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GENERAL SPECIFICATIONS

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FORWARD

The enclosed Standard Construction Details and Specifications are provided to outline the City of Greensburg's minimum criteria for the construction within the corporation limits.

All construction projects which are to become part of the City's system for operation and maintained by the City, shall conform to these standards. Construction drawings and specifications must be approved by the City and a written permit obtained in accordance with existing ordinances before constructions begin. In addition, sanitary sewer projects must be submitted to the Indiana Department of Environmental Management (IDEM) for approval. The City will not approve a sanitary sewer project for construction until an approval from IDEM is received.

Construction observation shall be provided by the City and a minimum of 48 hours notice shall be given prior to starting construction.

These standards were prepared with the intent of obtaining the highest quality of construction possible, consistent with accepted industry practices and specifications. As new materials become available and acceptable, the standards may be revised and updated.

Copies of the standards may be obtained from the City Hall, 314 West Washington Street, Greensburg, Indiana 47240, telephone number 812-663-3344.

SECTION 01001 - GENERAL REQUIREMENTS

1.1 DEFINITIONS

- A. Whenever used in these specifications the following terms have the meanings indicated which are applicable to both the singular and plural thereof:
1. City – The City of Greensburg, represented by the City Council, having the authority of approval of the plans, specifications and acceptance of the final construction.
 2. Engineer – City Engineer or representative to act on behalf of the City.
 3. Owner – Person or firm having control of the development site, and management of the project.
 4. Contractor – The person, firm or corporation with whom the developer has entered into an agreement for construction of the project.
 5. Project – The total construction of which the work to be provided may be the whole or part.
 6. Work – The entire completed construction or the various separately identified parts thereof required to be furnished.

1.2 WORK TO BE PERFORMED

Work to be performed shall be in accordance with drawings and specifications approved by the City.

1.3 LOCAL LABOR AND MATERIALS

- A. Whenever possible, the Contractor, his subcontractors, material men, or others who employ labor, shall employ such labor locally.
- B. The Contractor shall purchase materials such as sand, cement, gravel, pipe, steel, lumber, etc., from local dealers wherever such local dealers' prices meet competitors' and where such materials meet the specifications.

1.4 SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction."

1.5 DISCOVERY OF HAZARDOUS MATERIAL

If, during the course of this work, the existence of hazardous material, including asbestos containing material, is observed in the work area, the Contractor shall immediately notify the Owner in writing. The Contractor shall not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner and the City of Greensburg. Asbestos containing material includes transite pipe.

1.6 EASEMENTS

- A. The Developer will obtain right-of-way easements over and through certain private lands for the construction and rehabilitation. The width or limits of such rights-of-way will be defined by the City before the work or construction shall begin. If the methods of construction employed by the Contractor are such as to require the use of land beyond the limits obtained, he shall make his own agreements with the property owners affected for the use of such additional land.
- B. In all such right-of-way easements, the Contractor shall be required to carefully remove the property owner's fences, or other obstacles to the construction procedure, and replace the same after the work is installed. The backfilling shall be to the grade of the existing ground level or to the grade as established by the property owner in the event the property owner permits the deposit of excess material upon such land.
- C. The cost of all such restoration of property shall be included in this work.

1.7 OPERATIONS WITHIN RIGHT-OF-WAY

In public thoroughfares, all operations of the Contractor, including those of temporary nature, must be confined within the applicable right-of-way limits after having obtained approval of the City. If the methods of the construction employed by the Contractor are such as to require the use of land beyond the public thoroughfares, he shall make his own agreements with the property owners affected for the use of such additional.

1.8 PERMITS

- A. The Developer will obtain permits which relate to the completed facilities. Permits obtained by the Developer include permits from the following:
 - 1. Indiana Department of Environmental Management
 - 2. Department of Natural Resources
 - 3. Corps of Engineers

4. Indiana Department of Fire Prevention & Building Safety
5. Indiana Department of Transportation
6. Railroads
7. Erosion Control Permit

B. The Contractor shall obtain permits which relate to construction procedures.

1. All necessary permits or licenses required from the State or County in connection with construction procedures under or along existing highways shall be obtained by and at the expense of the Contractor. The construction shall be performed by the Contractor in full accordance with any and all requirements of the State Highway Commission or County Road Commission, including those applying to barricades, watchmen, guarding, lighting, storage of supplies, equipment and excavated materials, method of backfilling, final grading, replacement of pavement or road surface, and all other conditions or requirements which may be stipulated by the State Highway Commission or County Road Commission, whether specifically shown on the drawings or mentioned in the specification.
2. The Contractor shall obtain all blasting permits required.

1.9 MAINTAINING TRAFFIC

- A. Before closing any thoroughfare, the Contractor shall notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county, or city.
- B. The Contractor shall notify the City of his intention to close a particular street 72 hours in advance of the proposed closing. The Contractor shall place all proper detour signs and barricades prior to the actual street closing.
- C. During the construction, the Contractor shall be responsible for maintaining and protecting the pedestrian and vehicular traffic at all times on all streets involved and providing access to all residential and commercial establishments adjacent to the construction area. The Contractor shall furnish and maintain signage, barricades, flares, etc., in accordance with Indiana Manual on Uniform Traffic Control Devices. The signage, barricades, etc., must be in good condition.
- D. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Insofar as it is practicable, do not locate excavated material

and spoil banks in such manner as to obstruct traffic. Keep the traveled way of all street, roads, and alleys clear and unobstructed insofar as is possible. Do not use streets, roads, or alleys for the storage of construction materials, equipment supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed, except when and where necessary, and then only upon due advance notice to the Engineer and for the shortest practicable period of time, consistent with efficient and expeditious construction. The Contractor shall be liable for any damage to persons or property resulting from his work.

- E. Streets in which excavation has occurred shall be temporarily restored to receive traffic as soon as possible. Permission to close additional streets shall be denied the Contractor if, in the opinion of the City or the Engineer, the restoration on streets where excavation has occurred has not progressed satisfactorily.

1.10 WALKS AND PASSAGEWAYS

The Contractor, when required, shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise. Do not obstruct the sidewalks, gutters, or streets, or prevent in any manner the flow of water in streets. Use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter, exercising such precaution as may be directed by the Engineer. All material excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.

1.11 WARNING LIGHTS AND ARROW BOARDS

The Contractor shall place sufficient warning lights and arrow boards on or near the work and keep them illuminated during periods of construction and reduced visibility (from twilight in the evening until sunrise) and shall be held responsible for any damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

1.12 UTILITIES

- A. Temporary Removal: All existing utility systems which conflict with the construction of the work herein which can be temporarily removed and replaced shall be accomplished at the expense of the Contractor. Work shall be done by the utility unless the utility approves in writing that the work may be done by the Contractor.
- B. Permanent Relocation of Utilities: Water mains, storm sewer inlets, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light and traffic standards, cable ways, signals, and other utility appurtenances located in the public right-of-way which would permanently interfere with the proposed improvements will be moved by the utility involved and paid for by the Contractor.
- C. Payment for Utilities: The Contractor shall make all necessary applications and arrangements and pay all fees and charges for electrical energy for power and light, a gas energy, water service, and telephone service required for the construction of this Contract during its entire progress. He shall provide and pay for all temporary wiring, switches, connections, and meters.

1.13 DUST, NOISE, AND EROSION CONTROL

Dust shall be minimized by use of water and deliquescent salts. Noise shall be minimized by use of properly constructed and maintained equipment provided with suitable mufflers, and other sound attenuating devices and supports. Erosion shall be controlled in such manner that soil particles from the construction site are prevented from entering public waters or from being deposited on neighboring property, streets, and highways.

1.14 SUBMITTALS - CERTIFICATE OF COMPLIANCE

If required by the City of Greensburg, the Contractor shall submit to the City a Certificate of Compliance from the manufacturer and/or supplier of each and every specified material or manufactured equipment item. The Certificate shall state that the material or the item of equipment to be furnished has been manufactured with materials in accordance with the applicable sections of all required codes, specifications, and standards as required by the specifications.

1.15 MANUFACTURER'S SERVICE TIME

- A. When a lift station or other equipment is to be furnished by the Contractor and maintained by the City, service by the manufacturer is required to be furnished as part of the work and shall be at the Contractor's expense.

- B. The service provided shall be by a qualified representative to check the completed installation, place the equipment in operation, and instruct the City's operators in the operation and maintenance procedures.
- C. The services shall further demonstrate to the City's complete satisfaction that the equipment will satisfactorily perform the functions for which it has been installed.

1.16 GUARANTEE/WARRANTY

The Contractor shall provide a written or typed warranty for all equipment installed.

1.17 RECORD DRAWINGS

- A. Record drawings shall be submitted to City within thirty (30) days after the completion of construction.
- B. Record drawings are to be one (1) set of half-size (11" x 17") drawings, one (1) set of full size drawings (24" x 36") and one (1) set in an electronic file (compact disk, 3.5" disk, or electronic file transmission) utilizing AutoCAD (Release 14) or comparable computer-aided design software in "DWG" and/or "DFX" format.
- C. Record drawings shall be a full set of drawings showing all details required for the Final Plat drawings.
- D. Record drawings shall reflect any changes from the approved Final Plat drawings and showing accurate locations of all utilities including house/building services, utility crossings and other pertinent features.
- E. Record drawings shall be certified to accuracy by a Registered Professional Engineer.

END OF SECTION 01001

SECTION 02101 - TEMPORARY EROSION AND DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This item shall consist of temporary control measures as shown on the plans or as ordered by the Owner during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- B. Temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.
- C. Temporary control may include work outside the construction limits such as borrow pit operations, equipment, and material storage sites, waste areas, and temporary plant sites.

1.2 SUBMITTALS

Submit Erosion Control Plans to the City of Greensburg MS-4 Coordinator for review and approval in accordance with The City of Greensburg's Erosion Control Ordinance and IDEM standards.

PART 2 - PRODUCTS

2.1 GRASS

Grass which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover.

2.2 MULCHES

Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials.

2.3 FERTILIZER

Fertilizer shall be a standard 10-10-2 commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

2.4 STRAW BALE DIKE

Straw bale dikes, as illustrated in Detail I as shown on page 02101-5, shall be used to prevent soil erosion at all stream or ditch crossings. Individual straw bale dike locations are indicated on the site plans.

2.5 SLOPE DRAINS

Where construction disturbs grassy slopes equal to or steeper than 3:1 the slope shall be protected with an erosion control mat as illustrated in Details 2.A and 2.B as shown on pages 02101-6 and 7. Slope drains may be constructed of pipe, fiber mats, rubber, Portland cement concrete, bituminous concrete, or other materials that will adequately control erosion.

2.6 SILT FENCING

Silt fencing, as illustrated in Detail as shown on page 02101-8 shall be used to prevent soil erosion at top of slope locations as indicated on the site plans.

2.7 OTHER

All other materials shall meet commercial grade standards and shall be approved by the City of Greensburg before being incorporated into the project.

PART 3 - EXECUTION

3.1 GENERAL

- A. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.
- B. The Contractor shall be responsible for compliance to the extent that construction practices, construction operations, and construction work are involved.

3.2 SCHEDULE

Prior to the start of construction, the Contractor shall submit schedules for accomplishment of temporary and permanent erosion control work, as are applicable for clearing and grubbing, grading, construction, paving, and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.

3.3 AUTHORITY OF OWNER

The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

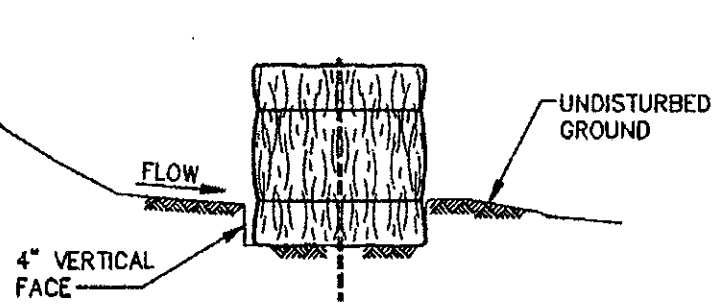
3.4 CONSTRUCTION DETAILS

- A. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design state; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.
- B. Where erosion is likely to be a problem, clearing and grubbing operations should be scheduled and performed so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.
- C. The Owner will limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current in

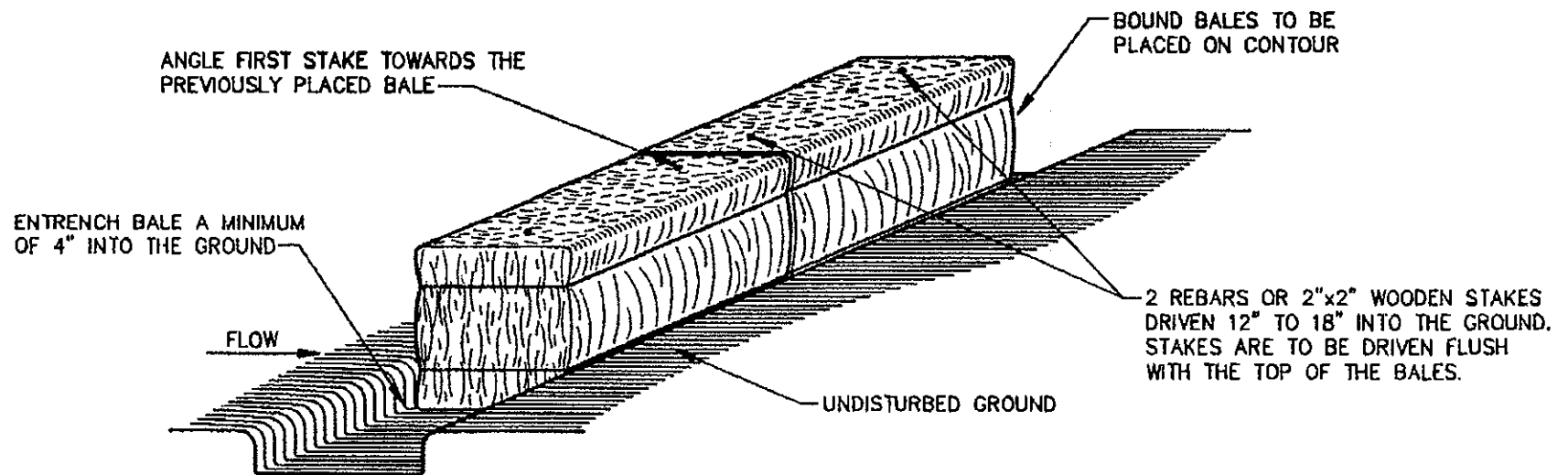
accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.

- D. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Owner, such work shall be performed by the Contractor at his/her own expense.
- E. The Owner may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.
- F. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period.
- G. Whenever construction equipment must cross watercourses at frequent intervals, and such crossings will adversely affect the sediment levels, temporary structures should be provided.
- H. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or manmade channels leading thereto.

END OF SECTION 02101



BEDDING DETAIL

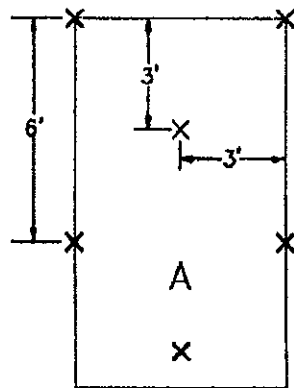


ANCHORING DETAIL

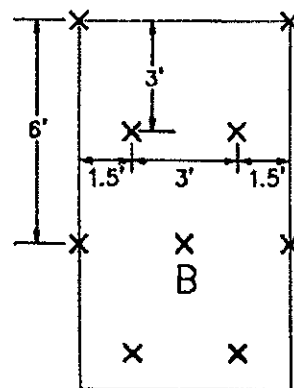
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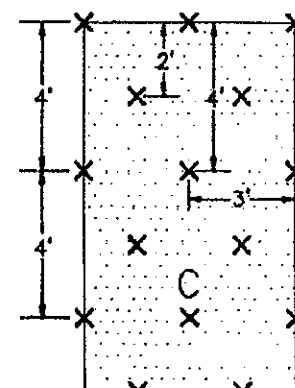
DETAIL 1
STRAW BALE ANCHORING & BEDDING DETAIL



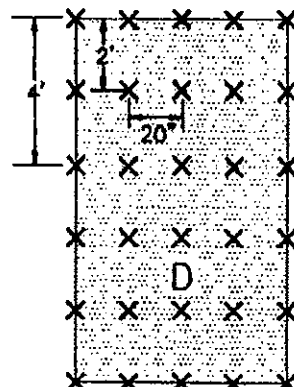
1 STAPLE PER SQ. YD.



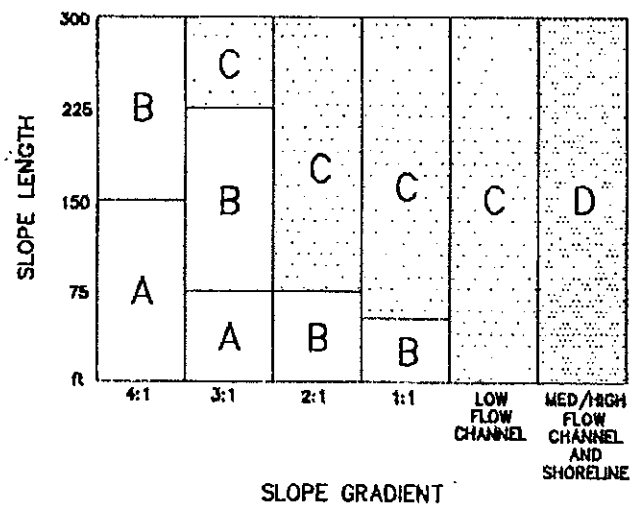
1.5 STAPLES PER SQ. YD.



2 STAPLES PER SQ. YD.



3.5 STAPLES PER SQ. YD.

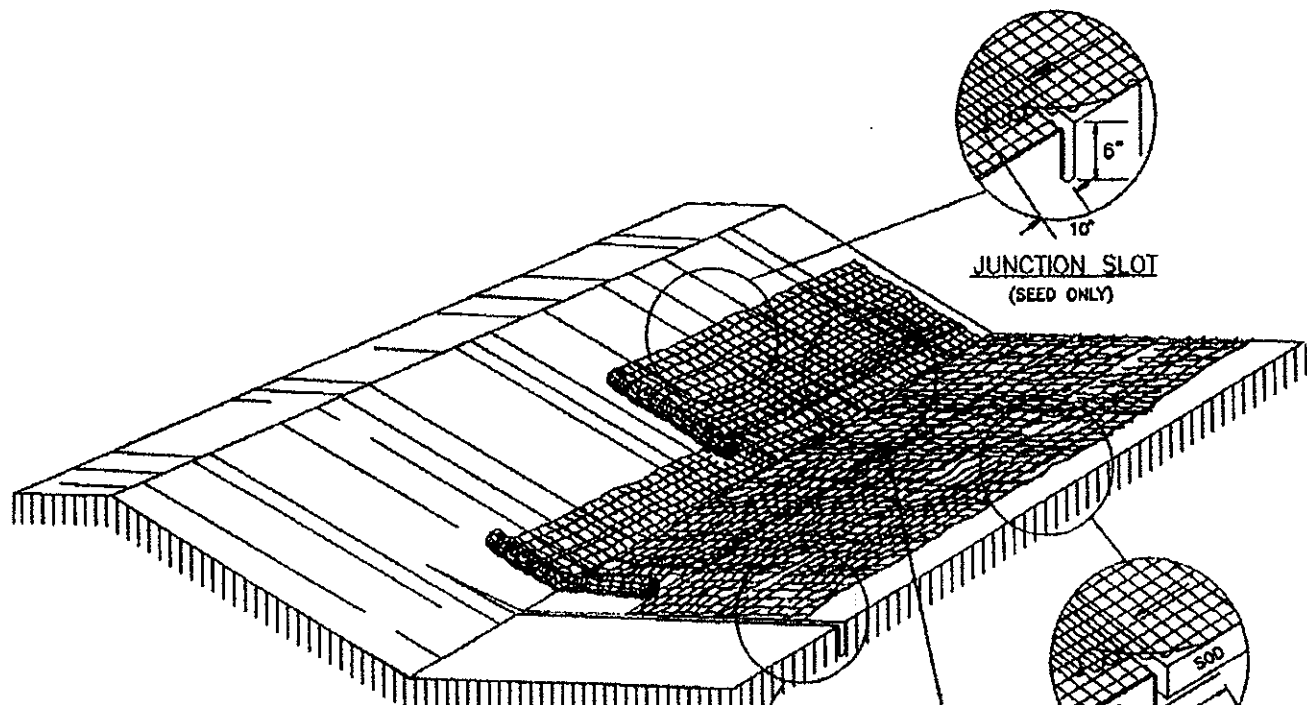


EROSION CONTROL MAT - STAPLE GUIDE NO SCALE

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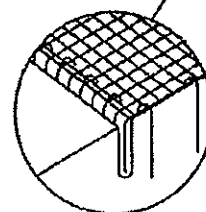
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DETAIL 2A
EROSION CONTROL MAT - STAPLE GUIDE



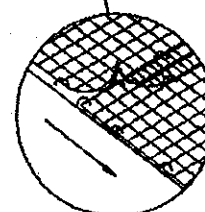
GENERAL NOTES

1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING APPLICATION OF LIME, FERTILIZER AND SEED.
2. BEGIN AT THE TOP OF THE CHANNEL BY ANCHORING THE BLANKET IN A 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
3. ROLL CENTER BLANKET IN DIRECTION OF WATER FLOW ON BOTTOM OF CHANNEL.
4. PLACE BLANKETS END OVER END (SHINGLE STYLE) WITH A 6" OVERLAP. USE A DOUBLE ROW OF STAGGERED STAPLES 4" APART TO SECURE BLANKETS.
5. FULL LENGTH EDGE OF BLANKETS AT TOP OF SIDE SLOPES MUST BE ANCHORED IN 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.
6. BLANKETS ON SIDE SLOPES MUST BE OVERLAPPED 4" OVER THE CENTER BLANKET AND STAPLED.
7. IN MEDIUM/HIGH FLOW CHANNEL APPLICATIONS, A STAPLE CHECK SLOT IS RECOMMENDED AT 30 TO 40 FOOT INTERVALS. USE A ROW OF STAPLES 4" APART OVER ENTIRE WIDTH OF THE CHANNEL. PLACE A SECOND ROW 4" BELOW THE FIRST ROW IN A STAGGERED PATTERN.
8. THE TERMINAL END OF THE BLANKETS MUST BE ANCHORED IN A 6" DEEP x 6" WIDE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING.



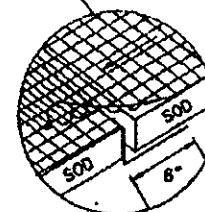
ANCHOR SLOT

AT BEGINNING AND END
OF EROSION MAT
(SEED AND SOD)



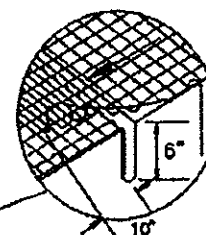
LAP JOINT

(SEED AND SOD)



JUNCTION SLOT

(SOD ONLY)



JUNCTION SLOT

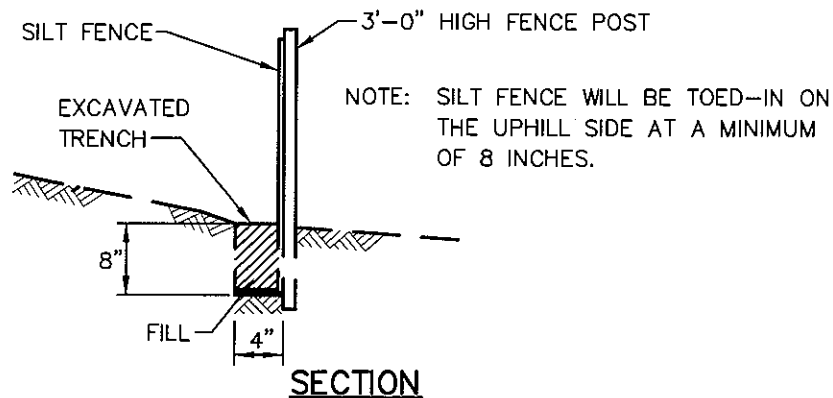
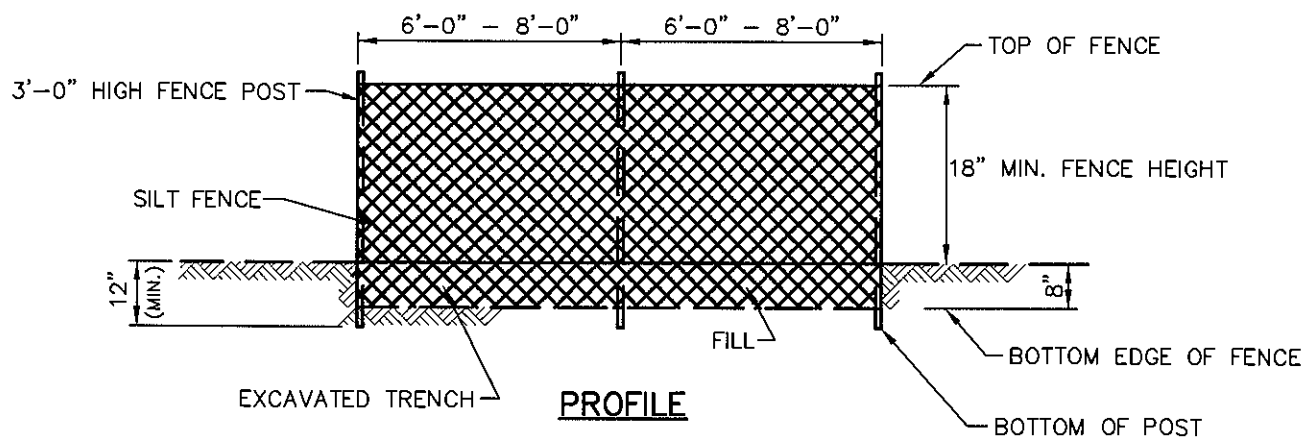
(SEED ONLY)

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DETAIL 2.B
EROSION CONTROL MAT - SLOPE DETAIL



INSTALLATION PROCEDURE

1. 2" x 2" x 36" HARDWOOD OR STEEL FENCE POSTS ARE INSTALLED 6' APART (w/ EXTRA STRENGTH FABRIC WITHOUT WIRE BACKING) OR 8' APART (w/ WIRE BACKING), ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE.
2. A TRENCH 4" WIDE BY 8" DEEP IS DUG ALONG THE UPHILL SIDE OF THE FENCE LINE.
3. THE SILT FENCE IS UNROLLED AND LAID OUT ALONG THE FENCE LINE.
4. A BUILT-IN ATTACHMENT CORD RUNS THROUGHOUT THE FULL LENGTH OF EACH 150 LINEAR FOOT ROLL. ONE END OF THE ROLL HAS APPROXIMATELY 5' OF CORD. THE OTHER END HAS APPROXIMATELY 20' OF CORD. THE END WITH 5' OF CORD IS WRAPPED AROUND THE FIRST POST AND SECURED.
5. THE FENCE IS PULLED TO THE NEXT POST AND A 1.5" SLIT IS MADE IN THE HEM DIRECTLY ABOVE THE CORD. THE CORD IS PULLED OUT OF THE HEM AND PULLED TAUT FROM THE PRECEDING POST AND WRAPPED TWICE AROUND THE POST.
6. THE SLITTING OF THE HEM ON EACH POST IS REPEATED UNTIL THE FINAL POST IS REACHED, AT WHICH TIME THE MATERIAL IS WRAPPED AROUND THE LAST POST AND SECURED WITH THE ENCLOSED CORD.
7. AT THIS TIME THE LOWER 8" OF THE FENCE IS LAID IN THE TRENCH AND CURLED TOWARD THE EROSION SOURCE. THE TRENCH IS THEN BACKFILLED WITH SOIL.

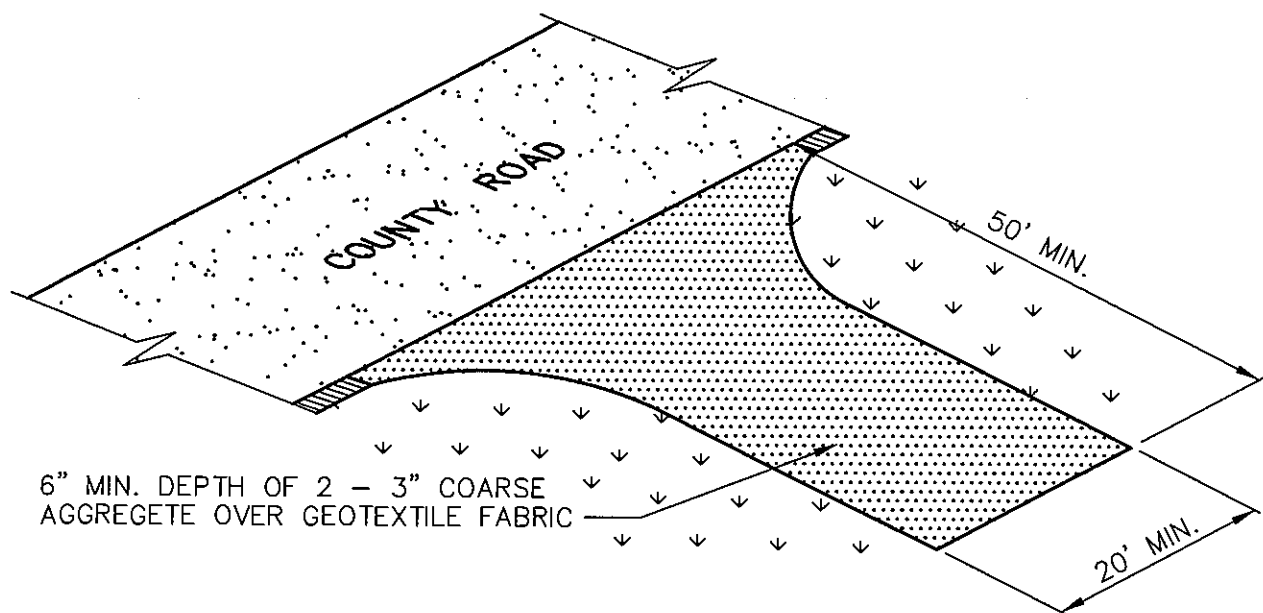
SILT FENCE DETAIL

CITY OF GREENSBURG, INDIANA

JULY 2007

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FIGURE W-100



CONSTRUCTION DRIVE DETAIL

CITY OF GREENSBURG, INDIANA

JULY 2007

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SECTION 02222 - EARTHWORK FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Specifications for the stripping of topsoil and vegetation, excavation, trenching, bedding, filling, backfilling, compaction, and related work in connection with the installation of water mains, gravity sanitary sewers, storm sewers, and force mains are included in this Section.
- B. Definitions
 - 1. Excavation: Removal of earth and rock to form a trench for the installation of a water main, gravity sanitary sewer, storm sewer, or force main.
 - 2. Earth: Unconsolidated material in the crust of the Earth derived by weathering and erosion. Earth includes:
 - a. Materials of both inorganic and organic origin;
 - b. Boulders less than 1/3 cubic yard in volume, gravel, sand, silt, and clay;
 - c. Materials which can be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift, or similar excavating equipment without the use of explosives, rock rippers, rock hammers, or jack hammers.
 - 3. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes:
 - a. Limestone, sandstone, dolomite, granite, marble, and lava;
 - b. Boulders 1/3 cubic yard or more in volume;
 - c. Materials which cannot be excavated by equipment which is used to remove earth overburden without the use of explosives, rock rippers, rock hammers, or jack hammers;
 - d. Materials which cannot be excavated with a backhoe, trenching machine, drag line, clam shell, bulldozer, highlift, or similar excavating equipment without the use of explosives, rock rippers, rock hammers, or jack hammers.
 - 4. Undercutting: Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.
 - 5. Subgrade: Undisturbed bottom of a trench.

6. Bedding: Earth placed in trench to support pipe and conduit.
7. Backfill and Fill: Earth placed in trench from the top of bedding to finished grade, or to subbase of pavement.
8. Topsoil: Earth containing sufficient organic materials to support the growth of grass.
9. Class II Bedding shall be No. 8 crushed limestone.

1.2 QUALITY ASSURANCE

- A. The blasting supervisor shall have no less than five (5) years experience in explosive demolition and excavation. The blasting supervisor and crews shall have all appropriate licenses for the handling and use of explosives.
- B. A Blasting Monitoring and Control Program shall be developed by the Contractor, and submitted to the Engineer, and the City of Greensburg prior to the commencement of blasting operations.
 1. The Blasting Monitoring and Control Program shall indicate the blasting area, the charge locations, number of explosive rounds at each charge location, the maximum charge per delay in pounds, and the maximum charge per round in pounds.

PART 2 - PRODUCTS

2.1 BEDDING, HAUNCHING AND INITIAL BACKFILL

Material to be used for bedding, haunching and initial backfill shall be No. 8 crushed limestone.

2.2 BACKFILL

- A. General: Backfill shall be earth of such gradation and moisture content that the soil will compact to the specified density and remain stable. Unsuitable materials shall not be used.
- B. Cover Material: Pipe cover material, from one foot above the pipe, shall be No. 8 crushed limestone.
- C. Granular Backfill - When indicated on the plans or as ordered by the City of Greensburg, shall be used. It shall be No. 8 crushed limestone.
- D. Gravel Backfill: When the material excavated from the trench is suitable for granular backfill, the City of Greensburg reserves the right to order, in writing, the use of this excavated material in place of the granular backfill.

E. Special Backfill - No. 8 crushed limestone

<u>Group Symbols</u>	<u>Typical Names</u>
GW	Well-graded gravels and gravel-sand mixtures, little or no fines
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
GM	Silty gravels, gravel-sand-silt mixtures
GC	Clayey gravels, gravel-sand-clay mixtures
SW	Well-graded sands and gravelly sands, little or no fines
SP	Poorly graded sands and gravelly sands, little or no fines
SM	Silty sands, sand-silt mixtures
SC	Clayey sands, sand-clay mixtures
ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays

- F. Unsuitable Materials: Materials which are unsuitable for backfill include stones greater than 8 inches in their largest dimension, pavement, rubbish, debris, wood, metal, plastic, and the following soils, classified by the Unified Soil Classification System, ASTM D-2487:

<u>Group Symbols</u>	<u>Typical Names</u>
OL	Organic silts and organic silty clays of low plasticity
MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH	Inorganic clays of high plasticity, fat clays
OH	Organic clays of medium to high plasticity
PT	Peat, muck, and other highly organic soils

- G. Concrete Backfill: Concrete used for backfill around sewers, water mains, or other utility piping shall be Class B concrete.
- H. Cellular Concrete: Light weight cellular concrete may be used for filling of abandoned sewers as a grouting mixture for filling voids and as a substitute for backfill concrete in tunnels or casing pipes. The cellular concrete shall be produced by blending preformed foam with cement-sand grout slurry to produce a concrete having a fresh weight per cubic foot of not less than 75 pounds.

PART 3 - EXECUTION

3.1 EXISTING UTILITIES, STRUCTURES, AND PROPERTY

- A. All poles, fences, sewer, gas, water or other pipes, wires, conduits and manholes, railroad tracks, buildings, structures and property along the routes of water mains, force mains, and sewers shall be supported and protected from damage by the Contractor.
- B. Movable items such as mail boxes may be temporarily relocated during construction. Place movable items in their original location immediately after backfilling is completed, unless otherwise shown on the drawings. Replace movable items which are damaged during construction.

- C. The Contractor shall proceed with caution in the excavation and preparation of trenches so that the exact location of underground utilities and structures, both known and unknown, may be determined. The Contractor shall be responsible for the repair of utilities and structures when broken or otherwise damaged.
- D. Whenever, in the opinion of the City of Greensburg, it is necessary to explore and excavate to determine the location of underground structures, the Contractor shall make explorations and excavations for such purpose.
- E. Wherever sewer, gas, water, or other pipes or conduits cross the trench, the Contractor shall support said pipes and conduits without damage to them and without interrupting this Contract. The manner of supporting such pipes, etc., shall be subject to the approval of the utility involved.
- F. When utility lines that have to be removed or relocated are encountered within the areas of operations, the Contractor shall notify the Engineer in ample time for the necessary measure to be taken to prevent interruption of the service.
- G. The Contractor shall so conduct the work that no equipment, material, or debris will be placed or allowed to fall upon private property in the vicinity of the work unless he shall have first obtained the property owner's written consent thereto and shall have shown said written consent to the Engineer.
- H. All excavated material shall be piled in a manner that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.
- I. All streets, alleys, pavements, parkways, and private property shall be thoroughly cleaned of all surplus materials, earth, and rubbish placed thereon by the Contractor.

3.2 CLEARING

- A. Clear and remove logs, stumps, brush, vegetation, rubbish, and other perishable matter from the project site as required to perform work.
- B. Do not remove or damage trees that do not interfere with the work. Completely remove trees required to be removed, including stumps and roots. Properly treat damaged trees which can be saved.

- C. Debris from the tree removal, including trunk, branches, leaves, roots and stumps, shall not be buried or burned on the job site, but must be completely hauled away and disposed of at the Contractor's expense.

3.3 STRIPPING AND STOCKPILING OF TOPSOIL

- A. Strip topsoil and vegetation from the excavated areas. Clean topsoil may be stockpiled for reuse as the upper 6 inches of the areas to be seeded.
- B. Do not intermix grass, weeds, roots, root mat, brush, and stones larger than 3 inches with stockpiled topsoil. Dispose of root contaminated topsoil.

3.4 PAVEMENT AND WALK REMOVAL

- A. Remove existing pavement and walks from the excavated areas. Remove excavated asphaltic and concrete materials from the job site as these materials are excavated.
- B. The width of pavement removed along the normal trench for the installation of pipe and structures shall not exceed the width of the trench by more than 12 inches on each side of the trench when the amount of pavement removed is less than 75% of the total existing pavement width. Remove all existing pavement when the excavation requires the removal of 75% or more of the total existing pavement width.
- C. Remove walks completely when excavation is along the length of a walk and requires the removal of part of the walk. Remove walks to existing joints in the walks when excavation crosses walks. If there are no joints in an existing walk, the width of walk removed shall not exceed the width of the trench by more than 12 inches on each side of the trench.
- D. Use methods to remove pavement and walks that will assure the breaking or cutting of pavement and walks along straight lines. The face of the remaining pavement and walk surfaces shall be approximately vertical.

3.5 EXCAVATING

- A. General: After stripping of topsoil and vegetation, perform excavations of every description regardless of material encountered within the grading limits of the project to lines and grades as indicated on the drawings or as otherwise specified.
 - 1. Materials removed below the depths indicated without specific direction of the City of Greensburg shall be replaced at no

additional cost to the City, to the indicated excavation grade with satisfactory bedding materials placed and compacted.

- B. Dewatering: Keep excavations free from water until the water mains, force mains, sewers, structures, and appurtenances to be constructed in the excavations are completed and will safely withstand forces from water. Provide sufficient dewatering equipment and make satisfactory arrangements for the disposal of the water without undue interference with other work, damage to property, or damage to the environment.

1. Operate dewatering equipment ahead of pipe laying and keep the water level below the pipe invert until the pipe is secured by backfill.

- C. Trenching: Trees, boulders, and other surface encumbrances, located so as to create a hazard to employees involved in excavation work or in the vicinity thereof at any time during operations, shall be removed or made safe before excavating is begun.

1. Do not open more than 100 feet of trench in advance of the installed pipe, unless otherwise directed or permitted by the Engineer. Excavate the trench within 6 inches of full depth for a distance of at least 30 feet in advance of the pipe laying, unless otherwise directed or permitted.
2. Contractor shall be responsible for the determination of the angle of repose of the soil in which the trenching is to be done. Excavate all slopes to at least the angle of repose except for areas where solid rock allows for line drilling or presplitting, or where shoring or trench box is to be used.
3. Sides, slopes, and faces of all excavations shall meet accepted engineering requirements by scaling, benching, barricading, rock bolting, wire meshing, or other equally effective means. Give special attention to slopes which may be adversely affected by weather or moisture content.
4. Flatten the trench sides when an excavation has water conditions, silty materials, loose boulders, and areas where erosion, deep frost action, and slide planes appear.
5. Shoring, sheeting, trench box, or other means shall be used to support sides of trenches in hard or compact soil when the trench is more than 5 feet in depth and 8 feet or more in length. Sides of trenches shall include embankments adjacent to trenches. In lieu of shoring, the sides of the trench above the 5-foot level may be sloped to preclude collapse, but shall not be steeper than a 1-foot rise to each 1/2-foot horizontal. Provide a bench of 4 feet minimum at the toe of the sloped portion of the trench wall when

- the outside diameter of the pipe to be installed is greater than 6 feet.
6. Use diversion ditches, dikes, or other suitable means to prevent surface water from entering an excavation and to provide adequate drainage of the area adjacent to the excavation. Do not allow water to accumulate in an excavation. If possible, the grade should be away from the excavation.
 7. Excavations shall be inspected by a competent Contractor's representative after every rainstorm or other hazard-increasing occurrence, and the protection against slides and cave-ins shall be increased, if necessary.
 8. Do not store excavated or other material nearer than 4 feet from the edge of any excavation. Store and retain materials as to prevent materials from falling or sliding back into the excavation. Install substantial stop log or barricades when mobile equipment is utilized or allowed adjacent to excavations.
 9. The width of trenches in earth for water main pipe, sewers, basin connections, house connections, and other drains up to and including 33 inches in internal diameter shall provide a clearance of not less than 8 inches or more than 10 inches on each side of the pipe. Trenches for pipe larger than 33 inches in internal diameter shall provide a clearance of not less than 10 inches or more than 14 inches on each side of the pipe.
 10. The maximum clear width of trenches in earth for manholes shall be the greatest external width of the structure plus the space necessary for the construction and removal of the forms and construction of masonry work.
 11. The design of the water main, force main, and/or sewer pipe and structures is predicated upon the width of trench specified in this Article. The Contractor shall be responsible for the provision and installation, at his own expense, of such remedial measures as may be directed by the Engineer, should the trench width limits specified in this Article be exceeded.
 12. Test the air in excavations in locations where oxygen deficiency or gaseous conditions are possible. Establish controls to assure acceptable atmospheric conditions. Provide adequate ventilation and eliminate sources of ignition when flammable gases are present. Attended emergency rescue equipment, such as breathing apparatus, a safety harness and line, and basket stretcher, shall be readily available where adverse atmospheric conditions may exist or develop in an excavation.
 13. Provide walkways or bridges with guardrails where employees or equipment are required or permitted to cross over excavations.
 14. Provide ladders where employees are required to be in trenches 4 feet deep or more. Ladders shall extend from the floor of the

trench to at least 3 feet above the top of the excavation. Locate ladders to provide means of exit without more than 25 feet of lateral travel.

15. Provide adequate barriers and physically protect all remotely located excavations. Barricade or cover all wells, pits, shafts, and similar excavations. Backfill temporary wells, pits, shafts, and similar excavations upon completion of exploration and similar operations.
- D. Quicksand: Carry on the work with utmost vigor and proceed with the work expeditiously when running sand, quicksand, or other bad or treacherous ground is encountered. Install bedding to support the pipe as directed by the Engineer.
 - E. Blasting: Removal of rock from the excavation may be facilitated by the use of controlled explosives.
 1. Blasting supervision and Blasting Monitoring and Control Programs shall meet the requirements of this Section.
 2. Storage procedures for explosives shall be developed by the Contractor and submitted to the City of Greensburg before explosives are brought to the job site.

3.6 SHEETING

- A. The Contractor shall be responsible for construction means, methods, techniques, and procedures, and for providing a safe place for the performance of the work by the Contractor, Subcontractors, suppliers and their employees, and for access use, work, or occupancy by all authorized persons.
- B. The Contractor shall be solely responsible for all obligations prescribed as employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction."
- C. Adequate supporting systems, such as sheeting, shoring, piling, cribbing, and bracing shall be furnished and installed by the Contractor as required to protect existing buildings, utilities, and property from damage during the progress of the work.

3.7 STORAGE AND REMOVAL OF EXCAVATED MATERIAL

- A. Suitable excavated material required for filling and backfilling operations may be stockpiled in on-site locations as approved by the Engineer, until the material is ready to be placed.
- B. Remove unsuitable materials from the job site as unsuitable materials are excavated. Remove surplus suitable materials from the job site as trenches are backfilled.

3.8 TEMPORARY PLUGS

Prevent foreign matter from entering pipe while it is being installed. Do not place debris, tools, clothing, or other material in the pipe. Close the open ends of pipe by watertight plugs when pipe laying is not in progress. Remove any earth or other material that enters pipe, lateral pipe, or appurtenances through any open pipe end. Remove earth and other materials at no additional cost to the Owner.

3.9 BACKFILLING WATER MAIN AND FORCE MAIN TRENCHES

- A. Backfilling of water main and force main trenches shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.
- B. Do not backfill trenches and excavations until all utilities have been inspected by the City's representative and until all underground utilities and piping systems are installed in accordance with the requirements of the specifications and the drawings. Required hydrostatic tests may be applied to the line either before or after the trench is backfilled, subject to the approval of the City.
- C. Place and tamp bedding and backfill in a manner which will not damage pipe coating, wrapping, or encasement.
- D. Material from the trench subgrade to the centerline of the pipe shall be Class II bedding. Place bedding by hand or approved mechanical methods in layers of 8 inches loose depth. Compact bedding by hand tamping or with a power operated hand vibrating compactor. Deposit bedding in the trench for its full width on each side of the pipe simultaneously.
- E. Place pipe cover material, special backfill, from the centerline of the pipe to 12 inches over the pipe. Compact pipe cover material to the density required to allow backfill over the pipe cover material to be compacted to the density specified in this Article.

- F. Do not use the following materials for backfill:
1. Unsuitable materials;
 2. Frozen materials;
 3. Materials which are too wet or too dry to be compacted to the densities specified in this Article.
- G. Trenches Requiring Special Backfill When Specified: Where the edge of the trench is 5 feet or less from the edge of the existing or proposed roadway pavement and trenches across roadways, driveways, utility crossing, or in areas to be paved or subjected to traffic, the trench shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as determined in accordance with AASHTO T99, Method A. Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Do not compact backfill by puddling.
- H. Trenches in State Highway Right-of-Way: Where excavation occurs within the right-of-way of a state highway, all areas within 12 feet of the pavement edge shall be backfilled with Grade "B Borrow" Special Backfill. All areas beyond 12 feet shall be backfilled in the manner specified in the following paragraph.
- I. Trenches Not Requiring Special Backfill: Backfill trenches not requiring granular backfill with suitable excavated material. Place and compact backfill to produce an adequate foundation for the applicable paved or unpaved surface treatment. Fill and restore any settlement of the backfill. In paved areas, backfill shall be maintained to subbase elevation. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.
- J. Trenches in Traveled Pavements: All cuts and trenches in paved streets or other paved areas shall be backfilled with No. 8 crushed limestone to within 12 inches of the street surface. The remainder of the trench is to be filled with No. 53 crushed limestone and compacted in place, prior to opening the street to traffic. The Contractor shall maintain the trenches, adding crushed stone and grading as necessary, until sufficient settlement has taken place and final restoration is made.

3.10 BACKFILLING SANITARY SEWER AND STORM SEWER TRENCHES

- A. Do not backfill trenches and excavations until all utilities have been inspected by the Utility Superintendent or their representative and until all underground utilities and piping systems are installed in accordance with the requirements of the specifications and the drawings.
- B. Place and tamp bedding and backfill in a manner which will not damage pipe coating, wrapping, or encasement.
- C. Bedding procedures for sanitary sewers and storm sewers shall be as specified in the Section for the applicable pipe material.
- D. If bedding does not cover the pipe, place special backfill from the top of bedding to 12 inches over the pipe. Compact pipe cover material to the density required to allow backfill over the pipe cover material to be compacted to the density specified in this Article.
- E. Do not use the following materials for backfill:
 - 1. Sand, grit or pea gravel;
 - 2. Unsuitable materials;
 - 3. Frozen materials;
 - 4. Materials which are too wet or too dry to be compacted to the densities specified in this Article.
- F. Trenches Requiring Special Backfill When Specified: Where the edge of the trench is 5 feet or less from the edge of the existing or proposed roadway pavement and trenches across roadways, driveways, utility crossings, or in areas to be paved or subjected to traffic, the trench shall be backfilled with Special Backfill. Backfill any trench specifically indicated on the drawings with Special Backfill. Place Special Backfill in lifts. Compact each lift of backfill to not less than 95% of the maximum dry density as determined in accordance with AASHTO T99, Method A. Compaction shall be by hand tamping or approved mechanical tamping devices, or in larger excavations by approved rollers. Do not compact backfill by puddling.
- G. Trenches in State Highway Right-of-Way: Where excavation occurs within the right-of-way of a state highway, all areas within 12 feet of the pavement edge shall be backfilled with Grade "B Borrow" Special Backfill. All areas beyond 12 feet shall be backfilled in the manner specified in the following paragraph.

- H. Trenches Not Requiring Special Backfill: Backfill trenches not requiring granular backfill with suitable excavated material. Place and compact backfill to produce an adequate foundation for the applicable paved or unpaved surface treatment. Fill and restore any settlement of the backfill. In paved areas, backfill shall be maintained to subbase elevation. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.
- I. Trenches in Traveled Pavements: All cuts and trenches in paved streets or other paved areas shall be backfilled and compacted with No. 8 crushed limestone to within twelve (12) inches of the finished grade of the roadway. The remainder of the trench is to be filled with No. 53 crushed limestone and compacted in place, prior to opening the street to traffic. The Contractor shall maintain the trenches, adding crushed stone and grading as necessary, until sufficient settlement has taken place and final restoration is made.

3.11 MAINTAINING TRAFFIC

- A. Before closing any thoroughfare, the Contractor shall notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county, or city, which notice shall be given not less than 72 hours in advance of the time when it may be necessary in the process of construction to close such thoroughfare.
- B. The Contractor shall conduct his work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Insofar as it is practicable, excavated material and spoil banks shall not be located in such manner as to obstruct traffic; and the traveled way of all streets, roads, and alleys shall be kept clear and unobstructed insofar as is possible and shall not be used for the storage of construction materials, equipment, supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, the Contractor shall, at his own expense, construct bridges or other temporary crossing structures over trenches so as not to unduly restrict traffic. Such structures shall be of adequate strength and proper construction and shall be maintained by the Contractor in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed except when and where necessary, and then only upon due advance notice to the Engineer and for the shortest practicable period of time consistent with efficient and expeditious construction. The Contractor shall be liable for any damages to persons or property resulting from his work.

3.12 WALKS AND PASSAGEWAYS

The Contractor, when required, shall make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise, and shall not obstruct the sidewalks, gutters, or streets, nor prevent in any manner the flow of water in the latter, but shall use all proper and necessary means to permit the free passage of surface water along the gutters. The Contractor shall immediately cart away all offensive matter, exercising such precaution as may be directed by the Engineer. All material excavated must be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. The Contractor may be required to erect suitable barriers to prevent such inconvenience or injury.

3.13 WARNING LIGHTS

The Contractor shall place sufficient warning lights on or near the work and keep them illuminated during periods of reduced visibility (from twilight in the evening until sunrise) and will be held responsible for any damages that any party or the Owner may sustain in consequences of neglecting the necessary precaution in prosecuting this work.

3.14 CLEANUP AND MAINTENANCE

- A. Cleanup the job site as backfilling is completed. Remove excess earth, rock, bedding, materials, and backfill materials. Remove unused piping materials, structure components, and appurtenances. Restore items moved, damaged, or destroyed during construction. Grade area to be restored. Leave backfill mounded over trenches which are not backfilled with Special Backfill. Cleanup and restoration specified in this paragraph shall be completed within 1,000 feet of excavation.
- B. Restoration of grass, bushes, trees, and other plants shall be completed by Contractor to original condition.
- C. Restoration of pavement and walks shall be specified in Section 02500, Paving and Surfacing. A temporary driving surface, such as crushed stone, shall be compacted in place in the trench area as backfilling is complete. Cold-mix asphalt patching material may be used as a temporary driving surface at the Contractor's option or when specifically called for in the plans or specifications. Temporary pavement shall not be more than 1,000 feet behind the excavation. When no existing pavement remains after excavation, a temporary compacted aggregate surfacing may be provided instead of the permanent pavement or a temporary cold-mix asphalt pavement. When the pavement is asphaltic concrete, placement of the

asphaltic concrete surface course may be delayed until all other heavy construction is completed.

- D. Maintain the job site until the work has been completed and accepted. Fill trenches which settle when settlement is visible. Restore items damaged by construction or improper restoration. Keep dust conditions to minimum by the use of water, salt, calcium chloride, oil, or other means.

END OF SECTION 02222

SECTION 02500 – PAVING AND SURFACING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section covers all work involved in the installation of new pavement, walks, and curbs, and the repair and replacement of existing streets, roads, highways, drives, parking areas, curbs, gutters, sidewalks, and other paved areas damaged or destroyed during construction of the work.
- B. Related Work Specified in Other Sections
 - 1. Section 02222 Earthwork for Utilities Subgrade Preparation
 - 2. Section 02902 Landscaping for Utilities Fine Grading & Seeding
- C. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto. Except as specifically modified in this specification, paving and surfacing operations, materials and testing will comply with the most current revisions of applicable sections of the 1995 Indiana Department of Transportation Standard Specifications.
- D. Definitions
 - 1. Abbreviations
 - a. INDOTSS Indiana Department of Transportation's Standard Specifications.
 - b. AASHTO American Association of State Highway & Transportation Officials.
 - c. ACI American Concrete Institute.
 - d. ASTM American Society for Testing & Materials.
 - e. NRMCA National Ready Mix Concrete Association.
 - 2. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces. Rock includes limestone, sandstone, dolomite, granite, marble, and lava.
 - 3. Subgrade: The prepared and compacted soil immediately below the pavement or walk system and extending to such depth as will affect the structural design.

4. Subbase: The layer of specified or selected material of designed thickness placed on a subgrade to support a base course and surface course.
5. Base Course: The layer of specified or selected material of designed thickness placed on a subbase to support a binder or surface course.
6. Binder Course: The layer of specified or selected material of designed thickness placed on a base course to support a surface course.
7. Surface Course: The layer of specified or selected material of designed thickness placed on a subbase or base course to support the traffic load.

1.2 QUALITY ASSURANCE

- A. The Contractor shall employ and pay for the services of an independent testing laboratory (unless otherwise noted) to perform specific services and necessary field density tests. The Contractor shall demonstrate to the City of Greensburg that proper compaction has been obtained and proper asphalt and concrete mix designs are in compliance with the specifications.
- B. Mixing Plant: Prior to placing any hot asphalt concrete pavement or Portland cement concrete pavement, the Contractor shall provide the City of Greensburg the name and location of the bituminous mixing or concrete mixing plant and the type and composition of mixes the Contractor proposes to use in the work.
- C. Paving and surfacing shall comply with the tolerances specified in Sections 401.15 (Bituminous), 501.15, 501.16 and 501.23 of INDOTSS.
 1. Subgrade and subbase shall be within 1/2 inch of dimensions indicated on drawings.
 2. Bituminous base shall not vary longitudinally more than 1/4 inch from a 10-foot straightedge. Bituminous and concrete surfaces shall not vary more than 1/8 inch from a 10-foot straightedge.
 3. Finished surface shall be within 1/4 inch of dimensions indicated on drawings.
- D. Asphalt and concrete pavement shall be installed by a contractor whose prime business is asphalt or concrete paving.

1.3 SUBMITTALS

- A. Submittals shall be as specified in Section 01001, General Requirements.

B. Submit the following:

1. Name and location of bituminous mixing plant or concrete ready-mix plant. Mixing plants and equipment shall meet the requirements of INDOTSS, Sections 401 and 501.
2. Type and composition of proposed materials and mixes. Job mix formulas shall be prepared and submitted for approval to the Engineer in accordance with INDOTSS 402 and 501. It shall include standard bituminous information including, but not limited to, aggregate gradation, binder content, maximum specific gravity, and air voids.
3. Certified copies of reports of tests specified in this Section and required by the referenced standards.

1.4 JOB CONDITIONS

- A. Do not place paving and surfacing materials on a wet surface, pumping subbase or when weather conditions would prevent the proper construction of paving and surfacing.
- B. Do not place aggregates on frozen subgrade. Do not place aggregates when air temperature is below 35°F.
- C. Bituminous materials are to be placed in accordance with INDOTSS 402.10, 405.04, and 406.05.
- D. Discontinue placing concrete when a descending air temperature away from artificial heat reaches 40°F, and do not resume placing concrete until an ascending air temperature away from artificial heat reaches 35°F.
- E. Do not place paving and surfacing materials when natural light is not sufficient to properly observe work or operations.

1.5 GRADE ADJUSTMENT OF EXISTING STRUCTURES

- A. When grade adjustment of existing structures is required, the manhole frames, covers and gratings, and the gas and water valve boxes and covers, shall be removed and reconstructed to grade as required.
- B. On resurfacing work, the castings and boxes shall be adjusted to grade after the last binder course has been laid and before placing the surface course.

- C. All castings, frames and valve boxes adjusted to grade shall be done in advance of the final paving.

1.6 CONTRACTOR'S ORGANIZATION

- A. The Contractor shall be a firm who's prime business is asphalt or concrete paving. The Contractor shall have a competent supervisor on the site during the progress of the work, acting for the Contractor in all matters concerning the work. He shall have the authority to receive directions and act upon them for the City of Greensburg through the City of Greensburg's authorized representative.
- B. The Contractor shall keep a set of Plans and Specifications available on the site and in good condition.

1.7 TRAFFIC CONTROL

The Contractor shall plan construction operations so that existing local traffic access can be maintained. During the construction, he will also maintain appropriate use of barricades, lights, flagmen and other protective devices, whether specified for the project or required by the local governing authority. Traffic control devices used for maintenance of traffic shall comply with the Indiana Manual on Uniform Traffic Control Devices.

