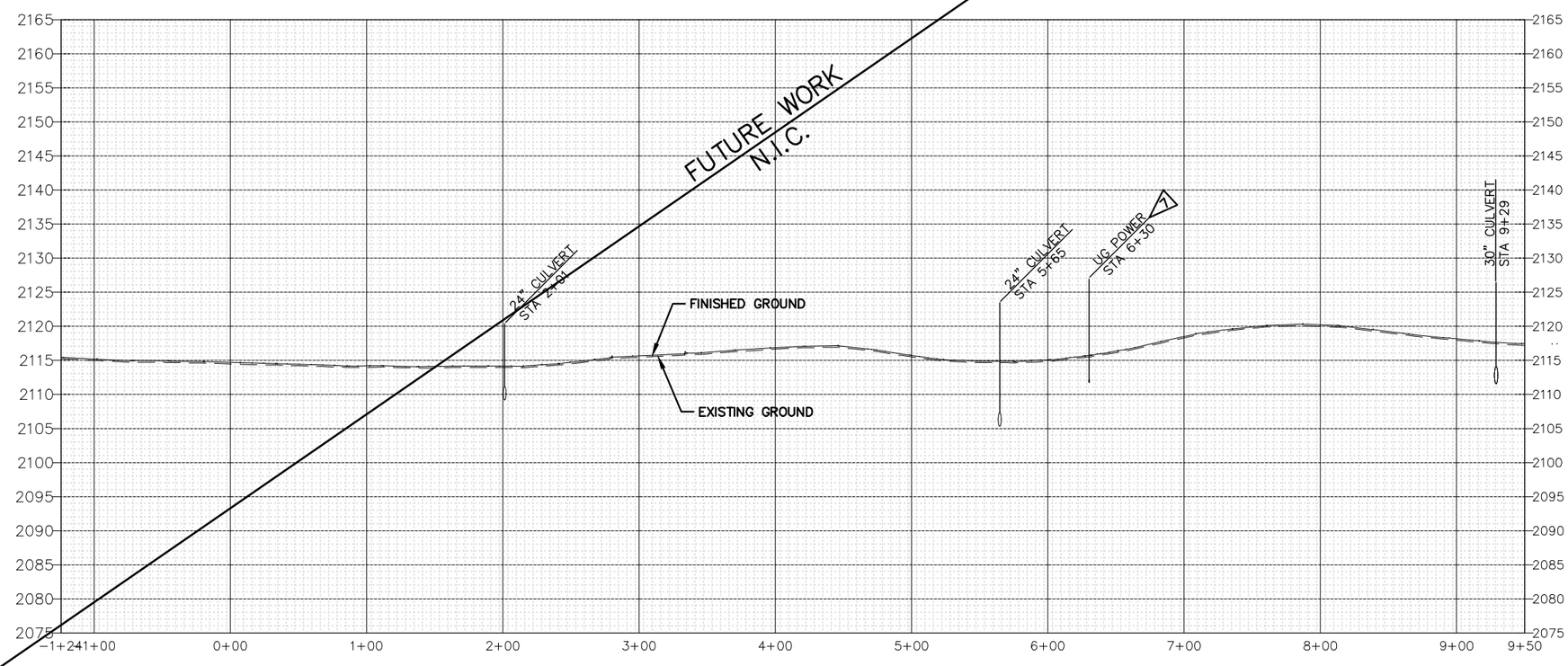
CONSTRUCTION NOTES:

1. SAW CUT AND MATCH EXISTING GRADE.
2. STA 2+00 TO 4+50 WIDER TYPICAL SECTION APPLIES AROUND MEDIAN AND ADJACENT APPROACH. MATCH EXISTING ROAD WIDTH.
3. DO NOT DISTURB.
4. SPEED BUMP BY OTHERS.
5. STA 6+40 TO 8+60 WIDER TYPICAL SECTION APPLIES FOR PARALLEL PARKING SOUTH SIDE OF ROAD
6. REMOVE AND REPLACE EXISTING DELINEATORS. TYP.
7. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).

