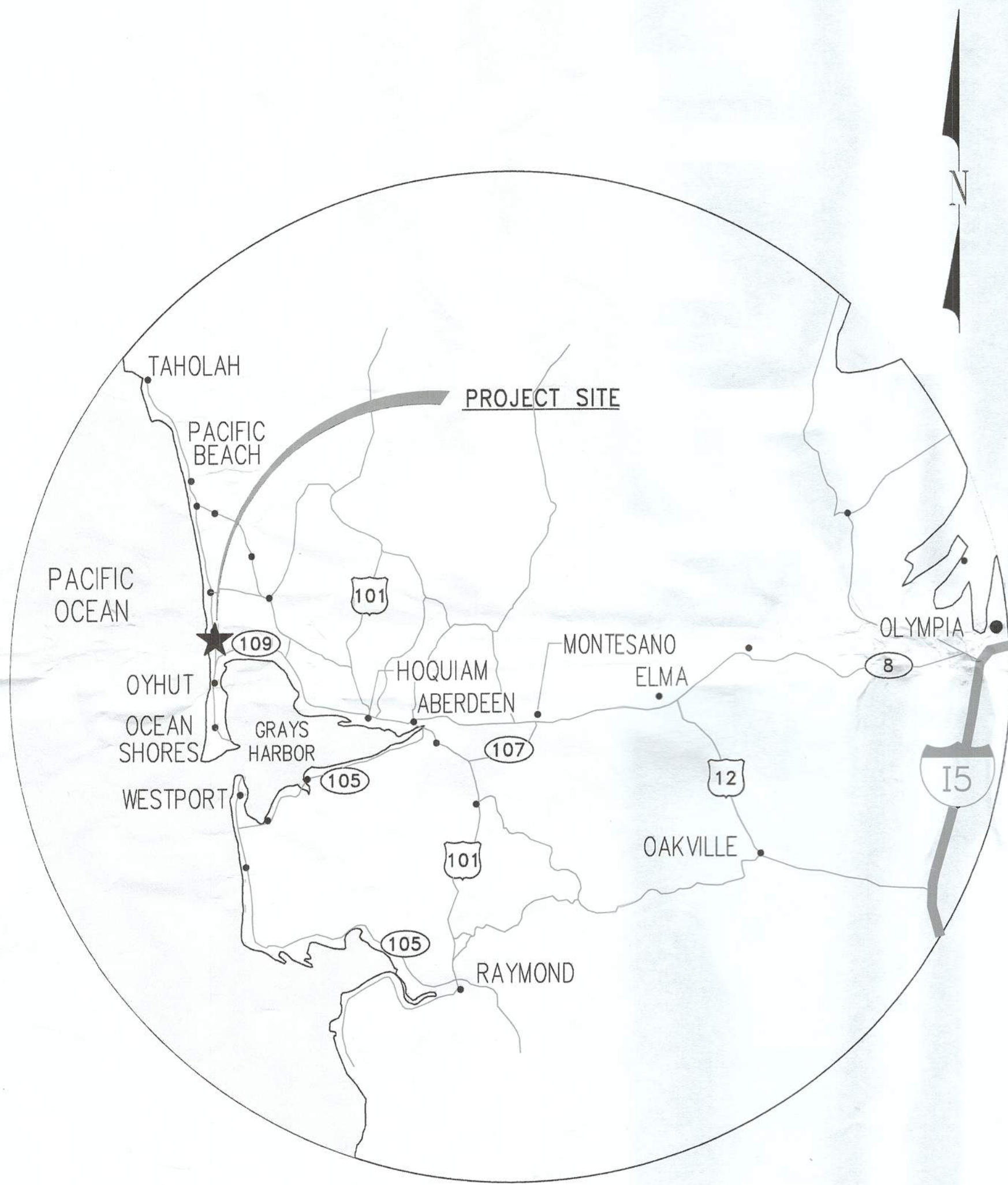


Dunes Estates, Inc.

Civil Design For Wetland Mitigation



VICINITY MAP
NTS

Project Location:

The Dunes Estates Subdivision is located to the west of State Route 109, north of the intersection of State Route 109 and State Route 115, approximately two miles south of Ocean City.

This project is located within Section 15, Township 18 North, Range 12 West, Willamette Meridian of Grays Harbor County.

General Notes:

1. Suitable fill material generated during wetland and parking area creation shall be utilized in the following order:

- A) Pond Enhancement.
- B) Two (2) feet of fill on lots 5,6,7,11,12, north end of 16, and lots 17 through 19.
- C) Fill on lots 5,6,7,11,12, north end of 16, and lots 17 through 19 to an elevation of 21.00 feet, as shown on the plans.
- D) Fill upland areas on lots 20 through 27.

NOTE: Wetland excavation material suitable for wetland enhancement is not necessarily the same material as that suitable for building pads. Decisions concerning the use of all materials shall be made on-site by the Project Manager and Wetland Specialist.

2. The contractor shall be fully responsible for the location and protection of all existing utilities. The contractor shall verify all utility locations prior to construction by calling the underground locate line at 1-800-424-5555 a minimum of 48 hours prior to any excavation.

Client:

Dunes Estates, Inc.
1301 Fifth Avenue, Suite 2600
Seattle, WA 98101

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Sheet	Description
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7 of 12	TESC Plan
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11 of 12	Culvert Design Details
12 of 12	Culvert Design Details

FOR
CONSTRUCTION



REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07

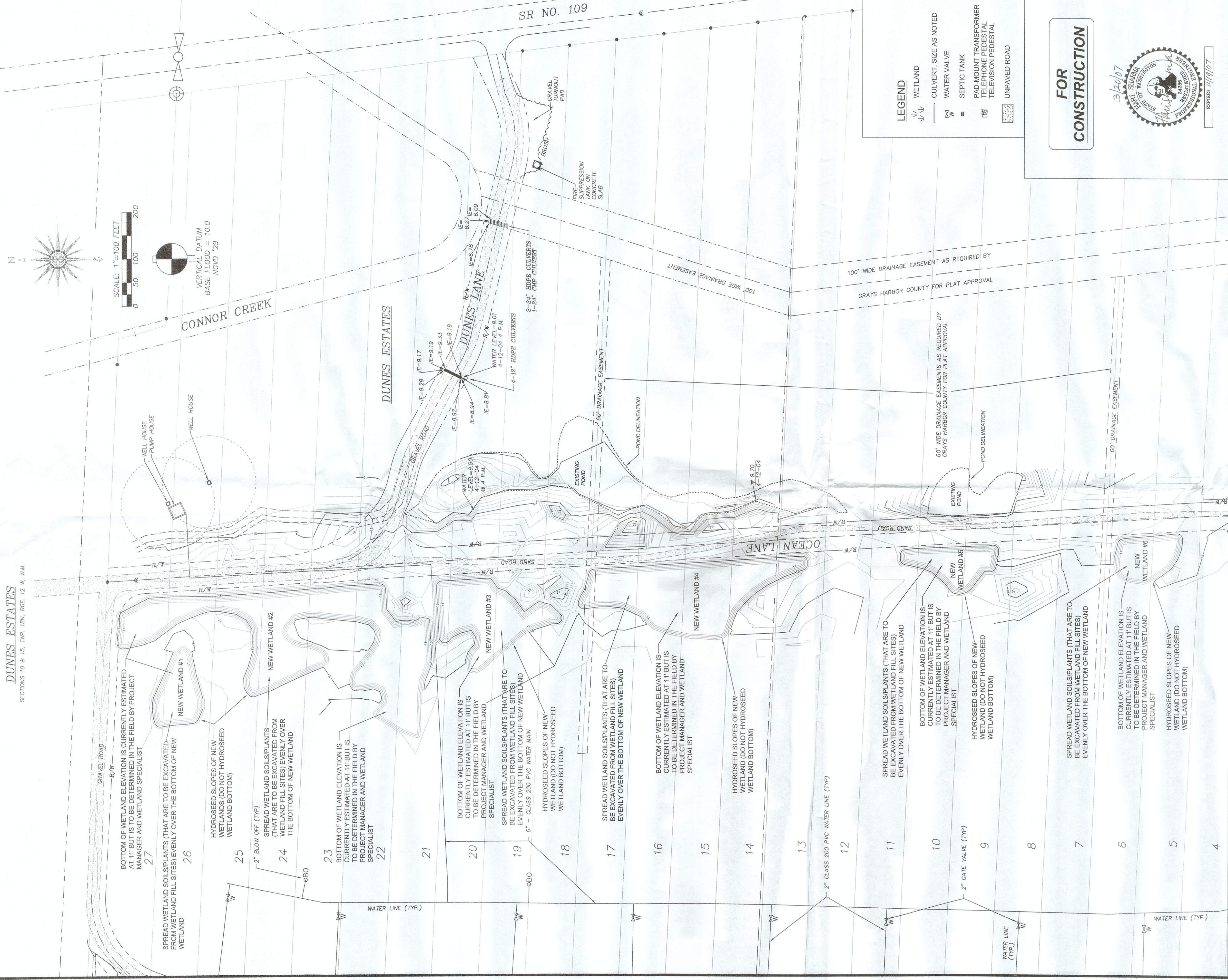
Title Sheet

Wetland Mitigation Civil Design
Dunes Estates, Inc.
1301 Fifth Avenue, Suite 2600
Seattle, WA 98101

BERGLUND, SCHMIDT & ASSOC., INC.
professional engineers and land surveyors
216 EAST FIRST STREET
ABERDEEN, WA, 98520
TEL.: (360)532-7630
FAX: (360)532-9682

JOB NO. 07.007
DATE 03/15/2007
SCALE NTS
DESIGNED HS
DRAWN JMK
CHECKED HS
APPROVED HS
DRAWING NUMBER
C-1
SHEET 1 OF 12

DUNES ESTATES
SECTIONS 10 & 15, TWP. 18N, RGE. 12 W, W.M.



NOTES:
 1. BOUNDARY OF THE NEW WETLANDS SHALL BE FIELD VERIFIED BY THE WETLAND SPECIALIST.
 2. NEW WETLAND BOTTOM AREAS SHALL NOT BE HYDROSEEDED - ONLY SLOPES OF WETLANDS SHALL BE HYDROSEEDED.
 3. ANY EXCESS FILL MATERIAL LEFT AFTER BUILDING SITES ARE FILLED SHALL BE SPREAD EVENLY OVER THE SURFACE OF OCEAN LANE.
 4. EXISTING WATERLINES MUST BE LOCATED PRIOR TO WETLAND CONSTRUCTION. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO LOCATE ALL EXISTING WATERLINES.
 5. EXCAVATED WETLAND MATERIAL FROM BUILDING SITES SHALL BE SPREAD EVENLY ON THE BOTTOM OF NEWLY CONSTRUCTED WETLANDS.

JOB NO.	07.007
DATE	03/15/2007
SCALE	1"=100'
DESIGNED	HS
DRAWN	JMK
CHECKED	HS
APPROVED	HS
DRAWING NUMBER	C-3
SHEET	3 OF 12

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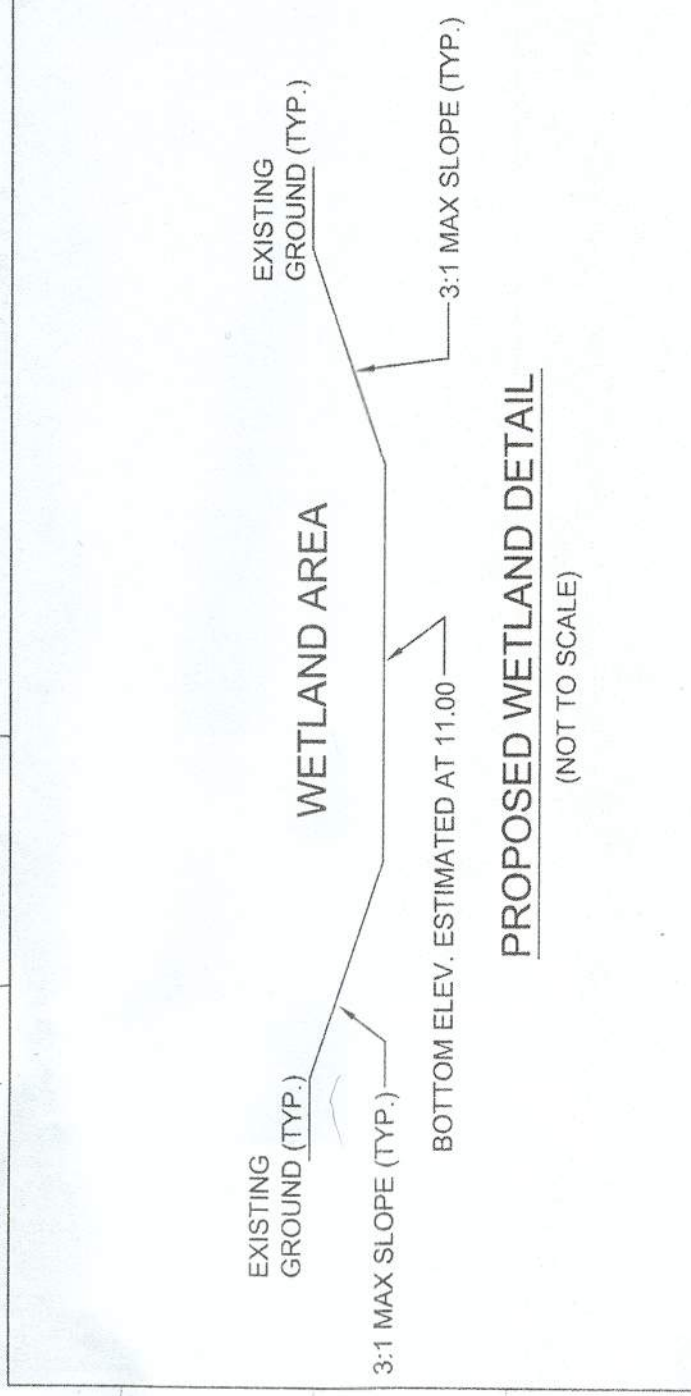
Wetland Creation

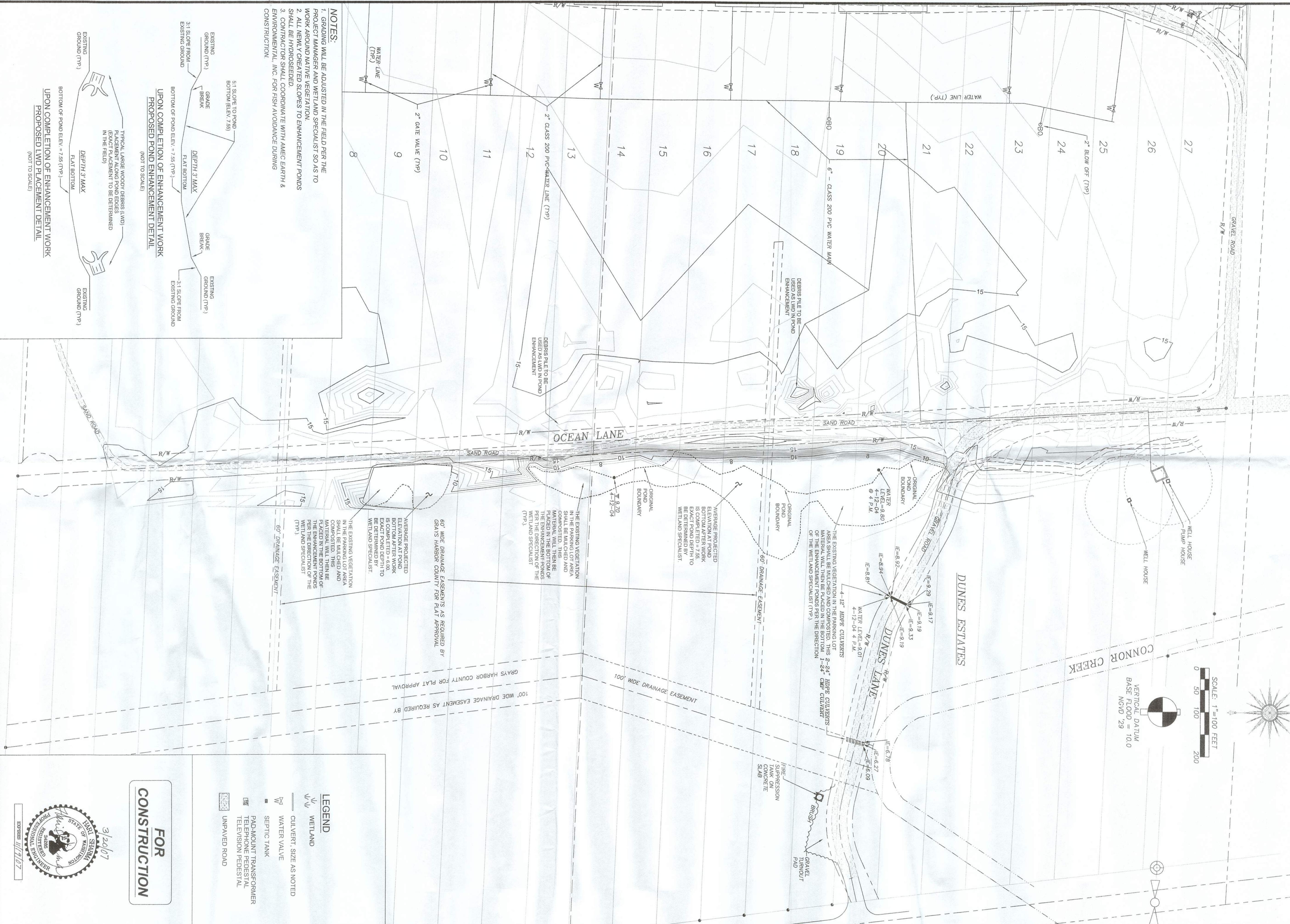
REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07