PART 2 - PRODUCTS

2.1 AGGREGATE

- A. Fine aggregates shall consist of natural sand or manufactured sand produced by crushing rock, shells, air-cooled blast furnace slag, or wetbottom boiler slag.
 - 1. Fine aggregates used in Portland cement concrete and bituminous pavements shall be free from injurious amounts of organic impurities. When subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be tested for effect of organic impurities on strength of mortar in accordance with AASHTO T 71. If the relative strength at 7 and 28 days, calculated in accordance with section 10 of T 71, is less than 95%, it shall be rejected.
- B. Coarse aggregates shall consist of clean, tough, durable fragments of crushed rock, crushed or uncrushed gravel or shells, or crushed and processed air-cooled blast furnace slag. These materials shall not contain

more than 15% flat or elongated pieces and shall not contain particles with an adherent coating. Flat or elongated pieces will be described as pieces having a length in excess of four times its width.

- C. Coarse aggregates shall comply with INDOTSS, Section 904.02. Fine aggregates shall comply with INDOTSS, Section 904.01.

2.2 BITUMINOUS MATERIALS

- A. Petroleum asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 347°F.
 - 1. Petroleum asphalt cement shall be PG Binder, grade PG 64-22.
 - 2. Petroleum asphalt emulsion shall be AE-60.
- B. Bituminous materials for prime coat shall consist of:
 - 1. Cut-back asphalt - MC-70; or
 - 2. Asphalt emulsion - AE-P.
 - 3. Materials shall conform to INDOTSS Sections 902.03 and 902.04.
- C. Bituminous materials for tack coat shall consist of:
 - 1. Asphalt emulsion - AE-T.
 - 2. Materials shall conform to INDOTSS 902.04.
- D. Bituminous materials for seal coat shall consist of:
 - 1. Asphalt emulsion - RS-2, AE-90, AE-150, HFRS-2.
 - 2. Materials shall conform to INDOTSS Sections 902.03.
- E. Cover aggregate shall consist of:
 - 1. Coarse aggregates, Class A or B, size no. 8, 9, 11 or 12.
 - 2. Fine aggregate (natural sand only), size no. 23 or 24.
 - 3. Materials shall conform to INDOTSS Sections 904.02 and 904.01, respectively.

2.3 HOT MIX ASPHALT (HMA)

- A. Hot mix asphalt (HMA) shall consist of an intimate mixture of coarse aggregate, fine aggregate (including mineral filler if required), and asphalt cement or emulsion combined in proportions specified in INDOTSS Section 402.04.

- B. When the use of one type or source of aggregate or binder is started, the use of that same type or source shall be continued for the entire lift being constructed, unless otherwise directed by the Engineer.
- C. The use of recycled materials, RAP or ARS, shall not be permitted unless otherwise directed and approved by Engineer.
- D. Preparation of HMA mixtures shall comply with the requirements of INDOTSS Section 402.04.

2.4 PORTLAND CEMENT CONCRETE

- A. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C 150, ACI 301, and ACI 318. Cement shall be Type 1 for normal use, Type 1A where air entrainment is desired, or Type III or Type IIIA where high early strength is desired and authorized by the Engineer. Blended hydraulic cements which meet the requirements of ASTM Specification C 595 Type 1P Portland pozzolan cement may be used where a more watertight concrete is required. Fly ash may also be used as a partial cement replacement for Types 1 or 1A. Cement shall meet requirements specified in INDOTSS Section 901.
- B. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of 3/4 inch, except in mass concrete the maximum size may be 1 1/2 inches.
 - 1. Lightweight fine and coarse aggregates shall meet the requirements of ASTM Specification C 330.
 - 2. Insulating fine and coarse aggregates shall meet the requirements of ASTM Specification C 332.
- C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. A maximum of 500 mg/L of chloride ion may be present in the water.
- D. Air entraining admixtures shall meet the requirements of ASTM Specification C 260.
 - 1. Water reducing and retarding admixtures shall meet the requirements of ASTM C494, Type A or Type D; however, they shall contain no chlorides, be nontoxic after 30 days and compatible with the air entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the

- manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification. Evidence that the admixture is included in the approved list of the INDOTSS Division of Materials and Tests, in accordance with INDOTSS Section 912.03, will satisfy the requirement for a compliance statement.
2. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 6%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.
- E. Reinforcing steel shall meet the requirements of ASTM Specification A 615, Grade 60.
1. Welded wire fabric or wire mesh shall meet the requirements of ASTM A 185.
 2. Reinforcing steel and appurtenances shall follow INDOTSS Section 910.01.
- F. Preformed expansion joint filler shall meet the requirements of ASTM Specification D 1752, Type III.
1. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D 1190.
 2. Waterproof expansion joint filler shall meet the requirements of ASTM Specification D 1850.
 3. Joint materials specified in INDOTSS Section 906 may be used, approved by the Engineer.
- G. Concrete pavement shall be wet cured by using burlap, waterproof blankets, or ponding; or by using a membrane compound. If the membrane method is used, the compound shall be Type 2, complying with AASHTO M148 for white pigmented compound. A pressure sprayer capable of applying a continuous uniform film to the pavement surfaces will be required.
- H. Dowel bars shall be smooth, round bars of plain billetsteel conforming to ASTM A615, Grade 40, and free of any deformation or foreign material that would restrict slippage in concrete. Dowel bars shall be coated as required by INDOTSS. For expansion joints, each bar shall be provided with a metal cap, or approved plastic cap, on one end that will provide for ample movement of the slabs.
1. Dowel bars and assemblies shall conform to the requirements of INDOTSS Section 501.14 (f).

- I. Concrete base shall meet the requirements of INDOTSS Section 307.
- J. Reinforced concrete pavement shall meet the requirements of INDOTSS Section 501.
- K. Reinforced concrete for sidewalks and steps shall meet the requirements of INDOTSS Section 604.
- L. Reinforced concrete for curbing shall meet the requirements of INDOTSS Section 605.

2.5 UNDERDRAINS

Underdrain material shall be 4-inch polyethylene perforated pipe meeting ASTM F405 specification and shall be per INDOT standard specification Section 718 – “Underdrain.”

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor is responsible to provide equipment, workmanship and materials required to achieve a finished product that meets these specifications.
- B. Use compaction equipment suitable to the material being placed. Compacting equipment shall include at least one piece of equipment capable of providing a smooth even surface on the pavement surface course.
- C. Prior to placing paving and surfacing materials, shape subgrade as required to produce finished pavement grades and cross-sections shown on drawings.
- D. Do not place paving and surfacing material before subgrade is reviewed and accepted by the Engineer. Do not place paving and surfacing materials on a frozen or muddy subgrade.
- E. Compact subgrade to not less than 100% of its maximum density as determined in accordance with AASHTO T99.
- F. Provide adequate drainage at all times to prevent water from standing on subgrade, pavement or walks.

3.2 SUBGRADE

The subgrade material and testing shall comply with INDOTSS Section 207, before placement of subbase.

3.3 SUBBASE PREPARATION

Provide 8 inches of subbase in locations where pavement is to be placed on a material other than Special Backfill. Subbase shall meet the requirements of INDOTSS Section 304.

3.4 AGGREGATE BASE, SURFACE, OR SHOULDERS

- A. Aggregate base, surface, or shoulders shall consist of crushed rock or gravel. The aggregate type shall be suitable for the area in which the project is located. The aggregate thickness shall be as shown on the drawings and as specified herein.
- B. Aggregate shall be Type "O" mix, unless otherwise specified by the City of Greensburg.
- C. Compacted aggregate materials and construction shall conform to INDOTSS Section 303.
- D. If the required thickness of the aggregate (Type O) exceeds 4 inches, the material shall be placed and compacted in separate lifts no less than 2 inches nor more than 4 inches of compacted depth. If Type P aggregate is used, it may be placed in individual lifts with a thickness of up to 6 inches.
- E. If spreading devices are used which will ensure proper depth and alignment, forms will not be required; otherwise, forms shall be required. Forms shall be of wood or steel, adequate in depth, straight, of uniform dimensions and equipped with positive means for holding the form ends rigidly together and in line. Segregation of material shall be avoided by any spreading method used. No payment will be made for aggregate placed beyond the dimensions shown on the drawings.
- F. Compact material in each lift after material is spread and shaped. Compact material to not less than 100% of maximum dry density as determined by AASHTO T99. Use construction procedures, including sufficient wetting and number of passes, to ensure specified density is attained.

- G. The Contractor shall employ an independent testing laboratory to perform field density tests to demonstrate proper compaction of aggregate surface pavement, if requested by the City of Greensburg.
- H. In a brick surfaced street, unless specifically excepted and pending the structural adequacy of any remaining brick, the Contractor may remove all brick and enough base material to allow full width repaving using either a bituminous or concrete pavement; or of providing a HMA base and HMA intermediate for the full depth of the brick across the trench and then replace the entire street with 1 inch of HAC surface.
- I. Unless otherwise shown on the drawings, the minimum section (excluding subgrade) of reinforced concrete shall be 6 inches of compacted #53, Type "O" aggregate base and 6 inches of 4,000 psi reinforced concrete.
- J. Unless otherwise shown on the drawings, for a street with a brick base and an asphalt surface, the replacement section shall be full depth asphalt from the bottom of the brick base to the top of the asphalt surface. The top 1 inch shall be #11 HMA surface.
- K. Unless otherwise shown on the drawings, for a street with a concrete base and an asphalt surface, the replacement section shall be a new concrete base, not less than 6 inches thick with #5 HMA base to within 1 inch of the existing grade and then 1 inch of #11 HMA surface.
- L. Unless otherwise shown on the drawings, chip and seal pavements shall have 8 inches of compacted aggregate base (#53, Type "O" crushed stone) and 1 inch processed bituminous coated aggregate pavement placed and rolled as specified in INDOTSS Section 404.
- M. Unless otherwise shown on the drawings, gravel pavement shall be replaced with 6 inches of #53, Type "O" compacted stone or gravel aggregate as specified in INDOTSS Section 303.

3.5 HOT MIX ASPHALT

- A. This work shall consist of constructing one or more courses of HMA base, intermediate, and wedge leveling or surface mixtures on a prepared foundation in accordance with these specifications and in reasonably close conformance with the lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.
 - 1. If the required finished depth of any course is to exceed three times the top size of the aggregate used as shown by actual screen

- analysis, the course shall be constructed in two or more lifts, as directed.
2. Mix type shall be as indicated on the drawings, without exception, unless otherwise approved in writing by the Engineer.
 - a. Job mix formulas shall be prepared and submitted for approval to the Engineer in accordance with INDOTSS 402. The job mix formula shall include standard bituminous mixture information including, but not limited to, aggregate gradation, binder content, maximum specific gravity, and air voids.
 3. Materials and construction requirements shall comply with the requirements of INDOTSS Section 402.
- B. If the previously constructed course is granular, a prime coat will be required.
1. Apply prime coat uniformly at a rate of 0.25 to 0.80 gallon per square yard depending on condition of surface and amount of loose aggregate.
 2. Apply prime coat with a pressure distributor. Temperature of prime coat shall not exceed 150°F.
 3. Squeegee excess prime coat from the subbase surface. Correct deficient or skipped area.
 4. Prime coat shall be placed in accordance with INDOTSS Section 405.07.
- C. Place and spread bituminous base mixture with a bituminous paver. In areas inaccessible to a paving machine, place and spread bituminous base mixture by other acceptable mechanical or hand methods.
- D. Tack coat shall be placed on existing bituminous or concrete surfaces before a new lift of bituminous material is added. Apply tack coat uniformly at a rate of 0.06 gallon per square yard (0.000252 ton per square yard).
1. Patch and clean existing surface. The surface shall be free of irregularities and provide a reasonably smooth and uniform surface to receive the tack coat. Remove and replace unstable corrugated areas with suitable patching materials.
 2. Tack coat shall be placed in accordance with INDOTSS Sections 406.03 through 406.05.

- E. Placement and compaction of hot mix asphalt (HMA) shall conform to INDOTSS Sections 402.08 through 402.11.
- F. Place binder used for wedging or leveling, approaches and feathering by mechanical methods or acceptable hand methods for placing and spreading in accordance with INDOTSS Section 400.

3.6 PORTLAND CEMENT CONCRETE PAVEMENT

- A. Portland cement concrete pavement shall consist of a coarse aggregate base (if required) and a reinforced or unreinforced Portland cement concrete surface, as shown on the drawings
 - 1. Use No. 53, Type "O" coarse aggregate for subbase, unless otherwise shown or specified.
 - 2. Pavement cross-section shall be as shown on drawings.
- B. Where an aggregate base course is shown or specified, it shall be constructed in accordance with Article 3.3 of this specification.
- C. Portland cement concrete pavement operations and materials shall comply with INDOTSS Section 501 unless otherwise specified by the Engineer.
 - 1. Alternate equipment to that specified in INDOTSS, Section 501 shall be allowed provided that line, grade, surface, smoothness and other requirements of the specifications are met. The equipment used shall be subject to the approval of the Engineer.
 - 2. Expansion and contraction joints shall be installed as indicated on the drawings or as required by INDOT standards. Expansion joints shall be required whenever new concrete abuts fixed objects or existing concrete surfaces, whether or not shown on the drawings.
 - 3. Keyway construction, load transfer devices, tie bars and slab and ear reinforcement shall be installed as indicated on the drawings.
 - 4. Unless otherwise shown on the drawings, the final finish of concrete pavement shall be by brooming, as set out as Method 1 in INDOTSS Section 501.15 (d), to form a transverse skid-resistant finish.
 - 5. The Contractor shall always have materials available to protect the surface of concrete against rain. These materials shall consist of burlap, curing paper or plastic sheeting.
 - 6. New concrete pavement shall be protected by the Contractor until opening to traffic is approved by the Engineer. It shall not be opened to traffic until the field-cured concrete has attained a flexural strength of 550 psi, or a compressive strength of 3,500 psi. If such tests are not conducted, the pavement shall not be opened to

traffic until 14 days after the concrete was placed. Before opening to traffic, the pavement shall be cleaned and permanent lane markings applied to the pavement.

3.7 WALKS

- A. Walks shall consist of a coarse aggregate subbase and a reinforced concrete surface. Use No. 24 fine aggregate for subbase, unless otherwise shown. Concrete shall be Class "A", 4,000 psi concrete.
- B. Subbase shall be 2 inches thick, and concrete shall be 4 inches thick, unless otherwise shown.
- C. A minimum of three (3) feet, but not greater than five (5) feet distance between the curb and sidewalk.
- D. Handicap Accessible Ramps shall be installed at all intersections. Please see detail P-11.
- E. Compact subbase to not less than 95% of maximum dry density, as determined in accordance with AASHTO T99.
- F. Proportion, mix, and place concrete as specified in INDOTSS Sections 604 and 702. Walks shall have a broom surface finish. Edge all outside edges of walk and all joints with a 1/4inch radius edging tool.
- G. Unless otherwise shown on the drawings, walks shall be divided into sections not more than five feet in length by dummy joints formed by a jointing tool with a 1/4-inch radius.
- H. Form construction joints around all abutting structures and appurtenances such as manhole, utility poles, hatches, and hydrants. Install 1/2inch thick pre-molded expansion joint filler in construction joints. Expansion joint material shall extend for the full depth of the walk.
- I. If existing sidewalk is to be removed and replaced with new sidewalk or new sidewalk extended from existing sidewalk, the existing sidewalk shall be removed to the nearest joint of suitable quality or as directed by the City of Greensburg's Representative and/or the Homeowner's Association.

3.8 CURBS

- A. The construction of curbs, combination curb and gutter, and integral curb and gutter shall be in accordance with these specifications and as shown

on the plans and shall be in reasonably close conformance with the lines and grades shown on the plans.

- B. Excavation for curbs shall be made to the required depth, and the subgrade or base upon which the curb is constructed shall be compacted to a firm, even surface to not less than 95% of maximum dry density as determined in accordance with AASHTO T99.
- C. Concrete for curbs shall be Class A, 4,000 psi, as specified previously for Concrete Pavement.
- D. The curbs shall be constructed by the use of wood or metal forms; or, if approved by the Engineer, the curb may be constructed using a curb slipform machine. Forms, if used, shall be straight, free from warped or bent sections, and shall extend for the entire depth of the curb and shall be securely held in place so that no deviation from alignment and grade will occur during placement of concrete. The concrete shall be consolidated by vibration or other acceptable methods. The top of the curb shall be floated smooth and the top outer corner rounded to a 1/4inch radius.
- E. The face, top, and gutter of curbs shall not have deviations or irregularities of more than 1/4inch when checked with a 10-foot straightedge.
- F. Construction joints shall be placed at 10-foot intervals. The joint shall be uniform, of 1/8 to 1/4 inch in width, and to a depth of approximately 2-1/2 inches. The joint may be saw cut or formed by approved removable strips providing a straight joint at right angles to the length of curb. Joints shall be filled with specified bituminous joint filler material. Construction joints shall be formed around all abutting structures such as inlets and shall be as specified previously.
- G. As soon as possible after placing and finishing of concrete, the curbing shall be moistened and kept moist for three days, or cured with the use of a specified membrane compound.
- H. If existing curb is to be removed and replaced with new curb or new curb extended from existing curb, the existing curb shall be removed to the nearest joint of suitable existing curb.

3.9 LANE STRIPING

- A. Lane striping is to be in accordance with all applicable standards of INDOTSS 808 and the construction plans.

- B. Parking lots are to be striped with standard white road paint. Spaces to be striped shall be 9 feet 0 inches wide by 18 feet 0 inches long with 4 inch wide stripes.
- C. Contractor will not permit traffic on any new pavement surface prior to striping.
- D. Contractor will clean the new pavement surface to remove all dust, dirt, mud and debris prior to striping.

3.10 TESTING FOR HOT MIX ASPHALT (HMA)

- A. The Contractor shall employ and pay for the services of a competent independent testing laboratory to take cores at selected locations and perform described tests. Compaction requirements for HMA mixtures placed in accordance with INDOTSS Section 402 shall be controlled by in place density determined from cores cut from the compacted pavement. A minimum of two cores per section shall be cut for each course of each material or as directed by the Engineer. Sections are defined as a maximum of 1000 Mg (1041 ton) of HMA base or intermediate or 600 Mg (624 ton) of HMA surface. The transverse core location shall be located so that the edge of the core will be no closer than 75 mm (3 inches) from a confined edge or 150 mm (6 inches) from a non-confined edge of the course being placed.
- B. For compaction of HMA mixtures with quantities less than 100 Mg (104 ton) per day, acceptance may be visual as determined by the City of Greensburg's Representative.
- C. The Contractor along with their independent testing lab representative shall obtain cores in the presence of the Engineer with a device that shall produce a uniform 150 mm (6 inches) in diameter pavement sample. Each HMA course shall be cored within one work day of placement. Damaged core(s) shall be discarded and replaced with a core from a nearby location as selected by the Engineer.
- D. The Contractor, in the presence of the Engineer, shall mark the core to define the course to be tested. If the defined area is less than 1.5 times the maximum particle size, the core will be discarded and a core from a new random location will be selected for testing as determined by the Engineer. Within one work day of coring operations the Contractor shall clean, dry, refill and compact the core holes with suitable material approved by the Engineer.

- E. The Contractor's testing lab representative shall take immediate possession of the cores. If the cores are subsequently damaged, additional coring within the specific section(s) will be required at locations to be determined by the Engineer.
- F. Each core shall be tested within one work day of coring operation to determine thickness, bulk specific gravity, aggregate gradation and binder content. Test results shall then be transmitted either verbally or by other means to both the Contractor and the Engineer for verification before each subsequent bituminous lift is placed.

1. Average thickness of the cores shall not vary from the plan thickness more than 12.5 mm (0.5 inch) for HMA base and intermediate course(s) and 6.25 mm (0.25 inch) for HMA surface course(s) for acceptance in accordance with INDOTSS section 105.03.
2. The bulk specific gravity shall be determined in accordance with AASHTO T166 or AASHTO T 275. The in place density of a section for a mixture shall be expressed as:

$$\text{Density \%} = (\text{BSG}/\text{MSG}) * 100$$

Where:

BSG = bulk specific gravity as determined from independent testing laboratory

MSG = maximum specific gravity as reported on job mix formula.

3. The calculated density of the cores shall not be less than 90% nor more than 96% a set out above. Test results which are outside stated limits shall be considered and adjudicated as a failed material in accordance with INDOTSS Section 105.03.
- G. The Contractor's independent testing laboratory representative shall determine the aggregate gradation and binder content of the core samples in accordance with ITM 571. Aggregate gradation shall be within tolerances set forth in INDOTSS Section 402.04 and binder content shall be within ± 0.5 percent from the job mix formula. Test results which are outside the stated limits shall be considered and adjudicated as a failed material in accordance with INDOTSS Section 105.03.

- H. A copy of all core test results shall be submitted to the Engineer for verification of specification compliance within one calendar week of core testing.
- I. The Contractor shall make the following tests at no additional cost to the City of Greensburg, and they shall be as specified in this Article and requested by the Engineer. Perform tests in accordance with the following ASTM Specifications:

<u>Test</u>	<u>ASTM Specification</u>
Slump	C143
Air Content	C173
Test Cylinders	C31 or C513
Core Samples	C42
Fly Ash	C311

1. Measure slump each time test beams or cylinders are to be made and at any other time requested by the Engineer. The slump shall be as specified in INDOTSS Section 501.03, or as otherwise specified herein, unless specifically excepted by the Engineer.
2. Measure air content each time test beams or cylinders are to be made and at any other time requested by the Engineer. The field test may be omitted if the air content is known prior to taking samples. The field test may not be omitted if fly ash is used in the mix.
3. Concrete paving mixes shall comply with guidelines of INDOTSS Section 501.03 and shall meet the testing requirements of Section 501.03 (a). However, in lieu of forming test beams as described in Section 501.03 (a) 2, the Contractor may substitute cylinder tests as follows:
 - a. Make test cylinders in sets of four. Field cure one cylinder and break at seven days. Laboratory cure the remaining three cylinders and break at 28 days. The Contractor shall be responsible for handling and transportation of cylinders.
 - b. If fly ash is used in the mix, a total set of seven cylinders shall be taken. The additional three cylinders shall be laboratory cured and broken at 56 days, if the 28-day strength does not meet specifications.
 - c. Make one set of test cylinders for each 100 cubic yards, or fraction of 100 cubic yards, of concrete placed; or at other times requested by the Engineer.

- d. Unless otherwise specified, concrete shall have a 28-day compressive strength of 4,000 psi, as demonstrated by laboratory tests of cylinders.

3.11 PROTECTION

- A. Maintain compacted aggregate subbase and surface true to line and grade and required density. Maintain subbase until prime coat is placed. Maintain surface until job is complete.
- B. Do not permit vehicular traffic of any kind on any bituminous course until the bituminous mixture has hardened sufficiently not to be distorted beyond specified tolerances. Remove any foreign material which is on the surface of any course before the course is rolled or any subsequent course is placed.
- C. Do not permit traffic on concrete pavement or walks until concrete has developed sufficient strength not to be marked or damaged. Do not permit vehicular traffic on concrete for at least 14 days.
- D. Repair or replace damaged pavement and walks to the satisfaction of the Engineer.

3.12 CLEANUP

Clean up the job site following pavement and surfacing restoration. Remove all rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable condition.

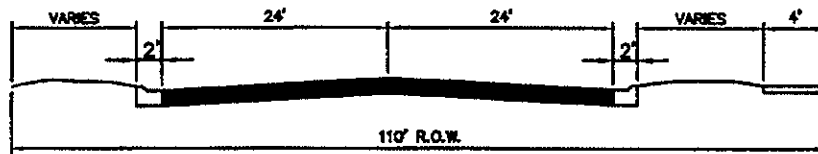
PART 4 - FIGURES

4.1 STANDARD PAVEMENT DETAILS

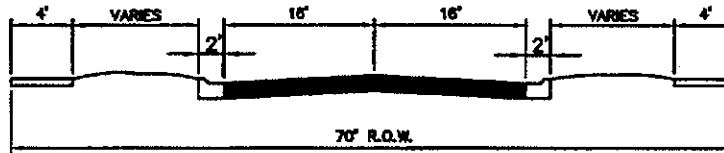
<u>FIGURE</u>	<u>DESCRIPTION</u>
P-1	Minimum Pavement Cross-sections
P-2	Minimum residential subdivision entrance from a thoroughfare
P-3	Typical Pavement Sections
P-4	Pavement Cross-section-joint Locations
P-5	Joint Detail
P-6	Structure Details
P-7	Joint Location
P-8	Concrete Curb and Gutter Type I & II

P-9	Pipe Underdrain
P-10	Sidewalk Details
P-11	Sidewalk for Handicapped
P-12	Subdivision Cul-de-sac
P-13	Subdivision Temporary Cul-de-sac
P-14	Standard Barricade
P-15	Street Signs
P-16	Residential Driveways
P-17	Typical Driveway Section
P-18	Repair of Cuts within Pavement Limits
P-19	Repair of Cuts within Pavement Limits (cont.)
P-20	Repair of Cuts within Pavement Limits (cont.)
P-21	Bicycle/Jogging Path

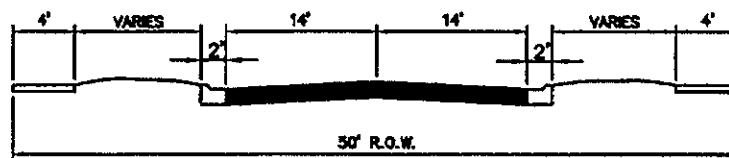
END OF SECTION 02500



PRINCIPAL OR MINOR ARTERIAL (2 LANE)



COLLECTOR (NO PARKING)



LOCAL (NO PARKING)

MINIMUM PAVEMENT CROSS SECTIONS

HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

JUNE, 2001

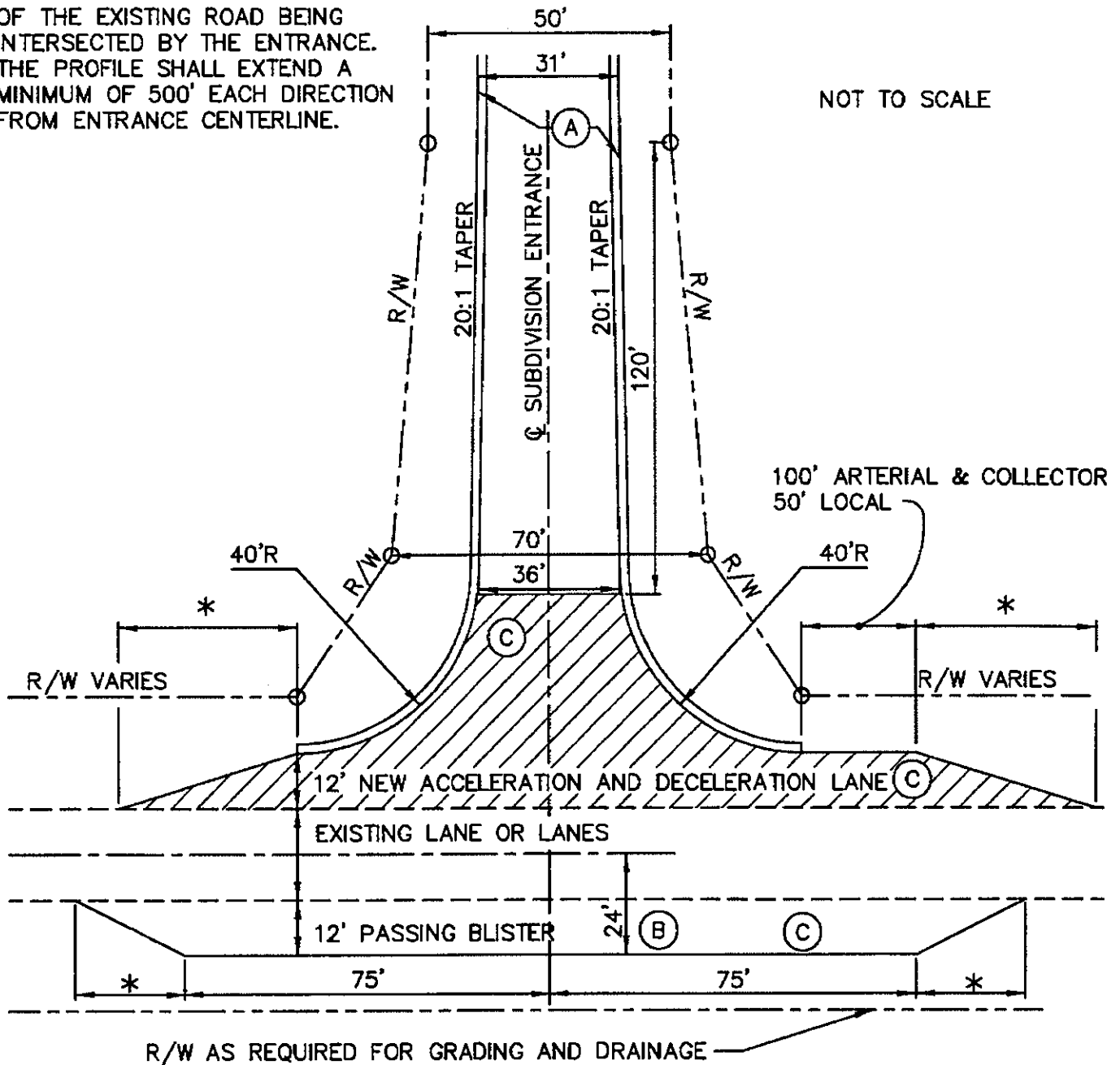
FIGURE P-1

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NOTE:
CONSTRUCTION PLANS SHALL
INCLUDE CENTERLINE PROFILE
OF THE EXISTING ROAD BEING
INTERSECTED BY THE ENTRANCE.
THE PROFILE SHALL EXTEND A
MINIMUM OF 500' EACH DIRECTION
FROM ENTRANCE CENTERLINE.

NOT TO SCALE



(A) 2' CURB & GUTTER

(B) PASSING BLISTER WHEN REQUIRED

(C) LANE WIDENING SHALL MATCH EXIST. PAVEMENT SURFACE TYPE

* 150' ARTERIAL
100' COLLECTOR
75' LOCAL

MINIMUM RESIDENTIAL SUBDIVISION ENTRANCE FROM A THOROUGHFARE

HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

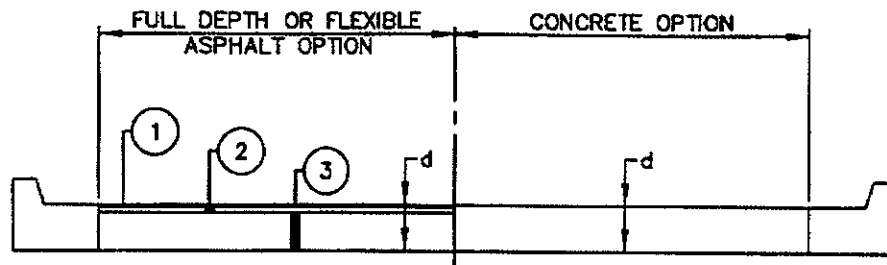
CITY OF GREENSBURG, INDIANA

JUNE, 2001

FIGURE P-2

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LOCAL STREETS

d=12" ASPHALT SURFACE
W/ AGGREGATE BASE

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 8" COMPACTED AGGREGATE TYPE (TYPE "O") (2-LIFTS)

d=9" FULL DEPTH ASPHALT

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 5" BASE #5

d=6" CONCRETE

COLLECTOR STREETS

d=16" ASPHALT SURFACE
W/ AGGREGATE BASE

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 12" COMPACTED AGGREGATE (TYPE "O") (2-LIFTS)

d=11" FULL DEPTH ASPHALT

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 7" BASE #5

d=7" CONCRETE

PRIMARY AND SECONDARY ARTERIAL STREETS

d=20" ASPHALT SURFACE
W/ AGGREGATE BASE

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 14" COMPACTED AGGREGATE (TYPE "O") (2-LIFTS)

d=12" FULL DEPTH ASPHALT

- ① 1" SURFACE #11
- ② 3" BINDER #9
- ③ 8" BASE #5 (2 LIFTS)

d=8" CONCRETE

GENERAL NOTES:

1. IF GREATER THAN 10% TRUCK TRAFFIC IS ANTICIPATED, ADD 1" TO ALL TOTAL THICKNESSES.
2. DEPTH OF CONCRETE CURB SHALL EQUAL DEPTH OF CONCRETE PAVEMENT.

TYPICAL PAVEMENT SECTIONS

NO SCALE

HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

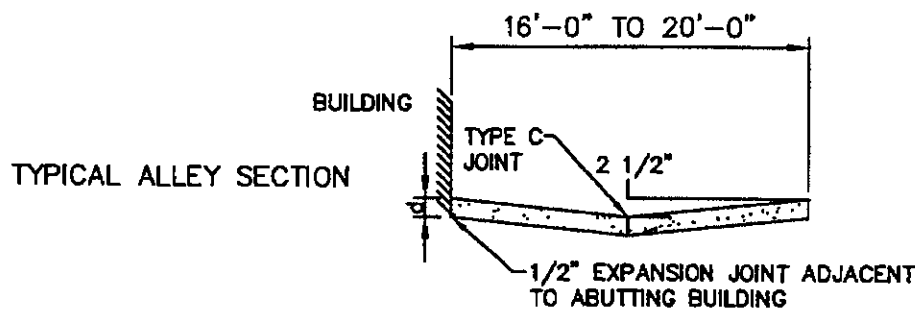
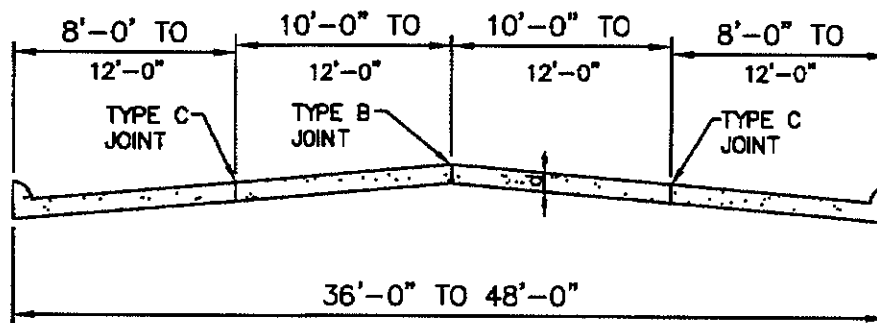
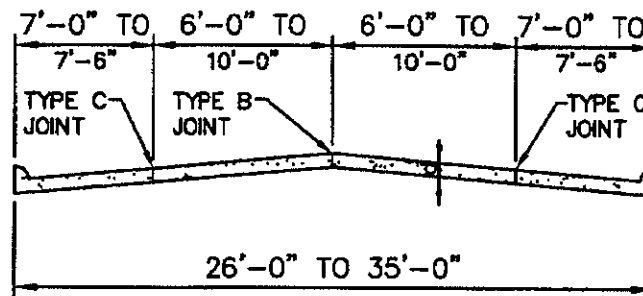
JUNE 2001

FIGURE P-3

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PAVEMENT CROSS SECTIONS--JOINT LOCATIONS

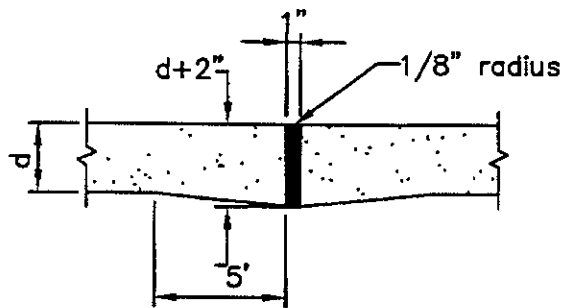
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INDIANAPOLIS, INDIANA

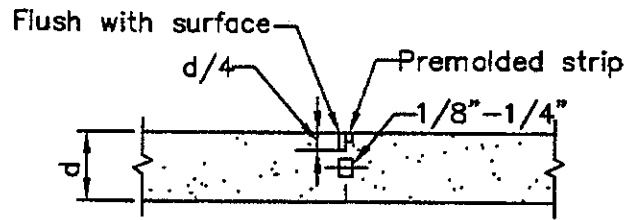
CITY OF GREENSBURG, INDIANA

JUNE 2001

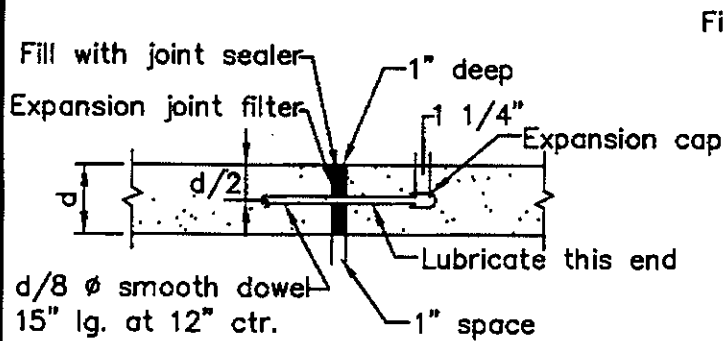
FIGURE P-4



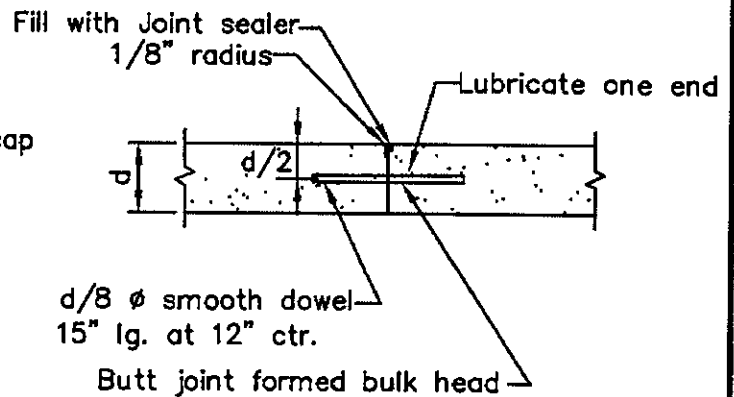
TYPE A
EXPANSION JOINT



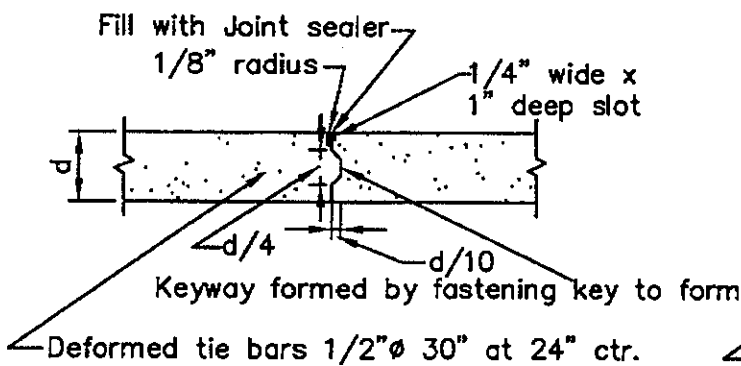
TYPE C
SAWED OR PREMOLDED STRIP
Longitudinal or Transverse



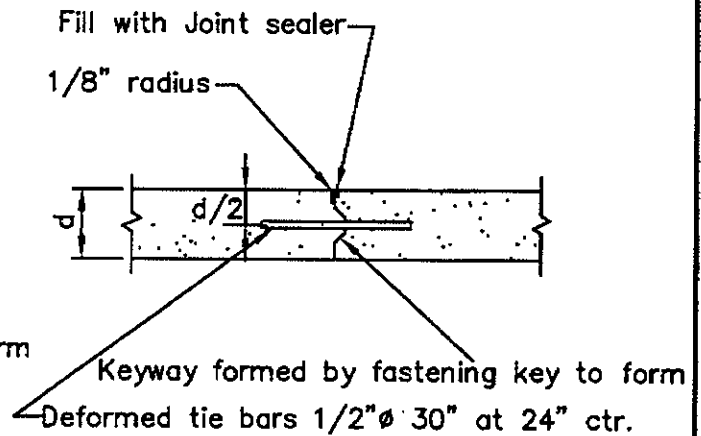
TYPE A-ALTERNATE
EXPANSION JOINT



TYPE D
TRANSVERSE CONSTRUCTION JOINT



TYPE B
LONGITUDINAL CONSTRUCTION JOINT



TYPE E
TIED TRANSVERSE CONSTRUCTION JOINT

JOINT DETAILS

HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

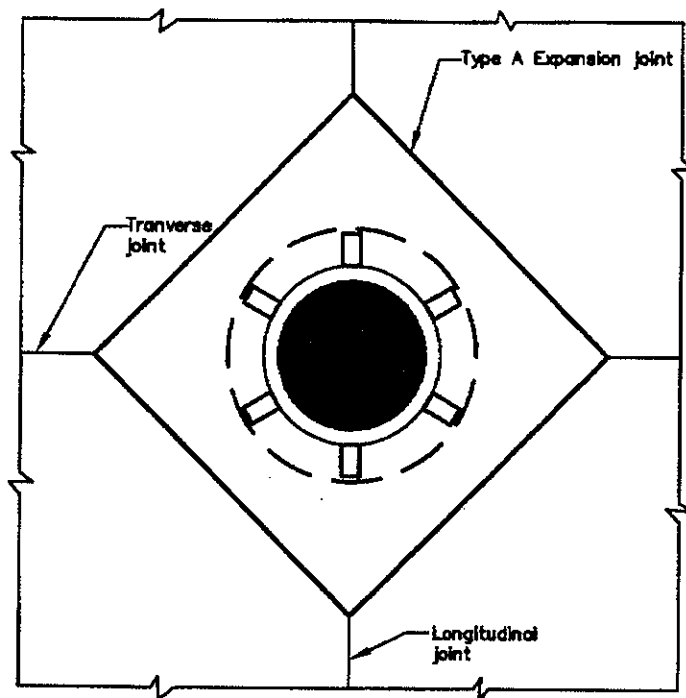
CITY OF GREENSBURG, INDIANA

JUNE 2001

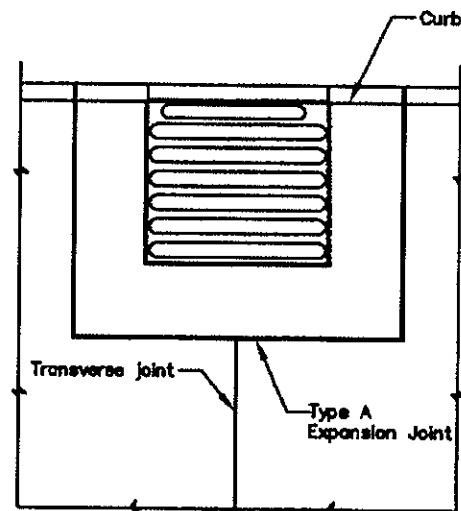
FIGURE P-5

Scale: 1:1

File name: \\NVRON\32980\CONST\STD\STREETS\POS.dwg



Manhole Boxout



Catch Basin Boxout

1. All catch basins shall be separated from the pavement and curb by boxing out around basin as shown above. Expansion joint material shall extend completely through curb and slab. Manhole castings within the pavement limits shall be boxed in like manner except when telescoping-type castings are used.
2. When a joint falls within 5 ft. of or contacts basins, manholes, or other structures, shorten one or more panels either side of opening to permit joint to fall on round structures and at or between corners of rectangular structures.

STRUCTURE DETAILS

HNTB

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INDIANAPOLIS, INDIANA

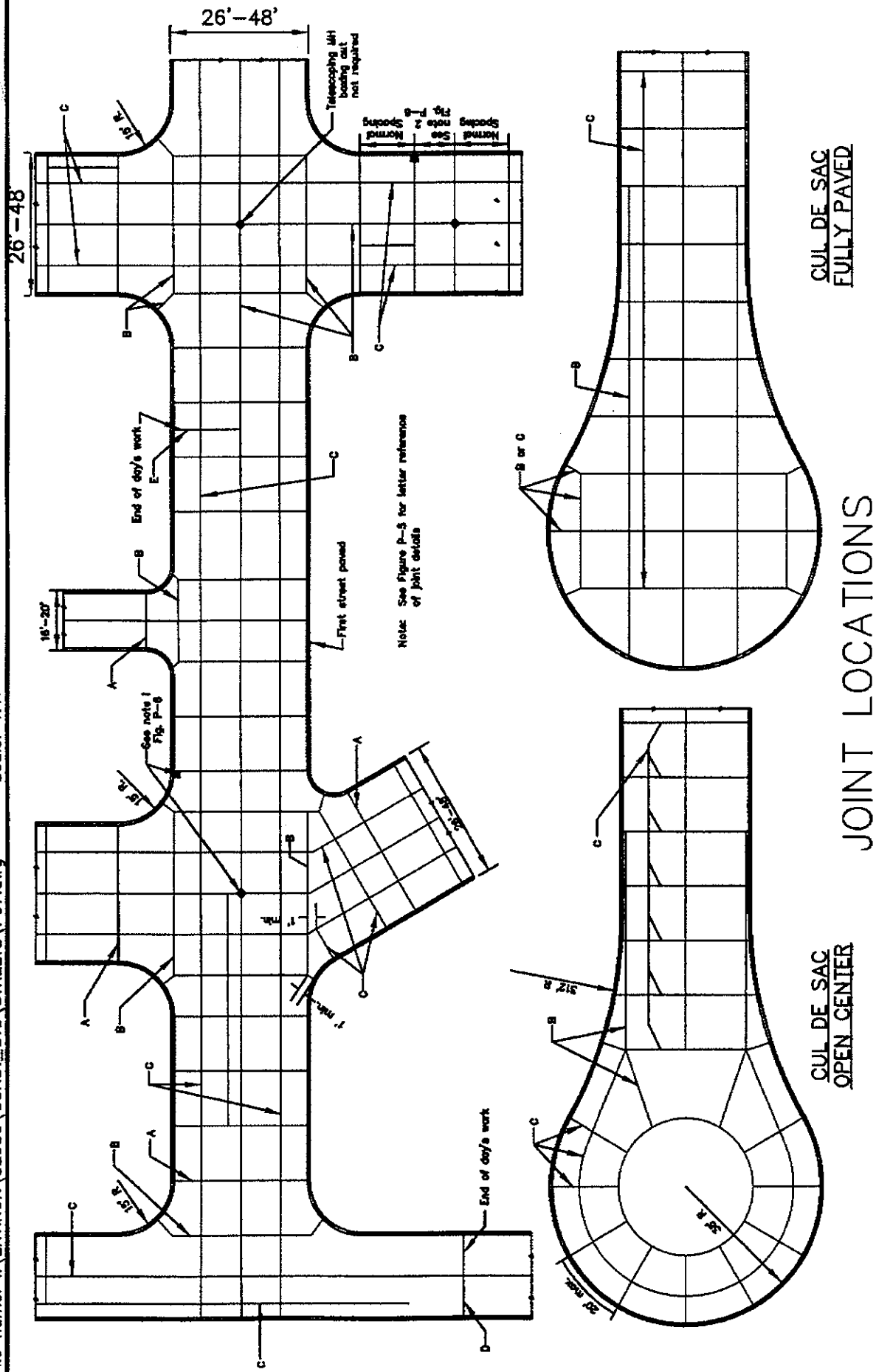
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-6

Scale: 1:1

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MTZI

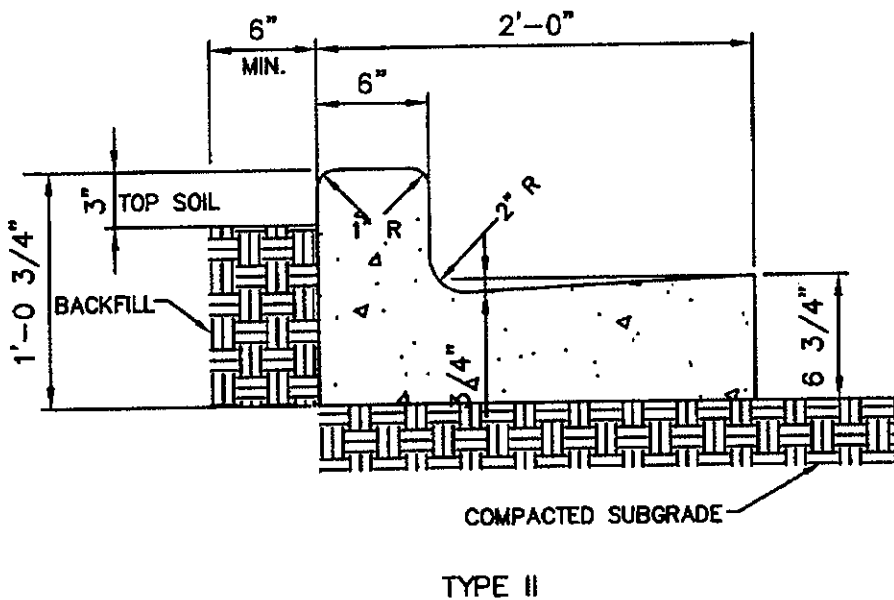
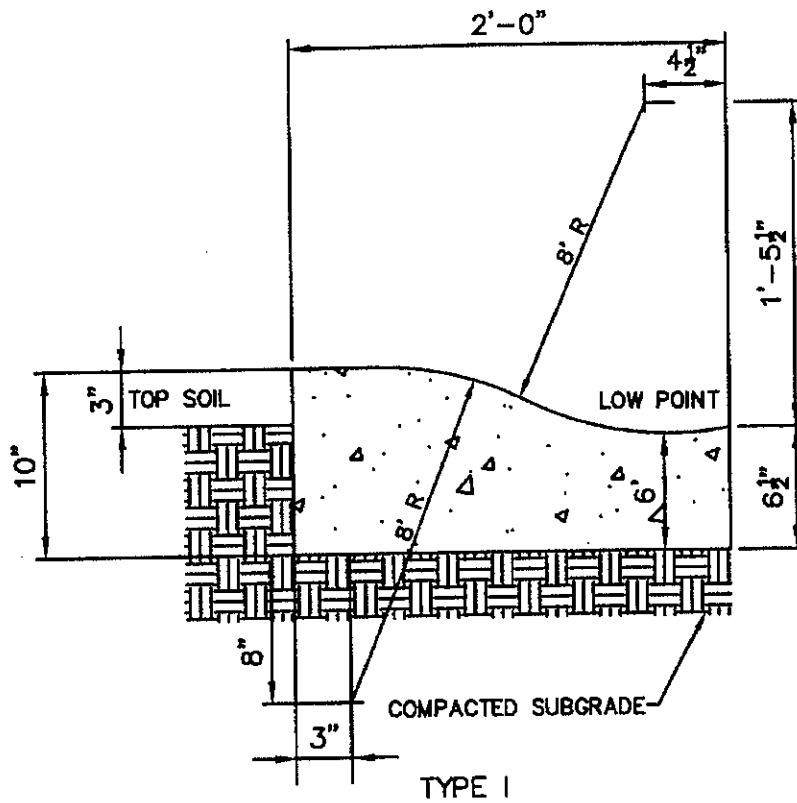
HOWARD NEEDLES TAMMEN & BERGENDOFF
INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

JUNE 2001

Scale: 1:1

File name: I:\IRON\32980\CONST_STD\STREETS\PO8.dwg



CONCRETE CURB & GUTTER TYPE I & II

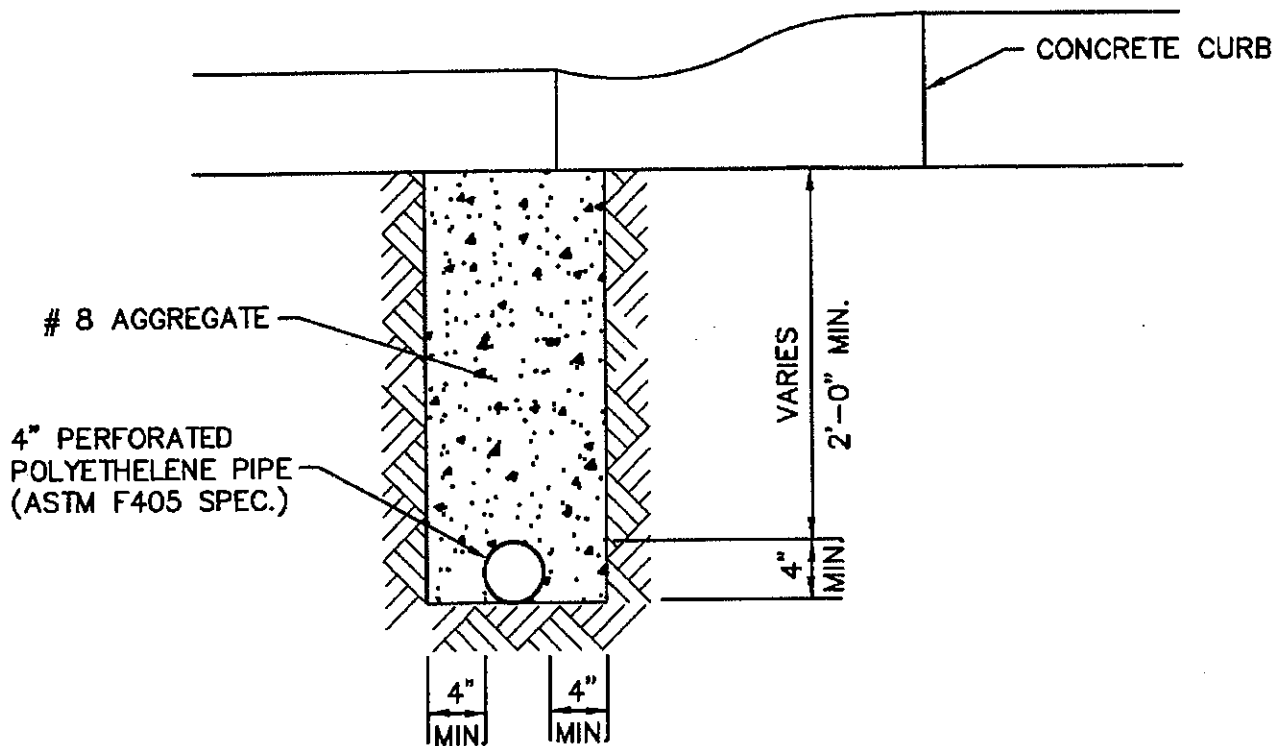
HNTB

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INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-8



NOTE: MATERIALS AND INSTALLATION SHALL MEET THE INDOT STANDARDS AS SPECIFIED IN SECTION 718 "UNDERDRAINS"

PIPE UNDERDRAIN DETAIL

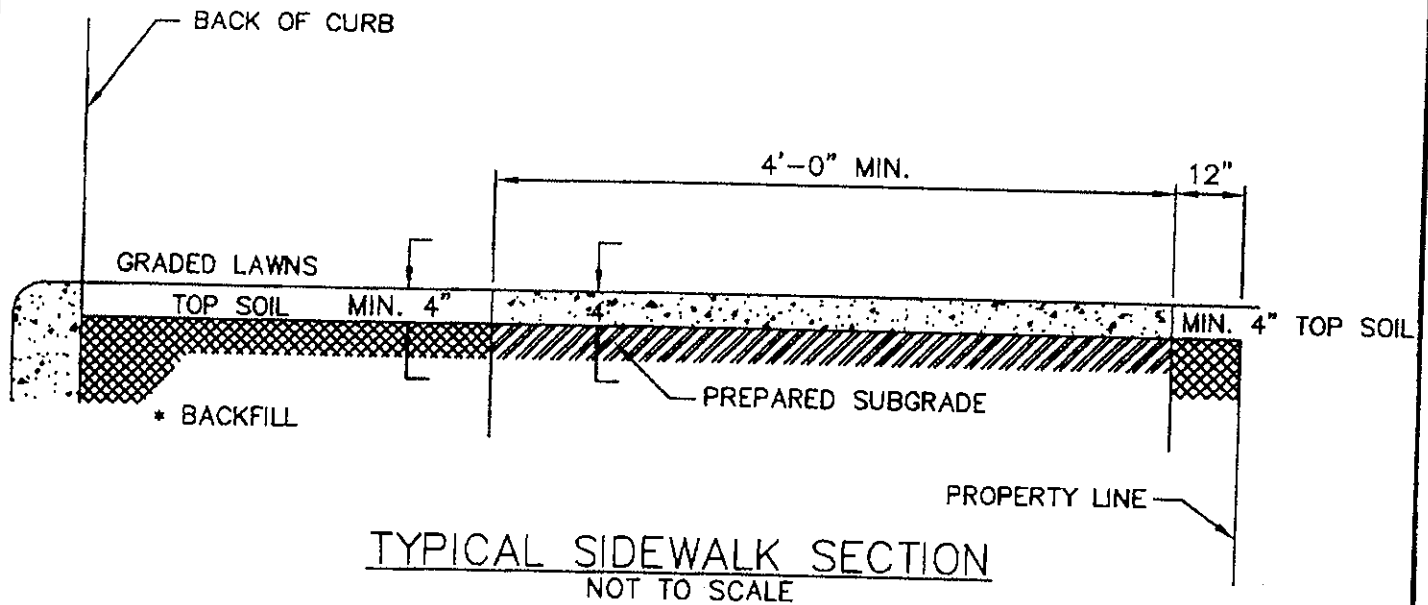
HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

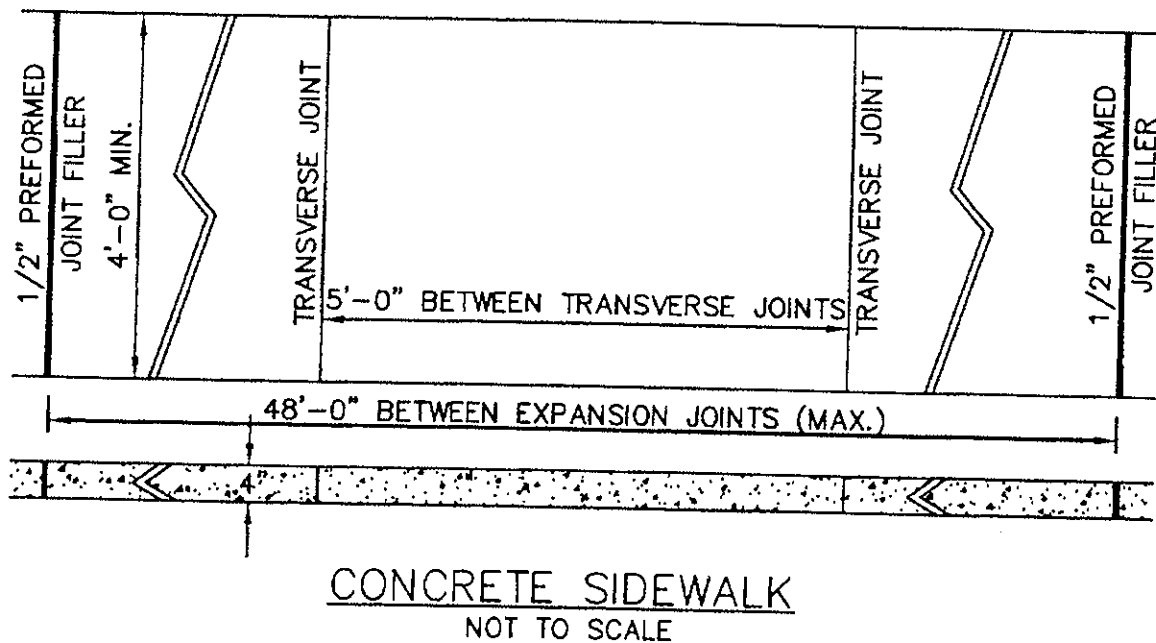
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-9



- * THE SPACE BEHIND THE CURB SHALL BE FILLED WITH SUITABLE MATERIAL TO THE REQUIRED ELEVATION AND COMPACTED IN LAYERS NOT TO EXCEED 6" IN DEPTH.
- SUBGRADE UNDER ALL CURBS, SIDEWALKS, AND DRIVES SHALL BE COMPACTED IN ACCORDANCE WITH I.N.D.O.T. SPECIFICATIONS.



