TOWN OF GROTON

ROAD AND DRAINAGE STANDARDS

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September, 2002

ROAD AND DRAINAGE STANDARDS

FOR

TOWN OF GROTON, CONNECTICUT

September, 2002

Adopted by the Town of Groton Planning Commission at their November 21, 2000 meeting

REVISED	
Revision Number:_____	Date:_____

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GENERAL

1.1 PREAMBLE

Following are the Town of Groton Road and Drainage Standards adopted by the Planning Commission into the Subdivision Regulations by reference.

All new road and drainage construction and the design necessary thereto, will in general adhere to these road and drainage construction standards. The only deviation from these road and drainage construction standards permitted will be those approved by the Director of Public Works.

The layout of new roads, together with the geometric requirements pertaining thereto; and the classification of new roads, will in general adhere to the Subdivision Regulations with said section of the Subdivision Regulations being hereby adopted into these road and drainage construction standards by reference. The only deviations permitted from the geometric requirements of the Subdivision Regulations will be those requested in writing and receiving an approval of the Planning Commission after having received the recommendations of the Director of Planning and Development Services and Development Services and the Director of Public Works.

The developer is advised that a close correlation of the information given in both of these Road and Drainage Standards and the Subdivision Regulations is required. The developer is further advised that during the design stage he should periodically check with the Director of Planning and Development Services and the Director of Public Works in order to minimize revisions to final plans.

1.2 DEFINITIONS

Whenever in this Standard the following terms or pronouns are used, the intent and meaning shall be interpreted as follows:

Working titles having a masculine gender, such as "workman" and "journeyman" and the pronoun "he", are utilized in the specifications for the sake of brevity and are intended to refer to persons of either sex.

Aggregate: Inert material such as sand, stone, gravel, broken stone, crushed stone, slag or combinations thereof.

Approved Plans: Plans approved by the Planning Commission or the Department if Planning Commission approval is not required.

Bank Run Gravel: Gravel found in natural deposits usually more or less intermixed with fine material such as sand or clay or combinations thereof and meeting the requirements of Section 4.2.5.

Bond: A type of surety or collateral posted by the Developer which guarantees that all required improvements shall be completed as per the approved plans and these standards.

Calendar Day: Every day shown on the calendar, Sundays and holidays included.

Channel: A channel shall be interpreted to mean a natural or artificial watercourse having an average width at the bottom, after excavation, of 4 feet or more.

Consultant: A Professional Engineer or Land Surveyor hired by the Developer to prepare plans for any development or construction activity in the Town's right-of-way.

Contractor: An individual, partnership firm, corporation, legal entity or agent thereof, who is hired by the developer to actually perform the construction activity.

Crushed Stone: The product resulting from the artificial crushing of rocks, boulders or large cobblestones; substantially all faces of which have resulted from the crushing operation.

Cul-de-sac: A street or portion of a street with only one vehicular outlet.

Department: The Town of Groton, Department of Public Works.

Developer: An individual, partnership firm, corporation, legal entity or agent thereof, who or which undertakes the subdivision, resubdivision, or any construction activity within the Town's right-of-way.

Development: Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations.

Director: The Director of Public Works for the Town of Groton.

Disturbed Area: An area where the ground cover is destroyed or removed leaving the land subject to accelerated erosion.

DOT: The State of Connecticut, Department of Transportation.

Drainage Ditch: A drainage ditch shall be interpreted to mean an unpaved, artificially constructed open depression having an average width of less than 4 feet at the bottom, after excavation, constructed for the purpose of carrying off surface water.

Easement: The right to use land owned by another for a special limited purpose.

Embankment: Any artificial bank.

Engineer: The Supervisor of Technical Services (a.k.a. Town Engineer) for the Town of Groton.

Erosion: The detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Form 814A: The State of Connecticut - Department of Transportation - Standard Specifications for Roads, Bridges, and Incidental Construction, 1995.

Grading: Any excavating, grubbing, filling (including hydraulic fill) or stockpiling of earth materials or any combination thereof, including the land in it's excavated or filled condition.

Gravel: The coarse granular material larger than sand resulting from the natural erosion of rock.

Gutter: The area where the road meets the curbing for the purposes of carrying off or directing surface water.

Highway: The whole right-of-way which is reserved for, or secured by the State DOT for their roads.

Inspector: An authorized representative of the Department, assigned to make any and all necessary inspections of the work performed and materials furnished by the Contractor.

Lane: A strip of traveled way intended to accommodate the forward movement of a single line of vehicles.

Pavement Structure: The combination of bituminous concrete base course and surface course placed on the subbase to support the traffic load.

Planning Commission: The Town of Groton Planning Commission.

Plans: All drawings, or reproductions of drawings, pertaining to the construction or details of the work contemplated and its' appurtenances.

Processed Gravel: Gravel found in natural deposits usually more or less intermixed with fine material such as sand or clay or combinations thereof and meeting the requirements of Section 4.2.6.

Right-of-way: That portion of land between property lines over which a road, sidewalk, driveway, utilities and other public improvements are built or reserved for future use.

Road: The paved portion of the right-of-way. Interchangeable with the word "street".

Sand: The fine granular material, usually smaller than 1/4 inch, resulting from the erosion of rock by natural agencies or from the mechanical reduction of stone.

Sediment: Solid material, either mineral or organic that is in suspension is transported or has been moved from its site of origin by erosion.

Shoulder: The portion of the road contiguous with the traveled way for accommodation of stopped vehicles for emergency use.

Standards: The description, provisions, and requirements contained herein, designated as The Town of Groton Road and Drainage Standards together with all written agreements made or to be made pertaining to the method and manner of performing the work, or the quantities and qualities of materials to be furnished.

State: The State of Connecticut

Street: The paved portion of the right-of-way. Interchangeable with the word "road".

Structures: Bridges, culverts, catch basins, drop inlets, retaining walls, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work and not otherwise classed herein.

Subbase: Specified or selected gravel material placed upon the floor of cuts or upon embankments, the top surface of which supports pavements, shoulders and related appurtenances.

Subgrade: The surface of upon which the subbase is constructed.

Testing Laboratory: An independent testing laboratory approved by the Engineer.

Ton: 2000 pounds avoirdupois.

Town: The Town of Groton, a municipal corporation in the State of Connecticut.

Traffic: Pedestrians, vehicles and other conveyances, using the right-of-way for purposes of travel.

Traveled Way: That portion of the road especially prepared for the use of vehicular traffic, excluding surfaced shoulders, gutters and median.

Trench: An excavation, later refilled, necessary to the installation or removal of pipes, drains, endwalls, tanks, catch basins, manholes, etc.

1.3 ABBREVIATIONS (PUBLICATIONS AND STANDARDS)

Whenever the following abbreviations are used in this standard, the intent and meaning shall be interpreted as follows:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ANSI	American National Standards Institute
ASTM	American Society of Testing and Materials
DEP	Department of Environmental Protection
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code

OSHA	Occupational Safety and Health Administration

Abbreviations (Terms): Abbreviations and terms used in this standard are in lieu of and are to be construed the same as the respective expressions represented. Some of these abbreviations and terms, but not necessarily all, are:

cfs	Cubic Feet per Second
F	Fahrenheit
ft.	Foot
HDPE	High Density Polyethylene
lbs.	Pounds
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
sec.	Second
sf	Square Foot

1.4 AUTHORITY

A. During the construction or design process, if the consultant or contractor needs interpretation regarding these Standards, than he shall request interpretation from either the Inspector or Engineer. If the consultant or contractor does not agree with the interpretation, then it may be appealed to the Director. The Director shall have the final decision in regards to these Standards.

B. Any proposed deviation from the design and construction methods in these standards must be requested in writing to the Director whose decision shall be final.

C. If there is any discrepancy between these standards and the approved plans in regard to materials, construction methods, or the details, these Standards shall supersede the approved plans.

D. The Director shall have the authority to update these Standards with minor modifications provided that these modifications do not affect public safety, conflict with Town, State, or Federal laws and regulations, nor alter the intent of these Standards.

SECTION 2
ADMINISTRATIVE REQUIREMENTS

2.1 ROAD ACCEPTANCE PROCEDURE

A. When an individual, firm, or corporation desires a road, constructed under these Standards, to be accepted by the Town into the existing road system. the following procedure is required.

1. Petition by owner of said road to be presented to the Planning Commission accompanied by all of the necessary deeds (Section 2.4) and "as-built" plans (Section 2.8).

2. Referral by the Planning Commission to the Director of Planning and Development Services for a report.

3. Referral by the Planning Commission to the Department for a report.

   a. Certification by the Director that the road was constructed in accordance with these Standards. The report shall include any deviations permitted by the Director and/or the Planning Commission.

4. Planning Commission will act and then forward its recommendation to the Representative Town Meeting (RTM) Public Works Committee.

5. Referral by RTM to Public Works Committee for report.

6. Action by RTM as a body.

B. Limits of Road Acceptance

1. No road will be accepted unless application, including the necessary deeds and as-built plans, has been filed with the Planning Commission prior to November 1 or after March 1 of the subsequent year.

2. No road will be accepted unless it is constructed for the entire length as shown on the approved plan by the Planning Commission. No temporary turn-around will be allowed unless the approved plans call for one.

3. An application for acceptance filed with the Planning Commission within three years from the date of final approval will be considered by the Planning Commission and the RTM for acceptance. Roads not offered for acceptance within five years (or more if an extension is granted by the Planning Commission) of final Planning Commission approval must be constructed in accordance with the Standards in effect at the time they are offered for acceptance.

2.2 PUBLIC IMPROVEMENT BONDS

A. In order to assure maintenance and completion of all proposed public improvements, the developer must post performance and maintenance bonds in accordance with Section 5 of the Towns' Subdivision Regulations.

2.3 EXCAVATION PERMIT

A. If a developer, contractor, utility company, or property owner is working within a Town right-of-way, easement, or on Town property, then an Excavation Permit from the Department is required.

B. The excavation permit shall be issued by the Department in accordance with the Town Code of Ordinances: Chapter 13.5, Articles II & III.

C. If a developer is working within a State highway then a Highway Encroachment Permit is required from the DOT.

2.4 RIGHT-OF-WAY DEEDS

A. The developer must submit, warranty deeds dedicating the right-of-way shown on the approved subdivision plans, to the Town. The deeds shall be written in a format approved by the Department.

2.5 EASEMENTS

A. Drainage Easements

1. Where drainage facilities are not included within the road right-of-way, a perpetual unobstructed easement at least 20' in width for such drainage facilities shall be provided across property outside the road right-of-way and with satisfactory access to the road. Drainage easements shall be carried from the road right-of-way to a natural watercourse or to other drainage facilities together with the right to discharge stormwater carried by the drainage system.

2. When a proposed drainage system will carry water across private land outside a subdivision, appropriate drainage easements must be secured at no cost to the Town. Said rights shall be deeded to the Town.

3. The developer must submit warranty deeds dedicating the easement, shown on the approved subdivision plans, to the Town. The deeds shall be written in a format approved by the Department.

B. Sidewalk Easements

1. Where special conditions make impractical the inclusion of a sidewalk within the road right-of-way, a perpetual unobstructed easement 1' outside the back of the sidewalk shall be provided across property outside the road right-of-way.

2. When a proposed sidewalk goes over private land outside of the right-of-way, appropriate easements must be secured at no cost to the Town. Said right shall be deeded to the Town.

3. The developer must submit warranty deeds dedicating the easement, shown on the approved subdivision plans, to the Town. The deeds shall be written in a format approved by the Department.

C. Utility Easements

1. Where utility (sanitary sewer, water, telephone, electric, gas, CATV) facilities are not included within the road right-of-way, a perpetual unobstructed easement at least 20' in width for such facilities shall be provided across property outside the road right-of-way and with satisfactory access to the road.

2. When a proposed utility goes over private land outside of the subdivision, appropriate easements must be secured at no cost to the Town. Said right shall be deeded to the Town.

3. The developer must submit warranty deeds dedicating the easement, shown on the approved subdivision plans, to the Town. The deeds shall be written in a format approved by the Department.

2.6 SLOPE RIGHTS

A. Whenever the construction of a road, sidewalk, drainage system or it's appurtenances requires the cutting, filling, or grading of land not owned by either the State, Town, or developer, then the developer shall obtain the right to cut, fill, or grade from the property owner.

B. Such rights shall be obtained whether the cutting, filling, or grading is temporary or permanent.

C. The developer must submit the slope rights to the Town in writing.

D. The slope rights may be in a letter format approved by the Department clearly stating the work to be done and signed by all affected parties.

2.7 CONSTRUCTION PLANS

A. Construction plans for any road and/or drainage improvements or installation shall be prepared and stamped by a Professional Engineer licensed in the State of Connecticut.

However, minor improvements such as the installation or replacement of a driveway apron on an existing road, curbing installation, etc... can be shown on a sketch prepared by the developer.

The Director shall determine whether or not an improvement needs to be shown on a plan prepared by a licensed Professional Engineer.

B. Plan sheet(s)

1. Plan sheet(s) shall be at a scale of no smaller than 1" = 40' showing the location of all existing and proposed underground and overhead utilities and topographic information to a point 25' outside the right-of-way line or construction limits. Contours at an interval of at least 2' shall be shown.

   The difference between existing and proposed information shall be clearly defined and easily recognizable.

C. Profile Sheet(s)

1. Profile sheet(s) shall be at a scale of no smaller than 1" = 4' vertically to 1" = 40' horizontally. The profile shall be along the road centerline and show, but not be limited to, the following:

   a. Existing and proposed road centerline profiles.

   b. Proposed road centerline grades at 25' stations.

   c. Vertical curve data shall be shown for all vertical curves.

   d. Existing and proposed storm drainage lines, sanitary sewers, watermains, and gas mains. Manholes and catch basins must note associated inverts and top of frame elevations.

D. Sightline Sheet(s)

1. Sightline distance shall be shown at all intersections at both existing and proposed roads. Distances and vertical heights shall be as defined in these standards and the *AASHTO* Manual on Road and Geometric Standards.

E. Cross Section Sheet(s)

1. Where steep cross slopes exist, cross sections of all proposed streets may be required. If required, they shall be at a scale of no smaller than 1" = 5' both vertically and horizontally. They shall be at right angles to the road centerline and at 50' stations and extend to at least 25' past the right-of-way line or where the proposed grade intersects the existing grade.

F. Special Structures

1. Detailed drawings shall be submitted for special structures proposed as part of road and drainage construction. These structures shall include, but are not limited to, the following:

   a. Retaining Walls
   b. Box Culverts
   c. Bridges
   d. End and Head Walls
   e. Special Storm Water Structures

2. Work shall not proceed on these structures or other related appurtenances until the drawings have been reviewed and approved by the Town.

   Failure to follow this requirement may result in rejection of such structure, requiring reconstruction of same.

G. Details

1. Detail drawings of all applicable structures and roadway appurtenances shall be included in the plan set. Many of the necessary details are included in Section 5 of this standard

2. The details shall comply with those shown in Section 5 of this standard.

2.8 AS-BUILT PLANS

A. As-built plans for work within the right-of-way, easements, drainage and sanitary sewer systems that the Town will own and maintain must be submitted to the department.

B. As-built plans must be original plans. Marked up construction plans will not be accepted.

C. As-built plans shall be in ink on mylar. Size shall be 24"x36".

D. Road/Drainage As-built plans shall include

1. Right-of-way

   a. Right-of-way lines with bearings and distances and all curve data.
   b. All monuments marking right-of-way
   c. One monument shall have coordinates based on the Connecticut Grid System 1988.

2. Easements and Open Space (Separate plan sheets may be required for clarity)

   a. Property/easement line with bearings and distances and all curve data.
   b. All monuments marking open space.

3. Road

   a. Curbline or edge of pavement
   b. Centerline grades at 25' stations
   c. Sidewalks and driveway aprons
   d. Handicap ramps

4. Utilities (electric, water, telephone, CATV, gas)

   a. Location of all manholes, handholes, streetlights, hydrants, transformers, CATV boxes, shut-off valves and other at-grade appurtenances.

5. Storm Drainage

   a. All catch basins, manholes, inlets, and outlets with all inverts and top of frame elevations.
   b. All pipe routes, pipe sizes and material, and pipe inverts.
   c. Any footing drain or underdrain pipe and size.

E. Sanitary Sewer

1. Sanitary sewer shall be on a separate sheet that contains the sanitary sewer as-built only.
2. As-built shall be prepared in accordance with the Town sewer construction standards.

SECTION 3
DESIGN SPECIFICATIONS

3.1 GENERAL

The following are standard design specifications and the sole interpretation of these standards shall be by the Director. In his interpretation, the Director may rely on supplementary specifications that are recognized in the design field. Omissions, errors or discrepancies in these specifications shall not relieve the developer and/or consultant from their responsibility of designing all facilities in a professional manner.

In addition to all requirements established herein, all designs shall comply with the following:

a. Applicable state and federal laws and regulations.

b. Applicable zoning and Town subdivision regulations, building and housing codes, and all other applicable Town laws, codes or regulations.

c. Town Plan of Development and Capital Improvement Program.

d. State of Connecticut Department of Transportation if the improvements impact a state highway or structure.

3.2 ROADWAY

1. General Requirements

   a. Proposed roads shall be laid out in accordance with the Towns' Subdivision Regulations.

   b. Proposed roads shall be designed in accordance with the construction standards and right-of-way widths shown in the construction details. Roads shall be designed in accordance with the classifications listed below.

2. Classification

a. All streets shall be designed and constructed in accordance with the following classifications:

1. *Arterial:* Arterial Streets are generally State highways and are therefore not covered under these Road and Drainage Standards. Consult with the Department and/or the State DOT for design and construction criteria for these types of roads.

2. *Collector Street:* A street carrying moderate volumes of traffic and serving areas that do not generate high traffic volumes. These streets provide links between access and arterial streets and are defined as Collector Streets in the Plan of Development. Existing Town collector streets are listed in the Appendix.

3. *Residential Access Street:* A street primarily providing access to individual properties and not likely to be used by traffic other than that having an origin or destination on the street.

4. *Village Road:* A street whose purpose is to serve a fixed number of lots (dwelling units) which will not overburden the roadway. The primary function of this street is access to property, not traffic movement. Village Roads shall not be considered where there are more than 20 dwelling units having access onto the proposed road or where total through traffic on the road exceeds substantially more than 400 Average Daily Traffic (approximately 40 dwelling units). The applicant shall demonstrate that there is a minimum of two off-street parking spaces for each dwelling unit proposed.

5. *Sub-Village Road:* A short street such as a cul-de-sac, loop street, or one-way loop, which serves a limited number of properties and which cannot be extended to serve undeveloped areas in the future. Sub-Village Roads shall not be considered where there are more than 10 dwelling units having access onto the proposed road or where total through traffic on the road exceeds substantially more than 200 Average Daily Traffic (approximately 20 dwelling units). The applicant shall demonstrate that there is a minimum of two off-street parking spaces for each dwelling unit proposed. Cul-de-sac roads to which this standard is applied shall not exceed a length of 450'.

3. Roadway and Intersection Geometric Standards

a. Proposed streets shall be designed in accordance with the following "Roadway Geometric Standards" and "Intersection Geometric Standards".

ROADWAY GEOMETRIC STANDARDS

	Road Classification			
	Collector	*Res. Access*	*Village*	*Sub-village*
Right-of-way width	60'	50'	50'	40'
Pavement width	36'	30'	26'	20'
Min. Grade	1%	1%	1%	1%
Max. Grade	8%[1]	10%	10%	10%
Min. centerline curve radius	500'	150'	150'	150'
Max. Superelevation rate	0.06ft./ft.[3]	None	None	None
Min. tangent between curves	150'	100'	50'	50'
Min. sight stopping distance[2]	300'	200'	150'	125'
Design Speed (MPH)	40	30	25	20

[1] Maximum Grade on collector street: Where physical conditions require, the maximum grade may be increased to 10% for a length not to exceed 500'. This increased grade may only be used with the approval of the Director.

[2] Stopping Sight Distance (SSD): Minimum **Vertical SSD** is determined by the minimum distance an observer 3.5 feet above the road surface can observe an object 0.5 feet above the road surface. Minimum **Horizontal SSD** is determined by the minimum distance an observer traveling in the center line of the inside lane can see an object in the center line of the inside lane while not requiring a line of sight outside of the road right-of-way.

[3]Superelevation shall only be used where it is needed for traffic safety. Consult the Department.

INTERSECTION GEOMETRIC STANDARDS

	Road Classification				
	Arterial	*Collector*	*Res. Access*	*Village*	*Sub-village*
Radius along property line	N/A	30'	25'	25'	25'
Radius along gutter line	N/A	40'	35'	35'	35'
Min. offset of intersections[1]	N/A	200'	150'	150'	150'
Min. tangent length[2]	N/A	50'	50'	50'	50'
Max. grade on tangent	N/A	2%	2%	2%	2%
Min. angle of intersection	80°	80°	80°	80°	80°
Min. sight distance[3]	550'	400'	300'	250'	250'

[1]From centerline to centerline

[2]From gutter line of intersecting street

[3]From a point 10' off the edge of pavement to center of traveled way in both directions. Eye height is 3.5' and object height is 3.5'. Sight distance for the major road being intersected shall be used.

3.3 SIDEWALKS AND CURBS

A. General Requirements

1. Concrete sidewalks shall be included in the non-paved right-of-way on both sides of all streets in all subdivisions unless waived by the Planning Commission.

2. Concrete curbs shall be provided on both sides of all streets in all subdivisions and shall be constructed to provide for driveway cuts and handicap ramps.

3. In lieu of the required sidewalks, the Planning Commission may require construction of a 6' wide bituminous concrete sidewalk/bike path.

B. Sidewalks

1. Concrete shall be used to construct all sidewalks. Bituminous Concrete may be used if the sidewalks temporary or in a rural area as determined by the Planning Commission.

2. Sidewalk Width

   a. Arterial ..... 5'
   b. Collector Street..... 5'
   c. Residential Access ..... 4'
   d. Village..... 4'
   e. Sub-Village ..... 4'

3. The sidewalks shall be designed in accordance with the standard details contained in this Standard.

4. Sidewalks shall be placed in a public right-of-way. If physical constraints prohibit this, then a sidewalk easement shall be granted to the Town (section 2.5.B).

C. Handicap Ramps

1. Handicap ramps shall be placed at all pedestrian crosswalks, intersections, commercial driveways, or other areas where handicap accessibility is required along the sidewalk route.

2. Handicap ramps shall be placed opposite each other at all corners of an intersection. At "T" intersections, ramps shall typically be placed in three locations.

3. The handicap ramp shall be designed in accordance with the details contained in this Standard.

D. Curbs

1. Concrete curbs, either pre-cast or cast-in-place, shall be used. Bituminous Concrete Lip Curbing (BCLC) may be used if the curb is temporary or as approved by the Director.

2. The curbing shall be designed in accordance with the details contained in this Standard.

3.4 DRAINAGE

A. General Requirements

1. All proposed roads and modifications to existing roads shall have a separate stormwater drainage system designed and constructed in accordance with these standards.

2. All roads should be built with curbs and a "closed" drainage system unless otherwise approved by the Town Inland Wetland Agency and the Planning Commission.

3. Storm sewers should be designed to flow full. It is permissible to allow them to flow under pressure provided that allowance is made at the upstream and downstream structures to accommodate the velocity head and 1' of freeboard to the top of frame.

4. When adding on to an existing system, then the capacity of the existing system shall be analyzed for the additional flow and the system upgraded as needed.

B. Analysis

1. Storm drainage design shall be based on land use within the area tributary to the point under design projected to full development under present zoning. It is the downstream owner's responsibility to design his drainage facilities to adequately carry the upstream runoff on this basis.

2. The following drainage design criteria shall be followed in the design of storm water drainage systems. A Professional Engineer licensed in the State of Connecticut shall prepare the design of a drainage system. All drainage calculations shall be submitted to the Department for review. Closed drainage system calculations shall be prepared in a table format similar to that shown in the appendix.

3. Storm Frequency

Pipe Design	25 Year Storm
Major Ditches and Channels	50 Year Storm
Positive Flood Relief and Tributary Areas over 100 Acres	100 Year Storm

Under certain circumstances for public safety, the storm frequency may be increased as directed by the Director.

C. Design Methods

1. *Rational Method:* The rational method shall be used for small drainage areas (0-20 acres) and pipe sizing. For rainfall intensity, the chart for New Haven, CT shall be used. The time of concentration shall be determined from the Seelye chart. Both of these charts are in the Appendix.

2. *Soil Conservation Service (SCS) TR-55:* The SCS TR-55 method shall be used for medium-sized drainage areas (20-2,000 acres) or when detention is needed.

3. *SCS TR-20:* The SCS TR-20 method shall be used for large drainage areas (over 2,000 acres).

D. Structures

1. Catch basins and drainage manholes shall be designed in accordance with the details contained in this standard.

2. Either a catch basin or a manhole shall be installed at intervals no greater than 350' along storm drain lines of diameters up to and including 36". On lines with diameters of 42" and above, this spacing may be increased to 500'.

3. Catch basins shall be spaced so that no more than 5 cfs, the maximum capacity of each structure, is intercepted by either the Type "C" or Type "C-L" catch basins. In conjunction with this, catch basin tops shall be depressed below the normal finished grading as shown in the standard details.

4. Generally all catch basins in roadways shall be Type "C"

5. Catch Basins shall be placed at street intersections to prevent gutter flow from crossing the intersection.

6. Space catch basins such that the maximum velocity of storm water flow in a gutter at the deepest point is no greater than 10 ft./sec.

7. Every cross culvert or drainage outlet shall be terminated with an appropriate endwall or flared end and riprap to prevent erosion and the displacement of the pipes. On steep slopes, storm drains shall be extended out to the toe with full outlet protection to prevent erosion.

8. Every cross culvert or open drainage inlet shall have an appropriate headwall or flared end and riprap to prevent erosion and the displacement of the pipes.

E. Pipe

1. Allowable Material:

Reinforced Concrete Pipe (RCP) (Class IV & V): *AASHTO* M170
High Density Polyethylene (HDPE): *AASHTO* M294 (Type 'S')

No other material shall be allowed.

2. Mannings Roughness Coefficient ('n'):

RCP.....0.013
HDPE.....0.010

3. Minimum Pipe Size: 15"

4. Minimum Slope: Pipe shall not be laid on a grade that would allow a velocity of less than 3 ft./sec. when flowing half full.

5. Maximum Velocity: 12 ft./sec.

6. Minimum Cover: 2'-6"

F. Underdrain

1. Underdrains shall be installed in all known wet areas that if left wet would affect the integrity of the roadway. They shall also be placed in areas found to be wet during construction, even if not shown on the plans, when directed by the Engineer.

2. Underdrains shall outlet into a drainage structure whenever possible. All underdrains, at the high end, shall be extended to the nearest structure and plugged.

3. If an independent underdrain outlet is necessary, it shall be terminated with either an endwall or flared end and riprap.

4. Underdrains shall be designed in accordance with the details contained in this standard.

G. Footing Drains and Sump Pumps

1. If at all possible, footing drains for foundations shall outlet on the property they are serving. If outletting on to the property is not possible then the footing drain may be connected to a storm system structure directly in front of the property served with approval from the Director.

2. In no case will a footing drain be allowed to run down the right-of-way to connect into a structure.

3. Sump pumps shall not be connected to any storm system pipe or structure.

3.5 EROSION AND SEDIMENTATION CONTROL

A. When erosion and sedimentation control is required by either; the Town of Groton Inland Wetlands Regulations, the Planning Commission, the Zoning Commission, the U.S. Army Corps of Engineers, or the Connecticut Department of Environmental Protection (DEP), then the plans shall be consistent with the Connecticut Council on Soil & Water Conservation document "Connecticut Guidelines for Soil Erosion and Sediment Control".

B. If the project involves the disturbance of 5 or more acres of land, then a National Pollutant Discharge Elimination System (NPDES) permit is needed from the DEP for a Construction Activity. Consult the DEP for further information.

C. Developers, contractors, and consultant engineers are reminded that within or adjacent to any project there may be inland or tidal wetlands that must be identified and properly permitted for.

3.6 UTILITIES

A. When new utilities are being placed in an existing or proposed street, the following line assignments shall be followed. Deviations from these line assignments will be allowed in special cases when requested by the utility company and approved by the Director. Deviations will only be allowed where they will not interfere with other existing or proposed utilities.

Utility	Line Assignment
Sanitary Sewer	Center line of road[1]
Storm Sewer	Gutter area of road
Water Mains	10' north and/or east of road centerline
Fire Hydrants	2' off face of curb in snow shelf
Underground Electric, Telephone, & CATV	Between curb and sidewalk in snow shelf
Electric, Telephone, & CATV cabinets	Behind sidewalk towards private property
Utility and streetlight poles	2' off face of curb in snow shelf
Gas Mains	8' south and/or west of road centerline

[1] When in a horizontal curve, additional manholes shall be used to follow the curve as closely as possible bearing in mind the relationship to other utilities.

B. Consult with each utility company for their specific requirements and details for the design and installation of their respective utility.

C. Consult with the appropriate Fire Marshal concerning the placement of fire hydrants.

D. When guy wires are installed over sidewalks, then standoffs shall be used to provide 8' of overhead clearance. Guy poles and guy anchors shall not be placed closer than 6" from the edge of the sidewalk.

E. When installing underground utilities, all necessary stubs or connections to lots or poles shall be installed so that the finished roadway will not be disturbed by subsequent construction.

3.7 GUARDRAIL

A. The necessity of guardrails along roads shall be determined by standard design guides (e.g. AASHTO "Roadside Design Guide") and/or the Department.

B. Guardrails will generally be required at culvert crossings, steep drop-offs, bridge approaches, sharp curves, and to provide protection from large fixed objects.

C. Guardrails shall be designed in accordance with DOT standards. Generally guardrail will be a metal beam rail of type "RI or "RB".

D. Guardrails shall be galvanized unless aesthetics is a concern in which case weathering steel or other approved materials may be used. The Director shall determine allowing the use of weathering steel or other materials.

E. All end anchors shall consist of concrete end anchor of type I or II. In no case shall bullnosed or pointed guardrail type ends be allowed.

3.8 STREET TREES

A. All street trees should normally be planted outside the right-of-way line on private property. If however, circumstances dictate that it is reasonable to place the street trees in the right-of-way, then this may be done with approval from the Director.

B. Street Trees shall be spaced according to the requirements of the Town Subdivision Regulations.

C. Approved street trees

Scientific Name	Common Name
Acer buergerianum	Trident Maple
Acer campestre	Hedge Maple
Fraxinus pennsylvanica 'Newport"	Newport Green Ash
Gleditsia tri. in. "Halka"	Halka Honeylocust
Malus "Adams"	Adams Crabapple
Malus "Centurion"	Centurion Crabapple
Platanus x acerifolia "Bloodgood"	London Plane Tree
Pyrus calleryana "Chanticleer"	Chanticleer Callery Pear
Quercus palustris	Pin Oak
Quercus rubra	Red Oak
Zelkova serrata	Zelcova

Note: Other varieties may be used with approval of the Town Tree Warden and the Department.

D. Street trees shall have a minimum height of 6' and have a caliper of 2" at time of planting.

E. Street trees shall not be placed where they will block sightlines from intersections.

F. If there are any existing invasive species within the right-of-way, they shall be removed as directed.

3.9 STREET LIGHTS

A. Streetlights shall be required for all new subdivision roads.

B. Streetlights shall be laid out and spaced according to the details.

C. A streetlight shall be provided at every street intersection and at the end of every cul-de-sac.

D. Place streetlights to avoid shining into existing and proposed houses.

E. Pole sizes, luminaire type and size, and footing sizes are shown in the details.

F. All new streetlight poles shall be numbered. This number shall be shown on the plans. Consult with the Department to obtain the pole numbers for poles that will be owned by the Town. If a streetlight is to be placed on a new CL&P, SNET, or City of Groton Utilities pole, then consult with the appropriate utility for the pole number.

3.10 PAVEMENT MARKINGS

A. Pavement markings shall be painted (reflectorized with glass beads) and conform to the *MUTCD*.

B. A 12" wide white stop bar shall be installed at all stop sign locations. The stop bar shall extend from the centerline of the road to the curb or edge of pavement.

C. Pedestrian crosswalks are only required on certain collector roads and State highways (as determined by the DOT). Crosswalks, where required, shall be placed between handicap ramps or as directed.

D. Requirements for centerline and shoulder line markings are as follows:

Road Classification	*Centerline*	*Shoulderline*
Collector	Double Yellow	Single White
Residential Access	None	None
Village	None	None
Sub-Village	None	None

3.11 SIGNS

A. The placement, design, and construction of all traffic signs shall be in accordance with *MUTCD*.

B. Sign posts shall be galvanized "U channels" specifically manufactured for this purpose.

C. The location of all regulatory signs shall be shown on the plans. Consult with the Town traffic authority regarding sign requirements.

D. Street signs indicating the names of intersecting streets shall be installed at all new street intersections.

1. The signs shall have green backgrounds with white lettering approximately 22" by $4^1/_2$" high in a criss-cross assembly.

2. In certain congested areas two street signs on diagonally opposite corners may be required.

3. In subdivisions where there is no outlet or a cul-de-sac, the street sign shall also have an additional sign attached above it indicating either "dead end" or "no outlet". This sign shall have a yellow background with black lettering.

4. Signs shall be mounted 8' above finished grade on a 2" diameter aluminum pole set in concrete.

5. At intersections with stop signs, combine the street sign and stop sign on one common pole.

6. The Department shall provide the signs noted in D.1D.3 above, to the Developer, for a nominal cost.

SECTION 4
CONSTRUCTION SPECIFICATIONS

4.1 GENERAL

4.1.1 SUBMITTALS

1. Submittal Procedures

   A. Contractor to review submittals prior to submission. Verify field measurements, catalog numbers and other information critical to construction or installation.

   B. Notify Engineer, in writing, at time of submission of deviations in submittals from requirements of these standards. Responsibility for a deviation from these standards or approved plans is not relieved by Engineer's review of submittals, except when given written acceptance of specific deviation.

   C. Transmit each submittal with Engineer accepted form.

   D. Identify Project, Contractor, Sub-contractor or supplier, pertinent drawing sheet and detail number(s), as appropriate.

   E. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of these standards.

   G. Identify variations from these standards and product or system limitations which may be detrimental to successful performance of the completed work.

   H. Provide space for Contractor review stamp and a 3"x5" Engineer review stamp.

   I. Obtain new samples, revise drawings and/or data as required by the Engineer's review and resubmit, identify changes made since previous submittal.

   J. Engineer will review shop drawings, product data, and samples and return submittals. The Engineer's stamp will read as follows:

      1. *Approved:* Means that fabrication, manufacture or construction may proceed, providing submittal complies with these standards. Contractor

assumes sole responsibility for the required compliance. No response is required of the Contractor.

2. *Approved as Noted - Resubmission Not Required:* Means that fabrication, manufacture or construction may proceed, provided the submittal is amended to comply with the Engineer's notations and these standards.

3. *Approved as Noted - Resubmission Required:* The Contractor will "resubmit" Shop Drawings or "Confirm" in writing that he will amend the Shop Drawings.

4. *Comments Attached or See Accompanying Letter:* Means that fabrication, manufacture or construction may proceed provided the Contractor complies with the comments attached. Engineer's comments may help to further clarify these standards or make required selections. The Contractor shall "resubmit" Shop Drawings or "Confirm" in writing that he will comply with Engineer's comments if so marked on the Shop Drawing Review Stamp. If for any reason the Contractor cannot comply with comments attached, the Contractor shall notify Engineer before fabrication, manufacture, or construction.

4. *Disapproval or Rejected:* Means that submittal does not comply with these standards and that fabrication, manufacture, or construction as submitted must not proceed under any circumstances. Submittals stamped "Rejected" are not permitted on job site.

L. Distribute copies of reviewed submittals to concerned persons including Testing Laboratory, Building Official, Planning Department, and Inspector. Instruct recipients to promptly report any inability to comply with provisions.

M. Begin no work, which requires submittals, until return of submittals with Engineer's review stamp and initials or signature indicating review and distribution to concerned persons.

2. Shop Drawings

A. Shop Drawings include specially-prepared technical data for this project, including Drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to several projects.

B. Provide newly prepared information, on reproducible sheets, with graphic information at accurate scale (except as otherwise indicated), with name of preparer indicated (firm name). Maximum sheet size shall be 24" x 36". Show dimensions and note, which are based on field measurements. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements.

C. Submit 1 reproducible mylar and 3 opaque reproductions of newly prepared Shop Drawings to Engineer. Where design calculations are required, submit 2 copies.

D. Do not allow Shop Drawing copies without appropriate approval markings by Engineer to be used in connection with the Work.

E. Indicate on shop drawing whether it is a full or partial submittal.

F. Fabrication and installation of components requiring Shop Drawings shall not begin until Shop Drawings have approval of Engineer unless directed otherwise in writing by same.

3. Product Data

A. Product data includes standard printed information on materials, products and systems; not specially prepared for this project, other than the designation of selections from among available choices printed therein.

B. Collect required data into one submittal for each unit of Work or system; and clearly mark each copy to show which choices and options are applicable to project. Include manufacturer's standard printed recommendations for application and use, compliance with standards, application of labels and seals, notation of field measurements which have been checked, special coordination requirements, instructions for delivery, storage, assembly, installation, adjusting and finishing.

C. Submit 3 copies of product data. The Engineer will retain one and the others returned to the contractor.

4. Samples

A. Samples include both fabricated and unfabricated physical examples of materials, products and units of Work; both as complete units and as smaller portions of units of Work; either for limited visual inspection or (where indicated) for more detailed testing and analysis.

B. Provide samples identical with the final condition of proposed materials or products for the Work. Include a "range" of samples (not less than 3 units) where unavoidable variations must be expected, and describe or identify variations between units of each set. Provide full set of optional samples where Engineer's selection is required. Include Information with each sample to show generic description, source or product name and manufacturers, limitations, and compliance with standards. Engineer will not "test" samples (except as otherwise indicated) for compliance with other requirements, which are therefore the exclusive responsibility of the Contractor.

5. Engineer Review

A. Engineer will endeavor to review shop drawings, product data, and samples, and to return submittals within 10 working days.

4.1.2 TESTING

1. General

   A. The contractor shall employ and pay for services of an independent testing laboratory to perform specified testing.

   B. Employment of a testing laboratory shall in no way relieve Contractor of obligation to perform Work in accordance with requirements of these standards.

   C. The testing laboratory is to supply a signed statement, which indicates that the testing procedures required have been performed along with a description of any discrepancies.

2. Laboratory Reports

   A. After each test, the testing laboratory will submit two copies of the laboratory report to the Engineer, and two copies to the Contractor.

   B. Report will include:

      1. Date issued
      2. Project title and number
      3. Name and signature of inspector
      4. Date and time of sampling or inspection
      5. Temperature and weather conditions
      6. Identification of product
      7. Location in the Project
      8. Type of inspection or test
      9. Date of test
      10. Results of tests
      11. Conformance with these Standards

   C. When requested by the Engineer, the laboratory will also provide interpretation of test results.

3. Limits on Testing Laboratory Authority

   A. Laboratory may not release, revoke, alter, or enlarge on requirements of these standards.

B. Laboratory may not approve or accept any portion of the work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop work.

4. Contractor Responsibilities

A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which require testing, together with proposed mix designs.

B. Cooperate with laboratory personnel, and provide access to work and to manufacturer's facilities.

C. Provide copies of reviewed and stamped shop drawings and product data as required by laboratory.

D. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

E. Provide to the laboratory and the Engineer the preliminary design mix proposed to be used for concrete and other material mixes, which require control by the testing laboratory.

F. Notify the laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

G. Furnish copies of product test reports as required.

H. Perform additional inspections, sampling and testing required when initial tests indicate work does not comply with these Standards.

I. Change concrete proportions and consistency to correct any deficiencies indicated by tests and laboratory or field specimens.

J. Facilitate work and cooperate with Laboratory Inspectors at all times. Contractor shall furnish ample notification of construction schedules and shall be responsible to insure that Laboratory Inspectors are present as required. No concrete shall be placed until Laboratory Inspector is present.

K. Provide concrete curing box with associated utilities for concrete cylinders per requirements of the laboratory.

4.1.3 INSPECTION

1. Authority

   A. Inspectors employed by the Town are required to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work, and to the preparation or manufacture of the materials to be used.

   B. The Inspector has the authority to reject materials that do not conform to these Standards.

   C. In case of any dispute arising between the contractor and the inspector as to the materials furnished or the manner of performing the work, the issue shall be referred to and decided by the Engineer. If the dispute is not resolved to the satisfaction of the parties involved then it may be appealed to the Director. The Director shall have the final decision in regards to these Standards.

   D. The Inspector is not authorized to revoke, alter, enlarge, relax, or release any requirements of this standard, stop work, to approve or accept any portion of the work, nor to issue instructions contrary to this standard unless it is a minor change (section 4.1.4).

   E. The Inspector shall in no case act as a foreman or fulfill other duties of the contractor. Any comments that the inspector may make to the contractor shall not be construed as binding the Town in any way, nor releasing the contractor from these standards.

2. Inspection

   A. All work within an existing or proposed street right of way, easement, or on Town property shall be inspected by the Department.

   B. The Inspector shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the contractor as necessary to make a complete, detailed, and timely inspection.

   C. The Contractor shall always notify the inspector of his intention to perform work on the project, including notice of the particular work he intends to perform, at least 24 hours prior to commencing such work.

   D. The Contractor shall not commence any portion of the work without prior related inspection.

E. Any work done or materials used without suitable inspection by the Inspector may be ordered exposed for examination and testing. If found unacceptable, the work shall be removed and replaced.

4.1.4 FIELD CHANGES

1. If field conditions warrant changes or deviations from the approved plans or these standards, then the following procedures shall be followed.

2. **Minor Changes** (such as slight adjustments in grades, minor deviations from these standards) can be authorized in the field by the Inspector.

3. **Moderate Changes** (such as relocation of utilities and structures, deviation from these standards, other than minor ones) must be submitted in writing along with necessary sketches to the Engineer for review and approval prior to making the requested changes. If the changes are associated with an approved site or subdivision plan then the request for change must be made through the Planning Department on their prescribed form.

4. **Major Changes** (e.g. road realignment, major grade changes, drainage system changes) must be submitted in writing to the Engineer for review and approval prior to making the requested changes. If the changes are associated with an approved site or subdivision plan then the request for change must be made through the Planning Department on their prescribed form. The Director of Planning and Development Services will determine if the change is large enough to request that the developer receive approval from the Planning Commission prior to making the requested changes.

4.1.5 CONSTRUCTION LAYOUT

1. General

   A. All staking shall be performed by qualified engineering or surveying personnel, who are trained, experienced and skilled in construction layout and staking of the type required.

   B. The Town may check the control of the work, as established by the Contractor, at any time as the work progresses. The Contractor will be informed of the results of these checks, but the Town by doing so in no way relieves the Contractor from his responsibility for the accuracy of the layout work. The Contractor shall correct or replace as required any deficient layout and construction work, which may be the result of inaccurate staking operations or inaccurate information on the plans.

2. Road, sidewalk and curbing stake out

   A. The contractor shall provide and maintain reference stakes at 50' intervals on both sides of straight portions of the road. Reference stakes shall be provided on 25' intervals on all vertical and horizontal curves.

   B. Stakes shall be clearly marked as to station, offset, and proposed finished grade.

   C. Centerline road grade stakes shall be used to establish finished grade of the gravel base.

3. Storm drainage stake out

   A. All drainage structures shall be laid out by use of a transit and level to establish horizontal location and top of frame levels.

   B. Drainage pipe shall be set to grade by use of an engineer's level, batter boards or a laser alignment system. Where deemed necessary by the Inspector, the laser alignment system shall be used.

4.1.6 MONUMENTATION

1. General

   A. Monuments marking the Town right-of-way or along the boundary of land to be dedicated to the Town shall be marked with a concrete monument with a brass plaque.

   B. Monuments shall be set under the direct supervision of a Connecticut licensed Land Surveyor.

   C. Monuments shall be placed plumb and square with the street or boundary line. Monuments shall be set 4" above grade in wooded areas, flush with grade in lawn areas, and flush with pavement in driveway or sidewalk areas.

   D. Monuments shall be installed to mark all street line curves, intersection curves, angle points, as shown on the plans or as directed by the Town.

   E. Monuments shall be installed to mark the major corners and angle points of all property that will be conveyed to the Town.

4.1.7 MAINTENANCE AND PROTECTION OF TRAFFIC

1. Signage

   A. All sign panels shall be the product of a professional sign painter or fabricator experienced in the production of signage meeting the requirements of the Manual of Uniform Traffic Control Devices. Panel size, colors, legend and letter type shall be strictly observed. Panel material shall be exterior plywood, aluminum sheet or extruded shapes, or other acceptable material. All items shall be completely weatherproof for the required length of the display.

   B. Panel supports shall be wood or metal of substantial proportions and sufficiently braced to provide a reliable installation for the duration of the work. Supports shall be designed for 60-mph wind loads. Portable installations shall be ballasted to meet this requirement.

2. Channeling Devices

   A. Traffic cones, pylons, vertical panels, barricades and other warning devices shall provide high visibility and be constructed of material which will impart minimum damage to errant vehicles or passengers. They shall contain bands of reflectorized material. Fifty-Five (55) gallon steel drums shall not be used.

3. Warning Lights

   A. Warning lights shall be self-contained, weatherproof units and maintained to produce a sharp strobe beam, amber in color. Flash frequency shall be at least 20 per minute.

4. Installation

   A. The type, number, deployment pattern, sequence of installation and dismantling, covering of permanent signs and all other details pertaining to various conditions evolving from construction operations as outlined in the Manual of Uniform Traffic Control Devices shall be strictly observed. Conditions not covered shall be resolved to the satisfaction of the regulatory agency having jurisdiction over the right of way.

5. Maintenance

   A. The Contractor shall maintain all installed devices. Losses incurred as the result of accident, errant vehicles or pilferage shall be replaced in kind at the earliest date possible.

5. Dismantling

A. As soon as the work is complete and the site capable of receiving normal traffic operations, all temporary signs and control devices shall be removed and the original patterns restored. Modifications to permanent signage shall be removed.

6. Temporary Access

A. Contractor shall arrange his operations to provide access to properties along the street including temporary bridges to driveways, and provide access to fire hydrants, manholes, gate boxes, or other utilities.

B. Whenever any trench will obstruct traffic in or to any public street, private driveway, or property entrance, the Contractor shall take such steps as required to maintain necessary traffic and access including temporary bridging if required.

C. The Contractor shall confine his occupancy of public or traveled ways to the smallest space compatible with the efficient and safe performance of the work contemplated by the Contract.

7. Snow Removal

A. If the Contractor's operations interfere with the removal or sanding of snow or ice by the public authorities or adjoining landowners, in their customary manner, then the Contractor shall be required to perform such services for the public authorities or adjoining owners.

B. If the Contractor fails to do so, he shall reimburse the public authorities or adjoining landowners for doing such work. Together with any damage to the equipment of said parties, or claims of any parties for damage or injury or loss by reason of failure to remove snow or ice or to sand icy spots under these conditions.

8. Road Closure

A. In certain cases where deemed necessary for protection of the public, the Director may officially close a road to vehicular traffic for a specified period of time. Prior to closing any roads, detours shall be established by the contractor and suitable signs erected. Access to all homes and businesses shall be maintained at all times for area residents and emergency vehicles. A request to close any road must be made in writing to the Director at least two days prior to the desired closure time.

4.1.8 TRAFFIC DIRECTORS

1. Traffic Directors

   A. Traffic Directors are responsible for human safety and make the greatest number of public contacts of all construction personnel. It is important that qualified personnel be selected. A Traffic Director shall possess the following minimum qualifications:

      1. Average Intelligence.
      2. Good physical condition, including sight and hearing.
      3. Mental alertness.
      4. Courteous but firm manner.
      5. Neat appearance.
      6. Sense of responsibility for safety of public and crew.

   B. The use of orange clothing such as a vest, shirt, or jacket shall be required for Traffic Directors. For nighttime conditions, similar outside garments shall be reflectorized.

   C. Traffic Directors are provided at work sites to stop traffic intermittently as necessitated by work progress or to maintain continuous traffic past a work site at reduced speeds to help protect the work crew. For both of these functions, the Traffic Director must, at all times, be clearly visible to approaching traffic for a distance sufficient to permit proper response by the motorist to the flagging instructions, and to permit traffic to reduce speed before entering the work site. In positioning Traffic Directors, consideration must be given to maintaining color contrast between the Traffic Director's protective garments and his background.

2. Flags

   A. Flags used for signaling purposes shall be a minimum of 24" by 24" in size, made of a good grade of red material securely fastened to a staff approximately 3' in length. The free edge should be weighted to insure that the flag will hang vertically, even in heavy winds.

3. Paddles

   A. Sign paddles should be at least 18" wide with letters at least 6" high. A rigid handle shall be provided. A 6' handle (staff) is recommended. This combination sign may be fabricated from sheet metal or other light semi-rigid material. The background of the "STOP" face shall be red with white letters and border. The background of the "SLOW" shall be orange with black letters

and border. When used at night the "STOP" face shall be reflectorized red with white reflectorized letters and border, and the "SLOW" face shall be reflectorized orange with black letters and border.

4. Flagging

A. The following methods of signaling with a flag shall be used:

1. **To Stop Traffic:** The Traffic Director shall face traffic and extend the flag horizontally across the traffic lane in a stationary position so that the full area of the flag is visible hanging below the staff. For greater emphasis, the free arm may be raised with the palm toward approaching traffic.

2. **When it is Safe for Traffic to Proceed:** The Traffic Director shall stand parallel to the traffic movement, and with flag and arm lowered from view of the driver, motion traffic ahead with his free arm. Flags shall not be used to signal traffic to proceed.

3. **Where it is Desired to Alert or Slow Traffic:** Where it is desired to alert or slow traffic by means of flagging, the Traffic Director shall face traffic and slowly wave the flag in a sweeping motion from the shoulder level to straight down without raising the arm above a horizontal position.

B. If a sign paddle is used, it shall be held in a stationary position with the arm extended horizontally away from the body. For added emphasis, the Traffic Director may slowly raise and lower his free hand with the palm down.

C. Lights, reflectorized sign paddles or reflectorized flags, shall be used to flag traffic at night. Daytime flagging procedures shall be followed whenever such lights, paddles or flags are used at night.

5. Traffic Directors Stations

A. Traffic Directors stations shall be located far enough in advance of the work site so that approaching traffic will have sufficient distance to reduce speed before entering the project. This distance is related to approach speed and physical conditions at the site, however, in no case will the distance be greater than 200 to 300' between stations.

B. The Traffic Directors shall stand either on the shoulder adjacent to the traffic he is controlling or in the barricaded lane. At a "spot" obstruction he may have to stand on the shoulder opposite the barricaded section to operate effectively.

Under no circumstances should he stand in the lane being used by moving traffic. He should be clearly visible to approaching traffic at all times. For this reason, he should stand alone, never permitting a group of workmen to congregate around him. He should be stationed sufficiently in advance of the work force to warn them of approaching danger, such as out-of-control vehicles.

C. Traffic Directors stations shall be adequately protected and preceded by proper advanced warning signs. At night, flagmen stations shall be adequately illuminated.

D. At short construction and maintenance lane closures where adequate sight distance is available for the safe handling of traffic, the use of one Traffic Director may be sufficient.

6. One-way Traffic Control

A. Where a one-way lane section is of any length, there shall be some means of coordinating movements at each end so that vehicles are not simultaneously moving in opposite directions in the section and so that delays are not excessive at either end.

B. Control points at each end of the route should be chosen so as to permit easy passing of opposing lines of vehicles.

C. Alternate one-way traffic control shall be accomplished by one of the following means:

1. Traffic Director control, one at each end, using hand signals.
2. Traffic Director control, using hand-held radios.

D. Where the one-lane section is short enough so that each end is visible from the other end, traffic may be controlled by means of a Traffic Director at each end of the section. One of the two should be designated as the Chief Traffic Director for purposes of coordinating movement. They should be able to communicate with each other verbally or by means of signals. These signals should not be such as to be mistaken for flagging signals.

E. Where the end of a one-lane section is not visible from the other end, the Traffic Director shall maintain contact by means of hand-held radios. So that a Traffic Director may know when to allow traffic to proceed into the section, description or license can identify the last vehicle from the opposite direction.

7. Coordination

A. If a Traffic Direction Service is used, the Contractor shall make all necessary arrangements and coordinate the need for traffic control before the service is required. The Contractor shall identify the number of personnel required and the time to report.

8. Use of Police

A. During certain times throughout the construction, and as determined by the Chief of Police, the Director, or the DOT, Police Officers may be required to be assigned to the construction site. These Officers will be assigned during period of heavy traffic or at intersection of major roads. The Police Officer will be in charge of traffic control at these sites. The Traffic Directors will augment the Police Officers. Coordination of the assignment of the Officers will occur between the Police Department and the Contractor. The Contractor is responsible for all costs associated with the use of Police Officers.

4.1.9 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1. Temporary Electricity and Lighting

   A. Arrange with utility company to provide service required for construction operations, with branch wiring and distribution boxes located to allow service and lighting by means of construction-type power cords.

   B. Provide artificial lighting as needed for safe construction operations when natural light is not adequate.

   C. Existing and permanent lighting may be used during construction. Maintain lighting and make routine repairs.

2. Temporary Heat and Ventilation

   A. Provide temporary heat and ventilation as required to maintain adequate environmental conditions to facilitate progress of the work, to meet specified minimum conditions for the installation of materials, and to protect materials and finishes from damage due to temperature or humidity.

   C. Maintain minimum temperatures as listed in the appropriate sections.

   D. Provide ventilation of enclosed areas to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases.

3. Temporary Water

   A. Arrange with utility company to provide service required for construction operations.

   B. Water may be trucked in at the Contractor's option.

4. Temporary Sanitary Facilities

   A. Provide and maintain required sanitary facilities and enclosures in compliance with all Health laws and regulations.

5. Barriers

   A. Provide as required to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways as required by governing authorities for public rights-of-way and for public access to existing buildings.

C. Provide barriers around trees and plants designated to remain. Protect against vehicular traffic, stored materials, dumping, chemically injurious materials, and puddling or continuous running water.