LEGEND

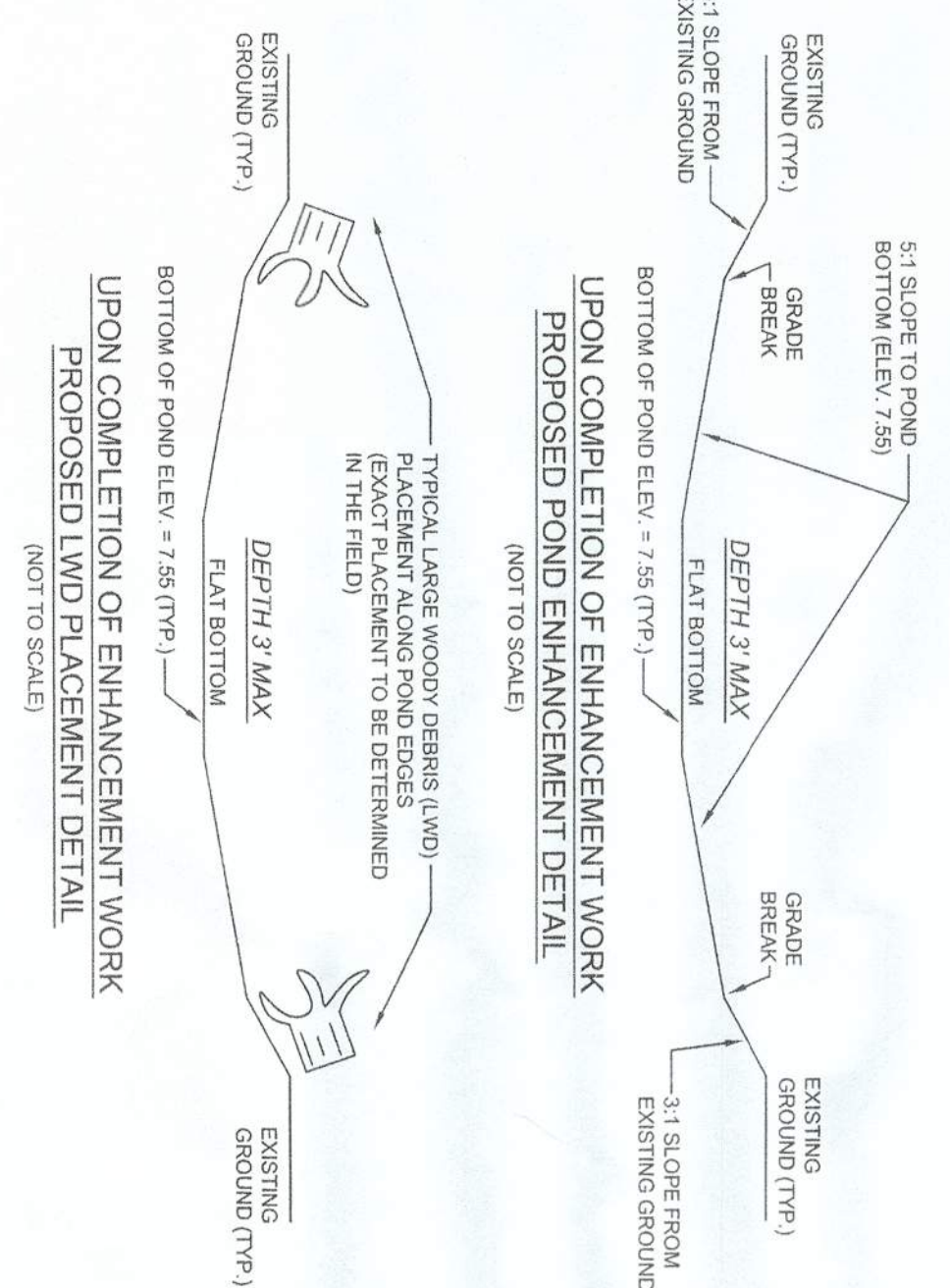
- WETLAND
- CULVERT, SIZE AS NOTED
- WATER VALVE
- SEPTIC TANK
- PAD MOUNT TRANSFORMER
- TELEPHONE PEDESTAL
- TELEVISION PEDESTAL
- UNPAVED ROAD

FOR CONSTRUCTION





NOTES:
 1. GRADING WILL BE ADJUSTED IN THE FIELD PER THE PROJECT MANAGER AND WETLAND SPECIALIST SO AS TO WORK AROUND NATIVE VEGETATION.
 2. ALL NEWLY CREATED SLOPES TO ENHANCEMENT PONDS SHALL BE HYDROSEDED.
 3. CONTRACTOR SHALL COORDINATE WITH AMEC EARTH & ENVIRONMENTAL, INC. FOR FISH AVOIDANCE DURING CONSTRUCTION.



BERGLUND, SCHMIDT & ASSOC., Inc.
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Wetland Mitigation Civil Design
 Dunes Estates, Inc.
 1301 Fifth Avenue, Suite 2600
 Seattle, WA 98101

Pond Enhancement

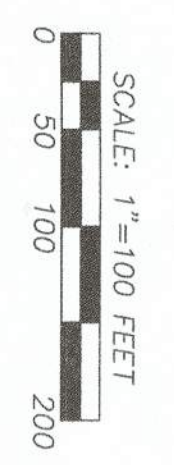
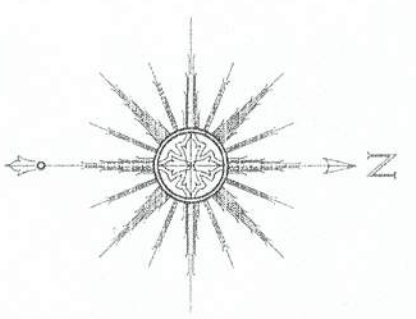
REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07



FOR CONSTRUCTION

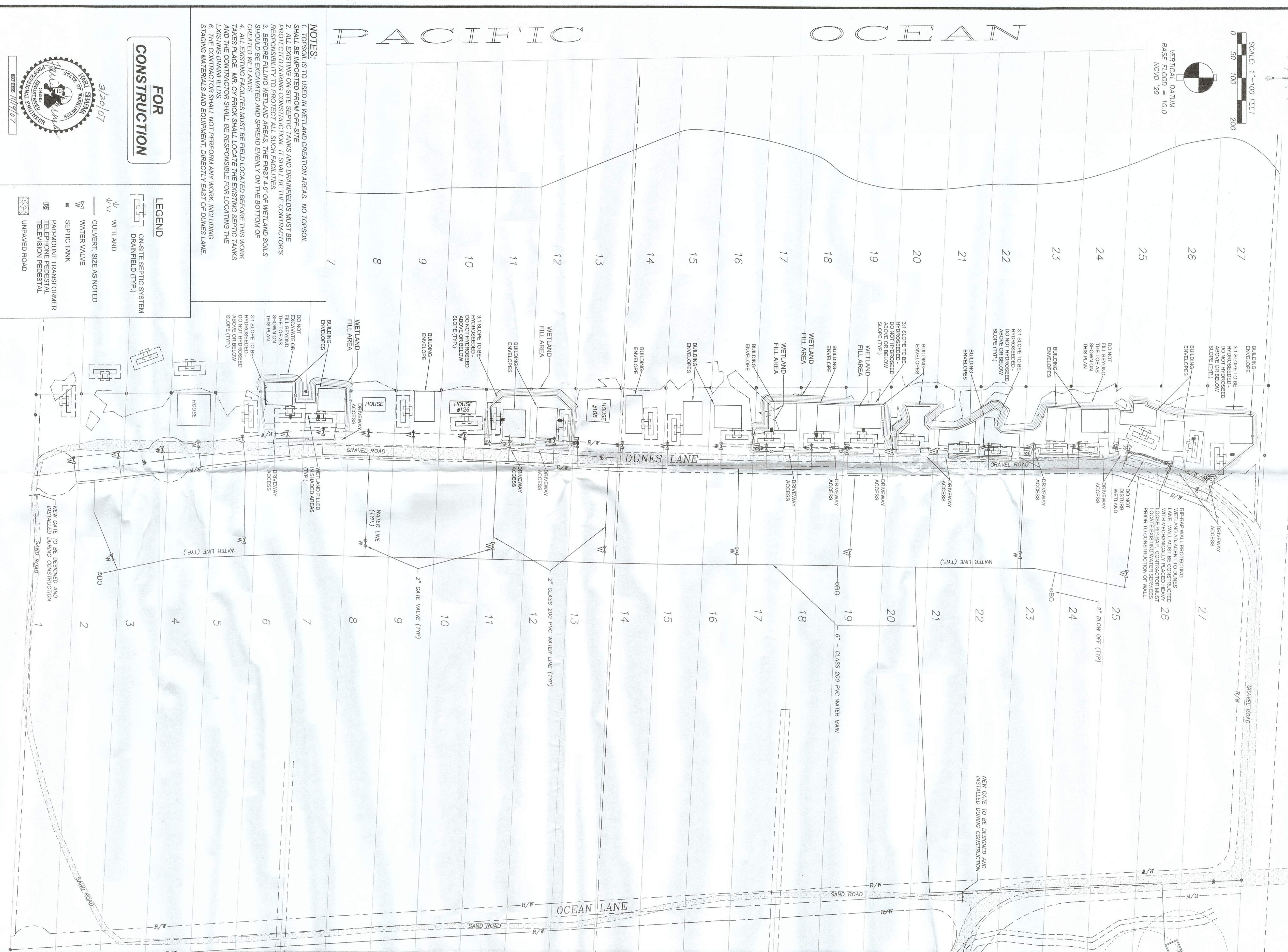
- LEGEND**
- W W WETLAND
 - CULVERT, SIZE AS NOTED
 - W WATER VALVE
 - SEPTIC TANK
 - ▭ PADMOUNT TRANSFORMER
 - ⊠ TELEPHONE PEDESTAL
 - ▭ TELEVISION PEDESTAL
 - ▭ UNPAVED ROAD

SHEET 4 OF 12
C-4
DRAWING NUMBER
CHECKED HS
APPROVED HS
DESIGNED HS
SCALE 1"=100'
DATE 03/15/2007
JOB NO. 02.007



VERTICAL DATUM
BASE FLOOD = 10.0
NGVD 29

PACIFIC OCEAN



- NOTES:**
1. TOPSOIL IS TO USED IN WETLAND CREATION AREAS. NO TOPSOIL SHALL BE IMPORTED FROM OFF-SITE
 2. ALL EXISTING ON-SITE SEPTIC TANKS AND DRAINFIELDS MUST BE PROTECTED DURING CONSTRUCTION. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PROTECT ALL SUCH FACILITIES.
 3. BEFORE FILLING WETLAND AREAS, THE FIRST 4'-6" OF WETLAND SOILS SHOULD BE EXCAVATED AND SPREAD EVENLY ON THE BOTTOM OF CREATED WETLANDS.
 4. ALL EXISTING FACILITIES MUST BE FIELD LOCATED BEFORE THIS WORK TAKES PLACE. MR. CY FRICK SHALL LOCATE THE EXISTING SEPTIC TANKS AND THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING THE EXISTING DRAINFIELDS.
 5. THE CONTRACTOR SHALL NOT PERFORM ANY WORK INCLUDING THE STAGING MATERIALS AND EQUIPMENT, DIRECTLY EAST OF DUNES LANE.

FOR CONSTRUCTION



- LEGEND**
- ON-SITE SEPTIC SYSTEM DRAINFIELD (TYP.)
 - WETLAND
 - CULVERT, SIZE AS NOTED
 - WATER VALVE
 - SEPTIC TANK
 - PAD-MOUNT TRANSFORMER TELEPHONE PEDESTAL
 - UNPAVED ROAD

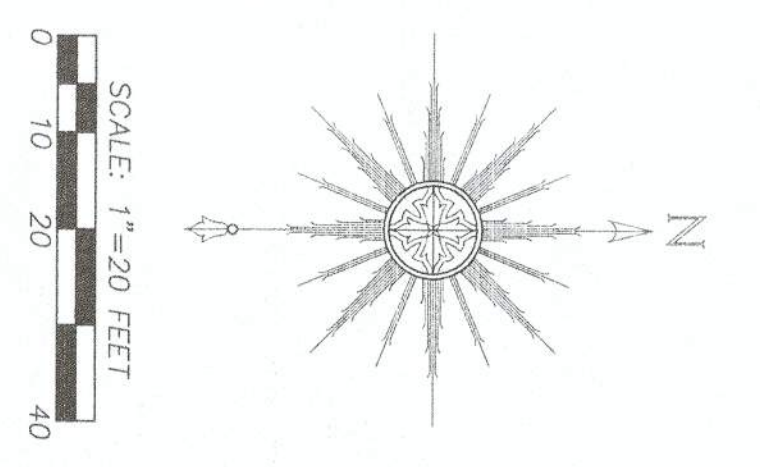
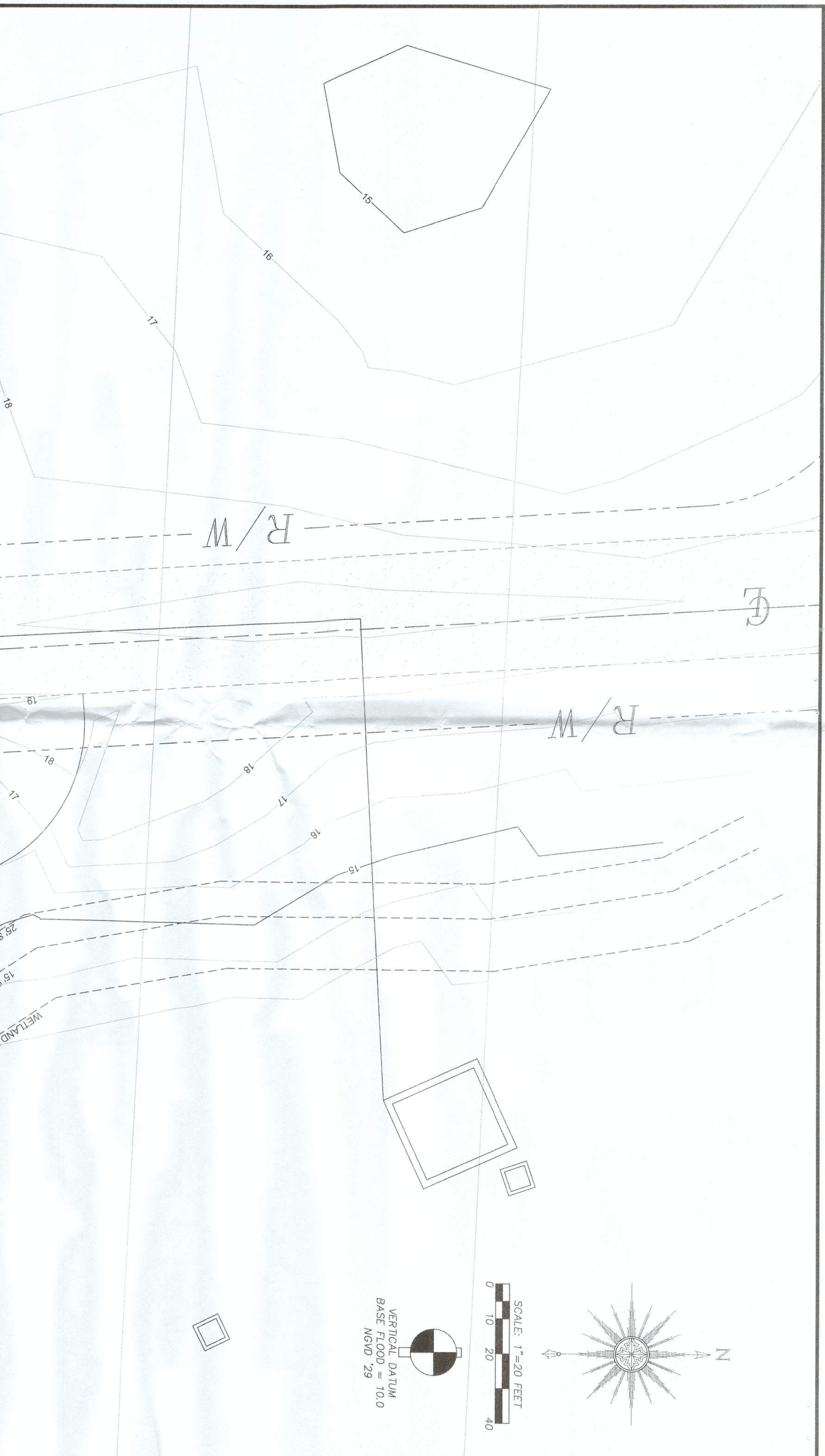
SHEET 5 OF 12
C-5
DRAWING NUMBER
APPROVED HS
CHECKED HS
DRAWN JMK
DESIGNED HS
SCALE 1"=100'
DATE 03/15/2007
JOB NO. 07.007