SIDEWALK DETAILS

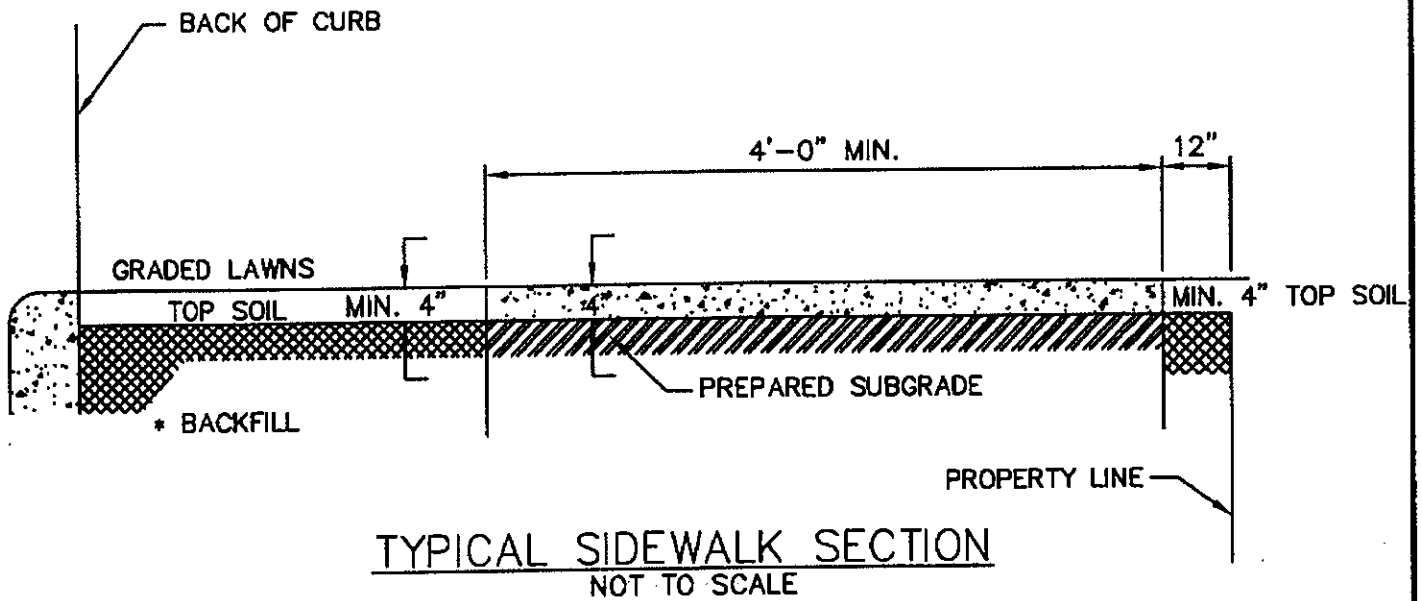
HNTB

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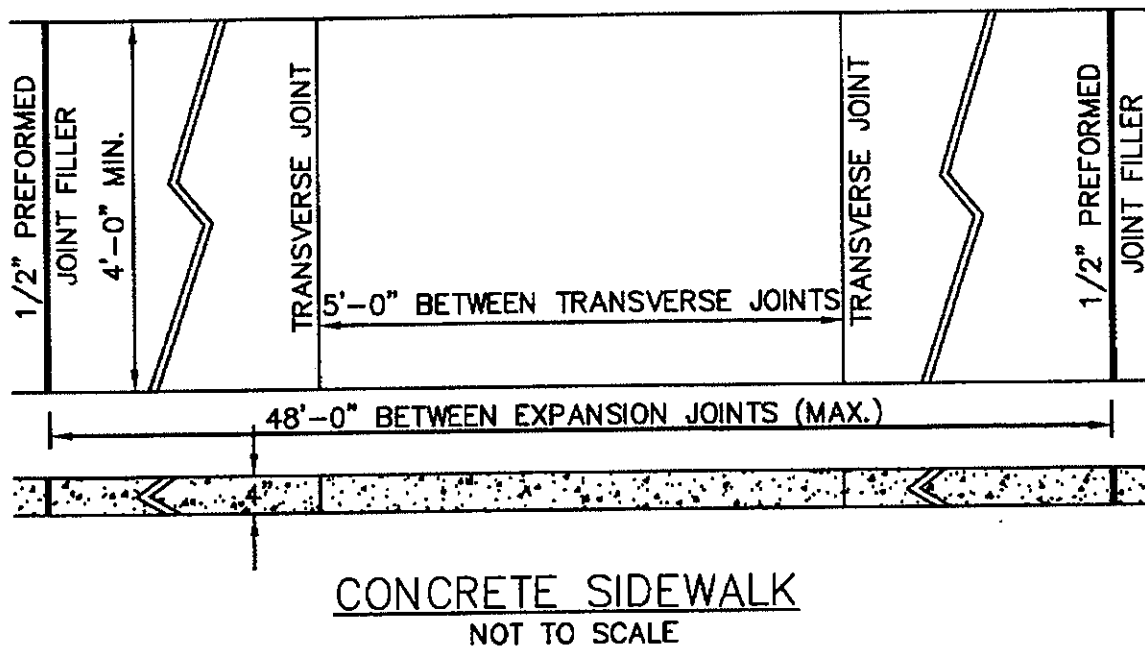
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-10



- * THE SPACE BEHIND THE CURB SHALL BE FILLED WITH SUITABLE MATERIAL TO THE REQUIRED ELEVATION AND COMPACTED IN LAYERS NOT TO EXCEED 6" IN DEPTH.
- SUBGRADE UNDER ALL CURBS, SIDEWALKS, AND DRIVES SHALL BE COMPACTED IN ACCORDANCE WITH I.N.D.O.T. SPECIFICATIONS.



SIDEWALK DETAILS

HNTB

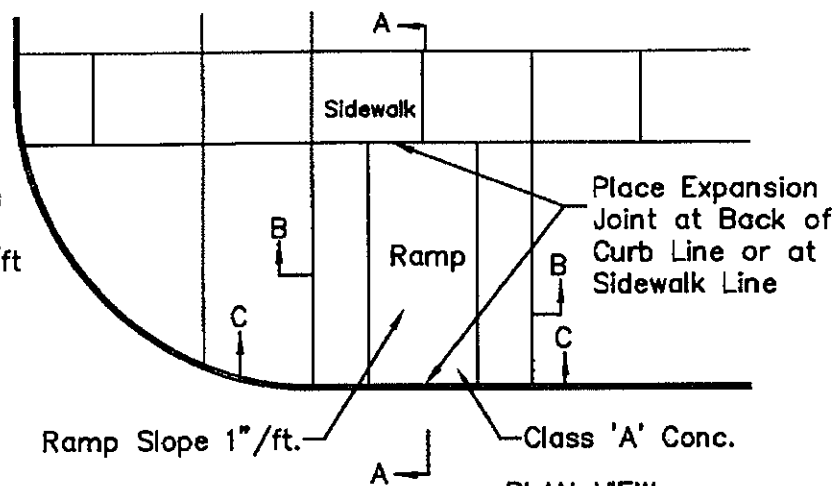
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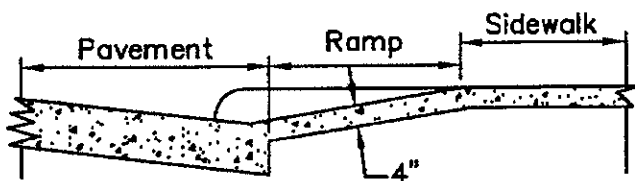
FIGURE P-10

Side Slope Varies uniformly to a maximum of 4"/ft of Gutter Line

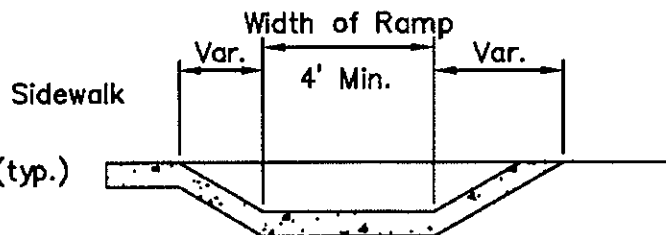


PLAN VIEW

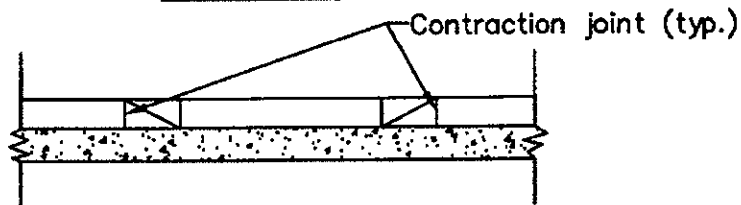
NOTE: DIMENSIONS SHOWN SHALL BE USED AND THE LATEST INDOT UPDATE



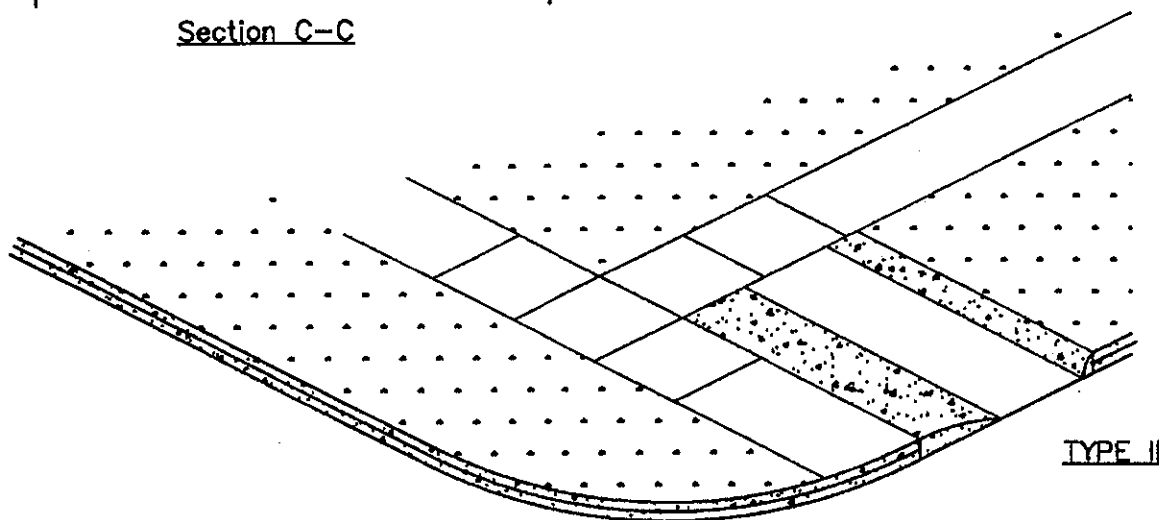
Section A-A



Section B-B



Section C-C



TYPE II

SIDEWALK RAMP FOR HANDICAPPED

HNTB

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INDIANAPOLIS, INDIANA

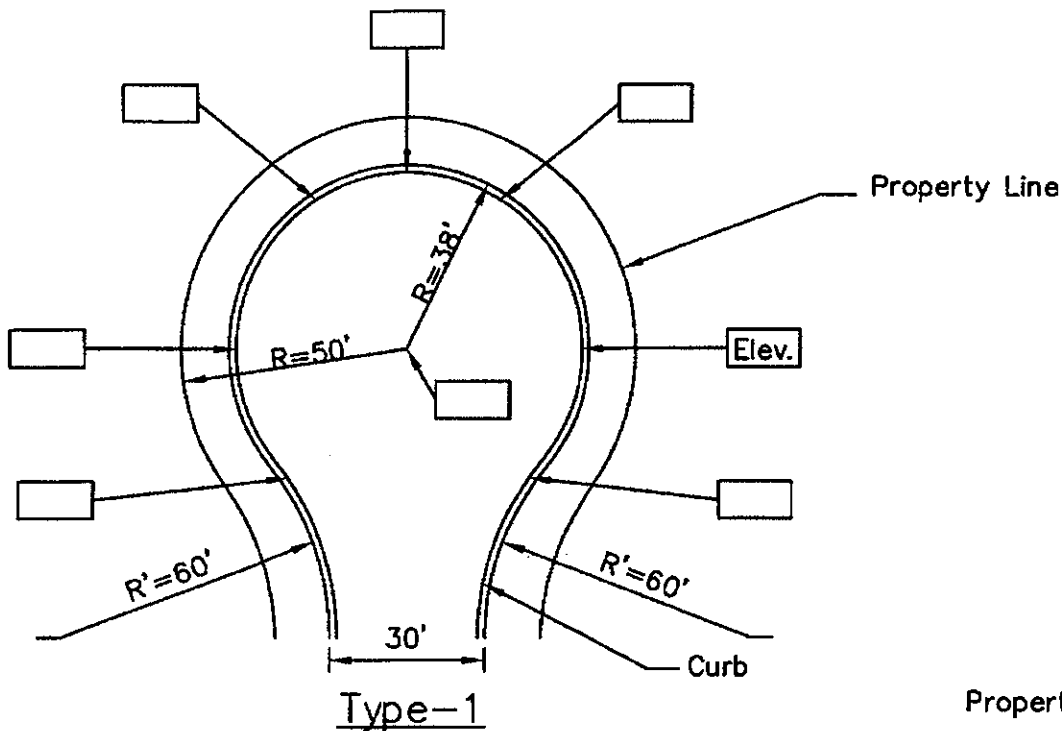
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-11

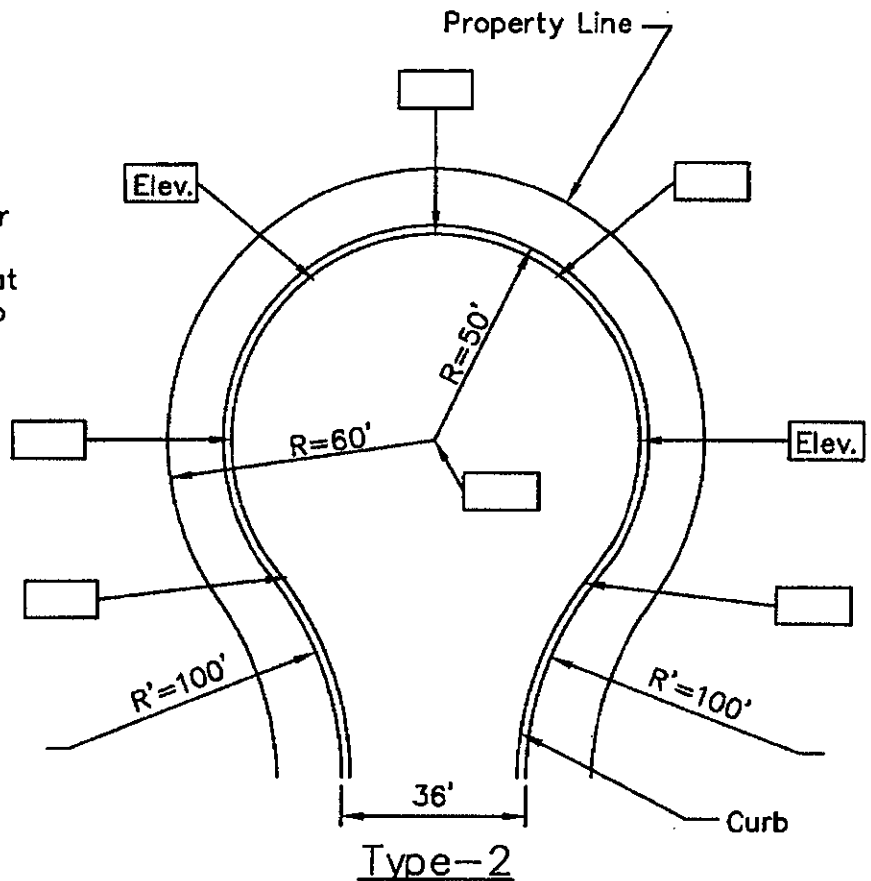
Scale: 1:1

File name: I:\ENVIRON\32980\CONST_STD\STREETS\P11.dwg



GENERAL NOTES:

1. Type-1 shall be used only in Residential subdivisions; all other use Type-2.
2. Warning signs shall be posted at entrance to street, indicating no outlet.
3. Detail shall be identified by street name.
4. Elevations provided shall be proposed flow line of gutter.
5. One detail shall be provided for each cul-de-sac.
6. Scale shall be $1"=40'$ or larger.



SUBDIVISION CUL-DE-SAC

HNTB

ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

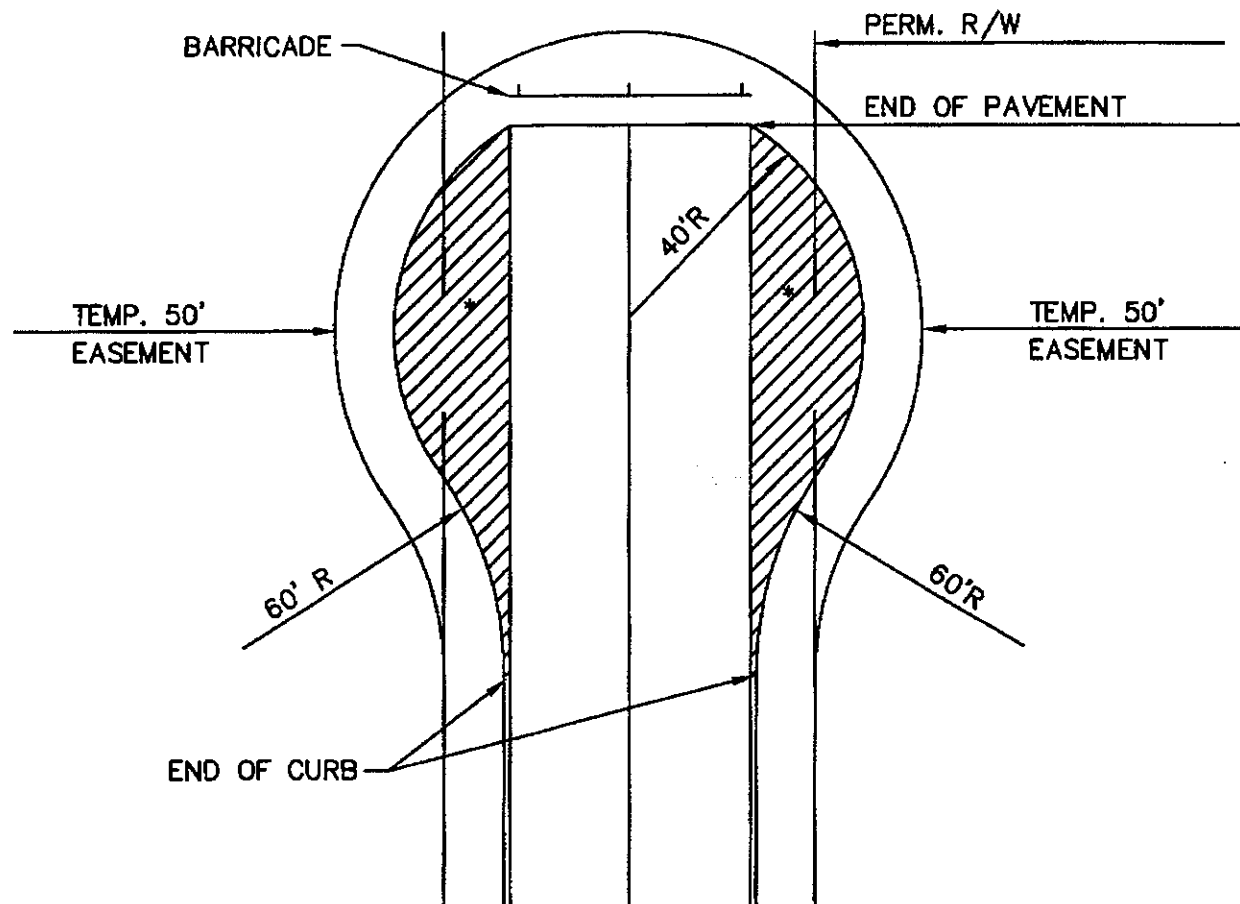
CITY OF GREENSBURG, INDIANA

JUNE 2001

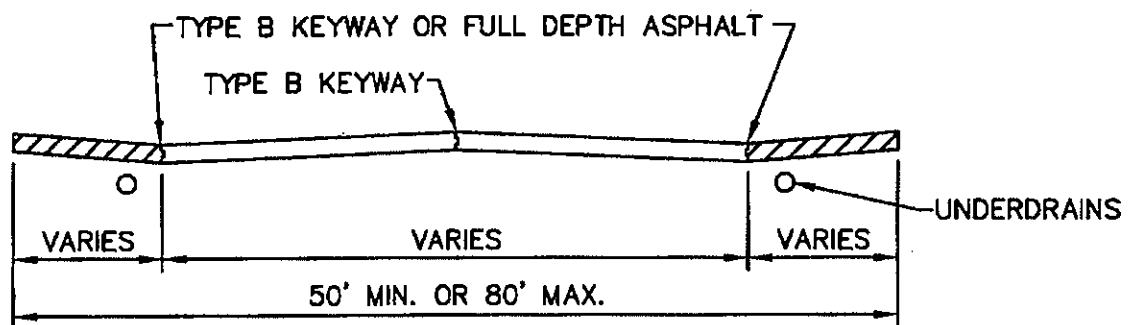
FIGURE P-12

Scale: 1:1

File name: \\NVRON\32980\CONST_STD\STREETS\P12.dwg



* TO BE REMOVED WHEN THE STREET IS CONTINUED.
THICKNESS AND TYPE TO MATCH PERMANENT PAVEMENT.



NOT TO SCALE

SUBDIVISION TEMPORARY CUL-DE-SAC

HNTB

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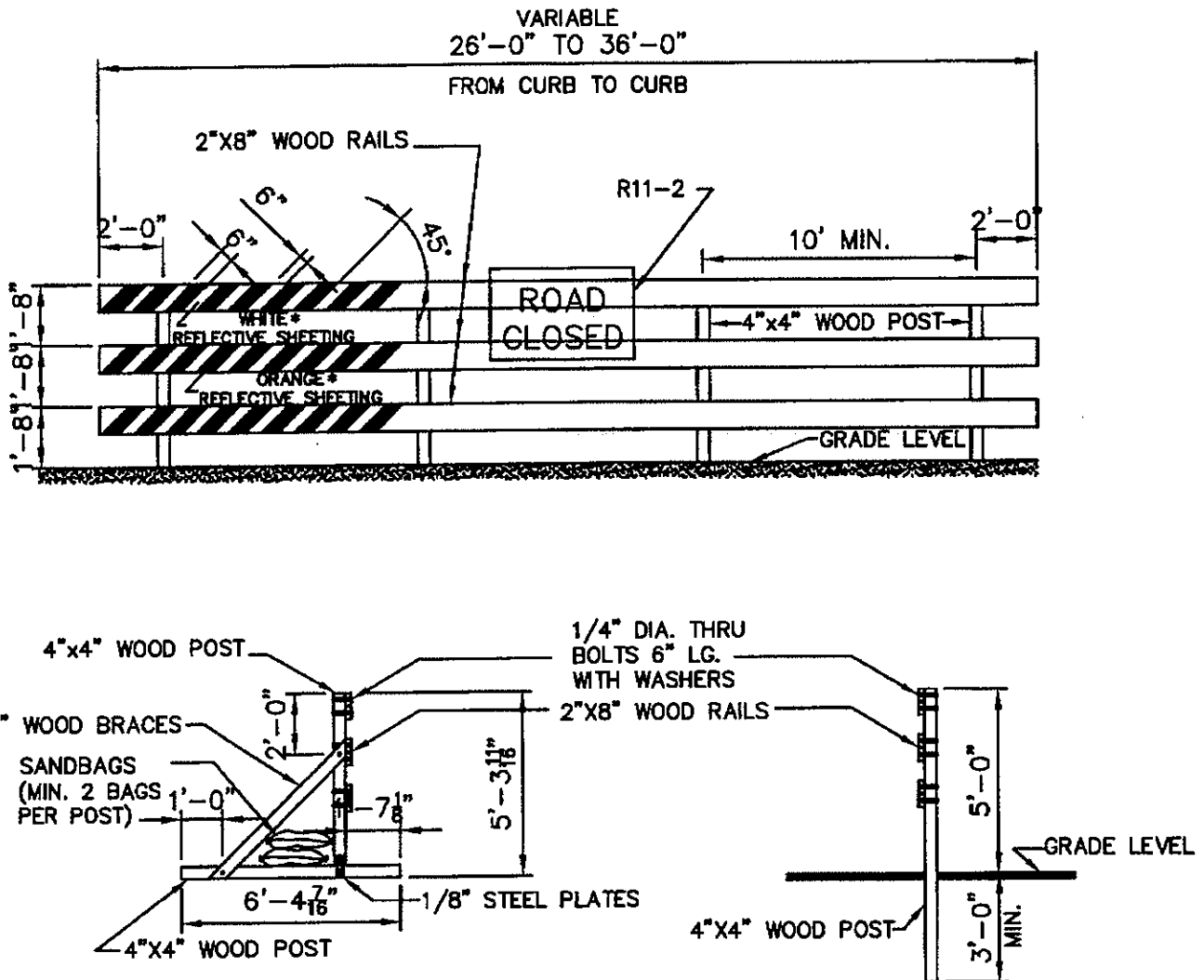
JUNE 2001

FIGURE P-13

Scale: 1:1

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RESIDENTIAL STREETS ONLY



- ① ALL WOOD POST AND SUPPORT MEMBERS SHALL BE PAINTED WITH TWO (2) COATS OF WHITE PAINT.
- ② LOCATION OF BARRICADE AS PER PLANS.
- ③ REFLECTIVE SHEETING TO BE IN ACCORDANCE WITH I.N.D.O.T. STANDARD SPECIFICATIONS.

- ⑤ REFER TO SECTION 801 OF THE INDIANA DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS AND LATEST ADDITION OF INDIANA MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
- ⑥ WHEN THE PROPOSED EXTENSION OF THE STREET IS TO BE a) LESS THAN TWO (2) YEARS USE THE SANDBAGS ON POSTS
b) GREATER THAN TWO (2) YEARS USE THE GROUND POSTS.

STANDARD BARRICADE

HNTB

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CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-14

Scale: 1:1

File name: C:\ENVIRON\32980\CONST_STD\STREETS\P14.dwg

SIGN MATERIALS:

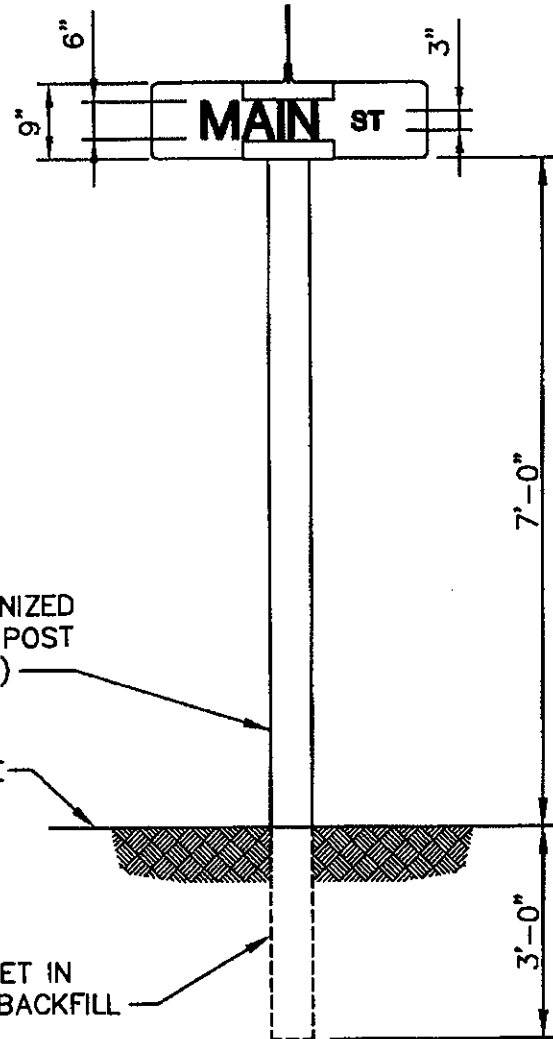
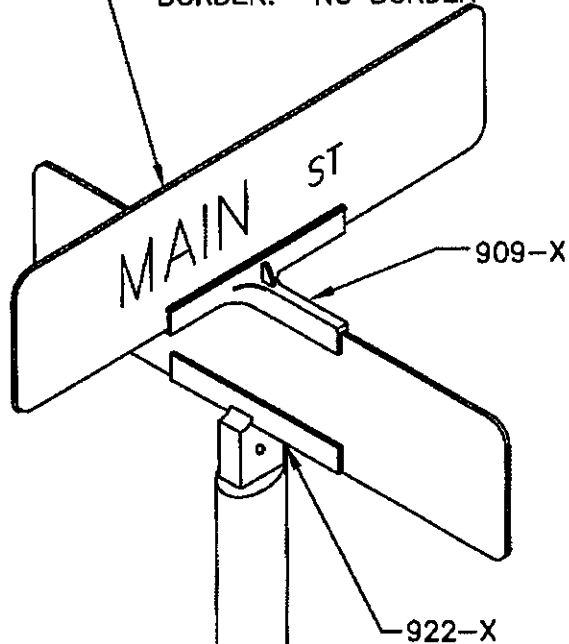
BLANK: 9" EXTRUDED ALUMINUM, 4-HOLE PUNCH FOR VPA HARDWARE

BACKGROUND: GREEN REFLECTIVE ASTM TYPE III

STREET NAME LETTERS: WHITE REFLECTIVE ASTM TYPE III 6" C OR B SERIES

STREET NAME SUFFIX: WHITE REFLECTIVE ASTM TYPE III 3" C OR B SERIES

BORDER: NO BORDER



12' - GALVANIZED
ROUND SIGN POST
(2 3/8" O.D.)

FINISH GRADE

DRIVEN OR SET IN
COMPACTED BACKFILL

NOTE: SIGN TO SUPPLIED BY HALL SIGN CO.
BLOOMINGTON, IN OR FISHER SIGN CO.

STREET SIGN DETAIL

HNTB

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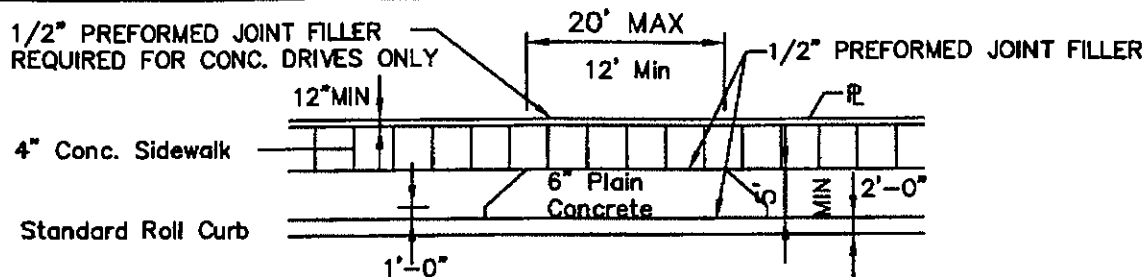
CITY OF GREENSBURG, INDIANA

JUNE 2001

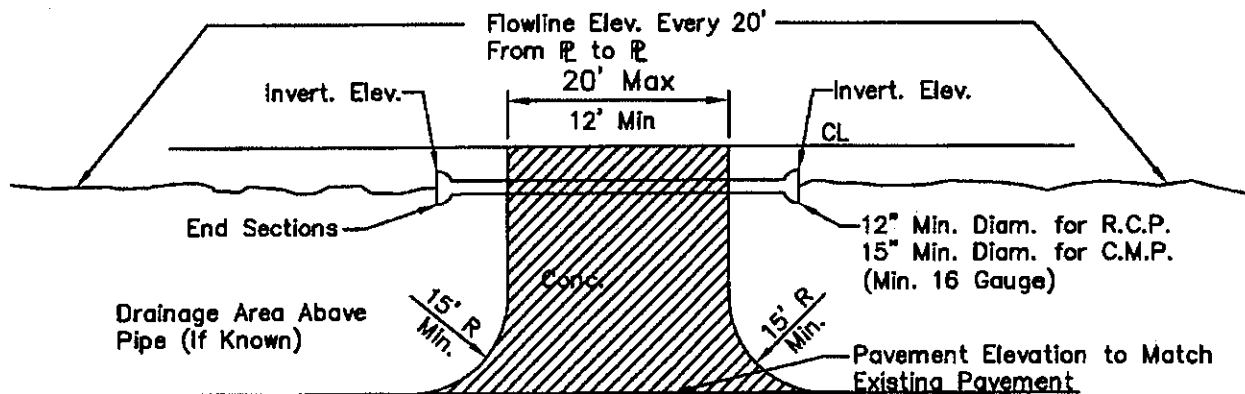
FIGURE P-15

Scale: 1:1

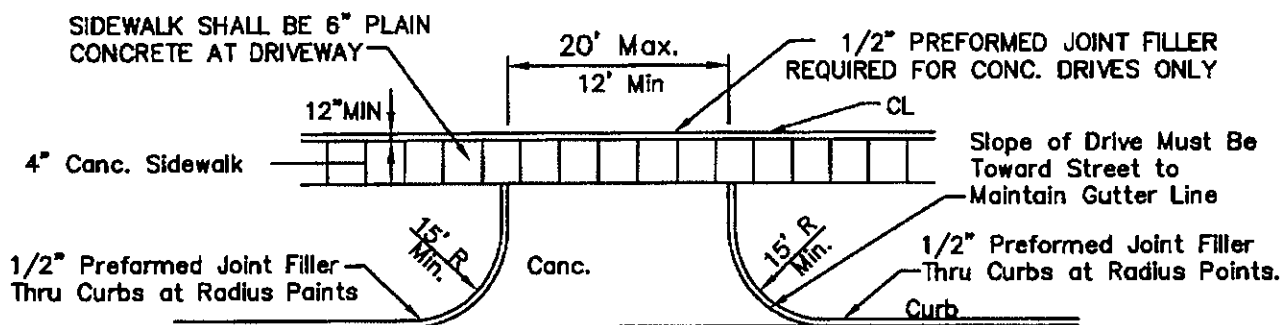
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PRIVATE DRIVE WITH ROLLED
CURB AND GUTTER WITH SIDEWALK



PRIVATE DRIVE WITH OPEN DITCHES



GENERAL NOTES

1. Cross-hatched areas shall be either 6" plain concrete or 1" bituminous surface on 2" bituminous base on 4" Type "O" No. 53 compacted aggregate base extending to the sidewalk or R/W Line whichever is nearest to the roadway.
2. Metal or Concrete end section shall be constructed on all pipes.
3. Subgrade under all curbs, sidewalks and drives shall be compacted in accordance with I.N.D.O.T.
4. Sidewalks shall be constructed in accordance with the appropriate standard and shall be continuous across the driveway.

RESIDENTIAL DRIVEWAYS



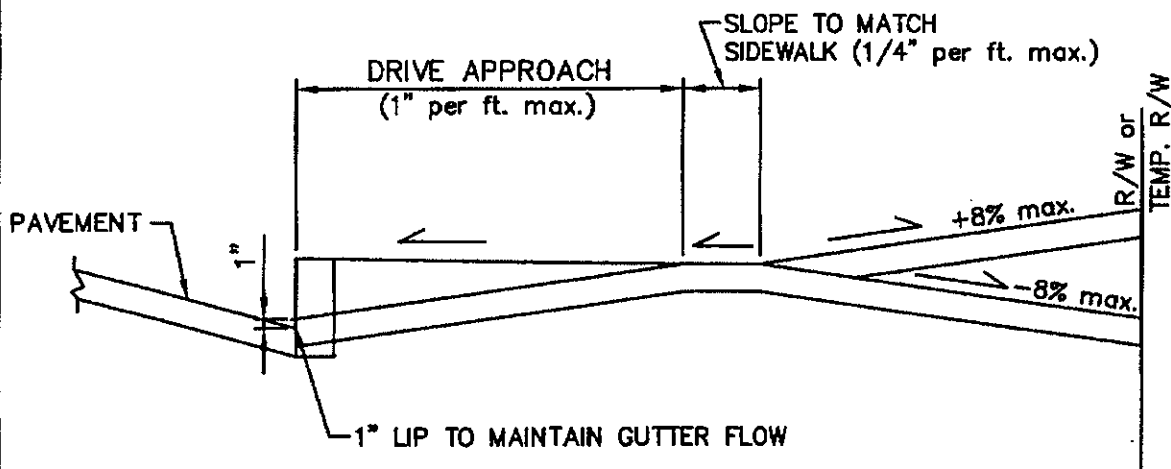
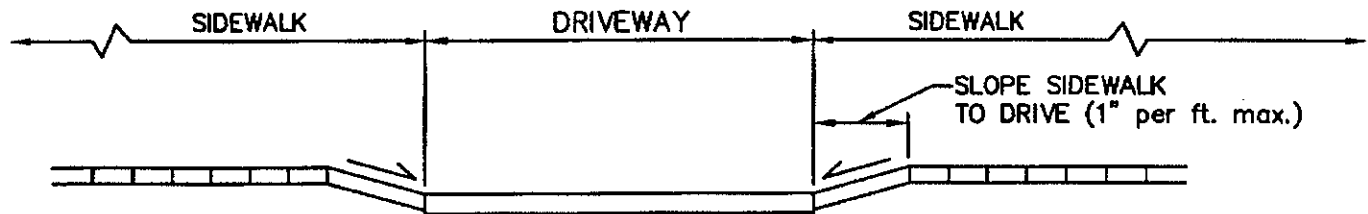
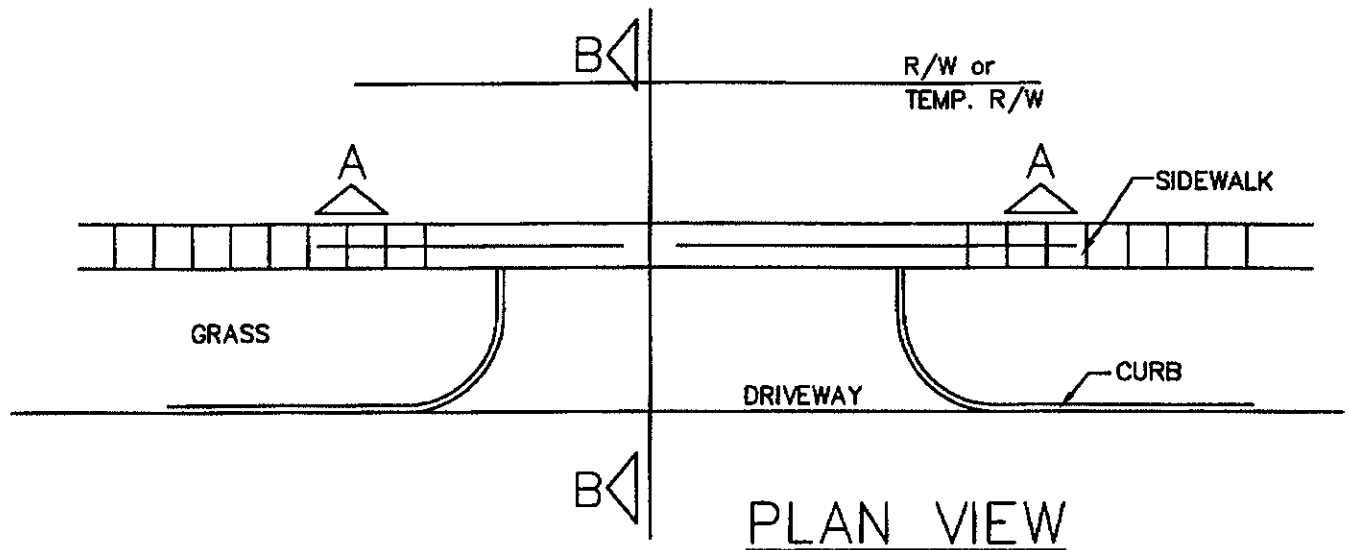
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CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-16

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TYPICAL DRIVEWAY SECTION

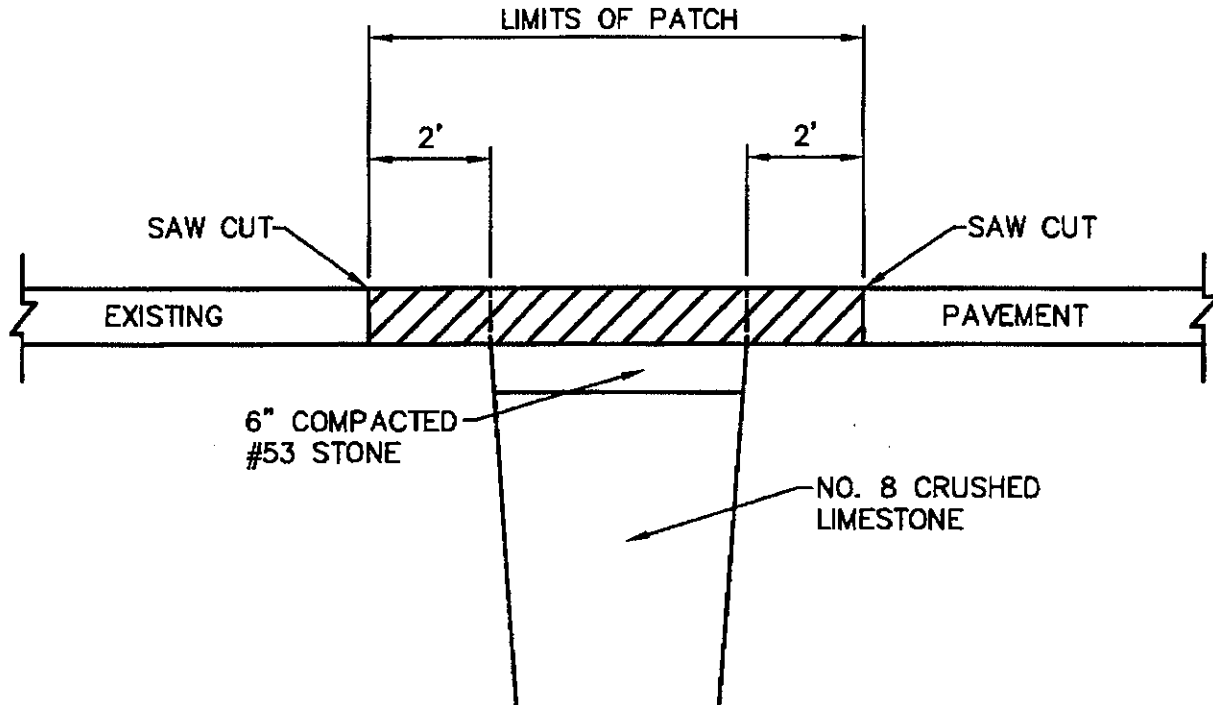
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JUNE 2001

FIGURE P-17



GENERAL DETAIL

NOTES:

1. SAW CUT 1/3 PAVEMENT THICKNESS THEN BREAK OUT.

NOT TO SCALE

REPAIR CUTS WITHIN PAVEMENT LIMITS

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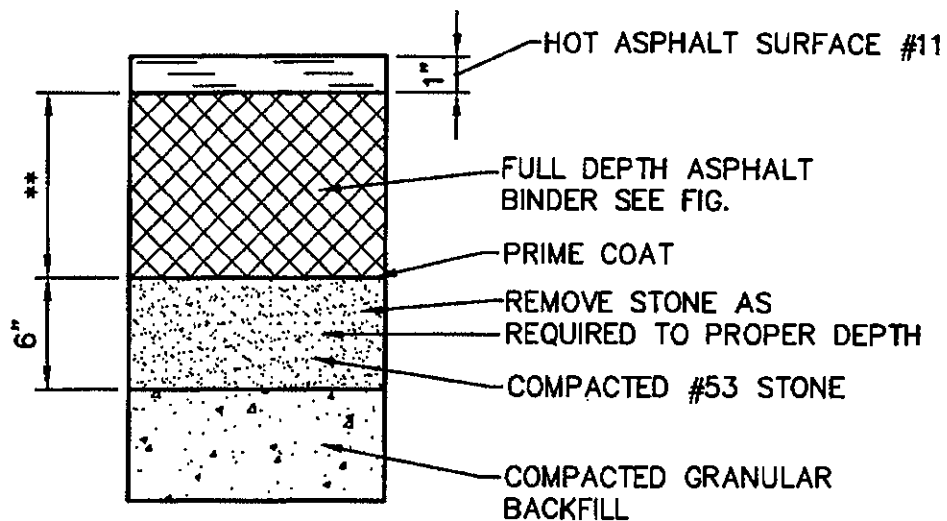
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CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-18

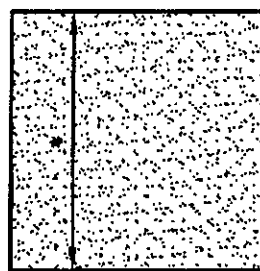
** ARTERIAL-10 1/2"
COLLECTOR-8 1/2"
LOCAL-6 1/2"



BITUMINOUS PATCHING

FIGURE I

* ARTERIAL- 8"
COLLECTOR -7"
LOCAL-6"



COMPACTED GRANULAR
BACKFILL AS REQUIRED

PLAIN CEMENT CONCRETE PATCHING

FIGURE II

NOT TO SCALE

FOR TEMPORARY
PATCHING DURING
WINTER SEE
FIGURE P-20

REPAIR CUTS WITHIN PAVEMENT LIMITS — CONT.

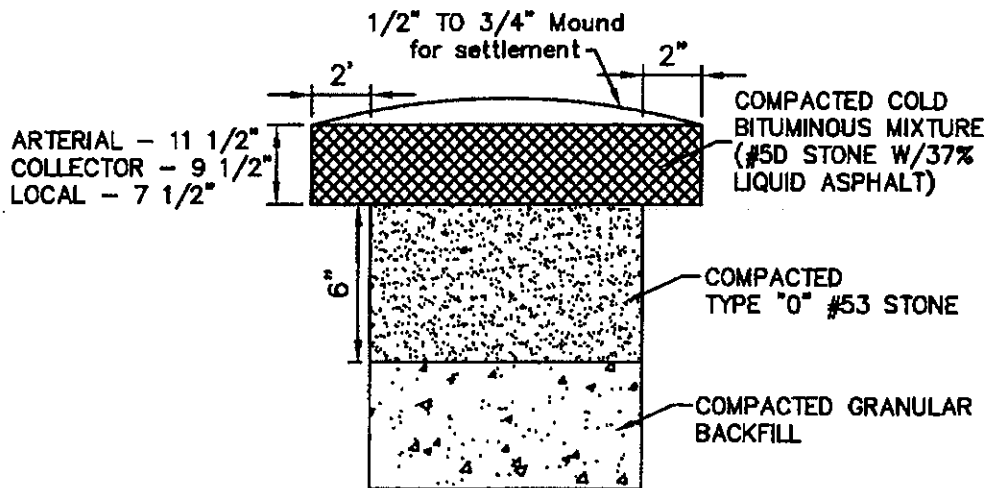
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CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-19



TEMPORARY PATCH
(FROM NOV.10-APRIL 15)

NOT TO SCALE

REPAIR OF CUTS WITHIN PAVEMENT LIMITS - CONT.

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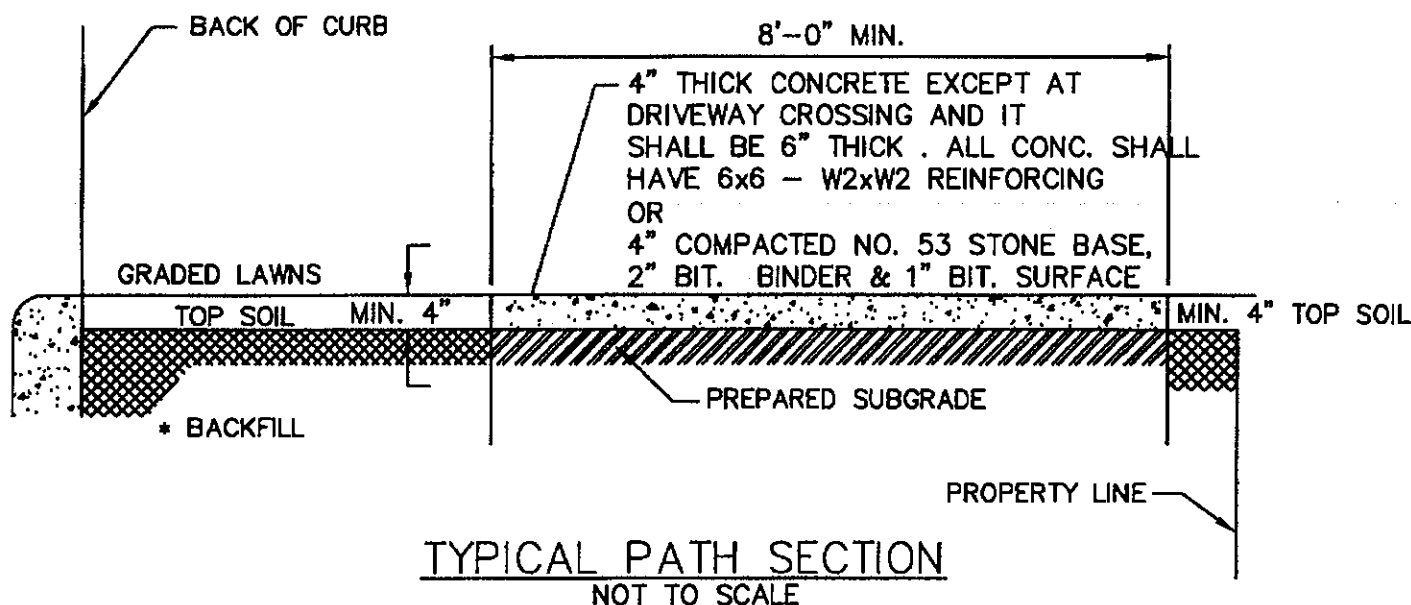
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-20

Scale: 1:1

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* THE SPACE BEHIND THE CURB SHALL BE FILLED WITH SUITABLE MATERIAL TO THE REQUIRED ELEVATION AND COMPACTED IN LAYERS NOT TO EXCEED 6" IN DEPTH.

SUBGRADE UNDER ALL CURBS, SIDEWALKS, PATHS AND DRIVES SHALL BE COMPACTED IN ACCORDANCE WITH I.N.D.O.T. SPECIFICATIONS.

SEE SECTION 02502 (STANDARDS FOR ROADWAY CONSTRUCTION) FOR DETAILED DISCRIPTION OF BICYCLE/JOGGING PATH CONSTRUCTION

BICYCLE/JOGGING PATH DETAIL

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INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE P-21

SECTION 02504 – ADJACENT ROADWAY IMPROVEMENTS

PART 1 - GENERAL

- 1.1 Roadways adjacent to proposed developments shall conform to the following requirements and standards:

A. Adjacent Roadway Improvements

1. Developers shall be responsible for improvements to the existing roadway(s) that front their property. These improvements shall include, but are not limited to, the following items:
 - a. Construction of acceleration lanes, deceleration lanes, and passing blisters for each entrance or street intersection. Reference Figure P-2.
 - b. In order to construct adequate passing blisters, right-of-way shall be obtained. A minimum of 500 feet full width right-of-way centered on the entrance or street intersection shall be obtained. Reference Figure P-2 and Figure P-23. The developer is responsible for the purchase of the right-of-way, at fair market value. The City will offer assistance in obtaining right-of-way if the initial purchase offer is unsuccessful. A written offer to the property owner is required.
 - c. The existing two (2)-lane roadway(s) that front the property shall be widened and overlaid in accordance with Figure P-22.
2. Additional improvements may be required depending on field conditions and as determined by the Technical Review Committee.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 02504

SECTION 02558 - IDENTIFICATION/LOCATION TAPE

PART 1 - GENERAL

1.1 SCOPE

Furnish and install identification/location, warning tape and three (3) strands of 10 gauge copper locator wire over the centerline of the buried non-metallic pipe.

PART 2 - PRODUCTS

2.1 IDENTIFICATION TAPE

A. Identification/Location Tape

1. Identification/location tape shall be manufactured of inert polyethylene so as to be highly resistant to alkalis, acids and other destructive agents found in soil, and shall have a minimum thickness of four mils. Tape width shall be a minimum of three inches and a maximum of six inches and shall have background color specified below, imprinted with black letters. Imprint shall be as specified below and shall repeat itself a minimum of once every two feet for entire length of tape.
2. Identification/location tape shall include a solid foil core which can be detected by cable locator.
3. Warning tape shall be as described above except no solid foil is required.
4. Provide electrical conductivity clips capable of piercing identification/ location tape exterior and connecting to the foil core at tape breaks and when connecting adjacent sections or rolls.

B. Tape background colors and imprints shall be as follows:

<u>Imprint</u>	<u>Background Color</u>
"Caution – Water Line Buried Below"	Blue
"Caution – Sanitary Force Main Buried Below"	Green

C. Identification tape shall be as follows:

1. For PVC Water Pipe: Terra Tape Sentry Line or approved equal.
2. For PVC Sanitary Force Main Pipe: Terre Tape Sentry Line or approved equal.

Products above are as manufactured by Reef Industries, Inc., Houston, Texas.

2.2 LOCATOR WIRE

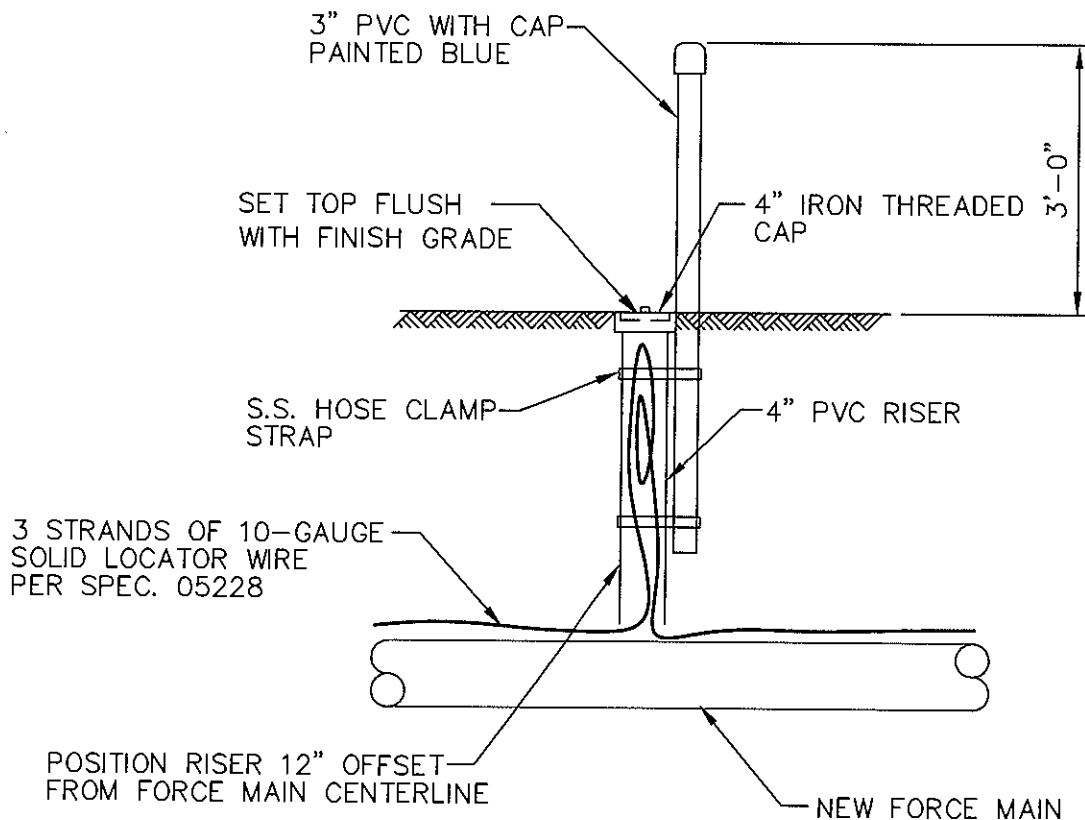
- A. Install two (3) solid 10 gauge copper wires with water mains or force mains.
- B. Locator wire is to be installed to fire hydrants, air/vacuum valves, and butterfly valves along water mains.
- C. Additional locator wire access points will be located along the water main as determined by the Water Superintendent.
- D. Locator wire is to be installed to the inside the manhole at the force main discharge.
- E. The locator is to be installed in the value box at the lift station.
- F. Additional locator wire access points will be located along the force main as determined by the Wastewater Superintendent.
- G. When the locator wire needs to spliced, the splice is to be soldered and the spliced wrapped with electrical tape.

PART 3 - EXECUTION

3.1 INSTALLATION OF IDENTIFICATION TAPE

- A. Identification tape shall be installed over all buried non-metallic piping in accordance with the manufacture's installation instructions and as specified herein.
- B. Identification tape shall be installed one foot over centerline of pipe.
- C. Warning tape shall be installed two feet below final grade over centerline of pipe.