6. Enclosures

A. Provide temporary insulated weather-tight closures where indicated and where reasonably required to ensure adequate workmanship and protection from weather and unsatisfactory ambient conditions for work to allow for temporary heating.

7. Protection of Installed Work

A. Protect installed work and provide special protection where required.

B. Provide temporary protection for installed products. Control activity in immediate area to minimize damage.

C. Prohibit traffic from lawns and landscaped areas.

8. Water Control

A. Grade site to drain.

B. Maintain excavations free of water. Provide, operate and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

9. Cleaning During Construction

A. Control accumulation of waste materials and rubbish; periodically dispose of off-site.

B. Streets and drives in the area of construction shall be kept free of accumulation of mud, clay, gravel, and any other materials which vehicles or equipment may track or scatter onto these surfaces.

C. No burning or disposal of rubbish at the job site will be permitted.

10. Field Offices and Sheds

A. Contractor may erect and maintain a temporary field office on the project site. Place field office in accordance with Town and State regulations.

4.1.10 EROSION AND SEDIMENTATION CONTROL

1. General

   A. The Contractor shall be totally responsible for protection of any lands or properties as may be subject to any effect or by-product of his demolition/construction effort. Special care shall be taken to avoid erosion of fill or cut slopes onto adjacent property or downstream siltation or diversion of existing surface drainage. Any damage is to be corrected immediately.

   B. Erosion control measures in the locations shown and as detailed and described in the plans, shall be considered minimum requirements and the Contractor shall take whatever other erosion and sedimentation control steps that are necessary to accommodate his particular construction procedures.

   C. Erosion control construction shall be done prior to the commencement of demolition, site preparation or earthwork operations. The Contractor shall install any additional protective measures as may be required to control siltation from the site.

2. Materials

   A. Silt Fence

      1. Silt Fence Fabric: Conform to Article M.08.01-26 of Form 814A. The fabric must be recommended, by the manufacturer, for use as silt fencing. It shall be a minimum of 30" high and fastened to posts.

      2. Posts: Provide hardwood or metal posts of the size shown in the plans and of sufficient strength to support the filter fabric.

   B. Straw hay bales for catch basin protection.

   C. Erosion Control Lining

      1. As specified in the plans

3. Installation

   A. Silt Fence:

      1. Install silt fences in the locations shown in the plans.

2. Drive the support posts firmly into the ground so as to maintain the silt fence in position.

3. Attach the filter fabric firmly to the stakes with the bottom edge of the fabric buried in a trench.

B. Erosion Control Lining:

1. Install erosion control lining on all exposed cut/fill slopes to protect against rainfall and wind erosion and hold moisture content to enhance vegetation growth in seed where shown in the plans.

2. Install erosion control lining in the required locations immediately after the area has been seeded.

3. Place the erosion control lining over the seed mulch to fit against the contours of the area. It shall be applied without stretching, lie smoothly but loosely, and be free of wrinkles and bunches. Roll the material in place and in the direction of the flow of surface water. Anchor the up-grade end of the erosion lining in a narrow trench 6" deep. Firmly tamp the trench backfill in place.

4. In ditches and on slopes, provide check or junction slots at no greater than 50' intervals.

5. Where the erosion lining comes into contact with the edges of catch basins or other structures, place a tight fold in the edge of the material and bury it a minimum of 6" into the soil.

6. Install staples no more than 6" apart at all anchor, junction or check slots.

7. Where two lengths of erosion control lining are joined, the end of the upgrade strip shall overlap the downgrade by a minimum of a 6" strip and the two strips shall be anchored together.

C. Catch Basins:

1. Existing catch basins shall be wrapped with filter fabric and ringed with hay bales.

2. Proposed catch basins and yard drains shall be wrapped and ringed with hay bales promptly after installation.

3. Maintenance and Cleaning

A. General: All temporary erosion and sedimentation control devices shall be maintained and cleaned as required from the time of their installation until their final removal. Permanent erosion control devices shall be maintained and cleaned as required until their final acceptance.

B. Erosion Control Supervisor:

1. The Contractor shall name one individual as his sediment and erosion control supervisor whose responsibility will be maintenance and repair of all on-site erosion and control measures. He will keep a daily log of his activities and an updated schedule of proposed construction activities. The log shall be made available to the local authority as well as any State/Federal Inspectors.

C. Silt Fences: Remove silt as required to maintain the integrity of silt fences. If required, remove the silt fence completely and remove all accumulated silt, then reinstall.

D. Erosion Control Lining: The Contractor shall maintain and protect the outlined areas until such time as the turf grass is established. The Contractor shall replace or repair all erosion control lining areas damaged by fire, water or other causes including construction operations.

4. Removal and Cleanup

A. At the end of construction, when turf is established, remove and legally dispose of, off site, all non-permanent erosion control devices and restore the damaged areas. Leave the site neat and clean.

4.1.11 SHEETING AND SHORING

1. General

   A. All excavations shall have a protective system meeting the requirements of CFR 29, Part 1926, Subpart P of *OSHA*.

2. Materials

   A. Lumber for sheeting and shoring shall be of spruce, douglas fir, or yellow pine, not less than 2" thick, free of defects that might impair its strength or tightness. Sheeting shall be planed at least on one side and shall be tongued and grooved.

   B. Steel for sheeting and shoring shall conform to the requirements of *ASTM* A-328.

   C. Steel boxes shall be certified and constructed to withstand the trench wall pressures and cave-ins and shall be fabricated so as to provide enough room and height for the safety of the workmen.

3. Execution

   A. Sheeting and shoring shall be adequate to support all loads imposed, and shall comply with any applicable safety regulations.

   B. Contractor shall have a competent person or persons, as required under the Occupational Safety and Health Act, on the site to inspect the work and to supervise the conformance of the Contractor's operations with the regulations of the Act.

4.2 ROADWAY

4.2.1 CLEARING AND GRUBBING

1. General

   A. Conform to applicable federal, state and local codes for disposal of excess material and debris.

2. Materials

   A. Fencing for Tree Protection: New standard snow fence of uniform color. Fence posts shall be steel and placed to firmly support fencing.

3. Work Limit

   A. Prior to any work, the Limit of Work Line will be laid out and staked in the field. Except as may be noted herein, no work will be allowed outside the Limit of Work Line.

   B. In areas where structures, or parts of structures, will be constructed on compacted fill, all stumps, together with their major roots, all vegetation, topsoil, organic matter or any other material encountered below the topsoil which is considered unfit for proper foundation, shall be stripped and removed.

      The extent of this stripping shall be within an area encompassed within the toe of a 1:1 slope extending down from a line located 2 feet outside the bottom perimeter of any footing or slab founded on fill.

   C. All areas within the Limit of Work not in excavated areas or under embankments or graded and paved areas shall be considered areas of Selective Clearing and Grubbing. In such areas certain trees and shrubs, specifically designated, shall not be cut, removed, damaged or destroyed but shall be saved and protected from harm and injury during construction. Underbrush, scrub growth and designated trees within such areas shall be removed and disposed of together with other cuttings and slash. Skilled workmen, in accordance with accepted tree surgery practices, shall trim unsound and unsightly branches on trees and shrubs designated to remain.

4. Protection

A. Protect overhead and underground utilities, sidewalks, drains, curbs, trees (including roots), shrubs, ground cover, bench marks, monuments, other reference points, adjacent buildings, materials, property owned by others that are to remain.

B. Protected items and areas, if disturbed or destroyed, shall be repaired or replaced.

C. Any existing plant materials designated to be saved, protected and/or undisturbed, that are cut or destroyed will be replaced in kind and size.

5. Clearing and Grubbing

A. Trees in the Town's right-of-way or on Town property that are designated to be removed shall be posted by the Town Tree Warden at least 5 working days prior to removal and shall only be removed with the Tree Warden's approval.

B. The stumps of trees and brush, together with their major roots, shall be grubbed and removed in excavation areas and under embankments and graded and paved areas when the original ground level is within 15' of the proposed finish surface.

C. Trees, stumps, and brush shall be cut off within 6" of the ground when the original ground level is more than 15' below the finished surface.

D. Grubbing shall consist of the grubbing up, removal and disposal of stumps and roots larger than $1^1/_2$" in diameter, and matted root formations from the designated areas to a depth below existing ground area of not less than 18". Rocks or boulders near the existing surface shall be removed and disposed of as waste materials.

E. Clearing operations shall be performed in a manner which will prevent damage by falling trees to trees left standing or to structures, and by methods which will provide for the safety of employees and other persons.

F. All holes left by the stump removal operation shall be backfilled and compacted with bank run gravel.

6. Disposal

A. Trees, brush, and stumps, removed shall become the property of the Contractor and shall be satisfactorily disposed of in a legal manner.

B. Burning will not be permitted.

C. Stumps, large logs, brush and all combustibles shall be disposed of off the site, or at approved locations on the site, provided all brush is chipped.

4.2.2 ROADWAY EXCAVATION AND FILLING

1. General

   A. Examine existing and finish grades as shown on grading plan and excavate and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction.

   B. Restore any and all areas outside the contract limit lines that are disturbed during the progress of work.

   C. Coordinate with affected utility companies. Contact "Call Before You Dig" at 1-800-922-4455, 48 hrs. prior to any work.

2. Protection

   A. Protect bench marks, monuments, other reference points, existing structures, roads, sidewalks, paving, curbs, overhead and underground utilities against damage from equipment and vehicular or foot traffic.

   B. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods as required to sustain excavated areas.

3. Stripping and stockpiling topsoil

   A. Reusable topsoil may be stripped and stockpiled for use in finish grading. Stockpile only soil, which conforms to Section 4.5.2. Topsoil shall be fertile, friable agricultural soil with a loam texture class capable of sustaining vigorous plant growth and suitable for growth of grass, neither excessively alkaline, nor acidic, and free from topsoil, clay lumps, gravel, brush, weeds, and objectionable material.

   B. Install all perimeter silt fence, sedimentation basins and other required erosion controls prior to stripping topsoil.

   C. Stockpile topsoil so that natural drainage is not obstructed and no off-site sediment damage shall result.

   D. Side slopes of the stockpile shall not exceed a 2:1 slope.

   E. Test stockpiled topsoil immediately following stockpiling operations and provide test results prior to spreading topsoil.

F. Seed stockpiled topsoil with temporary grass seed of the type and at the rate indicated in section 4.5.3 within ten days of the formation of the stockpile..

G. Install silt fence around perimeter of stockpiled topsoil.

H. No topsoil shall be excavated, graded or worked in frozen or muddy condition.

I. Dispose of unsuitable material off site in a legal manner.

4. Removing existing pavement surfaces

A. No excavation shall be made until existing paved surfaces have been neatly saw-cut. Pavement, which is weakened or destroyed beyond the limits indicated, shall be re-cut and trimmed.

B. All pavement removal within state highways shall be in strict accordance with all requirements of the DOT. Conditions of permits for excavation within established rights-of-way shall be strictly observed and the Contractor shall assume full responsibility for violations thereof.

5. Earth excavation

A. Excavation may be in open cut with sheeting provided in areas shown on the plans or as required.

6. Site contamination

A. The suspicion of, or unanticipated discovery of, contaminated ground during the excavation, or other work task under this contract, shall be reported immediately to the DEP and the Department. The Contractor, at all times, shall exercise caution to protect workmen, observers, and residents from harm. The Contractor shall provide all reasonable and necessary assistance to the DEP and the Department to ascertain the nature and source of ground contamination.

7. Protection of work

A. Provide safe working conditions for the protection of men, materials and equipment involved in the work, and to protect the public, adjacent structures, utilities, poles, pipe lines, duct, conduit, streets and other public or private property from cave-ins, slides, settlement or other damage.

B. Contractor shall assume full responsibility for compliance with all local codes or State and Federal laws which pertain to safe working conditions for the protection of men, materials and equipment during excavation.

C. Existing pipes, poles, wires, fences, curbing, property-line markers, and other structures, which must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury. Should such items be damaged, they shall be restored by the Contractor, to at least as good a condition as that in which they were found immediately before the work was begun.

D. Cooperate closely with all utility companies involved and to ascertain the exact locations of all utilities prior to excavation. Existing utilities will be protected from damage during construction, and if damaged, shall be repaired.

E. Power-driven excavating machinery shall be handled with care to prevent damage to shade trees, particularly to overhanging branches. Branches shall not be cut off.

F. Dig up, handle, protect and properly reset signs, posts, guard rails and the like along the line of or adjacent to the work.

G. Utility poles or other structures in close proximity to excavations must be tied back, braced or otherwise temporarily supported to the satisfaction of the utility company.

H. Damage to electric poles, or their attachments, underground duct lines, manholes, conduits or their components caused by the Contractor may be repaired by the controlling utility agency.

8. Care and restoration of property

A. Do not use or operate tractors, bulldozers, or other power-operated crawler equipment on paved surfaces; the treads or wheels of which are so shaped as to cut or otherwise injure such surfaces without providing proper protection for the pavement.

B. Replace in kind, all granite, concrete or bituminous curbing removed. Granite or pre-cast concrete curbing shall be set plumb and true to the lines and grades established and shall be backed up with materials equal to those removed. Existing bituminous, concrete, or granite curbing which is damaged or destroyed, and is not scheduled for removal, shall be replaced with new curbing equal to that removed.

C. All surfaces, which have been injured by the Contractor's operations, shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

D. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

9. Disposal of surplus and unsuitable excavated materials

A. Dispose of material off-site in a legal manner.

10. Dust control

A. Conduct operations and maintain the area of activities, including sweeping and sprinkling of area as necessary, so as to minimize the creation and dispersion of dust. If it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material as directed.

11. Sheeting and shoring

A. Provide sheeting and shoring conforming to Section 4.1.11.

12. Dewatering

A. The Contractor shall at all times keep the excavation free from water. The water shall be disposed of by the Contractor in accordance with applicable laws and regulations.

B. Contractor shall provide all necessary pumps, dams, drains, ditches, flumes, well points, and other means for excluding and removing water from excavations, and for preventing the slopes from sliding or caving in. Contractor shall satisfactorily remove all water, which interferes with the work. The Contractor shall sufficiently dewater all excavations to completely dry out and solidify the foundation below the bottom of the structure to whatever depth is necessary to provide a firm, solid, completely dry foundation on which to construct the structure.

C. Sediment laden water shall not be pumped off-site. It shall be filtered through a sediment fence, sediment basin, "dirt bag" or other approved filtration system prior to being discharged.

4.2.3 ROCK EXCAVATION

1. Explosives

   A. If explosives are used, obtain all necessary permits and licenses.

   B. Explosives must be carefully transported, stored, handled and used. Keep on the job only such quantities of explosives as may be needed for the work underway and only during such time as they are being used. Explosives shall be stored in a secure manner in locked containers and separate from all tools. Caps and detonators shall be stored separately from other explosives. When the need for explosives is ended, all such materials remaining on the job shall be promptly removed from the site. Care must be taken that no explosives, caps or detonators are stolen or get into the hands of unauthorized persons or left unguarded.

2. Blasting Log

   A. An accurate blasting log must be maintained. The Contractor shall record in the log, for each shot; the location of holes, depth, spacing, amount of explosive per hole; number, type and delay interval of blasting caps used; horizontal distance to existing structures and utilities (sewer, water, gas, etc.); and the date and exact time of the blast.

   B. The log shall include a sketch for each shot showing the location of every blasting cap and its delay period and comments regarding any property damage or unusual results.

3. Presplitting

   A. Presplit the bedrock along the proposed rock slopes to the lines and inclinations shown on the plans except as otherwise provided in the standards.

   B. Presplitting will be required where the backslope is designed at an inclination one (vertical) on one (horizontal) or steeper or where the cut in bedrock is ten feet or more, measured on the inclination of the proposed slope from the bottom of excavation to the natural surface of sound bedrock. The maximum vertical height of slope face, which can be presplit at any one time, shall be 50'.

   C. The presplitting holes shall follow the required rock slope lines and inclinations. Hole drilling shall commence only when solid bedrock is encountered and exposed.

D. Presplitting holes shall be extended from the top of solid bedrock surface to the toe of finished rock slope, unless lesser depths are specified on the plans. The proper angle of drilling shall be maintained at all times so all presplit holes lie essentially in the same plane and are paralleled to each other.

E. No holes shall deviate more than one-half foot at any place in the plane of the specified slope line nor in its vertical alignment. If any cut is presplit by vertical stages (lifts), the presplit holes may be offset.

F. Presplit holes shall be lightly loaded with a continuous column charge manufactured especially for presplitting. All space in each hole not occupied by the explosive charge shall be filled with minus $^{3}/_{8}$" clean stone chips or equivalent. Charges near the top of hole shall be reduced sufficiently to eliminate overbreak and heaving.

G. The methods of detonation shall be such that a uniform plane of rupture of the rock occurs from top to bottom and between presplit holes. If necessary, adjust the methods as outlined above so as to result in a uniform plane of rupture in the bedrock.

H. Unless otherwise approved, presplit holes shall be drilled ahead of and shall be detonated prior to the drilling and blasting of the general pattern holes within the section of any lift of bedrock to be excavated. The presplitting shall be performed so as to produce a uniform plane of rupture in the bedrock such that the resulting rock face will not be affected by subsequent blasting and excavation operations.

I. In the general pattern, the spacing of blast holes, distribution and type of explosives, methods of detonation, and the blasting techniques shall be adjusted according to the characteristics and structure of the bedrock encountered so as not to fracture the rock beyond the presplit face.

4. Blasting

A. A pre-blast survey is required for all new and existing structures, which could be affected by blasting.

B. An on-site seismologist shall be employed during all blasting operations.

C. Give at least 24 hours notice and a schedule of blasting operations to the operating official, company or companies leasing, owning or responsible for pipes, conduits, poles, wires, or any other public or private utilities which may be endangered by the blasting.

D. When blasting is necessary, it shall be done in accordance with all Town Ordinances, State Statutes and other pertinent regulations and under the direction of the Fire Marshal. Such ordinances, regulations and orders shall not, however, relieve the Contractor of any responsibility for damages caused by him or by his employees.

E. Prior to the firing of blasts, all persons in the vicinity shall be given ample warning. All blasts shall be well covered and provisions shall be made to protect all pipes, conduits, sewers and structures, and all persons or property along and adjacent to the site of the work.

F. If damage is incurred by adjacent properties, blasting shall cease until the extent of damage has been documented.

G. If damage occurs to any portion of new or existing structures or to the materials surrounding or supporting the same through blasting, rebuild or repair the structures and replace the material surrounding or supporting the same.

H. If any damage occurs to any existing utilities through blasting, the controlling utility company may elect to perform the repairs.

4. Shattered Rock

A. If rock below normal depth is shattered due to operations of the Contractor, and the Engineer considers such shattered rock to be unfit for foundations, the shattered rock shall be removed and the excavation shall be backfilled with fill as required.

5. Excess Rock Excavation

A. If rock is excavated beyond the limits indicated on the drawings, the excess excavation, whether resulting from overbreakage or other causes shall be backfilled using bank run gravel.

6. Splitting

A. Drilling and splitting rock by hydraulic means (or some other approved method) to remove it or to make it smaller, more manageable pieces to be removed by machinery is allowable.

7. Disposal

A. Excavated rock may be used for fill in embankment areas as directed.

B. Excess excavated rock shall be disposed of off-site in a legal manner.

4.2.4 SUBGRADE

1. Quality Assurance

   A. Testing of compacted fill materials shall be performed by an independent testing laboratory.

   B. When work of this section, or portions of work are completed, the contractor shall notify their testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.

   C. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, notify the Inspector as to direction to proceed. If required by the Inspector, remove the defective work, replace and retest.

   D. Ensure compacted fills are tested before proceeding with placement of surface materials.

   E. Examine existing and finish grades as shown on grading plan and excavation and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction. If disturbed, destroyed or exceeded, repair as directed.

2. Materials

   A. Fill: Usable material excavated within the limits of work conforming to Article M.02.06 Grading "A" of Form 814A.

   B. Bank Run Gravel: Conform to Article M.02.06 Grading "A" of Form 814A.

3. Subgrade Preparation

   A. All soft and yielding materials and other portions of the subgrade that will not compact readily when rolled or tamped, shall be removed. All loose rock or boulders over 5" in size, found in the earth, shall be removed or broken off to a depth of not less than 6" below the subgrade.

   B. All holes or depressions made by the removal of material, as described, shall be filled with approved fill material as described above and compacted uniformly.

4. Grading

A. The subgrade shall be graded to produce a smooth surface that when compacted meets the lines and grades shown on the plan.

B. Grading shall be done after all underground utilities have been installed and the trenches backfilled and compacted.

5. Compacting

A. Roll the entire subgrade with a power roller having a minimum compression of 300 pounds per inch of width of tread on the rear wheels and weighing not less than 10 tons. Vibrating units shall have a static weight of not less than 4 tons.

B. Any portion of the subgrade that is not accessible to a roller shall be compacted thoroughly with mechanical tampers.

C. The rolling and tamping shall be continued until the entire subgrade is uniformly and thoroughly compacted to the true lines and grades given.

D. The dry density after compaction shall not be less than 95 percent of the dry density for that soil when tested in accordance with *AASHTO* T 180, Method D. Correction for particles retained in the ¾" sieve shall be as specified in *AASHTO* Method T-224.

4. Impervious Material

A. Areas of the subgrade that have become impervious due to a concentration of fine materials and present a hard, smooth and dense surface, shall be lightly scarified, to correct the impervious condition and then recompacted. In particularly severe cases, it may become necessary to remove such fine materials and to replace them with suitable materials prior to recompaction.

5. Protection

A. All ditches and drains shall be completed sufficiently to drain the roadway effectively before the placing of any construction material shall be permitted. In handling materials, tools, equipment, etc.. Protect the subgrade from damage.

B. At all times the subgrade surface shall be kept in such condition that it will drain readily and correctly.

4.2.5 BANK RUN GRAVEL BASE

1. Quality Assurance

   A. Testing of bank run gravel materials shall be performed by an independent testing laboratory.

   B. When work of this section or portions of work are completed, the contractor shall notify their testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.

   C. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, notify the Inspector as to direction to proceed. If required by the Inspector, remove the defective work, replace and retest.

   D. Ensure compacted fills are tested before proceeding with placement of surface materials.

   E. Examine existing and finish grades as shown on grading plan and excavation and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction. If disturbed, destroyed or exceeded, repair as directed.

2. Materials

   A. Bank Run Gravel: Conform to Article M.02.06 Grading "A" of Form 814A.

3. Placing

   A. The bank run gravel base shall be spread upon the prepared subgrade in layers of not over 6" in depth after final compaction.

   B. Frozen material shall not be placed on the subgrade nor shall the bank run gravel be placed upon a frozen subgrade. Previously frozen material shall be removed or shall be otherwise treated as required before new material is placed.

4. Grading

   A. Each lift of bank run gravel shall be uniformly graded to produce a smooth surface and that the desired lines and grades are met after compaction.

   B. Bank run gravel must be finish graded using a motorized road grader specifically manufactured for that purpose.

C. Hand grading may be used where it is impractical for grading by machinery.

5. Compacting

A. After the bank run gravel is spread and graded, it shall be thoroughly compacted and bound by use of equipment specifically manufactured for that purpose. Rollers shall deliver a ground pressure of not less than 300 pounds per lineal inch of contact width and shall weigh not less than 10 tons. Vibratory rollers shall have a static weight of not less than 4 tons.

B. Where it is impractical to use large rollers, mechanical tampers or small rollers can be used.

C. The dry density after compaction shall not be less than 95 percent of the dry density for that subbase material when tested in accordance with *AASHTO* T-180, Method D. Correction for particles retained on the ¾" sieve shall be as specified in *AASHTO* T-224.

D. Water may be used during the compaction and binding operation as needed.

E. The compacting and binding operation shall begin at the outside edges, overlapping the shoulders for a distance of not less than 6" and progress towards the middle, parallel with the centerline of the pavement. The work shall cover the entire surface of the course with uniform overlapping of each preceding track or pass. Areas of super-elevation and special cross slope shall be compacted by beginning at the lowest edge and proceeding towards the higher edge.

F. The compacting and binding operation shall be continued until the voids in the aggregates have been reduced to provide a firm and uniform surface. The amount of compactive effort shall be as directed by the Inspector, but in no case shall be less than four complete passes of the compacting and binding operations.

G. All aggregate shall be completely compacted and bound at the end of each day's work or when traffic is to be permitted to operate on the road.

H. Should the subbase material become churned up or mixed with the bottom course material at any time, remove the mixture and add new subbase material, if required, and reshape and recompact the base.

I. Any surface irregularities which develop during, or after work, shall be corrected by loosening material already in place and removing or adding bank

run gravel as required. After which the entire area, including the surrounding surface, shall be recompacted until it is brought to a firm and uniform surface.

4.2.6 PROCESSED GRAVEL BASE

1. Quality Assurance

   A. Testing of processed gravel materials shall be performed by an independent testing laboratory.

   B. When work of this section or portions of work are completed, the contractor shall notify their testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.

   C. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, notify the Inspector as to direction to proceed. If required by the Inspector, remove the defective work, replace and retest.

   D. Ensure compacted fills are tested before proceeding with placement of surface materials.

   E. Examine existing and finish grades as shown on grading plan and excavation and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction. If disturbed, destroyed or exceeded, repair as directed.

2. Materials

   A. Processed Gravel: Conform to Article M.02.06 Grading "C" of Form 814A.

3. Placing

   A. The processed gravel base shall be spread upon the prepared bank run gravel base or subgrade in layers of not over 3" in depth after final compaction.

   B. Frozen material shall not be placed on the bank run gravel base or subgrade nor shall the processed gravel subbase be placed upon a frozen bank run gravel base or subgrade. Previously frozen material shall be removed or shall be otherwise treated as required before new material is placed.

4. Grading

   A. Each lift of processed gravel shall be uniformly graded to produce a smooth surface and that the desired lines and grades are met after compaction.

   B. Processed Gravel must be finish graded using a motorized road grader specifically manufactured for that purpose.

C. Hand grading may be permitted where it is impractical for grading by machinery.

5. Compacting

A. After the processed gravel is spread and graded, it shall be thoroughly compacted and bound by use of equipment specifically manufactured for that purpose. Rollers shall deliver a ground pressure of not less than 300 pounds per lineal inch of contact width and shall weigh not less than 10 tons. Vibratory rollers shall have a static weight of not less than 4 tons.

B. Where it is impractical to use large rollers, mechanical tampers or small rollers can be used.

C. The dry density after compaction shall not be less than 95 percent of the dry density for that subbase material when tested in accordance with *AASHTO* T-180, Method D. Correction for particles retained on the ¾" sieve shall be as specified in *AASHTO* T-224.

D. Water may be used during the compaction and binding operation as needed.

E. The compacting and binding operation shall begin at the outside edges, overlapping the shoulders for a distance of not less than 6" and progress towards the middle, parallel with the centerline of the pavement. The work shall cover the entire surface of the course with uniform overlapping of each preceding track or pass. Areas of super-elevation and special cross slope shall be compacted by beginning at the lowest edge and proceeding towards the higher edge.

F. The compacting and binding operation shall be continued until the voids in the aggregates have been reduced to provide a firm and uniform surface satisfactory to the Inspector. The amount of compactive effort shall be as directed by the Inspector, but in no case shall be less than four complete passes of the compacting and binding operations.

G. All aggregate shall be completely compacted and bound at the end of each day's work or when traffic is to be permitted to operate on the road.

H. Should the processed gravel material become churned up or mixed with the bottom course material at any time, remove the mixture and add new processed gravel material, if required, and reshape and recompact.

I. Any surface irregularities which develop during, or after work, shall be corrected by loosening material already in place and removing or adding processed gravel as required, after which the entire area, including the surrounding surface, shall be recompacted until it is brought to a firm and uniform surface.

4.2.7 BITUMINOUS CONCRETE PAVING

1. Materials

   A. Bituminous Concrete:

      1. Mixtures, sources of supply, formula for mix, mix tolerances, approval of mix formula and control of mixture for bituminous pavements shall conform to the requirements of Article M.04.01 of Form 814A.

      2. Classification of bituminous concrete shall conform to the classes as required in Article M.04.03 of Form 814A as shown on the Drawing.

   B. Tack Coat:

      1. Tack Coat: Conform to Article M.04.01 of Form 814A.

2. Transportation of Mixture

   A. Mixture shall be transported from the mixing plant in trucks having tight bodies, which have previously been cleaned of all foreign material.

   B. Use of kerosene, gasoline, fuel oil or similar products for the coating of the inside of truck bodies is strictly prohibited. Truck body coatings may consist of soapy water or commercial oil emulsions (also known as soluble oils) in the proportions recommended by the manufacturer. If such coatings are applied, truck bodies shall be raised immediately prior to loading to remove any excess coating material.

   C. Loaded trucks shall be tightly covered with waterproof canvas or other suitable covers. Mesh-type covers are prohibited. Both front and rear of the cover must be fastened to minimize air infiltration.

   D. Hot mixed bituminous concrete shall be delivered at a temperature that is within 25° F of the approved job mix formula.

3. Paving Equipment

   A. Paving equipment shall be of the self-powered type with an adapter to provide guidance of the screeding action. Screed or strike-off member shall be adjustable to the shape of the cross section of the finished pavement. Some method shall be provided for the tilting of the screed while in operation to secure the proper "drag" and to provide the compressive screeded surface required.

B. The machine shall have a sufficient number of driving wheels so there will be no undue amount of slippage. Whenever the design of the equipment and plan of operation are such that the driving wheels travel on the finished surface of a completed pavement, said wheels shall be equipped with rubber tires or other means to protect the finished surface.

C. Screeding members shall be preheated, and means shall be provided for heating the screeding members by some method that will prevent accumulation of bituminous material.

4. Placing of Mixture

A. Mixture shall not be placed when weather conditions of fog or rain prevail or when the pavement surface shows signs of any moisture.

B. Mixture shall be placed only when the base temperature is above 40° F and the depth of pavement to be placed is a minimum of $1^1/_2$". For a 1" depth of pavement to be placed, the base temperature shall be above 50° F.

C. When overtaken by sudden storms, the Inspector may permit work to continue up to the amount which may be in transit from the plant at the time, provided the mixture is within temperature limits specified.

D. At time of placement, the mixture shall be within 25° F of the temperature specified in the approved mix formula.

E. Upon arrival, mixture shall be dumped into the approved mechanical spreader and immediately spread and struck off to the full width required and to such appropriate loose depth for each successive course that when the work is completed, the designed depth will be obtained.

F. Hopper and tunnel shall be properly loaded at all times during the paving operations.

G. Before any rolling is started, the finished surface struck by the machine shall be checked. Any imperfections shall be repaired and all "dripping", i.e., fat, sandy accumulations from the screed, and all fat spots from any source, shall be removed and replaced with satisfactory material.

H. In areas where, because of physical limitations, it is impractical to operate paving equipment, use of other type spreaders is allowed or the mixture may be spread and screeded by hand.

1. When hand-spreading is permitted, the mixture shall be dumped on steel dump sheets outside of the area on which it is to be spread, and shall then be immediately distributed into place by means of suitable shovels and other tools. It shall then be spread with metal lutes in a uniformly loose layer of such depth as will result in a completed pavement having the designed depth. Any deviation from standard crown or section shall be immediately remedied by placing the additional material or removing surplus as directed.

I. Contact surfaces of curbing, gutters, manholes, etc., shall be painted with a thin uniform tack coat just before the mixture is placed against them.

J. A very light, web-like tack coat shall be applied to the entire pavement base before paving the surface course if the base has been in place longer than five calendar days. Emulsions for tack coat shall be diluted 50/50 with water and shall not be heated in excess of 160° F. Care must be taken not to apply too heavy a coating: application rate of the diluted emulsion shall be 0.03 to 0.10 gallons per square yard. The emulsion shall be applied by a pressurized spray method.

K. Refueling of equipment is prohibited in any location on the paving project where fuel might come in contact with bituminous concrete mixtures already placed or to be placed.

L. Solvents and cleaners for use in cleaning mechanical equipment or hand tools shall be stored well clear of areas paved or to be paved. Before any such equipment and tools are cleaned, they shall be moved off the paved or to-be-paved area, and they shall not be returned for use until after they have been allowed to dry.

M. Immediately before placing Class 12 bituminous concrete upon a waterproofing membrane, the membrane shall be swept clean by a method, which shall not damage the membrane. If damage does occur, it shall be repaired.

5. Compaction

A. After placing, each course shall be compacted to meet the following density requirements:

1. The in-place density of each layer or course of mixture of Class 1 or Class 2 placed shall be compacted to a density of at least 92 percent and no more than 97 percent of the theoretical void-free density as determined by *AASHTO* T209.

2. The in-place density of the completed Class 4 Premixed Bituminous Base shall be not less than 90 percent nor more than 98 percent of the theoretical void-free density.

3. Theoretical densities shall be determined by *AASHTO* T209.

B. Cessation temperature for continued compaction of the mat shall be 175° F.

C. Compaction equipment, whether vibratory or non-vibratory, must be of a type and size approved by the Inspector. Such equipment must be maintained in proper operating condition and must be ready, at the job site, prior to delivery of bituminous concrete.

D. On certain bridge deck overlays and paving jobs where, due to physical limitations, a full roller contingent is not practical, utilize a lesser number of rollers, provided all compaction requirements are met.

E. Non-vibratory Rollers

1. In general, rolling shall consist of initial or breakdown rolling, intermediate rolling and final or finish rolling. Rolling shall be performed with at least two power-driven steel-wheel tandem or 3-wheel rollers weighing not less than 10 tons.

2. Intermediate rolling may be done with a self-propelled pneumatic tire roller. If a pneumatic tire roller is used, it shall be equipped with wide-tread compaction tires capable of exerting an average contact pressure from 60 to 90 pounds per square inch uniformly over the surface, adjusting ballast and tire inflation pressure as required. Furnish evidence regarding tire size, pressure and loading to confirm that the proper contact pressure is being developed and that the loading and contact pressure are uniform for all wheels.

3. All non-vibratory rollers shall travel at a speed no greater than 5 mph (440 fpm).

F. Vibratory Rollers

1. A vibratory roller may be included in the compaction train providing the vibratory roller is operated in accordance with the manufacturer's recommendations. The vibratory roller shall be of a self-propelled type specifically designed for the compaction of bituminous concrete.

2. Vibratory rollers shall be equipped with a speed control device which shall be set to prevent the roller from traveling in excess of 2-1/2 mph or 220 fpm when operating in the vibratory mode, and 5 mph or 440 fpm when operating in the static mode.

3. Vibratory rollers shall be shut off from the vibrating mode when reversing directions. Vibratory rollers shall be equipped with automatic reversing eccentrics (weights).

4. One vibratory roller may be substituted for both a breakdown roller and pneumatic roller for the compacting train.

5. Every course placed shall be finish-rolled with a steel-wheel tandem roller having a minimum weight of 10 tons.

6. Dual vibrating drum roller meeting the requirements of a steel-wheel tandem roller and operating in the static mode may be used as the finish roller, however, this single vibratory shall not be used as both the breakdown roller and the finish roller.

7. One vibratory roller and one steel-wheel tandem roller shall be provided for each single-lane paver. The Engineer must approve the type(s) of rollers and number.

8. **THE USE OF A VIBRATORY ROLLER IN THE DYNAMIC OR VIBRATORY MODE IS STRICTLY PROHIBITED ON BRIDGE DECKS OR CONCRETE STRUCTURES.**

9. The Contractor assumes full responsibility for the cost of repairing all damages, which may occur to right-of-way components and adjacent property. If the Inspector determines that the compaction obtained is less than that specified, or damage to right-of-way components and/or adjacent property occurs with the use of the vibratory compaction equipment, immediately cease using the equipment and proceed with the work in accordance with the conventional compaction procedure outlined in the specifications.

6. Surface Test of the Pavement

A. Random spot-checks shall be performed with a contractor supplied, standard ten foot straightedge. Provide or designate some employee whose duty it is to use the straightedge under the observation of the Inspector.

B. Finished pavement shall not vary more than $^1/_4$" from a 10' straightedge applied parallel to the centerline of the pavement. Any irregularity of the surface exceeding the above limits shall be corrected. Depressions, which may develop after the initial rolling, shall be remedied. Such portions of the completed pavement that are defective in surface, compression or composition, or that do not comply with the requirements of the specifications shall be taken up, removed and replaced with suitable mixture, properly laid in accordance with these specifications.

C. The surface of the finished base course shall not vary by more than $^3/_8$" from a 10' straightedge applied perpendicular to the centerline of the pavement.

7. Joints

A. Placement of the bituminous material shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly placed mixture.

B. Transverse joints shall be formed by cutting back on the previous run, existing bituminous concrete pavement, or bituminous concrete driveways to expose the full depth of the course. Waste materials shall be disposed of in an acceptable manner.

C. On cold joints, a brush coat of asphaltic material or approved equal shall be used on contact surfaces of transverse and longitudinal joints just before additional mixture is placed against the previously rolled material.

D. The longitudinal joint in one layer shall offset the previous joint in the layer immediately below by approximately 6". However, the joint in the top layer shall be at the centerline of the pavement if the roadway comprises two lane width, or at lane lines if the roadway is more than two lanes in width.

E. In compacting the joint, the steel-wheel roller shall be shifted onto the previously placed lane so that only 1 or 2" of the drive wheel extends over the uncompacted material. The steel wheel roller shall continue to roll along this line and its position shifted gradually across the joint until the joint has been rolled with the entire width of the drive wheel. Rolling with steel wheel and pneumatic-tired rollers shall be continued until a thoroughly compacted, neat joint is obtained.

F. When the vibratory roller is used for breakdown rolling, compacting the joint shall be accomplished with the roller on the uncompacted material shifted 1 to 2" across the joint onto the previously placed lane.

4.2.8 PAVEMENT MARKINGS

1. Materials

   A. 15-minute dry paint: Conform to Article M.07.20 of Form 814A.

   B. Fast drying paint: Conform to Article M.07.21 of Form 814A.

   C. Glass beads: Conform to Article M.07.30 of Form 814A.

2. Preparation

   A. Pavement areas to be painted shall be dry and cleaned of sand and road debris so as to provide an acceptable bond between the paint and the pavement.

3. Application

   A. Paint shall be applied at a rate of 100 - 115 sf per gallon.

   B. Glass beads shall be applied at a rate of 6 lbs. per gallon of paint for painted pavement markings and painted legend, arrows, and markings. For fast drying painted pavement markings, the rate shall be at 8 lbs. per gallon of paint.

   C. Fast drying paint shall be applied at a temperature of 120 - 150 ^{0} F at the spray gun.

   D. Painted centerline and shoulder lines shall be applied with a truck mounted sprayer.

   E. All painting shall be performed in a neat and workmanlike manner. The lines shall be sharp and clear with no feathered edge or fogging and precautions shall be taken to prevent tracking by tires of the striping equipment. Paint shall be applied parallel to the road centerline or as shown on the plan with no unsightly deviations.

4. Protection

   A. After application, the paint shall be protected from crossing vehicles for a time at least equivalent to the drying time of the paint.

5. Removal

A. Any existing painted markings that are shown to be removed or are directed to be removed shall be permanently removed from the pavement by any method that that does not damage the integrity of the pavement. Marring of the surface by sandblasting methods will be acceptable.

B. Sand or other material deposited on the pavement as a result of the removal process shall be removed as work progresses.

C. Painting existing markings black shall not be allowed.

6. Temporary markings

A. Commercially available temporary marking tape shall be installed on roads being used when the permanent pavement markings will not be applied immediately following removal or covering of existing markings or where temporary markings are needed.

B. The materials used and the installation shall be done in accordance with Article 12.12 of Form 814A.

4.2.9 SIGNS

1. Materials

   A. Traffic shall meet the size and color requirements as shown in the *MUTCD*.

   B. Traffic signs shall be aluminum sheets constructed in accordance with the *MUTCD*.

   C. Traffic sign posts shall be galvanized steel "U" shaped channels.

   D. Street signs and posts shall meet the requirements in Section 3.11.

2. Location

   A. Signs shall be located as shown on the plan, or as directed by the Town Traffic Authority, and in accordance with the *MUTCD*.

3. Installation

   A. Set sign post firmly in the ground. Set plumb.

   B. Sign face shall be perpendicular to the travel lane.

4.3 CURBING AND SIDEWALKS

4.3.1 CONCRETE CURBING

1. Material

   A. Concrete:

      1. Cement shall meet *ASTM* C150 or C595 Type II.

      2. Mixing water shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances in accordance with *ACI* 318.

      3. Air-entraining admixture shall conform to *ASTM* C260.

      4. Any other admixtures shall only be used if approved by the Engineer.

      5. Concrete shall have the following properties:

         a. Materials shall be proportioned to produce concrete with a minimum compressive strength of 3,500 psi at 28 days.

         b. The air content shall be 5% by volume with a tolerance of $\pm$ 2%.

         c. Maximum size of aggregate shall be 3/4".

         d. Minimum cement content shall be 520 pounds per cubic yard.

         e. Concrete shall be delivered at the minimum slump necessary for efficient mixing, placing and finishing. The maximum slump shall be 4" with a tolerance of $\pm$ 1".

         f. The concrete shall be batched and mixed in accordance with *ASTM* C94.

   B. Pre-molded Joint Filler: Pre-formed strips, non-extruding and resilient bituminous type, of thickness indicated, complying with *ASTM* D994.

2. Excavation and Base Preparation

A. Excavate, prepare subgrade, and install processed gravel base in accordance with Sections 4.2.2, 4.2.4 and 4.2.6.

3. Forming

A. Set clean timber or metal forms true to line. Firmly stake forms in place, strong enough to resist the pressure of concrete without springing, and tight enough to prevent mortar leakage. Tops of forms shall be at exact finished grade.

4. Concreting

A. Spade concrete thoroughly along forms and expansion joints. Vibrate, tamp and screed to a dense mass.

B. Provide $^1/_2$" wide pre-molded expansion joints. Cut back joints $^1/_4$" below the top of curb. Provide additional expansion joints where concrete abuts other structures.

C. After concrete is placed, screeded, bullfloat and steel trowel to a smooth even surface. Bring sufficient mortar to the surface for the finish.

F. Finish the outside edge of the curb and all joints with a radius-edging tool. The greatest allowable ridge formed by the back of the edging or jointing tool is $^1/_8$".

G. The finished surface will be checked with a 5' straight-edge. No dips or rises over $^1/_8$" in the surface of the curb will be permitted.

H. Forms shall not be removed from freshly placed concrete until it has set. After the forms have been removed, the ends of all joints shall be cleaned and any "honeycombed" areas shall be patched with cement.

5. Curing

A. Moist Curing

1. After the surface of the concrete has been given its final finish and has adequately set, it shall be protected by covering it with either impervious sheets of plastic or paper.

2. Sheets shall be laid longitudinally over the surface of the curb by unrolling from a supported roll so as not to bring excessive weight upon, nor mar the new surface. Cover material shall be securely weighted down.

3. Sheets shall be kept on the curb for five days. During this period, concrete shall be kept thoroughly wet at all times.

4. In the event that hair checking develops before the cover can be placed, moist curing mats shall be used for the initial 24-hour period.

B. Membrane Curing

1. Apply suitable curing agent in accordance with the manufacturer's specifications. Membrane curing shall be applied in the presence of the Inspector and contain a fugitive dye to insure thorough application.

6. Protection

A. After the completion of curbing, traffic shall be kept at a safe distance for a period of not less than 24 hours or until the curbing has set sufficiently to prevent injury to the work.

B. Replace any broken or damaged curbing, until completion of the project, or acceptance of the road.

7. Pre-Cast Curbing

A. Concrete used for pre-cast curbing shall meet the requirements of section 4.3.1.1.A.

B. The profile for pre-cast curbing shall match that of cast-in-place curbing.

C. On curve with a radius of 100' or less, pre-cast curbs shall be curved to conform to the required radius (straight sections will not be allowed).

D. Excavate, prepare subgrade and install processed gravel in accordance with Sections 4.2.2, 4.2.4, and 4.2.6.

E. Set the top of the curb to finished grade. Dowel pre-cast curbing sections together. Backfill around the pre-cast curbing with processed gravel to ensure it remains in position during and after construction.

4.3.2 CONCRETE SIDEWALK AND DRIVEWAY APRONS

1. Materials

   A. Concrete:

      1. Cement shall meet *ASTM* C150 or C595 Type II.

      2. Mixing water shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances in accordance with *ACI* 318.

      3. Air-entraining admixture shall conform to *ASTM* C260.

      4. Any other admixtures shall only be used if approved by the Engineer.

      5. Concrete shall have the following properties:

         a. Materials shall be proportioned to produce concrete with a minimum compressive strength of 3,500 psi at 28 days.

         b. The air content shall be 5% by volume with a tolerance of $\pm$ 2%.

         c. Maximum size of aggregate shall be 3/4".

         d. Minimum cement content shall be 520 pounds per cubic yard.

         e. Concrete shall be delivered at the minimum slump necessary for efficient mixing, placing and finishing. The maximum slump shall be 4" with a tolerance of $\pm$ 1".

         f. The concrete shall be batched and mixed in accordance with *ASTM* C94.

   B. Pre-molded Joint Filler: Pre-formed strips, non-extruding and resilient bituminous type, of thickness indicated, complying with *ASTM* D994.

   C. Welded Wire Fabric: Cold-drawn steel wire conforming to *ASTM* A185 or A497 and the sizes indicated on the plans.

2. Excavation and Base Preparation

   A. Excavate, prepare subgrade, and install processed gravel base in accordance with Sections 4.2.2, 4.2.4, and 4.2.6.

3. Forming

A. Set clean timber or metal forms true to line. Firmly stake forms in place, strong enough to resist the pressure of concrete without springing, and tight enough to prevent mortar leakage. Tops of forms shall be at exact finished grade.

4. Concreting

A. Spade concrete thoroughly along forms and expansion joints. Vibrate, tamp and screed to a dense mass.

B. Provide $^1/_2$" wide pre-molded expansion joints. Cut back joints $^1/_4$" below top of walk/apron. Provide additional expansion joints around utility structures and where concrete abuts other structures.

C. After concrete is placed, screeded, bullfloat and steel trowel to a smooth even surface. Bring sufficient mortar to the surface for the finish.

D. Score contraction joints using scoring tool while concrete is workable.

E. Provide a broom finish using new street broom. Bristle marks shall be perpendicular to the length of the sidewalk.

F. Finish the outside edge of the slab and all joints with a $^1/_4$" radius-edging tool. Dummy joints must be straight and perpendicular to the sides of the sidewalk. The greatest allowable ridge formed by the back of the edging or jointing tool is $^1/_8$".

G. The finished surface will be checked with a 5' straight-edge. No dips or rises over $^1/_8$" in the surface of the sidewalk will be permitted.

H. Forms shall not be removed from freshly placed concrete until it has set for at least 24 hours. After the forms have been removed, the ends of all joints shall be cleaned and any "honeycombed" areas shall be patched with cement.

5. Curing

A. Moist Curing

1. After the surface of the concrete has been given its final finish and has adequately set, it shall be protected by covering it with either impervious sheets of plastic or paper.

2. Sheets shall be laid longitudinally over the surface of the finished walk by unrolling from a supported roll so as not to bring excessive weight upon, nor mar the new surface. Cover material shall be securely weighted down.

3. Sheets shall be kept on the sidewalk for five days. During this period, concrete shall be kept thoroughly wet at all times.

4. In the event that hair checking develops before the cover can be placed, moist curing mats shall be used for the initial 24-hour period.

B. Membrane Curing

1. Apply suitable curing agent in accordance with the manufacturer's specifications. Membrane curing shall be applied in the presence of the Inspector and contain a fugitive dye to insure thorough application.

6. Protection

A. After the completion of the walks and driveway aprons, traffic shall be kept at a safe distance for a period of not less than 24 hours or until the concrete has set sufficiently to prevent injury to the work.

B. Replace any broken or damaged walks and driveway aprons, until completion of the project, or acceptance of the road.

4.3.3 BITUMINOUS CONCRETE LIP CURBING

1. Materials

   A. Bituminous concrete:

      1. Mixtures, sources of supply, formula for mix, mix tolerances, approval of mix formula and control of mixture for bituminous pavements shall conform to the requirements of Article M.04.01 of Form 814A.

      2. Classification of bituminous concrete shall conform to Class 3 in Article M.04.03 of Form 814A.

   B. Tack Coat:

      1. Tack Coat: Conform to Article M.04 of form 814A. Tack coat shall be RS-1.

2. Transportation of Mixture

   A. Mixture shall be transported from the mixing plant in trucks having tight bodies, which have previously been cleaned of all foreign material.

   B. Use of kerosene, gasoline, fuel oil or similar products for the coating of the inside of truck bodies is strictly prohibited. Truck body coatings may consist of soapy water or commercial oil emulsions (also known as soluble oils) in the proportions recommended by the manufacturer. If such coatings are applied, truck bodies shall be raised immediately prior to loading to remove any excess coating material.

   C. Loaded trucks shall be tightly covered with waterproof canvas or other suitable covers. Mesh-type covers are prohibited. Both front and rear of the cover must be fastened to minimize air infiltration.

   D. Hot mixed bituminous concrete shall be delivered at a temperature that is within 25° F of the approved job mix formula.

3. Surface Preparation

   A. Prior to the arrival of the mixture on the site, the surface of the pavement where the curbing is to be constructed shall be cleaned of all loose and foreign material. The surface, which shall be perfectly dry and clean at the time the mix is placed and shall be coated with the tack coat just prior to placing the mixture.

4. Temperature Requirements

A. Mixture shall be placed only when the air temperature is above 40° F.

B. When overtaken by sudden storms, the Inspector may permit work to continue up to the amount which may be in transit from the plant at the time, provided the mixture is within temperature limits specified.

C. At time of placement, the mixture shall be within 25°F of the temperature specified in the approved mix formula.

5 Installation

A. On arrival at the site, the mixture shall be transferred from the truck to the hopper of the curbing machine; and the mixture shall be kept clean and free from dirt and foreign materials at all times.

B. The surface of the curbing shall be tested with a 10-foot straightedge, and any variation from a true line exceeding $^1/_4$" inch shall be satisfactorily corrected. The only compaction required shall be that obtained by the mechanical curbing machine.

C. Where machine work is impractical, hand-laid curbing may be used.

D. If the design of the curbing machine is such that the outside wheels operate outside of the curb, obtain a smooth surface by grading and consolidating the area on which the outside wheel of the machine rides.

6. Protection

A. After the completion of curbing, traffic shall be kept at a safe distance for a period of not less than 24 hours or until the curbing has set sufficiently to prevent injury to the work.

B. Replace any broken or damaged curbing, until completion of the project, or acceptance of the road.

4.3.4 BITUMINOUS CONCRETE SIDEWALKS AND DRIVEWAY APRONS

1. Materials

   A. Bituminous concrete:

      1. Mixtures, sources of supply, formula for mix, mix tolerances, approval of mix formula and control of mixture for bituminous pavements shall conform to the requirements of Article M.04.01 of Form 814A.

      2. Classification of bituminous concrete shall conform to Class 2 as required in Article M.04.03 of Form 814A.

2. Excavation and Base Preparation

   A. Excavate, prepare subgrade, and install processed gravel base in accordance with Sections 4.2.2, 4.2.4, and 4.2.6.

3. Forming

   A. Set clean timber or metal forms true to line. Firmly stake forms in place, strong enough to resist the pressure of paving without springing.

4. Transportation of Mixture

   A. Mixture shall be transported from the mixing plant in trucks having tight bodies, which have previously been cleaned of all foreign material.

   B. Use of kerosene, gasoline, fuel oil or similar products for the coating of the inside of truck bodies is strictly prohibited. Truck body coatings may consist of soapy water or commercial oil emulsions (also known as soluble oils) in the proportions recommended by the manufacturer. If such coatings are applied, truck bodies shall be raised immediately prior to loading to remove any excess coating material.

   C. Loaded trucks shall be tightly covered with waterproof canvas or other suitable covers. Mesh-type covers are prohibited. Both front and rear of the cover must be fastened to minimize air infiltration.

   D. Hot mixed bituminous concrete shall be delivered at a temperature that is within 25° F of the approved job mix formula.

5. Placing of Mixture

A. Mixture shall not be placed when weather conditions of fog or rain prevail or when the pavement surface shows signs of any moisture.

B. Mixture shall be placed only when the base temperature is above 40° F and the depth of pavement to be placed is a minimum of $1^1/_2$". For a 1" depth of pavement to be placed, the base temperature shall be above 50° F.

C. When overtaken by sudden storms, the Inspector may permit work to continue up to the amount which may be in transit from the plant at the time, provided the mixture is within temperature limits specified.

D. At time of placement, the mixture shall be within 25° F of the temperature specified in the approved mix formula.

E. Upon arrival, mixture shall be dumped into the formed sidewalk and immediately spread with metal lutes and struck off to the full width required and to such appropriate loose depth that when the work is completed, the designed depth will be obtained.

F. Contact surfaces of curbing, gutters, manholes, etc., shall be painted with a thin uniform tack coat just before the mixture is placed against them.

G. Refueling of equipment is prohibited in any location on the paving project where fuel might come in contact with bituminous concrete mixtures already placed or to be placed.

H. Solvents and cleaners for use in cleaning mechanical equipment or hand tools shall be stored well clear of areas paved or to be paved. Before any such equipment and tools are cleaned, they shall be moved off the paved or to-be-paved area, and they shall not be returned for use until after they have been allowed to dry.

6. Compaction

A. After placing, the bituminous concrete shall be compacted by multiple passes of a roller weighing not less than 500 pounds to meet the following density requirements:

1. The in-place density of each layer or course of mixture of Class 2 placed shall be compacted to a density of at least 92 percent and no

more than 97 percent of the theoretical void-free density as determined by *AASHTO* T209.

2. Theoretical densities shall be determined by *AASHTO* T209.

B. Cessation temperature for continued compaction of the mat shall be 175° F.

C. Compaction equipment must be maintained in proper operating condition and must be ready, at the job site, prior to delivery of bituminous concrete.

7. Surface Test of the Pavement

A. Random spot checks shall be performed with a Contractor supplied standard 10' straight edge. Provide or designate some employee whose duty it is to use the straight edge under the observation of the Inspector.

