TOWN OF KERSEY, COLORADO

STANDARDS & SPECIFICATIONS for the Design and Construction of Public Improvements



2015

Prepared by:





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DETAILS

ROADWAY

STORM DRAINAGE

WATER

SEWER



SECTION 1: INTRODUCTION

1.1 INTRODUCTION

The Engineering Standards regulate both public improvements and private work that will be either dedicated to or accepted by the Town. In addition, all work within the public ROW is governed by these regulations. They are intended to provide for coordinated modern development with adequate facilities to serve and protect the users.

The Engineering Standards are meant to apply to new developments which are not constrained by already existing improvements. However, since infill development in areas is often constrained when matching existing improvements, to the extent deemed possible by the Town Engineer, infill developments shall match these Engineering Standards. The Town Engineer may allow modification of these Standards when necessary to allow private and public construction that is compatible with surrounding in-place improvements.

These Engineering Standards may also be used in conjunction with the Town's zoning regulations and subdivision ordinances for site development work on private property.

These Engineering Standards must be used on all public improvement projects and private work which will be either dedicated to or accepted by the Town.



SECTION 2: ENGINEERING PLAN/REPORT SUBMITTALS

2.1 GENERAL INFORMATION

The Town of Kersey is responsible for the health, safety and welfare of the public within the Town ROW. Therefore, the Town Engineer has established and the Town BOARD has adopted construction standards and engineering reviews for proposed developments.

With the establishment of engineering reviews for proposed developments, developers are required to submit plans/reports for review. The developer is encouraged to have his engineer meet with the Town Engineer so that the project's technical aspects can be discussed prior to submitting plans. The submittals which may be required and their intent are as follows:

SUBDIVISION IMPROVEMENT AGREEMENT (SIA) – A subdivider of any land in the Town of Kersey is required to enter into an agreement with the Town of Kersey to guarantee the construction of all required improvements, including streets, curb and gutters, driveways, sidewalks, storm drainage systems, potable water systems, street lights, and landscaping.

GRADING PLANS – This submittal Details the overlot grading proposed for the site and should include significant features such as retaining walls and grades matching to adjacent properties. These are typically done with the drainage plans unless a separate overlot grading permit is desired.

PHASE I DRAINAGE REPORT – This report identifies and defines drainage problems and conceptually addresses the proposed drainage system including storm detention requirements and impacts on adjacent properties.

PHASE II DRAINAGE REPORT – This report contains construction documentation of the approved conceptual drainage system including engineering calculations and impacted adjacent property owner approvals, if required by the Town.

PHASE III DRAINAGE REPORT – This report updates the concepts and presents design Details for the drainage facilities discussed in the Phase II Drainage Report.

CONSTRUCTION PLANS – These are construction documents for the public improvements on the project. They include public and private street plans and drainage elements within easements or the public ROW water and sanitary sewer. They also may include signing, pavement marking and traffic signal plans.

PAVEMENT DESIGN REPORT – This documents the soil conditions and proposed pavement installation with the structural cross-sections for both parking lots and streets.

RETAINING WALL DESIGN REPORT – This report provides construction documents with all supporting engineering calculations necessary for retaining wall installations that are thirty inches (30") or more above finished grade.



These submittals are reviewed by the Town Engineer in conjunction with other Town staff to ensure conformance with Town Standards. All submittals are to be prepared by a Professional Engineer registered in the State of Colorado.

2.2 NUMBER OF SUBMITTALS

Three (3) sets of plans/reports are required on each initial submittal. If additional sets are needed for agency referral reviews, the applicant will be contacted by the Town Engineer.

Upon approval, electronic and/or additional copies of the submittal may be required. The applicant will be contacted by the Town Engineer regarding this.

A transmittal letter should accompany each submittal, giving pertinent information such as review desired and contact person.

2.3 APPROVED PLANS/REPORTS

Plans and/or reports must be approved prior to initiation of any construction activities. Approved plans and/or reports will be valid for two (2) years from the date of approval.

Review is for general compliance with Town of Kersey Engineering Standards and requirements. The Town of Kersey is not responsible for the correctness of design, dimensions, Details, quantities, or safety during construction.

2.4 DRAFTING/REPORT STANDARDS

All reports submitted for review must be type-written and legible. All drawings submitted for review shall be on 24" x 36" plan sheets.

2.5 STATE HIGHWAYS

Whenever a project is proposed on or adjacent to a state highway, the developer must coordinate the review of the project with the Colorado Department of Transportation (CDOT). The developer is also responsible for submitting all access permits to the Department once final construction plans have been approved by the Town Engineer.

Construction activities on state highways will be governed by CDOT's Standards, and inspection will be undertaken by the CDOT's inspections.

2.6 OTHER AGENCIES

Depending on the project's location, the Town may also refer the plans for review and comments to other agencies. Those agencies include: Army Corps of Engineers, State Engineer's Office, Colorado Department of Public Health and Environment, Weld County, Public Utility Companies, Central Weld Water District, and Fire Protection Districts. The proposed project's location and improvement plans will determine which agencies receive referrals.



2.7 PERMITS

The owner/developer is reminded of its responsibility to obtain all permits related to the design, approval, and construction of the development. Permits may be required from the following agencies:

- a. Army Corps of Engineers (Nationwide, 404)
- b. Colorado Department of Public Health and Environment (CDPHE)
- c. Federal Emergency Management Agency
- d. Colorado Department of Public Health and Environment

Final approval and signature of the engineering plans by the Town of Kersey, Platte Valley Fire Protection District, and any other public utility, may be required prior to commencement of any construction on the development. Final signatures on the plans shall be deemed "permit approval." A minimum of three (3) sets of plans shall be submitted for final signatures. The developer's contractor must have an approved set of plans on the project site at all times during construction.

2.8 CHECKLISTS

The following checklists are provided to assist in developing plans and reports which meet the Town's requirements for the specific submittal. Use of the checklists by designers has proven beneficial in speeding the Town review time for plan and report submittals.

The checklists include:

- a. Grading Plans
- b. Soils and Pavement Design Reports
- c. Street Construction Plans
- d. Retaining Wall Design
- e. Geologic and Mining Hazards Reports
- f. Drainage Report
- g. Sanitary Sewer Design
- h. Water System Design

DEVELOPMENT REVIEW CHECKLIST: GRADING PLANS

The Town of Kersey requires grading plans to detail overlot grading and document significant features such as retaining walls. Submittals are also necessary to ensure that on-site drainage is adequately handled and that the proposed development grading plans are compatible with adjacent property topography.



If the grading and drainage plans are being combined in one (1) submittal, the plan sheet should indicate this. Also, the grading plan checklist should be used in conjunction with the drainage report checklist in preparation of the plans.

The following checklist has been developed to assist in preparation of grading plans. It includes items pertinent for the Town 's review and reflects established professional engineering practice for preparation of grading plans. If you have any question regarding items on this list, please call the Town Engineer.

GENERAL NOTES

The general notes included with this checklist are to be used on grading plan submittals. This list of general notes is not intended to be all-inclusive for every project; therefore, additions may be appropriate.

APPROVAL BLOCK

II.

The approval block on the last page of this checklist must be on all grading plan sheets. It should be placed as close as possible to the title block in the lower right corner of the sheet.

I. PLAN SHEET FORMAT

		<u>PRESENT</u>	<u>COMMENT</u>
a. b. c. d. e. f. g. h. i. j. k. l. m. o.	Scale: 1" = 50' or larger North arrow Title Block Vicinity Map 1" = 500' Contour Lines (2' maximum intervals) 24" x 36" plan sheets Original and Revision Dates Dated, checked, sealed and signed by a Professional Engineer Legend Street names, dimensions and grades Match lines and sheet numbers Approval block General notes Bench mark description and elevation (must be USGS) Baseline or control line		
<u>PRE</u>	SENT SITE CONDITIONS		
		PRESENT	<u>COMMENT</u>
a. b.	Existing site topography extending a minimum of 50 feet past property limits		
D.	Existing features Easements and ROWs 		



III.

IV.

TOWN OF KERSEY, COLORADO STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

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	2. All utilities		
	3. Drainage ways with 100-year flood plain and floodway limits		
	 Irrigation ditches or laterals 		
	5. Buildings, fences, retaining walls, trees and other physical features		
<u>PRO</u>	POSED SITE CONDITIONS		
		PRESENT	<u>COMMENT</u>
a.	Proposed contours match to existing contours		
b.	Drainage flow arrows		
C.	Grade breaks and slopes Banks indicated on plan		
d.	Cut and fill areas and quantities		
e.	Proposed improvements 1. Sidewalks, bikepaths and other public		
	1. Sidewalks, bikepaths and other public improvements		
	 Driveway grades and dimensions 	·	
	3. Storm drainage structures		
	4. Fences, retaining walls and other physical site		
	improvements (cross-sections may be		
	necessary to detail these features)		
	5. Lowest finished floor elevations for all buildings		
f.	Erosion Protection		
g.	Limits of Grading		
<u>STAI</u>	IDARD DETAILS		
		PRESENT	COMMENT
a.	Town or CDOT standard Details referenced where		
<u>.</u>	applicable		
b.	Where Town or CDOT Standards cannot be used, Details in the plans		

GENERAL NOTES

- Grading plan is for rough grading only. Changes may be necessary to bring plan into conformance with approved Final Drainage Plan and Site Plan. 1.
- 2. Water truck, if called for by the Town Inspector, will be provided by the contractor to keep wind erosion in check.
- 3. Any settlement or soil accumulations beyond the property limits due to grading or erosion shall be repaired immediately by the contractor.
- 4. No grading shall take place in delineated Flood Hazard Areas until the Final Drainage



Plan has been approved and all appropriate permits have been obtained.

- 5. Any construction debris or mud tracking in the public ROW resulting from this development shall be removed immediately by the contractor. The contractor shall immediately fix any excavations or excessive pavement failures caused by the development and shall properly barricade the site until construction is complete. Failure by the contractor to correct any of the above within twenty-four (24) hours of written notice by the Town shall cause the Town to issue a stop work order (red tag) and/or do the work and make a claim against the letter of credit for any cost incurred by the Town .
- 6. Areas being disturbed by the grading shall be reseeded with native vegetation or as approved on the development plan.
- 7. It shall be the responsibility of the developer during construction activities to resolve construction problems due to changed conditions or design errors encountered by the contractor during the progress of any portion of the proposed work. If, in the opinion of the Town Inspector, the modifications proposed by the developer to the approved plans involve significant changes to the character of the work or to future contiguous public or private improvements, the developer shall be responsible for submitting revised plans to the Town of Kersey for approval prior to any further construction related to that portion of the work. Any improvements constructed not in accordance with the approved plans, or the approved revised plans, shall be removed and the improvements shall be reconstructed according to the approved plans.
- 8. The contractor shall be solely and completely responsible for conditions at and adjacent to the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.

The duty of the Town to conduct construction review of the contractor's performance is not intended to include review of the adequacy of the contractor's safety measures in, on, or near the construction site.

9. Utilities contractors shall contact the Utility Notification Center of Colorado (UNCC) for location of underground gas, electric, and telephone utilities at least forty-eight (48) hours prior to commencement of construction. Call 811.

APPROVAL BLOCK

ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL O TOWN OF KERSEY ENGINE AND REQUIREMENTS. THE NOT RESPONSIBLE FOR TH DESIGN, DIMENSIONS, DET DESIGN SAFETY.	ERING STANDARDS TOWN OF KERSEY IS IE CORRECTNESS OF
	TOWN ENGINEER	DATE



THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL. RESUBMITTAL TO THE TOWN IS REQUIRED AFTER THAT TIME PERIOD.



DEVELOPMENT REVIEW CHECKLIST: SOILS AND PAVEMENT DESIGN REPORT

The Town of Kersey requires pavement design reports for proposed streets and parking lots. The reports are to include the soils information necessary to substantiate the proposed pavement design.

The Colorado Department of Transportation (CDOT) methodology is accepted for both rigid and flexible street pavement designs. For parking lots, the Asphalt Institute or Portland Cement Association methodologies are also accepted in lieu of CDOT methodology. In no case shall flexible pavement sections be less than three-quarter-inch (¾") HBP on eight-inch (8") A.B.C. Rigid pavement sections shall not be allowed.

The following checklist has been developed to assist in preparation of soils and pavement design reports. It includes items pertinent for the Town 's review and reflects established professional engineering practice for pavement design. If you have any questions regarding items on this list, contact the Town Engineer.

APPROVAL BLOCK

The approval block shown on the last page of this checklist must be on the title page of the submittal.

I. <u>REPORT FORMAT</u>

			PRESENT	<u>COMMENT</u>
	a. b. c. d.	Title page with project address and approval block 8½" x 11" report, bound or in a folder Dated, checked, signed and sealed by a Professional Engineer (both soils and pavement if done by different parties) Original and revision dates		
II.	SOIL	S INFORMATION		
			PRESENT	<u>COMMENT</u>
111.	a. b. c. d. e. f. g. h. DES	Boring locations on site plan Boring logs Gradation tests Atterberg limits Compaction tests Percent swell* Soils classification (AASHTO) Problem areas on the site		
	DES			
			<u>PRESENT</u>	<u>COMMENT</u>



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		PRESENT	<u>COMMENT</u>
a.	Roadway classification		
b.	Forecast traffic volumes		
C.	Construction traffic forecast		
d.	18 KIP EDLA or DTN		
e.	Serviceability index		
f.	Regional factor		
IV. <u>PA</u>	VEMENT DESIGN		
		PRESENT	<u>COMMENT</u>
a.	Weighted structural number		
b.	CBR Tests		
C.	Design CBR		
d.	R value		
e.	Subgrade properties		
f.	Town of Kersey pavement design nomographs		
g.	Base course		
h.	Pavement		
i.	Alternatives		

V. CONSTRUCTION MEETINGS

- Utility trench test a.
- Subgrade test b.
- Curb, gutter and sidewalk test C.
- d. Base course test
- Pavement test e.
- f. Paving sequence
- Construction traffic control plan g.

*If percent swell exceeds one and one-half percent (1.5%), the report shall include the proposed method(s) to deal with swelling soil characteristics.

APPROVAL BLOCK

ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL COM TOWN OF KERSEY ENGINEERIN AND REQUIREMENTS. THE TOW NOT RESPONSIBLE FOR THE CO DESIGN, DIMENSIONS, DETAILS DESIGN SAFETY.	IG STANDARDS VN OF KERSEY IS ORRECTNESS OF	
	TOWN ENGINEER	DATE	
THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL. RESUBMITTAL TO THE TOWN IS REQUIRED AFTER THAT TIME PERIOD.			



DEVELOPMENT REVIEW CHECKLIST: STREET CONSTRUCTION PLANS

The Town of Kersey requires construction plan submittals on development projects when improvements are proposed within easements, public ROWs or on private streets. Plan submittals are required at two (2) points in the development process. The first is at the preliminary (functional) design stage, and the second is when plans are finalized.

The following checklist has been developed to assist in preparation of street construction plans. It includes items pertinent for the Town 's review and reflects established professional engineering practice for preparation of construction plans. If you have any questions regarding items on this list, please call the Town Engineer.

PRELIMINARY CONSTRUCTION PLANS

The purpose of the preliminary construction plan submittal is to allow the engineering staff and applicant to discuss the functional or preliminary design at an early stage in development. This will allow for a constructive discussion of the design submittal prior to initiation of the details required with final construction plans. The preliminary submittal should address the horizontally controlled plan elements plus any topographic details involving grade changes of three feet (3') or more that would require walls, slopes, utility relocations, etc. The preliminary submittal is also used for preparation of the Subdivision Improvement Agreement (SIA) and therefore must contain an approximate list of quantities for improvements within Town ROW or easements.

The items required on the preliminary plan submittal are indicated by an asterisk (*) on the following checklist.

FINAL CONSTRUCTION PLANS

The final construction plan submittal should be based on the approved preliminary plan. The submittal should be a complete and self-supporting plan set including all Details and documentation necessary for construction of the proposed improvements. Town of Kersey and CDOT Standards which are being used on the project can be referenced rather than detailed if desired.

GENERAL NOTES

The general notes included with this checklist are to be used on construction plan submittals. This list of general notes is not intended to be all-inclusive for every project; therefore, additions may be appropriate.

APPROVAL BLOCK

The approval block found on the last page of this checklist must be on all construction plan sheets. It should be placed as close as possible to the title block in the lower right corner of the sheet.



I. PLAN SHEET FORMAT

			PRESENT	<u>COMMENT</u>
	a.*	Scale: $1" = 50'$ horizontal or larger; $1" = 5'$ vertical		
	b.*	or larger North arrow		
	D. С.*	Title Block		
	d.*	Vicinity Map $1" = 500'$		
	e.*	24" x 36" plan sheets		
	f.*	Original and revision dates		
	g.*	Plans checked, sealed, signed and dated by a Professional Engineer		
	h.*	Legend		
	i.*	Street names and dimensions		
	j.*	Match lines and sheet numbers		
	k.* I.*	Approval block General notes		
II.	<u>HOR</u>	IZONTAL AND VERTICAL CONTROL		
			PRESENT	<u>COMMENT</u>
	a.*	Bench mark description and elevation (must be		
		Town of Kersey, USGS or NGS datum)		
	b.*	Section line or control line with ties to section corner		
	с.*	Beginning station tied and referenced to section		
		line or control line		
III.	<u>PLAN</u>	N REQUIREMENTS		
			PRESENT	<u>COMMENT</u>
	a.*	Existing improvements for the full width of the street up to 50' beyond the construction limits depicted by dashed (or screened) lines; proposed construction depicted by solid lines		
	b.*	Limits of construction noted		
	C.*	Location of proposed and existing property lines, easements, Town ROW, etc.		
	d.*	List of quantities (preliminary submittal only)		
	e.*	Existing utilities, proposed utilities and utilities to		
		be relocated (these may be on a separate plan		
	٤ *	sheet)		
	f.*	Locations of fixed objects (trees, poles, fences, etc.)		
	g.*	Proposed street improvements (sidewalk, curb and		
	э.	gutter, asphalt patch- back, etc.)		



	~			
			PRESENT	<u>COMMENT</u>
	h.*	Existing and proposed drainage structures (inlets, manholes, channels, outlet structures, etc.)		
	i.*	Curve layout including radius, length of curve, P.I. deflection angle, degree of curvature, P.C., P.T., and offsets		
	j.*	Proposed $1" = 50'$ striping and signing plan indicating lane width, etc.		
	k.*	Proposed 1" = 20' traffic signal plan		
IV.	<u>PRO</u>	FILE/CROSS SECTION REQUIREMENTS		
			PRESENT	<u>COMMENT</u>
	a.	Three (3) line profiles (centerline profile when not reflecting typical roadway section and flowlines) or centerline profile and cross sections every 50' extending a minimum of 50' beyond the project limits		
	b.	On widening/matching projects, 3 line profiles and cross sections every 25' extending a minimum of 50' beyond the project limits are required.		
	C.	Vertical curve data including length of curve, P.V.C., P.V.T., P.V.I., beginning and end grades		
	d. e.	Profiles for all curb returns Existing profile elevations extended 100' beyond the end/beginning of the project		
	f.	Cross sections extended 25' beyond property line		
V.	<u>STA</u>	NDARD DETAILS		
			PRESENT	<u>COMMENT</u>
	a.	Town or CDOT Standards referenced where applicable		
	b.	Where Town or CDOT Standards cannot be used, details on the plans		

GENERAL NOTES

- 1. All work within the public ROW or easement shall conform to the Town of Kersey Engineering Standards.
- 2. A Street Cut/Closure Permit for Work in Public Ways is required for all work in the public ROW, and any work performed within State ROW will also require a State construction permit.
- 3. It shall be the contractor's responsibility to notify the owner/developer of any problem in



conforming to the approved plans for any element of the proposed improvements prior to its construction.

- 4. It shall be the responsibility of the developer during construction activities to resolve construction problems due to changed conditions or design errors encountered by the contractor during the progress of any portion of the proposed work. If, in the opinion of the Town Inspector, the modifications proposed by the developer to the approved plans involve significant changes to the character of the work or to future contiguous public or private improvements, the developer shall be responsible for submitting revised plans to the Town of Kersey for approval prior to any further construction related to that portion of the work. Any improvements constructed not in accordance with the approved plans, or the approved revised plans, shall be removed and the improvements shall be reconstructed according to the approved plans.
- The Utility Notification Center of Colorado (UNCC) The Utilities contractor shall contact UNCC for location of underground gas, electric, and telephone utilities at least forty-eight (48) hours prior to commencement of construction. Phone 811.
- 6. All utility poles shall be relocated prior to beginning site work.
- 7. With notification to the Town, adjust rims of all cleanouts, manholes, valve covers and survey monuments to finish grade prior to final lift paving.
- 8. The contractor shall provide all lights, signs, barricades, flagmen or other devices necessary to provide for public safety in accordance with the current Manual on Uniform Traffic Control Devices.
- 9. The contractor shall provide ingress and egress to private property adjacent to the work throughout the period of construction. The contractor shall obtain written agreement from the affected property owners impacted by this access, prior to beginning work.
- 10. Prior to final placement of surface pavement, all underground utility mains shall be installed and service connections stubbed out beyond curb line when allowed by the utility. Service from public utilities shall be made available for each lot in such a manner that will not be necessary to disturb the street pavement, curb, gutter, and sidewalk when connections are made.
- 11. As-Built plans shall be submitted to the Town of Kersey per Section 12 of these Standards prior to Initial Acceptance of work.
- 12. The contractor shall notify the Town Inspector at least twenty-four (24) hours prior to desired inspection.
- 13. Survey Monuments must be set within sixty (60) days of completion of project.



APPROVAL BLOCK

ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL CON TOWN OF KERSEY ENGINEER AND REQUIREMENTS. THE TO NOT RESPONSIBLE FOR THE O DESIGN, DIMENSIONS, DETAIL DESIGN SAFETY.	ING STANDARDS OWN OF KERSEY IS CORRECTNESS OF	
	TOWN ENGINEER	DATE	
THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL.			
RESUBMITTAL TO THE TOWN IS REQUIRED AFTER THAT TIME PERIOD.			



DEVELOPMENT REVIEW CHECKLIST: RETAINING WALL DESIGN

The Town of Kersey requires retaining wall submittals for proposed retaining walls which exceed thirty (30") above the lowest finished grade and are on or near a property line, public ROW or public use area or impact the current grading or drainage characteristics on adjacent properties. This includes concrete, timber and rock walls.

The following checklist has been developed to assist in preparation of retaining wall submittals. It includes items pertinent for the Town 's review and reflects established professional engineering practice for design of retaining walls. If you have any questions regarding items on this list, contact the Town Engineer.

CALCULATIONS

Engineering calculations must be submitted with the construction drawings covering items noted in the checklist. If any commonly accepted "standard" wall design such as one from CDOT Bridge Standards is used, a copy of the design and the reference or source for the design can be submitted in lieu of calculations.

GENERAL NOTES

The general notes included with this checklist are to be used on retaining wall plan submittals. This list of general notes is not intended to be all-inclusive for every project; therefore, additions may be appropriate.

APPROVAL BLOCK

II.

The approval block shown on the last page of this checklist must be on the title page of the submittal.

I. <u>REPORT/PLAN FORMAT</u>

		<u>PRESENT</u>	<u>COMMENT</u>
a.	Title page with project address and approval block		
b.	8 ¹ / ₂ " x 11" Report and details on 24" x 36" plan sheet w/supporting calculations		
C.	Dated, checked, signed and sealed by a Professional Engineer		
d.	Original and revision dates		
e.	Site Plan with wall location (1" = 50' or larger)		
DES	IGN DATA		
		PRESENT	COMMENT
a.	Soils report and/or source of design data		
b.	Weight/Density soil, concrete, rock, timber		
C.	Allowable bearing pressure		
d.	Equivalent fluid pressure		
e.	Construction material strengths		



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		PRESENT	<u>COMMENT</u>
f.	Coefficient of friction		
g.	Adjacent ground surface slopes		
h.	Surcharge loadings		
I. <u>SYS</u>	TEM STABILITY CHECK		
		PRESENT	COMMENT
a.	Overturning factor of safety greater than 1.5	FRESENT	<u>COMMENT</u>
b.	Sliding factor of safety greater than 1.5		
С.	Bearing pressure less than allowable soil bearing		
	pressure		
d.	Footing base at or below 36" frost depth		-
e.	Slope Stability		
/. <u>PLA</u>	N REQUIREMENTS		
		DDECENT	
2	Existing improvements denicted by deshed (or	PRESENT	<u>COMMENT</u>
a.	Existing improvements depicted by dashed (or screened) lines; proposed construction by solid		
	lines		
b.	Limits of construction noted		
с.	Location of proposed and existing property lines,		
01	easements, etc.		
d.	Locations of fixed objects (trees, poles, fences, etc.)		
e.	Layout data		
	1. Profiles		
	2. Cross sections		
	Elevations with benchmark		
	4. Control line		
	5. Horizontal layout		
f.	Wall Dimensions		
WA	<u>L DETAILS</u>		
		PRESENT	COMMENT
a.	Concrete/Masonry		
	1. Reinforcing steel		
	2. Weep holes		
	3. Control/expansion joints		
	4. Type of concrete		
	5. Facing		
	Timber		
b.			
b.	1. Lumber Treatment		
b.			

TOWN OF KERSEY, COLORADO

STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

	 Tie backs/Anchors Batter 	PRESENT	<u>COMMENT</u>
C.	Stacked Rock 1. Base material 2. Rock sizes/shapes 3. Batter		
VI. <u>GR/</u>	ADING/DRAINAGE		
a. b. c. d. e.	Ground slope Backfill material Drainage system Contours Spot Elevations	<u>PRESENT</u>	<u>COMMENT</u>

GENERAL NOTES

- 1. A Building Permit is required for construction of retaining walls over thirty inches (30") tall.
- 2. UNCC The Utilities contractor shall contact 811 for location of underground gas, electric and telephone utilities at least forty-eight (48) hours prior to commencement of construction.
- 3. It shall be the responsibility of the developer during construction activities to resolve construction problems due to changed conditions or design errors encountered by the contractor during the progress of any portion of the proposed work. If, in the opinion of the Town 's inspector, the modifications proposed by the developer to the approved plans involve significant changes to the character of the work or to future contiguous public or private improvements, the developer shall be responsible for submitting revised plans to the Town of Kersey for approval prior to any further construction related to that portion of the work. Any improvements constructed not in accordance with the approved plans, or the approved revised plans, shall be removed, and the improvements shall be reconstructed according to the approved plans.
- 4. Copies of "As-Built" plans shall be submitted to the Town of Kersey prior to Initial Acceptance of work.
- 5. The contractor shall notify the Town Engineer least twenty-four (24) hours prior to desired inspection.



APPROVAL BLOCK

ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL CO TOWN OF KERSEY ENGINEER AND REQUIREMENTS. THE TO NOT RESPONSIBLE FOR THE DESIGN, DIMENSIONS, DETAIL DESIGN SAFETY.	ING STANDARDS OWN OF KERSEY IS CORRECTNESS OF		
	TOWN ENGINEER	DATE		
THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL. RESUBMITTAL TO THE TOWN IS REQUIRED AFTER THAT TIME PERIOD.				



DEVELOPMENT REVIEW CHECKLIST: DRAINAGE REPORT

The Town of Kersey requires drainage reports for proposed developments.

The following checklist has been developed to assist in preparation of drainage reports. It includes items pertinent for the Town 's review and reflects established professional engineering practice for drainage design. If you have any questions regarding items on this list, contact the Town Engineer.

APPROVAL BLOCK

The approval block shown on the last page of this checklist must be on the title page of the submittal.

I. <u>REPORT FORMAT</u>

			PRESENT	<u>COMMENT</u>
	a. b.	Title page with project address and approval block $8\frac{1}{2}$ " x 11" report, bound or in a folder		
	D. C.	Dated, checked, signed and sealed by a Professional Engineer (both soils and pavement if done by different parties)		
	d.	Original and revision dates		
II.	<u>GEN</u>	ERAL LOCATION AND DESCRIPTION		
			PRESENT	<u>COMMENT</u>
	a.	Location Map		
	b. c.	Existing Site Drainage Description of Existing Drainage		
111.	DESI	IGN CRITERIA		
			PRESENT	<u>COMMENT</u>
	a.	Major Basin Description		
	b.	Sub-Basin Description		
IV.	DRA	INAGE FACILITY DESIGN		
			PRESENT	<u>COMMENT</u>
	a.	Topographic Contours		
	b. c.	ROW and Easements Delineation of Basin and Sub-Basins		
	d.	Existing Drainage Patterns and Facilities		
	e. f.	Proposed Drainage Patterns and Facilities Proposed Outfall Points		
	1.			



<u>PRESENT</u>

<u>COMMENT</u>

- g. Routing of Offsite Drainage
- h. Routing from Site to Major

APPROVAL BLOCK

ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL COMPLI TOWN OF KERSEY ENGINEERING AND REQUIREMENTS. THE TOWN NOT RESPONSIBLE FOR THE CORI DESIGN, DIMENSIONS, DETAILS, Q DESIGN SAFETY.	STANDARDS OF KERSEY IS RECTNESS OF	
	TOWN ENGINEER	DATE	
THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL.			

THESE PLANS ARE VALID FOR TWO (2) YEARS AFTER THE DATE OF APPROVAL RESUBMITTAL TO THE TOWN IS REQUIRED AFTER THAT TIME PERIOD.



Π.

DEVELOPMENT REVIEW CHECKLIST: WATER PLANS

The purpose of this approval procedure check list is to familiarize all interested parties in the procedures followed by the Town concerning Town water plan approvals.

PLAN CHECK – CHECK LIST

The following information shall be included, where applicable, on all plans submitted to the Town Engineer.

Ι. **GENERAL UTILITY PLANS**

Cover Sheet	PRESENT	<u>COMMENT</u>
1. Name of Project		
2. Vicinity and location maps		
4. Sheet index		
Overall Utility (Water)		
1. Required notes (see attached sheets for examples of general notes, water main notes		
2. All street names		
3. North arrow and scale		
 Indicate individual sheet numbers for specific sections of lines to be shown on following sheets 		
5. Lot and block numbers and front lot dimensions		
6. A list of quantities for water materials		
Title Blocks		
2. Designed by, drawn by, checked by a Professional Engineer		
WATER PLANS		
	PRESENT	<u>COMMENT</u>
 An overall sheet is all that is required, provided the streets have been designed to be paved at finished grade and the water main is 12" or less in diameter. If the streets have not been designed to finish grade, the water main shall be shown in profile along with the existing ground and proposed finished grade. All water mains larger than 12" shall be profiled. All water mains of any size which are not under a 		
	 2. Vicinity and location maps 3. P.E. stamp and signature 4. Sheet index Overall Utility (Water) 1. Required notes (see attached sheets for examples of general notes, water main notes required by the Town) 2. All street names 3. North arrow and scale 4. Indicate individual sheet numbers for specific sections of lines to be shown on following sheets 5. Lot and block numbers and front lot dimensions 6. A list of quantities for water materials Title Blocks 1. Title, date, sheet number 2. Designed by, drawn by, checked by a Professional Engineer WATER PLANS Overall Sheet An overall sheet is all that is required, provided the streets have been designed to be paved at finished grade and the water main is 12" or less in diameter. If the streets have not been designed to finish grade, the water main shall be shown in profile along with the existing ground and proposed finished grade. All water mains larger than 12" shall be profiled. All water 	Cover Sheet



STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

	PRESENT	<u>COMMENT</u>
construction plans.		
-		
Water lines to be generally located north or		
east of street centerlines, with a minimum		
of 10' between sewer lines. The centerline		
of the water main shall be a minimum of 6'		
from lip of pan on the street side.		
3. Show station and label all fittings with top		
of pipe elevations, pipe distances		
(measured horizontally) between all fittings,		
valves, plugs, and size of pipe.		
4. Fire hydrants should be located on property		
line extensions if possible. 5. All valves shall be located at tees or	<u> </u>	
crosses for main line and fire hydrants.		
6. Indicate location of water lines from street		
centerlines or property lines.		
7. Minimum cover of pipe shall be noted on		
the plans.		
8. Length of restrained pipe, when and where		
required, shall be noted.		
9. Show linear feet of pipe of all fire hydrant		
laterals.		
10. The overall water sheet (or cover sheet)		
shall contain the following statement and		
appropriate signature"		
"All fire hydrants shall be installed according to		
Town Standards. The number and locations of		
the fire hydrants as shown on this water main		
installation are correct as specified by the Platte Valley Fire Protection District.		
(Signature of Fire Chief or Designated Representative		

Date Signed.

Note: If water plans are to be submitted to the Town Engineer for approval, "Town " in the above statement shall be followed by "and Town Engineer."

b. **Detail Sheet**

- 1. Compliance with applicable local government specifications.
- 2. Detail sheets to show blowoff assemblies, meter pits, thrust blocks, bedding, fire hydrant assemblies, curb stops, fire hydrant locations relative to property lines and walks, restraint details, etc.
- 3. Technical notes and installation instructions are

TOWN OF KERSEY, COLORADO STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS

Kersey (

c.

III.

 2015

 All plans submitted for review and approval by the Town Engineer shall be prepared in accordance with the latest revision of the Engineering Standards and plan submittal procedures of the Town.

 OVERALL MASTER PLAN

 PRESENT
 COMMENT

Overall master plan showing relative locations of multiple filings and proposed overall water layout, if available, should be included with the initial submittal. Distances are not necessary for small projects where only one (1) submittal is needed.

IV. EASEMENTS AND RECORDED PLATS

All submittals must be accompanied by recorded plats and/or easements for locations of all lines.

V. <u>CONSTRUCTION PROCEDURES</u>

		<u>PRESENT</u>	<u>COMMENT</u>
a.	A pre-construction meeting shall be held with the Town Engineer, Town Engineer, Inspector, Design Engineer, contractor and other inspecting agencies at least one (1) week prior to the start of construction.		
b.	Construction begins, inspected by Town and other inspecting agencies.		
C.	Upon completion of construction, compaction test results shall be received by the Town Engineer.		
d.	As-builts and electronics, including plats showing addresses for each lot to be served, submitted to Town Engineer.		
e.	Water mains tested in accordance with Town specifications and results submitted to Town Engineer.		
f.	Clean-up work completed by contractor and project reinspected for Initial Acceptance of construction.		
g.	Completion of curb, gutter and pavement inspection.		
h.	Review and approval of as-builts by inspector and other approving agencies.		
i.	Notice of Initial Acceptance and starting date sent		



		PRESENT	COMMENT
	to developer, Design Engineer and contractor.		
j.	The project will be inspected for Final Acceptance		
	approximately one (1) year and eleven (11)		
	months after Initial Acceptance.		
k.	Upon completion of the inspection, any problems		
	which need to be corrected will be itemized and		
	sent to the developer for correction prior to Final		
	Acceptance.		
I.	A final inspection will be made if deemed		
	necessary.		
m.	Final Acceptance of project and acceptance forms		
	signed, dated and distributed.		

GENERAL NOTES

1. Only the following fire hydrants and valve boxes listed below shall be accepted for construction by the Town Engineer.

Fire Hydrants:

A. Meuller Centurion Model 423.

Valve Boxes:

- A. Tyler screw Type "C" cast iron valve box assembly series 6860 with No. 160 oval base.
- B. Clay and Bailey screw Type 6 inch cast iron valve box assembly No. P-108 with No. 160 large oval base.
- 2. The contractor is responsible for:
 - A. Notifying all customers possibly affected by outage of water during construction.
- 3. Prior to installation of water mains, road construction must have progressed to at least the "sub-grade" stage. Sub-grade is defined as an elevation of no more than seven inches below the finished street grade.

All valve boxes and fire hydrants will be adjusted to the final finished grade by the contractor.

TOWN ACCEPTANCE NOTE

1. Upon completion of water construction and testing, the developer or contractor shall contact the Town for a Initial Acceptance inspection. A punchlist will be provided to the developer and contractor upon completion of the initial walk-thru and Initial Acceptance will be issued following completion and acceptance of the work outlined in the punchlist.



- 2. The contractor will be held responsible for the proper functioning of the lines for up to two (2) years from the date of Initial Acceptance of the lines by the Town . Any malfunction during this period shall be remedied by the contractor to the satisfaction of the Town Engineer at no expense to the Town .
- 3. The date of Final Acceptance will be indicated in the conditions of the Initial Acceptance Letter. The developer shall be responsible for contacting the Town for a final inspection and Final Acceptance.
- 4. Refer to **Section 2.11 Acceptance of Work** for additional details.

GENERAL NOTES

- 1. All construction shall comply with the Town of Kersey Engineering Standards. Copies of the Engineering Standards may be obtained from the Town of Kersey website.
- 2. The contractor shall contact all appropriate utility companies and the Town prior to the beginning of any construction. The contractor shall be responsible for locating any existing utility (including depths) which may conflict with the proposed construction. All existing utilities shall be protected from damage by the contractor. Damaged utilities shall be repaired by the contractor at his own expense.

All items shown on the plans as existing are shown in approximate locations only. The actual location may vary from the plans, especially in the case of underground utilities. Whenever the contractor discovers a discrepancy in locations, he shall contact the Town Engineer immediately.

- 3. The Town Engineer and other approving agencies are to be notified at least forty-eight (48) hours prior to construction.
- 4. The contractor shall obtain, at his own expense, all permits which are necessary to perform the proposed work.
- 5. All concrete shall be a minimum of four thousand (4,000) pound compression strength.
- 6. The Design Engineer shall submit one (1) set of "As-Built" prints to the Town Engineer for approval prior to printing. After approval has been granted by the Town Engineer, electronics shall be transmitted to the Town engineer and additional sets of prints shall be transmitted to the Town prior to Initial Acceptance.
- 7. All backfill material shall be compacted to ninety-five (95%) standard proctor density. All testing and compaction tests must be submitted in a typed format to the Town Engineer prior to Initial Acceptance. At the completion of the project, two (2) bound complete copies of all the material testing reports with a letter stamped by a Licensed Professional Engineer attesting that the work is in conformance with the project specifications will be furnished to the Town Engineer.
- 8. Trenches shall be excavated and the pipe exposed for the inspection at any location of the project if so ordered by the inspector.



- 9. The contractor will be held responsible for the proper functioning of the water lines for up to two (2) years from the date of Initial Acceptance of the lines by the Town . Any malfunction during this period of guarantee shall be remedied by the contractor to the satisfaction of the Town Engineer at no expense to the Town .
- 10. Surface grades are to be within plus or minus one-tenth foot $(\pm 1/10)$ of finished grade and verification of compaction results obtained prior to the installation of the water lines. Results must be submitted to the Town Engineer.
- 11. No work shall be backfilled until the construction has been inspected and approved for backfilling by the Town Engineer or representative of the Town Engineer.

WATER MAINS

- 1. All materials and workmanship shall be in conformance with the Town of Kersey Engineering Standards. All work shall be inspected and approved by the Town Engineer.
- 2. All water mains shall be Pressure Class 150. Provide 8 Mil. polyethylene wrapping per AWWA Standard C105 at storm and conduit crossings, and fire hydrants and valves. All fittings shall be made from gray-iron or ductile iron and furnished with mechanical joint ends. All fittings shall have a pressure rating of two hundred fifty (250) psi and shall be wrapped with an 8 Mil. minimum thickness polyethylene material per AWWA Standard C105. All ductile iron pipe to be polyethylene wrapped.
- 3. There shall be a minimum cover of four and one-half feet $(4\frac{1}{2})$ over all water mains.
- 4. Fire hydrants shall conform to Section 7. Fire hydrant assemblies shall include all pipe, fittings, valves, materials, and labor which are necessary to install the hydrant complete-in-place.
- 5. All bends, tees, fire hydrants, blow-offs and plugs at dead end mains shall be mega lugged and protected from thrust by using concrete thrust blocks per Details.
- 6. **Chlorination and Flushing:** The lines shall be chlorinated in accordance with AWWA C-601., "Disinfecting Water Mains." The preferred method is to use sufficient chlorine tablets to produce a 100 mg to 1 solution. These tablets should be adhered to the top of the pipe section with permatex no. 1 (red). The chlorination of any finished pipeline shall be done prior to the hydrostatic testing. Sterilization and flushing of all mains shall be inspected and certified by the Health Department having jurisdiction. One (1) copy of the certification shall be sent to the Town Engineer.
- 7. **Hydrostatic Testing:** All pipe shall be field pressure tested to a minimum of one hundred fifty (150) psi. All testing shall be done in the presence of a Town Inspector.
- 8. All valves are to be located at tees and crosses.



- 9. When necessary to lower or raise water lines at storm drains and other utility crossings, a minimum clearance of one and one-half feet (1½') shall be maintained between outside of pipes.
- 10. The contractor shall have in his possession at all times one (1) signed copy of the plans which have been approved by the Town .
- 11. The contractor shall notify the Town Engineer and the Town at least forty-eight (48) hours prior to any construction.
- 12. All required permits shall be obtained by the contractor from the Town and other agencies for work performed in the public right of way.
- 13. The contractor shall notify Utility Locates and determine the location of all existing underground utilities prior to proceeding with the excavation. All work performed in the area of the public utilities shall be performed according to the requirements of these agencies.
- 14. Compaction of all trenches must be attained in accordance with the soils report and compaction test results submitted to the Town Engineer prior to Initial Acceptance.
- 15. At least five (5) days prior to the start of construction, a pre-construction meeting will be held and attended by the contractor and representatives of other approving agencies. It will be the responsibility of the contractor to contact the Town Engineer.

DEVELOPMENT REVIEW CHECKLIST: SEWER PLANS

The purpose of this approval procedure check list is to familiarize all interested parties in the procedures followed by the Town concerning Town sewer plan approvals.

PLAN CHECK – CHECK LIST

The following information shall be included, where applicable, on all plans submitted to the Town Engineer.

I. <u>GENERAL UTILITY PLANS</u>

a.	 Cover Sheet Name of Project Vicinity and location maps P.E. stamp and signature Sheet index 	PRESENT	<u>COMMENT</u>
b.	 Overall Utility (Water) Required notes (see attached sheets for examples of general notes, sewer main notes required by the Town) All street names North arrow and scale 		



II.

III.

TOWN OF KERSEY, COLORADO STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

			PRESENT	COMMENT
	4.	Indicate individual sheet numbers for specific sections of lines to be shown on following sheets		
	-	Lot and block numbers and front lot dimensions A list of quantities for sewer materials		
c.	Tit	e Blocks		
		Title, date, sheet number Designed by, drawn by, checked by a Professional Engineer		
	<u>SEW</u>	ER PLANS		
a.	Sh	eets	<u>PRESENT</u>	<u>COMMENT</u>
		1. All sewer mains shall be profiled.		
		2. Sewer lines to be generally located south or west of street centerlines, with a minimum of 10' between water lines. The centerline of the water main shall be a minimum of 6' from lip of pan on the street side.		
		3. Show station and label all manholes with top of lid and invert elevations, pipe distances (measured horizontally) between all manholes and size of pipe.		
		 Indicate location of sewer lines from street centerlines or property lines. 		
b.		Detail Sheet		
		1. Compliance with applicable local government specifications.		
		2. Detail sheets to show manholes, service connections crossings, pipe bedding, etc.		
		3. Technical notes and installation instructions are also required.		
C.	To wit Sta	plans submitted for review and approval by the wn Engineer shall be prepared in accordance h the latest revision of the Engineering andards and plan submittal procedures of the wn.		
	<u>OVE</u>	RALL MASTER PLAN		
		erall master plan showing relative locations of noles and proposed overall sewer layout, if	PRESENT	<u>COMMENT</u>



IV.

available, should be included with the initial submittal.	PRESENT	<u>COMMENT</u>
EASEMENTS AND RECORDED PLATS		
All submittals must be accompanied by recorded plats and/or easements for locations of all lines.	<u>PRESENT</u>	<u>COMMENT</u>

2.9 INSPECTION

Contractors shall be responsible for notifying the Town Engineer at least forty-eight (48) hours prior to the start of any construction. If work is suspended for any period of time after initial start-up, contractors must notify the Town Engineer forty-eight (48) hours prior to restart.

Inspections will be performed on all development work by the Town Engineer or his/her designee as required to ensure all work is being constructed in accordance with the Town Standards. Contractors shall be responsible for organizing a pre-construction conference prior to the start of construction, at which shall attend, at least, the Town Staff, affected agencies, contractor's representatives, contractor's surveyors, contractor's material testing firm and the owner/developer's engineers. The Town's costs for all inspections and meetings related to the owner/ developer's project shall be in conformance with the terms and conditions of the signed cost agreement.

2.10 TESTING

Colorado Department of Transportation Standards for Road and Bridge Construction, as amended, and as amended by the Town of Kersey Engineering Standards, shall apply to roadway testing requirements.

All tests and inspection results performed by the testing firm in the employment of the owners/developers shall be submitted directly from the testing agency to the Town Engineer or his/her field representative at the time of field tests, and within ten (10) working days after the testing or retesting date of laboratory tests.

Any work performed inside the Town of Kersey ROW and associated easements shall be tested by an approved materials testing firm. Materials testing firms shall be approved by the Town Engineer and must employ a full-time registered professional engineer who directly supervises work of the firm. The costs of testing and associated reporting will be paid by the owner/developer.



The testing of all materials and construction shall be in conformance with the appropriate AASHTO, ASTM and CDOT Standards. A partial list of approved testing methods includes:

TEST PROCEDURES	<u>AASHTO</u>	<u>ASTM</u>
Atterberg Limits (LL & PL)	Т 89 & Т 90	D 4318
Gradations Analysis (except hydrometer)	T 27	D 422
CBR (as modified in Section 5.2.4.1)	193	-
R-value (subgrade & base)	T 190	D 2844
Marshall Stability	T 245	D 1559
R _t Value	T 246	D 1560
Compaction Curve (standard)	T 99	D 698
Compaction Curve (modified)	T 180	D 1557
Compaction Curve (CTAB)	T 134	-
Field Density Tests (Sand Cone)	T 191	D 1556
Field Density Test (Nuclear)	T 238/T 239	D 2922/D
3017		
Field Density Test (Balloon)	T 205	D 2167
Concrete Slump	T 119	C 143
Concrete Air Content	T 152	C 231
Concrete Compressive Strength	T 22	C 39
Concrete Sampling	T 141	C 172
Strength of Soil-Lime Mixtures	T 220	-
Asphalt Flow	T 245	D 1559
Air Voids	T 245	D 1559
Profil-o-graph	Colo.	
Procedure 64-85		

The design engineer is encouraged to discuss the project with the Town Engineer prior to the first submittal. This also has proven beneficial in reducing the Town's review time for plan and report submittals.

2.10.1 Backfilling of Utility Trenches, Inlets, Manholes and Junction Boxes

- 2.10.1.1 All utility trenches within the ROW shall be placed and compacted in accordance with the Details.
- 2.10.1.2 Field moisture-density testing shall be performed during backfill operations beginning one foot (1') above the top of the bedding and extending to the finished subgrade elevation. A sufficient number of tests shall be taken at various depths to confirm backfill compaction and moisture content specifications are met. As a minimum, one (1) test shall be taken within one foot (1') of manholes, water valves or other obstacles.

2.10.2 Curb, Gutter, Sidewalk, Crosspans, and Minor Drainage Structures

2.10.2.1 Subgrade shall be thoroughly compacted to the moisture and density specifications required for the material tested. The surface shall be smooth with no humps or depressions and to the final grade on which



the concrete will be placed.

- 2.10.2.2 Testing frequency for the subgrade shall be a minimum of each sixinch (6") lift on replacement materials with one (1) test for every two hundred fifty feet (250') of structure with more tests taken if necessary for control.
- 2.10.2.3 These test results shall be submitted to the field representative of the Town Engineer for compliance review.
- 2.10.2.4 Concrete with air entrained, Class A, B, or D shall be used.
- 2.10.2.5 Curing methods shall conform to CDOT Standards.
- 2.10.2.6 Concrete placement shall include methods which will not reduce the strength or integrity of the final product.
- 2.10.2.7 The slump, air content and unit weight tests shall be carried out in the first truck of concrete for the daily placement and thereafter in conformance with the following table:

ITEM	TESTING FREQUENCY
Sidewalks, crosspans, curb returns	1 set of 4 cylinders for every 1,000 square yards or fraction thereof of concrete placed.
Curbing and combination curb, gutter and walk	1 set of 4 cylinders for every 1,000 lineal feet or fraction thereof of curb and gutter placed.
Minor drainage structures	Each structure 1 set of 4

(MINIMUM OF 1 TEST PER DAY IF ONLY ONE TRUCK)

Note: The testing is to include the slump (T 119), air entrainment (T 152), temperature of concrete at placement, yield and compressive strength of the cylinders (T 22).

- 2.10.2.8 All work done by hand (non-extrusion) shall require a minimum of two (2) sets of tests per day.
- 2.10.2.9 These test results shall be submitted to the field representative of the Town Engineer for compliance review.
- 2.10.2.10 At the discretion of the Town Engineer, the contractor will provide core test results of concrete at random intervals, not averaging less than one (1) test in five hundred feet (500'), to verify the specified thickness of concrete was installed. Testing costs shall be paid for by the



owner/developer. If the Town Engineer has not been given the opportunity to inspect the subgrade and/or concrete forms prior to placement of the concrete, and at the discretion of the Town Engineer, the contractor will provide additional core tests.

2.10.3 Street Subgrade Preparation

- 2.10.3.1 The subgrade shall be free of organic material and shall be scarified to a depth of twelve inches (12"), moisture treated to within \pm two percent (2.0 \pm %) of optimum moisture content and compacted to ninety-five percent (95%) optimum density, AASHTO T-99.
- 2.10.3.2 Field moisture-density tests using acceptable methods will be required at random locations at the rate of one for each two hundred fifty (250) lineal feet of paving for each travel lane.
- 2.10.3.3 After the subgrade has been compacted, tested and found to meet specifications, the entire subgrade shall be proof-rolled with a heavily loaded vehicle to ensure uniformity of the subgrade. The vehicle must have a loaded GVW of fifty thousand (50,000) pounds with a loaded single axle weight of at least eighteen thousand (18,000) pounds and a tire pressure of ninety (90) psi. Subgrade which is pumping or deforming must be reworked, replaced or otherwise modified to form a smooth, stable, non-yielding base for subsequent paving courses. The Town Engineer shall be notified at least forty-eight (48) hours before final proof-rolling.
- 2.10.3.4 The results of field density tests and proof-rolling shall be submitted and reviewed by the Town Engineer. Provided all tests are acceptable, compaction will be approved for the placement of the next paving course. Should testing indicate unsatisfactory work, the necessary reworking, compaction or replacement will be required prior to continuation of the paving process. The approval is valid for twenty-four (24) hours. Changes in weather such as freezing or precipitation will require re-approval of the subgrade.

2.10.4 Lime Treated Subgrade

- 2.10.4.1 Lime treated subgrade shall be used only where a mix design has been previously submitted and approved by the Town Engineer.
- 2.10.4.2 Construction of lime treated subgrade shall be in accordance with the requirements of the CDOT Standards.
- 2.10.4.3 Lime treated subgrade will be observed and tested on a full-time basis and paid for by the owner/developer. Field moisture-density tests shall be taken at the rate of one for each two hundred fifty (250) lineal feet of travel lane for each lift. Compaction curves (AASHTO T 220) will be required for each soil type and field density shall be compared to the appropriate curve for percentage compaction determinations. Field compacted 7-day strength and lime content (AASHTO T 232)



determinations shall be required for each five hundred (500) tons of subgrade treated with a minimum of one (1) per project.

2.10.4.4 The results of field density, lime content and strength tests shall be submitted and reviewed by the Town Engineer. Provided all tests are acceptable, the subgrade will be approved and the paving course can be placed. Should these tests fail to meet project specifications, the strength reduction will be used to calculate increased pavement layer or overlay thickness required for the design section.

2.10.5 Aggregate Base Course

- 2.10.5.1 Aggregate Base Course materials must be from a currently approved source and conform to the requirements of the CDOT Standards. The owner/developer shall, upon request, provide verification of material properties.
- 2.10.5.2 Materials shall be placed on an approved subgrade which has been proof-rolled within the past twenty-four (24) hours and found to be stable and non-yielding. Should weather conditions change, such as freezing, precipitation, etc., aggregate base materials shall not be placed until the subgrade is reapproved.
- 2.10.5.3 Aggregate base materials shall be placed, moisture treated and compacted as outlined in the CDOT Standards.
- 2.10.5.4 At least one (1) sample of aggregate base course for each one thousand (1,000) tons of materials placed shall be tested to determine gradation and Atterberg Limits. Should these tests indicate the material does not meet specifications, the material shall be removed and replaced.
- 2.10.5.5 During placement and compaction, Compaction Curves will be required for each material used. Field moisture-density tests shall be taken of each lift of material at random locations at approximate intervals of two hundred fifty feet (250') in each travel lane. Tests shall also be taken within one foot (1') of manholes and valves.
- 2.10.5.6 The results of field density tests shall be submitted to and reviewed by the Town Engineer. Provided all tests are acceptable, the aggregate base course materials, placement and compaction will be approved and the next paving course can be placed. Should testing indicate unsatisfactory work, the necessary reworking, compaction or replacement will be required prior to continuation of the paving process.
- 2.10.6 <u>Cement Treated Aggregate Base Course</u>

Not allowed.

2.10.7 Plant Mix Hot Bituminous Pavement (HBP)



- 2.10.7.1 All asphalt, aggregate, fillers, and additives shall be combined to form a mix design in accordance with CDOT Standards. The mix design must be submitted to and approved by the Town Engineer.
- 2.10.7.2 Materials shall be placed upon an approved subgrade base course or previous paving course in accordance with the CDOT Standards. Prime or tack coats shall be applied in accordance with CDOT Standards.
- 2.10.7.3 When more than one (1) lift of pavement is required, where possible, the joints and seams between lifts shall be staggered so that joints are separated by at least two feet (2') in the horizontal direction.
- 2.10.7.4 The bituminous paving mix shall be compacted to at least ninety-five percent (95%) of the mix determined Marshall density or specified density from Hveem testing to achieve design strength.
- 2.10.7.5 During placement and compaction of plant mix bituminous pavement, observation and testing shall be on a full-time basis. For each one thousand (1,000) tons of material placed or at least one for each day of production, a field sample shall be taken and subjected to Marshall or Hveem testing, extraction and gradation analysis. Testing intervals may be increased to approximately one-half (1/2) of the daily tonnage to be placed at the discretion of the Town Engineer.
- 2.10.7.6 Mix temperatures will be checked on each truck and, where the temperature does not meet specifications, the load shall not be placed.
- 2.10.7.7 During compaction, the density of the pavement will be checked randomly at the rate of one test for each two hundred fifty (250) lineal feet of travel for each lift.
- 2.10.7.8 Either during or after completion of the paving, the final pavement thickness shall be determined for the plant mix bituminous pavement using corings, rings or other acceptable methods. Thickness determinations shall be made at random locations at intervals of approximately five hundred feet (500') in each travel lane.
- 2.10.7.9 The results of field density and laboratory tests shall be submitted to and reviewed by the Town Engineer. Provided all tests are acceptable, the asphalt concrete materials, placement and compaction will be approved. Acceptable results shall be in compliance with tolerances for gradation and extraction found in CDOT Standards. Marshall stability tests results shall average one thousand five hundred (1,500) pounds or more. Should testing indicate unsatisfactory work, removal and replacement or overlay work will be required.
- 2.10.7.10 Criteria used to determine satisfactory work shall be all for the following.

- a. Ninety percent (90%) of core test must meet or exceed design HBP thickness.
- b. Average of all core tests must meet or exceed design HBP thickness.
- c. All core test thickness must exceed design HBP thickness minus one-quarter inches (1/4").
- 2.10.7.11 If all these criteria are not met, additional core tests or approved nondestructive testing at the expense of the owner/developer may be required to further delineate the area(s) of unsatisfactory work which will require correction prior to acceptance.

2.10.8 Portland Cement Concrete

- 2.10.8.1 All aggregate, Portland cement, fly ash, water, admixtures, curing materials, and reinforcing steel shall meet the requirements of CDOT Standards. All materials shall be combined in accordance with CDOT Standards into a mix design and submitted to, and approved by, the Town Engineer.
- 2.10.8.2 Materials shall be proportioned, handled, measured, batched, placed, and cured in accordance with CDOT Standards.
- 2.10.8.3 During placement of Portland Cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production or every four hundred (400) cubic yards placed (or portion thereof), aggregate samples shall be obtained for gradation of both the coarse and fine aggregates.
- 2.10.8.4 Slump, air content, unit weight and mix temperature shall be tested every one hundred (100) cubic yards of pavement placed. The first three (3) loads shall be tested for slump and air content. If any one (1) test fails to meet requirements, slump and air content tests shall continue until three (3) consecutive loads meet requirements. Thereafter, slump and air shall be tested at least every fifth load.
- 2.10.8.5 Six (6) compressive strength cylinders shall be fabricated for each one hundred (100) cubic yards placed. Cylinders shall be tested as follows: two (2) at seven (7) days; two (2) at twenty-eight (28) days; and two (2) for backup, as required by the Town Engineer. Testing interval may be increased to approximately one-third (1/3) of the daily volume to be placed at the discretion of the Town Engineer.
- 2.10.8.6 Portland cement and fly ash will be accepted on the basis of current certificates of compliance and pre-testing by CDOT. Reinforcing steel, dowels and tie bars will be accepted by certificate of compliance and mill reports. Water, if not potable, shall be sampled and tested before use. Only CDOT approved brands of air entraining agents,



chemical admixtures and curing materials may be used and must be documented.

- 2.10.8.7 Thickness of fresh concrete must be checked every five hundred (500) lineal feet in each traffic lane. Any noted deficiency areas shall be corrected at that time. Surface deficiency areas shall be corrected at that time. Surface smoothness shall be tested and corrected as necessary according to CDOT.
- 2.10.8.8 All test results shall be submitted and reviewed by the Town Engineer. Provided all tests are acceptable, the pavement will be accepted. Should testing indicate unsatisfactory work, removal and replacement or grinding will be required.



STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS

2.11 ACCEPTANCE OF WORK

2.11.9 Initial Acceptance.

- 2.11.9.1 No later than thirty (30) days after Public Improvements are completed for the Site Plan or Development, the applicant shall request inspection by the Town. If the applicant does not request this inspection within thirty (30) days of completion of improvements, the Town may conduct the inspection without the approval of the applicant. The applicant shall provide "as-built" drawings and a certified statement of construction costs no later than forty-five (45) days after Public Improvements are completed (see Section 11 for as-built requirements). If the Public Improvements completed by the applicant are satisfactory, the Town shall grant "Initial Acceptance," which shall be subject to "Final Acceptance" as set forth below. If Public Improvements completed by the applicant are unsatisfactory, the Town shall provide written notice to the applicant of the repairs, replacements, construction or other work required to receive Initial Acceptance. The applicant shall complete all needed repairs, replacements, construction or other work within thirty (30) days of said notice, weather permitting. After the applicant completes the repairs, replacements, construction, or other work required, the applicant shall request of the Town a reinspection of such work to determine if Initial Acceptance can be granted, and the Town shall provide written notice to the applicant of the acceptability or unacceptability of such work prior to proceeding to complete any such work at the applicant's expense. If the applicant does not complete the repairs, replacements, construction or other work required within thirty (30) days of said notice, the Town may exercise its rights to secure performance. The Town reserves the right to schedule re-inspections, depending upon scope of deficiencies.
- 2.11.9.2 No building permit for the construction of any structure shall be issued by the Town until all the water lines, fire hydrants, sanitary sewer lines, storm drainage, curb, gutter, sidewalk and final lift of pavement have been completed and granted Initial Acceptance by the Town.

For a two (2) year period from the date of Probationary Acceptance of the Public Improvements related to the Site Plan or Development Plans, the applicant shall warrant all said Public Improvements and, at its own expense, make all needed repairs or replacements that, in the reasonable opinion of the Town, shall become necessary. If within forty-five (45) days after the applicant's receipt of written notice from the Town requesting such repairs or replacements, the applicant has not completed such repairs, the Town may exercise its rights to secure performance.

2.11.10 Final Acceptance.

At least forty-five (45) days before two (2) years have elapsed from the issuance of Initial Acceptance, or as soon thereafter as weather permits, applicant shall request a "Final Acceptance" inspection, the process of which is defined as follows:



The Town shall inspect the Public Improvements and shall notify the applicant in writing of all deficiencies and necessary repairs, if any. If there are no deficiencies, or after the applicant has corrected all deficiencies and made all necessary repairs identified in said written notice, the Town Board shall by resolution grant Final Acceptance. If the applicant does not correct all deficiencies and make repairs identified in said inspection to the Town 's satisfaction within thirty (30) days after receipt of said notice, weather permitting, the Town may exercise its rights to secure performance. If any mechanic's liens have been filed with respect to the Public Improvements, the Town may retain all or a portion of the Improvement Guarantee up to the amount of such liens. If the applicant fails to have the Public Improvements finally accepted within two (2) years of the date of the issuance of Initial Acceptance, or any Public Improvements are found not to conform to this Agreement or to applicable Town standards and specifications, then the applicant shall be in default of the Agreement and the Town may exercise its rights.

2.12 AS-BUILT SUBMITTAL PROCEDURE

- 2.1.1 Prior to **Initial Acceptance**, the Developer shall deliver to the Town Engineer and Town Engineer one (1) signed and sealed set of as-builts and electronics (See Section 9.1.8 and 9.1.9).
- 2.1.2 As-builts shall verify the location, size, type, class and elevation of all pipes (water, sanitary and storm) manholes, fire lines, curb stop boxes, meter pits, valves, fire hydrants, inlets, riprap, headwalls and other storm drainage infrastructure shown on the construction plans. This will include those improvements outside of public ROW and off-site improvements specified in the SIA.
- 2.1.3 Detention Ponds volumes, elevations of outlet structure and pipe, grade of trickle channels will need to be surveyed and certified. This information will be reviewed and approved by the Town Engineer.
- 2.1.4 The drawings and electronics will be revised to show all As-Built horizontal locations to within one foot (1') and all vertical elevations to within 0.1'
- 2.1.5 Certification Block for As-Built Drawings:

The responsible professional engineer, registered in the State of Colorado, for the project shall state:

"I hereby affirm that the public improvements (name of subdivision or project) have been constructed in compliance with the construction plans approved by the Town and revised as noted to reflect the "As-Built" conditions."

Name, P.E. Date

This block shall appear on the cover sheet of each set of drawings

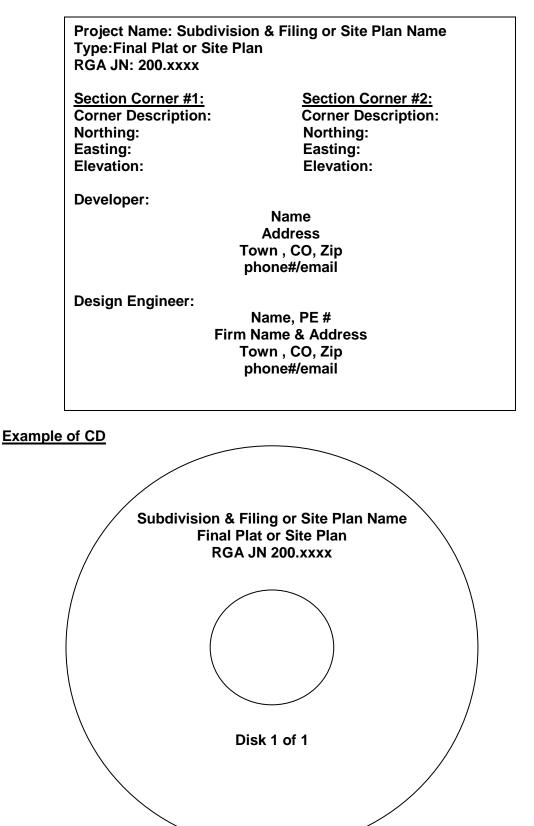


- 2.1.6 If the improvements for a project are constructed in phases, as-built drawings will be submitted at the completion of each phase.
- 2.1.7 Provide Northing, Easting and elevation for two (2) section corners adjacent to the site. If available, provide Weld County GIS coordinates/elevations.
- 2.1.8 Hard copies
 - 2.1.8.1 Prior to submittal of as-builts, submit one (1) paper copy to the Town Engineer and one (1) to the Town of Kersey for review.
 - 2.1.8.2 After addressing redline comments and prior to Initial Acceptance, provide to the Town :
 - Three (3) full-size paper and three (3) half-size paper, sealed and signed sets for the Town .
 - Two (2) full size paper, two (2) half size paper sealed and signed sets for Public Works.
 - One (1) full size paper, one (1) half size paper sealed and signed sets for the Town Engineer
 - Electronics as identified below.
- 2.1.9 <u>Electronics</u>
 - 2.1.9.1 All submittals must be on CD.
 - 2.1.9.2 Refer to disk/case labeling requirements, see below. Contact RG for electronics of CD Case Label and RGA Job Number.
 - 2.1.9.3 Provide two (2) copies of each CD.
 - 2.1.9.4 All CDs must be submitted in a hard plastic CD case.
 - 2.1.9.5 No projects will be accepted without the proper labeling.
 - 2.1.9.6 All drawings are to be in AutoCAD; for version, contact the Town Engineer.
- 2.1.10 PDF's
 - 2.1.10.1 Provide PDF's of the entire plan set. Each PDF will be 24"x36". PDF each sheet individually. Name the PDF by using the drawing name and inserting the sheet number at the beginning.
 - 2.1.10.2 All drawings must be to scale.
- 2.1.11 Contents of the Disk
 - 2.1.11.1 All information must be contained in two (2) folders; labeled "DRAWINGS" and "PDF's."



2.1.11.2 The "DRAWINGS" folder shall include all AutoCAD drawings for the project.

No permits will be issued until the hard copies and electronics are received by the Town. Example of CD Case



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SECTION 3: ROADWAY DESIGN AND TECHNICAL CRITERIA

3.1 GENERAL

This section sets forth the minimum design and technical criteria and specifications to be used in the preparation of all roadway plans.

3.2 ROADWAY DESIGN AND TECHNICAL CRITERIA

The Town has adopted the "Town of Kersey Transportation Plan," dated September 2002, based on traffic volumes, land use and expected growth. This Functional Street Classification Plan designates streets as: private, alleys, local, collector (major and minor), arterial. The following criteria apply to each classification. Standard roadway cross-sections, along with other related drawings and Details, are presented in the Appendix of these Engineering Standards.

3.2.1 Planning Principles for Local Circulation Systems

Basic considerations in the design of local circulation systems must recognize the following factors:

- a. <u>Safety</u>: for both vehicular and pedestrian traffic.
- b. <u>Efficiency of Service</u>: for all users.
- c. <u>Livability</u>: especially as affected by traffic elements in the circulation system.
- d. <u>Economy</u>: of both construction and use of land.

Each of the following principles is an elaboration on one (1) or more of these four (4) factors. The principles are not intended as absolute criteria, since instances may appear where certain principles conflict. Therefore, these principles should be used as guides to arrive at proper systems layout.

3.2.1.1 Ensure Vehicular and Pedestrian Access

The primary function of local streets is to serve abutting properties. Street widths, placement of sidewalks, patterns of streets, and number of intersections are related to safe and efficient access to abutting lands.

3.2.1.2 <u>Minimize Through Trips</u>

Through-traffic on local and collector streets increases the average speed and volume and thus the accident potential, thereby reducing residential amenities. Through-traffic can be discouraged by creating a circuitous route between neighborhoods and higher volume streets and by channelizing or controlling median crossings along peripheral routes.



3.2.1.3 Control Access to Arterials

Local circulation systems and land development patterns should not detract from the efficiency of peripheral arterial facilities. Ideally, land development should occur so that no local streets require direct access to arterial routes. The number of access points between the local circulation system and the arterial system should be minimized. Intersections along arterial routes should be properly spaced for efficient signalization and traffic flow. The streets that do intersect the arterial system will tend to have high volumes since they are the only exit points.

3.2.1.4 Discourage Speeding

Residential streets should be designed to discourage fast movement (more than twenty-five (25) mph), through the use of curvilinear alignments and circuitous routes in the street system.

3.2.1.5 <u>Minimize Pedestrian-Vehicular Conflicts</u>

Pedestrian travel from within the area to points outside should require a minimum of street crossings. Sometimes this may be achieved through proper design of street patterns, land use arrangements and pedestrian routes. Typical methods include use of cul-de-sacs and loop streets, special pedestrian routes or walkways, and the proper placement of high pedestrian traffic generators. In general, while vehicular flow must be outward-oriented to the peripheral arterials, pedestrian travel should be inward-oriented to avoid these heavier vehicular flows.