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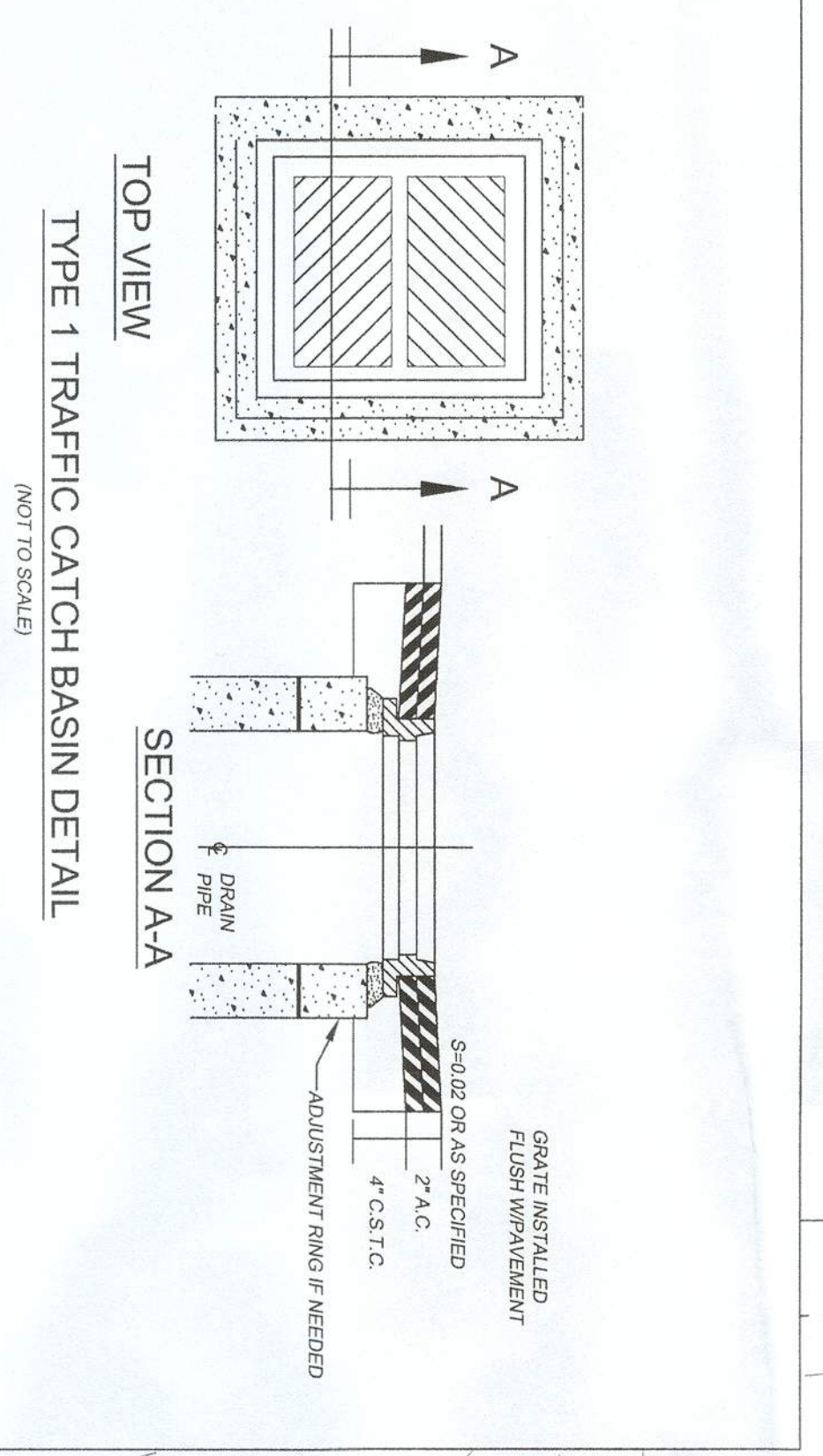
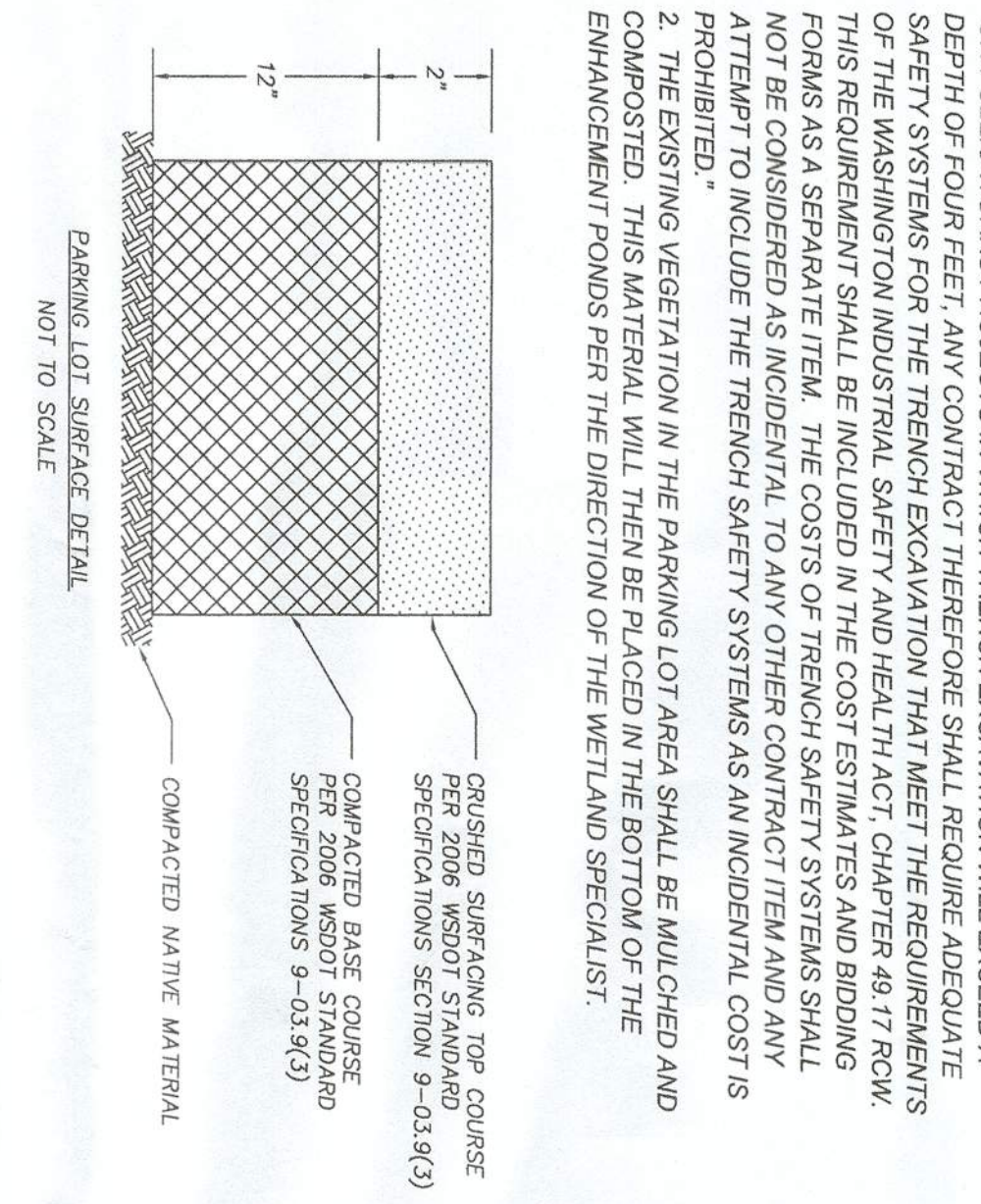
Wetland Fill
And Grading

REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07

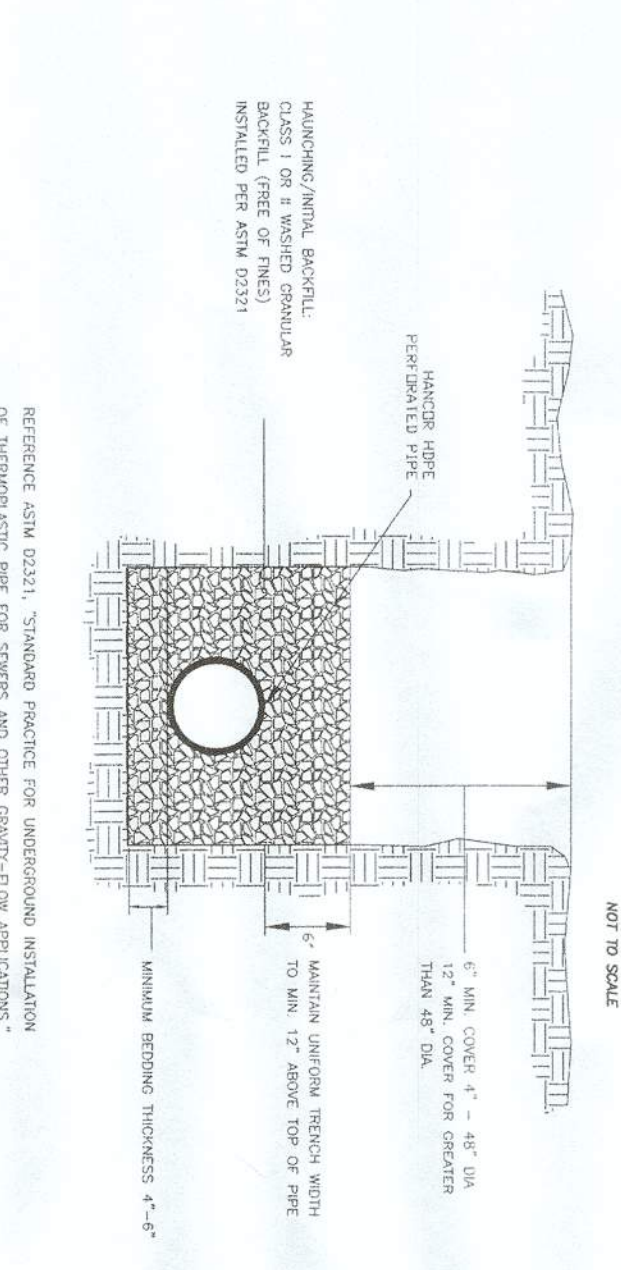


VERTICAL DATUM
BASE FLOOD = 10.0
NGVD '29

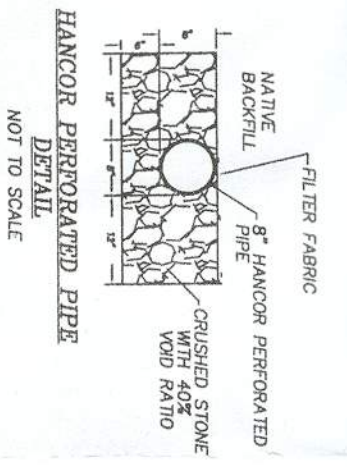
NOTES:
1. TRENCH EXCAVATION SHALL REQUIRE SAFETY SYSTEMS IN ACCORDANCE WITH ROW 39.04.180 AS FOLLOWS.
2. PUBLIC WORKS PROJECTS IN WHICH TRENCH EXCAVATION WILL EXCEED A DEPTH OF FOUR FEET, ANY CONTRACT THEREFOR SHALL REQUIRE ADEQUATE SAFETY SYSTEMS FOR THE TRENCH EXCAVATION THAT MEET THE REQUIREMENTS OF THE WASHINGTON INDUSTRIAL SAFETY AND HEALTH ACT, CHAPTER 49.17 ROW. THIS REQUIREMENT SHALL BE INCLUDED IN THE COST ESTIMATES AND BIDDING FORMS AS A SEPARATE ITEM. THE COSTS OF TRENCH SAFETY SYSTEMS SHALL NOT BE CONSIDERED AS INCIDENTAL TO ANY OTHER CONTRACT ITEM AND ANY ATTEMPT TO INCLUDE THE TRENCH SAFETY SYSTEMS AS AN INCIDENTAL COST IS PROHIBITED.
3. THE EXISTING VEGETATION IN THE PARKING LOT AREA SHALL BE MULCHED AND COMPOSTED. THIS MATERIAL WILL THEN BE PLACED IN THE BOTTOM OF THE ENHANCEMENT PONDS PER THE DIRECTION OF THE WETLAND SPECIALIST.



HANCOR PERFORATED HDPE TRENCH INSTALLATION DETAIL
OTHER BASIN REVIEW DETAIL
NOT TO SCALE



PIPE NUMBER	LENGTH (FEET)	DEPTH (FEET)	DIAMETER (INCHES)
1 - 8 (100-200)	24 (0.8)	24 (0.8)	4 (1.3)
2 - 12 (200-300)	24 (0.8)	24 (0.8)	4 (1.3)
3 - 16 (300-400)	24 (0.8)	24 (0.8)	4 (1.3)
4 - 20 (400-500)	24 (0.8)	24 (0.8)	4 (1.3)
5 - 24 (500-600)	24 (0.8)	24 (0.8)	4 (1.3)
6 - 28 (600-700)	24 (0.8)	24 (0.8)	4 (1.3)
7 - 32 (700-800)	24 (0.8)	24 (0.8)	4 (1.3)
8 - 36 (800-900)	24 (0.8)	24 (0.8)	4 (1.3)
9 - 40 (900-1000)	24 (0.8)	24 (0.8)	4 (1.3)
10 - 44 (1000-1100)	24 (0.8)	24 (0.8)	4 (1.3)
11 - 48 (1100-1200)	24 (0.8)	24 (0.8)	4 (1.3)
12 - 52 (1200-1300)	24 (0.8)	24 (0.8)	4 (1.3)
13 - 56 (1300-1400)	24 (0.8)	24 (0.8)	4 (1.3)
14 - 60 (1400-1500)	24 (0.8)	24 (0.8)	4 (1.3)
15 - 64 (1500-1600)	24 (0.8)	24 (0.8)	4 (1.3)
16 - 68 (1600-1700)	24 (0.8)	24 (0.8)	4 (1.3)
17 - 72 (1700-1800)	24 (0.8)	24 (0.8)	4 (1.3)
18 - 76 (1800-1900)	24 (0.8)	24 (0.8)	4 (1.3)
19 - 80 (1900-2000)	24 (0.8)	24 (0.8)	4 (1.3)
20 - 84 (2000-2100)	24 (0.8)	24 (0.8)	4 (1.3)
21 - 88 (2100-2200)	24 (0.8)	24 (0.8)	4 (1.3)
22 - 92 (2200-2300)	24 (0.8)	24 (0.8)	4 (1.3)
23 - 96 (2300-2400)	24 (0.8)	24 (0.8)	4 (1.3)
24 - 100 (2400-2500)	24 (0.8)	24 (0.8)	4 (1.3)



FOR CONSTRUCTION

- LEGEND**
- WETLAND
 - CULVERT, SIZE AS NOTED
 - WATER VALVE
 - SEPTIC TANK
 - PAD-MOUNT TRANSFORMER
 - TELEPHONE PEDESTAL
 - TELEVISION PEDESTAL
 - UNPAVED ROAD

SHEET 6 OF 12
C-6
DRAWING NUMBER
APPROVED HS
CHECKED HS
DRAWN JMK
DESIGNED HS
SCALE 1"=100'
DATE 03/15/2007
JOB NO. 02.007