B. Finished bituminous concrete sidewalks and driveway aprons shall not vary more than $^1/_4$" from a 10' straight edge applied parallel to the centerline of the sidewalk. Any irregularity of the surface exceeding the above limits shall be corrected. Depressions that may develop after the initial rolling shall be remedied. Such compression or compositions, or other irregularities that do not comply with the requirements of the specifications shall be taken up, removed and replaced with suitable mixture, properly laid in accordance with these specifications.

8. Joints

A. Placement of the bituminous material shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly placed mixture.

B. Transverse joints shall be formed by cutting back on the previous run, or existing bituminous concrete sidewalk to expose the full depth of the course. Waste materials shall be disposed of in an acceptable manner.

C. On cold joints, a brush coat of asphaltic material or approved equal shall be used on contact surfaces of transverse joints just before additional mixture is placed against the previously rolled material.

4.4 DRAINAGE

4.4.1 TRENCH EXCAVATING AND BACKFILLING

1. Quality Assurance

   A. Testing of compacted fill materials shall be performed by an independent testing laboratory.

   B. When work of this section or portions of work are completed, the contractor notify their testing laboratory to perform density tests. Do not proceed with additional portions of work until results have been verified.

   C. If, during progress of work, tests indicate that compacted materials do not meet specified requirements, notify the Inspector as to direction to proceed. If required by the Inspector, remove the defective work, replace and retest.

   D. Ensure compacted fills are tested before proceeding with placement of surface materials.

   E. Examine existing and finish grades as shown on grading plan and excavation and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction. If disturbed, destroyed or exceeded, repair as directed.

2. Protection

   A. Protect bench marks, monuments, other reference points, existing structures, roads, sidewalks, paving, curbs, overhead and underground utilities against damage from equipment and vehicular or foot traffic.

   B. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods as required to sustain excavated areas.

   C. Protect the bottom of excavations and soil around and beneath utilities from frost.

   D. Grade around excavation to prevent surface water run-off into excavated area.

3. Materials

   A. Fill: Usable material excavated within the limits of work conforming to Article M.02.06 Grading "A" of Form 814A.

B. Pipe Bedding: Conform to Article M.08.01-21 of Form 814A.

C. Sand: Conform to Article M.03.01-2 of Form 814A.

D. Crushed Stone: Conform to Article M.01.01 of Form 814A for the size indicated on the plans.

E. Bank Run Gravel: Conform to Article M.02.06 Grading "A" of Form 814A.

F. Processed Gravel: Conform to Article M.02.06 Grading "C" of Form 814A.

4. Stripping and Stockpiling Topsoil

A. Reusable topsoil shall be stripped and stockpiled for use in finish grading. Stockpile only soil, which conforms to Section 4.5.2. Topsoil shall be fertile, friable agricultural soil with a loam texture class capable of sustaining vigorous plant growth and suitable for growth of grass, neither excessively alkaline, nor acidic, and free from topsoil, clay lumps, gravel, brush, weeds, and objectionable material.

B. Install all perimeter silt fence, sedimentation basins and other required erosion controls prior to stripping topsoil.

C. Stockpile topsoil so that natural drainage is not obstructed and no off-site sediment damage shall result.

D. Side slopes of the stockpile shall not exceed a 2:1 slope.

E. Test stockpiled topsoil immediately following stockpiling operations and provide test results prior to spreading topsoil.

F. Seed stockpiled topsoil with temporary grass seed of the type and at the rate indicated in Section 4.5.3 within 10 days of the formation of the stockpile.

G. Install silt fence around perimeter of stockpiled topsoil.

H. No topsoil shall be excavated, graded or worked in frozen or muddy condition.

I. Dispose of unsuitable material off site in a legal manner.

5. Removing Existing Pavement Surfaces

A. No excavation shall be made until existing paved surfaces have been neatly saw-cut. Pavement, which is weakened or destroyed beyond the limits indicated, shall be re-cut and trimmed.

B. All pavement removal within state highways shall be in strict accordance with all requirements of the DOT. Conditions of permits for excavation within established rights-of-way shall be strictly observed and the Contractor shall assume full responsibility for violations thereof.

6. Earth Excavation

A. Excavation shall be in open cut with sheeting provided in areas shown on the plans or as required.

C. When materials encountered are not suitable for the utility or when it is found desirable or necessary to go to additional depth, the excavation shall be carried to an additional depth.

7. Site Contamination

A. The suspicion of, or unanticipated discovery of, contaminated ground during the excavation, or other work task under this contract, shall be reported immediately to the DEP and the Department. The Contractor, at all times, shall exercise caution to protect workmen, observers, and residents from harm. The Contractor shall provide all reasonable and necessary assistance to the DEP and the Department to ascertain the nature and source of ground contamination.

8. Protection of Work

A. Provide safe working conditions for the protection of men, materials and equipment involved in the work, and to protect the public, adjacent structures, utilities, poles, pipe lines, duct, conduit, streets and other public or private property from cave-ins, slides, settlement or other damage.

B. Contractor shall assume full responsibility for compliance with all local codes or State and Federal laws which pertain to safe working conditions for the protection of men, materials and equipment during excavation.

C. Existing pipes, poles, wires, fences, curbings, property-line markers, and other structures, which must be preserved in place without being temporarily or

permanently relocated, shall be carefully supported and protected from injury. Should such items be damaged, they shall be restored by the Contractor, without compensation, to at least as good a condition as that in which they were found immediately before the work was begun.

D. Cooperate closely with all utility companies involved and to ascertain the exact locations of all utilities prior to excavation. Existing utilities will be protected from damage during construction, and if damaged, shall be repaired. Note that it is generally not the policy of the local utilities to mark locations of services on private property. Therefore, it is the responsibility of the Contractor to locate utilities on the site.

E. Power-driven excavating machinery shall be handled with care to prevent damage to shade trees, particularly to overhanging branches. Branches shall not be cut off.

F. Dig up, handle, protect and properly reset signs, posts, guard rails and the like along the line of or adjacent to the work.

G. Utility poles or other structures in close proximity to trench excavations must be tied back, braced or otherwise temporarily supported to the satisfaction of the utility company. Costs for providing such support, or damages resulting from inadequate or insufficient support, shall be the Contractor's sole responsibility and no separate compensation will be made.

H. Damage to electric poles, or their attachments, underground duct lines, manholes, conduits or their components caused by the Contractor shall be repaired by the controlling utility agency.

9. Care and Restoration of Property

A. Do not use or operate tractors, bulldozers, or other power-operated crawler equipment on paved surfaces; the treads or wheels of which are so shaped as to cut or otherwise injure such surfaces without providing proper protection for the pavement.

B. Replace in kind, all granite, concrete or bituminous curbing removed. Granite or pre-cast concrete curbing shall be set plumb and true to the lines and grades established and shall be backed up with materials equal to those removed. Existing cast-in-place or bituminous curbing which is damaged or destroyed, or pre-cast concrete or granite curbing which is damaged, and is not scheduled for removal, shall be replaced with new curbing equal to that removed.

C. All surfaces, which have been injured by the Contractor's operations, shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

D. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

10. Disposal of Surplus and Unsuitable Excavated Materials

A. Dispose of material off-site in a legal manner.

11. Dust Control

A. Conduct operations and maintain the area of activities, including sweeping and sprinkling of area as necessary, so as to minimize the creation and dispersion of dust. If it is necessary to use calcium chloride for more effective dust control, the Contractor shall furnish and spread the material as directed.

12. Sheeting and Shoring

A. Provide sheeting and shoring conforming to Section 4.1.11.

13. Dewatering

A. Contractor shall at all times keep the excavation free from water. The water shall be disposed of by the Contractor in accordance with the General Conditions and applicable laws and regulations.

B. Contractor shall provide all necessary pumps, dams, drains, ditches, flumes, well points, and other means for excluding and removing water from trench excavations, and for preventing the slopes from sliding or caving in. Contractor shall satisfactorily remove all water, which interferes with the work. The Contractor shall sufficiently dewater trenches to completely dry out and solidify the foundation below the bottom of the pipe to whatever depth is necessary to provide a firm, solid, completely dry foundation on which to lay the pipe.

C. Sediment laden water shall not be pumped off-site. It shall be filtered through a sediment fence, sediment basin, "dirt bag" or other approved filtration system prior to being discharged.

14. Backfilling

A. As the various pipes or utilities are installed, refill the space outside and around the pipe walls with approved materials to the depths, and widths, and as shown on the plans. All forms, bracing, and lumber shall be removed before backfilling.

B. Frozen material shall not be placed in the backfill nor shall backfill be placed upon frozen material. Previously frozen material shall be removed or shall be otherwise treated as required before new backfill is placed.

C. Backfill shall be placed in lifts no greater than 6" and shall be well tamped or otherwise thoroughly compacted to 95 percent of maximum dry density as determined by *ASTM* test D1157, Method D, by mechanical compactors and/or vibrators before additional lifts are placed.

D. Backfill shall be placed and compacted in a manner so as not to damage any waterproofing materials applied to the outside of any structure. Any damage caused to waterproofing shall be repaired at the Contractor's expense.

E. If necessary to ensure proper compaction by tamping or rolling, the material shall first be wet by sprinkling. However, no compaction by tamping or rolling shall be done when the material is too wet either from rain or too great an application of water to be compacted properly. At such times, the work will be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain proper compaction.

F. Care shall be taken that stones and lumps do not become nested and that all voids between stones shall be completely filled with fine material.

G. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.

4.4.2 TRENCH ROCK EXCAVATION

1. Explosives

   A. If explosives are used, obtain all necessary permits and licenses.

   B. Explosives must be carefully transported, stored, handled and used. Keep on the job only such quantities of explosives as may be needed for the work underway and only during such time as they are being used. Explosives shall be stored in a secure manner in locked containers and separate from all tools. Caps and detonators shall be stored separately from other explosives. When the need for explosives is ended, all such materials remaining on the job shall be promptly removed from the site. Care must be taken that no explosives, caps or detonators are stolen or get into the hands of unauthorized persons or left unguarded.

2. Blasting Log

   A. An accurate blasting log must be maintained. The Contractor shall record in the log, for each shot; the location, number of holes, depth, spacing, amount of explosive per hole; number, type and delay interval of blasting caps used; horizontal distance to existing structures and utilities (sewer, water, gas, etc.); and the date and exact time of the blast.

   B. The log shall include a sketch for each shot showing the location of every blasting cap and its delay period and comments regarding any property damage or unusual results.

3. Blasting

   A. A pre-blast survey is required for all new and existing structures, which could be affected by blasting.

   B. An on-site seismologist shall be employed during all blasting operations.

   C. Give at least 24 hours notice and a schedule of blasting operations to the operating official, company or companies leasing, owning or responsible for pipes, conduits, poles, wires, or any other public or private utilities which may be endangered by the blasting.

   D. When blasting is necessary, it shall be done in accordance with all Town Ordinances, State Statutes and other pertinent regulations and under the direction of the Fire Marshal. Such ordinances, regulations and orders shall

not, however, relieve the Contractor of any responsibility for damages caused by him or by his employees.

E. Prior to the firing of blasts, all persons in the vicinity shall be given ample warning. All blasts shall be well covered and provisions shall be made to protect all pipes, conduits, sewers and structures, and all persons or property along and adjacent to the site of the work.

F. If damage is incurred by adjacent properties, blasting shall cease until the extent of the damage has been documented.

G. If damage occurs to any portion of structures or to the materials surrounding or supporting the same through blasting shall rebuild or repair the structures and replace the material surrounding or supporting the same.

H. If any damage occurs to any existing utility through blasting, the controlling utility company may do the repairs.

4. Shattered Trench Rock

A. If trench rock below normal depth is shattered due to operations of the Contractor, and the Engineer considers such shattered trench rock to be unfit, the shattered rock shall be removed and the excavation shall be backfilled with fill as required.

5. Excess Trench Rock Excavation

A. If trench rock is excavated beyond the limits indicated on the drawings, the excess excavation, whether resulting from overbreakage or other causes shall be backfilled using bank run gravel.

6. Splitting

A. Drilling and splitting trench rock by hydraulic means (or some other approved method) to remove it or to make it smaller, for more manageable pieces to be removed by machinery is allowable.

7. Disposal

A. Excavated trench rock may be used for fill in embankment areas as directed.

B. Excess excavated trench rock shall be disposed of off-site in a legal manner.

4.4.3 CATCH BASINS AND DRAINAGE MANHOLES

1. Materials

   A. Catch Basin and Manhole blocks and pre-cast units: Conform to Article M08.02 of Form 814A.

   B. Frames and grates: Conform to DOT drawing number 507-K. Frames and grates shall be galvanized, Type A.

   C. Crushed Stone: Conform to Article M.01.01 of Form 814A for the size indicated on the plans.

   D. Mortar: Conform to Article M.11.04 of Form 814A.

2. Construction Methods

   A. Excavate and backfill in accordance with Section 4.4.1.

   B. Place crushed stone base to the size and thickness as shown on the plans.

   C. Set pre-cast sump or pour concrete slab to the proper elevation.

   D. All concrete block and pre-cast units shall be laid in full mortar beds.

   E. Inside joints of concrete blocks are to be pointed flush.

   F. Inlet and outlet pipes shall extend through the walls for a sufficient distance beyond the outside surface to allow for satisfactory connections. The concrete and mortar shall be constructed around them neatly to prevent leakage along their outer surfaces.

   G. Pipe shall be cut flush with the inside face of the wall, or as shown on the plans.

   H. Set top to "top of frame" grade as shown on plans.

3. Cleaning Catch Basins

   A. During installation, use every precaution to keep drainage pipes free of foreign materials.

B. After all site work is completed, including spreading of topsoil and seeding, clean debris from all catch basins.

4.4.4 DRAINAGE PIPE

1. Materials

   A. Reinforced concrete pipe (RCP): Conform to Article M.08.01 (6) of Form 814A. Pipe shall be Class IV unless otherwise specified.

   B. High Density Polyethylene Pipe (HDPE): Conform to *AASHTO* M294, (Type "S').

2. Construction Methods

   A. Excavate and Backfill in accordance with Section 4.4.1.

   B. Pipe bedding shall be rounded to accommodate the bottom quadrant of the pipe. The interior of the pipe shall be clean when it is lowered into the trench.

   C. Pipe laying shall begin at the downstream end. No pipe shall be placed unless a suitable outlet is provided. Batter boards shall be placed at intervals of not over 25' or other suitable control shall be used to eliminate sag in the line during installation.

   D. Bell ends shall be placed upstream with the spigot ends fully inserted into the adjacent bell end.

   E. Any piping, which is not in true alignment, shows settlement or is otherwise unsatisfactorily bedded, shall be taken up and re-laid.

3. Cleaning Piping

   A. During installation, use every precaution to keep pipes free of foreign materials.

   B. After all site work is completed, including spreading of topsoil and seeding, clean debris from all lines.

4.4.5 UNDERDRAINS

1. Materials

   A. Slotted Reinforced Concrete Pipe (RCP): Conform to Article M.08.01 (10) of Form 814A. Pipe shall be Class IV unless otherwise specified.

   B. Perforated High Density Polyethylene Pipe (HDPE): Conform to *AASHTO* M294, (Type "S').

   C. Crushed Stone: Conform to Article M.08.03 of Form 814A for the size indicated on the plan.

   D. Geotextile fabric: Conform to Article M.08.01 (26) of Form 814A

2. Construction Methods

   A. Excavate and Backfill in accordance with Section 4.4.1.

   B. A geotextile filter fabric shall be used too completely encapsulate the underdrain system.

   C. The dimensions of the trench shall be as shown on the plans or as directed. Where the bottom of the trench is unstable, sufficient unstable material shall be removed and replaced with crushed stone or gravel to stabilize the trench bottom.

   D. Place fabric and 6" of crushed stone under the pipe. Place pipe with openings down.

   E Pipe laying shall begin at the downstream end. No pipe shall be placed unless a suitable outlet is provided. Batter boards shall be placed at intervals of not over 25' or other suitable control shall be used to eliminate sag in the line during installation.

   F Bell ends shall be placed upstream with the spigot ends fully inserted into the adjacent bell ends.

   G Any piping, which is not in true alignment, shows settlement or is otherwise unsatisfactorily bedded, shall be taken up and re-laid.

   H Backfill pipe to 12" above the top of pipe with crushed stone. Lay filter fabric over stone to completely enclose system. Lap the filter fabric a minimum of 6".

3. Cleaning Piping

A. During installation, use every precaution to keep pipes free of foreign materials.

B. After all site work is completed, including spreading of topsoil and seeding, clean debris from all lines.

4.4.6 FLARED ENDS

1. Material

   A. Reinforced Concrete Flared Ends: Conform to Article M.08.01-22 of Form 814A.

   B. HDPE flared ends shall not be used.

   C. Processed Gravel; Conform to Article M.02.06 Grading "C" of Form 814A.

   D. Mortar: Conform to Article M.11.04 of Form 814A.

2. Installation

   A. Flared ends shall be placed on a prepared gravel base to the grades and alignment shown on the plans.

   B. When using HDPE pipe, reinforced concrete flared ends shall still be used. The HDPE pipe shall be mortared into the concrete flared end.

4.4.7 RIPRAP

1. Material

   A. Riprap: Conform to Article M.12.02 of Form 814A for the size shown on the plan.

   B. Processed Gravel: Conform to Article M.02.06 Grading "C" of Form 814A.

   C. Geotextile: Conform to Article M.08.01-26 of Form 814A.

2. Preparation

   A. The area to be protected by riprap shall be accurately shaped prior to placing any geotextile, processed gravel, or riprap. Processed gravel and the geotextile shall be placed on the prepared area and compacted to the depth, lines and grades indicated on the plans.

3. Installation

   A. The riprap shall be placed to its full course thickness in one operation in such a manner as to produce a reasonably well graded mass of rock without causing displacement of the underlying material. Placing the material by methods likely to cause segregation of the various stone sizes will not be permitted.

   B. The finished surface shall be free from pockets of small stones and clusters of large stones. Rearranging of individual stones by mechanical or hand methods will be required to the extent necessary to obtain a reasonably well graded distribution of the specified stone size.

4.4.8 CONCRETE HEADWALLS AND ENDWALLS

1. Material

   A. Concrete:

      1. Cement shall meet *ASTM* C150 or C595 Type II.

      2. Mixing water shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances in accordance with *ACI* 318.

      3. Air-entraining admixture shall conform to *ASTM* C260.

      4. Any other admixtures shall only be used if approved by the Engineer.

      5. Concrete shall have the following properties:

         a. Materials shall be proportioned to produce concrete with a minimum compressive strength of 3,500 psi at 28 days.

         b. The air content shall be 5% by volume with a tolerance of $\pm$ 2%.

         c. Maximum size of aggregate shall be 3/4".

         d. Minimum cement content shall be 520 pounds per cubic yard.

         e. Concrete shall be delivered at the minimum slump necessary for efficient mixing, placing and finishing. The maximum slump shall be 4" with a tolerance of $\pm$ 1".

         f. The concrete shall be batched and mixed in accordance with *ASTM* C94.

   B. Reinforcing

      1. Reinforcing steel shall be deformed reinforcing bars meeting *ASTM A 615* and have a minimum yield strength of 60,000 psi.

2. Forming, placing steel, pouring and finishing

   A. All form work, forming, steel placement, pouring, curing and finishing shall be in accordance with *ACI 318-89*. Except that all exposed edges shall have a 1" chamfer and all exposed surfaces shall have a hand rubbed finish.

4.5 STREET SIDE APPURTENANCES

4.5.1 GUARDRAIL

1. Materials

   A. Metal Beam Rail: Conform to Article M.10.02 of Form 814A (except wood posts shall not be used).

   B. Concrete End Anchor: Conform to Article M.10.02 of Form 814A.

2. Metal Beam Rail

   A. The steel posts, with the exception of end anchor posts, shall be driven. Where rock or boulders are encountered in driving, this material shall be removed so as to make a hole of sufficient size to permit the setting of the post. The post shall then be set, and the area adjacent to the post shall be backfilled and thoroughly compacted before the driving of the posts. End anchor post, where required, shall be set in dug holes, and the area adjacent to the post shall be backfilled and thoroughly compacted. Any surplus material remaining after the completed installation shall be removed.

   B. The Contractor is cautioned that within the limits of any project, buried cable for illumination or utilities, which may be energized, may be present.

   C. In driving steel posts, suitable driving caps and equipment shall be provided to prevent battering or injury to the posts.

   D. The posts shall be located as shown on the plans, set plumb and in alignment with the rail or rail treatments. Where required, the brackets, rub rails, back-up rails and rail elements shall then be erected to produce a smooth, continuous rail as shown on the plans. The terminal sections, rub rails, and rail elements shall be lapped in the direction of traffic where possible.

   E. Whenever metal beam rail is being constructed adjacent to roadways open to traffic, complete the installation, including the designed terminal treatment, at the close of each day's work so as to prevent any hazard that would be caused by leaving an exposed end of the beam rail or rub rail.

   F. On long runs or other locations where it is not practical to complete the installation at the end of the day, use temporary methods for terminating the

beam rail so as to minimize any hazard. Lower the rail end to the ground and providing adequate anchorage of the same by bolting, weighting, burying, etc.

H. Furnish extra length posts at transition areas or where field conditions warrant. These posts shall be of such length that the minimum depth in the ground, as shown on the plans, shall be maintained.

4. Concrete End Anchorage

A. Excavate for concrete end anchors.

B. Form, place reinforcing bar and anchor bolts, and pour and cure concrete in accordance with *ACI 318-89*.

C. Backfill end anchor with suitable material.

D. Compact backfill in 6" lifts.

E. Any surplus material remaining after the completed installation shall be removed.

F. Anchorages, channels, rails, terminal sections and fittings shall be placed as indicated on the plans and in a workmanlike manner.

4.5.2 TOPSOIL

1. Quality Assurance

   A. Testing of topsoil materials shall be performed by an independent testing laboratory.

   B. When Work of this Section or portions of Work are completed, the contractor shall notify their testing laboratory to perform tests. Do not proceed with additional portions of Work until results have been verified.

   C. If, during progress of Work, tests indicate that Topsoil materials do not meet specified requirements, notify the Inspector as to direction to proceed. If required by the Inspector, remove the defective Work, replace and retest.

   D. Ensure compacted fills are tested before proceeding with placement of surface materials.

   E. Examine existing and finish grades as shown on grading plan and excavation and fill as indicated on plans and elevations. Protect and maintain site boundaries and project limits during construction. If disturbed, destroyed or exceeded, repair as directed.

2. Testing

   A. Topsoil shall be tested for the following: pH, Nitrogen, Phosphorus, Potash, Calcium, Aluminum, Magnesium, Soluble Salts and any other mechanical or chemical tests considered necessary by the testing agency. All tests shall be conducted in accordance with the current standards of the Association of Official Agricultural Chemists.

   B. Topsoil test reports will also contain specific recommendations as the exact types, times and rates of application of soil additives and fertilizers. These recommendations shall be followed during lawn construction. All materials and procedures, with respect to soil additives and fertilizers, contained herein are approximate and may be adjusted to comply with test reports.

3. Topsoil

   A. Topsoil stripped and stockpiled as specified under Section 4.2.2 and 4.4.1 may be used if tested and approved.

B. Additional Topsoil: Conform to Article M.13.01-1 of Form 814A. Texture Class: Loam.

4. Spreading, Grading and Compacting

A. Bring the subgrade to a true smooth slope, parallel to and 4" below finished grade, for all areas to be seeded.

B. The top 3" of the subgrade immediately prior to being covered with loam shall be raked, rototilled, or otherwise loosened and shall be free from stones, rock and other foreign material 3" or greater in dimensions.

C. Sufficient grade stakes shall be used to insure correct line and grade of subgrade and of finished grade.

D. Topsoil shall be as specified above, and shall be placed and spread over approved areas to a 4" thickness in such a manner that after natural settlement and light rolling, the completed work will conform to the lines, grades and elevations indicated. Additional topsoil, after testing and approval, shall be supplied as may be needed to provide the specified thickness and finished grades.

E. After topsoil has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter, and stones over 1" in diameter shall be removed from the topsoil which shall also be free of smaller stones in excessive quantities.

F. The surface shall then be rolled with a hand roller weighing not more than 100 lbs. per ft. of width.

G. During the rolling, all depressions caused by settlement of rolling shall be filled with additional topsoil and the surface shall be regraded and rolled until presenting a smooth and even finish to the required grade.

H. No topsoil shall be excavated, graded or worked in frozen or muddy conditions.

5. Stockpile

A. Stockpile topsoil so that natural drainage is not obstructed and no off-site sediment damage shall result.

B. Side slopes of stockpiles shall not exceed a 2:1 slope.

C. Install silt fence around perimeter of stockpiled topsoil.

4.5.3 SEEDING

1. Quality Assurance

   A. Include the following test requirements:

      1. Supply written analysis, and chemical requirements for lawns, based on the mechanical analysis and pH value of the tested topsoil.

   B. Provide letters from supplier(s) of grass seed and sod indicating mix analysis.

2. Materials

   A. Lime: Ground limestone, 95 percent passing through a 100-mesh screen.

   B. Fertilizer: Complete fertilizer as determined by topsoil analysis derived from natural organic sources. Store so as to be kept dry.

   C. Seed:

      1. Of the previous year's crop, weed seed content not to exceed one-quarter percent by weight, conforming to all State and Federal regulations.

         No noxious weeds will be allowed. The total percentage by weight of crop seed and weed seed shall be less than one-half percent. Inert matter shall be less than 3%.

      2. Mixtures shall be as follows (or approved equal):

Permanent Seed	% by Weight
Perennial Ryegrass	30
Kentucky Bluegrass (approved combination of three of the new improved varieties)	20
Creeping Red Fescue	20
Shadow Chewing Fescue	30

      3. Germination and purity minimum shall meet current standards of the Association of Official Seed Analysts.

4. Engineer may modify seed varieties, mixtures, and percentages due to topsoil analysis or time of seeding operation.

D. Water: Potable

E. Hay Mulch:

1. Obtained from acceptable grass or legume mowings, free from weeds, course matter or other objectionable material.

2. Free from rot or mold with moisture content of not more than 15 percent when delivered to project.

3. Mulch Adhesive: Emulsified asphalt conforming to *ASTM* D977, Grade SS-1H.

F. Jute Mesh: Heavy duty, uniform, plain weave with 11 gauge (or heavier) staples.

3. Time of Work

A. Normal time for lawn installation is between April 15 and June 30, or August 15 and September 30. Work to be performed at other times must be approved by the Engineer.

4. Rates of Product Application

A. Quantities of lime, fertilizer and other amendments shall be as recommended from the results of the topsoil test.

B.

Material	Per 1,000 Square Feet
Grass Seed	8 lbs. in Fall, 4 lbs. in Spring
Cellulose Pulp Fiber	32 lbs.
Hay Mulch	80 lbs. providing 75-90% coverage

5. Grass Construction

A. Preparation:

1. Loosen topsoil to a depth of 2" by scarifying or other disking methods. Obtain a loose friable soil.

2. Remove any weeds, and debris and stones having any dimension greater than 1".

3. Fine grade to a smooth even surface.

B. Hydraulic Seeding:

1. Mix materials with water. Keep in an agitated state so that the materials are uniformly suspended in the water.

2. Spraying equipment shall be so designed that when the solutions are sprayed over an area, the resulting deposits of lime, fertilizer, grass seed and mulch shall be equal in quantity to those specified.

C. Mechanical Seeding:

1. Apply lime and fertilizer evenly at rates determined by topsoil test results.

2. Rake finish surface smooth.

3. Sow seed applying half the quantity in one direction and the remaining quantity at right angles to it. Do not sow seed on a windy day, or when the ground is frozen, wet or otherwise non-tillable.

4. Cover seed with a thin layer of topsoil by raking or dragging.

5. Roll with a hand roller not heavier than 300 lbs.

6. Maintain a moist seedbed at all times. Water seed bed so that the topsoil is wet to a depth of 2". Apply one complete coverage to the seeded area in an 8-hour period.

D. Protect the seedbed with barricades, where necessary, to keep all traffic off the area.

E. Apply approved mulch on all seeded areas, which are less than a 3:1 slope. Install jute mesh on seeded slopes, which are 3:1 or steeper.

6. Clean Up

A. Dispose of off-site, excess materials and debris resulting from sodding and seeding work.

B. Leave work area clean and neat upon completion of the work.

7. Maintenance

A. Period Required: Immediately after installation and continue until acceptance.

B. Perform all reseeding and watering, mowing, weeding and rolling, insect or disease control, refertilizing and repair of wash-outs which are necessary.

C. Water minimum 3 times per week so that the depth of moisture is minimum 4".

D. When average height of grass becomes $3^1/_2$", mow to the height of $2^1/_2$". Remove heavy clippings.

E. Second Fertilization: In the Fall after Spring installation and in the Spring after Fall installation.

4.5.4 STREET TREES

1. Quality Assurance

   A. Obtain trees from a nursery specializing in growing and cultivating the varieties specified in this Section.

2. Delivery, Storage and Handling

   A. Deliver plant materials only immediately prior to placement.

   B. Deliver plant materials to the site in accordance with the best horticultural practices to prevent damage.

   C. "Heal-in" plants that cannot immediately be placed, with bark mulch or wood chips in a location which protects plants from the sun and wind. Rootballs and containers shall be completely covered and kept consistently moist.

   D. Move and handle plant materials to prevent damage to roots and crowns.

   E. Replace damaged and unhealthy trees prior to placement.

3. Trees

   A. Species and size shall be as shown on the plans or listed in Section 3.8. All trees shall be nursery grown, conforming to the American Association of Nurserymen Standards. All specimens shall be hardy under climatic conditions similar to those in the locality of the project. They shall be typical of their species or variety, with a normal habit of growth, sound, healthy and vigorous, well branched and densely foliated when in leaf, free of disease, insect pests, eggs or larvae, and with healthy, well developed root systems.

   B. Dimensions shall conform to specifications in the current edition of Horticultural Standards of the American Association of Nurserymen.

   C. Sizes shall conform to measurements specified.

4. Miscellaneous Materials

   A. Prepared Topsoil:

      1. Per Section 4.6

B. Peat Moss: Shall be domestic brown sphagnum peat; natural shredded or granulated with a pH of 4.0 to 5.0; low in woody material content; free from mineral matter such as sulfur and iron harmful to plant life; water absorbing capacity of 1100 to 2000%; and moisture content of 30%.

C. Staking: Use a rubber band staking system specifically manufactured for staking trees.

D. Bark Mulch: 100% shredded pine or hardwood bark, free of foreign matter.

E. Water: Potable.

5. Time of Work

A. Season(s) normal for planting; determine by weather conditions and local practices.

6. Excavation

A. Excavate hole to the size shown on the plans for the size root ball being planted.

B. Use a backhoe to excavate the hole. An auger shall not be used.

7. Setting plants

A. Place in center of pits or spaced in beds as called for on Drawing. Set plumb and straight and at such a level that after settlement, crown will be no more than 2" below finished grade. Adjust level of plant with prepared topsoil beneath ball. Remove burlap, ropes or wires from the tops of the balls. Backfill with prepared topsoil, and form shallow basin with a ridge of soil, slightly larger than the pit or bed to contain water. Neatly outline the edges of all pits and beds. Compact and water prepared topsoil to fill all voids.

8. Mulching

A. Cover all trees with bark mulch to a minimum depth of 4", immediately after all planting operations are complete.

9. Clean up

A. Dispose of excess material and debris resulting from planting work at an off-site location. Leave work areas clean and neat upon completion of the Work.

Repair any damage done to the existing site improvements as a result of the Work of this Section.

10. Plant maintenance

A. All plant materials shall be watered, fertilized, pruned, weeded, and sprayed as required to keep plant material in a healthy growing condition, and to keep planted areas neat and attractive.

B. Provide all equipment and means for proper application of water to those planted areas not equipped with an irrigation system.

C. Water twice per week for the first six weeks, then as necessary to support a vigorous, thriving condition.

D. Protect all planted areas against damage, including erosion and trespassing by providing and maintaining proper safeguards.

E. Reset settled plants to proper grade and position.

11. Replacements

A. Dead or declining plant material shall be removed immediately and replaced as soon as possible with a new and healthy plant of the same type and size.

4.5.5 STREET LIGHTS

1. Concrete Base (Foundation)

   A. Concrete:

      1. Cement shall meet *ASTM* C150 or C595 Type II.

      2. Mixing water shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials or other deleterious substances in accordance with *ACI* 318.

      3. Air-entraining admixture shall conform to *ASTM* C260.

      4. Any other admixtures shall only be used if approved by the Engineer.

      5. Concrete shall have the following properties:

         a. Materials shall be proportioned to produce concrete with a minimum compressive strength of 3,500 psi at 28 days.

         b. The air content shall be 5% by volume with a tolerance of $\pm$ 2%.

         c. Maximum size of aggregate shall be 3/4".

         d. Minimum cement content shall be 520 pounds per cubic yard.

         e. Concrete shall be delivered at the minimum slump necessary for efficient mixing, placing and finishing. The maximum slump shall be 4" with a tolerance of $\pm$ 1".

         f. The concrete shall be batched and mixed in accordance with *ASTM* C94.

   B. Reinforcing

      1. Reinforcing steel shall be deformed reinforcing bars meeting *ASTM A 615* and have a minimum yield strength of 60,000 psi.

   C. Conduit

      1. Use Schedule 40 PVC conduit that is UL listed conforming to *ANSI* standards for PVC conduits. Contact local utility company to determine if their requirements are different.

D. Anchor Bolts

1. Anchor bolts shall be high strength steel having a minimum yield strength of 50,000 psi.

2. The size shall be as shown in the details or as recommended by the pole manufacturer.

3. A hexagon nut, hold down washer, and lock washer shall be furnished with each bolt.

4. The threads, nuts, and washers shall be hot-dip galvanized as per *ASTM* A-153.

5. Anchor bolts shall have an "L" bend on the bottom.

E. Grout

1. Grout shall be a non-shrink cement grout.

2. Light Pole and Mounting Arm

A. The pole shaft and arm shall be fabricated of aluminum alloy 6063-T6 or 6005-T5 as specified under *AASHTO*. The pole shall be one piece, seamless, tapered, and circular in cross section.

B. The shaft and arm shall be finished with a uniform surface having the natural color of aluminum. It shall have a smooth uniform finish, free from disfiguring scratches, dents, and similar markings.

C. The pole shall have an aluminum pole cap securely attached.

D. The size of the pole and arm shall be as shown in the details.

E. The pole and arm shall be design to withstand a wind speed of 90 mph.

F. The pole shaft shall be welded to a cast aluminum base.

G. The pole shall have a handhole with a reinforced frame and cover approximately 4" x 6" located approximately 12" up form the base of the pole and placed 90^0 from the bracket arm on the far side if the traffic flow.

H. The arm shall have an upward sweep design (3'-6" max.) and shall accommodate a 2" slipfitter type luminaire.

I. All screws, nuts, bolts washers, and miscellaneous hardware used to assemble the light pole, base and arm shall be stainless steel with the exception of washers and nuts for the anchor bolts.

3. Luminaire

A. The luminaire shall be of the "cobra head" type for roadway lighting with a gray finish.

B. The housing shall be die cast aluminum with refractor door hinged on one end and latched on the other. It shall have a 2" slipfitter for end mounting and a factory install birdguard.

C. The reflector shall be aluminum and the refractor to be glass. The optical assembly shall have a captive, non-wicking gasket to filter air.

D. There shall be a photoelectric cell on each luminaire. It shall have a "fail on" safety device.

E. The lamp socket shall be porcelain enclosed for mogul base lamp.

F. The luminaire shall have an identification sticker indicating the lamp type and wattage located on the underside of the luminaire, in accordance with the current *ANSI* standards.

G. The lamp shall be an all position type of the source and wattage called for in the details and in accordance with the current *ANSI* specification. The lamp shall be new and unused at the time of installation.

4. Installation

A. Excavate and backfill for the concrete foundation in accordance with Section 4.4.1.

B. All form work, forming, steel placement, pouring, curing and finishing for the concrete foundation shall be in accordance with *ACI 318-89*. Except that all exposed edges shall have a 1" chamfer and all exposed surfaces shall have a hand rubbed finish.

C. It shall be the contractor's responsibility to verify location of anchor bolts and pattern to ensure proper orientation of the pole. Plumb anchor bolts and ensure adequate thread projection.

D. After the concrete has sufficiently set, the formwork shall be removed and the foundation backfilled.

E. After the foundation has been backfilled and compacted, install the light pole per the manufacturer's instruction. Install pole plumb.

F. The void between the pole base and the top of the concrete foundation shall be filled with non-shrink grout and finished to a neat appearance.

G. For ventilated poles, provide a means of condensate drainage in the non-shrink grout.

H. All poles shall be grounded as shown in the details. The ground wire shall be #8 AWG copper wire connected to the pole ground lug and cadwelded to the 8' copper ground rod.

I. Install the arm and luminaire per the manufacturer's instructions.

J. Clean all parts of the luminaire.

K. All work shall be done in accordance with the National Electrical Code.

SECTION 5
DETAILS

5.1 GENERAL

1. The detail drawings contained herein shall be considered a part of this Standard. Any notes specifications or dimensions on the drawings shall be adhered to. Any deviation requires approval of the Department.

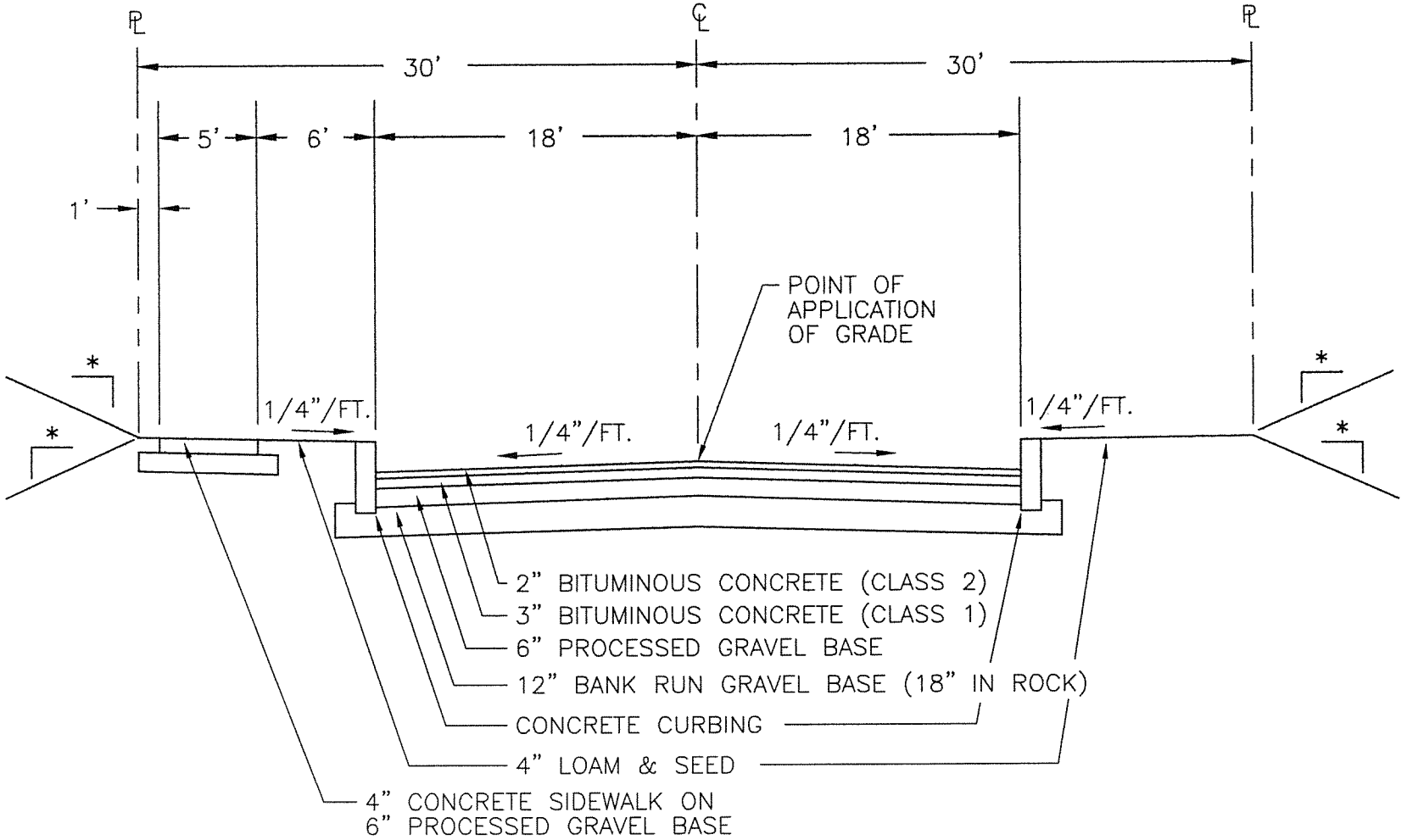
2. These drawings are not copyrighted and may be reused on plans prepared for sites or subdivision to be constructed in the Town. The Town assumes no responsibility for the use or misuse of any of these details on any drawings. In case of discrepancy the drawings contained herein shall take precedent over any details on the prepared plans.

3. These drawings are available in electronic format (AutoCad™) for a nominal fee.

5.2 DETAILS

Drawing Title	Drawing Number
Roads	
Collector Street	101
Residential Access Street	102
Village Road	103
Sub-Village Road	104
Road Widening	105
Utility Trench Patch	106
Rock Cut	107
4" Speed Hump	108
3" Speed Hump	109
Sidewalks and Curbing	
Concrete Curbing	201
Concrete Mountable Curbing	202
Bituminous Concrete Lip Curbing	203A
Bituminous Concrete "Cape Cod" Curbing	203B
Granite Curbing	204
Concrete Sidewalk	205
Asphalt Sidewalk	206

NORMAL SECTION



NOTE:

1. SIDEWALK SHOWN ON ONE SIDE ONLY. MAY BE REQUIRED ON BOTH SIDES OF ROAD.

* – 2 HORIZONTAL TO 1 VERTICAL MAXIMUM. IN LAWN AREAS, 4 HORIZONTAL TO 1 VERTICAL IS PREFERRED.

NOT TO SCALE

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS
COLLECTOR STREET

DWN BY: GMJ
APD BY: GMJ
DATE: 3/22/99
DWG NO. RDS-101

DATE	REVISION

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

RESIDENTIAL ACCESS STREET

DWN BY: GMJ

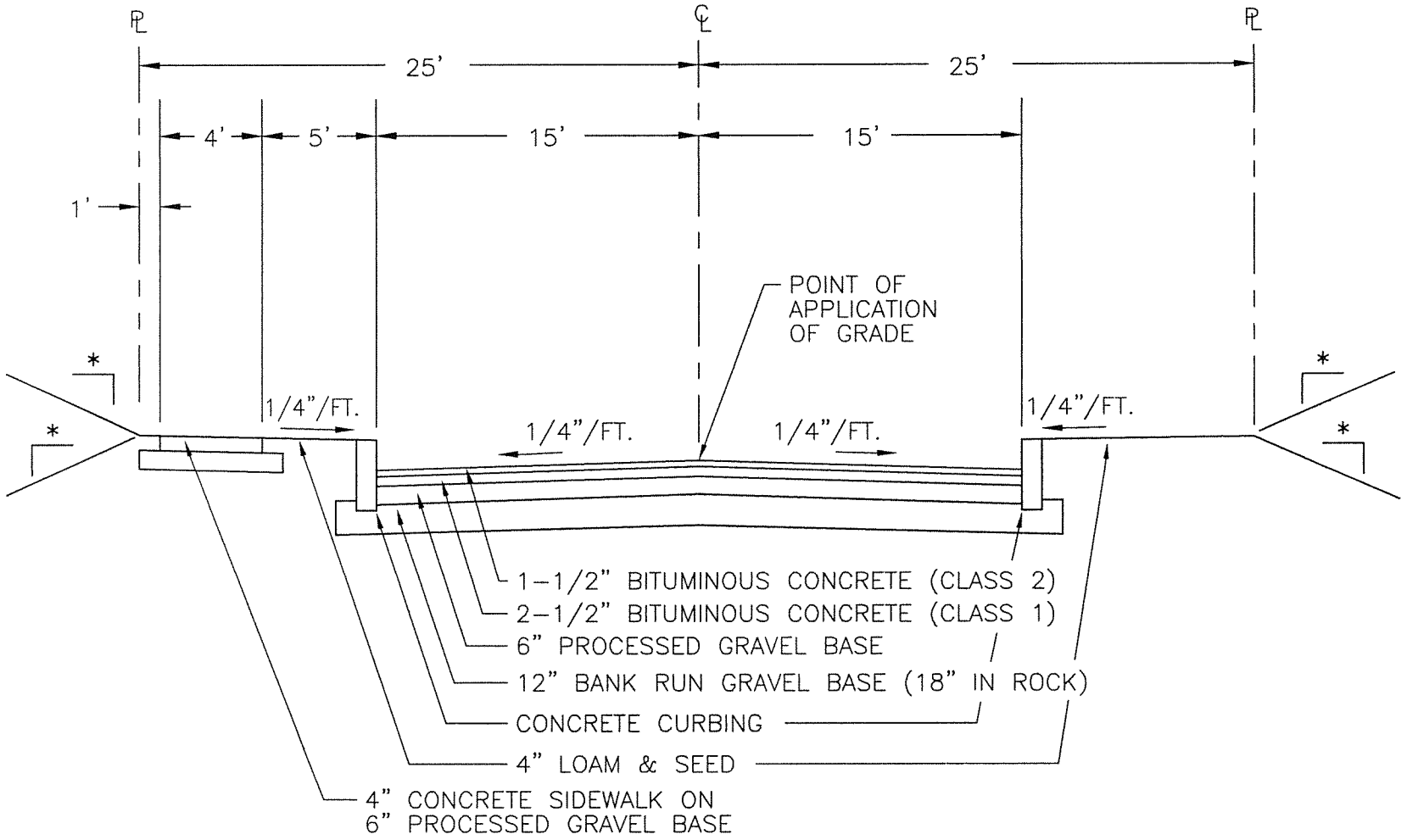
APD BY: GMJ

DATE: 6/20/00

DWG NO. RDS-102

NOT TO SCALE

NORMAL SECTION



NOTE:

1. SIDEWALK SHOWN ON ONE SIDE ONLY. MAY BE REQUIRED ON BOTH SIDES OF ROAD.

* – 2 HORIZONTAL TO 1 VERTICAL MAXIMUM. IN LAWN AREAS, 4 HORIZONTAL TO 1 VERTICAL IS PREFERRED.

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

VILLAGE ROAD

DWN BY: GMJ

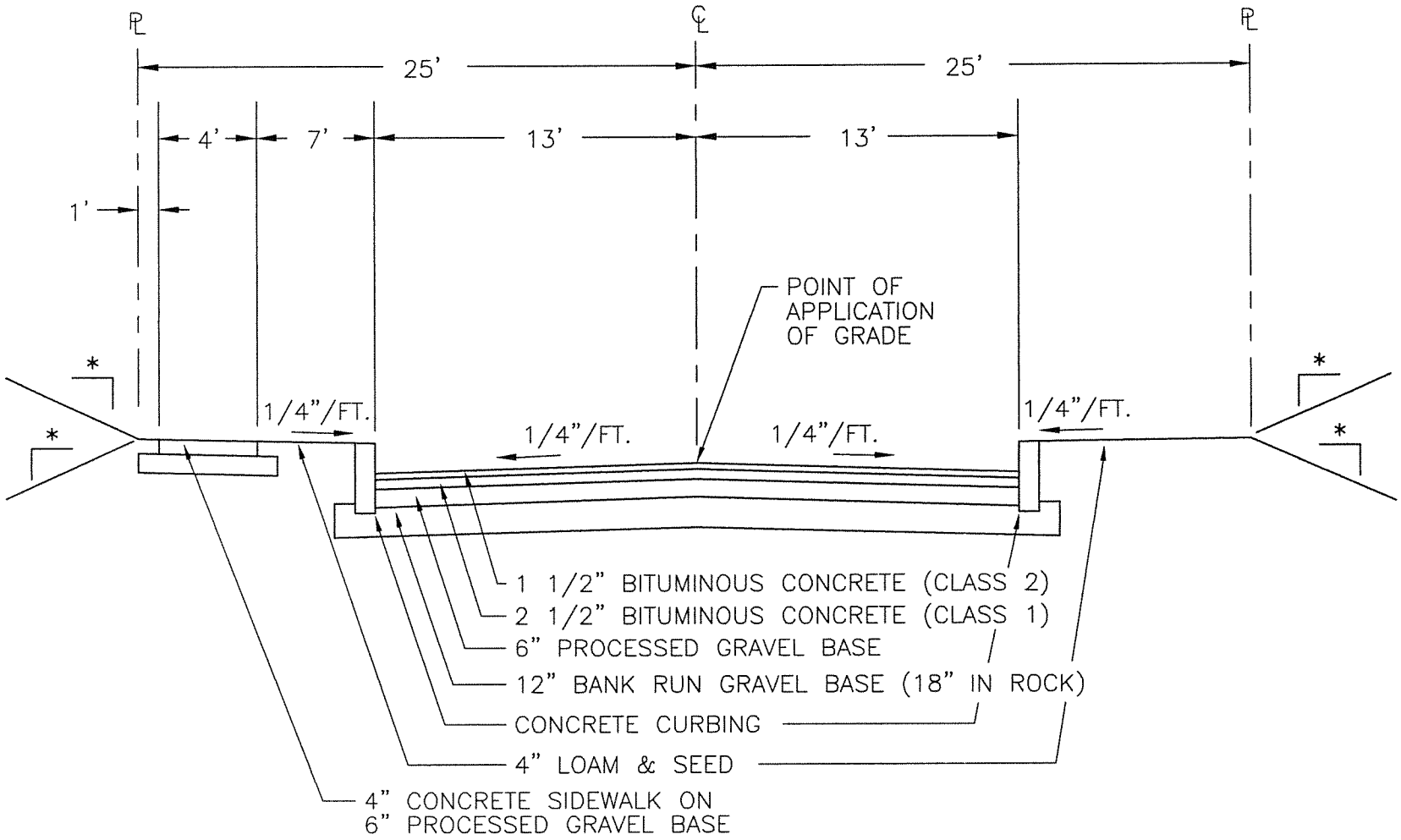
APD BY: GMK

DATE: 3/22/99

DWG NO. RDS-103

NOT TO SCALE

NORMAL SECTION



NOTE:

1. SIDEWALK SHOWN ON ONE SIDE ONLY. MAY BE REQUIRED ON BOTH SIDES OF ROAD.

* – 2 HORIZONTAL TO 1 VERTICAL MAXIMUM. IN LAWN AREAS, 4 HORIZONTAL TO 1 VERTICAL IS PREFERRED.