3.2.1.6 Minimize Space Devoted to Street Use

It is desirable to minimize local street mileage to reduce construction and maintenance costs as well as to permit the most economical land use. Streets should also have an appearance commensurate with their function. They should be in keeping with the residential character.

3.2.1.7 Relate Street to Topography

Local streets will be more attractive and economical, if they are constructed to closely adhere to topography. The important role that streets play in the overall storm drainage system can be enhanced by using the topography of the area.

3.2.1.8 General Roadway Layout Criteria

 The arrangements of streets should permit economical and practical patterns, shapes and sizes of development parcels. Streets as a function of land use must not unduly hinder the development of land. Distances between streets, number of



streets, and related elements all have a bearing on efficient subdivision of an area. Access to adjoining properties should also be encouraged.

- b. Where a development or subdivision abuts or contains an existing or proposed arterial street or highway, the Planning Commission may require adequate protection of the adjoining lots and/or require separation of through and local traffic. Such adequate protection may include service streets, reverse frontage lots with screen planting in a reservation strip along the rear property line, deep lots with rear service alleys abutting the primary street or highway, or such other treatment as may be necessary as determined by the Planning Commission.
- c. Where a development or subdivision borders on or contains a railroad ROW or limited access highway ROW, the Planning Commission may require a street approximately parallel to and on each side of such ROW, at a distance suitable for appropriate use of the intervening land. Such land would be appropriately used for park purposes in residential districts, or for commercial or industrial purposes in nonresidential districts. Such distances shall be determined with due regard for the requirements of approach grades and future grade separations.
- d. Local streets shall be laid out to discourage through traffic.
- e. All permanent dead-end streets, as opposed to temporary dead-end streets, shall be developed as cul-de-sacs in accordance with the Standards as set forth herein. Except where no other practical alternative is available, such streets may not extend more than seven hundred and fifty feet (750').
- f. The minimum radius of the turnaround portion for a residential cul-de-sac, as measured to the flowline, shall be thirty-nine feet (39'), for all cul-de-sacs, regardless of lot size or cul-de-sac length. The minimum ROW shall be a forty-six-foot (46') radius. Cul-de-sac bulbs shall be built with six-inch (6'') mountable curb and gutter, with four-foot, six-inch (4'6'') wide attached sidewalk See Details.
- g. Half streets (i.e. streets of less than full required ROW and pavement width) shall not be permitted, except where such streets, when combined with a similar street (developed previously or simultaneously) on property adjacent to the subdivision, creates or comprises a street that meets the ROW and pavement requirements as set forth herein.
- 3.2.1.9 Emergency vehicle access (EVA) may be required for portions of



developments having only a single access.

3.2.1.10 Landscaping in Areas Between Curb and Sidewalk

The type of vegetation and landscaping to be planted within the area between the curb and sidewalk shall meet the minimum landscape standards of the Town and shall depend on those particular utilities to be located underground in such areas. In general, planting of shallow rooted vegetation shall be encouraged to reduce adverse interaction between landscaping and any underground utilities and in the event that utilities must be repaired.

TABLE 3.1 ROADWAY CLASSIFICATIONS & REQUIREMENTS

(Refer to the Appendix for street sections)

Roadway	ROW Width	FL-FL Width	Travel	Recommended Median Width	Posted Speed	
Classification ^[1]	(feet) ^[2]		Lanes	(feet) ^[3]	(mph)	Parking
Alleys	20		1			
Rural Local	60	36	2		25	On-Street
Local	60	36	2		25	On-Street
Residential Collector	60	40	2		25	On-Street
Major Collector	80	40	3		30 - 45	No On-Street
Arterial	80	54	3		30 - 45	No On-Street
Major Arterial	100	74	4		30 - 45	No On-Street

Notes:

- 1. Final determination to be based on the projected traffic volumes in Table 3.2.
- 2. Additional easements may be required for wider pedestrian walkways per the utility entities (i.e., Xcel Energy, Qwest, etc.)
- 3. Medians in roadways are subject to final approval of the Town Engineer.
- 4. Residential cul-de-sac flowline radius shall be a minimum of thirty-nine feet (39').
- 5. Residential cul-de-sac ROW radius shall be a minimum of forty-six feet (46').
- 6. ROW may be required to be wider depending on utility needs.

TABLE 3.2ROADWAY CLASSIFICATION VERSUS VOLUME

Street Classification	Lanes	Average Daily Traffic
Alley	1	N/A
Local	2	Less than 1,000 VPD
Residential Collector	2	1,000 – 2,500 VPD
Major Collector	3	2,500 – 6,000 VPD
Arterial	3	6,000 – 12,000 VPD
Major Arterial	5	12,000 – 35,000 VPD



Note: For Commercial/Office Streets with greater than two thousand five-hundred (2,500) VPD, requirements for Major Collector Streets shall be used, subject to the Town Engineer's approval.

3.2.2 Roadway Classifications

- 3.2.2.1 <u>Alleys</u>
 - a. <u>Posted Speed Limit</u>

Speed Limit generally not posted. Design speed of fifteen (15) mph to be used for design purposes.

b. <u>Traffic Volumes</u>

Not Applicable, used only for dwelling access.

c. <u>Continuity</u>

Limited continuity. Length to be determined on a site by site basis. Alleys may intersect with local and minor collector streets. Intersecting alleys and alleys with turns to be subject to the Town Engineer's approval.

d. <u>Safety</u>

Not Applicable

e. <u>Traffic Control</u>

Stop signs, yield signs, or ROW rules for uncontrolled intersections.

f. Function

Alleys provide direct access to adjacent property. Utility line easements should be available.

g. <u>Right-of-Way/Easement</u>

Twenty feet (20') minimum ROW or easement required. Greater width may be necessary depending upon utility requirements and availability of turnouts. Any changes in ROW or easement width due to a change in street classification shall be made at intersections only. An appropriate radius of the ROW or easement will be provided at all intersections to ensure the sight distance triangle falls within the public ROW or easement.

h. <u>Number of Moving Lanes</u>



One (1).

i. <u>Access Conditions</u>

Intersections at grade with direct access to abutting property permitted.

j. <u>Planning Characteristics</u>

Alleys should be designed to discourage through-traffic from moving through the neighborhood. Alleys may intersect with local and minor collector streets, but are not permitted to intersect with major collectors or arterial streets.

k. <u>Type of Curb and Gutter</u>

Concrete valley gutter required in center of alley for drainage Refer to Details.

I. <u>Cul-De-Sacs/Knuckles/Bubbles</u>

Not applicable.

m. Sidewalk Width

Not applicable.

n. <u>Street Width</u>

Twenty feet (20') paved width (edge to edge pavement dimension) with concrete valley gutter along center of the alley.

o. <u>Minimum Radius of Curvature on Centerline (Horizontal)</u>

See Table 3.3.

p. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

q. <u>Minimum Tangent Lengths</u>

Fifty feet (50').

r. <u>Street Grades</u>

A minimum longitudinal grade of one percent (1.0%) shall be required on all alleys. Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain



cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

s. <u>Curb Return Radii</u>

See Table 3.4.

3.2.2.2 <u>Rural</u>

a. Posted Speed Limit: 25mph

Speed Limit generally not posted. Design speed of twenty-five (25) mph to be used for design purposes.

b. <u>Traffic Volumes</u>

Traffic volumes limited to access vehicles only.

c. <u>Continuity</u>

Limited continuity

d. <u>Safety</u>

Designed for the safety of pedestrians and bicyclists, and the ease of access to adjacent parcels of land. Rural Roads are typically used by single users and no through traffic or parking is allowed.

e. <u>Traffic Control</u>

Stop signs, yield signs, or ROW rules for uncontrolled intersections.

f. Function

Rural Roads provide direct access to adjacent property. No through traffic or parking is allowed. Utility line easements should be available.

g. Right-of-Way

Sixty feet (60').

h. <u>Number of Moving Lanes</u>

Two (2).

i. <u>Access Conditions</u>



Intersections at grade with direct access to abutting property permitted.

j. <u>Planning Characteristics</u>

Rural Roads should be designed to discourage through-traffic from moving through the neighborhood. Rural Roads should not intersect minor collectors, major collectors or arterial streets.

k. <u>Type of Curb and Gutter</u>

None.

I. <u>Cul-De-Sacs/Knuckles/Bubbles</u>

Not applicable.

m. Sidewalk Width

None.

n. <u>Street Width</u>

Minimum twenty-four feet (24') paved width.

o. <u>Minimum Radius of Curvature on Centerline (Horizontal)</u>

See Table 3.3.

p. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

q. <u>Minimum Tangent Lengths</u>

Fifty feet (50').

r. <u>Street Grades</u>

A minimum longitudinal grade of one percent (1.0%) shall be required on all alleys. Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

s. <u>Curb Return Radii</u>

Not Applicable.



3.2.2.3 <u>Local</u>

a. <u>Posted Speed Limit – 25 mph</u>

Posted or prima facie speeds for local street classifications shall be the same as the design speed of that street.

b. Traffic Volumes

Less than one thousand (1,000) vehicles per day.

c. <u>Continuity</u>

Limited continuity

d. <u>Safety</u>

Designed for the safety of pedestrians and bicyclists, and the ease of access to adjacent parcels of land. On-street parking is permitted.

e. <u>Traffic Control</u>

Stop signs, yield signs, or ROW rules for uncontrolled intersections.

f. Function

Local streets provide direct access to adjacent property. Traffic carried by local streets should have an origin or a destination within the neighborhood. Utility line easements should be available.

g. <u>Right-of-Way</u>

Sixty feet (60') minimum right-of way required. Any change in ROW width due to a change in street classification shall be made at intersections only. An appropriate radius of the ROW will be provided at all intersections to ensure the sight distance triangle falls within the public ROW. A sight distance triangle will also be acceptable for the same purpose, (with the shorter dimension lying parallel to the centerline of the minor street). The minimum ROW radius in a cul-de-sac, knuckle or bubble shall be Sixty feet (60').

h. <u>Number of Moving Lanes</u>

Two (2).

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i. <u>Access Conditions</u>

Intersections at grade with direct access to abutting property permitted.

j. <u>Planning Characteristics</u>

Local streets should be designed to discourage through traffic from moving through the neighborhood. Local streets should not intersect major collectors or arterial streets.

k. Type of Curb and Gutter

All local streets and cul-de-sac bulbs shall have mountable curb and gutter with attached or detached sidewalk. See Details.

I. <u>Cul-De-Sacs/Knuckles/Bubbles</u>

Cul-de-sacs, Knuckles and Bubbles, shall all have a minimum flowline radius of thirty-nine feet (39') and minimum ROW radius of forty-six (46') (See Details in the Appendix). Cul-desacs may have a maximum length of seven hundred and fifty feet (750') or a maximum of forty (40) dwelling units (if approved by the Fire District), whichever is most restrictive. Cul-de-sacs longer than six hundred feet (600'), or with more than twenty-five (25) dwelling units, may require all units to be sprinkled per NFPA-13D.

m. Sidewalk Width

See Details.

n. <u>Street Width</u>

Thirty-two feet (32') paved width plus two (2) two-foot (2') gutter pans. Thirty-six feet (36') flowline to flowline.

o. Minimum Radius of Curvature on Centerline (Horizontal)

See Table 3.3.

p. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

q. <u>Minimum Tangent Lengths</u>

Fifty feet (50').



r. <u>Street Grades</u>

A minimum longitudinal flowline grade of one percent (1.0%) shall be required on all Local streets; except at curb returns, knuckles, and bubbles where the minimum flowline grade shall be two percent (2.0%). Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

s. Curb Return Radii

See Table 3.4.

- 3.2.2.4 <u>Residential Collector</u>
 - a. <u>Posted Speed Limit 30 mph</u>

Posted or prima facie speeds shall be the same as the design speed.

b. <u>Traffic Volumes</u>

Greater than two thousand (2,000) vehicles per day, and less than eight thousand (8,000) vehicles per day.

c. <u>Continuity</u>

Continuous for 0.25 to 0.50 mile.

d. <u>Safety</u>

Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways. No back-out drives are permitted.

e. <u>Traffic Control</u>

Regulation of traffic accomplished through the use of stop signs and channelization. Traffic signals normally used only at intersections with major collectors and arterial streets.

f. <u>Function</u>

Collector streets collect and distribute traffic between arterial and local streets, and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by collector streets generally has an origin or a destination within the community. No back-out drives are permitted. On-Street Parking is not permitted. Utility line



easements should be available.

g. <u>Right-of-Way</u>

Sixty feet (60'). An appropriate chamfer for the ROW will be provided at all curb turns to ensure the sight distance triangle falls within the public ROW.

h. <u>Number of Moving Lanes</u>

Two (2).

i. <u>Access Conditions</u>

Intersections at grade with no direct access to abutting property permitted unless no other access is reasonably available.

j. <u>Planning Characteristics</u>

Minor Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood.

k. <u>Type of Curb and Gutter</u>

Six-inch (6") vertical curb and gutter.

I. <u>Sidewalk Width</u>

Sidewalk shall be eight feet (8') wide and detached.

m. <u>Street Widths</u>

Thirty-six foot (36') paved width plus two (2) two-foot (2') gutter pans. Thirty-six-foot (36') flowline to flowline, forming two (2) twelve-foot (12') travel lanes plus two (2) eight-foot (8') parking lanes. Additional lanes may be required at intersections.

n. <u>Minimum Radius of Curvature on Centerline (Horizontal)</u>

See Table 3.3.

o. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

p. <u>Minimum Length of Tangents Between Curves</u>

One hundred and fifty feet (150').



q. <u>Street Grades</u>

A minimum longitudinal grade of one percent (1.0%) shall be required along the centerline of all Collector streets. Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the approval of the Town Engineer

r. Curb Return Radii

See Table 3.4.

3.2.2.5 <u>Major Collector</u>

A major collector is a general term denoting a roadway with painted or raised median, designated or operating with the following characteristics:

a. <u>Posted Speed Limit – 45 mph</u>

Posted or prima facie speeds for the various street classifications shall be five (5) mph less than the design speed of that street.

b. <u>Traffic Volumes</u>

Generally greater than twenty-five thousand (2,500) vehicles per day and less than six thousand (6,000) vehicles per day.

c. <u>Continuity</u>

Continuous for 0.5 to 2.0 miles

d. <u>Safety</u>

Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways. No back-out drives are permitted.

- e. <u>Traffic Control</u>
 - 1. Regulation of traffic accomplished through the use of traffic signs, signals and channelization.
 - 2. Parking is prohibited.
 - 3. Traffic signals will normally be located only at intersections with streets of higher classification.



Function

f.

Major collector streets permit relatively unimpeded traffic movement and are intended for use on those routes where two (2) moving lanes are required but where a larger classified street is not warranted. No back-out drives are permitted. On-Street Parking is prohibited. Bike Lanes are to be provided in each direction.

g. Right-of-Way

Eighty feet (80'). An appropriate chamfer for the ROW will be provided at all curb returns to ensure the sight distance triangle falls within the public ROW

h. Number of Moving Lanes

Two (2) moving lanes with painted or raised curb and gutter median, and left and right turn lanes, as required.

i. <u>Access Conditions</u>

- 1. Intersections at grade.
- 2. Access from street of lower classification will be permitted but in all cases will be controlled by traffic control devices.
- 3. Direct access to abutting property is not permitted unless no other access is reasonably available.
- 4. Full movement intersections with other collector and arterial streets should be at least six hundred sixty feet (660').

j. <u>Planning Characteristics</u>

- 1. Major collector streets should be employed where traffic demands dictate.
- 2. Landscaping elements are encouraged (Trees, open space, etc.).

k. <u>Type of Curb and Gutter</u>

Six-inch (6") vertical curb and gutter.

I. <u>Sidewalk Width</u>

Five feet (5') attached, or detached.



m. <u>Street Widths</u>

Major Collector without Median Option: forty-four-foot (44') paved width plus two (2) two-foot (2') gutter pans, forty-eight feet (48') flowline to flowline, forming two (2) twelve-foot (12') paved lanes, one (1) twelve-foot (12') left-turn lane, two (2) six-foot (6') bike lanes.

n. Minimum Radius of Curvature on Centerline (Horizontal)

See Table 3.3.

o. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

p. <u>Minimum Length of Tangents Between All Curves</u>

One hundred fifty feet (150').

q. <u>Street Grades</u>

A minimum longitudinal grade of one percent (1.0%) shall be required along the centerline of all Collector and Arterial streets. Maximum grade five percent (5.0%). (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

r. Curb Return Radii

See Table 3.4.

3.2.2.6 Arterial

a. <u>Posted Speed Limit – 30-45 mph</u>

Actual posted speed to be determined by the Town Engineer prior to submittal of construction plans. Posted or prima facie speeds shall be ten (10) mph less than the design speed of that street.

b. <u>Traffic Volumes</u>

Generally greater than six thousand (6,000) vehicles per day and less than twelve thousand (12,000) vehicles per day.

c. <u>Continuity</u>



Continuous, two (2) to six (6) miles.

d. <u>Safety</u>

Designed to handle traffic volumes loading from and onto collector and arterial roadways.

e. Traffic Control

- 1. Regulation of traffic accomplished through the use of traffic signs, signals, and channelization.
- 2. Parking is prohibited.
- 3. Traffic signals will normally be required at major intersections.
- f. Function

Arterial routes permit relatively unimpeded traffic movement and are intended for use on these routes where two (2) moving lanes and one (1) center-turn lane are required. Bike Lanes are to be provided in each direction.

g. <u>Right-of-Way</u>

Eighty feet (80') (minimum). Additional ROW may be required based on future transit needs as identified by the Town Engineer and/or the Planning Commission.

h. <u>Number of Moving Lanes</u>

Two (2) moving lanes.

- i. <u>Access Conditions</u>
 - 1. Intersections at grade.
 - 2. Access from street of lower classification will be permitted, but in all cases will be controlled by traffic control devices.
 - 3. Direct access to abutting property is not permitted unless no other access is reasonably available.
- j. <u>Planning Characteristics</u>
 - 1. Arterials should be spaced from one half $(\frac{1}{2})$ to one (1) mile apart and, where possible, should be continuous.



- 2. Arterials should act as boundaries between neighborhood areas.
- 3. Full Intersection spacing shall be one-quarter (¼) mile.
- k. <u>Type of Curb and Gutter</u>

Six-inch (6") vertical curb and gutter with six-inch (6") vertical median curb and gutter (if applicable).

I. Sidewalk Width

Six feet (6') wide detached.

m. <u>Street Widths</u>

Two (2) twelve-foot (12') paved travel lanes, one (1) fourteenfoot (14') turn lane, two (2) six-foot (6') bike lanes, two (2) twofoot (2') gutter pans. Fifty feet (50') flowline to flowline. Left and right turn lanes; acceleration and deceleration lanes required at intersections, as necessary.

n. <u>Minimum Radius of Curvature on Centerline (Horizontal)</u>

See Table 3.3.

o. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

p. <u>Minimum Length of Tangents Between All Curves</u>

Three hundred feet (300').

q. <u>Street Grades</u>

A minimum longitudinal grade of one percent (1.0%) shall be required along the centerline of all Collector and Arterial streets. Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

r. Curb Return Radii

See Table 3.4.

- 3.2.2.7 Major Arterial
 - a. Posted Speed Limit 30-45 mph



Actual posted speed to be determined by the Town Engineer prior to submittal of construction plans. Posted or prima facie speeds shall be ten (10) mph less than the design speed of that street.

b. Traffic Volumes

Generally greater than twelve thousand (12,000) vehicles per day and less than thirty-five thousand (35,000) vehicles per day.

c. Continuity

Continuous, two (2) to six (6) miles.

d. <u>Safety</u>

Designed to handle traffic volumes loading from and onto collector and arterial roadways.

- e. Traffic Control
 - 4. Regulation of traffic accomplished through the use of traffic signs, signals, and channelization.
 - 5. Parking is prohibited.
 - 6. Traffic signals will normally be required at major intersections.
- f. Function

Arterial routes permit relatively unimpeded traffic movement and are intended for use on these routes where two (2) moving lanes and one (1) center-turn lane are required. Bike Lanes are to be provided in each direction.

g. Right-of-Way

One hundred feet (100') (minimum). Additional ROW may be required based on future transit needs as identified by the Town Engineer and/or the Planning Commission.

h. <u>Number of Moving Lanes</u>

Two (2) moving lanes.

- i. <u>Access Conditions</u>
 - 4. Intersections at grade.



- 5. Access from street of lower classification will be permitted, but in all cases will be controlled by traffic control devices.
- 6. Direct access to abutting property is not permitted unless no other access is reasonably available.
- j. <u>Planning Characteristics</u>
 - 4. Arterials should be spaced from one half $(\frac{1}{2})$ to one (1) mile apart and, where possible, should be continuous.
 - 5. Arterials should act as boundaries between neighborhood areas.
 - 6. Full Intersection spacing shall be one-quarter $(\frac{1}{4})$ mile.
- k. <u>Type of Curb and Gutter</u>

Six-inch (6") vertical curb and gutter with six-inch (6") vertical median curb and gutter (if applicable).

I. <u>Sidewalk Width</u>

Five feet (5') wide attached, or detached.

m. <u>Street Widths</u>

Four (4) twelve-foot (12') paved travel lanes, one (1) fourteenfoot (14') raised or painted median or left turn lane, two (2) sixfoot (6') bike lanes, two (2) two-foot (2') gutter pans and two (2) one-foot (1') median gutter pans if applicable); seventyeight (78') flowline to flowline. Left and right turn lanes; acceleration and deceleration lanes required at intersections, as necessary.

n. <u>Minimum Radius of Curvature on Centerline (Horizontal)</u>

See Table 3.3.

o. <u>Minimum Length of Vertical Curves</u>

See Table 3.6.

p. <u>Minimum Length of Tangents Between All Curves</u>

Three hundred feet (300').

q. <u>Street Grades</u>



A minimum longitudinal grade of one percent (1.0%) shall be required along the centerline of all Collector and Arterial streets. Maximum grade five percent (5.0%) (See Table 3.6). Also, see Section 3.4, Drainage. In certain cases, grades less than one percent (1.0%) may be permitted with the Town Engineer's approval.

r. <u>Curb Return Radii</u>

See Table 3.4.

3.3 SIDEWALKS, BICYCLE LANES, CURBS, GUTTERS AND DRIVEWAYS

- 3.3.1 Roadway typical sections shall be as specified by these Roadway Standards and the most recent edition of the *AASHTO Bicycle Manual*.
- 3.3.2 The sidewalks required by this section shall be constructed in accordance with the Town 's Engineering Standards, except that the Town may permit the installation of walkways constructed with other suitable materials when it has been concluded that:
 - a. Such walkways would serve the residents of the development as adequately as concrete sidewalks; and
 - b. Such walkways would be more environmentally desirable or more in keeping with the overall design of the development.
- 3.3.3 Whenever the Town finds that a means of pedestrian access is necessary from the subdivision to schools, parks, playgrounds, or other roads or facilities, and that such access is conveniently provided by sidewalks adjacent to the streets, the developer may be required to reserve an unobstructed easement of at least thirty feet (30') in width to provide access.
- 3.3.4 All public sidewalks shall be constructed to a minimum thickness of six inches (6") from four thousand (4,000) psi concrete. Private sidewalks may be constructed to a minimum thickness of four inches (4"). This does not apply to sidewalks that are to become the property of an HOA, in which case public standards shall apply.
- 3.3.5 Sidewalks or bicycle paths shall be constructed on both sides of all roadways as directed by the Town Engineer and in accordance with the Town of Kersey Comprehensive Plan.
- 3.3.6 Where "on-street" bicycle lanes are shown on the Town of Kersey Comprehensive Plan an additional six feet (6') of street width and ROW shall be added, in addition to the requirements of these Sections, to accommodate the bicycle lane.
- 3.3.7 Off-Street bikeways shall have ROW reserved and dedicated in accordance with Section 3.17.



- 3.3.8 All sidewalks shall have a minimum width of five feet (5') for local, commercial, collector and arterial streets.
- 3.3.9 Vertical or rollover curb, gutter and detached or mountable walk shall be used on all roadways.
- 3.3.10 State law requires that curb ramps be installed at all intersections and at certain mid-block locations, for all new construction or reconstruction of curb and sidewalk (CRS 43-2-107[2]). Curb ramps shall be constructed in accordance with the Details herein and, if required, in accordance with the Details found in the CDOT Standards. Curb ramps shall be shown at all curb returns, and must be shown (located) at all "T" intersections directly opposite either curb return. Whenever referencing a curb ramp, call out the specific Standard Detail to be used to construct that ramp. On local streets only, mid-block curb ramps should be constructed per the Details and if required, in accordance with the CDOT M-Standard for Curb Ramps.
- 3.3.11 Where curb cuts are allowed based on traffic considerations, concentrated storm water runoff must not be discharged across the sidewalk. These flows must be directed to a sidewalk chase section. If this is not possible due to grading constraints, radius returns and a crosspan must be used.
- 3.3.12 Curb cuts and driveways shall be constructed in accordance with the Details in the Appendix.
- 3.3.13 On all Town major collectors and arterials, wherever desirable, underpass or overpass (grade separated) pedestrian crossings will be provided for regional/neighborhood trails.
- 3.3.14 The provision of a bicycle circulation system must be considered in all developments. Walks or combination sidewalk/bicycle lanes, which serve both pedestrians and bicyclists, shall be at least ten feet (10') wide.
- 3.3.15 Pedestrian routes must occur along streets and extend into major accessible open space areas. Pedestrian and bicycle circulation within each parcel shall tie into the larger community systems.
- 3.3.16 Sidewalks may be eliminated along one or both sides of major streets if adequate provisions are made for alternative pedestrian circulation-ways.
- 3.3.17 Bicycle parking areas must be provided for all commercial, office and industrial developments. Bicycle parking areas should be located near building entries, but should not encroach into Pedestrian walkways.

3.4 DRAINAGE

The minor and major storm drainage systems are designed in accordance with the Section 6 of this manual. Because safe and efficient conveyance of traffic is the primary function of roadways, the storm drainage function of the roadway, (such as allowable



gutter capa Town and street overtopping), will be designed to the limits set forth in Section 6 of this manual.

- 3.4.1 Cross Pans
 - 3.4.1.1 Cross pans shall be constructed in accordance with the Details. Cross pans are not permitted across entry streets, collector roadways, or arterial roadways but may occur parallel to these streets across a local street intersection.
 - 3.4.1.2 If pavement is concrete, any drainage conveyance, such as cross pans, may be poured monolithically with the main line paving process.
 - 3.4.1.3 On a case-by-case basis, if an excessive length of storm drain must be constructed to comply with this requirement, causing undue financial hardship, a variance may be requested to use a ten-foot (10') wide cross pan across a local street, an entry street, or a minor collector roadway. If there is storm line in the street, and within a reasonable distance, no crosspans shall be allowed, except along local streets.
 - 3.4.1.4 No mid-block cross pans will be permitted within the Town of Kersey, under any circumstances.
- 3.4.2 Inlets

Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by the storm runoff. Refer to *Stormwater Regulations* for determining curb capacity. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Inlets are not allowed in the curb return, but will be located at or behind the tangent points of the curb returns. Minimum inlet length for Type R inlets shall be five feet (5').

- 3.4.3 Cross Slope
 - 3.4.3.1 Except at intersections, or where superelevation is required, roadways shall be level from top of curb to top of curb (or flowline to flowline) and shall have a two percent (2.0%) crown. At or within the "L" distance shown in Figure 3.1, the maximum elevation difference between flowlines is that dictated by the allowable intersection grade and the actual distance between flowlines.
 - 3.4.3.2 Parabolic or curved crowns are not permitted. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street.
- 3.4.4 The rate of change in pavement cross slope, when warping side streets at intersections, shall not exceed one percent (1.0%) every twenty-five feet (25') horizontally on a local roadway, one percent (1.0%) every thirty-seven and one-half feet (37 ½') horizontally on a collector roadway, or one percent (1.0%) every



fifty-six and one-half feet (56 ½') horizontally on arterial roadways (See Section 3.7).

3.4.5 Temporary Erosion Control

Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with Section 6 of these Standards, County, and CDPHE requirements and standard practice for erosion control utilized throughout the Region.

- 3.4.6 Sidewalk Chases
 - 3.4.6.1 Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks, but shall drain to the roadway by use of chase sections. Sidewalk chase sections shall not be located within the curb cut or driveway. Hydraulic design shall be in accordance with Section 6 of these Standards. Sidewalk chases will only be allowed in special situations, on a case-by-case basis, as determined by the Town Engineer. Sidewalk chases, when permitted, are to be used to allow surface drainage to enter into the street gutter, rather than being used to avoid the use of a standard inlet.
 - 3.4.6.2 All drainage structures shall be constructed in accordance with the Details included in the Appendix.

3.5 HORIZONTAL ALIGNMENT

3.5.1 Horizontal Curves

TABLE 3.3 HORIZONTAL CURVES

DESIGN SPEED (mph)	Max f	MINIMUM CURVE RADIUS* (FEET)
15	0.330	175
20	0.300	175
25	0.252	200
30	0.221	275
35	0.197	415
40	0.178	600
45	0.163	830

*Adapted and revised from AASHTO Exhibit 3-41 for the no superelevation case.



3.5.2 Curb Return Radii

TABLE 3.4 MINIMUM CURB RETURN RADII (Measured Along Flowline)

THROUGH STREET	ARTERIAL	COLLECTOR	LOCAL
ALLEYS	N/A	N/A	15ft.
RURAL	N/A	N/A	N/A
LOCAL	35ft.	35ft.	25ft.
COLLECTOR	50ft.	35ft.	35ft.
ARTERIAL	50ft.	50ft.	35ft.

3.5.3 Design Speed

- 3.5.3.1 Horizontal alignment design speed shall be consistent with the requirement for vertical alignment design speed.
- 3.5.3.2 If no superelevation is required and a normal crown section exists, the horizontal curve data as shown in Table 3.3 shall be used.

3.5.4 <u>Barricades</u>

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., Type 3 barricades shall be provided. Design and construction shall comply with the requirements of the most current edition of *The Manual of Uniform Traffic Control Devices*. All CDOT Standards and Details shall be shown on the construction drawings, and installation shall be provided and maintained by the developer.

3.5.5 <u>Superelevation</u>

- 3.5.5.1 Superelevation may be required for curves on arterial roadways and selected collector roadways. Horizontal curve radii and superelevation shall be in accordance with the recommendations of the latest edition of the *Policy on Geometric Design of Highways and Streets*, latest edition (Horizontal Alignment).
- 3.5.5.2 Superelevation shall not be used on local or other roadway classifications with a design speed of fifty (50) mph or less. Superelevation shall not be used without prior approval by the Town Engineer.
- 3.5.5.3 Definitions Regarding Superelevation

<u>Superelevation Runoff</u> – That length of roadway needed to accomplish the change in cross slope from a section with the adverse crown removed (flat) to the fully superelevated section, or vice versa.

Transition Points - Beginning or ending of tangent runout,



superelevation runoff or full superelevation.<u>Tangent Runout</u> – That length of roadway needed to accomplish the change in cross slope from a normal two percent (2.0%) crown section to a section with the adverse crown removed (flat), or vice versa.

3.5.5.4 General

- s. One of the most important factors to consider in highway safety is the centrifugal force generated when a vehicle traverses a curve. Centrifugal force increases as the velocity of the vehicle and/or the degree of curvature increases.
- t. It is impossible to balance centrifugal force by superelevation alone because, for any given curve radius, a certain superelevation rate is exactly correct for only one driving speed. At all other speeds there will be a side thrust either outward or inward, relative to the curve center, which must be offset by side friction.

3.5.5.5 <u>Standards for Superelevation</u>

- a. The CDOT Standards on Superelevation specify the required rate of superelevation for the various degrees of curvature.
- b. Maximum superelevation rates of 0.04 foot per foot are commonly used on major streets.

3.5.5.6 <u>Urban Street Conditions</u>

Every effort should be made to maintain standard rates of superelevation. However, in urban areas, street intersections, established street grades, curbs and drainage conditions may require a reduction in the rate of superelevation, or different rates for each half of the roadbed. In warping areas for drainage, adverse superelevations should be avoided.

3.5.5.7 Effect of Grade

Drivers tend to travel somewhat faster in the downgrade than in the upgrade direction. This should be recognized in the designs for divided highways and ramps on steep grades.

Where practical, the designer should use a higher design speed for the downgrade and a lower design speed for the upgrade. The variation of design speed will depend upon the rate and length of grade and the degree of curvature compared with other curves on the highway section.

3.5.6 <u>Cul-de-sacs</u>



Criteria for cul-de-sacs shall be in accordance with the requirements of Section 3.2.

3.5.7 Sight Distances

3.5.7.1 <u>General</u>

The major considerations in alignment design are safety, grade, profile, road area, design, speed, sight distance, topography, drainage, and performance of heavy-duty vehicles. Alignment should provide for safe and continuous operation at a uniform design speed. Road layout shall bear a logical relationship to existing or platted roads in adjacent properties.

3.5.7.2 Horizontal Alignment

- a. <u>Sight Distance</u>: Horizontal alignment must provide at least the minimum stopping distance for the design speed at all points. This includes visibility at intersections as well as around curves and roadside encroachments.
- b. <u>Stopping Sight Distance</u>: The minimum stopping sight distance is the distance required by the driver of a vehicle traveling at the design speed to bring the vehicle to a stop after an object on the road becomes visible. Object height is typically assumed to be two feet (2') above the road surface with the viewer's height is three and one-half feet (3 ½') above road surface. All Stopping Sight Distances shall be evaluated in accordance with the most recent edition of *Policy on Geometric Design of Highways and Streets*, latest edition, including along horizontal curves.

Typical sight distance obstructions include fences, abutments, trees, structures, sideslopes, etc. In no case shall the stopping sight distance be less than the distances specified in Table 3.5. The sight distance design procedure shall assume a six-foot (6') fence (as measured from actual finished grade) exists at all property lines except in the sight-distance triangles required at all intersections.



TABLE 3.5 STOPPING AND PASSING SIGHT DISTANCE

DESIGN SPEED (mph)	STOPPING SIGHT DISTANCE (FT)	PASSING SIGHT DISTANCE (FT)
20	115	710
25	155	900
30	200	1,090
35	250	1,280
40	305	1,470
45	360	1,625
50	425	1,835
55	495	1,985

From Policy on Geometric Design of Highways and Streets, latest edition.

- c. <u>Passing Sight Distance</u>: Passing sight-distance is the minimum sight distance that must be available to enable the driver of one vehicle to pass another safely and comfortably without interfering with oncoming traffic traveling at the design speed. Two-lane roads should provide adequate passing zones. Minimum required passing sight distances for specified design speeds are given in Table 3.5.
- d. <u>Intersection and Driveway Sight Distance (Sight Triangle)</u>: There shall be an unobstructed sight distance along both approaches of both sides at an intersection within the ROW for distances sufficient to allow the operators of vehicles, approaching simultaneously, to see each other in time to prevent collisions at the intersection. The sight triangle relationship developed for use in the Town is based upon the dimensions shown in Figure 3.2 for a stopped condition.
- e. Any object within the sight triangle more than thirty-six inches (36") above the flowline elevation of the adjacent street shall constitute a sight obstruction, and shall be removed or lowered. Such objects include: buildings, slope banks, hedges, trees, bushes, utility cabinets, or tall crops. This design criteria also requires the elimination of parking (except on local streets) within the sight triangle and applies whether the intersecting roads are level or on grades. The sight distance shall be measured to the centerline of the closest through lane in both directions.

3.6 VERTICAL ALIGNMENT

Vertical alignment sight distances, as with horizontal alignment, shall be evaluated in accordance with the *Policy on Geometric Design of Highways and Streets*, latest edition. Both the horizontal and vertical sight distances should be checked to ensure that the sight distance along the through street is sufficient to allow a vehicle to cross or turn left.



Design controls for vertical alignment are given in Table 3.6.

TABLE 3.6 VERTICAL ALIGNMENT CONTROLS

		MAX/(MIN) GRADE	K-VALUE RANGES		MIN V.C.L.	
	DESIGN	ALONG CENTERLIN	CREST	SAG	CREST	SAG
DESCRIPTION	SPEED	E (%)				
LOCAL/RURAL	25	5 (1)	25-30	25-30	50	50
ALLEYS	15	5 (1)	25-30	25-30	50	50
RESIDENTIAL	25	5 (1)	35-50	40-50	50	50
COLLECTOR						
MAJOR COLLECTOR	30-45	5 (1)	55-65	55-65	50	50
ARTERIAL	30-45	5 (1)	55-65	55-65	50	50
MAJOR ARTERIAL	30-45	5 (1)	115-220	90-125	110	90

Notes:

- 1. The design speed is equal to the posted speed for local streets. For Collector Streets, the design speed is considered a minimum of five (5) mph over the posted speed for all roads. The design speed of arterials is considered to be ten (10) mph over posted and design speeds are minimum for arterials.
- 2. In certain cases, grades less than the minimum grade specified in Table 3.6, may be permissible with the approval of the Town Engineer.
- 3. All vertical curves in flowlines of knuckles and bubbles shall have minimum lengths of fifty feet (50').

3.6.1 Permissible Roadway Grades

- 3.6.1.1 A minimum longitudinal flowline grade of one percent (1.0%) shall be required on all Local streets, except at curb returns, knuckles and bubbles where the minimum flowline grade shall be two percent (2.0%).
- 3.6.1.2 A minimum longitudinal grade of one percent (1.0%) shall be required along the centerline of all Collector and Arterial streets unless otherwise approved by the Town Engineer.
- 3.6.1.3 The maximum allowable grade for any roadway is shown in Table 3.6 of these regulations.
- 3.6.1.4 The maximum sideslopes in either excavated earth or earthfill will be 3 to 1, unless otherwise approved.
- 3.6.2 <u>Permissible Intersection Grades (Public Rights-of-Way)</u>
 - 3.6.2.1 The maximum permissible grade at intersections will be in accordance with Figure 3.1. These grades are maximum instantaneous flowline grades for the stated distances (each side of the street) for the minor



(intersecting) street. Desirable intersection grades should be in the range of two to four percent (2.0%-4.0%) for all intersecting streets with the limit of three percent (3.0%) for arterials.

- 3.6.2.2 The intersection grade of the major (through) street at the intersection may be dictated by design considerations for that street. The Town will dictate, however, that if the major street intersection grade exceeds three percent (3.0%), the type of access and access control to be utilized.
- 3.6.2.3 All private commercial driveways with curb return radii shall follow the standard set forth for a local street.
- 3.6.3 Changing Grades
 - 3.6.3.1 The use of grade breaks in lieu of vertical curves is not allowed.
 - 3.6.3.2 The maximum grade break allowed at the point of tangency of a curb return for local and collector roads shall be two percent (2.0%) and for arterial roadways a maximum of one percent (1.0%).
- 3.6.4 Cross Fall

Except at intersections, or where superelevation is required, roadways shall be level from top of curb to top of curb (or flowline to flowline). The distance from intersections with which "cross-fall" will be permitted shall be determined by criteria in Section 3.4.4, Cross-Slope.

3.6.5 Vertical Curves

When a longitudinal change in grade occurs, a vertical curve is to be used. Vertical Curve Design Criteria is presented in Table 3.6. All vertical curves shall be labeled, in the profile, with length of curve (L), and K. The high point and/or low point elevations, twenty-five-foot (25') stations, and PVI finished surface shall also be labeled on the profile.

All vertical curves in knuckles and bubbles shall have minimum lengths of fifty feet (50').

3.7 INTERSECTIONS

The following criteria shall apply at intersections:

- 3.7.1 The grade of the through street shall take precedence at intersections. At intersections of roadways with the same classification, the more important roadway, as determined by the Town Engineer, shall have this precedence. The design should warp intersecting streets to match through streets with minimal transition.
- 3.7.2 The key criteria for determining the elevation of the curb return on the



intersecting street and the amount of warp needed on an intersecting street transitioning to a through street are:

- a. Permissible grade in the stop/start lane (See Section 3.6.2).
- b. Pavement cross slope at the points of curvature (PCR's) of the curb returns on the intersecting street, and permissible warp in pavement cross slope (See Section 3.4.4).
- c. Normal vertical curve criteria (See Section 3.6.5).
- d. Vertical controls within the curb return itself (See Section 3.7.3).
- 3.7.3 The elevation at the PCR of the curb return on the through street is set by the cross slope grade of the through street in conjunction with normal pavement cross slope [two percent (2.0%)].
- 3.7.4 Carrying the crown of an intersecting street into the through street is not permitted. Refer to Section 3.4.4.2 for street cross slope allowances.
- 3.7.5 Dipping the flowline to the extent that the lip of gutter is dipped is not permitted. Dipping the flowline is only permitted as specified by the Details concerning curb opening inlets. Tipping an inlet for the benefit of drainage is not permitted.
- 3.7.6 A more detailed review shall be performed for arterial-arterial intersections to maximize driveability. Few arterial intersections will have a uniform two percent (2.0%) cross slope, the majority of them having one (1) or more sides warped. (See Sections 3.4.4 and 3.7.2 of this Section for rates of pavement warp allowed).
- 3.7.7 Whenever possible, intersections shall be made at right angles or radial to a curve. Intersections, that cannot meet this criterion, will require approval by the Town Engineer. Under no circumstances will any streets be permitted to intersect at angles less than eighty degrees (80°).
- 3.7.8 Intersection sight distances shall conform to the requirements of the *Policy on Geometric Design of Highways and Streets*, latest edition.
- 3.7.9 No more than two (2) streets shall intersect at one point.
- 3.7.10 Grades of Intersecting streets shall be as set forth in Figure 3.1 for the specified distance given in the table, unless otherwise approved by the Town Engineer.
- 3.7.11 The intersection of local streets with major collector or arterial streets shall be minimized. Whenever possible, proposed intersections along one (1) side of the street shall coincide with existing or proposed intersections on the opposite side of such street. In any event, where a centerline offset or jog occurs, at an intersection, the distances between centerlines of the intersecting streets shall not be less than one hundred fifty feet (150'). Roads with medians are exempted from this requirement.



3.7.12 Unless no other alternative is practicable or legally possible, no two (2) streets may intersect with any other street on the same side at a distance of less than three hundred feet (300') measured from centerline to centerline of the intersecting streets. When the intersected street is an arterial, the distance between the intersecting streets shall be six hundred sixty feet (660'). This does not apply to residential streets.

3.8 CURB RETURN PROFILES

Curb return profiles are required for radii equal to or greater than thirty feet (30') within the public ROW. A midpoint and both PCR's elevations along the arc length of the curb return shall be shown in plan view for all radii less than thirty feet (30'). Curb return design shall be set in accordance with the following design procedure. General standards for flowline control and profiles within the curb returns shall be as follows:

- a. The point of tangency at each curb return shall be determined by the projected tangent grade beginning at the point of intersection (P.I.) of the flowlines.
- b. The arc length of the curb return shall be computed and indicated on the drawing.
- c. Show the corresponding flowline grade for each roadway beyond the PCR.
- d. Design the flowline of the curb return such that the maximum slope along the flowline does not exceed eight percent (8.0%). The minimum slope shall be one percent (1.0%). Grade breaks at the PCR's will not exceed two percent (2.0%) for local and collector streets and one percent (1.0%) for arterials. Vertical curves will equal the arc length of the curb return. The elevation and location of the high or low point within the return, if applicable, is to be designated in the profile. Warp of the intersecting streets shall meet the normal roadway cross-section of the street within the "L" distance shown on Figure 3.1. No more than a one foot (1') vertical difference in elevation across the street at the PCR's is allowed.
- e. Curb return radii shall be shown.

3.9 CONNECTION WITH EXISTING ROADWAYS

- 3.9.1 Connections with existing roadways shall be smooth transitions conforming to normal vertical curve criteria (See Section 3.6) if the algebraic difference in grade (A) between the existing and proposed grade exceeds one-half percent (0.50%). When a vertical curve is used to make this transition, it shall be fully completed prior to the connection with the existing improvement, and shall also comply with the grade requirements at intersection approaches.
- 3.9.2 Existing grade shall be shown for at least three hundred feet (300') with field verified record drawings showing stations and elevations at twenty-five foot (25') intervals. In the case of connection with an existing intersection, these record drawings are to be shown within a three hundred foot (300') radius of the



intersection. This information will be included in the plan and profile of the proposed roadway.

- 3.9.3 Limits and characteristics of the existing improvements are the primary concern in the plan view. Such characteristics include horizontal alignment, off-site intersections, limits of the improvement, etc.
- 3.9.4 Previously approved designs for the existing improvement are not an acceptable means of establishing existing grades; however, they are to be referenced on the construction plan.
- 3.9.5 The basis of the as-built elevations shall be the same as the design elevations (both flowlines or both top or curbs, etc,) when possible. All elevations shall be based on USGS or other datum approved by the Town Engineer.

3.10 OFF-SITE DESIGN

The design grade, and existing ground at that design grade, of all roadways that deadend due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least five hundred feet (500') or to its intersection with another roadway. This limit shall be extended to one thousand feet (1,000') when arterial roadways are being designed.

3.10.1 If the off-site roadway, adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition for the safe conveyance of traffic from his improved section to the existing roadway. The following formula shall be applied to the taper of lane change necessary for this transition:

 $L = WS^{2}/60$

Where:

 $L = Length of transition in feet \\ W = Width of offset in feet \\ S = Speed limit or 85th percentile speed.$

3.10.2 The Town Engineer should be contacted to approve unusual transition criteria. This contact is the responsibility of the applicant.

3.11 ACCELERATION/DECELERATION LANES

The design of the arterial street system depends upon the proper control of access to developments. The location and design of access points must minimize traffic hazards and interference to through traffic movements. Acceleration/Deceleration lanes shall be designed in accordance with the most recent edition of the *State of Colorado, State Highway Access Code*, appropriate Sections of the *CDOT Road Design Manual*, and applicable CDOT Standards. The need for acceleration or deceleration lanes shall be established by the approved traffic impact study for the final plat or final development plan.



3.12 BUS PULLOUT LANES

If recommended by the Regional Transportation District, bus pullout lanes shall be designed and constructed by the adjacent developer.

3.12.1 The design of the pullout lanes will be governed by dimensions shown in Table 3.7 and shall be reviewed and approved according to procedures set forth in these Engineering Standards.

TABLE 3.7 BUS PULLOUT LANES

SPEED LIMIT	4.1.1.1 LEAD-IN LENGTH	LEAD-OUT LENGTH
35 mph and Under	60ft.	60ft.
40 mph	100ft.	70ft.
45 mph	150ft.	80ft.
50 mph	200ft.	90ft.
55 mph	250ft.	100ft.

3.12.2 Bus pullouts shall be constructed with no less than fifty feet (50') between an intersection curb return curve (PCR) and end of the lead-in taper.

3.13 CONSTRUCTION TRAFFIC CONTROL

3.13.1 Pedestrian Traffic

Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times. Flaggers shall be provided for guidance as necessary.

- 3.13.1.1 Where an excavation interrupts the continuity of the sidewalk, the contractor shall provide suitable bridge or deck facilities, to be supplemented by the use of such proper devices and measures as prescribed in the Manual of Uniform Traffic Control Devices most recent edition, for the safe and uninterrupted movement of pedestrian traffic. The edges or ends of the pedestrian bridge or decking shall be beveled or chamfered to a thin edge to prevent tripping.
- 3.13.1.2 Temporary diversion walkways shall be hard surfaced, and electric lighting shall be provided and kept on continuously during hours of darkness, unless otherwise directed by the Town Engineer.
- 3.13.1.3 Unless otherwise authorized by the Town Engineer, pedestrians shall not be forced to walk on a traveled portion of a roadway.
- 3.13.1.4 Under certain conditions, it may be necessary to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or at marked pedestrian crossovers,



with the Town Engineer's approval.

3.13.1.5 Facilities satisfactory to the Town Engineer shall be provided for pedestrians crossing at corners, pedestrian crossovers and public transportation stops.

3.13.2 Vehicular Traffic

- 3.13.2.1 Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the most recent edition of The Manual of Uniform Traffic Control Devices, and applicable Town Traffic Regulations. A Traffic Control Plan shall be submitted and accepted by the Town Engineer or his designate prior to the start of any construction.
- 3.13.2.2 During construction of new facilities, traffic control should strive to keep the motorist from entering the work area. The primary means to accomplish this is by use of temporary barricades and appropriate signage, located in advance of the point where new construction begins. New construction shall not be opened to traffic, nor shall construction traffic control be removed, without the approval of the Town Engineer.
- 3.13.2.3 The latest edition of Manual on Uniform Traffic Control Devices shall be the basis upon which the construction traffic control plan is designed, in concert with proper, prudent and safe engineering practice. All necessary signing, striping, channelization devices, barricades, etc. shall be shown on the plan.
- 3.13.2.4 In concept, Town streets shall not be closed overnight, and work shall not force road or lane closures before 8:30 a.m. or after 3:30 p.m. If exceptions to this are required, this shall be so noted on the construction traffic control plan and must be specifically approved by the Town Engineer.
- 3.13.2.5 Directional access on roadways may be restricted with a minimum travel lane width in construction area of ten feet (10'), but proper controls including flagging must be indicated. Removal of on-street parking should be considered, and noted where applicable.

3.14 MEDIAN ISLANDS

- 3.14.1 Median islands shall be designed per the Details as set forth herein.
- 3.14.2 The nose of the median island shall not extend past the curb return at the intersection and shall be designed to allow for clear passage of turning vehicles.
- 3.14.3 Landscaping on median islands shall have a mature height of twenty-four inches (24") or less above the traveled way in areas around intersections to facilitate adequate sight distance and will preferably be dry land or native vegetation. If



irrigation is planned for a median island, mitigation will be provided to protect the subgrade under the pavement from being saturated by using the median island detailed in the Details in the Appendix.

- 3.14.4 A minimum flowline to flowline dimension of twenty feet (20') must be maintained on both sides of all median islands. Refer to Roadway Section Details in Appendix I for required flowline to flowline dimensions for specific roadway classifications.
- 3.14.5 When median islands are constructed/designed for concrete streets and the island is hardscape, the developer shall install twice the thickness of the expansion material on each side of the median between the back of curb and "hardscape" and seal the expansion material.
- 3.14.6 Median islands four feet (4') wide or less may not be landscaped and must be designed as stamped or patterned concrete. All median materials, including colors, shall be approved by the Town Engineer to ensure uniformity of construction throughout the Town.

3.15 SIGNAGE AND STRIPING CRITERIA

Because the Town will maintain the permanent traffic control devices on public ROW, all traffic control devices shall be fabricated and installed in accordance with these Standards. A signage and striping plan and detail sheet, approved by the Town Engineer, shall be included in all sets of construction plans.

Permanent signage and striping shall be completely in place before any new roadway is opened to the public. These Standards are to be used in conjunction with other applicable Town Standards.

Traffic signal installation and equipment shall conform to *Construction Methodology and Materials* as set forth by CDOT. All signals, signs and other traffic control devices shall be installed in accordance with the most current edition of *The Manual on Uniform Traffic Control Devices (MUTCD)*. Signal Warrants shall be met for signal installation.



3.15.1 <u>Reflectivity</u>

All traffic control devices and all regulatory signs must have reflective materials. All reflective materials must qualify at 70-candlepower (E.G.) or above (High Intensity). All signs, or traffic control devices, must have a seven-year materials warranty. Regulatory signs must be <u>high intensity</u> grade reflectivity or greater; in particular, all STOP, YIELD, or DO NOT ENTER signs.

3.15.2 Design and Size

Sign specifications and diagrams are detailed in the latest editions of *MUTCD* and the Federal *"Standard Highway Signs."* (Publication available from the U.S. Department of Transportation, Federal Highway Administration, 1979.) Acceptable sign sizes are listed in the standard column of the table printed with each diagram. Expressway and construction signs will be a minimum thirty-six inches (36"). Stop signs used at major roadway intersections shall be a minimum thirty-six inches (36").

3.15.3 Backing Plates

Aluminum blanks of .080 gauge is standard, except for signs larger than 36 x 36 inches, which shall be .100 or .125 gauge aluminum.

3.15.4 Posts and Boots

- 3.15.4.1 Signs shall be mounted on two and one-quarter inch by two and one-quarter inch (2 ¼" x 2 ¼") square galvanized steel tubing, all four sides punched with 3/8-inch holes at one inch (1") centers. Refer to the Details in Appendix I of these Standards. Posts must be of appropriate length to pass the MUTCD specifications for the location, must conform to CDOT Specification Section 614, and must meet the Federal breakaway standards. Installation boots are to be two and one-fourth inch by three feet (2 ¼" x 3') four (4) punch tubing, driven down flush to within one inch (1") of ground level.
- 3.15.4.2 Sign boots are to be driven a minimum of three feet (3') into the ground, and longer boots may be required because of soil composition and compaction.
- 3.15.4.3 The height to the bottom of the sign assembly shall be at least eight feet (8') above the adjacent roadway crown, when installed exclusively for street name posting. When combined with traffic control (STOP or YIELD) signs, the street name sign assembly shall be at least nine feet (9') above the adjacent roadway crown.
- 3.15.4.4 Post caps and crosses shall have five-inch by one fourth inch (5" x $\frac{1}{4}$ ") slots for plates.
- 3.15.4.5 Street name assembly should be located at the point of curvature of the corner radius and should be placed according to the Details in



these Standards. When street name assembly is combined with regulatory signs, sign placement for the regulatory sign shall govern.

3.15.5 Street Names, Addresses and Signs

Street names shall be assigned by the developer and are subject to the Town 's approval. Proposed streets that are in obvious alignment with existing streets shall be given the same name. Newly created streets shall be given names that neither duplicate nor are phonetically similar to existing streets within the Town 's planning jurisdiction, regardless of the use of different suffixes.

- 3.15.5.1 Building Addresses shall be assigned and/or approved by the Town .
- 3.15.5.2 Six-inch (6") plates up to thirty inches (30") long may be used at all minor intersections, minimum two (2) plates per street sign assembly. Nine-inch (9") plates shall be used at all major intersections. All nine-inch by three-sixteenth-inch (9" x 3/16") and six-inch by thirty-inch (6" x 30") plates will be installed, two (2) for each road, minimum four (4) plates per street sign assembly and shall be installed with end bolts on all plates. In the instance where a street changes names, such name changes should be designated on the street name assembly by using directional arrows and will require two (2) additional plates.
- 3.15.5.3 Street name assembly should be located at the point of curvature of the corner radius and should be placed according to the following, as measured from the edge of the sign. When the street name assembly is combined with regulatory signs, sign placement for the regulatory sign shall govern. See Details.
- 3.15.5.4 The height to the bottom of the sign assembly shall be at least eight feet (8') above the adjacent roadway crown, when installed exclusively for street name posting. When combined with traffic control (STOP or YIELD) signs, the street name sign assembly shall be at least nine feet above the adjacent roadway crown.
- 3.15.5.5 Sign assemblies shall be installed on standard one and three-quarterinch (1 ³/₄"), four (4) punch square tubing, (three-eighths-inch (3/8") diameter holes on one inch (1") centers, galvanized), or mounted on available utility poles with suitable hardware, when required lateral clearance can be achieved.
- 3.15.5.6 When street name sign assemblies are posted with the traffic control, posts must be standard two-inch (2") tubing, using two and onequarter inch by three-foot (2 ¼" x 3') boots driven until flush with the grade. For exclusive street name installations, standard one and three-quarter inch (1 ¾") tubing with two-inch by three-inch (2" x 3") boots may be used.
- 3.15.5.7 Sign boots are to be driven a minimum of three feet (3') into the ground. Longer boots may be required because of soil composition



and compaction.

- 3.15.5.8 Post caps and crosses shall be 5 inch x ¹/₄-inch slots for plates.
- 3.15.5.9 All street signs will be high intensity white on reflectorized green.

3.15.6 Criteria on Special Allowances for Street Name Sign Variations

- 3.15.6.1 Plans for any variances must be submitted to and reviewed by the Town Engineer. List all specific variances from the Town Details in the special footnote box on the first page of the plans.
- 3.15.6.2 All street name signage size and reflectivity (red may not be used as background color) shall meet or exceed Town standards.

3.15.7 Consultant Engineer's Responsibility

These requirements for signage are intended for typical applications of signage and striping for standard conditions. These regulations do not alleviate the responsibility of the Consultant Engineer from exercising sound engineering judgment or from exceeding minimum standards in specific cases where conditions warrant.

3.15.8 Striping

- 3.15.8.1 All new striping on newly constructed streets shall meet the minimum standards for thermoplastic or epoxy applications.
- 3.15.8.2 All striping shall be in compliance with the most current editions of the MUTCD.
- 3.15.8.3 All temporary striping shall conform to the most current edition of *Standard Specifications for Road and Bridge Construction* published by the CDOT. All temporary markings shall be removed prior to the installation of the thermoplastic.
- 3.15.8.4 All stop bars shall be white and a minimum of twelve inches (12") wide. All centerline striping shall be yellow and four inches (4") wide. All raised crosswalk striping shall be white and a minimum of eight inches (8") wide.
- 3.15.8.5 All striping shall be shown along with signing on the roadway plans of the construction plans or on a separate sheet if the roadway design is for a collector or arterial roadway.

3.16 FIRE LANES

Any secondary access not constructed as part of the dedicated public street system shall meet the following design criteria in addition to the roadway design criteria within



these Standards. Fire lanes shall be required when safe access to structures within a Project is limited. The requirement for fire lanes shall be determined in the preliminary plat process by the Fire Department and/or Planning Commission.

3.17 REQUIRED RIGHT-OF-WAY DESIGNATION

- 3.17.1 At the time of final plat approval, the developer must dedicate to the Town the rights-of way required in these Sections along with all streets, alleys, walks, open space and easements shown on the plat, unless there are exceptions specifically noted on the plat. The dedicated ROWs will be shown on the final plat along with the dedication endorsement. Such dedication may be required to be made to the appropriate special district, or as required otherwise by the Town , with reversion clauses to the Town included.
- 3.17.2 Where trails or bikeways are shown on the Town of Kersey Comprehensive Plan as crossing a parcel proposed for development, the developer shall work with the Town to establish an alignment through the parcel and dedicate this alignment to the Town . In general, the width for trail or bikeway dedication shall be thirty feet (30'), if not associated with a street, unless otherwise approved by the Town . Areas dedicated for trails or bikeways may be included in the open space requirements of the development.

3.18 BRIDGES

All bridges shall be constructed in accordance with the most recent edition of the CDOT Standards for Roadway and Bridge Construction, except that bridges on streets not intended for public dedication may be approved, if designed by a licensed engineer.

3.19 TRAFFIC CALMING

Traffic calming involves changes in street alignments, installation of barriers, and other physical measures to reduce traffic speeds and/or cut-through volumes, in the interest of street safety, livability and other public purposes. It is the combination of physical measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users.

What is a safe and livable street? Many studies have shown that residents are more satisfied with the street environment when traffic volume speeds are low to moderate. Tolerable limits appear to be less than eight hundred (800) vehicles per day and top speeds of twenty (20) mph.

The Town of Kersey's Standards recognize the need to balance safety, efficiency of service, livability, and economy. A hierarchy of street classifications has been established, with the higher classification (arterials and major collectors) designed to carry higher volumes and higher speeds, and the lower classifications (minor collector and local streets) designed primarily to provide land access with expected lower volumes and lower speeds. Clearly, traffic calming measures would not be appropriate on arterials or major collectors. Minor collectors or local streets should be designed with traffic calming in mind.



In identifying streets that may be candidates for traffic calming measures, traffic volume and unimpeded street length should be considered. Unimpeded street length is the distance between speed impediments, i.e., stop signs, traffic signals, sharp turns, cul-desacs, etc. Streets that generally will require implementation of traffic calming measures are listed in Table 1.8 along with minimum criteria to qualify for Traffic Calming.

TABLE 3.8MINIMUM CRITERIA FOR TRAFFIC CALMING

Classification	Unimpeded Street Length	Traffic Volume
Local Street	> 1,200 feet	< 500 vpd
Local Street	> 900 feet	500 – 1,000 vpd
Minor Collector	> 900 feet	> 1,000 vpd

vpd = vehicles per day

There are many types of traffic calming measures that could be used on streets predicted to have higher than desired speeds or traffic volumes. The Institute of Transportation Engineers (ITE) has published several reports describing traffic calming measures and their effectiveness, including:

- Transportation Planning Handbook, latest edition
- Traffic Engineering Handbook, latest edition
- Traffic Calming: State of the Practice, latest edition

These resources should be consulted to identify and design appropriate traffic calming measures applicable for new developments. In general, vertical elements such as speed bumps and humps should be avoided, while horizontal elements such as roadway narrowing, medians, bulbouts and traffic circles, etc., should be used.



SECTION 4: ACCESS REQUIREMENTS AND CRITERIA

4.1 GENERAL

Access to Town streets and roadways are approved through one of two (2) mechanisms: (1) For new developments, access is granted through Town BOARD approval on the final plat; (2) To obtain access from existing developed property to Town streets, the mechanism is dependent on the zoning:

- 4.1.1 For Planned Developments, new or altered access must be obtained through the Town 's Platting Process. This involves applying through Planning Commission to create or amend the property's final development plan. The application should be accompanied by appropriate plans for the proposed access and technical justification, including justification for the extent of improvements proposed at the access point.
- 4.1.2 For ordinary-zoned property, application for access can be made using the Town 's Permit Application procedure. This application should be accompanied by plans of the proposed access and technical justification for the access and associated public improvements.

The Town Engineer is available to provide advice on the extent of technical justification required for any access request. It is recommended that this advice be sought prior to submitting any application.

All residential permits shall be issued through the Town 's Town Engineer. The Town Engineer will continue to review all commercial and industrial access (Site Plans) and State Highway access requests.

4.2 CRITERIA FOR ACCESS ONTO TOWN ROADWAYS

4.2.1 <u>State Highways</u>

Access to State Highways is governed by the most current State Highway Access Code.

4.2.2 Major Arterials

All new freeway access in the Town shall meet the requirements of the Colorado Department of Transportation.

- 4.2.2.1 An Access Permit must be obtained from the Town for any private access constructed to an arterial. In general, the Town will require an Access Management Plan to be developed and approved for all arterials.
- 4.2.2.2 Generally, no private direct access shall be allowed onto an arterial, unless a signal progression plan has been approved. Private direct access to arterials may be permitted only when the property in question has no other reasonable access to the general street system, or when denial of direct access to the arterial and alternative



direct access to another roadway would cause unacceptable traffic operation and safety problems to the overall traffic flow of the general street system. When private access must be provided, the following shall be considered:

- 4.2.2.2.1 Such access shall continue only until the time that some other reasonable access to a lower function category street is available and permitted. The Access Permit should specify the future reasonable access location(s), if known, and under what circumstances, what changes will be required.
- 4.2.2.2.2 No more than one (1) access shall be provided to an individual parcel, or to contiguous parcels, under the same ownership, unless it can be shown that: (1) allowing only one access conflicts with safety regulations, (e.g., fire access); or (2) additional access would significantly benefit safety and operation of the highway or street and is necessary to the safe and efficient use of the property.
- 4.2.2.2.3 An access shall be limited to right turns only, unless: (1) it has the potential for signalization; (2) left turns would not create unreasonable congestion or safety problems and lower the level of service; and (3) left turns would not cause unacceptable traffic operation and safety problems to the general street system.
- 4.2.2.3 Public direct access to an arterial, where left turns are to be permitted, must meet the following signal spacing criteria. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements of 4.2.2.2.c above. No local streets shall be permitted to intersect arterials.

4.2.2.4 Spacing and Signalization Criteria

In general terms, full access to arterials shall be limited to one-half $(\frac{1}{2})$ mile intervals, plus or minus approximately two hundred feet (200'), in order to achieve good speed, capacity and optimal signal progression. However, to provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization.

4.2.3 Major and Minor Collectors

- 4.2.3.1 Private access to collectors shall be governed by the following curb opening and driveway criteria. Single family residence access to collectors is not permitted, unless access to a lower function category street is not available.
- 4.2.3.2 Public streets shall intersect minor collectors not closer than two hundred fifty feet (250') from each other (centerline to centerline), and



shall intersect major collectors not closer than six hundred and sixty feet (660') from each other (centerline to centerline). On minor collectors, the closest local street intersection to an arterial shall be three hundred thirty feet (330') from the arterial (ROW line of arterial to centerline of local street), and on major collectors shall be six hundred and sixty feet (660') from the arterial (ROW line of arterial to centerline of local street). On minor collectors with an ultimate projected traffic volume of less than 2,500 V.P.D., intersection spacing may be two hundred fifty feet (250') (centerline to centerline) for first intersection from an arterial; two hundred ten feet (210') (centerline to ROW of arterial).

4.2.4 Local Streets

- 4.2.4.1 Private access to local streets shall be governed by the following curb opening and driveway criteria.
- 4.2.4.2 Public streets should not intersect local roadways closer than one hundred twenty-five feet (125') from each other (centerline to centerline). On a local street, the closest intersection to a collector street shall be at least two hundred ten feet (210') (centerline to centerline), and to an arterial street, the closest intersection shall be two hundred ten feet (210') (arterial ROW line to local street centerline).

When entry streets are used, the closest local street to an arterial shall be one hundred sixty feet (160') (centerline of local street to ROW of arterial); the closest local street to a minor collector shall be one hundred sixty feet (160') (centerline to centerline); and the closest street to a major collector shall be one hundred eight feet (180') (centerline to centerline).

4.2.4.3 <u>General Information</u>

The closest local street intersection to an arterial, (measured from the arterial ROW to the local street centerline), along a:

Major Collector	660 feet
Minor Collector	330 feet
Minor Collector <2500vpd	210 feet
Entry Street	160 feet

4.3 BASIC PRINCIPLES FOR CURB OPENINGS AND DRIVEWAYS

4.3.1 Certain control values for curb openings and driveways require minimum dimensions in some instances and maximum values for other dimensions. The design of curb openings and driveways within the range of these dimensions will provide for good service on the part of the motorist using the driveway, while at the same time minimizing the interference to the traffic using the street. By controlling the location and width of openings or driveways along the street, it will be possible to avoid or eliminate long, open stretches where motorists can



indiscriminately drive onto the street. The width of opening established in these Standards is based on studies that indicate that the various width openings will accommodate vehicles of maximum size authorized on Town streets and highways. In case of a conflict between requirements in the various sections of this Section, the more restrictive condition will normally apply.

- 4.3.2 The opening or driveway width should be adequate to properly handle the anticipated traffic volume and character of traffic, as well as being within the limits specified for the type of property development. The controls established for curb openings and driveways shall apply to existing streets as well as new streets that may be developed in the future.
- 4.3.3 To the greatest extent possible, all openings for driveways shall be located at the point of optimum sight distance along the street. For openings and driveways to commercial establishments and service stations, there shall be sufficient space reasonably cleared of any obstructions, such that drivers entering the property will have sufficient sight distance to enable them to make proper and safe movements. The profile of a driveway approach and the grading of the adjacent area shall be such that when a vehicle is located on the driveway outside the traveled portion of the street, the driver can see a sufficient distance in both directions so as to enable him to enter the street without creating a hazardous traffic situation. The driveway profile grade within public ROW shall not exceed four percent (4.0%).
- 4.3.4 Any adjustments which must be made to utility poles, street light standards, fire hydrants, catch basins, traffic signs and signals, or other public improvements or installations which are necessary as the result of the curb openings or driveways, shall be accomplished without any cost to the Town . Also, any curb opening or driveway which has been abandoned shall be restored by the property owner, except where such abandonment has been made at the request of, or for the convenience of, the Town .
- 4.3.5 Driveway approaches serving as an entrance only or as an exit only, shall be appropriately signed by, and at the expense of, the property owner. The property owner will be required to provide some physical means of ensuring that the motorists will use the driveway either as an entrance only or an exit only, but not both.

4.3.6 Rural Road Access from Private Property

New driveway accesses from private property to an existing graveled Town road shall be required to install a minimum of six inches (6") of compacted Class 6 aggregate base course or equivalent material from the ROW line to the edge of the traveled roadway. The width of the driveway within the ROW shall be sixteen to twenty-two feet (16'-22') and a minimum twenty-four-inch (24") diameter corrugated metal pipe (CMP) culvert, with flared end sections, shall be required at the established ditch flowline. A sketch plan of the installation must be submitted with the access permit application. CMP culverts are only allowed for private residential driveways, not for storm sewer or commercial driveways.