HORIZONTAL
50 0 50 100
(SCALE IN FEET)

VERTICAL
10 0 10 20
(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 0+00 TO 9+50

SHEET
CS301

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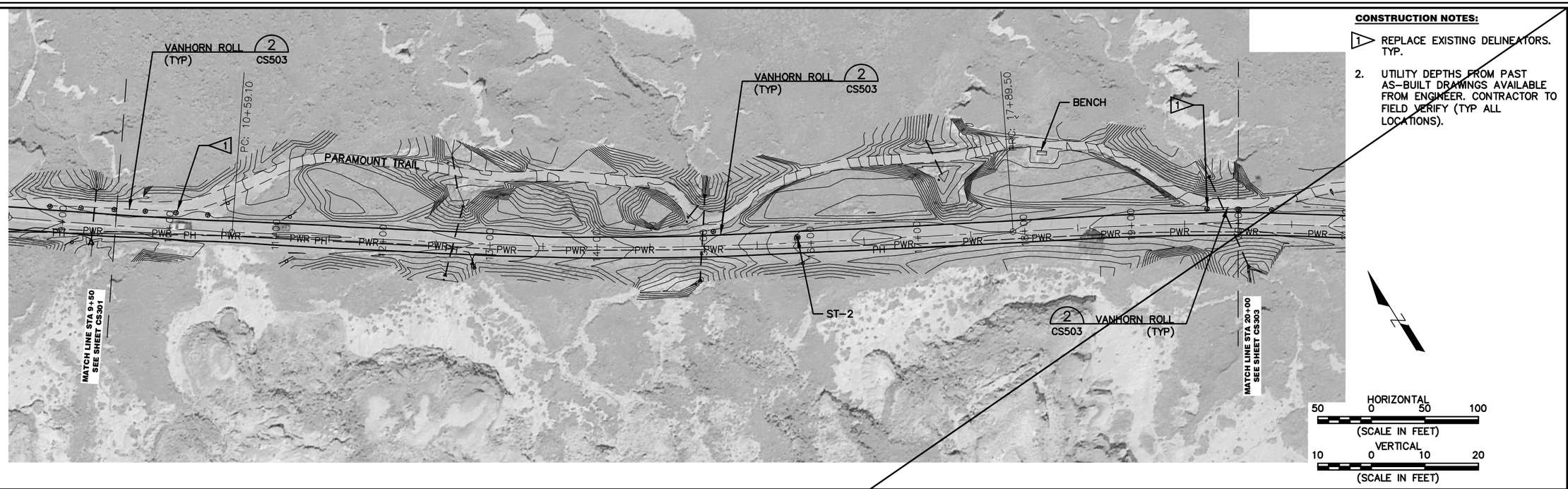
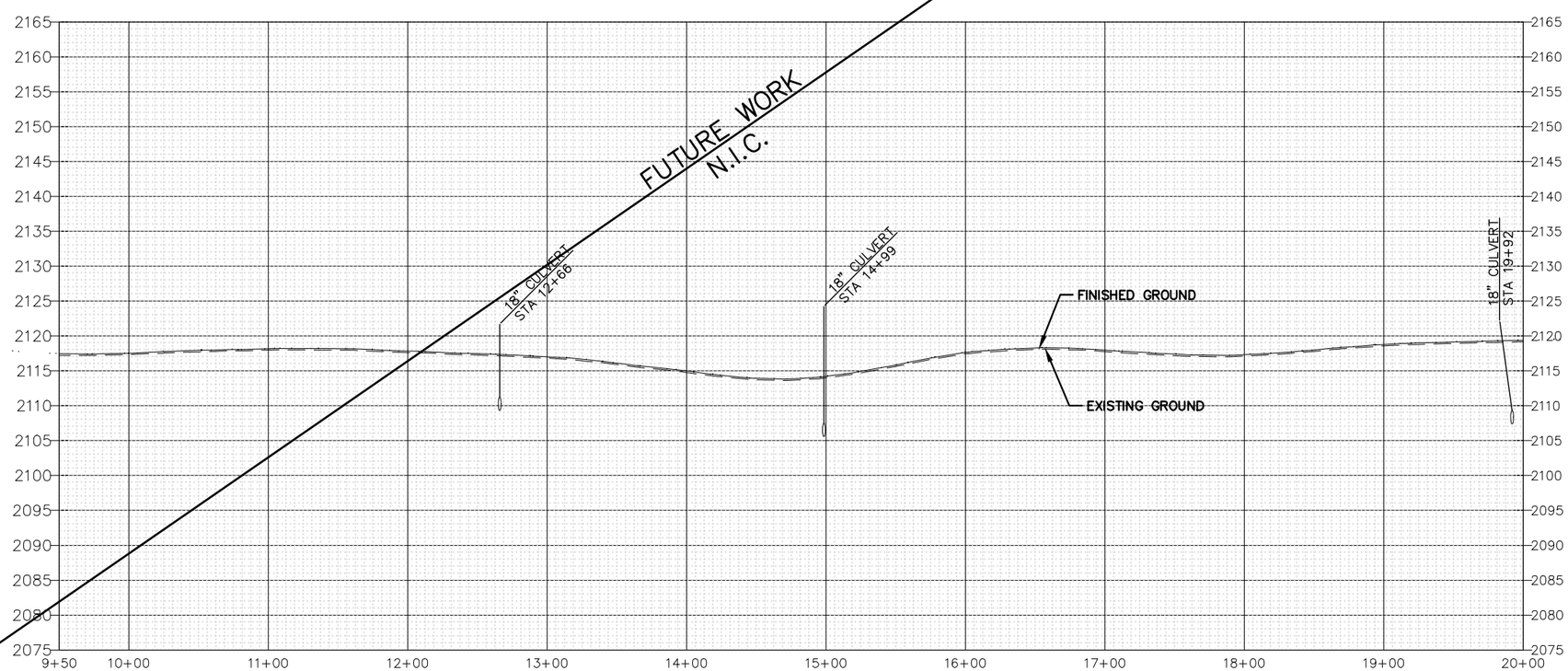