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

SUB-VILLAGE ROAD

DWN BY: GMJ

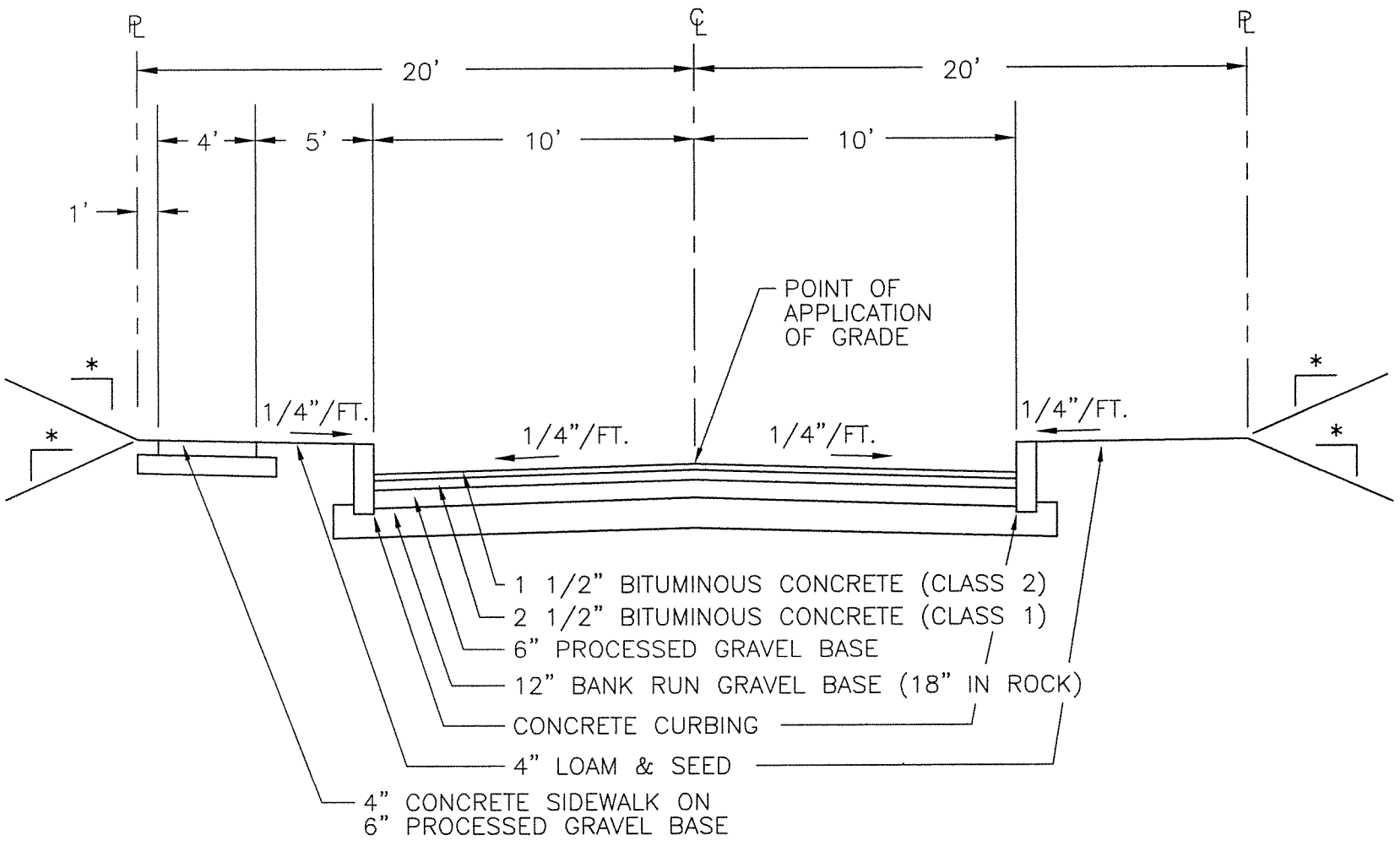
APD BY: GAH

DATE: 3/22/99

DWG NO. RDS-104

NOT TO SCALE

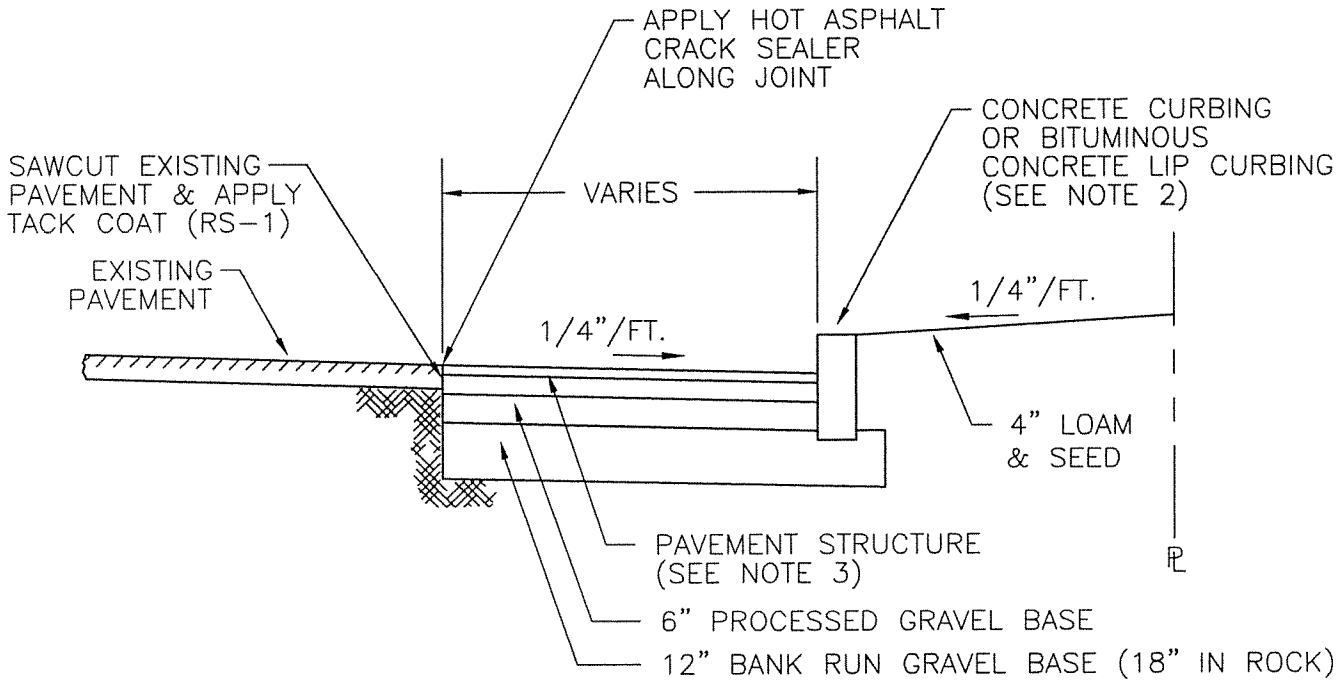
NORMAL SECTION



NOTE:

1. SIDEWALK SHOWN ON ONE SIDE ONLY. MAY BE REQUIRED ON BOTH SIDES OF ROAD.

* – 2 HORIZONTAL TO 1 VERTICAL MAXIMUM. IN LAWN AREAS, 4 HORIZONTAL TO 1 VERTICAL IS PREFERRED.

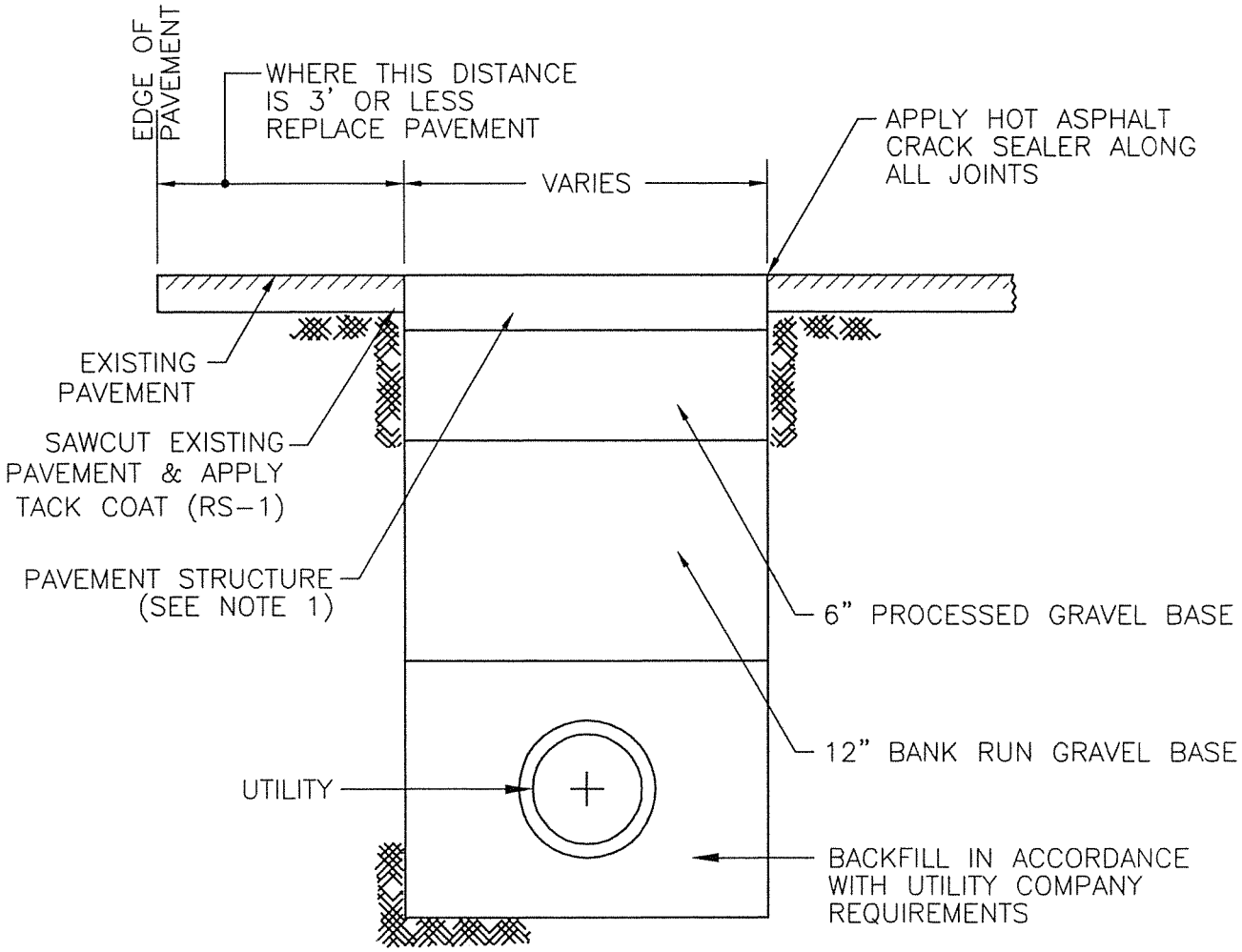


NOTES:

1. THIS DRAWING ONLY APPLIES TO WIDENING OF EXISTING ROADS.
2. BITUMINOUS CONCRETE LIP CURBING MAY BE USED WHERE ALLOWED.
3. THE PAVEMENT STRUCTURE SHALL BE BUILT IN ACCORDANCE WITH DWG. NOS. RDS-101, 102, 103 AND 104 DEPENDING ON THE CLASSIFICATION OF THE STREET BEING WIDENED OR MATCH EXISTING, WHICHEVER IS GREATER.

NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
		ROAD & DRAINAGE STANDARDS	APD BY: GMJ
		ROAD WIDENING	DATE: 3/22/99
			DWG NO. RDS-105

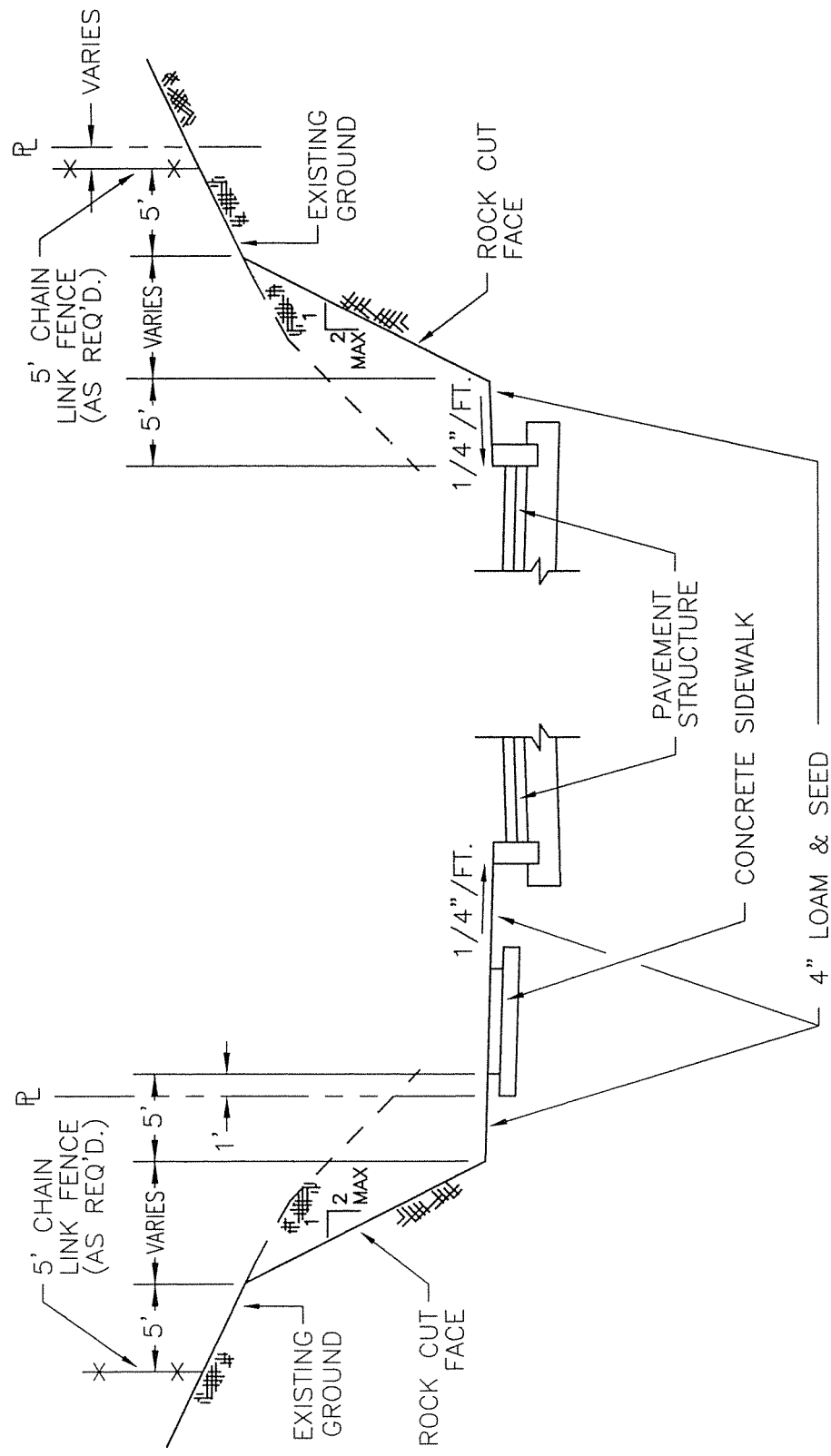


NOTES:

1. THE PAVEMENT STRUCTURE SHALL BE BUILT IN ACCORDANCE WITH DWG. NOS. RDS-101, 102, 103 AND 104 DEPENDING ON THE CLASSIFICATION OF THE STREET BEING TRENCHED OR MATCH EXISTING, WHICHEVER IS GREATER.
2. IF A TEMPORARY PATCH IS USED, OR REQUIRED, IT SHALL BE A MINIMUM OF 2 INCHES THICK BITUMINOUS CONCRETE (CLASS 1).

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	UTILITY TRENCH PATCH	DWG NO. RDS-106



NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works* ROAD & DRAINAGE STANDARDS ROCK CUT	DWN BY: GMJ APD BY: GMJ DATE: 3/22/99 DWG NO. RDS-107

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

4" SPEED HUMP

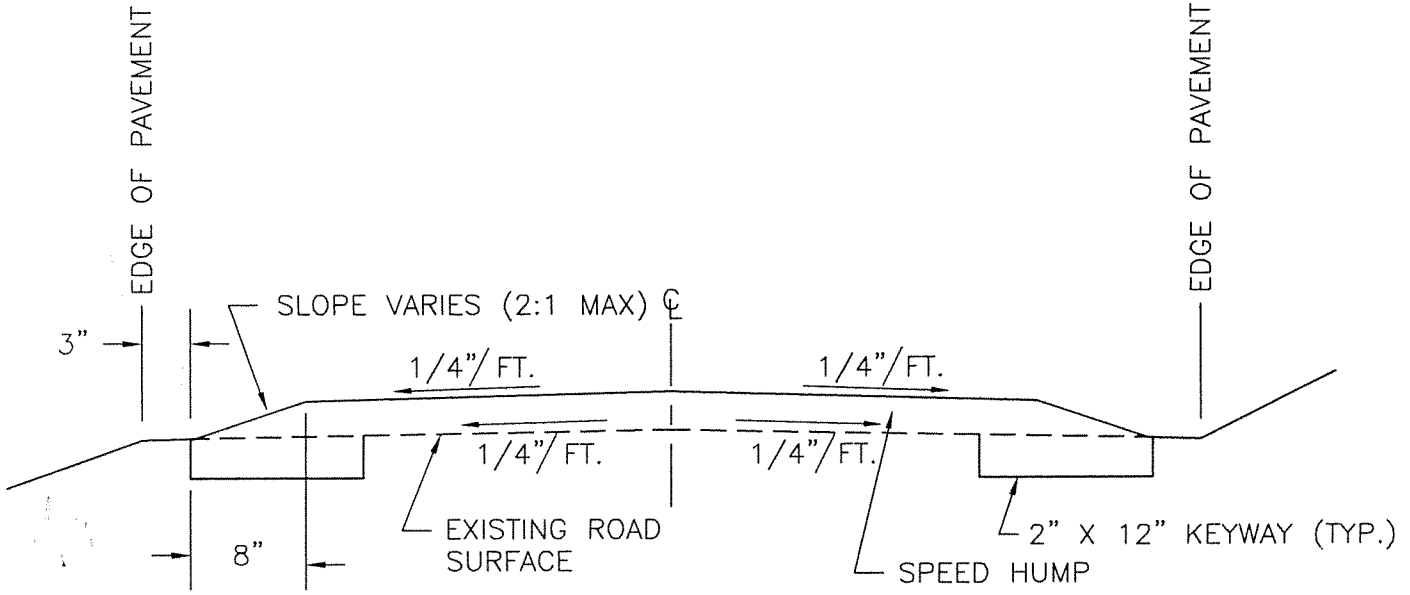
DWN BY: GMJ

APD BY: G.M.

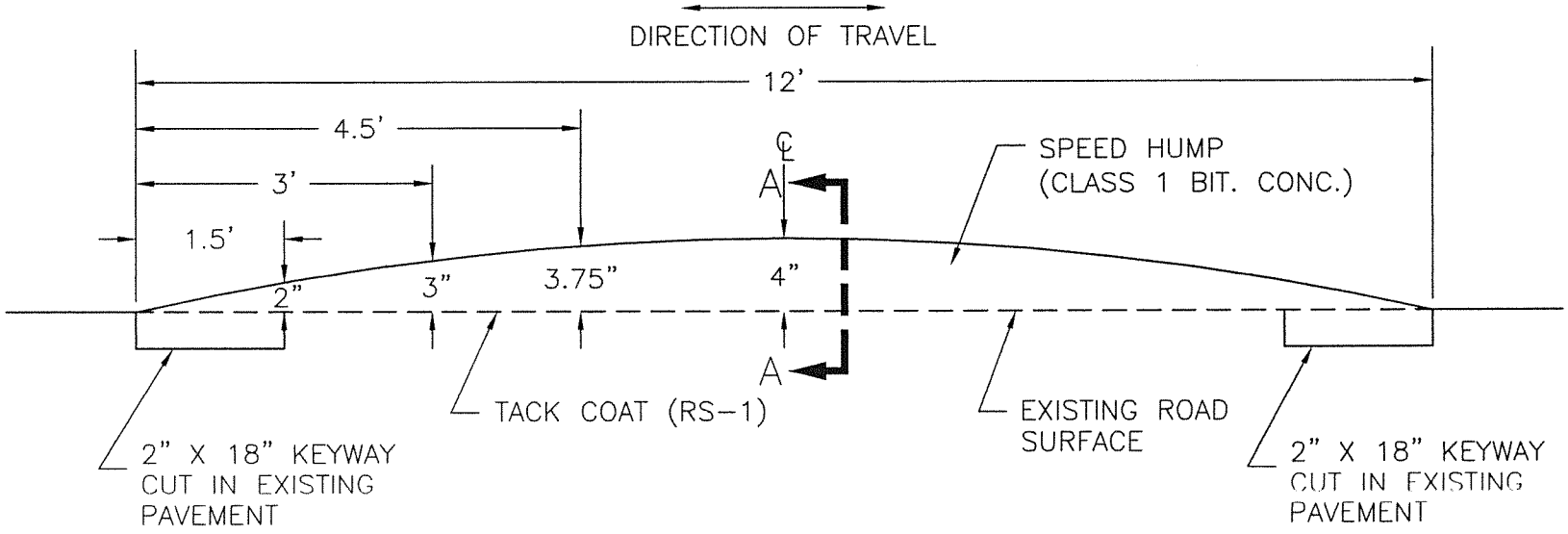
DATE: 3/22/99

DWG NO. RDS-108

NOT TO SCALE



SECTION A–A



DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

3" SPEED HUMP

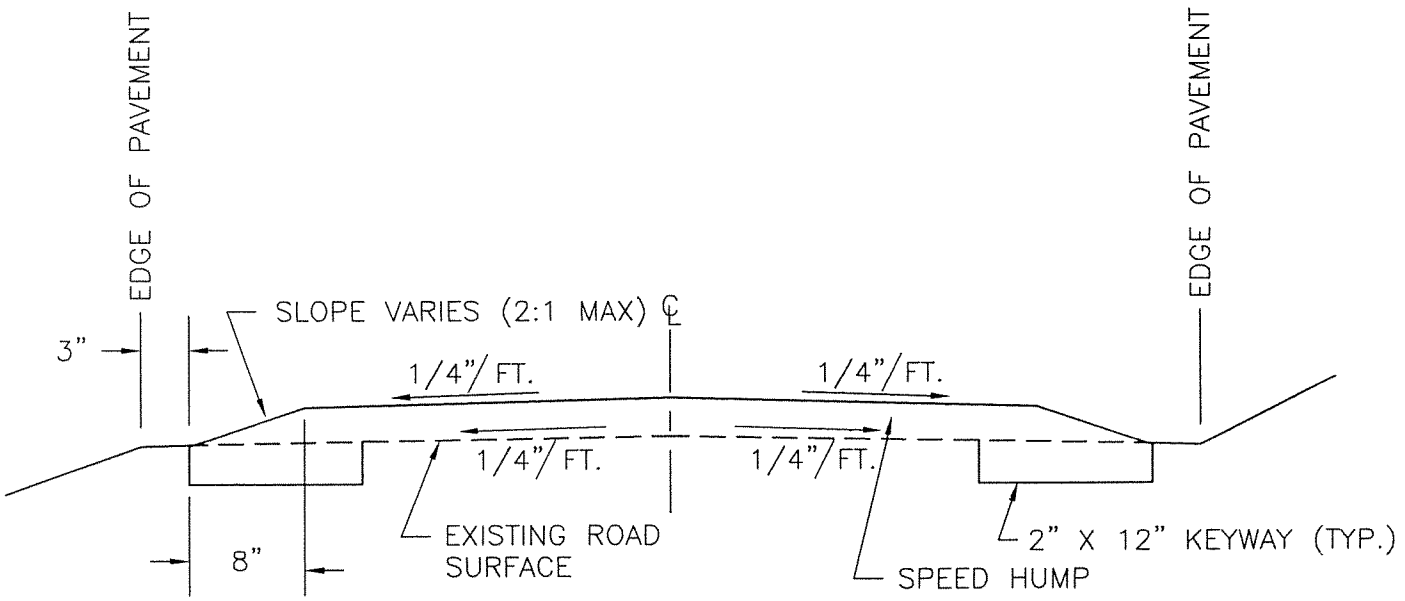
DWN BY: GMJ

APD BY: GMJ

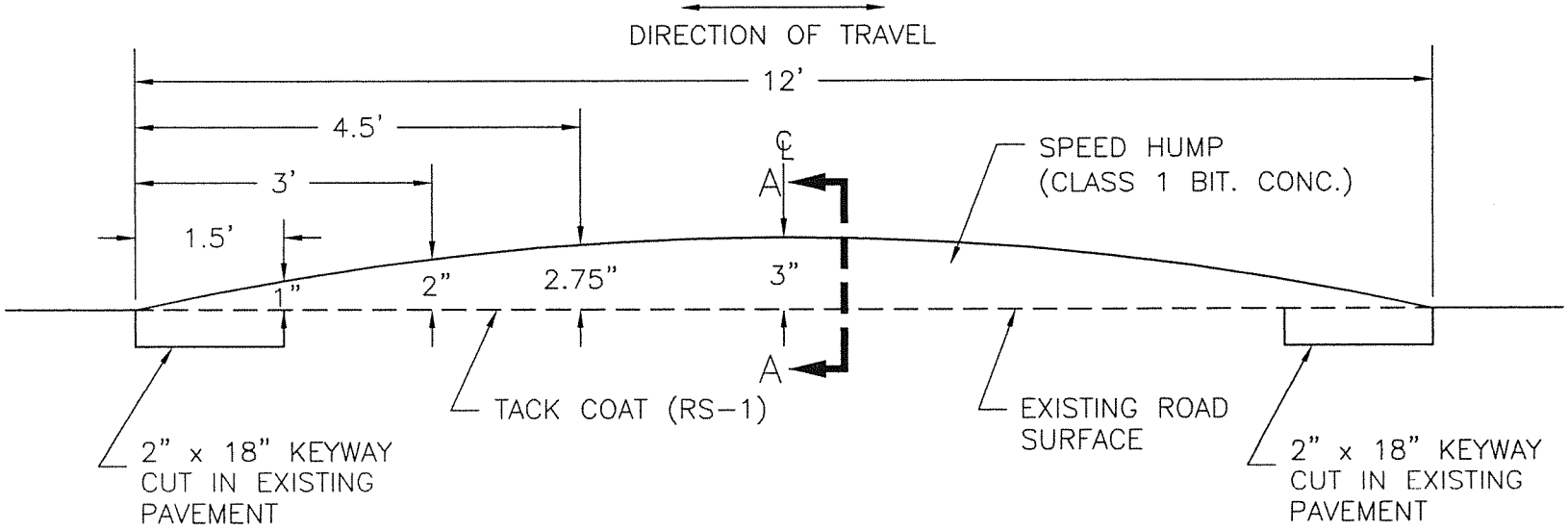
DATE: 3/22/99

DWG NO. RDS-109

NOT TO SCALE



SECTION A–A

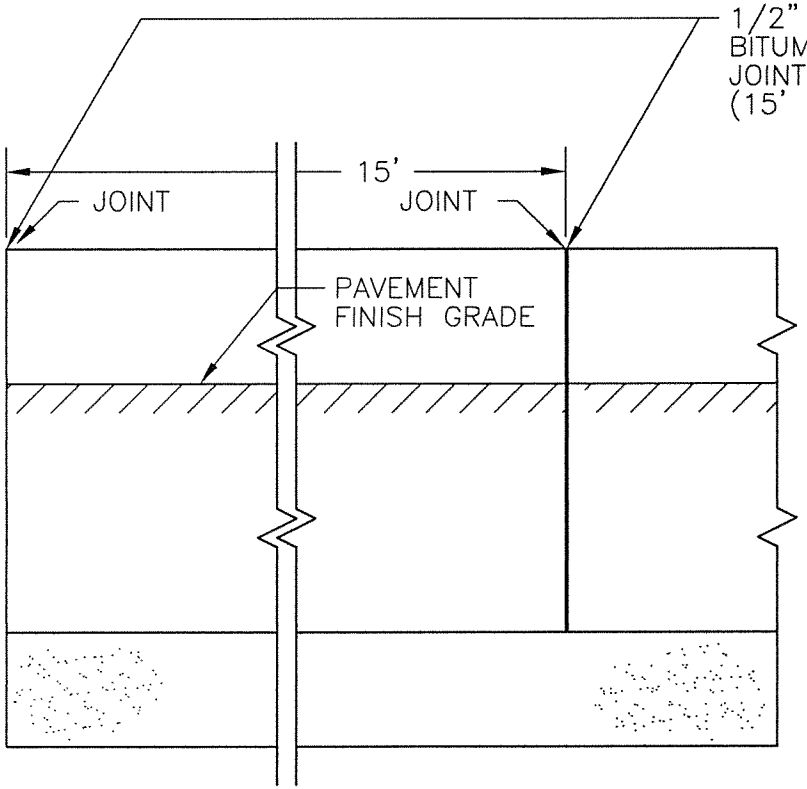


DATE	REVISION

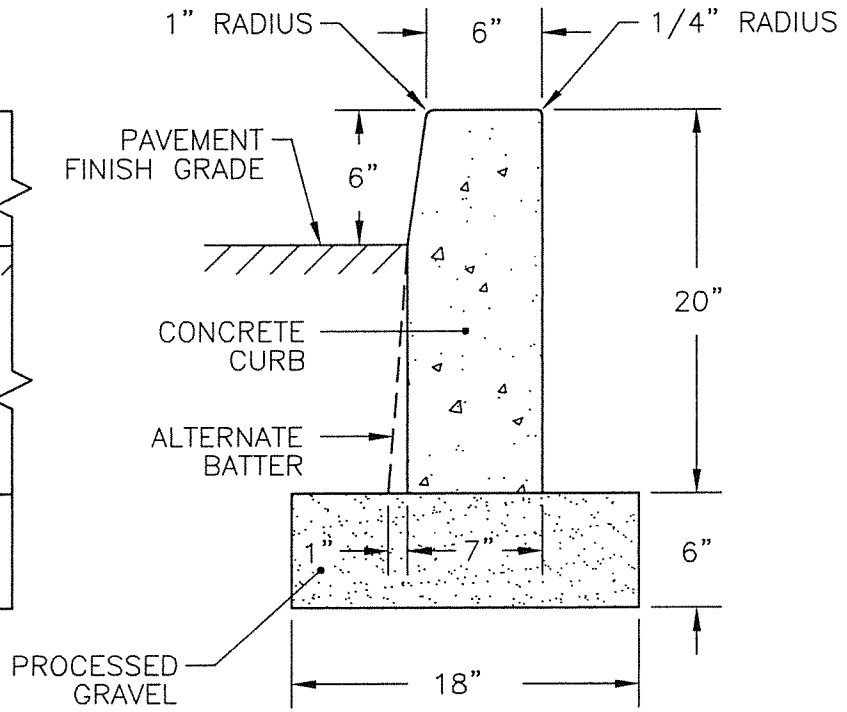
Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

CONCRETE CURBING



FRONT ELEVATION



SECTION

NOTES:

1. PROVIDE SMOOTH TROWEL OR HAIR BRUSH FINISH TO ALL EXPOSED SURFACES.
2. PRECAST CONCRETE CURB MAY BE USED WITH APPROVAL BY THE TOWN.
   - 2A. PRECAST CURBING SIZE SHALL MEET THE SIZE SHOWN ABOVE (18" HEIGHT MAY BE USED).
   - 2B. STRAIGHT SECTIONS SHALL NOT BE USED FOR RADII LESS THAN 100'.
   - 2C. CURBING SECTIONS SHALL BE PINNED TOGETHER.

NOT TO SCALE

DWN BY: GMJ	APD BY: GMJ	DATE: 3/22/99	DWG NO. RDS-201

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

CONC. MOUNTABLE CURBING

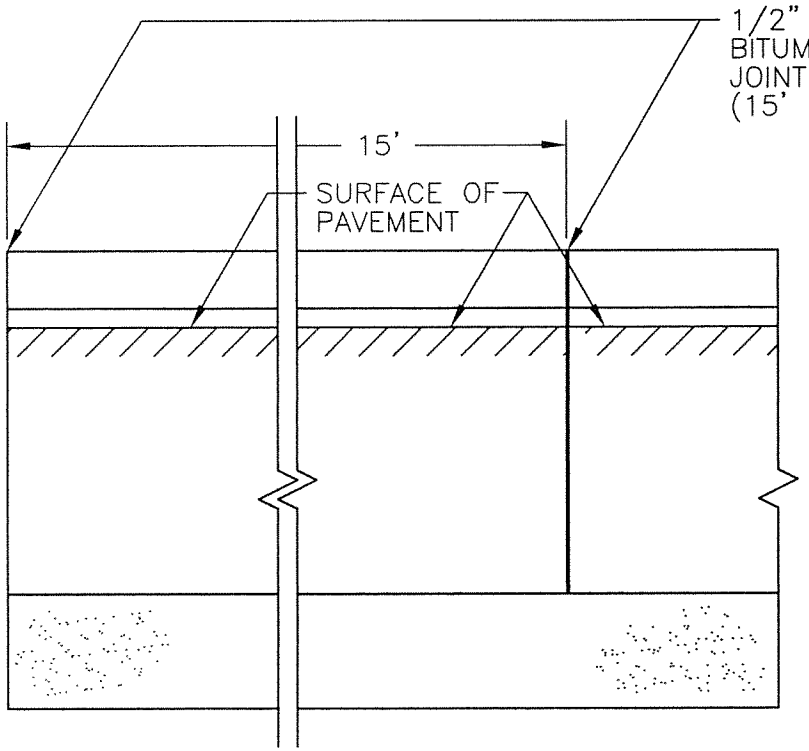
DWN BY: GMJ

APD BY: GAH

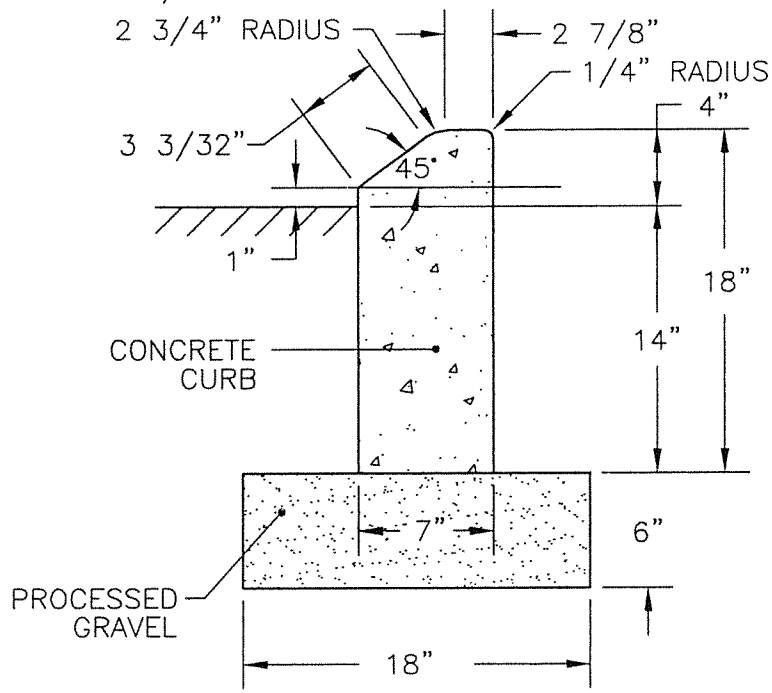
DATE: 11/17/99

DWG NO. RDS-202

NOT TO SCALE



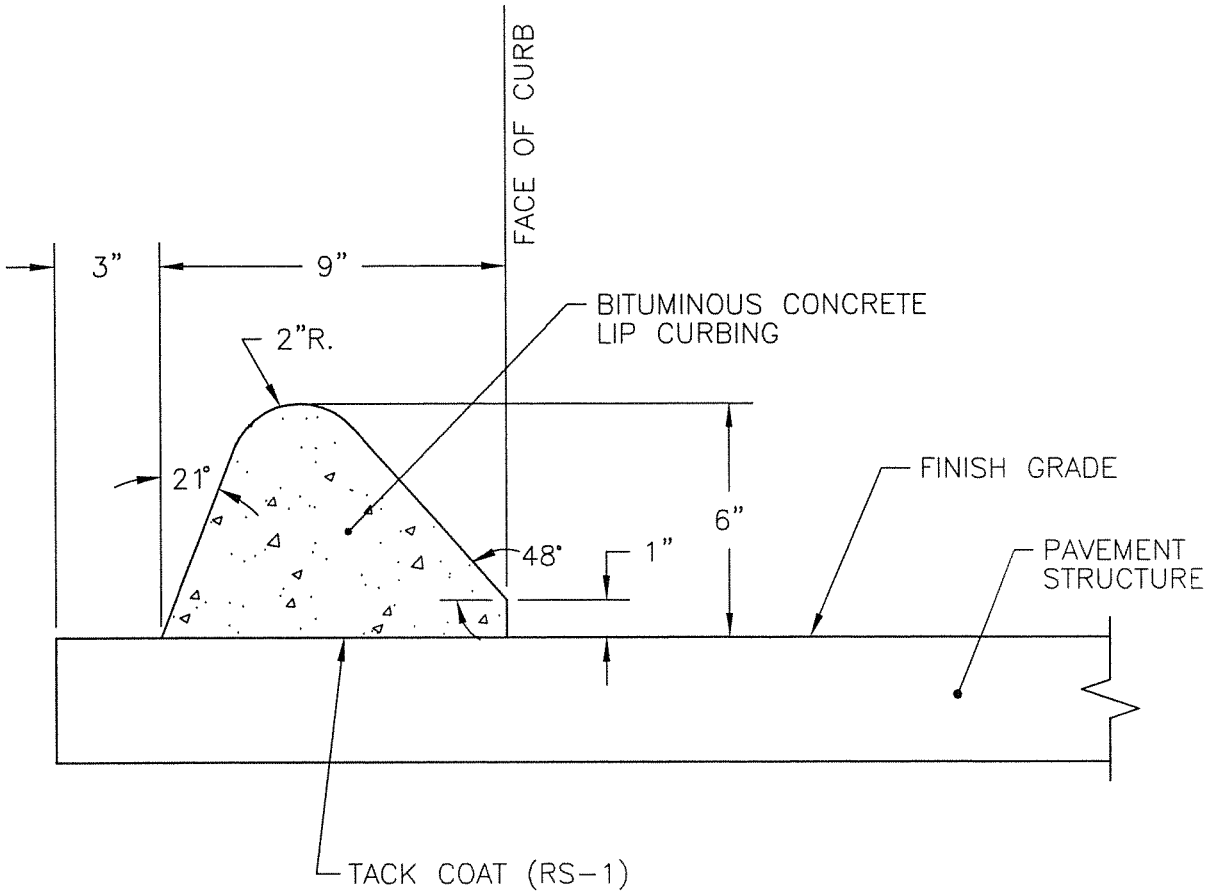
FRONT ELEVATION



SECTION

NOTES:

1. PROVIDE SMOOTH TROWEL OR HAIR BRUSH FINISH TO ALL EXPOSED SURFACES.
2. PRECAST CONCRETE CURB MAY BE USED WITH APPROVAL BY THE TOWN.
   - 2A. PRECAST CURBING SIZE SHALL MEET THE SIZE SHOWN ABOVE.
   - 2B. STRAIGHT SECTIONS SHALL NOT BE USED FOR RADII LESS THAN 100'.
   - 2C. CURBING SECTIONS SHALL BE PINNED TOGETHER.
3. ONLY TO BE USED WHERE ALLOWED BY THE PUBLIC WORKS DEPARTMENT.

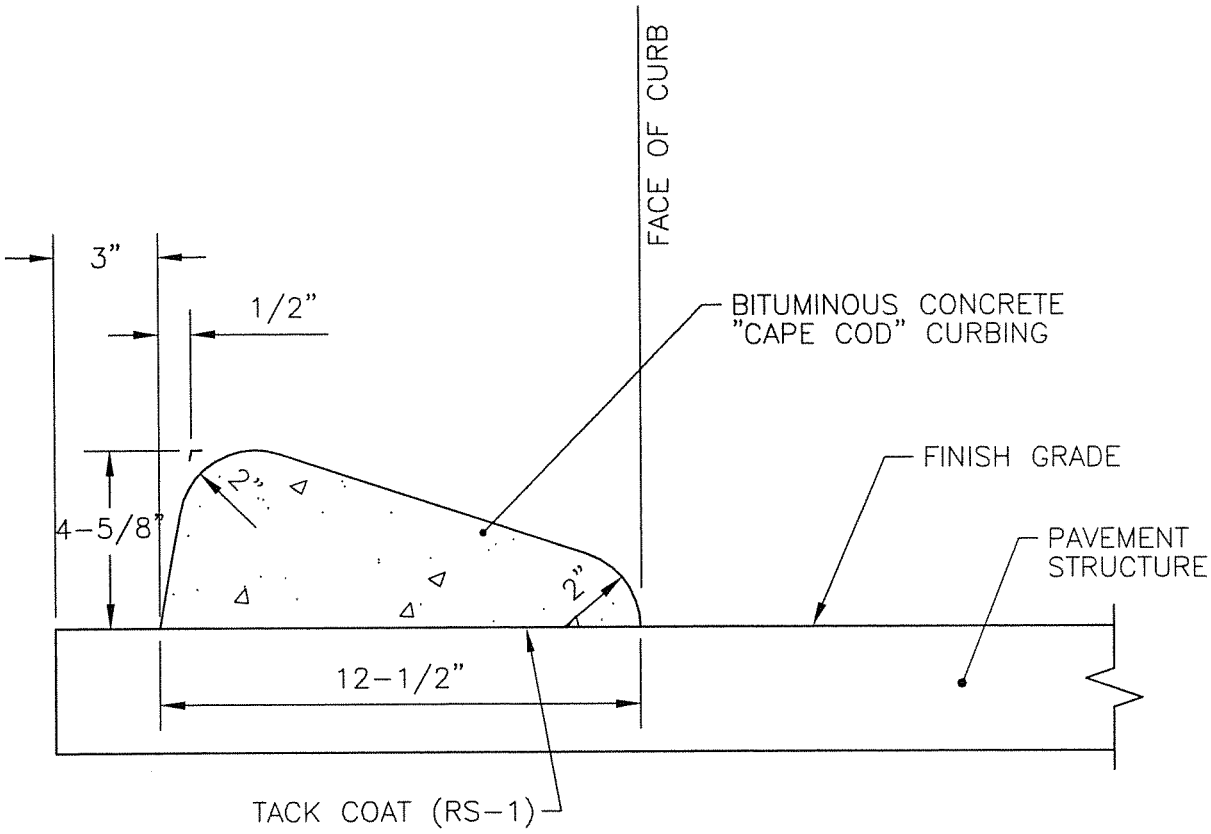


NOTE:

1. USE BITUMINOUS CONCRETE CLASS 3 FOR CURBING.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS	DATE: 11/17/99
DATE	REVISION	BIT. CONC. LIP CURBING	DWG NO. RDS-203A

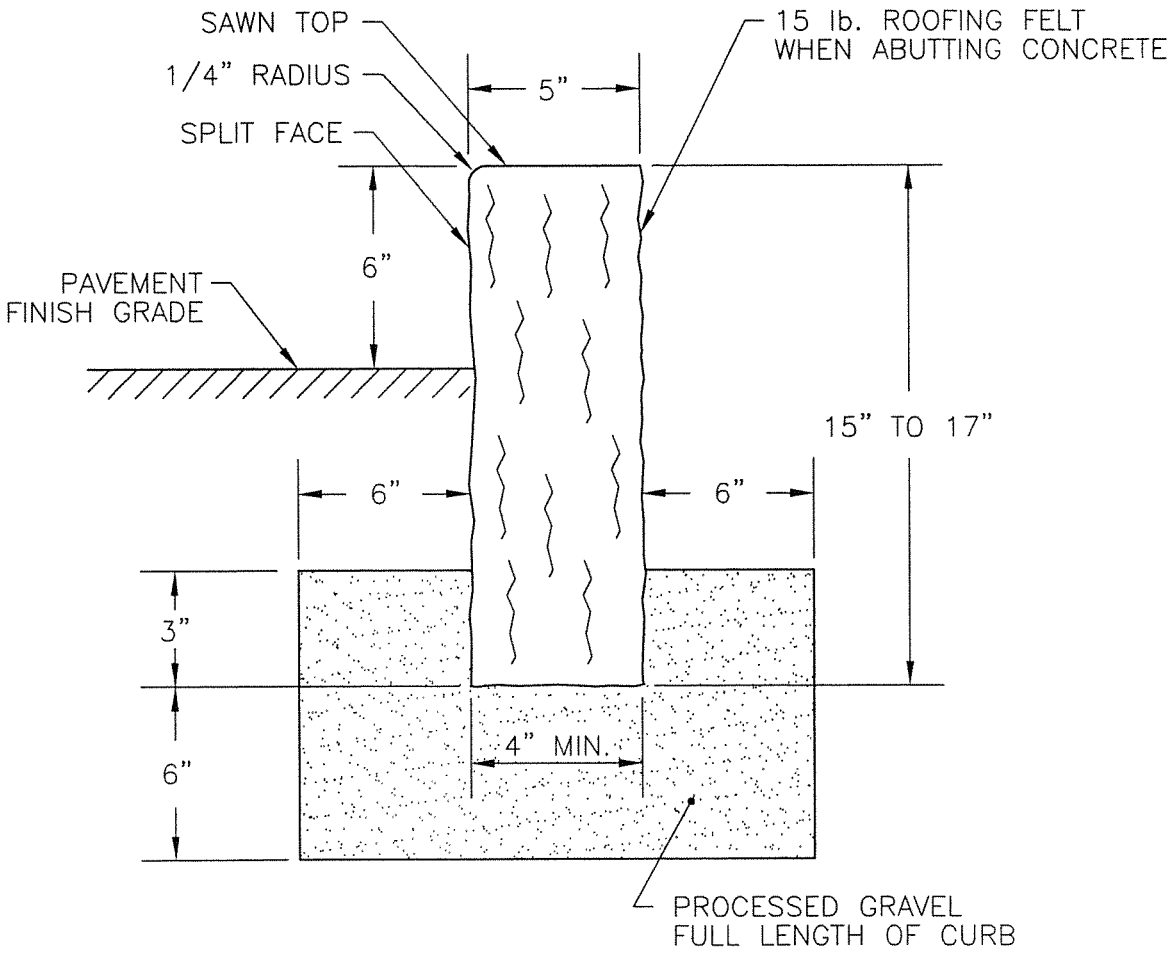


NOTE:

1. USE BITUMINOUS CONCRETE CLASS 3 FOR CURBING.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS BITUMINOUS CONCRETE "CAPE COD" CURB	DATE: 11/17/99
DATE	REVISION		DWG NO. RDS-203B



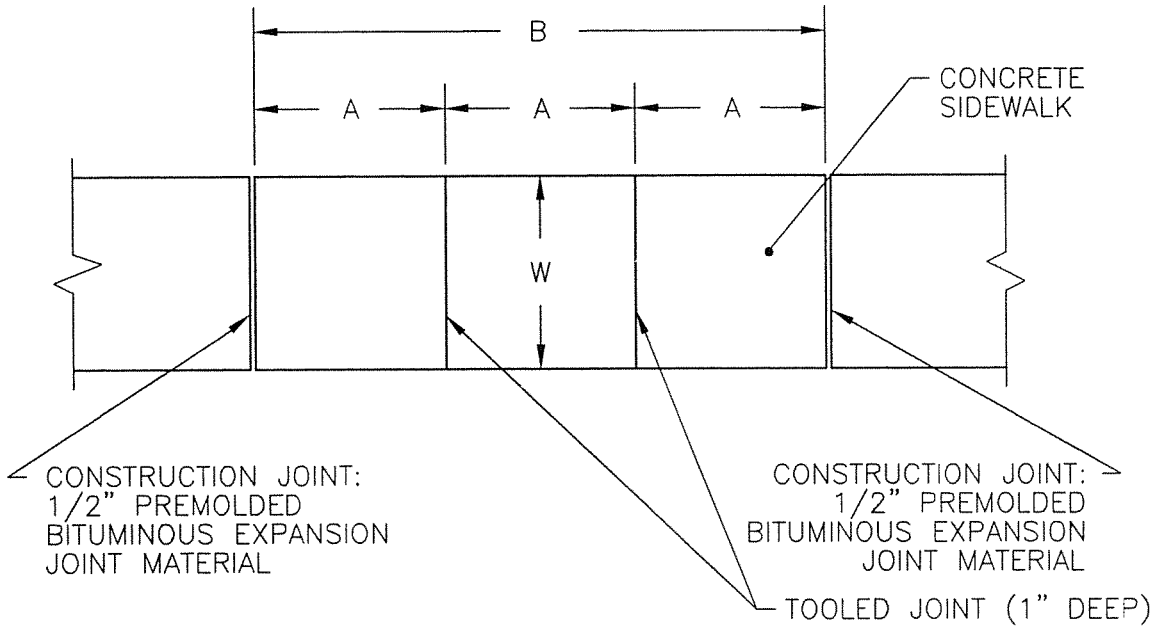
SECTION

NOTES:

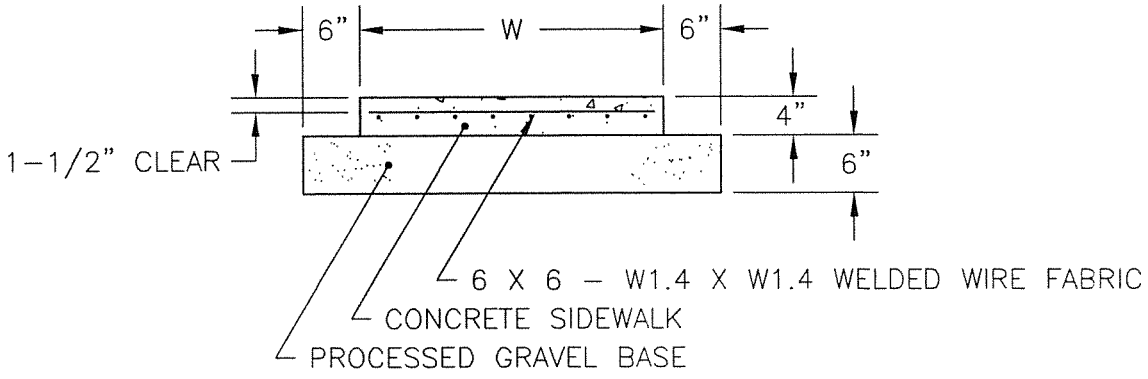
1. MORTAR ALL JOINTS. LEAVE UNMORTARED JOINT EVERY 50'±.
2. MAXIMUM ALLOWABLE BREAK BACK
   9" FOR CURB LENGTHS OF 6' OR MORE
   6" FOR CURB LENGTHS OF LESS THAN 6'
3. MINIMUM ACCEPTABLE LENGTH IS 3'.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	GRANITE CURBING	DWG NO. RDS-204



PLAN

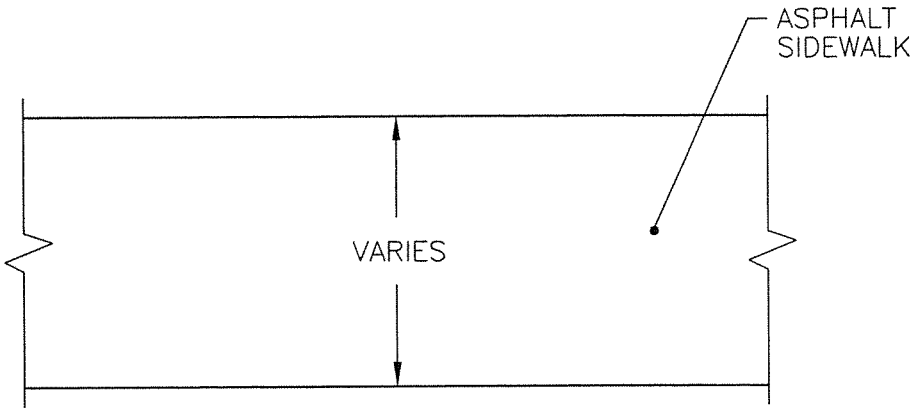


SECTION

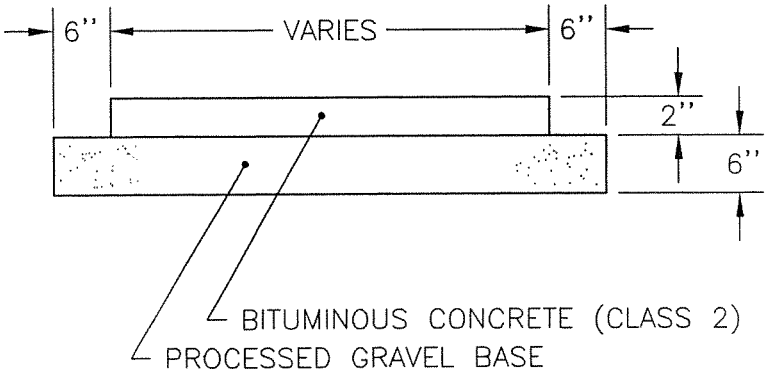
WIDTH W	A	B
4'	4'	12'
5'	5'	15'

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GWH
		ROAD & DRAINAGE STANDARDS CONCRETE SIDEWALK	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-205



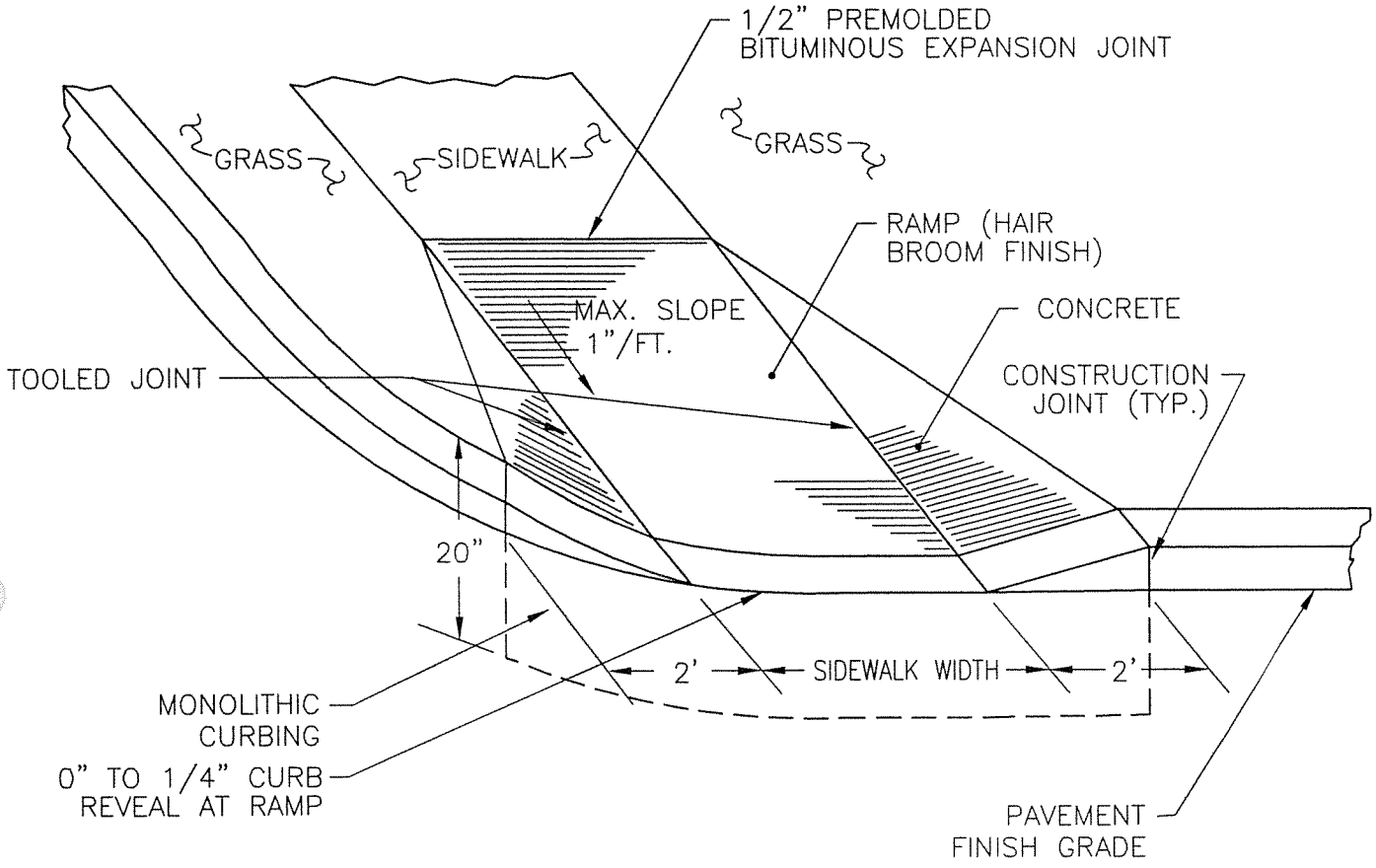
PLAN



SECTION

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAR
		ROAD & DRAINAGE STANDARDS ASPHALT SIDEWALK	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-206