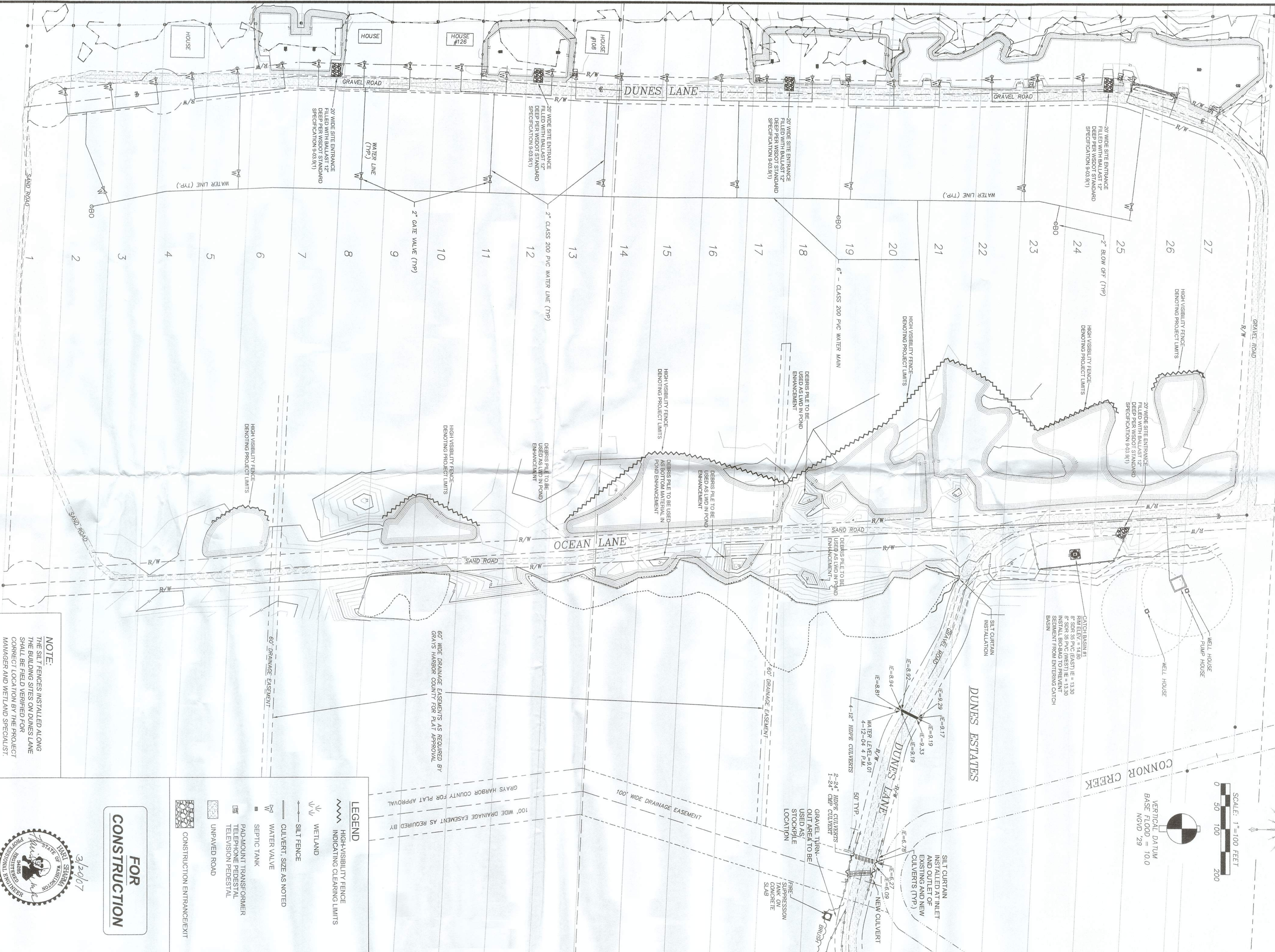
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Parking Lot
Grading And Drainage

REVISIONS

NO.	REVISION	BY	DATE
1	3rd Revision (Final)	HS	03/15/07



SCALE: 1"=100 FEET
0 50 100 200



NOTE:
THE SILT FENCES INSTALLED ALONG THE BUILDING SITES ON DUNES LANE SHALL BE FIELD VERIFIED FOR CORRECT LOCATION BY THE PROJECT MANAGER AND WETLAND SPECIALIST. THE CONTRACTOR SHALL NOT EXCAVATE OR FILL BEYOND THIS SILT FENCE LINE.



FOR CONSTRUCTION

LEGEND

- HIGH-VISIBILITY FENCE INDICATING CLEARING LIMITS
- WETLAND
- SILT FENCE
- CULVERT, SIZE AS NOTED
- WATER VALVE
- SEPTIC TANK
- PAD-MOUNT TRANSFORMER
- TELEPHONE PEDESTAL
- UNPAVED ROAD
- CONSTRUCTION ENTRANCE/EXIT

SHEET 7 OF 12
C-7
DRAWING NUMBER
APPROVED HS
CHECKED HS
DRAWN MMK
DESIGNED HS
DATE 03/19/2007
SCALE 1"=100'
JOB NO. 07.007

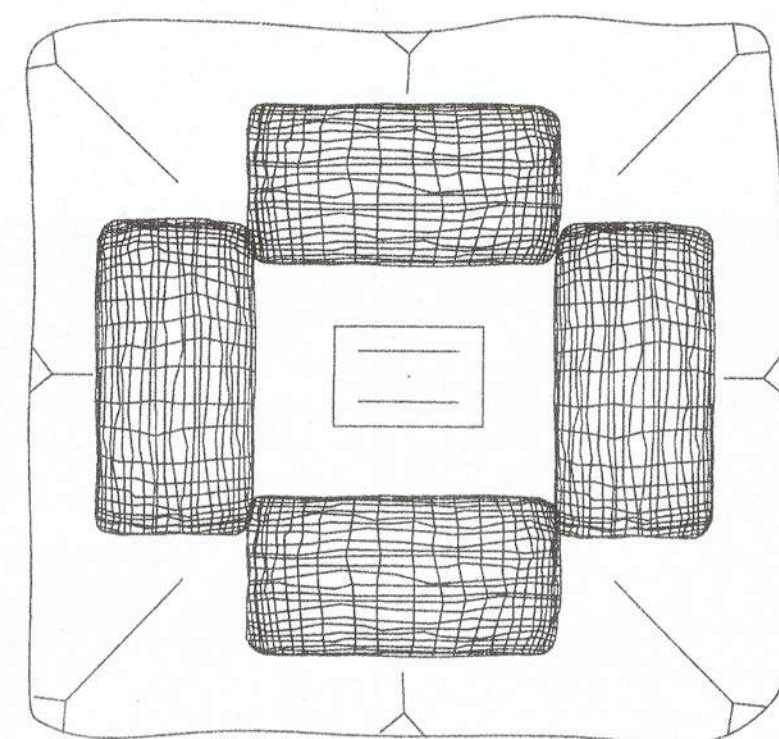
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Wetland Mitigation Civil Design
Dunes Estates, Inc.
1301 Fifth Avenue, Suite 2600
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TESC Plan

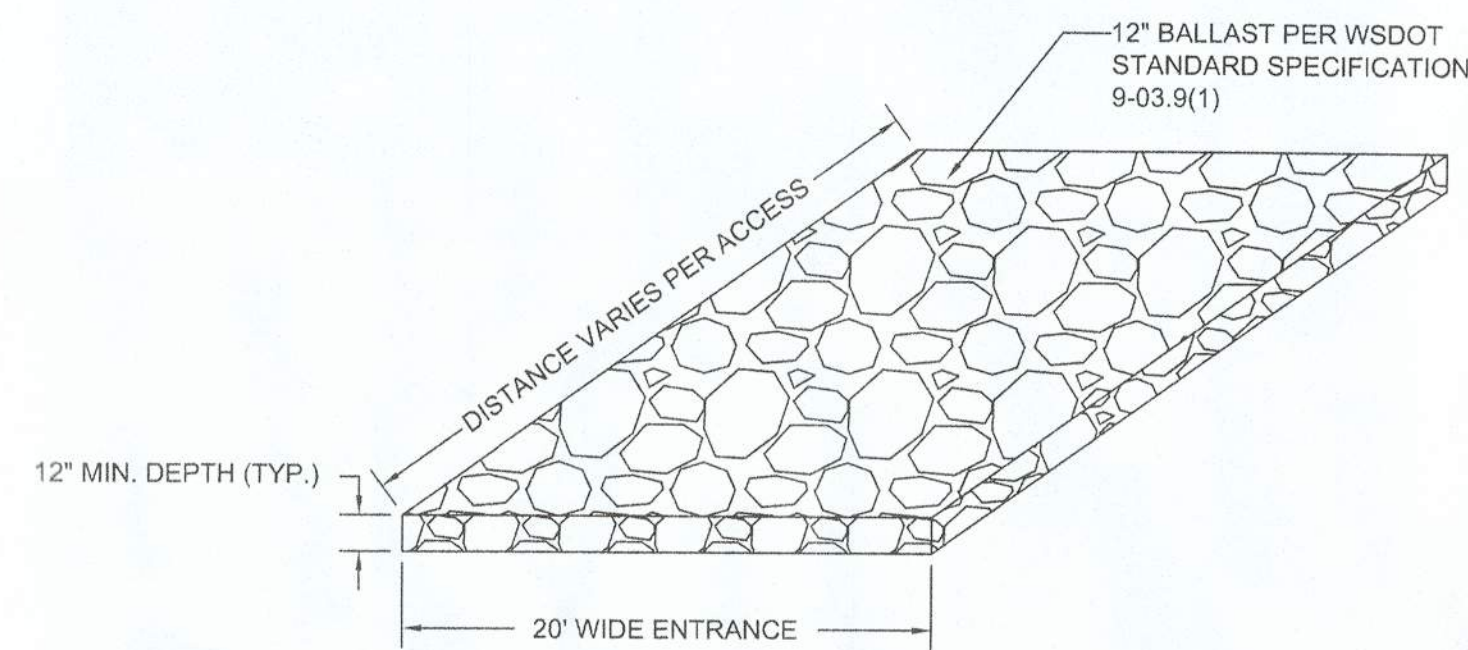
REVISIONS

NO.	DATE	BY
3rd Revision (Final)	03/15/07	HS



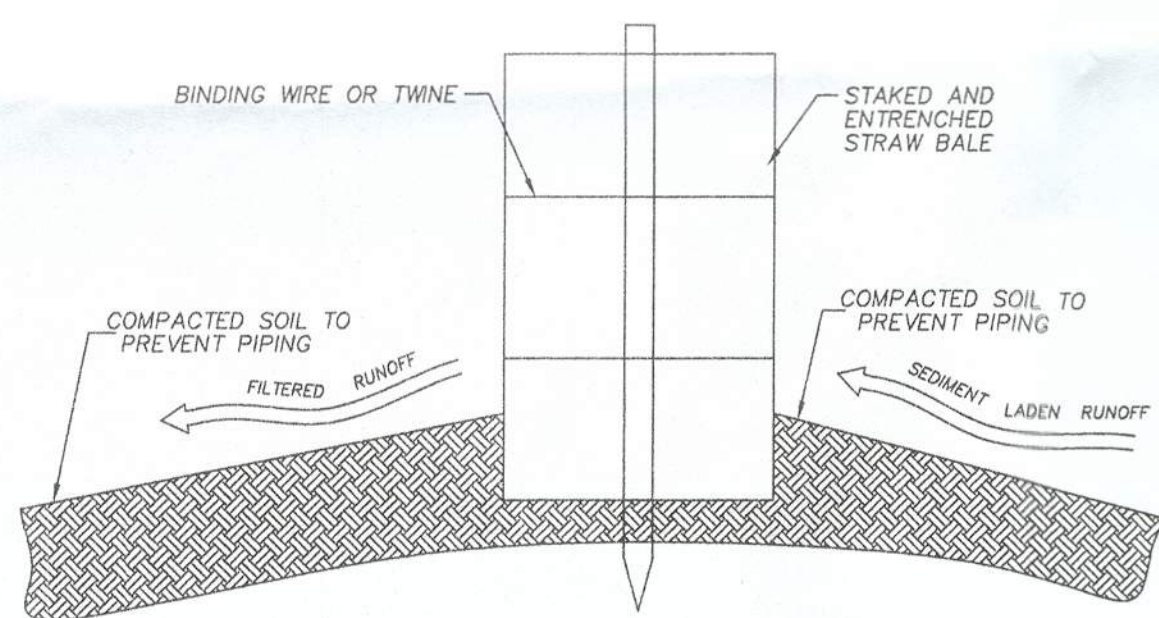
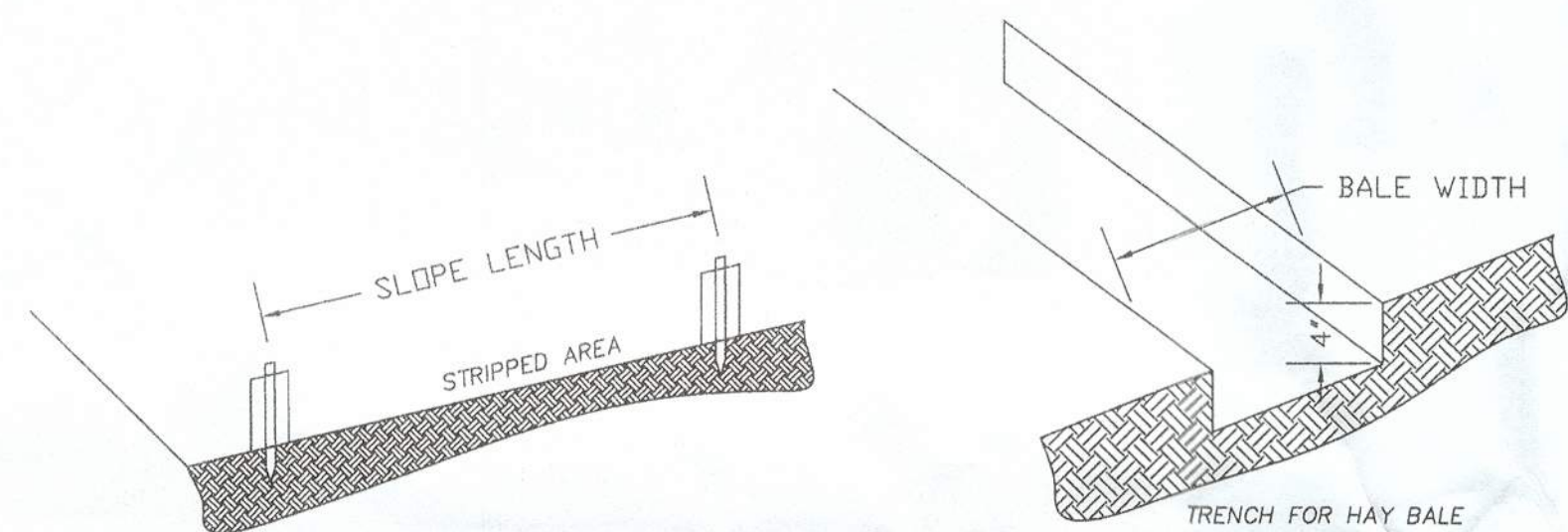
BIO BAG DETAIL

NOT TO SCALE



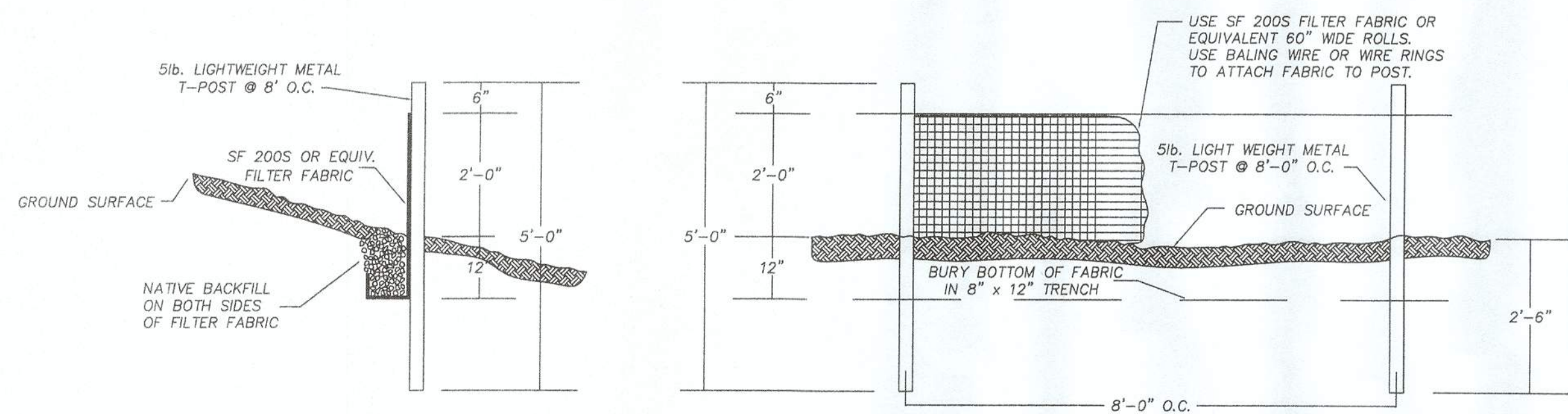
CONSTRUCTION ENTRANCE DETAIL

(NOT TO SCALE)



STRAW BALE CROSS-SECTION DETAIL

NOT TO SCALE



FILTER FABRIC FENCE DETAIL

NOT TO SCALE

Erosion Control General Notes:

1. Erosion control measures are not limited to the items on these plans. The contractor is responsible for the installation and maintenance of all erosion control measures. No siltation of existing or proposed drainage facilities shall be allowed. Care shall be taken to prevent migration of silts to adjoining wetlands.
2. Clearing limits and temporary erosion and sediment control (TESC) measures shall be in place prior to construction.
3. The contractor is responsible for maintaining and improving TESC measures as needed for the duration of the project and until acceptance of the owner. The contractor shall maintain erosion control measures in accordance with Department of Ecology standards.
4. All excavated materials shall be disposed of off site at a pre-approved and permitted location.
5. Apply coir netting or approved alternative to all embankment slopes greater than 4H:1V.
6. All work performed shall be per approved plans and specifications only.
7. Catch basins that may collect drainage from the site shall be protected with an approved BMP measure. The contractor shall verify location of all catch basins.
8. TESC measures shown are minimum requirements for anticipated site conditions. TESC facilities shall be upgraded as needed for unexpected storm events and modified to account for changing site conditions.
9. Any areas of exposed soils that will not be disturbed for two days during the wet season or seven days during the dry season shall be immediately stabilized with approved TESC methods (E.g. seeding, mulching, plastic covering, etc.).
10. Stabilize all areas that reach final grade within seven days.
11. Seed any areas to remain unworked for more than 30 days.
12. Upon completion of project, all disturbed areas must be stabilized.
13. Stockpiled material onsite shall be covered at all times when the stockpile is not in active use.
14. During the wet season, temporary cover shall be installed if an area is to remain unworked for more than two days.
15. Cover soils within two days from October 1st to April 30th and within seven days from May 1st to September 30th.
16. Clearing limits and TESC BMPs shall be in place prior to construction.
17. Bonded fiber matrix (BFM) shall be installed on finished slopes between August 15th and October 1st.