4.3.7 Access to Roadways with No Curb and Gutter



Private drive access to local, collector or arterial roadways that have no curb and/or gutter improvements shall be constructed to meet the following requirements:

- 4.3.7.1 Drive shall extend from ROW line to edge of existing driving surface and shall be constructed of either of the following, as approved by the Town Engineer:
 - a. A minimum of five inches (5") of concrete pavement over four inches (4") of Class 6 aggregate base material.
 - b. A minimum of four inches (4") of asphalt pavement over six inches (6") of Class 6 aggregate base material, i.e., minimum acceptable roadway pavement design.
- 4.3.7.2 The drive entrance shall be a minimum of sixteen feet (16') wide, maximum of twenty-two feet (22'), in the Town ROW.
- 4.3.7.3 A twenty-four-inch (24") diameter CMP culvert, or comparable size arch or elliptical pipe, shall be installed at the established roadside ditch flowline beneath the private drive access.
- 4.3.7.4 At no time will it be acceptable for asphalt or concrete pavement to be placed directly on the culvert.
- 4.3.8 Maintenance of the access and drainage improvements within the Town ROW shall be the responsibility of the adjacent property owner.

4.4 DEFINITION OF TERMS

Several terms are used herein which have a somewhat distinct meaning. For the purpose of clarity, the definitions of some of these terms are listed below:

<u>Width of Curb Opening (W)</u> – The width of curb opening measured at the curb line. For commercial and industrial driveways, see Table 4.1.

Edge Clearance (E) – The distance measured along curb line from the nearest edge of the curb opening to a point where the property line extended intersects the curb line.

<u>Corner Clearance (C)</u> – At an intersecting street, the distance measured along the curb line from the projection of the intersecting street flowline to the nearest edge of the curb opening.

Distance Between Double Driveways (D) – The distance measured along the curb line between the inside edges of two (2) adjacent curb openings.

<u>Setback(S)</u> – The lateral distance measured perpendicular to the street ROW line and extending from the ROW line to the closest point of a building or other permanent appurtenance.

Frontage – The distance along the street ROW line of a single property or development



within the property lines. Corner property at an intersection would have a separate frontage along each street.

<u>**Residential**</u> – Property used primarily for residential purposes such as single family, two-family and multi-family units.

- a. <u>Single Family (SF) Residential</u> Single, detached family dwelling, units or double bungalows or duplexes.
- b. <u>Multi Family (MF) Residential</u> Three (3) or more attached dwelling units including, townhouses, condominiums and apartments.

<u>Commercial</u> – Establishments where the buying and selling of commodities, entertainment or services is carried on. Included are such uses as service stations, office buildings, restaurants, hotels, motels, banks, grocery stores, theaters, parking lots, trailer courts, and other public buildings.

<u>Service Station</u> – Any property where flammable liquids used as motor vehicle fuel are stored and dispensed from fixed equipment into fuel tanks of motor vehicles.

Industrial or Warehouse – Any establishment that manufactures or stores an article or product.

4.5 GENERAL REQUIREMENTS

4.5.1 <u>Number of Openings</u>

<u>SF Residential</u> – In general, each SF residential property shall be limited to one (1) access point.

<u>MF Residential</u> – In general, access shall be determined by information provided by the developer in the Traffic Impact Analysis and by comments generated during the Town 's review and acceptance of that study.

<u>**Commercial**</u> – In general, commercial property having less than one hundred fifty feet (150') of frontage and located mid-block shall be limited to one (1) access point to the street. An exception to this rule may be where a building is constructed in the middle of a lot and parking is provided on each side of the building.

A second access point may be allowed for commercial property and service stations having more than one hundred fifty feet (150') of frontage where there is sufficient frontage to provide for minimum and maximum requirements. For commercial property and service stations located on a corner, one (1) access to each street may be permitted.

Industrial – Access shall be determined on a case-by-case basis. The Town shall consider good traffic engineering practice and the information provided by the applicant in the Traffic Impact Analysis accompanying his submittal.



4.5.2 <u>Amount of Curb Opening Permitted</u>

The total length of curb opening on a street for access to a commercial property or service station shall not exceed forty percent (40%) of the property frontage. This requirement does not apply to residential type curb openings.

4.5.3 Entrance Angle

In general, the entrance angle for all driveway approaches shall be as near ninety degrees (90°) to the centerline of the street as possible. The minimum angle permitted is eighty degrees (80°).

4.5.4 Minimum Space Between Openings (D)

The minimum spacing between curb openings shall be thirty-five feet (35') measured at the curb line. This spacing will apply to the distance between drives serving adjoining properties. This does not apply to residential projects using mountable curb, gutter, and sidewalks. A fifty-foot (50') spacing applies to commercial openings.

4.5.5 Joint Entrances

As determined by the Town , joint entrances will be provided to serve two (2) adjacent properties. Joint entrances are to be centered on the common property line.

4.5.6 Access Approaches

Access approaches shall not be approved for parking or loading areas that require backing maneuvers within Town ROW. All off-street parking areas must include on-site maneuvering, areas and aisles to permit user vehicles to enter and exit the site in forward drive without hesitation.

If a parcel of land with direct access has been in a state of non-use for more than four (4) years, recommencement of access use shall be considered a change in use. If the use of the access exceeds the design limitations of the access or is non-conforming with the present code, a new permit may be required.

If the use of an existing access to Town ROW changes, or there is a change in the use of the property, a new access permit may be required. Change in access or property use may include, but is not limited to, change in the amount or type of traffic, structural modifications, remodeling, change in type of business, expansion in existing business, change in zoning, change in property division, creating new parcels, etc.

4.6 CONTROL DIMENSIONS

To accomplish the objectives of the basic principles stated earlier, certain dimensions are necessary. There are many variables which affect these dimensions. Some of the variables are as follows: type of street classification, private property development, volume and type of traffic, and width of ROW.



4.6.1 <u>Width of Curb Opening (W)</u>

The total width of curb opening for properties on various Functional Street Classifications shall be in conformance with Table 4.1

TABLE 4.1 WIDTH OF CURB OPENINGS (W) (in ft.)

	RESIDENTIAL				
	SF	MF	COMMERCIAL	SERVICE STATION	INDUSTRIAL
	N/A	N/A	N/A	N/A	N/A
FREEWAY					
ARTERIAL	IF ALLOWED UNDER 4.2.3.2., DESIGN AS COLLECTOR				
MAJOR COLLECTOR	N/A	30-35	30-40	30-40	30-40
MINOR COLLECTOR	N/A	30-35	30-40	30-40	30-40
LOCAL	(*)	30-35	30-40	30-40	30-40

*For single family residential access to local streets:

Local (Suburban - with curb-gutter-sidewalk)	=	16 to 30 feet
Local (Urban - without	=	16 to 22 feet
curb-gutter-sidewalk) Local (Rural – Ag.	=	16 to 22 feet
zoned)		

Notes:

- 1. Curb openings of thirty feet (30') or more must be constructed with radius curb returns.
- 2. If radius curb returns are used, the width of the allowed driveway is measured at the throat along the extended flowline between the curb returns.
 - 4.6.2 Edge Clearance (E)

RESIDENTIAL

Arterial – None. (May not exceed the property line extended) Local – None. (May not exceed the property line extended)

COMMERCIAL AND SERVICE STATIONS

Arterial – twenty-five feet (25') minimum Local – twenty-five feet (25') minimum

Note: Joint access with adjoining property is encouraged. Joint access shall be the only justification for reducing the minimum edge clearance dimension.

4.6.3 Corner Clearance (C)



It is important to locate driveways away from major intersections. This constraint is as much for the ability to enter and leave the property as for the benefit of intersection safety and operations. Exiting a driveway during peak hour conditions at traffic signals is difficult where the queue of standing or slowmoving vehicles continually blocks the driveway.

4.6.4 Sight Distance

Sight distance for curb openings to private property shall consist of a sight triangle conforming to the requirements in the Details. This does not apply to driveways in single family residential projects using mountable curb, gutter and sidewalks.

4.7 UNPERMITTED ACCESS

Any access, driveway or curb-cut which is constructed within public ROW without an access permit issued by the Town shall be subject to a "Stop Work" order, and shall be removed immediately. Failure to remove the non-permitted access may result in the removal of said access by the Town. The cost for removal shall be charged to the property owner. Failure to obey the "Stop Work" order may result in the prosecution of the violators.



SECTION 5: PAVEMENT DESIGN AND TECHNICAL CRITERIA

5.1 GENERAL

5.1.1 This Section provides the basic criteria and design procedures for roadway pavements. Recommended design methodologies for asphalt and Portland cement concrete are addressed and essentially follow the Colorado Department of Transportation (CDOT) methodology. Some standardization of criteria has been made in design procedures. The developer and his geotechnical engineer should meet with the Town Engineer in regards to historical data in the area and discuss proposed subgrade treatments and pavement sections.

5.1.2 Pavement Design Report Submittal Options

There are two (2) acceptable submittal options for pavement design geotechnical reports related to the final construction plans:

- 5.1.2.1 The final pavement design may be completed concurrent with the final construction plans, with the pavement section dimensions and pavement material and construction specifications included in the final construction plan submittal. All soil samples must be taken after overlot grading has been completed.
- 5.1.2.2 The final pavement design may be completed and submitted after Town approval of the associated street plan, profile and drainage final construction plans. Pavement design shall occur prior to any paving and after overlot grading.

If the first option is chosen, the developer may obtain all necessary construction permits when the final construction plans are approved by the Town. If the second option is used, the developer may obtain pavement construction permits only after the final construction plans, which include the pavement design, are approved by the Town. If the second option is used, the application for pavement design approval must be in accordance with this Section.

5.1.2.3 If a street is to be built in phases, (i.e., the center two (2) lanes are built first, then at some later date more lanes are added), a new pavement design investigation and report for the additional lanes will be required if it has been more than two (2) years since the original design was made.

5.1.3 Preliminary Pavement Design Reports

For all Town land development approvals that involve a Subdivision Improvements Agreement for roadway construction, upon the request by the Town Engineer, the developer must provide, at a minimum, a preliminary subgrade investigation and pavement design report that recommends a typical pavement structural section based on the known site soil conditions and the valid Traffic Impact Analysis. The preliminary reports shall use the Equivalent (18 kip) Daily Load Applications (EDLA) of Table 5.2. This preliminary pavement design



serves as a justification of the roadway improvement costs included in the Subdivision Improvements Agreement or Public Improvements Agreement. A preliminary pavement design may be submitted with final construction plans for Developers using submittal Option 2 in Section 5.1.2. Table 5.1 provides a checklist for subgrade investigation and pavement design.

TABLE 5.1SUBGRADE INVESTIGATION AND PAVEMENT DESIGN CHECK LIST

SOI	SOIL CONSULTANT		K	REVIEWED BY	REJECTED
	SUBDIVISION			COMN	IENT
FILI	FILING JOB NO.				
STR	EET				
DAT	E	YES	NO		
1.	VICINITY MAP				
2.	DRAWING WITH LOCATION OF				
	BORINGS				
3.	DRAWING WITH ESTIMATED				
	EXTENT OF				
	SOIL TYPES AND EDLA				
4.	DRAWING WITH PAVEMENT				
	ALTERNATIVES				
5.	ATTERBERG LIMITS & % 200				
	PASSING NO. SIEVES				
6.	CORRECT SOIL CLASSIFICATION				
7.	COMPOSITE SAMPLES" CORRECTLY				
	GROUPED AT 250' MAXIMUM				
	INTERVALS				
8.	FOR CBR TESTING:				
	 Moisture-density curves 				
	 Stress-strain curves of CBR's shown 				
	- Surcharge weights (correct unit				
	weights, intensity of loading equal to				
	mass of pavement design ± 5 lbs.				
	- Percentage of swell on stress-strain				
	curves				
	- Moisture content & dry density for				
	each sample				
8b.	FOR R-VALUE TESTING:				
oD.	- Dry density & moisture content for				
	each sample				
	- Expansion pressure for each sample				
	- Exudation pressure - R Value curve				
9.	DESIGN NOMOGRAPH SHOWN WITH				
5.	CORRECT SOIL SUPPORT & EDLA				
10.	CORRECT DESIGN COEFFICIENT				
	USED FOR ASPHALT, BASE				
	COURSE, ETC.				





STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

SOI	SOIL CONSULTANT		K	REVIEWED BY	REJECTED
SUB	DIVISION			COMN	IENT
FILI	NG JOB NO.				
STR	EET				
DAT	E	YES	NO		
11.	DESIGN CALCULATIONS SHOWN				
	FOR ALL PHASES OF SOIL REPORT				
12.	MINIMUM PAVEMENT SECTIONS				
	MET FOR PROPER CLASSIFICATION				
13.	SPECIAL PROBLEMS (expansion, frost				
	heave, groundwater) WITH DESIGN &				
	CONSTRUCTION PROBLEMS				
14.	IF THE DENVER/COLORADO/				
	CONSOLIDATION SWELL TEST				
	SHOWS OVER 2.00% SWELL,				
	PROPOSED MITIGATIVE MEASURES				
	ACCEPTABLE TO ENGINEER				

5.2 SUBGRADE INVESTIGATION

5.2.1 Field Investigation

The field investigation shall consist of borings or other suitable methods of sampling subgrade soils to a depth of at least five feet (5') below proposed subgrade elevation, ten feet (10') below proposed subgrade on arterial roadways), at spacings of not more than two hundred fifty feet (250'), unless otherwise accepted by the Town Engineer. Every fifth (5th) hole shall be ten feet (10') deep. Samples are to be taken after grading is completed and the subgrade is rough cut.

5.2.2 Classification Testing

Each subgrade sample shall be tested to determine Liquid Limit, Plastic Limit, PlastiTown Index, Atterberg Limits and the percentage passing the U.S. Standard No. 200 sieve.

Samples of sands and gravels may require gradation analysis for classification determination. These data shall be determined using the following methods"

Liquid Limit – AASHTO T 89 (ASTM D 4318) Plastic Limit – AASHTO T 90 (ASTM D 4318) % Passing No. 200 – AASHTO T 11 (ASTM C 117) Gradation – AASHTO T 27 (ASTM D 422)

The results of these tests shall be used to calculate the AASHTO Classification and Group Index using AASHTO M 145.

5.2.3 Soil Grouping



To facilitate subgrade support testing, soil samples collected in the field investigation can be combined to form soil groups. These groups shall be based upon the AASHTO Classification, Group Index and location within the area investigated. Groupings shall not consist of samples with different AASHTO Classifications.

Note: there may be more than one group within a given classification). Composite samples can be manufactured by combining small portions of each subgrade sample contained within the group and mixing to provide a uniform composite sample of the soil group. Composite samples shall be subjected to Classification Testing as outlined in Item 5.2.2.

5.2.4 Subgrade Support Testing

Individual subgrade or composite samples shall be tested to determine the subgrade support value using either CBR (California Bearing Ratio) or Hveem Stabilometer (R-value) testing. These values shall be used in the design of pavement sections in accordance with the procedures outlined in Section 5.4. Tests shall be conducted in accordance with the procedures listed below in Items 5.2.4.1 or 5.2.4.2.

5.2.4.1 <u>CBR Tests</u>

California Bearing Ratio tests shall be conducted in accord with AASHTO T 193 with the following modifications:

- a. Note 4 of AASHTO T 193 shall not apply. A three-point CBR evaluation is required.
- b. The requirement for compaction shall be in accordance with the most recent edition of the CDOT Standards.
- c. Surcharge shall be calculated using a unit weight of one hundred forty (140) pcf for bituminous pavement, and one hundred thirty-five (135) pcf for untreated aggregate base course.
- d. The design CBR Value shall be determined from the CBR Dry Density Curve and shall be the CBR value at ninety-five percent (95%) compaction. A minimum CBR value of six (6) will be required for the subgrade over a depth of two feet (2').
- e. In addition to the values requested in AASHTO T 193, Stress-Penetration curves for each sample, a CBR Dry Density curve and Proctor Compaction test results shall be reported.

5.2.4.2 <u>R-Value Tests</u>

Hveem Stabilometer tests shall be conducted in accordance with AASHTO T 190. The design R-value shall be at three hundred (300) psi exudation pressure. The reported data shall consist of:



- a. Dry density and moisture content for each sample.
- b. Expansion pressure for each sample.Exudation Pressure corrected R-value curve showing the three hundred (300) psi design R-value.
- c. A minimum R-value of fifteen (15) shall be required for all subgrades to a depth of two feet (2').

5.2.4.3 Swell Test

A Colorado Swell Test, (also referred to as the Denver Swell Test or Swell Consolidation Test), shall be required in all pavement design reports.

If the swell, (at an overburden pressure of one hundred (100) to one hundred fifty (150) psi, at specified compaction per CDOT and at optimum moisture content), is two percent (2.0%) or greater, the pavement design report must provide mitigating measures to minimize the destructive swell potential. Since the pavement is not placed on the soils until after the soil has been scarified, moisture treated, and compacted to optimum, the "% swell" shall be measured from the point after the overburden pressure is applied, to the point after water is added. In other words, after the overburden pressure is applied and consolidation has occurred, the "swell" = 0.0%, then add water and measure the swell. Mitigation could be over-excavation and replacement with suitable non-expansive material to a depth sufficient to protect the pavement, lime treatment, French drains, or other procedures acceptable to the Town Engineer, as recommended and supported by a geotechnical engineer. Moisture treatment, by itself, may not be an adequate mitigating measure. If expansive soil mitigation is made, the soil treatment shall extend to the back-of-curb (if detached walk or no walk), or to the back-of-walk (if attached or monolithic walk).

5.3 PAVEMENT DESIGN CRITERIA

5.3.1 General

This section provides the parametric input data to be used for the design of pavements of various roadway classifications.

5.3.2 Equivalent (18 Kip) Daily Load Applications (EDLA)

The pavement design procedure in this chapter provides for a 20-year service life of pavement, given that normal maintenance is provided to keep roadway surface in an acceptable condition. EDLA and Design Traffic Number (DTN) are considered equivalent units, based on 20-year design criteria and an 18 kip axle loading. All data and design nomographs in this chapter use EDLA units for pavement loading repetitions.



EDLA criteria for each Town roadway classification are given in Table 5.2.

TABLE 5.2 RECOMMENDED EQUIVALENT (18 Kip) DAILY LOAD APPLICATIONS (EDLA)

CLASSIFICATION	CLASS MODIFIER	EDLA VALUES ¹		
Local/Alley	Residential			
	Serving <80 D.U.'s	5		
	All Others	10		
	Commercial ²	30		
	Office	100		
Minor Collector	Residential	30		
	Commercial ²	50		
2	Office ²	150		
Major Collector ²	Residential	100		
	Commercial ²	100		
	Office ²	150		
Major Arterial ²	All	200		
Entry Street		10		
	EDLA MINIMUM			
	(EDLA may be required to be 30 if number of DU's served is over 100)			

¹Alternative EDLA values may be considered with justification provided by the Traffic Impact Analysis, proposed land uses, and traffic analysis that defines proportion of truck vehicles. ²EDLA shall be calculated based on projected traffic uses. Minimum EDLA values are as prescribed in Table 5.2.

5.3.3 Design Serviceability

The following criteria shall be used for all Town roadways to be dedicated for public use:

TABLE 5.3 SERVICEABILITY INDEX

ROADWAY CLASSIFICATION	SI
Arterials	2.5
COLLECTORS	
Major	2.5
Minor Commercial/Office	2.5
Minor Residential	2.5
LOCAL	
Residential	2.0
Commercial/Office	2.5
ALLEYS	2.0



5.3.4 Minimum Pavement Section

This paragraph provides the minimum acceptable pavement sections for public roadways in the Town of Kersey. These pavement thicknesses may be used for preliminary planning purposes or for estimating collateral requirements for subdivision improvement agreements. Final pavement designs must be based on actual subgrade support test results. Table 5.4 lists these minimum thicknesses for each roadway classification.

TABLE 5.4 REQUIRED MINIMUM PAVEMENT SECTIONS

		COMPOSITE	ESECTION	
CLASSIFICATION	EDLA	ASPHALT (Inches)	TREATED SUBGRADE OR BASE (Inches)	FULL DEPTH ASPHALT (Inches)
Alleys	(Table 5.2)	3	8	Not Allowed
Local Residential Commercial Office	(Table 5.2) 30 100	4 4 4	8 8 8	Not Allowed
Minor Collector Residential Commercial Office	30 50 150	4 4 4.5	8 8 8	Not Allowed
Major Collector Residential Commercial Office	100 100 150	4 4 4.5	8 8 8	Not Allowed
Major Arterial	200	5	8	Not Allowed

5.3.5 Flexible Pavement Strength Coefficients

Table 5.5 contains the standard design coefficients for various pavement materials. Nonstandard design coefficients may be used, only if approved in advance by the Town Engineer. In addition, design values must be verified by predesign mix test data and supported by daily construction tests; or, redesign values will be required; i.e., add one-half inch ($\frac{1}{2}$ ") to one inch (1") to the in-place surface course of final Asphalt Concrete.



TABLE 5.5 STRENGTH COEFFICIENTS

The combination of one or more of the following courses placed on a subgrade to support the traffic load and distribute it to the roadbed.

PAVEMENT STRUCTURE COMPONENT	STRENGTH COEFFICIENTS	(LIMITING TEST CRITERIA)
CONVENTIONAL MATERIALS		
Plant Mix Seal Cost	.25	
Hot Bituminous Pavement	.40	(1,500 lbs. Marshall or Rt 90+)
Exist Bituminous Pavement	.30	(9-15 yr)
	.24	(>15 yr)
Aggregate Base Course	.12	(CBR 80+ or R 78+)
Exist Aggregate Base Course	.10	(CBR 50 + or R 69+)
Granular Subbase Course	.07	(CBR 1 5 or R 50+)
TREATED MATERIALS		
Cement Treated Aggregate Base	.23	(7 day, 640-1000psi)
Lime Treated Subgrade	.14	(7 day, 160 psi, Pl.<6)

- 5.3.5.1 <u>Subbase</u>. The layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course, surface course or both.
- 5.3.5.2 <u>Base Course</u>. The layer or layers of specified or selected material of designed thickness placed on a subbase or a subgrade to support a surface course.
- 5.3.5.3 <u>Surface Course</u>. One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called "Wearing Course."

5.3.6 Portland Cement Concrete Working Stress (f)

The working stress (f_t) to be used in the design shall be seventy-five percent (75%) of that provided by third-point beam loading, which shall have a minimum laboratory twenty-eight (28) day strength of six thousand (6,000) psi based on actual tests of materials to be used.

5.4 PAVEMENT DESIGN PROCEDURE

5.4.1 Flexible Pavements

The following procedure should be used in determining the Structural Number (SN) of the pavement being designed:

- 5.4.1.1 Determine roadway classification and corresponding EDLA (Table 5.2).
- 5.4.1.2 Determine the Serviceability Index (SI) of the roadway classification



(Table 5.3).

5.4.1.3 Select the proper nomograph:

Table 5.6 Flexible Pavements with SI =2.0

Table 5.7 Flexible Pavements with SI =2.5

- 5.4.1.4 Using subgrade CBR or R-value test results and EDLA, determine the SN from the appropriate design nomograph.
- 5.4.1.5 Once the Structural Number (SN) has been determined, the design thickness of the pavement structure can be determined by the general equation:

 $SN = a_1 D_1 + a_2 D_2 + a_3 D_3 + \dots$

Where:

a₁ = Hot Bituminous Pavement (HBP) strength coefficients

 a_1 , a_2 , a_n = strength coefficients of additional pavement components

D₁ = thickness of Hot Bituminous Pavement (HBP) (inches)

 D_2 , D_3 , D_n = thickness of additional pavement component sections

The strength coefficients for various components of the pavement structure are given in Table 5.5.

The component thickness selected must meet two (2) conditions:

- a. Total HBP thickness selected cannot be less than the minimum specified in Table 5.4 for the roadway classification.
- b. The base course thickness selected cannot exceed 2.5 times the HBP thickness selected.
- 5.4.1.6 The design must reference any mitigation measures required when the subgrade contains swelling soils, (swell potential > 2.00% under 100-150 psf surcharge pressures at ninety-five percent (95%) standard compaction from a Colorado (Denver) Swell Test; moisture treatment is not an adequate mitigative procedure). Design reports recommending permeable layers, such as untreated aggregate base course in the pavement system, must present the measures to be used to ensure adequate drainage of such layers, and to maintain segregation of the layers from the swelling soils. If expansive soil mitigation is made, the soil treatment shall extend to the back-of-curb, (if detached walk or no walk), or to the back-of-walk, (if attached or monolithic walk).



5.4.2 Rigid Pavement

Not Allowed.

5.5 SUBGRADE INVESTIGATION AND PAVEMENT DESIGN REPORT

The report shall be prepared by or under the supervision of and signed by a Professional Engineer, registered in the State of Colorado, and shall include the following information:

- a. Vicinity map to locate the investigated area.
- b. Scaled drawings showing the location of borings.
- c. Scaled drawings showing the estimated extent of subgrade soil types and EDLA for each street.
- d. Pavement design alternates for each street on a scaled drawing,
- e. Tabular listing of sample designation, sample depth, Group Number, Liquid Limit, PlastiTown Index, percent passing the No. 200 sieve, AASHTO Classification, Group Index and soil description.
- f. CBR or R-value test results of each soil type used in the design.
- g. Pavement design nomographs properly drawn to show Soil Support-EDLA-SN.
- h. Design Calculations.
- i. A discussion regarding potential subgrade soil problems including, but not limited to:
 - 1. heave or settlement prone soil;
 - 2. frost susceptible soils;
 - 3. ground water;
 - 4. drainage considerations (surface and subsurface);
 - 5. cold weather construction (if appropriate);
 - 6. other factors or properties which could affect the design or performance of the Pavement System.
- j. Recommendations to alleviate or mitigate the impact of problems discussed in Item i above.

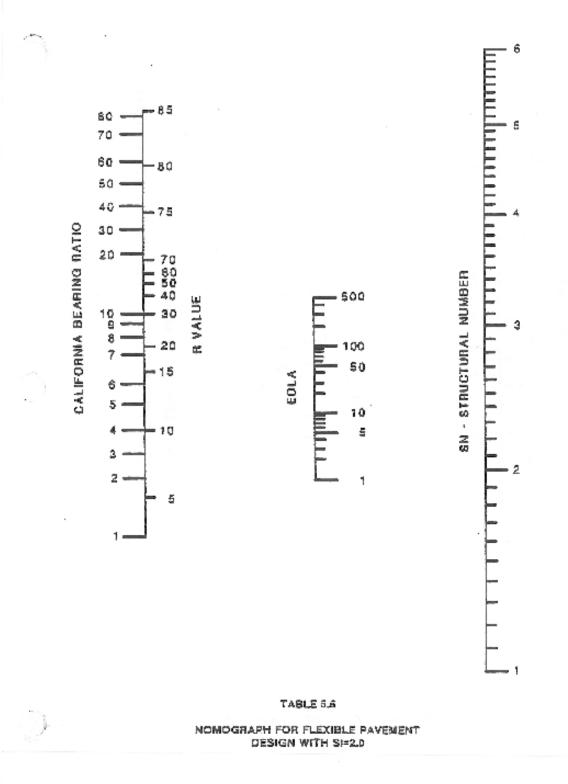
Note:



If any new fill material is imported on site from other areas during the construction phases of a project, the Town will require a new pavement design report or additional testing to verify the acceptability of this material for roadway fill.



TABLE 5.6 FLEXIBLE PAVEMENT NOMOGRAPH (SI=2.0)

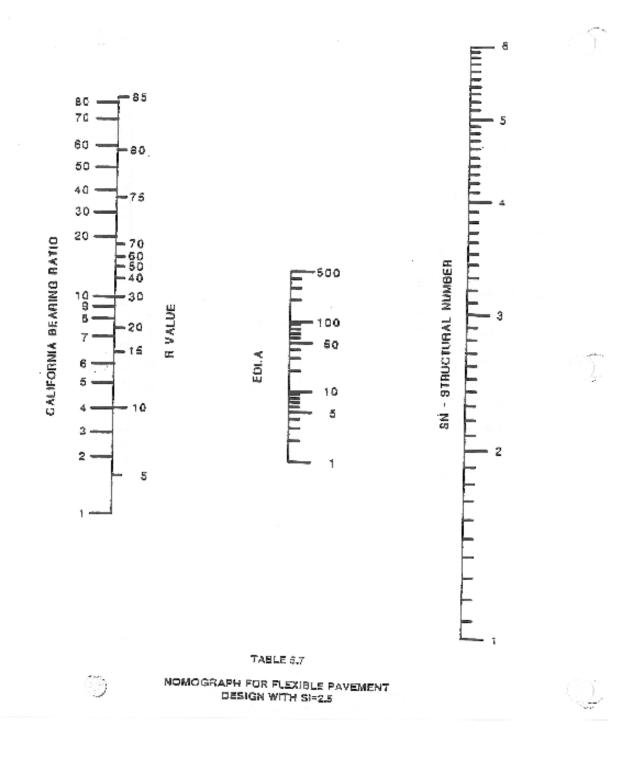




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TOWN OF KERSEY, COLORADO STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015







SECTION 6: STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

6.1 GENERAL PROVISIONS

6.1.1 Short Title

These Standards together with all future amendments shall be known as the "Town of Kersey Storm Drainage Design and Technical Criteria" (hereafter called Criteria) as referenced in the Town of Kersey Engineering Standards (hereafter called Standards).

6.1.2 Jurisdiction

These Criteria shall apply to all land within the Town, including any public lands. These Criteria shall apply to all facilities constructed on the Town ROW, easements dedicated for public use, and/or to all privately owned and maintained drainage facilities, including but not limited to detention ponds, storm sewer systems, underdrains, inlets, manholes, culverts, swales, channels, and watercourses.

6.1.3 Purpose and Effect

Presented in these Criteria are the minimum design and technical criteria for the analysis and design of storm drainage facilities. All subdivisions, re-subdivisions, planned unit developments, or any other proposed development or construction submitted for approval under the provisions of the Standards shall include adequate storm drainage system analysis and appropriate drainage system design. The applicant shall have the burden of showing that the options are equal or better.

6.1.4 Amendment and Revisions

These Criteria may be amended as new technology is developed and/or if experience gained in the use of these Criteria indicates a need for revision. Amendments and revisions will be made by resolution.

6.1.5 Enforcement Responsibility

It shall be the duty of the Town <u>BOARD</u> acting through the Town Engineer to enforce the provisions of these Criteria.

6.1.6 <u>Review and Approval</u>

The Town Engineer will review all drainage submittals for general compliance with these Criteria. An approval by the Town does not relieve the owner, engineer or designer from responsibility of ensuring that the calculations, plans, specifications, construction, and record drawings are in compliance with the Criteria.

6.1.7 Interpretation

The following shall govern the interpretation and application of the provisions of



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the Criteria.

- 6.1.7.1 In its interpretation and application, the provisions shall be regarded as the minimum requirements for the protection of public health, safety, and welfare of the residents of the Town.
- 6.1.7.2 Whenever a provision of these Criteria and any other provisions of the Standards or any provision in any law, ordinance, resolution, rule, or regulation of any kind, contain any restriction covering any of the same subject matter, whichever restrictions are more stringent or impose higher standards of requirement shall govern.
- 6.1.7.3 These Criteria shall not abrogate or annul any permits or approved drainage reports, construction plans, easements, or covenants issued before the effective date of these Criteria.

6.1.8 Relationship to Other Standards

If special districts impose more stringent Criteria, than presented herein, this difference is not considered a conflict. If the State or Federal Government imposes stricter criteria, standards, or requirements, these shall be incorporated into the Town 's requirement.

4.7.1 Other Standards

- 4.7.1.1 If not covered as a part of this Criteria, the Urban Drainage and Flood Control District Criteria Manual (Manual), Volumes I, II, III, and supporting documentation, latest revision, shall govern.
- 4.7.1.2 Colorado Department of Transportation (CDOT) Highway Standard Plans and Details, although not presented in these Criteria, shall be considered to be included as reference as a part of these documents.
- 4.7.1.3 Adjacent Town, County and District criteria and standards shall be considered when project(s) or drainage design(s) may impact those adjacent jurisdictions or facilities.



4.7.2 Abbreviations

As used in these Criteria, the following abbreviations shall apply:

CDOT	Colorado Department of Transportation
CSP	Corrugated Steel Pipe
CSPA	Corrugated Steel Pipe Arch
CWCB	Colorado Water Conservation Board
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
HERCP	Horizontal Elliptical Reinforced Concrete Pipe
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
ROW	Right-of-Way
SCS	Soil Conservation Service
SPP	Structural Plate Pipe
SPPA	Structural Plate Pipe Arch
UDFCD	Urban Drainage and Flood Control District
USDCM	Urban Storm Drainage Criteria Manual (Manual)
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6.2 DRAINAGE PLANNING SUBMITTAL REQUIREMENTS

6.2.1 <u>Review Process</u>

Drainage reports and plans, construction drawings, specifications, and as-built information shall be submitted and approved as required by the Standards, Site Plan and Building Permit Procedure.

A pre-application consultation is suggested for all applicants. The applicant shall consult with the Town Engineer for general information regarding subdivision regulations, required procedures, possible drainage problems, and specific submittal requirements.

6.2.2 Phase I Drainage Report

A Phase I Drainage Report is required to be submitted as part of the zoning/planning process if the property is traversed by a major drainageway that is to be modified or as a part of a regional master planning system. This report will review, at a conceptual level, the feasibility and design characteristics of the proposed development. The Phase I drainage report shall be in accordance with the following outline and contain the applicable information listed:

6.2.2.2 Phase I Drawing Concepts

 <u>General Location Map</u> – All drawings shall be 24" x 36" in size. A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1" = 1000' to 1" = 4000' and show a path of all drainage from the upper end of any offsite basins to the defined major drainageways.



The map shall identify any major facilities from the property (i.e., development, irrigation ditches, existing detention facilities, culverts, storm drains) along the flow path to the nearest major drainageway. Basins and flow paths are to be identified and topographic contours are to be included.

- b. <u>Floodplain Information</u> A copy of the location map showing the location of the subject property shall be included defining the floodplain or floodplain mapping. All major drainageways shall have the 100 year floodplain defined and shown on the report drawings.
- c. <u>Drainage Plan</u> Map(s) of the proposed development at a scale of 1" = 20' to 1" = 200' on a 24" x 36" drawing shall be included. The plan shall show the following:
 - 1. Existing topographic contours at two foot (2') maximum intervals. In steep areas, the maximum interval is five feet (5'). The contours shall extend a minimum of one hundred feet (100') beyond the property lines.
 - 2. All existing drainage facilities.
 - 3. Approximate flooding limits based on available information.
 - 4. Conceptual major drainage facilities including detention basins, storm system, swales, and outlet structures locations in the detail consistent with the proposed development plan.
 - 5. Major drainage boundaries and sub-boundaries.
 - 6. Any offsite feature influencing development.
 - 7. Proposed flow directions and, if available, proposed contours.
 - 8. Legend to define map symbols.

6.2.3 Phase II Drainage Report

The purpose of the Phase II Drainage Report is to identify and/or refine conceptual solutions to the problems which may occur onsite and offsite as a result of the development. The Phase II Drainage Report shall be submitted during the subdivision process with the application for Preliminary Plat. If the zoning and preliminary plat applications are submitted concurrently, the submittal requirements of this section shall apply. Any problems that exist on site prior to development must be addressed during the preliminary phase. All reports shall be typed on 8 1/2" by 11" paper and bound. The drawings, figures, plates, and tables shall be bound with the report or included in a pocket attached to the



report. The report presenting the preliminary design for review and shall be prepared by or supervised by an engineer licensed in Colorado. The report shall contain a certification sheet as follows:

"This report (plan) for the Phase II drainage design of <u>(Name of Development)</u> was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Kersey Storm Drainage Design and Technical Criteria, and was designed to comply with the provisions thereof. I understand that the Town of Kersey does not and will not assume liability for drainage facilities designed by others."

Registered Professional Engineer State of Colorado No. _____ (Affix Seal)

6.2.3.1 Phase II Report Contents

- I. GENERAL LOCATION AND DESCRIPTION
 - A. Location
 - 1. Town, County, State Highway and local streets within and adjacent to the site, or the area to be served by the drainage improvements
 - 2. Township, range, section, one-quarter (1/4) section
 - 3. Major drainageways and facilities
 - 4. Names of surrounding developments
 - B. Description of Property
 - 1. Area in acres
 - 2. Ground cover (type of ground cover and vegetation)
 - 3. Major drainageways
 - 4. Existing major irrigation facilities such as ditches and canals
 - 5. Proposed land use
- II. DRAINAGE BASINS AND SUB-BASINS
 - A. Major Basin Description
 - 1. Reference to major drainageway planning studies such as flood hazard delineation report, major drainageway planning reports, and flood insurance rate maps.



- 2. Major basin drainage characteristics, existing and planned land uses within the basin.
- 3. Identification of all nearby irrigation facilities within 100-feet of the property boundary, which may influence or be influenced by the local drainage
- B. Sub-Basin Description
 - 1. Discussion of historic drainage patterns of the property.
 - 2. Discussion of offsite drainage flow patterns and impact on development under existing and fully developed basin conditions.
- III. DRAINAGE FACILITY DESIGN
 - A. General Concept
 - 1. Discussion of concept and typical drainage patterns
 - 2. Discussion of offsite runoff considerations
 - 3. Discussion of proposed drainage patterns
 - 4. Discussion of detention storage and outlet design
 - B. Specific Details (Optional Information)
 - 1. Discussion of drainage maintenance and access
 - 2. Discussion of impacts on the downstream properties
- IV. REFERENCES

Reference all criteria, master plans, and technical information used in support of concepts.

6.2.3.2 Phase II Drawing Concepts

- <u>General Location Map</u> All drawings shall be 24" x 36" in size. A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1" = 1000' to 1" = 4000' and show the path of all drainage from the upper end of any offsite basins to the defined major drainageways. The map shall identify any major construction (i.e., development, irrigation ditches, existing detention facilities, culverts, storm drains) along the entire path of drainage. Basins and flow paths are to be identified and topographic contours are to be included.
- b. <u>Floodplain Information</u> A copy of the location map showing



the location of the subject property shall be included with the report. All major drainageways shall have the floodplain defined and shown on the report drawings.

- c. <u>Drainage Plan</u> Map(s) of the proposed development at a scale of 1" = 20' to 1" = 200' on a 24" x 36" drawing shall be included. The plan shall show the following"
 - 1. Existing and (if available) proposed contours at twofoot (2') maximum intervals. In steep areas, the maximum interval is five feet (5'). The contours shall extend a minimum of one hundred feet (100') beyond the property lines.
 - 2. Property lines and easements with purposes notes.
 - 3. Streets, indicating ROW width, flowline width, curb type, sidewalk, and approximate slopes.
 - 4. Existing drainage facilities and structures, including irrigation ditches, roadside ditches, crosspans, drainageways, gutter flow directions, and culverts. All pertinent information such as material, size, shape, slope, and location shall also be included.
 - 5. Overall drainage area boundary and drainage sub-area boundaries.
 - 6. Proposed type of street flow (i.e., vertical or combination curb and gutter), roadside ditch, gutter, slope and flow directions, and cross pans.
 - 7. Proposed location storm drains and open drainageways, including inlets, manholes, culverts, and other appurtenances, including riprap protection.
 - 8. Proposed outfall point for runoff from the developed area and facilities to convey flows to the final outfall point without damage to downstream properties. Routing and accumulation of flows at various critical points for the minor storm and major storm runoff listed on the drawing.
 - 9. Volumes and release rates for detention storage facilities and information on outlet works.
 - 10. Location and elevations of all existing floodplains affecting the property.
 - 11. Routing of offsite drainage flow through the

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development.

6.2.3.3 Phase III Drainage Report

The purpose of the Phase III Drainage Report is to update the concepts, and to present the design Details for the drainage facilities discussed in the Phase II Drainage Report. Also, any change to the Phase II concept must be presented.

The Phase III Drainage Report, which shall be submitted with the application for final plat, must address comments made during review of the Phase II Report. A Phase III Report which complies with the requirements of this Section must be submitted by the developer or owner and reviewed and approved by the Town Engineer prior to scheduling the final plat for the Town BOARD hearing.

All reports shall be typed on a 8-1/2" x 11" paper and bound. The drawings, figures, charts, plates and/or tables shall be bound with the report or included in a folder/pocket attached at the back of the report.

The report shall contain a certification sheet as follows:

"This report (plan) for the Phase III Drainage design of (Name of Developer) was prepared by me (or under my direct supervision)in accordance with the provisions of the Town of Kersey's Storm Drainage Design and Technical Criteria, and was designed to comply with the provisions thereof. I understand that the Town of Kersey does not and will not assume liability for drainage facilities designed by others."

> Registered Professional Engineer State of Colorado No. (Affix Seal)

The report shall also contain a developer certification sheet as follows:

"(Name of Developer) hereby certifies that the drainage facilities for (Name of <u>Development</u>) shall be constructed according to the design presented in this report. I understand that the Town of Kersey does not and will not assume liability for drainage facilities designed or reviewed by my engineer. I also understand that the Town of Kersey relied on the representations of others to establish that drainage facilities are designed and built in compliance with applicable guidelines, standards, or Standards. Review by the Town of Kersey can therefore in no way limit or diminish any liability which I or any other party may have with respect to the design or construction of such facilities."

(NAME OF DEVELOPER) By:

The Phase III Drainage Report shall be prepared in accordance with the outline below. The Phase III Drainage Report shall present a final design of Phase II Drawing Report.



6.2.3.4 Phase III Report Contents

The Report shall be in accordance with the following outline and contains the applicable information listed:

- I. GENERAL LOCATION AND DESCRIPTION
 - A. Location
 - 1. Township, range, section, one-quarter (1/4) section
 - 2. Local streets within and adjacent to the subdivision with ROW width shown
 - 3. Major drainageways, facilities, and easements within and adjacent to the site
 - 4. Names of surrounding developments
 - B. Description of Property
 - 1. Area in acres
 - 2. Ground cover (type of trees, shrubs, vegetation, general soil conditions, topography, and slope)
 - 3. Major drainageways
 - 4. General project description
 - 5. Irrigation facilities
 - 6. Proposed land use

II. DRAINAGE BASINS AND SUB-BASINS

- A. Major Basin Description
 - 1. Reference to major drainageway planning studies such as flood hazard delineation reports, major drainageway planning reports, and flood insurance rate maps.
 - 2. Major basin drainage characteristics, existing and planned land uses
 - 3. Identification of all irrigation drainage patterns of the property in question
- B. Sub-Basin Description
 - 1. Discussion of historic drainage patterns of the property in question



- 2. Discussion of offsite drainage flow patterns and impact on development under existing and fully developed basin conditions.
- III. DRAINAGE DESIGN CRITERIA
 - A. Regulations: Discussion of the optional provisions selected or the deviation from the Criteria, if any, and its justification.
 - B. Development Criteria Reference and Constraints
 - 1. Discussion of previous drainage studies (i.e., project master plans) for the site in question that influence or are influenced by the drainage design and how the plan will affect drainage design for the site
 - 2. Discussion of the effects of adjacent drainage studies
 - 3. Discussion of the drainage impact of site constraints such as streets, utilities, light rail rapid transit, existing structures, and development or site plan
 - C. Hydrological Criteria
 - 1. Identify design rainfall
 - 2. Identify runoff calculation method
 - 3. Identify detention discharge and storage calculation method
 - 4. Identify design storm recurrence intervals
 - D. Hydraulic Criteria
 - 1. Identify various capacity references
 - 2. Discussion of other drainage facility design criteria used that are not presented in the Criteria
 - E. Waivers from Criteria

Identify provisions by section number for which a waiver is requested

- IV. DRAINAGE FACILITY DESIGN
 - A. General Concept
 - 1. Discussion of concept and typical drainage patterns
 - 2. Discussion of compliance with offsite runoff considerations



- 3. Discussion of proposed drainage patterns
- 4. Discussion of detention storage and outlet design
- B. Specific Details
 - 1. Discussion of drainage problems encountered and solutions at specific design points
 - 2. Discussion of drainage maintenance and access
 - 3. Discussion of easements and tracts for drainage purposes
- V. CONCLUSIONS
 - A. Compliance with Standards
 - 1. Criteria
 - 2. Major Drainageway Planning Studies
 - B. Drainage Concept
 - 1. Effectiveness of drainage design to control damage from storm runoff
 - 2. Influence of proposed development on the Major Drainageway Planning Studies recommendation(s)
- **VI. REFERENCES**

Reference all criteria and technical information used

VII.APPENDICES

- A. Hydrologic Computations
 - 1. Land use assumptions regarding adjacent properties
 - 2. Initial and major storm runoff at specific design points
 - 3. Historic and fully developed runoff computations at specific design points
 - 4. Time of concentration and runoff coefficients for each basin
- B. Hydraulic Computations
 - 1. Culvert capacities
 - 2. Storm sewer capacity, including hydraulic grade line (HGL) elevations for both major and minor storm that include



junction/structure loss coefficients

- 3. Gutter capacity
- 4. Storm inlet capacity including inlet control rating at connection to storm sewer
- 5. Open channel design
- 6. Check and/or channel drop design
- 7. Detention area/volume capacity and outlet capacity
- 8. Downstream/outfall system capacity

Three (3) copies of the approved Phase III Drainage Plan and Report shall be submitted to the Town for signature and retention in its files.

The Phase III Drainage Plan shall be prepared in accordance with the drawing concept in 6.2.3.2.

6.2.4 Construction Plans

Where drainage improvements are to be constructed, the final construction plans $(24" \times 36")$ shall be submitted with the Phase III Drainage Report. Approval of the final construction plans by the Town Engineer is a condition of issuing the construction permits. Three (3) copies of the approved plans will be submitted to the Town for file. The plans for the drainage improvements will include:

- a. Storm system, inlets, outlets and manholes with pertinent elevations, dimensions, type, and horizontal control indicated.
- b. Culverts, end sections, and inlet/outlet protection with dimensions, type, elevations, and horizontal control indicated.
- c. Channels, ditches, and swales (including side/rear yard swales) with lengths, widths, cross-sections, and erosion control (i.e. riprap, concrete, grout) indicated.
- d. Checks, channel drops, erosion control facilities.
- e. Detention pond grading, trickle channels, outlets, and landscaping.
- f. Other drainage related structures and facilities (including underdrains and sump pump lines).
- g. Maintenance access considerations.
- h. Overlot grading and erosion and sedimentation control plan
- i. The information required for the plans shall be in accordance with sound engineering principles, these CRITERIA and the Town requirements for subdivision designs. Construction documents shall include geometric,

dimensional, structural, foundation, bedding, hydraulic, landscaping, and other Details as needed to construct the storm drainage facility. The approved Phase III Drainage Plan shall be included as part of the construction documents for all facilities affected by the drainage plan. Construction plans shall be signed by a registered professional engineer as being in accordance with the Town approved drainage report/drawings.

6.2.5 As-Built Drawings and Final Acceptance Certificate

As-built drawings for all improvements are to be submitted to the Town with the request for Probationary Acceptance. Certification of the record drawings is required as follows:

The Town of Kersey will require as-built drawings and electronics as a condition of acceptance. Certification of the record drawings requires the following:

A professional engineer registered in the State of Colorado shall undertake such investigation as may be necessary to determine or confirm the as-built detention pond volumes and surface areas at the design depths, outlet structure sizes and elevations, storm sewer sizes and invert elevations at inlets, manholes and discharge location, and representative open channel cross-sections, and dimensions of all the drainage structures. The Town Engineer will compare the as-built drawing information as verified by an engineer with the construction drawings. If the improvements for a project are constructed in phases, as-built drawings may be submitted at the completion of each phase.

Prior to the issuance of a Certificate of Acceptance, a professional engineer, registered in the State of Colorado, shall inspect the constructed facilities and submit to the Town in writing a signed and stamped letter that he has been afforded adequate opportunity to review and evaluate the drainage facilities during the course of construction thereof, and on the basis of such review and evaluation survey, has determined to the best of his knowledge and belief that such facilities were constructed in accordance with the approved drainage report and construction drawings.

6.3 DRAINAGE POLICY

Reference UDFCD Manual, Volume I, latest edition.

- 6.3.1 Water Rights
 - 6.3.1.1 When the drainage sub-system interferes with existing water rights, the value and use of the water are affected. The existing drainageways and storage locations frequently interrelate with the water rights, which must be addressed when planning the facility to preserve their integrity.
 - 6.3.1.2 Ditches which have direct flow rights from a stream are controlled by headgates. Drainage improvements, which alter the quantity (or quality) of the water available to the headgate, affect the ability to



divert water. Other ditches obtain all or portions of the rights by intercepting the shallow groundwater (seepage right). If the water right has not been abandoned or transferred to another location, the drainage design (including the sub-surface system) must be planned and constructed to preserve the water right. Similar situations can also occur when planning drainage facilities near reservoirs.

- 6.3.1.3 The policy of the Town shall be to recognize the possible effects on the water rights and to include the interrelationship in the planning and design of the proposed drainage facility.
- 6.3.2 Master Planning
 - 6.3.2.1 Drainage planning is required for all new development plans. In recognition that drainage boundaries are non-jurisdictional, the Town has participated in regional basin wide master plans to define the Major Drainageway Facilities. The Town will also encourage and participate in future master plans.
 - 6.3.2.2 The policy of the Town shall be to encourage the development of detailed regional drainage master plans which will set forth site requirements for new development and identify the required public improvements.
- 6.3.3 Special Planning Areas
 - 6.3.3.1 Presently, there are areas in the Town where significant drainage problems currently exist. Any new development or redevelopment in these areas may compound the existing drainage problems.
 - 6.3.3.2 The policy of the Town is to require additional analysis and/or definition of additional facilities required for development and redevelopment in current drainage problem areas as defined by the Town.
- 6.3.4 Storm Runoff Detention and Water Quality Enhancement
 - 6.3.4.1 Detention is considered a viable method to reduce urban drainage costs. Temporarily detaining a few acre-feet of runoff can significantly reduce downstream flow hazards as well as pipe and channel requirements in urban areas. Storage also provides for sediment and debris collection which helps to keep streams and rivers cleaner.
 - 6.3.4.2 The policy of the Town requires onsite detention for all new development, expansion, and redevelopment. The required minimum detention volume and maximum release rates at these volumes for the 10-year and 100-year recurrence interval storm shall be determined in accordance with the procedure and data set forth in these Criteria.
 - 6.3.4.3 Exemptions from the detention requirement may be granted for whenever the total area of land under identical ownership, including



the land to be developed or upon which buildings are to be constructed, equals or is less than 1 acre. Onsite detention requirements will be waived where regional detention facilities have been constructed with the capacity to accommodate flows from a fully developed basin and are publicly owned and maintained.

6.3.5 Operations and Maintenance

- 6.3.5.1 Sediment and debris must also be periodically removed from channels and storm drains. Trashracks and street inlets must be regularly cleared of debris to maintain system capacity. Channel bank erosion, damage to drop structures, crushing of pipe inlets and outlets, and deterioration to the facilities must be repaired to avoid reduced conveyance capability, unsightliness, and ultimate failure.
- 6.3.5.2 Maintenance responsibility lies with the owner of the land, except as modified by specific agreement. Maintenance responsibility shall be delineated on Plats and Final Development Plans.
- 6.3.5.3 The policy of the Town requires that maintenance access be provided to all storm drainage facilities to assure continuous operational capability of the system. Should the owner fail to adequately maintain said facilities, the Town shall have the right to enter said land for the purposes of operations and maintenance. All such maintenance costs will be assessed to the property owner.
- 6.3.5.4 The easements required to provide adequate maintenance access are as follows:
 - a. Storm Sewer
 - a) Less than 36"diameter, 20'
 - b) Equal to or greater than 36" diameter. Twice the pipe invert depth with sewer placed within the middle third of the easement (minimum width = 20')
 - 1. Open Channel/Swales
 - a) Q_{100} less than 20 cfs, 15'
 - b) Q₁₀₀ less than 100 cfs, 25'
 - c) Q₁₀₀ greater than 100 cfs, see UDFCD Volume I Major Drainage
 - 2. Detention Pond
 - a) As required to contain storage and associated facilities plus adequate maintenance access around perimeter.
- 6.3.6 Drainage easements shall be shown on the Plats and state that the Town has the right of access on the easements which shall be kept clear of obstructions to the flow and/or obstructions to maintenance access.



6.3.7 Technology Planning and Design

6.3.7.1 Minor and Major Drainage System

- a. The Minor Drainage System is designed to transport the runoff from more frequency events with a minimum disruption to the urban environment. Minor storm drainage can be conveyed in the curb and gutter area of the street or roadside ditch, by storm drain, channel, or other conveyance facility.
- b. The Major Drainage System is designed to convey runoff from the 100-year recurrence interval flood to minimize health and life hazards, damage to structures, and interruption to traffic and services. Major storm flows can be carried in the urban street system (within acceptable depth criteria), channels, storm drains, and other facilities.
- c. The policy of the Town requires that all subdivisions include the planning, designing and implementation for both the minor and major drainage systems in accordance with the following recurrence intervals:

LAND USE	RECURRENCE INTERVAL (YRS) MINOR DRAINAGE SYSTEM	RECURRENCE INTERVAL (YRS) MAJOR DRAINAGE SYSTEM
Residential – Urban	2	100
Residential – Rural	2	100
Commercial – Business	5	100
Industrial	5	100



6.3.7.2 Storm Runoff

- a. Storm runoff shall be determined by the CUHP Method for basins greater than ninety (90) acres and by the Rational Method for basins less than ninety (90) acres.
- b. The policy of the Town allows storm runoff to be determined by either the rational method or the Colorado Urban Hydrograph Procedure (CUHP), within the limitations as set forth in this CRITERIA and the UDFCD Manual.

6.3.7.3 <u>Streets</u>

- a. Streets are an integral part of the urban drainage system and may be used for transporting storm runoff up to design limits. The engineer or designer should recognize that the primary purpose of streets is for traffic, and therefore the use of streets for storm runoff must be restricted.
- b. Additional guidelines referenced in UDFCD Manual, Volume I, latest edition.
- c. The policy of the Town allows the use of streets for drainage within the following limitations:

DRAINAGE CLASSIFICATION	MAXIMUM THEORETICAL STREET ENCROACHMENT	
Type A (Local)	No curb overtopping. Flow may spread to Crown of street. (Flow may spread to back of the sidewalk for a four-inch (4") combination curb and sidewalk).	
Type B (Collector)	No curb overtopping. Flow spread must leave at least one (1) ten-foot (10') lane free of water, five feet (5') either side of the street crown.	
Type C (Arterial)	No curb overtopping. Flow spread must leave at least two (2) ten-foot (10') lanes free of water, ten feet (10') each side of the street crown or median.	

ALLOWABLE USE OF STREETS FOR MINOR STORM RUNOFF



ALLOWABLE USE OF STREETS FOR MAJOR STORM RUNOFF

DRAINAGE CLASSIFICATION	MAXIMUM THEORETICAL STREET ENCROACHMENT
Types A and B (Local and Collector)	Residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of water at the gutter flowline shall not exceed twelve inches (12').
Type C (Arterial)	Residential dwellings, public, commercial and industrial building shall not be inundated at the ground line. To allow for emergency vehicles, the depth of water shall not exceed six inches (6") at the street crown and twelve inches (12") at the gutter flowline, whichever is more restrictive.

ALLOWABLE CROSS STREET FLOW

DRAINAGE CLASSIFICATION	MINOR DRAINAGE SYSTEM MAXIMUM DEPTH	MAJOR DRAINAGE SYSTEM MAXIMUM DEPTH
Type A (Local)	6-inches of depth in cross pan or gutter flowline	12-inches of depth at gutter flowline
Type B (Collector)	None	12-inches of depth at gutter flowline
Type C (Arterial)	None	None



DRAINAGE CLASSIFICATION	MINOR DRAINAGE SYSTEM MAXIMUM DEPTH	MAJOR DRAINAGE SYSTEM MAXIMUM DEPTH
Types A and B (Local, collector)	None	12-inches of depth at gutter flowline
Type C (Arterial)	None	Not-to-exceed 6 inches at the street crown and 12 inches at the gutter flowline, whichever is more restricting

ALLOWABLE CULVERT OVERTOPPING

The maximum headwater for the 100-year design flows shall be 1.5 times the culvert diameter or 1.5 times the rise dimension for pipe shapes other than round or allowable culvert overtopping listed above, whichever is more restricting, for all street types.

6.3.7.4 Floodproofing

a. Floodproofing can be defined as those measures which reduce the potential for flood damages to existing properties within a floodplain. The floodproofing measures can range from elevating structures to intentional flooding of non-critical building spaces to minimize structural damages.

6.4 FLOODPLAIN REGULATIONS

6.4.1 Introduction

The regulation of floodplains is necessary to preserve and promote the general health, welfare, and economic well being of the region. The general purposes of floodplain regulations are summarized as follows:

- a. To reduce the hazard of floods to life and property;
- b. To protect and preserve hydraulic characteristics of water courses used for conveyance of flood waters; and
- c. To protect the public from the extraordinary financial expenditures for flood control and relief.
- d. Additional guidelines referenced in UDFCD Manual, Volume 1, latest edition.

It is the designer's responsibility to utilize the most current adopted floodplain regulations.

6.5 RAINFALL

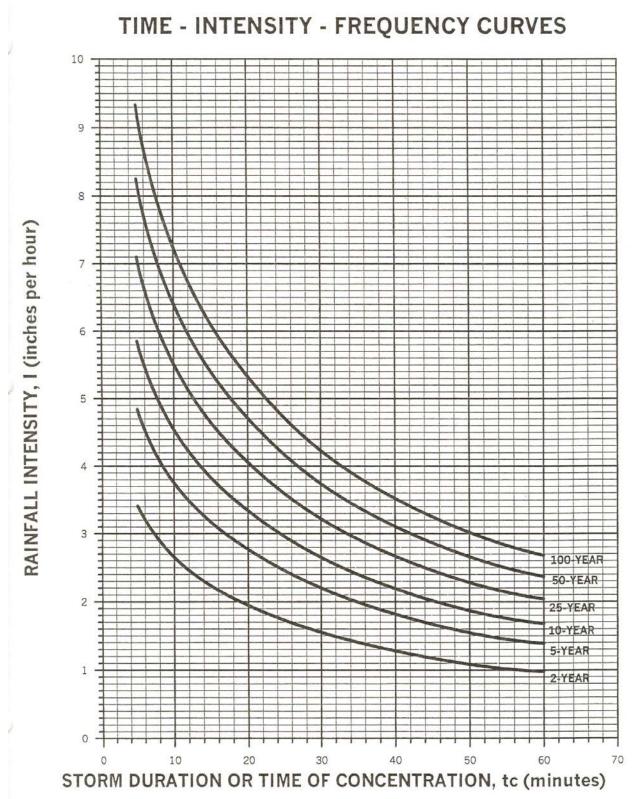


Rainfall guidelines referenced in UDFCD Manual, Volume I, latest edition.

6.5.1 <u>Time-Intensity-Frequency Curves</u>

Rainfall data should be current and appropriately selected by geographic region. Rainfall time intensity frequency (IDF) curves for the Town of Kersey are included on the following page. IDF curves were taken from the Town of Firestone Storm Drainage Criteria Manual as they match closely with the Point Precipitation Frequency Estimates provided in NOAA Atlas 14, Volume 8, Version 2. The Engineer shall use appropriate NOAA Rainfall Atlas information, or may use the Depth-Duration-Frequency data included in the Urban Drainage and Flood Control District's design manual, to generate necessary rainfall information.







6.6 RUNOFF

Runoff guidelines referenced in UDFCD Manual, Volume I, latest edition.

6.7 OPEN CHANNELS

Open Channel guidelines referenced in UDFCD Manual, Volume I, latest edition.

6.7.1 Roadside Ditches

The Criteria for the design of roadside ditches is similar to the guideline for grass lined channels presented in the UDFCD Manual with modifications for the special purpose of minor storm drainage. The Criteria is as follows:

6.7.7.1 Capacity

Roadside ditches shall have adequate capacity for the minor storm runoff peaks. Where the storm runoff exceeds the capacity of the ditch, a storm drainage system shall be required.

6.7.7.2 Flow Velocity

The maximum velocity shall not exceed five (5) feet per second.

6.7.7.3 <u>Curvature</u>

The minimum radius of curvature shall be twenty-five feet (25').

6.7.7.4 Roughness Coefficient

Manning's "n" values presented in UDFCD Manual Volume I, latest edition.

6.7.7.5 Driveway Culverts

Driveway culverts shall be sized to pass the 5-year ditch flow capacity without overtopping the driveway. The minimum size culvert shall be eighteen (18") CMP with flared end sections. More than one (1) culvert may be required.



6.8 STORM SEWERS

6.8.1 Introduction

Storm sewers are a part of the Minor Drainage System, and are required when the other parts of the minor system, primarily curb, gutter, and roadside ditches no longer have capacity for additional runoff.

Except as modified herein, the design of storm sewers shall be in accordance with the UDFCD Manual Section on "Storm Sewers," latest revision.

6.8.2 Construction Materials

Reinforced Concrete Pipe (RCP) in accordance with ASTM C-76, C-506, or C-507 is the only material acceptable for use in storm sewer construction within Town ROW. The minimum class of pipe shall be Class-III; however, the actual depth of cover, live load, and field conditions may require structurally stronger pipe.

6.8.3 Hydraulic Design

Storm sewers shall be designed to convey the minor storm flood peaks without surcharging the sewer. To ensure that this objective is achieved, the hydraulic grade line shall be calculated by accounting for pipe friction losses and pipe form losses. Total hydraulic losses will include friction, expansion, contraction, bend, and junction losses. The final hydraulic grade line shall be a minimum of 6" below the proposed ground surface.

See Storm Sewer Hydraulic Guidelines referenced in UDFCD Manual, Volume I, latest edition.

6.8.4 Vertical Alignment

The sewer grade shall be such that a minimum cover is maintained to withstand AASHTO HS-20 (or as designated by the Town) loading on the pipe. The minimum cover depends upon the pipe size, type and class, and soil bedding condition, but shall be not less than one foot (1') at any point along the pipe.

The minimum clearance between storm sewer and water main, either above or below, shall be twelve inches (12"). Concrete encasement of the water line will be required for clearances of twelve inches (12") or less.

The minimum clearance between storm sewer and sanitary sewer, either above or below, shall also be twelve inches (12"). In addition, when a sanitary sewer main lies above a storm sewer, or within eighteen inches (18") below, the sanitary sewer shall have an impervious encasement or be constructed of structural sewer pipe for a minimum of ten feet (10') on each side of where the storm sewer crosses.



6.8.5 <u>Pipe Size</u>

The minimum allowable pipe size for storm sewers except for detention outlets is dependent upon a practical diameter from the maintenance standpoint. The length of the sewer also affects the maintenance and, therefore, the minimum diameter.

ТҮРЕ	MINIMUM EQUIVALENT PIPE DIAMETER
Main Trunk	18"
Lateral from Inlet*	15"
Outlet from Detention Pond	12"

MINIMUM PIPE DIAMETER

6.8.6 Manholes

Manholes or maintenance access ports will be required whenever there is a change in size, direction, elevation, grade, or where there is a junction of two (2) or more sewers. The required manhole size shall be as follows:



MANHOLE SIZE

SEWER DIAMETER	MANHOLE DIAMETER
15" to 18"	4'
21" to 42"	5'
38" to 54"	6'
60" and larger	Std. Detail SD-6

Larger manhole diameters or a junction structures may be required when sewer alignments are not straight through or more than one sewer line goes through the manhole.

VERTICAL DIMENSION OF PIPE	MAXIMUM ALLOWABLE DISTANCE BEWTEEN MANHOLES AND/OR CLEANOUT
15"-36"	400'
42" and Larger	500'

6.9 STORM SEWER INLETS

6.9.1 Introduction

There are three types of inlets: curb opening, grated, and combination inlets. Inlets are further classified as being on a "continuous grade" or in a sump. The term "continuous grade" refers to an inlet so located that the grade of the street has a continuous slope past the inlet and, therefore, ponding does not occur at the inlet. The sump condition exists whenever water is restricted or ponds because the inlet is located at a low point. A sump condition can occur at a change in grade of the street from positive to negative, or at an intersection due to the crown slope of a cross street.

Except as modified herein, all storm sewer inlet criteria and inlet hydraulics shall be in accordance with the UDFCD Manual.



6.9.2 Standard Inlets

INLET TYPE	PERMITTED USE
Curb Opening Inlet Type R	All street types
Grated Inlet Type C	All streets with a roadside or median ditch
Grated Inlet Type 13	Alleys or private drives with a valley gutter [Private areas only]
Combination Inlet Type 13	Private areas only vertical curb

The standard inlets permitted for use in the Town are:

6.9.3 Inlet Hydraulics

To account for effects which decrease the capacity of the various types of inlets, such as debris plugging, pavement overlaying, and variations in design assumptions, the theoretical capacity calculated for the inlets is reduced to the allowed capacity by the factors presented below for the standard inlets.

CONDITION	INLET TYPE	PERCENTAGE OF THEORETICAL CAPACITY ALLOWED
	CDOT Type R	88
Sump or	5' length	92
Continuous Grade	10' length	_
	15' length	95
Sump or Continuous Grade	Grated Type 13	50
Continuous Grade	Combination Type 13	66
Sump	Grated Type C	50
Sump	Combination Type 13	50

ALLOWABLE INLET CAPACITY

Allowable inlet capacities for the standard inlets have been developed and are presented in the UDFCD Manual, Volume I, latest edition, and the associated spreadsheet.



6.9.4 Inlet Spacing

The optimum spacing of storm inlets is dependent upon several factors including traffic requirements, contributing land use, street slope, and distance to the nearest outfall system. The suggested sizing and spacing of the inlets is based upon the interception rate of seventy percent (70%) to eighty percent (80%). This spacing has been found to be more efficient than a spacing using one hundred percent (100%) interception rate. Using the suggested spacing only, the most downstream inlet in a development would be designed to intercept one hundred (100%) of the flow.

6.10 STREETS

6.10.1 Introduction

The criteria presented in this section shall be used in the evaluation of the allowable drainage encroachment within public streets. The review of all planning submittals (Section 6.2) will be based on the criteria herein. See Drainage referenced in UDFCD Manual Volume I, latest edition.

6.10.2 Function of Streets in the Drainage System

Urban and rural streets, specifically the curb and gutter or the roadside ditches, are part of the Minor Drainage System. When the drainage in the street exceeds allowable limits (refer to Section 6.3.4.4.), a storm sewer system (Section 6.9) or an open channel (Section 6.7) is required to convey the excess flows. The streets are also part of the Major Drainage System when they carry floods in excess of the minor storm (refer to Section 6.3.4.2), also subject to certain limitations (refer to Section 6.3.4.4). However, the primary function of urban streets is for traffic movement and, therefore, the drainage function is secondary and must not interfere with the traffic function of the street.

The primary function of the streets for the Minor Drainage System is therefore to convey the nuisance flows quickly and efficiently to the storm sewer or open channel drainage without interference with traffic movement. For the Major Drainage System, the function of the streets is to provide an emergency passageway for the flood flows with minimal damage to urban environment.

6.10.3 Street Classification

The Streets in the Town are classified for drainage use as Type A, B, or C according to the average daily traffic (ADT) for which the street is designed. The larger the ADT, the more restrictive the allowable drainage encroachment into the driving lanes.

Presented below is the Traffic Classification (i.e., Arterial, Collector, etc.), the corresponding Drainage Classification (i.e., Type A, B, or C), and the allowable theoretical flow depth before the reduction factor is applied for the minor storm.

TOWN OF KERSEY, COLORADO



STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

TRAFFIC AND DRAINAGE CLASSIFICATIONS AND ALLOWABLE FLOW DEPTH

TRAFFIC CLASSIFICATION	DRAINAGE CLASSIFICATION	ALLOWABLE THEORETICAL MINOR STORM FLOW DEPTH
Arterial (84' Flowline to Flowline with raised median)	Туре С	0.50'
Arterial (84' Flowline to Flowline without raised median)	Туре С	0.50'
Collector (48' Flowline to Flowline)	Туре В	0.47'
Collector (36' Flowline to Flowline, 6" V.C.)	Туре В	0.39'
Local (36' Flowline to Flowline, 4" Mountable Curb)	Туре А	0.42'

6.10.4 Hydraulic Evaluation

6.10.4.1 Allowable Capacity – Minor Storm

Based upon the policy of Section 6.3.4.4 and the Drainage Classification of each street in Section 6.10.3, the allowable minor storm capacity of each street section is calculated using the modified Manning's formula.