END OF SECTION 02558



NOTES:

1. CONTRACTOR SHALL SPACE LOCATOR WIRE ACCESS POINTS BETWEEN VALVES & MANHOLES AT A MAX. SPACING OF 600'.
2. LOCATOR WIRE SPLICE, WHERE NECESSARY, SHALL BE MIN. 12" IN LENGTH, SECURELY BRAIDED, CONTINUOUSLY SOLDERED AND WRAPPED WITH ELECTRICAL TAPE.

LOCATION TAPE DETAIL

CITY OF GREENSBURG, INDIANA

JULY 2007

HNTB

SECTION 02660 - WATER MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install pipe, fittings, valves, hydrants and appurtenances necessary to complete work shown or specified.
- B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.
- C. Definitions
 - 1. Abbreviations
 - a. ANSI - American National Standards Institute.
 - b. ASTM - American Society for Testing & Materials.
 - c. AWWA - American Water Works Association.
 - 2. All pipe, fitting and valve sizes and references to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 QUALITY ASSURANCE

- A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.
- B. The Contractor shall test and disinfect water mains constructed under this Contract, as specified in this Section.
- C. The Contractor shall collect samples of water from water mains constructed under this Contract, after the piping has been disinfected. Submit the samples to the applicable regulatory agency for bacteriological analysis. Collection and submittal of these samples shall meet the requirements of the applicable regulatory agency. If samples do not pass the requirements of the bacteriological analysis, the water main will be disinfected and sampled again. This procedure will be followed until the samples pass the analysis.
- D. A performance test may be required by the Utilities Superintendent, at any time, for each crew installing water mains. The Contractor shall perform

these tests at no additional cost to the Owner. When required by the Utilities Superintendent, the Contractor shall test a given section of water main installed by a given crew. The section shall be a continuous section of water main which can be isolated by valves shown on the drawings. The Contractor shall not install water mains in other sections until the first section has been successfully tested.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, hydrants and appurtenances shall be as shown on the drawings or as required by the manufacturer's and ANSI/AWWA specifications. All pipe, fittings, valves, hydrants and appurtenances shall be new and unused.

2.2 BURIED WATER MAIN PIPE AND FITTINGS

A. Polyvinyl Chloride Water Mains

1. Pipe

- a. Polyvinyl chloride pipe shall meet the requirements of ANSI/AWWA C900, Class 150/DR18. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications, shall be included.
- b. Polyvinyl chloride pipe shall have ductile-iron-pipe-equivalent outside diameter.
- c. Pipe joints shall be push-on type and meet the requirements of ANSI/AWWA C900. Do not use solvent-cement joints.

2. Fittings

- a. Fittings shall be ductile iron and meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi.
- b. Line the inside surfaces of fittings with cement mortar lining and bituminous seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of fittings with bituminous coating. Outside coating shall meet the requirements of ANSI/AWWA C110.

- c. Fitting joints shall be mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
- d. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.

3. Adapters

- a. Adapters from polyvinyl chloride water mains to victaulic, flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
- b. Line the inside surfaces of adapters with a single cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of adapters with bituminous coating, complying with ANSI/AWWA C110.
- c. Adapter ends connecting to polyvinyl chloride water mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
- d. Adapter ends connecting to victaulic, flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Gaskets

- a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of ANSI/AWWA C900.
- b. Gaskets for mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11 and ASTM F477.

5. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.

2.3 PIPE AND FITTINGS SMALLER THAN 2-INCH

- A. Pipe shall be Type K drawn copper and shall meet the requirements of ASTM B88.
- B. Fittings and couplings shall be cast bronze and shall meet the requirements of ASTM B16.18. Construct and manufacture fittings and couplings for a pressure rating of 150 psi.
- C. Unions shall be bronze and shall meet the requirements of ASTM B16.18. Design and manufacture unions for a pressure rating of 150 psi.
- D. Flanges for connection of screwed joint pipe to flange joint valves or fittings shall be 125-16 cast iron, screwed companion flanges, complying with both ASTM A126 and ANSI B16.1.
- E. Tape for screwed joints shall be teflon.
- F. Gaskets for flange joints shall be 1/16-inch thick, full face and conform to ANSI/AWWA C111/A21.11. Gaskets shall be rubber or as approved by the Utilities Superintendent.
- G. Bolts for flange joints shall be steel, heavy hexagon head machine bolts. Nuts shall be steel, semi-finished, heavy hexagon nuts. Nuts and bolts shall meet the requirements of ASTM A307 for Grade B and be zinc-coated alloy steel.

2.4 VALVES

- A. Butterfly Valves
 - 1. Butterfly valves and operators shall meet the requirements of AWWA Standard C504. Valves and operators shall be Class 150B.
 - 2. Buried butterfly valves shall have mechanical joints. Mechanical joints shall meet the requirements of AWWA C111. Butterfly valves installed above ground or in structures shall have flange joints as specified in AWWA Standard C504. Nuts, bolts, and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be cadmium plated. Gaskets shall be full face and shall be red rubber, or equal.
 - 3. Each buried butterfly valve shall have a manual operator and a 2-inch operating nut. Valve opening direction shall be consistent with operation of existing valves in the waterworks in which the valves are installed, unless otherwise directed by the Engineer.

4. Each butterfly valve installed above ground or in a structure shall have a manual operator and handwheel.

B. Gate Valves

1. Buried gate valves 4-inches and larger shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and have mechanical joint ends. Mechanical joints and joint accessories shall comply with ANSI/AWWA C111/A21.11. Valve opening direction shall be consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Utilities Superintendent.
2. Three-inch buried gate valves shall be full ductile iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509; except, ends shall be screwed. Screwed ends shall conform to ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the waterworks where the valves are installed, unless otherwise directed by the Utilities Superintendent.
3. Gate valves 4-inches and larger installed above ground or in structures shall be full ductile iron body, epoxy fusion bonded inside and out, outside screw and yoke gate valves. Valves shall correspond to ANSI/AWWA C500 or C509. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall be as specified in ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel. Gaskets shall be full face and rubber, or as approved by the Utilities Superintendent.
4. Gate valves smaller than 4-inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels. Valves shall meet the requirements of federal specifications WASTEWATER-V-54d for Class A, Type III Valves.

- C.** Buried valves 2-inch and smaller shall be curb stops. Curb stops shall meet the applicable requirements of ANSI/AWWA C800, ASTM B-62 for 85-5-5-5 composition bronze, and USAS B2.1. Curb stops shall be Mueller H-10283, Ford B11 Series, or as approved by the Utilities Superintendent.

D. Tapping Valves

1. Tapping valves shall comply with both ANSI/AWWA C500 or C509 and have flange mechanical joint ends. Double disc gate valve gates, gate rings and body-seat rings shall be oversized to permit entry and exit of tapping machine cutters.
2. Valve end connecting to tapping sleeve shall have a flange for bolting to the sleeve. The flange shall have a tongue which fits a recess in the sleeve. Tongues shall meet the requirements of MSS SP-60. Resilient seated gate valves having a port diameter equal to or exceeding 1/4 inch over nominal diameter shall not require a tongue. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts, bolts, and gaskets for flange joints shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be zinc-coated alloy steel, and gaskets shall be rubber, or as approved by the Utilities Superintendent. Mechanical joints and accessories shall meet the requirements of ANSI/AWWA C111/A21.11. A full nominal diameter cutter shall be used for tapping.
Tapping valves 14-inch and smaller shall be installed vertically. Tapping valves 16-inch and larger shall be installed horizontally and shall have bypass valves. Tapping valves installed horizontally shall have rollers and tracks. Valves 16-inch and larger shall have gear operators with enclosed gear cases suitable for buried service. Gear cases shall be extended type or totally enclosed type. Extended type gear cases shall have bolted side plates to cover stem and stuffing box.

E. Air and Vacuum Valves: Air and vacuum valves shall be as follows:

<u>Size</u>	<u>Specification</u>
½"	Apco No. 141WD, Val-Matic 100DWS, or equal
1"	Apco No. 142WD, Val-Matic 101DWS, or equal
2"	Apco No. 144WD, Val-Matic 102DWS, or equal
3"	Apco No. 146WD, Val-Matic 103DWS, or equal
4"	Apco No. 1604/152, Val-Matic 104DWS, or equal
6"	Apco No. 1606/153, Val-Matic 106DWS, or equal

2.5 VALVE BOXES

- A. Valve boxes for butterfly valves and gate valves shall be cast iron. Valve boxes shall be two piece or three piece type. Each two piece box shall be complete with bottom section, top section and cover. Each three piece box shall be complete with base, center section, top section and cover. Valve

boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16-inch. Cast the word "WATER" in each valve box cover.

- B. Valve boxes for curb stops shall be cast iron. Curb boxes shall be extension type. Each curb box shall be complete with foot piece, curb box and lid. Curb box shall be the following or as approved by the Utilities Superintendent:

<u>Curb Stop Size</u>	<u>Foot Piece</u>	<u>Curb Box with Lid & Plug</u>
½" & 5/8"	Mueller H-10390	Mueller H-10316
¾"	Mueller H-10391	Mueller H-10316
1"	Mueller H-10392	Mueller H-10316
1 ¼"	Mueller H-10393	Mueller H-10336
1 ½"	Mueller H-10394	Mueller H-10336
2"	Mueller H-10395	Mueller H-10336

2.6 FIRE HYDRANTS

Fire hydrants shall be dry-barrel, compression shutoff, traffic model and comply with ANSI/AWWA C502. Main valve size shall be 5-1/4 inch. Inlets shall be 6-inch mechanical joint. Each hydrant shall have two 2-1/2-inch nozzles and one 4-1/2-inch pumper nozzle. Nozzle threads and hydrant opening direction shall be consistent with existing fire hydrants in the waterworks in which the fire hydrants are installed, unless otherwise directed by the Utilities Superintendent. Each hydrant shall be the proper length for the water main to which the hydrant is connected. Fire hydrant coating shall meet the requirements of ANSI/AWWA C502. Paint color will be selected by the Utilities Superintendent. Hydrants shall be Model No. A423, as manufactured by Mueller Company or Waterous Pacer Hydrant WB67.

2.7 SPRINKLER SYSTEMS

Multi-family developments and hotels/motels shall be required to have sprinkler systems installed in the attics of said structures in accordance with the latest edition of the Indiana Fire and Building Standards. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the Greensburg Fire Department.

2.8 TAPPING SLEEVES

- A. Tapping sleeves shall be ductile iron split sleeves. Each sleeve shall have a branch connection with a flange end. The inside diameter of each branch shall be over-sized to permit entry and exit of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameters shown in ANSI/AWWA Standards.
- B. Tapping sleeves for 4-inch through 12-inch pipe shall be mechanical joint type. Design and manufacture tapping sleeves for a working pressure of 200 psi.

2.9 TAPPING ASSEMBLIES

Tapping assemblies for steel cylinder type prestressed concrete pressure pipe shall be specifically designed and manufactured for the tapped pipe. Design and manufacture assemblies for a working pressure of 150 psi. The inside diameter of the outlet branch shall be oversized to permit entry and exit of tapping machine cutters. Each outlet branch shall have a flange end with a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1.

2.10 TAPPING SADDLES

- A. Design and manufacture tapping saddles for a working pressure of 200 psi. Saddle bodies shall be ductile iron. Saddle straps shall be corrosion resistant steel alloy. Saddle gaskets shall be positively confined O-ring gasket. The sleeve dimensions shall be such that the sleeves will not leak when installed on cast iron, ductile iron, or polyvinyl chloride pipe with outside diameter shown in ANSI/AWWA Standards.
- B. Each saddle used for making a wet connection shall have a branch connection with a flange end. The inside diameter of each branch shall be oversized to permit entry and exist of tapping machine cutters. Each flange shall have a recess to center a tapping valve. Recesses shall meet the requirements of MSS SP-60. Flange dimensions and drilling shall meet the requirements of ANSI B16.1.
- C. Each saddle used for making a dry connection shall have a branch connection with a flange or mechanical joint end. Flange dimensions and drilling shall meet the requirements of ANSI B16.1. Nuts and bolts for

flange joints shall meet the requirements of ANSI/AWWA C110 and be zinc-coated alloy steel. Gaskets shall comply with ANSI/AWWA C110, be full face and rubber, or as approved by the Utilities Superintendent. Mechanical joints and accessories shall meet the requirements of ANSI/AWWA C111/A21.11.

- D. Gaskets used to seal joints between saddle bodies and tapped pipes shall be O-ring type, circular in cross section, and made of natural or synthetic rubber with a Durometer Hardness of 70 ± 5 .

2.11 FLANGE-MECHANICAL JOINT ADAPTERS

Flange-mechanical joint adapters shall be Dresser Style 127, Smith-Blair Type 912 or as approved by the Utilities Superintendent.

2.12 AIR AND VACUUM VALVE CHAMBERS

- A. Air and vacuum valve chambers shall be 4-foot diameter precast concrete manhole barrels with precast concrete flat slab tops. Precast manhole barrels shall meet the requirements of ASTM C478.
- B. Air and vacuum valve chamber access frames and cover shall be Neenah R-1915-G, or equal. Cast the word "WATER" in each cover.

PART 3 - EXECUTION

3.1 INSPECTION

Inspect water main pipe, fittings, valves, hydrants, and appurtenances prior to installation. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with undamaged and suitable products.

3.2 LAYING OF WATER MAINS

- A. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
- B. Lay and maintain pipe to the lines and grades shown on the drawings or to the minimum depth specified in this Article. Install fittings, valves and hydrants in the locations shown on the drawings.
- C. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the

piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Utilities Superintendent.

- D. Water mains shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Water mains crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. The 18-inch separation shall apply whether the water main is over or under the sewer or force main. Lay water mains at crossings of sewers and force mains so a full length of water main pipe is centered on the sewer or force main whenever possible. No water main shall pass through or come in contact with any part of a sanitary sewer manhole.
- E. For pipe 10 inches and smaller, pressure piping shall be laid at a depth that provides at least 4'-6" of cover. Also, at least 4'-0" of cover shall be present when the pressure piping is 12 inches or larger. Cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.
- F. Laying of water mains shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.
- G. Shape the bottom of the trench to give uniform circumferential support of the lower quarter of each pipe.
- H. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.
- I. As each length of pipe is placed in a trench, joint the pipe being laid to the previously laid pipe. Bring the pipe to correct line and grade. Secure the pipe in place with bedding tamped under the pipe. Tamp bedding up to the centerline of the pipe.
- J. Deflection from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.
- K. Provide thrust restraint at horizontal and vertical deflection fittings and at tees, plugs, tapping sleeves and tapping saddles. Restraint shall be concrete thrust blocking or restrained joint piping.

- L. Where concrete thrust blocking is used, cover the fitting to be blocked with visqueen or a heavy duty grease to prevent adherence of the concrete to the fitting.
- M. Block the open end of the pipe at the close of each day's work to prevent contamination from dirt or rain water and entry of any animal or foreign material.
- N. Lower pipe, fittings, valves and hydrants into the trench by hand or hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe, fittings, valves, or hydrants into the trench.

3.3 SETTING VALVES, VALVE BOXES AND FIRE HYDRANTS

- A. Clean the interiors of valves and hydrants of foreign matter before installation. Tighten stuffing boxes. Inspect valves and hydrants in opened and closed positions to ensure all parts are in working condition.
- B. Set valves and valve boxes plumb. Center valve boxes on the valves or valve operators. Locate valves outside the area of roads and streets where feasible. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face if less than 4 feet.
- C. Set hydrants plumb with the pumper nozzle facing the street. The centerline of the outlet nozzles shall be at least 18 inches or at most 30 inches above finished grade at a hydrant. Install hydrant extensions where required to bring hydrant to proper elevation. Set each hydrant upon a slab of stone or concrete not less than 4 inches thick and 15 inches square. Wedge the side of each hydrant opposite the pipe connection against the undisturbed trench face to prevent the hydrant from blowing off the branch connection. Compact the backfill around each hydrant to finish grade. Furnish and install a gate valve and valve box in each hydrant branch connection. In the field, apply two coats of red polyurethane epoxy to the fire hydrants installed.

3.4 CONNECTING TO EXISTING MAINS

- A. The Contractor shall locate and verify exact size of all existing mains, both horizontally and vertically. Additionally, allow adequate time, after location and prior to making new connections, for changes in the connection location and size. Backfill excavation immediately after main is located and measured.

- B. Make each wet connection with a tapping valve and tapping sleeve. Install and hydrostatically test each tapping valve and tapping sleeve assembly prior to tapping existing water main. Inspect each tapping valve prior to tapping existing water main. Open and close tapping valves, and inspect tapping valves in opened and closed positions to ensure all parts are in working condition. Inspect each tapping valve immediately before connecting tapping machine to ensure the tapping valve is open. Install watertight plug on the tapping valve outlet and backfill excavation if existing water main is not tapped within 48 hours after installing tapping valve and tapping sleeve or tapping saddle assembly. Install watertight plug on the tapping valve outlet and backfill excavation if new water main is not connected to tapping valve within 48 hours after making tap in existing water main.
- C. Make each dry connection with fittings and valves indicated on the drawings. Furnish and install sleeves required to complete connections. All required pipe, fittings, valves, tools, and equipment shall be at the connection site prior to starting connection. Wash interior of new pipe, fittings, and valves with a solution containing 50 mg/l of chlorine prior to making connection. Make connections at night and on weekends when required. The Owner will operate existing valves. Install sufficient water main and restrain joints so existing water mains can be up in service immediately after connection is completed. Inspect joints and eliminate leaks immediately after connection is completed and existing mains are put in service. Install watertight plugs on open ends of pipe and valves, and backfill excavation if new water main is not connected to dry connection within 48 hours after completing dry connection.

3.5 JOINTING

- A. Polyvinyl Chloride Push-on Joints
 - 1. Pipe must be cleaned and installed as specified by the manufacturer's requirements. Additionally, all joints must be free of all foreign material.
 - 2. Deflect the pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe.
- B. Mechanical Joints
 - 1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

<u>Pipe Size</u>	<u>Bolt Size</u>	<u>Torque Range</u>
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
4"	8° - 18'	31"
6"	7° - 7'	27"
8"	5° - 21'	20"
10"	5° - 21'	20"
12"	5° - 21'	20"
14"	3° - 35'	13-1/2"
16"	3° - 35'	13-1/2"
18"	3° - 0'	11"
20"	3° - 0'	11"
24"	2° - 23'	9"

C. Shouldered Type Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. The tightening torque shall not exceed the limits recommended by the joint manufacturer.
3. Deflect pipe, fittings, adapters or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the joint manufacturer.

D. Threaded Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Do not overtighten joints.
3. Backing off made-up threaded joints to facilitate fit-up or alignment will not be permitted

E. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.
2. Do not overtorque nuts and bolts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of at least 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall be at least the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

- B. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings.

C. Mechanical Joint Rod Restraint

1. Mechanical joint rod restraint shall be from fitting to fitting.
2. The number of rods shall conform to the following table:

<u>Pipe Size</u>	<u>Rod Size</u>	<u>Minimum No. of Rods</u>
4"	3/4"	2
6"	3/4"	2
8"	3/4"	4
10"	3/4"	4
12"	3/4"	6
14"	3/4"	6
16"	3/4"	8

18"	3/4"	8
20"	3/4"	10
24"	3/4"	16

D. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings and valves.
2. Support piping by suitable saddle stands, concrete piers or hangers.
3. Locate supports where necessary, at least 8 feet on center.

3.7 AIR AND VACUUM VALVE CHAMBERS

- A. Install air and vacuum valve chambers as indicated on the drawings.
- B. Mortar for joints and plastering shall consist of one part Portland Cement and two parts fine sand. Lime may be added to the mortar used for brick work. Add lime in an amount of not more than 20% of the volume of cement. Complete fill joints between precast chamber sections. Joints shall be smooth and free from surplus mortar on the inside surface of the chamber. Plaster brick at the top of chambers with 1/2-inch of mortar.
- C. Set frames and covers so the top of the cover will be flush with finished grade.
- D. Vent air and vacuum valve outlets to the surface. Terminate vent outlets 3 feet above finished grade. Screen vents to prevent the entrance of insects. Paint air and vacuum valve vents yellow.

3.8 HYDROSTATIC TEST

- A. Hydrostatic tests shall be performed on all water mains installed. The Contractor shall make arrangements with the City Engineer and/or City Representative for scheduling each test. Each test shall be performed on the day mutually agreed upon and in the presence of the City Engineer and/or City Representative.
- B. The Contractor shall furnish equipment, temporary piping, pumps, fittings, gauges, and operating personnel necessary to conduct the tests. Water for testing may be obtained from the Owner.
- C. The water mains may be tested in sections between valves when there is one or more intermediary valves in a water main.

- D. Test procedures shall meet the requirements of AWWA Standard C600.
- E. Each section of water main shall be complete, and thrust blocks shall have been in place for not less than 10 days prior to being tested.
- F. Expel all air from the water main test section during the filling of the main and prior to the application of test pressure. Tap the water main at high points, if necessary, to release all air from the water main. Plug taps after the test is successfully completed. Plugs shall be watertight.
- G. Test water mains at a static pressure of 150 pounds per square inch over a period of not less than two consecutive hours. The test will be considered successful when the pressure drop over the test period is 3 pounds per square inch or less. If the pressure drop exceeds 3 pounds per square inch, repair the leaks and repeat the test. Repair leaks and repeat the test until the pressure drop over the test period is 3 pounds per square inch or less.

3.9 FLUSHING

- A. Flush water mains and fire hydrants prior to disinfection. Flush water mains with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

<u>Pipe Size</u>	<u>Inside Diameter</u>	<u>Flow at a Velocity of 2.5 Feet per Second</u>
½"	0.622"	2.4 gpm
¾"	0.824"	4.2 gpm
1"	1.05"	6.8 gpm
1¼"	1.38"	12 gpm
1½"	1.61"	16 gpm
2"	2.07"	27 gpm
2½"	2.47"	38 gpm
3"	3.07"	58 gpm
4"	4"	98 gpm
6"	6"	220 gpm
8"	8"	390 gpm
10"	10"	620 gpm
12"	12"	880 gpm
14"	14"	1,200 gpm

- B. Flush water mains and hydrants until the water discharged is clear.

3.10 DISINFECTION

- A. Disinfect all new and repaired water mains prior to placing them in service. Disinfect pipe, fittings, valves and hydrants with a chlorine solution containing 50 mg/l \pm 5 mg/l of available chlorine.
- B. The chlorinating material shall be chlorine gas, calcium hypochlorite or sodium hypochlorite. Calcium hypochlorite shall have 70% available chlorine by weight, and sodium hypochlorite shall have 5.25% to 14.7% available chlorine. Placing chlorine tablets in the mains during construction is not an acceptable method of disinfection. The following table shows the quantity of chlorine or hypochlorite required to produce 50 mg/l of available chlorine per 100 feet of pipe.

Pipe Size	Inside Diameter	Chlorine Gas	Pounds		Ounces		Quarts	
			Cal. Hycl. (70%)	Cal. Hycl. (70%)	Sod. Hycl. (14.7%)	Sod. Hycl. (5.25%)	Sod. Hycl. (14.7%)	Sod. Hycl. (5.25%)
½"	0.622"	0.00066	0.00094	0.015	0.072	0.20	0.0022	
0.0063								
¾"	0.824"	0.0012	0.0017	0.026	0.13	0.35	0.0039	0.011
1"	1.05"	0.0019	0.0027	0.043	0.20	0.57	0.064	0.018
1¼"	1.38"	0.0032	0.0046	0.074	0.35	0.99	0.011	0.031
1½"	1.61"	0.0044	0.0063	0.10	0.48	1.3	0.015	0.042
2"	2.07"	0.0073	0.010	0.17	0.79	2.2	0.025	0.069
2½"	2.47"	0.010	0.015	0.24	1.1	3.2	0.035	0.099
3"	3.07"	0.016	0.023	0.37	1.7	4.9	0.055	0.15
4"	4"	0.027	0.039	0.62	3.0	8.3	0.093	0.26
6"	6"	0.061	0.087	1.4	6.7	19	0.21	0.58
8"	8"	0.11	0.16	2.5	12	33	0.37	1.0
10"	10"	0.17	0.24	3.9	19	52	0.58	1.6
12"	12"	0.24	0.35	5.6	27	75	0.83	2.3
14"	14"	0.33	0.48	7.6	36	100	1.1	3.2

- C. Tap water mains where required to inject chlorine solution into all pipe, fittings, valves and hydrants installed and repaired. Inject chlorine solution into water mains. Leave the chlorine solution in the water mains for 24 hours or longer. Open and close valves in lines being disinfected several times during contact period. Following the contact period, flush the water mains with potable water until the chlorine residual is 1.0 mg/l or less.
- D. Bacteriological Tests - The water main shall be tested for bacteriological quality after disinfection and final flushing. Two or more successive sets of bacteriologically satisfactory samples taken at 24-hour intervals must be

recorded before the facilities are released for use. Bacteriological testing shall meet the requirements of the applicable regulatory agency. Disinfection shall be repeated if the piping is not bacteriologically acceptable. Repeat disinfection and testing until the mains are approved for service by the applicable regulatory agency.

- E. Hose connections on fire hydrants shall not be used for collecting samples. Contact the applicable regulatory agency for sampling criteria and procedures.
- F. The time for disinfection, bacteriological testing, and approval of the main for service shall be included in the contract time.

3.11 COMPLETION SCHEDULING

Complete water mains as they are installed. Test, flush, sterilize, and place in service each part of the water main which is complete and can be placed in service without preventing work to continue on uncompleted parts of the new water mains.

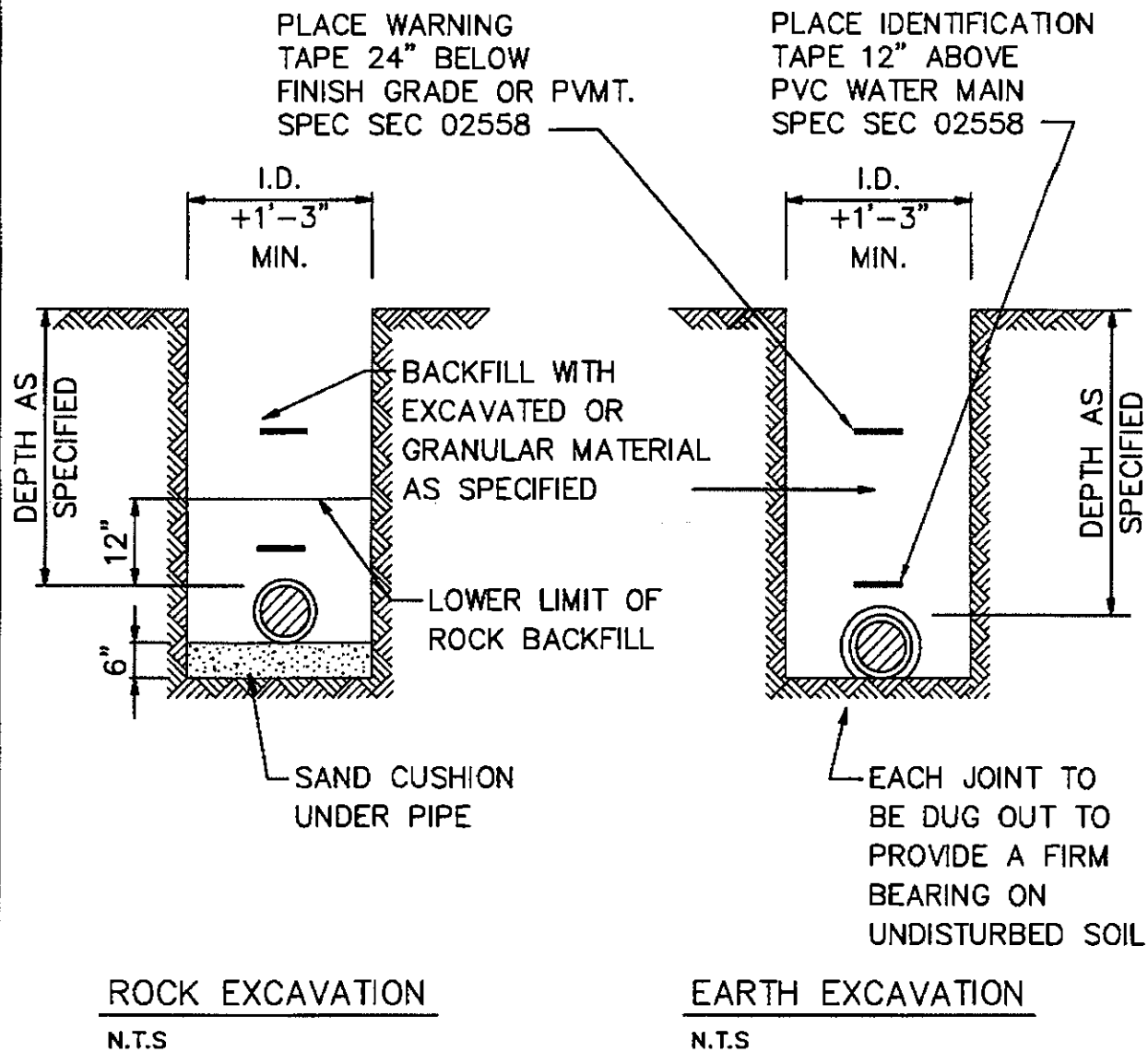
PART 4 – FIGURES

4.1 INDEX

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END OF SECTION 02660

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WATER MAIN INSTALLATION DETAIL

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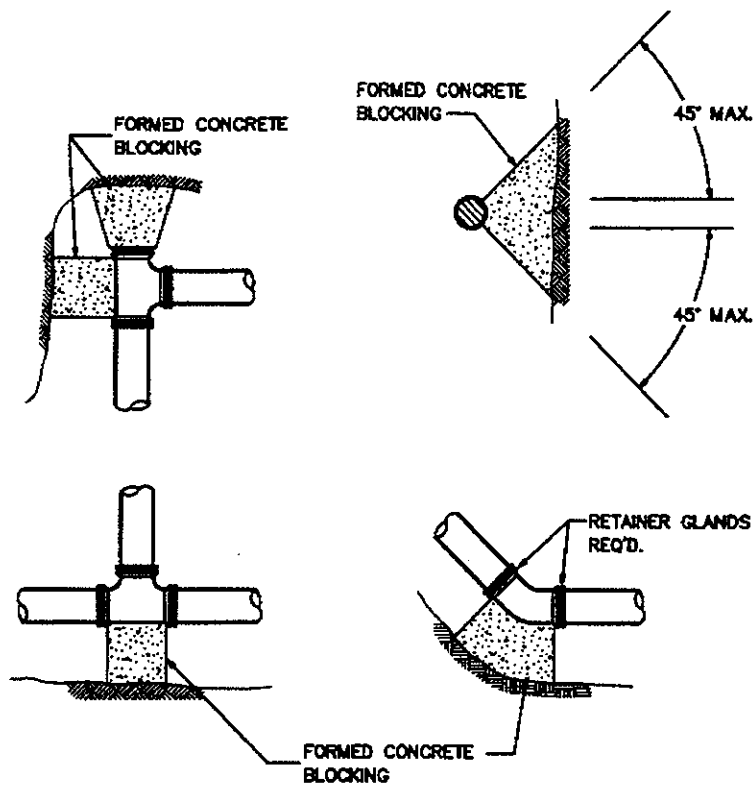
ARCHITECTS ENGINEERS PLANNERS
INDIANAPOLIS, INDIANA

CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE W-1

File name: ENVIRON\32980\CONST_STD\WATER\W-02.DWG PLOT SCALE:



SIZE	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
4"	2.0	2.5	1.5	1.0	1.0
6"	4.0	5.5	3.0	1.5	1.0
8"	6.5	9.0	5.0	2.5	1.5
10"	10.0	14.0	7.5	4.0	2.0
12"	14.0	20.0	11.0	5.5	3.0
14"	19.0	27.0	14.5	7.5	4.0
16"	25.0	35.0	19.0	10.0	5.0
18"	31.5	44.5	24.0	12.5	6.5
20"	40.0	54.0	31.0	16.5	7.5
24"	55.5	78.5	42.5	22.0	11.0
30"	86.5	122.0	66.0	34.0	17.0
36"	124.0	175.5	95.0	48.5	24.5
42"	168.0	237.5	128.5	65.5	33.0
48"	212.0	306.0	160.0	85.0	42.0

(AREA IN SQ. FT. REQUIRED FOR CONCRETE THRUST BLOCKING)

NOTE:

THE THRUST BLOCK AREAS ARE BASED ON A SOIL BEARING LOAD OF 2,000 LB./SQ. FT.

GREASE ALL WATER MAIN SURFACES PRIOR TO PLACEMENT OF CONCRETE

THRUST BLOCK DETAILS

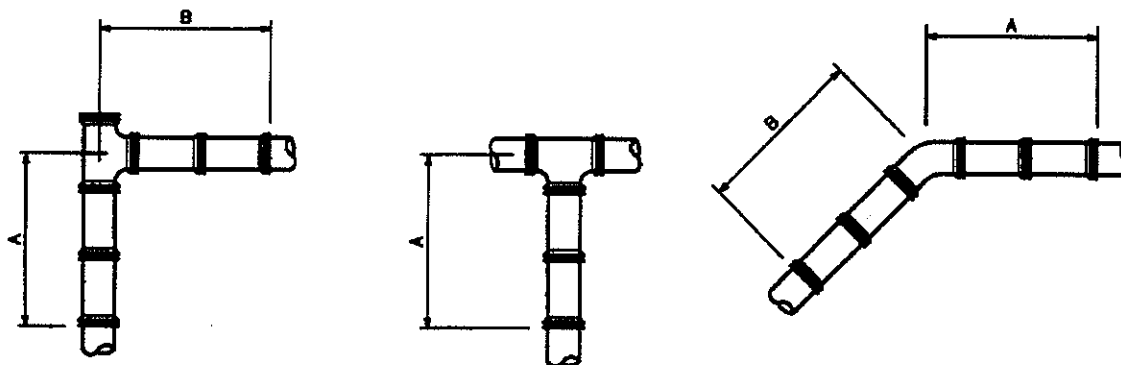
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FIGURE W-2



NOTE:

THE LENGTHS OF PIPE WITH
RESTRAINED JOINTS ARE BASED
ON A COMPACTED SILTY SOIL
SURROUNDING THE PIPE

	A		B		
SIZE	TEE & PLUG	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
6"	12'-0"	17'-0"	10'-0"	6'-0"	3'-0"
8"	16'-0"	22'-0"	13'-0"	8'-0"	4'-0"
10"	18'-0"	27'-0"	16'-0"	9'-0"	5'-0"
12"	23'-0"	32'-0"	19'-0"	11'-0"	6'-0"
14"	28'-0"	36'-0"	21'-0"	12'-0"	7'-0"
16"	29'-0"	41'-0"	24'-0"	14'-0"	8'-0"
18"	32'-0"	45'-0"	26'-0"	15'-0"	8'-0"
20"	35'-0"	50'-0"	29'-0"	16'-0"	9'-0"
24"	41'-0"	58'-0"	34'-0"	19'-0"	10'-0"
30"	50'-0"	70'-0"	40'-0"	22'-0"	12'-0"
36"	56'-0"	82'-0"	46'-0"	26'-0"	14'-0"
42"	66'-0"	93'-0"	52'-0"	29'-0"	15'-0"

(LENGTH IN FEET REQUIRED FOR RESTRAINING JOINTS)

RESTAINED JOINT DETAILS

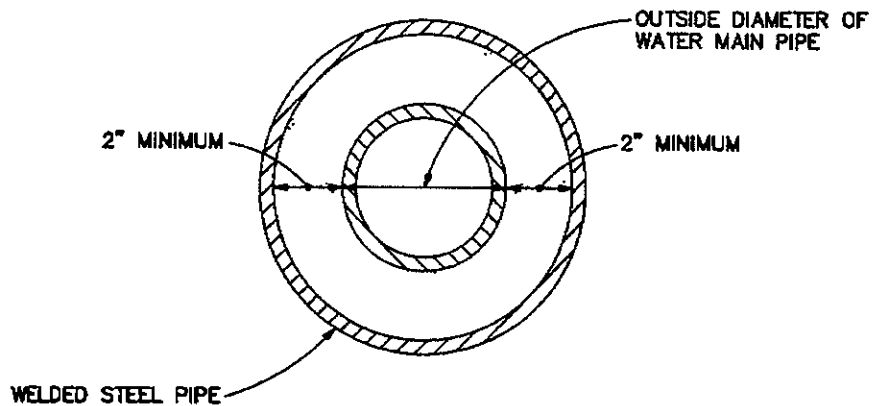
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FIGURE W-3



DIAMETER OF CASTING	WALL THICKNESS (INCHES)	
	UNDER HIGHWAY	UNDER RAILROAD
UNDER 14"	0.250	0.188
14"	0.250	0.219
16"	0.250	0.219
18"	0.250	0.250
20"	0.375	0.281
22"	0.375	0.312
24"	0.375	0.344
26"	0.375	0.375
28"	0.500	0.406
30"	0.500	0.406
32"	0.500	0.438
34"	0.500	0.469
36"	0.500	0.469
38"	0.500	0.500
40"	0.500	0.500
42"	0.500	0.500

STEEL CASING DETAIL

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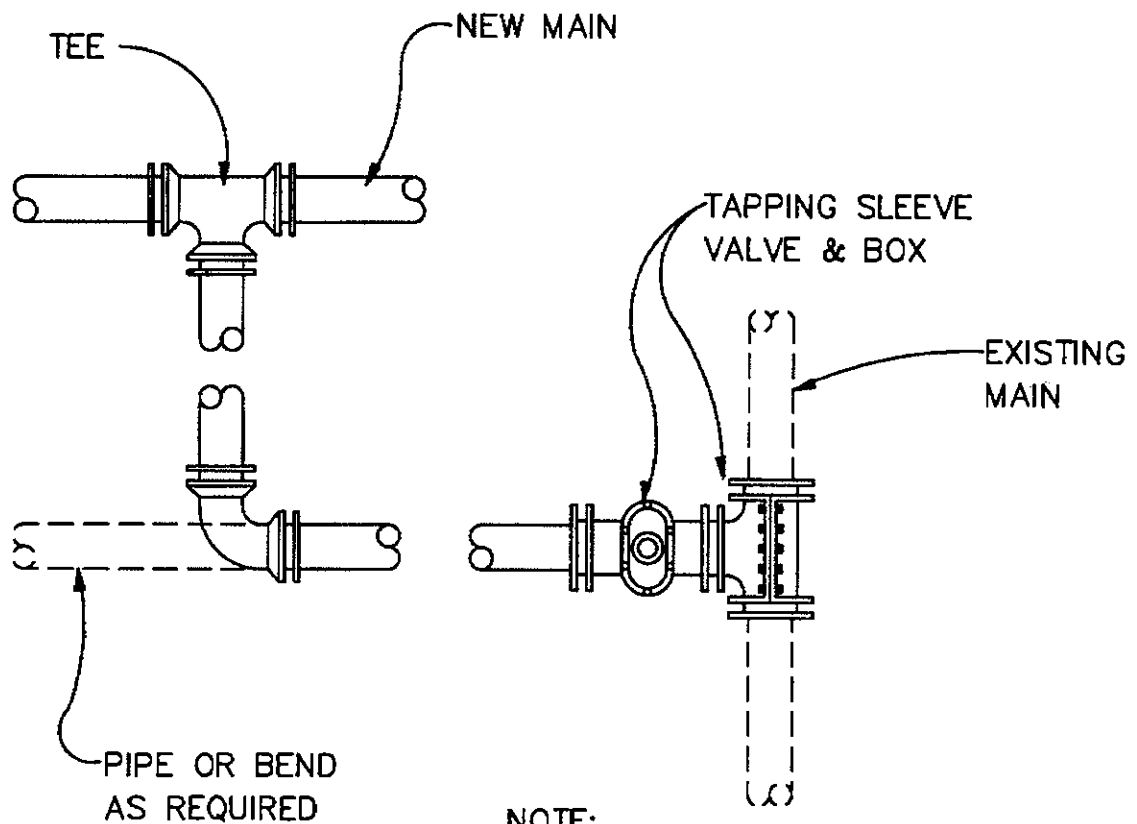
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FIGURE W-4

SCALE: 1:1

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NOTE:

BENDS & FITTINGS AS REQUIRED
SEE PLAN SHEETS FOR DETAILS

CONNECTION TO EXISTING MAIN

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FIGURE W-5

SET TOP FLUSH
WITH FINISH GRADE

ADJUSTABLE VALVE BOX
(COVER TO BE MARKED
"WATER")

WATER MAIN

VALVES 3" AND LARGER SHALL BE FULL
DUCTILE IRON BODY, NON-RISING STEM,
FUSION BOND EPOXY COATED GATE VALVES.
VALVES SHALL BE RESILIENT SEATED GATE
VALVES AND SHALL MEET THE REQUIRMENTS
OF ANSI/AWWA C-509 AND SHALL HAVE MECH.
JOINTS AND ACCESSORIES SHALL MEET THE
REQUIREMENTS OF ANSI/AWWA C111/A21.11

GATE VALVE AND BOX

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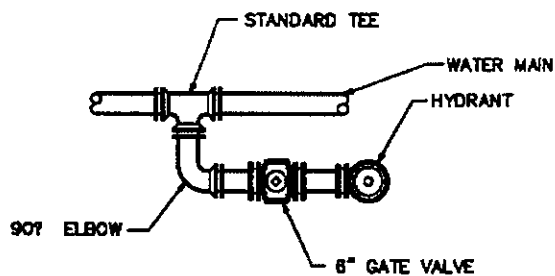
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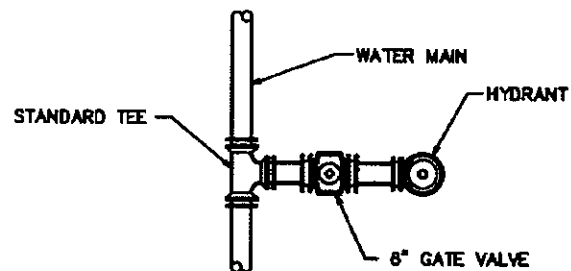
FIGURE W-6

SCALE: 1:1

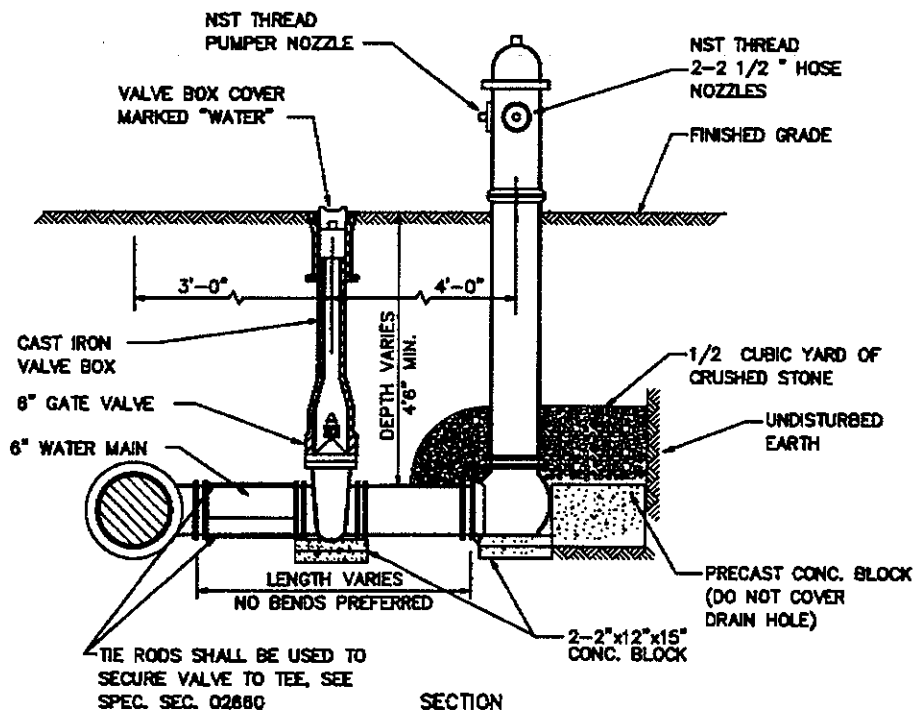
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INSTALLATION PARALLEL TO MAIN



INSTALLATION PERPENDICULAR TO MAIN



NOTE:

1. HYDRANT SHALL BE MODEL NO. WB-67 AS MANUFACTURED BY WATEREUS CO., OR MODEL A-423 AS MANUFACTURED BY MUELLER CO.
2. INTEGRAL CAP NUT AND LOWER WASHER SHALL BE EPOXY COATED.
3. SHOE SHALL BE FUSION BONDED EPOXY COATED INSIDE AND OUT.

FIRE HYDRANT DETAILS

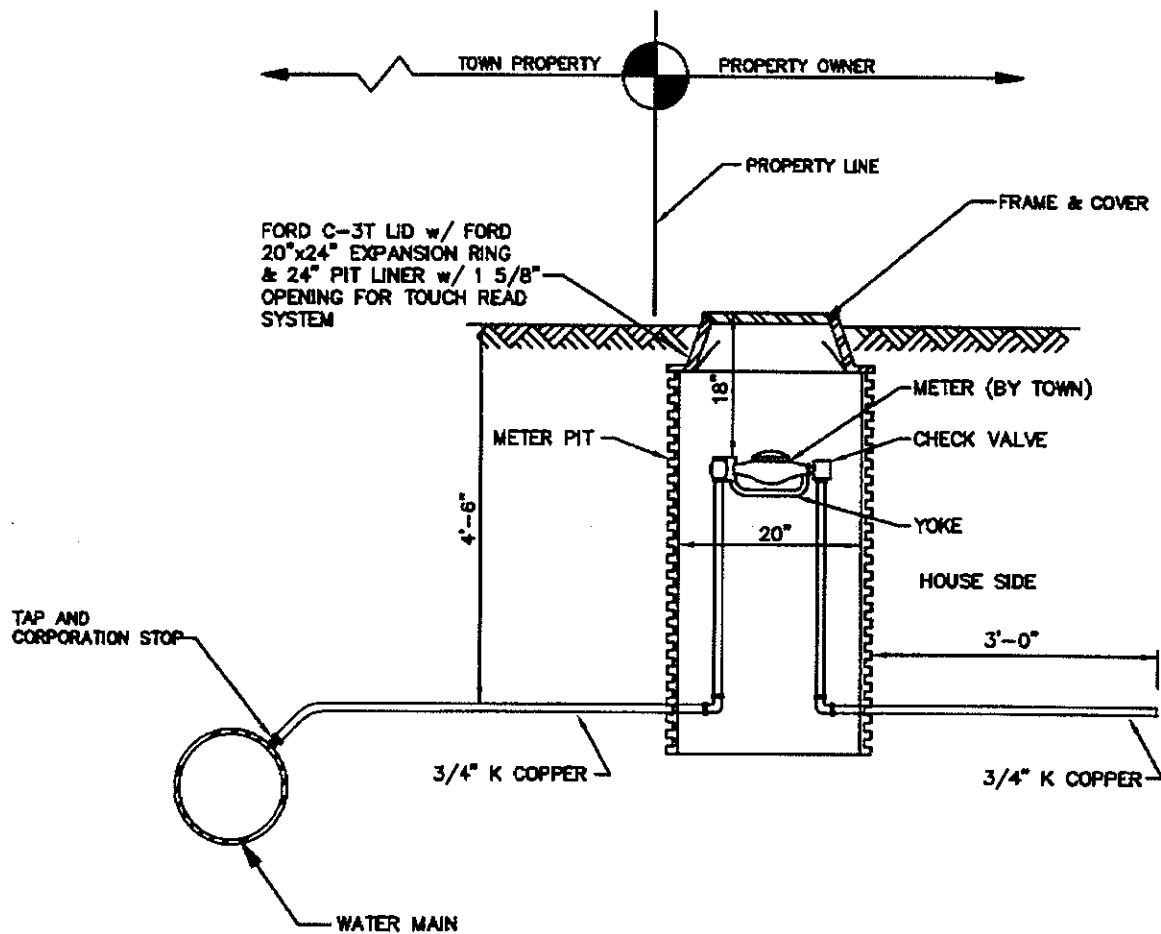
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FIGURE W-7



ITEMS SUPPLIED & INSTALLED BY CONTRACTOR	PART NUMBERS (FOR 3/4" SERVICE)	
	FORD METER BOX CO.	MUELLER CO.
YOKE	Y502	H-5020,5/8"
SHUT-OFF VALVE	AV 94-323	H-1426-3
CHECK VALVE	HA 94-323	H-1424-5
FRAME & COVER	NO. C-3T	TYLER MODEL 6150

3/4" - WATER METER AND PIT DETAIL (FOR RESIDENTIAL)

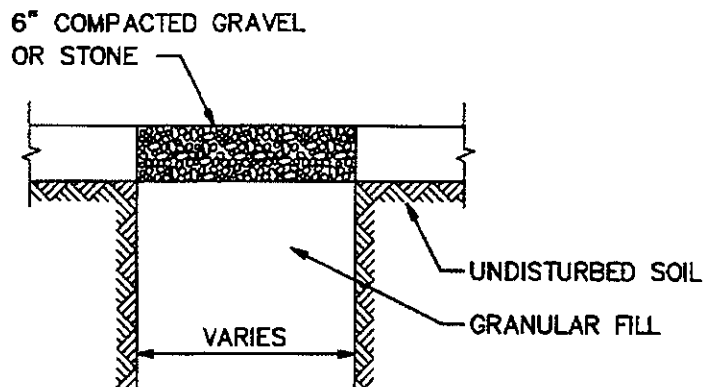
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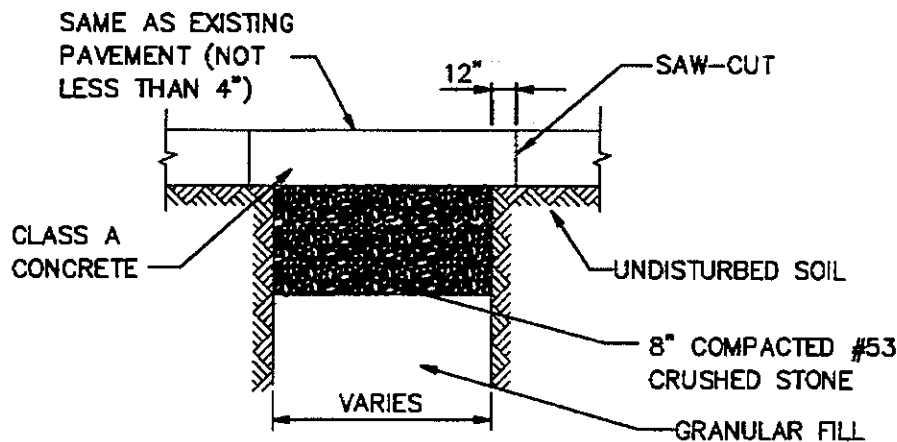
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FIGURE W-8



GRAVEL PAVEMENT



BRICK OR CONCRETE PAVEMENT*

NOTE:

ALL PUBLIC ROADS AND DRIVE CROSSINGS ARE TO BE BACKFILLED WITH GRANULAR MATERIAL AND TOPPED WITH 10" OF #53 CRUSHED STONE OR APPROVED MATERIAL DURING CONSTRUCTION OF WATER MAIN PRIOR TO FINAL PAVEMENT REPAIR.

* PAVEMENT REPAIR SHOWN IS MINIMUM FOR LOCAL STREETS. MATERIALS FOR COLLECTOR AND ARTERIAL STREETS SHALL MATCH CURRENT STANDARD TYPICAL PAVEMENT SECTIONS OR THE EXISTING PAVEMENT SECTION, WHICHEVER IS GREATER.

PAVEMENT REPAIR DETAILS-1

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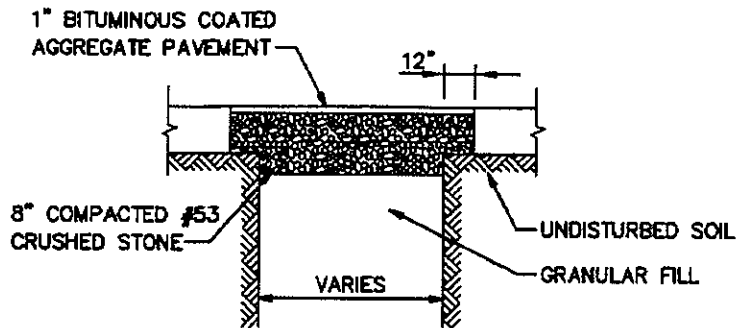
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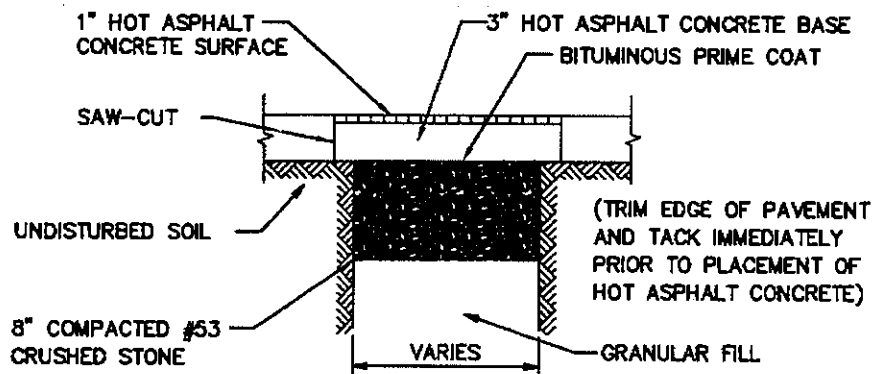
FIGURE W-9

SCALE: 1:1

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CHIP AND SEAL PAVEMENT



BITUMINOUS PAVEMENT*

NOTE:

ALL PUBLIC ROADS AND DRIVE CROSSINGS ARE TO BE BACKFILLED WITH GRANULAR MATERIAL AND TOPPED WITH 10" OF #53 CRUSHED STONE OR APPROVED MATERIAL DURING CONSTRUCTION OF WATER MAIN PRIOR TO FINAL PAVEMENT REPAIR.

* PAVEMENT REPAIR SHOWN IS MINIMUM FOR LOCAL STREETS. MATERIALS FOR COLLECTOR AND ARTERIAL STREETS SHALL MATCH CURRENT STANDARD TYPICAL PAVEMENT SECTIONS OR THE EXISTING PAVEMENT SECTION, WHICHEVER IS GREATER.