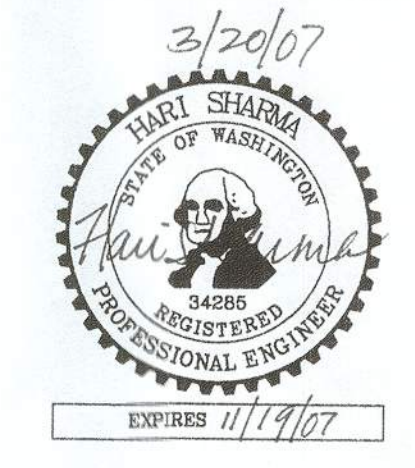
Silt Fence Notes:

1. Filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6" overlap, and securely fastened at both ends to post.
2. Posts shall be spaced a maximum of 6' apart and driven securely into the ground (minimum 30").
3. A trench shall be excavated approximately 8" wide and 12" deep along the line of posts and upslope from the barrier.
4. When standard strength filter fabric is used a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 1" long, tie wires or hog rings. The wire shall extend into the trench a minimum of 4" and shall not extend more than 36" above the original ground surface.
5. The standard strength filter fabric shall be stapled or wired to the fence, and 20" of the fabric shall be extended into the trench. The fabric shall not extend more than 36" above the original ground surface. Filter fabric shall not be stapled to existing trees.
6. When extra strength filter fabric and closer post spacing is used, the wire mesh support fence may be eliminated. In such case, the filter fabric is stapled or wired directly to the posts with all other provisions of above notes applying.
7. Filter fabric fences shall not be removed before the upslope area has been permanently stabilized.
8. Filter fabric fences shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.

Seeding Notes:

1. Erosion control measures shall consist of using bonded fiber matrix (BFM) and seeds. The contractor shall be responsible for retaining an erosion control specialist with knowledge in local soil and weather conditions to develop the erosion control measures. Erosion control measures shall consist of bonded fiber matrix (BFM) and appropriate seed mixtures to minimize impact to the wetlands.
2. Seed beds planted between May 1 and October 31 will require irrigation and other maintenance as necessary to frost and protect the root structure.
3. For seed beds planted between October 31 and April 30, armoring of the seed bed will be necessary, (e.g., geotextiles, jute mat, clear plastic covering).
4. Before seeding, install needed surface runoff control measures such as gradient terraces, interceptor dikes, swales, level spreaders and sediment basins.
5. The seed bed shall be firm with a fairly fine surface, following surface roughening. Perform all cultural operations across or at right angles to the slope.
6. Fertilizers are to be used according to suppliers recommendations. Amounts used should be minimized, especially adjacent to water bodies and wetlands.

FOR CONSTRUCTION



REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07

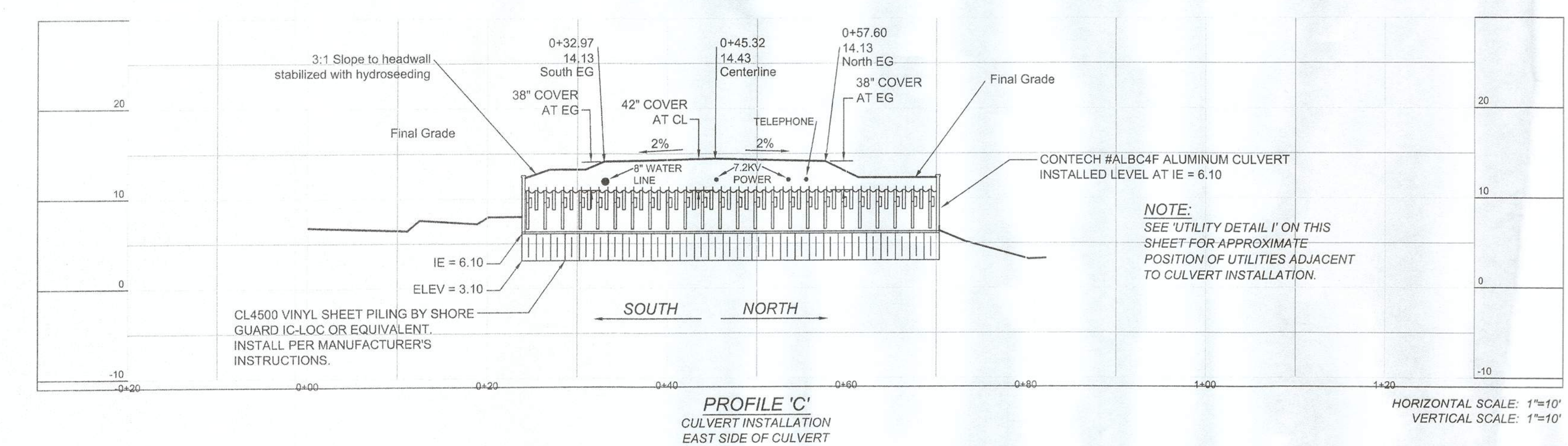
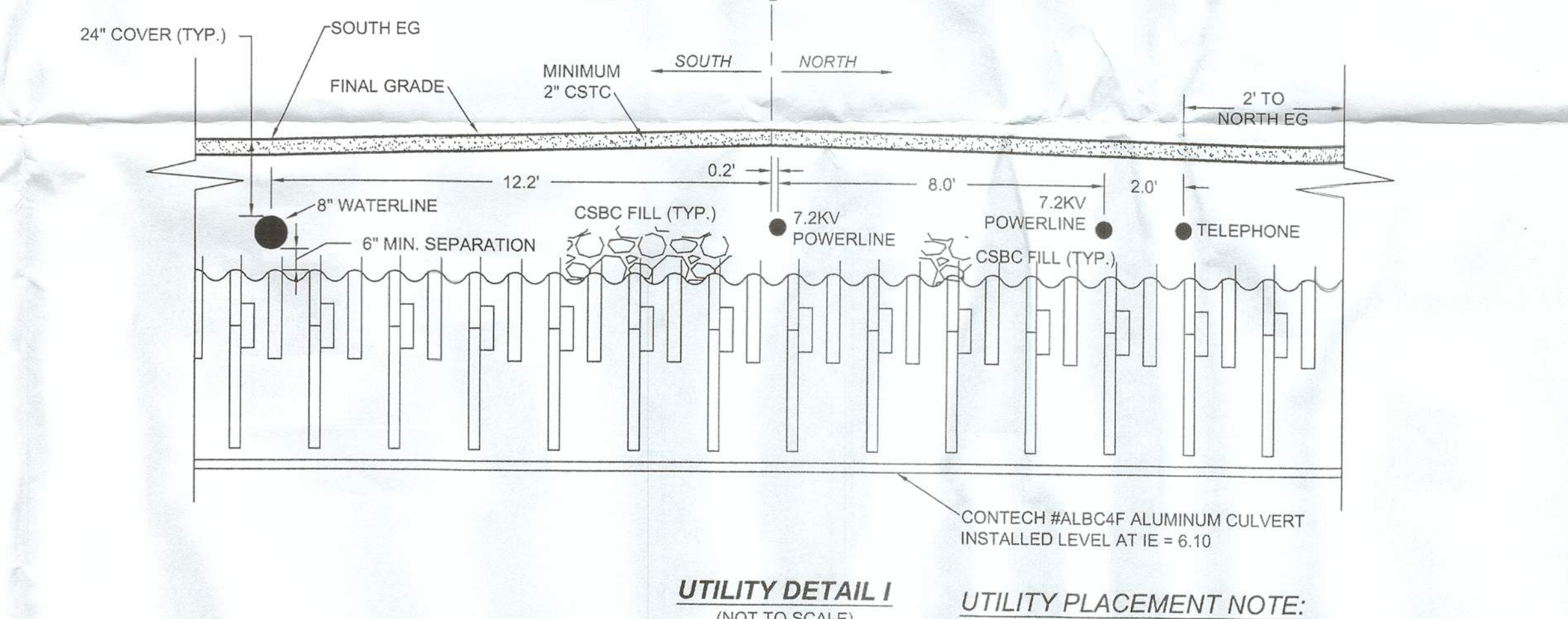
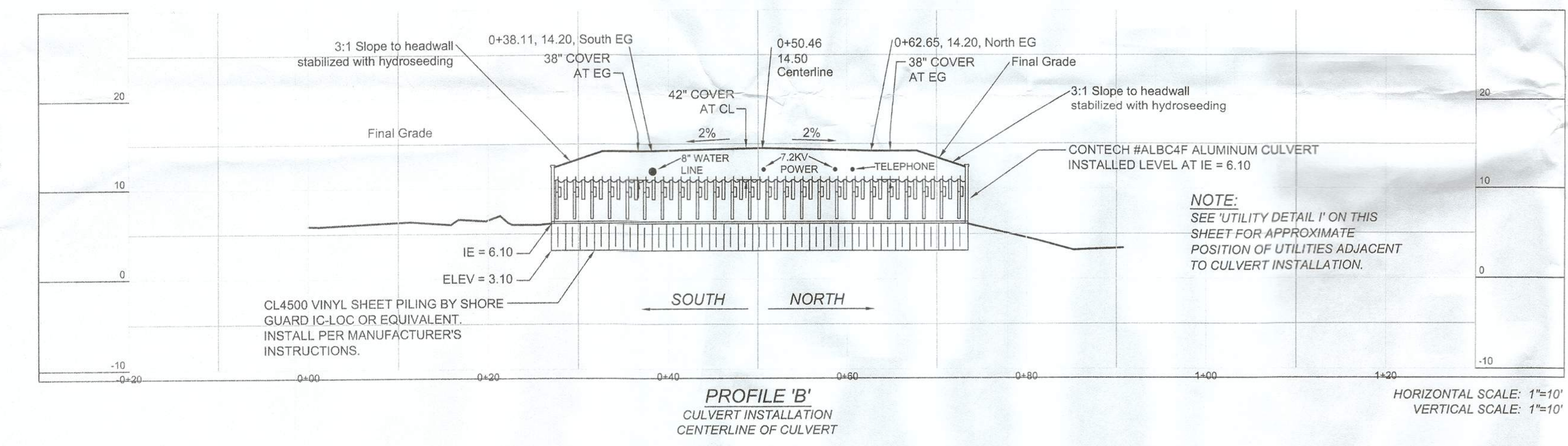
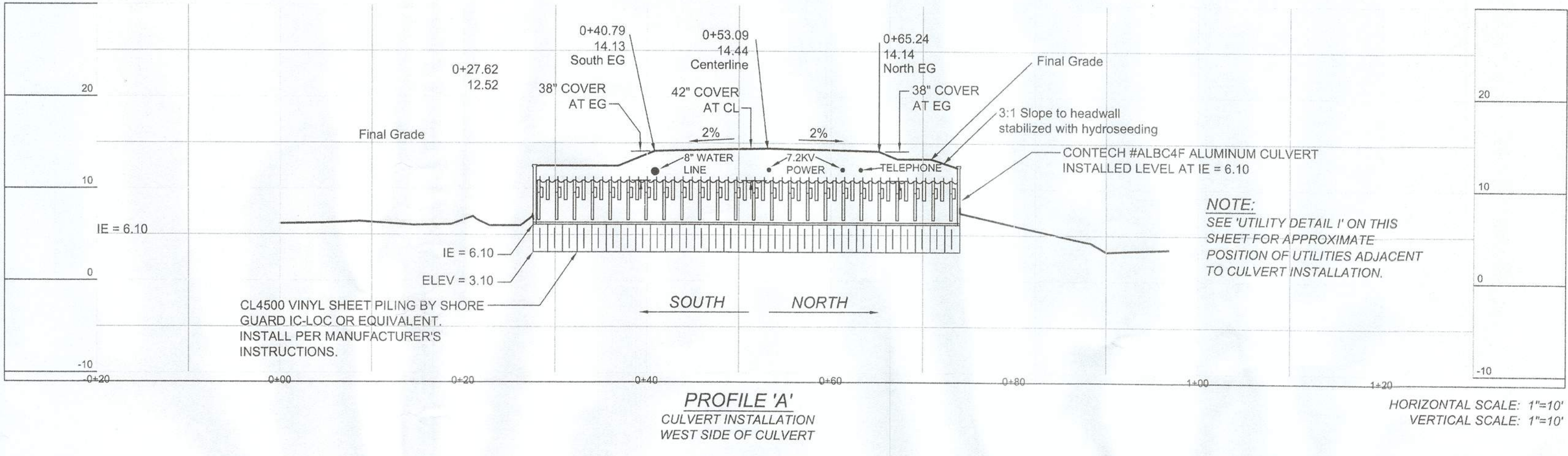
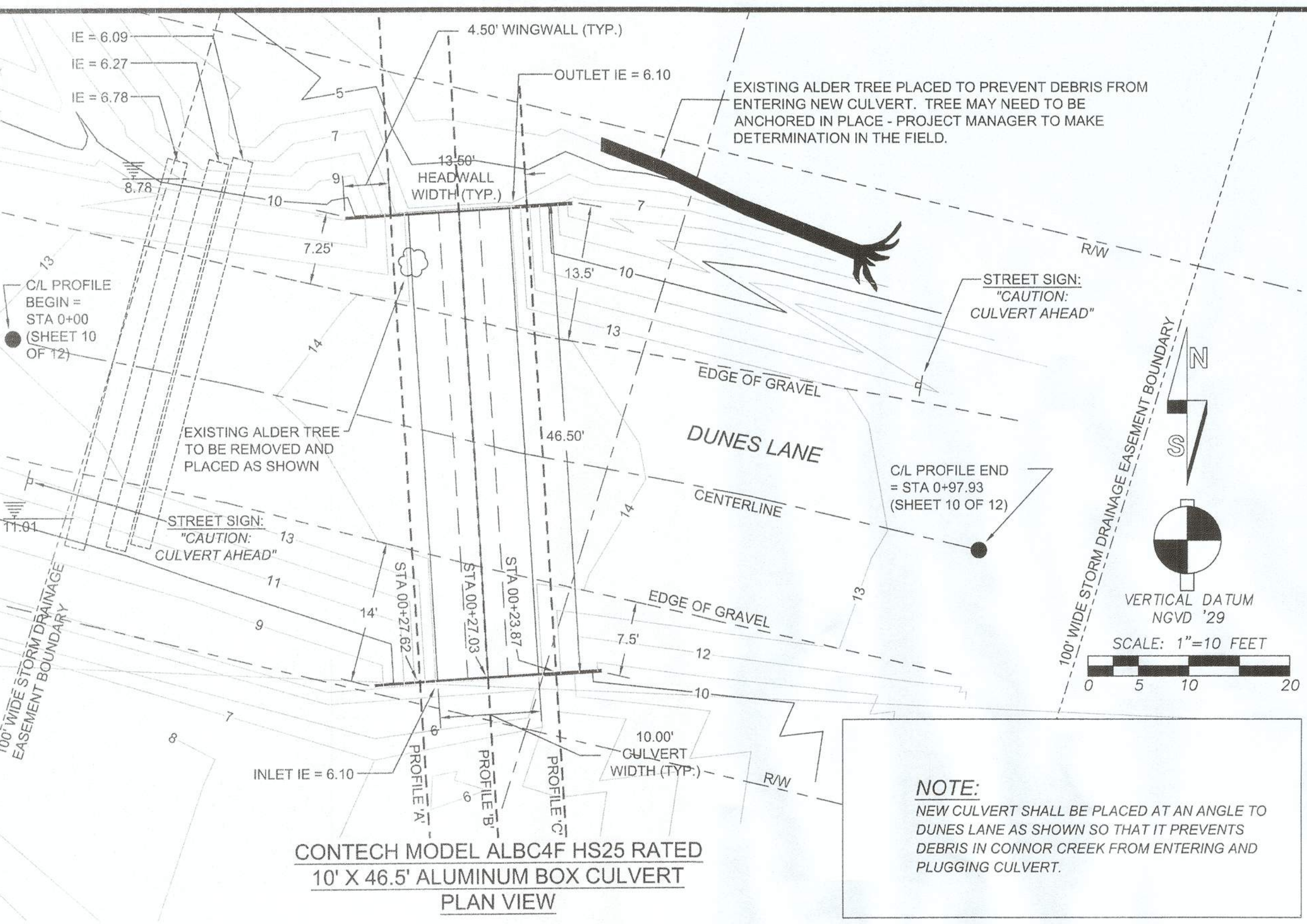
TESC Plan Details