- Q = $(0.56) (Z/n)S_{1/2} d_{8/3}$ (Equation 1001)
- Where Q = discharge in cfs
 - $Z = 1/S_x$, where S_x is the cross slope of the pavement (ft/ft)
 - d = depth of water at face of curb (feet)
 - S = longitudinal grade of street (ft/ft)
 - n = Manning's roughness coefficient

6.10.4.2 <u>Allowable Capacity – Major Storm</u>

The allowable street capacity for the major storm is calculated using the Manning's formula by first dividing the street cross section into the



pavement area and sidewalk/grass area and then computing the individual flow contributions. The backslope from the curb is assumed to be two percent (2.0%). The maximum allowable depth at the gutter is twelve inches (12").

6.10.4.3 <u>Rural Street</u>

Rural streets are characterized by roadside ditches rather than curb and gutters for urban streets. The capacity is limited by the depth in the ditch and the maximum flow velocity. Refer to Section 6.7.4.5 for the design and capacity of roadside ditches.

6.11 CULVERTS

6.11.1 Introduction

A culvert is defined as a conduit for the passage of surface drainage water under a highway, railroad, canal, or other embankment (except detention outlets). Culverts may be constructed with many shapes and materials.

6.11.2 Culvert Hydraulics

The procedures and basic data to be used for the hydraulic evaluation of culverts in the Town shall be in accordance with the UDFCD Manual Volume II, except as modified herein. The reader may also refer to the many texts covering the subject for additional information.

6.11.3 Culvert Design Standards

6.11.3.1 Construction Material and Pipe Size

- a. Within the Town of Kersey, culverts shall be constructed from corrugated steel or reinforced concrete. Other materials for construction shall be subject to written approval of the Town Engineer.
- b. The minimum pipe size for culverts within a public ROW shall be eighteen inches (18") diameter round culvert, or equivalent shapes. Roadside ditch culverts for driveways shall be eighteen inches (18") diameter round culvert or equivalent shape.

6.11.3.2 Inlet and Outlet Configuration

- a. Within the Town, all culverts are to be designed with headwalls and wingwalls, or with flared-end sections at the inlet and outlet. Flared-end sections are only allowed on pipes with diameters of forty-eight inches (48"), or equivalent or less.
- 6.11.3.4 <u>Velocity Considerations</u>
 - a. A minimum velocity of 3 fps flow is required to assure a self-

cleaning condition of the culvert.

b. The maximum velocity is dictated by the channel conditions at the outlet. Higher outlet velocities will require substantially more protection. If the culvert outlet velocity is greater than twelve (12) fps, an energy dissipator will be required.

6.11.3.5 <u>Headwater Considerations</u>

The maximum allowed headwater for the 100-year design flows shall be 1.5 times the culvert diameter, or 1.5 times the culvert rise dimension for shapes other than round. Also, the headwater depth may be limited by the street overtopping policy in Section 6.3.7.4.

6.11.3.6 <u>Structural Design</u>

As a minimum, all culverts shall be designed to withstand an HS-20 loading (unless designated differently by the Town) in accordance with the design procedures of *Policy on Geometric Design of Highways and Streets*, latest edition, and with the pipe manufacturer's recommendation.

6.11.3.7 Trashracks

a. Trashracks may be required at the entrance of culverts for some installations as designated by the Town. Installation of trashracks prevents debris from entering culverts.

6.12 HYDRAULIC STRUCTURES

6.12.1 Erosion Control

Hydraulic structures are used in storm drainage work to control the flow of the runoff. The energy associated with flowing water has the potential to create damage to the drainage works, especially in the form of erosion. Hydraulic structures, which include riprap, energy dissipators, check structures, brides, and irrigation ditch crossings, all control the energy and minimize the damage potential of storm runoff. All hydraulic structures should be designed and constructed to appear as natural land forms with natural colors.

The criteria to be used in the design of hydraulic structures shall be in accordance with the UDFCD Manual Volume II in the "Major Drainage" and "Structures" sections. The specific criteria to be used with the modifications for the Town are presented herein.

6.12.2 <u>Riprap</u>

The design of the riprap protection for culverts, channel bottom and banks, check drops, bridges, gabions or other areas subject to erosion, shall be in accordance with the Manual Volume 2, "Major Drainage Section 5 - Riprap," as revised.



6.12.3 Energy Dissipators

Where riprap structures are insufficient or uneconomical to control the storm runoff, concrete energy dissipator structures (stilling basins) shall be provided in accordance with the UDFCD Manual Volume II, "Structures, Section 2.2 - Energy Dissipators."

6.12.4 Check Structures

The design criteria for the check drops shall be in accordance with the UDFCD Manual Volume II, "Structures, Section 3 - Channel Drops."

6.12.5 Bridges

The design of bridges within the Town shall be in accordance with the Manual Volume 2, "Structures, Section 4 - Bridges." The design capacity of the bridge shall be determined by the method presented in Section 6.11.5 of these Criteria.

6.12.6 Irrigation Ditch Crossings

Any proposed development in the vicinity of ditches or canals that cross or utilize the said canals for surface drainage or proposes to make any modifications to the existing topography which alters and/or affects water quality and drainage patterns to the ditch shall have the plans approved by the ditch company prior to approval by the Town.

6.13 EROSION AND SEDIMENTATION CONTROL FROM CONSTRUCTION ACTIVITIES AND WATER QUALITY

6.13.1 Introduction

All new development shall have prepared and implemented an erosion and sedimentation control plan. The plan shall be prepared and will be reviewed in accordance with CDPHE, CDOT, County, and UDFCD criteria.

The clearing and stripping of land for development can cause high localized erosion rates with subsequent deposition and damage to offsite properties. Whereas erosion and sedimentation is a natural process, the intensity is increased by development which can destroy the aesthetic and practical values of other properties, streams, and lakes. The purpose of implementing an erosion and sedimentation control plan is to reduce the process to an acceptable level without placing undue burdens on the homeowner, builder, or community.

6.13.2 Erosion and Sedimentation Control

Prior to construction, an erosion and sedimentation control plan must be approved by the Town Engineer.

6.13.3 Water Quality

Water quality treatment is required. Water quality guidelines referenced in



UDFCD Manual Volume III, latest edition.

6.14 DETENTION

6.14.1 Introduction

The criteria presented in this section shall be used in the design and evaluation of all detention facilities. The review of all planning submittals (refer to Section 6.2) will be based on the criteria presented in this section.

The main purpose of a detention facility is to store the excess storm runoff associated with an increased basin imperviousness and discharge this excess at a rate similar to the rate experienced from the basin without development. The value of such detention facilities is discussed in Section 6.3.3.6. Any special design conditions which cannot be defined by these Criteria shall be reviewed by the Town Engineer before proceeding with design.

Dams and water diversion/detention areas should be designed and constructed to appear as natural features, creating site amenities. Techniques to achieve this include creation of topographic changes that mimic natural conditions (including a variety of slope changes), using natural materials such as stone, blending with the textures and patterns of the surrounding landscape, and using materials that match the local environment. When possible, preserve existing drainage patterns.

6.14.2 Detention Methods

The various detention methods are defined on the basis of where the facility is constructed, such as open space detention, parking lot, or underground.

6.14.3 Design Criteria

6.14.3.1 Volume and Release Rates

The minimum required volume shall be determined using the CUHP method or the following equations. These empirical equations were developed as part of the UDFCD hydrology research program. The equations are based on a computer modeling study and represent average conditions. One of the most difficult aspects of storm drainage is obtaining consistent results between various methods for estimating detention requirements. These equations will provide consistent and more effective approaches to the sizing of onsite detention ponds. For larger water sheds where the Colorado Urban Hydrograph Procedure can be used (i.e., 90+ acres), hydrograph routing procedures will be permitted in the design of these ponds, provided the historic imperviousness of two percent (2.0%) or less is used. Underlying assumption for equations 1404, 1405, and 1406 is historic imperviousness of two percent (2.0%). Any additional imperviousness due to development should be added to the two percent (2.0%).



Minimum Detention Volume:

V = KA (Equation 1404)

For the 100-year,

 K_{100} = (1.78I - 0.002[I]² - 3.56)/900 (Equation 1405)

For the 10-year,

 $K_{10} = (0.95I - 1.90)/1000$ (Equation 1406)

Where V = required volume for the 100- or 10-year storm (acre-feet)

I = Developed basin imperviousness (%)

A = Tributary area (Acres)

The maximum release rates at the ponding depths corresponding to the 10- and 100-year volumes are as follows:

	SOIL GROUP			
CONTROL FREQUENCY	А	В	C & D	
10-year	0.13	0.23	0.30	
100-year	0.50	0.85	1.00	

ALLOWABLE RELEASE RATES FOR DETENTION PONDS - CFS/ACRE

The predominate soil group for the total basin area tributary to the detention pond shall be used for determining the allowable release rate.

6.14.3.2 Design Frequency

All detention facilities are to be designed for two (2) storm frequencies: the 10-year and the 100-year recurrence interval floods.

6.14.3.3 Hydraulic Design

Hydraulic design data for sizing of detention facilities outlet works is as follows:

a. <u>Weir flow</u>

The general form of the equation for horizontal crested weirs is:



Where		Q C L H	= = = =	CLH ^{3/2} (Equation 1401) discharge (cfs) weir coefficient (Table 1401) horizontal length (feet) total energy head (feet)
		Anothe follows		nmon weir is the v-notch, whose equation is as
W	/here		=	2.5 tan (Θ /2)H ^{5/2} (Equation 1402) angle of the notch at the apex (degrees)
			•	ning or evaluating weir flow, the effects of

When designing or evaluating weir flow, the effects of submergence must be considered. A single check on submergence can be made by comparing the tailwater to the headwater depth.

b. Orifice Flow

The equation governing the orifice opening and plate is the orifice flow equation:

Q	=	C _d A (2gh) ^{1/2} (Equation 1403)
Where Q	=	Flow (cfs)
Cd	=	Orifice coefficient
А	=	Area (ft ²)
g	=	Gravitational constant = 32.2 ft/sec^2
ĥ	=	Head on orifice measured from centerline or orifice (ft)

An orifice coefficient (C_d) value of 0.65 shall be used for sizing of square edged orifice openings and plates.

6.14.4 Design Standards for Open Space Detention

6.14.4.1 State Engineer's Office

Any dam constructed for the purpose of storing water, with a surface area, volume, or dam height as specified in Colorado Revised Statutes 37-87-105 as amended, shall require the approval of the plans by the State Engineer's Office. Those facilities subject to state statutes shall be designed and constructed in accordance with the criteria of the state.

6.14.4.2 Grading Requirements

Slopes on earthern embankments five feet (5') in height or less shall not be steeper than 4 (horizontal) to 1 (vertical). For embankment heights between five feet (5') and ten (10'), the slopes shall not be steeper than 3 (horizontal) and 1 (vertical), but horizontal slope



distance shall not be less than twenty feet (20'). For embankments greater than ten feet (10') in height, the slopes shall be such to maintain slope stability, but horizontal slope distance shall not be less than thirty feet (30'). Contact the Town Engineer for additional requirements. All earthern slopes shall be covered with topsoil and revegetated with grass. Slopes on riprapped earthern embankments shall not be steeper than 3 (horizontal) to 1 (vertical). For grassed detention facilities, the minimum bottom slope shall be two percent (2.0%) measured perpendicular to the trickle channel.

6.14.4.3 Freeboard Requirements

The minimum required freeboard for open space detention facilities is one foot (1') above the computed 100-year water surface elevation.

6.14.4.4 <u>Trickle Flow Control</u>

All grassed bottom detention ponds shall include a concrete trickle channel or equivalent performing materials and design. Trickle flow criteria is presented in Section 6.7.4.2.6(a).

6.14.4.5 Outlet Configuration

- a. Examples for detention pond outlet configuration are presented in UDFCD Manual Volume II and Volume III. The grate must be designed to pass the 10-year flow with a minimum of fifty percent (50%) blockage (i.e., twice the 10-year flow). Since the minimum size of the outlet pipe is twelve inches (12"), then a control orifice plate at the entrance of the pipe may be required to control the discharge of the design flow (see Section 14.3.3). Other outlet configurations will be allowed provided they meet the requirements of the permitted release rates at the required volume and include proper provisions for maintenance and reliability.
- b. The outlet shall be designed to minimize unauthorized modifications which effect proper function. A sign with a minimum area of 0.75 square feet shall be attached to the outlet or posted nearby with the following message:

WARNING Unauthorized modification of this outlet is a code violation.

c. The difference between the 100-year discharge and the surcharged discharge on the 10-year outlet is released by the overflow weir or spillway. If sufficient pond depth is available, the drop inlet and the grate can be replaced by a depressed inlet with a headwall and trashrack. Depression of the inlet is required to reduce nuisance backup of flow into the pond during trickle flows. The maximum trashrack opening



dimension shall be equal to the minimum opening in the orifice plate.

6.14.4.6 <u>Embankment Protection</u>

Whenever a detention pond uses an embankment to contain water, the embankment shall be protected from catastrophic failure due to overtopping. Overtopping can occur when the pond outlets become obstructed or when a larger than 100-year storm occurs. Failure protection for the embankment may be provided in the form of a buried heavy riprap layer on the entire downstream face of the embankment or a separate emergency spillway having a minimum capacity of twice the maximum release rate for the 100-year storm. Structure shall not be permitted in the path of the emergency spillway or overflow. The invert of the emergency spillway should be set equal to or above the 100-year water surface elevation.

6.14.4.7 Vegetation Requirements

All open space detention ponds shall be revegetated by either irrigated sod or natural dry-land.

6.14.5 Design Standards for Parking Lot Detention

The requirements for parking lot detention are as follows:

6.14.5.1 Depth Limitation

The maximum allowable design depth of the ponding for the 100-year flood is eighteen inches (18").

6.14.5.2 <u>Outlet Configuration</u>

The minimum pipe size for the outlet is eighteen inches (18") diameter where a drop inlet is used to discharge to a storm sewer or drainageway. Where a weir and a small diameter outlet through a curb are used, the size and shape are dependent on the discharge/storage requirements. A minimum pipe size of three-inch (3") diameter is recommended.

6.14.5.3 <u>Performance</u>

To assure that the detention facility performs as designed, maintenance access shall be provided in accordance with Section 6.3.3.7. The outlet shall be designed to minimize unauthorized modifications which effect function. Any repaying of the parking lot shall be evaluated for impact on volume and release rates and is subject to approval by CDOT. A sign shall be attached or posted in accordance with Section 6.14.4.5.

6.14.5.4 Flood Hazard Warning

a. All parking lot detention areas shall have a minimum of two (2) signs posted identifying the detention pond area. The signs shall have a minimum area of 1.5 square feet and contain the following message:

WARNING This area is a detention pond and is subject to periodic flooding to a depth of (provide design depth).

6.14.6 Design Standards for Underground Detention

The requirements for underground detention are as follows:

6.14.6.1 <u>Materials</u>

Underground detention shall be constructed using corrugated aluminum pipe (CAP) or reinforced concrete pipe (RCP). The pipe thickness cover, bedding, and backfill shall be designed to withstand HS-20 loading or as required by the Town.

6.14.6.2 <u>Configuration</u>

- a. Pipe segments shall be sufficient in number, diameter, and length to provide the required minimum storage volume for the 100-year design. As an option, the 10-year design can be stored in the pipe segments and the difference for the 100year stored above the pipe in an open space detention (Section 6.14.4) or in a parking lot detention (Section 6.14.5). The minimum diameter of the pipe segments shall be thirty-six inches (36").
- b. The pipe segments shall be placed side by side and connected at both ends by elbow tee fittings and across the fitting at the outlet The pipe segments shall be continuously sloped at a minimum of 0.25% to the outlet. Manholes for maintenance access (see Section 6.14.6.4) shall be placed in the tee fittings and in the straight segments of the pipe, when required.
- c. Permanent buildings or structures shall not be placed directly above the underground detention.

6.14.6.3 Inlet and Outlet Design

a. The outlet from the detention shall consist of a short, maximum of twenty-five feet (25') length(s) of CAP or RCP with eighteen inch (18") minimum diameter. A two (2) pipe outlet may be required to control both design frequencies. The



invert of the lowest outlet pipe shall be set at the lowest point in the detention pipes. The outlet pipe(s) shall discharge into a standard manhole or into a drainageway with erosion protection provided. If an orifice plate is required to control the release rates, the plate(s) shall be hinged to open into the detention pipes to facilitate back flushing of the outlet pipe(s).

b. Inlet to the detention pipes can be by way of surface inlets and/or by a local private storm sewer system.

6.14.7 Checklist

To aid the designer and reviewer, the following checklist has been prepared:

- a. Earthen slopes are to be 4:1 or flatter.
- b. Minimum freeboard of 1 foot for the 100-year detention is required.
- c. Open space detention areas will include trickle channels.
- d. Protect embankments from the overtopping condition by adding riprap.
- e. Provide signs as required.
- f. Provide maintenance access.



REFERENCES

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- 6. <u>Design and Construction of Sanitary and Storm Sewers</u>, ASCE Manual of Engineering Practice No. 37, New York, New York, 1958.
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- 10. <u>Handbook of Steel Drainage and Highway Construction Products</u>, American Iron and Steel Institute, Washington D.C., 1971.
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- 12. <u>Hydraulic Charts for the Selection of Highway Culverts</u>, HEC No. 5, USDOT, FHWA, December 1965.
- 13. "Urban Runoff Quality in the Denver Region," DRCOG, Denver, Colorado, September 1983.
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SECTION 7: WATER SYSTEM CRITERIA AND SPECIFICATIONS

7.1 PURPOSE AND GENERAL REQUIREMENTS

7.1.1 General

All water distribution systems shall comply with the requirements of the Engineering Standards for water main and service line construction and may include special criteria established by the Town for the overall hydraulics of the water utility system. Special criteria shall be outlined at pre-design meetings scheduled, as determined necessary, by the Town Engineer. The requirements set forth in the latest edition of the Denver Water Board Engineering Standards shall apply for information omitted in these Engineering Standards.

7.1.2 <u>Water Source</u>

The Town of Kersey is supplied water from Central Weld Water District. All new developments may be required to install a master meter vault. The cost associated with the master meter vaults is the responsibility of the developer. Once it is determined that a new master meter vault is required, the developer shall request a letter be sent from the Town to Central Weld Water District for the installation of the new Master Meter Vault. Central Weld Water District will evaluate the vault location and set appropriate fees for the installation. Once the Master Meter is approved by the District, the developer is required to submit to the District the funds necessary for the District to install the Master Meter Vault. All funds must be collected prior to the District scheduling the installation. A meeting should be scheduled between the Town , Developer and Central Weld Water District prior to design to verify location, easements, and land dedications necessary for the installation of the Master Meter Vault.

7.2 DESIGN CRITERIA

7.2.1 Design Flow Requirements

The water demand criteria presented in the following table are minimum criteria and the Town reserves the right to modify the Criteria, at any time, for the design of specific projects. Potable water demand criteria for uses not provided in the table shall be determined during system design.

Use Units Per Acre Occupancy Peak Hour Demand

Residential Single family	3.1 persons 1.9 gpm/unit
Residential Mobile Home	2.7 persons 1.7 gpm/unit
Multi-Family	1.7 persons 1.1 gpm/unit

	AVG.	PEAK
Office Building	0.14 gpm	0.60 gpm
Restaurant	0.35 gpm	1.50 gpm
Small Businesses	0.14 gpm	0.60 gpm
Supermarket	0.14 gpm	0.60 gpm



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Big Box/Dept. Store	0.14 gpm	0.60 gpm
Laundry, Dry Cleaning	0.70 gpm	2.90 gpm
Service Station (No Car Wash)	0.02 gpm	0.08 gpm
Car Wash	1.32 gpm	5.50 gpm
Hotel/Motel	0.24 gpm	1.00 gpm
Warehouse (Non-industrial)	0.07 gpm	0.30 gpm
Irrigation	N/A	24
gpm/acre		

Irrigation is included in the residential water demand, but not included in the commercial water demand. Irrigation demands for commercial uses shall be determined using the provided irrigation demand criteria and the commercial development's estimated irrigated acreage.

Potable water demands have not been provided for industrial uses. Due to the extreme variation in water consumption amongst the different types of industry.

Fire flow requirements will be determined by the Fire District based on type of development and location.

7.2.2 Operating Pressure Requirements

All areas shall be designed to provide a maximum static pressure of ninety (90) psi, and a minimum static pressure of sixty (60) psi. Distribution systems shall also be designed to maintain a twenty (20) psi residual pressure during required fire flow and a sixty (60) psi residential residual during peak residential flows. The maximum pressure drop from static head for fire flow shall not exceed thirty (30) psi and residential shall not exceed ten (10) psi.

7.2.3 <u>Water Model Requirements</u>

- 7.2.3.1 Hydraulic Report Potable Water. A hydraulic analysis for the potable water distribution system for a given project shall be submitted as a report by the Engineer to the Town for review and acceptance. The report shall be accepted by the Town prior to final construction drawing acceptance. The Hydraulic Analysis Report will be reviewed by the Town , along with the construction drawings, in the same review and acceptance process. Projects that move forward to final design without a Town accepted potable water distribution system Hydraulic Analysis Report are subject to possible design changes, including, but not limited to, pipe re-alignment, upsizing, and extensions.
- 7.2.3.2 The objective of the Hydraulic Analysis Report is to assist the engineer with designing a project's potable water distribution system to adequately serve peak demands while adhering to the design requirements set forth in these criteria. For the potable water distribution system, the Hydraulic Report serves as a tool for demonstrating the necessary number of connection points to the existing system for adequate water line looping, system reliability, and required pipe sizing.



- 7.2.3.3 The written Hydraulic Report shall include the following information:
 - A. Title Page
 - a. Report title
 - b. Project name and location
 - c. The name, address, and phone number of the owner, developer and engineer that prepared the report
 - d. Report preparation date
 - B. Engineer Certification Sheet
 - a. The Report shall be prepared by or under the supervision of a professional engineer, licensed to practice in the state of Colorado, possessing adequate experience in the design of potable water distribution systems. The Report shall contain a certification sheet with the following statement to be signed and sealed by the Engineer:

"I understand the Town 's acceptance does not relieve the Engineer's responsibility for errors, omissions, or design deficiencies for which the Town is held harmless."

Registered Professional Engineer

(Affix Seal)

- C. Table of Contents
- D. Project Description and Location
 - a. Clearly state the location of the project. Provide a site vicinity map specifying the project's geographical location and the project area in acres. The project acreage shall be the same as on the project plat.
 - b. Clearly state the land-use zoning, estimated number of residential lots or living units, commercial square footages, and the irrigated acreages.
 - c. Indicate if the project will be phased. Elaborate on the anticipated timing for each project phase and the phase's associated building and infrastructure construction.
 - d. For multi-family, commercial or industrial developments, indicate if potable or non-potable water will be used for landscape irrigation.
 - e. Identify the locations of all potable water, sanitary sewer, and non-potable irrigation connection points to the existing



systems.

- f. Provide the pipe diameter, pipe material, and year of installation for the existing potable water lines.
- E. References and Appendices
 - Provide a page referencing all design criteria, resources, and modeling software used in preparing the hydraulic report.
 - b. Provide appendices as necessary to include modeling result printouts, copies of demand assumption data, and fire flow test results.
 - c. Hydrant flow tests results may be available from the Town. However, it is the responsibility of the developer to verify with their own testing (contact the Town prior to testing). Obtained fire flow test pressures will be evaluated for use by the Town on a case-by-case basis.
- F. Potable Water System Report Requirements and Assumptions
 - a. Provide all used equations, demand assumptions, and essential design requirements, parameters, constraints.
 - b. Indicate the software package(s) and version(s) used for the water system modeling.
 - c. Indicate in which Town of Kersey potable water pressure zone the project is located.
 - d. Provide calculations for estimated population, design flows, irrigate acreage, peaking factors, and any other necessary design calculations.
 - e. Provide hydrant fire flow and fire sprinkler system flow requirements.
- G. Potable Water System Analysis and Modeling
 - a. Modeling Software
 - i. Modeling shall be completed with EPANET.
 - b. Modeling Scenarios
 - i. <u>Static</u>. The static scenario shall establish the available water pressure for the site with no demands on the system and serves to check that pressure requirements are maintained.
 - ii. <u>Peak Hour Demand Plus Fire Flow</u>. This scenario shall include peak hour domestic water use



demands plus fire flow.

- iii. <u>Peak Hour Demand Plus Fire Flow with One (1)</u> <u>Water Connection Closed</u>. While using the determined potable water demands for the peak hour plus fire flow scenario, each connection to the existing potable water system shall be closed, in turn, and modeled. Fire flow shall be placed at a hydrant nearest to the closed connection. This scenario represents a worst-case water demand condition and shall only serve to demonstrate how the potable water distribution system within the development functions during this condition. It is acceptable to have the potable water system pressure and velocity requirements violated in this scenario only.
- iv. <u>Phasing</u>. Water modeling shall be required for the incomplete potable water system as indicated per the planned phasing on the construction drawings, in order to demonstrate that peak hour demand plus fire flow can be met for the interim phased condition.

The hydraulic report shall verify that a proposed potable water system can provide the required water demands for a given development, at an acceptable pressure, and meet the overall potable water system design requirements set forth in these criteria. Upsizing water mains within a development as a means to increase water system capacity in lieu of making a connection to another water source, is not permitted.

If the hydraulic water model demonstrates that a larger main is required to serve the phased condition than would be needed for the full build out condition, the developer is required to install the larger pipe at his expense and is not eligible for pipe oversizing reimbursement from the Town when the larger pipe is no longer needed.

v. <u>Additional Scenarios</u>. The Town may require additional scenarios, adjustments to the fire flow placement, and existing system connections, revisions to the pipe and node schematic layout, and other model modifications as necessary to verify that the proposed potable water system will meet the design requirements and potable water demands of the development and the Town as a whole.



At the Town 's discretion, the existing or future potable water system beyond the limits of the proposed development may require modeling as part of the hydraulic analysis.

- c. Modeling Procedure
 - i. Connections to the existing potable water distribution system are typically denoted as existing watermains with the same hydraulic grade elevation. The Town shall provide inflow pressure.
 - ii. Place estimated domestic water, fire sprinkler, and irrigation tap demands at appropriate node locations within the model as they relate within the project.
 - iii. Locate fire flow demands at hydrant locations according to the modeling scenarios in Section G of this criteria. The maximum allowable fire flow provided from any one (1) hydrant shall be 1,500 gpm. If the required fire flow is in excess of 1,500 gpm, the next closest hydrant shall be used until the required fire flow is met.
 - iv. Depending on the location of the development, existing potable water system performance and reliability in the area, number of available potable water connections, and surrounding land uses, some of the project's proposed potable water connections may require modeling as a demand point or no connection instead of a water source. The Town shall provide additional outflow demands for a development on a case-by-case basis.
- H. Potable Water System Report Results
 - a. Provide a schematic layout of the potable water distribution system showing and labeling the reservoir connections, pipe network, and demand nodes as presented and analyzed for each water model scenario.
 - b. Provide a Reservoir Report for the static condition. The Reservoir Report shall include the following information:
 - i. Reservoir Identification Label
 - ii. Elevation (ft)
 - c. Provide Pipe Reports for all modeled scenarios. Pipe Reports shall include the following information:

- i. Modeled Scenario Title
- ii. Pipe Identification Label
- iii. Pipe Length (ft)
- iv. Pipe Diameter (in)
- v. Pipe Material
- vi. Hazen-Williams Coefficient
- vii. Pipe Control Status (open or closed)
- viii. Pipe Velocity (ft/sec)
- ix. Upstream Calculated Pressure (psi)
- x. Headloss (ft)
- d. Provide Junction/Node Demand Reports for all modeled scenarios. Junction/Node Demand Reports shall include the following information:
 - i. Modeled Scenario Title
 - ii. Node Identification Label
 - iii. Node Evaluation (ft)
 - iv. Node Demand (gpm)
 - v. Calculated Hydraulic Grade (ft)
 - vi. Pressure (psi)
- I. Potable Water System Design Conclusions
 - a. Discuss hydraulic analysis results for all modeled scenarios.
 - b. Confirm that the pipe velocityand pressure requirements during the peak hour demand plus fire flow operating condition are met per report requirements of these criteria.
 - c. Discuss any potable water line oversizing required by the Town over and above what is necessary for the development's potable water needs.
 - d. For phased developments, discuss phased construction of the potable water distribution system and confirm that potable water pipes are sized appropriately to meet the peak hour plus fire flow demand velocity and pressure requirements during the interim condition.



7.2.4 Distribution System Layout

- 7.2.4.1 Distribution mains and lateral lines shall be located as indicated on the accepted plans, and shall be a minimum of eight-inch (8") diameter pipe.
- 7.2.4.2 Dead ends shall be minimized by looping whenever possible. All permanent dead ends shall require a fire hydrant.
- 7.2.4.3 Special attention should be given to other utilities (storm and sanitary sewer) during the design phase to minimize water lowerings.
- 7.2.4.4 Mains and laterals shall be extended to the boundaries of filings and completely across the frontage of individual lots. Valves shall be placed at the boundary and a minimum of two (2) lengths of pipe installed past the valve for future tie-ins.

7.2.5 Location of Water Lines and Appurtenances

7.2.5.1 <u>Water Mains in Streets</u>

When the water mains are placed in streets they shall be placed as follows:

- a. On streets running north and south, the water main shall be placed ten feet (10') east of the centerline of the street.
- b. On streets running east and west, the water main shall be placed ten feet (10') north of the centerline of the street.
- c. On streets shaped as a "U" or on streets having unusually sharp turns, the water main will conform to the above specifications as near as practical, but the final location shall be as determined by the Town Engineer or his representatives.

7.2.5.2 <u>Water Mains in Easements</u>

In areas where water mains are placed in easements, all water mains shall be located within the easements shown on the contract drawings. All water main easements must be a minimum of twenty feet (20') in width for exclusive easements and ten feet (10') additionally per each other utility for non-exclusive easements. No water line shall be located less than five feet (5') from the edge of an easement.

7.2.6 Service Line Layout and Locations

7.2.6.1 Water service shall be located a minimum of ten feet (10') horizontally from the sewer service. Service lines shall be installed in a continuous straight line and shall enter the property a minimum distance of five feet (5') from the nearest lot corner.



- 7.2.6.2 The main to be tapped must extend a minimum distance of eight feet (8') beyond the lot line of the property to be served and the service line connection and service must be a minimum distance of five feet (5') into the lot.
- 7.2.6.3 In the case of corner lots, the property may be served from the side lot line under the same regulations as above along as the water and sewer services are on the same side of the lot.
- 7.2.6.4 If service is requested for lots at the end of a cul-de-sac street, the main to be tapped must be not more than fifty feet (50') from any property line in the cul-de-sac. The service pipe shall be in a continuous straight line and shall enter the property a minimum distance of five feet (5') from the nearest lot corner.

7.2.7 Valve Spacing and Marking

- 7.2.7.1 Valves shall be placed with a maximum spacing of six hundred feet (600') in all distribution mains and lateral lines. Valves shall also be placed to ensure that only one (1) hydrant will be out of service in the event of a line break.
- 7.2.7.2 Tees shall require three (3) valves. Crosses shall require four (4) valves. All valves located at intersections shall be placed within three feet (3') of the tee or cross. All inline valves should be placed as close to fire hydrant tees as possible.
- 7.2.7.3 Valves shall also be placed at each end of a line running through an easement on private property, on each side of a creek or channel crossing, and on each side (at property lines extended) of a distribution line that provides service to a hospital, school, or large industrial user.
- 7.2.7.4 All valves located outside of a paved street will require permanent marker post per the Details.

7.2.8 Fire Hydrant Spacing and Locations

- 7.2.8.1 In single-family residential areas, fire hydrants shall be spaced a maximum of five hundred feet (500') apart as measured along street curb line. A hydrant shall be placed at the end of each cul-de-sac, and at all permanent dead end lines.
- 7.2.8.2 In business, industrial and high-density residential areas, hydrants shall be spaced not greater than three hundred feet (300') apart or as approved by Platte Valley Fire Protection DistrictFire Protection District.
- 7.2.8.3 Fire hydrants shall be located, where possible, on the northeast corner of an intersection a minimum of eighteen inches (18") behind the curb or sidewalk, or a minimum of twenty-four inches (24") inside

the street ROW, and set on the curb return. Where this is not possible, fire hydrants shall be located as directed by the Town Engineer. All fire hydrant street valves shall be six inches (6") and shall be located at, or within three feet (3') of, tee from the main line. See Valve and Fire Hydrant Location Detail.

7.2.9 <u>Pipe</u>

- 7.2.9.1 All pipe used for distribution mains and lateral lines having a diameter of sixteen inches (16") or less shall be PVC pipe unless otherwise approved in writing by the Town Engineer. Distribution mains in excess of sixteen inches (16") in diameter shall be subject to approval by the Town Engineer.
- 7.2.10.1 All pipe having a diameter of twelve inches (12") or larger shall be profiled on the construction drawings. All water mains of any size which are not under a designed street shall also be profiled on construction drawings.

7.2.10 Pipe Minimum Depth and Locator Wire

All pipe shall be installed with a minimum five feet (5') of cover from finished grade of street to the top of pipe. Twelve (12) gauge insulated tracer wire is required on all water lines, and locate stations at each hydrant are required.

7.2.11 <u>Pipe Deflection</u>

Changes in direction of waterline pipe shall require bends in all instances. Deflection of PVC pipe and Ductile Iron pipe may be achieved by deflection according to manufacturer's recommendations only. All deflections proposed on construction plans shall have distances and degrees of deflection.

7.2.12 Air Relief Valves

- 7.2.12.1 Air relief valves shall be installed at each high point in all distribution mains and at high points of lateral lines or other areas as directed by the Town Engineer.
- 7.2.12.2 Air relief valves shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere and in accordance with the Details.

7.2.13 Permanent and Temporary Blow-off Valves

Provisions shall be included in the design to allow for the flushing of distribution mains and lateral lines at any low point in the system, or at any point noted on the approved plans. Fire hydrants shall be used for all permanent blow-offs; however, for temporary dead end waterlines, a temporary blow-off valve may be permitted. The blow-off assembly shall be installed perpendicular to and on the downhill side of the main. The blow-off assembly standpipe must have a threaded end to accept a fire hose coupling. The top of the standpipe shall be between four and six inches (4"-6") below grade in accordance with the Details.



7.2.14 Pressure Reducing and Regulating Valves

Pressure reducing and regulating valves shall be of a type capable of maintaining pre-adjusted downstream pressures, varying rates of flow and upstream pressure without causing water hammer. Valves shall be piston type, not spring operated, with flanged end connections, and shall be installed in concrete valve vaults of sufficient size to provide adequate maintenance and operation. Valves shall have gate valves and pressure gauges on both upstream and downstream sides and shall have bypasses with smaller pressure reducing and regulating valves to handle minimum flows as determined by the Town Engineer. All gate valves in the vaults shall be capable of being operated from above ground by use of two-inch (2") square valve keys. All PRV's shall be as manufactured by Cla-Val.

7.2.15 Fire Lines

The property owner shall maintain all fire lines extending from the valve on the Town 's water main. Valves on newly constructed fire lines shall be located at the tee at the main line and one at the property line. Fire lines are to be used strictly for fire protection. Domestic water taps and/or irrigation taps shall not be allowed on the fire line without authorization from the Town Engineer. Fire line valve boxes will have "FIRE" printed on the valve lid instead of "WATER".

7.2.16 SCADA

SCADA will be required for all equipment which is necessary to monitor. SCADA shall be compatible with the Town 's system, and the system must be approved by the Town Engineer.

7.3 WATER MAIN CONSTRUCTION

7.3.1 <u>General Provisions</u>

All water main construction within the Town and all water service line construction connecting to the Cities water system shall be done in accordance with these Engineering Standards, and the accepted plans shall apply to new water system construction as well as repairs to existing facilities. When special conditions are encountered or deviations from these Engineering Standards are required by the Town Engineer or Director of Public Works, and such changes are in the best interest of the Town , the decision of the Town Engineer shall be final.

7.3.2 Permits Required

No permits will be issued until the Town Engineer or Director of Public Works has approved and signed final construction drawings. A pre-construction meeting with the Town Inspector and Town Engineer, the developer and contractor shall be scheduled and completed prior to the commencement of any Construction. A full set of submittals is required to be submitted at the pre-construction meeting. The Town Engineer shall be notified two (2) working days before construction is to begin.

7.3.3 Maintenance of Traffic



When street cuts are required for water and sewer facilities construction, the following conditions shall be met to avoid interference with traffic:

- a. Street service cuts shall be open only between 8:30 a.m. and 3:00 p.m.
- b. Two-way traffic shall be maintained at all times around the construction area. A Traffic Control Plan must be submitted to the Town Engineer for approval prior to the commencement of construction.

7.4 WATER MAIN EQUIPMENT

7.4.1 <u>Ductile Iron Pipe</u>

All ductile iron pipe furnished under this specification shall be manufactured in strict accordance with AWWA standard specification C-151 or latest revision thereof with the following additional requirements:

- a. <u>Size of Pipe</u> This specification shall cover four-inch, six-inch, eight-inch, and twelve-inch (4", 6", 8" and 12") diameter pipe.
- b. <u>Joint Type</u> All ductile iron pipe joints shall be "Push on joint single gasket" or "Mechanical joint single gasket." The rubber gasket shall conform to the requirements of AWWA C-111 or latest revision thereof.
- c. <u>Thickness Class</u> Pipe furnished shall be Class 50 for six-inch, eight-inch and twelve-inch (6", 8" and 12") diameter, and Class 51 for sixteen-inch and twenty-inch (16"and 20") and larger diameter pipe.
- d. <u>Laying Length</u> Pipe furnished shall have a normal laying length of eighteen feet (18') or twenty feet (20').
- e. <u>Grade of Iron</u> Iron used in the manufacture of pipe shall have 60/42/10 physicals.
- f. <u>Cement Mortar Lining</u> All pipe furnished shall have standard thickness cement mortar lining in accordance with AWWA C-104 or latest revision thereof.
- g. <u>Polyethylene Wrapping</u> Pipe furnished shall have polyethylene wrapping as specified in paragraph 3.6. The polyethylene wrapping shall conform to AWWA C-105/A21.5-82 or latest revision thereof. See Detail Polyethylene Wrapping.

7.4.2 Polyvinyl Chloride (PVC) Pressure Pipe

All polyvinyl pipe furnished under this specification shall be manufactured in strict accordance with AWWA Standard C-900 and shall conform to the following additional requirements:

a. <u>Size of Pipe</u> – This specification shall cover polyvinyl chloride pipe in fourinch, six-inch, eight-inch, ten-inch, twelve-inch, and sixteen-inch (4", 6", 8", 10", 12" and 16").



- b. <u>Joint Type</u> Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.
- c. <u>Class and Type</u> All sizes of pipe shall be Class 150, dimension ratio 18 (DR 18).
- d. <u>Pipe Lengths</u> Each length of pipe will be a standard laying length of twenty feet (20'). Random lengths shall not be acceptable.

7.4.3 Polyethylene Wrapping

Polyethylene wrapping shall be installed around all ductile iron pipe, fittings, valves, fire hydrant barrels, and rods and clamps and where specified by the Town Engineer. Polyethylene wrapping shall be in accordance with AWWA Specification C-105/A21.5-82 or latest revision. Minimum thickness of polyethylene wrapping shall be eight (8) mils.

7.4.4 Fittings

- 7.4.4.1 All fittings shall be ductile iron, cement mortar lined, and shall conform to AWWA C-110/A21.10-82 for mechanical joints and AWWA C-111-71 or ANSI A21.11 for push on joint gasket or latest revisions thereof.
- 7.4.4.2 Fittings shall be wrapped in polyethylene when used with wrapped pipe line.

7.4.5 <u>Valves</u>

- 7.4.5.1 <u>Gate Valves</u> shall conform to AWWA C-500-80 (or latest revision) flexible wedge, with a minimum working water pressure of two hundred fifty (250) PSIG for valves twelve inches (12") and smaller. Valve seats, the discs and the stem shall be constructed of bronze. Stem seals shall be with two (2) "O" rings, each of which shall be designed as to allow replacement under full line pressure when the valve is in the full open position. Valves shall have two-inch (2") square operating nuts and shall open counter clockwise (left) unless otherwise directed by the Town Engineer.
- 7.4.5.2 <u>Butterfly Valves</u> shall conform to AWWA C-504-80 (or latest revision) with a minimum working water pressure of one hundred fifty (150) PSIG and shall be supplied with flanged connections and shall be suitable for buried service installation. The pivot axis of the disc shall be mounted in the horizontal position and provided with geared operators and position indicators. Operator manholes shall be provided as shown in the Details. Valve operators shall have two-inch (2") square operating nuts and shall open counter clockwise (left).
- 7.4.5.3 <u>Fire Hydrants</u> shall conform to AWWA C-502-73 or latest revision. Hydrants shall have a 6" bell connection, two (2) two and one-half-



inch $(2 \frac{1}{2})$ hose connections and one (1) four and one-half-inch (4 $\frac{1}{2})$ pumper connection. Threads on the pumper and hose connections shall conform to the *National Standard Screw Threads for Fire Hose Couplings and Fittings* published by the Insurance Services office. Hydrants shall be designed to operate under one hundred fifty (150) psi working pressure and shall open counter clockwise (left) unless specified otherwise. Fire hydrants shall be cast iron and bronze mounted. Fire hydrants shall have auxiliary six-inch (6") gate valve anchored directly to or as near as possible to the main line tee as shown in the Details. The hydrant lateral shall be six-inch (6") PVC, and if more than one length of pipe is used the joints shall be restrained and shall be wrapped in polyethylene. All hydrants shall be Muller Centurion Model 423 five and one-fourth-inch (5 $\frac{1}{4}$ "). Color shall be red.

- 7.4.5.4 <u>Check Valves</u> shall be of the swing check type and shall be used wherever the flow of water must be in one direction only and reverse flow must be prevented. Check valves shall be of the outside spring and lever type and shall be installed in vaults or manholes. Check valves shall be furnished with flanged end connections and shall be installed in a manner which allows easy access for inspection, adjustment and maintenance.
- 7.4.5.5 <u>Valve Boxes and Valve Markers</u> shall be installed in accordance with the Details. Markers shall be installed to locate all valves on lines in easements or other ROWs when not at street intersections. Fire hydrant auxiliary valves shall not be marked unless specifically directed by the Town Engineer.
- 7.4.5.6 <u>Combination Air Relief-Vacuum Breaker Valves</u> shall be installed at each high point on all sixteen inches (16") and larger water mains and at all other locations as directed by the Town Engineer. Air Relief and Vacuum Breaker Valves shall be located in pre-cast concrete manholes in accordance with the Details and shall automatically release air from the lines when the lines are being filled with water, and shall admit air into the lines when water is being withdrawn in excess of the inflow. The valve and body shall be designed to operate under a maximum working pressure of one hundred fifty (150) psi. Valves shall be iron body, with bronze trim. Floats shall be stainless steel. One (1) two-inch (2") valve shall be installed on the stem between the pipe and relief valve or as shown in the Details.

Pipe and fittings used in the relief valve system shall be galvanized steel, standard weight, and connections shall be threaded. Gate valves shall be bronze, with female iron pipe thread ends and shall have handwheels.

7.4.5.7 <u>Restraints</u> – Mechanical restraints shall be used at all valves, bends, fittings with mechanical or push-on type connections and dead ends. Mechanical restraints shall be "Mega Lugs," "Star Products," "All Grip" Series 3600, uni-flange Series 1400 and 1500, or approved equal.



- 7.4.5.8 <u>Thrust Blocks</u> Concrete thrust blocks shall be installed at all tees, plugs, bends, and fire hydrants in accordance with the Details. Where thrust blocks are used to block plugs or valves or as indicated by the Town Engineer, the valve or plug shall be protected from concrete by an eight (8) mil thickness of polyethylene. Size of thrust block and dimensions shall be in accordance with the Details. The concrete used for the thrust blocks shall be three thousand (3,000) psi, twenty-eight (28) day strength. Thrust blocks shall be installed in addition to mega Lugs for all valves, bends, fire hydrants, and plugs.
- 7.4.5.9 <u>Pre-Cast Concrete Vaults and Manholes</u> All butterfly valve manholes, air relief and vacuum valve vaults, pressure reducing valve vaults, meter vaults, and other vaults shall be pre-cast or poured in place concrete. Design of manholes shall be for traffic loading and shall include aluminum rungs, sump pit, cast iron rings and covers of a pattern approved by the Town Engineer, with the word "water" cast thereon. All vaults and manholes shall be water tight and all joints, pipe openings, and other places where infiltration could exist shall be sealed from the outside with a mastic waterproof sealant. All inside joints shall be grouted.

7.4.6 Service Lines and Appurtenances

- 7.4.6.1 Water is conveyed from mains to the plumbing of licensed premises by service lines and their appurtenances. In the context of these Standards, service lines include all pipe and fittings up to the point of entry into a residence as shown in the Details. All water pipe beyond service pipe and meter shall be controlled by the local plumbing codes.
- 7.4.6.2 All new or replacement service lines and appurtenant fittings installed in areas being supplied with potable water from the Town shall conform to the following minimum standards which shall be binding regardless of the regulations of any other agency covering like installations.
- 7.4.6.3 The corporation stop and that portion of the service pipe between the meter and the corporation stop shall all be of the same size.

7.4.6.4 Ownership and Maintenance

These water system specifications are intended to be supplemental and subordinate to the operating rules of the Town and will be so construed in any conflicting situations.

- a. <u>Ownership</u> The service pipe and fittings from the meter to the house through which an owner receives water service from the facilities of the Town shall be installed and maintained at the expense of the owner.
- b. <u>Maintenance</u> The owner shall maintain all privately owned



piping except as set forth under the referenced operating rules. This shall include the service pipe and all fittings and fixtures from the meter to the house, except the water meter.

The curb stop service box and meter pit shall be kept conveniently accessible. Any box or pit not easily accessible shall be cleared by the owner of the premises within a reasonable time after notification by the Town . Failure by the owner to comply may cause the Town to do the necessary maintenance work and charge the cost thereof to the premises served.

c. <u>Frozen Service Pipes and Stub-In Connections</u> – The Town will not be responsible for the thawing of frozen service pipe or appurtenances or repair to stub-in connections installed to permit street paving.

7.4.6.5 Service Lines

Service lines shall be of the size which is adequate to supply the requirements of the property being served. The minimum size line shall be three-fourths inches ($\frac{3}{4}$ "). The only acceptable materials for a service line are seamless copper (Type K), HDPE 250 PSI and ductile iron pipe, PVC C-900 for services larger than two inches (2"). Service lines shall be of the same type material from beginning to end, unless the appropriate insulator is installed at the junctions of the dissimilar metals.

- a. <u>Compaction</u> Prior to any backfilling, the service line and all of its appurtenances from the tap to the dwelling shall be inspected and approved by a representative of the Town. Once approved for backfilling and compaction, the backfill material shall be carefully compacted as specified in Sections 6.6 and 6.7 of these specifications.
- b. <u>Separate Trenches</u> Service pipes may not be installed in trenches containing conduits which carry any substance other than potable water, and a service line shall be separated laterally from foreign conduits by a minimum of ten feet (10').
- c. <u>Combination Service Pipes</u>
 - 1. A property requiring a domestic service line and fire protection service line may be served from a single tap in some cases. The fire protection service line shall extend straight from the main to the property line and shall have a gate valve located two feet (2') minimum from the property line on the street side of the property line. A tee shall be placed on the fire protection service line on the inlet side of the gate valve for the domestic



service line. A domestic service tee may not be placed on an existing fire line.

 <u>Connections to Mains for Fire Sprinkler Lines</u> – Sprinkler heads found in department stores, warehouses, etc. are supplied by a fire line. The fire line shall be sized by an independent firm and reviewed by the local fire department and the persons responsible for the structure it protects. The Town will not size fire lines.

> The fire line shall be ductile iron pipe or PVC. The fire line shall have a valve two feet (2') from the property line on the street side of the property line as shown in the Details. The fire line connection may also serve as a domestic service line if the domestic tee is installed at the same location as the fire line this will require permission from the Town Engineer.

d. <u>Pipe Size</u>

- 1. Service lines shall be of a size which is adequate to supply the requirements of the property being served. The minimum size allowable for a service line shall be three-quarter inch (¾").
- 2. Adequate size for a service line shall be defined in terms of head loss as follows: The combined pressure drop in the service line and meter between the main and the building shall not exceed ten (10) psi at peak demand.
- 3. The requirements of the property being served shall be defined as peak demand, as calculated in the AWWA Manual of Water Supply Practices, entitled "Sizing Water Service Lines and Meters."

e. <u>Type of Pipe</u>

- 1. All service pipes supplying water from the Town's system shall conform to one of the following specifications..
- Seamless Copper Tube or HDPE 250 PSI of the type designated as "Type K" (soft) with insulator in the industry shall be used for service lines three-quarter (3/4") through two inches (2"). Only compression fittings are allowed.
- 3. <u>Ductile Pipe</u> conforming to the Materials Specification



as outlined in Section 7.4 of these specifications may be used for all service lines larger than two inches (2").

- f. <u>Installation</u> Service line from corp stop to curb stop is to be one continuous pipe.
- g. <u>Taps and Saddles</u> The size of tap and the tapping method for a given type and size of water line shall be as follows:

SIZE OF PIPE	DUCTILE IRON		DN PVC					
3⁄4"	1"	1-1/2"	2"	3⁄4"	1"	1-1/2"	2"	
3"	NO	NO	NO	NO	NO	NO	NO	NO
4"	S	S	NO	NO	S	S	NO	NO
6"	DT	S	S	S	S	S	S	S
8"	DT	DT	S	S	S	S	S	S
12"	DT	DT	S	S	S	S	S	S
16"	DT	DT	S	S				
20"	DT	DT	S	S				

TYPE OF PIPE AND SIZE OF TAP

 $\ensuremath{^{\circ}\text{S}}\xspace^{-}$ – Tapping saddle required – all saddles shall have the AWWA Taper on its threads.

"DT" - Direct tap permitted.

"NO" – No tap permitted with or without a saddle. A tee connection may be permitted if specifically authorized by the Water Department.

h. Tapping saddles with tap sizes two inches (2") and smaller for the ductile iron pipe shall consist of a bronze body with two (2) bronze straps. Saddles for PVC shall be "full support, wide bearing" type.

See Section MS-24 of the Material Specifications for further information on tapping saddles.

7.4.6.6 <u>Meter</u>

- a. All water meters installed for billing purposes shall be under the control of the Town.
- b. All water meters must be paid for prior to receiving a building permit.



- c. All water meters will be installed by the Town.
- d. <u>Size of Meter</u>
 - Meters shall be of the same size as the corporation stop and that portion of the service pipe between the meter and the corporation stop. In no case shall a meter smaller than five-eighths by three-quarter-inch (5/8"x³/4") be installed.
 - 2.
 - 3. The Townmay allow the installation of a meter of a size smaller than the service pipe in cases where the full capacity of a previously used service pipe is not required provided that the service pipe is reduced to the size of the meter for a distance of not less than ten (10) times the larger pipe diameter on the inlet or supply side of the meter. This will be reviewed on a case by case.
- e. <u>Valves for Use With Meters</u>
 - 1. Gate valves three-inch (3") and smaller to be used with copper service pipe shall be all bronze, with non-rising stems and solid wedge disc, manufactured in accordance with ASTM Specification B 62-76 and Federal Specification W.W.-V-54 Class A 125 psi W.S.P., two hundred (200) psi, W.O.G.
 - Valves for one and one-half inches (1 ½") and two-inch (2") meters shall be curb stops as shown on the Details.
 - 3. Valves three inches (3") and larger for use with ductile iron service pipe shall be gate valves with cast iron bodies conforming to the Materials Specifications, Section MS-6, of the Denver Water Department Engineering Standards, latest revision. All gate valves larger than three inches (3") shall be supported by adjustable steel valve supports.
- f. <u>Inside Meter Settings</u> Inside meters shall only be allowed by special permission from the Town.
- g. <u>Meter Bypass Lines</u> A bypass line shall be required for all meters four inches (4") and larger unless otherwise specified by the Town, whether installed in an outside or inside setting. Bypass lines shall contain an independent control valve and shall contain no tees, plugs, or other outlets through which water could be withdrawn. Bypass lines permit the consumer to have water while his meter is being repaired or replaced.



No bypass lines will be allowed for meters three inches (3") and smaller.

h. <u>Meter Check Valves</u> – Double check valves will be required for all meters one and one-half inches (1 ½") and larger unless otherwise specified by the Town, whether installed in an inside or outside setting. Double check valves shall be required on meters smaller than one and one-half inches (1 ½") to prevent backflow of water from the property to the main.

7.4.6.7 Backflow and Backflow Prevention Devices

- a. Backflow, which is the flow of water, or other liquid, or foreign materials into the distribution mains of the Town 's system from another source is strictly prohibited and shall be prevented by the installation of an appropriate, approved backflow prevention device, purchased and installed by the consumer at his own expense.
- b. The type and complexity of the backflow prevention device shall be determined by the Town in accordance with the *Manual of Cross-Connection Control for the Colorado Department of Health and Environment* and shall be based upon the degree of hazard caused to the public from contamination by toxic, or non-toxic substances.
- c. Backflow devices shall be tested annually at owner's expense. Test results shall be submitted to the Town Engineer.
- d. A toxic substance is any solid, liquid, or gas which, when introduced into the water supply system, creates a danger to the health and well being of the consumer.
- e. A non-toxic substance is any solid, liquid, or gas of a nonpoisonous nature that is potable or edible, and that creates a moderate or minor hazard to the domestic water system. Examples are connections of food processing lines such as syrups, lard, beer, etc., or connections to steam and steam boilers where the steam does not come into contact with poisonous materials.
- f. Devices vary as to function, and may be air gap type, reduced pressure backflow preventive type, pressure vacuum breaker, atmospheric vacuum break, or double check valve type. Backflow prevention devices are characterized by great care in construction Details, the use of materials that will give the least possible wear or corrosion, and ready accessibility for inspection and cleaning.



7.4.6.8 <u>Type of Service Line Material</u>

- a. All tapping saddles must be double-strap bronze type.
- b. Corporation stops must have AWWA taper CC threads.
- c. Curb stops must be Mueller or Ford compression.
- d. Service stop boxes must be Mc Donald 5601 Erie Pattern or Ford Arch Pattern with stationary rod, Type HS lid, 2 hole style "Erie Pattern."
- e. Meter Pits shall be twenty inches (20") DFW.
- f. Meter Pit Lids shall be:
 - 1. Twenty inches (20") Casting Meter Pit Cover With Cast Iron Lid
 - 2. 27/32" Pentagon Bolt (five star)
 - 3. 1 7/8" Drilled Hole
 - 4. Plastic Reset Frost Lid
- g. Yoke shall be Muller Compression w/check valve.
- 7.4.6.9 Meter Couplings

All meters one and one-half inches (1 ½") and larger shall be installed with a coupling to allow removal of the meter without disturbing the pipe. Couplings shall conform to the Materials Specifications, MS-24, of the Denver Water Department Engineering Standards, latest revision.

- 7.4.6.10 Pipeline Testing After Installation
 - a. <u>Chlorination</u> All mains, extensions and private pipe shall be chlorinated accordance with AWWA C-651, "Disinfecting Water Mains" and the local health authority having jurisdiction prior to the lines being accepted.

The chlorination of the finished pipelines shall be done in the presence of the Town Engineer. Prior to the hydrostatic testing the Town must receive documentation which indicates all Bacteriological test have passed.

b. <u>Material</u> – Chlorine tablets may be used for disinfection in twelve-inch (12") and smaller. For pipes having a larger diameter, a chlorine slurry is fed into the water filling the pipe.



If chlorine tablets are used, they shall be attached to the inside top of the pipe with red permatex just prior to the pipe installation. Hypochlorite may be used and shall conform to Federal specification O-C-114, Type II, Grade B.

The contractor shall take all necessary precautions to prevent the flow of strong chlorine solution into existing water facilities and shall assume all responsibility for damages done by heavily chlorinated water.

c. <u>Method</u> – Flushing and sterilization of lines shall be accomplished in accordance with the requirements of the Colorado State Board of Health. Chlorine dosage shall be at least one hundred (100) parts per million, and shall be retained in the line at least twenty-four (24) hours, after which time the residual at the end of the line and at other representative points in the line shall be at least ten (10) parts per million. If the residual at the end of twenty-four (24) hours is less than ten (10) parts per million, the entire operation shall be repeated.

All valves in the lines being sterilized shall be opened and closed several times during the contact period. After completion of sterilization, the system shall be flushed with clean water until the residual chlorine content is not greater than 1 part per million, or the existing systems normal residual. A Town representative will take all chlorine test. Dechlorination will be required on all flushing of lines with chlorine levels greater than system norm.

The contractor will be required to supply test bottles and pull clear water samples in the presence of a Town representative. A sample will be taken at every fire hydrant and blow off. The contractor will submit the samples to a state-certified laboratory.

- d. <u>Hydrostatic Pressure Test</u>
 - 1. The hydrostatic test pressure for any type of pipe shall be one hundred fifty (150) pounds per square inch based on the elevation of the lowest point in the line of section under test and carried to the elevation of the test gauge. All sections of newly laid pipe, subsequent to backfilling, shall be subjected to the hydrostatic pressure test.
 - 2. The duration of the hydrostatic pressure test shall be at least one (1) hour.



- 3. <u>Air Removal Before Test</u> Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points as the air can be expelled as the line is filling with water. After all the air has been expelled, the corporation cocks shall be closed and test pressure applied. Any cracked or defective pipe, fittings, valves or hydrants discovered in sequence of this pressure test shall be removed and replaced by the contractor with sound materials, and the test shall be repeated until results satisfactory to the Town Engineer are obtained.
- 4. <u>Procedure</u> Each valved section of pipe shall be slowly filled with water and the specified test pressure shall be applied by means of a pump connected to the pipe in manner satisfactory to the Town Engineer. The pump, pipe connection, gauges and all other necessary equipment and personnel to complete the test, shall be furnished by the contractor and shall be approved by the Town Engineer. All corporation cocks and taps to the main line and all connection piping and valves that may be required to make the test, whether or not specified or shown on the construction drawings, shall be installed by the contractor. The Town will furnish only the calibrated meter.

While the test pressure is maintained, the new pipe will be inspected and any leaks will be repaired. After all leakage has stopped, the pressure of one hundred fifty (150) psi shall be maintained for one (1) hour. Allowable leakage for each section between the line valves shall not exceed the following values:

INSIDE DIAMETER	D.I.	PVC
4	0.37	0.33
6	0.55	0.50
8	0.74	0.66
12	1.10	1.00
16	1.47	
20	1.84	

ALLOWABLE LEAKAGE PER 1000 FT/PIPE GALLONS/HR.

Should the leakage rate be greater than the above set



rates, the pipeline shall not be accepted. The pipeline shall be repaired, rechlorinated as described in 7.8.9.2 and retested.

The contractor shall ensure that a satisfactory test is completed and shall employ all methods necessary to pass the test, including disconnection from existing watermains and use of a temporary plug, if necessary.

5. <u>Test Results</u> – The contractor will be responsible for presenting certified test results to the Town Engineer prior to acceptance of the lines.

7.5 ENCASEMENT AND CASINGS

7.5.1 Pipe Casings

Pipe Casings shall be used where bores are required under ROWs by the using agency. All pipe casings shall be constructed to conform with the Details. The type of casing material and its properties shall have prior approval from the Town Engineer before using.

7.6 INSTALLATION

7.6.1 Excavation

Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the approved drawings or as otherwise approved by the Town Engineer. Any water which may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of the work.

- 7.6.1.1 <u>Limit of Excavation</u> Except by expressed written permission of the Town Engineer, the maximum length of open trench shall be six hundred feet (600'), or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying and appurtenances, construction and backfill which has not been temporarily resurfaced. No trench shall be left open at any time that the contractor is not on the job site engaged in construction operations. In existing developments excavation will not be permitted to advance more than one hundred fifty feet (150') ahead of pipe laying and two hundred feet (200') in advance of the backfill operations. No trench will be left open overnight without written permission of the Director of Public Works.
- 7.6.1.2 <u>Inspection by the Town Engineer</u> The purpose of the inspection shall be to cull and reject any pipe that, independent of the physical tests herein specified, fails to conform to the requirements of the



referenced specifications, or that may have been damaged during transportation and/or in subsequent handling.

The Town Engineer reserves the right to reject any and all pipe sections that may contain visual imperfections or imperfections of any type that may be considered by the Town Engineer to be detrimental to the operation and life of the pipe.

- 7.6.1.3 Trench Width - The overall trench width shall not be more than twentfour inches (24") nor less than twelve inches (12") wider than the largest outside diameter of the pipe to be laid therein, measured at the top of the pipe, exclusive of branches. Excavating and trenching shall be true to line so that a clear space of not more than twelve inches (12") or less than six inches (6") in width is provided on each side of the largest outside diameter of the pipe for proper placement and densification of the bedding or backfill. For the purpose of this section, the largest outside diameter shall be the outside diameter of the bell, on bell and spigot pipe. All trenching sizes shall be in accordance with the Standard Bedding Details. Where the width of the lower portion of the trench exceeds the maximum width herein stated, the contractor, at his own expense, shall furnish and install special pipe embedment or concrete encasement to protect the pipe from the additional loading. The pipe supplier shall determine the type and quantities of special pipe embedment, using trench-loading criteria based upon saturated backfill weighing 120 pounds per cubic foot and allowance for truck and other superimposed live loads.
- 7.6.1.4 <u>Excavation Below Grade</u> The trench shall be excavated to a minimum depth of six inches (6") below the bottom of the pipe. Before the pipe is laid, the subgrade shall be made by backfilling with an approved material in three-inch (3") uncompacted layers. The bedding material shall be hand leveled as to provide a continuous bearing and support for the pipe at every point.
- 7.6.1.5 <u>Trenching By Hand or Machine</u> Hand methods for excavation shall be employed in locations directed by the Town Engineer. In other locations, the contractor may use trench digging machinery or employ hand methods.
- 7.6.1.6 Bracing Excavations
 - a. All excavations shall be properly supported in the manner as required by Occupational Safety and Health Administration Federal Register Vol. 37, No. 243, Sub-part P, Section 1926.652 or as required by State laws and Municipal ordinances and as may be necessary to protect life, property, the work, or as ordered by the Town Engineer. Excavations shall be braced, sheeted and supported such that they will be safe, and the ground alongside the excavation will not slide or settle. Excavation shall be so braced or sheeted so as to provide conditions under which workmen may work safely and



efficiently at all times. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

- b. Care shall be exercised in the drawing or removing of sheeting, shoring, bracing and timbering to prevent the caving or collapsing of the excavation faces which are being supported.
- 7.6.1.7 <u>Grading and Stockpiling</u> The contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains or temporary drains.

7.6.2 Dewatering

- 7.6.2.1 The contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will insure a dry excavation and preservation of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines and other means, all subject to the approval of the Town Engineer.
- 7.6.2.2 Dewatering for the water lines shall commence when groundwater is first encountered, and shall be continuous until such time as water can be allowed to rise in accordance with the provisions of this section.
- 7.6.2.3 The contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property or to new construction.
- 7.6.2.4 The contractor shall have on sight at all times a Construction Dewatering permit issued by the Colorado Department of Public Health and Environment (CDPHE).

7.6.3 Foundations and Bedding

- 7.6.3.1 <u>Foundations in Poor Soil</u> If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Town Engineer and in accordance with the Standard Bedding Details.
- 7.6.3.2 <u>Foundations in Rock</u> Where rock is encountered, it shall be removed below grade and the trench backfilled with rock uniformly graded between three-quarter inches (³/₄") and one and one-half



inches (1 ½") to provide a compacted foundation cushion with minimum allowable thicknesses of three inches (3") under the outside diameter of the pipe bell and six inches (6") under the pipe barrel. Material, other than what has been stated, can be used if accepted by the Town Engineer and necessary agencies. Whether or not the foundation material will be considered as rock and require bedding as described above will be determined by the Town Engineer.

7.6.3.3 <u>Pipe Clearance in Rocks</u> – Ledge rock, boulders and large stones shall be removed to provide a clearance of at least six inches (6") below and on the side of the pipe and fittings.

7.6.3.4 <u>Bedding Procedure</u>

- a. The pipe shall be carefully bedded as shown in the Standard Bedding Details. The contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe for the width shown on the Bedding Details. Use of the drag template shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.
- b. Each joint shall be recessed in bedding material as required by the Bedding Detail in such a manner as to relieve the bell or coupling of the pipe of all load and to insure continuous bearing along the pipe barrel upon the pipe sub-grade.
- The pipe bedding, using either squeegee or clean imported c. sand shall conform to the limits set by the Town Standards. The bedding material, either squeegee or imported sand, shall be compacted by approved methods to a Standard Proctor Density of ninety (90%) in open areas (AASHTO T-180) and ninety-five percent (95%) in all Public ROW (AASHTO T-99). It shall be brought to an optimum moisture content and shall be placed by hand in layers not exceeding three inches (3") in thickness to the centerline (springline) of the pipe and each layer shall be solidly tamped with the proper tools so as not to injure, damage or disturb the pipe. Backfilling shall be carried on simultaneously on each side of the pipe to assure proper protection of the pipe. Water settling for compaction may be approved by the Town Engineer in the event the foundation and bedding materials are sufficiently granular and sandy in nature that the required compaction will be obtained. From the springline of the pipe to a distance twelve inches (12") above the top of pipe, the bedding material must be placed in layers not to exceed twelve inches (12").
- d. The area shown on the Details from trench bottom to twelve inches (12") above this pipe shall be called the "pipe zone."
- 7.6.4 Installation of the Water Pipe



7.6.4.1 General

- All pipe shall be laid without break from fitting to fitting. Pipe a. shall be laid to the line and, where required, grade, as shown on the approved plans and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the line. Where possible, vertical deflections shall be made at pipe joints and vertical bends shall be Permissible joint deflections are specified in eliminated. paragraph 6.4.3.7. The interior of the water pipe shall be cleaned of all dirt and superfluous material of all description as the work progresses.
- b. At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight.
- 7.6.4.2 Alignment and Grade
 - a. The water line shall be laid and maintained to the required lines and grades as shown on the plans.
- 7.6.4.3 Whenever obstructions not shown on the plans are encountered during the progress of the work and interfere to such an extent that an alteration in the approved plans is required, the Town Engineer shall have the authority to change the plans and order a deviation from the line and grade.
- 7.6.4.4 Laying of Pipe
 - Lowering of Water Main Material Into Trench Proper a. implements, tools and equipment satisfactory to the Town Engineer shall be provided and used by the contractor for the safe and convenient performance of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece in such a manner as to prevent damage to the water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

If damage occurs to any pipe, fittings, valves, hydrants or water main accessories in handling, the damage shall be immediately brought to the Town Engineer's attention.

b. Inspection Before Installation – All pipe and fittings shall be carefully examined for cracks and other defects while suspended and before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective pipe or fittings



shall be laid aside for inspection by the Town Engineer, who will prescribe corrective repairs or rejection.

- c. <u>Cleaning of Pipe and Fittings</u> All lumps, blisters and excessive coating shall be removed from the bell or coupling and spigot ends of each pipe, and the outside of the spigot and the inside of the bell or coupling shall be wire brushed and wiped clean and dry and free of oil and grease before the pipe is laid.
- d. <u>Laying of Pipe</u> Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying crew cannot put the pipe into the trench and place it without getting earth into it, the Town Engineer may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells or couplings. Precautions shall be taken to prevent dirt from entering the joint space.

- e. <u>Cutting of Pipe</u> The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe.
- f. <u>Bell or Coupling Ends to Face Direction of Laying</u> Pipe shall be laid with the bell or coupling ends facing in the direction of laying, unless otherwise specified by the Town Engineer. Where the pipe is laid on a grade of ten percent (10%) or greater, the laying shall proceed upward with the bell or coupling ends of the pipe upgrade, if the progression of work allows.
- g. <u>Permissible Deflection at Joints</u> Wherever it is necessary to deflect the pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or plumb stems or where long radius curves are permitted, the amount of deflection allowed shall not exceed that specified in Table 1 and Table 2 for mechanical joints and push on joints, respectively, and 4 degrees per joint or two degrees (2°) on each side of the coupling for polyvinyl chloride pipe.