CONSTRUCTION NOTES:

1. REPLACE EXISTING DELINEATORS. TYP.
2. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

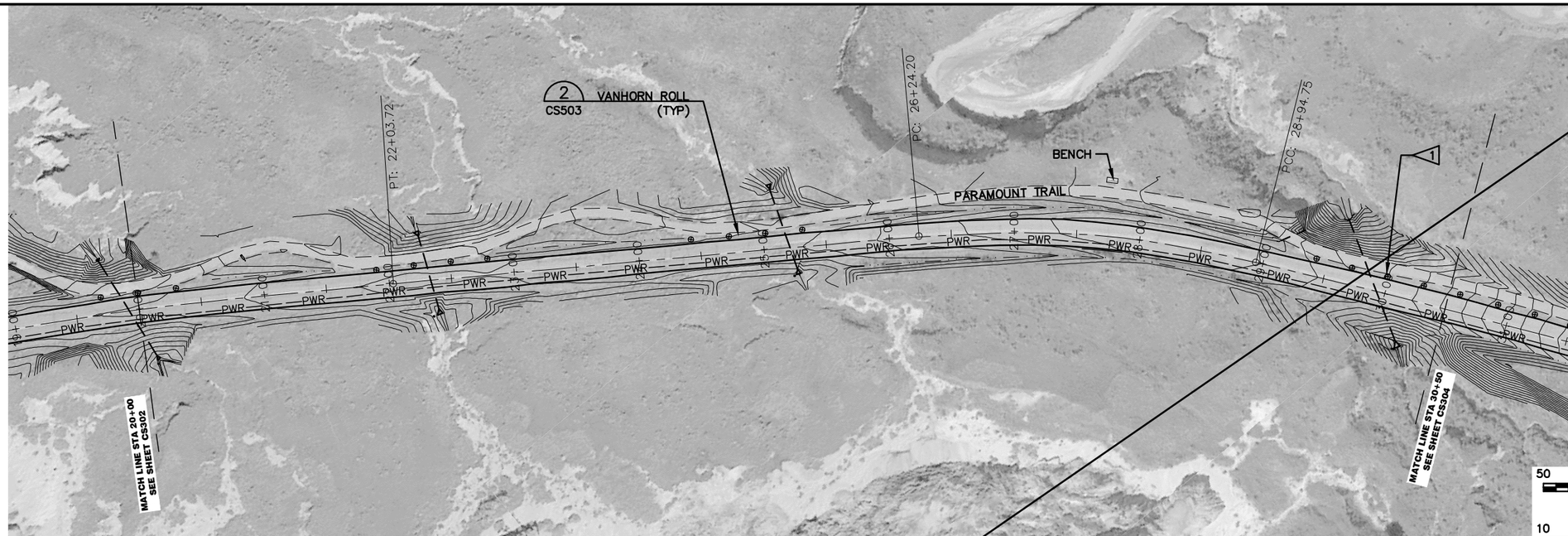
PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 9+50 TO 20+00

SHEET
CS302

20 OF 37

F:\natlres\17353 - FWP Makoshika\Makoshika-C3D\Cadd\Sheets\P&Ps-MAKOSHIKA.dwg Jun 05, 2018