Wetland Mitigation Civil Design
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BERGLUND, SCHMIDT & ASSOC., INC.

professional engineers and land surveyors
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JOB NO.	07.007
DATE	03/15/2007
SCALE	1"=100'
DESIGNED	HS
DRAWN	JMK
CHECKED	HS
APPROVED	HS
DRAWING NUMBER	C-8
SHEET	8 OF 12

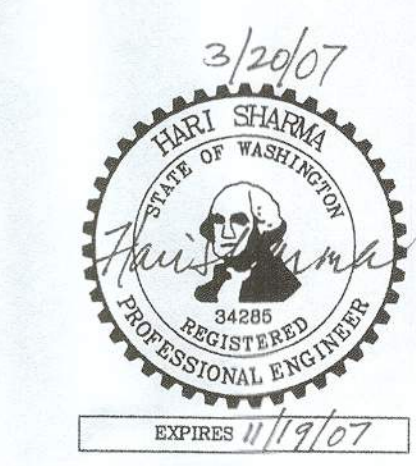


LEGEND

— CULVERT, SIZE AS NOTED

UNPAVED ROAD

FOR CONSTRUCTION



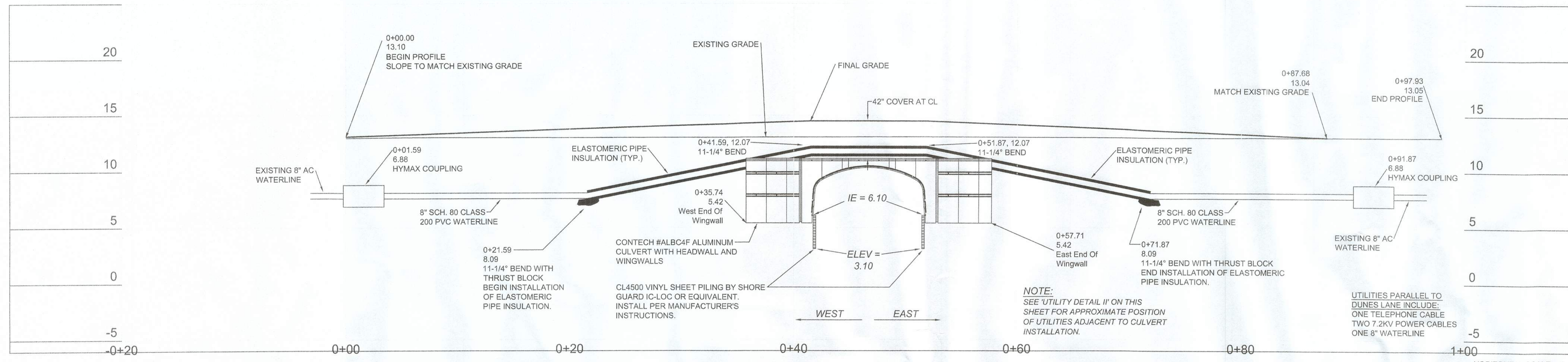
REVISIONS	BY	DATE
3rd Revision (Final)	HS	03/15/07

**Culvert Design
 Plan and Profile**

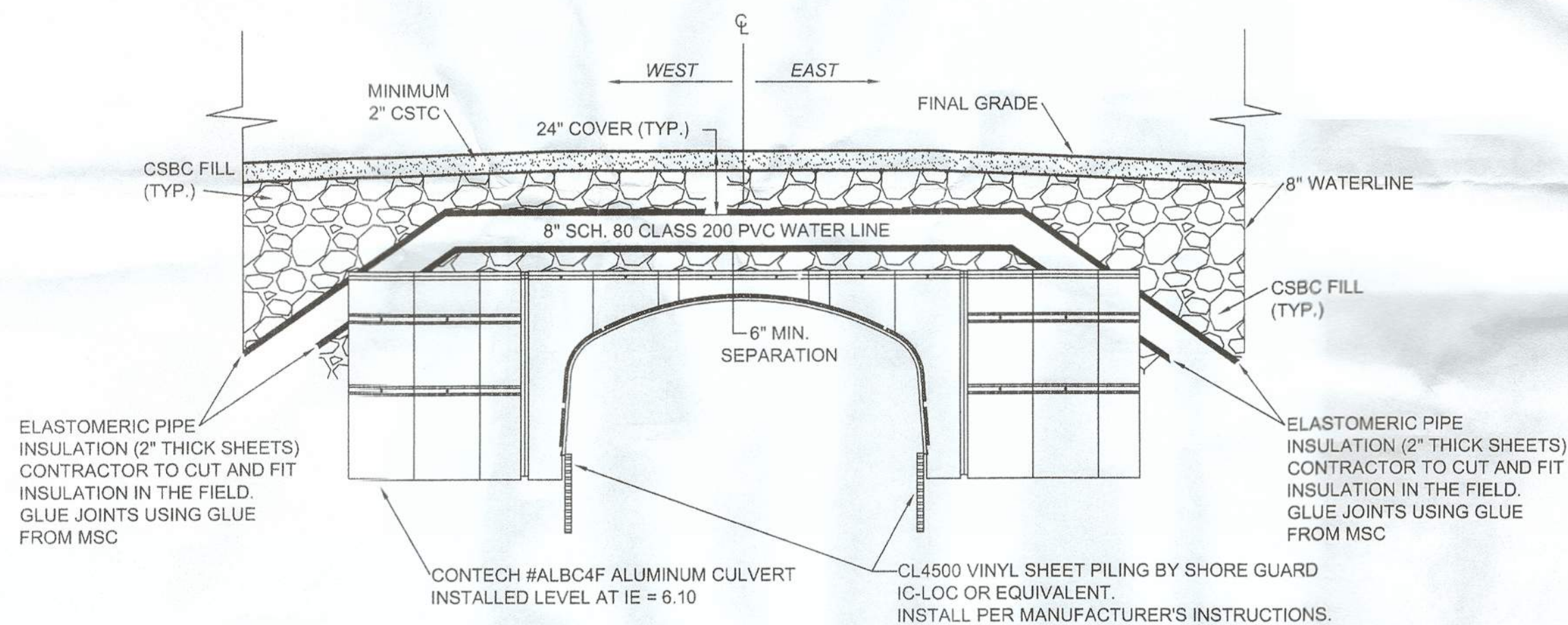
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APPROVED	HS
DRAWING NUMBER	C-9
SHEET	9 OF 12



PROFILE 'A'
CULVERT & WATER LINE INSTALLATION



UTILITY DETAIL II
(NOT TO SCALE)

WATER LINE NOTE:

WORK TO SLEEVE AND RELOCATE THE EXISTING 8" AC WATER LINE OVER THE NEW CULVERT, AS SHOWN ON THESE PLANS, IS BASED ON ASSUMED HORIZONTAL AND VERTICAL LOCATIONS RELATIVE TO THE NEW CULVERT. THE POSITIONS OF THE WATER LINE AND FITTINGS (11-1/2° BENDS, HYMAX COUPLINGS, THRUST BLOCKS, ETC.) MAY CHANGE AND WILL BE DETERMINED IN THE FIELD BY THE PROJECT MANAGER.

INSTALLATION DETAIL

NOTES:

1. CONCRETE THRUST BLOCKING TO BE POURED AGAINST UNDISTURBED EARTH.
2. PLASTIC BARRIER SHALL BE PLACED BETWEEN ALL THRUST BLOCKS & FITTINGS.
3. ANCHOR REBAR SHALL BE 5/8" MINIMUM DIAMETER.

THRUST LOADS

THRUST AT FITTINGS IN POUNDS AT 200 POUNDS PER SQUARE INCH OF WATER PRESSURE

PIPE DIAMETER	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND	DEAD END OR TEE
8"	14,300	7,700	4,000	2,000	10,100

THRUST BLOCK LOADING DETAILS

(NOT TO SCALE)

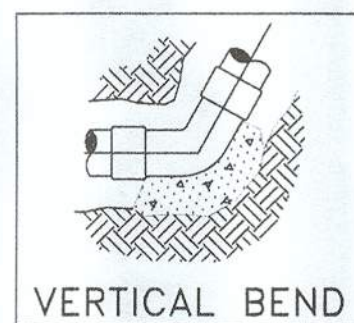
SAFE SOIL BEARING LOADS

FOR HORIZONTAL THRUSTS WHEN THE DEPTH OF COVER OVER THE PIPE EXCEEDS 2 FEET

SOIL	POUNDS PER SQUARE FOOT
MUCK, PEAT	0
SOFT CLAY	1,000
SAND	2,000
SAND & GRAVEL	3,000
SAND & GRAVEL CEMENTED WITH CLAY	4,000
HARD SHALE	10,000

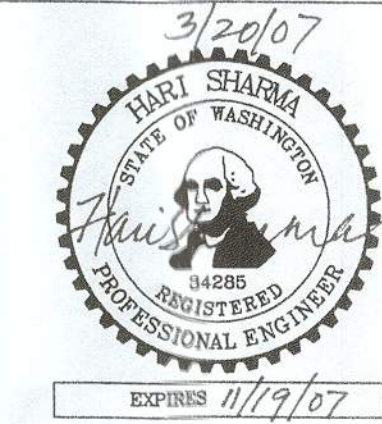
NOTES:

1. BLOCKING SHALL BE CEMENT CONCRETE CLASS "B" POURED IN PLACE AGAINST UNDISTURBED EARTH. FITTING SHALL BE ISOLATED FROM CONCRETE THRUST BLOCK WITH PLASTIC OR SIMILAR MATERIAL.
2. TO DETERMINE THE BEARING AREA OF THE THRUST BLOCK IN SQUARE FEET (S.F.):
EXAMPLE : 12" - 90° BEND IN SAND AND GRAVEL
32,000 LBS ÷ 3000 LB/S.F. = 10.7 S.F. OF AREA
3. AREAS MUST BE ADJUSTED FOR OTHER PIPE SIZE, PRESSURES AND SOIL CONDITIONS.
4. BLOCKING SHALL BE ADEQUATE TO WITHSTAND FULL TEST PRESSURE AS WELL AS TO CONTINUOUSLY WITHSTAND OPERATING PRESSURE UNDER ALL CONDITIONS OF SERVICE.



VERTICAL BEND

FOR CONSTRUCTION



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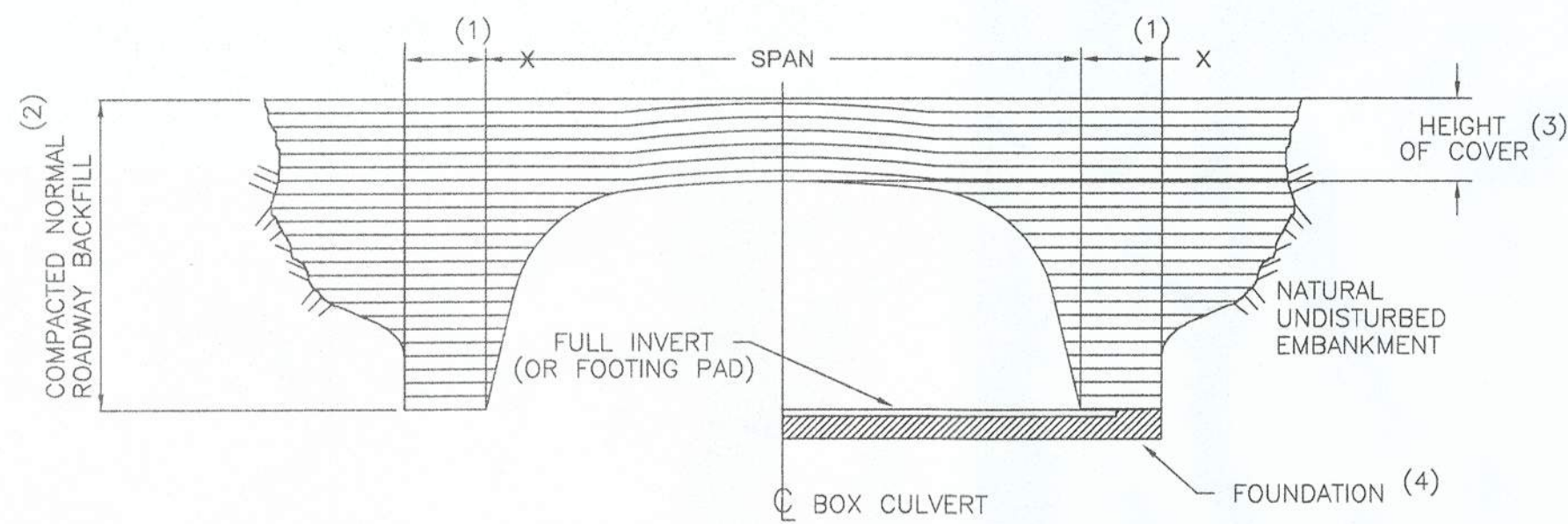
Culvert Design And Water Line Details

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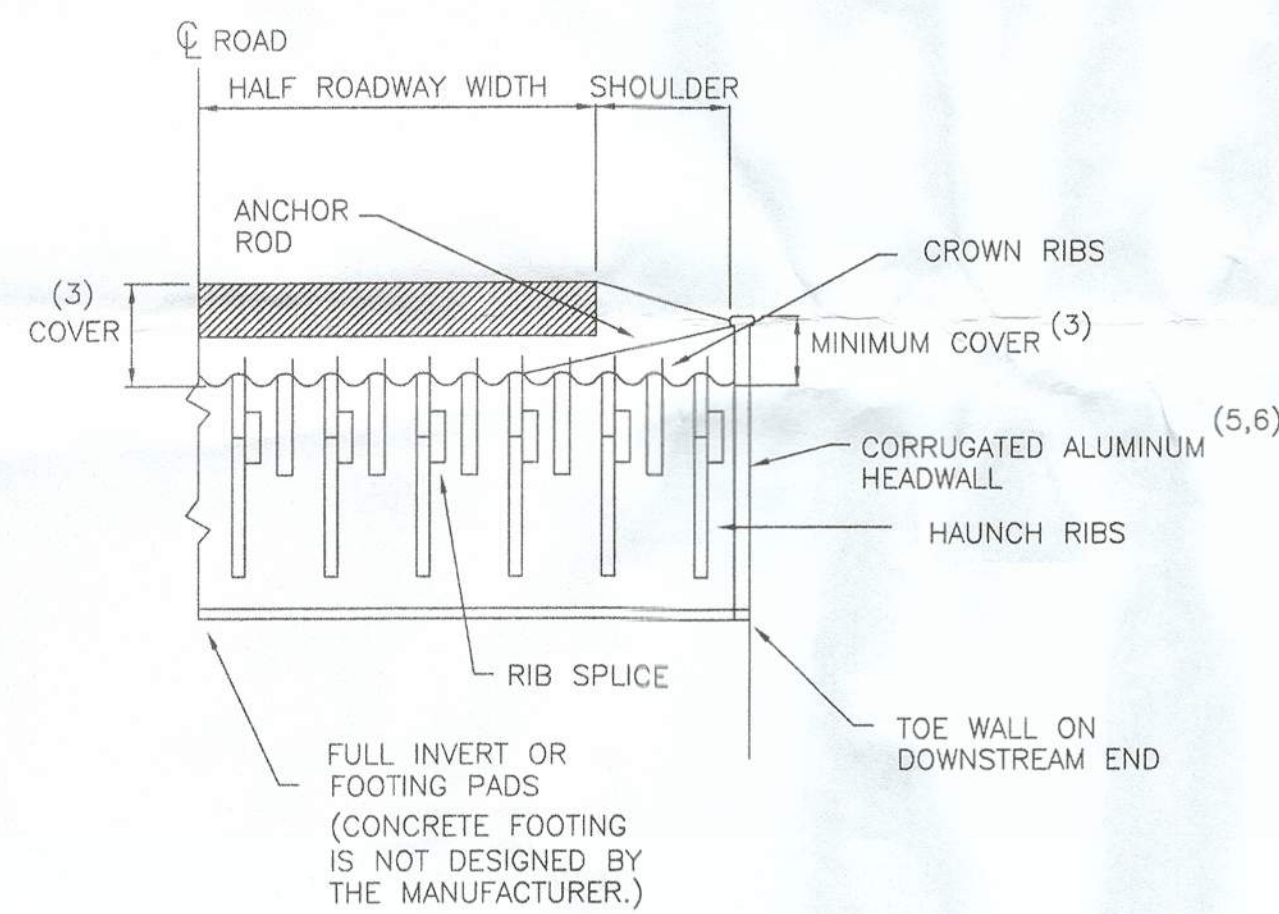
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DATE 03/15/2007
SCALE NTS
DESIGNED HS
DRAWN JMK
CHECKED HS
APPROVED HS
DRAWING NUMBER C-10
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INSTALLATION DETAILS