Table 1: Maximum Permissible Deflection in Laying Mechanical Joint Pipe

SIZE OF PIPE	MAXIMUM PERMISSIBLE DEFLECTION PER LENGTH (INCHES)			APPROX. RADIUS OF CURVE PRODUCED BY SUCCESSION OF JOINTS (FEET)			ON OF	
	12-ft.	16 ft	18 ft	20-ft.	12-ft.	16 ft.	18 ft.	20 ft.
	Length	Length	Length	Length	Length	Length	Length	Length
3	16	22	25		110	145	160	
4	46	22	25		110	145	160	
6	14	19	21		125	170	190	
8	11	14	16		165	220	250	
10	11	14	16		165	220	250	275
12	11	14	16	18	165	220	250	275
14	7	10	11	12	240	320	360	400
16	7	10	11	12	240	320	360	400
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	5	6	7	8	360	480	540	600
30	5	6	7	8	360	480	540	600
36	4	5.5	6	7	430	575	650	720
42	4	5	5.5	6	460	610	690	765
48	4	5	5.5	6	460	610	690	765



Table 2: Maximum Permissible Deflection in Laying Push-On Joint Pipe Ductile Iron or Cast Iron

SIZE OF PIPE	MAXIMUM PERMISSIBLE DEFLECTION PER LENGTH (INCHES)			APPROX. RADIUS OF CURVE PRODUCED BY SUCCESSION OF JOINTS (FEET)				
	12-ft.	16 ft	18 ft	20-ft.	12-ft.	16 ft.	18 ft.	20 ft.
	Length	Length	Length	Length	Length	Length	Length	Length
3	10	13.5	15	17	175	230	260	290
4	10	13.5	15	17	175	230	260	290
6	10	13.5	15	17	175	230	260	290
8	10	13.5	15	17	175	230	260	290
10	10	13.5	15	17	175	230	260	290
12	10	13.5	15	17	175	230	260	290
14	6	8	9	10	290	380	430	480
16	6	8	9	10	290	380	430	480
18	6	8	9	10	290	380	430	480
20	6	8	9	10	290	380	430	480
24	6	8	9	10	290	380	430	480
30	4	5	6	7	430	575	650	700
36	4	5	6	7	430	575	650	700
42	4	5	6	7	430	575	650	700
48	4	5	6	7	430	575	650	700

- h. <u>Insulation Between Different Metallic Pipe Materials</u> Whenever it is necessary to join pipe or fittings with dissimilar metal, a method of insulating against the passage of electric current shall be provided and shall be approved by the Town Engineer.
- i. <u>Installation of Polyethylene Wrapping</u> (When Specified). See Water Detail.
- j. <u>Pipe</u> Where specified in Section 3.6, all ductile iron pipe shall be wrapped with polyethylene wrapping, minimum 8 mil thickness. Suggested installation procedure for polyethylene tube wrapping is as follows:

Pick up the pipe with a sling or pipe tongs. Slip a polyethylene tube which is approximately two feet (2') longer than the pipe over the plain end and leave it bunched up accordion style.



Lower the pipe into the trench and make up the joint with the preceding pipe. Shallow bell holes are required to allow overlap of the tube at the joints.

Remove the sling or tong from the center of the pipe, raise the bell a few inches and slip the polyethylene tube along the pipe barrel, leaving approximately one foot (1') of the tube bunched up at each end of the pipe for wrapping the joints.

Overlap each joint by first pulling one bunched-up tube over the bell, folding it around the adjacent plain end, and securing it in place with two (2) or three (3) wraps of the polyethylene adhesive tape. Complete the overlap by repeating the same procedure with the bunched-up tube on the adjacent pipe.

Take up the slack tube along the pipe barrel by folding it over the top of the pipe holding the fold in place with polyethylene adhesive tape.

Repair any rips, punctures or other damage to the polyethylene with tape or by cutting open a short length of tube, wrapping it around the pipe and securing with tape.

k. <u>Fittings</u> – When specified in Section 3.6, all fittings for ductile iron, or polyvinyl chloride pipe shall be wrapped with polyethylene tubing as described above. Installation procedure shall be as follows:

> Wrap tees, crosses and other fittings with a flat sheet obtained by splitting open a length of polyethylene tube. Pass the sheet under the valve or fitting and bring it up around the body. Joint the seams by bringing the edges together, folding over twice and securing in place with tape.

> Handle slack tube and overlapping at joints in the same manner described above for pipe.

Prepare openings for air reliefs, etc., by making an X-shaped cut in the polyethylene and temporarily folding back the edges. After installation is completed, replace the polyethylene and repair the cut with polyethylene adhesive tape.

7.6.4.5 Jointing of Mechanical Joint Pipe

a. <u>Cleaning and Assembly of Joint</u> – The last eight inches (8") of the outside spigot and inside bell of mechanical joint pipe shall be thoroughly cleaned to remove oil, grease, grit, excess coating and other foreign matter from the joint and then painted with a soap solution made by dissolving one-half (½) cup of liquid soap in one (1) gallon of water. The cast iron gland shall be slipped on the spigot end of the pipe with the lip



extension of the gland toward the socket, or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with the thick edge towards the gland. All mechanical joints and fittings shall be wrapped in polyethylene wrap; see Standard Detail.

<u>Bolting of Joint</u> – The entire section of pipe shall be pushed forward to seat the spigot end in the bell. The gasket shall then be pressed into place within the bell. Care shall be taken to locate the gasket evenly around the entire joint. The cast iron gland shall be moved along the pipe into position for bolting, all of the bolts inserted, and the nuts screwed finger tight. All nuts shall be tightened with a torque limiting wrench. The torque for various sizes of bolts shall be as follows:

PIPE SIZE (INCHES)	(INCHES)	RANGE OF TORQUE MIN. (FT-#) MAX.
3	5.8	4560
4-24	3./4	75-90
30-36	1	100-120
42-48	1-1⁄4	120-150

Nuts spaced one hundred eighty degrees (180°) apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland.

c. <u>Permissible Deflection in Mechanical Joint Pipe</u> – Whenever it is desirable to deflect mechanical joint pipe in order to form a long-radius curve, the amount of deflection shall not exceed the maximum limits shown in Table 1 at the end of this section.

7.6.4.6 Jointing Push-on Joint Pipe

a. <u>Cleaning and Assembly of Joint</u> – The inside of the bell remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket, or the coupling end of polyvinyl chloride pipe.

A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the outside of the spigot end of the pipe or both. Gasket lubricant shall be supplied by the pipe manufacturer and approved by the Town Engineer.

The spigot end of the pipe shall be placed into the bell or coupling end, without touching the ground with the spigot end after cleaning. The joint shall then be completed by forcing the plain end to the bottom of the socket. Pipe shall be marked with a depth mark to insure that the spigot end is inserted to



the full depth of the joint. Field-cut pipe lengths shall be marked by painting or file mark. The spigot end shall be ground or filed to resemble manufacture pipe end. Complete assembly instructions shall be provided by the pipe manufacturer.

- b. <u>Permissible Deflection in Push-On Joint Pipe</u> Whenever it is desirable to deflect push-on joint pipe, in order to form a longradius curve, the amount of deflection shall not exceed the maximum limits shown in Table 2 at the end of this section for cast iron or ductile iron pipe, or four degrees (4°) coupling for polyvinyl chloride pipe.
- 7.6.4.7 <u>Setting of Fittings</u> Fittings and plugs shall be joined to pipe in the manner specified herein for cleaning, laying and joining pipe.

7.6.4.8 Installation of Water Line Appurtenances

- a. <u>Valve Boxes and Valve Vaults</u>
 - 1. A valve box or valve vault shall be provided for every valve.
 - 2. A valve box shall be provided for every valve that has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast iron grease case. All gate valves twelve inches (12") and less and all butterfly valves twenty inches (20") and less shall have valve boxes and all butterfly valves larger than twenty inches (20") shall have concrete manholes to house the opening. Pressure reducing valves, check valves, and air relief valves shall be installed in concrete vaults. Valve stem extensions are required on all valve nuts greater than five feet (5') in depth.
 - 3. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or embedded in an eighteen inches (18") square by six inches (6") thick concrete pad when placed in an area that is not paved.
 - 4. A concrete vault shall be provided for all butterfly valve operators as shown in the Details. The valve nut shall be readily accessible for operation through the opening in the vault, which shall be set flush with the finished surface of the pavement, or shall extend 6" above grade in unpaved areas.



- b. <u>Valve Markers</u> All valves installed on the main transmission line with the exception of those on extended property lines, shall be identified with a three inches (3") flat fiberglass post marker offset as directed by the Town Engineer and painted blue, with the distance to the valve and the appropriate identifying initials stenciled in black. Where the valve is to be installed in a vault equipped with a vent pipe, the vent pipe will also serve as a valve marker.
- c. <u>Dead Ends</u> All dead ends shall be closed with cast iron plugs which shall be mega lugged to the main line and provided with a kickblock as specified on the Details. Blow-off valves shall be located as specified in Section 4.2.8.
- d. <u>Fire Hydrants</u>
 - <u>Position</u> All hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to the main line, unless otherwise directed by the Town Engineer. Hydrants shall be set to established grade, with nozzles at least eighteen inches (18") above the ground, or as directed by the Town Engineer. The bottom flange of the hydrant shall be set three inches (3") above the finished grade. No portion of the fire hydrant may protrude into the sidewalk area.
 - 2. <u>Connection to Main</u> Each hydrant shall be connected to the main with a six inch (6") PVC branch controlled by an independent six inch (6") gate valve located next to mechanical joint tee with a six inch (6") anchor coupling. The branch line shall be mega lugged and wrapped, and the hydrant shoe and main line tee shall be thrust blocked.
 - 3. <u>Hydrant Drainage</u> A drainage pit three feet (3') in width and three feet (3') deep shall be excavated below each hydrant and filled completely with coarse gravel or crushed stone mixed with coarse sand, under and around the shoe of each hydrant and to a level six inches (6") above the top of the pipe lateral to allow for proper drainage.
 - 4. <u>Lateral Offsets</u> Six-inch (6") ductile iron manufactured offsets (swing arms) may be used on the branch line to allow proper elevation settling of the hydrant shoe.
 - 5. <u>Details</u> All fire hydrant installations shall be in accordance with the Details.
- e. <u>Anchorage</u> All plugs, valves, bends, reducers, tees, and fire hydrants shall be anchored by thrust blocks and mega lugged



in accordance with Sections 7.4.2.9 and 7.4.2.10, and with the Details.

- 7.6.5 Backfilling
 - 7.6.5.1 <u>General</u>
 - a. All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, inspected and approved by the Town Engineer. Bedding and "pipe zone" backfill shall be installed in accordance with this Section.
 - Whenever a compaction requirement value is specified herein, the optimum moisture content and Standard Proctor Density shall be determined in accordance with AASHTO T-99 for ninety-five percent (95%).
 - 7.6.5.2 <u>Density Requirements in Trench</u> The contractor shall obtain a Standard Proctor Density of ninety-five (95%) for the total depth of all trenches in open fields and in dedicated ROWs. Backfilling shall be done with good sound earth, sand or gravel, and no oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed six inches (6") in any dimension and are not placed within one foot of the 2-1/2' limit. Material of perishable, spongy or otherwise improper nature shall not be used in backfilling and no material greater than four inches (4") in any dimension shall be placed within one foot (1') of any pipe, manhole or structure. Backfilling shall be accomplished in the zone in layers not to exceed three feet (3'). All backfill material shall be subject to the approval of the Town Engineer.
 - 7.6.5.3 <u>Compacted Fill</u> Compaction shall be done by use of vibratory equipment, tamping rollers, pneumatic tire rollers or other mechanical tampers of the type and size approved by the Town Engineer. Hand tampers shall be used around all manholes, valve boxes, and any surface structure. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the specified density in Section 6.6.2. Any damage to the pipe as a result of contractor's operation shall be repaired and/or replaced.
 - 7.6.5.4 <u>Procedure at Street Zone</u> The top two and one-half-foot (2 ½') from finish street grade or ground surface, as the case may be, shall be compacted in horizontal layers not exceeding eight inches (8") in thickness, using approved hand pneumatic or mechanical type tampers to obtain a Standard Proctor Density of ninety-five percent (95%). Flooding and jetting are not permitted. From existing street grade to two and one-half-foot (2 ½') below street grade, the material for backfill may contain stones up to two inches (2") in diameter, in



quantity not exceeding twenty percent (20%) of the volume where said coarse materials are well distributed throughout the finer material and the specified compaction can be obtained.

7.6.6 Compaction Tests

Compaction tests will be taken by an approved testing laboratory at locations designated by the Town Engineer. All expenses involved in these tests will be borne by the developer/owner. Results of the tests will be made available to the Town Engineer immediately and copies of test results will be supplied to the Town Engineer once per week. A final typed bound copy of final test results must be submitted to the Town Engineer at the end of the project. In all cases where the tests indicate compaction less than that required in these Standards, additional compaction and tests will be required until these specifications are met. Probationary Acceptance of the lines by the Town will be contingent upon satisfactory compaction results. No hydrostatic testing of the water main will be allowed until satisfactory compaction is obtained. Frequency of testing will be as follows:

- a. One (1) test at every above ground appurtenance (i.e. valve box, manhole) at two-foot (2') increments.
- b. One (1) test every two hundred (200) LF of mainline trench at two-foot (2') increments beginning two feet (2') above pipe to final grade and one test at final grade.
- c. Two (2) tests at every service. One (1) test three feet (3') from proposed gutter and one (1) test behind proposed walk all at two-foot (2') increments.
- d. These requirements are for all utilities installed within public ROW and in dedicated easements.

7.6.7 Final Clean Up

After backfill and compaction has been completed, the ROW shall be dressed smooth and left in a neat and presentable condition as close to final grade as possible and to the satisfaction of the Town Engineer.

7.6.8 <u>Safety Precautions</u>

All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operation rules, orders and regulations prescribed by the Occupational Safety and Health Administration Federal Register. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.



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7.7 PROTECTION OF WATER LINES NEAR SANITARY SEWER FACILITIES

7.7.1 Crossings

- 7.7.1.1 Water mains shall be located a minimum of ten feet (10') horizontally from existing or proposed sanitary sewer lines (centerline distance). Where water mains cross house sewers or sanitary sewers, they shall be above sewers and laid to provide a vertical clear distance of at least eighteen inches (18") between the bottom of the water main and the top of the sewer. When a new water main crosses an existing sewer at a point less than eighteen inches (18") above the sewer, the Town Engineer shall be notified and adjustments shall be made. Stability of the water and sewer lines at a point of crossing is critical and care must be taken to ensure proper welding and compaction of both water and sewer lines.
- 7.7.1.2 Where it is not feasible to install a water main above an existing or proposed sewer, e.g., to maintain minimum cover, the water main shall be laid to provide a vertical clear distance of at least eighteen inches (18") between the bottom of the sewer and the top of the water main. When the clear distance is less than eighteen inches (18"), the Town Engineer shall be notified. Refer to Sheet 27 of the Detail Sheet for description of the proper materials and construction techniques.

7.7.2 Manholes

No water pipe or main shall pass through or, come within ten feet (10') horizontally of, any part of a sewer or manhole.

7.8 RESPONSIBILITY OF THE CONTRACTOR

- 7.8.1 The contractor shall be responsible for notifying the Town Engineer at least fortyeight (48) hours prior to start of any construction. If work is suspended for any period of time after initial start-up, the contractor must notify the Town Engineer forty-eight (48) hours prior to re-start.
- 7.8.2 At all points of connection of new water mains to existing water mains, the contractor will be responsible for excavating and verifying location of the existing lines, prior to installation of any new construction. If it is necessary to shut down any portions of the existing water system to make such connection, the contractor will be responsible for notifying all Town customers to be affected by water outage at least 48 hours prior to such outage. All existing water main valves shall be operated only by Town Staff. The duration of water outage to the existing Town customers shall be minimized and if directed by the Town Engineer, the contractor shall provide temporary water supply to the customers by means of tank trucks, temporary connections to charged facilities, etc.



SECTION 8: NON-POTABLE WATER SYSTEMS

8.1 Refer to the latest Denver Water Specifications for Non-Potable Water Systems.

SECTION 9: SANITARY SEWER SYSTEM SPECIFICATIONS

9.1 PURPOSE AND GENERAL REQUIREMENTS

9.1.1 Purpose

This publication is to provide information to all Engineers, Contractors, Builders, Developers, and other interested persons or firms on the Town requirements with respect to design and construction of sanitary sewer systems within the Town. This publication presents technical specifications for the design and installation of the sewers and should be used in conjunction with the Town Rules and Regulations by any firm or individual planning to design or construct sewer systems within the Town. In all cases in these specifications where reference is made to "Town Engineer" or "Engineer," the "Town Engineer" or "Engineer" shall mean any representative of the consulting engineering firm or other individual designated by the Town to provide inspection of the sewer system construction.

9.1.2 General Requirements

- 9.1.2.1 All contractors must notify the Town Engineer at least 48-hours prior to start of construction.
- 9.1.2.2 A pre-construction meeting must be arranged by the Contractor and held prior to the start of any work. The Town Engineer, Contractor, and Owner or Owner's Engineer must be represented at this meeting, which shall be held at the Kersey Town Hall.
- 9.1.2.3 Approved plans must be kept on the job site by the Contractor at all times.
- 9.1.2.4 All work shall comply with Acceptable Industry Standards.
- 9.1.2.5 Sanitary sewer lines are to be a minimum distance of 5-feet from lip of gutter pan.
- 9.1.2.6 Only squeegee bedding is to be used. On-site material is not acceptable without the approval of the Town Engineer.
- 9.1.2.7 Dry pit lift stations with adequate wet wells or non-submergible pumps will be allowed for installation within the Town.



9.2 LOCATION OF LINES

9.2.1 <u>Sewers in Streets</u>

When the sewers are placed in streets, they shall be placed as follows:

- 9.2.1.1 On streets running north and south, the sewer line shall be placed 5-feet west of the centerline of the street.
- 9.2.1.2 On streets running east and west, the sewer line shall be placed 5-feet south of the centerline of the street.
- 9.2.1.3 On streets shaped as a "U" or on streets having unusually sharp turns, the sewer line will conform to the above specifications as near as is practical, but the final location shall be as determined by the Engineer or his/her representatives. Curve sewer mains shall not be allowed without prior approval of the Engineer. Design must attempt to minimize the use of manholes.

9.2.2 <u>Sewers in Easements</u>

In areas where sewer lines are placed in easements, all sewer lines shall be located within the easements shown on the construction drawings. All sewer easements must be a minimum of 20-feet in width for exclusive easements, and 30-feet for non-exclusive easement. No sewer shall be located less than 5-feet from the edge of the easement. Any utility with an invert depth greater than 15-feet will require negotiation of easement width with the Town Engineer.

9.2.2.1 Markers

In areas where sewer lines are placed in easements, all manholes and force main valves shall be identified with a 4-inch steel marker post, offset as directed by the Town Engineer and painted green, with a 12-inch-long yellow section beginning 6 inches below the top, stenciled with the distance to the manhole or valve and the appropriate identifying initials stenciled in black.

9.3 PIPE

9.3.1 General

No public sewer main shall be less than 8-inches in diameter. Services may be 4- or 6-inches in diameter. No sewer line shall be less than 4-inches in diameter. The minimum and maximum slopes for sewer lines shall be as shown in Table I below. The slope between manholes must be uniform.

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TABLE 3 - I				
Minimum Slope Feet Per Hundred				
2.0				
0.5				
0.4				
0.28				
0.20				
0.15				
0.12				
0.092				
0.08				
0.065				
0.06				

The maximum slope for any sanitary sewer collection main shall be 5%.

9.3.2 Plastic Pipe

9.3.2.1 General

All Polyvinyl Chloride (PVC) Sewer Pipe and Fittings shall be in accordance with ASTM D-3034.

9.3.2.2 Material

All Polyvinyl Chloride shall meet the requirements for ASTM D-3034, "Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings."

9.3.2.3 <u>Test</u>

Contractor shall submit certified copies of all reports of tests conducted by an independent laboratory before installation of PVC Plastic Pipe. The tests shall conform to the following tests and Standards: the Quick Burst Test, ASTM D-1599, the Flattening Test, Extrusion Test ASTM D-2152, and Pipe Impact Test ASTM D-2444.

9.3.2.4 Straightness

Maximum allowable ordinate as measured from the concave side of the pipe shall not exceed 1/16-inch per foot of length. Pipe lengths shall be limited to 20-foot maximum to ensure compliance with this requirement.

9.3.2.5 Joint Type

The pipe joints shall be bell and spigot type with an elastomeric gasket



conforming to ASTM D-3212 and F-477. Solvent welded joints are not acceptable.

9.3.2.6 Pipe Diameter

The pipe diameters shall be per Denver Wastewater Department specifications.

9.3.2.7 Fittings and Specials

The fittings and specials shall be in accordance with ASTM D-3034.

9.3.2.8 Pipe Installation and Field Testing

Pipe shall be installed in full compliance with the recommended practice for "Underground Installation of Flexible Thermoplastic Sewer Pipe," ASTM Designation D-2321. Specifically, the bedding shall be Class "B" as shown in Section 13, Standard Details. The bedding trench shall be brought to proper grade and elevation prior to installation of pipe and assembly joints. The pipe shall be placed and joints made in a dry trench and bedding shall be placed in the trench up to one-half the diameter of the pipe (haunch) without lifting or laterally misaligning the pipe.

In addition to the construction and testing procedures outlined in other sections of these specifications, the Contractor shall be required to install the pipe in such a manner that the maximum ring deflection of the pipeline under load shall be limited to 5% of the vertical internal pipe diameter.



9.4 MANHOLES

9.4.1 General

All manholes shall be a minimum of 48-inches in diameter and shall be installed at the end of each sewer line at all changes in grade, size, or alignment and at all intersections. Manholes shall be installed at distances not greater than 400-feet. Longer spacing may be permitted, with prior approval of the Town Engineer, in sewer lines of larger diameter. All manholes in excess of 20-feet in depth, measured from cover to invert, shall have an intermediate platform located at the center of the depth, in accordance with the details.

9.4.2 Standard Manholes

Manholes may be either precast concrete or poured-in-place concrete. All concrete shall be mixed using Type II cement. For poured-in-place manholes, design details and analysis along with construction procedure must be submitted to and approved by the Town Engineer prior to start of construction. All manholes shall have an inside diameter at least 2-feet greater than the outside diameter of the sewer pipe or pipes entering and leaving the manhole, but in no case shall any manhole have an inside diameter less than 4-feet. Where a second sanitary sewer line enters a manhole, the invert on the second sewer line shall enter the manhole at least 0.2-foot higher than the invert of the main sewer line and shall enter the line of flow of the main sewer line with as near a full sweep 90-degree bend as possible. In no case shall a second line be allowed to intersect with this main line at an angle less than 90-degrees with the outlet portion of the main line. If alignment and slope allow, the sewer main should be laid through the manhole. A drop of 0.1-foot will be required from invert to outlet where the sewer main cannot be laid through the manhole. A drop of 0.2-foot shall be required on all angle manholes. All manholes subject to turbulent flows shall be epoxy-coated (e.g., outside/inside drops, interceptors, outfalls, and 90degree manholes).

9.4.2.1 Base

The base on all manholes shall be a minimum of 8-inches thick, and the overall outside dimensions shall be 1-foot greater than the outside dimensions of the manhole constructed thereon. Cylinders taken from the mix shall in 28-days have not less than 4,000 pounds crushing strength per square inch. Base reinforced steel or wire mesh shall be in accordance with the details. The Contractor shall be responsible for taking and testing cylinders as required by the Town Engineer.



9.4.2.2 Concrete Manholes

Concrete manholes shall be constructed of precast concrete rings composed of concrete meeting ASTM C33-54T, or latest revision thereof. Cement used shall meet ASTM C150. The concrete mix shall be made with Type II cement with a cement factor of six sacks per cubic yard. The coarse aggregate shall be no less than 40% of the combined mix. The minimum core strength in 28-days shall be 4,000 psi. Concrete manholes shall consist of one or more concentric rings according to the depth of the manhole. The top cone shall be eccentric and shall be approximately 1-foot below finished grade on the street in order that the manhole level can be brought to the finished grade with concrete rings by the Contractor when final grade on the street is established.

Plastic steps shall be firmly embedded in the walls of all manholes. They shall be placed in a straight line 12-inches O.C. vertical on the straight side of the manhole. Steps must be positioned to allow no more than 18-inch spacing from the rim to the first step, and 12-inch spacing thereafter. Steps shall conform to the details shown. Manhole covers shall be of close-grained gray iron semi-steel in the solid cover of a design conforming to the details shown. They shall be equal to the City of Denver Standard Traffic Pattern and weigh approximately 400-pounds. Covers shall be solid, and shall be machined so that they will not rock under traffic. Aluminum manhole rings and covers shall generally not be allowed.

Where manholes must be raised up to finished street grade, no more than 12-inches of rings shall be used. If greater than 12-inches is necessary to bring the manhole to finished grade, additional barrel sections should be added. All manhole rings shall be embedded in bituminous mastic (Ram-Neck or equal) and shall be watertight. Mortar mixed with Type II cement shall be used on the inside of ring joints. The word "Sewer" shall be boldly cast in a readily visible location on the cover. The bench shall slope at 2-inches-per-foot toward the sewer line in the manhole. The total chimney length shall not exceed 20-inches.

9.4.3 Drop Manholes

Drop manholes require advance approval from the Town Engineer. If allowed, the following shall apply: Drop manholes shall be constructed exactly the same as regular manholes except the manhole base shall be extended upstream far enough to form a base for the concrete encasing the sewer pipe drop entering the bottom of the manhole. The drop entering the manhole shall be completely encased in concrete up to the spring line of the pipe of the main sewer line.

All manholes in which the drop is 18-inches or greater must be constructed with an



outside drop as specified above. A cleanout must be placed in the manhole at the level of the main sewer line. All drop manholes shall be constructed in accordance with the details in Section II with the specific variation of the detail determined in advance by the Town Engineer. All drop manholes must be completely lined with coal tar epoxy.

Inside drops may be allowed.

9.4.4 Underdrain

No underdrains will be allowed.

9.4.5 Service Connection to Manholes

In general, sewer service lines will not be allowed to connect to manholes. Certain exceptions, however, may be made by the Town Engineer. Two service lines will be allowed to connect to a manhole located on the end of a sewer main in a cul-de-sac. The service line must be installed prior to placing the manhole base. No sewer service shall connect to the main line closer than 7-feet to the centerline of the uphill manhole.

9.4.6 Plastic Pipe Connections to Manholes

Where plastic pipe is used, all connections to manholes shall be sealed by approved methods. Placing the concrete manhole base directly around the plastic pipe will not be satisfactory. Approved rubber gaskets, bonding material, or other sealants must be used in accordance with the details.

9.5 CLEANOUTS

Cleanouts shall not be used in public streets unless so directed by the Town Engineer. All cleanouts shall be constructed in accordance with the details. Cleanouts shall be installed on private sewer services under the following guidelines:

- 9.5.1 At all changes in direction requiring bends on commercial services.
- 9.5.2 Not more than 100-feet of continuous sewer line shall be installed without at least one cleanout.
- 9.5.3 Cleanouts shall be located such that all portions of the line can be cleaned by rodding.

9.6 ENCASEMENT AND CASINGS

9.6.1 <u>Concrete Encasements</u>

Concrete encasements shall be installed under the following conditions:



9.6.1.1 Where sewer lines are at a depth too shallow to sustain traffic load or any other load to which they are subjected. The depth may range from 0- to 4-feet, depending on the loading conditions.

9.6.1.2 At all locations where infiltration is likely to be high.

9.6.1.3 At locations where horizontal movement of the sewer mains may be experienced; i.e., below stream beds.

9.6.1.4 At all crossings under gulches, channels, creeks, and stream beds. These encasements shall be reinforced.

9.6.1.5 At potable water supply crossings.

9.6.1.6 At any location designated by the Town Engineer.

All concrete encasements shall be reinforced in accordance with the details in and shall be of a length to completely span the condition encountered.

9.6.2 Pipe Casings

Pipe casings shall be used where bores are required under rights-of-way by the using agency. All pipe casings shall be constructed to conform to the details.

9.7 (Reserved for Future Use)

9.8 INSTALLATION OF SEWER PIPE

9.8.1 Excavation

Excavation for pipelines, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the approved drawings or as otherwise approved by the Town Engineer. Any water which may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of the work.

Tunneling may be permitted as indicated by economy of construction or the necessity of preserving existing improvements. If the earth in the tunnel sloughs off, the roof of the tunnel shall be broken down and the trench excavated as an open trench.

9.8.2 Limit of Excavation

Except by express written permission of the Town Engineer, the maximum length of



open trench shall be 600-feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying and appurtenances, construction, and backfill which has not been temporarily resurfaced. No trench shall be left open at any time when the Contractor is not on the job site engaged in construction operations.

9.8.3 Trench Width

The overall trench width shall not be more than 16-inches or less than 12-inches wider than the largest outside diameter of the pipe to be laid therein, measured at a point 12-inches above the top of the pipe, exclusive of branches. Excavating and trenching shall be true to line so that a clear space of not more than 12-inches or less than 6-inches in width is provided on each side of the largest outside diameter of the pipe in place. For the purpose of this section, the largest outside diameter shall be the outside diameter of the bell on bell and spigot pipe. All trenching sizes shall be in accordance with the Bedding Details.

9.8.4 Excavation Below Grade

The trench shall be excavated to 6-inches below specified grade. Before the pipe is laid, bedding shall be placed. The layers shall be thoroughly tamped as directed by the Town Engineer so as to provide a continuous bearing and support for the pipe at every point between bells.

9.8.5 <u>Correction of Faulty Grades</u>

Where excavation is inadvertently carried below subgrade and/or foundation elevations, suitable provision shall be made at the expense of the Contractor for adjustment of same, as directed by the Town Engineer to meet requirements incurred by the deeper excavation beneath pipe or structures. Over-depth excavation in such location shall be rectified by backfilling with approved sand and/or graded gravel, and shall be compacted to provide a firm and unyielding subgrade and/or foundation as directed by the Town Engineer.

9.8.6 Bracing Excavations

All excavations shall be properly supported in the manner required by OSHA Federal Register Vol. 37 No. 243, Sub-part P, Section 1926.652 or as required by state laws and municipal ordinances and as may be necessary to protect life, property, and the work. Excavations shall be braced, sheeted, and supported so that they will be safe and the ground alongside the excavation will not slide or settle. Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the drawing or removing of sheeting, shoring, bracing and timbering to prevent the caving or collapsing of the excavation faces which



are being supported.

9.8.7 Grading and Stockpiling

The Contractor shall control grading in a manner to prevent water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can be uninterrupted in existing gutters, other surface drains, or temporary drains.

9.8.8 <u>Dewatering</u>

The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Said methods may include well points, sump pumps, suitable rock or gravel placed below the required bedding for drainage and pumping purposes, temporary pipelines, and other means all subject to the approval of the Town Engineer.

Dewatering for the sewer lines shall commence when groundwater is first encountered, and shall be continuous until such time as water can be allowed to rise in accordance with the provisions of this section.

State water discharge permit is required.

The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. No water shall be drained into work, built or under construction, without prior consent of the Town Manager.

9.8.9 Foundations in Poor Soil

If excessively wet, soft, spongy, unstable or similarly unsuitable materials are encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Town Engineer and in accordance with the Bedding Details.

9.8.10 Foundations in Rock

Where rock is encountered, it shall be removed below grade and the trench backfilled with clean imported sand, squeegee, or 3/4-inch rock to provide a compacted foundation cushion with minimum allowable thicknesses of 6-inches. Whether or not the foundation material will be considered as rock will be at the discretion of the Town Engineer.

9.8.11 Pipe Clearance in Rocks

Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6-inches below the pipe and fittings.



9.8.12 Bedding Procedure

The pipe shall be carefully bedded as shown in the Bedding Details. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe for the width shown on the Bedding Details. Use of a drag template shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.

Each joint shall be recessed in bedding material as required by the Bedding Detail in such a manner as to relieve the bell of the pipe of all load and to ensure continuous bearing along the pipe barrel upon the pipe subgrade.

9.8.13.1 Class A Bedding (Concrete Arch or Cradle)

Class A Bedding shall be used when additional supporting strength of the pipe is required. The lower portion of the pipe shall be supported by means of a concrete arch or cradle. Class A Bedding will not be allowed for flexible pipe such as steel, corrugated steel, plastic and ductile iron pipe. Class A Bedding shall comply with the details.

9.8.13.2 Class B Bedding (Granular)

Class B Bedding material shall consist of a well-graded mixture of mineral aggregate. The aggregate shall be squeegee with the maximum amount of fines passing a No. 200 screen not to exceed 5% by weight. The aggregate shall comply with ASTM C-33 or ASTM D-448, gradation #6 or #67. If the excavation for bedding is below the water table, the sub-bedding material shall consist of 3/4- to 1-1/2-inch rock. Class B Bedding shall comply with the details.

9.8.14 Installation of the Sanitary Sewer Line

9.8.14.1 General

All pipe shall be laid without break from structure to structure, with the socket ends of the pipe upgrade. Pipe shall be laid to the line and grade shown on the approved plans and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. The interior of the sewer pipe shall be cleaned of all dirt and superfluous material of all descriptions as the work progresses.

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the sewers be used as drains for removing water which has infiltrated into the trenches.

9.8.14.2 Alignment and Grade



The sewer line shall be laid and maintained to the required lines and grades as shown on the Plans.

Whenever obstructions not shown on the Plans are encountered during the progress of the work and interfere to such an extent that an alteration in the approved Plans is required, the Town Engineer shall have the authority to change the Plans and order a deviation from the line and grade.

9.8.14.3 Placing of Sewer Pipe in the Trench

9.8.14.3.1 When placing the sanitary sewer pipe in the ditch, the recommended practice for installing sewer pipe ASTM C12-77 or latest revision thereof shall be used. Pipe shall be laid true to line and grade as shown on Plans approved by the Town Engineer.

> All pipe shall be protected during handling against impact shocks and free fall and no pipe shall be placed in the sewer line that has been damaged while lowering into the ditch. Bell holes shall be dug under the bells of all pipe regardless of the type of bedding used in the ditch, and the entire length of barrel of all sewer pipe shall rest firmly on the bedding material used in the ditch. The weight of the sewer pipe in no case shall be supported by the bells of the pipe.

> After lowering into the ditch, both the bell and spigot shall be thoroughly cleaned and free from any foreign material.

9.8.14.4 Pipe Fittings

9.8.14.4.1 General

Pipe fittings shall include branches of every type and stoppers. Fittings shall be furnished and installed at the locations, to the grades and of type and size shown on the Plans and in conformance with these specifications. Branches shall be installed in accordance with the details.

9.8.14.4.2 Branches

Branches of type shown on the Plans shall be furnished with connections of the sizes specified and shall be securely and completely fastened to the barrel of the pipe in the process of manufacture. In the case of pipe 15-inches or greater in diameter, in addition to other fastening material of approved quality there shall be a reinforcing collar of cement mortar around the outside of the joint, and there shall be no



exposure of cement mortar on the interior surface of the pipe. Wye branches shall have their axis approximately 45degrees (unless otherwise specified on the Plans) to the longitudinal axis of the pipe, measured from the socket end. All branches shall terminate in sockets and the barrel of the branch shall be of sufficient length to permit making a proper joint when the connecting pipe is inserted in the branch socket.

The quality of pipe fittings shall conform to the applicable provisions of these specifications and Section 3.0. Joints for fittings shall conform to applicable pipe material.

9.8.14.4.2.1 Installation of Branches

Pipe wyes and other types of branches shall be furnished and installed along with the sewer. Wyes of size specified on the Plans shall be installed for all sewer house connections and for future sewer house connections as shown on the Plans or specified in the detailed specifications. The longitudinal barrel of branch fittings to be placed in line and grade with the sanitary sewer mains shall be of the same diameter, quality, and type as said sewer. Installation, earthwork and bedding for branches shall conform to the applicable provisions set forth for said sewer pipe. Unless otherwise specified, the branch of wye fittings shall be inclined upward at an angle not greater than 45-degrees from a horizontal No wye for sewer house connection line. branches shall be placed closer than 7-feet, in the downstream side, to the centerline of any structure or manhole.

The Contractor shall hand tamp the backfill under every wye branch when installed.

9.8.14.4.3 Stoppers

Pipe stoppers shall be 3/4-inch in thickness and shall have a factory-made plasticized polyvinyl chloride compound joint material cast and bonded to the pipe. The material shall be molded and cured to a uniform hardness and compressibility and form a tight compression coupling when assembled. The material used for the compression joint shall conform to the type of pipe material specified.

Neoprene (synthetic rubber) stoppers shall be equal to those manufactured by Pacific Clay Products, Gladding McBean and



Company or approved equal. The joint formed by the stopper and pipe shall be a tight compression coupling when assembled.

All joints for stoppers shall be adequate to withstand the internal pressure of the leakage and/or infiltration test; however, joints shall be made in such a manner that they may be removed without injury to the socket.

9.8.14.5 Pipe at Manholes or Structures

Pipe joint of the same inside diameter as the adjoining pipe shall be placed at the inlet and outlet to each manhole or structure as shown on the details.

Pipe bells shall not be cast into manholes or structures. The bell shall be cut off so that no recess or offset appears on the exposed face from the inside wall of the pipe to the outside wall of the pipe (to be a plain end, flush with the inside wall of the manhole or structure, or as shown on the details.)

9.8.15 Backfilling

9.8.15.1 <u>General</u>

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed, inspected and approved by the Town Engineer. Bedding and "pipe zone" backfill shall be installed in accordance with Section 8.13.

Whenever a relative compaction requirement value is specified herein, the optimum moisture content and relative density shall be determined in accordance with AASHTO T-180 for 90% and AASHTO T-99 for 95%.

9.8.15.2 Density Requirements in Trench

The Contractor shall obtain a Standard Proctor Density of 90% for the total depth of all trenches in open fields and 95% in dedicated rights-ofway. Backfilling shall be done with good sound earth, sand or gravel, and no, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered, do not exceed 6-inches in any dimension, and are not placed within 1-foot of the 1-1/2-foot limit. Material of perishable, spongy or otherwise improper nature shall not be used in backfilling and no material greater than 4-inches in any dimension shall be placed within 1-foot of any pipe, manhole or structure. All backfill material shall be subject to the approval of the Town Engineer.



9.8.15.3 Compacted Fill

Compaction shall be done by use of vibratory equipment, tamping rollers, pneumatic tire rollers or other mechanical tampers of the type and size approved by the Engineer. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the density specified in Section

9.8.15.4 Any damage to the pipe as a result of Contractor's operation shall be repaired and/or replaced. Compaction around all manholes shall be by the use of a hand tamper in lifts not to exceed 2'.

9.8.15.5 Procedure at Street Zone

The top 2-1/2-feet from finish street grade or ground surface, as the case may be, shall be compacted in horizontal layers not exceeding 8-inches in thickness, using approved hand pneumatic or mechanical type tampers to obtain a Standard Proctor Density of 95%. Flooding and jetting will not be permitted. From existing street grade to 2-1/2-feet below street grade, the material for backfill may contain stones up to 2-inches in diameter, in quantity not exceeding 20% of the volume where said coarse materials are well distributed throughout the finer material and the specified compaction can be obtained.

9.8.16 Compaction Tests

When required by the Town Engineer, compaction tests will be taken by an approved testing laboratory at locations designated by the Town Engineer. All expenses involved in these tests will be borne by the Developer/Owner. Test results must be made available to the Town Engineer immediately and copies of results submitted once a week. In all cases where the tests indicate compaction less than that required in these specifications, additional compaction and tests will be required until these specifications are met. Initial acceptance of the lines by the Town will be contingent upon satisfactory compaction results. All compaction tests and acceptance of test results must be taken and reviewed prior to testing for infiltration and/or exfiltration. Frequency of testing will be as follows:

- One test location at every above ground appurtenance (manholes). Each test location shall have 1 test 2' above pipe, and 1 test for every 2' of fill
- One test location every 200 LF of mainline. Each test location shall have 1 test 2' above pipe and 1 test for every 2' of fill
- Two test locations at every sewer service, 1 location 3' from gutter line, and 1 location 1' behind sidewalk. Services shall be tested 2' above pipe and 1 test for every 2' of fill



9.8.17 Final Clean Up

After backfill has been completed, the right-of-way shall be dressed smooth and left in a neat and presentable condition and as close to its original condition as possible to the satisfaction of the Town Engineer.

9.8.18 Safety Precautions

All excavations shall be performed, protected and supported as required for safety and in the manner set forth in the operation rules, orders and regulations prescribed by the OSHA Federal Register.

Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.

9.9 **PROTECTION OF WATER SUPPLIES**

9.9.1 <u>Water Supply Inter-Connections</u>

There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.

9.9.2 Relation to Water Works Structures

While no general statement can be made to cover all conditions, it is generally recognized that sewers must be kept remote from public water supply wells or other water supply sources and structures.

9.9.3 Relation to Water Mains

Sewers shall be located a minimum of 10-feet horizontally from existing or proposed water mains (centerline distance). Where sewer lines cross water mains, the sewer pipe shall be a minimum of 18-inches clear distance vertically below the water main. If this clear distance is not feasible, the crossing must be designated and constructed so as to protect the water main. Minimum protection shall consist of the installation of an impervious and structural sewer, for example:

9.9.3.1 PVC sewer pipe with reinforced concrete encasement. Encasement shall be in accordance with the details and extend a distance of 10-feet either side of the water main.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of the higher pipe.



9.10 TESTS AND INSPECTION

9.10.1 Low Pressure Air Test

Low pressure air tests in accordance with UNI B-6-98 shall be used for testing of sewer lines.

Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. Plug all pipe outlets to resist the test pressure. For safety reasons it is extremely important that the various plugs be installed and braced such a way as to prevent blowouts. As a safety precaution, pressurizing equipment may include a regulator or relief valve set at ten (10) psi maximum to avoid over pressurizing and damaging an otherwise acceptable line.

Determine the test duration for the section under test by computation from the applicable formulas shown in UNI-B-6-98 or from Table 25-III. The pressure-holding time is based on an average holding pressure of three (3) psi gauge or a drop from three and one-half (3.5) psi to two and one-half (2.5) psi gauge. Add air until the internal air pressure of the sewer line is raised to approximately four (4) psi gauge. After an internal pressure of approximately four (4) psi is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test sections stabilizes.

When the pressure has stabilized and is at or above the starting pressure of three and one-half (3.5) psig, commence the test. Before starting the test, the pressure may be allowed to drop to three and one half (3.5) psig. Record the drop in pressure for the test period. If the pressure has dropped more than two (2) psig during the test period, the line is presumed to have failed. The test may be discontinued when the pressure test time has been completed even though the one (1) psig drop has not occurred.

A timed pressure drop of one-half (0.5) psig may be used in lieu of the 1.0 psig timed pressure drop. If a one-half (0.5) psig timed pressure drop is used, the appropriate required test times shall be exactly half as long as the required test times for a 1.0 psig timed pressure drop.



Air Test, Based on Formulas from UNI-B-6-98 Specification Time (Min: Sec) Required for Pressure Drop from 3 ½ to 2 ½ PSIG when Testing One Pipe Diameter Only

	Pipe Diameter (Inches)					
Length (Feet)	8	10	12	15	18	21
25	7:33	9:27	11:20	14:10	17:00	19:50
50	7:33	9:27	11:20	14:10	17:00	19:50
75	7:33	9:27	11:20	14:10	17:00	19:50
100	7:33	9:27	11:20	14:10	17:00	19:50
125	7:33	9:27	11:20	14:10	17:00	21:49
150	7:33	9:27	11:20	14:10	19:14	26:11
175	7:33	9:27	11:20	15:35	22:26	30:32
200	7:33	9:27	11:24	17:48	25:39	34:54
225	7:33	9:27	12:49	20:02	28:51	39:16
250	7:33	9:54	14:15	22:16	32:03	43:38
275	7:33	10:53	15:40	24:29	35:16	47:59
300	7:36	11:52	17:60	26:43	38:28	52:21
350	8:52	13:51	19:57	31:10	44:52	61:05
400	10:08	15:50	22:48	35:37	51:17	69:48

9.10.2 Vacuum Testing Manholes

The District reserves the right to require a vacuum test on all new manholes installed, particularly in areas where the groundwater level is high or where there are questions regarding the integrity of the new barrel sections. All manholes shall be vacuum tested in accordance with ASTM C1244. All lift holes and any pipes entering the manhole shall be plugged prior to a vacuum being drawn and the drop over a specified time determined. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of ten inches (10") of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to nine inches (9") of mercury. The manhole shall pass if the time for the vacuum reading to drop from ten inches (10") of mercury to nine inches (9") of mercury meets or exceeds the values indicated below.

TOWN OF KERSEY, COLORADO



STANDARDS & SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS 2015

Depth (Feet)	Diameter	(Inches)							
	30	33	36	42	48	54	60	68	72
	Time (Seconds								
<= 8	11	12	14	17	20	23	28	29	33
10	14	15	18	21	25	29	33	38	41
12	17	18	21	25	30	35	39	43	49
14	20	21	25	30	35	41	46	51	57
16	22	24	39	34	40	46	52	58	57
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	63	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	38	42	51	59	64	78	87	97
26	36	38	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

9.10.3 Television Inspection

All newly installed, repaired or rehabilitated sewer mains or trunk lines shall be televised by the contractor and two (2) copies of the videos and logs delivered to the Town engineer for review. Any defects found during television inspection shall be repaired prior to connecting any services to the main. All new sewer mains must be jet cleaned prior to the television inspection. Contractor will dump water down the sewer main prior to television inspection. Contractor will then pump water out of downstream manhole and dispose of the water at a Town-approved manhole. The maximum "belly" on low spots in the new sewer shall not exceed three-eighths inches (3/8").

9.10.4 Tests for Alignment and Grade, and Damaged or Defective Pipe in Place

After the pipe has been installed, tested for leakage, backfilled, manhole raised to grade, and the trenches reinforced, the Town Engineer and a representative of the Contractor will "lamp" all lines. All defective portions of the new facilities will be noted to the Contractor after the lamping operation is complete. A minimum 3/4 "moon" will be required. "Bellied" lines will be rejected. All lines should be flushed and manholes cleaned by the Contractor prior to "lamping." At the request of the Town Engineer, the line will be "balled" to remove dirt, rocks or other foreign matter not removed during the flushing operation. No flushed water or materials shall be discharged to existing sewer lines.

In areas where there are still some questions as to the condition of the sewer line, the Town Engineer may require that pictures be taken of the interior of that part of the sewer line under question. After the pictures have been interpreted by the Contractor and the Town Engineer, all cost of taking the pictures shall be borne by the Contractor. The Town reserves the right to require pictures be taken of any curved line approved for installation. In all such cases, the pictures will be taken at the expense of the Contractor and will become the property of the Town after interpretation.



Final acceptance of the lines will not be granted until all tests are successful and all items listed for correction by the Town Engineer have been accomplished.

9.11 RESPONSIBILITY OF THE CONTRACTOR

Prior to the start of any work where sewer mains to be installed tie into existing Town sewer systems, the nearest manhole to the point of tie-in shall be plugged with a plumber's plug on the outlet side by the Contractor. This plug shall remain in place until the main has been deemed acceptable for service by the Town Engineer. Its purpose is to prevent any mud, water, or other materials from entering the existing line during construction. The Contractor shall be responsible for pumping and cleaning these manholes and removing the plug when so instructed by the Town Engineer.

The Contractor is responsible also for maintaining As-Recorded drawings complete with GPS survey to include all distances between manholes and locations of wyes or service tees. These as-recordeds and survey shall be transmitted to the Town as either AutoCAD or AutoCAD compatible file on a CD. See As-built requirements.

The Contractor will be held responsible for the proper functioning of the lines for up to two (2) years from the date of probationary acceptance of the lines by the Town. Any malfunction during this period of guarantee shall be remedied by the Contractor to the satisfaction of the Town Engineer and at no expense to the Town.

9.12 SEWER SERVICES

Installation of any and all service lines, from the main line to the property line must be inspected by the Town Engineer. From property line to the building must be inspected by the Town, who shall be notified by the Contractor at least 48-hours prior to installation.

Concrete, cast-iron, or plastic sewer services will be acceptable if they conform to the specifications previously mentioned. All methods of joining the sewer service to the existing wye or tie at the main line, or to the ground iron stack at the building, must be approved by the Town in advance. In all cases where existing wyes or ties cannot be met, or are not available, mechanical methods must be used to tap the main line.

No sewer service taps shall be made prior to the acceptance of the completed main line by the Town Engineer. Where all taps are made, the Contractor must keep accurate records indicating the exact location of the tap. Installation of service pipe must conform to the specifications previously mentioned.

Multiple sewer connections must be made within or under any building. Any sewer service line exiting a building must be connected directly to a Town sewer main with no intermediate connections.

All sewer services must be bedded with squeegee, 4-inches below and 6-inches above the pipe. No horizontal bends will be allowed in the street. At the connection to the house service, no more than three bends totaling 135-degrees will be allowed. Calder couplings may be used, but the pipe deflection from these couplings may not exceed 2degrees. No 90-degree bends will be allowed. All sewer services will be installed with



6-inch-wide wire-impregnated green or metallic-backed marker tape buried above the pipe 12-inches maximum below final grade.

9.13 PRESSURIZED SEWER SYSTEM SPECIFICATIONS

9.13.1 Purpose and General Requirements

9.13.1.1 Purpose

This publication is to provide information to all Engineers, Contractors, Builders, Developers, and other interested persons or firms on the Town requirements with respect to design and construction of pressure sewer systems within the Town. This publication presents technical specifications for the design and installation of raw sewage and effluent mains and should be used in conjunction with the Town Rules and Regulations by any firm or individual planning to design or construct raw sewage and effluent systems within the Town. In all cases in these specifications where reference is made to "Town Engineer," the "Town Engineer" shall mean any representative of the Consulting Engineering firm or other individual designated by the Town to provide inspection of the raw sewage and effluent system construction.

9.13.1.2 General Requirements

It is the intent of these specifications to coincide and be similar to the Town's (Water Systems Specifications) with the exception of the following provisions:

- a. All mains shall be profiled on the construction plans. All mains shall be PVC pipes.
- b. Approved construction plans and a copy of these specifications must be kept on the job site by the Contractor at all times. Approved construction plans will expire 12-months from the date of approval.
- c. No work shall be backfilled (including bedding) materials above the spring line of the pipe) until the construction has been inspected ad approved for backfilling by the Town Engineer.
- d. The details for the water system specifications are to be used in construction of pressurized sewer systems.
- e. The maximum distance between main line valves shall be 1,500feet. Valves shall also be located at all intersections.
- f. Fire hydrants shall have NST (National Standard Thread). Color shall be safety green.
- g. Squeegee bedding shall be used. On-site material is not



acceptable without the approval of the Town Engineer.

9.13.2 Location of Lines and Appurtenances

9.13.2.1 Mains in Streets

When mains are placed in streets, they shall be placed as follows:

a. The main shall be placed 10-feet minimum horizontally from any domestic water main.

9.13.2.2 Mains in Easements

In areas where mains are placed in easements, all mains shall be located within the easements shown on the contract drawings. All main easements must be a minimum of 30-feet in width for exclusive easements or 50-feet for non-exclusive easements. No line shall be located less than 5-feet from the edge of an easement.

9.13.2.3 Valves

Valves shall be located, where possible, at a point on the main which would be intersected by the extension of a property line. Gate valves shall be used on sewage effluent mains and plug valves shall be used on raw sewage mains. Appropriate valve trim and seats shall be employed to prevent corrosion.

9.13.3 <u>Pipe</u>

9.13.3.1 General

Sizing shall be determined by the Town Engineer. Pipe in sizes 10- or 14-inch generally will not be allowed. Additional requirements for type of pipe shall be determined by the Town Engineer.

9.13.3.2 Polyvinyl Chloride (PVC) Pressure Pipe

All polyvinyl pipe furnished under this specification shall be manufactured in strict accordance with AWWA Standard C-900 and shall conform to the following additional requirements:

a. Size of Pipe

This specification shall cover polyvinyl chloride pipe in 6- and 8-inch nominal diameters with cast-iron pipe equivalent outside diameters.

b. Joint Type

Pipe joints shall be made using an integral bell with an



elastomeric gasket push-on type joint or using machined coupling of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.

Solvent cement joints are strictly prohibited.

c. Class and Type

All sizes of pipe shall be Class 200, dimension ratio 14 (DR 14) or as directed by the Town Engineer.

d. Pipe Lengths

Each length of pipe will be a standard laying length of 20-feet. Random lengths shall not be acceptable.

e. Manufacturer

Unless otherwise authorized by the Town Engineer, only Johns-Manville "Blue Brute," CertainTeed "Vinyl-Iron," Northstar "Aqua-lite," or Robintech shall be acceptable.

f. Fittings

All fittings shall be ductile iron, cement mortar lined, and shall conform to AWWA C-110/A21.10-82 for mechanical joints and AWWA C-111-71 or ANSI A21.11 for push on joint gasket or latest revisions thereof. Other linings may be used when authorized by the Town Engineer.

Fittings shall be wrapped in polyethylene.

9.13.4 Main Equipment

- 9.13.4.1 Buried valves shall be open-right (clockwise) and shall have valve boxes similar to domestic water valves except the valve box lid shall be labeled "Sewer".
- 9.13.4.2 Above ground valves shall be open-right (clockwise) and be equipped with an appropriate hand-wheel or lever operator.
- 9.13.4.3 Maker posts shall be 4-inch steel posts painted green with a 12-inchlong yellow section beginning 6-inches below the top, with the distance to the manhole or valve and the appropriate identifying initials stenciled in black
- 9.13.4.4 Warning signs shall be placed along pressurized sewer systems at the direction of the Town Engineer to warn the public that pressurized sewer system is non-potable water.



9.14 OIL, SAND AND GREASE INTERCEPTORS

9.14.1 General

Interceptors shall be provided when required, when in the judgment of the Town or its Engineer they are necessary for the proper handling of liquid wastes containing grease or solids which may be harmful to, or cause obstruction of, the publicly owned treatment works, or interfere with the operation of the treatment works.

All drains from the kitchen, food preparation, and dishwashing areas shall be connected to the grease interceptor. Fixtures to be connected include, but are not limited to, scullery sinks, pot and pan sinks, dishwashing machines, soup kettles, and floor drains located in areas where grease containing materials may exist. Garbage disposal (Garbage Grinders) will be required to be connected to an approved interceptor.

Toilets, urinals, and similar fixtures shall not waste through the interceptor. All waste shall enter the interceptor through the inlet pipe only.

Upon approval by the Town, installation of an interceptor will not be required of facilities that do not cook the food that is served, and/or do not wash equipment or utensils associated with preparation or service of cooked foods. All new commercial building within the Town must have an Industrial Waste Questionnaire form completed and on file with the Town.

9.14.2 Approval

The size, type and location of each interceptor shall be approved and inspected by the Town or its Engineer, in accordance with Town Standards regarding interceptors. Except where otherwise specifically permitted, no wastes other than those requiring separation shall be discharged into any interceptor. Two sets of plans, including complete mechanical and plumbing sections, shall be submitted to the Town Engineer for approval prior to construction. Such plans shall include the size, type and location of each interceptor.

9.14.3 <u>Design</u>

All interceptors for grease and heavy solids shall be so designed and located as to be readily accessible for cleaning and shall have a water seal of not less than 6-inches. Interceptors shall be constructed in accordance with the design specifications contained herein, shall be approved by the Town Engineer, and shall have a minimum of two compartments with fittings designed for grease retention. There shall be a minimum of two manholes to provide access for cleaning and inspection of all fixtures and compartments of the interceptor, a minimum of one per 10-feet of interceptor length. In the case of smaller or circular interceptors, where it is not practical to install two manholes, a single manhole shall be located so as to permit entrance to the first compartment, and inspection of the second. All areas of the second compartment shall be accessible for cleaning.

9.14.4 Location

All interceptors shall be readily accessible for inspection, servicing, and maintaining in proper working condition. The use of ladders or the removal of bulky equipment in order to inspect or service interceptors shall constitute a violation of accessibility. All interceptors shall be located outside of the facility served. Interceptors may not be installed in any part of a building where food is handled. Location of all interceptors shall be approved by the Town or its Engineer, and shall be shown on the approved building plan. There shall be no interceptors in drive-through driveways or next to main entranceways.



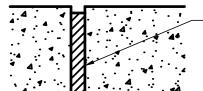


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ROADWAY AND CURB, GUTTER AND SIDEWALK

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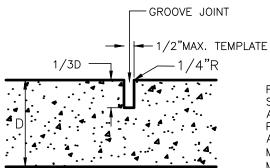
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- R-3 Curb, Gutter & Walk
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- R-22 Signage Placement
- R-23 Road & Street Name Signs
- R-24 Survey Monument In Pavement
- R-25 Approval Block
- R-26 Compaction Testing Requirements



EXPANSION JOINT

• 1/2" PREMOLDED NON-EXTRUDING EXPANSION JOINT MATERIAL TO MEET AASHTO SPEC. M-59.

• EXPANSION JOINTS SHALL BE INSTALLED WHEN ABUTTING EXISTING CONCRETE OR FIXED STRUCTURES SUCH AS INLETS AND DRIVEWAYS, AND EVERY 50' ON LONG STRAIGHT CONCRETE STRETCHES.



CONTRACTION JOINT

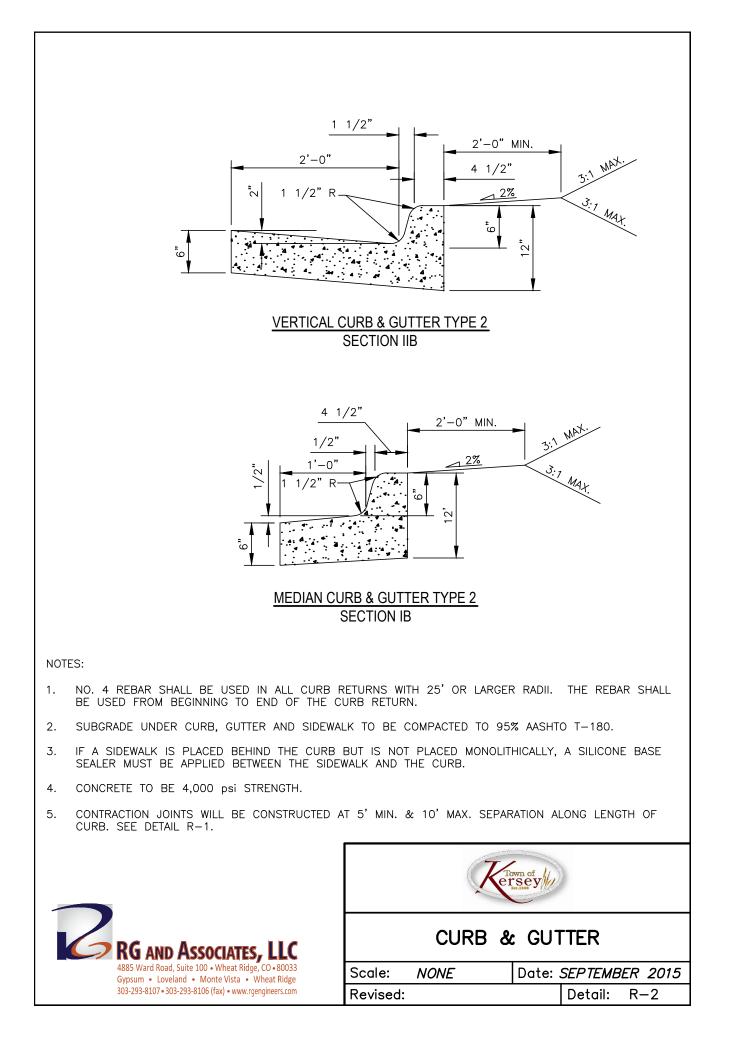
FORM WITH TEMPLATE OR SAWCUT JOINTS. SAWCUT JOINTS, IF USED SHALL BEGIN AS SOON AS CONCRETE IS HARDENED SUFFICIENTLY TO PERMIT SAWING WITHOUT EXCESSIVE REVELING AND BEFORE UNCONTROLLED CRACKING OCCURS. MAXIMUM DISTANCE BETWEEN JOINTS IS 10'. MINIMUM DISTANCE IS 5'.