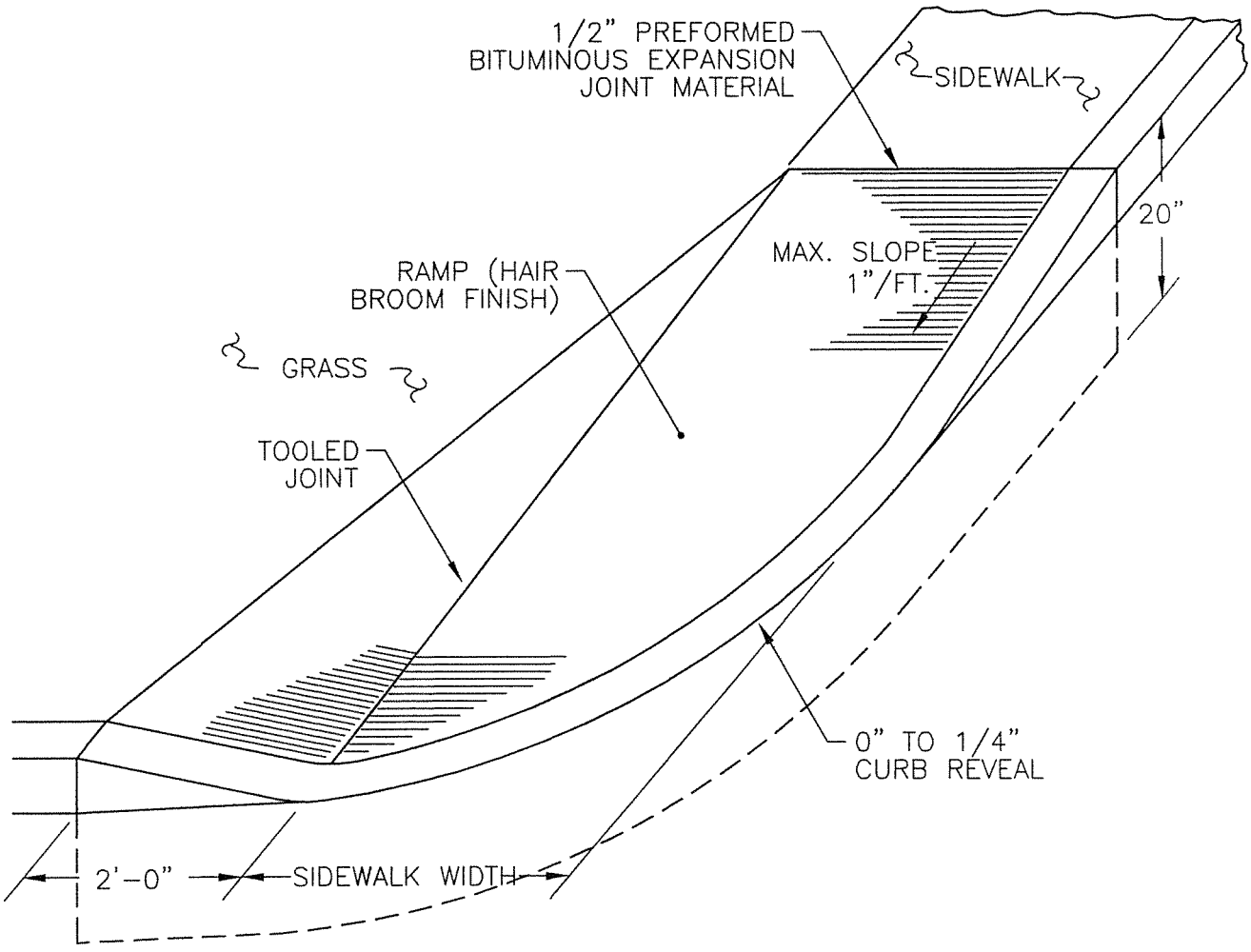


NOTE:

1. RAMP SECTION SHALL CONFORM TO DWG. NO. RDS-210.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
		TYPE I HANDICAP RAMP	DWG NO. RDS-207A
DATE	REVISION		

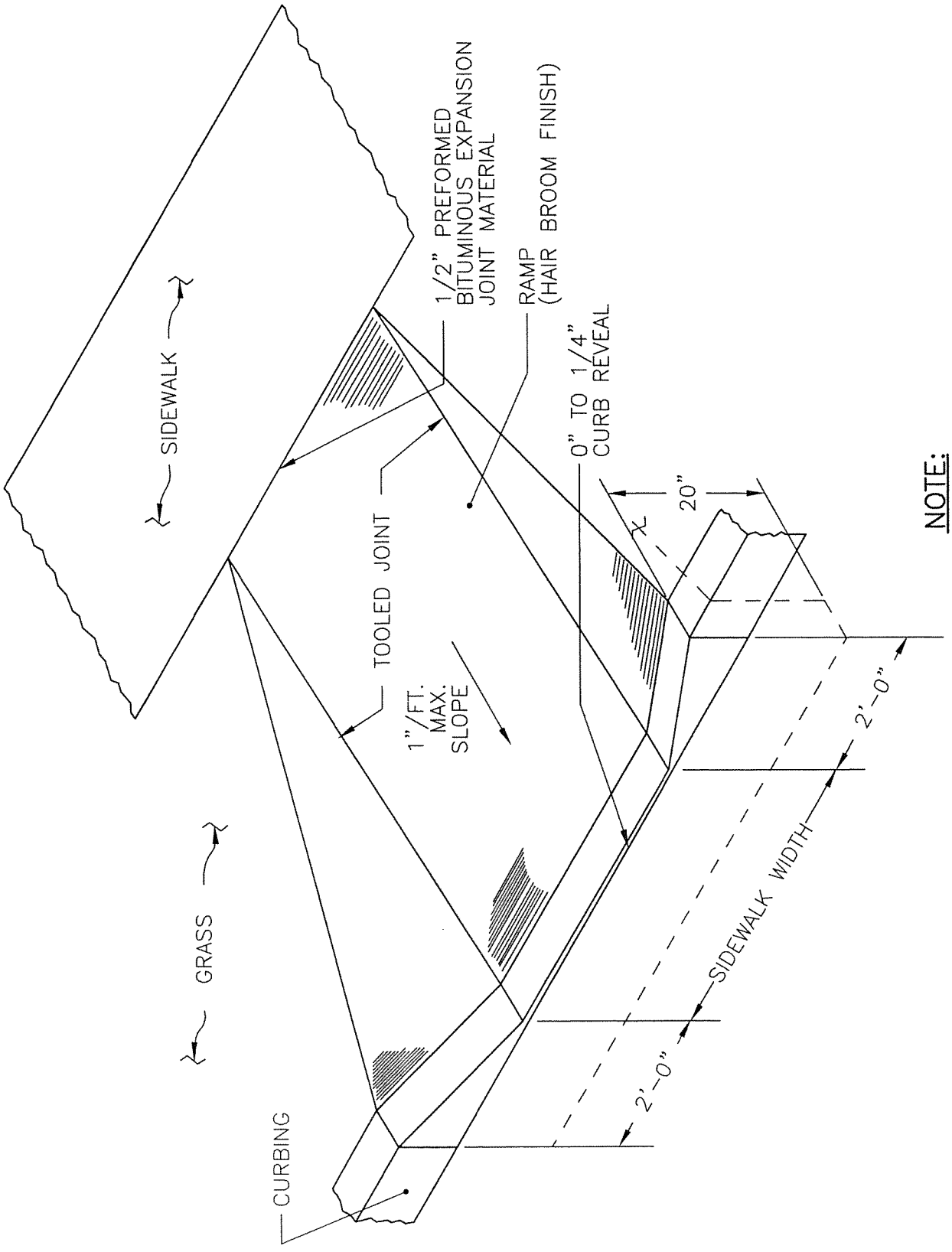


NOTE:

1. RAMP SECTION SHALL CONFORM TO DWG. NO. RDS-210 & DWG. NO. RDS-213.

NOT TO SCALE

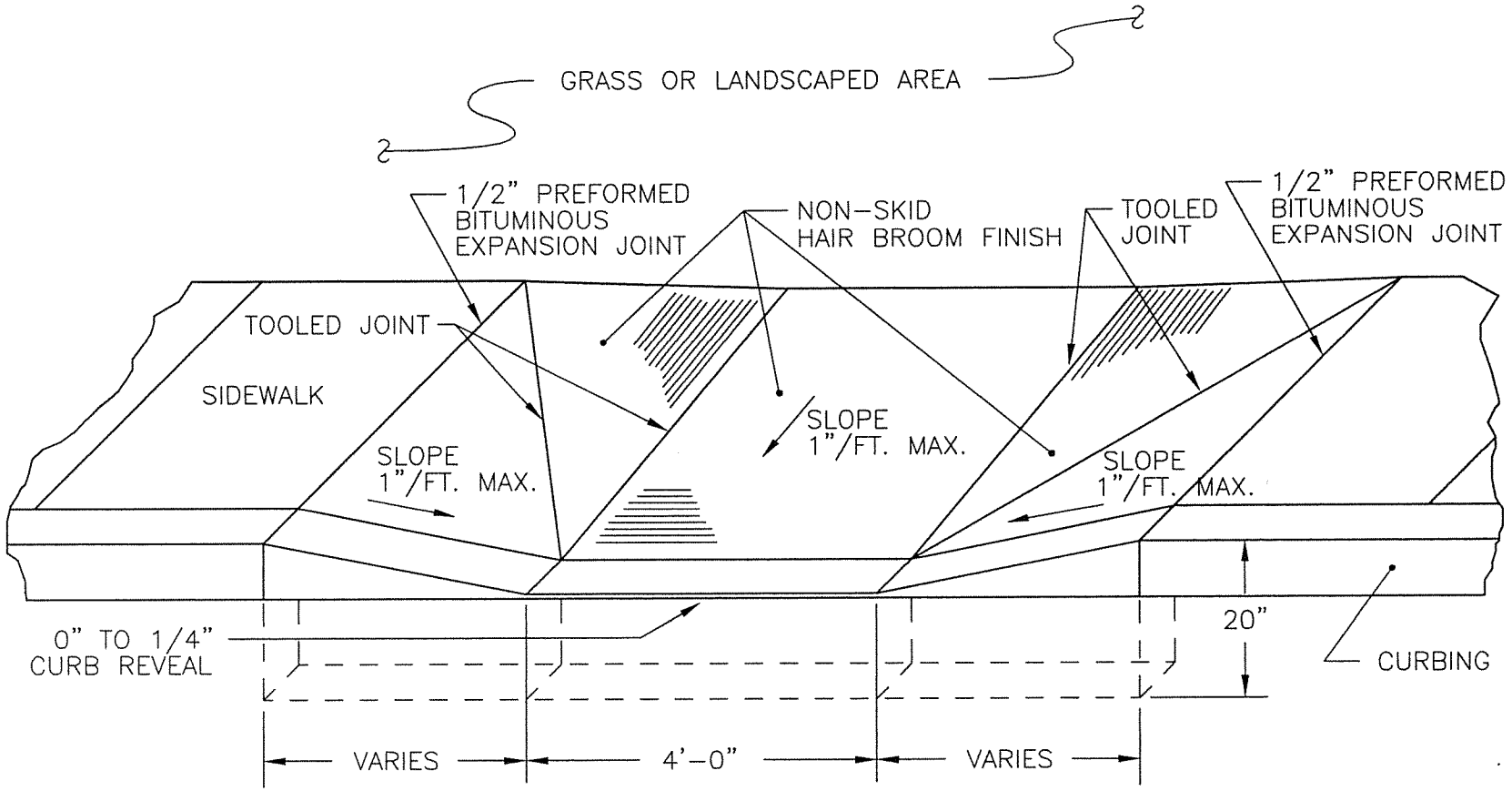
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	TYPE IA HANDICAP RAMP	DWG NO. RDS-207B



NOTE:
1. RAMP SECTION SHALL CONFORM TO DWG. NO. RDS-210.

NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS TYPE II HANDICAP RAMP	DATE: 3/22/99
			DWG NO. RDS-208

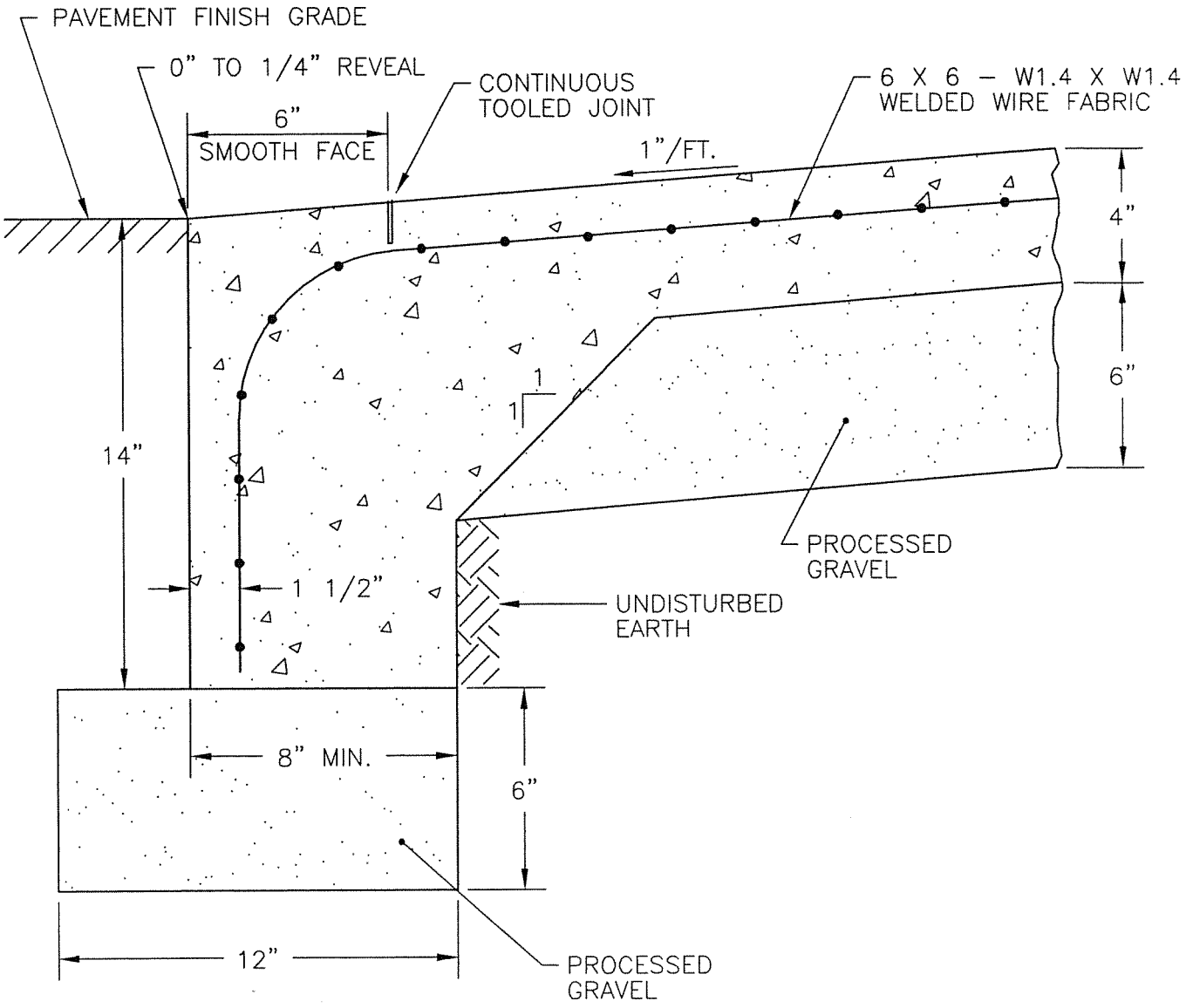


NOTE:

1. RAMP SECTION SHALL CONFORM TO DWG. NOS. RDS-210 & RDS-213.

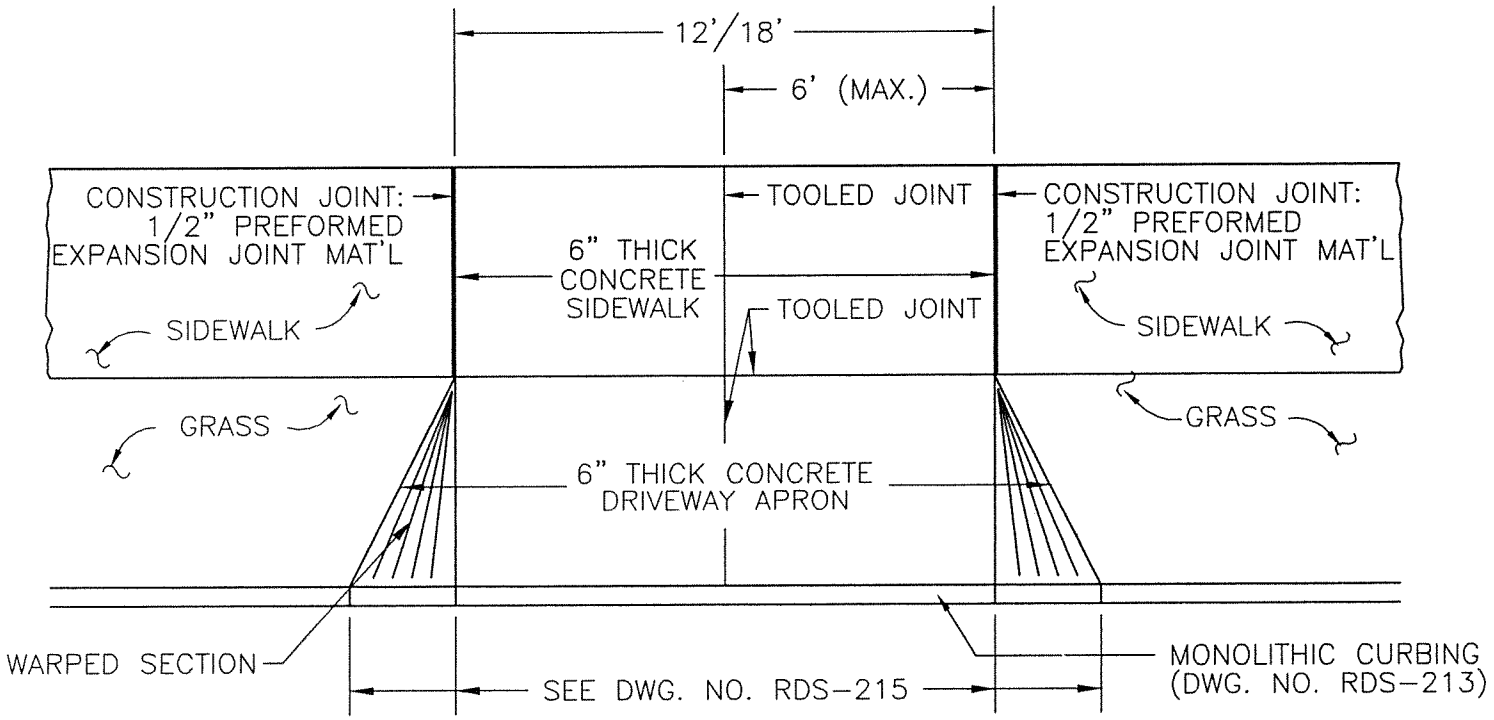
NOT TO SCALE

DATE	REVISION	Town of Groton Department of Public Works	DWN BY: GMJ
		ROAD & DRAINAGE STANDARDS	APD BY: [signature]
		TYPE III HANDICAP RAMP	DATE: 3/22/99
			DWG NO. RDS-209

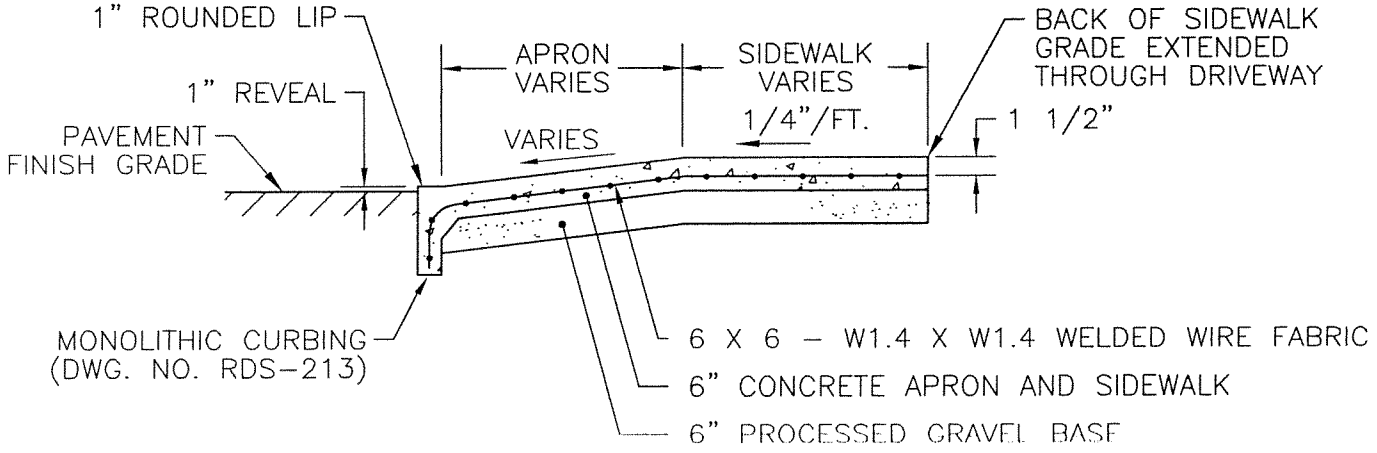


NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	HANDICAP RAMP & CURB	DWG NO. RDS–210



PLAN



SECTION

NOT TO SCALE

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

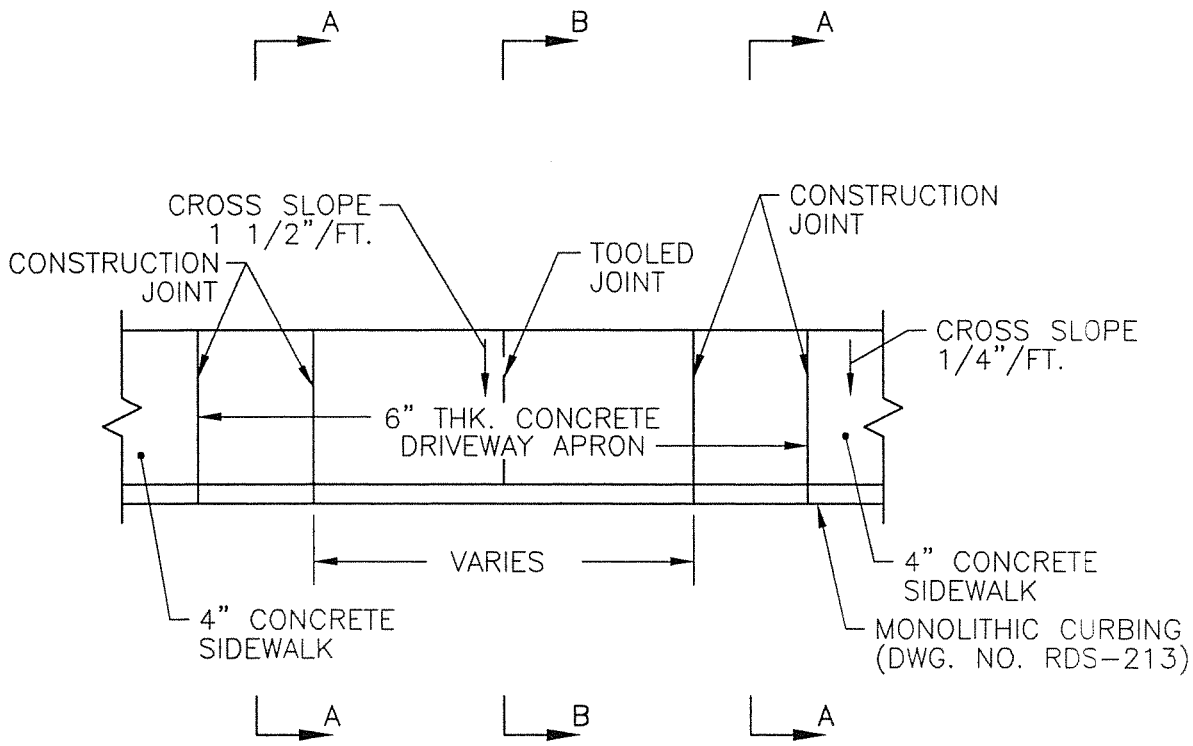
CONCRETE DRIVEWAY APRON

DWN BY: GMJ

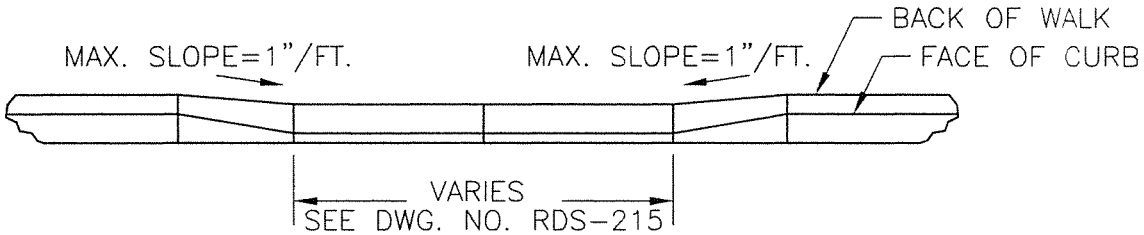
APD BY: [signature]

DATE: 3/22/99

DWG NO. RDS-211



PLAN



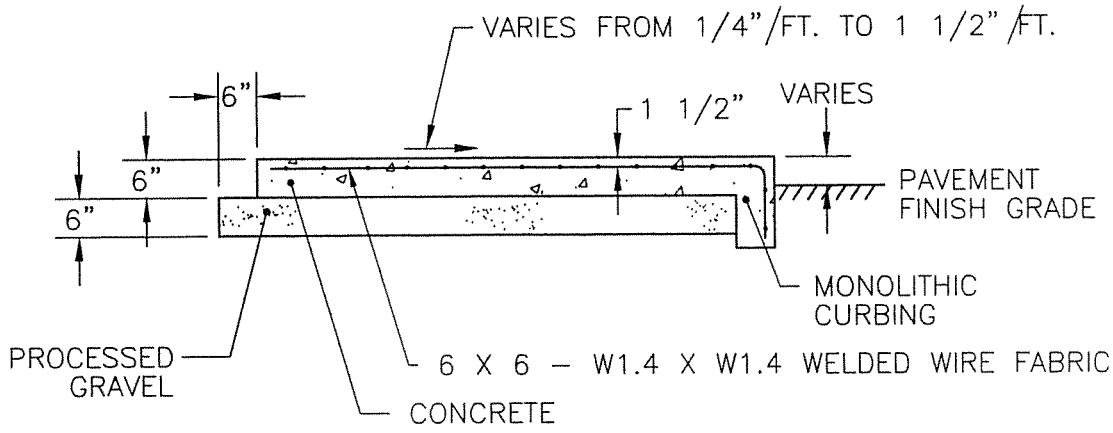
ELEVATION

NOTES:

1. SEE DWG. RDS-212B FOR SECTIONS.
2. TO BE USED ONLY WHERE RIGHT-OF-WAY WIDTH PROHIBITS INSTALLATION OF DRIVEWAY APRON AS PER DWG. RDS-211.

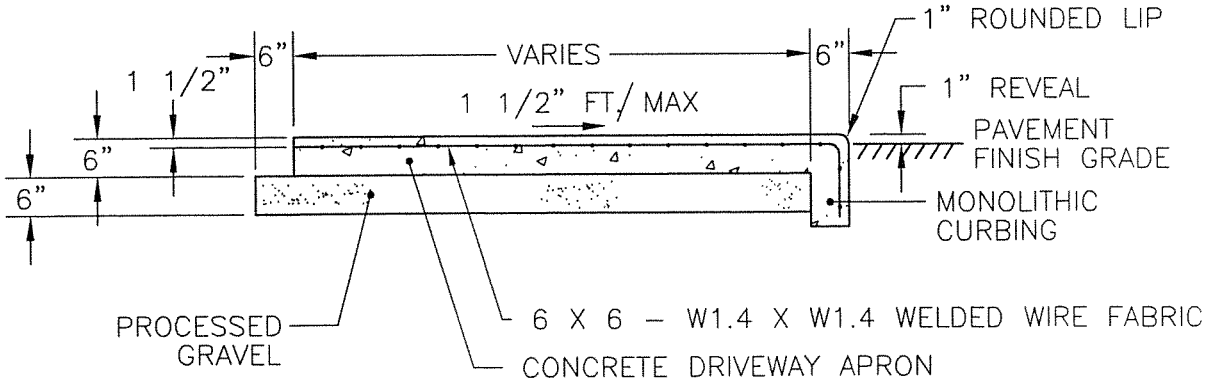
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS CONCRETE DRIVEWAY APRON ADJACENT SIDEWALK	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-212A



*TOOLED JOINTS IN DRIVEWAY APRON TO BE PLACED WHERE DIRECTED WITH 6' MAXIMUM SPACING.

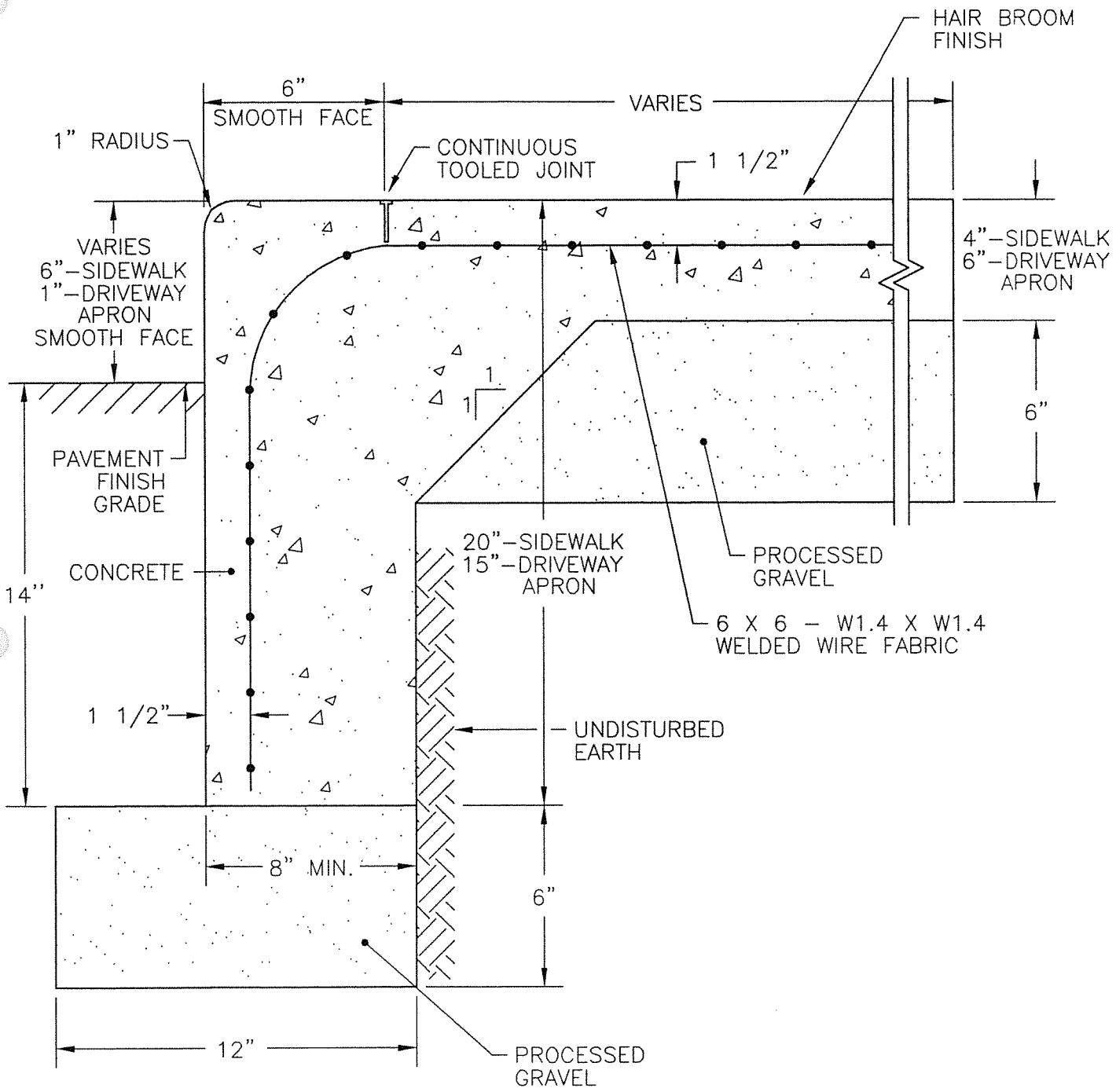
SECTION A–A



SECTION B–B

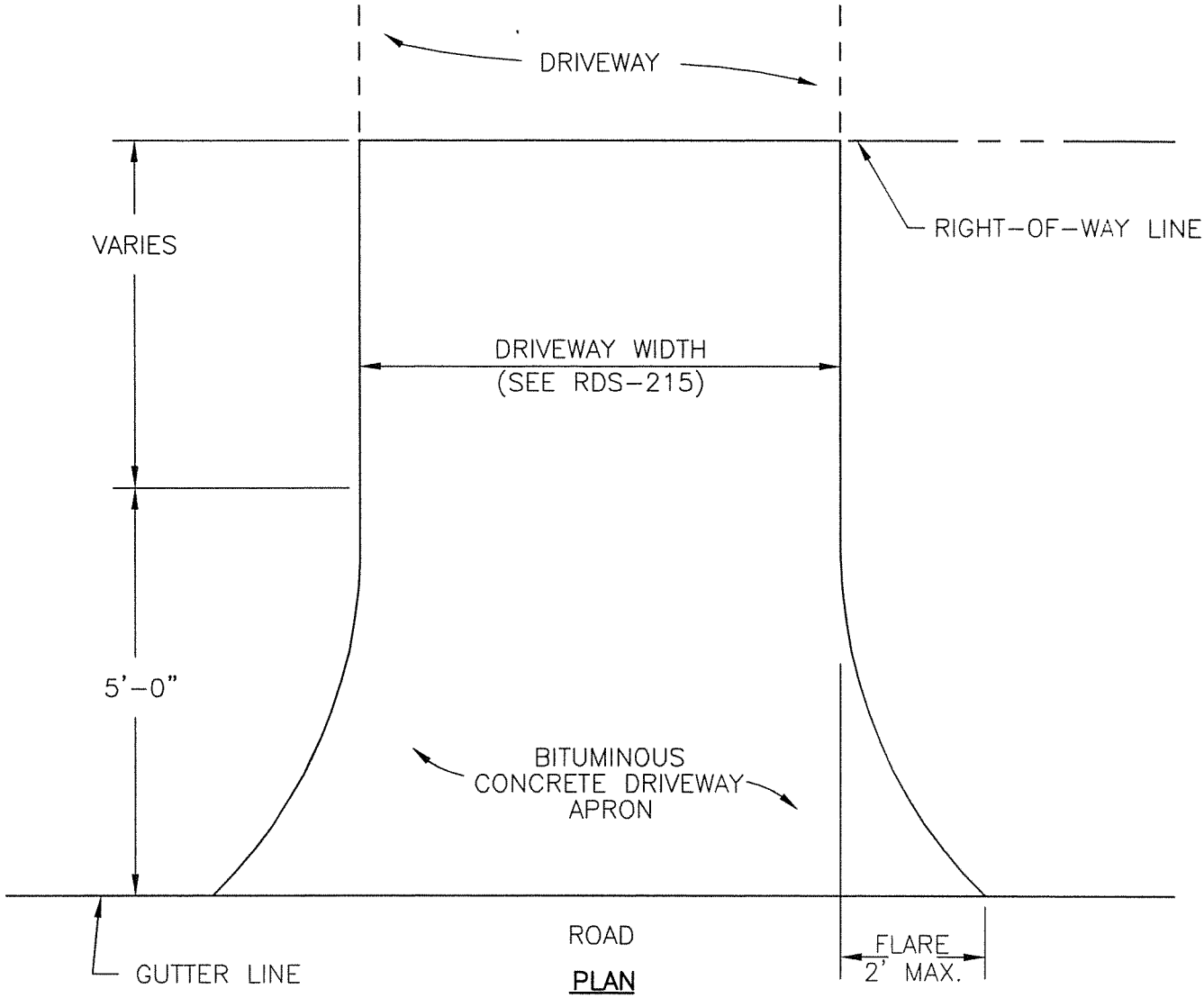
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS CONCRETE DRIVEWAY APRON ADJACENT SIDEWALK	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS–212B

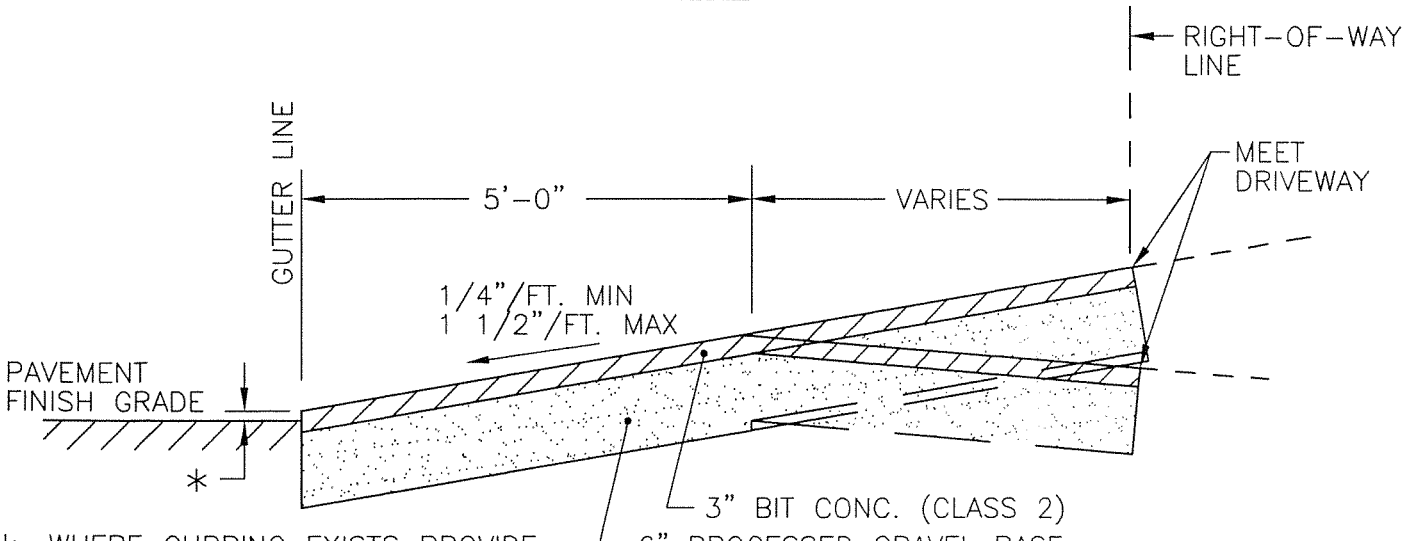


NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS MONOLITHIC CURB AND SIDEWALK/DRIVEWAY APRON	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-213



PLAN

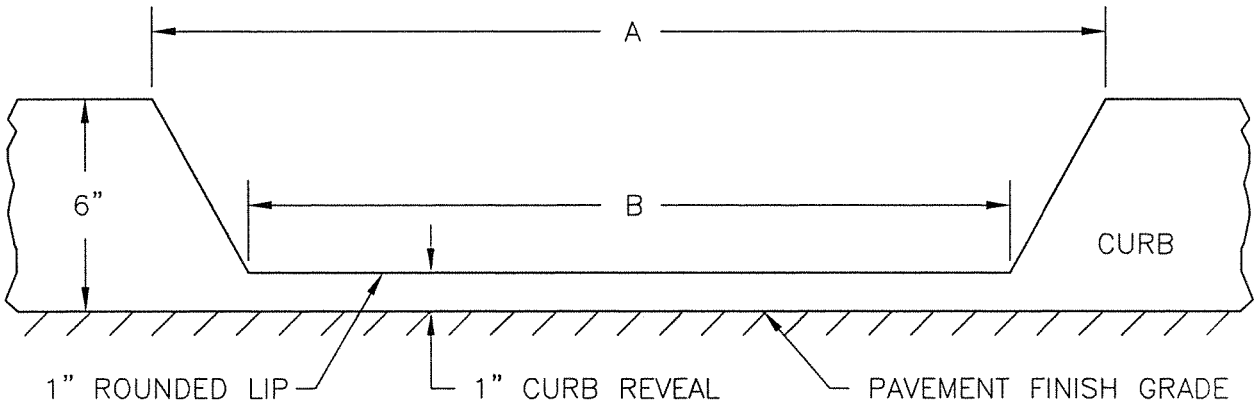


* -WHERE CURBING EXISTS PROVIDE 1" REVEAL. IF NO CURBING THEN DRIVEWAY TO BE FLUSH WITH ROAD.

SECTION

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	BIT. CONC. DRIVEWAY APRON	DWG NO. RDS-214



SINGLE DRIVEWAY

A = 16'

B = 12'

DOUBLE DRIVEWAY

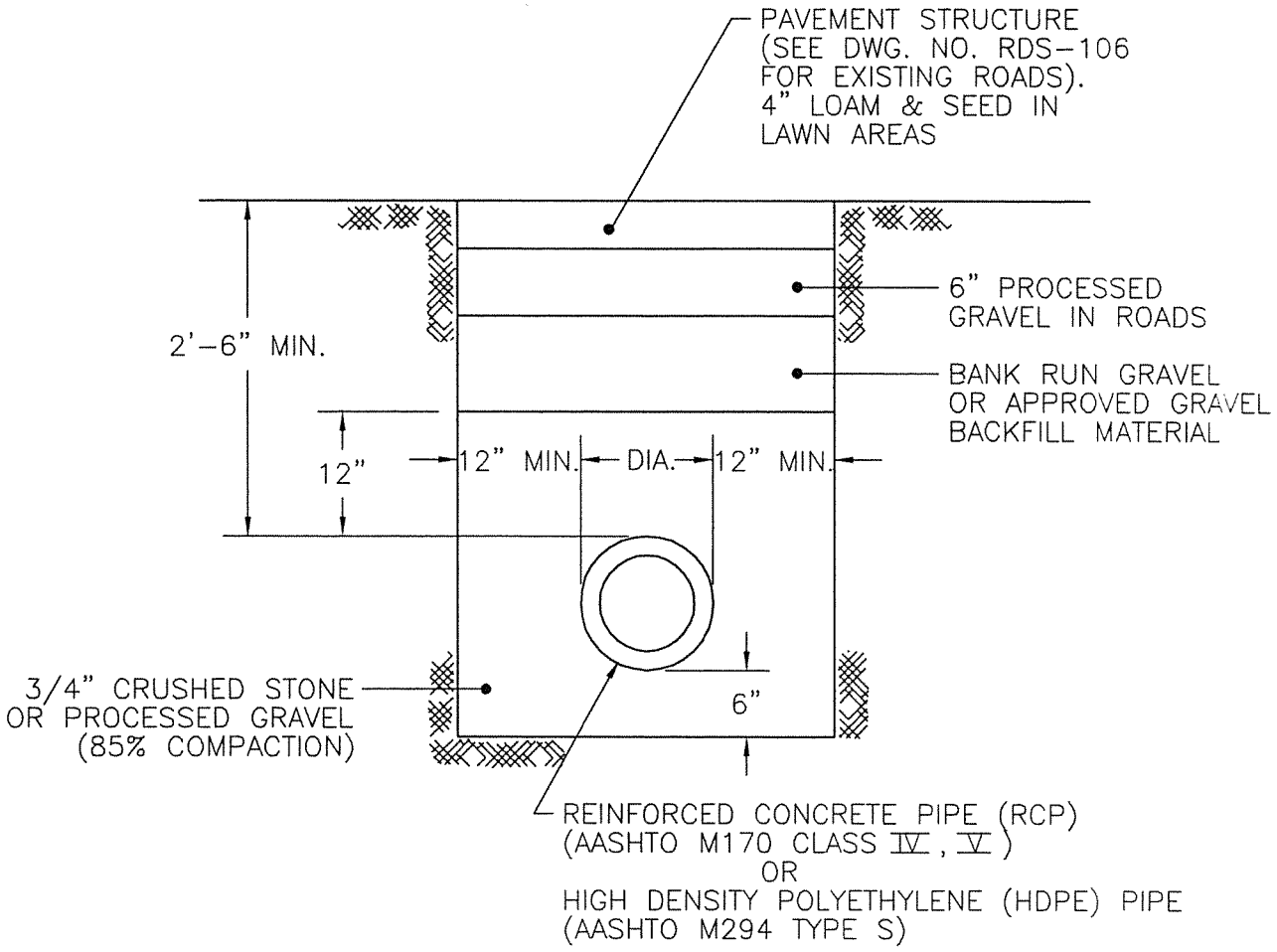
A = 22'

B = 18'

NOTE: DIMENSION "A" DOES NOT APPLY WHEN DRIVEWAY APRON IS IN A SIDEWALK ADJACENT TO CURB. SEE DWG. RDS-212A.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	DRIVEWAY CUTS	DWG NO. RDS-215

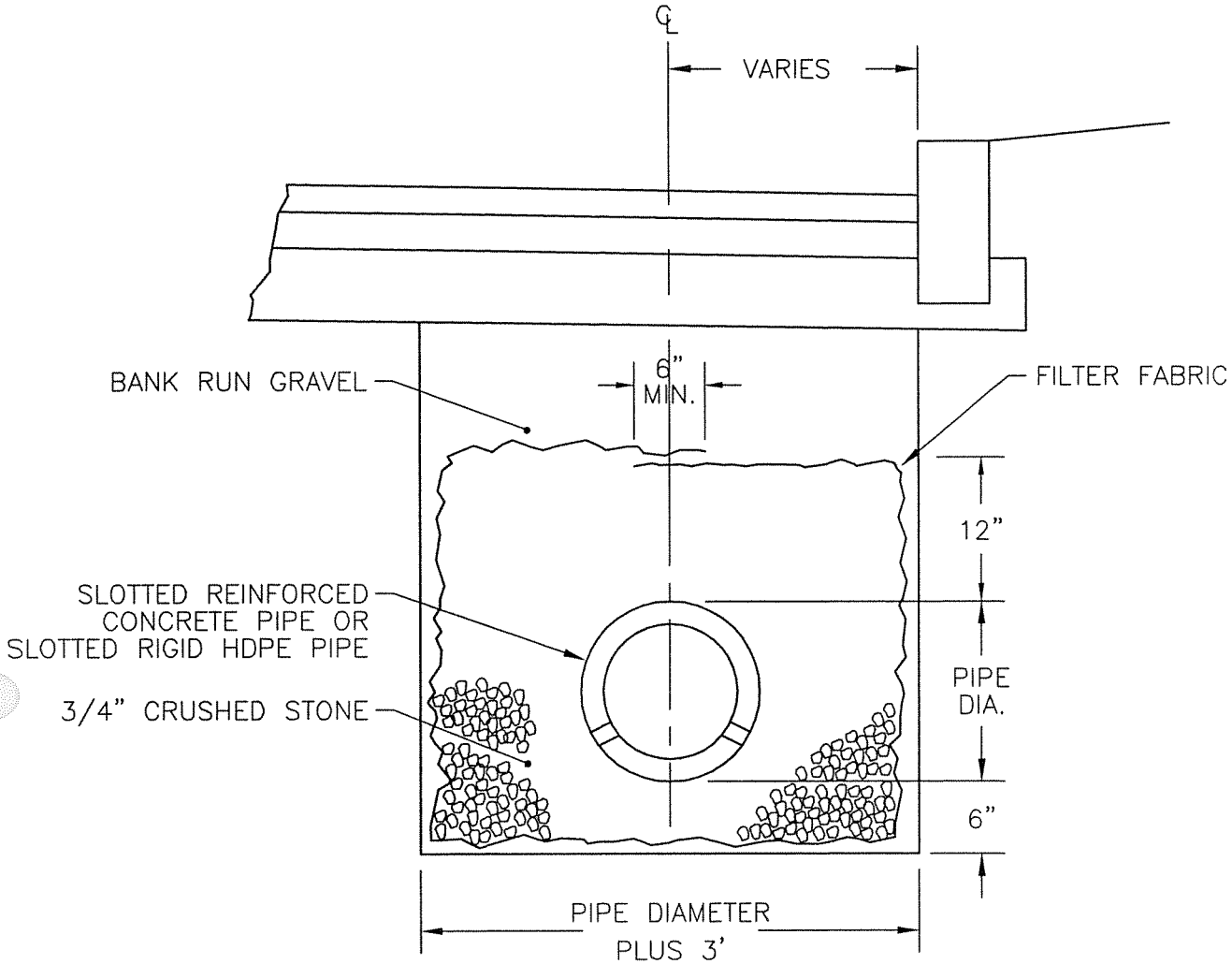


NOTE:

1. IF PIPE IS PLACED IN OR ON LEDGE, ALL LEDGE WITHIN 12" OF PIPE SHALL BE REMOVED AND REPLACED WITH PIPE BEDDING.

NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
		DRAINAGE PIPE TRENCH	DWG NO. RDS-301

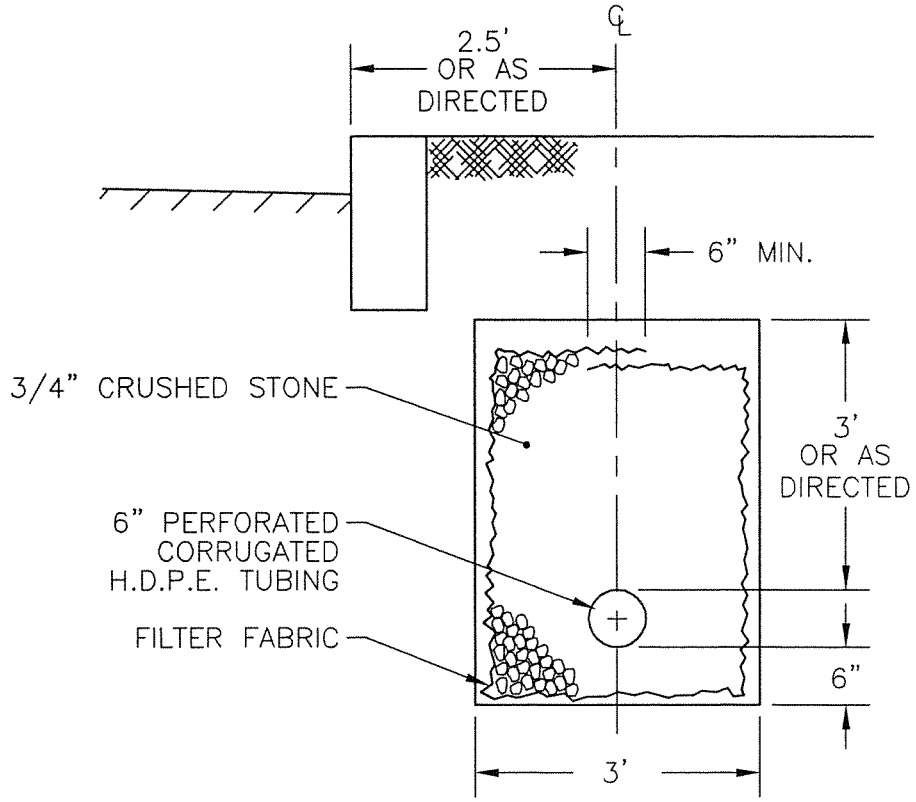


NOTE:

1. SLOTS SHALL BE PLACED DOWN.
2. FILTER FABRIC SHALL BE MIRAFI 140NS, EXXON 150EX, AMOCO 4545, TREVIRA 1114 OR APPROVED EQUAL.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS SLOTTED UNDERDRAIN	DATE: 3/22/99
			DWG NO. RDS-302
DATE	REVISION		

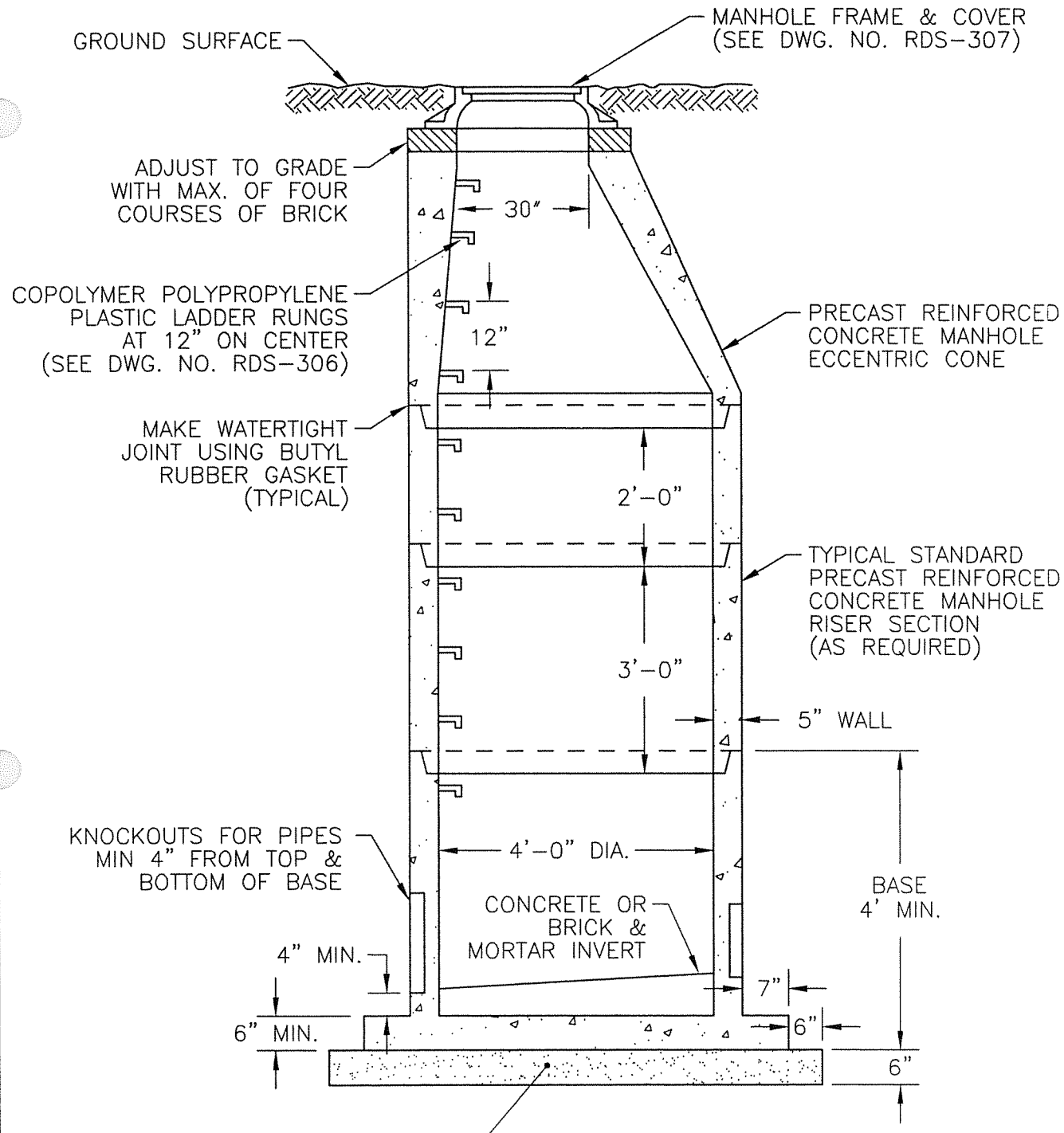


NOTES:

1. PERFORATIONS SHALL BE PLACED DOWN.
2. PIPE SHALL NOT BE PLACED WITHIN 36" OF ANY UTILITY POLE.
3. FILTER FABRIC SHALL BE MIRAFI 140NS, EXXON 150EX, AMOCO 4545, TREVIRA 1114 OR APPROVED EQUAL.