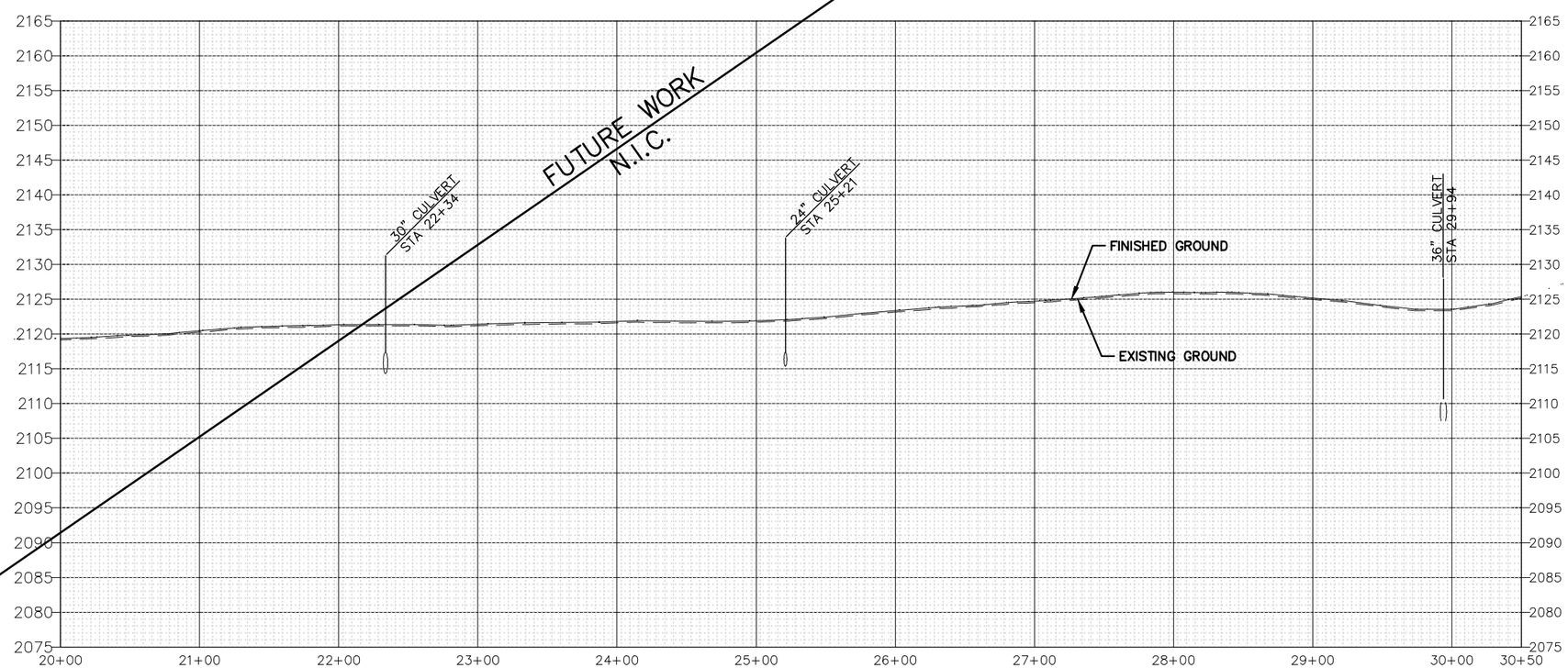
CONSTRUCTION NOTES:

1. REMOVE AND REPLACE EXISTING DELINEATORS. TYP.
2. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).

HORIZONTAL
50 0 50 100
(SCALE IN FEET)

VERTICAL
10 0 10 20
(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

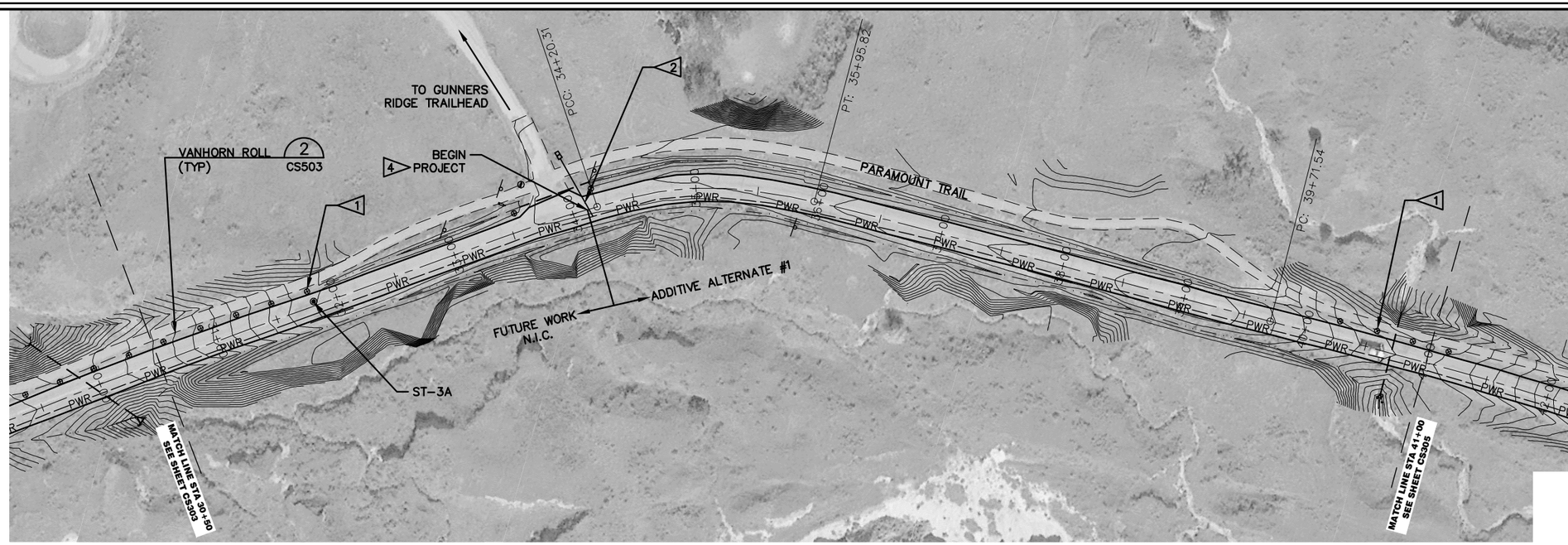
PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 20+00 TO 30+50