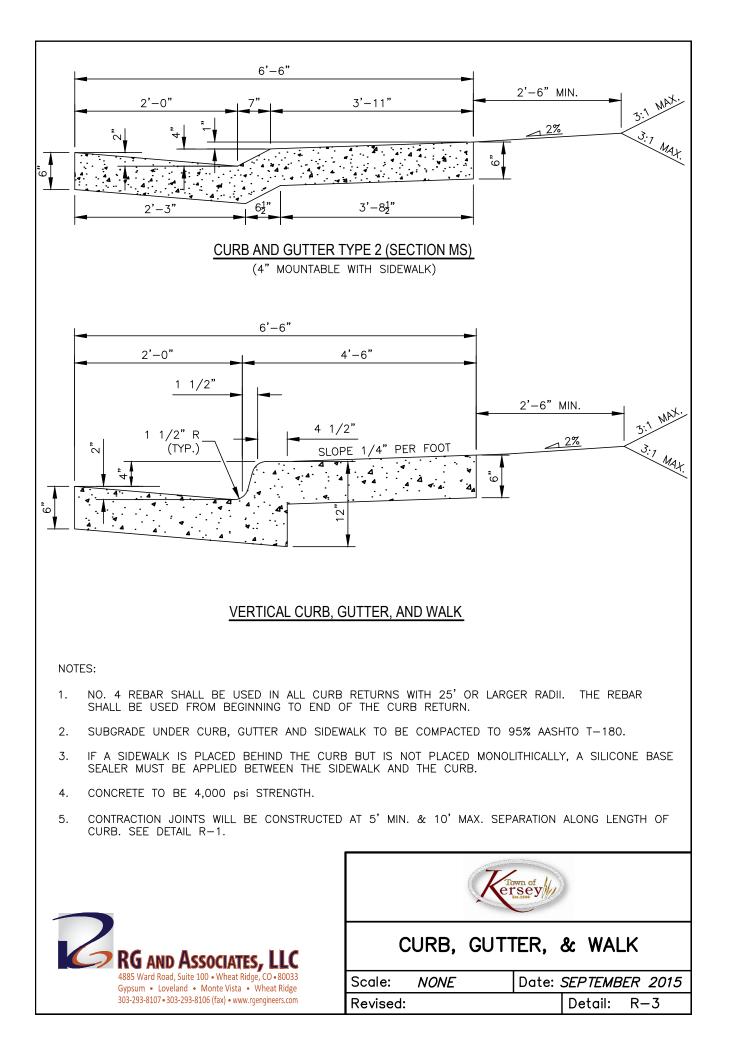


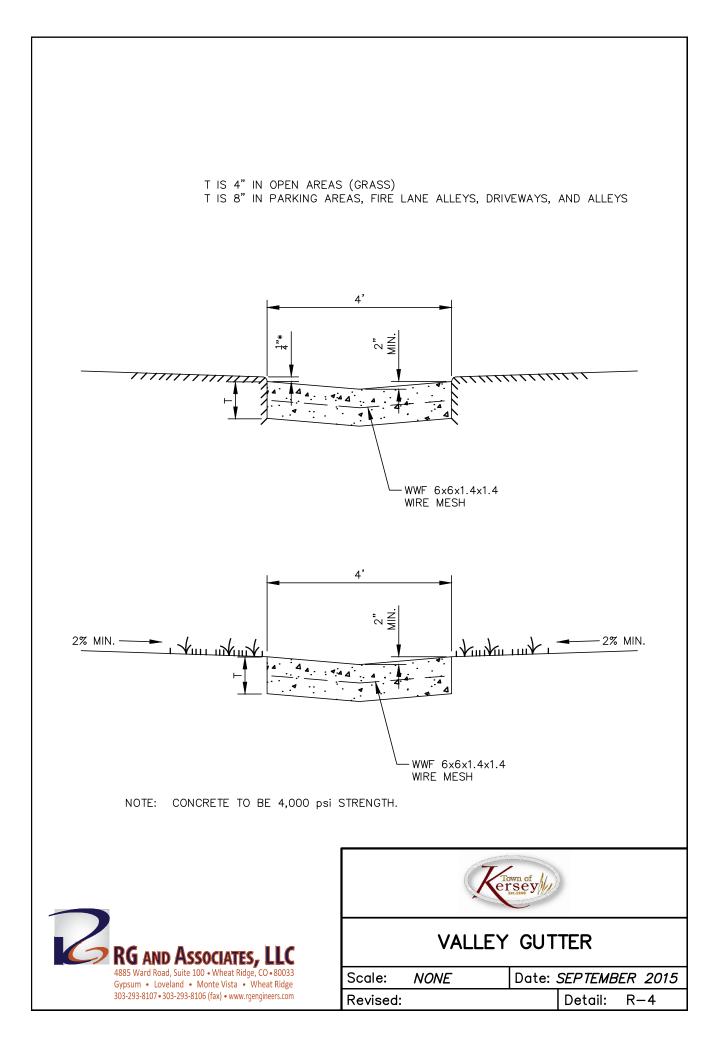


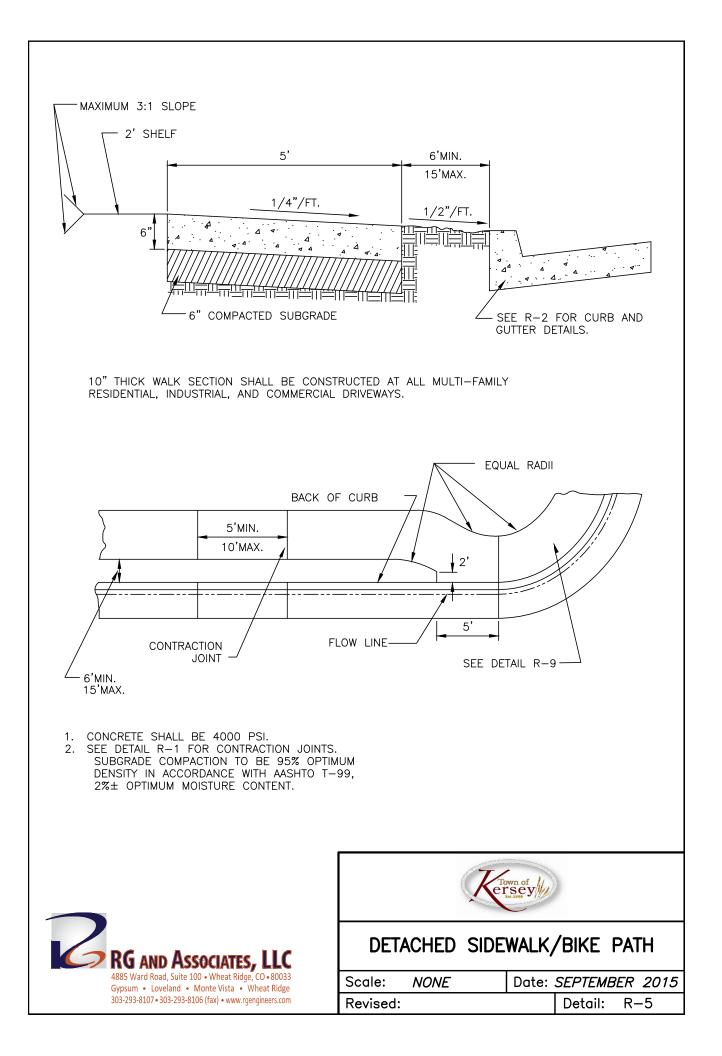
CONCRETE JOINTS

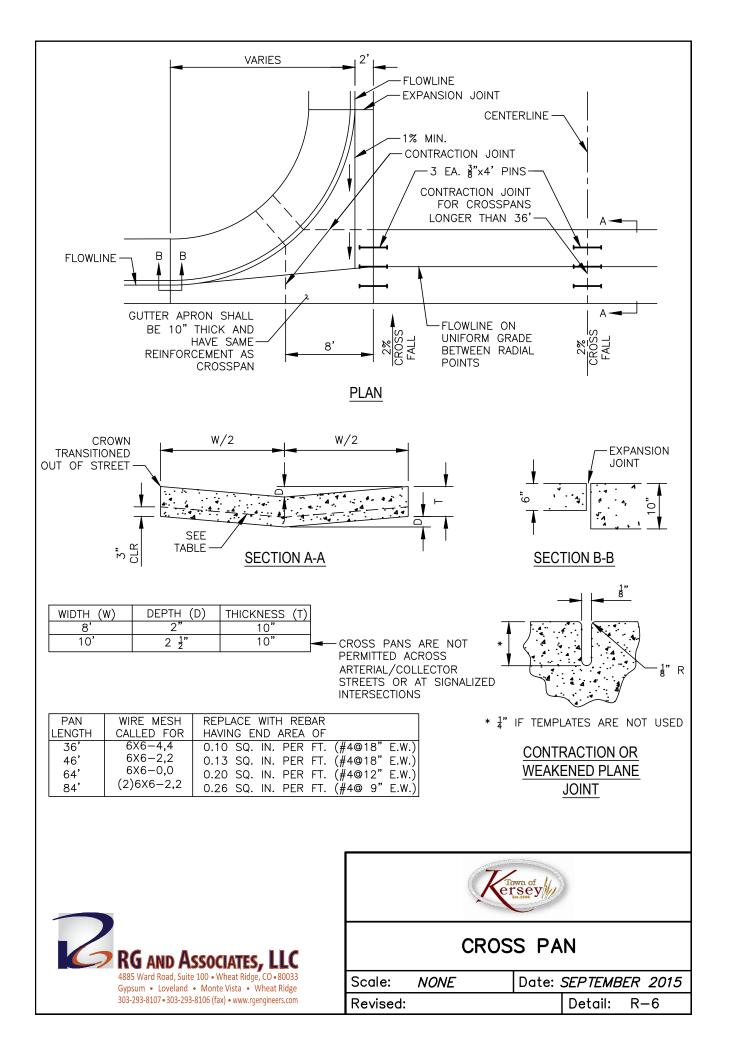
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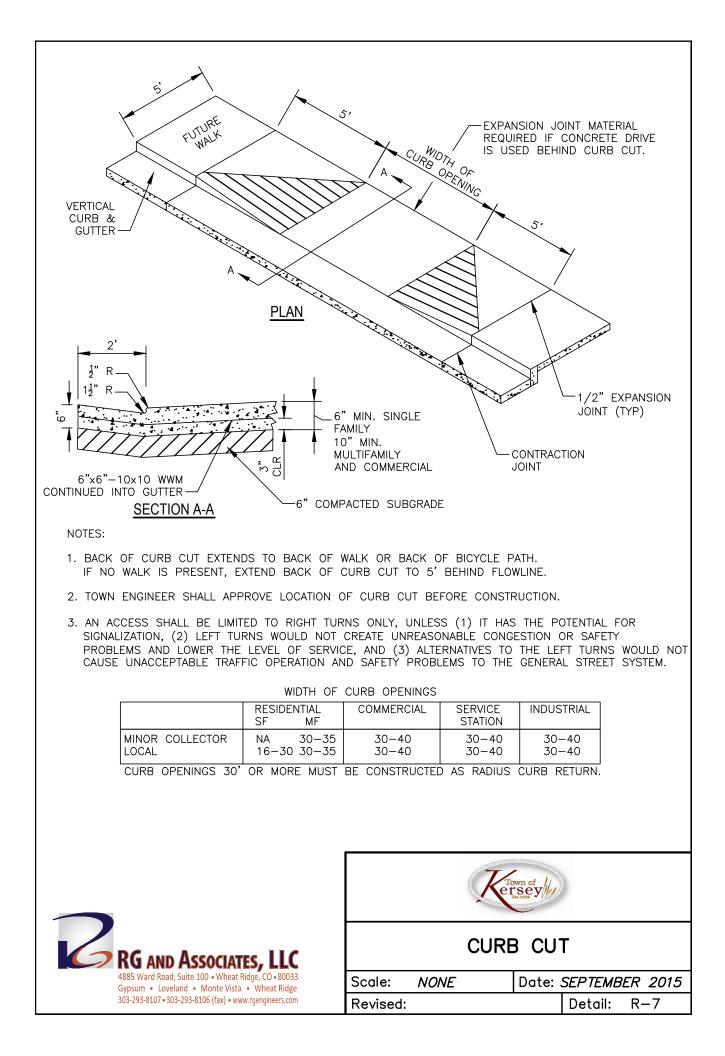


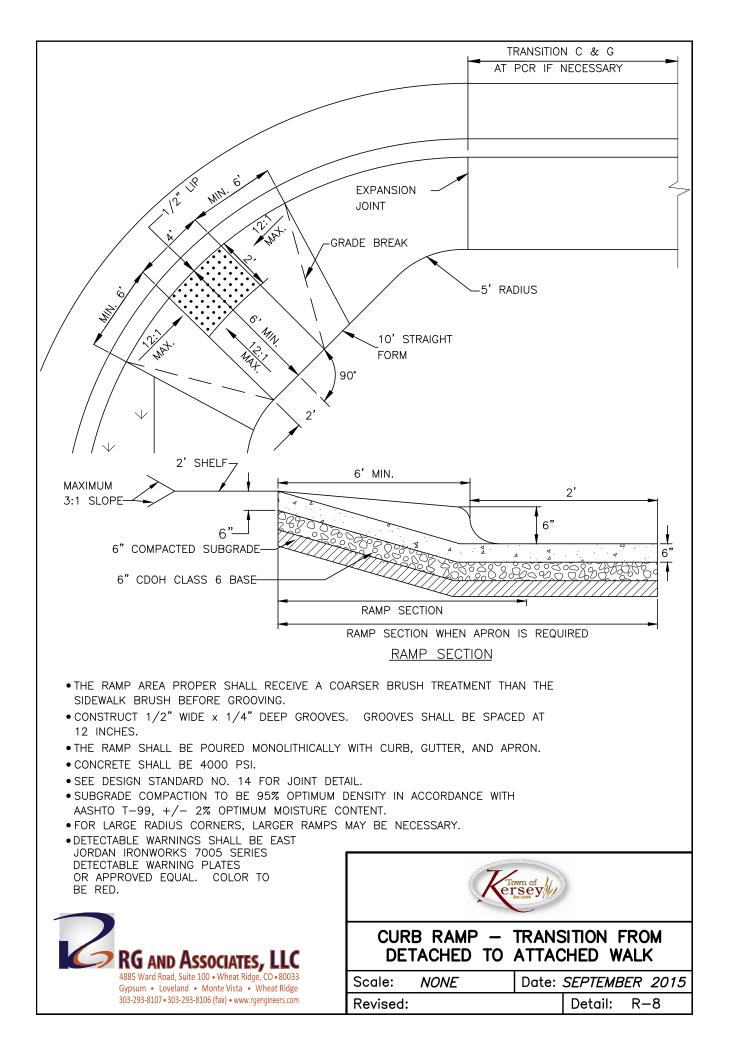


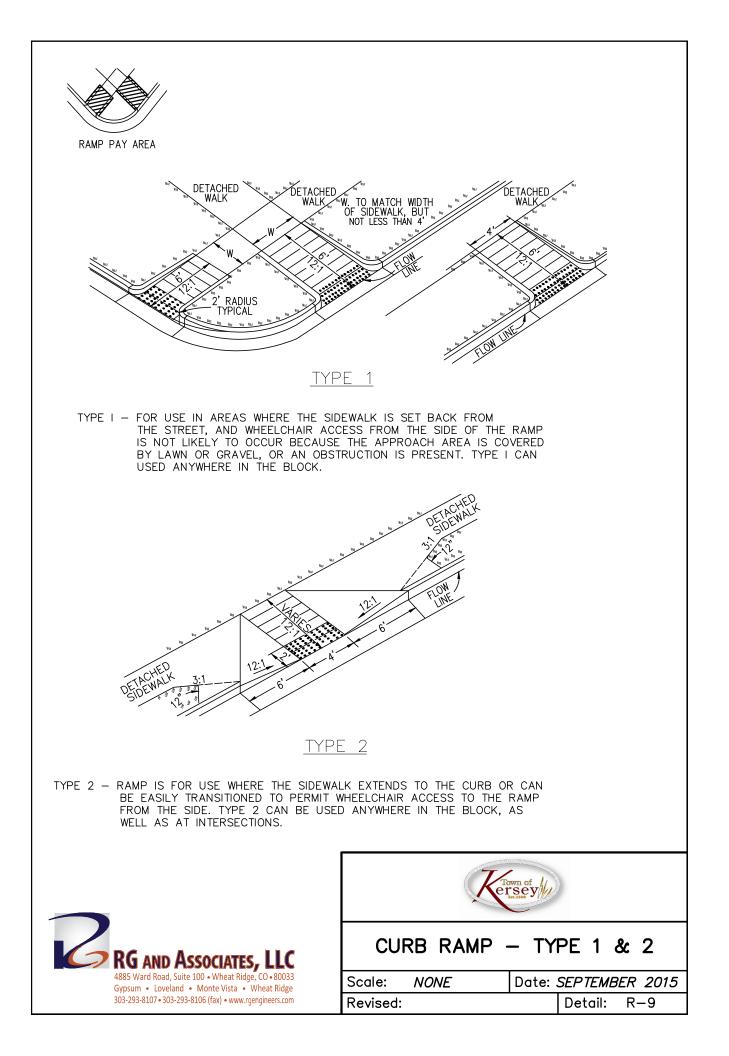


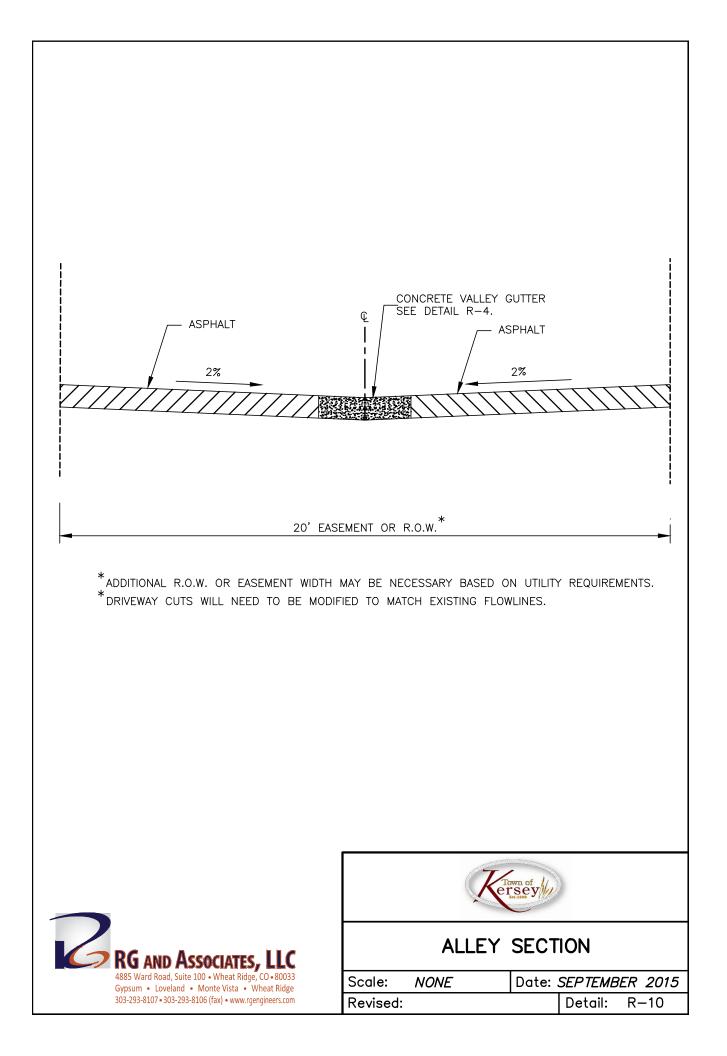


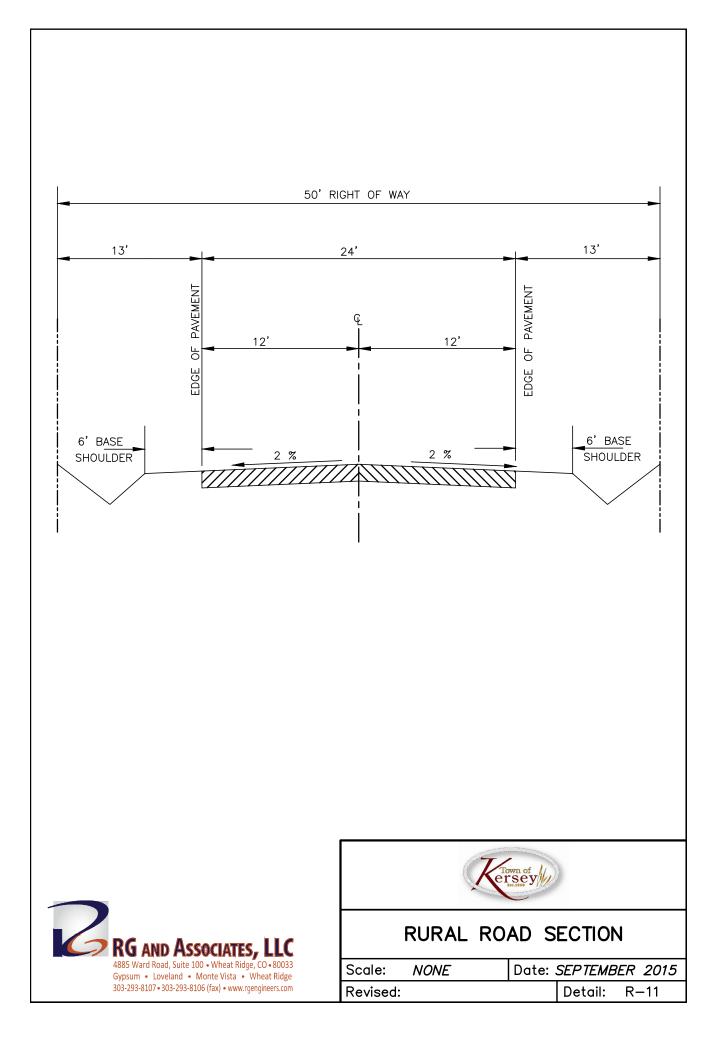


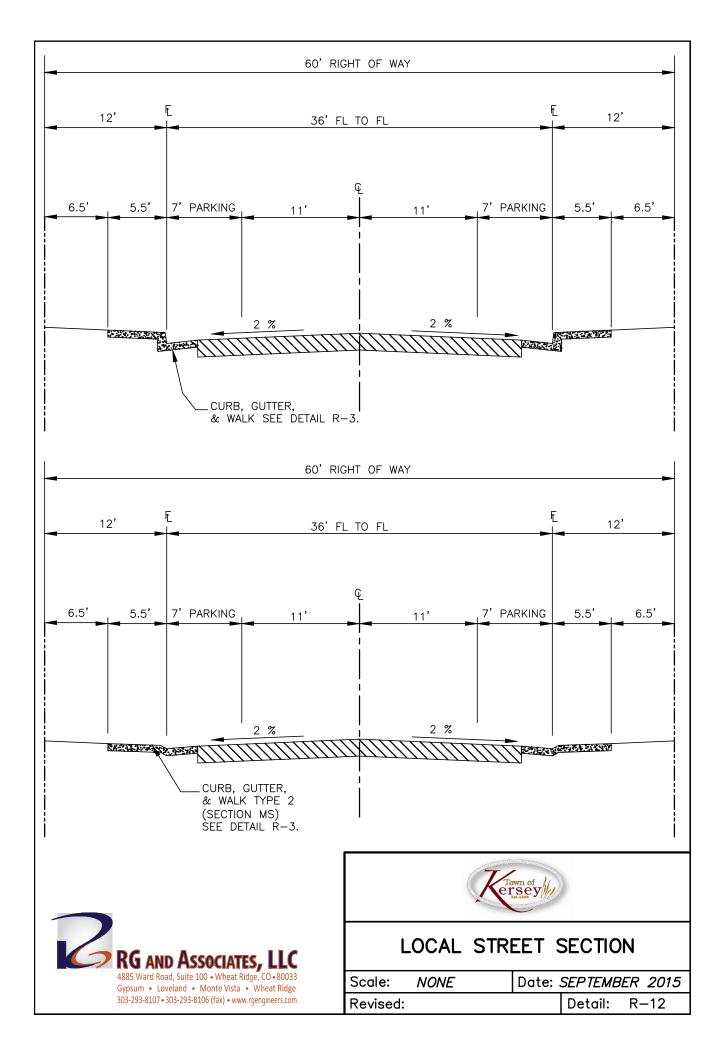


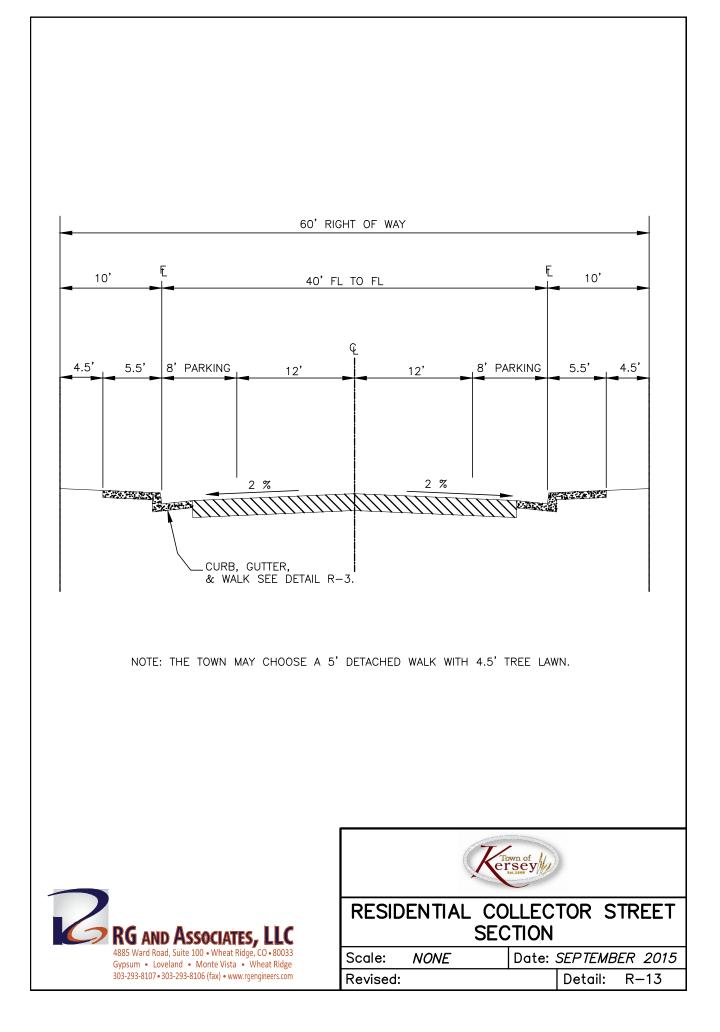


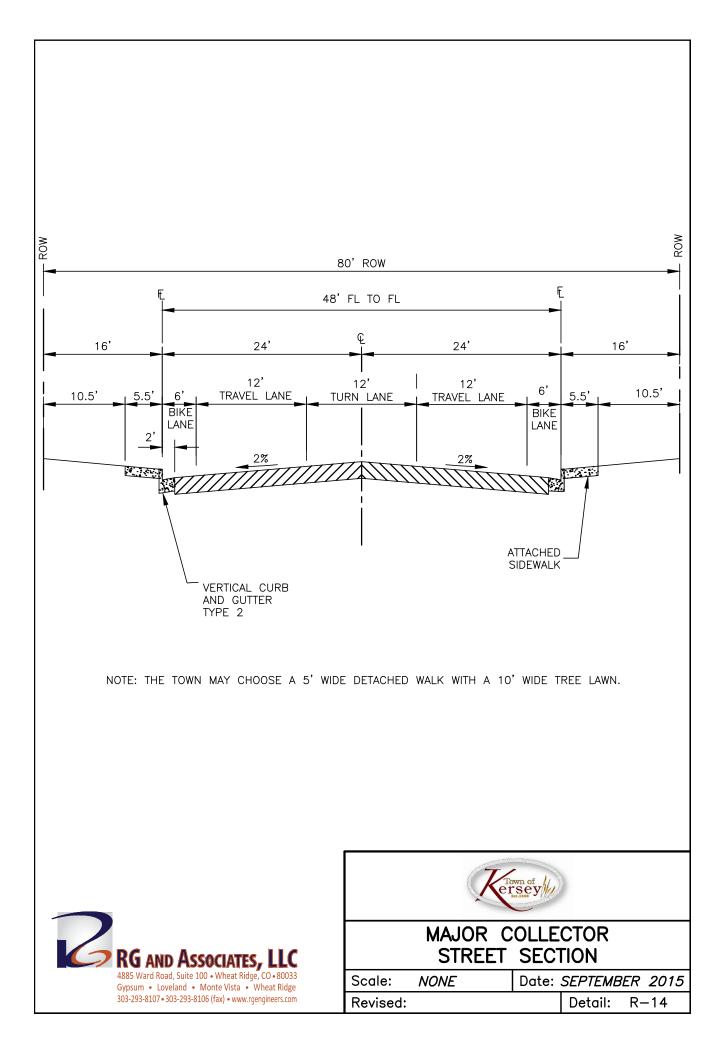


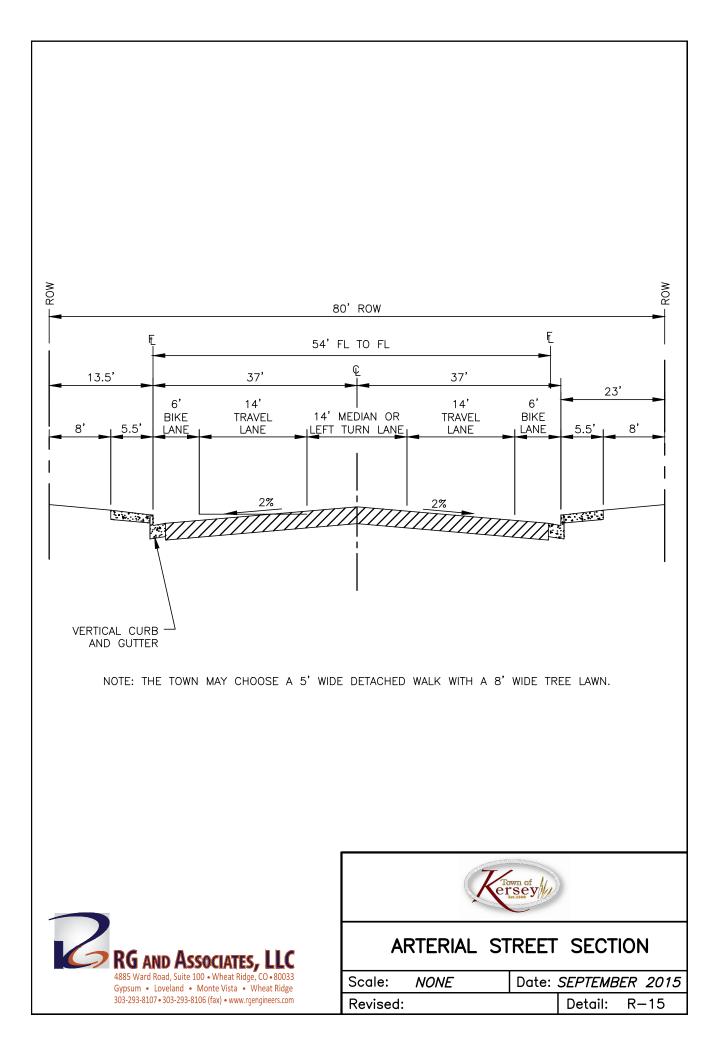


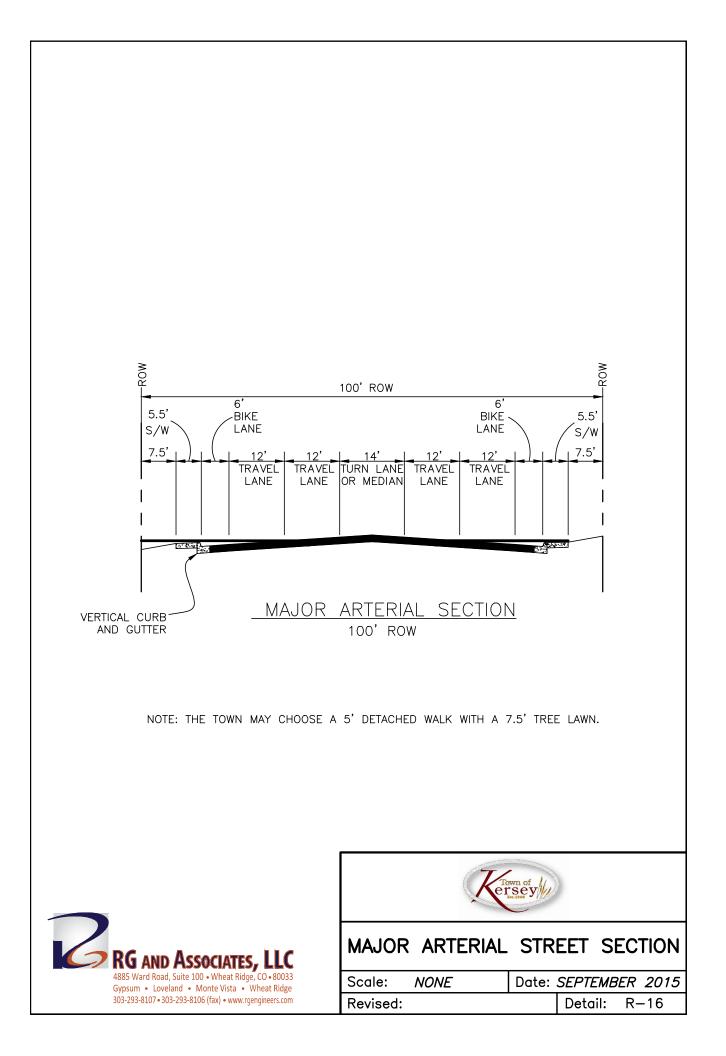


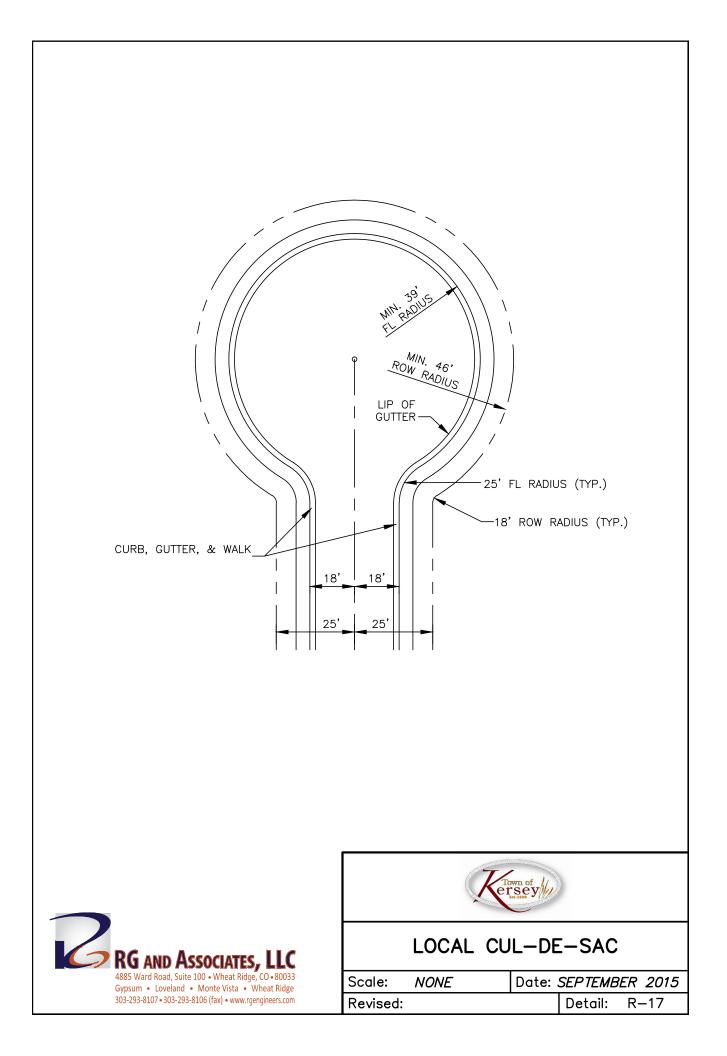


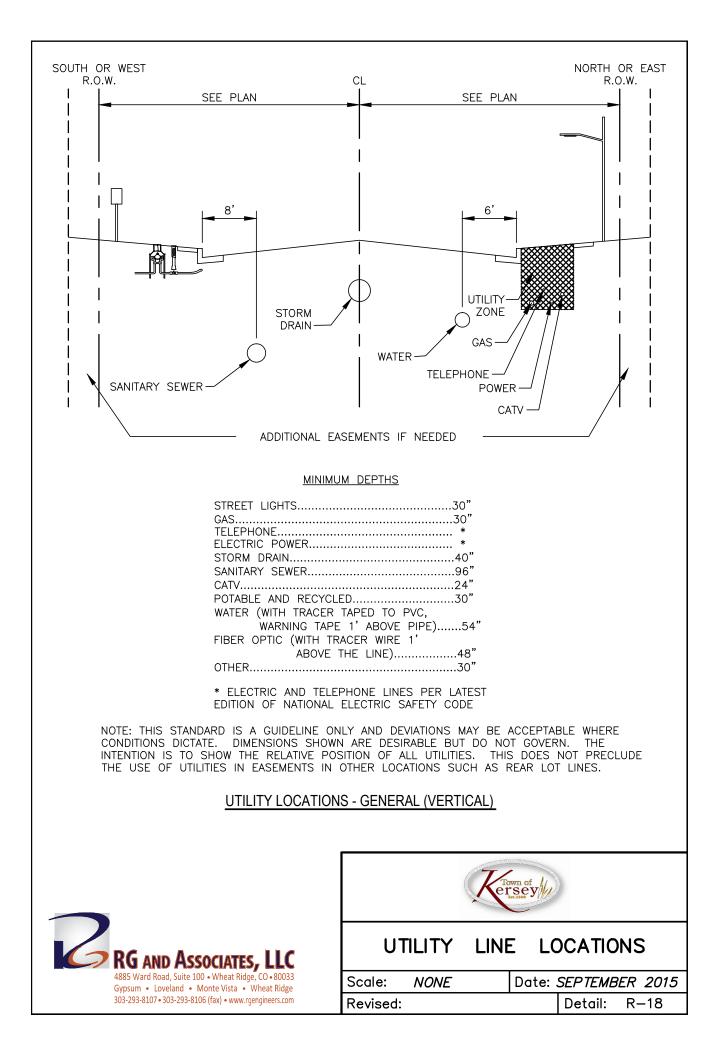




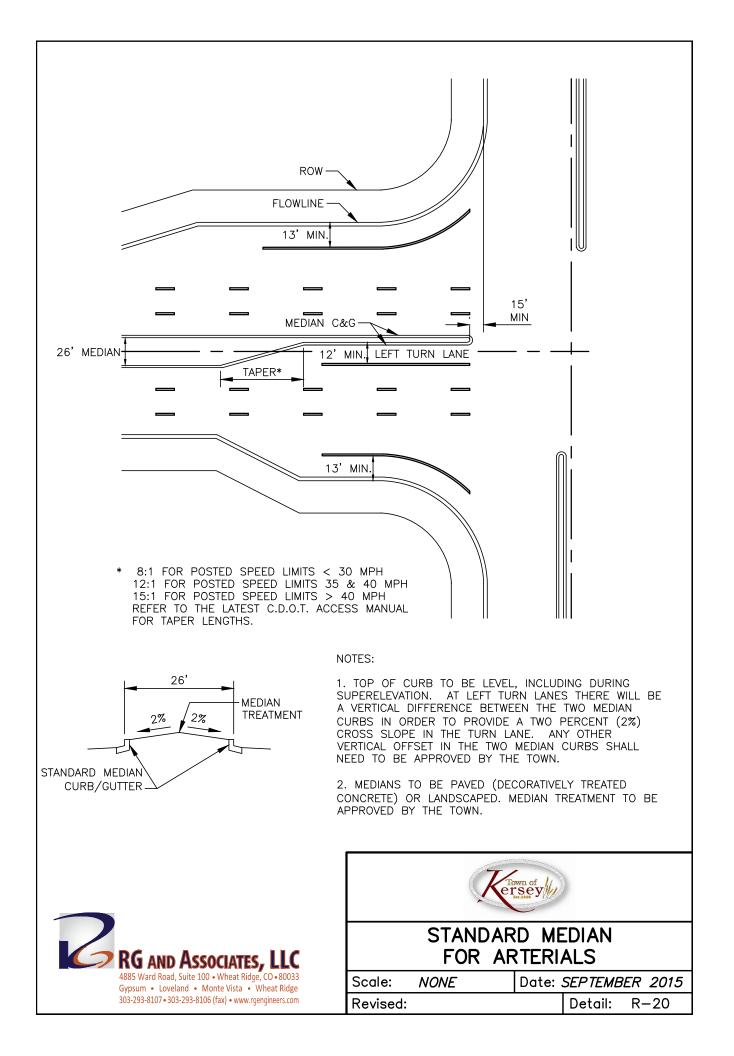


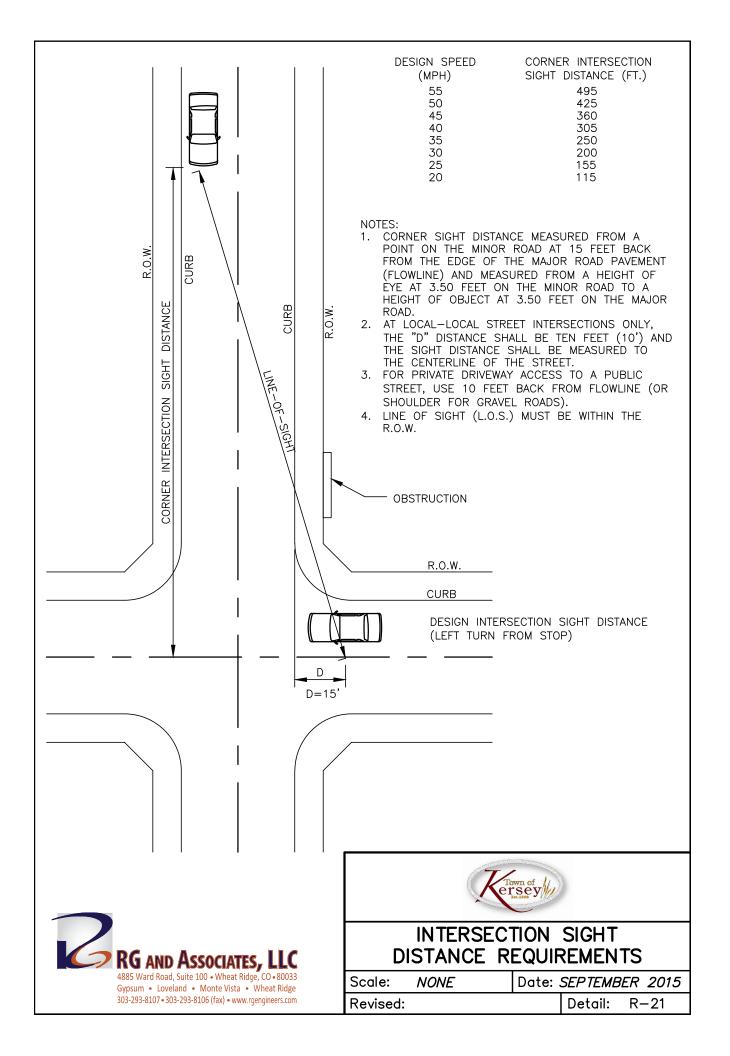


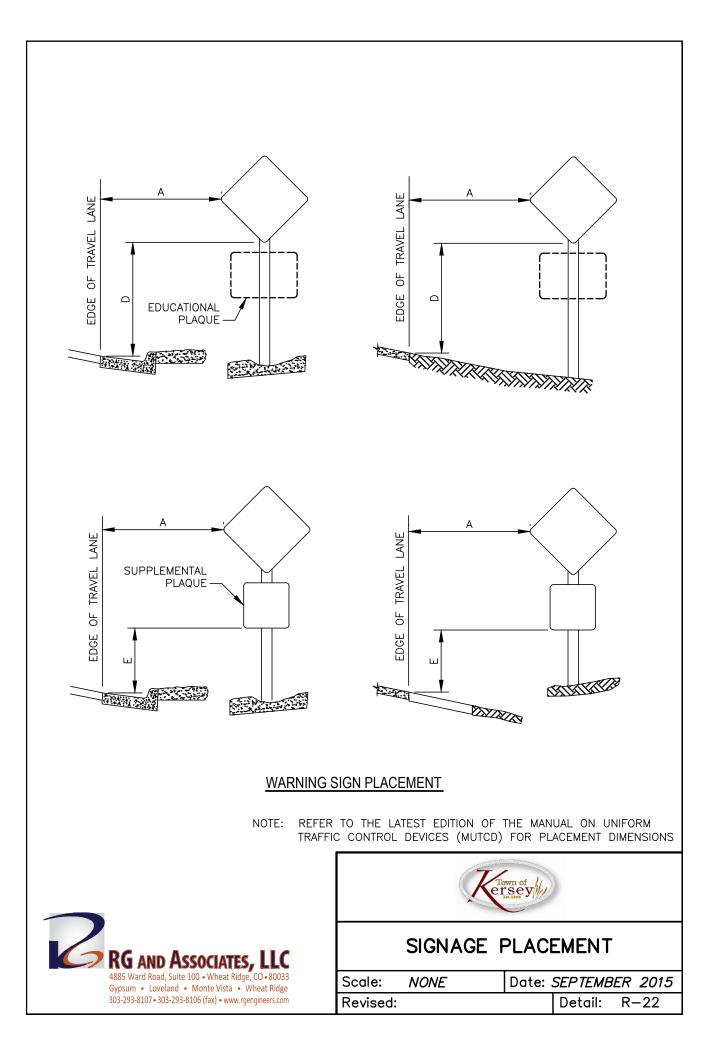




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PLACE I FAICH						
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, Aller		/	ONE-FOOT L	_IFTS.		
TRENCH WALLS TO BE	-	[<u> </u>			
"V"ED OR SHORED, PER OSHA REQUIREMENTS, ABOVE THIS POINT.			NOTE: THE REQUIRE FLO IN CERTAIN	OW FILL		
SOIL CLASSIFICATION	4	MIN. RELATIV	E STANDARD			
(ASTON M145)		COMPACTION		_		
A-1, A-3, A-2-4,	A-2-5	95%	ASTON T180 *	_		
ALL OTHERS	95%	ASTON T99 **				
* ASTM D1557 ** ASTM D698						
OPEN STREET CUTS WILL HAVE THE FOLLOWING MINIMUM PATCH REQUIREMENTS OR MATCH EXISTING PAVEMENT THICKNESS — WHICHEVER IS GREATER:						
		MINIMUM ASPH	ALT PATCH THICKNESS	5		
			ZONING			
STREET CLASSIFICATION	INDUSTRIAL		ALL OTI	ALL OTHER		
	THICKNES	SS LIFTS	THICKNESS	LIFTS		
ARTERIAL	10 ½"	4	9"	3		
COLLECTOR	9"	3	7 ½"	3		
LOCAL	5"	2	6"	2		
MAXIMUM LIFT DEPTH – 3"						
MINIMUM LIFT DEPTH -1 1/2" THICKNESS OF EACH LIFT BELOW THE TOP						
SHALL NOT VARY MORE THAN ¾" TOP LIFT SHALL BE GRADE SX HOT BITUMINOUS PAVEMENT TRENCH PATCH						
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Clark Street С

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DIMENSION	SIGN TYPE			
	LOCAL	COLLECTOR & ARTERIAL	SIGNALIZED INTERSECTION	
A	6"	9"	18"	
В	4"	6"	10"	
С	2 1/2"	3"	5"	
D	AS REQUIRED	AS REQUIRED	AS REQUIRED	

D

NOTES:

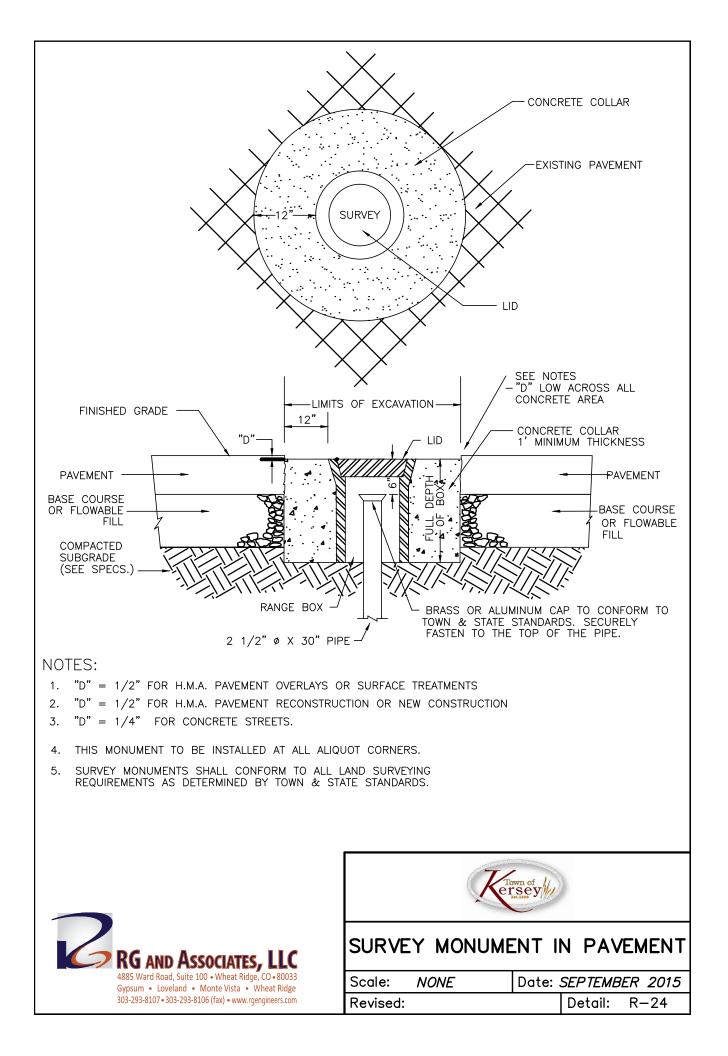
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- 1. SIGN BANKS SHALL BE 6061 OR 5052-H38 ALUMINUM ALLOY; MINIMUM SIGN DANKS SHALL BE GOOT ON SUS2-TISS ALCOMINGM ALLOT 0.080" THICK, FLAT PLATE.
 STREET NAME PLATES SHALL BE DOUBLE FACED.
 FACING SHALL BE GREEN HI-INTENSITY REFLECTIVE SHEETING.
 LETTERS AND NUMBERS SHALL BE WHITE RETRO-REFLECTIVE.

- B



Reverse y					
ROAD & STREET NAME SIGNS					
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ENGINEERING REVIEW TOWN OF KERSEY	REVIEW IS FOR GENERAL ENGINEERING STANDARDS THE TOWN OF KERSEY IS THE CORRECTNESS OF DI	AND REQUIRE NOT RESPO	EMENTS. NSIBLE FOR
□ NO EXCEPTIONS TAKEN	QUANTITIES, AND DESIGN	SAFETY.	,
□ MAKE CORRECTIONS NOTED			
REJECTED-SEE CHECKLIST	TOWN ENGINEER		DATE
THESE PLANS ARE VALID FOR TWO RESUBMITTAL TO THE TOWN IS REC) (2) YEARS AFTER THE DATE QUIRED AFTER THAT TIME PER	OF APPROVA	AL.
		Town of	
RG AND Associates, LLC	APPF	ROVAL B	LOCK

1. DENSITY - 95% STANDARD PROCTOR 2. MOISTURE 2%±

TRENCH TESTING

- 1. PERFORMED EVERY 200'
- 2. PERFORMED 2' ABOVE PIPE
- 3. PERFORMED IN 2' INCREMENTS TO FINAL GRADE
- 4. PERFORM 1 TEST AT FINAL GRADE

HAND COMPACTION IS REQUIRED AROUND ALL MANHOLES, VALVE BOXES, CURB STOP BOXES, METER PITS, STORM INLETS AND ALL OTHER ABOVE GROUND OBSTACLES. TEST REQUIREMENTS ARE THE SAME AS ABOVE WITHIN 1' OF EACH OBSTACLE.

SERVICE LINES

TEST REQUIREMENTS ARE THE SAME AS ABOVE WITH 1 TEST LOCATION BEING IN THE STREET ZONE, 3' FROM PROPOSED GUTTER, AND ONE TEST LOCATED 1' BEHIND PROPOSED SIDEWALK.

CURB, GUTTER, SIDEWALK

1. REPLACEMENT MATERIALS SHALL BE COMPACTED AT 6" LIFTS.

2. PERFORM 1 COMPACTION TEST AT INTERVALS OF EVERY 200 LF.

CROSSPANS

1 COMPACTION TEST WILL BE PERFORMED AT EACH CROSSPAN.

STREET SUBGRADE

- 1. REPLACEMENT MATERIALS FOR THE TOP 2.5' OF SUBGRADE SHALL BE PLACED IN LIFTS NO GREATER THAN 8". 2. PERFORM 1 COMPACTION TEST EVERY 200 LF IN EACH TRAVEL LANE.
- 3. INITIAL TEST IS REQUIRED PRIOR TO THE PLACEMENT OF THE NEXT LIFT. NO POTHOLE TESTING WILL BE ALLOWED.





COMPACTION TESTING REQUIREMENTS

2015

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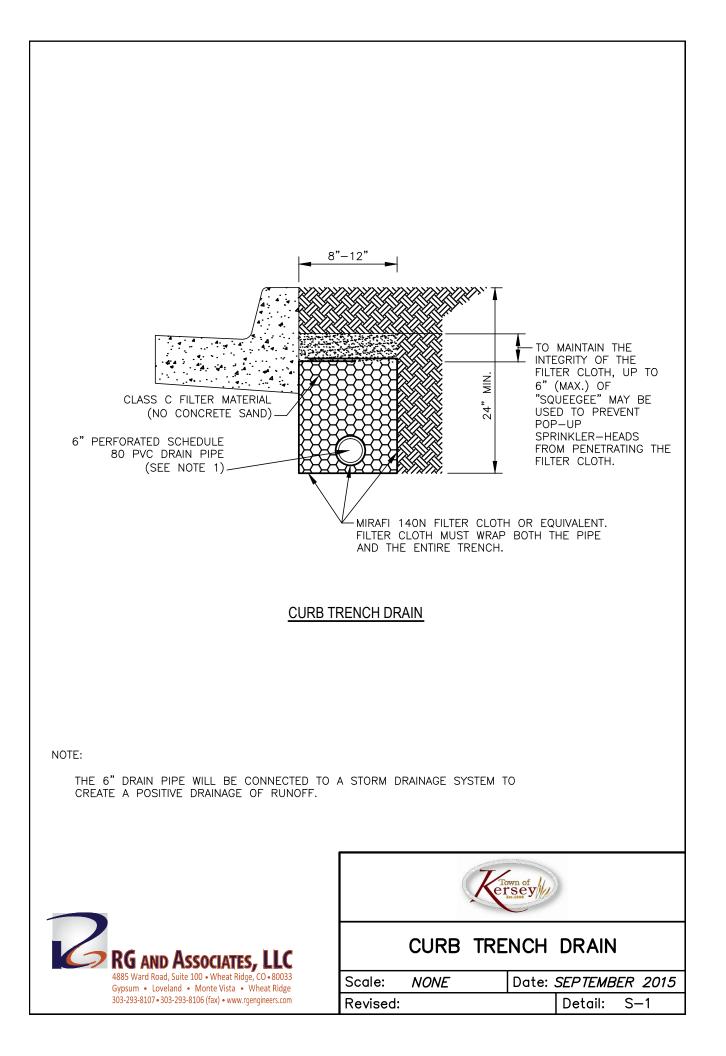
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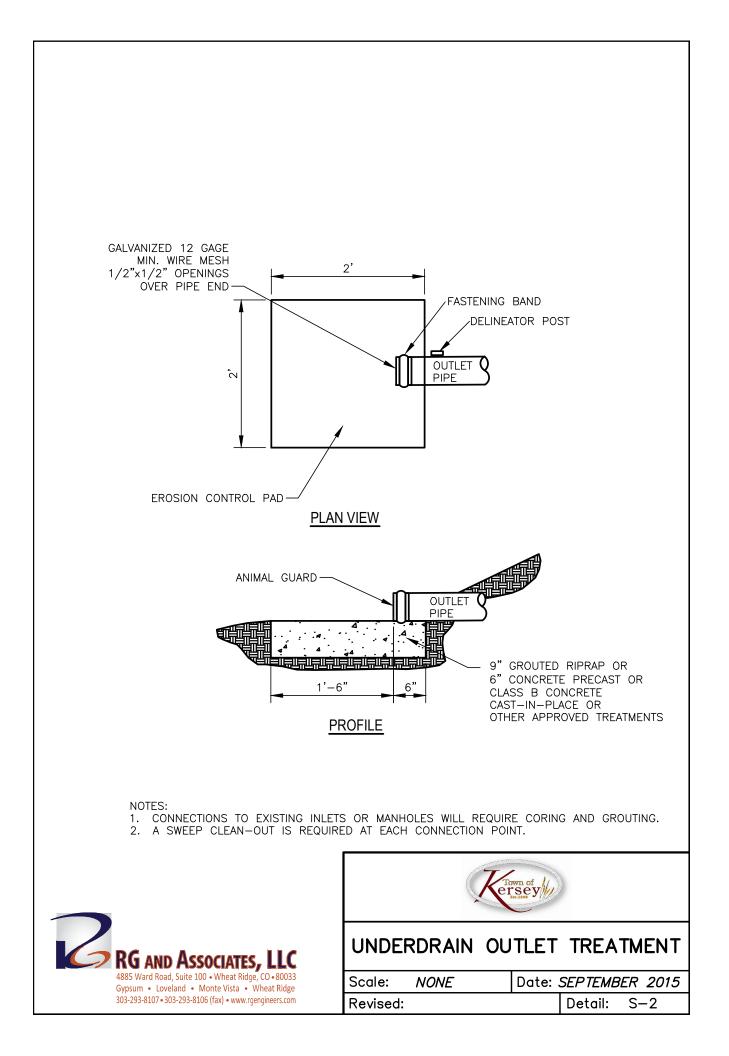
STORM

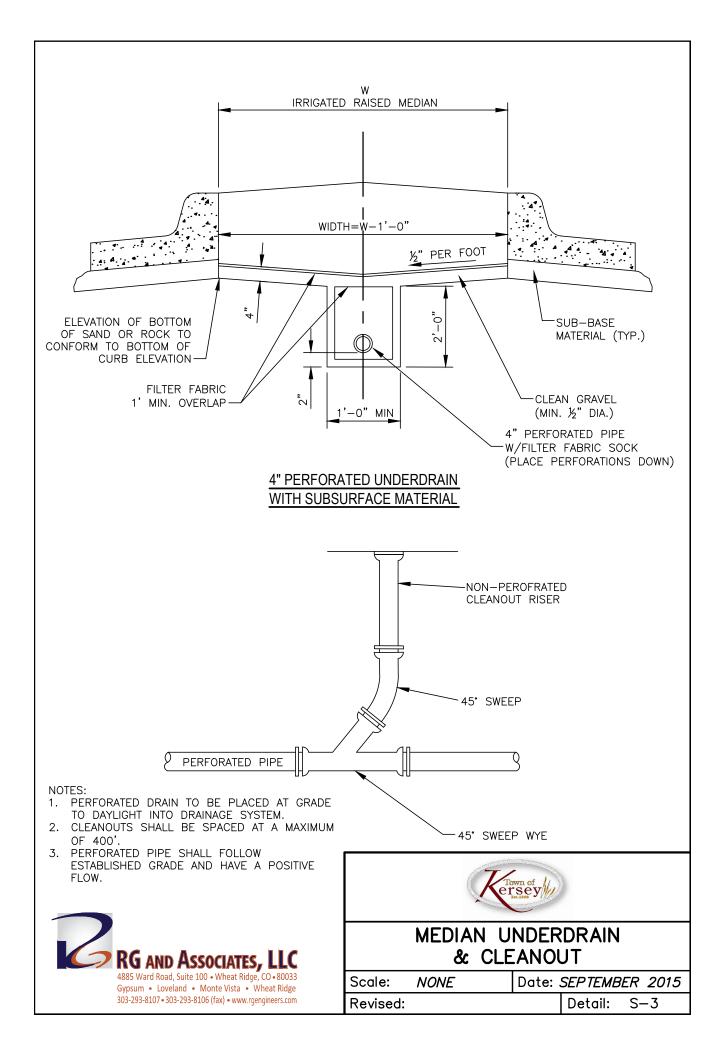
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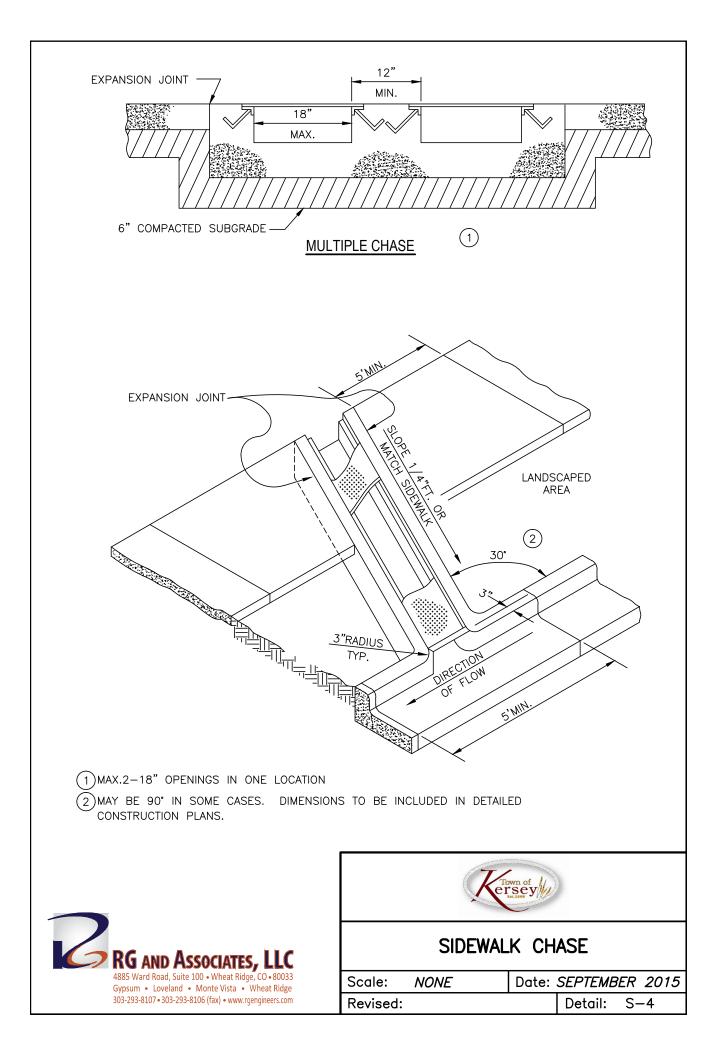
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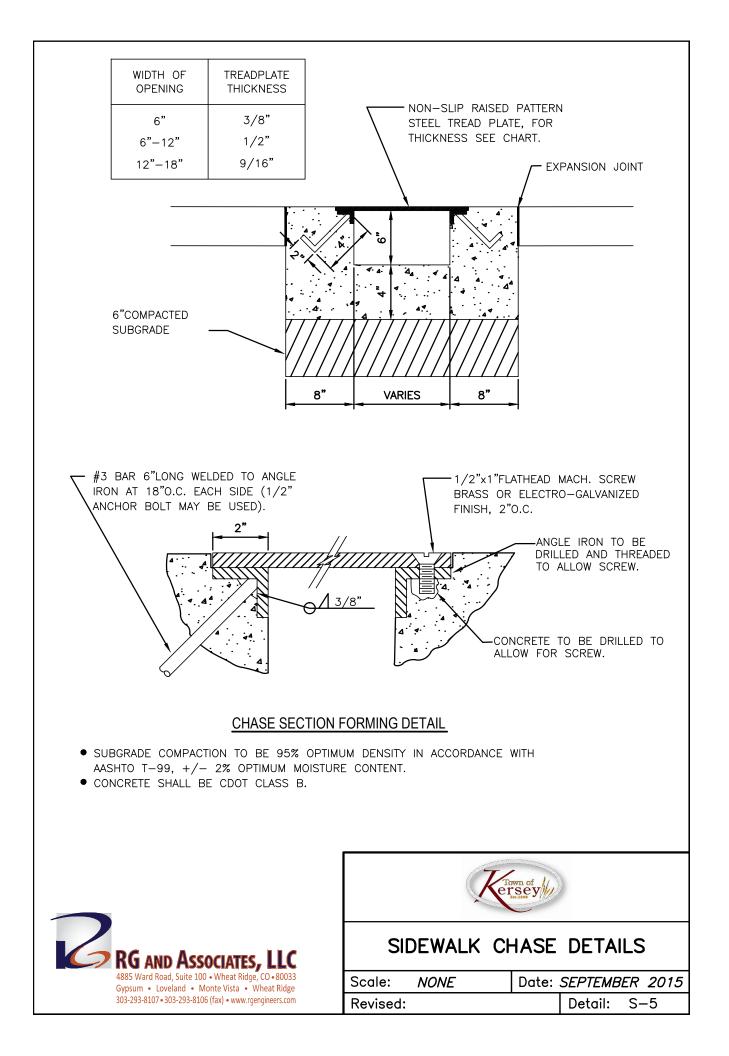
Note: For all other Drainage-related Details, refer to the latest Urban Drainage and Flood Control District's Manual and the latest CDOT Specifications.

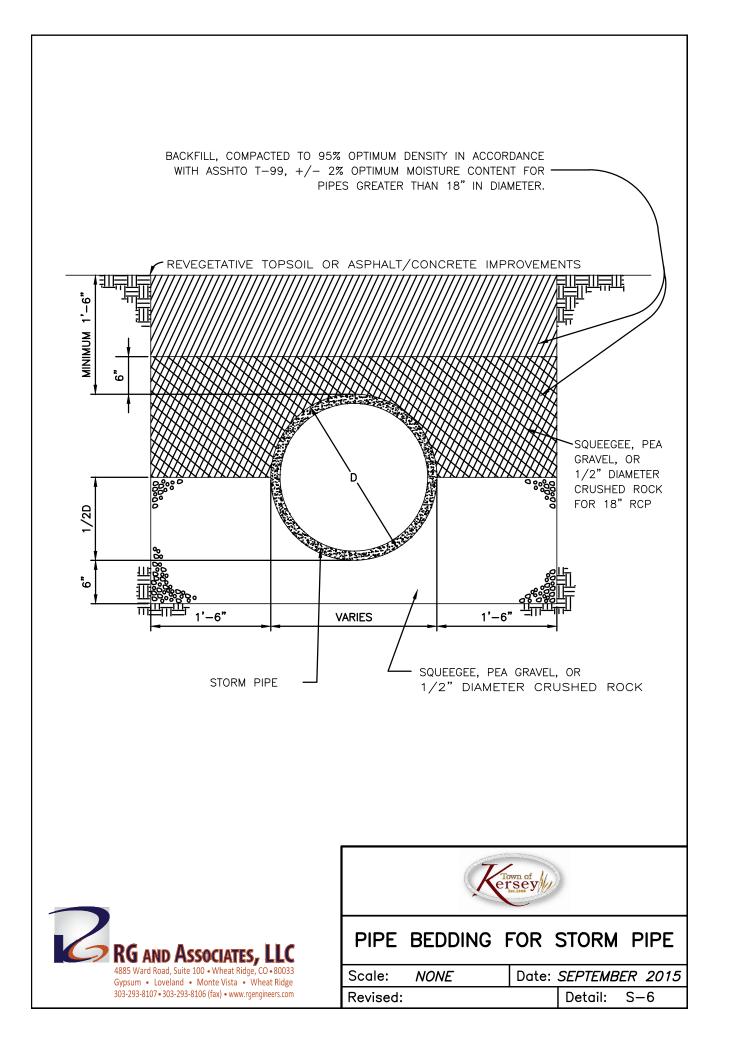














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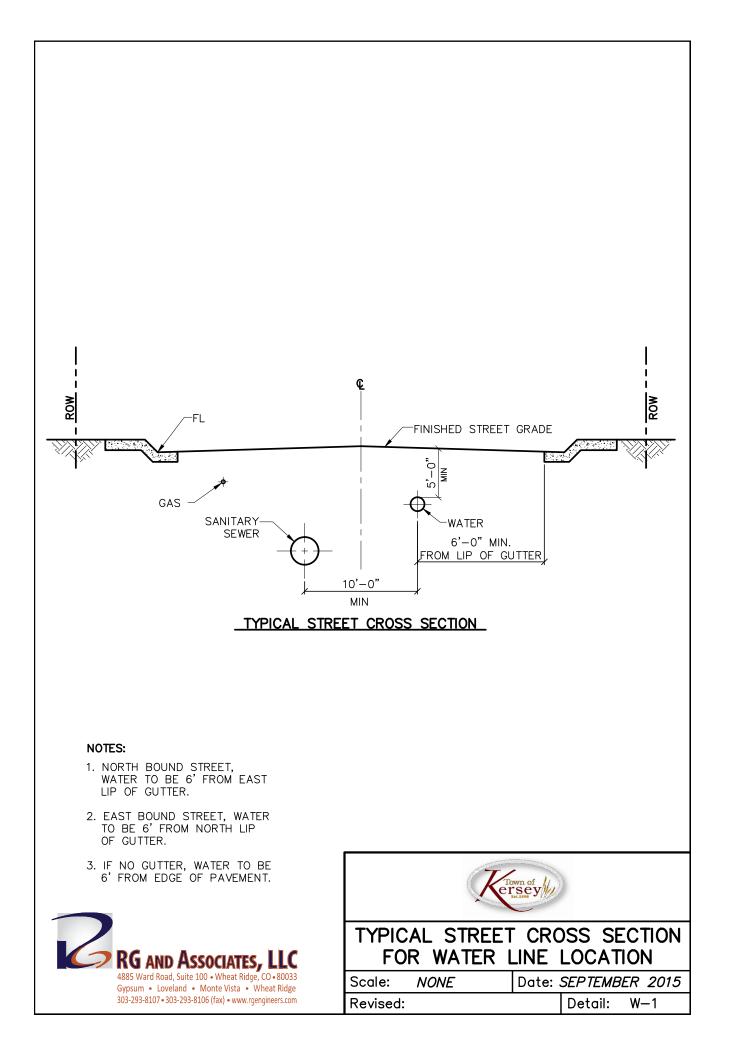
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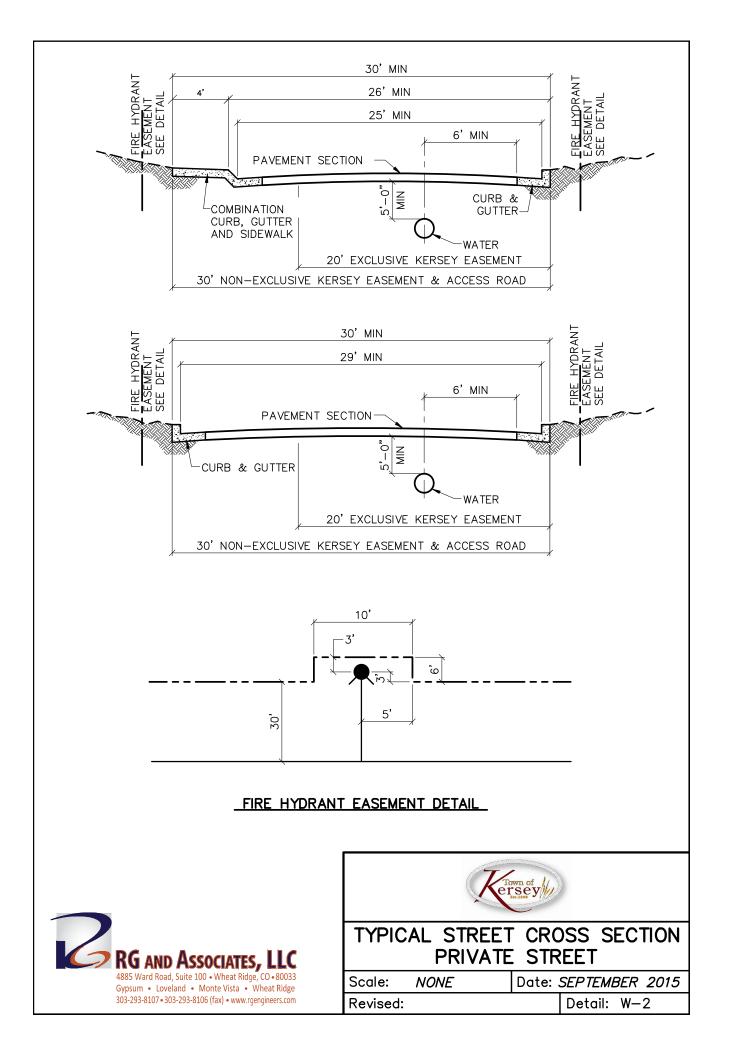
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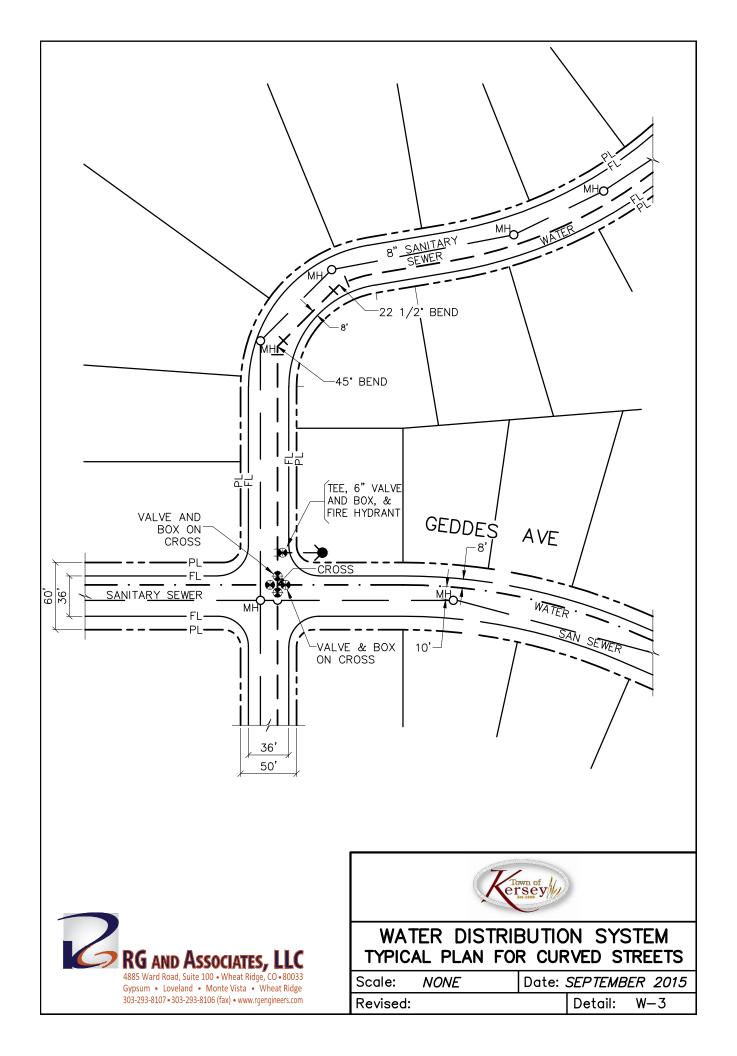
TOWN OF KERSEY, COLORADO

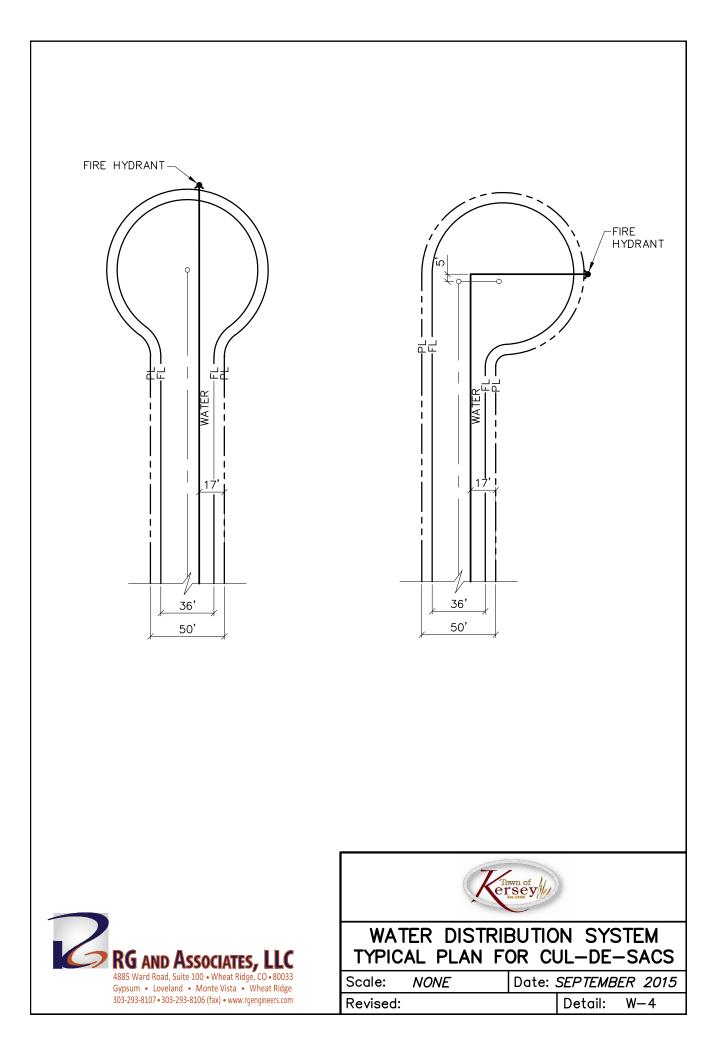


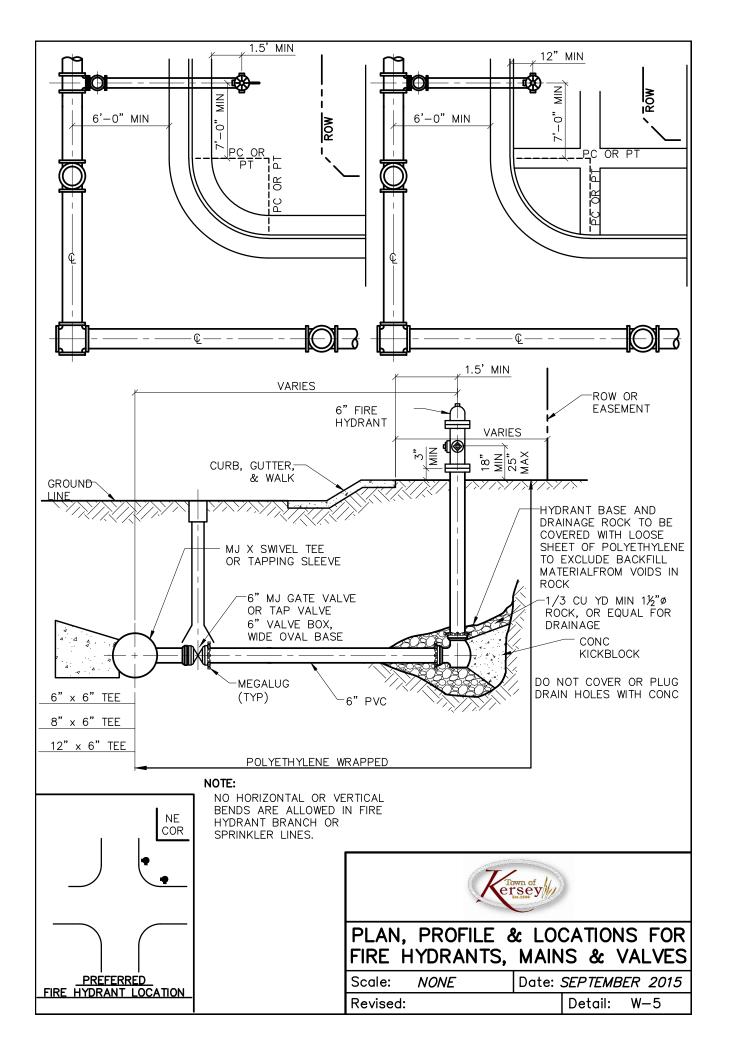
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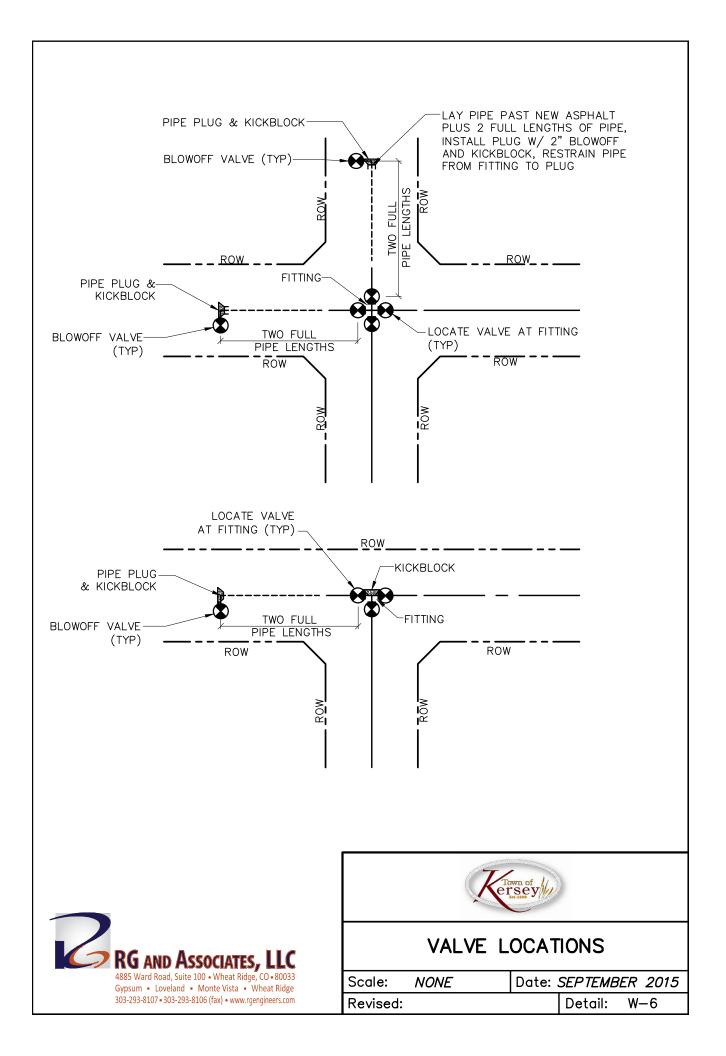


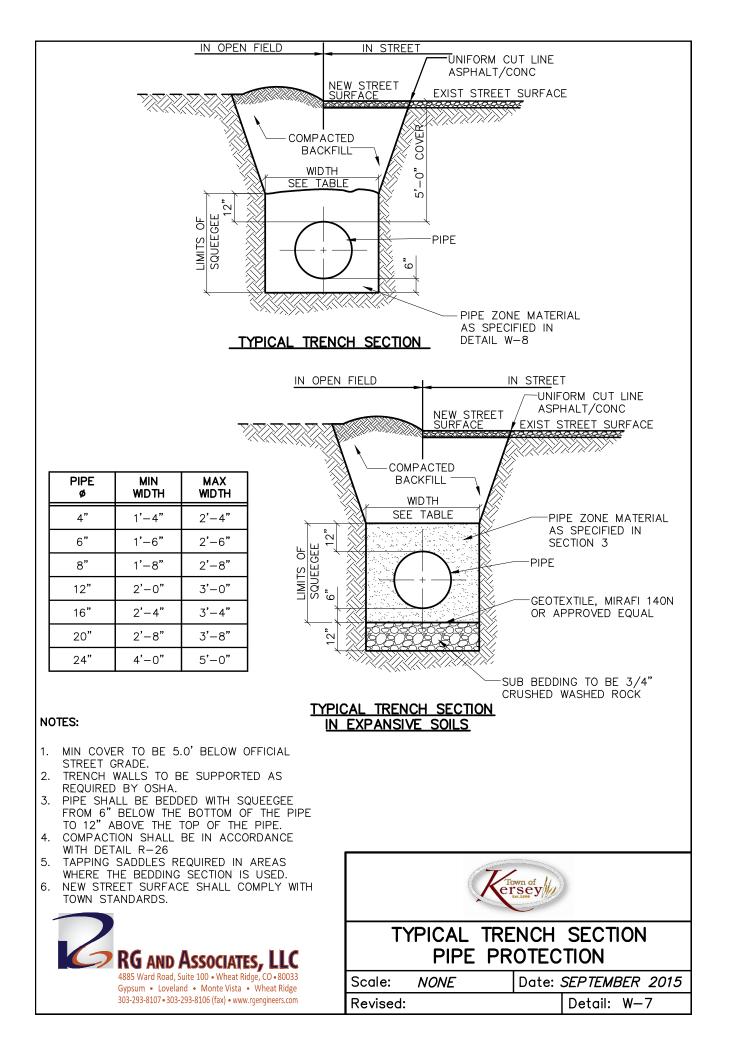












PIPE BEDDING:

(a) <u>Installation of Bedding and Pipe</u>: After completion of the trench excavation and proper preparation of the foundation, six inches (6") of bedding material shall be placed on the trench bottom for support under the pipe. Bell holes shall be dug deep enough to provide a minimum of two inches (2") of clearance between the bell and bedding material. All pipe shall be installed in such a manner as to insure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade, and the joint is made, the bedding material shall be carefully placed and tamped under the haunches of the pipe and in the previously dug bell holes.