NOT TO SCALE

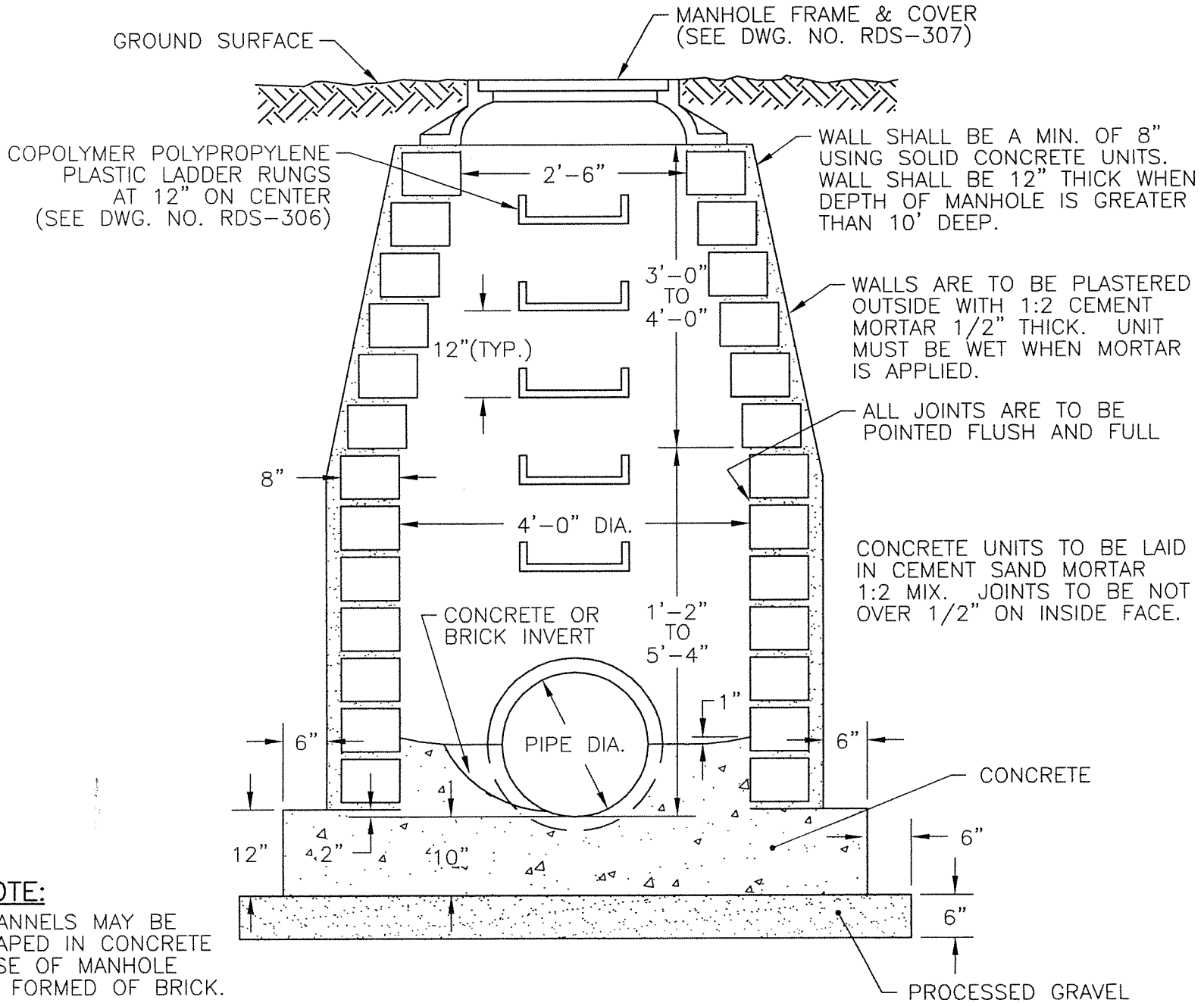
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	UNDERDRAIN WITH 6" PIPE	DWG NO. RDS-303



NOTE: 5' OR 6' DIA. PRECAST BASES MAY BE USED WHEN REQUIRED DUE TO SIZE OR NUMBER OF PIPES AT THE MANHOLE. PRECAST REDUCERS WILL BE PLACED ABOVE THE 5' AND 6' BASES AS DIRECTED BY THE ENGINEER. WALL THICKNESS TO INCREASE 1" FOR EACH 1' OF INSIDE DIAMETER INCREASE.

NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS PRECAST CONCRETE DRAINAGE MANHOLE	DATE: 3/22/99
			DWG NO. RDS-304



NOTE:

CHANNELS MAY BE SHAPED IN CONCRETE BASE OF MANHOLE OR FORMED OF BRICK.

NOT TO SCALE

DATE	REVISION

Town of Groton
Department of Public Works

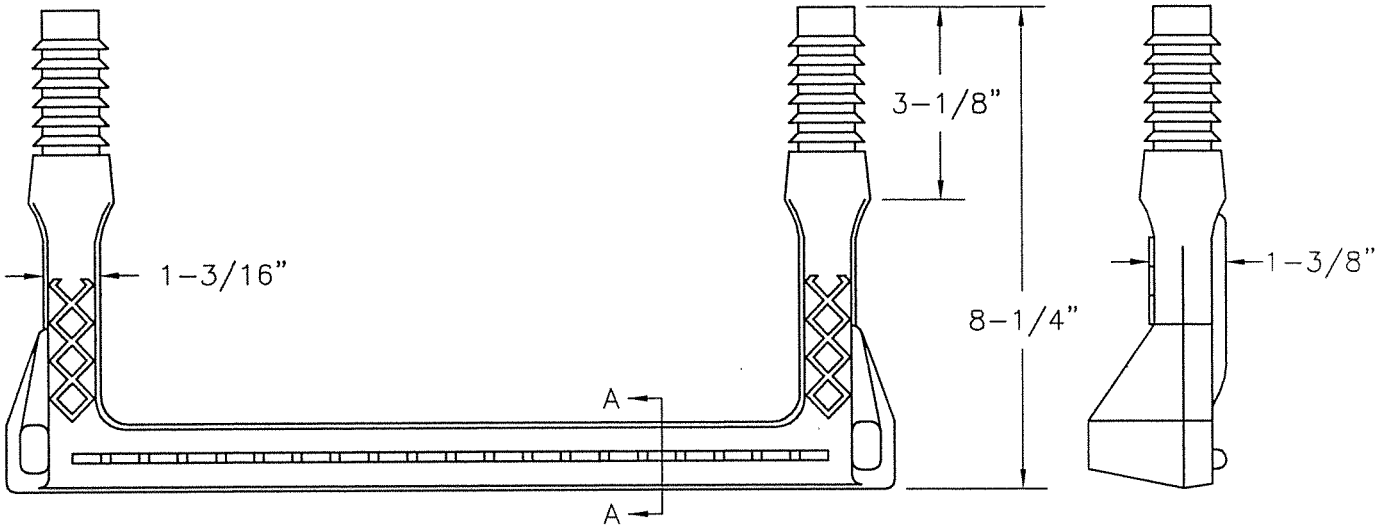
ROAD & DRAINAGE STANDARDS
MASONRY UNIT
DRAINAGE MANHOLE

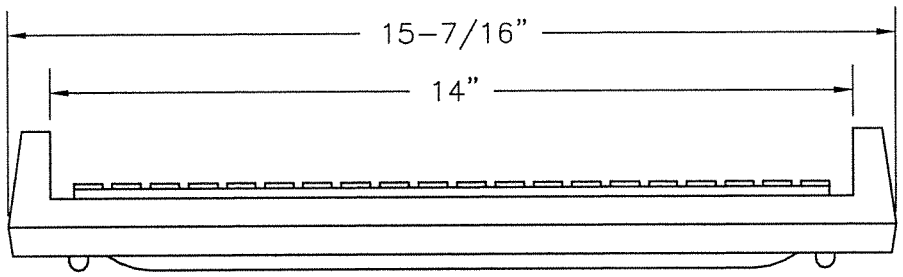
DWN BY: GMJ

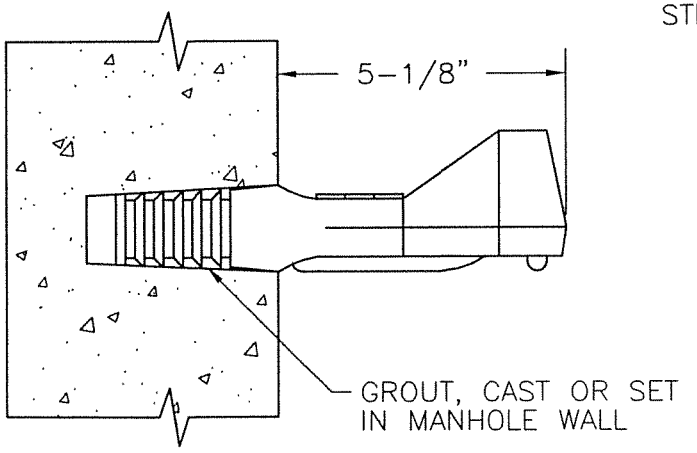
APD BY: GMJ

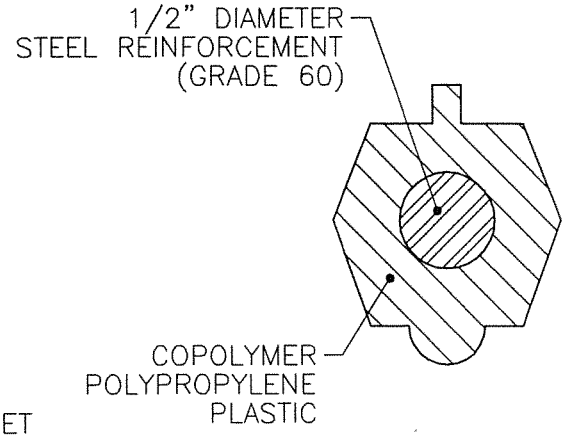
DATE: 3/22/99

DWG NO. RDS-305





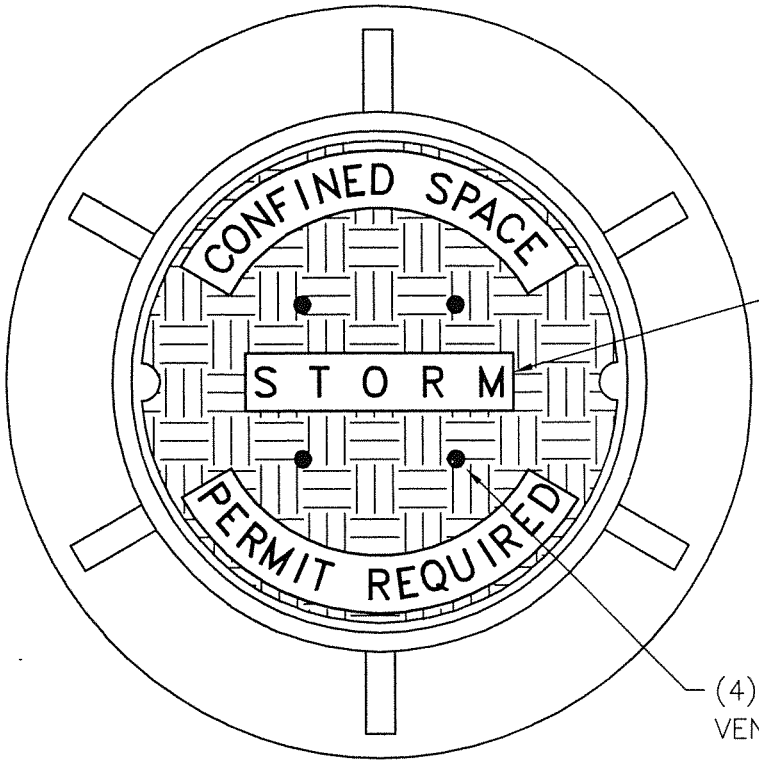


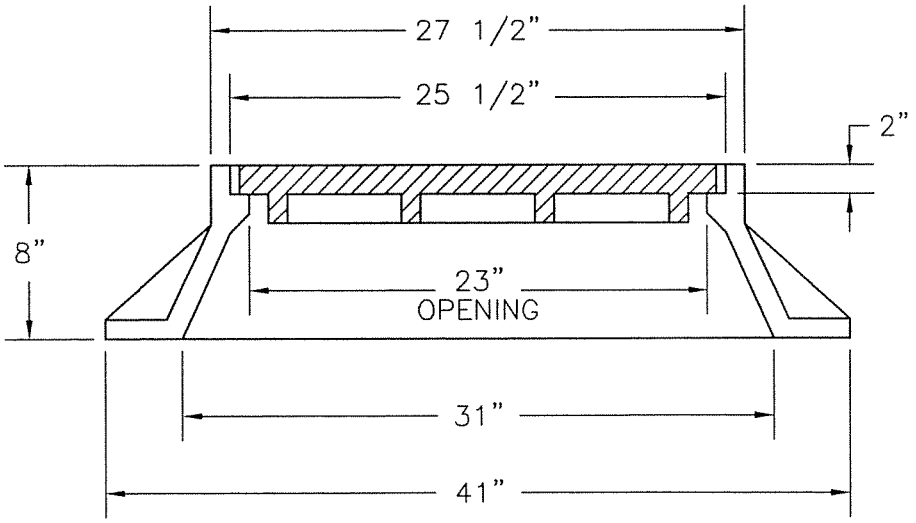


SECTION A-A

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	MANHOLE STEP	DWG NO. RDS-306





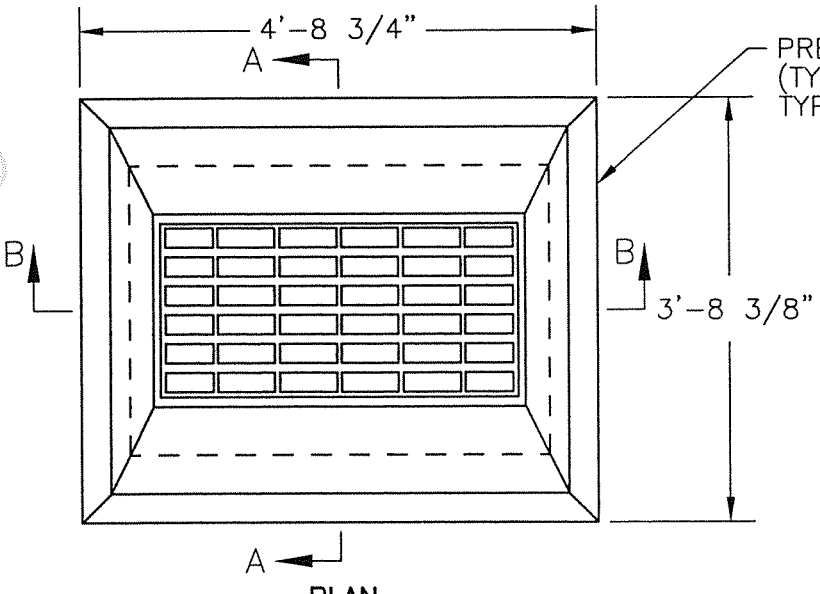
FRAME AND COVER SHALL BE:

LeBARON FOUNDARY CATALOG NO. LK 310

MINIMUM WEIGHT OF FRAME AND COVER = 500 LBS.

NOT TO SCALE

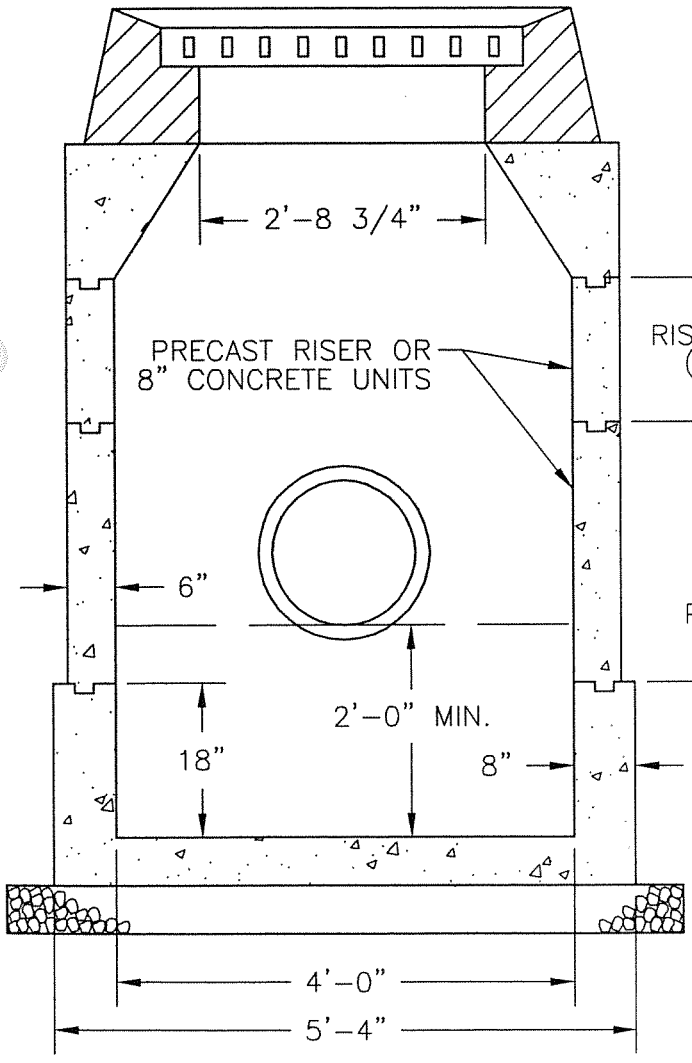
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 4/20/01
DATE	REVISION	MANHOLE FRAME & COVER	DWG NO. RDS-307



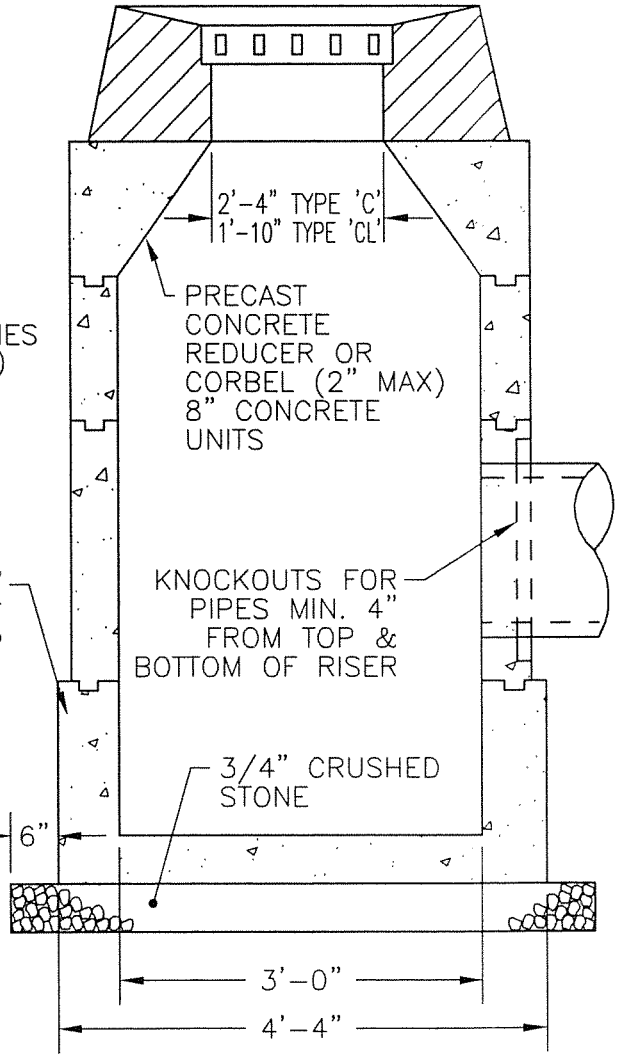
PLAN

NOTES:

1. IN PRECAST RISER SECTIONS, THE KNOCKOUTS OR OPENINGS AROUND THE PIPES SHALL BE MORTARED TO 6".
2. PRECAST REDUCER SHALL BE SPECIFICALLY SIZED & PLACED FOR THE TYPE OF TOP USED.
3. PLACE ALL PRECAST UNITS, TOPS AND CONCRETE BLOCKS IN A CEMENT MORTAR BED.
4. PRECAST UNITS SHALL BE REINFORCED WITH WELDED WIRE FABRIC.



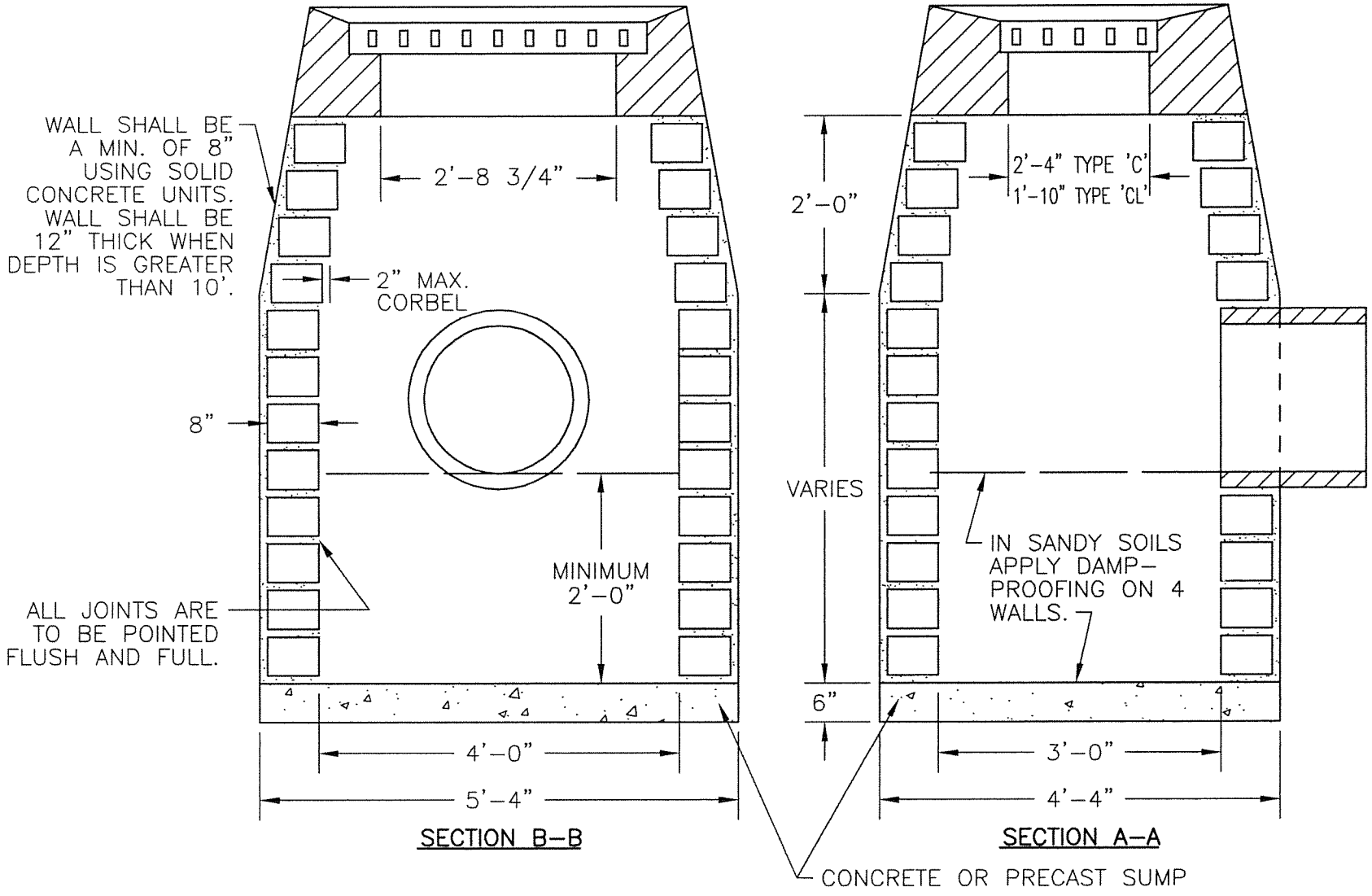
SECTION B-B



SECTION A-A

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	PRECAST CATCH BASIN	DWG NO. RDS-308



NOTES:

1. WHERE PRECAST CONCRETE UNIT IS USED FOR SUMP, THE TOP OF THE UNIT SHALL BE AT LEAST 6" BELOW THE BOTTOM OF THE PIPE OUTLETTING FROM THE CATCH BASIN.
2. CONCRETE UNITS TO BE LAID IN CEMENT SAND MORTAR 1:2 MIX. JOINTS NOT TO BE OVER 1/2" ON INSIDE FACE.
3. WALLS ARE TO BE PLASTERED OUTSIDE WITH 1:2 CEMENT MORTAR 1/2" THICK. UNITS MUST BE WET WHEN MORTAR IS APPLIED.

NOT TO SCALE

DATE | REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

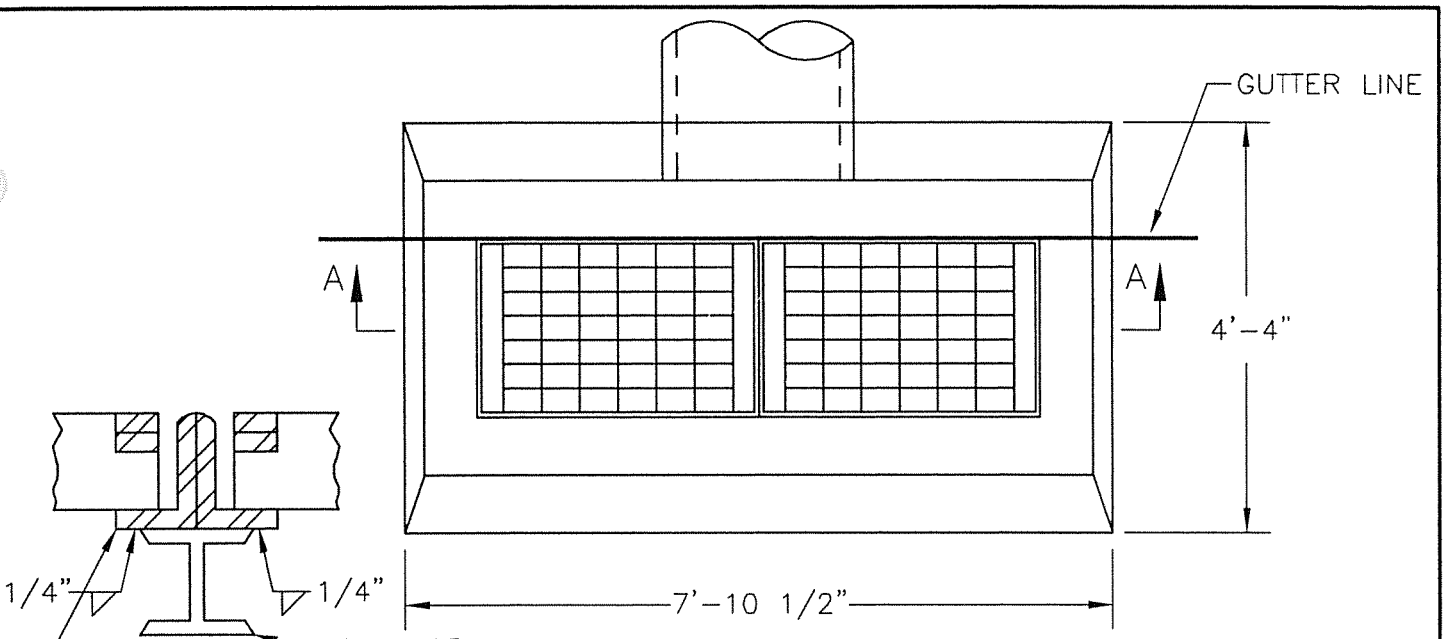
MASONRY UNIT CATCH BASIN

DWN BY: GMJ

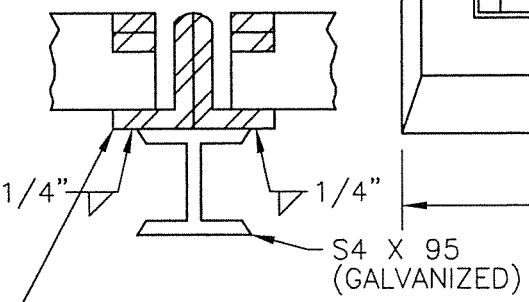
APD BY: GWH

DATE: 3/22/99

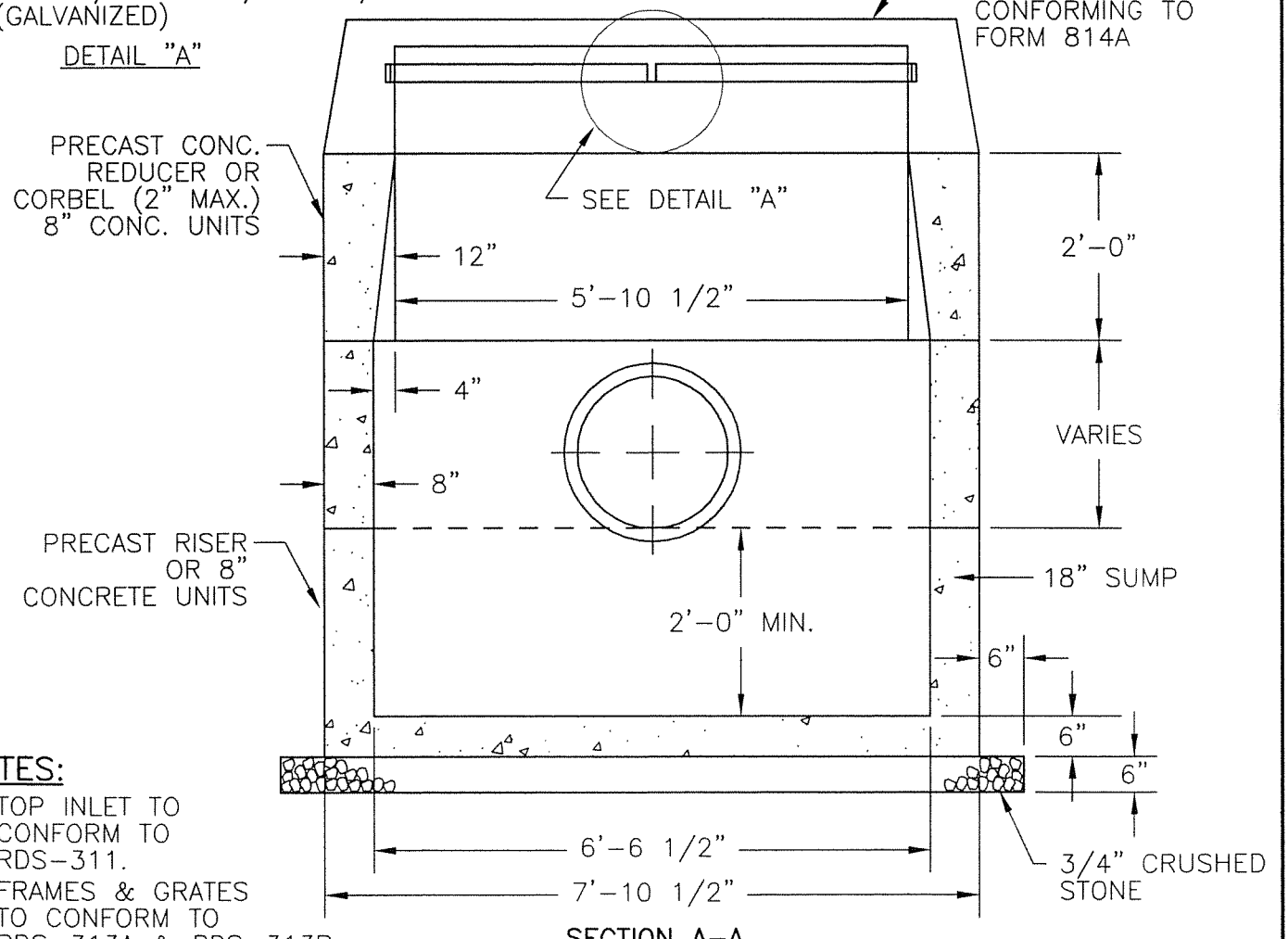
DWG NO. RDS-309



PLAN



DETAIL "A"



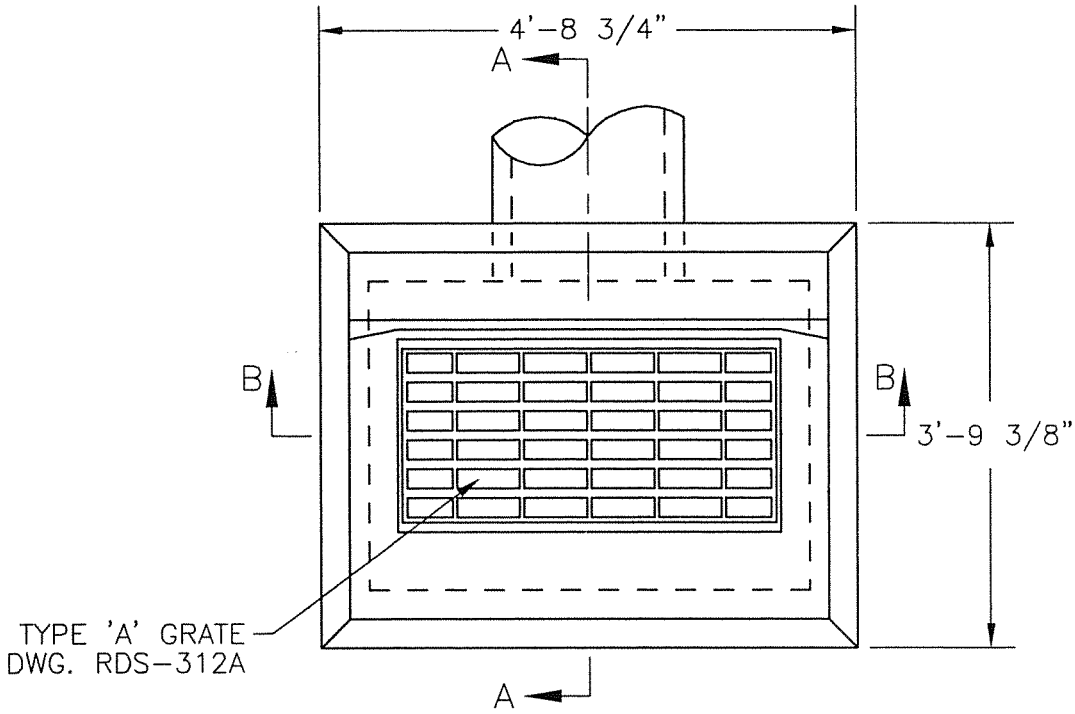
SECTION A-A

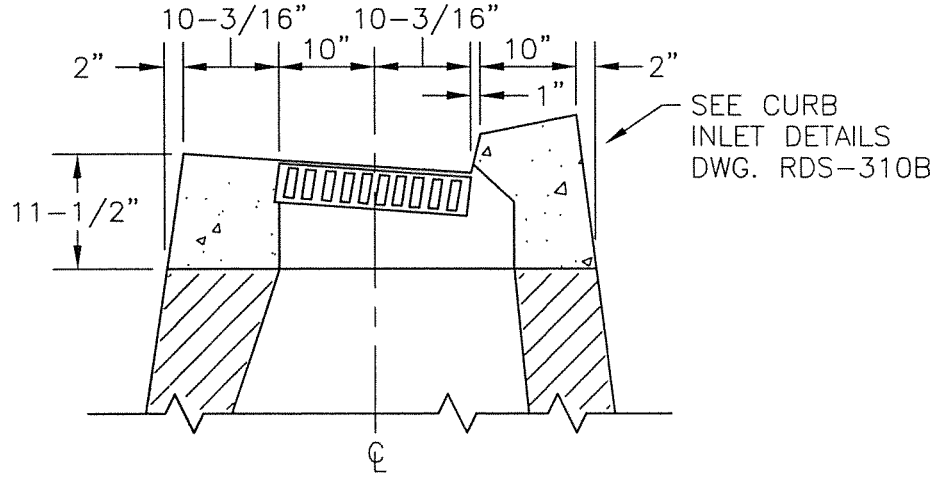
NOTES:

1. TOP INLET TO CONFORM TO RDS-311.
2. FRAMES & GRATES TO CONFORM TO RDS-313A & RDS-313B.

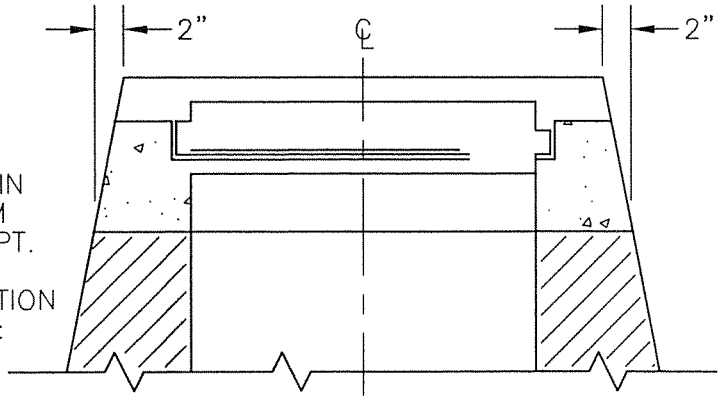
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS DOUBLE CATCH BASIN	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-310





SECTION A-A



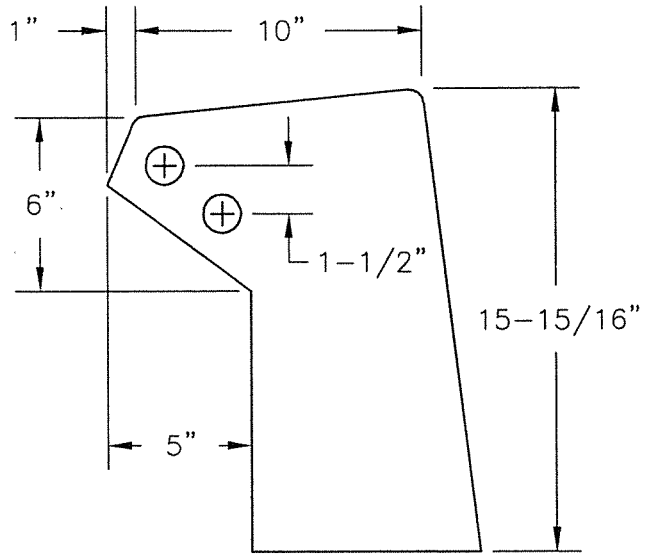
SECTION B-B

NOTE:

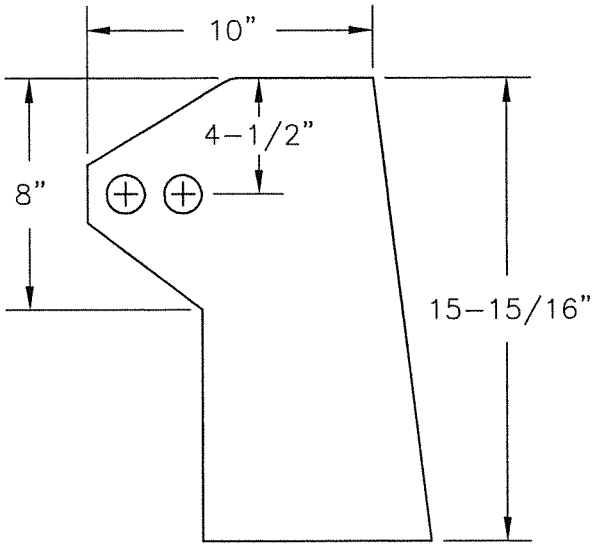
1. TYPE 'C' CATCH BASIN TOP SHALL CONFORM TO CONNECTICUT DEPT. OF TRANSPORTATION STANDARD SPECIFICATION FORM 814A SECTION: M. 08. 02-4.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	TYPE 'C' CATCH BASIN TOP	DWG NO. RDS-311A



FOR USE WITH CONCRETE AND GRANITE CURBING



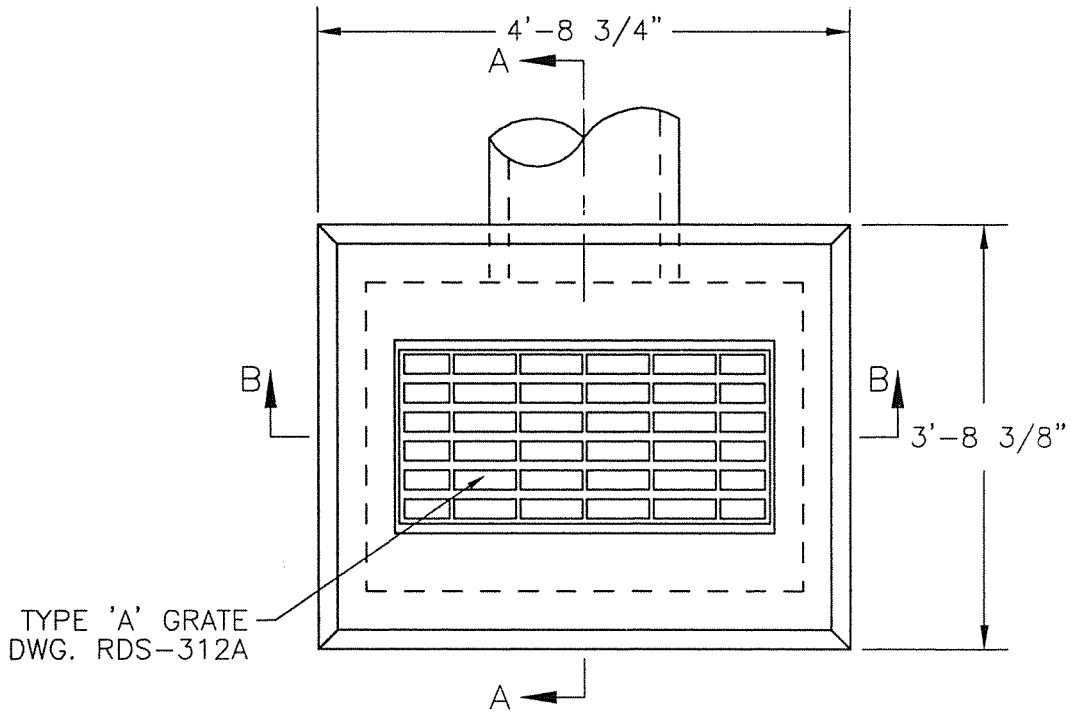
FOR USE WITH BITUMINOUS CURBING

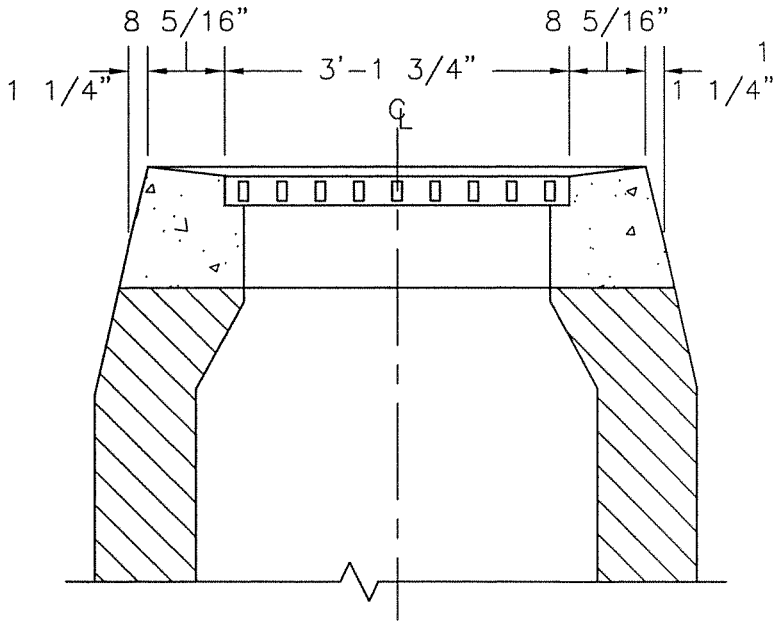
NOTE:

1. CURB INLETS SHALL BE CONSTRUCTED IN ACCORDANCE WITH CONNECTICUT D.O.T. STANDARDS.

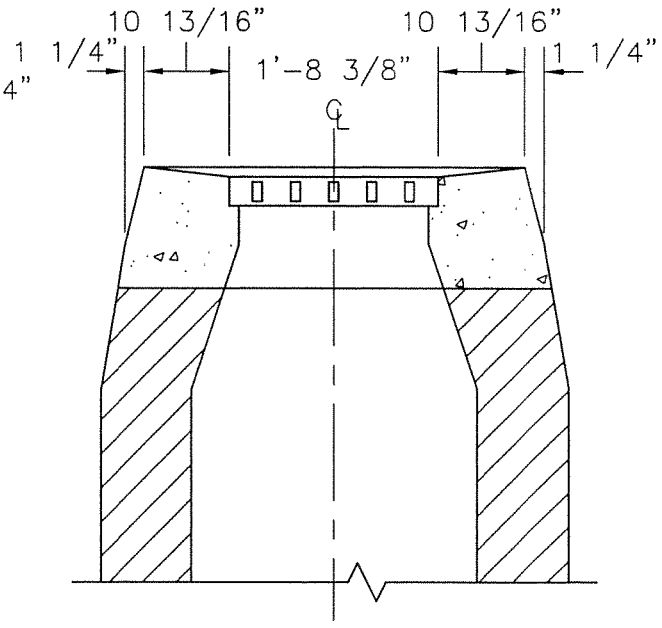
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	CURB INLETS	DWG NO. RDS-311B





SECTION B-B



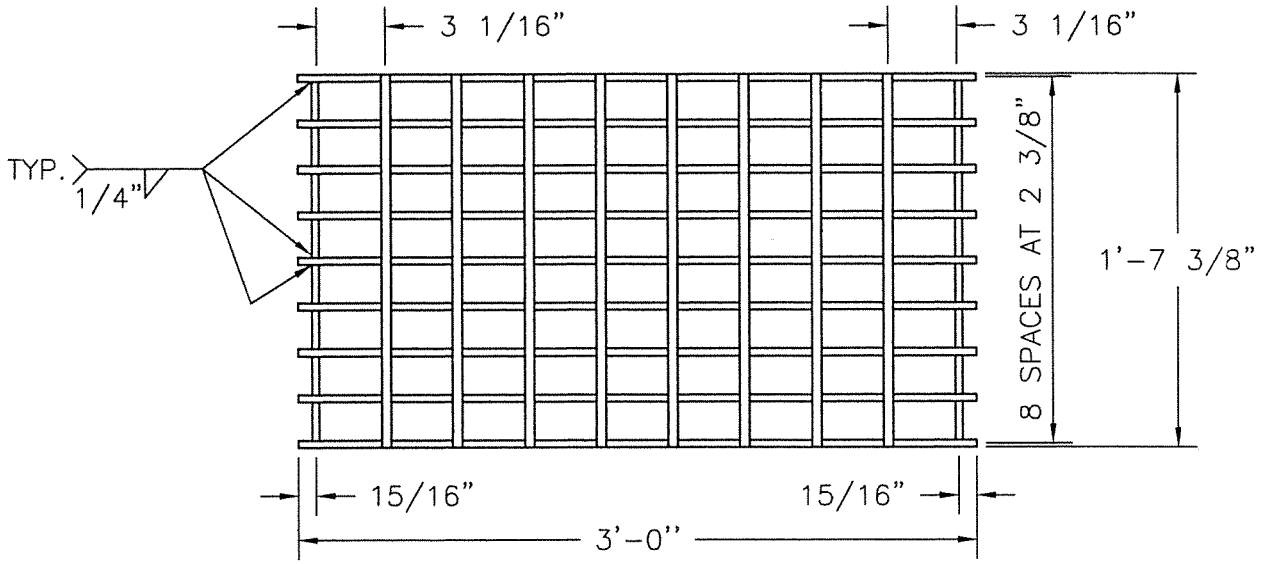
SECTION A-A

NOTE:

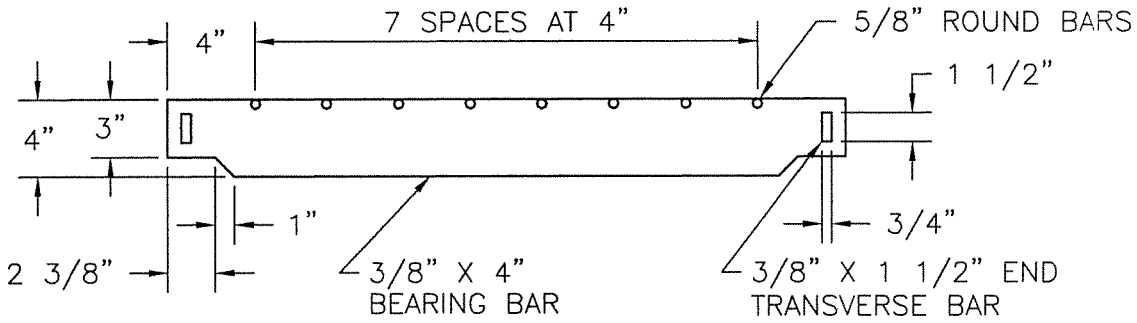
1. TYPE 'CL' CATCH BASIN TOPS SHALL CONFORM TO CONNECTICUT DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATION FORM 814A SECTION: M.08.02-4.

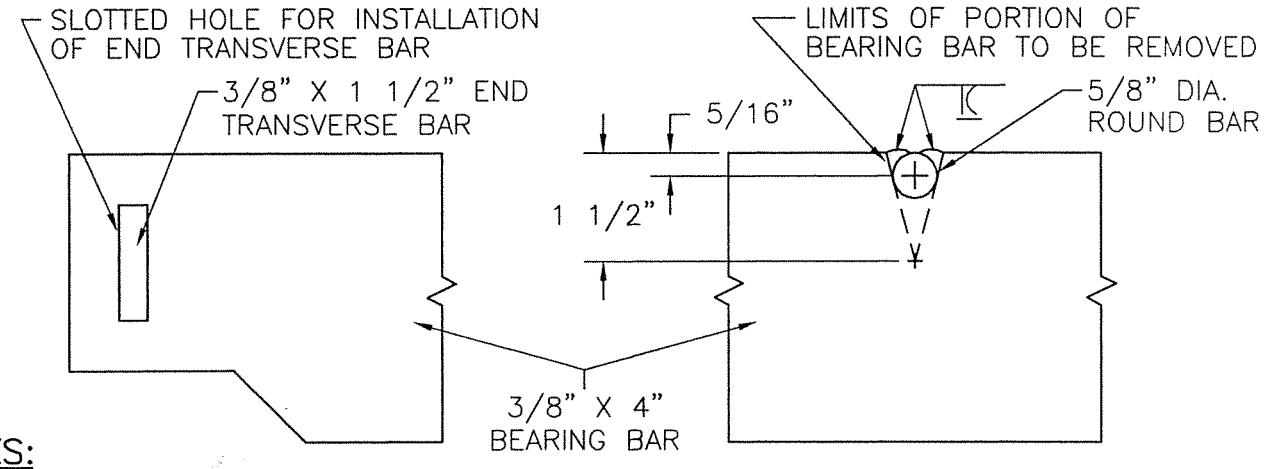
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	TYPE 'CL' CATCH BASIN TOP	DWG NO. RDS-312



TYPE A





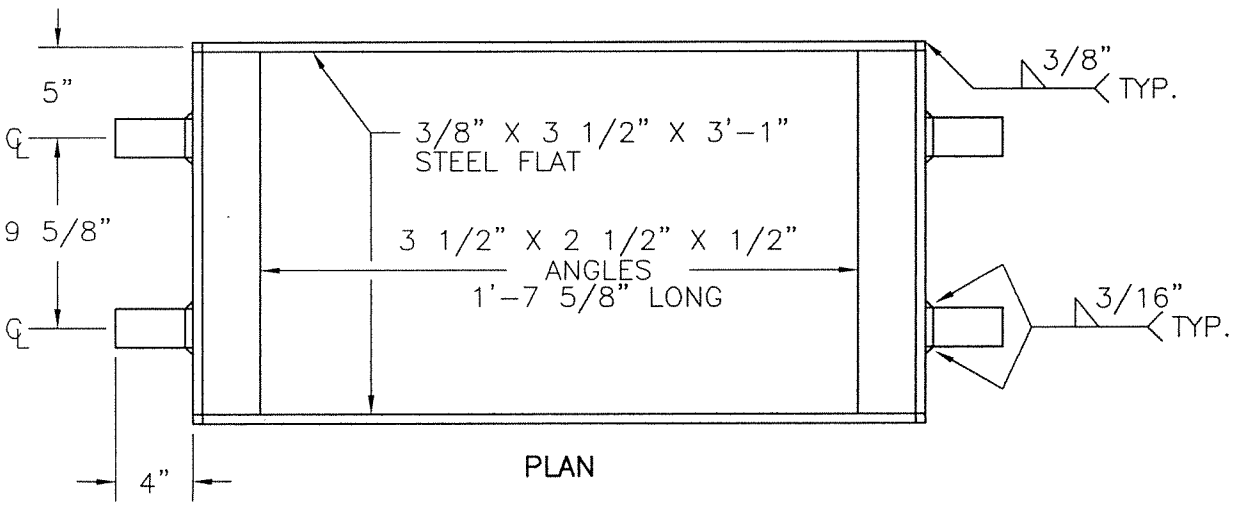
NOTES:

1. CATCH BASIN GRATE SHALL CONFORM TO CONNECTICUT D.O.T. STANDARD DRAWING #507K TYPE-A.
2. STEEL FRAMES AND GRATES SHALL BE GALVANIZED IN ACCORDANCE WITH M.06.03 OF D.O.T. FORM 814A.
3. ALL BARS SHALL BE WELDED AT ALL INTERSECTIONS.
4. ALL METAL UNITS SUBJECT TO MANUFACTURING TOLERANCES.
5. ONLY LOW HYDROGEN ELECTRODES SHALL BE USED.
6. DIMENSIONAL TOLERANCES MAY BE ±1/16".
7. WELDING WILL BE PERFORMED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR ROADS, BRIDGES AND INCIDENTAL CONSTRUCTION.