SHEET
CS303

21 OF 37

F:\natfres\17353 - FWP Makoshika\Makoshika-C3D\Cadd\Sheets\P&Ps-MAKOSHIKA.dwg Jun 05, 2018

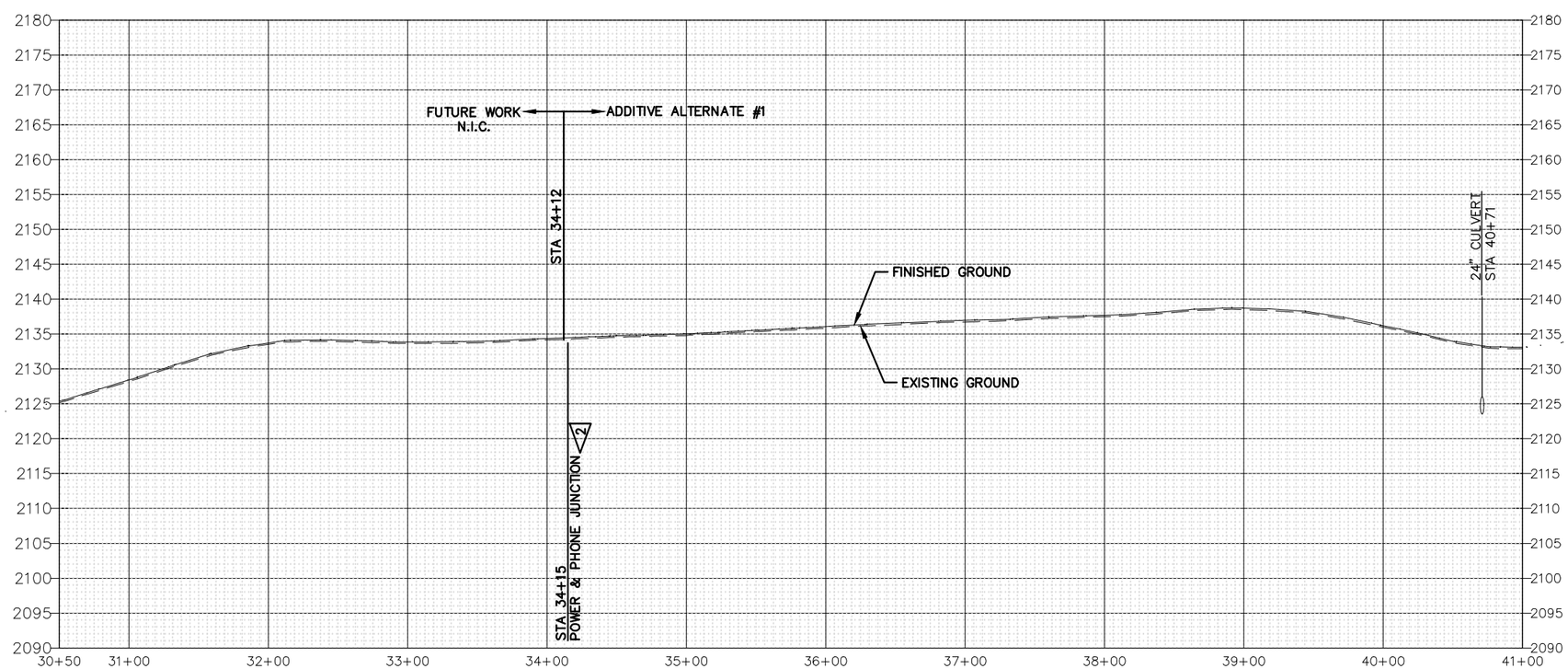


CONSTRUCTION NOTES:

1. REMOVE AND REPLACE EXISTING DELINEATORS. TYP.
2. PROVIDE POWER AND PHONE STUB-OUT FOR FUTURE CAMPGROUND CONNECTION. LOCATION AND JUNCTION BOX MATERIALS PER UTILITY COMPANY AND ENGINEER APPROVAL.
3. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).
4. SAW CUT AND MATCH EXISTING GRADE.