Tamping is herein defined as the act of placing approved bedding material under the haunches of the pipe, paying particular attention to voids, bell holes, and sling holes. The purpose of tamping is to ensure uniform support for the pipe.

The limits of bedding shall be from six inches (6") below the bottom of the pipe to twelve inches (12") above the top of the pipe. Approved backfill may then be installed to the groundline.

Compaction of bedding is not required. The only requirement is sufficient tamping to achieve uniform support under the pipe. See Detail W—7 of the Standard Drawings for a typical trench cross section.

(b) <u>Bedding Material:</u> The bedding material shall be a clean well—graded sand or squeegee sand and shall conform to the following limits when tested by means of laboratory sieves:

Well-Graded Sand

<u>Sieve Size</u>	Total Percent <u>Passing by Weight</u>
3/8 inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10
No. 200	0

Squeegee Sand

<u>Sieve Size</u>	Total Percent <u>Passing by Weight</u>
3/8 inch	100
No. 100	0-5

F

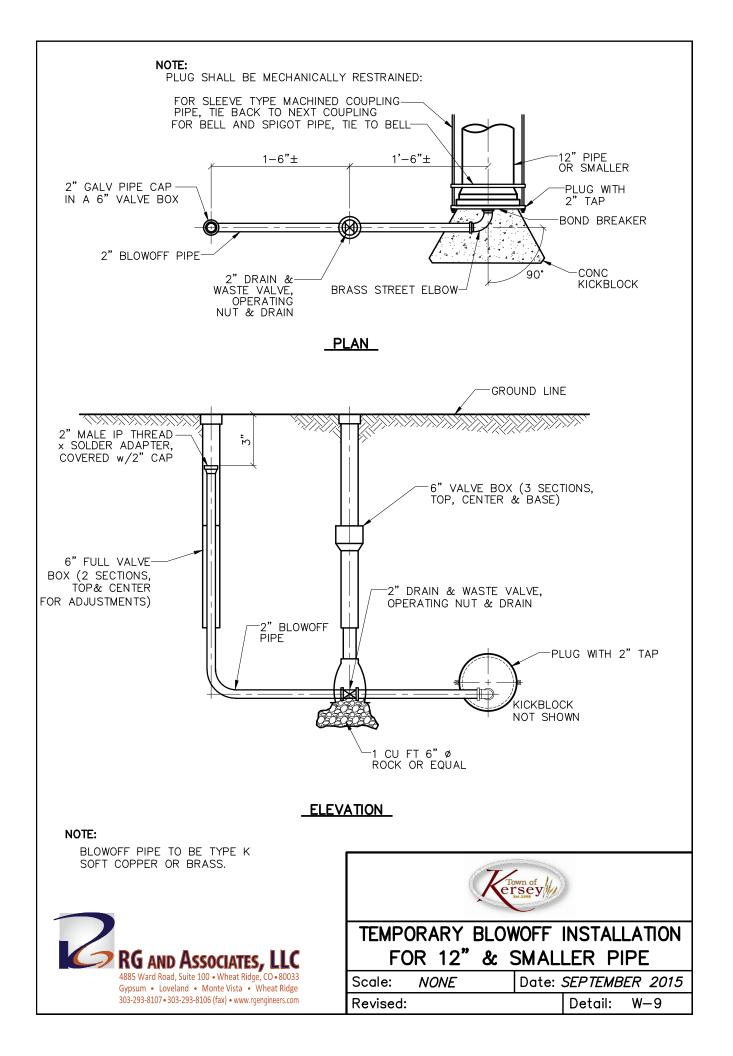
If approved by the Town, fines form the trench walls and spoils pile may be used to provide uniform support for the pipe. No rock or stone larger than that allowed by the sieve analysis, or any other detrimental substance, shall be placed closer to the pipe than six inches (6"). Approved bedding materials shall be stockpiled on the jobsite to be used in the event natural materials become unsatisfactory. The Town reserves the right to require the use of the specified bedding material at any time.

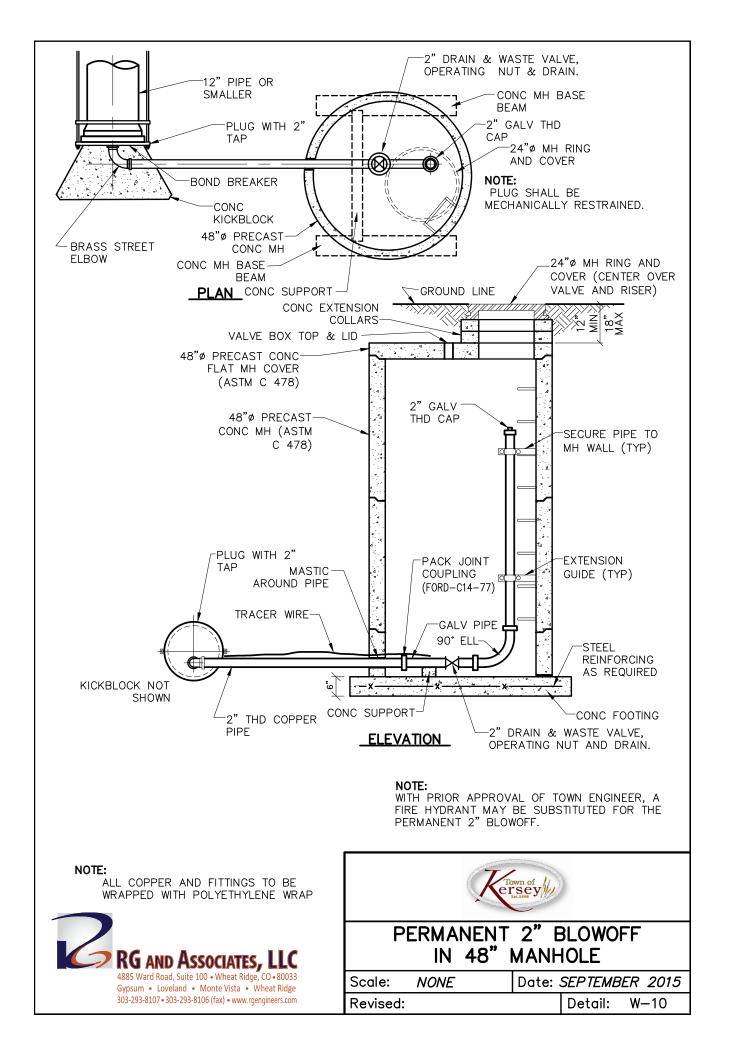


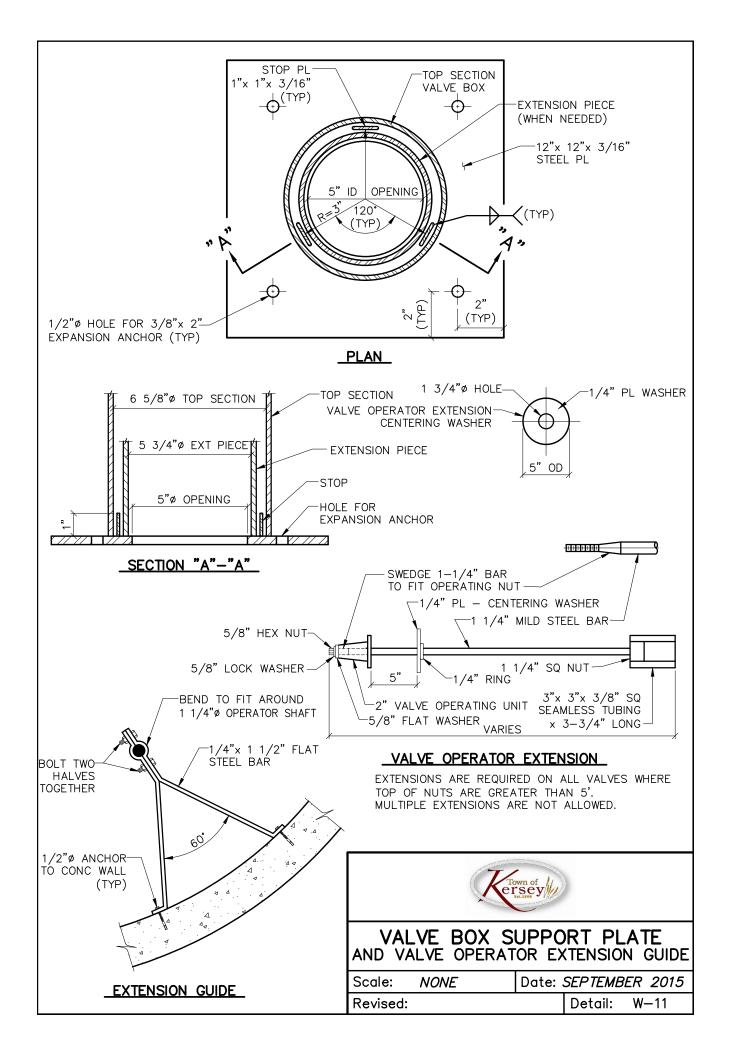
Scale: NONE Date: SEPTEMBER 2013	5
Revised: Detail: W-8	

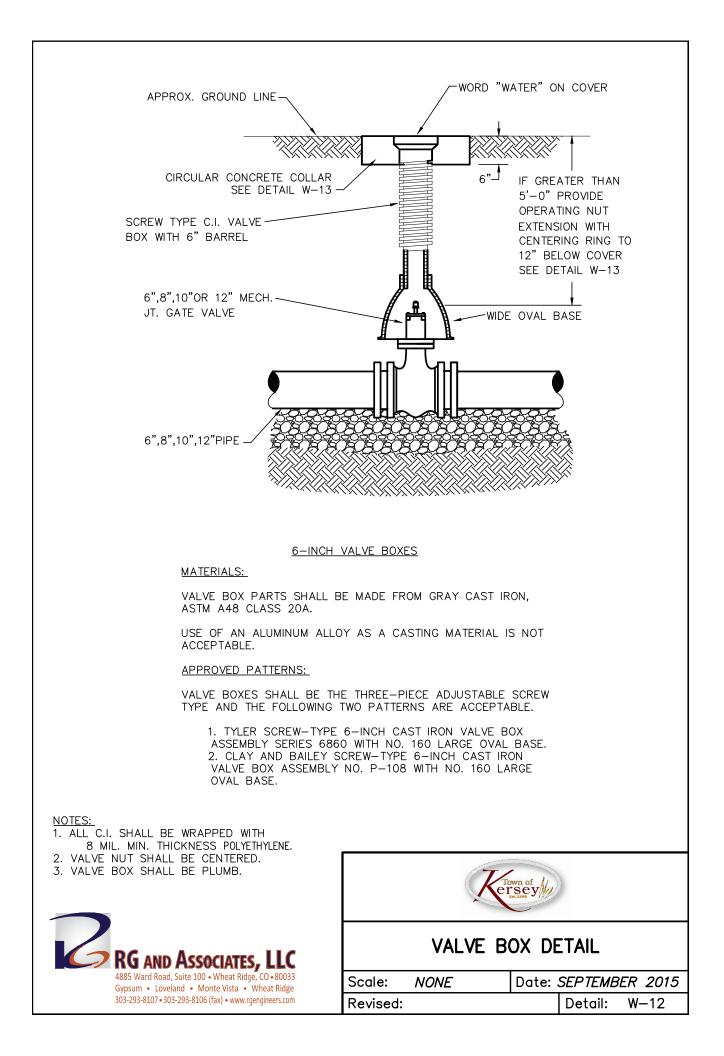
PIPE BEDDING

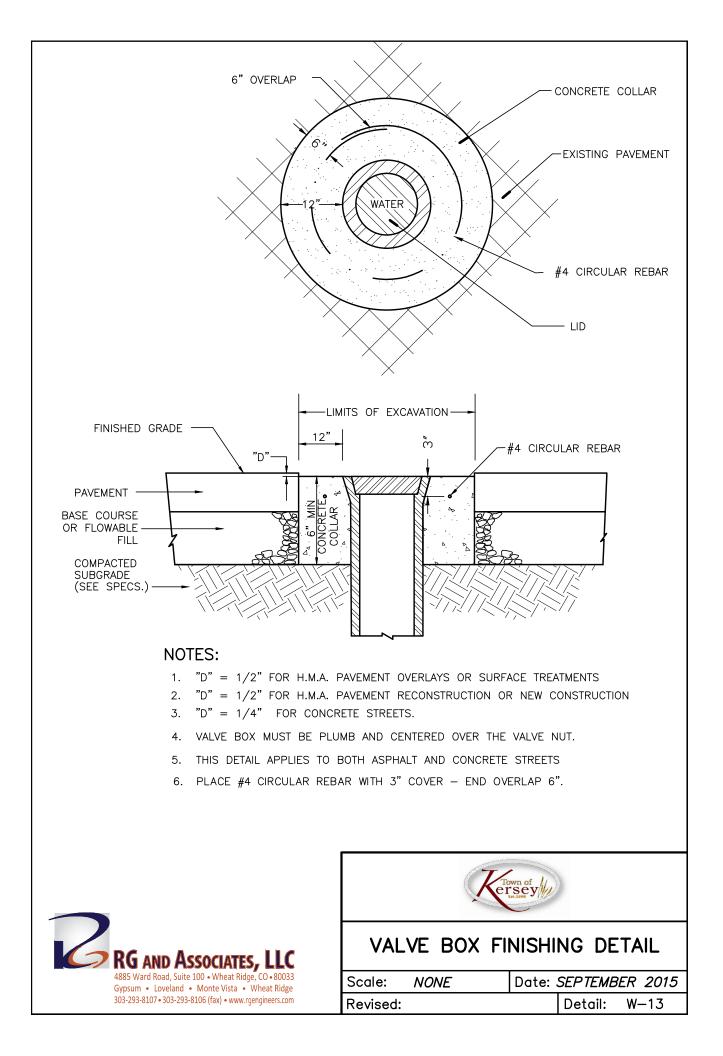
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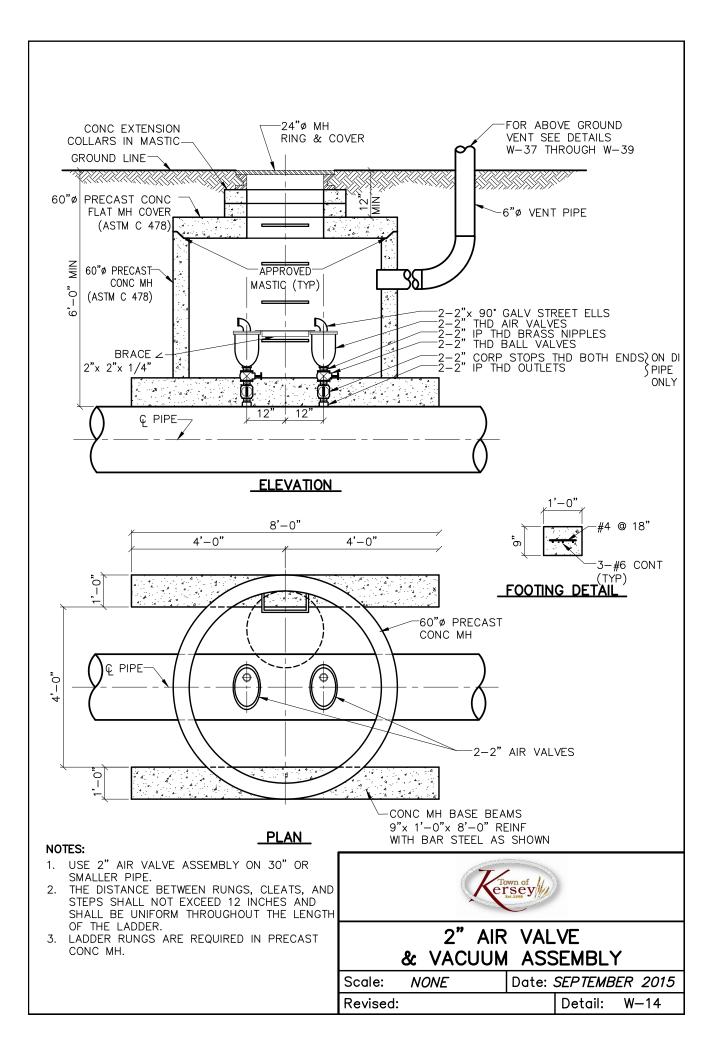


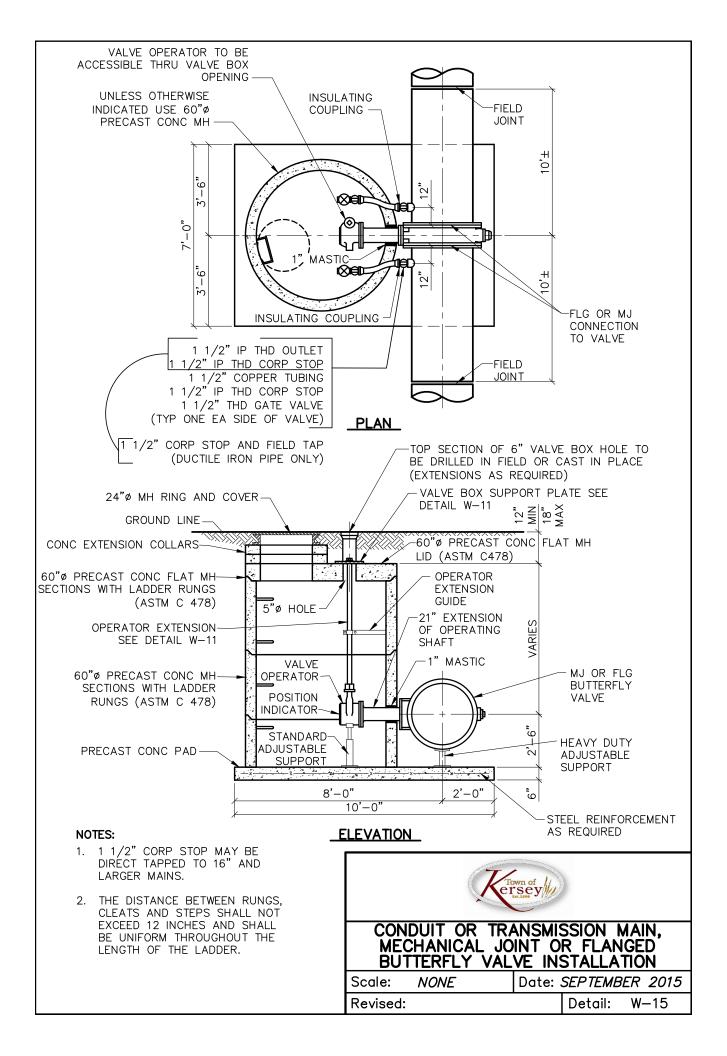


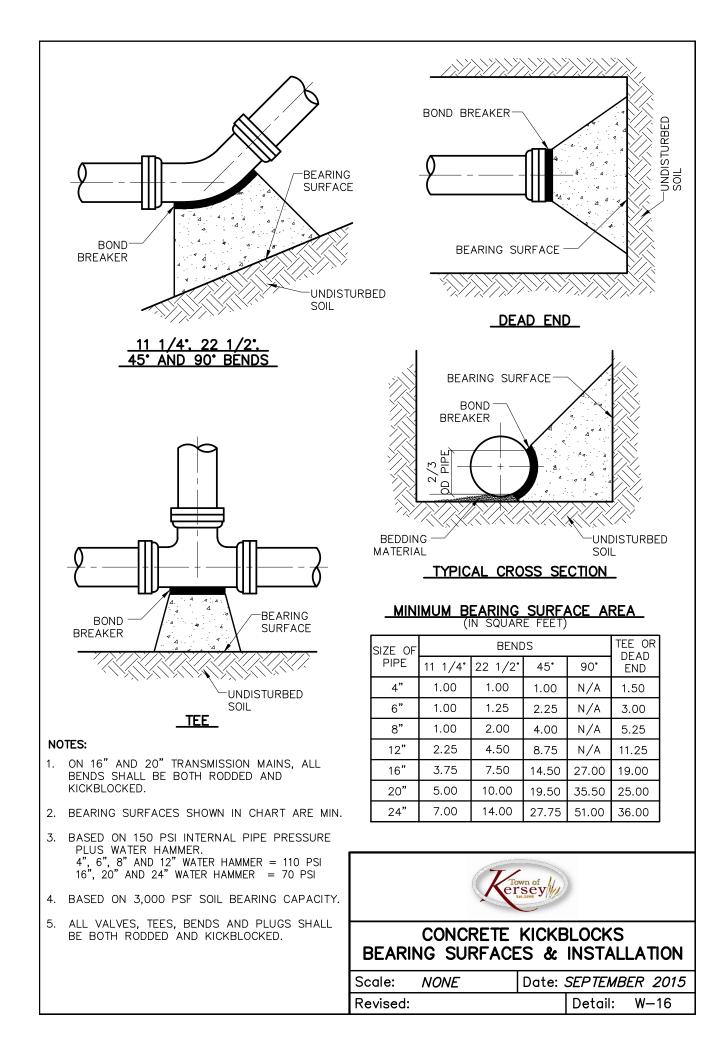


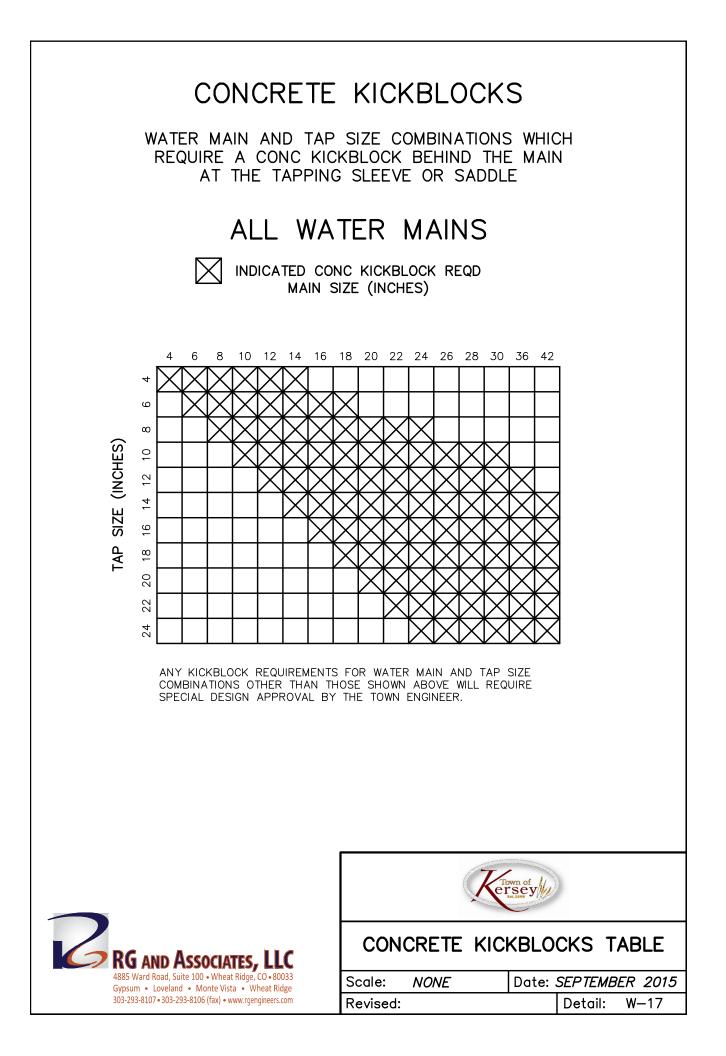




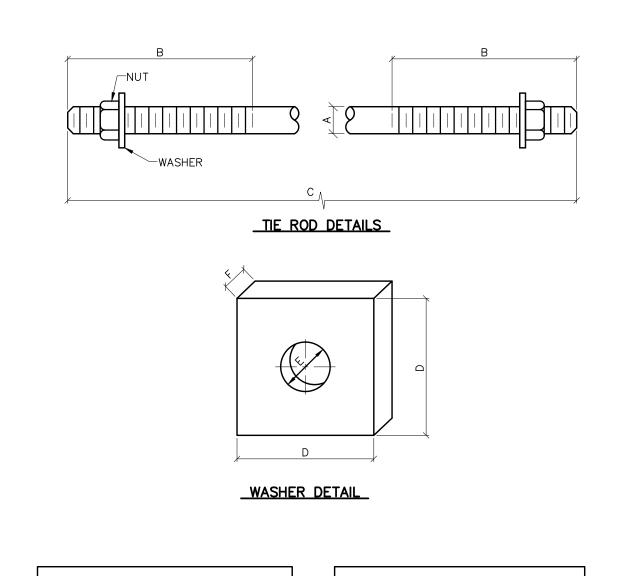








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	.,	D		1	I	1	VALVES AND BENDS. GER PIPES. S=HIGH STRENGTH. HER. AVY SERIES. HS NUTS S ALL W-20, CLAMP AND RESTRAINED TOGETHER GTH OF JOINT RESTRAIN ONS. A MECHANICAL JOINT A MECHANICAL JOINT A MECHANICAL JOINT CNS. A MECHANICAL JOINT EXCAVATING NEXT TO A IN ADDITION TO RESTRAINT LENGTH OF RESTRAINT CFTER IS OVER 10", THE FOR REVIEW.
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	20"		212'	104,	50	15'	DM VA LARG LARG AME AME LENG LENG ECTION ECTION CECTIO
Ы		D	1 1/4"	1 1/4"	1 <i>X</i> 4"	1 1/4"	EACH WAY FROM VAL ED FOR 24" & LARGEF MS=MILD STEEL, HS=I PLUS WATER HAMMER GRADE B7. OR B HEXAGON HEAVY ROD COUPLING DETAIL E WHICH MUST BE RES E RODS. ALSO FOR THE LENGTH APPLICABLE DIRECTIONS E FITTING OR VALVE. W-24. BE CLOSED WHEN EXC SHALL BE USED IN USTALLATIONS THE LEN STALLATIONS THE LEN OF RESTRAINED PIPE I OF RESTRAINED PIPE I
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AINE	16"	Γ	173'	85'	41,	13'	D EAC E PLU E PLU E PLU E PLU E PLU A APPL C
STR		D	1"	"1		., 1	MEASURED EACH WAY FROM VALVES AND BENDS NOT ALLOWED FOR 24" & LARGER PIPES. GEGRADE, MS=MILD STEEL, HS=HIGH STRENGTH. UIRED. PRESSURE PLUS WATER HAMMER. A 36. SA 36. STM A 193 GRADE B7. GRADE A OR B HEXAGON HEAVY SERIES. HS NU ADE 24. GRADE A OR B HEXAGON HEAVY SERIES. HS NU ADE 24. UNT OF PIPE WHICH MUST BE RESTRAINED TOGET UNT OF PIPE WHICH MUST BE RESTRAINED TOGET GRADE OF THE ROD COUPLING DETAIL W-20, CLAMP UNT OF PIPE WHICH MUST BE RESTRAINED TOGET GRADE A OR B HEXAGON HEAVY SERIES. HS NU ADE 24. UNT OF PIPE WHICH MUST BE RESTRAINED TOGET GRATE SHALL HAVE A MECHANICAL JO SIDE OF THE FITTING OR VALVE. MECHANICAL JO SIDE OF THE
OF R		ც	HS	SH	HS	HS	
ытн (12"		134'	66'	32'	10,	ES: LENGTH OF RESTRAINED PIPE CLAMPS, RODS & MEGALUGS I D=ROD DIAMETER, L=LENGTH, MIN 5.0° GROUND COVER REQU BASED ON 150 PSI INTERNAL MS = MILD STEEL ROD ASTM MS = MILD STEEL ROD ASTM SEE TIED PIPE DETAIL W-25. CONFORM TO ASTM A194 GRA SEE TIED PIPE DETAIL W-25. CONFORM TO ASTM A104 GRA SEE TIED PIPE DETAIL W-25. STER SEE TIED PIPE DETAIL W-25. STEEL SEE TIED PIPE DETAIL W-25. STER SEE TIED PIPE DETAIL W-25. STER SEE TIED PIPE DE
E & LENGTH OF RESTRAINED		D	3/4"	3/4"	3/4"	3/4"	ES: LENGTH OF RESTRAINED CLAMPS, RODS & MEGAL D=ROD DIAMETER, L=LEN MIN 5.0° GROUND COVER BASED ON 150 PSI INTER MS = MILD STEEL ROD / HS = HIGH STRENGTH R HS = HIGH STRENGTH R CONFORM TO ASTM A194 SEE TED PIPE DETAIL W CLAMP DETAIL W 22. LENGTH OF RESTRAINED FOR MEGALUGS. THE IS NOT NECESSARILY THI LENGTH OF RESTRAINED FOR MEGALUGS. TOR MEGALUGS. TESTRAINT DEVICE SHALL A SECOND VALVE WILL B EXISTING VALVE WILL B MHEN REDUCERS ARE US SHALL BE BASED ON TH IF INTERNAL PRESSURE R IDESIGN ENGINEER WILL P
		9	MS	MS	MS	WS	ES: LENGTH OF RESTRA CLAMPS, RODS & N D=ROD DIAMETER, J MIN 5.0' GROUND G BASED ON 150 PSI MS = MILD STEL I HS = HICH STREL I HS = HICH STREL I HS = HICH STREL I HS = HICH STREL I HS = HICH STRENC CONFORM TO ASTM SEE TIED PIPE DET CLAMP DETAIL W-2 LENGTH OF RESTRA CONFORM TO ASTM SEE TIED PIPE DET CONFORM TO ASTM SEE TIED PIPE DET CONFORM TO ASTM STRENC NOT NECESSARIL CONFORM TO ASTM STRENC NOT NECESSARIL CONFORM TO ASTM STRENC VALVE A SECOND VALVE V EXISTING VALVE ON PLUGS, TEES AI WHEN REDUCERS AI SHALL BE BASED C SHALL BE BASED C STALL BE BASED C STALL BE BASED C STALL BE BASED C STRENAL PRESS
<u>GRADE</u>	°80 100		94'	46'	23'	7,	ES: LENGTH OF RESI CLAMPS, RODS & D=ROD DIAMETEF MIN 5.0° GROUNU BASED ON 150 F BASED ON 150 F CONFORM TO AS SEE TIED PIPE D CLAMP DETAIL W LENGTH OF RESI FOR MEGALL OF CONFORM TO AS SEE TIED PIPE D CLAMP DETAIL W LENGTH OF RESI FOR MEGALL F FOR MEGALUGS. FOR MUST. FOR MUST. FO
		D	3/4"	3/4"	3/4"	3/4"	ES: LENGTH CCLAMPS, CCLAMPS, DEROD MIN 5.0' MIN
<u>DIAMETER.</u>	.9	9	MS	MS	WS	I	NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NOTE: NO
DIA			71,	35'	17'	I	
ROD		D	3/4"	3/4"	3/4"	I	
1		9	WS	WS	MS	I	
	4		, 50'	, 25'	12,	I	
	1.1	D	E, 3/4"	3/4"	3/4"	I	$\mathbf{T} \rightarrow \mathbf{I} \qquad \mathbf{I} \rightarrow $
	SIZE	FITTING	ND, TEI VALVE	BEND	ND 2.	1/4. END	
	PIPE	FIT	90° BEND, TEE, PLUG, VALVE	45•	22 1/2 BEND	11 BE	
			0,				
							Kersey (
-							
	E	7 R(j and	Ass	οςιατ	es, L	LENGTH OF RESTRAINED PIPE
		4885 Gyps	Ward Road um • Love	l, Suite 100 eland • N) • Wheat F Ionte Vista	idge, CO • 8 • Wheat I	0033 Scale: NONE Date: SEPTEMBER 2015
		503-2	93-8107 • 30	13-732-910	∪ (IdX) ● WW	w.rgenginee	s.com Revised: Detail: W-18



TIE RODS								
A	В	С						
ROD Ø	THREAD LENGTH	ROD LENGTH	GRADE					
3⁄4"	6"	1'TO 11'& 20'	MS					
1", 1 ¼"	ALL THREAD	1'TO 11'& 20'	HS					

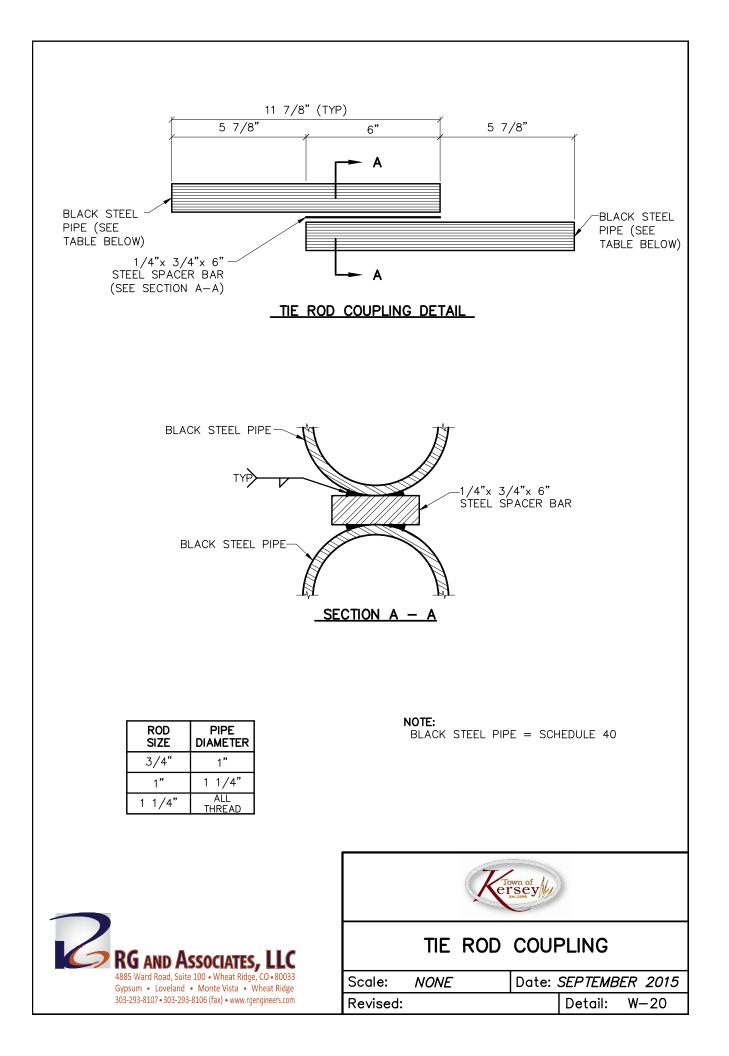
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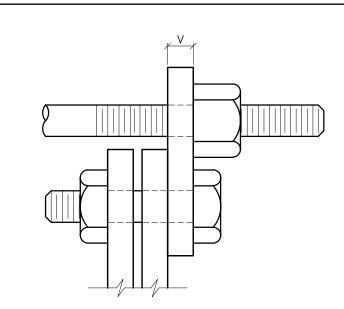
- 1. SEE TIED JOINTS, ROD DIMENSIONS SHEET.
- 2. SEE CLAMP DETAILS AND DIMENSION FOR PROPER PLACEMENT OF WASHERS.
- 3. MS=MILD STEEL HS=HIGH STRENGTH

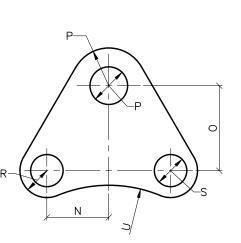


WASHERS									
D	E	F							
WIDTH	HOLE Ø	THICKNESS							
5"	1/8" LARGER THAN ROD Ø	1/2"							
6"	1/8" LARGER THAN ROD Ø	5/8"							









FLANGE LUG DETAIL

PIPE			HS RODS		MS RODS						PIPE
ø	N	0	Ρ	ROD Ø	Р	ROD Ø	R	S	U	V	ø
3	2 1/8	2 9/16	-	-	7/8	3/4	3/4	5/8	2 3/8	3/4	3
4	1 7/16	2	-	-	7/8	3/4	3/4	5/8	3 1/8	3/4	4
6	1 13/16	2 1/16	-	_	7/8	3/4	7/8	3/4	4	3/4	6
8	2 1/4	2 1/4	-	-	7/8	3/4	7/8	3/4	5 1/8	3/4	8
10	1 7/8	2 1/16	-	_	7/8	3/4	1	7/8	6 1/4	3/4	16
12	2 1/4	2 5/16	7/8	3/4	-	-	1	7/8	5 7/8	1	10
16	2 1/8	2 7/16	1 1/8	1	-	-	1 1/8	1	9 5/8	1 1/8	12
20	2	2 5/8	1 3/8	1 1/4	-	-	1 1/4	1 1/8	11 3/8	1 1/4	20
24	RODS AND CLAMPS NOT ALLOWED										24

DIMENSIONS (IN INCHES)

NOTES:

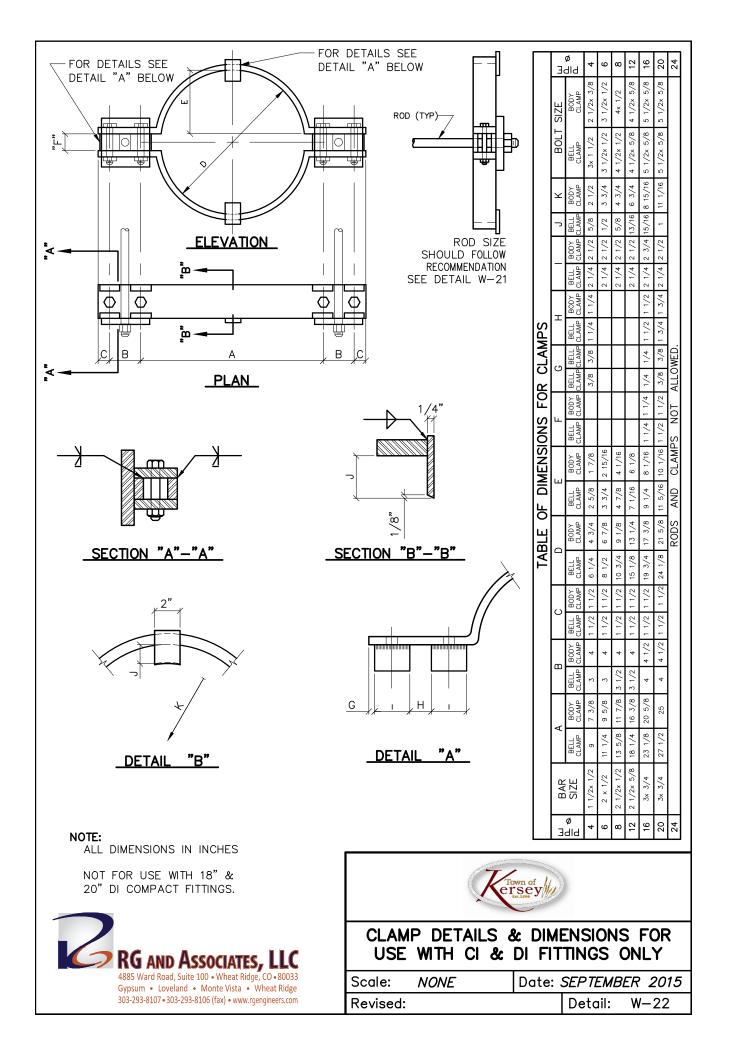
- 1. MS MEANS MILD STEEL ROD ASTM A 36 (NUTS SHALL BE ASTM A 307 GRADE A OR B HEXAGON HEAVY SERIES)
- 2.HS MEANS HIGH STRENGTH STEEL ROD ASTM A 193 GRADE B7. (NUTS SHALL BE ASTM A 194 GRADE 2H)

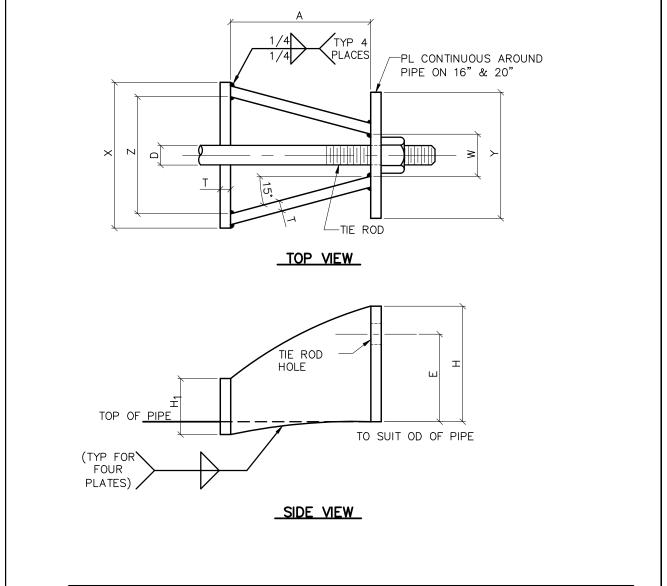




FLANGE LUG DETAIL

Scale:	NONE	Date:	SEPTEMB	ER 2015
Revised:			Detail:	W-21





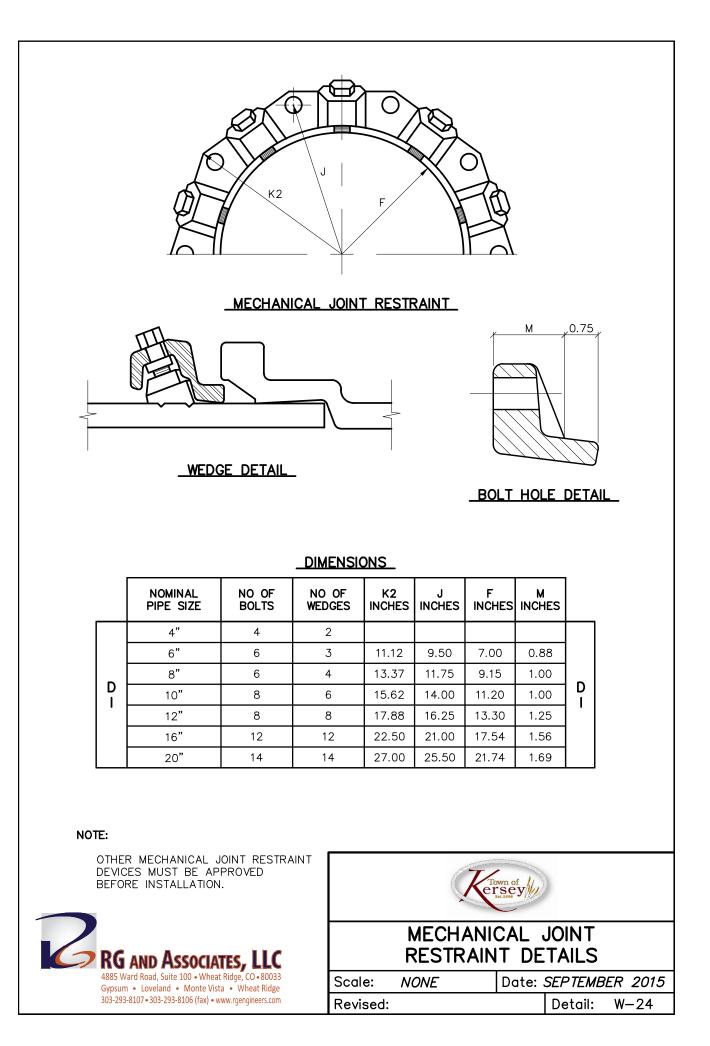
	CARRIER PIPE NOMINAL Ø	STUD Ø D	A	w	Z	т	н	E	H ₁	Y	x
	4" TO 12"	3/4"	5"	1 1/2"	3 3/4"	3/8"	4 1/8"	3 1/8"	2"	4 1/2"	5"
	16"	1"	5 3/4"	1 3/4"	4 1/2"	1/2"	4 1/2"	3 1/4"	2"	RING	6 "
_ <u> </u>	20"	1 1/4"	7 1/2"	2"	5 3/4"	5/8"	5"	3 3/4"	2 1/2"	RING	7 1/2"

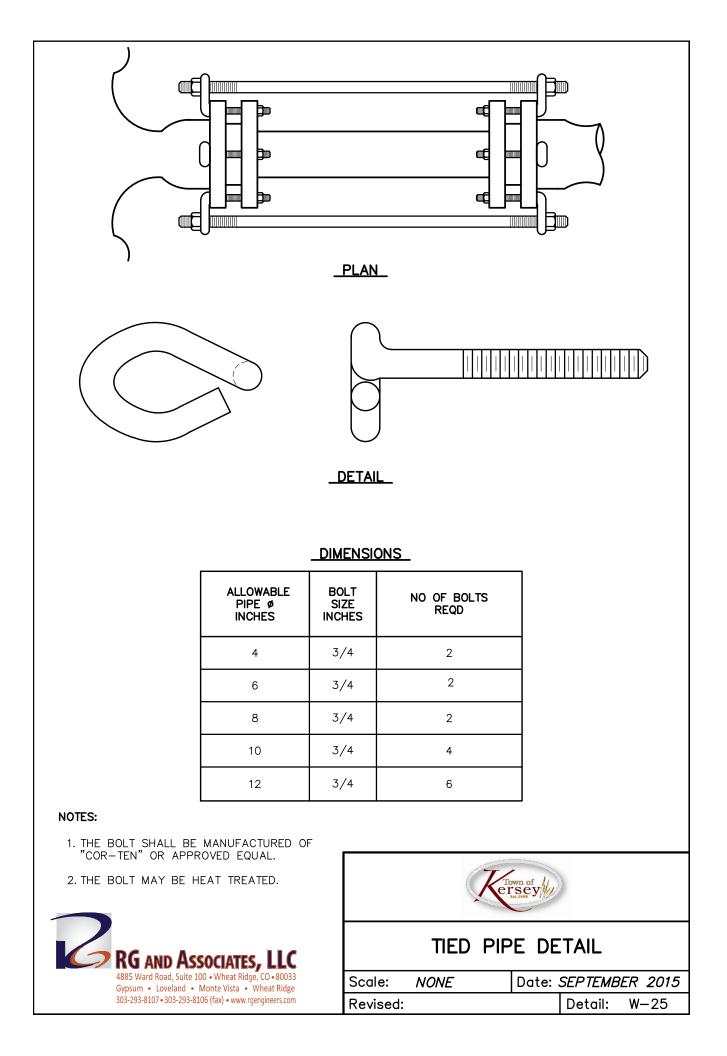
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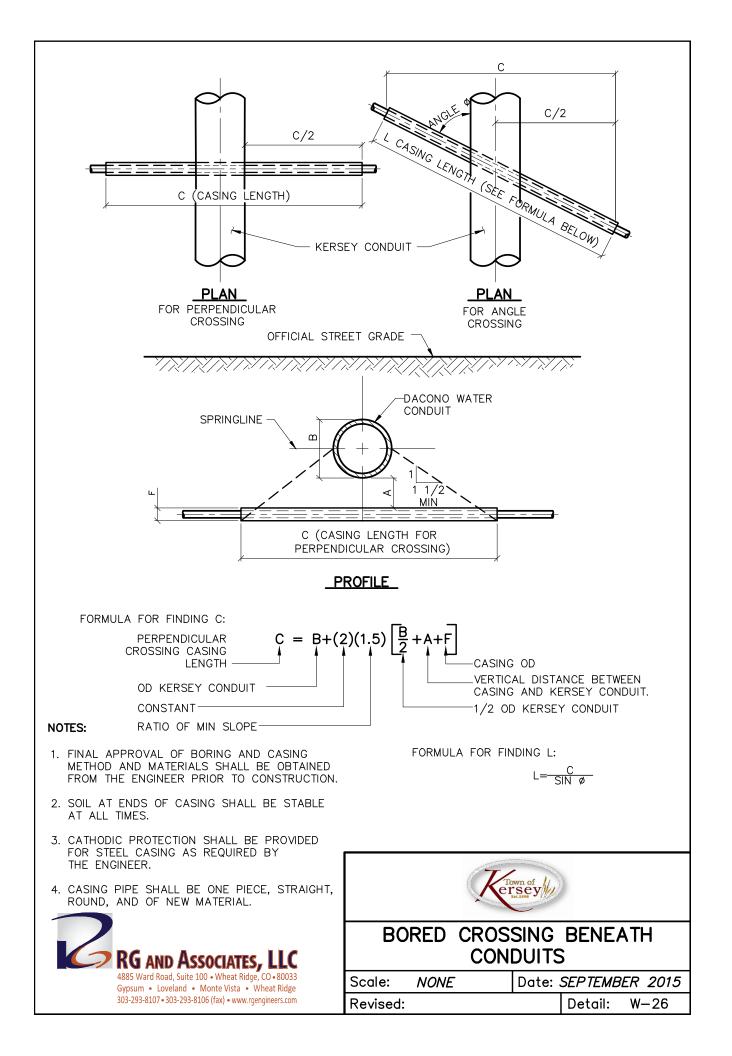
- 1. USE TWO HS STEEL TIE RODS AT END OF CASING.
- 2. TIE ROD HOLE Ø 1/8" LARGER THAN STUD Ø.
- 3. BOTTOM EDGE OF ALL PLATES SHAPED TO FIT OD OF PIPE.
- 4. HARNESS LUGS AS PER AWWA MANUAL M11.