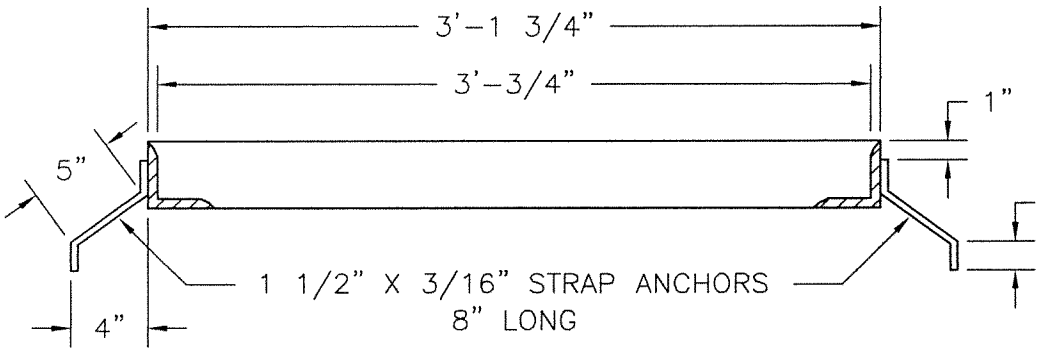
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	CATCH BASIN GRATE	DWG NO. RDS-313A

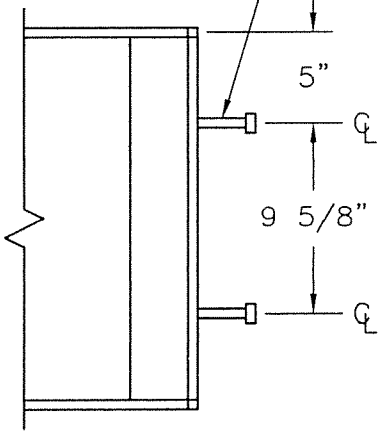
STEEL FRAME



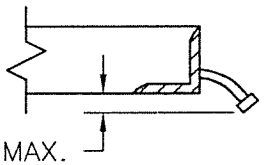
PLAN

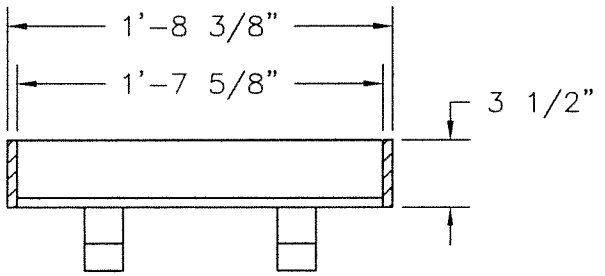


LONGITUDINAL SECTION



STUD ANCHOR ALTERNATE





TRANSVERSE SECTION

NOTE:

1. SEE NOTES ON DWG. NO. RDS-313A.

NOT TO SCALE

DWN BY: GMJ

APD BY: GMJ

DATE: 3/22/99

DWG NO. RDS-313B

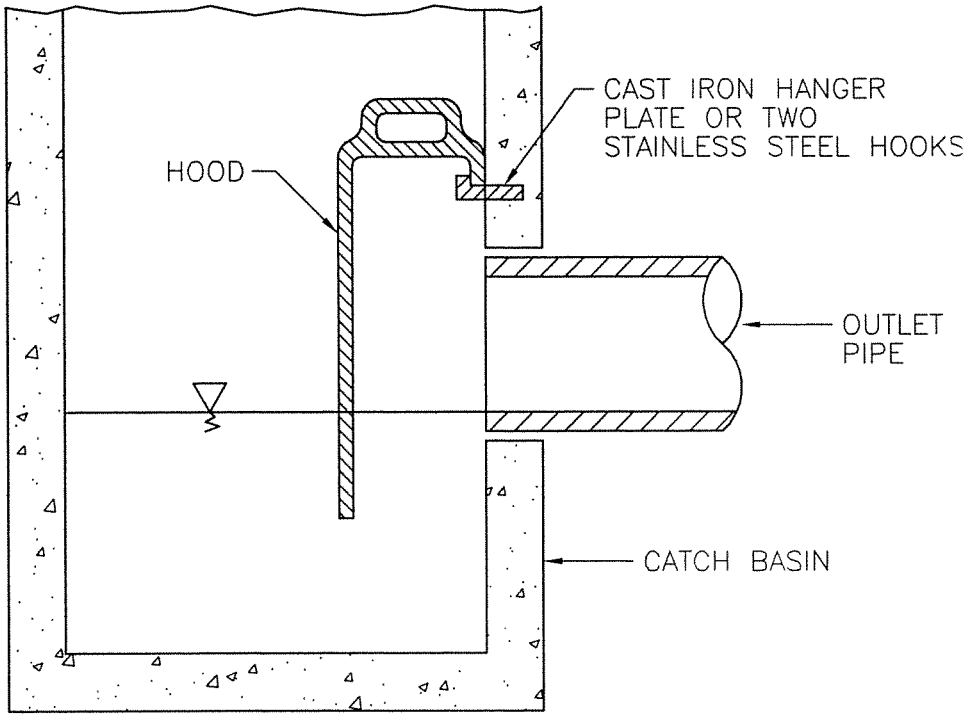
Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

CATCH BASIN GRATE FRAME

DATE	REVISION

PIPE SIZE	PATTERN NUMBER *
15"	2564
18"	2565
21"	2566
24"	2568A
30" & LARGER	CONSULT MANUF.



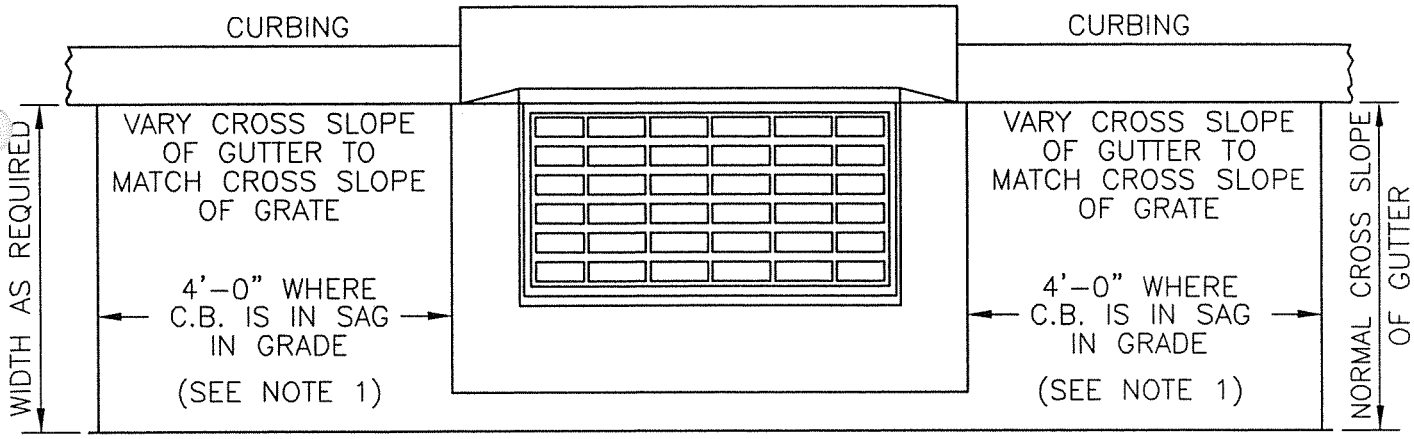
NOTES:

1. USE CAST IRON HOOD FOR PIPE SIZES UP TO 24".
2. USE GALVANIZED FABRICATED STEEL HOOD FOR PIPE SIZES 24" AND LARGER.

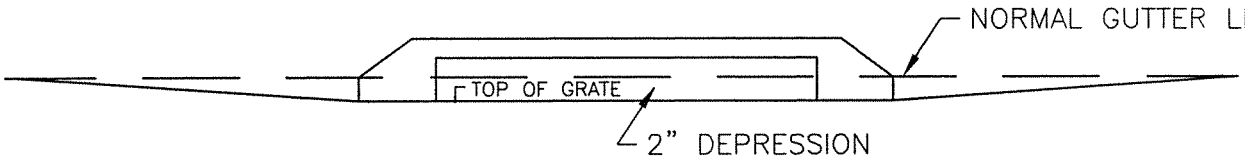
* CAMPBELL FOUNDRY CO. PATTERN NUMBERS

NOT TO SCALE

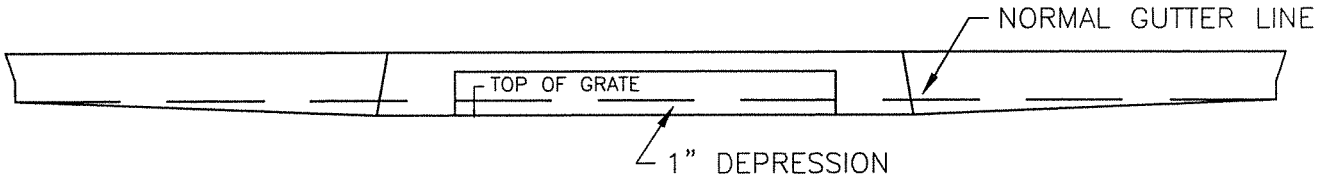
DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS CATCH BASIN HOOD	DATE: 3/22/99
			DWG NO. RDS-314



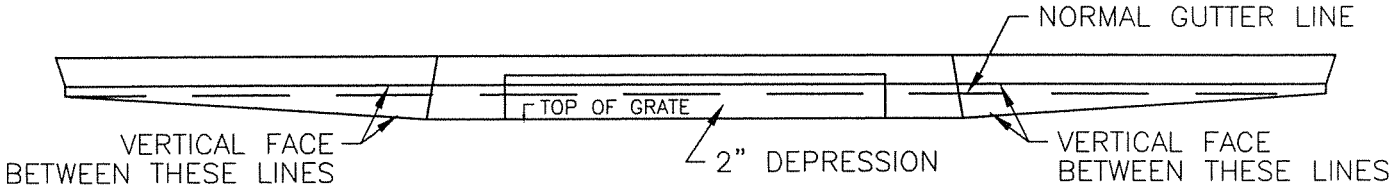
PLAN



FOR CATCH BASINS WHERE NO CURBING OF ANY TYPE EXISTS OR IS PROPOSED.



FOR CATCH BASINS IN A LINE OF CONCRETE CURBING OR GRANITE CURBING.



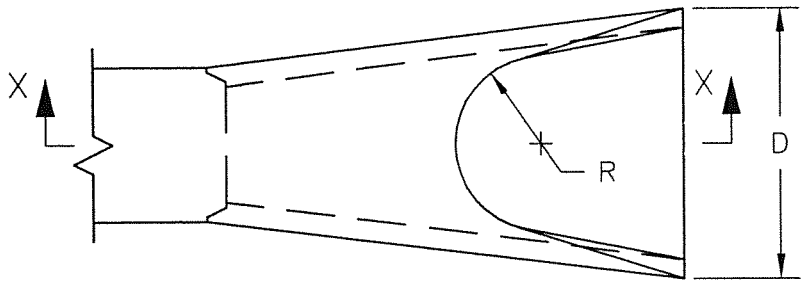
FOR CATCH BASINS IN A LINE OF BITUMINOUS CONCRETE LIP CURBING.

NOTE:

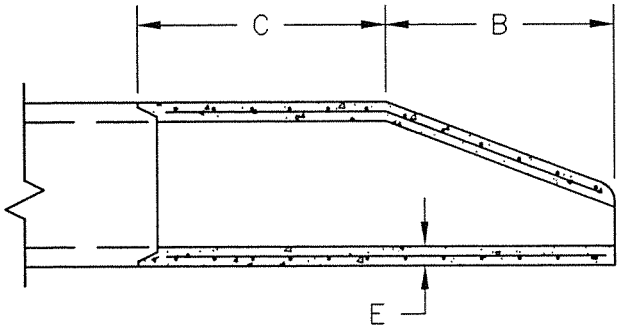
1. 6'-0" ON UPGRADE SIDE OF CONTINUOUS GRADE, 1'-0" ON DOWNGRADE SIDE OF CONTINUOUS GRADE OR AS DIRECTED.

NOT TO SCALE

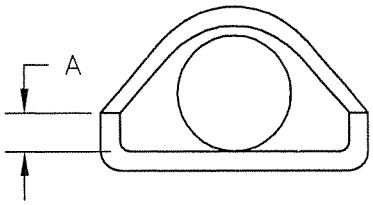
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS CATCH BASIN GUTTER DEPRESSION	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-315



PLAN



SECTION X–X



END VIEW

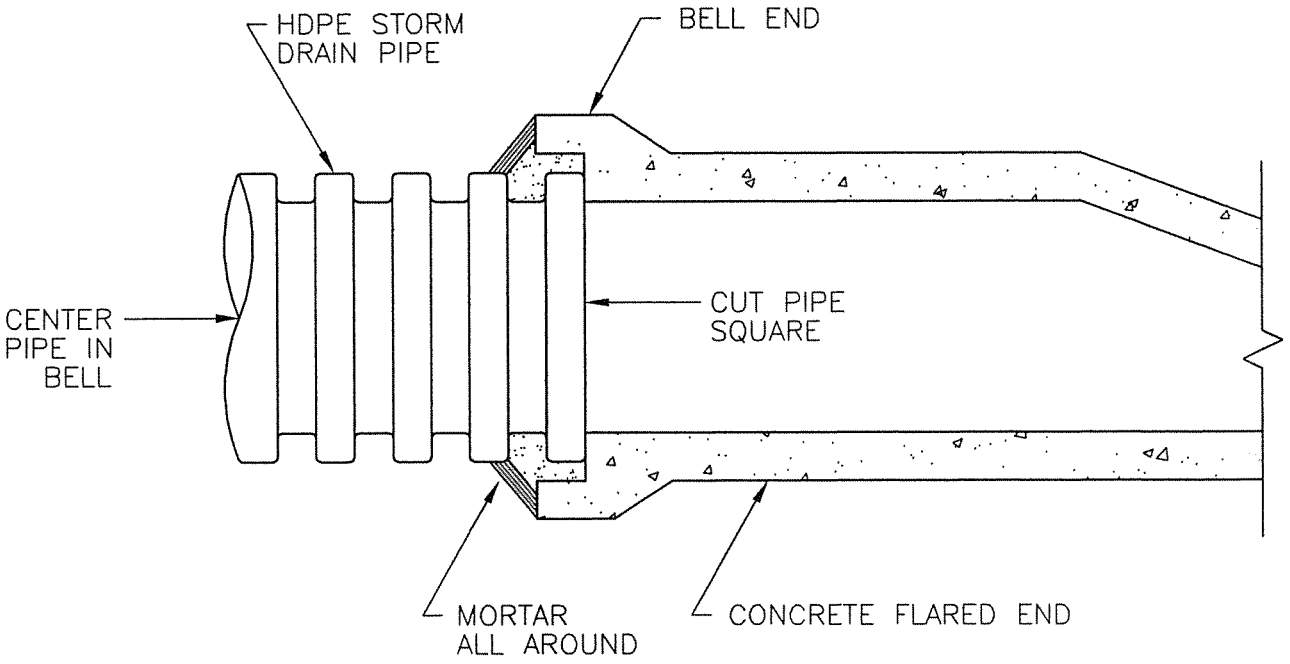
DIMENSION TABLE						
DIA.	A	B	C	D	E	R
15"	6"	2'–3"	3'–10"	2'–6"	2 1/4"	11"
18"	9"	2'–3"	3'–10"	3'–0"	2 1/2"	12"
24"	9 1/2"	3'-7 1/2"	2'–6"	4'–0"	3"	14"
30"	12"	4'–6"	1'-7 3/4"	5'–0"	3 1/2"	15"
36"	15"	5'–3"	2'-10 3/4"	6'–0"	4"	20"
42"	21"	5'–3"	2'–11"	6'–6"	4 1/2"	22"
48"	24"	6'–0"	2'–2"	7'–0"	5"	22"
54"	27"	5'–5"	2'–11"	7'–6"	5 1/2"	24"
60"	30"	5'–0"	3'–3"	8'–0"	6"	24"

NOTE:

1. CULVERT END (FLARED END) SECTIONS SHALL CONFORM TO CONNECTICUT DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATION FORM 814A SECTION: M.08.01–22.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	FLARED END	DWG NO. RDS–316



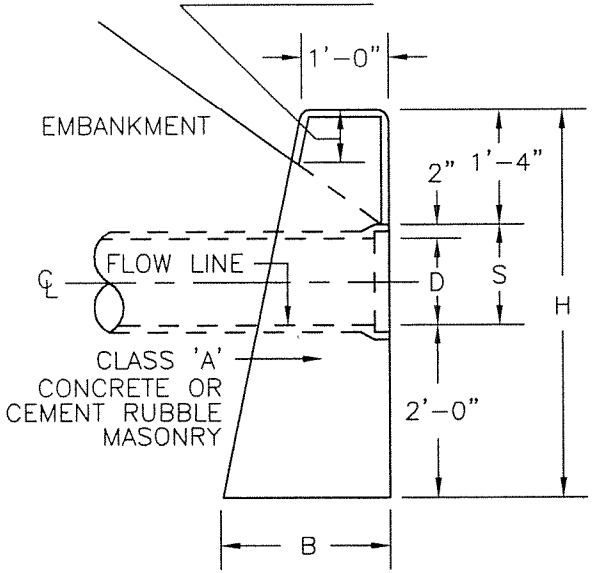
NOTE:

1. WHEN USING HDPE PIPE, CONCRETE FLARED ENDS MUST BE USED. HDPE FLARED ENDS WILL NOT BE ALLOWED.
2. FLARED END SHALL CONFORM TO DWG. NO. RDS-314.

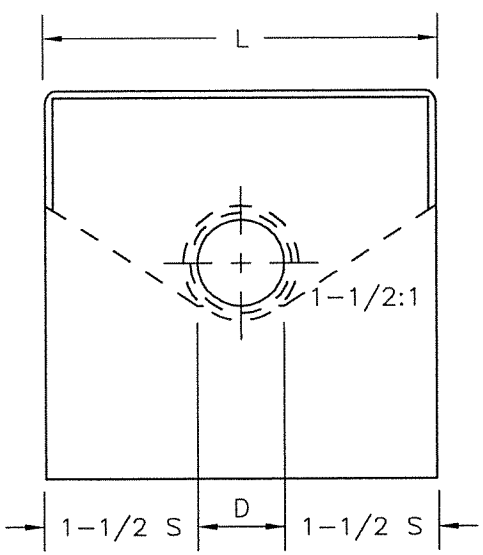
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
		HDPE PIPE FLARED END	DWG NO. RDS-317
DATE	REVISION		

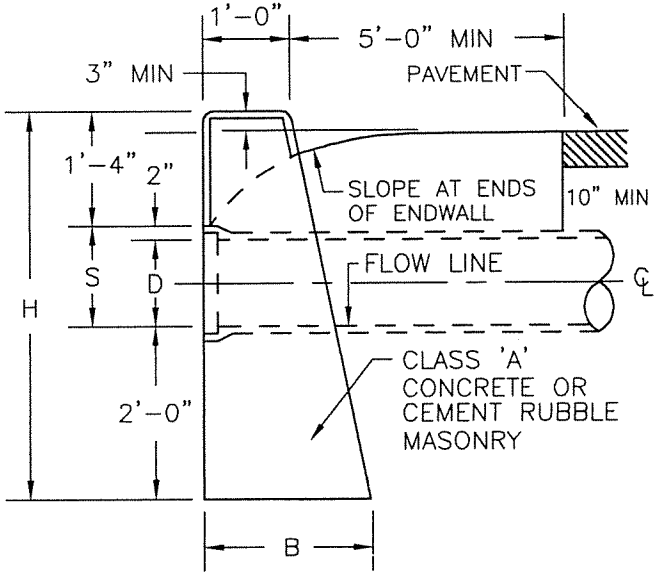
EXPOSED HEIGHT OF BACK OF WALL ABOVE SLOPE TO BE –
7" FOR SLOPE OF 1–1/2":1 & 4:1
9" FOR SLOPE OF 2:1



WALL AT FOOT OF SLOPE



FRONT ELEVATION



WALL AT SHOULDER

All edges of exposed surfaces shall be chamferred one inch.

DIMENSIONS & QUANTITIES FOR ONE END WALL BASED ON S = D + 2"						
D	S	H	L	BATTER	B	VOL.
in.	ft. & in.	ft. & in.	ft. & in.	in./ft.	ft. & in.	cu. yds.
12	1'–2"	4'–6"	4'–6"	2 1/2"	1'-11 1/4"	1.10
15	1'–5"	4'–9"	5'–6"	2 1/2"	1'-11 5/8"	1.45
18	1'–8"	5'–0"	6'–6"	2 1/2"	2'-0 1/2"	1.83
21	1'–11"	5'–3"	7'–6"	2 1/2"	2'-1 1/8"	2.26
24	2'–2"	5'–6"	8'–6"	2 1/2"	2'-1 3/4"	2.72
30	2'–8"	6'–0"	10'–6"	2 1/2"	2'–3"	3.79
36	3'–2"	6'–6"	12'–6"	3"	2'-7 1/2"	5.45
42	3'–8"	7'–0"	14'–6"	3"	2'–9"	6.40*
48	4'–2"	7'–6"	16'–6"	3"	2'-10 1/2"	8.00*

* – VOLUME OF PIPE WITHIN ENDWALL HAS BEEN DEDUCTED.

H = TOTAL HEIGHT OF ENDWALL
B = BASE
D = INSIDE DIAMETER OF PIPE
S = HEIGHT OF SLOPE ABOVE FLOW LINE AT FACE OF WALL – MINIMUM = D + 2"
L = LENGTH OF WALL = 3S + D

WHEN ONE ENDWALL IS TO BE USED FOR TWO PIPES, THE DIMENSIONS OF THAT ENDWALL SHALL CONFORM TO THOSE REQ'D FOR THE LARGER PIPE, EXCEPT THE DIMEN. "L" SHALL BE INCREASED BY THE OUTSIDE DIAMETER OF THE SMALLER PIPE PLUS TWO FEET.

DATE | REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

TYPE I ENDWALL

DWN BY: GMJ
APD BY: [signature]
DATE: 3/22/99
DWG NO. RDS–318

NOT TO SCALE

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

TYPE II ENDWALL

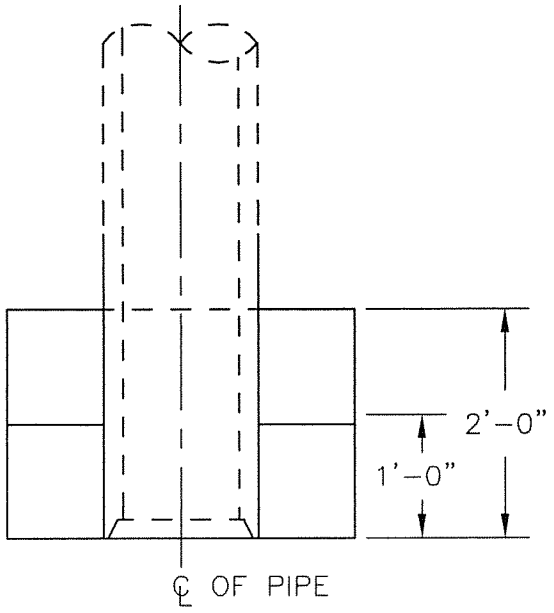
DWN BY: GMJ

APD BY: [signature]

DATE: 3/22/99

DWG NO. RDS-319

NOT TO SCALE



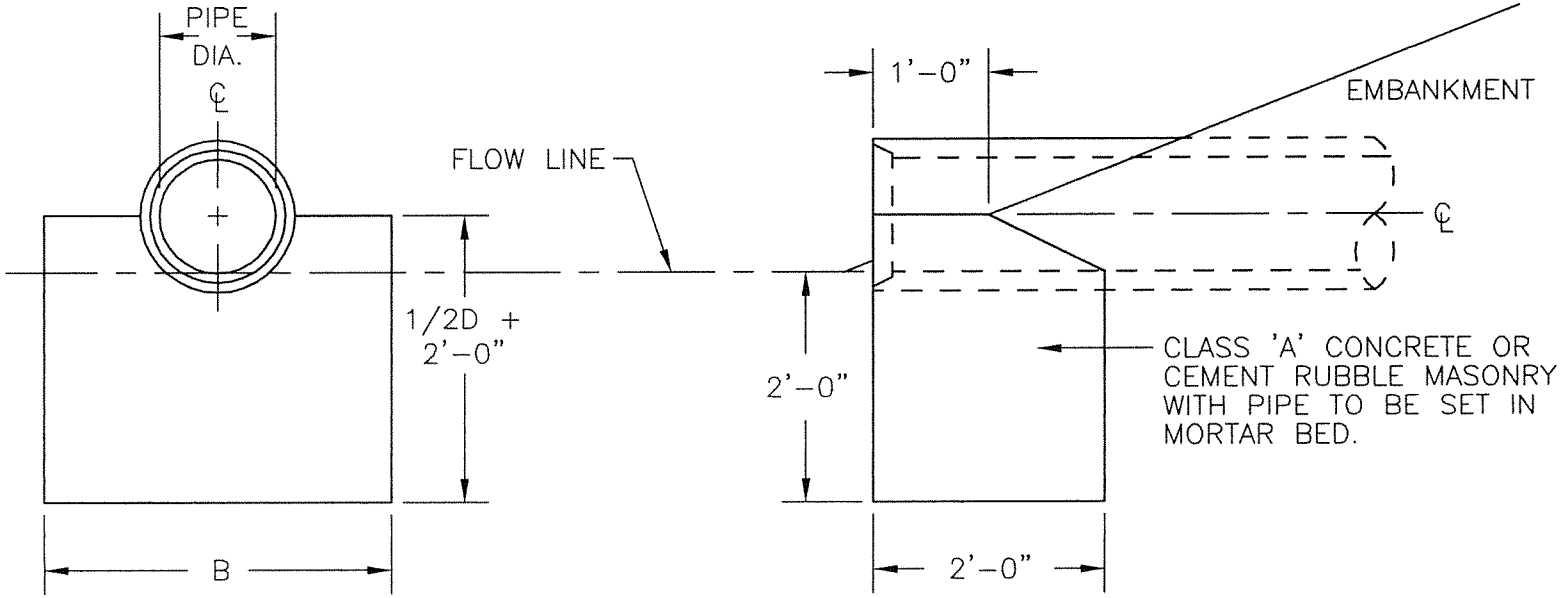
PLAN

TABULATION		
D	B	VOLUME OF ENDWALL
IN.	FT. & IN.	CU. YDS.
12	3'-0"	0.49
15	3'-9"	0.63
18	4'-6"	0.77
21	5'-3"	0.95
24	6'-0"	1.09
30	7'-6"	1.35
36	8'-0"	1.55
42	8'-6"	1.69
48	9'-0"	1.82
54	9'-6"	1.95
60	10'-0"	2.08
72	11'-0"	2.34

NOTE:

WHEN ONE ENDWALL IS TO BE USED FOR TWO PIPES, THE DIMENSIONS OF THAT ENDWALL SHALL CONFORM TO THOSE REQUIRED FOR THE LARGER PIPE, EXCEPT THE DIMENSION 'B' SHALL BE INCREASED BY THE OUTSIDE DIAMETER OF THE SMALLER PIPE PLUS TWO FEET.

D = DIAMETER OF PIPE



FRONT ELEVATION

SIDE ELEVATION

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

TYPE III ENDWALL

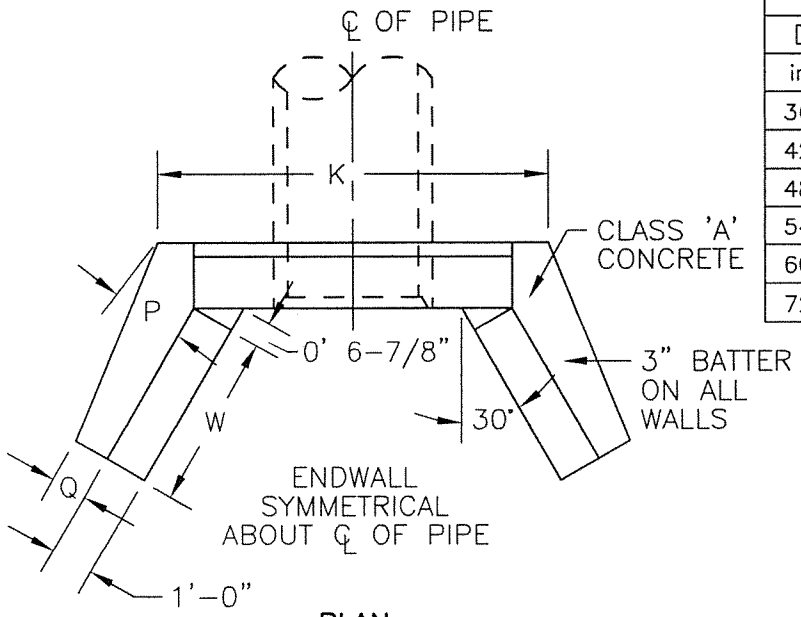
DWN BY: GMJ

APD BY: *GMJ*

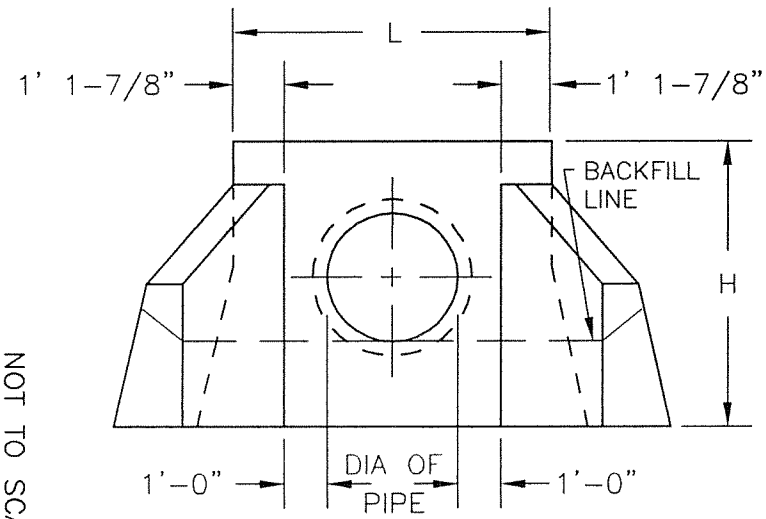
DATE: 3/22/99

DWG NO. RDS-320

NOT TO SCALE



PLAN

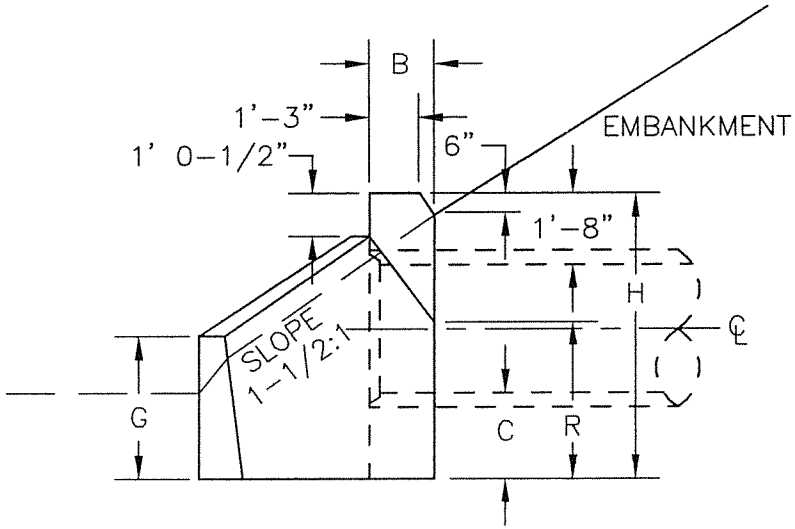


FRONT ELEVATION

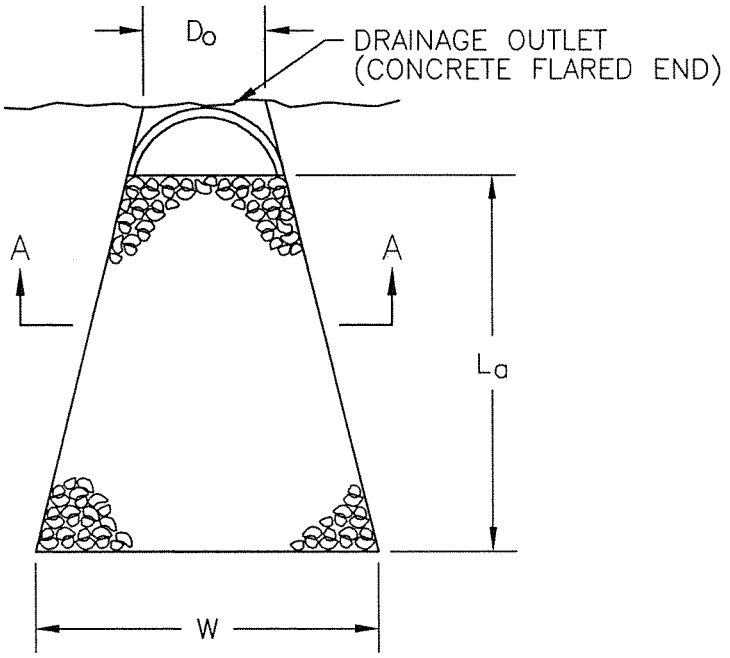
DIMENSIONS & QUANTITIES FOR ONE WING TYPE ENDWALL											
D	B	C	G	H	K	L	P	Q	R	W	VOL.
in	ft & in	ft & in	ft & in	ft & in	ft & in	ft & in	ft & in	ft & in	ft & in	ft & in	cu yds
36"	1'-6"	2'-0"	3'-3"	6'-8"	9'-1 1/2"	7'-3 3/4"	1'-4 7/8"	0'-9 3/4"	3'-4 7/8"	4'-1 3/8"	5.17
42"	1'-6"	2'-0"	3'-3"	7'-2"	9'-10 1/2"	7'-9 3/4"	1'-6 3/8"	0'-9 3/4"	3'-10 1/2"	4'-11 3/4"	5.75
48"	1'-7"	2'-6"	3'-9"	8'-2"	10'-10"	8'-3 3/4"	1'-9 3/8"	0'-11 1/4"	4'-9"	5'-10"	7.78
54"	1'-7"	2'-6"	3'-9"	8'-8"	11'-7 1/2"	8'-9 3/4"	1'-10 7/8"	0'-11 1/4"	5'-3"	6'-8 1/2"	8.51
60"	1'-7"	2'-6"	3'-9"	9'-2"	12'-4 1/2"	9'-3 3/4"	2'-0 3/8"	0'-11 1/4"	5'-9"	7'-7"	10.46
72"	1'-7"	2'-6"	3'-9"	10'-2"	13'-10 3/4"	10'-3 3/4"	2'-3 3/8"	0'-11 1/4"	6'-9"	9'-3 3/4"	13.56

NOTES:

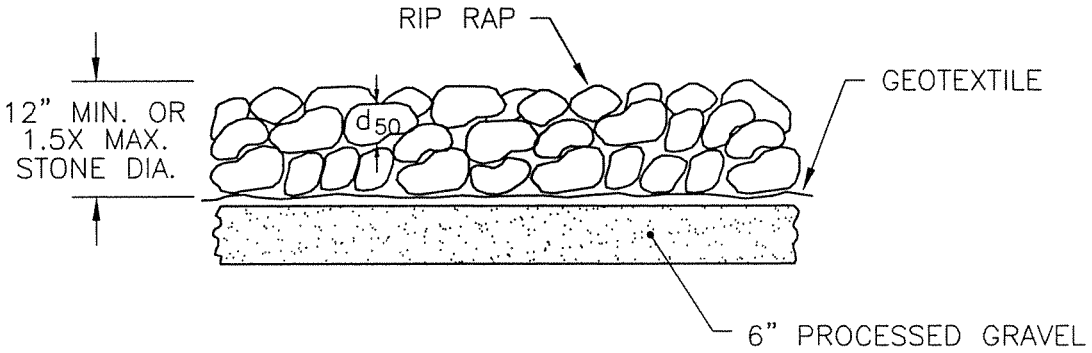
1. WHEN ONE END WALL IS TO BE USED FOR TWO PIPES, THE DIMENSIONS OF THE ENDWALL SHALL CONFORM TO THOSE REQ'D. FOR THE LARGER PIPE, EXCEPT THE DIMENSION "L" SHALL BE INCREASED BY THE OUTSIDE DIAMETER OF THE SMALLER PIPE PLUS TWO FEET.
2. ALL EDGES OF EXPOSED SURFACES SHALL BE CHAMFERRED ONE INCH.



SIDE ELEVATION



PLAN



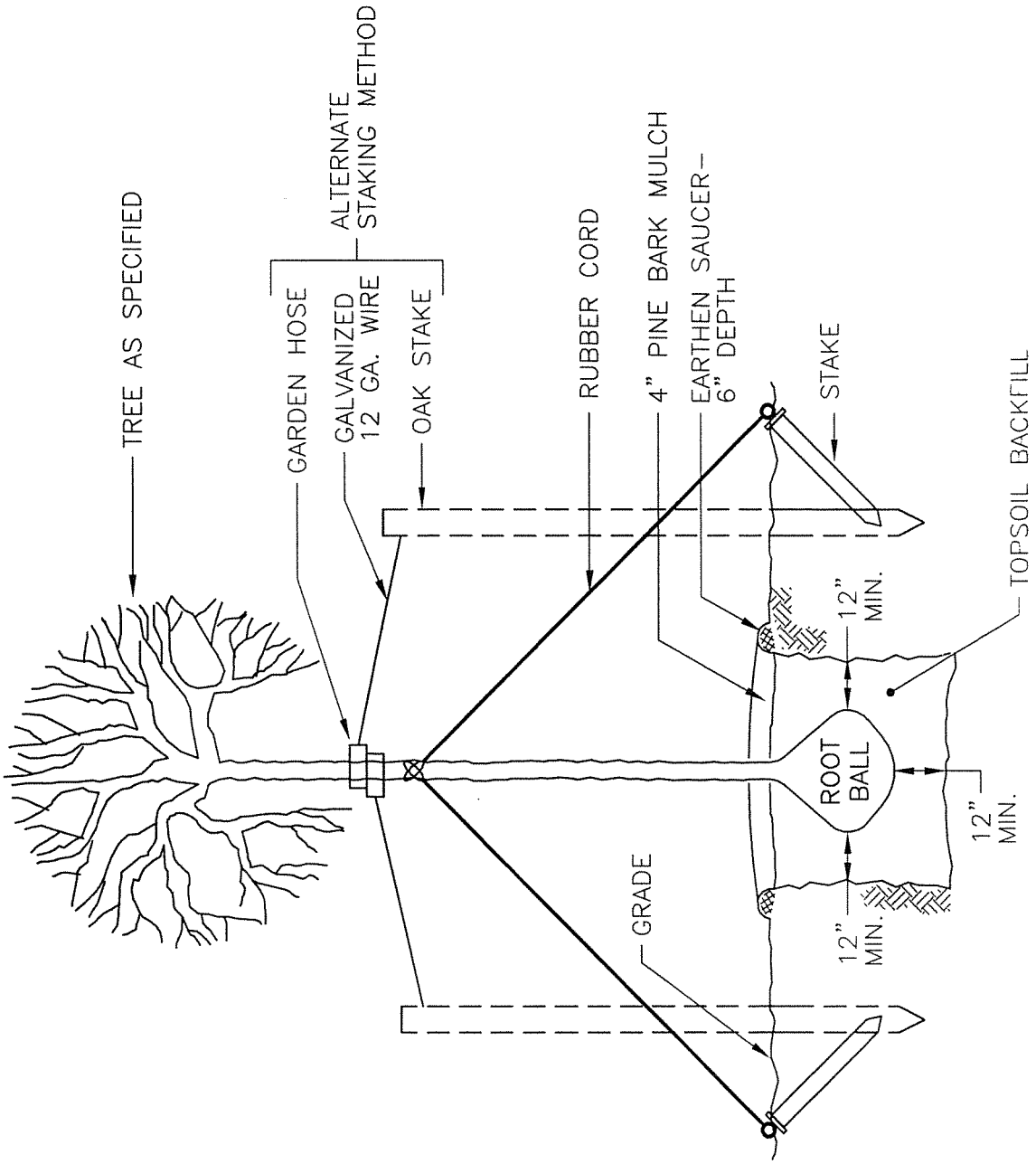
SECTION A–A

NOTES:

1. ALL SIZES SHOWN L_a, W, D_o AND d_{50} SHALL BE CALCULATED USING CONNECTICUT GUIDELINES FOR SOIL EROSION & SEDIMENT CONTROL.
2. FILTER FABRIC SHALL BE MIRAFI 500X, EXXON GTF200, AMOCO 2199 OR APPROVED EQUAL.
3. RIP RAP PROTECTION SHALL BE PLACED AT ALL DRAINAGE INLETS AND OUTLETS.
4. RIP RAP STONE SHALL MEET THE REQUIREMENTS OF CONNECTICUT D.O.T. STANDARD SPECIFICATION FORM 814A ARTICLE: M.12.02.

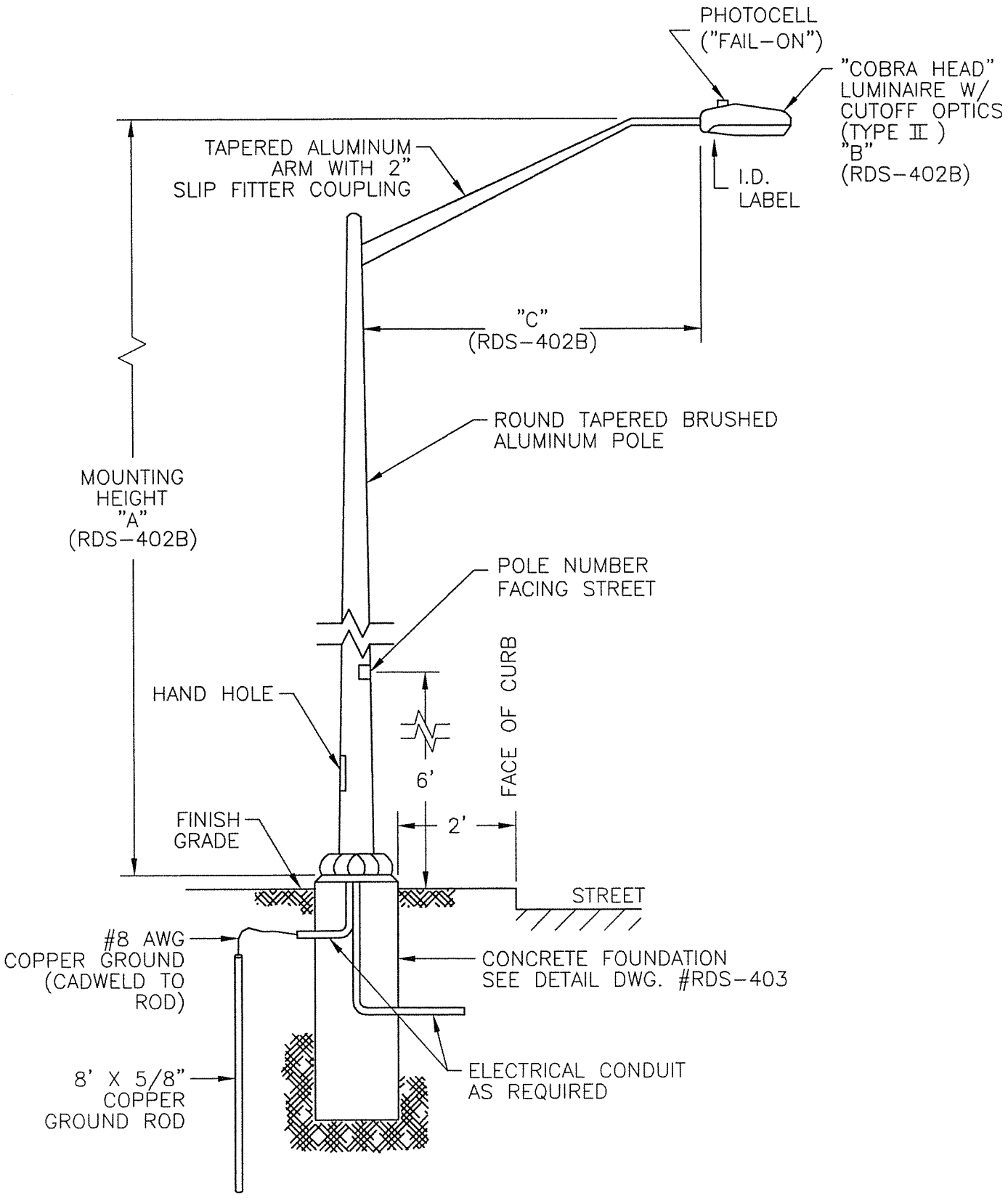
NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
		RIP RAP OUTLET	DWG NO. RDS–321



NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works* ROAD & DRAINAGE STANDARDS TREE PLANTING	DWN BY: GMJ APD BY: GAH DATE: 3/22/99 DWG NO. RDS–401



NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS STREET LIGHT	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-402A

STREET TYPE	MOUNTING HEIGHT "A"	LUMINAIRE "B"			ARM "C"	POLE SPACING	I.D. LABEL	
		WATTS	LUMEN	TYPE*			NUMERAL	BACKGROUND COLOR
COLLECTOR	30'	150	16,000	HPS	6'	200'	15	GOLD
RESIDENTIAL ACCESS	25'	100	9,500	HPS	6'	200'	10	GOLD
RESIDENTIAL VILLAGE	25'	70	6,300	HPS	6'	225'	7	GOLD
RESIDENTIAL SUB-VILLAGE	20'	50	4,000	HPS	4'	175'	5	GOLD

*HPS = HIGH PRESSURE SODIUM

NOTE:

1. LUMINAIRE SHALL HAVE CUTOFF OPTICS SUCH AS GE MODEL M-250R2.

NOT TO SCALE

DATE | REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS

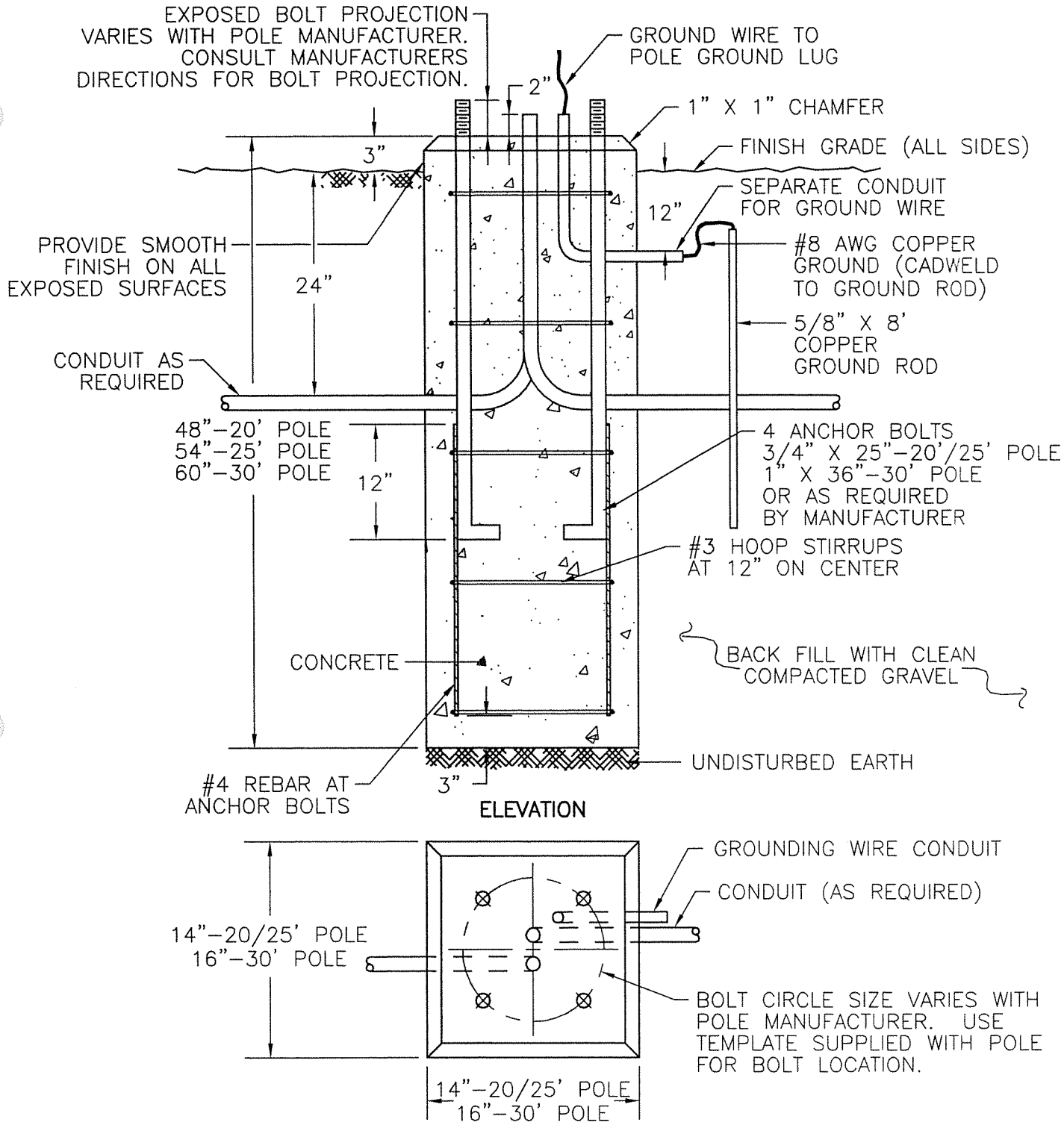
STREET LIGHT TABLE

DWN BY: GMJ

APD BY: GMJ

DATE: 3/22/99

DWG NO. RDS-402B



NOTES:

1. AFTER PLUMBING POLE, INSTALL NON–SHRINK GROUT BETWEEN POLE ANCHOR BASE AND TOP OF FOOTING. PROVIDE WEEP HOLE FOR MOISTURE TO DRAIN.
2. FOOTING SIZES SHOWN ARE MINIMUM. A LICENSED PROFESSIONAL ENGINEER SHALL VERIFY SIZE BASED ON SOIL CONDITIONS, WIND CONDITIONS, AND POLE AND LUMINAIRE SIZE AND WEIGHT.
3. PRECAST FOOTINGS MAY BE USED WITH APPROVAL BY THE TOWN.