HORIZONTAL
50 0 50 100
(SCALE IN FEET)
VERTICAL
5 0 5 10
(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 30+50 TO 41+00

SHEET
CS304

22 OF 37

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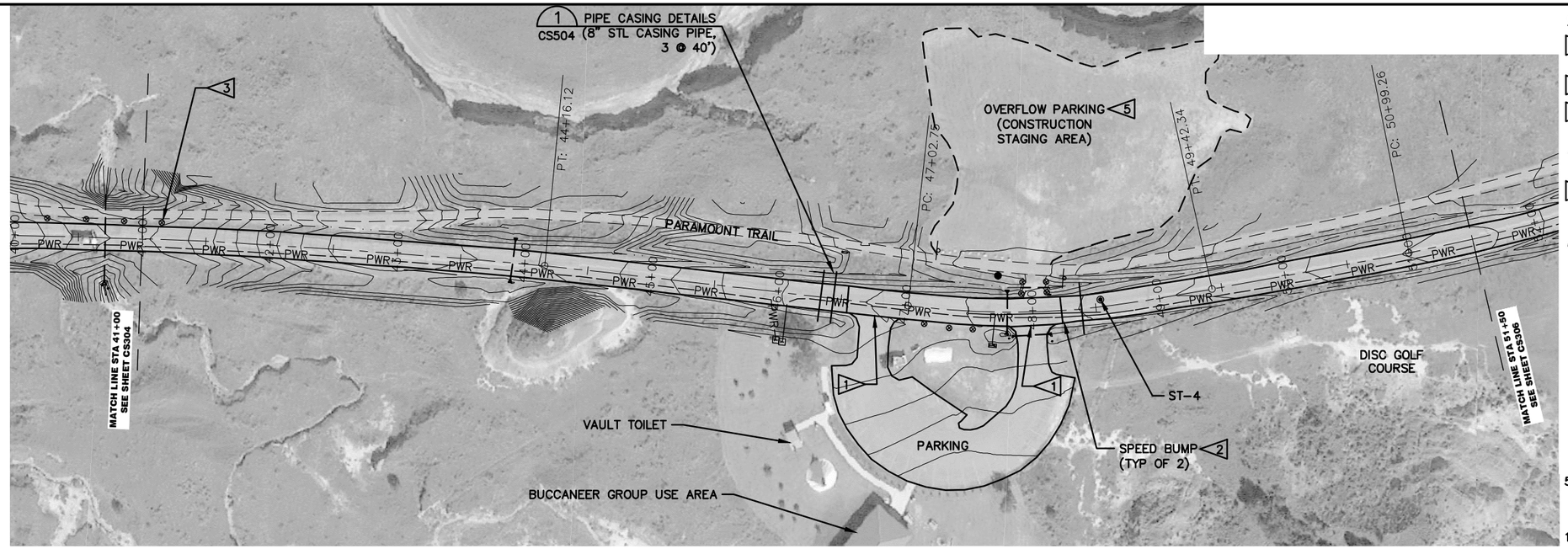
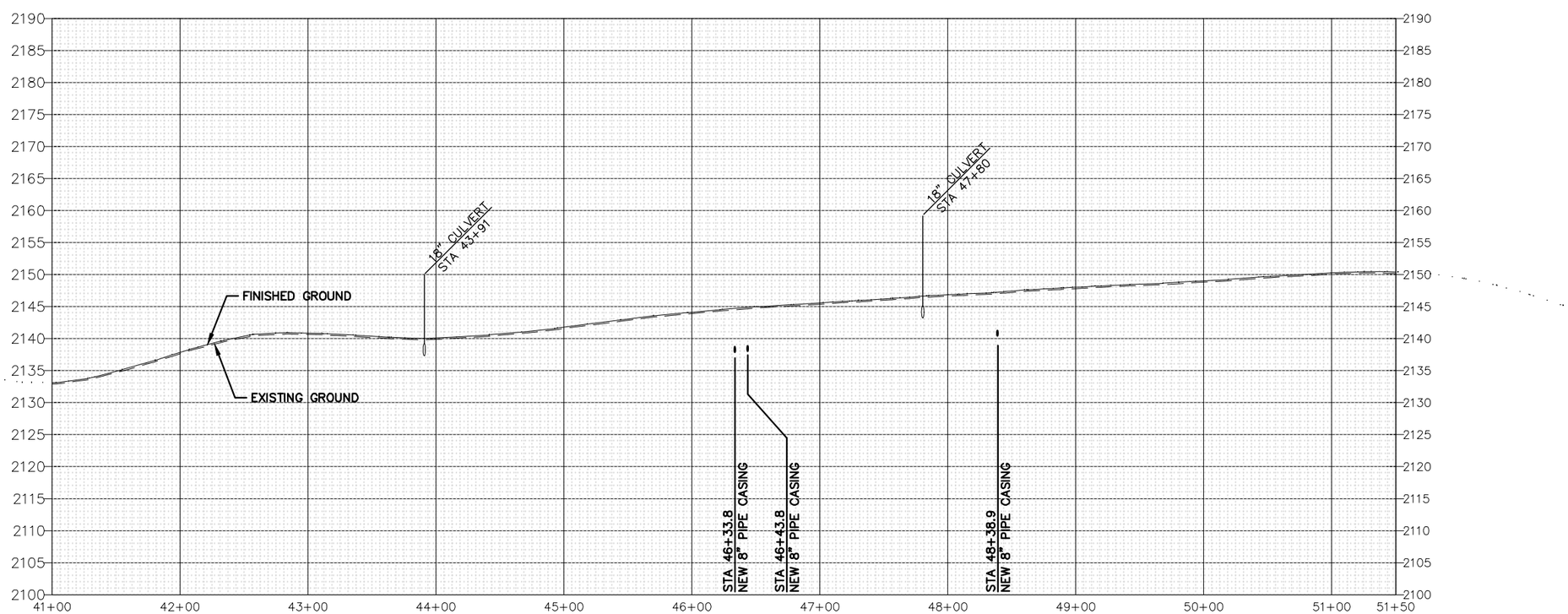