TYPICAL BACKFILL CROSS SECTION FOR CONTECH ALUMINUM BOX CULVERTS NOT TO SCALE

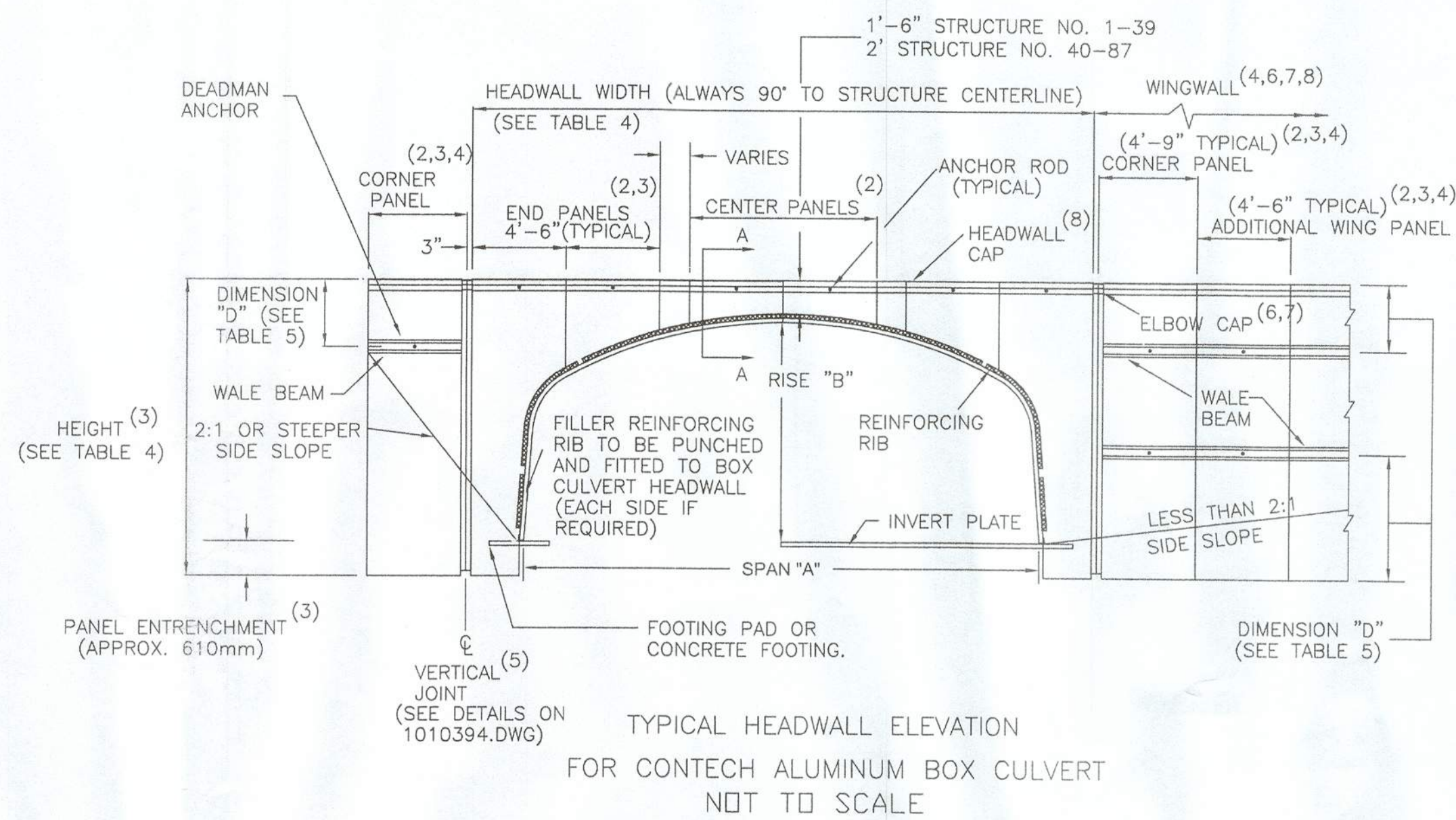
INSTALLATION DETAILS



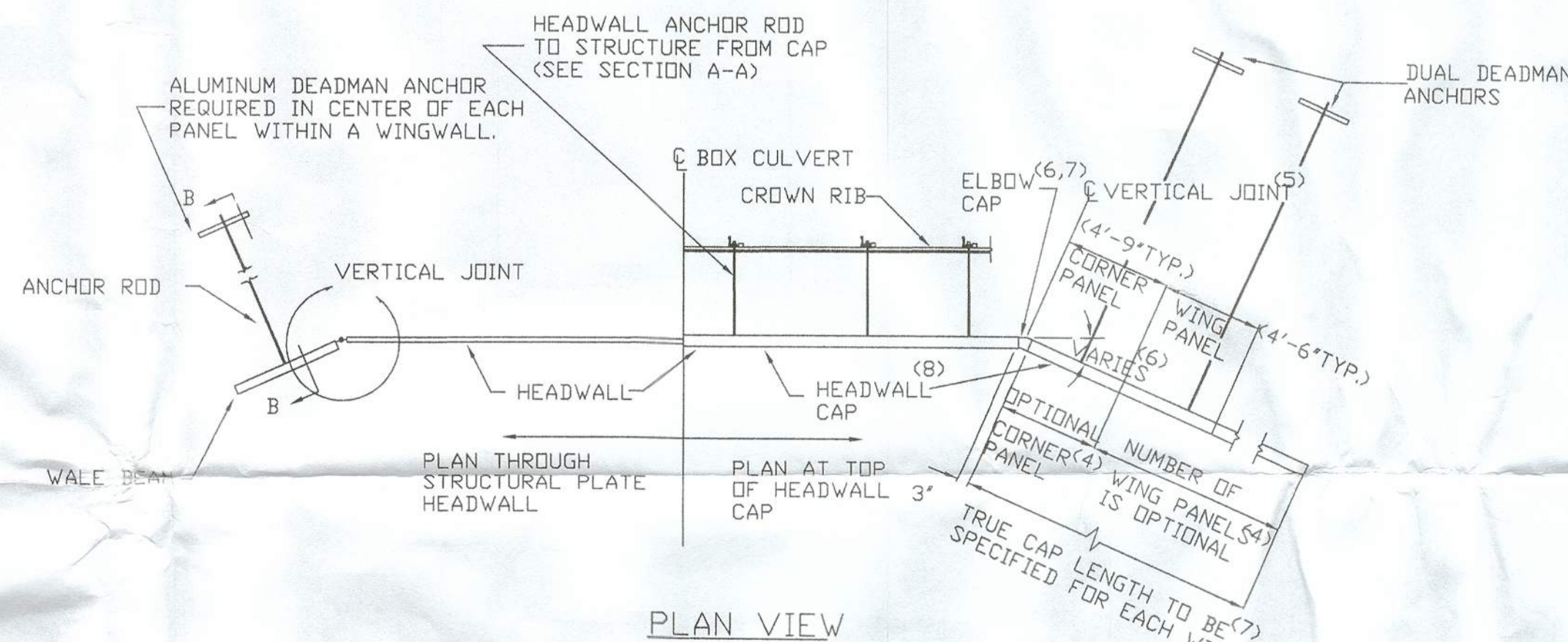
TYPICAL SQUARE END WITH ALUMINUM HEADWALL

INSTALLATION NOTES:

- X = SUFFICIENT SPACE FOR COMPACTION EQUIPMENT. IF SPACE IS NARROW, SPECIAL EQUIPMENT IS REQUIRED FOR COMPACTION OR CONCRETE GROUT IS REQUIRED.
- BACKFILL TO BE WELL GRADED GRANULAR, A-1, A-3, A-2-4, OR A-2-5, PER AASHTO M145, PLACED IN SIX- TO EIGHT- INCH LIFTS SYMMETRICALLY ON EACH SIDE COMPACTED TO MINIMUM 90% DENSITY PER AASHTO T180. D-4 OR SMALLER TO OPERATE NEAR AND ABOVE STRUCTURE DURING BACKFILLING TO FINISH GRADE. REFER TO ASTM B789 INSTALLATION SPECIFICATION.
- MINIMUM COVER MAY NEED TO BE INCREASED TO HANDLE TEMPORARY CONSTRUCTION VEHICLE LOADS (LARGER THAN D4) BUT NOT TO EXCEED MAXIMUM ALLOWABLE COVER FOR THE SPECIFIC BOX CULVERT DESIGN.
- FOUNDATION TO HAVE MINIMUM 4,000 PSF BEARING BEDDING. IT SHOULD CONSIST OF STABLE, WELL GRADED GRANULAR MATERIAL.
- STANDARD HEADWALLS SHOWN ARE FOR VERTICAL ORIENTATION ONLY. ANY DESIGN, OTHER THAN VERTICAL ORIENTATION, MUST BE REVIEWED BY THE DESIGN ENGINEER.
- THE TYPE AND EXTENT OF END TREATMENT ON THE BOX CULVERT SHOULD BE CHOSEN AND DESIGNED SO AS TO PREVENT THE LOSS OF BACKFILL DUE TO HIGH FLOW CONDITIONS.
- BOLT TORQUE REQUIREMENTS - PLATE LAP MUST BE PROPERLY MATED IN A TANGENT FASHION USING PROPER ALIGNMENT TECHNIQUES AND ADEQUATE BOLT TORQUE TO SEAT THE CORRUGATION. THE RECOMMENDED INSTALLATION BOLT TORQUE FOR ALUMINUM BOX CULVERTS IS 90-115 FT/LBS FOR FULL INVERTS AND 115-135 FT/LBS FOR ALL OTHER COMPONENTS. WHEN SEAM SEALANT TAPE IS USED, BOLTS SHALL BE INSTALLED AND RETIGHTENED TO THESE TORQUE LEVELS AFTER 24 HOURS. TORQUE LEVELS ARE FOR INSTALLATION, NOT RESIDUAL, IN-SERVICE REQUIREMENTS.
- FOR ASSEMBLY INFORMATION, SEE THE MANUFACTURER'S DETAILED ASSEMBLY DRAWINGS AND INSTRUCTIONS.



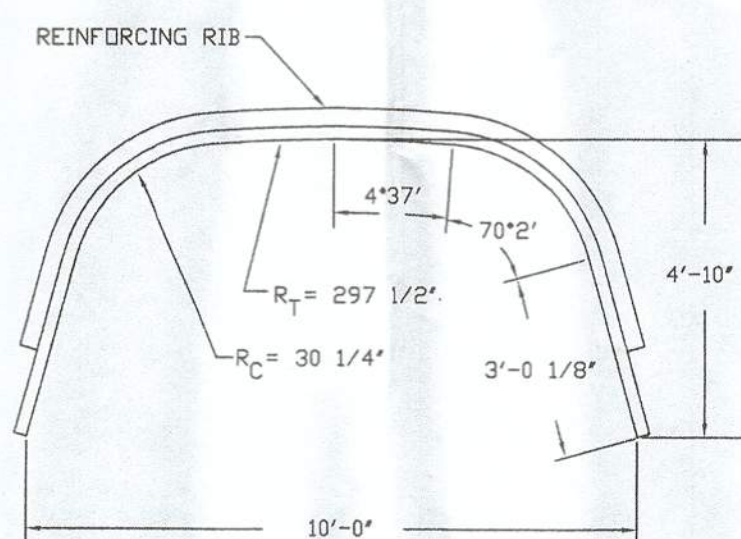
TYPICAL HEADWALL ELEVATION FOR CONTECH ALUMINUM BOX CULVERT NOT TO SCALE



PLAN VIEW

NOTES - HEADWALL

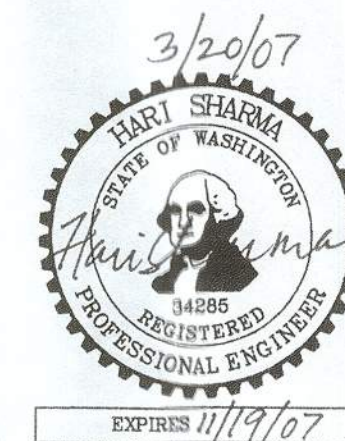
- ALL PANELS ARE FABRICATED FROM ALUMINUM STRUCTURAL PLATE AS SPECIFIED IN ASTM B746.
- CENTER PANELS ABOVE THE BOX CULVERT CROWN RADIUS ARE 0.100" THICKNESS FOR STRUCTURES 1-39 AND 0.125" FOR STRUCTURES 40-87. ALL OTHER PANELS ARE 0.150" THICKNESS. SEE TABLE 5 FOR PANEL THICKNESS.
- HEIGHT OF HEADWALL LISTED IN TABLE 4 PERMITS APPROXIMATELY 24" ENTRENCHMENT DEPTH BELOW THE INVERT. ALL HEADWALL PANELS MUST BE TRENCHED INTO EXISTING GROUND. IF STABLE ROCK FOUNDATION IS ENCOUNTERED, THE PANELS MAY BE TRIMMED AND PLACED INTO A CEMENT-GROUTED KEYWAY.
- NUMBER OF CORNER PANELS AND ADDITIONAL WING PANELS IS OPTIONAL.
- A VERTICAL JOINT IS USED ONLY WHEN A WINGWALL IS AT AN ANGLE WITH RESPECT TO THE HEADWALL.
- SPECIFY THE DEGREE OF HORIZONTAL ROTATION ON THE WINGWALL. THIS ANGLE SHOULD NOT EXCEED 90 DEGREES.
- THE TOP OF A HEADWALL AND ITS WINGWALL IS ALWAYS HORIZONTAL, UNLESS BEVELED WINGWALLS ARE REQUIRED. SPECIFY THE VERTICAL DROP IN ELEVATION FOR THE WINGWALL. THIS WILL SET THE PROPER VERTICAL ANGLE FABRICATION FOR THE HEADWALL ELBOW CAP AND THE PROPER OVERALL LENGTH OF THE WINGWALL CAP.
- HEADWALL CAP MUST BE FIELD-DRILLED AND BOLTED TO THE HEADWALL PANELS. SEE ASSEMBLY DRAWINGS FOR MORE DETAILS.
- STANDARD HEADWALLS SHOWN ARE FOR VERTICAL AND SQUARE ORIENTATION ONLY. ANY DESIGN, OTHER THAN VERTICAL AND SQUARE ORIENTATION, MUST BE REVIEWED BY THE DESIGN ENGINEER.
- IF SIDE SLOPE IS FLATTER THAN 2:1, A DOUBLE TIEBACK ASSEMBLY IS REQUIRED FOR EACH DEADMAN.
- STANDARD HEADWALLS ARE SHOWN. HS-20 WHEEL LOADS MUST BE KEPT A MINIMUM OF 36' FROM THE WALL FACE. SPECIAL HEADWALL PACKAGES CAN BE FABRICATED TO MEET OTHER LOADING REQUIREMENTS.
- CENTER OF DEADMAN ANCHOR IS PLACED 9" BELOW CENTER OF WALE BEAM.
- THE CROWN RIB USED TO CONNECT THE HEADWALL MUST BE ORIENTED SO THAT THE FLAT SURFACE IS FACING AWAY FROM THE HEADWALL. THIS MAXIMIZES THE LOAD CARRYING CAPABILITY OF THE CONNECTION SHOWN IN SECTION A-A.
- STRUCTURES ON CONCRETE FOOTINGS THAT USE HEADWALLS REQUIRE FIELD MODIFICATIONS OF THE HEADWALL PLATES SO THEY FIT AROUND THE FOOTINGS. THE NEED TO ATTACH THE PLATES TO THE FOOTING DEPENDS ON THE BACKFILL MATERIAL AND ITS POTENTIAL ERODIBILITY.