PAVEMENT REPAIR DETAILS-2

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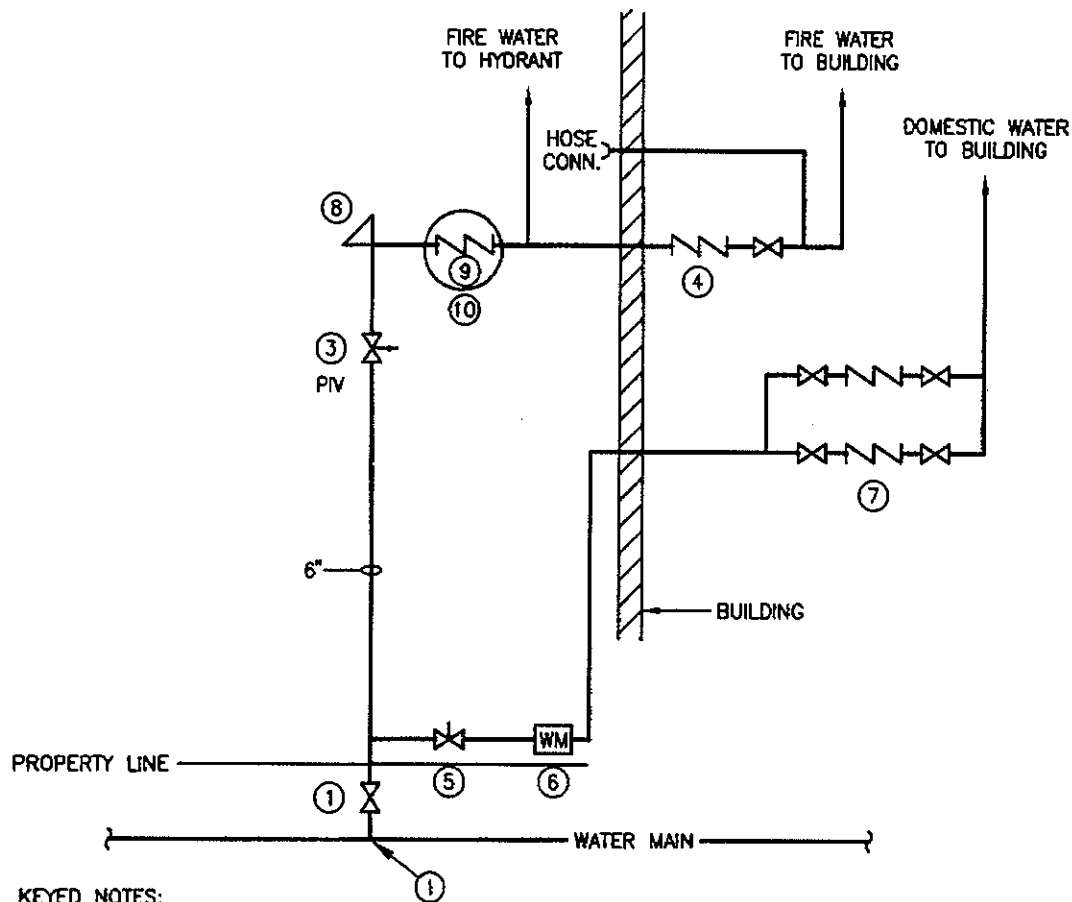
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FIGURE W-10

PLOT SCALE:

File name: ...ENVIRON\32980\CONST_STD\WATER\W-10.DWG



KEYED NOTES:

- | | |
|--|---|
| ① DUCTILE IRON TAPPING TEE | ⑥ WATER METER BY WESTFIELD UTILITY |
| ② WATER TAP AND TAPPING VALVE | ⑦ DUPLEX REDUCED PRESSURE BACKFLOW PREVENTERS |
| ③ POST INDICATOR VALVE | ⑧ THRUST BLOCK PER SIZING SCHEDULE |
| ④ DOUBLE DETECTOR CHECK VALVES | ⑨ ALTERNATE LOCATION OF CHECK VALVES IN VALVE VAULT |
| ⑤ LINE SIZE GATE VALVE WITH BOX AND LID TO GRADE | ⑩ VALVE PIT SHALL BE 6'X6'X7' HIGH I.D PRECAST CONCRETE |

TYPICAL COMMERCIAL WATER SERVICE DIAGRAM

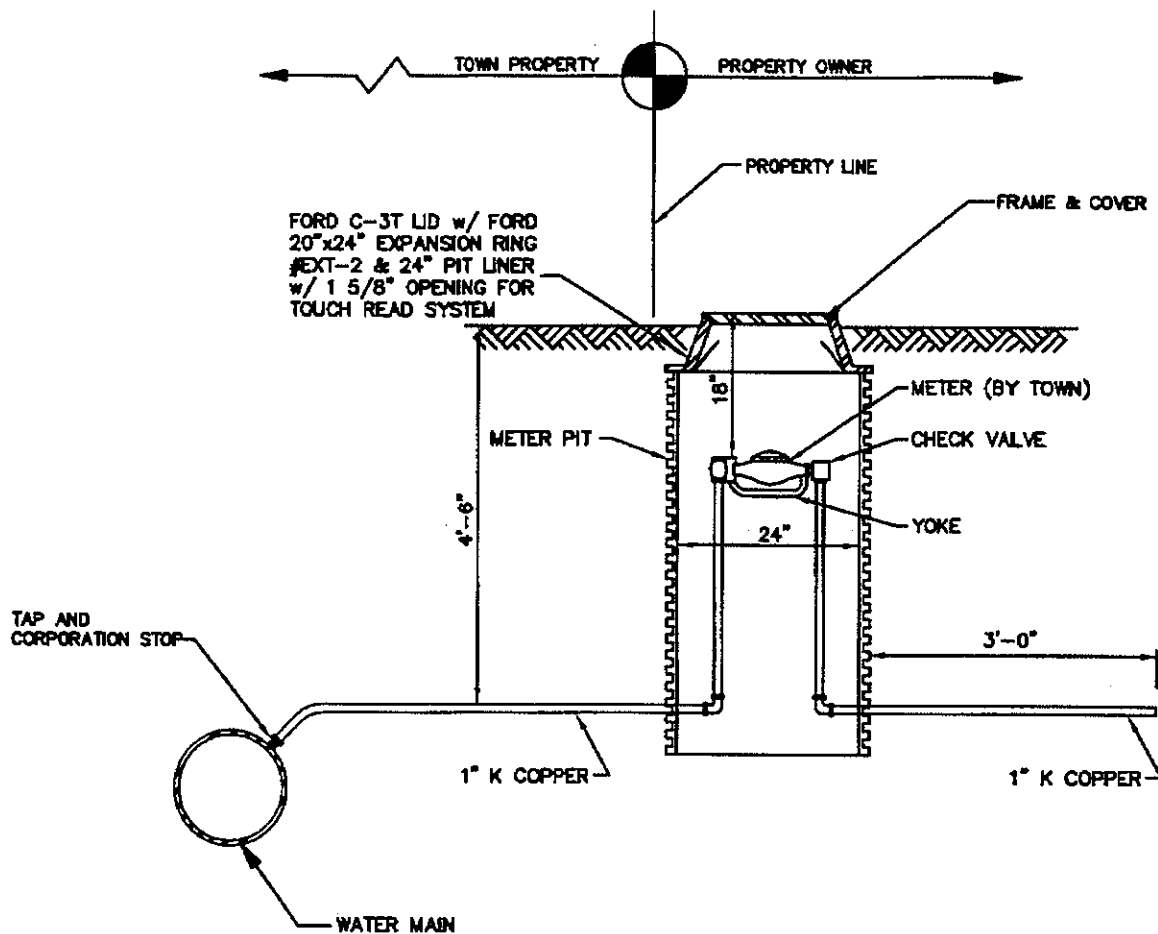
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FIGURE W-11



ITEMS SUPPLIED & INSTALLED BY CONTRACTOR	PART NUMBERS	
	FORD METER BOX CO.	MUELLER CO.
YOKE	Y502	H-5040
SHUT-OFF VALVE	AV 94-444	B2426-4
CHECK VALVE	HA 91-444	14248 w/ #15425 MALE ADAPTER
1" EXPANSION CONNECTION	EC-4	H14234

1" - WATER METER AND PIT DETAIL

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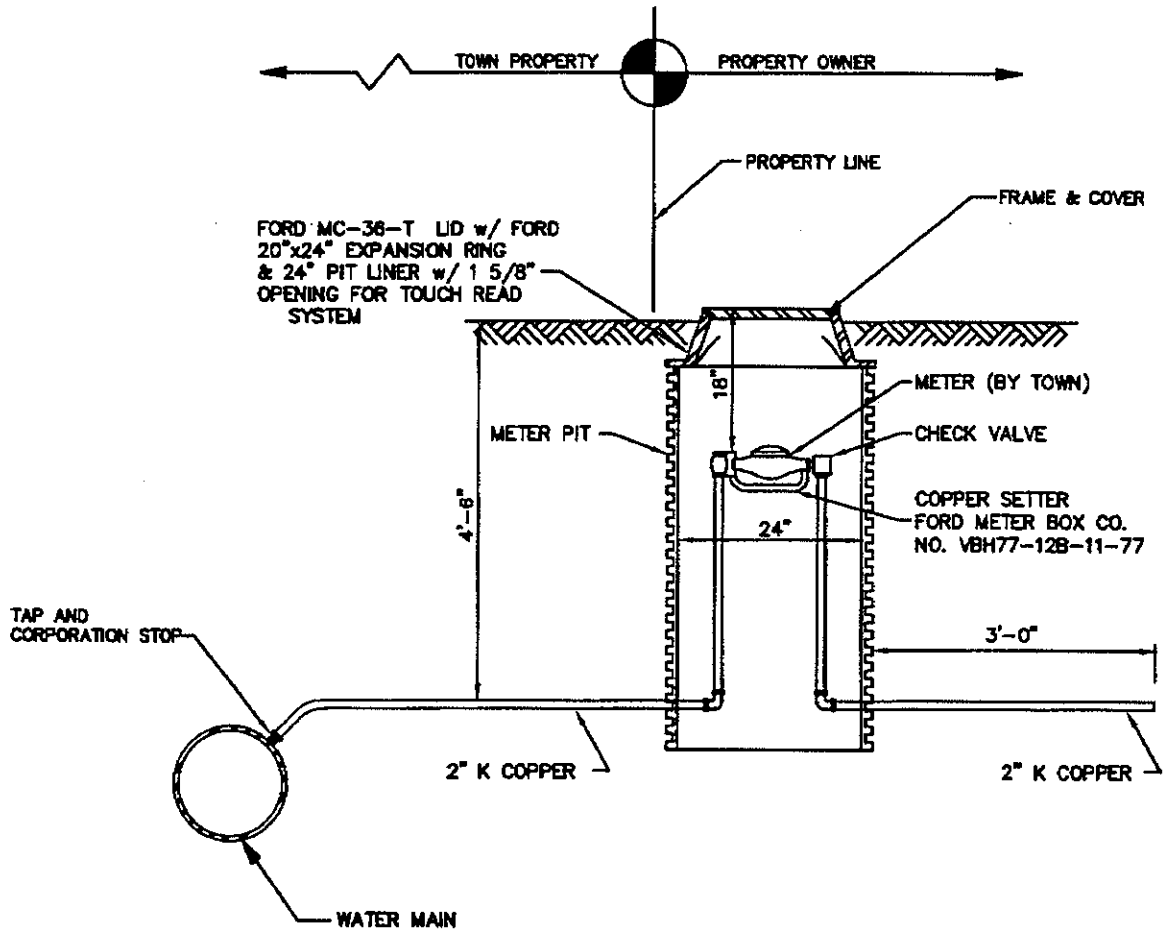
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FIGURE W-12

File name: \\ENVIRO\\32980\\CONST\\STD\\WATER\\W-13.DWG PLOT SCALE:



2" - WATER METER AND PIT DETAIL

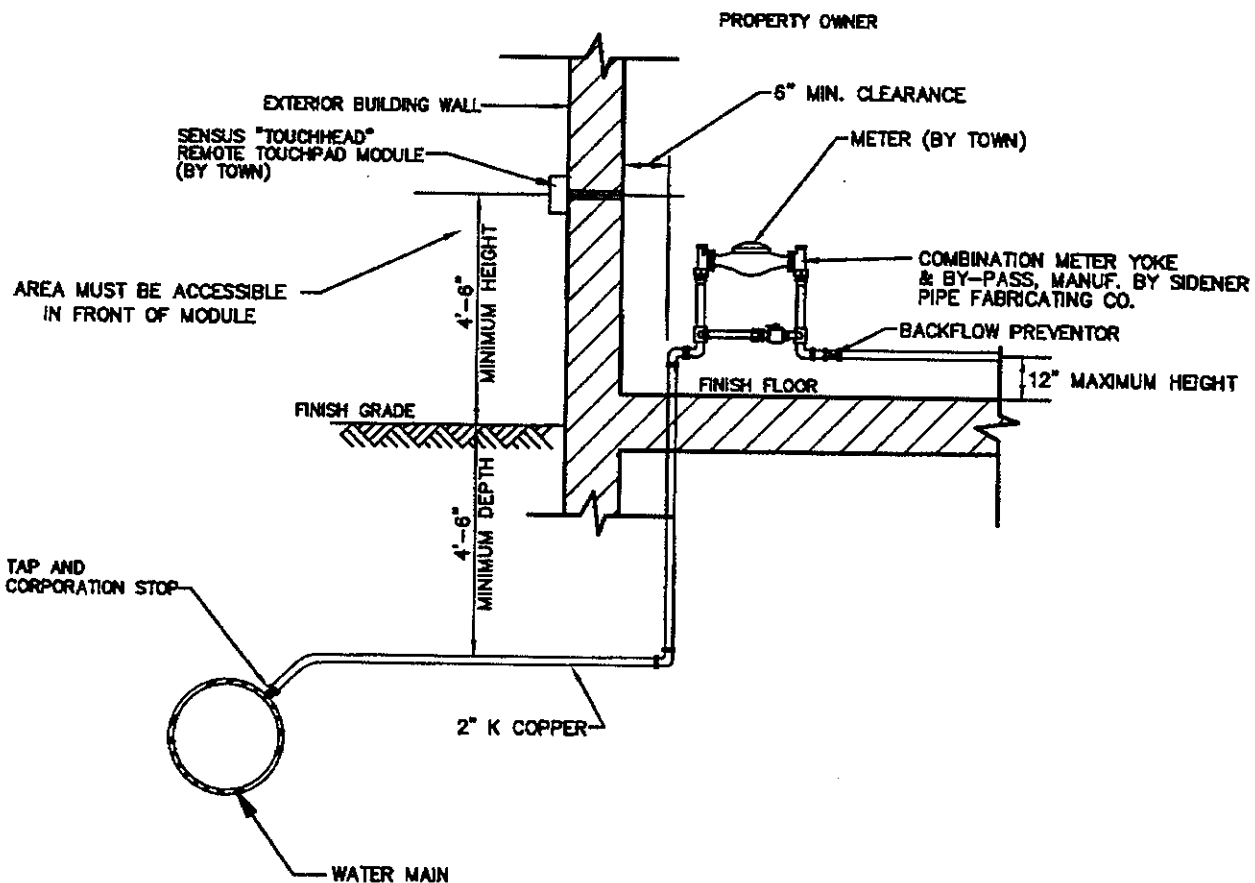
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FIGURE W-13



2" COMMERCIAL - INDUSTRIAL WATER METER DETAIL

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FIGURE W-14

SECTION 02721 - STORM SEWERS

PART 1 - GENERAL

1.1 GENERAL

- A. This section covers all work necessary for the construction of the storm sewer piping systems and related items complete, including catch basins and inlet drains, manholes, junction chambers, diversion chambers, outfall structures, and miscellaneous structures.
- B. This section shall be used only when non-watertight joints will be allowed, and hydrostatic or air testing will not be required for storm sewers unless because of suspected leakage or other problems the Street Superintendent deems necessary.
- C. This specification covers the following types of materials for storm sewers, culverts, underdrains, inlet drains, conduits, and miscellaneous applications:
 - 1. Reinforced Concrete Pipe and Fittings
 - 2. Polyvinyl Chloride Pipe (PVC)
 - 3. Corrugated Metal Pipe
 - 4. Structural Plate Arches
 - 5. Aluminum or Aluminized Steel Pipe and Structural Plate
 - 6. Multi-Plate Pipe and Pipe Arches
 - 7. PVC Composite Pipe
 - 8. Corrugated Polyethylene Pipe
- D. Sewer pipe shall be of the size shown on the drawings and shall meet all requirements of these specifications.
- E. This specification requires project plans and construction specifications to be submitted to and approved by all appropriate regulatory agencies prior to beginning any work.

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 SUBMITTALS

Before construction and preferably before fabrication, the Contractor shall submit to the Street Superintendent for approval calculations on the thickness or strength class and drawings showing pipe lengths, joints, and other construction and installation details. All pipe furnished under this Contract shall be fabricated only in accordance with the drawings and these specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

The City and its Engineer may, at their option, specify a material to be used on the drawings; and the developer or Contractor shall furnish and install the pipe material or materials specified and will only offer other equal materials.

2.2 REINFORCED CONCRETE PIPE AND FITTINGS

- A. Reinforcing concrete pipe and fittings shall conform to ASTM C76, latest revision, for circular pipe and ASTM C507 for elliptical pipe.
- B. Reinforced concrete pipe and fittings for normal conditions shall be reinforced in accordance with ASTM C76, Class III, Wall B (minimum). Acceptance shall be on the basis of Subsection 4.1.1 of ASTM C76.
- C. Circumferential reinforcing in circular pipe shall be required. No elliptical reinforcing or combination of elliptical and circumferential reinforcing or part circular reinforcing shall be permitted in circular pipe.
- D. Concrete pipe shall be steam cured and shall not be shipped from point of manufacture for at least five days after having been cast.
- E. Joints shall conform to the requirements of ASTM C443. Gaskets shall be of an oil resistant type having a maximum swell of 90% when tested in accordance with ASTM D471. Lubricant for jointing shall be approved by gasket manufacturer.
 - 1. All rubber gasket similar to and equal to "Press-Seal" or "Tylox" conforming to ASTM Designation C443, latest revision. The gasket shall be attached to the spigot of the pipe and shall be the sole element depended upon to make the joint flexible and practically watertight.
 - 2. Butyl mastic joint sealant in rope or trowel applied form specifically made for permanently sealing joints in tongue and

groove concrete sewer pipe. The material shall adhere tightly to the pipe surface and form a tight, flexible joint. The material shall have been in use for at least five years. Test results and material specifications shall be submitted to the City of Greensburg and shall have been approved prior to use on the project.

2.3 POLYVINYL CHLORIDE PIPE AND FITTINGS

Polyvinyl chloride (PVC) pipe and fittings shall comply with ASTM D 3034.

2.4 CORRUGATED METAL PIPE AND PIPE ARCHES

- A. The following specifications shall govern the manufacture of the corrugated steel pipe and pipe arches.
 - 1. Specifications for Zinc Coated (galvanized) Steel Sheets (ASTM A444).
 - 2. Manufacture of Corrugated Steel Culverts and Underdrains (AASHTO M-36).
 - 3. Structural Plate for Pipe, Pipe Arches, and Arches (AASHTO M-167).
 - 4. Bituminous Coated Corrugated Steel Pipe and Arches (AASHTO M-190).
 - 5. Sheet Material (ASTM A525).
- B. Bituminous Coated Welded Seam Helically Corrugated Steel Pipe: The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by 1/2-inch depth. Each pipe shall have two annular corrugations rolled in each end. After the ends are rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch as required by AASHTO M-190 for Type A coating.
- C. Bituminous Coated and Paved Invert Welded Seam Helically Corrugated Steel Pipe
 - 1. The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by 1/2-inch depth. Each pipe shall have two annular corrugations rolled in each end.
 - 2. After the ends are rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch. In addition, bituminous material shall be applied to form a smooth

pavement in the bottom 25% of pipe and in the bottom 40% of pipe arch as required by AASHTO M-190 for Type C coating.

D. Smooth Lined Welded Seam Helically Corrugated Steel Pipe

1. The pipe shall be fabricated from flat coils. The base metal, spelter coating, and fabrication shall meet the applicable requirements of AASHTO M-36. Corrugations shall be 2-2/3-inch pitch by 1/2-inch depth. Each pipe shall have two annular corrugations rolled in each end. Each pipe shall have two lifting lugs welded to the outside of the pipe.
2. After the ends have been rolled, the pipe shall be coated with bituminous material, inside and outside, to a minimum thickness of 0.05 inch as required by AASHTO M-190 for Type A coating. The pipe shall be centrifugally lined on the inside with bituminous material to form a smooth surface which fills the corrugations to a minimum thickness of 1/8 inch above the crests of the corrugations. The bituminous lining material shall meet the requirements of AASHTO M-190.

2.5 CORRUGATED METAL PIPE COUPLINGS

Bituminous Coated Pipe Couplings: Coupling bands shall be the same base metal and spelter coating as the pipe. Bands shall be 0.064-inch thick and 10-1/2 inches wide. Bands shall be bituminous coated and shall have two corrugations 7-5/8 inches center to center. Bands 12-inch diameter through 30-inch diameter shall be one-piece, and 36-inch diameter through 96-inch diameter shall be two-piece. Band laps 12-inch diameter through 48-inch diameter shall be joined by one galvanized bar, bolt, and strap connector. Band laps 54-inch diameter through 96-inch diameter shall be joined by two galvanized bar, bolt, and strap connectors.

2.6 ALUMINUM OR ALUMINIZED STEEL CORRUGATED PIPE AND STRUCTURAL PLATES

A. Aluminum Alloy Structural Plate

1. Aluminum alloy plates and fasteners intended for use in the construction of structural plate pipe and pipe arch for storm sewers shall meet the applicable requirements of AASHTO M-219. The plate shall be fabricated from aluminum alloy 5052 H141. The chemical composition of the plates shall conform to ASTM B209 alloy 5052.
2. The corrugations shall have a pitch of 9 inches plus or minus 3/8 inch and depth of 2-1/2 inches plus or minus 1/8 inch. The inside crown radius of the corrugations shall be not less than 2 inches.

3. The structural plate pipe or arches shall be assembled in accordance with the manufacturer's erection instructions and in accordance with the drawings.

B. Aluminized Steel Pipe and Arches

1. Aluminized coated corrugated steel pipe and pipe arch intended for use in the construction of storm sewers shall meet the applicable requirements of AASHTO M-36. Sheet material shall meet the latest revision of ASTM A525 and AASHTO M-274. The coils from which the pipe is produced shall be coated with 1.0 ounce per square foot of commercially pure aluminum.
2. Pipe shall be furnished circular or as a pipe-arch shape as required and shall be fabricated with helical corrugations and a continuous welded seam extending from end to end of each length of pipe.
3. Each end of each pipe with the welded seam shall have two annular corrugations reformed to permit joining with hugger bands.
4. Coupling bands shall be hugger bands.

2.7 MULTI-PLATE PIPE AND PIPE ARCHES

- A. Multi-plate pipe and pipe arch structures shall be in accordance with AASHTO M-167. They shall be made with steel sections with corrugations 6 inches wide by 2 inches deep running at right angles to the section.
- B. Bolts and nuts shall be special heat-treated galvanized 3/4-inch diameter bolts in accordance with ASTM specifications.
- C. Multi-plate pipes and pipe arches shall be designed in accordance with the manufacturer's design criteria and in accordance with the drawings.
- D. Detailed instructions regarding erection shall be furnished by the manufacturer.

2.8 CORRUGATED POLYETHYLENE PIPE AND FITTINGS

Corrugated polyethylene pipe and fittings shall be high density polyethylene and shall conform to ASTM D 3350, with a minimum cell classification of PE 334413.

2.9 MANHOLES AND OTHER STRUCTURES

- A. Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to requirements of ASTM Specification C478, latest revision.
- B. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:
 - 1. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C150, ACI 301, and ACI 318. Concrete for precast manhole sections shall be 3000 psi concrete. Monolithic manholes shall use 4000 psi concrete. Ready-mix concrete shall conform to ASTM C94, Alternate 2. Maximum size of aggregate shall be 3/4 inch. Slump shall be between 2 and 5 inches.
 - 2. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
 - 3. Reinforcing steel shall conform to ASTM A615, Grade 60 deformed bars, or ASTM A616 Grade 60 deformed bars.
 - 4. Mortar Materials:
 - a. Sand - ASTM Designation C144, passing a No. 8 sieve.
 - b. Cement - ASTM Designation C150, Type 1.
 - c. Water - shall be potable.
 - 5. The manufacturer shall provide openings for sewers entering and leaving the manhole. Any additional openings needed to be made in the field shall be made by drilling holes at least 1/2 inch in diameter with a maximum spacing of 3 inches.
 - 6. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Castings shall have a total weight of not less than 355 pounds and shall conform to the design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section with four (4) 3/8-inch bolts, nuts, and washer.
 - 7. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements.
 - 8. Any other special manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall be constructed as detailed on the drawings.

2.10 CATCH BASINS AND DRAIN INLETS

Cast iron or ductile iron frames and gratings for catch basins and drain inlets shall be as shown on the drawings. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blow holes, shrinkage, cold shuts, and all defects and shall conform to ASTM A48 Class No. 30-B. During construction, precautionary measures such as adequate screening of grates shall be maintained to deter earth and other materials from entering the drains.

2.11 STORM SEWER LATERALS

Storm Sewer Laterals are required within any new development for each platted lots. The lateral must be a minimum of six (6) inches in diameter and be made of Reinforced Concrete Pipe and Fittings, Polyvinyl Chloride Pipe (PVC), PVC Composite Pipe or Corrugated Polyethylene Pipe.

PART 3 - EXECUTION

3.1 INSPECTION AND REJECTION OF PIPE

- A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Street Superintendent. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.
- B. Prior to being lowered into the trench, each pipe shall be carefully inspected and those not meeting the specifications shall be rejected and at once removed from the work.
- C. The Street Superintendent shall have the right to cut cores from such pieces of the concrete pipe as he desires for such inspection and tests as he may wish to apply.
- D. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.
- E. The Street Superintendent shall also have the right to take samples of concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.

- F. Any pipe which has been damaged after delivery will be rejected and replaced solely at the Contractor's expense.

3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the Street Superintendent approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

3.3 NOTICE TO ENGINEER

The Street Superintendent shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

3.4 LAYING PIPE

- A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and shall be removed immediately from the site of the work.
- B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.
- C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.
- D. Practically watertight work is required, and the Contractor shall construct the sewers with the type of joint specified.
- E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.
- F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the recommendations of the manufacturer on particular type of joint and the directions of the Street Superintendent. All joint work shall be done by experienced workmen.

- G. All pipe shall be bedded as described in this specification under Pipe Bedding. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.
- H. Each length of pipe shall be mechanically pulled "home" with a winch or come-along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place.
- I. The Contractor shall use laser beam equipment, surveying instruments, or other proven techniques to maintain accurate alignment and grade.
- J. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.

3.5 PIPE BEDDING AND HAUNCHING

- A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.
- B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 - 1. No. 8 crushed limestone shall be used for bedding. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. The material is used for bedding, must also be utilized for haunching up to or higher than the spring line of the pipe to avoid loss of side support.
- C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe,

whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.

- D. The rigid pipe, such as concrete, or ductile iron, backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.
- E. For flexible pipe, corrugated metal pipe, the placement of embedment material or haunching around the pipe must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Crushed stone shall be used to backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe, it shall be hand placed. Care should be taken so not to compact directly over the pipe.
- F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation.
- G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches (150 mm) crushed stone bedding placed prior to pipe installation.

3.6 CONCRETE CRADLE (CLASS "A" BEDDING)

Concrete cradles shall be constructed of Class "B" concrete and of the design shown on the detailed drawings.

3.7 MANHOLES AND OTHER STRUCTURES

- A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:
 - 1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:
 - a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.
 - b. The joint shall consist of a flat rubber gasket attached to the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation 443, latest revision.

2. Openings in manhole sections for storm sewer connections shall be cut at the point of manufacture and shall be circular or horseshoe shaped with grooved or roughened surfaces to improve mortar bond. Any additional holes cut in the field shall be accomplished in a manner approved by the street commissioner.
3. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet. Manhole bases shall be cast on a minimum of 6 inches of compacted crushed stone.
4. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.
5. Manhole frames and lids shall weigh not less than 355 pounds and be of good quality cast iron, conforming to ASTM Designation A48 and as shown on Detail #2 on the Standard Detail Sheet. Unless specifically designated otherwise, manhole castings shall be the non-locking type. All manhole frames shall be cast or drilled with three holes equally spaced around base of frame and shall be securely anchored to cone section with three 3/8-inch bolts, nuts, and washers. The joint between the casting frame and cone section shall be fully mortared or gasketed and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.
6. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. Steps shall be placed as shown on the drawings.

3.8 FINAL STORM SEWER CLEANING

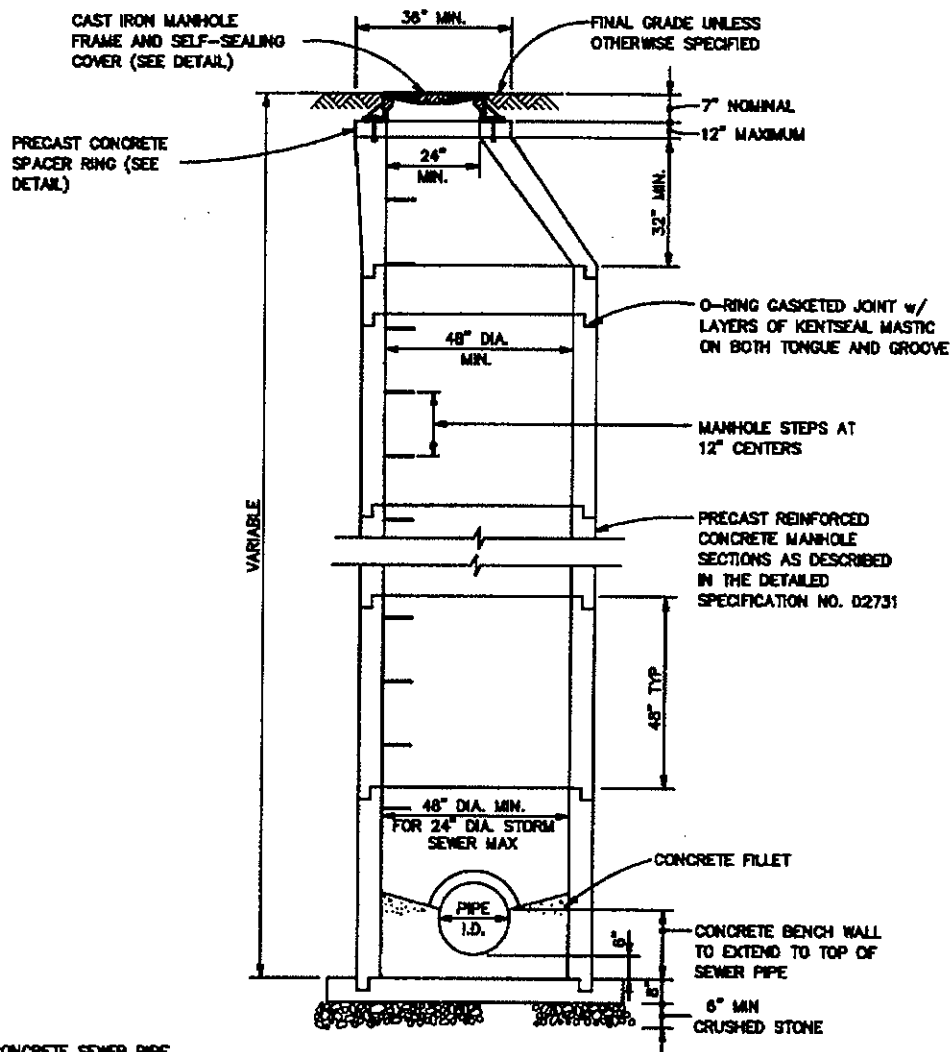
- A. Prior to final acceptance and final manhole-to-manhole inspection of the storm sewer system by the Street Superintendent, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon the Street Superintendent's final manhole-to-manhole inspection of the storm sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

PART 4 - FIGURES

4.1 INDEX

<u>Figure</u>	<u>Description</u>
ST-1	Standard Storm Sewer Manhole Detail
ST-2	Type I Storm Sewer Manhole Detail
ST-3	Straight Curb Inlet Casting Type 1
ST-4	Straight Curb Inlet Casting Type 2
ST-5	Rolled Curb Inlet Casting Type 3
ST-6	Beehive Curb Inlet Casting Type 4
ST-7	Flat Curb Inlet Casting Type 5
ST-8	Inlet Structure Type 1A
ST-9	Inlet Structure Type 1B
ST-10	Catch Basin Structure Type CA

END OF SECTION 02721



NOTE:

1. GROUT CONCRETE SEWER PIPE WATERTIGHT TO MANHOLE WALL
2. INSTALL BUTYL RUBBER WATERSTOP FOR PIPE OTHER THAN CONCRETE SEWER PIPE
3. SEE TYPE 1 STORM SEWER MANHOLE DETAIL FOR SEWERS LARGER THAN 24"

STANDARD STORM MANHOLE DETAIL

HNTB

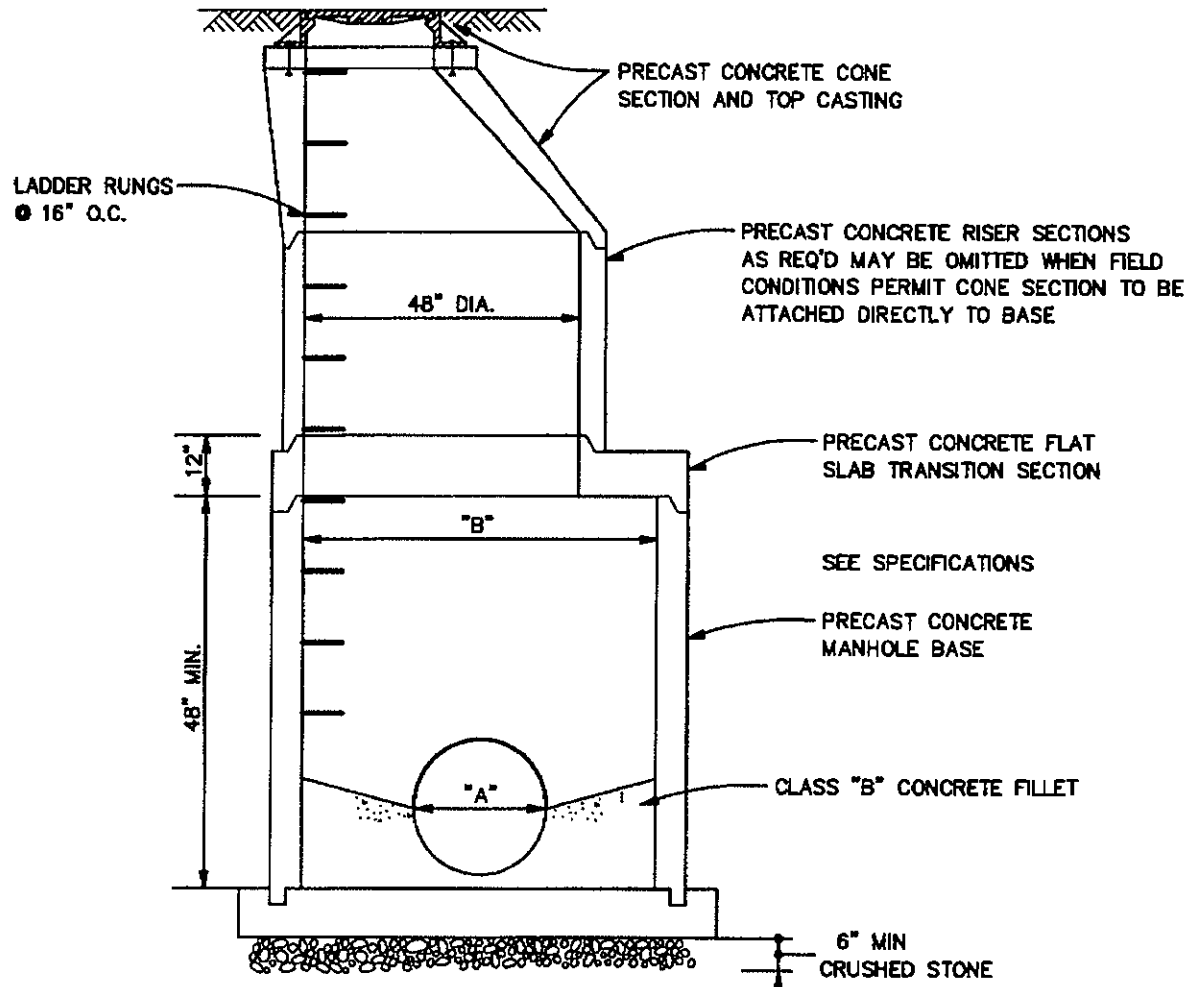
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JUNE 2001

FIGURE ST-1

File name: N:\IRON\32980\STORM\ST-02.DWG PLOT SCALE: 1:1



TYPE 1 MANHOLE STRUCTURE DATA		
PIPE DIA. "A"	INTERSECTING ANGLE	PIPE DIA. "B"
30"	0° TO 44°	30"
30"	44° TO 90°	30"
36"	0° TO 44°	36"
36"	44° TO 90°	36"

NOTES:

1. SEE STANDARD STORM SEWER MANHOLE DETAIL FOR OTHER DETAIL & DIMENSIONS
2. RISER & CONE SECTIONS SHALL BE AS SHOWN ON STANDARD STORM SEWER MANHOLE DETAIL

TYPE 1 STORM SEWER MANHOLE DETAIL

HNTB

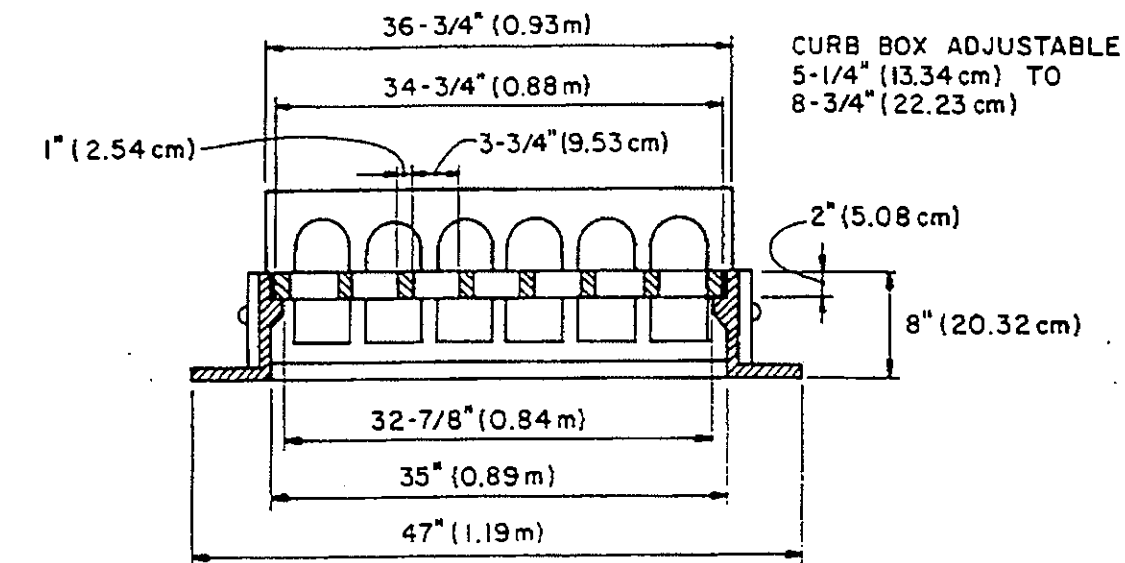
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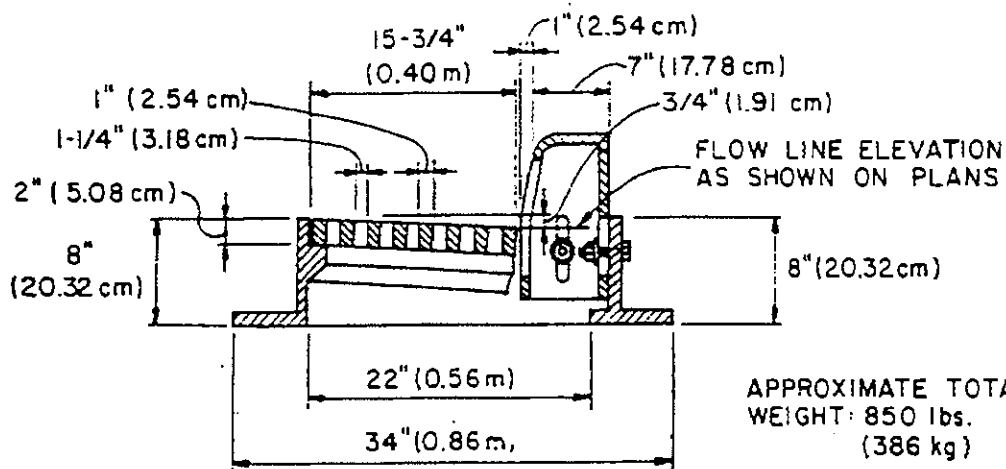
JUNE 2001

FIGURE ST-2

File name: I:\IRON\32980\CONSTR_STD\STORM_SEWER\ST-03.DWG PLOT DATE: 1:1



ELEVATION



SECTION

MANUFACTURER	CATALOG NO.
NEENAH	R-3287

STRAIGHT CURB INLET CASTING TYPE 1

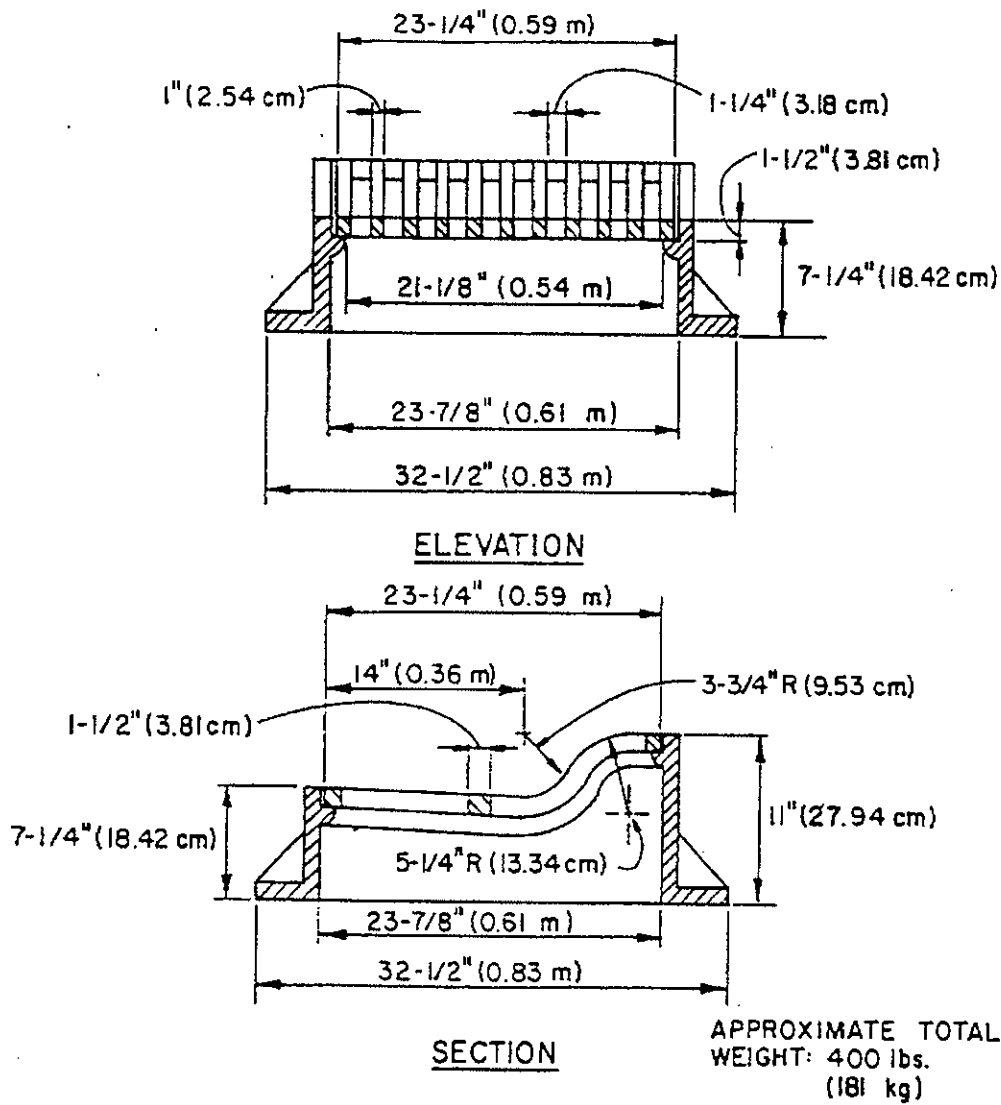
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FIGURE ST-3



MANUFACTURER	CATALOG NO.
NEENAH	R-350I-N

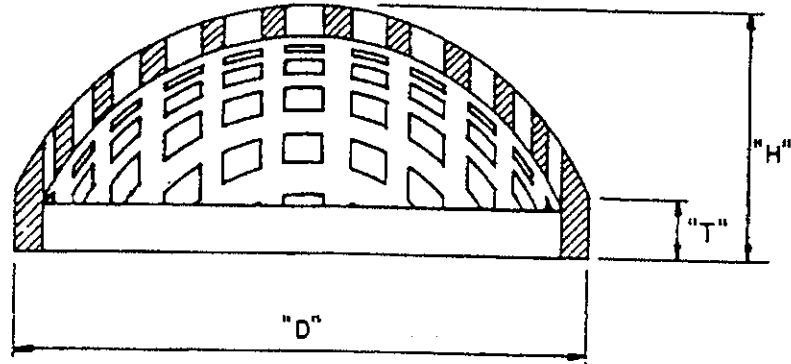
ROLLED CURB INLET CASTING TYPE 3

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SECTION

PIPE SIZE	"D"	"T"	"H"	APPROX. WEIGHT
12" (30.48 cm)	14-3/4" (37.47 cm)	2-1/2" (6.35 cm)	5-1/2" (13.97 cm)	50 lbs. (23 kg)
15" (38.10 cm)	18-1/4" (46.36 cm)	2-1/2" (6.35 cm)	6-1/4" (15.88 cm)	75 lbs. (34 kg)
18" (45.72 cm)	22" (55.88 cm)	3" (7.62 cm)	7-1/2" (19.05 cm)	100 lbs. (45 kg)
24" (60.96 cm)	29" (73.66 cm)	3" (7.62 cm)	9" (22.86 cm)	180 lbs. (82 kg)

MANUFACTURER	CATALOG NO.
NEENAH	R-4350
EAST JORDAN	6530

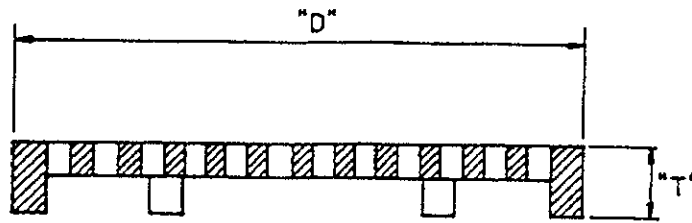
BEEHIVE INLET CASTING TYPE 4

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JUNE 2001



SECTION

PIPE SIZE	"D"	"T"	APPROX. WEIGHT
12" (30.48 cm)	14-3/4" (37.47 cm)	2-1/2" (6.35 cm)	32 lbs. (15 kg)
15" (38.10 cm)	18-1/4" (46.36 cm)	2-3/4" (6.99 cm)	55 lbs. (25 kg)
18" (45.72 cm)	22" (55.88 cm)	2-3/4" (6.99 cm)	75 lbs. (34 kg)
24" (60.96 cm)	29" (73.66 cm)	3-1/4" (8.26 cm)	140 lbs. (64 kg)

MANUFACTURER	CATALOG NO.
NEENAH	R-4030
EAST JORDAN	.6000

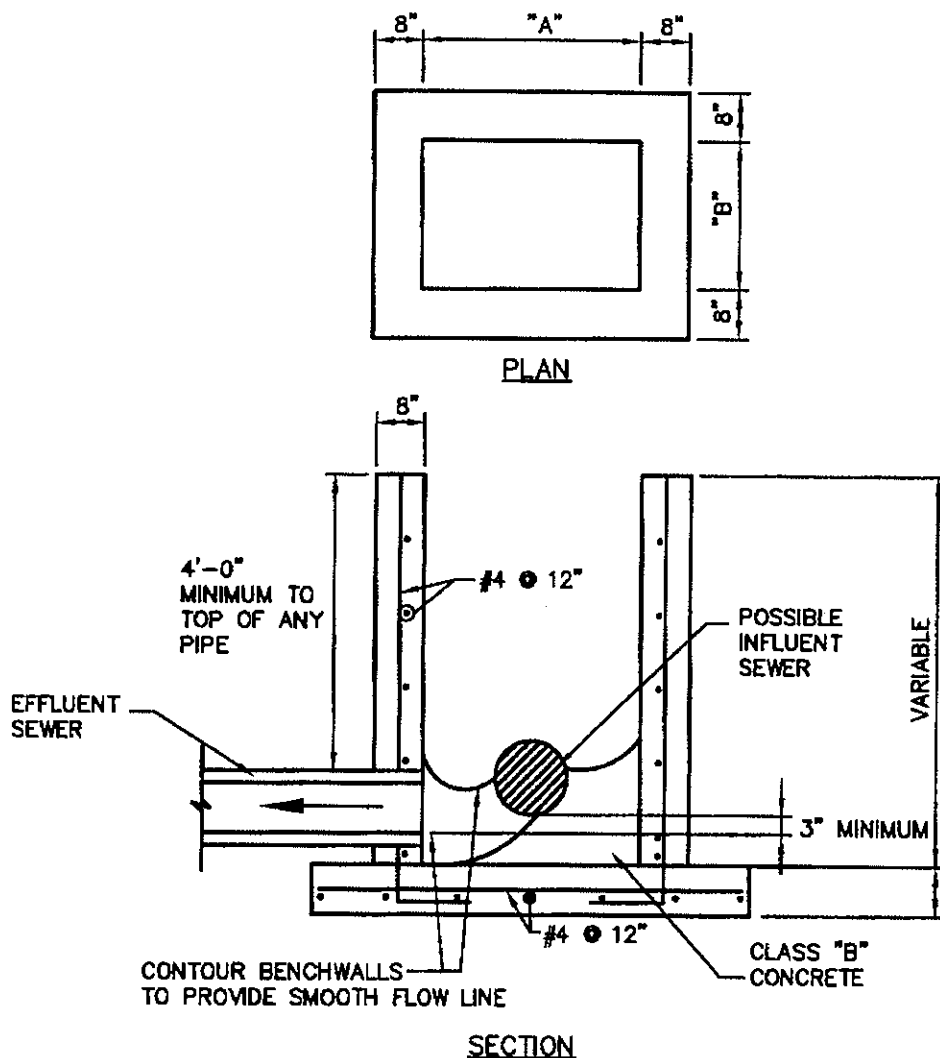
FLAT INLET CASTING TYPE 5

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CAST	"A"	"B"
TYPE 1	36"(0.91m)	24"(0.61m)
TYPE 2	24"(0.61m)	22"(0.56m)
TYPE 3	22"(0.56m)	20"(0.51m)

NOTE:

1. THESE DIMENSIONS ARE ALSO APPLICABLE TO TYPE CA CATCH BASINS.
2. PRECAST INLETS AND CATCH BASINS SHALL BE CONSIDERED AN ACCEPTABLE ALTERNATE IF APPROVED BY THE ENGINEER OR OWNER.

INLET STRUCTURE TYPE 1A

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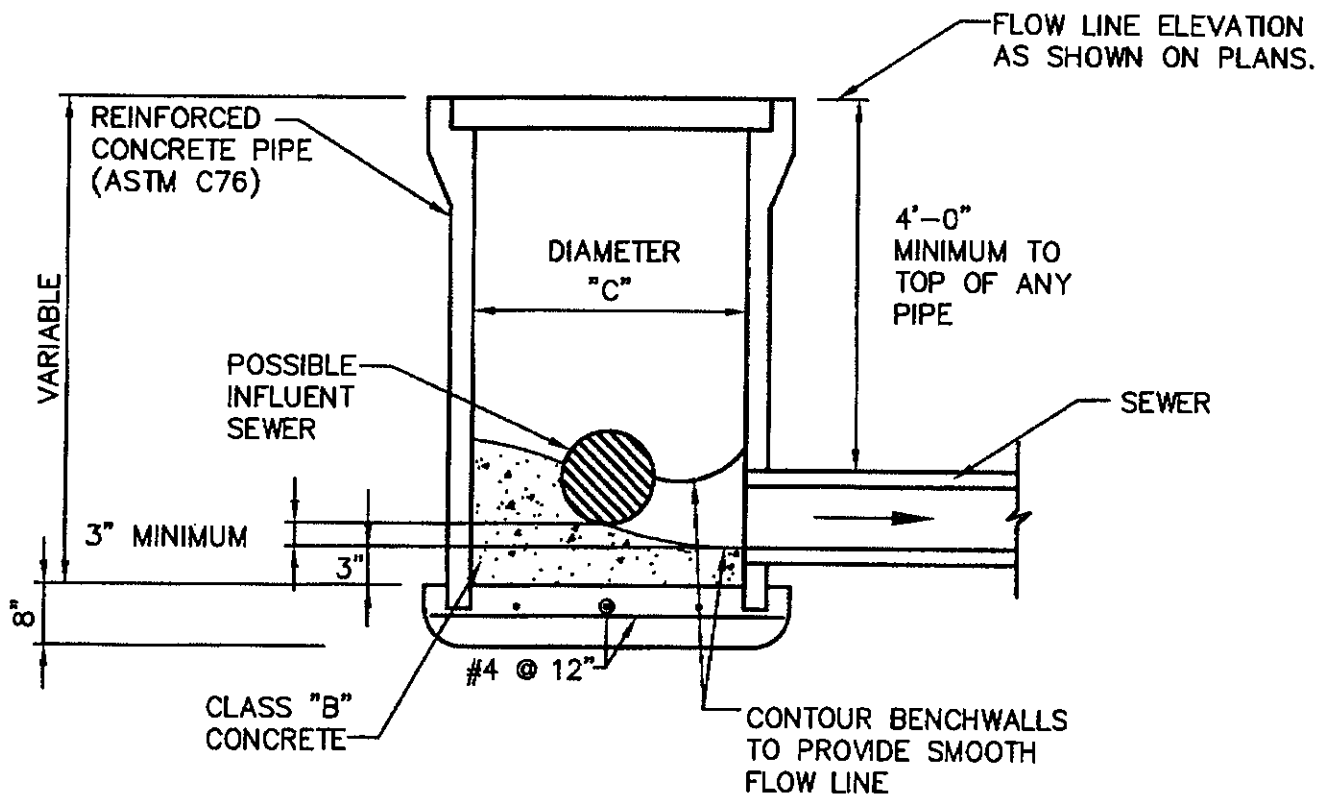
CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE ST-8

Plot Scale 1

File name: ENVIRON\32980\CONST_STD\STORM\ST-09.dwg



NOTE:

DIMENSION "C" SHALL BE 24" (0.61m) UNLESS OTHERWISE NOTED ON THE DRAWINGS

SECTION

CAST	"A"	"B"
TYPE 1	36" (0.91m)	24" (0.61m)
TYPE 2	24" (0.61m)	22" (0.56m)
TYPE 3	22" (0.56m)	20" (0.51m)

NOTES:

1. THESE DIMENSIONS ARE ALSO APPLICABLE TO TYPE CA CATCH BASINS.
2. PRECAST INLETS AND CATCH BASINS SHALL BE CONSIDERED AN ACCEPTABLE ALTERNATE IF APPROVED BY THE ENGINEER OR OWNER.

INLET STRUCTURE TYPE 1B

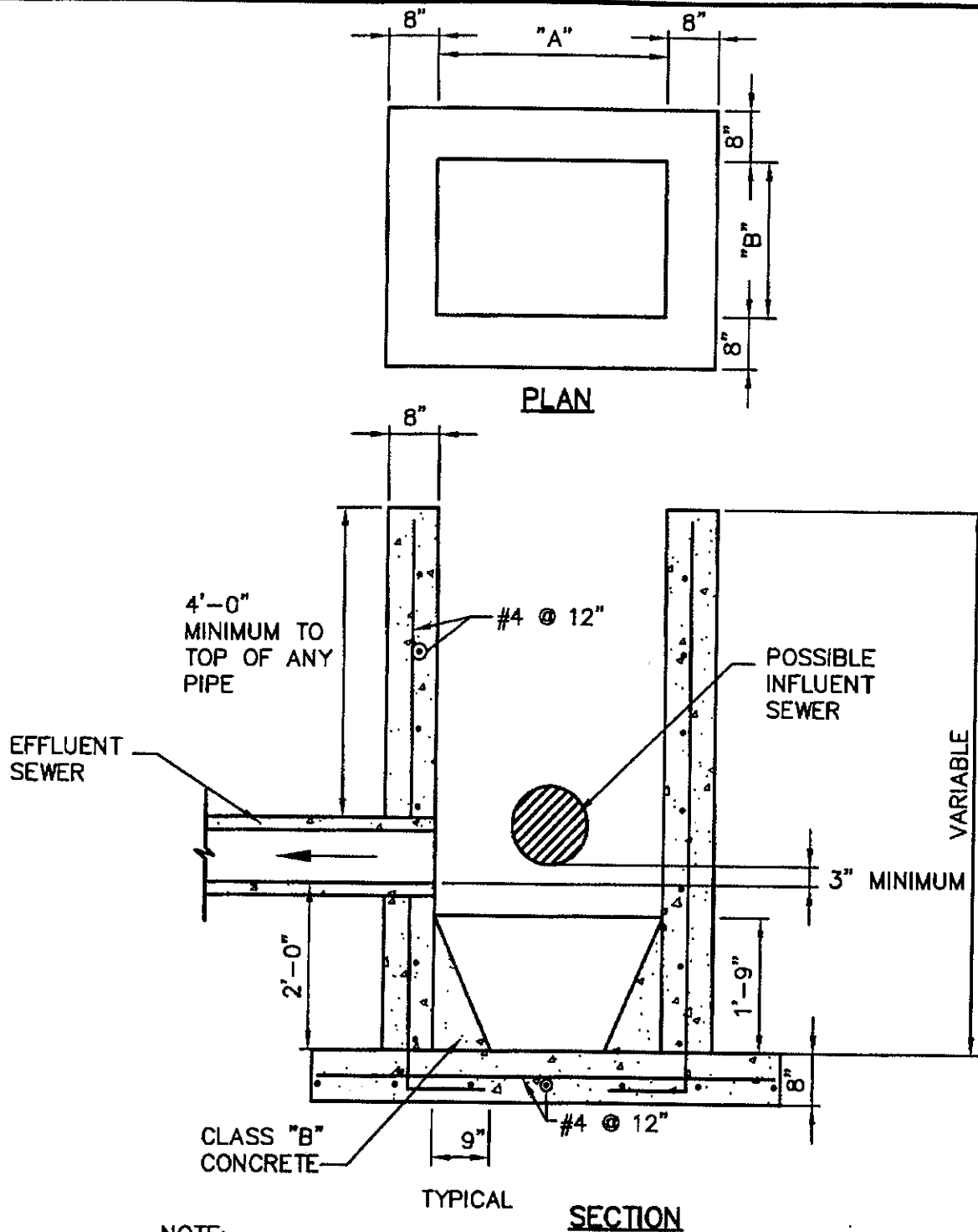


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CITY OF GREENSBURG, INDIANA

JUNE 2001

FIGURE ST-9



NOTE:

1. DIMENSION "A" SHALL BE 36" (0.91m)
AND DIMENSION "B" SHALL BE 24" (0.61m)
UNLESS OTHERWISE NOTED ON THE DRAWINGS.
2. PRECAST CATCH BASINS SHALL BE CONSIDERED AN ACCEPTABLE
ALTERNATE IF APPROVED BY THE ENGINEER OR OWNER.

TYPE CA CATCH BASIN DETAIL

HNTB

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FIGURE ST-10

SECTION 02731 - GRAVITY SANITARY SEWERS

PART 1 - GENERAL

1.1 GENERAL

- A. This section covers all work necessary for the installation of gravity sanitary sewers and related items complete, including manholes, junction chambers, diversion chambers, house services, and miscellaneous concrete structures. This section also describes the definitions, policies and procedures for the construction of sanitary sewers in the City of Greensburg.
- B. All sanitary sewers constructed in the City of Greensburg are to meet the following specifications, state and federal regulations and the Recommended Standards for Wastewater Facilities.
- C. All easements for collection system sewers must prohibit the construction of any permanent structure over the sanitary sewer and must also provide enough access for maintenance with mechanical equipment.
- D. A sanitary sewer construction permit, where required, shall be obtained from the Indiana Department of Environmental Management (IDEM). An IDEM sanitary sewer construction permit shall not be required for the following:
 - 1. A storm sewer that transports only surface run-off.
 - 2. Construction of a house connection for a single-family dwelling or residence.
 - 3. Construction of a building connection for a multi-unit residence building, commercial, manufacturing, or industrial building, provided that no toxic or other pollutants that are incompatible with the publicly owned treatment works and collection system are present in the wastewater served by the sewer or that are incapable of being treated to an acceptable quality.
- E. All required permits or exemptions from other federal, state, and local units must be obtained prior to the commencement of construction of any sanitary sewer.
- F. The Superintendent of the Greensburg Wastewater Treatment Plant is to be notified twenty-four (24) hours before installation of any sanitary sewer.