CONSTRUCTION NOTES:

1. SAW CUT AND MATCH EXISTING GRADE.
2. SPEED BUMP BY OTHERS..
3. REMOVE AND REPLACE EXISTING DELINEATORS. TYP.
4. FIELD VERIFY POWER AND PHONE LOCATION.
5. RETURN STAGING AREA TO EXISTING CONDITION OR BETTER.
6. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).

HORIZONTAL
50 0 50 100
(SCALE IN FEET)
VERTICAL
10 0 10 20
(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 41+00 TO 51+50

SHEET
CS305

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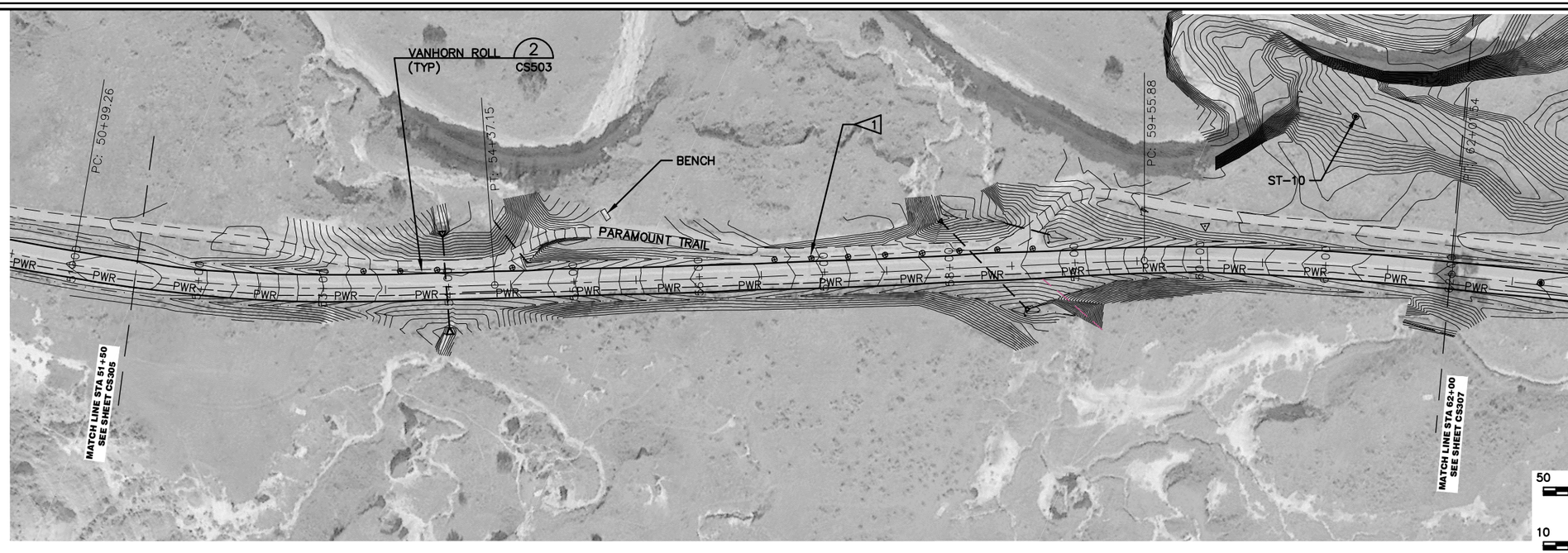
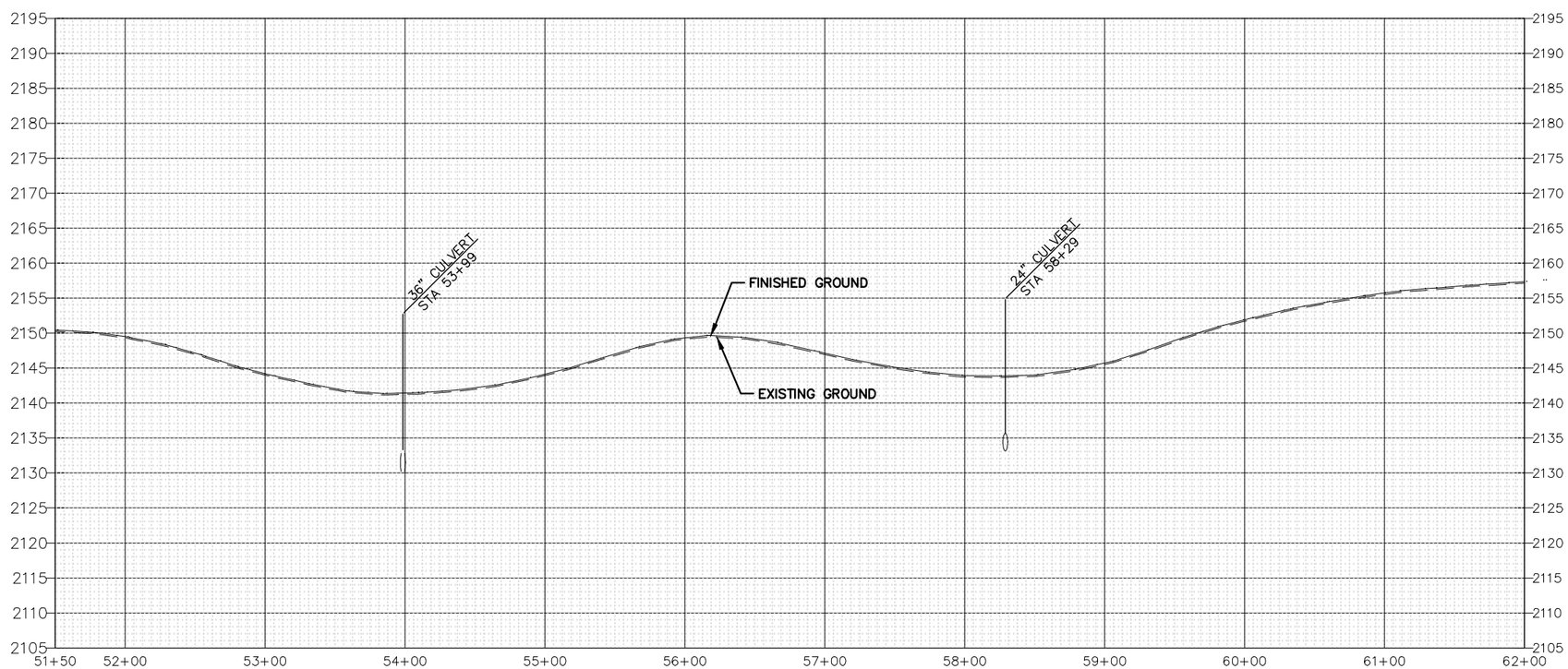


CONSTRUCTION NOTES:

1. REMOVE AND REPLACE EXISTING DELINEATORS. TYP.
2. UTILITY DEPTHS FROM PAST AS-BUILT DRAWINGS AVAILABLE FROM ENGINEER. CONTRACTOR TO FIELD VERIFY (TYP ALL LOCATIONS).

HORIZONTAL
50 0 50 100
(SCALE IN FEET)
VERTICAL
10 0 10 20
(SCALE IN FEET)

MAKOSHIKA STATE PARK ROAD



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JUNE 2018 — DATE
17353 — PROJECT NO.
P&Ps-MAKOSHIKA — FILE

PROJECT TITLE
MAKOSHIKA STATE PARK ROAD INFRASTRUCTURE REPAIRS
Glendive, Montana

SHEET TITLE
MAKOSHIKA ROAD PLAN AND PROFILE STA 51+50 TO 62+00

SHEET
CS306

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