ALUMINUM HEADWALL DETAILS FOR CONTECH ALUMINUM BOX CULVERT NOT TO SCALE

SCALE: 1/2" = 1'-0"
APPROX. AREA = 40.2 SQ. FT.
ALUMINUM BOX CULVERT
STRUCTURE #4
10'-0" SPAN x 4'-10" RISE

FOR CONSTRUCTION



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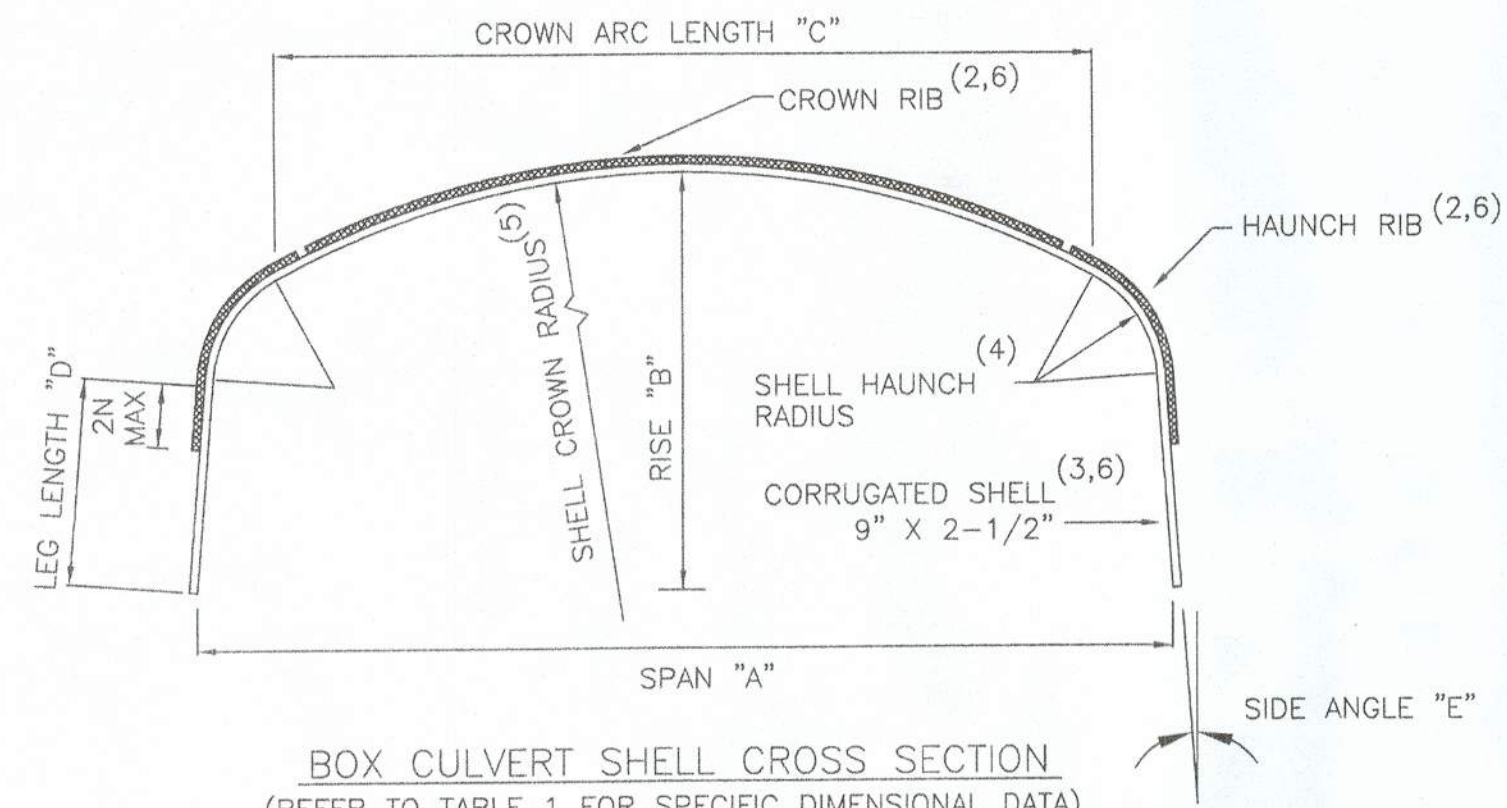
Culvert Design Details

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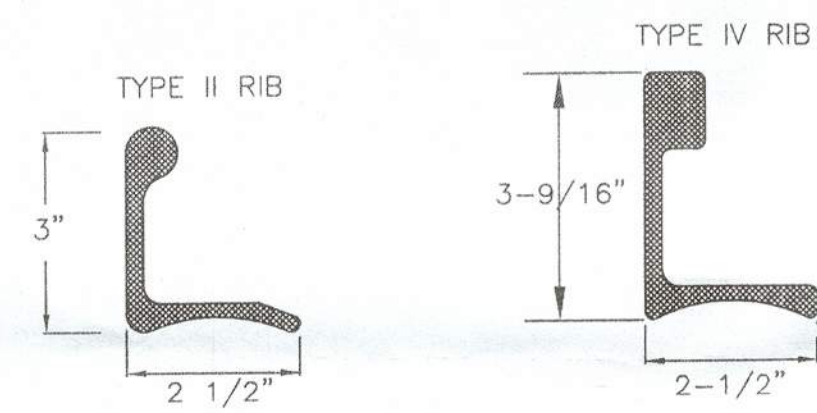
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PLATE AND RIB DETAILS



BOX CULVERT SHELL CROSS SECTION
(REFER TO TABLE 1 FOR SPECIFIC DIMENSIONAL DATA)



RIB GEOMETRY (2)

NOTES - SHELL

- N = 9.625" OR 9-5/8".
- ALL RIBS ARE TYPE IV, EXCEPT HAUNCH RIBS FOR STRUCTURES 1-39 WHICH ARE TYPE II.
- STRUCTURE 1 IS A ONE-PLATE SHELL. STRUCTURES 2-26 ARE TWO-PLATE SHELLS. STRUCTURES 27-87 ARE THREE-PLATE SHELLS.
- SHELL HAUNCH RADIUS FOR STRUCTURES 1-39 IS 30-1/4". SHELL HAUNCH RADIUS FOR STRUCTURES 40-87 IS 37-3/8".
- SHELL CROWN RADIUS FOR STRUCTURES 1-39 IS 297-1/2". SHELL CROWN RADIUS FOR STRUCTURES 40-87 IS 258-3/4".
- IN SHELL FILL HEIGHT TABLE 1, THE HG\CG DESIGNATION INDICATES THICKNESS OR GAGE OF HAUNCH (HG) AND CROWN (CG) PLATES AS FOLLOWS:
2 = .125", 3 = .150", 4 = .175", 5 = .200", 6 = .225", 7 = .250".
EXAMPLE: 3\6 = .150" HAUNCH AND .225" CROWN PLATE THICKNESS.
THE HRS\CRS DESIGNATION INDICATES THE RIB SPACING ON THE HAUNCH (HRS) AND CROWN (CRS) PLATES.
EXAMPLE: 27\9 = 27" O.C. HAUNCH AND 9" O.C. CROWN.
- ALLOWABLE COVER (MINIMUM AND MAXIMUM) IS MEASURED FROM THE OUTSIDE VALLEY OF CROWN PLATE TO BOTTOM OF FLEXIBLE PAVEMENT OR FROM THE OUTSIDE VALLEY OF CROWN PLATE TO TOP OF RIGID PAVEMENT. MINIMUM COVER IS MEASURED AT THE LOWEST FILL AREA SUBJECTED TO POSSIBLE WHEEL LOADS (TYPICALLY AT THE ROADWAY SHOULDER). THE ROADWAY SURFACE MUST BE MAINTAINED TO ENSURE MINIMUM COVER TO PREVENT HIGH-IMPACT LOADS BEING IMPARTED TO THE STRUCTURE. MAXIMUM COVER IS MEASURED AT THE HIGHEST FILL AND/OR PAVEMENT ELEVATION.
- SELECT THE STRUCTURE, WITH THE LOWEST ALPHABET SUB-DESIGNATION AND COVER RANGE, THAT WILL INCLUDE THE ACTUAL MINIMUM AND MAXIMUM COVER.
EXAMPLE: STRUCTURE 51-A IS MORE ECONOMICAL THAN 51-B IF THE COVER IS BETWEEN 3.0 AND 4.5 FEET.
- SHELL WT./FT. SHOWN IS MAXIMUM HANDLING WEIGHT AND IS BASED ON HEAVIEST COMPONENT MAKEUP FOR A SPECIFIC SPAN AND RISE COMBINATION. WEIGHT PER FOOT OF SHELL INCLUDES PLATES, REINFORCING RIBS, RIB SPLICES, BOLTS AND NUTS.
- TOTAL STRUCTURE LENGTH CAN BE ANY DIMENSION, BUT WHENEVER POSSIBLE, IT IS RECOMMENDED TO WORK WITH A MULTIPLE OF 4.5' (NET PLATE WIDTH). THIS PRACTICE USUALLY RESULTS IN LOWER TOTAL STRUCTURE COST.
EXAMPLE: 50' PROPOSED STRUCTURE / 4.5' = 11.1, NEAREST WHOLE NUMBER IS 11, THEREFORE USE 11 X 4.5' = 49.5' FOR TOTAL STRUCTURE LENGTH. WHEN ORDERING A STRUCTURE WITH TOEWALLS AND/OR HEADWALLS ON EACH END, TOTAL STRUCTURE LENGTH SHOULD BE A MULTIPLE OF 9'.
- ALUMINUM BOX CULVERTS, AS SHOWN ON THIS DRAWING, ARE DESIGNED TO MEET OR EXCEED THE AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGE'S SECTION 12.8 FOR STANDARD HIGHWAY HS-20 & HS-25 WHEEL LOADS.

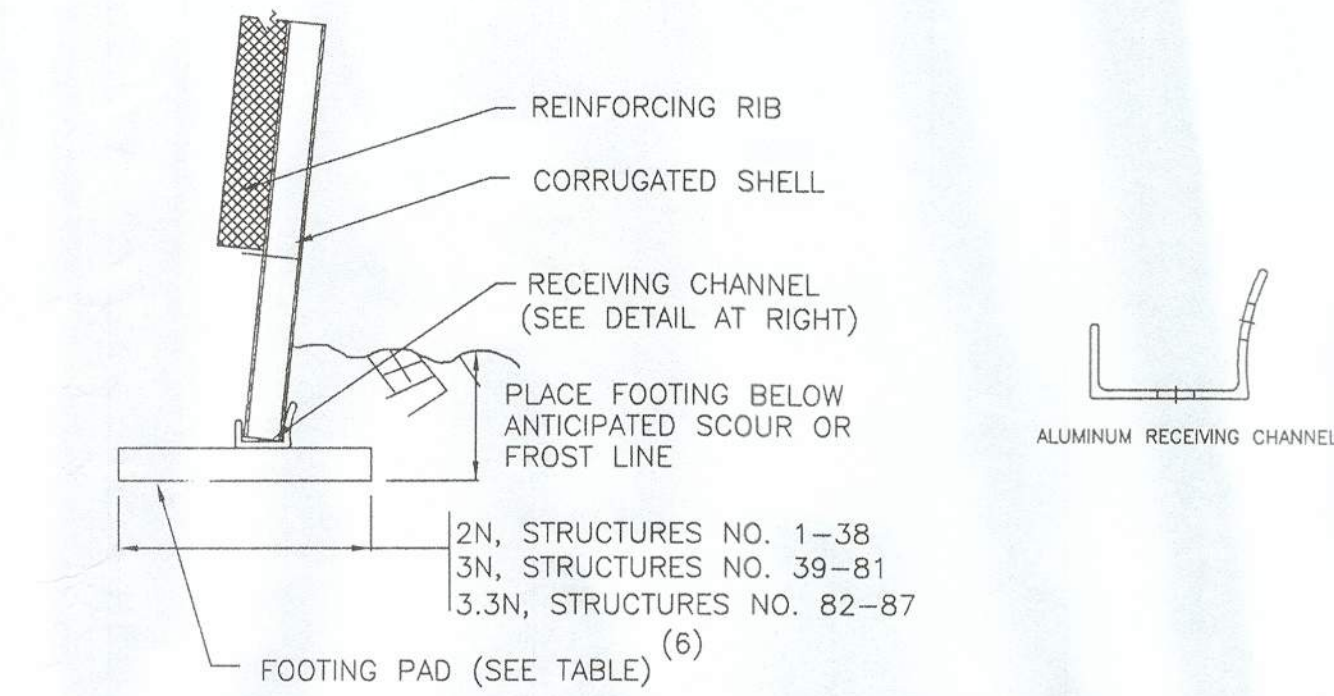
FOR CONTECH ALUMINUM BOX CULVERTS

TABLE 1B
PLATE AND RIB COMBINATIONS WITH (6,7,8)
ALLOWABLE HEIGHT OF COVER

HS-25 LOADING (11)

(3) STRUCT. NUMBER	SPAN "A" (FT-IN)	RISE "B" (FT-IN)	AREA (SQ. FT)	F		
				HG\CG (GA.)	HRS\CRS (IN.)	MIN MAX (FEET)
4	10-0	4-10	40.2	2\2	54\18	2.5 5.0

FOR CONTECH ALUMINUM BOX CULVERTS



ALUMINUM FOOTING PAD OPTION
FOR CONTECH ALUMINUM BOX CULVERT
NOT TO SCALE

NOTES:

- N = 9.625 INCHES.
- MINIMUM ALLOWABLE SOIL-BEARING PRESSURE IS 4,000 LB./SQ. FT. THIS APPLIES SPECIFICALLY FOR WIDTH "G" BELOW THE RECEIVING CHANNEL. OTHER CONDITIONS MAY BE ACCOMMODATED. CONTACT A CONTECH REGIONAL OFFICE FOR MORE INFORMATION.
- STRUCTURES WITH FULL INVERTS AND FOOTING PADS ARE LIMITED TO 4 FT. OR LESS MAXIMUM COVER. SPECIAL FULL INVERT AND FOOTING PAD DESIGNS OR SLOTTED CONCRETE FOOTINGS CAN ACCOMMODATE MAXIMUM COVERS SHOWN IN TABLE 1.
- INVERT PLATES OR FOOTING PADS MUST NOT BE OVERLAPPED ON ADJACENT STRUCTURES.
- STRUCTURES WITH .5 N TO 1.5 N LEG LENGTH REQUIRE FOOTING SPACING OR SLOT WIDTH TO ALLOW CLEARANCE FOR REINFORCING RIB EXTENDING INTO FOOTING SLOT.
- WHEN THE THICKNESS LISTED IS GREATER THAN 0.250 INCHES, THE FOOTING PADS WILL BE TWO OR MORE PIECES EQUALING THE COMPOSITE THICKNESS REQUIRED. SEE TABLE.

FOOTING PADS

STRUCT. NUMBER	HS-20 LOADING		HS-25 LOADING		MAX BOLTS /FT. (EA.)	(7) WT./FT. MAX (LB.)
	(8) GAGE WIDTH (IN.)	(1) GAGE WIDTH (N)	(8) GAGE WIDTH (IN.)	(1) GAGE WIDTH (N)		
4	0.100	2	0.100	2	3.56	22.9

NOTES - FULL INVERT & FOOTING PADS

- N = 9.625 INCHES.
- MINIMUM ALLOWABLE SOIL-BEARING PRESSURE IS 4,000 LB./SQ. FT. THIS APPLIES SPECIFICALLY FOR WIDTH "G" BELOW THE RECEIVING CHANNEL. OTHER CONDITIONS MAY BE ACCOMMODATED. CONTACT A CONTECH REGIONAL OFFICE FOR MORE INFORMATION.
- STRUCTURES WITH FULL INVERTS AND FOOTING PADS ARE LIMITED TO 4 FT. OR LESS MAXIMUM COVER. SPECIAL FULL INVERT AND FOOTING PAD DESIGNS OR SLOTTED CONCRETE FOOTINGS CAN ACCOMMODATE MAXIMUM COVERS SHOWN IN TABLE 1.
- WEIGHT PER METER OF FULL INVERT INCLUDES RECEIVING CHANNELS, SCALLOP PLATES, NUTS AND BOLTS, AND ALL PLATES FOR HS-20 LOADS.
- FULL INVERT PLATES ARE 0.100 INCHES THICK. WHEN REACTIONS TO THE INVERT REQUIRE ADDITIONAL THICKNESS, SUPPLEMENTAL PLATES OF THE THICKNESS AND WIDTH LISTED IN TABLE 2 ARE FURNISHED TO BOLT BETWEEN THE FULL INVERT AND THE RECEIVING CHANNEL.
- INVERT WIDTHS, 20N AND GREATER, ARE TWO-PIECES.
- WEIGHT PER METER OF FOOTING PADS INCLUDES RECEIVING CHANNELS, NUTS AND BOLTS, AND PLATES FOR HS-20 LOADS.
- WHEN THE THICKNESS LISTED IS GREATER THAN 0.250 INCHES, THE FOOTING PADS WILL BE TWO OR MORE PIECES EQUALING THE COMPOSITE THICKNESS REQUIRED. SEE TABLE 3.
- FLAT SHEET TOEWALLS ARE PROVIDED FOR BOTH END OF STRUCTURES USING A FULL CORRUGATED ALUMINUM INVERT TO HELP PREVENT WATER FROM UNDERMINING THE STRUCTURE.
- AN ALUMINUM SCALLOP PLATE DOES NOT MAKE A JOINT TIGHT ENOUGH TO PREVENT INFILTRATION OF FINE SILTS AND SANDS. IF THE BACKFILL INCLUDES SUCH MATERIAL, SOME ADDITIONAL STEPS SHOULD BE TAKEN AFTER ASSEMBLY, BUT PRIOR TO BACKFILLING. GEOTEXTILE IS PROVIDED FOR THIS PURPOSE.
- GROUT SHOULD BE NON-METALLIC, NON-SHRINK MATERIAL AND SHOULD CONTAIN NO CORROSION-PROMOTING AGENTS.
- THE TOTAL FLOW AREA OF ALL BOX CULVERTS INCLUDES THE AREA FROM THE CROWN TO THE INVERT OR FOOTING PADS IF THE PADS ARE BURIED. A REDUCTION IN THE TOTAL AREA SHOULD BE TAKEN INTO CONSIDERATION.
- INVERT PLATES OR FOOTING PADS MUST NOT BE OVERLAPPED ON ADJACENT STRUCTURES.
- STRUCTURES WITH .5 N TO 1.5 N LEG LENGTH REQUIRE FOOTING SPACING OR SLOT WIDTH TO ALLOW CLEARANCE FOR REINFORCING RIB EXTENDING INTO FOOTING SLOT.

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