1.2 DEFINITIONS

- A. Backfill: Material placed in trench from the top of bedding to finish grade, or subbase of pavement.
- B. Bedding: Material placed in trench to support pipe and conduit.
- C. Building Drain: That part of the lowest horizontal piping of a building drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning two (2) feet outside the inner face of the building wall.
- D. Building Sewer: The extension from the building drain to the Service Lateral or other place of disposal also called house connection.
- E. Excavation: Removal of earth and rock to form a trench for the installation of a gravity sanitary sewer.
- F. Earth: Unconsolidated material in the crust of the Earth derived by weathering and erosion.
- G. Earth includes:
 - 1. Materials of both inorganic and organic origin.
 - 2. Boulders less than 1/3 cubic yard in volume, gravel, sand, silt, and clay.
 - 3. Materials, which can be excavated with a backhoe, trenching machine, dragline, clamshell, bulldozer, highlight, or similar excavating equipment without the use of explosives, rock tippers, rock hammers, or jackhammers.
- H. House Connection: Means the pipe carrying the wastewater from a single-family dwelling to a common public sewer.
- I. Sanitary Sewer: Means a sewer that conveys liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, and to which storm surface, and ground waters are not intentionally allowed to enter.
- J. Rock: A natural aggregate of mineral particles connected by strong and permanent cohesive forces.

K. Rock includes:

1. Limestone, sandstone, dolomite, granite, marble, and lava.
2. Boulders 1/3 cubic yard or more in volume.
3. Materials, which cannot be excavated by equipment, which is used to remove earth overburden without the use of explosives, rock tippers, rock hammers, or jack hammers.

L. Service Lateral: The pipe that conveys wastewater from the property and/or easement line to the public sanitary sewer.

M. Sanitary Superintendent: The Superintendent of the Greensburg Wastewater Treatment Plant or his representative.

N. Subgrade: Undisturbed bottom of trench.

O. Topsoil: Earth containing sufficient organic materials to support the growth of grass.

P. Wastewater: Liquid and water carried industrial wastes and sewage from residential dwellings, commercial buildings, industrial and manufacturing facilities, and institutions, whether treated or untreated, which are contributed to the POTW.

Q. Undercutting: Excavation of rock and unsuitable earth below the bottom of the pipe or conduit to be installed in the trench.

1.3 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.4 QUALITY ASSURANCE

- A. Performance Tests: The Contractor shall test all gravity sewers constructed. The Contractor shall constantly check horizontal and vertical alignment. Testing for vertical deflection in the case of non-rigid pipe and sewer watertightness testing in the case of all gravity sewers and hydrostatic testing of ductile iron pipe shall be as specified in this Section.
- B. Line and Grade Requirements: The Contractor shall provide assurance to the City of Greensburg or the City of Greensburg's representative that the

sewer is laid accurately to the required line and grade as shown on the drawings. The Contractor shall utilize a laser beam instrument to lay and check the alignment and grade between manholes. Before proceeding with the next section of sewer, the last section shall be checked for proper line and grade. Variations from a uniform line and grade as shown on the drawings and described below shall be cause for the line to be rejected.

1. Variance from established line and grade shall not be greater than $\frac{1}{32}$ of an inch per inch of pipe diameter and not to exceed $\frac{1}{2}$ inch, provided that such variation does not result in a level or reverse sloping invert; provided also that the variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed $\frac{1}{64}$ inch per inch of pipe diameter or $\frac{1}{2}$ inch maximum.

C. Test Sections

1. Initial Performance Test: An initial performance and leakage test may be required on the first sections of sanitary sewer constructed of approximately 600 feet in length of each size and type sewer material installed. No additional sewer pipe shall be installed until the first section of sewer of each size and type of sewer material has satisfactorily passed the test for line and grade and the leakage test.
2. Subsequent Performance Testing: After the initial performance test and leakage test and as work progresses, the City of Greensburg may designate additional sections for testing as conditions in his opinion warrant. If a review of the Contractor's workmanship leads the City of Greensburg to question whether or not the tolerances and standards specified are being met, the City of Greensburg reserves the right to select other locations and lengths to be tested. The City of Greensburg shall notify the Contractor of the location where a test is to be required not later than 15 days after the sewer installation has been completed. Unless otherwise authorized, the Contractor shall arrange to commence the test within 15 days after the sewer has been installed or 15 days after receiving notification by the City of Greensburg, whichever date is later.
3. Final Performance Testing for Acceptance: Before acceptance and final payment for all new sanitary sewers, the Contractor and the City of Greensburg or the City of Greensburg's representative shall check all sewers, even if previously checked, for accurate alignment and grade. Also, all sanitary sewers shall be tested as specified in Articles 3.10 through 3.14 of this Section for watertightness. The program of testing whether by infiltration,

exfiltration, airtesting, or vacuum testing shall be determined by the City of Greensburg.

4. All tests to be performed are to be witnessed by the design City of Greensburg (Engineer (or their representative) and the Wastewater Treatment Plant Superintendent (or their representative). The Superintendent shall be notified at least twenty-four (24) hours prior to testing.

1.5 LENGTH OF OPEN TRENCH

Except by permission of the City of Greensburg, not more than 100 feet of trench shall be opened at any one time. Not more than 30 feet of trench may be opened in advance of the completed pipe laying operation, and not more than one street crossing may be obstructed by the same trench at any one time.

1.6 RELATION TO WATER MAINS

- A. Sewers must be laid at least 10 feet horizontally from any existing or proposed water main. The distance is to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the City of Greensburg for specific instructions regarding the treatment of the separation. Special conditions may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18 inches above the top of the sewer. It may be necessary to install 150 psi water main pipe and joints as sewer pipe for the congested areas.
- B. Whenever the sewer crosses a water main, it should be laid at least 18 inches below the main, or the water main should be reaid with fittings to cross over the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
- C. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling. Maximum distance between sewer pipe joints and water pipe shall be provided where vertical separation is a problem.

1.7 COLLECTION SYSTEMS NEAR SURFACE WATER BODIES

- A. Sanitary sewers and lift stations shall be separated from existing or proposed water bodies by ten (10) feet horizontally measured from the outside edge of the sanitary sewer to the edge of the water line at normal pool elevation.

- B. Sanitary sewers located above surface water bodies shall be in accordance with the following:
 - 1. Supported and anchored at each point.
 - 2. Protected from damage and freezing with any of the following:
 - a. Insulation.
 - b. Increased slope.
 - c. Accessible for repair or replacement.
- C. Sanitary sewers located under surface water bodies shall be constructed with ductile iron pipe or, PVC having a SDR ratio of 21 and in conformance with ASTM D2241-96b, Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe, with mechanical joints rated to two hundred (200) pounds per square inch.
- D. Backfilled with stone, gravel, or coarse aggregate and covered in accordance with the following:
 - 1. Below the channel pavement if the channel is paved.
 - 2. Twelve (12) inches of cover shall be provided where the sewer is located in rock.
 - 3. Thirty-six (36) inches of cover shall be provided in all other areas.
- E. Sanitary sewers that cross streams or rivers shall be in accordance with the following:
 - 1. Cross perpendicular to the stream flow.
 - 2. Have no change in grade.
- F. Sanitary lift stations shall be capable of remaining fully operational and accessible during a twenty-five (25) year flood.
- G. Sanitary lift stations, structures, and electrical and mechanical equipment shall be protected from physical damage potentially caused by a one hundred (100) year flood.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings and appurtenances shall be new, unused and as shown on the drawings or as required by the manufacturer and ANSI/AWWA or ASTM specifications.

2.2 SEWER PIPE 18 INCHES AND LARGER

- A. Sewers 18-inches through 27-inches in diameter shall be large diameter polyvinyl chloride pipe.
- B. Large Diameter Polyvinyl Chloride Pipe
 - 1. Large diameter solid wall polyvinyl chloride pipe shall conform to ASTM F679, SDR 35.
 - 2. Joints shall be the integral bell type with a locked in sealing ring meeting the requirements of ASTM D3212.

2.3 SEWERS 15 INCHES OR SMALLER

- A. Sewers 15 inches in diameter or smaller shall be polyvinyl chloride pipe, or ductile iron pipe.
- B. Polyvinyl Chloride Pipe and Fittings
 - 1. Polyvinyl chloride pipe and fittings shall conform to ASTM D3034 SDR 35, Type PSM, latest revision.
 - 2. Maximum diameter of PVC sewer pipe to be used is 15 inches.
 - 3. Joints on PVC sewer pipe shall be the integral bell type gasketed joint designed so that when assembled the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with manufacturer's recommendations. The joint shall comply with the physical requirements of ASTM D3212, and the gasket shall be the only element depended upon to make the joint flexible and watertight.
 - 4. All PVC Pipe entering a manhole shall have a manhole waterstop gasket as supplied by the manufacturer firmly clamped around the pipe at the manhole. If flexible entry type manhole system is used, the waterstop gasket is not required.
- C. Ductile Iron Pipe and Fittings: Ductile iron pipe and fittings shall conform to the requirements of ANSI/ASTM A746, Ductile Iron Gravity Sewer Pipe.
 - 1. Thickness class requirements of ductile iron pipe to be used in conveyance of sanitary sewage by gravity shall be minimum

thickness of Class 350 unless otherwise noted for standard length pipe.

2. Outside surfaces of the pipe and fittings shall be bituminous coated complying with ANSI/AWWA A21.51/C151 and ANSI/AWWA A2110/C110.
3. Inside surfaces of all pipe, fittings and adapters shall be lined with cement mortar and a bituminous seal coat. Cement mortar lining and bituminous seal coat shall meet the requirements of ANSI/AWWA A21.4/C104.
4. Ductile iron pipe and fittings shall be push-on type conforming to ANSI A21.11 (AWWA C111), latest revision. Fittings shall be ductile iron and shall comply with ANSI Specification A21.10, latest revision, with mechanical joints for 150 psi working pressure.

D. Fittings

1. Fittings such as wyes, tees, and bends shall be made in such a manner as will provide strength and watertightness at least equal to the class of the adjacent main line pipe to which they are jointed and shall conform to all other requirements specified for pipe of corresponding class and internal diameter. Joints shall be of the same type as used on the adjoining pipe.
2. Fabricated branches for wyes and tees shall be securely attached to the wall of the pipe in a watertight manner and shall be flush with the inside surface of the pipe. The branches shall have their axes perpendicular to the longitudinal axis of the pipe. Wye branches shall have their axes approximately 60 degrees for clay pipe and 45 degrees for concrete pipe from the longitudinal axis of the pipe, measured from the bell end. Pipe reinforcement shall not be interrupted beyond a radial distance of 3 inches outside of the fitting.

2.4 MANHOLES AND OTHER STRUCTURES

- A. Manholes shall be constructed of monolithic concrete or precast manhole sections. Precast manhole sections shall conform to requirements of ASTM Specification C478, latest revision.
- B. Openings in manhole sections for sewer connections shall be cast into the manhole as specified by the connector manufacturer. A flexible pipe-to-manhole connector shall be employed in the connections of the sanitary sewer pipe to precast manholes. The connector shall be the sole element relied on to assure a flexible, watertight seal of the pipe to the manhole. The connector shall be constructed solely of polyisoprene or natural rubber, and shall meet and/or exceed the requirements of ASTM C923. The resilient connectors shall be A-Lok Products, Inc., Press-Seal Gasket Corp., or similar manhole connectors approved by the City of Greensburg.
- C. In the field, any additional openings needed shall be made by core drilling and booted as approved by the City of Greensburg. A flexible pipe-to-manhole connector shall be employed in the connection of the sanitary sewer pipe to precast manholes. The connector assembly shall be the sole element relied on to assure a flexible watertight seal of the pipe to the manhole. The rubber gasket shall be constructed solely of polyisoprene or natural rubber and shall meet/exceed the requirements of ASTM C923. If metal, the internal expansion sleeve and the external compression clamps shall be constructed of Series 304 and Series 305 nonmagnetic stainless, and shall utilize no welds in its construction.
- D. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:
 - a. Concrete for precast manhole sections shall be 3000 psi concrete. Monolithic manholes shall use 4000 psi concrete. Ready-mix concrete shall conform to ASTM C94 Alternate 2. Maximum size of aggregate shall be 1-1/2 inches. Slump shall be between 2 and 4 inches.
 - b. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
 - c. Reinforcing steel shall conform to ASTM A615, Grade 40 deformed bars, or ASTM A616, Grade 40 deformed bars.
 - d. Mortar Materials
 - (1) Sand - ASTM Designation C144, passing a No. 8 sieve.

- (2) Cement - ASTM Designation C150, Type 1.
- (3) Water - shall be potable.
- e. All joints shall be fully sealed and waterproofed. Rubber gaskets for precast concrete manhole sections shall meet the requirements of ASTM C443. The gasket shall be the sole element depended upon to make the joint flexible and watertight.
- f. The manufacturer of the precast manholes shall provide core-drilled openings to produce a smooth, uniform, cylindrical hole of the proper size to accommodate a resilient connector meeting the requirements of ASTM C 923 for all sewers entering and leaving the manhole. The resilient connectors shall be either Press-Seal Gasket Corp., which provides PSX gasket or Press Wedge II; or similar flexible manhole sleeves furnished by Kor-N-Seal by NPG Systems, Inc.; or equal.
- g. Precast manhole sections shall be steam cured and shall not be shipped from the point of manufacture for at least five days after having been cast. The exterior surface of each section shall be thoroughly coated with a coal tar epoxy type coating as manufactured by TNEMEC Co, Tnemec-46H413 Hi-Build Tneme-Tar; or approved equal by the City of Greensburg. Final dry mils thickness shall be a minimum of 12 mils. Monolithic concrete manholes and other concrete structures shall be cured for a minimum of seven days and then coated in the field with a coal tar epoxy type coating as mentioned above.
- h. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Castings shall have a total weight of not less than 375 pounds and shall conform to the design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section to provide a water tight-fit with three 3/8-inch stainless steel bolts and expansion shields. Unless specifically designated otherwise, manhole castings shall be the non-locking type.
- i. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements. Manhole steps manufactured by M. A. Industries, Inc., PS-I-PF, Clay & Bailey Mfg. Co., or equal, are acceptable. Steps shall be placed as shown in Standard Detail Figure S-1.

- j. Manholes shall have grade adjustment rings sealed with non-shrinking grout in conformance with ASTM C978, latest revision for Precast Reinforced Concrete Manhole Sections. The maximum height of adjustment rings shall not exceed twelve (12) inches. The exterior of the adjustment rings shall be coated 1/4" Butyl Rubber Trowelable grade back plaster material.
 - k. The Contractor may, at his option, furnish and install a combination precast concrete base and first section with precut openings for services. Detailed drawings shall be submitted to the City of Greensburg prior to manufacture.
 - l. Precast manhole sections shall have a lifting eye cast into the wall for lifting the section. Lifting holes through the precast section will not be allowed.
- E. Grease Trap: Grease trap tank shall be constructed of 6000 psi concrete. All tank joints shall be sealed watertight with butyl rubber extrudible preformed gasket material. All outside riser ring surfaces shall be waterproofed 1/8" with trowelable grade butyl rubber back plaster.

PART 3 - EXECUTION

3.1 INSPECTION AND REJECTION OF PIPE

- A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the City of Greensburg. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample pipes may have been accepted as satisfactory at the place of manufacture.
- B. Prior to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and at once removed from the work.
- C. The City or its representatives shall have the right to cut cores from such pieces of the concrete pipe as he desires for such inspection and test as he may wish to apply.
- D. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer of the pipe.

- E. The City or its representatives shall also have the right to take samples of concrete after it has been mixed, or as it is being placed in the forms or molds, and to make such inspection and tests thereof as he may wish.
- F. Any pipe which has been damaged after delivery will be rejected and replaced solely at the Contractor's expense.

3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the City of Greensburg approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

3.3 NOTICE TO CITY OF GREENSBURG

The Wastewater Superintendent shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

3.4 LAYING PIPE

- A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound or damaged will be rejected and shall be removed immediately from the site of the work.
- B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.
- C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.
- D. Practically watertight work is required, and the Contractor shall construct the sewers with the type of joint specified.
- E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.
- F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the

recommendations of the manufacturer on particular type of joint and the directions of the City of Greensburg. All joint work shall be done by experienced workmen.

- G. PVC (polyvinyl chloride) gravity sewer pipe and fittings, ASTM Designation D3034 SDR 35, shall be installed in accordance with the directions contained in ASTM Designation D2321. Only materials classified as Class I will be acceptable for bedding, haunching, and initial backfill of the pipe placed and compacted in accordance with ASTM D2321.
- H. Joints on PVC pipe shall be the integral bell type gasketed joint designed so that when assembled the elastomeric gasket inside the bell is compressed radially on the pipe spigot to form a positive seal. The joint shall be so designed to avoid displacement of the gasket when installed in accordance with the manufacturer's recommendations. The gasket shall be the only element depended upon to make the joint flexible and watertight.
- I. All PVC pipe entering a manhole shall have manhole waterstop gasket as supplied by the manufacturer firmly clamped around the pipe. If flexible entry type manhole system is used, the waterstop gasket is not required.
- J. All PVC pipe shall have a deflection test performed by the Contractor in the presence of the City of Greensburg or his representative.
- K. All pipe shall be bedded as described in this specification under Pipe Bedding. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.
- L. Each length of pipe shall be mechanically pulled "home" with a winch or come-along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place. Pushing the pipe home shall be done by means of a block and push bar. Use of hydraulic excavating equipment as the means of pushing or moving the pipe to grade will not be permitted.
- M. The Contractor shall use laser beam equipment to maintain accurate alignment and grade. A qualified operator shall handle the equipment during the course of construction. If bending of the laser beam due to air temperature variations or dust in the air is apparent "within the pipe" units, a fan shall be provided to circulate the air. However, air velocity shall not

be so excessive as to cause pulsating or vibrating of the beam. Survey instruments may be used for checking alignment and grade if questions arise about the accuracy of the work.

- N. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.
- O. The Contractor shall conduct a leakage test as described in Sewer Tests of the specification on the first section of sewer of each size and type sewer material installed. No additional sewer pipe shall be installed until the first reach of sewer of each size and each type sewer material has satisfactorily passed the leakage test.
- P. The Contractor shall prevent all ground water and surface water from entering the existing sewer system during construction of a new sewer or force main extension.

3.5 PIPE BEDDING, HAUNCHING AND BACKFILLING

- A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.
- B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 - 1. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding.
- C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.
- D. For rigid pipe, such as concrete or ductile iron, backfill between the bedding material and a plane 12 inches (300 mm) over the top of the pipe

shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.

- E. For flexible pipe such as PVC, the placement of embedment material, consisting of bedding, haunching, and initial backfill, must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Class I material, as defined in specification Section 02222, Article 2.01, paragraph A, shall be used as embedment material for flexible pipe. Bedding thickness shall be as specified in paragraph C of this Section. The haunching material (the material from the bedding to the pipe springline) and initial backfill (the material from the pipe springline to a plane 12-inches over the top of pipe), shall be hand placed. Care must be taken to not cause damage by compacting the material directly over the pipe.
- F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
- G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6 inches (150 mm) crushed stone bedding placed prior to pipe installation.
- H. For backfilling requirements for sanitary sewers, refer to Section 02222-12, Article 3.10, of these Standards.

3.6 MANHOLES AND OTHER STRUCTURES

- A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:
 - 1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:
 - a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.
 - b. The joint shall consist of a round rubber gasket confined in a groove in the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation C443, latest revision and a flexible butyl rubber joint sealant between joints.

2. Manhole bases shall be cast-in-place concrete, reinforced as shown on the Standard Detail Sheet (S-1), or monolithic base and first section combination. Manhole bases shall be cast or placed on a minimum of 6 inches of compacted crushed stone.
3. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.
4. The bench shall have a surface slope of not less than four percent (4%), and receive no discharge onto the surface of the bench from a lateral, service connection or drop manhole pipe.
5. Any additional holes cut in the field shall be drilled with a core-drill or in a manner approved by the City of Greensburg.
6. The joint between the casting frame and cone section shall be sealed with a pliable butyl rubber and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.

3.7 HOUSE/BUILDING SERVICES

- A. The Contractor shall install 6-inch diameter house/building service sewer shall be installed as shown on the Standard Detail Sheets (S-10, S-11 and S-12). The house/building service shall extend from a "wye" or "tee" fitting in the main sewer line to the property line or easement line, unless stated otherwise.
- B. Fittings for house/building service connections on a main line sewer shall be tees or 45-degree wyes and shall be of the same material as the main line sewer, unless otherwise approved by the Wastewater Superintendent.
- C. Six-inch lateral pipe shall connect to the main line sewer at an angle of 15 degrees to 45 degrees from the spring line and shall include the necessary bends and straight pipe sections to reach the property line at a maximum depth of 10 feet and approximately 15 feet from the adjacent property line at the elevations specified. A pipe stopper or a bell cap shall be placed on/in the last bell. This stopper or bell cap should be compatible with the type of infiltration/exfiltration test performed on the sewer.
- D. The Contractor shall furnish and use the proper fittings, couplings, and adapters suited to make the transition between different pipe materials which will maintain the structural integrity and the watertightness of the entire sewer system.
- E. At the discretion of the Wastewater Superintendent, when and where he feels that improper installation practices are suspected, or questionable bedding materials and methods are employed, or where the installations

are severe, the Contractor will have to perform deflection testing on the 6-inch house laterals as specified in Article 3.9.

- F. Backfill around fittings and lateral pipe shall be carefully placed and compacted to prevent damage from backfill settlement and shall be installed in same manner as described for sewer installation.
- G. The Contractor shall bring the sanitary sewer lateral at least three (3) feet above finished grade (capped). The lateral must be located behind the property line of each lot.
- H. In new subdivision, where new curbs are being installed, the contractor is to mark an "S" in the curb where the lateral crosses under the curb.
- I. The Contractor shall keep accurate horizontal and vertical location measurements of each house/building service installed. The location of all house/building services shall be shown on record drawings as noted in Section 1.17 Record Drawings. The accuracy of the measurements shall be the Contractor's responsibility.

3.8 STUBS, CONNECTIONS, BULKHEADS, AND MISCELLANEOUS ITEMS OF WORK

- A. Where special junction chambers are to be constructed or where existing sewers carrying sanitary sewage are encountered, the Contractor shall provide and maintain temporary connections to prevent a nuisance. All such temporary connections, pumping, and diversion shall be included in the price bid for this work.
- B. Where called for shop connections and stubs for future sewer connections shall be provided.
- C. New sewer connections to existing manholes shall be neatly made by cutting a hole in the existing structure, concreting the sewer in place, and providing a watertight connection.
- D. The Contractor shall not connect any existing sewers or house/building services prior to the completion of the exfiltration/infiltration tests, air tests, and acceptance of the sewer without the written permission of the City of Greensburg.

3.9 VERTICAL DEFLECTION TESTING

For PVC pipe, the entire length of installed mainline pipe shall be tested for acceptance with an approved go-no-go mandrel under the observation of the

Wastewater Superintendent or their representative. The testing shall be conducted after the final backfill has been in place for at least 30 days. No pipe shall exceed a deflection of 5%. The deflection test shall be run using a mandrel having a diameter equal to 95% of the inside diameter of the pipe in accordance with ASTM D-3034 Appendixes. The pipe shall be measured in compliance with ASTM D-2122. All pipe exceeding the allowable deflection shall be replaced, repaired, and retested.

3.10 INFILTRATION LIMITS

- A. Maximum infiltration/exfiltration limits for all new sanitary sewers shall not exceed 200 gallons per inch of diameter per mile of pipe per 24 hours. This standard is for the overall project and includes all manholes and house service connections. All sections of the sewer shall be tested, and any sections not meeting this infiltration standard shall be repaired and retested.
- B. The Contractor shall note the special provision under Article 3.04, paragraph 0., that the first section of sewer of each size and type of sewer shall be given a satisfactory leakage test before proceeding with any additional construction.

3.11 SEWER WATERTIGHTNESS TESTING

- A. Tests for watertightness shall be conducted on all installed sewers in the presence of and in the manner accepted by the City of Greensburg. The Contractor shall furnish and install all equipment necessary for the sewer tests.
- B. Watertightness tests shall be conducted on short sections of the sewer as soon as the manholes have been constructed and the backfilling completed.
- C. Where the section tested is in excess of the allowable limits, the Contractor shall correct the construction of the sewer so that the section tested is within the allowable limit. All methods and materials used in the repair shall be approved by the City of Greensburg.
- D. The program of testing shall fit the conditions as determined by the City of Greensburg using Air Test for Leakage. When ductile iron pipe with push-on type joints are used for sewer construction, a hydrostatic pressure test shall be performed.
 - 1. The Air Test for Leakage

- a. The air test for leakage shall be used to test sewer watertightness on all sewer pipe unless otherwise noted.
- b. The ends of the sewer section being tested shall be sealed and properly blocked. The seal at one end shall have an orifice through which to pass air into the pipe. An air supply shall be connected to the orifice at one end of the section. The air supply line will contain an off-on gas valve and a pressure gauge having a range from 0 to 25 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of the nearest ± 0.1 psi. The seals at each manhole shall be properly blocked to prevent displacement while the line is under pressure.

2. Procedure for Conducting a Low Pressure Air Test

- a. Clean pipe to be tested by propelling a snug fitting inflated ball through the pipe by water pressure or other adequate method. This step is important because it not only flushes out construction debris, but the water used to flush the ball through the pipe dampens the pipe wall. The rate of air loss through pipe wall permeation can be significant on dry pipes.
- b. Plug all pipe outlets with pneumatic plugs having a sealing length equal to or greater than the diameter of the pipe to be tested. The pneumatic plug shall be able to resist internal testing pressures without requiring external bracing.
- c. The groundwater level surrounding the section of sewer under testing shall be determined by one of the procedures previously outlined in paragraph D(1). If the groundwater table is above the pipe, then test pressures shall be increased by the corresponding increment (e.g., if the groundwater table is above the lowest crown of the pipe, the air pressure should be increased 0.43 times each foot of water.)
- d. Once the pipe outlet plugs are securely in place, pressurized air is introduced to the system. The air shall be fed through a single control panel with three individual hose connections as follows:
 - (1) from control panel to pneumatic plugs for inflation in sewer pipe;
 - (2) from control panel to sealed line for introducing the pressurized air;

(3) from sealed line to control panel. This line will enable continuous monitoring of the air pressure rise in the sealed line.

- e. The air shall be introduced slowly to the section of pipe under evaluation until the internal air pressure is raised to 4.0 psig greater than the hydrostatic pressure head created by the existence of groundwater that is over the pipe section.
- f. A minimum of two minutes shall be provided for the air pressure to stabilize to conditions within the pipe. (This stabilization period is necessary for variations in temperature to adjust to the interior pipe conditions.) Air may be added slowly to maintain a pressure to 3.5 to 4.0 psig for at least two minutes.
- g. After the stabilization period, when the pressure reaches exactly 3.5 psig, the stopwatch shall be started; and when the pressure reaches 2.5 psig, it is stopped. The portion of the line being tested shall be acceptable if the time in minutes for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than the time shown in the following table:

Pipe Diameter (Inches)	Time (Minutes)
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

- h. In areas where the groundwater is above the top of the pipe, the test pressures shall be increased by 0.433 per foot of groundwater (e.g., if the groundwater is 11-1/2 feet, the 3.5 to 2.5 pressure drop will be increased by 5 psi; the time then will be measured for a pressure drop from 8.5 psi to 7.5 psi.)

3. Safety Precautions During Air Test

- a. The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. Inasmuch as a force of 250 pounds is exerted on an 8-inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
- b. As a safety precaution, pressurizing equipment should include a regulator set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

3.12 HYDROSTATIC TESTING

- A. A hydrostatic test on ductile iron pipe with push-on type joints has two purposes: one is to set the gaskets in place, and the other is to provide a leakage test.
- B. Said test shall include all ductile iron sewer pipe with push-on type joints installed by the Contractor in this Contract. The Contractor shall make arrangements with the City of Greensburg for scheduling the test after the sewer pipe has been accepted as being ready for testing. The test shall be performed in the presence of the City of Greensburg on the day mutually agreed upon.
- C. Water for testing may be purchased from the City of Greensburg. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test.
- D. Hydrostatic test on ductile iron pipe with push-on type joints installed as gravity sewers and siphons shall be in accordance with the following provisions:
 1. The ends of the sewer section being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
 2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The benchwall shall be formed in the manhole after the test section has been approved.
 3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or

- cap to expel air when filling the system with water. All air shall be expelled from the pipe.
4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
 5. The system shall be tested in conformance with Section 13 of AWWA Specifications 600, at 50 pounds per square inch over a period of not less than one hour. The system will not be acceptable until all leaks have been repaired.
 6. Hydrostatic test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. Inasmuch as a force of 2500 pounds is exerted on an 8-inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.
- E. A hydrostatic test on ductile iron pipe with push-on type joints installed as force main shall be in accordance with Article 3.12, paragraph D., with the following exception:
1. The force main shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.

3.13 MANHOLE VACUUM TESTING

- A. A vacuum test shall be conducted by the Contractor on all manholes to ensure watertightness and manhole integrity.
- B. The equipment required to conduct a vacuum test on manholes includes inflatable pipe plugs, test head, vacuum pump, flexible air hose, and a vacuum gage. The test equipment shall be capable of drawing a vacuum of 10-inch Hg. The equipment shall be designed specifically for the purpose of testing manholes and shall be as manufactured by P.A. Glazier, Inc., Worchester, Massachusetts 10002, or equal.
- C. The procedure for conducting an air test on manholes shall be in accordance with the following procedure:
1. Each manhole including riser rings and casting shall be tested.
 2. All lift holes shall be plugged with non-shrink grout.
 3. All pipes entering the manhole shall be securely plugged and adequately braced against the inside of the manhole to prevent being drawn out of the pipe.

4. The test head shall be placed on the inside of the cone section and sealed with an inflatable seal.
5. A vacuum of 10 inches of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than the following:

<u>Manhole Size</u>	<u>Minimum Test Time</u>
48"	60 seconds
60"	75 seconds
72"	90 seconds
84"	105 seconds

3.14 CLOSED CIRCUIT TELEVISION INSPECTION

- A. All sections of sewers requiring an IDEM construction permit shall be inspected by closed circuit television and shall be repaired as directed by the City of Greensburg and/or the Wastewater Superintendent prior to acceptance.
- B. The Contractor shall furnish a qualified television technician, a trained supervisor, and sufficient personnel to perform all the work required in the inspection operation.
- C. The Contractor shall furnish spare cameras and related equipment to prevent delays due to equipment breakdowns. Cameras shall be equipped with remote-control focusing devices, remote-control devices to adjust the light intensity, and enough cable shall be furnished to inspect 1,000 linear feet of sewer in a continuous operation. One camera shall be small enough to pass through a 6-inch opening.
- D. The Contractor shall clean the sewer, where required, one section at a time. After the sewer is cleaned, the television camera shall be attached to end of a rod or line so that it can be pulled through the pipe line. The camera shall trail a line of steel cable which will be attached to a winch of sufficient size to be able to pull back or retrieve the camera whenever necessary.
- E. The camera shall transmit a continuous image to the television monitor. This image shall be clear and sharp enough to enable those viewing the monitor to be able to easily see the interior condition of the pipe line being inspected.

- F. For each television inspection unit being used, the Contractor shall provide a mobile air conditioned viewing room large enough to accommodate at least three people for the purpose of viewing the monitor while the inspection is in progress. Minimum size of the monitors shall be 17 inches, measured diagonally across the viewing screen. Electrical power to operate the equipment shall be provided by the Contractor.
- G. The Contractor shall furnish all equipment required for making a continuous video tape of the view which appears on the monitor.
- H. The City of Greensburg and the Wastewater Superintendent or their representative shall be present at all times during television inspection of the sewers and will indicate to the Contractor whatever data may be required to be logged and prepared for record purposes. The Contractor shall prepare and furnish to the City one (1) copy of the complete record, video tape, and report of all inspection work done.

3.15 RECORD DRAWINGS

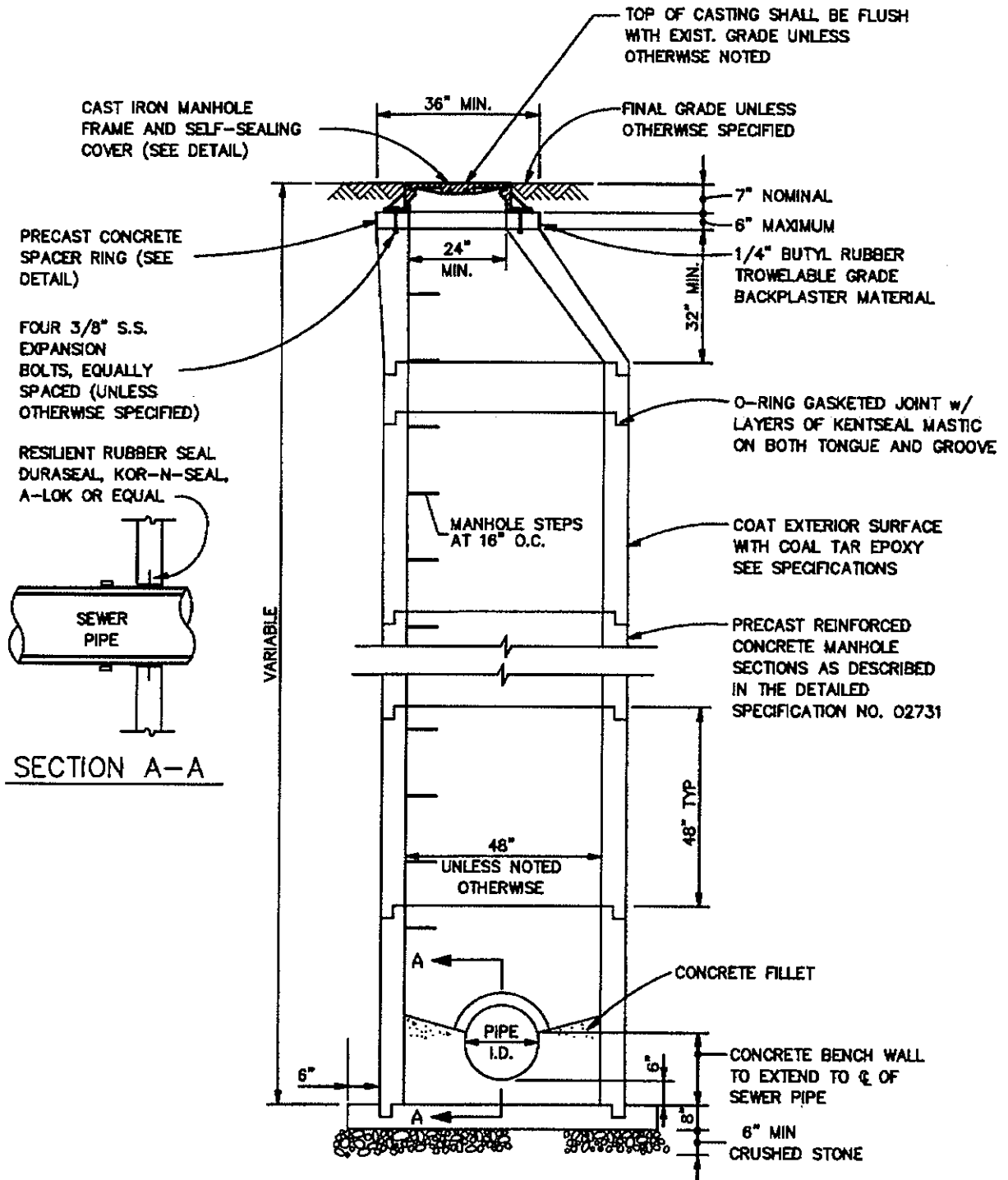
- A. The Contractor shall prepare or be responsible for the preparation and submittal of record drawings as described in Section 01001, Article 1.17.
- B. Record drawings shall be certified to accuracy by a registered professional City of Greensburg.

PART 4 - FIGURES

4.1 STANDARD DETAILS

<u>Figure</u>	<u>Description</u>
S-1	Standard Sanitary Manhole Detail
S-2	Standard Sanitary Manhole Spacer Ring Detail
S-3	Standard Sanitary Manhole Frame and Cover Details
S-4	Force Main Discharge Detail
S-5	Sewer Pipe Bedding Details
S-6	Concrete Encasement Detail
S-7	Drop Pipe Details
S-8	Alternate Drop Pipe Details
S-9	Jacking and Boring Detail
S-10	House/Building Service Detail-1
S-11	House/Building Service Connection Detail-2
S-12	House/Building Service Bedding Detail
S-13	House/Building Service Clean-out Detail
S-14	Grease Trap Detail

END OF SECTION 02731



STANDARD SANITARY MANHOLE DETAIL

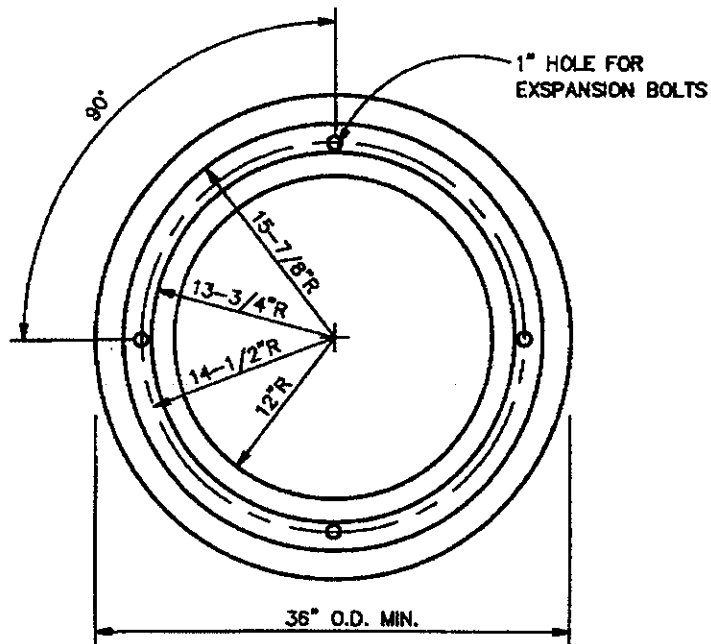
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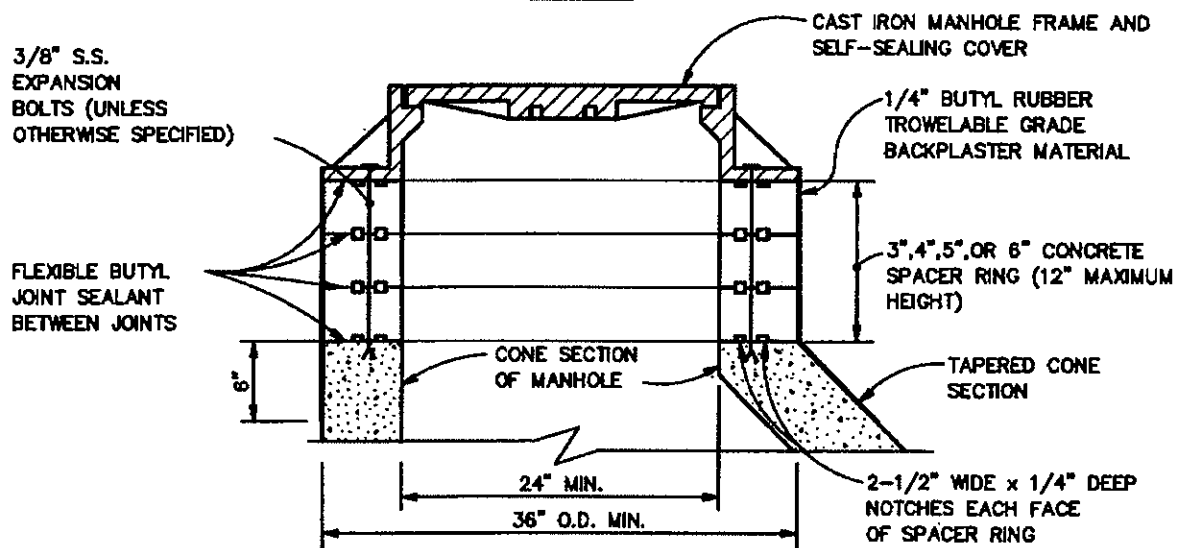
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FIGURE S-1



PLAN



SECTION

STANDARD SANITARY MANHOLE SPACER RING DETAIL

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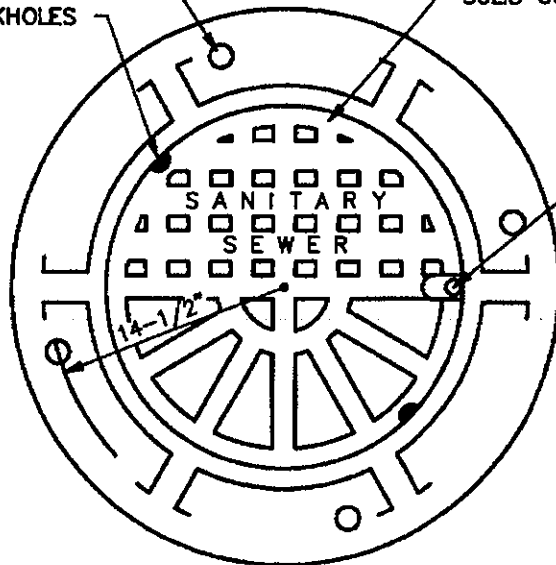
FIGURE S-2

FOUR 3/8" S.S.
EXPANSION
BOLTS, EQUALLY SPACED
90° APART

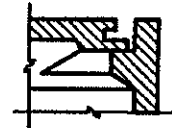
TWO CONCEALED
PICKHOLES

SOLID COVER

COVER BOLT
SEE NOTES
2 AND 3



PLAN

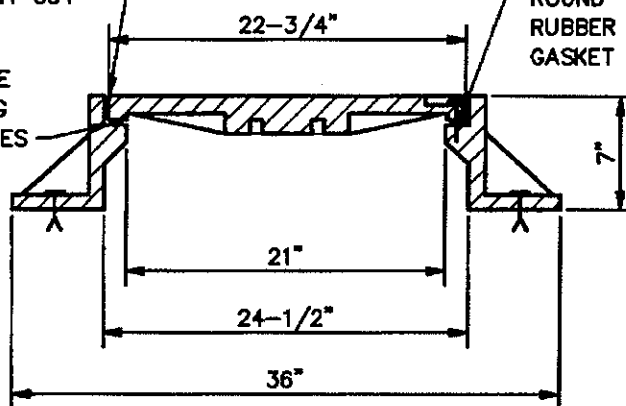


PICKHOLE
DETAIL
NO SCALE

VERTICAL
BEARING
STRAIGHT CUT

MACHINE
BEARING
SURFACES

ROUND
RUBBER
GASKET



SECTION

NOTES:

1. TOTAL WEIGHT OF FRAME AND LID = 375 lbs
TYPE 1 SELF SEALING COVER IS NOT BOLTED TO FRAME AND SHALL BE USED UNLESS TYPE 11 IS SPECIFICALLY INDICATED
3. TYPE 11 SELF SEALING COVER IS BOLTED TO FRAME WITH FOUR 1/2" BRONZE HEXAGONAL HEAD COUNTERSUNK BOLTS
4. CASTING SHALL BE CATALOG NO. 1022-3WT AS MANUFACTURED BY EAST JORDAN IRON WORKS, INC. OR EQUAL

STANDARD SANITARY MANHOLE FRAME AND COVER DETAILS

HNTB

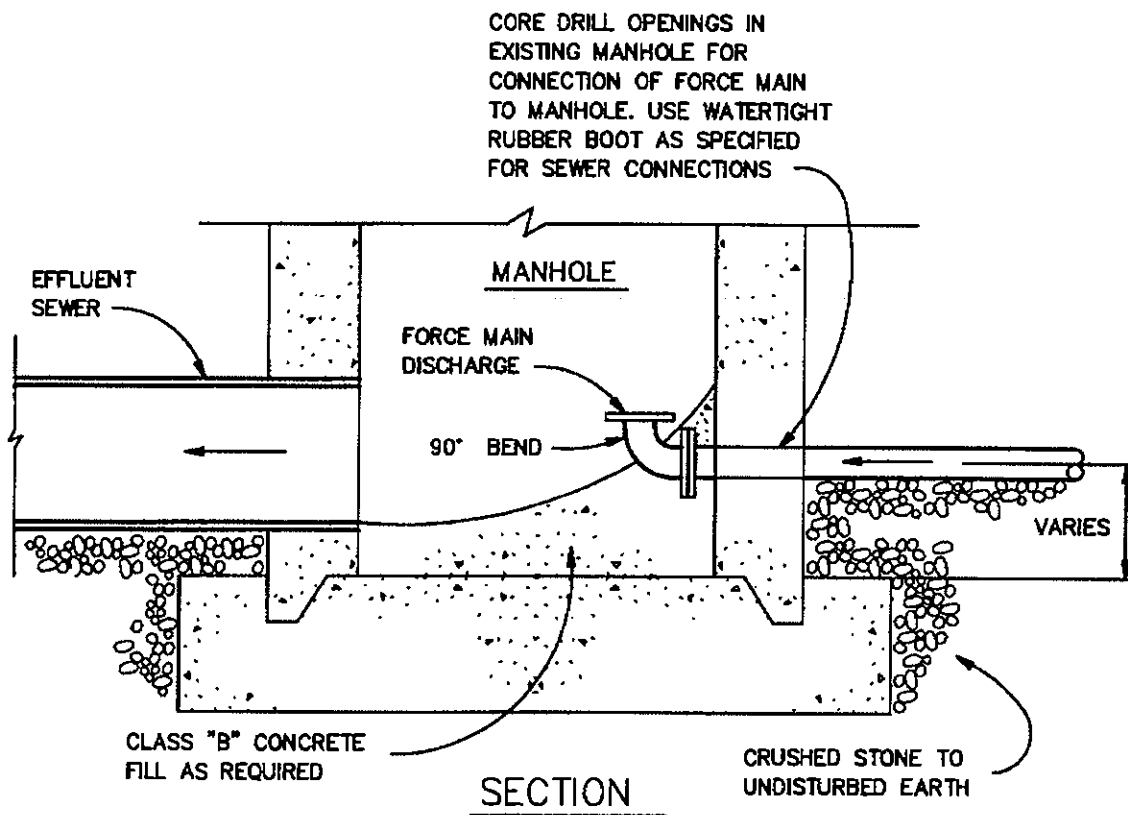
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FIGURE S-3

Plot Scale: 1" = 1'

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FORCE MAIN DISCHARGE DETAIL

HNTB

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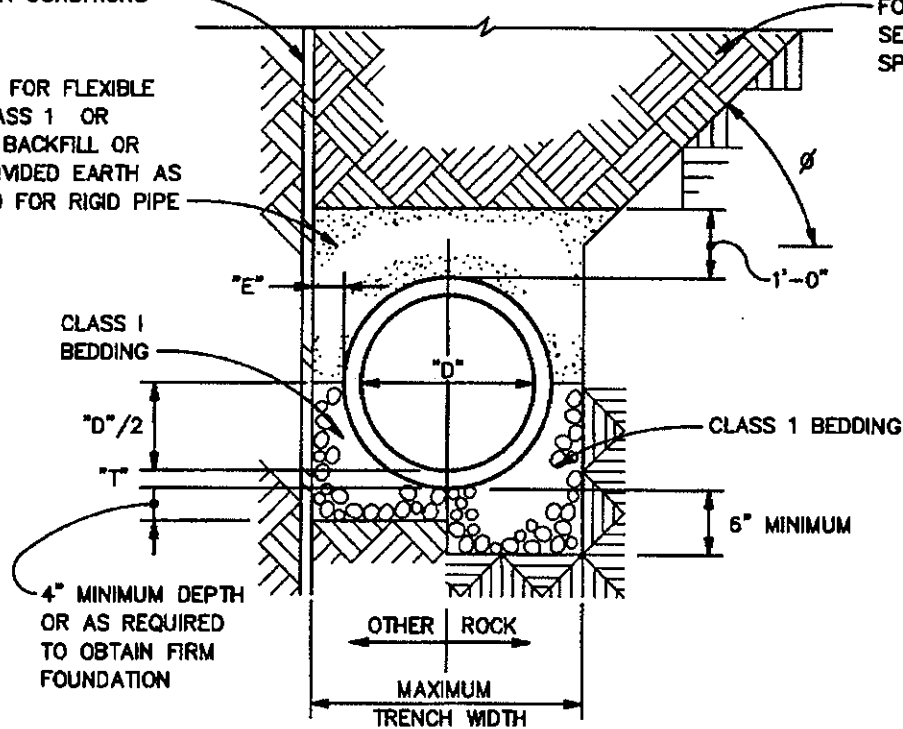
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FIGURE S-4

CLASS 1
BACKFILL FOR FLEXIBLE
PIPE, CLASS 1 OR
CLASS II BACKFILL OR
FINELY DIVIDED EARTH AS
SPECIFIED FOR RIGID PIPE

**-FOR BACKFILLING
SEE DETAILED
SPECIFICATIONS**



TYPICAL SECTIONS IN FIRM FOUNDATIONS

1. SLOPE ANGLE, α , SHALL BE LESS THAN THE FRICTION ANGLE OF THE EXCAVATED MATERIAL.
2. "D" = NOMINAL PIPE SIZE.
3. "T" = PIPE WALL THICKNESS.
4. "E" = 10" MAXIMUM FOR SEWERS UP TO AND INCLUDING 33" DIAMETER.
5. INSTALLATION OF FLEXIBLE PIPE SHALL BE IN ACCORDANCE WITH DIRECTIONS CONTAINED IN ASTM D-2321

SEWER PIPE BEDDING DETAIL

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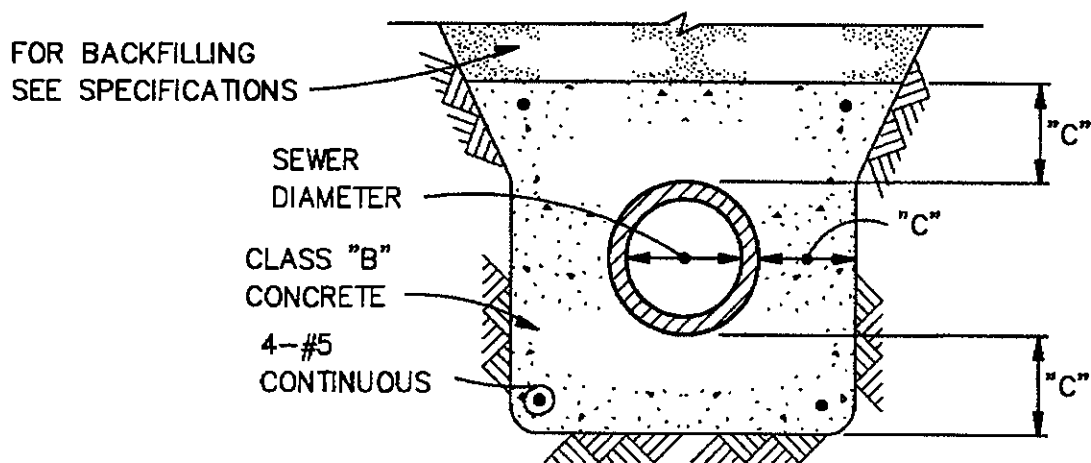
FIGURE S-5

Plot Scale: 1

\\VIRON\32980\CONST_STD\SEWER\S-05.dwg

File name:

File name: I:\VIRON\32980\CONST_STD\SEWER\S-06.dwg Plot Scale: 1:



NOTE:

"C" = 6" MINIMUM
OR AS INDICATED
ON THE PLANS.

CONCRETE ENCASEMENT DETAIL

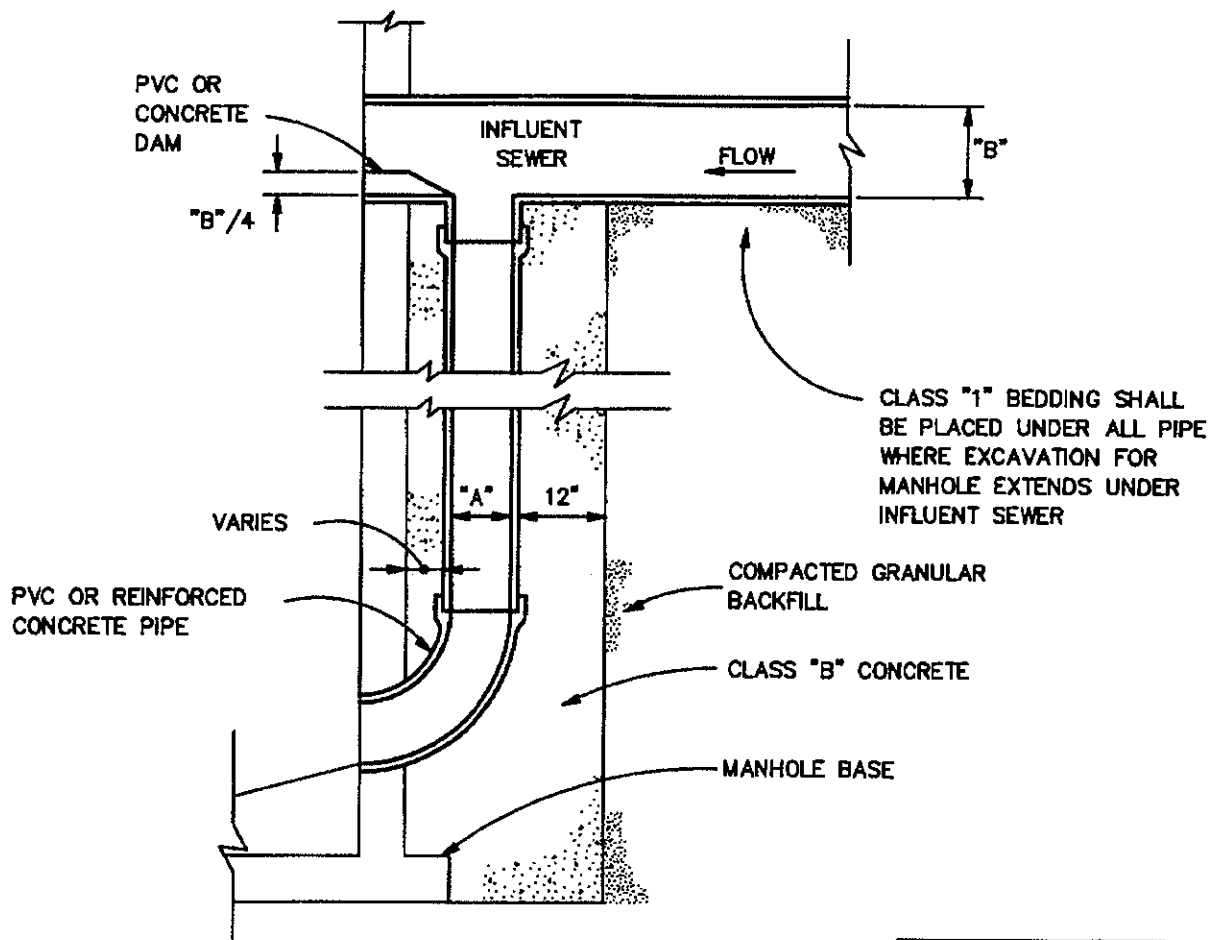
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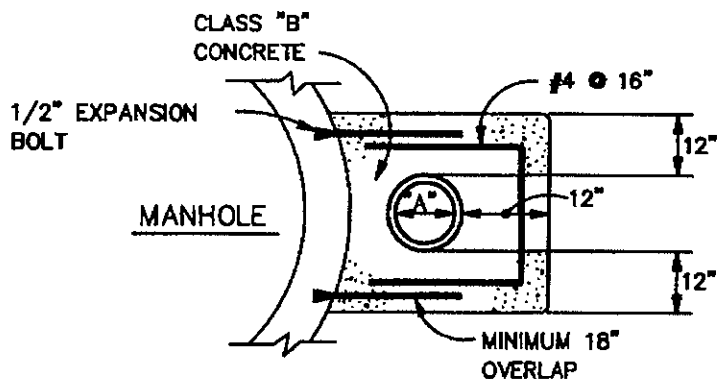
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FIGURE S-6



SECTION

"A"	"B"
8"	21" OR LESS
12"	24" TO 36"



SECTION PLAN

DROP PIPE DETAILS

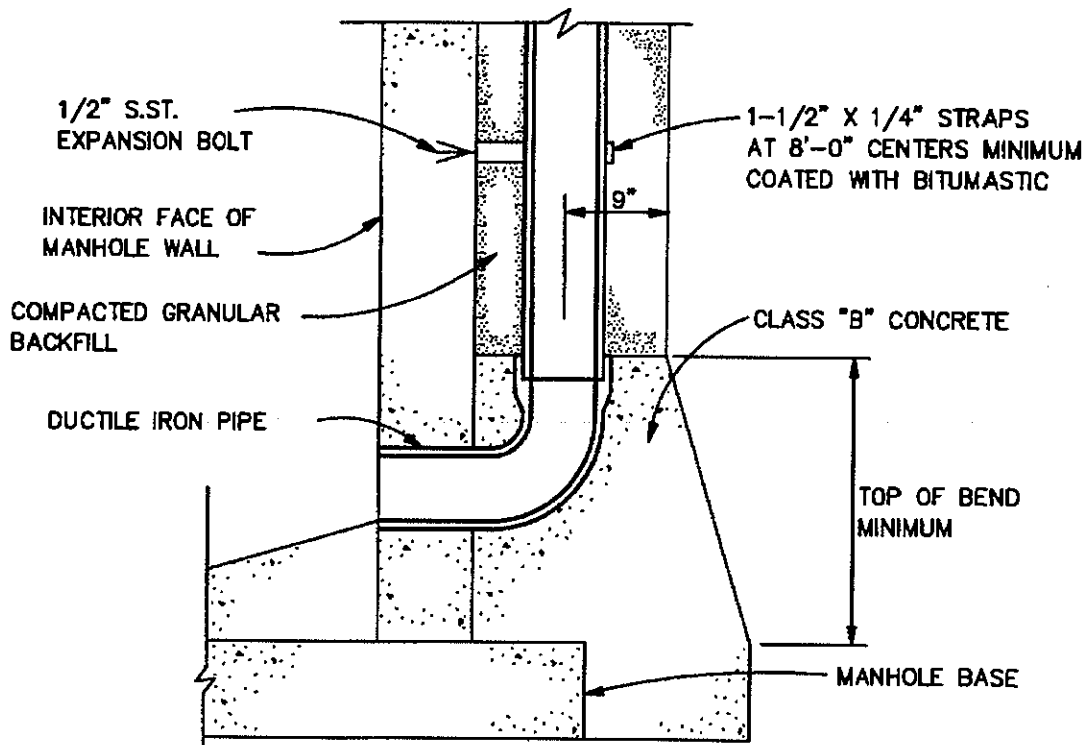
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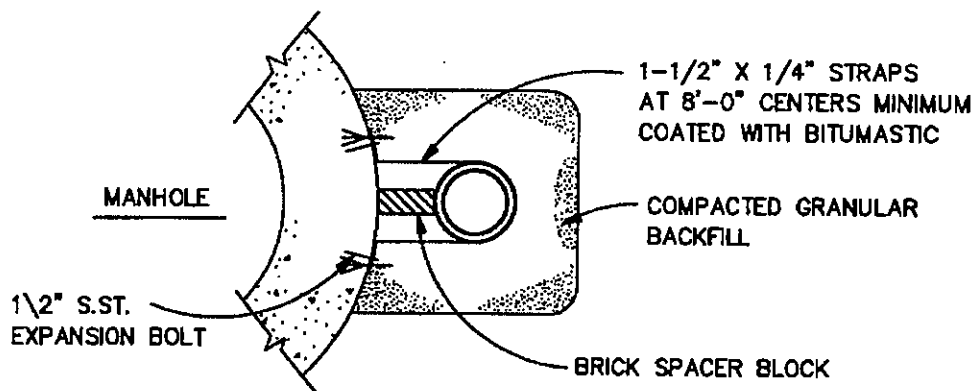
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FIGURE S-7



SECTION



SECTIONAL PLAN

ALTERNATE DROP PIPE DETAILS

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FIGURE S-8

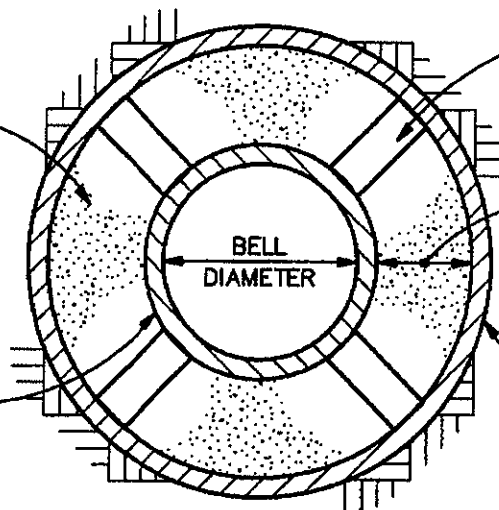
Plot Scale: 1

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File name:

GROUT (IF REQUIRED) TO
BE PLACED BY A METHOD
APPROVED BY THE ENGINEER

CARRIER PIPE



SPACER BLOCKS SECURED
TO PIPE WITH SS. STRAPS
TO MAINTAIN CARRIER
PIPE ALIGNMENT

3" MINIMUM

STEEL CASING

JACKING AND BORING DETAIL

HNTB

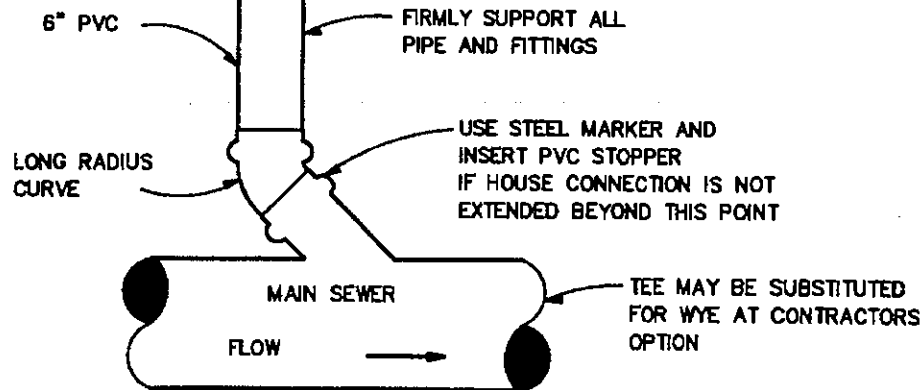
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FIGURE S-9

INSERT WATERTIGHT PLUG.
HOUSE CONNECTION SHOULD NOT BE
EXTENDED FOR USE UNTIL THE
MAIN SEWER AND HOUSE CONNECTION
HAS PASSED THE AIR TEST
AND BEEN ACCEPTED BY THE OWNER.