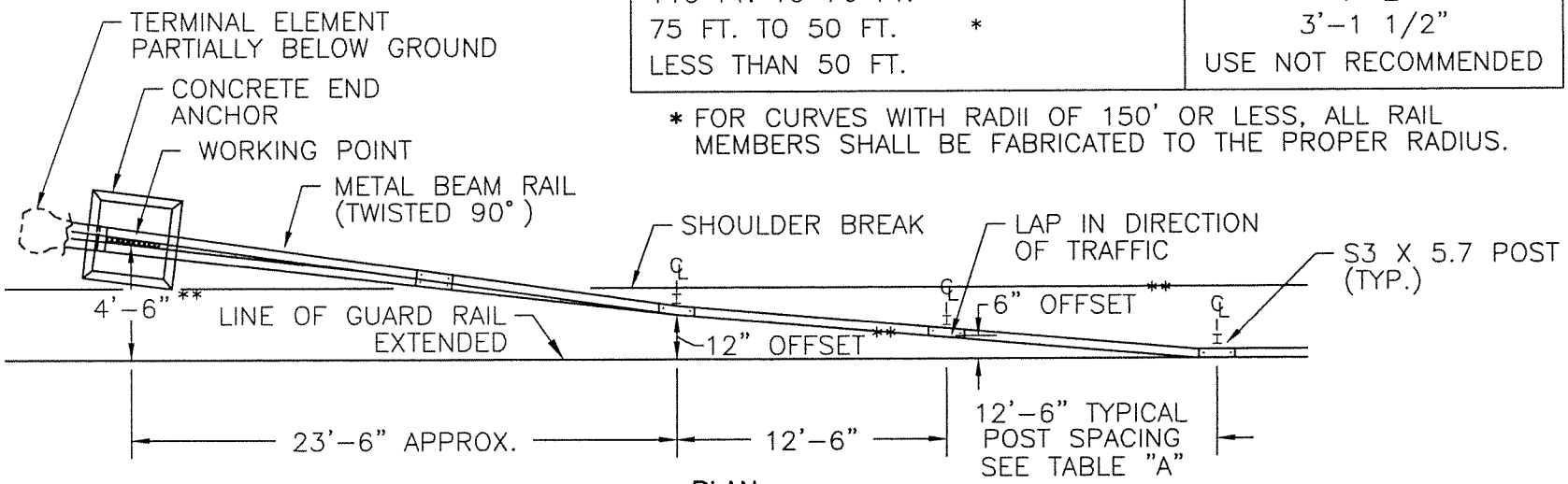
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	STREET LIGHT FOOTING	DWG NO. RDS–403

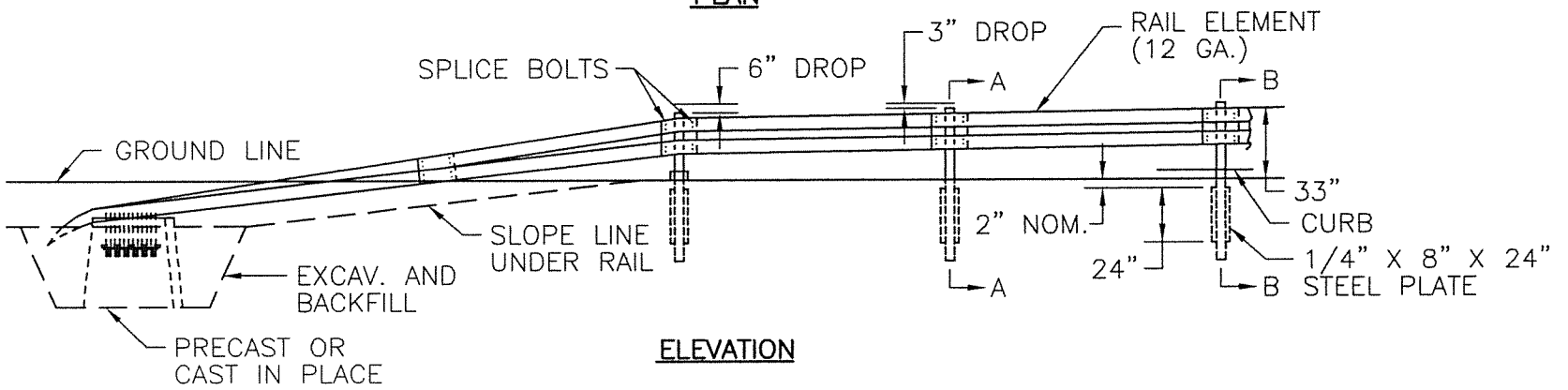
DATE	REVISION

TABLE "A"	
CURVATURE (DEGREE OR RADIUS)	POST SPACING
LESS THAN 26° (220' RAD OR MORE)	12'–6"
219 FT. TO 111 FT. *	6'–3"
110 FT. TO 76 FT. *	4'–2"
75 FT. TO 50 FT. *	3'–1 1/2"
LESS THAN 50 FT.	USE NOT RECOMMENDED

* FOR CURVES WITH RADII OF 150' OR LESS, ALL RAIL MEMBERS SHALL BE FABRICATED TO THE PROPER RADIUS.



PLAN



ELEVATION

NOT TO SCALE

NOTES:

1. CONCRETE END ANCHOR AND ALL RAIL COMPONENTS ARE DETAILED ON, AND SHALL CONFORM TO, CONNECTICUT D.O.T. DWG. 910–C.
2. ALL RAILS, POSTS AND COMPONENTS SHALL BE GALVANIZED.
3. TYPE I END ANCHORAGE SHOWN. TYPE II END ANCHORAGE (RDS–406) MAY BE USED WHERE NECESSARY.

** OFFSET DIMENSIONS AS SHOWN FOR R–I END ANCHORAGE TYPE I APPLY TO TRAILING END. LOCATION OF LEADING END ANCHORAGE AS DIRECTED.

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS
METAL BEAM RAIL
TYPE 'RI'

DWN BY: GMJ
APD BY: GMJ
DATE: 3/22/99
DWG NO. RDS–404A

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS
METAL BEAM RAIL
TYPE 'RI'

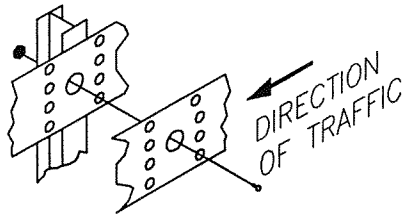
DWN BY: GMJ

APD BY: GMJ

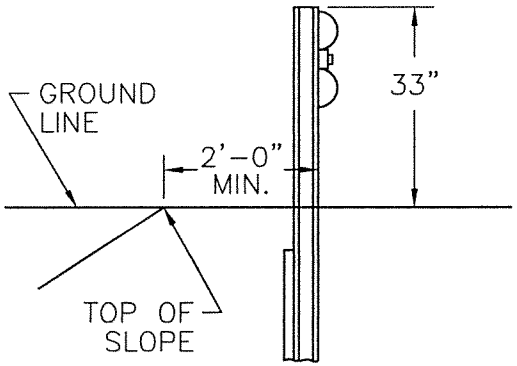
DATE: 3/22/99

DWG NO. RDS-404B

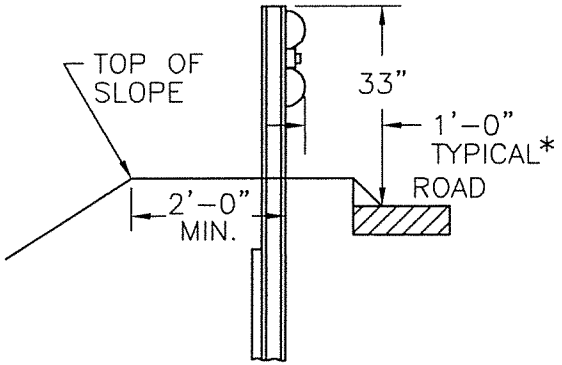
NOT TO SCALE



LAP RAIL SECTIONS
IN DIRECTION
OF TRAFFIC



SECTION A–A
NORMAL HEIGHT

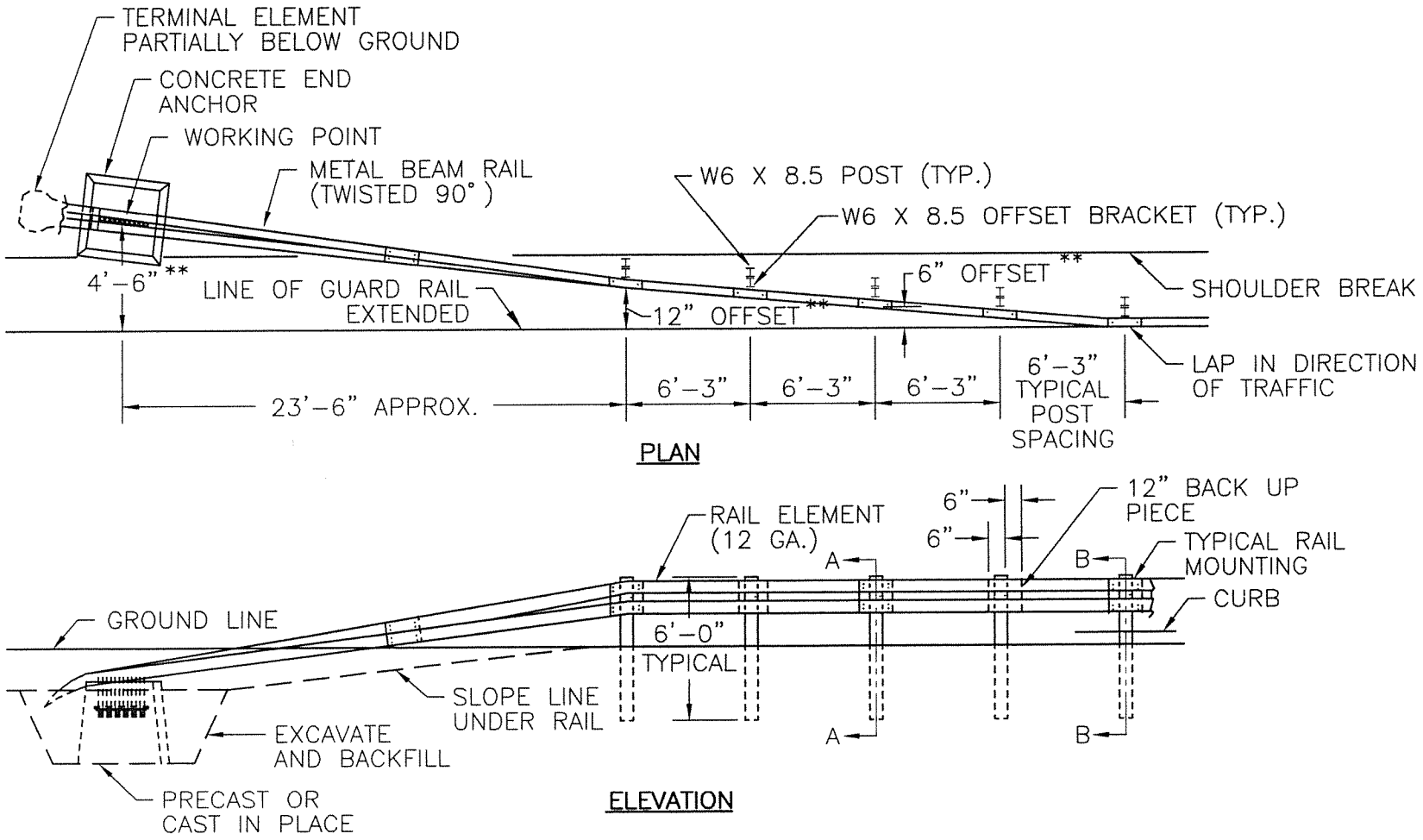


SECTION B–B
HEIGHT WITH CURBING

NOTE:

* WHERE THIS DIMENSION IS LESS THAN 2'–0" THE HEIGHT WILL BE MEASURED FROM THE GUTTER LINE (AS SHOWN) AND WHERE IT IS GREATER THAN 2'–0" THE NORMAL 33" HEIGHT WILL BE MEASURED FROM THE GROUND LINE (SECTION A–A).

DATE	REVISION



NOTES:

1. CONCRETE END ANCHOR AND ALL RAIL COMPONENTS ARE DETAILED ON, AND SHALL CONFORM TO, CONNECTICUT D.O.T. DWG. 910-C.
2. BACK UP PIECES TO BE CLASS A (12 GA.) FOR ALL RAIL, AND TO BE PLACED BEHIND RAIL ELEMENTS AT NON-SPLICE POSTS.
3. FOR CURVES WITH RADII OF 150' OR LESS ALL RAIL MEMBERS SHALL BE FABRICATED TO THE PROPER RADIUS.
4. STRUCTURAL SHAPE W6 X 9 MAY BE USED IN PLACE OF W6 X 8.5 FOR POSTS OR BRACKETS.
5. TYPE I END ANCHORAGE SHOWN. TYPE II END ANCHORAGE (RDS-406) MAY BE USED WHERE NECESSARY.
6. ALL RAILS, POSTS AND COMPONENTS SHALL BE GALVANIZED.

** OFFSET DIMENSIONS AS SHOWN FOR R-B END ANCHORAGE TYPE I APPLY TO TRAILING END ONLY. LOCATION OF LEADING END ANCHORAGE AS DIRECTED.

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS
METAL BEAM RAIL
TYPE 'RB'

DWN BY: GMJ
APD BY: GMJ
DATE: 3/22/99
DWG NO. RDS-405A

NOT TO SCALE

DATE	REVISION

Town of Groton
Department of Public Works

ROAD & DRAINAGE STANDARDS
METAL BEAM RAIL
TYPE 'RB'

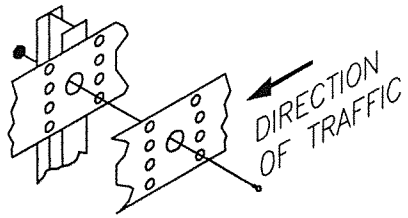
DWN BY: GMJ

APD BY: GMJ

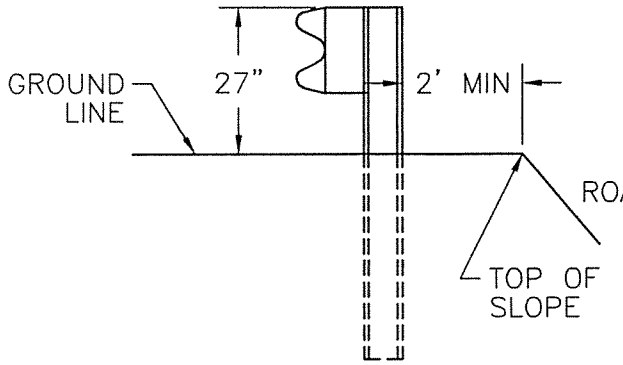
DATE: 3/22/99

DWG NO. RDS-405B

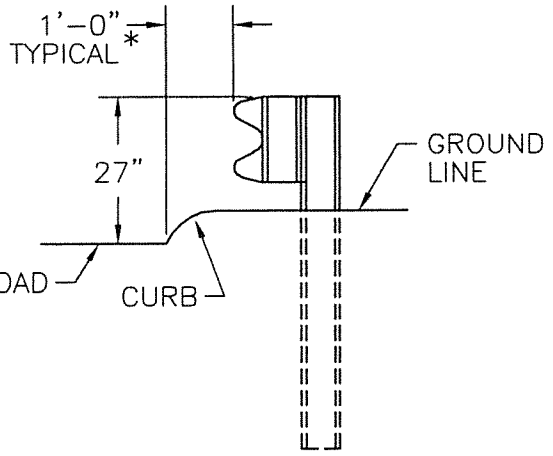
NOT TO SCALE



LAP RAIL SECTIONS
IN DIRECTION
OF TRAFFIC



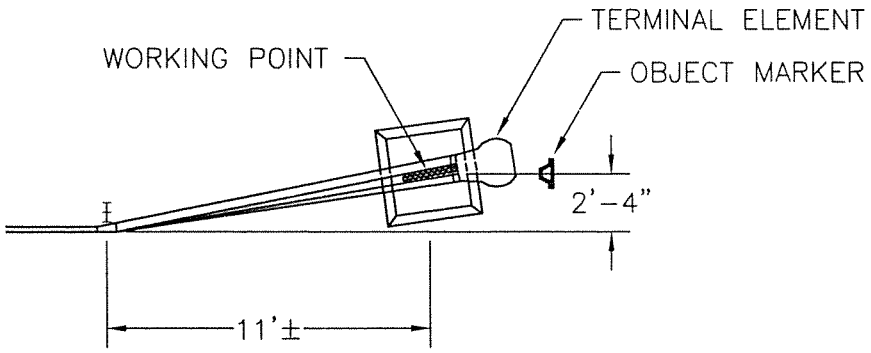
SECTION A–A
NORMAL HEIGHT



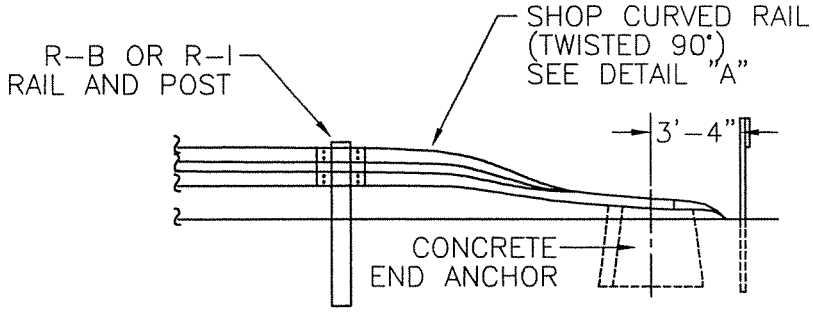
SECTION B–B
HEIGHT WITH CURBING

NOTE:

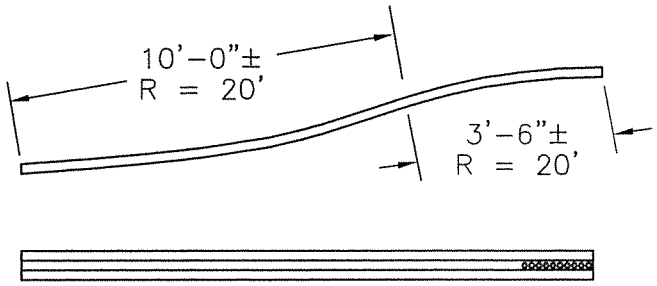
* WHERE THIS DIMENSION IS LESS THAN 2'–0" THE HEIGHT WILL BE MEASURED FROM THE GUTTER LINE (AS SHOWN) AND WHERE IT IS GREATER THAN 2'–0" THE NORMAL 27" HEIGHT WILL BE MEASURED FROM THE GROUND LINE (SECTION A–A).



PLAN



ELEVATION



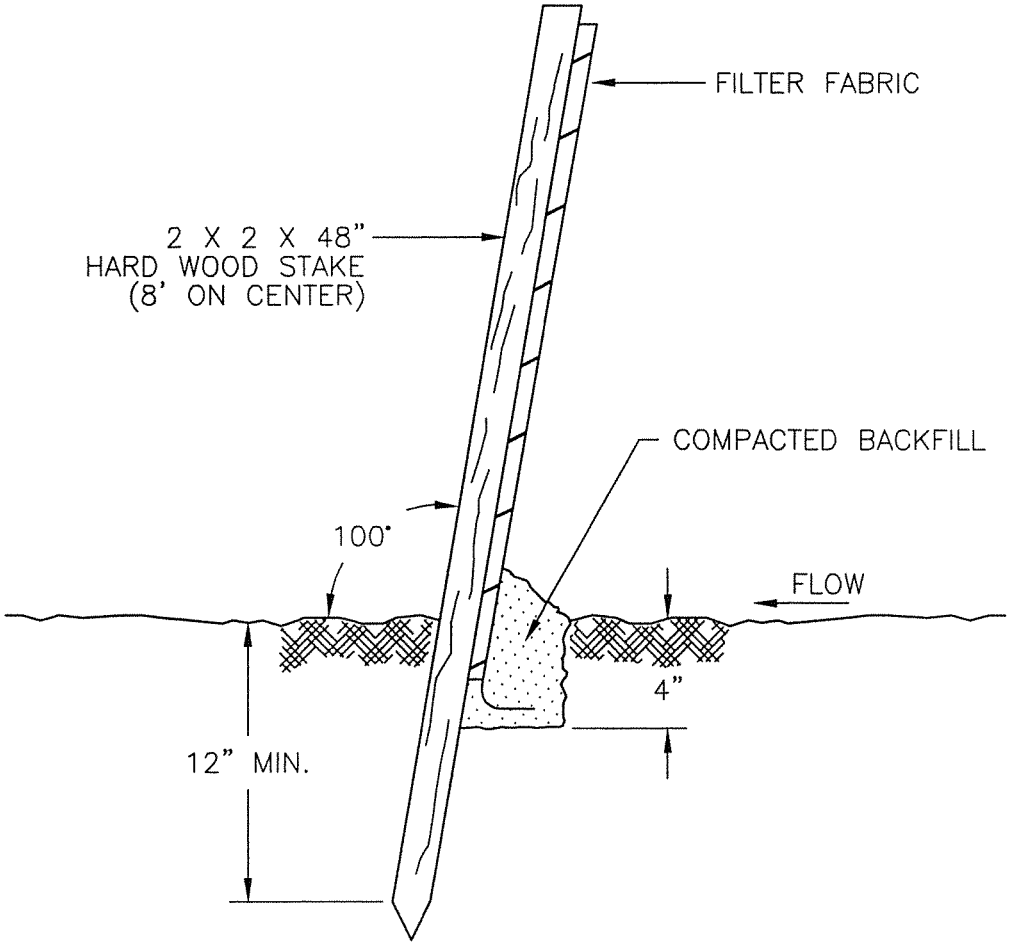
DETAIL "A"
SHOP CURVED RAIL

NOTES:

1. CONCRETE END ANCHOR AND ALL RAIL COMPONENTS ARE DETAILED ON, AND SHALL CONFORM TO, CONNECTICUT D.O.T. DWG. 910-C.
2. END ANCHORAGE TYPE II WILL BE USED ONLY WHERE NARROW OPENINGS ARE REQUIRED ALONG THE GUIDE RAILING ALIGNMENT, SUCH AS DRIVEWAYS.
3. OTHER RADII CONFIGURATIONS WHICH CAN BE DEMONSTRATED TO PROVIDE THE INSTALLATIONS SHOWN IN END ANCHORAGES TYPE II MAY BE APPROVED.

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS METAL BEAM RAIL END ANCHORAGE TYPE II	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-406

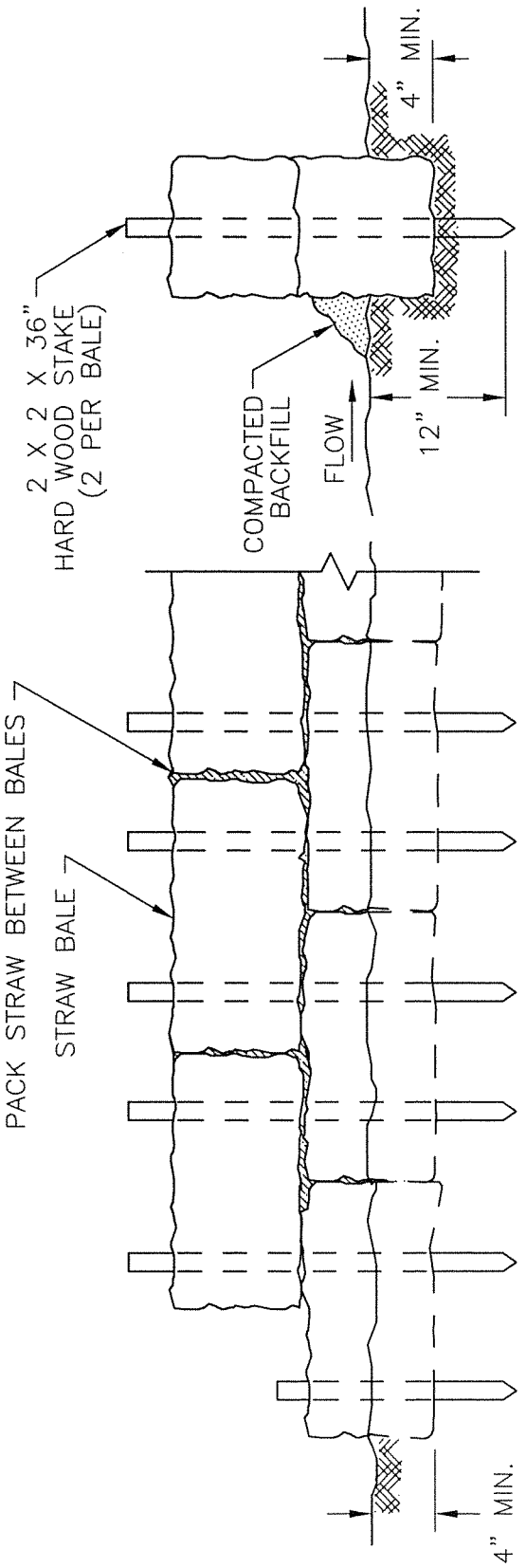


NOTE:

1. FILTER FABRIC SHALL BE MIRAFI "SILT FENCE", EXXON GTF 180, AMOCO 1380, OR APPROVED EQUAL.

NOT TO SCALE

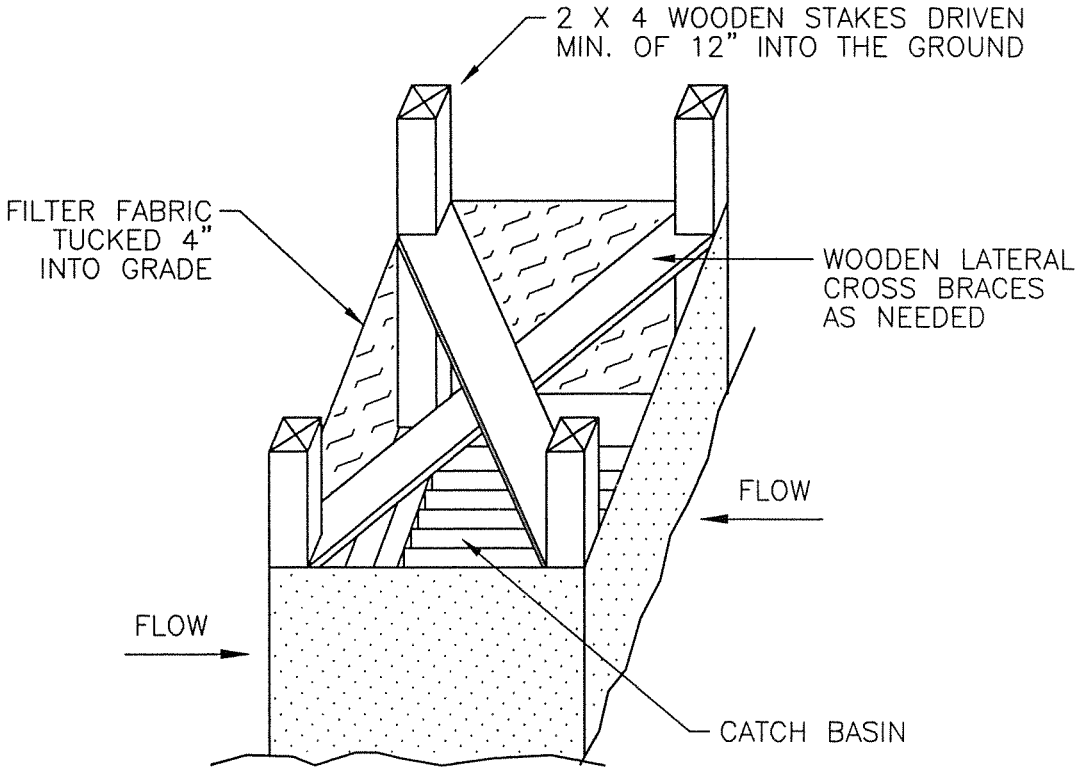
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS SEDIMENT CONTROL FILTER FABRIC BARRIER	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-501



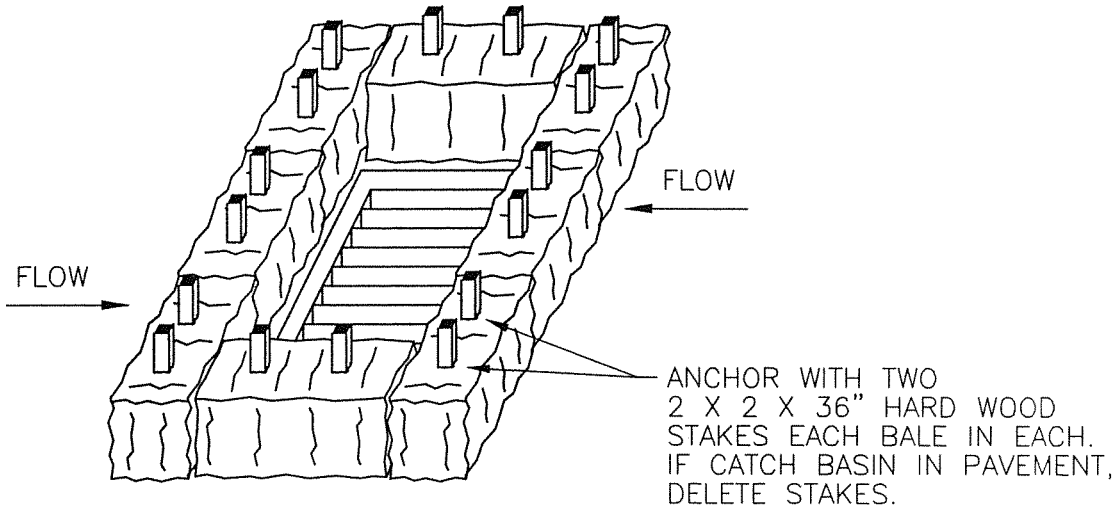
NOTE:
1. USE SINGLE OR DOUBLE BALE HEIGHT AS REQUIRED.

NOT TO SCALE

DATE	REVISION	*Town of Groton* *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS SEDIMENT CONTROL STRAW BALE BARRIER	DATE: 3/22/99
			DWG NO. RDS-502



SILT FENCE INSTALLATION AT
CATCH BASINS



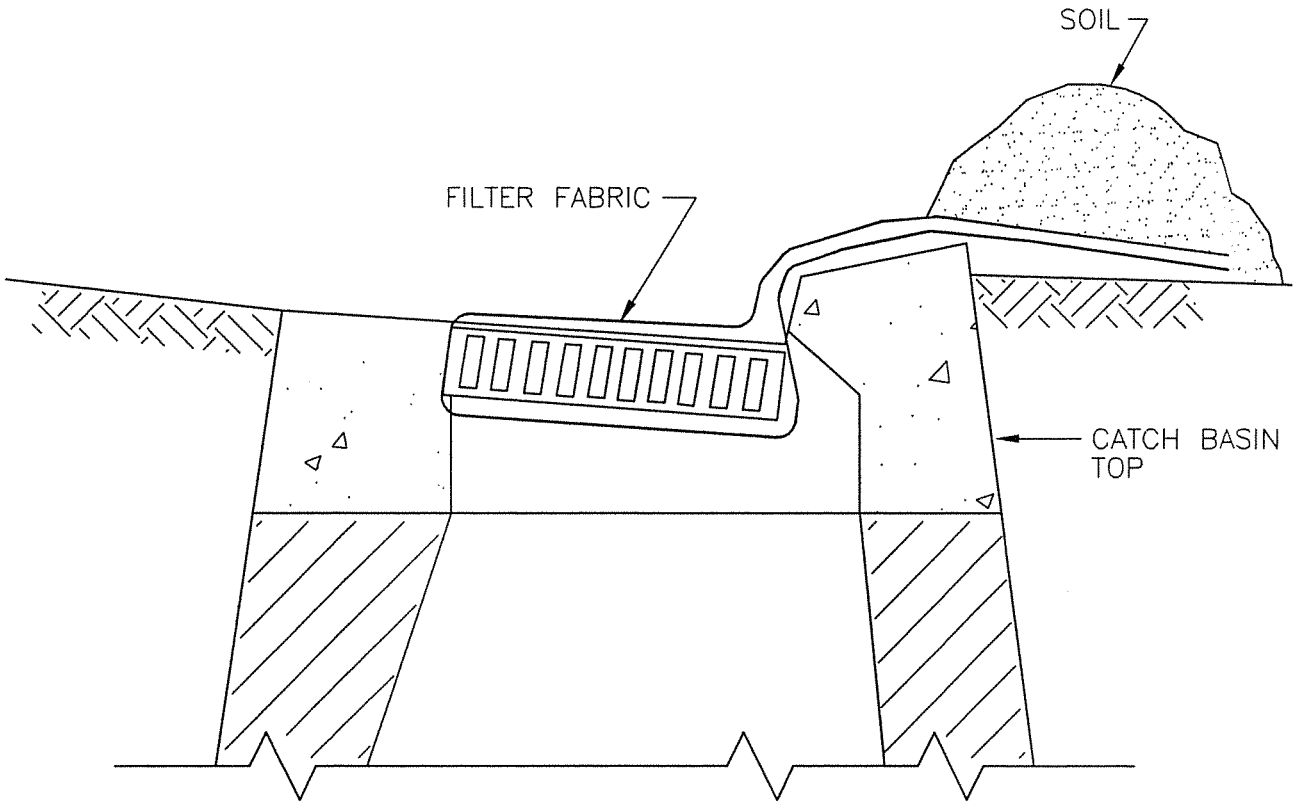
HAY BALE INSTALLATION AT
CATCH BASINS

NOTE:

1. FILTER FABRIC SHALL BE MIRAFI "SILT FENCE", EXXON GTF 180, AMOCO 1380 OR APPROVED EQUAL.

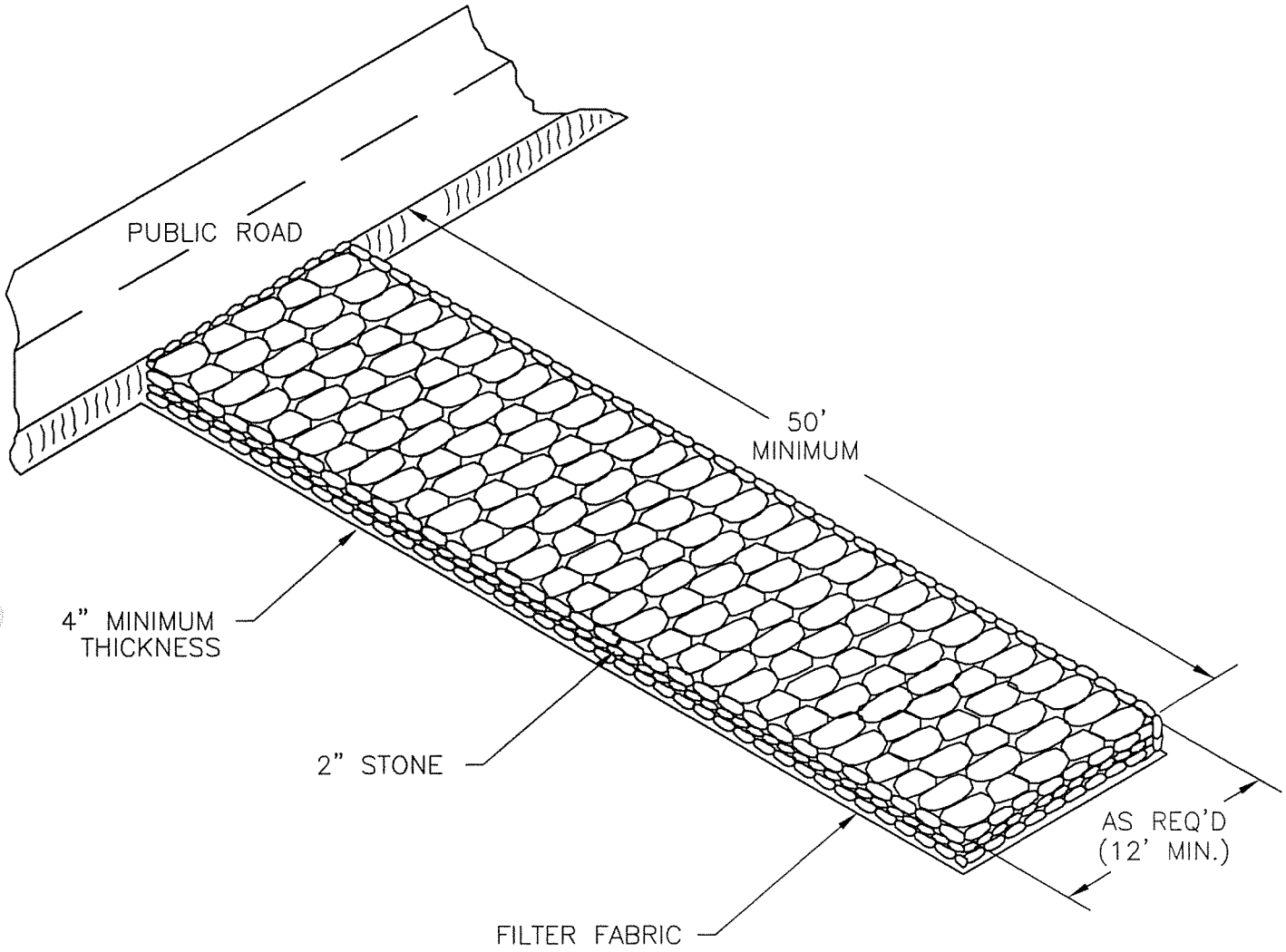
NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	CATCH BASIN BARRIERS	DWG NO. RDS-503A



NOT TO SCALE

		Town of Croton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	CATCH BASIN BARRIERS	DWG NO. RDS-503B



NOTE:

1. FILTER FABRIC SHALL BE MIRAFI 500X, EXXON GTF 200, AMOCO 1199 OR APPROVED EQUAL.

NOT TO SCALE

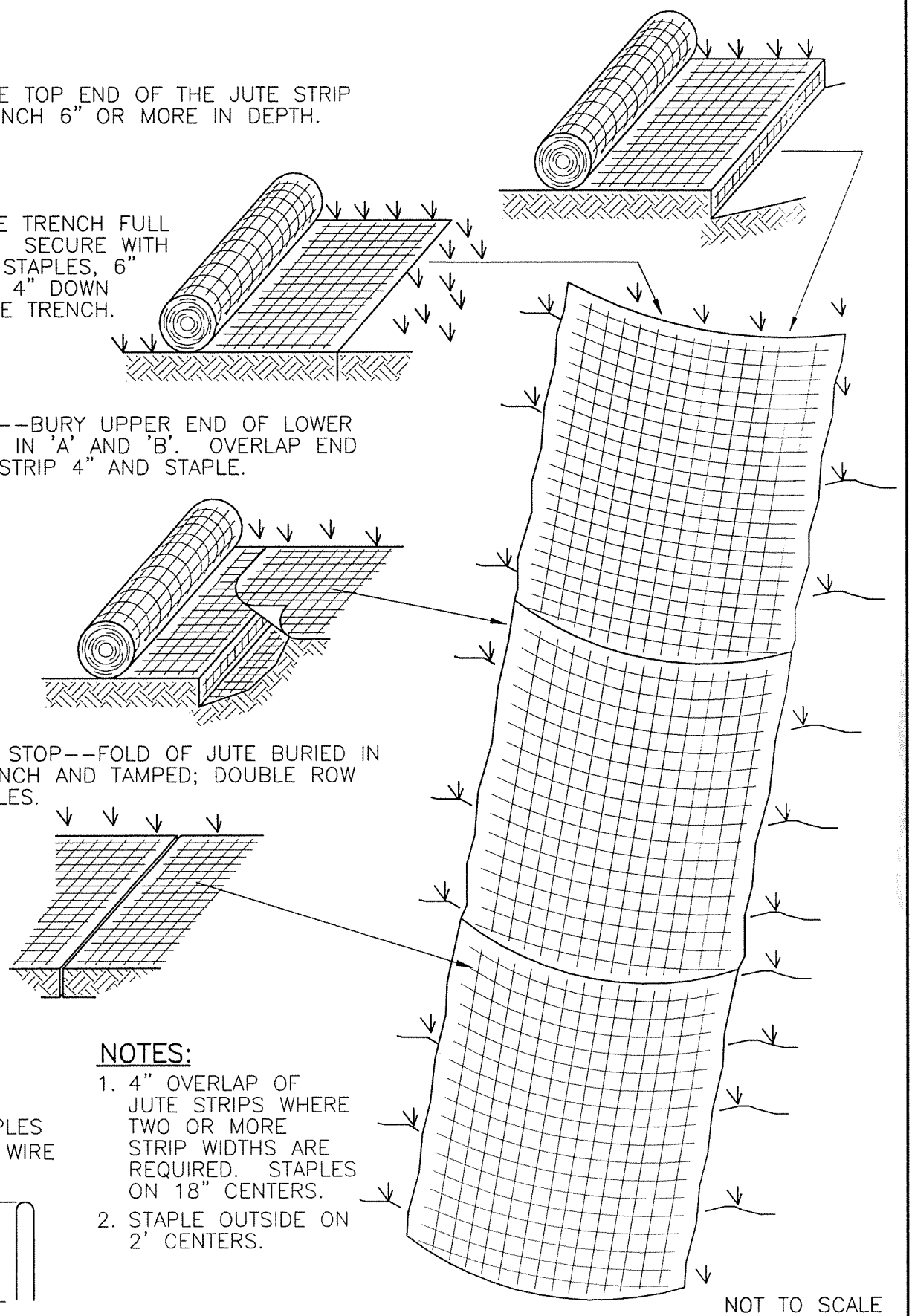
		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMH
		ROAD & DRAINAGE STANDARDS CONSTRUCTION ENTRANCE	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS-504

A. BURY THE TOP END OF THE JUTE STRIP IN A TRENCH 6" OR MORE IN DEPTH.

B. TAMP THE TRENCH FULL OF SOIL. SECURE WITH ROW OF STAPLES, 6" SPACING, 4" DOWN FROM THE TRENCH.

C. OVERLAP--BURY UPPER END OF LOWER STRIP AS IN 'A' AND 'B'. OVERLAP END OF TOP STRIP 4" AND STAPLE.

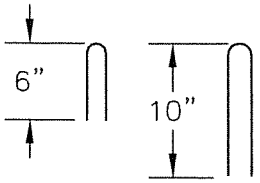
D. EROSION STOP--FOLD OF JUTE BURIED IN SLIT TRENCH AND TAMPED; DOUBLE ROW OF STAPLES.



NOTES:

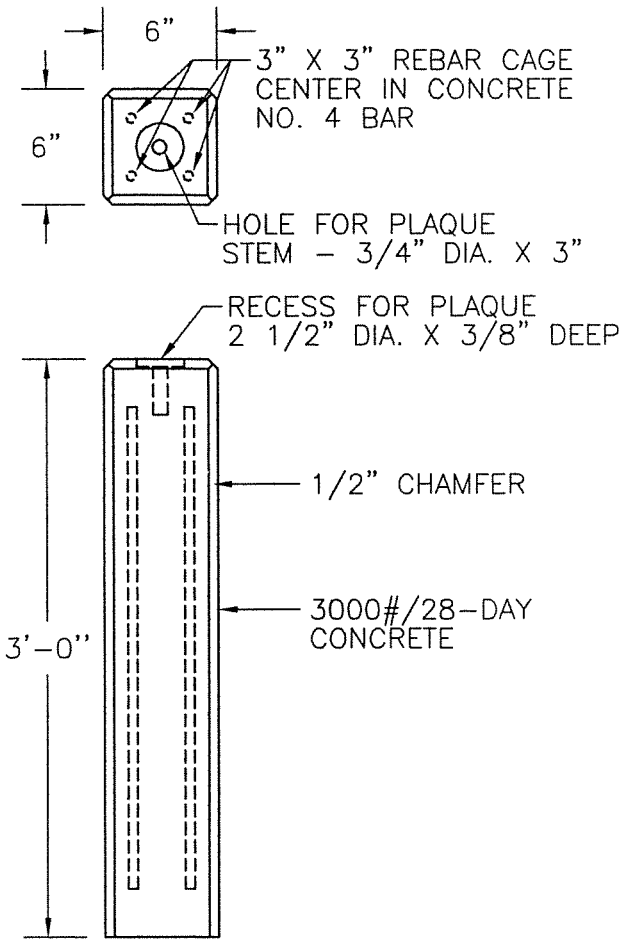
1. 4" OVERLAP OF JUTE STRIPS WHERE TWO OR MORE STRIP WIDTHS ARE REQUIRED. STAPLES ON 18" CENTERS.
2. STAPLE OUTSIDE ON 2' CENTERS.

TYPICAL STAPLES
NO. 8 GAUGE WIRE

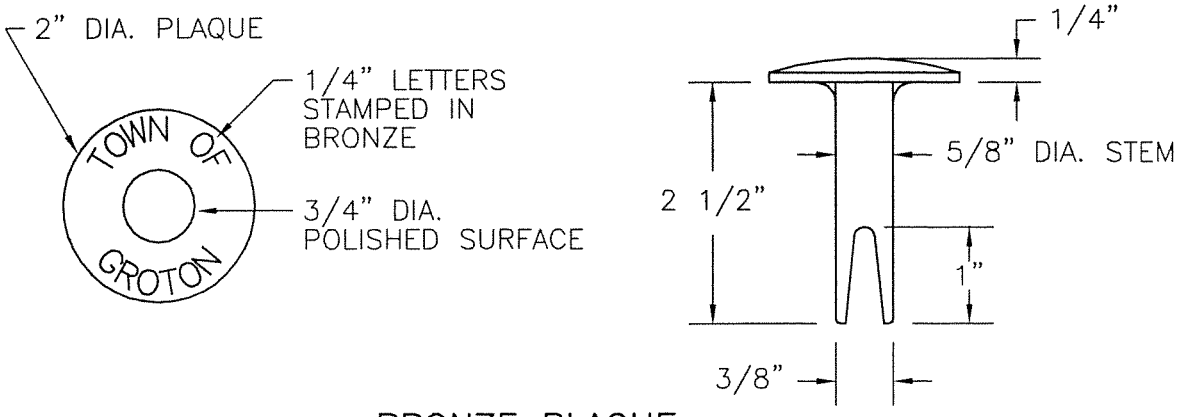


NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GMJ
		ROAD & DRAINAGE STANDARDS	DATE: 3/22/99
DATE	REVISION	INSTALLATION OF JUTE NETTING	DWG NO. RDS-505



CONCRETE MONUMENT



BRONZE PLAQUE

NOT TO SCALE

		Town of Groton *Department of Public Works*	DWN BY: GMJ
			APD BY: GAH
		ROAD & DRAINAGE STANDARDS MONUMENT & PLAQUE	DATE: 3/22/99
DATE	REVISION		DWG NO. RDS–601

SECTION 6
APPENDIX

TOWN OF GROTON
COLLECTOR STREETS

Antonino Road

Bridge Street

Brook Street

Buddington Road

Colonel Ledyard Highway

Cow Hill Road

Crystal Lake Road

Depot Road

Fishtown Road

Flanders Road

Gales Ferry Road

Groton Long Point Road

Gungywamp Road

High Street

Kings Highway

Lambtown Road

Main Street

Marsh Road

Meridian Street

Military Highway

Mosher Avenue

Noank-Ledyard Road

North Pleasant Valley Road

Ocean View Avenue

Poquonnock Road

Pumpkin Hill Road

Sandy Hollow Road

Shewville Road

South Pleasant Valley Road

Terrace Avenue

Thomas Road

Toll Gate Road

Walker Hill Road

West Mystic Avenue

Winding Hollow Road

D/collector streets/mch

Storm Drain Computation Sheet - English

Computed _____ Date _____

Checked _____ Date _____

Project _____

Route _____

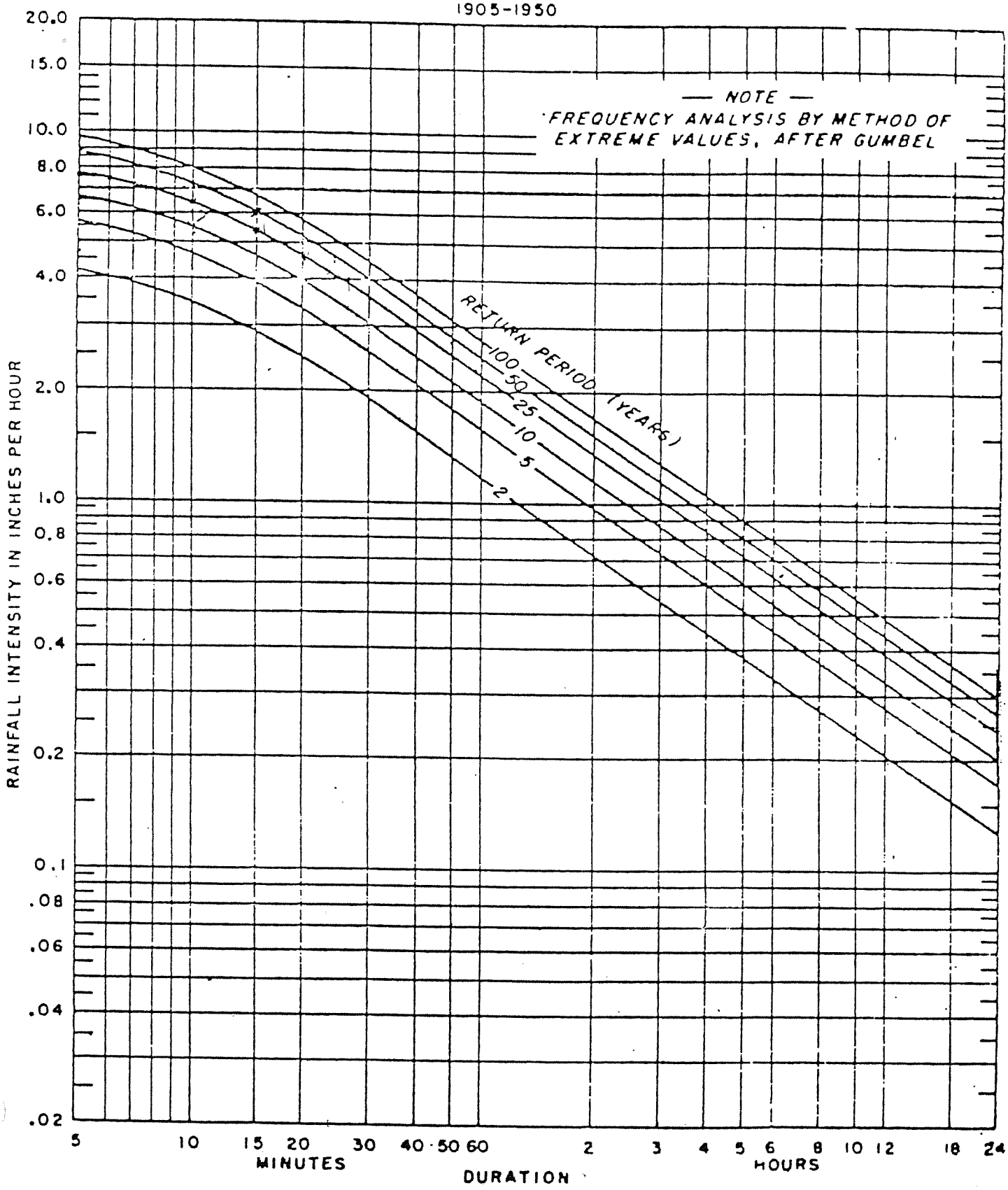
Station _____

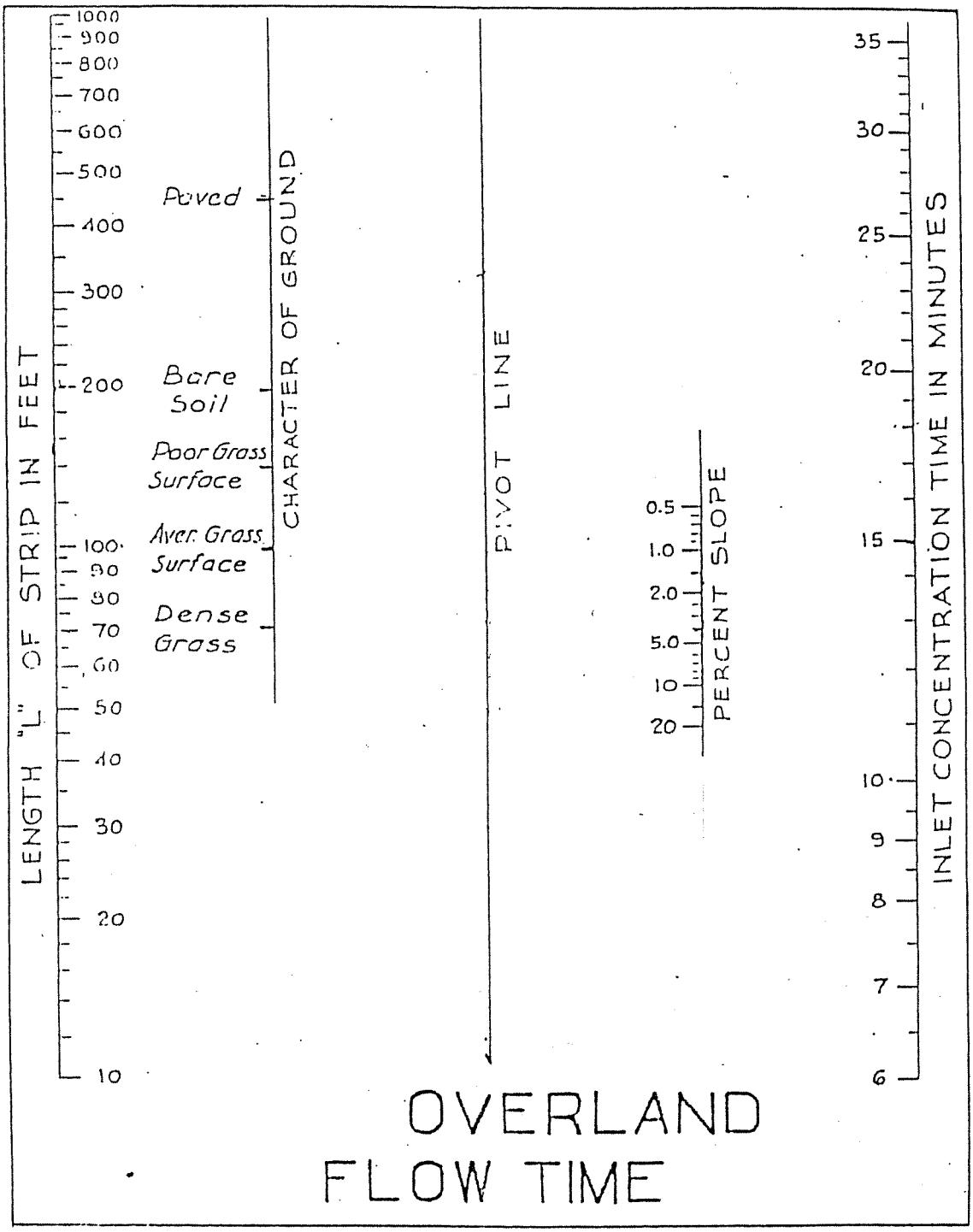
Town _____

Station		Length, L (ft)	Drainage Area, A (acres)		Runnoff Coefficient, C	A x C		Flow Time, T_c (min)		Rainfall Intensity, I (in/hr)	Total Runoff, CIA / 360 = Q (cfs)	Pipe Diameter, D (in)	Capacity Ful,l, Q_F (cfs)	Velocity (fps)		Invert Elevation, (ft)		Manhole Invert Drop (ft)	Slope of Drain, S_o (ft/ft)
From	To		Increment	Total		Increment	Total	To Upper End	In Section					Flowing Full, V_F	Design Flow, V	Upper End	Lower End		

NEW HAVEN, CONNECTICUT

1905-1950





OVERLAND FLOW TIME