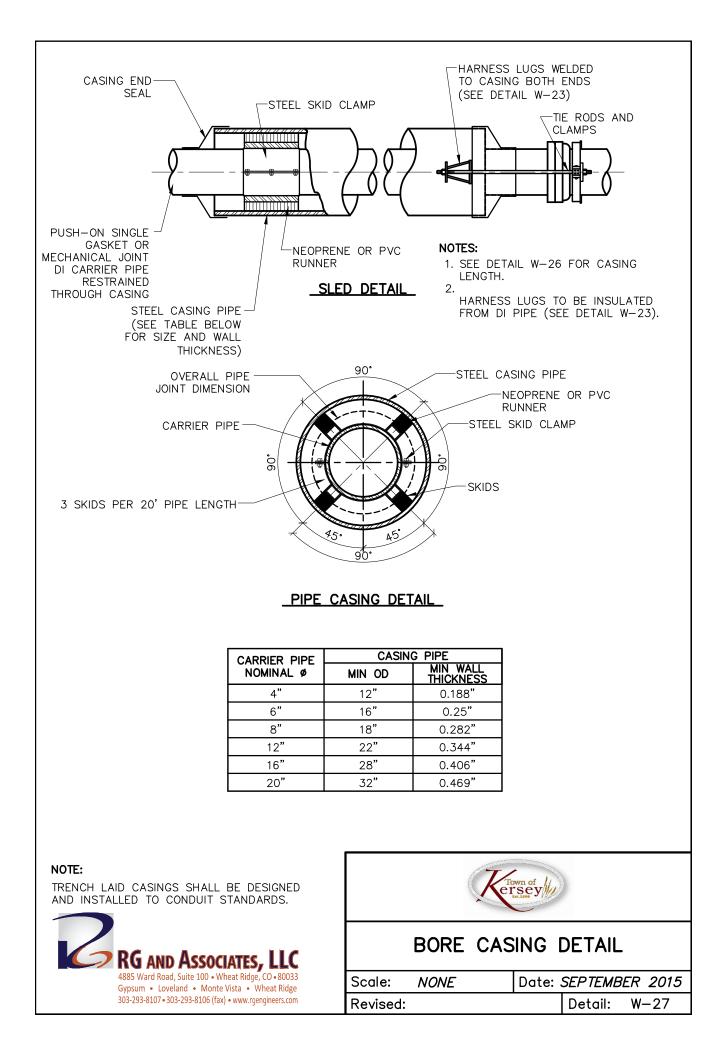


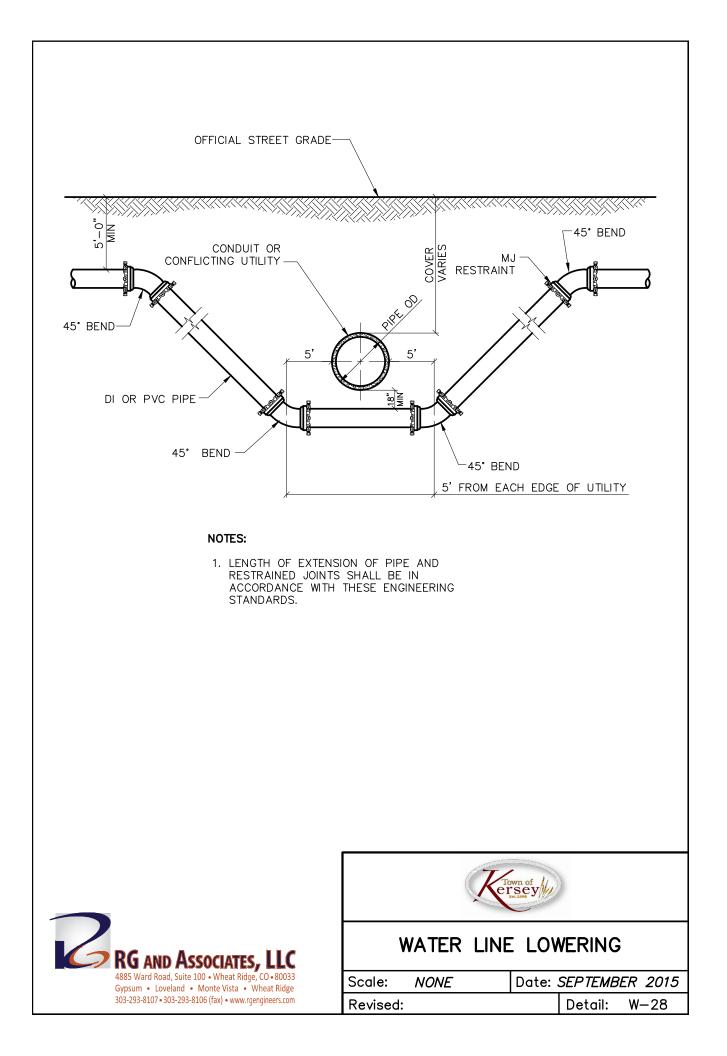


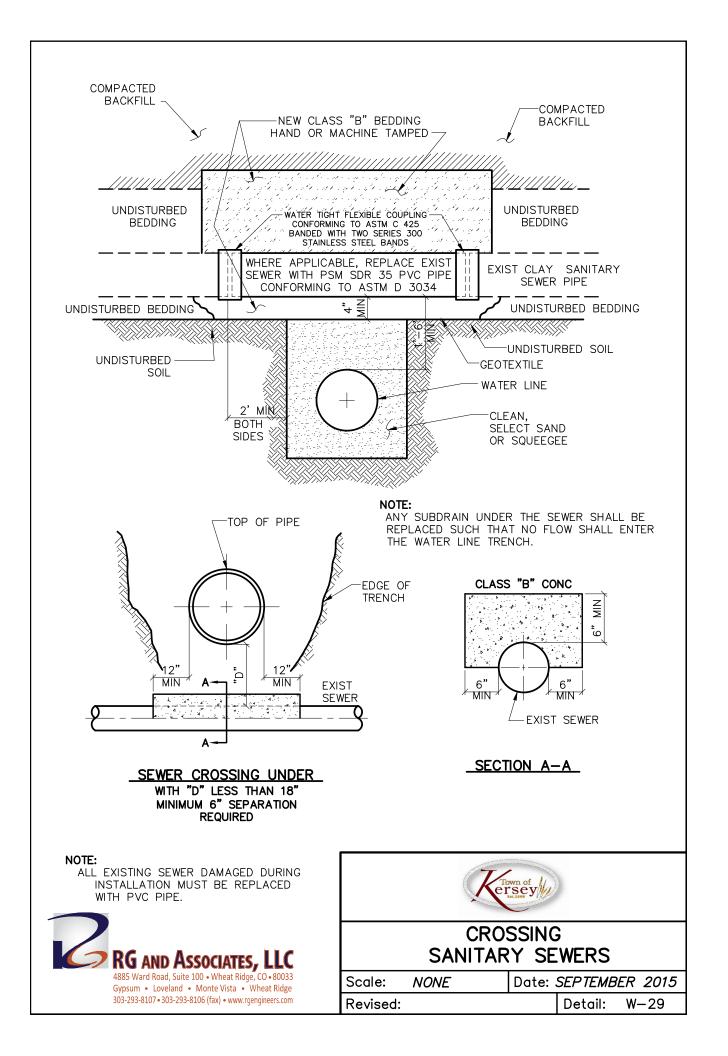


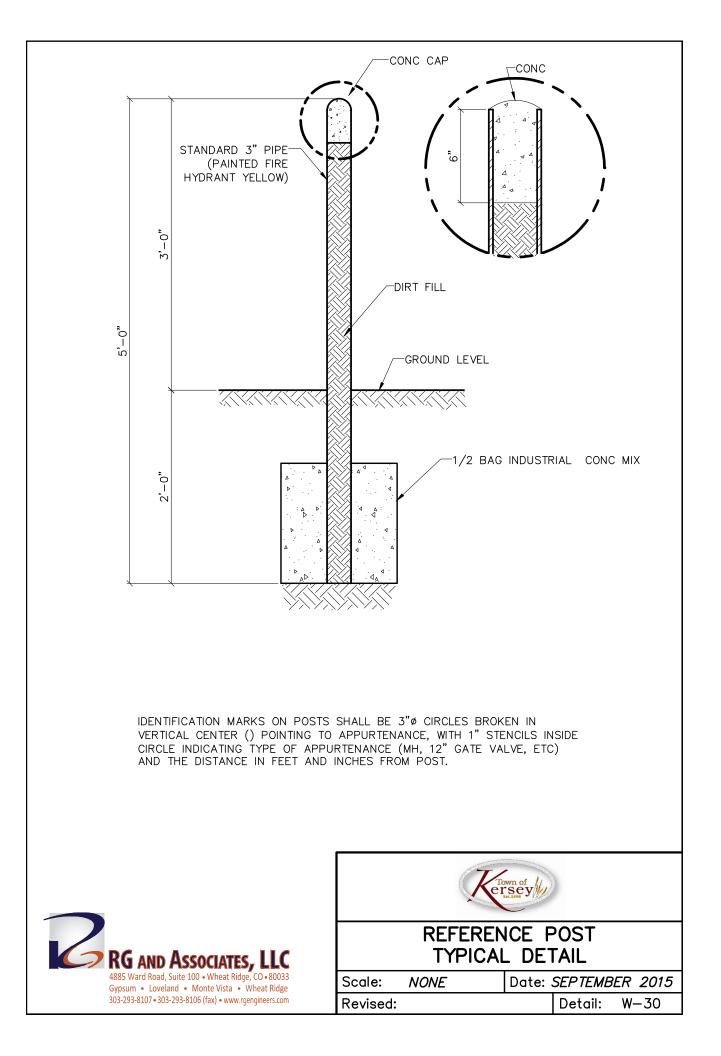


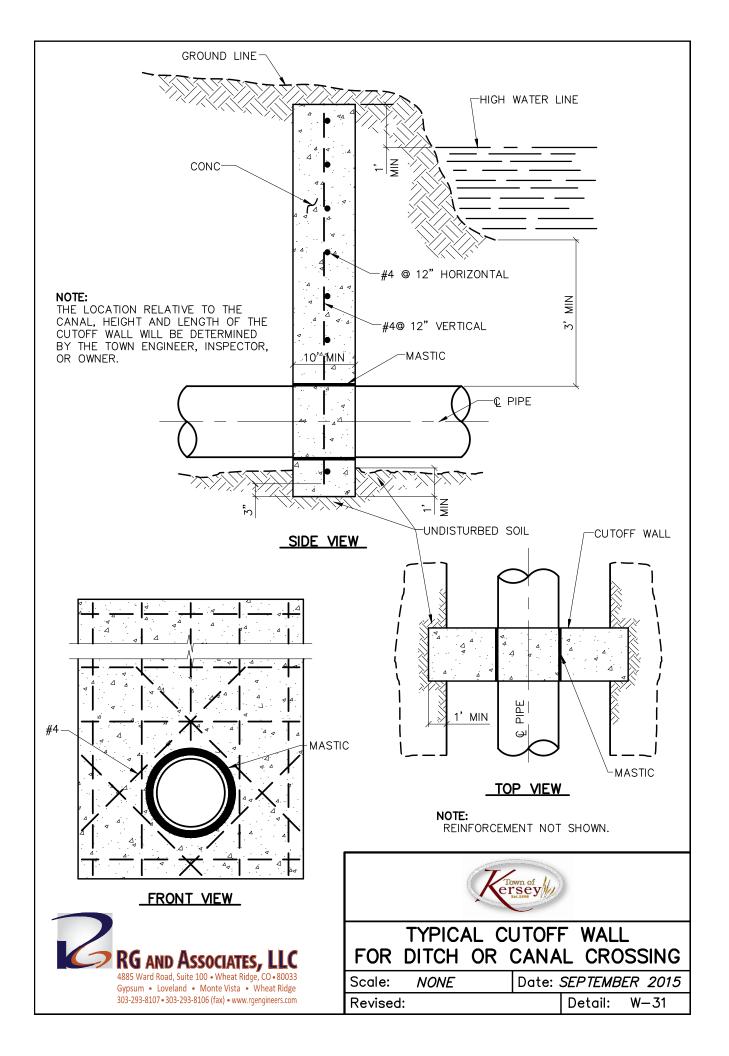


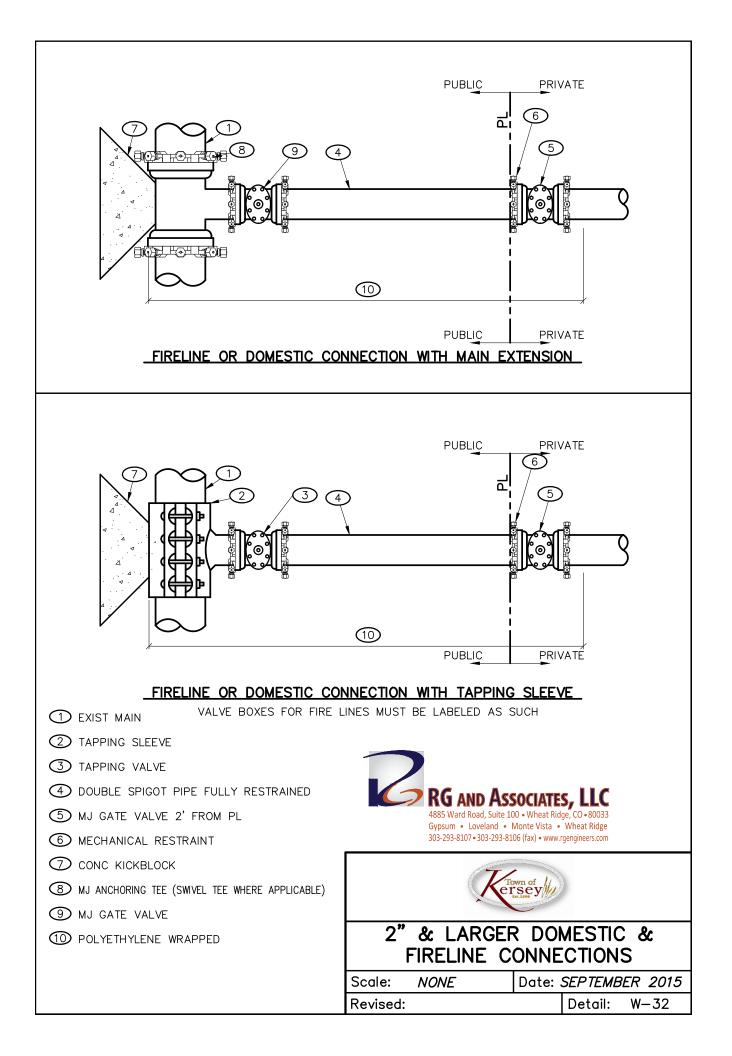


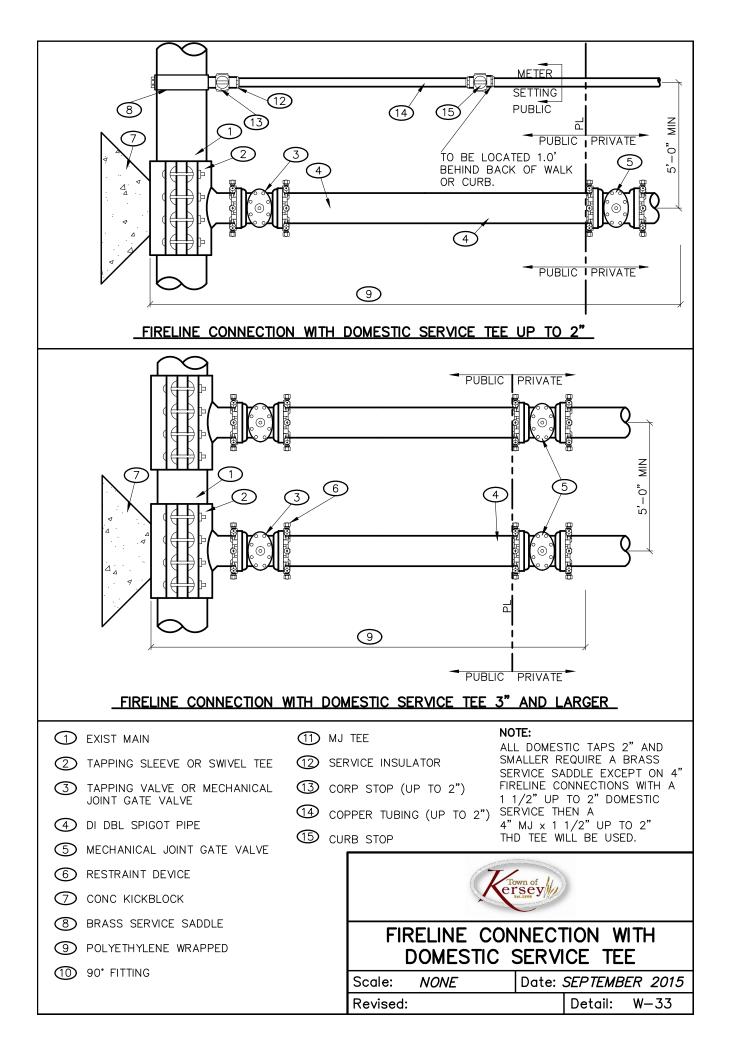


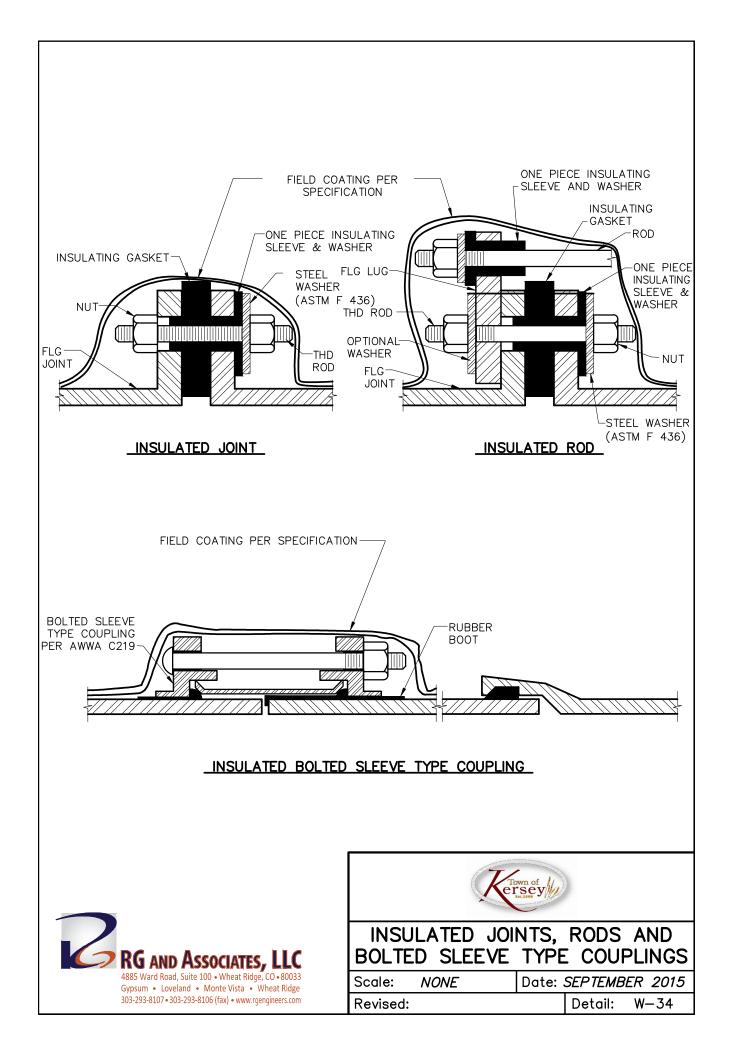


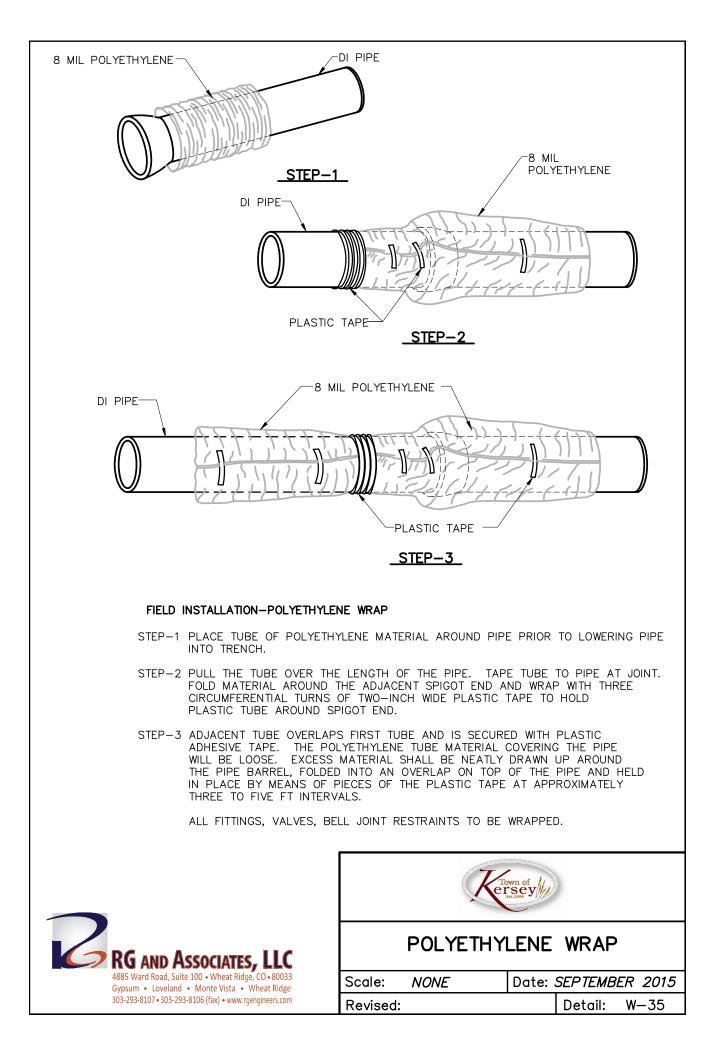


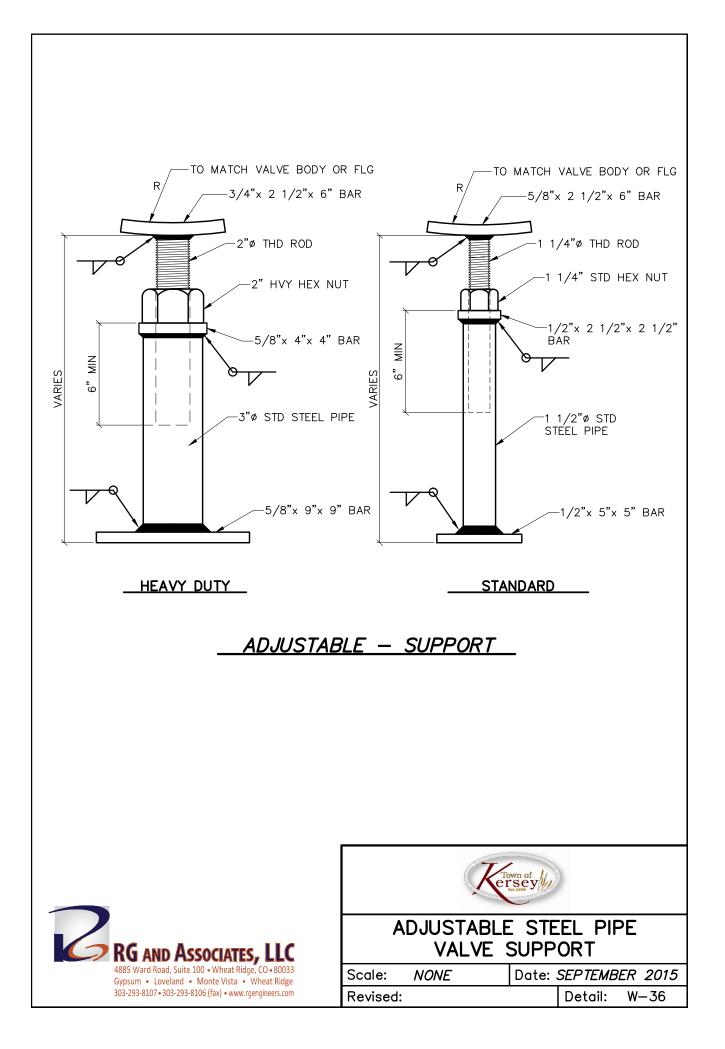


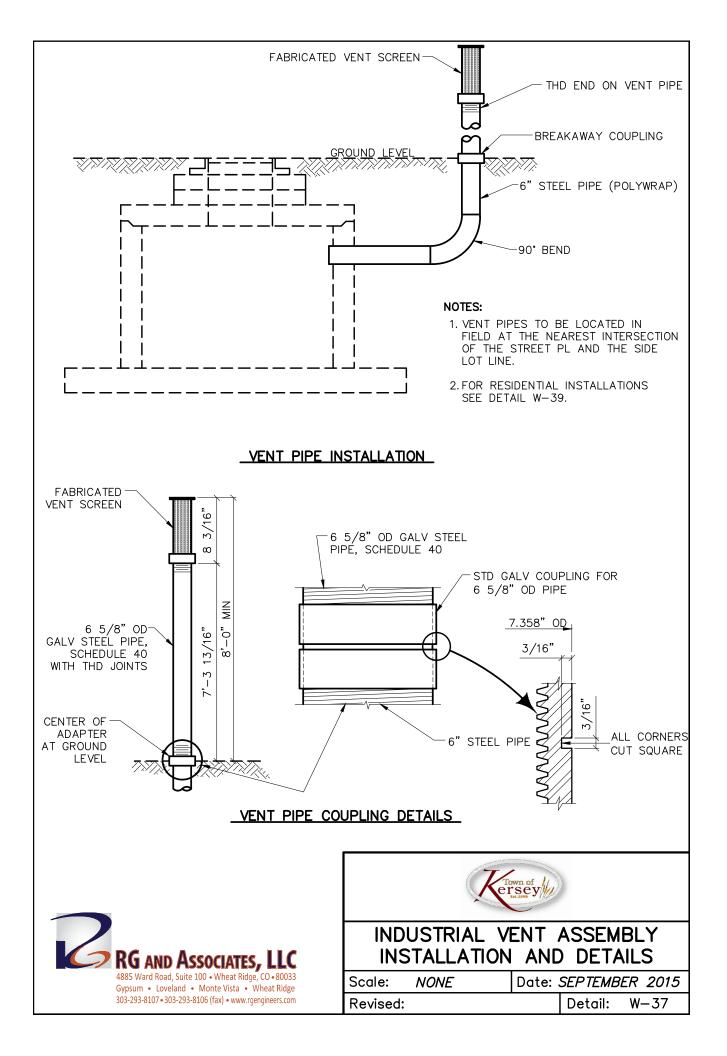


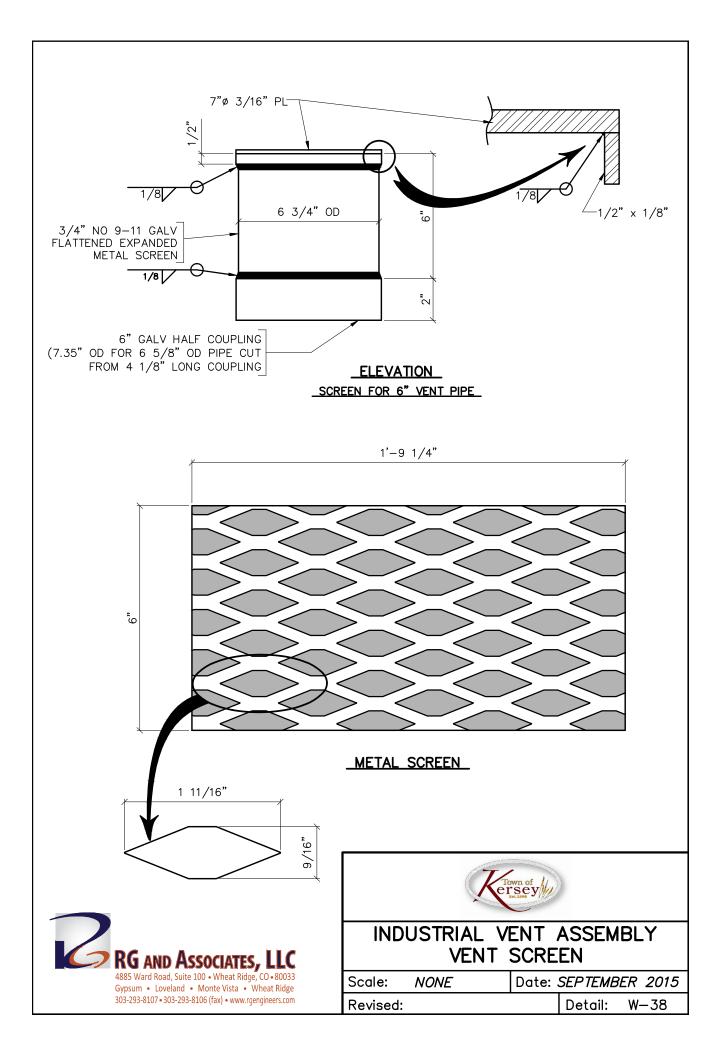


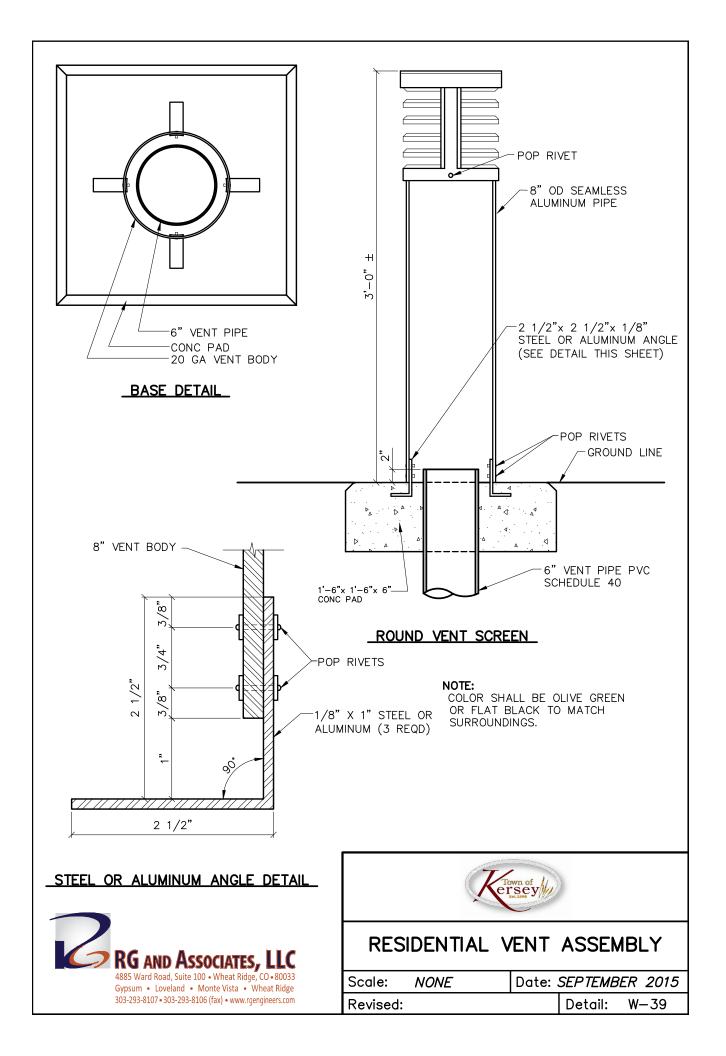


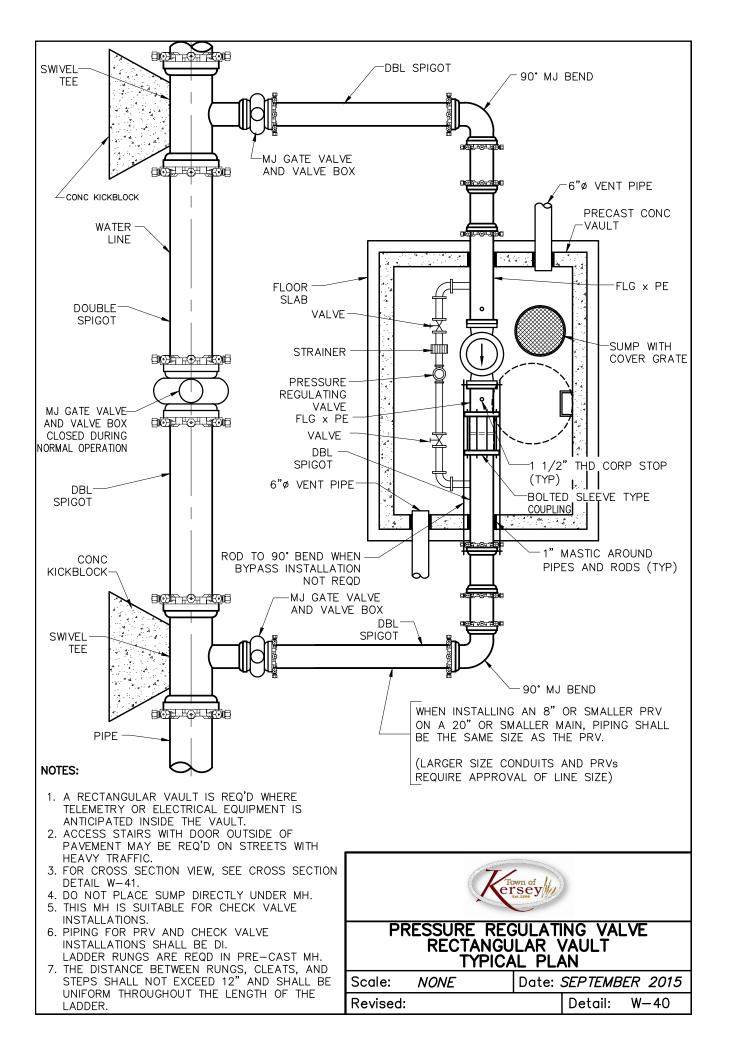


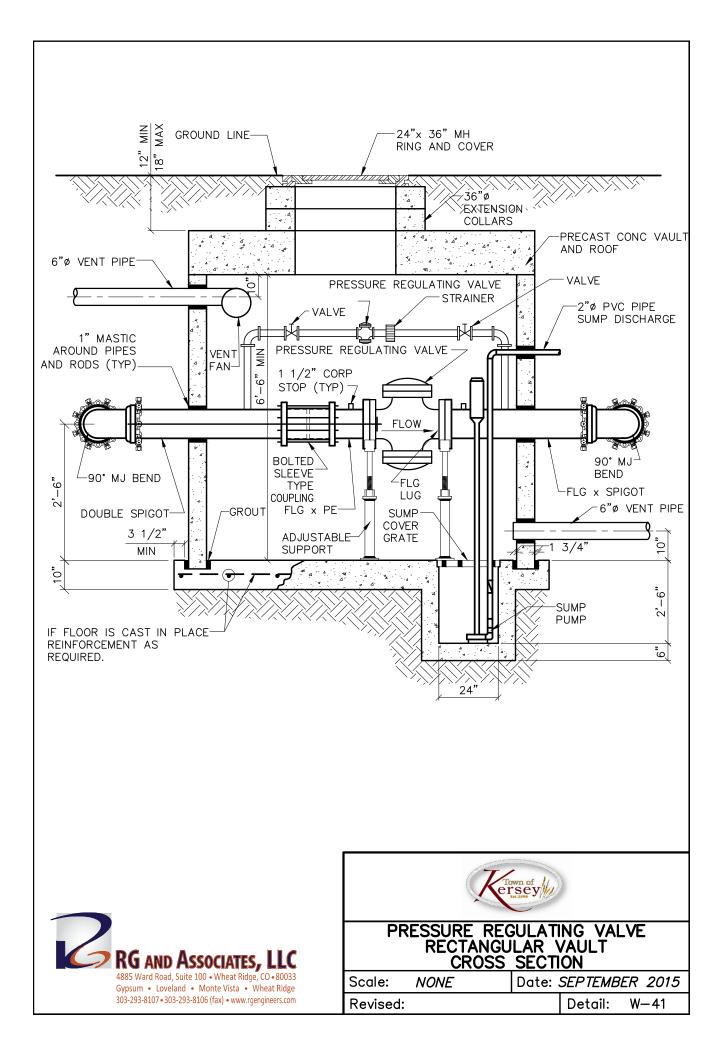


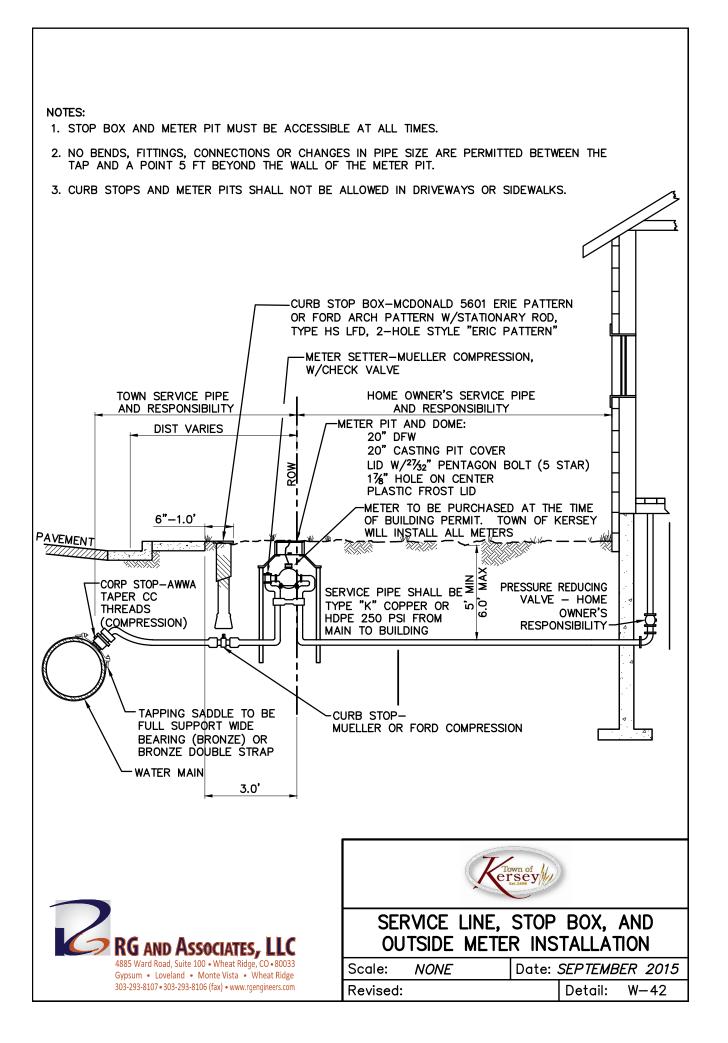


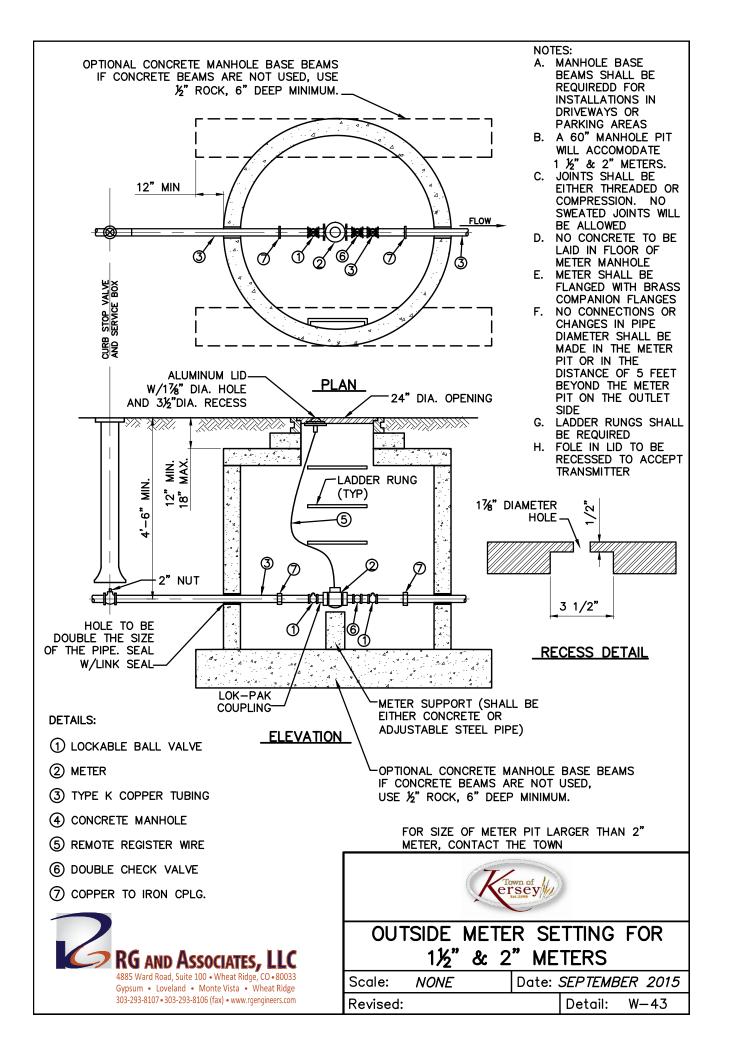


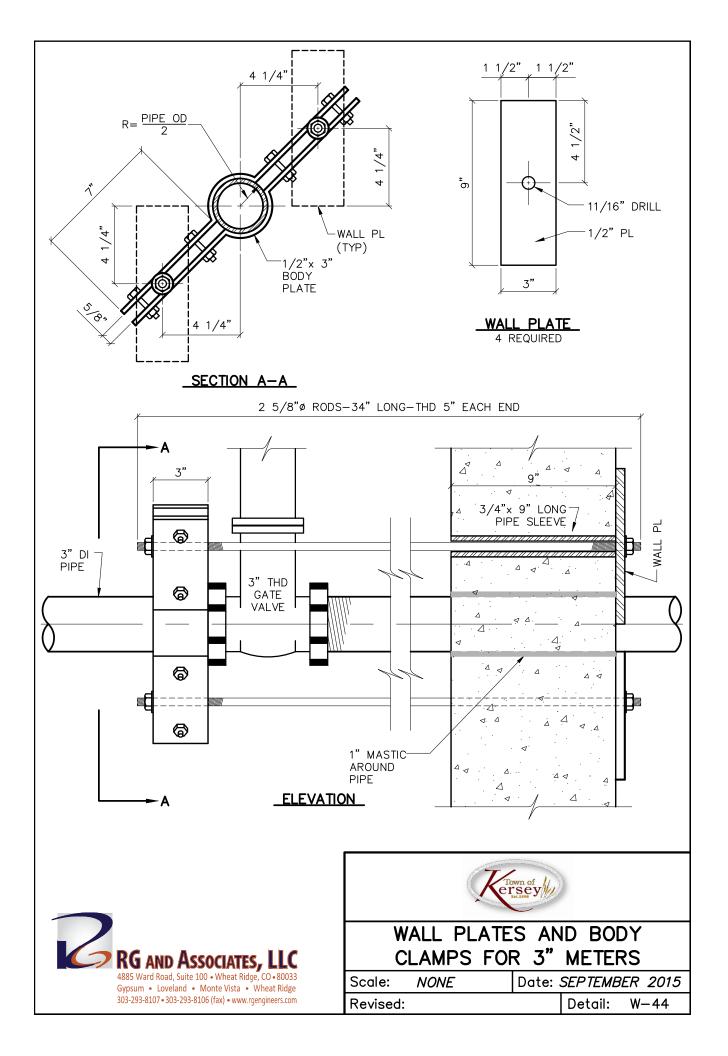


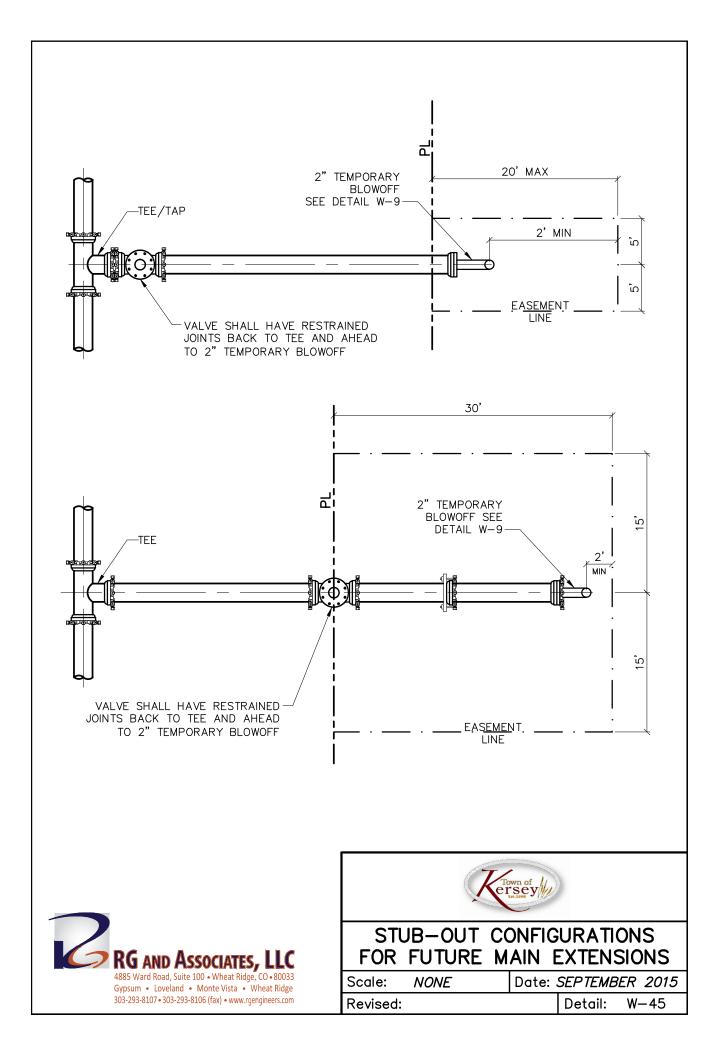


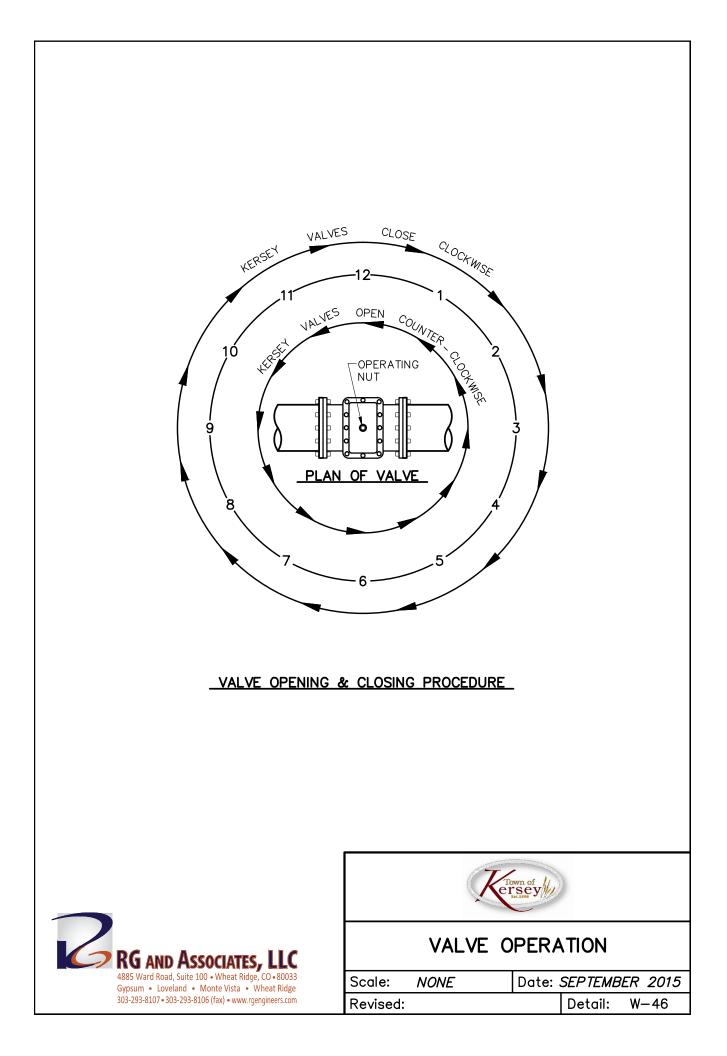


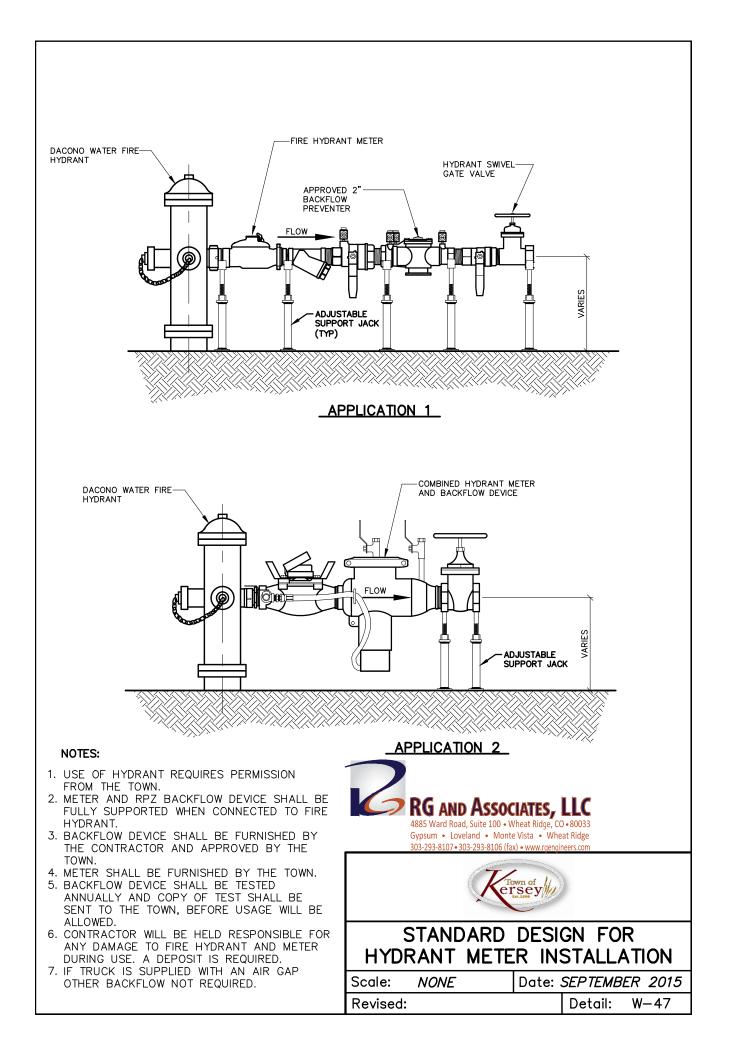


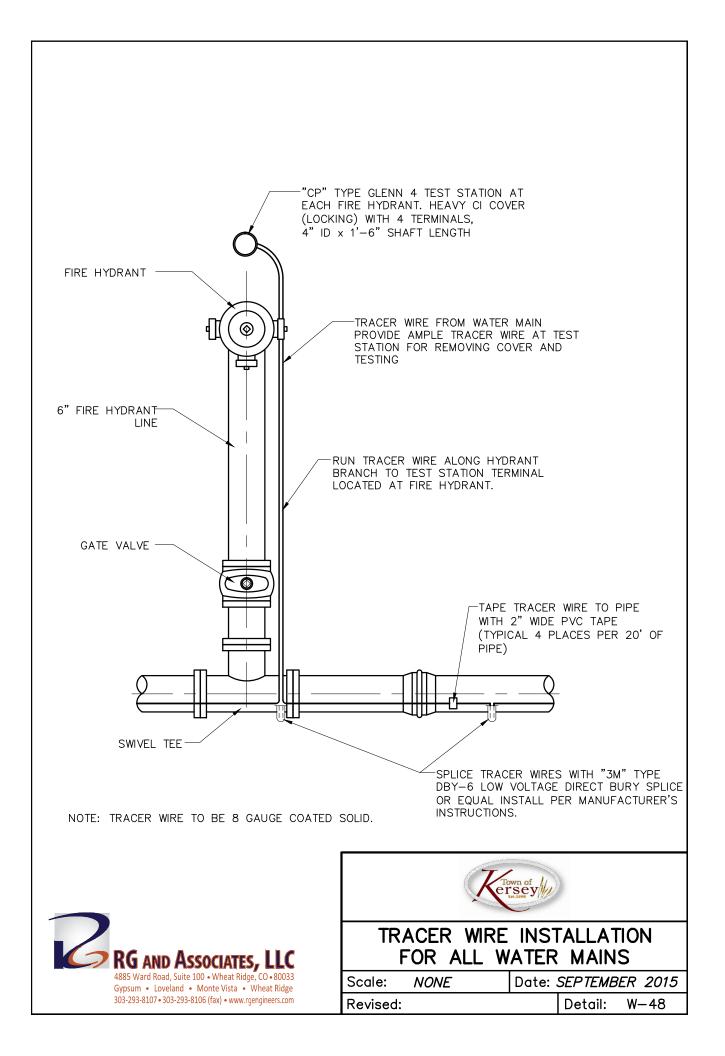


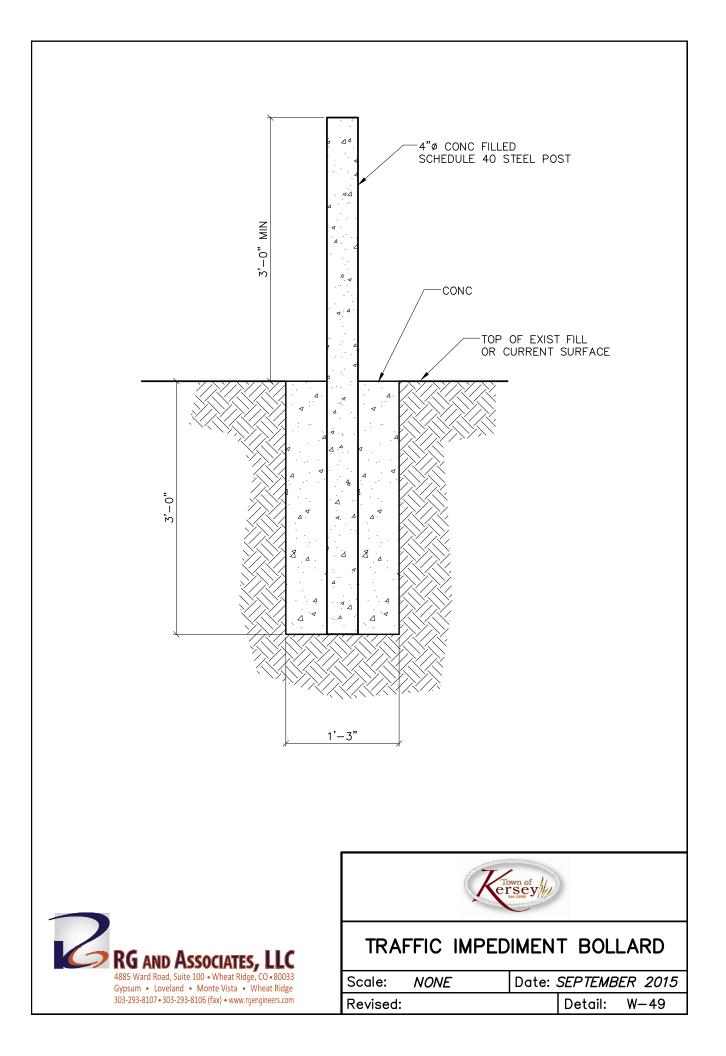












- 1. ALL MATERIALS AND WORKMANSHIP SHALL BE IN CONFORMANCE WITH TOWN OF KERSEY ENGINEERING STANDARDS MATERIALS SPECIFICATION AND STANDARD DRAWINGS. ALL WORK SHALL BE INSPECTED AND APPROVED BY PERSONNEL OF THE TOWN.
- 2. ALL WATER MAINS, EXCEPT LEADS, SHALL BE PVC C-900 PRESSURE CLASS 150. ALL FITTINGS SHALL HAVE A PRESSURE RATING OF 250 PSI AND SHALL BE WRAPPED WITH AN 8 MIL. MINIMUM THICKNESS POLYETHYLENE MATERIAL PER A.W.W.A. STANDARD C105. ALL DUCTILE IRON PIPE TO BE POLYETHYLENE WRAPPED.
- 3. BENDS TO BE RESTRAINED AS PER STANDARD DETAIL W-18.
- 4. THERE SHALL BE A MINIMUM COVER OF 5 FEET OVER ALL WATER MAINS.
- 5. FIRE HYDRANTS SHALL CONFORM TO THE TOWN OF KERSEY STANDARDS.
- 6. ALL BENDS, TEES, FIRE HYDRANTS, BLOW-OFFS AND PLUGS AT DEAD END MAINS SHALL BE PROTECTED BY USING CONCRETE THRUST BLOCKS PER KERSEY STANDARDS.
- 7. CHLORINATION AND FLUSHING: THE LINES SHALL BE CHLORINATED IN ACCORDANCE WITH A.W.W.A. C-601. "DISINFECTING WATER MAINS", THE PREFERRED METHOD, IS TO USE SUFFICIENT CHLORINE TABLETS TO PRODUCE A 50 PPM SOLUTION. THESE TABLETS SHOULD BE ADHERED TO THE TOP OF THE PIPE SECTION WITH PERMATEX NO. I (RED). THE CHLORINATION AND FLUSHING OF ANY FINISHED PIPELINE SHALL BE DONE PRIOR TO THE HYDROSTATIC TESTING. DE-CHLORINATION IS REQUIRED.
- 8. HYDROSTATIC TESTING: ALL PIPE SHALL BE FIELD PRESSURE TESTED, VALVE TO VALVE, TO A MINIMUM OF 150 PSI FOR 1 HOUR. ALL TESTING SHALL BE DONE IN THE PRESENCE OF A TOWN INSPECTOR.
- 9. ALL VALVES ARE TO BE LOCATED AT TEES AND CROSSES. OTHER VALVE LOCATIONS MAY BE REQUIRED AS SHOWN ON THE PLAN.
- 10. WHEN NECESSARY TO LOWER OR RAISE WATER LINES AT STORM DRAINS AND OTHER UTILITY CROSSINGS, A MINIMUM CLEARANCE OF 1.50 FEET BETWEEN OUTSIDE OF PIPES IS REQUIRED.
- 11. THE CONTRACTOR SHALL HAVE IN HIS POSSESSION AT ALL TIMES ONE (1) SIGNED COPY OF THE PLANS WHICH HAS BEEN APPROVED BY THE TOWN.
- 12. THE CONTRACTOR SHALL NOTIFY THE TOWN ENGINEER AT LEAST 48 HOURS PRIOR TO ANY CONSTRUCTION.
- 13. ALL REQUIRED PERMITS SHALL BE OBTAINED FROM THE TOWN BY THE CONTRACTOR FOR WORK PERFORMED IN THE PUBLIC RIGHT OF WAY.

14. THE CONTRACTOR SHALL NOTIFY ALL UTILITY COMPANIES AND DETERMINE THE LOCATION OF ALL EXISTING UNDERGROUND UTILITIES PRIOR TO PROCEEDING WITH THE EXCAVATION. ALL WORK PERFORMED IN THE AREA OF THE PUBLIC UTILITIES SHALL BE PERFORMED ACCORDING TO THE REQUIREMENTS OF THESE AGENCIES.

- 15. COMPACTION OF ALL TRENCHES MUST BE ATTAINED IN ACCORDANCE WITH THE SOILS REPORT AND COMPACTION TEST RESULTS SUBMITTED TO THE TOWN ENGINEER ON A DAILY BASIS PRIOR TO INITIAL ACCEPTANCE.
- 16. AT LEAST FIVE (5) DAYS PRIOR TO THE START OF CONSTRUCTION, A PRE-CONSTRUCTION MEETING WILL BE HELD AT THE KERSEY TOWN HALL AND ATTENDED BY THE CONTRACTOR AND REPRESENTATIVES OF OTHER APPROVING AGENCIES. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT THE TOWN ENGINEER.





WATER MAIN NOTES

Scale:	NONE	Date: .	SEPTEMB	ER 2015
Revised:			Detail:	W-50

<u>PIPE</u>

P.V.C.

AWWA STANDARD SPECIFICATION C 900 6" THROUGH 12" CLASS 150 (DR 18)

D.I.P.

AWWA STANDARD SPECIFICATION C-151/ A21.51-81 OR LATEST REVISION WITH THE FOLLOWING REQUIREMENTS: 6" THROUGH 16" CLASS 50 20" AND LARGER CLASS 51

POLYETHYLENE WRAPPING- AWWA C-105/A21.5-82, OR LATEST REVISION. MIN. 8 MILS.

VALVES

GATE VALVES

AWWA C-500-80 (OR LATEST REVISION) FLEXIBLE WEDGE MINIMUM WORKING PRESSURE 200 PSIG FOR 12" AND SMALLER VALVE SEATS, THE DISCS AND THE STEM SHALL BE CONSTRUCTED OF BRONZE STEM SEALS SHALL BE WITH 2 "O" RINGS, EACH OF WHICH SHALL BE DESIGNED AS TO ALLOW REPLACEMENT UNDER FULL LINE PRESSURE WHEN THE VALVE IS IN THE FULL OPEN POSITION 2" SQUARE OPERATING NUTS OPEN COUNTER CLOCKWISE (LEFT)

FIRE HYDRANTS

MUELLER CENTURION MODEL 423 OPEN COUNTER CLOCKWISE (LEFT) COLOR SHALL BE RED EACH HYDRANT SHALL BE RESTRAINED IF THERE IS MORE THAN ONE JOINT OF PIPE AND WRAPPED FROM THE HYDRANT SHOE TO THE MAIN LINE TEE, AND SHALL BE THRUST BLOCKED.

VALVE BOXES

TYLER SCREW- TYPE 6" C.I. SERIES 6860 WITH NO. 160 LARGE OVAL BASE OR CLAY & BAILEY SCREW- TYPE 6" C.I. NO. P-108 WITH NO. 160 LARGE OVAL BASE. WORD WATER ON COVER



Kersey //
FOUNDMENT ST

WATER EQUIPMENT STANDARD MATERIALS (SHEET 1)

NONE Date: SEPTEMBER 2015 Scale: **Revised:**

Detail: W-51 TAPPING SADDLES

PVC- FULL SUPPORT WIDE BEARING (BRONZE) OR BRONZE DOUBLE STRAP D.I.P.- 2" AND SMALLER BRONZE DOUBLE STRAP

<u>CORPS</u>

AWWA TAPER CC THREADS

CURB STOPS

MUELLER OR FORD (COMPRESSION)

CURB STOP BOXES

MC DONALD 5601 ERIE PATTERN OR FORD ARCH PATTERN WITH STATIONARY ROD, TYPE HS LID, 2 HOLE STYLE "ERIE PATTERN"

METER PIT

20" DFW

METER PIT LID

20" CASTING METER PIT COVER WITH ALUMINUM LID 27/32" PENTAGON BOLT (FIVE STAR) 1 %" DRILLED HOLE (OFFSET RIGHT SINGLE HOLE) INTER LID (FROST LID)

<u>Y0KE</u>

MUELLER COMPRESSION W/CHECK VALVE

SERVICE LINE MATERIAL

TYPE K COPPER OR HDPE 250 PSI



Reverse y Marine					
WATER EQUIPMENT STANDARD MATERIALS (SHEET 2)					
Scale:	NONE	Date: SEPTEMBER 2015			
Revised:			Detail: W—52		



INDEX OF DETAILS

SANITARY SEWER

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- SS-2 Sanitary Sewer Bore Casing Detail
- SS-3 Sanitary Sewer Manhole (CIP Base)
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- SS-5 Reference Post Typical Detail
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- SS-7 Sanitary Sewer Wye Branch Connection for Main Depth Less Than 12'

TOWN OF KERSEY GENERAL SANITARY SEWER NOTES:

1. ALL MATERIALS AND WORKMANSHIP FOR SANITARY SEWER CONSTRUCTION SHALL CONFORM TO THE LATEST TOWN OF KERSEY, CDPHE AND ALL OTHER APPLICABLE AGENCIES.

2. ALL DIRECT BURY SEWER MAINS SHALL BE PVC, ASTM D-3034, SDR35 OR APPROVED EQUAL.

3. SEWER LINES SHALL BE 10 FEET FROM WATER LINES EXCEPT WHEN CROSSING EACH OTHER. FOR SEWER LINES WHICH CROSS LESS THAN 1 ½ FEET VERTICALLY FROM WATER LINES, THE CLOSEST SANITARY SEWER JOINT SHALL BE A MINIMUM OF 6 FEET FROM THE CROSSING.

4. ALL MANHOLES SHALL BE WATER TIGHT PRECAST CONCRETE, A MINIMUM OF 48 INCH IN DIAMETER WITH CONCENTRIC CONE, 24 INCH CAST IRON RING (8" DEPTH) AND COVER, UNLESS OTHERWISE SPECIFIED. CONCRETE ADJUSTMENT RINGS SHALL BE USED FOR ADJUSTMENT TO MATCH FINAL PAVEMENT ELEVATIONS

AND SET IN MASTIC TO OBTAIN A WATER TIGHT SEAL. CONCRETE ADJUSTMENT RINGS SHALL BE 4" MINIMUM IN DEPTH TO ELIMINATE MULTIPLE JOINTS.

5. SEWER RIM ELEVATIONS SHOWN ARE APPROXIMATE ONLY AND ARE NOT TO BE TAKEN AS FINAL ELEVATIONS.

6. THE CONTRACTOR TO VERIFY THE HORIZONTAL AND VERTICAL LOCATION OF ALL TIE IN POINTS PRIOR TO CONSTRUCTION AND PROVIDE THE DATA TO THE TOWN ENGINEER.

7. SANITARY SEWER SERVICES SHALL BE SEWER WYES. SEWER SERVICE WYES FOR EACH UNIT SHALL BE STAKED BY A SURVEY CREW, AND FURNISHED AND INSTALLED BY THE CONTRACTOR. THE CONTRACTOR SHALL FURNISH TO THE ENGINEER "AS RECORD" LOCATION OF WYES.

8. PIPE BEDDING SHALL BE CLASS "B" AND SHALL CONFORM TO ASTM C-33 OR D-448 GRADATION NO. 6 OR NO. 67. SQUEEGEE BEDDING IS PREFERRED. BEDDING DEPTH SHALL BE 6" UNDER AND AROUND THE SIDES OF THE PIPE AND 12" OVER THE PIPE. CONSOLIDATION IN PIPE ZONE SHALL BE BY HAND TAMPING.

9. AT LEAST 5 DAYS PRIOR TO THE START OF CONSTRUCTION, A PRE-CONSTRUCTION MEETING WILL BE HELD AT THE TOWN AND ATTENDED BY THE CONTRACTOR AND REPRESENTATIVES OF THE OTHER APPROVING AGENCIES. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT THE TOWN ENGINEER TO SCHEDULE THIS MEETING.

10. THE CONTRACTOR WILL IDENTIFY THE HORIZONTAL AND VERTICAL LOCATION OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTION. THE CONTRACTOR WILL REPORT ANY DISCREPANCIES TO THE ENGINEER IMMEDIATELY AND PRIOR TO CONSTRUCTION.

11. THE CONTRACTOR SHALL HAVE IN THEIR POSSESSION AT ALL TIMES ONE SIGNED COPY OF PLANS APPROVED BY THE TOWN OF KERSEY AND THE TOWN ENGINEER. THESE PLANS WILL ALSO INCLUDE ALL ADDENDUMS OR REVISIONS WHICH HAVE BEEN REVIEWED AND APPROVED BY THE TOWN OF KERSEY AND THE TOWN ENGINEER.

12. ALL MANHOLES SHALL HAVE SHAPED INVERTS.

13. ALL SEWER LINES SHALL BE TESTED IN ACCORDANCE WITH THE LATEST TOWN OF KERSEY STANDARDS PRIOR TO INITIAL ACCEPTANCE OR ANY CONNECTION TO AN EXISTING SEWER LINE. THE MAXIMUM "BELLY" ON LOW SPOTS IN THE NEW SEWER MAIN SHALL NOT EXCEED $\frac{1}{2}$ INCHES.



Kersey //						
GENERAL SANITARY SEWER NOTES (SHEET 1)						
Scale:	NONE		Date: SEPTEMBER 2015			
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14. PRIOR TO START OF WORK WHERE THE NEW SEWER MAIN IS TO BE INSTALLED INTO EXISTING TOWN SEWER SYSTEMS, THE NEAREST MANHOLE TO THE POINT OF TIE-IN SHALL BE PLUGGED WITH A PLUMBER'S PLUG ON THE INLET SIDE BY THE CONTRACTOR. THIS PLUG SHALL REMAIN IN PLACE UNTIL INITIAL ACCEPTANCE BY THE TOWN. ITS PURPOSE SHALL BE TO PREVENT MUD, WATER OR OTHER MATERIALS FROM ENTERING THE LINE DURING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PUMPING AND CLEANING THESE MANHOLES AND REMOVING THE PLUG WHEN SO INSTRUCTED BY THE TOWN.

15. PRIOR TO THE INITIAL ACCEPTANCE WALK-THROUGH, THE CONTRACTOR/DEVELOPER SHALL JET CLEAN THE ENTIRE SANITARY SEWER SYSTEM AND PUMP OUT AT THE PLUGGED MANHOLE. AFTER CLEANING THE SEWER MAIN, THE CONTRACTOR WILL DUMP CLEAN WATER DOWN THE SEWER MAIN PRIOR TO THE VIDEO INSPECTION. THE CONTRACTOR WILL PUMP OUT AND DISPOSE OF WATER AT A TOWN APPROVED MANHOLE. CONTRACTOR WILL VIDEO THE SEWERS BEFORE ACCEPTANCE BY THE TOWN. CONTRACTOR SHALL PUMP-OUT AND DISPOSE OF JET-CLEANING WATER OFFSITE IN ACCORDANCE WITH LATEST CDPHE STANDARDS.

16. ABANDONING PROCEDURES:

FOR SANITARY SEWER MAINS TO BE ABANDONED - PLACE MECHANICAL PLUG IN THE PIPE AND FILL 5' OF ABANDONED SEWER LINES WITH CONTROLLED LOW SLUMP MATERIAL (CLSM).

FOR SANITARY SEWER MANHOLES TO BE ABANDONED – FILL LOWER 1/3 OF MANHOLE WITH CLSM AND REMAINDER OF MANHOLE WITH SQUEEGEE. IF THE CHIMNEY LENGTH IS LESS THAN 18", REMOVE CONE SECTION AS WELL. IN BOTH CASES, REMOVE THE CAST IRON COVER, RING AND CONCRETE ADJUSTMENT RINGS.

17. ALUMINUM FOIL WARNING TAPE SHALL BE USED FOR ALL NEW DIRECT BURY SEWER MAINS. THE TAPE WILL BE INSTALLED 2' BELOW FINISHED GRADE. TAPE MUST BE GREEN IN COLOR.

18. FERNCO **STRONGBACK** RC SERIES PIPE COUPLINGS WILL BE REQUIRED FOR PIPE AND LATERAL SERVICES.

19. DURAN **RELINER** WILL BE REQUIRED FOR INSIDE DROP MANHOLES. STAINLESS STEEL BOLTS WILL BE REQUIRED.

20. ALL BARREL SECTIONS OF MANHOLES SHALL BE GROUTED INSIDE AT JOINTS.

21. IF SEWAGE BYPASS PUMPING IS NECESSARY, A PUMPING PLAN SHALL BE SUBMITTED AND APPROVED BY THE TOWN ENGINEER, THE CONTRACTOR WILL SUPPLY AND MONITOR THE PUMP DURING THE ENTIRE PUMPING PERIOD. A BACK-UP PUMP WILL BE ONSITE FOR USE IF NECESSARY. BYPASS HOSE SHALL BE PROTECTED FROM TRAFFIC DAMAGE USING APPROVED APPARATUS. FOR ALL SEWAGE BYPASS PUMPING. THE CONTRACTOR WILL HAVE CONTINUOUS ON SITE MONITORING OF PUMPING OPERATIONS.

22. SHOULD TRENCH DEWATERING BECOME NECESSARY, THE CONTRACTOR WILL OBTAIN ALL REQUIRED PERMITS AND SUPPLY THE PUMPS REQUIRED AT NO ADDITIONAL COST TO THE OWNER.

23. THE OPENING OR CHANNEL IN THE MH MUST BE NO LESS THAN THE DIAMETER OF THE PIPE, AND NO LESS THAN THE MH DIAMETER MINUS 4 INCHES IN LENGTH TO ACCOMMODATE EQUIPMENT NECESSARY TO MAINTAIN THE SEWER LINE.

24. ALL MANHOLE AND SANITARY SEWER MAIN TESTING SHALL BE WITNESSED BY A REPRESENTATIVE OF THE TOWN. A MINIMUM OF 24 HOURS ADVANCED NOTICE IS REQUIRED PRIOR TO TESTING.

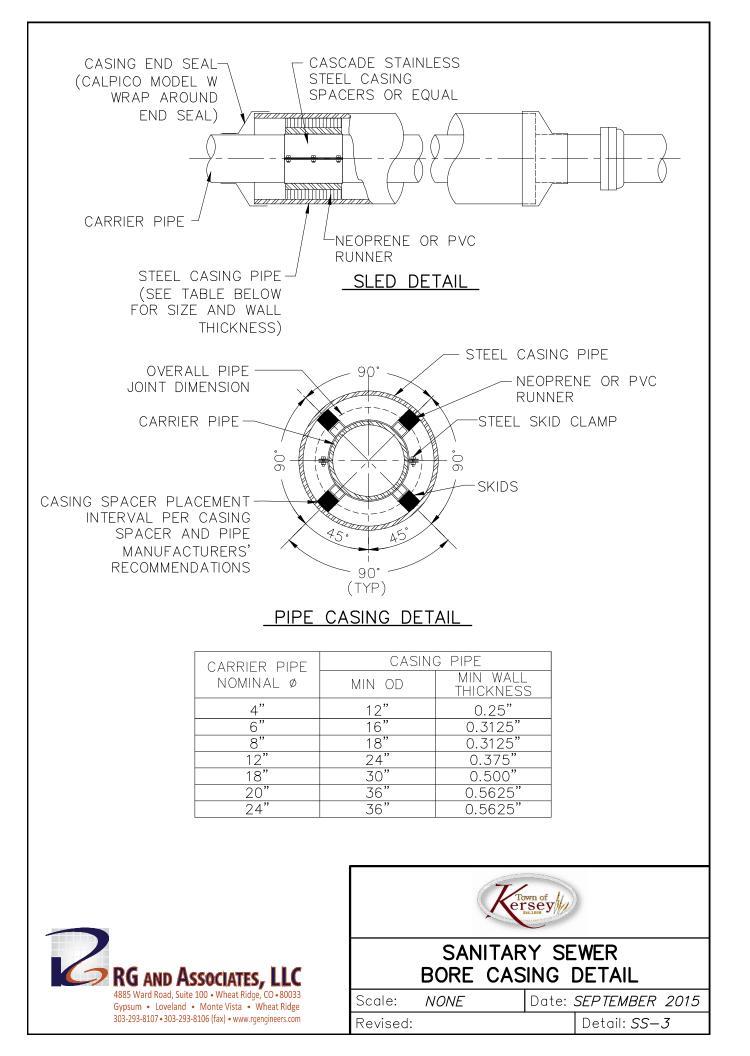
25. ALL MANHOLE/VAULT EXTERIOR JOINTS SHALL BE WRAPPED IN 12-INCH WIDE CONSEAL CS 212 OR APPROVED EQUIVALENT.

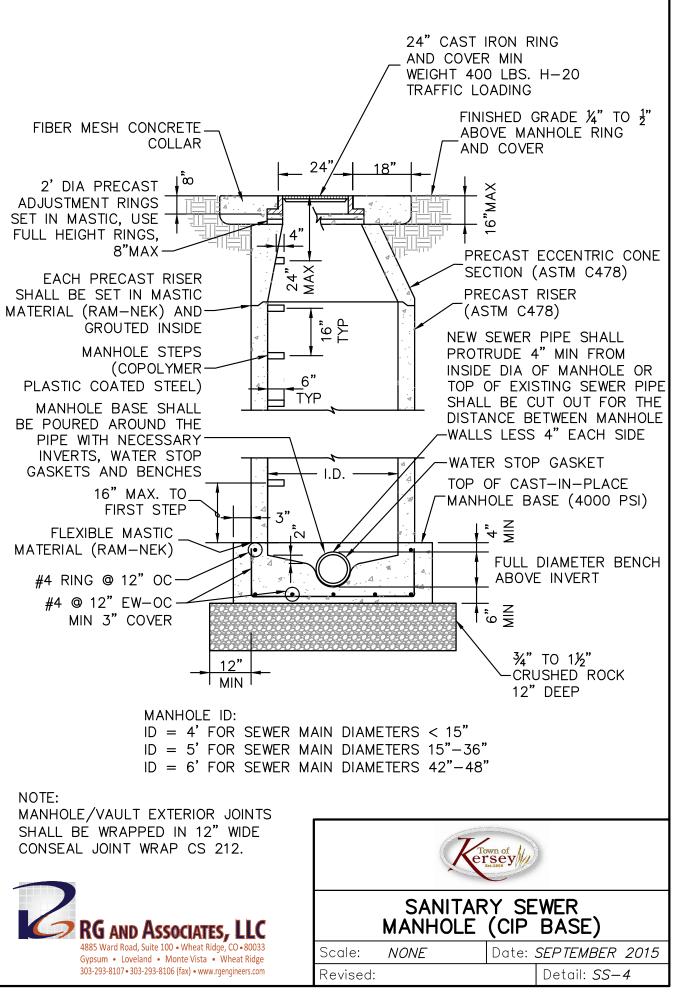
26. MANHOLE/VAULT BARREL SECTIONS WILL REQUIRE AN EXTERIOR COATING OF TNEMEC SERIES 46-465 OR APPROVED EQUIVALENT IF GROUNDWATER IS ENCOUNTERED IN THE TRENCH.

27. ALL PRECAST CONCRETE SHALL BE 5,000 PSI MINIMUM STRENGTH.



Rersey /						
GENERAL SANITARY SEWER NOTES (SHEET 2)						
Scale: NON	Έ	Date:	SEPTEME	BER 2015		
Revised:			Detail: S	55–2		





NOTE: MANHOLE/VAULT BARREL SECTIONS WILL REQUIRE AN EXTERIOR COATING OF TNEMEC SERIES 46-465 OR APPROVED EQUIVALENT IF GROUNDWATER IS ENCOUNTERED IN THE TRENCH.