CONTRACTOR TO MARK END OF EACH LATERAL
WITH 5/8" DIAMETER, 5'-0" LONG STEEL
ROD PLACED VERTICALLY. ROD SHALL BE
PAINTED YELLOW AND DRIVEN FLUSH WITH EXISTING
GROUND. ACCURACY OF THE MEASUREMENTS
LOCATING LATERALS SHALL BE THE CONTRACTOR'S
RESPONSIBILITY. TO BE USED ONLY IF LATERAL IS
NOT EXTENDED FOR IMMEDIATE USE.



PLAN VIEW

NOTES:

1. WYE BRANCHES OR TEES SHALL BE INSTALLED WHERE DESIRED BY PROPERTY OWNER OR WHERE INDICATED ON THE DRAWINGS. THEY SHALL BE EXTENDED TO PROPERTY LINE OF STREETS OR ALLEYS OR TO DISTANCES AS SHOWN ON THE DESIGN DRAWINGS AND SHALL BE OF 6" PVC SDR 35 UNLESS OTHERWISE SHOWN.
2. DEPTH AT PROPERTY LINE SHALL BE APPROXIMATELY 8'-0" UNLESS SEWER DEPTH IS LESS, IN WHICH EVENT A MINIMUM SLOPE OF 1/8" PER 1'-0" SHALL BE USED.
3. HOUSE SERVICE PIPE SHALL BE PVC SDR 35 CONFORMING TO ASTM D3034 WITH GASKETED JOINTS CONFORMING TO ASTM D3212 UNLESS OTHERWISE INDICATED.
4. HOUSE SERVICE PIPE SHALL BE INSTALLED PER SAME SPECIFICATIONS & DETAIL AS FOR MAIN LINE SEWER.

HOUSE/BUILDING SERVICE CONNECTION DETAIL 1

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FIGURE S-10

Plot Scale: 1

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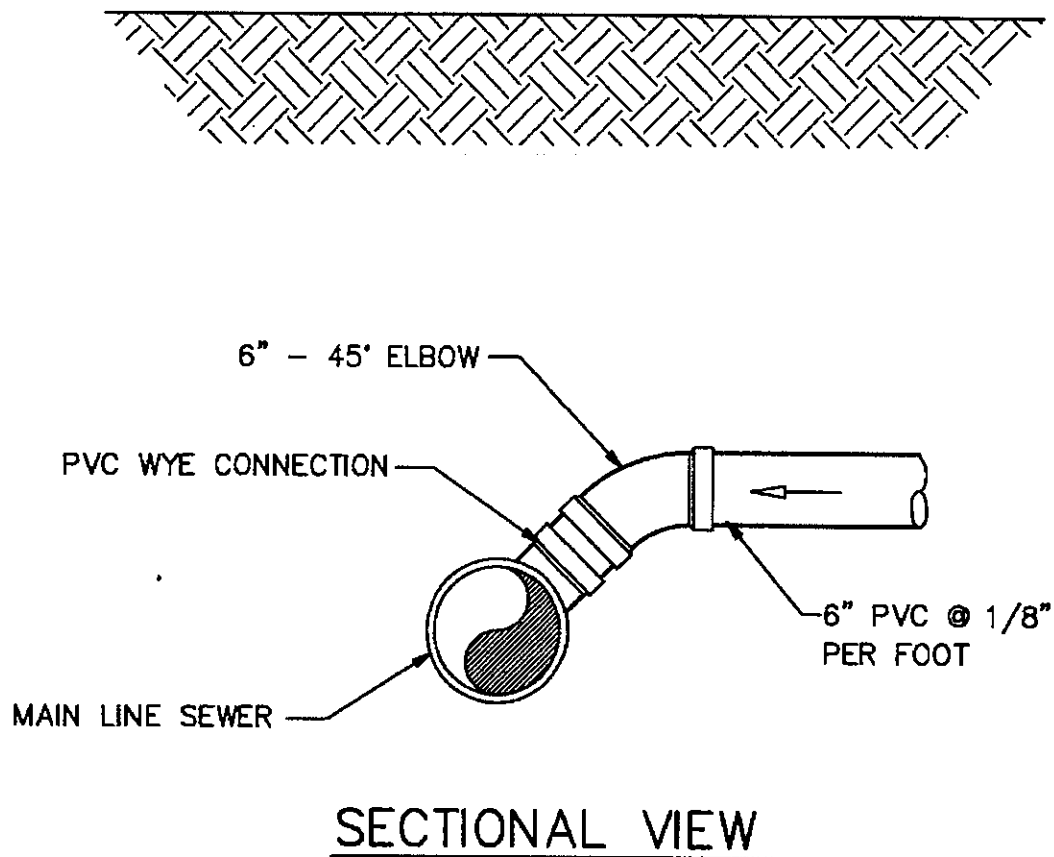
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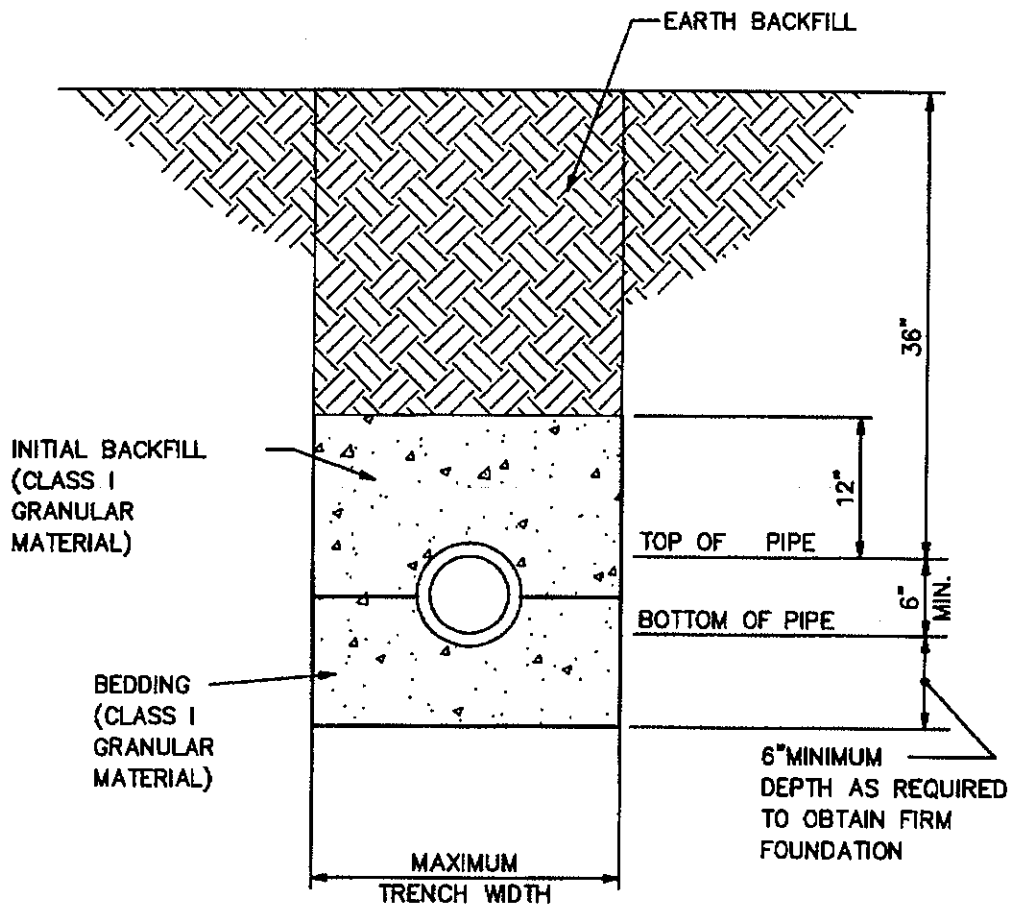
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FIGURE S-11



HOUSE/BUILDING SERVICE
CONNECTION DETAIL 2



NOTES:

1. NOMINAL PIPE SIZE. (6" MIN.)
2. INSTALLATION OF FLEXIBLE PVC PIPE SHALL BE IN ACCORDANCE WITH SPECIFICATIONS CONTAINED IN ASTM D-2321
3. CLASS I GRANULAR MATERIAL SHALL BE 1/4" TO 1 1/2" GRADED STONE, PER ASTM D2321 (#8 CRUSH STONE)
4. SEE FIGURE S-5 FOR MAIN LINE SEWERS PIPE BEDDING DETAILS.

HOUSE/BUILDING SERVICE BEDDING DETAILS

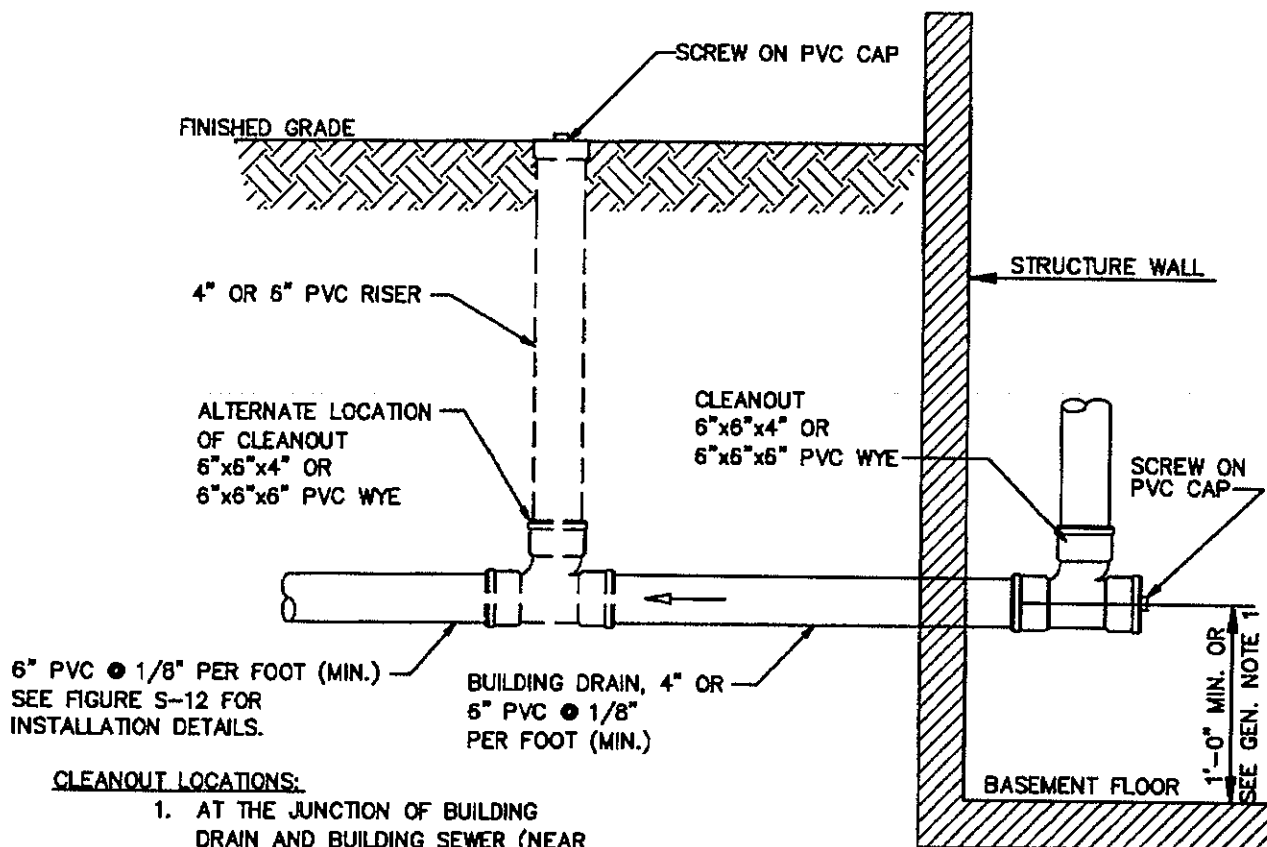
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FIGURE S-12



CLEANOUT LOCATIONS:

1. AT THE JUNCTION OF BUILDING DRAIN AND BUILDING SEWER (NEAR EXTERIOR FACE OF BUILDING)
2. IF BUILDING SEWER IS MORE THAN 100 FEET FROM MAIN LINE SEWER, CLEAN-OUTS SPACING SHALL NOT EXCEED 100 FEET.
3. A CLEANOUT IS REQUIRED AT EACH BEND THAT IS GREATER THAN 45 DEGREES.
4. THERE SHALL BE NO BASEMENT DRAINS CONNECTED TO SERVICE CONNECTION

GENERAL REQUIREMENTS

1. THE LOWEST FLOOR ELEVATION RECEIVING GRAVITY SERVICE MUST BE A MIN. ONE (1.0) FOOT ABOVE TOP NEAREST MANHOLE RIM.

HOUSE/BUILDING SERVICE CLEAN-OUT DETAIL

HNTB

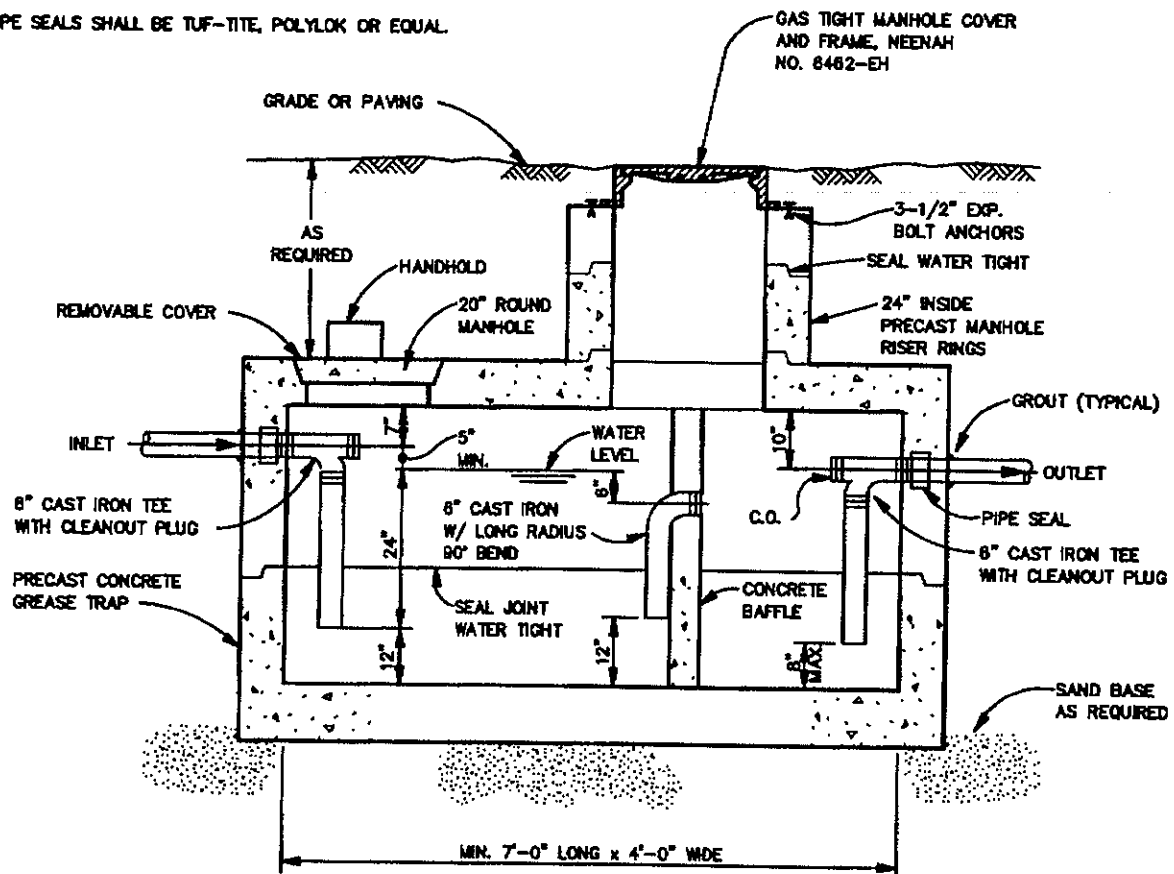
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JUNE 2001

FIGURE S-13

1. ALL TANK JOINTS SHALL BE SEALED WATERTIGHT WITH BUTYL RUBBER EXTRUDIBLE PREFORMED GASKET MATERIAL, HAMILTON KENT-SEAL OR EQUAL.
2. ALL OUTSIDE RISER RINGS SURFACES SHALL BE WATERPROOFED 1/8" WITH TROMBLEABLE GRADE BUTYL RUBBER BACK PLASTER.
3. PIPE SEALS SHALL BE TUF-TITE, POLYLOK OR EQUAL.

NOTE:
ALL DIMENSIONS SHOWN SHALL
BE VERIFIED WITH LOCAL
AUTHORITY HAVING JURISDICTION.



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FIGURE S-14

SECTION 02732 - FORCE MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Specifications for force main pipe, fittings, valves, and appurtenances are included in this Section.
- B. Definitions: All pipe, fitting and valve size, and all reference to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.
 - 1. AWWA, where used in these specifications, shall mean American Water Works Association.
 - 2. ANSI, where used in these specifications, shall mean American National Standard Institute.
 - 3. ASTM, where used in these specifications, shall mean American Society for Testing & Materials.
- C. This specifications cover the following types of material:
 - 1. Ductile Iron.
 - 2. Polyvinyl Chloride (PVC).

1.2 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, and the date of manufacture. Each length shall likewise be marked to designate the class or strength of the pipe. The marking shall be made on the exterior or interior of the pipe barrel near the bell or groove end and shall be plainly visible.

1.3 RELATION TO WATER MAINS

- A. Sanitary force mains must be laid at least 10 feet horizontally from any existing or proposed water main. The distance to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Engineer for specific instructions regarding the treatment of the separation.
- B. Whenever the force main crosses a water main, it should be laid to provide a minimum vertical distance of 18 inches between the outside of the force

main and the outside of the water main. The force main can be either above or below the water main.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, and appurtenances shall be as shown on the drawings and specified in this Section. All pipe, fittings, valves, and appurtenances shall be new and unused.

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151) and the additional requirements specified herein. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness pressure class shall be class 150.
 - 1. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Fast, Lok-Tyte, or equal.
 - 2. Mark each length of pipe. Marking shall include pipe class, casting period, manufacturer's name or trademark, and year of manufacture. Marking shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151).
- B. Lining and Coating: Outside surfaces of the pipe and fittings shall be bituminous coated complying with ANSI/AWWA A21.51/C151 and ANSI/AWWA A21.10/C110.

2.3 PVC PIPE

- A. Polyvinyl Chloride (PVC) Force Mains
 - 1. Pipe
 - a. Polyvinyl chloride pipe shall meet the requirements of AWWA Standard C900. The color of the pipe shall be blue. Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in

this Section. The dimension ratio shall not be greater than 18.

- b. Polyvinyl chloride pipe shall have cast-iron-pipe-equivalent outside diameter.
 - c. Pipe joints shall be push-on type. Joints shall meet the requirements of AWWA Standard C900. Do not use solvent-cement joints.
 - d. Mark each length of pipe. Markings shall meet the requirements of AWWA Standard C900.
- 2. The inside surface of the pipe for pipe 4 inches and larger shall be mechanically grit blasted to white metal and then lined with a virgin polyethylene material having a nominal thickness of 40 mils or a two-component coal tar epoxy compound (Duraline) having a nominal thickness of 45 mils.
 - 3. The linings shall have a minimum dry film thickness of 40 to 45 mils. The thickness shall generally equal or exceed 40 to 45 mils throughout the pipe, except at the ends where the thickness may taper for a distance of 4 inches to a minimum 10 mils thickness.

2.4 FITTINGS

- A. Fittings shall be ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi.
 - 1. Fitting joints shall be restrained mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be used instead of thrust blocking. Restrained joints shall be Lok-Fast, TR Flex, Lok-Ring, or equal. Pipe connecting to restrained joint fittings shall also have restrained joints as indicated on the drawings and specified in this Section.
 - 2. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.

2.5 ADAPTERS

- A. Adapters from polyvinyl chloride force mains to victaulic or flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
- B. Line the inside surfaces of adapters with cement mortar lining and bituminous seal coating. Cement mortar lining and bituminous seal

coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of adapters with bituminous coating. Outside coating shall meet the requirements of ANSI/AWWA C110.

- C. Adapter ends connecting to polyvinyl chloride force mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
- D. Adapter ends connecting to victaulic or flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.
- E. Adapters from ductile iron force mains to victaulic or flange joint valves or fittings shall be cast iron or ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
 - 1. Adapter ends connecting to ductile iron force mains shall have plain ends, push-on joints, mechanical joints, or restrained push-on joints. Adapters with plain ends, push-on joints, or mechanical joints may be used where restrained joints are not required. Adapters shall have restrained push-on joints where restrained joint piping is required as indicated on the drawings and specified in this Section. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Fast, Lok-Tyte, or equal.
 - 2. Adapter ends connecting to victaulic or flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.
 - 3. Gaskets
 - a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements of AWWA Standard C900.
 - b. Gaskets for mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.
 - 4. Nuts and Bolts
 - 5. Nuts and bolts for mechanical joints shall be high strength, heat treated, cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.
- F. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA A21.11/C111.

- G. Nuts and bolts for mechanical joints shall be high strength, heat treated, cast iron. Nuts shall be hexagon nuts. Bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA A21.11/C111.
 - 1. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.
- H. Polyethylene encasement for ductile iron force mains, when specifically called for on the drawings, shall meet the requirements of ANSI Specification A21.5 (AWWA Standard C105).

2.6 VALVES AND VALVE BOXES

- A. Eccentric Type Plug Valves: Plug valves shall be nonlubricated eccentric type with resilient faced plugs having mechanical joint or flanged ends.
 - 1. Port areas of 4-inch to 20-inch valves shall be at least 80% of full pipe area. Port area for 24-inch and larger valves shall be at least 70% of full pipe area.
 - 2. Valve seats, valve plug stem sleeves and plug stem bushings shall be fabricated of materials which are corrosion and abrasive resistant. The corrosion resistance shall be such that exposure over a period of five years to domestic wastewater, industrial wastewater, domestic sludges or industrial sludges containing sulfuric acid, hydrochloric acid, acetic acid, mineral oils, vegetable oils, polymers, esters or acetones shall not result in sufficient corrosion to interfere with the serviceability of the plug valve.
 - 3. Seals shall be capable of being replaced while the line and valve remain in service, if under submerged conditions, thereby eliminating the need to take process units out of service.
 - 4. All exposed nuts, bolts, springs, and washers shall be plated with corrosion resistant material. Means of actuation shall be by lever, gear actuator, tee wrench, extension stem, or floor stand, as indicated.
 - 5. All plug valves shall be equipped with an underground operator.
 - 6. Plug valves 10-inch and larger shall be equipped with gear actuators. All gearing shall be enclosed and lubricated with seals provided on all shafts to prevent entry of dirt and fluid into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator shall clearly indicate valve positions, and an adjustable stop shall be provided to set closing torque. Valve stop shall be positive and shall not move due to repeated operation of the valve.
 - 7. Valves shall be DeZurik Series 100.

B. Gate Valves: Buried gate valves 4-inch and larger shall be full iron body, epoxy fusion bonded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 and shall have mechanical joint ends. Mechanical joints and joint accessories shall meet the requirements of ANSI/AWWA A21.11/C111. Valve opening direction shall be consistent with operation of existing valves in the utility in which the valves are installed, unless otherwise directed by the Engineer.

1. Three-inch buried gate valves shall be iron body, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500, except ends shall be screwed. Screwed ends shall meet the requirements of ANSI B16.3. Valve opening direction shall be consistent with operation of existing valves in the utility in which the valves are installed, unless otherwise directed by the Engineer.
2. Gate valves 4-inch and larger installed above ground or in structures shall be iron body, outside screw, and yoke gate valves. Valves shall meet the requirements of ANSI/AWWA C500, except those parts of ANSI/AWWA C500 only applicable to non-rising stem gate valves and wrench nuts. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be cadmium plated. Gaskets shall be full face and shall be velumoid, or equal.
3. Gate valves smaller than 4-inch installed above ground or in structures shall be bronze, 125 lb. S.W.P. double disc, screwed-in bonnet, rising stem, inside screw gate valves with screwed ends and malleable iron handwheels. Valves shall meet the requirements of Federal Specification WW-V-54d for Class A, Type III valves.

C. Valve boxes for plug valves and gate valves shall be cast iron. Valve boxes shall be two piece or three piece type. Each two piece box shall be complete with bottom section, top section, and cover. Each three piece box shall be complete with base, center section, top section, and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16 inch. Valve box cover shall be blank with no wording.

2.7 SEWAGE AIR AND VACUUM VALVES

Sewage combination air and vacuum valves shall be as follows:

<u>Size</u>	<u>Specification</u>
2" x 1"	Apco No. 401 SC, Val-Matic Co. No. 301 BWA, or equal
2" x 2"	Apco No. 402 SC, Val-Matic Co. No. 302 BWA, or equal
3" x 3"	Apco No. 403 SC, Val-Matic Co. No. 303 BWA, or equal

2.8 AIR AND VACUUM VALVE CHAMBERS

- A. Air and vacuum valve chambers shall be 4-foot diameter precast concrete manhole barrels with precast concrete flat slab tops. Precast manhole barrels shall meet the requirements of ASTM C478.
- B. Air and vacuum valve chamber access frames and cover shall be Neenah R-1915-G, or equal. Cast the word "SEWER" in each cover.

PART 3 - EXECUTION

3.1 HANDLING AND CUTTING PIPE

- A. Pipe and fittings shall be handled carefully to avoid cracking or abrasion of the pipe coating.
- B. Any fitting showing a crack and any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- C. In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved, may be cut off by and at the expense of the Contractor before the pipe is laid so that the pipe used may be perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.
- D. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose. All cut ends shall be examined for possible cracks caused by cutting.

3.2 INSTALLATION OF PIPING

- A. All piping shall be installed to accurate lines and grades and shall be supported, guided, or anchored as shown, as specified, or as necessary.
- B. Restrained joints shall be provided at vertical and horizontal deflection points, tees, and crosses, or as directed by the Engineer.
- C. All piping installations shall be done in a neat and workmanlike manner.
- D. Install identification/location tape over all new non-metallic force main piping. See specification section 02558 "Identification/Location Tape" for material and installation requirements.

3.3 LAYING PIPE AND FITTINGS

- A. No defective pipe or fittings shall be placed in the work, and any piece found to be defective after having been placed shall be removed and replaced by a second piece and at the expense of the Contractor.
- B. Every pipe and fitting shall be cleaned of all debris, dirt, and other foreign material before being laid, and shall be kept clean until accepted in the completed work.
- C. When bell and spigot pipe is laid, the bell of the pipe shall be cleaned of tar or other obstruction and wiped out before the clean spigot of the next pipe is inserted into it. The new pipe shall then be shoved home firmly against the back of the bell and securely held until the joint has been completed.

3.4 PIPE BEDDING AND HAUNCHING

- A. Each pipe section shall be laid in a firm foundation of bedding material and haunched and backfilled with care.
- B. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
 - 1. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. If Class I material is used for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe. Class I material shall be No. 8 crushed limestone.

- C. Bedding material shall have a minimum thickness beneath the pipe of 4 inches (100 mm) or one-eighth of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe one-sixth of the outside diameter of the pipe.
- D. The rigid pipe, such as concrete or ductile iron, backfill between the bedding material and a plane 12-inches (300 mm) over the top of the pipe shall be hand-placed finely divided earth, free from debris and stones, or granular backfill if required.
- E. For flexible pipe such as PVC, the placement of embedment material, consisting of bedding, haunching, and initial backfill, must be done with care. The ability of the pipe to withstand loading in a trench depends a large part on the method employed in its installation. Crushed stone shall be used to backfill between the bedding material and a plane 12-inches over the top of pipe, and shall be hand placed. Care must be taken to not cause damage by compacting the material directly over the pipe.
- F. In yielding subsoils, the trench bottom shall be undercut to the depth necessary and backfilled with graded, crushed stone to form a firm foundation. No additional payment shall be made for stabilizing yielding subsoils.
- G. Where excavation occurs in rock or hard shale, the trench bottom shall be undercut and a minimum of 6-inches (150 mm) crushed stone bedding placed prior to pipe installation. Additional payment for rock excavation shall be made on "unit cost" projects only, and as prescribed under basis for payment.

3.5 JOINTING

A. Polyvinyl Chloride (PVC) Push-On Joints

1. Clean the bell and spigot of the pipe sections being joined. Wipe the outside of each spigot and inside of each bell clean of all dirt and other foreign matter. Wipe each bell and spigot dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Seat a gasket in the bell of the receiving pipe. Thoroughly lubricate the spigot end of the pipe being installed. Use the lubricant furnished by the pipe manufacturer. Center the spigot end of the pipe being installed in the bell of the receiving pipe. Support the pipe being installed so the pipe being installed is jointed along the centerline of the receiving pipe. Push or pull the pipe being installed home. After jointing, check the gasket to

ensure the gasket has not pushed out of its seat and the gasket is uniformly compressed around the pipe.

3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe manufacturer.

B. Mechanical Joints

1. Remove lumps, blisters, and excess bituminous coating from the bell and spigot end of each iron pipe, fittings, and valve. Wire brush the outside of each iron pipe or fitting spigot and inside of each bell. Wipe each bell, spigot, and ring gland clean of all dirt, oil, grease, and other foreign matter. Wipe each bell, spigot, and ring gland dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Brush each spigot and gasket with soapy water. Slip a ring gland followed by a gasket over the spigot. Center the end of the pipe, fitting, or valve being installed on the end of the receiving pipe, fitting, or valve. Support the pipe, fitting, or valve being installed so the pipe, fitting, or valve being installed is jointed along the centerline of the receiving pipe, fitting, or valve. Push or pull the pipe, fitting, or valve being installed home. Push the gasket into position. Move the gland into position against the face of the gasket. Loosely assemble the joint bolts and nuts. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

<u>Pipe Size</u>	<u>Bolt Size</u>	<u>Torque Range</u>
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Deflect pipe, fittings, or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

<u>Pipe Size</u>	<u>Maximum Deflection Angle</u>	<u>Maximum Deflection Based Upon 18-Foot Pipe Length</u>
4"	8°-18'	31"
6"	7°-7'	27"
8"	5°-21'	20"
10"	5°-21'	20"

C. Flange Joints

1. Remove antirust coating from machined surfaces. Clean joint surfaces of the pipe, fittings, and valves being joined. Wipe surfaces clean of all dirt, oil, grease, and other foreign matter. Wipe surfaces dry. Wipe each gasket clean of all dirt, dust, and other foreign matter.
2. Align the flange of the pipe, fitting, or valve being installed with the flange of the receiving pipe, fitting, or valve. Support the pipe, fittings, and valves being joined so the flanges are properly aligned. Lubricate bolts and nuts with a graphite and oil mixture prior to installation of bolts and nuts. Install gasket between the flanges. Loosely assemble bolts and nuts. Check gasket to ensure the gasket is in proper position. Evenly tighten bolts and nuts. Tighten bolts and nuts so the joint will not leak. Do not overtorque bolts and nuts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of not less than 2,000 psi.
2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.
3. Construct thrust blocks between fittings to be restrained and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall not be less than the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

- B. Restrained Joint Piping: Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings.

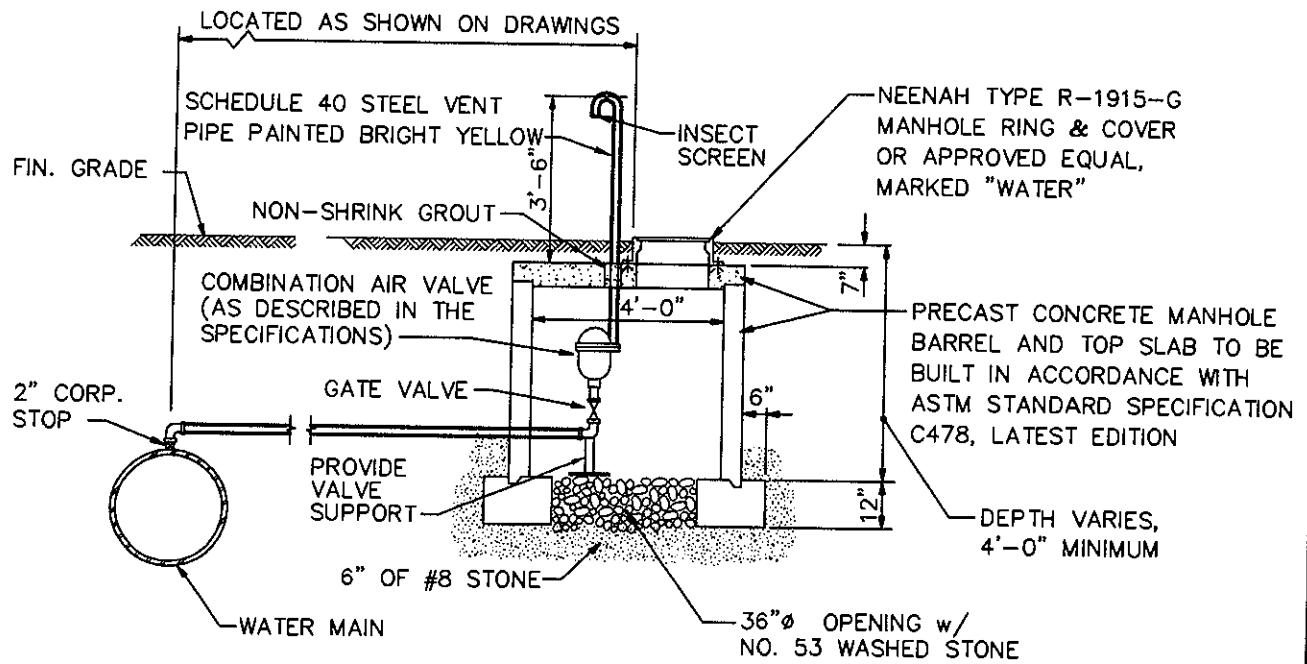
C. Pipe Supports

1. Furnish and install supports required to hold pipe, fittings, and valves at the lines and grades indicated on the drawings and without strain upon pipe, fittings, and valves.
2. Support exposed piping by suitable saddle stands, concrete piers, or hangers.
3. Locate supports where necessary and not less than 8 feet on center.

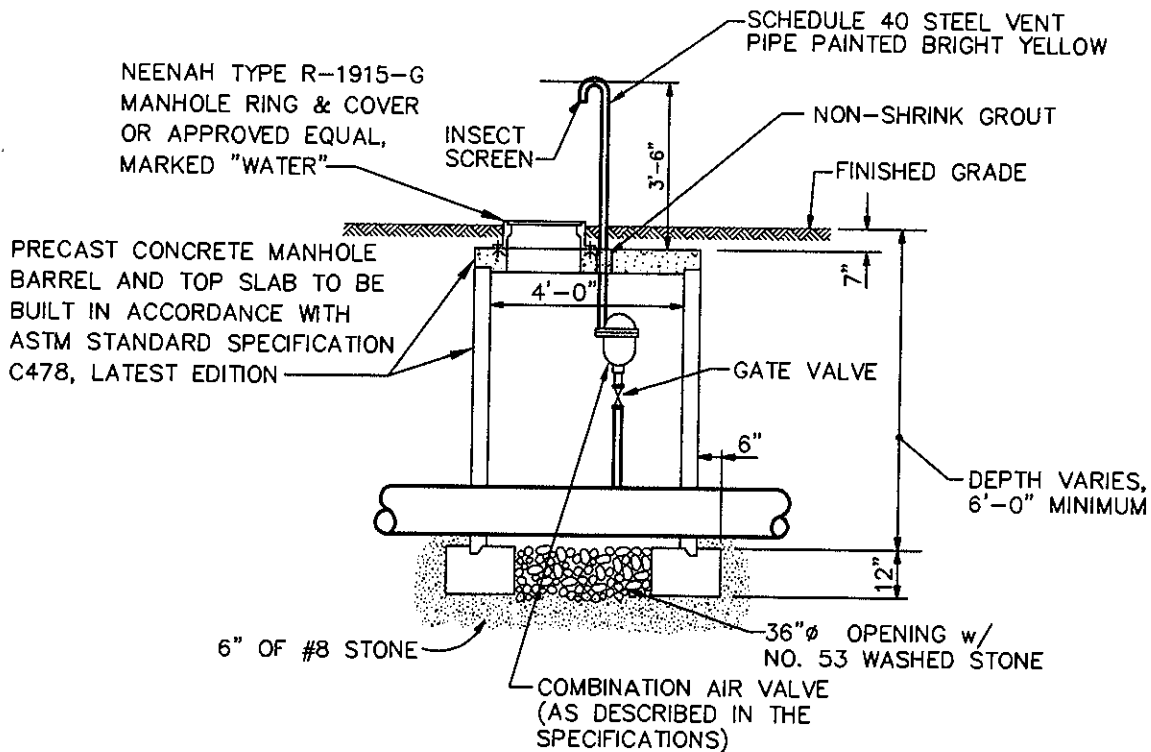
3.7 HYDROSTATIC TEST

- A. A leakage test must be successfully performed on the new force main in accordance with the following provisions:
1. Said test shall include all force main in this contract as shown on the drawings. The Contractor shall make arrangements with the City's Representative for scheduling the test after the piping has been accepted as being ready for testing. All concrete thrust blocks shall have been in place for a period of at least ten days prior to the test. The test shall be performed on the day mutually agreed upon and in the presence of the City's Representative.
 2. Water for testing will be obtained by the Contractor at his cost. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test. The system shall be tested in conformance with Section 13 of AWWA Specification C600 at static pressure of 100 pounds per square inch over a period of not less than eight consecutive hours. The system will not be acceptable until all leaks have been repaired to the satisfaction of the Engineer.
 3. At the option of the Contractor, the force main may be tested in sections approximately 500 feet in length (subject to the approval of the Engineer); and upon satisfactory completion of the leakage test, the trench shall be backfilled as specified.
 4. During the filling of the pipe and before the application of the specified test pressure, all air shall be expelled from the pipe line, if necessary, by means of taps at points of highest elevation; and after completion of the test, the taps shall be tightly plugged, unless otherwise specified.

END OF SECTION 02732



VAULT OFFSET FROM MAIN



VAULT OVER MAIN

AIR RELEASE VALVE VAULT DETAIL

CITY OF GREENSBURG, INDIANA

JULY 2007

HNTB

FIGURE W-102

SECTION 02902 - LANDSCAPING FOR UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install topsoil, fertilizer, seed, mulch, sod, trees, bushes, ornamental plants, fencing, mail boxes, planters, and related items necessary to complete work shown or specified.
- B. The Contractor shall repair or replace lawn areas, trees, and ornamental plants damaged or destroyed during construction of the work, unless otherwise shown on the drawings. The Contractor shall repair or replace fences, mail boxes, planters, and other items damaged or destroyed during construction of the work, unless otherwise shown on the drawings.
- C. Lawn areas include grassed areas which are cut and maintained on a routine basis. Lawn areas include lawns at homes and businesses and grass shoulders of streets, roads, and highways.
- D. Replacement of underbrush in fields and woods, along farm fences and roads, and in similar areas is not required, unless otherwise shown on the drawings.

1.2 JOB CONDITIONS

- A. Seed between February 15 and June 1 and between August 15 and November 1. Do not sow seed during adverse weather conditions. Do not broadcast seed during high wind. Do not sow seed when the moisture content of the soil is too low or too high for seed germination.
- B. Plant trees and ornamental plants during the proper time and under the proper conditions for the particular tree or plant.

PART 2 - PRODUCTS

2.1 LAWN PRODUCTS

- A. Limestone: Limestone shall be agricultural grade with a minimum total neutralizing power of 90. At least 40% of the limestone shall pass a No. 100 sieve, and at least 90% shall pass a No. 8 sieve.
- B. Fertilizer: Fertilizer shall be 12-12-12 grade.

C. Seed:

1. Seed mix shall be as follows:

<u>Seed Description</u>	<u>Percent by Weight</u>
Kentucky Blue Grass (<i>Poa pratensis</i>)	35 to 40
Kentucky 31 Fescue (<i>Festuca arundinacea</i> var. KY 31)	30 to 35
Perennial Rye (<i>Lolium multiflorum</i>)	30 to 35

2. Seed shall not contain more than 5% inert matter. Seed shall not contain objectional weeds.

D. Mulch: Mulch shall be straw, grass, hay, pine needles, or wood fiber. Straw shall be threshed straw of cereal grain such as oats, wheat, barley, rye, and rice. Mulch shall not contain objectional weed seeds or other material that might be detrimental to the planting being established.

E. Asphalt Adhesive: Asphalt adhesive shall be emulsified asphalt. Adhesive shall meet the requirements of ASTM D977 for Grade SS-1.

2.2 SOD

Provide strongly rooted sod, not less than two years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of Kentucky Bluegrass (*Poa pratensis*).

2.3 TOP SOIL

- A. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 1 inch in any dimension, and other extraneous or toxic matter harmful to plant growth.
- B. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.4 FENCE AND OTHER PRODUCTS

Replacement fence, mail boxes, planters, and other items shall be new and unused. Fence, mail boxes, planters, and other items shall be the same type as the items removed. Fence, mail boxes, planters, and other items shall be of equal quality to the items removed when the items removed were new.

PART 3 - EXECUTION

3.1 GRADING

Fine grade all non-paved areas disturbed during construction. Areas shall be smooth and uniform. Finish elevations and grades shall be the same as elevations and grades prior to construction, unless otherwise shown on the drawings.

3.2 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 - 1. Mix lime with dry soil prior to mixing fertilizer.
 - 2. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

3.3 SEEDING

- A. Loosen the seed bed, if not loose, to a depth of from 1 to 2 inches below finished grade.
- B. Seeds and fertilizers can be sown with standard agricultural drills. Grass seeds may be sown broadcast or with a special seeder attachment on agricultural drills, but shall not be covered with more than 1/2-inch of soil, whether drilled or raked in. If not covered by the drill, all uncovered seed

shall, immediately after sowing, be slightly raked or harrowed to cover the seed.

- C. Apply fertilizer in the amount of 20 pounds per 1,000 square feet.
- D. Sow grass seed at the rate of not less than four pounds per 1,000 square feet.
- E. Apply adequate mulching material following seeding and fertilizing.
- F. Keep seeded and fertilized areas adequately watered until germination of all seed is completed and uniform grass cover is accomplished.

3.4 PREPARATION OF SODDED AREAS

- A. Prior to preparation of areas to be sodded, remove existing grass, vegetation, and turf. Dispose of such material outside of Owner's property. Do not turn over any removed material into the soil being prepared for sodding.
- B. Loosen subgrade of areas to be sodded to a minimum depth of 4 inches. Remove stones over 1-1/2 inch in any dimension and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
- C. Place 4 inches of topsoil to be sodded.
 - 1. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.
 - 2. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
 - 3. Allow for sod thickness in areas to be sodded.
- D. Grade areas to be sodded to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
- E. Moisten prepared areas to be sodded before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

- F. Restore areas to be sodded to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.5 SODDING

- A. Sod areas indicated on drawings to be sodded.
- B. Loosen the surface to a depth of 1 to 2 inches and rake area before sod is placed. Remove clods, lumps, boulders, and debris.
- C. Apply limestone at a rate of 25 pounds per 1,000 square feet. Apply fertilizer at a rate of 10 pounds per 1,000 square feet.
- D. Lay sod strips by hand. Fit sod to surrounding grade and fixed objects. Butt sod strips together so there are no open joints. Tamp or roll sod after initial watering. The sod shall have a smooth even surface after tamping and rolling.
- E. Stake or peg sod when the sodded area has a slope of less than 4 feet horizontal to 1 foot vertical.
- F. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.

3.6 PLANTING TREES AND OTHER PLANTS

- A. Plant trees and other plants in the proper manner for the particular tree or plant being planted.
- B. Keep trees and plants properly watered until growth is assured.

3.7 FENCING AND OTHER RESTORATION

- A. Locate fences, mail boxes, planters, and other items in the same location that the item had been prior to construction. Erect wire and board fences plumb and on straight lines. Set mail boxes, posts, poles, and similar items plumb. Restore planters and similar items to the same shape the items had been prior to construction.
- B. Wire fences shall have the proper tension for the type of wire fence restored. Other fences and items shall be properly erected or constructed.

3.8 CLEAN-UP

Cleanup the job site following landscaping. Remove rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable condition.

END OF SECTION 02902

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and place plain and reinforced concrete and do related work necessary to complete work shown or specified.
- B. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.
 - 1. Following is a partial list of American Concrete Institute publications which are applicable to concrete construction:
 - a. ACI 318 Building Code Requirements for Reinforced Concrete.
 - b. ACI 211.1 Recommended Practice for Selecting Proportions for Normal Weight Concrete.
 - c. ACI 211.2 Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.
 - d. ACI 347 Recommended Practice for Concrete Formwork.
 - e. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - f. ACI 308 Recommended Practice for Curing Concrete.
 - g. ACI 306 Recommended Practice for Cold Weather Concreting.
 - h. ACI 305 Recommended Practice for Hot Weather Concreting.
 - i. ACI 304 Recommended Practice for Measuring, Mixing, and Placing Concrete.
 - j. ACI 503.1 Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete with a Multi-Component Epoxy Adhesive.
 - k. ACI 503.2 Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.

1.2 QUALITY ASSURANCE

- A. Testing Laboratory Services: The Contractor shall employ and pay for the services of an independent testing laboratory to perform specific services and necessary tests as outlined below:
1. Tests: Establish each proposed design mix prior to placing the first concrete at the job site. Make a set of four test cylinders for each proposed mix. Break one cylinder from each set at seven days. Break the remaining cylinders at 28 days. A mix will be considered satisfactory if the average strength of three 28-day breaks equals or exceeds the specified 28-day strength. Adjust the design mix and repeat the test procedure if the average strength of three 28-day breaks is less than the specified 28-day strength.
- B. Tolerances: Finish concrete shall meet the following tolerances:
1. Variations from Plumb: $\pm 1/4$ -inch per 10 feet but not more than 1 inch
 2. Variations from Level or Indicated Grade: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch
 3. Variations from Horizontal: $\pm 1/4$ -inch per 10 feet but not more than $1/2$ -inch
 4. Variations in Size and Locations of Openings or Sleeves: $\pm 1/4$ -inch
 5. Variation in Steps Flight of Stairs:
 - a. Riser: $\pm 1/8$ -inch
 - b. Tread: $\pm 1/4$ -inch
 6. Variation in Steps Consecutive Steps:
 - a. Riser: $\pm 1/16$ -inch
 - b. Tread: $\pm 1/8$ -inch
 7. Reinforcing Steel Placement: $\pm 3/8$ -inch

1.3 SUBMITTALS

- A. Submittals shall be as specified in the General Requirements Section 01001.

B. Submit the following:

1. Certified copies of test reports of concrete mixes required by the applicable standards.
2. Shop and placing drawings, bending diagrams, and mill test reports for reinforcing steel bars for cast-in-place concrete structures.
3. Samples of waterstops, vapor barrier, and perimeter insulation.
4. For concrete restoration and repair work, submit complete description of proposed method of repair, including sequence of work, dimensions, method of surface preparation, protection of existing structures and materials.
5. Sample and test reports of fly ash.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Promptly remove damaged or unsuitable products from the job site. Replace damaged products with undamaged products. Replace unsuitable products with suitable products.

1.5 JOB CONDITIONS

- A. Follow methods outlined in ACI 306 if concrete is to be placed when the atmospheric temperature is expected to be less than 40°F.
- B. Calcium chloride will not be considered for approval as an accelerating admixture during cold weather construction.
- C. Follow methods outlined in ACI 305 if concrete is to be placed when the atmospheric temperature is expected to exceed 90°F.
- D. Manufacturer's recommendations shall be strictly followed in regard to atmospheric temperature limitations during application of epoxy or acrylic polymer modified concrete materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cement shall be Portland cement and shall meet the requirements of ASTM Specification C 150, ACI 301, and ACI 318. Cement shall be Type 1 for normal use, Type 1A where air-entrainment is desired, or Type

III or Type IIIA where high early strength is desired and authorized by the Engineer. Blended hydraulic cements which meet the requirements of ASTM Specification C-595 Type 1-P Portland-pozzolan cement may be used where a more watertight concrete is required. Fly ash may also be used as a partial cement replacement for Types 1 or 1A.

B. Aggregate

1. Regular fine and coarse aggregates shall meet the requirements of ASTM Specification C 33. Aggregate shall be crushed limestone with a maximum size of 3/4 inch, except in mass concrete the maximum size may be 1-1/2 inches.
2. Lightweight fine and coarse aggregates shall meet the requirements of ASTM Specification C 330.
3. Insulating fine and coarse aggregates shall meet the requirements of ASTM Specification C 332.

C. Water shall be potable, clean, and free from injurious amounts of oils, acids, alkalis, organic materials, or other substances that may be deleterious to concrete or steel. A maximum of 500 mg/L of chloride ion may be present in the water.

D. Admixtures

1. Air-entraining admixtures shall meet the requirements of ASTM Specification C 260.
2. Water-reducing and retarding admixtures shall meet the requirements of ASTM Specification C 494, Type A or Type D, except that they shall contain no chlorides, shall be non-toxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the manufacturer's requirements. Furnish a compliance statement that the admixture used satisfies all requirements of this specification.
3. Fly ash shall meet the chemical and physical requirements of ASTM C 618 for mineral admixture Class F, except loss on ignition shall not exceed 6%. Fly ash shall be sampled and tested in accordance with ASTM C 311 prior to use.

E. Reinforcement

1. Reinforcing steel shall meet the requirements of ASTM Specification A 615, Grade 60.
2. Welded wire fabric or wire mesh shall meet the requirements of ASTM A 185.

F. Joint Filler

1. Preformed expansion joint filler shall be chosen to suit the job requirements as follows:
 - a. Type A: Asphalt filler for unsealed expansion or isolation joints in sidewalks, driveways, floor slabs on-grade, and elsewhere as indicated on the drawings. Filler shall meet the requirements of ASTM Specification D994.
 - (1) Sealtight asphalt expansion joint filler, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
 - b. Type B: Self-expanding cork filler for standard or waterproof sealed expansion joints in walls, slabs, and elsewhere as indicated on the drawings. Sealing shall be installed in accordance with the details shown on the drawings. Filler shall meet the requirements of ASTM Specification D1752, Type III.
 - (1) Sealtight self-expanding cork expansion joint filler as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
 2. Hot-poured elastic joint filler shall meet the requirements of ASTM Specification D1190.
 - a. Sealtight No. 164, as manufactured by W. R. Meadows, Inc., Elgin, Illinois, or approved equal, will be acceptable.
- G. Waterstops shall meet the requirements of Corps of Engineers CRD-C572. Waterstops shall be of the configurations as shown on the standard detail drawings or as specified.
- H. Curing Compounds: Curing compounds shall meet the requirements of ASTM Specification C 309, Type I.
- I. Epoxy Adhesive and Grout
1. Epoxy adhesive and grout shall be epoxy-resin systems meeting the requirements of ASTM C 881 and the additional requirements herein.

2. The proper type, grade, and class (ASTM C 881) shall be chosen to suit the job requirements as follows:

a. Type

- (1) I - For bonding hardened concrete and other materials to hardened concrete and setting anchor bolts and reinforcing bars in hardened concrete.
- (2) II - For bonding freshly mixed concrete to hardened concrete.
- (3) III - For bonding skid resistant materials to hardened concrete and as a binder in epoxy mortars or epoxy concrete.

b. Grade

- (1) 1 - For crack injection and spray application, light viscosity.
- (2) 2 - For brush application, medium viscosity.
- (3) 3 - For trowel or caulking gun application, non-sagging heavy viscosity for filling voids and gaps.

c. Class

- (1) A - For use below 40°F.
- (2) B - For use between 40°F and 60°F.
- (3) C - For use above 60°F.

d. Color: All epoxy adhesives and grouts shall be concrete gray or clear if they will be visible on the final concrete surface.

3. The epoxy material shall consist of a two-component system conforming to the following requirements:

a. Properties of mixed components shall meet the following requirements:

- (1) Solids content: 100% by weight
- (2) Pot life: 30 minutes (minimum) @ 75°F
- (3) Contact time: 2 hours @ 75°F
- (4) Tack free time: 4 hours minimum @ 75°F

- b. Properties of cured material shall meet the following requirements:
 - (1) Neat Binder
 - (a) Tensile Strength ASTM D-638: 3200 psi minimum @ 14 days, 75°F cure
 - (b) Tensile Elongation ASTM D-638 (Modified): 1% minimum @ 14 days, 75°F cure
 - (c) Compressive Strength ASTM D-695: 12,000 psi minimum @ 14 days, 75°F
 - (d) Compressive Modulus: 400,000 psi minimum @ 28 days, 75°F
 - (e) Water Absorption: 1% by weight, maximum 14 days 75°F cure 24 hours immersion
 - (2) Grout: One part Binder to three-and-quarter parts Aggregate by loose volume
 - (a) Compressive Strength ASTM C-109 (Modified) (2" Cubes): 12,000 psi minimum @ 28 days, 75°F cure
 - (b) Compressive Modulus (Modified): 1,250,000 psi minimum @ 28 days, 75°F cure
- c. Aggregate shall meet the requirements of the resin manufacturer.
- d. Chemical acceptance for SPI Classification -2- ('A' Component).
 - (1) The cured system shall meet the requirements of the U.S. Department of Agriculture for use in food processing plants.
 - (2) The cured system shall meet the requirements of U.S. Government regulations requiring water extractables of less than 0.5 MG per square inch of exposed surface for potable water containers. Tests for water extractables shall meet the requirements of the Environmental Control Administration of the U.S. Public Health Service.

- e. The following epoxy manufacturers' products, or equal products, will be considered for approval:

- (1) SIKADUR as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
- (2) EPOTOX as manufactured by Toch Division, Carbolina, St. Louis, Missouri.
- (3) SONOBOND as manufactured by Sonneborn - Contech, Minneapolis, Minnesota.
- (4) PROBOND as manufactured by Protex Industries, Denver, Colorado.

J. Modified Concrete

1. Polymer Modified Concrete: The purpose of this specification is to describe a two-component, polymer-modified, cementitious, fast-setting, trowel grade, structural repair mortar. This system shall be used on horizontal, vertical, and overhead surfaces, on grade, above and below grade on concrete and mortar.

- a. The polymer-modified cementitious system shall consist of a factory preproportioned two-component system whose components conform to the following requirements:

- (1) Component A shall be a liquid polymer emulsion of an acrylic copolymer base and additives. This acrylic copolymer shall have the following properties:
 - (a) Ph: 4.5 - 6.5
 - (b) Minimum Film Forming Temperature: Approx. 68°F
 - (c) Tear Strength: Approx. 990-1420 psi
 - (d) Elongation at Break: 500-900%
 - (e) Particle Size Range: Less than 0.1 micron
- (2) Component B shall be a blend of selected Portland cements, specially graded aggregates, organic accelerator, and admixtures for controlling setting time, water reducers for workability, and a corrosion inhibitor.
- (3) The component ratio A:B shall be as required by the manufacturer. The system shall not contain chlorides, nitrates, added gypsum, added lime, or

high alumina cements. The system shall be noncombustible, either before or after cure.

- (4) Typical properties of mixed components:
 - (a) Application Time(Working Time): 15 min. after combining components
 - (b) Finishing Time: 20-60 min. after combining components
 - (c) Color: Concrete Gray
- (5) Typical properties of cured material:
 - (a) Abrasion Resistance: 6 times that of controlled concrete
 - (b) Bond Strength (Pull off Method): 100% concrete substrate failure
 - (c) Modulus of Elasticity: 4.5×10^6
 - (d) Surface Scaling (De-icing salt solution freeze/thaw): No deterioration after 120 cycles
 - (e) Compressive Strength 2 hours 50% RH): 150 minimum
 - (f) Compressive Strength 28 days 50% RH): 5,500 psi minimum
 - (g) Flexural Strength 28 days 50% RH): 1,300 psi minimum
 - (h) This system shall conform with ECA/USPHS Standards for surface contact with potable water.
 - (i) This system shall not produce a vapor barrier.
 - (j) This system shall be thoroughly compatible with concrete.

2. Epoxy-Modified Concrete: The purpose of this specification is to describe a two-component, 100% solids, liquid epoxy-resin system which is formulated as an additive to Portland cement concrete or mortar mixes to produce a high strength structural repair concrete or mortar. This system shall be applicable for use on horizontal, vertical, and overhead surfaces, on grade, above or below grade.

- a. The concrete or mortar mix shall be in accordance with the manufacturer's recommendations. Cement, aggregate, sand, and water shall meet the requirements specified elsewhere in this Section.

- b. If the color of the cured epoxy modified concrete does not reasonably match the color of the existing concrete to the satisfaction of the Engineer, the Contractor shall apply an approved surface coating, suitable for the intended exposure of the patched area, to blend the patchwork into the surrounding concrete.
- c. The following manufacturer's products, or equal products, will be considered for approval:
 - (1) SIKADUR 362 as manufactured by Sika Corp., Lyndhurst, New Jersey.
 - (2) DURALGUARD Modifier E Gel as manufactured by Dural International Corp., Deer Park, New York.

K. Type 1 Grout

- 1. Type 1 grout shall be expansive grout.
- 2. The grout shall be composed of selected silica sands, modified cements, pozzolanic, plasticizing, and water reducing admixtures.
- 3. The grout shall be entirely non-metallic and shall be suitable for both interior and exterior applications.
- 4. The grout shall be a one-step product delivered to the job site in bags containing a premixed formulation requiring only the addition of water prior to use.
- 5. The physical properties of the grout shall meet the following requirements:
 - a. Initial Set (ASTM C 1910): 45 min.
 - b. Final Set (ASTM C 191): 180 min.
 - c. Compressive Strength (ASTM C 109):
 - (1) 24 hours: 5,000 psi
 - (2) 3 days: 6,000 psi
 - (3) 7 days: 8,000 psi
 - (4) 28 days: 10,000 psi
 - d. Volume Change (ASTM C 827):
 - (1) 24 hours: +0.032%
 - (2) 3 days: +0.033%
 - (3) 7 days: +0.035%
 - (4) 28 days: +0.035%

e. Tensile Strength:

- (1) 24 hours: 400 psi
- (2) 3 days: 460 psi
- (3) 7 days: 550 psi
- (4) 28 days: 600 psi

6. The following grout manufacturers' products, or equal products, will be considered for approval:

- a. SONOGROUT as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.
- b. FIVE STAR GROUT as manufactured by U.S. Grout Corp., Old Greenwich, Connecticut.
- c. SET NON-SHRINK GROUT as manufactured by Set Products, Macedonia, Ohio.
- d. SEALTIGHT 588 as manufactured by W. R. Meadows, Elgin, Illinois.

L. Bonding Agents: The following bonding agent manufacturers' products, or equal products, will be considered for approval:

- 1. EPOXTITE BINDER as manufactured by Construction Products Div., W. R. Grace & Co., Cambridge, Massachusetts.
- 2. SIKADUR HI-MOD EPOXIES as manufactured by Sika Chemical Corp., Lyndhurst, New Jersey.
- 3. SONOBOND as manufactured by Sonneborn-Contech, Minneapolis, Minnesota.

M. Cement Based and Acrylic Polymer Compounds: The following cement based or acrylic polymer compound manufacturers' products, or equal products, will be considered for approval:

- 1. THOROSEAL as manufactured by Standard Dry Wall Products, Inc., Miami, Florida.
- 2. LATEX LIQUID FLOOR as manufactured by the Camp Co., Inc., Chicago, Illinois.

2.2 CONCRETE

A. General

- 1. Concrete shall be Class A, B, C, or D as specified in this Article. All concrete shall be assumed to be Class A, unless specifically excepted.

2. The slump of all concrete shall be not more than 5 inches or less than 2 inches unless specifically excepted by the Engineer.
3. The air content by volume of all concrete shall be 6% plus or minus 1%.
4. Class A concrete shall contain a water-reducing and retarding admixture, unless specifically excepted. Use of a water-reducing and retarding admixture in Class B, C, or D concrete is optional. Use of a retarding admixture with fly ash concrete is optional.
5. Do not exceed the water-cement ratio of the design mix which includes all water added. The water-cement ratio shall not exceed 0.45. The water-cement ratio shall be based on the total cementitious materials content.
6. The water reducing and retarding admixture shall be in accordance with the manufacturer's requirements.
7. Class A concrete shall have a minimum cement content of 564 lbs./cubic yard.
8. An approved fly ash may added to the cement in Class A or B concrete in an amount not to exceed 15% by weight of cement, provided all applicable requirements for these classes of concrete are met and proposed mix designs are approved.

B. Class A Concrete

1. Class A concrete shall be structural concrete with a 28-day compressive strength of 4,000 psi.
2. Proportion Class A concrete in accordance with ACI 211.1.

C. Class B Concrete

1. Class B concrete shall be plain concrete with a 28-day compressive strength of 2,000 psi.
2. Proportion Class B concrete in accordance with ACI 211.1.

D. Class C Concrete

1. Class C concrete shall be structural lightweight concrete with a 28-day compressive strength of 3,000 psi.
2. Proportion Class C concrete in accordance with ACI 211.2.
3. The maximum density shall be 115 pcf.

E. Class D Concrete

1. Class D concrete shall be insulating concrete with a 28-day compressive strength of 140 psi.
2. The minimum density shall be 24 pcf.

- F. Type 2 Grout: Type 2 grout shall be cement mortar grout. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion materials to produce a grout which is suitable for the intended application.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

- A. Subgrade shall be free of sawdust, debris, water, ice, snow, frozen material, extraneous oil, mortar, or any other substances that may be deleterious to the concrete.
- B. Clean rock surfaces by air-water cutting, wet sandblasting, or wire brush scrubbing. Wet rock surfaces immediately prior to placement of concrete.
- C. Earth surfaces shall be firm and damp.
- D. Do not place Class A concrete on mud, dried earth, uncompacted fill, or frozen subgrade. Mud mats of Class B concrete will be permitted upon written approval of the Engineer.
- E. When Class A concrete is to be placed on highly pervious materials which might allow flowing groundwater to damage fresh concrete, the contact surface shall be covered with a layer of asphalt-impregnated building paper or polyvinyl sheeting prior to placement of the concrete.

3.2 FORMWORK

- A. All formwork shall be done in accordance with recommended practices contained in ACI 347.
- B. Forms shall be of wood, plywood, steel, or other approved materials and shall be mortar-tight.
- C. Construct forms and associated falsework so finished concrete conforms to the dimensions and contours shown on the drawings.
- D. Form surfaces shall be smooth and free from holes, dents, sags, or other irregularities.
- E. Coat forms with a non-staining oil before being set in place.

- F. Metal ties or anchorages within the forms shall be equipped with cones, she-bolts, or other devices that permit their removal to a depth of at least 1 inch without injury to the concrete.
- G. Remove forms in a manner and at such time to ensure complete safety of the structure. Do not remove supporting forms or shoring until sufficient strength has been developed in the concrete to support weight and load.

3.3 REINFORCING STEEL

- A. Reinforcement shall be free from excessive amounts of scale, rust, form oil, or any other coating that will reduce bond.
- B. Cut and bend reinforcement in accordance with recommended practices contained in ACI 315.
- C. Bar supports shall conform to standards recommended in ACI 315.
- D. Any dowel or lap shown on the drawings and not dimensioned and any splices required but not shown shall be the minimum allowable Class C tension splice according to ACI 318, based on Grade 60 steel reinforcing and 4,000 psi 28-day concrete.
- E. A mat of steel shall be considered as two layers of reinforcing bars forming a grid. When one mat of steel is to be placed in a wall or slab, place the mat in the center of the section unless specifically excepted. When two mats of steel are to be placed in a wall or slab, place one mat in each face of the section utilizing the minimum allowable clear distance per ACI 318, unless specifically excepted.

3.4 CONCRETE

- A. General: Measure and mix concrete in accordance with ACI 614.
- B. Class A Concrete
 - 1. Concrete shall be Class A concrete, unless otherwise shown on the drawings or specified in this Section.
 - 2. No measurable amount of water shall pass through structural concrete when a head of water equal to 12 inches of depth per inch of concrete is applied.
 - 3. Use one brand of cement only in concrete which will have exposed surfaces.

- C. Class B Concrete: Fillets shall be Class B concrete, unless fillets are constructed monolithic with walls or slabs. Mud mats shall be Class B concrete, unless specifically excepted.
- D. Class C Concrete: Use Class C concrete where shown on drawings.
- E. Class D Concrete
 - 1. Insulating concrete on roofs shall be Class D concrete.
 - 2. Class D concrete shall not be less than 1 inch or more than 8 inches thick.
 - 3. Application of Class D concrete shall meet the requirements of the concrete manufacturer.
 - 4. Limit foot traffic on new concrete until roof material has been applied.
- F. Ready-Mixed Concrete
 - 1. Mix, deliver, and place ready-mixed concrete in accordance with ASTM Specification C 94.
 - 2. Discharge concrete from a truck within 1-1/2 hours after water has been added to the mix in the truck.
 - 3. The delivery ticket shall contain the cubic yards in the load, the percent of air, the total number of bags of cement in the load, and the total gallons of water in the load. Copy of delivery ticket shall be given to the Engineer's representative.
 - 4. Water may be added at the job site if the water-cement ratio after the addition of the water does not exceed the water-cement ratio of the applicable design mix. When water is added at the job site, there shall be a minimum of 1-1/2 minutes of mixing per each cubic yard remaining in the truck.
- G. Site-Mixed Concrete
 - 1. Thoroughly mix site-mixed concrete in an approved type batch mixer having a capacity of not less than 1/2 cubic yard. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer.
 - 2. The mixing time for each batch, after addition of water to cement and aggregate, shall not be less than 1-1/2 minutes for each 1 cubic yard of materials. Operate the mixing drum at the speed for which it was designed, provided the speed is more than 14 rpm and less than 20 rpm.

3.5 WATERSTOPS

- A. Waterstops shall be placed in all walls and floor slabs where earth or air is on one side and fluid on the other side.
- B. Waterstops shall be placed in all walls and floors slabs where it is possible to isolate one tank or structure from each other.
- C. Waterstops will not be placed in divider walls where fluid is on either side, except in the case where tank or structure can be isolated.

3.6 EQUIPMENT MOUNTING PADS

All floor mounted equipment shall be installed on a minimum 4" concrete pad as shown on standard detail drawings. Type 1 grout shall be used on all equipment mounting pads, unless otherwise directed by the Engineer.

3.7 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304. Provide chutes, drop pipes, and other placing equipment properly designed and appropriate for the intended use to prevent segregation of coarse aggregate.
- B. Remove construction debris and extraneous matter from within the forms.
- C. Remove temporary struts, stays, bracing, and blocks serving to hold the forms in correct shape and alignment until concrete is placed.
- D. Place concrete on clean, damp surfaces, free from running or standing water.
- E. Deposit concrete in approximately horizontal layers, not to exceed 18 inches.
- F. Consolidate concrete by means of mechanical vibrating. Insert and remove vibrators vertically at regular intervals to ensure uniform consolidation. Do not use vibrators to transport concrete inside the forms. Internal vibrators shall maintain a speed of not less than 7,000 impulses per minute when in operation. At least one standby vibrator shall be on hand at all times during placing.

3.8 CURING

- A. Prevent concrete from drying for a period of 7 days after it is placed.

- B. Curing may be accomplished by any of the approved methods as listed in ACI 308.
- C. Concrete with fly ash may require longer curing time. Curing shall be continuous for a minimum of 7 days or for the time necessary to attain 70% of the specified compressive strength, whichever is greater.

3.9 EPOXY ADHESIVE AND GROUT

- A. Use epoxy-resin system in accordance with ACI 503.1 when it is required to grout reinforcing bars or non-expansive anchors into existing concrete.
- B. Use epoxy-resin system in accordance with ACI 503.2 when it is required to bond fresh (plastic) concrete to hardened concrete.
- C. Joining of new and old concrete shall meet the requirements of the epoxy-resin system manufacturer.
- D. Install reinforcing bars and non-expansive anchors as follows:
 - 1. Non-expansive anchors shall be threaded at least the full length of the embedded portion.
 - 2. Concrete strength shall be a minimum of 3,000 psi before starting the embedment procedure.
 - 3. Embedment length shall be a minimum of 10 times the nominal anchor or bar diameter but not less than 6 inches.
 - 4. Diameter of hole shall be a minimum of 1/2 inch and a maximum of 1-1/2 inches greater than the anchor or bar, bolt-head diagonal or washer diameter, whichever is greater.
 - 5. Vacuum or blow out the hole using oil-free compressed air when a dry drilling method is used.
 - 6. When the drilling process requires the use of water, carefully wash out the hole after drilling to remove residue of drilling slurry. Hole should then be dried if possible.
 - 7. Condition materials to approximately 75°F for ease of mixing and handling of grout prior to mixing epoxy-resin system.
 - 8. Premix components for one minute with mixing paddle attached to low speed (400-600 rpm) electric drill. Pour equal volumes of each component into clean pail. Mix to uniform color. Add approximately a third of the aggregate; mix for another minute. Add remaining aggregate; continue mixing for two to three minutes until grout is thoroughly blended. Move drill continuously to thoroughly mix components. Keep paddle below surface of material to avoid whipping air into mix. Mix only that quantity which can be placed within 30 minutes.

9. Anchors or bars shall be clean, dry, degreased, and free of rust and scale.
10. Vertical Installation
 - a. Anchor bolts, dowels, and reinforcing bars may be installed by either of the following methods:
 - (1) Pour grout to a predetermined level in bolt hole and insert bolt into grout. Work bolt up and down while tapping lightly to ensure complete embedment.
 - (2) Insert bolt and pour grout into annular space between bolt and hole.
 - b. Use templates or wedges to hold bolts, dowels, or reinforcing bars in position until grout sets.
11. Horizontal Installation: Install anchor bolts, dowels, and reinforcing bars as follows:
 - a. Place grout using a hand- or power-operated caulking gun with a large-diameter tip and polyethylene-tube extension. Install grout to a predetermined depth in bolt hole; insert bolt in grout. Work back and forth, up and down to ensure complete embedment. Pack grout in tightly at the surface; trowel even with the concrete. Position bolt, dowel, or bar in center of drill hole with template or wedges until grout sets.

3.10 MODIFIED CONCRETE

A. Surface Preparation

1. Remove all loose deteriorated concrete, soil, dirt, and any deleterious material down to sound concrete. Undercut concrete a minimum of 1/2 inch. Do not featheredge patch material.
2. Sandblast or wirebrush clean concrete and reinforcing steel.
3. Moisten surface and allow to dry until damp.

- B. Epoxy Modified Bond Coat: Prior to placing epoxy modified concrete or mortar, coat surface of existing concrete and reinforcing steel with epoxy modified bond coat in accordance with the manufacturer's recommendations.

- C. Curing: Immediately after placing patch material, cover with wet burlap or polyethylene sheeting for a minimum of 24 hours and protect from heat, sunlight, and wind.

3.11 TYPE 1 GROUT

- A. Use Type 1 grout in all areas where the grout could be expected to have some structural requirements such as under column base plates, and all equipment mounting pads.
- B. Grout storage, handling, mixing, and placing shall meet the requirements of the grout manufacturer.
- C. The clearance between foundations and base plates or equipment bases shall not be less than 1 inch for each 16 inches the grout must flow horizontally.
- D. All areas to be grouted shall be clean and free of oil, grease, dirt, and contaminants. Remove all loose material. Provide air relief openings where required to avoid entrapment of air. All metal components to be in contact shall be derusted and free of paint or oils. All concrete to come into contact with the grout shall be rough finished and shall be thoroughly saturated by dampening or soaking prior to placement of grout. Remove excess water from holes and voids.
- E. Use forming procedures that allow proper and complete placement of the fluid grout, including the use of head forms. Support elements to be anchored so that no movement is possible. Remove support only after grout has hardened sufficiently. Pretreat wood surfaces that can absorb moisture with forming oils. Cut back edges of concrete to be grouted which are less than 1- inch thick to form a uniform butt.
- F. Place grout in accordance with standard grouting procedures and recommendations of ACI for placing and curing of concrete. Use chains, rods, or tamping devices to compact grout tightly, completely removing all air voids. Place grout quickly and continuously, striking off exposed areas. Cure finished grout by standard methods.
- G. Grout protection shall meet the requirements of the grout manufacturer.

3.12 TYPE 2 GROUT

- A. Use Type 2 grout for leveling courses, screeded toppings for tank base slabs, and other similar applications.

- B. The grout shall be composed of cement, fine aggregate, coarse aggregate, and water. Proportion the materials to produce a grout that is suitable for the intended application.
- C. Use a bonding agent to bond the grout to the surface receiving the grout. Use of the bonding agent shall meet the requirements of the bonding agent manufacturer's requirements.
 - 1. The surface to which grout is applied shall be clean and sound. Remove oil, grease, and similar substances. Remove unsound concrete, loose material, and foreign matter by scarifying or other mechanical means. Etch all concrete, whether new or old, with a 1:1 muriatic acid solution (approximately 14%) and thoroughly rinsed with water to remove all traces of acid.
 - 2. Mix and place bonding agent according to bonding agent manufacturer's instructions.

3.13 FINISHING

- A. All concrete and grout surfaces shall be true and even, and shall be free from open or rough spaces, depressions, or projections.
- B. Accurately screed exposed surfaces of concrete to grade and then float prior to final finishing. Do not use excessive floating or trowel while concrete is soft. Do not add dry cement or water to the surface of screeded concrete to expedite finishing.
- C. After removal of forms, remove all bulges, fins, form marks, or other irregularities that may adversely affect the appearance or function of the concrete.
- D. Clean and patch all cavities left by form ties or any other device. Use expansive grout for patching.
- E. Finish concrete in accordance with the following schedule, unless specifically excepted.

<u>Surface</u>	<u>Finish</u>
All exposed vertical surfaces from 6 inches below grade or minimum operating level	Smooth rubbed finish
Floor slabs of tanks and channel floors	Smooth floated finish

Floor slabs of tanks or channel floors which will receive leveling grout	Brushed finish
Interior building floors not receiving fluid applied resilient flooring	Steel trowel finish
Interior building floors which will receive fluid applied resilient flooring	Brushed finish
Leveling grout for tank slabs and channel floors	Screeded with steel trowel finish
Exterior horizontal traveled surfaces	Brushed finish
Exposed exterior horizontal surfaces except as listed above	Smooth rubbed finish

- F. Cement based or acrylic polymer compounds will be considered as an alternative to rubbing. Preparation and application shall meet the requirements of cement based and acrylic polymer compound manufacturers.

3.14 TESTING

- A. The Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform the following tests as specified below and as requested by the Engineer.

1. Perform tests in accordance with the following ASTM Specifications:

<u>Test</u>	<u>ASTM Specifications</u>
Slump	C 143
Air Content	C 173
Test Cylinders	C 31 or C 513
Core Samples	C 42
Fly Ash	C 311

- B. The Contractor and the Engineer's representative shall measure slump each time test cylinders are to be made and at any other time requested by the Engineer. The slump limits given herein-before shall not be exceeded unless specifically excepted by the Engineer.

- C. Measure air content each time test cylinders are to be made and at any other time requested by the Engineer. The field test may be omitted if the air content is known prior to taking samples. The field test may not be omitted if fly ash is used in the mix.
- D. Make test cylinders in sets of four. Field cure one cylinder. Break field cured cylinder at seven days. Laboratory cure the remaining three cylinders from each set of four. Break laboratory cured cylinders at 28 days. The Contractor shall be responsible for handling and transportation of cylinders. If fly ash is used in the mix, a total set of seven cylinders shall be taken. The additional three cylinders shall be laboratory cured and broken at 56 days, if the 28 day strength does not meet specifications.
- E. Make one set of test cylinders for each 50 cubic yards, or fraction of 50 cubic yards, of concrete placed, or at other times requested by the Engineer.
- F. Fly ash shall be sampled and tested as specified in ASTM C 311 prior to use as an admixture in concrete.

END OF SECTION 03300

SECTION 11319 - SUBMERSIBLE LIFT STATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish and install a submersible, non-clog lift station and all appurtenances necessary to complete same as shown or specified.
 - 1. The lift stations shall be complete with submersible sewage pumps, motors, discharge elbows, access hatch, guide system, piping, valves, electrical controls, and appurtenances. All components of the lift station shall be furnished by one manufacturer.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified. Where used in these specifications, the following acronyms shall represent:
 - 1. ANSI - American National Standards Institute.
 - 2. ASTM - American Society for Testing & Materials.
 - 3. HI - Hydraulic Institute.
 - 4. NEMA - National Electric Manufacturer's Association.

1.2 QUALITY ASSURANCE

- A. The pumping unit manufacturer shall test each pump for mechanical and electrical correctness.
- B. Perform field tests specified in this Section.

1.3 SUBMITTALS

- A. Submittals shall be submitted to the City of Greensburg.
- B. Submit the following:
 - 1. Manufacturer's Certificate of compliance certifying compliance with the referenced specifications and standards.
 - 2. Shop drawings with performance data and physical characteristics.
 - 3. Manufacturer's installation instructions.
 - 4. Manufacturer's operation and maintenance material and manuals.
 - 5. Certified copies of test reports.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall be responsible for the delivery, storage, and handling of products.
- B. Load and unload all pumps, motors, and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Pad slings and hooks in such a manner to prevent damage to products.
- C. The pumps furnished shall be packaged in such a manner as to provide ample protection from damage during handling, shipment, and outdoor storage at the lift station site. All openings shall be capped with dustproof closures and all edges sealed or taped to provide a dust-tight closure.
- D. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish complete a submersible lift stations consisting of submersible non-clog sewage pumps, motors, piping, valves, reinforced concrete wet well, electrical controls, guide system, and other appurtenances as specified in this Section and as shown on the drawings.
- B. Pumping units shall meet the requirements of HI standards.
- C. Pump materials shall meet the requirements of the latest editions of the following specifications:

<u>Material</u>	<u>ASTM or ANSI Designation</u>
Cast Iron	A-48 Class 30
Stainless Steel	ANSI Type 316L, 304, and 431
Bronze	B-144 Class 3B
Hot Rolled Steel	A 107-50-T Gr. 1015 .20 Cu. Min.
Cold Rolled Steel	A 108-50-T Gr. 1141 Turned, Ground &
Polished	
Pipe	ANSI A21.51

- D. Where applicable specifications are not designed herein, supply high class commercial grades of materials that meet the requirements specified and which are satisfactory to the Engineer.

2.2 PUMP DESIGN

- A. Pumps shall be capable of handling raw, unscreened sewage and 3-inch spherical solids.
- B. The design shall be such that the pump unit will be automatically and firmly connected to the discharge piping when lowered into place on its mating discharge connection, which shall be permanently installed in the wet well.
- C. The pump shall be easily removable for inspection or service, requiring no bolts, nuts, or other fastenings to be disconnected. For this purpose, there shall be no need for personnel to enter the wet well.
- D. Each pump shall be fitted with a stainless steel lifting chain of adequate strength and length to permit raising and lowering the pump for inspection and removal. The lifting system must permit the pump to be removed in one continuous motion, without intermediate hooking.
- E. The pump, with all its appurtenances and cable, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 65 feet.

2.3 PUMP CONSTRUCTION

- A. All major parts, such as stator casing, oil casing, sliding bracket, volute and impeller, shall be gray cast iron, Class 30, with smooth surfaces devoid of blow holes and other irregularities. All surfaces coming in contact with sewage shall be protected by an approved coating resistant to sewage. All exposed bolts and nuts shall be 304 stainless steel.
- B. The wear ring shall consist of a stationary ring made of nitrile rubber molded with a steel ring insert which is drive-fitted to the volute inlet and rotating stainless steel ANSI 304 ring which is drive-fitted to the impeller eye.
- C. The impeller shall be gray cast iron of a non-clogging design capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications. The impeller shall be constructed with a long throughlet without acute turns. The impeller shall be dynamically balanced. Static and dynamic balancing operations shall not deform or

weaken it. The impeller shall be slip fit to the shaft and key driven. Non-corroding fasteners shall be used.

1. The volute shall be of single piece design and shall have smooth fluid passages large enough at all points to pass any size solid which can pass through the impeller.
- D. Pump shall be provided with a mechanical rotating shaft seal system consisting of two totally independent seal assemblies running in an oil reservoir having separate, constantly hydro-dynamically lubricated lapped seal faces. The (lower) seal unit between the pump and the oil chamber shall contain one stationary and one positively driven rotating tungsten-carbide ring.
- E. The (upper) seal unit between the oil sump and motor housing shall contain one stationary tungsten-carbide ring and one positively driven rotating carbon ring. Each interface shall be held in contact by a spring system. The seals shall require neither maintenance nor adjustment, but shall be easily inspected and replaceable. Shaft seals which are lubricated by oil and not the pumped liquid may utilize carbon and ceramic, Type 21, to be considered equal. The shaft sealing system shall be capable of operating when the pump is submerged to depths of/or pressures equivalent to 65 feet. No seal damage shall result from operating the pumping unit out of its liquid environment for extended periods of time. The pump shall be capable of operating for 24 hours in a dry condition without damage to the pump motor or mechanical seal.
- F. The pump shaft shall be stainless steel ANSI 420 stainless steel.
- G. The cable entry water seal design shall be such that precludes specific torque requirements to ensure a watertight and submersible seal. The cables shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit with cable and housing; strain relief and sealing of the cable is done separately within the body; the cable entry junction chamber and the motor shall be separated by a stator lead sealing gland or terminal board. Epoxy filled terminal housing shall be considered equal providing individual wire leads are spliced in the motor terminal housing and the individual splice caps are filled with epoxy; such construction shall not require a terminal board to isolate the motor interior and the pump top.
- H. All mating surfaces of major parts shall be machined and fitted with nitrile O-rings where watertight sealing is required.

- I. Machining and fitting shall be such that sealing is accomplished by automatic compression in two planes and O-ring contact made on four surfaces. Square rings which provide the controlled compression of an O-ring and the ease of assembly of a flat gasket shall be considered equal.
- J. Tolerances of all parts shall be such that allows replacement of any part without additional machining required to ensure sealing as described above.
- K. Each unit shall be provided with an adequately designed cooling system. Thermal radiators integral to the stator housing, cast in one unit, are acceptable. Units which utilize an oil-filled motor and which operate considerably cooler than air-filled motors shall not require additional cooling to be considered equal. Thermal radiators integral to the stator housing, cast in one unit, are acceptable. Where water jackets alone or in conjunction with radiators are used, separate circulation shall be provided. Cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provision for external cooling and flushing shall be provided.
- L. Internal thermal sensors shall be required on each pump motor. Thermal sensors shall be used to monitor stator temperatures. There shall be one for each phase group in the motors. These shall be used in conjunction with and supplemental to external motor overcurrent protection, and they shall be located in the control panel. The internal thermal sensors shall show and/or sound an alarm and automatically shutdown the pump before motor damage occurs.
- M. Moisture sensing probes shall be installed in the mechanical seal cavity of each pump unit. These probes shall sense the intrusion of the pumped liquid into the seal cavity, send a signal to the panel mounted alarm device, and shut the pump down immediately. The alarm device shall be activated until the pump is removed from service/or repair.

2.4 GUIDE SYSTEM

- A. A sliding guide bracket shall be an integral part of the pump unit. The volute casing shall have a machined discharge flange to automatically and firmly connect with the cast iron discharge connection which, when bolted to the floor of the sump and discharge line, will receive the pump discharge connecting flange without the need of adjustment, fasteners, clamps, or similar devices.
- B. Installation of a pump unit to the discharge connection shall be the result of a simple linear downward motion of the pump unit guided by two guide rails, a T-bar, or other suitable guide system.

- C. Guide rail pipes shall be constructed using 304 stainless steel or reinforced fiberglass material.
- D. No other motion of the pump unit, such as tilting or rotating, shall be required. No portion of the pump unit shall bear directly on the floor or wet well. There shall be no more than one 90 degree bend allowed between the volute discharge flange and station piping.

2.5 MOTOR

- A. The pump motor shall be housed in an air-filled, watertight casing and shall have moisture resistant Class F 155°C insulation. Oil-filled motors shall be considered equal providing they are the standard design of a U.S. manufacturer and do not utilize a heat shrunk, pressed in stator assembly. Thermal switches set to open at 120°C shall be embedded in the stator lead coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with supplemental to external motor overload protection and shall be connected to the control panel. The motor shall be NEMA design B and designed for continuous duty, capable of sustaining a minimum of 10 starts per hour. No motor winding damage shall result from operating the pumping unit out of its liquid environment for extended periods of time.
- B. Pump motor cable installed shall be suitable for submersible pump applications and this shall be indicated by a code or legend permanently embossed on the cable. Cable sizing shall conform to NEC specifications for pump motors and shall be of adequate size to allow motor voltage conversion without replacing the cable. Unless otherwise noted, provide adequate cable to complete the installation shown on the drawings.

2.6 ACCEPTABLE PUMP MANUFACTURERS

- A. The Flygt Pumps
- B. Hydromatic Pumps

2.7 CONTROLS

- A. The pump station shall be provided with a NEMA 4X stainless steel starter panel, which shall be sized to accommodate starters and controls for specified pumps. The present pump size shall be as indicated in the pump

data sheet below. The starter panel shall consist of, but not be limited to, the following:

1. NEMA 4X stainless steel enclosure, with padlocking hasp and staple, and provided with matching stainless steel drip shield.
 - a. The bottom of the enclosure shall be provided with two 1/2-inch drains located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 17.
 - b. The top of the enclosure shall be provided with two 1/2-inch breathers located at opposite sides of the enclosure, similar to Crouse-Hinds No. ECD 16.
 - c. The enclosure shall be provided with an internal mounting panel and a swing-out panel.
 - d. The interior of the enclosure shall be provided with properly sized industrial grade corrosion inhibitors.
 - e. The enclosure shall be provided with thermostatically controlled, properly sized condensate heater. The heater shall be mounted on the lower portion of the enclosure internal mounting panel.
 - f. The enclosure shall be provided with a door limit switch actuated panel fluorescent light, which shall be similar in construction to Hoffman Catalog No. A-LFDA2.
 - g. All wiring within the enclosure shall be installed in a plastic wiring duct. Low level signal wiring shall not be mixed with high voltage (110 Volts AC or greater) wiring within the same duct.
 - h. All wiring within the enclosure shall be terminated at terminal blocks; splices shall not be permitted within the enclosure.
 - i. All conduit entry into the enclosure, originating from the wetwell, shall be sealed to prevent moisture and gas vapors from entering the enclosure.
 - j. All low level signal wiring (mA DC) shall be twisted shielded cable types.
2. The enclosure shall be sized to house all electrical equipment described herein, including, but not limited to the telephone dialer as specified herein.
3. The incoming power wiring shall be terminated at distribution lugs and shall be provided with voltage surge arresters to protect all equipment mounted within the enclosure from switching surges and lightning induced surges.
4. Power within the panel shall be distributed further through thermal magnetic circuit breakers and motor circuit protectors, which shall

be accessible from the front of the swing-out panel without opening the swing-out panel. Provide the following:

- a. A motor circuit protector for each pump starter.
 - b. A circuit breaker for a 480/120 Volt AC transformer (only if the incoming power is 480 Volts AC). The circuit breaker shall have a minimum interrupting rating of 25,000 Amperes.
5. If the incoming power is greater than 120/240 Volts AC, provide a transformer which shall step down the incoming power to 120 Volts AC. The transformer shall be high efficiency type, with 105° Celsius temperature class, extra regulation and low losses. The minimum size of the transformer shall be 1.0 KVA. The primary feeder of the transformer shall be protected by the circuit breaker described above. The transformer shall be sized to provide power to all 120 Volt AC loads listed below.
6. The 120 Volt AC power within the enclosure shall be further distributed through single pole, 15 Ampere circuit breakers, with 10,000 A.I.C. A dedicated circuit breaker shall be required for each of the following items:
- a. Motor control circuit.
 - b. Panel light and thermostatically controlled enclosure heater described above.
 - c. Convenient receptacle.
 - d. An alarm beacon light fixture.
 - e. A telephone dialer.
7. Provide a duplex convenient receptacle unit, which shall be mounted within the starter enclosure, accessible from the front of the swing-out panel. The receptacles shall be 15 Ampere, GFI (Ground Fault Interrupting) types.
8. Each starter power feed shall be provided with magnetic only motor circuit protector. The motor circuit protectors shall be as follows:
- a. They shall be provided with adjustable instantaneous trips.
 - b. As a minimum, they shall be rated 25,000 A.I.C. (Amperes Interrupting Capacity). The size, voltage and configuration shall be as required.
 - c. The motor circuit protectors shall be accessible from the front of the swing-out panel without opening the swing-out panel.

9. Motor starters shall be NEMA rated, full-voltage, non-reversing type. I.E.C. rated motor starters shall not be acceptable. The starters and thermal overloads shall be sized according to the motor nameplate data.
10. Provide a duplex pump alternator, which shall automatically sequence the operation of the pumps.
11. Control devices shall be industrial grade oiltight and watertight types. Each pump shall be provided with the following controls, which shall be visible from the front of the swing-out panel, with the enclosure door opened:
 - a. An H-O-A selector switch.
 - b. An amber "FAIL" pilot light.
 - c. An amber "SEAL FAILURE" pilot light.
 - d. A red motor "RUN" pilot light.
 - e. A green motor "OFF" pilot light.
 - f. A "RESET" push button.
 - g. A non-resettable elapsed time meter.
12. Each starter shall be provided with the following:
 - a. A minimum of two sets of normally open starter auxiliary contacts.
 - b. A minimum of two sets of normally closed starter auxiliary contacts
 - c. One set of normally open auxiliary overload alarm contacts.
13. Control circuits shall be designed such that the pump station will operate as follows:
 - a. When the H-O-A selector switch is in the "H" position, the pump motor shall run.
 - b. When the switch is in the "O" position, the pump motor shall be off.
 - c. When the switch is in the "A" position, the pump shall operate automatically as described below.
 - d. The amber "FAIL" light shall be energized when the starter thermal overload relay trips, or when the motor winding temperature detector trips.
 - e. The amber "SEAL FAILURE" light shall be energized when the seal failure contacts trip.

14. Pump motors shall be provided with motor high winding temperature and seal failure detector.
 - a. The detector circuit shall shut down the motor and energize the pump "FAIL" pilot light when the motor winding temperature detector trips. The motor shall remain shut down until its' associated "RESET" push button is depressed.
 - b. The detector circuit shall energize the "SEAL FAILURE" pilot light when the seal failure detector trips. The seal failure detector shall automatically reset when moisture is no longer detected in the motor housing.
 15. The following single-pole double-throw (SPDT) dry contacts shall be provided for remote monitoring purposes:
 - a. Pump failure status of each pump motor, which shall include the following conditions:
 - (1) Starter thermal overload.
 - (2) Motor winding temperature high.
 - (3) Seal failure.
 - b. Wet well high level condition, which shall include contacts from the high level float switch and from the electronic pump controller high level alarm.
 - c. Level sensor failure from the electronic pump controller.
 16. Their wiring shall be terminated at terminal blocks, grouped and dedicated to remote monitoring.
 17. The system shall be provided complete with electro-mechanical relays as necessary to achieve the intended operation as described herein.
- B. The pump station shall be provided with the following types of level control systems:
1. Pump station less than 15 feet in depth shall be provided with four float switches, to control the pump operation:
 - a. High level alarm float switch.
 - b. Start lag pump float switch.
 - c. Start lead pump float switch.
 - d. Low level shutdown float switch.

2. Pump station deeper than 15 feet in depth shall be provided with the following pump control systems;
 - a. High level alarm float switch.
 - b. Low level shutdown float switch.
 - c. Submersible hydrostatic pressure type level sensor.
 - d. Electronic pump controller.
- C. The pump station shall be provided with float switches, which shall be constructed as follows:
1. The float switches shall be watertight, encapsulated mercury switch type, encased in a chemical-resistant polypropylene casing.
 2. Each float switch shall be suspended on its own cable, which shall be long enough to reach the bottom of the wet well. The switch shall be weighted with enamel coated cast iron weight to permit the float to pivot for proper operation.
 3. All installation hardware shall be of 316 stainless steel.
 4. The float switch elevations shall be adjustable over the entire wet well depth.
 5. The pump station shall be provided with a high level alarm float switch and a low level emergency shutdown float switch.
- D. The pump station shall be provided with a submersible hydrostatic pressure type level sensor and an electronic pump controller. The system shall be constructed as follows:
1. The hydrostatic pressure type level sensor shall be submersible type, suspended on its cable, which upper end shall be secured as shown on the drawings.
 2. The level sensor shall be mounted on pipe assemblies as shown on the drawings.
 3. The level sensor tip shall be suspended not lower than 12 inches above the wet well floor.
 4. The level sensor shall be as follows:
 - a. The sensor range shall be selected based on the wet well depth.
 - b. The sensor output shall be 4 to 20 mA DC proportional to water level, 2-wire type, with loop power supply of 12 to 40 Volts DC.
 - c. All exposed parts shall be constructed of 316 Stainless Steel
 - d. The sensor shall be filled with Silicon Oil

5. The electronic pump controller shall be mounted in the starter panel enclosure, and shall be visible from the front of the swing-out panel, with the enclosure door opened. The electronic pump controller shall be as follows:
 - a. The electronic pump controller shall accept a 4 to 20 mA DC, 2-wire level signal, and shall indicate the wet well level digitally in direct engineering units (feet).
 - b. The unit shall provide a minimum of four pump control outputs, with independent adjustment for each starting and stopping setpoint. Each level setpoint shall be indicated digitally in direct engineering units.
 - c. In addition to the pump control outputs, the unit shall provide outputs for the following points:
 - (1) High Water Alarm
 - (2) Low Water Alarm
 - (3) Level Sensor Failure or signal loss
 - d. A built-in adjustable time delay for each actuation point shall be provided to permit level signal to stabilize before control actions are initiated.
 - e. Power to the unit shall be 120 Volts AC.
 - f. Interposing relays shall be provided for each control output, to provide signal isolation.
 - g. The electronic pump controller shall be ESSEX Engineering Corporation, model 2410, or equal.

E. PUMP AUTOMATIC OPERATION

1. When the pumps are in the automatic mode, (their mode selector switches are in the "A" position), the pumps shall alternate through the following sequence: lead and lag. The level setpoints at which each pump starts and stops in sequence shall be field adjustable through the front panel of the electronic pump controller.
2. The station shall be provided with a back-up high level alarm float switch. When level in the wet well rises to the float elevation, both pumps shall be forced to run.
3. The station shall be provided with back-up low level shut down float switch. When level in the wet well falls to the float elevation, the switch shall open, both pumps shall be forced to shut down.

F. Provide an alarm beacon light, which shall be energized on high water alarm condition only. The alarm beacon light shall be as follows:

1. The beacon light shall be watertight, suitable for outdoor installation and provided with a red lense.
2. The light source shall be high intensity strobe type, with light intensity of 1,000,000 (1-million) peak candle power.
3. The beacon light shall be mounted on top of the starter panel enclosure using water tight conduit hub, similar to Myers ST-1, T&B 401, or OZ-Gedney CHM-50T.

G. Acceptable Manufacturers:

1. Motor starters and control components: Allen Bradley.
2. Circuit breakers and motor circuit protectors: Square "D".
3. Electronic pump controller: ESSEX Engineering Corporation, Model 2410.
4. Level sensor:
 - a. Ametek, model 575, or
 - b. Delta Controls Corporation.
5. Beacon light: Federal Signal "Fireball 2".
6. Alternator: Furnas.

2.8 AUTOMATIC TELEPHONE DIALER

A. The automatic telephone dialer shall be a microprocessor based unit, which, upon an alarm condition, shall be able to automatically dial user preprogrammed telephone numbers, and annunciate the alarm condition in digitally prerecorded users voice.

B. The automatic telephone dialer shall have the following features:

1. Digital, tapeless, user voice recording system, through a built-in microphone. Users prerecorded alarm messages shall be stored in solid-state, non-volatile memory. Length of recorded message per alarm point shall be 8 seconds or better.
2. Capable of annunciating the status of at least eight (8) digital inputs (8 channel). Each channel shall be able to totalize the number of contact closures.
3. In addition to external inputs, it shall be capable of annunciating AC power failure.

4. Provided with battery backup system, which shall be sufficient to allow the dialer to perform its alarm call-out function for a minimum of 12 hours upon loss of primary AC power.
5. Upon an alarm condition, it shall be capable of dialing the first of up to sixteen (16) user-programmed telephone numbers. The unit shall be capable of storing 8 lists of 8 telephone numbers, or 4 lists of 16 telephone numbers.
6. The unit shall be capable of detecting a busy signal, at which point it shall abort the call and wait for a minimum of 15 seconds before attempting to call subsequent telephone numbers. If the dialer detects a ring back signal, it shall wait between 30 and 60 seconds for the call to be answered.
7. The unit shall be capable of responding to a phone generated alarm acknowledgment tone, at which point it shall cease the dialing process, and wait for a period of user-programmed time (from 1 to 9,999 minutes) for the alarm conditions to be corrected. If this period of time elapses and the alarm conditions still exist, the dialer shall begin the alarm notification cycle again.
8. Housed in a NEMA 4X fiberglass enclosure with windowed door
9. The dialer shall meet FCC Part 68 and FCC Part 15 requirements and shall have a valid FCC registration number as described in Part 68.
10. The unit shall be provided with electrical surge and lightning protection on its telephone input, AC power input and each digital input. The unit shall have been tested by a nationally recognized testing laboratory to meet ANSI C37.90 requirements.

C. The telephone dialer shall be programmed to annunciate the following:

1. Station identification: "THIS IS THE (INSERT) LIFT STATION IN GREENSBURG"
2. Alarm conditions:
 - a. "WETWELL HIGH WATER LEVEL"
 - b. "PUMP NUMBER 1 FAILURE"
 - c. "PUMP NUMBER 2 FAILURE"
 - d. "LEVEL SENSOR FAILURE"
 - e. "DIALER POWER FAILURE"
3. Status (only when queried):
 - a. "PUMP NUMBER 1 IS ON (or OFF)"
 - b. "PUMP NUMBER 2 IS ON (or OFF)"

- D. The telephone dialer shall be ADAS Dialog Plus, by KAYE Instruments, Inc, or approved equal.

2.9 PIPING MATERIALS

- A. Ductile iron pipe shall meet the requirements of ANSI Specification A21.51 (AWWA Standard C151). Design and manufacture pipe for a working pressure of 150 psi plus 100 psi surge and a safety factor of 2 and a depth of cover indicated on the drawings and specified in this Section. Minimum thickness class shall be 350.
- B. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Restrained joints shall be Lok-Ring, Lok-Fast, Lok-Tyte, or equal.
- C. Fittings shall be cast iron or ductile iron. Fittings shall meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi. Fitting joints shall be mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA A21.11/C111. Thrust blocking or restrained joints may be as required or necessary.
- D. Gate valves 4-inch and larger shall be full ductile iron body, epoxy fusion bounded inside and out, non-rising stem gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509 and shall have mechanical joint ends. Exposed bolts and nuts shall be stainless steel. Joint accessories shall meet the requirements of ANSI/AWWA C11/A21.11. Valve opening direction shall be counter-clockwise.
 - 1. Gate valves 4-inch and larger installed in structures shall be full ductile iron body, outside screw, and yoke gate valves. Valves shall meet the requirements of ANSI/AWWA C500 or C509, except those parts of ANSI/AWWA C500 or C509 only applicable to non-rising stem gate valves and wrench nuts. Outside screw and yoke gate valves shall have flange joint ends and malleable iron handwheels. Flange joints and accessories shall meet the requirements of ANSI/AWWA C110. Nuts and bolts shall be stainless steel. Gaskets shall be full face and shall be red rubber or equal.
 - 2. Gate valves shall be as manufactured by Waterous, U.S. Valve, or equal.
- E. Single disc, swing check valves, 4-inch and larger, shall be used in sewage pump stations and shall be iron body, bronze-mounted, swing check, bolted cover, flanged ends, 125 psig working pressure, AWWA

Standard C508, suitable for use in a horizontal position. Flanges shall conform in dimensions and drilling to ANSI B16.1.

1. Swing check valves shall have outside weight and lever.

2.10 CONCRETE WET WELL AND VALVE VAULT

- A. The Contractor shall furnish and install a monolithic concrete or precast manhole type wet well as indicated on the drawings. Pump and related equipment shall be installed and/or mounted as shown.
- B. A concrete valve vault shall be furnished and installed to house the valves and appurtenances.
- C. Precast manhole sections shall conform to requirements of ASTM Specification C478.
- D. Contractor may offer wet well sections conforming to ASTM C-76, Class IV, Wall B pipe sections if shown on the drawings.

2.11 ALUMINUM COVERS

- A. Frame shall be 1/4-inch extruded aluminum with built-in neoprene cushion and with strap anchors bolted to exterior. Cover leaf shall be 1/4-inch aluminum reinforced with aluminum stiffeners as required. Stainless steel hinges shall be bolted to underside and pivot on all stainless bolts and hardware shall be used. The cover shall open to 90 degrees and lock automatically in that position. A vinyl grip handle shall be provided to release and close the cover with one hand. Covers shall be built to withstand a live load of 150 pounds per square foot, and equipped with a snap lock and removable handle. When closed, covers shall not protrude above the operating surface in which they are installed. Factory finish shall be aluminum lacquer. Surface contacting concrete shall have bituminous coating.
- B. Covers shall be diamond pattern plate.
- C. Aluminum covers shall be Bilco Type K or KD, Durred Products Type SLA, DLA or TLA, or equal.
- D. When flush mounted covers are furnished, provide two wrenches for opening covers.
- E. Valve vault cover shall be water tight with drain system.

- F. The Contractor shall provide padlocks for new wet well and valve vault covers. The locks shall be keyed alike with a lock provided by the Owner.

PART 3 - EXECUTION

3.1 INSPECTION

Inspect all pumps, motors, and appurtenances prior to installation in the work. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with new, undamaged and suitable products.

3.2 INSTALLATION

- A. Install the submersible pumps in accordance with the drawings and manufacturer's written instructions.
- B. The discharge elbow of each pump shall be securely anchored to the wet well base and properly aligned with the guide system and upper guide bracket.
- C. The discharge piping shall be properly anchored and supported inside the manhole.
- D. All electrical work shall be done by a qualified electrician and shall conform to the National Electric Code.

3.3 TESTING

Each pump shall be fully tested in accordance with manufacturer's written instructions. Certified copies of the test results shall be furnished with each pumping unit. Record the test voltage and amperage measurements.

3.4 WARRANTY

- A. The pump manufacturer shall warrant the pumps being supplied to the Owner against defects in workmanship and materials for a period of five years under normal use, operation, and service. In addition, the manufacturer shall replace certain parts which shall become defective through normal use and wear or a progressive schedule of cost for a period of five years; parts included are the mechanical seal, impeller, pump housing, wear ring, and ball bearings. The warranty shall be in published form and apply to all units. The warranty shall not start until the equipment has been placed in operation for beneficial use as determined by the Owner.

- B. The manufacturer shall provide the services of a factory trained representative for a period of one day at each lift station to perform initial start-up of the pumping station, to instruct operating personnel in the operation and maintenance of the equipment, and to demonstrate satisfactorily the performance of each piece of equipment.
- C. All equipment supplied and installed under this item of the specifications shall meet the requirements of the Occupational Safety & Health Act of 1970.

PART 4 - FIGURES

4.1 STANDARD DETAILS

<u>FIGURE</u>	<u>DESCRIPTION</u>
LS-1	Sanitary Lift Station - Plan, sections and Details
LS-2	Sanitary Lift Station - Electrical Details

SUBMERSIBLE LIFT STATION DATA SHEET

1. GENERAL INFORMATION

- A. Lift Station Name: _____
- B. Application: Wastewater
- C. Location: _____

2. OPERATING CONDITIONS

- A. Pumping Temperature Range: 55°-70°F
- B. Vapor Pressure: 1 psig
- C. Product Handled: Domestic Wastewater
- D. Suction Head: _____

3. PUMP CHARACTERISTICS

<u>Flow Rate (gpm)</u>	<u>Total Dynamic Head (Feet)</u>	<u>Efficiency (%)</u>
------------------------	----------------------------------	-----------------------

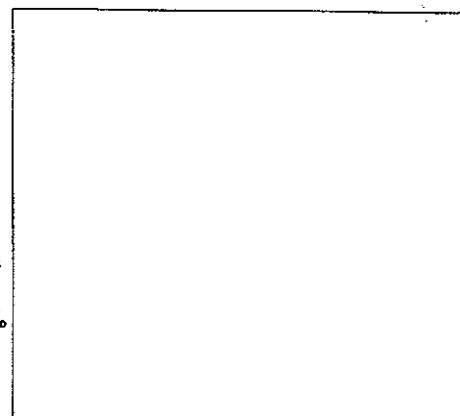
(List three or four points on pump curve)

4. PUMP DATA

- A. No. of Pumps: _____
- B. Type: Submersible Non-Clog
- C. RPM: _____
- D. Discharge Size: _____
- E. Motor HP: _____
- F. Motor Electrical Data: _____
- G. Manufacture & Model: _____

5. AVERAGE DESIGN FLOW: ____ gpm
6. WET WELL: 6'-0" Diameter
7. PUMP OPERATING RANGE: _____
8. AVERAGE WET WELL DETENTION TIME: _____

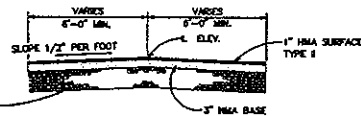
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NO SCALE

DESIGN BY LADDER MANUFACTURER

SCALE: 1"=1'-0"

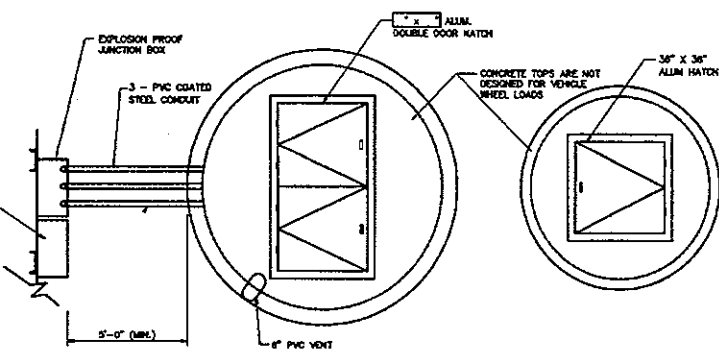


SCALE NONE



TEAM MEMBER

1. VALVE MUST BE CONTRICTED ON UNDISTURBED SOIL
2. NON-SHOCK CIRCUIT SHALL BE USED AROUND ALL PIPES WHERE EXTENDING THROUGH WALLS.
3. ALL WATER PIPING SHALL BE COATED WITH THERMITE BY HOT EPOXY OR EQUAL.
4. ALL ANCHOR BOLTS, EXPANSION BOLTS ETC. SHALL BE 304 S.S.
5. SEE SHEET NO. LS-2 FOR ELECTRICAL AND CONTROL INFORMATION.
6. INSTALL A "RED VALVE" PRESSURE SENSOR SERIES 40 OF FORCE MANN, PLACE AN ASBESTOS TUBE 10" LONG STL. STL. 4 1/2" PRESSURE GAUGE & VALVE ON PRESSURE SENSOR. THE PRESSURE GAUGE SHALL HAVE A RANGE AND VALVE FROM 0 TO 75 PSI.
7. THE HYDROSTATIC PRESSURE SYSTEM SHALL BE USED FOR LIFT STA. THAT EXCEEDS 15' DEEP INFLU OF FLOAT CONTROL. SEE SPECIFICATIONS.
8. INSTALL RETRACTABLE SAFETY POST ON ALUMINUM LADDERS.
- PUMP STA. CONTROL. SEE DETAIL



STARS: 1000000

DESIGNER	
DRAFTING	
PROJ. ENGR.	
PROJ. MGR.	

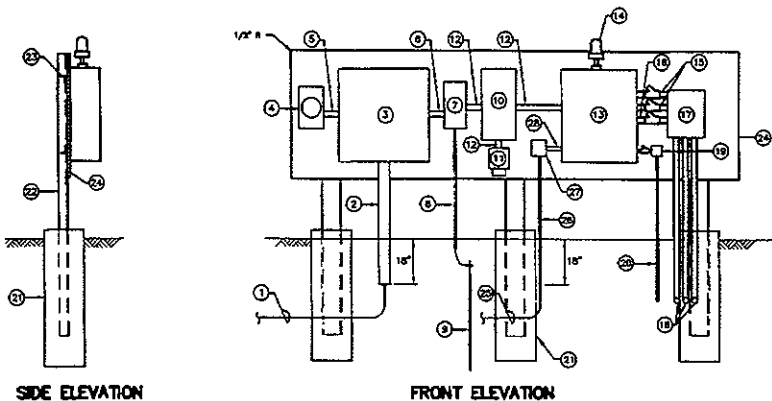
BY _____
DATE _____

HNTB
ARCHITECTS ENGINEERS PLANNERS
HNTB CORPORATION
111 Monument Circle, Indianapolis, Indiana 46204-5170

JOE NO.
12345-PL -001-001
DATE APR 2001

CITY OF GREENSBURG, INDIANA
STANDARD CONSTRUCTION DETAILS
SANITARY LIFT STATION
PLANS, SECTIONS AND DETAILS

SHEET NO.
LS-1

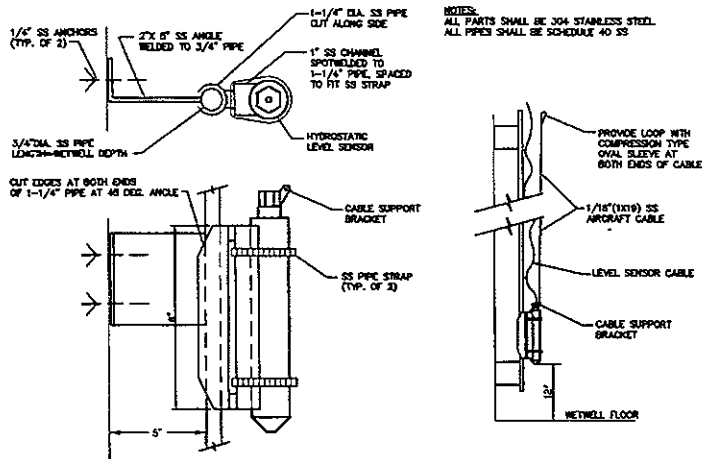


PUMP STATION CONTROL PANEL INSTALLATION DETAIL

NOT TO SCALE

CONCRETE FOOTING DETAIL

SCALE: 1/2\"/>



LEVEL SENSOR MOUNTING BRACKET DETAIL

SCALE: NONE

GENERAL NOTES:

- A. THE AREA AROUND THE LIFT STATION SHALL BE CLASSIFIED AS A HAZARDOUS LOCATION. ANY SPACE WITHIN 3' (ANY DIRECTION) FROM A VENT IS CLASSIFIED AS CLASS I, DIVISION 1, GROUPS C & D WITH THE SPACE FROM 3' TO 5' FROM A VENT CLASSIFIED AS CLASS I, DIVISION 2, GROUPS C & D. IN ADDITION, ANY SPACE EXTENDING OUTWARD 3' PAST THE EDGE OF ANY HATCH OPENINGS IN THE TOP OF THE STRUCTURE TO A HEIGHT OF 16\"/>

- B. THE DESIGN SHOWN ON THIS DRAWING IS BASED ON A MAXIMUM PUMP SIZE OF 15 HP.

KEYED NOTES:

- ① ELECTRICAL SERVICE CONDUCTORS TO BE INSTALLED BY CHEROKEE. SERVICE SHALL BE 480/277 VOLT, 3 PHASE, 4 WIRE.
- ② CONTRACTOR TO PROVIDE AND INSTALL AN EMPTY 4\"/>

VERIFY SCALES	SYMBOL	REVISIONS	BY	DATE	APPROVED
BAR IS ONE INCH ON ORIGINAL DRAWING.					
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.					

DESIGNER	
DRAWING	
PROJ. ENG.	
PROJ. MGR.	
BY	
DATE	

HNTB
ARCHITECTS ENGINEERS PLANNERS

HNTB CORPORATION
111 Monument Circle, Indianapolis, Indiana 46204-3179

JOB NO.	
22000-PL	
-001-001	
DATE	
JAN 2001	

CITY OF GREENSBURG, INDIANA
STANDARD CONSTRUCTION DETAILS
SANITARY LIFT STATION
ELECTRICAL DETAILS

SHEET NO.
LS-2